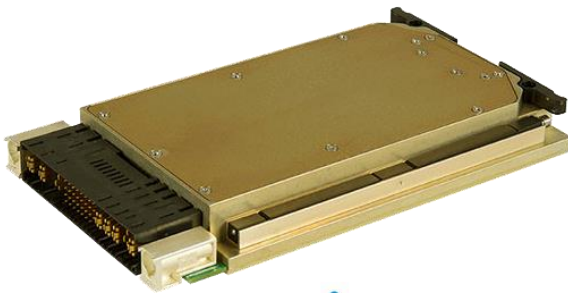


## M4013 SERIES

DC/DC POWER SUPPLY



### PRODUCT HIGHLIGHTS

- VITA 62 COMPLIANT
- 3U VPX FORM FACTOR
- SIX OUTPUTS
- DC/DC CONVERTER
- 350W
- Input Options:
  - MIL-STD-704
- Cyber secure

## Applications

Military, Ruggedized, Telecom, Industrial

### Special Features

- VITA 62 compliant
- Wide input range
- Remote sense
- Fixed switching frequency (220khz)
- External synchronization capability
- Indefinite short circuit Protection
- Over-voltage shutdown with auto-recovery
- Reverse battery protection
- Over temperature shutdown with auto-recovery
- EMI filters included
- I2C communication

### Environmental

Design to Meet MIL-STD-810G

#### Temperature

Operating: -55°C to +85°C at unit edge

Storage: -55°C to +125°C

#### Altitude

Method 500.5, Procedure I & II Storage/Air

Transport: 40 Kft

Operation/Air carriage: 70 Kft

#### Humidity

Method 507.5, Up to 95% RH

#### Fungus

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

#### Shock

Method 516.6

40g, 11msec saw-tooth (all directions)

#### Vibration

Vibration: Figure 514.6E-1. General minimum integrity exposure. (1 hour per axis.)

#### Salt Fog:

Method 509.5

**Reliability: 510,000 Hours, calculated IAW MIL-HDBK-217F Notice 2 at +65 °C, GF.**

*Note: Environmental Stress Screening (ESS) Including random vibration and thermal cycles is also available. Please consult factory for details.*

### Electrical Specifications

#### DC Input

18 to 48 V<sub>DC</sub>

Max Non-Operating 100V

Options:

- 1) MIL-STD-704 (A-F) Normal and Abnormal Steady State
- 2) MIL-STD-704(A-F) transients Up to 50V, 80V.

#### Efficiency

Up to 86%

(Full load room temperature)

#### EMC

Design to meet with MIL-STD 461F (5μH LISN):

CE101, CE102, CS101, CS114, CS115, CS116

#### Load Transient Overshoot and

##### Undershoot

Output dynamic response of less than 5% at load Step of 60%-90%.

Output returns to regulation in less than 1mSec

#### Ripple and Noise

Typically, less than 50mV<sub>p-p</sub> (max. 1%<sub>p</sub>). Measured across a 0.1μF capacitor and 10μF capacitor on load at Input Voltage of 18V-36V, all Temperature Range.

#### Communication

I2C protocol available for voltages, currents and temperature for all outputs (GAx, SCL, SDA)

#### DC Output

VS1: 12V, up to 20A

VS2: 3.3V, up to 5A

VS3: 5V, up to 12A

12V\_Aux: 12V, up to 1A

-12V\_Aux: -12V, up to 1A

3.3V\_Aux: 3.3V, up to 5A

## **Protections**

### **Input**

- **Inrush Current Limiter**  
Peak value of  $5 \times I_{IN}$  for initial inrush currents lasting more than 50 $\mu$ Sec.
- **Under Voltage**  
Unit shuts down when input steady state voltage drops  
Automatic restart when input voltage returns to nominal range.
- **Over Voltage Lock-Out**  
Unit shuts down when input steady state voltage rise above  $55 \pm 2V_{DC}$ .  
Automatic restart when input voltage returns to nominal range.

### **Output**

- **Passive or Active over voltage protection on VS2, VS3, 3.3Vaux and -12Vaux**  
Transorb, selected at  $25\% \pm 5\%$  above nominal voltage, is placed across the output for passive voltage limit.
- **Active over voltage protection on VS1 and 12Vaux**  
 $20\% \pm 5\%$  above nominal voltage.  
Automatic recovery when output voltage drops below threshold.
- **Overload / Short-Circuit Protection**  
VS#: Continuous protection (10-30% above maximum current) for unlimited time (Hiccup). Automatic recovery when overload/short circuit removed.  
12Vaux: typical 1.5A to 2A  
-12Vaux: typical 2.5A to 3A  
3.3Vaux: typical 8A

### **General**

- **Over Temperature Protection**  
Automatic shutdown at internal temperature of  $95 \pm 5^{\circ}C$ .  
Automatic recovery when temperature drops below  $90 \pm 5^{\circ}C$ .

*Note: Thresholds and protections can be modified / removed (please consult factory)*

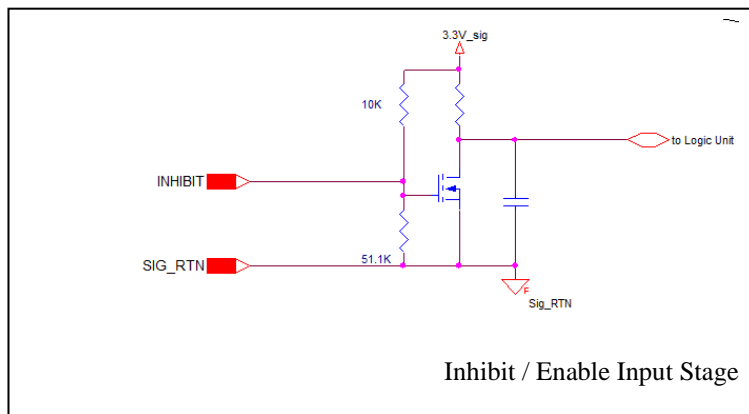
## Functions and Signals - According to VITA 62

Signal No.	Signal Name	Type	Description
1	FAIL*	Output	Indicates to other modules in the system that a failure has occurred in one of the outputs. Please refer to Figure 2 This signal is referenced to <b>SIGNAL RTN</b> .
2	SYSRESET*	Output	Indicates to other modules in the system that all outputs are within their working level. Please refer to Figure 2 This signal is referenced to <b>SIGNAL RTN</b> .
3	INHIBIT*	Input	Controls power supply outputs. This signal in conjunction with <b>INHIBIT</b> controls the outputs. Please refer to Table 1 and Figure 1 This signal is referenced to <b>SIGNAL RTN</b> .
4	ENABLE*	Input	Controls power supply outputs. This signal in conjunction with <b>INHIBIT</b> controls the outputs. Please refer to Table 1 and Figure 1 This signal is referenced to <b>SIGNAL RTN</b> .
5	GA0*, GA1	Input	Used for geographical addressing. GA1 is the most significant bit and GA0 is the least significant bit.
6	SCL, SDA	Bidirectional	I2C bus Clock and Data respectively. Through this bus the voltage and temperature readouts can be shared.
7	REF_CLK	Input	The Sync signal is used to allow the power supply frequency to sync with the system frequency. (Optional)
8	VOUT SENSE	Input	The SENSE is used to achieve accurate load regulations at load terminals (this is done by connecting the pins directly to the load's terminals).

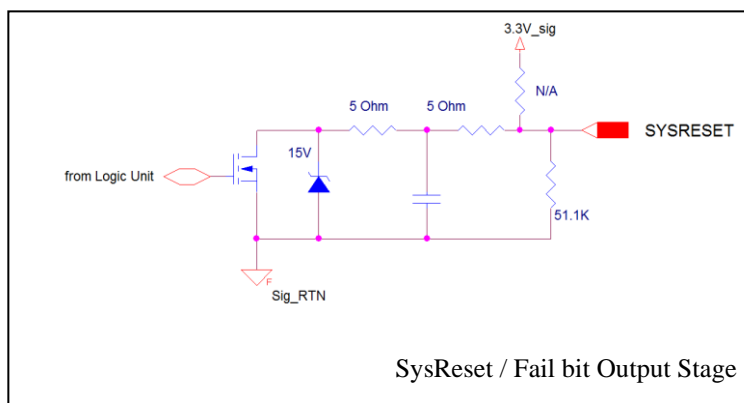
**Table 1 – Inhibit and Enable Functionality**

<b>INHIBIT*</b>	<b>Low</b>	<b>Low</b>	<b>High</b>	<b>High</b>
<b>ENABLE*</b>	<b>Low</b>	<b>High</b>	<b>Low</b>	<b>High</b>
<b>VS1, VS2, VS3, ±12VAux</b>	OFF	OFF	ON	OFF
<b>3.3V_AUX</b>	ON	OFF	ON	OFF

**Figure 1 – Inhibit and Enable Input stage**



**Figure 2 – SysReset and Fail Bit output stage**



## Detailed Information

### 1. M4013 Input Voltage Operation.

The M4013 steady state operation voltage is 18V to 48V and will continuously work up to 50V Input line. When Configurable to support MIL-STD 704/1275 transients or surges, the unit will shut down when input voltage rises above 60V or under 16V for more than 2 sec and immediate shut down under 12V or above 100V Input. Power supply automatically recover when it's Input goes back to normal steady state line.

### 2. Outputs Voltage Regulation

The M4013 contains accurate internal sense lines to keep output voltage at less than 4% regulation for all Line/ Load and temperature range (see Table 2).

Output	12V/15A	5V/12A	3.3V/5A	3.3VAux/5A	12VAux/1A	(-)12VAux/1A
Voltage Range	11.85 - 12.15	4.9 - 5.1	3.28 - 3.42	3.2 - 3.4	VS1 - VS1-0.2V	(-)11.8 - (-)12.15

Table 2: Outputs voltage regulation. VIN 18V – 48V, Temperature -55°C – 85°C

#### 2.1. 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 3.

Each VSx output has its own *Sense Lines*, additional common *Sense RTN Line* is provided for all VSx Outputs (VITA 62 Standard). Contact Factory for Sense configuration different than the VITA 62 standard

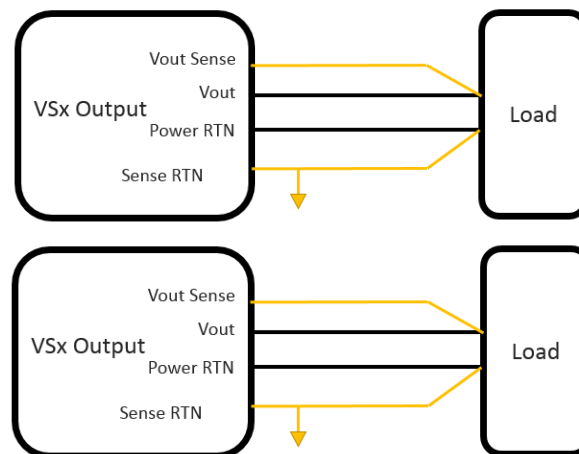


Figure 3: M4013 Sense line connection

### 3 Output Power

The M4013 can deliver up to 350W steady State at all temperature and input range.

Total Power Output	12V/20A	5V/12A	3.3V/5A	3.3VAux/5A	12VAux/1A	(-)12VAux/1A
--------------------	---------	--------	---------	------------	-----------	--------------

## 4 Advanced I2C Protocol

### Electrical Parameters

Vcc: 3.3Vdc  
 Pull-up: 10kOhm  
 Input Capacitance 330pF

### Slave Device Addressing

- 256 address spaces
- Baud rate: 200kHz maximum
- 7 Bit Protocol
- Support Slot Addressing per VITA 62

Slot Number	MSB							LSB
	A6	A5/*GAP	A4/*GA41	A3/*GA3	A2/*GA2	A1/*GA1	A0/*GA0	R/W
Slot0	1	0	0	0	0	0	0	
Slot1	1	0	0	0	0	0	0	1
Slot2	1	0	0	0	0	1	0	
Slot3	1	0	0	0	0	1	1	

\* Slot location is determined by GAx per VITA 62.

### Communication Supported

Read Command – 21Hex, deliver 64Bytes of Data. (More commands are available by request)  
 The communication starts when the master sends a start followed by the unit slave address, command, checksum and a stop. A second start followed by the slave address and a read will be followed by a 64 Bytes response.

S	Slave Address	R/W	A	Command	A	Check sum	A	P
	A6:A0	0	0	21 Hex	0	DF Hex	0	

S	Slave Address	R/W	A	DATA	A	DATA	A	DATA	A	...	DATA	A	Check sum	N/A	P
	A6:A0	1	0	D7:D0	0	D7:D0	0	D7:D0	0		D7:D0	0	D7:D0	1	

Command – 21Hex read all 64 Bytes

S - Start

P - Stop

Master Transmit	Unit Transmit

## M4013 SERIES VPX DC/DC POWER SUPPLY

### Memory Space

Response Byte #	Data Type	Meaning	Interpretation	Reading Range
	Integer, MSB First	cho of Command		1 Hex
	Integer, MSB First	/A		0 Hex
	Integer, MSB First	emperature	(C°)=+/- 7bit Dec	5 to 125 °C
	Integer, MSB First	eserved	0Hex	
5	Integer, MSB First	O1 12V Voltage	(out) = Data/ m2	0.48V
7	Integer, MSB First	O2 12V Voltage	(out) = Data/ m2	0.48V
9	Integer, MSB First	O3 12V Voltage	(out) = Data/ m2	0.48V
10-11	Integer, MSB First	3.3V Aux Voltage	(out) = Data/ m2	0.48V
12-13	Integer, MSB First	2VAux Voltage	(out) = Data/ m2	ptional
14-15	Integer, MSB First	)12V Aux Voltage	(out) = Data/ m2	ptional
16-17	Integer, MSB First	2V Total Current	(out) = Data/ m3	0A
18-19	Integer, MSB First	2V Total Current - Copy	(out) = Data/ m3	0A
20-21	Integer, MSB First	2V Total Current - Copy	(out) = Data/ m3	0A
22-23	Integer, MSB First	.3VAux Current	(out) = Data/ m5	0A
24-35	Integer, MSB First	2V Aux Current	(out) = Data/ m4	ptional
26-27	Integer, MSB First	)12V Aux Current	(out) = Data/ m4	ptional
28-29	Integer, MSB First	eserved	0Hex	
30-31	Integer, MSB First	eserved	0Hex	
32-51	Character String (ASCII)	art Number	14013-xxx* (Note1)	0 Characters
52-53	ecimal, MSB First	erial Number, 2MSB Dig	,X Dec (Note2)	ptional
54-55	ecimal, MSB First	erial Number, 2LSB Dig	,X Dec (Note2)	ptional
56-57	ecimal, MSB First	ate Code	Week, Year (Note3)	ptional
58-59	Character String (ASCII)	ardware Rev	01 & B02 Boards (note4)	Characters
60-61	ecimal, MSB First	irmware Rev	,X,X,X Dec (Note5)	digits
62	Integer, MSB First	eserved		A Hex
63	Integer, MSB First	ero Checksum	alue required to make the sum of bytes 0 to 62 added to a multiple of 256	

**Note:**

$M_2 = 20.48 / 2^{16-1}$

$M_3 = 40 / 2^{16-1}$

$M_4 = 10 / 2^{16-1}$

$M_5 = 20 / 2^{16-1}$

\*Matching unit part number



Notes 1 to 5:

1. Part Number Example: M4065-4

Byte No'	32	33	34	35	36	37	38	39-51
Character	M	4	0	6	5	(-)	4	0
Hex	4D	34	30	36	35	2D	34	00

2. Serial Number Example: 25

Byte No'	52		53		54		55	
Dec Number	0	0	0	0	0	0	2	5
Binary	"0000"	"0000"	"0000"	"0000"	"0000"	"0000"	"0010"	"0101"

3. Date Code Example: week 35 of 2018

Byte No'	56		57	
Dec Number	3	5	1	8
Binary	"0011"	"0101"	"0001"	"1000"

4. Hardware Rev Example: B01 Rev (-), B01 Rev A

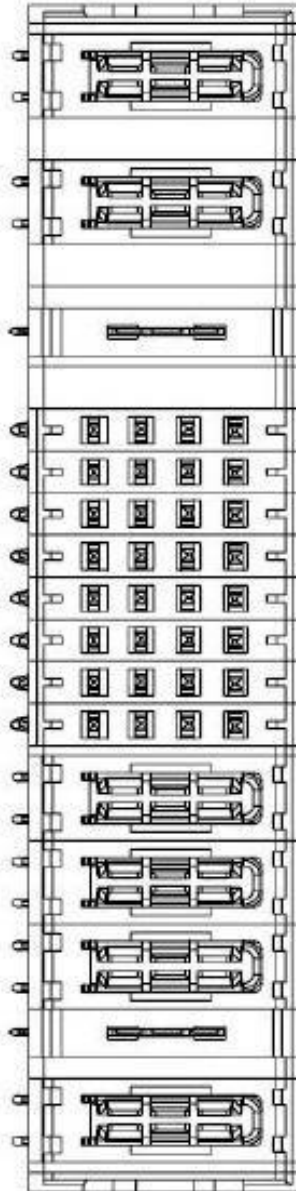
Byte No'	58		59	
Character	(-)		A	
Hex	2D		41	

5. Firmware Rev Example: 2.1.0.0

Byte No'	60		61	
Dec Number	2	1	0	0
Binary	"0010"	"0001"	"0000"	"0000"

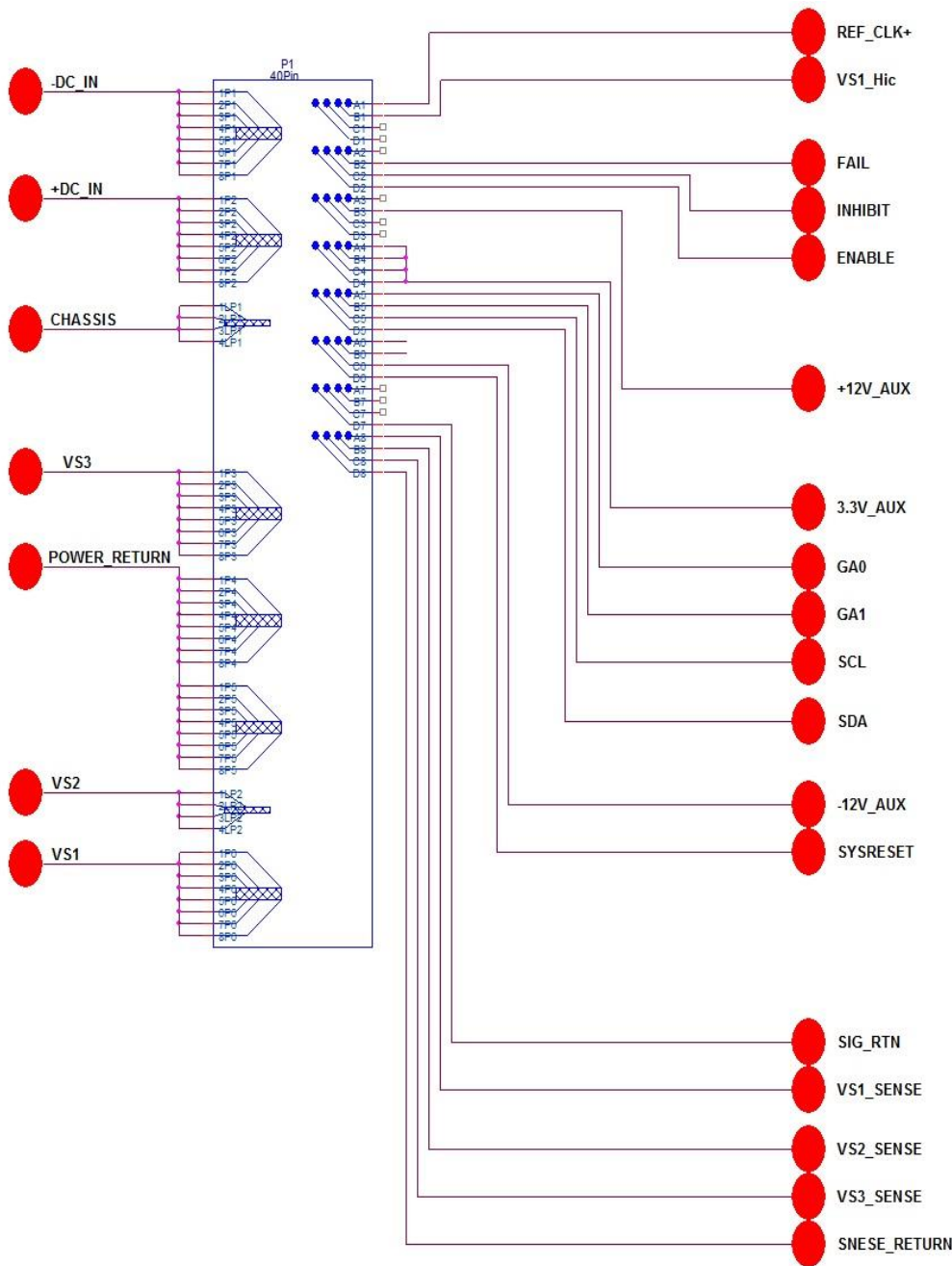
**M4013 SERIES VPX DC/DC POWER SUPPLY**

**Pin Assignment**



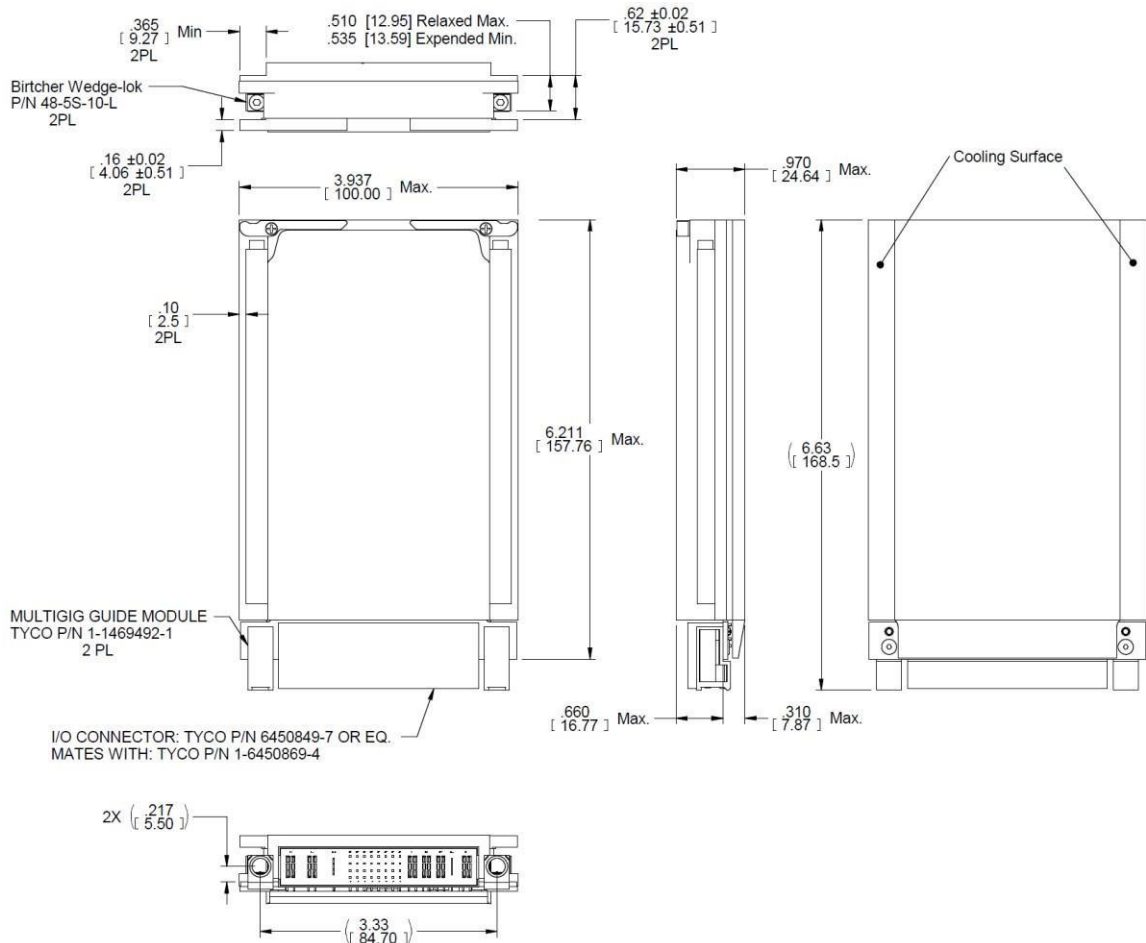
PART NUMBER	ROWS	POWER		SIGNAL								POWER						
		P1	P2	LP1	1	2	3	4	5	6	7	8	P3	P4	P5	LP2	P6	
6450849-7	D				Z5	Z5	Z5	Z5	Z5	Z5	Z5	Z5	Z5	Z5				
	C	TT	TT	LT	Y5	Y5	Y5	Y5	Y5	Y5	Y5	Y5	Y5	Y5	TT	TT	TT	LT
	B				R5	R5	R5	R5	R5	R5	R5	R5	R5	R5				
	A				05	05	05	05	05	05	05	05	05	05	01			
2ACP+1LP+32S+3HDP+1LP+1HDP																		

# M4013 SERIES VPX DC/DC POWER SUPPLY



Pin Number	Pin Name
P1	-DC_IN
P2	+DC_IN
LP1	CHASSIS
P3	VS3
P4	POWER_RETURN
P5	POWER_RETURN
LP2	VS2
P6	VS1
A8	VS1_SENSE
B8	VS2_SENSE
C8	VS3_SENSE
D8	SENSE_RETURN
A7	N.C
B7	N.C
C7	N.C
D7	SIG_RTN
A6	N.C
B6	N.C
C6	-12V_AUX
D6	SYSRESET*
A5	GA0*
B5	GA1*
C5	SCL
D5	SDA
A4	+3.3V_AUX
B4	+3.3V_AUX
C4	+3.3V_AUX
D4	+3.3V_AUX
A3	N.C
B3	+12V_AUX
C3	N.C
D3	N.C
A2	N.C
B2	FAIL*
C2	INHIBIT*
D2	ENABLE*
A1	REF_CLK+
B1	N.C
C1	N.C
D1	N.C

## Outline Drawing



### Notes

1. Dimensions are in Inches [mm]
2. Tolerance is:  
.XX ± 0.02 IN  
.XXX ± 0.008 IN
3. Weight: Approx. 690 g (24.34) oz
4. 3D model available

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