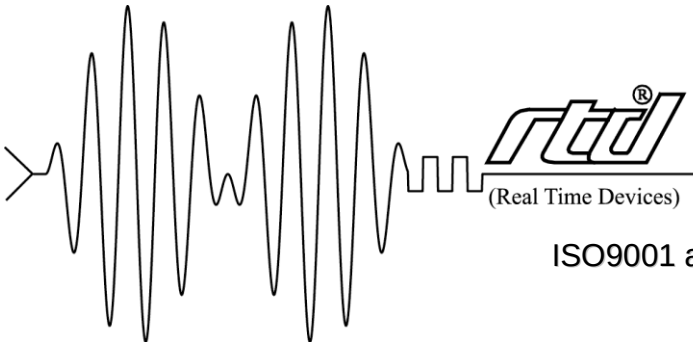
# IATX104plusHR
# High efficiency PC/104-Plus power Supply module

# User's Manual



RTD Embedded Technologies, Inc.

*"Accessing the Analog World"®*

ISO9001 and AS9100 Certified

BDM-610020067
Rev. D

# IATX104PLUSHR
# Power supply module
# User's Manual

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Revision History

| | |
|---|---|
| Rev A | Initial Release |
| Rev B | Name change |
| Rev C | Galvanic Isolation voltage added to specifications, output power correction |
| Rev D | Adjusted the 3.3V ratings. |

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# Chapter 1 INTRODUCTION

This user's manual describes the operation of the IATX104PLUSHR power supply unit for automotive and industrial applications.

## *Features*

Some of the key features of the IATX104PLUSHR include:

- Input voltage range 18V-36V DC
- No heat sink required with natural convection cooling up to 45˚C,
- 166W total output power ***with adequate cooling***,
- 5V with 90% efficiency
- 5V STBY with 83% efficiency
- 3.3V with 89% efficiency
- 12v with 93% efficiency
- -12V with 88% efficiency
- -5V LDO with 37% efficiency
- Synchronized supplies reduce switching stresses
- Remote ON/OFF operation
- IATX104PLUSHR outputs +3.3V, +5V, +12V, -12V, -5V, 5V STDBY
- Five voltage status LED's
- **Operating temperature range -40 to +85 C**

The following paragraphs briefly describe the major features of the IATX104PLUSHR. A more detailed discussion is included in Chapter 3 (Hardware description). The board installation is described in Chapter 2 (Board Installation).

## *Board Versions*

The IATX104plusHR is a PC/104-*Plus* power supply module, with an ISA and a PCI connector.

The IATX8104HR is a PCI-104 power supply module, with a PCI connector only.

Stack-through and non-stack-through bus versions available upon request

## *Power Supply Unit Description*

The IATX104PLUSHR power supply unit offers a complete reliable power subsystem for your sophisticated computer and peripherals. To improve reliability in harsh environments, the IATX104PLUSHR is designed using protection devices against over voltages, noise spikes and reverse input voltage. The output current of the +5V and the +3.3V converter are limited to 20A. These features allow reliable system operation in distributed industrial installations.

A 5V STDBY supply capable of 2A is present so ATX compliant systems can be built on this board. ATX support signals PS_ON# and PWR_OK allow software controlled shutdown and power monitoring available for your CPU.

The +5V and the +3.3V computer power supplies are designed using high efficiency switching regulators providing high output current (20A) with efficiency as high as (90 %). The secondary peripheral power supplies are designed using +12V and -12V converters that are supplied by the +5V DC/DC converter. Extensive use of SMD technology ensures low weight and reliable operation.

The IATX104PLUSHR can be “switched off” from a remote source.

## *Mechanical description*

The IATX104PLUSHR is designed on a PC/104+ form factor. An easy mechanical interface to both PC/104+ and EBX systems can be achieved. Stack your IATX104PLUSHR directly on a PC/104+ compliant computer using the onboard mounting holes. Care must be taken to ensure adequate heat dissipation from the board in high output power installations.

## *Connector description*

The power connections are made using "cable plug" type terminal blocks. This enables removing connections from the board without opening the cables from the terminal blocks. The IDAN-IATX104PLUSHR boards always feature screw terminal blocks for inter-frame wiring.

## *What comes with your board?*

Your IATX104PLUSHR package contains the following items:

- IATX104PLUSHR board with mating connectors for power connections
- CD Containing User's manual

If any item is missing or damaged, please call RTD Embedded Technologies, Inc. customer service department at the following number: (814) 234-8087.

## *Using this manual*

This manual is intended to help you install your new IATX104PLUSHR module and get it working quickly, while also providing enough detail about the board and its functions so that you can enjoy maximum use of its features even in the most demanding applications.

## *When you need help*

This manual will provide you with enough information to fully utilize all the features on this board. If you have any problems installing or using this board, contact our Technical Support Department (814) 234-8087. Alternatively, send a FAX to (814) 234-5218 or Email to techsupport@rtd.com. When sending a FAX or Email request please include the following information: Your Company’s name and address, your name, your telephone number, and a brief description of your questions.

# Chapter 2 BOARD INSTALLATION

The IATX104PLUSHR power supply module is very easy to connect to your industrial or automotive control system. Direct interface to PC/104+ systems as well as EBX size boards is achieved. This chapter tells you step-by-step how to install your IATX104PLUSHR into your system.

## *Board installation*

Keep your board in its antistatic bag until you are ready to install it to your system! When removing it from the bag, hold the board at the edges and do not touch the components or connectors. Please handle the board in an antistatic environment and use a **grounded** workbench for testing and handling of your hardware. Before installing the board in your computer, check the power cabling. Failure to do so may cause the power supply unit to malfunction or even cause permanent damage.

**General installation guidelines:**

- Touch the grounded metal housing of your computer to discharge any antistatic buildup and then remove the board from its antistatic bag.
- Hold the board by the edges and install it in an enclosure or place it on the table on an antistatic surface.
- Install your board in your system, and wire the power supply correctly.
- Failure to do so may cause the power supply unit to malfunction or even cause permanent damage to the device.
- Check all wiring connections once and then once more again.
- Check the input power to the board is in the specified range.
- Apply power to your IATX104PLUSHR, and make sure the diagnostic LED's indicate correct operation.
- Do not attach any other boards until you are sure the power supply is connected correctly and have powered it on once.

**Installation integrated with a PC/104+ module stack:**

- Secure the four PC/104+ installation holes with standoffs.
  Connect the board to the power supply using the power interface connectors.

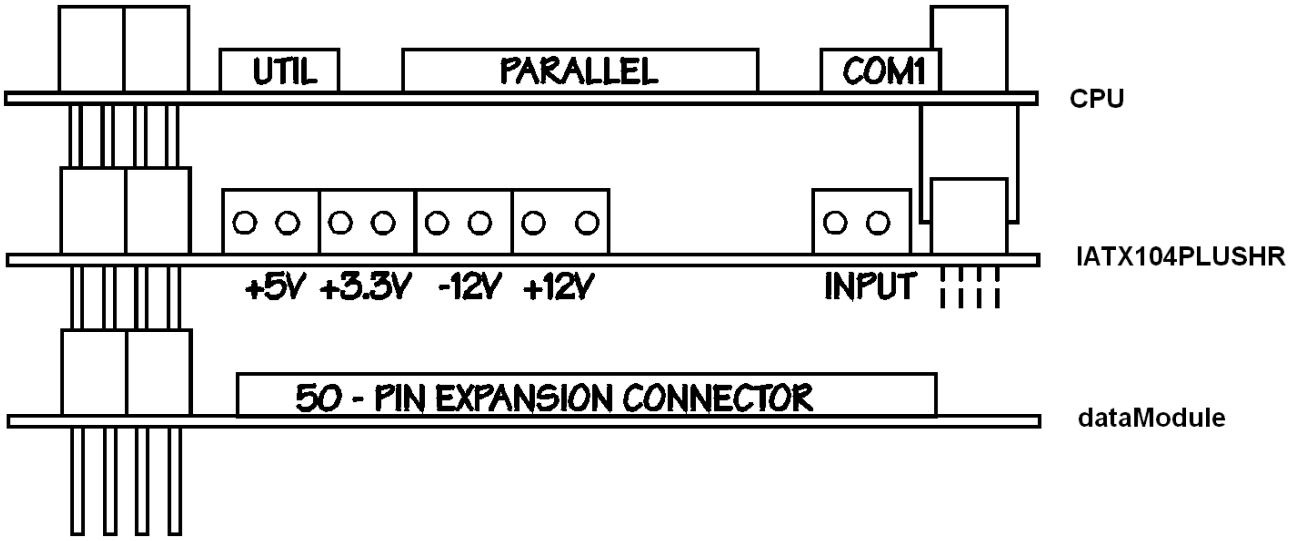



**Figure 1: IATX104PLUSHR powering an RTD PC/104+ cpuModule stack**

| | |
|---|---|
| Note: | For full output power performance, install your IATX104PLUSHR at the top of your PC/104+ system and make sure adequate cooling is provided. |

## *External power connections*

The illustration 2-2 below indicates the input and output power connections of the IATX104PLUSHR

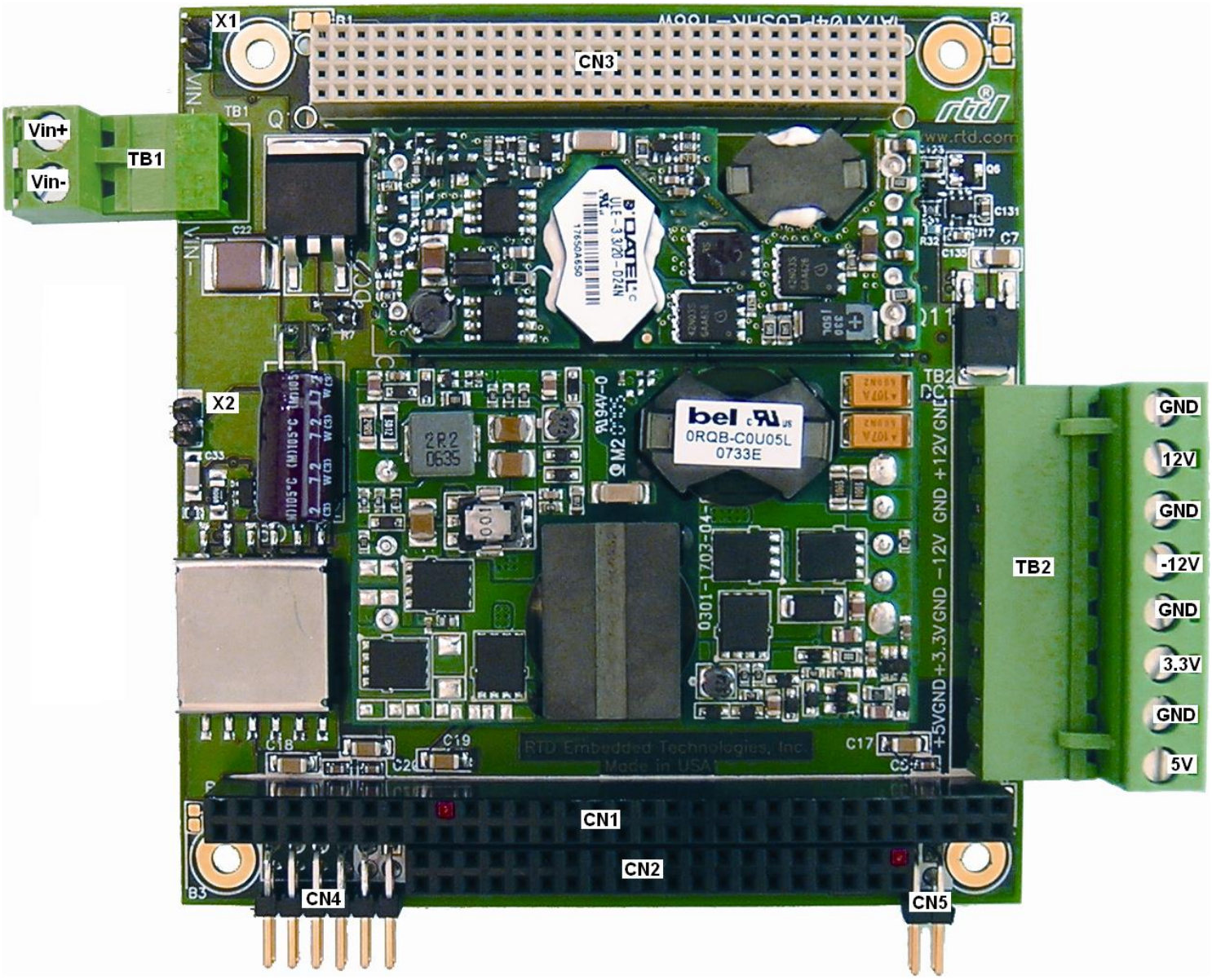



**Figure 2: IATX104PLUSHR power supply power connections**

## *Connector descriptions:*

- ***TB1*:** Raw input power to the IATX104PLUSHR, voltage range is 18-36V DC. Overvoltage protected with transient absorber.

| | |
|---|---|
| Note: | The module input power may be up to 185 Watts or 10.25 Amps at 18Vin. This condition will require AWG 16 wire (1.14mm$^2$) (Make sure this input wire is kept as short as possible to reduce voltage drops (0.005Ω/foot) and inductive spikes (513 nH/foot). Also wrap the positive and return input leads at least once every 2 inches to reduce inductance. |

- ***TB2 :*** +5V Output of the main DC/DC power supply
- ***TB2 :*** +3.3V Output of the main DC/DC power supply
- ***TB2:*** -12V Output
- ***TB2 :*** +12V Output
- ***X1 :*** Remote ON/OFF , close this jumper to enable the IATX104PLUSHR (standby remains active) This is actually the PS_ON# signal
- ***X2:*** Remote ON/OFF for 5V STDBY, close this jumper to disable 5V STDBY
  - Populating this jumper shuts the board off.
- ***CN4:***
  - Pin 1 Ground
  - Pin 2 +5V
  - Pin 3 +5VSTBY
  - Pin 4 +12V
  - Pin 5 No Connect
  - Pin 6 -12V
  - Pin 7 Ground
  - Pin 8 +5V
  - Pin 9 Ground
  - Pin 10 +3.3V
  - Pin 11 PS_ON#
  - Pin 12 +3.3V
- ***CN5:***
  - Pin1 GND
  - Pin2 PS_ON# active low power supply enable signal
  - Pin3 PWR_OK active high signal indicating 3.3V and 5V are above 95%
  - Pin4 +5VSTDBY 2.0A 5V supply for power saving modes

The output voltages are also indicated on the silk-screen on the solder side of the module under the terminal blocks. Check these before making any external power connections. The input of the IATX104PLUSHR is protected against reverse voltages, but will not withstand long term overvoltage. The transient absorbers will clip all fast disturbance and noise on the input, but may overheat if continuous overvoltage is present.

# Chapter 3 IDAN CONNECTIONS

This power supply module, like all other RTD 104 modules, can be packaged in Intelligent Data Acquisition Node (IDAN) frames, which are milled aluminum frames with integrated heat sinks and heat pipes for fanless operation. RTD modules installed in IDAN frames are called building blocks. IDAN building blocks maintain the simple but rugged stacking concept of PC/104 and PC/104-Plus. Each RTD module is mounted in its own IDAN frame and all I/O connections are brought to the walls of each frame using standard PC connectors. No connections are made from module to module internal to the system other than through the PC/104 and PC/104-Plus bus, enabling quick interchangeability and system expansion without hours of rewiring and board redesign.

The following Tables list the connections on the outside of the IDAN frame.

**Power Input – 2 Pin Quick Disconnect Connector (Female)**

| IDAN Pin # | Signal |
|---|---|
| 1 | 18-36 V DC (Isolated) |
| 2 | Isolated Ground |

**Power Output – 9 Pin "D" Connector (Female)**

| IDAN Pin # | Signal |
|---|---|
| 1 | +5V |
| 2 | Ground |
| 3 | +12V |
| 4 | Ground |
| 5 | -12V |
| 6 | +5V |
| 7 | Ground |
| 8 | +3.3V |
| 9 | Ground |

# Chapter 4 - HARDWARE DESCRIPTION

This chapter describes the major features of the IATX104PLUSHR, which are the following:

- The main +5V and +3.3V converter for the PC/104 and PC/104+ busses
- The secondary power output converters +12V , –12V, 5V STDBY, and –5V
- Onboard status LED's
- Overload protection
- Output power calculations

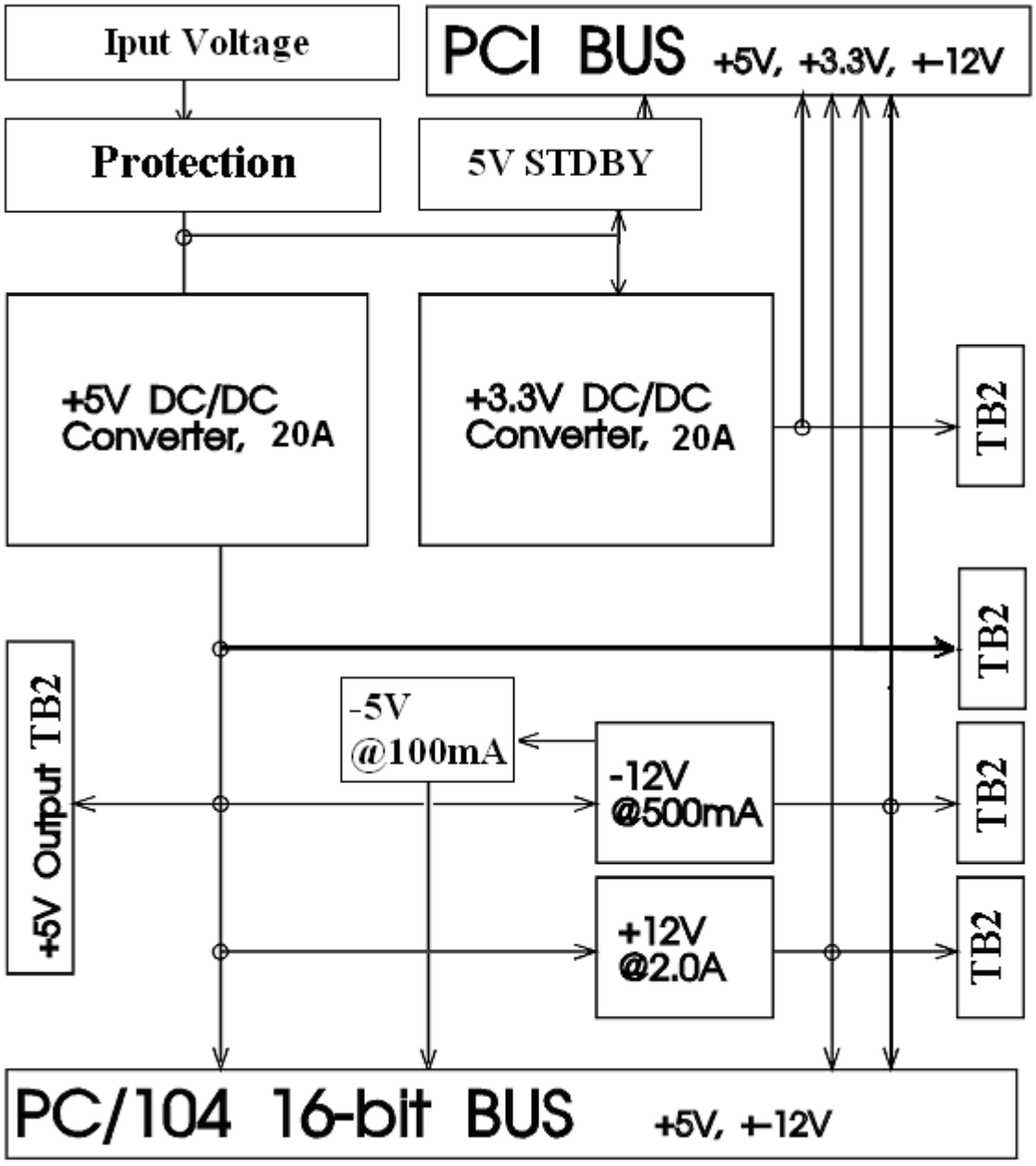



Figure 3: Block diagram of the IATX104PLUSHR

## *Main +5V and +3.3V converter for the computer*

The main +5V and the PCI bus +3.3V output use an isolated synchronous, switch-mode DC-DC converter design. The output current of both of these independent converters this limited to 20A. These converters have excellent dynamic and transient response capabilities making it an ideal high-speed computer power supply. Use of low loss MOSFET-transistors allows operation without an additional heat-sink. Internal layers of the PCB are used to distribute heat evenly.

Input circuitry of the IATX104PLUSHR is protected with a fast transient absorber diode and a low loss solid-state reverse protection circuit. These devices are necessary to protect the input in automotive and industrial installations against fast over-voltage spikes and reverse voltage conditions. These situations exist in vehicle systems with alternators/chargers or in systems with electrically controlled hydraulic or pneumatic inductive valves and solenoids.

The +5V converter, located closer to the power connectors, feeds the PC/104 AT bus and the PCI bus +5V pins with power. This power can also be supplied from the board from an external terminal block TB2. (See previous section for the location of terminal block TB2.) The +3.3V converter located near the PCI bus connector to the +3.3V power pins of the PCI bus and supplies the + and -12V circuits. A terminal block at the side of the board next to the +5V output can be used to power other external +3.3V devices.

Input range is guaranteed inside the specified range of you board (18-36V) under full load and in worst conditions over the full rated temperature range (with air flow). Note that start up current may exceed stead-state current consumption.

### Current Limit

To protect against fault or short-circuit conditions 5V and 3.3V voltages are equipped with current fold-back, current limiting circuitry to provide continuous overload protection. The 12V and the -12V circuits are cascaded off of the 5V and are protected by the 5V fold-back protection. After reaching the current limit point the voltage output will range between the rated output and zero depending on the amount of overload. Once the short circuit condition is removed, the output will return to the nominal value without restarting the unit.

**Remote On/Off control (IMPORTANT!!!)**

Header connector X1 near the input terminal block is the remote ON/OFF selection switch. Shorting pins 1-2 will enable the IATX104PLUSHR and turn the converter “ON”. This signal could be connected to the ignition key of an automobile or machine. When the X1 jumper is shorted, the PS_ON# signal from an outside source, will **“not”** turn off the +5V and 3.3V converters. When the X1 jumper is off, the supply is controlled by PS_ON#. PS_ON# is floated high when not driven so X1 can operate independent of PS_ON#. One can connect a switch to PS_ON# to also turn the power supply on and off.

X2 is connected to the enable of the 5VSTDBY converter. Shorting this jumper will disable (turn “OFF”) the 5VSTDBY and the rest of the board.

## *Secondary +12V and -12V and –5V converters*

+3.3V to +-12V converters generates +-12V for peripheral devices such as EL- or TFT- panels, hard drives, motors etc. The +12V output is capable of supplying up to 2.0A of current. +12V power is available from terminal block TB2. The -12V power is available from terminal block TB2. (See previous section for location of TB2). The +12V and -12V supplies also power the PC/104 and the PCI bus. A 100mA output –5V supply output is regulated from the –12V supply. This –5V output is only connected to the ISA-bus –5V power pin and is not externally available.

### Onboard status LED's

The IATX104PLUSHR is equipped with 5 indicator LED's. The function of the LED's is described below. These LEDs are driven by 5VSTBY.

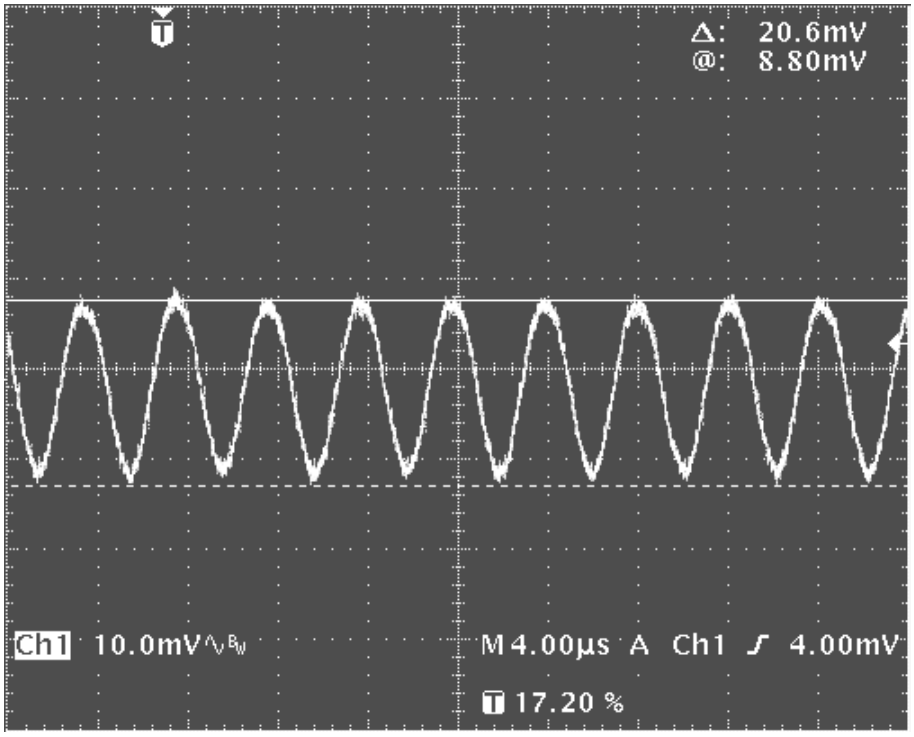
- LED1 - Green. Indicates +5V power converter is operational and greater than 95%
- LED2 - Green. Indicates +3.3V power converter is operational and greater than 95%
- LED3 - Green. Indicates +12V converter is operational
- LED4 - Green. Indicates -12V converter is operational
- LED5 - Green. Indicates -5V converter is operational

### Overload protection

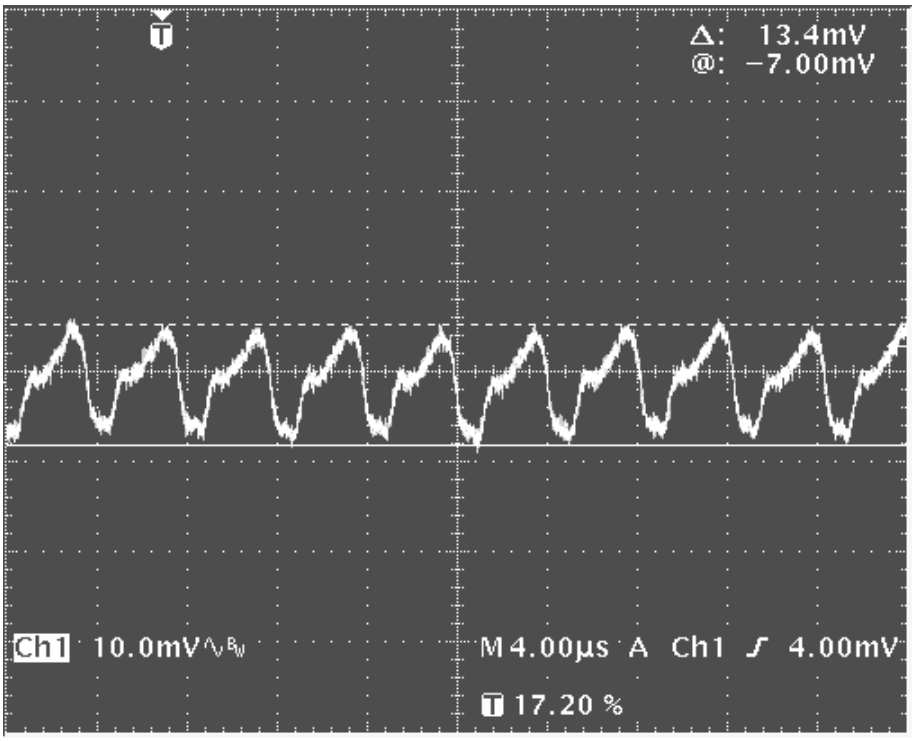
Both +5V and the +3.3V converter is current limited to 20A. The current limit is slightly higher that the maximum continuous output current to ensure reliable operation near the maximum rated output power.

The +12V converter is rated to 2A and the -12V converter is rated for 500mA. The +12V converter output is limited to 2.0A. The -12V converter output is limited to 500mA. The outputs of the +12V and -12V converters will allow short-term error conditions, and are not designed to accept long-term over-voltage or reverse polarity.

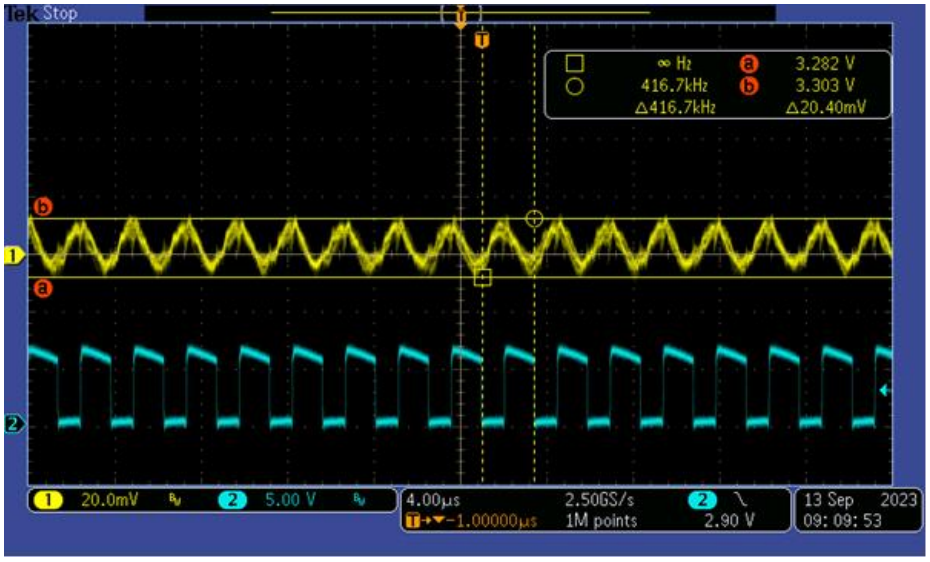
Use of Ultra-low ESR tantalum capacitors and stable temperature characteristics ensure low noise and good transient performance over the complete rated operating temperature range of –40 to +85C. PCB layout is optimized to provide lowest radiated and conducted noise.



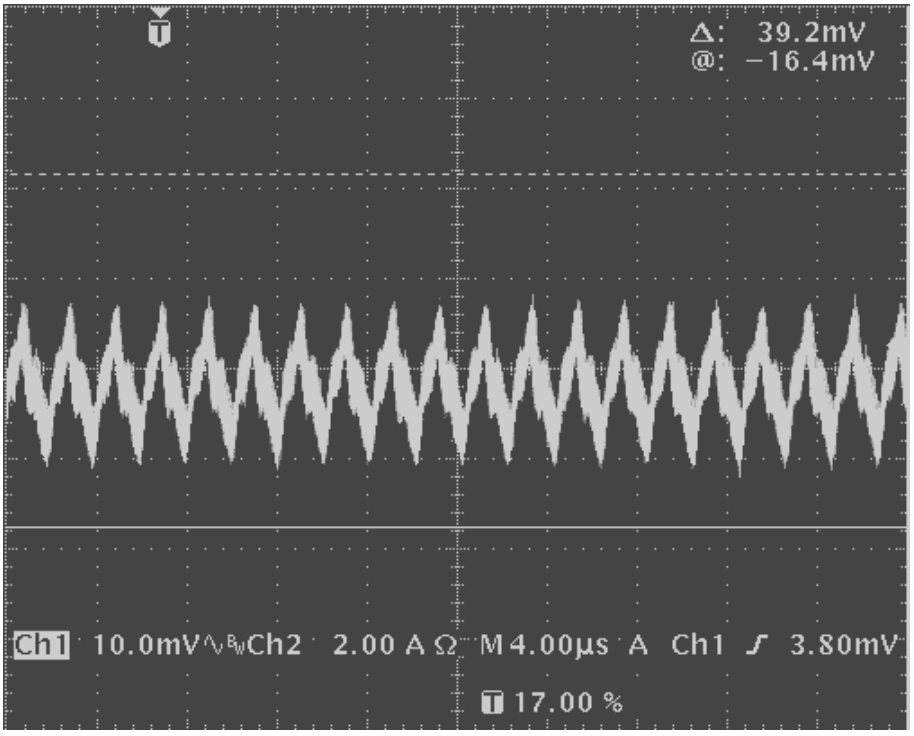

+12V ripple at full load 20.6mV P-P



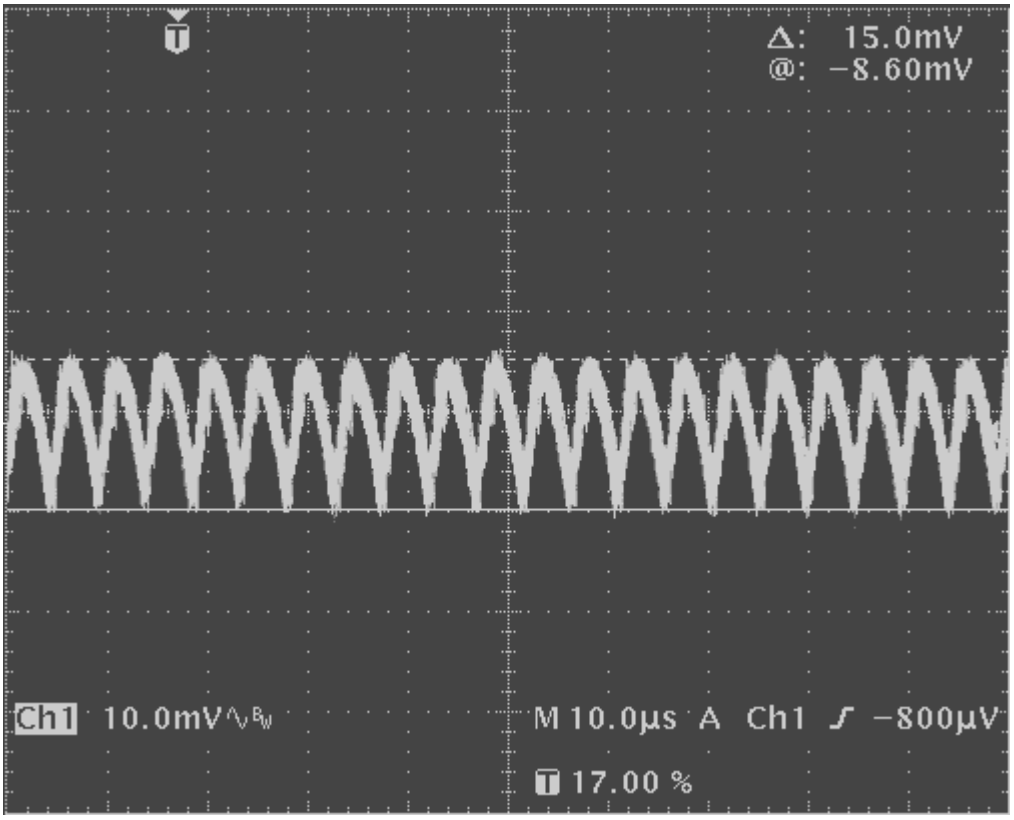

-12V ripple at full load 12.6mV P-P




3.3V ripple at full load 20.4mV P-P




5V ripple at full load 17.6mV P-P



5V STDBY ripple at full load 15.0mV P-P

- The maximum available power for the +5V computer system can be estimated using the following method:

  5V efficiency 90%
  5V STDBY efficiency 83%
  3.3V efficiency 89%
  12V efficiency 93%
  -12V efficiency 88%
  -5V efficiency 37%
  All loads are in Watts
  L1 = 5V primary load (100W fully available)
  L2 = 3.3V load
  L3 = 12V load
  L4 = -12V primary load (load on just -12V supply)
  L5 = -5V load
  L6 = -12V total load = L4 + (L5/0.37)
  L7 = 5V total load = L1 + (L3/0.93) + (L6/0.88)
  $L_{TOTAL}$ = L2 + L7
  $L_{TOTAL}$ < 166 Watts
  **L**$_{STDBY}$ < 10 Watts

Note: Even though the total output power figure of 166 Watts is not exceeded, one must remember not to overload an individual output! Care must be taken not to thermally overload the unit. The maximum specified output power may not be available if the ambient temperature rises, and in this case additional heat sinking or additional airflow may be necessary. Even though the unit can stay cooled with natural convection, enclosing the unit in a container may require heat sinking depending on the load and temperature in the container.

# Chapter 5 IATX104PLUSHR SPECIFICATIONS

## *Host interface*

PC/104+ busses with +5V, +5VSTDBY, +3.3V, +12V, -12V, and –5V

## *Power supply specifications*

**Input voltage ranges**

18-36 VDC

**Output voltage ripple at full load (measured peak to peak)**

| | |
|---|---|
| +5V | 17.6 mV |
| +5V STDBY | 15.0 mV |
| +3.3V | 20.4 mV |
| +12V | 20.6 mV |
| -12V | 12.6 mV |

**Output Power (166W total)**

+5V@20A for 50W
+5V STDBY@ 2A for 10W
+3.3V@10A for 33W
+12V@2.0A for 24W
-12V@500mA for 6W
-5V@100mA for 0.5W

133W available

123W deliverable

**Efficiencies**

| | |
|---|---|
| 5V efficiency | 90% |
| 5V STDBY efficiency | 83% |
| 3.3V efficiency | 89% |
| 12V efficiency | 93% |
| -12V efficiency | 88% |
| -5V efficiency | 37% |
| Overall | 87% |

**Maximum Board Power dissipation (worst conditions)**

25 Watts

**Output voltage regulation**

+-5% (max) all outputs

**Galvanic Isolation Voltage**

1500 V

**Connectors**

Power connectors — Phoenix Contact Combicon Series

Host bus — PC/104+ bus

PC/104 stack-through, PCI solder-tail (Optionally no bus connectors)

**Electromechanical**

Operating temperature range — -40 to +85C (may require airflow and or heat sinking in containers)

May operate at full load up to 45˚C with no additional airflow

Tested with full load at 85˚C with 200 LFM with no heat sink

Maximum Internal power dissipated by LEDs and internal circuitry (no load)
0.70 Watts @ 8V Vin
1.76 Watts @ 36V Vin

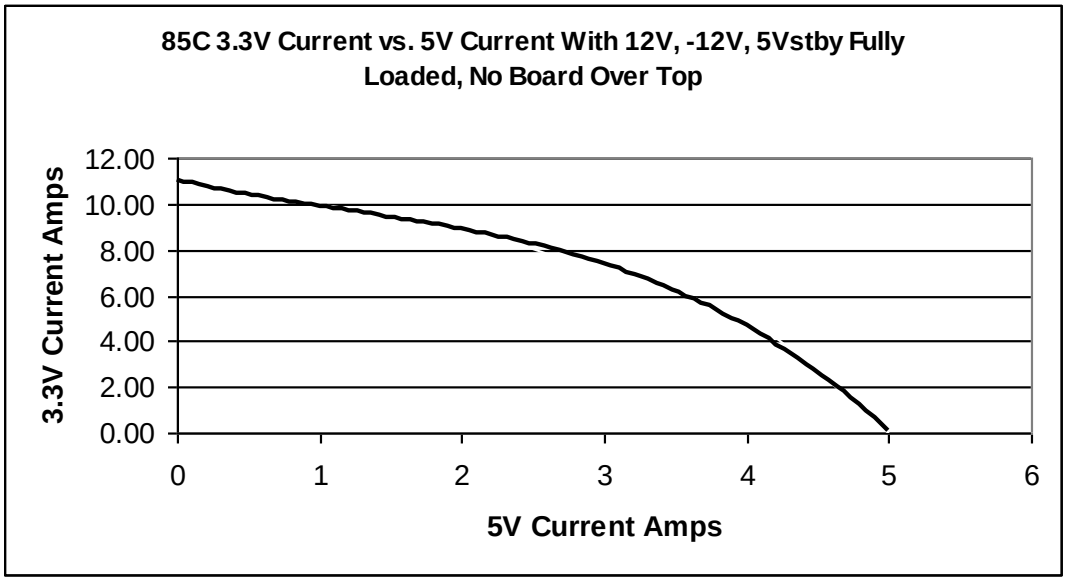
Maximum power dissipated when supply is disabled — 14 mWatts @ 8V Vin
135 mWatts @ 36V Vin

**Derating**

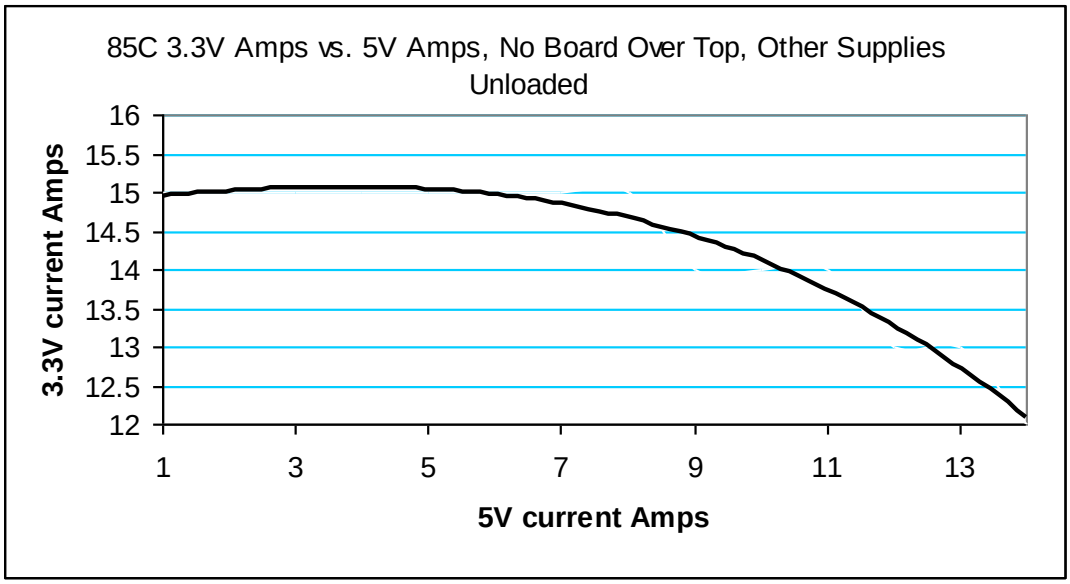
There are complex thermal interrelationships between all the converters on this power supply. The information below will give a good idea of the thermal behavior of this power supply under many situations.

| | **5V Max Load, All Supplies On with 0 Amps** | **Ambient temp C** | **airflow** | **board over top** | | **3.3V Max Load, All Supplies On with 0 Amps** | **Ambient temp C** | **airflow** | **board over top** |
|---|---|---|---|---|---|---|---|---|---|
| **Results** | 14 | 85 | 44'/min | no | | 15 | 85 | 44'/min | no |
| | 20 | 25 | | | | 15 | 25 | | |
| | 20 | 60 | | | | 15 | 70 | | |
| | 17 | 25 | none | | | 15 | 25 | none | |
| | | | | | | | | | |
| | 12 | 85 | 44'/min | yes | | 13 | 85 | 44'/min | yes |
| | 20 | 25 | | | | 15 | 25 | | |
| | 20 | 52 | | | | 15 | 57.1 | | |
| | 15 | 25 | none | | | 15 | 25 | none | |

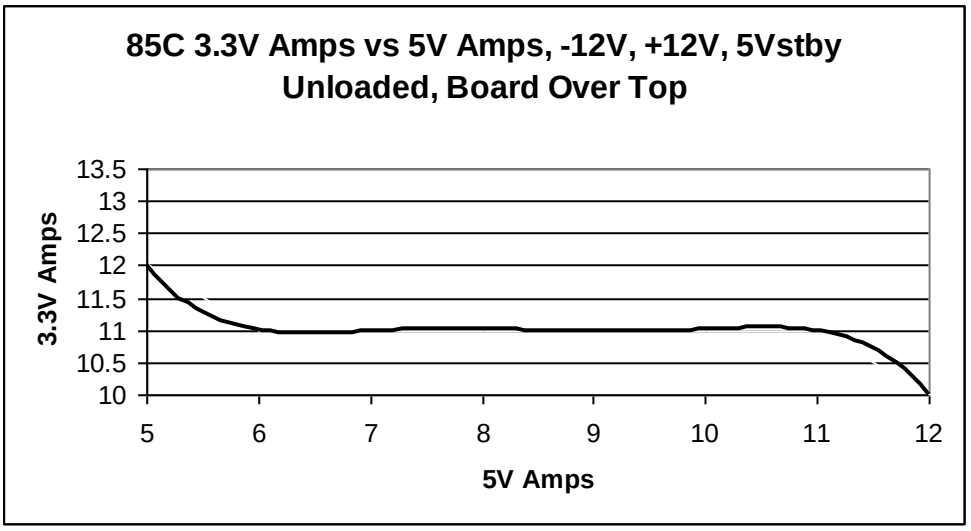
The table above shows the heating characteristics of the 5V and the 3.3V converters individually at various temperatures and with a board obstructing air flow over top.




The above graph describes how the 5V and the 3.3V converters cross heat each other at 85C with **+-12V, and 5Vstby fully loaded**, 44'/min. airflow and no board over top blocking airflow.




The above graph describes how the 5V and the 3.3V converters cross heat each other at 85C with 44'/min. airflow and no constriction. All other supplies at zero load.




The above graph describes how the 5V and the 3.3V converters cross heat each other at 85C with 44'/min. airflow and a constricting board over top. **All other supplies are fully loaded.**

**RTD offers an IDAN frame that directly heat sinks the 3.3V and 5V converters and greatly improves dead air performance.**

# Chapter 6 RETURN POLICY AND WARRANTY

## *Return Policy*

If you wish to return a product to the factory for service, please follow this procedure:

Read the Limited Warranty to familiarize yourself with our warranty policy.

Contact the factory for a Return Merchandise Authorization (RMA) number.

Please have the following available:

- Complete board name
- Board serial number
- A detailed description of the board's behavior

**List the name of a contact person**, familiar with technical details of the problem or situation, **along with their phone and fax numbers, address, and e-mail address** (if available).

**List your shipping address!!**

Indicate the shipping method you would like used to return the product to you.
*We will not ship by next-day service without your pre-approval.*

*Carefully package the product, using proper anti-static packaging.*

*Write the RMA number in large (1") letters on the outside of the package.*

*Return the package to:*

*RTD Embedded Technologies, Inc.*
*103 Innovation Blvd.*
*State College PA 16803-0906*
*USA*

# Chapter 7 LIMITED WARRANTY

RTD Embedded Technologies, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from RTD Embedded Technologies, INC. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, RTD Embedded Technologies will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to RTD Embedded Technologies. All replaced parts and products become the property of RTD Embedded Technologies. Before returning any product for repair, customers are required to contact the factory for an RMA number.

THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by RTD Embedded Technologies, "acts of God" or other contingencies beyond the control of RTD Embedded Technologies), OR AS A RESULT OF SERVICE OR MODIFICATION BY ANYONE OTHER THAN RTD Embedded Technologies. EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND RTD Embedded Technologies EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN. ALL IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES FOR MECHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS WARRANTY. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, THE PURCHASER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES WILL RTD Embedded Technologies BE LIABLE TO THE PURCHASER OR ANY USER FOR ANY DAMAGES, INCLUDING ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOST PROFITS, LOST SAVINGS, OR OTHER DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, AND SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

RTD Embedded Technologies, Inc.
103 Innovation Blvd.
State College PA 16803-0906
USA
Our website: www.rtd.com