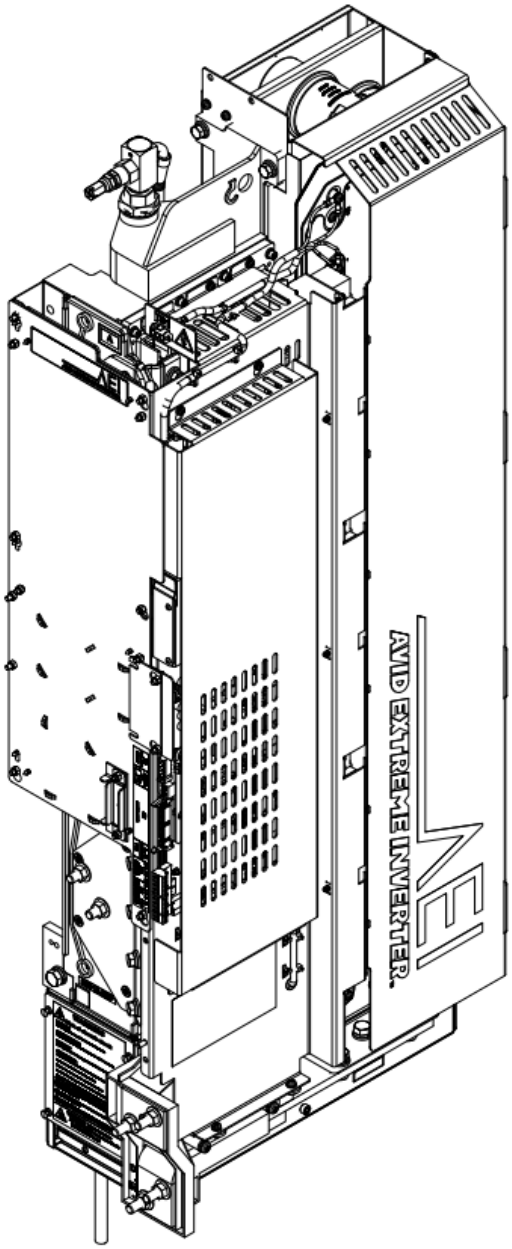


REV 06

DATE: October 5 2017

Avid Controls Inc.
41261 Park 290 Drive, Waller, TX 77484, USA
info@avidcontrolsinc.com
(+1) (281) 640-8600

AVID Controls Inc. pursues a policy of continuous product improvement and innovation. This may not be the latest revision of this publication and may not reflect all current product changes. Contact AVID Controls Inc. for the latest revision of this data sheet and information on other product enhancements.

Contents

1. Introduction

- The AEI900L/AEI1000L/AEI1250L and AEI1400L inverter modules are high reliability liquid cooled inverter modules with nominal ratings from 900A to 1250A at 690Vac and 1400A at 600Vac for use with MV3000 AC drives, controlled by the Common Drive Controller (CDC).

- The AEI900L can also be operated at a nominal rating of 800A for compatibility purposes.

- Its significant technical attributes are:
  - Sintered solder-free IGBT modules for extended life operation
  - Ruggedized IGBT die for improved environmental robustness
  - Reduced internal voltage overshoot
  - More robust, fully digital gate driver
  - IGBT modules are fully sealed for protection from condensation
  - Continuous, accurate monitoring of IGBT silicon temperature under all operating conditions

2. WARNINGS

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

- Wait at least 5 minutes after isolating supplies and check that the voltage between DC+ and DC- has reduced to a safe level before working on the equipment.

- Surfaces on the coolant pipes can reach high temperatures and remain hot for some time after power is removed.

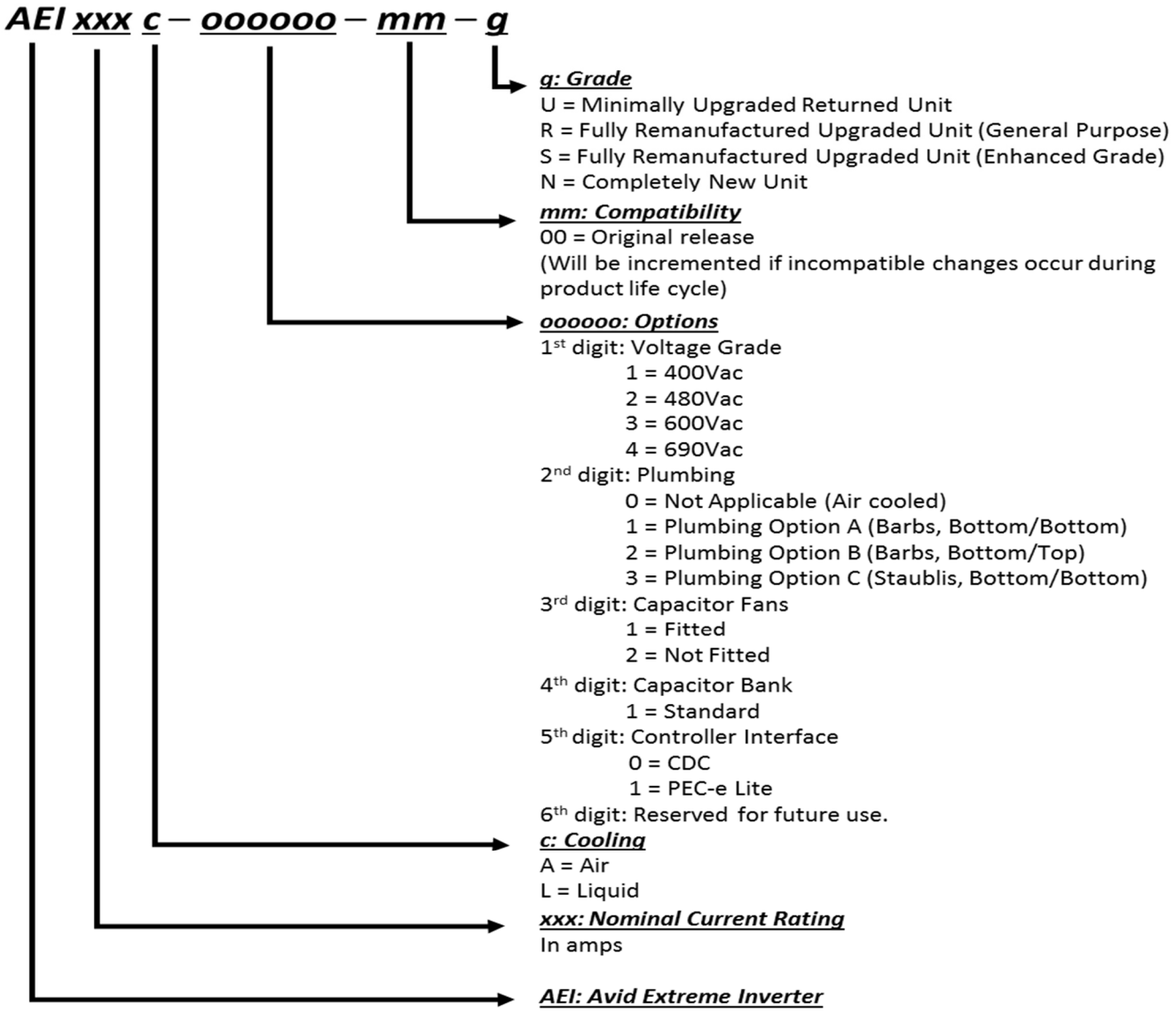
- Ensure that all coolant has cooled to a safe temperature and the equipment is suitably drained and isolated before the external pipework is disconnected from the equipment.

- Unit is heavy: 105kg (231 lb.) for the AEI900L / AEI1000L and 125kg (276 lb.) for the AEI1250L/AEI1400L

3. Specification

3.1 Model Numbers

- All Avid Extreme Inverter products use a consistent Model Number scheme:



- Unless otherwise stated, this data sheet is applicable to all CDC interfaced Avid Extreme Inverter models beginning AEI900L, AEI1000L, AEI1250L and AEI1400L.

- Note that not all options that can be defined by this scheme are actual products – contact Avid Controls for specific product availability.

3.2 Electrical – Power Section

Specification	*AEI900L*	*AEI1000L*	*AEI1250L*	*AEI1400L*	Notes & Applicable Conditions
Continuous Current, 690V Renewable Energy Applications*	900A	1000A	1250A	1250A	60s Overload = 110% once per 10 minutes DC Link Voltage = 1100V Coolant Temp. = 60°C 50°C for AEI1250L PWM Frequency = 1.8kHz (Generator) = 2.5kHz (Network) Generator Power Factor = -0.89 Network Power Factor = 1.00 Generator & Mains Freq. > 20Hz
Continuous Current, 600V Pump Applications*	900A	1000A	1250A	1400A	60s Overload = 110% once per 10 minutes DC Link Voltage = 850V Coolant Temp. = 60°C 50°C for AEI1400L PWM Frequency = 2.5kHz Motor Power Factor = 0.85 Motor Frequency > 20Hz
Continuous Current, 600V Hoist Applications*	660A	733A	916A	1026A	60s Overload = 150% once per 10 minutes DC Link Voltage = 820V Coolant Temp. = 60°C PWM Frequency = 2.5kHz Motor Power Factor = 0.85 Motor Frequency > 1Hz
Continuous DC Link Operating Voltage	1188 V				
Short Term (7.5s) DC Link Operating Voltage	1262 V				
Non-Operating DC Link Withstand Voltage	1350 V				
DC Link Capacitance	11600 µF	16800 µF	23800 µF	23800 µF	+20/-10 %
Maximum PWM Frequency	2.5 kHz				In some circumstances, higher frequencies may be used with de-rating – contact Avid Controls if this is required.

* For other applications contact AVID Controls Inc.

3.3 Electrical – Control & Interface Section

Specification	***AEI900L / AEI1000L***	***AEI1250L / AEI1400L***	Notes
Control Power Source	Avid Auxiliary Power Unit (APU) Model Numbers: AEI-APU-B	Avid Auxiliary Power Unit (APU) Model Number: AEI-APU-C	Customers wishing to provide their own auxiliary power should contact Avid Controls for further information
Analog Outputs	4 Channels +/-10V		Optional indication for phase currents, temperatures etc. DIP switch function selection See section 6.3 for more details
Fault Indication	• Fault Codes indicated by controller for all compatible faults • Two-digit LED display for additional diagnostic codes • Two 24V Solid-State relay outputs for indication of fault status		See section 7.3 for definition of fault codes.
Operational Indication	Two-digit LED display for display of DC link voltage, currents and temperatures		See section 7.2 for details.
DC Link Voltage Feedback Accuracy	+/- 4V @ 1000V DC		Measured internally within inverter unit

3.4 Cooling

Specification	*Value*
Coolant Type	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	• 1x hose-barb top, 1x hose-barb bottom (Option A) • 2x hose-barb at bottom of unit (Option B) • 2x Quick-Disconnect at bottom of unit (Option C)

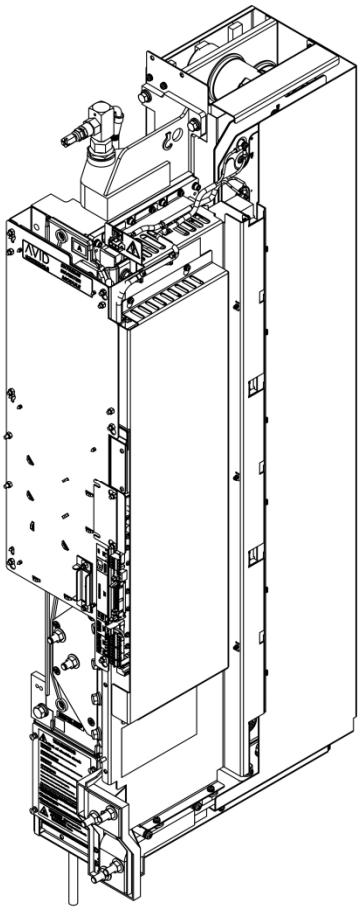
<table>
<tr><th>Specification</th><th>Value</th></tr>
<tr><td>Typical heat loads to coolant
(allow 33% more than quoted values when designing cooling system)</td><td>
<table>
<tr><th>DC Link V</th><th>PWM Freq. kHz</th><th>Power Factor</th><th>Current A</th><th>Typical Heat Load kW</th></tr>
<tr><td rowspan="8">1100</td><td rowspan="4">2.5</td><td rowspan="4">1.0</td><td>800</td><td>8.7</td></tr>
<tr><td>900</td><td>10.0</td></tr>
<tr><td>1000</td><td>11.5</td></tr>
<tr><td>1250</td><td>14.8</td></tr>
<tr><td rowspan="4">1.8</td><td rowspan="4">-0.89</td><td>800</td><td>7.0</td></tr>
<tr><td>900</td><td>8.0</td></tr>
<tr><td>1000</td><td>9.1</td></tr>
<tr><td>1250</td><td>11.8</td></tr>
<tr><td rowspan="3">976</td><td rowspan="3">1.25</td><td rowspan="3">0.90</td><td>900</td><td>6.3</td></tr>
<tr><td>1000</td><td>7.2</td></tr>
<tr><td>1250</td><td>9.4</td></tr>
<tr><td rowspan="6">850</td><td rowspan="3">1.25</td><td rowspan="3">0.90</td><td>900</td><td>5.9</td></tr>
<tr><td>1000</td><td>6.7</td></tr>
<tr><td>1400</td><td>10.3</td></tr>
<tr><td rowspan="3">2.5</td><td rowspan="3">0.90</td><td>900</td><td>8.1</td></tr>
<tr><td>1000</td><td>9.1</td></tr>
<tr><td>1400</td><td>14.0</td></tr>
</table>
</td></tr>
</table>

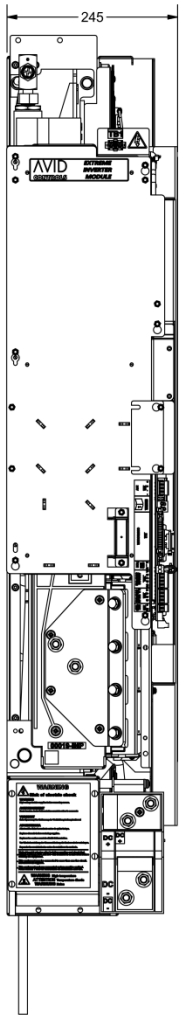
3.5 Environmental

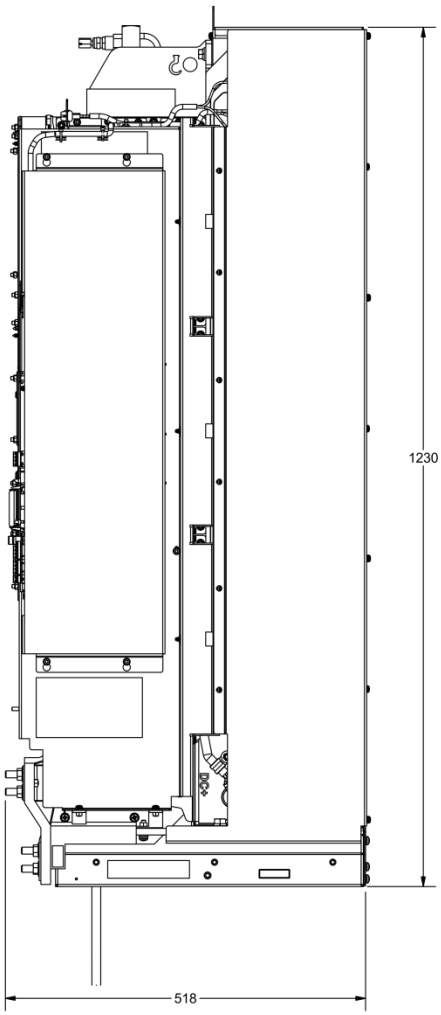
Specification	*Value*
Ambient Temperature (Internal cabinet temperature)	0 to 50°C
Cabinet air	Pollution Degree 2 as per IEC60664-1, UL 840 & CSA C22.2 No. 0.2-93 i.e. clean, free from dust, condensation and conductive or corrosive gases. Maximum chemicals 15ppm H_2S, 25ppm NO_2, 25ppm SO_2
Humidity	5% to 95% RH Unit must not be operated in the presence of condensation.

3.6 Mechanical

Specification	*Value*
Dimensions	248mm W x 1232mm H x 546mm D (9.75” W x 48.5” H x 21.5’ D)
Enclosure	IP00 (IEC 60529:1989; BS EN 60529:1992) NEMA 1 Must always be installed within suitable enclosure with restricted access
Mass	105kg (231 lb.) for AEI900L/AEI1000L 125 kg (276 lb.) for AEI1250L/AEI1400L







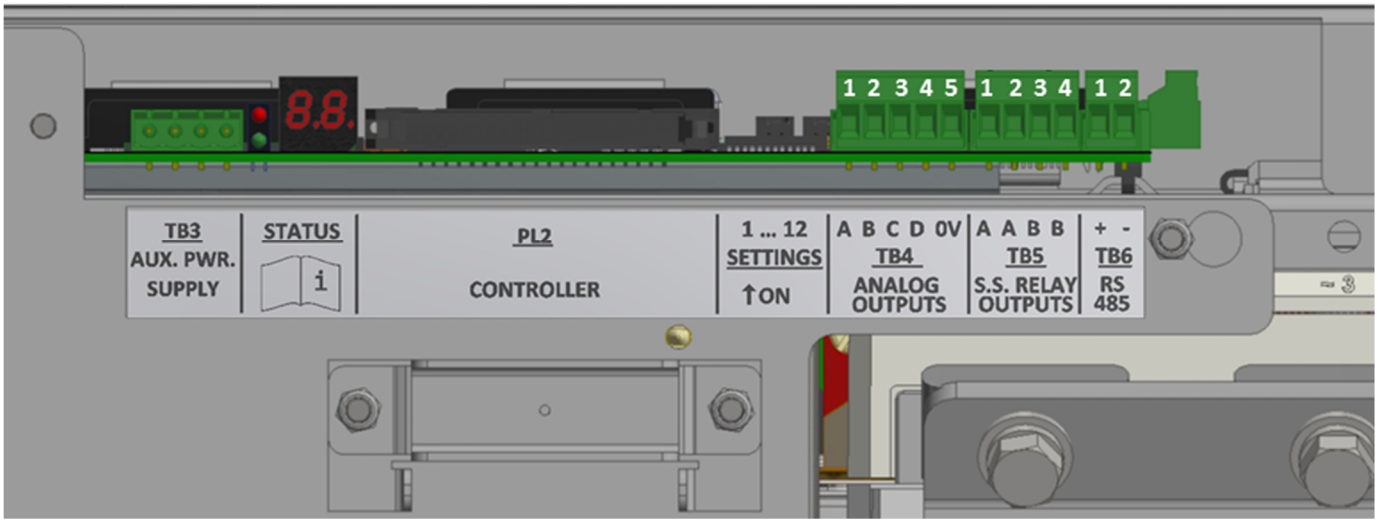
4. High Voltage / Power Connections

Connection	*Value for AEI900L*	*Value for AEI1000L / AEI1250L / AEI1400L*
AC Power Terminals	2 x M10 studs per phase Maximum cable size per stud is120mm^2	3 x M10 studs per phase Maximum cable size per stud is120mm^2
DC Power Terminals	2 x M10 studs each for DC+ and DC- Maximum cable size per stud is120mm^2	3 x M10 studs each for DC+ and DC- Maximum cable size per stud is120mm^2
Ground Connection	1 x M10 bolt	

5. Low Voltage / Control Connections

5.1 Overview

- All control connections are made to terminals and plugs on the ***Controller Interface Board*** (hereinafter referred to as the ***C.I.B.***) as shown in the following image (left hand side is towards the top of the unit when installed):



- The terminal blocks may not be physically numbered – pin one is always towards the top of the unit when installed.

- The pin numbers for TB3 are not shown since the cable and header are pre-made as part of the Auxiliary Power Unit assembly.

5.2 TB3 – Auxiliary Power Supply

- Auxiliary power is generally provided to the AEI unit from an Avid Auxiliary Power Unit.
- For reference, the following gives more details of TB3:

Terminals	Function	Specifications and Notes
1, 2	AUX. PWR. SUPPLY [+]	• 24V DC, +/-5%, 15A maximum load • Power cycle must be monotonic • [-] terminals are connected to system 0V [GROUND] on the C.I.B.
3, 4	AUX. PWR. SUPPLY [-]	

- Customers wishing to provide their own auxiliary power should contact Avid Controls for further information.

5.3 TB4 – Analog Outputs

Terminals	Function	Specifications and Notes
1, 2, 3, 4	ANALOG OUTPUT A, B, C, D	• Analog outputs for user diagnostic monitoring • See section 6.3 for details on selecting specific signals to be output via analog outputs. • Range is +/-10V • Maximum load current is 5mA • Output source impedance is 100Ω • Maximum error at all outputs is +/- 1% of full range with zero load
5	0V (GND)	

5.4 TB5 – Solid State Relays

Terminals	Function	Specifications and Notes
1, 2	SS RELAY A	• Inverter module fault indication • Relay energized indicates no fault condition • Relay de-energized indicates a fault condition
3, 4	SS RELAY B	• Internal cooling fan fail indication • Relay energized indicates internal cooling fans are operating normally • Relay de-energized indicates internal cooling fans are operating below minimum speed • Under high load conditions, the unit will trip with a fan fail fault. See section 7.4 for details
		• Maximum operating voltage is 60Vdc / 40Vac(rms) • Maximum load current is 0.4A • Typical ON resistance is 0.5 Ω • NOT overload (short-circuit) or overvoltage protected • For reference, on-board device is Panasonic AVQ202A or AVQ252GA solid-state relay.

5.5 TB6 – RS485

- The AEI inverter module has been equipped with a single RS485 digital interface.
- As of this revision of the Data Sheet, this function is unused and no connection should be made to TB6.

5.6 PL2 – Controller Connection

- Standard 40-way ribbon cable header

6. User Selectable Options

6.1 Overview

- There are a number of options for the inverter unit that must be configured.
- These are configured using a set of 12 DIP switches on the C.I.B.
- These switches are numbered from 1 to 12, the ON position is towards the PCB itself, and the OFF position is towards the edge of the board.
- The DIP switches are very small, so a fine point instrument is needed to set them correctly.
- The default options are identified in the following descriptions.

6.2 Over-volts Trip Mode (SW1 to SW4)

- The overvoltage thresholds and delays are configured by **SW1** to **SW4**.
- The following table defines the operation of these switches:

SWITCH SETTINGS				DC Link Voltage Trip Instant	DC Link Voltage Trip Delayed	Delay Time	Notes
SW 1	**SW 2**	**SW 3**	**SW 4**				
OFF	OFF	OFF	OFF	1188 Vdc	None	N/A	Legacy behavior for non-renewable energy systems
OFF	OFF	OFF	ON	1262 Vdc	1188 Vdc	0.5s	Units configured in one of these modes are used in position 1 of the system. ***Default is 1s delay.***
OFF	OFF	ON	OFF			1.0s	
OFF	OFF	ON	ON			1.5s	
OFF	ON	OFF	OFF			2.0s	
OFF	ON	OFF	ON			2.5s	
OFF	ON	ON	OFF			3.0s	
OFF	ON	ON	ON			3.5s	
ON	OFF	OFF	OFF			4.0s	
ON	OFF	OFF	ON			4.5s	
ON	OFF	ON	OFF			5.0s	
ON	OFF	ON	ON			5.5s	
ON	ON	OFF	OFF			6.0s	
ON	ON	OFF	ON			6.5s	
ON	ON	ON	OFF			7.5s	
ON	ON	ON	ON	1290 Vdc	None	N/A	This mode is used in positions 2 to 6 of a parallel inverter system.

6.3 Analog Output Mode (SW5 and SW6)

- The unit provides four analog outputs for system monitoring / debugging.
- See section 5.3 for electrical specifications.
- Scaling of different signal types is as follows:

Signal Type	Scaling
Current	• +/- 10 V output is equivalent to +/- 2500A • Positive values are defined as positive current OUT of the AC terminals of the unit. • When the output mode is rectified phase currents, only positive values will be output. • The formula for rectified mode is: Output = MAXIMUM (|Ia|, |Ib|, |Ic|).
DC Link Voltage	• 0 to +10V is equivalent to 0 to 1500 Vdc
Temperature	• 0 to +10V is equivalent to 0 to 150°C • Note that due to the nature of the internal temperature sensor, any temperature below 30°C will be indicated as 30°C.

- The signals that are output are controlled by DIP switches **SW6** & **SW7**:

Switch Positions		Mode	Analog Channel Outputs			
SW5	**SW6**		A	B	C	D
OFF	OFF	MIXED	Full wave rectified AC currents	Maximum IGBT module temperature	Minimum IGBT module temperature	DC Link Voltage
ON	OFF	CURRENTS	A phase AC current	B phase AC current	C phase AC current	
OFF	ON	TEMPS.	A phase IGBT module temperature	B phase IGBT module temperature	C phase IGBT module temperature	
ON	ON	UNUSED	Undefined value between -10V and +10V			

- ***The default mode is MIXED***.

6.4 Compatibility Rating Mode (SW7)

- Certain models of Avid Extreme Inverter may be configured to report a lower rating to the controller than that of which they are actually capable.
- This feature is provided to support compatibility with legacy systems and to increase flexibility in different applications.
- Not all Avid Extreme Inverter units support a compatibility rating.
- Compatibility Rating Mode is enabled by setting DIP switch **SW7** to the ON position (its ***default is OFF***).
- The following table shows those modules that support this mode:

MODEL	Compatibility Rating (Reported to Controller) (DIP Switch **SW7** = ON)
AEI900L	110% Overload Duty: 800A 150% Overload Duty: 587A
AEI1000L / AEI1250L / AEI1400L	No compatibility rating is supported. **SW7** has no effect.

6.5 Unused Switches (SW8 to SW12)

- These switches currently have no assigned functions.
- They should be left in the OFF position.

7. LED's and Fault Indication

- The unit has two discrete LED's (red and green) and a two-digit LED display.
- The discrete LED's indicate the operational state of the unit and the numeric display may either indicate various feedback signals or all active faults.

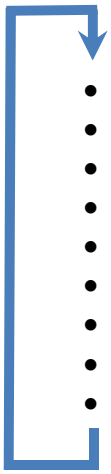
7.1 Discrete LED's

- OFF - ON - FLASHING

RED LED	GREEN LED	Meaning
		Auxiliary supply is not present
		Internal error present on C.I.B. or auxiliary supply is out of tolerance
		Unit healthy (not tripped) and disabled (IGBT's not switching)
		Unit healthy (not tripped) and enabled (IGBT's switching)
		Unit faulted. Fault codes will be displayed on 2-digit display, appropriate fault codes sent to controller (as supported – see section7.3)
		Controller is attempting a reset cycle

7.2 LED Feedback Indication

- When the unit is not faulted, the 2-digit LED display cycles through indications of a number of operational feedbacks.
- Each feedback is displayed for 1s, before the display cycles to the next feedback. A "--" pattern is used to indicate the start of the cycle.
- The cycle is:



- "--"
- CURRENT - A PHASE
- CURRENT - B PHASE
- CURRENT - C PHASE
- TEMPERATURE – A PHASE IGBT
- TEMPERATURE – B PHASE IGBT
- TEMPERATURE – C PHASE IGBT
- TEMPERATURE – C.I.B.
- DC LINK VOLTAGE

- In a similar manner to the analog outputs, most values are displayed as the percentage of a defined value. The exception is the C.I.B. temperature which is displayed in °C.

Signal Type	Explanation & Scaling
Current	• 100% output is equivalent to 2500A • The formula for the indication is: ○ % CURRENT = 100% x $AVERAGE_{1s}$ (|Phase Current|) / 2500A • Or, in words, the formula is ***the absolute current averaged over 1s, expressed as a percentage of 2500A***
DC Link Voltage	• Average over 1s expressed as percentage of 1500 Vdc
IGBT Temperature	• Expressed as percentage of 150°C (0°C = 0%, 150°C = 100%) • Note that due to the nature of the internal temperature sensor, any temperature below 30°C will be indicated as 20%.
C.I.B. Temperature	• This is displayed in °C • Note due to absence of negative sign any value below 0°C will be displayed as '00'

7.3 Fault Codes

- When the unit has a fault, the 2-digit LED display cycles through a list of all active faults.
- Each fault that the unit recognizes is encoded into a compatible fault code for indication by the controller.
- The Avid unit can identify many more and different faults than the controller can recognize, so some rationalization has been necessary.
- The following table describes each fault code on the unit, together with the fault code that is transmitted to the controller for each of the faults recognized by the C.I.B.:

Fault Code on LED Display	Meaning	Trip Code Transmitted to Controller[*1]
1	A Phase IGBT Self-Protect Fault	31
2	B Phase IGBT Self-Protect Fault	33
3	C Phase IGBT Self-Protect Fault	35
4	A Phase Heatsink Over Temperature Fault	32
5	B Phase Heatsink Over Temperature Fault	34
6	C Phase Heatsink Over Temperature Fault	36
7	A Phase Silicon Over Temperature Fault	32
8	B Phase Silicon Over Temperature Fault	34
9	C Phase Silicon Over Temperature Fault	36
10	Over Voltage (DC Link)	38
11	External Trip Fault	37
12	Internal Fan 1 Failure (on units where this fan is fitted)	243
13	Internal Fan 2 Failure (on units where this fan is fitted)	243
14	Internal Fan 3 Failure (on units where this fan is fitted)	243
15	External Fan Failure (on units where this fan is fitted)	243
16	Internal Fault[*2]	240
17	Internal Fault[*2]	241
18	Internal Fault[*2]	242
19	Internal Fault[*2]	240
20	Internal Fault[*2]	240
21	Internal Fault[*2]	247
22	Internal Fault[*2]	248

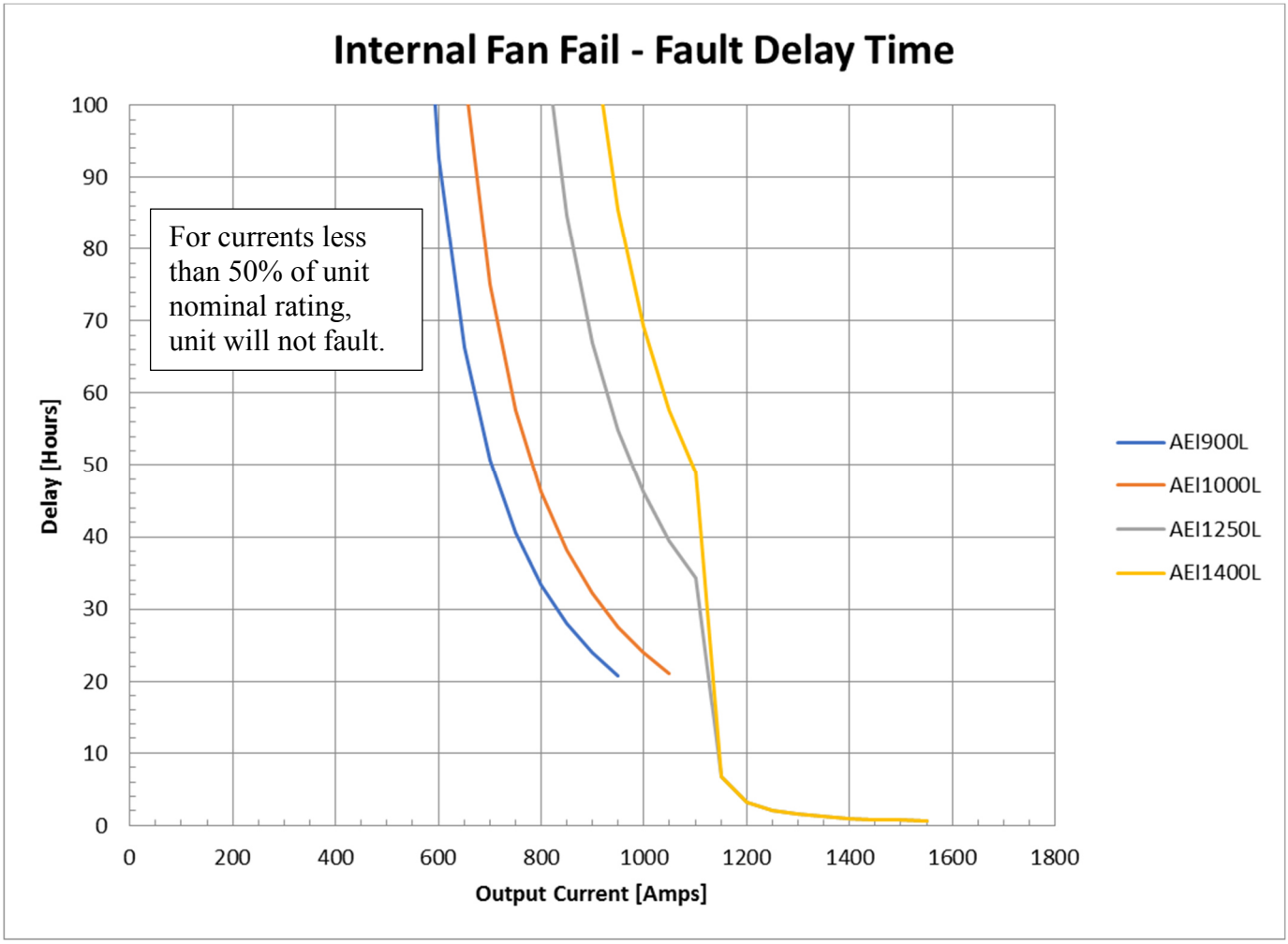
Fault Code on LED Display	Meaning	Trip Code Transmitted to Controller[*1]
23	Internal Fault[*2]	249
24	Internal Fault[*2]	244
25	Internal Fault[*2]	245
26	Internal Fault[*2]	246
27	A Phase Positive Instantaneous Overcurrent	31
28	A Phase Negative Instantaneous Overcurrent	31
29	B Phase Positive Instantaneous Overcurrent	33
30	B Phase Negative Instantaneous Overcurrent	33
31	C Phase Positive Instantaneous Overcurrent	35
32	C Phase Negative Instantaneous Overcurrent	35
33	Internal Fault[*2]	212
34	Internal Fault[*2]	212

***1:** The fault code for a unit connected to position 1 of the controller system is given. For units in other positions the equivalent fault code will be displayed by the controller.

***2:** These faults indicate a fault within the complete system. They do not occur in normal operation and user fault-finding is generally not possible. In the unlikely event that these faults are experienced, contact Avid Controls for support.

7.4 Internal Cooling Fan Fault

- AEI units with internal cooling fans continually monitor the fans' speed, and take action if they drop below minimum speed.
- Certain AEI900L and AEI1000L models do not have internal cooling fans. In these cases, the user MUST implement external capacitor cooling fans for the unit. These external fans are NOT monitored by the unit and their failure may result in failure of the unit. If you are using AEI900L or AEI1000L units without internal fans, it is highly recommended that you contact Avid Controls for additional technical support.
- All units immediately indicate fan failure via SS RELAY B, see section 5.4 for details.
- After a load dependent delay, the unit will fault, indicating the appropriate fault code from section 7.3
- The following figure shows the fault delay time as a function of the load current:



8. Document Revision History

Rev.	Date	Author	Changes
00	3/14/2016	Gary Pace	Document created
01	5/18/2016	Gary Pace	Default options for DIP switches changed & documented
02	8/8/2016	Gary Pace	Additional environmental specifications given DC link capacitance corrected
03	12/1/2016	Gary Pace	Models changed to AEI900L and AEI1000L
04	1/4/2017	Gary Pace	SW9 function added Minor stylistic changes throughout
05	7/17/2017	Gary Pace	Note about negative CIB temperature added SW5 functionality changed Fault code descriptions changed Analog output modes changed SW9 function removed
06	10/5/2017	Gary Pace	Details for AEI1250L and AEI1400L added Internal fan failure description changed