

VPWR104HR

High efficiency PC/104 power supply module

User's Manual



BDM-610020029
Rev. A

VPWR104HR

Power supply module

User's Manual



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05/05/2003	Small corrections, preliminary removed -5V added
Rev A	Complete board redesign

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Chapter 1 INTRODUCTION

This user's manual describes the operation of the VPWR104HR power supply unit for automotive and industrial applications.

Features

Some of the key features of the VPWR104HR include:

- No electrolytic capacitors for higher temperature range and use at high elevations.
- Wide input voltage range 8-32 V DC (36V absolute max)
- No heat sink required with natural convection cooling,
- 50W total output power guaranteed **with adequate cooling**,
- Up to 90 % efficiency
- Dual phase construction to all but eliminate input ripple current and improve step response
- Synchronized supplies eliminate noisy beat frequencies and reduce switching stresses
- Outputs continuous short circuit protected
- Remote ON/OFF operation
- VPWR104HR outputs +5V, +12V, -12V, -5V
- Four status LED's
- Fully PC/104 compliant
- **Operating temperature range -40 to +85 C**

The following paragraphs briefly describe the major features of the VPWR104HR. A more detailed discussion is included in Chapter 3 (Hardware description). The board installation is described in Chapter 2 (Board Installation).

Power Supply Unit Description

The VPWR104HR power supply unit offers a complete reliable power subsystem for your sophisticated computer and peripherals. To improve reliability in noisy environments, the VPWR104HR is designed using protection devices against over voltages, noise spikes and reverse input voltage. The output current of the +5V converter is limited to 10A. These features allow reliable system operation in distributed industrial installations.

The +5V computer power supply is designed using a high efficiency switching regulator providing high output current (10A) with efficiency as high as (90 %) under all conditions. The secondary peripheral power supplies are designed using +12V and -12V converters that are supplied by the +5V DC/DC converter. Low component count and extensive use of SMD technology ensures low weight and reliable operation. Special care has been taken to reduce radiated and conducted emissions. Optimized multi-phase circuit layout ensures good EMI immunity over the operating temperature range under all loads.

The VPWR104HR can be “switched off” from a remote source. If this switch (jumper) is closed the power supply will become inactive while still powered.

Mechanical description

The VPWR104HR is designed on a PC/104 form factor. An easy mechanical interface to both PC/104 and EBX systems can be achieved. Stack your VPWR104HR 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-VPWR104HR boards always feature screw terminal blocks for inter-frame wiring.

What comes with your board?

Your VPWR104HR package contains the following items:

- VPWR104HR board with mating connectors for power connections
- 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 VPWR104HR 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 VPWR104HR isolated 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 VPWR104HR 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 range of 10 to 32V DC (36V max)
- Apply power to your VPWR104HR, and make sure the diagnostic LED's indicate correct operation.

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.

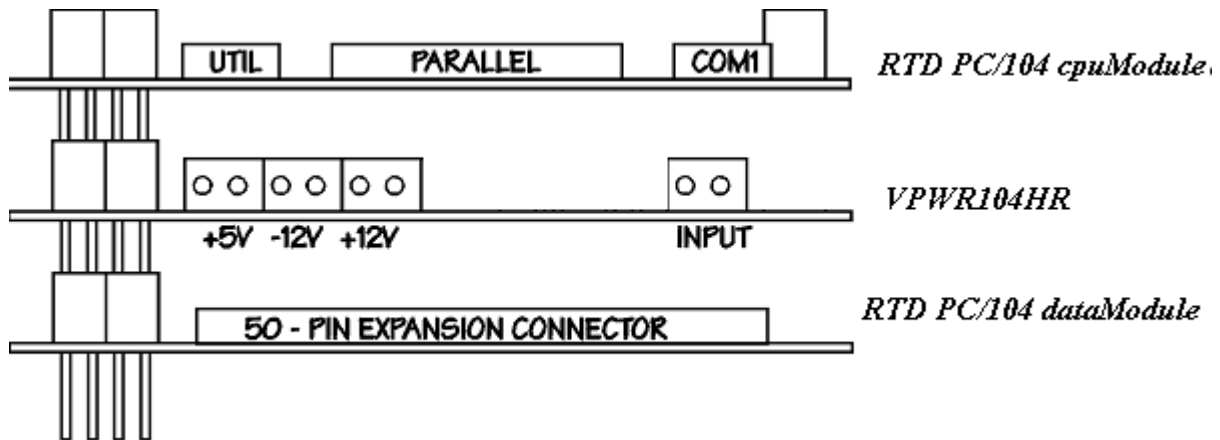


Figure 1: VPWR104HR powering an RTD PC/104 cpuModule stack

Note: For full output power performance, install your VPWR104HR at the top of your PC/104 system and make sure adequate cooling is provided. You may increase airflow with the EFAN104 fan module available from RTD Embedded Technologies, Inc..

External power connections

The illustration 2-2 below indicates the input and output power connections of the VPWR104HR

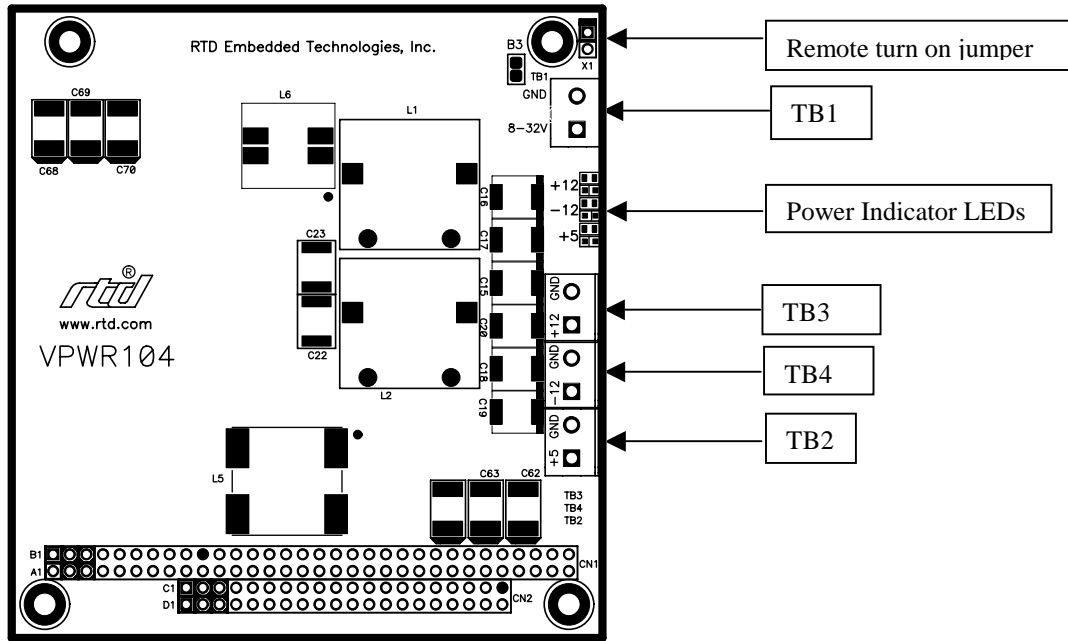


Figure 2: VPWR104HR power supply power connections

Connector descriptions:

- **TB1:** Raw input power to the VPWR104HR, voltage range is 8-32 V (36V absolute max) DC. Over-voltage protected with transient absorber with cutoff at 39V DC.

Note: The module input power may be up to 100 W, this will require AWG 16 wire (1.14mm²)(Make sure this input wire is kept as short as possible to reduce voltage drops (0.005Ω/foot) and inductive spikes (513 nH/foot).

- **TB2 :** +5V Output of the main DC/DC power supply
 - **TB4:** -12V Output
 - **TB3 :** +12V Output
 - **X1 :** Remote ON/OFF , close this jumper to disable the VPWR104HR
- 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 VPWR104HR is protected against reverse voltages, but will not withstand long term Over-voltage. The transient absorbers will clip all fast disturbance and noise on the input, but may overheat if continuous over-voltage is present.

Chapter 3 - **HARDWARE DESCRIPTION**

This chapter describes the major features of the VPWR104HR, which are the following:

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

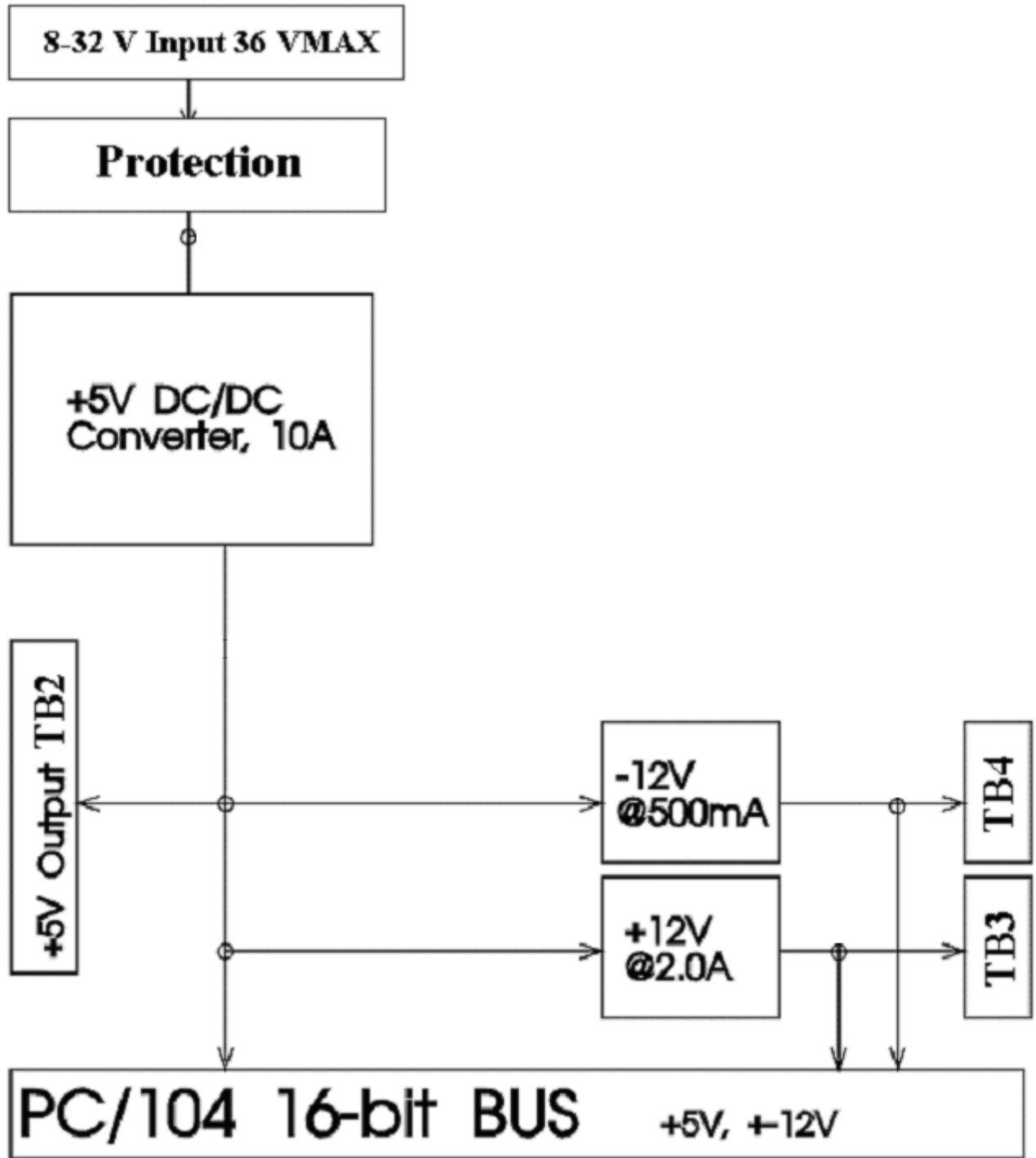


Figure 3: Block diagram of the VPWR104HR, -5V linear regulator omitted.

Main +5V converter for the computer

The main +5V output use a synchronous, switch-mode DC-DC converter design. The output current of both of these independent converters this limited to 10A. 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 VPWR104HR is protected with a 36V fast transient absorber diode and a low loss forward schottky diode. These devices are necessary to protect the input in automotive and industrial installations against fast over-voltage spikes and reverse voltage transients. 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 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.)

Input range is guaranteed from 8 up to 32V(36V max) under full load and in worst conditions over the full rated temperature range. Note that start up current may exceed stead-state current consumption.

Current Limit

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

Remote On/Off control

Header connector X1 near the input terminal block is the remote ON/OFF selection switch. Closing this connection will disable the VPWR104HR and turn the converter "OFF". In this condition the VPWR104HR will consume minimum power. This signal could be connected to the ignition key of an automobile or machine.

Secondary +12V and -12V and -5V converters

+5V 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 TB3. The -12V power is available from terminal block TB1. (See previous section for location of TB3). The +12V and -12V supplies also power the PC/104 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 VPWR104HR is equipped with 3 indicator LED's. The function of the LED's is described below.

- LED1 - Green. Indicates +5V power converter is operational
- LED2 - Green. Indicates +12V converter is operational
- LED3 - Green. Indicates -12V converter is operational

Overload protection

The +5V converter is current limited to 10A. The current limit is slightly higher than 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 with 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.

Output power calculations

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

5V efficiency 90%

12V efficiency 90%

-12V efficiency 77%

-5V efficiency 30%

All loads are in Watts

L1 = 5V primary load (load on just 5V supply)

L3 = 12V load

L4 = -12V primary load (load on just -12V supply)

L5 = -5V load

L6 = -12V total load = $L4 + (L5/0.3)$

L7 = 5V total load = $L1 + (L3/0.9) + (L6/0.77)$

$L_{TOTAL} = L7$

$L_{TOTAL} < 50$ Watts

Note: Even though the total output power figure of 50 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 4 VPWR104HR SPECIFICATIONS

Host interface

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

Power supply specifications

Input voltage range

8-32V DC (36V absolute maximum)

Output Power (50W total)

+5V@10A
 +12V@2,0A
 -12V@500mA
 -5V@100mA

Input Surge Current

27 Amps for 15 uSec

Efficiencies

5V efficiency 90%
 12V efficiency 90%
 -12V efficiency 77%
 -5V efficiency 30%
 Overall 50%

Maximum Board Power dissipation(worst conditions)

13 Watts

Output voltage regulation

+5% (max)

Connectors

Power connectors

Phoenix Contact
 Combicon Series
 PC/104 bus

Host bus

PC/104 stack-through (Optionally no bus connectors)

Electromechanical

Operating temperature range

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

Maximum Internal power dissipated by LEDs and internal circuitry
1.85 Watts

Chapter 5 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 6 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 MERCHANTABILITY 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.

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