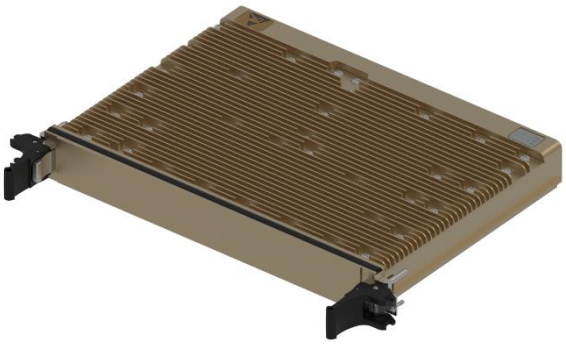
# M4700 SERIES

*AC/DC POWER SUPPLY*



### PRODUCT HIGHLIGHTS

- **VITA 62 COMPLIANT**
- **6U VPX FORM FACTOR**
- **AC/DC CONVERTER**
- **Up to 1000W Steady State**
- **Cyber Secure**

# Description

M4700 is a military grade 6U VPX, VITA62 power supply that provides 12V, 5V and VAUX per VITA 62 that is rated at 1000W output power. Features include: Air Flow By cooling, 1.2" pitch, current-sharing, internal EMI filters, VITA 46.11 system management. AC input is 115V per MIL-STD-704. Designed to meet MIL-STD-810 and MIL-STD-461.

## Applications

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

## Special Features

- VITA 62 6U 1.2”
- High efficiency
- Input / Output isolation
- Remote sense
- EMI filters included
- Fixed switching frequency
- Parallel configuration
- 46.11 Tier 2 communication
- External Inhibit & Enable
- Indefinite short circuit protection with auto-recovery
- Over temperature shutdown with auto recovery

## Electrical Specifications

***AC Input***

115 VAC (Y)

- Works Through MIL-STD-704 (B-F) Normal and Abnormal Steady State.
- Works Through MIL-STD-704(B-F) Normal transients
- Protected MIL-STD-704(B-F) Abnormal Transients

***Line/Load regulation***

±1% or better (no load to full load, low line to high line (–55°C to 85°C).

***Ripple and Noise***

Less than 50mV$_{p-p}$, typical (max. 1%), Under all Line, Load, and temperature condition (Line frequency 380 to 420Hz). measured across 0.1µF and 10µF on Load.

***System Management Options***

1) I2C
2) VITA 46.11 Tier II IPMC

Data available:

- Output voltages and currents
- Input voltage
- Card temperature
- Card status

***DC Outputs***

| | |
|---|---|
| PO1&PO2 | 12V/60A |
| PO3 | 5V/30A |
| 3.3Vaux | 3.3V/20A |
| 12Vaux | 12V/1A |
| (-)12Vaux | (-) 12V/1A |

Total Steady state Power 1000W (–55°C to +85°C Frame).

***Power Factor***

> 0.87 at 1kW

***Current Share***[4]

12V Active Current share
5V Active Current share

***Load Transient***

Output dynamic response up to 5% at step load of 30%-90%.
Output return to steady stated within 300-500µSec

***Isolation***

500V$_{DC}$ Input to Output
500V$_{DC}$ Input to Case
500V$_{DC}$ Output to Case

***EMC***

Designed to meet MIL-STD-461F [2] CE102[3], CS101, CS114, CS115, CS116, CS117 & RE102

***Efficiency***

Typical 87% (Nominal line, nominal load, room temperature)

Notes:

[1] Contact Factory for peak power options
[2] RE102 Supported at system Level
[3] CE102 deviation below 70KHz for output power above 800W
[4] Current share is optional, default configuration does not support current share.

## Protections (Thresholds and protections can be modified / removed – please consult factory).

***Input***

- **Inrush Current Limiter**: peak value of 5 x $I_{IN}$ for inrush currents lasting longer than 100µs.
- **Under Voltage Lock-Out** Unit shuts down when input voltage is below 70VAC ± 5VAC.
- **Catastrophic Failure Protection** Fuses are available to protect from catastrophic failure. The fuses are rated not to engage due to any normal type operation.

***Outputs***

- **Over Voltage Protection**: 12V latch & fused Zener 5V latch & fused Zener 3.3Vaux fused Zener 12Vaux Hiccup (-)12Vaux fused Zener
- **Overload / Short Circuit Protection** 12V, 5V Output-Continuos Hiccup protection (110-130%). 3.3Vaux Hiccup protection (110-150%). 12Vaux Hiccup (110-180%) (-)12Vaux Hiccup/foldback (110-180%)

***General***

**Over temperature Protection**: Shutdown at +100 °C±5°C[1] [2] Recovery at +90 °C±5°C.

[1] Max Heat sink Temperature.

[2] Thermal S.D done by analog sensor located on PCB with correlation to heatsink temperature. After Thermal analysis is completed, it would be calibrated to reflect max heat sink temperature. I2C temperature sensors are located on PCB and will have correlation to Heat sink depends on load and airflow.

## Environmental

Designed to meet MIL-STD-810G and VITA 47

***Temperature***

Operating: –55°C to +85°C (Max +85°C Envelope). Storage: –55°C to +125°C

**Humidity**

810G Method 507.5 & VITA 47 Para. 5.6, Up to RH 95%.

**Reliability**

> 314,000 hours, calculated per MIL-STD-217F Notice 2 at +65°C on unit chassis, Ground Fixed. (complete analysis is still required)

***Altitude***

810G Method 500.5, Procedure II (Operational) & VITA 47 para. 5.7 60,000 ft.

**Vibration**

810G Method 514.6 Procedure I. General minimum integrity exposure. (1 hour per axis & VITA 47 Vibration Class V3

**Salt Fog**

Method 509.5

**Shock**

810G Method 516.6 Procedure I & VITA 47 Shock Class OS2 Saw-tooth, 40g peak, 11ms

***Fungus***

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

## Environmental Stress Screening (ESS)

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

## Functions and Signals (according to VITA 62.0)

| Signal Name | Type | Description |
|---|---|---|
| FAIL* | Output | Indicates to other modules in the system that a failure has occurred in one of the outputs. Please refer to Figure 2 |
| SYSRESET* | Output | Indicates to other modules in the system that all outputs are within [1] their working level. Please refer to Figure 2 |
| INHIBIT* | Input | Controls power supply outputs. This signal in conjunction with ***Enable*** controls the outputs. Please refer to Table 1 and Figure |
| ENABLE* | Input | Controls power supply outputs. This signal in conjunction with **INHIBIT** controls the outputs. Please refer to Table 1 and Figure 1 |
| GA0-4*, GAP* | Input | Used for geographical addressing. GA4 is the most significant bit and GA0 is the least significant bit. |
| SCL, SDA | Bidirectional | I2C bus Clock and Data respectively. Through this bus the voltage and temperature readouts can be shared. |
| Temperature BIT | Output | Indicates to other modules about input missing phase. |
| Missing Phase BIT | Output | Indicates to other modules about input missing phase. |
| 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). |
| 12VCS, 5VCS | Bidirectional | Support current share between Outputs. Two pins required. [1] [2] |
| 12V ACS, 5V ACS | Bidirectional | Support Active current share between Outputs. See Current Share para. [1] [2] |

Notes:

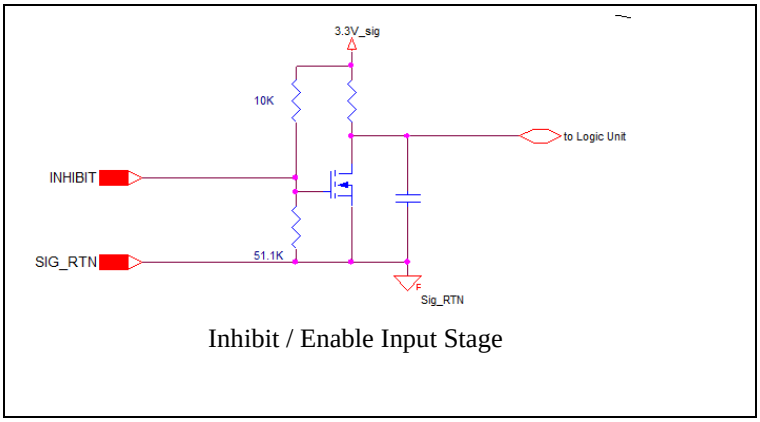
[1] All Signals referenced to **SIGNAL RTN**

[2] When not used leave open

**Table 1 – Inhibit and Enable Functionality**

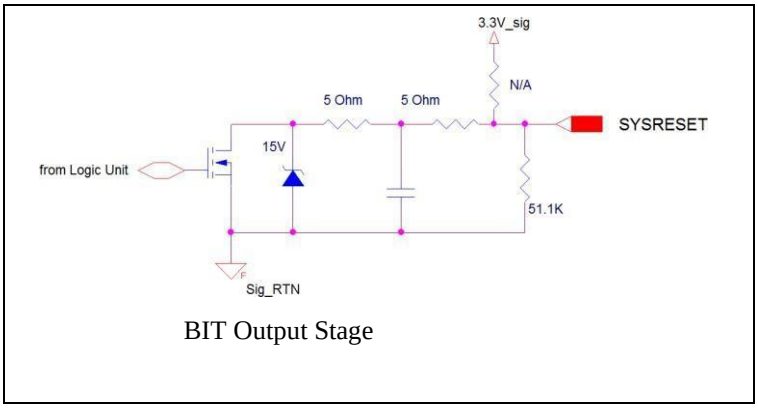
| INHIBIT* | Low | Low | High | High |
|---|---|---|---|---|
| ENABLE* | Low | High | Low | High |
| **All Outputs** | OFF | OFF | ON | OFF |
| **3.3V_AUX** | ON | OFF | ON | OFF |

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




Inhibit / Enable Input Stage

**Figure 2 –BIT Output Stage**




BIT Output Stage

## Detailed Information

### 1. Input Voltage Operation.

The M4700 steady state operation is per Mil-STD-704. Unit will work thorough all Normal Transients per Mil- STD-704 B to F, protected to all other transients and interrupts.

### 2. Outputs Voltage Regulation

The M4700 contains accurate internal sense lines to keep output voltage at less than 3% regulation for all Line / Load and temperature range (see Table 2).

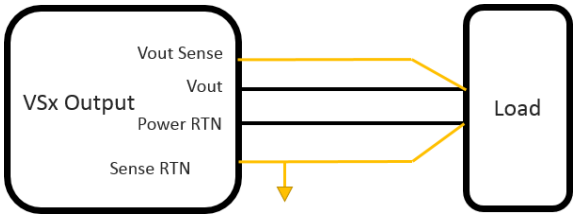
The M4700 contains three 12V sense line pairs. These sense lines are all shorted together internally. For proper operation, connect only a single sense line to the point of load regulation. The same recommendation applies to the sense return line.

For proper current shared operation, connect a single sense line from each M4700 to the same point of load regulation.

| Part number | Input | Outputs | | | | |
|---|---|---|---|---|---|---|
| | | VS1 & VS2 | VS3 | 3.3VAux | 12VAux | (-)12VAux |
| M4700-1 | 100-125VAC<br>3 Phase,380Hz- 420Hz | 12V/60A | 5V/30A | 3.3V/20A | 12V/1A | -12V/1A |

**Table 2: Outputs voltage regulation. Under all Temperature range**

**Figure 3 – Sense Lines connection**



## 3. Current Share (C.S, Optional)

Current Share of two or more units is optional (Contact Factory). VSx outputs will current share with about 2-4A load balance.

### 3.1 Active Current Sharing (A.C.S, Optional)

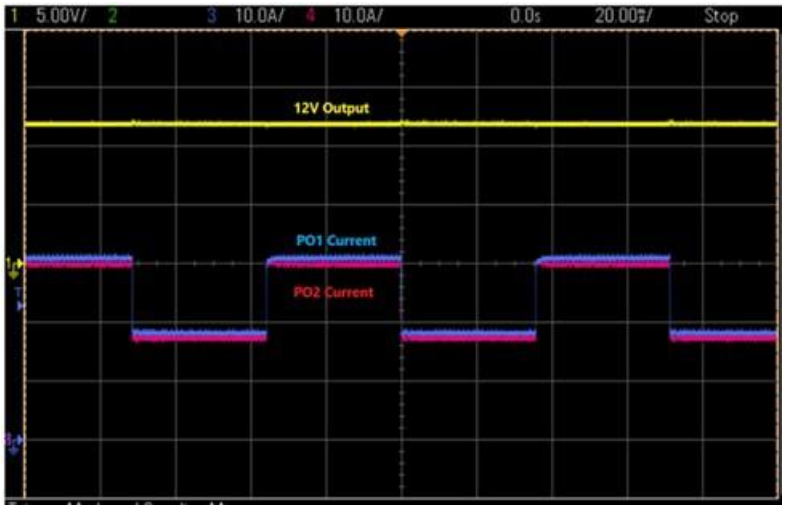
Current share done in a closed-loop. All paralleled outputs are compared and feedback is used to balance their load current. The result is a more stable, less sensitive output voltage without voltage drop. Typical Load Balance of about 1 to 4A for all Load range is expected.

### 3.2 Current share connection between two Units.

For a required output to current share please connect the following Pins between the two units

- **PO#_Sense** & **PO#_Sense_RTN** of each output should be connected to its corresponding output on the paralleled unit (for best performance, Pins from paralleled units should be connected to a single point and as close as possible to the load point).
- **VSx CS** of each output should be connected to its corresponding output on the paralleled unit.
- **VSx ACS** of each output should be connected to its corresponding output on the paralleled unit.
- In case two VSx have same output (E.g. VS1, VS2 are 12V), a single output can be connected and the other can be left open.
- When not used, share pins pins can be left open

**Figure 4 -Typical ACS Dynamic Load of Two 12V Paralleled Outputs**



## 4. Communication Protocol

Unit communication protocol can be configured as VITA 46.11 Tier 2 IPMC, VITA 46.11 Tier 1 IPMC or Advanced I2C protocol. For more details on protocols refer to para. 5.1 and 5.2

### 4.1 Advanced I2C Protocol

**Electrical Parameters**

| | |
|---|---|
| Vcc | 3.3VDC |
| Pull-up | 20kOhm |
| Input capacitance | 100pf |

**Slave Device Addressing**

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

| | MSB | | | | | | | LSB | |
|---|---|---|---|---|---|---|---|---|---|
| Slot Number | A6 | A5/*GAP | A4/*GA41 | A3/*GA3 | A2/*GA2 | A1/*GA1 | A0/*GA0 | R/W | GAP |
| Slot0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | Short |
| Slot1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | | Open |
| Slot2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | | Open |
| Slot3 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | | Short |
| Slot4 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | | Open |
| ... | | | | | | | | | |
| Slot31 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | Open |

* 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 Bites 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 |
|---|---|

## Memory Space

| Response Byte # | Data Type | Meaning | Interpretation | Reading Range |
|---|---|---|---|---|
| 0 | U Integer, MSB First | Echo of Command | | **21 Hex** |
| 1 | U Integer, MSB First | N/A | | **00 Hex** |
| 2 | S Integer, MSB First | Temperature | T(C°)=+/- 7bit Dec | **-55 to 125 °C** |
| 3 | U Integer, MSB First | Reserved | 00Hex | |
| 4-5 | U Integer, MSB First | 12V Voltage | V(out) = Data/ m2 | **20.48V** |
| 6-7 | U Integer, MSB First | N/A | V(out) = Data/ m2 | **"00"** |
| 8-9 | U Integer, MSB First | 5V Voltage | V(out) = Data/ m2 | **20.48V** |
| 10-11 | U Integer, MSB First | 3.3V Aux Voltage | V(out) = Data/ m2 | **20.48V** |
| 12-13 | U Integer, MSB First | 12VAux Voltage | V(out) = Data/ m2 | **Optional** |
| 14-15 | U Integer, MSB First | (-)12V Aux Voltage | V(out) = Data/ m2 | **Optional** |
| 16-17 | U Integer, MSB First | 12V Current | V(out) = Data/ m3 | **80A** |
| 18-19 | U Integer, MSB First | N/A | V(out) = Data/ m3 | **"00"** |
| 20-21 | U Integer, MSB First | 5V Current | V(out) = Data/ m3 | **40A** |
| 22-23 | U Integer, MSB First | 3.3VAux Current | V(out) = Data/ m5 | **20A** |
| 24-35 | U Integer, MSB First | 12V Aux Current | V(out) = Data/ m4 | **Optional** |
| 26-27 | U Integer, MSB First | (-)12V Aux Current | V(out) = Data/ m4 | **Optional** |
| 28-29 | U Integer, MSB First | Reserved | 00Hex | |
| 30-31 | U Integer, MSB First | Reserved | 00Hex | |
| 32-51 | Character String (ASCII) | Part Number | M4700-xxx* (Note1) | **20 Characters** |
| 52-53 | Decimal, MSB First | Serial Number, 2MSB Dig | X,X Dec (Note2) | **Optional** |
| 54-55 | Decimal, MSB First | Serial Number, 2LSB Dig | X,X Dec (Note2) | **Optional** |
| 56-57 | Decimal, MSB First | Date Code | Week, Year (Note3) | **Optional** |
| 58-59 | Character String (ASCII) | Hardware Rev | B01 & B02 Boards (note4) | **2 Characters** |
| 60-61 | Decimal, MSB First | Firmware Rev | X,X,X,X Dec (Note5) | **4 digits** |
| 62 | U Integer, MSB First | Reserved | | **AA Hex** |
| 63 | **U Integer, MSB First** | **Zero Checksum** | **Value required to make the sum of bytes 0 to 62 added to a multiple of 256** | |

Note:

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

$M_3$=140 / $2^{16}$-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
2. 

| 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 |

3. 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" |

4. Date Code Example: week 35 of 2018

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

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

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

6. Firmware Rev Example: 2.1.0.0

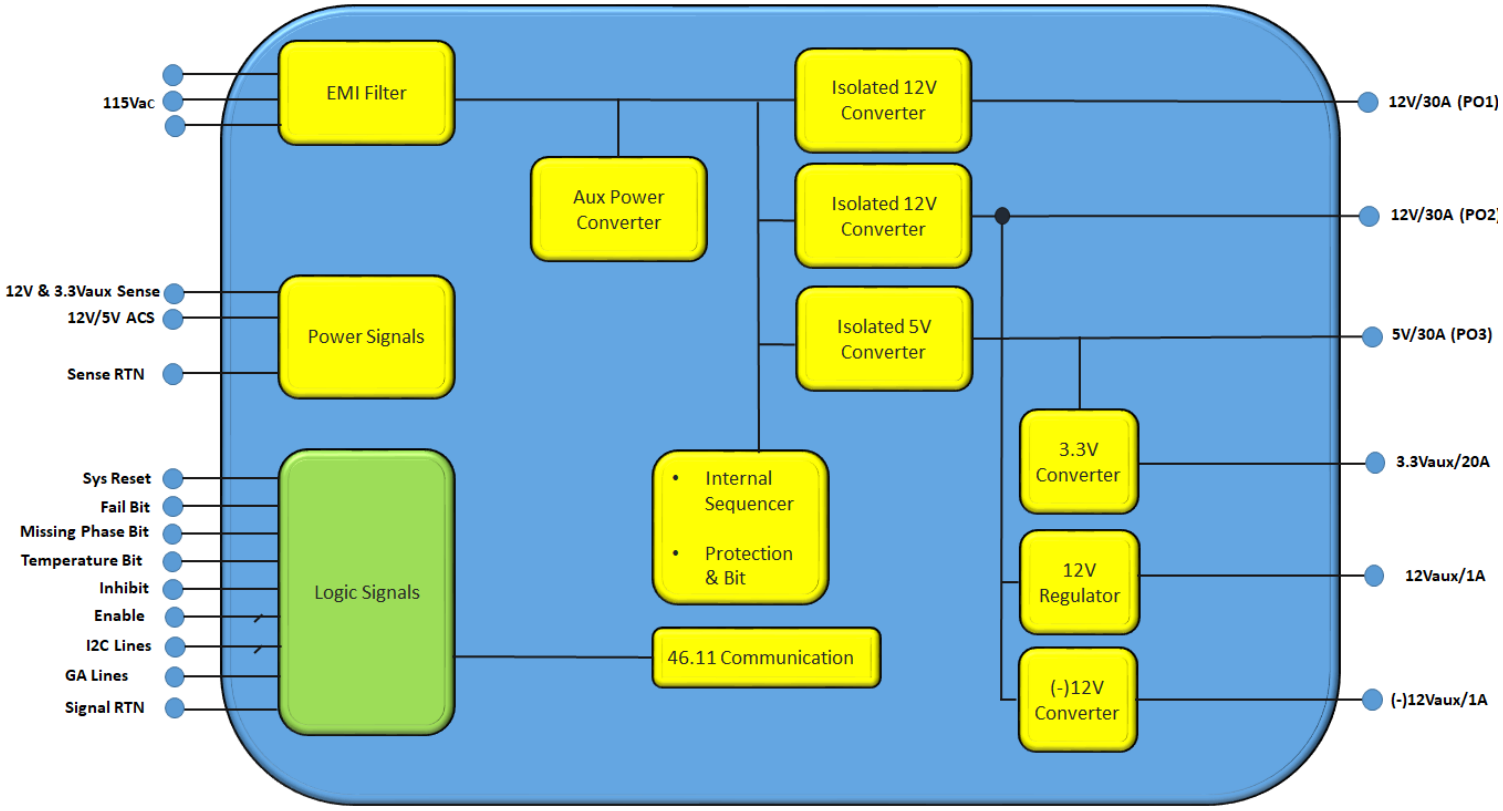
| Byte No' | 60 | | 61 | |
|---|---|---|---|---|
| Dec Number | 2 | 1 | 0 | 0 |
| Binary | "0010" | "0001" | "0000" | "0000" |

## 4.2 VITA 46.11 Tier 1 and Tier 2 IPMC

Please see 46.11 User Manual for detailed information of operation. Sensors included are seen in the table below.

| Record ID | Sensor ID | Sensor Type | Name |
|---|---|---|---|
| 0000 | 00 | F0h | FRU State Sensor |
| 0001 | 01 | F1h | System IPMB Link Sensor |
| 0002 | 02 | F2h | FRU Health Sensor |
| 0003 | 03 | 02h | FRU Voltage Sensor |
| 0004 | 04 | F3h | FRU Temperature Sensor |
| 0005 | 05 | F4h | Payload Test Results Sensor |
| 0006 | 06 | F5h | Payload Test Status Sensor |
| 0100 | 07 | 02h | VS1 Voltage |
| 0103 | 0A | 02h | VS2 Voltage |
| 0106 | 0D | 02h | VS3 Voltage |
| 0109 | 10 | 02h | 3.3VAux Voltage |
| 010C | 13 | 02h | 12VAux Voltage |
| 010F | 16 | 02h | (-)12VAux Voltage |
| 0112 | 19 | 03h | VS1 Current |
| 0115 | 1C | 03h | VS2 Current |
| 0118 | 1F | 03h | VS3Current |
| 011B | 22 | 03h | 12VAux Current |
| 011E | 25 | 03h | (-)12VAux Current |
| 0121 | 28 | 01h | Analog Temperature |
| 0122 | 29 | 01h | Analog Temperature 2 |
| 9999 | N/A | N/A | Device Management |

## block diagram



## 5. Pin Assignment

Connector P1: Connector type: 6450849-6 or eq

| *Pin Number* | *Pin Name* |
|---|---|
| P10 | 12V/30A (VS1, VS2) |
| P9 | 12V/30A (VS1, VS2) |
| A9 | 12V_SENSE |
| B9 | 12V_SENSE |
| C9 | 5V_SENSE |
| D9 | Missing Phase BIT |
| A8 | 12V_SENSE_RTN |
| B8 | 12V_SENSE_RTN |
| C8 | 5V_SENSE_RTN |
| D8 | Temperature BIT |
| A7 | 12V_CS |
| B7 | 12V_ACS |
| C7 | 5V_CS |
| D7 | SIGNAL_RETURN |
| P8 | POWER_RETURN |
| P7 | POWER_RETURN |
| A6 | SCL_B |
| B6 | SDA_B |
| C6 | -12V_AUX |
| D6 | SYSRESET* |
| A5 | GAP* |
| B5 | GA4* |
| C5 | SCL |
| D5 | SDA |
| A4 | GA3* |
| B4 | GA2* |
| C4 | GA1* |
| D4 | GA0* |
| A3 | N.C |
| B3 | +12V_Aux |
| C3 | N.C |
| D3 | N.C |
| P6 | 5V/30A |
| P5 | 5V/30A |
| P4 | POWER_RETURN |
| P3 | POWER_RETURN |
| A2 | N.C |
| B2 | FAIL* |
| C2 | INHIBIT* |
| D2 | ENABLE* |
| A1 | N.C |
| B1 | 5V_ACS |
| C1 | 3.3Vaux Sense |
| D1 | 3.3Vaux Sense return |
| P2 | 3.3V/20A |
| P1 | POWER_RETURN |

Connector P0
Connector type: 2348886-1 or eq.

| Pin Number | Signal Name |
|---|---|
| P7 | PHASE A |
| P6 | PHASE B |
| P5 | PHASE C |
| P4 | |
| P3 | |
| P2 | |
| P1 | CHASSIS_GND |

Notes:
• P5, P6 are shorted internally.
• P9, P10 are not shorted internally.
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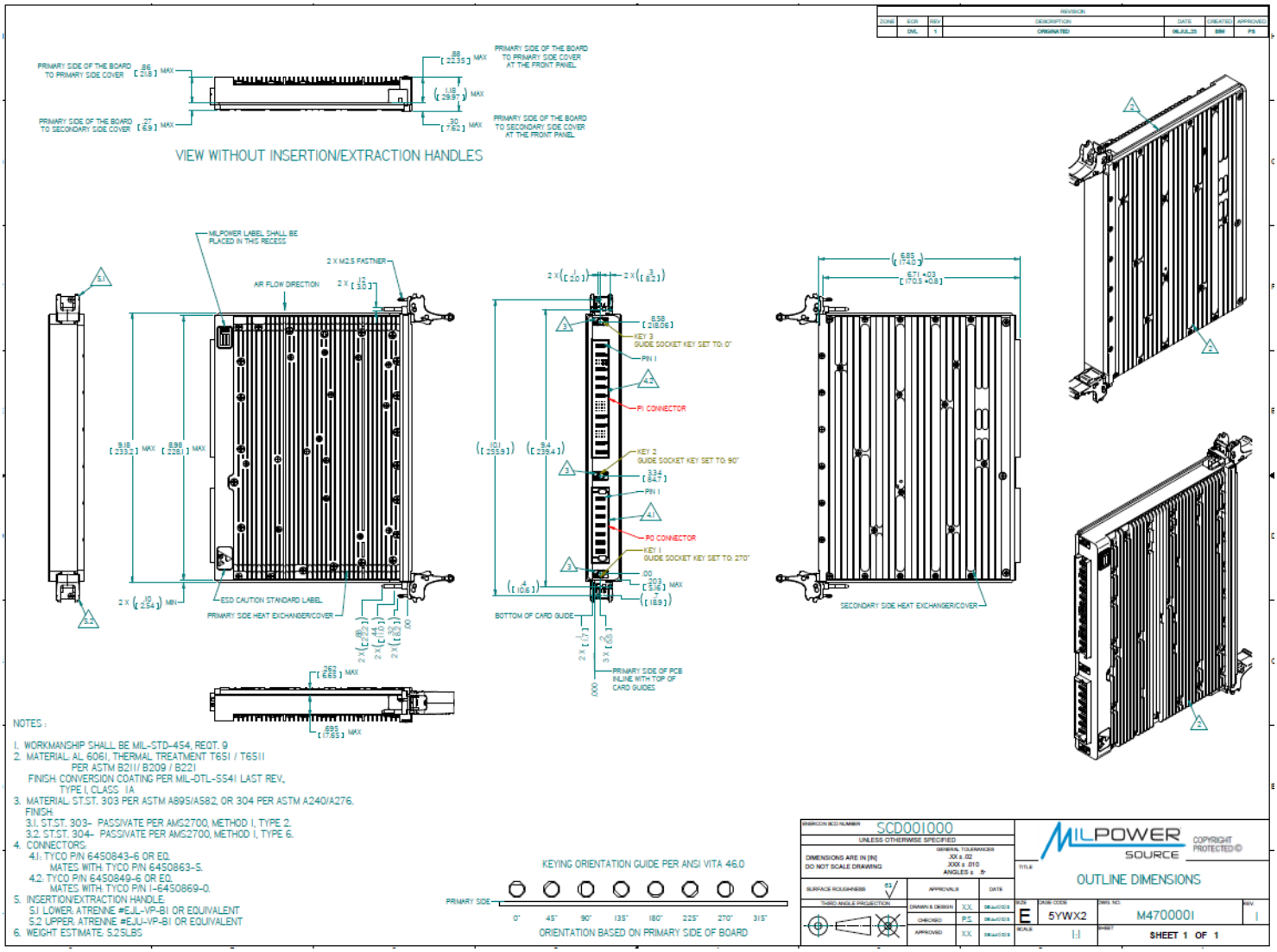
## Outline Drawing

**For detailed dimensions and tolerances see Drawing: M4700001**




based on VITA 48.7 class B, No seals for Module to Backplane seal plate or Primary side cover to secondary side cover interface

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