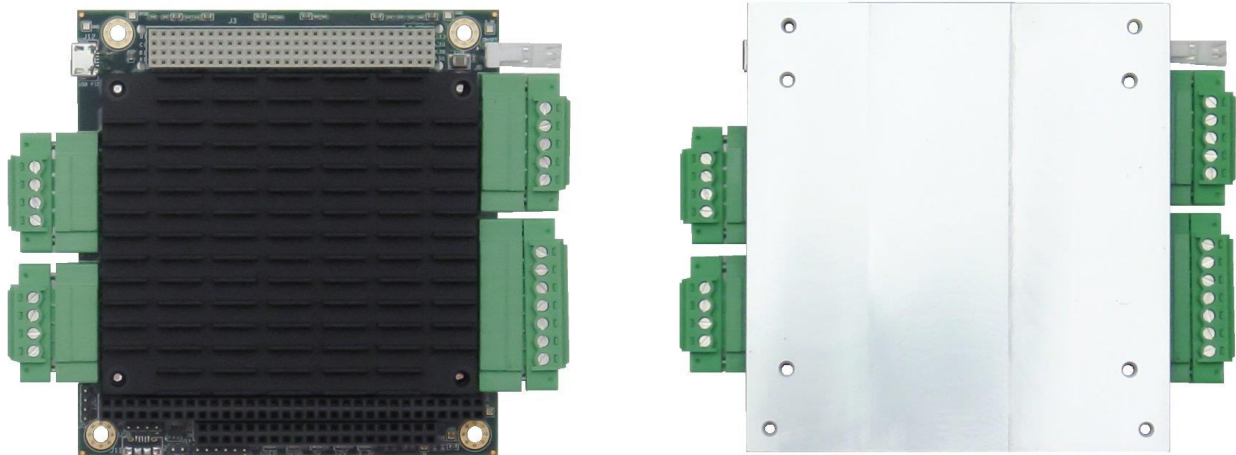# Jupiter-MM-5000

Advanced Technology 218W DC/DC Power Supply PC/104-*Plus* Module
User Manual

Revision B.01

Revision	Date	Comment
A.00	1/5/2016	Initial Release
B.00	3/24/16	Updated with Intelligent Model information
B.01	3/22/2022	Added new JMM-5012 models

Contents

1. IMPORTANT SAFE HANDLING INFORMATION

WARNING!

ESD-Sensitive Electronic Equipment

Observe ESD-safe handling procedures when working with this product.

Always use this product in a properly grounded work area and wear appropriate ESD-preventive clothing and/or accessories.

Always store this product in ESD-protective packaging when not in use.

Safe Handling Precautions

The board contains a high density connector with many connections to sensitive electronic components. This creates many opportunities for accidental damage during handling, installation and connection to other equipment. The list here describes common causes of failure found on boards returned to Diamond Systems for repair. This information is provided as a source of advice to help you prevent damaging your Diamond (or any vendor's) boards.

ESD damage – This type of damage is usually almost impossible to detect, because there is no visual sign of failure or damage. The symptom is that the board eventually simply stops working, because some component becomes defective. Usually the failure can be identified and the chip can be replaced. To prevent ESD damage, always follow proper ESD-prevention practices when handling computer boards.

Damage during handling or storage – On some boards we have noticed physical damage from mishandling. A common observation is that a screwdriver slipped while installing the board, causing a gouge in the PCB surface and cutting signal traces or damaging components.

Another common observation is damaged board corners, indicating the board was dropped. This may or may not cause damage to the circuitry, depending on what is near the corner. Most of our boards are designed with at least 25 mils clearance between the board edge and any component pad, and ground / power planes are at least 20 mils from the edge to avoid possible shorting from this type of damage. However these design rules are not sufficient to prevent damage in all situations.

A third cause of failure is when a metal screwdriver tip slips, or a screw drops onto the board while it is powered on, causing a short between a power pin and a signal pin on a component. This can cause overvoltage / power supply problems described below. To avoid this type of failure, only perform assembly operations when the system is powered off.

Sometimes boards are stored in racks with slots that grip the edge of the board. This is a common practice for board manufacturers. However our boards are generally very dense, and if the board has components very close to the board edge, they can be damaged or even knocked off the board when the board tilts back in the rack. Diamond recommends that all our boards be stored only in individual ESD-safe packaging. If multiple boards are stored together, they should be contained in bins with dividers between boards. Do not pile boards on top of each other or cram too many boards into a small location. This can cause damage to connector pins or fragile components.

Power supply wired backwards – Our power supplies and boards are not designed to withstand a reverse power supply connection. This will destroy each IC that is connected to the power supply (i.e. almost all ICs). In this case the board will most likely will be unrepairable and must be replaced. A chip destroyed by reverse power or by excessive power will often have a visible hole on the top or show some deformation on the top surface due to vaporization inside the package. **Check twice before applying power!**

Overvoltage on analog input – If a voltage applied to an analog input exceeds the design specification of the board, the input multiplexor and/or parts behind it can be damaged. Most of our boards will withstand an erroneous connection of up to ±36V on the analog inputs, even when the board is powered off, but not all boards, and not in all conditions.

Overvoltage on analog output – If an analog output is accidentally connected to another output signal or a power supply voltage, the output can be damaged. On most of our boards, a short circuit to ground on an analog output will not cause trouble.

Overvoltage on digital I/O line – If a Digital I/O is connected to a voltage above the maximum specified voltage, the digital circuitry can be damaged. On most of our boards the acceptable range of voltages connected to digital I/O signals is 0-5V, and they can withstand about 0.5V beyond that (-0.5 to 5.5V) before being damaged. However logic signals at 12V and even 24V are common, and if one of these is connected to a 5V logic chip, the chip will be damaged, and the damage could even extend past that chip to others in the circuit.

2. INTRODUCTION

Jupiter-MM-5000 is a family of PC/104-*Plus* and PC/104 DC/DC power supplies with wide input range and high output power. The nominal output power is 5VDC @ 100 Watts at 25ºC (5VDC @ 20A), with additional power provided on 12V and +3.3V rails plus +5V and +3.3V standby voltages optional. The output power may be de-rated at the high end of the temperature range based on the cooling capacity of the thermal solution, as well as de-rated at low input voltages based on the current capacity of the input circuit and connector.

Available in both basic and intelligent models, the intelligent models offer complete software programmability of the power supply.

2.1 Key Features

♦ Up to 218W total output power at 25ºC

♦ +5VDC at 20A maximum output (100W)

♦ +12VDC at 8A maximum output (96W)

♦ +3.3VDC at 5A maximum output (16.5W)

♦ +5VDC standby option at 1A maximum output (5W)

♦ +3.3VDC standby option at 0.1A maximum output (0.33W)

♦ Extreme load stability: 0.35% maximum output voltage droop at 5V output, 0-20A load, $V_{IN} = 12V$, $T_A = 25ºC$

♦ Extremely low ripple: 12mV peak-to-peak ripple at 5V output, 0-20A load, $V_{IN} = 12V$, $T_A = 25ºC$

♦ High efficiency: 92-94% at 5V output, 0-20A load, $V_{IN} = 12V$, $T_A = 25ºC$

♦ Excellent transient load response: +/-72mV at 5V output, 25-75% load step, 2.5A/usec ramp rate, $V_{IN} = 24V$, $T_A = 25ºC$

♦ Extreme temperature stability: +/-0.5% at 5V output, 10A load, $V_{IN} = 24V$, $T_A = -40ºC$ to $+85ºC$

♦ Input protection circuit protects from over/under voltage, reverse polarity, surges, transients, reflected noise

♦ Advanced System Controller with:
  o Individual supply on/off control for all voltage outputs
  o Individual supply output voltage / current monitoring
  o Output voltage sequencing and slew rate control
  o Output voltage monitoring
  o Fault handling based on programmable limits with interrupt notification, including supply shutdown in case of overload or other programmed conditions
  o Hiccup mode for auto-restart when fault conditions are removed
  o Min / max voltage and temperature logging
  o Secondary input cutover voltage selection

♦ Wide input range: +7 to +34VDC

♦ Heat sink or heat spreader cooling solutions

♦ PC/104 form factor: 3.550" x 3.775" (90mm x 96mm)

♦ PC/104 and PC/104-*Plus* bus connector options

♦ -40ºC to +85ºC (-40°F to +185°F) operating temperature

♦ MIL-STD-202G shock and vibration compatible

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2.2 Cooling

All significant heat generating components are mounted on the top side of the board and are thermally connected to the thermal solution with thermal pads. The JMM-5000 power supply offers two cooling methods:

Heat spreader: A heat spreader on the top side may be used for all cooling as shown at the right. The heat spreader is the size and shape of the PC/104 board. It contains the standard mounting hole patterns for #6 and M3 screws. The Diamond Systems' PC/104 heat sink accessory may be installed on top of this heat spreader as an option. When the heat spreader is installed, the PC/104 and PC/104-*Plus* connectors have bottom-side pins only and do not support stacking of modules on the top side of the board. The heat spreader configuration, when attached to a suitable heat dissipation surface or when the heat sink accessory is installed, supports the full power output at 85°C. The heat spreader supports the installation of PC/104 heat sink accessory ACC-HS104-12.7.
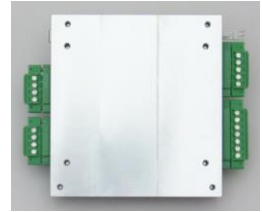
Heat sink: A low profile heat sink may be installed on the board in the area between the PC/104 and PC/104-*Plus* connectors as shown at the right. The heat sink should be used only in applications with power dissipation of 100W or less. The height of the heat sink conforms to PC/104 height limits of 0.435" / 11mm max height above the PCB top surface. The heat sink configuration may have a lower total output power capacity at 85°C and/or a lower maximum operating temperature at full power output.

2.3 LED Indicators

A green LED is provided for each output voltage to indicate proper operation. The LEDs are located along the lower edge of the PCB below the PC/104 connector. All LEDs are calibrated to have equal brightness at the nominal output voltage for their designated power supply.

2.1 Available Models

Model	5V 20A	12V 8A	3.3V 5A	5V Standby	3.3V Standby	ISA Bus	PCI Bus	System Controller	Thermal
JMM-5312-APDRH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Heat spreader
JMM-5312-APDRK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Heat sink
JMM-5312-ADRH	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Heat spreader
JMM-5312-ADRK	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Heat sink
JMM-5012-APDRH	Yes	Yes		Yes		Yes	Yes	Yes	Heat spreader
JMM-5012-APDRK	Yes	Yes		Yes		Yes	Yes	Yes	Heat sink
JMM-5012-ADRH	Yes	Yes		Yes		Yes		Yes	Heat spreader
JMM-5012-ADRK	Yes	Yes		Yes		Yes		Yes	Heat sink
JMM-5012-APH	Yes	Yes		Yes		Yes	Yes		Heat spreader
JMM-5012-APK	Yes	Yes		Yes		Yes	Yes		Heat sink
JMM-5012-AH	Yes	Yes		Yes		Yes			Heat spreader
JMM-5012-AK	Yes	Yes		Yes		Yes			Heat sink
JMM-5000-APH	Yes					Yes	Yes		Heat spreader
JMM-5000-APK	Yes					Yes	Yes		Heat sink
JMM-5000-AH	Yes					Yes			Heat spreader
JMM-5000-AK	Yes					Yes			Heat sink

3. FUNCTIONAL OVERVIEW

3.1 Functional Block Diagram

Figure 1 shows the block diagram for the Jupiter-MM-5000 family. All models of the family are represented in the lock diagram with the items in green only being included on the full featured intelligent models.
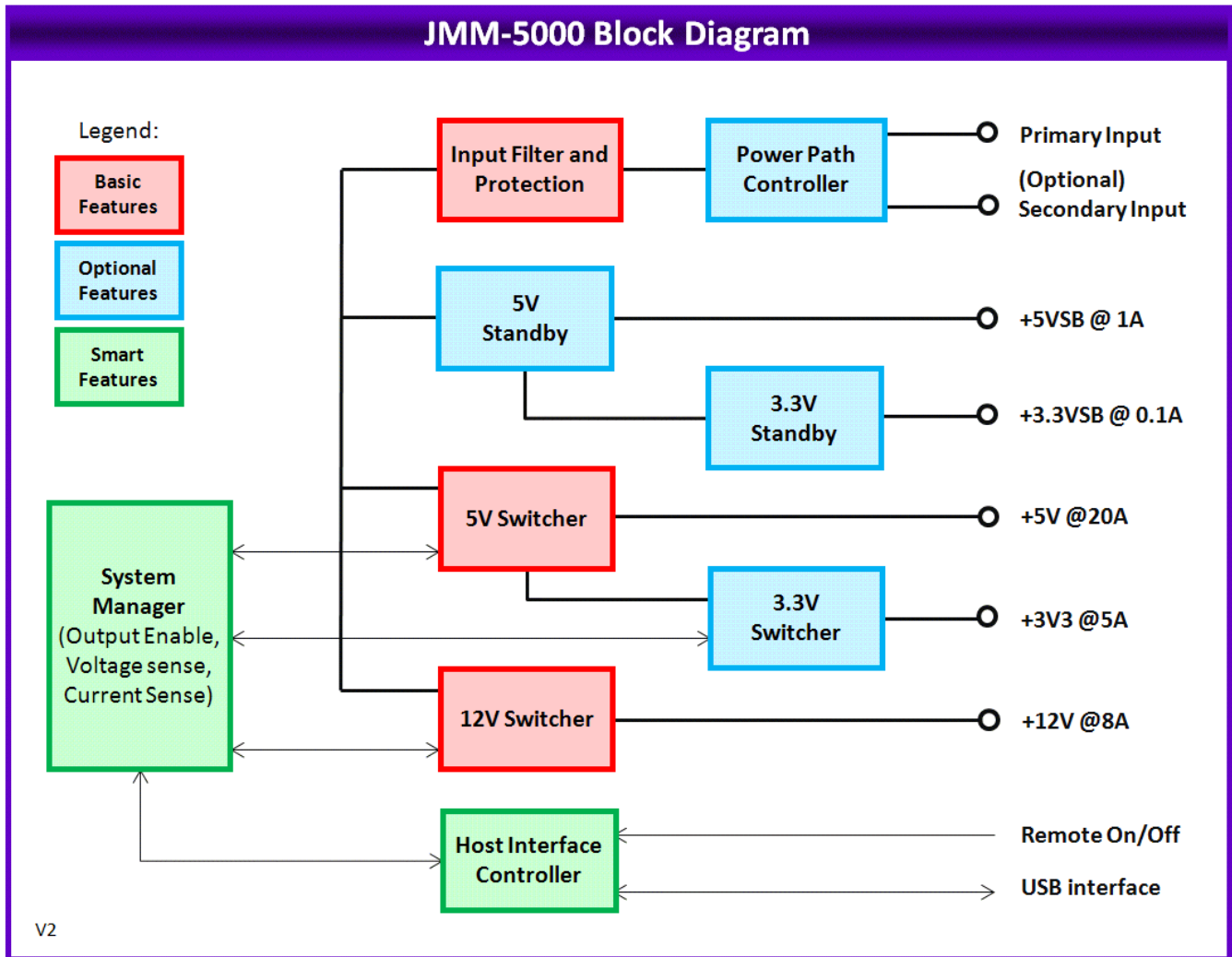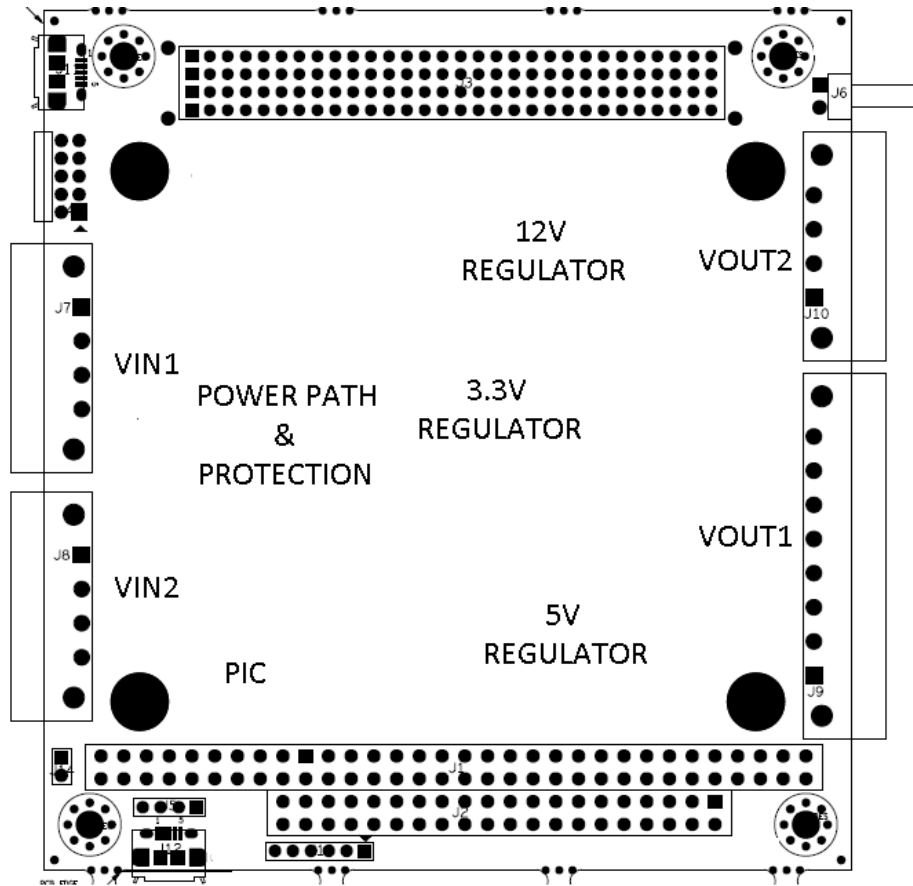

Figure 1: Block Diagram

3.2   Mechanical Board Drawing

Figure 2 shows the mechanical drawing for Jupiter-MM-5000 with locations of the key features. Figure 3 is a dimensioned drawing of the Jupiter-MM-5000. The power supply modules adhere to the PC/104-*Plus* standard.
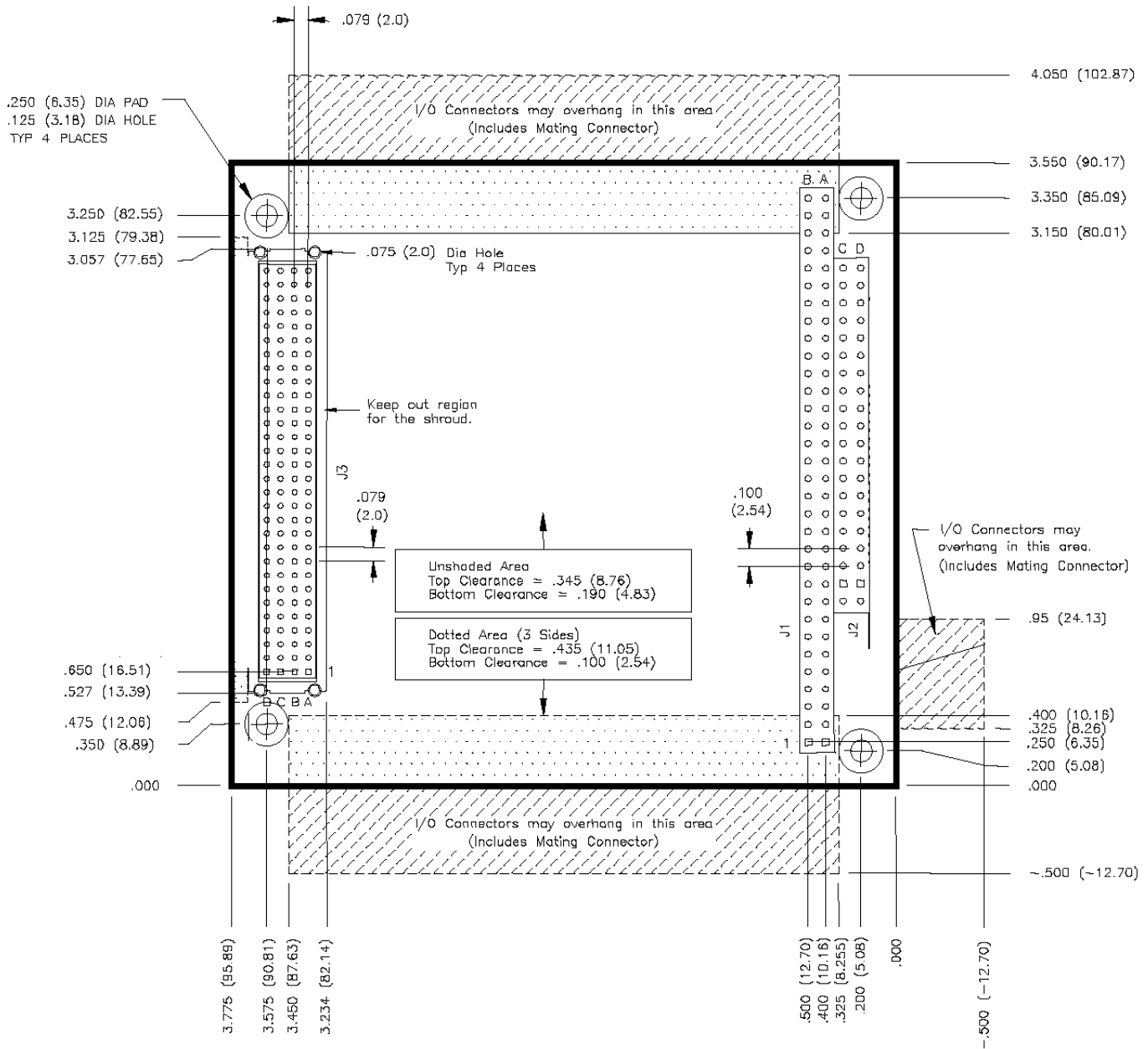
Figure 3: Dimensioned Mechanical Drawing

4. POWER SUPPLY OPERATION

4.1 Source Selection

The power supply takes its input from either the main input connector or the optional backup / battery input connector, with precedence given to the main input connector. If the input voltage on the main input connector is above the designated threshold voltage, it will be used as the source for the power supply. If the input voltage falls below the minimum, the supply will automatically switch to the backup / battery input. If this secondary input does not have sufficient voltage, the supply will shut off.

The design supports the use of either single or dual power sources using the LTC4417 chip.

4.2 +5V Output Functionality

The +5V output uses a multi-phase design. The 5V is generated from a dual LTC3890 switch. Each switch output can produce up to 5A of output current for a total of 20A capacity with all 4 outputs enabled. In this fashion the output efficiency can be optimized based on the load, resulting in higher efficiency across the full rated output power of the supply.

4.3 +12V Output Functionality

The LT3790 synchronous 4-switch buck-boost voltage/ current regulator controller is used for generating +12V output. The current output is limited to 8A maximum.

4.4 +3.3V Output Functionality

A TI-based power module is used for generating +3.3V output at 5A maximum. The LMZ31710 is a SIMPLE SWITCHER power module and an easy-to-use integrated power solution that combines a 10A DC/DC converter with power MOSFETs, a shielded inductor, and passives in a low profile, QFN package. The module is powered using the 5V supply.

4.5 +5V Standby Output Functionality

A LT8620 2A regulator is used for the +5V standby supply. The +5V standby supply is used to supply the power controller and to generate the +3.3V standby voltage. +5V standby at 1A maximum is available at the output connector.

4.6 +3.3V Standby Output Functionality

The AP7167-SPG-13 is used for generating the +3.3V standby supply. The +3.3V standby supply is used to supply the PIC microcontroller and the USB to I2C chip. 3.3V standby 0.1A maximum is available at the output connector.

4.7 Input Protection

JMM-5000 includes an input protection circuit based on the LTC4364 chip. This device provides surge / spike protection, load dump protection, overvoltage / under voltage protection, reverse polarity protection, and input current limiting (circuit breaker). Filtering is also added to limit noise reflected back onto the input.

4.8   Remote On/Off

The power supply can be switched on and off remotely in two ways; through a discrete logic input or through a programmable serial command.

For the discrete logic input, a 2-pin connector is used to provide an on/off control and ground. Driving the on/off control to a logic 0, or shorting it to the power supply common, will shut off all supply outputs (except the auxiliary +5V for the microcontroller and power controller circuit). The control input has a pull-up resistor to drive it to a default on state. The remote on/off circuit is always operational when appropriate power is supplied through either the main input or the backup / battery input connections.

Usage of the programmable serial command remote on/off can be found in the Janus-MM-5000 Software Users Manual.

4.9   Advanced System Controller

The intelligent Jupiter-5000 models include a system controller that offers advanced configuration, control, and monitoring features. The system controller is accessed via a USB port and is accompanied by benchtop configuration software as well as an application library for in-application real-time control.

- Individual supply on/off control for +12V, +5V, and +3.3V outputs
- Individual supply output voltage / current monitoring
- Output voltage sequencing and slew rate control
- Output voltage adjustment
- Input voltage monitoring
- Fault handling based on programmable limits with interrupt notification, including supply shutdown in case of overload or other programmed conditions
- Hiccup mode for auto-restart when fault conditions are removed
- Min / max voltage and temperature logging
- Secondary input cutover voltage selection

Information on using the advanced systems controller can be found in the Janus-MM-5000 Software Users Manual.

5. CONNECTOR LOCATION AND DESCRIPTION

J3 PCI Bus

J12 USB to Microcontroller

J7 Primary Input Power

J8 Secondary Input Power

J5 Factory Use

J6 Remote On/Off

J10 12V / 3.3V Output

J9 5V Output

J1 ISA Bus Main Connector

J2 ISA Bus 16-Bit Extension
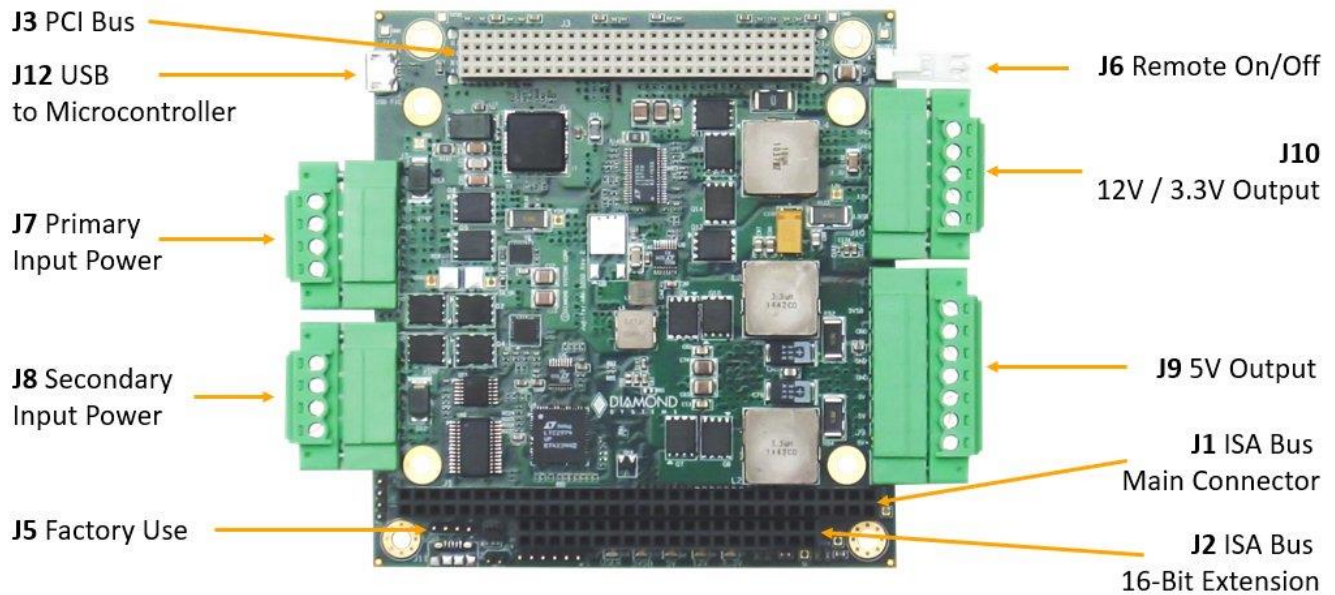
(Heat sink removed for clarity)

J1	ISA Bus (PC/104) main connector
J2	ISA Bus (PC/104) 16-bit extension connector
J3	PCI Bus connector (PCI-104)
J4	Not present
J5	Factory use (microcontroller programming)
J6	Not present
J7	Primary input power connector
J8	Secondary input power connector
J9	5V / 5V standby output connector
J10	12V / 3.3V / 3.3V standby output connector
J11	Not present
J12	USB connector to communicate between power management microcontroller and host PC

6. CONNECTOR PINOUT AND PIN DESCRIPTION

6.1 Primary Power Input Connector (J7)

A four position screw terminal block is used to provide main input power to the board. This terminal block is located along the left side of the board. The connector supports 16A total on the two input terminals and 16A total on the two ground terminals.

J7

Vin 7-34VDC	1
Vin 7-34VDC	2
GND	3
GND	4

Connector Part Number: 1827884

Mating Part Number: 1827729

6.2 Secondary Power Input Connector (J8)

Power can also be provided from a battery source through the connector J8. A 4-position screw terminal block is used to provide backup / battery input power to the board. The minus terminal is connected to the power supply common. This terminal block is located along the left side of the board. The connector supports 8A on each terminal.

J8

Vin 7-34VDC	1
Vin 7-34VDC	2
GND	3
GND	4

Connector Part Number: 1827884

Mating Part Number: 1827729

6.3   Output Power Connectors (J9 & J10)

Two screw terminal blocks are used for output power. J9 is a 7-pin block provides +5V and +5V standby output. J10 is a 5-pin block and provides +12V, +3.3V, and +3.3V standby outputs. Following are the pinouts for the mentioned connectors.

	J9			**J10**
+5V out	1		+3.3V standby	1
+5V out	2		+12V out	2
+5V out	3		+3.3V out	3
GND	4		GND	4
GND	5		GND	5
GND	6			
+5V standby	7			

Connector J9:

Part Number: 1827910

Mating part Number: 1827758

Connector J10:

Part Number: 1827897

Mating part Number: 640621-2

6.4   Remote On/Off Control (J6)

A 2-position latching pin header can be used to connect a remote on/off signal to the power supply. This connector is located along the right side of the board. An active low signal / contact closure between the input and ground will turn off all outputs.

	J6
On/Off	1
GND	2

Part Number: 640457-2

Mating part Number: 1827732

6.5   USB Connector for Control Panel Interface (J12)

A micro USB connector is used for the USB interface to the PIC microcontroller for communication between host SBC and PIC microcontroller.

1	VBUS
2	D-
3	D+
4	NC
5	Gnd

Part Number: 10118194-0001LF

6.6   ISA Connectors (J1 & J2)

For simplicity, signal names are only shown for pins with connections on board. All remaining pins are not used on JMM-HP.

J2: PC/104 8-bit bus connector   **J1: PC/104 16-bit bus connector**

				A	B	
				A1	B1	Ground
				A2	B2	
				A3	B3	+5V
				A4	B4	
				A5	B5	-5V
				A6	B6	
				A7	B7	-12V
				A8	B8	
Ground	D0	C0	Ground	A9	B9	+12V
	D1	C1		A10	B10	
	D2	C2		A11	B11	
	D3	C3		A12	B12	
	D4	C4		A13	B13	
	D5	C5		A14	B14	
	D6	C6		A15	B15	
	D7	C7		A16	B16	
	D8	C8		A17	B17	
	D9	C9		A18	B18	
	D10	C10		A19	B19	
	D11	C11		A20	B20	
	D12	C12		A21	B21	
	D13	C13		A22	B22	
	D14	C14		A23	B23	
	D15	C15		A24	B24	
+5V	D16	C16		A25	B25	
	D17	C17		A26	B26	
Ground	D18	C18		A27	B27	
Ground	D19	C19		A28	B28	
				A29	B29	+5V
				A30	B30	
				A31	B31	Ground
			Ground	A32	B32	Ground

Connector Part Number / Description

J1:   EPT Connectors 962-60323-12 64 pins .435" high solder tails

J2:   EPT Connectors 962-60203-12 40 pins .435" high solder tails

6.7 PC-104 Connector (J3)

The board contains a PC-104 connector, J3, on the top side in the standard position as described by the PC/104-*Plus* specification.

Pin	A	B	C	D
			J3	
Pin	**A**	**B**	**C**	**D**
1	GND/5.0V KEY[2]	Reserved	+5	AD00
2	VI/O	AD02	AD01	+5V
3	AD05	GND	AD04	AD03
4	C/BE0*	AD07	GND	AD06
5	GND	AD09	AD08	GND
6	AD11	VI/O	AD10	M66EN
7	AD14	AD13	GND	AD12
8	+3.3V	C/BE1*	AD15	+3.3V
9	SERR*	GND	SB0*	PAR
10	GND	PERR*	+3.3V	SDONE
11	STOP*	+3.3V	LOCK*	GND
12	+3.3V	TRDY*	GND	DEVSEL*
13	FRAME*	GND	IRDY*	+3.3V
14	GND	AD16	+3.3V	C/BE2*
15	AD18	+3.3V	AD17	GND
16	AD21	AD20	GND	AD19
17	+3.3V	AD23	AD22	+3.3V
18	IDSEL0	GND	IDSEL1	IDSEL2
19	AD24	C/BE3*	VI/O	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+5V	AD28	AD27
22	+5V	AD30	GND	AD31
23	REQ0*	GND	REQ1*	VI/O
24	GND	REQ2*	+5V	GNT0*
25	GNT1*	VI/O	GNT2*	GND
26	+5V	CLK0	GND	CLK1
27	CLK2	+5V	CLK3	GND
28	GND	INTD*	+5V	RST*
29	+12V	INTA*	INTB*	INTC*
30	-12V	Reserved	Reserved	GND/3.3V KEY[2]

Connector Type: 30 x 4 pin 2mm pitch with solder tails

7. INSTALLATION

All JMM-5000 power supplies are load tested prior to shipping. The power supplies ship with all the external connectors required to start using your power supply immediately.

No user configuration is required for any version of JMM-5000. Simply plug in the input power and the supply is operational. To power up your supply:

1. For protection, if you are unfamiliar with the use of this product, do not plug any other boards onto it when powering it up for the first time.

2. Connect a DC source to the primary power input connector, J7, or to the secondary power input connector, J8, if it is available. The supply will operate with input voltages from +7 to +34VDC.

   CAUTION: Voltages above 35V will be shunted to ground through a transient voltage suppressor (TVS) on the board. The TVS is rated for 1,500 watt surges. However it could be damaged by sustained voltages above 35V.

3. Once the input voltage is in the valid range, verify that the proper power output indicator LEDs along the lower edge of the board are illuminated. This verifies your input power connections and the power supply is fully functional. Note that only indicators corresponding to the voltages available on the supply will be lit.

4. Power down the supply. Plug the supply into your PC/104 stack. Your system is ready to use.

8. OUTPUT VOLTAGES AND CURRENTS

JMM-5000 provides output voltages based on the model and options ordered. The outputs appear on the PC/104 bus headers J1 / J2 as well as on the output power connectors J9 and J10. The table below lists the maximum ratings for each output voltage on each base Jupiter-5000 model.

| Output	JMM-5000	JMM-5012	JMM-5312
+5V	20A	20A	20A
+12V	-	8A	8A
+3.3V	-	-	5A
+5V standby	-	-	1A
+3.3V standby	-	-	0.1A

9. CONTROL SOFTWARE

JMM-5000 models with the advanced system controller (models with AD in the part number) are accompanied by two software products:

- Graphical user interface program for Windows for configuration and monitoring
- Programing library for real-time control and monitoring of the power supply in the system software

User manuals for both software packages are available from the support tab on the product web page:

https://www.diamondsystems.com/products/jupiter5000

The graphical user interface (GUI) program provides a control panel that provides access to all the features of the power supply. An example screenshot is shown below. The GUI is typically used in a factory environment for configuring the power supply prior to installation in the end system, and it can also be used for testing and diagnostic purposes.
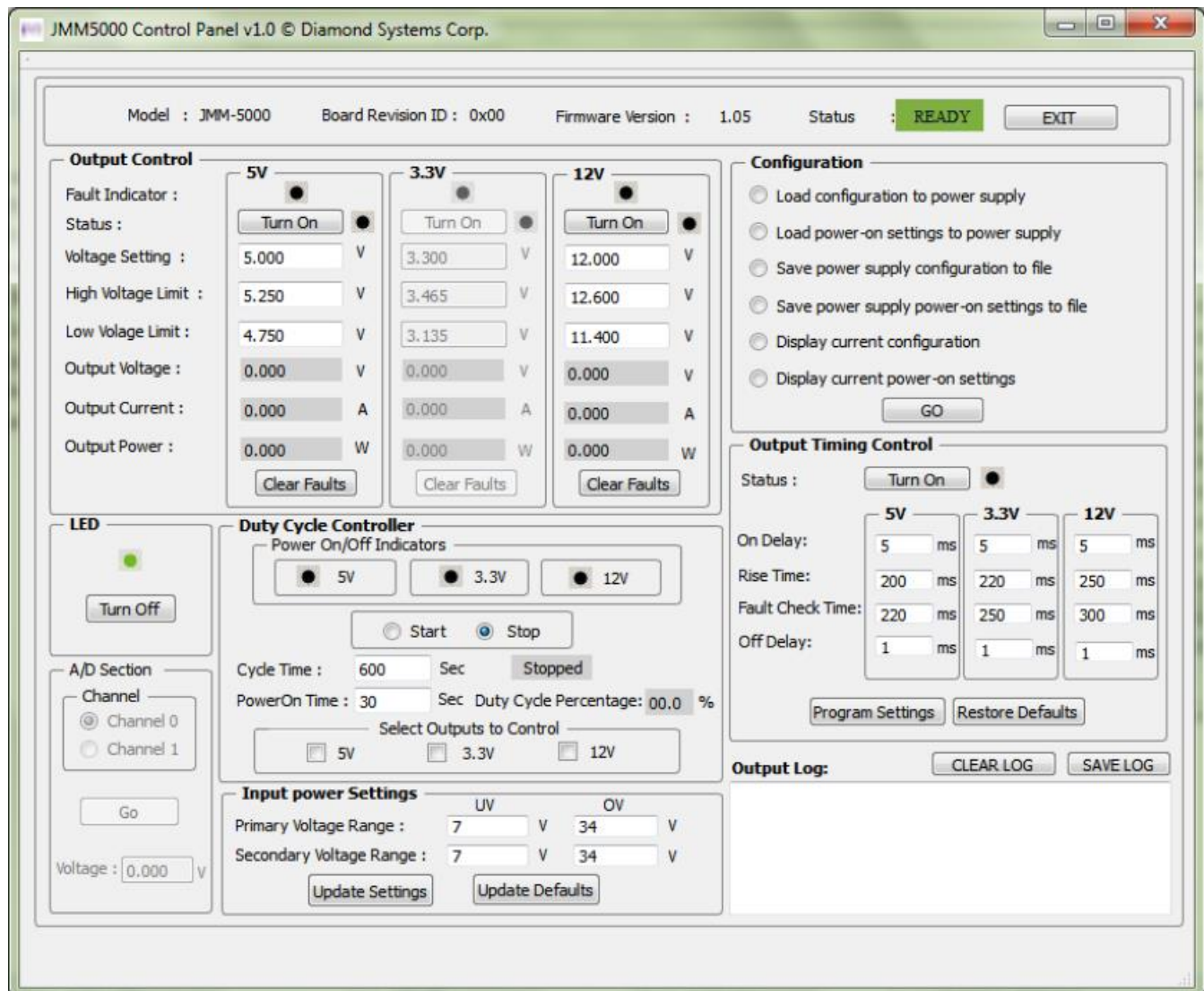
The programming library includes a driver and a set of functions that can be incorporated into a C language program to execute all the functions available in the GUI program. The system software can monitor the power supply performance in real-time for various purposes including health check, prevention of system overload, and software-driven power cycling.

10. SPECIFICATIONS

Input	
Input voltage	7 – 34VDC
Input protection	Over / under voltage, reverse polarity, surges, transients, reflected noise
Output	
Output voltage/current	+5V at 20A maximum +12V at 8A maximum +3.3V at 5A maximum +5V standby at 1A maximum +3.3V standby at 0.1A maximum
Output protection	Current limit and short circuit protection
Load regulation	±0.8%, Vmin to Vmax, 0-100% load on all outputs, -40°C to +85°C 0.35% maximum output voltage droop at 5V output, 0-20A load, V_{IN} = 12V, T_A = 25°C
Output ripple	44mV peak-to-peak maximum 12mV peak-to-peak at 5V output, 0-20A load, V_{IN} = 12V, T_A = 25°C
Efficiency	92-94% at 5V output, 0-20A load, V_{IN} = 12V, T_A = 25°C
Transient load response	+/-72mV at 5V output, 25-75% load step, 2.5A/usec ramp rate, V_{IN} = 24V, T_A = 25°C
Temperature stability	+/-0.5% at 5V output, 10A load, V_{IN} = 24V, T_A = -40°C to 85°C
General	
On / Off	Remote or programmable on/off logic input
Dimensions	PC/104 form factor: 3.55" x 3.775" (90mm x 96mm) not including screw terminals Maximum height .435" (11mm) above PCB top surface
Bus connection options	16-bit stackthrough ISA bus 32-bit PCI bus
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Operating humidity	5 to 95% non-condensing
Shock	MIL-STD-202G compatible
Vibration	MIL-STD-202G compatible
Weight	6.3oz (178.6g) heat sink 8.1oz (229.6g) heat spreader
RoHS	Compliant