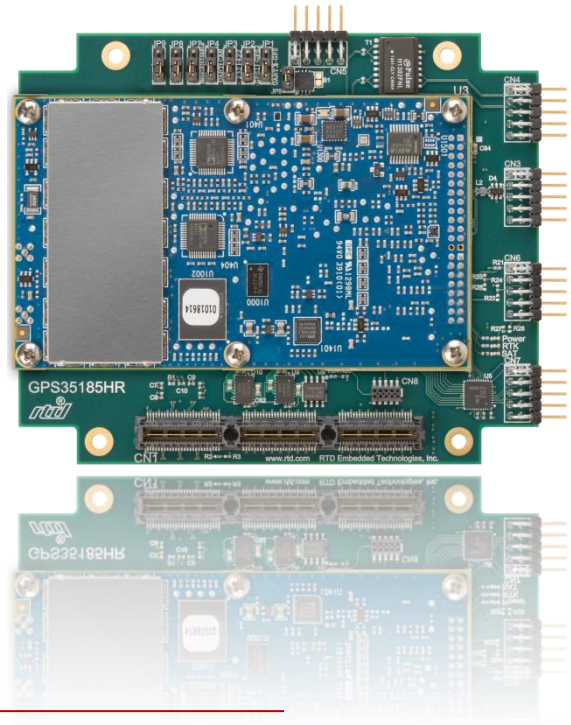
GPS35185HR

PCIe Novatel GPS Carrier Module

User's Manual

BDM-610020117 Rev. C



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Revision History

Rev A	Initial Release
Rev B	Updated Table 14
Rev C	Removed Octal UART References

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1 Introduction

1.1 Product Overview

The GPS35185 is designed to provide a PCIe UART interface to a Novatel OEM628 GPS. It uses a PCIe/104 interface to the CPU module, and provides the ability to communicate with all three GPS serial interfaces. Additionally, the module provides connectors for Ethernet, CAN, and USB to the module. It is compatible with all PCIe/104 modules.

1.2 Board Features

- PCIe Interface to CPU
- UART interface to Novatel GPS modules
- Ethernet connector to GPS module
- USB connector to GPS module
- CAN connector to GPS module
- External serial interface to GPS module, optionally a RS-232/422 serial port

1.3 Ordering Information

The GPS35185 is available with the following options:

Table 1: Ordering Options

Part Number	Description
GPS35185HR	Novatel GPS Carrier Module
GPS35185HR-xxx	GPS35185HR with Novatel OEM628-xxx GPS
IDAN-GPS35185HRS	Novatel GPS Carrier Module in IDAN enclosure
IDAN-GPS35185HRS-xxx	GPS35185HR with Novatel OEM628-xxx GPS in IDAN enclosure

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.

1.4 Contact Information

1.4.1 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

1.4.2 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_{cc5}	5V Supply Voltage		4.75	5.25	V
V_{cc3}	3.3V Supply Voltage		n/a	n/a	V
V_{cc12}	12V Supply Voltage		n/a	n/a	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

Table 3: Electrical Characteristics

Symbol	Parameter		Test Condition	Min	Typical	Max	Unit
P	Power Consumption		V_{cc5} = 5.0V		TBD		W
I_{cc5}	5V Input Supply Current		Active		TBD		A
	PCIe/104 Bus						
	Differential Output Voltage			0.8		1.2	V
	DC Differential TX Impedance			80		120	Ω
	Differential Input Voltage			0.175		1.2	V
	DC Differential RX Impedance			80		120	Ω
	Electrical Idle Detect Threshold			65		175	mV
	CAN Port						
	Positive-going Input Threshold				750	900	mV
	Negative-going Input Threshold			500	650		mV
	Hysteresis Voltage				100		mV
	Input Resistance			20		50	KΩ
	Output Voltage (Dominant)	CAN-H		2.75	3.5	4.5	V
		CAN-L		0.5		2	
	Output Voltage (Recessive)	CAN-H		2	2.5	3	V
		CAN-L		2	2.5	3	
	Differential Output (Dominant)			1.2	2	3	V
	Differential Output (Recessive)			-120		12	mV
	Termination Resistor				121		Ω
	Miscellaneous						
	GPS Reset Pulse Delay		• DTR Reset (1 to 0 transitions) • Utility_GPS_Signal (0 to 1 transitions)		60		us

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 55 g (0.12 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (4.570 in L x 3.775 in W)

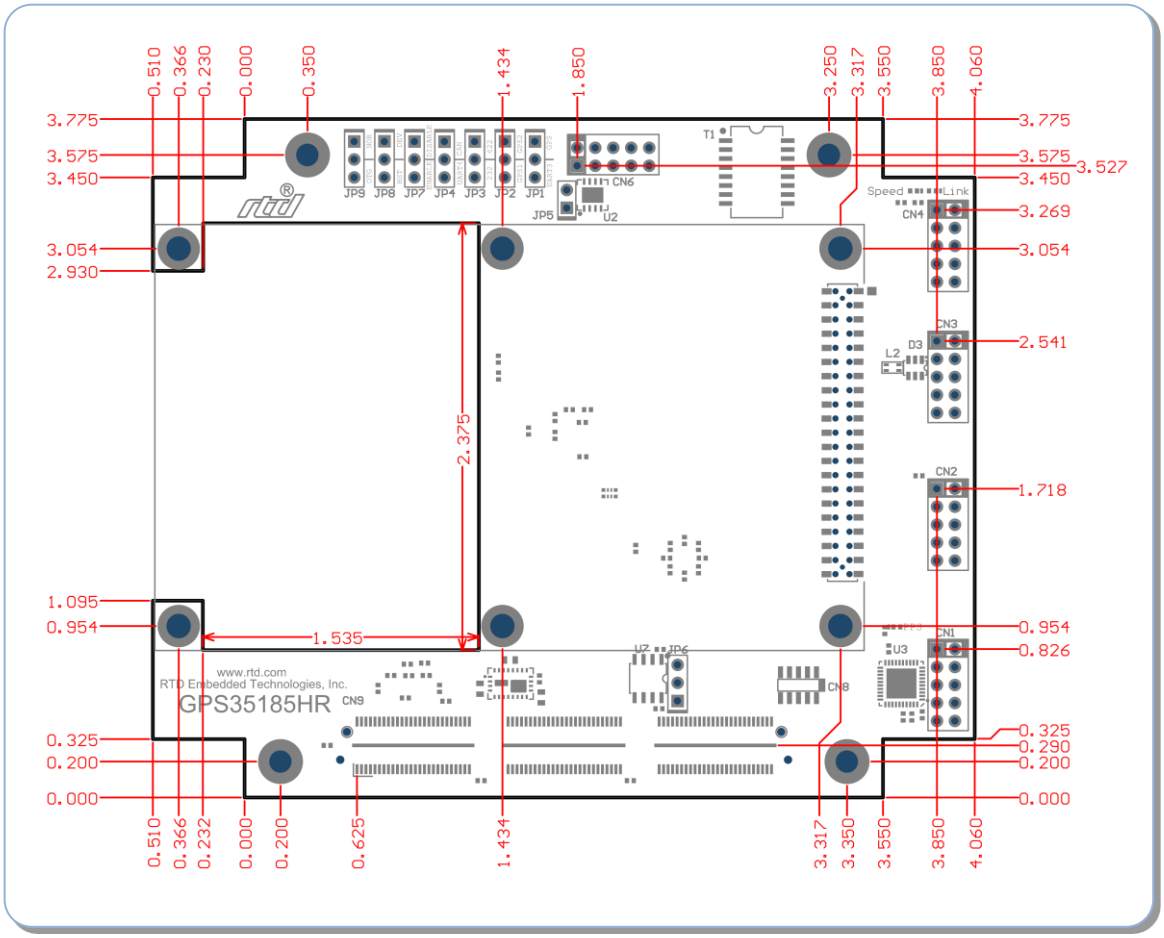

Figure 1: Board Dimensions

3.3 Connectors and Jumpers

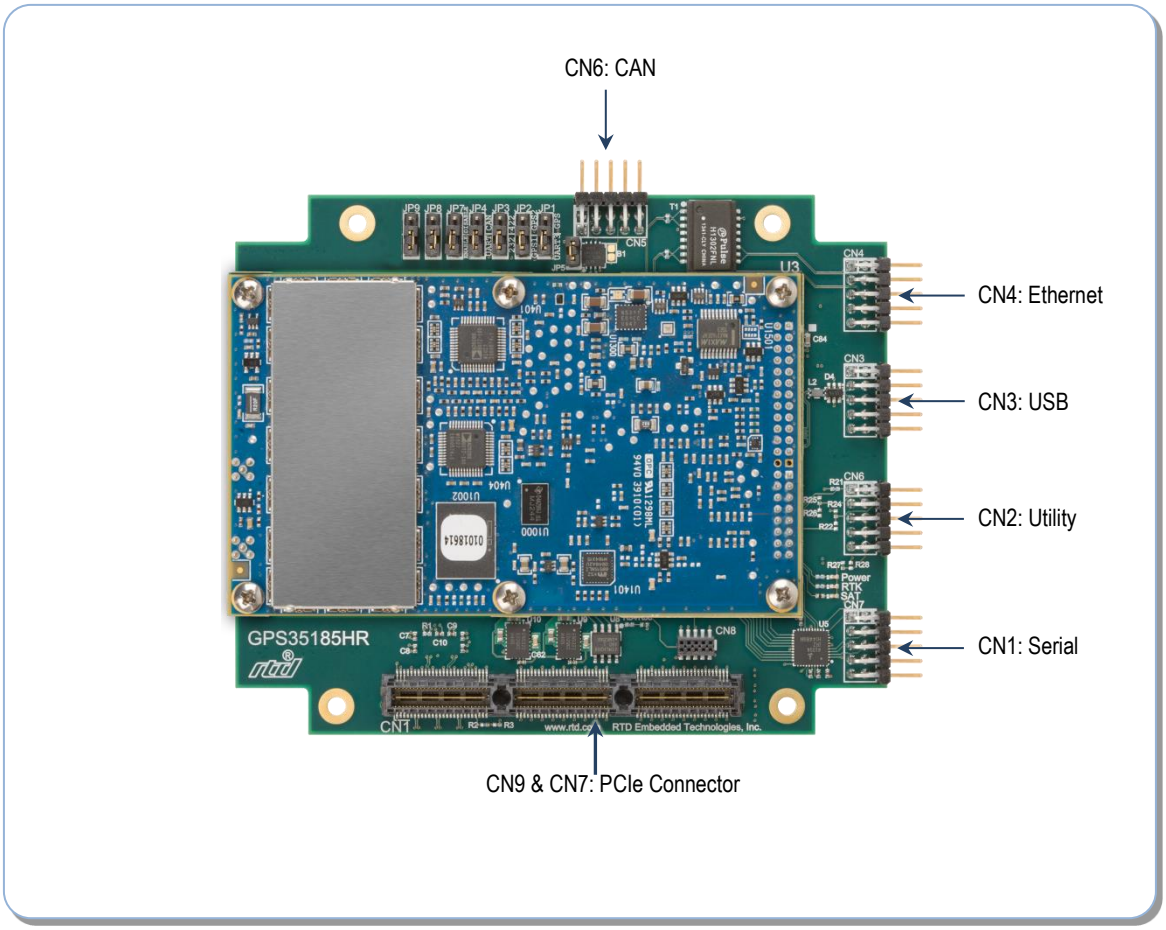

Figure 2: Board Connections

3.3.1 Bus Connectors

CN9(Top) & CN7(Bottom): PCIe Connector

The PCIe connector is the connection to the system CPU. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 20)

The GPS35185 is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

3.3.2 External I/O Connectors

CN1: Serial I/O Connector

CN1 is an RS-232/RS-422/RS-485 interface that can be configured to be a serial port off the CPU or one of the first two serial ports from the GPS. Table 4 and Table 5 is the pin out in RS-232 mode, if JP3 has pins 2-3 shorted.

Table 4: CN1 in UART RS-232 Mode

Pin Name	Pin #	Pin #	Pin Name
DSR	2	1	DCD
RTS	4	3	RxD
CTS	6	5	TxD
RI	8	7	DTR
GND	10	9	GND

Table 5: CN1 in GPS RS-232 Mode

Pin Name	Pin #	Pin #	Pin Name
-	2	1	-
RTS	4	3	RxD
CTS	6	5	TxD
-	8	7	-
GND	10	9	GND

Table 6 and Table 7 is the pin out of CN1 in RS422/485 mode, if JP3 has pins 1-2 shorted. Note that when connected to the UART, RTS is used to enable the driver. When connected to the GPS the driver is always enabled.

Table 6: CN1 in UART RS-422/485 Mode

Pin Name	Pin #	Pin #	Pin Name
-	2	1	-
TxD+	4	3	RxD-
RxD+	6	5	TxD-
-	8	7	-
GND	10	9	GND

Table 7: CN1 in GPS RS-422/485 Mode

Pin Name	Pin #	Pin #	Pin Name
-	2	1	-
TxD+	4	3	RxD-
RxD+	6	5	TxD-
-	8	7	-
GND	10	9	GND

CN2: GPS Utility Connector

CN2 is the GPS Utility connector. It contains the GPS external reset, a buffered 1 pulse-per-second with a 7 ns maximum delay, the GPS Event 1 input, and three GPS LED signals. All signals go through the EPLD so they are 5 volt tolerant and the LED signals are capable of +8/-4 mA. Table 8 is the pin out of the Utility connector.

Table 8: CN2 GPS Utility

Pin Name	Pin #	Pin #	Pin Name
PValid	2	1	Reset
GND	4	3	1PPS
GND	6	5	VARF
GND	8	7	Event1
GND	10	9	Error

CN3: GPS USB Connector

CN3 is the GPS USB port. It connects directly to the GPS USB port. Table 9 is the pin out of the USB connector.

Table 9: CN3 GPS USB

Pin Name	Pin #	Pin #	Pin Name
Rsvd	2	1	Rsvd
Rsvd	4	3	USB+
Rsvd	6	5	USB-
GND	8	7	GND
GND	10	9	GND

CN4: GPS 10/100 Mbps Ethernet Connector

CN4 is the GPS 10/100 Mbps Ethernet port. The GPS35185 provides the magnetics required to connect the GPS directly to 10/100 Mbps network. It is full duplex with auto-negotiation enabled. Table 10 is the pin out of the Ethernet connector.

Table 10: CN4 GPS Ethernet

Pin Name	Pin #	Pin #	Pin Name
RX-	2	1	RX+
Term	4	3	Term
TX-	6	5	TX+
Term	8	7	Term
GND	10	9	GND

CN6: GPS CAN Bus Connector

CN6 is the GPS CAN Bus port. The GPS35185 provides the CAN transceiver required to connect the GPS directly to CAN network. This requires the GPS module to configure COM3 as CAN. Jumper JP4 controls the GPS to CAN transceiver connection. If JP4 has pins 1 – 2 shorted GPS COM3 is connected to the UART channel 3. If JP4 has pins 2 – 3 shorted GPS COM3 is connected to the CAN transceiver. Table 11 is the pin out of the Ethernet connector.

Table 11: CN6 GPS CAN

Pin Name	Pin #	Pin #	Pin Name
GND	2	1	Rsvd
CAN-H	4	3	CAN-L
Rsvd	6	5	GND
+5V[1]	8	7	Rsvd
Rsvd	10	9	GND

[1] Only Available when B1 is shorted

Note: CN8 is for Factory Use only

3.3.3 JUMPERS

JP1 and JP2: CN1 Serial Port Source

JP1 and JP2 are 3-pin two position jumpers that are used to select if the UART or a GPS serial port is connected to CN1. These jumpers affect UART serial ports 1, 2, and 4 as well as GPS serial ports 1 and 2. Table 12 has JP1 and JP2 setting information.

Table 12: JP1 and JP2 Settings

JP1 Setting	JP2 Setting	Description	Notes
1-2	1-2	GPS serial port 1 connected to UART serial port 1 GPS serial port 2 connected to CN1 UART serial port 2 monitors GPS serial port 2 GPS serial port 3 connected to UART serial port 3 UART serial port 4 is unused	
	2-3	GPS serial port 1 connected to CN1 UART serial port 1 monitors GPS serial port 1 GPS serial port 2 connected to UART serial port 2 GPS serial port 3 connected to UART serial port 3 UART serial port 4 is unused	
2-3	Any Position	GPS serial port 1 connected to UART serial port 1 GPS serial port 2 connected to UART serial port 2 GPS serial port 3 connected to UART serial port 3 UART serial port 4 is connected to CN1	Factory default is 2-3 for both JP1 and JP2

JP3: CN1 Serial Port Mode

JP3 is used to select the mode of serial port CN1. The options are shown in Table 13.

Table 13: JP3 Settings

Setting	Description	Notes
1 – 2	RS-422/485	
2 – 3	RS-232	Factory default

Note that in RS-422 mode when connected to the UART (JP1 is 1 – 2) RTS is used to enable the driver. When connected to the GPS (JP1 is 2 – 3) the driver is always enabled.

JP4: GPS CAN Port Selection

JP4 is used to select which GPS CAN port is connected to CAN transceiver and connector CN6. The options are shown in Table 14.

Table 14: JP4 Settings

Setting	Description	Notes
1 – 2	GPS CAN port 2 connected to CN6	
2 – 3	GPS CAN port 1 connected to CN6	Factory default

JP5: CAN Bus Termination

JP5 is used terminate the CAN bus. If this device is not at the end of the CAN bus, remove this jumper. The options are shown in Table 15: JP5 Settings.

Table 15: JP5 Settings

Setting	Description	Notes
1 – 2 Short	CAN Bus Terminated	Factory default
1 – 2 Open	CAN Bus Not Terminated	

JP7: GPS Software Reset

JP7 is used enable/disable the DTR GPS reset. The options are shown in Table 16.

Table 16: JP7 Settings

Setting	Description	Notes
1 – 2	DTR GPS Reset is Disabled	
2 – 3	DTR GPS Reset is Enabled	Factory default

Note: JP8 and JP9 are Factory Use only

3.3.4 LEDs

One Pulse Per Second LED

The One Pulse Per Second (1PPS) LED is connected to the 1PPS of the GPS module. The falling edge of the GPS 1PPS causes the LED to turn on for 0.25 seconds.

Ethernet LEDs

These two LEDs are driven by buffered GPS LED_A and LED_B signals.

GPS LED_A signal goes to the green LED labeled "L" and is Link/Act. It will be on when there is an Ethernet link and flash when there is Ethernet activity.

GPS LED_B signal goes to the amber LED labeled "S" and is the 100/10Mb LED. It will be on when the connection is at 100Mb and off when the connection is 10Mb.

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.

NOTE: When using under Windows, the GPS may be incorrectly detected as a Serial Mouse, causing erratic mouse cursor behavior. This issue has been documented by Microsoft. For more information, refer to Microsoft Knowledge Base Article 283063.

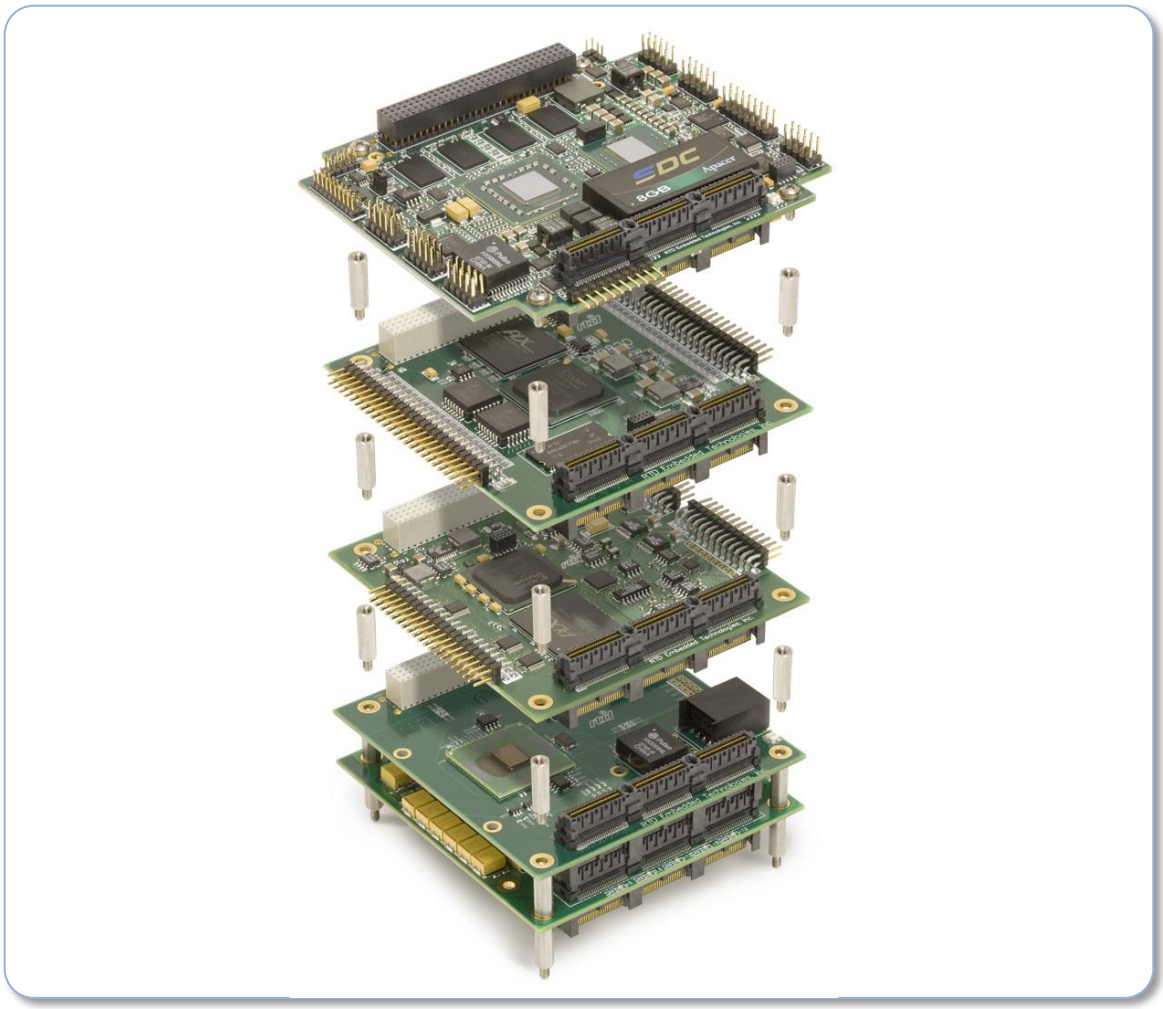

Figure 3: Example 104™ Stack

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 Physical Characteristics

- Weight: Approximately 0.21 Kg (0.46 lbs.)
- Dimensions: 151.972 mm L x 129.978 mm W x 16.993 mm H (5.983 in L x 5.117 in W x 0.669 in H)

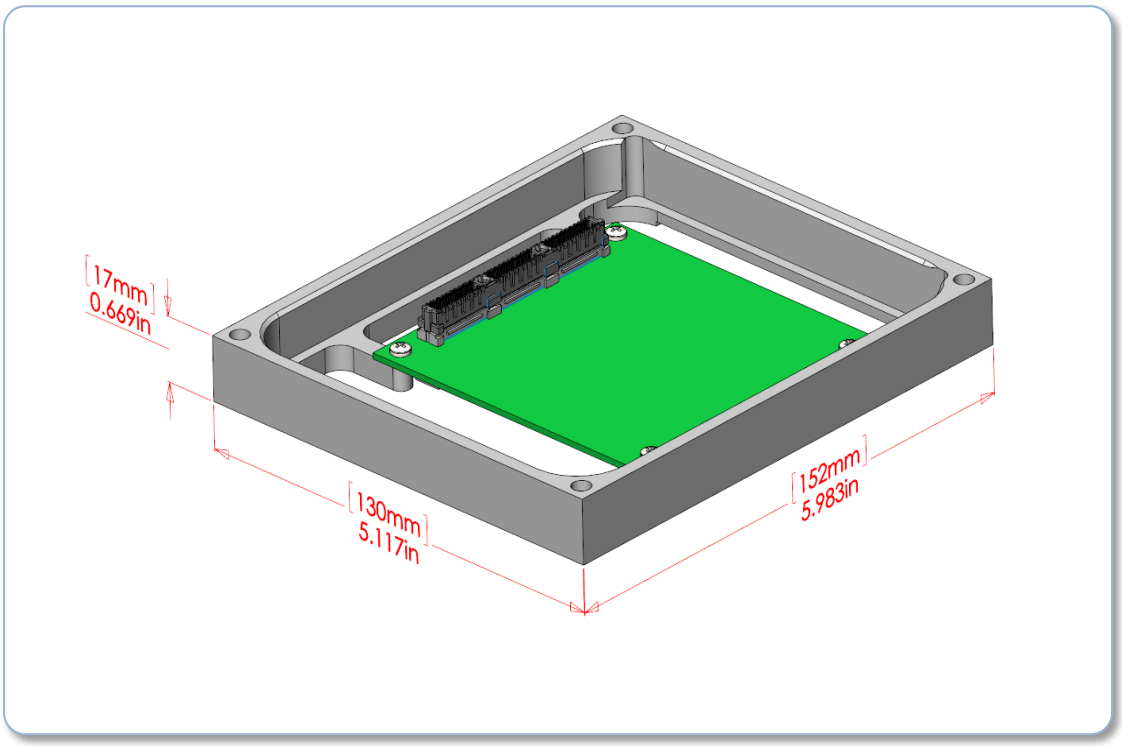

Figure 4: IDAN Dimensions

4.3 Connectors

4.3.1 Bus Connectors

CN1(Top) & CN2(Bottom): PCIe Connector

The PCIe connector is the connection to the system CPU. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 20)

The GPS35185 is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

4.3.2 External I/O Connectors

4.4 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.

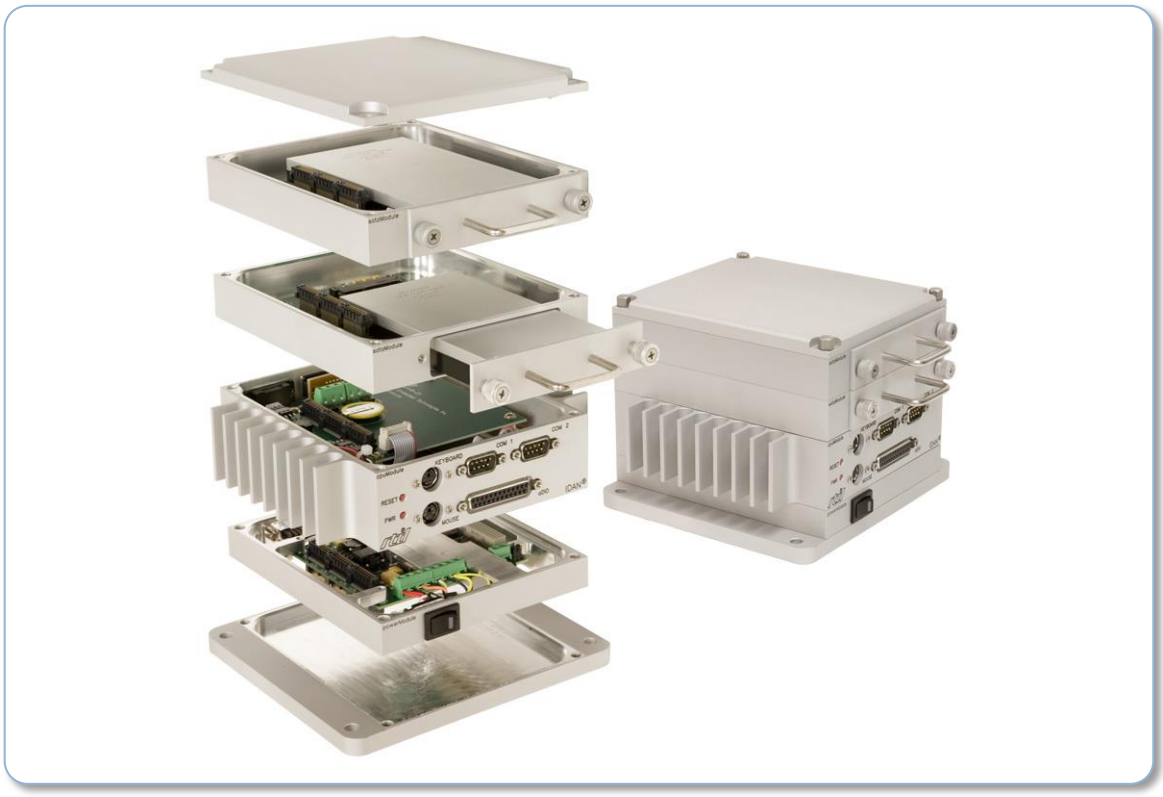

Figure 5: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the GPS35185. The various parts of the block diagram are discussed in the following sections.

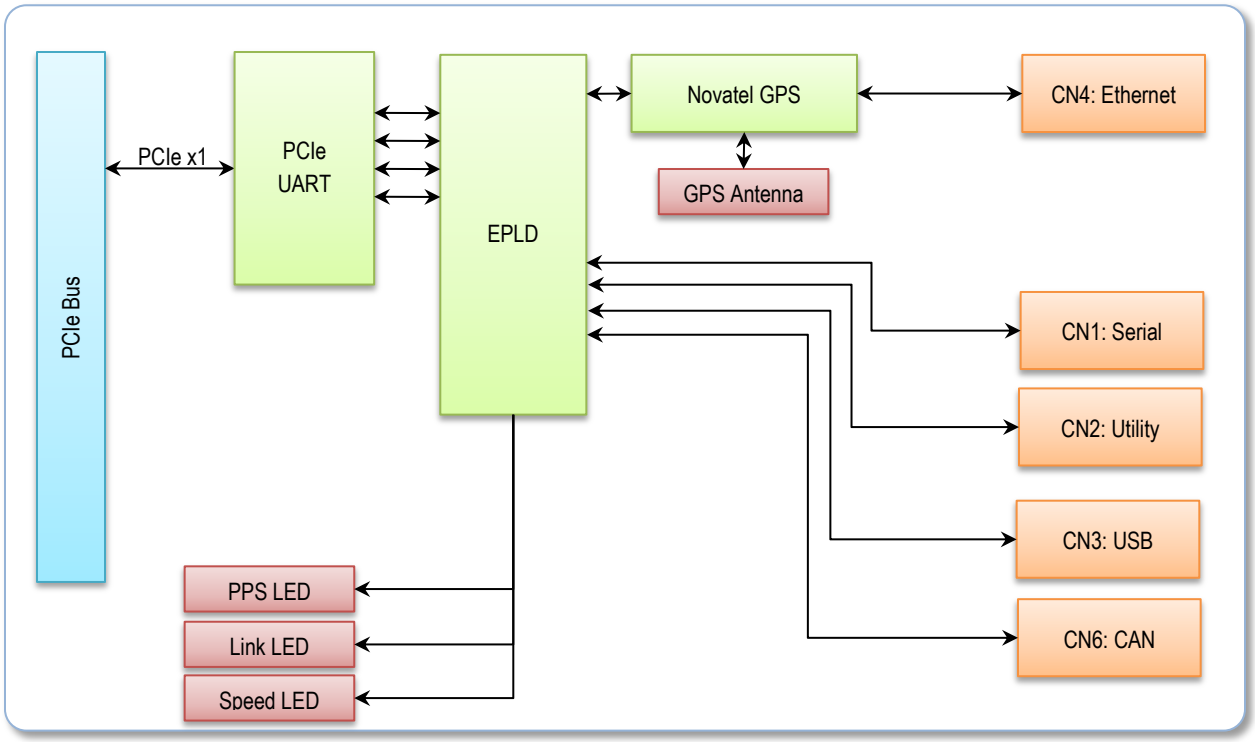

Figure 6: GPS35185 Block Diagram

5.2 GPS Interface

The GPS35185 is a carrier board for a Novatel GPS receiver. It provides an UART interface to the PCIe bus that can be connected to all three serial ports of the GPS and serial connector CN1. Optionally, one of the GPS serial ports can be connected to CN1. If the GPS module has CAN bus capability on the third serial port, it can be connected to an onboard CAN transceiver. The GPS antenna connects directly to the GPS module.

5.2.1 PCIe UART

The GPS35185 provides multiple independent UARTs. By default they are connected as follows:

- UART 1 to GPS COM1
- UART 2 to GPS COM2
- UART 3 to GPS COM3
- UART 4 to serial port connector CN1

Jumper JP1 and JP2 selection may disable some of these ports to allow the GPS COM ports to connect to serial connector CN1. Refer to Jumpers on page 12.

5.2.2 DTR GPS Reset

The DTR signal of the first UART is used to generate a GPS reset signal. A reset pulse will be generated when the DTR signal transition from asserted to de-asserted (MCR bit 0 transitions from 1 to 0). JP7 needs set to 2-3 to enable this function.

6 Software

6.1 Installing the Software

The GPS35185 use a PCIe UART which will require software and drivers for proper operation. Drivers are provided for Windows XP/7, DOS, and Linux Kernel 2.6.37 and newer.

The drivers are provided on the companion CD and are also available on the RTD web site (http://www.rtd.com) for download.

6.2 Software Programming

6.2.1 API Interface

Once the drivers for the GPS35185 have been properly loaded, all ports should be available as standard serial ports. All ports can then be controlled using the standard serial port interfaces built into the operating system.

A description of serial port programming for operating systems is beyond the scope of this manual. Consult the operating system documentation for information on how to interface with serial ports via software.

6.2.2 COM Port Numbering

Serial ports (aka COM ports) are typically assigned numbers by the operating system (e.g. COM1). These numbers are typically dynamically assigned by the operating system. However, different applications may enumerate the COM ports differently, assigning different port numbers (e.g. COM3-10 vs COM5-12). When developing your own serial port application, consult your operating system's documentation for the proper method of enumerating COM ports.

Note: Some applications are written to assume that no more than four COM ports are present in a system. These applications may have compatibility issues with the Exar PCIe UART.

6.2.3 Base Address and Register Mapping

The GPS35185 exposes all of the registers available on the Exar XR17V354/ XR17V358. The register set of the XR17V354/ XR17V358 mimics the standard 16C550 UART register map. However, the XR17V354/ XR17V358 contains some additional registers not found in a typical ISA-based UART.

Additionally, the base address of the GPS35185's serial ports will be different than the standard PC serial port locations (0x3F8, 0x2F8, etc). The GPS35185 is a memory mapped device. Since it is PCI-based, it may be mapped to any location within the 4GB address space of the CPU. The base address of PCI devices is determined by the CPU's BIOS and operating system at boot time.

The register-level differences between the GPS35185 and a standard 16C550 UART should be abstracted via the software drivers. Most users will not need to concern themselves with the actual registers of the board. If one is interested in directly accessing the registers of the board, consult the XR17V354/XR17V358 data sheet available from Exar.

7 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.

8 Additional Information

8.1 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

8.2 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

9 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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