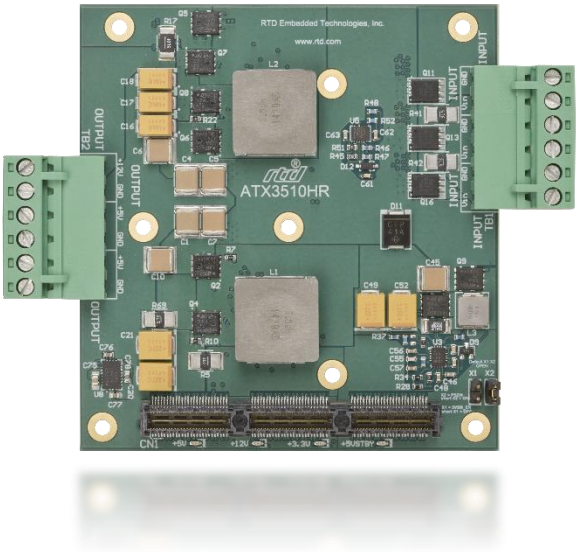
ATX3510HR-190W

PCIe/104 DC/DC Power Supply

User's Manual



BDM-610020096 Rev.I

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Revision History

Rev A	04/03/2012	Initial Release
Rev B	07/30/2012	Added IDAN Photos. Corrected Pin out of IDAN power input connector. Added heat sink photo.
Rev C	05/01/2014	Referenced mating connectors.
Rev D	02/20/2015	Added 3.3V to the design
Rev E	05/31/2016	Added new IDAN measured drawing (Figure 5) with the connector locations clearly displayed
Rev F	10/06/2016	Corrected Figure 3 and added information about the IDAN- XKCM44
Rev G	01/24/2017	Adjusting images for clarity.
Rev H	08/08/2019	Corrected block diagram.
Rev I	04/19/2024	Enhanced IDAN power cable connector description

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1 Introduction

1.1 Product Overview

The ATX3510HR is a 190 Watt embedded power supply with a PCIe/104 stackable bus structure. With 5V standby, 5V main, 3.3V, and 12V, this module is also input protected against over-voltage, over-current, and reverse voltage. This rugged power supply is synchronized to reduce noise and system stress. The small footprint and high power capabilities of the ATX3510HR-190W make it suitable for many technology-rich, high-reliability military, industrial, and research applications.

The ATX3510HR-190W was designed to meet the power requirements of the PCIe/104 Specification Version 2.01.

1.2 Board Features

- PCIe pass through bus
- 16.8 Amps of 5V
- 2.0 Amps of 3.3V
- 8.4 Amps of 12V
- 2.0 Amps of 5VSB
- Remote ON/OFF control
- Reverse voltage protection
- Input over voltage protection
- Input over current protection
- ATX functionality

The ATX3510HR-190W is available with the following options:

Table 1: Ordering Options

Part Number	Description
ATX3510HR-190W	Standard Configuration as pictured on cover
IDAN-ATX3510HR-190W	Board Mounted in IDAN frame
ID-ATX3510HR-190W	Board with screw terminals for power connections
ATX3510HR-190W-XNS	Standard Configuration as pictured on cover, except without downward express connector installed.
ID-ATX3510HR-190W-XNS	Board with screw terminals for power connections, except without downward express connector installed.
AC/DC-PS-190W	Recommended 24 V 220.8 Watt AC adapter
IDAN-AC/DC-PS-190W	Recommended 24 V 220.8 Watt AC adapter (for IDAN)

AC/DC-PS-190W ,Pictured above, recommended for powering the ATX3510HR-190W

The Intelligent Data Acquisition Node (IDAN™) building block can be used in just about any combination with other IDAN building blocks to create a simple but rugged 104™ stack. This module can also be incorporated in a custom-built RTD HiDAN™ or HiDANplus High Reliability Intelligent Data Acquisition Node. Contact RTD sales for more information on our high reliability systems.

1.3 Contact Information

1.3.1 Sales Support

For sales inquiries, you can contact RTD Embedded Technologies sales via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: sales@rtd.com

1.3.2 Technical Support

If you are having problems with you system, please try the steps in the Troubleshooting section of this manual.

For help with this product, or any other product made by RTD, you can contact RTD Embedded Technologies technical support via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: techsupport@rtd.com

2 Specifications

2.1 Operating Conditions

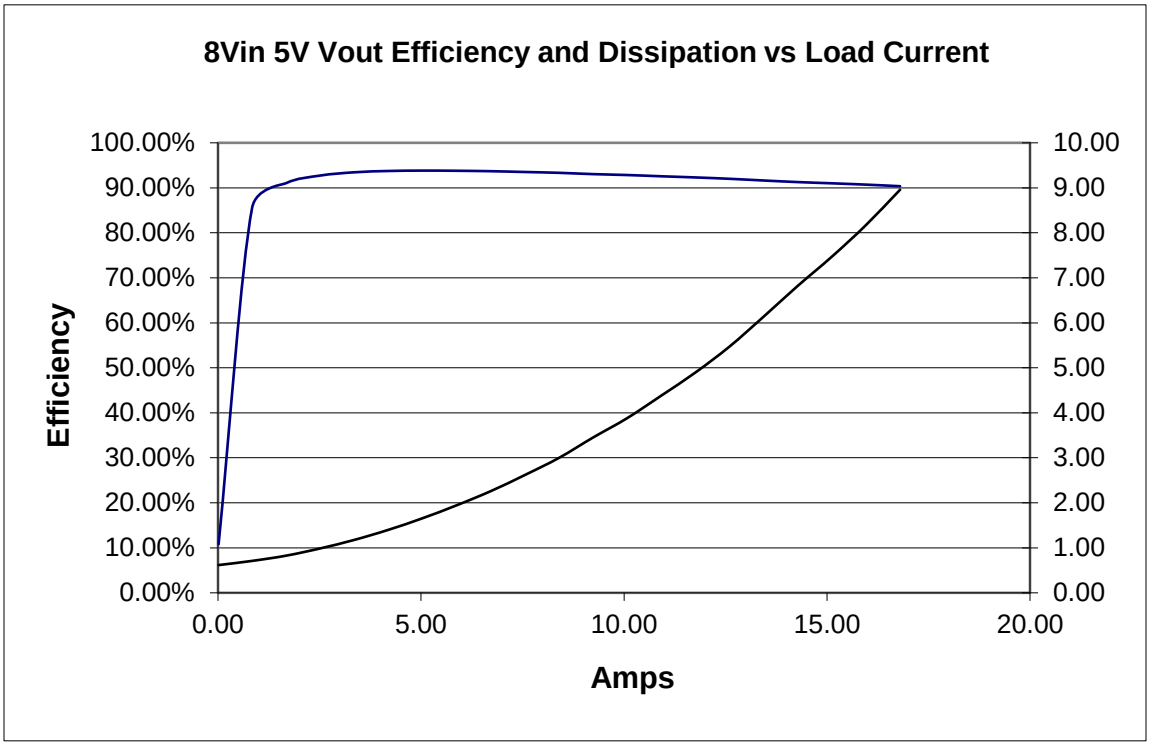
Table 2: Operating Conditions

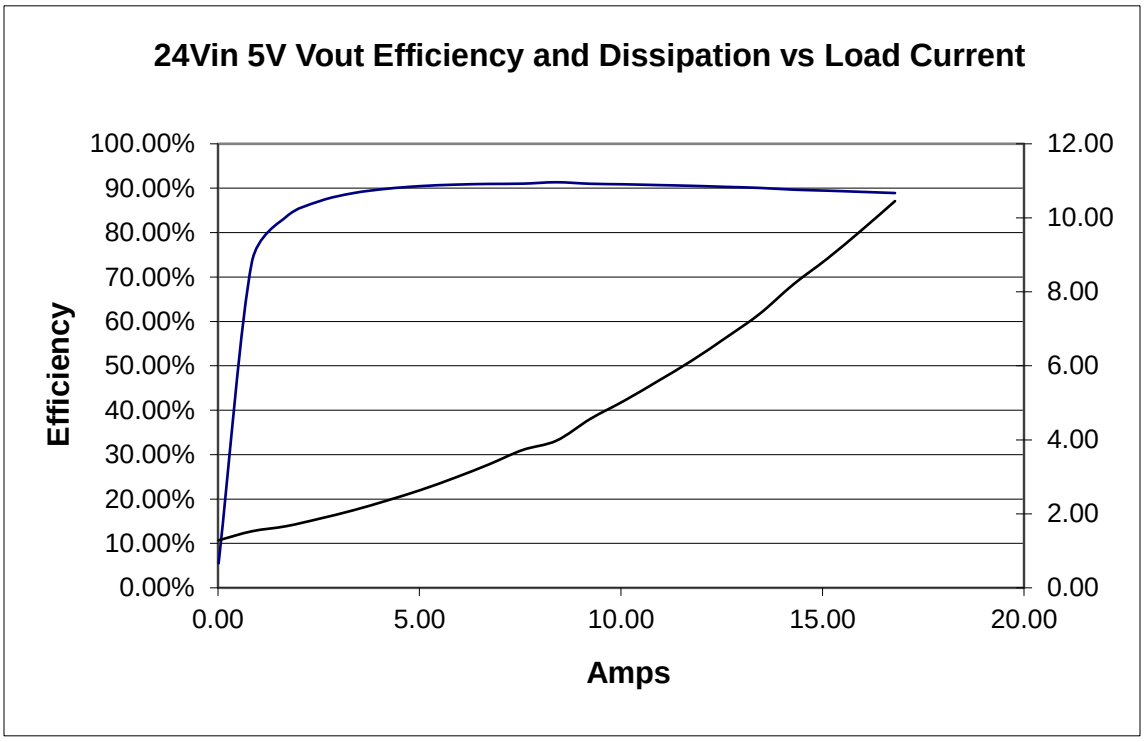
Symbol	Parameter	Test Condition	Min	Max	Unit
V_{in}	Supply Voltage		8.00	36.00	V
T_a	Operating Temperature		-40	+85	C
T_s	Storage Temperature		-55	+125	C
RH	Relative Humidity	Non-Condensing	0	90%	%
MTBF	Mean Time Before Failure	Telcordia Issue 2 30°C, Ground benign, controlled		TBD	Hours

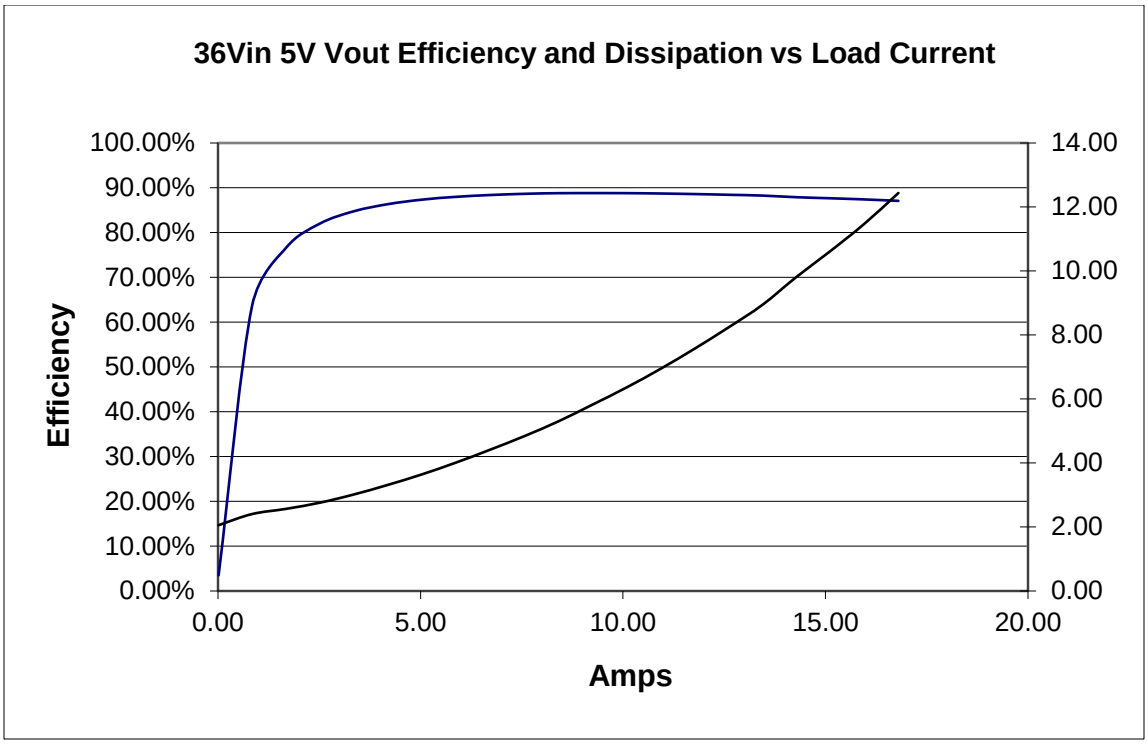
2.2 Electrical Characteristics

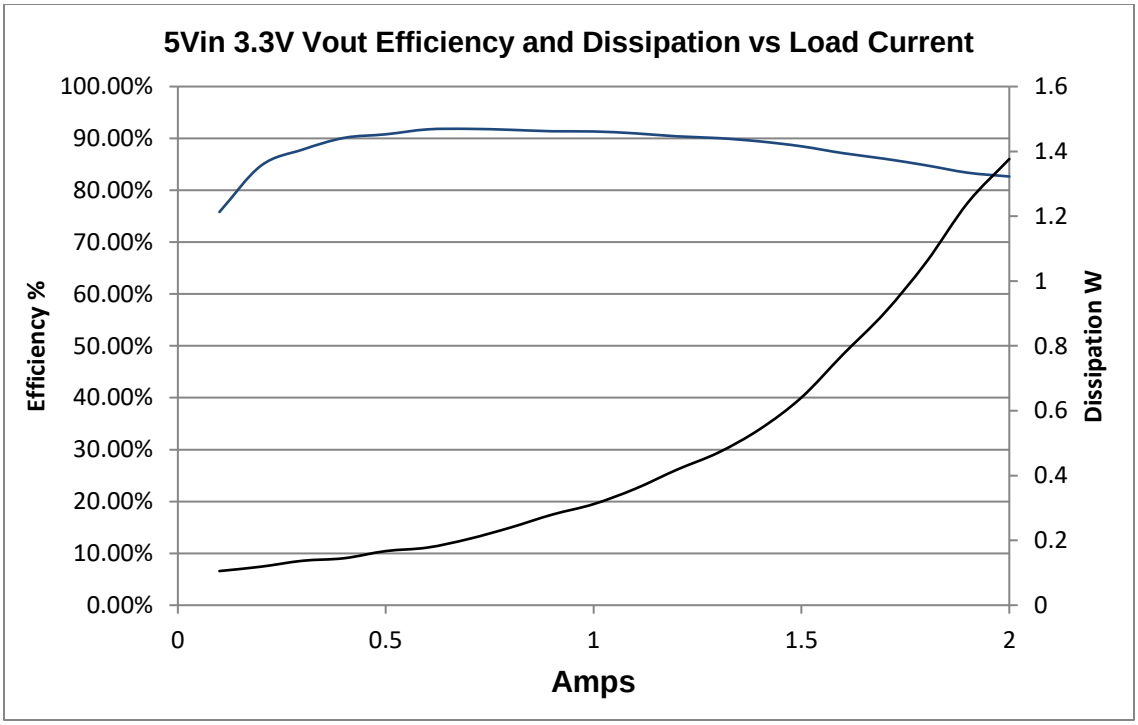
Parameter	Test Condition	Max	Unit
Power Dissipation	23°C 36.00V Vin four Hour Soak no Airflow no Heat Sink	21.9	W
Combined Efficiency 8Vin	23°C Max load	89.76	%
Combined Efficiency 24Vin	23°C Max load	91.04	%
Combined Efficiency 36Vin	23°C Max load	89.66	%
5V Efficiency with 8Vin	23°C 16.8 Amp load	90.36	%
5V Efficiency with 24Vin	23°C 16.8 Amp load	88.91	%
5V Efficiency with 36Vin	23°C 16.8 Amp load	87.08	%
3.3V Efficiency with5Vin	23°C 2.0 Amp load	82.66	%
5VSB Efficiency with 8Vin	23°C 2 Amp load	94.54	%
5VSB Efficiency with 24Vin	23°C 2 Amp load	91.21	%
5VSB Efficiency with 36Vin	23°C 2 Amp load	88.77	%
12V Efficiency with 8Vin	23°C 8.4 Amp load	90.40	%
12V Efficiency with 24Vin	23°C 8.4 Amp load	94.55	%
12V Efficiency with 36Vin	23°C 8.4 Amp load	93.63	%
5V DC Load Regulation	23°C	22.00	mV
3.3V DC Load Regulation	23°C	20.00	mV
5VSB DC Load Regulation	23°C	4.00	mV
12V DC Load Regulation	23°C	40.00	mV
5VSB P-P voltage ripple	23°C 2.0 Amp load	22.00	mV
5V P-P voltage ripple	23°C 16.8 Amp load	50.80	mV
3.3V P-P voltage ripple	23°C 2.0 Amp load	78.40	mV
12V P-P voltage ripple	23°C 8.4 Amp load	47.60	mV
Switching Frequency of 5V STBY, 5V, and 12V	23°C	400	KHz+-2%
Switching Frequency of 3.3V	23°C	4.23	MHz+-10%
Reverse Voltage Protection	23°C	-36	V

2.3 Efficiency Graphs






36Vin 5V Vout Efficiency and Dissipation vs Load Current
Efficiency
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
5.00
10.00
15.00
20.00
Amps


5Vin 3.3V Vout Efficiency and Dissipation vs Load Current
Efficiency %
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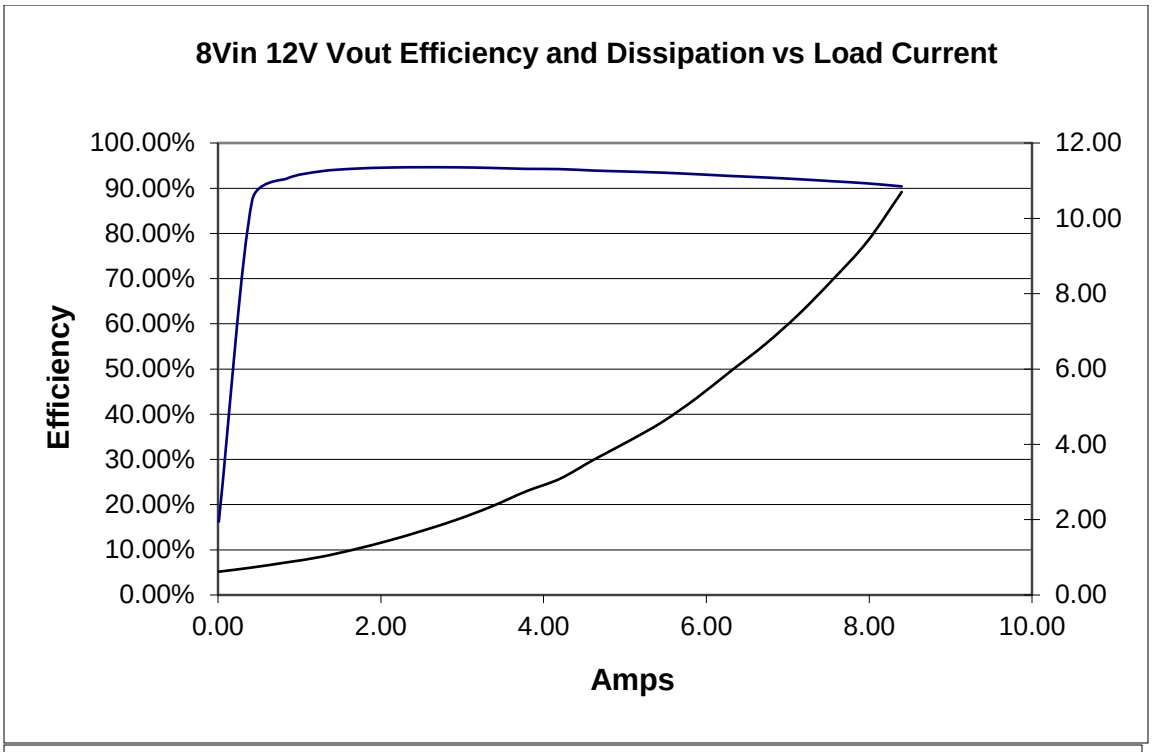
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dissipation W
0
0.5
1
1.5
2
Amps


8Vin 12V Vout Efficiency and Dissipation vs Load Current
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80.00%
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60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
12.00
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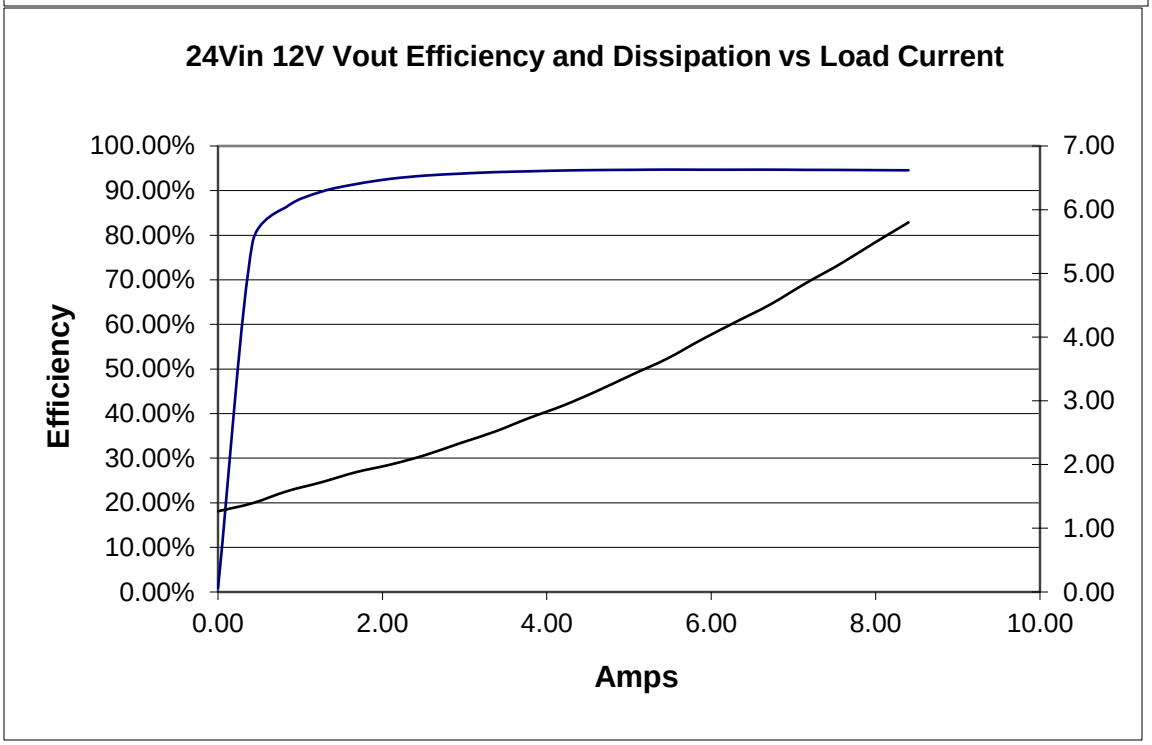
4.00
6.00
8.00
10.00
Amps


24Vin 12V Vout Efficiency and Dissipation vs Load Current
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70.00%
60.00%
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30.00%
20.00%
10.00%
0.00%
7.00
6.00
5.00
4.00
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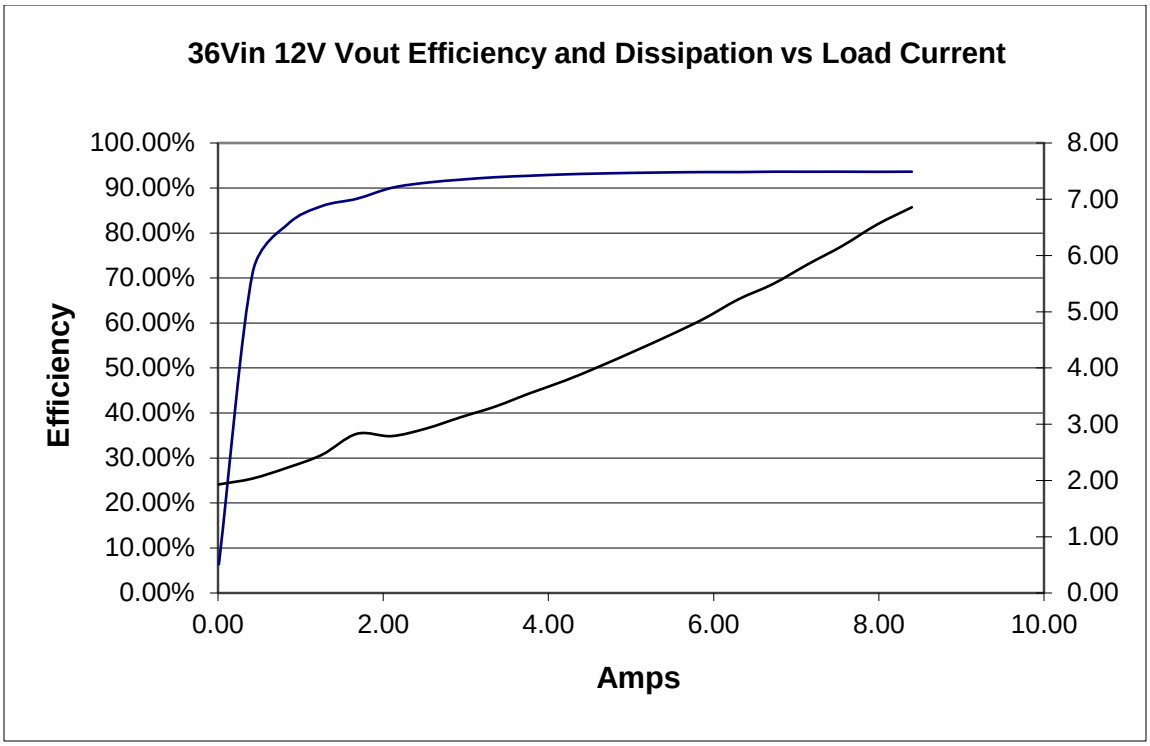
4.00
6.00
8.00
10.00
Amps


36Vin 12V Vout Efficiency and Dissipation vs Load Current
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70.00%
60.00%
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40.00%
30.00%
20.00%
10.00%
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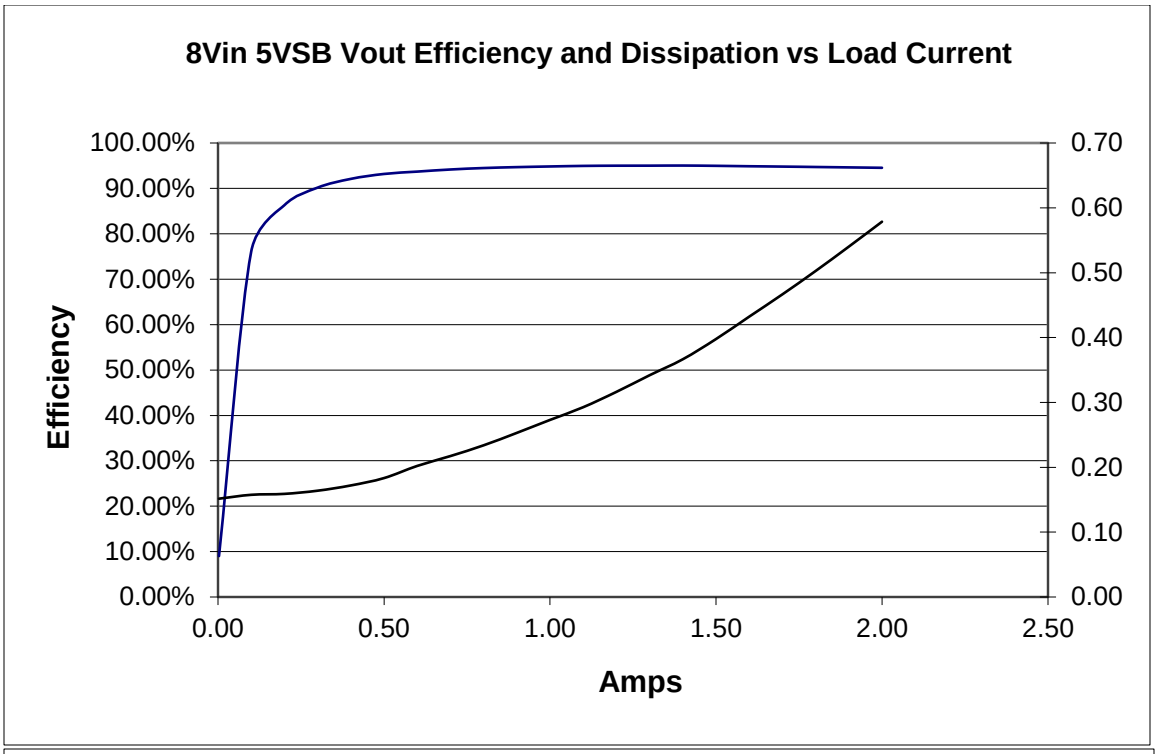
Amps


8Vin 5VSB Vout Efficiency and Dissipation vs Load Current
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70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
0.70
0.60
0.50
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0.20
0.10
0.00
0.00
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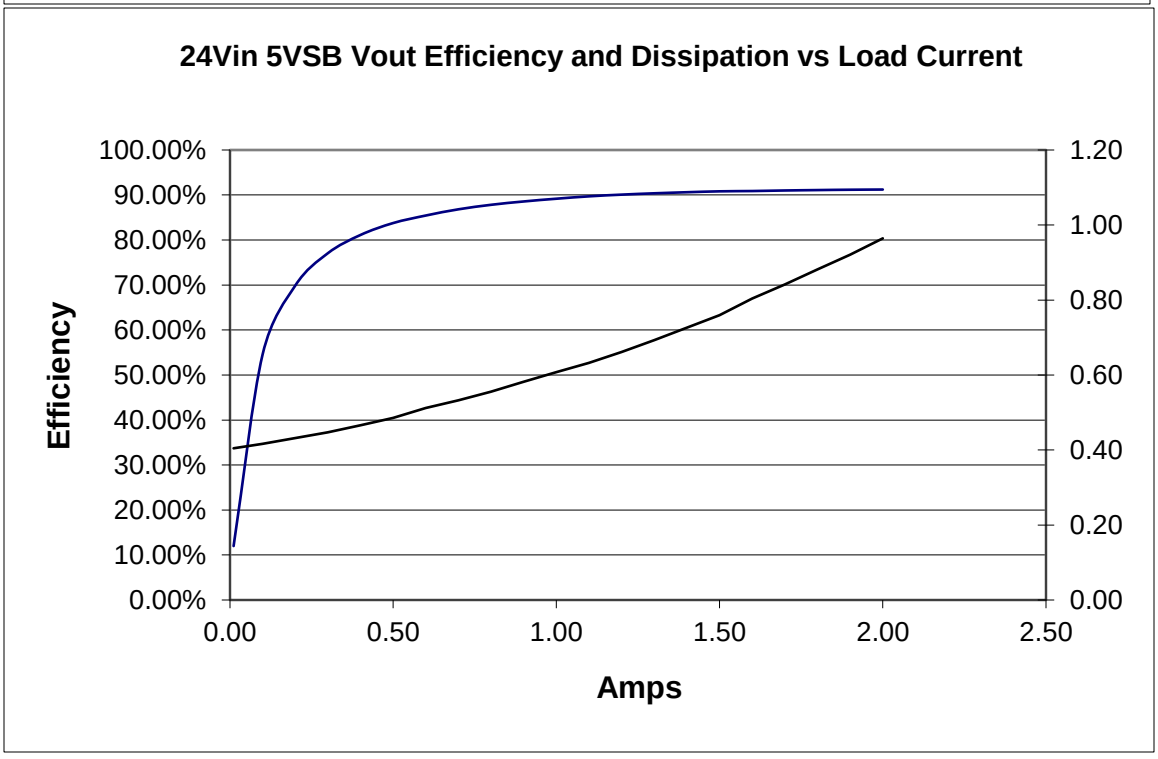
1.00
1.50
2.00
2.50
Amps


24Vin 5VSB Vout Efficiency and Dissipation vs Load Current
Efficiency
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90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
1.20
1.00
0.80
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0.40
0.20
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0.00
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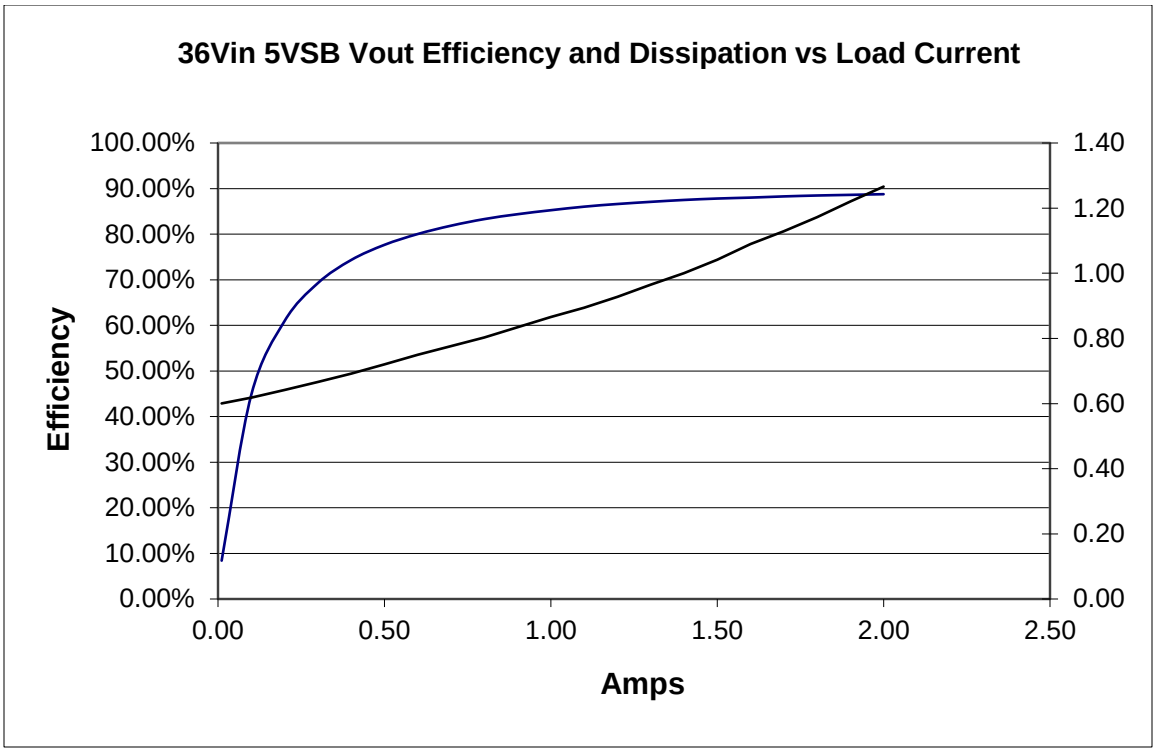
1.00
1.50
2.00
2.50
Amps


36Vin 5VSB Vout Efficiency and Dissipation vs Load Current
Efficiency
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90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
1.40
1.20
1.00
0.80
0.60
0.40
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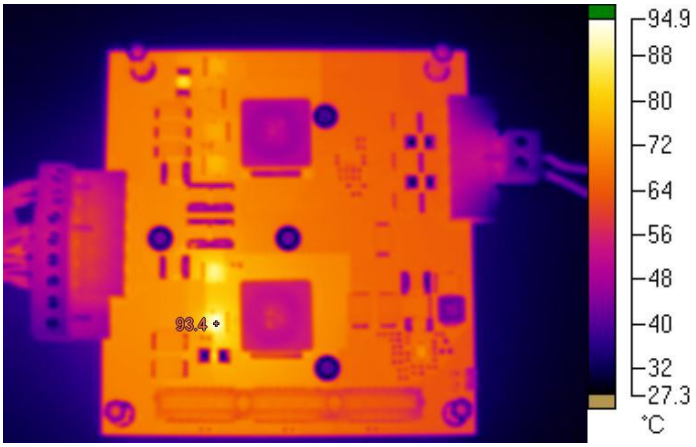
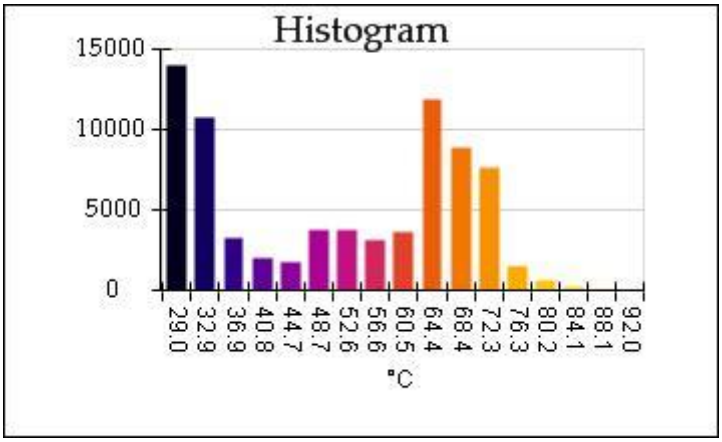
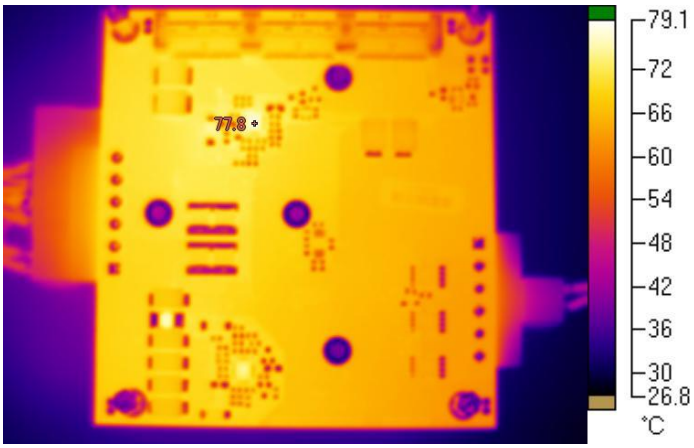
0.00
0.50
1.00
1.50
2.00
2.50
Amps

2.4 Thermal Image

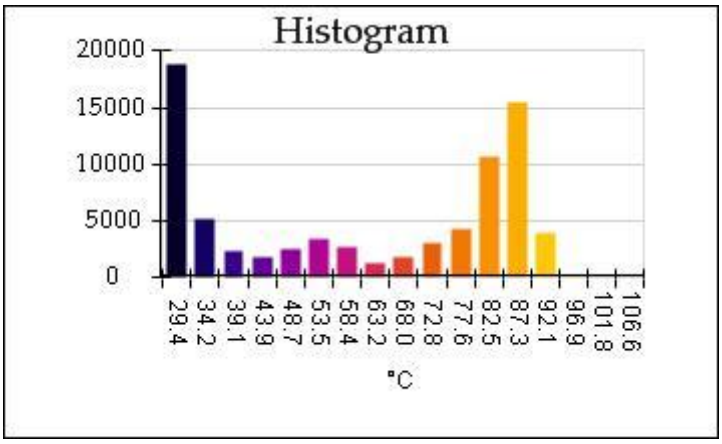


Top; No Heat Sink, 23°C, Max Load, 24Vin, At thermal equilibrium, Max temperature is 93.4C

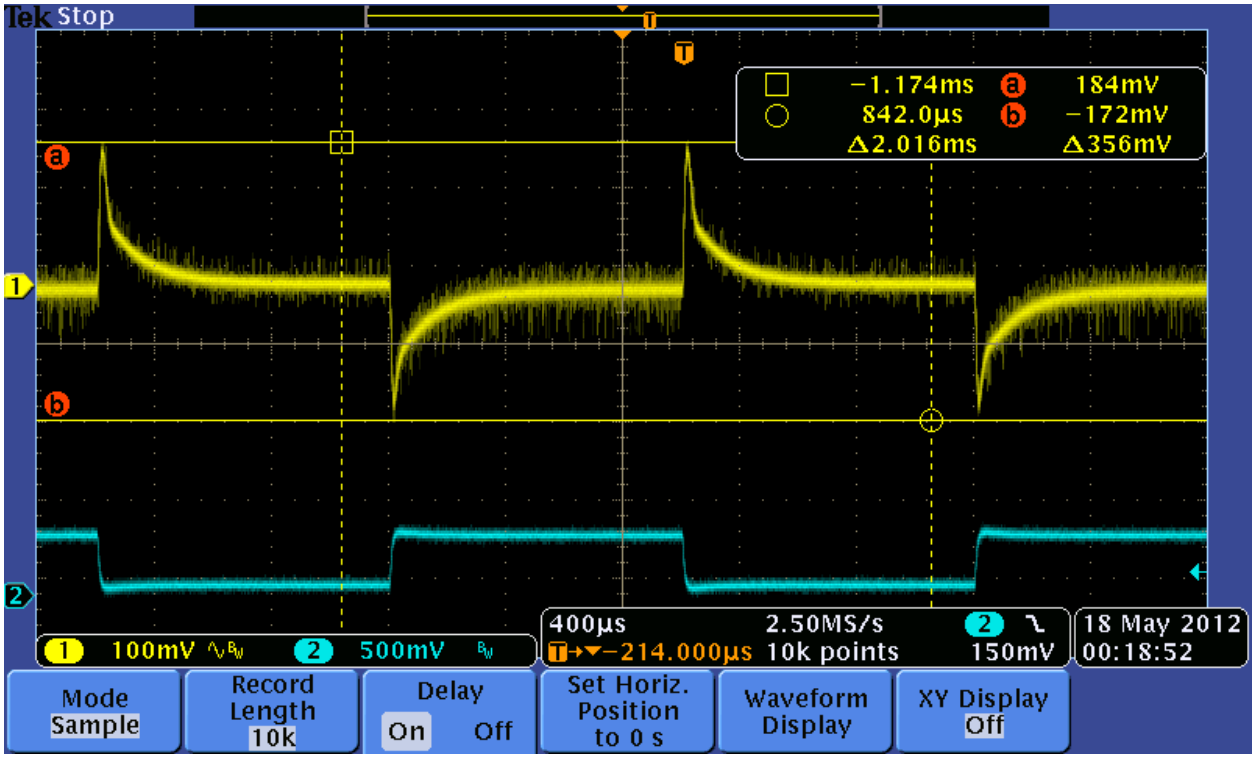




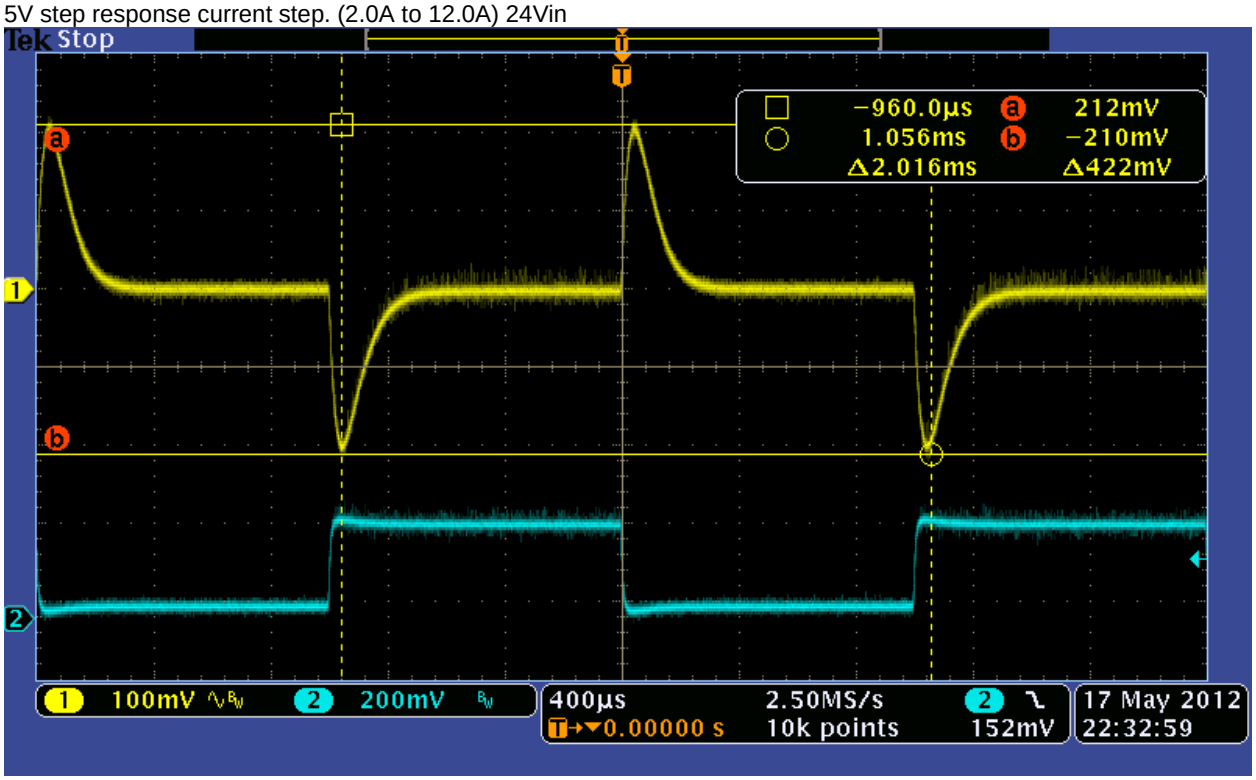
Bottom; No Heat Sink, 23°C, Max Load, 24Vin, At thermal equilibrium, Max temperature is 77.8C



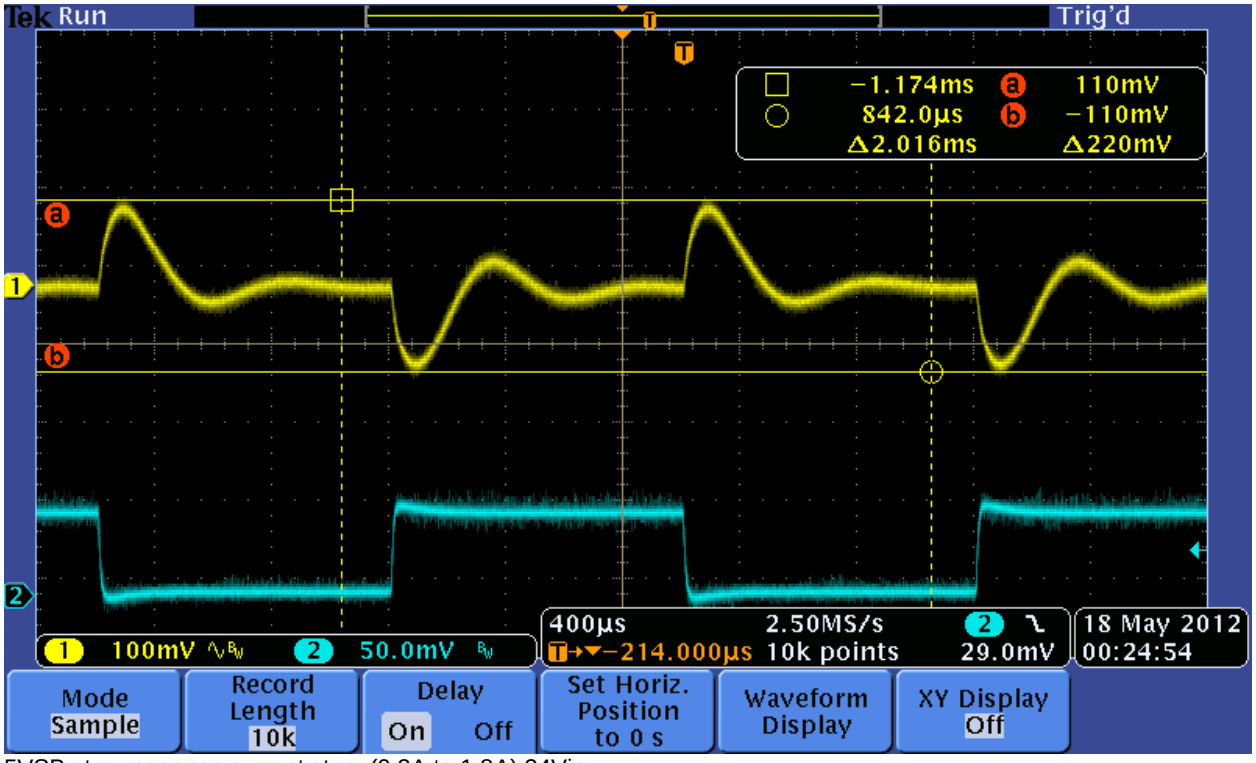
2.5 Step Response



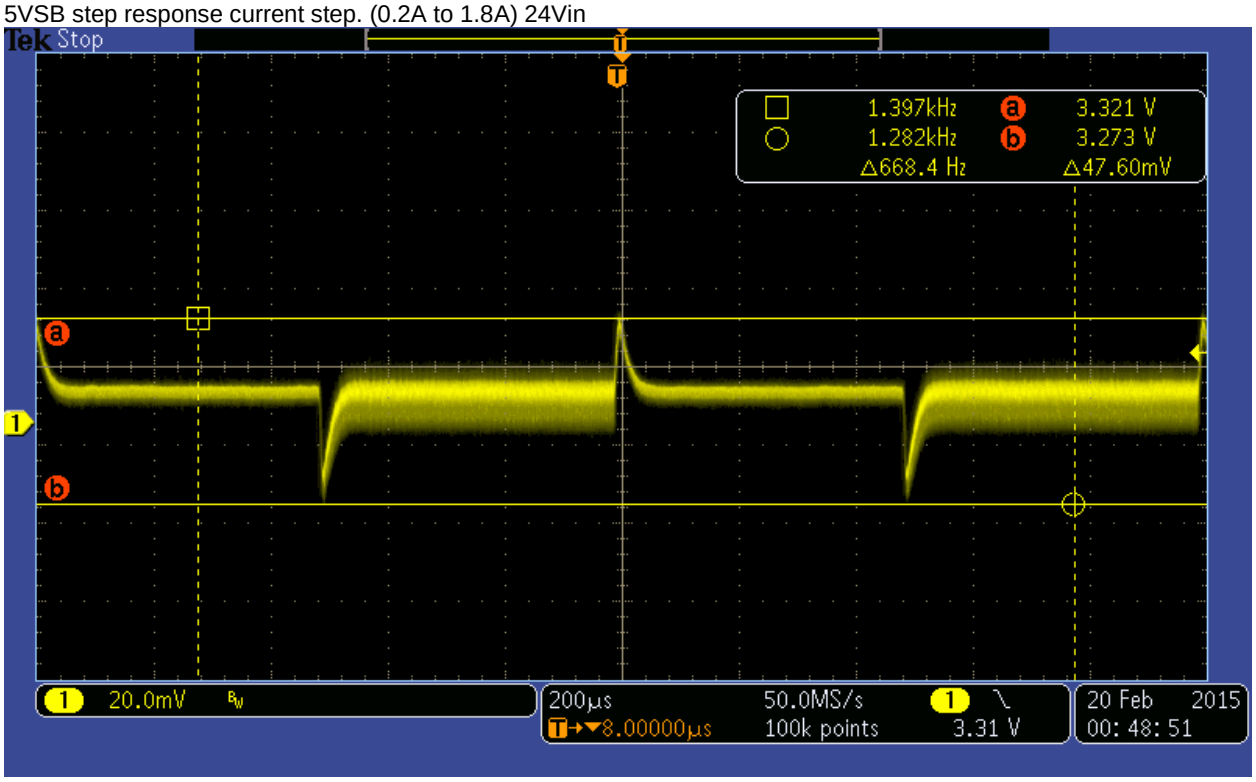
5V step response current step. (2.0A to 12.0A) 24Vin



12V step response current step. (2.0A to 12.0A) 24Vin

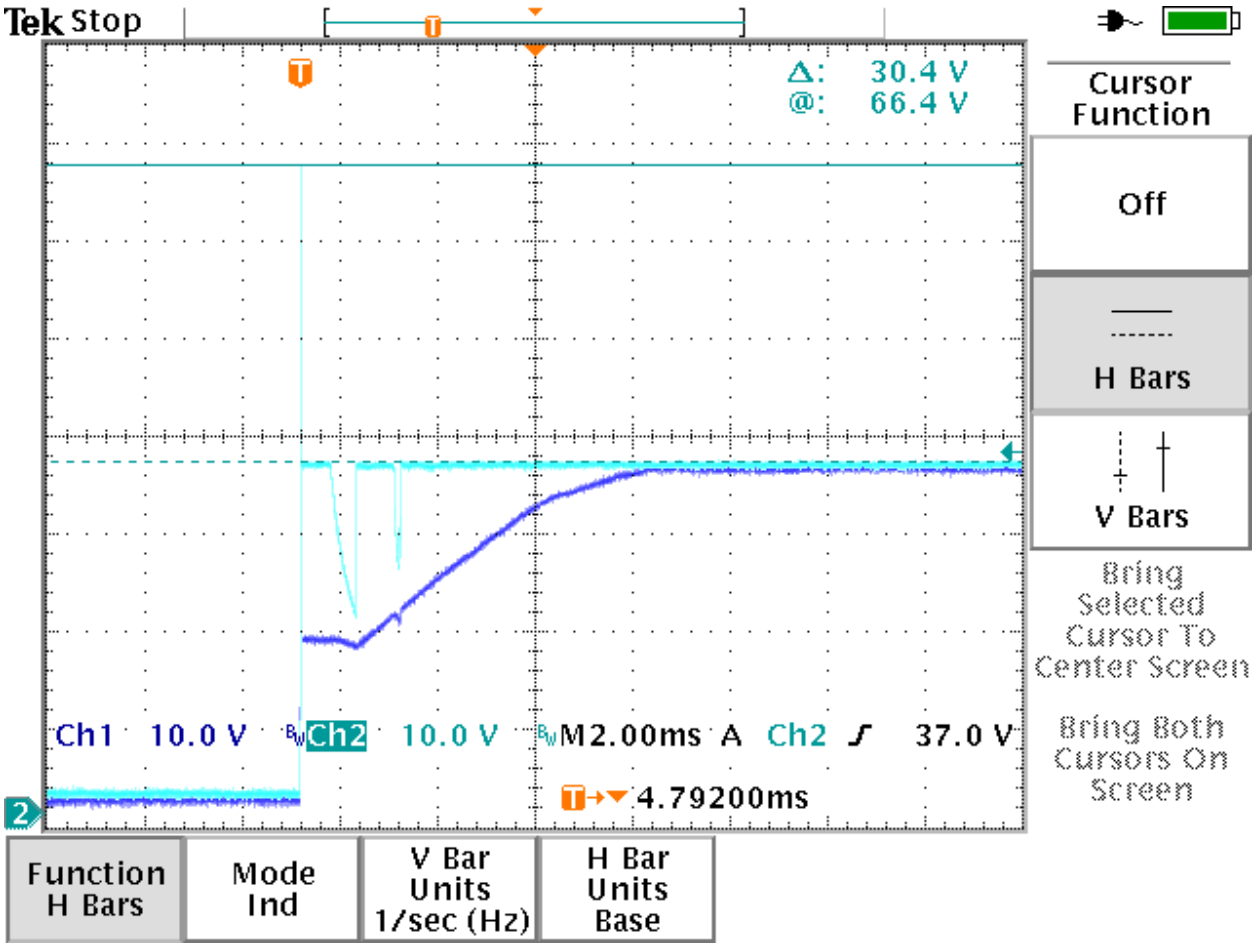


5VSB step response current step. (0.2A to 1.8A) 24Vin



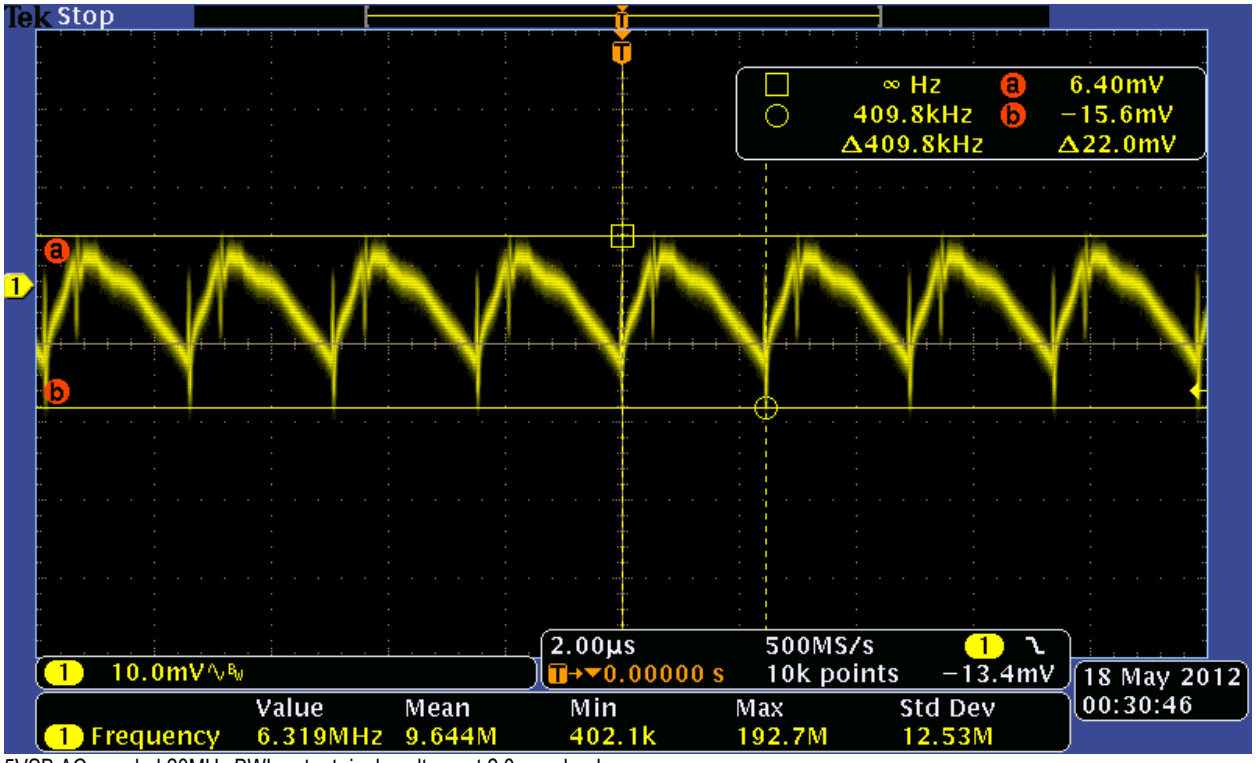
3.3V step response current step. (0.2A to 1.8A) 5Vin

2.6 Input Protection

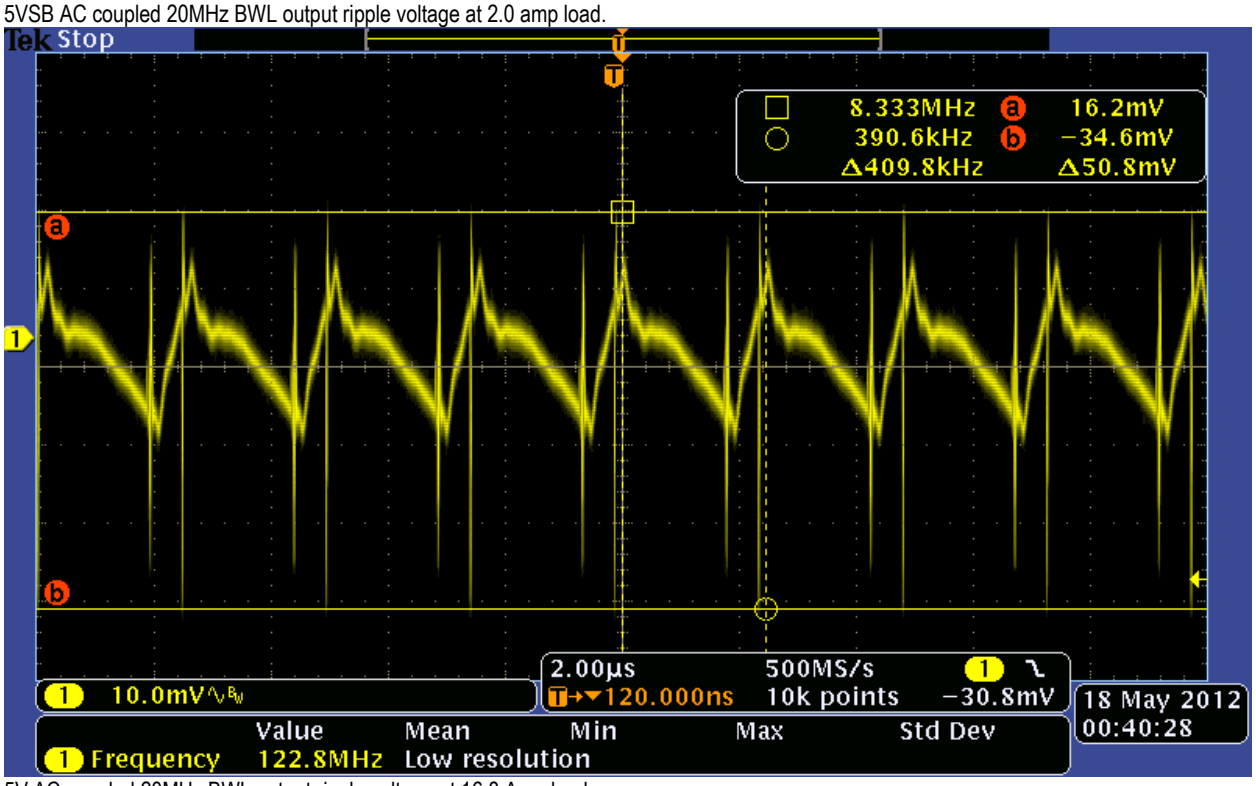


Input surge protection test. 36Vin and rocker switch produced a 66.4V spike but the input did not go above 36V

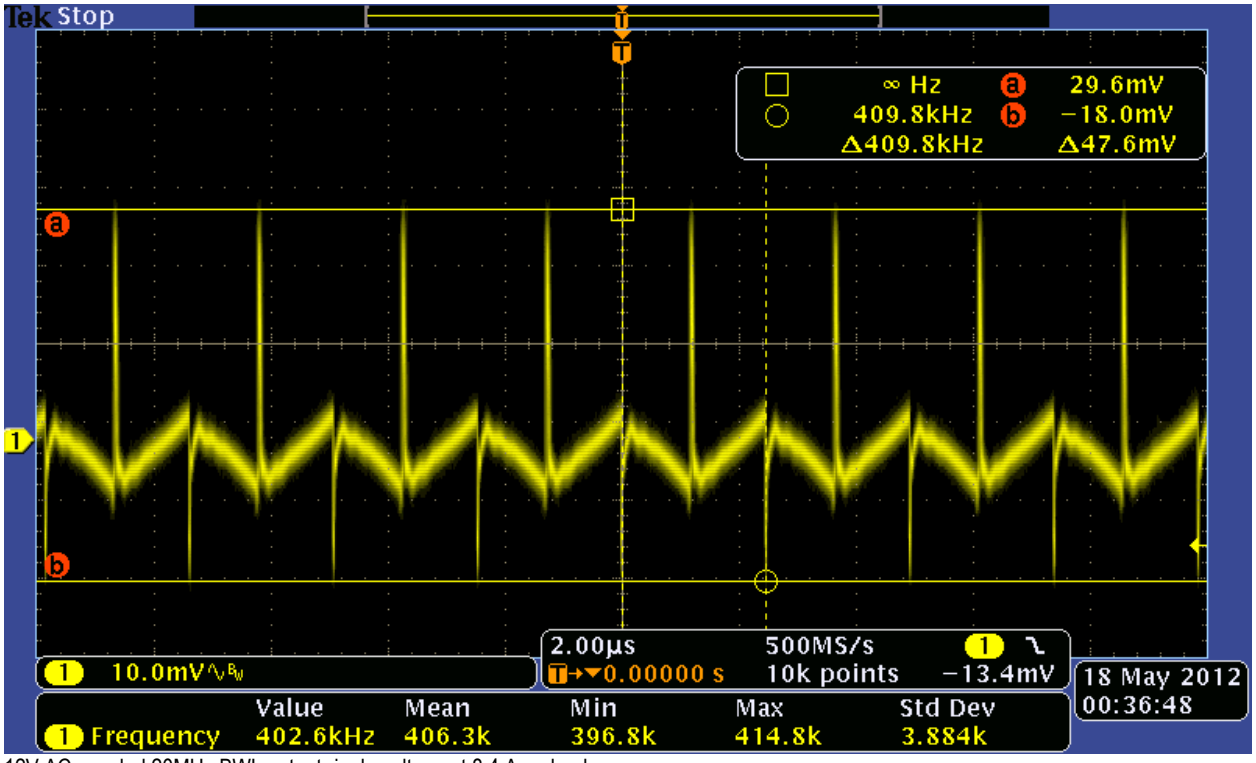
2.7 Ripple Voltage



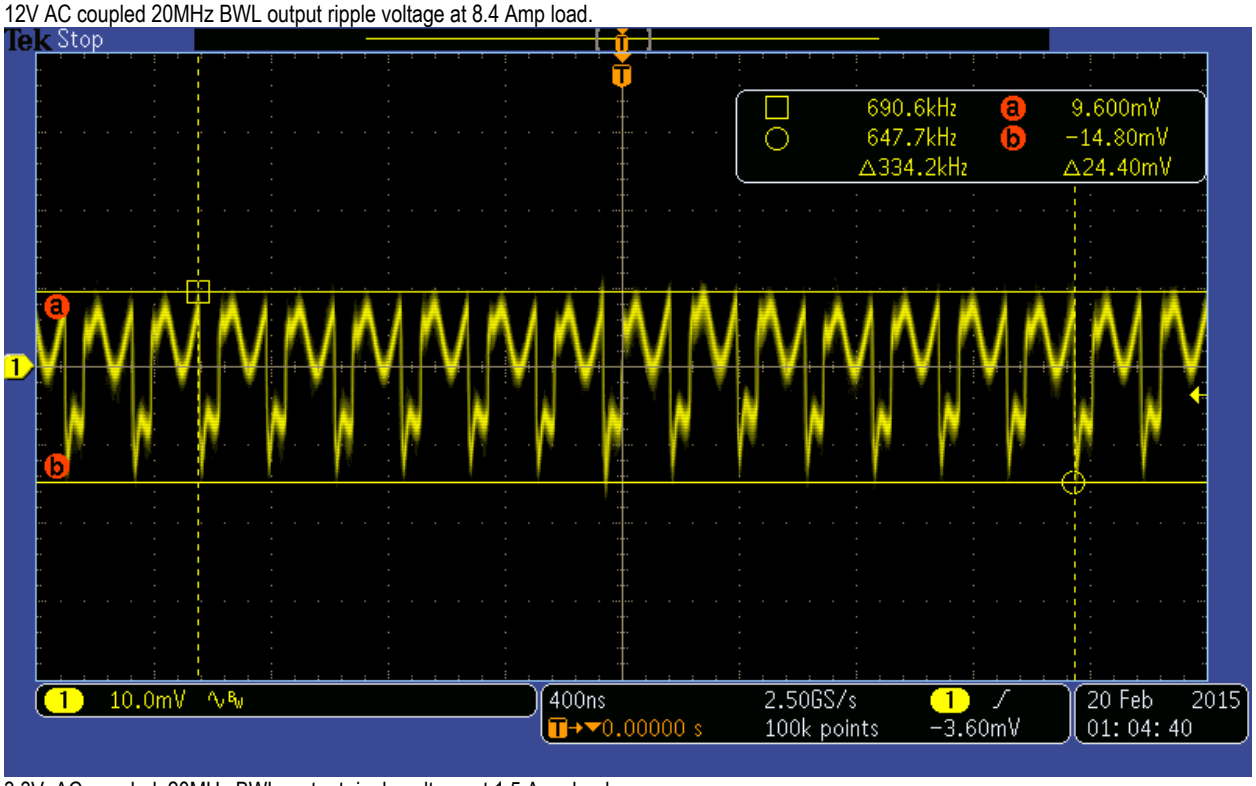
5VSB AC coupled 20MHz BWL output ripple voltage at 2.0 amp load.



5V AC coupled 20MHz BWL output ripple voltage at 16.8 Amp load.



12V AC coupled 20MHz BWL output ripple voltage at 8.4 Amp load.



3.3V, AC coupled, 20MHz BWL, output ripple voltage at 1.5 Amp load.

3 Board Connection

3.1 Board Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your board in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the board at the edges, and do not touch the components or connectors. Handle the board in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

3.2 Physical Characteristics

- Weight: Approximately 220g (0.48 lbs.) with heat sink
- Weight: Approximately 130g (0.28 lbs.) board only
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)

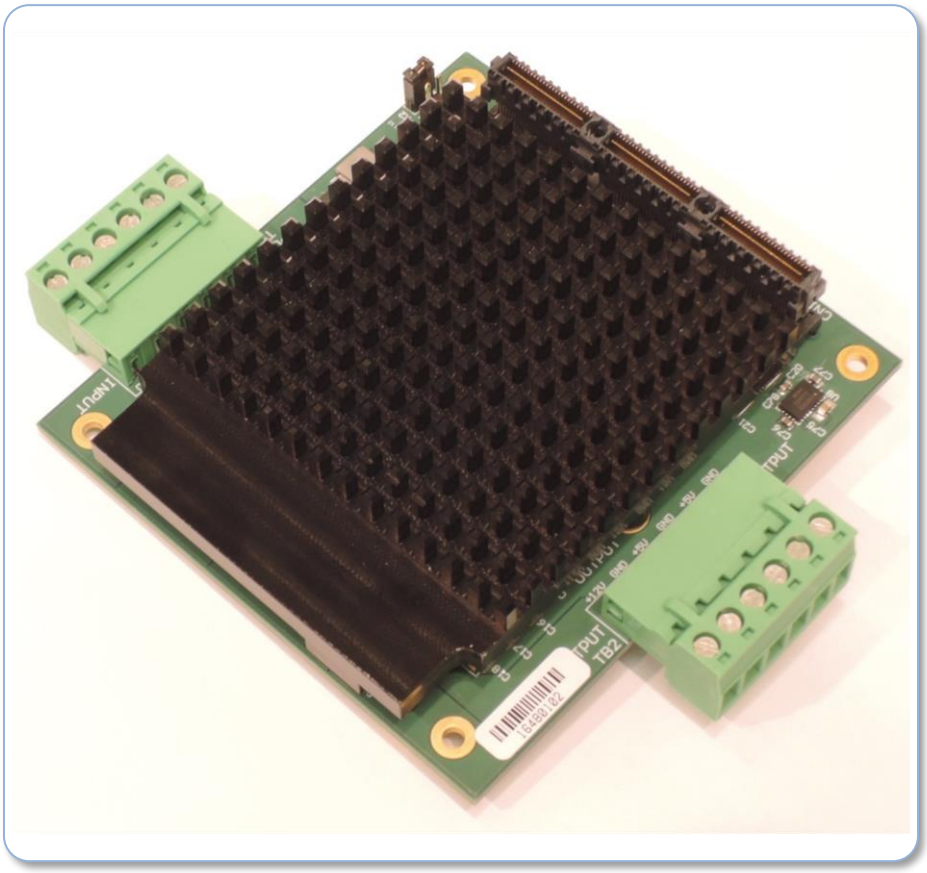


Figure 1 Board Pictured with Heat Sink (ATX3510HR-190W shown)

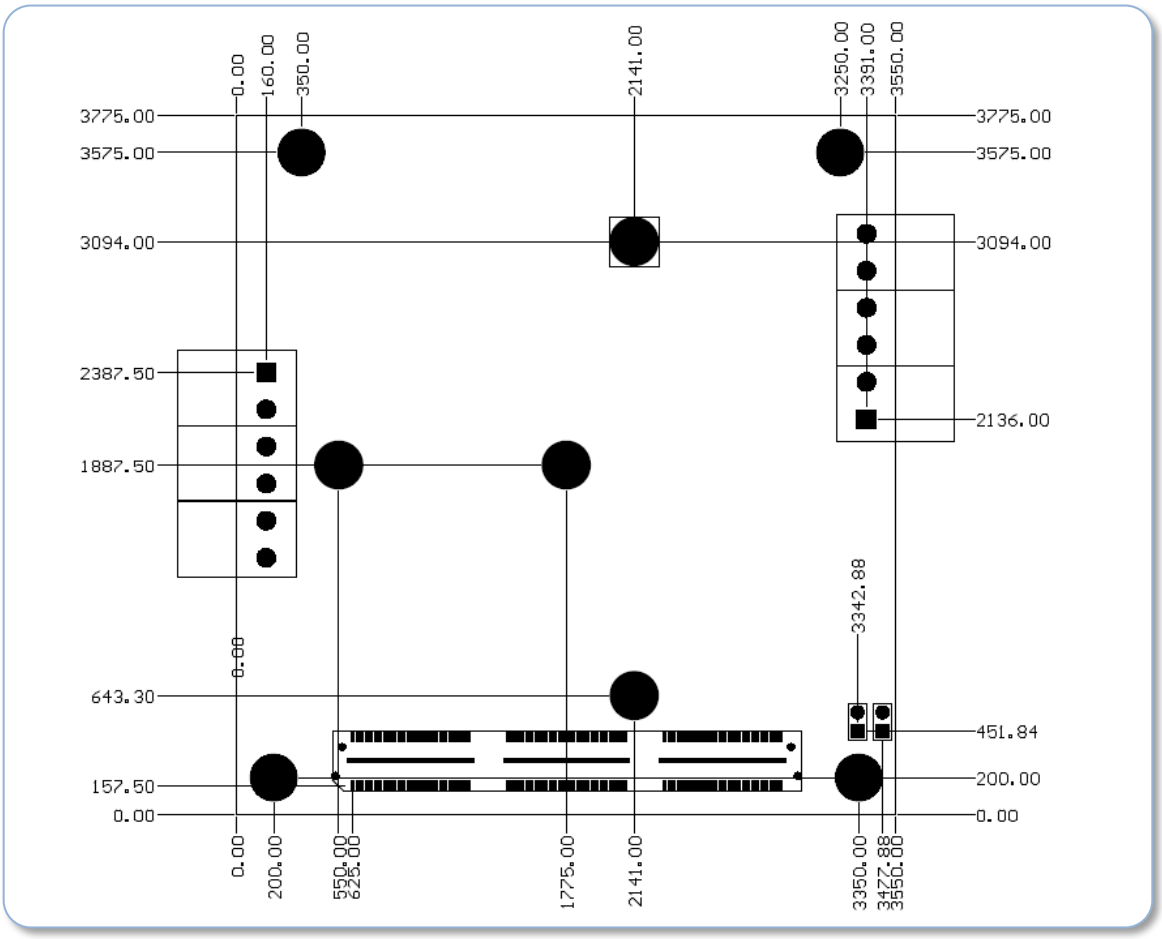


Figure 2: Board Dimensions

3.3 Connectors, Jumpers, and LEDs

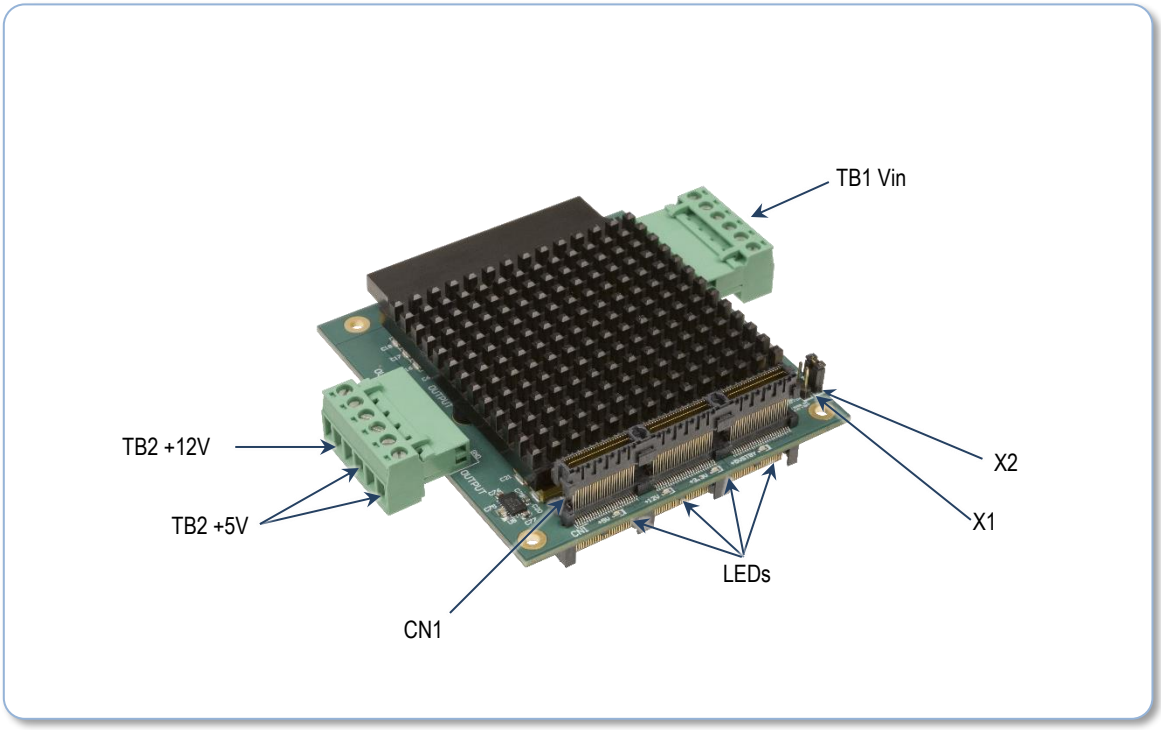


Figure 3: Board Connections, Jumpers, and LEDs

3.3.1 CONNECTORS AND JUMPERS

All I/O connectors have Pin 1 designated by a thick white silkscreen line, and/or a square pad on the PCB.

Power Connectors

TB1 is a six pin input power connector. Each pin is labeled on the PCB. Mating connector is a Phoenix contact 1781027 (www.Phoenixcontact.com)

Facing the connector, from left to right, the pin out is:

Table 3 TB1 Vin Connector

TB1 Pin	Pin Name	Function	IDAN JBX
1	Vin	8V to 36V input	1, 2, and 3
2	GND	Ground connection	4, 5, and 6
3	Vin	8V to 36V input	1, 2, and 3
4	GND	Ground connection	4, 5, and 6
5	Vin	8V to 36V input	1, 2, and 3
6	GND	Ground connection	4, 5, and 6

TB2 is a six pin auxiliary power connector. Both +5V pins are sourced from the same 5V supply. Each pin is labeled on the PCB. Mating connector is a Phoenix contact 1781027 (www.Phoenixcontact.com)

Facing the connector, from left to right, the pin out is:

Table 4 TB2 Vout Connector

TB2 Pin	Pin Name	Function	IDAN 9-pin "D"
1	+12V	12V auxiliary output	3
2	GND	Ground connection	2, 4, and 7
3	+5V	5V auxiliary output	1 and 6
4	GND	Ground connection	2, 4, and 7
5	+5V	5V auxiliary output	1 and 6
6	GND	Ground connection	2, 4, and 7

IDAN connector shown above. Phoenix Contact 1729160. Screw terminal for AWG 26-16 wire gauges.

CN1 and CN2 PCIe Bus

CN1 and CN2 are the PCIe connectors. All pins stack through with no lane shifting.

Table 5 CN1 and CN2 PCIe Bus

CN2 Pin	Signal	Signal	CN2 Pin
1	USB_OC#	PE_RST#	2
3	3.3V	3.3V	4
5	USB_1p	USB_0p	6
7	USB_1n	USB_0n	8
9	GND	GND	10
11	PEx1_1Tp	PEx1_0Tp	12
13	PEx1_1Tn	PEx1_0Tn	14
15	GND	GND	16
17	PEx1_2Tp	PEx1_3Tp	18
19	PEx1_2Tn	PEx1_3Tn	20
21	GND	GND	22
23	PEx1_1Rp	PEx1_0Rp	24
25	PEx1_1Rn	PEx1_0Rn	26
27	GND	GND	28
29	PEx1_2Rp	PEx1_3Rp	30
31	PEx1_2Rn	PEx1_3Rn	32
33	GND	GND	34
35	PEx1_1Clkp	PEx1_0Clkp	36
37	PEx1_1Clkn	PEx1_0Clkn	38
39	+5V_SB	+5V_SB	40
41	PEx1_2Clkp	PEx1_3Clkp	42
43	PEx1_2Clkn	PEx1_3Clkn	44
45	DIR	PWRGOOD	46
47	SMB_DAT	PEx_x4_Clkp	48
49	SMB_CLK	PEx_x4_Clkn	50
51	SMB_ALERT	PSON#	52
53	STK0 / WAKE#	STK1 / PEG_ENA#	54
55	GND	GND	56
57	PEx4_1T(0)p	PEx4_0T(0)p	58
59	PEx4_1T(0)n	PEx4_0T(0)n	60
61	GND	GND	62
63	PEx4_1T(1)p	PEx4_0T(1)p	64
65	PEx4_1T(1)n	PEx4_0T(1)n	66
67	GND	GND	68
69	PEx4_1T(2)p	PEx4_0T(2)p	70
71	PEx4_1T(2)n	PEx4_0T(2)n	72
73	GND	GND	74
75	PEx4_1T(3)p	PEx4_0T(3)p	76
77	PEx4_1T(3)n	PEx4_0T(3)n	78
79	GND	GND	80
81	SATA_T1p	SATA_T0p	82
83	SATA_T1n	SATA_T0n	84
85	GND	GND	86
87	SSTX1p	SSTX0p	88
89	SSTX1n	SSTX0n	90
91	GND	GND	92
93	Reserved	Reserved	94
95	Reserved	Reserved	96
97	GND	GND	98
99	SATA_DET#1	SATA_DET#0	100
101	SATA_PWREN#1	SATA_PWREN#0	102
103	GND	GND	104
105	STK2 / SDVO_DAT	LPC_CLK	106
107	GND	GND	108
109	PEx4_1R(0)p	PEx4_0R(0)p	110

111	PEx4_1R(0)n	PEx4_0R(0)n	112
113	GND	GND	114
115	PEx4_1R(1)p	PEx4_0R(1)p	116
117	PEx4_1R(1)n	PEx4_0R(1)n	118
119	GND	GND	120
121	PEx4_1R(2)p	PEx4_0R(2)p	122
123	PEx4_1R(2)n	PEx4_0R(2)n	124
125	GND	GND	126
127	PEx4_1R(3)p	PEx4_0R(3)p	128
129	PEx4_1R(3)n	PEx4_0R(3)n	130
131	GND	GND	132
133	SATA_R1p	SATA_R0p	134
135	SATA_R1n	SATA_R0n	136
137	GND	GND	138
139	SSRX1p	SSRX0p	140
141	SSRX1n	SSRX0n	142
143	GND	GND	144
145	LPC_AD0	LPC_DRQ#	146
147	LPC_AD1	LPC_SERIRQ#	148
149	GND	GND	150
151	LPC_AD2	LPC_FRAME#	152
153	LPC_AD3	RTC_Battery	154
155	GND	GND	156

X1 Jumper

The X1 jumper is the enable for the entire board. Default is open or attached to the power switch in IDAN. Board is labeled with settings. When set to OFF, all supplies on the board are disabled. When set to ON, The board is controlled via PS_ON#.

Table 6 X1 Board Enable Jumper

X1 Pin	Signal	Function	IDAN	
1	RUN	Short to Pin 2=OFF Open = ON (Default)	Power Switch	
2	GND	N/A	Power Switch	

X2 Jumper

The X2 jumper is the PS_ON# signal. Default is open. When set to ON, all board supplies are enabled. When set to OFF; only 5VSB is enabled.

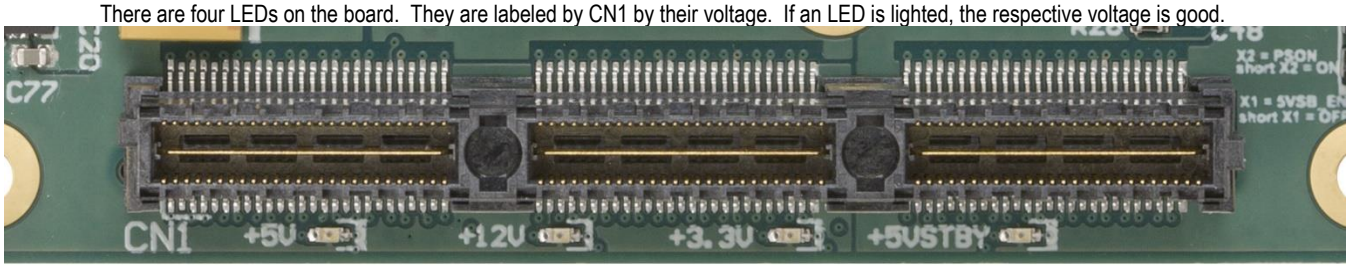
Table 7 X2 PS_ON# Jumper

X2 Pin	Signal	Function	IDAN	
1	PS_ON#	Short to Pin 2=ON Open = OFF (Default)	N/C	
2	GND	N/A	N/C	

3.3.2 LEDs

Voltage indicator LEDs

There are four LEDs on the board. They are labeled by CN1 by their voltage. If an LED is lighted, the respective voltage is good.



3.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the PC/104 system or stack.
3. Select and install stand-offs to properly position the module on the stack.
4. Remove the module from its anti-static bag.
5. Check that pins of the bus connector are properly positioned.
6. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
7. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the module onto the PC/104 stack.
9. If any boards are to be stacked above this module, install them.
10. Attach any necessary cables to the PC/104 stack.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.
13. Any wires into or out of the board should be twisted to reduce inductance.
14. Wires are to be kept as short as possible to reduce unnecessary voltage drops.
15. Power wires should be able to carry at least 10 Amps of current.

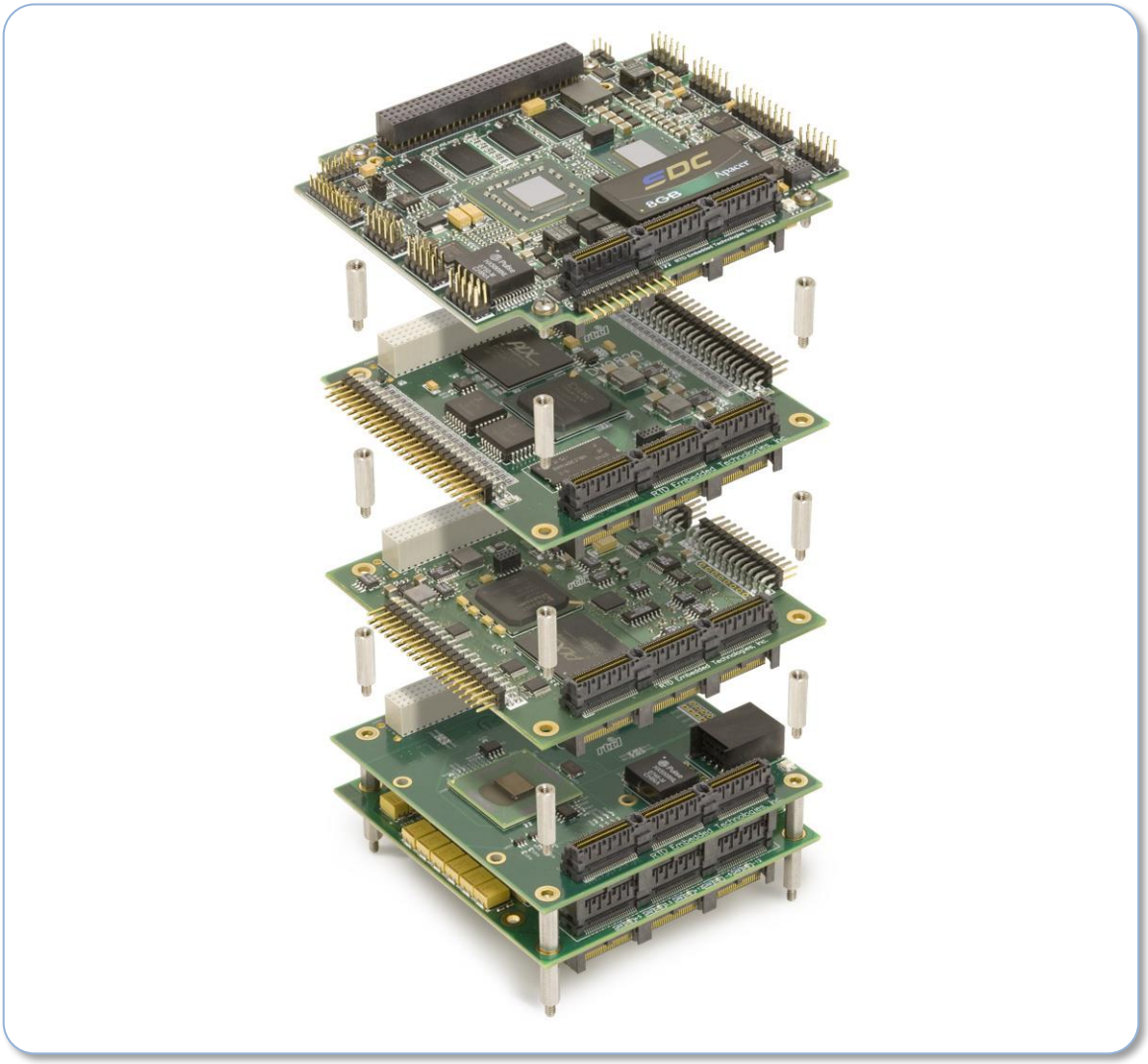


Figure 4: Example 104™ Stack

4 IDAN Connections

4.1 Module Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your module in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the module by the aluminum enclosure, and do not touch the components or connectors. Handle the module in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

4.2 Connectors

4.2.1 External I/O Connectors

The power ON/OFF switch with LED is located on the front of the frame. The 6-pin push-pull power input connector and the 9-pin "D" power output connector are brought out of the back of the frame.

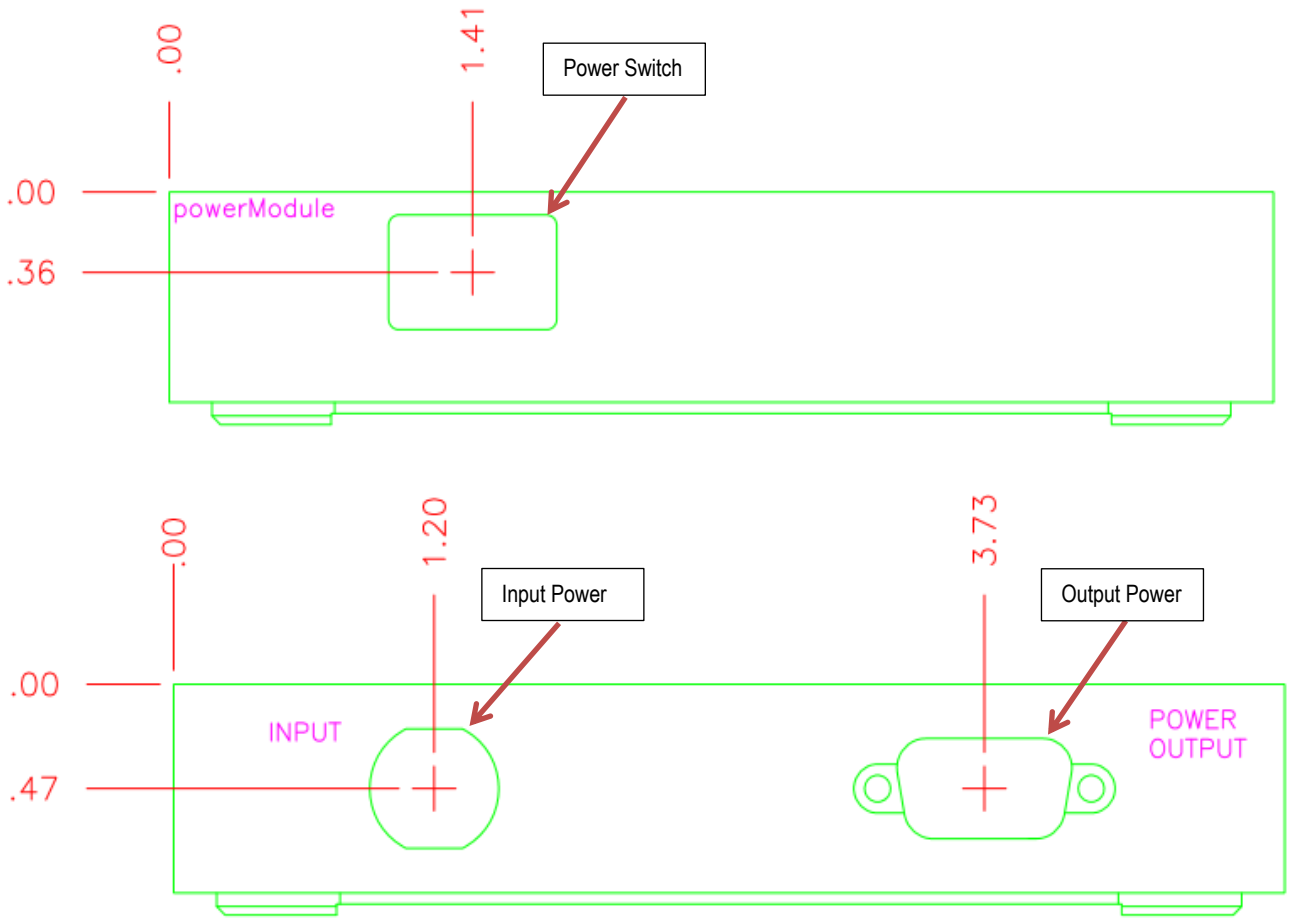


Figure 5 AXT3510HR-190W IDAN connector location

LED on Power switch lights when outputs are on.

4.2.1 IDAN FRAME DIMENSIONS

0.935" H x 5.117" W x 5.983 D

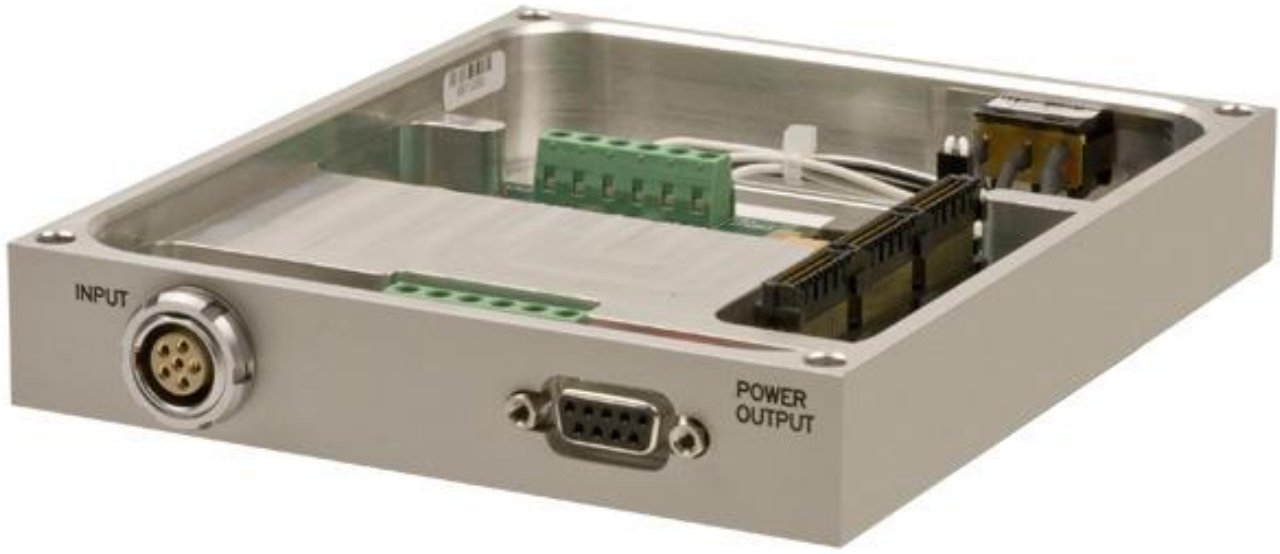


Figure 6 IDAN frame rear view

Figure 7 IDAN frame front view

Recommended IDAN-AC/DC-109W to power IDAN.

Figure 8 Power Output Connector DB9

Table 8: IDAN Power Output Connector Pin-out

Pin Number	Description
1	5V
2	GND
3	12V
4	GND
5	N/C
6	5V
7	GND
8	N/C
9	N/C

Three amp current rating per pin.
*3.3V is not brought out and is only available on the PCIe bus

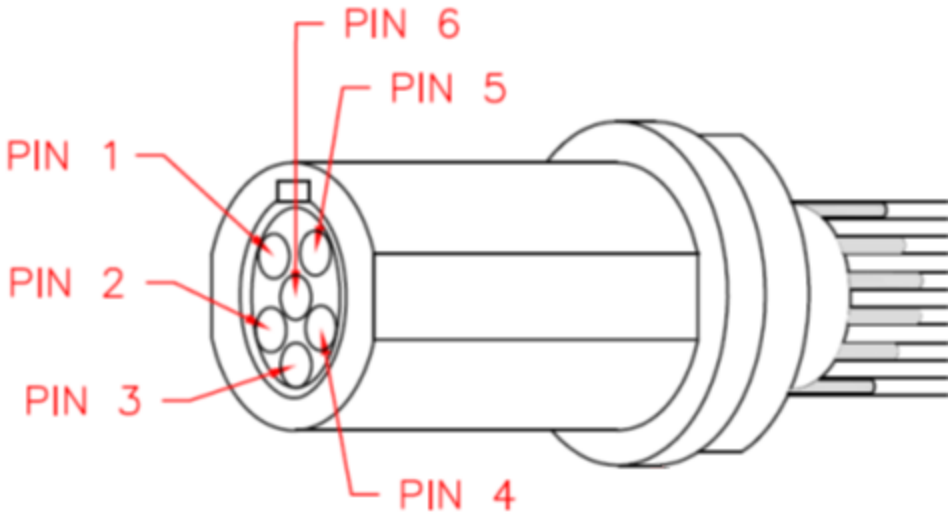


Figure 9 Power Input Connector

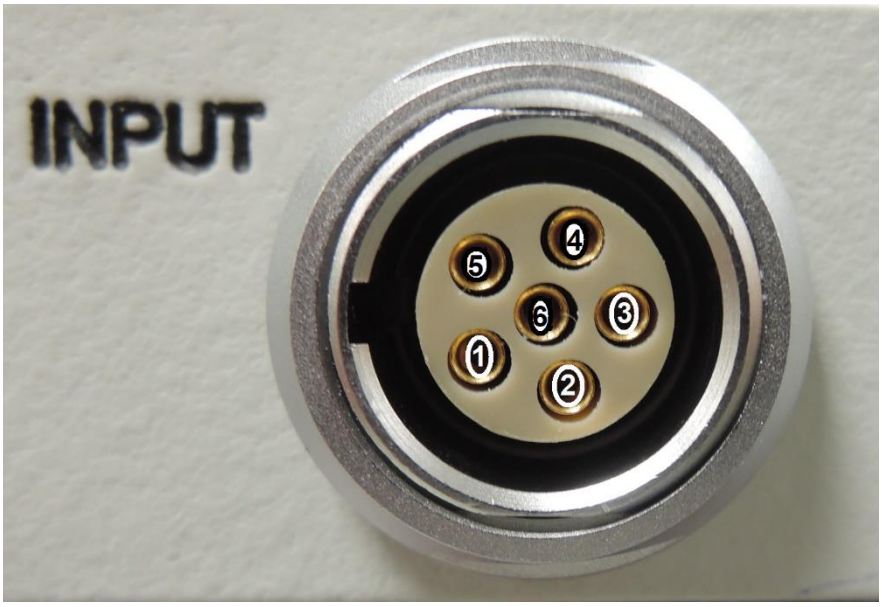


Figure 10 IDAN Power Connector Installed in Frame

White wire pin numbers in Figure 10 are circled in white.

Table 9: IDAN Power Input Connector Pin-out

Pin Number	Description
1	Vin
2	Vin
3	Vin
4	GND
5	GND
6	GND

Ten amp current rating per pin.

The mating connector is a Souriau JBXFD2G06MSSDSMR. (www.souriau.com)

Figure 11 IDAN power cable pictured above is included with the IDAN-ATX3510HR-190W

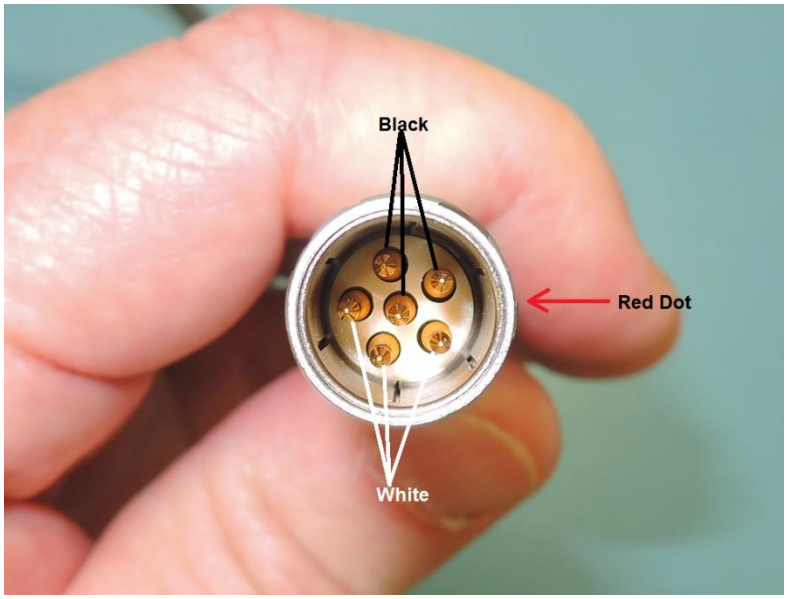


Figure 12 Looking Into the IDAN-XKCM44 IDAN Power Cable Connector

Figure 21 shows the wire colors of the IDAN-XKCM44 in reference to the red keying indicator dot.

4.3 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the IDAN system.
3. Remove the module from its anti-static bag.
4. Check that pins of the bus connector are properly positioned.
5. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
6. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
7. Gently and evenly press the module onto the IDAN system.
8. If any boards are to be stacked above this module, install them.
9. Finish assembling the IDAN stack by installing screws of an appropriate length.
10. Attach any necessary cables to the IDAN system.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

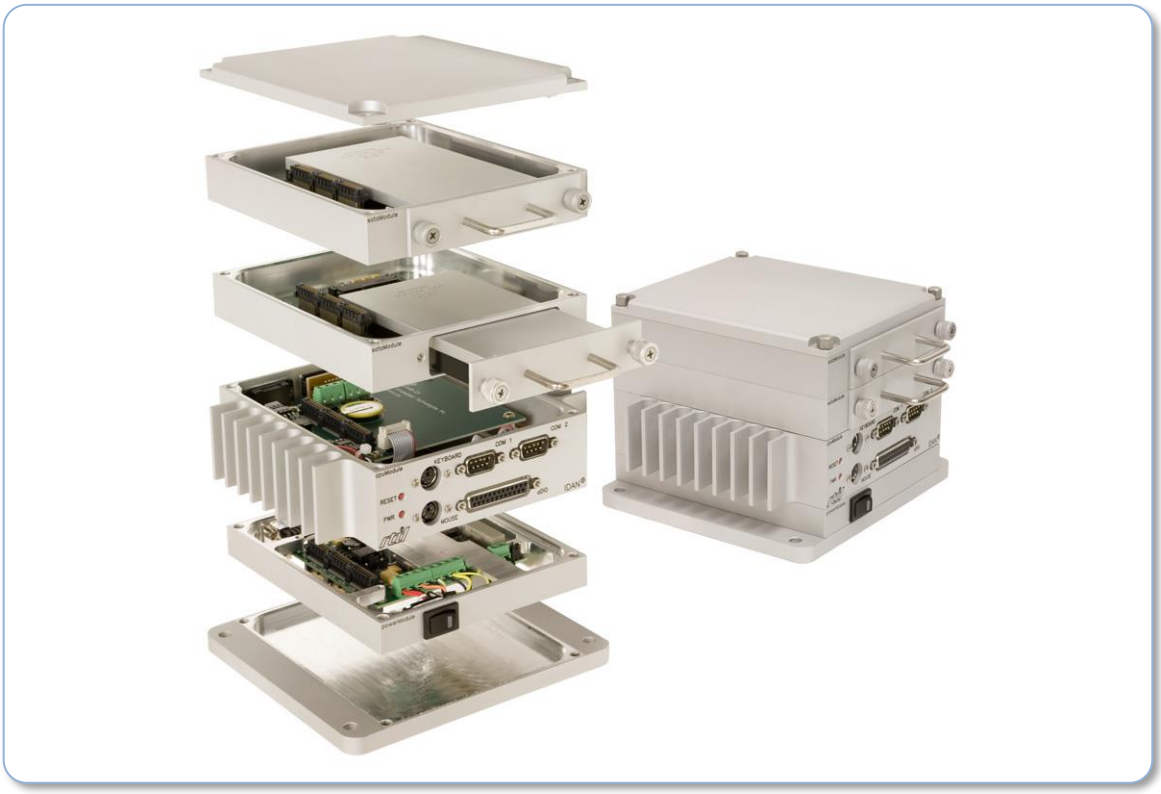


Figure 13: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the ATX35110HR-190W. The various parts of the block diagram are discussed in the following sections.

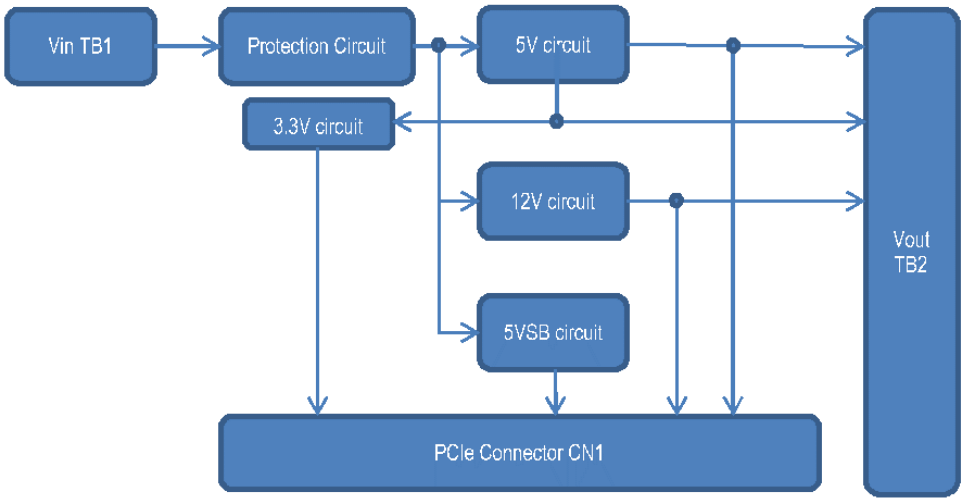


Figure 14: ATX3510HR-190W Block Diagram

5.2 Synchronization

The board is designed that all three supplies are synchronized 120 degrees out of phase. This characteristic results in less input ripple current.

Note: 3.3V is not synchronized and runs at 4.0 MHz

6 Troubleshooting

If you are having problems with your system, please try the following initial steps:

- **Simplify the System** – Remove modules one at a time from your system to see if there is a specific module that is causing a problem. Perform you troubleshooting with the least number of modules in the system possible.

- **Swap Components** – Try replacing parts in the system one at a time with similar parts to determine if a part is faulty or if a type of part is configured incorrectly.

If problems persist, or you have questions about configuring this product, contact RTD Embedded Technologies via the following methods:

Phone: +1-814-234-8087
E-Mail: techsupport@rtd.com

Be sure to check the RTD web site (http://www.rtd.com) frequently for product updates, including newer versions of the board manual and application software.

7 Additional Information

7.1 PC/104 Specifications

A copy of the latest PC/104 specifications can be found on the webpage for the PC/104 Embedded Consortium:

www.pc104.org

7.2 PCI and PCI Express Specification

A copy of the latest PCI and PCI Express specifications can be found on the webpage for the PCI Special Interest Group:

www.pcisig.com

8 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 a Return Material Authorization (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.

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.

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