

GROUND POWER UNITS (JETWAY MOUNTED) AND PC AIR HANDLERS



Proposal for



Date of the proposal: 05/20/2021



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1. Introduction

Cavotec is a global engineering group that designs and manufactures automated connection and electrification systems for ports, airports and industrial applications worldwide. Our innovative technologies ensure safe, efficient and sustainable operations, and contribute to a future world that is cleaner, safer and more efficient.

Cavotec is made up of two divisions: Ports & Maritime and Airports & Industry.

Ports & Maritime manufactures innovative automated mooring, shore power, crane electrification, and connection and charging systems for ports and marine applications.

Airports & Industry manufactures state-of-the-art ground support equipment (GSE) for aircraft, and automation, control and electrification systems for a wide variety of industry sectors.

Ports & Maritime and Airports & Industry are supported by Services, which provides comprehensive aftersales support.

We are a global engineering group and our systems support customers in more than 80 countries. We share a common identity and direction based on a clearly defined culture and vision:

WHAT

We connect the future.

WHY

We want to contribute to a world that is cleaner, safer and more efficient by providing innovative connection solutions for ships, aircraft and mobile equipment today.

HOW

We thrive by shaping future expectations in the areas in which we are active. Our credibility derives from our expertise and dedication to innovation and world-class operations. Our success rests on our core values: Integrity, Accountability, Performance, and Teamwork.

Cavotec is a leading Ground Support Equipment (GSE) specialist, engineering a wide range of state-of-the-art systems and services for contact gates, remote aprons and Maintenance Repair and Overhaul (MRO) hangars for commercial and military applications.

Working closely with customers and industry bodies, Cavotec is the only supplier of fully integrated gate and remote apron solutions that minimize the use of auxiliary power units, thereby reducing fuel costs and emissions.

Cavotec's comprehensive range of systems meet all aircraft requirements including the New Aircraft Generation (NAG) such as the A380, B787 and A350. Our innovative solutions include 400Hz and 28VDC Ground Power Units (GPU), Pre-Conditioned Air (PCA) systems, wet services and fuel systems integrated under passenger boarding bridges, as well as in-ground pits and tunnel systems.

Delivering integrated solutions Cavotec's role as a complete systems integrator is exemplified by our performance in the airport sector. Our advanced power, fuel, and air supply systems are helping to drive operational efficiencies at airports worldwide, reduce tarmac congestion, and improve air quality.

We continuously strive to contribute to airports' functionality and sustainability – thus providing substantive operational and environmental benefits for operators, airlines, passengers, and the wider community.

The Cavotec Airport Division is a complete ground support system designer, integrator, product manufacturer, and supplier for commercial and defense aviation sectors.

Comprising of three dedicated Centres of Excellence, located in Cypress California - U.S.A., Dietzenbach Germany, and the Stockton-On-Tees, Cleveland - the

United Kingdom, we work closely with Airport operators, Airlines, Aircraft Manufacturers, Defense Organizations, and Consulting Engineers. Our field of expertise covers all airport industries, including commercial or defense contracts, contact gates, remote aprons, and M.R.O.

Following requests from our customers and through organic growth and a keen acquisition strategy, Cavotec has today become a 'one-stop-shop' providing a single point of contact with a solely responsible supplier and under one functional responsibility.

Cavotec has developed a diversified and specialized range of advanced ground support equipment (GSE) and system designs in line with its very distinct customer base.

Cavotec has progressed from a product supplier to system designer and integrator for the following services:

- 400Hz
- Pre Conditioned Air (P.C.A.)
- Wet Services (Potable Water, Blue Water, lavatory Drainage)
- Fuel

Along with the many GSE products that we offer, the Cavotec Airport Division includes:

Cavotec Aviation Design Services

Cavotec has assembled and developed a team of engineers who can design full gate in-ground systems for 400 Hz, Fuel, Wet Service, and P.C.A. We have a proven track record and a substantial reference list working as a gate designer for all of our in-ground GSE services. Cavotec can take on a turnkey gate design or portions of the design to work as a consultant to the consultant, depending on the project requirements.

Cavotec System Integration

System Integration has been the backbone at Cavotec Centres for the last forty years. This expertise and knowledge have been transferred to all the Cavotec Aviation Market Unit and offered throughout our complete range of GSE Systems. Using a combination of

Cavotec's own manufactured equipment and strategic partner products and systems, we can provide full Ground Support Equipment System Integration.

Cavotec System Installation

Depending upon geographic location, Cavotec can support our customers as the sub-contractor or product supplier.

Cavotec Services

Depending upon geographic location, Cavotec can support our customers with a dedicated field service engineer, supporting our clients during the after-sales service with local spare parts stock.

The full product range includes:

- 400Hz: Fixed or mobile solid-state frequency converters, Central 400Hz Rotary Motor Generators, 400Hz cable coilers and hoists, 400Hz pits, plugs, and cable
- Pre Conditioned Air (P.C.A.): Point of Use DX, Central PCA DX Arctic or Glycol P.C.A., Pre-compressed air P.C.A., P.C.A. pits, bridge telescopic air ducts, P.C.A. hose baskets, plugs and hoses
- Aircraft water treatment system: Potable water cabinet, central Wet Service plant for potable and blue water and through underground pit solutions
- Fuel hydrant: Complete fuel hydrant system with fuel hydrant pit and valves, high and low point pits, prefabricated isolation valve pits, vault access covers, cathodic protection, and leak detection pits
- Refueling systems: loading and unloading arms, floating suction arms, pantograph, refueling skid with fuel control valves, filtering, metering, and fuel surge absorbers

Strengths of Cavotec

- 40 years of experiences in the engineering and manufacturing of 400Hz, P.C.A., refueling and utility pits solutions

- Leading company in various fields and above all in the 400hz, P.C.A. and refueling technology
- Advanced GSE technologies with a product offering of complete fueling solutions, fixed, mobile, Point of Use, or central systems for 400Hz and P.C.A.
- Capabilities in engineering complete system solutions delivering the functionality and designed according to the aircraft types and ambient conditions
- Global company with a local office located in Texas, Florida and Corporate office in Cypress California.

Cavotec U.S.A. Inc.

Reclamation of a Historical Name

CAVOTEC U.S.A. Inc. has a proud history of being at the forefront of new technology applications to increase efficiency for practical fixed pre-conditioned air and 400Hz ground power systems.

As a division of Teledyne Industries until 1992, the company pioneered the development of modern fixed 400Hz ground power and cabin conditioning methods for commercial and military aircraft. Purchased by MagneTek, Inc. in 1992, the company extended its ramp system leadership to integrate its equipment into passenger boarding bridges and remote digital monitoring/control systems.

In November 1994, the operation, including its European subsidiary, was purchased from MagneTek by the senior airport division management team, who reclaimed the original INET name. Today, the company is dedicated solely to the supply, design, and building of specialized airport systems centered on the aircraft parking position. This transition between MagneTek to INET Airport Systems Inc. (Now Cavotec U.S.A. Inc.) was made while maintaining a high degree of continuity of all key management, technical, and marketing personnel.

CAVOTEC USA Inc. continues its focus on innovative design, supply, construction, ground support equipment, and systems while expanding its capabilities

to include total apron and airport operations through highly selective global partnerships.

CAVOTEC U.S.A manufactures specialized 400Hz power conditioning systems and control equipment such as uninterruptible power systems (U.P.S.), frequency converters, and static transfer switches.

CAVOTEC U.S.A. Inc. is headquartered in Cypress, California, United States, with international operating and sales offices in Texas and Florida.

Founded:

Originally established in 1967 under Teledyne INET. INET Airport Systems Inc. was restructured in November 1994 via management buyout from MagneTek, Inc. In 2011, INET merged assets with Cavotec group and was renamed Cavotec U.S.A Inc.

Location:

5665 Corporate Ave, Cypress CA 90630, U.S.A.; with a facility totaling 160,000 sq. ft. for project engineering, design, prototype assembly with research and development division.

Services:

- System & Product Design
- Project & Construction Management
- Maintenance
- System Integration

Products:

Specialized 400Hz Ground Power Units, Cabin Conditioning Equipment, Related Accessories, Management Data Systems

Markets:

Airlines, Airport Authorities, Air Couriers, Aircraft

Maintenance Bases, Aircraft Manufacturers

Competition:

No direct competitors with the same mix of products and services

A strong belief in the principles of intelligent integration of products and technologies across classic restrictive lines led the company to develop a strong capability in passenger boarding bridges. Cavotec products are most often found mounted to bridges at numerous airports throughout the world. Our bridge capabilities and cohesive relationship with bridge manufacturers help ensure the most effective project implementation.

Using our core technology specialties as a basis, the company uses its systems expertise to make strategic connections with other firms using airport technology and experience. These alliances allow us to expedite assembly while overseeing a comprehensive approach to various airport projects in developing areas.

Historical Highlights

- 1967, formed as part of Teledyne INET
- 1970, developed vertical, synchronized 400Hz motor generators with auto paralleling in ranges up to 313KVA, making central 400Hz systems practical and reliable
- 1970, developed first centralized aircraft ground power systems
- 1971, invented the 400Hz capacitor, allowing long distribution cables to aircraft positions.
- 1981 - 84, developed centralized cabin conditioning systems
- 1983, developed Super-Cool patented air system
- 1983, developed ice storage methods for aircraft central cooling systems
- 1983, developed patented telescoping air delivery ducts, for installation across apron-driven bridges
- 1983 - 94, installed 2,200 gates of 400Hz and 800 gates of cabin conditioning at 52 airports
- 1984, developed the first microprocessor auto paralleling system for vertical Motor
- Generators (M.G.), eliminating mechanical parts, in sizes up to 375KVA.
- 1990, developed patented "service transport unit" to esthetically carry E.G.W., power, potable water, compressed air, and other services across apron drive passenger bridges

- 1992, Airport Systems acquired by MagneTek, Inc.
- 1993, installed world's first integrated bridge system servicing 21 gates at Chicago O'Hare new International Terminal 5, combining pre-conditioned air, 400Hz power, and passenger bridges in a single package design
- 1994, completed the world's largest ground support systems at new Denver International Airport
- 88 gates including passenger bridges, pre-conditioned air, 400Hz and digital remote monitoring/control system.
- 1994, MagneTek Airport Systems acquired by the management team, the name changed to INET Airport Systems (INET)
- 1996, achieved the 3,000-gates milestone for 400Hz and 1,000-gates milestone for and pre-conditioned air system
- 1996, developed first INET mobile 400Hz and pre-conditioned air equipment
- 1999-2000, completed 71 "Y2K" upgrade projects on existing systems, with no glitches reported during the year 2000 turnover or critical milestone dates.
- 2006, designed and manufactured a 225KVA mobile 400Hz unit for use on Boeing's 787 Dreamliner
- 2010, designed and manufactured a multi-range, high pressure, mobile diesel-powered air conditioning unit for NASA – Edwards A.F.B., CA
- 2011, INET merged assets with Cavotec Group and became Cavotec INET Inc.

Products and Services

Specialized equipment for ground support systems:

- 400Hz solid-state and rotary M.G. frequency converters for centralized systems (125KVA - 2,000KVA)
- 400Hz solid-state frequency converters for point-of-use at aircraft positions
- (45KVA - 180KVA)

- 400Hz uninterruptible solid-state frequency converters for areas of unreliable utility (50Hz or 60Hz) input power
- Ground power distribution equipment
- Gate air handlers for aircraft cooling/heating, used with central plants, ranging from commuter through jumbo (B747) aircraft
- Gate-mounted packaged DX units for aircraft cooling/heating, ranging from commuter through jumbo (B747) aircraft
- Air conditioning distribution and delivery equipment
- Passenger boarding bridge integration products
- Digital remote control and monitoring hardware and software
- Mobile 400Hz and pre-conditioned air equipment

Professional and Technical Services:

Complete turnkey design/build systems: design, manufacture, procure, program management, install, and maintain:

- Cabin conditioning systems
- 400Hz ground power systems
- Potable water delivery to aircraft
- Integration of GSE products into passenger boarding bridges
- Aircraft fuel storage, pumping, dispensing systems complete, integrated airport ramp systems
- Airport ground side facilities management systems
- Feasibility and economic studies
- Project design and Program management
- Construction management
- Maintenance
- Training courses
- Operation

Cavotec Military

- Over the past fifty-five years, Cavotec has the longest continuous history in the design and manufacture of motor-generator sets of any company in the world!

- Over 3,000 MG's shipped, having a total capacity of more than 600 megawatts. Our product offering addressed the U.S. Air Force, U.S. Army, Navy... for 400Hz and P.C.A. requirements.



Pictures of Cavotec U.S.A.

Cavotec U.S.A. Inc. philosophy is to optimize its products or systems' efficiency, which can only be done by manufacturing most of its components in-house. Integral to our manufacturing philosophy is the practice of "continuous improvement" to follow the permanent technical aircrafts technical evolution and the continuous airport search for optimization.

Our processes are designed to streamline production and utilize the most up-to-date technology for guaranteeing a high-quality level. Our facility is a major asset for innovating and customizing products upon specific requests from our clients, whether it be from military or commercial sectors.

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2. Proposal overview

2.1 General information about this proposal

In response to a IFB No.29285J, Ground Power Units (Jetway Mounted) and PC Air Handlers, this document has been produced. The proposal has been based on data received from the Denver International Airport attachments and specifications:

- Attachment A - NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION
- Attachment B - Federal Equipment Contract Provisions
- Exhibit A PRECONDITIONED AIR DX AIR HANDLING UNITS
- Exhibit B PRECONDITIONED AIR DUCTWORK AND ACCESSORIES
- Exhibit C PRECONDITIONED AIR ELECTRIC CONTROL SYSTEMS
- Exhibit D PRECONDITIONED AIR SEQUENCE OF OPERATION
- Exhibit E PRECONDITIONED AIR HYDRONIC AIR HANDLING UNITS
- Exhibit F AIRCRAFT GROUND POWER UNITS

2.2 Description of this proposal

Cavotec’s offer is related to the following products (Appendix 2 – Equipment Datasheets):

- Pre Conditioned Air Units (Direct Exchange Type) (Manufactured by Cavotec located in Cypress California U.S.A)
- Air Handling Units (Chill Water/Glycol Type) (Manufactured by Cavotec located in Cypress California U.S.A)
- Solid State Frequency Converters (IGBT based) (Manufactured by Cavotec located in Cypress California U.S.A)
- Aircraft GSE accessories (Manufactured by Cavotec approved vendors in design and manufactured in the U.S.A)

Based on the documentation provided to our attention, we have been able to issue the pricing schedule that you will find enclosed in this document.

Our commercial offer separate document IFB No.29285J, Ground Power Units (Jetway Mounted) and PC Air Handlers Pricing is based the Exhibits A thru F for specifications and Bill of Quantity per document IFB No.29285J, Ground Power Units (Jetway Mounted) and PC Air Handlers.

3. System Supply

3.1 Pre Conditioned Air (Direct Exchange Type)

Please see Appendix 1 – Equipment Datasheets, Drawings, and Manual

The Series PDXC air conditioner is a complete, self-contained unit to supply the demanding air pressures, volume, and low-temperature air for effective cooling (and heating) of all commercial aircraft.

This unit will accommodate the full range of commercial aircraft from commuters.

A programmable logic controller provides modulation of airflow & temperature as required for varying aircraft types and ambient conditions.

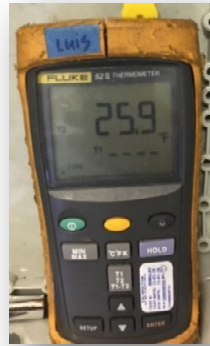
Key features	
High visibility display on lift column	Aluminum enclosure
Over 256 data registers for monitoring webserver	Low Noise
Efficient Control Loop	Strategically placed access doors vs panels for service

PDX Performance:

PDX60C Pre-Conditioned Air Units	
Weight	4,430 LBs
Refrigerant	407C
Power	480/60/3
Amps	200A (175A Standard)
Compressors	30 ton + 30 ton
Blower	40Hp (30Hp Standard)
Airflow	250 lb/min
Static	32 in wc
Outlet temperature	25°F - 130°F



25°F



3.2 Air Handling Units (Chill Water/Glycol Type)

Please see Appendix 2 – Equipment Datasheets, Drawings, and Manual

Cavotec Series PAC air handlers are specially designed to accommodate the serve air pressure and flow requirements for ground-based cooling, heating and ventilation of commercial passenger aircraft.

These lite weight units contain air filter, blower, heat exchanger coil, outlet plenum, digital controls, and a range of accessories to provide fully automatic cabin conditioning in conjunction with central chillers and distribution.

Key features	
High visibility display on lift column	Aluminum enclosure
Complete data set for monitoring webserver	Efficient blower
Efficient Control Loop	Strategically placed access doors vs panels for service

PAC Performance:

PAC60 Air Handling Units	
Weight	2750 LBs
EG/W Supply/Temp.Range degrees	20 to 150°F
Max EG/W Pressure Drop	40 psi
MCA (Minimum Circuit Ampacity)	109Amp@ 480V, 60Hz 3 phase
Minimum Service Required (Disconnect)	125Amp
Variable-Speed Units:(@ 3500 max rpm) speed	20 to 60Hz
Airflow	250 lb/min
Static	32 in wc
Outlet temperature	25°F - 130°F



Miami International Airport



San Francisco International Airport

3.3 Solid State Frequency Converters (IGBT Type)

Please see Appendix 3 – Equipment Datasheets, Drawings, and Manual

The 2500+ series is a self-contained unit capable of converting 50/60Hz input power to 400Hz output power for a combination of linear and nonlinear loads. The 2500+ Series is an advanced frequency converter equipped with a power factor correction front end capable of achieving less than 2% input current harmonics and less than 2% output voltage harmonics. The user interface provides the means to access critical and non-critical data from all over the world via smart devices using an internet connection or Wi-Fi.

The 2500+ Series is a fully solid-state electronic construction design and contains no moving parts to accomplish the power conversion. Cooling fans are turned on as needed to cool the power module when high ambient conditions are present and need extra cooling. On board, thermal sensors on the power module provide feedback to the fan control circuits to provide optimum cooling without deteriorating performance or efficiency.

The 2500+ is constructed of modular and easily replaceable subassemblies and components. The 2500+ enclosure is designed for passenger loading bridge applications or free standing with a floor mounting stand, either horizontal or vertical. A hinged door and access covers have been provided to ease maintenance, repair, and replacement of modular components and subassemblies. The 2500+ enclosure is designed for outdoor operation in accordance with MIL-STD-810F and can also be used for mobile applications or used in aircraft hangars. Its advanced control algorithms provide precise control and monitoring to the system. All critical and non-critical functions or operations are continuously monitored via the “Skyway Interface touch panel.” Components of the 2500+ are UL recognized or listed for their intended application. The 2500+ is UL listed to UL1012, 508C, and CE covering all the configurations in the product datasheet.

Key features	
Modular	Modbus or Bacnet
5.7” Sunlight readable Multicolor Display	10,000 data logging events
Smart Device enabled	Strategically placed access doors and panels for service
Resistive and Inductive line drop compensation	No Break Power Transfer Protection
90% Cable Interlock (Pilot Switch)	E & F Interlock
10 free relay contacts (open and assignable)	RAL 9010 C4 Paint System

Solid State Frequency Converters Performance

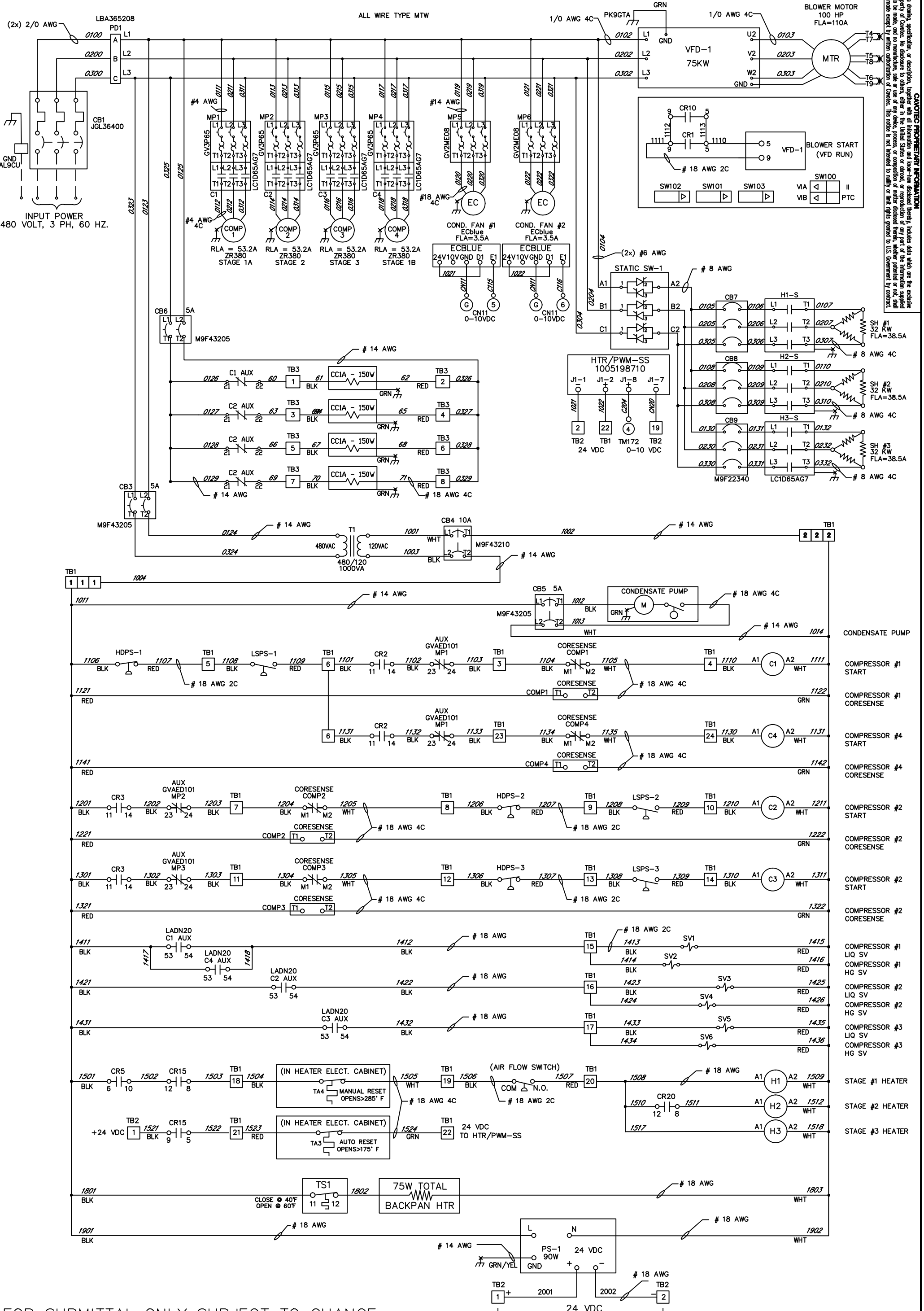
2500+ Series	
Output @60°C	90KW (1.0 PF Continuous duty cycle)
Overload	500%
Input Frequency	50/60Hz
Input Voltage	480vac
Input Amps	- 92A @ 90KVA (0.8pf) - 115A @ 90KW (1.0pf)
Output plugs	Single or Dual 400Hz
Input THD	<2%
Output THD	<2%
Unbalanced Load THD @ 30%	1.5%
Efficiency	94%
Output voltage	200/115Y @400Hz
MTRR	20 minutes

4.0 Appendixes

4.1 Appendix 1 – PDXC Equipment Datasheets, Drawings, and Manual

PDXC Equipment Datasheets, Drawings, and Manual Appendix 1

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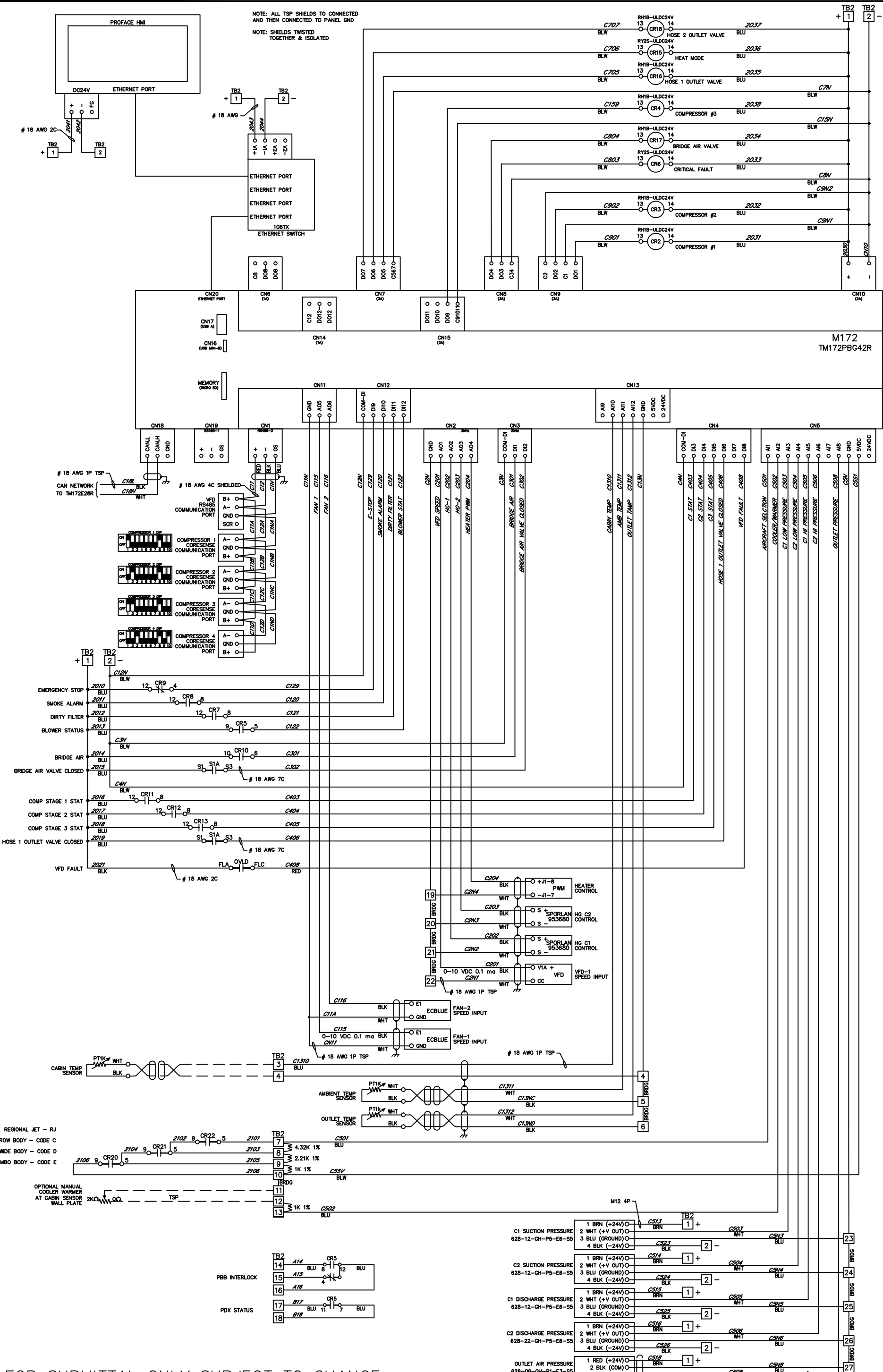


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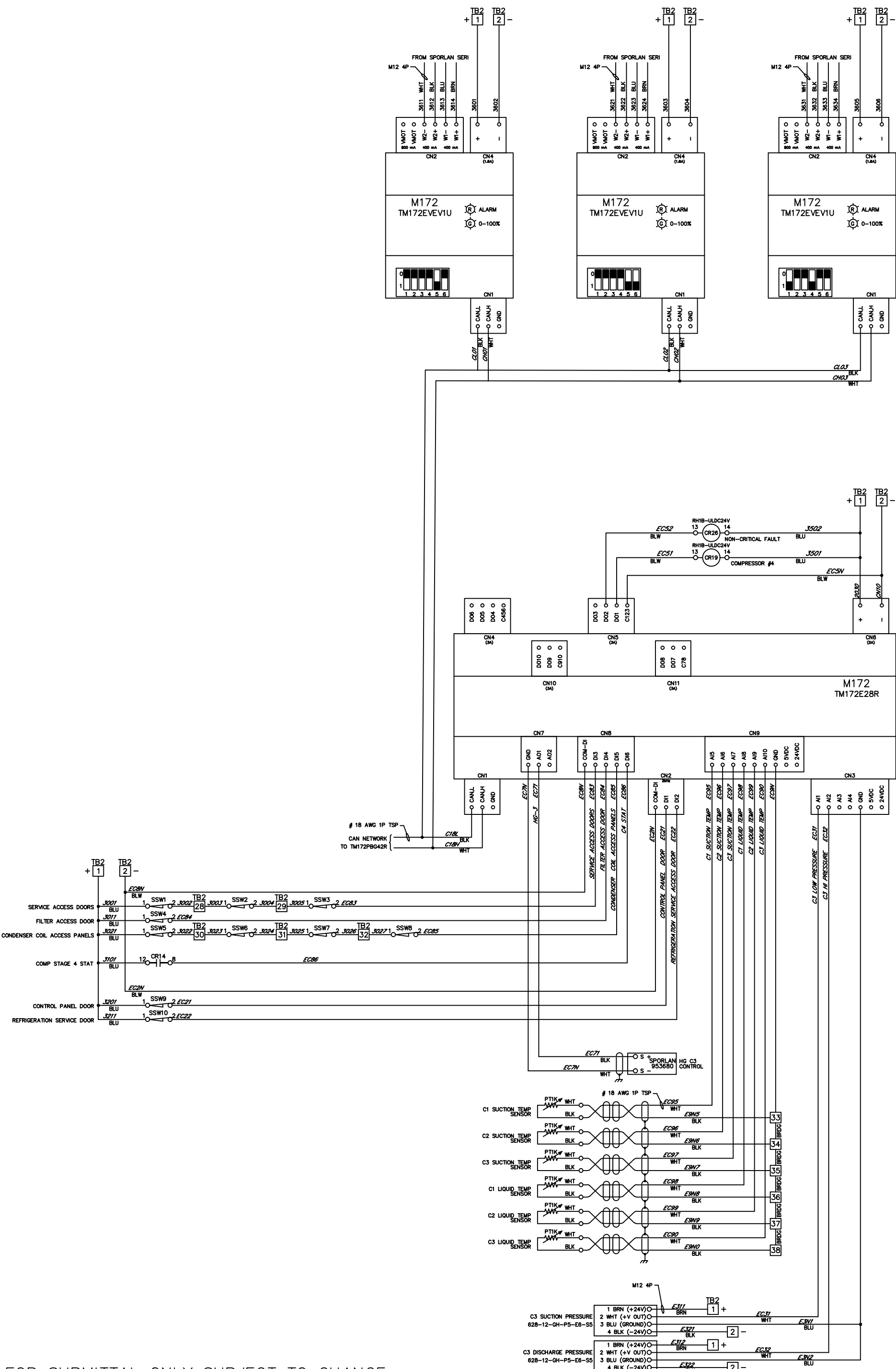
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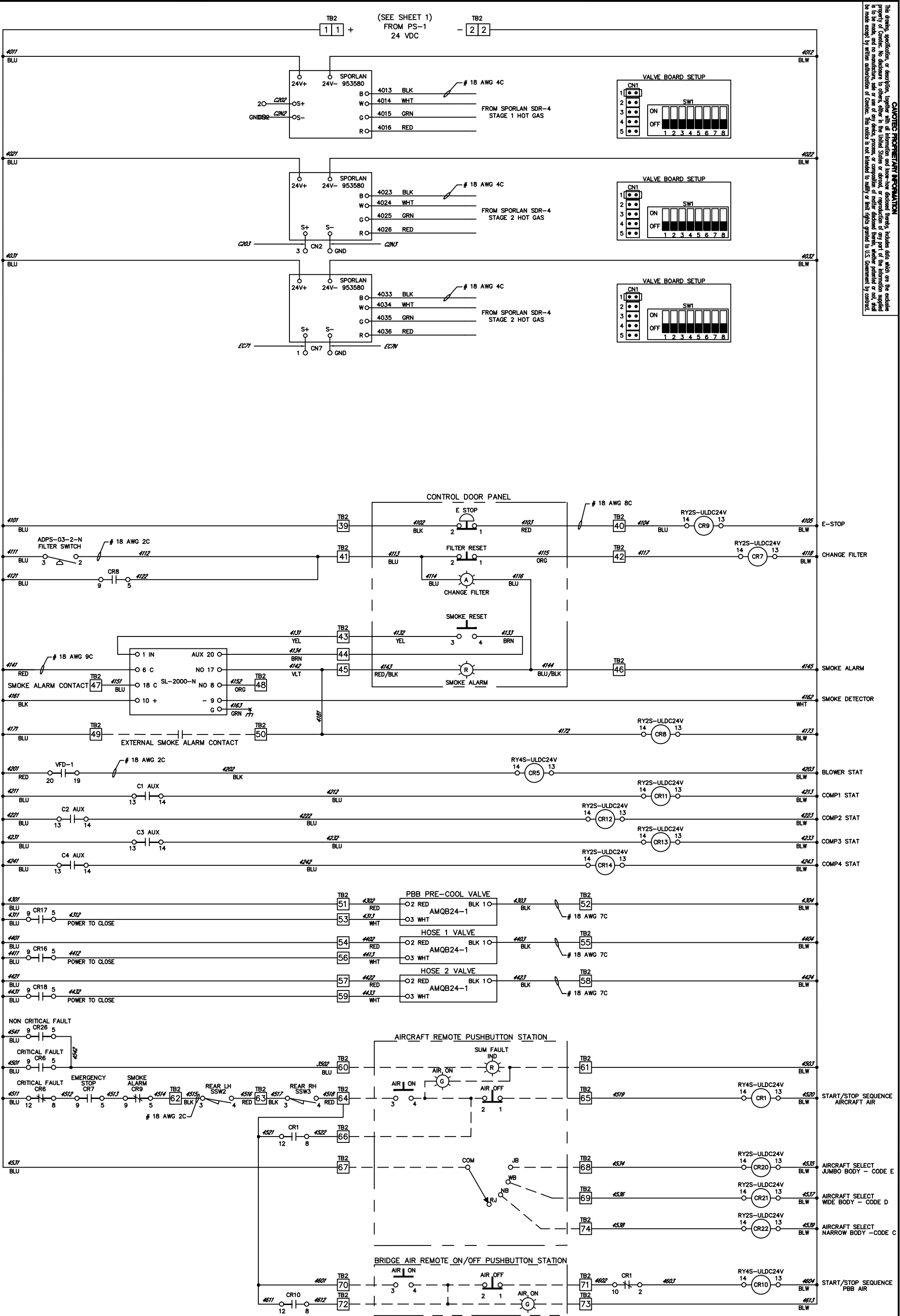
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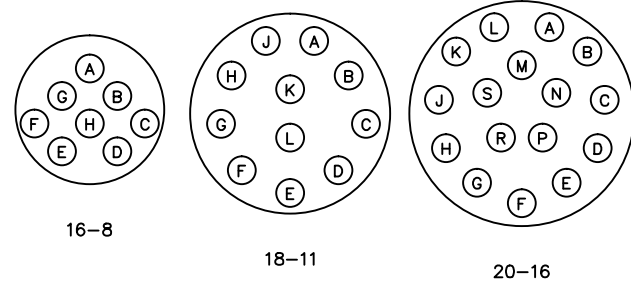
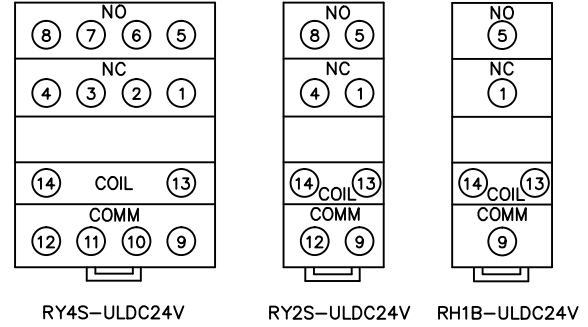


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LEGEND

ELECTRICAL SYMBOLS	
SYMBOLS	DEFINITIONS
	CIRCUIT BREAKER
	NORMALLY OPEN CONTACT
	NORMALLY CLOSED CONTACT
	HEATER
	NORMALLY OPEN FLOAT SWITCH
	NORMALLY OPEN PRESSURE SWITCH
	NORMALLY CLOSED PRESSURE SWITCH
	SOLENOID VALVE
	TEMPERATURE SENSOR
	GROUND
	RESISTOR
	VARIABLE RESISTOR
	POTENTIOMETER (MANUAL VARIABLE RESISTOR)
	120 VAC / 24 VAC STEP-DOWN TRANSFORMER
	480 VAC / 120 VAC STEP-DOWN TRANSFORMER
	NORMALLY OPEN PUSHBUTTON
	NORMALLY CLOSED PUSHBUTTON
	NORMALLY CLOSED EMERGENCY STOP PUSHBUTTON
	ILLUMINATED INDICATOR (GREEN)
	ILLUMINATED INDICATOR (AMBER)
	ILLUMINATED INDICATOR (RED)
	AUDIBLE ALARM
	FIELD WIRING
	TERMINAL BLOCK CONNECTION NUMBER
	QUICK DISCONNECT CONNECTION NUMBER
	OVERLOAD



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ABBREVIATIONS			
SYMBOLS	DEFINITIONS	SYMBOLS	DEFINITIONS
AMB	AMBER	NC	NORMALLY CLOSED
AUX	AUXILIARY	NO	NORMALLY OPEN
BLK	BLACK	OVR	OVERLOAD
BLU	BLUE	PCA	PRE-CONDITIONED AIR
BLW	BLUE-WHITE	PD	POWER DISTRIBUTION
BRN	BROWN	POS	POSITION
BRDG	TERMINAL BRIDGE/JUMPER	PS-1	POWER SUPPLY
BLWR	BLOWER	PWM	PULSE WIDTH MODULATION
BMS	BUILDING MANAGEMENT SYSTEM	RED	RED
C1	COMPRESSOR 1	RH	RIGHT HAND
C2	COMPRESSOR 2	RLA	RATED LOAD AMPS
C3	COMPRESSOR 3	STG	STAGE
CB	CIRCUIT BREAKER	STAT	STATUS
CC	CRANK CASE	SV	SOLENOID VALVE
CLSD	CLOSED	SW	SWITCH
CMD	COMMAND	TB	TERMINAL BLOCK
COMP	COMPRESSOR	TE	TEMPERATURE ELEMENT
CR	CONTROL RELAY	TS	TEMPERATURE SENSOR
FLA	FULL LOAD AMPS	TSP	TWISTED SHIELDED PAIR 8760
GND	GROUND	VFD	VARIABLE FREQUENCY DRIVE
GRN	GREEN	WHT	WHITE
HDPS	HIGH DISCHARGE PRESSURE SWITCH		
HG	HOT GAS		
HTR	HEATER		
LH	LEFT HAND		
LSPS	LOW SUCTION PRESSURE SWITCH		
M	MOTOR OR MODULE		
MP	MOTOR PROTECTOR		

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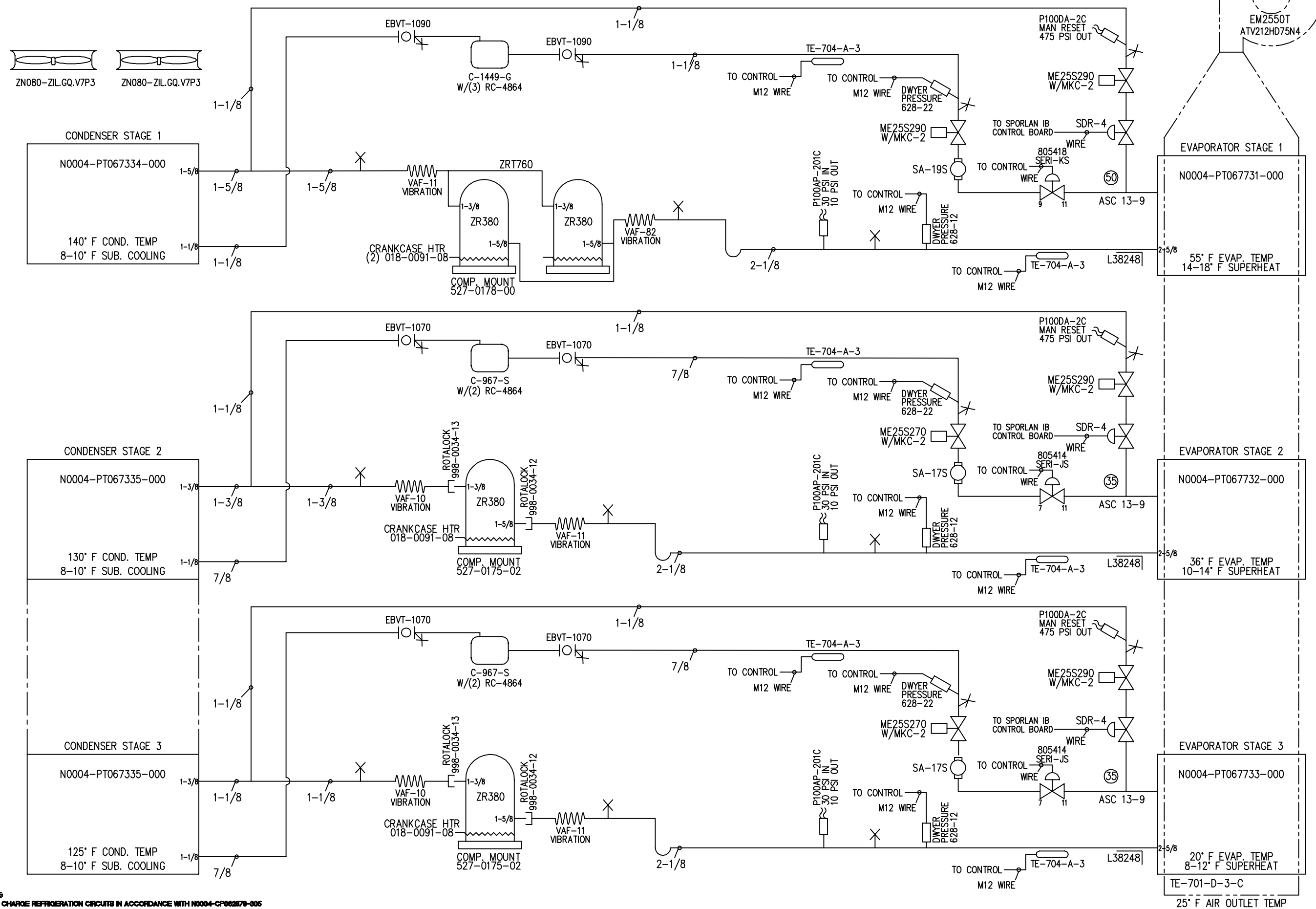
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90° F DRY BULB
 72° F WET BULB

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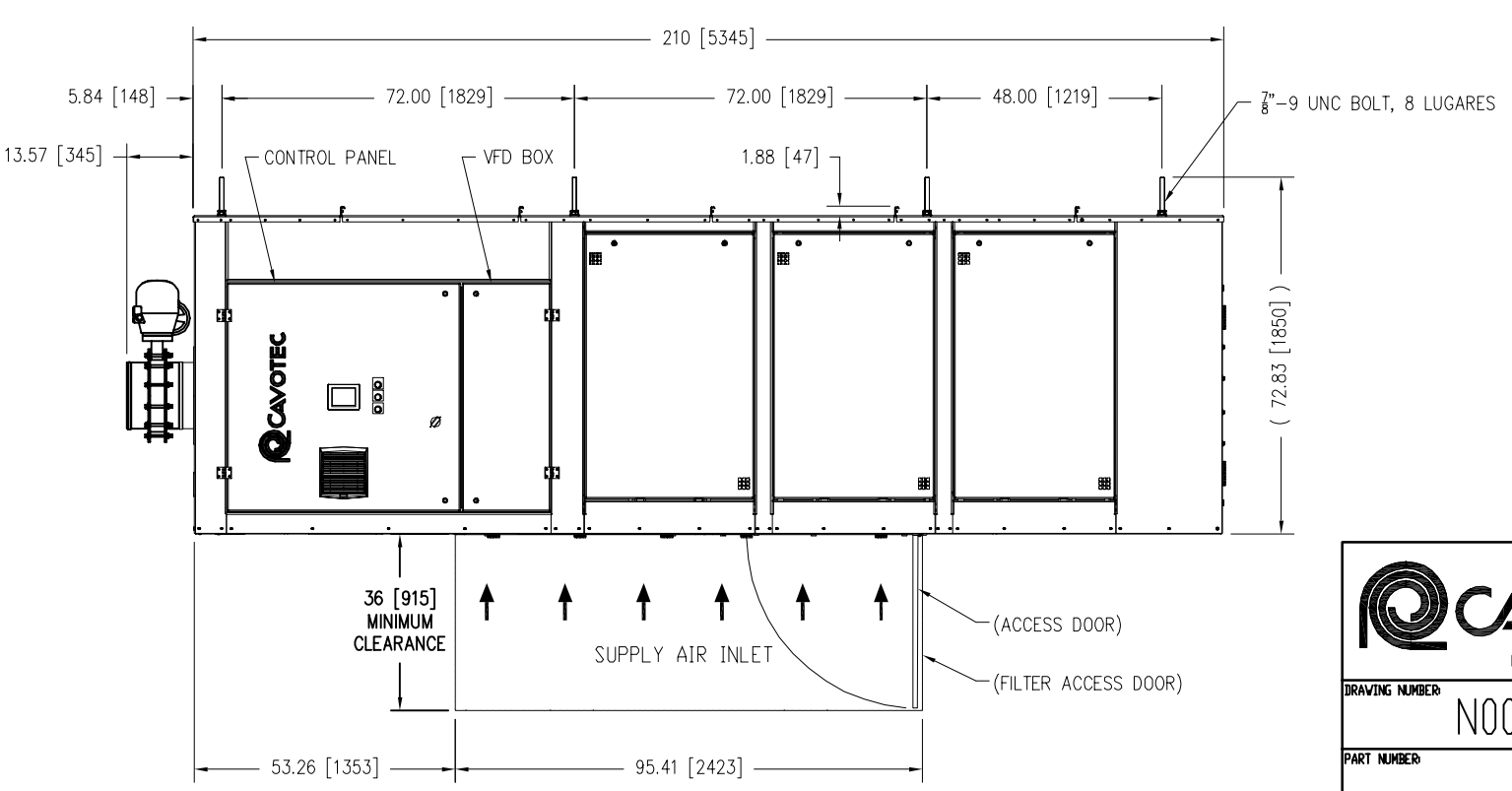
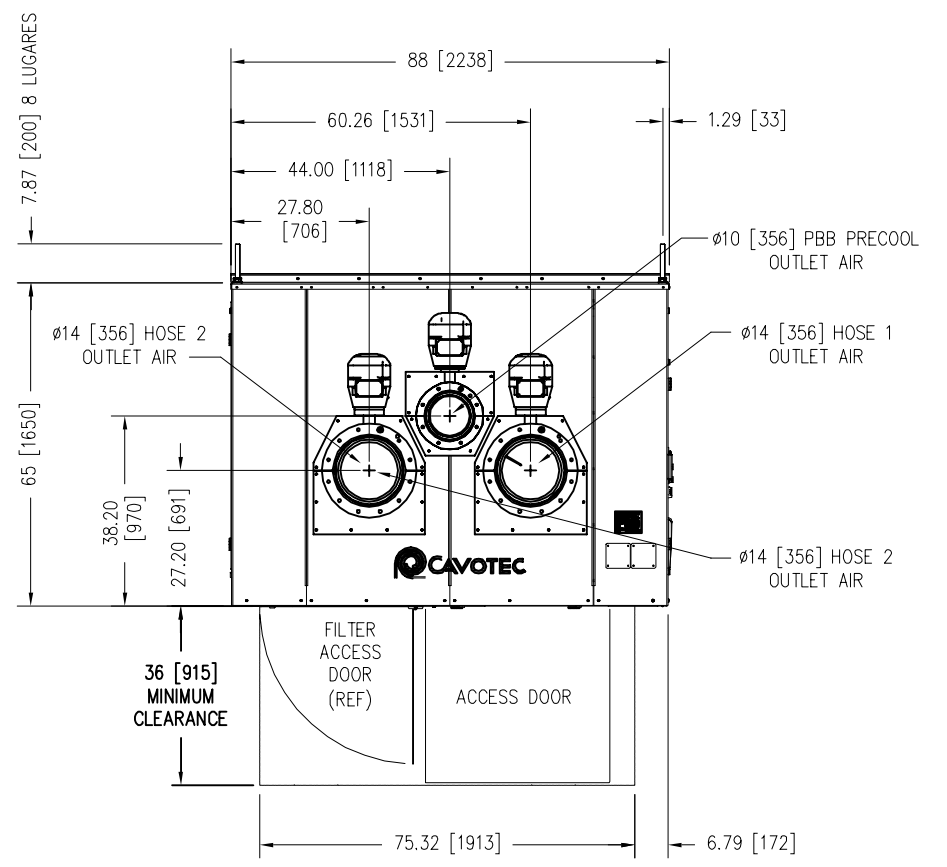
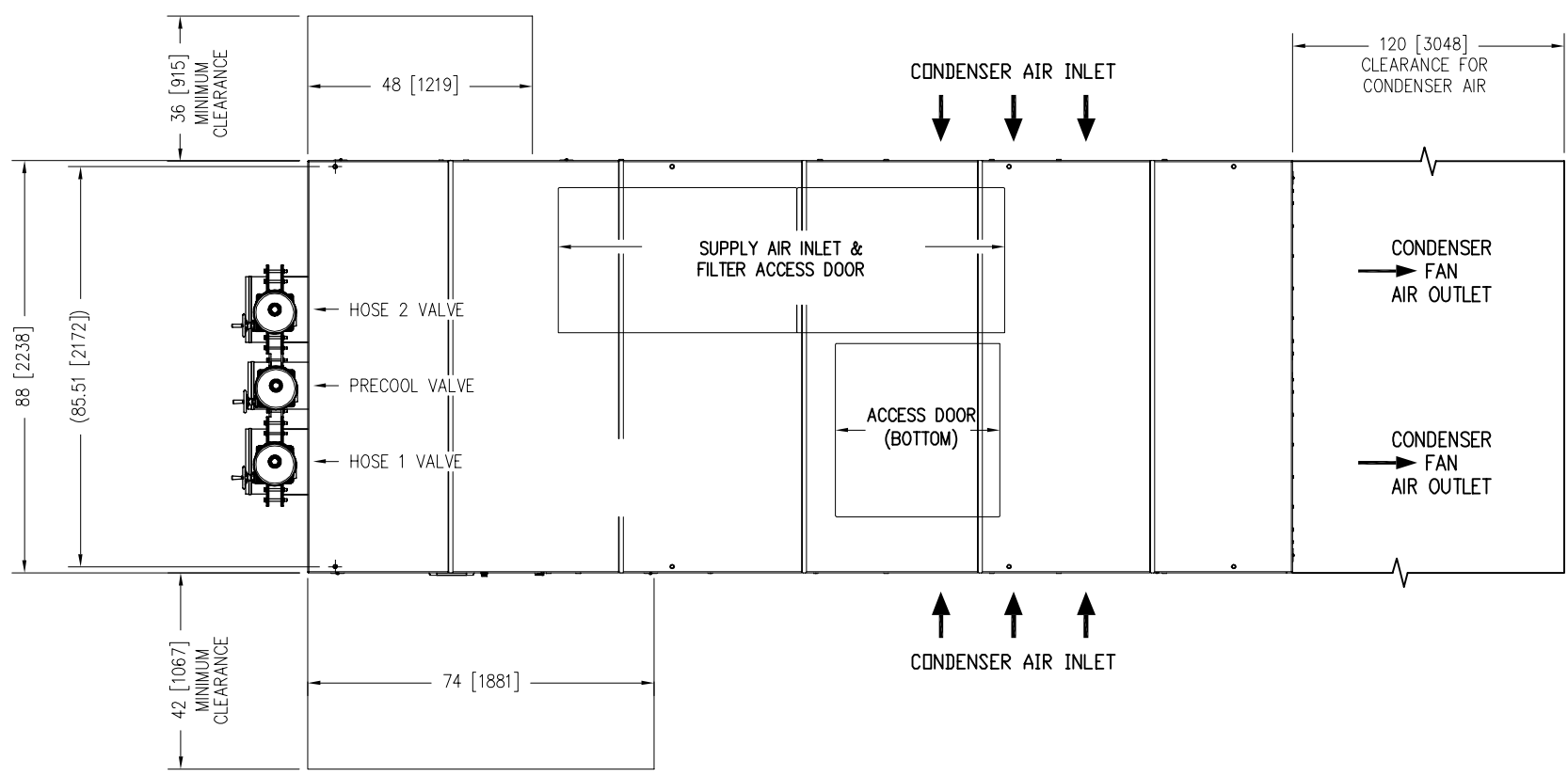




REVOLUTIONS		DESCRIPTION	DATE	REV	DWN	APPR	BH
		HIGH LIMIT LOCKOUT	6/10/19	A			

DRAWN B HANNA CHECKED	DESIGN APPROVAL	APPROVAL	TITLE		SCALE : NONE	CAD FILE: TIGER TEAM
			REFRIGERATION SCHEMATIC FOR 480 VAC 60HZ R407C			
1/9/19			SIZE	DRAWING No.		
			B	N0004-SC066791-112		
SHEET 1 OF 1						

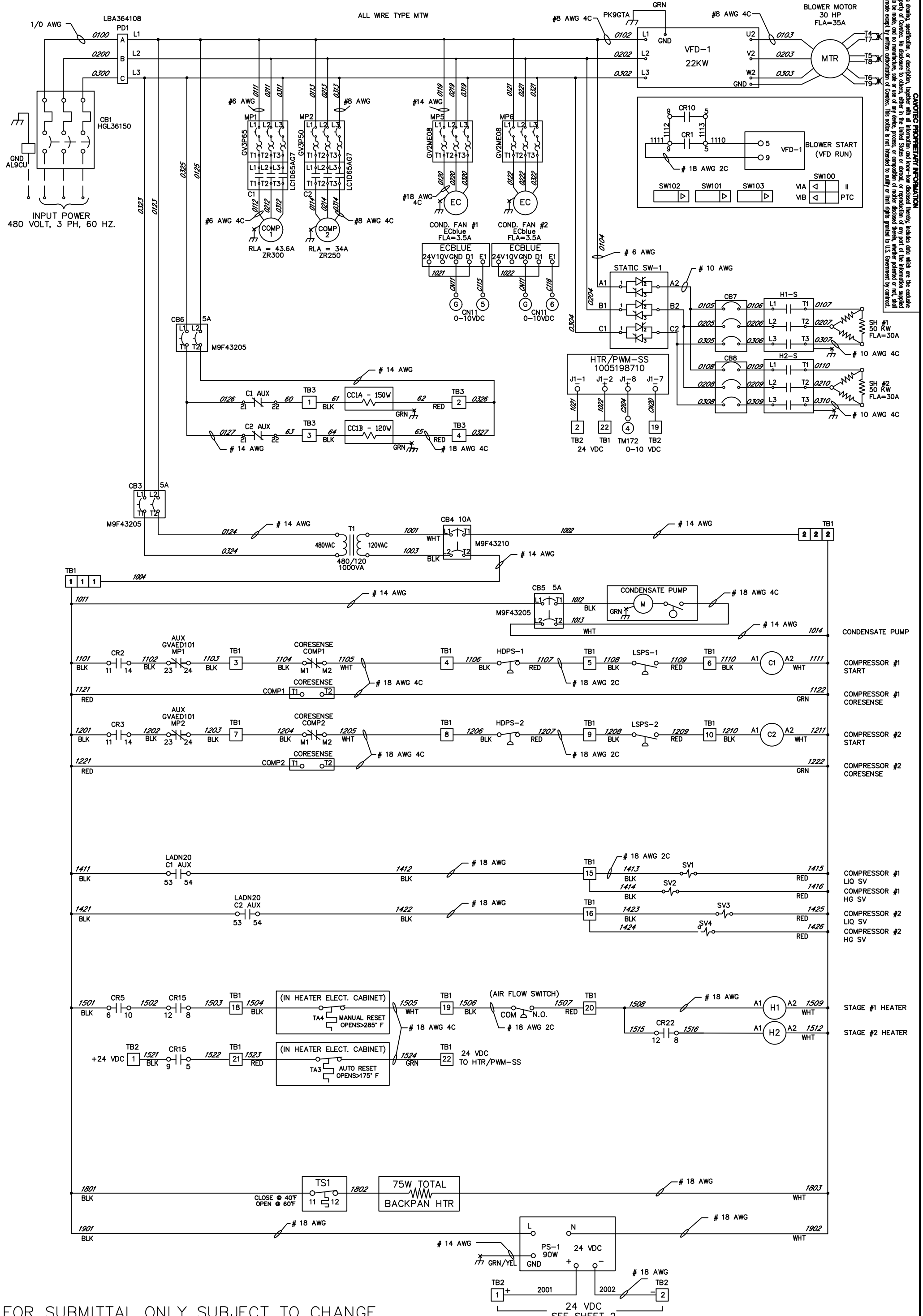
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	SHEET 1 OF 1	

NOTE: CHARGE REFRIGERATION CIRCUITS IN ACCORDANCE WITH N0004-CP062870-305



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DRAWING NUMBER:		REVISION:	
N0004-AS069316-063		1	
PART NUMBER:		APPROVED:	
N0004-AS069316-003		CC	
MATERIAL:		TITLE:	
		TRIPLE OUTLET PDX90C	
FINISH: SEE N0300-CP056953-304		INFD:	MASS (lb):
NONE		CAGE CODE: 6S1M4	8950
LAS DIMENSIONES ESTAN EN PULGADAS A MENOSQUE SE INDIQUE LO CONTRARIO		TOLERANCING:	SHEET SIZE: SHEET:
		CP057289-mK	NONE B 1 OF 1

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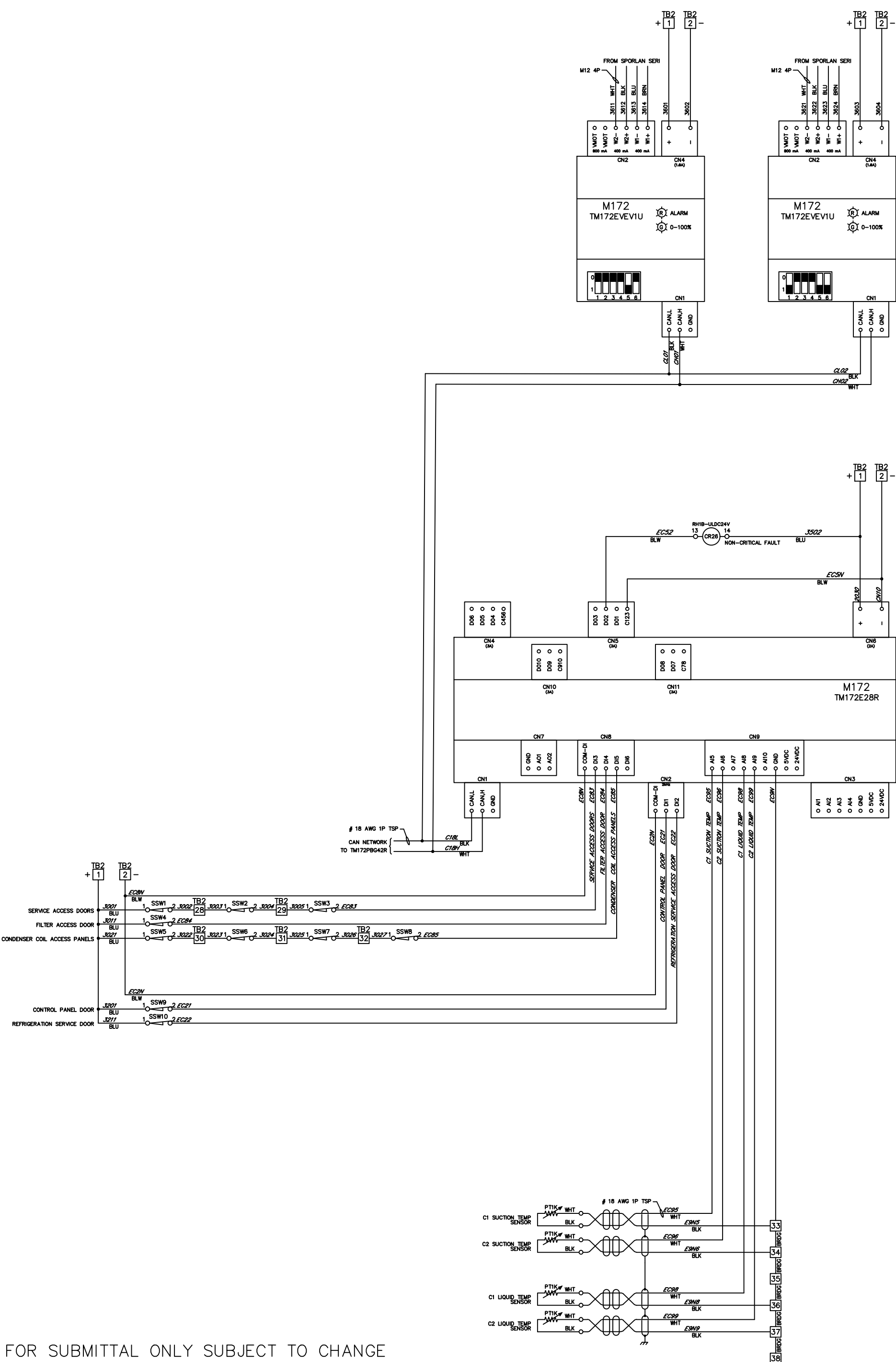


DRAWN BRAD HANNA CHECKED	10/6/20
DESIGN APPROVAL	
APPROVAL	
APPROVAL	

TITLE SCHEMATIC WIRING DIAGRAM PDX-45C WITH 50 KW HEATING 480 VOLT MODEL	
SIZE B	DRAWING No. N0004-SC066792-402
SCALE :NONE	

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

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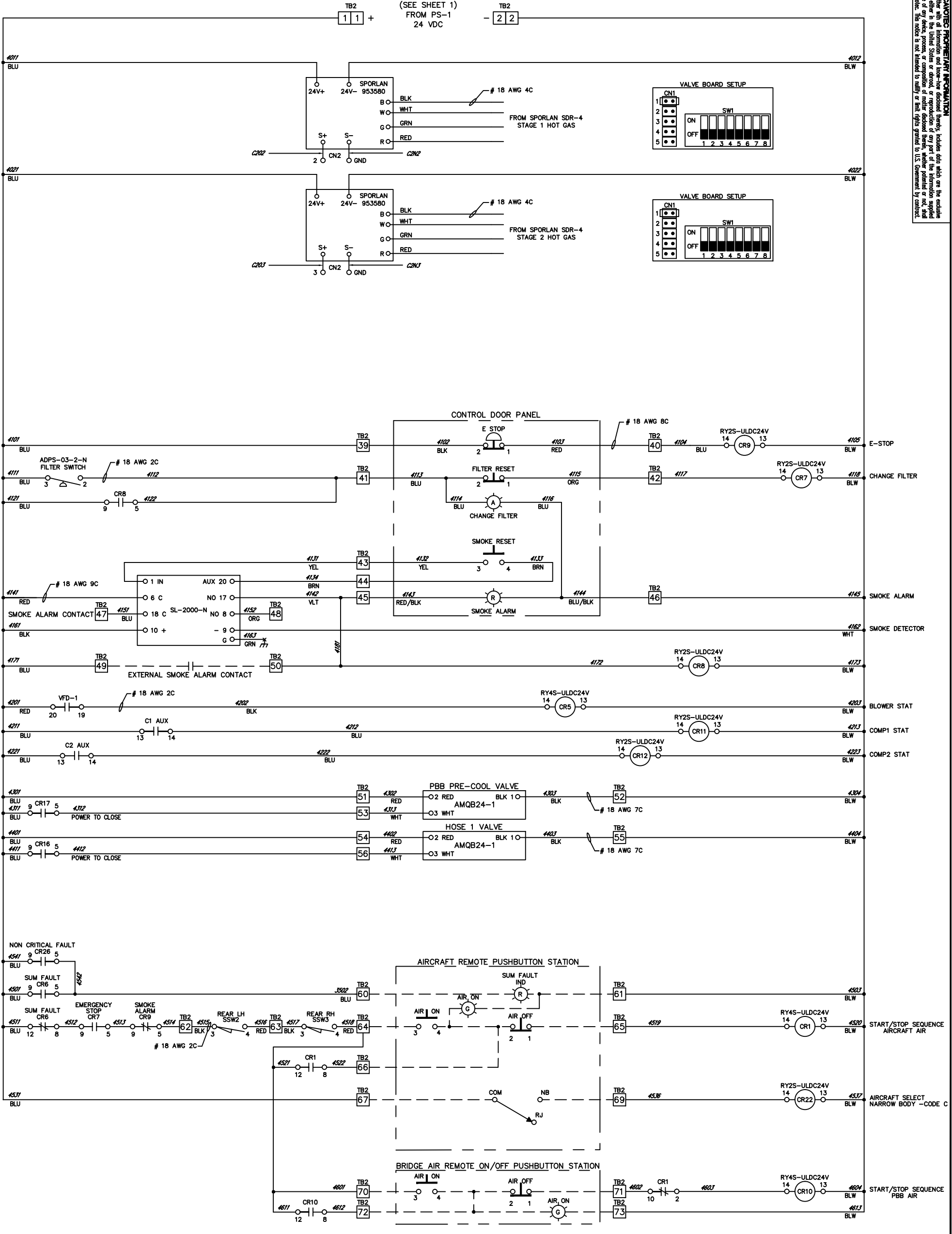
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SHEET 3 OF 5			

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

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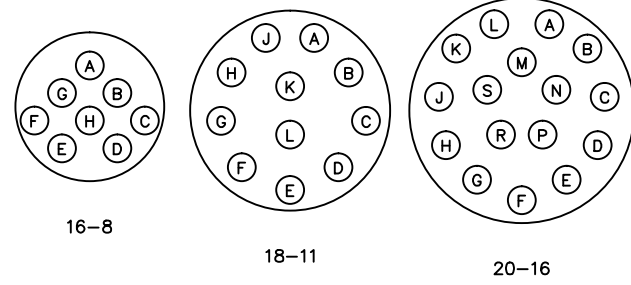
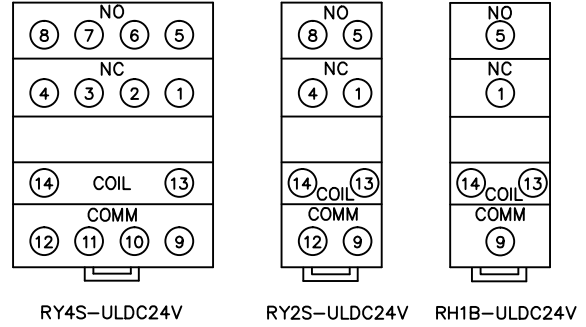


DRAWN BRAD HANNA	10/6/20	SIZE B	DRAWING No. N0004-SC066792-402
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.		SCALE :NONE	
SHEET 4 OF 5			

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

LEGEND

ELECTRICAL SYMBOLS	
SYMBOLS	DEFINITIONS
	CIRCUIT BREAKER
	NORMALLY OPEN CONTACT
	NORMALLY CLOSED CONTACT
	HEATER
	NORMALLY OPEN FLOAT SWITCH
	NORMALLY OPEN PRESSURE SWITCH
	NORMALLY CLOSED PRESSURE SWITCH
	SOLENOID VALVE
	TEMPERATURE SENSOR
	GROUND
	RESISTOR
	VARIABLE RESISTOR
	POTENTIOMETER (MANUAL VARIABLE RESISTOR)
	120 VAC / 24 VAC STEP-DOWN TRANSFORMER
	480 VAC / 120 VAC STEP-DOWN TRANSFORMER
	NORMALLY OPEN PUSHBUTTON
	NORMALLY CLOSED PUSHBUTTON
	NORMALLY CLOSED EMERGENCY STOP PUSHBUTTON
	ILLUMINATED INDICATOR (GREEN)
	ILLUMINATED INDICATOR (AMBER)
	ILLUMINATED INDICATOR (RED)
	AUDIBLE ALARM
	FIELD WIRING
	TERMINAL BLOCK CONNECTION NUMBER
	QUICK DISCONNECT CONNECTION NUMBER
	OVERLOAD



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ABBREVIATIONS			
SYMBOLS	DEFINITIONS	SYMBOLS	DEFINITIONS
AMB	AMBER	NC	NORMALLY CLOSED
AUX	AUXILIARY	NO	NORMALLY OPEN
BLK	BLACK	OVR	OVERLOAD
BLU	BLUE	PCA	PRE-CONDITIONED AIR
BLW	BLUE-WHITE	PD	POWER DISTRIBUTION
BRN	BROWN	POS	POSITION
BRDG	TERMINAL BRIDGE/JUMPER	PS-1	POWER SUPPLY
BLWR	BLOWER	PWM	PULSE WIDTH MODULATION
BMS	BUILDING MANAGEMENT SYSTEM	RED	RED
C1	COMPRESSOR 1	RH	RIGHT HAND
C2	COMPRESSOR 2	RLA	RATED LOAD AMPS
C3	COMPRESSOR 3	STG	STAGE
CB	CIRCUIT BREAKER	STAT	STATUS
CC	CRANK CASE	SV	SOLENOID VALVE
CLSD	CLOSED	SW	SWITCH
CMD	COMMAND	TB	TERMINAL BLOCK
COMP	COMPRESSOR	TE	TEMPERATURE ELEMENT
CR	CONTROL RELAY	TS	TEMPERATURE SENSOR
FLA	FULL LOAD AMPS	TSP	TWISTED SHIELDED PAIR 8760
GND	GROUND	VFD	VARIABLE FREQUENCY DRIVE
GRN	GREEN	WHT	WHITE
HDPS	HIGH DISCHARGE PRESSURE SWITCH		
HG	HOT GAS		
HTR	HEATER		
LH	LEFT HAND		
LSPS	LOW SUCTION PRESSURE SWITCH		
M	MOTOR OR MODULE		
MP	MOTOR PROTECTOR		

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DRAWN
 BRAD HANNA
 10/6/20
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 DIMENSIONS ARE IN INCHES.
 SHEET 5 OF 5

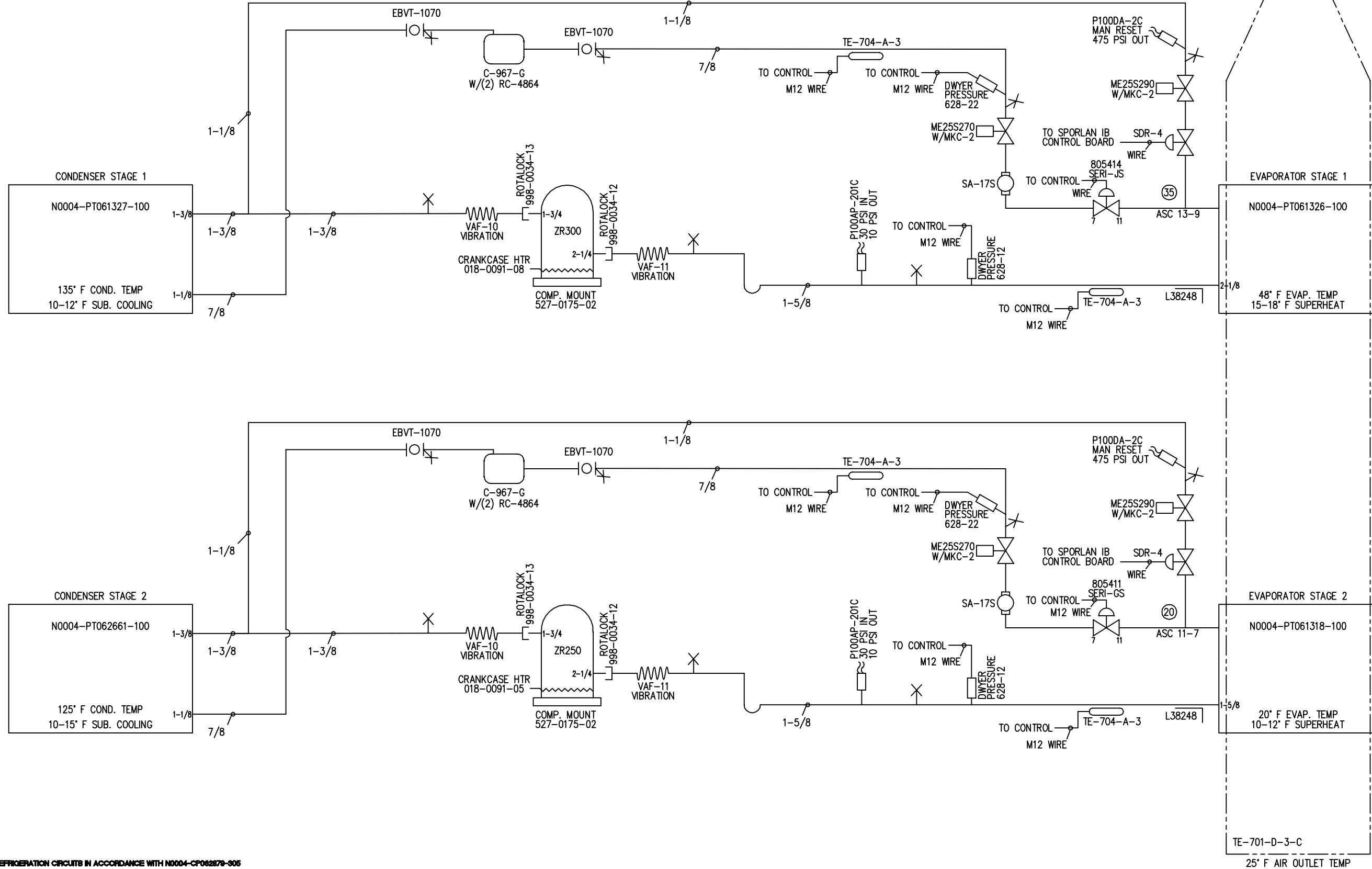
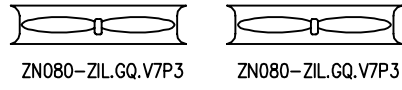
SIZE B
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 SCALE :NONE

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

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 72° F WET BULB

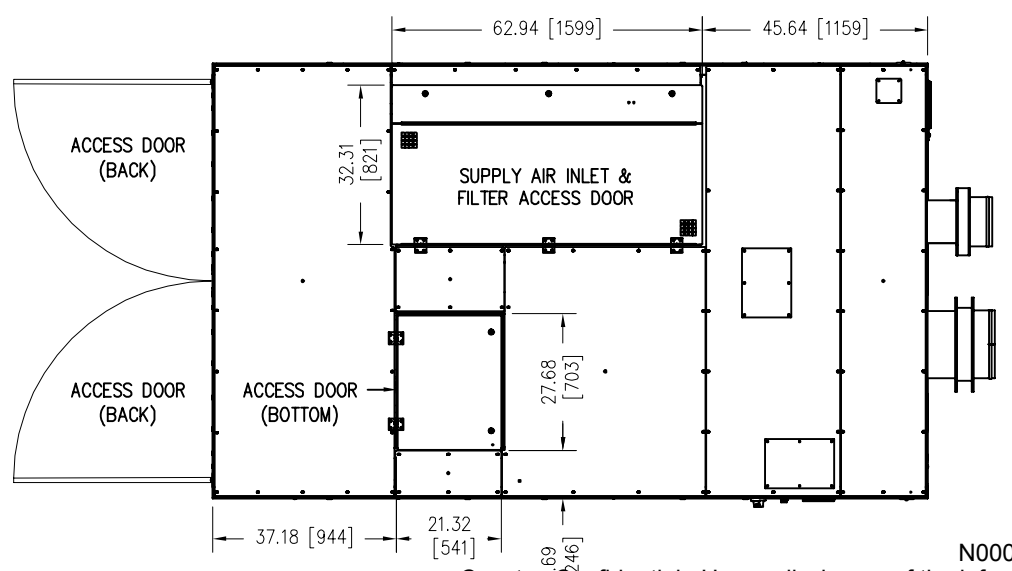
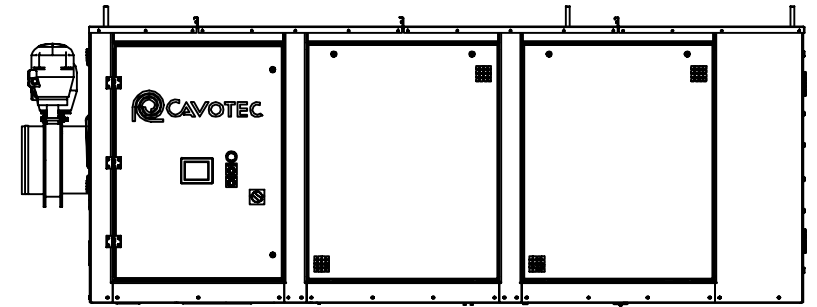
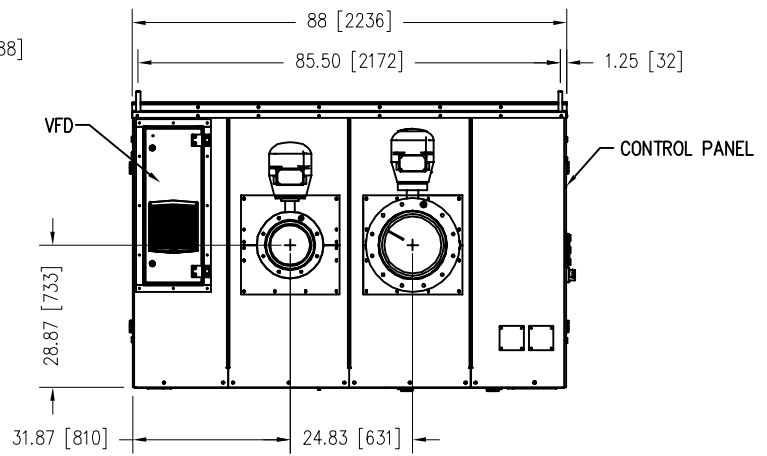
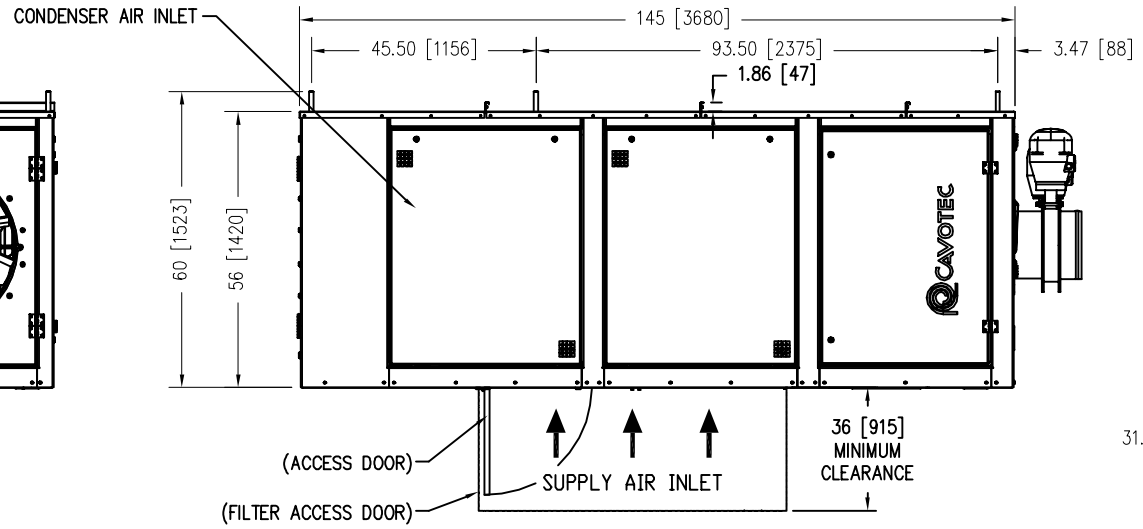
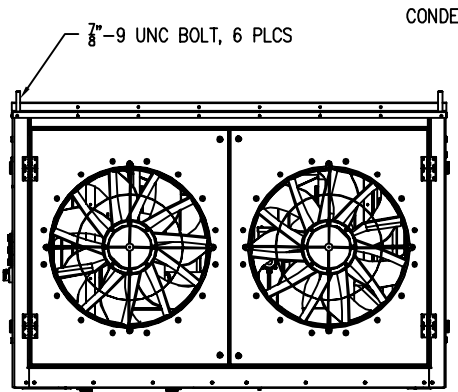
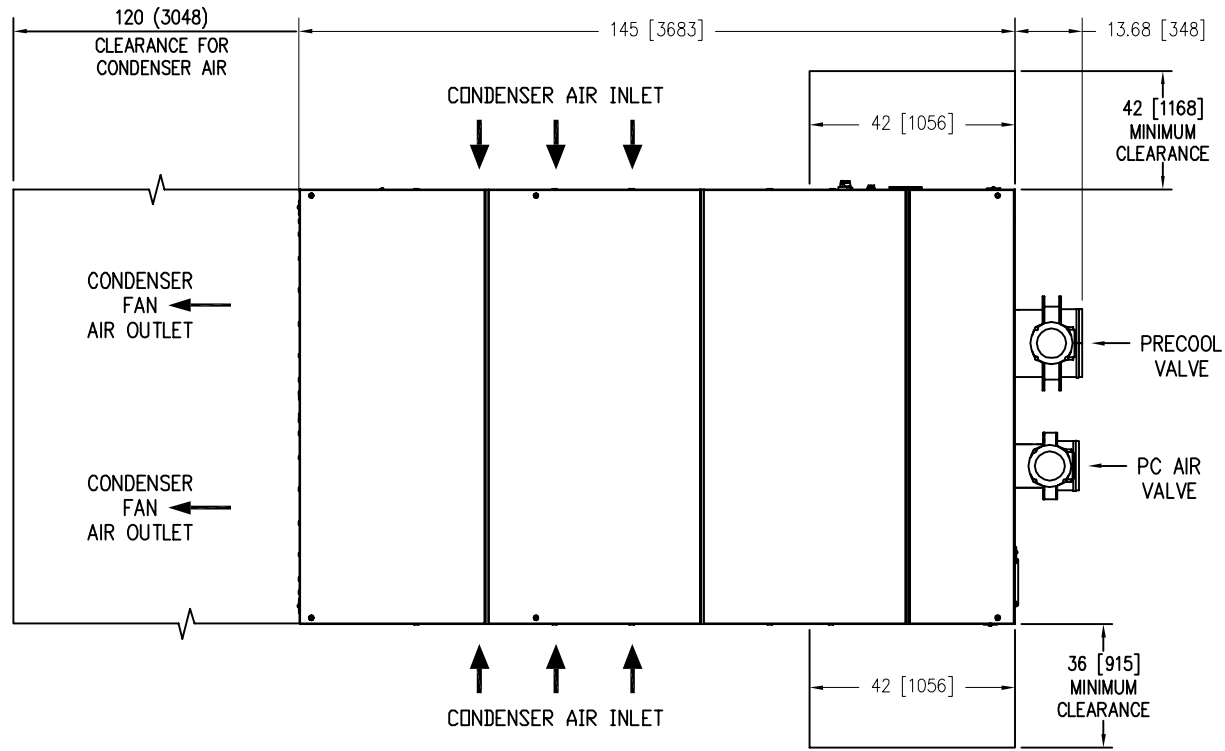


REVISES		DESCRIPTION	DATE	REV	DWN	APPR	BH
BY	DATE						
	A	HIGH LIMIT LOCKOUT	6/10/19				

TITLE	PDX-45C	
	REFRIGERATION SCHEMATIC FOR 480 VAC 60HZ R407C	
SIZE	DRAWING No.	
	B	
SCALE	NONE	
	CAD FILE: TIGER TEAM	
DRAWN	1/9/19	
CHECKED	B HANNA	
DESIGN APPROVAL		
APPROVAL		
SHEET 1 OF 1		

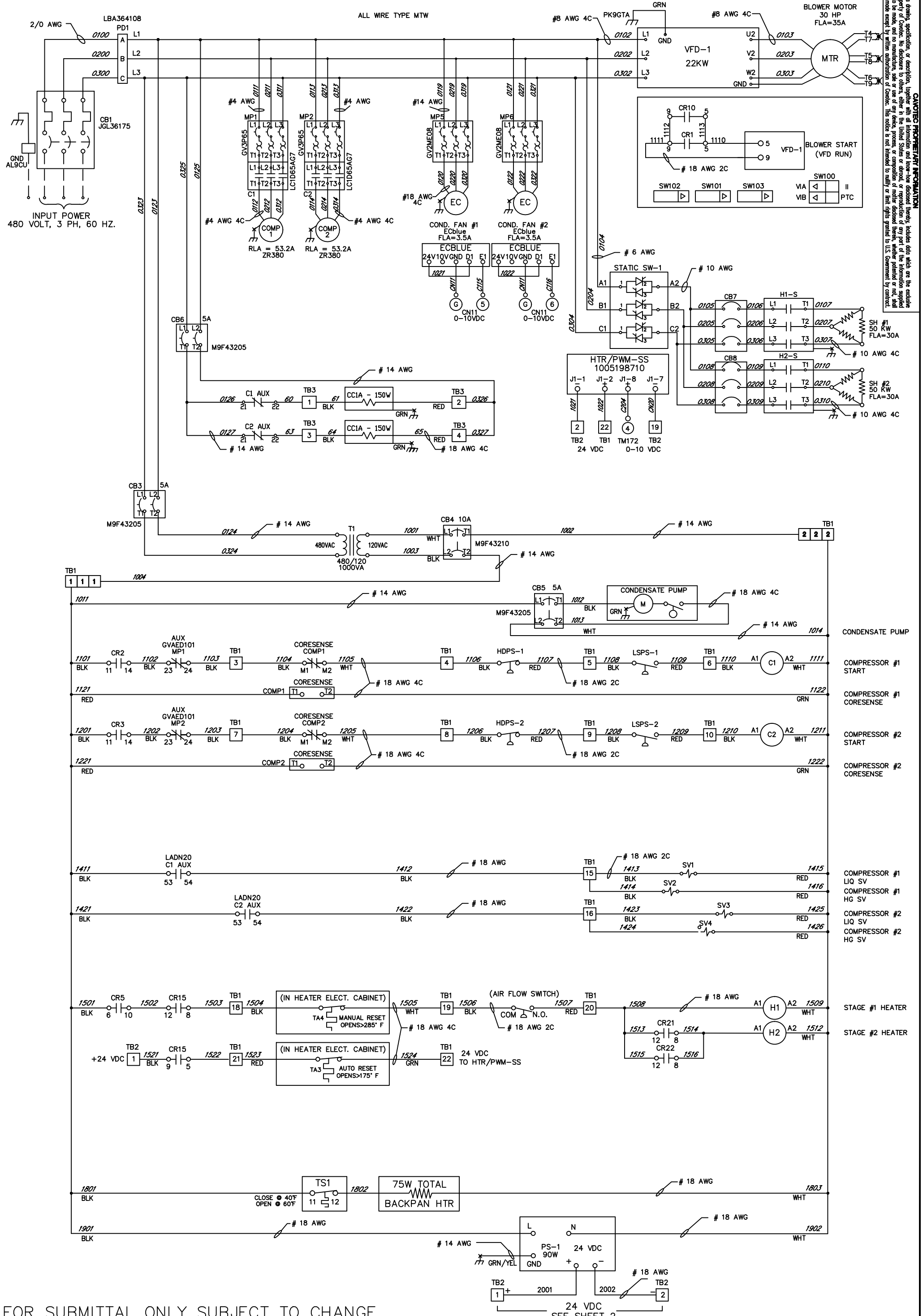
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PART NUMBER:		APPROVED:	
N0004-AS068368-012			
MATERIAL:		TITLE:	
REFER TO PARTS LIST		OUTLINE DRAWING PDX 45C DUAL OUTLET	
FINISH: SEE N0300-CP056953-304		INFD:	
		MASS (lb):	
		4360	
DIMENSIONS IN Inches UNLESS OTHERWISE STATED		TOLERANCING:	SCALE: SHEET SIZE: SHEET:
		CP057289-	1:40 B 1 OF 1

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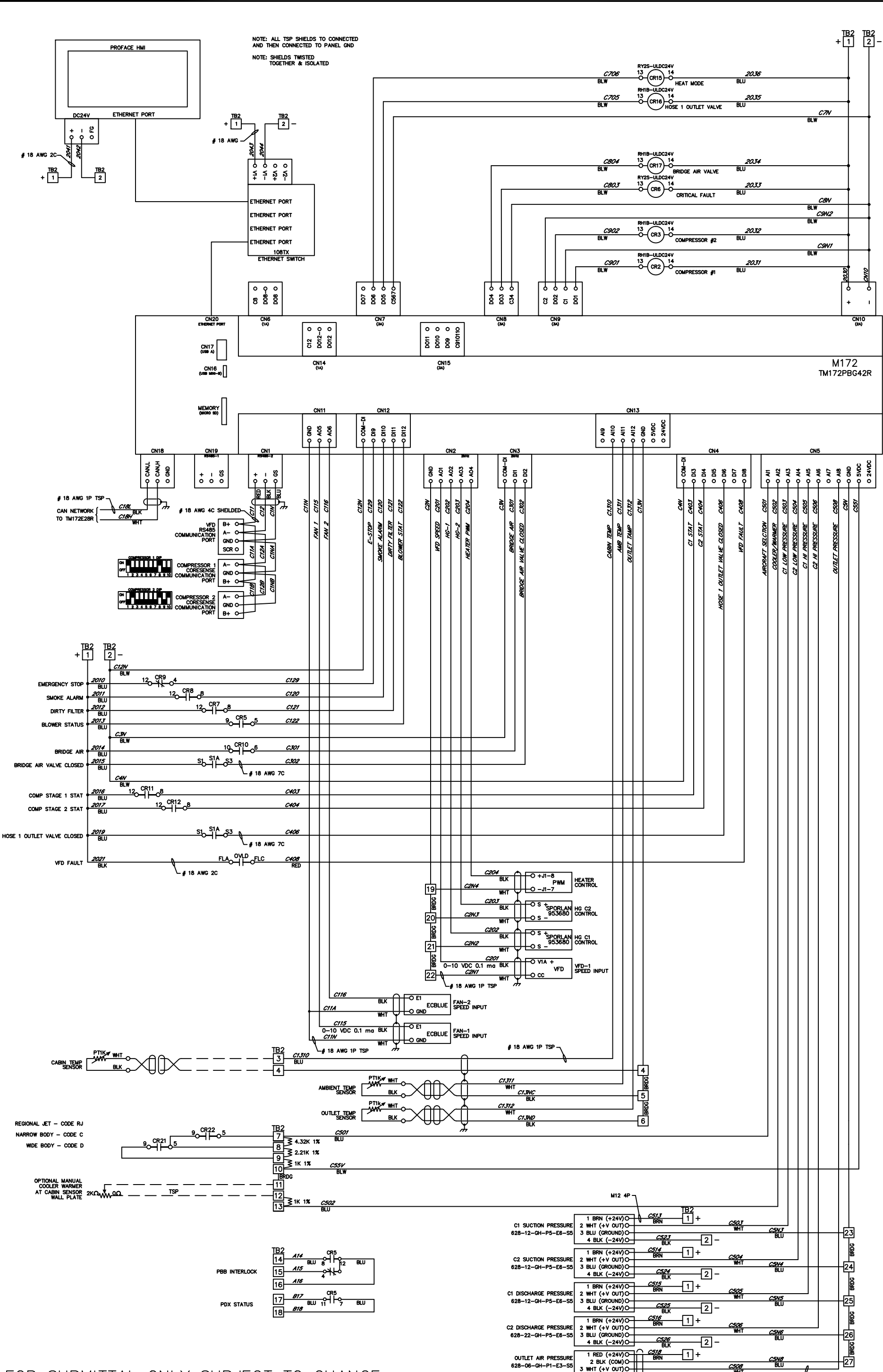


DRAWN BRAD HANNA	11/17/20
CHECKED	
DESIGN APPROVAL	
APPROVAL	
APPROVAL	

TITLE SCHEMATIC WIRING DIAGRAM PDX-60C WITH 50 KW HEATING 480 VOLT MODEL	
SIZE B	DRAWING No. N0004-SC066792-602
SCALE :NONE	

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

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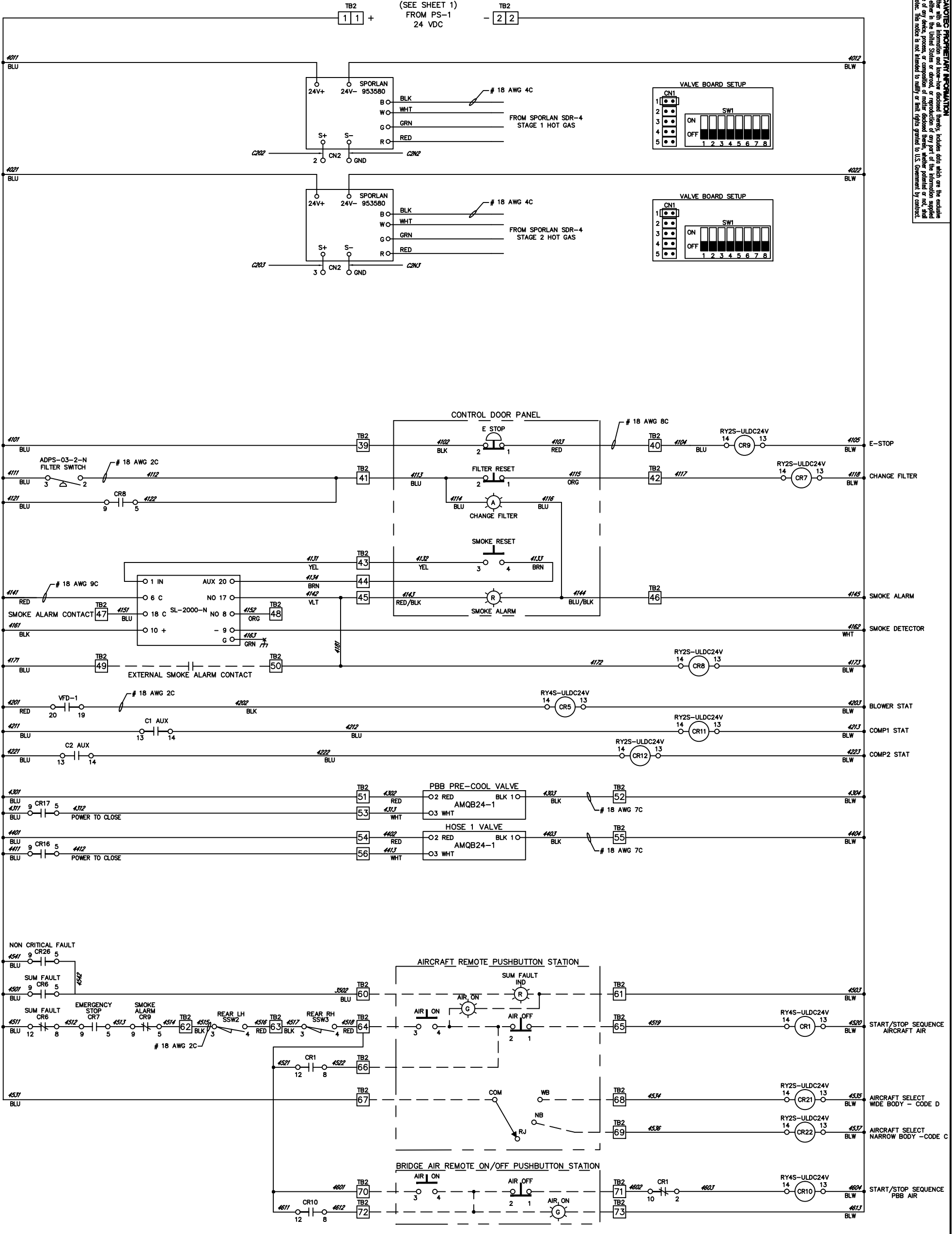
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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.		SCALE :NONE	
SHEET 2 OF 5			

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

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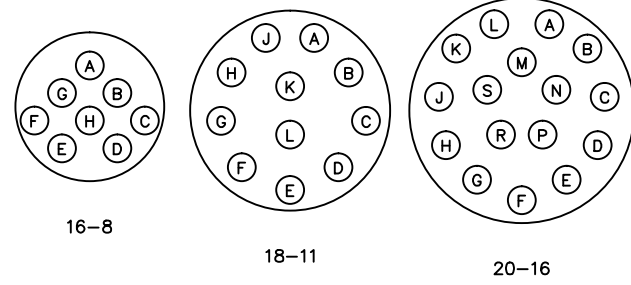
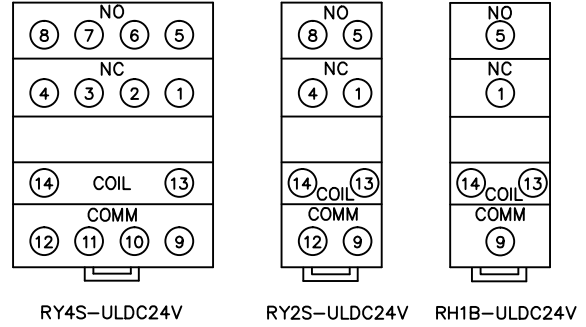


DRAWN BRAD HANNA	11/17/20	SIZE B	DRAWING No. N0004-SC066792-602
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.		SCALE :NONE	
SHEET 4 OF 5			

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

LEGEND

ELECTRICAL SYMBOLS	
SYMBOLS	DEFINITIONS
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	NORMALLY OPEN CONTACT
	NORMALLY CLOSED CONTACT
	HEATER
	NORMALLY OPEN FLOAT SWITCH
	NORMALLY OPEN PRESSURE SWITCH
	NORMALLY CLOSED PRESSURE SWITCH
	SOLENOID VALVE
	TEMPERATURE SENSOR
	GROUND
	RESISTOR
	VARIABLE RESISTOR
	POTENTIOMETER (MANUAL VARIABLE RESISTOR)
	120 VAC / 24 VAC STEP-DOWN TRANSFORMER
	480 VAC / 120 VAC STEP-DOWN TRANSFORMER
	NORMALLY OPEN PUSHBUTTON
	NORMALLY CLOSED PUSHBUTTON
	NORMALLY CLOSED EMERGENCY STOP PUSHBUTTON
	ILLUMINATED INDICATOR (GREEN)
	ILLUMINATED INDICATOR (AMBER)
	ILLUMINATED INDICATOR (RED)
	AUDIBLE ALARM
	FIELD WIRING
	TERMINAL BLOCK CONNECTION NUMBER
	QUICK DISCONNECT CONNECTION NUMBER
	OVERLOAD



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BRN	BROWN	POS	POSITION
BRDG	TERMINAL BRIDGE/JUMPER	PS-1	POWER SUPPLY
BLWR	BLOWER	PWM	PULSE WIDTH MODULATION
BMS	BUILDING MANAGEMENT SYSTEM	RED	RED
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C3	COMPRESSOR 3	STG	STAGE
CB	CIRCUIT BREAKER	STAT	STATUS
CC	CRANK CASE	SV	SOLENOID VALVE
CLSD	CLOSED	SW	SWITCH
CMD	COMMAND	TB	TERMINAL BLOCK
COMP	COMPRESSOR	TE	TEMPERATURE ELEMENT
CR	CONTROL RELAY	TS	TEMPERATURE SENSOR
FLA	FULL LOAD AMPS	TSP	TWISTED SHIELDED PAIR 8760
GND	GROUND	VFD	VARIABLE FREQUENCY DRIVE
GRN	GREEN	WHT	WHITE
HDPS	HIGH DISCHARGE PRESSURE SWITCH		
HG	HOT GAS		
HTR	HEATER		
LH	LEFT HAND		
LSPS	LOW SUCTION PRESSURE SWITCH		
M	MOTOR OR MODULE		
MP	MOTOR PROTECTOR		

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DRAWN
 BRAD HANNA
 11/17/20
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 DIMENSIONS ARE IN INCHES.
 SHEET 5 OF 5

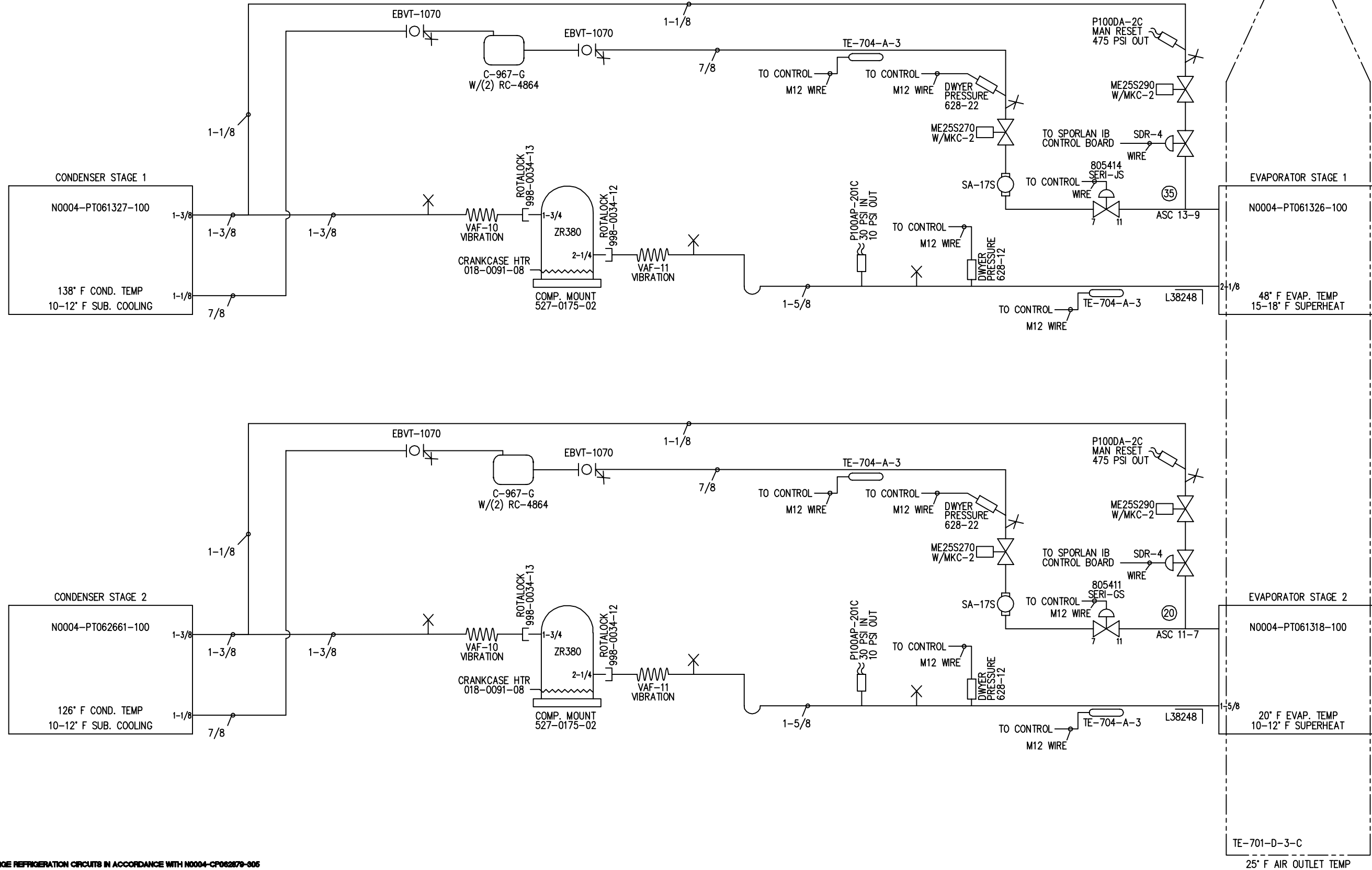
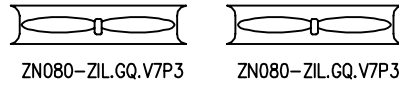
SIZE
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 DRAWING No.
 N0004-SC066792-602
 SCALE :NONE

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

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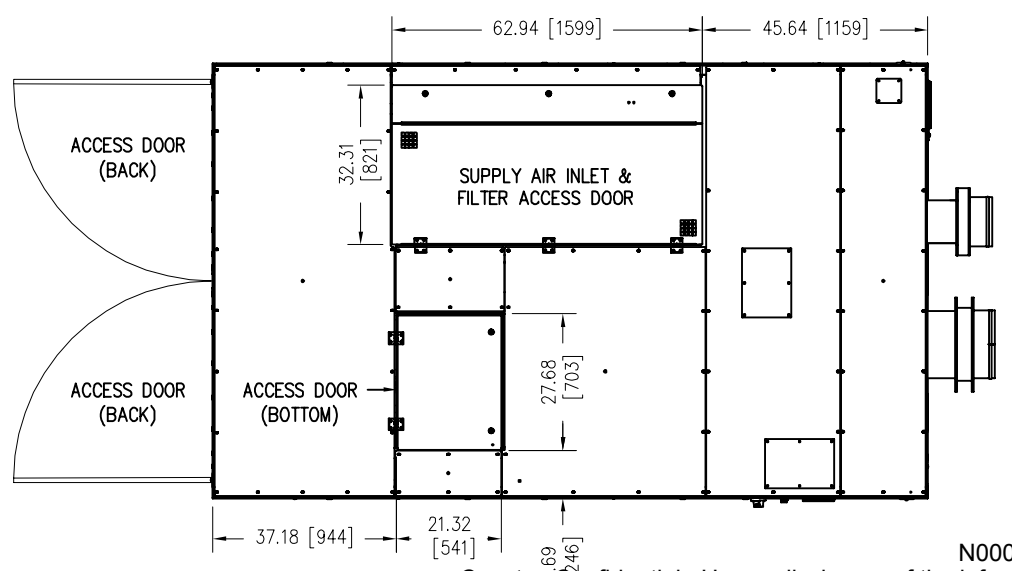
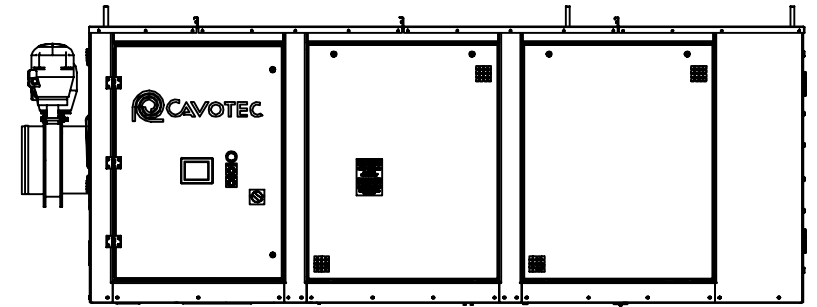
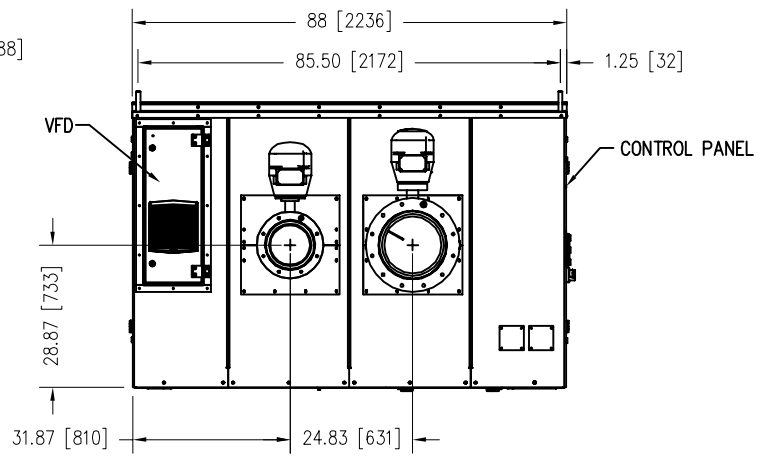
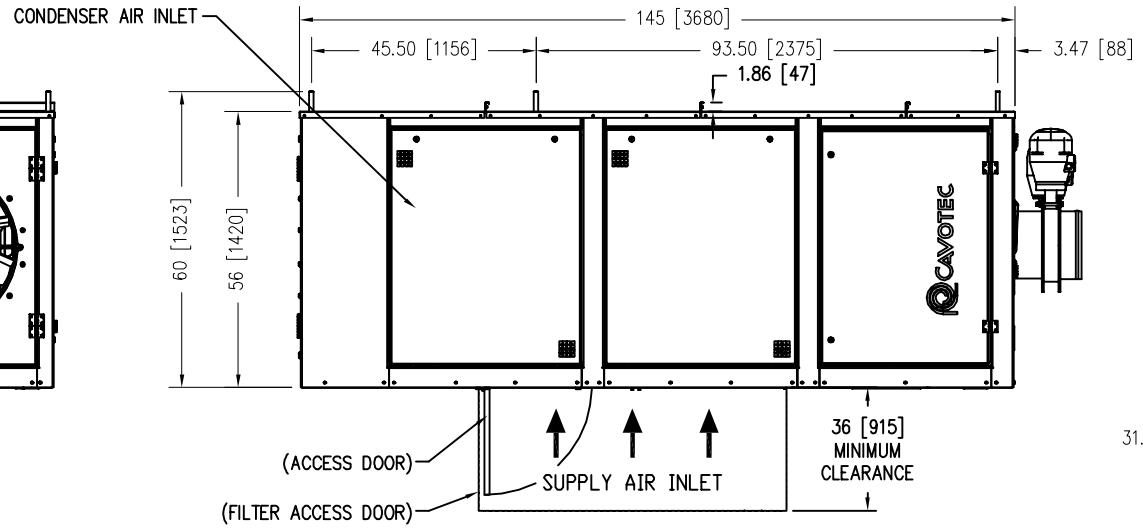
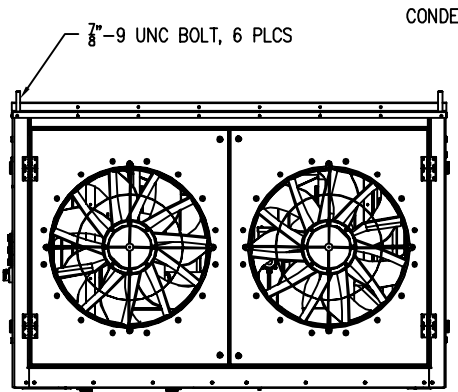
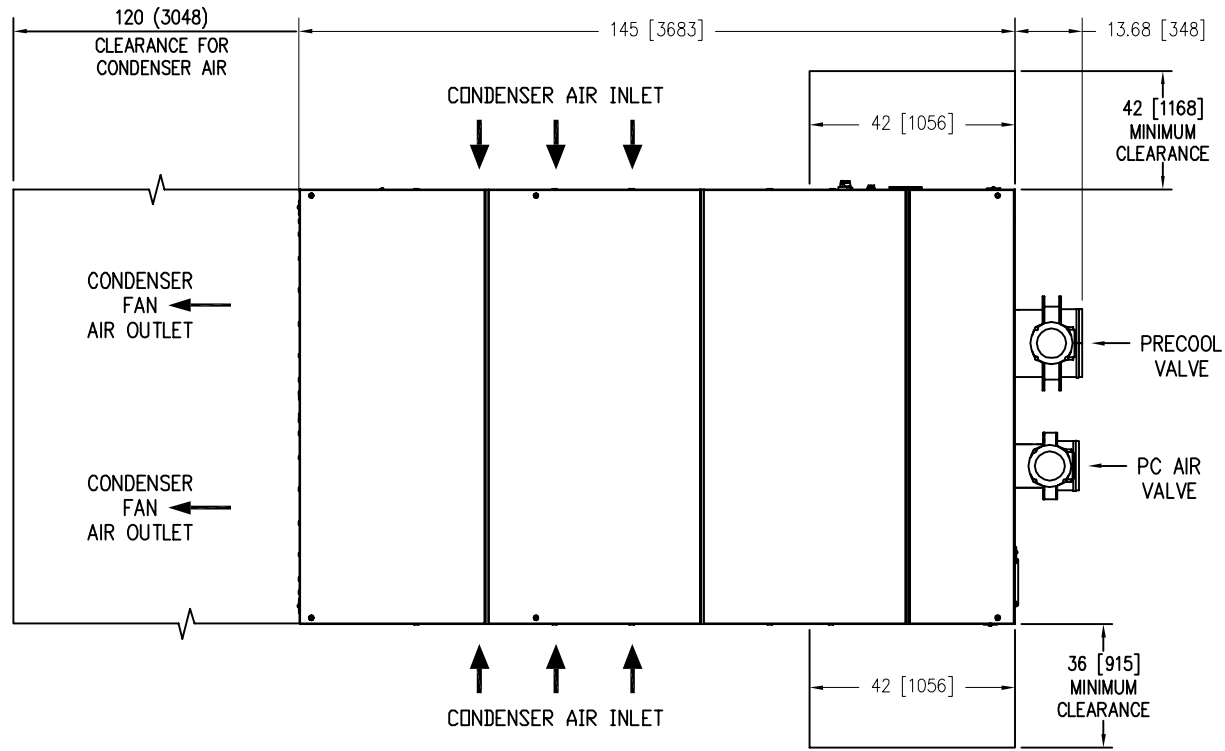
90° F DRY BULB
 72° F WET BULB



REVIEWS		REV	DATE	DESCRIPTION	DWN	APPR	BH
		A	6/10/19	HIGH LIMIT LOCKOUT			BH

DRAWN B HANNA CHECKED	1/9/19	TITLE REFRIGERATION SCHEMATIC FOR 480 VAC 60HZ R407C	SIZE B	DRAWING No. N0004-SC066791-111	SCALE : NONE	SHEET 1 OF 1	DESIGN APPROVAL	APPROVAL	 <small>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES</small> <small>TOLERANCE ON : ANGLES DECIMALS ± 1/32 .XX ±.010 .XXX ±.005</small>

NOTE
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DRAWING NUMBER:		REVISION:	
N0004-AS067675-062		1	
PART NUMBER:		APPROVED:	
N0004-AS067675-012			
MATERIAL:		TITLE:	
REFER TO PARTS LIST		OUTLINE DRAWING PDX 60C DUAL OUTLET	
FINISH: SEE N0300-CP056953-304		INFD:	
		MASS (lb):	
		4430	
DIMENSIONS IN Inches UNLESS OTHERWISE STATED		TOLERANCING:	SCALE: SHEET SIZE: SHEET:
		CP057289-	1:40 B 1 OF 1

Sample Cooling Calculations

PART 1 - APPLICATION

- 1.1 Project Location: DENVER INTL
- 1.2 Ambient Conditions: -5°F DB (ASHRAE 99% = +5.3°F) Elevation: 5,400 ft
- 1.3 Aircraft Model: B767-400ER Aircraft Category: D
- 1.4 Equipment Design:
- PCA Type: DX Point-of-Use (PDX)
 - Equipment Location: Bridge Mounted
 - Air Delivery: Flexible Hose
 - Semi-rigid duct from PCA to Hose: 14 "ø 156 "Long with 1 bend(s)
 - Telescopic duct, total length: 0 ft
 - Number of Hose(s): 1 Hose Length: 65 ft
- 1.5 Occupancy Configuration:
- Passenger Load: Cockpit: 0 Cabin Crew: 0 Passengers: 0
 - Cabin Set-Point Temperature: 68 °F

PART 2 - HEAT LOADS AND HEATING REQUIREMENTS

- 2.1 Aircraft Heat Loads:
- | | |
|-------------------------|-----------------------|
| Occupancy load: | 0 Btu/hr |
| Conduction load: | -69,788 Btu/hr |
| Solar load: | 0 Btu/hr |
| Electrical load: | 0 Btu/hr |
| TOTAL HEAT LOAD: | -69,788 Btu/hr |
- 2.2 Required Air Flow and Temperature:
- | | |
|--------------------------------|------------|
| Required Airflow for Aircraft: | 140 lb/min |
| Required Temp at Aircraft: | 100.8 °F |
| Hose heat gain: | -13.3 °F |
| Hose Inlet Temp: | 114.1 °F |
| Required PCA Outlet Temp: | 118.3 °F |
- 2.3 Required Ventilation Loads:
- | | |
|------------------|----------------|
| PCA Inlet Temp: | -5.0 °F |
| PCA Outlet Temp: | 118.3 °F |
| PCA Airflow: | 140 lb/min |
| Heat required: | 262,105 Btu/hr |
- 2.4 Required Blower Performance:
- | | |
|--|----------------|
| Required Airflow for Aircraft: | 140 lb/min |
| Required Airflow Pressure at Aircraft: | 10.6 inch W.G. |
| Airflow Delivery Pressure Drop: | 7.9 inch W.G. |
| Required PCA Discharge Pressure: | 18.5 inch W.G. |
| Calculated Blower Heat Load: | 38,135 Btu/hr |
- 2.5 Required Total Heating Performance:
- | | |
|--|----------------|
| | 223,970 Btu/hr |
| | 65,632 Watts |

PART 3 - CAVOTEC PROPOSED AHU UNIT FOR COMPLYING WITH THE PROJECT REQUIREMENTS

- 3.1 Cavotec Model: PDX-60C
- | | |
|-----------------------------|--------------|
| Maximum Airflow: | 250 lb/min |
| Maximum Discharge Pressure: | 32 inch W.G. |
| Heating Capacity: | 70 KW |
| Maximum Outlet Temperature: | 140 °F |

PART 1 - APPLICATION

- 1.1 Project Location: DENVER INTL
- 1.2 Ambient Conditions: -5°F DB (ASHRAE 99% = +5.3°F) Elevation: 5,400 ft
- 1.3 Aircraft Model: B777-300 Aircraft Category: E
- 1.4 Equipment Design:
- PCA Type: DX Point-of-Use (PDX)
- Equipment Location: Bridge Mounted
- Air Delivery: Flexible Hose
- Semi-rigid duct from PCA to Hose: 14 "ø 156 "Long with 1 bend(s)
- Telescopic duct, total length: 0 ft
- Number of Hose(s): 2 Hose Length: 65 ft
- 1.5 Occupancy Configuration:
- Passenger Load: Cockpit: 0 Cabin Crew: 0 Passengers: 0
- Cabin Set-Point Temperature: 68 °F

PART 2 - HEAT LOADS AND HEATING REQUIREMENTS

- 2.1 Aircraft Heat Loads:
- | | |
|-------------------------|------------------------|
| Occupancy load: | 0 Btu/hr |
| Conduction load: | -116,435 Btu/hr |
| Solar load: | 0 Btu/hr |
| Electrical load: | 0 Btu/hr |
| TOTAL HEAT LOAD: | -116,435 Btu/hr |
- 2.2 Required Air Flow and Temperature:
- | | |
|--------------------------------|------------|
| Required Airflow for Aircraft: | 230 lb/min |
| Required Temp at Aircraft: | 101.3 °F |
| Hose heat gain: | -16.4 °F |
| Hose Inlet Temp: | 117.8 °F |
| Required PCA Outlet Temp: | 120.4 °F |
- 2.3 Required Ventilation Loads:
- | | |
|------------------|----------------|
| PCA Inlet Temp: | -5.0 °F |
| PCA Outlet Temp: | 120.4 °F |
| PCA Airflow: | 230 lb/min |
| Heat required: | 437,837 Btu/hr |
- 2.4 Required Blower Performance:
- | | |
|--|----------------|
| Required Airflow for Aircraft: | 230 lb/min |
| Required Airflow Pressure at Aircraft: | 7.7 inch W.G. |
| Airflow Delivery Pressure Drop: | 6.5 inch W.G. |
| Required PCA Discharge Pressure: | 14.1 inch W.G. |
| Calculated Blower Heat Load: | 73,130 Btu/hr |
- 2.5 Required Total Heating Performance:
- | | |
|------------------------|----------------|
| | 364,708 Btu/hr |
| HW Inlet Temperature: | 140 °F |
| HW Outlet Temperature: | 110 °F |
| EG Flow Rate: | 25.9 gpm |

PART 3 - CAVOTEC PROPOSED AHU UNIT FOR COMPLYING WITH THE PROJECT REQUIREMENTS

- 3.1 Cavotec Model: PAC-90
- | | |
|---|-------------|
| Maximum Airflow: | 440 lb/min |
| Maximum Discharge Pressure: | 43 inch WG. |
| Maximum Water flow: | 65 gpm |
| Unit Pressure Drop at Maximum Water flow: | 40 psi |
| Maximum Outlet Temperature: | 140 °F |

PART 1 - APPLICATION

1.1	Project Location:	DENVER INTL		
1.2	Ambient Conditions:	95°F DB/ 63°F WB	Elevation: 5,400 ft	
1.3	Aircraft Model:	B767-300ER	Aircraft Category: D	
1.4	Equipment Design:	PCA Type: DX Point-of-Use (PDX)		
	Equipment Location:	Bridge Mounted		
	Air Delivery:	Flexible Hose		
	Semi-rigid duct from PCA to Hose:	14 "∅	156 "Long	with 1 bend(s)
	Telescopic duct, total length:	0 ft		
	Number of Hose(s):	1	Hose Length:	65 ft
1.5	Occupancy Configuration:	Passenger Load: Cockpit: 2 Cabin Crew: 4 Passengers: 243		
	Cabin Set-Point Temperature:	75 °F		

PART 2 - HEAT LOADS AND COOLING REQUIREMENTS

2.1	Aircraft Heat Loads:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
	Occupancy load:	44,906 Btu/hr	63,495 Btu/hr
	Conduction load:	31,668 Btu/hr	31,668 Btu/hr
	Solar load:	14,338 Btu/hr	14,338 Btu/hr
	Electrical load:	48,180 Btu/hr	48,180 Btu/hr
	TOTAL HEAT LOAD:	139,091 Btu/hr	157,681 Btu/hr
2.2	Required Air Flow and Temperature:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
	Required Airflow for Aircraft:	250 lb/min	250 lb/min
	Required Temp at Aircraft:	38.3 °F	33.5 °F
	Hose heat gain:	4.2 °F	4.6 °F
	Hose Inlet Temp:	34.1 °F	28.8 °F
	Required PCA Outlet Temp:	33.4 °F	28.0 °F
2.3	Required Ventilation Loads:		
	Ambient Conditions:	95°F DB/ 63°F WB	
	Enthalpy at Ambient Conditions:	31.39 Btu/lb	
	Enthalpy at PCA Outlet Conditions:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
		12.26 Btu/lb	10.10 Btu/lb
2.4	Required Blower Performance:		
	Required Airflow for Aircraft:		250 lb/min
	Required Airflow Pressure at Aircraft:		19.0 inch W.G.
	Airflow Delivery Pressure Drop:		5.0 inch W.G.
	Required PCA Discharge Pressure:		24.0 inch W.G.
	Calculated Blower Heat Load:		76,998 Btu/hr
2.5	Required Total Cooling Performance:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
		363,888 Btu/hr	396,348 Btu/hr
		30.3 Tons	33.0 Tons

PART 3 - CAVOTEC PROPOSED AHU UNIT FOR COMPLYING WITH THE PROJECT REQUIREMENTS

3.1	Cavotec Model:	<input type="text" value="PDX-60Ci"/>	Maximum Airflow:	250 lb/min
			Maximum Discharge Pressure:	32 inch WG.
			Nominal Cooling Capacity:	60 Tons
			Minimum Outlet Temperature:	25 °F

PART 1 - APPLICATION

1.1	Project Location:	DENVER INTL		
1.2	Ambient Conditions:	95°F DB/ 63°F WB	Elevation: 5,400 ft	
1.3	Aircraft Model:	B767-400ER	Aircraft Category: D	
1.4	Equipment Design:	PCA Type: Central Plant (PAC)		
	Equipment Location:	Bridge Mounted		
	Air Delivery:	Flexible Hose		
	Semi-rigid duct from PCA to Hose:	14 "ø	156 "Long with	1 bend(s)
	Telescopic duct, total length:	0 ft		
	Number of Hose(s):	1	Hose Length:	65 ft
1.5	Occupancy Configuration:	Passenger Load: Cockpit: 2 Cabin Crew: 4 Passengers: 243		
	Cabin Set-Point Temperature:	75 °F		

PART 2 - HEAT LOADS AND COOLING REQUIREMENTS

2.1	Aircraft Heat Loads:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
	Occupancy load:	44,906 Btu/hr	63,495 Btu/hr
	Conduction load:	31,668 Btu/hr	31,668 Btu/hr
	Solar load:	14,338 Btu/hr	14,338 Btu/hr
	Electrical load:	48,180 Btu/hr	48,180 Btu/hr
	TOTAL HEAT LOAD:	139,091 Btu/hr	157,681 Btu/hr
2.2	Required Air Flow and Temperature:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
	Required Airflow for Aircraft:	250 lb/min	250 lb/min
	Required Temp at Aircraft:	38.3 °F	33.5 °F
	Hose heat gain:	4.2 °F	4.6 °F
	Hose Inlet Temp:	34.1 °F	28.8 °F
	Required PCA Outlet Temp:	33.4 °F	28.0 °F
2.3	Required Ventilation Loads:	Ambient Conditions: 95°F DB/ 63°F WB	
	Enthalpy at Ambient Conditions:	31.39 Btu/lb	
	Enthalpy at PCA Outlet Conditions:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
		12.26 Btu/lb	10.10 Btu/lb
2.4	Required Blower Performance:	Required Airflow for Aircraft: 250 lb/min	
	Required Airflow Pressure at Aircraft:	19.0 inch W.G.	
	Airflow Delivery Pressure Drop:	5.0 inch W.G.	
	Required PCA Discharge Pressure:	24.0 inch W.G.	
	Calculated Blower Heat Load:	76,998 Btu/hr	
2.5	Required Total Cooling Performance:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
		363,888 Btu/hr	396,348 Btu/hr
		30.3 Tons	33.0 Tons
2.6	Required Required AHU EG flow Capacity:	EG Inlet Temperature: 20.0 °F	
		EG Outlet Temperature: 62.0 °F	
	EG Flow Rate:	<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
		18.5 gpm	20.1 gpm

PART 3 - CAVOTEC PROPOSED AHU UNIT FOR COMPLYING WITH THE PROJECT REQUIREMENTS

3.1	Cavotec Model:	<input type="text" value="PAC-45"/>	Maximum Airflow:	250 lb/min
			Maximum Discharge Pressure:	32 inch WG.
			Maximum Chilled Water flow:	35 gpm
			Unit Pressure Drop at Maximum Chilled Water flow:	30 psi
			Minimum Outlet Temperature:	25 °F

PART 1 - APPLICATION

1.1	Project Location:	DENVER INTL		
1.2	Ambient Conditions:	95°F DB/ 63°F WB	Elevation: 5,400 ft	
1.3	Aircraft Model:	B777-300	Aircraft Category: E	
1.4	Equipment Design:	PCA Type: Central Plant (PAC)		
	Equipment Location:	Bridge Mounted		
	Air Delivery:	Flexible Hose		
	Semi-rigid duct from PCA to Hose:	14 "ø	156 "Long	with 1 bend(s)
	Telescopic duct, total length:	0 ft		
	Number of Hose(s):	2	Hose Length:	65 ft
1.5	Occupancy Configuration:	Passenger Load: Cockpit: 2 Cabin Crew: 16 Passengers: 378		
	Cabin Set-Point Temperature:	75 °F		

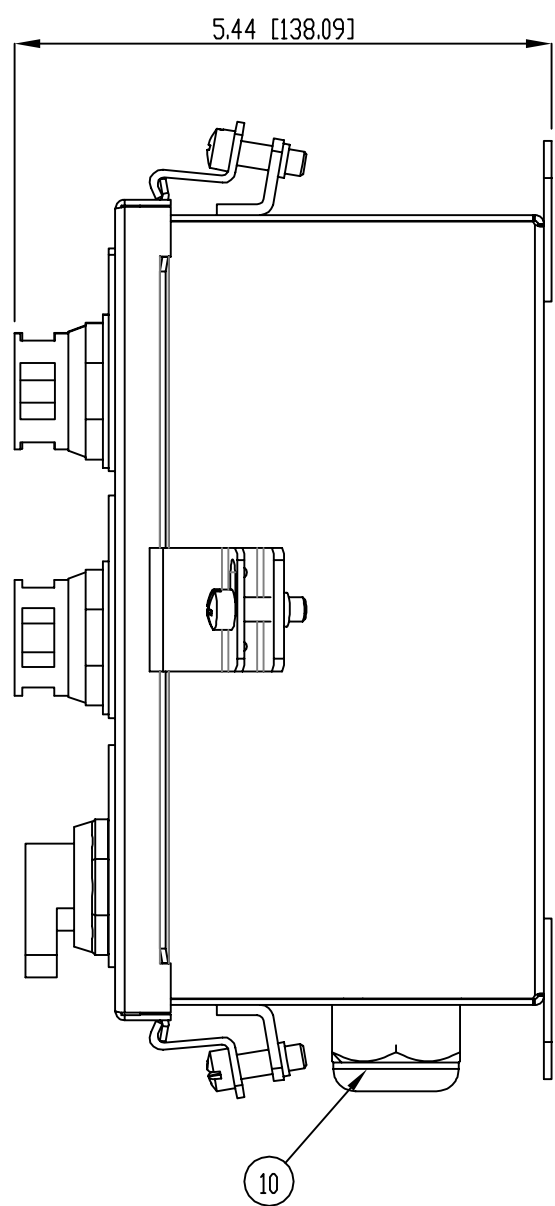
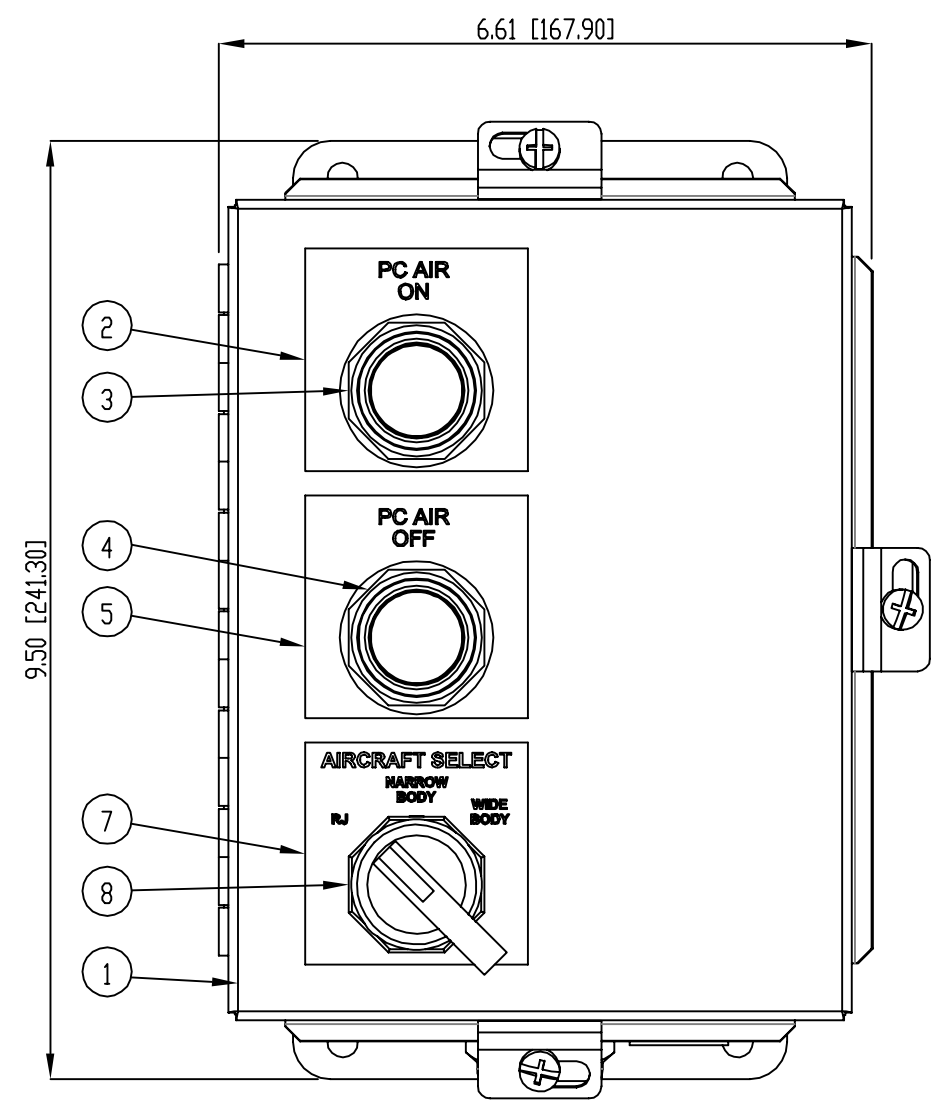
PART 2 - HEAT LOADS AND COOLING REQUIREMENTS

2.1	Aircraft Heat Loads:		<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
	Occupancy load:		70,650 Btu/hr	99,000 Btu/hr
	Conduction load:		52,834 Btu/hr	52,834 Btu/hr
	Solar load:		28,000 Btu/hr	28,000 Btu/hr
	Electrical load:		96,000 Btu/hr	96,000 Btu/hr
	TOTAL HEAT LOAD:		247,484 Btu/hr	275,834 Btu/hr
2.2	Required Air Flow and Temperature:		<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
	Required Airflow for Aircraft:		440 lb/min	440 lb/min
	Required Temp at Aircraft:		37.9 °F	33.7 °F
	Hose heat gain:		4.9 °F	5.2 °F
	Hose Inlet Temp:		33.1 °F	28.5 °F
	Required PCA Outlet Temp:		32.6 °F	28.0 °F
2.3	Required Ventilation Loads:			
	Ambient Conditions:		95°F DB/ 63°F WB	
	Enthalpy at Ambient Conditions:		31.39 Btu/lb	
	Enthalpy at PCA Outlet Conditions:		<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
			12.01 Btu/lb	10.10 Btu/lb
2.4	Required Blower Performance:			
	Required Airflow for Aircraft:		440 lb/min	
	Required Airflow Pressure at Aircraft:		24.0 inch W.G.	
	Airflow Delivery Pressure Drop:		6.1 inch W.G.	
	Required PCA Discharge Pressure:		30.1 inch W.G.	
	Calculated Blower Heat Load:		129,693 Btu/hr	
2.5	Required Total Cooling Performance:		<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
			641,378 Btu/hr	691,749 Btu/hr
			53.4 Tons	57.6 Tons
2.6	Required Required AHU EG flow Capacity:			
	EG Inlet Temperature:		20.0 °F	
	EG Outlet Temperature:		62.0 °F	
	EG Flow Rate:		<u>70% Diversification</u>	<u>Full Crew & Passengers</u>
			32.6 gpm	35.1 gpm

PART 3 - CAVOTEC PROPOSED AHU UNIT FOR COMPLYING WITH THE PROJECT REQUIREMENTS

3.1	Cavotec Model:	<input type="text" value="PAC-90"/>	Maximum Airflow:	440 lb/min
			Maximum Discharge Pressure:	43 inch WG.
			Maximum Chilled Water flow:	65 gpm
			Unit Pressure Drop at Maximum Chilled Water flow:	40 psi
			Minimum Outlet Temperature:	25 °F

BOM TABLE FOR REFERENCE ONLY			
ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	1	N0004-PT064038-001	NEMA 4X SS ENCLOSURE PC AIR PB STATION
2	1	N034-ALFD29911DN-G-24V	PUSH BUTTON, ILLUMINATED, GRN, 30mm
3	1	N054-1004979401	PCAIR ON PLATE
4	1	N054-1004979402	PCAIR OFF PLATE
5	1	N034-ALFD29911DN-R-24V	PUSH BUTTON, ILLUMINATED, RED, 30mm
6	1	HEC-000000-0062631	CABLE MTW AWM1015 B-CU 1C #18 16ST BU
7	1	N0004-PT064253-002	3-POS PB STATION LABEL RJ-NB-WB
8	1	HES-000000-0065294	SELECTOR SWITCH 30mm WITH STANDARD KNOB, 3-POS
9	150	HEC-000000-0064246	CABLE CONTROL MULTICORE 8C #18 600V
10	1	HEC-000000-060380	CABLE GRIP 0.24-.47" NPT 1/2" LIQUID TIGHT



- GENERAL NOTES:
- DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5 - 2009 AND ISO 128, 129 & 2768.
 - DIMENSIONS IN BRACKETS ARE MILLIMETERS.
 - CAPTIVE SCREWS SUPPLIED WITH ITEM 1.
 - PERFORM FATP IN ACCORDANCE WITH N0004-PR064142-090.

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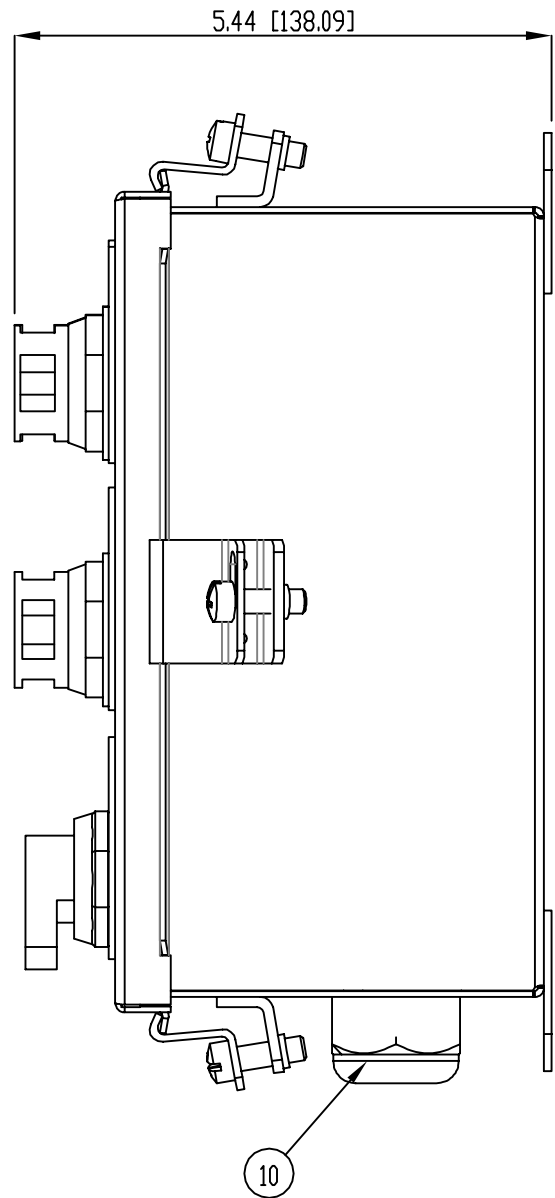
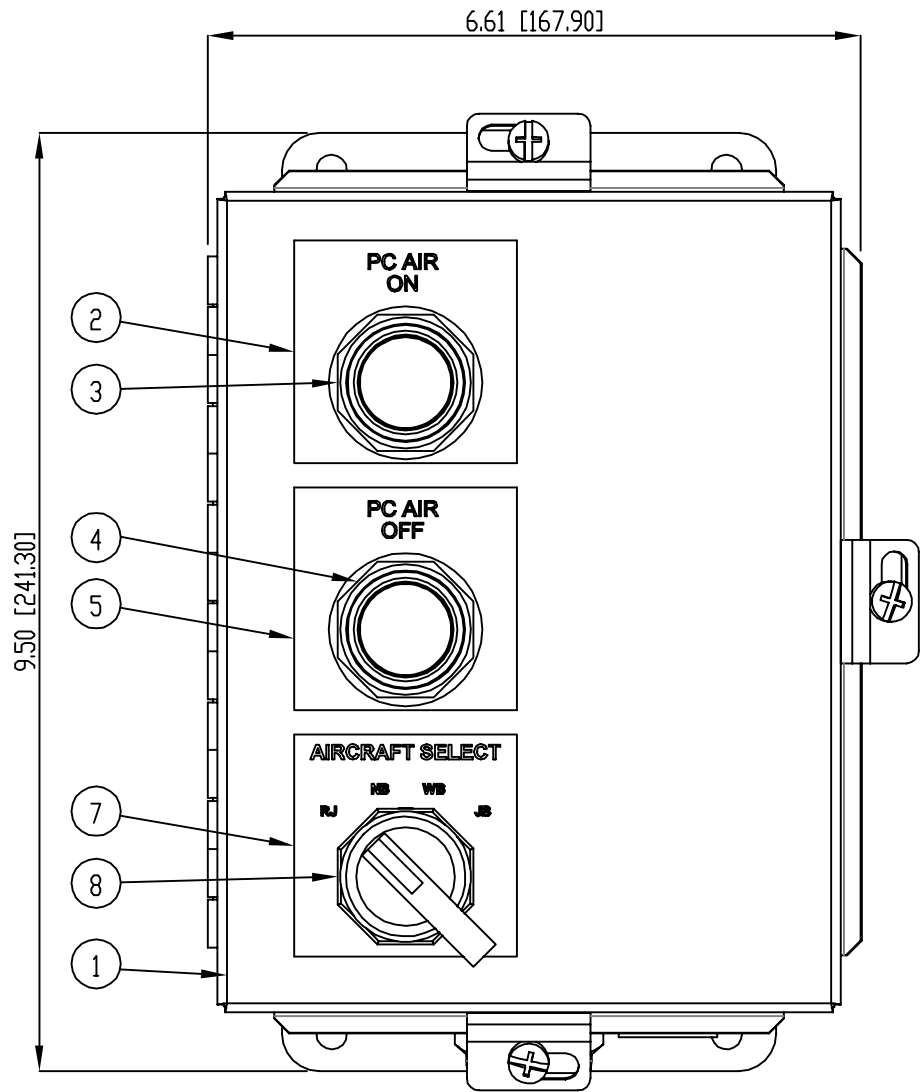
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DRAWING NUMBER: N0004-AS069348-000	REVISION: 01
PART NUMBER: N0004-AS069348-000	APPROVED:
MATERIAL: REFER TO PARTS LIST	TITLE: PCA PB STATION ASSY ON/OFF/RJ/NB/WB
FINISH: SEE N0300-CP056953-304 NONE	MASS (lb): 7.5
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING: CP057289-mK
SCALE: 1:3	SHEET SIZE: B
	SHEET: 1 OF 1

A	RELEASED	BJH	12/1/2020	
REV	DESCRIPTION	DRAWN BY	DATE	REF

1 2 3 4 5 6 7 8 9 10 11 12 13 14

BOM TABLE FOR REFERENCE ONLY			
ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	1	N0004-PT064038-001	NEMA 4X SS ENCLOSURE PC AIR PB STATION
2	1	N034-ALFD29911DN-G-24V	PUSH BUTTON, ILLUMINATED, GRN, 30mm
3	1	N054-1004979401	PCAIR ON PLATE
4	1	N054-1004979402	PCAIR OFF PLATE
5	1	N034-ALFD29911DN-R-24V	PUSH BUTTON, ILLUMINATED, RED, 30mm
6	1	HEC-000000-0062631	CABLE MTW AWM1015 B-CU 1C #18 16ST BU
7	1	N0004-PT064253-004	4-POS PB STATION LABEL RJ-NB-WB-JB
8	1	HES-000000-0065296	SELECTOR SWITCH 30mm WITH STANDARD KNOB, 4-POS
9	150	HEC-000000-0064246	CABLE CONTROL MULTICORE 8C #18 600V
10	1	HEC-000000-060380	CABLE GRIP 0.24-.47" NPT 1/2" LIQUID TIGHT



- GENERAL NOTES:
101. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5 - 2009 AND ISO 128, 129 & 2768.
 102. DIMENSIONS IN BRACKETS ARE MILLIMETERS.
 103. CAPTIVE SCREWS SUPPLIED WITH ITEM 1.
 104. PERFORM FATP IN ACCORDANCE WITH N0004-PR064142-090.

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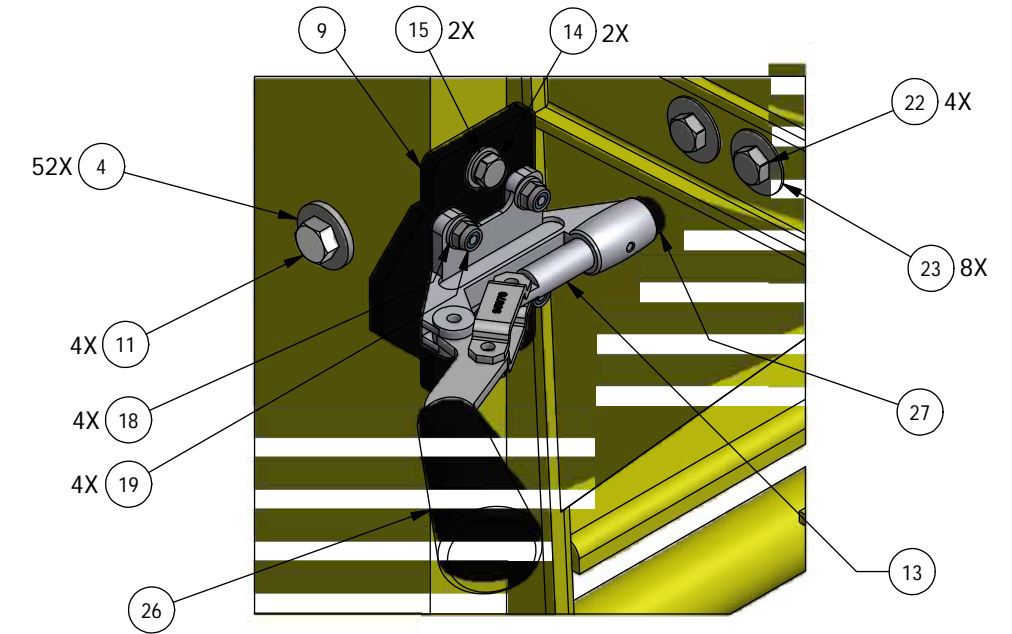
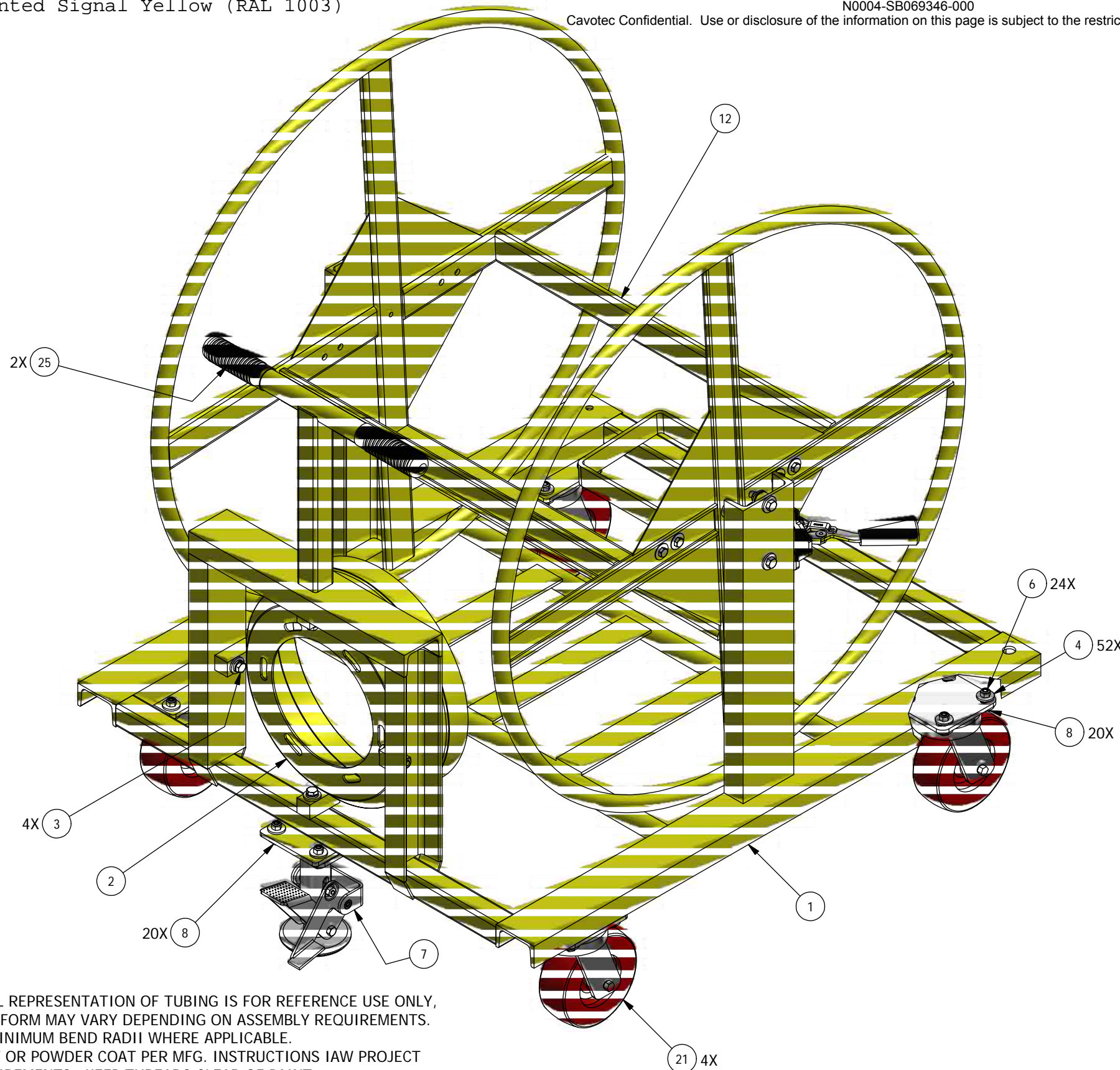
DRAWING NUMBER:	N0004-AS069349-000	REVISION:	02
PART NUMBER:	N0004-AS069349-000	APPROVED:	
MATERIAL:	REFER TO PARTS LIST	TITLE:	PCA PB STATION ASSY ON/OFF/RJ/NB/WB/JB
FINISH: SEE N0300-CP056953-304	NONE	CAGE CODE:	6S1M4
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING:	SCALE:	1:3
REV:	A	DESCRIPTION:	RELEASED
REV:		DESCRIPTION:	
DRAWN BY:	BJH	DATE:	12/1/2020
REF:			
MASS (lb):	7.5	SHEET SIZE:	B
		SHEET:	1 OF 1

A	RELEASED	BJH	12/1/2020	
REV	DESCRIPTION	DRAWN BY	DATE	REF

*Painted Signal Yellow (RAL 1003)

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REVISION HISTORY				
REV	DESCRIPTION	DESIGNER	DATE	APPROVED
A	REVISED AND REDRAWN, DELETED SHEET 2	KLC	3/27/2014	



ITEM	QTY	PART NUMBER	DESCRIPTION	STOCK NUMBER	RAW STK. QTY.
27	1	N123-9753K44	CAP, VINYL, 1/2"ID x 1/2"ID HEIGHT		
26	1	N123-9692K38	SLIDE-ON FLAT GRIP, BLACK		
25	2	N123-97045K61	SLIDE-ON RND GRIP, BLACK		
24	4	HNM1-T22GO-WOH000	5/16 Std NC Nylock Nut		
23	8	HWM4-T10GO-WOG000	WASHER, FLAT, 5/16		
22	4	HSM4-T01GO-WOG010	SCREW, HX, 5/16-18 x 1"		
21	4	N118-PPA4060SA1-PU	CASTER, SWIVEL RED WHEEL		
20	1	1005168703	BRACKET, HOSE REEL		
19	4	HNM1-T22GO-WODD000	NUT NYLON 10-32		
18	4	HWM4-T00GO-WOFD	WASHER, FLAT, #10		
17	4	HSM5-T10GO-WON00	SCREW, FLAT HD 10-32 x 3/4"		
16	2	HWM4-T16GO-WOF000	WASHER, LOCK, 1/4-20		
15	2	HWM4-T10GO-WOF000	WASHER, FLAT, 1/4 SS 304		
14	2	HSM4-T01GO-WOF00N	HEX SCREW 1/4-20-.750		
13	1	N101-GH-36092	HANDLE, VEN/P/N KD10112SS		
12	1	1005168720	TOP WHEEL ASSY		
11	4	HBM1-T01GO-WOH01K	HEX H. BOLT, 3/8"x1 1/2", Zinc Plated		
10	2	N123-5968K75	BEARING, FLANGE 1" DIA		
9	1	10055094A	LOCKING HANDLE MOUNTING PLATE		
8	20	HSM5-T01GO-WOH010	HEX SCREW 3/8-16 x 1-1/4"		
7	1	N123-2478T67	FRONT PEDAL FLOOR LOCK		
6	24	HNM8-T20GO-WOH000	NYLON NUT 3/8-16		
5	4	HWM5-T16GO-WOH000	WASHER, LOCK, 3/8"		
4	52	HWM4-T10GO-WOH000	WASHER, 3/8"		
3	4	HBM4-T01GO-WOH01N	SCREW, HX, 3/8-16 x 1 3/4"		
2	1	NR12-10056057	ADAPTER WLDMT, HOSE REEL		
1	1	NR12-10056056	BASE WLDMT, HOSE REEL		

7. VISUAL REPRESENTATION OF TUBING IS FOR REFERENCE USE ONLY, FINAL FORM MAY VARY DEPENDING ON ASSEMBLY REQUIREMENTS. USE MINIMUM BEND RADII WHERE APPLICABLE.
6. PAINT OR POWDER COAT PER MFG. INSTRUCTIONS IAW PROJECT REQUIREMENTS. KEEP THREADS CLEAR OF PAINT.
5. COMPLETE WIRING PER SCHEMATIC.
4. APPLY TEFLON TAPE, AS NEEDED TO ALL PIPE THREADS PRIOR TO ASSEMBLY.
3. INTERPRET WELD SYMBOLS PER ANSI Y32.3.
2. THREADS PER FEW-STD-H28.
1. INTERPRET DRAWING PER ASME Y14.100, Y14.24, Y14.34M & Y14.35M.

NOTE: UNLESS OTHERWISE SPECIFIED

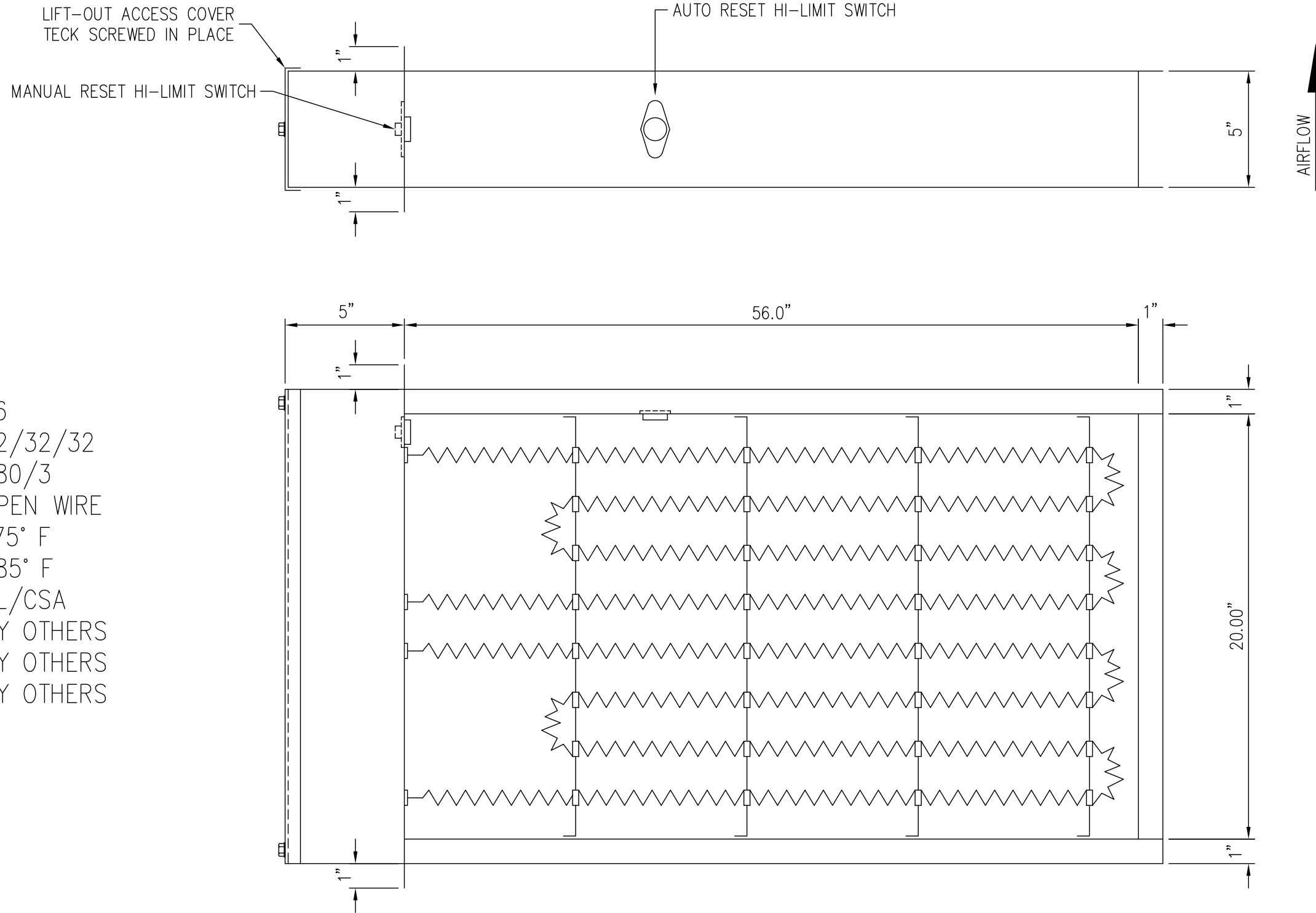
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		DRAWN	KLC	3/27/2014
TOLERANCES:		CHECKED		
FRACTIONS	DECIMALS	ANGLES		
± 1/32	.X ± .1	± 1'		
	.XX ± .02			
	.XXX ± .010			
MACHINE OR CUT SURFACE ROUGHNESS: 125		DESIGN APPROVAL		
REMOVE ALL BURRS AND SHARP EDGES. ALL BENDS TO BE OF MIN RADII IN RESPECT TO MATERIAL TYPE, GRADE AND THICKNESS. WELD PER MIL-STD-2219, CLASS C.		APPROVAL		
SCALE:	MASS (LBS)			
SHEET 1 OF 1	lbs.			

TITLE		CAGE CODE: 651M4	
STANDARD AIR SERVICE HOSE REEL ASSEMBLY			
SIZE	DRAWING No.	REV.	
B	NR12-10051687	A	

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Cavotec INET US INC.
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TOTAL KW: 96
 KW PER STAGE: 32/32/32
 VOLTAGE/PHASE: 480/3
 TYPE: OPEN WIRE
 AUTO RESET TEMP.: 175° F
 MANUAL RESET TEMP.: 285° F
 APPROVAL: UL/CSA
 CONTACTORS: BY OTHERS
 FUSES: BY OTHERS
 AIRFLOW SWITCH: BY OTHERS

QUANTITY:

REVISIONS			
REV	DATE	DESCRIPTION	DWN APPR

BOSTON LOGAN 480 VAC 96 KW ELEC HEAT FOR PDX-40		DRAWING No. 10053178	CAD FILE: HEATER\PDX40-09\53178
TITLE	DATE	SIZE	SCALE
	6/30/09	B	NONE

DRAWN	DESIGN APPROVAL	SHEET 1 OF 1
E. JOHNSON		
CHECKED	APPROVAL	

INET
 AIRPORT SYSTEMS
 4111 N. PALM ST. FULLERTON CA 92635

UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN INCHES

TOLERANCE ON : ANGLES
 FRACTIONS DECIMALS .XX ±.010 ±1/4
 ± 1/32 .xxx ±.005

NOTES: UNLESS OTHERWISE SPECIFIED

FANselect

fan data

18.12.2018

version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)



type	ZN080-ZIQ.GL.V7P3
article no.	161405 Portfolio STD-WW

technical data

motor	ECblue
mains supply	- 3~ 460V 60Hz
ambient temperature, max. limit (t_a)	°C 55
efficiency grade η_{statA}	% 58,0
efficiency grade N_{actual} N_{target}	61,6 40
ErP-conformity	2015 EC controller integrated
grille influence	pressure side measured

fan data

SFP-class SFP-value (P_{SFP})	- Ws/m ³	1 295
airflow volume (q_v)	ft ³ /min	10000.0
pressure, stat. (p_{sF}) tot. (p_F)	in.wg.	0.550 0.769
electrical power input (P_{sys})	W	1394
system eff., stat. ($\eta_{sF,sys}$) tot. ($\eta_{F,sys}$)	%	46.4 64.9
fan speed (n) max. (n_{max})	rpm	889 1100
fan speed, set value (% n_{max})	%	81
frequency (f_{BP}) (f_{max})	Hz	60 60
voltage (U_{DP})	V	460
current (I_{DP})	A	1.96
acoustics, suction side ($L_{w(A),5}$) ($L_{w,5}$)	dB	76 82
acoustics, pressure side ($L_{w(A),6}$) ($L_{w,6}$)	dB	77 82
product weight (m_{pr})	kg	45.3

PF:PF_00; BR:BR_52; qv:10000.0 ft³/min; p_{sF}:0.550 in.wg.; mains:3~ / 460V / 60 Hz; t_a:115 °F; p:0.072 lbs/ft³; STol:+-10 %; BF:V-Q(ZN)



FANselect

performance curve / acoustics

18.12.2018

version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)

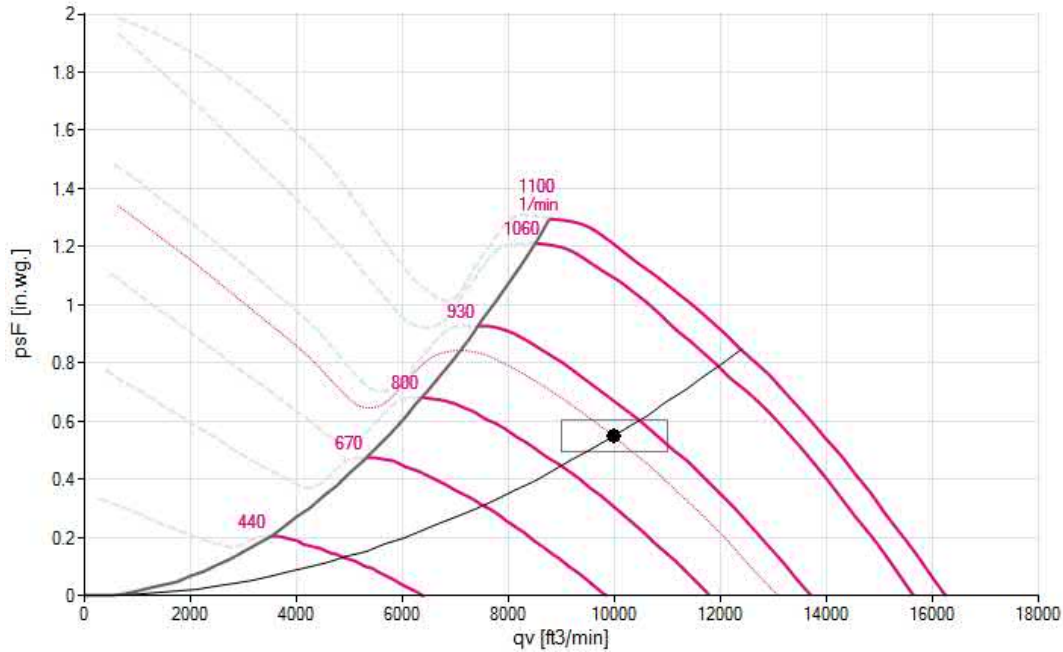
1 ZN080-ZIQ.GL.V7P3

Measured in ZPlus with guard grille on pressure side with airflow direction V in installation type A according to ISO 5801

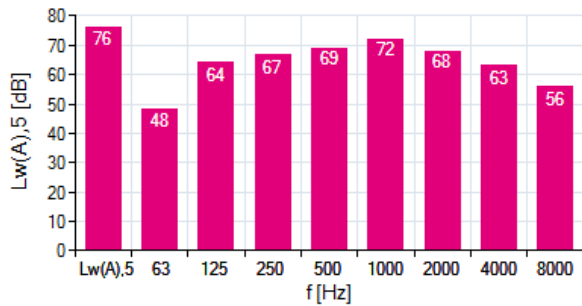
161405 | Portfolio STD-WW

measurement density 0.072 [lbs/ft³]

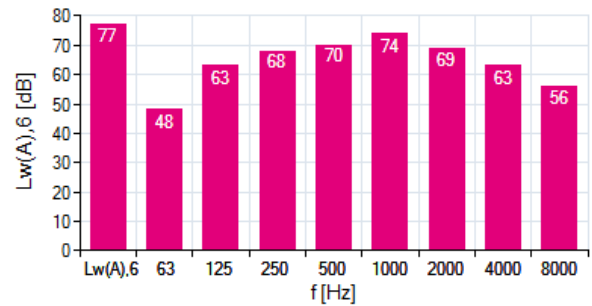
air performance p_{sF}



acoustics ($L_{w(A),5}$)



acoustics ($L_{w(A),6}$)



1 ZN080-ZIQ.GL.V7P3

f [Hz]	sum	63	125	250	500	1000	2000	4000	8000
$L_{w(A),5}$	76	48	64	67	69	72	68	63	56
$L_{w,5}$	82	73	79	74	73	72	67	62	57

f [Hz]	sum	63	125	250	500	1000	2000	4000	8000
$L_{w(A),6}$	77	48	63	68	70	74	69	63	56
$L_{w,6}$	82	73	78	76	74	74	68	62	57

FANselect

efficiency grade / power input

18.12.2018

version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)

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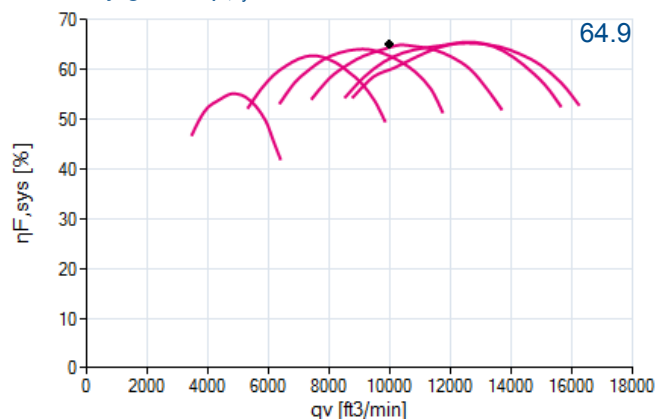
ZN080-ZIQ.GL.V7P3

Measured in ZAPlus with guard grille on pressure side with airflow direction V in installation type A according to ISO 5801

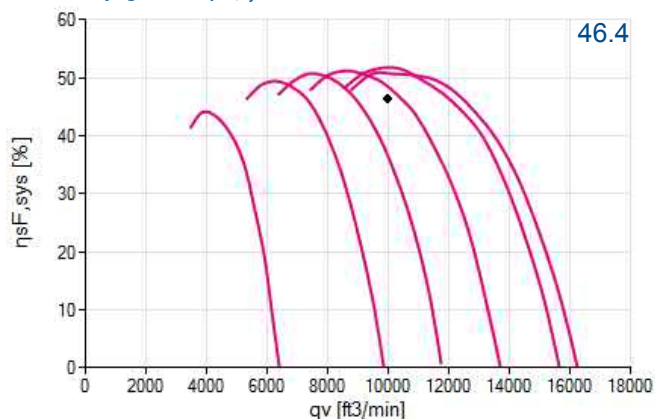
161405 | Portfolio STD-WW

measurement density 0.072 [lbs/ft³]

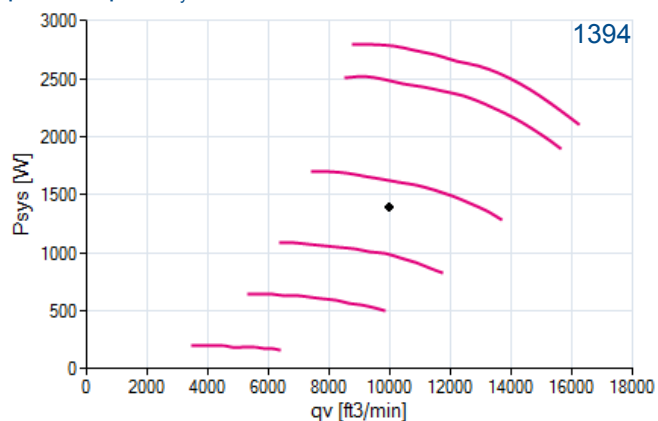
efficiency grade $\eta_{F,sys}$



efficiency grade $\eta_{sF,sys}$



power input P_{sys}



FANselect

nominal values

18.12.2018

version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)

1



ZN080-ZIQ.GL.V7P3

161405

3~ 380-480V 50Hz P1 2.80kW
 4.40-3.50A 1100/MIN 55°C
 3~ 380-480V 60Hz P1 2.80kW
 4.40-3.50A 1100/MIN 55°C
 IP54 THCL155

drawing

18.12.2018

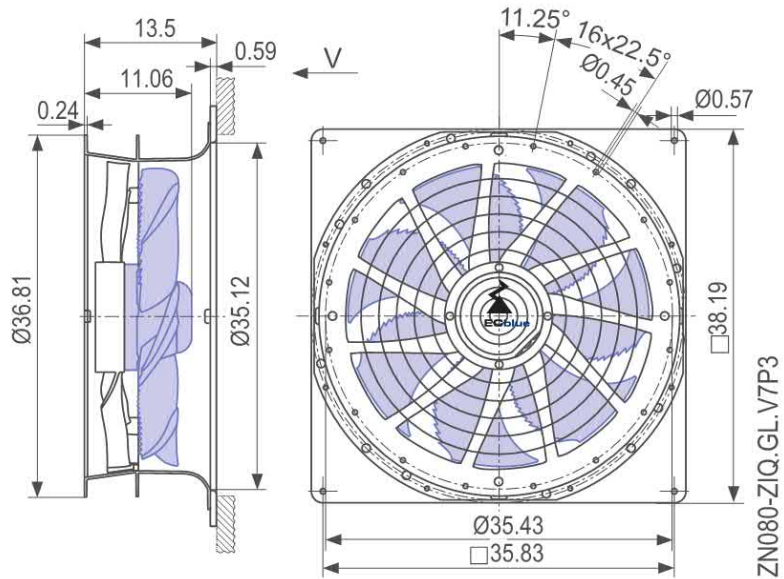
version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)

1



ZN080-ZIQ.GL.V7P3

161405



wiring diagram

18.12.2018

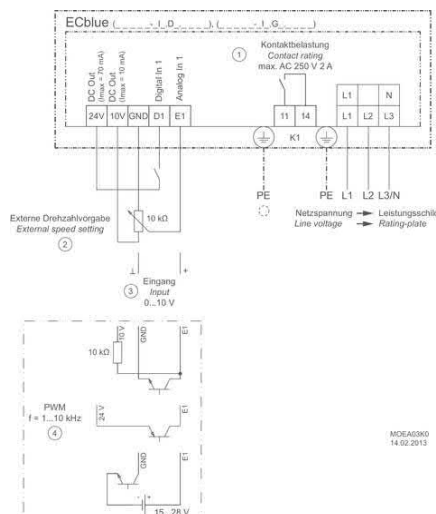
version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)

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ZN080-ZIQ.GL.V7P3

161405

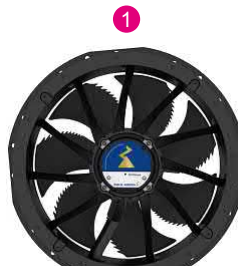


FANselect

system components

18.12.2018

version FANselect V 1.01 (181214), AMCA V 1.02 April, 2018 / 1.18.12.14 | 745 | (user raulhuangliu)



type	ZN080-ZIQ.GL.V7P3
article no.	161405

- control component**
- ECblue AM module
type: AM-MODBUS
article no.: 349045

 - ECblue AM module
type: AM-PREMIUM
article no.: 349046

 - ECblue AM module
type: AM-MODBUS-W
article no.: 349050

 - ECblue AM module
type: AM-PREMIUM-W
article no.: 349051

FANselect

fan data

08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)



type	ZN080-ZIL.GQ.V7P3
article no.	170278 Portfolio STD-WW

technical data

motor	ECblue
mains supply	- 3~ 460V 60Hz
ambient temperature, max. limit (t_r)	°C 45
efficiency grade η_{statA}	% 57,2
efficiency grade N_{actual} N_{target}	59,7 40
ErP-conformity	2015 EC controller integrated
grille influence	pressure side measured

fan data

SFP-class SFP-value (P_{SFP})	- Ws/m^3	1 437
FEI	-	1.07
airflow volume (q_v)	ft^3/min	16000.0
pressure, stat. (p_{sF}) tot. (p_F)	in.wg.	0.550 1.105
electrical power input (P_{sys})	W	3299
system eff., stat. ($\eta_{sF,sys}$) tot. ($\eta_{F,sys}$)	%	31.4 63.0
fan speed (n) max. (n_{max})	rpm	1216 1250
fan speed, set value ($\%n_{max}$)	%	97
frequency (f_{BP}) (f_{max})	Hz	60 60
voltage (U_{DP})	V	460
current (I_{DP})	A	4.37
acoustics, suction side ($L_{w(A),5}$) ($L_{w,5}$)	dB	84 87
acoustics, pressure side ($L_{w(A),6}$) ($L_{w,6}$)	dB	86 88
product weight (m_{pr})	kg	49

PF:PF_00; BR:BR_01; q_v :16000.0 ft^3/min ; p_{sF} :0.550 in.wg.; mains:3~ / 460V / 60 Hz; t_r :68 °F; size:800 mm; p :0.072 lbs/ft³; STol:+-10 %; BF:V-L(ZN)

FANselect

performance curve / acoustics

08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)

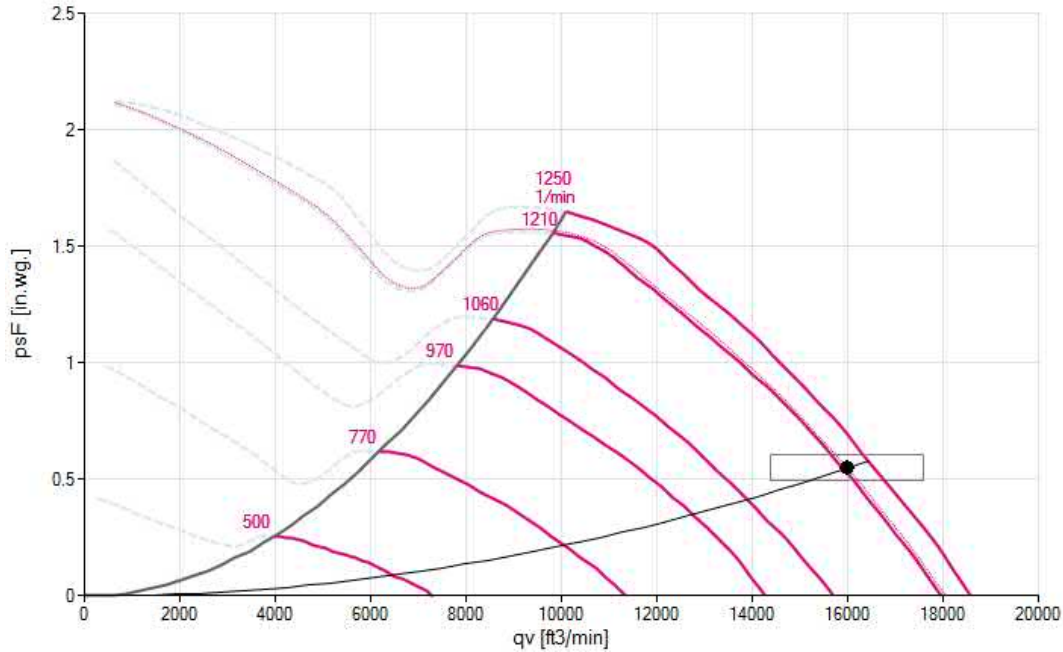
1 ZN080-ZIL.GQ.V7P3

Measured in ZPlus with guard grille on pressure side with airflow direction V in installation type A according to ISO 5801

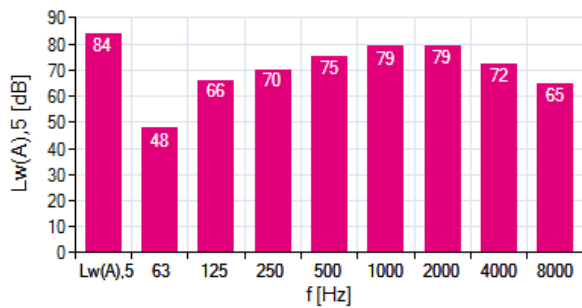
170278 | Portfolio STD-WW

measurement density 0.072 [lbs/ft³]

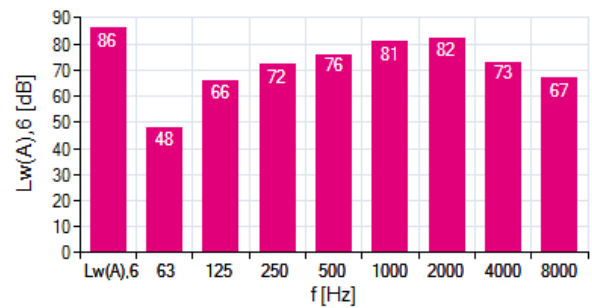
air performance p_{sF}



acoustics ($L_{w(A),5}$)



acoustics ($L_{w(A),6}$)



1 ZN080-ZIL.GQ.V7P3

f [Hz]	sum	63	125	250	500	1000	2000	4000	8000
$L_{w(A),5}$	84	48	66	70	75	79	79	72	65
$L_{w,5}$	87	72	81	78	79	79	78	71	66

f [Hz]	sum	63	125	250	500	1000	2000	4000	8000
$L_{w(A),6}$	86	48	66	72	76	81	82	73	67
$L_{w,6}$	88	73	81	79	80	81	81	72	68

FANselect

efficiency grade / power input

08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)

1

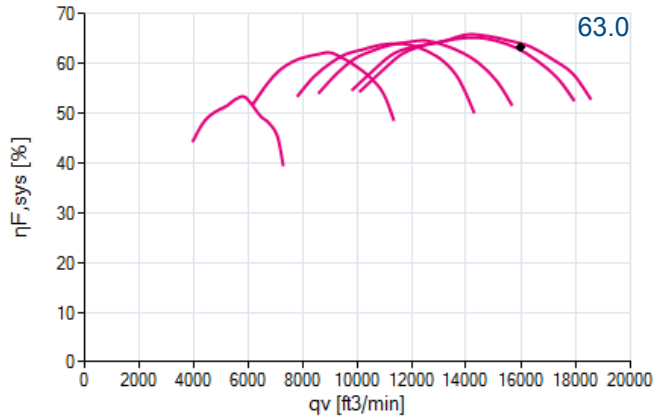
ZN080-ZIL.GQ.V7P3

Measured in ZAPlus with guard grille on pressure side with airflow direction V in installation type A according to ISO 5801

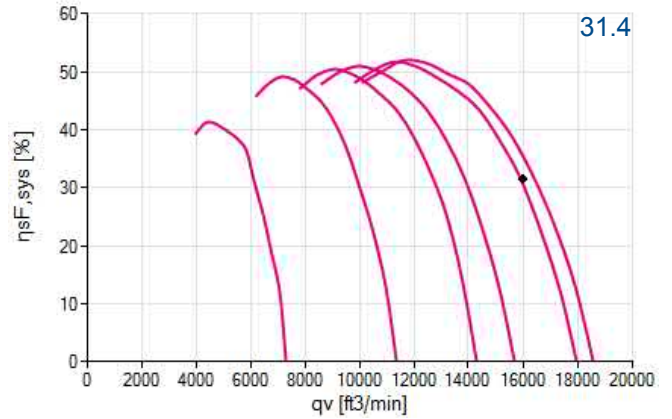
170278 | Portfolio STD-WW

measurement density 0.072 [lbs/ft³]

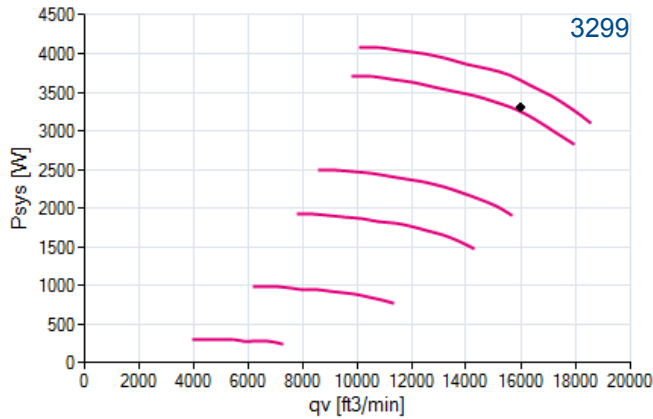
efficiency grade $\eta_{F,sys}$



efficiency grade $\eta_{sF,sys}$



power input P_{sys}



FANselect

nominal values

08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)

1



ZN080-ZIL.GQ.V7P3
170278

3~ 380-480V 50Hz P1 4.00kW
6.60-5.20A 1250/MIN 45°C
3~ 380-480V 60Hz P1 4.00kW
6.60-5.20A 1250/MIN 45°C
IP54 THCL155

drawing

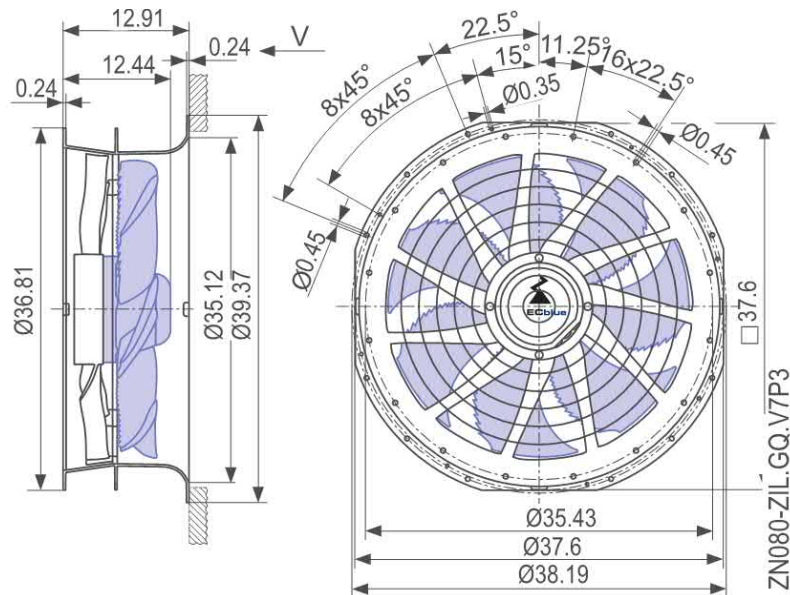
08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)

1



ZN080-ZIL.GQ.V7P3
170278



wiring diagram

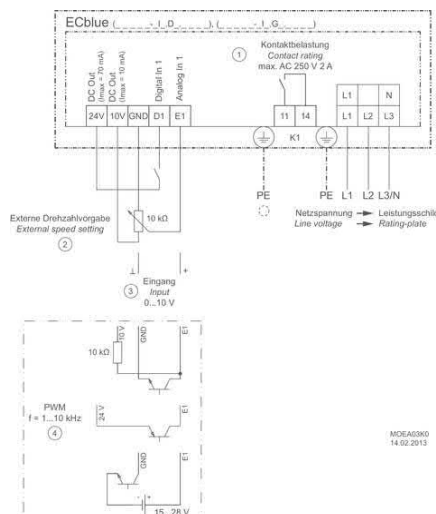
08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)

1



ZN080-ZIL.GQ.V7P3
170278



FANselect

system components

08.05.2019

version FANselect V 1.01 (190508), AMCA V 1.03 February, 2019 / 1.19.05.08 | 498 | (user Crenshaw)



type	ZN080-ZIL.GQ.V7P3
article no.	170278



Why Chemical Breakdown Occurs



MOISTURE

Water or moisture is always present in refrigeration systems, especially with the use of hygroscopic polyolester (POE) lubricants. Acceptable limits vary from one unit to another and from one refrigerant to another. Moisture is harmful even if “freeze-ups” do not occur. Moisture is an important factor in the formation of acids, sludge, copper plating, and corrosion. To be *safe* and *sure*, keep the moisture level as low as possible.



DIRT

Dirt, oxide, scale, sludges, flux, and metallic particles are frequently found in refrigeration systems. Numerous metallic contaminants — cast iron dust, rust, scale, steel, copper, and brass chips — can damage cylinder walls, bearings, and plug capillary tubes or thermostatic expansion valve screens. In addition to mechanical damage and “plug-ups,” these contaminants catalyze chemical reactions that contribute to decomposition of the refrigerant-lubricant mixture at elevated temperatures.



ACIDS

Refrigerants by themselves are very stable, even when heated to a high temperature. However under some



conditions, reactions do occur which can result in the formation of acids. For example, Refrigerant 22 will decompose at high temperatures to form hydrochloric acid where an “acid acceptor” such as electrical insulation paper is present. The reaction of refrigerants with water may cause hydrolysis and the formation of hydrochloric and hydrofluoric acids. These acids are usually present as a gas in the system and are highly corrosive. In ordinary usage this reaction is negligible, but in a very wet system operating at abnormally high temperatures, some hydrolysis may occur.

All of these reactions are increased by elevated temperature and are catalytic in effect, resulting in the formation of corrosive compounds.

Another significant source of acidity in refrigeration systems is organic acid formed from lubricant breakdown. Acid is formed when POE lubricant reacts with moisture. Appreciable amounts of *organic acid* are found in lubricant samples analyzed in our laboratory. Since acids corrode metals in a system, they must be removed.

SLUDGE AND VARNISH

Although the utmost pre-caution may be taken in the design and fabrication of a system, once in operation, unusually high discharge temperatures will cause



the lubricant to breakdown. By-products of mineral/alkylbenzene lubricant decomposition are varnish, sludge, and possibly carbonaceous powder.

Temperatures may vary in different makes of compressors and under different operating conditions. While temperatures of 265°F/129°C are not unusual at the discharge valve under normal operation, temperatures well above 300°F/149°C frequently occur under unusual conditions. Common sources of high temperatures in refrigeration systems are dirty condensers, non-condensable gases in the condenser, high compression ratio, high superheat of suction gas returned to compressor, fan failure on forced convection condensers, and others.

In addition to high discharge temperatures, there are certain *catalytic metals* that contribute to the lubricant-refrigerant mixture breakdown. The most noted of these in a refrigeration system is iron. It is used in one form or another in all systems and is an active catalyst. Copper is in the same category as iron, but its action is slower. However, the end result is the same. This reaction causes sludge formation and other corrosive materials that will hinder the normal operation of compressor valves and control devices. **In addition, air in a system will accelerate the deterioration of the lubricant.**

Catch-All® How It Works



The famous molded porous core of the Catch-All® Filter-Drier performs these vital functions:

REMOVES MOISTURE

The *Catch-All Filter-Drier* removes moisture from the refrigerant and lubricant by adsorbing and retaining moisture deep within the desiccant granules. The blend of desiccants used in the Catch-All is specially formulated for exceptional moisture removal. The high degree of activation ensures maximum water capacity, which means the core removes a large amount of water in one pass, thereby protecting the expansion valve from possible freeze-up. Since the refrigerant must flow through the core, maximum contact between the two ensures rapid system dehydration.

REMOVES FOREIGN MATTER

Scale, solder particles, dirt, and all types of foreign substances must be removed to protect the compressor, solenoid valves,

expansion valves, capillary tubes, and other close tolerance parts of a refrigeration system.

The solution to system filtration is the Catch-All Filter-Drier. The Catch-All has been designed to do the job with maximum efficiency. It removes these particles, down to the minimum size, in one pass filtration. Furthermore, the large filtering surface available on the core results in the ability to collect a large amount of dirt with negligible pressure drop. If plugged, the Catch-All will not burst allowing trapped substances back into the system.

REMOVES ACIDS

The *Catch-All Filter-Drier* is unexcelled in acid removal ability. The hydrochloric, hydrofluoric, and various organic acids found in used oil samples are harmful in a system. These acids are adsorbed and

remain on the desiccant in a manner similar to the adsorption of moisture.

Laboratory tests have shown that the Catch-All Filter-Drier's desiccant has an acid removal ability superior to other desiccants used in other refrigeration driers. Compared to other filter-driers designed for today's systems, tests show the *Catch-All Filter-Drier* removes much more acid (on an equal weight basis).

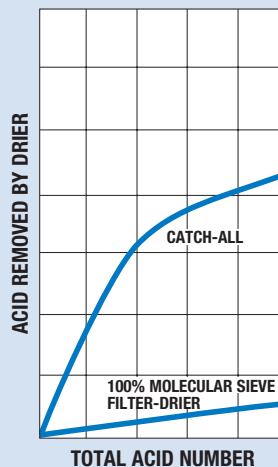
The Catch-All has demonstrated excellent field performance in cleaning up severely contaminated systems, whether due to acid, lubricant breakdown, or to hermetic motor burnout. Its success in field service work and in protecting new systems is largely due to its outstanding ability to remove acid and the products of lubricant breakdown.

REMOVES SLUDGE AND VARNISH

Even the best refrigeration lubricants frequently break down to produce organic acids and possibly varnish and sludge. These products of lubricant decomposition, are formed due to excessive heat or air in the system. Varnish can plug small orifices and accumulate on compressor valves causing eventual valve failure.

The ability of various desiccants to remove these products of lubricant decomposition has been evaluated in sealed glass tubes. Of all the desiccants tested, only the desiccant used in the Catch-All Filter-Driers proved capable of removing the products of lubricant breakdown. This ability makes the Catch-All Filter-Drier highly effective in cleaning systems that have had a hermetic motor burnout, and in protecting new systems by preventing an accumulation of these lubricant breakdown products.

ORGANIC ACID REMOVAL ABILITY



For additional information on "The Secret of the Catch-All's Success" request Form 40-119



The Inside Story

CATCH-ALL FILTER-DRIERS PROVIDE THESE PROVEN BENEFITS:

BLEND OF DESICCANTS

Through constant engineering research, Sporlan developed a blend of desiccants that gives each core maximum contaminant removal characteristics for today's systems. Each core is formulated with molecular sieve for high water capacity and activated alumina for acid removal. A special grade of activated alumina granules is used to obtain the maximum ability to remove acids and products of lubricant breakdown. The overall result is balanced contaminant removal ability.



SPECIAL CHARCOAL BLEND

The HH core, which incorporates activated charcoal along with other desiccants, will remove wax, resins, and lubricant breakdown materials that normal desiccants do not remove. Therefore, this type of core is especially useful on low temperature systems when wax is suspected in the system or when wax-like substances are found in the metering device.

The HH style core has also found wide application for clean-up after a hermetic motor burnout where its ability to remove all types of contaminants is very advantageous. **BE SELECTIVE!** Choose a core designed for the specific application involved.

UNIFORM MOLDING

Sporlan pioneered the molded porous core. The core is carefully molded to ensure a uniform porosity throughout

the entire length and surface of the core. The granules of desiccant are carefully sized and controlled to obtain the proper porosity for maximum filtration ability.

SHOCKPROOF ASSEMBLY

The core is held in place by a heavy leaf spring at the inlet end of the Catch-All assembly. This spring holds the core in position and makes the assembly highly resistant to core breakage. The heavy spring gives a "pre-stressed effect" that significantly reduces the tendency of the core to break if the Catch-All is accidentally dropped.



NO BYPASSING

The core is sealed to the shell wall at the outlet end with a gasket or fibrous pad, which prohibits any possible bypassing of refrigerant around the core. All the flow passes through the core for maximum contaminant removal.

OUTLET SAFETY FILTER

A final "safety filter" is used in the outlet of every Catch-All. This involves either a specially developed polyester pad or 100 mesh screen that collects particles that might have rubbed off during assembly,



and serves as added protection in case the molded core is broken.

LEAKPROOF SHELL

The Catch-All shell is tig welded providing a very smooth, strong, entirely leakproof joint. The fittings are attached to the shell by copper brazing. This type of joint is one of the strongest and most reliable joining methods known. Each Catch-All is pressure tested in our factory to make sure that it does not leak. The overall result is a Catch-All with strong, entirely leakproof joints.

QUALITY FITTINGS

The flare fittings and solder fittings used on Sporlan Catch-Alls are inspected 100% during manufacture to make sure no defects are present. The solder fittings are copper fittings with reliable ID dimension for exact fit to the copper tubing. Flare fittings are nickel plated and their surfaces are smooth and free of scratches. Any imperfect flare fittings are resurfaced during manufacture.



BE SELECTIVE

In addition to being manufactured to high quality standards, the Catch-All has been designed specifically for field service work and OEM use. In situations requiring wax removal or clean-up after a hermetic motor burnout, choose the HH style Catch-All core, which is specifically designed for these applications.



Liquid Line

Ratings and Selection Recommendations

■ GENERAL

The selection of a filter-drier for a given application involves such technical factors as: the amount of moisture to be expected in a system — operating temperatures — amount of foreign matter present — allowable pressure drop through the filter-drier — its ability to retain both liquid and solid contaminants, and bursting pressure. Proper evaluation of these factors is necessary for optimum service and economy. As an aid, the important factors to be considered for selection purposes are discussed briefly in the following sections.

■ ATEX COMPLIANCE

For full ATEX compliance information, see page 44.

■ STANDARD RATINGS

ASHRAE-AHRI

The American Society of Heating, Refrigerating and Air Conditioning Engineers Standard 63, “Methods of Testing Liquid Line Refrigerant Driers,” sets up a test procedure to follow for determining the water capacity and refrigerant flow capacity under certain conditions. The Air Conditioning, Heating, and Refrigerating Institute subsequently issued AHRI Standard 710, which specifies the rating conditions for water capacity, refrigerant flow capacity, and safety requirements.

This Standard is intended to provide **comparison points** only. It is a basis for drier evaluation at the specified rating conditions, but does not attempt to govern the performance of a drier over the entire range of possible applications. It serves only to compare driers on their ratings for water capacity, refrigerant flow capacity, and safety requirements.

WATER CAPACITY

Water capacity is the amount of water (in drops or grams) that a drier will hold at the standard temperatures and equilibrium point dryness (EPD) specified. Twenty drops equal one gram, equal one

milliliter or one cubic centimeter.

Equilibrium Point Dryness (EPD) — is used to define the lowest possible water content in liquid refrigerant attainable by a filter-drier at a specific temperature after it has collected a specific quantity of water after equilibrium has been reached between the water in the refrigerant and the water in the drier. Equilibrium point dryness is expressed in parts per million (ppm) by weight.

REFRIGERANT FLOW CAPACITY

The maximum flow of liquid refrigerant (in tons) that a drier will pass at a 1 psi/0.07 bar pressure drop is the refrigerant flow capacity. The “ton” ratings are based on 86°F/30°C liquid temperature and refrigerant flows of...

- 3.1 lbs. per minute per ton for R-134a
- 3.0 lbs. per minute per ton for R-22
- 3.9 lbs. per minute per ton for R-404A
- 2.6 lbs. per minute per ton for R-407A
- 2.9 lbs. per minute per ton for R-407C
- 2.9 lbs. per minute per ton for R-407F
- 2.8 lbs. per minute per ton for R-410A
- 4.1 lbs. per minute per ton for R-507

SAFETY

Safety is based on drier shell bursting pressure. All liquid line driers manufactured under AHRI Standard 710 must meet the requirements of Underwriters’ Laboratories, Inc., Standard 207, “Refrigerant Containing Components and Accessories, Nonelectrical.”

■ SELECTION

When selecting a filter-drier the following should be considered:

WATER CAPACITY AND REFRIGERANT FLOW

Water capacity and refrigerant flow comparisons can be made on the basis of AHRI Standard data supplied by the manufacturer. **However, it should be remembered that flow ratings are based on the ideal situation of a completely clean system.** Flow is reduced as dirt accumulates on the filtering surface.

FILTRATION

Filtration characteristics of a filter-drier are not readily defined or evaluated since laboratory tests cannot reproduce the range of conditions and contaminants seen in an actual system. The ability to filter and **hold** foreign matter varies with the brand and type of filter-drier. The simplest guide to follow is that filter capacity is proportional to **filtering area**. In the tables that follow, the filtering areas of all Catch-All Filter-Driers are tabulated. Filters should be selected with an adequate reserve capacity to allow for the contamination found in most systems.

ACID REMOVAL

Acid Removal is also difficult to measure. There are no standard ratings to follow. However, both laboratory and field tests have demonstrated that the **Catch-All** core has superior acid removal ability — many times the acid capacity of competitive filter-driers developed for today’s systems.

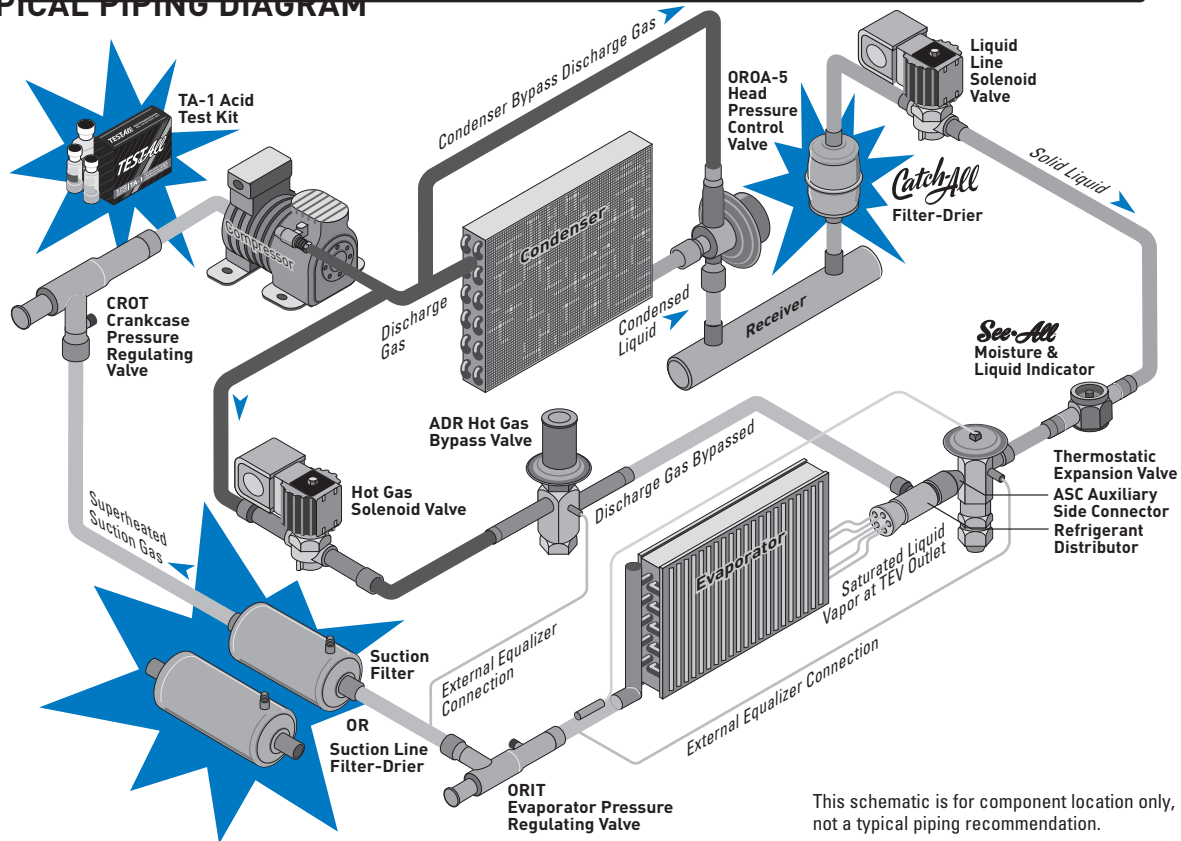
■ SPORLAN RECOMMENDATIONS

Sporlan’s **Selection Recommendations** are based on the technical data currently available and more than 60 years of **field experience** with molded porous core filter-driers. Satisfactory results will be obtained with the sizes recommended for all normal refrigeration systems. We have considered the difference in requirements for air conditioning and refrigeration applications. Recommendations for these categories are made on pages 12 through 16 and pages 25 through 28. Recommendations for suction line use of filter-driers are in Form 40-109. Form 40-109 is a quick reference guide for suction line filter-drier selection.

Drier manufacturers establish ratings for their product, but... the final selection of the correct drier should be based on the conditions expected for each job. Consideration should be given to providing extra water capacity and filtering area within economical limits.

Catch-All Application – Installation

TYPICAL PIPING DIAGRAM



This schematic is for component location only, not a typical piping recommendation.

■ CATCH-ALL LOCATION

Catch-All Filter-Driers are most effective in the **liquid line**. Place the filter-drier immediately ahead of other liquid line controls, such as the thermostatic expansion valve, solenoid valve, and **See-All Moisture & Liquid Indicator**. When applied in this way, the Catch-All provides maximum protection for the expansion valve and solenoid valve from dirt that may be in the system. If the system contains appreciable moisture, then this location gives the best results in protecting the expansion valve from freeze-up. If possible, place the filter-drier in a **cold location**. The **acid removal ability** of the Catch-All Filter-Drier is the same whether it is installed in the liquid line or suction line.

Catch-All Filter-Driers are frequently installed in the **suction line** just ahead of

the compressor. This procedure is used to clean up a new system or a system that has had a hermetic motor burnout. The main advantage of this location is that it is directly ahead of the compressor, and therefore offers maximum protection to the compressor from all contaminants, even those that may be in the low side of the system. Suction line filter-driers give excellent performance in removing water, dirt and acid. A larger size filter-drier is required than if it had been placed in the liquid line. The refrigerant velocity in the suction line is about six times the velocity in the liquid line. Therefore, a larger filter-drier is required in order to maintain a sufficiently low pressure drop.

The **water capacity of a Sporlan Catch-All in the suction line** is equal to or slightly greater than the liquid line water capacity. Filtration and acid removal in the suction line is equal to that obtained

in the liquid line. The main disadvantage of the suction line location is that a larger more expensive filter-drier is required.

Catch-All Filter-Driers are not recommended for use in the **discharge line**. The water capacity in this location would be greatly reduced due to the high operating temperature.

Catch-All Filter-Driers may be installed in **any position**, with top or bottom feed. However, it is advisable to mount replaceable core models horizontally so that foreign material cannot drop into the outlet fitting when the cores are removed. Always observe the flow direction. Except for Catch-Alls used in heat pump systems (HPC models), Catch-Alls must **never** be subjected to reverse flow.

Catch-All Application – Installation

■ CAPILLARY TUBE SYSTEM

The C-032-CAP Catch-All is designed specifically for capillary tube systems. This unit consists of a C-032-S with 1/4" copper tubes brazed into each end, giving an overall length of 5.81"/148 mm. Capillary tubes of any size may be inserted into the 1/4" copper tube on this Catch-All, then the tubing pinched down, and soldered. In this way the excellent contaminant removal qualities of the Catch-All can be used on domestic refrigerators and freezers. The C-032-CAP-T model has an **access valve for charging purposes**.

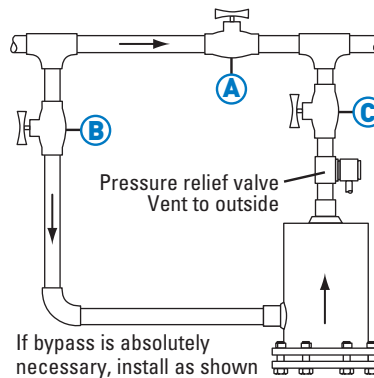
The best filter-drier location is immediately ahead of the capillary tube. The **amount of liquid refrigerant** that the smaller size Catch-All Filter-Driers will contain at 100°F/38°C is shown in table below.

■ BYPASS INSTALLATION

It is preferred that the Catch-All Filter-Drier be installed in the **main liquid line** for maximum protection. When located in a bypass line, dirt or foreign material may pass into the system through the unprotected main line.

When a **bypass** installation is necessary (see illustration), a hand throttling valve **A** is recommended. By throttling valve **A**, a certain portion of refrigerant can be made to pass through the filter-drier. Note that hand valves **B** and **C** are required only if it is desired to replace the filter-drier without pumping down from the receiver. Always pump out the section of the line containing the filter-drier by closing hand

valves **A** and **B** (note direction of flow). Permit isolated section to pump out, close valve **C**, then change the **Catch-All Filter-Drier**.



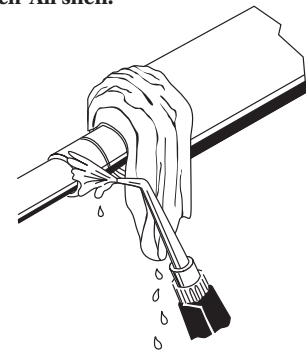
■ WARNING ■

Dangerous hydraulic pressures may develop if hand valves **B** and **C** are closed and the filter-drier is full of liquid. If there is a possibility of inexperienced personnel closing the valves without pumping down, a pressure relief device is recommended.

■ BRAZING AND SOLDERING

The solder fittings on sealed model and replaceable core Catch-All Filter-Driers are copper. Copper fittings are suitable for all types of brazing and soldering alloys including soft solder, 95-5 solder,

50a Brice solder, silver brazing alloy, Sil-Fos, or phos-copper alloys. The fittings on the Catch-All have been carefully cleaned and sealed before shipment, and do not require further cleaning before brazing. **Proper brazing technique involves using a wet cloth draped around the shell, and/or the use of Parker Virginia Thermal Block™, and proper torch tip for rapid heating, and also directing the flame away from the Catch-All shell.**



■ SEAL REMOVAL

The normal procedure in removing seals from either solder or flare connections is to gently cut them away with a knife, as shown in the illustration. With flare connections **caution** should be exercised to avoid damaging the flare surface. The seals cannot be removed and replaced without tearing them.



Catch-All Liquid Refrigerant Capacities

CATCH-ALL SERIES TYPE NO.	LIQUID CAPACITY													
	OUNCES OF REFRIGERANT BY WEIGHT AT 100°F							kg OF REFRIGERANT BY WEIGHT AT 38°C						
	REFRIGERANT							REFRIGERANT						
	22	134a	404A	407A/F	407C	410A	507	22	134a	404A	407A/F	407C	410A	507
C-030	1.4	1.4	1.1	1.3	1.2	1.2	1.2	0.04	0.04	0.03	0.04	0.03	0.03	0.03
C-050	3.4	3.4	2.8	3.2	3.0	3.0	2.9	0.10	0.10	0.08	0.09	0.08	0.08	0.08
C-080	5.2	5.3	4.3	4.9	4.6	4.5	4.5	0.15	0.15	0.12	0.14	0.13	0.13	0.13
C-160	9	9.1	7.4	8.5	7.9	7.9	7.7	0.26	0.26	0.21	0.24	0.22	0.22	0.22
C-300	14	14.2	11.5	13.2	12.3	12.2	12.0	0.40	0.40	0.33	0.38	0.35	0.35	0.34
C-410	16	16.2	13.1	15.1	14.1	14.0	13.8	0.45	0.46	0.37	0.43	0.40	0.40	0.39
HPC-080	8.5	-	-	-	7.5	7.4	-	0.24	-	-	-	0.21	0.21	-
HPC-100	8.7	-	-	-	7.7	7.6	-	0.25	-	-	-	0.22	0.22	-
HPC-160	11	-	-	-	9.7	9.6	-	0.31	-	-	-	0.27	0.27	-
HPC-300	17	-	-	-	15.0	14.9	-	0.48	-	-	-	0.42	0.42	-



Liquid Line

Quick Selection Recommendations

SYSTEM SIZE		FIELD REPLACEMENT			
TONS	LINE SIZE Inches OD	AIR CONDITIONING		REFRIGERATION	
		R-12 & R-134a	R-22, R-407C & R-410A*	R-12, R-134a, R-404A, R-502 & R-507	R-22
SEALED TYPES - SPECIFY FLARE OR SOLDER					
1/4 - 1/3	CAP TUBE 1/4	C-032-CAP	C-032-CAP	C-032-CAP	C-032-CAP
		C-032(-S)	C-032(-S)	C-032(-S)	C-032(-S)
1/2 - 1	1/4	C-052(-S)	C-052(-S)	C-082(-S)	C-082(-S)
	5/16	C-0525-S	C-0525-S	C-0825(-S)	C-0825-S
	3/8	C-053(-S)	C-053(-S)	C-083(-S)	C-083(-S)
1-1/2 - 2-1/2	5/16	C-0825-S	C-0825-S	C-1625-S	C-1625-S
	3/8	C-083(-S)	C-083(-S)	C-163(-S)	C-163(-S)
	1/2	C-084(-S)	C-084(-S)	C-164(-S)	C-164(-S)
3 - 6	5/16	C-1625-S	C-1625-S	—	—
	3/8	C-163(-S)	C-163(-S)	C-303(-S)	C-303(-S)
	1/2	C-164(-S)	C-164(-S)	C-304(-S)	C-304(-S)
	5/8	C-165(-S)	C-165(-S)	C-305(-S)	C-305(-S)
7 - 9	1/2	C-304(-S)	C-304(-S)	C-414(-S)	C-414(-S)
	5/8	C-305(-S)	C-305(-S)	C-415(-S)	C-415(-S)
	7/8	C-307-S	C-307-S	C-417-S	C-417-S
10 - 12	1/2	—	C-414(-S)	—	C-414(-S)
	5/8	C-415(-S)	C-415(-S)	C-415(-S)	C-415(-S)
	7/8	C-417-S	C-417-S	C-417-S	C-417-S
	1-1/8	C-419S	C-419S	C-419-S	C-419-S
13 - 18	5/8	—	C-415(-S)	—	C-415(-S)
	7/8	C-607-S	C-607-S	C-607-S	C-607-S
	1-1/8	C-609-S	C-609-S	C-609-S	C-609-S
REVERSIBLE HEAT PUMP FILTER-DRIER					
1-5	3/8	—	HPC-103-S / HPC-163-S-HH	—	—
	1/2	—	HPC-104-S / HPC-164-S-HH	—	—
	5/8	—	HPC-165-S-HH	—	—
5-16	3/8	—	HPC-303-S-HH / HPC-304-S-HH	—	—
	1/2	—	HPC-305-S-HH / HPC-307-S-HH	—	—
	5/8	—	—	—	—
	7/8	—	—	—	—
REPLACEABLE CORE TYPES					
4 - 9	5/8	C-485-G	C-485-G	C-485-G	C-485-G
	7/8	C-487-G	C-487-G	C-487-G	C-487-G
10 - 15	5/8	—	C-485-G	—	C-485-G
	7/8	C-487-G	C-487-G	C-487-G	C-487-G
	1-1/8	C-489-G	C-489-G	C-489-G	C-489-G
16 - 29	7/8	C-967-G	C-967-G	C-967-G	C-967-G
	1-1/8	C-969-G	C-969-G	C-969-G	C-969-G
	1-3/8	C-9611-G	C-9611-G	C-9611-G	C-9611-G
30 - 39	7/8	—	C-967-G	—	C-967-G
	1-1/8	C-1449-G	C-969-G	C-1449-G	C-969-G
	1-3/8	C-14411-G	C-9611-G	C-14411-G	C-9611-G
40 - 59	1-1/8	C-1449-G	C-14411-G	—	C-1449-G
	1-3/8	C-19211-G	C-14413-G	C-19211-G	C-14411-G
	1-5/8	C-19213-G	C-19213-G	C-19213-G	C-14413-G
60 - 75	1-1/8	—	C-1449-G	—	—
	1-3/8	C-19211-G	C-19211-G	C-19211-G	C-19211-G
	1-5/8	C-19213-G	C-19213-G	C-19213-G	C-19213-G
76 - 99	1-3/8	—	C-19211-G	—	C-19211-G
	1-5/8	C-30013-G	C-19213-G	C-30013-G	C-19213-G
	2-1/8	C-40017-G	C-19217-G	C-40017-G	C-19217-G
100 - 130	1-5/8	—	C-30013-G	—	C-30013-G
	2-1/8	C-40017-G	C-40017-G	C-40017-G	C-40017-G
131 - 150	2-1/8	(2) C-30017-G	C-40017-G	(2) C-30017-G	C-40017-G



CATCH-ALL SIZE	NO. OF CORES	SECONDARY FILTER	CORE TYPE
C-R420 Series Shell	1	—	RCW-42
C-480 Series Shell	1	FS-480	RCW-48, RC-4864, or RC-4864-HH
C-960 Series Shell	2	FS-960	
C-14400 Series Shell	3	FS-1440	
C-19200 Series Shell	4	FS-19200	RCW-100, RC-10098, or RC-10098-HH
C-30000 Series Shell	3	—	
C-40000 Series Shell	4	—	



*C-30000 and C-40000 Series shells are not approved for R-410A.



Koch Filter Corporation
Filtration Products Crafted with Pride

New Design and Improved Performance

Multi-Pleat XL8™

*MERV 8 Extended Surface Pleated Panel
Filters with Mechanical Media*



- Upgrade from standard pleated filters
- MERV 8 and MERV-A 8 performance ratings
- Mechanical MERV 8 media is not reliant on electrostatic charge for efficiency
- Low resistance to airflow
- High Dust Holding Capacity
- Sturdy double-wall frame design
- Moisture resistant beverage board frame
- Standard and High Capacity models
- Available in 1", 2", 4" and 6" depths

Koch Filter Corporation...Durable. Reliable. Versatile.

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N0004-SB069346-000 Bulletin No. K-100B

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Multi-Pleat XL8 Mechanical MERV 8 Extended Surface Pleated Panel Filters



The Koch **Multi-Pleat XL8** is a medium efficiency extended surface pleated panel filter, engineered to provide higher initial efficiencies and overall superior performance than standard pleated filters.

The **Multi-Pleat XL8** carries a MERV 8 and MERV-A 8 performance rating in accordance with ASHRAE Test Standard 52.2-2007.

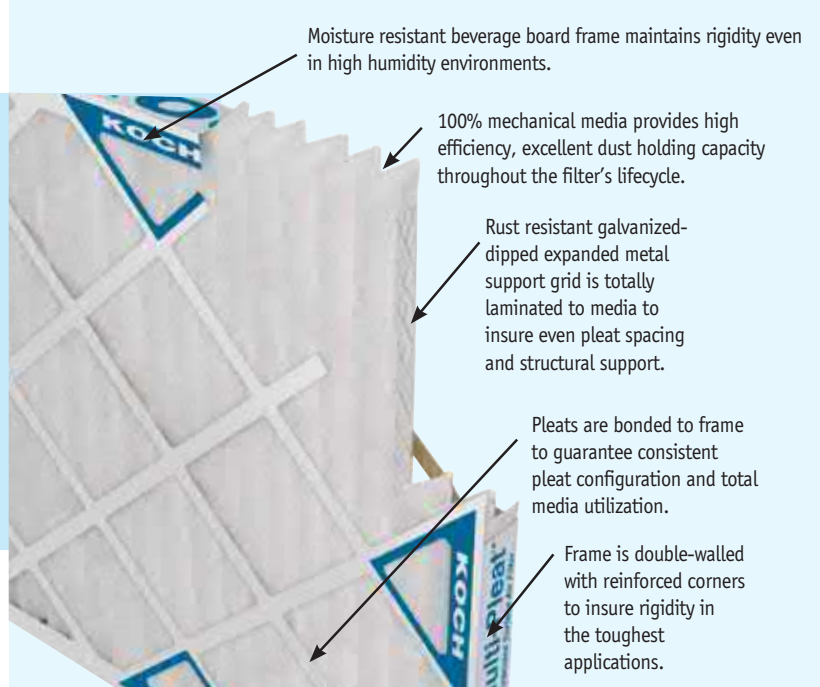
The MERV 8 and MERV-A 8 performance rating provided by the **Multi-Pleat XL8** make the filter an excellent upgrade from disposable filters and standard MERV 6 and 7 rated pleated filters. The **Multi-Pleat XL8** is the best selection in applications such as hospitals, laboratories, pharmaceutical plants, commercial office buildings, and in any system in which a higher degree of indoor air quality is required.

Multi-Pleat XL8 Construction

The **Multi-Pleat XL8** media is produced with an optimal blend of highly specialized fibers, developed by Koch Filter Corporation specifically for use in extended surface air filters.

Developed to deliver a “one of a kind” performance, this specialized media operates on mechanical filtration principles which provide high efficiency, low pressure drop and high dust holding capacity.

The Koch Multi-Pleat XL8 maintains a MERV 8 performance rating before and after conditioning steps when tested in accordance to ASHRAE Test Standard 52.2-2007 and 52.2-2007 Appendix J.



Two Media Area Capacity Levels

The **Multi-Pleat XL8** is an extremely versatile line of pleated panel filters which can be used in a wide variety of filtration systems worldwide. In order to meet the different requirements found in these applications, Koch offers the XL8 Series in two media area capacity levels.



Standard Capacity

Standard Capacity **XL8-SC** filters provide a combination of efficiency, economy, and excellent overall performance. Standard Capacity XL8 filters are an excellent choice in applications where filter change schedules are based on preventive maintenance schedules.



High Capacity - 30% more media

High Capacity **XL8-HC** filters are similar in construction to the Standard Capacity but have the added advantage of approximately 30% more media. The additional media results in extended filter life, making the XL8-HC the ideal filter for use in filtration systems where filter change schedules are predicated on recommended final pressure drop readings.

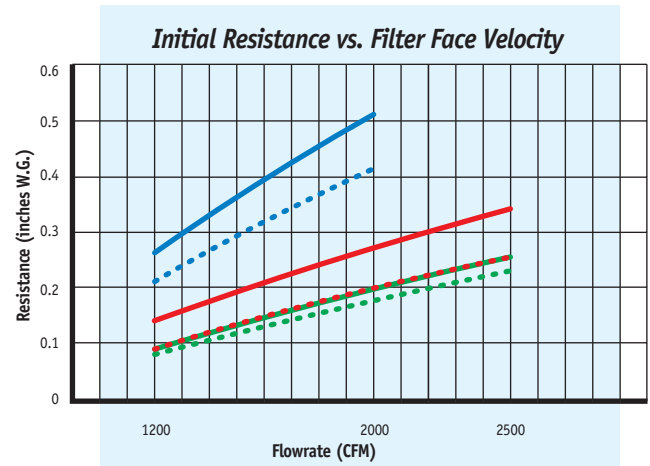
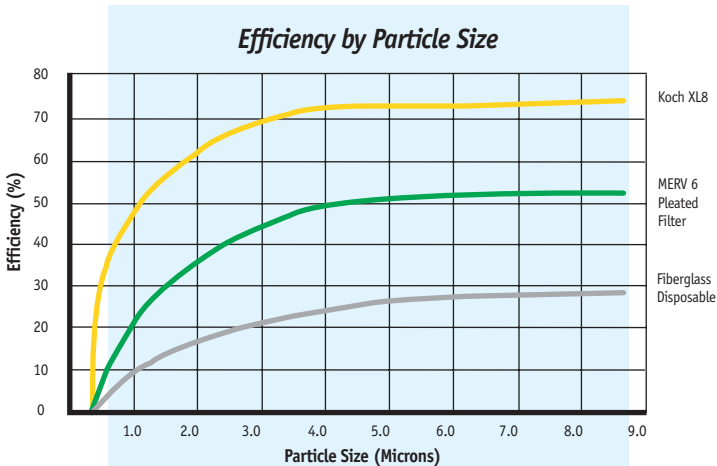
Multi-Pleat XL8 Technical Data

Standard Capacity XL8-SC High Capacity XL8-HC

Size (Nominal)	Size (Actual in inches)	Capacity			Resistance				Media Area (Sq. Ft.)	Resistance				Media Area (Sq. Ft.)
		Low (CFM)	Med	High	Low	Med	High	Final		Low	Med	High	Final	
10x20x1	9½ x 19½ x ¾	(CFM) 425	700	NR	0.26	0.51	NR	1.0"	2.3	0.21	0.41	NR	1.0"	2.9
12x20x1	11½ x 19½ x ¾	500	840	NR	0.26	0.51	NR	1.0"	2.8	0.21	0.41	NR	1.0"	3.5
12x24x1	11½ x 23¾ x ¾	600	1000	NR	0.26	0.51	NR	1.0"	3.3	0.21	0.41	NR	1.0"	4.2
14x20x1	13½ x 19½ x ¾	590	980	NR	0.26	0.51	NR	1.0"	3.3	0.21	0.41	NR	1.0"	4.1
14x25x1	13½ x 24½ x ¾	730	1215	NR	0.26	0.51	NR	1.0"	4.1	0.21	0.41	NR	1.0"	5.1
15x20x1	14½ x 19½ x ¾	625	1050	NR	0.26	0.51	NR	1.0"	3.5	0.21	0.41	NR	1.0"	4.4
16x20x1	15½ x 19½ x ¾	670	1115	NR	0.26	0.51	NR	1.0"	3.8	0.21	0.41	NR	1.0"	4.7
16x25x1	15½ x 24½ x ¾	840	1400	NR	0.26	0.51	NR	1.0"	4.7	0.21	0.41	NR	1.0"	5.9
18x24x1	17¾ x 23¾ x ¾	900	1500	NR	0.26	0.51	NR	1.0"	5.1	0.21	0.41	NR	1.0"	6.3
18x25x1	17¾ x 24½ x ¾	940	1570	NR	0.26	0.51	NR	1.0"	5.3	0.21	0.41	NR	1.0"	6.6
20x20x1	19½ x 19½ x ¾	840	1400	NR	0.26	0.51	NR	1.0"	4.8	0.21	0.41	NR	1.0"	5.9
20x25x1	19½ x 24½ x ¾	1050	1740	NR	0.26	0.51	NR	1.0"	6.0	0.21	0.41	NR	1.0"	7.4
24x24x1	23¾ x 23¾ x ¾	1200	2000	NR	0.26	0.51	NR	1.0"	6.8	0.21	0.41	NR	1.0"	8.5
25x25x1	24¾ x 24¾ x ¾	1310	2170	NR	0.26	0.51	NR	1.0"	7.4	0.21	0.41	NR	1.0"	9.3
10x20x2	9½ x 19½ x 1¾	(CFM) 425	700	875	0.14	0.25	0.34	1.0"	4.0	0.09	0.18	0.25	1.0"	6.0
12x20x2	11½ x 19½ x 1¾	500	840	1050	0.14	0.25	0.34	1.0"	4.8	0.09	0.18	0.25	1.0"	7.2
12x24x2	11½ x 23¾ x 1¾	600	1000	1250	0.14	0.25	0.34	1.0"	5.7	0.09	0.18	0.25	1.0"	8.6
14x20x2	13½ x 19½ x 1¾	590	980	1215	0.14	0.25	0.34	1.0"	5.6	0.09	0.18	0.25	1.0"	8.4
14x25x2	13½ x 24½ x 1¾	730	1215	1520	0.14	0.25	0.34	1.0"	7.1	0.09	0.18	0.25	1.0"	10.6
15x20x2	14½ x 19½ x 1¾	625	1050	1310	0.14	0.25	0.34	1.0"	6.1	0.09	0.18	0.25	1.0"	9.1
16x20x2	15½ x 19½ x 1¾	670	1115	1400	0.14	0.25	0.34	1.0"	6.7	0.09	0.18	0.25	1.0"	9.9
16x24x2	15½ x 23¾ x 1¾	800	1350	1675	0.14	0.25	0.34	1.0"	7.8	0.09	0.18	0.25	1.0"	11.6
16x25x2	15½ x 24½ x 1¾	840	1400	1740	0.14	0.25	0.34	1.0"	8.1	0.09	0.18	0.25	1.0"	12.1
18x20x2	17¾ x 19½ x 1¾	750	1250	1570	0.14	0.25	0.34	1.0"	7.3	0.09	0.18	0.25	1.0"	10.9
18x24x2	17¾ x 23¾ x 1¾	900	1500	1875	0.14	0.25	0.34	1.0"	8.8	0.09	0.18	0.25	1.0"	13.1
18x25x2	17¾ x 24½ x 1¾	950	1570	1960	0.14	0.25	0.34	1.0"	9.1	0.09	0.18	0.25	1.0"	13.7
20x20x2	19½ x 19½ x 1¾	840	1400	1740	0.14	0.25	0.34	1.0"	8.3	0.09	0.18	0.25	1.0"	12.4
20x24x2	19½ x 23¾ x 1¾	1000	1675	2100	0.14	0.25	0.34	1.0"	9.8	0.09	0.18	0.25	1.0"	14.6
20x25x2	19½ x 24½ x 1¾	1050	1740	2170	0.14	0.25	0.34	1.0"	10.5	0.09	0.18	0.25	1.0"	15.5
24x24x2	23¾ x 23¾ x 1¾	1200	2000	2500	0.14	0.25	0.34	1.0"	11.8	0.09	0.18	0.25	1.0"	17.9
25x25x2	24¾ x 24¾ x 1¾	1310	2170	2720	0.14	0.25	0.34	1.0"	12.8	0.09	0.18	0.25	1.0"	19.1
12x24x4	11½ x 23¾ x 3¾	(CFM) 600	1000	1250	0.09	0.18	0.25	1.0"	10.6	0.08	0.16	0.23	1.0"	12.9
16x20x4	15½ x 19½ x 3¾	670	1115	1400	0.09	0.18	0.25	1.0"	12.0	0.08	0.16	0.23	1.0"	14.7
16x24x4	15½ x 23¾ x 3¾	800	1350	1675	0.09	0.18	0.25	1.0"	14.3	0.08	0.16	0.23	1.0"	17.5
16x25x4	15½ x 24½ x 3¾	840	1400	1750	0.09	0.18	0.25	1.0"	15.0	0.08	0.16	0.23	1.0"	18.4
18x24x4	17¾ x 23¾ x 3¾	900	1500	1875	0.09	0.18	0.25	1.0"	16.3	0.08	0.16	0.23	1.0"	19.9
20x20x4	19½ x 19½ x 3¾	840	1400	1740	0.09	0.18	0.25	1.0"	15.1	0.08	0.16	0.23	1.0"	18.4
20x24x4	19½ x 23¾ x 3¾	1000	1675	2100	0.09	0.18	0.25	1.0"	18.1	0.08	0.16	0.23	1.0"	22.2
20x25x4	19½ x 24½ x 3¾	1050	1740	2170	0.09	0.18	0.25	1.0"	19.5	0.08	0.16	0.23	1.0"	23.6
24x24x4	23¾ x 23¾ x 3¾	1200	2000	2500	0.09	0.18	0.25	1.0"	22.5	0.08	0.16	0.23	1.0"	27.5
24x24x6	23¾ x 23¾ x 5¼	(CFM) 1200	2000	2500	0.13	0.19	0.29	1.0"	33.3	0.11	0.17	0.28	1.0"	40.7

Additional Multi-Pleat XL8 Product Information

MERV (Minimum Efficiency Reporting Value) • Recommended Final Pressure Drop is 1.0" w.g. • Performance data is based on ASHRAE Test Standards 52.1-1999 and 52.2-2007. Recommended maximum continuous operational temperature is 200°F. • Multi-Pleat XL8 filters are classified as Underwriter's Laboratories Class 2 according to U.L. Standard 900.





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The Complete Line of Air Filtration
Products for Commercial, Industrial,
Hospital, Gas Turbine and
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Koch Filter Corporation: Founded in 1966 by Joseph Koch and still managed by the Koch family, Koch Filter Corporation is a world class manufacturer of air filtration products. Koch Filter is recognized globally for its premier brand of high efficiency air filtration products and the industry's broadest range of air filters for any application. Our wide array of filtration products is currently installed in over 50,000 commercial, medical and industrial accounts worldwide.



Corporate Offices

P.O. Box 3186 • 625 West Hill Street (40208)
Louisville, KY 40201 • 502.634.4796
Fax: 502.637.2280 • E mail: info@kochfilter.com
www.kochfilter.com

Regional Sales Offices/Distribution Centers

Atlanta, GA • Detroit, MI • East Greenville, PA* • Houston, TX* • Indianapolis, IN
Kansas City, MO • Louisville, KY* • Madbury, NH • Nashville, TN • Rancho Cucamonga, CA*

*Denotes manufacturing site.

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Koch Filter Corporation maintains a policy of continuous product research and improvement, and retains the right to change product specification and design without notice.

Look for the Koch Green icon! Whenever you see the Koch Green icon, we are identifying a product that meets or exceeds our criteria in one or more of the following categories: **Earns LEED Points, Reduces Energy Costs, Extends Filter Lifecycles, Conserves Resources, and Improves Indoor Environmental Quality.**

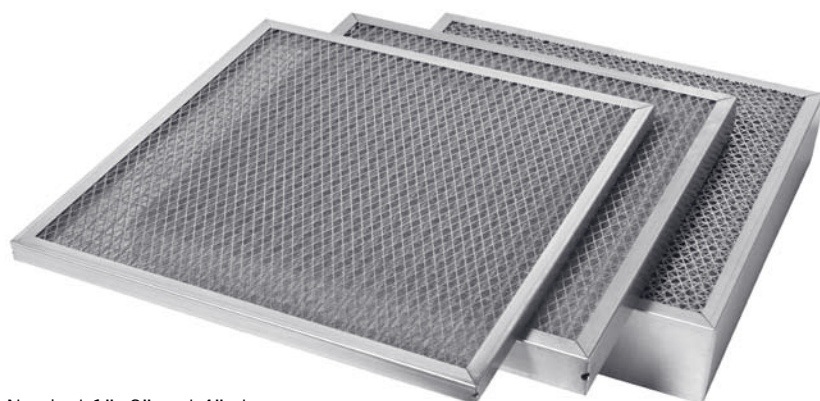
Distributed by

HI SERIES

INDUSTRIAL GRADE FILTER



FILTERS AIRBORNE PARTICULATE AND COOLANT MIST



Nominal 1", 2" and 4" shown

Application: The **HI SERIES INDUSTRIAL GRADE FILTER** is designed for use in residential, commercial and industrial HVAC applications to remove airborne particulate and coolant mist from the airstream. It can be used dry or coated with Filter Coat and is built to withstand repeated cleanings. Select from three different metal alloys to obtain the best filter for your application.

Construction: The HI Series uses a metal frame to enclose the media pack which consists of multiple layers of corrugated screen wire assembled in a criss-cross fashion for strength. The pack is then placed between two layers of expanded metal and is made to fit firmly inside the frame giving the HI Series filter its exceptional strength and durability. The frame is made with mitered corners and is secured with pop-rivet(s).

AVAILABLE IN THREE ALLOYS

HIA

Aluminum

HIG

Galvanized Steel

HIS

Stainless Steel

PRODUCT HIGHLIGHTS

- Ridgid, Multi-Layered Construction
- Washable and Reusable
- Strong and Durable
- Corner Drain Holes

FAST FACTS

LEAD TIME:

5 Days

MINIMUM ORDER:

No Minimum Order

SIZING OPTIONS:

Standard and Special Sizes

Please see reverse side for details.

CLASSIFICATION:

UL 900 Class 1 and 2

Due to continuing research and development, we reserve the right to make modifications to any product.

HI SERIES ~ Filter Selection Chart

MODEL	HIA			HIG			HIS		
CONSTRUCTION	ALL ALUMINUM			GALVANIZED FACE / ALUMINUM MEDIA			ALL STAINLESS STEEL		
Frame Alloy	.030" thick aluminum			22 gauge galvanized steel			24 gauge stainless steel		
Frame Thickness	1/2" exact; nominal* 1", 2" and 4"			Nominal* 1", 2" and 4"			Nominal* 1", 2" and 4"		
Face Grids	.020" thick aluminum			28 gauge galvanized steel			28 gauge stainless steel		
Media	Aluminum screen wire			Aluminum screen wire			Stainless steel screen wire		
APPLICATION									
Application	Airborne particulate and coolant mist			Airborne particulate and coolant mist			Airborne particulate and coolant mist		
Environment	Normal environment			Normal environment			Corrosive environment		
Washability	Frequent and moderate			Frequent and rigorous			Frequent and rigorous		
STANDARD SIZES									
Nominal* Dimensions (H x W x T)	Part Number	Carton Quantity	Carton Weight	Part Number	Carton Quantity	Carton Weight	Part Number	Carton Quantity	Carton Weight
12 x 24 x 1	HIA101224	12	18.0	HIG101224	12	25.0	HIS101224	12	37.0
16 x 20 x 1	HIA101620	12	20.0	HIG101620	12	29.0	HIS101620	12	39.0
16 x 25 x 1	HIA101625	12	24.0	HIG101625	12	34.0	HIS101625	12	46.0
20 x 20 x 1	HIA102020	12	24.0	HIG102020	12	34.0	HIS102020	12	46.0
20 x 25 x 1	HIA102025	12	29.0	HIG102025	12	41.0	HIS102025	12	55.0
24 x 24 x 1	HIA102424	12	33.0	HIG102424	12	44.0	HIS102424	12	62.0
12 x 24 x 2	HIA201224	12	25.0	HIG201224	12	38.0	HIS201224	12	53.0
16 x 20 x 2	HIA201620	6	14.0	HIG201620	6	18.0	HIS201620	6	29.0
16 x 25 x 2	HIA201625	6	17.0	HIG201625	6	22.0	HIS201625	6	35.0
20 x 20 x 2	HIA202020	6	17.0	HIG202020	6	22.0	HIS202020	6	35.0
20 x 25 x 2	HIA202025	6	21.0	HIG202025	6	27.0	HIS202025	6	41.0
24 x 24 x 2	HIA202424	6	23.0	HIG202424	6	30.0	HIS202424	6	46.0
12 x 24 x 4	HIA401224	3	12.0	HIG401224	3	26.0	HIS401224	3	25.0
16 x 20 x 4	HIA401620	3	13.0	HIG401620	3	28.0	HIS401620	3	27.0
16 x 25 x 4	HIA401625	3	16.0	HIG401625	3	33.0	HIS401625	3	32.0
20 x 20 x 4	HIA402020	3	16.0	HIG402020	3	33.0	HIS402020	3	32.0
20 x 25 x 4	HIA402025	3	19.0	HIG402025	3	39.0	HIS402025	3	38.0
24 x 24 x 4	HIA402424	3	21.0	HIG402424	3	44.0	HIS402424	3	43.0

HI SERIES NOTES

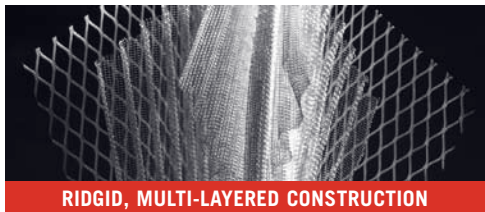
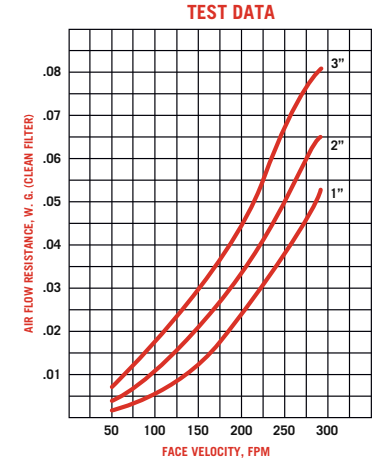
- SIZING INFORMATION**
- * What does Nominal mean? Standard size filters are of a nominal dimension. This means the height, width and thickness dimensions are undercut by a certain amount. See below for the exact amount of undercut for each dimension.
 - 1. Six standard nominal size filters are available in thicknesses of nominal 1" (actual 7/8"), nominal 2" (actual 1-3/4") and nominal 4" (actual 3-3/4") and are 1/2" undercut on the height and width dimensions.
 - 2. Special size filters are available in thicknesses of 1/2" exact (HIA only) and nominal 1" (actual 7/8"), nominal 2" (actual 1-3/4") and nominal 4" (actual 3-3/4"). These filters must be purchased using the exact height, width and thickness dimensions to eliminate any confusion when ordering.
 - 3. Tolerance height and width: ± 1/8"
 - 4. Tolerance thickness: ± 1/32"

- CLASSIFICATION AND TEST NOTES**
1. The HI Series filter is listed as UL 900 Class 1 when used dry and UL 900 Class 2 when used with Filter Coat.
 2. Recommended final resistance is 0.5" W.G.

- FILTER CLEANING AND COATING**
1. To clean a dirty filter, rinse it with a moderate-to-heavy stream of warm water. High-powered steam cleaning or chemical dips are unnecessary and not recommended. Re-spraying with Filter Coat after cleaning will help maintain the filter's efficiency.
 2. An HI Series filter is not supplied from the factory with filter adhesive coating. If desired, it may be sprayed before installation with Filter Coat, a water soluble adhesive and detergent. The adhesive helps to retain the airborne particulate, and when the filter is washed, the detergent helps to release the used adhesive and contaminants from the media pack.

- INSTALLATION CONSIDERATIONS**
1. The HI Series filter may be installed in HVAC systems vertically or horizontally.

- ADDITIONAL INFORMATION**
1. The 1/2" exact filter uses an .025" thick aluminum frame.
 2. The 1/2" exact filter is 4-ply.
 3. The nominal 1" (actual 7/8") filter is 5-ply.
 4. The nominal 2" (actual 1-3/4") filter is 7-ply.
 5. The nominal 4" (actual 3-3/4") filter is 10-ply.



TOIH 1090

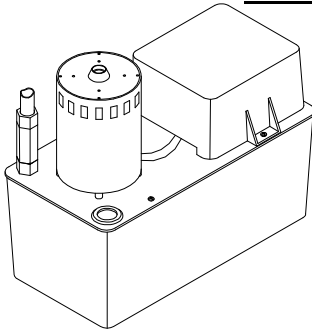
Owners Manual

AUTOMATIC CONDENSATE UNIT

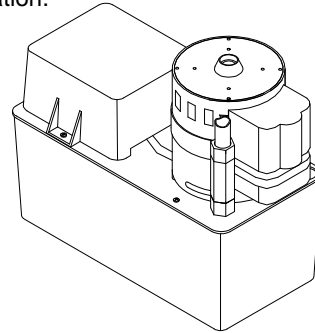
Keep For Future Reference **CB501ULHT**

INSTALLATION OPERATION

CAUTION: Read rules for Safe Operation and Installation.



Model: CB25*
23' LIFT



Model: CB50*
48' LIFT

*Suffix denotes features
Example: CB25 **1** | **UL** | **HT**

Base Model | High Temperature Model, for use with maximum 190°F water.
UL Listed

Voltage:
1 = 115V; 2 = 230V; 4 = 460V; 7 = 277V

INTRODUCTION

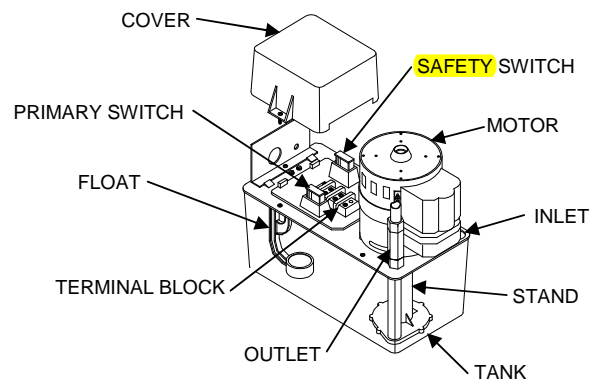
RULES FOR SAFE OPERATION

1. Carefully read the Owners Manual and rules for safe operation.
2. All wiring must conform to local codes. Use the National Electric Code if local code is nonexistent.
3. **CAUTION!** To reduce risk of electric shock disconnect from power supply before servicing, pull the plug on models which have plug-in connections.
4. Do not handle the pump with wet hands or when standing in water as fatal shock could occur. Disconnect main power before handling unit for ANY REASON!
5. Protect the power cable from coming in contact with sharp objects.
6. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
7. Make certain that line voltage conforms to the voltage specified on motor and nameplate.
8. **WARNING!** To reduce risk of electrical shock, connect only to a properly grounded grounding type receptacle.

INSTALLATION

Select a location for the pump. It should be as near as possible to the air conditioning coil. **The pump must be level.** The inlet hole must be below the coil drain. Carefully unpack the pump. Remove the switch cover. Check each float rod for "free" action.

CB25
CB50



BECKETT CORPORATION

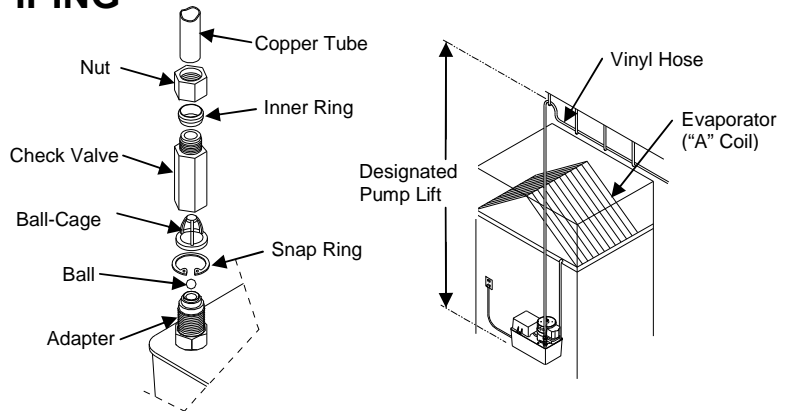
Irving, Texas
www.beckett pumps.com
Phone: 972-871-8000
Toll Free: 1-888-BECKETT
Fax: 972-871-8888

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Y8611 Rev. E

PIPING

Run a drain line from the evaporator coil drain to the pump. Use the flexible plastic pipe where the code permits. Insert the pipe 1" below the pump cover. Do not install inlet drain line that would interfere with operation of floats. Connect outlet tubing (copper or vinyl) to discharge on pump. Do not run tubing vertical more than is recommended by the lift on each unit. For good flow, slant the horizontal run downward toward the drain. Each CB25 comes standard with a check valve for connecting to 3/8" O.D. copper tubing. Each CB50 unit comes standard with a check valve for connecting to 1/2" O.D. copper tubing. A copper tube adapter is included for vinyl hose hook-up.



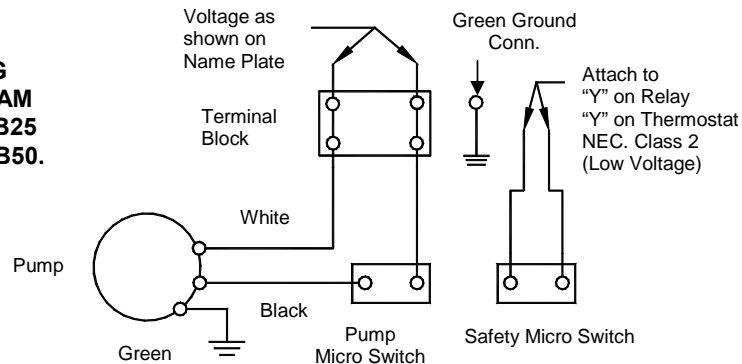
WIRING

The wiring must comply with local codes.

WARNING

Turn the electric power off at the fuse box before making any line voltage connections.

WIRING DIAGRAM FOR CB25 AND CB50.



To test safety float switch, temporarily stop flow of discharge line by sharply bending vinyl tubing. Pour more water into pump inlet. Water level will rise beyond high level of control float until safety float switch breaks the "Y" thermostat circuit shutting down air conditioner condensing unit. Unbend the tube and the pump will empty the entire sump. Replace inlet line into pump inlet.

MAINTENANCE AND TROUBLE SHOOTING

1. Remove dirt that may collect in bottom sump.
2. Look at vinyl DISCHARGE LINE to see that it is open and water can pass through freely.
3. Always replace cover to keep electrical parts clear of dust and grime.
4. See item 7 of Introduction.

LIMITED WARRANTY

These Beckett pumps are warranted to the user against defective material and workmanship under normal use, for a period of 1 year from the date of purchase by the original purchase. All other Beckett products are warranted to the user against defective material and workmanship for 3 months from the date of purchase. Replacement liability in all events is limited to the replacing or repairing at Beckett's sole discretion of any part or parts, which are defective in material or workmanship. Proof of purchase is required on all claims in the form of invoice copy, sales ticket, etc.

APPLICATION: Warranty covers only properly installed and maintained units. Warranty is limited to applications pumping fresh water at temperatures of 32°-98°F (0°-36°C), with a pH range of 5 to 9. Beckett Corporation must approve other liquid applications and extreme temperature uses in advance in writing.

ADMINISTRATION: Warranty claims must be made by returning the defective part, freight prepaid, along with proof of purchase, to: Beckett Corporation, Customer Care Dept., Irving, TX. Phone authorization is required prior to returning merchandise (972-871-8000). All items returned will be inspected to determine cause of failure before warranty is approved.

INSTALLATION and/or REMOVAL CHARGES: Warranty does not cover any costs associated with the installation or removal of products subject to warranty claims.

DISPOSITION: Beckett will make a good-faith effort for prompt disposition regarding any item in warranty, which proves to be defective. If products were damaged in transit, please file a claim with the carrier.

DISCLAIMER: Any oral statements about the product made by the seller, the manufacturer, the representatives or any other parties, do not constitute warranties, should not be relied upon by the user, and are not part of the contract for sale. Seller's and manufacturer's only obligation and buyer's and user's only remedy, shall be for the manufacturer to either replace and/or repair at the manufacturer's sole discretion the Beckett product as described above. Neither seller nor the manufacturer shall be liable for any injury, loss or damage, direct, incidental or consequential (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss), arising from any cause whatsoever, no matter whether based upon warranty, contract, negligence or other misuse, and the buyer and user agree that no other remedy shall be available to them. Before using, the buyer and user shall determine the suitability of the product for the intended use, and assumes all risk and liability whatsoever in connection herewith. The warranty and remedy described in this limited warranty is an EXCLUSIVE warranty and remedy. IN LIEU of any other warranty or remedy, expressed or implied, which other warranties and remedies are hereby expressly EXCLUDED, including but not limited to any implied warranty of MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This Warranty gives buyer and user specific legal rights, and buyer and user may also have other rights that vary from state to state. Some states do not allow the exclusion or limitations of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Y8611 Rev. E

AIR PRODUCTS AND CONTROLS INC.
INSTALLATION AND MAINTENANCE INSTRUCTIONS
FOR SL-2000 SERIES DUCT SMOKE DETECTORS

SL-2000-N 4-Wire, Ionization Type

SL-2000-P 4-Wire, Photoelectric Type

PRODUCT OVERVIEW

PRODUCT APPLICATION

SL-2000 Series duct smoke detectors provide early detection of smoke and products of combustion present in air moving through an HVAC duct supply, return, or both in commercial, industrial, and residential applications. These devices are designed to prevent the recirculation of smoke in areas by the air handling system's fans and blowers. Complete systems may be shut down in the event of smoke detection.

⚠ NOTE: For the correct installation of a duct smoke unit, please refer to the NFPA 72 (National Fire Alarm Code), NFPA 90A (Standard for Installation of Air Conditioning and Ventilation Systems), NFPA 92A (Recommended Practice for Smoke Control Systems.), NFPA 5000 (Building Construction and Safety Code), IMC (International Mechanical Code), and IFC (International Fire Code).

This detector is not intended for open area protection nor should it be used for early warning detection or replace a regular fire detection system.

PRODUCT DESCRIPTION

The SL-2000 Series smoke detector is fitted with a mounting base that will accept an ionization smoke detector head model 55000-225APO or photoelectric smoke detector head model 55000-328APO. The duct unit supports two sets of form "C" alarm contacts, one form "A" alarm contact and one form "C" trouble contact. The trouble contact supervises the presence of the input power, removal of the detector cover and the removal of the smoke detector head.

⚠ This detector is equipped with a cover removal switch that instantly provides a trouble condition upon removal of the clear cover. For all testing and inspection with the cover removed, the cover removal switch (designated as SW1 on PCB) must be manually depressed to simulate standard "pilot" operation. THE TROUBLE CONTACTS (TERMINALS 4, 15, 5) ARE SHOWN IN THE NON-ENERGIZED CONDITION.

The trouble contacts **will not** operate in the event of a smoke alarm. The SL-2000 Series duct detector will operate from various input voltage sources; namely 24VAC, 24VDC, 115VAC and 230VAC.

SAMPLING TUBES

The operating principle of a duct detector is based on the Venturi effect. Two tubes extend into the HVAC duct. Air flowing through the duct is forced into the air intake (inlet) tube via the air intake holes, (facing the airflow) and passes over the detector head. The air will be drawn out via the exhaust tube back into the HVAC duct. (A 7" exhaust tube is provided in the installation kit.) When the concentration of smoke particles suspended in the air stream reach the alarm threshold of the detector head, the unit will go into alarm.

The duct smoke detector units are designed to operate in duct widths from 6" to 10' wide with an air velocity between 100 to 4,000 feet per

minute. To verify correct installation, the pressure differential between the sampling (high side) and exhaust (low side) tubes should be measured using a Magnehelic pressure gauge or equivalent. An acceptable reading is between 0.01 and 1.2 inches of water.

To minimize the impact of air turbulence and stratification on performance, a duct smoke detector should be located as far as possible downstream from any obstruction (i.e. deflector plates, elbows, dampers, etc.). In all situations, confirmation of velocity and pressure differential within specifications is required.

REMOTE ACCESSORIES

Audible and visual alarm indicators, remote status indicators, and remote reset/test switches can be accommodated by the SL-2000 Series duct units by connecting to DC voltage output terminals as described on Page 4. These terminals are not supervised and the voltage/current will only be present when the detector unit is in alarm. The remote pilot (green) LED will be permanently illuminated when connected to the output terminals as long as input power and detector head are present.

SL-2000 AT-A-GLANCE

MODEL NUMBER:

SL-2000-N 4-Wire Ionization Duct Smoke Detector

SL-2000-P 4-Wire Photoelectric Duct Smoke Detector

DETECTOR HEAD MODEL NUMBER:

Ionization Detector Head: 55000-225APO

Photoelectric Detector Head: **55000-328APO**

POWER REQUIREMENTS:

STANDBY CURRENT

24VAC 39.4mA

24VDC 13.5mA

115VAC 13.8mA

230VAC 7.9mA

ALARM CURRENT

24VAC 59.3mA

24VDC 128.7mA

115VAC 27.0mA

230VAC 16.0mA

RELAY CONTACT RATINGS:

Alarm contacts: 2 Sets form "C" rated at 10A @ 115VAC resistive
1 form "A" rated at 2A

Trouble contacts: 1 Set form "C" rated at 10A @ 115VAC resistive

Air velocity: 100 to 4,000ft/min.

Ambient temperature: SL-2000-N: 32°F to 158°F (0°C to 70°C)

SL-2000-P: 32°F to 140°F (0°C to 60°C)

Humidity: 10% to 85% RH Non-Condensing/Non-Freezing

Material: Gray plastic back box with clear plastic cover (Makrolon 94V-0)

Dimensions: 13½" L X 4½" W X 2¼" D

Max. net wt.: 3½ lbs.

Radioactive element: SL-2000-N (Ionization) - Americium 241, 0.9 micro curie.

Do not expose to corrosive atmospheres.

U.S. Patents 6,741,181 and Patents Pending

Page Y-1

MECHANICAL INSTALLATION

LOCATION PREREQUISITES

This guideline contains general information on duct smoke detector installation, but does not preclude the NFPA and/or ICC documents listed. Air Products and Controls assumes no responsibility for improperly installed duct detectors. To determine the correct installation position for an SL-2000 Series duct smoke detector, the following factors must be considered.

- 1) A uniform non-turbulent (laminar) airflow between 100 ft/min. to 4,000 ft/min. must be present in the HVAC duct. To determine duct velocities, examine the engineering specifications that define the expected velocities or use an Anor model 6000AP velocity meter (or equivalent).
- 2) To minimize the impact of air turbulence and stratification on performance, a duct smoke detector should be located as far as possible downstream from any obstruction (i.e. deflector plates, elbows, dampers, etc.). In all situations, confirmation of velocity and pressure differential within specifications is required.

The pressure differential between the input sampling (high pressure) tube and exhaust (low pressure) tube for the SL-2000 Series smoke duct detector should be greater than 0.01 inches of water and less than 1.2 inches of water.

- 3) Identify a code compliant location (supply or return side, or both) for the installation of the duct unit that will permit easy access for viewing and serviceability.
- 4) When installing on the return side, install duct units prior to the air being exhausted from the building or diluted with outside "fresh" air.
- 5) When installing duct smoke units downstream of filters, fires occurring in the filters will be detected, but if the filters become blocked, insufficient air flow through the duct unit will prevent the correct operation of the duct detector. Duct units installed in the supply air side may monitor upstream equipment and/or filters.
- 6) Where possible, install duct detectors upstream of air humidifiers and downstream of dehumidifiers.
- 7) To prevent false alarms, the duct detector should not be mounted in areas of extreme high or low temperatures, in areas where high humidity exists, or in areas where the duct may contain gases or excessive dust.

SAMPLING TUBE ASSEMBLY

The SL-2000 Series duct smoke detectors employ a specially notched sampling tube, which may be ordered separately in one of four standard lengths.

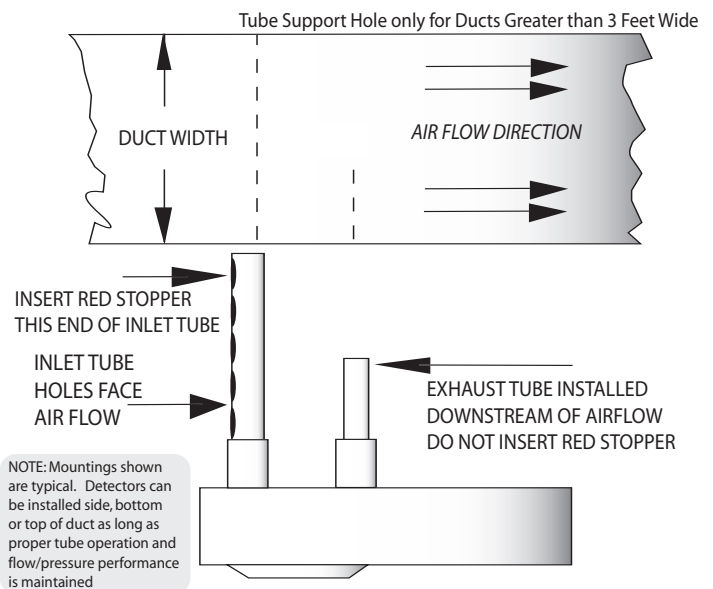
- STN-1.0** For duct widths of 6" TO 1.0'
- STN-2.5** For duct widths of 1.0' TO 3.0'
- STN-5.0** For duct widths of 3.0' TO 5.0'
- STN-10.0** For duct widths of 5.0' TO 10.0'

Standard sampling tubes are steel tubes with air intake holes drilled the entire length of the tube. These tubes can be cut to length and must span at least 80% the width of the duct. Sampling tubes over 3.0' must be supported on the opposite side of the duct. To ensure the correct operation of the sensing tube, the red end cap (red stopper in installation kit) must be inserted in the end of the air intake sampling tube. For custom duct widths, always use the next longest standard size and cut down to the exact requirement.

"NO-TOOLS" TUBE INSTALLATION

The SL-2000 Series duct smoke detector provides a unique, patent-pending mechanism for installation and/or removal of the sampling and exhaust tubes from either the front or rear of the detector housing.

Once the airflow direction has been determined, insert the inlet and exhaust tubes into the duct smoke detector. If the cover is in place, the tubes may be inserted into the back of the detector via the key-slots provided. Simply push the tube into place against the spring loaded retainer, and turn into the correct position, allowing the key to "lock" the tube in the desired orientation. For front side installation, simply rotate the tube retainer until the tube may be inserted and oriented properly. Once the tube is installed, rotate the retainer back into place to lock down the tube. Ensure air intake sampling tube is positioned so that the inlet holes are directly facing the airflow.



DUCT PREPARATION

Remove mounting template from the installation kit. Remove paper backing from the mounting template and affix it to the duct at the desired location. Using the template as a guide, drill (2) mounting holes, 3/32" (2.5mm) for the #12 X 1/2" sheet metal screws packaged in the installation kit. Drill or punch (2) 1 1/4" (32mm) holes for inlet sampling and exhaust tubes, using the template as a guide. Clean all holes.

MOUNTING

After securing the sampling and exhaust tubes to the duct smoke unit, (or initially placing the tubes through the 1 1/4" holes drilled or punched in the HVAC duct to accept the inlet sampling and exhaust tubes and then attaching them to the duct unit), hold the duct unit assembly in position and use (2) # 12 X 1/2" sheet metal screws (packaged in the installation kit) to secure the duct smoke detector to the HVAC duct sheet metal.

AIR SAMPLING VERIFICATION

To ensure correct operation of the duct unit use a Magnehelic differential pressure gauge, Dwyer 2000 or 4000 Series (or equivalent) to determine the differential pressure between the inlet (high side) and exhaust (low side) tubes. The differential pressure between the two tubes should be greater than 0.01 inches of water and less than 1.2 inches of water.

AIR SAMPLING VERIFICATION (CONT'D)

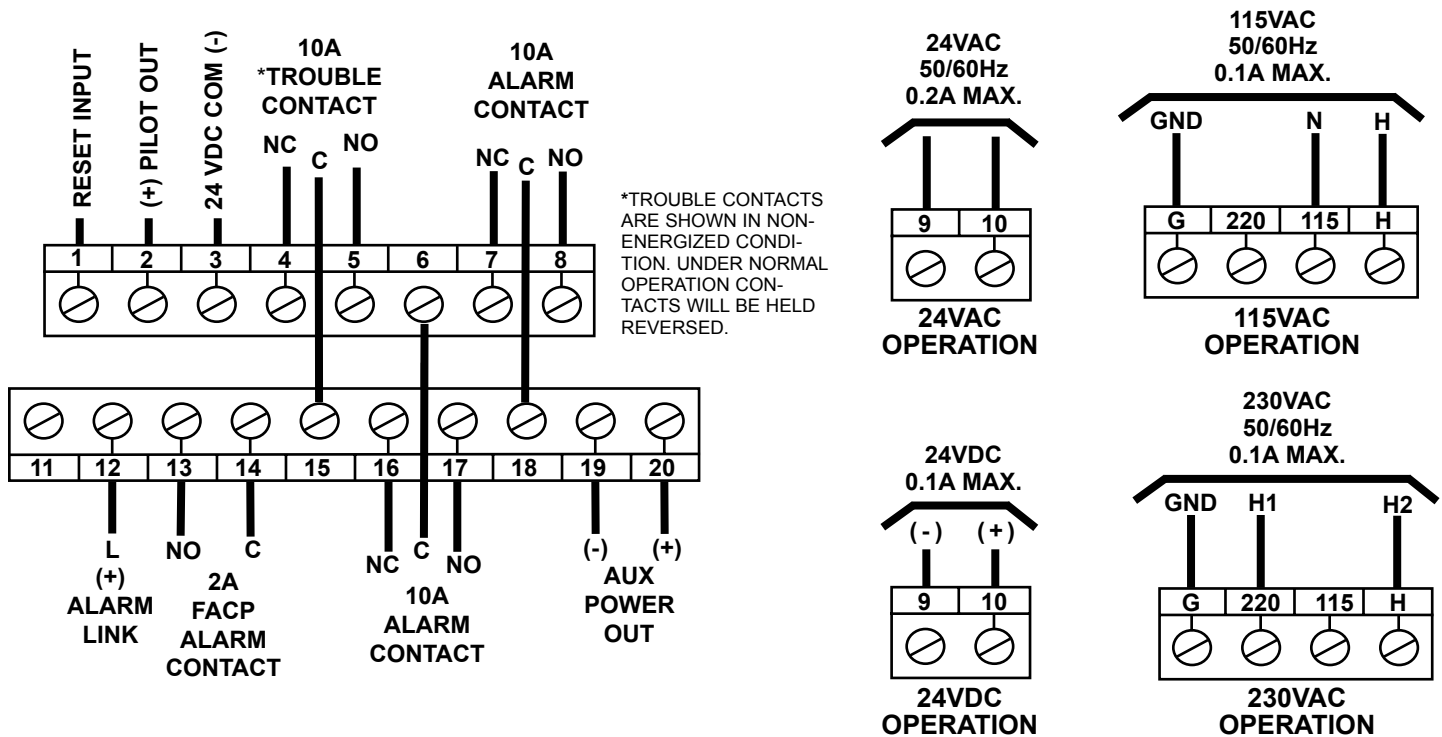
This duct smoke detector is shipped with a velocity adapter insert, either factory installed (SL-2000-P), or found in the installation kit (SL-2000-N). When installed, this adapter will allow the duct detector to operate at extremely low air velocities. To install the adapter, simply insert it into the slots provided inside the detector housing so that the adapter fits snugly over the smoke detector head. Unless your system is consistently operating in the slower velocity range (where the adapter is specifically required), we recommend that the adapter not be inserted. If you experience false alarms at higher velocities with the adapter in place, the adapter should be removed. Please use the following chart for guidance on when the velocity adapter should be used. For reference, the speeds indicated are intended to represent the velocity of air within the duct under normal operational conditions.

	100 ft/min	300 ft/min	500 ft/min	1,000 ft/min	2,000 ft/min	3,000 ft/min	4,000 ft/min
SL-2000-N	UL Listed without insert installed (300-4,000 ft/min)						
	UL Listed with insert installed (100-2,000 ft/min)						
SL-2000-P	UL Listed without insert installed (1,000-4,000 ft/min)						
	UL Listed with insert installed (100-4,000 ft/min)						

ELECTRICAL INSTALLATION

TERMINAL AND POWER CONNECTIONS

Prior to connecting input power to the duct unit, determine the correct input voltage/ current availability and ensure it is connected to the correct terminals.

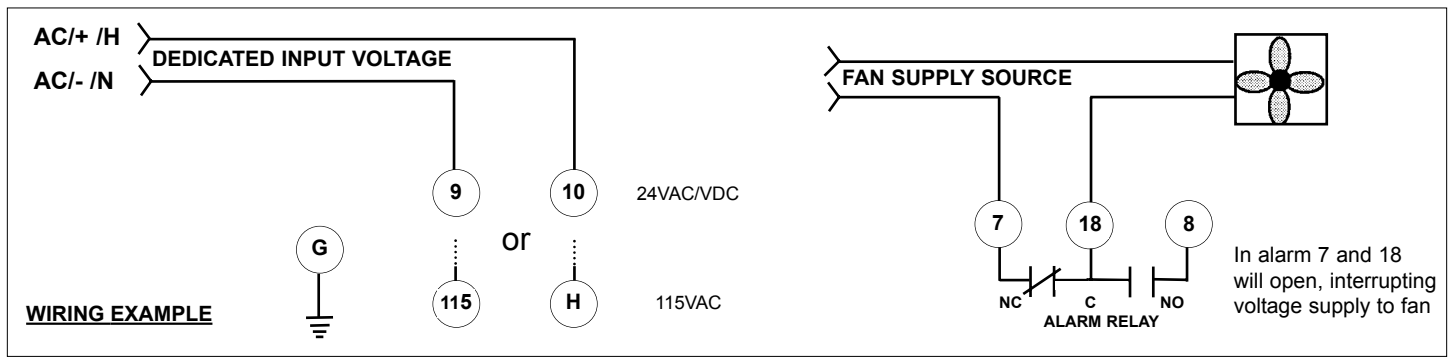


WIRING

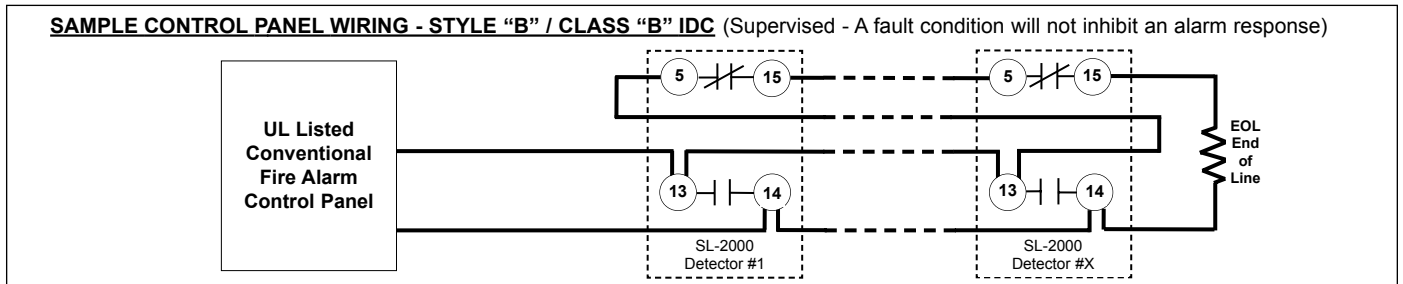
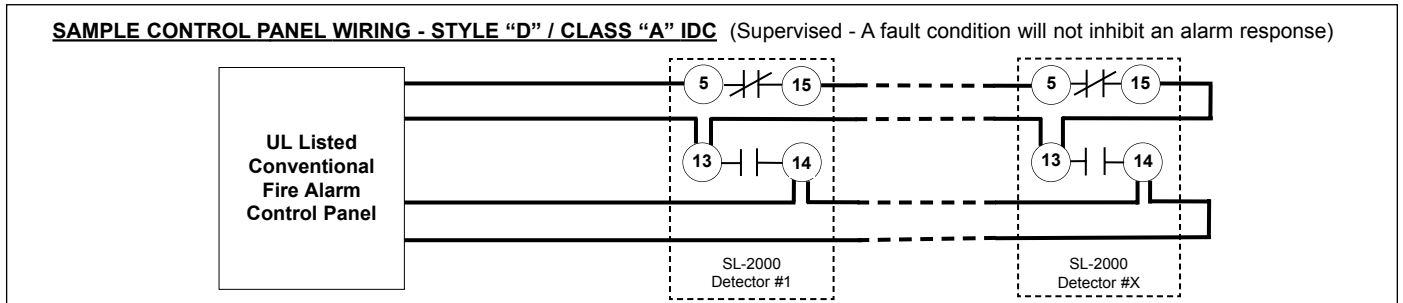
CAUTION: Do not use looped wire under terminals. Break wire run to provide for proper supervision of connections.

With detector head removed, connect one of the appropriate dedicated power sources to the applicable terminals (see above). Replace detector head and depress the cover removal switch (SW1) and the unit will be energized. The green pilot LED will be illuminated, and when pressing the test/reset button (SW2), the red alarm LED will be illuminated. This test confirms the correct basic operation of the duct smoke unit, excluding the detector head (see functional testing).

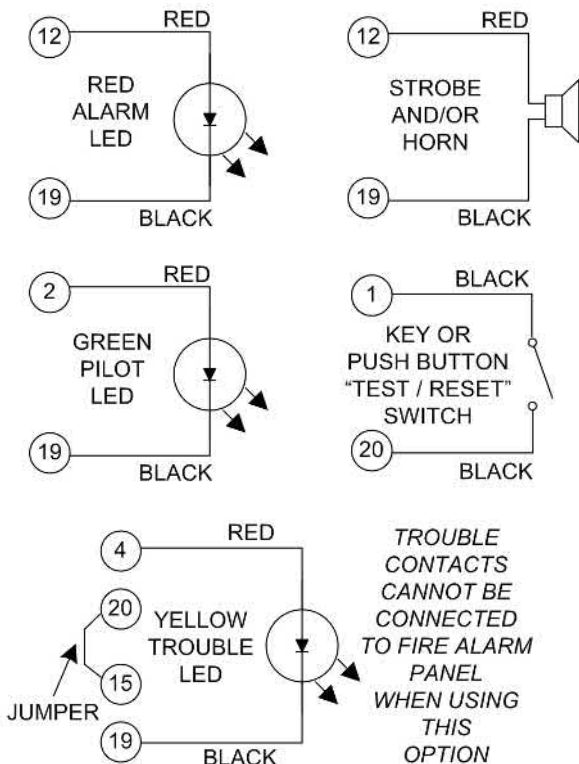
In the event of a fire alarm, certain equipment may be required to be shut down. For example, shut down may be achieved by interrupting the fan supply source to that particular piece of equipment when wired as indicated on Page 4.



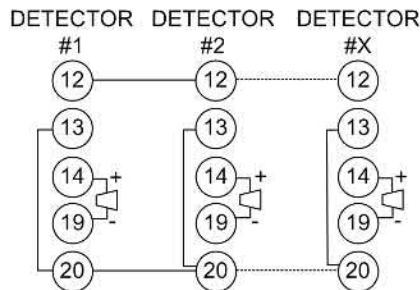
FIRE ALARM CONTROL PANEL WIRING



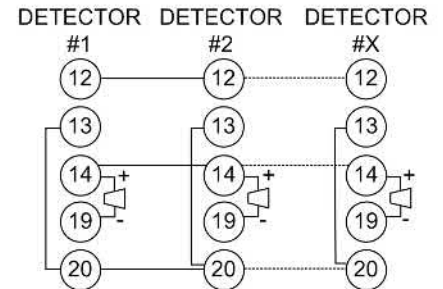
REMOTE ACCESSORY WIRING



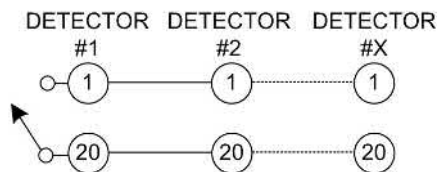
INTERCONNECTION WIRING FOR COMMON FUNCTIONS



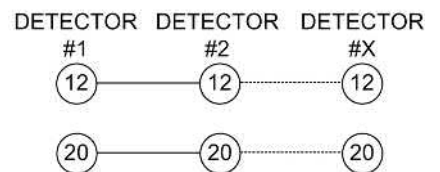
All alarm relays operate with single alarm. Individual horn/strobe units operate on alarmed detector only. 30 detectors max.



All alarm relays operate with single alarm. All horn/strobe units operate on any single alarm. 10 detectors max.



Common test/reset. 30 detectors max. (Use normally open test/reset switch)



All alarm relays operate with single alarm. 30 detectors max.



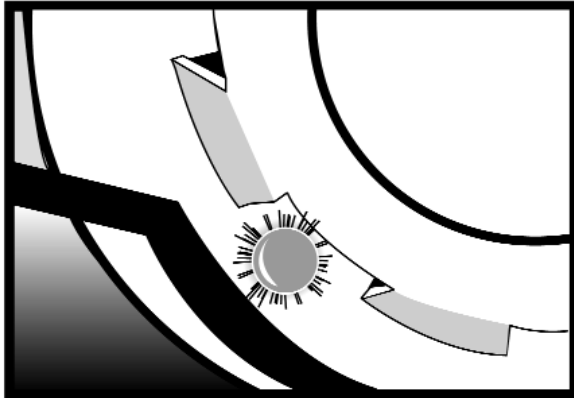
NOTE: A common power supply must be used for all interconnected detectors.

TESTING AND MAINTENANCE PROCEDURES

OPERATIONAL TESTING

To determine the correct operation of the SL-2000 Series duct smoke detector, ensure input power is connected and the green pilot LED is illuminated.

The LED on the detector head of both the ionization and photoelectric models will flash while the unit is in standby mode. The LED on the smoke detector head will be permanently illuminated when smoke is detected and the head is in alarm.



Above: The LED will be permanently illuminated when the unit is in alarm.

With the air handling unit shut down (not connected), and the clear cover removed, press and hold the test/reset button and the cover removal switch on the SL-2000. The red alarm LED on the circuit board will be illuminated and the alarm relay outputs will change state. Using a multimeter set to OHMS (or continuity buzzer function on the meter) place the meter probes on the following terminals, and ensure the contacts are closed (continuity) (8-18) and (6-17). When releasing the test/reset button these contacts will open.

The trouble contacts (4,15,5) on the SL-2000 detector will not change state in the event of a fire alarm, operational, or functional testing. The trouble contacts can be tested by either releasing the cover removal switch, or depressing the cover removal switch after rotating the smoke detector head counter-clockwise and removing the detector head. This action will extinguish the green pilot LED and cause the trouble contacts to change state, (4-15) will be closed (continuity) and (5-15) will be open circuit. Replacing the detector head and rotating it clockwise until it locks, will cause the green pilot LED to be illuminated and the unit will be operational, terminals (4-15) will be an open circuit and (5-15) will be closed (continuity).

FUNCTIONAL TESTING

Once operational testing is concluded the unit requires functional testing to determine the correct operation of the detector head.

MAGNET TESTING: Place the magnet provided with the installation kit on top of the housing between the raised sections above the detector head (as indicated on the unit cover. Allow at least five seconds for alarm initiation. Remove magnet and reset detector.

SMOKE TESTING: Using smoke test canister with testing nozzle (available from Air Products and Controls Inc. part number TG-2000), insert the test gas nozzle into the test port on the unit cover. Press can against cover to release gas into the chamber.



CAUTION: DO NOT SPRAY GAS FOR MORE THAN ½ SECOND. OVERUSE OF TEST GAS FACILITY MAY RESULT IN DETECTOR CONTAMINATION.

After 15 to 20 seconds the detector head will go into alarm, illuminating the detector head LED and causing the duct unit functions to operate, alarm relays will change state, and the alarm related remote accessories, if attached, will function.

If no test gas is available to conduct functional testing, remove cover and, while holding down the cover removal switch, blow smoke from a cotton wick or punk directly at the head to cause an alarm. The alarm indicator should illuminate within one minute.

Should additional testing also be required for simulated fire conditions, smoke bombs placed in the duct may not be suited for the particular detector head (photoelectric or ionization) selected and installed. Consult the smoke bomb data for proper use and compatibility with detector type.

The S65A ionization detector head (55000-225APO) utilizes a radioactive source as its means of detection and will detect smoke particles of between .1 and 1 micron in size.

The S65A photoelectric detector head (55000-328APO) operates on the principle of light scatter and will detect smoke particles of between 1 and 10 microns in size.

When purchasing smoke bombs for additional required functional testing, ensure smoke particle sizes comply with the criteria as described above.

MAINTENANCE

Each installation location must be assessed on its own merits. If the protected area is of a very dirty nature then the SL-2000 Duct unit(s) will have to be checked and cleaned on a quarterly basis or when cleaning is required.

As a guideline the smoke detector head should be cleaned every six months or as required. The best methods of cleaning are to vacuum the detector head thoroughly or to blow the detector head out using clean, dry compressed air.

Do not use chemicals or non-conforming air to clean the detector head housing as this could contaminate the detector head and damage the casing.

Sensing tubes must be inspected and cleaned in accordance with the schedule as determined above, to allow the free flow of air through both inlet and exhaust tubes.

Consult your local code and AHJ requirements for required maintenance schedules.



AIR PRODUCTS AND CONTROLS INC.
1749 E. Highwood Pontiac, MI 48340 USA
Telephone: (248) 332-3900 www.ap-c.com

AVAILABLE ACCESSORIES FOR USE WITH SL-2000 SERIES DUCT SMOKE DETECTORS

REMOTE ACCESSORIES	
MS-RA	Remote Alarm
MS-RA/R	Remote Alarm, push button Test/Reset Switch
MS-RA/P/R	Remote Alarm, Pilot, push-button Test/Reset Switch
MS-KA/R	Remote Alarm, key-operated Test/Switch
MS-KA/P/R	Remote Alarm, Pilot, key-operated Test/Reset Switch
MS-RA/P	Remote Alarm, Pilot
MS-RH	Remote Alarm Horn
MS-RH/KA/P/R	Remote Alarm, Pilot, Horn, key-operated Test/Reset Switch
MS-RH/P/A	Remote Alarm, Pilot, Horn
MS-RH/KA/P/A/T	Remote Alarm, Trouble, Pilot, Horn, key-operated Test/Reset Switch
MS-RA/P/T	Remote Pilot, Trouble
MS-RA/FT/P	Remote Pilot, Trouble, push-button Test/Reset Switch
MS-KA/P/R/T	Remote Pilot, Trouble, key-operated Test/Reset Switch
MS-RD	Remote Alarm
MS-F/T	Remote Trouble
SHP24-1575R	Horn/Strobe, red housing, clear cover
SHP24-1575O	Horn/Strobe, white housing, opaque cover
SHP24-1575W	Horn/Strobe, white housing, clear cover

SMOKE TEST GAS

TG-2000 Solo Aerosol Test Gas with Nozzle for Test Port

NOTCHED SAMPLING TUBES

STN-1.0 For duct widths of 6" TO 1.0'
STN-2.5 For duct widths of 1.0' TO 3.0'
STN-5.0 For duct widths of 3.0' TO 5.0'
STN-10.0 For duct widths of 5.0' TO 10.0'

WEATHERPROOF ENCLOSURES

WP-2000 Weatherproof Enclosure

REPLACEMENT SMOKE DETECTOR HEADS

55000-225APO S65 Ionization Detector Replacement Head
55000-328APO S65 Photoelectric Detector Replacement Head

POWER SUPPLIES

T-PB 202-1 24VAC @ 4.0A Class I Power Supply
T-PB 202-0 24VAC @ 4.0A Class I Power Supply
T-PB 303-1 24VAC @ 3.0A Class II Power Supply
T-PB 303-0 24VAC @ 3.0A Class II Power Supply

AIR PRODUCTS
AND
CONTROLS



SL-2000 SERIES DUCT SMOKE DETECTORS

INSTALLATION AND MAINTENANCE INSTRUCTIONS



SL-2000-N Ionization Type, 4-Wire Duct Smoke Detector

SL-2000-P Photoelectric Type, 4-Wire Duct Smoke Detector

NOTICE: The information contained in this document is the most current available at the time of shipment of accompanying product, and is subject to change without notice. Future references should always be made to the most current revision of this document. The information contained in all this document should be considered before installing or using the product. Any example applications shown are subject to the most current enforced local/national codes, standards, approvals, certifications, and/or the authority having jurisdiction. All of these resources, as well as the specific manufacturer of any shown or mentioned related equipment, should be consulted prior to any implementation. For further information or assistance concerning this product, contact Air Products and Controls Inc. Air Products and Controls Inc. reserves the right to change any and all documentation without notice.

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UNTIL INSTALLATION BY ALL TRADES IS FULLY COMPLETE. FOLLOWING FINAL
INSPECTION, A COPY SHOULD BE LEFT WITH THE OWNER/USER.**

AP/Armaflex® Black LapSeal™

Tube Insulation with
Reinforced Lap Seal

Fiber Free

The original flexible elastomeric pipe insulation with a new and improved lap seal for greater seam security and increased protection against condensation, mold and energy loss.



- Angled cut with more surface area for a better bond
- A single interior adhesive liner for quicker application
- New durable, low-profile lap seal with wider release tab, stays closed and looks neat
- Easy to install – an excellent choice for retrofit applications
- 25/50 rated for use in air plenums
- Fiber-free, formaldehyde-free, low VOC and non-particulating formulation protects indoor air quality
- Microban® antimicrobial product protection inhibits the growth of mold and mildew in the insulation

armacell®



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N0004-SP069346-000

GREENGUARD Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product use. For more information, visit ul.com/gg.

Microban® is not a disinfectant, sanitizer, or sterilant. It is limited to the product itself and is not designed to protect the users of these products from disease-causing microorganisms, or as a substitute for normal cleaning and hygiene practices.*

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Technical Data: AP Armaflex® Black LapSeal™ Tube Insulation

Description:

Black flexible closed-cell elastomeric thermal insulation in tubular form with a self-seal system reinforced with lap seal tape

Specifications Compliance:

ASTM C 534, Type I – Grade 1
ASTM E 84
NFPA 255

UL 723
NFPA 90A, 90B
UL 181

ASTM G-21/C1338
ASTM G-22
ASTM D 1056, 2B1

Approvals, Certifications, Compliances:

- Key physical properties are approved by Factory Mutual.
- GREENGUARD Gold Certified.
- Manufactured without CFCs, HFCs, HCFCs, PBDEs, or Formaldehyde.

- Made with EPA registered Microban® antimicrobial product protection..
- All Armacell facilities in North America are ISO 9001:2008 certified.

Typical Properties

Specifications:	Values:		Test Method:
	3/8" through 1" Walls	1-1/2" and 2" Walls	
Thermal Conductivity: Btu • in./h • ft ² • °F (W/mK)			
75°F Mean Temperature [24°C]	0.245 (0.0353)	0.28 (0.040)	ASTM C 177 or C 518
90°F Mean Temperature [32°C]	0.254 (0.0366)	0.286 (0.041)	
Water Vapor Permeability: Perm-in. [Kg/[s • m • Pa]]	0.05 (0.725 x 10 ⁻¹³)	0.08 (1.16 x 10 ⁻¹³)	ASTM E 96, Procedure A
Flame Spread and Smoke Developed Index:	25/50 rated	25/50 rated	ASTM E 84
Water Absorption, % by Volume:	0.2%	0.2%	ASTM C 209
Mold Growth:	Passed	Passed	UL181
Fungi Resistance:			ASTM G21/C1338
Bacterial Resistance:			ASTM G22
Upper Use Limit:	220°F (105°C)	220°F (105°C)	ASTM C534
Lower Use Limit: ¹	-297°F (-183°C) ²	-297°F (-183°C) ²	ASTM C534
Ozone Resistance:	GOOD	GOOD	Ozone Chamber Test

Tamaños:

Wall Thickness (nominal) Form	3/8", 1/2", 3/4", 1", 1-1/2", 2" (10 mm, 13 mm, 19 mm, 25 mm, 38 mm, 50 mm)
Inside Diameter, Tubular Form	3/8" ID to 6" (10 mm to 153 mm)
Length of Sections, Tubular Form	6' (1.8m)

Outdoor Use

Painting with WB Finish or other protective jacketing is required for exterior applications.

¹ At temperatures below -20°F (-29°C), elastomeric insulation starts to become less flexible. However, this characteristic does not affect thermal efficiency and resistance to water vapor permeability of Armaflex insulation.

² For applications of -40°F to -297°F (-40°C to -183°C), contact Armacell.

ARMACELL LLC
TEL: 800.866.5638
FAX: 919.304.3847

info.us@armacell.com
www.armacell.us
7600 Oakwood Street Extension, Mebane, NC 27302



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Cavotec INET US Inc.



5665 Corporate Avenue,
Cypress, CA 90630
USA

Tel.: +1 714 947 0005
Fax: +1 714 947 0090
E-mail: inet@cavotec.com
Website: www.cavotec.com

N0004-SB069346-000

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Fiber Free

AP/Armaflex® SA AP/Armaflex® FS SA Self-Adhering Sheet & Roll Insulation

The original, fiber-free, flexible elastomeric pipe, valve and duct insulation – with a labor-saving self-adhering system – for reliable protection against condensation, mold and energy loss. AP Armaflex FS SA is PVC free.



- Self-adhering system makes application easy and reduces installation time
- Fiber-free, formaldehyde-free, low VOC and non-particulating formulation protects indoor air quality
- Closed-cell structure provides excellent condensation control
- Built-in vapor barrier eliminates need for additional vapor retarder
- Microban® antimicrobial product protection inhibits the growth of mold and mildew in the insulation
- 25/50 rated for use in air plenums:
Up to 1" thickness in AP Armaflex
1-1/2" and 2" thickness in AP Armaflex FS
- Thickness up to 2" with R-value up to R-8

 armacell®



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N0004-SB069316-000

GREENGUARD Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product manufacturing. Microban antimicrobial product protection is limited to the product itself and is not designed to protect the users of this product from illness based on the use of the product. Microban antimicrobial product protection is not a substitute for proper cleaning and hygiene practices.*

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Technical Data: AP Armaflex® SA and AP Armaflex® FS SA Self-Adhering Sheet and Roll Insulation

Description:

Black flexible closed-cell elastomeric thermal insulation in sheet and roll form with a self-adhering backing.

Specifications Compliance:

ASTM C 534, Type II — Sheet Grade 1 ASTM C 1534 ASTM D 1056, 2B1	ASTM E 84, NFPA 255, UL723 ASTM G21/C1338 ASTM G22 CAN/ULC S102 ¹	MEA 107-89M MIL-P-15280J, FORM S ² MIL-C-3133C (MIL STD 670B) Grade SBE 3 ²	NFPA 90A, 90B UL 181 City of LA – RR 7642
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Approvals, Certifications, Compliances:

- GREENGUARD Gold Certified.
- Manufactured without CFCs, HFCs, HCFCs, PBDEs, or Formaldehyde.
- Made with EPA registered Microban® antimicrobial product protection.
- All Armacell facilities in North America are ISO 9001:2008 certified.

Typical Properties

Specifications:	Values	AP Armaflex FS SA 1-1/2" & 2"	AP Armaflex SA 1-1/2" & 2"	Test Method:
N081-SAS34043	AP Armaflex SA through 1"			
Thermal Conductivity: Btu • in./h • ft ² • °F (W/mK)				
75°F Mean Temperature (24°C)	0.25 (0.036)	0.28 (0.040)	0.25 (0.036)	ASTM C 177 or C 518
90°F Mean Temperature (32°C)	0.256 (0.037)	0.286 (0.041)	0.256 (0.037)	
Water Vapor Permeability: Perm-in. [Kg/(s • m • Pa)]	0.05 (0.725 x 10 ⁻¹³)	0.08 (1.16 x 10 ⁻¹³)	0.05 (0.725 x 10 ⁻¹³)	ASTM E 96, Procedure A
Flame Spread and Smoke Developed Index:	25/50 rated	25/50 rated	Does not pass	ASTM E 84 CAN/ULC S102 ¹
Water Absorption, % by Volume:	0.2%	0.2%	0.2%	ASTM C 209
Mold Growth: Fungi Resistance: Bacterial Resistance:	Passed	Passed	Passed	UL181 ASTM G21/C1338 ASTM G22
Upper Use Limit:	180°F (82°C)	180°F (82°C)	180°F (82°C)	
Lower Use Limit: ³	-297°F (-183°C) ⁴	-297°F (-183°C) ⁴	-297°F (-183°C) ⁴	
Ozone Resistance:	GOOD	GOOD	GOOD	

R-Value:	R-1.6	R-2.1	R-3.1	R-4.2	R-6	R-8
Thickness:	3/8"	1/2"	3/4"	1"	1-1/2"	2"

Sizes:	
Sheet: Width x Length Thickness (nominal)	36" x 48" (.915m x 1.22m) 1/4", 3/8", 1/2", 3/4", 1", 1-1/2" & 2" (6, 10, 13, 19, 25, 38 & 50mm)
Roll: Width Thickness (nominal) x Length	48" wide (1.22m) 3/8" x 100' (10mm x 30.5m) 1" x 35' (25mm x 10.7m) 1/2" x 70' (13mm x 21.4m) 1-1/2" x 25' (38mm x 7.6m) 3/4" x 50' (19mm x 15.2m) 2" x 18' (50mm x 5.4m)

¹ AP Armaflex meets CAN/ULC S102 through 1" thickness.

² AP Armaflex meets MIL-P-15280J, FORM S and MIL-C-3133C (MIL STD 670B) Grade SBE through 1" thickness. Only AP Armaflex is FM Certified.

³ At temperatures below -20°F (-29°C), elastomeric insulation starts to become less flexible. However, this characteristic does not affect thermal efficiency and resistance to water vapor permeability of Armaflex insulation.

⁴ For applications of -40°F to -297°F (-40°C to -183°C), contact Armacell.

ARMACELL LLC

TEL: 800.866.5638

FAX: 919.304.3847

info.us@armacell.com

www.armacell.us

7600 Oakwood Street Extension, Mebane, NC 27302



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AP Armaflex SA & AP Armaflex FS SA	Sheet Roll	Submittal	013	Eng/USA	2/2015
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PDX Materials, Gauges and Finishes	
Item	Gauge and/or Finish and Material
Metal Finishing	Primer: Epoxy, Zinc-Rich Powder Coat Top Coat: Polyester TGIC Powder Coat
Sheet Steel	18 ga. Galvanized Condenser Fan Housing: 10 ga. Cold Rolled
Aluminum Sheet	Plenum Housing: 10 ga. 5052-H32 Alloy Plenum Skin: 20 ga. 5052-H32 Alloy
Aluminum Structural Forms	.125 in. Stock, 6061-T4 or T6 Alloy
Exterior Hardware	Stainless Steel

ATV212HD22N4

variable speed drive ATV212 - 22kW - 30hp - 480V - 3ph - EMC - IP21



Main

Range of product	Altivar 212
Product or component type	Variable speed drive
Device short name	ATV212
Product destination	Asynchronous motors
Product specific application	Pumps and fans in HVAC
Assembly style	With heat sink
Network number of phases	3 phases
Motor power kW	22 kW
Motor power hp	30 hp
Power supply voltage	380...480 V (- 15...10 %)
Power supply voltage limits	323...528 V
Supply frequency	50...60 Hz (- 5...5 %)
Network frequency	47.5...63 Hz
EMC filter	Class C2 EMC filter integrated
Line current	41.6 A for 380 V 33.1 A for 480 V

Complementary

Apparent power	33.2 kVA for 380 V
Prospective line I _{sc}	22 kA
Continuous output current	43.5 A at 380/460 V
Maximum transient current	47.9 A for 60 s
Speed drive output frequency	0.5...200 Hz
Nominal switching frequency	8 kHz
Switching frequency	8...16 kHz with derating factor 6...16 kHz adjustable
Speed range	1...10
Speed accuracy	+/- 10 % of nominal slip for 0.2 T _n to T _n torque variation
Torque accuracy	+/- 15 %
Transient overtorque	120 % of nominal motor torque, +/- 10 % for 60 s
Asynchronous motor control profile	Voltage/Frequency ratio, 2 points Voltage/Frequency ratio, 5 points Flux vector control without sensor, standard Voltage/Frequency ratio - Energy Saving, quadratic U/f Voltage/Frequency ratio, automatic IR compensation (U/f + automatic U ₀)
Regulation loop	Adjustable PI regulator
Motor slip compensation	Adjustable Automatic whatever the load Not available in voltage/frequency ratio motor control
Local signalling	1 LED - red - DC bus energized
Output voltage	<= power supply voltage
Isolation	Electrical between power and control
Type of cable for external connection	UL 508 cable with UL Type 1 kit: 3 wire(s) - 40 °C, copper 75 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 70 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 90 °C / XLPE/EPR
Electrical connection	Terminal 50 mm ² / AWG 1/0 (L1/R, L2/S, L3/T) Terminal 2.5 mm ² / AWG 14 (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

Tightening torque	24 N.m - 212 lb.in (L1/R, L2/S, L3/T) 0.6 N.m (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)
Supply	Internal supply: 24 V (21...27 V) DC - <= 200 A with overload and short-circuit protection Internal supply for reference potentiometer (1 to 10 kOhm): 10.5 V DC, +/- 5 % - <= 10 A with overload and short-circuit protection
Analogue input number	2
Analogue input type	Configurable voltage: (VIB) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Switch-configurable current: (VIA) 0...20 mA - 250 Ohm - resolution: 10 bits Switch-configurable voltage: (VIA) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Configurable PTC probe: (VIB) 0...6 probes - 1500 Ohm
Sampling duration	22 ms +/- 0.5 ms (VIB) - analog input(s) 3.5 ms +/- 0.5 ms (VIA) - analog input(s) 2 ms +/- 0.5 ms (RES) - discrete input(s) 2 ms +/- 0.5 ms (R) - discrete input(s) 2 ms +/- 0.5 ms (F) - discrete input(s)
Response time	7 ms +/- 0.5 ms (RY, RC) - discrete output(s) 7 ms +/- 0.5 ms (FLB, FLC) - discrete output(s) 7 ms +/- 0.5 ms (FLA, FLC) - discrete output(s) 2 ms +/- 0.5 ms (FM) - analog output(s)
Accuracy	+/- 1 % (FM) for a temperature variation 60 °C +/- 0.6 % (VIB) for a temperature variation 60 °C +/- 0.6 % (VIA) for a temperature variation 60 °C
Linearity error	+/- 0.2 % for output (FM) +/- 0.15 % of maximum value for input (VIB) +/- 0.15 % of maximum value for input (VIA)
Analogue output number	1
Analogue output type	Switch-configurable current: (FM) 0...20 mA - 970 Ohm - resolution: 10 bits Switch-configurable voltage: (FM) 0...10 V DC - 7620 Ohm - resolution: 10 bits
Discrete output number	2
Discrete output type	Configurable relay logic: (RY, RC) NO - 100000 cycles Configurable relay logic: (FLB, FLC) NC - 100000 cycles Configurable relay logic: (FLA, FLC) NO - 100000 cycles
Minimum switching current	3 mA at 24 V DC (configurable relay logic)
Maximum switching current	2 A at 30 V DC on inductive load - cos phi = 0.4 - L/R = 7 ms (FL, R) 2 A at 250 V AC on inductive load - cos phi = 0.4 - L/R = 7 ms (FL, R) 5 A at 30 V DC on resistive load - cos phi = 1 - L/R = 0 ms (FL, R) 5 A at 250 V AC on resistive load - cos phi = 1 - L/R = 0 ms (FL, R)
Discrete input type	Programmable (RES) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (R) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (F) 24 V DC, with level 1 PLC - 4700 Ohm
Discrete input logic	Negative logic (sink) (F, R, RES), >= 16 V (state 0), <= 10 V (state 1) Positive logic (source) (F, R, RES), <= 5 V (state 0), >= 11 V (state 1)
Acceleration and deceleration ramps	Automatic based on the load Linear adjustable separately from 0.01 to 3200 s
Braking to standstill	By DC injection
Protection type	With PTC probes for motor Motor phase break for motor Thermal protection for motor Against input phase loss for drive Line supply undervoltage for drive Line supply overvoltage and undervoltage for drive Against exceeding limit speed for drive Break on the control circuit for drive Overvoltages on the DC bus for drive Overcurrent between output phases and earth for drive Input phase breaks for drive Short-circuit between motor phases for drive Thermal power stage for drive Overheating protection for drive
Dielectric strength	5092 V DC between control and power terminals 3535 V DC between earth and power terminals
Insulation resistance	>= 1 MOhm at 500 V DC for 1 minute
Frequency resolution	0.024/50 Hz for analog input 0.1 Hz for display unit

Communication port protocol	APOGEE FLN BACnet LonWorks METASYS N2 Modbus
Connector type	1 RJ45 1 open style
Physical interface	2-wire RS 485
Transmission frame	RTU
Transmission rate	9600 bps or 19200 bps
Data format	8 bits, 1 stop, odd even or no configurable parity
Type of polarization	No impedance
Number of addresses	1...247
Communication service	Monitoring inhibitable Read device identification (43) Read holding registers (03) 2 words maximum Time out setting from 0.1 to 100 s Write multiple registers (16) 2 words maximum Write single register (06)
Option card	Communication card for LonWorks
Operating position	Vertical +/- 10 degree
Width	240 mm
Height	420 mm
Depth	214 mm
Product weight	26.4 kg
Power dissipation in W	626 W
Fan flow rate	214 m3/h

Environment

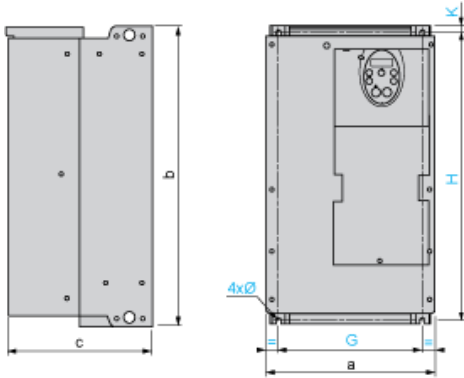
Electromagnetic compatibility	Voltage dips and interruptions immunity test conforming to IEC 61000-4-11 Conducted radio-frequency immunity test level 3 conforming to IEC 61000-4-6 1.2/50 μ s - 8/20 μ s surge immunity test level 3 IEC 61000-4-5 Electrical fast transient/burst immunity test level 4 conforming to IEC 61000-4-4 Radiated radio-frequency electromagnetic field immunity test level 3 conforming to IEC 61000-4-3 Electrostatic discharge immunity test level 3 conforming to IEC 61000-4-2
Pollution degree	3 IEC 61800-5-1
IP degree of protection	IP20 on upper part without blanking plate on cover conforming to EN/IEC 60529 IP20 on upper part without blanking plate on cover conforming to EN/IEC 61800-5-1 IP41 on upper part conforming to EN/IEC 60529 IP41 on upper part conforming to EN/IEC 61800-5-1 IP21 conforming to EN/IEC 60529 IP21 conforming to EN/IEC 61800-5-1
Vibration resistance	1 gn (f = 13...200 Hz) conforming to EN/IEC 60068-2-8 1.5 mm (f = 3...13 Hz) conforming to EN/IEC 60068-2-6
Shock resistance	15 gn for 11 ms conforming to IEC 60068-2-27
Environmental characteristic	Classes 3S2 conforming to IEC 60721-3-3 Classes 3C1 conforming to IEC 60721-3-3
Noise level	59.9 dB conforming to 86/188/EEC
Operating altitude	1000...3000 m (limited to 2000 m for the Corner Grounded distribution network) with current derating 1 % per 100 m <= 1000 m without derating
Relative humidity	5...95 % without dripping water conforming to IEC 60068-2-3 5...95 % without condensation conforming to IEC 60068-2-3
Ambient air temperature for operation	> 40...50 °C with derating factor -10...40 °C without derating
Ambient air temperature for storage	-25...70 °C

Standards	EN 55011 class A group 1 EN 61800-3 EN 61800-3 category C2 EN 61800-3 category C3 EN 61800-3 environments 1 category C1 EN 61800-3 environments 1 category C2 EN 61800-3 environments 1 category C3 EN 61800-3 environments 2 category C1 EN 61800-3 environments 2 category C2 EN 61800-3 environments 2 category C3 EN 61800-5-1 IEC 61800-3 IEC 61800-3 category C2 IEC 61800-3 category C3 IEC 61800-3 environments 1 category C1 IEC 61800-3 environments 1 category C2 IEC 61800-3 environments 1 category C3 IEC 61800-3 environments 2 category C1 IEC 61800-3 environments 2 category C2 IEC 61800-3 environments 2 category C3 IEC 61800-5-1 UL Type 1
Product certifications	CSA C-Tick NOM 117 UL
Marking	CE

Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 1050 - Schneider Electric declaration of conformity download declaration of conformity
Product end of life instruction	Available Download End Of Life Manual

Dimensions



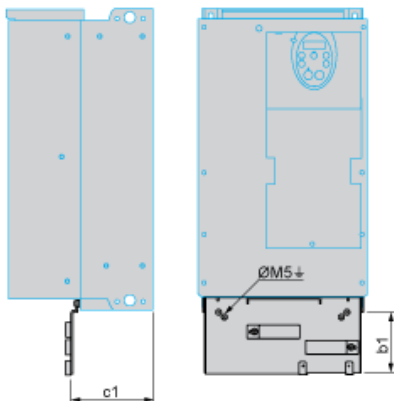
Dimensions in mm

ATV212H	a	b	c	G	H	K	Ø
D22M3X D22N4, D30N4	240	420	214	206	403	10	6
D37N4, D45N4	240	550	244	206	529	10	6

Dimensions in in.

ATV212H	a	b	c	G	H	K	Ø
D22M3X D22N4, D30N4	9.45	16.54	8.43	8.11	15.87	0.39	0.24
D37N4, D45N4	9.45	21.65	9.60	8.11	20.83	0.39	0.24

EMC mounting plate (supplied with drive)



Dimensions in mm

ATV212H	b1	c1
D22M3X D22N4, D30N4	122	120
D37N4, D45N4	113	127

Dimensions in in.

ATV212H	b1	c1
D22M3X D22N4, D30N4	4.80	4.72
D37N4, D45N4	4.45	5.00

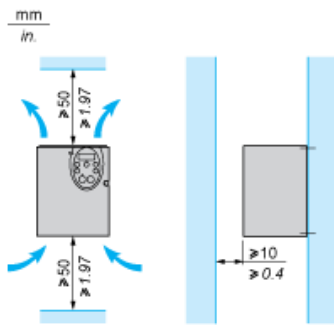
Mounting Recommendations

Clearance

Depending on the conditions in which the drive is to be used, its installation will require certain precautions and the use of appropriate accessories.

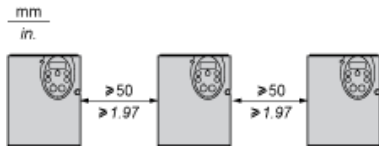
Install the unit vertically:

- Do not place it close to heating elements.
- Leave sufficient free space to ensure that the air required for cooling purposes can circulate from bottom to the top of the unit.



Mounting Types

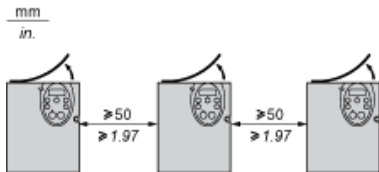
Type A mounting



Type B mounting



Type C mounting



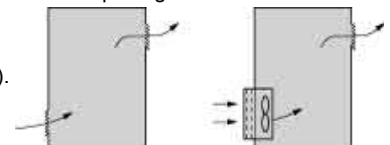
By removing the protective blanking cover from the top of the drive, the degree of protection for the drive becomes IP21. The protective blanking cover may vary according to the drive model, see opposite.

Specific Recommendations for Mounting in an Enclosure

To help ensure proper air circulation in the drive:

- Fit ventilation grilles.
- Check that there is sufficient ventilation. If there is not, install a forced ventilation unit with a filter. The openings and/or fans must

provide a flow rate at least equal to that of the drive fans (refer to the product characteristics).



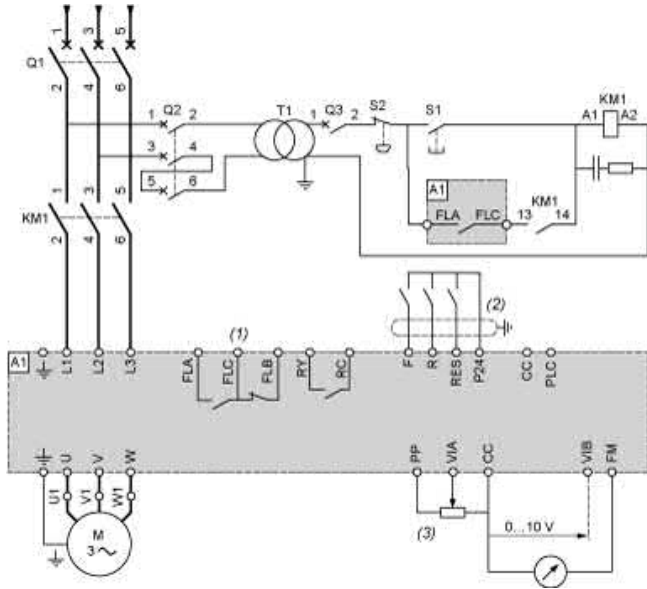
- Use special filters with UL Type 12/IP54 protection.
- Remove the blanking cover from the top of the drive.

Sealed Metal Enclosure (IP54 Degree of Protection)

The drive must be mounted in a dust and damp proof enclosure in certain environmental conditions, such as dust, corrosive gases, high humidity with risk of condensation and dripping water, splashing liquid, etc. This enables the drive to be used in an enclosure where the maximum internal temperature reaches 50°C.

Recommended Wiring Diagram

3-Phase Power Supply



- A1: ATV 212 drive
- KM1: Contactor
- Q1: Circuit breaker
- Q2: GV2 L rated at twice the nominal primary current of T1
- Q3: GB2CB05
- S1, XB4 B or XB5 A pushbuttons
- S2:
- T1: 100 VA transformer 220 V secondary
- (1) Fault relay contacts for remote signalling of the drive status
- (2) Connection of the common for the logic inputs depends on the positioning of the switch (Source, PLC, Sink)
- (3) Reference potentiometer SZ1RV1202

All terminals are located at the bottom of the drive. Install interference suppressors on all inductive circuits near the drive or connected on the same circuit, such as relays, contactors, solenoid valves, fluorescent lighting, etc.

Switches (Factory Settings)

Voltage/current selection for analog I/O (VIA and VIB)



Voltage/current selection for analog I/O (FM)



Selection of logic type

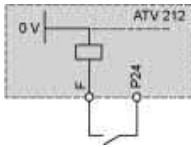


- (1) negative logic
- (2) positive logic

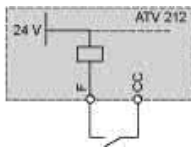
Other Possible Wiring Diagrams

Logic Inputs According to the Position of the Logic Type Switch

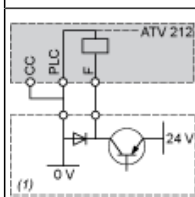
“Source” position



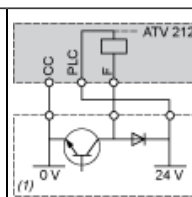
“Sink” position



“PLC” position with PLC transistor outputs

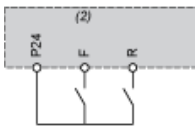


(1) PLC



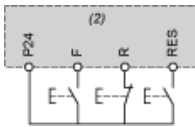
(1) PLC

2-wire control



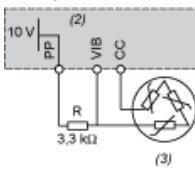
F: Forward
R: Preset speed
(2) ATV 212 control terminals

3-wire control



F: Forward
R: Stop
RES: Reverse
(2) ATV 212 control terminals

PTC probe

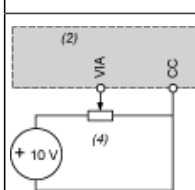


(2) ATV 212 control terminals
(3) Motor

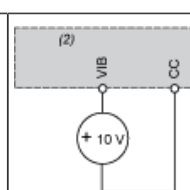
Analogue Inputs

Voltage analog inputs

External +10 V

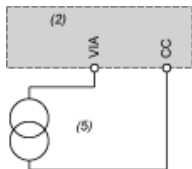


(2) ATV 212 control terminals
(4) Speed reference potentiometer 2.2 to 10 kΩ



(2) ATV 212 control terminals

Analog input configured for current: 0-20 mA, 4-20 mA, X-Y mA



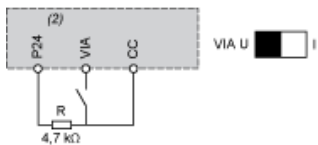
- (2) ATV 212 control terminals
- (5) Source 0-20 mA, 4-20 mA, X-Y mA

Analog input VIA configured as positive logic input ("Source" position)



- (2) ATV 212 control terminals

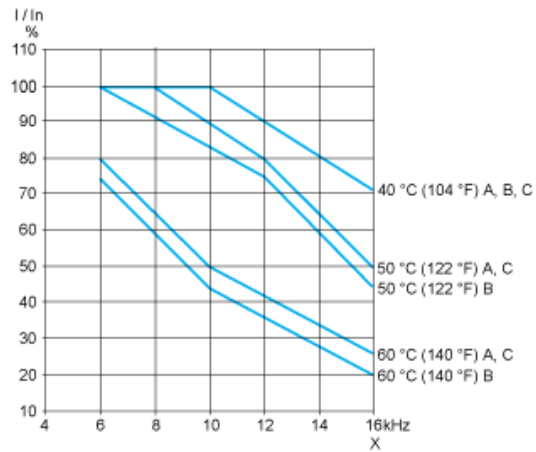
Analog input VIA configured as negative logic input ("Sink" position)



- (2) ATV 212 control terminals

Derating Curves

The derating curves for the drive nominal current (In) depend on the temperature, the switching frequency and the mounting type (A, B or C). For intermediate temperatures (45°C for example), interpolate between 2 curves.



X Switching frequency

ATV212HD75N4

variable speed drive ATV212 - 75kW - 100hp - 480V - 3ph - EMC - IP21



Main

Range of product	Altivar 212
Product or component type	Variable speed drive
Device short name	ATV212
Product destination	Asynchronous motors
Product specific application	Pumps and fans in HVAC
Assembly style	With heat sink
Network number of phases	3 phases
Motor power kW	75 kW
Motor power hp	100 hp
Power supply voltage	380...480 V (- 15...10 %)
Power supply voltage limits	323...528 V
Supply frequency	50...60 Hz (- 5...5 %)
Network frequency	47.5...63 Hz
EMC filter	Class C2 EMC filter integrated
Line current	111.3 A for 480 V 141.8 A for 380 V

Complementary

Apparent power	105.3 kVA for 380 V
Prospective line I _{sc}	22 kA
Continuous output current	160 A at 380/460 V
Maximum transient current	176 A for 60 s
Speed drive output frequency	0.5...200 Hz
Nominal switching frequency	8 kHz
Switching frequency	8...16 kHz with derating factor 6...16 kHz adjustable
Speed range	1...10
Speed accuracy	+/- 10 % of nominal slip for 0.2 T _n to T _n torque variation
Torque accuracy	+/- 15 %
Transient overtorque	120 % of nominal motor torque, +/- 10 % for 60 s
Asynchronous motor control profile	Voltage/Frequency ratio, 2 points Voltage/Frequency ratio, 5 points Flux vector control without sensor, standard Voltage/Frequency ratio - Energy Saving, quadratic U/f Voltage/Frequency ratio, automatic IR compensation (U/f + automatic U ₀)
Regulation loop	Adjustable PI regulator
Motor slip compensation	Adjustable Automatic whatever the load Not available in voltage/frequency ratio motor control
Local signalling	1 LED - red - DC bus energized
Output voltage	<= power supply voltage
Isolation	Electrical between power and control
Type of cable for external connection	UL 508 cable with UL Type 1 kit: 3 wire(s) - 40 °C, copper 75 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 70 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 90 °C / XLPE/EPR
Electrical connection	Terminal 150 mm ² kcmil size: 300 (L1/R, L2/S, L3/T) Terminal 2.5 mm ² / AWG 14 (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

Tightening torque	41 N.m - 360 lb.in (L1/R, L2/S, L3/T) 0.6 N.m (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)
Supply	Internal supply: 24 V (21...27 V) DC - <= 200 A with overload and short-circuit protection Internal supply for reference potentiometer (1 to 10 kOhm): 10.5 V DC, +/- 5 % - <= 10 A with overload and short-circuit protection
Analogue input number	2
Analogue input type	Configurable voltage: (VIB) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Switch-configurable current: (VIA) 0...20 mA - 250 Ohm - resolution: 10 bits Switch-configurable voltage: (VIA) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Configurable PTC probe: (VIB) 0...6 probes - 1500 Ohm
Sampling duration	22 ms +/- 0.5 ms (VIB) - analog input(s) 3.5 ms +/- 0.5 ms (VIA) - analog input(s) 2 ms +/- 0.5 ms (RES) - discrete input(s) 2 ms +/- 0.5 ms (R) - discrete input(s) 2 ms +/- 0.5 ms (F) - discrete input(s)
Response time	7 ms +/- 0.5 ms (RY, RC) - discrete output(s) 7 ms +/- 0.5 ms (FLB, FLC) - discrete output(s) 7 ms +/- 0.5 ms (FLA, FLC) - discrete output(s) 2 ms +/- 0.5 ms (FM) - analog output(s)
Accuracy	+/- 1 % (FM) for a temperature variation 60 °C +/- 0.6 % (VIB) for a temperature variation 60 °C +/- 0.6 % (VIA) for a temperature variation 60 °C
Linearity error	+/- 0.2 % for output (FM) +/- 0.15 % of maximum value for input (VIB) +/- 0.15 % of maximum value for input (VIA)
Analogue output number	1
Analogue output type	Switch-configurable current: (FM) 0...20 mA - 970 Ohm - resolution: 10 bits Switch-configurable voltage: (FM) 0...10 V DC - 7620 Ohm - resolution: 10 bits
Discrete output number	2
Discrete output type	Configurable relay logic: (RY, RC) NO - 100000 cycles Configurable relay logic: (FLB, FLC) NC - 100000 cycles Configurable relay logic: (FLA, FLC) NO - 100000 cycles
Minimum switching current	3 mA at 24 V DC (configurable relay logic)
Maximum switching current	2 A at 30 V DC on inductive load - cos phi = 0.4 - L/R = 7 ms (FL, R) 2 A at 250 V AC on inductive load - cos phi = 0.4 - L/R = 7 ms (FL, R) 5 A at 30 V DC on resistive load - cos phi = 1 - L/R = 0 ms (FL, R) 5 A at 250 V AC on resistive load - cos phi = 1 - L/R = 0 ms (FL, R)
Discrete input type	Programmable (RES) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (R) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (F) 24 V DC, with level 1 PLC - 4700 Ohm
Discrete input logic	Negative logic (sink) (F, R, RES), >= 16 V (state 0), <= 10 V (state 1) Positive logic (source) (F, R, RES), <= 5 V (state 0), >= 11 V (state 1)
Acceleration and deceleration ramps	Automatic based on the load Linear adjustable separately from 0.01 to 3200 s
Braking to standstill	By DC injection
Protection type	With PTC probes for motor Motor phase break for motor Thermal protection for motor Against input phase loss for drive Line supply undervoltage for drive Line supply overvoltage and undervoltage for drive Against exceeding limit speed for drive Break on the control circuit for drive Overvoltages on the DC bus for drive Overcurrent between output phases and earth for drive Input phase breaks for drive Short-circuit between motor phases for drive Thermal power stage for drive Overheating protection for drive
Dielectric strength	5092 V DC between control and power terminals 3535 V DC between earth and power terminals
Insulation resistance	>= 1 MOhm at 500 V DC for 1 minute
Frequency resolution	0.024/50 Hz for analog input 0.1 Hz for display unit

Communication port protocol	APOGEE FLN BACnet LonWorks METASYS N2 Modbus
Connector type	1 RJ45 1 open style
Physical interface	2-wire RS 485
Transmission frame	RTU
Transmission rate	9600 bps or 19200 bps
Data format	8 bits, 1 stop, odd even or no configurable parity
Type of polarization	No impedance
Number of addresses	1...247
Communication service	Monitoring inhibitable Read device identification (43) Read holding registers (03) 2 words maximum Time out setting from 0.1 to 100 s Write multiple registers (16) 2 words maximum Write single register (06)
Option card	Communication card for LonWorks
Operating position	Vertical +/- 10 degree
Width	320 mm
Height	630 mm
Depth	290 mm
Power dissipation in W	1945 W
Fan flow rate	666 m3/h

Environment

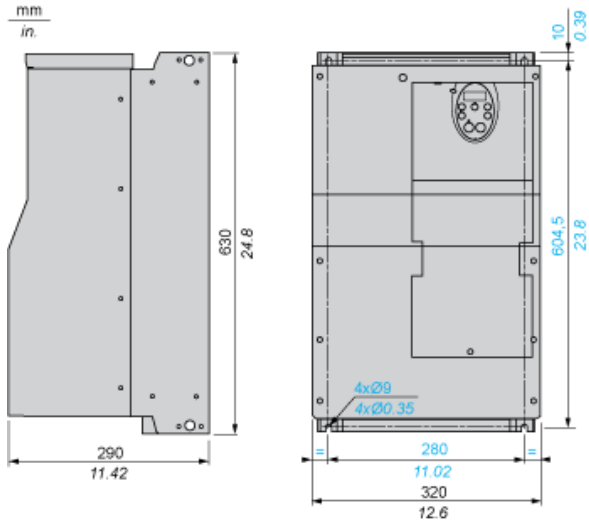
Electromagnetic compatibility	Voltage dips and interruptions immunity test conforming to IEC 61000-4-11 Conducted radio-frequency immunity test level 3 conforming to IEC 61000-4-6 1.2/50 µs - 8/20 µs surge immunity test level 3 IEC 61000-4-5 Electrical fast transient/burst immunity test level 4 conforming to IEC 61000-4-4 Radiated radio-frequency electromagnetic field immunity test level 3 conforming to IEC 61000-4-3 Electrostatic discharge immunity test level 3 conforming to IEC 61000-4-2
Pollution degree	3 IEC 61800-5-1
IP degree of protection	IP20 on upper part without blanking plate on cover conforming to EN/IEC 60529 IP20 on upper part without blanking plate on cover conforming to EN/IEC 61800-5-1 IP41 on upper part conforming to EN/IEC 60529 IP41 on upper part conforming to EN/IEC 61800-5-1 IP21 conforming to EN/IEC 60529 IP21 conforming to EN/IEC 61800-5-1
Vibration resistance	1 gn (f = 13...200 Hz) conforming to EN/IEC 60068-2-8 1.5 mm (f = 3...13 Hz) conforming to EN/IEC 60068-2-6
Shock resistance	15 gn for 11 ms conforming to IEC 60068-2-27
Environmental characteristic	Classes 3S2 conforming to IEC 60721-3-3 Classes 3C1 conforming to IEC 60721-3-3
Noise level	63.7 dB conforming to 86/188/EEC
Operating altitude	1000...3000 m (limited to 2000 m for the Corner Grounded distribution network) with current derating 1 % per 100 m <= 1000 m without derating
Relative humidity	5...95 % without dripping water conforming to IEC 60068-2-3 5...95 % without condensation conforming to IEC 60068-2-3
Ambient air temperature for operation	> 40...50 °C with derating factor -10...40 °C without derating
Ambient air temperature for storage	-25...70 °C

Standards	EN 55011 class A group 1 EN 61800-3 EN 61800-3 category C2 EN 61800-3 category C3 EN 61800-3 environments 1 category C1 EN 61800-3 environments 1 category C2 EN 61800-3 environments 1 category C3 EN 61800-3 environments 2 category C1 EN 61800-3 environments 2 category C2 EN 61800-3 environments 2 category C3 EN 61800-5-1 IEC 61800-3 IEC 61800-3 category C2 IEC 61800-3 category C3 IEC 61800-3 environments 1 category C1 IEC 61800-3 environments 1 category C2 IEC 61800-3 environments 1 category C3 IEC 61800-3 environments 2 category C1 IEC 61800-3 environments 2 category C2 IEC 61800-3 environments 2 category C3 IEC 61800-5-1 UL Type 1
Product certifications	CSA C-Tick NOM 117 UL
Marking	CE

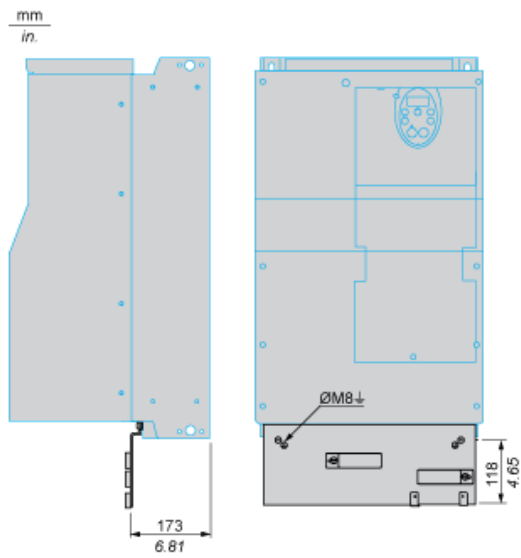
Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 1050 - Schneider Electric declaration of conformity download declaration of conformity
Product end of life instruction	Available Download End Of Life Manual

Dimensions



EMC mounting plate (supplied with drive)



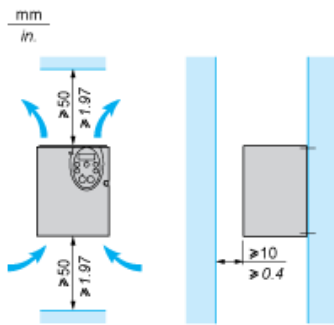
Mounting Recommendations

Clearance

Depending on the conditions in which the drive is to be used, its installation will require certain precautions and the use of appropriate accessories.

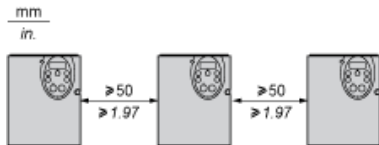
Install the unit vertically:

- Do not place it close to heating elements.
- Leave sufficient free space to ensure that the air required for cooling purposes can circulate from bottom to the top of the unit.

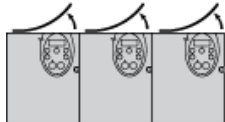


Mounting Types

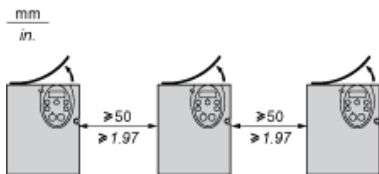
Type A mounting



Type B mounting



Type C mounting



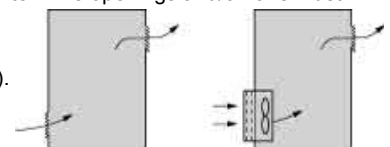
By removing the protective blanking cover from the top of the drive, the degree of protection for the drive becomes IP21. The protective blanking cover may vary according to the drive model, see opposite.

Specific Recommendations for Mounting in an Enclosure

To help ensure proper air circulation in the drive:

- Fit ventilation grilles.
- Check that there is sufficient ventilation. If there is not, install a forced ventilation unit with a filter. The openings and/or fans must

provide a flow rate at least equal to that of the drive fans (refer to the product characteristics).



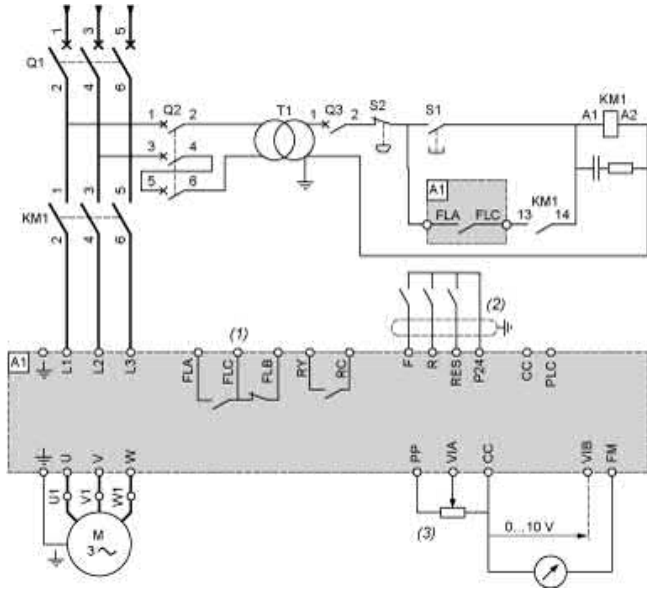
- Use special filters with UL Type 12/IP54 protection.
- Remove the blanking cover from the top of the drive.

Sealed Metal Enclosure (IP54 Degree of Protection)

The drive must be mounted in a dust and damp proof enclosure in certain environmental conditions, such as dust, corrosive gases, high humidity with risk of condensation and dripping water, splashing liquid, etc. This enables the drive to be used in an enclosure where the maximum internal temperature reaches 50°C.

Recommended Wiring Diagram

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- A1: ATV 212 drive
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- Q1: Circuit breaker
- Q2: GV2 L rated at twice the nominal primary current of T1
- Q3: GB2CB05
- S1, XB4 B or XB5 A pushbuttons
- S2:
- T1: 100 VA transformer 220 V secondary
- (1) Fault relay contacts for remote signalling of the drive status
- (2) Connection of the common for the logic inputs depends on the positioning of the switch (Source, PLC, Sink)
- (3) Reference potentiometer SZ1RV1202

All terminals are located at the bottom of the drive. Install interference suppressors on all inductive circuits near the drive or connected on the same circuit, such as relays, contactors, solenoid valves, fluorescent lighting, etc.

Switches (Factory Settings)

Voltage/current selection for analog I/O (VIA and VIB)



Voltage/current selection for analog I/O (FM)



Selection of logic type

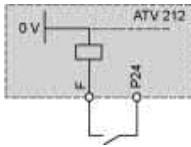


- (1) negative logic
- (2) positive logic

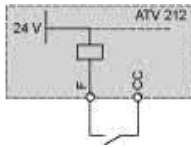
Other Possible Wiring Diagrams

Logic Inputs According to the Position of the Logic Type Switch

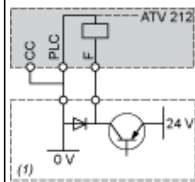
"Source" position



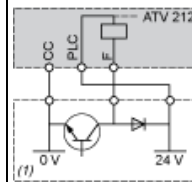
"Sink" position



"PLC" position with PLC transistor outputs

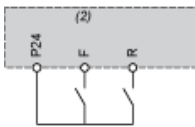


(1) PLC



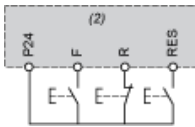
(1) PLC

2-wire control



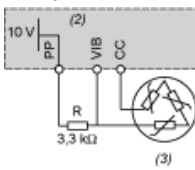
F: Forward
R: Preset speed
(2) ATV 212 control terminals

3-wire control



F: Forward
R: Stop
RES: Reverse
(2) ATV 212 control terminals

PTC probe

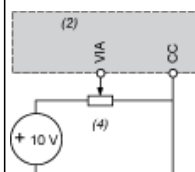


(2) ATV 212 control terminals
(3) Motor

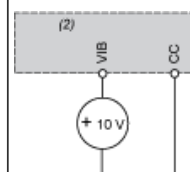
Analogue Inputs

Voltage analog inputs

External +10 V

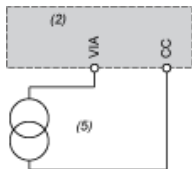


(2) ATV 212 control terminals
(4) Speed reference potentiometer 2.2 to 10 kΩ



(2) ATV 212 control terminals

Analog input configured for current: 0-20 mA, 4-20 mA, X-Y mA



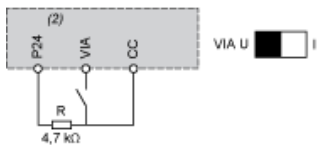
- (2) ATV 212 control terminals
- (5) Source 0-20 mA, 4-20 mA, X-Y mA

Analog input VIA configured as positive logic input ("Source" position)



- (2) ATV 212 control terminals

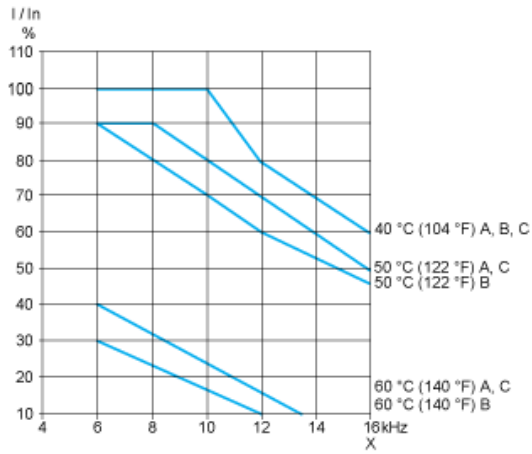
Analog input VIA configured as negative logic input ("Sink" position)



- (2) ATV 212 control terminals

Derating Curves

The derating curves for the drive nominal current (I_n) depend on the temperature, the switching frequency and the mounting type (A, B or C). For intermediate temperatures (45°C for example), interpolate between 2 curves.



X Switching frequency

Steps for setting-up the drive

INSTALLATION

1. Please, refer to the installation manual..

PROGRAMMING



Tips:

- Before beginning programming, complete the customer setting tables, page [203](#).
- Perform an auto-tuning operation to optimize performance, page [75](#).
- If you get lost, return to the factory settings, page [66](#).

2. Apply input power to the drive, but do not give a run command.

3. Configure

- the nominal frequency of the motor [Parameter reset] (*LRP*) = [50 Hz reset] (*I*) if this is not 50Hz,
- the motor parameters, page [70](#), only if the factory configuration of the drive is not suitable,
- the application functions in the Drive Control Parameters section, page [87](#) and the I/O Control Parameters section, page [99](#), only if the factory configuration of the drive is not suitable.

4. Adjust the application parameters

- [Acceleration time 1] (*ACC*), page [93](#) and [Deceleration time 1] (*dEC*), page [93](#).
- [Low limit frequency] (*LL*), page [92](#) and [Upper limit freq] (*UL*), page [92](#).
- [Motor thermal prot.] (*tHr*), page [74](#).

5. Start the drive

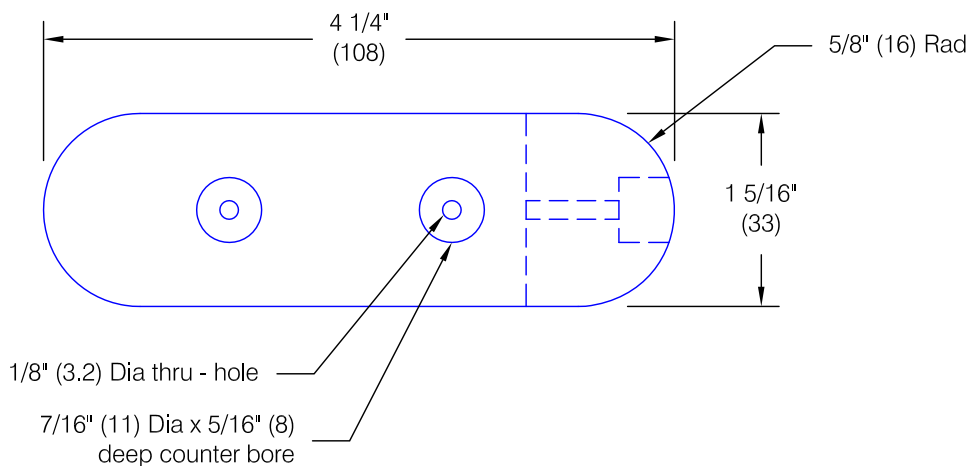
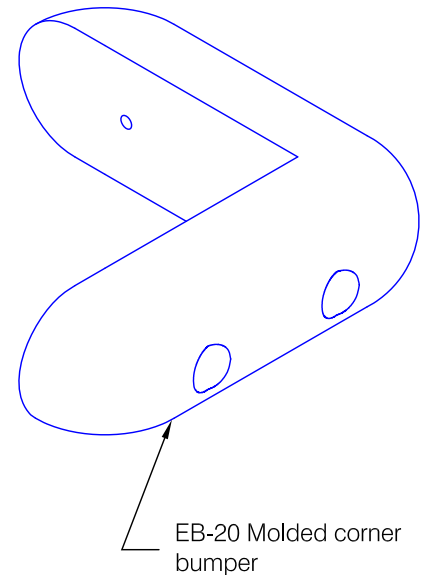
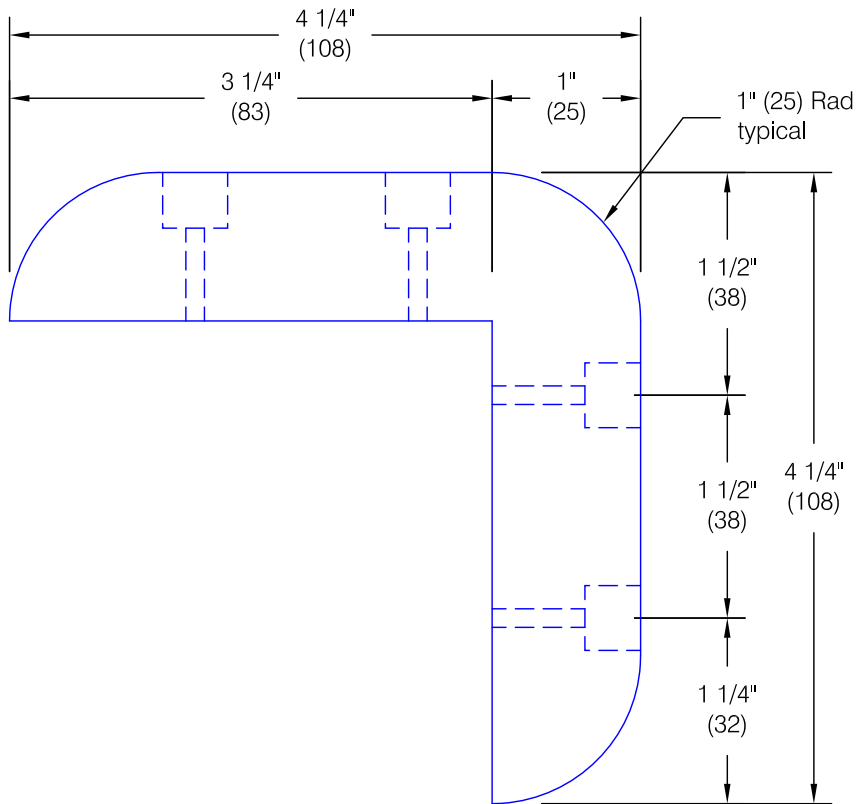
EB-20 Molded Corner Bumper

Features:

- Molded solid neoprene and natural rubber blend
- Durometer: 55 - 60

Standard Colors:

- Gray #5



Pawling Corporation reserves the right to discontinue a design or modify an existing design without prior notice

Customer :

Project : AK-1

Architect :

NO. 04 SP 069346-000
 Sales Rep :

CD.111.0b

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ULINE VINYL SAFETY TAPE



ULINE INDUSTRIAL TAPE – Unlaminated, general purpose.

SIZE	MODEL NO. / COLOR		MIL	ROLLS/ CASE	PRICE PER ROLL (MIN. 3)					
					3	6	12	24+		
1" x 36 yds.	S-7193	White	S-7189	Red	6	48	\$4.20	\$3.90	\$3.40	\$3.10
	S-7190	Yellow	S-7192	Blue						
	S-16861	Orange	S-7191	Green						
	S-16859	Purple	S-16860	Black						
	S-11641	Yellow/Black	S-16872	Red/White						
	S-16862	White/Black	S-16876	Green/White						
2" x 36 yds.	S-2230	White	S-385	Red	6	24	6.80	\$4.50 per roll		
	S-386	Yellow	S-7194	Blue						
	S-9665	Orange	S-7195	Green						
	S-13511	Purple	S-9732	Black						
	S-2183	Yellow/Black	S-16873	Red/White						
	S-13512	White/Black	S-16877	Green/White						
3" x 36 yds.	S-3359	White	S-3358	Red	6	16	12.10	11.50	9.60	8.30
	S-659	Yellow	S-11643	Blue						
	S-11644	Orange	S-9733	Green						
	S-13513	Purple	S-11642	Black						
	S-2184	Yellow/Black	S-16874	Red/White						
	S-13514	White/Black	S-16878	Green/White						
4" x 36 yds.	S-16863	White	S-7204	Red	6	12	16.60	15.50	13.20	10.40
	S-3054	Yellow	S-11646	Blue						
	S-16866	Orange	S-16865	Green						
	S-16867	Purple	S-16864	Black						
	S-11645	Yellow/Black	S-16875	Red/White						
	S-16868	White/Black	S-16879	Green/White						

OSHA SAFETY COLOR CODES

CAUTION – Yellow/Black, Yellow
Physical hazards, poles, stairs and corners.

DANGER – Red/White, Red
Fire Protection equipment and obstructions.

BOUNDARIES – White/Black, Orange, White, Blue, Purple, Black
Housekeeping and traffic markings.

SAFETY – White/Green, Green
Safety and First Aid equipment.

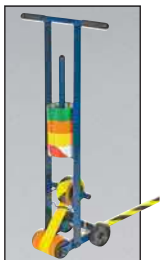
Additional colors, see uline.com



TAPE APPLICATOR

**SPECIAL OFFER:
SAVE \$78**

Order 24+ rolls of Uline Safety Tape and pay only \$55 for H-418 applicator.



MODEL NO.	HOLDS WIDTHS	PRICE EACH	
		1	2+
H-418	1-4"	\$133	\$123

ULINE HEAVY DUTY TAPE – Overlaminated, stays cleaner longer.

SIZE	MODEL NO. / COLOR		MIL	ROLLS/ CASE	PRICE PER ROLL (MIN. 3)					
					3	6	12	24+		
2" x 36 yds.	S-383	Yellow/Black	S-12877	Green/White	8.8	24	\$11.50	\$10.40	\$9.40	\$8.30
	S-395	White/Black	S-16869	Yellow						
	S-384	Red/White								
3" x 36 yds.	S-658	Yellow/Black	S-3356	Red/White	8.8	16	17.40	15.70	14.20	12.60
	S-3357	White/Black	S-16870	Yellow						
4" x 36 yds.	S-3565	Yellow/Black	S-13517	White/Black	8.8	12	23.00	20.90	18.80	16.70

Page AK-2

Product availability : Stock - Normally stocked in distribution facility



Main

Range of product	Modicon M171/M172
Product or component type	Programmable controllers
Product specific application	HVAC and pumping solution
Variant	Programmable
Total inputs/outputs	42
Discrete input number	12
Discrete output number	2 relay outputs SPST with same common 2 relay outputs SPST with independent common 2 relay outputs SPDT with same common 3 relay outputs SPST with independent common
Discrete output current	1 A relay SPDT 3 A relay SPST
Analogue input number	12 configurable by pair
Analogue output number	4 voltage 0...10 V 2 voltage/current 4...20 mA or 0...10 V or PWM (2 kHz)

Complementary

Number of port	1 CAN port - screw terminal block 1 USB type A - USB type A female 1 USB type mini B - USB device port Mini-B 2 RS485 - screw terminal block Modbus serial link or BACnet MS/TP) 1 Ethernet - RJ45 Modbus TCP and BACnet IP with webserver)
Input/Output number	12 analog input 6 analog output 12 digital input 12 digital output
Discrete input logic	Sink or source (positive/negative)
Discrete input voltage	24 V AC/DC
Discrete input current	2.5 mA

Input impedance	20 kOhm
Analogue input type	impedance 0...1500 hOhm impedance 0...300 daOhm direct input NTC temperature probe - 50...110 °C 0.1 °C extended) voltage 0...10 V NTC temperature probe - 40...150 °C 0.1 °C current 0...20 mA/4...20 mA PTC temperature probe - 55...150 °C 0.1 °C voltage 0...5 V absolute or ratiometric) Pt 1000 temperature probe - 200...850 °C 0.1 °C
Sensor power supply	5 V DC 50 mA supplied by the controller 24 V DC 150 mA supplied by the controller
[Us] rated supply voltage	24 V +/- 10 % AC 20...38 V DC
Power consumption in W	15 W 24 V AC/DC
Realtime clock	Built-in -4...140 °F (-20...60 °C)
Display type	Without display
Overvoltage category	II
Local signalling	Programmable 1 LED red) Programmable 1 LED yellow) Programmable 1 LED green) Power 1 LED green)
Mounting support	Panel mounting with accessory DIN rail
Width	5.67 in (144 mm)
Height	4.33 in (110 mm)
Depth	2.38 in (60.5 mm)
Net weight	0.85 lb(US) (0.385 kg)

Environment

Directives	1907/2006/EC - REACH directive 2011/65/EU - RoHS directive 2006/95/EC - low voltage directive 86/188/EEC - physical agents (noise) directive
Standards	EN/IEC 60730
Product certifications	EAC (pending) CURus (pending) CE CSA (pending)
Ambient air temperature for operation	-4...140 °F (-20...60 °C) UL 60730-1 -4...149 °F (-20...65 °C) with derating UL 60730-1
Ambient air temperature for storage	-22...158 °F (-30...70 °C)
Relative humidity	5...95 % non-condensing
IP degree of protection	IP20
Pollution degree	2

Ordering and shipping details

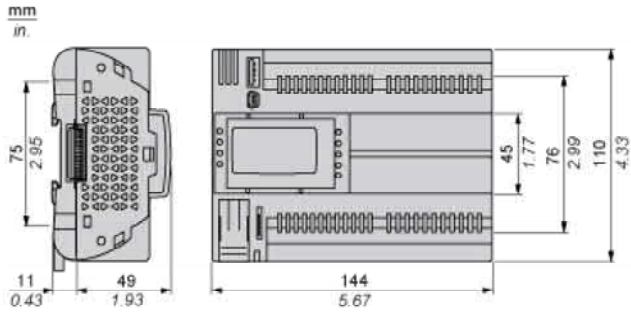
Category	22537 - M171 / M172 HVAC CONTROLLERS
Discount Schedule	PC12
GTIN	00785901502098
Package weight(Lbs)	0.43 kg (0.94 lb(US))
Returnability	Yes
Country of origin	IT

Offer Sustainability

Sustainable offer status	Green Premium product
--------------------------	-----------------------

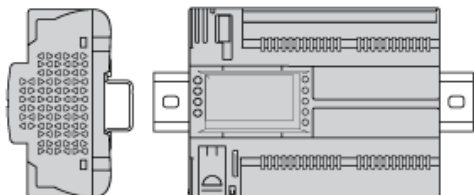
California proposition 65	WARNING: This product can expose you to chemicals including: Lead and lead compounds which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
REACH Regulation	REACH Declaration
EU RoHS Directive	Pro-active compliance (Product out of EU RoHS legal scope) EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration
Environmental Disclosure	Product Environmental Profile
Circularity Profile	End of Life Information
WEEE	The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins.

Dimensions



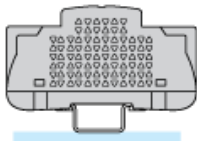
Mounting Positions

Correct Mounting Position

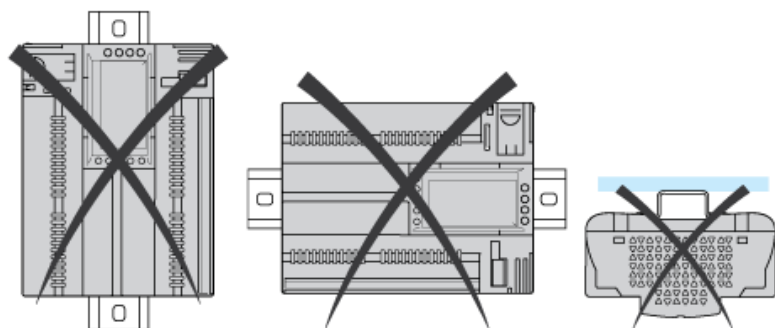


Acceptable Mounting Position

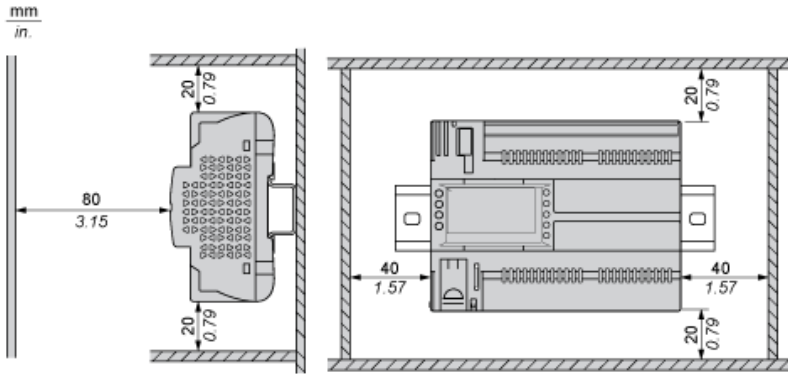
Controller can be mounted horizontally upward with a temperature derating (maximum ambient temperature: 60 °C (140 °F)).



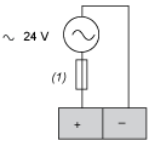
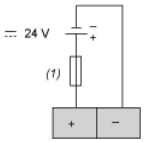
Incorrect Mounting Position



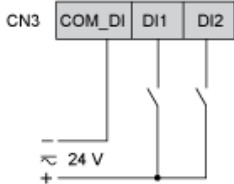
Clearance



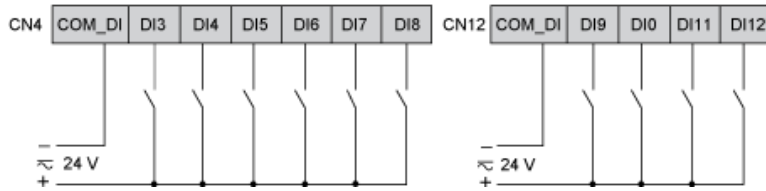
Power Supply

24 Vac	24 Vdc
	

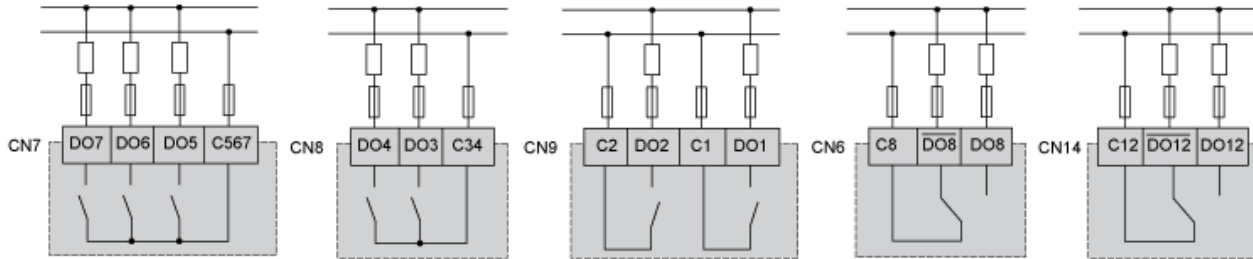
CN3 Fast Digital Inputs



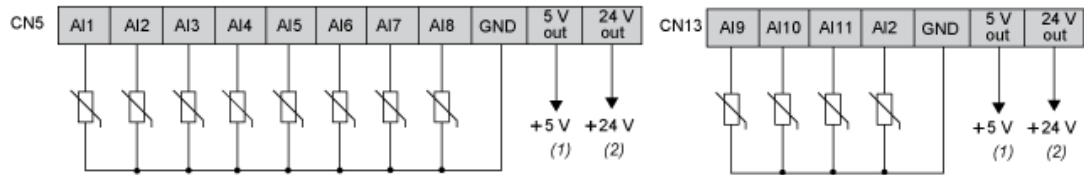
CN4, CN12 Digital Inputs



CN7, CN8, CN9, CN6, CN14 High Voltage Relay SPST Digital Output



CN5, CN13 Analog Inputs

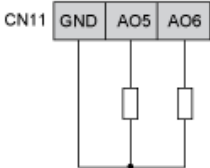


- (1) (CN5 + CN13) Max. current : 50 mA.
- (2) (CN5 + CN13) Max. current : 150 mA.

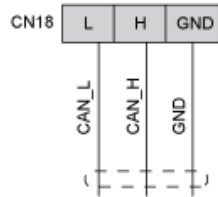
CN2, CN11 Analog Outputs



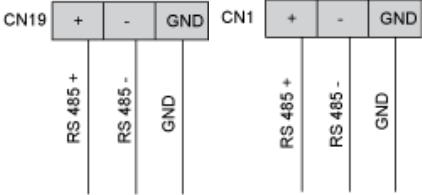
AO3, AO4 can be used also as PWM generator, up to 2kHz.



CN18 CAN Expansion Bus Port



CN19, CN1 CAN Expansion Bus Port



Modicon M171/M172

For HVAC control solutions

Logic controllers and Configuration software

Catalog

October 2018



Schneider
Electric

Page AM-15

N0004-SB069346-000

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Life Is On



General content

Modicon M171/M172 for HVAC control solutions Logic controllers and configuration software

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Empowering industrial OEMs for the digital era

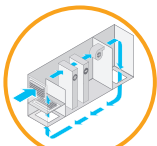
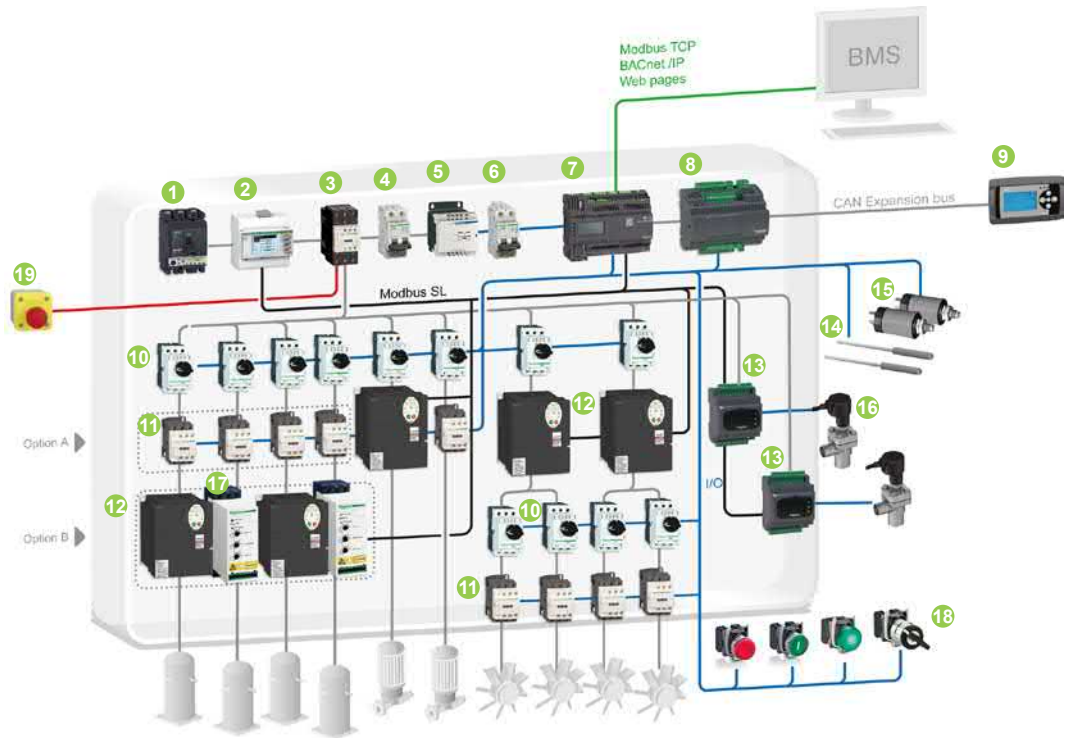
To be competitive in today’s digital era, machine builders must be innovative. Smart machines, those that are better connected, more flexible, more efficient, and safe, are enabling machine builders to innovate in ways never before possible.

- > EcoStruxure™ Machine, our open, interoperable, IoT-enabled system architecture helps you build smarter machines and equipment faster, making your business more efficient, profitable, and sustainable.
- > EcoStruxure Machine brings together key technologies for product connectivity and edge control on premises, and cloud technologies to provide analytics and digital services.
- > EcoStruxure Machine helps you bring more innovation and added value to your customers throughout the entire machine life cycle

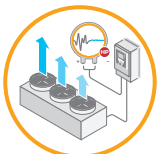
Ready-to-use architectures and function blocks

- > Tested, Validated, and Documented Architectures (TVDAs) are just one of the ways we help to reduce design time.
- > Whether machines are simple or complex, Application Function Blocks (AFBs) make system design fast and easy.

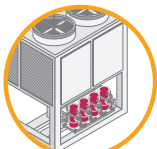
Modicon M171/M172 is part of EcoStruxure Machine



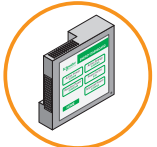
Fan management



Floating High Pressure control



Compressor management



Energy management

Application Function Blocks (AFBs)

HVAC/Chiller/Modbus SL/Modicon M172 performance logic controller

Solution breakdown

- | | |
|---|--|
| <ul style="list-style-type: none"> 1 Compact NSX circuit breaker 2 iEM3000 energy meter 3 TeSys D contactor 4 C60L-MA modular circuit breaker 5 Phaseo switch mode power supply 6 C60L-DC DC circuit breaker 7 Modicon M172 performance logic controller 8 Modicon M172 I/O module 9 Modicon M171 remote display 10 TeSys GV2L magnetic circuit breaker 11 TeSys D contactor | <ul style="list-style-type: none"> 12 Altivar 212 variable speed drive, for 0.75 to 75 kW (1.0 to 100 hp) motors 13 Modicon M171 electronic expansion valve driver 14 Modicon TM1S humidity and temperature probes 15 Telemecanique sensors: XMLP pressure transmitters 16 Electronic expansion valve 17 Altistart 01 soft starter 18 Harmony XB4/XB5 signaling units 19 Harmony XALK Emergency stop push button |
|---|--|

Flexible

Flexible and scalable performance

Whether you specialize in chillers, Air Handling Units for commercial buildings, residential, or industrial applications, etc.

With the range of Modicon M171/M172 logic controllers, EcoStruxure™ Machine is well positioned.

Multiple BMS (Building Management System) connectivity, embedded or as an option, and an embedded web server make remote control and remote access simple to implement, while a unique software environment supports the development of algorithms and functions that can be used on any platform.



Modicon M172 performance logic controllers



Modicon M172 optimized logic controllers



Modicon M171 optimized logic controllers



Performance and connectivity

- > Best-in-class versatility and compact size
- > Best-in-class performance

- > Modicon™ **M172 logic controllers** for any size of connectable or connected HVAC machine. With Modicon **M172 optimized**, manage small to large HVAC machines, connectable to BMS or the cloud. Or use **Modicon M172 performance** to have native connectivity for connected HVAC machines.
- > **Modicon M171 optimized logic controller** for simple and compact machines is one of the smallest programmable controllers on the market. Available also for flush mounting, it requires minimal installation time and offers tremendous versatility.
- > **Modicon M171 performance logic controller** for complex and BMS connectable machines, can be adapted to virtually any application.

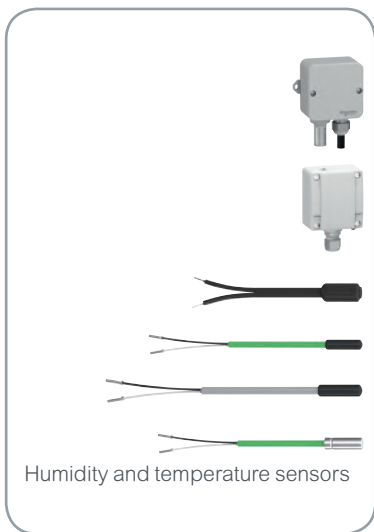
Efficient









Everything needed is embedded

The high degree of flexibility makes it very easy to install additional modules and still keep everything in just one configuration:

- > Controllers
- > Remote displays
- > Expansion modules
- > Communication modules
- > Wide range of humidity and temperature probes

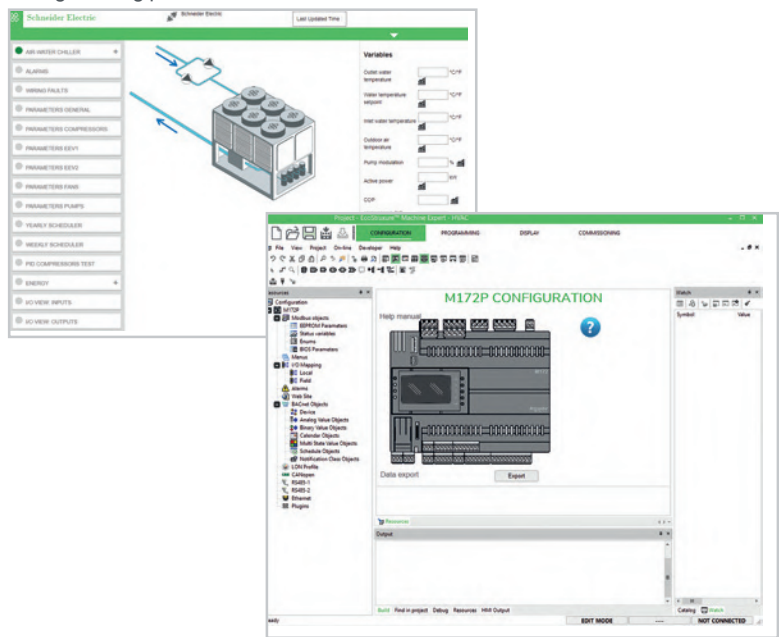


Humidity and temperature sensors

Logic controllers	Remote displays	Expansion modules
 <p>Modicon M171 optimized, for simple and compact machines</p>		
 <p>Modicon M172, for any size of connectable or connected machine</p>		
<p>Communication modules</p>		

Intuitive automation with EcoStruxure Machine Expert - HVAC

- > EcoStruxure Machine Expert - HVAC is the universal programming software for machines automated by Modicon M171/M172 logic controllers.
- > Simplified navigation that requires only a few clicks delivers a more efficient engineering process.



- > EcoStruxure Machine Expert - HVAC simplifies each of the steps in machine design and commissioning

Connected



Connected everywhere

Depending on your connectivity needs, select the right product

- > **M171 optimized** for simple and compact machines
 - Modbus RTU
 - LAN Expansion Bus
- > **M172** for any size of connectable (**M172 optimized**) or connected (**M172 performance**) machine
 - Modbus RTU
 - Modbus TCP
 - BACnet MS/TP (B-AAC Profile certified BTL)
 - BACnet /IP (B-AAC Profile certified BTL)
 - ASCII support for GSM Modem
 - CAN Expansion Bus
 - LonWorks (FFT-10)
 - Webserver, FTP Client/Server, Email, Proxy management, white list, SNTTP

Customization and services

Our experts help you every step of the way, from perfecting machine design to on-site servicing of the finished machine

- > Global support, 24/7 hotline services, and replacement parts centers around the world enable you to deliver superior customer support and satisfaction

Fully customized solution and co-design with our Application Design Experts (ADE)

- > Design an optimized solution for your machine to create added value, with the help of our experienced ADEs

Turnkey control panel

- > Engineering expertise for codes and standards compliance
- > Custom engineering to provide the optimum solution and meet specific needs

Collaboration from design to commissioning

- > Recruited directly from the industries they serve, ADEs collaborate with you from design through to programming, as well as in the commissioning of turnkey installations

Expert support throughout your system's life cycle

- > A dedicated team of Schneider Electric application design experts provides worldwide support for your HVAC solution

General presentation

The Modicon M171/M172 logic controller range has been developed to manage digital and analog inputs and outputs for controlling HVAC machines and to offer numerous possibilities for connection to different Building Management System communication networks.

Modicon M171/M172 range

- The range of Modicon M171/M172 logic controllers is a consistent offer made up of:
 - several types of controller depending on the requested performance and connectivity
 - a variety of communication modules to connect them to the BMS
 - a choice of expansion modules to increase and adapt the number and type of I/O
 - monochrome and color displays
 - EcoStruxure Machine Expert - HVAC, the dedicated software used to program, commission and debug applications
 - and a set of sensors
- The M171/M172 range is suitable for customized applications designed to control HVAC machines such as:
 - Air/water-cooled chiller
 - Rooftop unit
 - Heat pump
 - Compressor rack
 - Ventilation unit
 - Precision air conditioner
 - Heat recovery unit
 - Air handling unit
- The offer is flexible and scalable, depending on the application requirements. Any existing controller can evolve later as all M171/M172 controllers are programmed with the same EcoStruxure Machine Expert - HVAC software.
 - M171 optimized controllers are designed for simple and compact machines when only Modbus SL is needed with less than 44 I/O.
 - M172 controllers are designed for any size of connectable (M172 optimized) or connected (M172 performance) machines, from 7 to 238 I/O and can be used with expansion modules. M172 performance controllers embed connectivity, and M172 optimized controllers offer optional connectivity.



HVAC



Heat pump



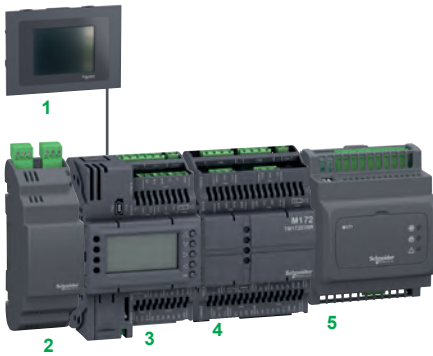
Chiller



Air handling unit



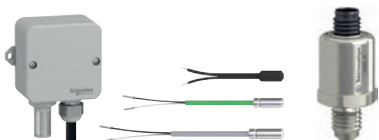
- 1 Remote flush mounting display
- 2 Remote wall mounting display
- 3 M171 optimized logic controller
- 4 I/O expansion module



- 1 Color touch screen display
- 2 Communication module
- 3 M172 optimized logic controller
- 4 I/O expansion module
- 5 Electronic expansion valve driver



- 1 Color touch screen display
- 2 M172 performance logic controller
- 3 I/O expansion module



Measurement accessories

Pressure transmitters

General presentation

System components

Each family of M171 and M172 controllers, is available in both an optimized and performance version, and comprises several types of product sorted by function and compatibility.

Modicon M171/M172 logic controllers are available with or without an embedded display, with or without SSE output depending on the base product. I/O expansion modules are mixed digital and analog I/O types.

M171 optimized logic controllers

- **TM171O●●●●** optimized logic controllers, [see page 22](#) and **TM171EO●●R** I/O expansion modules, [see page 24](#) and **TM171D●●●●** remote displays, [see page 26](#)

M171 performance logic controllers

- **TM171P●●●●** performance logic controllers, [see page 28](#) and **TM171EP●●R** I/O expansion modules [see page 30](#) and **TM171DGRP** remote displays [see page 29](#)

M172 optimized and performance logic controllers

- **TM172O●●●●** optimized and **TM172P●●●●** performance logic controllers, [see page 14](#) and **TM172E●●R** I/O expansion module, [see page 18](#) and **TM172DC●●●●** remote color touch screen displays, [see page 20](#)

Communication modules

- **TM171A●●●●** communication modules (BMS fieldbus interfaces) provide the **TM171P●●●●** performance, **TM172O●●●●** optimized and **TM172P●●●●** performance logic controllers with a connection to:
 - BACnet MS/TP (B-AAC profile) or IP
 - Modbus SL (Serial Link)
 - Modbus TCP
 - LonWorks (FFT-10)
 - Profibus
 - CAN bus
 - Etc. [see page 32](#).

Electronic expansion valve drivers

- **TM171VEV●●** electronic expansion valve drivers compatible with the entire Modicon M171/M172 logic controller range and also with third party controllers and electronic expansion valves, [see page 34](#)

Measurement accessories

- Specific measurement accessories **TM1S●●●●**: humidity and temperature probes, [see page 36](#).
- Pressure transmitters from our partner Telemecanique sensors, [see page 38](#)

Software

- EcoStruxure Machine Expert - HVAC programming software, and programming accessories, [see page 40](#).

Connection accessories

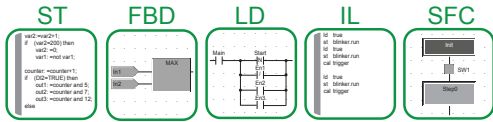
- Adapted connection accessories: I/O connectors and cables, [see page 27](#).

General presentation (continued)

Configuration software

Modicon M171/M172 logic controllers are supported by an intuitive software package: EcoStruxure Machine Expert - HVAC, [see page 40](#). This software follows a simple drag-and-drop function block approach to configuration and is completed with a library of Application Function Blocks (AFBs) and logic functions. EcoStruxure Machine Expert - HVAC uses five languages compliant with IEC 61131-3.

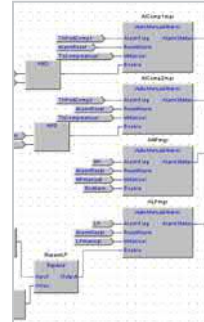
Examples:



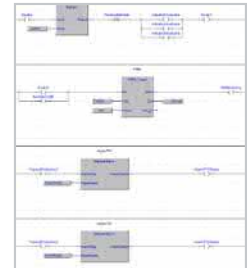
5 languages compliant with IEC 61131-3



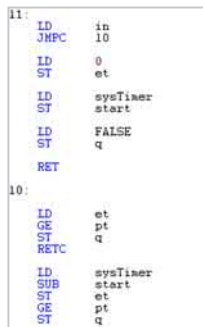
Structured Text language (ST)



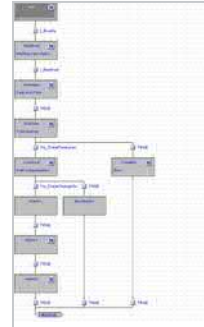
Function Block Diagram language (FBD)



Ladder Diagram language (LD)



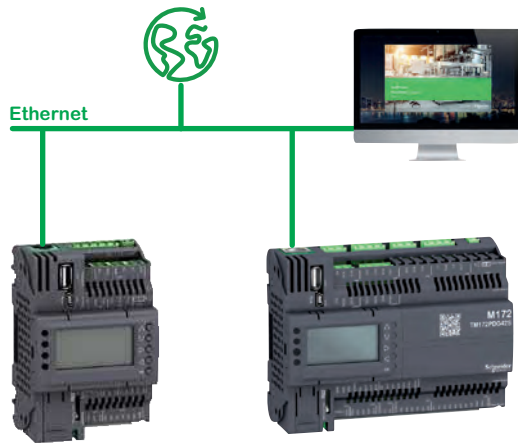
Instruction List language (IL)



Sequential Function Chart language (SFC)

Available resources on logic controllers for IEC programming

	Logic controller type		
	M172 optimized and M172 performance	M171 optimized	M171 performance
CPU	120 MHz, 32 MB RAM	14.7 MHz	72 MHz, 32 MB RAM
Available memory for application	1.0 MB	188 kB	1.0 MB
Available memory for user interface	1.5 MB	—	1.5 MB
Flash memory data	5 MB	—	126 MB
RAM memory (automatic mapping)	512 kB (256000 word)	2048 B (1024 word)	512 kB (256000 word)
RAM memory (Modbus mapping)	10 kB (5000 word)	1024 B (512 word)	10 kB (5000 word)
EEPROM variables	28 kB (14000 word)	1024 B (512 word)	28 kB (14000 word)



M172 performance logic controllers linked to Ethernet via the embedded RJ45 ports

General presentation (continued)

Ethernet connection

Ethernet access is available on M171/M172 logic controllers:

- embedded in M172 performance logic controllers
- optional with M171 performance and M172 optimized logic controllers by means of a communication module, [see page 32](#)

Ethernet access enables several functions such as:

- > HTTP Webserver (Webvisu)
- > Remote access
 - Download program
 - Display program download
 - Download, upload parameters
 - Download firmware
 - Debug
 - File management
- > Bridge: specific function allowing controllers connected in Modbus SL to the same controller to be programmed via Modbus
- > FTP client/server

These services are not always available:

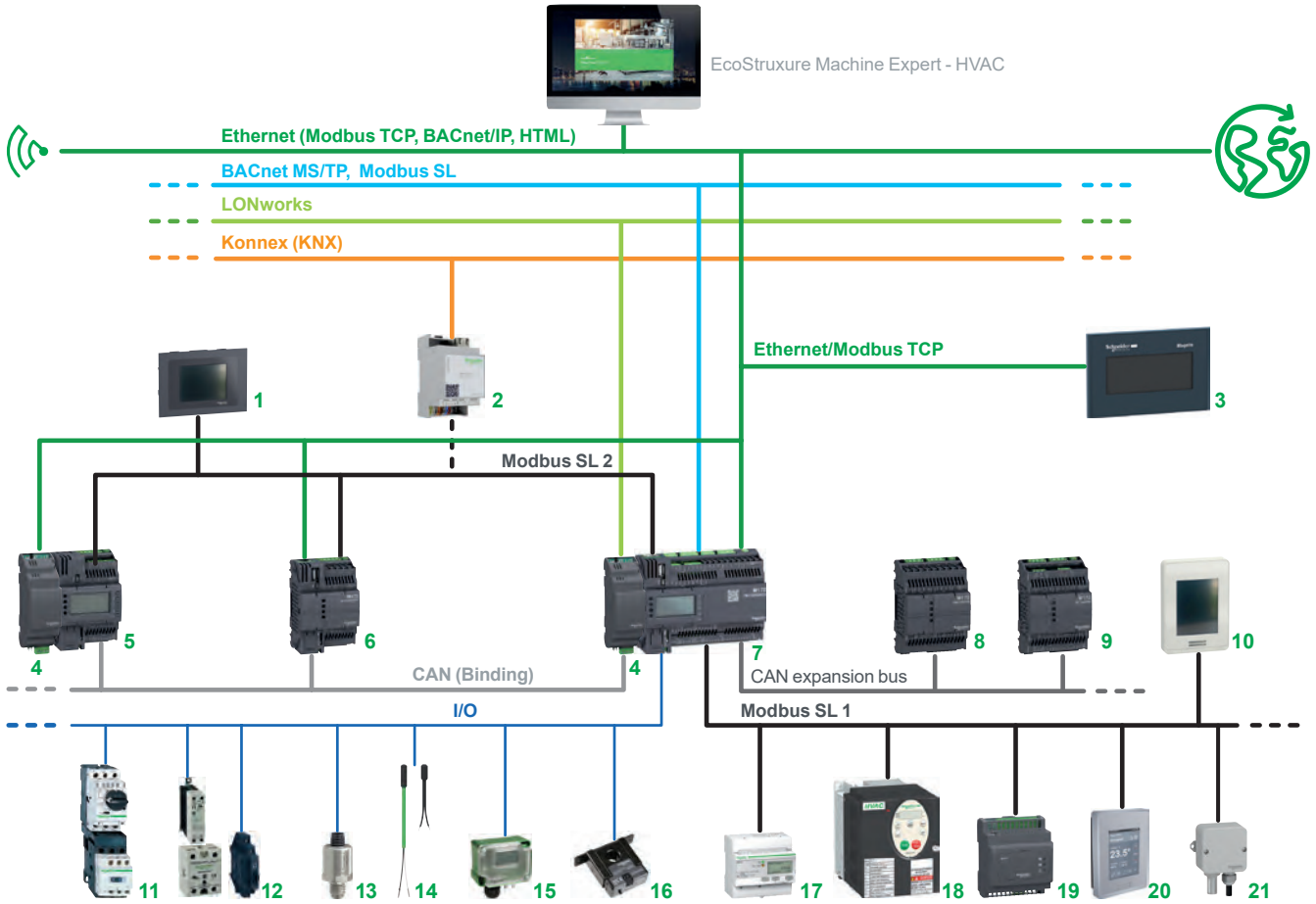
- > the service can be enabled or disabled via the controller programming
- > a white list is used to provide access (no white list defined by default)



M172 optimized logic controller linked to Ethernet via the TM171AETH or TM171AETHRS485 communication module

General presentation (continued)

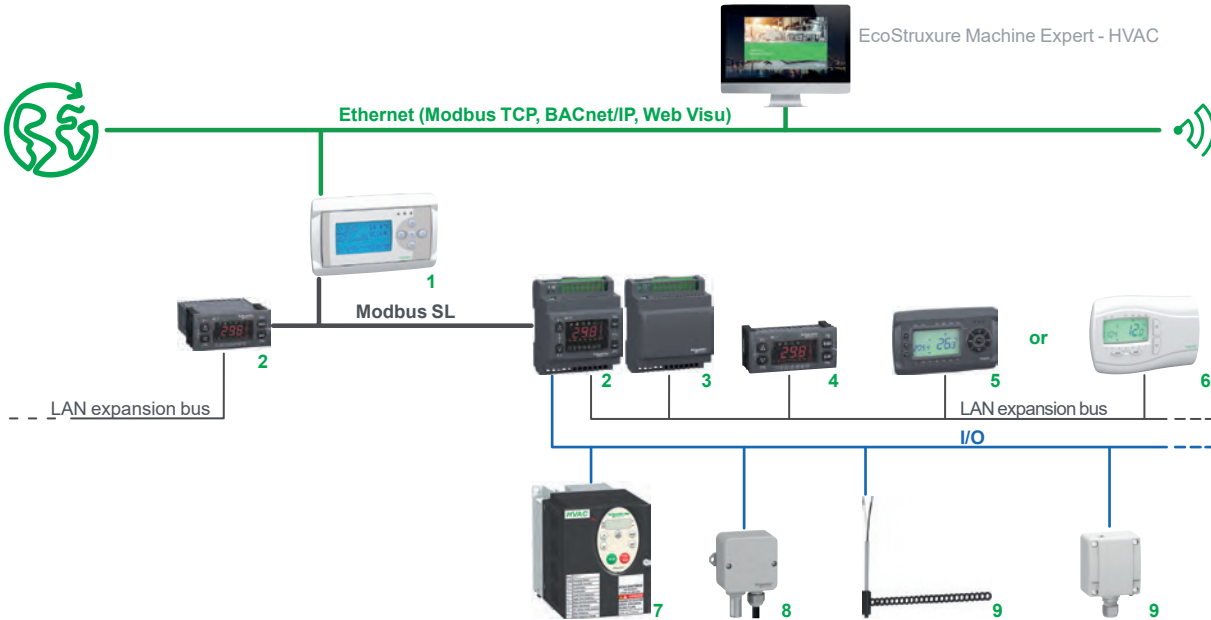
Modicon M172 logic controllers for any size of connectable or connected HVAC machines



- 1 **TM172DCLF** flush mounting display, see page 21
- 2 **spaceLYnk** gateway, see on our website www.schneider-electric.com
- 3 **Magelis STO/STU** HMI, see on our website www.schneider-electric.com
- 4 **TM171ALON** communication module, see page 32
- 5 **TM171OD** optimized logic controller (18 I/O in 4 DIN), see page 16
- 6 **TM172PB** performance logic controller (7 or 18 I/O in 4 DIN), see page 17
- 7 **TM172PD** performance logic controller (28 or 42 I/O in 8 DIN), see page 14
- 8 **TM172E12R** I/O expansion module (12 I/O in 4 DIN), see page 18
- 9 **TM172E28R** I/O expansion module (28 I/O in 4 DIN), see page 18
- 10 **TM172DCW** wall mounting remote display, see page 20
- 11 **TeSys D** motor starter, see on our website www.schneider-electric.com
- 12 Electromechanical relays, solid state relays, see on our website www.schneider-electric.com
- 13 **XMLP** pressure transmitter, see page 38
- 14 **TM1ST** temperature sensor PT1000 or NTC, see page 37
- 15 **SPD310** Differential pressure sensor, see on our website www.schneider-electric.com
- 16 **H721LC-S6** current transducer, see on our website www.schneider-electric.com
- 17 **IEM 3000** energy meter, see on our website www.schneider-electric.com
- 18 **Altivar 212** variable speed drive, see on our website www.schneider-electric.com
- 19 **TM171VEV** electronic expansion valve driver, see page 34
- 20 **SE8000** room controller (thermostat), see on our website www.schneider-electric.com
- 21 **TM1SH** humidity sensor, see page 37

General presentation (continued)

Modicon M171 optimized logic controllers for simple and compact machines



- 1 *TM171PFE03 performance logic controller, see page 28*
- 2 *TM171OFM22R optimized logic controller - flush mounting, see page 22*
- 3 *TM171EO●● I/O expansion module, see page 24*
- 4 *TM171DLED remote display, see page 26*
- 5 *TM171DLCD remote display, see page 26*
- 6 *TM171DWAL remote wall mounting display, see page 26*
- 7 *Altivar 212 variable speed drive, see on our website www.schneider-electric.com*
- 8 *TM1ST●● temperature sensor PT1000 or NTC, see page 37*
- 9 *TM1SH●● humidity sensor, see page 37*

Applications

M172 optimized logic controllers for any size of connectable machines	M172 performance logic controllers for any size of connected machines
<ul style="list-style-type: none"> Air/water-cooled chiller Rooftop unit Heat pump Precision air conditioner Compressor rack Heat recovery unit 	



Programming software

EcoStruxure Machine Expert - HVAC V2.4 or higher	EcoStruxure Machine Expert - HVAC V2.4 or higher
--	--

Maximum number of I/O with expansion modules

238 (TM172ODM42R + 7 TM172E28R)	238 (TM172PDG42RI + 7 TM172E28R)
---------------------------------	----------------------------------

Generic programmable inputs

2, 8 or 12 digital inputs 8 or 12 analog inputs	2, 8 or 12 digital inputs 2, 8 or 12 analog inputs
--	---

Generic programmable outputs

6, 8 or 12 digital outputs 2, 4 or 6 analog outputs	3, 6, 8 or 12 digital outputs 0, 2, 4 or 6 analog outputs
--	--

Communication

<ul style="list-style-type: none"> 2 RS485, Modbus SL master/slave (only 1 master), 1 BACnet MS/TP (B-AAC profile) 1 CAN expansion bus 	<ul style="list-style-type: none"> 2 RS485, Modbus SL master/slave (only 1 master), 1 BACnet MS/TP (B-AAC profile) 1 RJ45 connector for Modbus TCP master/slave and BACnet IP (B-AAC profile), Ethernet (Webvisu, FTP, etc.) 1 CAN expansion bus
--	---

Optional communication (see page 32)

<ul style="list-style-type: none"> With TM171A communication modules: <ul style="list-style-type: none"> RS485 (Modbus SL or BACnet MS/TP) CAN bus RS232 LonWorks (FFT-10) Modbus TCP, BACnet /IP, Ethernet 	<ul style="list-style-type: none"> With TM171A communication modules: <ul style="list-style-type: none"> RS485 (Modbus SL or BACnet MS/TP) CAN bus RS232 LonWorks (FFT-10)
--	--

USB port

Yes: 1 USB-Mini-B	Yes: 1 USB-A and 1 USB-Mini-B
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Services

<ul style="list-style-type: none"> Download the program via USB-A or Modbus SL Optional services depending on the Ethernet communication module 	<ul style="list-style-type: none"> Download the program through USB-A or Modbus SL Remote access HTTP Webserver (Webvisu) FTP client/server SNPT
---	---

Power supply

24 V ~	24 V ~
--------	--------

Display

Yes, on TM172ODM controllers	Yes, on TM172PDG controllers
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Remote

Yes, - with TM172DCL color touch screen displays - with TM171DGRP display - with HMI Magelis offer, see on our website www.schneider-electric.com	
--	--

Mounting

35 mm / 1.38 in. rail, or on panel with TM172AP12PM mounting accessory	
--	--

Product certifications

CE, cURus (UL Recognized), CSA, EAC, RCM, RoHS China, BACnet BTL	
--	--

Logic controller reference

TM172O●M18R TM172O●28R TM172O●M42R	TM172P●G07R TM172P●G18● TM172P●G28● TM172P●G28●I TM172P●G42● TM172P●G42●I
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Page

16	17
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(1) On the same port at the same time

M171 optimized logic controllers for simple and compact machines	M171 performance logic controllers for complex and BMS connectable machines
<ul style="list-style-type: none"> Air/water-cooled chiller Rooftop unit Heat pump Compressor rack Ventilation unit 	<ul style="list-style-type: none"> Air/water-cooled chiller Rooftop unit Heat pump Precision air conditioner Compressor rack Heat recovery unit



Programming software

EcoStruxure Machine Expert - HVAC V1.0 or higher	EcoStruxure Machine Expert - HVAC V1.0 or higher
--	--

Maximum number of I/O with expansion modules

44	28	351	327
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Generic programmable inputs

6 digital inputs 5 configurable analog inputs	2 digital inputs 5 configurable analog inputs	9 digital inputs 6 configurable analog inputs	- 3 configurable analog inputs
--	--	--	-----------------------------------

Generic programmable outputs

6 digital outputs 5 analog outputs	4 digital outputs 5 analog outputs	7 digital outputs 5 analog outputs	- -
---------------------------------------	---------------------------------------	---------------------------------------	--------

Communication

<ul style="list-style-type: none"> 1 wired connector for LAN expansion bus 1 wired connector for Modbus SL master/slave for TM171O●M●●● 	<ul style="list-style-type: none"> 1 CAN expansion bus 1 Modbus SL master/slave 	<ul style="list-style-type: none"> 1 CAN expansion bus 1 Modbus SL master/slave or BACnet MS/TP (B-AAC profile) 1 RJ45 connector for Modbus TCP and BACnet IP (B-AAC profile) (WebVisu) (1)
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None except with a gateway

None except with a gateway	With TM171A communication modules: <ul style="list-style-type: none"> Modbus TCP (WebVisu) Modbus SL BACnet MS/TP (B-AAC profile, certified BTL) BACnet IP (B-AAC profile, certified BTL) CAN bus RS 232 Profibus LonWorks (FFT-10) 	None except with a gateway
----------------------------	---	----------------------------

No (program can be downloaded with the TM171AMFK programming stick and TM171ADMI programming cable)

No (program can be downloaded with the TM171AMFK programming stick and TM171ADMI programming cable)	Yes: 1 USB-A and 1 USB-Mini-B	No
---	-------------------------------	----

Remote download via Modbus SL

Remote download via Modbus SL	<ul style="list-style-type: none"> Remote download File management (virtual FTP) Text e-mail Datalogging
-------------------------------	--

Power supply

12-24 V ~ or 24 V --- for all, 12-24 V ~ for TM171O●●22S	100...240 V ~, isolated	24 V ~ or 48 V ---
--	-------------------------	--------------------

Display

Yes, on TM171OD●22● controllers	Yes	Yes, on TM171ODM14R controllers	Yes, on TM171PDM27● controllers	Yes
---------------------------------	-----	---------------------------------	---------------------------------	-----

Yes,
 - with TM171DLED, TM171DLCD, and TM171DWAL2● displays
 - with TM172DCL color touch screen displays
 - with HMI Magelis offer, see on our website www.schneider-electric.com

Yes,
 - with TM171DGRP display
 - with TM172DCL color touch screen displays
 - with HMI Magelis offer, see on our website www.schneider-electric.com

Mounting

35 mm / 1.38 in. rail	Flush mounting	35 mm / 1.38 in. rail	35 mm / 1.38 in. rail	Flush mounting
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Product certifications

CE, cURus (UL Recognized), CSA, EAC, RCM, RoHS China	CE, cURus (UL Recognized), CSA, EAC, RCM, RoHS China
--	--

Logic controller reference

TM171O●●22● TM171OF22R, TM171OFM22R	TM171O●M14R, TM171OD14R	TM171PDM27●, TM171PBM27R	TM171PFE03●
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(1) On the same port at the same time

Presentation

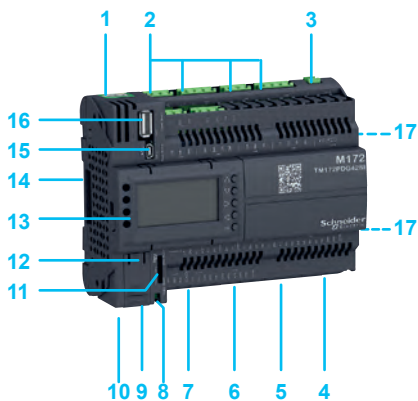
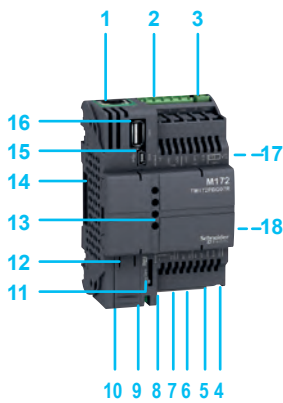
M172 optimized and performance logic controllers

The Modicon M172 logic controllers consist of the M172 optimized and the M172 performance logic controllers, differentiated by the connectivity: embedded on M172 performance, optional on M172 optimized.

M172 controllers embed 7, 18, 28 or 42 I/O, and can be fitted with a display, with relay outputs, and with SSR outputs, depending on the model.

- The M172 logic controller offer comprises:
 - a M172 model to control from 7 up to 18 embedded I/O (digital and analog), in 4 DIN (controller width is 72 mm /2.83 in.)
 - and M172 models to control from 28 up to 42 embedded I/O (digital and analog), in 8 DIN (controller width 144 mm /5.66 in.)
- Power supply: 24 V $\overline{\sim}$
- Two types of housing:
 - with built-in display
 - without display
- Two types of mounting:
 - On 35 mm/1.38 in. \perp rail mounting: for M172 controllers to be mounted inside a cabinet
 - On panel with an accessory: for M172 controllers to be mounted on a panel with **TM172AP12PM** fixing accessory
- Communication ports on M172 optimized logic controllers:
 - Two RS485 for Modbus SL (master/slave) (only 1 master) or 1 for BACnet MS/TP (B-AAC profile, BACnet BTL certified)
 - One for CAN expansion bus
 - Plus one communication module connector
- Communication ports on M172 performance logic controllers: same as M171 optimized, plus one RJ45 for Modbus TCP, BACnet IP (B-AAC profile, BACnet BTL certified) and Ethernet
- M172 logic controllers can be connected to communication modules, offering another connection to a CAN expansion bus, Modbus SL or LonWorks, etc., [see page 32](#).
- The M172 logic controllers are certified Cc, cURus (UL Recognized), CSA, EAC, RCM, RoHS China, and BACnet BTL certified.
- Micro SD card: a slot for a micro SD memory card is available on the front face of the M172 performance controllers (1).
The micro SD card is used for:
 - Data logging
 - Webserver storage
- USB programming ports
 - The USB-A port is available on M172 performance logic controllers, used to transfer programs with a memory stick.
 - USB mini B is available on M172 optimized and performance logic controllers, used to connect to a PC for programming, [see page 41](#).

(1) M172 optimized logic controllers do not have a slot for a micro SD card (no slot can be added later).



Description

M172 optimized and performance logic controllers

M172 logic controllers with 7 or 18 I/O (in 4 DIN: controller width is 72 mm / 2.83 in.) (1)

- 1 RJ45 connector for Modbus TCP, BACnet IP (B-AAC profile) and Ethernet (2)
- 2 Connector for removable terminal block for digital outputs
- 3 Connector for removable terminal block for power supply (24 V \sphericalangle) (3)
- 4 Connector for removable terminal block for analog inputs
- 5 Connector for removable terminal block for digital inputs
- 6 Connector for removable terminal block for fast digital inputs (high speed counter)
- 7 Connector for removable terminal block for analog outputs
- 8 Connector for removable terminal block for RS485-1 (Modbus SL or BACnet MS/TP) (3)
- 9 Connector for removable terminal block for RS485-2 (Modbus SL or BACnet MS/TP) (3)
- 10 Connector for removable terminal block for CAN expansion bus
- 11 Slot for micro SD card (2)
- 12 Slot for battery (behind the front flap)
- 13 On TM172D●●●: Built-in display, 4 status LEDs and 5 command keys for setting controller parameters
On TM172B●●●: 4 status LEDs and 5 command keys for setting controller parameters, behind a front panel
- 14 Connector for communication module
- 15 USB mini-B port to link a PC
- 16 USB-A port for USB stick (2)
- 17 Mounting clips for 35 mm / 1.38 in. \perp rail mounting
- 18 Two slots for the TM172AP12PM fixing accessory

M172 logic controllers with 28 or 42 I/O (in 8 DIN: controller width is 144 mm / 5.66 in.) (1)

- 1 RJ45 connector for Modbus TCP and BACnet IP (B-AAC profile) and Ethernet (2)
- 2 Connector for removable terminal block for digital outputs
- 3 Connector for removable terminal block for power supply (24 V \sphericalangle) (3)
- 4 Connector for removable terminal block for analog inputs
- 5 Connector for removable terminal block for digital inputs
- 6 Connector for removable terminal block for fast digital inputs (high speed counter)
- 7 Connector for removable terminal block for analog outputs
- 8 Connector for removable terminal block for RS485-1 (Modbus SL or BACnet MS/TP) (3)
- 9 Connector for removable terminal block for RS485-2 (Modbus SL or BACnet MS/TP) (3)
- 10 Connector for removable terminal block for CAN expansion bus
- 11 Slot for micro SD card (2)
- 12 Slot for battery (behind the front flap)
- 13 On TM172PDG●●●: Built-in display, 4 status LEDs and 5 command keys for setting controller parameters
On TM172PBG●●●: 4 status LEDs and 5 command keys for setting controller parameters, behind a front panel
- 14 Connector for communication modules
- 15 USB mini-B port to connect a PC
- 16 USB-A port for USB stick (2)
- 17 Mounting clips for 35 mm / 1.38 in. \perp rail mounting
- 18 Two slots for the TM172AP12PM fixing accessory

(1) TM172ASCTB●●● removable terminal blocks to be ordered separately, see page 16.

(2) Only for M172 performance

(3) TM172O●●●●, TM172P●G07R, TM172P●G18●, TM172P●G28●I and TM172P●G42●I have an isolated power supply and two isolated RS485 ports.

References

M172 optimized logic controllers: Power supply: 24 V ~

35 mm/1.38 in. rail mounting performance controllers, and Panel mounting with accessory

No. of I/O	Number and type of channels	Embedded communication port	Display	Reference	Weight kg/lb
------------	-----------------------------	-----------------------------	---------	-----------	--------------

18	2 digital inputs: ■ 2 high speed counter (2 kHz), dry contact 8 analog inputs (configurable in pairs): ■ 8 NTC, or PT1000, or PTC, or 0-20 mA, or 4-20 mA, or 0-5 V, or 0-10 V, or hOhm, or daOhm, or digital input	6 digital outputs: ■ 1 SPDT relay 3 A ■ 2 SPST 3 A with the same common ■ 1 SPST 3 A ■ 2 SPST 3 A with independent common 2 analog outputs: ■ 2 x 0-10 V, or 4-20 mA, or PWM (2 kHz, 24 V ---)	■ 1 CAN expansion bus ■ 2 RS485 ■ 1 USB Mini-B ■ 1 Communication module port	Remote display (optional)	TM172OBM18R (1)	0.170/ 0.375
				Built-in display 128x64 LCD with backlight	TM172ODM18R (1)	0.195/ 0.430



TM172OBM18R



TM172ODM18R

28	8 digital inputs: ■ 6 24 V ~ or --- ■ 2 high speed counters, dry contact 8 analog inputs (configurable in pairs): ■ 8 NTC, or PT1000, or PTC, or 0-20 mA, or 4-20 mA, or 0-5 V, or 0-10 V, or digital input	8 digital outputs: ■ 1 SPDT Relay 3 A ■ 3 SPST 3 A with the same common ■ 2 SPST 3 A with the same common ■ 2 SPST 3 A with independent common 4 analog outputs ■ 2 x 0-10 V, or 4-20 mA, or PWM (2 kHz, 24 V ---) ■ 2 x 0-10 V	■ 1 CAN expansion bus ■ 2 RS485 ■ 1 USB Mini-B ■ 1 Communication module port	Remote display (optional)	TM172OBM28R (1)	0.390/ 0.859
				Built-in display 128x64 LCD with backlight	TM172ODM28R (1)	0.390/ 0.859



TM172OBM28R



TM172ODM28R

42	12 digital inputs: ■ 10 24 V ~ or --- ■ 2 high speed counters, dry contact 12 analog inputs (configurable in pairs): ■ 12 NTC, or PT1000, or PTC, or 0-20 mA, or 4-20 mA, or 0-5 V, or 0-10 V, or digital input	12 digital outputs: ■ 2 SPDT Relay 3 A ■ 3 SPST 3 A with the same common ■ 3 SPST 3 A with the same common ■ 2 SPST 3 A with the same common ■ 2 SPST 3 A with independent common 6 analog outputs: ■ 2 x 0-10 V, or 4-20 mA, or PWM (2 kHz, 24 V ---) ■ 4 x 0-10 V	■ 1 CAN expansion bus ■ 2 RS485 ■ 1 USB Mini-B ■ 1 Communication module port	Remote display (optional)	TM172OBM42R (1)	0.480/ 1.058
				Built-in display 128x64 LCD with backlight	TM172ODM42R (1)	0.480/ 1.058



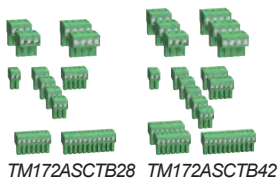
TM172OBM42R



TM172ODM42R

Accessories to be ordered separately

Designation	Use for	Reference	Weight kg/lb
I/O screw terminal blocks	TM172●●●07R logic controllers	TM172ASCTB07	0.025/ 0.055
	TM172●●●18● logic controllers	TM172ASCTB18	0.040/ 0.088
	TM172P●●●28●, TM172P●●●28●l logic controllers	TM172ASCTB28	0.100/ 0.220
	TM172P●●●42●, TM172P●●●42●l logic controllers	TM172ASCTB42	0.150/ 0.331



TM172ASCTB28 TM172ASCTB42

Fixing accessory: 12 clip-on locks for panel mounting For mounting M172 logic controllers and M172 expansion modules on panel **TM172AP12PM** 0.050/
0.110

(1) Products equipped with an isolated power supply, and two isolated RS485 ports



TM172AP12PM

Presentation

I/O expansion modules

Two I/O expansion modules are available, dedicated to M172 optimized and M172 performance logic controllers.

- They are used to increase the number of I/O up to 238 on M172 logic controllers.
- Expanded I/O types are digital and analog; the mix between inputs and outputs differs according to the module, making it easier to adapt the configuration to each need.
- They are connected via the CAN expansion bus on M172 logic controllers.
- All M172 logic controllers are compatible with all M172E expansion modules. Legacy TM171EP expansion modules are also compatible with M172.
- The maximum number of expansion modules on the CAN expansion bus is 7, in any combination (if more expansions are needed, please contact our Customer Care Centre).
- The M172E expansion modules are equipped with DIP switches which can be used to set the baud rate, the network address and also to incorporate a 120 ohm terminal resistor.
- The I/O can be configured in pairs, like M172 controllers.

Description

35 mm/1.38 in. \perp rail mounting I/O expansion modules (panel mounting with accessory)

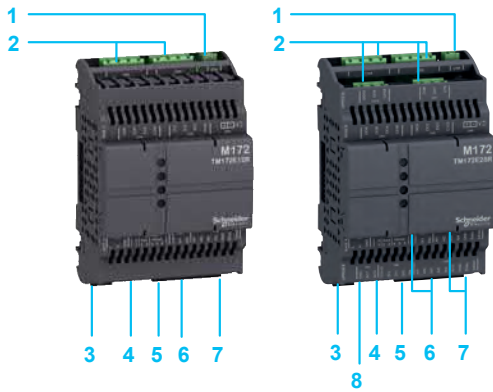
TM172E12R and TM172E28R expansion modules (1)

- 1 Connector for removable terminal block for power supply (24 V \sim)
- 2 Removable terminal block for digital outputs
- 3 Connector for removable terminal block for CAN expansion bus
- 4 DIP switches
- 5 Clip for 35 mm/1.38 in. \perp rail mounting
- 6 Connector for removable terminal block for digital inputs
- 7 Connector for removable terminal block for analog inputs with 5 V \sim /24 V \sim output power supply

TM172E28R expansion module (1)

- 8 Connector for removable terminal block for analog outputs
- 9 Two slots for **TM172AP12PM** fixing accessory

(1) Removable terminal blocks to be ordered separately, see page 19.



TM172E12R

TM172E28R



TM172E●●R

References

35 mm/1.38 in. rail mounting expansion modules

No. of I/O	Number and type of channels		Compatibility	Embedded communication connection	Reference	Weight kg/lb
	Inputs (1)	Outputs (1)				
12	2 digital inputs: <ul style="list-style-type: none"> 2 high speed counters, dry contact 4 analog inputs: <ul style="list-style-type: none"> 4 NTC or PT1000, or PTC, or 0-20 mA, or 4-20 mA, or 0-5 V, or 0-10 V, or hOhm, or daOhm, or digital inputs 	6 digital outputs: <ul style="list-style-type: none"> 3 SPST 3 A with the same common 3 SPST 3 A with the same common 	M172 logic controllers	<ul style="list-style-type: none"> 1 CAN expansion bus 	TM172E12R	0.140/ 0.308
28	6 digital inputs: <ul style="list-style-type: none"> 4 ~ or 24 V $\overline{\text{---}}$ 2 high speed counters, dry contact 10 analog inputs: <ul style="list-style-type: none"> 10 NTC or PT1000, or PTC, or 0-20 mA, or 4-20 mA, or 0-5 V, or 0-10 V, or hOhm, or daOhm, or digital inputs 	10 digital outputs: <ul style="list-style-type: none"> 3 SPST 3 A with the same common 3 SPST 3 A with the same common 2 SPST 3 A with the same common 2 SPST 3 A with the same common 2 analog outputs: <ul style="list-style-type: none"> 2 x 0-10 V, or 4-20 mA, or PWM (2 kHz, 24 V $\overline{\text{---}}$) 	M172 logic controllers	<ul style="list-style-type: none"> 1 CAN expansion bus 	TM172E28R	0.190/ 0.418



TM172E12R



TM172E28R

Accessories to be ordered separately

Designation	Compatibility	Reference	Weight kg/lb
Screw terminal blocks (inputs, outputs, and communication bus)	TM172E12R expansion module	TM172ASCTB12E	0.070/ 0.154
	TM172E28R expansion module	TM172ASCTB28E	0.100/ 0.220
Fixing accessory: 12 clip-on locks for panel mounting	TM172E●●R expansion modules	TM172AP12PM	0.055/ 0.110

(1) Removable terminal blocks to be ordered separately.



TM172ASCTB12E



TM172ASCTB28E



TM172AP12PM

Presentation

Remote color touch screen displays

Five remote color touch screen displays are dedicated to the M172 optimized and M172 performance logic controllers, distinguished by use and type of mounting. These displays can be also used with M171 controllers with Modbus SL or with third-party products equipped via Modbus SL. They are all programmable with EcoStruxure Machine Expert - HVAC V2.4 or higher. The remote color touch screen displays have the same firmware, meaning they can be swapped interchangeably.

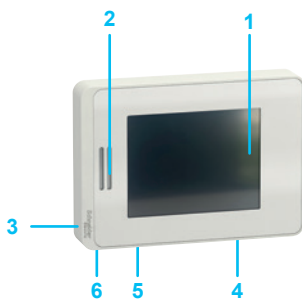
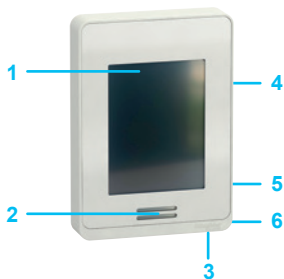
There are two types of remote color touch screen display:

- Three **TM172DCLW●●●** designed for:
 - wall mounting
 - indoor use
 - depending on the reference with temperature, relative humidity and built-in PIR presence sensor
- Two **TM172DCLF●** designed for
 - flush mounting or wall mounting with an accessory
 - indoor or outdoor use
 - white or dark gray housing
 - installing displays on a wall with TM172ABKP●● accessories, useful for a plant room.
- **TM172DCLWT●●●** and **TM172DCLF●** displays can be mounted vertically (portrait) or horizontally (landscape) (1).
- They can be configured for Modbus SL as master or slave, by means of the software.
 - On Modbus SL Slave, up to 8 displays can be installed in the same network.
 - On Modbus SL Master, up to 8 devices can be managed via the display.

Description

TM172DCLWT●●●

- 1 3.5" color touch screen LCD (320 x 240 pixels)
- 2 Holes for presence (motion) detection
- 3 Input connector (USB Micro-B port)
- 4 Power Supply (24 V \sim)
- 5 RS485 Modbus serial line
- 6 Holes for temperature and humidity measurement



TM172DCLWT●●●

TM172DCLF●●

- 1 3.5" color touch screen LCD (320 x 240 pixels)
- 2 Input connector (USB Micro-B port)
- 3 Power Supply (24 V \sim)
- 5 RS485 Modbus serial line



TM172DCLF●

(1) With landscape mounting, temperature and humidity sensors cannot be used as they are not accurate.

References

Remote color touch screen displays

Type	Description	Housing	Built-in sensor for	Reference	Weight kg/lb
Remote color touch screen wall mounting displays	<ul style="list-style-type: none"> ■ Power supply: 24 V \sphericalangle ■ Color touchscreen ■ Size: 3.5" ■ Resolution: 320 x 240 pixels ■ IP20 ■ Communication port: 1 RS485, Modbus SL with terminal blocks 	White	■ Temperature	TM172DCLWLT	0.340/ 0.749
			■ Temperature ■ Relative humidity	TM172DCLWTH	0.340/ 0.749
			■ Temperature ■ Relative humidity ■ Presence PIR	TM172DCLWTHP	0.340/ 0.749
Remote color touch screen flush mounting displays	<ul style="list-style-type: none"> ■ Power supply: 24 V \sphericalangle ■ Color touchscreen ■ Size: 3.5" ■ Resolution: 320 x 240 pixels ■ IP65 (front face) ■ Communication port: 1 RS485, Modbus SL with terminal blocks 	White	–	TM172DCLFW	0.205/ 0.452
		Gray	–	TM172DCLFG	0.205/ 0.452



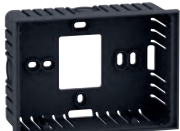
TM172DCLWTHP



TM172DCLFW



TM172DCLFG



TM172ABKPG

Accessories to be ordered separately

Type	Use	Reference	Weight kg/lb
Mounting accessories (1)	White wall support for TM172DCLFW display	TM172ABKPW	0.060/ 0.132
	Gray wall support for TM172DCLFG display	TM172ABKPG	0.060/ 0.132

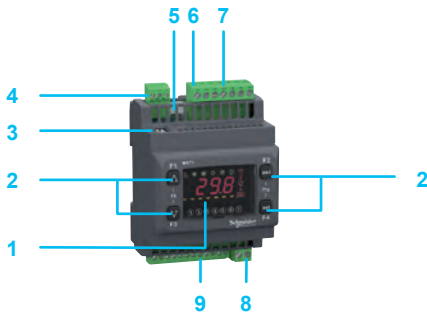
(1) With the use of TM172ABKP●● accessories, the degree of protection for the TM172DCLF● displays is IP20.

Presentation

M171 optimized controllers

The M171 optimized logic controllers comprise 10 models that can be used to control from 14 up to 22 embedded I/O (digital and analog).

- Two types of power supply are available:
 - 100-240 V ~
 - 12-24 V ~ or 24 V ⎓
- Two types of housing:
 - with built-in display
 - with remote display that can be added by means of the LAN expansion bus
- Two types of mounting:
 - Flush mounting: controllers to be mounted on a cabinet door
 - On 35 mm/1.38 in. rail mounting: controllers to be mounted inside a cabinet
- Communication ports on M171 optimized logic controllers:
 - One optional Modbus SL bus
 - One LAN expansion bus
- The M171 optimized logic controllers are certified CE, UL (recognized), cURus, CSA, EAC, RCM, RoHS China.



Description

35 mm/1.38 in. rail mounting M171 optimized controllers

TM171O●14R optimized logic controllers

- 1 Display
- 2 Four navigation keys for setting controller parameters
- 3 Programming port (TTL)
- 4 Removable terminal block for RS 485 serial port (TM171O●M14R)
- 5 Wired connector for LAN expansion bus
- 6 Mounting clip for 35 mm/1.38 in. rail mounting
- 7 Removable terminal block for digital outputs
- 8 Removable terminal block for 100...240 V ~ power supply
- 9 Removable terminal block for I/O



TM171O●22R optimized logic controllers (1)

- 1 Display
- 2 Four navigation keys for setting controller parameters
- 3 Programming port (TTL)
- 4 Wired connector for RS 485 serial port (TM171O●M14R)
- 5 Mounting clip for 35 mm/1.38 in. rail mounting
- 6 Removable terminal block for outputs
- 7 Wired connector for 12-24 V ~ or 24 V ⎓ power supply, and for low voltage I/O
- 8 Wired connector for analog output
- 9 Wired connector for LAN expansion bus



Flush mounting M171 optimized controllers

TM171OF●22R optimized logic controllers (1)

- 1 Display
- 2 Four navigation keys for setting controller parameters
- 3 Wired connector for RS 485 serial port (TM171OF●M22R)
- 4 Wired connector for analog outputs
- 5 Wired connector for LAN expansion bus
- 6 Programming port (TTL)

(1) Connectors to be ordered separately, see page 25.



TM171OBM14R



TM171OD14R



TM171ODM14R



TM171OB22R



TM171OBM22R



TM171OD22R



TM171ODM22R



TM171ODM22S



TM171OF22R



TM171OFM22R

References

M171 optimized logic controllers: Power supply: 100-240 V ~

35 mm/1.38 in. rail mounting optimized controllers (1)

No. of I/O	Number and type of channels	Embedded communication	Display	Reference	Weight kg/lb	
14	2 digital inputs: ■ 2 open collector or digital inputs (2) 5 configurable analog inputs: ■ 2 NTC, or PT1000, or digital inputs ■ 2 NTC, or 0-20 mA, or 4-20 mA, or 0-10 V, or 0-5 V, or 0-1 V, or digital inputs ■ 1 NTC, or PT1000, or 0-20 mA, or 4-20 mA, or 0-10 V, or 0-5 V, or 0-1 V, or digital input	4 digital outputs: ■ 3 SPST (2 A, 230 V ~) with the same common ■ 1 SPDT (2 A, 230 V ~)	■ 1 RS485 ■ 1 LAN expansion bus	Remote display (optional)	TM171OBM14R	0.190/ 0.420
				Built-in display	TM171OD14R	0.190/ 0.420
			■ 1 RS485 ■ 1 LAN expansion bus	Built-in display	TM171ODM14R	0.190/ 0.420

M171 optimized logic controllers: Power supply: 12-24 V ~ or 24 V ̄ (3) (4)

35 mm/1.38 in. rail mounting optimized controllers

22	6 digital inputs: ■ 6 volt-free in 1 group 5 configurable analog inputs: ■ 3 NTC or digital inputs ■ 2 NTC, or 0-20 mA, or 4-20 mA, or 0-10 V, or 0-5 V, or 0-1 V, or digital inputs	6 digital outputs: ■ 3 SPST (2 A, 230 V ~) with the same common ■ 2 SPST (2 A, 230 V ~) with independent common ■ 1 open collector 5 analog outputs: ■ 2 open collector for 12 V PWM/PPM ■ 3 x 0-10 V	■ 1 LAN expansion bus ■ 1 RS485 ■ 1 LAN expansion bus	Remote display (optional)	TM171OB22R	0.190/ 0.420
				Remote display (optional)	TM171OBM22R	0.190/ 0.420
			■ 1 LAN expansion bus ■ 1 RS485 ■ 1 LAN expansion bus	Built-in display	TM171OD22R	0.190/ 0.420
				Built-in display	TM171ODM22R	0.190/ 0.420
		6 digital outputs: ■ 3 SPST (2 A, 230 V ~) with the same common ■ 2 SSR (3 A, 230 V ~) ■ 1 open collector 5 analog outputs: ■ 2 open collector for 12 V PWM/PPM ■ 3 x 0-10 V	■ 1 RS485 ■ 1 LAN expansion bus	Built-in display	TM171ODM22S	0.190/ 0.420

Flush mounting optimized controllers

22	6 digital inputs: ■ 6 volt-free in 1 group 5 configurable analog inputs: ■ 3 NTC or digital input ■ 2 NTC, or 0-20 mA, or 4-20 mA, or 0-10 V, or 0-5 V, or 0-1 V, or digital inputs	6 digital outputs: ■ 3 SPST (2 A, 230 V ~) with the same common ■ 2 SPST (2 A, 230 V ~) with independent common ■ 1 open collector 5 analog outputs: ■ 2 open collector for 12 V PWM/PPM ■ 3 x 0-10 V	■ 1 LAN expansion bus ■ 1 RS485 ■ 1 LAN expansion bus	Built-in display	TM171OF22R	0.164/ 0.360
				Built-in display	TM171OFM22R	0.164/ 0.360

Remote display for M171 optimized logic controllers

Remote displays See page 26

Accessories for M171 optimized logic controllers

Connectors See page 27
 Low voltage connector, Analog output connector, Modbus SL connector, LAN expansion bus connector

(1) Terminal blocks are supplied with **TM171OBM14R**, **TM171OD14R**, and **TM171ODM14R**.
 (2) Both I/O are the same. On the same channel: 2 digital inputs or 2 analog outputs (depending on the configuration).
 (3) Except for **TM171ODM22S**: 12-24 V ~
 (4) Connectors to be ordered separately, see page 25.

Presentation

I/O expansion modules

Three I/O expansion modules are available, dedicated to M171 optimized logic controllers.

- They are used to increase the number of I/O up to 44 on M171 optimized logic controllers
- Expanded I/O types are digital and analog
- They are connected via the LAN expansion bus on M171 optimized logic controllers

Compatibility between logic controllers and I/O expansion modules

Logic controller type	Reference	Compatible I/O expansion module (reference)
M171 optimized	TM171OBM14R, TM171OD14R, TM171ODM14R	TM171EO14R
	TM171OB22R, TM171OBM22R, TM171OD22R, TM171ODM22R, TM171ODM22S, TM171OF22R, TM171OFM22R	TM171EO15R, TM171EO22R

Description

TM171EO●●R expansion modules (1)

35 mm/1.38 in. rail mounting I/O expansion modules

- 1 Service port (TTL)
- 2 Wired connector for removable terminal block for Modbus SL
- 3 Connector for removable terminal block for digital outputs
- 4 Wired connector for removable terminal block for power supply (12-24 V ~ or 24 V - -),
- 5 Wired connector for low voltage I/O
- 6 Clip for 35 mm/1.38 in. rail mounting
- 7 Wired connector for removable terminal block for analog outputs
- 8 Wired connector for removable terminal block for LAN expansion bus

(1) Removable terminal blocks to be ordered separately, except for **TM171EO14R**, see page 25.





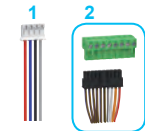
TM171EO14R



TM171EO15R



TM171EO22R



Connection accessories (2)
for expansion modules:
TM171EO15R, M171EO22R

References

I/O expansion modules for Modicon M171 optimized logic controllers

35 mm / 1.38 in. rail mounting expansion modules

No. of I/O	Number and type of channels	Compatibility	Embedded communication connection	Reference	Weight kg/lb
14	2 digital inputs: 2 open collector or digital inputs (1)	TM171OBM14R, TM171OD14R, TM171ODM14R	■ 1 LAN expansion bus	TM171EO14R	0.190/ 0.420
	4 digital outputs: ■ 3 SPST (2 A, 230 V ~) with the same common ■ 1 SPDT (2 A, 230 V ~)				
14	5 configurable analog inputs: ■ 2 NTC, PT1000 or digital inputs ■ 2 NTC, or 0-20 mA, or 4-20 mA, or 0-10 V, or 0-5 V, or 0-1 V, or digital inputs ■ 1 NTC, or PT1000, or 0-20 mA, or 4-20 mA, or 0-10 V, or 0-5 V, or 0-1 V, or digital input	TM171OBM14R, TM171OD14R, TM171ODM14R	■ 1 LAN expansion bus	TM171EO14R	0.190/ 0.420
	5 analog outputs: ■ 2 open collector for 12 V PWM/PPM or digital inputs (1) ■ 2 x 0-10 V ■ 1 x 4-20 mA				
15	6 digital inputs: voltage-free	TM171OB22R, TM171OBM22R, TM171OD22R, TM171ODM22R, TM171ODM22S, TM171OF22R, TM171OFM22R	■ 1 LAN expansion bus	TM171EO15R	0.190/ 0.420
	3 analog inputs: NTC or digital inputs				
15	4 digital outputs: ■ 3 2 A, 250 V ~ ■ 1 open collector	TM171OB22R, TM171OBM22R, TM171OD22R, TM171ODM22R, TM171ODM22S, TM171OF22R, TM171OFM22R	■ 1 LAN expansion bus	TM171EO15R	0.190/ 0.420
	2 analog outputs: open collector (PPM/PWM)				
22	6 digital inputs: voltage-free	TM171OB22R, TM171OBM22R, TM171OD22R, TM171ODM22R, TM171ODM22S, TM171OF22R, TM171OFM22R	■ 1 LAN expansion bus	TM171EO22R	0.190/ 0.420
	5 analog inputs: ■ 3 NTC or digital inputs ■ 2 NTC, or 0-20 mA, or 4-20 mA, or 0-10 V, or digital inputs				
22	6 digital outputs: ■ 5 2 A, 250 V ~ ■ 1 open collector	TM171OB22R, TM171OBM22R, TM171OD22R, TM171ODM22R, TM171ODM22S, TM171OF22R, TM171OFM22R	■ 1 LAN expansion bus	TM171EO22R	0.190/ 0.420
	5 analog outputs: ■ 2 open collector (PPM/PWM) ■ 3 x 0-10 V				

Accessories for I/O expansion modules

Designation	Description	Cable length (m/ft.)	Unit reference	Weight kg/lb
Accessories to be ordered separately				
Analog output connector (0-10 V outputs) Sold in lots of 5 (item 1)	Cordset equipped with a 4-pin connector at one end	1/3.3 2/6.6	TM171ACB4OAO1M TM171ACB4OAO2M	0.075/ 0.170 0.125/ 0.280
Low voltage connector Sold in lots of 5 (item 2)	Screw terminal block and a cordset equipped with a 20-pin connector at one end	1/3.3 2/ 6.6	TM171ACB4OI1M TM171ACB4OI2M	0.575/ 1.270 1.120/ 2.470
Accessory – Supplied with each expansion module				
LAN expansion bus connector Sold in lots of 5 (item 3)	Cordset equipped with a 3-pin connector at each end	2/6.6	TM171ACB4OLAN	0.060/ 0.130

(1) On the same channel: 2 digital inputs or 2 analog outputs (depending on the configuration).
(2) Minimum set for operating controllers.

Presentation

Remote displays for M171 optimized logic controllers

The four available remote displays for the M171 optimized logic controller offer are distinguished by technology and type of mounting.

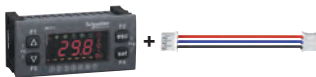
- Technology: LED display or LCD display, with or without backlight
- Mounting: flush mounting or wall mounting

The remote displays are connected to the LAN expansion bus which provides the power supply.

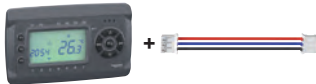
References

Type	Description	Reference	Weight kg/lb
Remote flush mounting displays With realtime clock	<ul style="list-style-type: none"> ■ LED display: 4 digits,7 segments ■ Keyboard: 4 buttons ■ Communication port: 1 for LAN expansion bus – with wired connector (1) or screw terminal blocks 	TM171DLED	0.042/ 0.090
	<ul style="list-style-type: none"> ■ LCD display (with segments) ■ Keyboard: 7 buttons ■ Flush mounting ■ Communication port: 1 for LAN expansion bus – with screw terminal blocks ■ 2 analog inputs: <ul style="list-style-type: none"> - 1 NTC or digital input - 1 NTC or 4-20 mA or digital input 	TM171DLCD2U	0.170/ 0.370
Remote wall mounting displays With realtime clock	<ul style="list-style-type: none"> ■ Without backlight 	TM171DWAL2U	0.143/ 0.320
	<ul style="list-style-type: none"> ■ With backlight 	TM171DWAL2L	0.143/ 0.320

(1) Supplied with LAN expansion bus connector **TM171ACB4OLAN**



TM171DLED (1)



TM171DLCD2U



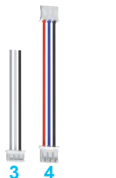
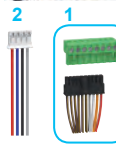
TM171DWAL2U



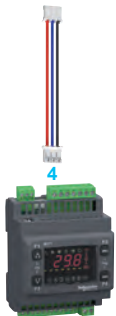
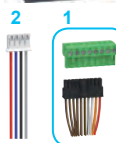
TM171DWAL2L



Connection accessories (1) for M171 optimized logic controller (rail mounting):
TM171OB22R, TM171OBM22R,
TM171OD22R, TM171ODM22R and
TM171ODM22S



Connection accessories (1) for M171 optimized logic controller (flush mounting):
TM171OF22R and TM171OFM22R



Connection accessories (1) for M171 optimized logic controller (rail mounting):
TM171OBM14R, TM171OD14R,
TM171ODM14R
N.B.: terminal blocks are supplied with
TM171OBM14R, TM171OD14R, and
TM171ODM14R

References

Connection accessories for M171 optimized logic controllers to be ordered separately

Type	Item	Description	Cable length (m/ft.)	Unit reference	Weight kg/lb
Low voltage connector Sold in lots of 5	1	Screw terminal block and a cordset equipped with a 20-pin connector at one end	1/3.3	TM171ACB4OI1M	0.575/ 1.270
			2/6.6	TM171ACB4OI2M	1.120/ 2.470
Analog output connector (0-10 V outputs) Sold in lots of 5	2	Cordset equipped with a 4-pin connector at one end	1/3.3	TM171ACB4OAO1M	0.075/ 0.170
			2/6.6	TM171ACB4OAO2M	0.125/ 0.280
Modbus SL connector Sold in lots of 5	3	Cordset equipped with a 3-pin connector at one end	1/3.3	TM171ACB4ORS485	0.052/ 0.110
LAN expansion bus connector Sold in lots of 5	4	Cordset equipped with a 3-pin connector at each end	2/6.6	TM171ACB4OLAN	0.060/ 0.130

(1) Minimum set for operating controllers.

Presentation

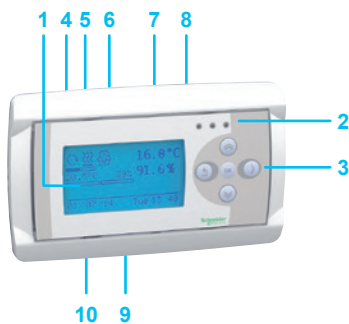
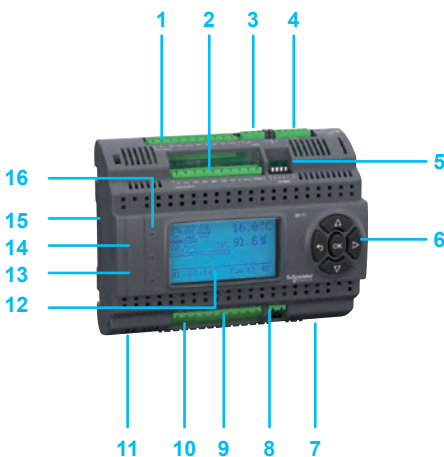
M171 performance logic controllers

M171 performance logic controllers comprise 5 models that can be used to control from 3 up to 27 embedded I/O (digital and analog).

- Power supply: 24 V \sim or 48 V ---
- Two types of housing:
 - with built-in display
 - without display

Each controller includes a connection (through the CAN expansion bus or through Modbus SL) for a remote display, available in the catalog.

- Two types of mounting:
 - On 35 mm/1.38 in. \perp rail mounting: controllers to be mounted inside a cabinet
 - Flush mounting: controllers to be mounted on a cabinet door or wall-mounted using the wall bracket accessory, [see page 29](#).
- Communication ports on M171 performance logic controllers:
 - One Modbus SL master/slave
 - Two USB
 - One CAN expansion bus
 - On flush mounting version:
 - One Modbus SL master/slave
 - One Modbus TCP and BACnet IP (B-AAC profile) (WebVisu)
 - One CAN expansion bus
- M171 performance logic controllers can be connected to communication modules, adding another connection for the CAN expansion bus, Ethernet network, or Profibus, etc., [see page 32](#).
- M171 performance logic controllers are certified CE, cURus (UL Recognized), CSA, EAC, RCM, RoHS China.



Description

35 mm/1.38 in. \perp rail mounting performance controllers

TM171P●M27● performance logic controllers (1)

- 1 Connector for removable terminal block for digital inputs
- 2 Connector for removable terminal block for analog inputs
- 3 Connector for removable terminal block for Modbus SL
- 4 Connector for removable terminal block for CAN expansion bus
- 5 4-position DIP switches for address selection
- 6 Five command keys for setting controller parameters
- 7 Connector for removable terminal block for power supply (24 V \sim , 48 V ---)
- 8 Connector for removable terminal block for fast digital inputs (high speed counter)
- 9 Connector for removable terminal block for digital outputs
- 10 Connector for removable terminal block for analog outputs
- 11 Mounting clips for 35 mm/1.38 in. \perp rail mounting
- 12 On **TM171PDM27●**: display
On **TM171PBM27R**: 6- and 10-position DIP switches, behind a front panel

Behind the removable protective cover: 13 and 14

- 13 USB mini-B port to connect a PC
- 14 USB-A port for USB stick
- 15 Connector for communication module
- 16 Three status LEDs

Flush mounting performance controllers

TM171PFE03R●●● performance logic controllers (2)

- 1 Display
- 2 Three status LEDs
- 3 Five command keys for setting controller parameters

On the rear side of the controller

- 4 Terminal block for power supply (24 V \sim or 48 V ---)
- 5 Terminal block for CAN expansion bus
- 6 Terminal block for Modbus SL
- 7 Terminal block for analog input
- 8 RJ45 connector for Ethernet
- 9 Built-in NTC sensor (analog)
- 10 Built-in humidity sensor (analog) (on **TM171PFE03HR**)

(1) **TM171ASCTB27** removable terminal blocks to be ordered separately, [see page 29](#).

(2) Terminal blocks supplied with flush mounting version of performance controllers.



TM171PBM27R



TM171PDM27R



TM171PDM27S



TM171PFE03



TM171PFE03HR



TM171ASCTB27



TM171ABKPB



TM171ABKPG



TM171DGRP

References

M171 performance logic controllers: Power supply: 24 V ~, 48 V ---

35 mm/1.38 in. rail mounting performance controllers

No. of I/O	Number and type of channels	Embedded communication port	Display	Reference	Weight kg/lb
27	9 digital inputs (8 + 1): ■ 2 groups of 4 digital inputs, 24 V ~ or 48 V --- ■ 1 fast digital input, or high speed counter volt-free 6 configurable analog inputs: ■ 2 NTC or digital inputs, or 4-20 mA, or 0-5 V, or 0-10 V, or 0-30 kΩ/0-5 kΩ variable resistor, or digital inputs	7 digital outputs: ■ 2 SPDT (8 A, 230 V ~) with independent common ■ 5 SPST (5 A, 230 V ~) with independent common 5 analog outputs: ■ 3 x 0...+10 V or 4-20 mA ■ 2 x 0...+10 V, or 4-20 mA, or digital output open collector 7 digital outputs: ■ 2 SPDT (8 A, 230 V ~) with independent common ■ 3 SPST (5 A, 230 V ~) with independent common ■ 2 SSR (1 A, 230 V ~) outputs 5 analog outputs: ■ 3 x 0...+10 V or 4-20 mA ■ 2 x 0...+10 V, or 4-20 mA, or digital output open collector	■ 1 RS485 ■ 1 CAN expansion bus Remote display (optional)	TM171PBM27R	0.385/ 0.850
			■ 1 RS485 ■ 1 CAN expansion bus Built-in display 128x64 LCD with backlight	TM171PDM27R	0.385/ 0.850
27	9 digital inputs (8 + 1): ■ 2 groups of 4 digital inputs, 24 V ~ or 48 V --- ■ 1 fast digital input, or high speed counter volt-free 6 configurable analog inputs: ■ 2 NTC or digital inputs, or 4-20 mA, or 0-5 V, or 0-10 V, or 0-30 kΩ/0-5 kΩ variable resistor, or digital inputs	7 digital outputs: ■ 2 SPDT (8 A, 230 V ~) with independent common ■ 5 SPST (5 A, 230 V ~) with independent common 5 analog outputs: ■ 3 x 0...+10 V or 4-20 mA ■ 2 x 0...+10 V, or 4-20 mA, or digital output open collector 7 digital outputs: ■ 2 SPDT (8 A, 230 V ~) with independent common ■ 3 SPST (5 A, 230 V ~) with independent common ■ 2 SSR (1 A, 230 V ~) outputs 5 analog outputs: ■ 3 x 0...+10 V or 4-20 mA ■ 2 x 0...+10 V, or 4-20 mA, or digital output open collector	■ 1 RS485 ■ 1 CAN expansion bus Remote display (optional)	TM171PDM27S	0.385/ 0.850
			■ 1 RS485 ■ 1 CAN expansion bus Built-in display	TM171PDM27S	0.385/ 0.850

Flush mounting performance controllers (to be used with the wall bracket accessory – see below)

No. of I/O	Number and type of channels	Embedded communication port	Display	Reference	Weight kg/lb
3	3 configurable analog inputs: ■ 1 built-in NTC ■ 1 NTC or digital input ■ 1 x 4-20 mA or 0-10 V 3 configurable analog inputs: ■ 1 built-in NTC ■ 1 NTC or digital input ■ 1 built-in humidity sensor	■ 1 RS485 ■ 1 CAN expansion bus ■ 1 RJ45 for Modbus TCP and BACnet IP (B-AAC profile) and MS/TP (B-AAC profile)	Built-in display	TM171PFE03	0.320/ 0.710
			Built-in display	TM171PFE03HR	0.350/ 0.770

Accessories for M171 performance logic controllers to be ordered separately

Designation	Use	Reference	Weight kg/lb
Screw terminal blocks	For TM171PBM27R, TM171PDM27R, and TM171PDM27S	TM171ASCTB27	0.100/ 0.220
Wall bracket for flush mounting performance logic controllers	For TM171PFE03 and TM171PFE03HR	TM171ABKPB TM171ABKPG	0.015/ 0.030 0.015/ 0.030

Remote display, HMI

Type	Description	Reference	Weight kg/lb
Remote display	128x64 LCD, with backlight Use for M171 performance and M172 logic controllers	TM171DGRP	0.197/ 0.430
HMI Magelis STU/STO	Please consult our website: www.schneider-electric.com		

Presentation

I/O expansion modules for Modicon M171 and M172 logic controllers

Two I/O expansion modules are available, dedicated to M171 performance logic controllers, and also compatible with M172 logic controllers.

- They are used to increase the number of I/O:
 - up to 351 on M171 performance logic controllers
 - up to 366 on M172 logic controllers
- Expanded I/O types are digital and analog
- They are connected via the CAN expansion bus on M171 performance and M172 logic controllers.

Compatibility between logic controllers and I/O expansion modules

Logic controller type	Reference	Compatible I/O expansion module (reference)
M171 performance	TM171PBM27R, TM171PDM27R, TM171PDM27S, TM171PFE03, TM171PFE03HR	TM171EP14R, TM171EP27R
M172	TM172OBM18R, TM172ODM18R, TM172PBG07R, TM172PDG07R, TM172PBG18R, TM172PDG18R, TM172PDG18S, TM172PBG28R, TM172PDG28R, TM172PDG28S, TM172PBG42R, TM172PDG42R, TM172PDG42S	

Description

35 mm/1.38 in. 1/2 rail mounting I/O expansion modules

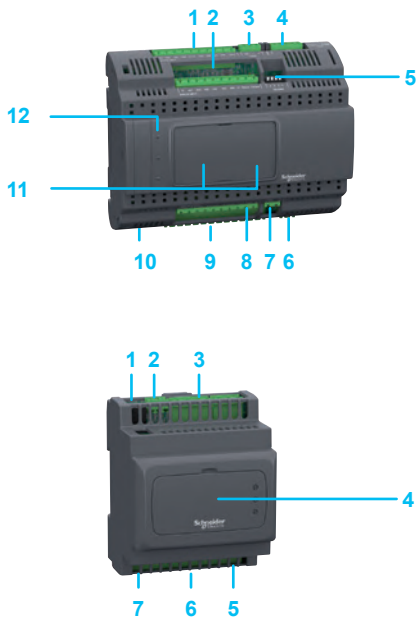
TM171EP27R expansion module (1)

- 1 Connector for removable terminal block for digital inputs
- 2 Connector for removable terminal block for analog inputs
- 3 Connector for removable terminal block for Modbus SL
- 4 Connector for removable terminal block for CAN expansion bus
- 5 4-position DIP switches for address selection
- 6 Connector for removable terminal block for power supply (24 V $\overline{\sim}$, 48 V $\overline{\sim}$)
- 7 Connector for removable terminal block for fast digital inputs
- 8 Connector for removable terminal block for digital outputs
- 9 Connector for removable terminal block for analog outputs
- 10 Clip for 35 mm/1.38 in. 1/2 rail mounting
- 11 6- and 10-position DIP switches for address selection
- 12 3 status LEDs

TM171EP14R expansion module (1)

- 1 4-position DIP switches
- 2 Connector for removable terminal block for CAN expansion bus
- 3 Removable terminal block for digital outputs
- 4 Behind the removable protective cover: Service port (TTL)
- 5 Connector for low voltage I/O
- 6 Clip for 35 mm/1.38 in. 1/2 rail mounting
- 7 Connector for removable terminal block for power supply (24 V $\overline{\sim}$)

(1) Removable terminal blocks to be ordered separately, see page 31



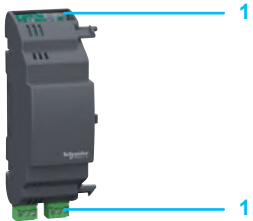
Presentation

Communication modules for M171 performance and M172 logic controllers

The communication module offer is dedicated to M171 performance and M172 logic controllers (1).

The 8 optional modules provide specific connections:

- To fieldbuses, including:
 - CAN bus
 - Modbus TCP
 - Profibus
 - Modbus SL (RS 485)
 - BACnet MS/TP (B-AAC profile)
 - BACnet IP (B-AAC profile)
 - RS 232 serial link
 - LonWorks (FFT-10)
 - Konnex (KNX) via Schneider Electric' spaceLYnk gateway, please consult our website: www.schneider-electric.com
- To services, including:
 - Ethernet
 - WebVisu and remote download functions
- They are mounted by simply interlocking on the left-hand side of M171 performance or M172 logic controllers (1). Only one communication module can be added to a logic controller.
- The communication module is powered by the controller.
- Each communication module has its own type of connector, adapted to the bus or communication network, see page 33.



Description

TM171A●●●● I/O communication modules

- 1 Communication connector (1)
- 2 Locking device
- 3 Expansion connector to the controller (2)
- 4 Clip for 35 mm/1.38 in. 1/2 rail mounting

(1) The communication connector type depends on the communication modules, see page 32.

(2) Compatibility between M172 optimized, M172 performance and M171 performance logic controllers and communication modules, see table below:

Compatibility between logic controllers and communication modules

Logic controllers	Communication modules
M172 optimized logic controllers (TM172O●●●●)	TM171ACAN, TM171AMB, TM171ARS485, TM171ARS232, TM171ALON, TM171AETH, TM171AETHRS485, TM171APBUS
M172 performance logic controllers (TM172P●●●●)	TM171ACAN, TM171AMB, TM171ARS485, TM171ARS232, TM171ALON
M171 performance logic controllers (TM171P●●●●)	TM171ACAN, TM171AETH, TM171APBUS, TM171AMB, TM171ARS485, TM171ARS232, TM171AETHRS485, TM171ALON

References

Communication modules for M171 performance and M172 logic controllers

35 mm / 1.38 in. rail mounting

Fieldbus, services access	Compatibility with logic controller	Communication port	Reference (1)	Weight kg/lb
<ul style="list-style-type: none"> ■ CAN 	M172 optimized, M172 performance, M171 performance	<ul style="list-style-type: none"> ■ 2 screw terminal blocks (1) 	TM171ACAN	0.077/ 0.170
<ul style="list-style-type: none"> ■ Modbus TCP ■ Ethernet ■ BACnet IP (B-AAC profile) ■ WebVisu and remote download functions 	M171 performance M172 optimized	<ul style="list-style-type: none"> ■ 1 RJ45 	TM171AETH	0.077/ 0.170
<ul style="list-style-type: none"> ■ Profibus 	M171 performance M172 optimized	<ul style="list-style-type: none"> ■ 1 SUB-D 9 	TM171APBUS	0.077/ 0.170
<ul style="list-style-type: none"> ■ Modbus SL (RS485) 	M172 optimized, M172 performance, M171 performance	<ul style="list-style-type: none"> ■ 2 screw terminal blocks (1) 	TM171AMB	0.077/ 0.170
<ul style="list-style-type: none"> ■ Modbus SL or BACnet MS/TP (B-AAC profile) 	M172 optimized, M172 performance, M171 performance	<ul style="list-style-type: none"> ■ 2 screw terminal blocks (1) 	TM171ARS485	0.077/ 0.170
<ul style="list-style-type: none"> ■ RS 232 serial link ■ Relay output 	M172 optimized, M172 performance, M171 performance	<ul style="list-style-type: none"> ■ 1 SUB-D 9 for RS 232 ■ 1 screw terminal block for relay output (1) 	TM171ARS232	0.077/ 0.170
<ul style="list-style-type: none"> ■ Modbus TCP and BACnet/IP ■ Modbus SL or BACnet MS/TP (B-AAC profile) ■ WebVisu and remote download functions ■ Ethernet 	M171 performance M172 optimized	<ul style="list-style-type: none"> ■ 1 RJ45 for Ethernet ■ 2 screw terminal blocks for RS485 (1) 	TM171AETHRS485	0.077/ 0.170
<ul style="list-style-type: none"> ■ LonWorks (FFT-10) 	M172 optimized, M172 performance, M171 performance	<ul style="list-style-type: none"> ■ 1 screw terminal block for LON bus 	TM171ALON	0.077/ 0.170



TM171ACAN



TM171AETH



TM171APBUS



TM171AMB



TM171ARS485



TM171ARS232



TM171AETHRS485



TM171ALON

(1) Removable terminal blocks supplied with communication modules.

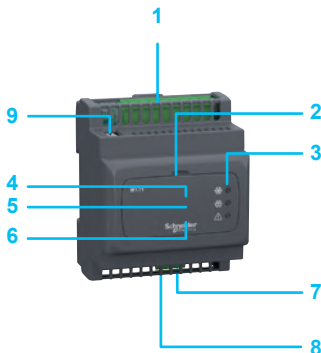
Presentation

Electronic expansion valve drivers

The 3 types of electronic expansion valve drivers are used to control the electronic expansion valve so as to control superheating after the evaporator.

- They are compatible with either performance or optimized logic controllers.
- They operate independently on measurement accessories such as:
 - NTC or PT1000 probes
 - Pressure transducers
- The 3 available electronic expansion valve drivers are compatible with competing valve brands such as those given in the table below:

Electronic expansion valve drivers Brand and type	Expansion valves Brand and type
Schneider Electric TM171VEVA2, TM171VEVD4, TM171VEVM4	ELIWELL™ SXVB
	ALCO™ EX4, EX5, EX6, EX7, EX8
	DANFOSS™ ETS50, ETS100
	SPORLAN™ SER(I) G, J, K, B, C, D SER1.5 to 20, SEI 30,50, SEH



Description

35 mm/1.38 in. rail mounting

TM171V●● electronic expansion valve drivers (1)

- 1 Output terminal block and power supply connector (24 V \sim)
 - 2 Protective cover
 - 3 Three status LEDs
- Behind the removable protective cover:
- 4 6-position DIP switches
 - 5 Status LED (for operation with TM171AMFK programming stick)
 - 6 LAN serial port for connecting TM171DLED remote display
 - 7 Terminal block for analog/digital inputs
 - 8 Clip for 35 mm/1.38 in. rail mounting
 - 9 TTL programming port

(1) TM171ASCTBVEV screw terminal block to be ordered separately, see page 35

References

Electronic expansion valve drivers

Application	Number and type of channels	Reference	Weight kg/lb
Actuator, convert 0-10 V or 4-20 mA in opening position contact	Inputs	Outputs	
	1 analog input: 1 x 4-20 mA, 0-5 V, or 0-10V	1 digital output: 1 open collector (100 mA, 12 V $\overline{---}$)	TM171VEVA2 0.190/ 0.420
Autonomous, wired to manage On/Off contact	2 digital inputs: ■ 2 volt-free ■ 2 NTC or PT1000, 4-20 mA, 0-5 V, or 0-10 V	2 digital outputs: ■ 1 open collector (100 mA, 12 V $\overline{---}$) ■ 1 SPST NO relay contact, 5 A, 250 V \sim	TM171VEVD4 0.190/ 0.420
	4 analog inputs: ■ 2 NTC or PT1000 (1)		
Autonomous, managed by Modbus (RS485)	2 digital inputs: ■ 2 volt-free	2 digital outputs: ■ 1 open collector (100 mA, 12 V $\overline{---}$) ■ 1 SPST NO relay contact, 5 A, \sim 250 V	TM171VEVM4 0.190/ 0.420
	4 analog inputs: ■ 2 NTC (-50...+110 °C, -40...+150 °C/ -58...+203 °F, -40...+302 °F), PT1000, 4-20 mA, 0-5 V, or 0-10 V (1) ■ 2 NTC (-50...+110 °C, -40...+150 °C/ -58...+203 °F, -40...+302 °F), or PT1000 (1)		



TM171VEVA2



TM171VEVD4



TM171VEVM4








Accessories for electronic expansion valve drivers to be ordered separately

Designation	For connecting	Reference	Weight kg/lb
Screw terminal block for electronic expansion valve drivers	Power supply, sensor power supply, digital and analog I/O, Modbus link	TM171ASCTBVEV	0.050/ 0.110







TM171ASCTBVEV

(1) Two PT1000 (-50...+99.9 °C/-58... + 211.82 °F).

References								
Designation	Use Applications	Description	Cable length m (ft)	Unitreference	Sold in lots of (1)	Weight kg/ lb		
Measurement accessories								
Temperature control								
NTC probes 	Multi-purpose ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- IP 68 - Gray - Equipped with 2 conductor cables for controller side	1.5 (4.92)	TM1STNTCRN52015	8	0.144/0.320		
						TM1STNTCRN5201P	100	0.144/0.320
			3 (9.84)			TM1STNTCRN52030	5	0.180/0.400
						TM1STNTCRN5203P	50	0.180/0.400
			5 (16.40)			TM1STNTCRN52050	4	0.228/0.500
				TM1STNTCRN5205P	25	0.228/0.500		
NTC probes 	Multi-purpose ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- IP 67 - Gray - Equipped with 2 conductor cables for controller side	1.5 (4.92)	TM1STNTCRN61515	8	0.104/0.230		
						TM1STNTCRN6151P	100	0.104/0.230
			3 (9.84)			TM1STNTCRN61530	5	0.125/0.280
						TM1STNTCRN6153P	50	0.125/0.280
			5 (16.40)			TM1STNTCRN61550	4	0.164/0.360
				TM1STNTCRN6155P	25	0.164/0.360		
NTC probes 	Multi-purpose ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- FAST - IP 67 - Gray - Equipped with 2 conductor cables for controller side	1.5 (4.92)	TM1STNTCSF44015	8	0.144/0.320		
						TM1STNTCSF4401P	100	0.144/0.320
			3 (9.84)			TM1STNTCSF44030	5	0.175/0.390
						TM1STNTCSF4403P	50	0.175/0.390
NTC probes 	Multi-purpose ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- IP 68 - Gray - Equipped with 2 conductor cables for controller side	1.5 (4.92)	TM1STNTCSN62015	8	0.144/0.320		
						TM1STNTCSN6201P	100	0.144/0.320
			3 (9.84)			TM1STNTCSN62030	5	0.175/0.390
						TM1STNTCSN6203P	50	0.175/0.390
			5 (16.40)			TM1STNTCSN62050	4	0.232/0.510
				TM1STNTCSN6205P	25	0.232/0.510		
NTC probes with a strap 	Pipe ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- IP 68 - Gray - Equipped with 2 conductor cables for controller side - Equipped with strap	1.5 (4.92)	TM1STNTCTN62015	8	0.152/0.340		
						TM1STNTCTN6201P	100	0.152/0.340
			3 (9.84)			TM1STNTCTN62030	5	0.180/0.400
						TM1STNTCTN6203P	50	0.180/0.400
PT1000 probes 	Multi-purpose ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- IP 68 - Green - Equipped with 2 conductor cables for controller side	1.5 (4.92)	TM1STPPTS62015	8	0.144/0.320		
						TM1STPPTS6201P	100	0.144/0.320
			3 (9.84)			TM1STPPTS62030	5	0.175/0.390
						TM1STPPTS6203P	50	0.175/0.390
PT1000 probes 	Multi-purpose ■ Temperature control: - 50...+110 °C (-122...+230 °F)	- IP 68 - Green - Equipped with 2 conductor cables for controller side	1.5 (4.92)	TM1STPPTS52015	8	0.136/0.300		
						TM1STPPTS5201P	100	0.136/0.300
			3 (9.84)			TM1STPPTS52030	5	0.175/0.390
						TM1STPPTS5203P	50	0.175/0.390
			5 (16.40)			TM1STPPTS52050	4	0.232/0.510
				TM1STPPTS5205P	25	0.232/0.510		

(1) The given value is the number of products delivered for one ordered reference.

References					
Designation	Use Applications	Description	Reference	Weight kg/ lb	
Measurement accessories					
Temperature control					
NTC probe 	Outside air	- IP 65 - Wall mounting - NTC 10kOhm /25°C	TM1STNTCW69755	0.050/ 0.110	
	■ Temperature control: -50...100 °C (-58...212 °F)				
NTC probe 	Inside air (room)	- IP 30 - Indoor wall mounting - NTC 10kOhm /25°C	TM1STNTCWN75750	0.050/ 0.110	
	■ Temperature control: -25...40 °C (-13...104 °F)				
Humidity control					
Humidity probe 	Multi-purpose	- IP 65 - Wall mounting - 4-20 mA	TM1SHC4	0.140/ 0.308	
	■ Humidity control: 0...100%				
Humidity & temperature control					
Humidity & temperature probes 	Multi-purpose	- IP 65 - Wall mounting - 4-20 mA, NTC 10kOhm /25°C	TM1SHTCN4	0.140/ 0.308	
	■ Humidity control: 0...100% ■ Temperature control: -40...60 °C (-40...140 °F)				
	Multi-purpose	- IP 65 - Wall mounting - 2x 4-20 mA			TM1SHTCC4
■ Humidity control: 0...100% ■ Temperature control: -40...60 °C (-40...140 °F)					
	Multi-purpose	- IP 65 - Wall mounting - 2x Modbus ports embedded (RS-485 / Modbus RTU)	TM1SHTM4	0.140/ 0.308	
	■ Humidity control: 0...100% ■ Temperature control: -40...60 °C (-40...140 °F)				



XMLP pressure transmitters

Presentation

Schneider Electric recommends his partner Telemecanique Sensors, which proposes the range of XMLP pressure transmitters.

XMLP pressure transmitters rated greater than or equal to 9 bar or 100 psi

These transmitters integrate a metal pressure measuring cell. This measuring cell, which is welded directly onto the AISI 316L stainless steel transmitter body, offers the following advantages:

- An all-metal pressure chamber, with no elastomer gasket in contact with the fluid
 - Compatibility with a large number of fluids: air, fresh water, hydraulic oils, refrigeration fluids, all fluids or gases compatible with AISI 316L stainless steel
- > Pressure transmitters can control fluids ranging in temperature from -30 to 120 °C. (-22 to 248 °F)

General characteristics

- > Made of stainless steel, XMLP pressure transmitters are compact and rugged.
- > Their degree of protection varies according to the type of connector:
 - IP 65 for EN 175301-803-A connector versions
 - IP 65 and IP 67 for Packard Metri-Pack connector versions
 - IP 65, IP 67 and IP 69K for M12 connector versions
- > With typical precision better than 0.5% of the rating, XMLP transmitters are suitable for industrial applications such as HVAC systems (for ratings greater than or equal to 9 bar or 100 psi only)
- > Their power supply (1) depends on the type of analogue output:
 - 5 V +/- 10% for the 0.5...4.5 V ratiometric output
 - 12 or 24 V (nominal), operating from 7 to 33 V for the 4...20 mA output
 - 24 V (nominal), operating from 12 to 33 V for the 0...10 V output

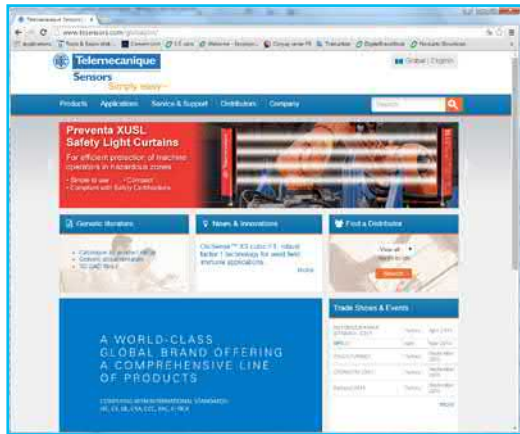
Functions

XMLP pressure transmitters have an analogue output which delivers a signal proportional to the measured pressure.

This output can be one of the following types:

- 4...20 mA
 - 0...10 V
 - 0.5...4.5 V ratiometric
- > The pressure ranges available are:
- vacuum measuring
 - -1...0 bar
 - -14.5...0 psi
 - pressure measuring
 - 0...600 bar
 - 0...6,000 psi
 - combined pressure measuring (vacuum and pressure)
 - -1...25 bar
 - -14.5...60 psi
- > The XMLP offer is available with four types of electrical connection:
- M12, 4-pin connector
 - EN 175301-803-A (ex DIN 43650) connector
 - Packard Metri-Pack 150 connector
 - 2 m PVC cable
- > Several types of fluid connection are available:
- G1/4 A male
 - 1/4"-18NPT male
 - SAE 7/16-20UNF-2A male
 - SAE 7/16-20UNF-2B female (with or without Schrader pin depending on the model)

(1) Use Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV) power supply.



Discover XMLP offer on the web site:
<http://www.tesensors.com/global>
 Access to the catalog by product at this URL:
<http://www.tesensors.com/global/en/product/catalog/>

Application	Type of machine controlled	Compressor			
		Number of phases			
		1	3		
	Type of motor	Asynchronous	Asynchronous and Synchronous	Asynchronous and Synchronous for scroll	
Compressor size	0.18 kW (0.25 HP)	Altivar 12	Altivar 320	-	
	0.37 kW (0.5 HP)			-	
	0.75 kW (1 HP)			Altivar 212	
	2.2 kW (0.25 HP)				
	4.0 kW (5 HP)				
	7.5 kW (10 HP)				-
	15 kW (20 HP)				-
	18.5 kW (25 HP)				-
	22 kW (30 HP)				-
	30 kW (40 HP)				-
	37 kW (50 HP)	-			
	45 kW (60 HP)	-			
	55 kW (67 HP)	-			
	75 kW (100 HP)	-			
	90 kW (120 HP)	Altivar Process ATV600	-		
	110 kW (150 HP)		-		
	315 kW (422 HP)		-		
	355 kW (480 HP)		-		
	400 kW (540 HP)		-		
	450 kW (603 HP)		-		
500 kW (670 HP)	Altivar Process Drive Systems (1)		-		
560 kW (750 HP)			-		
630 kW (850 HP)			-		
710 kW (950 HP)			-		
800 kW (1100 HP)		-			

Compatible range of variable speed drives

Application	Type of machine controlled	Fan	
		Number of phases	
		1	3
Fan size	0.18 kW (0.25 HP)	Altivar 12	-
	0.37 kW (0.5 HP)		-
	0.75 kW (1 HP)		Altivar 212
	2.2 kW (0.25 HP)		
	4.0 kW (5 HP)		
	7.5 kW (10 HP)	-	
	15 kW (20 HP)	-	
	75 kW (100 HP)	-	
	> 75 kW (> 100 HP)	-	Altivar Process ATV600 and Altivar Process Drive Systems (1)

Compatible range of variable speed drives

(1) Altivar Process Drive Systems is a customized offer based on Altivar Process ATV600 products.

Presentation



EcoStruxure Machine Expert - HVAC programming software

Software solution

EcoStruxure Machine Expert - HVAC programming software is compliant with IEC 61131-3. It can be used to develop, configure, and commission HVAC solution systems.

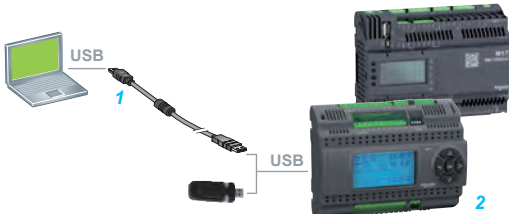
It includes:

- Programming Modicon M171/M172 logic controllers (performance and optimized) and remote display units
- Setting up expansion buses and networks
- Creating the screen of the displays (built-in and displays of the M171/M172 logic controller offer)
- Configuring BMS communication modules on BACnet MS/TP (B-AAC profile), Modbus SL, Modbus TCP, BACnet MS/TP, BACnet IP (B-AAC profile), and LonWorks (FFT-10)
- Dedicated libraries such as:
 - a library of application function blocks
 - a library of Tested, Validated, and Documented Applications (TVDA)
- Full simulation mode

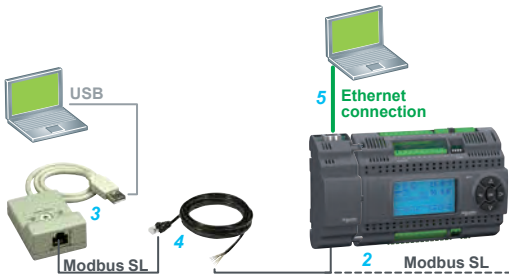
General characteristics

Overview

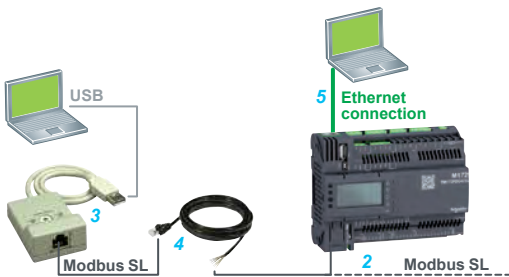
Programming languages	<ul style="list-style-type: none"> ■ ST (Structured Text) ■ FBD (Function Block Diagram) ■ LD (Ladder) ■ IL (Instruction List) ■ SFC (Sequential Function Chart)
Applications	<ul style="list-style-type: none"> ■ Graphical and text-based languages: <ul style="list-style-type: none"> - Adaptation to each developer background - Library management - Code debugging - Parameter definition - Simulation mode ■ Advanced programming: <ul style="list-style-type: none"> - Vectors - Pointers
System solutions management	<ul style="list-style-type: none"> ■ Multi-target project ■ Management of Modbus data ■ Data exchange between several Modicon M171/M172 performance logic controllers
Graphical user interface	<ul style="list-style-type: none"> ■ Graphic display: <ul style="list-style-type: none"> - Multipage - Buttons - Edit box - Static text - Images - Animations - Bars - Lists of data (parameters/variables/alarms) ■ Configurable buttons ■ Multilanguage ■ Automatic documentation
Communication bus configurators	<ul style="list-style-type: none"> ■ Control networks: Modbus TCP, Modbus SL, Profibus ■ Expansion bus fieldbus: CAN expansion bus ■ BMS connectivity: BACnet MS/TP (B-AAC profile), BACnet IP (B-AAC profile), LonWorks (FFT-10)
Advanced simulation options	<ul style="list-style-type: none"> ■ Full simulation <ul style="list-style-type: none"> - I/O emulation - HMI - IEC code - Live debug - Triggers - Oscilloscope
Advanced debugging and simulation options	<ul style="list-style-type: none"> ■ Remote control/download: <ul style="list-style-type: none"> - Modbus SL & TCP - CAN - Modem ■ Parameter management ■ Status monitoring ■ Field test: <ul style="list-style-type: none"> - Oscilloscope - Debug window - Export to Excel



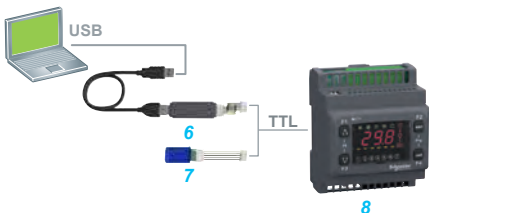
Local programming, download - M171 & M172 performance - through USB port



Remote programming - M171 performance



Remote programming - M172 performance



Local programming, download - M171 optimized - via TTL port



Remote programming - M171 optimized

Product offer

EcoStruxure Machine Expert - HVAC software is supplied on a DVD or can be downloaded from our website www.schneider-electric.com. The product version concerned offers the EcoStruxure Machine Expert - HVAC functions associated with logic controllers.

References

System configuration:

- Processor: Pentium 1.6 GHz or higher
- RAM: 1 GB; 2 GB recommended
- Hard disk: 500 MB minimum
- OS: 32-bit Windows; XP Pro SP3 or Windows 7 (32-bit or 64-bit) or Windows 8
- Drive: DVD drive
- Display: SVGA video card; 800×600, 128 MB; 1024×768, 256 MB recommended
- Peripheral device: A mouse or compatible pointing device
- Peripheral device: USB interface

Programming software

Designation	Application	Reference	Weight kg/lb
EcoStruxure Machine Expert - HVAC programming software	M171 optimized logic controllers, M171 performance logic controllers,	TM171SW	0.050/0.110
	M172 optimized logic controllers, M172 performance logic controllers		

Programming accessories for M171 and M172 performance logic controllers

The USB cable is recommended for local programming. An Ethernet port is recommended for remote download or remote programming.

Description	Characteristics and use	Length m/ft.	Reference	Weight kg/lb
Programming via USB port				
Programming cables (1)	From the PC USB-A port to the USB mini-B port on M171 (2) and M172 performance logic controllers (2)	3/0.98	TCSXCNAMUM3P (1)	0.065/0.143
		1.8/5.90	BMXXCAUSBH018	0.065/0.143

Programming via Modbus SL and/or Ethernet

USB to RS485 converter (3)	To be used on M171 (2) and M172 performance logic controllers (2). Equipped with 1 RJ45 connector at the controller end and 1 USB-A connector at the PC end	0.4/1.31	TSXCUSB485	0.144/0.320
Connection cable for Modbus serial link (4)	Equipped with 1 RJ45 connector at one end and flying leads at the other end	3/9.84	VW3A8306D30	0.250/0.550

Ethernet connection cable

Ethernet Connexium cable - shielded twisted pair straight cord (5)	For connection to terminal devices (DTE). Equipped with 1 RJ45 connector at each end. CE compatible	2/6.56 (2)	490NTW00002	-
--	---	------------	-------------	---

(1) Unshielded cable without grounding. To be used only for temporary connections. For permanent connections, use the reference **BMXXCAUSBH018**.
 (2) Other lengths available: 5 m/16.40 ft, 12 m/39.37 ft, 40 m/131.23 ft, and 80 m/262.47 ft, see on our website www.schneider-electric.com

Programming accessories for M171 optimized logic controllers

Programming via TTL programming port

Description	Characteristics and use	Reference	Weight kg/lb
Programming cable (6)	To be used between a PC and the TTL programming port of M171 optimized logic controllers (8)	TM171ADMI	0.157/0.350
Programming stick (7)	To be used to transfer parameters from one M171 optimized logic controller (8) to another, or to download the program	TM171AMFK	0.010/0.020

Programming via USB port

USB to RS485 converter (3)	See above
Connection cable for Modbus serial link (4)	See above

Modicon M171/M172 for HVAC control solutions

Logic controllers and Configuration software
Product reference index

4			
490NTW00002	41	TM171ACB4OI1M	25 27
B		TM171ACB4OI2M	25 27
BMXXCAUSBH018	41	TM171ACB4OLAN	25 27
T		TM171ACB4ORS485	27
TCSXCNAMUM3P	41	TM171ADMI	41
TM1SHC4	37	TM171AETH	32 33
TM1SHTCC4	37	TM171AETHRS485	32 33
TM1SHTCN4	37	TM171ALON	32 33
TM1SHTM4	37	TM171AMB	32 33
TM1STNTCRN5201P	36	TM171AMFK	41
TM1STNTCRN5203P	36	TM171APBUS	32 33
TM1STNTCRN5205P	36	TM171ARS232	32 33
TM1STNTCRN6151P	36	TM171ARS485	32 33
TM1STNTCRN6153P	36	TM171ASCTB14	31
TM1STNTCRN6155P	36	TM171ASCTB27	29 31
TM1STNTCRN52015	36	TM171ASCTBVEV	35
TM1STNTCRN52030	36	TM171DGRP	29
TM1STNTCRN52050	36	TM171DLCD2U	26
TM1STNTCRN61515	36	TM171DLED	26
TM1STNTCRN61530	36	TM171DWAL2L	26
TM1STNTCRN61550	36	TM171DWAL2U	26
TM1STNTCSF4401P	36	TM171EO14R	24 25
TM1STNTCSF4403P	36	TM171EO15R	24 25
TM1STNTCSF44015	36	TM171EO22R	24 25
TM1STNTCSF44030	36	TM171EP14R	30 31
TM1STNTCSN6201P	36	TM171EP27R	30 31
TM1STNTCSN6203P	36	TM171OB22R	23 24
TM1STNTCSN6205P	36	TM171OBM14R	23 24
TM1STNTCSN62015	36	TM171OBM22R	23 24
TM1STNTCSN62030	36	TM171OD14R	23 24
TM1STNTCSN62050	36	TM171OD22R	23 24
TM1STNTCTN6201P	36	TM171ODM14R	23 24
TM1STNTCTN6203P	36	TM171ODM22R	23 24
TM1STNTCTN62015	36	TM171ODM22S	23 24
TM1STNTCTN62030	36	TM171OF22R	23 24
TM1STNTCW69755	37	TM171OFM22R	23 24
TM1STNTCWN75750	37	TM171PBM27R	29 30
TM1STPTTSN5201P	36	TM171PDM27R	29 30
TM1STPTTSN5203P	36	TM171PDM27S	29 30
TM1STPTTSN5205P	36	TM171PFE03	29 30
TM1STPTTSN6201P	36	TM171PFE03HR	29 30
TM1STPTTSN6203P	36	TM171SW	41
TM1STPTTSN52015	36	TM171VEVA2	35
TM1STPTTSN52030	36	TM171VEVD4	35
TM1STPTTSN52050	36	TM171VEVM4	35
TM1STPTTSN62015	36	TM172ABKPG	21
TM1STPTTSN62030	36	TM172ABKPW	21
TM171ABKPB	29	TM172AP12PM	16 19
TM171ABKPG	29	TM172ASCTB07	16
TM171ACAN	32 33	TM172ASCTB12E	19
TM171ACB4OAO1M	25 27	TM172ASCTB18	16
TM171ACB4OAO2M	25 27	TM172ASCTB28	16
		TM172ASCTB28E	19
		TM172ASCTB42	16
		TM172DCLFG	21
		TM172DCLFW	21
		TM172DCLWT	21
		TM172DCLWTH	21
		TM172DCLWTHP	21
		TM172E12R	19
		TM172E28R	19
		TM172OBM18R	16 30
		TM172OBM28R	16
		TM172OBM42R	16
		TM172ODM18R	16 30
		TM172ODM28R	16
		TM172ODM42R	16
		TM172PBG07R	17 30
		TM172PBG18R	17 30
		TM172PBG28R	17 30
		TM172PBG28RI	17
		TM172PBG42R	17 30
		TM172PBG42RI	17
		TM172PDG07R	17 30
		TM172PDG18R	17 30
		TM172PDG18S	17 30
		TM172PDG28R	17 30
		TM172PDG28RI	17
		TM172PDG28S	17 30
		TM172PDG28SI	17
		TM172PDG42R	17 30
		TM172PDG42RI	17
		TM172PDG42S	17 30
		TM172PDG42SI	17
		TSXCUSB485	41
		V	
		VW3A8306D30	41



[www.schneider-electric.com/Machine control solutions](http://www.schneider-electric.com/Machine%20control%20solutions)

Schneider Electric Industries SAS

Head Office
35, rue Joseph Monier
F-92500 Rueil-Malmaison
France

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Design: Schneider Electric
Photos: Schneider Electric

4.2 Appendix 2 – PAC AHU Equipment Datasheets, Drawings, and Manual

PAC AHU Equipment Datasheets, Drawings, and Manual Appendix 2

1665.8, 49.9

The New York Blower Company

Type HP Pressure Blower
27012 Aluminum
Arr.: 4

Fan-to-Size
Volume Flow Rate: 6,120 CFM
Fan Static Press.: 42.7 in wg
Speed: 3300 rpm
Power: 66.0 bhp

Temp.: 92 Deg F
Altitude: 29 ft
Density: 0.0719 lb/ft³
Outlet Velocity: 7796 ft/min

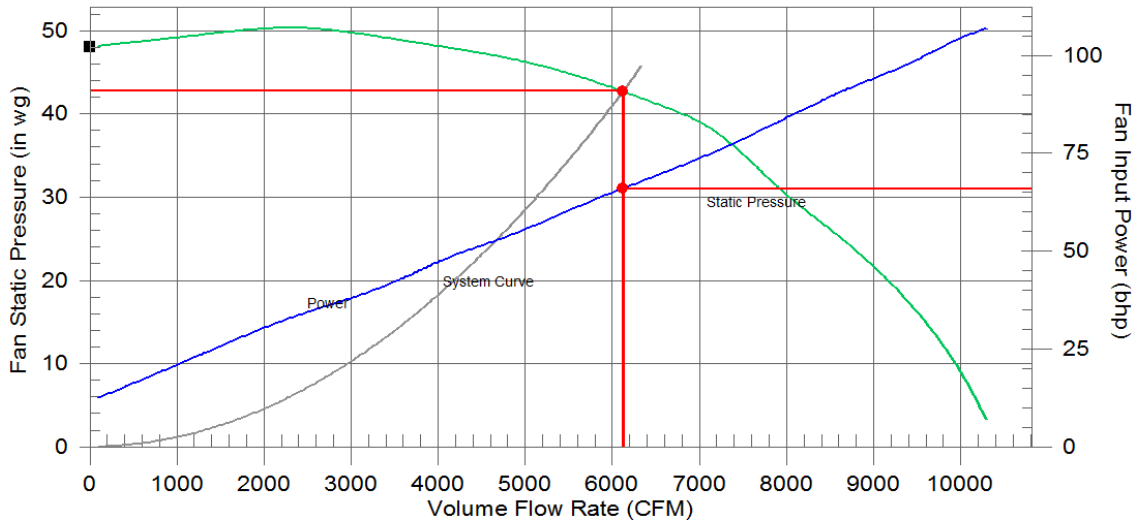


Figure B-1. PAC-90 Blower Performance Curve.

Design Point at 440 lbs/min Air Flow at 42 in. wg, Static.

BALDOR® • ***RELIANCE***

Product Information Packet

EM2549T

75HP,3540RPM,3PH,60HZ,364TS,4254M,OPSB,F

Part Detail							
Revision:	D	Status:	PRD/A	Change #:		Proprietary:	No
Type:	AC	Prod. Type:	4254M	Elec. Spec:	42WGW903	CD Diagram:	
Enclosure:	OPSB	Mfg Plant:		Mech. Spec:	42E212	Layout:	
Frame:	364TS	Mounting:	F1	Poles:	02	Created Date:	01-21-2011
Base:	RG	Rotation:	R	Insulation:	F	Eff. Date:	07-26-2013
Leads:	9#6	Literature:		Elec. Diagram:		Replaced By:	

Nameplate NP2138L

CAT.NO.	EM2549T	P/N		ENCLOSURE	OPSB		
SPEC.	42E212W903	CC	010A	FRAME	364TS	S/N	
HP	75	CLASS	F	HZ	60		
RPM	3540	PH	3	DES	B		
VOLT	230/460	KVA-CODE	G	ODE BRG	6311	DE BRG	6313
AMP	164/82	USABLE AT 208V	178				
RATING	40C AMB-CONT	GREASE	POLYREX EM				
NEMA-NOM-EFF	93.6	PF	91	SER.F.	1.15		
HTR-VOLTS		HTR-AMPS		MAX. SPACE HEATER TEMP.			

Parts List		
Part Number	Description	Quantity
SA215622	SA 42E212W903	1.000 EA
RA202812	RA 42E212W903	1.000 EA
S/P107-000-004	SUPER-E(284 FR. & UP)-CL PLANT,POLYREX E	1.000 EA
HA6360	LIFTING LUG FOR 42 FRAME MOTORS.	2.000 EA
HA6017A01	CAST ADAPTOR	1.000 EA
19XW3118A12	.31-18 X .75 HEX WASHER HEAD TAPTITE II	2.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	2.000 EA
10CB3002	CONDUIT BOX CAST W/3.625 LEAD HOLE	1.000 EA
19XW3118A12	.31-18 X .75 HEX WASHER HEAD TAPTITE II	4.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	4.000 EA
WD1000B16	T&B CX70TN TERMINAL	1.000 EA
51XF2520A08	SCREW, HEX SER SLT HD, ZN 1/4-20 X .50 L	1.000 EA
42EP3200A01	FR ENDPLATE, MACH 324-6T	1.000 EA
HW5100A13	W4627-047 WVY WSHER	1.000 EA
42EP1202A01	STD PU ENDPLATE MODEL 42 313 BRG.	1.000 EA
10XN3816K44	3/8-16 X 2.75 HEX HD CAP SCREW, GRADE 5	4.000 EA
HW1001A38	LOCKWASHER 3/8, ZINC PLT .688 OD, .382 I	4.000 EA
XY5013A12	NUT,1/2-13,HEX,STEEL,ZINCPLATED	8.000 EA
10CB3500SP	CONDUIT BOX LID, CAST	1.000 EA
51XW2520A12	.25-20 X .75, TAPTITE II, HEX WSHR SLTD	4.000 EA
HW2501H18	KEY, 1/2 SQ X 2.000	1.000 EA
LB1115	LABEL,LIFTING DEVICE	1.000 EA
LB5040	INSTRUCTION TAG, AC & DC	1.000 EA
HW4500A03	GREASE FITTING, .125 NPT 1610(ALEMITE) 8	1.000 EA

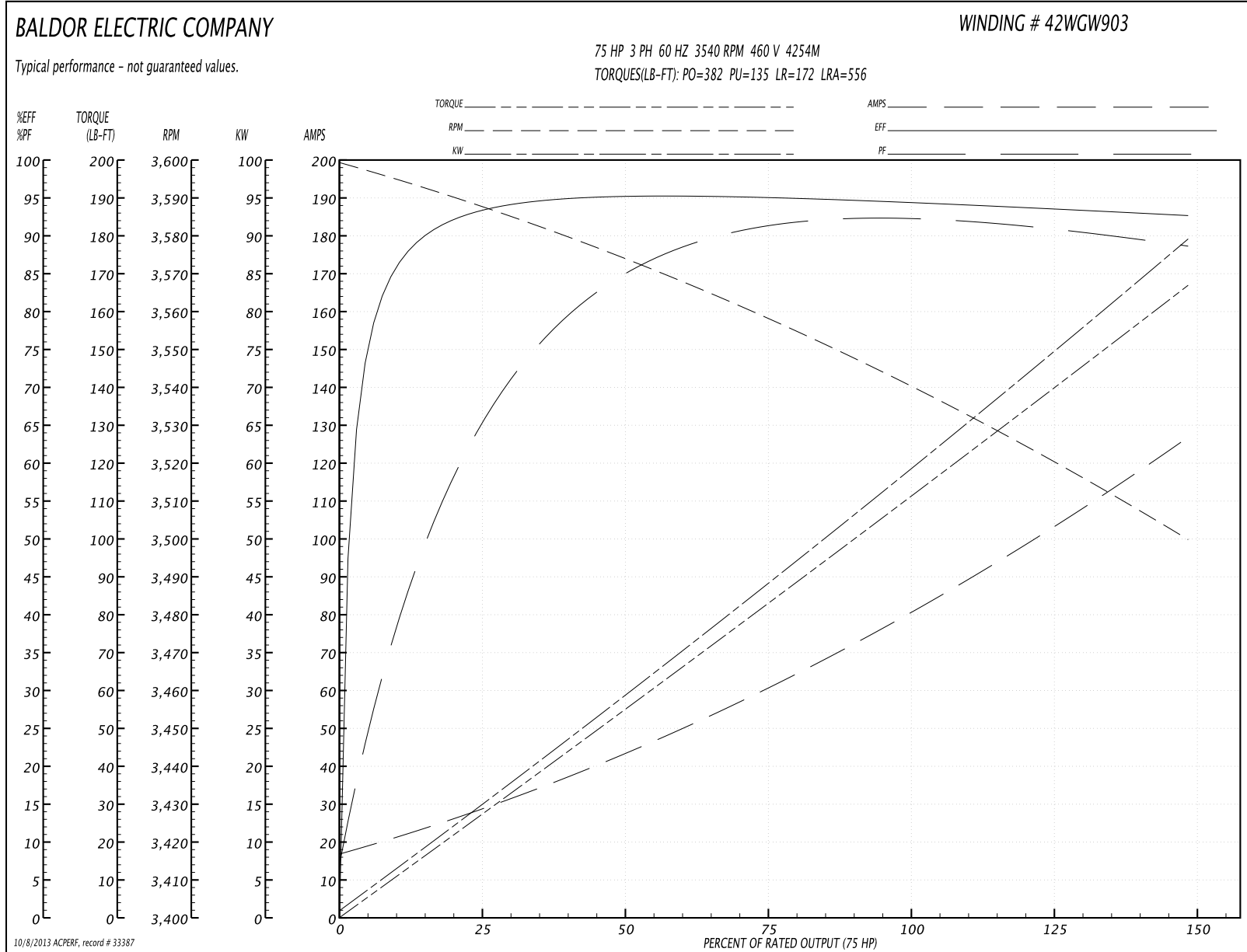
Parts List (continued)		
Part Number	Description	Quantity
HW4500A20	1/8NPT SL PIPE PLUG	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
MJ1000A75	GREASE, POLYREX EM EXXON	0.030 LB
HW4500A03	GREASE FITTING, .125 NPT 1610(ALEMITE) 8	1.000 EA
HW4500A20	1/8NPT SL PIPE PLUG	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
MG1000Y03	WILKO 689.710 GOLD PAINT SUPER E	0.050 GA
85XU0407A04	#4-7 X 1/4 DRIVE PIN	4.000 EA
42AD2001B01	BAFFLE PLATE 42 OPEN, SLOTTED BAND MTRS	1.000 EA
42AD2001B01	BAFFLE PLATE 42 OPEN, SLOTTED BAND MTRS	1.000 EA
HA3151A07	THRUBOLT STUD 1/2-13 X 20.000	4.000 EA
LB1119	WARNING LABEL	1.000 EA
LB1125C02	SUPER-E (STOCK CTN LABEL SUPER-E WITH FL	4.000 EA
LC0181	CONNECTION LABEL	1.000 EA
NP2138L	ALUM SUPER-E UL CSA-EEV PREM CC (300	1.000 EA
40PA1000	PACKAGING GROUP	1.000 EA
LB1506	LABEL "AMERICAN MADE" 1.50 X 1.00	1.000 EA

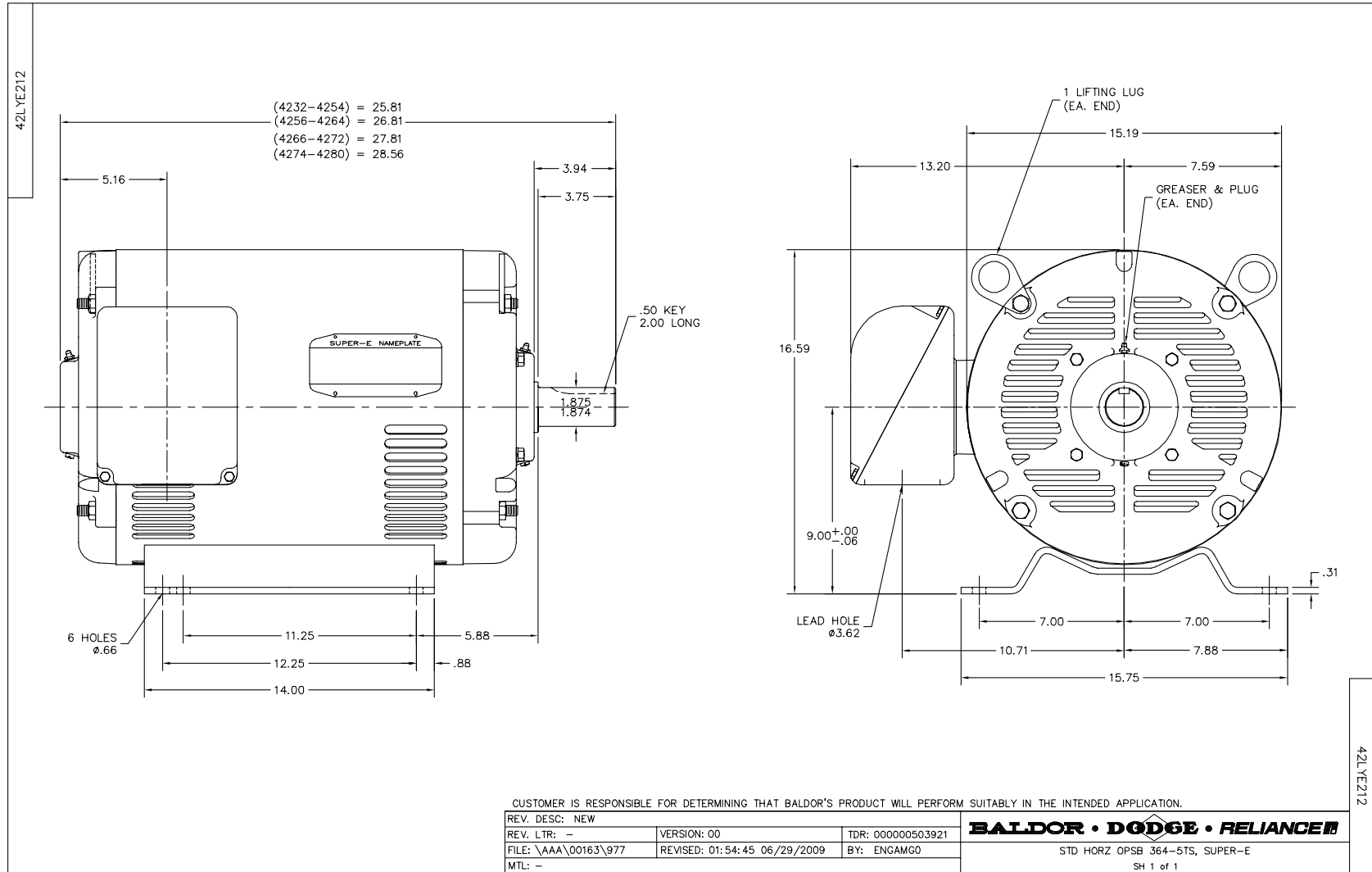
Accessories		
Part Number	Description	Multiplier
42-1400	C FACE KIT	A8

Performance Data at 460V, 60Hz, 75.0HP (Typical performance - Not guaranteed values)

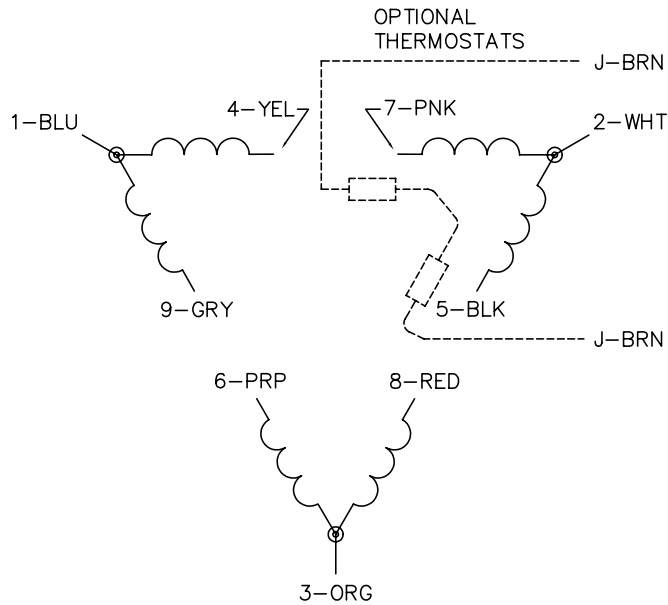
General Characteristics							
Full Load Torque:	111.0 LB-FT			Start Configuration:	DOL		
No-Load Current:	18.5 Amps			Break-Down Torque:	382.0 LB-FT		
Line-line Res. @ 25°C.:	0.0817 Ohms A Ph / 0.0 Ohms B Ph			Pull-Up Torque:	135.0 LB-FT		
Temp. Rise @ Rated Load:	42 C			Locked-Rotor Torque:	172.0 LB-FT		
Temp. Rise @ S.F. Load:	52 C			Starting Current:	556.0 Amps		
Load Characteristics							
% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor:	72.0	86.0	90.0	91.0	90.0	89.0	90.0
Efficiency:	93.0	95.1	95.0	94.3	93.7	92.6	94.0
Speed:	3588.0	3574.0	3558.0	3540.0	3521.0	3500.0	3529.0
Line Amperes:	26.4	43.0	61.6	81.5	103.0	126.0	94.4

Performance Graph at 460V, 60Hz, 75.0HP Typical performance - Not guaranteed values

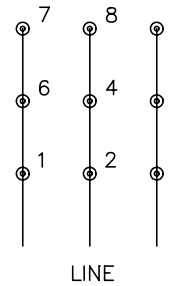




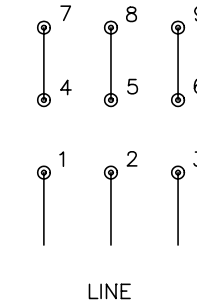
CD0180



LOW VOLTAGE
(2D)



HIGH VOLTAGE
(1D)



NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

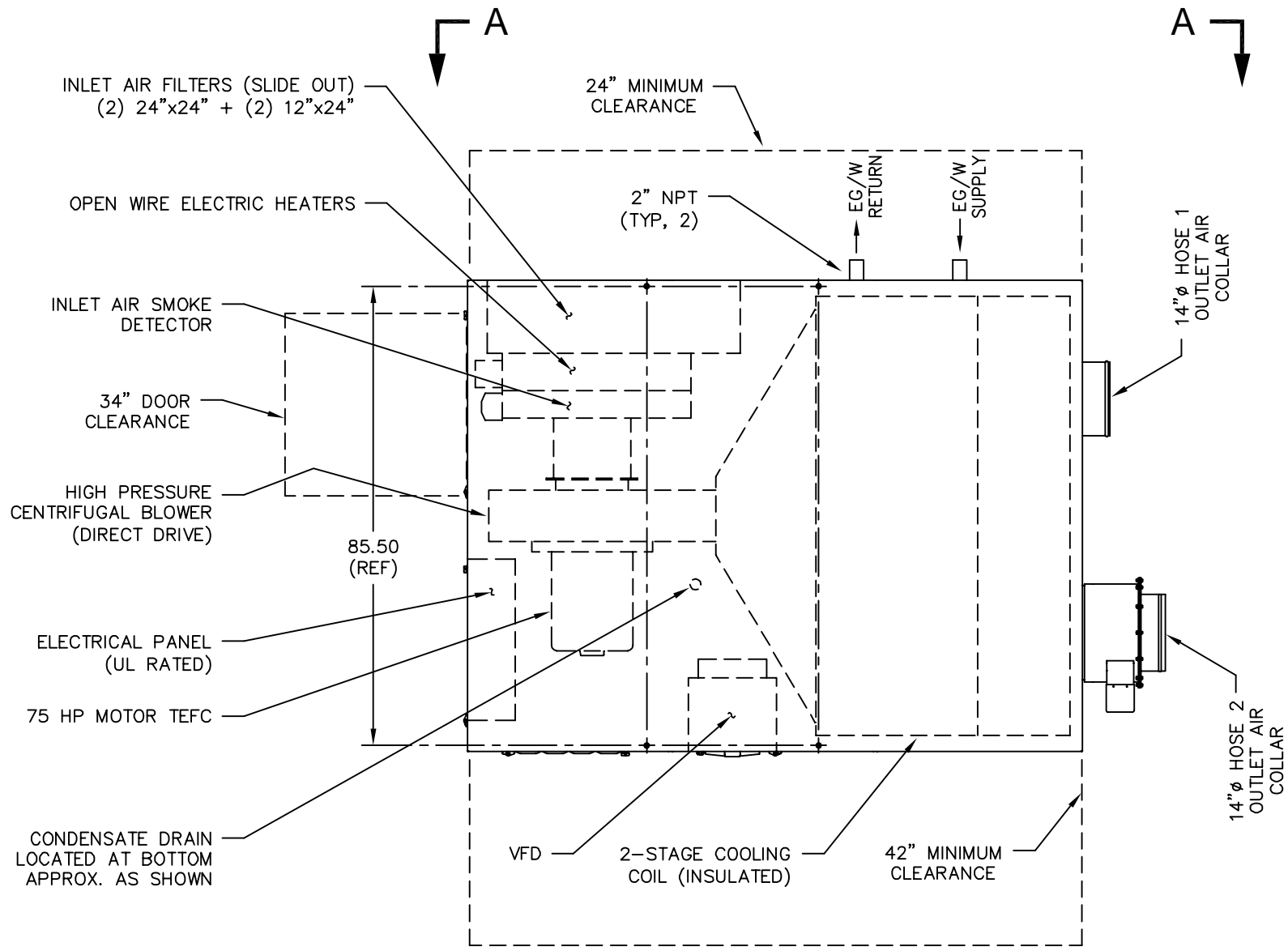
REV. DESC: REVISE TO SHOW OPTIONAL COLORS			
REV. LTR: C	BY: JLP	REVISED: 01/21/99 2:28	TDR: 0171435
0810D0		FILE: AAA00005148	MDL: -
		MTL: -	

BALDOR ELECTRIC Co.

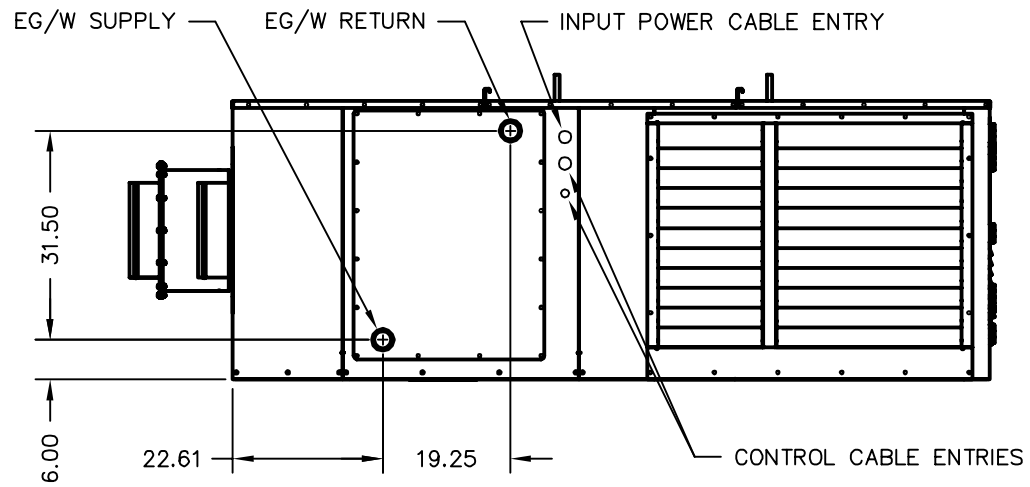
3PH, DV, 9 LEADS, DELTA CONNECTION

CD0180

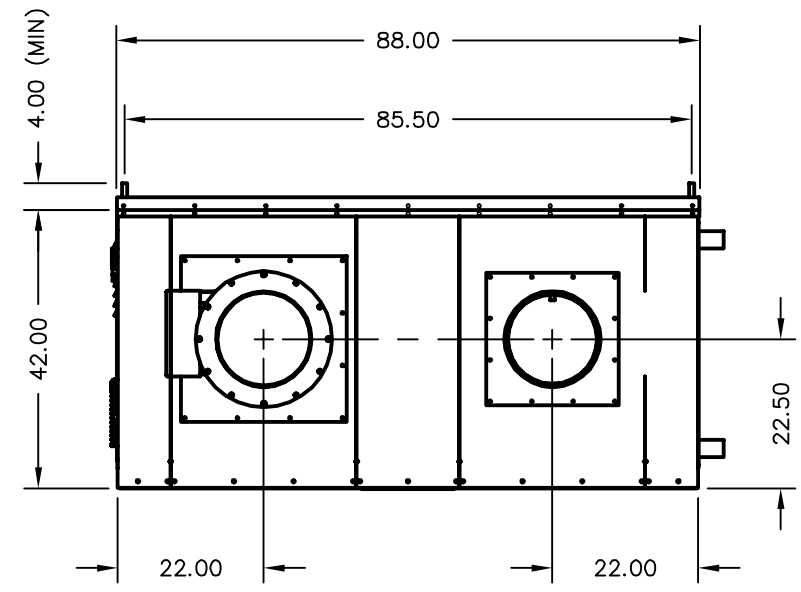
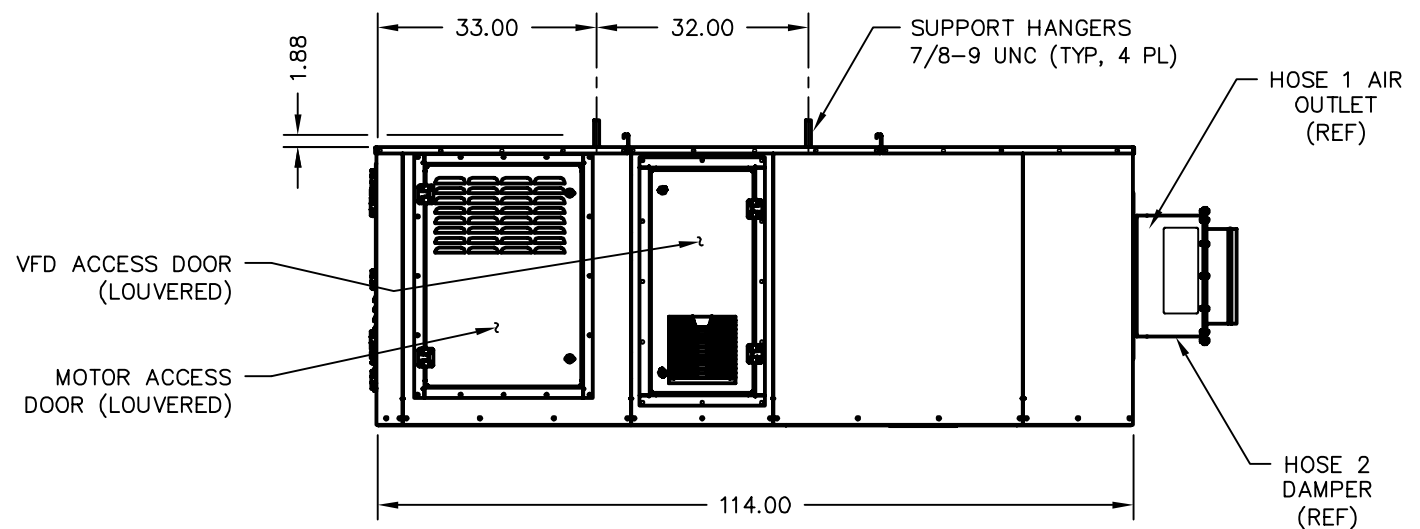
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GENERAL NOTES:
1. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5-2009.




VIEW A-A
(ROTATED 180°)



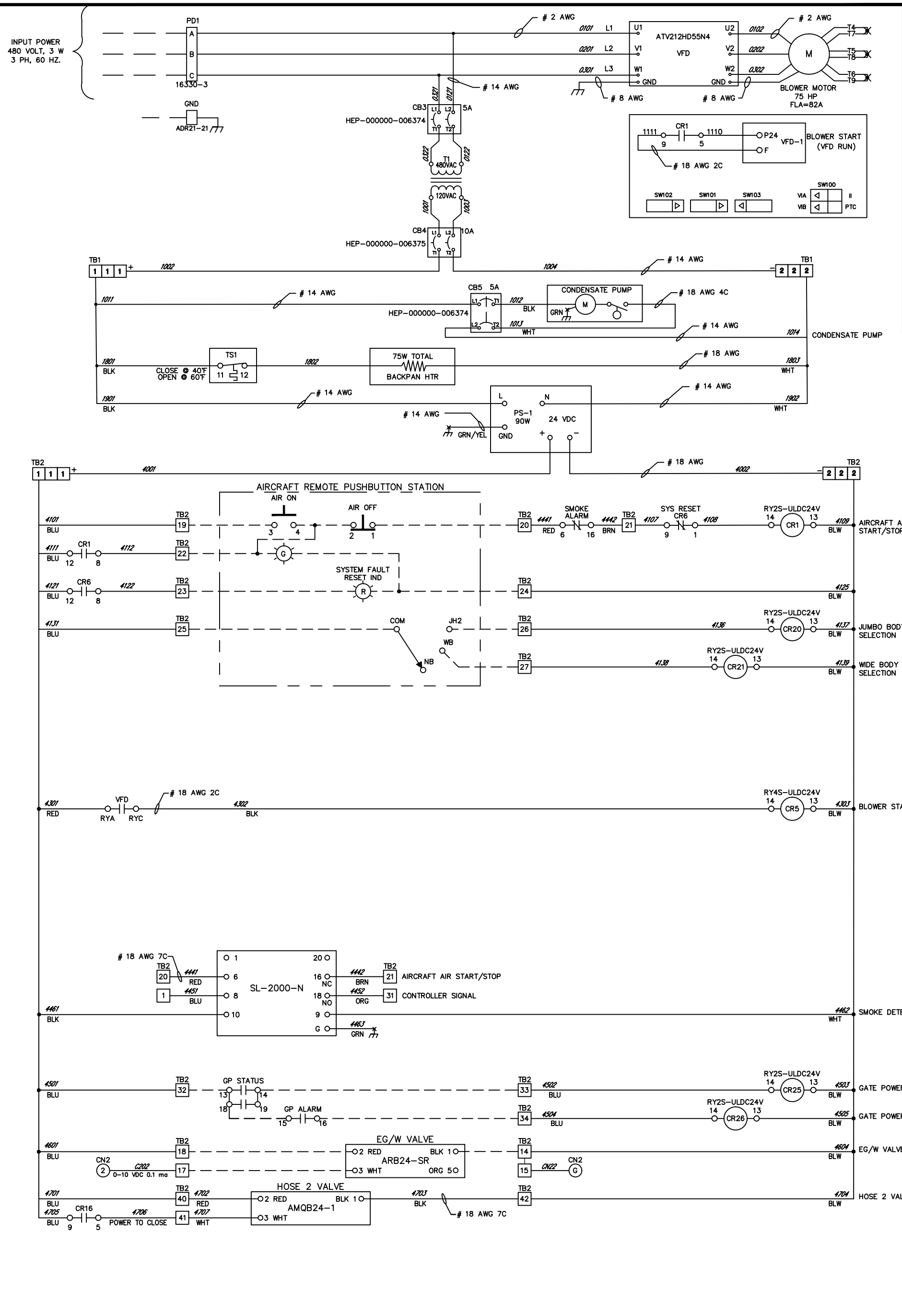
REVISIONS		REV	DATE	DESCRIPTION	DWN	APPR
A		7/24/18	RELEASED		CLC	

TITLE	INSTALLATION OUTLINE	07/24/18	
	LH SIDE EG/W SUPPLY & RETURN		
	PAC-90 AIR HANDLER UNIT		
SIZE	DRAWING No.		
B	N0010-AS065827-062		
SCALE:	NONE		

DRAWN	CESAR L. CHAINGAN	
CHECKED		
DESIGN APPROVAL		
APPROVAL		
APPROVAL		

 CYPRESS, CALIFORNIA, USA	UNLESS OTHERWISE SPECIFIED
	DIMENSIONS ARE IN INCHES
	TOLERANCE ON : FRACTIONS ± 1/32 DECIMALS .XX ±.010 ANGLES ±1/4 .xxx ±.005

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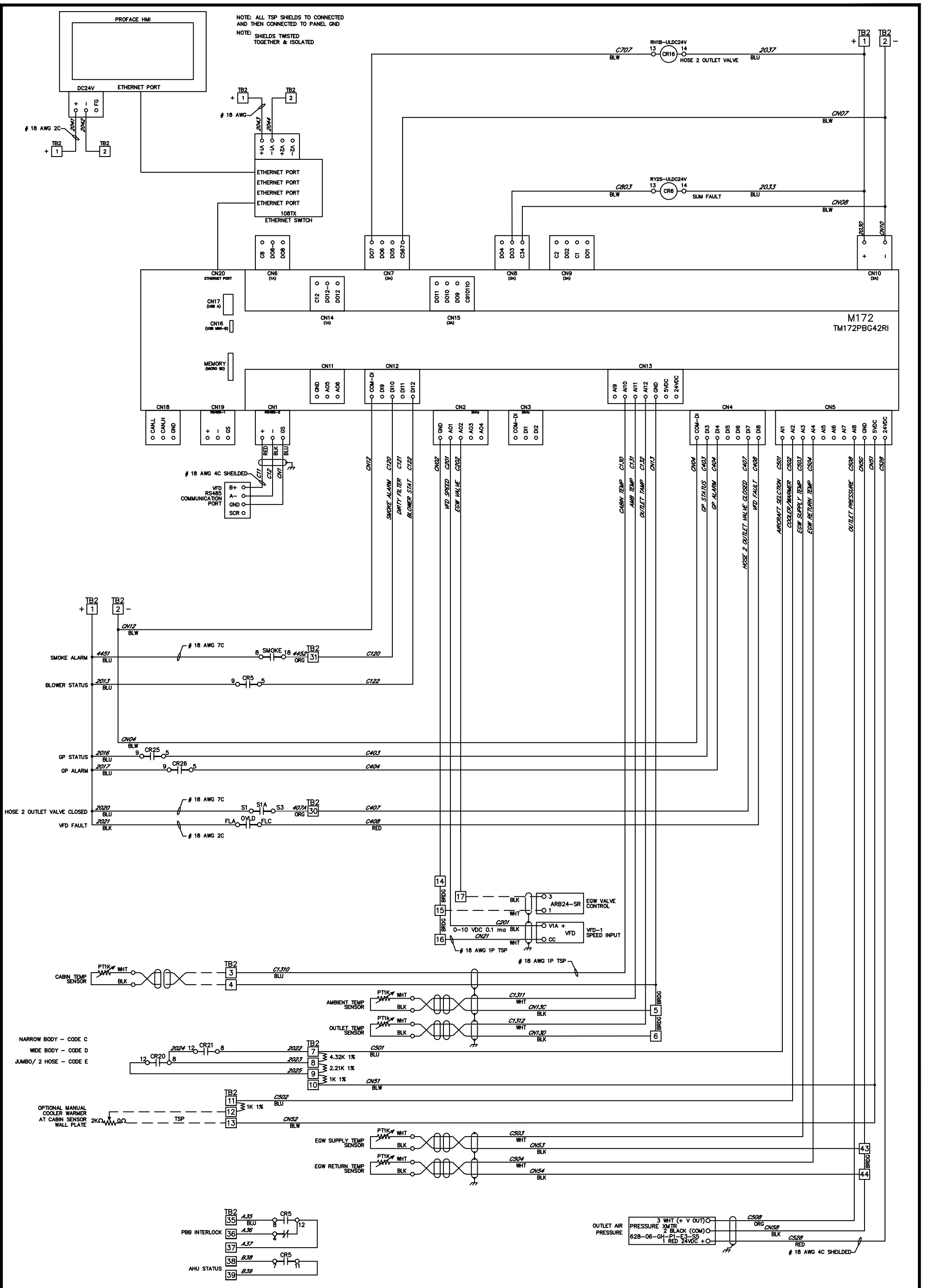



NOTE: FIELD WIRING SHALL BE A MIN. OF 600 V RATING, 105°C WIRE



DRAWN BRAD HANNA CHECKED APPROVAL UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. SHEET 1 OF 3	10/28/2020	TITLE SCHEMATIC WIRING DIAGRAM PAC-80 DUAL OUTLET 480 VOLT 60 HZ MODEL MIAMI DADE GATE D1, D8, D14, E11, H8, H10 SIZE B DRAWING No. N0004-SC068829-103 SCALE : NONE CAD FILE:
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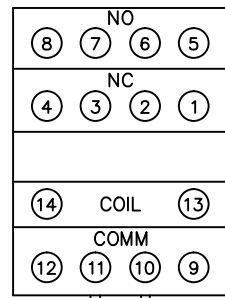
REVISIONS					
REV	DATE	DESCRIPTION	DWN	APPR	



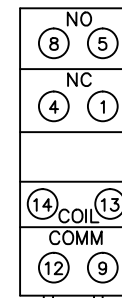
 <p>CAVOTEC CYPRESS, CALIFORNIA, USA</p>	DRAWN BRAD HANNA CHECKED APPROVAL UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. SHEET 2 OF 3	7/15/2020 TITLE SCHEMATIC WIRING DIAGRAM PAC-80 DUAL OUTLET 480 VOLT 60 HZ MODEL MIAMI DADE GATE D1, D8, D14, E11, H8, H10 SIZE B SCALE : NONE	TITLE SCHEMATIC WIRING DIAGRAM PAC-80 DUAL OUTLET 480 VOLT 60 HZ MODEL MIAMI DADE GATE D1, D8, D14, E11, H8, H10 DRAWING No. N0004-SC068829-103 CAD FILE:	REVISIONS				
				REV DATE DESCRIPTION DWN APPR				

LEGEND

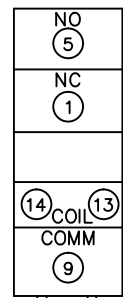
ELECTRICAL SYMBOLS	
SYMBOLS	DEFINITIONS
	CIRCUIT BREAKER
	NORMALLY OPEN CONTACT
	NORMALLY CLOSED CONTACT
	HEATER
	NORMALLY OPEN FLOAT SWITCH
	NORMALLY OPEN PRESSURE SWITCH
	NORMALLY CLOSED PRESSURE SWITCH
	SOLENOID VALVE
	TEMPERATURE SENSOR
	GROUND
	RESISTOR
	VARIABLE RESISITOR
	POTENTIOMETER (MANUAL VARIABLE RESISTOR)
	120 VAC / 24 VAC STEP-DOWN TRANSFORMER
	480 VAC / 120 VAC STEP-DOWN TRANSFORMER
	NORMALLY OPEN PUSHBUTTON
	NORMALLY CLOSED PUSHBUTTON
	NORMALLY CLOSED EMERGENCY STOP PUSBUTTON
	ILLUMINATED INDICATOR (GREEN)
	ILLUMINATED INDICATOR (AMBER)
	ILLUMINATED INDICATOR (RED)
	AUDIBLE ALARM
	FIELD WIRING
	TERMINAL BLOCK CONNECTION NUMBER
	QUICK DISCONNECT CONNECTION NUMBER
	OVERLOAD



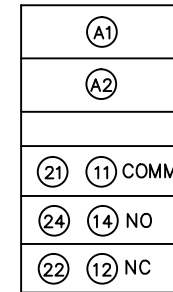
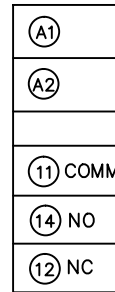
RY4S-ULDC24V



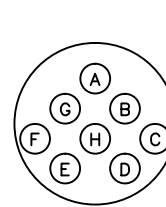
RY2S-ULDC24V



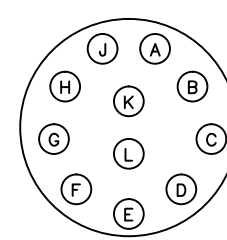
RH1B-ULDC24V



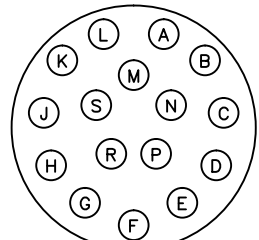
PLC-RSC-24UC/21 PLC-RSC-24UC/21-21



16-8



18-11



20-16

ABBREVIATIONS			
SYMBOLS	DEFINITIONS	SYMBOLS	DEFINITIONS
AMB	AMBER	NC	NORMALLY CLOSED
AUX	AUXILIARY	NO	NORMALLY OPEN
BLK	BLACK	OVR	OVERLOAD
BLU	BLUE	PCA	PRE-CONDITIONED AIR
BLW	BLUE-WHITE	PD	POWER DISTRIBUTION
BRN	BROWN	POS	POSITION
BRDG	TERMINAL BRIDGE/JUMPER	PS-1	POWER SUPPLY
BLWR	BLOWER	PWM	PULSE WIDTH MODULATION
BMS	BUILDING MANAGEMENT SYSTEM	RED	RED
C1	COMPRESSOR 1	RH	RIGHT HAND
C2	COMPRESSOR 2	RLA	RATED LOAD AMPS
C3	COMPRESSOR 3	STG	STAGE
CB	CIRCUIT BREAKER	STAT	STATUS
CC	CRANK CASE	SV	SOLENOID VALVE
CLSD	CLOSED	SW	SWITCH
CMD	COMMAND	TB	TERMINAL BLOCK
COMP	COMPRESSOR	TE	TEMPERATURE ELEMENT
CR	CONTROL RELAY	TS	TEMPERATURE SENSOR
FLA	FULL LOAD AMPS	TSP	TWISTED SHIELDED PAIR 8760
GND	GROUND	VFD	VARIABLE FREQUENCY DRIVE
GRN	GREEN	WHT	WHITE
HDPS	HIGH DISCHARGE PRESSURE SWITCH		
HG	HOT GAS		
HTR	HEATER		
LH	LEFT HAND		
LSPS	LOW SUCTION PRESSURE SWITCH		
M	MOTOR OR MODULE		
MP	MOTOR PROTECTOR		



DRAWN
BRAD HANNA
7/15/2020

CHECKED

APPROVAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES.

SHEET 3 OF 3

TITLE
**SCHEMATIC WIRING DIAGRAM
PAC-90 DUAL OUTLET
480 VOLT 60 HZ MODEL
MIAMI DADE GATE D1, D8, D14, E11, H8, H10**

SIZE
B DRAWING No.
N0004-SC068829-103

SCALE : NONE CAD FILE:

REVISIONS

REV	DATE	DESCRIPTION	DWN	APPR

ATV212HD55N4

variable speed drive ATV212 - 55kW - 75hp -
480V - 3ph - EMC - IP21



Main

Range of product	Altivar 212
Product or component type	Variable speed drive
Device short name	ATV212
Product destination	Asynchronous motors
Product specific application	Pumps and fans in HVAC
Assembly style	With heat sink
Network number of phases	3 phases
Motor power kW	55 kW
Motor power hp	75 hp
Power supply voltage	380...480 V (- 15...10 %)
Power supply voltage limits	323...528 V
Supply frequency	50...60 Hz (- 5...5 %)
Network frequency	47.5...63 Hz
EMC filter	Class C2 EMC filter integrated
Line current	89 A for 480 V 102.7 A for 380 V

Complementary

Apparent power	76.3 kVA for 380 V
Prospective line I _{sc}	22 kA
Continuous output current	116 A at 380/460 V
Maximum transient current	127.6 A for 60 s
Speed drive output frequency	0.5...200 Hz
Nominal switching frequency	8 kHz
Switching frequency	8...16 kHz with derating factor 6...16 kHz adjustable
Speed range	1...10
Speed accuracy	+/- 10 % of nominal slip for 0.2 T _n to T _n torque variation
Torque accuracy	+/- 15 %
Transient overtorque	120 % of nominal motor torque, +/- 10 % for 60 s
Asynchronous motor control profile	Voltage/Frequency ratio, 2 points Voltage/Frequency ratio, 5 points Flux vector control without sensor, standard Voltage/Frequency ratio - Energy Saving, quadratic U/f Voltage/Frequency ratio, automatic IR compensation (U/f + automatic U ₀)
Regulation loop	Adjustable PI regulator
Motor slip compensation	Adjustable Automatic whatever the load Not available in voltage/frequency ratio motor control
Local signalling	1 LED - red - DC bus energized
Output voltage	<= power supply voltage
Isolation	Electrical between power and control
Type of cable for external connection	UL 508 cable with UL Type 1 kit: 3 wire(s) - 40 °C, copper 75 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 70 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 90 °C / XLPE/EPR
Electrical connection	Terminal 150 mm ² kcmil size: 300 (L1/R, L2/S, L3/T) Terminal 2.5 mm ² / AWG 14 (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

Tightening torque	41 N.m - 360 lb.in (L1/R, L2/S, L3/T) 0.6 N.m (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)
Supply	Internal supply: 24 V (21...27 V) DC - \leq 200 A with overload and short-circuit protection Internal supply for reference potentiometer (1 to 10 kOhm): 10.5 V DC, \pm 5 % - \leq 10 A with overload and short-circuit protection
Analogue input number	2
Analogue input type	Configurable voltage: (VIB) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Switch-configurable current: (VIA) 0...20 mA - 250 Ohm - resolution: 10 bits Switch-configurable voltage: (VIA) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Configurable PTC probe: (VIB) 0...6 probes - 1500 Ohm
Sampling duration	22 ms \pm 0.5 ms (VIB) - analog input(s) 3.5 ms \pm 0.5 ms (VIA) - analog input(s) 2 ms \pm 0.5 ms (RES) - discrete input(s) 2 ms \pm 0.5 ms (R) - discrete input(s) 2 ms \pm 0.5 ms (F) - discrete input(s)
Response time	7 ms \pm 0.5 ms (RY, RC) - discrete output(s) 7 ms \pm 0.5 ms (FLB, FLC) - discrete output(s) 7 ms \pm 0.5 ms (FLA, FLC) - discrete output(s) 2 ms \pm 0.5 ms (FM) - analog output(s)
Accuracy	\pm 1 % (FM) for a temperature variation 60 °C \pm 0.6 % (VIB) for a temperature variation 60 °C \pm 0.6 % (VIA) for a temperature variation 60 °C
Linearity error	\pm 0.2 % for output (FM) \pm 0.15 % of maximum value for input (VIB) \pm 0.15 % of maximum value for input (VIA)
Analogue output number	1
Analogue output type	Switch-configurable current: (FM) 0...20 mA - 970 Ohm - resolution: 10 bits Switch-configurable voltage: (FM) 0...10 V DC - 7620 Ohm - resolution: 10 bits
Discrete output number	2
Discrete output type	Configurable relay logic: (RY, RC) NO - 100000 cycles Configurable relay logic: (FLB, FLC) NC - 100000 cycles Configurable relay logic: (FLA, FLC) NO - 100000 cycles
Minimum switching current	3 mA at 24 V DC (configurable relay logic)
Maximum switching current	2 A at 30 V DC on inductive load - $\cos \phi = 0.4$ - L/R = 7 ms (FL, R) 2 A at 250 V AC on inductive load - $\cos \phi = 0.4$ - L/R = 7 ms (FL, R) 5 A at 30 V DC on resistive load - $\cos \phi = 1$ - L/R = 0 ms (FL, R) 5 A at 250 V AC on resistive load - $\cos \phi = 1$ - L/R = 0 ms (FL, R)
Discrete input type	Programmable (RES) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (R) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (F) 24 V DC, with level 1 PLC - 4700 Ohm
Discrete input logic	Negative logic (sink) (F, R, RES), \geq 16 V (state 0), \leq 10 V (state 1) Positive logic (source) (F, R, RES), \leq 5 V (state 0), \geq 11 V (state 1)
Acceleration and deceleration ramps	Automatic based on the load Linear adjustable separately from 0.01 to 3200 s
Braking to standstill	By DC injection
Protection type	With PTC probes for motor Motor phase break for motor Thermal protection for motor Against input phase loss for drive Line supply undervoltage for drive Line supply overvoltage and undervoltage for drive Against exceeding limit speed for drive Break on the control circuit for drive Overvoltages on the DC bus for drive Overcurrent between output phases and earth for drive Input phase breaks for drive Short-circuit between motor phases for drive Thermal power stage for drive Overheating protection for drive
Dielectric strength	5092 V DC between control and power terminals 3535 V DC between earth and power terminals
Insulation resistance	\geq 1 MOhm at 500 V DC for 1 minute
Frequency resolution	0.024/50 Hz for analog input 0.1 Hz for display unit

Communication port protocol	APOGEE FLN BACnet LonWorks METASYS N2 Modbus
Connector type	1 RJ45 1 open style
Physical interface	2-wire RS 485
Transmission frame	RTU
Transmission rate	9600 bps or 19200 bps
Data format	8 bits, 1 stop, odd even or no configurable parity
Type of polarization	No impedance
Number of addresses	1...247
Communication service	Monitoring inhibitable Read device identification (43) Read holding registers (03) 2 words maximum Time out setting from 0.1 to 100 s Write multiple registers (16) 2 words maximum Write single register (06)
Option card	Communication card for LonWorks
Operating position	Vertical +/- 10 degree
Width	320 mm
Height	630 mm
Depth	290 mm
Power dissipation in W	1455 W
Fan flow rate	498 m3/h

Environment

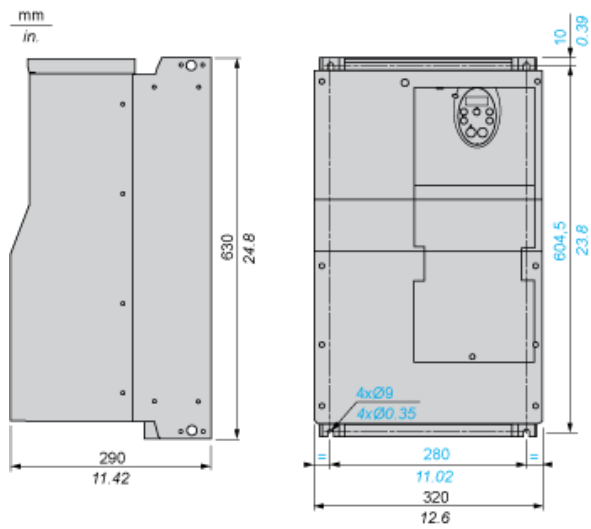
Electromagnetic compatibility	Voltage dips and interruptions immunity test conforming to IEC 61000-4-11 Conducted radio-frequency immunity test level 3 conforming to IEC 61000-4-6 1.2/50 µs - 8/20 µs surge immunity test level 3 IEC 61000-4-5 Electrical fast transient/burst immunity test level 4 conforming to IEC 61000-4-4 Radiated radio-frequency electromagnetic field immunity test level 3 conforming to IEC 61000-4-3 Electrostatic discharge immunity test level 3 conforming to IEC 61000-4-2
Pollution degree	3 IEC 61800-5-1
IP degree of protection	IP20 on upper part without blanking plate on cover conforming to EN/IEC 60529 IP20 on upper part without blanking plate on cover conforming to EN/IEC 61800-5-1 IP41 on upper part conforming to EN/IEC 60529 IP41 on upper part conforming to EN/IEC 61800-5-1 IP21 conforming to EN/IEC 60529 IP21 conforming to EN/IEC 61800-5-1
Vibration resistance	1 gn (f = 13...200 Hz) conforming to EN/IEC 60068-2-8 1.5 mm (f = 3...13 Hz) conforming to EN/IEC 60068-2-6
Shock resistance	15 gn for 11 ms conforming to IEC 60068-2-27
Environmental characteristic	Classes 3S2 conforming to IEC 60721-3-3 Classes 3C1 conforming to IEC 60721-3-3
Noise level	63.7 dB conforming to 86/188/EEC
Operating altitude	1000...3000 m (limited to 2000 m for the Corner Grounded distribution network) with current derating 1 % per 100 m <= 1000 m without derating
Relative humidity	5...95 % without dripping water conforming to IEC 60068-2-3 5...95 % without condensation conforming to IEC 60068-2-3
Ambient air temperature for operation	> 40...50 °C with derating factor -10...40 °C without derating
Ambient air temperature for storage	-25...70 °C

Standards	EN 55011 class A group 1 EN 61800-3 EN 61800-3 category C2 EN 61800-3 category C3 EN 61800-3 environments 1 category C1 EN 61800-3 environments 1 category C2 EN 61800-3 environments 1 category C3 EN 61800-3 environments 2 category C1 EN 61800-3 environments 2 category C2 EN 61800-3 environments 2 category C3 EN 61800-5-1 IEC 61800-3 IEC 61800-3 category C2 IEC 61800-3 category C3 IEC 61800-3 environments 1 category C1 IEC 61800-3 environments 1 category C2 IEC 61800-3 environments 1 category C3 IEC 61800-3 environments 2 category C1 IEC 61800-3 environments 2 category C2 IEC 61800-3 environments 2 category C3 IEC 61800-5-1 UL Type 1
Product certifications	CSA C-Tick NOM 117 UL
Marking	CE

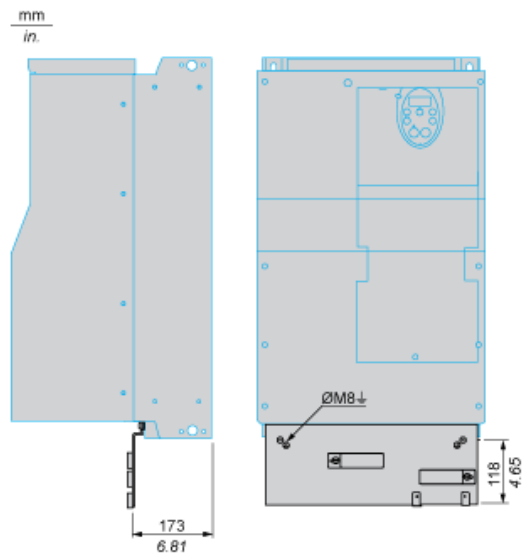
Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 1050 - Schneider Electric declaration of conformity download declaration of conformity
Product end of life instruction	Available Download End Of Life Manual

Dimensions



EMC mounting plate (supplied with drive)



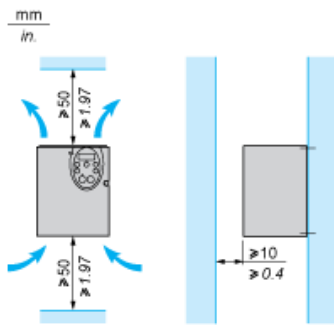
Mounting Recommendations

Clearance

Depending on the conditions in which the drive is to be used, its installation will require certain precautions and the use of appropriate accessories.

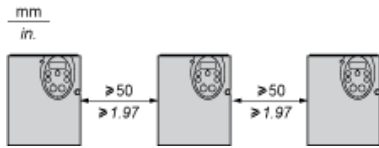
Install the unit vertically:

- Do not place it close to heating elements.
- Leave sufficient free space to ensure that the air required for cooling purposes can circulate from bottom to the top of the unit.

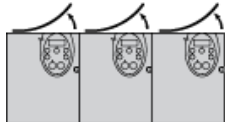


Mounting Types

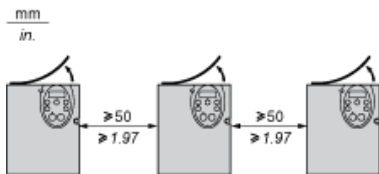
Type A mounting



Type B mounting



Type C mounting



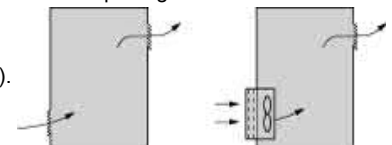
By removing the protective blanking cover from the top of the drive, the degree of protection for the drive becomes IP21. The protective blanking cover may vary according to the drive model, see opposite.

Specific Recommendations for Mounting in an Enclosure

To help ensure proper air circulation in the drive:

- Fit ventilation grilles.
- Check that there is sufficient ventilation. If there is not, install a forced ventilation unit with a filter. The openings and/or fans must

provide a flow rate at least equal to that of the drive fans (refer to the product characteristics).



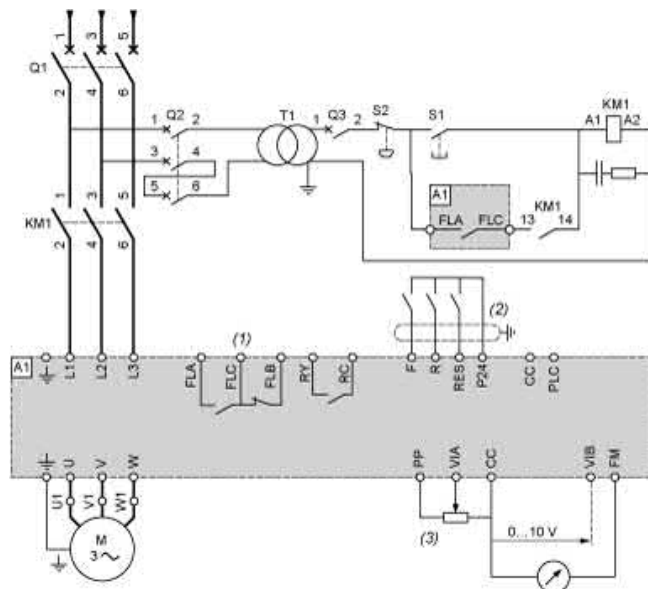
- Use special filters with UL Type 12/IP54 protection.
- Remove the blanking cover from the top of the drive.

Sealed Metal Enclosure (IP54 Degree of Protection)

The drive must be mounted in a dust and damp proof enclosure in certain environmental conditions, such as dust, corrosive gases, high humidity with risk of condensation and dripping water, splashing liquid, etc. This enables the drive to be used in an enclosure where the maximum internal temperature reaches 50°C.

Recommended Wiring Diagram

3-Phase Power Supply



- A1: ATV 212 drive
- KM1: Contactor
- Q1: Circuit breaker
- Q2: GV2 L rated at twice the nominal primary current of T1
- Q3: GB2CB05
- S1, XB4 B or XB5 A pushbuttons
- S2:
- T1: 100 VA transformer 220 V secondary
- (1) Fault relay contacts for remote signalling of the drive status
- (2) Connection of the common for the logic inputs depends on the positioning of the switch (Source, PLC, Sink)
- (3) Reference potentiometer SZ1RV1202

All terminals are located at the bottom of the drive. Install interference suppressors on all inductive circuits near the drive or connected on the same circuit, such as relays, contactors, solenoid valves, fluorescent lighting, etc.

Switches (Factory Settings)

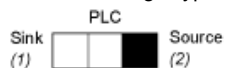
Voltage/current selection for analog I/O (VIA and VIB)



Voltage/current selection for analog I/O (FM)



Selection of logic type

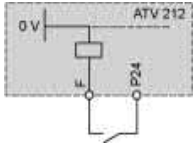


- (1) negative logic
- (2) positive logic

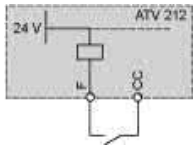
Other Possible Wiring Diagrams

Logic Inputs According to the Position of the Logic Type Switch

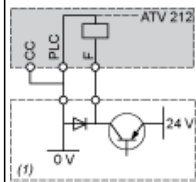
"Source" position



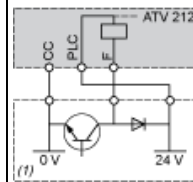
"Sink" position



"PLC" position with PLC transistor outputs

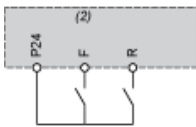


(1) PLC



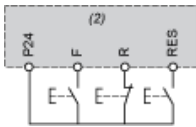
(1) PLC

2-wire control



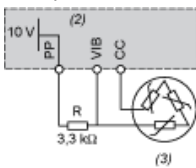
F: Forward
R: Preset speed
(2) ATV 212 control terminals

3-wire control



F: Forward
R: Stop
RES: Reverse
(2) ATV 212 control terminals

PTC probe

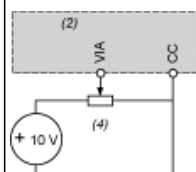


(2) ATV 212 control terminals
(3) Motor

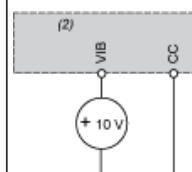
Analogue Inputs

Voltage analogue inputs

External +10 V

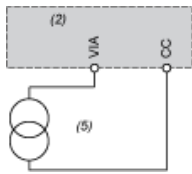


(2) ATV 212 control terminals
(4) Speed reference potentiometer 2.2 to 10 kΩ



(2) ATV 212 control terminals

Analog input configured for current: 0-20 mA, 4-20 mA, X-Y mA



(2) ATV 212 control terminals

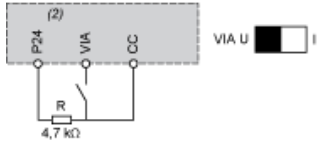
(5) Source 0-20 mA, 4-20 mA, X-Y mA

Analog input VIA configured as positive logic input ("Source" position)



(2) ATV 212 control terminals

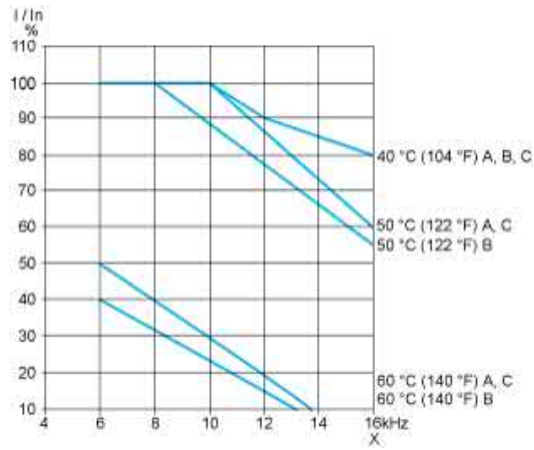
Analog input VIA configured as negative logic input ("Sink" position)



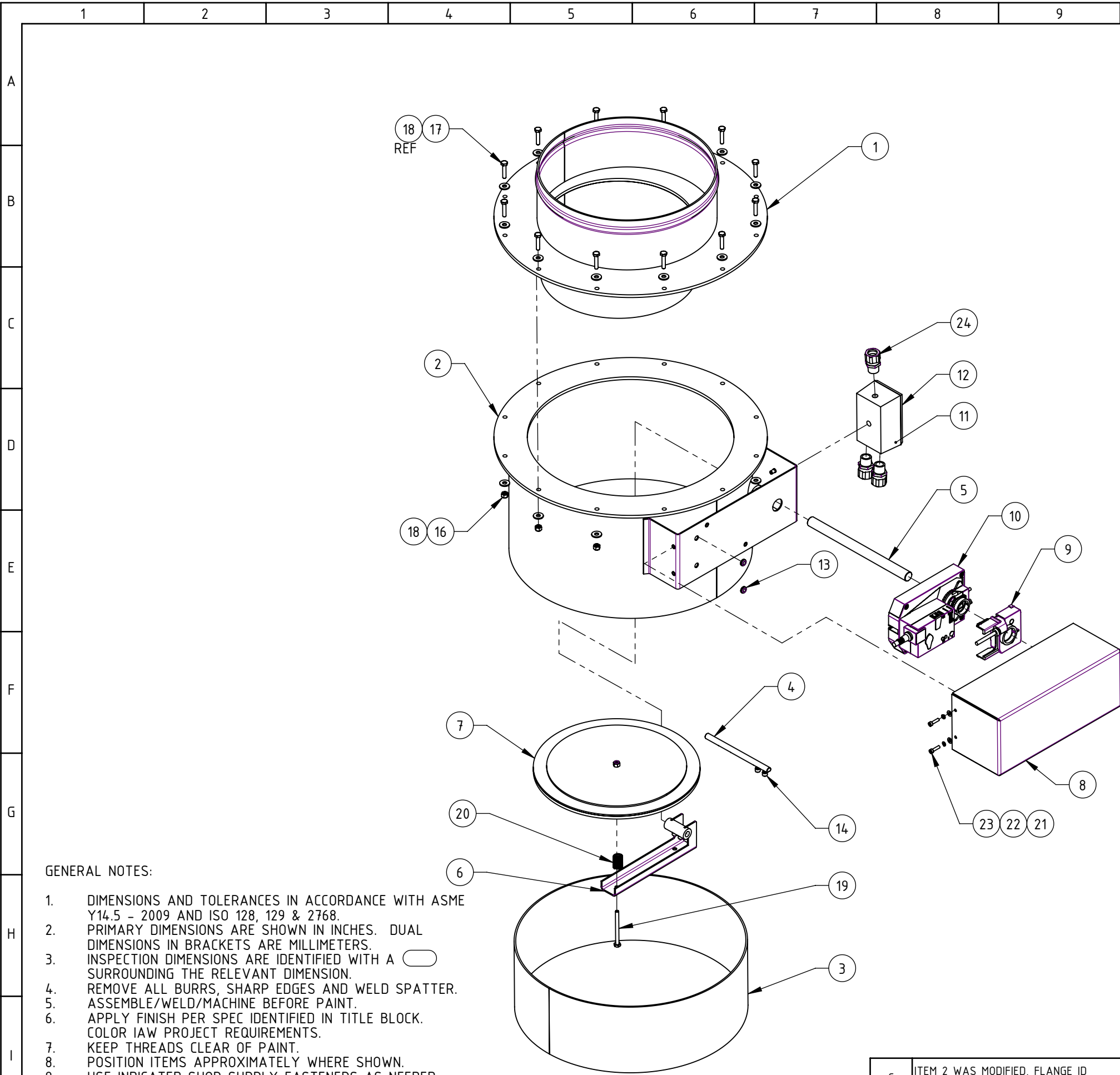
(2) ATV 212 control terminals

Derating Curves

The derating curves for the drive nominal current (I_n) depend on the temperature, the switching frequency and the mounting type (A, B or C). For intermediate temperatures (45°C for example), interpolate between 2 curves.



X Switching frequency



BOM TABLE FOR REFERENCE ONLY					
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	MASS (lbs)	DRAWING NUMBER
1	N0004-PT059373-000	LH-RH HOSE 2 VALVE SEAT ASSY FOR DUAL DUCT	1	9.9	N0004-PT059373-000
2	N0004-PT059374-000	HOSE 2 DAMPER HOUSING ASSY LH	1	5.2	N0004-PT059374-000
3	N0004-PT059375-000	LH-RH 17.5 INCH JOINT SLEEVE PC AIR OUTLET	1	4.0	N0004-PT059375-000
4	N0004-PT059376-000	HOSE 2 VALVE SHAFT 1	1	0.3	N0004-PT059376-000
5	N0004-PT059377-000	HOSE 2 VALVE SHAFT 2	1	1.2	N0004-PT059377-000
6	N0004-PT059378-000	HOSE 2 VALVE LEVER ASSEMBLY	1	0.5	N0004-PT059378-000
7	N0004-PT059379-000	HOSE 2 LID ASSEMBLY	1	2.1	N0004-PT059379-000
8	N0004-PT059383-000	HOSE 2 VALVE ACTUATOR COVER	1	1.9	N0004-PT059383-000
9	N040-S1A	BELIMO AUXILIARY SWITCH	1	0.2	-
10	N065-AMQB24-1	ACTUATOR MOTOR BRIDGE DAMPER	1	0.0	-
11	N098-5324-0	4.5 INCH X 2.75 INCH WEATHERPROOF ELECTRICAL BOX	1	0.2	-
12	N098-5173-0	ELECTRICAL BOX COVER WATERPROOF	1	0.0	-
13	N085-B971	GROMMETS 0.25 INCH ID 0.5 INCH OD	2	0.0	-
14	HSM0-T02G0-W0Q00K	Allen Socket Set Screw 0.25-28 UNF-0.5 Lg	4		
15	N087-27100	LOCTITE	1	0.0	-
16	HFU-NNC025-0031AN0	NYLON INSERT NUT 0.25-20 INCH SS-316	13	0.001	HFU-NNC025-0031AN0
17	HFU-BHC025-0125ANS	HEX HEAD SCREW 0.25-20 X 1.25 INCH SS-316	12	0.00	
18	HFU-WFN025-0080AN0	Flat Washer 0.25 Inch SS-316	25	0.01	HFU-WFN025-0080AN0
19	HFU-BHC025-0300ANS	HEX HEAD SCREW 0.25-20 X 3 INCH SS-316	1	0.01	HFU-BHC025-0300ANS
20	N198-C-750	TENSION SPRING 2 INCH LONG	1	0.003	
21	HFU-WFC019-0030AN0	FLAT WASHER #10 SS-316	4	0.00	HFU-WFC019-0030AN0
22	HFU-WCC019-0047AN0	SPLIT WASHER 10-32 INCH SS-316	4	0.00	HFU-WCC019-0047AN0
23	HFU-BCC019-0075ANS	SOCKET HEAD CAP SCREW 10-32 X 0.75 INCH LONG SS-316	4	0.00	
24	N073-2920	0.5" STRAIN RELIEF CORD CONNECTOR-STRAIGHT	3	0.0	N073-2920
25	N087-615279	SMALL BOTTLE OF LOCTITE CRAZY GLUE	1	0.0	-

GENERAL NOTES:

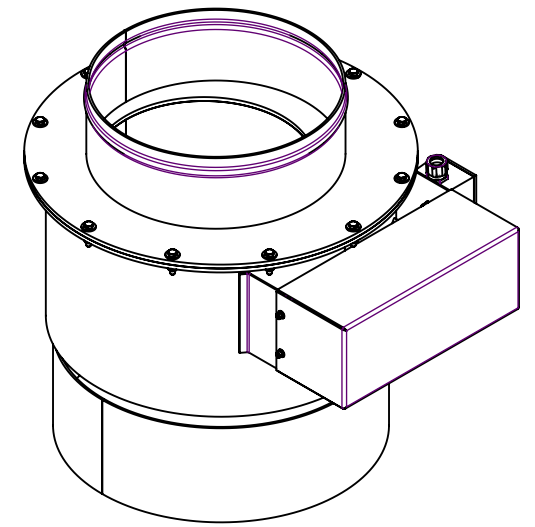
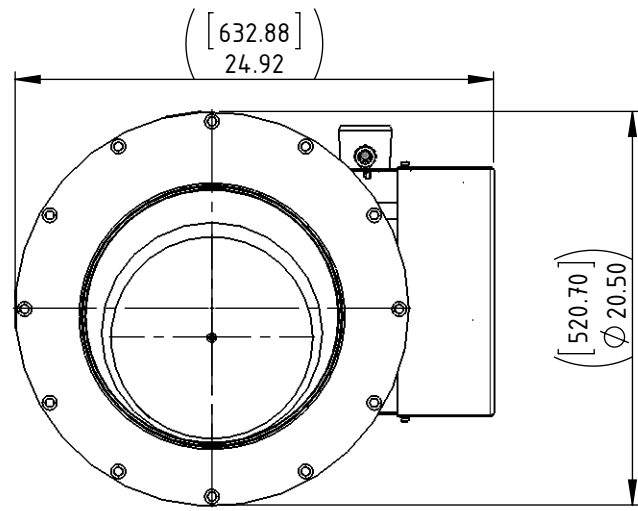
1. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5 - 2009 AND ISO 128, 129 & 2768.
2. PRIMARY DIMENSIONS ARE SHOWN IN INCHES. DUAL DIMENSIONS IN BRACKETS ARE MILLIMETERS.
3. INSPECTION DIMENSIONS ARE IDENTIFIED WITH A SURROUNDING THE RELEVANT DIMENSION.
4. REMOVE ALL BURRS, SHARP EDGES AND WELD SPATTER.
5. ASSEMBLE/WELD/MACHINE BEFORE PAINT.
6. APPLY FINISH PER SPEC IDENTIFIED IN TITLE BLOCK.
7. COLOR IAW PROJECT REQUIREMENTS.
8. KEEP THREADS CLEAR OF PAINT.
9. POSITION ITEMS APPROXIMATELY WHERE SHOWN.
10. USE INDICATED SHOP SUPPLY FASTENERS AS NEEDED.
11. APPLY TORQUE & LUBRICANT PER N0300-CP059071-305.

C	ITEM 2 WAS MODIFIED, FLANGE ID DIM ϕ 15.5 WAS ϕ 14.0	AS / DD	4/22/2016	
REV	DESCRIPTION	DRAWN BY	DATE	REF

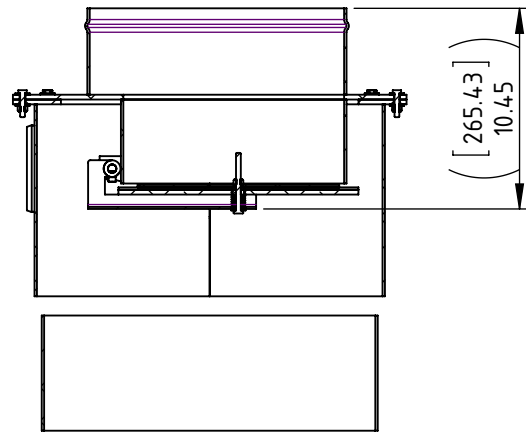
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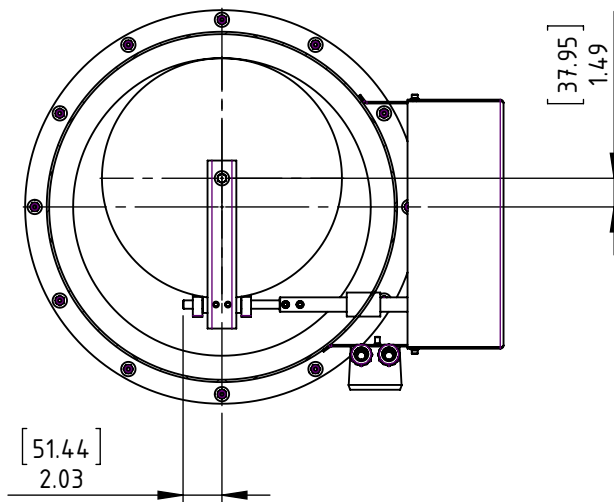
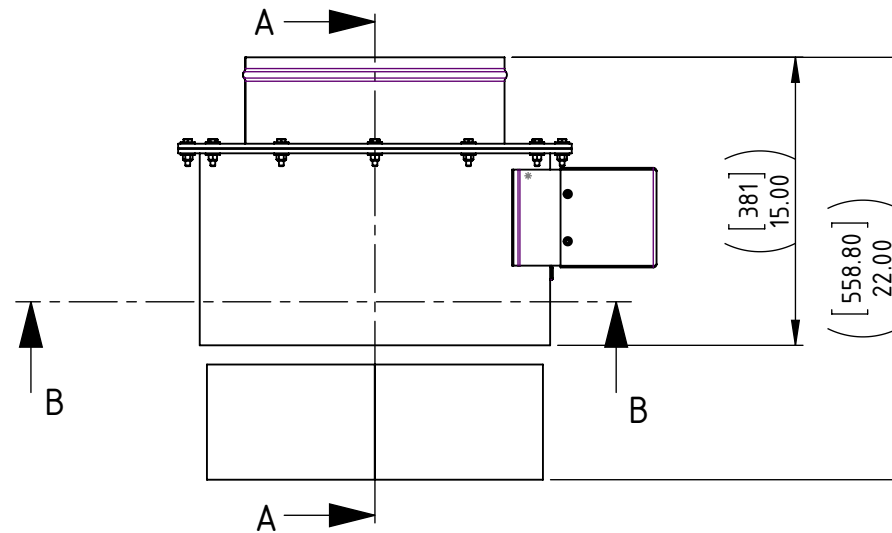
DRAWING NUMBER: N0004-AS059372-000		REVISION: C
PART NUMBER: N0004-AS059372-000		APPROVED: DD
MATERIAL: REFER TO BOM	TITLE: HOSE 2 DAMPER ACTUATOR ASSEMBLY LH	
FINISH: SEE N0300-CP056953-304 SP056955	INFO: CAGE CODE:6S1M4	MASS (lb): 35.2
DIMENSIONS IN inches UNLESS OTHERWISE STATED	TOLERANCING: CP057289-mK	SCALE: 1:8
		SHEET SIZE: 11x17
		SHEET: 1 OF 2




SCALE 1 : 10



SECTION A-A
SCALE 1 : 10



SECTION B-B
SCALE 1 : 10

 <p>CAVOTEC Cavotec INET US INC. www.cavotec.com</p>		<small>This drawing and the rights and privileges in this drawing are the property of Cavotec. This drawing or any part thereof must not be copied, reproduced or communicated to any person, or otherwise used beyond the purposes for which it is provided, without written permission of Cavotec ©</small>	
		DRAWING NUMBER: N0004-AS059372-000	REVISION: C
PART NUMBER: N0004-AS059372-000		APPROVED: DD	
MATERIAL: REFER TO BOM	TITLE: HOSE 2 DAMPER ACTUATOR ASSEMBLY LH		
FINISH: SEE N0300-CP056953-304 SP056955	INFO: CAGE CODE:6S1M4	SCALE: 1:10	MASS (lb): 35.2
DIMENSIONS IN inches UNLESS OTHERWISE STATED	TOLERANCING: CP057289-mK	SHEET SIZE: 11x17	SHEET: 2 OF 2

AMQB(X)24-1

On/Off Control, Non-Spring Return, Direct Coupled, 24V



Technical Data	AMQB(X)24-1
Power Supply	24 VAC ±20% 50/60 Hz 24 VDC ±10%
Power Consumption	12 W (1.5 W)
Transformer Sizing	18 VA (Class 2 power source)
Electrical Connection	
AMQB24-1	3 ft [1m] 18 GA plenum rated cable Protected NEMA 2 (IP54)
AMQX24-1	□ 3 ft [1m] □ 10 ft [3m] □ 16 ft [5m] 18 GA plenum rated cable Protected NEMA 2 (IP54)
Overload Protection	electronic throughout 0 to 95° rotation
Control	On/Off
Input Impedance	1000 Ω
Angle of Rotation	min. 30°, max. 95°, adjust. with mechanical stop
Torque	140 in-lb [16 Nm]
Direction of Rotation	reversible with switch
Position Indication	reflective visual indicator (snap-on)
Manual Override	external push button
Running Time	
AMQB24-1	7 seconds (default) constant independent of load
AMQX24-1	7, 10, 15 or 20 seconds constant independent of load
Humidity	5 to 95% RH non-condensing (EN 60730-1)
Ambient Temperature	-22°F to 122°F [-30°C to 50°C]
Storage Temperature	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA 2, IP54, UL enclosure type 2
Housing Material	UL94-5VA
Agency Listings	cULus acc. to UL 60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EEC and 2006/95/EC
Noise Level	<52 dB(A)
Servicing	maintenance free
Quality Standard	ISO 9001
Weight	3.75 lbs [1.7 kg]

Rated Impulse Voltage 800V, Type of action 1, Control Pollution Degree 3.

Torque min. 140 in-lb for control of damper surfaces up to 35 sq ft.

Application

For On/Off control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp, self-centered default. A crankarm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

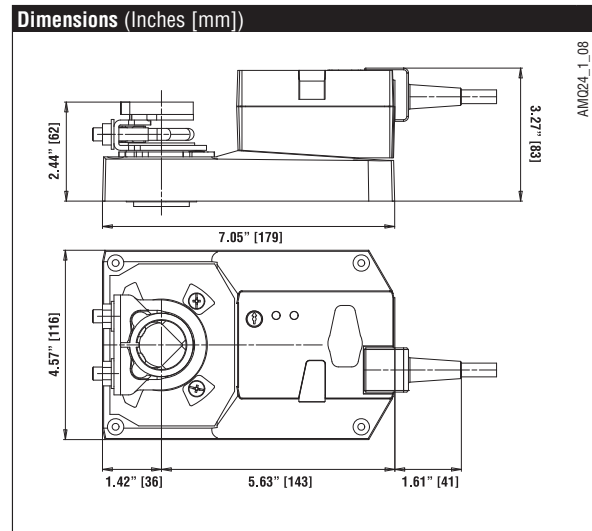
Operation

The actuator is not provided with and does not require any limit switches, but is electronically protected against overload. The anti-rotation strap supplied with the actuator will prevent lateral movement.

The AMQB(X) series provides 95° of rotation and a visual indicator indicates position of the actuator. When reaching the damper or actuator end position, the actuator automatically stops. The gears can be manually disengaged with a button on the actuator cover.

The AMQB(X)24-1 actuators use a sensorless Brushless DC motor, which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing (DRS) function to prevent damage to the actuator in a stall condition. Power consumption is reduced in holding mode.

Add-on auxiliary switches or feedback potentiometers are easily fastened directly onto the actuator body for signaling and switching functions.



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800-543-9038 USA

866-805-7089 CANADA

203-791-8396 LATIN AMERICA

Accessories	
K-GM20	½" -1.05" Shaft Clamp
ZG-100	Universal Mounting Bracket
ZG-102	Universal Mounting Bracket
Z-GMA	Retrofit Mounting Bracket
ZG-NMA	Crankarm Adaptor Kit
AV8-25	Universal Shaft Extension
ZG-JSA (-1, 2, 3)	Jackshaft Adaptors for Hollow Jackshafts
ZS-100	Weather Shield - Steel
ZS-150	Weather Shield - Polycarbonate
ZS-260	Explosion Proof Housing
ZS-300 (-1) (-5)	NEMA 4X Housing
Tool-06	8 mm & 10 mm Wrench
PS-100	Actuator Power Supply Simulator
S1A, S2A	Auxiliary Switch (es)
P370	Shaft Mount Auxiliary Switch
P...A	Feedback Potentiometers

NOTE: When using AMQB(X)24-1 actuators, only use accessories listed on this page.

Typical Specification

On/Off control damper actuators shall be electronic direct-coupled type, which require no crankarm and linkage and be capable of direct mounting to a shaft up to 1.05" diameter. Actuators shall have Brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. Run time shall be constant and independent of torque. Actuators shall be cULus listed, have a 5-year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams

✂️ INSTALLATION NOTES

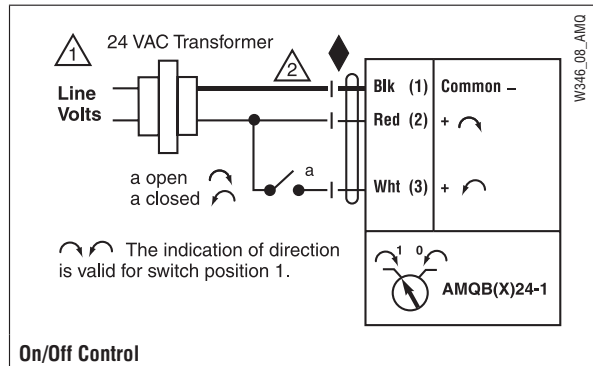
- ⚠️ 1 Provide overload protection and disconnect as required.
- ⚠️ 3 Actuators may also be powered by 24 VDC.

📄 APPLICATION NOTES

- ◆ Meets cULus or UL and CSA Standard requirements without the need of an electrical ground connection.

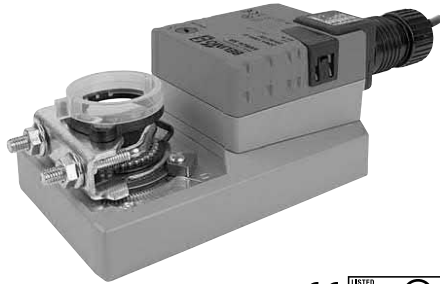
⚠️ WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



AMB(X)24-SR(-T)

Proportional, Non-Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA



Technical Data	AMB(X)24-SR(-T)
Power supply	24 VAC \pm 20% 50/60 Hz 24 VDC \pm 10%
Power consumption	2.5 W (0.4 W)
Transformer sizing	5 VA (Class 2 power source)
Electrical connection	18 GA plenum rated cable 1/2" conduit connector protected NEMA 2 (IP54) 3 ft [1m] 10 ft [3m] 16 ft [5m]
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y	2 to 10 VDC, 4 to 20 mA
Input impedance	100 k Ω (0.1 mA), 500 Ω
Feedback output U	2 to 10 VDC (max 0.5 mA)
Angle of rotation	max. 95°, adjust. with mechanical stop
Torque	180 in-lb [20 Nm]
Direction of rotation	reversible with switch actuator will move: =CCW with decreasing control signal (10 to 2V) =CW with decreasing control signal (10 to 2V)
Position indication	reflective visual indicator (snap-on)
Manual override	external push button
Running time	300 seconds 150 seconds 95 seconds constant independent of load
Humidity	5 to 95% RH non condensing (EN 60730-1)
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA 2, IP54, UL enclosure type 2
Housing material	UL94-5VA
Agency listings†	cULus acc. to UL 60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EEC and 2006/95/EC
Noise level	<45dB(A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	2.2 lbs [1000 Kg]

AMB(X)24-SR-T	
Electrical connection	screw terminal (for 26 to 14 GA wire) unprotected (NEMA 1/IP20)

†Rated Impulse Voltage 800V, Type of action 1, Control Pollution Degree 3.

Torque min. 180 in-lb for control of damper surfaces up to 45 sq ft.

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp, 1/2" self-centered default. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication or master-slave applications.

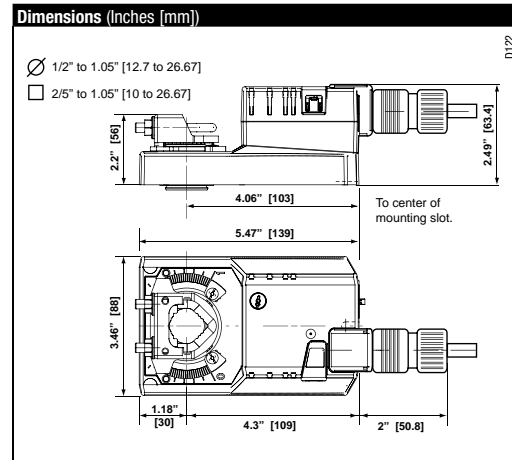
Operation

The actuator is not provided with and does not require any limit switches, but is electronically protected against overload. The anti-rotation strap supplied with the actuator will prevent lateral movement.

The AMB(X) series provides 95° of rotation and a visual indicator indicates position of the actuator. When reaching the damper or actuator end position, the actuator automatically stops. The gears can be manually disengaged with a button on the actuator cover.

The AMB(X)24-SR... actuators use a sensorless brushless DC motor, which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing (DRS) function to prevent damage to the actuator in a stall condition. Power consumption is reduced in holding mode.

Add-on auxiliary switches or feedback potentiometers are easily fastened directly onto the actuator body for signaling and switching functions.



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800-543-9038 USA

866-805-7089 CANADA

203-791-8396 LATIN AMERICA

Accessories	
X-SA	Reversible Clamp
ZG-100	Universal Mounting Bracket
ZG-101	Universal Mounting Bracket
ZG-103	Universal Mounting Bracket
ZG-104	Universal Mounting Bracket
Z-SMA	AM/SM to AM Retrofit Mounting Bracket
ZG-NMA	Crank arm Adaptor Kit
AV8-25	Universal Shaft Extension
ZG-JSA (-1, 2, 3)	Jackshaft Adaptors for Hollow Jackshafts
ZS-T	Terminal Cover NEMA 2
ZS-100	Weather Shield - Steel
ZS-150	Weather Shield - Polycarbonate
ZS-260	Explosion Proof Housing
ZS-300 (-1) (-5)	NEMA 4X Housing
Tool-06	8 mm & 10 mm Wrench
S1A, S2A	Auxiliary Switch (es)
P370	Shaft Mount Auxiliary Switch
P...A	Feedback Potentiometers
SGA24	Min positioners in NEMA 4 housing
SGF24	Min positioners for flush panel mounting
PTA-250	Pulse Width Modulation Interface
IRM-100	Input Rescaling Module
ADS-100	Analog to Digital Switch
ZG-R01	Resistor for 4 to 20 mA Conversion
NSV24 US	Battery Back-Up Module
ZG-X40	Transformer

NOTE: When using AMB(X)24-SR... actuators, only use accessories listed on this page.

Typical Specification

Proportional control damper actuators shall be electronic direct-coupled type, which require no crank arm and linkage and be capable of direct mounting to a shaft up to 1.05" diameter. Actuators must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. Actuators shall have brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. If required, actuator will be provided with screw terminal strip for electrical connections (AMX24-SR-T). Run time shall be constant and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position indication. Actuators shall be cULus listed, have a 5-year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams

INSTALLATION NOTES

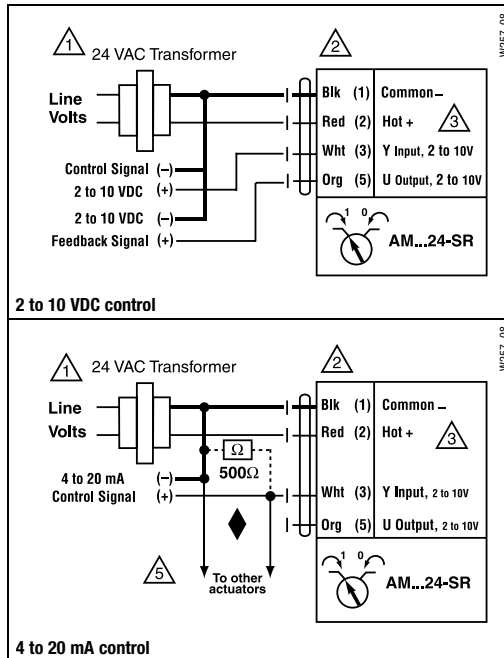
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 5 Only connect common to neg. (-) leg of control circuits.

APPLICATION NOTES

- ◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC, up to 2 actuators may be connected in parallel.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



2015-24-2

The New York Blower Company

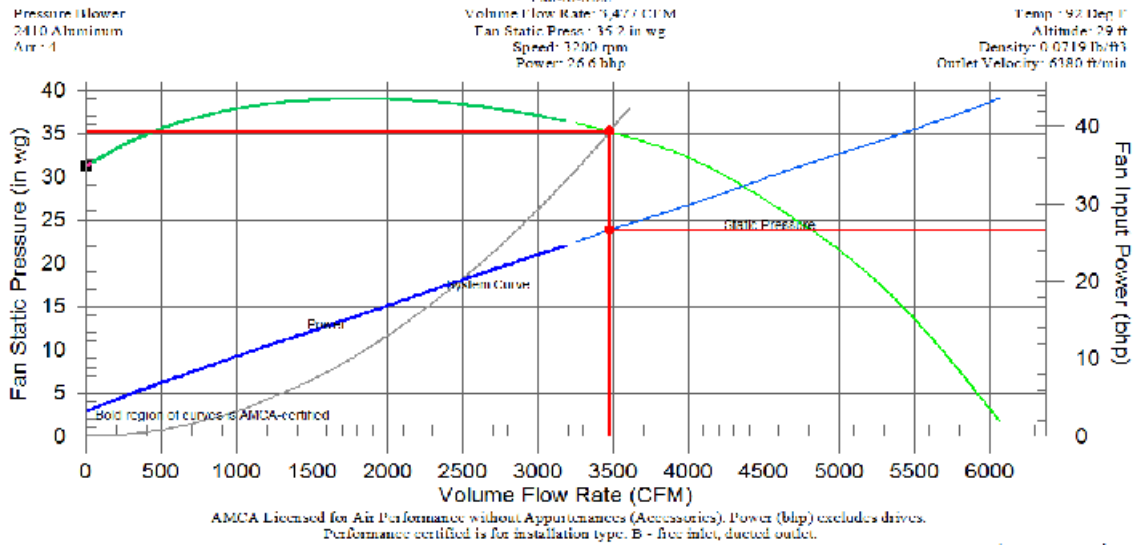


Figure I-1. PAC-45 Blower Performance Curve.

Design Point at 255 lbs/min Air Flow Rate.

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Product Information Packet

EM2534T

30HP,3530RPM,3PH,60HZ,284TS,4040M,OPSB,F

Part Detail							
Revision:	E	Status:	PRD/A	Change #:		Proprietary:	No
Type:	AC	Prod. Type:	4040M	Elec. Spec:	40WGX193	CD Diagram:	
Enclosure:	OPSB	Mfg Plant:		Mech. Spec:	40G51	Layout:	
Frame:	284TS	Mounting:	F1	Poles:	02	Created Date:	10-15-2010
Base:	RG	Rotation:	R	Insulation:	F	Eff. Date:	07-26-2013
Leads:	9#8	Literature:		Elec. Diagram:		Replaced By:	

Nameplate NP2138L

CAT.NO.	EM2534T	P/N		ENCLOSURE	OPSB		
SPEC.	40G051X193	CC	010A	FRAME	284TS	S/N	
HP	30	CLASS	F	HZ	60		
RPM	3530	PH	3	DES	A		
VOLT	208-230/460	KVA-CODE	H	ODE BRG	6309	DE BRG	6311
AMP	76-70/35	USABLE AT 208V					
RATING	40C AMB-CONT	GREASE	POLYREX EM				
NEMA-NOM-EFF	91.7	PF	87	SER.F.	1.15		
HTR-VOLTS		HTR-AMPS		MAX. SPACE HEATER TEMP.			

Parts List		
Part Number	Description	Quantity
SA204544	SA 40G051X193	1.000 EA
RA191791	RA 40G051X193	1.000 EA
S/P107-000-004	SUPER-E(284 FR. & UP)-CL PLANT,POLYREX E	1.000 EA
HA6361A01	LIFTING LUG FOR 37, 39 & 40 FRAME (AUTOP	2.000 EA
HW3022L07	3/8 X .750 LONG BLACK OXIDE ROLLED SPRIN	1.000 EA
HA6017A01	CAST ADAPTOR	1.000 EA
19XW3118A12	.31-18 X .75 HEX WASHER HEAD TAPTITE II	2.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	2.000 EA
10CB3000SP	STD KO BOX MODEL 310,312,314 MTRS W/2.00	1.000 EA
19XW3118A12	.31-18 X .75 HEX WASHER HEAD TAPTITE II	4.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	4.000 EA
WD1000B16	T&B CX70TN TERMINAL	1.000 EA
51XF2520A08	SCREW, HEX SER SLT HD, ZN 1/4-20 X .50 L	1.000 EA
40EP3200A02	STD FREP OPEN 309 BRG	1.000 EA
HW5100A11	W3917-042 WVY WSHR (WB)	1.000 EA
40EP3200B05	STD PUEP OPEN 311 BRG	1.000 EA
XY3816A12	3/8-16 FINISHED NUT	8.000 EA
10CB3500SP	CONDUIT BOX LID, CAST	1.000 EA
51XW2520A12	.25-20 X .75, TAPTITE II, HEX WSHR SLTD	4.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	4.000 EA
HW2501G17	KEY, 3/8 SQ X 1.875	1.000 EA
LB1115	LABEL,LIFTING DEVICE	1.000 EA
LB5040	INSTRUCTION TAG, AC & DC	1.000 EA
HW4500A03	GREASE FITTING, .125 NPT 1610(ALEMITE) 8	1.000 EA

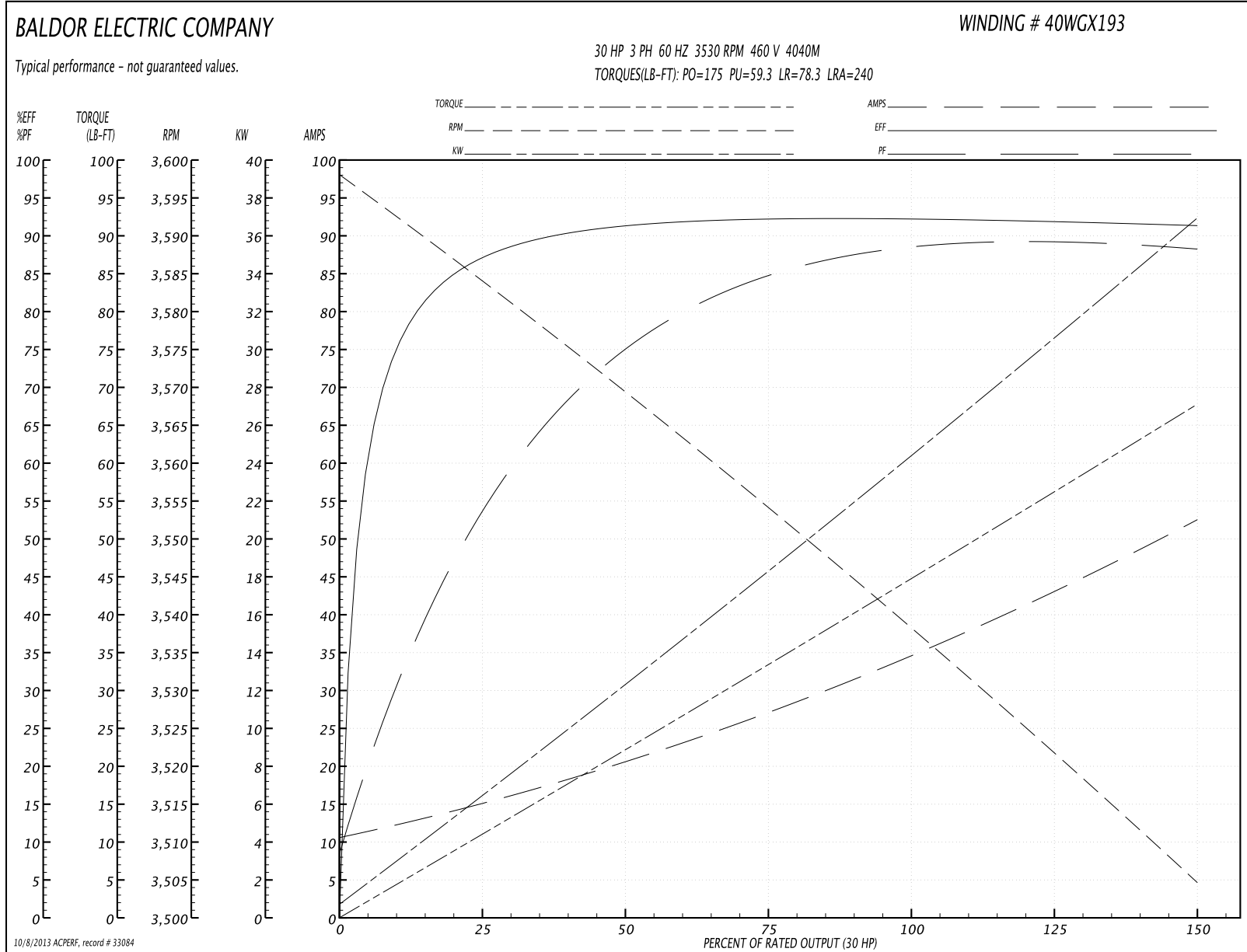
Parts List (continued)		
Part Number	Description	Quantity
HW4500A20	1/8NPT SL PIPE PLUG	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
MJ1000A75	GREASE, POLYREX EM EXXON	0.050 LB
HW4500A03	GREASE FITTING, .125 NPT 1610(ALEMITE) 8	1.000 EA
HW4500A20	1/8NPT SL PIPE PLUG	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
MG1000Y03	WILKO 689.710 GOLD PAINT SUPER E	0.070 GA
85XU0407A04	#4-7 X 1/4 DRIVE PIN	4.000 EA
40AD2002B01	LEXAN BAFFLE 40 FR OPEN	1.000 EA
40AD2002B01	LEXAN BAFFLE 40 FR OPEN	1.000 EA
HA3154A03	STUD, 3/8-16 X 17.75	4.000 EA
LB1119	WARNING LABEL	1.000 EA
LB1125C02	SUPER-E (STOCK CTN LABEL SUPER-E WITH FL	4.000 EA
LC0181	CONNECTION LABEL	1.000 EA
NP2138L	ALUM SUPER-E UL CSA-EEV PREM CC (300	1.000 EA
40PA1000	PACKAGING GROUP	1.000 EA
LB1506	LABEL "AMERICAN MADE" 1.50 X 1.00	1.000 EA

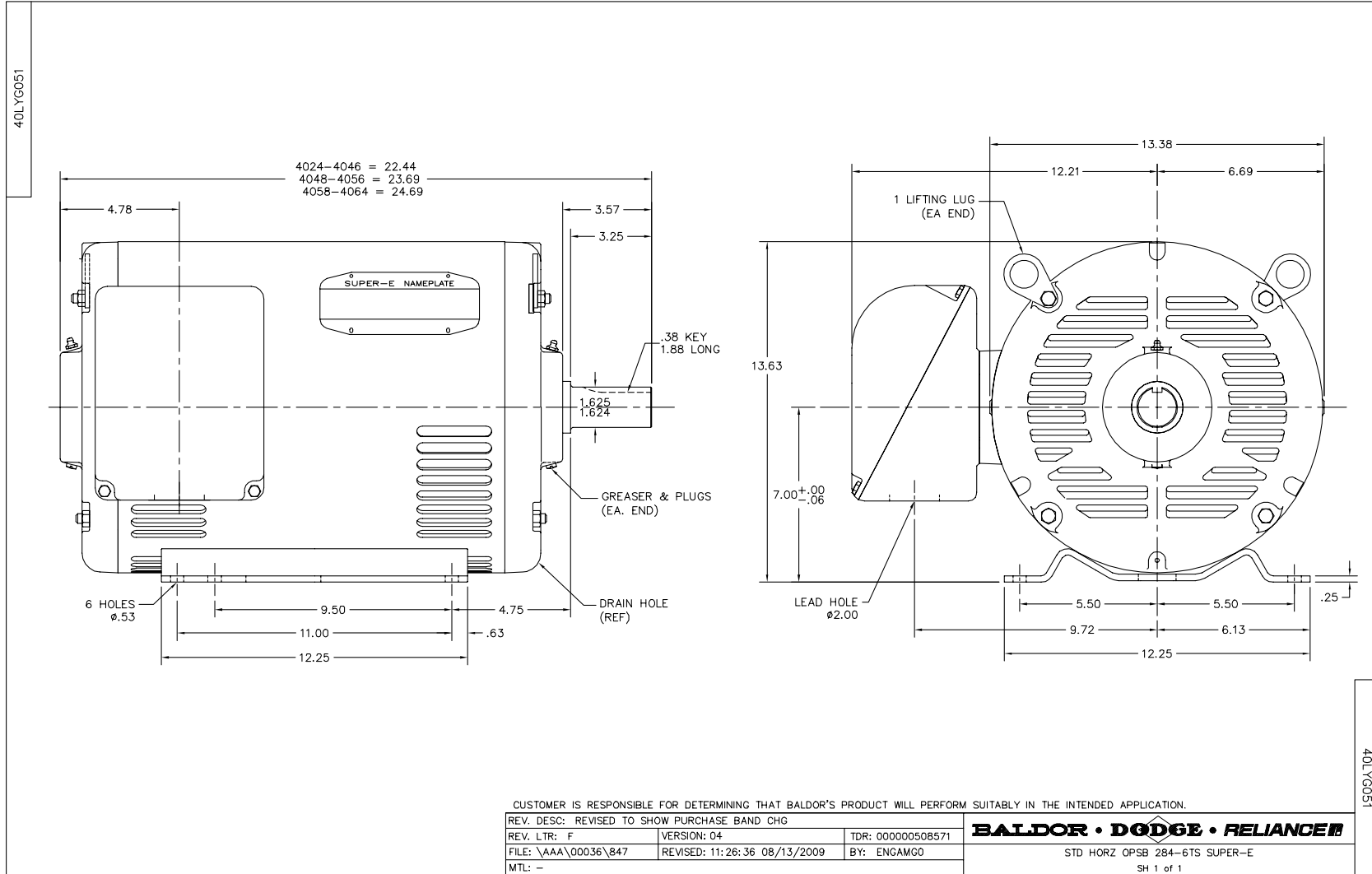
Accessories		
Part Number	Description	Multiplier
40-1400	C FACE KIT	A8

Performance Data at 460V, 60Hz, 30.0HP (Typical performance - Not guaranteed values)

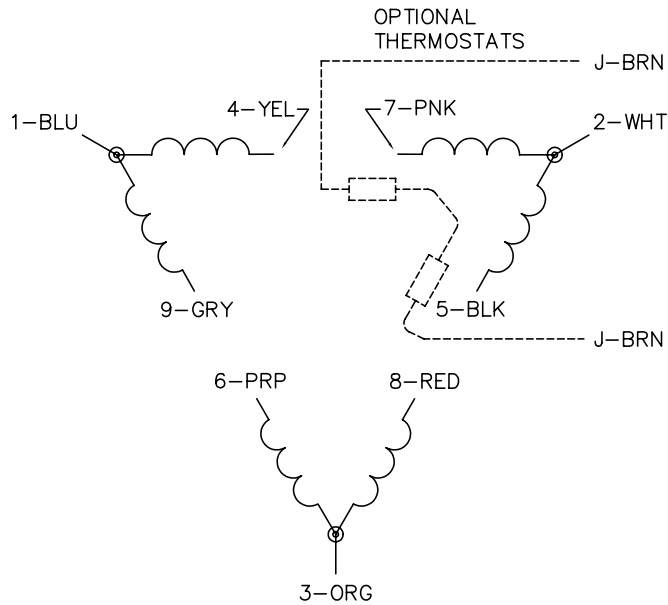
General Characteristics							
Full Load Torque:	44.7 LB-FT			Start Configuration:	DOL		
No-Load Current:	11.2 Amps			Break-Down Torque:	175.0 LB-FT		
Line-line Res. @ 25°C.:	0.21802 Ohms A Ph / 0.0 Ohms B Ph			Pull-Up Torque:	59.3 LB-FT		
Temp. Rise @ Rated Load:	23 C			Locked-Rotor Torque:	78.3 LB-FT		
Temp. Rise @ S.F. Load:	28 C			Starting Current:	240.0 Amps		
Load Characteristics							
% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor:	58.0	77.0	84.0	87.0	88.0	89.0	88.0
Efficiency:	89.3	92.8	93.4	93.2	92.6	91.8	92.8
Speed:	3582.7	3568.7	3554.6	3538.7	3522.3	3504.1	3529.0
Line Amperes:	14.4	20.3	27.2	35.1	43.4	52.1	40.1

Performance Graph at 460V, 60Hz, 30.0HP Typical performance - Not guaranteed values

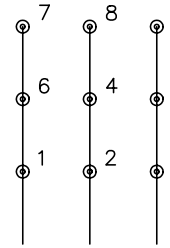




CD0180

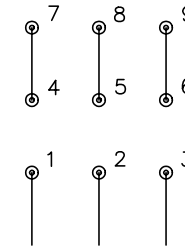


LOW VOLTAGE
(2D)



LINE

HIGH VOLTAGE
(1D)



LINE

NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

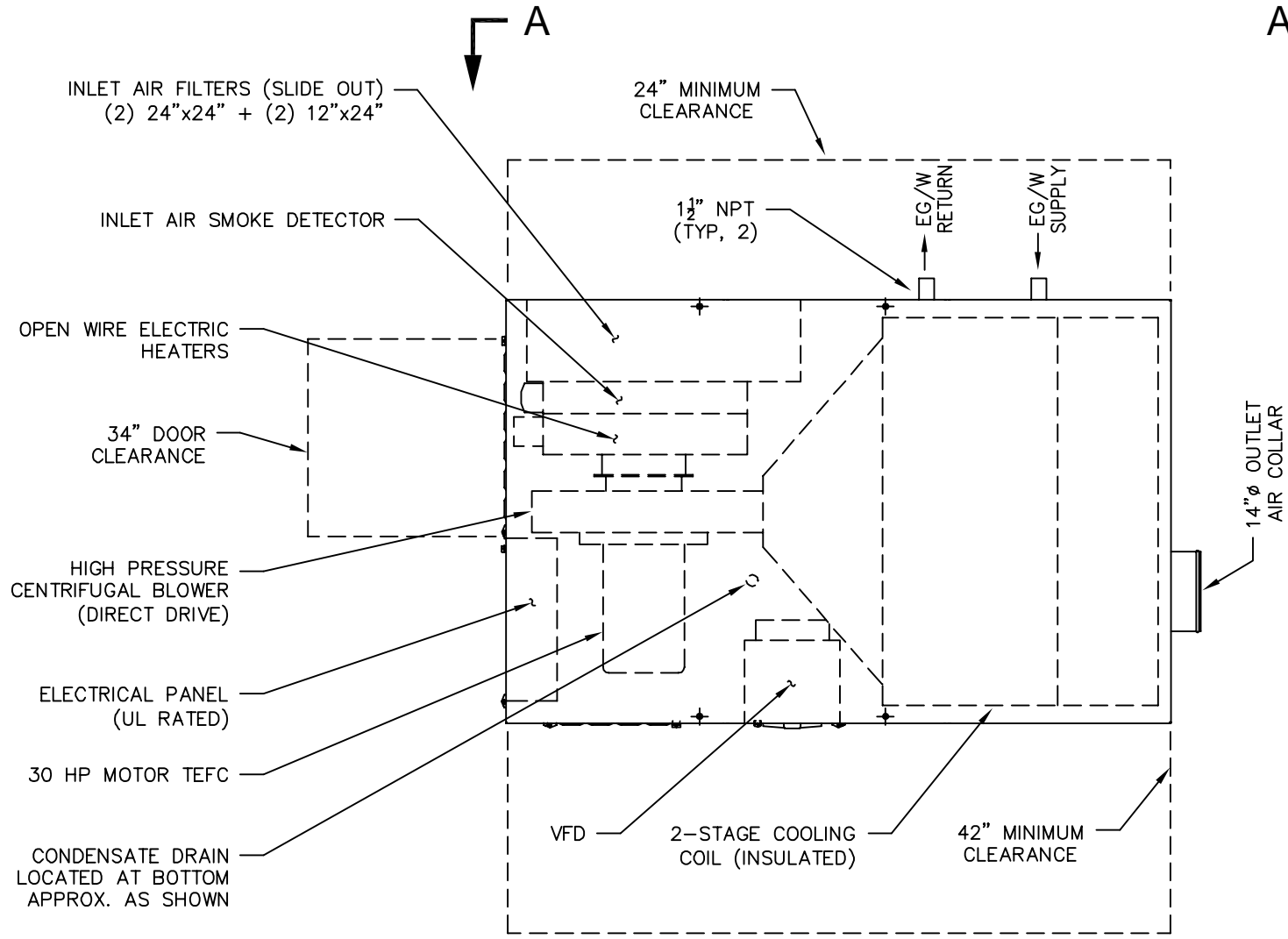
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REV. LTR: C	BY: JLP	REVISED: 01/21/99 2:28	TDR: 0171435
0810D0		FILE: AAA00005148	MDL: -
		MTL: -	

BALDOR ELECTRIC Co.

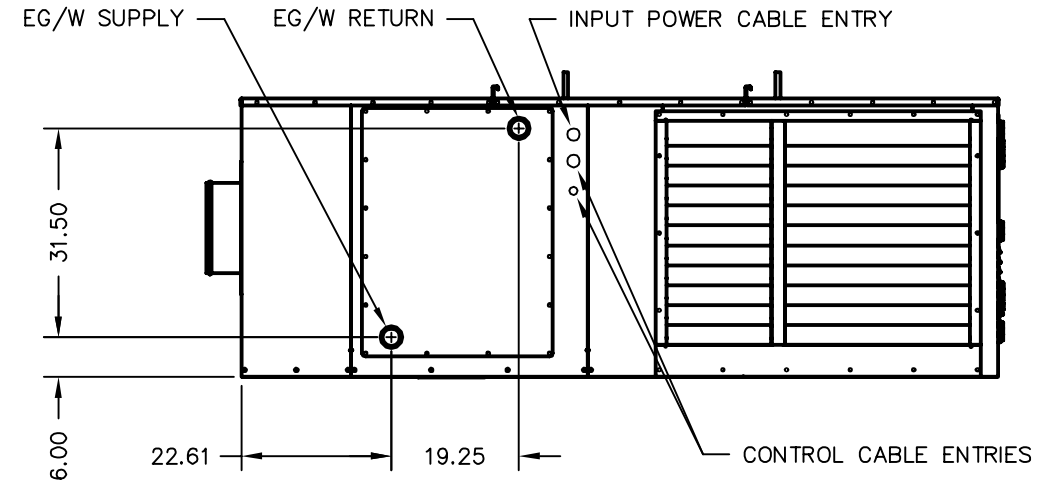
3PH, DV, 9 LEADS, DELTA CONNECTION

CD0180

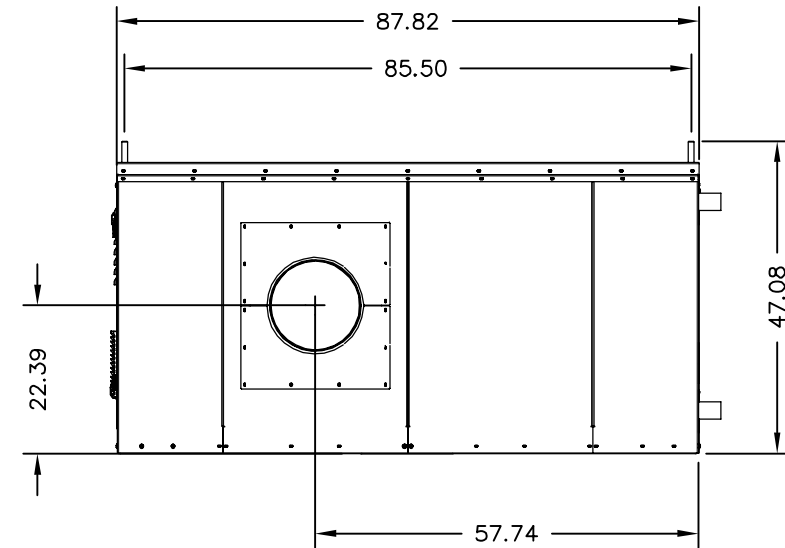
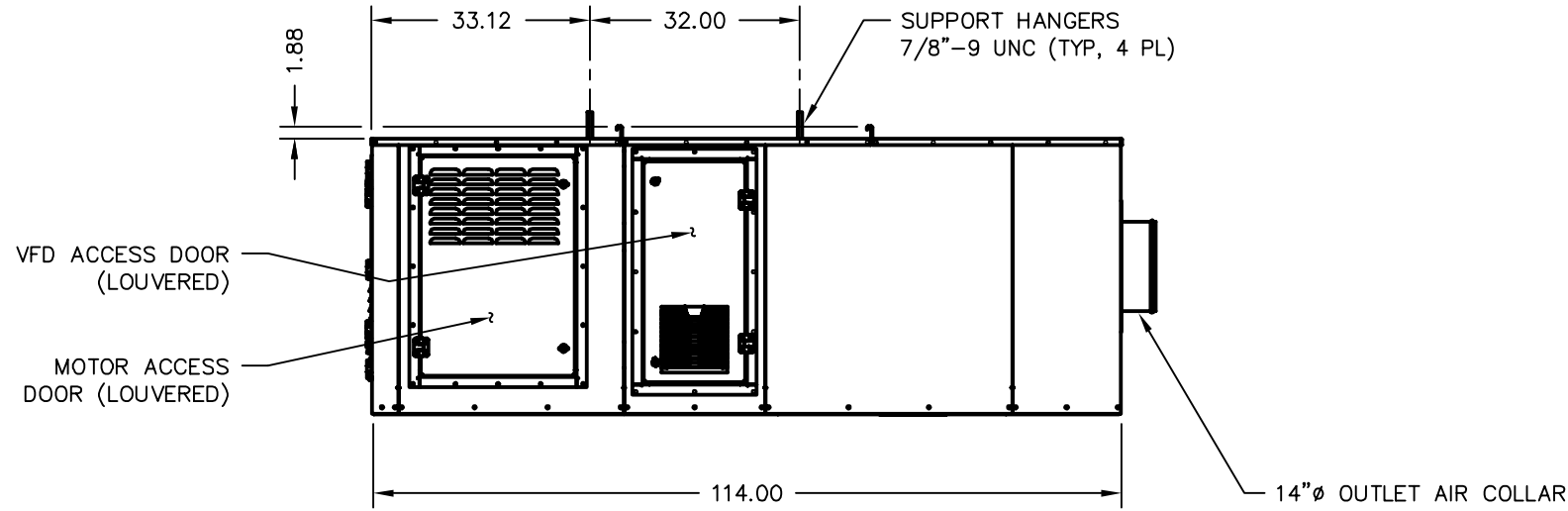
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GENERAL NOTES:
1. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5-2009.



VIEW A-A
(ROTATED 180°)



REVISIONS

REV	DATE	DESCRIPTION	DWN	APPR

TITLE
INSTALLATION OUTLINE
LH SIDE EG/W SUPPLY & RETURN
PAC-45 AIR HANDLER UNIT

SIZE
DRAWING No.
B
N0010-AS066482-062

SCALE: NONE

07/24/20

DRAWN
CESAR L. CHAINGAN

CHECKED

DESIGN APPROVAL

APPROVAL

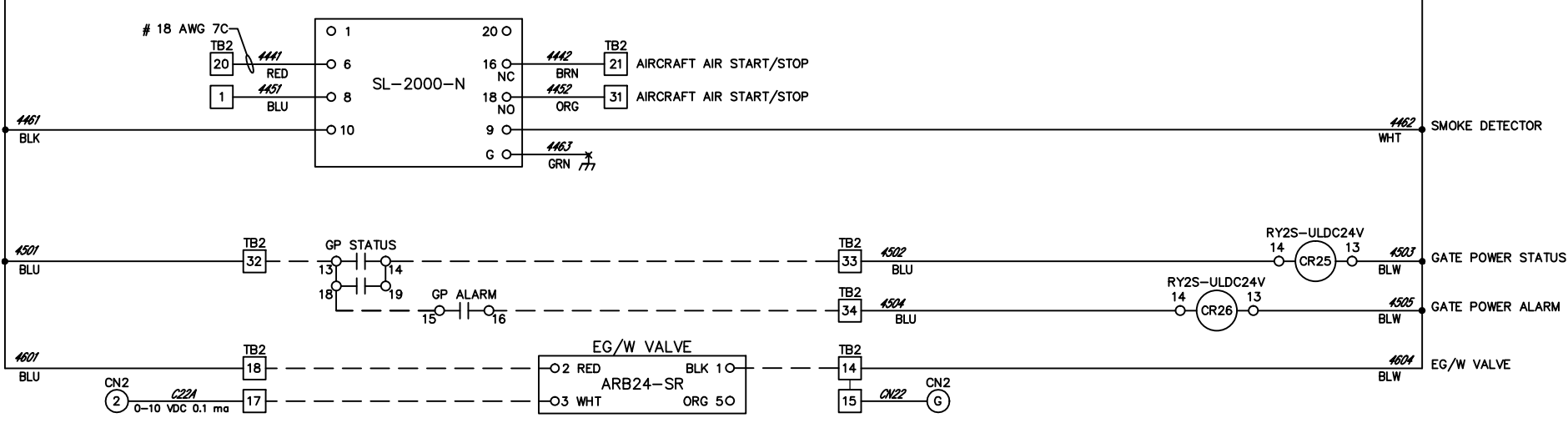
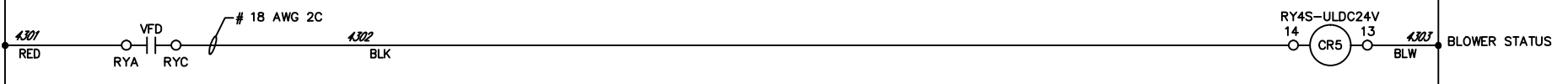
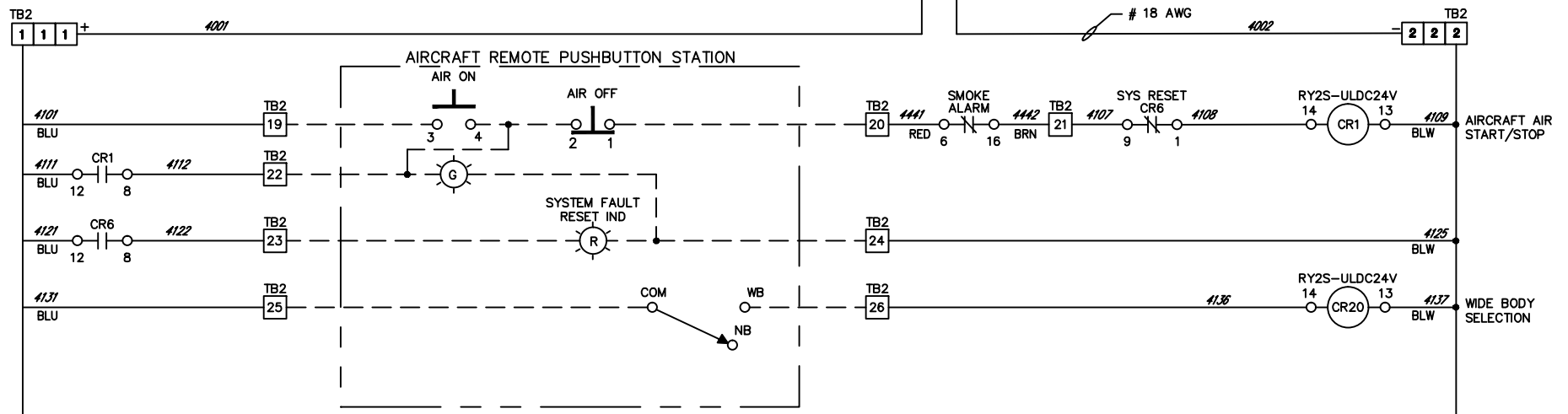
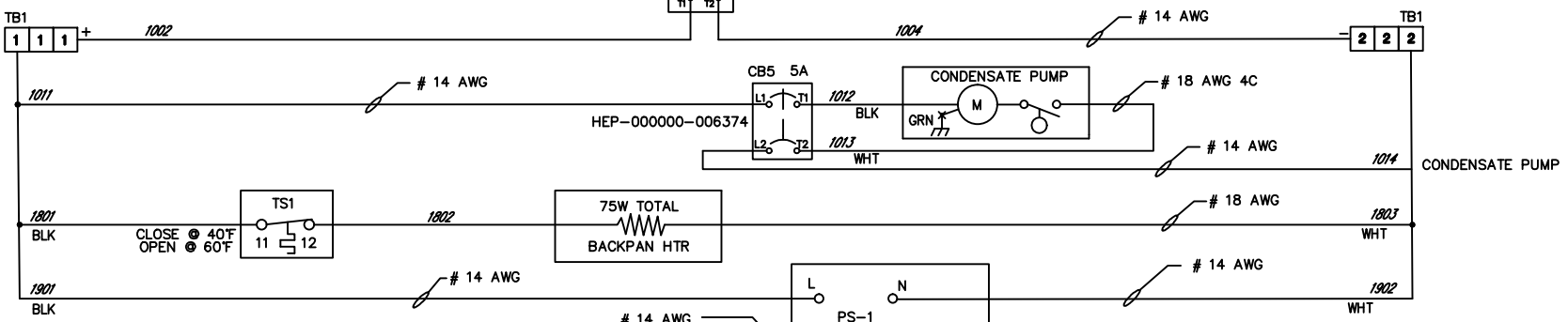
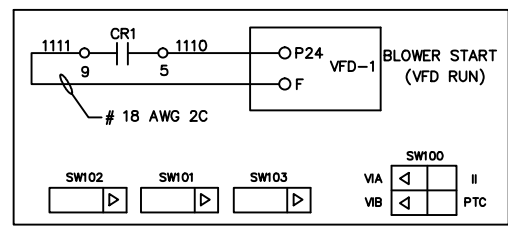
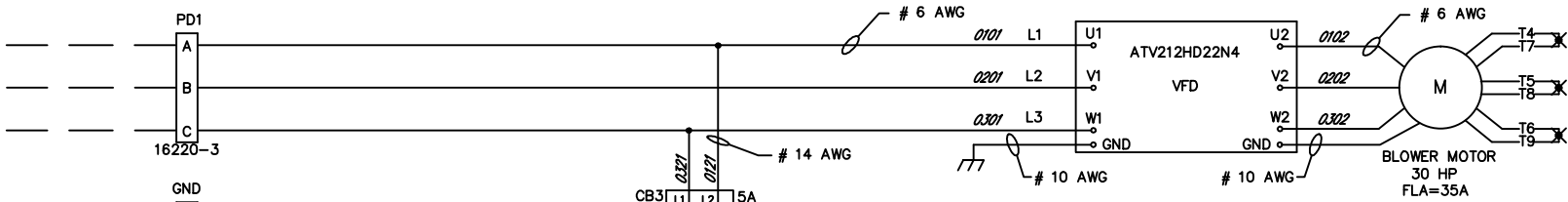
APPROVAL



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES

TOLERANCE ON :
FRACTIONS ± 1/32
DECIMALS .XX ±.010
ANGLES ±1/4
.xxx ±.005

INPUT POWER
480 VOLT, 3 W
3 PH, 60 HZ.



NOTE: FIELD WIRING SHALL BE A MIN. OF 600 V RATING, 105°C WIRE

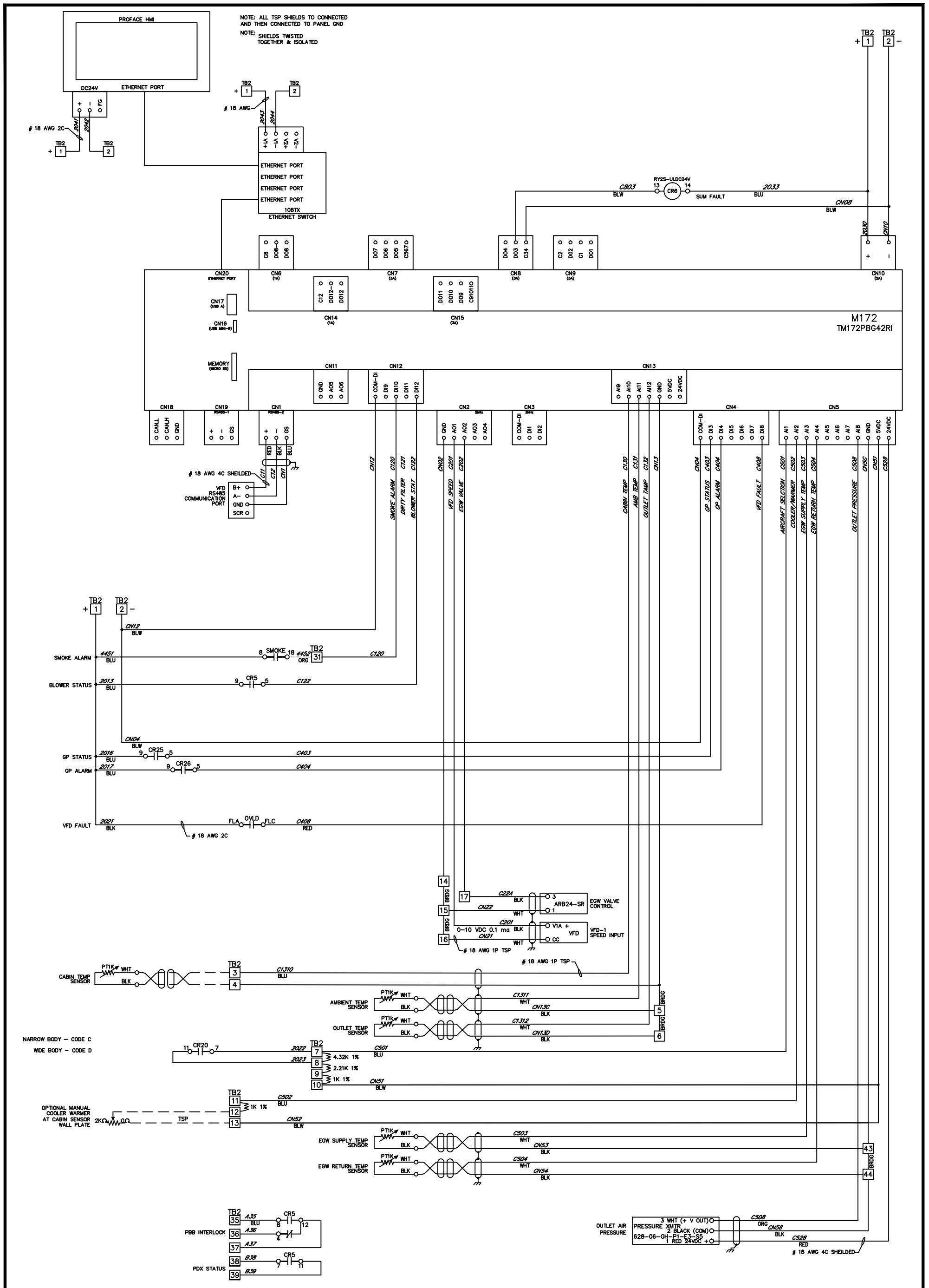


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DIMENSIONS ARE IN INCHES.
SHEET 1 OF 3

TITLE
**SCHEMATIC WIRING DIAGRAM
PAC-45 SINGLE OUTLET
480 VOLT 60 HZ MODEL
MIAMI DADE GATE D6, D11, E7, E9**
SIZE
B
DRAWING No.
N0004-SC068829-104
SCALE : NONE
CAD FILE:

REVISIONS					
REV	DATE	DESCRIPTION	DWN	APPR	

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 SHEET 2 OF 3

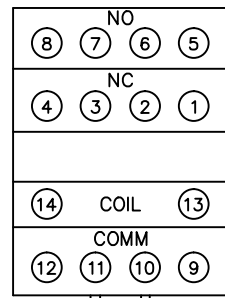
TITLE
**SCHEMATIC WIRING DIAGRAM
 PAC-45 SINGLE OUTLET
 480 VOLT 60 HZ MODEL
 MIAI DADE GATE D6, D11, E7, E9**
 SIZE
B
 DRAWING No.
N0004-SC068829-104
 SCALE : NONE
 CAD FILE:

REVISIONS				
REV	DATE	DESCRIPTION	DWN	APPR

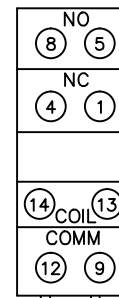


LEGEND

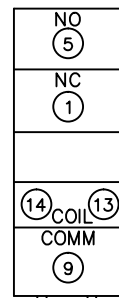
ELECTRICAL SYMBOLS	
SYMBOLS	DEFINITIONS
	CIRCUIT BREAKER
	NORMALLY OPEN CONTACT
	NORMALLY CLOSED CONTACT
	HEATER
	NORMALLY OPEN FLOAT SWITCH
	NORMALLY OPEN PRESSURE SWITCH
	NORMALLY CLOSED PRESSURE SWITCH
	SOLENOID VALVE
	TEMPERATURE SENSOR
	GROUND
	RESISTOR
	VARIABLE RESISTOR
	POTENTIOMETER (MANUAL VARIABLE RESISTOR)
	120 VAC / 24 VAC STEP-DOWN TRANSFORMER
	480 VAC / 120 VAC STEP-DOWN TRANSFORMER
	NORMALLY OPEN PUSHBUTTON
	NORMALLY CLOSED PUSHBUTTON
	NORMALLY CLOSED EMERGENCY STOP PUSHBUTTON
	ILLUMINATED INDICATOR (GREEN)
	ILLUMINATED INDICATOR (AMBER)
	ILLUMINATED INDICATOR (RED)
	AUDIBLE ALARM
	FIELD WIRING
	TERMINAL BLOCK CONNECTION NUMBER
	QUICK DISCONNECT CONNECTION NUMBER
	OVERLOAD



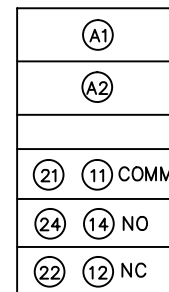
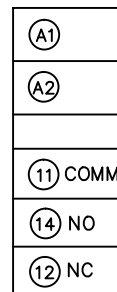
RY4S-ULDC24V



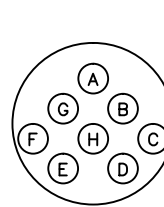
RY2S-ULDC24V



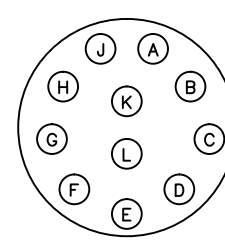
RH1B-ULDC24V



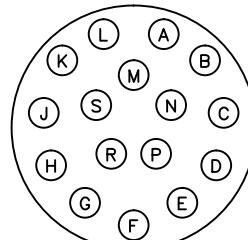
PLC-RSC-24UC/21 PLC-RSC-24UC/21-21



16-8



18-11



20-16

ABBREVIATIONS			
SYMBOLS	DEFINITIONS	SYMBOLS	DEFINITIONS
AMB	AMBER	NC	NORMALLY CLOSED
AUX	AUXILIARY	NO	NORMALLY OPEN
BLK	BLACK	OVR	OVERLOAD
BLU	BLUE	PCA	PRE-CONDITIONED AIR
BLW	BLUE-WHITE	PD	POWER DISTRIBUTION
BRN	BROWN	POS	POSITION
BRDG	TERMINAL BRIDGE/JUMPER	PS-1	POWER SUPPLY
BLWR	BLOWER	PWM	PULSE WIDTH MODULATION
BMS	BUILDING MANAGEMENT SYSTEM	RED	RED
C1	COMPRESSOR 1	RH	RIGHT HAND
C2	COMPRESSOR 2	RLA	RATED LOAD AMPS
C3	COMPRESSOR 3	STG	STAGE
CB	CIRCUIT BREAKER	STAT	STATUS
CC	CRANK CASE	SV	SOLENOID VALVE
CLSD	CLOSED	SW	SWITCH
CMD	COMMAND	TB	TERMINAL BLOCK
COMP	COMPRESSOR	TE	TEMPERATURE ELEMENT
CR	CONTROL RELAY	TS	TEMPERATURE SENSOR
FLA	FULL LOAD AMPS	TSP	TWISTED SHIELDED PAIR 8760
GND	GROUND	VFD	VARIABLE FREQUENCY DRIVE
GRN	GREEN	WHT	WHITE
HDPS	HIGH DISCHARGE PRESSURE SWITCH		
HG	HOT GAS		
HTR	HEATER		
LH	LEFT HAND		
LSPS	LOW SUCTION PRESSURE SWITCH		
M	MOTOR OR MODULE		
MP	MOTOR PROTECTOR		



DRAWN
BRAD HANNA
CHECKED

10/28/2020

TITLE
**SCHEMATIC WIRING DIAGRAM
PAC-45 SINGLE OUTLET
480 VOLT 60 HZ MODEL
MIAMI DADE GATE D6, D7, E7, E9**

SIZE
B DRAWING No.
N0004-SC068829-104

APPROVAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES.

SHEET 3 OF 3

SCALE : NONE CAD FILE:

REVISIONS

REV	DATE	DESCRIPTION	DWN	APPR

ATV212HD22N4

variable speed drive ATV212 - 22kW - 30hp -
480V - 3ph - EMC - IP21



Main

Range of product	Altivar 212
Product or component type	Variable speed drive
Device short name	ATV212
Product destination	Asynchronous motors
Product specific application	Pumps and fans in HVAC
Assembly style	With heat sink
Network number of phases	3 phases
Motor power kW	22 kW
Motor power hp	30 hp
Power supply voltage	380...480 V (- 15...10 %)
Power supply voltage limits	323...528 V
Supply frequency	50...60 Hz (- 5...5 %)
Network frequency	47.5...63 Hz
EMC filter	Class C2 EMC filter integrated
Line current	41.6 A for 380 V 33.1 A for 480 V

Complementary

Apparent power	33.2 kVA for 380 V
Prospective line I _{sc}	22 kA
Continuous output current	43.5 A at 380/460 V
Maximum transient current	47.9 A for 60 s
Speed drive output frequency	0.5...200 Hz
Nominal switching frequency	8 kHz
Switching frequency	8...16 kHz with derating factor 6...16 kHz adjustable
Speed range	1...10
Speed accuracy	+/- 10 % of nominal slip for 0.2 T _n to T _n torque variation
Torque accuracy	+/- 15 %
Transient overtorque	120 % of nominal motor torque, +/- 10 % for 60 s
Asynchronous motor control profile	Voltage/Frequency ratio, 2 points Voltage/Frequency ratio, 5 points Flux vector control without sensor, standard Voltage/Frequency ratio - Energy Saving, quadratic U/f Voltage/Frequency ratio, automatic IR compensation (U/f + automatic U ₀)
Regulation loop	Adjustable PI regulator
Motor slip compensation	Adjustable Automatic whatever the load Not available in voltage/frequency ratio motor control
Local signalling	1 LED - red - DC bus energized
Output voltage	<= power supply voltage
Isolation	Electrical between power and control
Type of cable for external connection	UL 508 cable with UL Type 1 kit: 3 wire(s) - 40 °C, copper 75 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 70 °C / PVC IEC cable without mounting kit: 1 wire(s) - 45 °C, copper 90 °C / XLPE/EPR
Electrical connection	Terminal 50 mm ² / AWG 1/0 (L1/R, L2/S, L3/T) Terminal 2.5 mm ² / AWG 14 (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

Tightening torque	24 N.m - 212 lb.in (L1/R, L2/S, L3/T) 0.6 N.m (VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES)
Supply	Internal supply: 24 V (21...27 V) DC - \leq 200 A with overload and short-circuit protection Internal supply for reference potentiometer (1 to 10 kOhm): 10.5 V DC, \pm 5 % - \leq 10 A with overload and short-circuit protection
Analogue input number	2
Analogue input type	Configurable voltage: (VIB) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Switch-configurable current: (VIA) 0...20 mA - 250 Ohm - resolution: 10 bits Switch-configurable voltage: (VIA) 0...10 V DC - 24 V max - 30000 Ohm - resolution: 10 bits Configurable PTC probe: (VIB) 0...6 probes - 1500 Ohm
Sampling duration	22 ms \pm 0.5 ms (VIB) - analog input(s) 3.5 ms \pm 0.5 ms (VIA) - analog input(s) 2 ms \pm 0.5 ms (RES) - discrete input(s) 2 ms \pm 0.5 ms (R) - discrete input(s) 2 ms \pm 0.5 ms (F) - discrete input(s)
Response time	7 ms \pm 0.5 ms (RY, RC) - discrete output(s) 7 ms \pm 0.5 ms (FLB, FLC) - discrete output(s) 7 ms \pm 0.5 ms (FLA, FLC) - discrete output(s) 2 ms \pm 0.5 ms (FM) - analog output(s)
Accuracy	\pm 1 % (FM) for a temperature variation 60 °C \pm 0.6 % (VIB) for a temperature variation 60 °C \pm 0.6 % (VIA) for a temperature variation 60 °C
Linearity error	\pm 0.2 % for output (FM) \pm 0.15 % of maximum value for input (VIB) \pm 0.15 % of maximum value for input (VIA)
Analogue output number	1
Analogue output type	Switch-configurable current: (FM) 0...20 mA - 970 Ohm - resolution: 10 bits Switch-configurable voltage: (FM) 0...10 V DC - 7620 Ohm - resolution: 10 bits
Discrete output number	2
Discrete output type	Configurable relay logic: (RY, RC) NO - 100000 cycles Configurable relay logic: (FLB, FLC) NC - 100000 cycles Configurable relay logic: (FLA, FLC) NO - 100000 cycles
Minimum switching current	3 mA at 24 V DC (configurable relay logic)
Maximum switching current	2 A at 30 V DC on inductive load - $\cos \phi = 0.4$ - L/R = 7 ms (FL, R) 2 A at 250 V AC on inductive load - $\cos \phi = 0.4$ - L/R = 7 ms (FL, R) 5 A at 30 V DC on resistive load - $\cos \phi = 1$ - L/R = 0 ms (FL, R) 5 A at 250 V AC on resistive load - $\cos \phi = 1$ - L/R = 0 ms (FL, R)
Discrete input type	Programmable (RES) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (R) 24 V DC, with level 1 PLC - 4700 Ohm Programmable (F) 24 V DC, with level 1 PLC - 4700 Ohm
Discrete input logic	Negative logic (sink) (F, R, RES), \geq 16 V (state 0), \leq 10 V (state 1) Positive logic (source) (F, R, RES), \leq 5 V (state 0), \geq 11 V (state 1)
Acceleration and deceleration ramps	Automatic based on the load Linear adjustable separately from 0.01 to 3200 s
Braking to standstill	By DC injection
Protection type	With PTC probes for motor Motor phase break for motor Thermal protection for motor Against input phase loss for drive Line supply undervoltage for drive Line supply overvoltage and undervoltage for drive Against exceeding limit speed for drive Break on the control circuit for drive Overvoltages on the DC bus for drive Overcurrent between output phases and earth for drive Input phase breaks for drive Short-circuit between motor phases for drive Thermal power stage for drive Overheating protection for drive
Dielectric strength	5092 V DC between control and power terminals 3535 V DC between earth and power terminals
Insulation resistance	\geq 1 MOhm at 500 V DC for 1 minute
Frequency resolution	0.024/50 Hz for analog input 0.1 Hz for display unit

Communication port protocol	APOGEE FLN BACnet LonWorks METASYS N2 Modbus
Connector type	1 RJ45 1 open style
Physical interface	2-wire RS 485
Transmission frame	RTU
Transmission rate	9600 bps or 19200 bps
Data format	8 bits, 1 stop, odd even or no configurable parity
Type of polarization	No impedance
Number of addresses	1...247
Communication service	Monitoring inhibitable Read device identification (43) Read holding registers (03) 2 words maximum Time out setting from 0.1 to 100 s Write multiple registers (16) 2 words maximum Write single register (06)
Option card	Communication card for LonWorks
Operating position	Vertical +/- 10 degree
Width	240 mm
Height	420 mm
Depth	214 mm
Product weight	26.4 kg
Power dissipation in W	626 W
Fan flow rate	214 m3/h

Environment

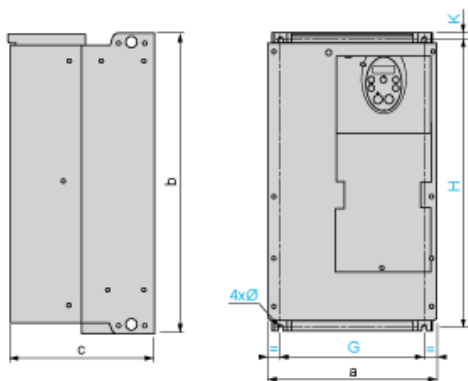
Electromagnetic compatibility	Voltage dips and interruptions immunity test conforming to IEC 61000-4-11 Conducted radio-frequency immunity test level 3 conforming to IEC 61000-4-6 1.2/50 μ s - 8/20 μ s surge immunity test level 3 IEC 61000-4-5 Electrical fast transient/burst immunity test level 4 conforming to IEC 61000-4-4 Radiated radio-frequency electromagnetic field immunity test level 3 conforming to IEC 61000-4-3 Electrostatic discharge immunity test level 3 conforming to IEC 61000-4-2
Pollution degree	3 IEC 61800-5-1
IP degree of protection	IP20 on upper part without blanking plate on cover conforming to EN/IEC 60529 IP20 on upper part without blanking plate on cover conforming to EN/IEC 61800-5-1 IP41 on upper part conforming to EN/IEC 60529 IP41 on upper part conforming to EN/IEC 61800-5-1 IP21 conforming to EN/IEC 60529 IP21 conforming to EN/IEC 61800-5-1
Vibration resistance	1 gn (f = 13...200 Hz) conforming to EN/IEC 60068-2-8 1.5 mm (f = 3...13 Hz) conforming to EN/IEC 60068-2-6
Shock resistance	15 gn for 11 ms conforming to IEC 60068-2-27
Environmental characteristic	Classes 3S2 conforming to IEC 60721-3-3 Classes 3C1 conforming to IEC 60721-3-3
Noise level	59.9 dB conforming to 86/188/EEC
Operating altitude	1000...3000 m (limited to 2000 m for the Corner Grounded distribution network) with current derating 1 % per 100 m <= 1000 m without derating
Relative humidity	5...95 % without dripping water conforming to IEC 60068-2-3 5...95 % without condensation conforming to IEC 60068-2-3
Ambient air temperature for operation	> 40...50 °C with derating factor -10...40 °C without derating
Ambient air temperature for storage	-25...70 °C

Standards	EN 55011 class A group 1 EN 61800-3 EN 61800-3 category C2 EN 61800-3 category C3 EN 61800-3 environments 1 category C1 EN 61800-3 environments 1 category C2 EN 61800-3 environments 1 category C3 EN 61800-3 environments 2 category C1 EN 61800-3 environments 2 category C2 EN 61800-3 environments 2 category C3 EN 61800-5-1 IEC 61800-3 IEC 61800-3 category C2 IEC 61800-3 category C3 IEC 61800-3 environments 1 category C1 IEC 61800-3 environments 1 category C2 IEC 61800-3 environments 1 category C3 IEC 61800-3 environments 2 category C1 IEC 61800-3 environments 2 category C2 IEC 61800-3 environments 2 category C3 IEC 61800-5-1 UL Type 1
Product certifications	CSA C-Tick NOM 117 UL
Marking	CE

Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 1050 - Schneider Electric declaration of conformity download declaration of conformity
Product end of life instruction	Available Download End Of Life Manual

Dimensions



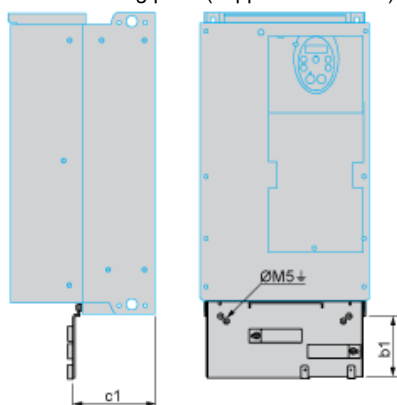
Dimensions in mm

ATV212H	a	b	c	G	H	K	Ø
D22M3X D22N4, D30N4	240	420	214	206	403	10	6
D37N4, D45N4	240	550	244	206	529	10	6

Dimensions in in.

ATV212H	a	b	c	G	H	K	Ø
D22M3X D22N4, D30N4	9.45	16.54	8.43	8.11	15.87	0.39	0.24
D37N4, D45N4	9.45	21.65	9.60	8.11	20.83	0.39	0.24

EMC mounting plate (supplied with drive)



Dimensions in mm

ATV212H	b1	c1
D22M3X D22N4, D30N4	122	120
D37N4, D45N4	113	127

Dimensions in in.

ATV212H	b1	c1
D22M3X D22N4, D30N4	4.80	4.72
D37N4, D45N4	4.45	5.00

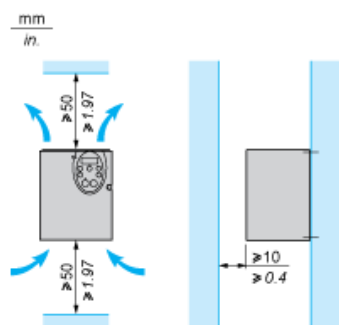
Mounting Recommendations

Clearance

Depending on the conditions in which the drive is to be used, its installation will require certain precautions and the use of appropriate accessories.

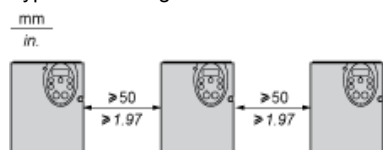
Install the unit vertically:

- Do not place it close to heating elements.
- Leave sufficient free space to ensure that the air required for cooling purposes can circulate from bottom to the top of the unit.

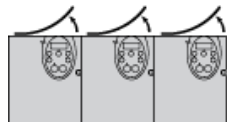


Mounting Types

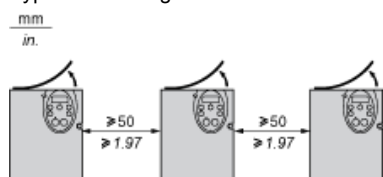
Type A mounting



Type B mounting



Type C mounting



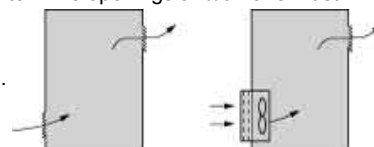
By removing the protective blanking cover from the top of the drive, the degree of protection for the drive becomes IP21. The protective blanking cover may vary according to the drive model, see opposite.

Specific Recommendations for Mounting in an Enclosure

To help ensure proper air circulation in the drive:

- Fit ventilation grilles.
- Check that there is sufficient ventilation. If there is not, install a forced ventilation unit with a filter. The openings and/or fans must

provide a flow rate at least equal to that of the drive fans (refer to the product characteristics).



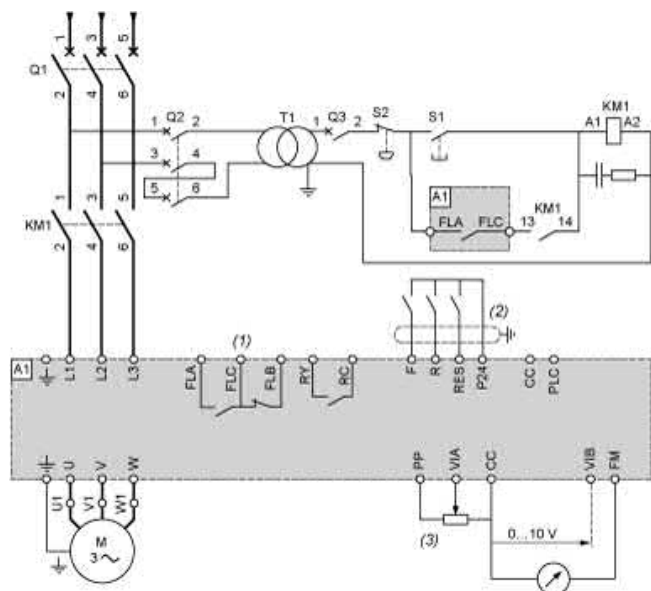
- Use special filters with UL Type 12/IP54 protection.
- Remove the blanking cover from the top of the drive.

Sealed Metal Enclosure (IP54 Degree of Protection)

The drive must be mounted in a dust and damp proof enclosure in certain environmental conditions, such as dust, corrosive gases, high humidity with risk of condensation and dripping water, splashing liquid, etc. This enables the drive to be used in an enclosure where the maximum internal temperature reaches 50°C.

Recommended Wiring Diagram

3-Phase Power Supply



- A1: ATV 212 drive
- KM1: Contactor
- Q1: Circuit breaker
- Q2: GV2 L rated at twice the nominal primary current of T1
- Q3: GB2CB05
- S1, XB4 B or XB5 A pushbuttons
- S2:
- T1: 100 VA transformer 220 V secondary
- (1) Fault relay contacts for remote signalling of the drive status
- (2) Connection of the common for the logic inputs depends on the positioning of the switch (Source, PLC, Sink)
- (3) Reference potentiometer SZ1RV1202

All terminals are located at the bottom of the drive. Install interference suppressors on all inductive circuits near the drive or connected on the same circuit, such as relays, contactors, solenoid valves, fluorescent lighting, etc.

Switches (Factory Settings)

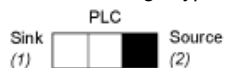
Voltage/current selection for analog I/O (VIA and VIB)



Voltage/current selection for analog I/O (FM)



Selection of logic type

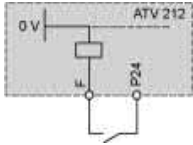


- (1) negative logic
- (2) positive logic

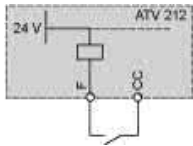
Other Possible Wiring Diagrams

Logic Inputs According to the Position of the Logic Type Switch

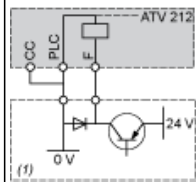
"Source" position



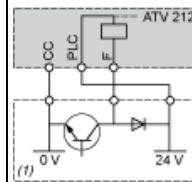
"Sink" position



"PLC" position with PLC transistor outputs

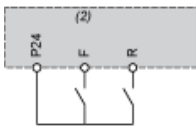


(1) PLC



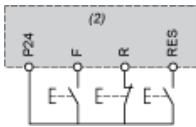
(1) PLC

2-wire control



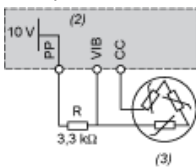
F: Forward
R: Preset speed
(2) ATV 212 control terminals

3-wire control



F: Forward
R: Stop
RES: Reverse
(2) ATV 212 control terminals

PTC probe

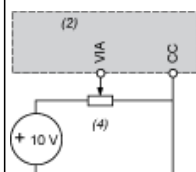


(2) ATV 212 control terminals
(3) Motor

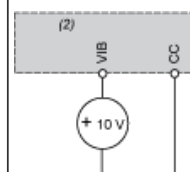
Analogue Inputs

Voltage analogue inputs

External +10 V

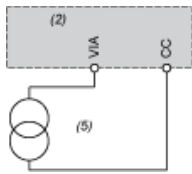


(2) ATV 212 control terminals
(4) Speed reference potentiometer 2.2 to 10 kΩ



(2) ATV 212 control terminals

Analog input configured for current: 0-20 mA, 4-20 mA, X-Y mA



(2) ATV 212 control terminals

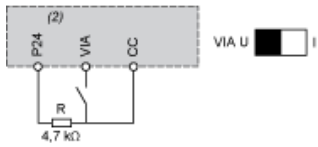
(5) Source 0-20 mA, 4-20 mA, X-Y mA

Analog input VIA configured as positive logic input ("Source" position)



(2) ATV 212 control terminals

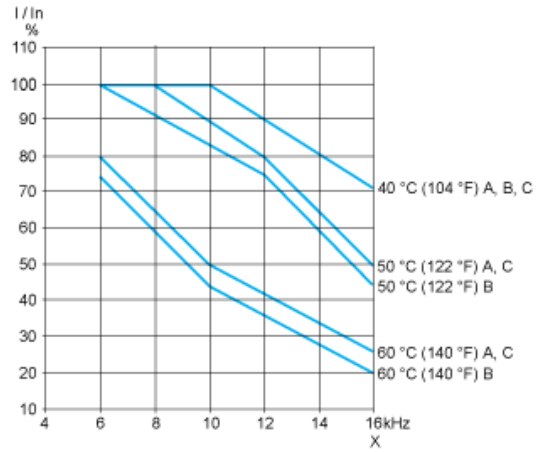
Analog input VIA configured as negative logic input ("Sink" position)



(2) ATV 212 control terminals

Derating Curves

The derating curves for the drive nominal current (I_n) depend on the temperature, the switching frequency and the mounting type (A, B or C). For intermediate temperatures (45°C for example), interpolate between 2 curves.



X Switching frequency



Koch Filter Corporation
Filtration Products Crafted with Pride

New Design and Improved Performance

Multi-Pleat XL8™

*MERV 8 Extended Surface Pleated Panel
Filters with Mechanical Media*



- Upgrade from standard pleated filters
- MERV 8 and MERV-A 8 performance ratings
- Mechanical MERV 8 media is not reliant on electrostatic charge for efficiency
- Low resistance to airflow
- High Dust Holding Capacity
- Sturdy double-wall frame design
- Moisture resistant beverage board frame
- Standard and High Capacity models
- Available in 1", 2", 4" and 6" depths

Koch Filter Corporation...Durable. Reliable. Versatile.

Bulletin No. K-100B

Multi-Pleat XL8 Mechanical MERV 8 Extended Surface Pleated Panel Filters



The Koch **Multi-Pleat XL8** is a medium efficiency extended surface pleated panel filter, engineered to provide higher initial efficiencies and overall superior performance than standard pleated filters.

The **Multi-Pleat XL8** carries a MERV 8 and MERV-A 8 performance rating in accordance with ASHRAE Test Standard 52.2-2007.

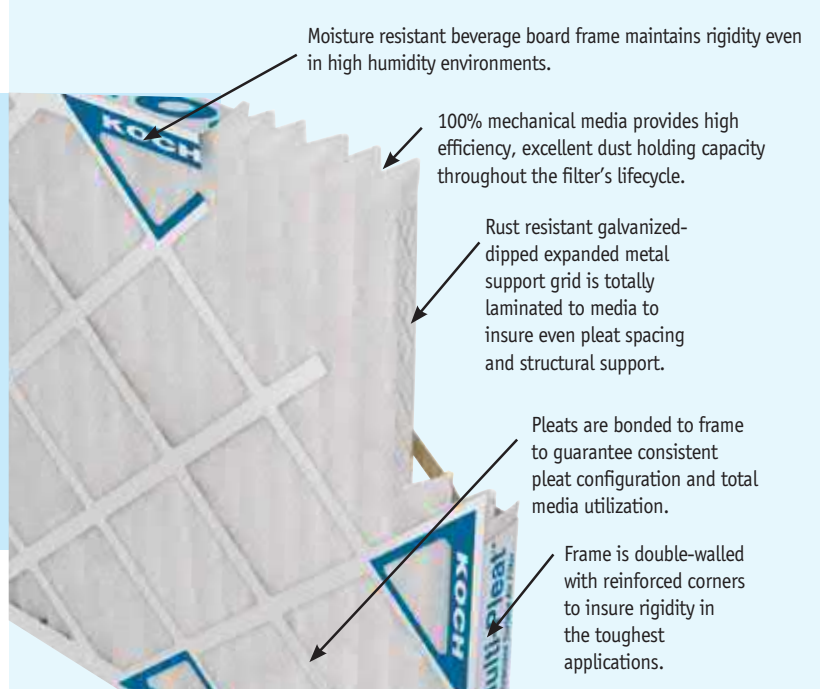
The MERV 8 and MERV-A 8 performance rating provided by the **Multi-Pleat XL8** make the filter an excellent upgrade from disposable filters and standard MERV 6 and 7 rated pleated filters. The **Multi-Pleat XL8** is the best selection in applications such as hospitals, laboratories, pharmaceutical plants, commercial office buildings, and in any system in which a higher degree of indoor air quality is required.

Multi-Pleat XL8 Construction

The **Multi-Pleat XL8** media is produced with an optimal blend of highly specialized fibers, developed by Koch Filter Corporation specifically for use in extended surface air filters.

Developed to deliver a “one of a kind” performance, this specialized media operates on mechanical filtration principles which provide high efficiency, low pressure drop and high dust holding capacity.

The Koch Multi-Pleat XL8 maintains a MERV 8 performance rating before and after conditioning steps when tested in accordance to ASHRAE Test Standard 52.2-2007 and 52.2-2007 Appendix J.



Two Media Area Capacity Levels

The **Multi-Pleat XL8** is an extremely versatile line of pleated panel filters which can be used in a wide variety of filtration systems worldwide. In order to meet the different requirements found in these applications, Koch offers the XL8 Series in two media area capacity levels.



Standard Capacity

Standard Capacity **XL8-SC** filters provide a combination of efficiency, economy, and excellent overall performance. Standard Capacity XL8 filters are an excellent choice in applications where filter change schedules are based on preventive maintenance schedules.



High Capacity - 30% more media

High Capacity **XL8-HC** filters are similar in construction to the Standard Capacity but have the added advantage of approximately 30% more media. The additional media results in extended filter life, making the XL8-HC the ideal filter for use in filtration systems where filter change schedules are predicated on recommended final pressure drop readings.

Multi-Pleat XL8 Technical Data

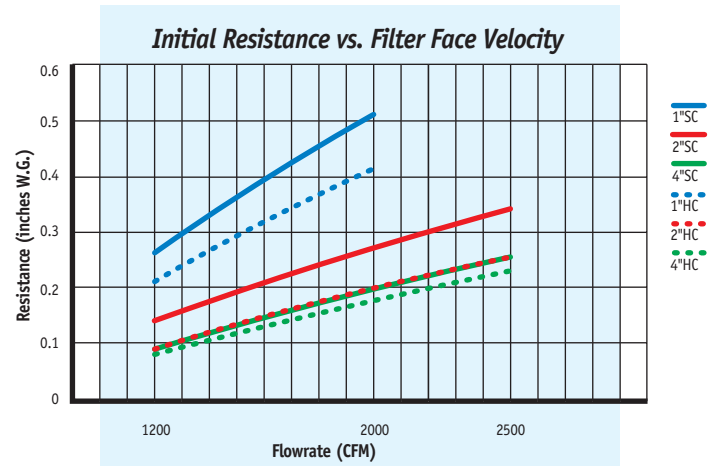
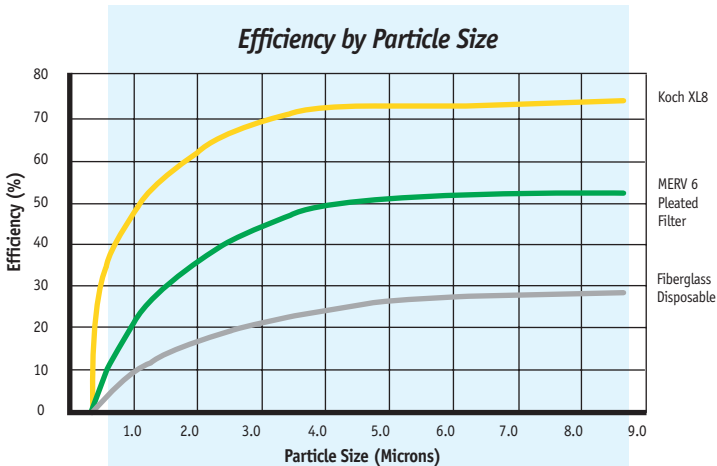
Standard Capacity XL8-SC

High Capacity XL8-HC

Size (Nominal)	Size (Actual in inches)	Capacity			Resistance				Media Area (Sq. Ft.)	Resistance				Media Area (Sq. Ft.)
		Low (CFM)	Med	High	Low	Med	High	Final		Low	Med	High	Final	
10x20x1	9½ x 19½ x ¾	(CFM) 425	700	NR	0.26	0.51	NR	1.0"	2.3	0.21	0.41	NR	1.0"	2.9
12x20x1	11½ x 19½ x ¾	500	840	NR	0.26	0.51	NR	1.0"	2.8	0.21	0.41	NR	1.0"	3.5
12x24x1	11½ x 23½ x ¾	600	1000	NR	0.26	0.51	NR	1.0"	3.3	0.21	0.41	NR	1.0"	4.2
14x20x1	13½ x 19½ x ¾	590	980	NR	0.26	0.51	NR	1.0"	3.3	0.21	0.41	NR	1.0"	4.1
14x25x1	13½ x 24½ x ¾	730	1215	NR	0.26	0.51	NR	1.0"	4.1	0.21	0.41	NR	1.0"	5.1
15x20x1	14½ x 19½ x ¾	625	1050	NR	0.26	0.51	NR	1.0"	3.5	0.21	0.41	NR	1.0"	4.4
16x20x1	15½ x 19½ x ¾	670	1115	NR	0.26	0.51	NR	1.0"	3.8	0.21	0.41	NR	1.0"	4.7
16x25x1	15½ x 24½ x ¾	840	1400	NR	0.26	0.51	NR	1.0"	4.7	0.21	0.41	NR	1.0"	5.9
18x24x1	17½ x 23½ x ¾	900	1500	NR	0.26	0.51	NR	1.0"	5.1	0.21	0.41	NR	1.0"	6.3
18x25x1	17½ x 24½ x ¾	940	1570	NR	0.26	0.51	NR	1.0"	5.3	0.21	0.41	NR	1.0"	6.6
20x20x1	19½ x 19½ x ¾	840	1400	NR	0.26	0.51	NR	1.0"	4.8	0.21	0.41	NR	1.0"	5.9
20x25x1	19½ x 24½ x ¾	1050	1740	NR	0.26	0.51	NR	1.0"	6.0	0.21	0.41	NR	1.0"	7.4
24x24x1	23½ x 23½ x ¾	1200	2000	NR	0.26	0.51	NR	1.0"	6.8	0.21	0.41	NR	1.0"	8.5
25x25x1	24½ x 24½ x ¾	1310	2170	NR	0.26	0.51	NR	1.0"	7.4	0.21	0.41	NR	1.0"	9.3
10x20x2	9½ x 19½ x 1¾	(CFM) 425	700	875	0.14	0.25	0.34	1.0"	4.0	0.09	0.18	0.25	1.0"	6.0
12x20x2	11½ x 19½ x 1¾	500	840	1050	0.14	0.25	0.34	1.0"	4.8	0.09	0.18	0.25	1.0"	7.2
12x24x2	11½ x 23½ x 1¾	600	1000	1250	0.14	0.25	0.34	1.0"	5.7	0.09	0.18	0.25	1.0"	8.6
14x20x2	13½ x 19½ x 1¾	590	980	1215	0.14	0.25	0.34	1.0"	5.6	0.09	0.18	0.25	1.0"	8.4
14x25x2	13½ x 24½ x 1¾	730	1215	1520	0.14	0.25	0.34	1.0"	7.1	0.09	0.18	0.25	1.0"	10.6
15x20x2	14½ x 19½ x 1¾	625	1050	1310	0.14	0.25	0.34	1.0"	6.1	0.09	0.18	0.25	1.0"	9.1
16x20x2	15½ x 19½ x 1¾	670	1115	1400	0.14	0.25	0.34	1.0"	6.7	0.09	0.18	0.25	1.0"	9.9
16x24x2	15½ x 23½ x 1¾	800	1350	1675	0.14	0.25	0.34	1.0"	7.8	0.09	0.18	0.25	1.0"	11.6
16x25x2	15½ x 24½ x 1¾	840	1400	1740	0.14	0.25	0.34	1.0"	8.1	0.09	0.18	0.25	1.0"	12.1
18x20x2	17½ x 19½ x 1¾	750	1250	1570	0.14	0.25	0.34	1.0"	7.3	0.09	0.18	0.25	1.0"	10.9
18x24x2	17½ x 23½ x 1¾	900	1500	1875	0.14	0.25	0.34	1.0"	8.8	0.09	0.18	0.25	1.0"	13.1
18x25x2	17½ x 24½ x 1¾	950	1570	1960	0.14	0.25	0.34	1.0"	9.1	0.09	0.18	0.25	1.0"	13.7
20x20x2	19½ x 19½ x 1¾	840	1400	1740	0.14	0.25	0.34	1.0"	8.3	0.09	0.18	0.25	1.0"	12.4
20x24x2	19½ x 23½ x 1¾	1000	1675	2100	0.14	0.25	0.34	1.0"	9.8	0.09	0.18	0.25	1.0"	14.6
20x25x2	19½ x 24½ x 1¾	1050	1740	2170	0.14	0.25	0.34	1.0"	10.5	0.09	0.18	0.25	1.0"	15.5
24x24x2	23½ x 23½ x 1¾	1200	2000	2500	0.14	0.25	0.34	1.0"	11.8	0.09	0.18	0.25	1.0"	17.9
25x25x2	24½ x 24½ x 1¾	1310	2170	2720	0.14	0.25	0.34	1.0"	12.8	0.09	0.18	0.25	1.0"	19.1
12x24x4	11½ x 23½ x 3¾	(CFM) 600	1000	1250	0.09	0.18	0.25	1.0"	10.6	0.08	0.16	0.23	1.0"	12.9
16x20x4	15½ x 19½ x 3¾	670	1115	1400	0.09	0.18	0.25	1.0"	12.0	0.08	0.16	0.23	1.0"	14.7
16x24x4	15½ x 23½ x 3¾	800	1350	1675	0.09	0.18	0.25	1.0"	14.3	0.08	0.16	0.23	1.0"	17.5
16x25x4	15½ x 24½ x 3¾	840	1400	1750	0.09	0.18	0.25	1.0"	15.0	0.08	0.16	0.23	1.0"	18.4
18x24x4	17½ x 23½ x 3¾	900	1500	1875	0.09	0.18	0.25	1.0"	16.3	0.08	0.16	0.23	1.0"	19.9
20x20x4	19½ x 19½ x 3¾	840	1400	1740	0.09	0.18	0.25	1.0"	15.1	0.08	0.16	0.23	1.0"	18.4
20x24x4	19½ x 23½ x 3¾	1000	1675	2100	0.09	0.18	0.25	1.0"	18.1	0.08	0.16	0.23	1.0"	22.2
20x25x4	19½ x 24½ x 3¾	1050	1740	2170	0.09	0.18	0.25	1.0"	19.5	0.08	0.16	0.23	1.0"	23.6
24x24x4	23½ x 23½ x 3¾	1200	2000	2500	0.09	0.18	0.25	1.0"	22.5	0.08	0.16	0.23	1.0"	27.5
24x24x6	23½ x 23½ x 5¼	(CFM) 1200	2000	2500	0.13	0.19	0.29	1.0"	33.3	0.11	0.17	0.28	1.0"	40.7

Additional Multi-Pleat XL8 Product Information

MERV (Minimum Efficiency Reporting Value) • Recommended Final Pressure Drop is 1.0" w.g. • Performance data is based on ASHRAE Test Standards 52.1-1999 and 52.2-2007. Recommended maximum continuous operational temperature is 200°F. • Multi-Pleat XL8 filters are classified as Underwriter's Laboratories Class 2 according to U.L. Standard 900.





Koch Filter Corporation
Filtration Products Crafted with Pride

Louisville, KY ▶
Headquarters, Manufacturing Plant,
and Regional Sales Office



East Greenville, PA
Manufacturing Plant
and Regional Sales Office



Serving
The World

Rancho Cucamonga, CA ▲
Manufacturing Plant
and Regional Sales Office



◀ Houston, TX
Manufacturing Plant
and Regional Sales Office



The Complete Line of Air Filtration
Products for Commercial, Industrial,
Hospital, Gas Turbine and
Paint Filtration Applications.

Koch Filter Corporation: Founded in 1966 by Joseph Koch and still managed by the Koch family, Koch Filter Corporation is a world class manufacturer of air filtration products. Koch Filter is recognized globally for its premier brand of high efficiency air filtration products and the industry's broadest range of air filters for any application. Our wide array of filtration products is currently installed in over 50,000 commercial, medical and industrial accounts worldwide.



Corporate Offices

P.O. Box 3186 • 625 West Hill Street (40208)
Louisville, KY 40201 • 502.634.4796
Fax: 502.637.2280 • E mail: info@kochfilter.com
www.kochfilter.com

Regional Sales Offices/Distribution Centers

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Kansas City, MO • Louisville, KY* • Madbury, NH • Nashville, TN • Rancho Cucamonga, CA*

*Denotes manufacturing site.

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Koch Filter Corporation maintains a policy of continuous product research and improvement, and retains the right to change product specification and design without notice.



Look for the Koch Green icon. Whenever you see the Koch Green icon, we are identifying a product that meets or exceeds our criteria in one or more of the following categories: **Earns LEED Points, Reduces Energy Costs, Extends Filter Lifecycles, Conserves Resources, and Improves Indoor Environmental Quality.**

Distributed by

T-Bolt Clamps

Features:**Style TBC**

- can be applied with a standard 7/16" socket wrench
- ¾" wide, .025" thick, 300 series stainless steel band
- alloy steel bolt, torque rating: 70 in/lbs

Style STBC

- can be applied with a standard 7/16" socket wrench
- ¾" wide, .025" thick, 300 series stainless steel band
- 300 series stainless steel bolt, torque rating: 50 in/lbs

Hose OD		style TBC Part #	Price/E	style STBC Part #	Price/E	Opt Qty
from	to					
1.250"	1.406"	TBC131	\$10.20	STBC131	\$14.60	25
1.344"	1.562"	TBC150	7.60	STBC150	8.70	25
1.474"	1.692"	---	---	STBC163	8.70	25
1.594"	1.812"	TBC175	7.60	STBC175	8.70	25
1.724"	1.942"	TBC188	7.60	STBC188	8.70	25
1.844"	2.062"	TBC200	7.60	STBC200	8.70	25
1.964"	2.182"	---	---	STBC212	8.80	25
2.094"	2.312"	TBC225	7.60	STBC225	8.80	25
2.224"	2.442"	TBC238	7.60	STBC238	8.80	25
2.344"	2.562"	TBC250	7.80	STBC250	8.90	25
2.326"	2.622"	TBC256	7.40	STBC256	8.50	25
2.396"	2.692"	TBC263	7.40	STBC263	8.50	25
2.516"	2.812"	TBC275	7.40	STBC275	8.50	25
2.646"	2.942"	TBC288	7.50	STBC288	8.50	25
2.766"	3.062"	TBC300	7.50	STBC300	8.60	25
2.886"	3.182"	TBC312	7.60	STBC312	8.60	25
3.016"	3.312"	TBC325	7.60	STBC325	8.60	25
3.266"	3.562"	TBC350	7.90	STBC350	8.90	25
3.386"	3.682"	---	---	STBC362	8.90	25
3.516"	3.812"	TBC375	7.90	STBC375	8.90	25
3.586"	3.882"	TBC382	8.00	STBC382	8.90	25
3.766"	4.062"	TBC400	8.00	STBC400	8.90	25
4.016"	4.312"	TBC425	8.00	STBC425	9.00	25
4.266"	4.562"	TBC450	8.00	STBC450	9.00	25
4.516"	4.812"	TBC475	8.00	STBC475	9.60	25
4.766"	5.062"	TBC500	8.10	STBC500	9.80	25
5.016"	5.312"	TBC525	8.10	STBC525	9.80	25
5.266"	5.562"	TBC550	8.60	STBC550	10.30	25
5.516"	5.812"	TBC575	8.60	STBC575	10.30	25
5.766"	6.062"	TBC600	8.70	STBC600	10.30	25
6.016"	6.312"	TBC625	8.70	STBC625	10.30	25
6.266"	6.562"	TBC650	8.80	STBC650	10.30	25
6.516"	6.812"	TBC675	8.80	STBC675	10.30	25
6.766"	7.062"	TBC700	8.90	STBC700	10.70	25
7.016"	7.312"	---	---	STBC725	10.80	25
7.266"	7.562"	TBC750	8.90	STBC750	10.80	25
7.766"	8.062"	---	---	STBC800	11.10	25
8.016"	8.312"	---	---	STBC825	11.10	25
8.266"	8.562"	---	---	STBC850	11.10	25
8.646"	8.942"	---	---	STBC888	11.80	25
8.766"	9.062"	---	---	STBC900	11.80	25
9.266"	9.562"	---	---	STBC950	11.80	25
9.766"	10.062"	---	---	STBC1000	11.80	10
10.646"	10.942"	---	---	STBC1088	12.70	10
11.766"	12.062"	---	---	STBC1200	12.70	10
12.646"	12.942"	---	---	STBC1288	12.70	10



style TBC



style STBC

K

King™ Combination Nipples

**Applications:**

- Recommended for low-pressure discharge and suction service for compatible liquids.
Sizes 1¼" and above are not for compressible products such as air or nitrogen.
- **King™ Combination Nipples are not recommended for steam.**
- *The working pressure may vary with the construction of the hose, the type of clamping system used and the application. Consult Dixon™ for recommendations.*
- In accordance with the Association for Rubber Products Manufacturers (ARPM) bulletin for oil suction and discharge hose, a coupled length of hose in any size, should be tested to 1½ times the working pressure and held for fifteen minutes without leaking or coupling movement. For additional information and detailed instruction on testing procedures, see the Association for Rubber Products Manufacturers (ARPM) handbook.

NPT threaded end with knurled wrench grip

Size	Opt Qty	Unplated Steel		Plated Steel		Brass		Aluminum	
		Part #	Price/E	Part #	Price/E	Part #	Price/E	Part #	Price/E
½"	50	ST1	\$4.60	STC1	\$4.95	BST1	\$21.20	AST1	\$20.40
¾"	50	ST5	5.35	STC5	5.45	BST5	31.70	AST5	15.60
1"	50	ST10	6.95	STC10	7.30	BST10	32.25	AST10	18.60
1¼"	50	ST15	9.35	STC15	10.05	---	---	---	---
1½"	50	ST20	9.65	STC20	10.30	---	---	---	---
2"	25	ST25	11.95	STC25	12.60	---	---	---	---



knurled wrench grip

G

NPT threaded end no knurl

Size	Opt Qty	Unplated Steel		Plated Steel		Brass		Aluminum	
		Part #	Price/E	Part #	Price/E	Part #	Price/E	Part #	Price/E
1¼"	50	---	---	---	---	BST15	\$35.40	AST15	\$17.60
1½"	50	---	---	---	---	BST20	44.75	AST20	17.70
2"	25	---	---	---	---	BST25	66.70	AST25	19.95
2½"	10	ST30	\$19.75	STC30	\$22.35	BST30	106.60	AST30	59.00
3"	10	ST35	23.55	STC35	27.75	BST35	148.60	AST35	47.00
4"	4	ST40	36.40	STC40	40.80	BST40	283.90	AST40	72.60
5"	4	ST50	84.10	STC50	89.25	---	---	AST50	164.85
6"	2	ST60	93.10	STC60	105.00	---	---	AST60	178.50
8"	2	ST80	165.00	STC80	202.80	---	---	---	---
10"	1	ST100	267.50	STC100	337.50	---	---	---	---
12"	1	ST120	420.00	STC120	480.00	---	---	---	---



no knurl brass

Size	Opt Qty	316 Stainless Steel		Hastelloy®	
		Part #	Price/E	Part #	Price/E
½"	50	RST1 ¹	\$21.10	---	---
¾"	50	RST5 ¹	21.15	---	---
1"	50	RST10	21.25	---	---
1¼"	50	RST15	27.10	---	---
1½"	50	RST20	33.25	---	---
2"	25	RST25	45.00	HST25	\$780.00
2½"	10	RST30	82.75	---	---
3"	10	RST35	117.40	HST35	1450.00
4"	4	RST40	184.20	---	---
5"	4	RST50	405.00	---	---
6"	4	RST60	508.20	---	---
8"	2	RST80	975.00	---	---



no knurl stainless

¹ made from investment casting

Product availability : Stock - Normally stocked in distribution facility



Main

Range of product	Modicon M171/M172
Product or component type	Programmable controllers
Product specific application	HVAC and pumping solution
Variant	Programmable
Total inputs/outputs	42
Discrete input number	12
Discrete output number	2 relay outputs SPST with same common 2 relay outputs SPST with independent common 2 relay outputs SPDT with same common 3 relay outputs SPST with independent common
Discrete output current	1 A relay SPDT 3 A relay SPST
Analogue input number	12 configurable by pair
Analogue output number	4 voltage 0...10 V 2 voltage/current 4...20 mA or 0...10 V or PWM (2 kHz)

Complementary

Number of port	1 CAN port - screw terminal block 1 USB type A - USB type A female 1 USB type mini B - USB device port Mini-B 2 RS485 - screw terminal block Modbus serial link or BACnet MS/TP) 1 Ethernet - RJ45 Modbus TCP and BACnet IP with webserver)
Input/Output number	12 analog input 6 analog output 12 digital input 12 digital output
Discrete input logic	Sink or source (positive/negative)
Discrete input voltage	24 V AC/DC
Discrete input current	2.5 mA

Input impedance	20 kOhm
Analogue input type	impedance 0...1500 hOhm impedance 0...300 daOhm direct input NTC temperature probe - 50...110 °C 0.1 °C extended) voltage 0...10 V NTC temperature probe - 40...150 °C 0.1 °C current 0...20 mA/4...20 mA PTC temperature probe - 55...150 °C 0.1 °C voltage 0...5 V absolute or ratiometric) Pt 1000 temperature probe - 200...850 °C 0.1 °C
Sensor power supply	5 V DC 50 mA supplied by the controller 24 V DC 150 mA supplied by the controller
[Us] rated supply voltage	24 V +/- 10 % AC 20...38 V DC
Power consumption in W	15 W 24 V AC/DC
Realtime clock	Built-in -4...140 °F (-20...60 °C)
Display type	Without display
Overvoltage category	II
Local signalling	Programmable 1 LED red) Programmable 1 LED yellow) Programmable 1 LED green) Power 1 LED green)
Mounting support	Panel mounting with accessory DIN rail
Width	5.67 in (144 mm)
Height	4.33 in (110 mm)
Depth	2.38 in (60.5 mm)
Net weight	0.85 lb(US) (0.385 kg)

Environment

Directives	1907/2006/EC - REACH directive 2011/65/EU - RoHS directive 2006/95/EC - low voltage directive 86/188/EEC - physical agents (noise) directive
Standards	EN/IEC 60730
Product certifications	EAC (pending) CURus (pending) CE CSA (pending)
Ambient air temperature for operation	-4...140 °F (-20...60 °C) UL 60730-1 -4...149 °F (-20...65 °C) with derating UL 60730-1
Ambient air temperature for storage	-22...158 °F (-30...70 °C)
Relative humidity	5...95 % non-condensing
IP degree of protection	IP20
Pollution degree	2

Ordering and shipping details

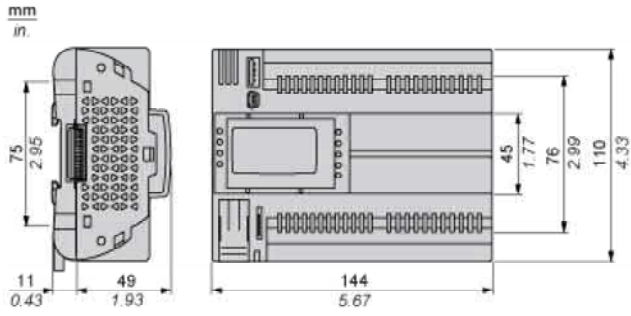
Category	22537 - M171 / M172 HVAC CONTROLLERS
Discount Schedule	PC12
GTIN	00785901502098
Package weight(Lbs)	0.43 kg (0.94 lb(US))
Returnability	Yes
Country of origin	IT

Offer Sustainability

Sustainable offer status	Green Premium product
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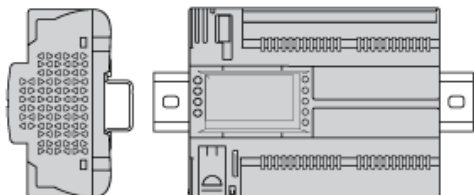
California proposition 65	WARNING: This product can expose you to chemicals including: Lead and lead compounds which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
REACH Regulation	REACH Declaration
EU RoHS Directive	Pro-active compliance (Product out of EU RoHS legal scope) EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration
Environmental Disclosure	Product Environmental Profile
Circularity Profile	End of Life Information
WEEE	The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins.

Dimensions



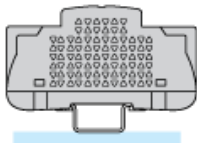
Mounting Positions

Correct Mounting Position

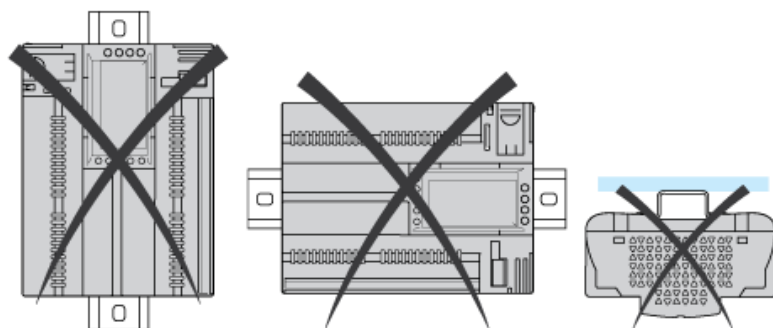


Acceptable Mounting Position

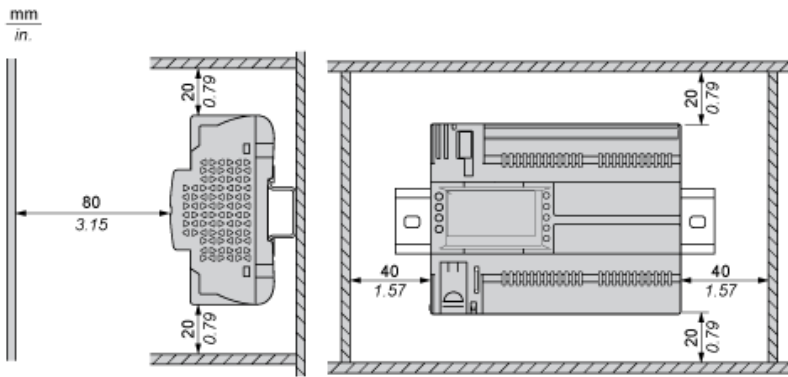
Controller can be mounted horizontally upward with a temperature derating (maximum ambient temperature: 60 °C (140 °F)).



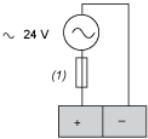
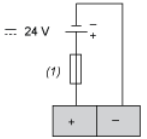
Incorrect Mounting Position



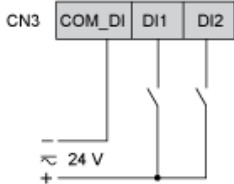
Clearance



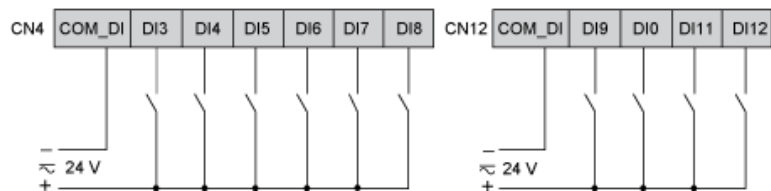
Power Supply

24 Vac	24 Vdc
	

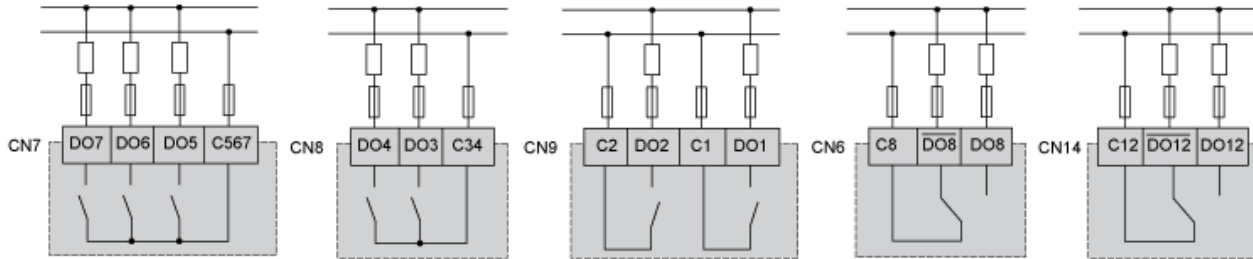
CN3 Fast Digital Inputs



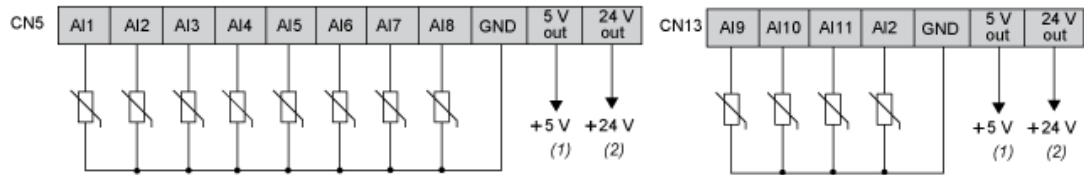
CN4, CN12 Digital Inputs



CN7, CN8, CN9, CN6, CN14 High Voltage Relay SPST Digital Output



CN5, CN13 Analog Inputs

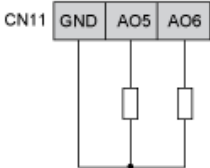


- (1) (CN5 + CN13) Max. current : 50 mA.
- (2) (CN5 + CN13) Max. current : 150 mA.

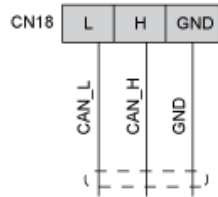
CN2, CN11 Analog Outputs



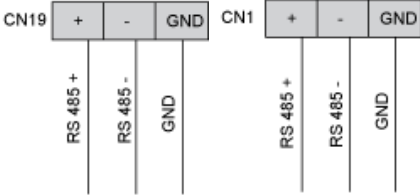
AO3, AO4 can be used also as PWM generator, up to 2kHz.



CN18 CAN Expansion Bus Port



CN19, CN1 CAN Expansion Bus Port



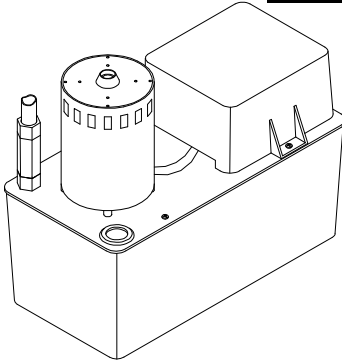
Owners Manual

AUTOMATIC CONDENSATE UNIT

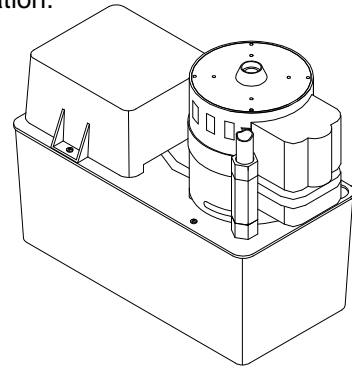
Keep For Future Reference **CB501ULHT**

INSTALLATION OPERATION

CAUTION: Read rules for Safe Operation and Installation.



Model: CB25*
23' LIFT



Model: CB50*
48' LIFT

*Suffix denotes features
Example: CB25 | 1 | UL | HT
Base Model | Voltage: | UL Listed | High Temperature Model, for use with maximum 190°F water.
1 = 115V; 2 = 230V; 4 = 460V; 7 = 277V

INTRODUCTION

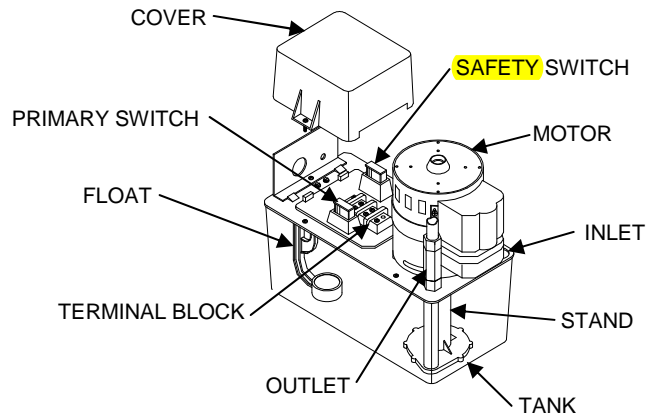
RULES FOR SAFE OPERATION

1. Carefully read the Owners Manual and rules for safe operation.
2. All wiring must conform to local codes. Use the National Electric Code if local code is nonexistent.
3. **CAUTION!** To reduce risk of electric shock disconnect from power supply before servicing, pull the plug on models which have plug-in connections.
4. Do not handle the pump with wet hands or when standing in water as fatal shock could occur. Disconnect main power before handling unit for ANY REASON!
5. Protect the power cable from coming in contact with sharp objects.
6. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
7. Make certain that line voltage conforms to the voltage specified on motor and nameplate.
8. **WARNING!** To reduce risk of electrical shock, connect only to a properly grounded grounding type receptacle.

INSTALLATION

Select a location for the pump. It should be as near as possible to the air conditioning coil. **The pump must be level.** The inlet hole must be below the coil drain. Carefully unpack the pump. Remove the switch cover. Check each float rod for "free" action.

CB25
CB50



BECKETT CORPORATION

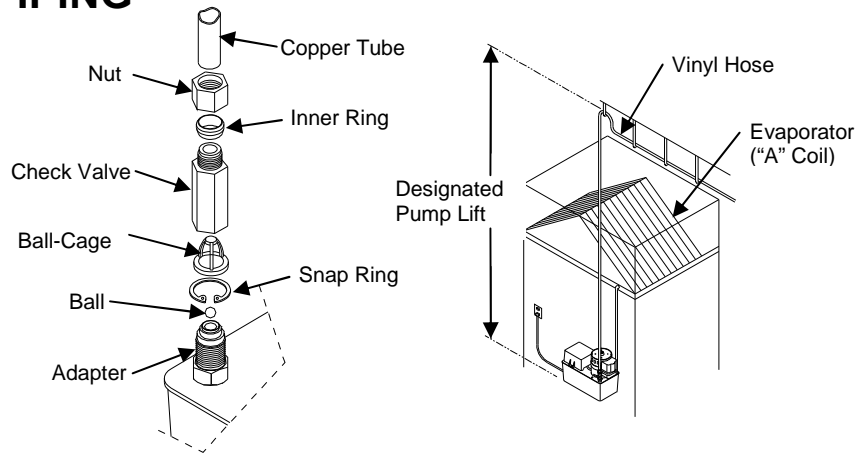
Irving, Texas
www.beckett pumps.com
Phone: 972-871-8000
Toll Free: 1-888-BECKETT
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Y8611 Rev. E

PIPING

Run a drain line from the evaporator coil drain to the pump. Use the flexible plastic pipe where the code permits. Insert the pipe 1" below the pump cover. Do not install inlet drain line that would interfere with operation of floats. Connect outlet tubing (copper or vinyl) to discharge on pump. Do not run tubing vertical more than is recommended by the lift on each unit. For good flow, slant the horizontal run downward toward the drain. Each CB25 comes standard with a check valve for connecting to 3/8" O.D. copper tubing. Each CB50 unit comes standard with a check valve for connecting to 1/2" O.D. copper tubing. A copper tube adapter is included for vinyl hose hook-up.



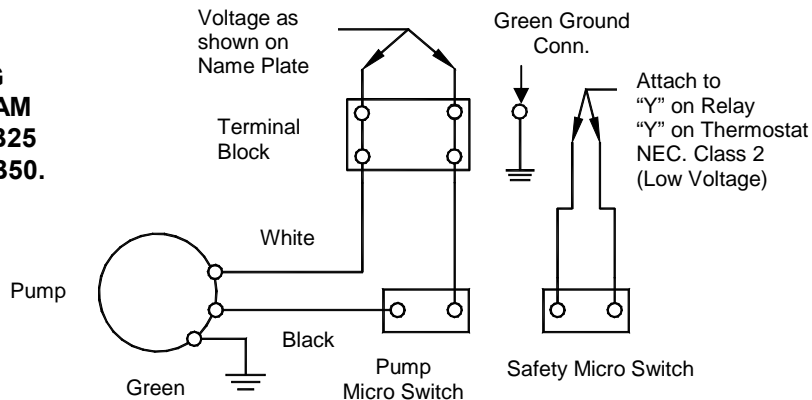
WIRING

The wiring must comply with local codes.

WARNING

Turn the electric power off at the fuse box before making any line voltage connections.

WIRING DIAGRAM FOR CB25 AND CB50.



To test safety float switch, temporarily stop flow of discharge line by sharply bending vinyl tubing. Pour more water into pump inlet. Water level will rise beyond high level of control float until safety float switch breaks the "Y" thermostat circuit shutting down air conditioner condensing unit. Unbend the tube and the pump will empty the entire sump. Replace inlet line into pump inlet.

MAINTENANCE AND TROUBLE SHOOTING

1. Remove dirt that may collect in bottom sump.
2. Look at vinyl DISCHARGE LINE to see that it is open and water can pass through freely.
3. Always replace cover to keep electrical parts clear of dust and grime.
4. See item 7 of Introduction.

LIMITED WARRANTY

These Beckett pumps are warranted to the user against defective material and workmanship under normal use, for a period of 1 year from the date of purchase by the original purchase. All other Beckett products are warranted to the user against defective material and workmanship for 3 months from the date of purchase. Replacement liability in all events is limited to the replacing or repairing at Beckett's sole discretion of any part or parts, which are defective in material or workmanship. Proof of purchase is required on all claims in the form of invoice copy, sales ticket, etc.

APPLICATION: Warranty covers only properly installed and maintained units. Warranty is limited to applications pumping fresh water at temperatures of 32°-98°F (0°-36°C), with a pH range of 5 to 9. Beckett Corporation must approve other liquid applications and extreme temperature uses in advance in writing.

ADMINISTRATION: Warranty claims must be made by returning the defective part, freight prepaid, along with proof of purchase, to: Beckett Corporation, Customer Care Dept., Irving, TX. Phone authorization is required prior to returning merchandise (972-871-8000). All items returned will be inspected to determine cause of failure before warranty is approved.

INSTALLATION and/or REMOVAL CHARGES: Warranty does not cover any costs associated with the installation or removal of products subject to warranty claims.

DISPOSITION: Beckett will make a good-faith effort for prompt disposition regarding any item in warranty, which proves to be defective. If products were damaged in transit, please file a claim with the carrier.

DISCLAIMER: Any oral statements about the product made by the seller, the manufacturer, the representatives or any other parties, do not constitute warranties, should not be relied upon by the user, and are not part of the contract for sale. Seller's and manufacturer's only obligation and buyer's and user's only remedy, shall be for the manufacturer to either replace and/or repair at the manufacturer's sole discretion the Beckett product as described above. Neither seller nor the manufacturer shall be liable for any injury, loss or damage, direct, incidental or consequential (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss), arising from any cause whatsoever, no matter whether based upon warranty, contract, negligence or other misuse, and the buyer and user agree that no other remedy shall be available to them. Before using, the buyer and user shall determine the suitability of the product for the intended use, and assumes all risk and liability whatsoever in connection herewith. The warranty and remedy described in this limited warranty is an EXCLUSIVE warranty and remedy. IN LIEU of any other warranty or remedy, expressed or implied, which other warranties and remedies are hereby expressly EXCLUDED, including but not limited to any implied warranty of MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This Warranty gives buyer and user specific legal rights, and buyer and user may also have other rights that vary from state to state. Some states do not allow the exclusion or limitations of incidental or consequential damages, so the above limitation or exclusion may not apply to you.



AMBIENT AND OUTLET TEMP SENSOR
TE-701-D-3-C



Duct Temperature Sensors

Model TE-701 / 702



- Five installation options — probe with mounting flange or bulkhead fitting, plastic, galvanized steel, or NEMA-4 / IP-65 steel enclosure offer the industry's most extensive range to satisfy all HVAC, appliance and industrial applications.
 - 304 SS thin wall probe with a cold rolled hermitically sealed end forms a monolithic encapsulation cavity for the sensor and is immune to failures caused by high humidity, contamination, thermal shock and vibration.
 - The flat probe end provides a large thermally sensitive area and the sensor is in direct thermal contact to this surface. As a result, extremely fast response is achieved to changes in temperature.
 - Probe is attached to the enclosure or the flange using a patented process to provide a rugged, reliable and low profile attachment for ease of installation.
- More than 12 types of interchangeable NTC thermistors, precision platinum, nickel or balco RTD's are available for universal compatibility.

TE-701/702 temperature sensors offer the industry's most extensive range of enclosure, installation and sensor types to satisfy all HVAC, industrial and commercial applications. These revolutionary sensors incorporate more than twenty years of product development and experience drawn from millions of installations world wide in all types of applications. This product and process design combined with automated manufacturing processes yields a rugged, reliable, repeatable and stable temperature sensor at a low cost.

For large volume OEM customers, TE-701/702 temperature sensors are available in many custom configurations. Wire type, length or gage, terminals, connectors, probe lengths, enclosure options or sensor types may be customized based on volume.

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TE-701/702

TE-701-A/B Temperature Sensor Flange Mount

Incorporate a hermitically sealed 304 SS probe, crimped on to a 304 SS flange providing rugged assembly for duct temperature sensing. Two mounting holes are provided for #8 screws and the flange mating surface is fully gasketted to seal off the probe and screw holes. TE-701-A is available with 3 in/75mm wire leads and the TE-701-B has 6 ft/1.8 meter plenum rated cable. TE-701-A/B is an ideal product for a rugged, reliable, quick and easy installation in air handlers, fan coil units, ducts, furnaces, freezers, ovens or any other through the wall temperature sensing application.



TE-701-C/D Temperature Sensor Bulkhead mount

Fast response 304 SS probe with a brass bulkhead fitting and a compression sleeve forms a strong assembly for duct temperature sensing if adjustable insertion depth is desired. The bulkhead fitting is installed in the duct, compression sleeve loosened, probe inserted to the desired length and the sleeve is tightened. Sensor is available with 3 in/75mm leads or 6 ft/1.8 meter plenum rated cable. TE-701-C/D sensors provide a low cost, rugged, quick and easy installation in air handlers, fan coil units, ducts, plenum, furnaces, freezers, ovens or any other through the wall temperature sensing application which requires adjustable insertion length.



TE-702-A Temperature Sensor Polycarb Enclosure

Corrosion free 30% glass filled polycarbonate enclosure designed to withstand temperature extremes, mechanical shock and vibration. 304 SS probe crimp attached to the enclosure flange for a low profile mating surface, external mounting bracket to conform to irregular surfaces, single screw cover attachment, cradle molded into the enclosure to secure the rising cage terminal block are some of the features which improve reliability and lower installation cost. TE-702-A temperature sensors provide a cost effective and reliable solution for air handlers, fan coil units, ducts, plenums, furnaces or any other application which does not require conduit wiring.



TE-701/702

TE-702-B Temperature Sensor Galvanized Steel Enclosure

Industry standard NEMA-1 / IP-30 galvanized sheet metal enclosure designed for all industrial and commercial duct temperature sensing applications. Hermetically sealed, fast response 304 SS probe crimp attached to the enclosure flange to provide a low profile mating surface, external mounting bracket to conform to uneven surfaces, keyed enclosure cover to swing open without removing the screws, 1/2" conduit opening, rising cage terminal block are some of the features which improve reliability and lower installation cost.



TE-702-C Temperature Sensor Powder Coated Steel Enclosure

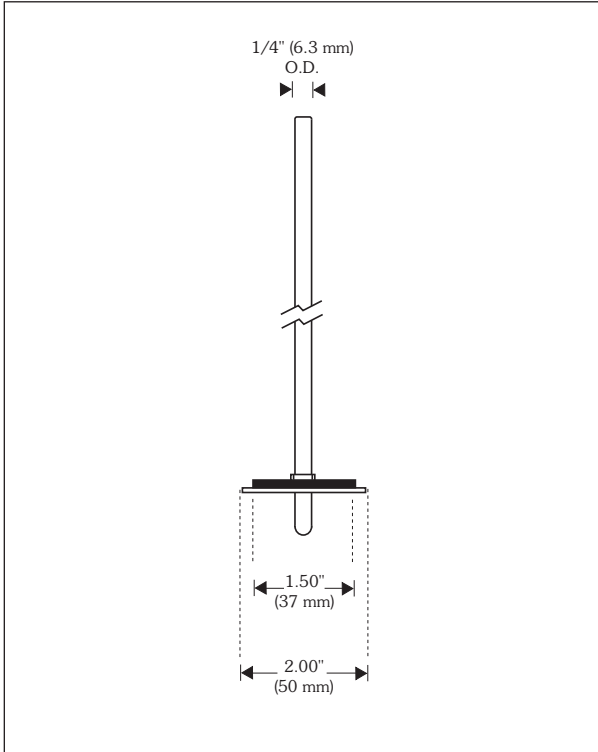
Rugged steel enclosure with welded seams, gasketed cover and powder coated finish, rated NEMA-4 / IP-65 for harsh environments. TE-702-C has all the other features including a 304 SS probe, external mounting bracket, terminal block, conduit opening similar to the TE-702-B series except designed for applications in unconditioned environments where the unit maybe subjected to dirt, condensation, oil vapor and other contaminants.



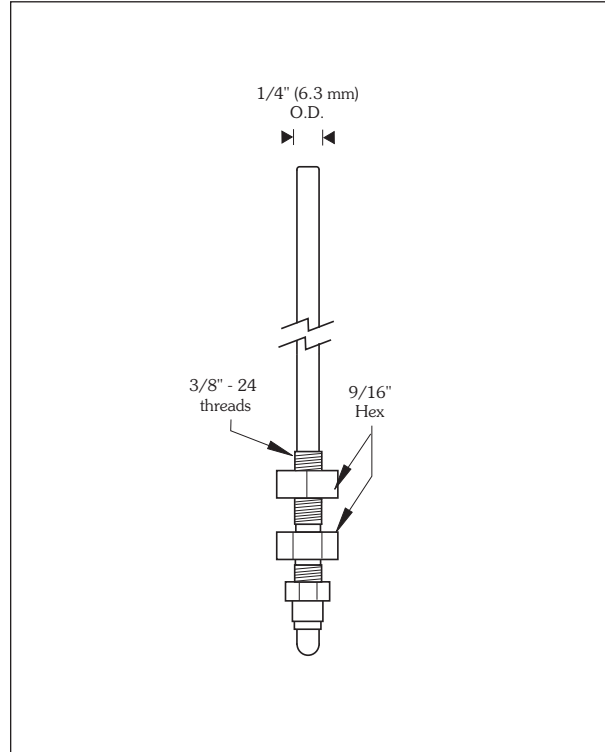
SPECIFICATIONS:

Platinum RTD sensors:	+/- 0.1% @ 0 C, Alpha : 385 per DIN 43760
Nickel RTD sensors:	+/- 0.5 F @ 70 F / 21.1 C, 6000 PPM/K T.C.R.
Balco RTD sensors:	+/- 0.5 F @ 70 F /21.1 C, 4300 PPM/K T.C.R.
Thermistor sensors:	+/- 0.2 C interchangeability @ 77 F/ 0 C
Probe Material:	1/4" / 6.3mm O.D, 0.020" / 0.5mm wall 304 Stainless Steel
Flange Material:	304 Stainless Steel
Bulkhead Fitting:	Brass with poly compression sleeve
Plastic Enclosure:	Polycarbonate 30% glass filled, rated UL 94V-5-0
Steel NEMA-1 / IP-30:	18 Ga. Galvanized Steel
Steel NEMA-4 / IP-65:	18 Ga. Cold Rolled Steel, Powder coated

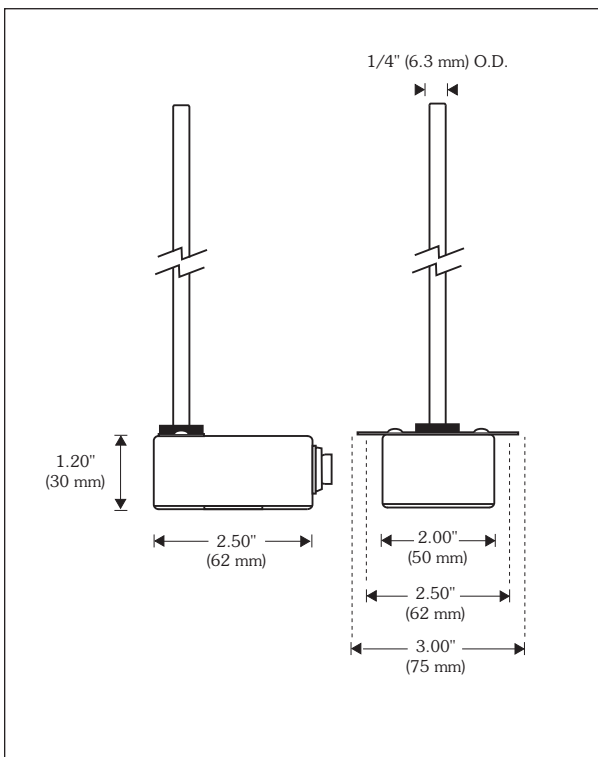
TE-701-A/B



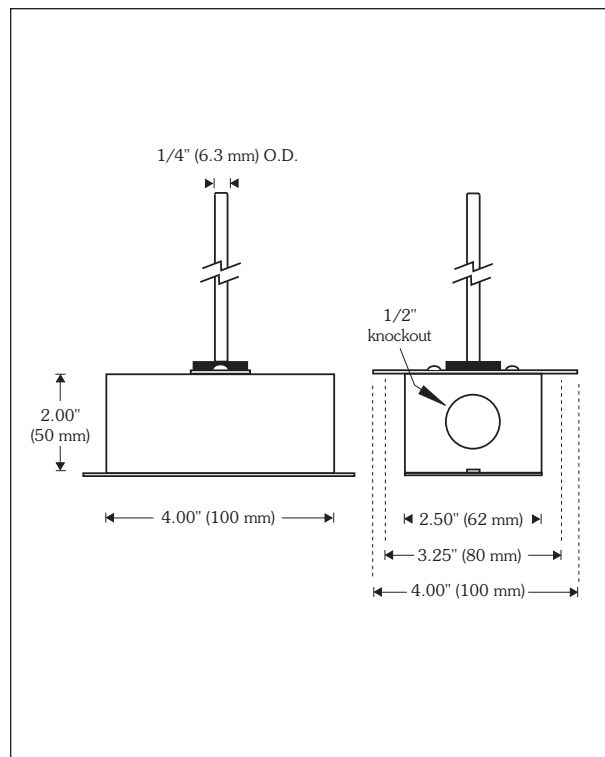
TE-701-C/D



TE-702-A



TE-702-B/C



ORDERING INFORMATION: TE-701

Installation		Sensor*		Probe Length	
A	Flange mount 3 in/175mm wire leads	1	100 ohm Platinum RTD	A	4 inches/100mm
		3	1000 ohm Platinum RTD	B	6 inches/150mm
B	Flange mount 6 ft/1.8m plenum cable	4	1000 ohm Nickel RTD	C	8 inches/200mm
		5	1000 ohm Balco RTD	D	12 inches/300mm
C	Bulkhead mount 3 in/175mm wire leads	7	10,000 ohm thermistor		
		10	3,000 ohm thermistor		
D	Bulkhead mount 6 ft/1.8m plenum cable	12	10,000 ohm thermistor		
		13	5,000 ohm thermistor		
		15	100,000 ohm thermistor		
		17	20,000 ohm thermistor		
		18	2,252 ohm thermistor		
		21	1,800 ohm thermistor		

Example: TE-701-B-10-A: Flange mount with 6 ft cable, 3000 ohm thermistor and 4 inch probe length.

ORDERING INFORMATION: TE-702

Installation		Sensor*		Probe Length	
A	Polycarb Plastic Enclosure IP-54	1	100 ohm Platinum RTD	A	4 inches/100mm
		3	1000 ohm Platinum RTD	B	6 inches/150mm
B	Galvanized Steel Enclosure NEMA-1 / IP-30	4	1000 ohm Nickel RTD	C	8 inches/200mm
		5	1000 ohm Balco RTD	D	12 inches/300mm
C	Painted Steel Enclosure NEMA-4 / IP-65	7	10,000 ohm thermistor		
		10	3,000 ohm thermistor		
		12	10,000 ohm thermistor		
		13	5,000 ohm thermistor		
		15	100,000 ohm thermistor		
		17	20,000 ohm thermistor		
		18	2,252 ohm thermistor		
		21	1,800 ohm thermistor		

Example: TE-702-A-2-D: Polycarb plastic enclosure with 1000 ohm Platinum RTD and 12 inch probe length.

* For sensor compatibility, please refer to TI.700-10.

** For a complete Resistance vs. Temperature tables, please refer to TI.700-11.



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Chin Hin Hang Building
Singapore • 388421
65-3927273 • Fax 65-3927276*

Sensor Type 21. 1,800 ohm Thermistor
Fahrenheit

Temp	Resis	Temp	Resis	Temp	Resis	Temp	Resis	Temp	Resis
-40	39073	19	7077	78	1762	137	558	196	213
-39	37836	20	6896	79	1725	138	548	197	210
-38	36644	21	6720	80	1689	139	539	198	207
-37	35492	22	6549	81	1653	140	529	199	204
-36	34382	23	6383	82	1619	141	520	200	201
-35	33310	24	6221	83	1585	142	511	201	198
-34	32275	25	6065	84	1552	143	502	202	195
-33	31276	26	5912	85	1520	144	494	203	192
-32	30312	27	5764	86	1489	145	485	204	189
-31	29380	28	5621	87	1458	146	477	205	187
-30	28481	29	5481	88	1428	147	469	206	184
-29	27612	30	5345	89	1399	148	461	207	181
-28	26773	31	5213	90	1370	149	453	208	179
-27	25963	32	5085	91	1343	150	445	209	176
-26	25180	33	4960	92	1315	151	438	210	173
-25	24423	34	4839	93	1289	152	430	211	171
-24	23692	35	4721	94	1263	153	423	212	169
-23	22985	36	4607	95	1238	154	416	213	166
-22	22301	37	4495	96	1213	155	409	214	164
-21	21641	38	4387	97	1189	156	402	215	161
-20	21002	39	4282	98	1165	157	395	216	159
-19	20384	40	4179	99	1142	158	389	217	157
-18	19787	41	4079	100	1120	159	382	218	155
-17	19209	42	3982	101	1098	160	376	219	153
-16	18651	43	3888	102	1076	161	370	220	150
-15	18110	44	3796	103	1055	162	364	221	148
-14	17587	45	3707	104	1034	163	358	222	146
-13	17081	46	3620	105	1014	164	352	223	144
-12	16591	47	3535	106	995	165	346	224	142
-11	16117	48	3452	107	975	166	341	225	140
-10	15658	49	3372	108	957	167	335	226	138
-9	15214	50	3294	109	938	168	330	227	137
-8	14784	51	3218	110	920	169	324	228	135
-7	14368	52	3144	111	903	170	319	229	133
-6	13964	53	3072	112	886	171	314	230	131
-5	13574	54	3002	113	869	172	309	231	129
-4	13196	55	2933	114	852	173	304	232	128
-3	12829	56	2867	115	836	174	299	233	126
-2	12474	57	2802	116	821	175	295	234	124
-1	12130	58	2739	117	805	176	290	235	122
0	11797	59	2677	118	790	177	286	236	121
1	11474	60	2617	119	776	178	281	237	119
2	11161	61	2559	120	761	179	277	238	118
3	10858	62	2502	121	747	180	272	239	116
4	10563	63	2446	122	733	181	268	240	115
5	10278	64	2392	123	720	182	264	241	113
6	10002	65	2339	124	707	183	260	242	112
7	9734	66	2288	125	694	184	256	243	110
8	9474	67	2238	126	681	185	252	244	109
9	9222	68	2189	127	669	186	248	245	107
10	8977	69	2141	128	657	187	244	246	106
11	8740	70	2095	129	645	188	241	247	104
12	8509	71	2049	130	633	189	237	248	103
13	8286	72	2005	131	622	190	233	249	102
14	8069	73	1962	132	611	191	230	250	100
15	7859	74	1920	133	600	192	226		
16	7655	75	1879	134	589	193	223		
17	7456	76	1839	135	579	194	220		
18	7264	77	1800	136	568	195	216		

AIR PRODUCTS AND CONTROLS INC. INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR SL-2000 SERIES DUCT SMOKE DETECTORS

SL-2000-N 4-Wire, Ionization Type

SL-2000-P 4-Wire, Photoelectric Type

PRODUCT OVERVIEW

PRODUCT APPLICATION

SL-2000 Series duct smoke detectors provide early detection of smoke and products of combustion present in air moving through an HVAC duct supply, return, or both in commercial, industrial, and residential applications. These devices are designed to prevent the recirculation of smoke in areas by the air handling system's fans and blowers. Complete systems may be shut down in the event of smoke detection.

⚠ NOTE: For the correct installation of a duct smoke unit, please refer to the NFPA 72 (National Fire Alarm Code), NFPA 90A (Standard for Installation of Air Conditioning and Ventilation Systems), NFPA 92A (Recommended Practice for Smoke Control Systems.), NFPA 5000 (Building Construction and Safety Code), IMC (International Mechanical Code), and IFC (International Fire Code).

This detector is not intended for open area protection nor should it be used for early warning detection or replace a regular fire detection system.

PRODUCT DESCRIPTION

The SL-2000 Series smoke detector is fitted with a mounting base that will accept an ionization smoke detector head model 55000-225APO or photoelectric smoke detector head model 55000-328APO. The duct unit supports two sets of form "C" alarm contacts, one form "A" alarm contact and one form "C" trouble contact. The trouble contact supervises the presence of the input power, removal of the detector cover and the removal of the smoke detector head.

⚠ This detector is equipped with a cover removal switch that instantly provides a trouble condition upon removal of the clear cover. For all testing and inspection with the cover removed, the cover removal switch (designated as SW1 on PCB) must be manually depressed to simulate standard "pilot" operation. THE TROUBLE CONTACTS (TERMINALS 4, 15, 5) ARE SHOWN IN THE NON-ENERGIZED CONDITION.

The trouble contacts **will not** operate in the event of a smoke alarm. The SL-2000 Series duct detector will operate from various input voltage sources; namely 24VAC, 24VDC, 115VAC and 230VAC.

SAMPLING TUBES

The operating principle of a duct detector is based on the Venturi effect. Two tubes extend into the HVAC duct. Air flowing through the duct is forced into the air intake (inlet) tube via the air intake holes, (facing the airflow) and passes over the detector head. The air will be drawn out via the exhaust tube back into the HVAC duct. (A 7" exhaust tube is provided in the installation kit.) When the concentration of smoke particles suspended in the air stream reach the alarm threshold of the detector head, the unit will go into alarm.

The duct smoke detector units are designed to operate in duct widths from 6" to 10' wide with an air velocity between 100 to 4,000 feet per

minute. To verify correct installation, the pressure differential between the sampling (high side) and exhaust (low side) tubes should be measured using a Magnehelic pressure gauge or equivalent. An acceptable reading is between 0.01 and 1.2 inches of water.

To minimize the impact of air turbulence and stratification on performance, a duct smoke detector should be located as far as possible downstream from any obstruction (i.e. deflector plates, elbows, dampers, etc.). In all situations, confirmation of velocity and pressure differential within specifications is required.

REMOTE ACCESSORIES

Audible and visual alarm indicators, remote status indicators, and remote reset/test switches can be accommodated by the SL-2000 Series duct units by connecting to DC voltage output terminals as described on Page 4. These terminals are not supervised and the voltage/current will only be present when the detector unit is in alarm. The remote pilot (green) LED will be permanently illuminated when connected to the output terminals as long as input power and detector head are present.

SL-2000 AT-A-GLANCE

MODEL NUMBER:

SL-2000-N 4-Wire Ionization Duct Smoke Detector

SL-2000-P 4-Wire Photoelectric Duct Smoke Detector

DETECTOR HEAD MODEL NUMBER:

Ionization Detector Head: **55000-225APO**

Photoelectric Detector Head: **55000-328APO**

POWER REQUIREMENTS:

STANDBY CURRENT

24VAC 39.4mA

24VDC 13.5mA

115VAC 13.8mA

230VAC 7.9mA

ALARM CURRENT

24VAC 59.3mA

24VDC 128.7mA

115VAC 27.0mA

230VAC 16.0mA

RELAY CONTACT RATINGS:

Alarm contacts: 2 Sets form "C" rated at 10A @ 115VAC resistive
1 form "A" rated at 2A

Trouble contacts: 1 Set form "C" rated at 10A @ 115VAC resistive

Air velocity: 100 to 4,000ft/min.

Ambient temperature: SL-2000-N: 32°F to 158°F (0°C to 70°C)

SL-2000-P: 32°F to 140°F (0°C to 60°C)

Humidity: 10% to 85% RH Non-Condensing/Non-Freezing

Material: Gray plastic back box with clear plastic cover (Makrolon 94V-0)

Dimensions: 13½" L X 4½" W X 2¼" D

Max. net wt.: 3½ lbs.

Radioactive element: SL-2000-N (Ionization) - Americium 241, 0.9 micro curie.

Do not expose to corrosive atmospheres.

U.S. Patents 6,741,181 and Patents Pending

MECHANICAL INSTALLATION

LOCATION PREREQUISITES

This guideline contains general information on duct smoke detector installation, but does not preclude the NFPA and/or ICC documents listed. Air Products and Controls assumes no responsibility for improperly installed duct detectors. To determine the correct installation position for an SL-2000 Series duct smoke detector, the following factors must be considered.

- 1) A uniform non-turbulent (laminar) airflow between 100 ft/min. to 4,000 ft/min. must be present in the HVAC duct. To determine duct velocities, examine the engineering specifications that define the expected velocities or use an Anor model 6000AP velocity meter (or equivalent).
- 2) To minimize the impact of air turbulence and stratification on performance, a duct smoke detector should be located as far as possible downstream from any obstruction (i.e. deflector plates, elbows, dampers, etc.). In all situations, confirmation of velocity and pressure differential within specifications is required.

The pressure differential between the input sampling (high pressure) tube and exhaust (low pressure) tube for the SL-2000 Series smoke duct detector should be greater than 0.01 inches of water and less than 1.2 inches of water.

- 3) Identify a code compliant location (supply or return side, or both) for the installation of the duct unit that will permit easy access for viewing and serviceability.
- 4) When installing on the return side, install duct units prior to the air being exhausted from the building or diluted with outside "fresh" air.
- 5) When installing duct smoke units downstream of filters, fires occurring in the filters will be detected, but if the filters become blocked, insufficient air flow through the duct unit will prevent the correct operation of the duct detector. Duct units installed in the supply air side may monitor upstream equipment and/or filters.
- 6) Where possible, install duct detectors upstream of air humidifiers and downstream of dehumidifiers.
- 7) To prevent false alarms, the duct detector should not be mounted in areas of extreme high or low temperatures, in areas where high humidity exists, or in areas where the duct may contain gases or excessive dust.

SAMPLING TUBE ASSEMBLY

The SL-2000 Series duct smoke detectors employ a specially notched sampling tube, which may be ordered separately in one of four standard lengths.

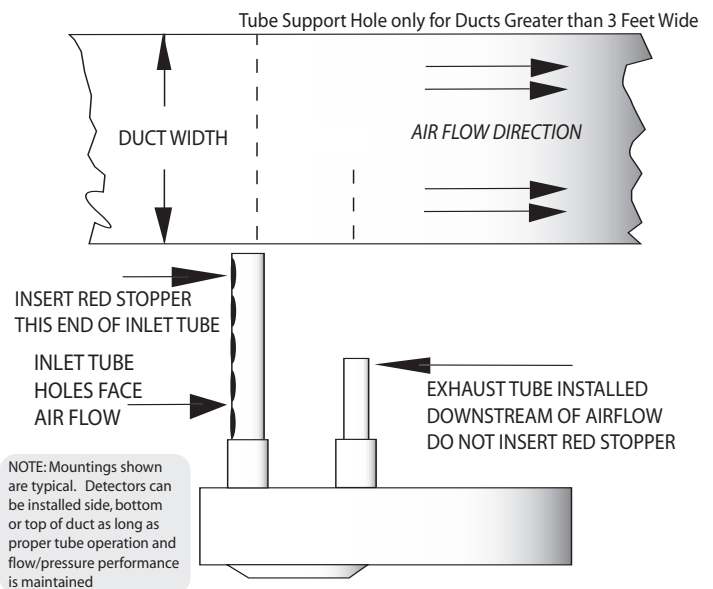
- STN-1.0** For duct widths of 6" TO 1.0'
- STN-2.5** For duct widths of 1.0' TO 3.0'
- STN-5.0** For duct widths of 3.0' TO 5.0'
- STN-10.0** For duct widths of 5.0' TO 10.0'

Standard sampling tubes are steel tubes with air intake holes drilled the entire length of the tube. These tubes can be cut to length and must span at least 80% the width of the duct. Sampling tubes over 3.0' must be supported on the opposite side of the duct. To ensure the correct operation of the sensing tube, the red end cap (red stopper in installation kit) must be inserted in the end of the air intake sampling tube. For custom duct widths, always use the next longest standard size and cut down to the exact requirement.

"NO-TOOLS" TUBE INSTALLATION

The SL-2000 Series duct smoke detector provides a unique, patent-pending mechanism for installation and/or removal of the sampling and exhaust tubes from either the front or rear of the detector housing.

Once the airflow direction has been determined, insert the inlet and exhaust tubes into the duct smoke detector. If the cover is in place, the tubes may be inserted into the back of the detector via the key-slots provided. Simply push the tube into place against the spring loaded retainer, and turn into the correct position, allowing the key to "lock" the tube in the desired orientation. For front side installation, simply rotate the tube retainer until the tube may be inserted and oriented properly. Once the tube is installed, rotate the retainer back into place to lock down the tube. Ensure air intake sampling tube is positioned so that the inlet holes are directly facing the airflow.



DUCT PREPARATION

Remove mounting template from the installation kit. Remove paper backing from the mounting template and affix it to the duct at the desired location. Using the template as a guide, drill (2) mounting holes, 3/32" (2.5mm) for the #12 X 1/2" sheet metal screws packaged in the installation kit. Drill or punch (2) 1 1/4" (32mm) holes for inlet sampling and exhaust tubes, using the template as a guide. Clean all holes.

MOUNTING

After securing the sampling and exhaust tubes to the duct smoke unit, (or initially placing the tubes through the 1 1/4" holes drilled or punched in the HVAC duct to accept the inlet sampling and exhaust tubes and then attaching them to the duct unit), hold the duct unit assembly in position and use (2) # 12 X 1/2" sheet metal screws (packaged in the installation kit) to secure the duct smoke detector to the HVAC duct sheet metal.

AIR SAMPLING VERIFICATION

To ensure correct operation of the duct unit use a Magnehelic differential pressure gauge, Dwyer 2000 or 4000 Series (or equivalent) to determine the differential pressure between the inlet (high side) and exhaust (low side) tubes. The differential pressure between the two tubes should be greater than 0.01 inches of water and less than 1.2 inches of water.

AIR SAMPLING VERIFICATION (CONT'D)

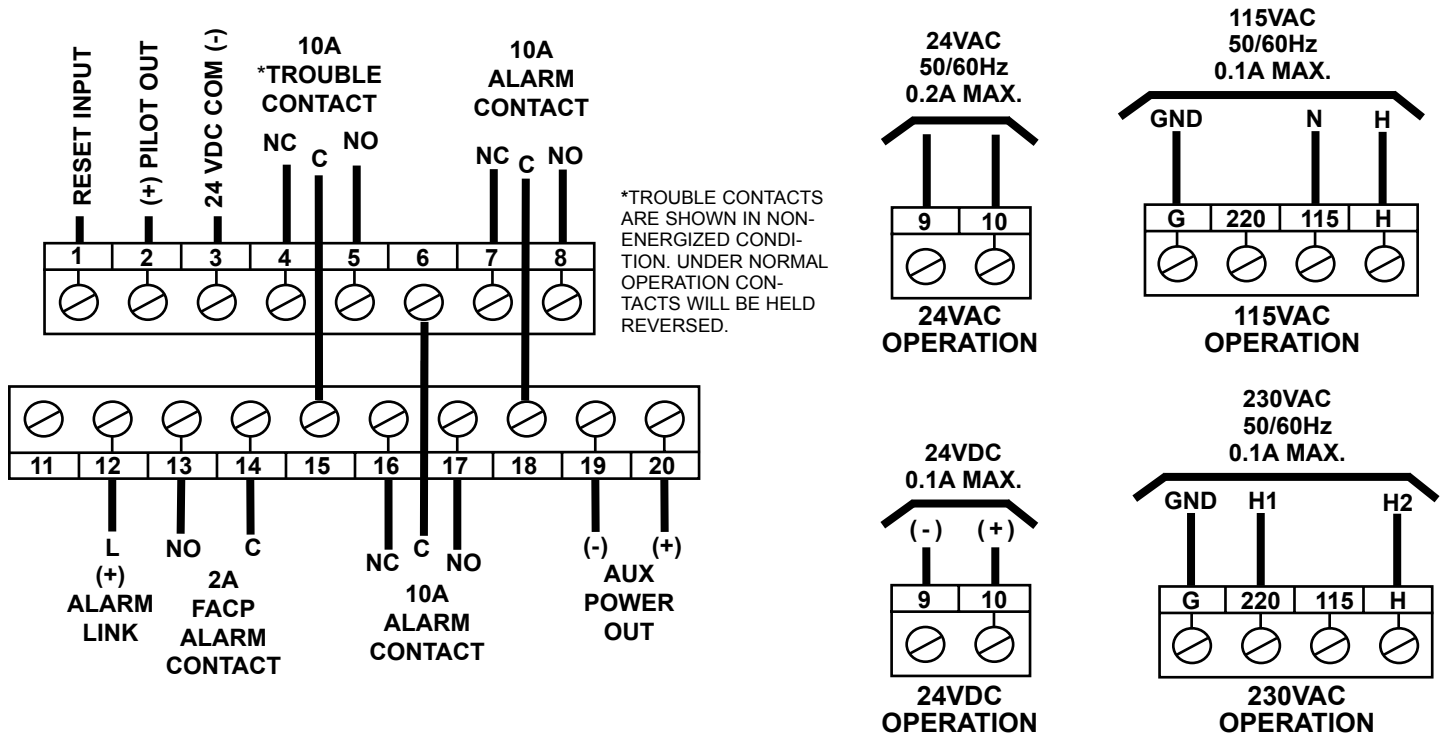
This duct smoke detector is shipped with a velocity adapter insert, either factory installed (SL-2000-P), or found in the installation kit (SL-2000-N). When installed, this adapter will allow the duct detector to operate at extremely low air velocities. To install the adapter, simply insert it into the slots provided inside the detector housing so that the adapter fits snugly over the smoke detector head. Unless your system is consistently operating in the slower velocity range (where the adapter is specifically required), we recommend that the adapter not be inserted. If you experience false alarms at higher velocities with the adapter in place, the adapter should be removed. Please use the following chart for guidance on when the velocity adapter should be used. For reference, the speeds indicated are intended to represent the velocity of air within the duct under normal operational conditions.

	100 ft/min	300 ft/min	500 ft/min	1,000 ft/min	2,000 ft/min	3,000 ft/min	4,000 ft/min
SL-2000-N	UL Listed without insert installed (300-4,000 ft/min)						
	UL Listed with insert installed (100-2,000 ft/min)						
SL-2000-P	UL Listed without insert installed (1,000-4,000 ft/min)						
	UL Listed with insert installed (100-4,000 ft/min)						

ELECTRICAL INSTALLATION

TERMINAL AND POWER CONNECTIONS

Prior to connecting input power to the duct unit, determine the correct input voltage/ current availability and ensure it is connected to the correct terminals.

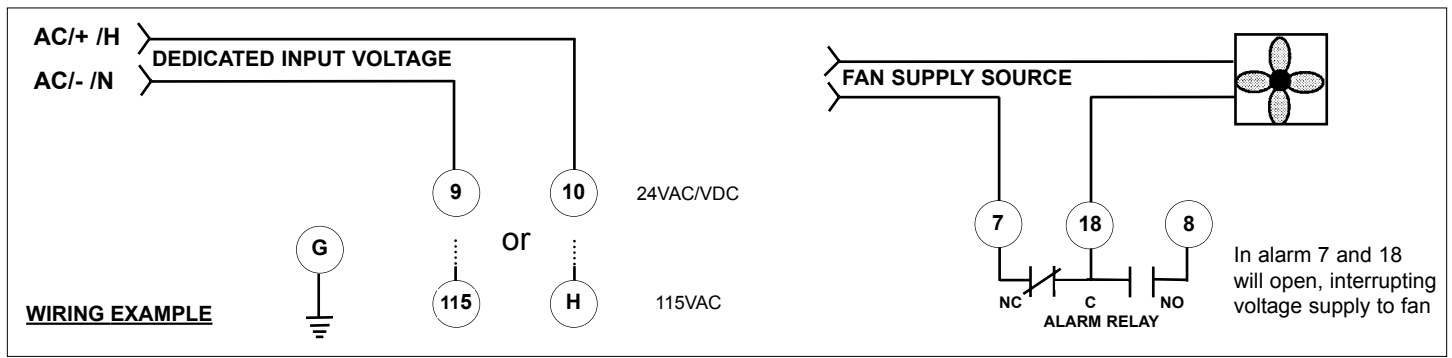


WIRING

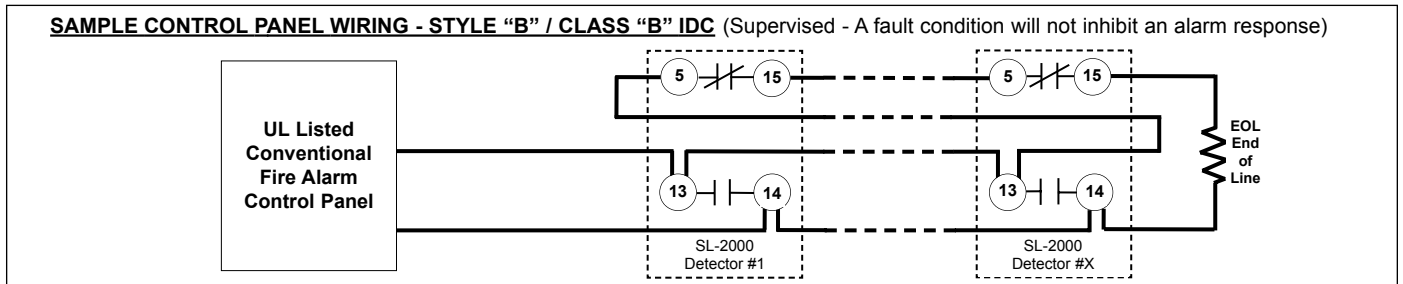
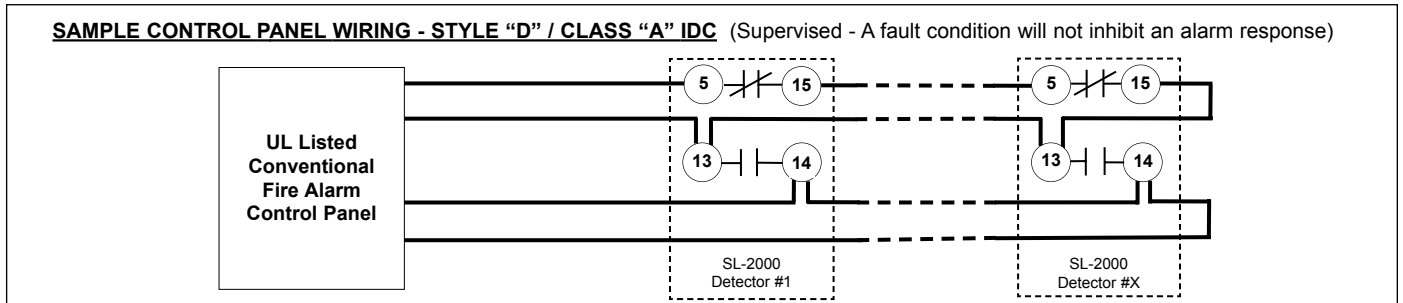
CAUTION: Do not use looped wire under terminals. Break wire run to provide for proper supervision of connections.

With detector head removed, connect one of the appropriate dedicated power sources to the applicable terminals (see above). Replace detector head and depress the cover removal switch (SW1) and the unit will be energized. The green pilot LED will be illuminated, and when pressing the test/reset button (SW2), the red alarm LED will be illuminated. This test confirms the correct basic operation of the duct smoke unit, excluding the detector head (see functional testing).

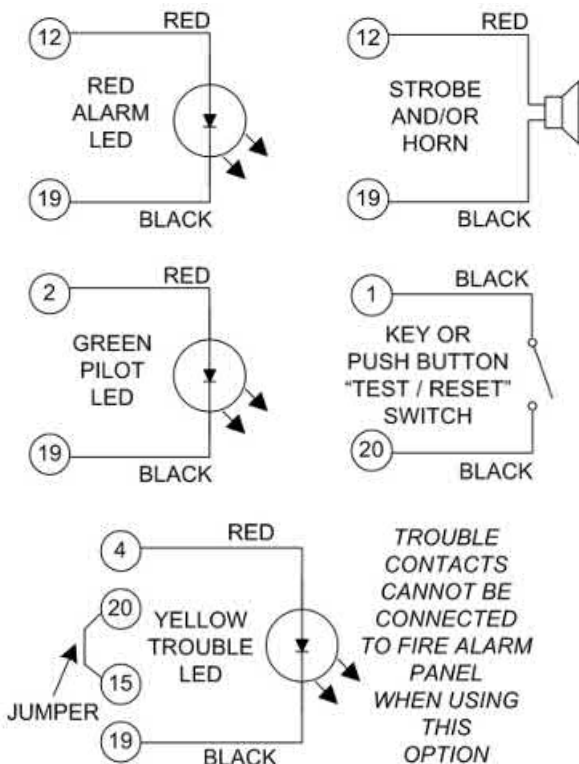
In the event of a fire alarm, certain equipment may be required to be shut down. For example, shut down may be achieved by interrupting the fan supply source to that particular piece of equipment when wired as indicated on Page 4.



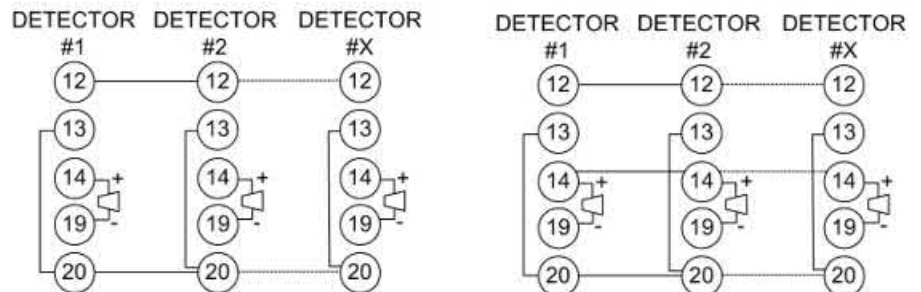
FIRE ALARM CONTROL PANEL WIRING



REMOTE ACCESSORY WIRING

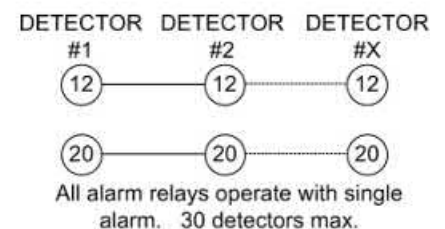
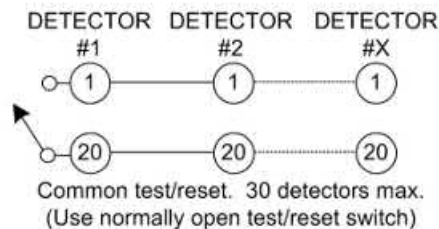


INTERCONNECTION WIRING FOR COMMON FUNCTIONS



All alarm relays operate with single alarm. Individual horn/strobe units operate on alarmed detector only. 30 detectors max.

All alarm relays operate with single alarm. All horn/strobe units operate on any single alarm. 10 detectors max.



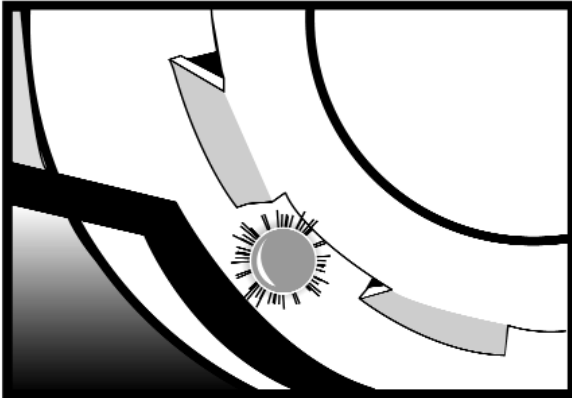
NOTE: A common power supply must be used for all interconnected detectors.

TESTING AND MAINTENANCE PROCEDURES

OPERATIONAL TESTING

To determine the correct operation of the SL-2000 Series duct smoke detector, ensure input power is connected and the green pilot LED is illuminated.

The LED on the detector head of both the ionization and photoelectric models will flash while the unit is in standby mode. The LED on the smoke detector head will be permanently illuminated when smoke is detected and the head is in alarm.



Above: The LED will be permanently illuminated when the unit is in alarm.

With the air handling unit shut down (not connected), and the clear cover removed, press and hold the test/reset button and the cover removal switch on the SL-2000. The red alarm LED on the circuit board will be illuminated and the alarm relay outputs will change state. Using a multimeter set to OHMS (or continuity buzzer function on the meter) place the meter probes on the following terminals, and ensure the contacts are closed (continuity) (8-18) and (6-17). When releasing the test/reset button these contacts will open.

The trouble contacts (4,15,5) on the SL-2000 detector will not change state in the event of a fire alarm, operational, or functional testing. The trouble contacts can be tested by either releasing the cover removal switch, or depressing the cover removal switch after rotating the smoke detector head counter-clockwise and removing the detector head. This action will extinguish the green pilot LED and cause the trouble contacts to change state, (4-15) will be closed (continuity) and (5-15) will be open circuit. Replacing the detector head and rotating it clockwise until it locks, will cause the green pilot LED to be illuminated and the unit will be operational, terminals (4-15) will be an open circuit and (5-15) will be closed (continuity).

FUNCTIONAL TESTING

Once operational testing is concluded the unit requires functional testing to determine the correct operation of the detector head.

MAGNET TESTING: Place the magnet provided with the installation kit on top of the housing between the raised sections above the detector head (as indicated on the unit cover. Allow at least five seconds for alarm initiation. Remove magnet and reset detector.

SMOKE TESTING: Using smoke test canister with testing nozzle (available from Air Products and Controls Inc. part number TG-2000), insert the test gas nozzle into the test port on the unit cover. Press can against cover to release gas into the chamber.



CAUTION: DO NOT SPRAY GAS FOR MORE THAN ½ SECOND. OVERUSE OF TEST GAS FACILITY MAY RESULT IN DETECTOR CONTAMINATION.

After 15 to 20 seconds the detector head will go into alarm, illuminating the detector head LED and causing the duct unit functions to operate, alarm relays will change state, and the alarm related remote accessories, if attached, will function.

If no test gas is available to conduct functional testing, remove cover and, while holding down the cover removal switch, blow smoke from a cotton wick or punk directly at the head to cause an alarm. The alarm indicator should illuminate within one minute.

Should additional testing also be required for simulated fire conditions, smoke bombs placed in the duct may not be suited for the particular detector head (photoelectric or ionization) selected and installed. Consult the smoke bomb data for proper use and compatibility with detector type.

The S65A ionization detector head (55000-225APO) utilizes a radioactive source as its means of detection and will detect smoke particles of between .1 and 1 micron in size.

The S65A photoelectric detector head (55000-328APO) operates on the principle of light scatter and will detect smoke particles of between 1 and 10 microns in size.

When purchasing smoke bombs for additional required functional testing, ensure smoke particle sizes comply with the criteria as described above.

MAINTENANCE

Each installation location must be assessed on its own merits. If the protected area is of a very dirty nature then the SL-2000 Duct unit(s) will have to be checked and cleaned on a quarterly basis or when cleaning is required.

As a guideline the smoke detector head should be cleaned every six months or as required. The best methods of cleaning are to vacuum the detector head thoroughly or to blow the detector head out using clean, dry compressed air.

Do not use chemicals or non-conforming air to clean the detector head housing as this could contaminate the detector head and damage the casing.

Sensing tubes must be inspected and cleaned in accordance with the schedule as determined above, to allow the free flow of air through both inlet and exhaust tubes.

Consult your local code and AHJ requirements for required maintenance schedules.



AIR PRODUCTS AND CONTROLS INC.
1749 E. Highwood Pontiac, MI 48340 USA
Telephone: (248) 332-3900 www.ap-c.com

AVAILABLE ACCESSORIES FOR USE WITH SL-2000 SERIES DUCT SMOKE DETECTORS

REMOTE ACCESSORIES	
MS-RA	Remote Alarm
MS-RA/R	Remote Alarm, push button Test/Reset Switch
MS-RA/P/R	Remote Alarm, Pilot, push-button Test/Reset Switch
MS-KA/R	Remote Alarm, key-operated Test/Switch
MS-KA/P/R	Remote Alarm, Pilot, key-operated Test/Reset Switch
MS-RA/P	Remote Alarm, Pilot
MS-RH	Remote Alarm Horn
MS-RH/KA/P/R	Remote Alarm, Pilot, Horn, key-operated Test/Reset Switch
MS-RH/P/A	Remote Alarm, Pilot, Horn
MS-RH/KA/P/A/T	Remote Alarm, Trouble, Pilot, Horn, key-operated Test/Reset Switch
MS-RA/P/T	Remote Pilot, Trouble
MS-RA/FT/P	Remote Pilot, Trouble, push-button Test/Reset Switch
MS-KA/P/R/T	Remote Pilot, Trouble, key-operated Test/Reset Switch
MS-RD	Remote Alarm
MS-F/T	Remote Trouble
SHP24-1575R	Horn/Strobe, red housing, clear cover
SHP24-1575O	Horn/Strobe, white housing, opaque cover
SHP24-1575W	Horn/Strobe, white housing, clear cover

SMOKE TEST GAS

TG-2000 Solo Aerosol Test Gas with Nozzle for Test Port

NOTCHED SAMPLING TUBES

STN-1.0 For duct widths of 6" TO 1.0'
STN-2.5 For duct widths of 1.0' TO 3.0'
STN-5.0 For duct widths of 3.0' TO 5.0'
STN-10.0 For duct widths of 5.0' TO 10.0'

WEATHERPROOF ENCLOSURES

WP-2000 Weatherproof Enclosure

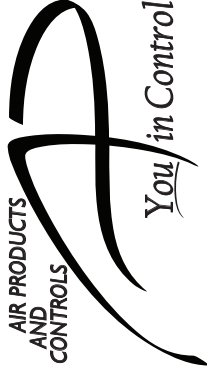
REPLACEMENT SMOKE DETECTOR HEADS

55000-225APO S65 Ionization Detector Replacement Head
55000-328APO S65 Photoelectric Detector Replacement Head

POWER SUPPLIES

T-PB 202-1 24VAC @ 4.0A Class I Power Supply
T-PB 202-0 24VAC @ 4.0A Class I Power Supply
T-PB 303-1 24VAC @ 3.0A Class II Power Supply
T-PB 303-0 24VAC @ 3.0A Class II Power Supply

AIR PRODUCTS
AND
CONTROLS



SL-2000 SERIES DUCT SMOKE DETECTORS

INSTALLATION AND MAINTENANCE INSTRUCTIONS



SL-2000-N Ionization Type, 4-Wire Duct Smoke Detector
SL-2000-P Photoelectric Type, 4-Wire Duct Smoke Detector

NOTICE: The information contained in this document is the most current available at the time of shipment of accompanying product, and is subject to change without notice. Future references should always be made to the most current revision of this document. The information contained in all this document should be considered before installing or using the product. Any example applications shown are subject to the most current enforced local/national codes, standards, approvals, certifications, and/or the authority having jurisdiction. All of these resources, as well as the specific manufacturer of any shown or mentioned related equipment, should be consulted prior to any implementation. For further information or assistance concerning this product, contact Air Products and Controls Inc. Air Products and Controls Inc. reserves the right to change any and all documentation without notice.
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INSPECTION, A COPY SHOULD BE LEFT WITH THE OWNER/USER.**



Series
626
&
628

Industrial Pressure Transmitter

Complete Offering of Ranges, Connections and Outputs



General Purpose Housing (-GH)



General Purpose Housing (-GH) with DIN C



626 with LED Display (CH housing only)



Conduit Housing (-CH)

*Please see our website for dimensional drawings.

The Series 626 Pressure Transmitters possess a highly precise 0.25% piezo-resistive sensor contained in a compact, rugged, NEMA 4X stainless steel general purpose housing or cast aluminum conduit housing.

The Series 628 Pressure Transmitters are ideal for OEMs with 1% full scale accuracy sensors. The transmitter is also available in the general purpose stainless steel housing and the cast aluminum conduit housing.

The corrosion resistant 316L stainless steel wetted parts allow the Series 626 and 628 transmitters to measure the pressure in a multitude of processes from hydraulic oils to chemicals. The Series 626 and 628 are available in ranges of vacuum, compound to 5000 psi with a variety of optional outputs, process connections and electrical terminations to allow you to select the right transmitter for your application.

APPLICATIONS

- Compressors
- Pumping systems
- Irrigation equipment
- Hydraulic
- Industrial process monitoring

FEATURES

- Metal conduit housing option
- Robust 316 SS oil filled sensor
- Compact design

SPECIFICATIONS

Service: Compatible gases and liquids.

Wetted Materials: Type 316L SS.

Accuracy: 626: 0.25% full scale; 626 absolute ranges: 0.5% full scale; 628: 1% full scale. (Includes linearity, hysteresis, and repeatability.)

Temperature Limit: 0 to 200°F (-18 to 93°C).

Compensated Temperature Range: 0 to 175°F (-18 to 79°C).

Thermal Effect: ±0.02% FS/°F (includes zero and span).

Pressure Limits: See table.

Power Requirements: 10 to 30 VDC.

Output Signal: 4 to 20 mA. Optional 0-5, 1-5 or 0-10.

Response Time: 50 msec.

Loop Resistance: 0 - 1300 ohms maximum for current. For voltage outputs, minimum load resistance: 2000 ohms.

Stability: 1.0% FS/year (Typ.).

Current Consumption: 38 mA (maximum).

Electrical Connections: Conduit Housing (-CH): terminal block, 1/2" female NPT conduit; General Purpose Housing (-GH): cable DIN EN 175801-803-C.

Process Connection: 1/4" male or female NPT and BSPT.

Enclosure Rating: NEMA 4X (IP66).

Mounting Orientation: Mount in any position.

Weight: 10 oz (283 g).

Agency Approvals: CE.

Pressure Limits

Range Number	Pressure Range	Maximum Pressure (psig)	Over Pressure (psig)	Range Number	Pressure Range (psig)	Maximum Pressure (psig)	Over Pressure (psig)
00	0-15 psia	30	45	11	0-150	300	750
30	15-0 psia	30	45	12	0-200	400	1000
06	0-5 psig	10	50	13	0-300	600	1500
07	0-15 psig	30	150	14	0-500	1000	2500
08	0-30 psig	60	300	15	0-1000	2000	5000
09	0-50 psig	100	300	16	0-1500	3000	5000
10	0-100 psig	200	500	18	0-3000	6000	7500
				19	0-5000	7500	10000
				26	0-8000	10000	12000

Ordering Chart

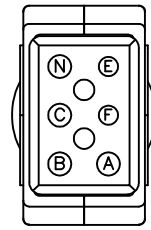
Accuracy	626								0.25% Full Scale Accuracy 1.0% Full Scale Accuracy
Range		-00 -01 -02 -03 -04 -05 -06 -07 -08 -09 -10 -11 -12 -13 -14 -22 -15 -16 -18 -19 -26 -67 -71 -75 -81							0-15 psia 0-30 psia 0-50 psia 0-100 psia 0-200 psia 0-300 psia 0-5 psi 0-15 psi 0-30 psi 0-50 psi 0-100 psi 0-150 psi 0-200 psi 0-300 psi 0-500 psi 0-600 psi 0-1000 psi 0-1500 psi 0-3000 psi 0-5000 psi 0-8000 psi 0-0.5 bar 0-2.5 bar 0-10 bar 0-40 bar
Housing			-CH -GH						Conduit Housing General Purpose Housing
Process Connection				-P1 -P2 -P3 -P5 -P9					1/4" male NPT 1/4" female NPT 1/4" male BSPT 1/4" female SAE with Refrigerant Valve Depressor ① 1/2" male NPT①
Electrical Connection					-E1 -E3 -E4 -E5 -E6				Cable Gland with 3' of Prewired Cable Cable Gland with 9' of Prewired Cable DIN EN 175801-803-L ① 1/2" female NPT Conduit ② M-12 4 Pin Connector
Signal Output						-S1 -S2 -S4 -S5			4-20 mA 1-5 Volt 0-5 Volt 0-10 Volt
Options							-AT -NIST -LED		Aluminum Tag NIST Traceable Certificate Bright Red LED display②③

① Available with -GH Housing only
 ② Available with -CH Housing only
 ③ LED option is not NEMA 4X

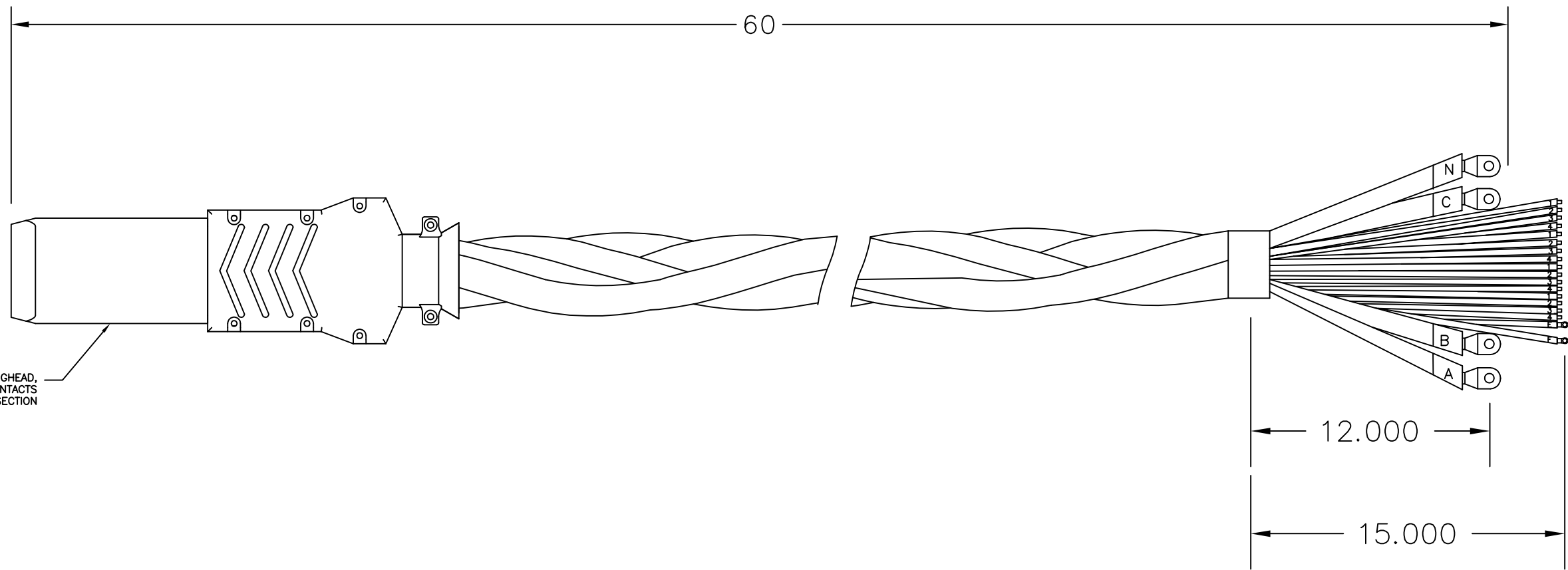
4.3 Appendix 3 – SSFC Equipment Datasheets, Drawings, and Manual

SSFC Equipment Datasheets, Drawings, and Manual Appendix 3

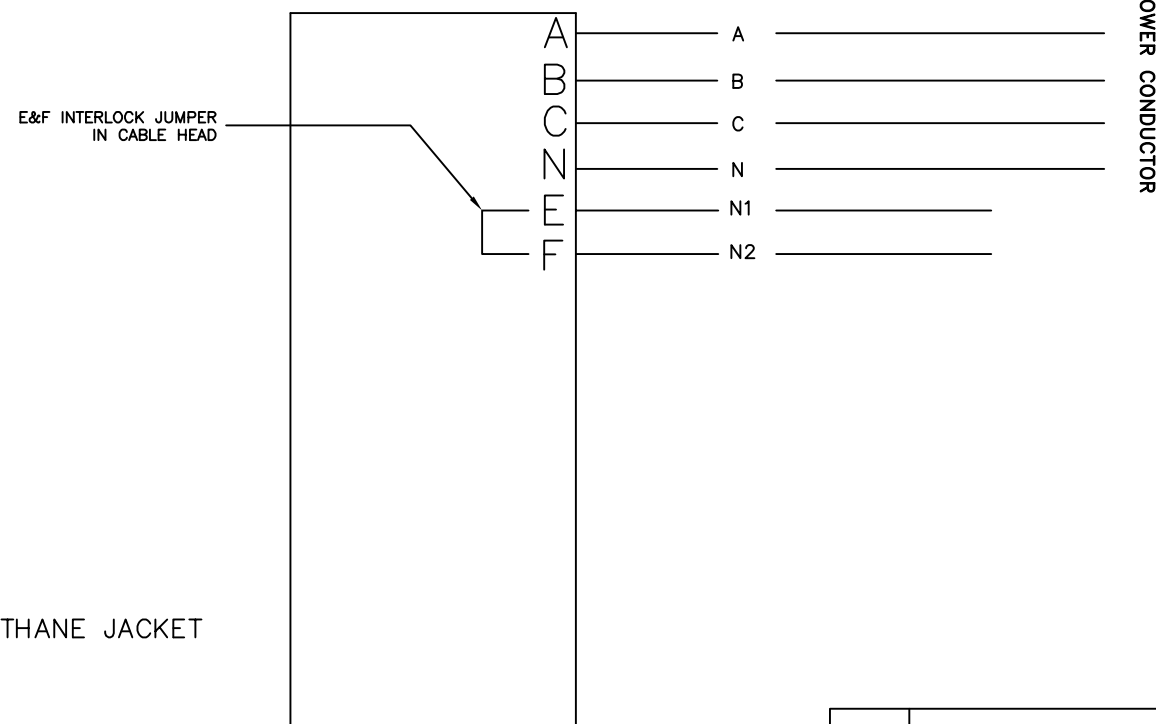
NOSE CONFIGURATION



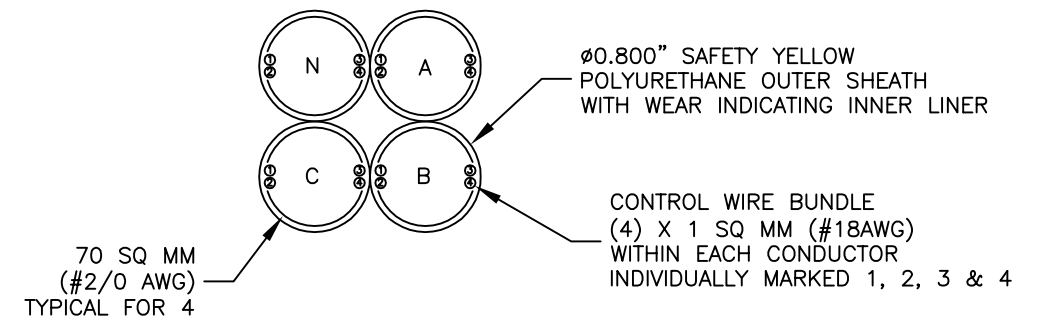
CRUSHPROOF PLUGHEAD, REPLACEABLE CONTACTS & NOSE SECTION



WIRING DIAGRAM



CABLE CONFIGURATION



CROSS SECTION

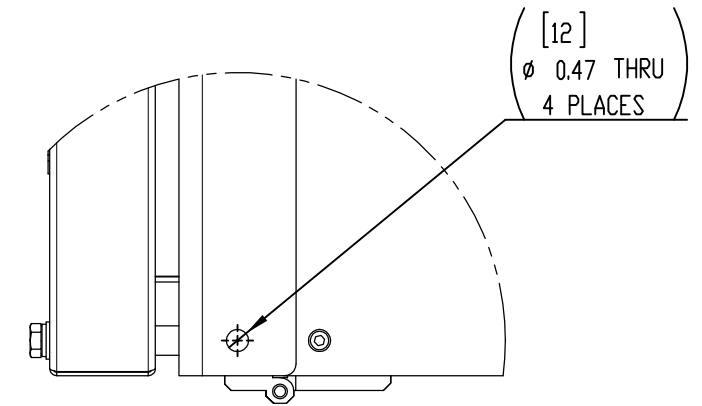
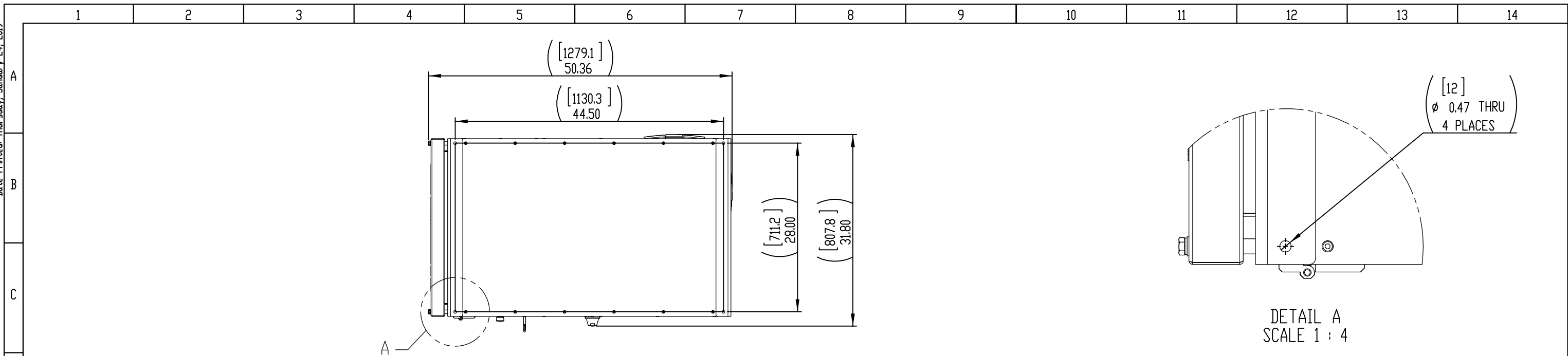
- ELECTRICAL RATING:
CONNECTOR - 200/115 VAC @ 400Hz.
CABLE - 600 VAC @ 400Hz.
AMPERES - 260 A.
- MATERIALS:
A. CONTACTS - SILVER PLATED COPPER.
B. CABLE - 4x70mm, 12x1mm WITH AN OVERALL REINFORCED POLYURETHANE JACKET
- MATES WITH RECEPTACLE MS90362.

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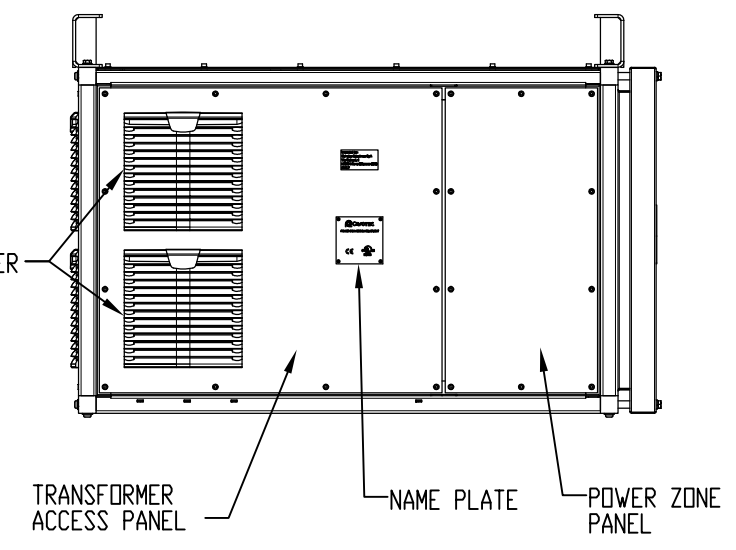
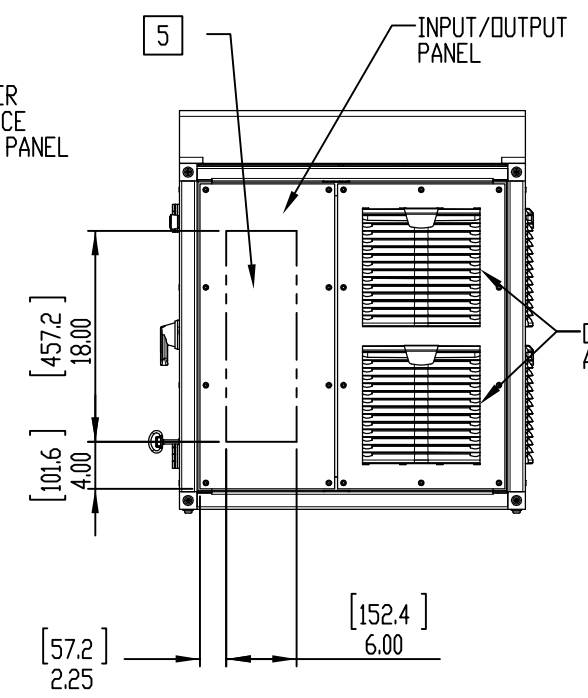
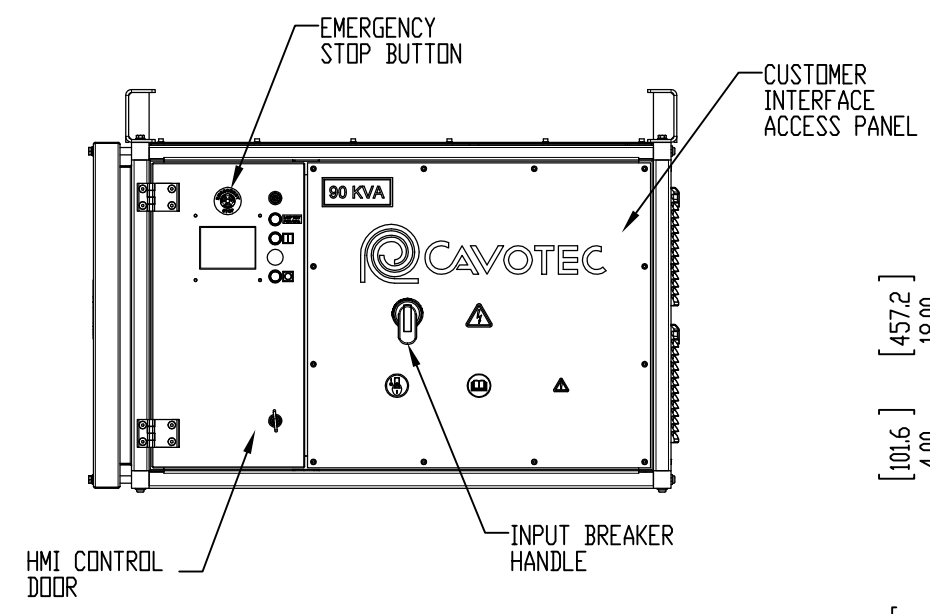
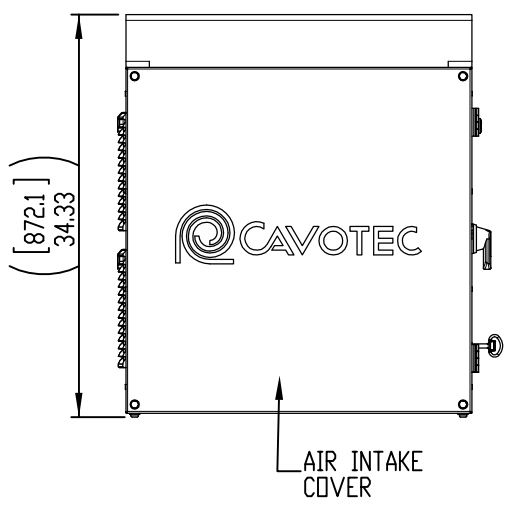
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DRAWING NUMBER: N0001-AS860608-002	REVISION: A
PART NUMBER: N0001-AS860608-002	APPROVED:
MATERIAL:	TITLE: 400HZ AIRCRAFT CABLE 60FT NO INDICATORS, PB, OR FB
FINISH: SEE N0300-CP056953-304	INF:
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING:
SCALE:	SHEET SIZE: B
	SHEET: 1 OF 1

REV	DESCRIPTION	DRAWN BY	DATE	REF
A	INITIAL RELEASE	ERIK L.	1/6/2021	



DETAIL A
SCALE 1 : 4



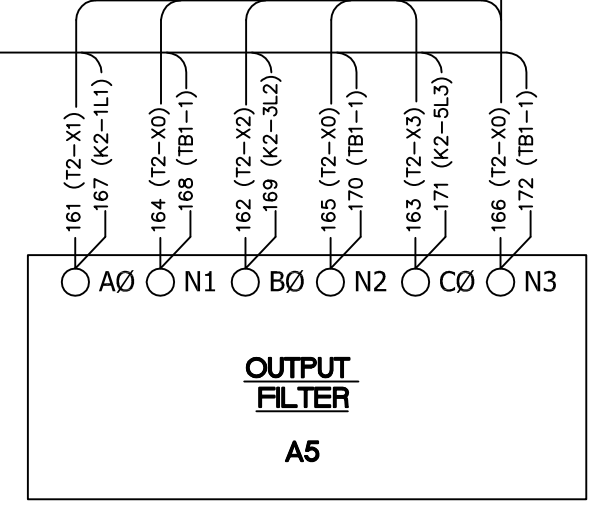
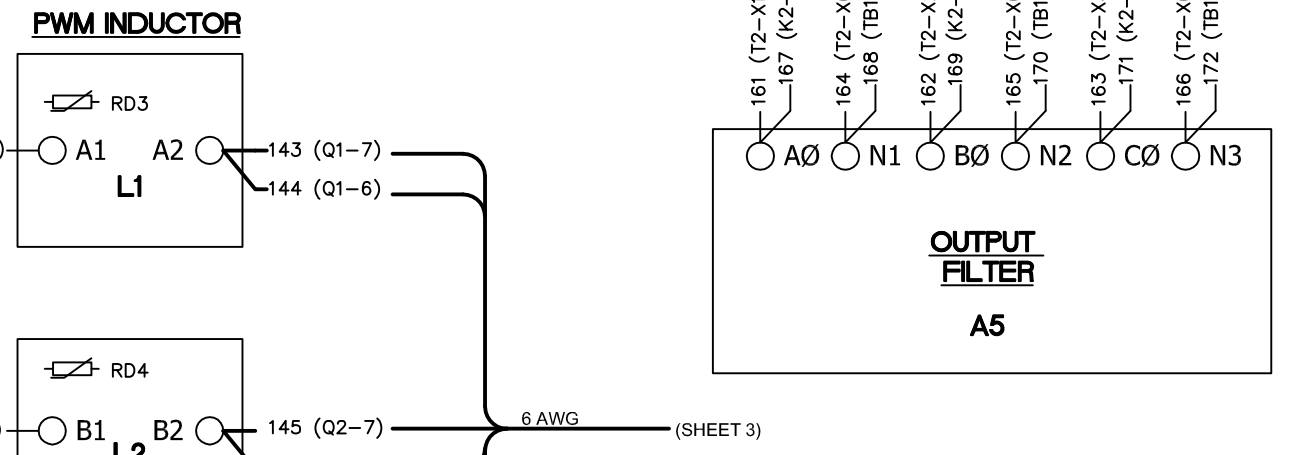
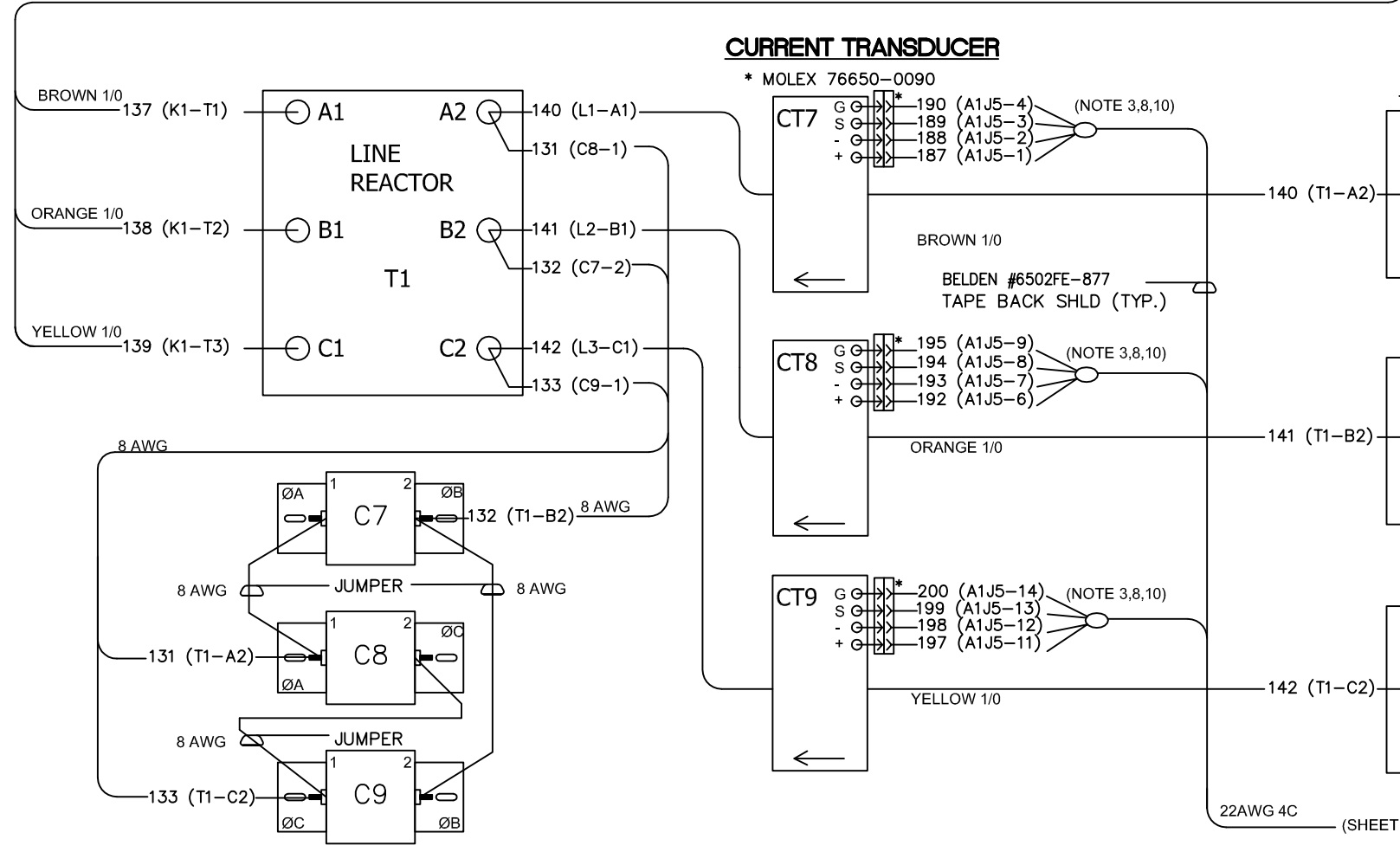
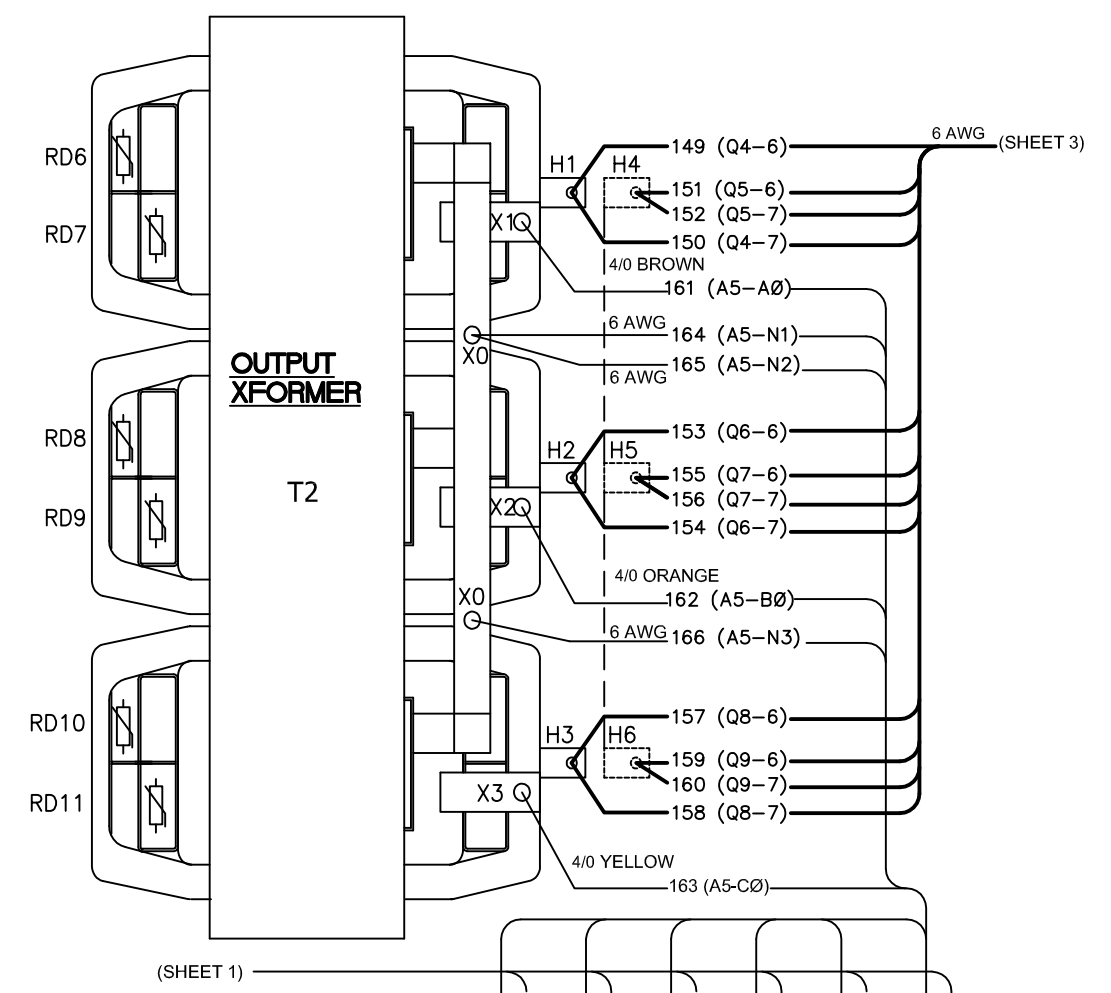
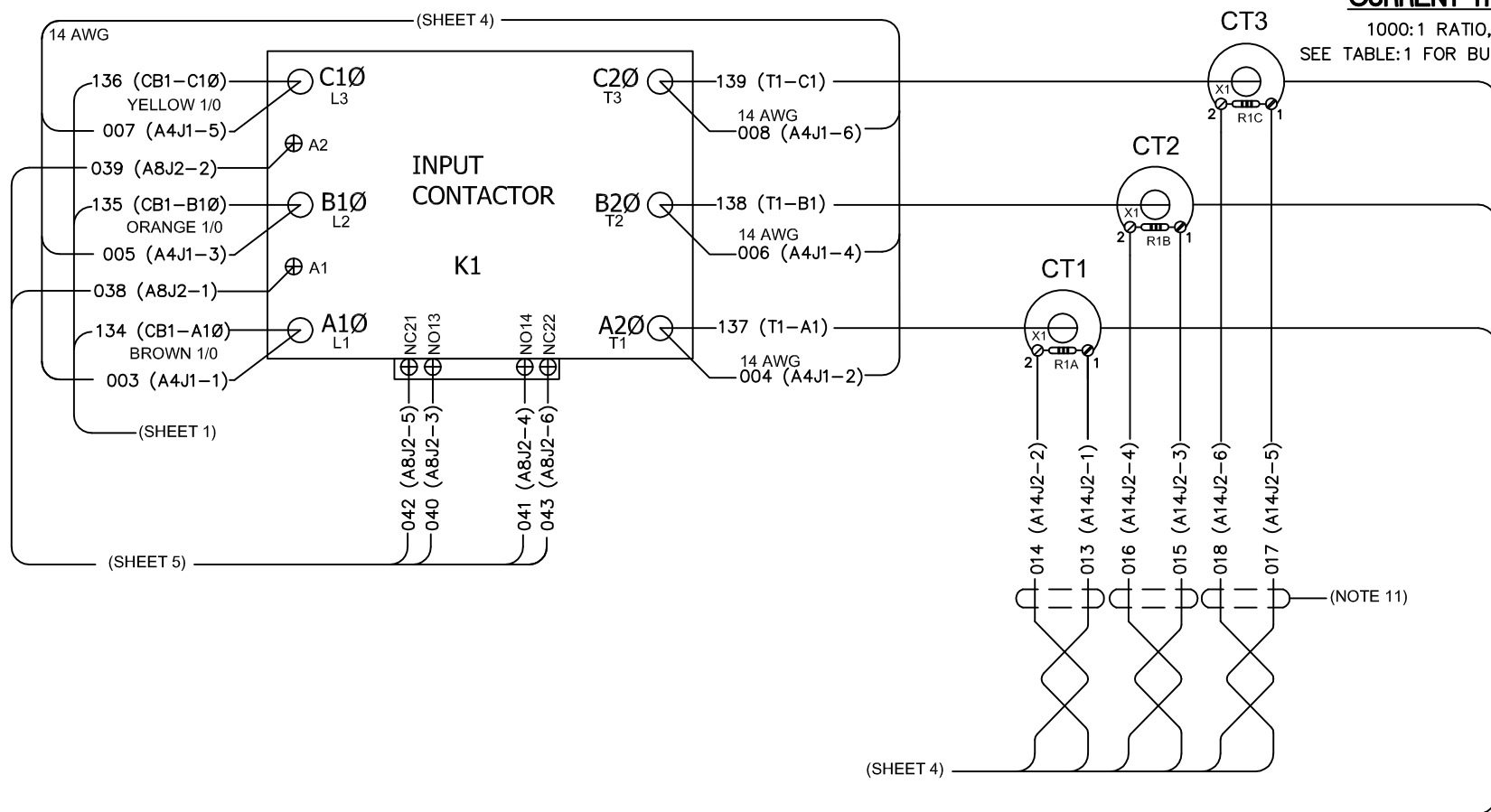
GENERAL NOTES:

1. DIMENSIONS AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5 - 2009 AND ISO 128, 129 & 2768.
 2. DIMENSIONS IN BRACKETS ARE MILLIMETERS.
 3. ASSEMBLY No. N0001-AS064423-000.
 4. WIRE IN ACCORDANCE WITH ELECTRICAL SCHEMATIC N0001-SC900906-002.
- [5.] INSTALL WATER PROOF CABLE GLANDS IN THIS AREA ONLY.

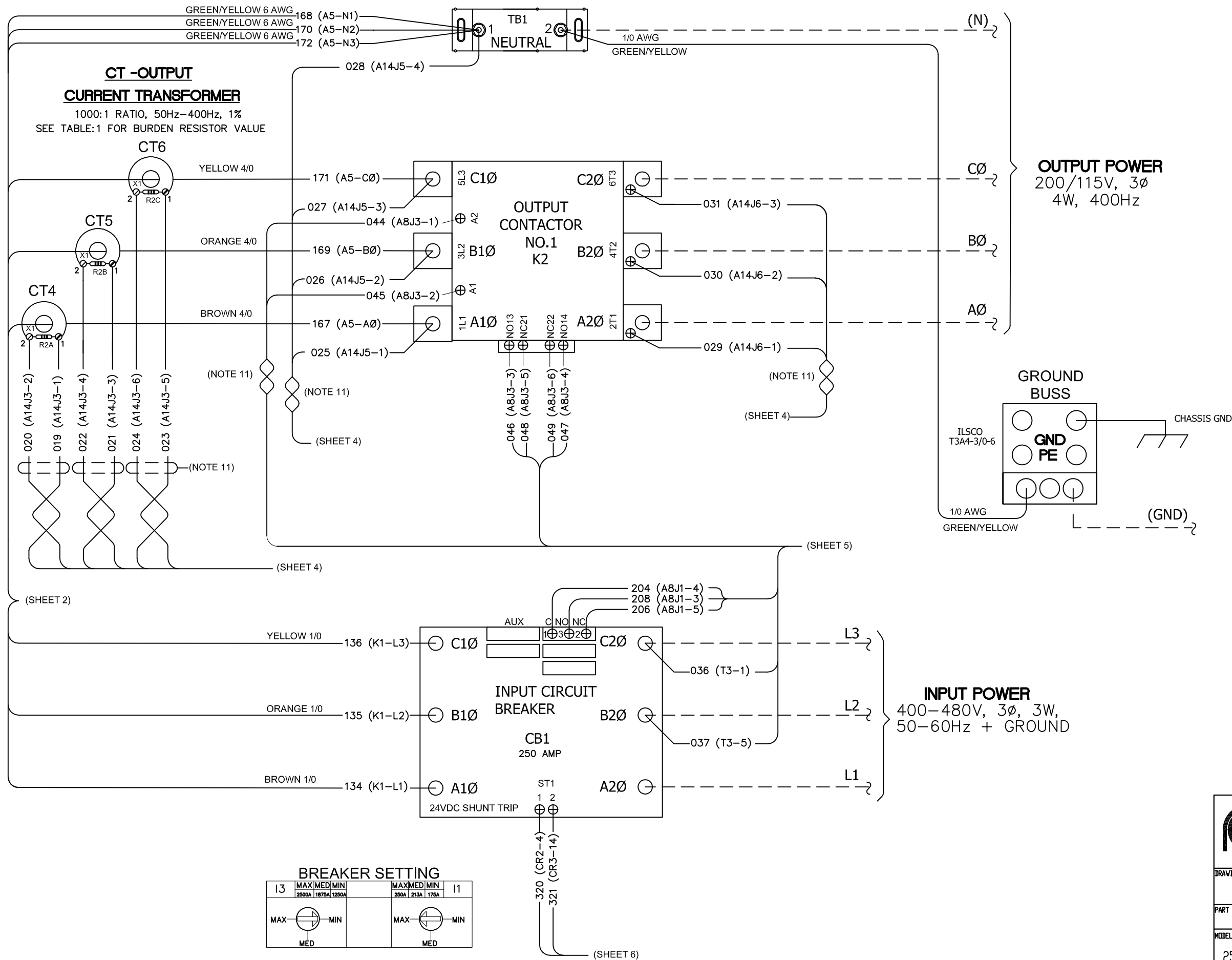
[6.] FILTER RATED IP55

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DRAWING NUMBER: N0001-DL900906-002		REVISION: B	
PART NUMBER: N0001-AS900906-002		APPROVED:	
MATERIAL:	TITLE: 2500+ 25C90S-HB HORIZONTAL BRIDGE		
FINISH SEE N0300-CP056953-304	INFD:	CAGE CODE: 6S1M4	MASS (lb): 1156.0
DIMENSIONS IN Inches UNLESS OTHERWISE STATED		TOLERANCING:	SCALE: 1:16 SHEET SIZE: B SHEET: 1 OF 1

B	ECR# 1989	EL	1/24/19	STD
REV	DESCRIPTION	DRAWN BY	DATE	REF



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DRAWING NUMBER:		REVISION:	
N0001-SC900906-002		E	
PART NUMBER:		APPROVED:	
N0001-AS900906-002			
MODEL NUMBER:		TITLE:	
25C90S-HB		400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ	
FINISH: SEE N0300-CP056953-304		INFID:	
		MASS (lbs)	
DIMENSIONS IN Inches UNLESS OTHERWISE STATED		TOLERANCING:	
		SCALE:	
		SHEET SIZE:	
		B	
		SHEET:	
		2 OF 7	



NOTES :

- ALL CONTROL WIRING SHALL BE HIGH-TEMP. #18 STRANDED COPPER, 600V, TYPE TEFLON, 105°, WHITE COLOR, U.L. LISTED, STYLE 1371. GROUND WIRES SHALL BE GREEN/YELLOW.
- THE COMPONENT LAYOUT ON THIS DRAWING DOES NOT NECESSARILY REFLECT THE ACTUAL LAYOUT OF THE PARTS.
- FOR SHIELDED AND TWISTED PAIR WIRE CONNECTIONS WHERE THE SHIELD IS REMOVED, THE EXPOSED (UNSHIELDED) WIRE LENGTH SHOULD BE AS SHORT AS POSSIBLE (2" MAX.)
- CONTROL WIRES FROM CONTROL PANEL ASSEMBLY SHOULD BE ROUTED SEPARATELY FROM POWER WIRES.
- WIRE LEGEND: 001 (A4J2-1)
 L TERMINAL NUMBER
 L DESTINATION OBJECT
 W WIRE NUMBER
- COLOR OF ALL WIRES SHALL BE WHITE EXCEPT FOR WIRES 8 AWG OR LARGER AND GROUND.
- COMPONENTS ARE TO BE IDENTIFIED WITH LABELS AS SHOWN WITH 1/2" BOLD LETTER (BLACK ON WHITE SELF-ADHESIVE TAPE).
- ALL TSP WIRING SHALL BE SINGLE PAIR 22 AWG, STRANDED COPPER, TWISTED & INDIVIDUALLY SHIELDED WITH OVERALL JACKET (BELDEN No. 6502FE).
- LAST WIRE TAG NUMBER USED : 321
- TWISTED SHIELDED PAIR (TSP)
- TWISTED GROUP 1 TURN/INCH [1 TURN/26MM]

FIELD WIRING

TABLE: 1

INPUT BURDEN	OUTPUT BURDEN
R1A, R1B, R1C	R2A, R2B, R2C
10 OHM, 6.5W	5 OHM, 6.5W

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DRAWING NUMBER: N0001-SC900906-002	REVISION: E
PART NUMBER: N0001-AS900906-002	APPROVED:
MODEL NUMBER: 25C90S-HB	TITLE: 400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ
FINISH: SEE N0300-CP056953-304	INFO: MASS (lbs):
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING: SCALE: SHEET SIZE: SHEET: B 1 OF 7

E	ECR# 2195	J. BIBEAU	9/15/2020	STD
REV	DESCRIPTION	DRAWN BY	DATE	REF

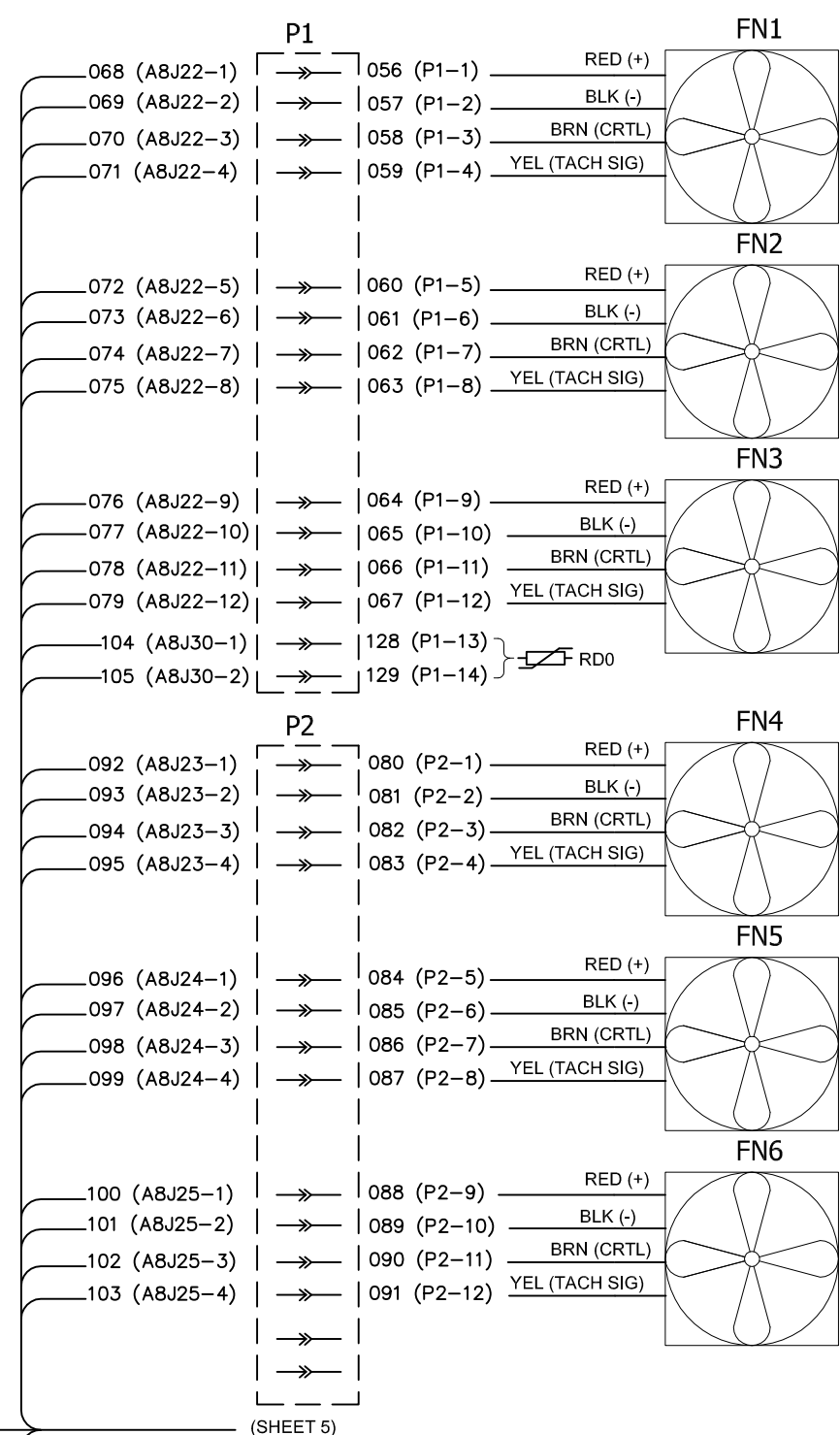
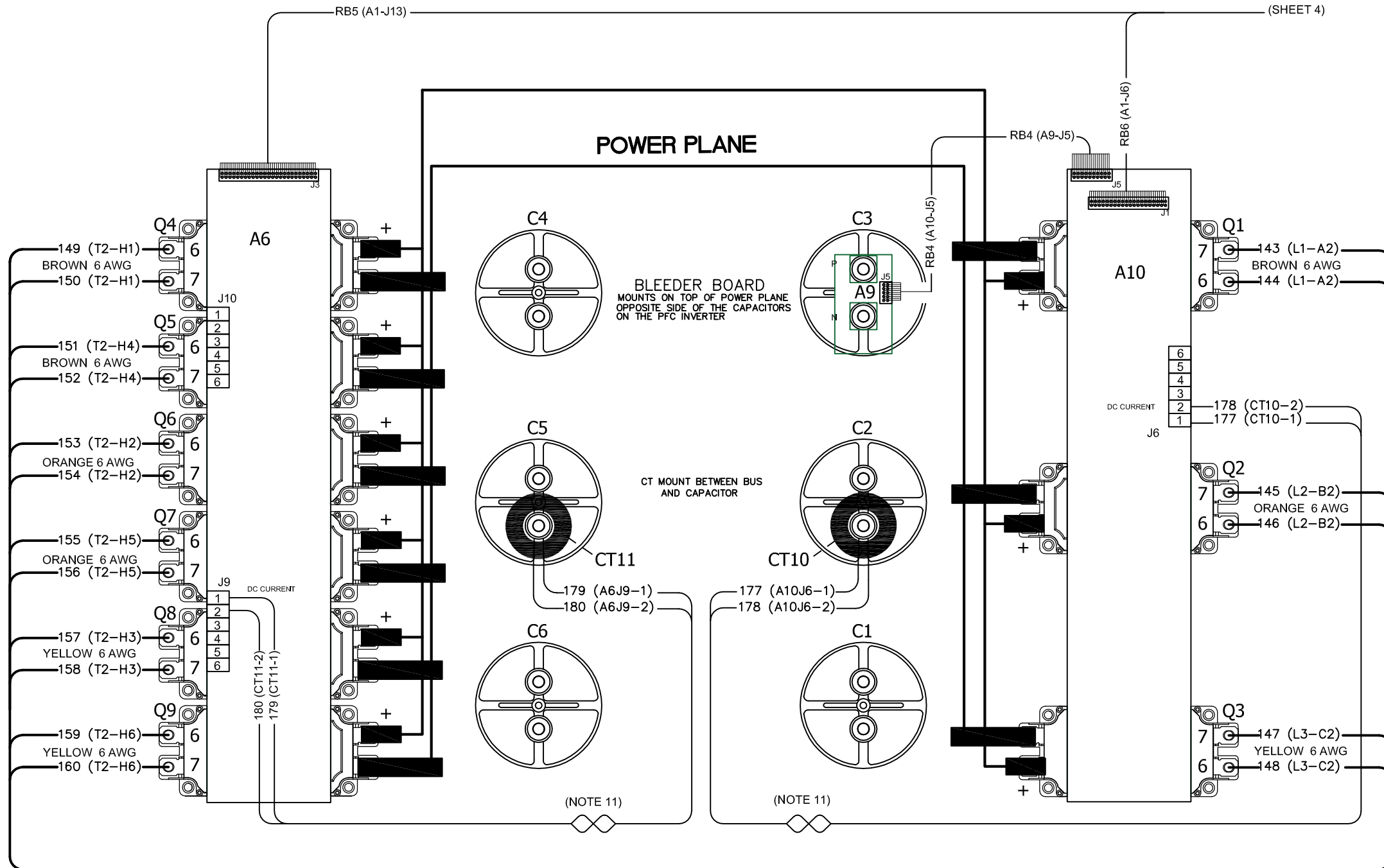
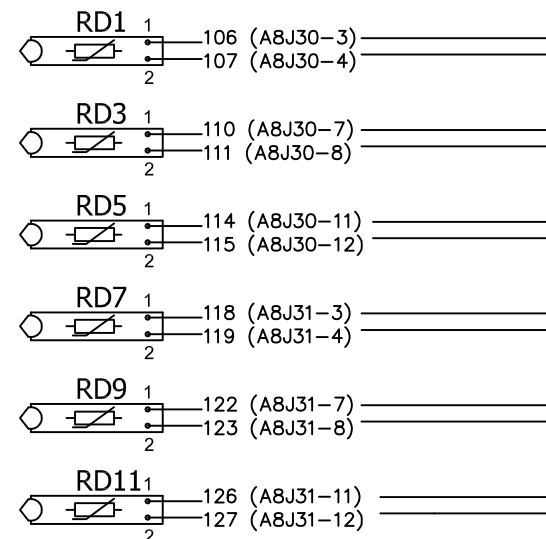
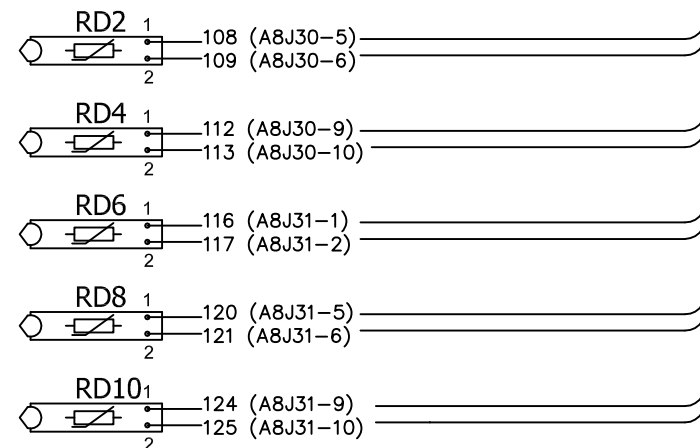


TABLE: 2

RESISTANCE TEMPERATURE DETECTORS (RTD) PT1000 MATRIX -40° TO 150°		
LOCATION	DESIGNATION	CONNECTION
INLET TEMP	RD0	P1
OUTLET TEMP	RD1	A8-J30
LINE REACTOR	RD2	A8-J30
L1 INDUCTOR	RD3	A8-J30
L2 INDUCTOR	RD4	A8-J30
L3 INDUCTOR	RD5	A8-J30
T2-HI COIL	RD6	A8-J31
T2-H4 COIL	RD7	A8-J31
T2-H2 COIL	RD8	A8-J31
T2-H5 COIL	RD9	A8-J31
T2-H3 COIL	RD10	A8-J31
T2-H6 COIL	RD11	A8-J31

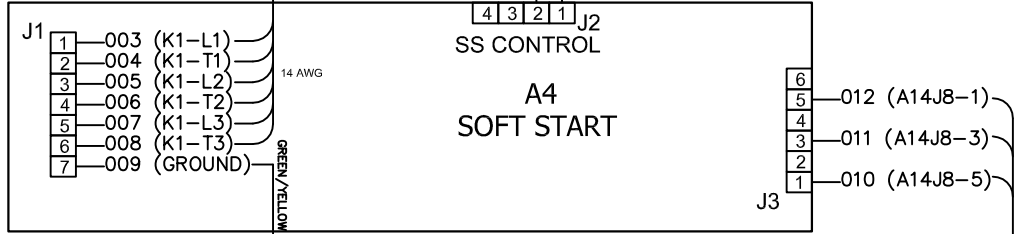
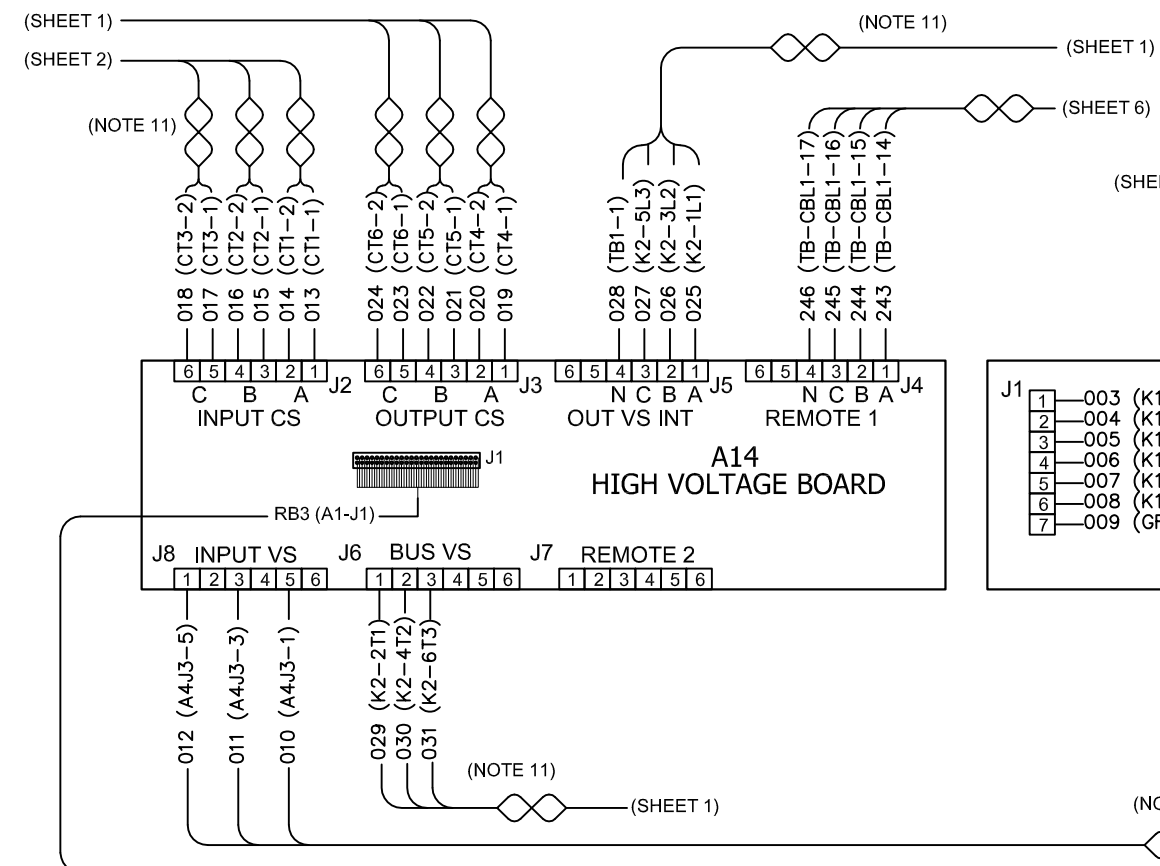
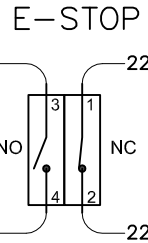
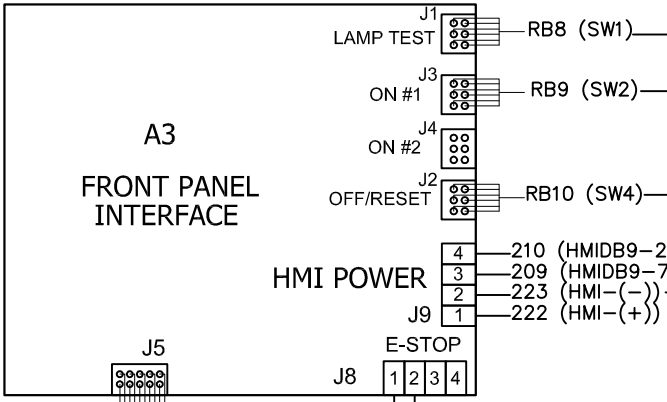
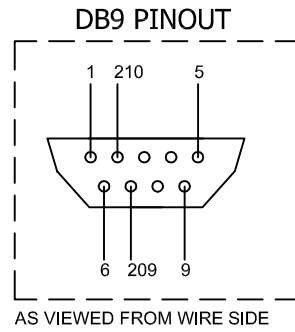
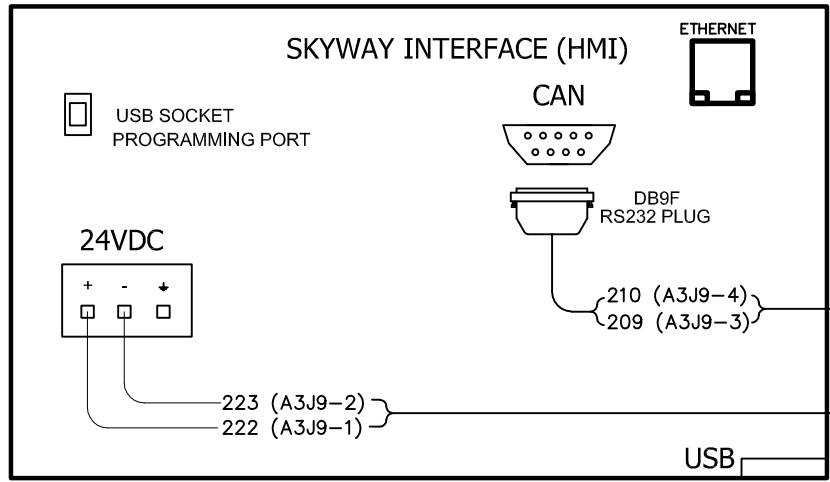
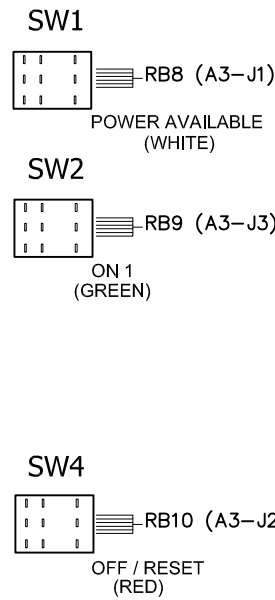
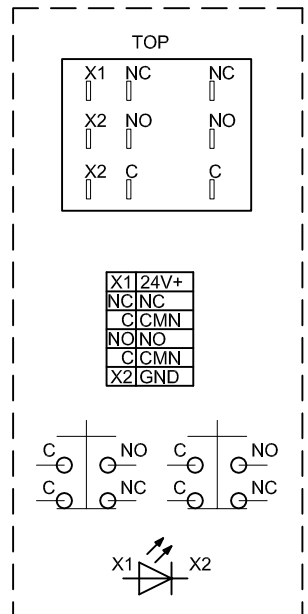


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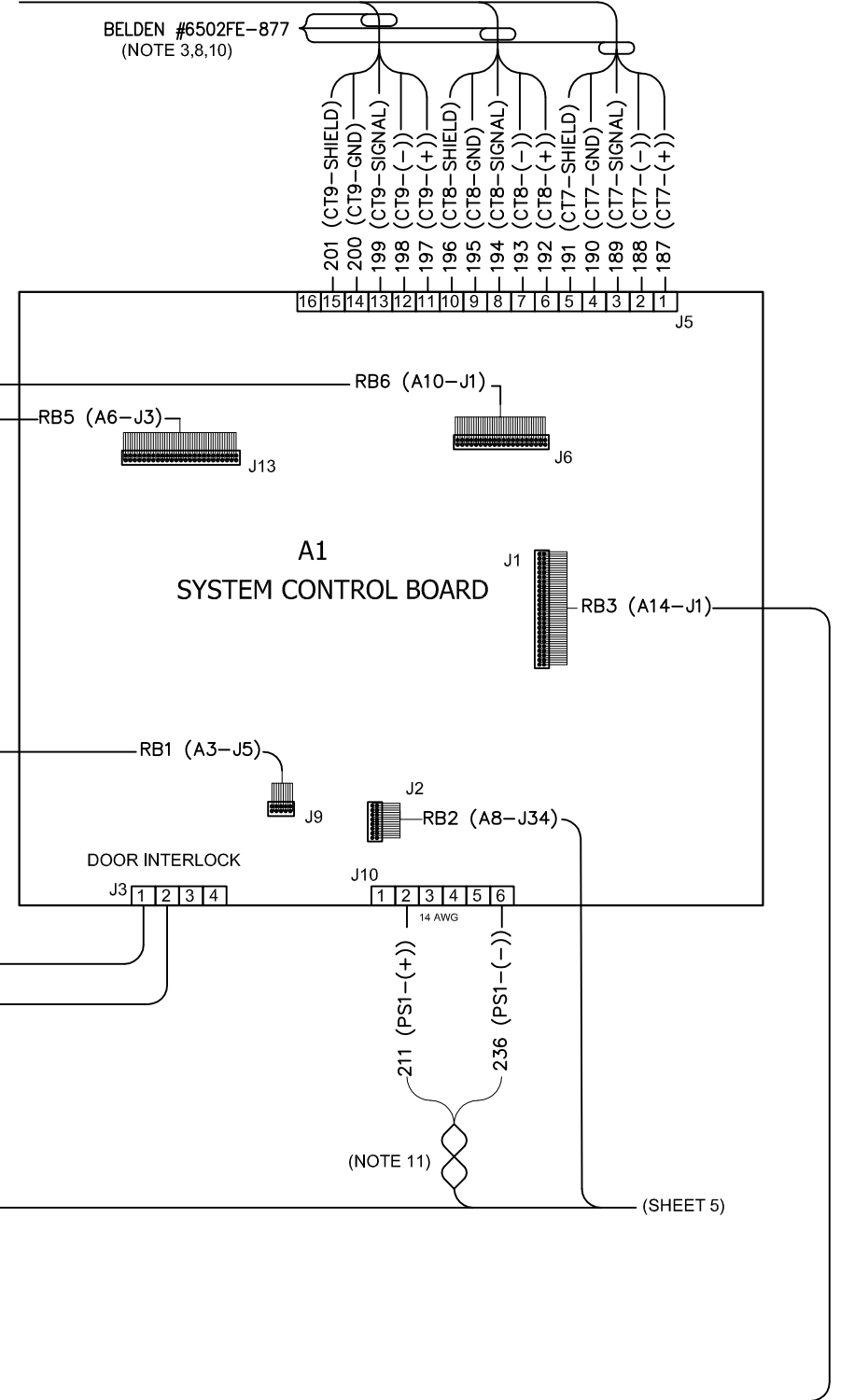
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DRAWING NUMBER: N0001-SC900906-002		REVISION: E
PART NUMBER: N0001-AS900906-002		APPROVED:
MODEL NUMBER: 25C90S-HB	TITLE: 400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ	
FINISH: SEE N0300-CP056953-304	INFO:	MASS (lbs):
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING:	SCALE:
		SHEET SIZE: SHEET: B 3 OF 7

PUSHBUTTON PINOUT



(SHEET 2)

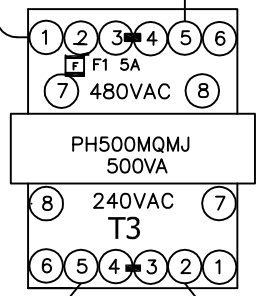


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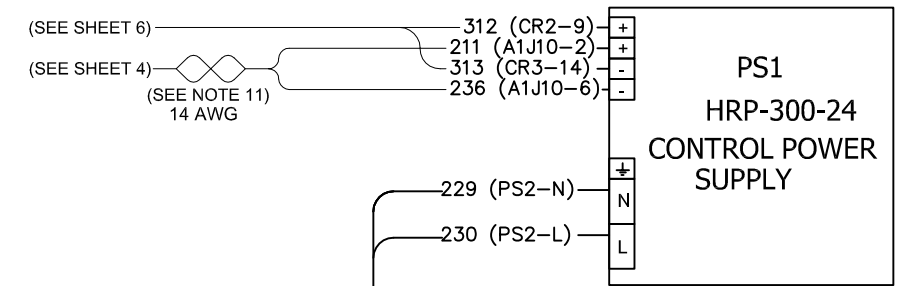
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PART NUMBER: N0001-AS900906-002		APPROVED:
MODEL NUMBER: 25C90S-HB	TITLE: 400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ	
FINISH: SEE N0300-CP056953-304	INFO:	MASS (lbs):
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING:	SCALE:
SHEET SIZE: B		SHEET: 4 OF 7

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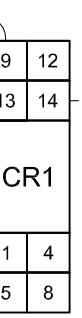
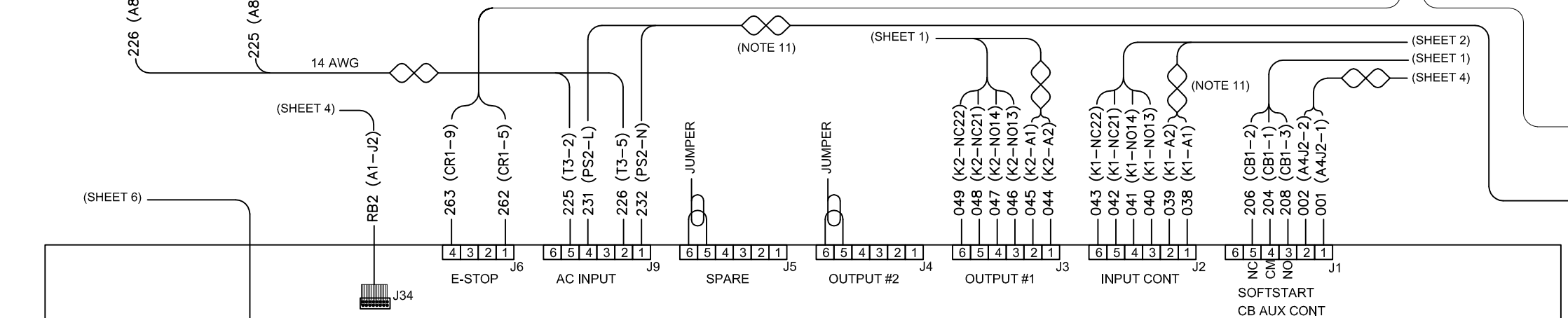
CLASS CC 5A FUSE TO TERMINALS 2 & 7



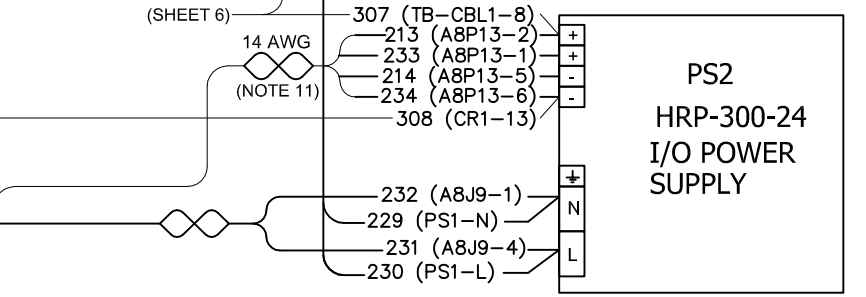
FACTORY INSTALLED JUMPERS ON TERMINALS 3 & 4 BOTH HIGH AND LOW SIDE



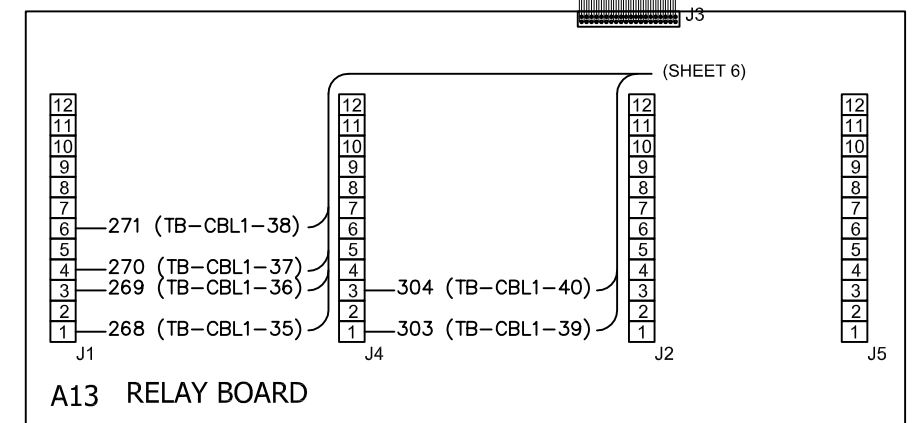
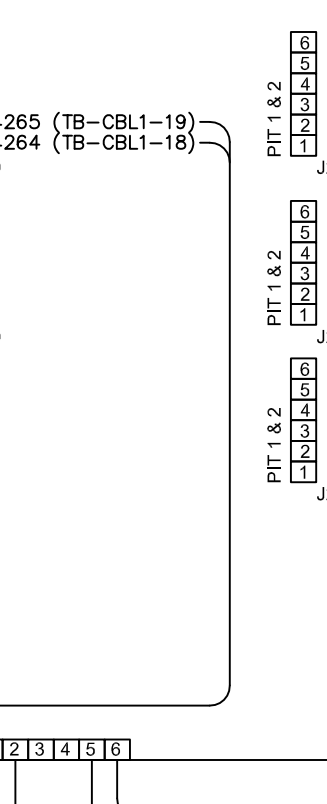
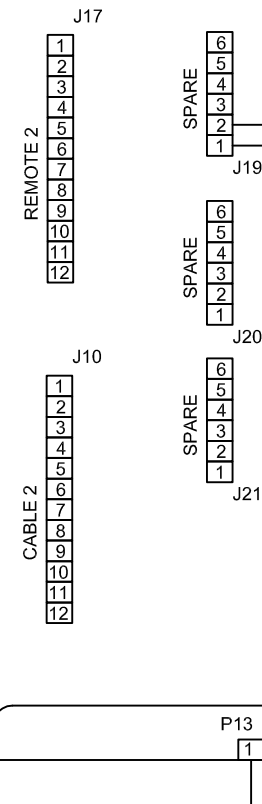
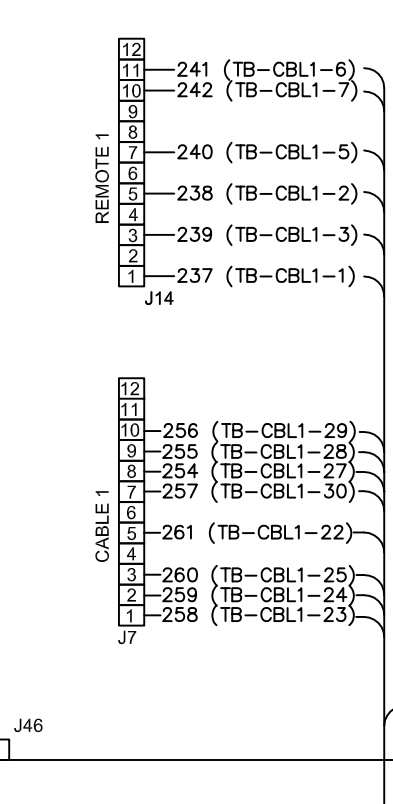
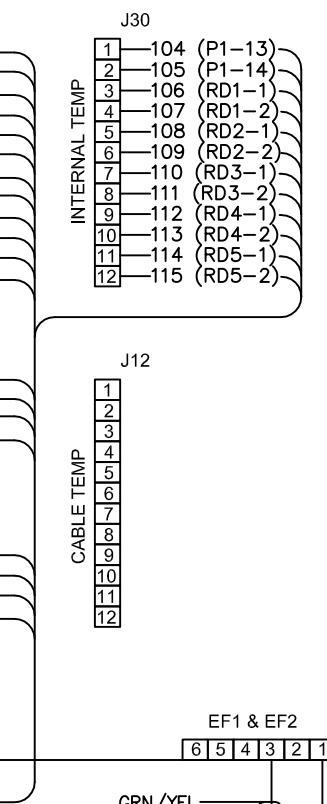
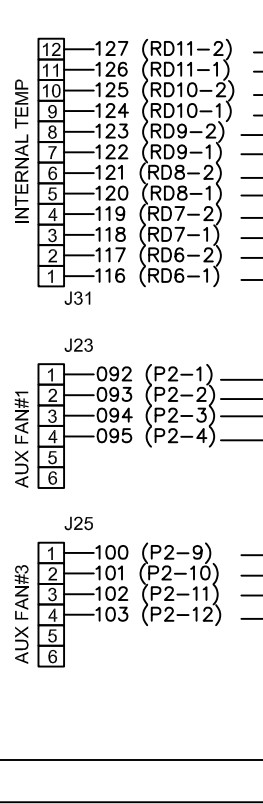
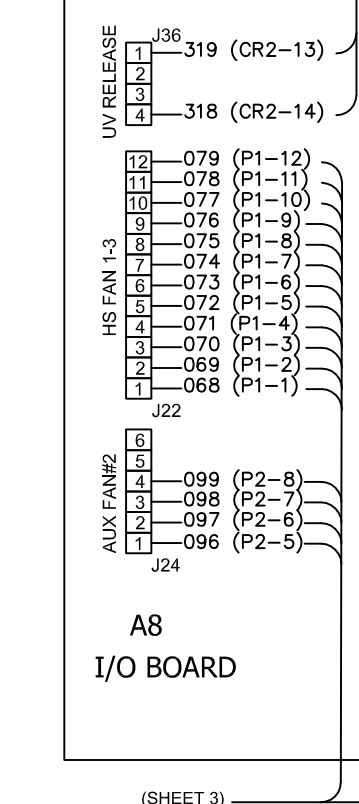
(SEE SHEET 6) 312 (CR2-9)
(SEE SHEET 4) 211 (A1J10-2)
(SEE NOTE 11) 313 (CR3-14)
14 AWG 236 (A1J10-6)



263 (A8J6-4)
308 (PS2-(-))
262 (A8J6-1)
309 (TB-CBL1-9)



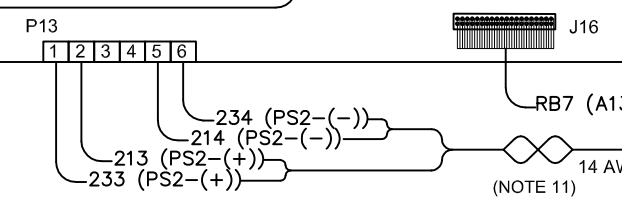
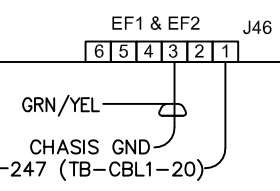
(SHEET 6) 307 (TB-CBL1-8)
14 AWG (NOTE 11) 213 (A8P13-2)
233 (A8P13-1)
214 (A8P13-5)
234 (A8P13-6)
308 (CR1-13)



A13 RELAY BOARD

(SHEET 3)

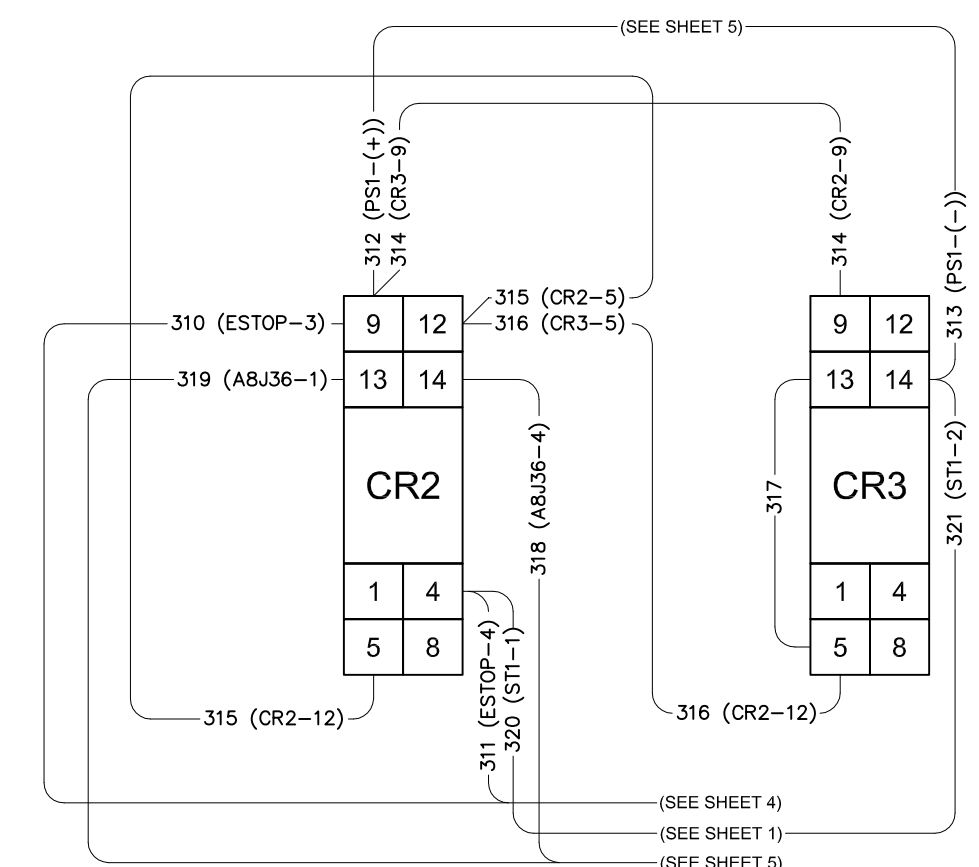
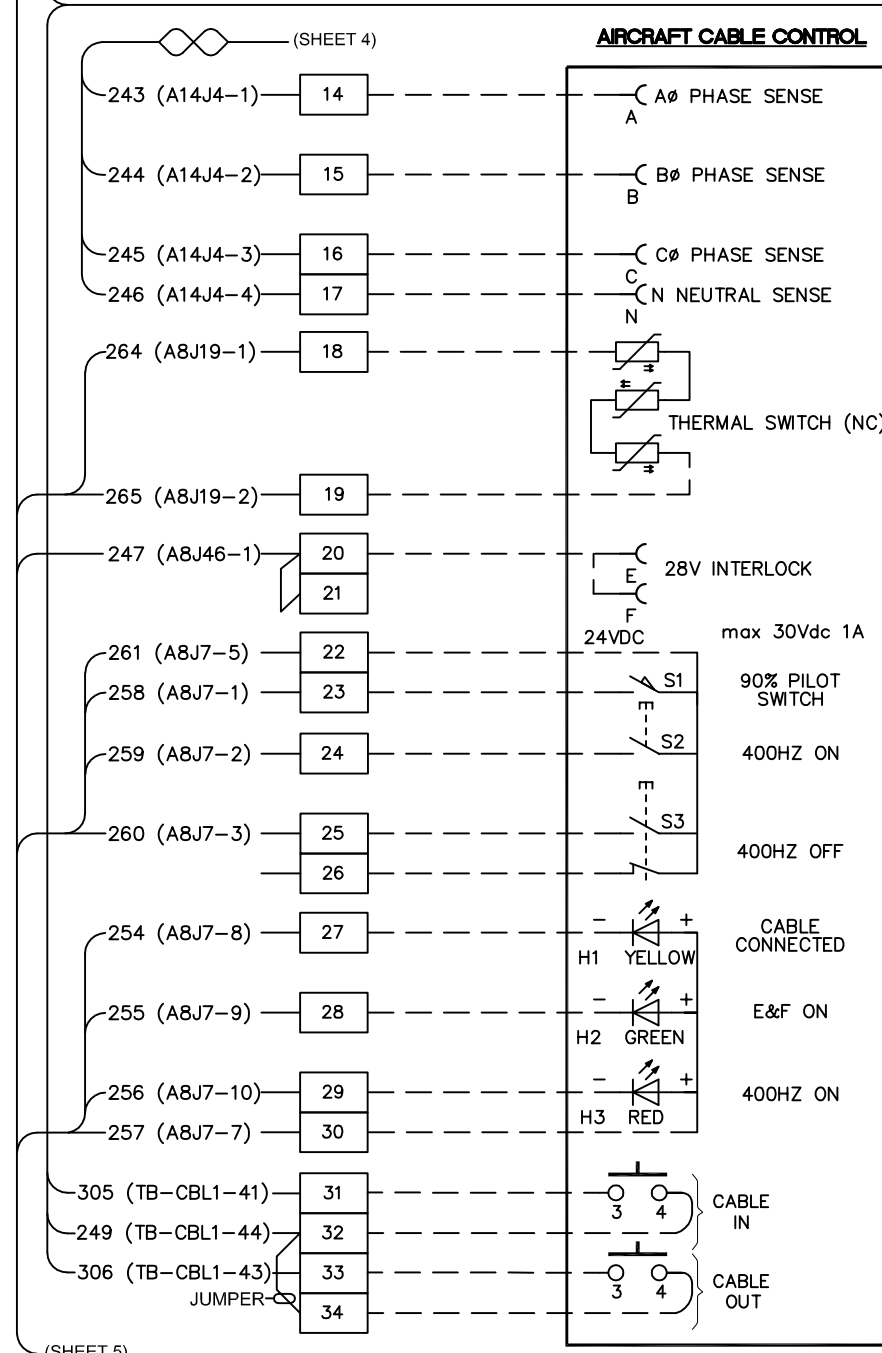
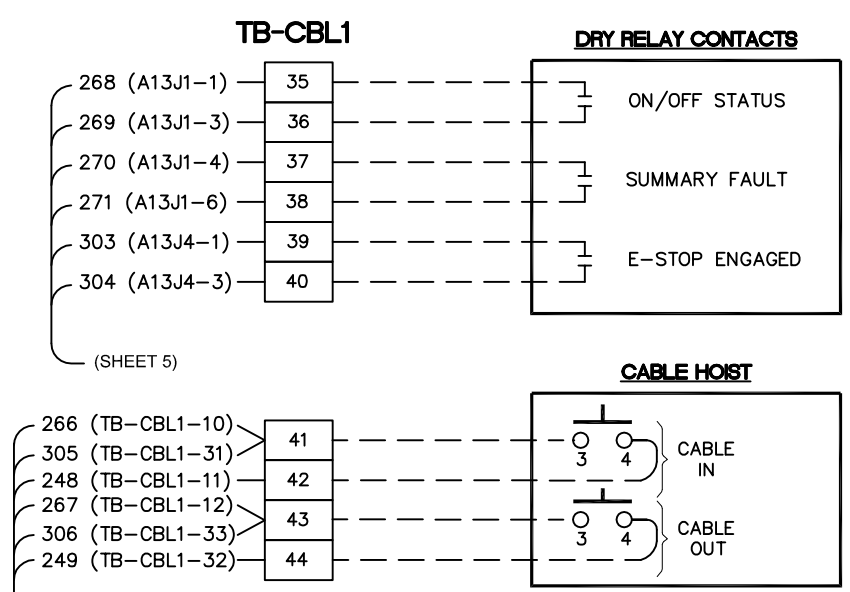
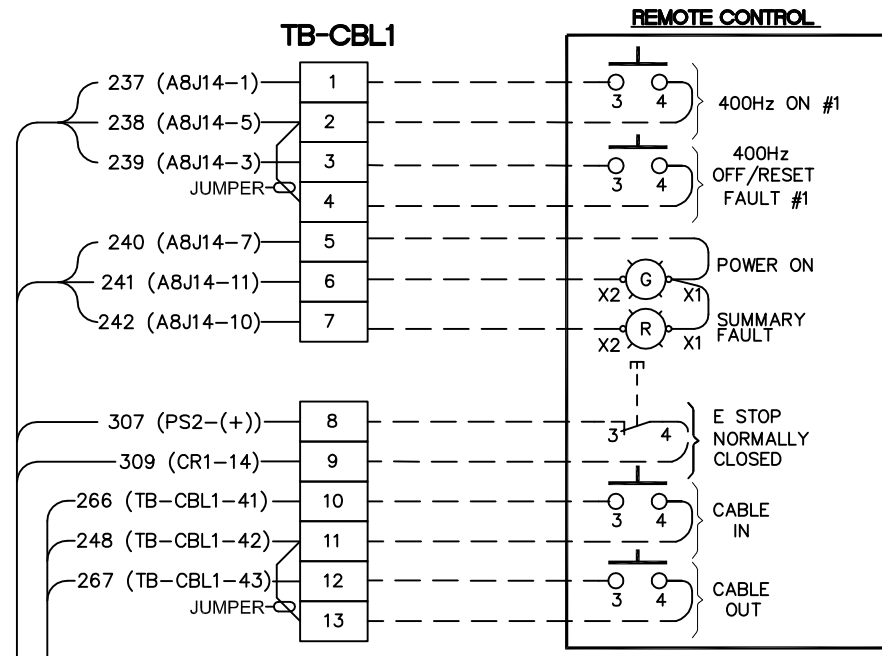
(SHEET 6)



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DRAWING NUMBER: N0001-SC900906-002	REVISION: E
PART NUMBER: N0001-AS900906-002	APPROVED:
MODEL NUMBER: 25C90S-HB	TITLE: 400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ
FINISH: SEE N0300-CP056953-304	INFO: MASS (lbs):
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING: SCALE: SHEET SIZE: SHEET: B 5 OF 7



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DRAWING NUMBER:	N0001-SC900906-002	REVISION:	E
PART NUMBER:	N0001-AS900906-002	APPROVED:	
MODEL NUMBER:	25C90S-HB	TITLE:	400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ
FINISH: SEE N0300-CP056953-304	INFO:	MASS (lbs):	
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING:	SCALE:	SHEET SIZE: SHEET: B 6 OF 7

DESIGNATOR LEGEND

A1	SYSTEM CONTROL BOARD	N0001-PC060379-000
A3	FRONT PANEL INTERFACE BOARD	N0001-PC060381-000
A4	SOFT START BOARD	N0001-PC060376-000
A5	OUTPUT FILTER BOARD	N0001-PC060375-000
A6	6 GATE DRIVER BANK	N0001-PC060377-000
A8	I/O BOARD	N0001-PC060386-000
A9	BLEEDER BOARD	N0001-PC060382-000
A10	12 GATE DRIVER BOARD	N0001-PC060378-000
A13	RELAY BOARD	N0001-PC060383-000
A14	HIGH VOLATGE BOARD	N0001-PC060387-000
C1-C6	DC LINK FILM CAPACITOR	HEX-000000-0059064
C7-C9	METALLIZED FILM CAPACITOR	HEC-000000-0062659
CB1	CIRCUIT BREAKER	HEX-000000-0062218
CR1-CR3	CONTROL RELAY	N045-RH2B-ULDC24V
CT1-CT6	CURRENT TRANSFORMER	HEX-000000-0058798
CT7-CT9	CURRENT TRANSDUCER	HEX-000000-0058797
CT10-CT11	TRANSIENT DC CURRENT SENSE	NR01-10054102
E-STOP	EMERGENCY STOP	HEX-000000-0063612
FN1-FN6	HEAT SINK FANS	HEX-000000-0059094


GND	GROUND	N090-T3A4-3/0N
HMI	HUMAN MACHINE INTERFACE	HEE-000000-0065037
K1	INPUT CONTACTOR	HEC-000000-0062216
K2	OUTPUT CONTACTOR NO.1	HEC-000000-0062217
L1-L3	PWM INDUCTOR	HEX-000000-0058799
P1-P2	CONNECTOR	HET-000000-0062081
PS1,PS2	I/O AND CONTROL POWER SUPPLY	HEP-000000-0060773
Q1-Q9	IGBT	N0001-AS062165-000
RD0-RD11	RESISTANCE TEMP. DETECTOR	HEI-000000-0060770
ST1	SHUNT TRIP UNIT	HEC-000000-0066799
SW1	WHITE PUSHBUTTON	HES-000000-0064514
SW2	GREEN PUSHBUTTON	HES-000000-0063384
SW4	RED PUSHBUTTON	HES-000000-0063385
SW5	DOOR INTERLOCK SWITCH	HES-000000-0058876
T1	LINE REACTOR	HEX-000000-0058795
T2	OUTPUT TRANSFORMER	HEX-000000-0058651
T3	CONTROL TRANSFORMER	HEU-000000-0066213
TB1	NEUTRAL TERMINAL BLOCK	HET-000000-0062048
TB-CBL1	TERMINAL BLOCK CABLE 1	N037-3044102

UNUSED WIRES

032	033	034	035	050	051	052	053
054	055	130	173	174	175	176	181
182	183	184	185	186	205	207	212
215	216	217	218	219	220	221	224
235	250	251	252	253	272	273	274
275	276	277	278	279	280	281	282
283	284	285	286	287	288	289	290
291	292	293	294	295	296	297	298
299	300	301	302				

AWG TO mm²

AWG	mm ²
22	0.33
18	0.82
14	2.08
8	8.37
6	13.3
1/0	53.5
2/0	67.4
4/0	107

 <p>CAVOTEC Cavotec US INC. www.cavotec.com</p>		<small>This drawing and the rights and privileges in this drawing are the property of Cavotec. This drawing or any part thereof must not be copied, reproduced or communicated to any person, or otherwise used beyond the purposes for which it is provided, without written permission of Cavotec ©</small>	
		DRAWING NUMBER:	REVISION:
N0001-SC900906-002		E	
PART NUMBER:		APPROVED:	
N0001-AS900906-002			
MODEL NUMBER:	TITLE:		
25C90S-HB	400HZ WIRE SCHE 2500 SINGLE 90KW 400-480VAC 50-60HZ		
FINISH: SEE N0300-CP056953-304	INFO:	MASS (lbs):	
DIMENSIONS IN Inches UNLESS OTHERWISE STATED	TOLERANCING:	SCALE:	SHEET SIZE: SHEET:
			B 7 OF 7



Operation and Maintenance Manual

2500+

Single Output

Ground Power Units

Model 25C90S-HB

January 25, 2019

N0001-MN900906-002, Rev. B

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The contents have been written solely as a guide to provide operating instructions and routine preventive maintenance instructions for its products. Servicing of equipment should only be performed by qualified Cavotec Inet factory trained and certified technicians.

Any attempt to perform preventive or remedial repair of the equipment by unqualified personnel can be extremely dangerous and can result in severe injury or death and serious damage to equipment.

Use of this technical manual, in whole or in part, by unauthorized personnel to attempt maintenance, repair of equipment covered by the technical manual may void any existing factory warranties.

MACHINE DESCRIPTION	Type:	Ground Power Unit
	Model:	25C90S-HB

MANUFACTURER	Cavotec Inet US, Inc. 5665 Corporate Avenue Cypress, CA 90630 United States of America Telephone: +1 (714) 947-0005 Fax: +1 (714) 947-0090
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INTRODUCTION

This operating and maintenance manual is intended to provide assistance and reference data to a qualified, experienced engineer or technician trained by Cavotec Inet US, Inc. personnel specifically in the use, servicing and adjustment of the company's 2500+ ground power unit (GPU).

This manual covers the GPU and associated control equipment. Multiple ground power units of different ratings and additional items of aircraft power equipment and other electrical and mechanical equipment may be supplied and/or installed by Cavotec Inet US, Inc. or others as part of the same project, all designed to work together with the centralized ground power plant to form a complete system. In such cases, this manual may be found as one volume of a set of manuals covering the entire system. Please refer to other system volumes for information and procedures for operation and maintenance of related accessory equipment.

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SAFETY NOTES AND PRECAUTIONS

The equipment covered by this manual is designed and tested for safe operation and maintenance when performed by qualified, trained personnel.

However, as in all power equipment, extreme care must be exercised at all times when connecting or maintaining the equipment, especially with its doors opened. The equipment cabinet doors are designed to remain closed during all operating modes and require the use of tools to open them.

Input voltage of 400 – 480 Vac and output voltage of 200/115 Vac and 825 Vdc are present within the unit. Even with the unit not operating, if the 50/60 Hz input power is connected to the unit, high voltage power will be present in the equipment compartment. Observe all precautions dealing with high voltage. Always verify power is OFF with a voltmeter or voltage tester before beginning maintenance.



WARNING

ALLOW A TWO MINUTE WAITING PERIOD FOR ALL CHARGED CAPACITORS TO DISCHARGE BEFORE BEGINNING TROUBLESHOOTING. ENSURE ALL POWER IS OFF AND PROPER LOCKOUT/TAGOUT PROCEDURES ARE FOLLOWED.



WARNING

LOCAL DISCONNECT DOES NOT REMOVE CONTROL CIRCUIT VOLTAGES, SPECIFICALLY COMPONENTS PS1, PS2, T3, AND A8 IDENTIFIED IN THE WIRING DIAGRAM. VOLTAGES AT HALF THE LINE-TO-LINE INPUT VOLTAGE ARE PRESENT AT THESE COMPONENTS AND ALL SYSTEM PRINTED CIRCUIT BOARDS HAVE 24 VDC CONTROL VOLTAGE PRESENT.

MAINTENANCE OF THE GPU SHALL BE COMPLETED WITH AN UP-STREAM DISCONNECT IN THE OPEN POSITION TO REMOVE ALL VOLTAGES WITHIN THE ENCLOSURE.

1. Operate, service and maintain the unit as described in this manual.
2. Understand unit and system operation and their functions thoroughly.
3. Know and understand all controls, indicators and operating limits. Rely on unit and test instruments; record and compare readings to detect developing abnormalities.
4. Before operating the unit, learn the significance of possible malfunctions and be prepared to take appropriate action in case of a malfunction.
5. Understand and observe the following safety notices and precautions.

The GPU is classified in accordance with EN 55011 as Group1, Class A. Group 1 equipment is that equipment which does not intentionally generate radio frequency (RF) energy in the 9 kHz to 400 GHz range. Class A equipment is equipment suitable for all locations other than those in residential environments and those

directly connected to a low voltage power supply network which supplies buildings used for domestic purposes. The GPU is intended to be used at locations where there is a distance greater than 30 m (98.4 ft.) between the unit and third party sensitive radio communications.

WARNINGS, CAUTIONS and NOTES are included throughout this manual. They emphasize critical and important information for personal safety and have the following form and significance.



WARNING

A WARNING POINTS OUT A PROCEDURE, PRACTICE, CONDITION, OR PRECAUTION WHICH IF NOT HEDED COULD RESULT IN PERSONAL INJURY OR LOSS OF LIFE.



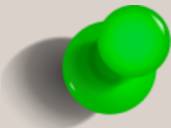
WARNING

A WARNING THAT POINTS OUT THAT HIGH VOLTAGE IS USED IN THIS EQUIPMENT. EXTREME CARE SHALL BE USED WHEN PERFORMING INSPECTION AND MAINTENANCE TASKS TO PREVENT ACCIDENTAL INJURY OR ELECTROCUTION.



CAUTION

A CAUTION POINTS OUT A PRECAUTION WHICH, IF NOT OBSERVED, COULD DAMAGE OR DESTROY THE EQUIPMENT.



NOTE

A NOTE HIGHLIGHTS INFORMATION NEEDED TO UNDERSTAND OR FOLLOW A PROCEDURE, PRACTICE, CONDITION OR DESCRIPTION.

HANDLING OF ELECTROSTATIC DISCHARGE SENSITIVE ASSEMBLIES

Electrostatic discharge (ESD) precautions must be observed when troubleshooting, handling, aligning, adjusting, removing, repairing, replacing, unpacking, or packing ESD sensitive items. The following items are considered ESD sensitive:

1. All electronic circuit card assemblies (printed circuit boards), whether or not they are marked ESD sensitive.
2. All parts, assemblies, and equipment marked ESD sensitive.
3. Internal and external cable connectors, when one end is still attached to an ESD sensitive item.
4. Drawers or panels when open, disconnected, or removed from the parent unit.
5. Electronic components, especially integrated circuit chips, microprocessors, etc.

General Instructions:

1. Only personnel trained in use of ESD preventive devices, tools, and techniques are to handle ESD sensitive items.
2. Synthetic clothing is not to be worn; synthetic cloth is not suitable for use as cleaning rags. All-cotton material is preferred.
3. A properly-grounded ESD wrist strap, consisting of a stainless steel inner band that makes contact with bare skin, is to be worn.
4. ESD sensitive items will be placed only upon properly grounded ESD protective matting when not installed in equipment.
5. ESD items are not to be transported without proper ESD protective coverings.
6. Do not damage or discard materials used to package ESD sensitive items. The packing material may be re-used to return defective items.
7. Do not allow connector pins of ESD sensitive items to contact a non-ESD protected surface.

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CHAPTER 1
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1. GENERAL INFORMATION AND OPERATION

1.1. DESCRIPTION

This Operation and Maintenance manual provides information on the installation, operation, maintenance, and troubleshooting procedures for the bridge mounted single output 2500+, 400 Hz ground power unit (GPU), model 25C90S-HB, manufactured by Cavotec Airport Solutions USA, Cypress located at 5665 Corporate Ave, Cypress, CA 90630.

The principle electrical characteristics of the units covered by this manual are as follows.

Input Voltage Range:	3Ø, 4- wire, 400 – 480 Vac ± 15%
Input Frequency:	50/60 Hz ± 5 Hz
Rated Power:	90 kVA / 90 kW
Output Frequency:	400 Hz
Overall Efficiency @ 100% Load:	> 94%
Overload Capacity:	500% for 1.5 seconds
Operating Temperature:	-40 °C to +60 °C for all load conditions

An exterior view of the single output unit is shown in Figure 1-1. The dual output unit is identical with the exception of one additional output and one more ON pushbutton.

The units covered by this manual are based on a standard Cavotec mode

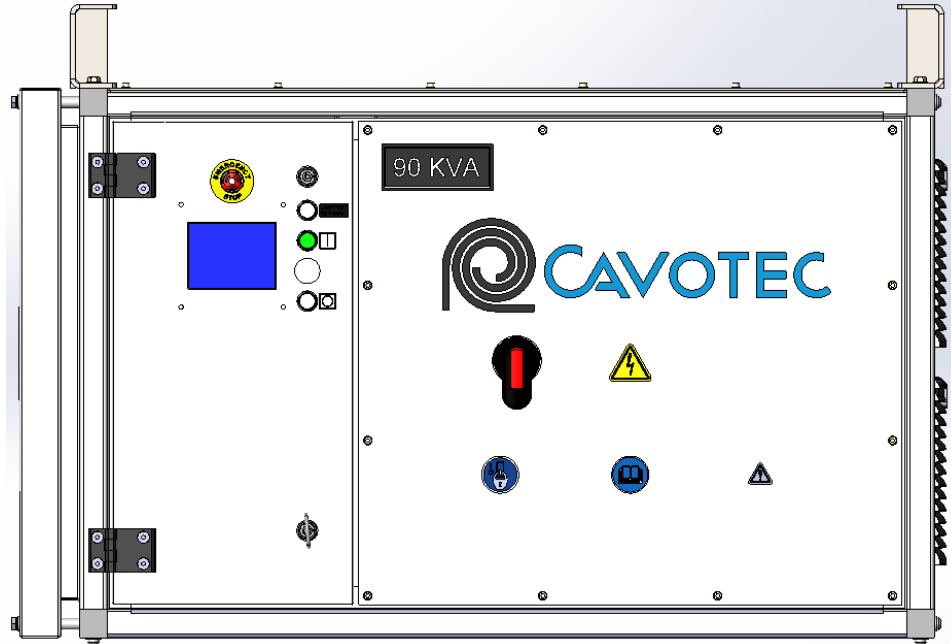


Figure 1-1. Cavotec 2500+ GPU Model 25C90S-HB Exterior View

1.1.1. INTENDED USE

The GPU is a solid-state static frequency converter (SSFC) utilizing state of the art switching technology. The purpose of the GPU is to convert an input of 50/60 Hz and 400 – 480 Vac to an output of 400 Hz and 115 Vac for all types of aircraft power requirements and operating methods. The flexibility of the enclosure design ensures that the GPU can be installed in various locations such as on a passenger boarding bridge (PBB), on the ground, on a mobile unit, and mounted either horizontally or vertically.

Any other use or modification of the system without written agreement from the manufacturer will be regarded as noncompliant and the manufacturer will not be liable for resulting damages. The risk lies entirely with the user.

1.1.2. INTENDED AUDIENCE

This operating and maintenance manual shall be kept for future use. The frequency of inspections and control measures shall be observed.

The installation, maintenance and fault finding operations described in this manual shall only be performed by qualified personnel.

1.1.2.1. INSTRUCTED PERSON

An instructed person is someone who has been instructed by a qualified person about the duties assigned to them, the associated possible hazards and, if necessary, the required safety equipment and protective measures.

1.1.2.2. QUALIFIED PERSON

A qualified person is someone with suitable training, appropriate education and experience to be able to identify risks and to avoid hazards.

1.1.3. SYSTEM BLOCK DIAGRAM OVERVIEW

A system block diagram overview of the GPU is shown in Figure 1-2.

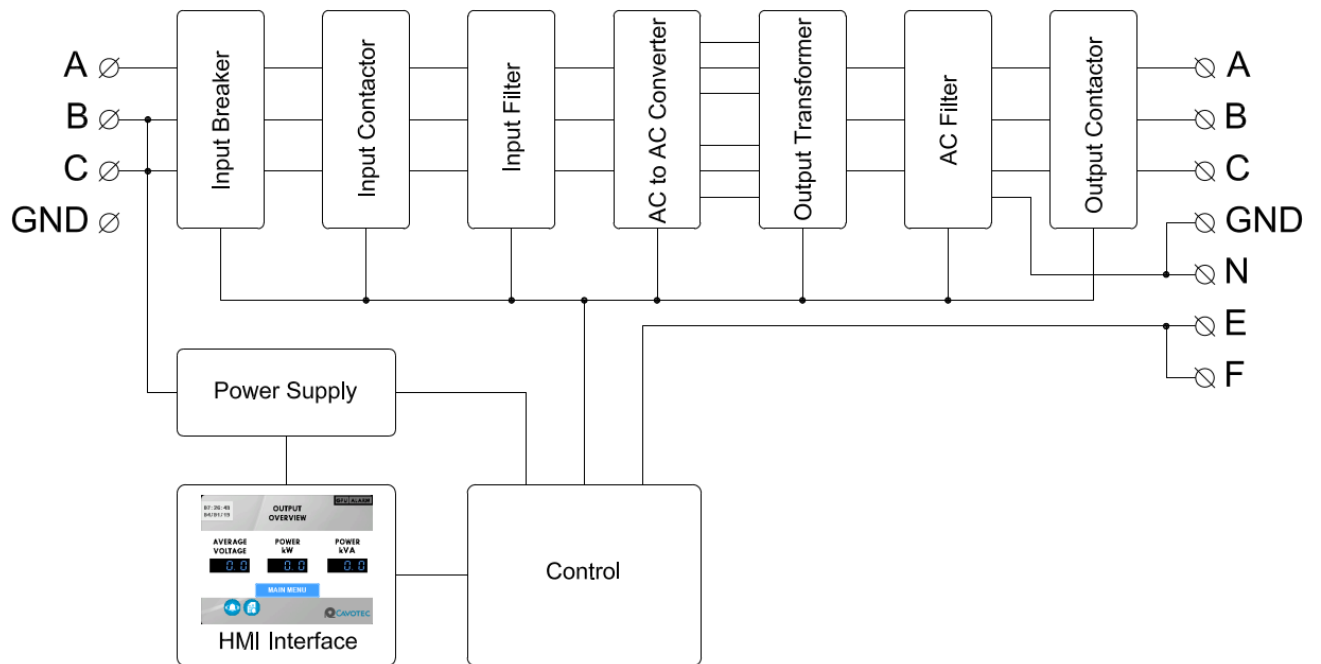


Figure 1-2. 2500+ 25C90S-XX GPU System Overview

1.1.3.1. INPUT BREAKER

Except for the control board and communication circuit power which is taken upstream of the input breaker, the input breaker connects or disconnects the GPU's power electronics section from the mains either manually, or automatically when a fault occurs.



WARNING

THE INPUT CIRCUIT BREAKER IS EQUIPPED WITH AN UNDER VOLTAGE RELEASE MECHANISM. THIS UNDER VOLTAGE RELEASE WILL TRIP AND PREVENT THE INPUT CIRCUIT BREAKER FROM BEING TURNED ON. ATTEMPTS TO TURN ON THE CIRCUIT BREAKER WITHOUT INPUT POWER AVAILABLE WILL CAUSE THE DEVICE TO IMMEDIATELY GO TO THE TRIP POSITION. REPEATED ATTEMPTS TO CLOSE THE CIRCUIT BREAKER WITHOUT INPUT VOLTAGE WILL CAUSE DAMAGE TO THE HANDLE MECHANISM. UTILIZE THE POWER AVAILABLE LED ON THE FRONT PANEL TO DETERMINE THE BREAKER'S SUITABILITY FOR BEING SWITCHED TO THE ON POSITION.



WARNING

LOCAL DISCONNECT DOES NOT REMOVE CONTROL CIRCUIT VOLTAGES FROM COMPONENTS PS1, PS2, T3, AND A8 IDENTIFIED IN THE WIRING DIAGRAM. VOLTAGES AT HALF THE LINE-TO LINE INPUT VOLTAGE ARE PRESENT AT THESE COMPONENTS AND ALL SYSTEM PRINTED CIRCUIT BOARDS WILL HAVE 24 VDC CONTROL VOLTAGES PRESENT.

MAINTENANCE OF THE GPU SHALL BE COMPLETED WITH AN UP-STREAM DISCONNECT IN THE OPEN POSITION TO REMOVE ALL VOLTAGES WITHIN THE ENCLOSURE.

1.1.3.2. INPUT CONTACTOR

The input contactor connects or disconnects the mains to the power electronics section as directed by the control board.

1.1.3.3. INPUT FILTER

The input filter minimizes the harmonics coming from the mains to the GPU and that generated by the GPU power electronics section to the mains.

1.1.3.4. AC-TO-AC CONVERTER

The AC-to-AC converter is the core of the power electronics section and consists of two stages called the front and back ends. The front end is an active boost rectifier (also called an active power factor correction rectifier) capable of rectifying the wide 50/60 Hz input voltage range to a DC voltage and maintaining the unity input power factor (pf). The back end is a voltage-source-inverter (VSI) capable of synthesizing the 400 Hz output from the DC voltage and the pulse-width modulated signals generated by the control board.

1.1.3.5. OUTPUT TRANSFORMER

The output transformer provides the following functions:

1. Isolation between input and output voltage.
2. Adapts inverter output voltage to the level required by the aircraft (3 \emptyset , 115/200 Vac) and a neutral.
3. Filters the output voltage using an embedded inductance and AC filter capacitors.

1.1.3.6. AC FILTER

The output filter is an inductive-capacitive low pass filter that is able to block the high frequency harmonic content generated by the switching voltage in the VSI.

1.1.3.7. OUTPUT CONTACTOR

The output contactor connects or disconnect the mains to the power electronics section in response to commands from the control board or the front panel.

1.1.3.7.1. COMMANDS FROM THE FRONT PANEL

The output contactor can be controlled from the following front panel user interfaces.

1. ON push button(s)
2. OFF push button
3. Emergency stop button

1.1.3.7.2. COMMANDS FROM THE CONTROL BOARD

The output contactor is controlled via the control board in response to the following events.

1. Interlock voltage coming from the aircraft (E and F)
2. A fault occurrence
3. 90% switch enable
4. Pit switches (Open and Close)

1.1.3.8. POWER SUPPLY

The power supply system comprises a stepdown transformer and AC-to-DC converters. This system provides low voltage DC to power the controls and the human machine interface (HMI).



WARNING

LOCAL DISCONNECT DOES NOT REMOVE CONTROL CIRCUIT VOLTAGES FROM COMPONENTS PS1, PS2, T3, AND A8 IDENTIFIED IN THE WIRING DIAGRAM. VOLTAGES AT HALF THE LINE-TO-LINE INPUT VOLTAGE ARE PRESENT AT THESE COMPONENTS AND ALL SYSTEM PRINTED CIRCUIT BOARDS WILL HAVE 24 VDC CONTROL VOLTAGES PRESENT.

MAINTANENCE OF THE GPU SHALL BE COMPLETED WITH AN UP-STREAM DISCONNECT IN THE OPEN POSITION TO REMOVE ALL VOLTAGES WITHIN THE ENCLOSURE.

1.1.3.9. HUMAN MACHINE INTERFACE (HMI)

The HMI allows the user to interact with the unit. The HMI is based on a 7 inch (178 mm) touchscreen. By means of the touchscreen the user can:

1. Navigate through menus which show the equipment operating status.
2. Adjust equipment configuration parameters.

For more information about the HMI screens and menus refer to chapter 3.

1.1.3.10. GPU CONTROL

The GPU's control system is based on a microcontroller plus a field programmable gate array (FPGA). Together, they monitor all the analog and digital inputs coming from the power electronics, make calculations in order to generate the insulated-gate bipolar transistor (IGBT) triggering pulses, and supervise all parameters to be within design limits. In the case that internal or external errors are detected, the errors are shown on the HMI screen and the GPU is locked out. The control system is physically located on four printed circuit boards.

1.1.4. SYSTEM BOARDS

The following is a description of the different printed circuit boards (PCBs) used in the 2500+.

1.1.4.1. CONTROL BOARD

The control board is the primary board used for control of the system input and output. The control board is used for the following purposes.

- Input voltage monitoring
- Input current control
- DC bus voltage regulation
- 400Hz voltage and load current sense
- 400 Hz waveform generation
- 400 Hz line drop compensation
- Power factor correction
- AC current, DC bus voltage, VAR, and 400 Hz control loops

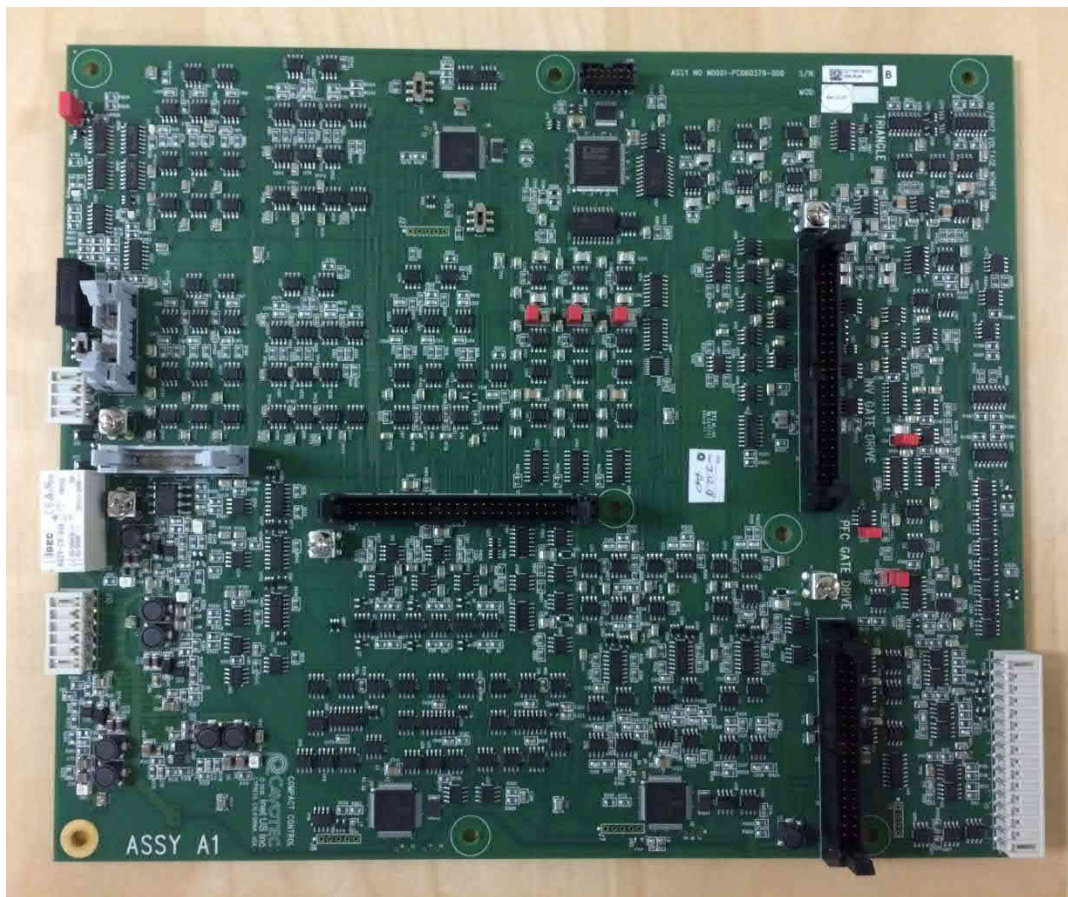


Figure 1-3. Control Board

1.1.4.2. FRONT PANEL BOARD

The front panel board is the primary communications board for the 2500+ system. It is responsible for receiving configurations from the HMI and pushbuttons to the GPU. The front panel board acts as a buffer for all system conditions and measurements displayed on the local HMI.

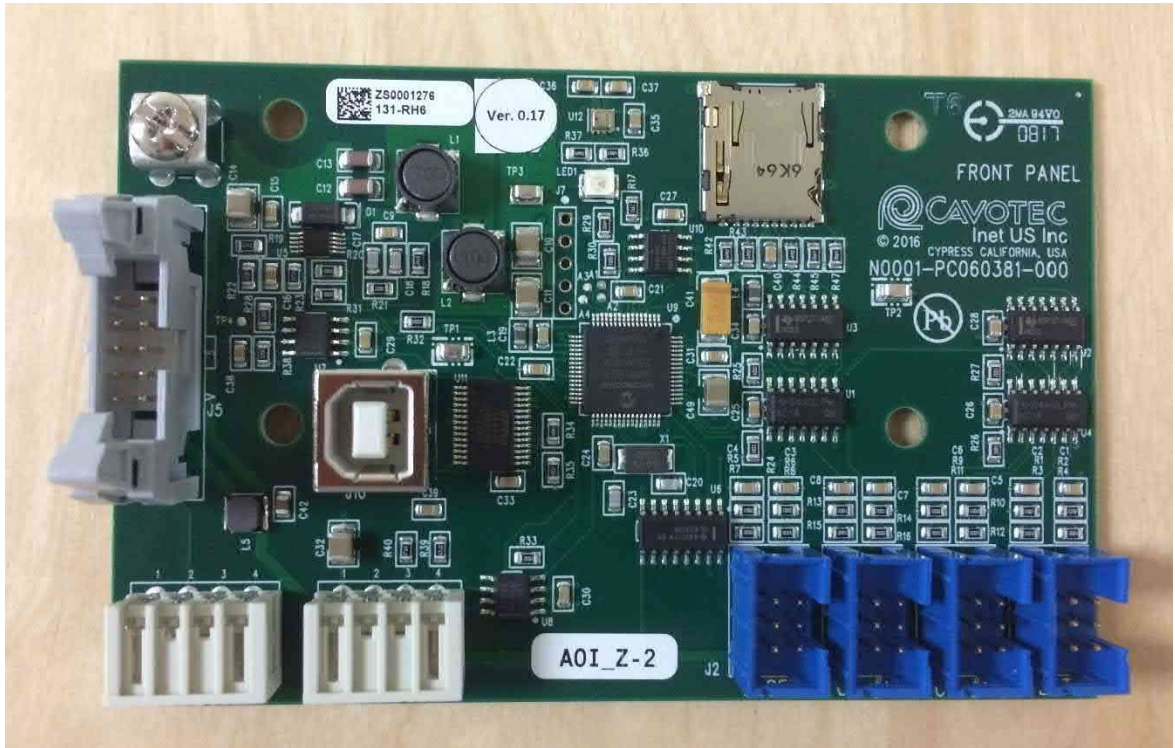


Figure 1-4. Front Panel Board

1.1.4.3. IO BOARD

The IO board handles many of the system inputs and outputs including the soft start, input circuit breaker, input contactor, output contactors, RTDs, E&F, and fans.



Figure 1-5. IO Board

1.1.4.4. SOFT START BOARD

The soft start board allows the DC bus to ramp up during starting sequence in order to limit the amount of inrush current to below 100% rated input current. It has voltage sense pass through and other input line protection devices such as surge protection.

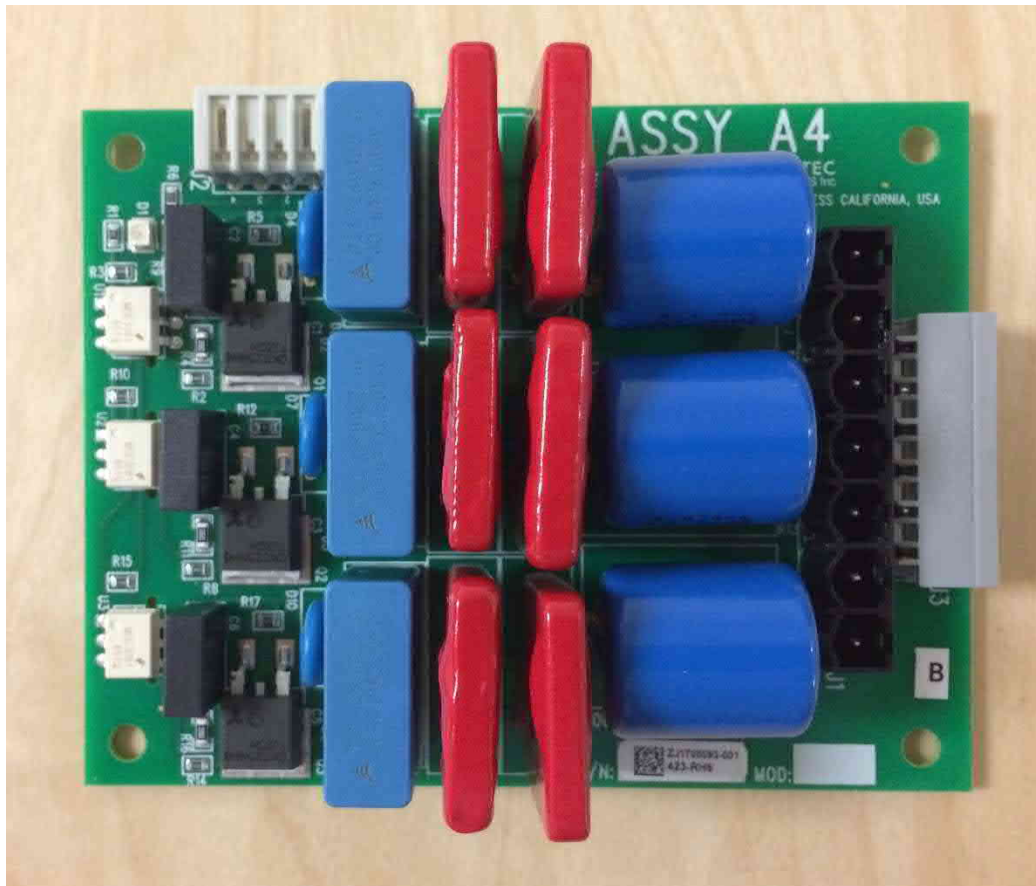


Figure 1-6. Soft Start Board

1.1.4.5. HIGH VOLTAGE BOARD

The high voltage board is responsible for voltage and current sense for both three phase input and output. It is also a voltage sense buffer for bus 1, bus 2, remote 1, and remote 2.

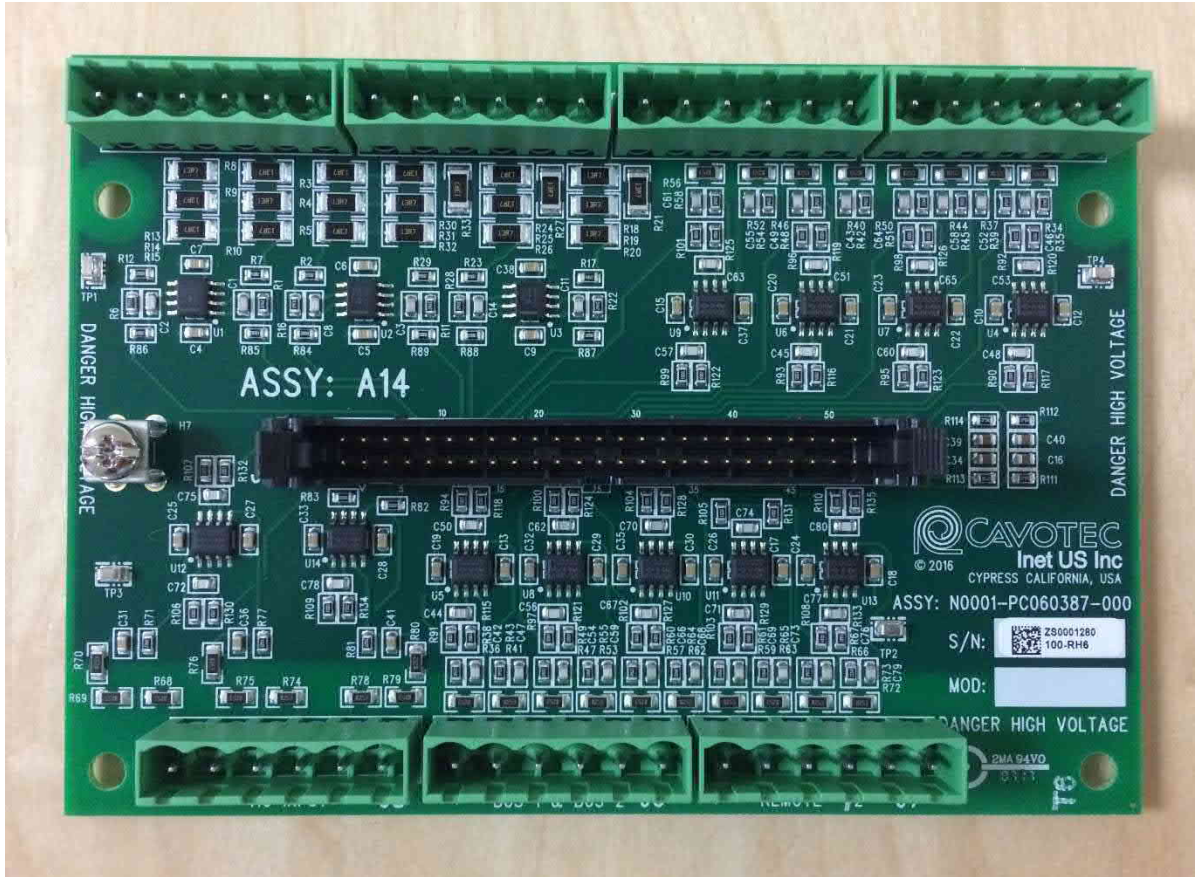


Figure 1-7. High Voltage Board

1.1.4.6. IGBT DRIVER BOARD

The IGBT driver board mounts on top of the IGBT modules. It amplifies the switching signal from the control board to each gate inside the IGBT module. There are nine identical IGBT driver boards per system.

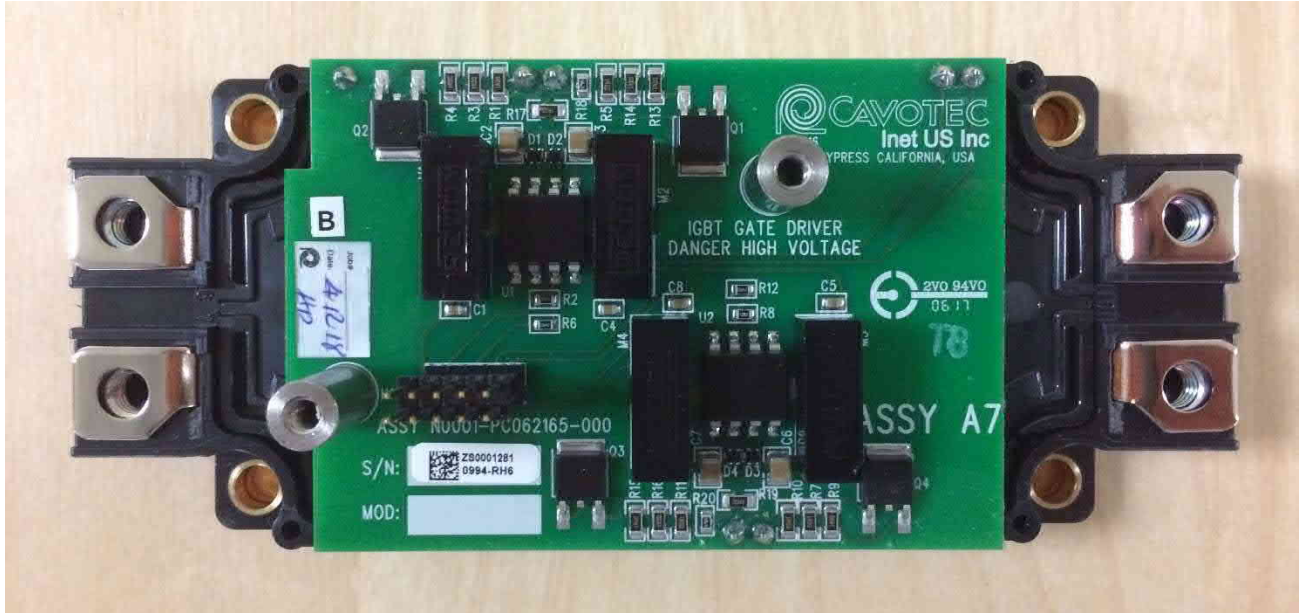


Figure 1-8. IGBT Driver Board (with IGBT Module)

1.1.4.7. PFC 6 GATE DRIVER BOARD

The PFC 6 gate driver board monitors gate drive inputs while also providing IGBT and board temperature data for the input rectifier. It also prevents upper and lower IGBTs to be gated at the same time while providing DC over current detection to turn off all IGBTs.

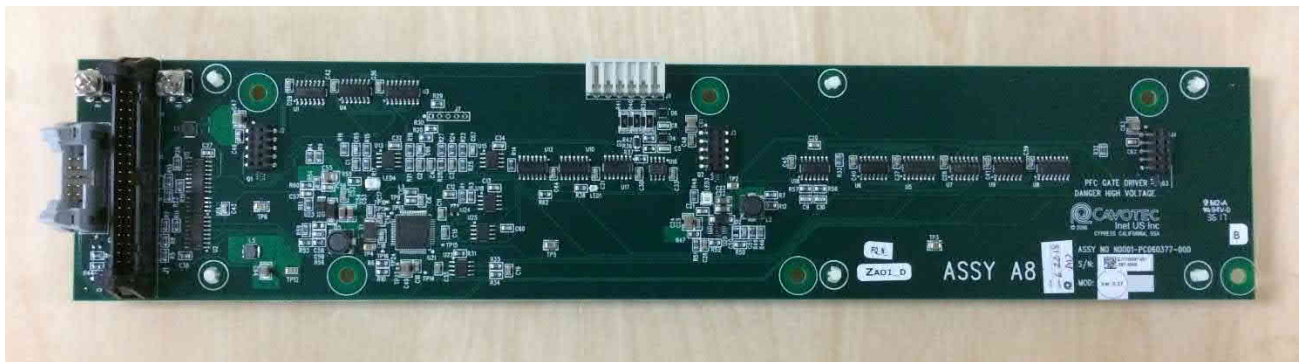


Figure 1-9. PFC 6 Gate Driver Board

1.1.4.8. INV 12 GATE DRIVER BOARD

The INV 12 gate driver board is similar to the PFC 6 gate driver board. It monitors gate drive inputs on the inverter side and provides additional board and IGBT temperature data. It also prevents upper and lower IGBTs to be gated at the same time while providing DC over current detection.

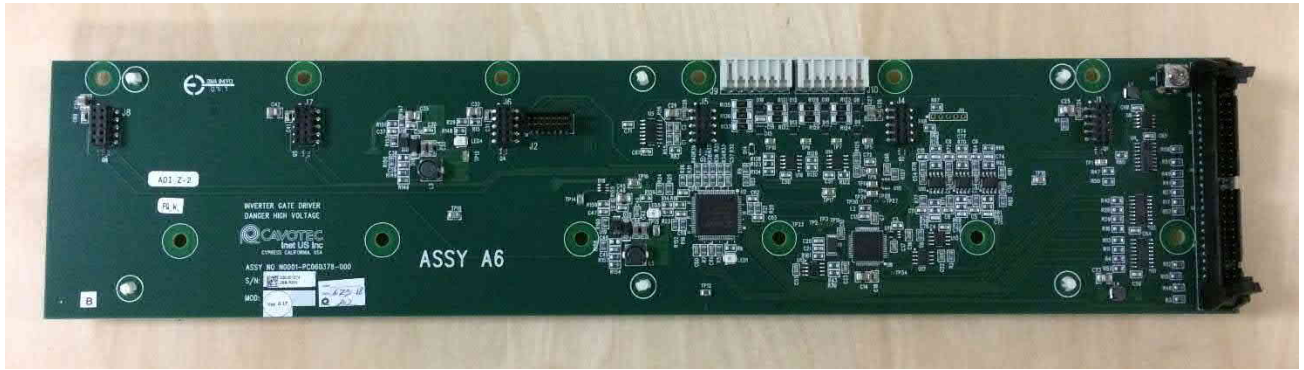


Figure 1-10. INV 12 Gate Driver Board

1.1.4.9. BLEEDER BOARD

The bleeder board helps to quickly “bleed” the DC bus to prevent energized components long after shut down. The bleed down time of the DC bus is 5 seconds. Always proceed with extreme caution while performing maintenance in this section of the GPU. Always measure and verify that voltage is not present before any work begins.

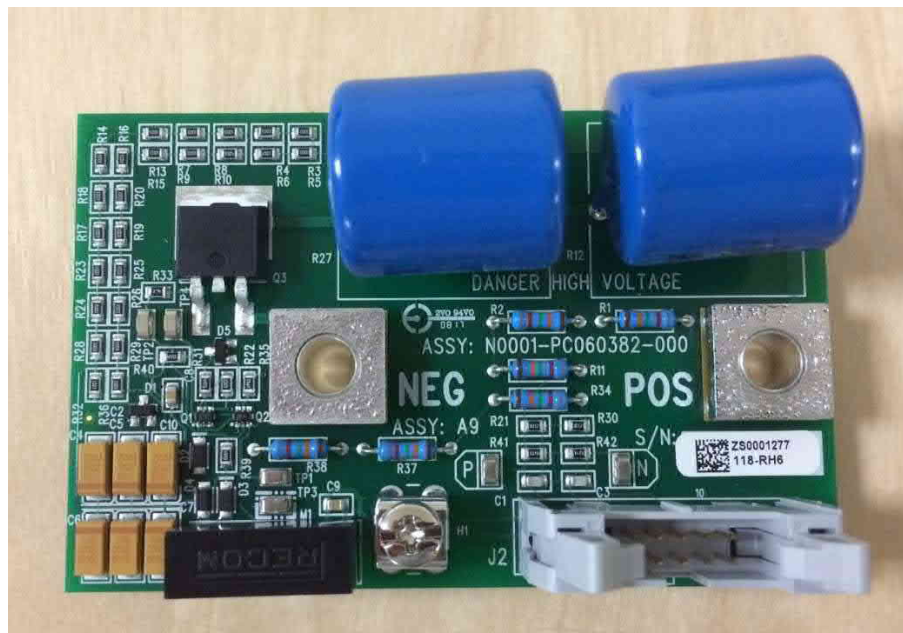


Figure 1-11. Bleeder Board

1.1.4.10. OUTPUT FILTER BOARD

The output filter board is a low pass filter that blocks high frequency harmonic content generated during switching.

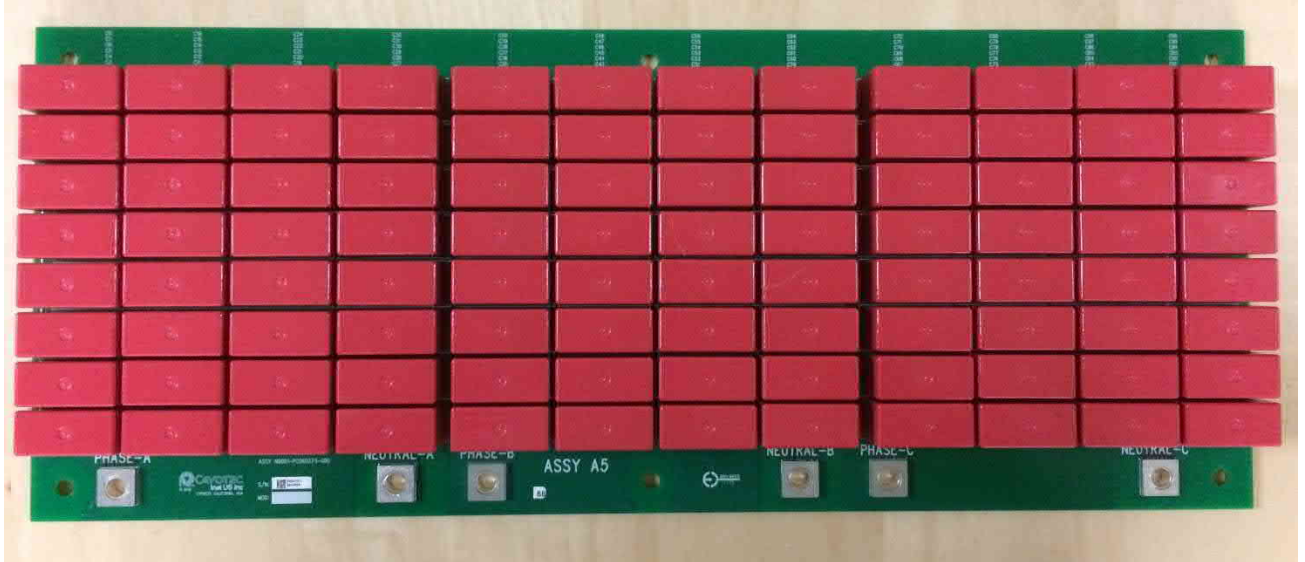


Figure 1-12. Output Filter Board

1.1.4.11. DRY RELAY BOARD

The dry relay board is an array of 16 independently controlled relays to provide system status. See GPU wiring diagram for the configuration of the relays.



Figure 1-13. Dry Relay Board

1.1.5. FAN CONTROL CIRCUIT

Cooling fan speed is PWM controlled and depends on the GPU operating mode. A schematic diagram of the fan control circuit is shown in Figure 1-14. When the GPU is in standby (no generation of 400 Hz), the fans will be off to conserve energy and reduce the amount of accumulated run time.

When the GPU is commanded to generate 400 Hz output power, the fans will be commanded to rotate at 1/3 of rated speed to verify function. Once the GPU output contactor has closed to deliver 400 Hz power to the aircraft, the fans will be commanded to rotate at full rated speed.

The fans will remain at full rated speed until the GPU is commanded to turn off. Upon receiving the command to turn off, the GPU will continue to run the fans at full rated speed for 10 minutes to continue cooling the unit.

Fan operation is not temperature controlled and will always follow the sequence described above.

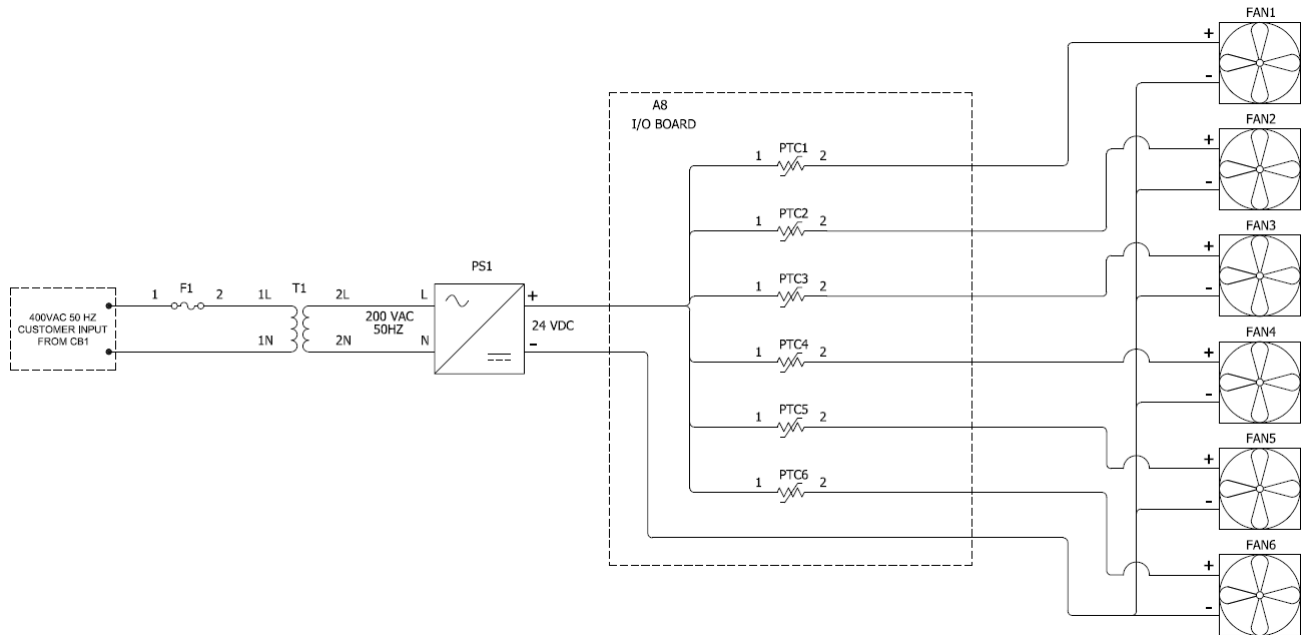


Figure 1-14. 2500+ GPU Fan Control Circuit

1.1.6. PROTECTION FEATURES

The GPU shuts down to protect itself and an alert is communicated to the front panel HMI for the following conditions.

1. Input over/under voltage
 - a. Input over-voltage of 552 Vac
 - b. Input under-voltage of 340 Vac
 - c. Single phase loss
2. Output over/under voltage
 - a. Minimum output voltage of 108 Vac
 - b. Maximum output voltage of 128 Vac
 - c. Phase unbalance
3. Overload
 - a. 125 % for 600 seconds
 - b. 150 % for 90 seconds
 - c. 250 % for 30 seconds
 - d. 300 % for 15 seconds
 - e. 400 % for 3 seconds
 - f. 500 % for 1.5 seconds
4. Internal high temperature
 - a. IGBTs limited to 145°C (293 °F)
 - b. Inductors continuously monitored
 - c. Fans monitored for failure
 - d. Transformer cooling air inlet and exhaust temperatures monitored
5. Output short circuit results in an instantaneous shutdown with short circuit displayed as an alarm.
6. Neutral voltage supervisor shuts unit down when 10 Vac exists between neutral and ground.

1.2. OPERATION

The 3-phase, 3-wire input power to the GPU can range from 45 to 65 Hz and 400 to 480 Vac line-to line. The GPU converts this input power to 400 Hz, 3-phase, 4-wire, 115 Vac line-to-neutral and 200 volts line-to-line output power.

The GPU rectifies the input AC voltage to DC voltage and then inverts it back to AC voltage for the output.

Refer to the GPU wiring diagram in chapter 5 for component designations.

1.2.1. FREQUENCY CONTROL 400 HZ

The GPU output frequency is controlled by a crystal oscillator. The frequency control and digital waveform circuits are implemented within an FPGA.

1.2.2. HUMAN MACHINE INTERFACE (HMI)

The GPU incorporates an HMI that provides the majority of monitoring, calibration, and control capabilities for the unit. The HMI features an analog touch, high-speed, color liquid crystal display (LCD). The HMI incorporates Ethernet connection and universal serial bus (USB) ports, allowing for software updates as well as data transfer and storage. A full description of HMI functionality is detailed in chapter 3.

1.2.3. CONTROLS AND INDICATORS

The controls and indicators for the single output GPU are shown in Figure 1-15. The function of each control and indicator is described in Table 1-1.

The controls and indicators for the dual output GPU are identical to those of the single output GPU with the exception that there is an ON #2 pushbutton instead of a Blank.

5 - Emergency Stop



6 - HMI



1 – Lamp Test/
Power Available



2 – ON #1



3 – Blank



4 – OFF/Reset

Figure 1-15. 2500+ GPU Single Output Controls and Indicators

Table 1-1. 2500+ GPU Single Output Controls and Indicators			
Item No.	Component Designation	Type of Control	Function
1	Lamp Test / Power Available	Illuminated Pushbutton, White	Illuminates when input power is available. When pressed, all pushbuttons will illuminate to show all buttons work properly.
2	ON #1	Illuminated Pushbutton, Green	Closes output contactor 1 when pressed. Illuminates when output contactor 1 is closed and unit is supplying 400 Hz to the load.
3	Blank	Blank	Blank, for dual output units only
4	OFF/Reset	Illuminated Pushbutton, White	Illuminates when any fault has occurred in the system. Opens output contactors and resets fault circuits when pressed.

Table 1-1. (Cont.)			
2500+ GPU Single Output Controls and Indicators			
Item No.	Component Designation	Type of Control	Function
5	Emergency Stop	Mushroom Pushbutton, Red	When pressed, shunt trips input circuit breaker removing incoming power to the unit from the power electronics section. Refer to warning in section 1.1.3.1.
6	Human Machine Interface (HMI)	LCD Touch Display	Used for monitoring, calibration, and control. Described in detail in Chapter 3.

1.2.4. GPU MONITORING SENSORS

The GPU incorporates nine thermistors, twelve RTDs, and five board monitors. The output of each of these sensors are displayed on the HMI as described in chapter 3. Both input and output IGBTs overheating will trigger an alarm and shutdown the unit. The thermistors monitoring the IGBT modules are internal to the modules. Two pins on the IGBT are connected to their respective gate driver printed circuit board (PCB). The thermistor pairs are routed to the power factor correction (PFC) gate driver interface board via connectors J1, J2, and J3 on the PFC gate driver printed wiring board (PWB) for phase A, B, and C temperatures. The six temperatures for the inverter IGBT are input to the inverter gate driver PCB via connectors J1, J4, J5, J6, J7, and J8.

System temperatures are measured with resistance temperature detectors (RTDs). The RTDs connect to the input/output (I/O) PWB via connectors J30 and J31. The RTD voltage is buffered and measured with the ADC inputs on the DSP. Each temperature measurement is scaled to display in Celsius with an option to convert to Fahrenheit. Temperatures measured with RTDs are the cooling inlet and exhaust air, transformer coils, PFC inductor coils, and the line reactor coil.

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1.3. SPECIFICATION AND CAPABILITIES

Complete specifications for the unit are provided in Table 1-2.

Table 1-2. 2500+ GPU Specifications	
Parameter	Value
Input Power	
Voltage Range	3 x 400 – 480 Vac \pm 15%
Frequency	50/60 Hz \pm 5 Hz
Rectification	Active PFC
Rated Current @ 480 Vac	115 A
Rated Current @ 400 Vac	138 A
Line Current Distortion	< 2% at full load
Power Factor	1.0 at any load
Inrush Current	None
Rated Power	90 kVA / 90 kW
Output Power	
Voltage	4 x 115/200 Vac
Frequency	400 Hz \pm 0.1 Hz
Power Factor	0.5 lagging to 0.8 leading
Voltage Regulation	< 0.5% for a balanced load up to 40% for an unbalanced load
Voltage Recovery	U < 2% and recovery time < 10 ms at 100% load change
Total Harmonic Content	< 2% at linear load (typical 1.5%) < 2% at non-linear load according to ISO 1540
Crest Factor	1.414 \pm 3%
Voltage Modulation	< 0.1%

Table 1-2. (Cont.) 2500+ GPU Specifications	
Phase Angle Symmetry	120° ± 1° for a balanced load 120° ± 2° for an unbalanced load
Voltage Drop Compensation	> 20 V phase-to-neutral
Efficiency	
Overall Efficiency @ 100% Load	> 94%
Standby Losses	< 50 W
No-Load Losses	< 1.5 kW
Overload Capacity	
125% for 600 seconds 150% for 90 seconds 250% for 30 seconds 300% for 15 seconds 400% for 3 seconds 500% for 1.5 seconds	
Environmental	
Operating Temperature	-40 °C to +60 °C for all load conditions
Relative Humidity	10 to 100%, non-condensing
Noise Level	< 65 dB(A) at 1 m
Protection	
Protection class IP55 No-break power transfer Over/under voltage at in/output Overload Internal high temperature Control voltage error Short circuit at output Neutral voltage supervision Broken neutral supervision	

Table 1-2. (Cont.)	
2500+ GPU Specifications	
Miscellaneous	
MTTR	20 minutes max.
Color (standard)	RAL 9010 matte, pure white
Weight	
Fixed and PBB units	570 kg
Dimensions	
See outline drawings in Chapter 5	

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1.4. GPU SIGNAL AND MODBUS INTERFACE

This section describes the interface capabilities of the GPU including terminal block signals and Modbus communication addresses.

Table 1-3 presents the GPU terminal block signal connections and descriptions for the 2500+ frequency converter, model 25C90S-HB.

The Modbus addresses listed in Table 1-4 are identical for single, dual, and DC output units, models 25C90S-XX, 25C90D-XX, and 25C90S-XX-286.

Terminal Block	Signal	Description
TB-CBL1-1	Remote 1 On	On command for output number 1 from Remote 1 station
TB-CBL1-2	Remote 1 Common	Remote pushbutton common
TB-CBL1-3	Remote 1 Off/Reset	Off/Reset from remote station
TB-CBL1-4	Remote 1 Common	Remote pushbutton common
TB-CBL1-5	Remote 1 LED Source	LED 24VDC source for Remote 1 station
TB-CBL1-6	Remote 1 On LED	Remote 1 GPU On LED indicator
TB-CBL1-7	Remote 1 Fault LED	Remote 1 summary fault LED indicator
TB-CBL1-8	Cable 1 RVS A	Output 1 remote voltage sense phase A
TB-CBL1-9	Cable 1 RVS B	Output 1 remote voltage sense phase B
TB-CBL1-10	Cable 1 RVS C	Output 1 remote voltage sense phase C
TB-CBL1-11	Cable 1 RVS N	Output 1 remote voltage sense phase N
TB-CBL1-12	Thermal Switch	Interface point for cable head 1 thermal switch
TB-CBL1-13	Thermal Switch	Interface point for cable head 1 thermal switch
TB-CBL1-14	Cable 1 E&F	Output 1 E&F interlock signal from aircraft
TB-CBL1-15	Cable 1 E&F Jumper	Redundant jumper for E&F signal from aircraft
TB-CBL1-16	Cable 1 Switch Common	Common pulldown source for cable head 1 pushbuttons
TB-CBL1-17	Cable 1 Pilot Switch	Cable head 1 pilot switch, cable connected
TB-CBL1-18	Cable 1 On Switch	Cable head 1 On command for output number 1
TB-CBL1-19	Cable 1 Off/Reset NO	Cable head 1 Off/Reset command, normally open
TB-CBL1-20	Cable 1 Off/Reset NC	Cable head 1 Off/Reset command, normally closed
TB-CBL1-21	Cable 1 Connect LED	Cable head 1 connected LED indicator
TB-CBL1-22	Cable 1 E&F LED	Cable head 1 E&F present LED indicator
TB-CBL1-23	Cable 1 On LED	Cable head 1 On Lead indicator
TB-CBL1-24	Cable 1 LED Source	LED 24VDC source for cable head 1
TB-CBL1-25	Pit 1 E-Stop	Pit 1 E-Stop signal, normally closed
TB-CBL1-26	Pit 1 E-Stop	Pit 1 E-Stop signal, normally closed

Table 1-3. (Cont.)

GPU Terminal Block Signal Connections and Descriptions (Single Output)

Terminal Block	Terminal Block	Terminal Block
TB-CBL1-27	Pit 1 Open Switch	Switch indicator that the pit hatch is open
TB-CBL1-28	Pit 1 Open Switch	Switch indicator that the pit hatch is open
TB-CBL1-29	Pit 1 Closed Switch	Switch indicator that the pit hatch is closed
TB-CBL1-30	Pit 1 Closed Switch	Switch indicator that the pit hatch is closed
TB-CBL1-31	Pit 1 Flood	Indicator from pit sump pump that pit is flooded, alarm
TB-CBL1-32	Pit 1 Flood	Indicator from pit sump pump that pit is flooded, alarm
TB-CBL1-33	Relay Contact ON	Normally open relay contact for GPU on status
TB-CBL1-34	Relay Contact ON	Normally open relay contact for GPU on status
TB-CBL1-35	Relay Contact Fault	Normally open relay contact for GPU summary fault
TB-CBL1-36	Relay Contact Fault	Normally open relay contact for GPU summary fault
TB-CBL1-37	Relay Contact E-Stop	Normally open relay contact for E-Stop active
TB-CBL1-38	Relay Contact E-Stop	Normally open relay contact for E-Stop active

Table 1-4.

GPU Modbus Interface Address Map (HMI Version 1.6 SS)

Modbus Buffer Tag	Size	Address	Direction	Description
COMS_400HzI_BOO	Bit	%M00000	Input	Aircraft present
COMS_400HzI_OVA	Word	%MW00001	Output	GPU output voltage phase A and B multiplied by 10 for 1 decimal place
COMS_400HzI_OVB	Word	%MW00002	Output	GPU output voltage phase B and C multiplied by 10 for 1 decimal place
COMS_400HzI_OVC	Word	%MW00003	Output	GPU output voltage phase C and A multiplied by 10 for 1 decimal place
COMS_400HzI_OPF	Word	%MW00004	Output	Power factor multiplied by 100 to give two decimal places
COMS_400HzI_FRC	Word	%MW00005	Output	Free running counter to confirm communications
COMS_400HzI_HM_HOURS	Word	%MW00006	Output	Number of hours in the current run
COMS_400HzI_HM_MINUTES	Word	%MW00007	Output	Number of minutes in the current run
COMS_400HzI_HM_SECONDS	Word	%MW00008	Output	Number of seconds in the current run
COMS_400HzI_PCP	Word	%MW00009	Output	Instantaneous power in kW times ten to give one decimal place
COMS_400HzI_PCT1	Word	%MW00010	Output	Output kW-hours used on current run no decimal places
COMS_400HzI_PC2	Word	%MW00011	Output	Total usage of the GPU for the life of the unit in MW-hours
COMS_400HzI_LAA	Word	%MW00012	Output	Output power of phase A in amps
COMS_400HzI_LAB	Word	%MW00013	Output	Output power of phase B in amps
COMS_400HzI_LAC	Word	%MW00014	Output	Output power of phase C in amps
COMS_400HzI_VAA	Word	%MW00015	Output	Output voltage of phase A to neutral X 10 to give a decimal place
COMS_400HzI_VAB	Word	%MW00016	Output	Output voltage of phase B to neutral X 10 to give a decimal place

Table 1-4. (Cont.)

Modbus Interface Address Map (HMI Version 1.6 SS)

Modbus Buffer Tag	Size	Address	Direction	Description
COMS_400HzI_VAC	Word	%MW00017	Output	Output voltage of phase C to neutral X 10 to give a decimal place
COMS_400HzI_F	Word	%MW00018	Output	Output frequency of the GPU
COMS_400HzI_LPM	Word	%MW00019	Output	Output kW-hours used on last run no decimal places
COMS_400HzI_LHM	Word	%MW00020	Output	Output usage time in minutes for the current run
COMS_400HzI_TDY	Word	%MW00021	Input	Two digit year
COMS_400HzI_TDM	Word	%MW00022	Input	Two digit month
COMS_400HzI_TDD	Word	%MW00023	Input	Two digit day
COMS_400HzI_TDH	Word	%MW00024	Input	Two digit hours
COMS_400HzI_TDN	Word	%MW00025	Input	Two digit minutes
COMS_400HzI_TDS	Word	%MW00026	Input	Two digit seconds
COMS_400HzI_PPC	Bit	%MW00027:X00	Output	Pit 1 closed status. ON=closed.
COMS_400HzI_PPO	Bit	%MW00027:X01	Output	Pit 1 open status. ON=open.
COMS_400HzI_OM01	Bit	%MW00027:X02	Output	GPU standby. ON=standby mode. No alarms, ready to run, not running.
COMS_400HzI_OM02	Bit	%MW00027:X03	Output	GPU running. ON=running. No alarms, running.
COMS_400HzI_OM03	Bit	%MW00027:X04	Output	General notification that an ALARM is active. ON=alarmed.
COMS_400HzI_OM04	Bit	%MW00027:X05	Output	GPU running. ON=running. No alarms, running.
COMS_400HzI_ES	Bit	%MW00027:X06	Output	E-Stop error. ON=E-Stop.
COMS_400HzI_PT	Bit	%MW00027:X07	Output	Indicates a cable head is overheated. ON=cable head over temperature.
COMS_400HzI_P90	Bit	%MW00027:X08	Output	Indicates a cable head is inserted past the 80% switch. ON=inserted.
COMS_400HzL_PLCF	Bit	%MW00027:X09	Output	Indicates a control board fault of some kind. ON=PLC fault.
COMS_400HzI_OV	Bit	%MW00027:X10	Output	Output over voltage Alarm. ON=over voltage.

Table 1-4. (Cont.)

Modbus Interface Address Map (HMI Version 1.6 SS)

Modbus Buffer Tag	Size	Address	Direction	Description
COMS_400HzI_OF	Bit	%MW00027:X11	Output	Output frequency is high. ON=output over frequency.
COMS_400HzI_UV	Bit	%MW00027:X12	Output	Output low voltage. ON=output low voltage.
COMS_400HzI_UF	Bit	%MW00027:X13	Output	Output frequency is low. ON=output under frequency.
COMS_400HzI_EF1	Bit	%MW00027:X14	Output	Cable head 1 E & F signal. ON=E & F present.
COMS_400HzI_EF2	Bit	%MW00027:X15	Output	Cable head 2 E & F signal. ON=E & F Present.
COMS_400HzI_IF	Bit	%MW00028:X00	Output	Input voltage error. ON=alarm
COMS_400HzI_OL	Bit	%MW00028:X01	Output	Overload alarm. ON=alarm
COMS_400HzI_SS	Bit	%MW00028:X02	Output	Soft start alarm. ON=alarm.
COMS_400HzI_DCLV	Bit	%MW00028:X03	Output	DC bus low voltage. ON=alarm
COMS_400HzI_DCOV	Bit	%MW00028:X04	Output	DC bus high voltage. ON=alarm
COMS_400HzI_MC	Bit	%MW00028:X05	Output	Main contactor error. ON=alarm
COMS_400HzI_PSA	Bit	%MW00028:X06	Output	Input power supply error. ON=alarm
COMS_400HzI_ILV	Bit	%MW00028:X07	Output	PFC low voltage alarm. ON=alarm
COMS_400HzI_IHV	Bit	%MW00028:X08	Output	PFC high voltage alarm. ON=alarm
COMS_400HzI_DI	Bit	%MW00028:X09	Output	Door safety interlock. ON=alarm
COMS_400HzI_PFCGOT	Bit	%MW00028:X10	Output	PFCG over temperature. ON=alarm
COMS_400HzI_INGOT	Bit	%MW00028:X11	Output	INVG over temperature. ON=alarm
COMS_400HzI_C1E	Bit	%MW00028:X12	Output	Contactora 1 error. ON=alarm
COMS_400HzI_C2E	Bit	%MW00028:X13	Output	Contactora 2 error. ON=alarm
COMS_400HzI_BF	Bit	%MW00028:X14	Output	Phase voltage unbalance alarm. ON=alarm
COMS_400HzI_FF	Bit	%MW00028:X15	Output	Fan failure alarm. ON=Alarm
COMS_400HzI_NG	Bit	%MW00029:X00	Output	Neutral - ground voltage alarm. ON=alarm
COMS_400HzI_INCBE	Bit	%MW00029:X01	Output	Input circuit breaker alarm. ON=alarm

Table 1-4. (Cont.)

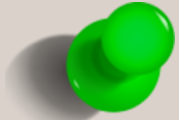
Modbus Interface Address Map (HMI Version 1.6 SS)

Modbus Buffer Tag	Size	Address	Direction	Description
COMS_400HzI_BUSB	Bit	%MW00029:X02	Output	DC bus bleeder alarm. ON=alarm
COMS_400HzI_PFC_F	Bit	%MW00029:X03	Output	PFC frequency alarm. ON=alarm
COMS_400HzI_P1F	Bit	%MW00029:X04	Output	Pit 1 flooded alarm. ON=alarm
COMS_400HzI_P2F	Bit	%MW00029:X05	Output	Pit 2 flooded alarm. ON=alarm
COMS_400HzI_PPC2	Bit	%MW00029:X06	Output	Pit 2 closed status. ON=closed.
COMS_400HzI_PPO2	Bit	%MW00029:X07	Output	Pit 2 open status. ON=open.
COMS_400HzI_PC3	Word	%MW00030	Output	Total usage of the GPU for the life of the unit in kW-hours
COMS_400HzI_ATA	Bit	%MW00031:X00	Output	Summary fault

1.5. SHIPPING

1.5.1. DELIVERY

The GPU may be delivered either horizontally or vertically in a wooden crate. The GPU shall be unloaded with extreme caution with a fork lift or crane. Be careful not to damage the paint. Should the paint be damaged correct as soon as possible to prevent corrosion.



NOTE

Cavotec shall not take responsibility for damage incurred during shipping or unloading.

1.5.2. LIFTING THE GPU FOR INSTALLATION

Upon removal of the GPU from its shipping crate, it may be lifted as specified in Figures 1-16 and 1-17.

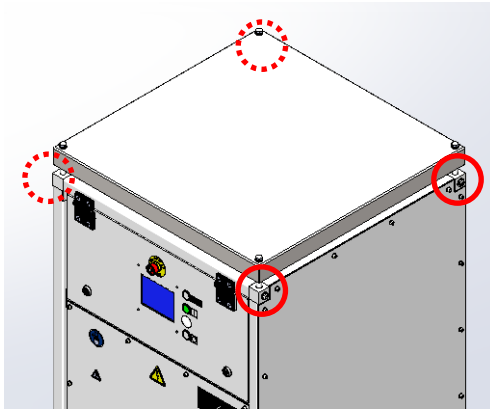


Figure 1-16. Remove the Plastic Inserts From the Four Corners Indicated

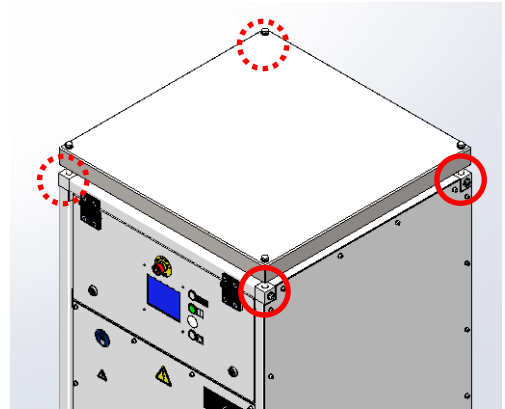


Figure 1-17. Install Four M10 Eye Bolts and Adequate Slings/Lifting Gear

1.5.1. RECOMMENDED FEED BREAKER

The recommended input circuit breaker amperage rating is 325A for upstream breakers. This will allow the circuit breaker inside the GPU to trip first should input current spike.

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1.6. STORAGE

1.6.1. STORAGE BEFORE INSTALLATION



CAUTION
DO NOT STACK UNCRATED UNITS.

It is recommended that the GPU is stored inside in a covered, dry, clean area to protect it from rain and excessive humidity while it is left without power, to secure optimal storage conditions prior to installation. Only equipment in a seaworthy packing can be stored outside.

1.6.2. OPERATIONAL AND ENVIRONMENTAL CONDITIONS AFTER COMMISSIONING

When the converter has been installed and commissioned, it is recommended that the input power is always kept ON to provide optimal conditions for electric components and to avoid condensation from forming on vital parts.

If for some reason the converter has been without input power for a period of time, a visual inspection should be carried out. In the case that condensation has been discovered on any internal components, the components must be dried out before input power is applied again.

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Chapter 2
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2. MAINTENANCE

Maintain the unit according to this manual to ensure that the unit is always ready for use. The recommended maintenance intervals are listed. Keep a record of all maintenance activities.

	<p><u>WARNING</u> ALL PERSONNEL SHALL TAKE PRECAUTIONS AND FOLLOW THE MAINTENANCE INSTRUCTIONS PRECISELY FOR SAFETY.</p>
	<p><u>WARNING</u> ONLY QUALIFIED PERSONNEL ARE ALLOWED TO REMOVE COVERS FOR SERVICE AND MAINTENANCE.</p>
	<p><u>WARNING</u> ELECTRICAL WORK SHALL ONLY BE CARRIED OUT BY A TRAINED ELECTRICIAN.</p>
	<p><u>WARNING</u> SECURE WORKING AREA WITH TRAFFIC CONES AND CORDON IT OFF DURING MAINTENANCE WORK.</p>
	<p><u>WARNING</u> FOLLOW SAFETY REGULATIONS FOR WORK WITH ELECTRICAL EQUIPMENT:</p> <ol style="list-style-type: none">1. DISCONNECT MAINS2. PREVENT RECONNECTION3. TEST FOR ABSENCE OF HARMFUL VOLTAGES4. GROUND AND SHORT CIRCUITS5. COVER OR CLOSE OFF NEARBY LIVE PARTS

2.1. SERVICING

Periodic maintenance at regular intervals will reduce the possibility of component failure to a minimum and the equipment will give many years of uninterrupted service. Service intervals depend largely on the environmental conditions. The instructions given in this chapter apply to temperate zone environmental conditions. Servicing should be more frequent when operating conditions are severe.

2.1.1. AIR FILTERS

Frequency: Every Month

Perform the following steps to check the air filters.

1. Outlet Filters: Check the four exhaust filters by lifting the plastic tab to reveal the filter inside. If filters are noticeably dirty, rinse thoroughly and leave out to dry. If washing does not adequately clear the filter or if the filter is damaged, replace the filter.
2. Intake Filters: Remove the fan shroud. If the fan filter is noticeably dirty, rinse thoroughly and leave out to dry. If washing does not adequately clear the filter or if the filter is damaged, replace the filter.

2.1.2. FAN FUNCTIONALITY

Frequency: Every 6 Months

Perform the following steps to check the fan functionality.

1. With the circuit breaker closed, press the ON 1 push button located on the front panel. The unit will start and the output contactor will close.
2. On the OUTPUT OVERVIEW screen shown in Figure 2-1, press MAIN MENU.

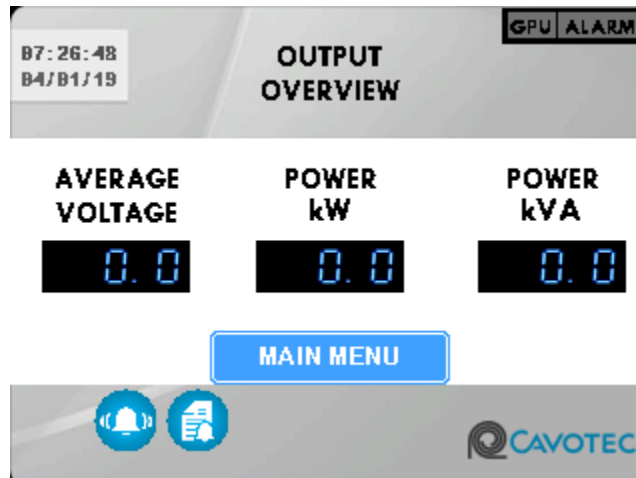


Figure 2-1. Output Overview Screen

3. On the MAIN MENU screen shown in Figure 2-2, press STATUS.

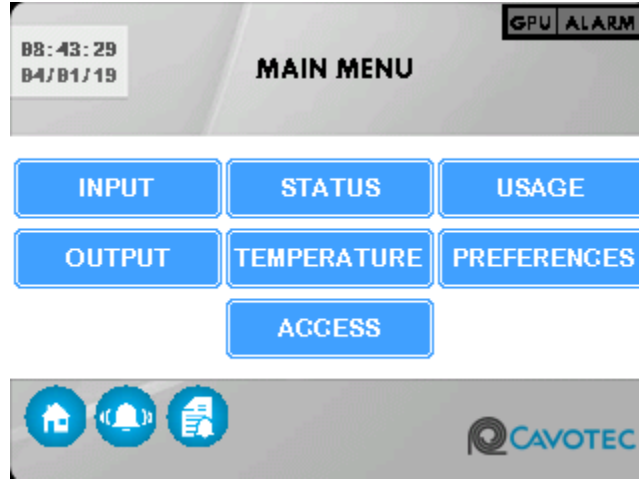


Figure 2-2. Main Menu Screen

4. On the STATUS screen shown in Figure 2-3, press FAN SPEEDS.

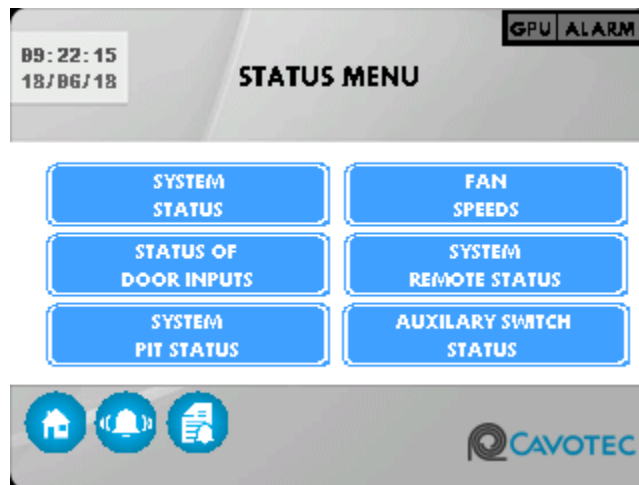


Figure 2-3. Status Menu Screen

- On the FAN SPEEDS screen shown in Figure 2-4, ensure that each fan is running between 170 Hz and 185 Hz. If any fans are running at an unacceptable speed, replace the fan.

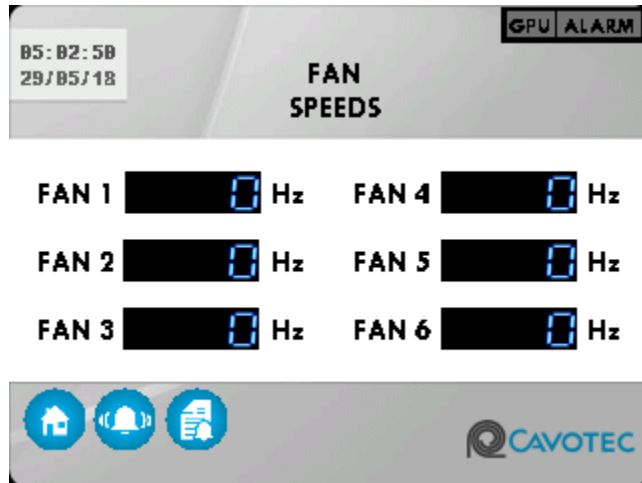


Figure 2-4. Fan Speeds Screen

2.1.3. INTERNAL BOLT/SCREW AND CABLE CONDITIONS

Frequency: Every 6 Months

Perform the following steps to check internal connections.

- Remove utility power from the unit. Unit should be entirely powered down.
- Unlock and open the front door on the unit. Push each connector on the Front Panel board and the Control board to ensure that it is securely connected. Close and lock the front door.
- Remove the circuit breaker panel. Push each connector on the IO board to ensure that it is securely connected.
- Verify the tightness of bolts on the output contactors, input contactor, main circuit breaker, and neutral transformer block using a calibrated torque wrench. Acceptable values listed in Table 2-1.

Table 2-1 Bolt Torque Requirements	
Component	Torque (ft-lb)
Output Contactor	19.5 – 20.5
Input Contactor	5.5 – 6.5
Main Circuit Breaker	16 – 17
Neutral Terminal Block	7.5 – 14.5

- Visually inspect any other accessible bolts and screws to ensure strong connection.

2.1.4. HMI DISPLAY

Frequency: Every 6 Months

Perform the following steps to check the functionality of the HMI display.

1. Visually check for screen cracks, distorted picture, dead pixels, and other screen damages.
2. Test HMI functionality by pressing MAIN MENU on the OUTPUT OVERVIEW screen.
3. Press INPUT on the MAIN MENU screen.
4. Press INPUT VOLTAGES and verify that the input voltage displays when the input circuit breaker is closed.

2.1.5. OUTPUT VOLTAGES

Frequency: Every 6 Months

Perform the following steps to check the output voltages at the aircraft connector.

1. Connect the unit to the load bank using the site 400 Hz aircraft ground power cable for output 1. Ensure that the cable head is fully inserted into the load bank socket.
2. Adjust the load bank to apply a 90 kW resistive load to the unit.
Note: If only 72 kW load bank is available continue test at 72 kW.
3. With the circuit breaker closed, press the ON 1 push button located on the front panel. The unit will start and the output contactor will close.
4. Measure the line-to-neutral voltage at the load bank voltage sense terminals for each phase using a multimeter. Voltage readings shall be 114.5 – 116.5 Vac.

2.1.6. PUSHBUTTONS AND LEDS

Frequency: Every 6 Months

Perform the following steps to check the functionality of all push buttons and LEDs.

1. Press LAMP TEST located on the front panel. Acceptable if ring around all push buttons is illuminated.
2. With the circuit breaker closed, press the ON 1 push button located on the front panel. Acceptable if unit starts and output contactor closes.
3. Press the RESET push button located on the front panel. Acceptable if contactor opens and unit shuts down.
4. If a second output is present, press the ON 2 push button located on the front panel. Acceptable if unit starts and output contactor closes.
5. If a second output is present, Press the RESET push button located on the front panel. Acceptable if contactor opens and unit shuts down.

2.1.7. EMERGENCY STOP BUTTON

Frequency: Every 6 Months

Perform the following steps to check for the functionality of the Emergency Stop button.

1. With the circuit breaker closed, press the ON 1 push button located on the front panel. The unit will start and the output contactor will close.

2. Press the Emergency Stop button located on the front panel and seen in Figure 2-5. Acceptable if unit shuts down and E-STOP alarm appears on the HMI screen.



Figure 2-5. Emergency Stop Button

3. Twist the Emergency Stop button to reset the latch. Reset the input circuit breaker by twisting the circuit breaker handle counter clockwise until the indicator is in the reset position. Press the RESET push button and ensure that the E-STOP alarm is cleared then close the input circuit breaker.

2.1.8. SEALING GASKETS

Frequency: Every 12 Months

Perform the following steps to check the sealing gaskets.




1. Unlock and open the front door. Ensure that the gaskets along the edges are undamaged.
2. If only one output is used, ensure that the rubber stopper on the front panel is securely in place.
3. Remove each panel and ensure that the gaskets along the edges are undamaged.

2.2. TROUBLESHOOTING

2.2.1. TROUBLESHOOTING PROCEDURES

This section contains general troubleshooting guidelines for all alarms and other possible failures. Refer to the unit's wiring schematic for assistance in troubleshooting. When troubleshooting, keep complete notes of all steps and an accurate log of adjustments so a corrective procedure may be reversed. Comprehensive notes and a log make it possible to relate progress to others and facilitate communications regarding repair procedures.

To use the tables in this section, find the alarm or symptom that best describes the fault. Then proceed to perform each solution corresponding to each possible cause in order. After completing each possible solution, attempt to clear the alarm with the reset button and try again. Proceed step-by-step until the fault is isolated and make the repairs indicated.

	<p><u>CAUTION</u> MINOR TROUBLES MAY BE INVESTIGATED BY THE SYSTEM OPERATOR; HOWEVER, MAJOR TROUBLESHOOTING MUST BE UNDERTAKEN ONLY BY QUALIFIED AND EXPERIENCED TECHNICIANS.</p>
	<p><u>ELECTRICAL HAZARD</u> HIGH VOLTAGE IS USED IN THIS EQUIPMENT. USE EXTREME CARE WHEN TROUBLESHOOTING TO PREVENT ACCIDENTAL INJURY OR ELECTROCUTION.</p>
	<p><u>ELECTRICAL HAZARD</u> ALLOW TWO MINUTES FOR ALL CHARGED CAPACITORS TO DISCHARGE BEFORE TROUBLESHOOTING. MAKE SURE ALL POWER IS "OFF" AND CHECKED WITH A VOLTMETER BEFORE BEGINNING.</p>

The following test equipment is required to troubleshoot the GPU:

- a. Digital multi-meter, Fluke 87 or equivalent

Table 2-2. Alarm Troubleshooting		
Alarm	Possible Causes	Solutions
SOFT START	More than 5 start attempts in 10 minutes.	Wait 10 minutes and try again.
	Damaged Soft Start Board (A4).	Replace Soft Start Board (A4).
	Damaged Input IGBTs (Q1-Q3).	Replace damaged IGBTs (Q1-Q3).
DC LOW	Damaged Bleeder Board (A9).	Replace Bleeder Board (A9).
	Damaged Control Board (A1).	Replace Control Board (A1).
DC HIGH	Damaged Bleeder Board (A9).	Replace Bleeder Board (A9).
	Damaged Control Board (A1).	Replace Control Board (A1).
INPUT VOLTAGE	Circuit breaker is open.	Reset/close circuit breaker and try again.
	Facility input breaker is open or faulty.	Reset/close main facility input breaker that feeds the GPU. Measure voltage at input of unit to ensure 3 X 400 - 480 VAC \pm 15%.
	Loose, damaged, or misplaced input voltage sensing wiring.	Verify input voltage sensing wiring against the wiring schematic (Wires 3, 5, 7, 10, 11, & 12). Verify wires are not damaged.
	Loose or damaged input cable.	Verify that measured voltage at circuit breaker matches displayed input voltage on the HMI. Circuit breaker must be closed for voltage to display on HMI.
	Damaged High Voltage Board (A14).	Replace High Voltage Board (A14).
	Damaged Control Board (A1).	Replace Control Board (A1).
INPUT CONTACTOR	Loose, damaged, or misplaced contactor switch wiring.	Verify input contactor switch wiring against the wiring schematic (Wires 40, 41, 42, & 43). Verify wires are not damaged.
	Damaged IO Board (A8).	Replace IO Board (A8).
	Damaged Input Contactor (K1).	Replace Input Contactor (K1).
INV DAISY CHAIN	Loose Inverter Board (A6) or ribbon cable.	Secure board to IGBT Driver boards and connect ribbon cables.
PFC DAISY CHAIN	Loose PFC Board (A10) or ribbon cable.	Secure board to IGBT Driver boards and connect ribbon cables.
OUTPUT OVERLOAD	GPU sustained output overload for set amount of time.	Wait for HMI red screen to disappear. Reduce load as necessary upon restart.
	Damaged input CTs or burden resistors (CT1-CT3).	Replace input CTs and burden resistors (CT1-CT3).
Table 2-2. (Cont.) Alarm Troubleshooting		

Alarm	Possible Causes	Solutions
NODE MISSING	Loose or damaged ribbon cables.	Secure or replace ribbon cables as necessary.
	Damaged power supply.	Verify that each power supply has an illuminated "DC OK" LED. If power supply has overheated, it will automatically restart once it is cool enough. Otherwise, replace damaged power supply.
	Damaged communications board.	One by one, replace the Control (A1), IO (A8), PFC (A10), and Inverter (A6) boards.
OUTPUT LOW VOLTAGE	Incorrect voltage set point.	Verify that voltage set point is approximately 3500 for each phase.
	Loose, damaged, or misplaced output voltage sensing wiring.	Verify output voltage sensing wiring against the wiring schematic (Wires 25, 26, & 27). Verify wires are not damaged.
	Damaged Inverter Board (A6).	Replace Inverter Board (A6).
	Damaged IGBT Assembly (Q4-Q9).	Replace IGBT assemblies one at a time (Q4-Q9).
	Damaged High Voltage Board (A14).	Replace High Voltage Board (A14).
OUTPUT HIGH VOLTAGE	Incorrect voltage set point.	Verify that voltage set point is approximately 3500 for each phase.
	Loose, damaged, or misplaced output voltage sensing wiring.	Verify output voltage sensing wiring against the wiring schematic (Wires 25, 26, & 27). Verify wires are not damaged.
	Damaged Inverter Board (A6).	Replace Inverter Board (A6).
	Damaged High Voltage Board (A14).	Replace High Voltage Board (A14).
PFC LOW VOLTAGE	While GPU is running, input voltage drops below the allowable value.	Verify that facility input voltage is 340-552 VAC phase to phase.
PFC HIGH VOLTAGE	While GPU is running, input voltage raises above the allowable value.	Verify that facility input voltage is 340-552 VAC phase to phase.

Table 2-2. (Cont.)
Alarm Troubleshooting

Alarm	Possible Causes	Solutions
-------	-----------------	-----------

DOOR INTERLOCK	Control door is open.	Close control door.
	Door interlock switch is misplaced or damaged.	Reposition or replace the door interlock switch.
	Door interlock is not disabled as intended.	To disable the door interlock, slide switch SW3 on the Control Board (A1).
E-STOP	E-Stop button is pressed.	Turn clockwise to release.
	Damaged Front Panel Board (A3).	Replace Front Panel Board (A3).
	Damaged Control Board (A1).	Replace Control Board (A1).
	Damaged IO Board (A8).	Replace IO Board (A8).
	If remote station is used, the E-Stop loop may be broken.	Check wiring to ensure that the E-Stop circuit is complete.
CIRCUIT BREAKER TRIP	Circuit Breaker has tripped	Resolve any other alarms and reset circuit breaker.
PFC OVER TEMP	Input IGBTs (Q1-Q3) exceed maximum allowable temperate.	Allow IGBTs (Q1-Q3) to cool and replace as necessary.
INV OVER TEMP	Output IGBTs (Q4-Q9) exceed maximum allowable temperate.	Allow IGBTs (Q4-Q9) to cool and replace as necessary.
OUTPUT 1 CONTACTOR	Loose, damaged, or misplaced contactor switch wiring.	Verify output 1 contactor switch wiring against the wiring schematic (Wires 46, 47, 48, & 49). Verify wires are not damaged.
	Damaged IO Board (A8).	Replace IO Board (A8).
	Damaged Output Contactor (K2).	Replace Output Contactor (K2).
OUTPUT 2 CONTACTOR	Loose, damaged, or misplaced contactor switch wiring.	Verify output 2 contactor switch wiring against the wiring schematic (Wires 52, 53, 219, & 220). Verify wires are not damaged.
	Damaged IO Board (A8).	Replace IO Board (A8).
	Damaged Output Contactor (K2).	Replace Output Contactor (K2).
OUTPUT UNBALANCED	A single phase's voltage is not equal to other phase voltages.	Adjust voltage set points so that each phase is approximately equal.
FAN FAILURE	Damaged or disconnected fan.	Check fan status on the Fan Speeds screen. Ensure all fan wires are securely connected. Replace as necessary.
	Damaged IO Board (A8).	Replace IO Board (A8).

Table 2-2. (Cont.)
Alarm Troubleshooting

Alarm	Possible Causes	Solutions
-------	-----------------	-----------

NEUTRAL-GROUND	Neutral is disconnected from ground.	Check that all neutral wires have continuity to ground and connect/replace as necessary.
INPUT CIRCUIT BREAKER	Loose, damaged, or misplaced contactor switch wiring.	Verify contactor switch wiring against the wiring schematic (Wires 40, 41, 42, 43, 46, 47, 48, 49, 52, 53, 204, 206, & 208). Verify wires are not damaged.
	Damaged Inverter Board (A6).	Replace Inverter Board (A6).
	Damaged PFC Board (A10).	Replace PFC Board (A10).
	Damaged Bleeder Board (A9).	Replace Bleeder Board (A9).
	Damaged IO Board (A8).	Replace IO Board (A8).
PFC RIBBON CABLE	Loose or damaged ribbon cable.	Secure or replace the ribbon cables on the PFC Board (A10).
	Loose or damaged ribbon cable.	Secure or replace the ribbon cables on the Inverter Board (A6).
DC BUS BLEEDER	Damaged Bleeder Board (A9).	Replace Bleeder Board (A9).
	Damaged Input Contactor (K1).	Verify that the input contactor (K1) is open when the unit is not running. Replace as necessary.
OUTPUT FREQUENCY	Loose, damaged, or misplaced board wiring.	Verify wiring to Control Board (A1) and High Voltage Board (A14) against the wiring schematic.
	Damaged High Voltage Board (A14).	Replace High Voltage Board (A14).
	Damaged Control Board (A1).	Replace Control Board (A1).
MISSING EF	400Hz cable is unplugged.	Ensure 400Hz cable is fully inserted into the aircraft.
	Loose, damaged, or misplaced E&F wiring.	Verify E&F wiring against the wiring schematic (J46 on IO Board (A8)). Ensure voltage across pins 1 & 3 and 4 & 6 (Dual) is approximately 28VDC.
	Damaged IO Board (A8).	Replace IO Board (A8).

Table 2-2. (Cont.)
Alarm Troubleshooting

Alarm	Possible Causes	Solutions
-------	-----------------	-----------

MISSING SPLIT PIN	28VDC cable is unplugged.	Ensure 28VDC cable is fully inserted into the aircraft.
	Loose, damaged, or misplaced split pin wiring.	Verify split pin wiring against the wiring schematic (J46 on IO Board (A8)). Ensure voltage across pins 4 & 6 is approximately 28VDC.
	Damaged IO Board (A8).	Replace IO Board (A8).
PFC FREQUENCY ALARM	Circuit breaker closed with unexpected input voltage level.	Ensure input voltage is 340-552 VAC when circuit breaker is closed.
PIT 1 FLOOD	Pit 1 is flooded.	Drain pit and thoroughly dry all equipment.
	Flood switch is inverted.	Change switch configuration on Pit Switch Configuration screen.
	Flood detecting pit equipment is damaged.	Replace flood detecting pit equipment.
PIT 2 FLOOD	Pit 2 is flooded.	Drain pit and thoroughly dry all equipment.
	Flood switch is inverted.	Change switch configuration on Pit Switch Configuration screen.
	Flood detecting pit equipment is damaged.	Replace flood detecting pit equipment.
HEAD 1 OVER TEMP	Overheated cable.	Check cable head for high temperatures. Allow to cool.
	Damaged or corroded cable connector.	Clean head and ensure there is no physical damage.
	Damaged thermal switch.	Check for continuity and replace as necessary.
	Damaged RTD.	Measure resistance to approximately 1.00kΩ and replace as necessary.
HEAD 2 OVER TEMP	Overheated cable.	Check cable head for high temperatures. Allow to cool.
	Damaged or corroded cable connector.	Clean head and ensure there is no physical damage.
	Damaged thermal switch.	Check for continuity and replace as necessary.
	Damaged RTD.	Measure resistance to approximately 1.00kΩ and replace as necessary.

Table 2-2. (Cont.)
Alarm Troubleshooting

Alarm	Possible Causes	Solutions
-------	-----------------	-----------

28V OVERVOLTAGE	28VDC output voltage is above allowable value.	Adjust voltage set point or over voltage trip point.
	Loose, damaged, or misplaced feedback wiring.	Verify wiring to TB-DC2 pin 6 and J6 pin 6 on the High Voltage Board (A14).
28V UNDERVOLTAGE	28VDC output voltage is below allowable value.	Adjust voltage set point or under voltage trip point.
	Loose, damaged, or misplaced feedback wiring.	Verify wiring to TB-DC2 pin 6 and J6 pin 6 on the High Voltage Board (A14).
OUTPUT SHORT CIRCUIT	Output cable has exposed wires or shorts.	Check for exposed wires or shorts by measuring resistance phase to phase and phase to neutral. If circuit is not open, replace the output cable.
INPUT OVERLOAD FAULT	The GPU input current is above allowable value.	Increase input overload set point on Input/Low Use Configuration screen or decrease output power.
	Damaged input CTs or burden resistors (CT1-CT3).	Replace input CTs and burden resistors (CT1-CT3).

Table 2-3.
HMI/Operational Troubleshooting

Symptom	Possible Causes	Solutions
HMI Screen is black	Loss of input voltage.	Reset/close main facility input breaker that feeds the GPU. Measure voltage at input of unit to ensure 3 X 400 - 480 VAC \pm 15%.
	Damaged fuse.	Ensure that the fuse on the step down transformer (T3) has continuity across it. Replace if damaged.
	Loose, damaged, or misplaced ribbon cable between the Control Board (A1) and Front Panel Board (A3).	Ensure that the ribbon cable between the Control Board (A1) and Front Panel Board (A3) is intact and secure.
	Loose, damaged, or misplaced wiring between the Front Panel Board (A3) and HMI.	Verify HMI wiring against the wiring schematic (Wires 222 & 223). Verify wires are not damaged.
	HMI is over compressed.	Loosen the screws holding the HMI in place and reset power.
	Damaged control power supply (PS1).	Ensure output of the control power supply (PS1) is 24VDC. Replace power supply or wiring as necessary.
	HMI displays "WARNING: USB NOT CONNECTED"	Missing USB.
Incorrect USB format.		Insert the USB device into a computer. Right click on the device file and select "Format". Select FAT32 as the File System. Select "Quick Format" and press Start.
No alarms present, GPU unable to run	Micro switch not activated.	Ensure that the aircraft cable is completely inserted into the load (aircraft).
	Incorrect micro switch settings.	Turn off the micro switch setting on the output settings screen.
	Pit not completely open.	Ensure the pit is completely open when attempting to turn on the GPU.
	Incorrect pit settings.	Enable/disable or invert the relevant pit switches on the pit switch configuration screen to match the airport configuration.

2.2.2. UNIT VENTILATION AND COOLING CONSIDERATIONS

Clearance of at least 1.5 m (5 ft.) shall be provided around all unit cooling fans and louvers.

2.2.3. WATER AND MOISTURE

The unit is designed for outdoor use and provides a degree of protection against rain and ice. As with any other electrical equipment, the enclosure shall not be installed directly under liquid-carrying pipes or drains, under ducts where condensation can drain directly onto the unit or be subjected to “hose-down” when the passenger boarding bridge is washed or the hangar floor is scrubbed and cleaned.

2.2.4. UNIT ELECTRICAL CONNECTIONS



WARNING

INPUT AND OUTPUT POWER CAN CAUSE SEVERE INJURY OR DEATH. WHEN INPUT POWER IS CONNECTED, INPUT POWER IS PRESENT AT THE GPU TRANSFORMER PRIMARY AND SECONDARY, POWER SUPPLY, CONTACTORS, AND CONTROL AND PROTECTION BOARD. OBSERVE ALL PRECAUTIONS COMMONLY REQUIRED WHEN DEALING WITH HIGH VOLTAGE.

All unit field wiring done by the installing contractor shall comply with applicable electrical codes as specified by the jurisdiction authority.

An electrical disconnect switch shall be installed to disconnect all power to the unit.

Connect all wiring to the appropriate terminals as shown on the electrical wiring diagram supplied with the unit. The wiring and electrical components shall be adequate for the service listed on the unit’s electrical data nameplate.



NOTE

Use only flexible cabling designed for outdoor use when routing power and control cabling across a movable bridge.

2.2.5. PRECAUTIONS BEFORE INITIAL STARTUP



CAUTION

DO NOT OPERATE THE UNIT UNTIL ALL INSTALLATION AND CONNECTION ARRANGEMENTS HAVE BEEN OBSERVED. BE SURE ALL SWITCHES AND CIRCUIT BREAKERS ARE OFF AND INPUT VOLTAGE, PHASE ROTATION AND FREQUENCY REQUIREMENTS HAVE BEEN MET.

A variety of safety procedures are available from the factory. It is the responsibility of the customer or his Engineer to determine if the unit has been specified with all of the safety devices required for this application, specialized safety regulations or work rules.

Safety considerations include the accessibility of the equipment to non-service personnel, the provision of electrical lockout switches, maintenance procedures and automatic control sequences.



CAUTION

DISCONNECT INPUT POWER TERMINAL BLOCKS AND ALL INPUT AND OUTPUT CABLE CONNECTIONS TO THE BMS BEFORE APPLYING INPUT POWER TO THE UNIT TO AVOID DAMAGING THE BMS.

1. Check for proper input power phase rotation (A, B, C) to the unit on line side of service disconnect feeding the unit.
2. Make sure that the input power rating; voltage and frequency correspond with unit nameplate and/or project/specific installation drawings. Take voltage measurements on the line side of circuit breaker that will feed the service cabinet.
3. Open access doors and visually check all components and exposed wiring.
4. Check ventilation openings for obstructions.



WARNING

LOOSE POWER CABLE CONNECTIONS CAUSE HEATING AT THE TERMINALS AND EVENTUALLY DAMAGE THE EQUIPMENT AND MAY CAUSE A FIRE.

5. Check that input and output power cabling is tightly secured in terminal blocks. Ensure that all cable connections to the unit are made with weather-tight cable sealing hubs of the proper size for the cable being connected.
6. Complete all project requirements for testing the unit.

2.3. REPAIRS

Repair of malfunctioning or damaged components shall be accomplished by the removal and replacement of the malfunctioning or damaged component.

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3. GENERAL INFORMATION AND OPERATION INSTRUCTIONS

This section of the manual provides information regarding safety precautions, operation and monitoring of the unit. Manual operation procedures described in this chapter are limited to trained maintenance technicians only.

3.1. GENERAL

3.1.1. SAFETY PRECAUTIONS

Operators must read, understand and follow all instructions on the 2500+ GPU and in the manuals. Operators must be familiar with the controls and wear personal protection equipment before operating.

	<p><u>WARNING</u> ONLY QUALIFIED PERSONNEL SHALL INSTALL, OPERATE, AND MAINTAIN THIS GROUND POWER UNIT.</p>
	<p><u>WARNING</u> THE ELECTRICAL INSTALLATION SHALL FULFILL ALL LOCAL REGULATIONS AND LEGISLATION TO ENSURE THE HEALTH AND SAFETY OF PERSONNEL.</p>
	<p><u>WARNING</u> ELECTRICAL POWER OR TOUCHING LIVE PARTS CAN CAUSE FATAL SHOCKS AND SEVERE BURNS.</p>
	<p><u>WARNING</u> MAKE SURE THAT THE OUTPUT POWER IS OFF WHEN CONNECTING THE UNIT TO THE AIRCRAFT.</p>
	<p><u>WARNING</u> FREQUENTLY INSPECT THE INSTALLATION FOR DAMAGE AND BARE WIRING. REPAIR/REPLACE AS NECESSARY.</p>
	<p><u>WARNING</u> ROTATING FAN BLADES CAN CAUSE SERIOUS INJURY OR CUTS. KEEP HANDS CLEAR. TURN OFF UNIT BEFORE SERVICING.</p>
	<p><u>WARNING</u> HOT SURFACES INSIDE! CONTACT MAY CAUSE BURNS. DO NOT TOUCH. ALLOW A COOLING PERIOD BEFORE SERVICING.</p>

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3.2. OPERATOR'S INSTRUCTIONS

3.2.1. BASIC OPERATION

The unit can be operated using the pushbuttons on the front panel. The HMI is used primarily for settings and monitoring and will be discussed in the next section. A description of each control and indicator can be found in Chapter 1 in Table 1-1. The following is a sequence of the standard flow of operation.

1. Turn the circuit breaker handle to the ON position. Verify that the input voltage levels are as expected on the Input Voltage Screen described in Section 3.2.2.3.3. Ensure that there are no errors present on the HMI.
2. Depending on the desired output, press either ON #1 or ON #2 (Dual output or Combi only). This will start the 400 Hz output or second output respectively.
3. To stop the unit, press the OFF/Reset button.
4. Turn the circuit breaker handle to the OFF position to completely power down the unit.

Do not use the Emergency Stop button except in the case of emergencies. Continuous use of the Emergency Stop button instead of the OFF/Reset button can cause damage to the unit. To reset the Emergency Stop button, turn it clockwise until it pops up to its original position, reset the breaker and return to step one above.

3.2.2. HUMAN MACHINE INTERFACE

The human machine interface (HMI) allows an operator to control and configure the 2500+ GPU via a touchscreen.

Figure 3-1 contains the HMI menu system.

Table 3-1 describes the HMI screen elements.

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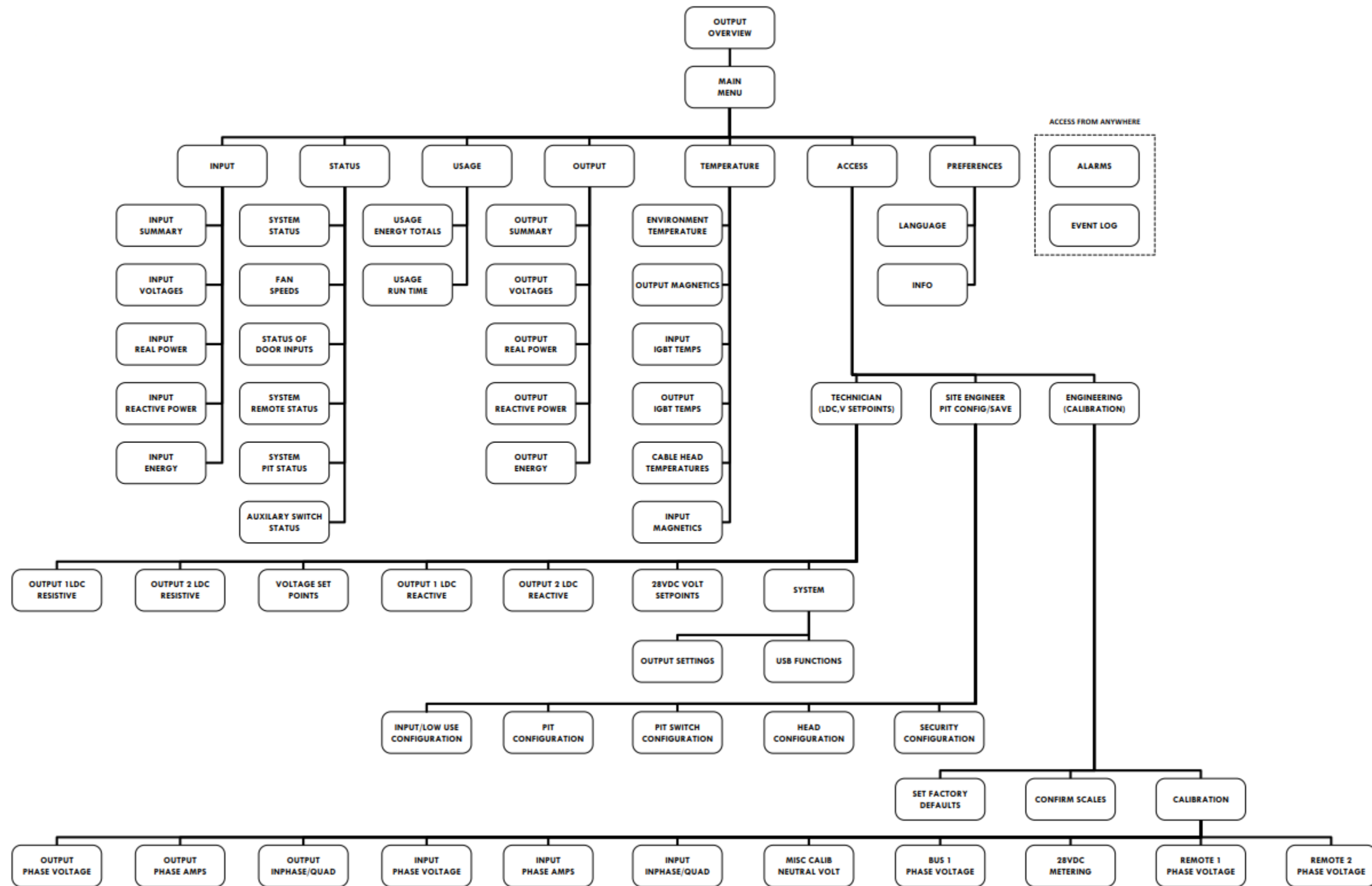
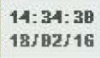







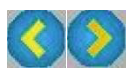
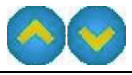


Figure 3-1. 2500+ HMI Menu System

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Table 3-1. HMI Touch Screen Element Description	
Symbol	Description
	Time and Date
	Status indicator GPU, Grey = Off, Green = On
	Alarm Indicator, Grey = No Alarm, Red = Alarm Active
	Pit 1 Switch Indicator, Grey = Closed, Yellow = Transition State, Green = Open
	Pit 2 Switch Indicator, Grey = Closed, Yellow = Transition State, Green = Open
	Home button -> Overview screen
	Alarm button -> Active alarm screen
	Event log screen -> last alarm screen
	Pushing the arrow left or arrow right buttons will scroll through the different screens
	Pushing the arrow up or arrow down buttons will increase or decrease a value

3.2.2.1. HMI OUTPUT OVERVIEW

The default HMI display screen that is normally active when the unit is running is shown in Figure 3-2. Several features on this screen are common to all screens. These features include a GPU RUNNING indicator and an ALARM indicator. Not shown in this illustration is a PIT STATUS indicator that is not visible if the system does not include pits such as when the GPU is mounted under a passenger boarding bridge.

The default display screen will also show a pop-up alarm banner that indicates the most recent alarm. If the unit is in an overload condition, an overload indicator progressively turns the large white area behind the power meters red from the bottom up. When the white area turns completely red the GPU will shut down due to an overload condition. Figures 3-3 to 3-5 illustrate the progressive change in background color to red and Figure 3-5 illustrates the pop-up alarm indication of OUTPUT OVERLOAD in the bottom of the screen.

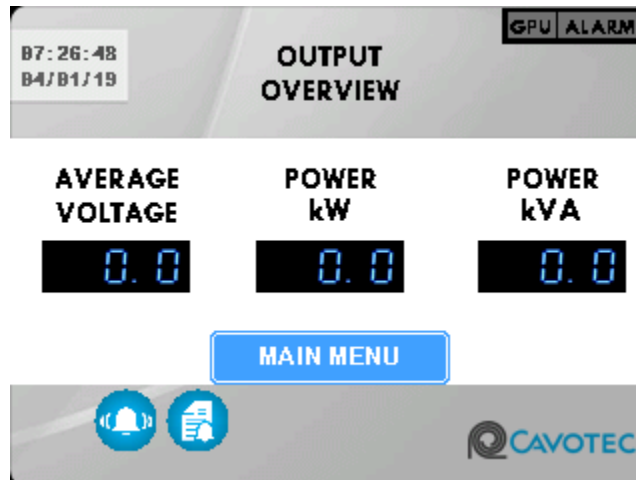


Figure 3-2. Overview Screen

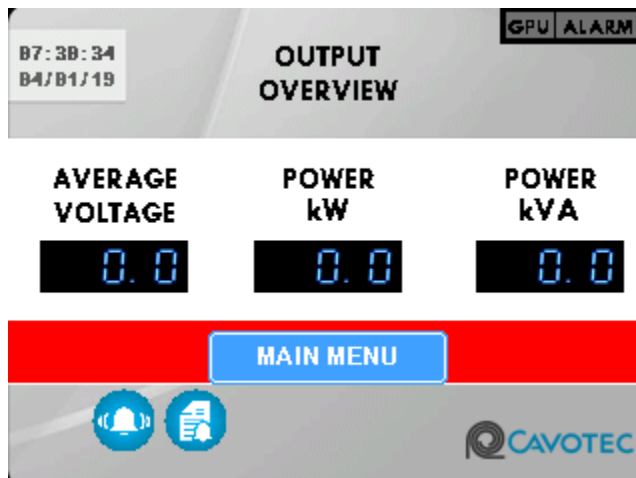


Figure 3-3. Overview Screen with Overload Indicator at 25%

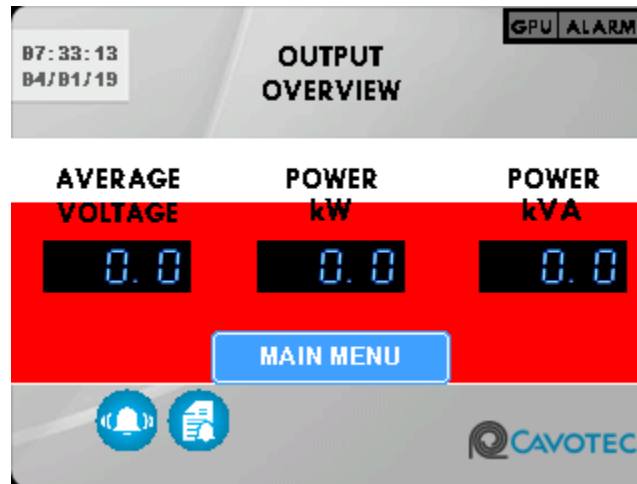


Figure 3-4. Overview Screen with Overload Indicator at 75%

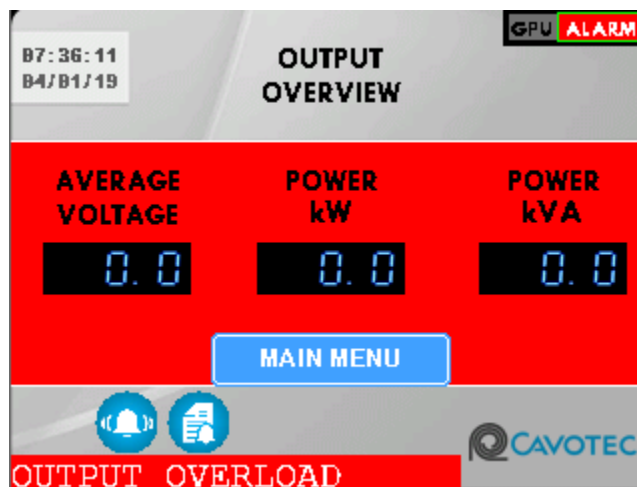


Figure 3-5. Output Overview Screen in Full Overload Condition

3.2.2.1.1. AVERAGE VOLTAGE

The value shown in the average voltage field on the output overview screen shown in Figure 3-2 is calculated by averaging all three output phase-to-neutral voltages.

3.2.2.1.2. POWER KW

The value shown in the power kW field on the overview screen shown in Figure 3-2 is calculated by summing the power supplied by all three phases. The individual per-phase power is the product of the in-phase current and the phase-to-neutral voltage.

3.2.2.1.3. POWER KVA

The value shown in the power kVA field on the overview screen shown in Figure 3-2 is calculated by multiplying the voltage in each phase line to neutral by the total current in each phase. The displayed value is the sum of the kVA per phase.

3.2.2.1.4. PIT STATUS INDICATOR

Figures 3-6 through 3-8 show the various overview screens showing PIT STATUS.

Figure 3-6 shows a single pit configuration with the pit not making the OPEN or CLOSED status switches.

Figure 3-7 shows a two-pit configuration with the EMERGENCY STOP alarm active.

Figure 3-8 shows a single pit configuration with all conditions normal and the pit fully open.

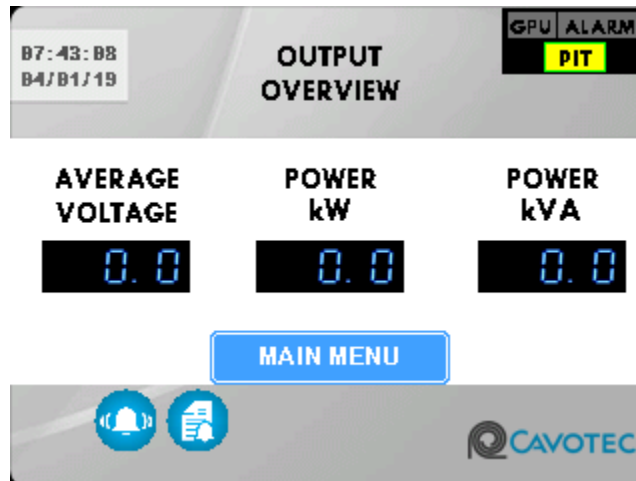


Figure 3-6. Overview Screen Configured for One Pit with Pit Not Making the OPEN or CLOSED Switches

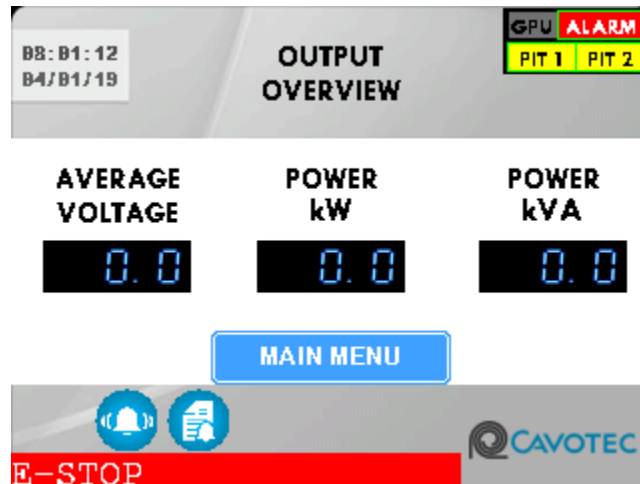


Figure 3-7. Overview Screen Configured for Two Pits and E-STOP Alarm Active

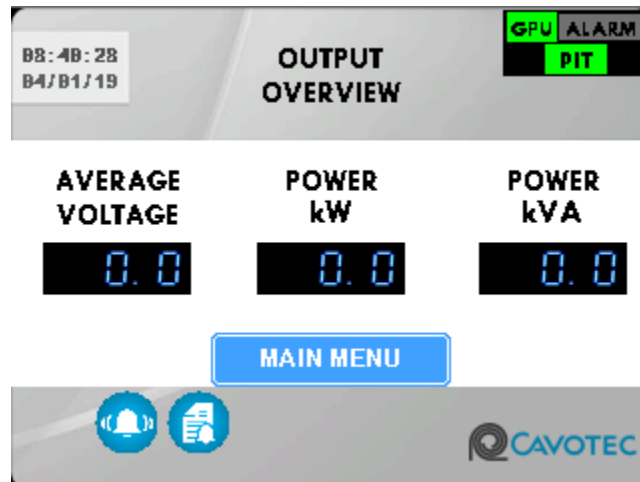


Figure 3-8. Overview Screen Configured for One Pit, Running Normally, Pit Fully OPEN and No Alarm

3.2.2.2. MAIN MENU SCREEN

The main menu screen shown in Figure 3-9 is one of the few screens that shows no indications other than the normal status indicators in the upper right, the alarm annunciator on the bottom and the overload indication in the white area. This central screen is the gateway to access the available features included in this system.

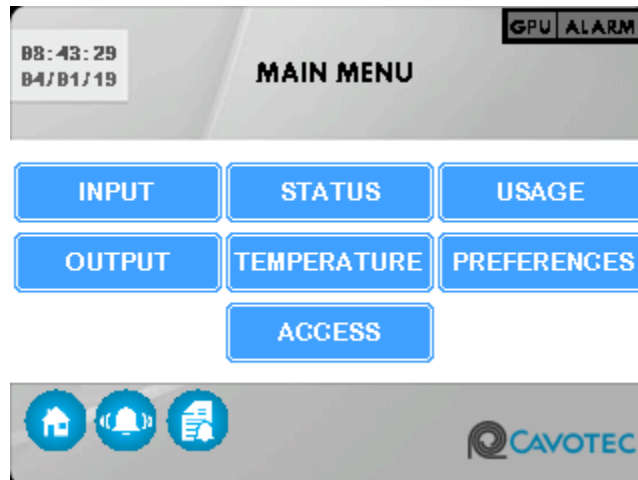


Figure 3-9. Main Menu

3.2.2.3. INPUT SCREENS

3.2.2.3.1. INPUT MENU

The input menu screen shown in Figure 3-10 allows the operator to select which input screen needs to be viewed. Every available input screen is listed here for easy selection. Each screen is further defined in the sections that follow.

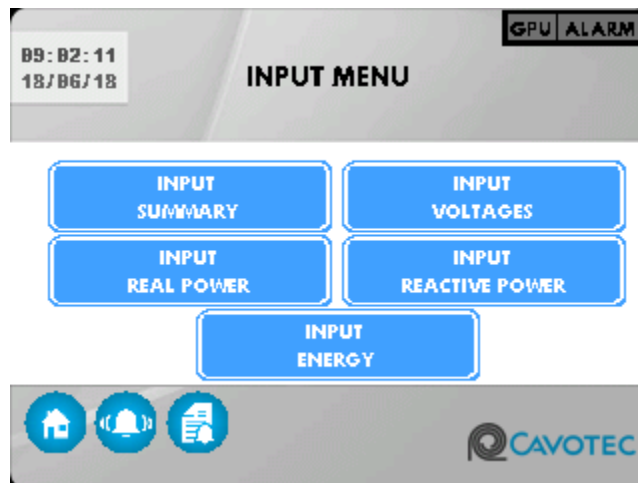


Figure 3-10. Input Menu

3.2.2.3.2. INPUT SUMMARY

The input summary screen shown in Figure 3-11 shows the various meters associated with the incoming power supplied to the GPU. In addition to the input menu screen, this screen example shows a typical

navigation shortcut cluster in the lower left hand corner of the screen. From left to right, the navigation shortcut functions are defined by their graphic. The small house graphic is the home button and returns the user to the previous menu screen when pressed. The bell graphic is the alarm button and takes the user to the ACTIVE ALARMS screen. The paper list with the small bell graphic on the lower right takes the user to the EVENT LOG screen.

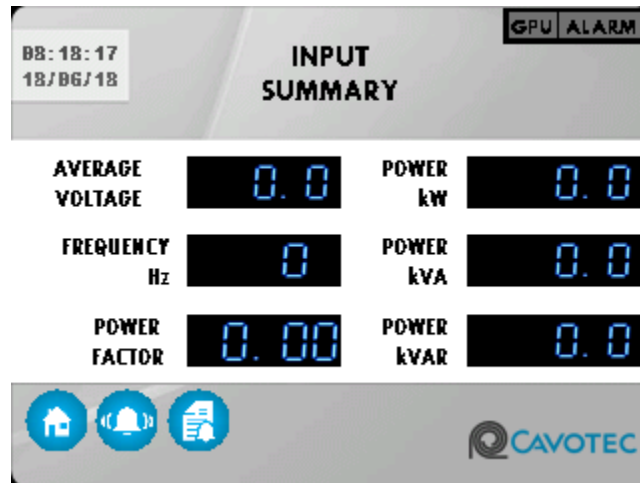


Figure 3-11. Input Summary

3.2.2.3.2.1. AVERAGE VOLTAGE

The value displayed in the average voltage field shown in Figure 3-11 is the average of the sum of the individual line-to-line voltages.

3.2.2.3.2.2. POWER KW

The value displayed in the power kW field shown in Figure 3-11 is calculated by summing the product of the in-phase current and line-to-neutral voltage for each phase.

3.2.2.3.2.3. POWER KVA

The value displayed in the power kVA field shown in Figure 3-11 is calculated by summing the product of the voltage and total current for each phase.

3.2.2.3.2.4. FREQUENCY HZ

The value displayed in the frequency Hz field shown in Figure 3-11 is measured by the input voltage sense.

3.2.2.3.2.5. POWER FACTOR

The value displayed in the power factor field shown in Figure 3-11 is calculated by averaging the sum of the phase power factors. Phase power factor is measured by dividing the in-phase current by total phase current.

3.2.2.3.2.6. POWER KVAR

The value displayed in the power kVAR field on the input summary screen shown in Figure 3-11 is calculated by summing the phase kVAR. Phase kVAR is the product of phase quadrature current and phase line-to-neutral voltage.

3.2.2.3.3. INPUT VOLTAGES

The input voltage screen shown in Figure 3-12 shows the meters associated with the line-to-line voltages being supplied to the GPU and the DC bus voltage.

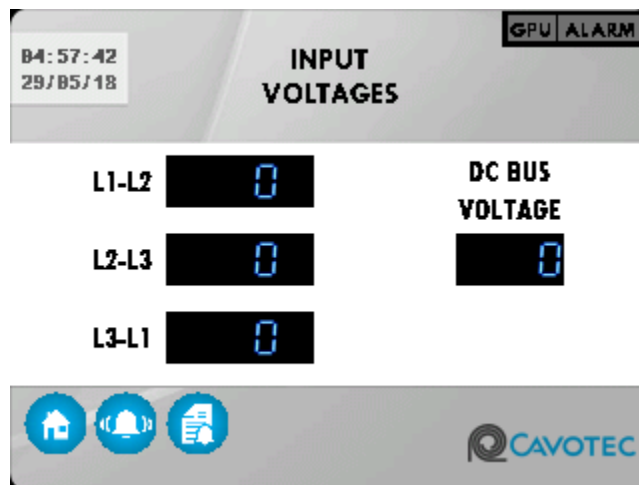


Figure 3-12. Input Voltages

3.2.2.3.3.1. INPUT VOLTAGE L1-L2, L2-L3, AND L3-L1

The value shown in the L1-L2, L2-L3 and L3-L1 fields in Figure 3-12 are 12 bit values (0-4095) scaled to show the voltage between phases L1 and L2, L2 and L3, and L3 and L1 respectively.

3.2.2.3.3.2. DC BUS VOLTAGE

The value shown in the DC bus voltage field in Figure 3-12 is a 12 bit value (0-4095) scaled to show the voltage on the DC bus.

3.2.2.3.4. INPUT REAL POWER

The input real power screen shown in Figure 3-13 presents the input phase amps and kilowatts.

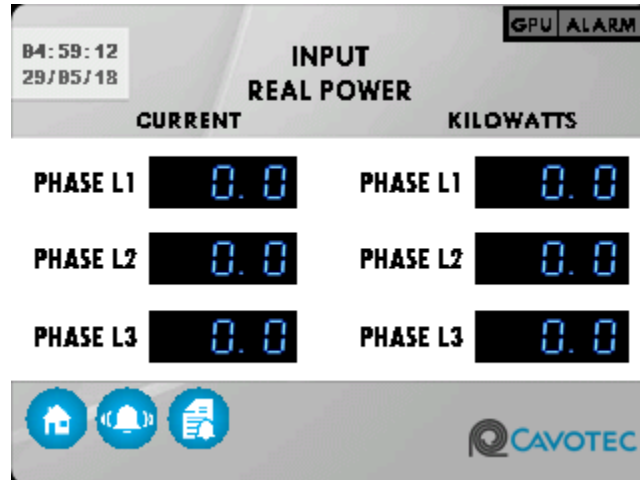


Figure 3-13. Input Real Power

3.2.2.3.4.1. CURRENT PHASE L1, L2, AND L3

The values shown in current phase L1, L2 and L3 fields in Figure 3-13 are 12 bit values (0-4095) scaled to show the total amps for phase L1, L2 and L3 respectively.

3.2.2.3.4.2. KILOWATTS PHASE L1, L2, AND L3

The values shown in the kilowatts phase L1, L2 and L3 fields in Figure 3-13 are the product of in-phase L1, L2 and L3 currents and phase L1, L2 and L3 voltages respectively.

3.2.2.3.5. INPUT REACTIVE POWER

The input reactive power screen shown in Figure 3-14 indicates the kVA and kVAR associated with each phase of the input power.

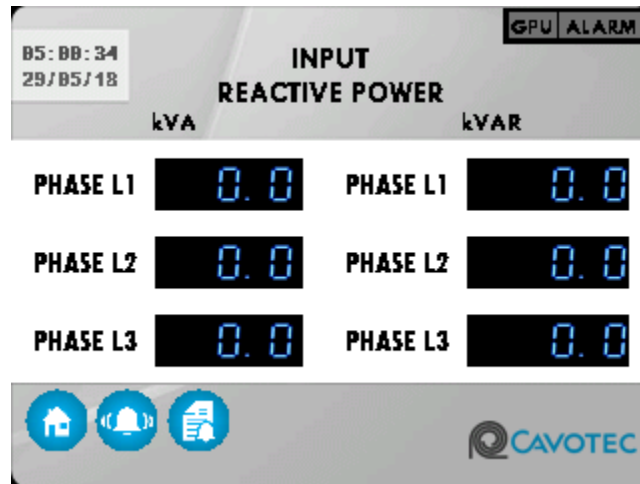


Figure 3-14. Input Reactive Power

3.2.2.3.5.1. KVA PHASE L1, L2, AND L3

The values shown in the kVA phase L1, L2 and L3 fields in Figure 3-14 are 12 bit values (0-4095) scaled to show the kVA for phase L1, L2 and L3 respectively.

3.2.2.3.5.2. KVAR PHASE L1, L2, AND L3

The values shown in the kVAR phase L1, L2 and L3 fields in Figure 3-14 are the product of phase L1, L2 and L3 quadrature current and phase L1, L2 and L3 line-to-neutral voltages respectively.

3.2.2.3.6. INPUT ENERGY

The screen shown in Figure 3-15 indicates power usage in kW, kVA, and kVAR for the input side of the GPU.

This is the last of the input screens. From the main menu screen shown in Figure 3-9, press the status button to navigate to the next series of screens.

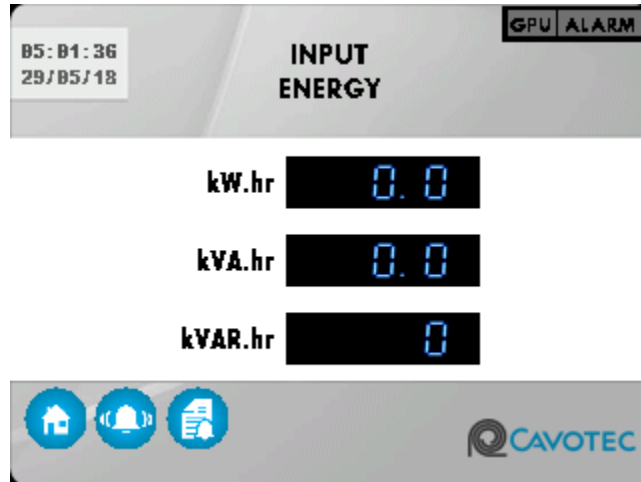


Figure 3-15. Input Energy

3.2.2.3.6.1. KW.HR, KVA.HR, AND KVAR.HR

The kW.hr, kVA.hr and kVAR.hr fields in Figure 3-15 are totalizing fields that add 1/3600 of the kW, kVA and kVAR respectively every second.

3.2.2.4. STATUS SCREENS

3.2.2.4.1. STATUS MENU

The status menu screen shown in Figure 3-16 allows the operator to select any of the six status screens for viewing. Each screen is explained in the following sections.

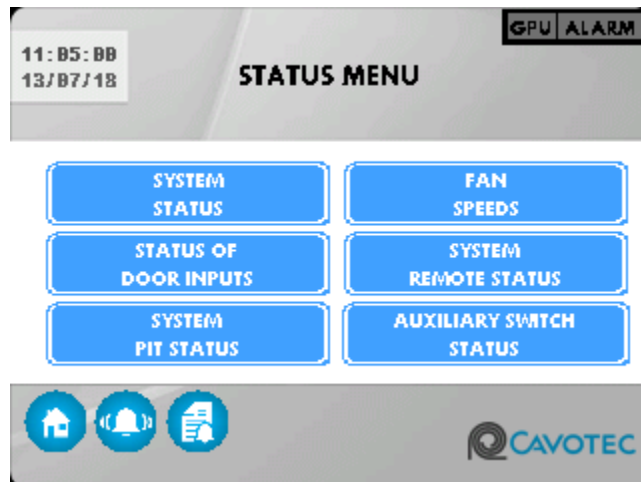


Figure 3-16. Status Menu

3.2.2.4.2. SYSTEM STATUS

The system status screen shown in Figure 3-17 is the first of six status screens. Unlike many other screens, this screen has no meters as it is monitoring digital points. When a condition is true, the text for that indicator turns white and the rectangle containing the text turns from grey to green. These values set status and also create entries in the alarm event table.

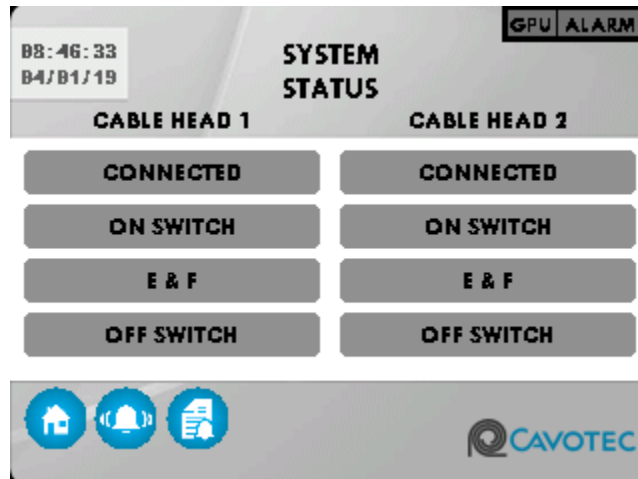


Figure 3-17. System Status

3.2.2.4.3. FAN SPEEDS

The system fan status screen shown in Figure 3-18 indicates the running frequency of each air intake cooling fan.

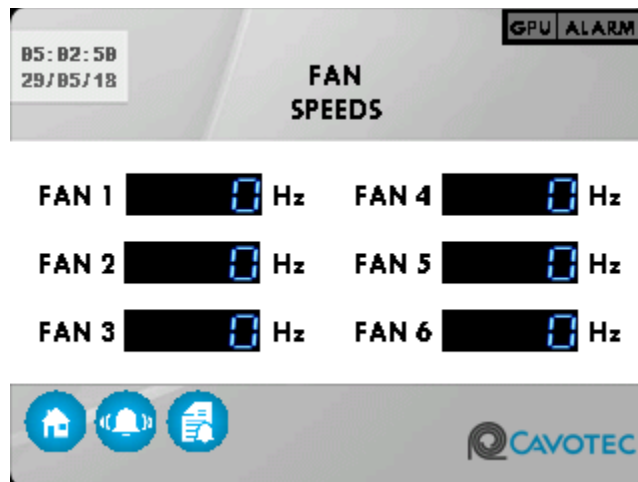


Figure 3-18. Fan Speeds

3.2.2.4.4. SYSTEM STATUS OF DOOR INPUTS

The status of door inputs screen shown in Figure 3-19 allows the operator to confirm that every electrical component on the GPU front panel is correctly signaling the GPU. For example, if the E-STOP is pressed, the corresponding graphic will activate on the screen. The same is true for each of the other buttons.

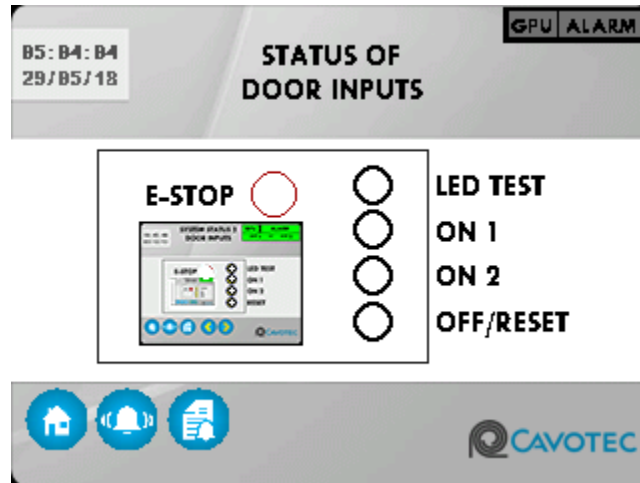


Figure 3-19. System Status of Door Inputs

3.2.2.4.5. SYSTEM REMOTE STATUS

The system remote status screen is shown in Figure 3-20. As with the first system status screen, the grey indicators will turn green and the text will turn white if the corresponding sensor is activated. The large green area identifies the voltage source.

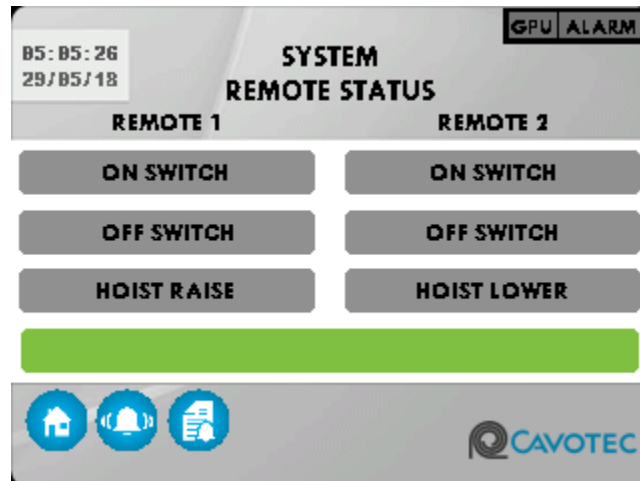


Figure 3-20. System Remote Status

3.2.2.4.6. SYSTEM PIT STATUS

The system pit status screen shown in Figure 3-21 helps diagnose and confirm the status of the pit indication switches.

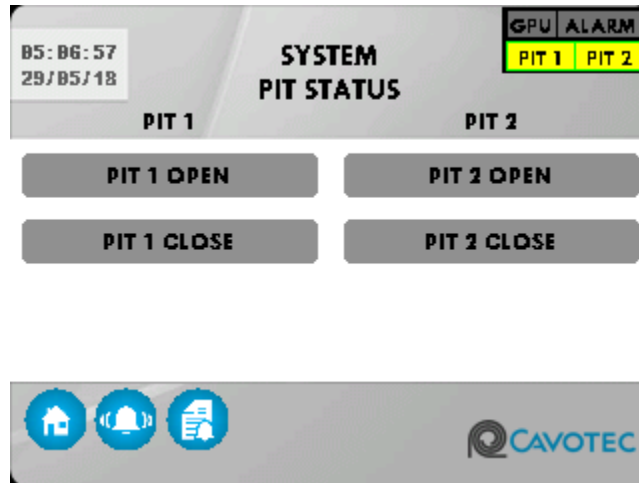


Figure 3-21. System Pit Status

3.2.2.4.7. AUXILIARY SWITCH STATUS

The GPU's inter breaker status is reported in the screen shown in Figure 3-22.

The main circuit breaker is operated in the GPU by the handle mounted to the customer interface panel.

The input contactor receives input power for the GPU after the soft-start sequence is complete.

Output 1 contactor provides output power to one set of aircraft supply cables and output 2 contactor provides output power to a second set of aircraft supply cables.

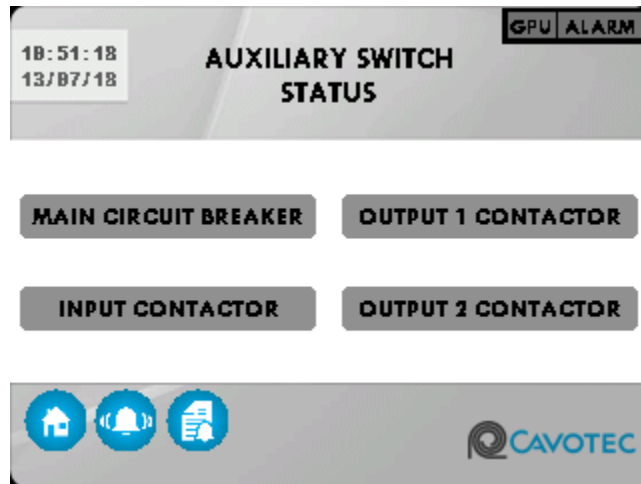


Figure 3-22. Auxiliary Switch Status

3.2.2.5. USAGE SCREENS

3.2.2.5.1. USAGE MENU

The usage menu screen is shown in Figure 3-23. This menu allows the operator to select between the two usage screens.

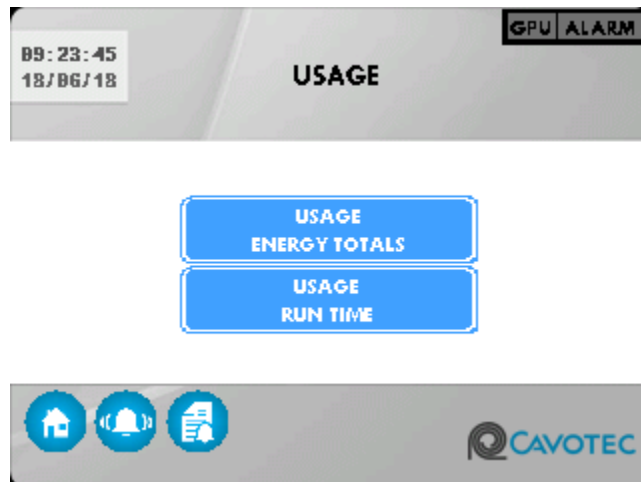


Figure 3-23. Usage Menu

3.2.2.5.2. USAGE ENERGY TOTALS

There are two screens associated with electrical power usage. The first usage screen is shown in Figure 3-24 and displays the totals for the previous aircraft and the current aircraft as well as the total system MW-Hour usage for the life of the machine as well as the rate at which it is using power.

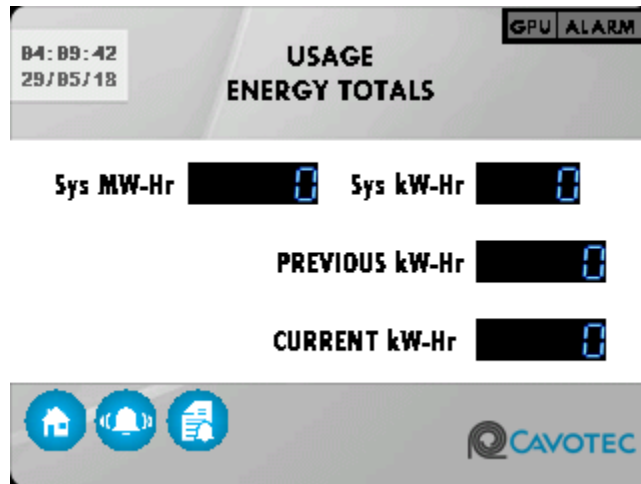


Figure 3-24. Usage Energy Totals

3.2.2.5.3. USAGE RUN TIME

The usage run time screen is shown in Figure 3-25. The screen reports the total number of hours this GPU has been in use since it was installed, how long the GPU was used the last time it ran, and how long the GPU has been running since it was last started.

This is the last of the usage screens. From the main menu screen shown in Figure 3-9, press the output button to navigate to the next series of screens.

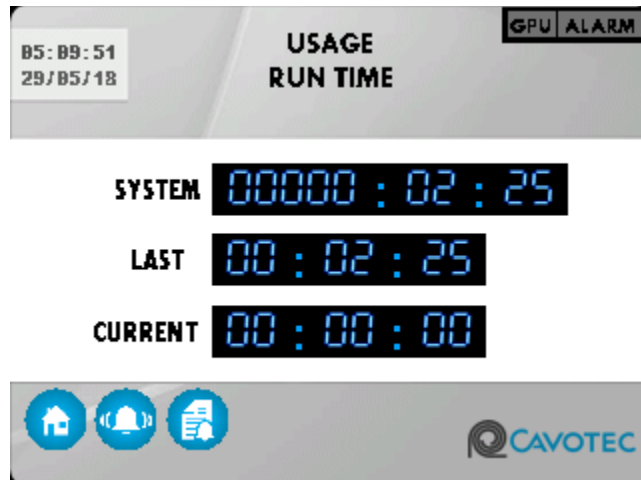


Figure 3-25. Usage Run Time

3.2.2.6. OUTPUT SCREENS

3.2.2.6.1. OUTPUT MENU

The output menu screen is shown in Figure 3-26. This screen allows the operator to select which output screen is to be viewed. Every available output screen is listed in the output menu screen. Each output screen is further defined in the following sections.

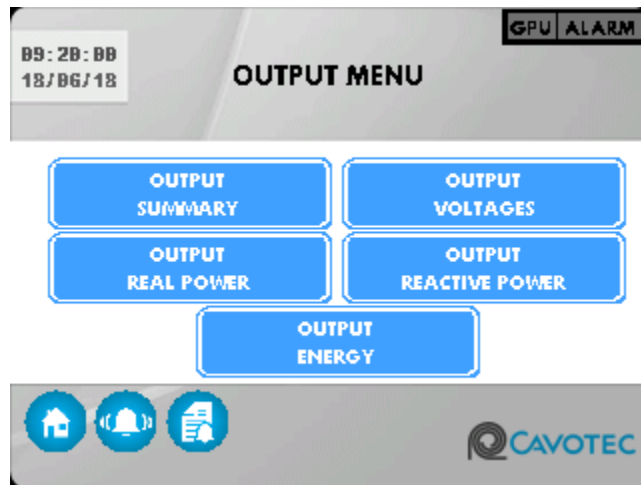


Figure 3-26. Output Menu

3.2.2.6.2. OUTPUT SUMMARY

The output summary screen is shown in Figure 3-27. This screen shows the meters associated with the outgoing power being supplied by the GPU.

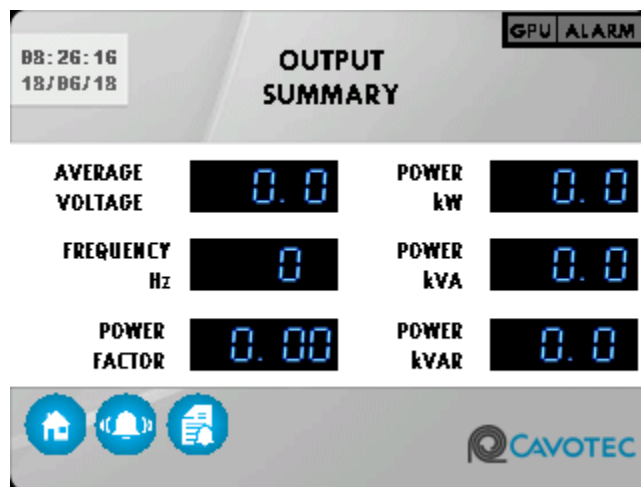


Figure 3-27. Output Summary

3.2.2.6.2.1. AVERAGE VOLTAGE

The value displayed in the average voltage field in Figure 3-27 is the average of the sum of the individual line-to-neutral voltages.

3.2.2.6.2.2. POWER KW

The value displayed in the power kW field in Figure 3-27 is calculated by summing the product of the in-phase current and line-to-neutral voltage for each phase.

3.2.2.6.2.3. POWER KVA

The value displayed in the power kVA field in Figure 3-27 is calculated by summing the product of the voltage and total current for each phase.

3.2.2.6.2.4. FREQUENCY HZ

The value shown in the frequency HZ field in Figure 3-27 is a measurement of the 400Hz output frequency.

3.2.2.6.2.5. POWER FACTOR

The value displayed in the power factor field in Figure 3-27 is calculated by averaging the power factors measured for each phase individually. Phase power factor measured by the ratio of the in-phase current and total phase current.

3.2.2.6.2.6. POWER KVAR

The value displayed in the power kVAR field in Figure 3-27 is calculated by summing the kVAR for each phase. Phase kVAR is the product of phase quadrature current and phase line-to-neutral voltage.

3.2.2.6.3. OUTPUT VOLTAGES

The output voltage screen is shown in Figure 3-28. This screen shows the meters associated with the phase line-to-neutral voltage and the line-to-line voltage being supplied by the GPU inverter to the output cables.

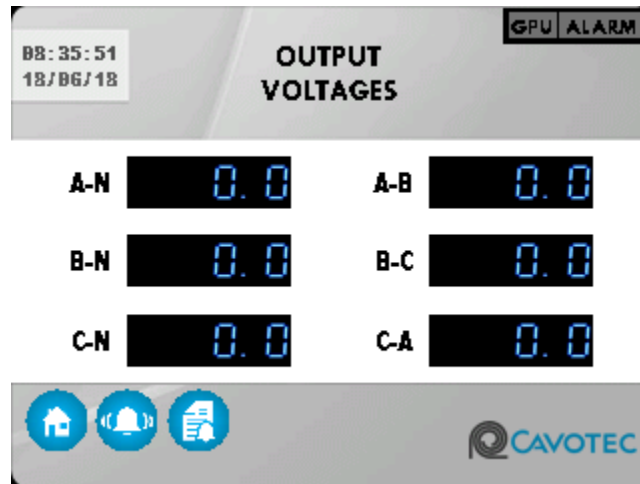


Figure 3-28. Output Voltages

3.2.2.6.3.1. OUTPUT VOLTAGE A-N, B-N, AND C-N

The output voltages in the A-N, B-N and C-N fields in Figure 3-28 show the voltage measured at the point of regulation. When local sense is used the measured values will be from the output contactor. If remote sense is used then the measured voltage from the remote connection will be displayed.

3.2.2.6.3.2. OUTPUT VOLTAGE A-B, B-C, AND C-A

The output voltages in the A-B, B-C and C-A fields in Figure 3-28 show the voltage measured at the point of regulation. When local sense is used the measured values will be from the output contactor. If remote sense is used then the measured voltage from the remote connection will be displayed.

3.2.2.6.4. OUTPUT REAL POWER

The output real power screen is shown in Figure 3-29 and displays the current and kilowatts for each inverter phase.

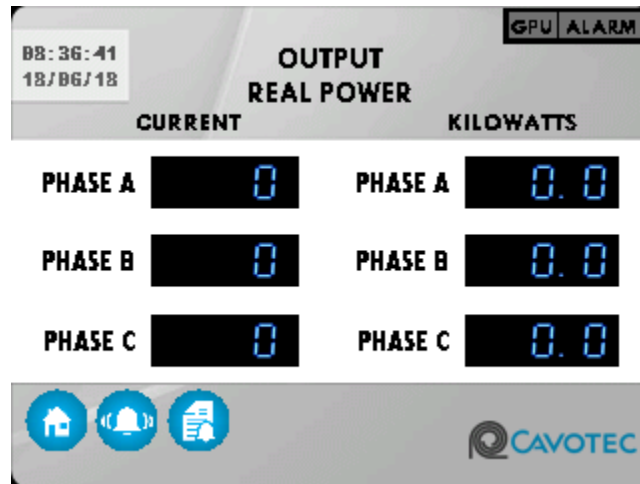


Figure 3-29. Output Real Power

3.2.2.6.4.1. CURRENT PHASE A, B, AND C

The values displayed in the current phase A, B and C fields in Figure 3-29 are 1 measured from the output current transformers located on the line side of the output contactor.

3.2.2.6.4.2. KILOWATTS PHASE A, B, AND C

The values displayed in the kilowatts phase A, B and C fields in Figure 3-29 are the inverter phase A, B and C in-phase currents multiplied by phase A, B and C voltages respectively.

3.2.2.6.5. OUTPUT REACTIVE POWER

The output reactive power screen is shown in Figure 3-30 and indicates the kVA and kVAR associated with each phase of the inverter output power.

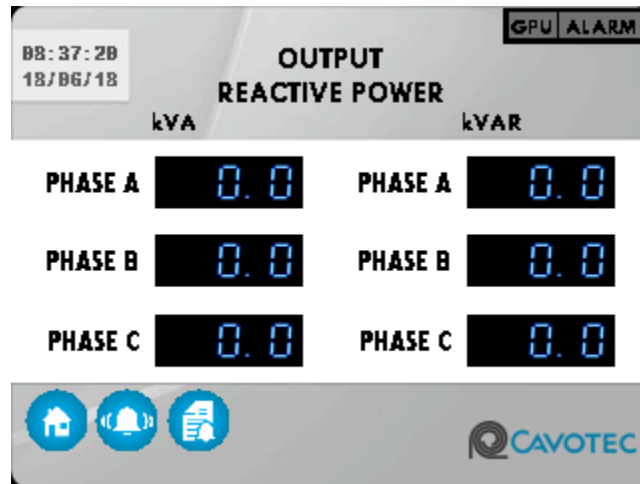


Figure 3-30. Output Reactive Power

3.2.2.6.5.1. KVA PHASE A, B, AND C

The values displayed in the kVA phase A, B and C fields shown in Figure 3-32 is the product of the output voltage line to neutral and the total measured current for that phase.

3.2.2.6.5.2. KVAR PHASE A, B, AND C

The values in the kVAR phase A, B and C fields shown in Figure 3-32 are the product of inverter phase quadrature current and inverter line to neutral voltage for phases A, B and C respectively.

3.2.2.6.6. OUTPUT ENERGY

The output energy screen is shown in Figure 3-31 and indicates power usage in kW, kVA, and kVAR for the output side of the GPU.

This is the last of the output screens. From the main menu screen shown in Figure 3-9, press the alarms button to navigate to the next series of screens.

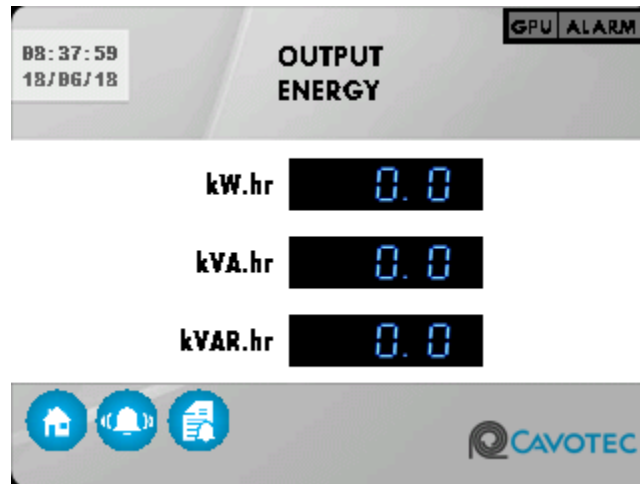


Figure 3-31. Output Energy Screen

3.2.2.6.6.1. KW.HR, KVA.HR, AND KVAR.HR

The kW.hr, kVA.hr and kVAR.hr fields in Figure 3-31 are totalizing fields that add 1/3600 of the kW, kVA and kVAR respectively every second.

3.2.2.7. ALARM SCREENS

3.2.2.7.1. ACTIVE ALARMS

The active alarms screen is shown in Figure 3-32. This screen displays all active alarms and alarms that have not been cleared. Up to six alarms can be displayed at a time. A fully populated view of the active alarms screen is shown in Figure 3-33. Alarms will be cleared once the issue has been resolved and the reset button has been pushed. Table 3-2 gives the name and description of each possible alarm in the system. See Chapter 2 for troubleshooting procedures for each alarm.

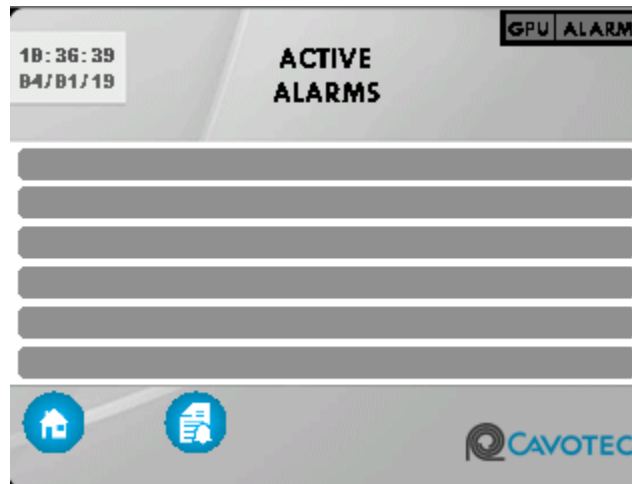


Figure 3-32. Active Alarms Screen (Empty)

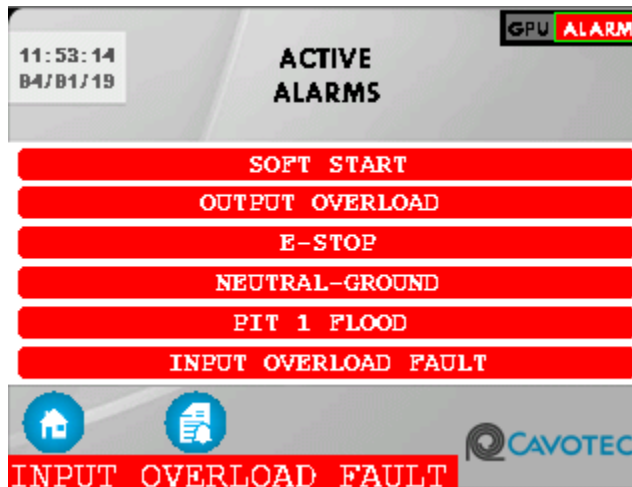


Figure 3-33. Active Alarms Screen (Populated)

Table 3-2.
Alarm Descriptions

Alarm	Description
SOFT START	Unit startup failure
DC LOW	Voltage of the DC bus drops below allowed value
DC HIGH	Voltage of the DC bus raised above allowed value
INPUT VOLTAGE	Circuit breaker is open or supply voltage is not within specified range
INPUT CONTACTOR	Input contactor feedback disconnected or contactor has failed

Table 3-2. (Cont.)	
Alarm Descriptions	
Alarm	Description
INV DAISY CHAIN	Inverter gate driver board not properly connected
PFC DAISY CHAIN	PFC gate driver board not properly connected
POWER SUPPLY	Board power supplies have failed
OUTPUT OVERLOAD	I ² t timer has accumulated to max. value due to overload
FORCED SHUTDOWN	Automatic shutdown caused by internal failure
NODE MISSING	Internal processor offline
OUTPUT LOW VOLTAGE	Output voltage drops below allowed value
OUTPUT HIGH VOLTAGE	Output voltage raised above allowed value
PFC LOW VOLTAGE	Input voltage drops below allowed value
PFC HIGH VOLTAGE	Input voltage raised above allowed value
DOOR INTERLOCK	HMI panel door is open
E-STOP	Emergency Stop has been pressed or disconnected
CIRCUIT BREAKER TRIP	Circuit breaker tripped due to internal fault
PFC OVER TEMP	Input IGBTs exceed maximum allowable temperature
INV OVER TEMP	Output IGBTs exceed maximum allowable temperature
OUTPUT 1 CONTACTOR	Output 1 contactor feedback disconnected or contactor has failed
OUTPUT 2 CONTACTOR	Output 2 contactor feedback disconnected or contactor has failed
OUTPUT UNBALANCED	Output voltage sum is not equal to zero
FAN FAILURE	Fan has malfunctioned or become disconnected
NEUTRAL-GROUND	Neutral to ground voltage exceeds allowable level
INPUT CIRCUIT BREAKER	Input circuit breaker feedback disconnected or breaker has failed
PFC RIBBON CABLE	PFC ribbon cable not properly connected
INV RIBBON CABLE	Inverter ribbon cable not properly connected
DC BUS BLEEDER	DC bus failed to properly bleed down to safe level
OUTPUT FREQUENCY	Output frequency is out of range
MISSING EF	Missing E & F feedback
MISSING SPLIT PIN	Missing split pin feedback
PFC FREQUENCY ALARM	PFC frequency is out of range
PIT 1 FLOOD	Pit 1 is flooded

Table 3-2. (Cont.)	
Alarm Descriptions	
Alarm	Description
PIT 2 FLOOD	Pit 2 is flooded
HEAD 1 OVER TEMP	Cable head 1 exceeds maximum allowable temperature
HEAD 2 OVER TEMP	Cable head 2 exceeds maximum allowable temperature
28V OVERCURRENT	DC output current exceeds maximum allowable value
28V OVERVOLTAGE	DC output voltage raises above set limit
28V UNDERVOLTAGE	DC output voltage drops below set limit
OUTPUT SHORT CIRCUIT	Short circuit detected on the output
28V OVERTEMP	DC output cable exceeds maximum allowable temperature
INSULATION FAULT	Insulation resistance drops below minimum allowable value
INPUT OVERLOAD FAULT	Input current exceeds set limit for a set amount of time

3.2.2.7.2. EVENT LOG

The event log screen is shown in Figure 3-36. The event log shows the alarms and the day and time the alarm occurred. Events such as buttons pressed and interlocks will show as events with a date and time stamp. Active alarms are shown in red text. Alarms that have been resolved are in green text. Events that do not constitute an alarm are in blue text as long as they are active and gray text when the conditions that triggered the blue text are no longer present.

This is the last of the alarms screens. From the main menu screen shown in Figure 3-9, press the temperature button to navigate to the next series of screens.

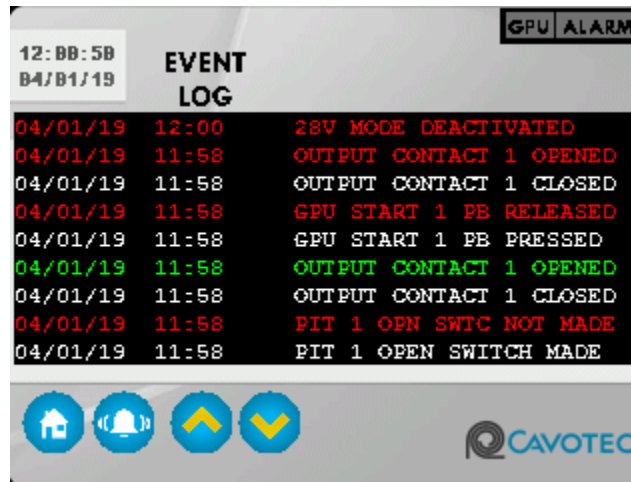


Figure 3-34. Event Log Screen

3.2.2.8. TEMPERATURE SCREENS

3.2.2.8.1. TEMPERATURE MENU

The menu screen shown in Figure 3-35 allows the operator to select the desired temperature monitoring screen. There are six temperature screens total with each monitoring a maximum of seven temperatures from RTDs mounted in the GPU for a total of 31 temperatures. Each screen has a pushbutton to convert all temperatures to °F. Each screen is described in the following sections.

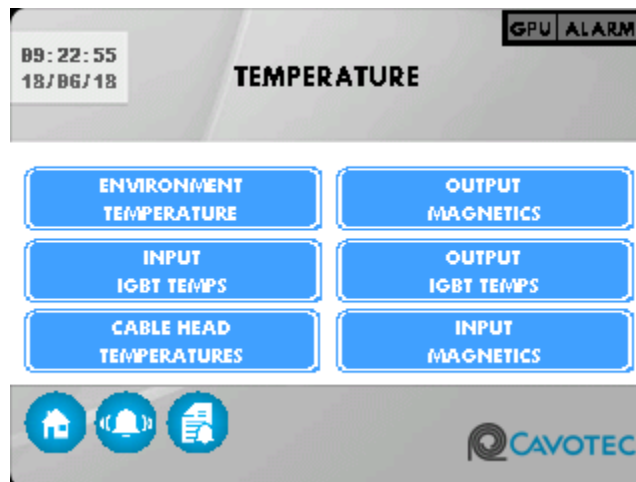


Figure 3-35. Temperature Menu

3.2.2.8.2. ENVIRONMENT TEMPERATURES

The environmental temperature screen is shown in Figure 3-36. Reporting the cooling air exhaust temperature and the cooling air inlet temperature together will provide operators and maintainers with information to determine if heat dissipation requires attention. Other values displayed on the environmental temperature screen include PWB IO/ADC board temperature and air pressure.

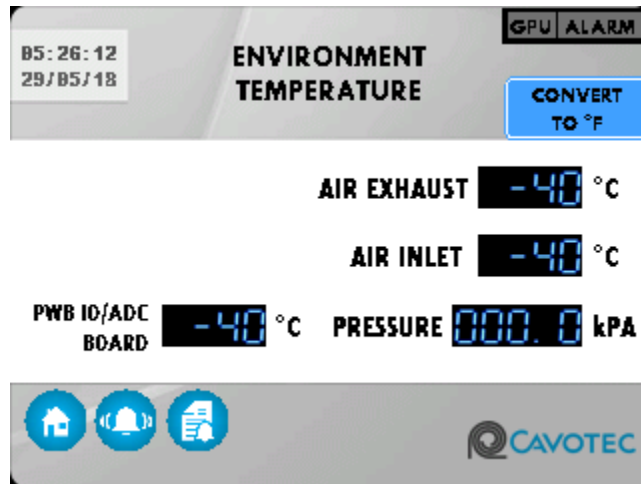


Figure 3-36. Environment Temperature

3.2.2.8.3. OUTPUT MAGNETICS TEMPERATURES

The screen shown in Figure 3-37 shows the 400 Hz transformer temperatures.

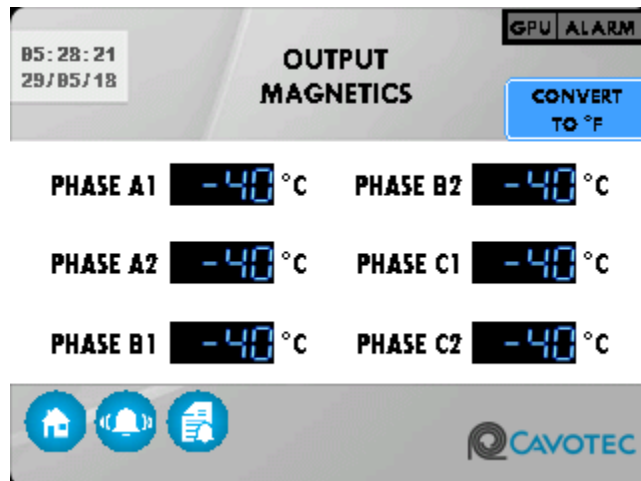


Figure 3-37. Output Magnetics Temperature

3.2.2.8.4. INPUT IGBT TEMPERATURES

The input IGBT temperature screen is shown in Figure 3-38. This screen is useful for determining that the IGBT's thermal conductivity to the heat sink is not impeded during routine maintenance.

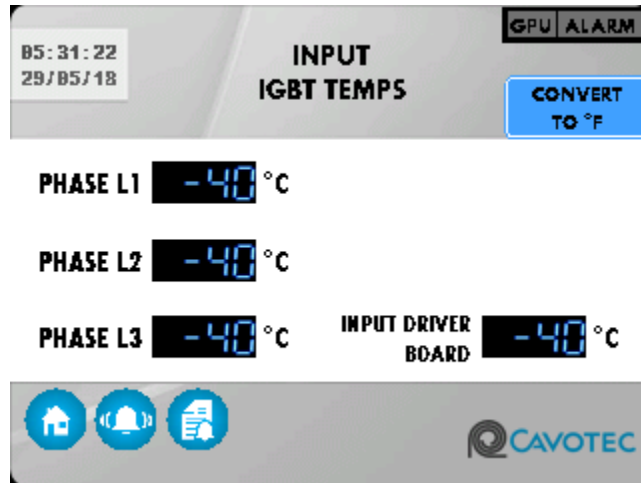


Figure 3-38. Input IGBT Temperature

3.2.2.8.5. OUTPUT IGBT TEMPERATURES

The screen shown in Figure 3-39 shows the output IGBT temperatures. This screen is useful for determining that the IGBT's thermal conductivity to the heat sink is not impeded during routine maintenance.

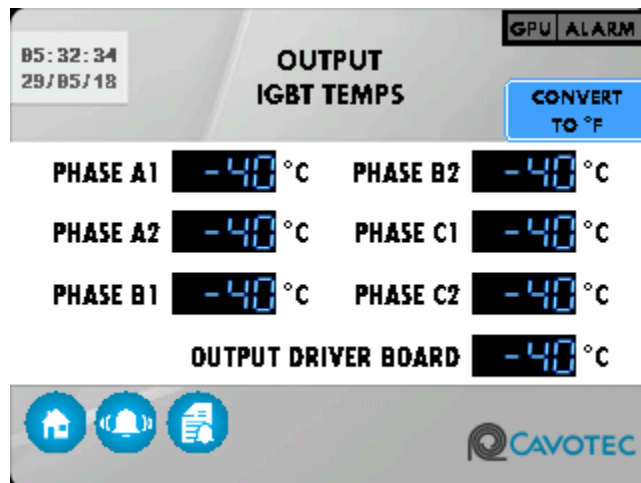


Figure 3-39. Output IGBT Temperatures

3.2.2.8.6. CABLE HEAD TEMPERATURES

The cable head temperature monitoring screen is shown in Figure 3-40. Temperature is reported by phase using a PT1000 type RTD installed inside the cable head.

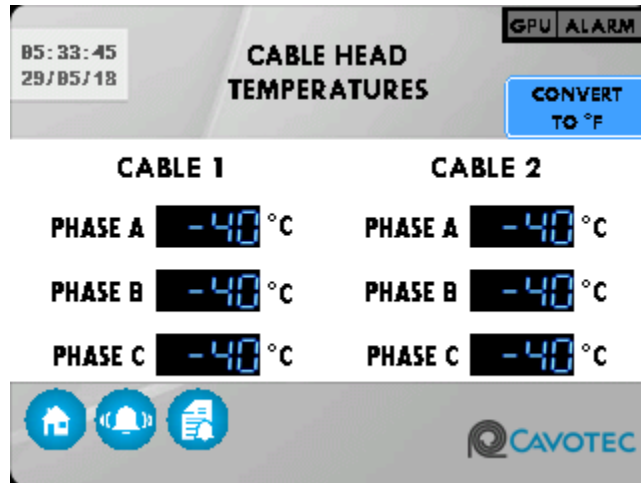


Figure 3-40. Cable Head Temperatures

3.2.2.8.7. INPUT MAGNETICS TEMPERATURES

The power brick input temperature screen is shown in Figure 3-41. This screen monitors the temperature of the input or PFC side of the GPU.

This is the last of the temperature screens. From the main menu screen shown in Figure 3-9, press the access button to navigate to the next series of screens.

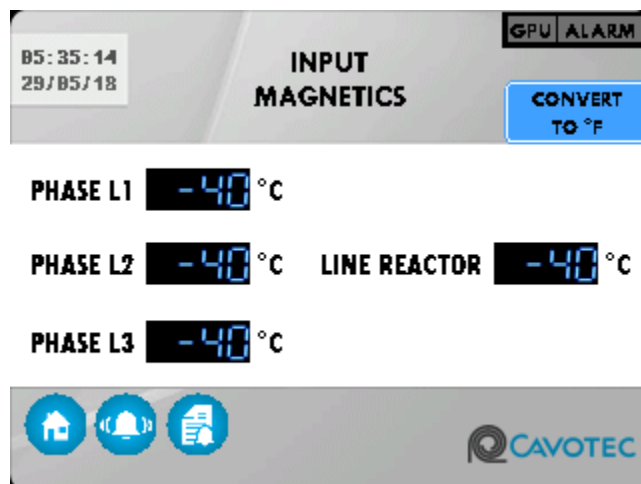


Figure 3-41. Input Magnetics Temperatures

3.2.2.9. ACCESS SCREENS

3.2.2.9.1. ACCESS MENU

The access menu screen is shown in Figure 3-42. This menu allows the operator to access secure functions not generally required for the day-to-day operation of the system.

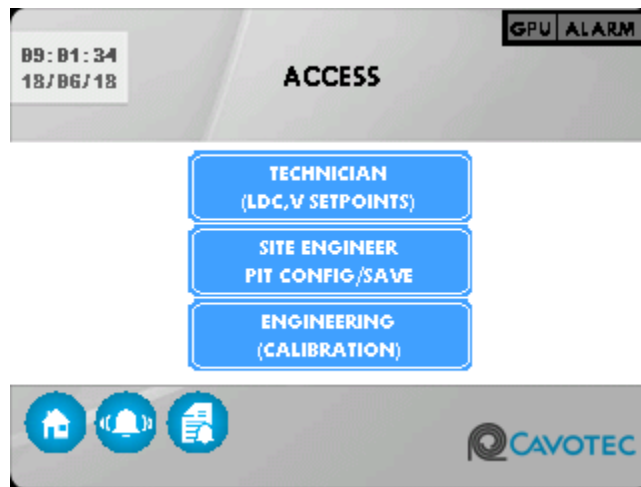


Figure 3-42. Access Menu Screen

3.2.2.9.2. SECURITY SCREEN

The security screen is shown in Figure 3-43. This screen is used to prevent unauthorized access to the unit's scaling parameters.



Figure 3-43. Security Screen

3.2.2.9.3. TECHNICIAN SETTINGS

The technical settings menu screen is shown in Figure 3-44. This menu allows access to the unit’s line drop compensation, voltage set points, and system settings. 28VDC volt set points will not be used in this training manual.

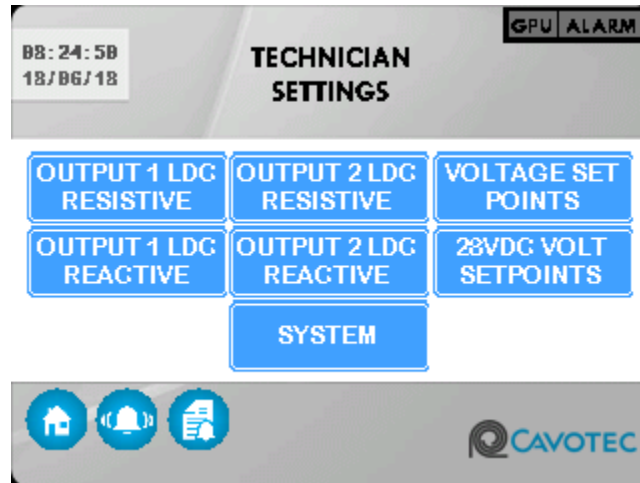


Figure 3-44. Technician Settings

3.2.2.9.4. LINE DROP COMPENSATION RESISTIVE SCREEN

The line drop compensation resistive screen is shown in Figure 3-45. It can be selected for output 1 or for output 2 on dual units. This screen is designed to input the desired compensation values quickly. The six large up and down arrow buttons add or subtract 5 from the value on the meter. The six smaller buttons add or subtract 1 from the value on the meter. Holding the button changes the number faster. When the selector switch for “ONE PHASE” or “ALL PHASES” is set to “ALL PHASES” any up or down button will add or subtract the same amount from all three phases.

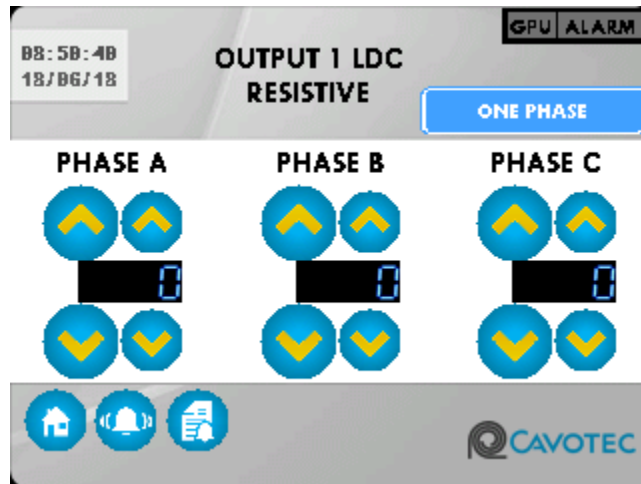


Figure 3-45. Line Drop Compensation Resistive Screen

3.2.2.9.5. LINE DROP COMPENSATION REACTIVE SCREEN

The line drop compensation reactive screen is shown in Figure 3-46. It can be selected for output 1 or for output 2 on dual units. This screen is designed to input the desired compensation values quickly. The six large up and down arrow buttons add or subtract 5 from the value on the meter. The six smaller buttons add or subtract 1 from the value on the meter. Holding the button changes the number faster. When the selector switch for “ONE PHASE” or “ALL PHASES” is set to “ALL PHASES” any up or down button will add or subtract the same amount from all three phases.

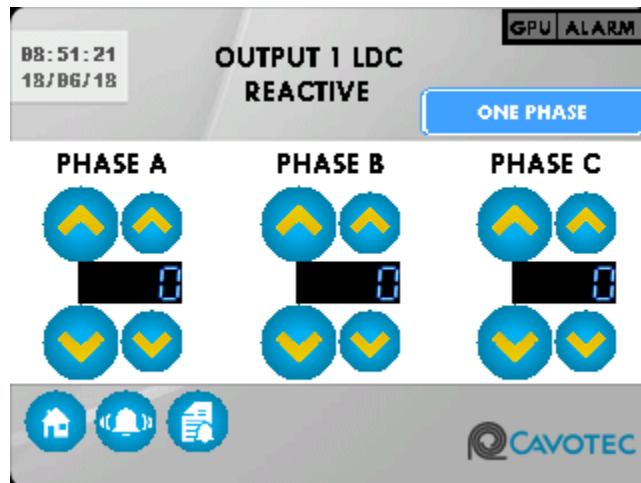


Figure 3-46. Line Drop Compensation Reactive

3.2.2.9.6. VOLTAGE SET POINTS SCREEN

The voltage set points screen is shown in Figure 3-47. This screen is designed to input the desired compensation values quickly. The six large up and down arrow buttons add or subtract 5 from the value on the meter. The six smaller buttons add or subtract 1 from the value on the meter. Holding the button changes the number faster. When the selector switch for “ONE PHASE” or “ALL PHASES” is set to “ALL PHASES” any up or down button will add or subtract the same amount from all three phases.

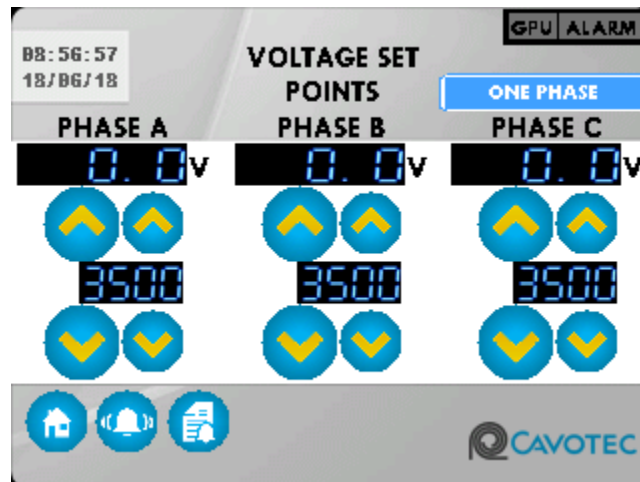


Figure 3-47. Voltage Set Points Screen

3.2.2.9.7. SETTINGS

The settings menu screen is shown in Figure 3-48. This menu allows access maintenance mode, output interlock, output settings, system idle, and USB functions.

Maintenance mode when activated will prevent the unit from starting under any circumstances.

Output interlocked when activated will prevent the unit from closing both output contactors at the same time. Only applicable to dual output units.

System idle will shut down the inverter if the output contactor is deactivated for over 4 minutes. If the unit is not in idle mode, then the unit will continue to run even when not supplying output power.

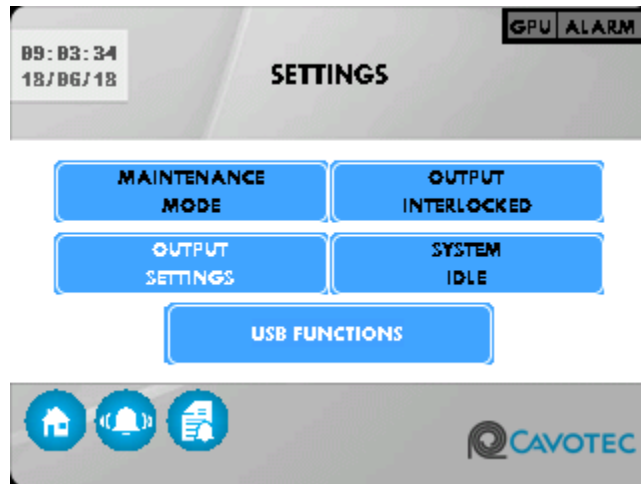


Figure 3-48. Settings Screen

3.2.2.9.8. OUTPUT SETTINGS

The output settings screen is shown in Figure 3-49. This screen is where the micro switch and E & F can be enabled or disabled. On dual output units each output can be toggled separately.

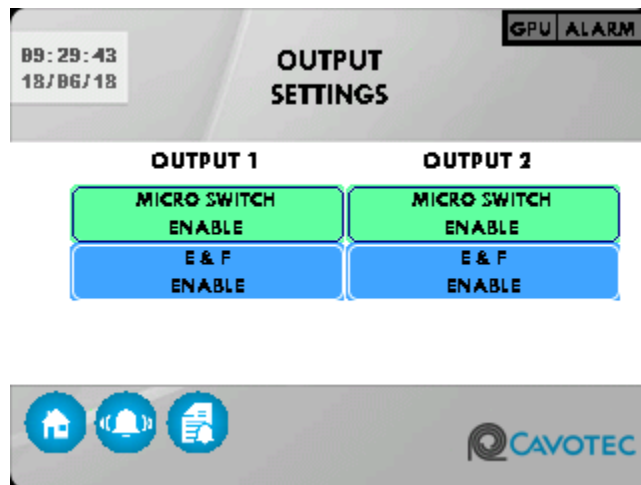


Figure 3-49. Output Settings Screen

3.2.2.9.9. USB FUNCTIONS

The USB menu screen is shown in Figure 3-50. If no USB flash drive is installed, the small red indicator light just below “USB ACTIVE” will not be visible. When a USB flash drive is plugged into the USB port and the HMI recognizes the flash drive, the red indicator light will be visible. To check the files on the flash drive,

press the “DISP” button located in the upper right corner. Once the button is pressed, a file menu will become visible in the gray lined area on the left as shown in Figure 3-51.

Once the file menu is up, scroll up or down to get to the appropriate sub directory. The original “DISP” button, located in the upper right hand corner, will turn off the visibility of this file area. Once at the desired directory, press the smaller black-on-gray “DISP” button that is part of the file menu. This action will reveal the contents of that sub directory in the file area as shown in Figure 3-52.

Use the file menu black-and-gray up and down buttons to scroll to the desired comma-separated values (CSV) file and then press the file menu “DISP” button (nothing will appear to have happened). Then press the “DISP” button located in the upper right hand corner to see the contents of the CSV file as shown in Figure 3-53. Use the blue navigation buttons with white text to pan through the CSV file. These navigation buttons are intended to confirm data logging at start-up and are not a full-fledged CSV monitoring utility. To get immediate full access to the CSV data it is recommended to press the “REMOVE USB” button and view the CSV data on a separate computer.

The HMI will generate two types of CSV files. The first type is a file that will record all events documented in the event log. The second type of file will record the analogue readings of the unit’s temperatures. The first file type will appear as a single file, while the second file type will consist of a series of files on the USB.

Once the “REMOVE USB” button is pressed, the red indicator light will no longer be visible. The HMI will now no longer be using the USB flash drive and it is safe to remove the flash drive.

When the flash drive isn’t available to store data the HMI stores data in internal memory. If there is no flash drive in the HMI, every screen will display a warning as seen in Figure 3-54

When the USB flash drive is reinstalled, or a different USB flash drive is installed, the HMI will write all the data that is in internal memory to the USB drive. It is not recommended to leave the USB out of the HMI for more than 6 hours as data loss may occur when the HMI runs out of memory. When this happens, the HMI will overwrite the oldest data, record by record.

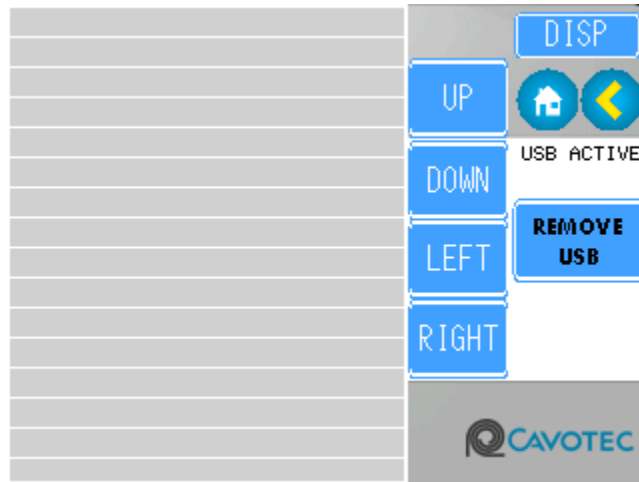


Figure 3-50. USB Menu Screen without Data Displayed

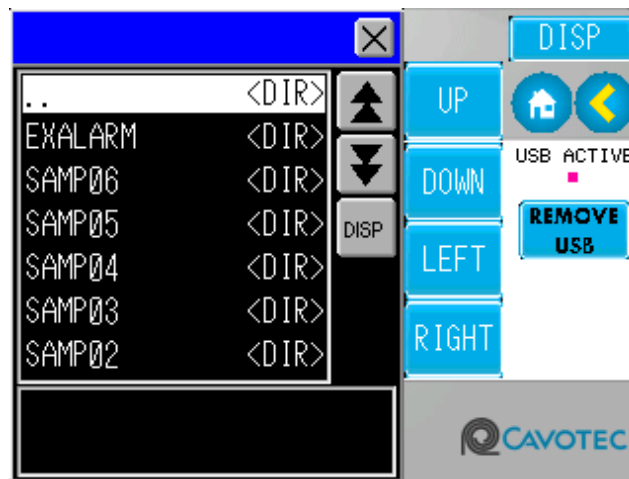


Figure 3-51. USB Menu Screen with Data Displayed

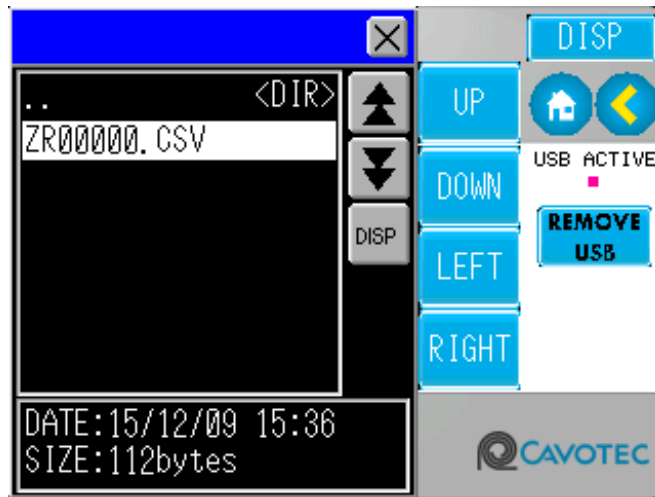


Figure 3-52. USB Menu Screen with File Displayed

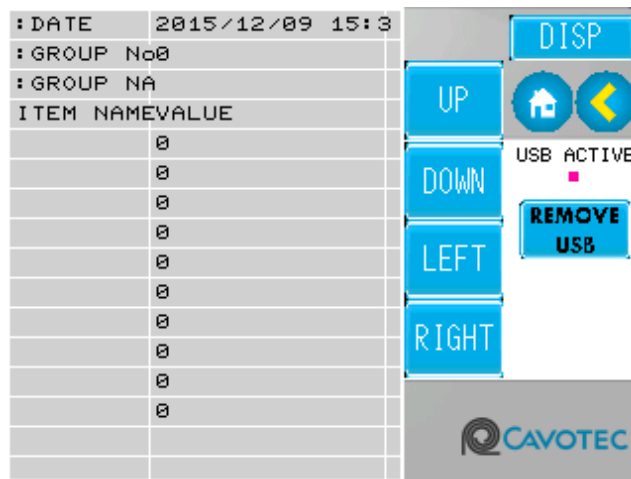


Figure 3-53. USB Menu Screen with File Open

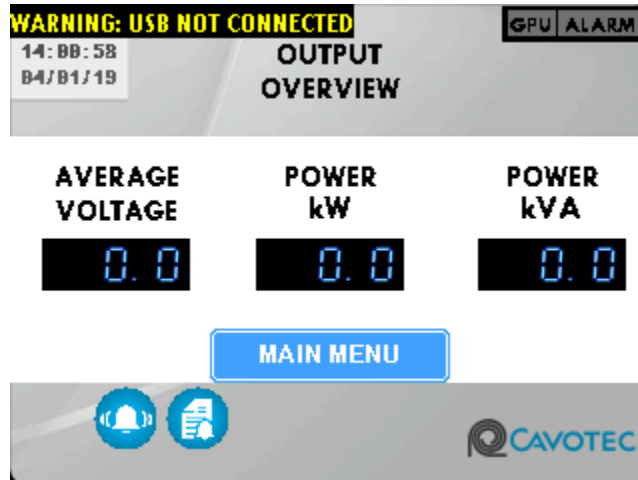


Figure 3-54. Output Overview Screen without USB Connected

3.2.2.9.10. SITE ENGINEERING SCREEN

The site engineering menu screen is shown in Figure 3-55. This menu is where the general unit configuration, i.e., single pit, dual pit, or bridge configuration is set up. On this screen the GPU settings can be saved to and loaded from the GPU. This is useful in situations where the HMI must be replaced and settings can be restored. With an additional password, the security configuration can be adjusted from this screen.

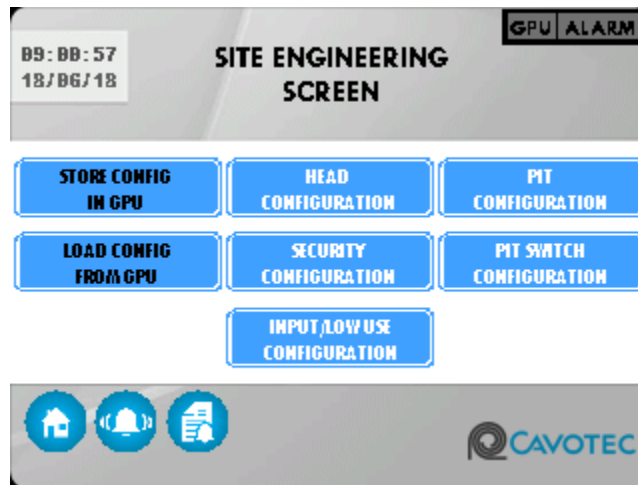


Figure 3-55. Site Engineering Screen

3.2.2.9.11. CABLE HEAD CONFIGURATION SCREEN

The head configuration screen is shown in Figure 3-56. The switch configuration menu allows the user to configure the unit for an over temperature switch in the cable head. The over temperature switch can also be changed from normally closed (NC) to normally open (NO). Pressing the head temperature button allows the user to adjust the temperature at which the unit shuts down for a thermocouple as seen in Figure 3-57.

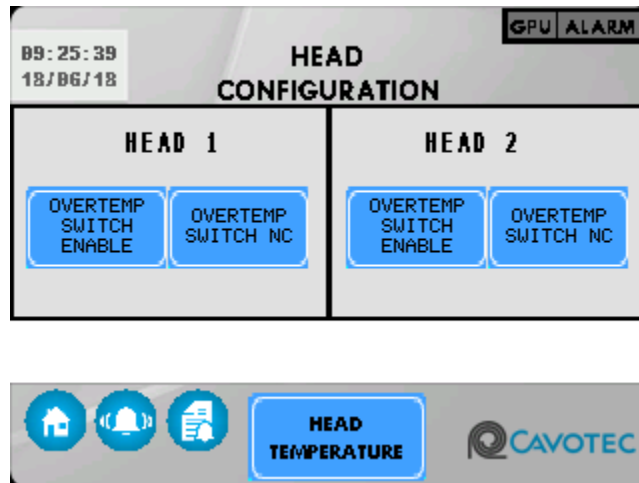


Figure 3-56. Cable Head Configuration Screen

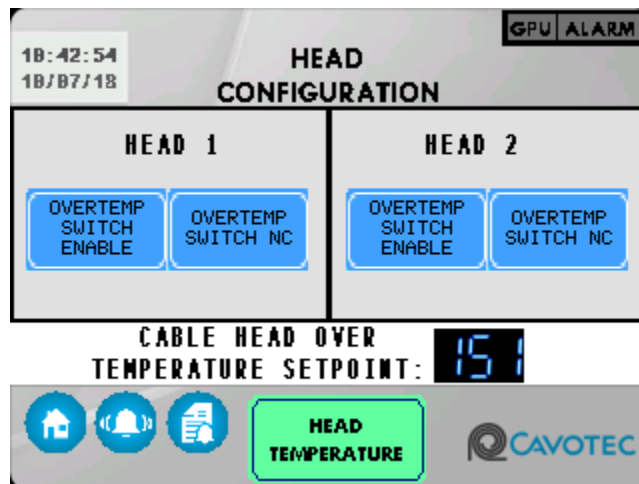


Figure 3-57. Cable Head Configuration with Head Temperature Screen

3.2.2.9.12. PIT CONFIGURATION SCREEN

The pit configuration screen is shown in Figure 3-58. There are two selections available; one is a three-way switch for bridge or the number of pits and the other is a selection between using a reel or hoist for the aircraft cables.

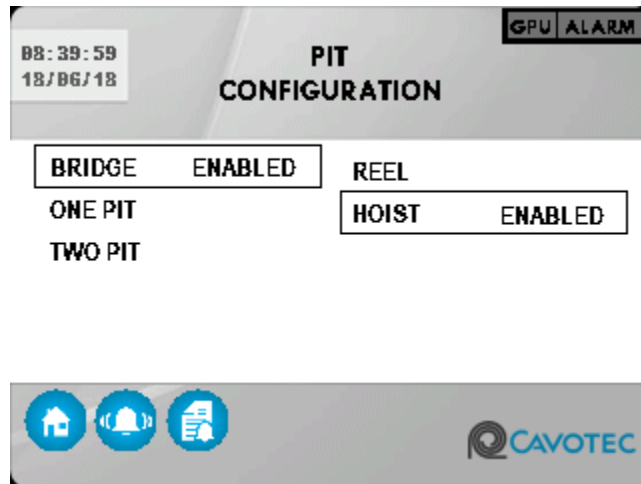


Figure 3-58. Pit Configuration Screen

3.2.2.9.13. PIT SWITCH CONFIGURATION SCREEN

The pit switch configuration screen is shown in Figure 3-59. For either pit 1 or pit 2, the user can enable the flood switch which would trigger an alarm in the case of a flood. The user can also enable an open or closed pit switch. Each of these switches can be inverted.

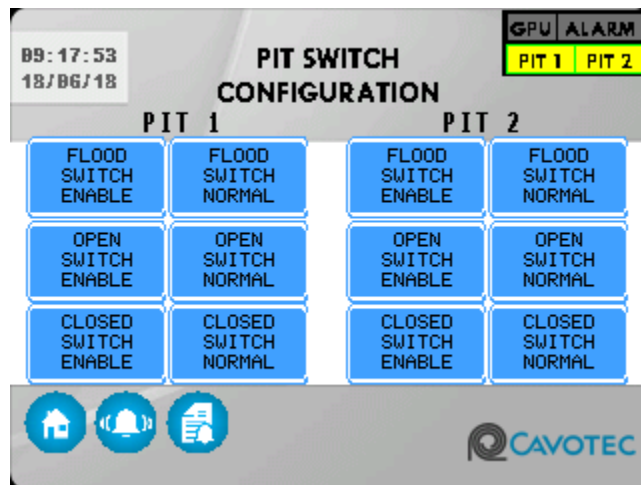


Figure 3-59. Pit Switch Configuration Screen

When the 2500+ is configured for bridge mode, the GPU will hide the pit switch configuration so that the operator is always aware of the current settings. These configurations will allow the GPU to only turn ON when the pit is fully open providing safety to the operator. The system is flexible enough to adapt to any unique pit configuration. This is seen in Figure 3-60.

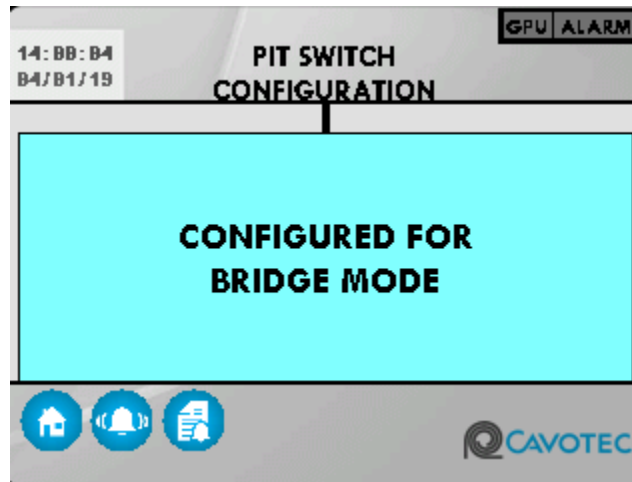


Figure 3-60. Pit Switch Configuration Screen in Bridge Mode

3.2.2.9.14. INPUT/LOW USE CONFIGURATION SCREEN

The input/low use configuration screen is shown in Figure 3-61. The user can enable the unit to shut down in the case of an overload for a certain amount of time or from low use for a certain amount of time. The exact set points can be adjusted by pressing the four digit number in the appropriate box.

This is the last of the access screens. From the main menu screen shown in Figure 3-9, press the preferences button to navigate to the next series of screens.

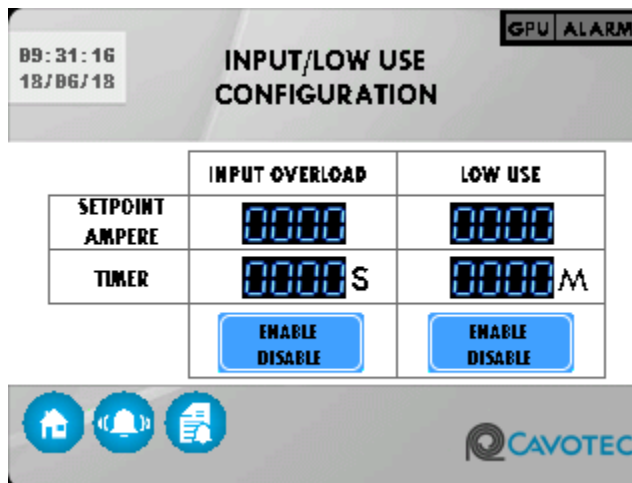


Figure 3-61. Input/Low Use Configuration Screen

3.2.2.10. PREFERENCES SCREENS

3.2.2.10.1. PREFERENCES TIME & LANGUAGE

The preferences time and language screen is shown in Figure 3-62. The primary purpose for this screen is to set the system date and time. The screen also allows the user to select the language and view unit information. The language push button navigates to the language selection screen. The info push button navigates to an information screen that displays information about the unit.

Each of the groups of two digits in the system time and date windows is a user entry field that allows for time and date correction.

Each has minimum and maximum allowable number as listed in Table 3-3.

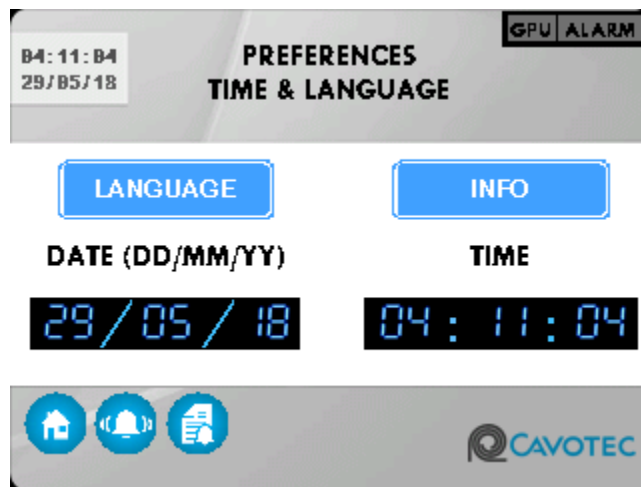


Figure 3-62. Preferences Time and Language Screen

Table 3-3. Allowable Values for Time Settings	
Unit	Range
Day	Min 1 to Max 31
Month	Min 1 to Max 12
Year	Min 15 to Max 99
Hour	Min 00 to Max 23
Minute	Min 00 to Max 59
Second	Min 00 to Max 59

3.2.2.10.2. INFORMATION SCREEN

The information screen shown in Figure 3-63 may be exited at any time by touching the screen anywhere. The home page is the next screen that will appear.

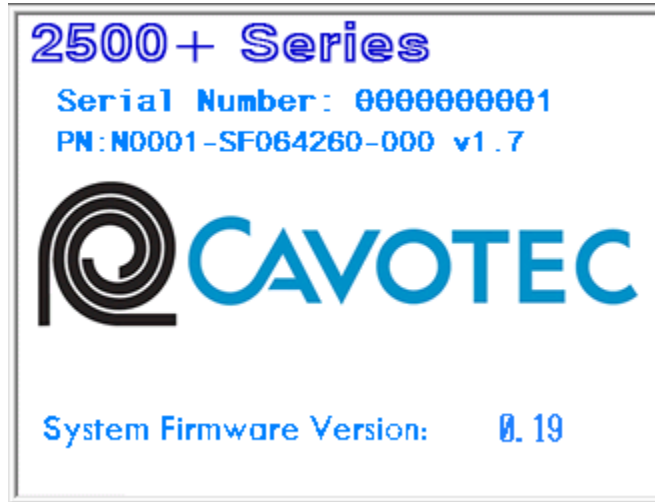


Figure 3-63. Information Screen

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Chapter 4
Table of Contents

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Unit Serial Numbers		1
Sample Order Form		1
Recommended Spare Parts List		3
Parts Lists		4
Illustrated Parts List	4-2	1

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4. ILLUSTRATED PARTS LISTS

A list of recommended spare parts pertinent to the maintenance and repair of a standard unit is included in Table 4-1. For each spare part, the quantity used per unit is identified.

The recommended quantity of spare parts to keep on hand are for a single unit and will vary as a function of the number of units on site.

The recommended spare outlet air filter quantities should support 90 days of unit operation assuming filter changes every 30 days. The inlet air filter is a washable type filter and shall be cleaned during the inspection period. If the filter shows signs of damage or cannot be cleaned, it shall be replaced.

4.1. ORDERING PARTS

Replacement parts may be ordered from the factory using the information given in the replacement parts list. To help speed processing of an order and identifying and confirming the correct parts, it is important to provide the most complete and accurate description of the parts and the unit for which they are intended. In the case of warranty replacement, it helps if the part to be replaced is sent to the factory to compare it with the new part, as well as allowing an investigation on the old part.

4.1.1. UNIT SERIAL NUMBERS

It is helpful when ordering parts or requesting service, that the serial number of the unit be identified. The serial number uniquely identifies the unit including date of manufacture and all included options or special-order features. Record the serial number(s) of all units on the record list found in the front matter of this manual. If the serial numbers are not already recorded in this manual, look at the unit nameplates.

4.1.2. SAMPLE ORDER FORM

The following page shows a sample order form for mail or fax ordering of parts or to use as a guide when ordering by telephone. Order spare or replacement parts from:

Cavotec Inet US, Inc.
Customer Service Department
5665 Corporate Ave,
Cypress, CA 90630,
USA

TEL: +1 (714) 947-0005
FAX: +1 (714) 947-0090
EMAIL: inet.service@cavotec.com

4.1.3. RECOMMENDED SPARE PARTS LIST

Table 4-1 presents the recommended spare parts list.

Table 4-1. 2500+ Single Output GPU Recommended Spare Parts List				
Item No.	Description	Designator	Spare Qty	Cavotec Part Number
1	Circuit Breaker XT4N 250A	CB1	1	HEX-000000-0062218
2	XT4N Rotary Handle Base	NA	1	HEX-000000-0062220
3	24VDC Under Voltage Release for XT4N	NA	1	HES-000000-0066262
4	146A Input Contactor	K1	1	HEC-000000-0062216
5	305A Output Contactor	K2	1	HEC-000000-0062217
6	Power Supply 24V 336W 14A	PS1-PS2	2	HEP-000000-0060773
7	Current Transformer 1000:1	CT1-CT6	6	HEX-000000-0058798
8	Hall Effect Current Transducer	CT7-CT9	3	HEX-000000-0058797
9	Current Transducer Wiring Harness	NA	1	N0001-AS065860-000
10	IGBT With Driver	Q1-Q9	9	N0001-AS062165-000
11	Heatsink Compound, 1oz Tube	NA	1	HMS-000000-0066189
12	HMI Screen With UV Protection	NA	1	HEE-000000-0065037
13	24 V 120x38mm 211.8 CFM Fans	FN1-FN6	6	HEX-000000-0059094
14	System Control Board	A1	1	N0001-PC060379-000
15	Front Panel Board	A3	1	N0001-PC060381-000
16	Soft Start Board	A4	1	N0001-PC060376-000
17	Output Filter Board	A5	1	N0001-PC060375-000
18	6-Gate Driver Board	A6	1	N0001-PC060377-000
19	IO Board	A8	1	N0001-PC060386-000
20	DC Bleeder Board	A9	1	N0001-PC060382-000
21	12 -Gate Driver Board	A10	1	N0001-PC060378-000
22	Dry Relay Board	A13	1	N0001-PC060383-000
23	High Voltage Board	A14	1	N0001-PC060387-000
24	Push Button Switch White	SW1	1	HES-000000-0064514
25	Push Button Switch Green	SW2	1	HES-000000-0063384
26	Push Button Switch Red	SW4	1	HES-000000-0063385
27	Plenum 1000 Ohm RTD 2.5 in	RD0-RD11	6	HEI-000000-0060770

Table 4-1. (Cont.)				
2500+ Single Output GPU Recommended Spare Parts List				
Item No.	Description	Designator	Spare Qty	Cavotec Part Number
28	Air Outlet Filter 5/PCK.	NA	2	HMA-000000-0064568
29	Air Inlet Filter	NA	1	HMA-000000-0059095
30	DC Link Film Capacitor	C1-C6	6	HEX-000000-0059064
31	Metallized Film Capacitor 20 μ F	C7-C9	3	HEC-000000-0062659
32	Laminated DC Power Plane	NA	1	N0001-PT058486-000
33	Aluminum Board for 6-Gate Driver Board	NA	1	N0001-PT058332-000
34	Aluminum Board for 12-Gate Driver Board	NA	1	N0001-PT058333-000

4.1.4. PARTS LIST

Table 4-2 presents the single output unit major parts list. Item numbering is a continuation from table 4-1.

Table 4-2.				
2500+ Single Output GPU Major Parts List				
Item No.	Description	Designator	Unit Qty	Cavotec Part No.
35	Line Reactor ST-9622	T1	1	HEX-000000-0058795
36	95 kVA Transformer	T2	1	HEX-000000-0058651
37	500 VA Transformer 4.17/0.08 A	T3	1	HEU-000000-0066213
38	PWM Reactor ST-9623	L1-L3	3	HEX-000000-0058799
39	Heat Sink 90 kVA	NA	1	N0001-AS058484-000

4.2. ILLUSTRATED PARTS LIST

Figures 4-1 through 4-9 present the illustrated parts list identifying the major components and the recommended spare parts list items shown in Tables 4-1 through 4-2.

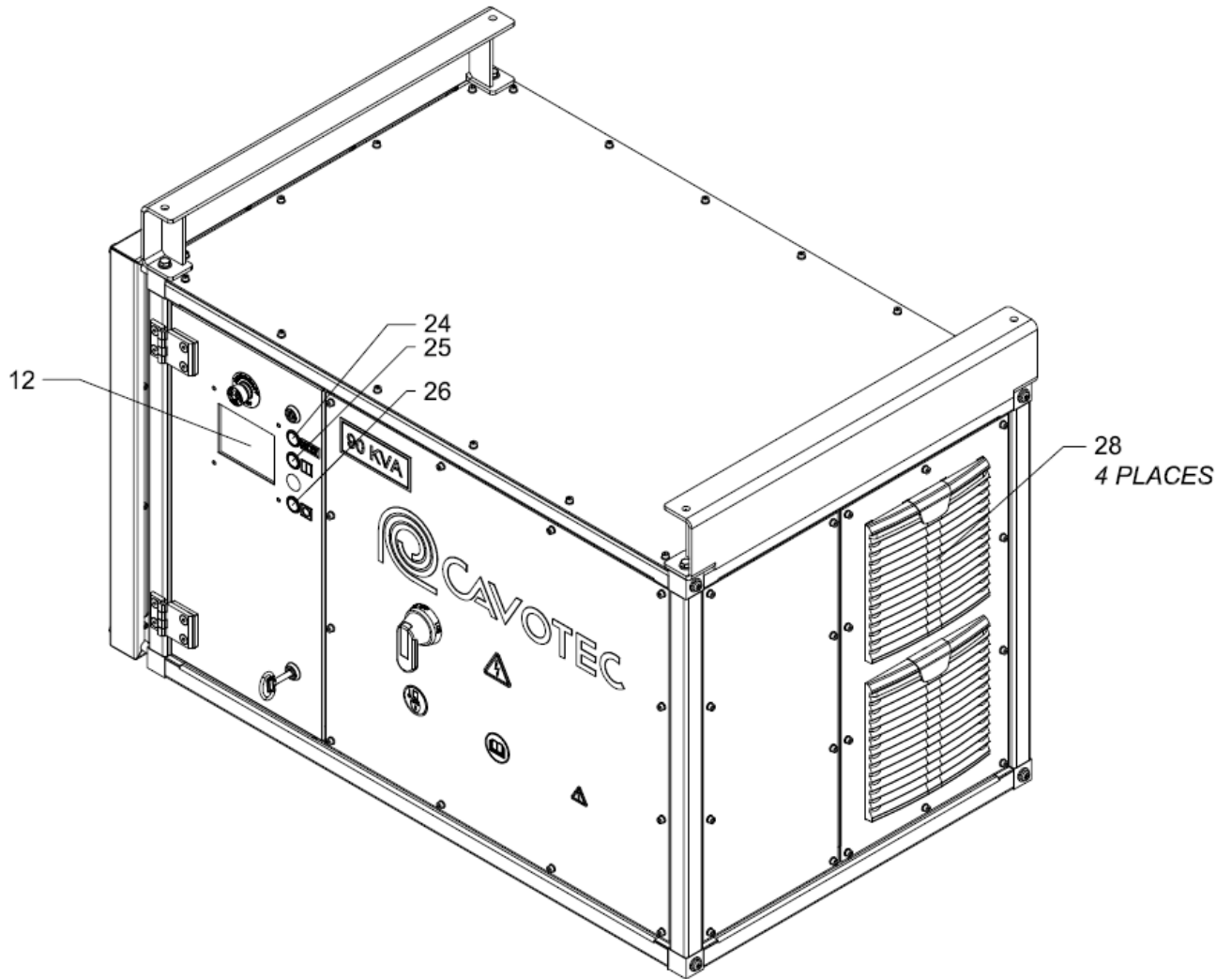


Figure 4-1. 2500+ GPU Illustrated Parts List, Enclosure

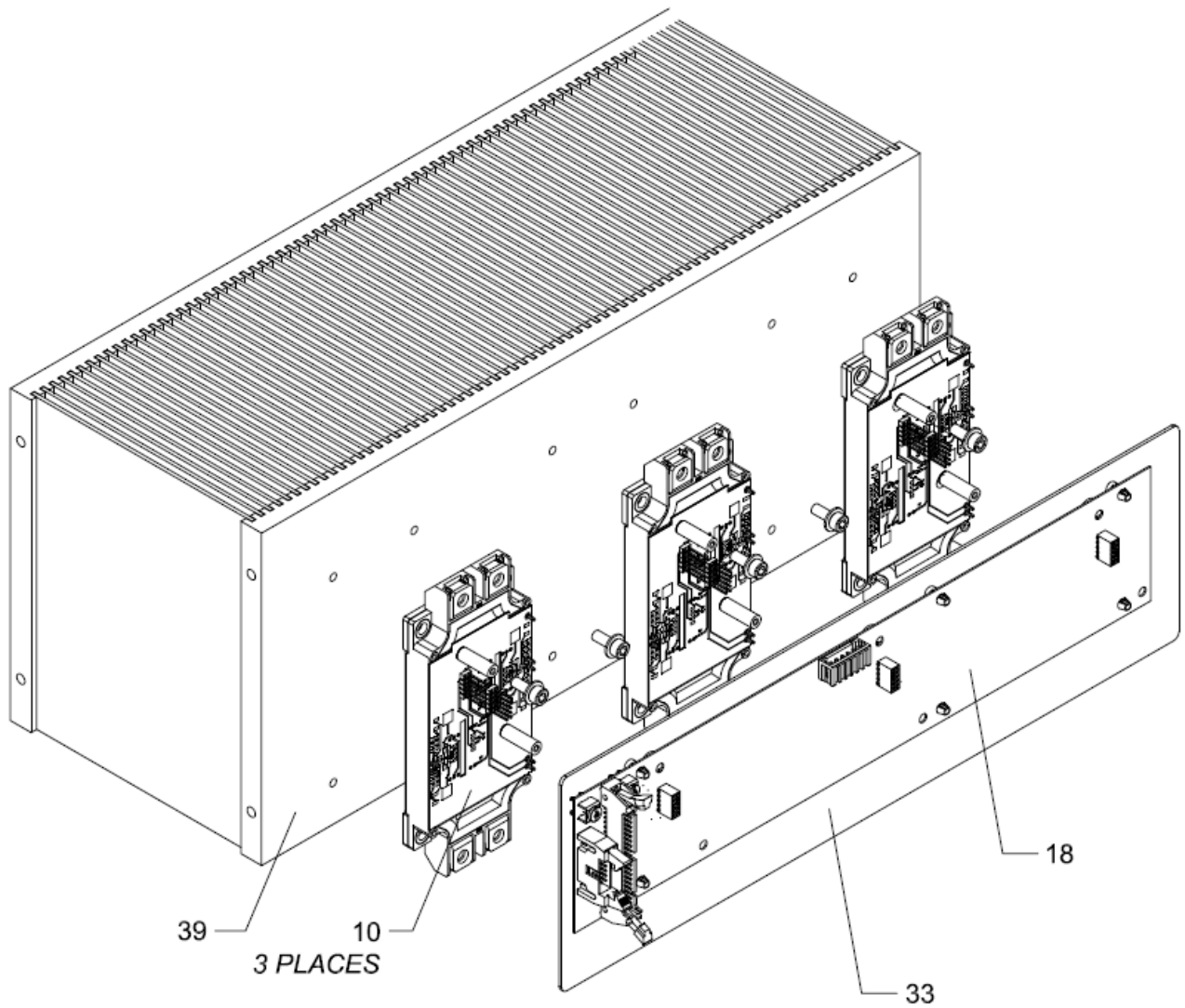


Figure 4-2. 2500+ GPU Illustrated Parts List, Heat Sink PFC

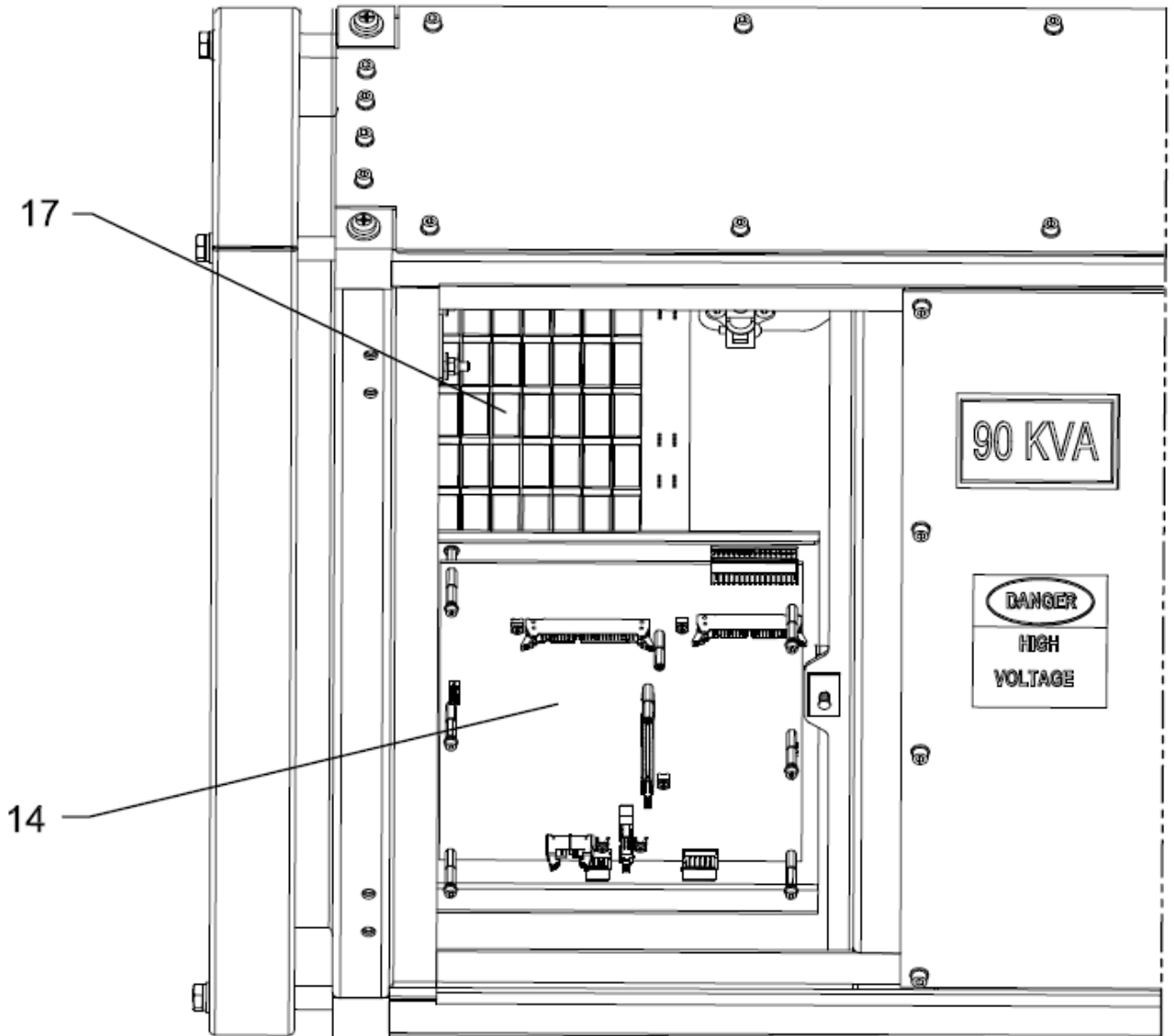


Figure 4-3. 2500+ GPU Illustrated Parts List Control Board and Filter Board

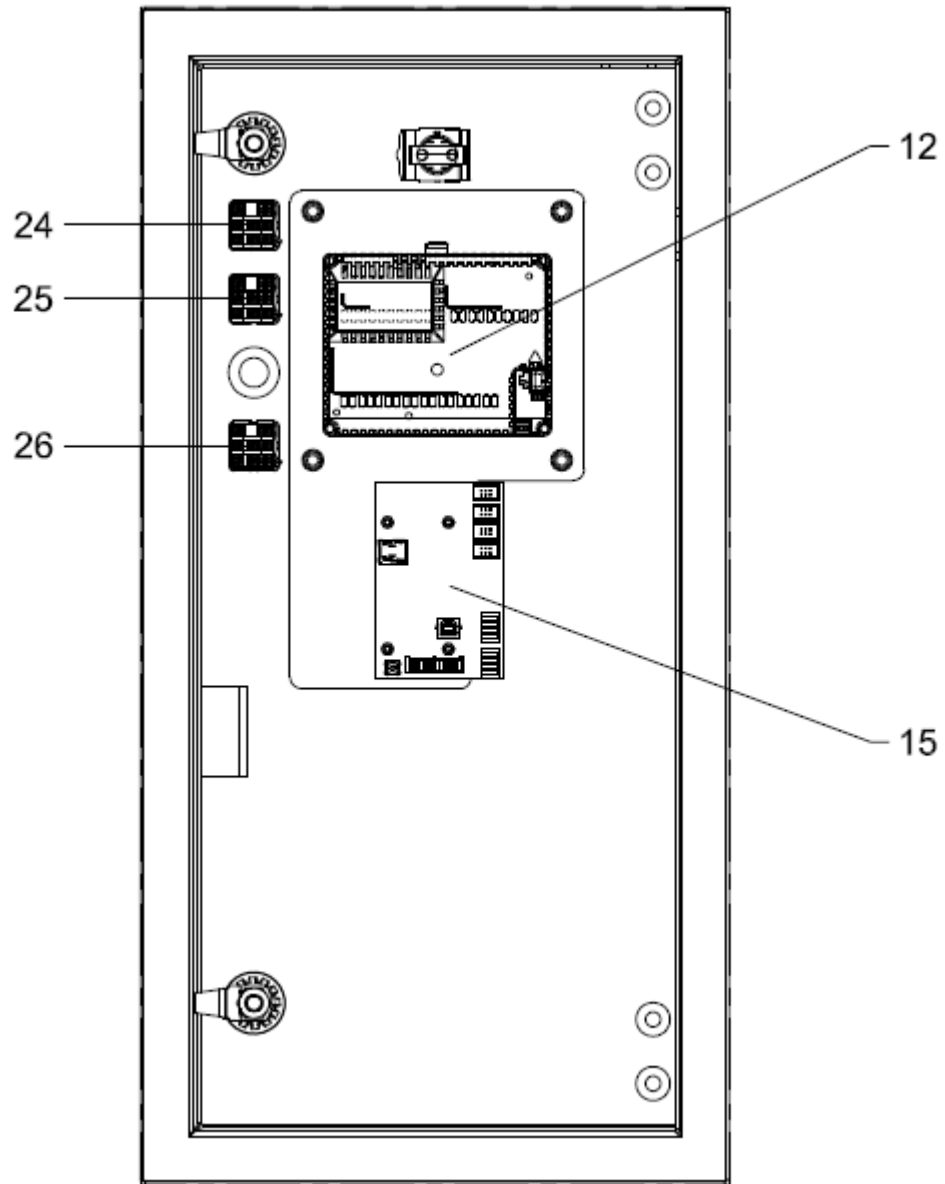


Figure 4-4. 2500+ GPU Illustrated Parts List, Front Panel Assembly

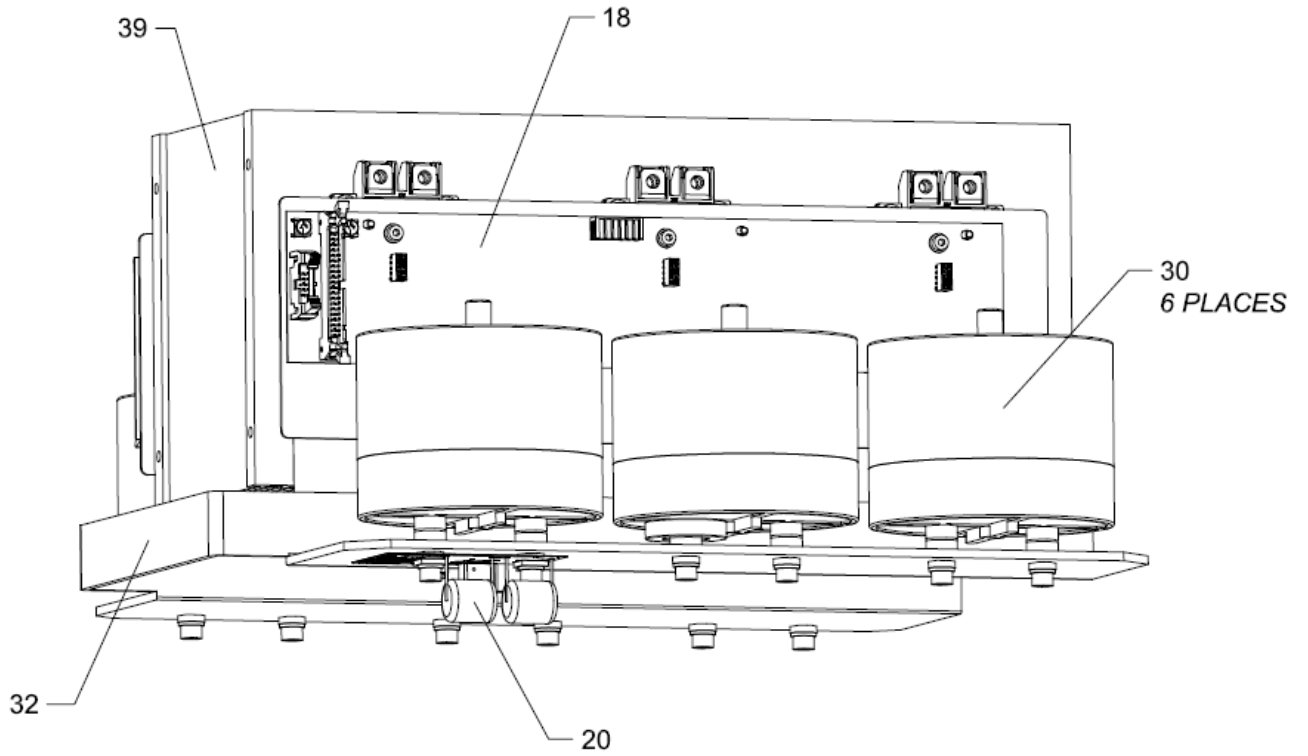


Figure 4-5. 2500+ GPU Illustrated Parts List, Power Brick

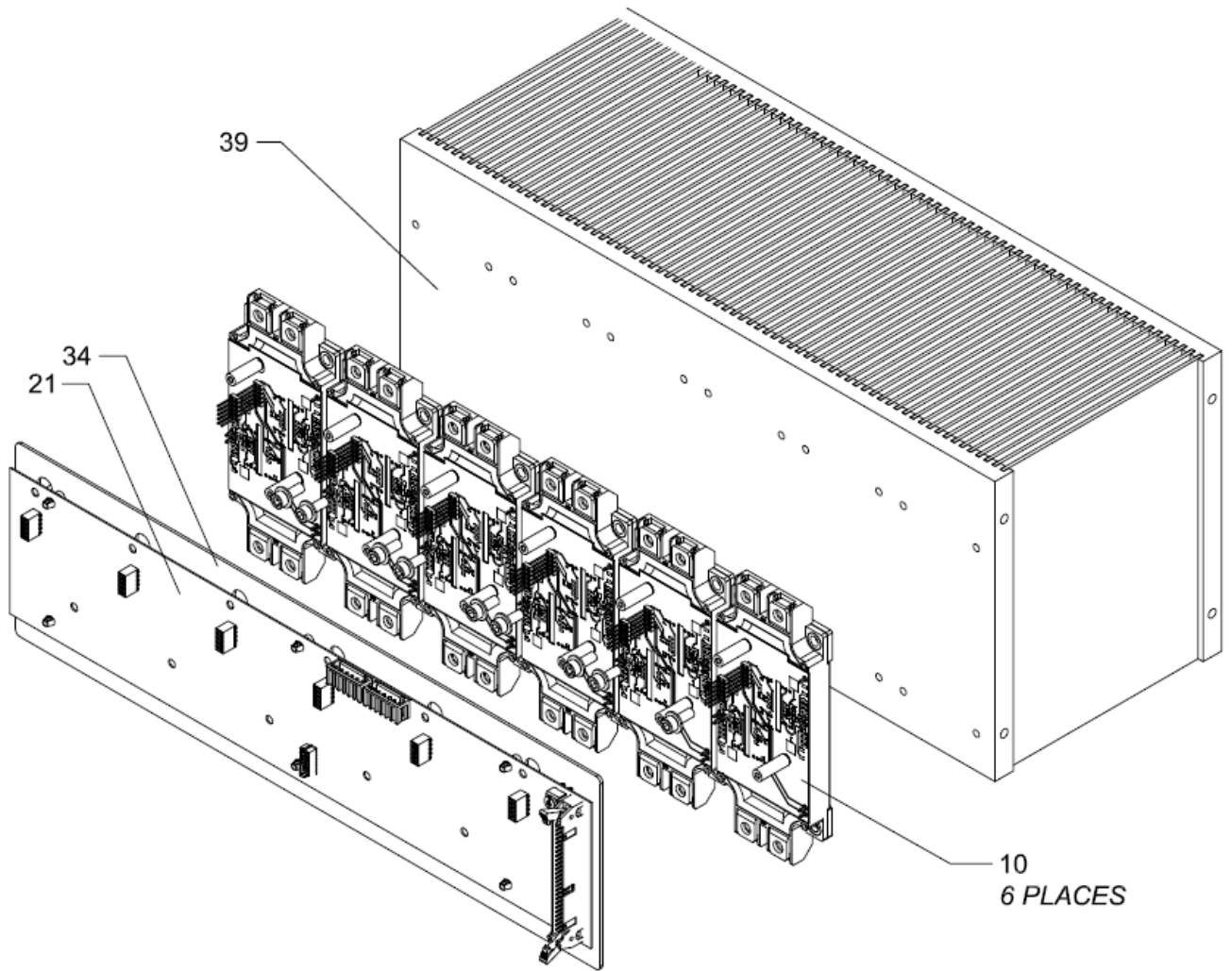


Figure 4-6. 2500+ GPU Illustrated Parts List, Inverter Heat Sink

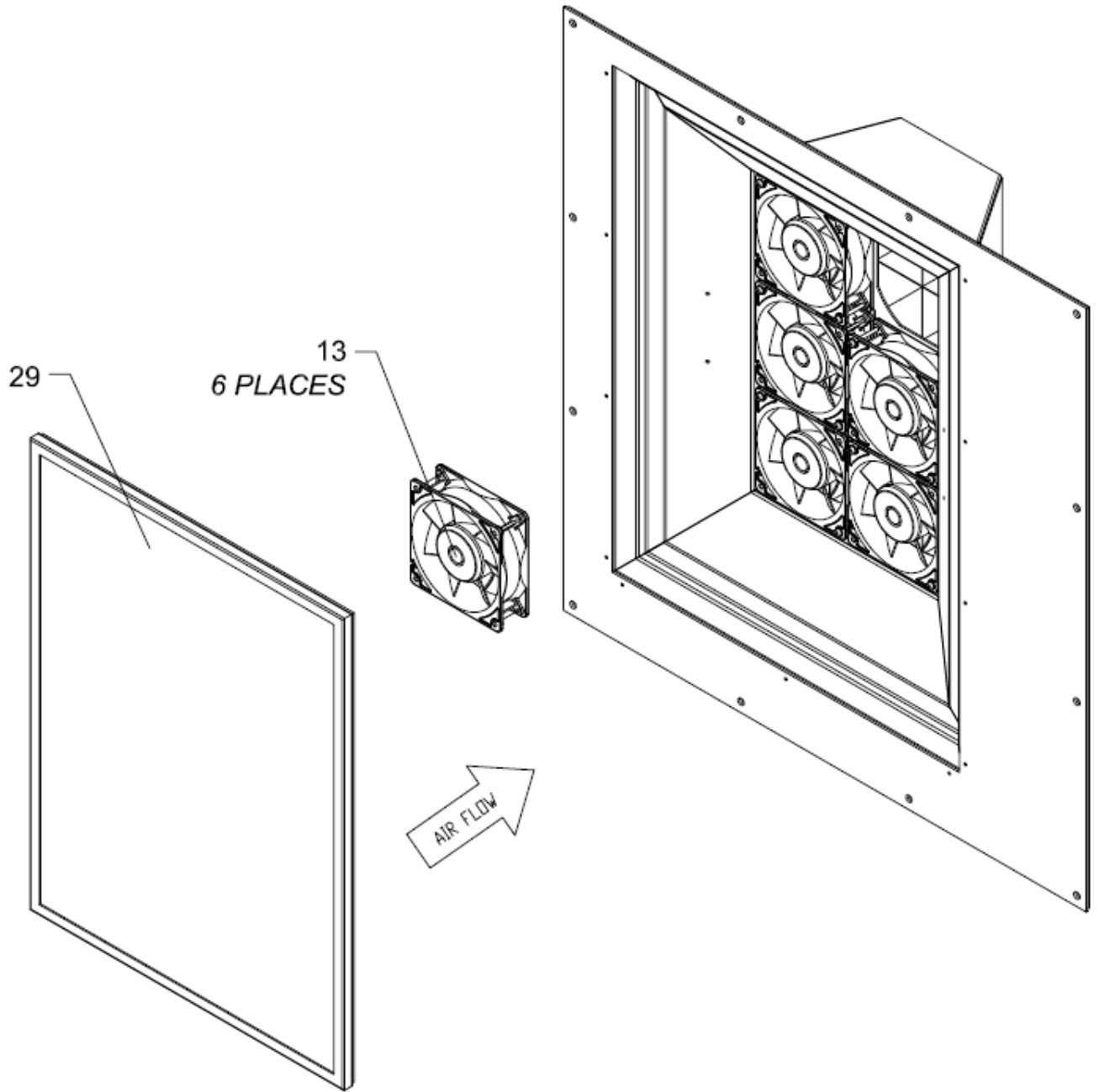


Figure 4-7. 2500+ GPU Illustrated Parts List, Fan Assembly

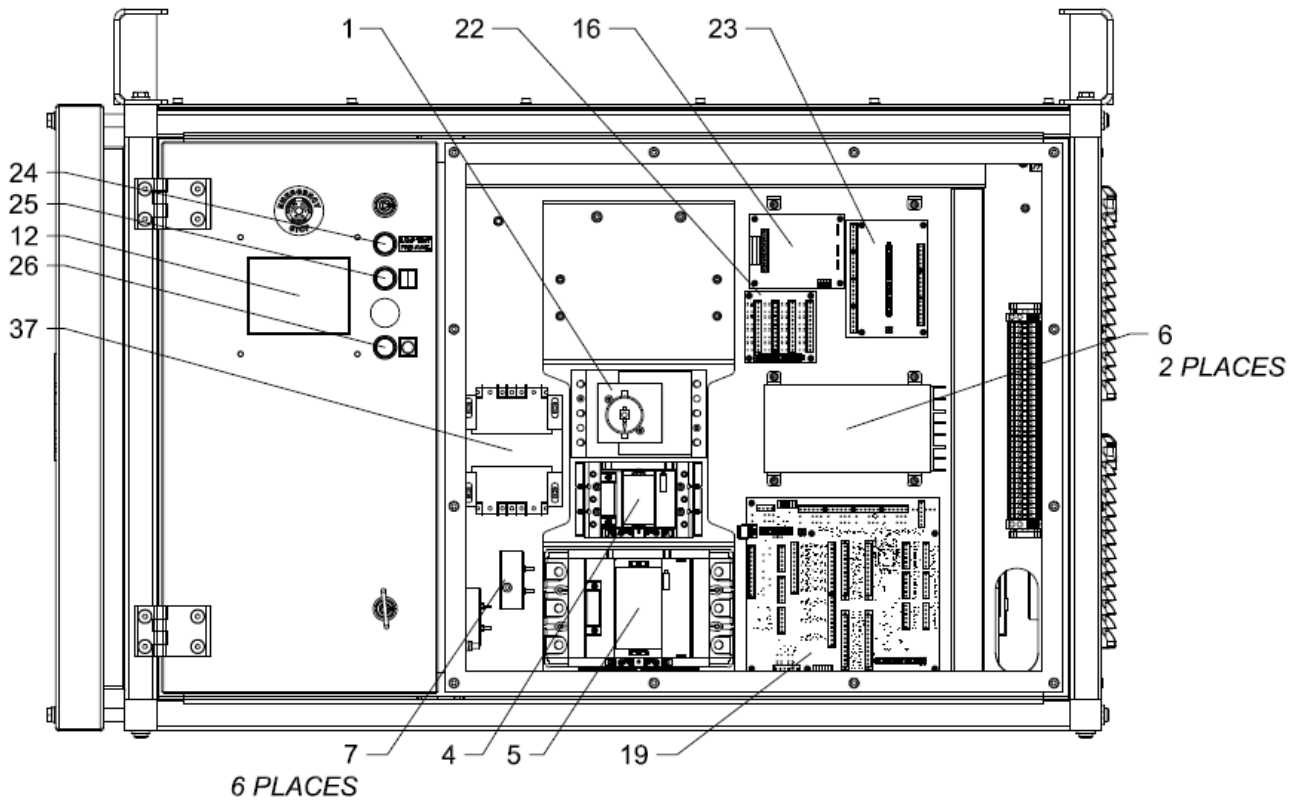


Figure 4-8. 2500+ GPU Illustrated Parts List, Customer Interface Zone

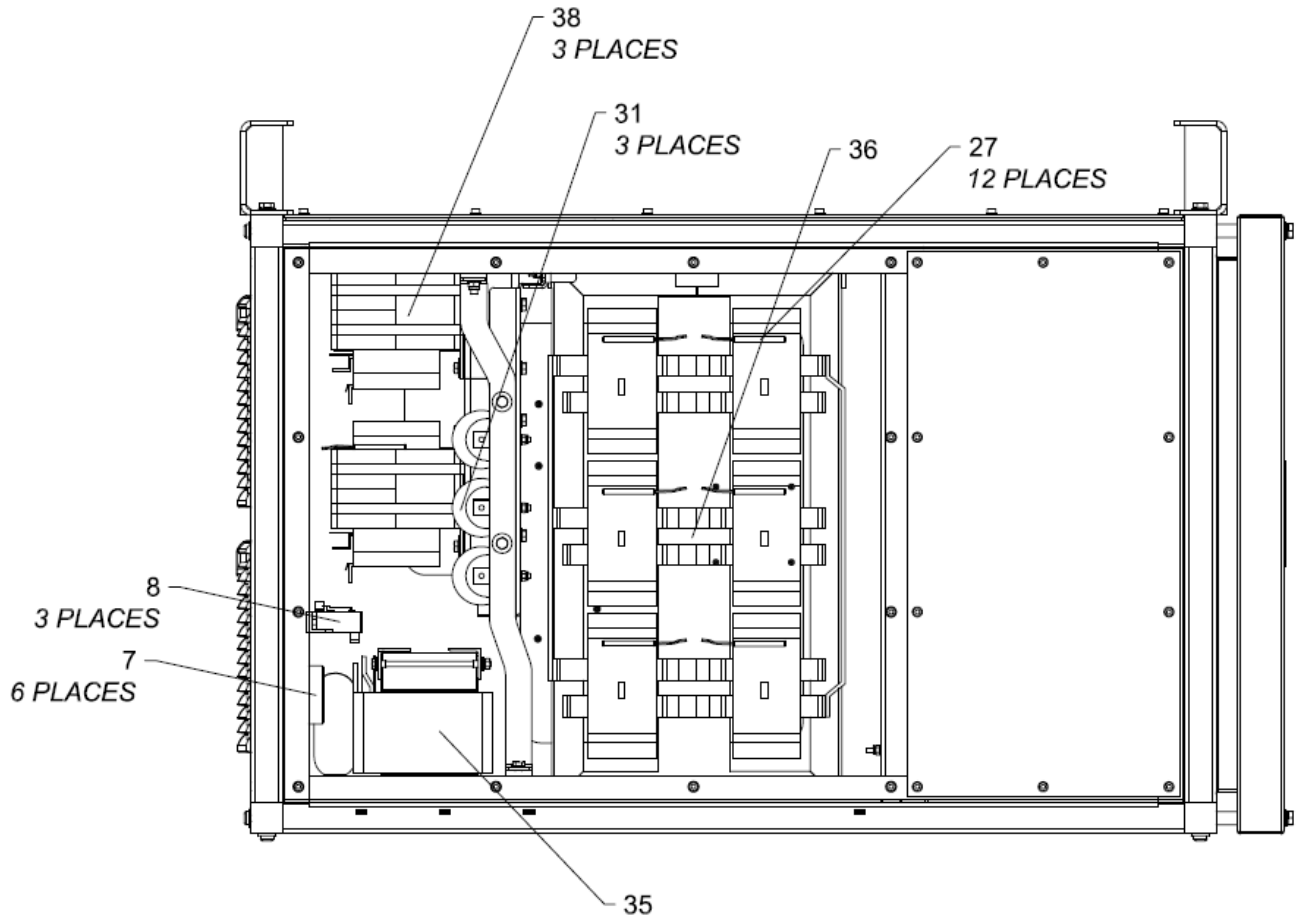


Figure 4-9. 2500+ GPU Illustrated Parts List, Magnetics Zone

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Chapter 5
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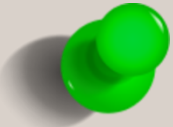
<u>MANUFACTURER'S APPENDICES</u>	<u>CHAPTER/SECTION</u>	<u>PAGE</u>
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5. MANUFACTURER’S APPENDICES

The following section contains drawings specific to the unit and associated components. Please note that additional relevant drawings may be contained as part of the following:

1. Option supplements to this manual.
2. System-level drawings unique to the project installation.



NOTE
Additional drawings provided in the options supplements (if any) and in the system manual volumes may provide additional important information about the unit relevant to the installed project. This information may take precedence over information in the standard drawings that follow, especially for installation and set-up of the unit. Operating and maintenance personnel shall be familiar with the options and system sections of the complete GPU system.

5.1. CAVOTEC DRAWINGS

Table 5-1 lists the Cavotec Inet unit drawings contained in the Appendices to Chapter 5.

Table 5-1. GPU Drawing List		
Appendix	Drawing Title	Drawing Number
A	Outline Drawing, Horizontal Single Output	N0001-OL900906-002
B	Single Output Wiring Diagram	N0001-SC900906-002

4.4 Appendix 4 – Accessories Equipment Datasheets

Accessories Equipment Datasheets Appendix 4

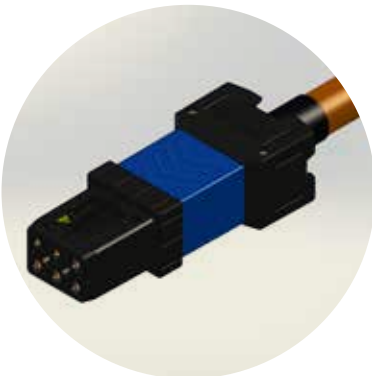
Aircraft Ground Connection Systems

Aircraft Connectors



Cavotec wants to contribute to a future world that is cleaner, safer and more efficient by providing innovative connection solutions for ships, aircraft and mobile equipment today.

Cavotec has been a pioneer of airport ground support equipment (GSE) for more than forty years. The company was an early developer of 400Hz technology, specialised cable reels and aircraft connectors, which are now industry standard at airports worldwide.



400Hz connector, front part with protector



400Hz connector integrated with 400Hz in-ground pit system



28V DC XP connector

Aircraft Connectors

Cavotec 400Hz & 28V DC connectors have changeable nose and contacts for a longer service life and reduced maintenance costs. Our popular SP model can be integrated with our 400Hz in-ground pit systems, cable coilers, cable hoists, converters and caddys.

Benefits

- Modular design allows connector configuration
- Customizable integrated LED and push-button
- Replaceable
 - rubber protectors (with wear indicators), main/control contacts and connector front part
- Short, main contacts for low voltage drop
- Maintenance opening allows:
 - adjustment and repair of internal control wiring
 - fast replacement of push buttons, LEDs and pilot contacts
- LEDs on connector back side always visible even when plugged in, Shock-proof, highly abrasion and chemically resistant material
- Wide operating temperature range
- Resin protects connector from moisture ingress and acts as persistent strain relief for the 400Hz cable

Options

- Pilot contact with switch signals when connector is securely engaged, ensures voltage is applied only when proper electrical connection is established. The pilot contact can also be used for locking the boarding bridge.
- Status LEDs for 400Hz power, 28VDC control voltage and pilot contact
- Control buttons let operator control 400Hz/28V DC supply and cable coiler directly at connector
- Temperature sensors in main contacts prevent connector from overheating by sending a signal to the ground power unit
- Shock absorbing ring for use with other Cavotec products like pit systems or cable coilers
- Adjustable cable strain relief, plastic hook prevents accidental damage to the aircraft

Main components

- Rubber protectors
- Silver plated main contacts
- Connector front part
- Connector housing



400Hz Pluggable Coupling

The Cavotec 400Hz Pluggable Coupling used in this application is adapted from our proven Power Connector Push&Pull System and is often used on applications such as the cable coil where the connector has to be frequently connected and disconnected. The coupling is available in a wide variety: in general the male receptacle holds a 50mm² or a 70mm² cable, the female socket holds a 3x50mm², 3x70mm² or 7x35mm² cable.

Benefits

- Robust design made for harsh environments
- All wear parts are replaceable
- Highly abrasion and chemical resistant material for housing: conditioned thermoplastic
- All contacts sealed with water proof resin
- IP67 protection
- Fast and easy replacement of connectors

Main components

- 4 power contacts and up to 16 control contacts, all silver plated, with wear protection ring, fully molded
- Male Connector: 13 or 16 contacts (depending on the version); silver plated contacts.
- Female Connector: contact holder; circlip; fixed silver plated contacts; protection ring.



PC4 coupling profile



400Hz receptacle



Accessories

400Hz & 28V DC receptacle

The Cavotec 400Hz & 28V DC receptacle complies with all major international standards. Designed to meet the high demands of the aircraft industry, it provides excellent performance even under extreme conditions.

Service and test device for aircraft connectors

Avoid damages and malfunctions through regular inspections and maintenance of the aircraft connector contacts. With the measuring device the pull-out force of every aircraft connector contact can be measured. In this way an optimal connection between connector and aircraft can be guaranteed.

Dimensions (LxHxW) mm [in]:
440x355x145 [17x14x6]

Content:

- Calibrated precision spring balance with drag pointer
- Test pin for main contacts A, B, C, N, and for control contacts E, F
- Cleaning brushes for main and control contacts
- Tools for dismantling the connector nose
- Cleaning fluid
- Cleaning/polish cloth

Technical characteristics

Mechanical and electrical characteristics				
	400Hz Connector	28V DC Connector	Pluggable Coupling	400Hz & 28V DC Receptacle
Nominal voltage	115/200V, 400Hz	28V DC	U _i 115/200V/400Hz	115/200V, 400Hz / 28V DC
Nominal current	260A	100-400A	260A	260A
Current carrying capacity	300A	383A	260A/90kVA	-
Current overload	600A/30min, 1000A/3min, 2000A/3sec		700A/3min	600A/30min, 1000A/3min, 2000A/3 sec
Test voltage AC	4kV at 400Hz main wires/2kV at 28V control wires	4kV	4kV	4kV
Pilot contact switch	max. 30V DC, 1A, NO/NC	max. 30V DC, 0.5A	-	-
Control contacts	2	1	13 or 16 (depending on the version)	2(400Hz), 1(28VDC)
Control button	30V DC, 1.5A	30V DC, 1.5A	-	-
Operating temperature, °C [°F] which cable withstands 125°C	-40° to +125° [-40° to +257°]	-40° to +125° [-40° to +257°]	-40° to +125° [-40° to +257°]	-40° to +125° [-40° to +257°]
Protection class	IP67 for resined connector without contacts	IP67 for resined connector without contacts	IP67 for resined and connected coupling	-
Push and pull forces	acc. to DIN EN 61984 ≤ 445 N	acc. to DIN EN 61984 134-223 N	-	acc. to DIN EN 61984 ISO 461-1 and connector
Weight kg [lbs]	2.9 (3.5 with resin) [6.4 (7.7)]	2.0 (2.6 with resin) [4.4 (5.7)]	2.5 (3.0 with resin) [5.5 (6.6)]	400Hz Receptacle: 0.9 [2] 28V DC Receptacle: 0.7 [1.5]
Applicable norms	2006/42/EC Machinery Directive, VG 95319, ISO 461, MIL-C-7974D, MS 25486, DFS 400, mates to Mil Spec MS90362 receptacle	VG 95319, ISO 461 -1/-2, LN 9064, MIL-C-5756, MIL-STD-810F 2006/42/EC Machinery Directive	2006/42/EC Machinery Directive	2006/42/EC Machinery Directive, VG 95319, ISO 461, MIL-C-7974D, MS 25486, DFS 400, mates to Mil Spec MS90362 receptacle
All contacts exchangeable	yes	yes	yes	yes

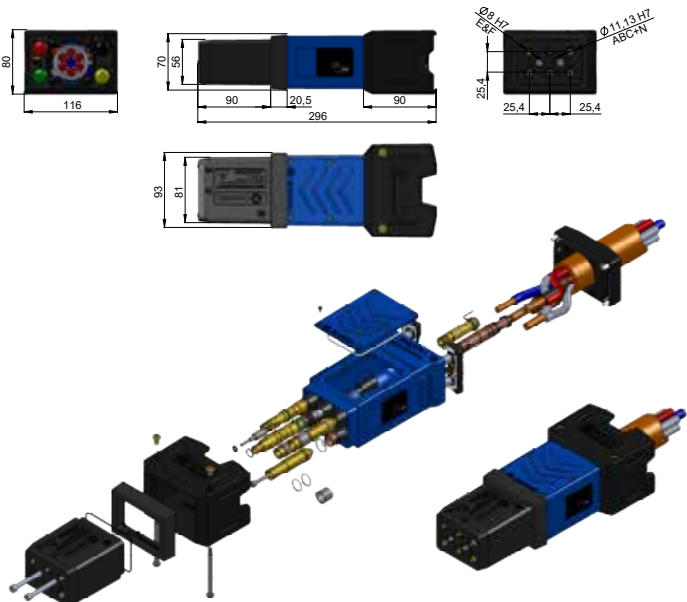
	Connector version	Buttons		Micro switch	LED	Temp. sensors*	Replaceable contacts	Conductor size mm ²
		on/off	in/out					
400Hz Connector	400 SP	0	0	0-2	0-3	optional	Yes	35/50/70
	400 SP-2	2	0	0-2	0-3	optional	Yes	35/50/70
	400 SP-4	2	2	0-2	0-3	optional	Yes	35/50/70
28V DC Connector	28 XP	0	0	0-1	0-2	optional	Yes	120/140cm ²
	28 XP-2	2	0	0-1	0-2	optional	Yes	120/140cm ²
	28 XP-4	2	2	0-1	0-2	optional	Yes	120/140cm ²

* Temperature sensors optionally available as: PTC, PT100 or PT1000 (depending on the requirements of the converter).

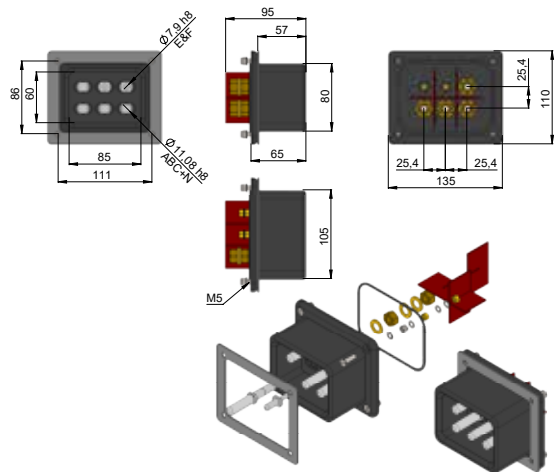
Technical dimensions

Unit: Millimeters

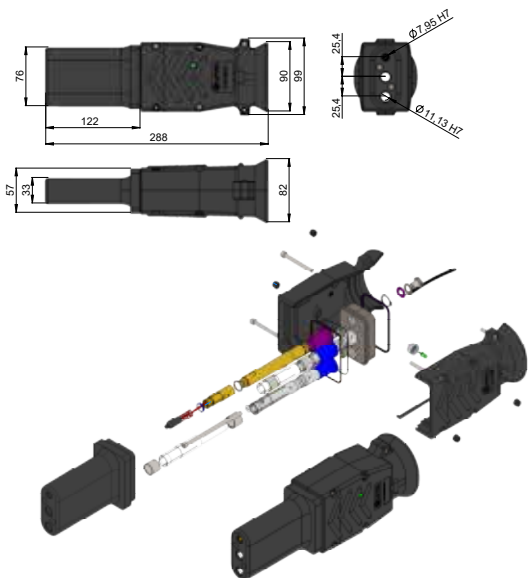
400Hz Aircraft Connector



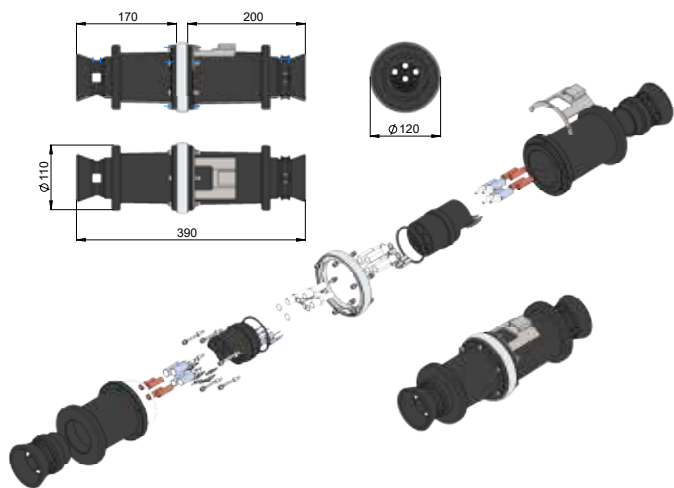
400Hz Receptacle



28V DC Aircraft Connector



400Hz Pluggable Coupling



Please contact your local Cavotec Sales Office for further information at cavotec.com.
Disclaimer: specifications are subject to change without notice.



SERIES 2500+
THE ULTIMATE
GROUND POWER UNIT



 **CAVOTEC**

GOING BEYOND THE HORIZON WITH CAVOTEC SERIES 2500+ GPU

Airports are an integral part of national and global transport infrastructure. The aviation industry needs to plan for its future development in this context. Key issues facing the sector include improving turnaround times, reducing emissions, operational expenditures, and enhancing safety.

With the Cavotec 400Hz Ground Power Units Series 2500+, we offer to the industry the ultimate 400Hz solid state frequency converter integrating the highest electrical and communication performances.



The 2500+ meets the needs of today's and tomorrow's demanding aviation industry.

- **3G Ready:** Global design for Global clients in a Global market.
- **NGA Ready:** New Generation Aircraft (A380, B787, A350), ISO6858 Ready, 500% overload.
- **90kW (PF 1):** continuous load at 60°C ambient temperature.
- **28VDC (TRU):** Integrated transformer unit for regional aircraft and helicopters power supply.

Enhanced with Cavotec Skyway, Cavotec Series 2500+ combines increased reliability, optimizes ground handling operations and maximizes profitability.

- At the forefront of the energy savings with **>94% overall efficiency**.
- Cavotec Skyway Interface: **visualization of diagnostics, connections, and operations remotely.**
- Interconnected digital technologies with data collection for preventive maintenance for a **reduced OPEX**.
- Durable design for **maximizing gate utilization** and **Return On Investment**.

Series 2500+ is offered with the 3 following configurations:

- 2500+: 400Hz power
- 2500+ DC Combi: 400Hz + 28VDC Power
- 2500+ PowerPack I-Connect: 400Hz power with an integrated 400Hz coiler

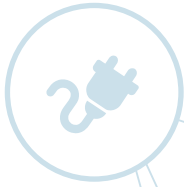
Clean, reliable, and sustainable 400Hz power.



Series 2500+
PowerPack I-Connect



Cavotec Skyway Interface



Clean, reliable, sustainable, and secured 400Hz electricity delivery

Cavotec Series 2500+ GPU offers with its **pulse-width modulated** proven technology an advanced 400Hz power solution ensuring the unique 400Hz power will be delivered **reliably without unforeseen changes in quality**.

Designed for **all ambient conditions** and aircraft types including **New Generation Aircraft (NGA)**, the Series 2500+ delivers **90kW PF 1 continuous at 60°C** and can go **up to 500% overload** bringing **peace of mind** to airlines and ground handling operators.

When configured with Series 2500+ DC Combi unit, we offer an integrated solution for powering both commercial and regional aircraft with either 90kW or 28VDC.



3G ready: Global design for Global clients in a Global market

Cavotec 2500+ solid state frequency converter can service all types of aircraft (up to A380, including B787 & A350) under the **most severe ambient conditions** (-40°C to +60°C at PF 1) with a **continuous 90kW** output power and around the globe with 50/60Hz input and dual output.

The unit complies with the highest industry standards of which **DFS-400, MIL-STD-704F & exceeds the ISO-6858**.

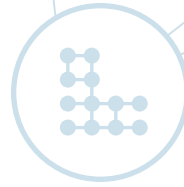
ONE technology providing **ALL solutions** to **ALL** types of **airport** designs and configurations.

>94% Efficiency



Allocating the right investment for reducing operating expenses and maximizing the revenue streams

We value the importance of providing a **sustainable solution** where the **lower energy associated with a reduced consumption (overall efficiency of >94%), maintenance and downtime** bring **considerable savings and an unprecedented reduced Total Cost of Ownership** to the industry.



Technology integration

Cavotec Series 2500+ has been engineered and **pre-programmed** for all types of 400Hz power **distribution systems** such as **400Hz coilers and pit systems**. The **embedded** functions in the **system logic** enable a **fast site deployment** and **wiring for trouble free 400Hz system start-up**.

Cavotec, world's leading Ground Support System provider



Series 2500+
Vertical ground mounted



Series 2500+ DC Combi
Horizontal PBB mounted



Series 2500+
PowerPack I-Connect



400Hz Centralized MGs



Digitising the 400Hz Ground Power Unit

Cavotec Series 2500+ equipped with **Cavotec Skyway (5.7" sunlight readable multicolour display) and Cavotec Skyway Operator Terminal** provide a new way of operating. The addition of the **remote operation** enhances the **operations safety** and the **real time system monitoring**.

The **multiple functionalities and flexibility** of the Cavotec Skyway provide **digital information** that will guarantee **live information on the GPU and proactive maintenance** plans for **maximizing the gate utilization and revenues**.

Updates can be done in two ways: Basic mode with a **USB/Flash drive**, and Advanced mode with an ethernet connection.

500%
overload

90kW
PF 1



Advanced manufacturing

Cavotec offers clients the possibility to **have factory tested products on two continents**, but also the complete 400Hz system (i.e. Test of 400Hz system including the GPU connected to a pit system) ensuring the **total reliability** of the **system performance** before shipment. Our products are **serviced by Cavotec local sales offices** located in **over 30 sales** companies for a **professional and reliable** local after-sales service.

The world's largest in-house 400Hz versatile system offer



400Hz Pop-up Pit



400Hz Coiler



400Hz Power Converter Caddy



400Hz Aircraft Plugs

Technical Information - 2500+ Series

Input Power

Voltage range:	3 x 400-480V ±15%
Frequency:	50/60 Hz ±5 Hz
Rectification:	Active PFC
Rated current:	115A @ 480VAC And 90kW (1.0PF) 138A @ 400VAC And 90kW (1.0PF) 92A @ 480VAC And 90kVA (0.8PF) 111A @ 400VAC And 90kVA (0.8PF)
Line current distortion:	<2% @ full load*
Power factor:	1 @ any load*
Inrush current:	None

Output Power

Rated power:	90kVA/90kW
Voltage:	3 x 115/200V
Frequency:	400Hz ± 0.01%
Power factor:	0.5 lagging to 0.8 leading*
Voltage regulation:	<0.5% for balanced load & up to 40% unbalanced load
Voltage recovery:	U <2% and rec. time <10 ms at 100% load* change
Total harmonic content:	<2% at linear load (typ. 1.5%) <2% at non linear load according to ISO1540
Crest factor:	1.414 ± 3%
Voltage modulation:	<1.0%
Phase angle symmetry:	120° ± 1° for balanced load 120° ± 2° for 30% unbal. load
Voltage drop compensation:	>20V phase to neutral

Output Power 28VDC

Voltage:	28 VDC
Current:	600A
Voltage regulation:	<0.5%
Voltage ripple:	<1.5%
Voltage transient recovery:	In compliance with ISO 6858 and MIL-704F

Efficiency

Overall efficiency:	>94% 90kVA at 0.8PF
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Overload Capability

125% for 600 seconds	400% for 3 seconds
150% for 90 seconds	500% for 1.5 seconds*
250% for 30 seconds	Follows I ² t curve
300% for 15 seconds	

Overload Capability 28VDC

750 A for 600 seconds	2400 A for 10 seconds
1500 A for 90 seconds	3000 A for 2 seconds
1800A for 20 seconds	

Environmental

Operating temperature:	-25°C to +60°C for all load conditions
Relative humidity:	10 to 100% non-condensing
Noise level:	<65 dB(A)@1m

Norms and Standards

MIL-STD-704F:	Aircraft Electrical Power Characteristics
DFS-400:	400Hz aircraft ground power
ISO-6858:	Aircraft Ground Power Supplies
ATA-101:	Ground equipment technical data
NFPA 70:	National Electrical Code
UL 1012:	Under Writers Laboratories, INC. (UL)
BS 2G 219:	General Requirements for Ground Support Equipment
EN-62040 1.1:	Uninterruptible power systems (UPS) –Part 1-1: General and safety requirements for UPS used in operator access areas.
IEEE STD 127:	Aerospace Equipment and Frequency Rating
ISO-461:	Connectors for Ground Electrical Supplies
ISO-1540:	Aerospace. Characteristics of Aircraft Electrical Systems.
SAE-ARP-5015:	Ground Equipment 400Hz Ground Power Performance Requirements
EN-1915-1:	Aircraft ground support equipment. General requirements. Basic safety requirements.
EN-12312-20:	Aircraft ground support equipment. Specific Requirements. Part 20. Ground Power Equipment.
IEC 61800-5-1:	Adjustable speed electrical power drive systems. Safety requirements; electrical, thermal, energy.
Others:	
	MIL-S-19500 – IEC-60146 – ST-20-1972(R-1978) – IEC-60310 EN-50124 EN-61000 – IEC-60529 – BS-EN-61558 – IEEE STD 500 – UL508A

Protection

Protection class: IP55	Control voltage error
No break power transfer	Short circuit at output
Over/under voltage at in/output	Neutral voltage supervision
Input/output overload	
Internal high temperature	

Miscellaneous

MTTR:	max. 20 minutes
Colour:	RAL 9010 (standard)

Weight

Fixed & PBB units:	570kg / 1,257lbs
Mobile units:	770kg / 1,698lbs
2500+ DC Combi:	762kg / 1,680lbs

Dimensions

2500+:	48x30x30 in / 1220x760x760 mm
2500+ DC Combi:	73x30x30 in / 1854x760x760 mm
2500+ PowerPack:	71.2x50.9x40.2 in / 1809x1292x1022 mm

Warranty

	Standard 12 months warranty
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*All characteristics are valid for an altitude up to 3000m (10000 ft)



3G and NGA Ready



90kW, 500% overload



Remote monitoring
with Smartphones and tablets

Optional Features

- Dual 400Hz output
- Terminal extension for output distribution
- Remote HMI with Cavotec Skyway Interface
- Cover for instrumentation
- TCP/IP Modbus ready
- Military interlock
- GPU user enable
- Energy Management
- Leakage current supervision
- 90% switch interlock
- Cavotec Skyway service tool
- BMS integration
- Portable trailer/cable kit
- 180kVA Kit
- 28VDC TRU (Combi)
- Beacon indicator
- Low usage power saving mode

Cavotec Skyway

Cavotec Skyway is a modern and easy system visualization which has been developed with the aim of offering extensive connectivity, easy-to-read displays, and remote connectivity via Ethernet/Internet Remote Connectivity.

We bring you the information in real time wherever you are and on various interfaces (Smartphones, Tablets...) for ensuring an instant system information.

The 5.7" High Brightness TFT Graphical Touch Screen will allow you to communicate with your 2500+ 400Hz Solid State Frequency Converter and offers our customers extensive, built-in, time-saving features that help customers develop fast and consistent GSE in operation. Extend the system to other Cavotec GSE (i.e. Cavotec PCA) and you will complete the winning combination with a unique Gate Vision System.

Installation Data

Cavotec Series	Continuous Rating (kVA) / (kW) / (kW 28VDC)	Input Amps with full load (90kVA) at the output 0.8 PF / 1.0 PF		Dimensions W x D x H		Installed Weight	
		@ 400V input	@ 480V input	(inches)	(millimeters)	(lbs)	(kg)
2500+	90/90	138A @ 400VAC and 90kW (1.0PF) 111A @ 400VAC and 90kVA (0.8PF)	115A @ 480VAC and 90kW (1.0PF) 92A @ 480VAC and 90kVA (0.8PF)	48x30x30	1220x760x760	1257	570
2500+ PowerPack I-Connect*				71.2x50.9x40.2	1809x1292x1022	1985	900*
2500+ DC Combi (90kVA/28VDC)	90/90/17			73x30x30	1854x760x760	1680	762

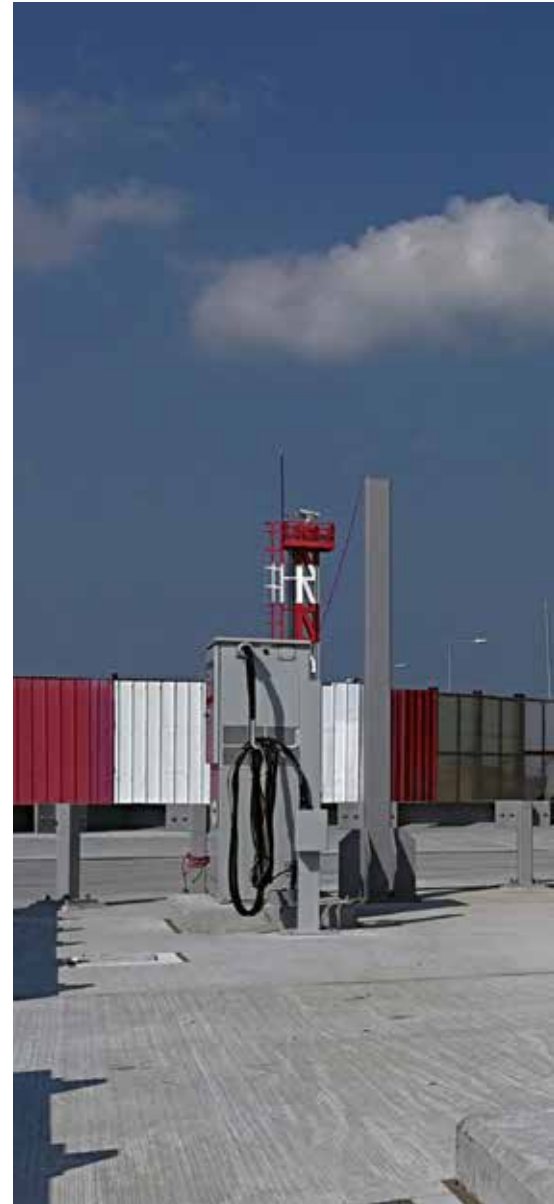
* data without cable

Model Numbers

	Output	Continuous Rating (kVA) / (kW) / (kW 28VDC)	Bridge mounted (Horizontal)	Ground mounted (Vertical)	Mobile (Horizontal)
2500+	Single	90/90	25C90S-HB	25C90S-VG	25C90S-HM
	Dual		25C90D-HB	25C90D-VG	25C90D-HM
2500+ PowerPack I-Connect	Single		25P90S-HB	25P90S-VG	25P90S-HM
2500+ DC Combi (90kVA/28VDC)	Single	90/90/17	25C90S-HB-286	25C90S-VG-286	25C90S-HM-286

We are present in:

Australia	Germany	New Zealand	Switzerland
China	Hong Kong	Norway	Turkey
Denmark	India	Singapore	UAE
Finland	Italy	Spain	UK
France	The Netherlands	Sweden	USA



cavotec.com

Disclaimer: specifications are subject to change without notice

Central Air Handling Units

Series PAC

Bridge or Ground mounted



Cavotec Inet has a proud history of being at the forefront of new technology applications to increase efficiency for practical fixed pre-conditioned air and 400Hz ground power systems.

General information

Cavotec Inet's Series PAC air handlers are specially designed to accommodate the severe air pressure and flow requirements for groundbased cooling, heating and ventilation of commercial passenger aircrafts.

These light-weight units contain air filter, blower, heat exchanger coil, output plenum, digital controls and a range of accessories to provide fully automatic cabin conditioning in conjunction with a central chilled water plant.

PAC units and Central PCA systems provide the lowest maintenance and operational costs of all the various PCA design concepts. ROI's of less than 3-4 years are not unusual. Resulting in saved dollars for other facility improvements.

Units are available in ratings to service a full range of aircraft from narrow body through the new A380 configuration.

In the cooling mode, the air handlers use Cavotec Inet's patented SuperCool technology to optimize overall energy input and to reduce size and weight. Optional heating can be achieved by either built-in electrical resistance units, centralized hot water or a combination of these.

Operating mode, airflow, and supply temperature are automatically and continuously adjusted to accommodate varying climate and aircraft conditions.

Standard features

- Energy Efficient VFD control of Blower Motor.
- Universal mounting points to allow either bridge mounting or Ground mounting.
- Hot Gas Bypass control for efficient operation, minimal compressor cycling & improved defrost capability.
- Large access doors for inspection and maintenance.
- Fire alarm interface, for remote shutdown, and annunciation.
- Aluminum Enclosure and ducting, providing reduced weight load on passenger board bridges and corrosion protection.
- Powder Coat paint systems to handle harsh airport environments.
- Automatic defrost control to ensure low unit outlet temperatures
- Safety interlocks to limit passenger bridge movement during PCA operation to protect personnel, aircraft and equipment.
- Control panel layout allows easy maintenance and access.
- Exceeds requirements of AHM 974
- Proven discharge air control system. Allows larger units to handle broad range of aircraft types. From RJ all the way to Code E & F aircraft in MARS Gate Configurations
- Inlet air Filtration monitoring, to notify maintenance when filters require replacement



Bridge mounted unit



Local controls, remote provisions



Cavotec Inet's patented SuperCool technology

Technical information

Information below is based upon standard design conditions of 95°F db/78°F wb (35°C db/26°C wb @ Sea Level)

	PAC30	PAC45	PAC75	PAC90
Aircraft types served (Aircraft-Unit compatibility to maintain 24°C (75°F) Cabin)				
Regional Jet	X	X	X	X
Narrow Body, B737, A319/20/21	X	X	X	X
Wide Body, B767, B787, A310		X	X	X
Code E, B747, A350, B777, A340			X ³	X
Code F, A380				X (2) ¹
Supply air				
Air Flow Lbs/min (kg/s)	70-180 (32-81)	90-244 (41-111)	90-440 (41-200)	90-440 (41-200)
Outlet Pressure @ Max .Air Flow inchesWC (mmWC)	up to 24" (610mm)	up to 30" (762mm)	up to 43" (1100mm)	up to 43" (1100mm)
Unit Outlet Air Temperature °F (°C)	25 to 130 (-4 to +55)			
Aircraft Outlet Hose(s)	1	1	2	2
Centrifugal blower				
Speed	VFD Controlled. Variable to Maximum 3550 RPM			
Rating HP (KW)	20 (15)	30 (24)	75 (60)	75 (60)
Coil (Cooling)				
EG/W Supply Temp °F (°C)	20 (-6.6)			
EG/W Return Temp °F (°C)	55 (12.7)			
Maximum EG/W Pressure Drop PSI (kpa)	28 (193)	32 (221)	60 (414)	65 (448)
EG/W Flow GPM (L/S)	30 (1.89)	45 (2.83)	65 (4.1)	70 (4.4)
Coil (Heating, Option Selected)				
EG/W Supply Temp °F (°C)	140 (60)			
EG/W Supply Pressure PSI (kpa)	135 (930)			
Maximum EG/W Pressure Drop PSI (kpa)	28 (193)	32 (221)	60 (414)	65 (448)
EG/W Flow GPM (L/S)	30 (1.89)	45 (2.83)	65 (4.1)	70 (4.4)
Electrical/physical (without optional electrical heat)				
Nominal Voltage	400V, 3Ø, 50 Hz, 4W			
Power Consumption (KW, 0.85 PF)	21	29	67	67
MCA	30	41	95	95
Minimum Service Disconnect Sizing	50	75	125	125
Dimensions inches (mm)	L114 x W72 x H42 (L2895 x W1828 x H1066)	L114L x W72 x H42 (L2895 x W1828 x H1066)	L220 x W88 x H62 (L5588 x W2235 x H1575)	L114 x W88 x H42 (L2895 x W2235 x H1066)
Maximum Operating Weight lbs (kg's)	1300 (591)	1850 (841)	2420 (1100)	2750 (1250)
Notes				
¹ A380 requires two units				
² Maximum Air flow requires two discharge hoses.				
³ PDX75 will handle cooling requirements of B747-400, B777, and B787, when ambient conditions are less than 90°F db/74°F wb (32°C db/23°C wb)				

Cavotec Inet has a unit and system that will meet your needs. Systems that cover the demands in various Worldwide locations. Please see the various offerings in the other Data sheets located in our Website, www.cavotec.com

Important Note:

The application data shown on this data sheet depicts a basic unit for standard design ambient conditions with the most common outlet air delivery configurations. Other performance models may be selected by the factory to optimize operating conditions for a given aircraft mix, climate, altitude, and installation factors. It is suggested that this data be used as an initial guide only, pending analysis of full system operating requirements by Cavotec Inet application engineering staff.

Options

- Building Management System Interface. (BMS)
 - Provides Central monitoring and remote control, for maintenance, billing, and ease of operations
 - Able to interface with all of the major BMS protocols
 - Automatic Message alerts to maintenance personnel upon unit trouble alert.
 - Ability to integrate BMS PLC control schemes
- Bridge Cooling/Heating
 - Allows the efficiency of the PCA unit to be utilized to cool or heat the passenger boarding bridge. Ensuring passenger comfort during the boarding/ disembarking process.
- Specialty Coil coatings to eliminate the corrosive effects of extreme airport environments.
- Integral Electrical disconnects.
 - Reducing Installation costs, and
 - Provides ease of maintenance.
- Electrical Heat Strip systems
 - Provides high discharge temperatures to warm up cold soaked aircraft, and maintain, passenger comfort, when the Aircraft engines and APU are shutdown.
 - Includes Multi safety interlocks to limit discharge temperatures
- Local displays and indicators.
 - Have numerous options for local display, control and indication, to ensure efficient operation and maintenance.
- Labelling & Signage in the language of the destination
- Multi outlet MARS pit controls.
 - Allows one unit that is capable of serving the larger center line aircraft, to also simultaneously serve two narrow body aircraft when the center line is unoccupied.
- Extended Warranties for additional 1-5 years operation.
- On site service contracts & Inspections by factory approved technicians
- Unit Mounting Brackets
 - For Passenger Bridge installation.
 - Or ground mount placement

Related products/services

- Complete central system
- System feasibility studies
- Turnkey design/build projects
- Commissioning and Training
- Point of Use PC Air Units
- 400Hz equipment and systems
- Complete integrated gate systems
- Precision power products

PCA Systems

PDX Series

PCA Systems for bridge and ground mounting



September 2019 - DAS-PCA-00

Cavotec wants to contribute to a future world that is cleaner, safer and more efficient by providing innovative connection solutions for ships, aircraft and mobile equipment today.

Cavotec has a proud history of providing Pre-Conditioned Air (PCA) equipment that exceeds the cooling and heating expectations of our clients and their passengers.

General information

Cavotec's PDX Series has a model that covers the aircraft types you must service. From RJ's and Code D/E aircraft, up to the A380 Code F aircraft, we have PDX units that not only handle but exceed the task. The PDX line is specifically designed for the North American power and duty requirements.

Each unit is specifically designed for mounting under the passenger boarding bridge or alternately, on an apron mounting stand.

In addition, options such as bridge cooling, BMS integration, and various hose management systems can be offered.

Local climate conditions significantly impact output performance. Therefore we suggest you contact the factory for the most appropriate configuration for your application. See ratings for various aircraft types and applications: PDX30, PDX45, PDX45C, PDX60C, PDX75 and PDX90.

Units come with single or dual outlets to provide the necessary airflow and pressure for the required aircraft. We have mounting brackets for all of the major bridge manufacturers and their specific bridge models.



Bridge mounted unit



Up to 3 cooling stages for demanding applications



Ground mounted unit



Standard features

- Energy efficient VFD control of blower motor.
- Hot gas bypass control for efficient operation, minimal compressor cycling and improved defrost capability.
- Large access doors for inspection and maintenance.
- Fire alarm interface, for remote shutdown, and annunciation.
- Aluminum enclosure and ducting, providing reduced weight load on passenger board bridges and corrosion protection.
- Powder coat paint systems to handle harsh airport environments.
- Automatic defrost control to ensure low unit outlet temperatures.
- Safety interlocks to limit passenger bridge movement during PCA operation to protect personnel, aircraft and equipment.
- Control panel layouts allow for easy maintenance and access.
- In compliance with AHM 974.
- Proven air distribution system, allows larger units to handle broad range of aircraft types, from RJ all the way to Code E & F Aircraft in MARS Gate Configurations.
- Inlet air filtration monitoring to notify maintenance when filters require replacement.

Options

- Building Management System interface (BMS):
 - Provides central monitoring and remote access, for maintenance, billing, and ease of operations.
 - Able to interface with all of the major BMS protocols.
 - Automatic message alerts to maintenance personnel upon unit trouble alert.
 - Ability to integrate BMS PLC control schemes.
- Bridge cooling/heating:
 - Allows to be used to cool or heat the passenger boarding bridge. Ensures passenger comfort during the boarding/disembarking process.
- Specialty coil coatings to eliminate the corrosive effects of extreme airport environments.
- Electrical heat strip systems:
 - Provides high discharge temperatures to warm up cold soaked aircraft, and maintain, passenger comfort, when the aircraft engines and APU are shutdown.
 - Includes multi safety interlocks to limit discharge temperatures.
- Local displays and indicators:
 - Numerous options for local display, control and indication, to ensure efficient operation and maintenance.
- Labelling and signage in the language of the destination.
- MARS gate with pits integration.
- Extended warranties - up to 5 years.
- On site service contracts and inspections by factory approved technicians.
- Unit installation:
 - Ground mount stand (shown in picture below).
 - Passenger Boarding Bridge Brackets.
- Overnight mode.



Ground mounted unit

Technical characteristics

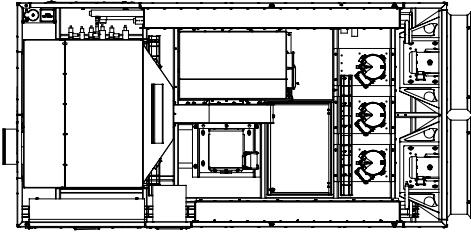
Information below is based upon standard design conditions of 95°F db/77°F wb (35°C db/25°C wb @ Sea Level)

PDX SERIES	PDX305C	PDX30C	PDX45C	PDX60C	PDX75C	PDX90C	PDX120C
Aircraft types served (Aircraft-Unit compatibility to maintain 75°F (24°C) Cabin)							
Regional Jet	X	X	X	X	X	X	X
Narrow Body, B737, A319/20/21	X ¹	X	X	X	X	X	X
Wide Body, B767, B787, A310			X	X	X	X	X
Code E, B747, A350, B777, A340					X ²	X	X
Code F, A380						X (2) ¹	X (2)
Supply air							
Air Flow Lbs/min (kg/s)	70-180 (0.53-1.36)	70-180 (0.53-1.36)	90-250 (0.68-1.89)	90-250 (0.68-1.89)	90-440 (0.68-3.33)	90-440 (0.68-3.33)	530 (4)
Outlet Pressure @ Max. Air Flow inchesWC (Pascal Pa)	up to 24 (5978)	up to 24 (5978)	up to 32 (7962)	up to 32 (7962)	up to 43 (10711)	up to 43 (10711)	up to 43 (10711)
Unit Outlet Air Temperature Degrees °F (degrees °C)	25 at design ambient variable to 130 (-4 to +55)						
Aircraft Outlet Hose(s)	1	1	1	1	2	2	2
Centrifugal blower							
Speed	VFD Controlled variable to maximum 3550 RPM						
Rating Hp (kW)	20 (15)	20 (15)	30 (22)	30 (22)	75 (56)	75 (56)	100 (75)
Electrical/physical							
Nominal Voltage	460V, 3Ø, 60Hz, 4W						
Power Consumption at operating point, kW	49	50	78	99	142	161	214
MCA (Minimum Circuit Ampacity)	96	99	136	167	245	274	363
Minimum Service Required (Disconnect)	100	100	150	175	250	300	400
Nominal Tons	30	30	45	60	75	90	120
Dimensions inches (mm) Note: do not include outlet pipe	L130 x W88 x H47 (L3302 x W2235 x H1194)		L145 x W88 x H57 (L3683 x W2235 x H1448)			L210 x W88 x H65 (L5334 x W2235 x H1651)	
Maximum Operating Weight Lbs (Kg's)	3880 (1764)	3950 (1795)	4360 (1978)	4430 (2009)	7748 (3521)	8520 (3872)	8950 (4068)
Compressors/Condensers/Evaporators							
Type of Compressor	Hermetic Scroll, 407C						
Quantity	2	2	2	2	3	3	4
Stages	2	2	2	2	3	3	3
Rating	15+15 Tons*	15+15 Tons*	25+20 Tons*	30+30 Tons*	25+25+25 Tons*	30+30+30 Tons*	30+30+30+30Tons*
Coils	Rifled Copper Coil, Aluminum Fins						
(*) Nominal at 60Hz							
Notes							
¹ A380 requires two units							
² Maximum Air flow requires two discharge hoses.							
³ PDX75 will handle cooling requirements of B747-400, B777, and B787, when ambient conditions are less than 90°F db/74°F wb (32°C db/23°C wb)							
⁴ PDX305 will handle cooling requirements of B737, 757-200, and A321, when ambient conditions are less than 90°F db/72°F wb (32°C db/22°C wb)							
⁵ PDX20C Ampacity without heater, 100A disconnect required if unit is supplied with upto a 50kW heater.							
Cavotec has a unit and system that will meet your needs. Systems that cover the demands in various worldwide locations. Please see the various offerings in the other data sheets located in our website, www.cavotec.com							
Important Note: The application data shown on this data sheet depicts a basic unit for standard design ambient conditions with the most common outlet air delivery configurations. Other performance models may be selected by the factory to optimize operating conditions for a given aircraft mix, climate, altitude, and installation factors. It is suggested that this data be used as an initial guide only, pending analysis of full system operating requirements by Cavotec application engineering staff.							

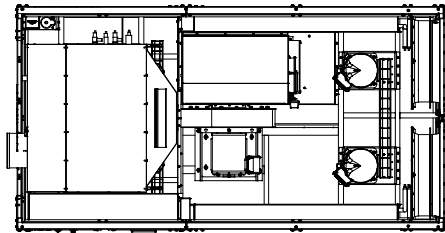
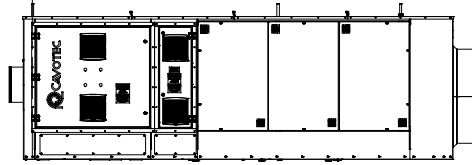
Cavotec has a unit and system that will meet your needs. Systems that cover the demands in various worldwide locations. Please see the various offerings in the other data sheets located in our website, www.cavotec.com

Important Note:
The application data shown on this data sheet depicts a basic unit for standard design ambient conditions with the most common outlet air delivery configurations. Other performance models may be selected by the factory to optimize operating conditions for a given aircraft mix, climate, altitude, and installation factors. It is suggested that this data be used as an initial guide only, pending analysis of full system operating requirements by Cavotec application engineering staff.

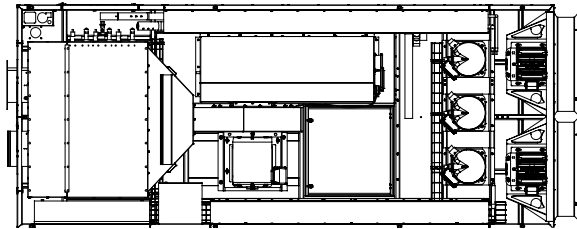
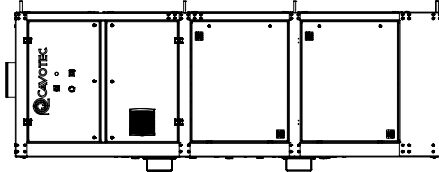
Technical drawings



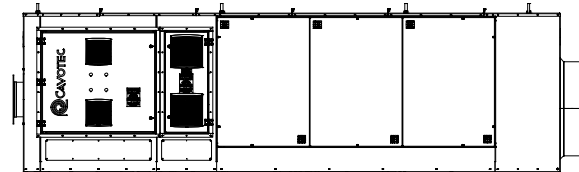
PDX30 & PDX45



PDX45C & PDX60C



PDX75 & PDX90



DAS-CI-78-US



Series PCA Hose Baskets

Cavotec Inet has a proud history of being at the forefront of new technology applications to increase efficiency for practical fixed pre-conditioned air and 400Hz ground power systems.



PHB-S2 - Dual Hose Basket



PHB-S1 - Single Hose Basket



PHB-B1 - Aluminum Post Basket

GENERAL INFORMATION

Cavotec Inet's PCA Basket and Hose Reels are designed for the demanding applications of fixed and mobile preconditioned air systems for aircraft ground support at airport ramps and bridge mounted units.

These equipments are a key element of our PCA system in order to guarantee the right cooling performance at the aircraft inlets.

Cavotec Inet PCA basket or reels can handle 80' of 14" (24m of 36cm) I.D. preconditioned air ducting and are designed for ergonomic handling of air ducting in airport ground support applications.

Their large casters make it easy to move around the ramp with minimum effort. When properly connected, the PCA basket or reels supply continuous clean preconditioned air to stationed aircraft. The PCA baskets or reels also offer numerous ergonomic options such as a standard clutch, dual sealed bearing rollers. The Cavotec PCA baskets or reels are offered in multiple sizes and colors.

SPECIFICATIONS

- Powder coated with 3 mills of paint that provides superior corrosion resistance.
- Capable of storing 80' of 14" (24m of 36cm) diameter air delivery duct
- Design is for easy tow out and rewind of hose on 4" (10cm) casters
- Designed for easy attachment to ramp mounted or bridge mounted preconditioned air units
- Finishes in safety yellow
- Available with MD-80 extension
- Hoses are rated for temperatures ranging from - 20°F to 200°F (-29° to 93°C in multiple lengths)

DAS-CI-56-US



Series PC Hose Reels

Cavotec Inet has a proud history of being at the forefront of new technology applications to increase efficiency for practical pre-conditioned air and 400Hz ground power systems.



Hose Reels



Used with our PCA units



Dual Hose Reels

GENERAL INFORMATION

Cavotec Inet's PC Hose Reels are designed for the demanding applications of fixed and mobile preconditioned air systems for aircraft ground support at airport ramps and bridge mounted units.

Cavotec Inet PCA reels handle 80' of 14" I.D. preconditioned air ducting and are designed for ergonomic handling of air ducting in airport ground support applications. The large casters make it easy to move around the ramp with minimum effort. When properly connected, the PCA reels supply continuous clean preconditioned air to stationed aircraft. The reels are powder coated with 3 mills of paint that provides superior corrosion resistance. The PCA reels also offer numerous ergonomic options such as a standard clutch, dual sealed bearing rollers. The Cavotec PCA reels are offered in multiple sizes and colors.

SPECIFICATIONS

- Capable of storing 80' of 14" diameter air delivery duct
- Design is for easy tow out and rewind of hose on 4" casters
- Designed for easy attachment to ramp mounted or bridge mounted preconditioned air units
- Finishes in safety yellow
- Available with MD-80 extension
- Hoses are rated for temperatures ranging from - 20°F to 200°F in multiple lengths

TWG Green UltraLite-HD

Lightweight | Heavy-Duty



TWG's Green UltraLite-HD PCA Hose The Lightest and Strongest PCA Hose on the Market

Combining lightweight convenience and heavy-duty performance, the TWG Green UltraLite-HD Hose is constructed of a Heavy-Duty Nylon outer shell with a No-Rip Inner liner. This reduced weight makes it the safest PCA hose for use on the ramp.

- At 60FT the Green UltraLite-HD Hose is 35LB's compared to conventional Hoses that can weigh 90+ LB's.
- Metalized on Polyethylene insulation Layer provides superb radiant heat insulation. Its unique construction allows the material to have great flexibility without cracking or flaking.
- Outer Nylon Fabric is urethane coated for 2.5 times better abrasion resistance. The fabric is resistant to the degrading effects of Glycol Alcohol (Skydrol) exposures.
- No-Rip woven nylon inner liner.

	Specifications
Temperature	20 DEG to 180 DEG
Length(s)	5', 10', 15', 20', 25' (Custom Lengths available upon request)
Diameter(s)	8", 12", 14" (Larger Diameter available upon request)
Standard Color	Hi-Viz Safety Green, (other colors available upon request)
Cuff Type(s)	Standard Velcro Cuff, Clamp Cuff or Zipper/Velcro Cuff



Sales@TWGSupply.com

twgsupply.com

817.210.4353

PO Box 1268, Grapevine, TX 76099

DAS-CI-36-US

Rev 02MAR14



Series PDH Flexible Air Delivery Duct and Accessories

Cavotec Inet has a proud history of being at the forefront of new technology applications to increase efficiency for practical fixed pre-conditioned air and 400Hz ground power systems.



PCA hose connection at the AHU outlets



Mobile PCA hose reel



Mobile PCA hose basket

GENERAL INFORMATION

Cavotec Inet's Series PDH duct and accessories are designed for the demanding applications of fixed and mobile preconditioned air systems for aircraft ground support. This insulated, flexible duct is designed for airport ramp and bridge-mounted duty.

All duct types meet the pressure drop and thermal requirements of Cavotec Inet's system design parameters. It is available in two configurations: Type Y standard hose for easy ground crew handling, storage and scuff resistance and Type Z is with wire re-enforced steel wire helix and wear strip for transitions from fixed components to the standard hose when required.

A complete range of accessories and related options make this hose suitable for all your flexible air delivery needs.

TECHNICAL INFORMATION

Material:	18 oz/sq yd polyester reinforced PVC fabric and insulation
Flame Resistance:	Per UL94VTM-O Test Methods
Temperature Range:	-20°F to +200°F (-29°C to + 93°C)
Max Air Pressure:	55" (1400mm) water gauge
Diameter:	10", 12", 14", 18" standard. Others available
Section Lengths:	15', 20', 25'. Others available
Color:	Yellow with black wear-strip is standard. Others available
End Finish:	Standard - plain. For other options, see Accessories listed on overleaf

STANDARD FEATURES

Type PDH-Y

Insulated Flat Hose

- A light, collapsible flat duct
- Patented rip-top scrim feature for high wear strength
- For applications requiring minimum flexion
- Lightest weight of all the flexible duct types



Type PDH-Z

Heavily insulated hoses with no wear strip, wire re-enforced

- With abrasion-resistant wear-strip
- A portable and compressible lightweight hose which retracts to about 1/7th of its full length
- Ideal for horizontal suspension/retraction/extension
- Helix pitch = 4" - 6"



OPTIONS & ACCESSORIES

The duct products above are supplied with standard plain ends. To meet your special job applications, it may be necessary to add specific Adapters, Attachments, Accessories or Optional End Finishes.

Please note that when working with a product that has a steel-wire helix construction or flame-resistant wear strip, these features terminate at the end of the ducting or tubing fabric.

Type PDH-VZ

Velcro & Zipper

- For use with PDH-X & Y
- Industrial quality zippers are sewed to the tube ends
- The flap of material seals cut dust and dirt



Type PDH-RX & RZ

Reducer

- The RZ is designed with steel-wire construction and wear strip
- Ideal when making a transition in diameter to an adaptor or air fitting



Hose Nozzle - PCA Non Metallic Adapters

MATERIAL:

- High strength plastic body eliminates rusting and corrosion
- Unit not subject to deformity if dropped

GASKET:

- Polyurethane with high strength all weather adhesive
- Excellent memory – does not take a "set"
- Good chemical resistance

HOOKS:

- Steel hooks will not rust
- Dual hook action for a good secure fit

HARDWARE:

- Stainless Steel
- Heavy duty positive lock stainless steel clamp

WEIGHT BY MODEL NUMBER:

MODEL	SIZE	WEIGHT
N172-MB828	8"	6 lbs



Important Note:

The application data shown on this data sheet depicts a basic unit for standard design ambient conditions with the most common outlet air delivery configurations. Other performance models may be selected by the factory to optimize operating conditions for a given aircraft mix, climate, altitude, and installation factors. It is suggested that this data be used as an initial guide only, pending analysis of full system operating requirements by Cavotec Inet application engineering staff.

For further information please visit www.cavotec.com

Disclaimer: specifications are subject to change without notice

DAS-CI-50-EU



Series TAD Telescoping Air Duct

Cavotec has a proud history of being at the forefront of new technology applications to increase efficiency for practical fixed pre-conditioned air and 400Hz ground power systems.

GENERAL INFORMATION

As part of Cavotec's PCA System, Cavotec's Series TAD Telescoping Air Duct assembly is designed to transport cold or hot pre-conditioned air (pc air) across the telescoping sections of an apron-drive passenger boarding bridge.

With thousands of gates in service world-wide since 1984, these units have demonstrated an extremely high level of reliability and maintenance-free long life. The duct is fully insulated, flame-proof and smoke retardant, with significant air losses and pressure drop.

The TAD is comprised of sections of fiberglass and internal insulating urethane foam. The complete TAD assembly as shipped includes the telescoping duct sections, seals, bearings, mounting clamps and bridge mounting brackets.

Units may be mounted either on the top, side or underneath the boarding bridge. They are available in either 2-tunnel or 3-tunnel versions.

Cavotec's custom-configures the assemblies to fit the unique models by any of the many passenger bridge companies worldwide, as determined by detailed coordination during the project. They are typically supplied in a finish to match or complement the bridge color scheme.

The TAD is a Cavotec innovation covered by patent in the US and several other countries.



TAD with PCA basket hose



High insulation properties



Integration onto the PBB

STANDARD FEATURES

- Light-weight fiberglass three layers
- Allows mounting of AHU with no weight on bridge
- Internal urethane foam insulation between fiberglass
- Pressure rating exceeds all pc air requirement
- Efficient insulation: no condensation
- Air seals allow insignificant air leakage
- ETL, UL, and CSA Standards
- No maintenance required for 10 years
- Greater than 20-year life for ducts/bearings
- 2-tunnel or 3-tunnel models available
- Side or under-bridge mounting
- Cavotec's custom configurations for any boarding bridge
- Custom colors to match boarding bridge finish

GENERAL DESIGN NOTES

The Cavotec TAD is covered under US and several international patents and is installed at over 3,000 gates world wide.

The TAD assembly is comprised of either 2 or 3 sections which fit into one another, allowing it to expand or contract together with the boarding bridge to which it is mated. The TAD presents a smooth-walled, well insulated path for the air flow, with minimum pressure drop and heat gain, and with no condensation at design temperatures with supply air to -50°C. It is made in sections of 14"/16"/18" for 3-tunnel models. It is normally supplied with all mounting clamps to be attached to points on the bridge as coordinated with the bridge factory.



MATERIALS/METHODS/SPECIFICATIONS - SERIES TAD

Outer and inner duct layers are hand laid-up plies of fiberglass cloth impregnated and treated with fire-proof and smoke-retardant resin. Between the inner and outer fiberglass layers is 1/4 inch thickness of urethane foam insulation.

Self-centering bearings are teflon-derivative solid, all around 20-yr life. Seals have minimum 10-yr life, of alimorphic solid foam, 4 per section.

Overall assembly is proven and tested flame-proof and not to produce smoke or any toxic fumes at prolonged fire and super-heated air, in accordance with LUL and CSA standards, tested by MT Labs.

Maximum Pressure:	1200mm H2O
Maximum Airflow:	280 kg/min
Internal Air Temp:	-20°C to +90°C
Ambient Temp:	-30°C to +55°C
Temp rises @37°C amb, 440 lb/min:	0.5°C
Air loss:	<0.5% new, 1% @ 5 years
Weight Estimates (depends on configuration):	about 220 kg for 3-tunnel
Diameter:	18" (457mm) outer duct 16" (406mm) 2nd duct 14" (355mm) inner*
Insulation K-factor, BTU/hr/degF/ft2	- insulation layer: K=0.5 - overall assembly, effective K=0.31

*If needed

Important Note:

The application data shown on this data sheet depicts a basic unit for standard design ambient conditions with the most common outlet air delivery configurations. Other performance models may be selected by the factory to optimize operating conditions for a given aircraft mix, climate, altitude, and installation factors. It is suggested that this data be used as an initial guide only, pending analysis of full system operating requirements by Cavotec application engineering staff.

ILLUSTRATIONS



2-tunnel TAD at DFW International Airport, one of 48 installed in 1987. Notice air handler mounted to bridge rotunda column, with no weight transferred to any of the bridge sections. Bridge and tire life are not at all impaired.

Duct is mounted to side of bridge to allow full use of underbridge area for vehicle traffic. Seals have been replaced in 2000, after 13 years of operation. Bearings and ducts are original.



2-tunnel TAD at Brussels International Airport, one of 53 installed between 1992 and 2002. Notice that in this case the TAD is mounted to the underside of the bridge, since the glass-walled bridges made esthetic appearance from inside the bridge an important consideration, and no traffic was expected below the bridge.

In this case, the AHU is ground-mounted due to architectural considerations. Bridge life is not affected by the pc air system.

In addition to specific PCA distribution systems, Cavotec engineers and manufacture a wide range of PCA mobile and fix AHU (Point of Use or Central System) - please contact us for any inquiry.

4.5 Appendix 5 – Customer References

Customer References Appendix 5

January 6, 2021

To whom it may concern:

SUB-PROJECT PHYSICAL COMPLETION ACCEPTANCE CERTIFICATE

This is to confirm and certify that:

1. All the work components of the below Sub-projects has been satisfactorily executed and completed.
2. All the completed works components have been satisfactorily executed and completed, in compliance with the details and specifications contained in the approved drawings / Bill of Quantities / Bill of materials / and Work plans.

Project References

Project Name	Point of Contact (Name)	Title/Position	Phone:	Project Completion
Airbus Americas, Inc.- CFAL	Clint Wilcher – Ivey Mechanical	Project Manager	601-750-2444	05/2020
Miami International Airport MIA PAC Replacements	Eugene Strozier – Miami Dade Aviation Department	Airport Facilities Superintendent, PBB	305-876-0270	10/2020
PHL – Gate A09	Loren Mora – Daniel J. Keating Company	Project Manger	610-348-0147	12/2020
American Airlines – (LAX)	Mij Bolyard – American Airlines	Head of Facilities	650-534-8620	09/2020



Mo Jadbabaei

Director of Operations

Cavotec USA Inc.



4.6 Appendix 6 – Certifications
PDX Underwriters Laboratories

Certifications Appendix 6

PDX Underwriters Laboratories

CERTIFICATE OF COMPLIANCE

Certificate Number UL-US-L44509-11-90207102-1
Report Reference SA44509-20170209
Date 14-May-2021

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

Model	Category Description
PDX, followed by 45,60,75,90, or 120, followed by 5 or 6, followed by 1 or 2, followed by HB, HG, or VG	Special-purpose air conditioner Series
PDX120	Special-purpose air conditioner
PDX120C	Special-purpose air conditioner
PDX120CI	Special-purpose air conditioner
PDX120I	Special-purpose air conditioner
PDX30	Special-purpose air conditioner
PDX30C	Special-purpose air conditioner
PDX30CI	Special-purpose air conditioner
PDX30I	Special-purpose air conditioner
PDX30S	Special-purpose air conditioner
PDX30SC	Special-purpose air conditioner
PDX45	Special-purpose air conditioner
PDX45C	Special-purpose air conditioner
PDX45CI	Special-purpose air conditioner
PDX45I	Special-purpose air conditioner
PDX60	Special-purpose air conditioner
PDX60C	Special-purpose air conditioner
PDX60CI	Special-purpose air conditioner
PDX60I	Special-purpose air conditioner
PDX75	Special-purpose air conditioner
PDX75C	Special-purpose air conditioner
PDX75CI	Special-purpose air conditioner
PDX75I	Special-purpose air conditioner
PDX90	Special-purpose air conditioner
PDX90C	Special-purpose air conditioner
PDX90CI	Special-purpose air conditioner
PDX90I	Special-purpose air conditioner



Bruce Mahrenholz, Director North American Certification Program

UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at <http://ul.com/aboutul/locations/>



CERTIFICATE OF COMPLIANCE

Certificate Number UL-CA-L44509-21-90207102-1
Report Reference SA44509-20170209
Date 14-May-2021

Issued to: CAVOTEC INET US INC
5665 Corporate Ave Cypress, CA
United States 90630

**This is to certify that
representative samples of**

LZFE7 - Heating and Cooling Equipment Certified for
Canada

See Addendum Page for Product Designation(s).

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: CSA C22.2 NO. 236-15, 5th Ed., Issue Date: 2015-07-31

Additional Information: See the UL Online Certifications Directory at
<https://iq.ulprospector.com> for additional information

This Certificate of Compliance does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



Bruce Mahrenholz, Director North American Certification Program

UL LLC

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Certifications Appendix 6

PAC Underwriters Laboratories

CERTIFICATE OF COMPLIANCE

Certificate Number 20170208 – E94767
Report Reference E94767 – 19861023
Issue Date 2017-FEBRUARY-08

Issued to: CAVOTEC INET US INC
5665 Corporate Ave
Cypress, CA 90630 USA

This is to certify that representative samples of Industrial Control Panels
USL, CNL - Industrial control panels – General Coverage.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 508A, "Industrial Control Panels."
CSA-C22.2 No. 14, "Industrial Control Equipment."

Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.



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Certifications Appendix 6

Solid State Frequency Converters Underwriters Laboratories & ISO 6858

CERTIFICATE OF COMPLIANCE

Certificate Number 20170131-E479671
Report Reference E479671-20170124
Issue Date 2017-JANUARY-31

Issued to: CAVOTEC INET US INC
5665 Corporate Ave
Cypress CA 90630

**This is to certify that
representative samples of**

POWER SUPPLIES, GENERAL PURPOSE
Series 2500+, followed by 25C90S, 25C90D, 25P90S, or
25P90D, followed by HB, or VG, or HM, followed by 284,
286, or 288, pulse-width modulated Static Frequency
Converter.

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 1012 - Standard For Power Units Other Than Class 2.
CSA C22.2 No. 107.1-01 - Standard For General Use
Power Supplies.

Additional Information: See the UL Online Certifications Directory at
www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's
Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.



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UL LLC

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contact a local UL Customer Service Representative at <http://ul.com/aboutul/locations/>



CERTIFICATE OF COMPLIANCE

Certificate Number 20161227-E479670
Report Reference E479670-20161220
Issue Date 2016-DECEMBER-27

Issued to: CAVOTEC INET US INC
5665 Corporate Ave
Cypress CA 90630

**This is to certify that
representative samples of**

POWER CONVERSION EQUIPMENT

Series 2500+, followed by 25C90S, 25C90D, 25P90S, or 25P90D, followed by HB, or VG, or HM, followed by 284, 286, or 288, pulse-width modulated Static Frequency Converter

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety:

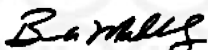
UL 61800-5-1 Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy First Edition
CSA C22.2 NO. 274-13 Adjustable speed drives - First Edition

Additional Information:

See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.



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UL LLC

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4.7 Appendix 7 – RFI request for deviation

RFI request for deviation Appendix 7



DENVER
THE MILE HIGH CITY

General Services

Purchasing Division
201 W. Colfax Avenue, Dept. 304
Denver, CO 80202
P: 720.913.8100
F: 720.913.8101
www.denvergov.org/purchasing

Date: May 18, 2021

ADDENDUM NO. 1
PROPOSAL NO. 29285J
GROUND POWER UNITS (JETWAY MOUNTED) AND PC AIR HANDLERS

The following questions and answers shall hereby become a part of this proposal.

- Q1. Exhibit F, Section 263544--1.4.A.1
Can you please confirm full quantity of units to be proposed are 'Bridge Mounted'?
- A1. All units are to be mounted on the bridge itself, behind the cab. Except when gate application precludes cab-mounting.
- Q2. 1.8.A.&B Maintenance Materials
Are parts, software and tool to be supplied?
Please clarify if the specified spare parts, software and tools listed in sections A & B to be provided and included in proposed "Unit" or "Total Delivered Price" for Items #7 and #8 OR is it the intent these specific items be provided and shown as a "price list" for submission?
- A2. 1.8.A. Yes
1.8.B.
- Provide one set of all special tools required for the installation, operation and maintenance of all equipment furnished and installed under this Section. YES
 - Provide one set of all diagnostic tools, including diagnostic software and hardware toolkit to evaluate the performance parameters of the GPU. YES
 - Provide a list of recommended additional spare parts for the GPU, including price and availability for each listed item. NO
- Q3. 2.2.C Overload Capacity
Table provides requirement of 300% for 6 seconds, 400% for 4 seconds and 500% for 2 seconds
Question: Can you please accept our standard overload performance of:
125 % load of nominal for: 600 seconds
150 % load of nominal for: 60 seconds
200 % load of nominal for: 30 seconds
300 % load of nominal for: 10 seconds
400 %load of nominal for: 1 second
- A3. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

- Q4. 2.2.E.1 Controls
Manual Start/stop: Momentary pushbuttons, located on the control door. Provide circuitry for remote control.
Question: Our standard PLB mounted equipment provides remote operator station as standard and omits controls from front of the GPU. This allows controls to be within easy reach (ground level) for safe operation and observation by ground crew. Can our standard offering of remote in lieu of front mount controls please be accepted?
- A4. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q5. 2.4.A Input Cable –
Provide bundled, UL type STOW severe-service portable cord for use in pantograph system.
Questions: Can you confirm input cable is existing and/or ‘provided by others’ so that an input cable is not within requirement of 29010 Final items to be quoted?
- A5. Yes, cable is provided by others.
- Q6. 2.5.(A-C) 400 Hz Output Cable:
Question: The specification differs from the cables widely utilized at DEN. Can you confirm if JB9516-60 can be accepted as an alternative to cable specification provided?
- A6. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q7. 2.5.(A-C) 400 Hz Output Cable:
Question: Are output cables to be provided within unit pricing of the GPUs?
If so, can you please confirm required length output cable for the 90kVA and 180kVA units?
- A7. Yes to be provided; 90Kva 60’ 180 Kva 90’
- Q8. 3.1.A Execution
Equipment shall be transported, unloaded, handled, stored, and installed in accordance with manufacturer’s written instructions.
Question: Can you please confirm, solicitation is for acquisition of specified equipment only and no unloading, storage, touch up or installation is included in the solicitation requirements?
- A8. Solicitation is for equipment only and no unloading, storage, touch up or installation is required. As specified however, commissioning is to be included in vendor’s proposal.
- Q9. Section A Document IFB No. 29285
A.20.a : Please confirm if federal or city taxes are the equipment supplier’s responsibility, and need to be included with the bid.
- A9. No taxes shall be included in your submitted pricing.
- Q10. Exhibit A
2.2.B: Please confirm if stand mounting, rotunda mounting, or C tunnel mounting are required.

- A10. All units are to be mounted on the bridge itself, behind the cab. Except when gate application precludes cab-mounting.
- Q11. Exhibit A
2.2.O: Please confirm if guard posts are required as part of this equipment scope.
- A11. No.
- Q12. Exhibit A
2.3.A: Our 45 Ton DX unit utilizes a two loop refrigeration system, consisting of (1) 20 ton and (1) 25 ton compressors. Please confirm if this is acceptable.
- A12. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q13. Exhibit B
2.1.A: May Our Company be added as an approved MFG for flexible aircraft ducts?
- A13. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q14. Exhibit B
2.8.c: Please confirm pantographs are required with every new PCA - DX and AHU models. If pantographs are required with this scope, please provide bridge model numbers.
- A14. No pantographs are required for this scope.
- Q15. Exhibit E
2.4.C: Please confirm if units are to be rotunda mounted or under C tunnel mounted.
- A15. Per gate application that is being replaced.
- Q16. Exhibit E
2.4.C.10: Please confirm if guard posts are to be supplied with this scope.
- A16. No guard posts to be provided in proposal. DEN utilizes bollards by others.
- Q17. Exhibit E
2.4.C.12: Coils are specified as copper tube with copper fin. This requirement is not only costly as compared with standard HVAC aluminum fin copper tube, but also will add additional weight to the units. We would like to propose our standard coils, which are aluminum fin, copper tube, as an alternate.
- A17. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q18. Exhibit F
1.8.B: Please confirm if the airport would consider a load bank as part of maintenance equipment to be furnished as part of this scope.

- A18. No load bank as part of scope.
- Q19. Exhibit F
2.1.A: Our Company has been a prominent manufacturer supplying the aviation industry with ground support equipment for over 10 years. Our GPU product line has been in production since 2018. May Our Company be considered an acceptable manufacturer?
- A19. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q20. Please confirm mounting requirements for all DX and AHU Preconditioned air units to be supplied.
- A20. Depending on location of mounting unit, applicable hardware will be supplied by vendor.
- Q21. Please provide glycol supply & return temperatures.
- A21. Conditions leaving the PCA Plants, 30% ethylene glycol mix:
Heating Mode: 180° F supply to PCA units, 140° F return from PCA units
Cooling: 20° F supply to PCA units, 36° F return from PCA units
- Q22. Please provide glycol flow (GPM) supply.
- A22. The flow through each PCA varying by size/tonnage. In general, flow through a PCA unit is 1.0 GPM/Nominal Ton.
- Q23. Please confirm if new glycol supply lines are required.
- A23. No. Glycol lines are by PLB Manufacturer.
- Q24. Please confirm if new power cables are required for DX and AHU Preconditioned Air Units.
- A24. No input cable is required by vendor as the PLB manufacturer will provide.

The JB9516-60 is preferred. DEN Prefers all GPUs to be bridge mounted with same JB9516 cable to avoid compatibility issues with the wear nose. Provide cable that is similar and compatible with equipment vendor represents.
- Q25. Please confirm if new bridge interlock cables are required for GPUs and Preconditioned Air Units.
- A25. No, cable is provided by PLB manufacture
- Q26. Please confirm if new cable hoists are required for new GPUs.
- A26. No, Hoists are provided by PLB manufacture.
- Q27. SECTION 236611 - PRECONDITIONED AIR DX AIR HANDLING UNITS - AVIATION

PART 2 - PRODUCTS

2.1. a

“or approved equal.”

Question:

“Can Our Company be accepted as an approved manufacturer?”

A27. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q28. SECTION 236611 - PRECONDITIONED AIR DX AIR HANDLING UNITS - AVIATION
PART 2 - PRODUCTS

2.2. L

“Where applicable, equipment exterior shall be primed and painted to match bridge color.
Equipment interior shall be manufacturer's standard.”

Question:

“Please, provide RAL number to match bridge color.”

A28. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q29. SECTION 236619 - PRECONDITIONED AIR SEQUENCE OF OPERATION - AVIATION
PART 2 - PRODUCTS

2.1.A.3

“or approved equal.”

Question:

“Can Our Company standard controller be accepted?”

A29. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q30. Question:

“Can the following characteristics for PDX-60C Tons: 60 be acceptable?

Weight: 4,430 lbs.

Refrigerant: 407C

Power: 480/60/3

Amps: 200A (standard 175A)

Compressors: 30, 30 Ton

Blower 40 HP (standard 30hp)

Airflow: 250 lb/min

Static: 32 in wc

Outlet: 25°F - 130°

A30. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q31. SECTION 236614 - PRECONDITIONED AIR DUCTWORK AND ACCESSORIES -
AVIATION

PART 2 - PRODUCTS

2.1. A.1.d

“or approved equal.”

Question:

“Can TWG Green Ultra Lite be acceptable?”

A31. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q32. SECTION 236614 - PRECONDITIONED AIR DUCTWORK AND ACCESSORIES - AVIATION

PART 2 - PRODUCTS

2.1. A.2.d

“or approved equal.”

Question:

“Can TWG Green Ultra Lite be acceptable?”

A32. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q33. SECTION 236614 - PRECONDITIONED AIR DUCTWORK AND ACCESSORIES - AVIATION

PART 2 - PRODUCTS

2.1. A.3.b

“or approved equal.”

Question:

“Can Our Company be accepted as an approved manufacturer?”

A33. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q34. SECTION 236614 - PRECONDITIONED AIR DUCTWORK AND ACCESSORIES - AVIATION

PART 2 - PRODUCTS

2.1. A.4.d

“or approved equal.”

Question:

“Can Our Company be accepted as an approved manufacturer?”

A34. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q35. SECTION 236614 - PRECONDITIONED AIR DUCTWORK AND ACCESSORIES - AVIATION

PART 2 - PRODUCTS

2.1. A.3.b

“or approved equal.”

Question:

“Can Our Company be accepted as an approved manufacturer?”

- A35. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q36. SECTION 236600 - PRECONDITIONED AIR HYDRONIC AIR HANDLING UNITS - AVIATION
PART 2 - PRODUCTS
2.1. A.2.c “or approved equal.”
Question:
“Can Our Company be accepted as an approved manufacturer?”
- A36. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q37. SECTION 263544 - AIRCRAFT GROUND POWER UNITS
PART 2 - PRODUCTS
2.2. A.1
“Frequency: 457-653 Hz.”
Question:
“Should the input frequency range be 47-63 Hz?”
- A37. Yes.
- Q38. SECTION 263544 - AIRCRAFT GROUND POWER UNITS
PART 2 - PRODUCTS
2.2. C.1
“Overload, percentage of rated output Minimum Duration of Stable Operation
125% 20 minutes
150% 150 seconds
200% 30 seconds
300% 8 seconds
400% 4 seconds
500% 2 seconds.”
Question:
“Are the below overload values acceptable?
125% for 600 seconds
150% for 90 seconds
250% for 30 seconds
300% for 15 seconds
400% for 3 seconds
500% for 1.5 seconds?”
- A38. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.
- Q39. SECTION 263544 - AIRCRAFT GROUND POWER UNITS
PART 3 - EXECUTION
3.2. B.1.a
“Measure performance parameters including input current, output voltage, output current, harmonic distortion, and output frequency.”
Question:

“Is it acceptable to just measure input voltage, output voltage, output current, input frequency, and output frequency as part of our field testing and all other parameters tested at factory?”

A39. Upon receipt of all submittals, DEN will analyze all exceptions taken by proposers and make a determination if it is acceptable as an approved equal.

Q40. SECTION 263544 – AIRCRAFT GROUND POWER UNITS
PART 3 - EXECUTION

3.3. A Installation, General

“PCA air handling units shall be mounted underneath and on the bridge.”

Question:

“Is the bid equipment supply only or installation required and by whom?”

A40. It is supply only, no installation.

Q41. SECTION 263544 – AIRCRAFT GROUND POWER UNITS
PART 3 - EXECUTION

3.4. A. 1. DEMONSTRATION AND TRAINING

“Provide a video recording of all training sessions in accordance with Section 013233

“Photographic Documentation.”

Question:

“Is the video recording recorded after start up and commissioning is completed?”

A41. Yes

Q42. Terms and Conditions

Question: Please verify if terms and conditions can be negotiated post award?

A42. You must submit any requests for exemption on the purchase order terms and conditions with your proposal.

For all questions above that asked if a deviation from the specification is acceptable, please note the exception in your submittal and each noted exception will be considered during the evaluation.

Proposer shall initial here _____ and attach to proposal. Failure to do so may be cause to consider your proposal non-responsive and cause for rejection.

Company: _____



Kenton Janzen
Senior Procurement Analyst

4.8 Appendix 8 – Bill of Quantity

Bill of Quantity Appendix 8

PER 29285J VALE IFB REFERENCE

BILL OF QUANTITIES

Systems:

Group I Proposal Item # 1- 45-TON GLYCOL PRECONDITIONED AIR HANDLING UNITS EACH UNIT PRICE INCLUDES THE FOLLOWING:

#	Part Number	Description	Qty	Unit of measure
1	058-PC	Central Air Handling Units PAC Systems, PAC45 Bridge Mounted	1	PCS
2	058-MAA	Mounting Bracket (45T)	1	PCS
3	058-HA	PDX 80FT TWG HOSE ASSEMBLY KIT	1	PCS
4	150-AP	CABIN TEMP SENSOR ASSEMBLY KIT	1	PCS
5	058-PBA	3-POSITION PC AIR PUSH BUTTON STATION: RJ/NB/WB	1	PCS
6	058-HC	NR12-10051687 - AIR SERVICE HOSE REEL ASSEMBLY,STANDARD	1	PCS
7	058-HB	NR12-1004949505 - PCAIR HOSE STORAGE BASKETSINGLE/DUAL AIR SERVICE HOSE	1	PCS
8	058-TD	Telescopic Air Duct with mounting	1	PCS
9	058-ADK	Trolley capacity of 80 feet of 14" PCA hose	1	PCS
10	058-PC	Temperature / Flow Control Valve kit	1	PCS
11	058-PC	Extended warranty five years from startup	1	PCS

Cavotec USA Inc		
5665 Corporate Ave.	Phone: 1-714-947-0005	
CYPRESS, 90630	Fax: 1-714-947-0098	VAT:
United States	cavotec.com	

Group I Proposal item #2- 45-TON DX PRECONDITIONED AIR HANDLING UNITS EACH UNIT INCLUDES THE FOLLOWING:

#	Part Number	Description	Qty	Unit of measure
1	058-PC	PDX Systems, PDX Series Model PDX45C, Bridge Mounted	1	PCS
2	058-MAA	Mounting Bracket (45T)	1	PCS
3	058-HA	PDX 80FT TWG HOSE ASSEMBLY KIT	1	PCS
4	150-AP	CABIN TEMP SENSOR ASSEMBLY KIT	1	PCS
5	058-PBA	3-POSITION PC AIR PUSH BUTTON STATION: RJ/NB/WB	1	PCS
6	058-ADK	Trolley capacity of 80 feet of 14" PCA hose	1	PCS
7	058-PD	Pre-cool assembly	1	PCS
8	058-PC	"Ready" light (lighted pushbutton).	1	PCS
9	058-PC	30HP to 40HP motor difference	1	PCS
10	058-PC	Extra Set of Filters 2" Washable Type Alum	1	PCS
11	058-PC	Extended warranty five years from startup	1	PCS
12	058-PC	14" Reducer to 8" Hose Duct	1	PCS
13	058-PC	2" tall reflective black and yellow, angle-stripped, reflective safetytape	1	PCS

Group I Proposal Item #3 - 60-TON GLYCOL PRECONDITIONED AIR HANDLING UNITS | EACH UNIT INCLUDES THE FOLLOWING:

#	Part Number	Description	Qty	Unit of measure
1	058-PC	Central Air Handling Units PAC Systems, PAC60 Bridge Mounted	1	PCS
2	058-MAA	Mounting Bracket (60T)	1	PCS
3	058-CA	PDX 80FT TWG HOSE ASSEMBLY KIT	1	PCS
4	150-AP	CABIN TEMP SENSOR ASSEMBLY KIT	1	PCS
5	058-PBA	3-POSITION PC AIR PUSH BUTTON STATION: RJ/NB/WB	1	PCS
6	058-HC	NR12-10051687 - AIR SERVICE HOSE REEL ASSEMBLY, STANDARD	1	PCS
7	058-HB	NR12-1004949505 - PCAIR HOSE STORAGE BASKETS SINGLE/DUAL AIR SERVICE HOSE	1	PCS
8	058-TD	Telescopic Air Duct with mounting	1	PCS
9	058-ADK	Trolley capacity of 80 feet of 14" PCA hose	1	PCS
10	058-PC	Temperature / Flow Control Valve kit	1	PCS
11	058-PC	Extended Warranty five years from startup	1	PCS

Group I Proposal Item # 3- 60-TON DX PRECONDITIONED AIR HANDLING UNITS | EACH UNIT INCLUDES THE FOLLOWING:

Cavotec USA Inc		
5665 Corporate Ave.	Phone: 1-714-947-0005	
CYPRESS, 90630	Fax: 1-714-947-0098	VAT:
United States	cavotec.com	



We connect the future.

#	Part Number	Description	Qty	Unit of measure
1	058-PC	PDX Systems, PDX Series Model PDX60C	1	PCS
2	058-MAA	Mounting Bracket (60T)	1	PCS
3	058-HA	PDX 80FT TWG HOSE ASSEMBLY KIT	1	PCS
4	150-AP	CABIN TEMP SENSOR ASSEMBLY KIT	1	PCS
5	058-PBA	3-POSITION PC AIR PUSH BUTTON STATION: RJ/NB/WB	1	PCS
6	058-ADK	Trolley capacity of 80 feet of 14" PCA hose	1	PCS
7	058-PD	Pre-cool assembly	1	PCS
8	058-PC	"Ready" light (lighted pushbutton).	1	PCS
9	058-PC	30HP to 40HP motor difference	1	PCS
10	058-PC	Extra Set of Filters 2" Washable Type Alum	1	PCS
11	058-PC	Extended warranty five years from startup	1	PCS
12	058-PC	14" Reducer to 8" Hose Duct	1	PCS
13	058-PC	2" tall reflective black and yellow, angle-stripped, reflective safetytape	1	PCS

Group I Proposal Item #5- 90-TON DX PRECONDITIONED AIR HANDLING UNITS | EACH UNIT INCLUDES THE FOLLOWING

#	Part Number	Description	Qty	Unit of measure
1	058-PC	PDX Series Model PDX90C Bridge Mounted	1	PCS
2	058-MAA	Mounting Bracket (90T)	1	PCS
3	058-HA	PDX 80FT TWG HOSE ASSEMBLY KIT	2	PCS
4	150-AP	CABIN TEMP SENSOR ASSEMBLY KIT	1	PCS
5	058-PBA	4-POSITION PC AIR PUSH BUTTON STATION: RJ/NB/WB/JH2	1	PCS
6	058-ADK	Trolley capacity of 80 feet of 14" PCA hose	2	PCS
7	058-PD	Pre-cool assembly	1	PCS
8	058-PC	"Ready" light (lighted pushbutton).	1	PCS
9	058-PC	Extra Set of Filters 2" Washable Type Alum	1	PCS
10	058-PC	Extended warranty five years from startup	1	PCS
11	058-PC	14" Reducer to 8" Hose Duct	1	PCS
12	058-PC	2" tall reflective black and yellow, angle-stripped, reflective safetytape	1	PCS

Group I Proposal Item #6- Startup PCA QUANTITY 8 DAYS OF COMMISSIONSING(4 UNITS PER DAY)

Cavotec USA Inc		
5665 Corporate Ave.	Phone: 1-714-947-0005	
CYPRESS, 90630	Fax: 1-714-947-0098	VAT:
United States	cavotec.com	

Group II Proposal Item #7 - 90 KVA AIRCRAFT GROUND POWER UNITS \ EACH UNIT INCLUDES THE FOLLOWING:

#	Part Number	Description	Qty	Unit of measure
1	058-FC	Series 2500+25C90S-HB Bridge Mounted	1	PCS
2	058-PBF	STAINLESS STEEL Nema 4x REMOTE PUSHBUTTON STATION2500+ SINGLE CABLE HOIST ON OFF	1	PCS
3	058-CA	400HZ 60FT W/ BUTTONS OUTPUT SINGLE BANDED CABLE	1	PCS
4	058-FC	Extended Warranty two years from startup	1	PCS
5	058-FC	BACnet Module	1	PCS
6	058-FC	2500+ MTG BRKT ASSY	1	PCS

Group II Proposal Item #8 - 180 KVA AIRCRAFT GROUND POWER UNITS | EACH UNIT INCLUDES

#	Part Number	Description	Qty	Unit of measure
1	058-FC	2500+25C180D-HB, Bridge Mounted	1	PCS
2	058-PBF	STAINLESS STEEL Nema 4x REMOTE PUSHBUTTON STATION2500+ DUAL CABLE HOIST ON OFF	1	PCS
3	058-CA	400HZ 90FT W/ BUTTONS OUTPUT SINGLE BANDED CABLE	2	PCS
4	058-FC	Extended warranty two years from startup	1	PCS
5	058-FC	DUAL 2500+ MTG BRKT ASSY	1	PCS
6	058-FC	BACnet Module	1	PCS

Group II Proposal Item #9- Startup GPU QUANTITY 18 DAYS OF COMMISSIONING (4 UNITS PER DAY)

Cavotec USA Inc		
5665 Corporate Ave.	Phone: 1-714-947-0005	
CYPRESS, 90630	Fax: 1-714-947-0098	VAT:
United States	cavotec.com	