

## PIM200X Series; ATCA Board Power Input Modules

### -38 to -75 Vdc; 200W Input

### RoHS Compliant



### Applications

- ATCA Front Board / Blade
- Central Office Telecom equipment
- High availability server and storage applications

### Options

- Choice of System Management Power:
  - 3.3Vdc (PIM200F)
  - 5.0Vdc (PIM200A)
- Choice of short pin lengths
- Basic Insulation (-B)

### Description

The PIM200X-series is a new class of power modules designed to greatly simplify the task of implementing dual redundant, hot swap -48Vdc power distribution with EMI filtering on an ATCA or other telecom boards. The PIM200X, when used with a variety of Lineage Power's dc-dc converters/POLs provides for a quick, simple and elegant power architecture solution to a wide variety of complex power requirements. While providing high reliability, innovative features and compact design at a low cost, the module significantly reduces the valuable telecom board real estate compared to conventional discrete designs. Besides processing the main -48V bus, the module greatly simplifies the task of powering the IPM (for ATCA applications), system management or other housekeeping functions by providing a completely isolated auxiliary 3.3V or 5.0V power bus.

### Features

- 200W / -48V telecom input power distribution
- 8W (3.3Vdc or 5.0Vdc) of isolated Management Power for IPM or other housekeeping functions
- OR'ing functionality for the A/B & RTN power feeds as well as Enable A/B signals
- Inrush protection / hot swap capability
- Integral EMI filter designed for the ATCA board to meet CISPR Class B
- Independent 72Vdc output for charging the external holdup capacitors resulting in significant board real estate savings and bleed resistor power dissipation
- A/B Feed Loss or open fuse alarm (opto-isolated)
- Protection: Reverse Polarity, under voltage, input transient over voltage, over current & over temperature
- High efficiency : 97% @ -48V / 200W (@ 25C)
- -5 to 70°C ambient temperature operation
- Compact design : 70.6 mm x 36.8 mm x 12.7 mm  
(2.78 in x 1.45 in x 0.5 in)
- MTBF : 1,565,825 hours per TELCORDIA
- ISO\*\* 9001 & ISO 14001 certified manufacturing facilities
- Compliant to RoHS EU Directive 2002/95/EC
- *UL*\* 60950-1 Recognized, *CSA*† C22.2 No. 60950-1-03 Certified, EN 60950-1 (*VDE*‡ 0805: 2001-12) Licensed , CE

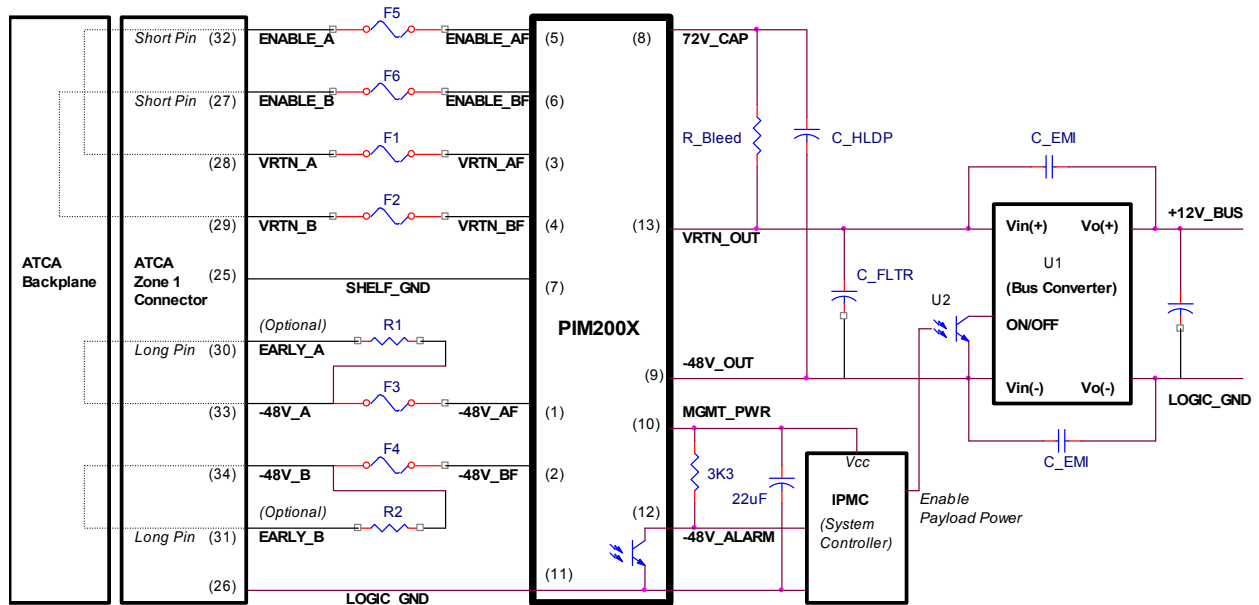
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### 200W ATCA Board Typical Application



$$C\_HLDP(\mu F) \geq [P_{out}(W) * \{T_{holdup}(ms) + 1.7\}] / 1.9$$

$$R\_Bleed(\Omega) \leq 5.485 / C\_HLDP(F)$$

### Suggested Bill of Materials

(Note: Customer is ultimately responsible for the selection and verification of the suggested parts).

Qty	Ref Des	Description	MFR / PN (or equivalent)	Comments
2	F1, F2	Fuse, SMT, 10 Amp	Bel Fuse: SSQ Series	VRTN_A, VRTN_B
2	F3, F4	Fuse, SMT, 8 Amp	Littelfuse 451/ 453 Series (Voltage rating >=75V)	-48V_A, -48V_B
2	F5, F6	Fuse, SMT, 1/16th Amp		ENABLE_A, ENABLE_B
1	C_FLTR	Capacitors, Al Electrolytic 150uF/100V	Nippon/Chemicon; KZE Series Panasonic: FK Series (SMT) Nichicon: UJ Series	C_FLTR (Max) = 220uF
3 OR 1	C_HLDP	Capacitors, Al Electrolytic 470uF/80V  OR Capacitors, Al Electrolytic 1800uF/80V	Nippon/Chemicon; KZE Series Panasonic: FK Series (SMT)  OR Panasonic / ECEC1KP182DL 30mm(OD) X 20mm(L)	=1400 uF (1200uF + 20% Tol) (for 200W & Tholdup=9.3 msecs)  OR Snap-In Radial
1	R_Bleed	SM, 3.9Kohms, 1W		For C_HLDP=1400uF
2	C_EMI	SM, 4700pF, >=1500V	Novacap, Murata or Syfer	Size: >= 1210
1	U1	200W/12V Bus Converter	Lineage Power: QBW018A0B1	
1	U2	Opto-coupler (1500V)	Fairchild : HMHA2801	Safety approved
2	R1, R2	High Surge Power, 15 Ohms	KOA: SG73 (Size >=1206)	Optional; See "Design Consideration" section

### Absolute Maximum Ratings:

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Device	Symbol	Min	Typ	Max	Unit
<b>Input Voltage (Absolute values)</b>						
Continuous	All	$V_I$	0	-48	-75	Vdc
Transient (Pulse duration above -75V = 1ms)	All	$V_{Tr}$	-75		-100	Vdc
<b>Temperature</b>						
Normal Operating Ambient Temperature (See Thermal Considerations section)	All	$T_A$	-5		70	°C
Storage Temperature	All	$T_{stg}$	-55		125	°C
<b>Power</b>						
Input Power, Maximum Allowable	All	$P_{in,max}$			200	W
Power Dissipation (Internal Module Dissipation @ Pin, max) (with MGMT_PWR = 8W)	All	$P_{diss}$		6		W
Output Power, Maximum Deliverable (Management Power + Payload Power)	All	$P_{out}$		194		W
Management Power, Maximum Deliverable (MGMT_PWR)	All	$P_{MGMT\_PWR}$			8	W
Module Standby Power (@-48V <sub>in</sub> & MGMT_PWR=0W, P <sub>out</sub> =0W)	All	$P_{Stdby}$		2.0		W
<b>Isolation</b>						
Input to MGMT_PWR Output Voltage	All				1500	Vdc
Input to SHELF_GND Voltage	All				1500	Vdc
Input to LOGIC_GND Voltage	All				1500	Vdc
LOGIC_GND to SHELF_GND Insulation Resistance with 100Vdc Test Voltage	All		9			MOhms

**CAUTION: This power module is not internally fused. Both A & B feeds and their corresponding returns must be individually fused.**

To preserve maximum flexibility, internal fusing is not included. However, to achieve maximum safety and system protection, the safety agencies require a fast-acting fuse with a maximum rating of 10 Amps and voltage rating of >=75Vdc for the -48AF, -48BF VRTN\_AF & VRTN\_BF feeds. Consult Fusing and fault protection (Section 4.1.4) of PICMG 3.0 ATCA specifications for additional information. Based on the information provided in this data sheet on inrush current and maximum dc input current, the same type of fuse with a lower rating can be used. Refer to the fuse manufacturer's data sheet for further information.

### Electrical Specifications:

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Parameter	Device	Symbol	Min	Typ	Max	Unit
<b>Main Input (-48_AF,-48_BF,VRTN_AF,VRTN_BF); (Absolute values)</b>						
Operating Input Voltage (Module will operate down to -36V depending on the output power and thermal environment but may not support holdup time requirements)	All	$V_I$	-38	-48	-75	Vdc
Input Voltage Turn-on Threshold (Module On)	All	$V_{UVHI}$	-34.3	-35.3	-36.0	Vdc
Under Voltage Lockout Threshold (Module Off)	All	$V_{UVLO}$	-32.4	-33.7	-34.1	Vdc
Maximum current drain if input voltage falls below $V_{UVLO}$ for > 2 seconds.	All	$I_{stdby}$			10	mA
Maximum Input Current ( $V_I=0V$ to -75Vdc, $P_{in}=P_{in,max}$ )	All	$I_{I,max}$			6	Adc
Inrush Transient (with $C_{FLTR,max} = 220\mu F$ )	All					
Duration: 0.1 to 0.9 ms		$I_{pk}$			30	Adc
Duration: 0.9 to 3 ms (Logarithmically declining)		$I_{pk}$			30 to 12	Adc
Duration: 3 to 100 ms		$I_{pk}$			6	Adc
<b>ENABLE A/B Signal Inputs (ENABLE_A, ENABLE_B)</b>						
Enable A / B Signals current drain ( $V_{in} = -75Vdc$ )	All				700	$\mu A_{dc}$
<b>Main Output (-48V_OUT, VRTN_OUT)</b>						
External Output Filter Capacitance ( $C_{FLTR}$ )	All	$C_{FLTR}$	100*		220	$\mu F$
<b>72V Holdup Capacitor Output (72V_CAP)</b>						
72V_CAP Output Voltage Tolerance	All		68.4	72.0	74.2	Vdc
72V_CAP ON (OR'd) Input Voltage Threshold			-36.2	-37.7	-39.2	Vdc
<b>A/B Feed Loss / Fuse Alarm Output (-48V_ALARM)</b>						
-48V_ALARM is an Opto-isolated open collector output with the emitter internally referenced to LOGIC_GND. Alarm Characteristics: Power Good / Fuse Good = LO (Opto conducting) A or B Feed Loss / Fuse (open) = HI (Opto off)						
Alarm ON Input Voltage Threshold	All		-36.1	-37.2	-38.2	Vdc
Opto Transistor Collector to Emitter Voltage		$V_{ceo}$			40	Vdc
Opto Transistor Collector to Emitter Dark Current (Opto Diode current, $I_d = 0A$ )		$I_{ceo}$			100	nA
Opto Transistor Collector Current		$I_c$			5	mA
Opto Transistor Collector Saturation Voltage		$V_{CE(sat)}$			0.3	Vdc

Note: \* See "Design Considerations" section for further information.

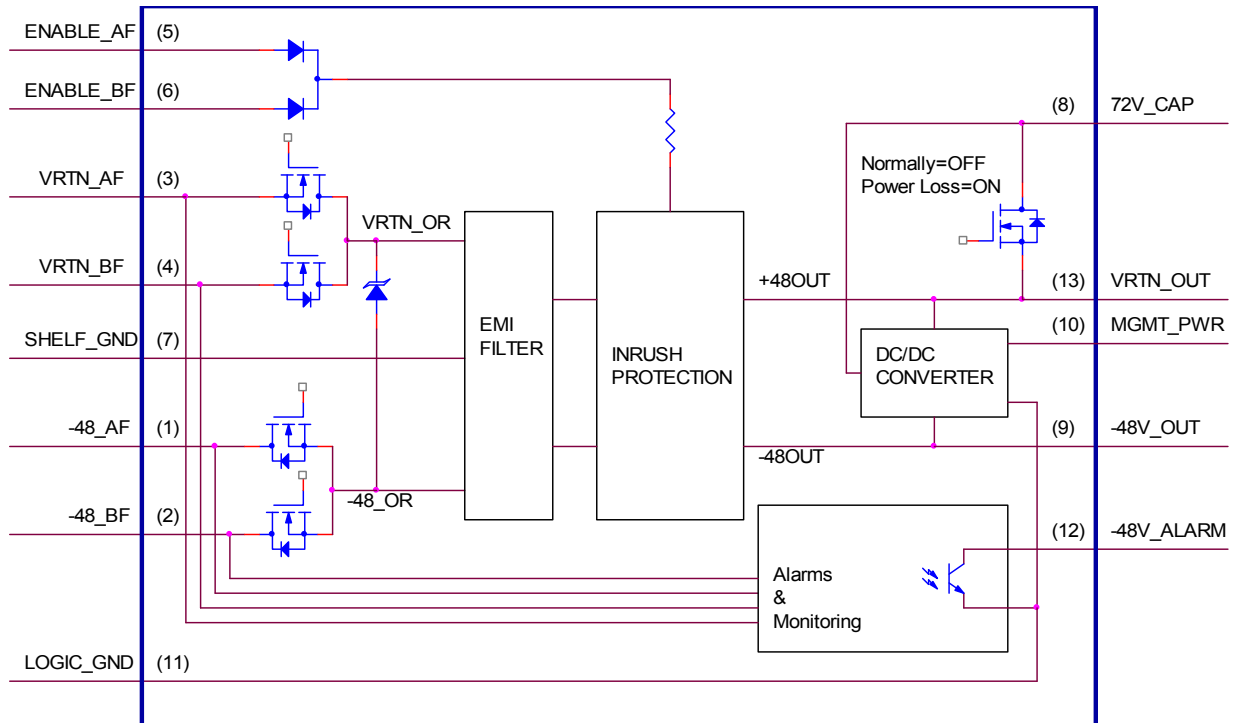
Electrical Specifications (continued):

Parameter	Output Voltage	Symbol	Min	Typ	Max	Unit
<b>Management Power Output (MGMT_PWR)</b>						
Operating Input Voltage	3.3V/5.0V	$V_I$	-36	-48	-75	Vdc
Output Voltage Set-point ( $V_I = -48\text{Vdc}$ , $I_O = I_{O,max}$ , $T_A = 25^\circ\text{C}$ )	3.3V/5.0V	$V_{O,set}$	-2.0	—	+2.0	% $V_{O,set}$
Output Voltage (Over all operating input voltage, resistive Load and temperature conditions until end of life)	3.3V/5.0V	$V_O$	-3.0	—	+3.0	% $V_{O,set}$
Output Regulation Line ( $V_I = V_{I,min}$ to $V_{I,max}$ ) Load ( $I_O = I_{O,min}$ to $I_{O,max}$ ) Temperature ( $T_A = T_{A,min}$ to $T_{A,max}$ )	3.3V/5.0V		—	0.05	0.2	% $V_{O,set}$
Output Ripple and Noise Measured across 22 $\mu\text{F}$ Tantalum capacitor $V_I = V_{I,nom}$ $T_A = 25^\circ\text{C}$ , $I_O = I_{O,max}$ RMS (5Hz to 20 MHz bandwidth) Peak-to-peak (5Hz to 20MHz bandwidth)	3.3V/5.0V		—	—	25	mV <sub>rms</sub>
External Load Capacitance	3.3V/5.0V	$C_{O,max}$	0	—	1000	$\mu\text{F}$
Output Current	3.3V 5.0V	$I_O$ $I_O$	0 0	— —	2.4 1.6	A <sub>dc</sub> A <sub>dc</sub>
Output Current-Limit Inception	3.3V 5.0V	$I_{O,lim}$ $I_{O,lim}$		3 2.5	— —	A <sub>dc</sub> A <sub>dc</sub>
Output Short-circuit Current (RMS)	3.3V 5.0V	$I_{O,sc}$ $I_{O,sc}$	— —	8 6	— —	A <sub>rms</sub> A <sub>rms</sub>
Dynamic Response ( $di/dt = 0.1\text{A}/\mu\text{s}$ , $V_{in} = V_{in,nom}$ , $T_A = 25^\circ\text{C}$ ) Load change from $I_O = 50\%$ to $75\%$ of $I_{O,max}$ , Peak Deviation Settling Time ( $V_O < 10\%$ of peak deviation)	3.3V/5.0V	$V_{pk}$ $t_s$		3 800	5	% $V_{O,set}$ $\mu\text{s}$
Turn-On Delay and Rise Times ( $I_O = 80\%$ of $I_{O,max}$ , $T_A = 25^\circ\text{C}$ )	3.3V/5.0V	T <sub>delay</sub>		20	50	msec
Output voltage overshoot ( $I_O = 80\%$ of $I_{O,max}$ , $V_I = 48\text{Vdc}$ $T_A = 25^\circ\text{C}$ )	3.3V/5.0V				3%	% $V_{O,set}$
Output Over Voltage Protection	3.3V 5.0V	$V_{O,limit}$	3.7 5.6		5.4 7.0	V

General Specifications

Parameter	Min	Typ	Max	Unit
Calculated MTBF ( $P_{in} = 80\%$ of $P_{in,max}$ , $T_A = 40^\circ\text{C}$ , $V_{in} = -48\text{Vdc}$ ) (Per Telcordia SR-332 Issue 1:Method 1 Case 3)		1,565,825		Hours
Weight	—	29 (1.02)	—	g (oz.)

### PIM200X Internal Block Diagram



### PIN FUNCTIONS

PIN NO.	PIN NAME	I/O	DESCRIPTION
1	-48_AF	I	-48V_A Feed (Externally Fused)
2	-48_BF	I	-48V_B Feed (Externally Fused)
3	VRTN_AF	I	VRTN_A Feed (Externally Fused)
4	VRTN_BF	I	VRTN_B Feed (Externally Fused)
5	ENABLE_AF	I	ENABLE_A Feed (Externally Fused) (Short Pin, connected to VRTN_A on the back plane)
6	ENABLE_BF	I	ENABLE_B Feed (Externally Fused) (Short Pin, connected to VRTN_B on the back plane)
7	SHELF_GND	I/O	Shelf / Chassis / Safety Ground
8	72V_CAP	O	Holdup/Bulk capacitor output voltage
9	-48V_OUT	O	OR'd and Inrush Protected -48V Output Bus
10	MGMT_PWR	O	3.3V / 5.0V Isolated Management Power Output ( w.r.t LOGIC_GND)
11	LOGIC_GND	I/O	Logic / Secondary / Isolated Ground
12	-48V_ALARM	O	Opto-isolated -48V A/B Feed Loss or Open Fuse Alarm (w.r.t LOGIC_GND)
13	VRTN_OUT	O	OR'd and Inrush Protected VRTN Output Bus

## Characteristic Curves

The following figures provide typical characteristics for the PIM200X modules at 25°C.

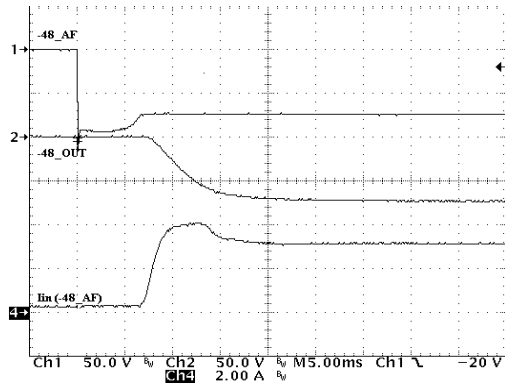


Figure 1. Inrush Current @ -75Vin & 3A Out  
CH1: -48\_AF, CH2: -48V\_OUT,  
CH4: in(-48\_AF)

**Test Conditions:**

-48\_AF=-75Vdc, -48V\_BF=0Vdc  
I(-48V\_OUT)=3A, I(MGMT\_PWR)=0A  
C\_FLTR=220μF

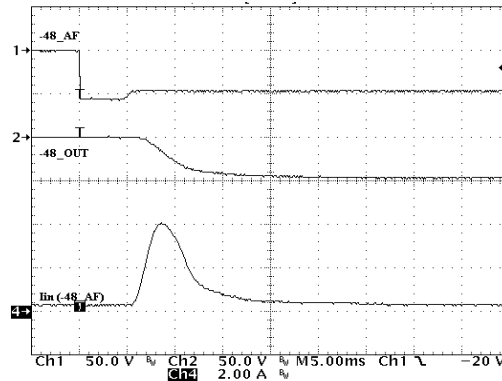


Figure 2. Inrush Current @ -48Vin & 0A Out  
CH1: -48\_AF, CH2: -48V\_OUT,  
CH4: in(-48\_AF)

**Test Conditions:**

-48\_AF=-48Vdc, -48V\_BF=0Vdc  
I(-48V\_OUT)=0A, I(MGMT\_PWR)=0A  
C\_FLTR=220μF

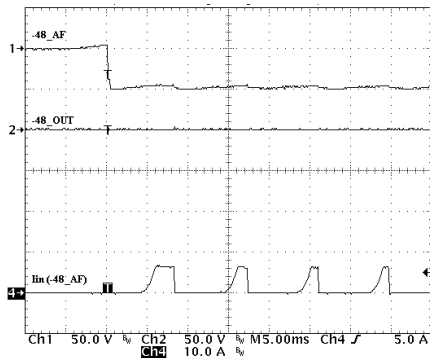


Figure 3. Power Up into Shorted Output  
CH1: -48\_AF, CH2: -48V\_OUT,  
CH4: in(-48\_AF)

**Test Conditions:**

-48\_AF=-48Vdc, -48V\_BF=0Vdc  
I(-48V\_OUT)=0A, I(MGMT\_PWR)=0A  
C\_FLTR=220μF

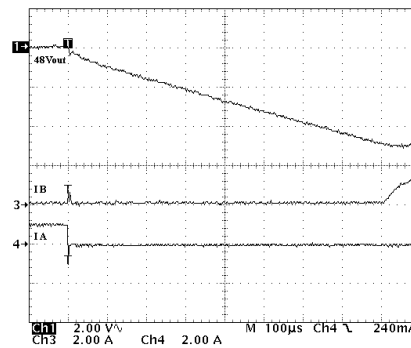


Figure 4. OR'ing Functionality when Feed A is shorted  
CH1: -48V\_OUT, CH3: in(-48\_BF)  
CH4: in(-48\_AF)

**Test Conditions:**

-48\_AF=-50Vdc, -48V\_BF=-45Vdc  
I(-48V\_OUT) = 1A  
C\_FLTR=220μF, C\_HLDP=1000μF

Characteristic Curves (continued)

The following figures provide typical characteristics for the PIM200X modules at 25°C.

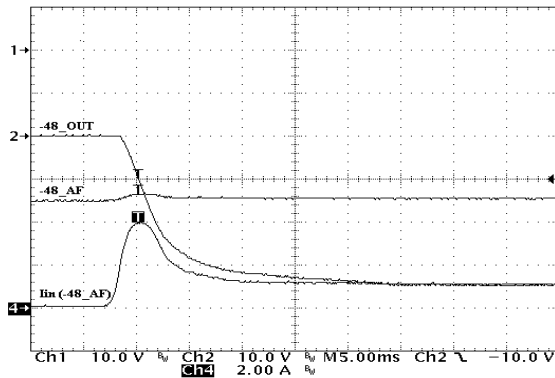


Figure 5. Input Voltage Turn-On Threshold  
CH1: -48\_AF, CH2: -48V\_OUT,  
CH4: Iin(-48\_AF)

Test Conditions:  
-48\_AF=-48Vdc, -48V\_BF=0Vdc  
I(-48V\_OUT)=1A, I(MGMT\_PWR)=0A  
C\_FLTR=220µF

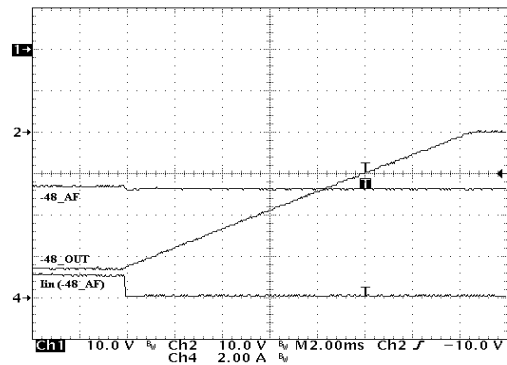


Figure 6. Input Voltage Turn-Off Threshold  
CH1: -48\_AF, CH2: -48V\_OUT,  
CH4: Iin(-48\_AF)

Test Conditions:  
-48\_AF=-48Vdc, -48V\_BF=0Vdc  
I(-48V\_OUT)=1A, I(MGMT\_PWR)=0A  
C\_FLTR=220µF

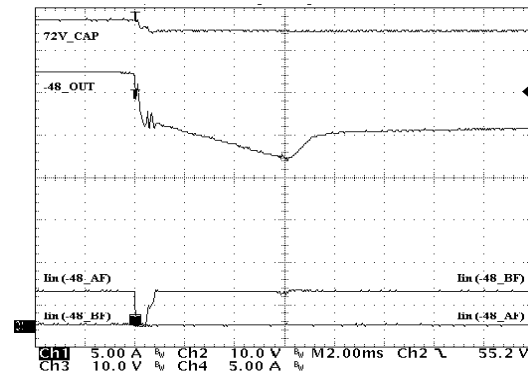


Figure 7. Loss of Feed A; Switchover to Feed B  
CH1: Iin(-48\_AF), CH2: -48V\_OUT,  
CH3: Iin(-48\_BF), CH4: 72V\_CAP

Test Conditions:  
1. Feed A (-48V\_AF=60V) > Feed B (-48V\_BF=48V)  
2. Fast Loss of Feed A; Switchover to Feed B  
3. I(-48V\_OUT)=4A, I(MGMT\_PWR)=2A  
4. C\_FLTR=220µF, C\_HLDP=1,000µF

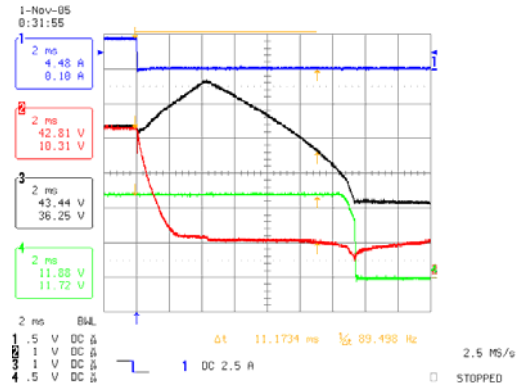


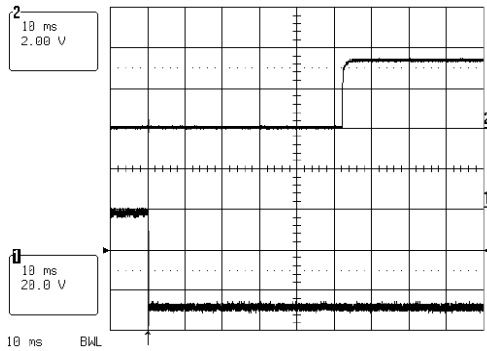
Figure 8. Holdup Performance; Loss of Feed A (with Feed B=0Vdc); Load=QBW  
CH1(Blue): Iin(-48V\_AF), CH2(Red): 48V\_OUT,  
CH3(Black): 48V\_OUT, CH4(Green): 12Vout

Test Conditions:  
1. 48\_AF= 43Vdc; 48V\_BF=0 Vdc  
2. Pin=200W; 12Vout=14.3A; 3.3V=2.42A  
3. C\_FLTR=100µF, C\_HLDP=Qty3 X 470µF



**Characteristic Curves** (continued)

The following figures provide typical characteristics for the PIM200X modules at 25°C (unless specified otherwise).

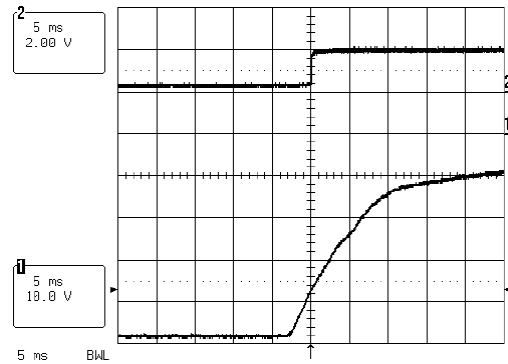


**Figure 9. Typical Start-Up of MGMT\_PWR(3.3Vdc) with application of -48Vin.**

CH1: -48\_AF, CH2: MGMT\_PWR (3.3Vdc) Output

Test Conditions:

-48AF=-48Vdc; I(MGMT\_PWR)=2.4A

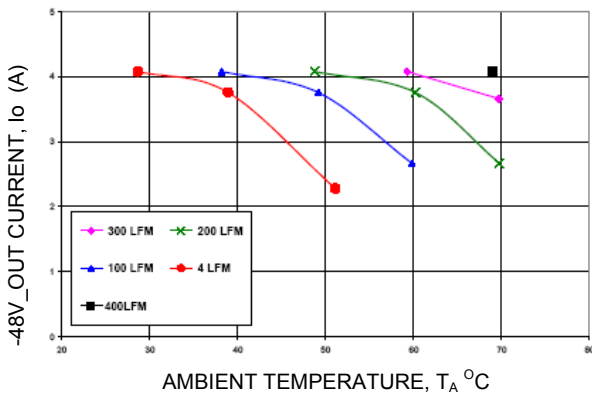


**Figure 10. -48V\_ALARM with Loss of Feed**

CH1: -48V\_AF, CH2: -48V\_ALARM

Test Conditions:

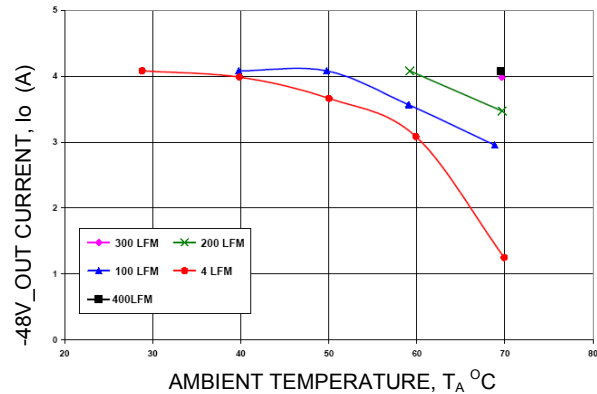
-48AF=-48VB= -48Vdc ; Turn Off -48VA supply



**Figure11. PIM200F Output Current Derating versus Local Ambient Temperature and Airflow**

Test Conditions:

Vin = -48Vdc; 3.3V @ 2.46A; Longitudinal Orientation



**Figure12. PIM200A Output Current Derating versus Local Ambient Temperature and Airflow**

Test Conditions:

Vin = -48Vdc; 5.0V @ 1.6A; Longitudinal Orientation

## Design Considerations

### Introduction

The PIM200X module is designed to support the Advanced Telecommunications Computing Architecture (ATCA) power entry distribution requirements for the Front Board / Blade per the PICMG 3.0 specifications.

The PICMG 3.0 specification defines the Mechanical, Shelf Management Interface, Power Distribution, Thermal, Data I/O and Regulatory requirements for the next generation of modular telecom architecture platform for use in Central Office telecom environments.

### Input Pin Connections

The ATCA board is specified to accept up to a maximum of 200W of input power via dual, redundant -48Vdc Feeds through the Zone 1 (Power and Management) Positronic connector, designated P10.

The power connector provides board to backplane engagement via pins of varying lengths. Please consult the PICMG 3.0 specifications for details.

The following are the design considerations of the input pin connections of the PIM200X to the ATCA power connector.

From ATCA (P10 Connector)		Connection Requirement	To PIM200X	
Pin #	Pin Designation		Pin #	Pin Designation
33	-48V_A	Via Fuse(F3)	1	-48V_AF
34	-48V_B	Via Fuse(F4)	2	-48V_BF
28	VRTN_A	Via Fuse(F1)	3	VRTN_AF
29	VRTN_B	Via Fuse(F2)	4	VRTN_BF
30	EARLY_A*	Via Resistor(R1)	1	-48V_AF
31	EARLY_B*	Via Resistor(R2)	2	-48V_BF
32	ENABLE_A	Via Fuse(F5)	5	ENABLE_AF
27	ENABLE_B	Via Fuse(F6)	6	ENABLE_BF
26	LOGIC_GND	Direct	11	LOGIC_GND
25	SHELF_GND	Direct	7	SHELF_GND

\* Optional

The first pins to mate in the ATCA power connector are the EARLY\_A, EARLY\_B, the two grounds (LOGIC\_GND, SHELF\_GND) and the two returns (VRTN\_A, VRTN\_B); followed by staggered connections of -48V\_A and -48V\_B power Feeds. The last pins to engage are the two short pins, ENABLE\_A

& ENABLE\_B. The ATCA backplane connects the ENABLE\_A to VRTN\_A, ENABLE\_B to VRTN\_B, EARLY\_A to -48V\_A and EARLY\_B to -48V\_B.

### Optional EARLY\_A & EARLY\_B Connections:

During hot insertion of the ATCA board, the Inrush Control circuit limits the surge current to the C\_FLTR capacitor. However, due to the presence of a small amount of EMI filter capacitance (located before the Inrush Control circuit), there is a possibility of a surge current that results in a voltage sag for 5 to 10 microseconds. In most cases this should not be of concern because all the ATCA Boards and FRU's on the -48V bus should be able to ride thru a 5msec/0Volt transient event per the PICMG 3.0 specifications. In case this is undesirable, it is recommended that Precharge resistors, R1 & R2 (15 Ohms) should be connected as described in the Typical Application circuit.

### Output Pin Connections

The out pin connections of the PIM200X to the system board is described below:

From PIM200X		To Board		Notes
Pin #	Pin Designation	Terminal	Component	
9	-48V_OUT	Vin(-)	DC/DC Converter	(1)
13	VRTN_OUT	Vin(+)	DC/DC Converter	(1)
8	72V_CAP	+ve	C_HLDP	(2)
10	MGMT_PWR	Vcc	IPM/	(3)
12	-48V_ALARM		System Controller	

### Notes:

#### (1) -48V Main Output Bus:

#### (Signal Names: -48V\_OUT & VRTN\_OUT)

This is the main -48V output bus that provides the payload power to the downstream (one or more) DC/DC converters. The PIM200X module does not regulate or provide isolation from the input -48V A/B feeds.

The main functionality of the module is to provide -48V A/B Feeds OR'ing, inrush protection for hot swap capability and EMI filtering to attenuate the noise generated by the downstream DC/DC converters.

- The -48V\_OUT pin connects to the Vin(-) pin and the VRTN\_OUT pin connects to the Vin(+) pin of the DC/DC converter(s).

- The -48V\_OUT bus may require a fuse depending on the power and fusing requirements of the DC/DC converter(s).
- Input filtering of the DC/DC converter is provided by C\_FLTR close to the input pins of the DC/DC converter(s); additional high frequency decoupling ceramic capacitors (0.01 to 0.1µF are strongly recommended for improved EMI performance.
- The maximum C\_FLTR capacitance across all the downstream DC/DC converters should not exceed 220µF. The recommended capacitor voltage rating should be >= 100Vdc.
- The minimum C\_FLTR capacitance (200µF) recommendation is based on meeting the EMI requirements. Based on end systems test, the capacitance may be lowered if real estate is an issue. As a minimum, 50 µF to 100 µF is strongly recommended to stabilize the line impedance for proper startup of the DC/DC converter. Refer to the DC/DC converter's data sheet for the recommended capacitor.

## (2) Holdup / Bulk Capacitor Output (72V\_CAP)

This output provides the high voltage (nominal 72Vdc) to charge the C\_BULK capacitor(s) to allow the ATCA board to meet the 5ms, 0Volts transient requirements.

- The 72V\_CAP connects to the +ve terminals of the C\_HLDP capacitors while the -ve terminals of the C\_HLDP connects to the -48V\_OUT bus.
- Since the 72V\_CAP output is regulated to 72Vdc (+3%/ -5%) and the capacitors are off line during normal operation, the capacitors may be selected with voltage rating of >= 80V to minimize the real estate on the board.
- The C\_HLDP capacitance is dependent on the system power and the holdup time requirements based on the following formula

$$C\_HLDP(\mu F) \geq [P_{out}(W) * \{T_{holdup}(ms) + 1.7\}] / 1.9$$

The capacitance tolerance (normally +20%) should be added to the calculated value.

- Bleed Resistor ( R\_Bleed ) : The PICMG 3.0 specifications requires a discharge mechanism (e.g. bleed resistor) to discharge the holdup/bulk capacitance to less than -60Vdc and less than 20 joules within one second of disconnection from the backplane. This requirement is fulfilled by installing R\_Bleed resistor that is selected based on the C\_HLDP selected in the previous step. The formula for selecting the resistor is :

$$R\_Bleed(\Omega) \leq 5.485 / C\_HLDP(F)$$

For 200W and 9.3 ms holdup requirements, this results in a 3.9 Kohm resistor with 1W rating.

Worst case power dissipation of R\_Bleed (=3.9Kohms) @ -36V is 0.33W.

- The R\_Bleed is connected across the 72V\_CAP and VRTN\_OUT pins of the PIM200X.

## (3) Management Power (MGMT\_PWR)

The MGMT\_PWR output is an isolated secondary voltage ( 3.3V for PIM200F or 5.0V for PIM200A) referenced to LOGIC\_GND that provides 8W(maximum) power to the IPM Controller for the ATCA board or to the power up system controller for other applications.

- Per PICMG 3.0 Specs, the ATCA board **shall** not consume more than 10W of input power; this includes the standby power of PIM200X (typically 1.7W) as well as all the on board DC/DC power converters. It is the responsibility of the board designer to insure that this requirement is met prior to power-up rights have been negotiated with the Shelf Manager.
- The management power is available even when the input voltage is down to -36Vdc.
- No additional output capacitors are required, but a 22µF tantalum and a 0.01 to 0.1µF ceramic capacitors are highly recommended to contain the switching ripple and noise.
- Higher output capacitance may be required in case of large input line or output load transient conditions.

## (4) -48V Feed Loss or Open Fuse Alarm (-48V\_ALARM)

The -48V\_ALARM output is an opto-isolated signal internally referenced to the LOGIC\_GND. The signal is an open collector output that requires an external pull up resistor. A 3.3K pull up resistor to 3.3V, MGMT\_PWR ( for PIM200F) should suffice. During normal operation, the signal is LO (opto conducting). During fault condition, the opto shall stop conducting and the alarm signal shall assume a HI state.

## Safety Considerations

For the system safety agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL 60950-1, CSA

C22.2 No. 60950-1-03, and VDE 0850:2001-12 (EN60950-1) Licensed.

The power input to these units is to be provided with a maximum of 10 Amps fuses with a voltage rating of at least 75Vdc.

Refer to “Thermal Considerations” section for additional safety considerations.

## Feature Description

### A/B Feed OR'ing

The module provides dedicated OR'ing functionality to both Feeds A & B and their corresponding returns. The following pairs of signals are OR'd within the module:

-48V\_AF / -48\_BF, VRTN\_AF / VRTN\_BF, and ENABLE\_AF/ ENABLE\_B.

The -48V A/B feeds and their corresponding returns are OR'd via N-channel MOSFET power devices resulting in a highly efficient system compared to conventional diode OR'ing scheme.

### EMC Filtering

The module incorporates an EMI filter that is designed for the ATCA board to help meet the conducted emissions requirements of CISPR 22 Class B when used in conjunction with Lineage Power DC/DC converters approved for ATCA applications. The following insertion loss table is provided as filter performance guidelines.

Parameter	Typical	Unit
<b>Common-Mode Insertion Loss</b>		
50 Ohms circuit, 200kHz	25	dB
50 Ohms circuit, 500kHz	30	dB
50 Ohms circuit, 1MHz	40	dB
<b>Differential-mode Insertion Loss</b>		
50 Ohms circuit, 200kHz	80	dB
50 Ohms circuit, 500kHz	70	dB
50 Ohms circuit, 1MHz	60	dB

The following Figure 13 depicts the Class B EMI performance of PIM200F when tested with QBW018A0B1 on a stand alone basis (ATCA form factor load board with resistive loads and only power, return and chassis connections to the backplane). The external filtering components are identified in the Typical Application circuit.

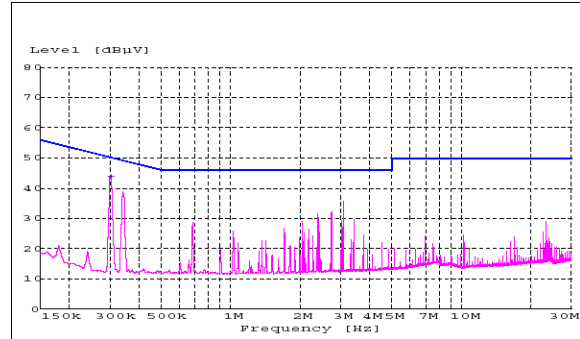


Figure 13. Typical Class B EMC signature of PIM200F with QBW018A0B1 module.

For Safety and noise considerations, copper traces must not be routed directly beneath the power module (PWB top layer). C\_EMI capacitors must make direct connections (preferably without vias) to the DC/DC module pins with as much copper width as possible. In case vias are necessary, allow for multiple connections to the inner plane with vias placed outside the footprint of the module. For additional layout guide-lines, refer to Lineage Power's FLT007A0 Input Filter Module data sheet.

### Inrush Current Control / Hot Plug Functionality

The module provides inrush current control / hot plug capability. The peak value of the inrush current and the duration complies with the PICMG 3.0's Inrush Transient specifications. The specifications shall be met with the external C\_HLDP and C\_FLTR capacitances as specified in the previous sections.

The unique design of the module where the large energy storage capacitors are segregated from the input filter capacitors allows the module to meet the stringent PICMG's inrush transient specifications. In conventional designs where the energy storage capacitors and the filter capacitors are in parallel, it is extremely difficult to meet the inrush transient specifications without over sizing the inrush control power FET.

### A/B Feed / Fuse Alarm (-48V\_ALARM)

The module monitors the A & B feeds as well as the status of the A&B feed fuses and provides an opto-isolated signal in case of loss of a feed or the opening of any of the fuses. The response time of the fault condition is < 100 μsec. The alarm signal indicates normal operation when the optocoupler transistor is conducting and a fault condition by an off state.

### Holdup Capacitor Charging Current (72V\_CAP)

The module employs a unique feature to charge and recharge the external energy storage holdup/bulk capacitors (C\_HLDP) within seconds from the application of power to a nominal voltage of 72Vdc (+3%/-5%) resulting in significant reduction in the real estate on the board in order to comply with the PICMG 3.0's 0 volt/5msec transient requirements. Since the 72V\_CAP is also regulated, there is further reduction in real estate board because now 80V capacitors with higher capacitance can be used instead of the  $\geq 100$ Vdc caps required in conventional designs. The maximum rate of input voltage change (dv/dt) shall not exceed 5V/ms when the -72V\_CAP output is switched on the -48V\_OUT/VRTN\_OUT bus.

The holdup capacitors are switched on automatically when there is a loss of power on both feeds A & B or both feeds have dropped below -38V (typical).

Upon restoration of normal power on either or both feeds, the holdup capacitors automatically go off line and are recharged for the next power loss event.

Note 1: The holdup capacitors and the bleed resistor are installed external to the module.

Note 2: The PICMG 3.0's requirements for the 0 Vdc transient for 5ms is normally interpreted as the holdup time requirement by many. In actuality, when one considers the additional specification of 50V/ms fall time and 12.5 V/ms rise time to and from the 0Vdc condition, this leads to a 9.3ms of total hold up time requirement when power is interrupted at -43Vdc. The 72V\_CAP output provided by the module to charge the bulk capacitors provides a tremendous advantage over conventional designs in terms of real estate requirements on the board (1,400 $\mu$ F vs 6,000 $\mu$ F) with the added benefit of the usage of 80V capacitor rating vs  $\geq 100$ V.

The holdup time,  $T_{holdup}$ , is defined for power loss at -43Vdc input and the C\_HLDP maintaining -48V\_OUT bus to at least -36Vdc (which is the minimum operating voltage of the downstream DC/DC bus converter).

Note 3: Bleed Resistor (R\_Bleed): Normally, the bleed resistor is not required as there is sufficient standby current drain within the module to bleed the holdup capacitors from 75V to 60V in 1 second as specified in the PICMG 3.0. Again, due to the PIM200X's unique design, the placement of the bleed resistor results in significantly less power dissipation compared with conventional designs where the bleed resistor is sized for -75Vdc continuous maximum voltage and -100V transients.

### Over Current Protection (-48V\_OUT Bus)

To provide protection in a fault (output overload or short circuit) condition, the unit is equipped with internal current-limiting circuitry. The unit can endure current overload conditions continuously or shutdown due to thermal protection depending on operating ambient temperature conditions. The unit will restart automatically once the overload condition is removed.

### Input Under Voltage Lockout

At input voltages below the input undervoltage lockout threshold limit ( $V_{UVLO}$ ), the module operation is disabled. The module will begin to operate at an input voltage above the undervoltage lockout turn-on threshold ( $V_{UVHI}$ ). Please see the Electrical Specifications Table for the specified trip points.

### Transient Over Voltage Protection

The module incorporates a Transient Voltage Suppressor (TVS). This feature helps protect the module and the downstream DC/DC converters from input voltage transients exceeding -75Vdc. The TVS is rated for 1500W of Peak Pulse Power with the Breakdown Voltage ( $V_{BR}$ ) of 77.8V to 86.0V.

### Input Reverse polarity protection

The module shall not be damaged from reverse polarity connection in the event of miswiring of either input feeds at the shelf input terminals.

### Over Temperature Protection

To provide over temperature protection in a fault condition, the unit will shutdown if the thermal reference point  $T_{ref}$  (Figure 15), exceeds 115°C (typical). The thermal shutdown is not intended as a guarantee that the unit will survive temperatures beyond its rating. The module will automatically restart after it cools down.

### Management Power (MGMT\_PWR)

- The module provides up to 8W of 3.3V (PIM300F) or 5.0V (PIM300A) of isolated output power referred to LOGIC\_GND.
- The management power is available automatically as soon as the input voltage levels are within -36Vdc to -75Vdc.
- The output is short circuit and over voltage protected with low ripple and noise.

### Thermal Considerations

Power modules operate in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation.

Considerations include ambient temperature, airflow, module power dissipation, and the need for increased reliability. A reduction in the operating temperature of the module will result in an increase in reliability. The thermal data presented here is based on physical measurements taken in a wind tunnel. The test set-up is shown in Figure 14.

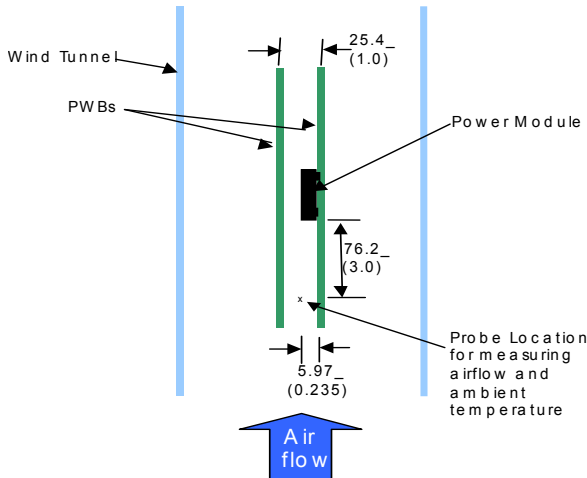


Figure 15. Thermal Test Set-up

Note that the airflow is parallel to the long axis of the module as shown in Figure 15. The derating data applies to airflow in either direction of the module's long axis.

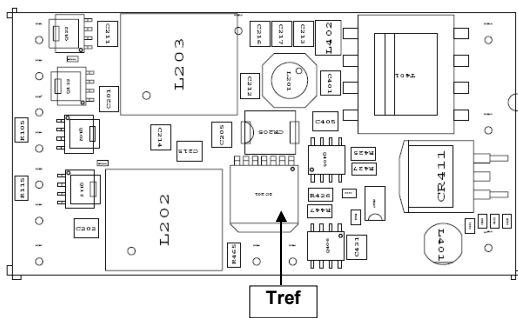


Figure 16.  $T_{ref}$  Temperature measurement location

The thermal reference point,  $T_{ref}$  used in the specifications is shown in Figure 16. For reliable operation this temperature should not exceed 115°C. The output power of the module should not exceed the rated input power of the module i.e. 200W.

Please refer to the Application Note “Thermal Characterization Process For Open-Frame Board-Mounted Power Modules” for a detailed discussion of thermal aspects including maximum device temperatures.

### Heat Transfer via Convection

Increased airflow over the module enhances the heat transfer via convection. Thermal derating curves showing the maximum output current that can be delivered by the module versus local ambient temperature ( $T_A$ ) for natural convection and up to 2m/s (400 ft./min) are shown in the Characteristics Curves (Figs 11 & 12).

### Manufacturing Considerations

#### Lead Free Soldering Information

The RoHS-compliant through-hole products use the SAC (Sn/Ag/Cu) Pb-free solder and RoHS-compliant components. They are designed to be processed through single or dual wave soldering machines. The pins have an RoHS-compliant finish that is compatible with both Pb and Pb-free wave soldering processes. A maximum preheat rate of 3°C/s is suggested. The wave preheat process should be such that the temperature of the power module board is kept below 210°C. For Pb solder, the recommended pot temperature is 260°C, while the Pb-free solder pot is 270°C max. If additional information is needed, please consult with your Lineage Power representative for more details.

#### Post Solder Cleaning and Drying Considerations

Post solder cleaning is usually the final circuit-board assembly process prior to electrical board testing. The result of inadequate cleaning and drying can affect both the reliability of a power module and the testability of the finished circuit-board assembly. For guidance on appropriate soldering, cleaning and drying procedures, refer to Lineage Power's *Board Mounted Power Modules: Soldering and Cleaning* Application Note (AP01-056EPS)

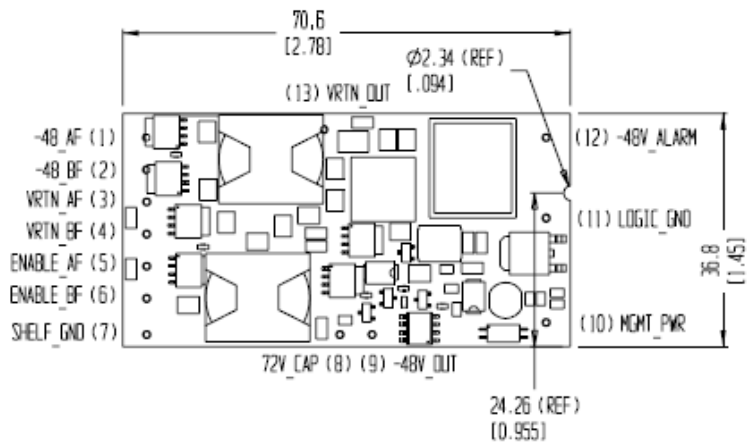
**Mechanical Outline for PIM200X Module**

Dimensions are in millimeters and (inches).

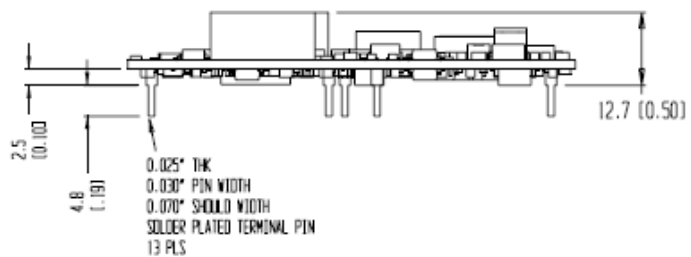
Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

x.xx mm ± 0.25 mm (x.xxx in ± 0.010 in.)

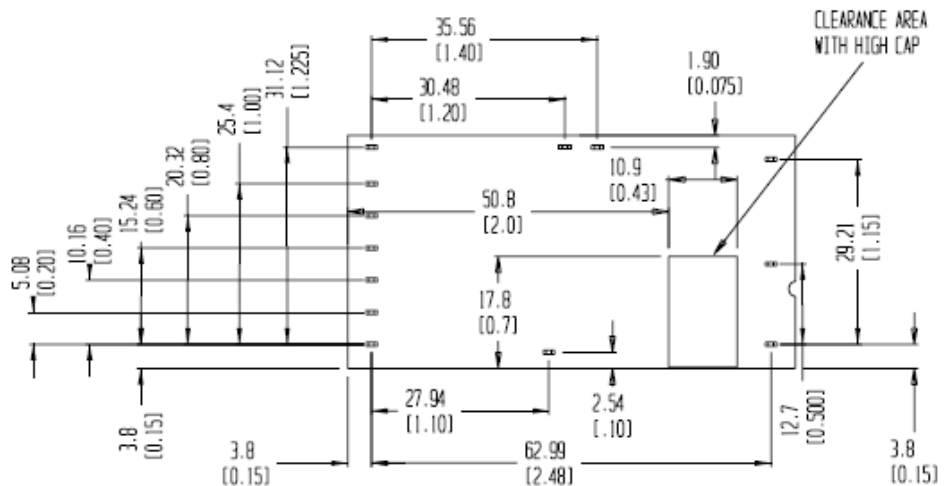
TOP VIEW



SIDE VIEW



BOTTOM VIEW

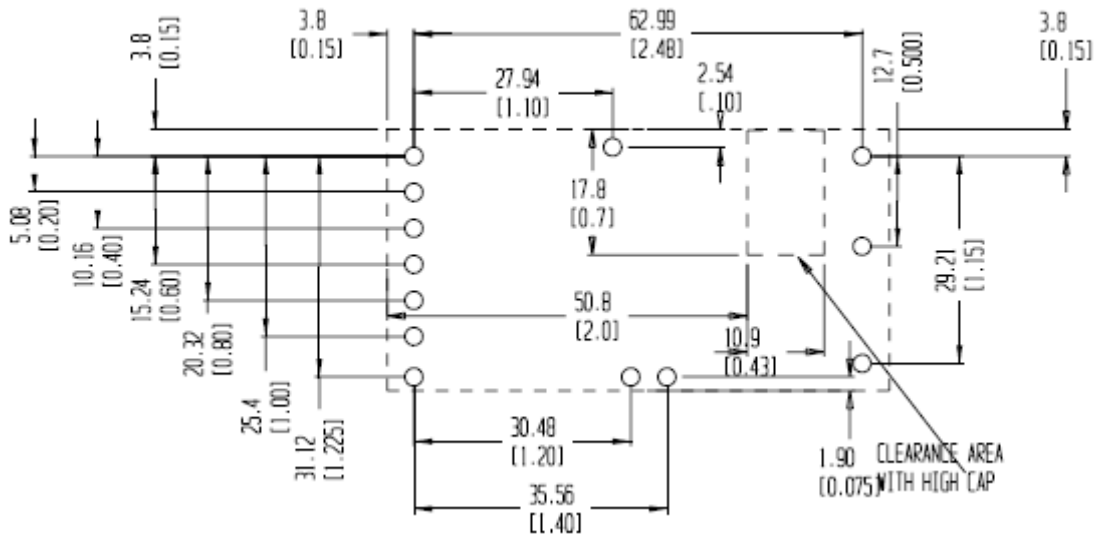


### Recommended Pad Layout

Dimensions are in millimeters and (inches).

Tolerances: x.x mm  $\pm$  0.5 mm (x.xx in.  $\pm$  0.02 in.) [unless otherwise indicated]

x.xx mm  $\pm$  0.25 mm (x.xxx in.  $\pm$  0.010 in.)



#### NOTES:

1. For the pins, use 1.27(mm) / 0.050(in) diameter Plated Trough Hole



## Ordering Information

Please contact your Lineage Power's Sales Representative for pricing, availability and optional features.

**Table 1. Device Code**

Input Voltage	Power Rating	Auxiliary Output Voltage	Auxiliary Output Current	Options	Product codes	Comcodes
-38 to -75 Vdc	200W	3.3Vdc	2.4A		PIM200F	108994471
-38 to -75 Vdc	200W	3.3Vdc	2.4A	RoHS	PIM200FZ	CC109101813
-38 to -75 Vdc	200W	3.3Vdc	2.4A	Basic Insulation	PIM200F-B	CC109101912
-38 to -75 Vdc	200W	5.0Vdc	1.6A		PIM200A	108996286
-38 to -75 Vdc	200W	5.0Vdc	1.6A	RoHS	PIM200AZ	CC109106762

\* Consult factory for availability.

**Table 2. Device Options**

Option	Device Code Suffix
Basic Insulation	-B
RoHS Compliant (Lead Free)	-Z
Short pins: 3.68mm ± 0.25mm (0.145 in. ± 0.010 in.)	-6
Short pins: 2.79mm ± 0.25mm (0.110 in. ± 0.010 in.)	-8

**Table 3. Related Products**

Description	Product Code	Comcode
PIM Evaluation Board	N/A	848755868
200W Bus converter; 36-75Vdc Input, 12Vdc / 18A Output	QBW018A0B1	108989356
200W Bus converter; 36-75Vdc Input, 12Vdc / 18A Output (RoHS compliant)	QBW018A0B1Z*	TBD
200W Bus converter; 36-75Vdc Input, 12Vdc / 18A Output (RoHS compliant & designed for high capacitance loads e.g. VRMs)	QBW018A0B1-TZ	CC109101846
300W Bus converter; 36-75Vdc Input, 12Vdc / 25A Output	QBW025A0B1	CC109102464
300W Bus converter; 36-75Vdc Input, 12Vdc / 25A Output (RoHS compliant)	QBW025A0B1Z*	TBD

\* Consult factory for availability.



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