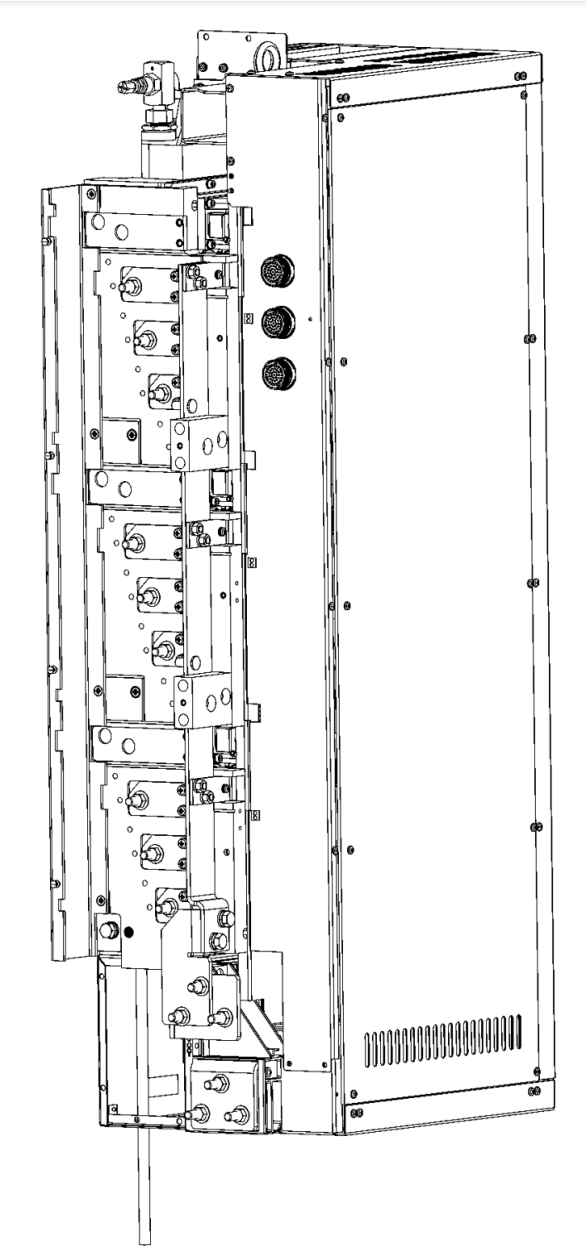

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Contents

1. Introduction

- The AE221K is a Liquid-Cooled Avid Extreme Drive (AED) which provides three motor outputs of 221A @ 110% overload rating per channel.

- This drive is available in two voltage ratings:
  - AE221K6A1 which is nominally rated at 600/690V AC.
  - AE221K4A1 which is nominally rated at 440/480V AC.

- Both model variants contain three independent SKiiP®7 IGBTs which are the latest generation offering all the benefits and improvements of intelligent power modules from preceding SKiiP generations.

- Each drive requires three externally mounted drive controllers and I/O assemblies. This arrangement allows each motor to be controlled separately in either vector or VF mode.

2. WARNINGS

Operation of this equipment requires detailed installation and operation instructions provided in this manual; this information should be retained with this product.

- This equipment may be connected to more than one live circuit.

- All power supplies must be switched off and isolated before working on the equipment, failure to do so could result in death or serious injury.

- Wait at least 8 minutes after isolating supplies and check that the voltage between DC+ and DC- has reduced to a safe level before working on the equipment.

- Risk of burn - surfaces on the coolant pipes, cables and busbars can reach high temperatures and remain hot for some time after power is removed.

- Confirm that the coolant has cooled to a safe temperature and that the equipment is properly drained and isolated before disconnecting any external pipework.

- The unit is heavy: 144 Kg (318 lb.)

- The Liquid Cooled Avid Extreme Drive Modules are of IP00 construction and must be built into an enclosure or cabinet.

- If the Power Drive System that utilizes the modules is configured to auto-restart, the motor may start rotating without an operator input. Precautions Must be taken to prevent injury to personnel.

- Units are designed and manufactured to comply with EN 61800-5-1 and UL 61800-5-1.

3. Electrical – Power Section

Specification	AE221K4A1	AE221K6A1
Supply Voltage :	Min: 450V DC Typical: 678V DC Max: 820V DC	Min: 550V DC Typical: 975V DC Max: 1075V DC
Output Frequency Range :	0 to 200Hz	
Instantaneous Voltage Trip Level:	882V DC (limited by SMPS over-voltage trip)	1170V DC (limited by SMPS over-voltage trip)
Maximum DC Surge Voltage :	1275V DC (SMPS limit must be respected)	
Maximum DC Link Capacitor Bank Voltage:	1315V DC (SMPS limit must be respected)	
Maximum Silicon Voltage (VCES) :	1700V DC (SMPS limit must be respected)	
Current Rating with 1.1 x Overload* :	221A per output	
Current Rating with 1.5 x Overload* :	165A per output	
Instantaneous Over-current Trip Level :	625A	
Brick-wall Current Level :	419A	
DC Link Capacitance :	16,800µF (12 parallel paths of 3 series 4,200µF)	
Output Switching Frequency - Default Setting	1.25 kHz, 2.5 kHz, 5 kHz and 7.5 kHz for all drives (programmable by P35.00).	
Output - Overload Current	50% or 10% for one minute, once every 10 minutes, as selected.	
Insulation - Standards	Designed to meet UL 61800-5-1/EN 61800-5-1 TN or TT network: Overvoltage Category III IT network: Overvoltage Category II	

3.1 Losses

Specification	*Value*
Losses at 1.1 Current Rating	5,400 W (IGBT)
Losses at 1.5 Current Rating	3,300 W (IGBT)

NOTE: Losses are based on nominal voltage and current, 1.25 kHz PWM frequency and 40°C (104°F) coolant temperature. Refer to Avid Controls for losses under other operating conditions.

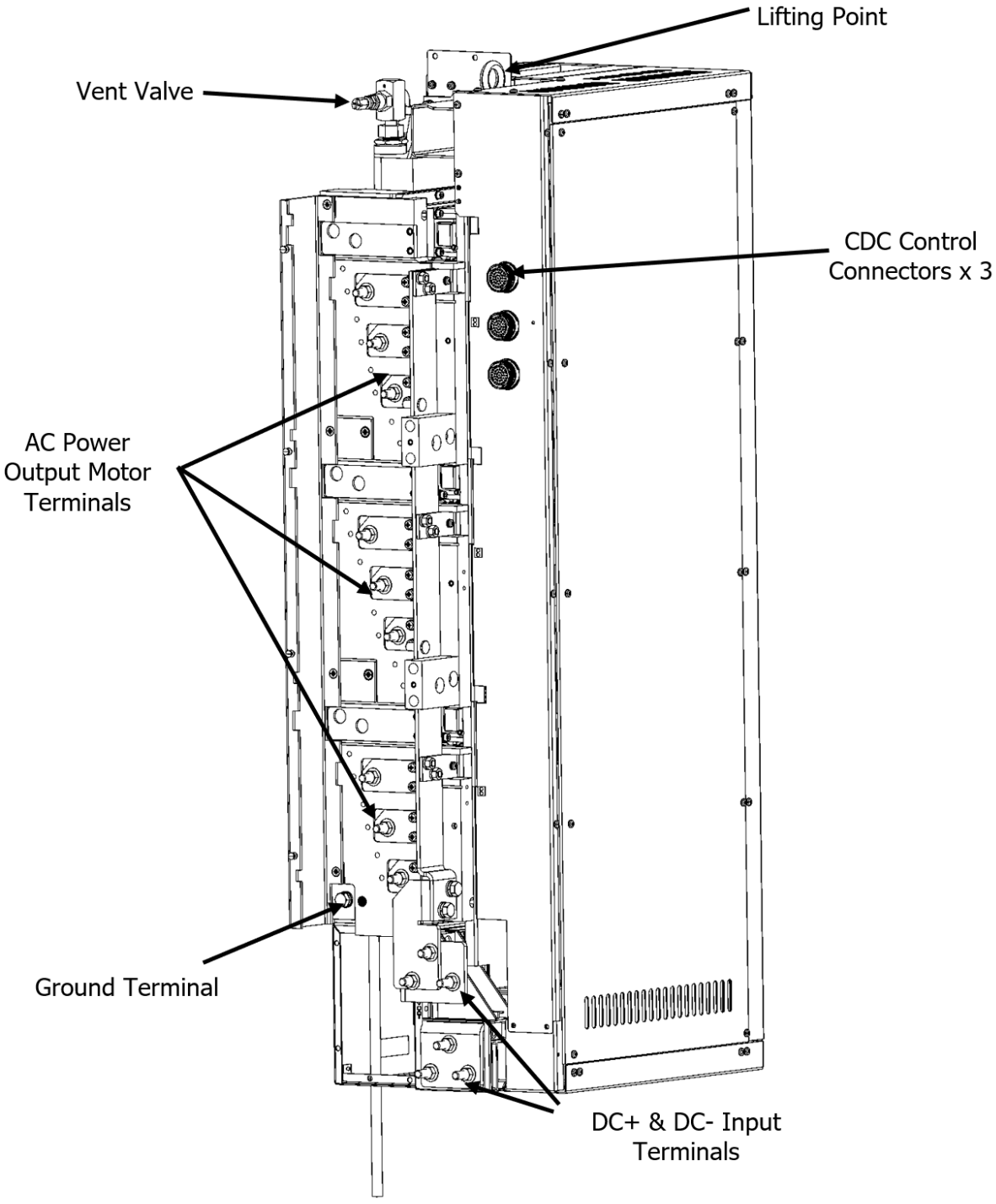
3.2 High Voltage / Power Connections

Connection	*Value*	*Size*
AC Power Customer Supply Terminals	Not applicable for these models	
AC Power Customer Motor Terminals	1 x M10 stud per phase	Min: 1 x 120mm^2 cable per phase Max: 1 x 150mm^2 cable per phase
DC Power Customer Supply Terminals	3 x M10 studs each for DC+ and DC-	Min: 2 x 120mm^2 cable per phase Max: 3 x 150mm^2 cable per phase
Ground Connection	1 x M10 bolt	
Low Voltage Control Connections	3 x 41-Way round socket for connection to the CDC and I/O assembly	

- Recommended fastening torque for power terminals is 35Nm (26 ft-lbs.).
- All power cables must have insulation rated to a minimum temperature of 125°C. Recommended insulation materials include high temperature silicone rubber and extruded radiation-crosslinked polyolefin.
- AC and GROUND cables must have insulation rated to a minimum of 690V AC.
- DC cables must have insulation rated to a minimum of 1200V DC.
- Suitable cable types include:
  - Nexans - SIWO-KUL B10 1x120 1.1Kv YE
  - Huber and Shuner - Radox 125 600/1000V AC

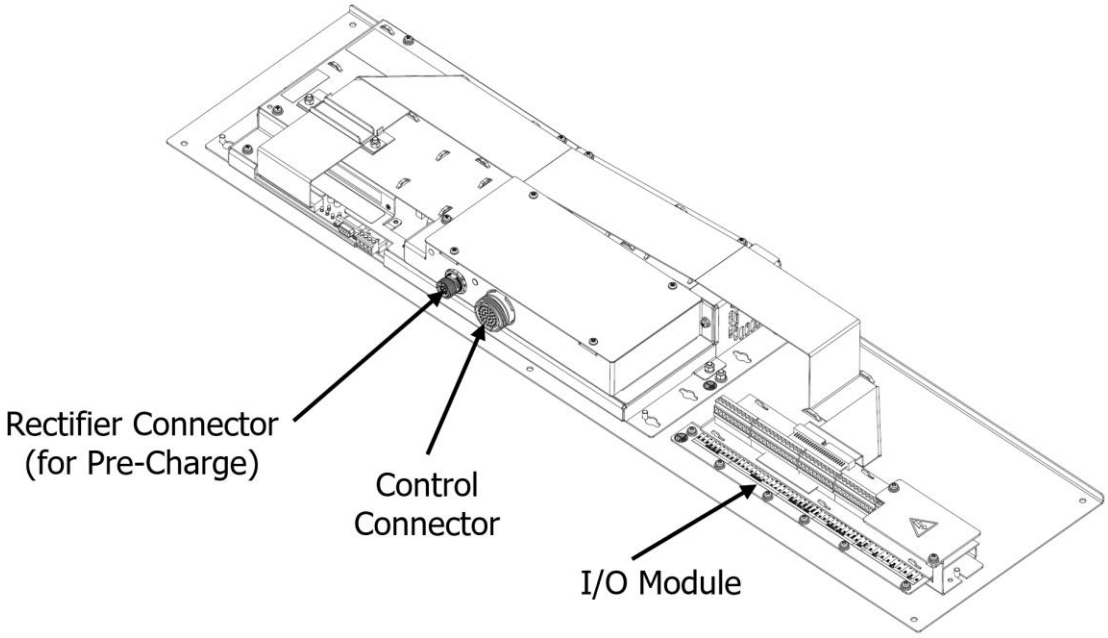
3.4 Control Connections

- The AED has 3 x 41-way circular sockets on the front panel for connections to each Control and I/O Assembly.



Overview of AE221K6A1/ AE221K4A1

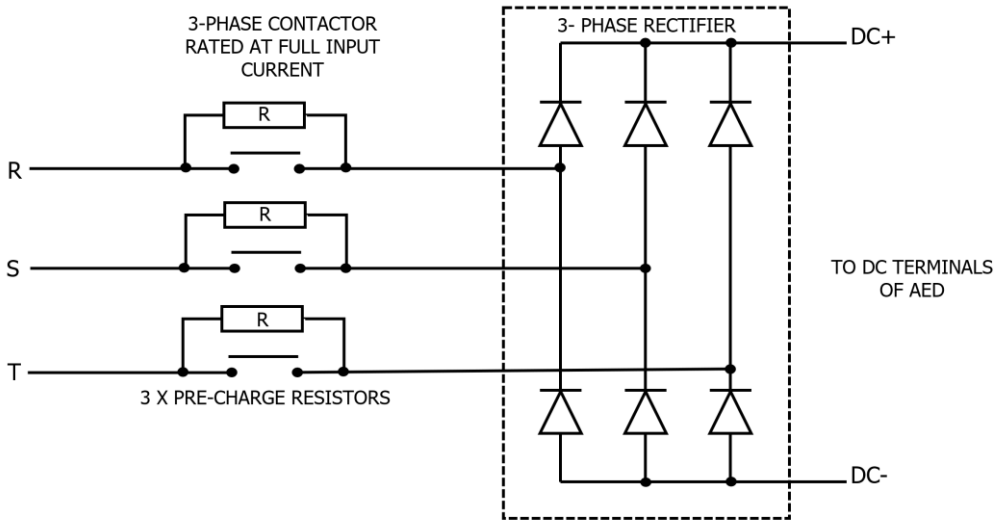
- The Control and I/O Assembly MVC3001-4005-A is mounted on a steel panel
- Three custom round screened cables (03602-WRH-A) are provided for connection between each Control Assembly and the AED. Length: 6.5 ft (2m).



Overview of MVC3001-4005-A - Control and I/O Assembly

3.5 External Pre-Charge

- These drive products require the user to supply DC to each drive via an external pre-charge arrangement.
- **Warning: Applying DC direct to the inverter will cause damage to the module and will likely blow the supply fuses.**
- Pre-charge is normally achieved by feeding a 3-phase rectifier via pre-charge resistors designed to limit the current to a low value. This current then charges the DC link capacitors in the AED in a controlled manner.
- Typical pre-charge currents are <10A and the wattage of the resistor can be calculated based on the supply voltage. When pre-charge is complete, a suitably rated contactor shorts out the pre-charge resistors so that the full supply is applied to the AED.



Schematic for the Pre-Charge

3.6 Rectifier Cable and Controller Configuration

- The Rectifier Cable (3607-WRH-A) is a 2-meter (6-foot) assembly designed to interface the CDC and I/O Assembly with an AC-fed AED unit.
- For DC-fed AEDs, users are required to provide their own pre-charge panel. The same cable can be utilized; however, one connector must be removed, and the individual color-coded conductors can be connected directly as described below.

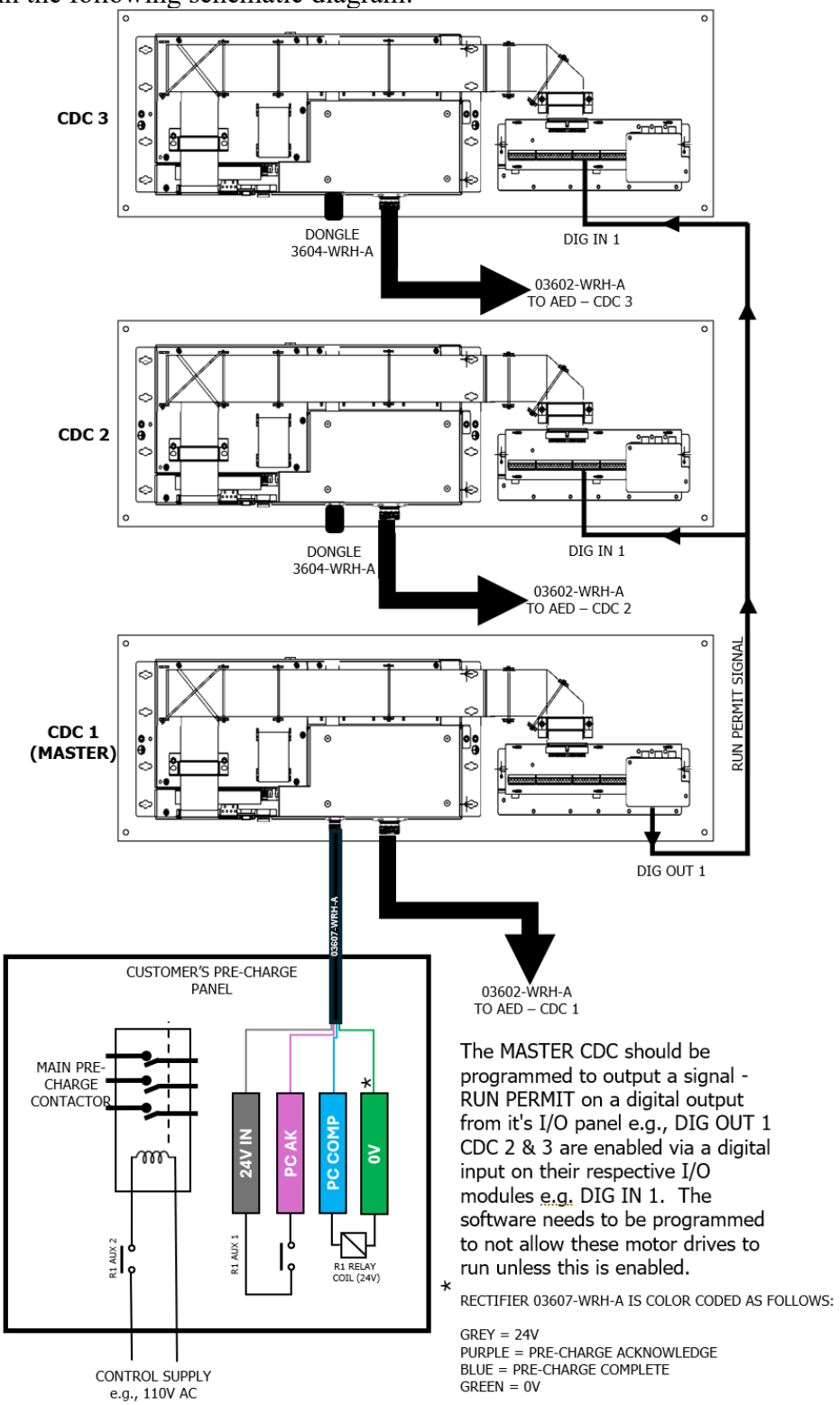
- Cable Color Coding and Signal Description:

Wire Color	Signal Name	Function Description
Grey	+24V Supply	Controller provides 24 VDC to one side of the auxiliary contact, the other side returning to the Pre-Charge Acknowledge input.
Purple	Pre-Charge Acknowledge	Input signal to the controller. Indicates acknowledgment from the pre-charge circuit.
Blue	Pre-Charge Complete	Controller output provides 24V DC when the pre-charge cycle is complete.
Green	0V Reference	Ground reference for the above control signals.

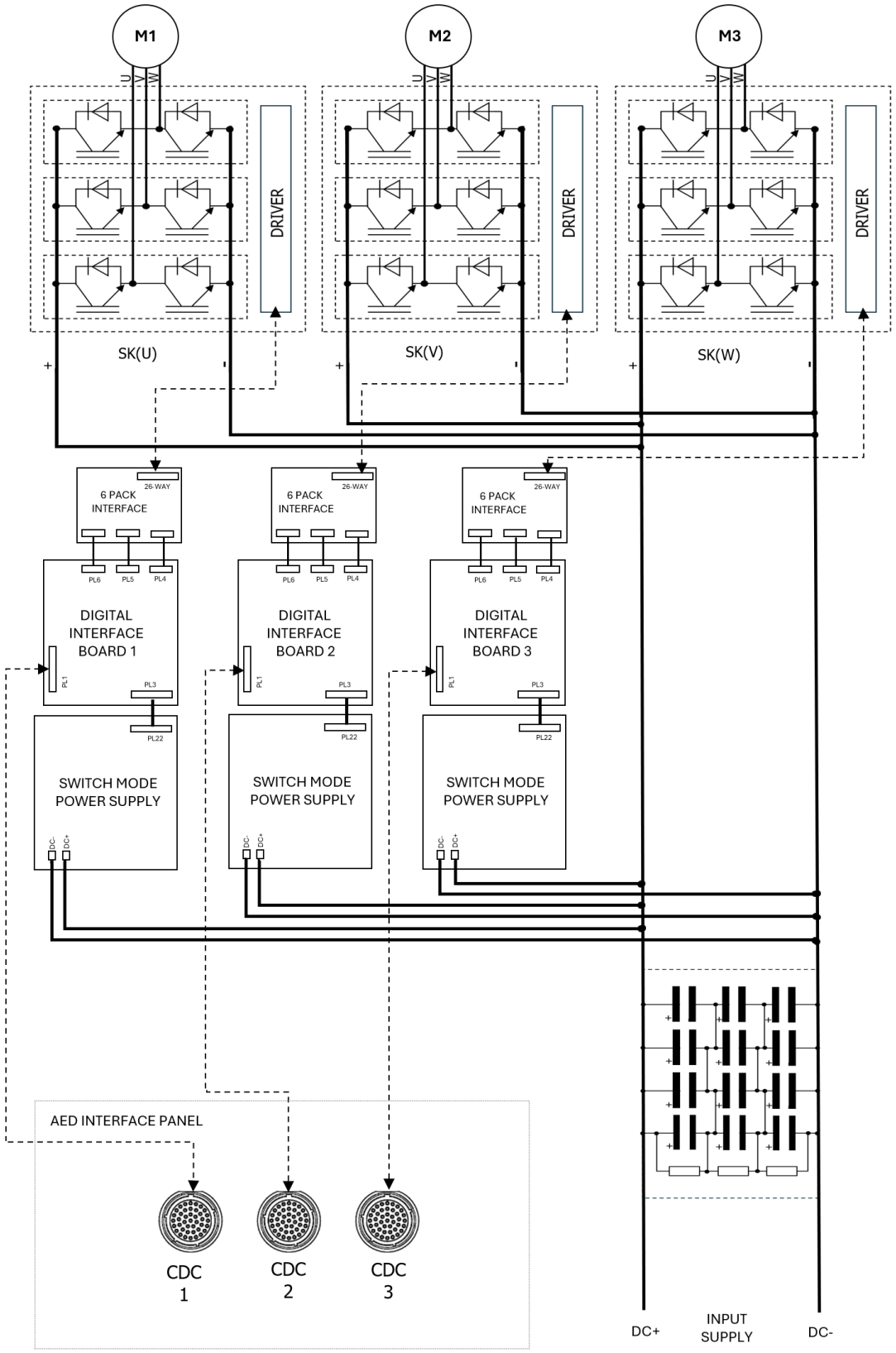
3.6.1 Controller Assembly Configuration

- Each AED system includes three Controller Assemblies which need to be configured as follows:
    - One (1) Master Controller Assembly.
    - Two (2) Slave Controller Assemblies.
- The Master CDC interfaces directly with the users pre-charge panel, providing required control functions. It generates and manages all control signals related to pre-charge acknowledgment and completion. See diagram on next page.
- Each Slave CDC requires a Termination Plug (P/N 03604-WRH-A sometimes referred to as a “Dongle”) to ensure correct input signal conditions are satisfied. Slave controllers need to be programmed so as to inhibit RUN mode until a RUN PERMIT signal is received from the Master Controller.
- The RUN PERMIT functionality is achieved through a direct connection from the digital output on the Master Controller’s I/O and a digital input of the Slave Controllers.
  This configuration ensures proper interlock and synchronized operation of all controller assemblies within the AED system.

- This is shown in the following schematic diagram:



Schematic of External Pre-Charge on the Triple AED



Schematic of AE221K6A1/AE221K4A1 DC Fed 3-Motor Output Drive

4. Specifications

4.1 Cooling

Specification	***Value***
Coolant Type*1	Water / Ethylene Glycol Maximum 50% Ethylene Glycol With suitable corrosion inhibitors
Minimum Coolant Flow	25 liters/min (6.6 US-GPM)
Maximum Coolant Inlet Pressure	300kPa (45psi)
Maximum Coolant Inlet Temperature	60°C
Minimum Coolant Inlet Temperature	0°C
Coolant Strainer	Coolant must be strained to remove particles Maximum recommended strainer mesh is 0.7mm (0.028”) Inspect and clean strainer every six months
Coolant Lifetime	Check coolant constituent concentration every six months Remove coolant, flush system with de-ionized water and refill with new coolant every 24 months.
Coolant Connection Options	2x Quick-Disconnect at bottom of unit *2

*1: The materials used in ***all*** cooling system components must be compatible with ethylene glycol. Incompatible materials may be corroded or degraded over time causing leakage. Therefore, it is important to check the compatibility of the coolant with all components.

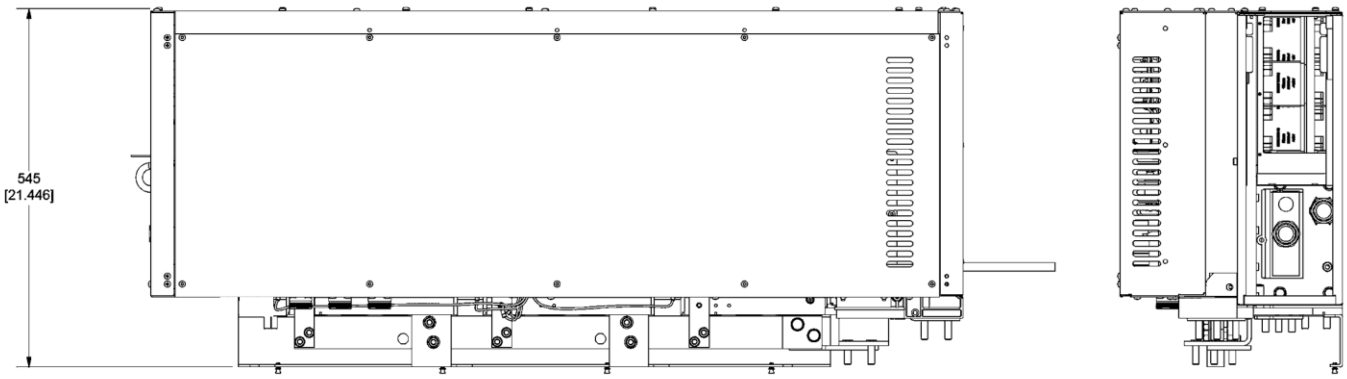
*2: Modules are fitted with Self-sealing Staubli RME 16 connectors.

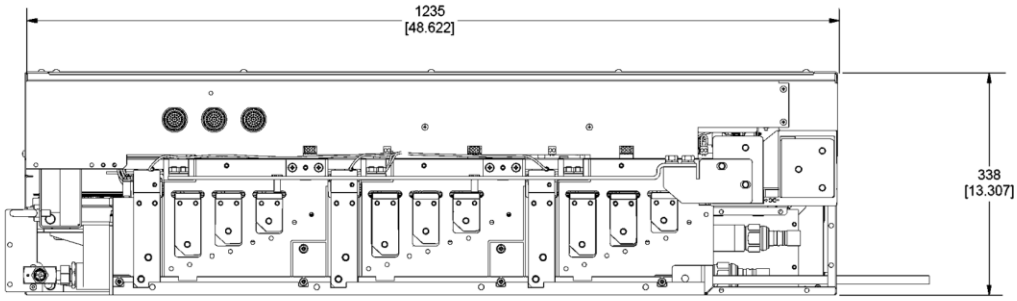
4.2 Environmental

Specification	***Value***
Ambient Temperature (Internal cabinet temperature) - Operating	0 to 50°C
Temperature – Storage or Transport	-13°F to 131°F (-25 to +55°C)
Altitude – Operating	Up to 3280ft. (1000m) ASL. Between 3280ft. (1000m) and 6551ft. (2000m) apply derating of 7.5% per 3280ft. (1000m).
Altitude – Storage	Up to 9842ft. (3000m) ASL
Altitude - Transport	Will withstand air transport
Vibration – Transport	IEC 60721-3-2:1997 Class 2M1, in transport packaging.
Humidity – Operating, Storage or Transport	5% to 95% RH, Non-condensing.
Cabinet air – Operating	Pollution Degree 2 as per IEC60664-1, UL 840 & CSA C22.2 No. 0.2-93 i.e. clean, free from dust, condensation and conductive or corrosive gases. Maximum chemicals 15ppm H_2S, 25ppm NO_2, 25ppm SO_2

4.3 Mechanical

Specification	*Value*
Dimensions	338mm W x 1263mm H x 544mm D (13.3” W x 49.7” H x 21.4” D)
Enclosure	IP00 (IEC 60529:1989; BS EN 60529:1992) NEMA 1 Must always be installed within suitable enclosure with restricted access
Mass	144 Kg (318 lb.)





5. Fusing

- Fuse selection depends on many external factors, including:
  - The current/time loading conditions
  - Number of starts per hour/day etc.
  - Fuse cooling.
  - Ambient temperature.
  - Continuous running or intermittent running.
  - Fuse connection/mounting arrangements.

- The fuse information provided here outlines a basic fusing arrangement for a single unit operating at its rated current and voltage, assuming an overload lasting 60 seconds every 10 minutes and one start/stop cycle per day.

Specification	***Value***
1.1 Overload Rating 480/525V AC	Bussmann 170M6114
	Ferraz 7.5 URD 44 TTQF 1200, Ref No. : N229 207A
1.5 Overload Rating 480/525V AC	Bussmann 170M6114
	Ferraz 6.9 URD 33 TTF 0900, Ref No. : A 300 081A

6. Installation

6.1 Enclosure/Cabinet Information

- The Avid Extreme Drive must be fitted into an enclosure.
- Rittal VX25 basic enclosures are recommended, e.g., VX 8806.000 (H 1800mm x W 600mm x D 600mm) and VX 8208.000 (H 2000mm x W 1200mm x D 800mm).
- The MINIMUM depth of an enclosure is 600mm for clearance of the modules to the front and back.
- The following compatible cubicle mounting accessories are available from Avid:

Description
Cross Rail Lower Front, VX25 800mm Wide Cubicle (8806.000)
Cross Rail Lower Rear, VX25 800mm Wide Cubicle (8806.000)
Guide Plate Lower, VX25 800mm Wide Cubicle (8806.000)
Guide Plate Upper, VX25 800mm Wide Cubicle (8806.000)
Cross Rail Lower Front, VX25 1200mm Wide Cubicle (8208.000)
Cross Rail Lower Rear, VX25 1200mm Wide Cubicle (8208.000)
Guide Plate Lower, VX25 1200mm Wide Cubicle (8208.000)
Guide Plate Upper, VX25 1200mm Wide Cubicle (8208.000)
Side Rail, VX25 800mm Wide Cubicle (8806.000)
Side Rail, VX25 1200mm Wide x 800 Deep Cubicle (8208.000)

6.2 Fitting the Avid Extreme Drive

- Fit guide rails, cross rails etc. into the enclosure as shown:
- The type of guide rails needed is dependent on size of enclosure and number of modules.

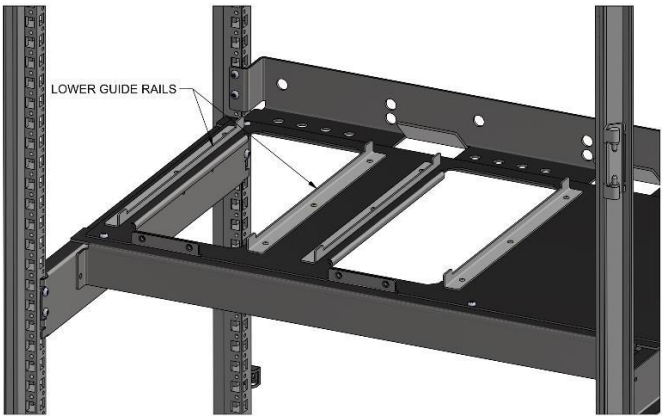
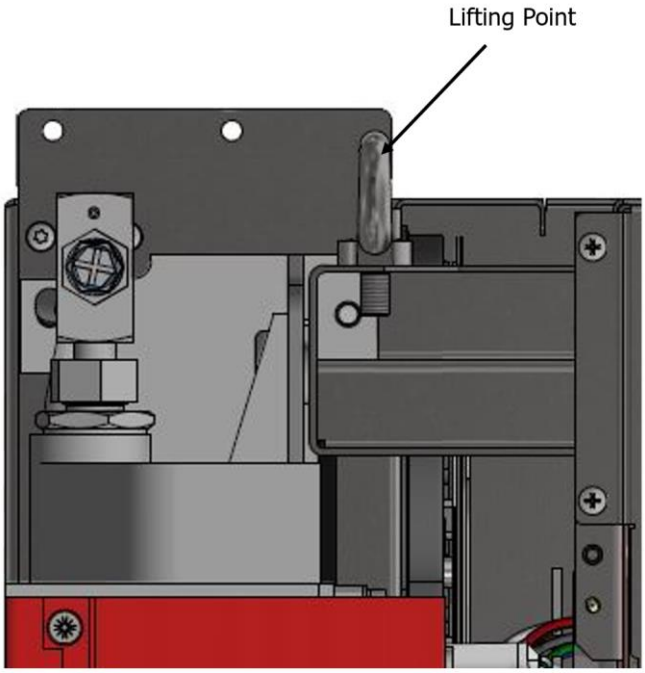


Diagram of AED mounting rails

- The module is heavy and MUST be positioned into the enclosure using suitable lifting equipment rated for the weight of the module 144 Kg (318 lb.).
- The lifting eye is located at the top of the module and marked with a label.



Location of lifting eye

- Using the lifting equipment raise the AED module so that its base is level with the lower guide plate.
- Locate the bottom of the module between the lower guide rails.
- When engaged slide the module backwards into the enclosure.
- When the top of the AED module engages with the upper guide rails the lifting hook can be detached.
- Slide the AED Module in the direction shown until fully home.
- Secure the AED module to the top rail using 2 x M5x10 Taptite screws.
- Secure to the lower mounting rail using 2 x M6x16 hex bolts, flat and spring washers.

7. Protection Requirements

7.1 Access

WARNING

- The AED module is of IP00 construction and MUST always be installed in an enclosure with restricted access.
- Additional protection against accidental contact is provided in the form of polycarbonate covers (shrouds) for the AC and DC terminals.
- The AED module must only be powered when these shrouds are fitted, and the enclosure doors are closed and secured.
- Yellow warning labels on the AED module instruct users to wait for 8 minutes after power is removed before working on the equipment (this is to allow DC link energy to discharge to a safe voltage).

7.2 Motor Overload & Thermal Protection

- Motor protection is provided by the MV3000 Common Drive Controller and I/O Assembly connected to the AED. The following section details settings in the controller in order to provide comprehensive motor protection.
- The following sections detail the options provided by the Common Drive Controller for motor thermal protection.
- NOTE: For complete motor protection against sustained overloads or other operational issues, direct measurement of motor temperature using embedded thermostats and thermistors is required. This is detailed in the section below.

7.3 Motor I^2T Function

- The common drive controller continuously monitors the motor current and performs a standard I^2T ("I-Squared-T") calculation to detect motor overload.
- The AED modules are dual rated. They can operate with either a 110% overload or a 150% overload. The value set in parameter P99.02 selects the drive Full Load Current for the chosen rating as follows:
    - 0 = (Disabled) 150% overload - for industrial plant applications.
    - 1 = (Enabled) 110% overload - typically for fans and pumps. (This is the default value)

- The overload time has a default value of 60 seconds. This can be reduced or increased using parameter P2.07 and the range of values is from 10s to 3600s.

7.4 Motor Thermostat Protection

- Motor Thermostat protection is provided by connecting the motor thermostat to one of the digital inputs (DIGIN 1 to 6) on terminal block TB3 on the I/O Panel.

- The thermostat should be of the Normally Open contact type. The I/O module has solid state inputs therefore, no appreciable load is presented to the thermostat contacts. Connect this digital input to MTRIP, Control Flag 113 (P2.11).

- The motor thermostat input is normally held high (logic 1). In the event of the motor overheating the thermostat becomes open circuit (logic 0).

- P2.10 parameter controls the action of the drive when the MTRIP digital Input = (logic) 0.

- Options are:
  - 0 = No Action
  - 1 = Warning (No. 101)
  - 2 = Trip (No. 21)

7.5 Motor Thermistor Protection

- Connecting a motor Positive Temperature Coefficient (PTC) thermistor between TB5/1 and TB5/3 on the I/O Panel can provide motor PTC protection.

- There are several parameters withing the Common Drive Controller that configure the operation of the PTC input:

- P2.13 - Motor PTC Trip Resistance
  This is the value of motor PTC resistance to be determined as the trip level, i.e., above this value the motor is too hot; there is ±0.1kΩ hysteresis on this value.
  Allowed range: 0.10kΩ to 10.00kΩ

- P2.14 - Measured PTC Resistance
  This is the value of resistance that the drive has determined between TB5/1 and TB5/3. Allowed range: 0.10kΩ to 10.00kΩ

- P2.15 - Motor PTC Action
  This parameter specifies the action to be taken by the drive when the measured PTC resistance is above the Trip value, i.e., when P2.14 > P2.13. Options are:
  - 0 = No Action (default)
  - 1 = Warning - drive issues a PTC Warning (No. 103)

- 2 = Trip - drive issues a PTC Trip (No. 66)
- 3 = Warning and Current Limit - drive issues a PTC Warning and additionally the current limit is reduced to the motor's capability at this speed.

- The motor PTC Trip is made auto-resettable by setting P28.10 (Motor Trips Auto-Reset Enable).

7.6 Grounding Requirements

- The AED module will be grounded (earthed) by the metal contact when bolted in place on the cross rails of the enclosure.
- This contact must be tested using a current of at least 10A passed between the ground stud of the AED module and the enclosure.
- The resistance must be $\leq 0.02\Omega$.
- If this cannot be achieved, then a separate cable must be fitted between the AED modules ground terminal and the main system ground.

7.7 Shrouding

- The AED is designed to be operated with the enclosure doors closed and locked.
- As an additional safety measure to prevent accidental contact with live parts, shrouding is required inside the enclosure.
- The AED module is provided with shrouding which ***MUST*** be fitted.
- Consideration should be given to other components within the enclosure such as reactors, filter terminals, fuse panels etc. When designing and fitting shrouds, the material would normally be clear polycarbonate sheet of >2.0mm thickness and having a recognized flame retardancy rating.
- Shrouding should be designed so as not to restrict the air flows inside the enclosure.
- All shrouding should be fitted with electrical hazard warning signs/labels to alert personnel of danger:

Electrical Hazard sign

7.8 Other Safety/Protection Requirements

7.8.1 Control and Power Separation

- It is good practice to mount the low voltage components e.g., controller, I/O units, communications modules etc. in a segregated or separated part of the enclosure from the high-power Avid Extreme Drive Modules.

7.8.2 Arc Containment

- The system designer should consider arc containment issues.
- In the event of a catastrophic failure of power components, arcing, flash energy and debris may be released.
- It is essential that this will not result in injury to personnel near to the enclosure.
- Such measures will include consideration of placement of ventilation louvres, roof mounted arc flaps which both absorb energy and enable pressure to be released safely.

7.8.3 Circuit Breakers

- Install a suitably rated circuit breaker on the incoming mains supply.

8. Bonding

- Electromagnetic Compatibility (EMC) is a property of electrical/electronic equipment that allows it to operate in proximity to other electrical/electronic equipment without interfering with the other equipment.
- In a drive, control equipment can be adversely affected by the switching noise of the IGBTs.
- To reduce this interference low voltage components e.g., controller & I/O Assembly modules should be mounted in a segregated or separated part of the enclosure from the high-power AED modules (normally separated by a grounded steel panel).

9. Enclosure Cooling

- The air within the enclosure housing the AED module must be maintained at 50°C or below during operation.
- Note that although ~90% of heat produced by the AED is removed by the liquid cooling system, approximately 400W per AED module will still be dissipated into the cabinet air.
- Therefore, suitable cooling fans are likely needed for the enclosure – the selection, quantity and location of these depends upon all of the heat being dissipated in the cabinet, combined with the external environmental conditions.
- If a completely sealed enclosure is required, other methods of removing heat, such liquid-liquid and liquid-air heat exchangers, will be required.

10. Contact Details: Sales, Service and Support

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11. Document Revision History

Rev.	Date	Author	Changes
00	20th October 2025	M Woods	Document Created