ENERCON
TECHNOLOGIES LTD

FIELD-PROVEN COTS, MOTS AND CUSTOM MILITARY POWER SOLUTIONS

M4168 SERIES

DC/DC POWER SUPPLY

PRODUCT HIGHLIGHTS

- **VITA 62 COMPLIANT**
- **6U VPX FORM FACTOR**
- **HIGH DENSITY**
- **SIX OUTPUTS**
- **DC/DC CONVERTER**
- **UP TO 1080W**

NON ITAR

AS9100D CERTIFIED ISO 9001

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Applications

Military (Airborne, ground-fix, shipboard), Ruggedized, Telecom, Industrial, VPX Power Supply

Special Features

- VITA 62 standard compliant
- High density – up to 18 W/in^3
- High efficiency – up to 90%
- Wide input voltage range
- Input / Output isolation
- Remote sense (@ PO# outputs)
- Remote Inhibit & Enable
- Fixed switching freq. (250 kHz)
- External sync. capability
- EMI filters included
- I^{2}C communication
- PO# outputs parallelable (optional)
- Reverse input protection
- Conduction cooled via card edge
- Non-latching protections:
  - Overload / short-circuit
  - Over-voltage
  - Over-temperature

Electrical Specifications

DC Input

- Steady-State: 18 to 48 V_{DC}
- Operates during normal over-voltage transients IAW MIL-STD-704(A-F) and MIL-STD-1275(A-D)
- No damage due to transients IAW MIL-STD-704(A-F) and MIL-STD-1275(A-D)

DC Output*

PO1: 12 V up to 40 A
PO2: 12 V up to 40 A
PO3: 5 V up to 12 A
+12V_Aux: +12 V up to 1 A
–12V_Aux: –12 V up to 1 A
3.3V_Aux: 3.3 V up to 12 A

Isolation

Input to Output: 200 V_{DC}
Input to Case: 200 V_{DC}
Output to Case: 100 V_{DC}

Output voltage regulation

Up to ±1% for 12V & 5V Outputs. 1.5% for 3.3V Output (Low to high input line voltage, no load to full load,–55 °C to +85 °C).

Efficiency

88% - Typical (Nominal line voltage, full loads, room temperature)

EMC

Designed to meet† MIL-STD-461F: CE101, CE102, CS101

Ripple and Noise

Measured at 18V to 36V range. Typically less than 50 mV_{p-p} (max. 100 mV_{p-p}), measured across a 0.1 µF capacitor, with 10 µF capacitor across load.

Transient Over-and-undershoot

Output dynamic response of less than 5% at load Step of 30%-90%. Output returns to regulation in less than 1 ms

Communication

I^{2}C protocol available for voltages, currents and temperature for all positive voltages (GAx, SCL, SDA)

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* All PO# outputs have remote sense lines for voltage drop compensation and current share ability

† Compliance achieved with 5 µH LISNs and static resistive loads.

Protections ‡

Input

- **Reverse Polarity Protection**
  Protection for unlimited time, up to -48 V_{DC}.
- **Under-Voltage Lockout**
  Unit shuts down if input voltage drops below 16.5 ± 1 V.
  Automatic restart when input voltage rises above 19 ± 1 V.
  Minimum hysteresis: 2 V.
- **Over-Voltage Lockout**
  Unit shuts down if input voltage rises above 55 ± 2 V.
  Automatic restart when input voltage falls below 38 ± 2 V.
  Lockout is delayed by at least 100ms from the onset of the over-voltage state, to allow operation through normal transients, per MIL-STD-704 and MIL-STD-1275.

Output

- **Over-Voltage Protection**
- **Overload / Short-Circuit Protection**
  Continuous protection (10-30% above maximum current) for unlimited time (Hiccup).
  Automatic recovery when overload/short-circuit removed.

General

- **Over Temperature Protection**
  Automatic shutdown in case internal temperature (communicated via I^2C) rises above 105 ± 5 °C.
  Operation *guaranteed* at card edge temperature up to +85 °C under full load conditions.

Environmental Conditions

Designed to meet MIL-STD-810G

Temperature
Operating: –55 °C to +85 °C at card edge (consult factory)
Storage: –55 °C to +125 °C

Altitude
Method 500.5, Procedure I & II
Storage/Air Transport: 40 kft
Operation/Air carriage: 70 kft

Salt Fog:
Method 509.5

Fungus
Does not support fungus growth, in accordance with the guidelines of MIL-STD-454, Requirement 4.

Humidity
Method 507.5, Up to 95% RH

Shock Method 516.6
40 g, 11 ms saw-tooth (all directions)

Vibration
Shock: Saw-tooth, 20 g peak, 11 ms.
Vibration: Figure 514.6E-1. General minimum integrity exposure. (1 hour per axis.)

Environmental Stress Screening (ESS)

Including random vibration and thermal cycles is also available. **Please consult factory for details.**

‡ Thresholds and protections can be modified / removed – please consult factory.

Functions and Signals (according to VITA 62.0)

Signal No.	Signal Name	Type	Description
1	FAIL*	Output	Indicates to other modules in the system that a failure has occurred in the module. Normally Open, Low during failure
2	SYSRESET*	Output	Indicates to other modules in the system that all outputs are within their Nominal range. Goes Open when outputs are within their range.
3	INHIBIT*	Input	Controls power supply outputs. Connecting this signal to **SIG_RTN** turns the output power OFF.
4	ENABLE*	Input	Controls the input power to the power supply. This signal in conjunction with **INHIBIT*** turns the output power ON and OFF. Please refer to Table 1 for combination of **INHIBIT*** & **ENABLE***.
5	PO#_SHARE	Bidirectional	Enables current share between two paralleled outputs on two devices. Connect required outputs (same voltage) of both devices in parallel, and their appropriate SHARE signals for proper operation.
6	PO#_SENSE PO#_SENSE_RTN	Input	Used to correct output voltage at regulation point, when voltage droop occurs due to current flowing through output wires. This feature is limited up to approximately 0.5V above nominal voltage.
7	GA0*,GA1*,GA2* GA3*& GAP*	Input	Used for geographical addressing. GA4* is the most significant bit and GA0* is the least significant bit. GAP* indicates the parity.
8	SCL	Bidirectional	I2C bus Clock Through this bus the voltage and temperature readouts can be shared.
9	SDA	Bidirectional	I2C bus Data
10	+/-CLK	Input	The REF_CLK signal is used to allow the power supply frequency to sync with the system frequency.

Control Inputs		Power Outputs	
ENABLE*	**INHIBIT***	**3.3V_AUX**	**PO1, PO2, PO3, +12V_AUX, and -12V_AUX**
High	High	Off	Off
High	Low	Off	Off
Low	High	On	On
Low	Low	On	Off

NOTE: All Signals with an asterisk (*) suffix represent signals which are "active low".

Detailed Information

1. M4168 Input Voltage Operation.

The M4168 steady state operation voltage is 18V to 36V and will continuously work up to 50V input line.
During MIL-STD 704/1275 transients or surges the unit will shut down itself when input voltage rise above 50V and automatically recover when it drops down below 40V.
For application where it require to have continuous work during the 80V/100V transient, a different configuration is optional, contact Factory for more information

2.1 Low Line Turn-on and Turn-off Limits

To avoid Turn-on and Turn-off glitch the unit have about 2.5V Hysteresis. The Turn-on threshold is under 20V and turn-off under 18V.
Those limits can be adjusted, contact Factory for more information.

2. Outputs regulation

The M4168 contains accurate internal sense lines to keep output voltage at less than 1.5% regulation for all Line/ Load and temperature range (see Table 2).
For Parallel configuration output regulation please contact Factory.

Output	12V	5V	3.3V	3.3VAux	12VAux	(-)12VAux
Voltage Range	11.85 ÷ 12.15	5.05 ÷ 4.95	3.35 ÷ 3.25	3.35 ÷ 3.25	VS1 ÷ VS1-0.2V	(-)11.85 ÷ (-)12.15

Table 2: Single Unit

3. Sense Lines

Sense Lines are provided for VS1, VS2 and VS3 output to compensate line voltage drop. *Sense Lines* proper connection is shown in Figure 1.
Each VSx output has its own *Sense Lines*, additional common *Sense RTN Line* is provided for all VSx Outputs (Vita 62 Standard).
A 12V VS1 & VS2 configuration is available.
Contact Factory for Sense configuration different than the Vita62 standard

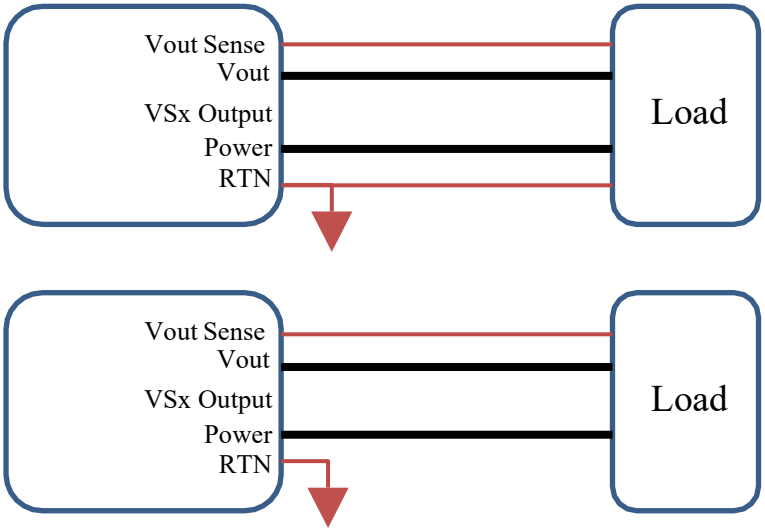

Figure 1: M4168 Sense line connection

4. Output Power

The basic configuration of the M4168 support up to 1000W with the standard configuration of power per output. Configuration is shown in
table 4. Contact Factory for more details

Total Power Output	12V VS1	5V/12V VS2	5V VS3	3.3VAux/5A	12VAux/1A	(-)12VAux/1A
1000W	**40A**	**40A**	**12A**	**12A**	**1A**	**1A**

Table 4: M4168 Max current per output (contact Factory)

4.1. Current sharing (optional)

Current sharing gives the option to draw more current from the main Outputs: VS1, VS2 and VS3

Internal sharing configuration of VS1 & VS2 is available on the M4168-1 Normally the current share will be ±10% between the outputs.

To obtain a good current sharing the following steps should be taken

- Connect *Load Share* pins of desired outputs to guarantee simultaneously turn-on of paralleled outputs.
- Connect *Sense* Line of both outputs to the same point.
- Make sure Power trace are as identical as possible for both current sharing outputs.

For all other outputs (12Vaux, (-) 12Vaux & 3.3Vaux), parallel connection is possible but no current sharing is implemented. Max current from each paralleled output should not be higher than a single output.

5. I²C Protocol

Electrical Parameters

Vcc: 3.3VDC
Pull-up: 2.2kOhm
Input capacitance: 330pf

Slave Device Addressing

- 256 address spaces
- Baud rate: 400kHz maximum
- 7 Bit Protocol
- Support Slot Addressing per Vita62
- Support Global Address 1010101 R/W

	MSB							LSB
Slot Number	A6	A5	A4	A3	A2	A1	A0	R/W
Slot1	1	0	0	0	0	0	1	
Slot2	1	0	0	0	0	1	0	
Slot3	1	0	0	0	0	1	1	
Slot4	1	0	0	0	1	0	0	
Slot5	1	0	0	0	1	0	1	
Slot6	1	0	0	0	1	1	0	
Slot7	1	0	0	0	1	1	1	
Slot8	1	0	0	1	0	0	0	
Slot9	1	0	0	1	0	0	1	
Slot10	1	0	0	1	0	1	0	
Slot11	1	0	0	1	0	1	1	
Slot12	1	0	0	1	1	0	0	
Slot13	1	0	0	1	1	0	1	
Slot14	1	0	0	1	1	1	0	
Slot15	1	0	0	1	1	1	1	
Slot16	1	0	1	0	0	0	0	
Global Address	1	0	1	0	1	0	1	

* Slot location is determined by GAx per Vita62

Communications Supported

Single read request

S	Physical Address	W	A	Memory Address	A	S	Physical Address	R	A	DATA	A	P
	A6:A0	0	0	B7:B0	0		A6:A0	1	0	D7:D0	1	

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S	Physical Address	W	A	Memory Address	A	S	Physical Address	R	A	DATA	A	DATA	A	• • •	DATA	A	P
	A6:A0	0	0	B7:B0	0		A6:A0	1	0	D7:D0	0	D7:D0	0		D7:D0	1	

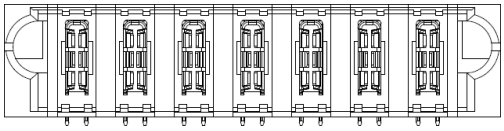
S – Start, **P**- Stop
W – Write bit
A – Acknowledge by master
A – Acknowledge by slave, DATA – Slave response

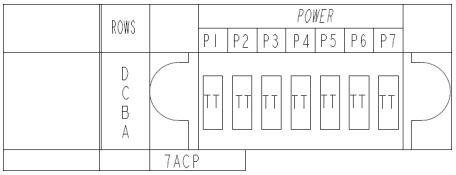
Memory Space

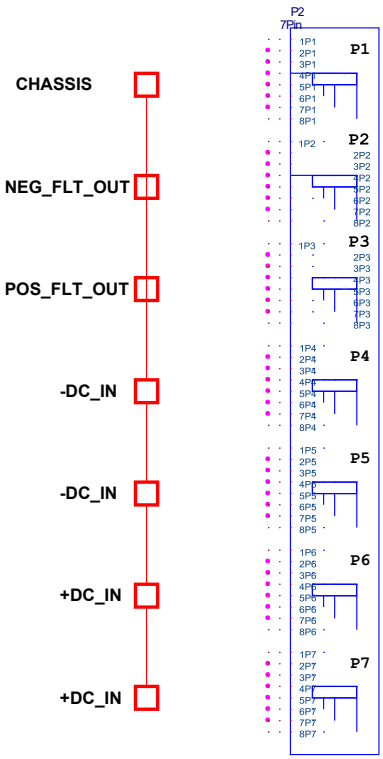
Address [8Bit]	Data [8Bit]	Description [00-FF]
0x00	Temperature 1	-55C° ÷ +120C° Range
0x01	Vin	0V ÷ 64V Range
0x02	+12V VS1 & VS2	0V ÷ 16V Range
0x03	+12V Aux	0V ÷ 16V Range
0x04	+12V VS1 & VS2	0V ÷ 16V Range
0x05	+5V VS3	0V ÷ 16V Range
0x06	+3.3V Aux	0V ÷ 16V Range
0x07	-12V Aux	0V ÷ 16V Range
0x08	Temperature 2	-55C° ÷ +120C° Range
0x09	Software Version	X,Y Hex
0x0A		
0x0B		
0x0C		
0x0D		
0x0E		
0x0F ÷ 0xFF		

Pin Assignment

Connector PO

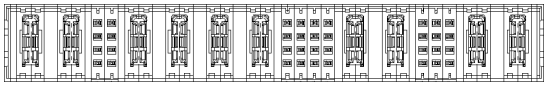


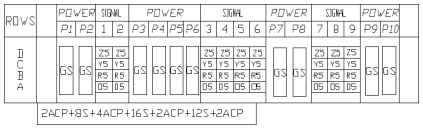


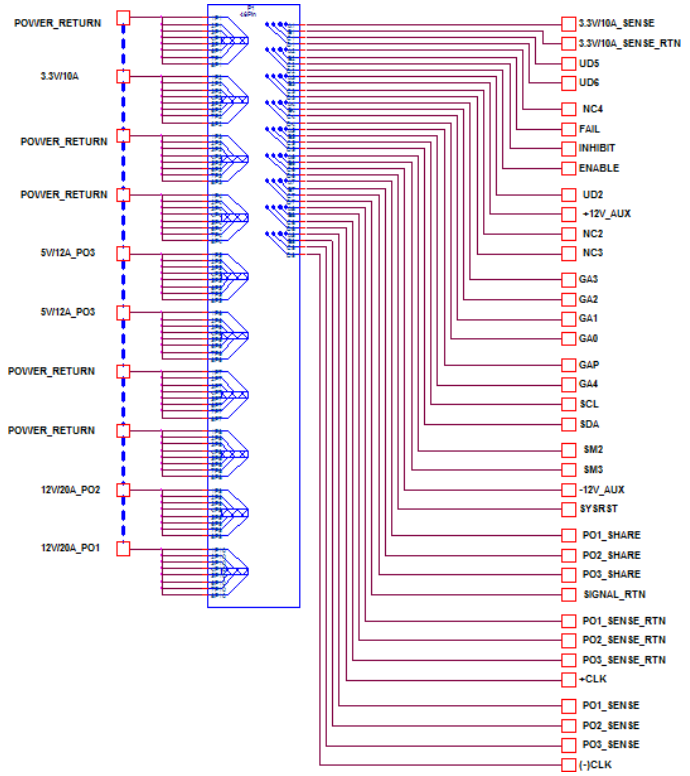


Pin Number	Signal Name
P7	+DC_IN
P6	+DC_IN
P5	-DC_IN
P4	-DC_IN
P3	POS_FLT_OUT
P2	NEG_FLT_OUT
P1	CHASSIS_GND

Connector P1:

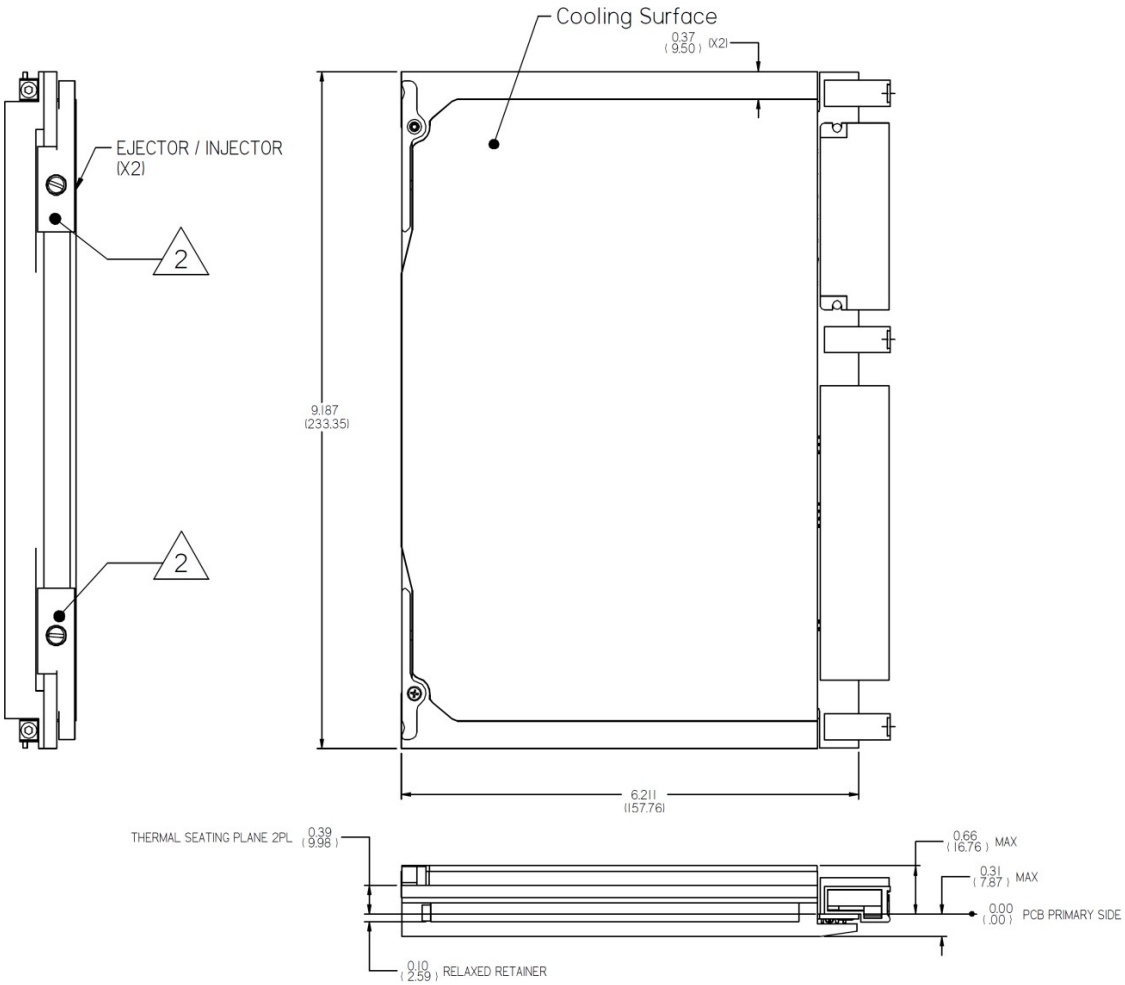


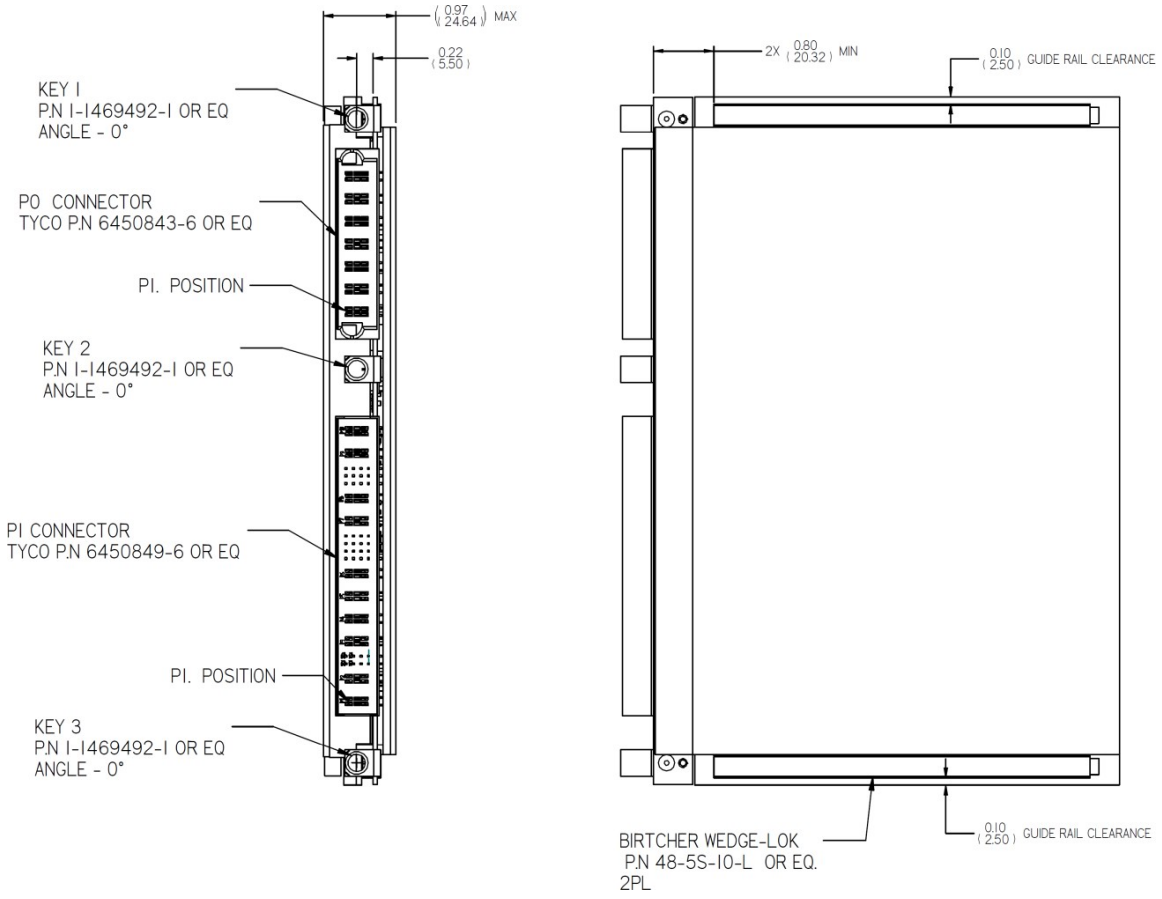




Pin #	Signal Name
P10	12V/20A_PO1
P9	12V/20A_PO2
A9	PO1_SENSE
B9	PO2_SENSE
C9	PO3_SENSE
D9	UD0
A8	PO1_SENSE_RTN
B8	PO2_SENSE_RTN
C8	PO3_SENSE_RTN
D8	UD1
A7	PO1_SHARE
B7	PO2_SHARE
C7	PO3_SHARE
D7	SIGNAL_RTN
P8	POWER_RTN
P7	POWER_RTN
A6	+CLK
B6	-CLK
C6	-12V_AUX
D6	SYSRESET*
A5	GAP*
B5	GA4*
C5	SCL
D5	SDA
A4	GA3*
B4	GA2*
C4	GA1*
D4	GA0*
A3	UD2
B3	+12V_AUX
C3	NC2
D3	NC3
P6	5V/12A_PO3
P5	5V/12A_PO3
P4	POWER_RTN
P3	POWER_RTN
A2	NC4
B2	FAIL
C2	INHIBIT*
D2	ENABLE*
A1	3.3V/10A_SENSE
B1	3.3V/10A_SENSE_RTN
C1	UD5
D1	UD6
P2	3.3V/10A
P1	POWER_RTN

Outline Drawing





Notes

1. Dimensions are in Inches [mm]
2. Tolerance is:

.XX ± 0.01 IN

.XXX ± 0.005 IN

3. Weight: Approx. 3 lbs (1.36 kg)

Note: Specifications are subject to change without prior notice by the manufacturer.