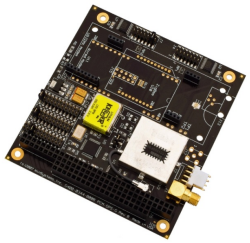
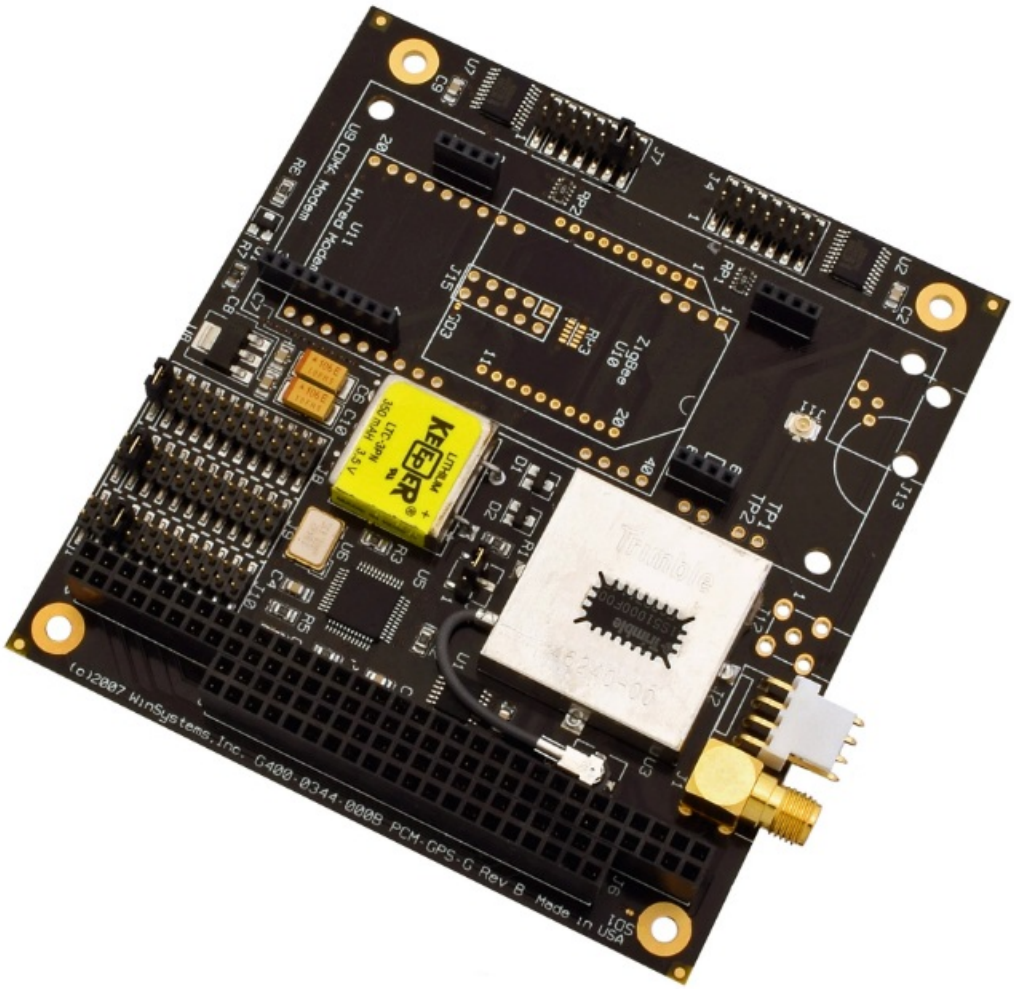


WinSystems PCM-GPS Receiver Module User Manual

Contents

WinSystems PCM-GPS Receiver Module



Product Information

Specifications

- GPS Features: TSIP, TAIP and NEMA 0183 protocols supported
- Pulse output support for accurate time standard
- External power antenna connection via a Standard SMA
- On-board battery retains GPS Almanac
- Cell Modem (optional)
- ZigBee Support (optional)
- Modem Support (optional)
- Industrial Operating Temperature Range
- Form Factor: PCM-GPS board

Product Usage Instructions

Introduction

This manual provides the necessary information regarding the configuration and usage of the PCM-GPS board. If you have any questions or need assistance, you can contact our Technical Support Group at (817) 274-7553, Monday through Friday, between 8 AM and 5 PM Central Standard Time (CST).

General Information

The PCM-GPS board offers various features and capabilities:

- GPS Features: The board supports TSIP, TAIP, and NEMA 0183 protocols. It also provides pulse output for accurate time standard. Additionally, it has an external power antenna connection via a Standard SMA and an on-board battery that retains GPS Almanac.
- Optional Cell Modem: The board supports an optional cell modem for enhanced functionality.
- Optional ZigBee Support: The board also offers optional ZigBee support for wireless communication.
- Optional Modem Support: It provides optional modem support for additional connectivity options.
- Industrial Operating Temperature Range: The board is designed to operate in an industrial temperature range.
- Form Factor: The PCM-GPS board is designed with a specific form factor for easy integration into your system.

Functional Capability

I/O Address Selection

The I/O address selection allows you to configure the board's
I/O base address. To select the address, follow these steps:

1. Locate jumper J4/J7 on the board.
2. If you want to set the address to 300H, place a jumper on all 7 positions (1-14).
3. If you want to disable a port, place a jumper on all 7 positions (1-14) for that particular port. This sets the address to 000H.

Interrupt Routing

The interrupt routing feature allows you to route interrupts to specific sources. To route an interrupt, follow these steps:

1. Locate the desired IRQ position for the source you want to route the interrupt to.
2. Place a jumper at the desired IRQ position
3. For unused sources, leave them unjumpered.
4. Each source must have its own unique interrupt.

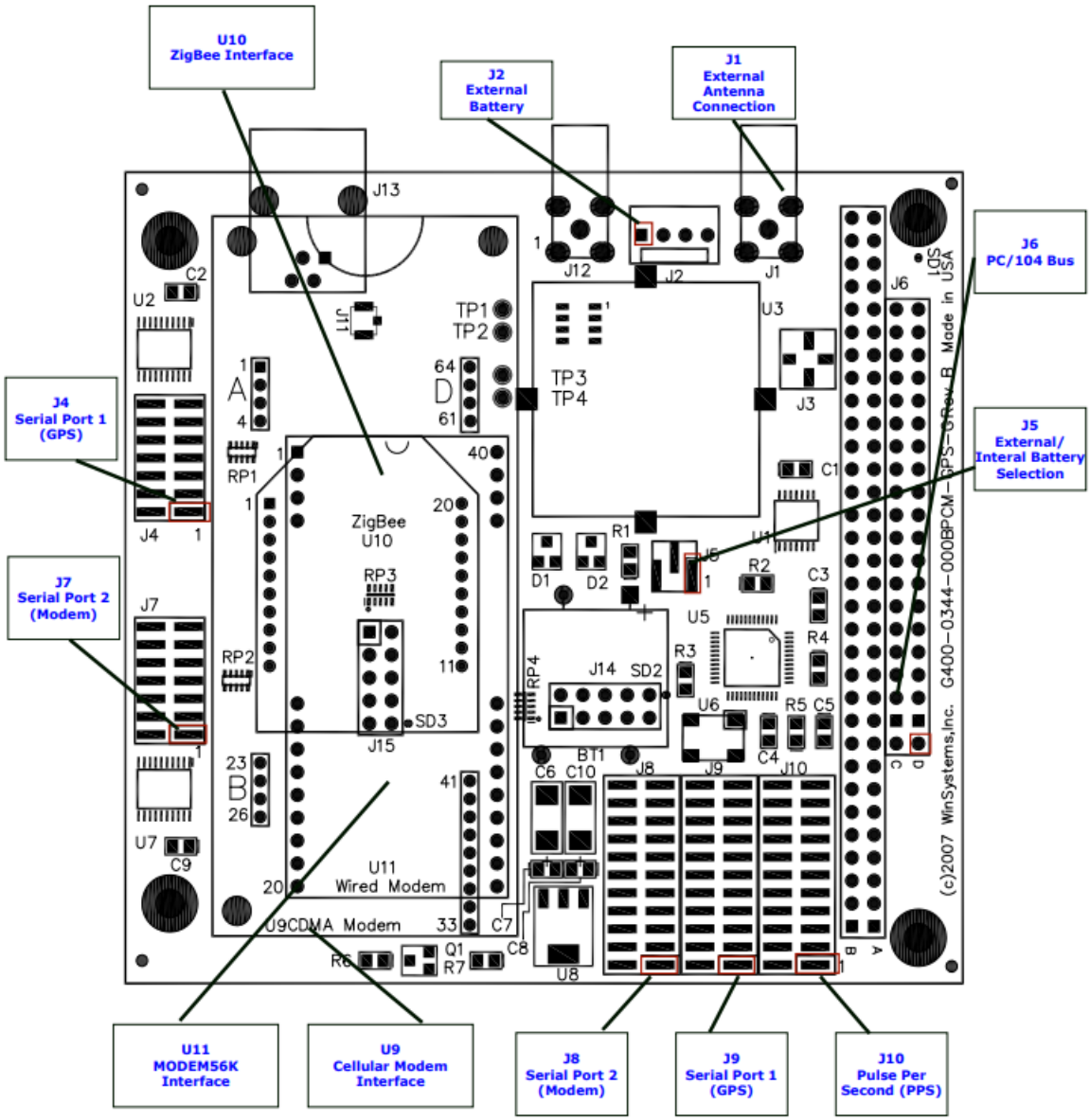
FAQ

Q: How can I contact Technical Support?

A: You can contact our Technical Support Group at (817) 274-7553, Monday through Friday, between 8 AM and 5 PM Central Standard Time (CST).

Top View – Connectors

For the convenience of the user, a copy of the Visual Index has been provided with direct links to connector and jumper configuration data.



Introduction

This manual is intended to provide the necessary information regarding configuration and usage of the PCM-GPS board. WinSystems maintains a Technical Support Group to help answer questions regarding usage or programming of the board. For answers to questions not adequately addressed in this manual, contact Technical Support at (817) 274-7553, Monday through Friday, between 8 AM and 5 PM Central Standard Time (CST). General Information

Features

Dual function PC/104-compatible board with GPS and optional Cell Modem support

1. **GPS Features**
    1. Trimble Lassen® receiver module
    2. TSIP, TAIP and NEMA 0183 protocols supported
    3. Pulse output support for accurate time standard
    4. External power antenna connection via a Standard SMA
    5. On-board battery retains GPS Almanac
2. **Cell Modem (optional)**

    1. GSM/GPRS and CDMA standard support
    2. Socket support for MultiTech® wireless module
    3. Recognizes standard AT commands
    4. Alarm management, phone book management and Short Message Service (SMS) support
3. **ZigBee Support (optional)**
    1. IEEE 802.15.4 ZigBee™ Wireless Interface
    2. Up to 1 mile line of sight range
    3. 2.4 GHz ISM frequency band
    4. 60 mW, 100 mW EIRP power output
4. **Modem Support (optional)**
    1. 56 kbps PC/104 Modem
    2. V.42, MNP Class2-4 error correction
    3. V.42bis, MNP 5 compression
    4. Integrated DAA provides compliance to global telephone standards
    5. Built-in fuse and SiDactor
    6. Caller ID Detection
    7. Parallel phone detection
    8. DTMF dialing
5. **Industrial Operating Temperature Range**
    1. 40°C to 85°C
6. **Form Factor**
    1. PC/104-compliant
    2. 3.60 in x 3.80 in (90 mm x 96 mm)
7. **Additional Specifications**
    1. Programmable address and interrupt setting support

General Description

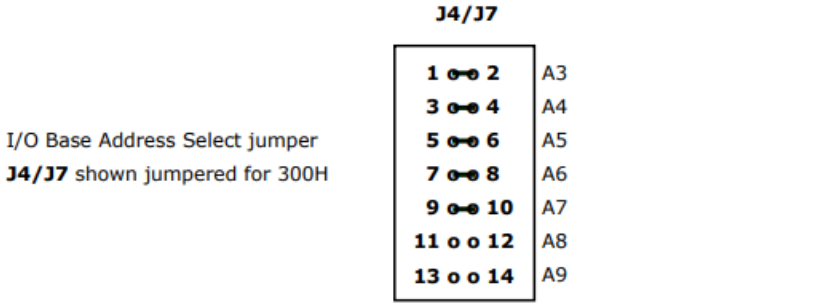
The PCM-GPS from WinSystems is a PC/104 module incorporating the Lassen IQ 12-channel parallel tracking GPS receiver from Trimble®. The GPS receiver is interfaced to an on-board 16550 compatible DUART which receives the serial data sent by the GPS module. The data output as supplied by the factory is in TSIP format making it compatible with all off-the-shelf mapping, navigation, and geocaching application software. Supplied C source code assists the integrator in creating custom applications utilizing the PCM-GPS. The PCM-GPS also supports the Trimble receiver's high precision Pulse Per Second (PPS) output for use in critical time keeping or synchronizing applications. The PCM-GPS also supports the CDMA and GPRS/GSM cellular SocketModems® from Multi-Tech Systems®. These modems, when combined with the GPS positioning data, can provide a "phone home" function to report its current location.

Functional Capability

I/O Address Selection

The PCM-GPS requires eight consecutive I/O addresses beginning on an 8-byte boundary for each of the two on-board serial channels. The jumper blocks at J4 and J7 allow selection of the primary (GPS) and secondary serial (SocketModem®) port I/O addresses respectively. Address selection is made by placing a jumper on the jumper pair for the address bit, if a 0 is desired or leaving the jumper pair open if a 1 is required for the desired address. The illustration below shows the relationship between the address bits and the jumper position and a sample jumpering for an address of 300H.

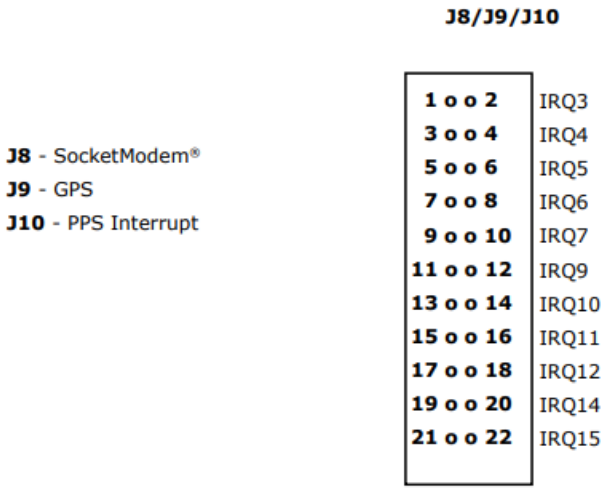
To disable a port, place a jumper on all 7 positions 9Address = 000H.



To disable a port, place a jumper on all 7 positions 9Address = 000H.

Interrupt Routing

The PCM-GPS can source up to three unique on-board interrupts. Two are available for each of the serial interfaces and a third for the Pulse Per Second (PPS) interrupt from the GPS. The jumper blocks at J8, J9, and J10 allow for routing of the interrupts for the SocketModem®, the GPS serial output, and the PPS source respectively.
To route an interrupt to a source, place a jumper at the desired IRQ position. Unused sources should be left unjumpered. Each source must have its own unique interrupt.

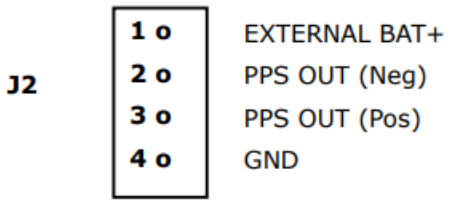


On-board PPS Usage

The GPS receiver generates a 4 µs wide positive pulse every second with the leading edge synchronized to UTC time within ±95 nanoseconds when valid position fixes are being reported. WinSystems' on-board implementation degrades this accuracy by buffering the PPS output using a 74HCT14 Schmitt trigger device which also inverts the signal. Since PC interrupts are edge-triggered on the rising edge, the actual interrupt will occur 4 µs plus the inverter propagation time later (typical 17 ns). This added delay is actually insignificant to any software synchronizing routines as the entire hardware interrupt acknowledgment process will consume many additional microseconds in a best-case scenario. The PPS signal begins immediately at power-up and continues even if the receiver loses GPS lock. The drift of the signal without GPS lock is unspecified.

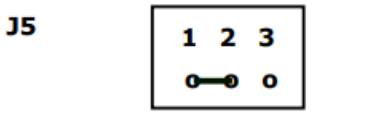
External PPS Usage

The PPS signal, in addition to being available on-board for interrupt generation, is also terminated at two polarities on the J2 connector. The negative pulsed output at pin 2 of J2 is driven by a 74HCT14 inverter with a typical propagation delay of 17 ns.
The positive signal is available on pin 3 of J2 and is double-buffered by the same type device for a typical delay of 34 ns. Either of these signals can be used by external hardware for time synchronization purposes.

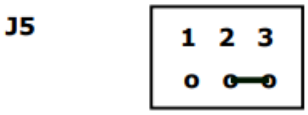


GPS Almanac Battery

The PCM-GPS is shipped with a 350 mAH 3.5V Lithium battery. This battery is used to retain GPS Almanac and Ephemeris data which provides for a greatly improved time
to position fix from power-up. With the battery available, and valid Almanac data, the time for a valid fix is reduced from under 2 minutes to under 20 seconds. The Trimble® published current draw on the battery backup line is 19 µA typical at 25ºC. Alternately, an external battery may be connected between Pin 1 (+) and Pin 4 (-) of J2. An externally connected battery should be rated at 3.5V ±.2V. The jumper block at J5 is used to select the GPS backup battery source as shown below. The jumper may be removed or moved to the external position for long-term storage of boards for battery preservation.



On-board battery selection



Off-board connector selection
External Battery **J2** (pin 1)

GPS Antenna

The PCM-GPS requires an external outdoor antenna with a clear view of the sky in order to receive and track satellites in the GPS constellation. J1 is a standard SMA connector for attachment of the antenna. It must be an active antenna powered by the 3.3V supplied by the GPS and with a typical gain of 28 dB. WinSystems offers an optional magnetic mount antenna P/N ANTENNA-MAGNETIC built by Trimble® for this module. Other antennas meeting the above specifications should work as well.

Optional Cellular Modem Interface

The PCM-GPS supports optional CDMA and GPRS/GSM cellular SocketModem™ modules from Multi-Tech Systems (**www.multitech.com**). The modem modules are installed in the U9 position and secured with screws and standoffs, Velcro, or double-stick tape as desired. The SocketModems™ use the secondary serial port on the PCM-GPS and are controlled in software by a number of AT commands. Cellular data service must be purchased from one of the supported cellular providers. Contact Multi-Tech or one of their distributors directly for answers to all questions regarding the installation, configuration, programming or usage of the Multi-Tech cellular modem modules.
The Multi-Tech part numbers for compatible SocketModems™ are :

- MTSMC-C CDMA Modem
- MTSMC-G GSM/GPRS Modem

Note: The PCM-GPS can support either: cellular modem, ZigBee® or Modem56K modules. WinSystems can package the PCM-GPS board with either add-on module. Please contact a WinSystems Applications Engineer for additional information.

Optional IEEE 802.15.4 Support

The PCM-GPS supports an optional IEEE 802.15.4 ZigBee® wireless interface from Digi (**www.digi.com**). This interface provides low-power wireless networking solutions. ZigBee® modules are installed in the U10 position, a 20-pin socket which is compatible with Digi XBee™/XBee-PRO™ OEM RF modules. The ZigBee® interface is PC/104- compatible and is configurable using AT and API Command modes.
The ZigBee® transceiver is configured as either an XBee™ or XBee-PRO™ module that is wired to an SMA RF connector on the edge of the board. The difference between the two modules is the amount of power consumed (1 mW vs. 60 mW) and signal range.

Note: The PCM-GPS can support either: cellular modem, ZigBee® or Modem56K modules. WinSystems can package the PCM-GPS board with either add-on module. Please contact a WinSystems Applications Engineer for additional information.

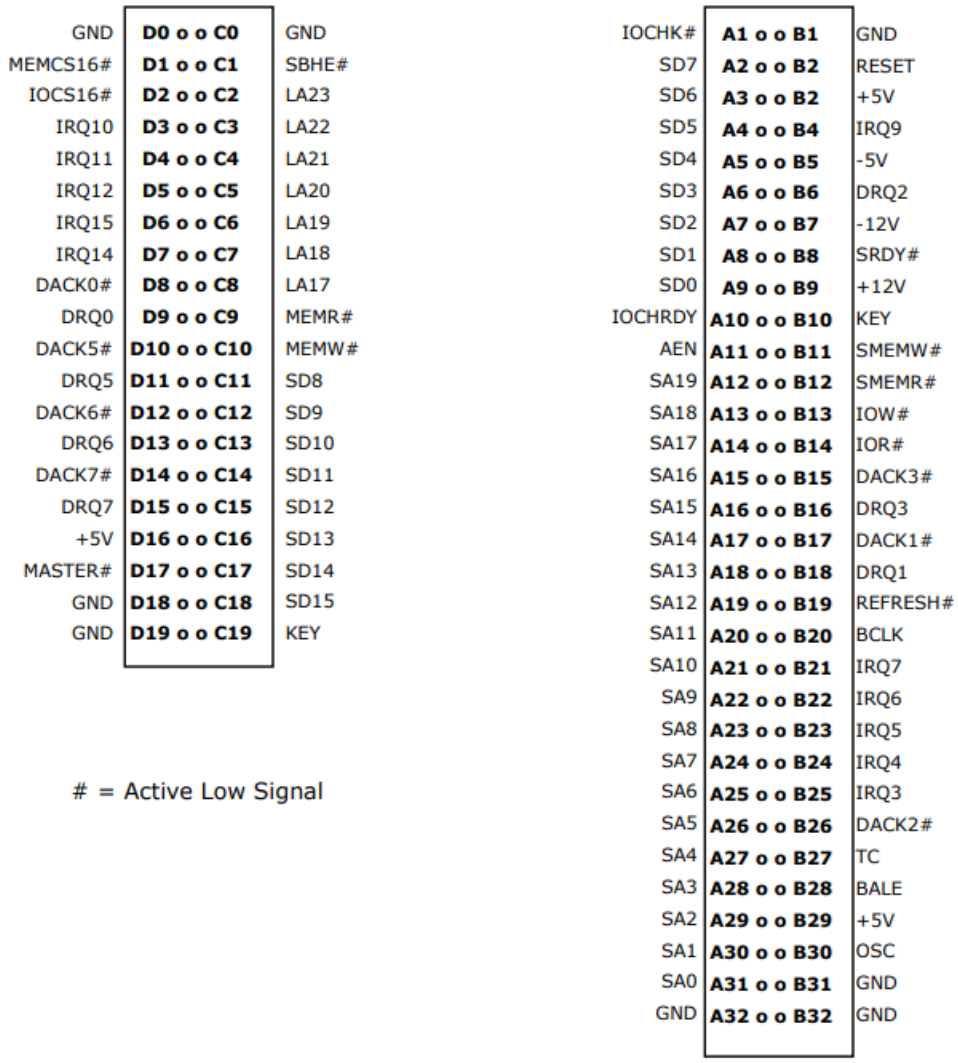
For more information on XBee™, see the ZigBee® Product manual.

Optional Modem56K Interface

The U11 position provides support for Wintec®'s PC/104-compatible 56 kbps modem. This modem replaces WinSystems' PCM-33.6 board and supports data rates up to 56,000 bps. The modem also supports MNP error correction and data compression. Based on the DSP hardware chipset, the modem uses the AT command set to control its operation and register settings.
Note: The PCM-GPS can support either: cellular, ZigBee® or Modem56K modules. WinSystems can package the PCM-GPS board with either add-on module. Please contact a WinSystems Applications Engineer for additional information.

PC/104 Bus Interface

The PCM-GPS connects to the processor through the PC/104 bus connector at J6. The pin definitions for the 8-bit and 16-bit halves of J6 are provided here for reference. Refer to the PC/104 Bus Specification for specific signal and mechanical specifications.



NOTES:

1. Rows C and D are not required on 8-bit modules.
2. B10 and C19 are key locations. WinSystems uses key pins as connections to GND.
3. Signal timing and function are as specified in ISA specification.
4. Signal source/sink current differ from ISA values.

PCM-GPS Programming Reference

Introduction

The software standard for commercial GPS receivers is TSIP format (www.trimble.com). The Trimble Lassen® IQ GPS module is also capable of transmitting and receiving serial data in a Trimble proprietary format known as TSIP. This is a binary protocol which ordinarily runs at 9600 baud, an 8-bit word, and odd parity. PCM-GPS boards as shipped, default to this TSIP standard.
The Trimble Lassen® IQ GPS module is also capable of transmitting and receiving serial data in NMEA 0183 format. This is a simple ASCII, serial communications protocol that defines how data is transmitted. Users requiring a NMEA interface to the GPS should see the Software Drivers & Examples section of this manual or contact WinSystems Technical Support for details on converting the PCM-GPS to NMEA.

TSIP Software Interface

The serial port driver in the iQ_CHAT Tool Kit matches the Lassen iQ GPS receiver serial port characteristics. The TSIPPRNT program converts binary data logged with the iQ_CHAT program into text that may be printed and displayed. Both of these tools are included in the Software Developer's Toolkit.

Warning – When using the TSIP protocol to change port assignments or settings, confirm that your changes do not affect the ability to communicate with the receiver (e.g., selecting the PC COM port settings that do not match the receiver's, or changing the output protocol to TSIP while not using iQ_CHAT).

Communicating with the Lassen iQ GPS Receiver

The Lassen iQ GPS Receiver supports three message protocols: TSIP, TAIP, and NMEA. Communication with the module is through two CMOS compatible, TTL level serial ports. The port characteristics can be modified to accommodate your application requirements. Port parameters can be stored in non-volatile memory (FLASH) which does not require backup power. Table 3.1. lists the default port characteristics.

Software Tools

The Software Tools provided on the Starter Kit CD-ROM include both user friendly Windows and DOS applications to facilitate communication with the receiver, via the Trimble Standard Interface Protocol (TSIP). This CD also includes sample C source code and reusable routines to aid in developing applications.
Note – The TSIP, TAIP, and NMEA protocols are discussed beginning on page 42 of this chapter, and in the Appendices of this document.

The serial port driver in the iQ_CHAT Tool Kit matches the Lassen iQ GPS receiver serial port characteristics. The TSIPPRNT program converts binary data logged with the iQ_CHAT program into text that may be printed and displayed. Both of these tools are included in the Software Developer's Toolkit.

Warning – When using the TSIP protocol to change port assignments or settings, confirm that your changes do not affect the ability to communicate with the receiver (e.g., selecting the PC COM port settings that do not match the receiver's, or changing the output protocol to TSIP while not using iQ_CHAT).

TSIP Data Output Modes

TSIP is the default protocol for Port 1 on the Lassen iQ GPS receiver. This binary language offers users a wide variety of commands and reports. TSIP enables the Lassen iQ GPS receiver to operate in two data output modes, both available during operation. In Query Mode, packet data is returned in response to input query packets. In Automatic Mode, a selected group of data packets is output continuously at two fixed rates – every second and every five seconds. The format and ensemble of the automatic output packets is configured using packets 0x35, 0x70, and 0x8E-20 (see Appendix A for packet details). Packet settings are stored in BBRAM. They can also be saved in non-volatile memory (Flash) using command packet 0x8E-26. See Appendix A for additional information on Flash storage for custom operation.

Default TSIP Output Settings

Default 0x35 setting (byte 0=2, 1= 2, 2=0, 3=0)

- Position and velocity data precision: single precision floating point
- Position output option and format (byte 0 setting):
    - Latitude – radian
    - Longitude – radian
    - Altitude – meters (WGS-84)
- No super-packet output

- Velocity output option and format:
  - East Velocity – meters/sec.; + for East
  - North Velocity – meters/sec.; + for North
  - Up Velocity – meters/sec.; + for Up
- • Timing
  - GPS Time Output
  - PPS Always ON

Default 0x70 setting (byte 0=1, 1=1. 2=1. 3=0):

- Position-Velocity Dynamic Filter enabled
- Position-Velocity static Filter enabled
- Altitude Filter enabled

Default 0x8E-20 setting (byte 1 = 1):

- 0x8F-20 output is included in the super-packet for automatic output IF packet 0x35 selects the super-packet for automatic output options

Automatic TSIP Output Packets (fixed rate)

One second interval

- 0x4A – (1) GPS position fix; (2) clock bias and time of fix; {20 byte format}
- 0x56 – velocity fix
- 0x6D – (1) list of satellites used for position fixes; (2) PDOP, HDOP, VDOP; (3) fix mode
- 0x82 – DGPS position fix mode

Five second interval

- 0x41 – (1) GPS time of the week (seconds); (2) extended GPS week number; (3) GPS UTC offset (seconds)
- 0x46 – health of receiver
- 0x4B – (1) Machine/Code ID; (2) Real-time-clock availability status; (3) almanac validity status; (4) having super-packet support status

Packet Output Order

After power up or a software reset (packet 0x1E), seven start-up packets are sent, only once, by the receiver in this order: 45, 46, 4B, 4A, 56, 41, 82
Before position fixes are available, the 1 second and 5 second interval packets are sent in this order, periodically:

- Every one second for 5 seconds: 6D, 82
- Every five seconds 41, 46, 4B

When position fixes are available, the 1 second and 5 second interval packets are sent in this order, periodically:

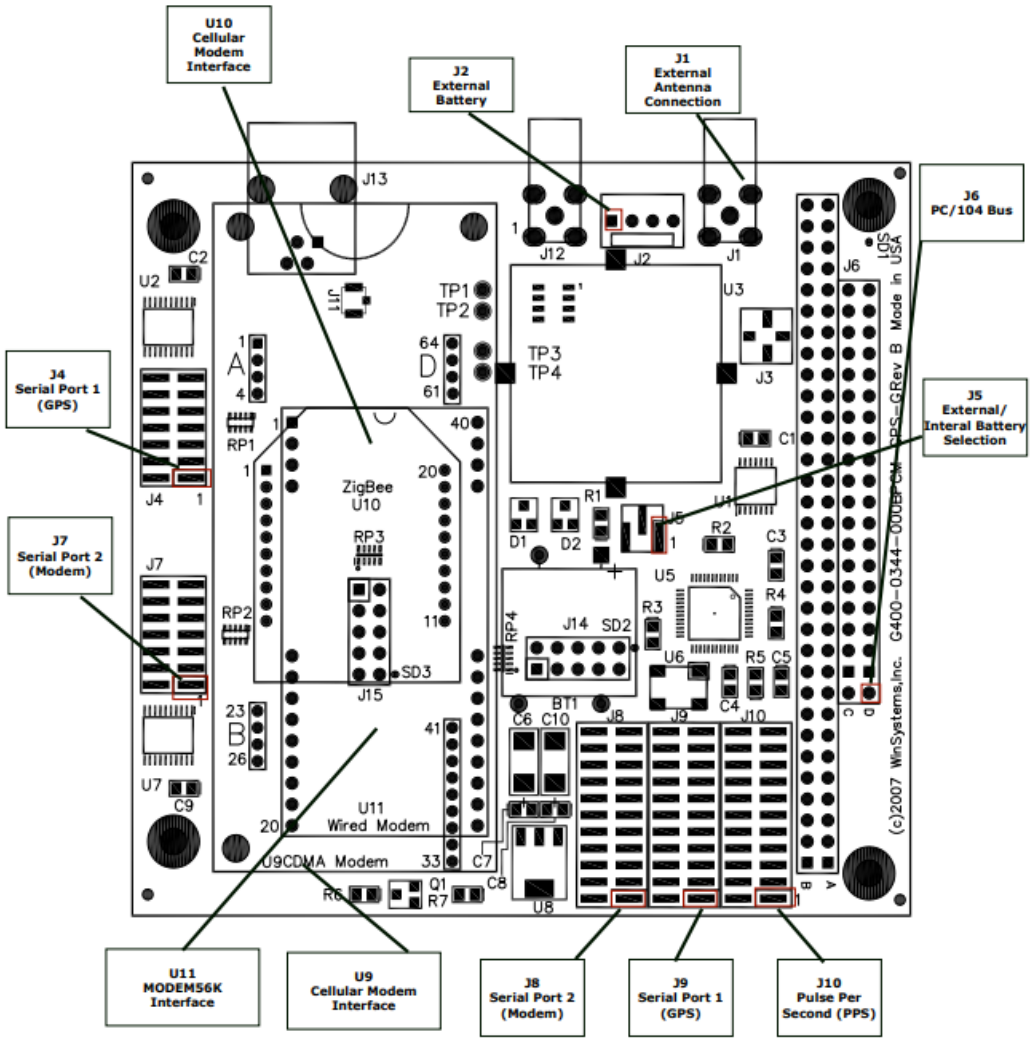
- Every one second for 4 seconds: 4A, 56, 6D, 82
- Every 5 seconds: 4A, 56, 41, 46, 4B, 6D, 82

Software Drivers & Examples

Documentation	
Trimble® Manual Reprint	**LassenManual.pdf**
GSM Programming Quick Start Guide	**gsm_quickstart.pdf**
Examples	
PCM-GPS Example Program with source	**nmea3.zip**
GPS Configuration Utility	**IQ_CHAT.EXE**
Monitoring Software including TSIPCHAT and TSIPPRNT	**iQ_Monitor_V1-52.exe**
NMEA Software Standard	**nmea.pdf**
Examples	
(Source Code Sample)	
TSIP	**iQSource.zip**

Jumper Reference

Drawings ONLY – for more detailed information on these parts, refer to the descriptions shown previously in this manual.



I/O Address Selection

J4/J7

I/O Base Address Select jumper
J4/J7 shown jumpered for 300H

1 o o 2	A3
3 o o 4	A4
5 o o 6	A5
7 o o 8	A6
9 o o 10	A7
11 o o 12	A8
13 o o 14	A9

To disable a port, place a jumper on all 7 positions 9Address = 000H.

To disable a port, place a jumper on all 7 positions 9Address = 000H.

Interrupt Routing

To route an interrupt to a source place a jumper at the desired IRQ position. Unused sources should be left unjumpered. Each source must have its own unique interrupt.

J8/J9/J10

J8 - SocketModem®
J9 - GPS
J10 - PPS Interrupt

1 o o 2	IRQ3
3 o o 4	IRQ4
5 o o 6	IRQ5
7 o o 8	IRQ6
9 o o 10	IRQ7
11 o o 12	IRQ9
13 o o 14	IRQ10
15 o o 16	IRQ11
17 o o 18	IRQ12
19 o o 20	IRQ14
21 o o 22	IRQ15

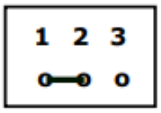
External PPS Usage GPS

J2

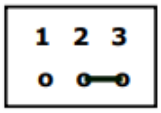
1 o	EXTERNAL BAT+
2 o	PPS OUT (Neg)
3 o	PPS OUT (Pos)
4 o	GND

Almanac Battery

J5



J5



Specifications

Electrical

Bus Interface	:PC/104 16-Bit, stackthrough
VCC	:+5V required, 50 mA typical, GPS module only. Add 20 mA typical for Trimble® magnetic mount antenna
I/O Addressing	:10-Bit user jumperable address. Each board uses 2 sets of 8 consecutive I/O addresses.
PPS Output	:1PPS (4 µs width) TTL Level both positive and negative available

Mechanical

Dimensions	:3.6" X 3.8" (90 mm x 96 mm)
Weight	:2.5 oz (70.87 gm)
PC Board	:FR-4 Epoxy glass with 2 signal layers 2 power planes, screened component legend, and plated through holes.
Jumpers	:0.020" square posts on 2.0 mm centers
Connectors	:PPS/External Battery : Molex 4 pin :GPS: 50Ω SMA with power for antenna
PC/104	:64-pin, 0.100" (32-pin double row) :40-pin, 0.100" (20-pin double row)

Environmental

Operating Temperature	:-40°C to +85°C (without optional cell modem installed)
Noncondensing humidity	:5% to 95%
MTBF	:54.11 yrs rate based upon MIL-HDBK-217C data

WARRANTY REPAIR INFORMATION

WARRANTY

(**http://www.winsystems.com/company/warranty.cfm**)

WinSystems warrants to Customer that for a period of two (2) years from the date of shipment any Products and Software purchased or licensed hereunder which have been developed or manufactured by WinSystems shall be free of any material defects and shall perform substantially in accordance with WinSystems' specifications therefore. With respect to any Products or Software purchased or licensed hereunder which have been developed or manufactured by others, WinSystems shall transfer and assign to Customer any warranty of such manufacturer or developer held by WinSystems, provided that the warranty, if any, may be assigned. Notwithstanding anything herein to the contrary, this warranty granted by WinSystems to the Customer shall be for the sole benefit of the Customer, and may not be assigned, transferred or conveyed to any third party. The sole obligation of WinSystems for any breach of warranty contained herein shall be, at its option, either (i) to repair or replace at its expense any materially defective Products or Software, or (ii) to take back such Products and Software and refund the Customer the purchase price and any license fees paid for the same. Customer shall pay all freight, duty, broker's fees, insurance charges for the return of any Products or Software to WinSystems under this warranty. WinSystems shall pay freight and insurance charges for any repaired or replaced Products or Software thereafter delivered to Customer within the United States. All fees and costs for shipment outside of the United States shall be paid by Customer. The foregoing warranty shall not apply to any Products of Software which have been subject to abuse, misuse, vandalism, accidents, alteration, neglect, unauthorized repair or improper installations.

THERE ARE NO WARRANTIES BY WINSYSTEMS EXCEPT AS STATED HEREIN, THERE ARE NO OTHER WARRANTIES EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, IN NO EVENT SHALL WINSYSTEMS BE LIABLE FOR CONSEQUENTIAL, INCIDENTIAL OR SPECIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF DATA, PROFITS OR GOODWILL. WINSYSTEMS' MAXIMUM LIABILITY FOR ANY BREACH OF THIS AGREEMENT OR OTHER CLAIM RELATED TO ANY PRODUCTS, SOFTWARE, OR THE SUBJECT MATTER HEREOF, SHALL NOT EXCEED THE PURCHASE PRICE OR LICENSE FEE PAID BY CUSTOMER TO WINSYSTEMS FOR THE PRODUCTS OR SOFTWARE OR PORTION THEREOF TO WHICH SUCH BREACH OR CLAIM PERTAINS.

WARRANTY SERVICE

1. To obtain service under this warranty, obtain a return authorization number. In the United States, contact the WinSystems' Service Center for a return authorization number. Outside the United States, contact your local sales agent for a return authorization number.
2. You must send the product postage prepaid and insured. You must enclose the products in an anti-static bag to protect from damage by static electricity. WinSystems is not responsible for damage to the product due to static electricity.

Documents / Resources

	WinSystems PCM-GPS Receiver Module [pdf] User Manual PCM-GPS Receiver Module, PCM-GPS, Receiver Module, Module

References

- IIoT Devices and Services for M2M Networking | Digi International
- MultiTech Homepage - MultiTech
- Manual-Hub.com - Free PDF manuals!
- User Manual