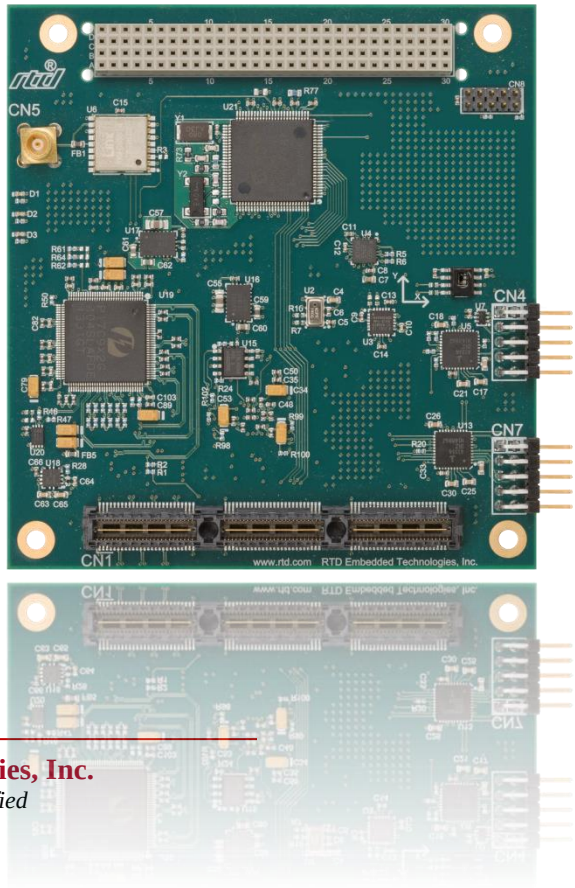
GPS25162HR/GPS35162HR

PCIe/104 GPS Receiver

User's Manual

BDM-610020158 Rev. A



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Revision History

Rev A	Initial Release

Advanced Analog I/O, Advanced Digital I/O, aAIO, aDIO, a2DIO, Autonomous SmartCal, "Catch the Express", cpuModule, dspFramework, dspModule, eBuild, expressMate, ExpressPlatform, "MIL Value for COTS prices", multiPort, PlatformBus, and PC/104EZ are trademarks, and "Accessing the Analog World", dataModule, IDAN, HiDAN, HiDANplus, RTD, the RTD logo, and StackNET are registered trademarks of RTD Embedded Technologies, Inc. (formerly Real Time Devices, Inc.). PS/2 is a trademark of International Business Machines Inc. PCI, PCI Express, and PCIe are trademarks of PCI-SIG. PC/104, PC/104-Plus, PCI-104, PCIe/104, PCI/104-Express and 104 are trademarks of the PC/104 Consortium. All other trademarks appearing in this document are the property of their respective owners.

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1 Introduction

1.1 Product Overview

The GPS35162 is designed to provide a PCIe UART interface to a GPS Receiver. This GPS module utilizes the Linx RXM-GNSS-TM GPS Receiver. This provides a low-power solution that supports NMEA-0183 protocol. This module also supports +3.3V and +5V active antennas.

1.2 Board Features

- PC/104 form factor
- Bus Structure Options:
  - **PCIe/104 (GPS35162HR)**
    - PCIe universal expansion bus (Type 1 or Type 2)
  - **PCI/104-Express (GPS25162HR)**
    - PCIe universal expansion bus (Type 1 or Type 2)
    - PCI pass-through expansion bus
- PCIe x1 interface (Gen 2, 5 GT/s)
- PCIe link repopulation allowing increased PCI Express stack capacity
- Linx RXM-GNSS-TM GPS engine
  - L1 1575.42MHz, C/A code
  - 33-channel satellite tracking
  - Position accuracy: 2.5m
  - Time accuracy of ±11ns
  - 1Hz update rate (configurable up to 10Hz)
  - Tracking sensitivity down to -164 dBm
  - Protocol: NMEA-0183 ver 4.10
  - Constellation System Support:
    - GPS
    - GLONASS
    - GALILEO
    - QZSS
  - DGPS support:
    - (SBAS) Satellite-Based Augmentation System
    - (RTCM) Radio Technical Commission for Maritime Services
    - (WAAS) Wide-Area Augmentation System
    - (EGNOS) European Geo-Stationary Navigation System
    - (MSAS) MTSAT Satellite-Based Augmentation System
    - (GAGAN) GPS-Aided Geo-Augmented Navigation
- Supports active (+3.3V or +5V) and passive antennas
- Requires only +5 VDC for operation

1.3 Ordering Information

The GPS35162 is available with the following options:

Table 1: Ordering Options

Part Number	Description
GPS35162HR	PCIe/104 GPS Receiver with Linx RXM-GNSS-TM GPS Engine
SK-GPS35162HR	Starter Kit including GPS35162HR, adapter cable, and antenna (XK-CM57)
GPS25162HR	PCI/104 Express GPS Receiver with Linx RXM-GNSS-TM GPS Engine
SK-GPS25162HR	Starter Kit including GPS25162HR, adapter cable, and antenna (XK-CM57)
IDAN-GPS35162HRS	PCIe/104 GPS module in modular IDAN frame
IDAN-SK-GPS35162HRS	PCIe/104 GPS module in modular IDAN frame; with cables and antennae kit (IDAN-XKCM34)
IDAN-GPS25162RS	PCI/104 Express GPS module in modular IDAN frame
IDAN-SK-GPS25162HRS	PCI/104 Express GPS module in modular IDAN frame; with cables and antennae kit (IDAN-XKCM34)

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.

1.3.1 Cable Kits

XK-CM57

The XK-CM57 is a GPS antenna for use with the stand-alone GPS25162HR/GPS35162HR.

- 50-Ohm MCX Plug connector
  - 1.575 GHz
  - +5 VDC Active Antenna
  - Magnetic Base Mount
- Dimensions
  - Cable length: 16 feet
  - Height: 0.5 inches
  - Base: 1.8 inches square
- Weight: < 1 lbs.
- Operating temperature, 90% humidity non-condensing: -40 to +85C
- Storage temperature, -40 to +85C

IDAN-XKCM34

The IDAN-XKCM34 is a GPS antenna for use with the IDAN-GPS25162HRS and IDAN-GPS35162HRS.

- 50-Ohm SMA connector
  - 1.575 GHz
  - +5 VDC Active Antenna
  - Magnetic Base Mount
- Dimensions
  - Cable length: 16 feet
  - Height: 0.5 inches
  - Base: 1.8 inches square
- Weight: < 1 lbs.
- Operating temperature, 90% humidity non-condensing: -40 to +85C
- Storage temperature, -40 to +85C

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

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

STEP model is available upon request; contact RTD Tech Support for more information.

- Weight: Approximately 80 g (0.18 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (4.570 in L x 3.775 in W)

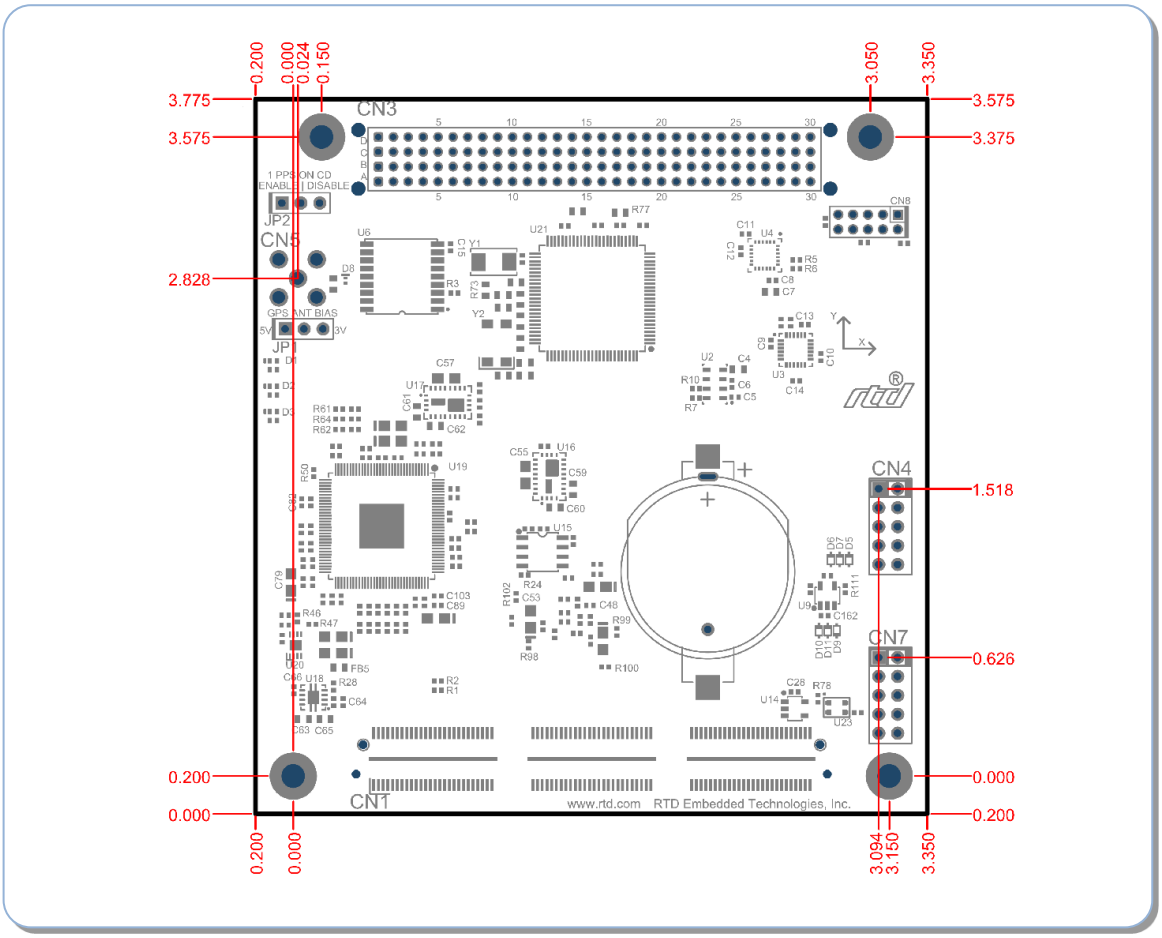

Figure 1: Board Dimensions

3.3 Connectors and Jumpers

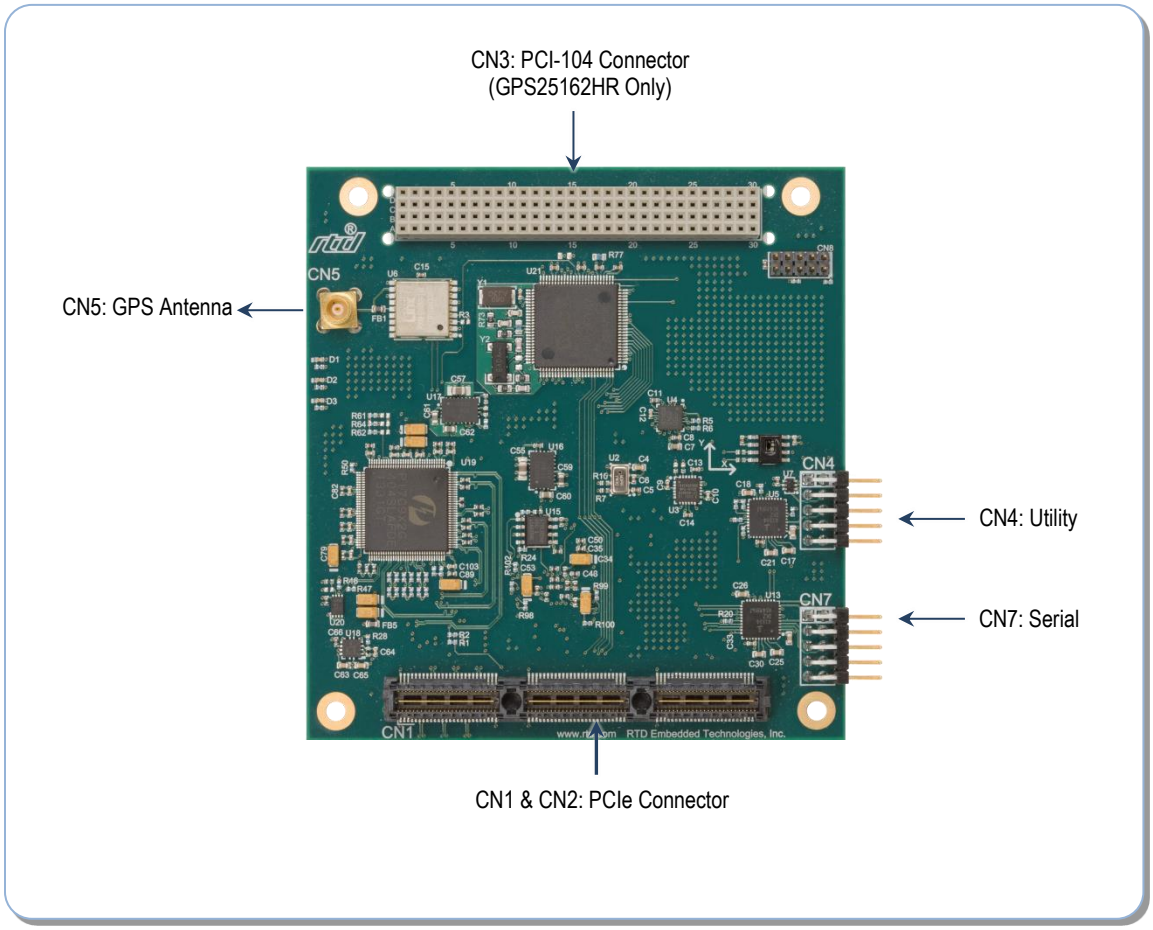

Figure 2: Board Connections

3.3.1 Bus Connectors

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 22)

The GPS35162 is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

CN3: PCI Connector (GPS25162HR Only)

The PCI connector is the connection to PCI peripheral modules. This connector is used only as a pass through connector on this board.

3.3.2 External I/O Connectors

CN7: Serial I/O Connector

CN7 is an RS-232 interface that is connected to the third port of the UART. Table 4 has the pin-out.

Table 4: CN7 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

CN4: Utility Connector

CN4 is the Utility connector. It contains a buffered 1 pulse-per-second with a 6 ns maximum delay, RS-232 level GPS output data and an external battery connector for GPS module.

Table 5: CN4 Utility

Pin Name	Pin #	Pin #	Pin Name
GND	2	1	RSVD
1PPS	4	3	RSVD
GPS TX	6	5	GND
GND	8	7	External Battery
GND	10	9	RSVD

CN5: GPS Antenna Connector

The GPS35162 provides an MCX connector for the GPS antenna.

Connector Part #: SPC Technology 8589-0853 **Example Mating Connector:** Amp 901-9877-RFX

Note: CN8 is for Factory Use only

3.3.3 JUMPERS

JP1: GPS Antenna Bias

JP1 is used to select the antenna bias level. The available bias levels are shown in Table 6.

Table 6: JP3 Settings

Setting	Description	Notes
1 – 2	5V Bias Antenna	
2 – 3	3.3V Bias Antenna	Factory default
Open	Passive Antenna	

JP2: 1 PPS on Carrier Detect

JP2 is used to connect/disconnect the 1 PPS signal from UART 1 carrier detect. The options are shown in Table 7.

Table 7: JP4 Settings

Setting	Description	Notes
1 – 2	1PPS is connected to the UART 1 CD	Factory default
2 – 3	1PPS is disconnected from UART 1 CD	

3.3.4 LEDS

D1: GPS Fix LED

D1 shows if the GPS has a 3D fix. The LED will be on if the GPS has a fix.

D2: 1PPS LED

D2 shows the status of the GPS's 1PPS signal.

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.

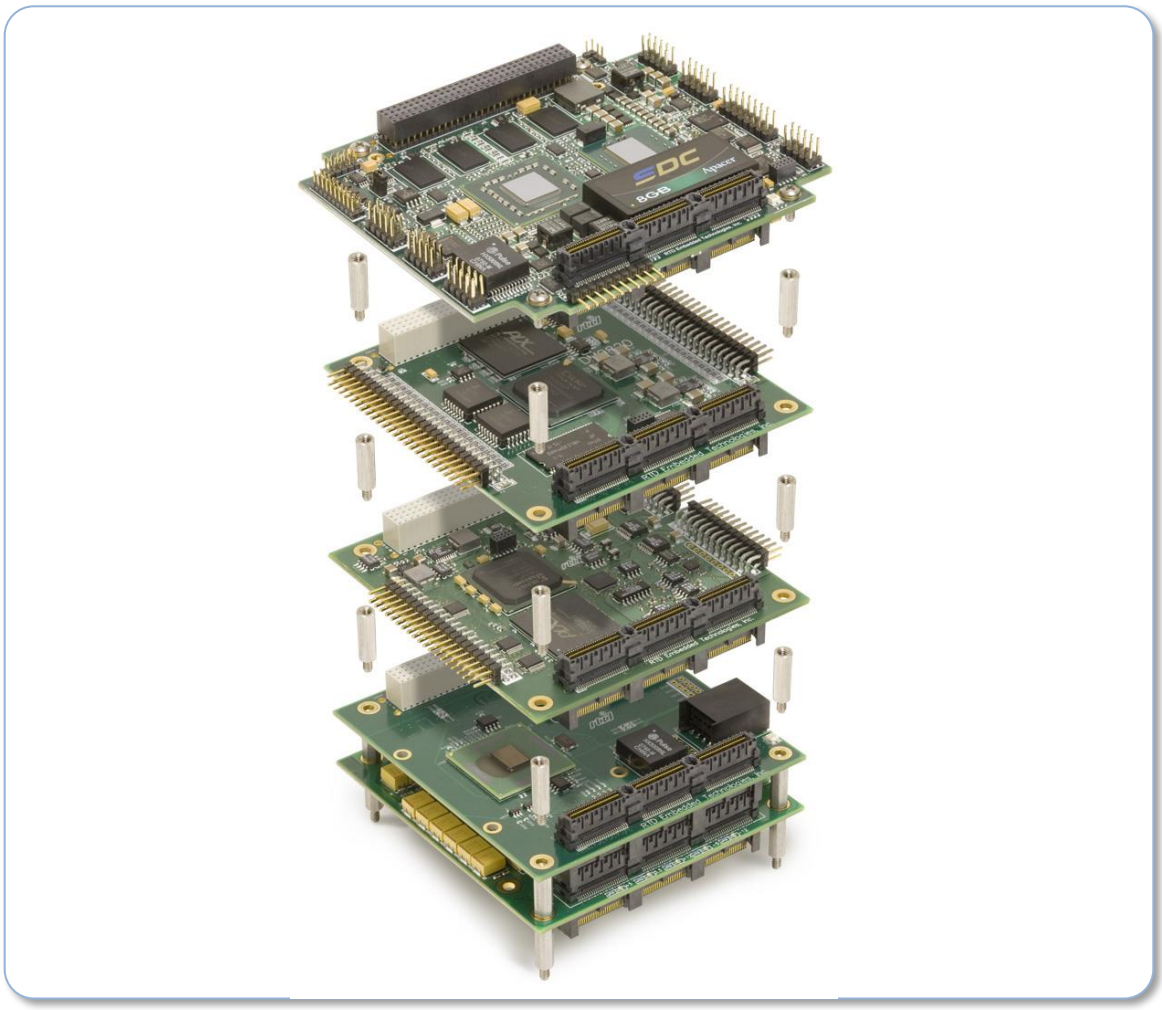

Figure 3: Example 104™ Stack

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: 151.8 mm L x 129.8 mm W x 17.0 mm H (5.98 in L x 5.12 in W x 0.67 in H)

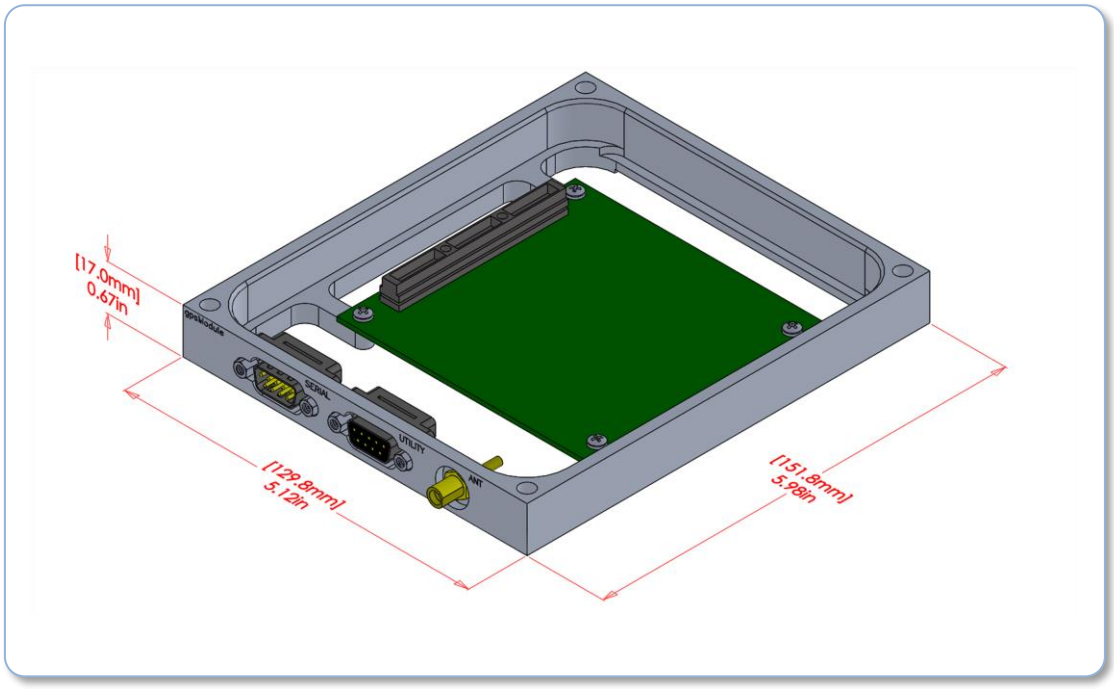

Figure 4: IDAN Dimensions

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 22)

The GPS35162 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

The figure below shows the pin orientation of the connectors on the IDAN-GPS35162HRS.

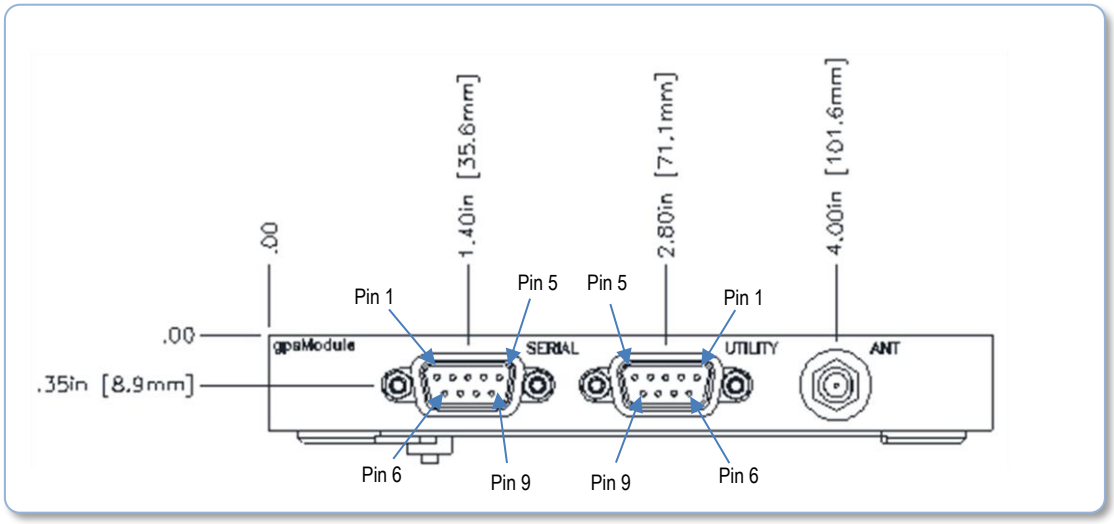

Figure 5: IDAN Front Panel

Utility Connector - 9-pin "D" Female Connector

Connector Part #: Amp 1658610-4 **Example Mating Connector:** Amp 1658608-4

Table 8: IDAN-GPS35162 Utility Connector

IDAN Pin#	Signal	GPS35162 Pin #	
1	RSVD	CN4	1
2	RSVD	CN4	3
3	GND	CN4	5
4	External Battery	CN4	7
5	RSVD	CN4	9
6	GND	CN4	2
7	1PPS	CN4	4
8	GPS TX	CN4	6
9	GND	CN4	8

Serial Connector - 9-pin "D" Male Connector

Connector Part #: VALCON DF-9P-CN **Example Mating Connector:** Amp 1658610-4

Table 9: IDAN-GPS35162 Serial Connector

IDAN Pin#	Signal(RS-232)	(RS-232)	GPS35162 Pin #	
1	DCD	-	CN7	1
2	RxD	RxD-	CN7	3
3	TxD	TxD-	CN7	5
4	DTR	-	CN7	7
5	GND	GND	CN7	9
6	DSR	-	CN7	2
7	RTS	TxD+	CN7	4
8	CTS	RxD+	CN7	6
9	RI	-	CN7	8

GPS Antenna - SMA Female Connector

Connector Part #: SPC Technology 8589-0853 **Example Mating Connector:** Amp 901-9877-RFX

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.

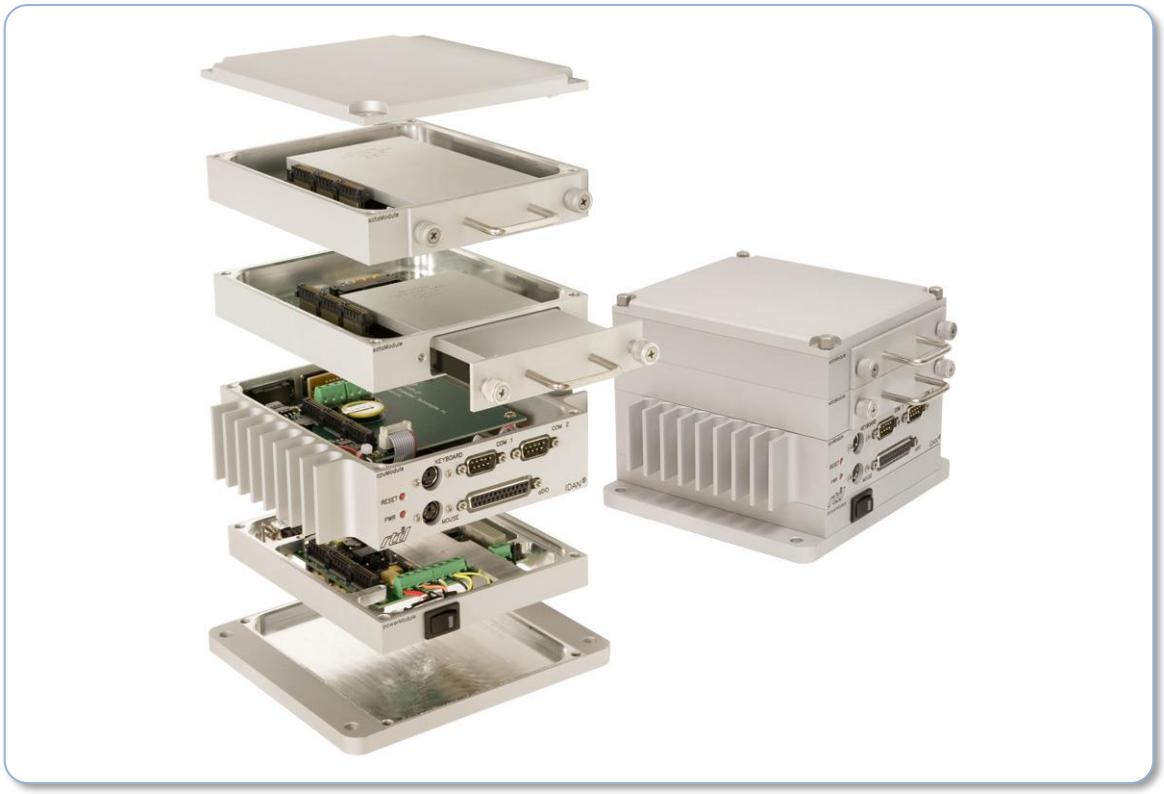

Figure 6: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the GPS35162. The various parts of the block diagram are discussed in the following sections.

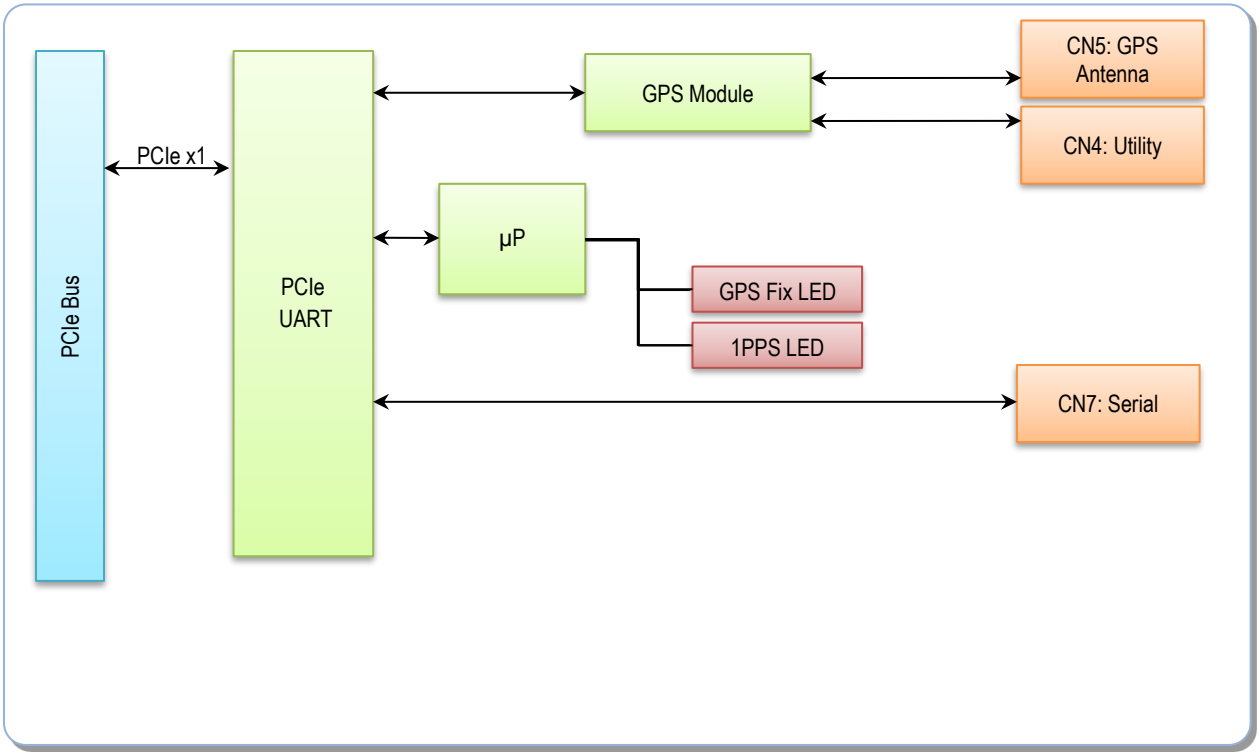

Figure 7: GPS35162 Block Diagram

5.2 PCIe UART

The GPS35162 provides a UART interface to the PCIe bus that connects to a GPS and a serial connector CN7. There are four independent UARTs that are connected as follows:

- UART 1 to GPS
- UART 2 is unused.
- UART 3 to CN7
- UART 4 is unused.

5.2.1 GPS Interface

Integrated on the GPS35162 is a Linx RXM-GNSS-TX, a low power fast-fix 33-channel GPS receiver. This GPS receiver is especially designed for portable and mobile applications. The Linx RXM-GNSS-TM provides NMEA-0183 version 4.10 data and a 1 PPS signal.

A complete list of NMEA Messages and command messages is available from the manufacturer's website at www.linxtechnologies.com.

GPS module interface

The RXM-GNSS-TM GPS is connected to the host computer through a dedicated serial port. The default configuration for the serial port is:

- 9600 Baud
- 8 Data bits
- No parity
- 1 Stop bit
- No Flow Control

GPS Antenna

Most GPS antennas are “active” which means they have a low noise amplifier (LNA) built into the antenna that requires a power source for the GPS module. While the GPS35162 will work with a passive antenna, better performance will be achieved with an active antenna. The GPS35162 provides +3.3V/+5V for active GPS antennas.

COCOM Limits

The GPS module disables tracking when both altitude (18,000m) and speed (515 m/s) limits are exceeded. However, the module has an acquisition altitude limit of 10,000m. So, it cannot be powered on and acquire a position above 10,000m, but it will continue tracking if a position is acquired below 10,000m and then the module goes higher.

6 Software

6.1 Installing the Software

The GPS35162 uses a PCIe UART which will require software and drivers for proper operation. Drivers are provided for Windows XP/7, DOS, and Linux with pre-3.8 kernels. The UART is supported in 3.8+ kernels.

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 GPS35162 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 GPS35162 exposes all of the registers available on the Exar XR17V358. The register set of the XR17V358 mimics the standard 16C550 UART register map. However, the XR17V358 contains some additional registers not found in a typical ISA-based UART.

Additionally, the base address of the GPS35162's serial ports will be different than the standard PC serial port locations (0x3F8, 0x2F8, etc.). The GPS35162 is a memory mapped device. Since it is PCI-based, it may be mapped to any location within the 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 GPS35162 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 XR17V358 data sheet available from Exar.

6.3 Windows

When using the GPS35162, a terminal emulator can be used to communicate with the GPS. Since HyperTerminal is no longer provided with Windows, we recommend using Real Term or Tera Term. Default GPS serial settings can be found in the GPS module interface section (page 19). Default sensor interface serial settings can be found in the **Error! Reference source not found.** section (page **Error! Bookmark not defined.**).

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.

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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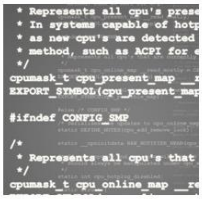

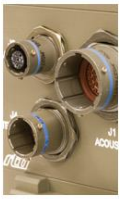
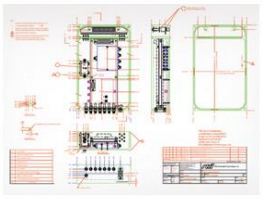

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