IPWR104HR-60/100W Isolated PC/104 Power supply module

User's Manual

BDM-610020007
Rev. B

ISO9001 and AS9100 Certified

IPWR104HR-60/100W
Power supply module
User's Manual

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Revision History

01/06/1998	HW Release 1.0
16/03/1999	HW Release 2.0 CE information included
28/06/1999	Small corrections made
10/07/2001	name of company changed and formatted
Rev. A	New manual naming method
Rev. B	Added step response and additional specifications
Rev. C	note about X1 jumper conversion to a wire bridge

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Chapter 1 INTRODUCTION

This user's manual describes the operation of the IPWR104HR high power density galvanically isolated power supply unit for automotive and industrial applications.

Features

Some of the key features of the IPWR104HR include:

- Wide input voltage range 18-36V DC or 36 to 75V DC
- 60W / 100W output power guaranteed ***with adequate cooling***, 88% efficiency
- Remote ON/OFF operation (at request)
- Power output options include: +5V, +12V, -12V
- Three status LED's
- Standard floppy power output connector (J12)
- Fully PC/104 compliant
- DC/DC converter conforms to UL1950 , EN60950 and CSA22.2 #234
- Extended operating temperature (-40 to +85 C) available in IDAN enclosures

The following paragraphs briefly describe the major features of the IPWR104HR. A more detailed discussion is included in Chapter 3 (Hardware description) The board installation is described in Chapter 2 (Board Installation).

Power supply units

The IPWR104HR isolated power supply unit offers a complete reliable power subsystem for your sophisticated computer and peripherals. To improve reliability in noisy environments, the IPWR104HR is designed using an isolated power supply module for the computer and the peripheral system components. This enables reliable system operation in distributed industrial installations.

The main +5V computer power supply is designed using a monolithic switching regulator module providing high output current (12A) with a high efficiency (88%) under all conditions. The secondary peripheral power supplies are designed using +12V and -12V "boost" converters.

The IPWR104HR can be "switched off" from a remote source. If this switch (jumper) is opened the power supply will become inactive while still powered.

Board options

The IPWR104HR is available in two main output configurations as set out below:

Option 1	***IPWR104HR-H***	+5V, +12V, -12V outputs, 33-75V input range
Option 2	***IPWR104HR-L***	+5V, +12V, -12V outputs, 18-36V input range

Mechanical description

The IPWR104HR is designed on a PC/104 form factor. An easy mechanical interface to both PC/104 and EUROCARD systems can be achieved. Stack your IPWR104HR directly on a PC/104 compatible computer using the onboard mounting holes. Care must be taken to ensure adequate heat dissipation from the onboard heat sink in high output power installations. (RTD can offer heat sinks for the DC/DC converter).

Connector description

The power connections can be made with "cable plug" type terminal blocks. This enables removing connections from the board without opening the cables from the terminal blocks. A 4-pole "floppy type" connector is also available for easy wiring to PC peripherals.

What comes with your board

Your IPWR104HR package contains the following items:

- IPWR104HR board with mating connectors for the 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 IPWR104HR module and get it working quickly, while also providing enough detail about the board and it's functions so that you can enjoy maximum use of it's features even in the most demanding applications.

When you need help

This manual and all the example programs 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 sales@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 the problem.

Chapter 2 BOARD INSTALLATION

The IPWR104HR 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 EUROCARD boards is achieved. This chapter tells you step-by-step how to install your IPWR104HR 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 may 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 18 to 36V DC or 36 to 72V DC.
- Apply power to your IPWR104HR, and make sure the diagnostic LED's will 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 supplies using the power interface connectors.

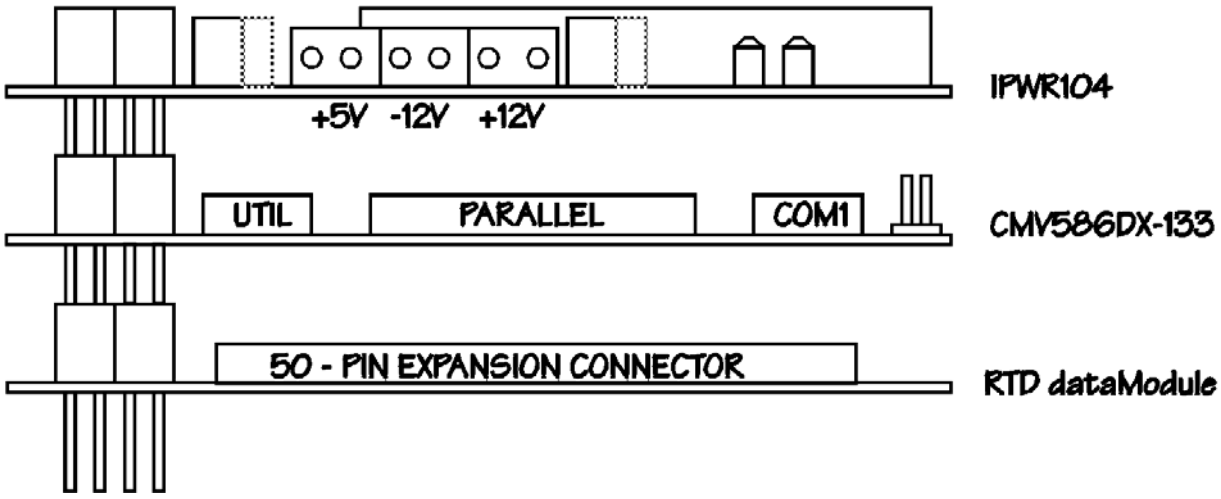


Fig. 1-1: IPWR104HR integrated in a RTD PC/104 cpuModule stack

Note: For the full output power performance, install your IPWR104HR at the top of your PC/104 system and make sure adequate cooling is provided. You may wish to increase airflow with the EFAN104 fan module available from Real Time Devices.

3U rack or enclosure installation with EUROCARD CPU and IPWR104HR.

The PC/104 system can easily be inserted into a 19" rack installation using the CPU as a "form factor adapter". Assemble your PC/104 data modules on a RTD single board EUROCARD computer and install the system in a 19" enclosure.

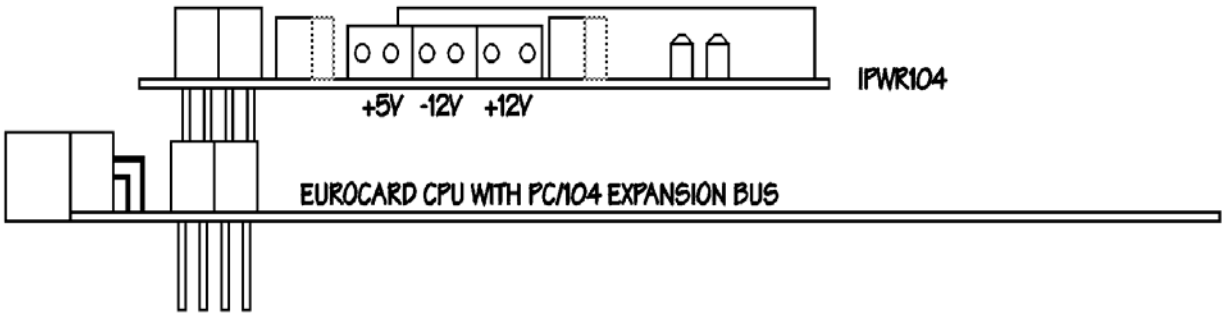


Fig. 1-2: 19" Eurocard rack installation with IPWR104HR and a EUROCARD cpuModule computer

External power connections

The illustration 1-3 below shows the power connections of the IPWR104HR board.

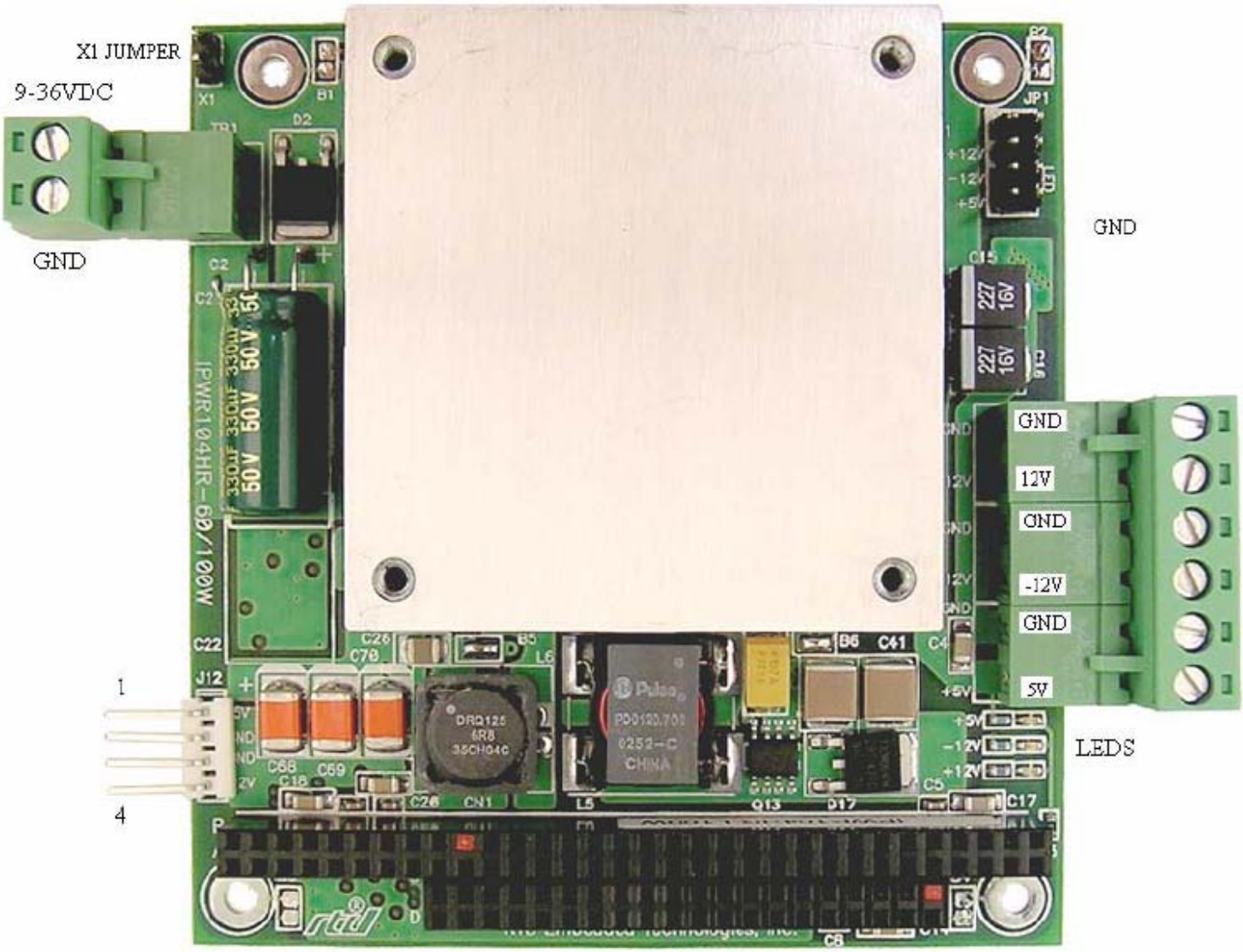


Fig. 1-3 IPWR104HR power supply power connections

Connector descriptions:

- ***J1*:** Input power to the IPWR104HR. Input voltage ranges 18-36V / 36-72V DC.

Note: The module input power may be up to 75 W (4A), this will require a cable wire diameter of 1,5 to 2,0 sq. mm. Make sure this input wire is kept as short as possible to reduce voltage drops.

- ***J2***: +5V Output of the main power supply
- ***J11:*** -12V Output (Only on -2 versions of IPWR104HR)
- ***J4:*** +12V Output (Only on -2 versions of IPWR104HR)
- ***J12*:** Floppy power output connector , +5V and +12V outputs:
  Pin #1 +5V, #2,3 GND and pin #4 +12V
- **X1:** Remote ON/OFF , close this jumper to disable the IPWR104HR

Note: The X1 jumper has been replaced by a wire to improve vibration performance. If the customer requires the remote ON/OFF function, contact the factory for details.

Chapter 3 - HARDWARE DESCRIPTION

This chapter describes the major features of the IPWR104HR, which are the following:

- The main +5V converter for the computer and PC/104 bus
- The secondary power output converters +12V and -12V for peripheral devices
- Onboard status LED's
- Fuses and protection
- Output power calculations
- Power derating of the +5V converter

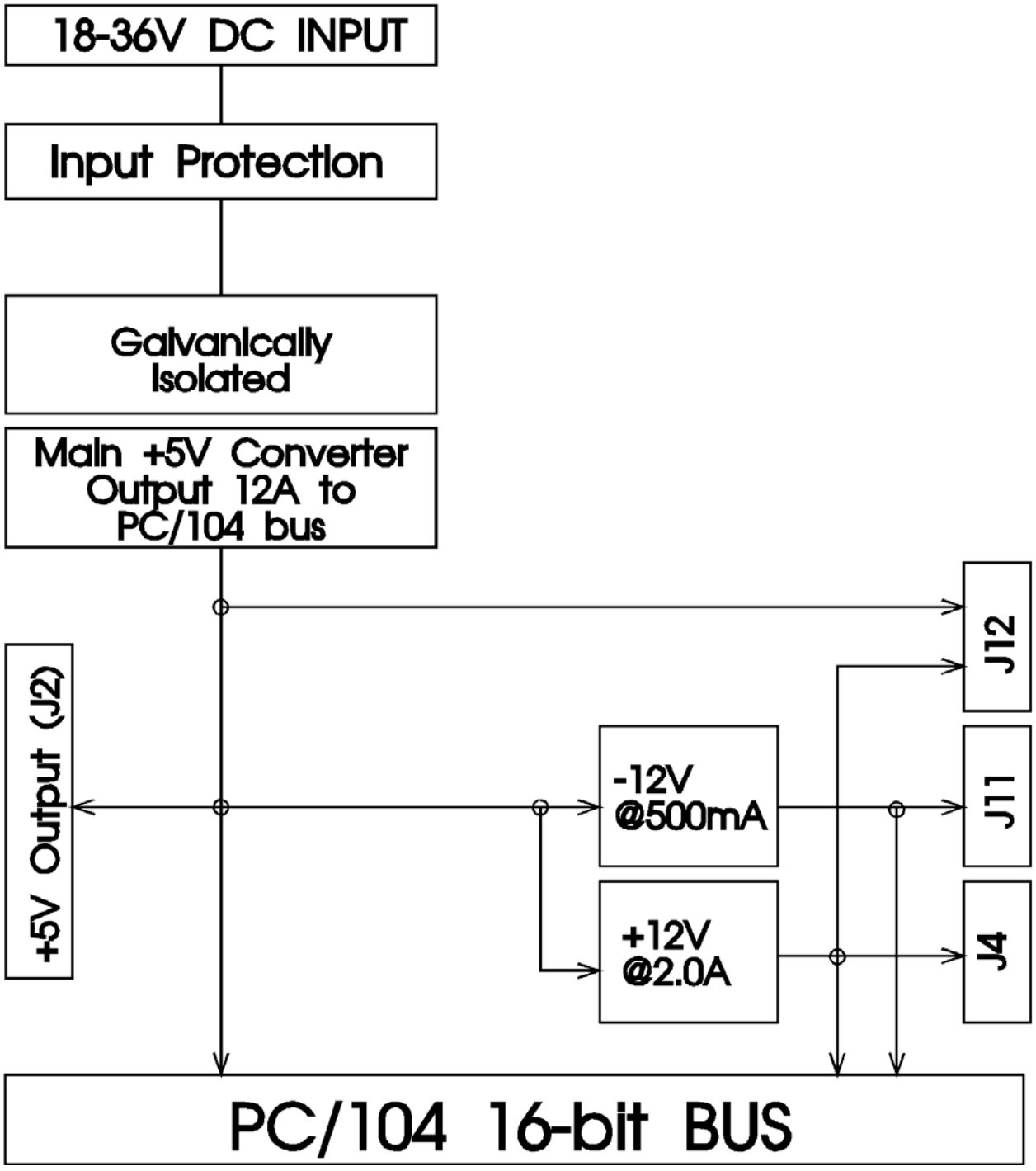


Fig. 2-1 Block diagram of the IPWR104HR-L (-H has a 33-75V input range)

60

Main +5V converter for computer

The main +5V output is implemented with a monolithic, switch-mode DC-DC converter module. The output current of this unit is 12A or 20A for the 60W and 100W versions. This converter has excellent dynamic and transient response capabilities making it an ideal high-speed computer power supply. The output current is internally limited against over current and short circuit faults.
The input of this converter is protected with a transient absorber diode and a Schottky diode. These devices are necessary to protect the input in automotive and industrial installations against overvoltage spikes and reverse voltage transients. These situations exist in vehicle systems that use electrically controlled hydraulic or pneumatic inductive valves.
The main +5V DC/DC converter is galvanically isolated. This improves reliability in airborne and industrial applications. Isolation voltages can reach 1.5 KV.
The main +5V converter feeds the PC/104 AT bus +5V pins with power. This power can be taken from the board from an external terminal block. (See previous section for location of 5V output.)

Current Limit

To the device protect against fault or short-circuit conditions, the +5V DC/DC converter module is equipped with a current limiting circuitry to provide continuous overload protection. After reaching the current limit point, (typically 30 to 50% over the rated current) this circuit will be active. 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-power connector terminal block is the remote ON/OFF selection switch. Closing this connection will enable the IPWR104HR and place the primary side circuits “ON”. When the X1 jumper is closed the IPWR104HR will consume approximately 2.5W of power with no load. When the X1 jumper is open the IPWR104HR will consume approximately 0.129W of power.

Secondary +12V and -12V converters for peripherals

A 5V to +-12V converter, with 92%(+12) and 83%(-12) efficiency, generates power for peripheral devices such as EL- or TFT- panels, Hard drives, motors etc. The +12V output delivers 2.0A of current. The +12V power is available from terminal block TB3. The -12V power at 6 Watts is available from terminal block TB4. (See previous section for locations.) . The +12V and -12V supplies also power the PC/104 bus.

Onboard status LED's

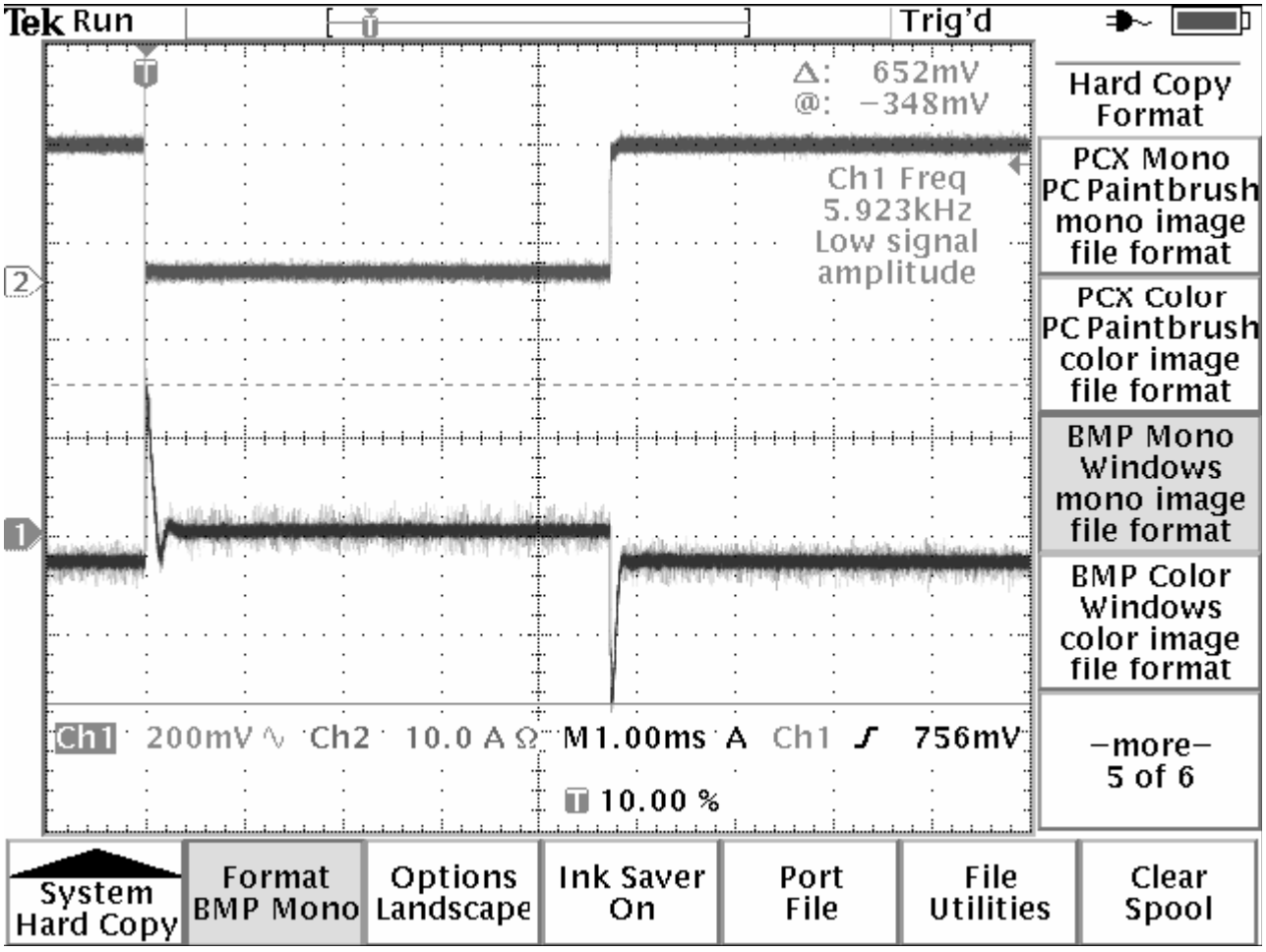
The IPWR104HR is equipped with three voltage-LEDs. These LEDs are near the edge on the board and labeled +5V, +12V, and -12V. If these LEDs are evenly lighted then the board voltages are in specification. If they are unevenly lighted, check the output voltages.

Output power calculations

The maximum available power for the +5V computer system can be estimated using the following formula:
I1 = (+12V output current)
I2 = (-12V output current)
I3 = (+5V auxiliary output current)
I4 = (+5V output current to bus)
Load = (I1*12)/0.922 + (I2*12)/0.838 + (I3*5)/0.836 + (I4*5)/0.836
Load < 60W or Load < 100W

The absolute maximum long-term output figures are:
+12V -> 2.0A
-12V -> 0.5A
+5V -> 12A for 60Watt module and 20A for 100Watt module

Note: Even though the total output power is not exceeded you 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 airflow may be necessary. See the following passage for more information on thermal behavior of your IPWR104HR.

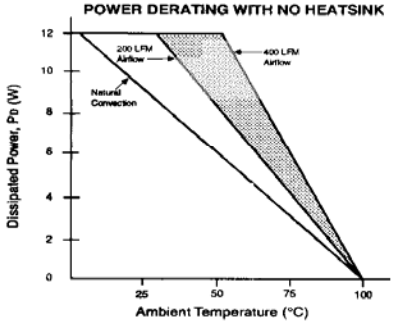


Step response 10% and 72% loads at 500 Hz. Stepping load from 2 Amps to 14.4 Amps. Step load rise time 200 nSec. Peak deviations stay within 7%. Deviation duration 115.0 uSec. Measured at the 5V output.

Power Derating

POWER DERATING

POWER DERATING WITH NO HEATSINK



Thermal Equations

1) Efficiency = $\eta = P_{OUT} / P_{IN}$
2) Dissipated Power = $P_D = P_{OUT} \{(1-\eta)/\eta\}$
3) Temperature Rise = $P_D \times \Theta_{BA} = P_{OUT} \times \Theta_{BA} \{(1-\eta)/\eta\}$
4) Maximum Output Power
   $= \{T_{CASE}(max) - T_A\} / [\Theta_{BA}\{(1-\eta)/\eta\}]$
5) Minimum Thermal Impedance
   $= \{T_{CASE}(max) - T_A\} / [P_{OUT}\{(1-\eta)/\eta\}]$

Example 1: The maximum operating ambient temperture to provide an output of 5V at 10A using natural convection.

Output = 5V x 10A = 50 Watts
% of full load = 10A/12A x 100% = 83%

From graph of efficiency vs load current, η = 88%

$P_D = P_{OUT} \{(1-\eta)/\eta\} = 50W \{(1-.88)/.88\} = 6.8W$

From derating curve above, T_A (max) = 44°C/W

Example 2: The maximum output power available for a VKP60LS05 with no heatsink, 200 LFM and a maximum ambient temperature of 50°C.

T_{CASE} (max) = 100°C
T_A = 50°C
Θ_{BA} = 5.5°C
η = 88% (0.88)

Max Output Power
$= \{T_{CASE}(max) - T_A\} / [\Theta_{BA} \{(1 - \eta)/\eta\}]$
$= (100-50)$ °C/[5.5°C/W $\{(1-.88)/.88\}] = 66.7$ watts

THERMAL IMPEDANCE CHART

AIR FLOW	Θ_{BA}* (°C/W) NO HEATSINK	NOTE (1)	NOTE (2)	NOTE (3)
Free Air	8.2	7.4	5.1	7.9
200 LFM	5.5	5.0	3.2	5.3
400 LFM	4.0	3.6	2.3	3.7
600 LFM	3.2	2.9	1.9	3.0
800 LFM	2.8	2.5	1.6	2.6
1000 LFM	2.5	2.3	1.5	2.4

(1) With heatsink Kit #HSK-W4
(2) With heatsink Kit #HSK-L7
(3) With heatsink Kit #HSK-L4

* Values of Θ_{BA} for modules with added heatsinks have included a baseplate-to-heatsink thermal impedance of 0.1° C/W using a thermally conductive interface material.

Example 3: The thermal impedance necessary to cool a VKP60LS05 with 400 LFM at 55°C while providing 60 watts output power.

T_{CASE} (max) = 100°C
T_A = 55°C
P_{OUT} = 60 Watts
η = 88% (0.88)

Minimum Thermal Impedance
$= \{T_{CASE}(max) - T_A\} / [P_{OUT} \{(1-\eta)/\eta\}]$
$= (100-55)$ °C/[60W $\{(1-.88)/.88\}] = 5.49$°C/W

In order to provide 60 watts at 55°C, the following configurations are acceptable:

1) No heatsink with 300 LFM forced convection
2) Heatsink #HS-2324W4 with 200LFM forced convection
3) Heatsink #HS-2324L7 with natural convection

Chapter 4 IPWR104HR SPECIFICATIONS

Host interface

16-bit PC/104 bus connector

Power supply specifications

Input voltage range 18-36V DC for IPWR104HR-L versions
36-72V DC for IPWR104HR-H versions
Output Power +5V@12A and 20A (60W and 100W)
(100W device also available) +12V@2.0A
-12V@500mA
5V Efficiency IPWR104HR-L 88%
5V Efficiency IPWR104HR-H (measured at 36V Vin) (20A load) 83.6%
12V Efficiency (2A load) 92.2%
-12V Efficiency (0.5A load) 83.8%
Combined full load efficiency (all supplies fully loaded) 80.74%
Output voltage unloaded +5.05V (max)
Output voltage fully loaded +4,95V (min@12A)
No load power (measured at 36V on H unit) 2.5 Watts
Standby power (module disabled) (measured at 36V on H unit) 0.129 Watts
Thermal shut down temp. (measured at the 5V module case) 100°C
5V converter switching frequency 420KHz
+-12V converter switching frequency 250KHz

Connectors

Power connectors Phoenix Contact
Combicon-series
"mini-floppy" connector
Host bus AT PC/104 bus
(Optionally no bus connector)

Electromechanical

Operating temperature range 0 to +70° C
-40 to +85 C in IDAN or HiDAN
Base plate temperature (Max) +100° C
Internal power dissipation IPWR104HR-L 14W (Max) (cooling required)
Internal power dissipation IPWR104HR-H 22.51W (Max)

Chapter 5 CHAPTER 5 POWER SUPPLY DEBUG:

Turn on voltage spike is high:

Caused by long input power leads
Caused by input power leads that are not twisted
Curable by adding over 100uF to input

Power supply shuts down after running for some time

Caused by over temperature
Check case temperature of 5V converter
Curable by adding extra heat sinking and or air flow

Power supply power cycles

Check input power supply
    Input supply may not be able to supply enough instantaneous current
    Even two different input supplies of the same Wattage may behave differently
    Switch to a higher current input supply or a higher frequency input supply
Remove IPWR from stack and check for shorts on the outputs
Check voltage drop across input leads
    If they are too long, the voltage drop across them may cause the input at the IPWR to drop below its minimum value.

The voltage at my CPU is too low for it to start

Check the voltage drop over the bus
    Try moving the CPU closer to the IPWR in the stack
Remove boards from stack to isolated the board causing the power draw.

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.

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