WinSystems®

The Embedded Systems Authority

IO60-GNSS

GNSS/GPS Receiver Module with Bus Expansion

Product Manual

WinSystems, Inc. | 715 Stadium Drive, Arlington, Texas 76011 | 817-274-7553 | info@winsystems.com | www.winsystems.com

Revision History

Document Version	Last Updated Date	Brief Description of Change
v1.0	1/2016	Initial release

Copyright and Trademarks

Trademark Acknowledgments

Table of Contents

1. Before You Begin

Review the warnings (in this section) and the best practice recommendations (see “Best Practices” on page 14) when using and handling the WinSystems IO60-GNSS. Following these recommendations provides an optimal user experience and prevents damage. Read through this document and become familiar with the IO60-GNSS before proceeding.

FAILING TO COMPLY WITH THESE BEST PRACTICES MAY DAMAGE THE IO60-GNSS AND VOID YOUR WARRANTY.

1.1 Warnings

Only qualified personnel should configure and install the IO60-GNSS. While observing the best practices, pay particular attention to the following:

Avoid Electrostatic Discharge (ESD)
Only handle the circuit board and other bare electronics when electrostatic discharge (ESD) protection is in place. Having a wrist strap and a fully grounded workstation is the minimum ESD protection required before the ESD seal on the product bag is broken.

2. Introduction

This manual provides configuration and usage information for the IO60-GNSS. If you still have questions, contact Technical Support at (817) 274-7553, Monday through Friday, between 8 AM and 5 PM Central Standard Time (CST).

Refer to the WinSystems website for other accessories (including cable drawings and pinouts) that can be used with your IO60-GNSS.

3. Functionality

The WinSystems IO60-GNSS Receiver Module with Bus Expansion is a self-contained, high performance Global Navigation Satellite System receiver with either a GPS only or a GNSS/GPS combination receiver. Models with the GPS receiver are based on the MediaTek 3337 chip set. Models with the GNSS receiver are based on the MT3333 chipset and can simultaneously acquire and track up to 33 satellites in the GPS, GALILEO, GLONASS, and QZSS satellite constellations.

These include the United States GPS System, Europe’s GALILEO, Russia’s GLONASS, and Japan’s QZSS. Small and lightweight, with minimal power demand, this high performance module is ideal for a variety of applications such as:

- Positioning and Navigation
- Surveying

- Security/Loss Prevention
- Location and Tracking
- Logistics
- Fleet Management

NOTE WinSystems can provide custom configurations for OEM clients. Please contact an Application Engineer for details.

4. Features

The IO60-GNSS provides the following general features:

- Simultaneous acquisition and tracking of multiple satellite constellations, including GPS, GALILEO, GLONASS, and QZSS—see Model Specifics (GPS receiver and GNSS/GPS receiver)
- Exceptional sensitivity even in dense foliage and urban canyons
- Low power consumption/maximum run-time
- Small (50 mm x 72 mm) Form Factor
- 15 second cold start
- Fast Time To First Fix
- High-performance RF architecture acquires and tracks signals as low as -161 dBm
- Compatible with wide range of external antennas
- Low profile and vibration resistant
- Battery-backed SRAM
- Standard NMEA data output
- 1 Pulse-per-second (PPS) signal available—see Model Specifics (GPS receiver and GNSS/GPS receiver)

4.1 Model Specifics (GPS receiver and GNSS/GPS receiver)

The IO60-GNSS with the GPS-only receiver uses the Linx RM Series GPS receiver module. The IO60-GNSS with the combination GNSS/GPS receiver uses the Linx GM Series GNSS/GPS receiver module.

- The RM Series GPS receiver module is a self-contained high-performance GPS receiver based on the MT3337 chipset.
- The GM Series GNSS/GPS receiver module is a self-contained high-performance Global Satellite Navigation System receiver based on the MT3333 chipset. It can simultaneously acquire and track multiple satellite constellations. These include the United States GPS system, Europe's GALILEO, Russia's GLONASS and Japan's QZSS.

Both modules output standard NMEA data through a UART interface.

The 1PPS signal (pin 29 of J100) outputs 1 pulse per second on the rising edge of the GPS/GNSS second when the receiver has an over-solved navigation solution from five or more satellites.

- On board circuitry inverts the receiver module's 1PPS signal to ensure full voltage swing and voltage compatibility
- The resulting 1 PPS signal is high at 3.3 V until the receiver has a fix, then pulses low to 0 V for 100 ms on the rising edge of each GPS/GNSS second

Refer to “Other Manufacturer’s Information” on page 13, for additional information.

5. General Operation

The unit is designed to work with a backup battery to keep the SRAM memory and RTC powered when the RF section and main positioning system are powered down. While significantly reducing power consumption, this feature also allows for fast position fixes when power resumes.

System mechanics are designed around the WinSystems IO60 connector platform. IO60 can support a single mezzanine card or multiple boards on a stack. GNSS receiver data is in NMEA standard message format. The messages are sent to the host over the IO60 UART connection.

Augment your new or existing infrastructure with the next generation of global satellite navigation. Deploy the WinSystems GNSS/GPS Receiver Module and realize the rewards of precision acquisition and tracking combined with a durable design for remote locations.

6. Specifications

The IO60-GNSS adheres to the following specifications and requirements. Refer to Table 1–1 for models with GNSS Receivers, Table 1–2 on page 4 for models with GPS-only Receivers, and Table 1–3 on page 5 for general specifications and requirements that apply to both models.

Table 1–1: GNSS Receiver Electrical Specifications

Parameter	Symbol	Min	Typ	Max	Units	Notes
Power Supply						
Operating Voltage	V_{CC}	3.3	5.0	5.5	VDC	
Supply Current	I_{CC}					
Peak				150	mA	1, 2
Acquisition			24		mA	2
Tracking			16		mA	2
Standby			0.365		mA	2
Backup Battery Voltage	V_{BAT}	2.0		4.3	VDC	
Backup Battery Current	I_{BAT}		7		µA	3

Table 1–1: GNSS Receiver Electrical Specifications (Continued)

Parameter	Symbol	Min	Typ	Max	Units	Notes
Power Supply (Continued)						
VOUT Output Voltage	V_{OUT}	2.7	2.8	2.9	VDC	
VOUT Output Current	I_{OUT}			30	mA	2
Minimum RESET Pulse	T_{RST}	1			ms	
Receiver Section						
Receiver Sensitivity						
Tracking			-161		dBm	
Cold Start			-143		dBm	
Acquisition Time						
Hot Start (Open Sky)			1		s	
Hot Start (Indoor)			30		s	
Cold Start			33		s	
Cold Start, AGPS			15		s	
Position Accuracy						
Autonomous			3		m	
SBAS			2.5		m	
1PPS Accuracy		-11		11	ns	
Altitude				18,000	m	
Velocity				515	m/s	
Chipset	MediaTek MT3333					
Frequency	**GPS, GALILEO, QZSS:** L1 1575.42 MHz, C/A code **GLONASS:** L1 1598.0625 MHz through 1605.375 MHz, C/A code					
Channels	99					
Update Rate	1 Hz default, up to 10 Hz					
Protocol Support	NMEA 0183 ver 4.10					
1. This is the current when downloading AGPS data to the module 2. V_{CC} = 3.3 V, without active antenna, ephemeris prediction is off 3. V_{CC} = 0 V						

Table 1–2: GPS Receiver Electrical Specifications

Parameter	Symbol	Min	Typ	Max	Units	Notes
Power Supply						
Operating Voltage	V_{CC}	3.3	5.0	5.5	VDC	
Supply Current	I_{CC}					
Peak				44	mA	1
Acquisition			14		mA	1
Tracking			12		mA	1
Standby			0.135		mA	1
Backup Battery Voltage	V_{BAT}	2.0		4.3	VDC	
Backup Battery Current	I_{BAT}		6		µA	2
VOUT Output Voltage	V_{OUT}	2.7	2.8	2.9	VDC	
VOUT Output Current	I_{OUT}			30	mA	1
Minimum RESET Pulse	T_{RST}	1			ms	

Table 1–2: GPS Receiver Electrical Specifications (Continued)

Parameter	Symbol	Min	Typ	Max	Units	Notes
Receiver Section						
Receiver Sensitivity						
Tracking			-161		dBm	
Cold Start			-143		dBm	
Acquisition Time						
Hot Start (Open Sky)			1		s	
Hot Start (Indoor)			30		s	
Cold Start			33		s	
Position Accuracy						
Autonomous			3		m	
SBAS			2.5		m	
1PPS Accuracy		-11		11	ns	
Altitude				50,000	m	
Velocity				515	m/s	
Chipset	MediaTek MT3337					
Frequency	L1 1575.42 MHz, C/A code					
Channels	22 tracking, 66 acquisition					
Update Rate	1 Hz default, up to 10 Hz					
Protocol Support	NMEA 0183 ver 3.01					
1. V_{CC} = 3.3 V, without active antenna, position fix is available 2. V_{CC} = 0 V 3. No pull-up or pull-down on the lines						

Table 1–3: General Specifications (applies to both GNSS and GPS models)

Mechanical	
Dimensions	length 72 mm, width 50 mm
Weight	0.864 oz (24.5 gm)
PCB thickness	0.078 inch (1.98 mm)
Environmental	
Temperature	-40 °C to +85 °C
Humidity (RH)	5% to 95% non-condensing
Random Shock Testing	MIL-STD-202G, Method 213B, Condition A, 50g half-sine, 11ms duration per axis, 3 axis
Random Vibration Testing	MIL-STD-202G, Method 214A, Condition D, 01g/Hz (11.95g rms), 20 minutes per axis, 3 axis
RoHS Compliant	Yes
Operating Systems	
Windows and Linux x86/64-bit drivers and sample code are available for single board computers featuring IO60 expansion.	

6.1 Additional Accessories

A standoff kit part number, KIT-IO60-STANDOFF-2, is included for use with the IO60-GNSS. The kit contains the following items:

Component	Description	Qty
Standoff	Aluminum, 5 MM HEX,12 MM Long, 3.5 MM THREAD, Male/Female	2
Hex Nut	Zinc Finish, M3-0.5 DIN	2
Screw	Stainless Steel, M3 x 0.5 MM x 6 MM PPH	2

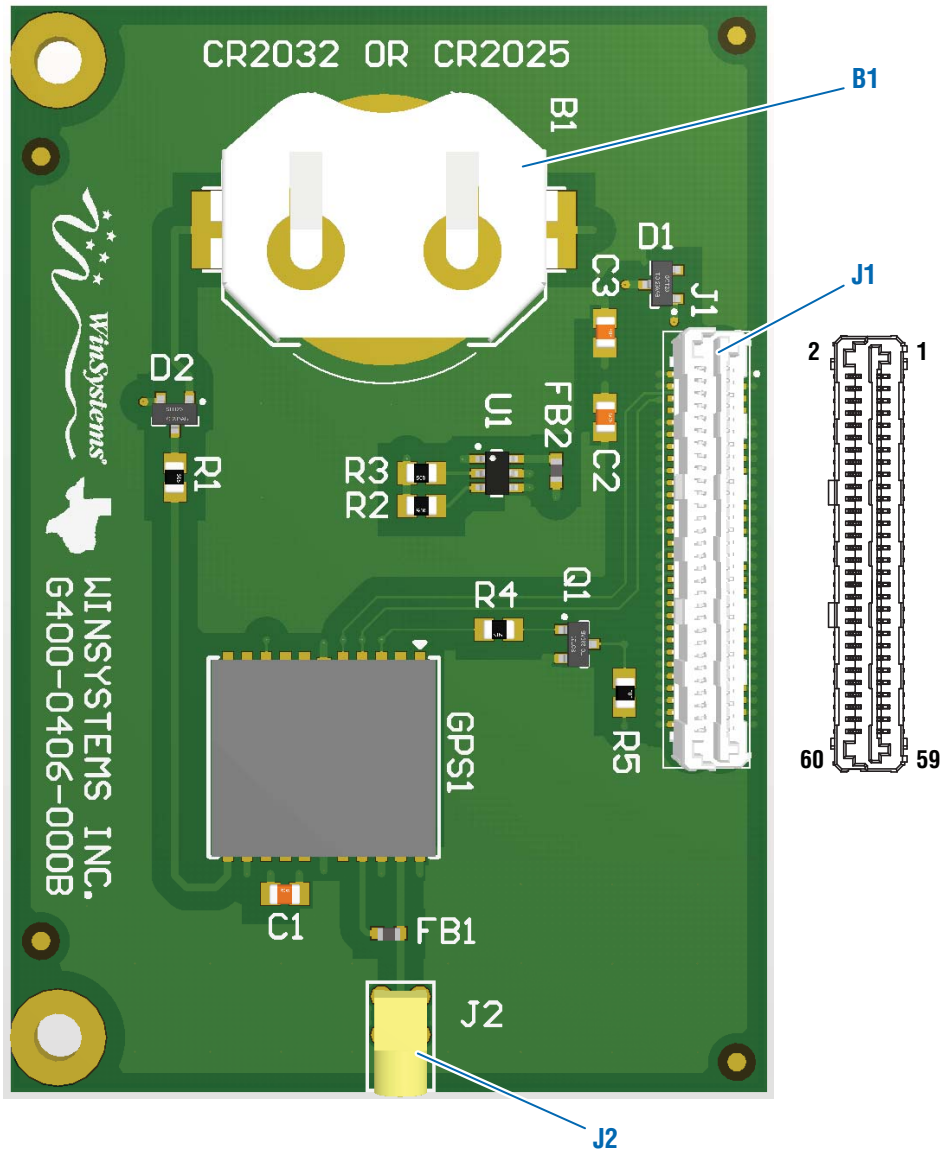
7. Configuration

This section describes the IO60-GNSS components and configuration.

7.1 Component Layout

The IO60-GNSS provides components on the top and bottom of the board.

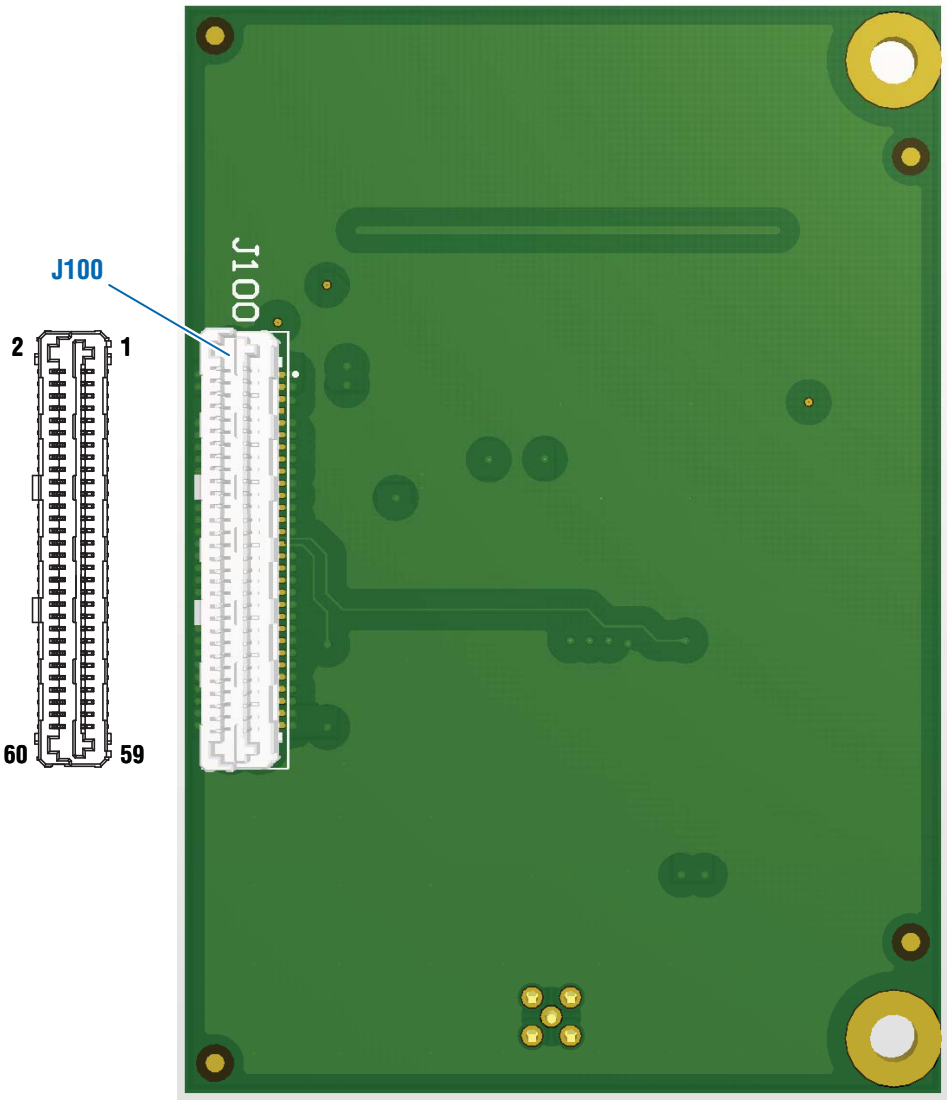
7.1.1 Top View



Top View Components:

Item	Description	Reference
J1	IO60 Top Connector (J1)	page 10
J2	RF connector (J2)	page 12
B1	Battery (B1)	page 9

7.1.2 Bottom View



Bottom View Components:

Item	Description	Reference
J100	IO60 Bottom Connector (J100)	page 11

7.2 Power

The IO60-GNSS draws power through the IO60 connector. It requires 5 VDC and 3.3 VDC and typically operates below 1 A. The power requirement varies depending on how the module is being utilized.

7.3 Battery (B1)

The backup battery keeps the SRAM memory and RTC powered when the RF section and main positioning system are powered down. While significantly reducing power consumption, this feature also allows for fast position fixes when power resumes.

The IO60-GNSS uses a CR-2032 or CR-2025 battery. The nominal voltage of both batteries is 3.0 V.

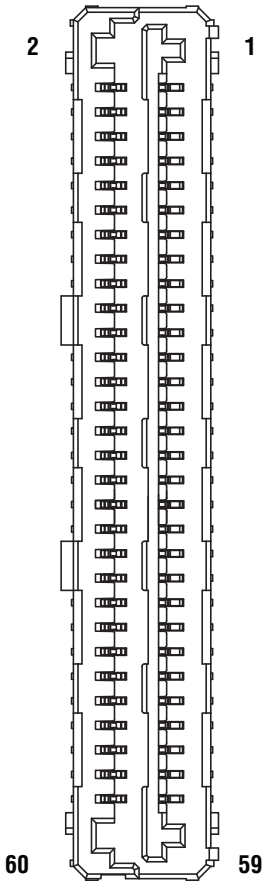
7.4 Embedded Computer Connection

The IO60-GNSS is connected to a host embedded system through the IO60 interface (above the board through J1 or below the board through J100).

7.4.1 IO60 Top Connector (J1)

Purpose: IO60 Expansion Interface Connection to host computer

Layout and Pin Reference:



Pin	Name (Signal)	Pin	Name (Signal)
1	VCC5	2	VCC5
3	VCC5	4	VCC5
5	TX (NC)	6	RX (NC)
7	RTS (NC)	8	CTS (NC)
9	GND	10	MUXCTRL (GND)
11	SCLK	12	MISO
13	SPI_CS0	14	MOSI
15	SPI_CS1	16	SPI_CS2 (NC)
17	SPI_CS3	18	SPI_RDY
19	GND	20	GND
21	SCL	22	SDA
23	GND	24	GND
25	PWM0	26	EPIT1
27	GND	28	GND
29	POR	30	GPIO_0 (GPIO_1)
31	GPIO_1 (GPIO_2)	32	GPIO_2 (GPIO_3)
33	GPIO_3 (GPIO_4)	34	GPIO_4 (GPIO_5)
35	GPIO_5 (GPIO_6)	36	GPIO_6 (GPIO_7)
37	GPIO_7 (GPIO_8)	38	GPIO_8 (NC)
39	GND	40	GND
41	RSVD1	42	RSVD2
43	RSVD3	44	RSVD4
45	GND	46	GND
47	RSVD5	48	RSVD6
49	RSVD7	50	RSVD8
51	GND	52	GND
53	RSVD9	54	RSVD10
55	RSVD11	56	RSVD12
57	VCC3	58	VCC3
59	VCC3	60	VCC3
Gray Pins are not used by the IO60-GNSS.			

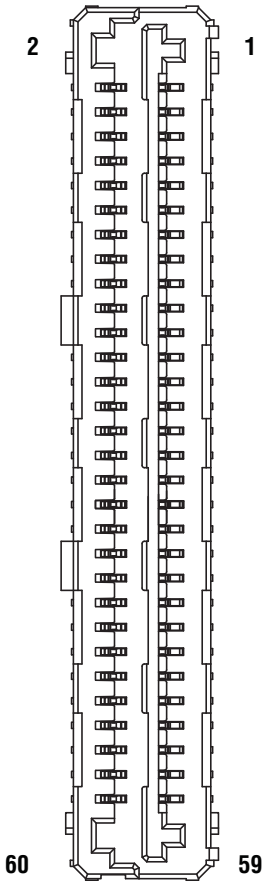
Additional Information

This connection uses a Samtec LSEM-130-06.0-L-DV-A-N-K-TR connector (WinSystems part number: G650-0060-070). Same matching connector.

7.4.2 IO60 Bottom Connector (J100)

Purpose: IO60 Expansion Interface Connection to host computer

Layout and Pin Reference:



Pin	Name (Signal)	Pin	Name (Signal)
1	VCC5	2	VCC5
3	VCC5	4	VCC5
5	RX (TX_OUT)	6	TX (RX_IN)
7	CTS (NC)	8	RTS (NC)
9	MUXCTRL (GND)	10	GND
11	MISO	12	SCLK
13	MOSI	14	SPI_CS0
15	SPI_CS2	16	SPI_CS1
17	SPI_RDY	18	SPI_CS3
19	GND	20	GND
21	SDA	22	SCL
23	GND	24	GND
25	EPIT1	26	PWM0
27	GND	28	GND
29	GPIO_0 (1PPS_N)	30	POR
31	GPIO_2	32	GPIO_1
33	GPIO_4	34	GPIO_3
35	GPIO_6	36	GPIO_5
37	GPIO_8	38	GPIO_7
39	GND	40	GND
41	RSVD2	42	RSVD1
43	RSVD4	44	RSVD3
45	GND	46	GND
47	RSVD6	48	RSVD5
49	RSVD8	50	RSVD7
51	GND	52	GND
53	RSVD10	54	RSVD9
55	RSVD12	56	RSVD11
57	VCC3	58	VCC3
59	VCC3	60	VCC3
Gray Pins are not used by the IO60-GNSS.			

Additional Information

This connection uses a Samtec LSEM-130-06.0-L-DV-A-N-K-TR connector (WinSystems part number: G650-0060-070). Same matching connector.

7.5 RF connector (J2)

Connect to an SH Series GPS Antenna with the following specifications:

Specification	Value
Center Frequency	1575.42 MHz
Impedance	50 Ω
Voltage	2.8 VDC compatible
Amperage	< 30 mA @ 2.8 V
MMCX connector	See “Other Manufacturer’s Information” on page 13.

8. Other Manufacturer's Information

Refer to manufacturer's data sheets for information.

Linx RXM-GNSS-GM Datasheet:
http://www.linxtechnologies.com/resources/data-guides/rxm-gnss-gm.pdf

Linx RXM-GPS-RM Datasheet:

http://www.linxtechnologies.com/resources/data-guides/rxm-gps-rm.pdf

Linx MMCX/RP-MMCX Specifications:

https://www.linxtechnologies.com/resources/documents/mmcx_rp-mmcx_specs.pdf

Appendix A. Best Practices

The following sections outline the best practices for operating the IO60-GNSS in a safe, effective manner, that will not damage the board. Please read this section carefully.

Avoid Electrostatic Discharge (ESD)—Only handle the circuit board and other bare electronics when electrostatic discharge (ESD) protection is in place. Having a wrist strap and a fully grounded workstation is the minimum ESD protection required before the ESD seal on the product bag is broken.

Power Down

Make sure that power has been removed from the system before making or breaking any connections.

Power Supply OFF—The power supply should always be off before it is connected to the IO60-GNSS.

Connections OFF—Connections should also be off before connecting them to the IO60-GNSS or any cards. Connecting hot signals can cause damage whether the embedded system is powered or not.

Mounting and Protecting the IO60-GNSS

The IO60-GNSS must be mounted properly to avoid damage.

You can order additional standoff kits from WinSystems, part number KIT-IO60-STANDOFF-2. The kit contains the following items:

Component	Description	Qty
Standoff	Aluminum, 5 MM HEX,12 MM Long, 3.5 MM THREAD, Male/Female	2
Hex Nut	Zinc Finish, M3-0.5 DIN	2
Screw	Stainless Steel, M3 x 0.5 MM x 6 MM PPH	2

Do Not Bend or Flex the IO60-GNSS—Never bend or flex the embedded computer module. Bending or flexing can cause irreparable damage. Embedded computer modules are especially sensitive to flexing or bending around Ball-Grid-Array (BGA) devices. BGA devices are extremely rigid by design and flexing or bending the embedded computer module can cause the BGA to tear away from the printed circuit board.

Mounting Holes—The mounting holes are plated on the top, bottom and through the barrel of the hole and are connected to the embedded computer module's ground plane. Traces are often routed in the inner layers right below, above or around the mounting holes.

- Never use a drill or any other tool in an attempt to make the holes larger.
- Never use screws with oversized heads. The head could come in contact with nearby components causing a short or physical damage.
- Never use self-tapping screws; they will compromise the walls of the mounting hole.
- Never use oversized screws that cut into the walls of the mounting holes.
- Always use all of the mounting holes. By using all of the mounting holes you will provide the support the embedded computer module needs to prevent bending or flexing.

Plug or Unplug Connectors Only on Fully Mounted Boards—Never plug or unplug connectors on a board that is not fully mounted. Many of the connectors fit rather tightly and the force needed to plug or unplug them could cause the embedded computer module to be flexed.

Avoid Cutting of the IO60-GNSS—Never use star washers or any fastening hardware that will cut into the IO60-GNSS.

Avoid Over-tightening of Mounting Hardware—Causing the area around the mounting holes to compress could damage interlayer traces around the mounting holes.

Use Appropriate Tools—Always use tools that are appropriate for working with small hardware. Large tools can damage components around the mounting holes.

Avoid Conductive Surfaces—Never allow the embedded computer module to be placed on a conductive surface. Many embedded systems use a battery to back up the clock-calendar and CMOS memory. A conductive surface such as a metal bench can short the battery causing premature failure.

Conformal Coating

Applying conformal coating to a WinSystems product will not in itself void the product warranty, if it is properly removed prior to return. Coating may change thermal characteristics and impedes our ability to test, diagnose, and repair products. Any coated product sent to WinSystems for repair will be returned at customer expense and no service will be performed.

Operations/Product Manuals

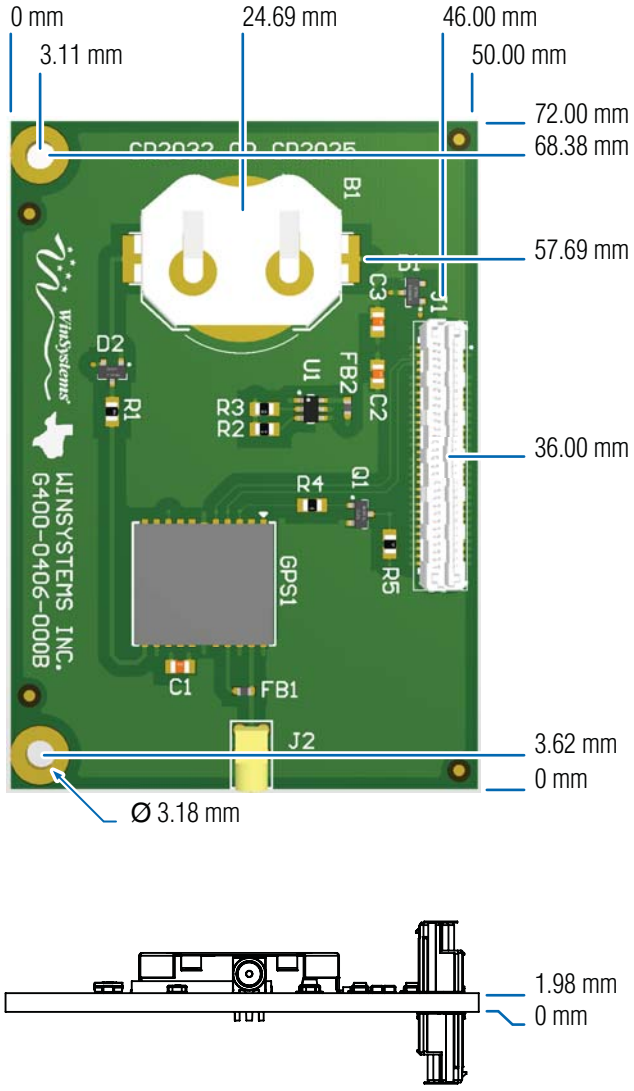
Every single board computer has an Operations manual or Product manual.

Periodic Updates—Operations/Product manuals are updated often. Periodically check the WinSystems website (http://www.winsystems.com) for revisions.

Check Pinouts—Always check the pinout and connector locations in the manual before plugging in a cable. Many modules will have identical headers for different functions and plugging a cable into the wrong header can have disastrous results.

Contact an Applications Engineer—If a diagram or chart in a manual does not seem to match your board, or if you have additional questions, contact a WinSystems Applications Engineer at: +1-817-274-7553.

Appendix B. Mechanical Drawing



Appendix C. Warranty Information

WinSystems warrants 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 defects and shall perform substantially in accordance with WinSystems' specifications therefor. 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. 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 and other fees and 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 or Software which have been subject to abuse, misuse, vandalism, accident, alteration, neglect, unauthorized repair or improper installation.

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In the event this Order is placed in the hands of an attorney or collection agency by WinSystems to collect any sums due hereunder to WinSystems, Customer shall pay all reasonable attorney's fees, expenses, collection and court costs incurred by WinSystems.

THIS AGREEMENT SHALL BE GOVERNED AND CONSTRUED UNDER THE TEXAS UNIFORM COMMERCIAL CODE AND THE APPLICABLE LAWS OF THE STATE OF TEXAS. THE PARTIES ACKNOWLEDGE THAT ANY ACTION BROUGHT HEREUNDER SHALL ONLY BE BROUGHT IN A COURT OF COMPETENT JURISDICTION IN TARRANT COUNTY, TEXAS.

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.