Linx TECHNOLOGIES

FM Series
GPS Receiver Module
Data Guide

Wireless made simple®

Warning: Linx radio frequency ("RF") products may be used to control machinery or devices remotely, including machinery or devices that can cause death, bodily injuries, and/or property damage if improperly or inadvertently triggered, particularly in industrial settings or other applications implicating life-safety concerns. No Linx Technologies product is intended for use in any application without redundancies where the safety of life or property is at risk.

The customers and users of devices and machinery controlled with RF products must understand and must use all appropriate safety procedures in connection with the devices, including without limitation, using appropriate safety procedures to prevent inadvertent triggering by the user of the device and using appropriate security codes to prevent triggering of the remote controlled machine or device by users of other remote controllers.

All RF products are susceptible to RF interference that can prevent communication. Lack of good sight of the GPS satellites (open sky) can affect the accuracy of a position fix or prevent a fix entirely.

Do not use any Linx product over the limits in this data guide. Excessive voltage or extended operation at the maximum voltage could cause product failure. Exceeding the reflow temperature profile could cause product failure which is not immediately evident.

Do not make any physical or electrical modifications to any Linx product. This will void the warranty and regulatory and UL certifications and may cause product failure which is not immediately evident.

Warning: This product incorporates numerous static-sensitive components. Always wear an ESD wrist strap and observe proper ESD handling procedures when working with this device. Failure to observe this precaution may result in module damage or failure.

A large-print version of this document is available at www.linxtechnologies.com.

Ordering Information

Ordering Information	
Part Number	**Description**
RXM-GPS-FM-x	FM Series GPS Receiver Module
MDEV-GPS-FM	FM Series GPS Receiver Master Development System
EVM-GPS-FM	FM Series Evaluation Module

x = "T" for Tape and Reel, "B" for Bulk

Reels are 1,500 pieces. Quantities less than 1,500 pieces are supplied in bulk

Figure 2: Ordering Information

Absolute Maximum Ratings

Absolute Maximum Ratings		
Supply Voltage V_{CC}	+4.3	VDC
Input Battery Backup Voltage	+4.3	VDC
VOUT Output Current	50	mA
Operating Temperature	–40 to +85	ºC
Storage Temperature	–40 to +85	ºC

Exceeding any of the limits of this section may lead to permanent damage to the device. Furthermore, extended operation at these maximum ratings may reduce the life of this device.

Figure 3: Absolute Maximum Ratings

Electrical Specifications

FM Series GNSS Receiver Specifications						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Notes**
Power Supply						
Operating Voltage	V_{CC}	3.0	3.3	4.3	VDC	
Supply Current	I_{CC}					
Peak				66	mA	1
Acquisition			14		mA	1
Tracking			12		mA	1, 2
Standby			0.150		mA	1
Backup Battery Voltage	V_{BAT}	2.0		4.3	VDC	
Backup Battery Current	I_{BAT}		7		µA	2
Antenna Port						
RF Impedance	R_{IN}		50		Ω	

Pin Assignments

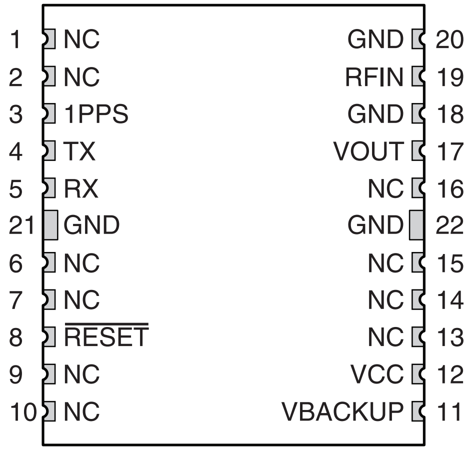

Figure 5: FM Series GPS Receiver Pinout (Top View)

Pin Descriptions

Pin Descriptions			
Pin Number	**Name**	**I/O**	**Description**
1, 2, 6, 7, 9, 10, 13, 14, 15, 16	NC	–	No electrical connection
3	1PPS	O	1 Pulse Per Second (11nS accuracy)
4	TX	O	Serial output (default NMEA)
5	RX	I	Serial input (default NMEA)
8	$\overline{\text{RESET}}$	I	Active low module reset. This line is pulled high internally. Leave it unconnected if it is not used.
11	VBACKUP	P	Backup battery supply voltage. This line must be powered to enable the module.
12	VCC	P	Supply Voltage
17	VOUT	O	2.8V output for an active antenna
18, 20, 21, 22	GND	P	Ground
19	RFIN	I	GPS RF signal input

Figure 6: FM Series GPS Receiver Pin Descriptions

Time To First Fix (TTFF)

TTFF is often broken down into three parts:

Cold: A cold start is when the receiver has no accurate knowledge of its position or time. This happens when the receiver's internal Real Time Clock (RTC) has not been running or it has no valid ephemeris or almanac data. In a cold start, the receiver takes up to 30 seconds to acquire its position.

Warm: A typical warm start is when the receiver has valid almanac and time data and has not significantly moved since its last valid position calculation. This happens when the receiver has been shut down for more than 2 hours, but still has its last position, time, and almanac saved in memory, and its RTC has been running. The receiver can predict the location of the current visible satellites and its location; however, it needs to wait for an ephemeris broadcast (every 30 seconds) before it can accurately calculate its position.

Hot: A hot start is when the receiver has valid ephemeris, time, and almanac data. In a hot start, the receiver takes 1 second to acquire its position. The time to calculate a fix in this state is sometimes referred to as Time to Subsequent Fix or TTSF.

Module Description

The FM Series GPS Receiver module is based on the MediaTek MT3339 chipset, which consumes less power than competitive products while providing exceptional performance even in dense foliage and urban canyons. No external RF components are needed other than an antenna. The simple serial interface and industry standard NMEA protocol make integration of the FM Series into an end product extremely straightforward.

The module's high-performance RF architecture allows it to receive GPS signals that are as low as –161dBm. The FM Series can track up to 22 satellites at the same time. Once locked onto the visible satellites, the receiver calculates the range to the satellites and determines its position and the precise time. It then outputs the data through a standard serial port using several standard NMEA protocol formats.

The GPS core handles all of the necessary initialization, tracking, and calculations autonomously, so no programming is required. The RF section is optimized for low level signals, and requires no production tuning.

Antenna Considerations

The FM Series module is designed to utilize a wide variety of external antennas. The module has a regulated power output which simplifies the use of GPS antenna styles which require external power. This allows the designer great flexibility, but care must be taken in antenna selection to ensure optimum performance. For example, a handheld device may be used in many varying orientations so an antenna element with a wide and uniform pattern may yield better overall performance than an antenna element with high gain and a correspondingly narrower beam. Conversely, an antenna mounted in a fixed and predictable manner may benefit from pattern and gain characteristics suited to that application. Evaluating multiple antenna solutions in real-world situations is a good way to rapidly assess which will best meet the needs of your application.

For GPS, the antenna should have good right hand circular polarization characteristics (RHCP) to match the polarization of the GPS signals. Ceramic patches are the most commonly used style of antenna, but there are many different shapes, sizes and styles of antennas available. Regardless of the construction, they will generally be either passive or active types. Passive antennas are simply an antenna tuned to the correct frequency. Active antennas add a Low Noise Amplifier (LNA) after the antenna and before the module to amplify the weak GPS satellite signals.

For active antennas, a 300 ohm ferrite bead can be used to connect the VOUT line to the RFIN line. This bead prevents the RF from getting into the power supply, but allows the DC voltage onto the RF trace to feed into the antenna. A series capacitor inside the module prevents this DC voltage from affecting the bias on the module’s internal LNA.

Maintaining a 50 ohm path between the module and antenna is critical. Errors in layout can significantly impact the module’s performance. Please review the layout guidelines section carefully to become more familiar with these considerations.

Slow Start Time

The most critical factors in start time are current ephemeris data, signal strength and sky view. The ephemeris data describes the path of each satellite as they orbit the earth. This is used to calculate the position of a satellite at a particular time. This data is only usable for a short period of time, so if it has been more than a few hours since the last fix or if the location has significantly changed (a few hundred miles), then the receiver may need to wait for a new ephemeris transmission before a position can be calculated. The GPS satellites transmit the ephemeris data every 30 seconds. Transmissions with a low signal strength may not be received correctly or be corrupted by ambient noise. The view of the sky is important because the more satellites the receiver can see, the faster the fix and the more accurate the position will be when the fix is obtained.

If the receiver is in a very poor location, such as inside a building, urban canyon, or dense foliage, then the time to first fix can be slowed. In very poor locations with poor signal strength and a limited view of the sky with outdated ephemeris data, this could be on the order of several minutes. In the worst cases, the receiver may need to receive almanac data, which describes the health and course data for every satellite in the constellation. This data is transmitted every 15 minutes. If a lock is taking a long time, try to find a location with a better view of the sky and fewer obstructions. Once locked, it is easier for the receiver to maintain the position fix.

NMEA Output Messages

The following sections outline the data structures of the various NMEA messages that are supported by the module. By default, the NMEA commands are output at 9,600bps, 8 data bits, no parity and 1 stop bit.

Six messages are output at a 1Hz rate by default. These messages are shown in Figure 8.

NMEA Output Messages	
Name	**Description**
GGA	Contains the essential fix data which provide location and accuracy
GLL	Contains just position and time
GSA	Contains data on the Dilution of Precision (DOP) and which satellites are used
GSV	Contains the satellite location relative to the receiver and its signal to noise ratio. Each message can describe 4 satellites so multiple messages may be output depending on the number of satellites being tracked.
RMC	Contains the minimum data of time, position, speed and course
VTG	Contains the course and speed over the ground

Figure 8: NMEA Output Messages

Details of each message and examples are given in the following sections.

GLL – Geographic Position – Latitude / Longitude

Figure 11 contains the values for the following example:

*$GPGLL,2503.6319,N,12136.0099,E,053740.000,A,A*52*

Geographic Position – Latitude / Longitude Example			
Name	**Example**	**Units**	**Description**
Message ID	$GPGLL		GLL protocol header
Latitude	2503.6319		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12136.0099		dddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Time	053740.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=autonomous, D=DGPS, N=Data not valid, R=Coarse Position, S=Simulator
Checksum	*52		
<CR> <LF>			End of message termination

Figure 11: Geographic Position – Latitude / Longitude Example

GSA – GPS DOP and Active Satellites

Figure 12 contains the values for the following example:

*$GPGSA,A,3,24,07,17,11,28,08,20,04,,,,,2.0,1.1,1.7*35*

GPS DOP and Active Satellites Example			
Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Figure 14
Mode 2	3		1=No fix, 2=2D, 3=3D
ID of satellite used	24		Sv on Channel 1
ID of satellite used	07		Sv on Channel 2
...			...
ID of satellite used			Sv on Channel N
PDOP	2.0		Position Dilution of Precision
HDOP	1.1		Horizontal Dilution of Precision
VDOP	1.7		Vertical Dilution of Precision
Checksum	*35		
<CR> <LF>			End of message termination

Figure 12: GPS DOP and Active Satellites Example

RMC – Recommended Minimum Specific GNSS Data

Figure 15 contains the values for the following example:

*$GPRMC,053740.000,A,2503.6319,N,12136.0099,E,2.69,79.65,100106,,,A*53*

Recommended Minimum Specific GNSS Data Example			
Name	**Example**	**Units**	**Description**
Message ID	$GPRMC		RMC protocol header
UTC Time	053740.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.6319		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12136.0099		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed over ground	2.69	knots	TRUE
Course over ground	79.65	degrees	
Date	100106		ddmmyy
Magnetic Variation		degrees	Not available, null field
Variation Sense			E=east or W=west (not shown)
Mode	A		A=autonomous, D=DGPS, E=DR, N= Data not valid, R=Coarse Position, S=Simulator
Checksum	*53		
<CR> <LF>			End of message termination

Figure 15: Recommended Minimum Specific GNSS Data Example

Input Messages

The following outlines the serial commands input into the module for configuration. There are 3 types of input messages: commands, writes and reads. The module outputs a response for each input message.

The commands are used to change the operating state of the module. The writes are used to change the module's configuration and the reads are used to read out the current configuration. Messages are formatted as shown in Figure 18. All fields in each message are separated by a comma.

Serial Data Structure		
Name	**Example**	**Description**
Start Sequence	$PMTK	
Message ID	<MID>	Message Identifier consisting of three numeric characters.
Payload	DATA	Message specific data.
Checksum	CKSUM	CKSUM is a two-hex character checksum as defined in the NMEA specification, NMEA-0183 Standard for Interfacing Marine Electronic Devices. Checksums are required on all input messages.
End Sequence	<CR> <LF>	Each message must be terminated using Carriage Return (CR) Line Feed (LF) (\r\n, 0x0D0A) to cause the receiver to process the input message. They are not printable ASCII characters, so are omitted from the examples.

Figure 18: Serial Data Structure

Figure 19 shows the input commands.

Input Commands	
Name	**Description**
101	Hot Re-start
102	Warm Re-start
103	Cold Re-start
104	Restore Default Configuration
161	Standby Mode
220	Position Fix Interval
223	Ephemeris Data Receive Time
225	Receiver Duty Cycle
251	Baud Rate

Figure 19: Input Commands

101 – Hot Re-start

This command instructs the module to conduct a hot re-start using all of the data stored in memory. Periodic mode and static navigation settings are returned to default when this command is executed.

*$PMTK101*32<CR><LF>*

102 – Warm Re-start

This command instructs the module to conduct a warm re-start that does not use the saved ephemeris data. Periodic mode and static navigation settings are returned to default when this command is executed.

*$PMTK102*31<CR><LF>*

103 – Cold Re-start

This command instructs the module to conduct a cold re-start that does not use any of the data from memory. Periodic mode and static navigation settings are returned to default when this command is executed.

*$PMTK103*30<CR><LF>*

104 – Restore Default Configuration

This command instructs the module to conduct a cold re-start and return all configurations to the factory default settings.

*$PMTK104*37<CR><LF>*

161 – Standby Mode

This command instructs the module to enter a low power standby mode. Any activity on the RX line wakes the module.

*$PMTK161,0*28<CR><LF>*

The module outputs the startup message when it wakes up.

*$PMTK010,001*2E<CR><LF>*

223 – Extended Receive Time

This command extends the amount of time that the receiver is on when in duty cycle mode. This allows the module to refresh its stored ephemeris data by staying awake until it received the data from the satellites.

Extended Receive Time Command and Response

Command

Start	Msg ID	SV	On Time	Extend Time	Extend Gap	Checksum	End
$PMTK	223	,SV	,SNR	,EXT	,EXG	*Cksum	<CR><LF>

Response

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,223	,Flg	*Cksum	<CR><LF>

Figure 23: Extended Receive Time Command and Response

Extended Receive Time Fields

Field	Description
SV	The minimum number of satellites required to have valid ephemeris data. The extend time triggers when the number of satellites with valid ephemeris data falls below this number. The value is 1 to 4.
SNR	The minimum SNR of the satellites used for a position fix. The module will not wait for ephemeris data from any satellites whose SNR is below this value.
EXT	The extended time in ms to stay on to receive ephemeris data. This value can range from 40000 to 180000.
EXG	The minimum time in ms between a subsequent extended receive period. This value can range from 0 to 3600000.

Figure 24: Extended Receive Time Fields

The following example configures an extended on time to trigger if less than 1 satellite has valid ephemeris data. The satellite must have a signal to noise ratio higher than 30dB–Hz in order to be used. The module will stay on for 180,000ms and will have a gap time of 60,000ms.

*$PMTK223,1,30,180000,60000*16<CR><LF>*

251 – Baud Rate

This command sets the serial port baud rate.

Serial Port Baud Rate Command and Response

Command

Start	Msg ID	Rate	Checksum	End
$PMTK	251	,Rate	*Cksum	<CR><LF>

Response

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,251	,Flg	*Cksum	<CR><LF>

Figure 27: Serial Port Baud Rate Command and Response

Rate = serial port baud rate
- 0 = default setting (9,600bps)
- 4800
- 9600
- 14400
- 19200
- 38400
- 57600
- 115200

The following example sets the baud rate to 57,600bps.

*$PMTK251,57600*2C<CR><LF>*

DGPS Source

This enables or disables DGPS mode and configures its source.

DGPS Souce Command and Response

Write Message

Start	Msg ID	Mode	Checksum	End
$PMTK	301	,Mode	*Cksum	<CR><LF>

Acknowledge Response Message

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,301	,Flg	*Cksum	<CR><LF>

Read Message

Start	Msg ID	Checksum	End
$PMTK	401	*37	<CR><LF>

Response Message

Start	Msg ID	Mode	Checksum	End
$PMTK	501	,Mode	*Cksum	<CR><LF>

Figure 29: DGPS Source Command and Response

Mode = DGPS source mode
- 0 = No DGPS source
- 1 = RTCM
- 2 = WAAS

Differential Global Positioning System (DGPS) enhances GPS by using fixed, ground-based reference stations that broadcast the difference between the positions indicated by the satellite systems and the known fixed positions. The Radio Technical Commission for Maritime Services (RTCM) is an international standards organization that has a standard for DGPS. Wide Area Augmentation System (WAAS) is maintained by the FAA to improve aircraft navigation. This setting automatically switches among WAAS, EGNOS, MSAS and GAGAN when detected in covered regions

The following example sets the DGPS source to RTCM.

*$PMTK301,1*2D<CR><LF>*

The following example reads the current DGPS source and the module responds with the DGPS source as RTCM.

*$PMTK401*37<CR><LF>*
*$PMTK501,1*2B<CR><LF>*

NMEA Output Messages

This configures how often each NMEA output message is output.

NMEA Output Messages Command and Response

Write Message

Start	Msg ID	GLL	RMC	VTG	GGA	GSA	GSV	DATA	CK	End
$PMTK	314	,GLL	,RMC	,VTG	,GGA	,GSA	,GSV	,0,0,0,0,0,0,0,0,0,0,0,0,0,	*CK	<CR><LF>

Acknowledge Response Message

Start	Msg ID	CMD	Flag	CK	End
$PMTK	001	,314	,Flg	*CK	<CR><LF>

Read Message

Start	Msg ID	CK	End
$PMTK	414	*33	<CR><LF>

Response Message

Start	Msg ID	GLL	RMC	VTG	GGA	GSA	GSV	DATA	CK	End
$PMTK	514	,GLL	,RMC	,VTG	,GGA	,GSA	,GSV	,0,0,0,0,0,0,0,0,0,0,0,0,0,	*CK	<CR><LF>

Figure 31: NMEA Output Messages Command and Response

Each field has a value of 1 through 5 which indicates how many position fixes should be between each time the message is output. A 1 configures the message to be output every position fix. A value of 2 configures the message to be output every other position fix and a value of 5 configures it to be output every 5th position fix. This along with message 220 or 300 sets the time between message outputs.

A value of 0 disables the message.

The example below sets all of the messages to be output every fix.

*$PMTK314,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0*28<CR><LF>*

The following example reads the current message configuration and the module responds that all supported messages are configured to be output on every position fix.

*$PMTK414*33<CR><LF>*

*$PMTK514,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0*2E<CR><LF>*

Static Navigation Threshold

This configures the speed threshold to trigger static navigation. If the measured speed is below the threshold then the module holds the current position and sets the speed to zero.

Static Navigation Threshold Command and Response

Write Message

Start	Msg ID	Thold	Checksum	End
$PMTK	386	,Thold	*Cksum	<CR><LF>

Acknowledge Response Message

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,386	,Flg	*Cksum	<CR><LF>

Read Message

Start	Msg ID	Checksum	End
$PMTK	447	*35	<CR><LF>

Response Message

Start	Msg ID	Thold	Checksum	End
$PMTK	527	,Thold	*Cksum	<CR><LF>

Figure 33: Static Navigation Threshold Command and Response

Thold = speed threshold, from 0 to 2.0m/s. 0 = disabled.

The following example sets the threshold to 1.2m/s.

*$PMTK386,1.2*3E<CR><LF>*

The following example reads the static navigation threshold and the module responds with 1.2m/s

*$PMTK447*35<CR><LF>*
*$PMTK527,1.20*03<CR><LF>*

Typical Applications

Figure 35 shows the FM Series GPS receiver in a typical application using a passive antenna.

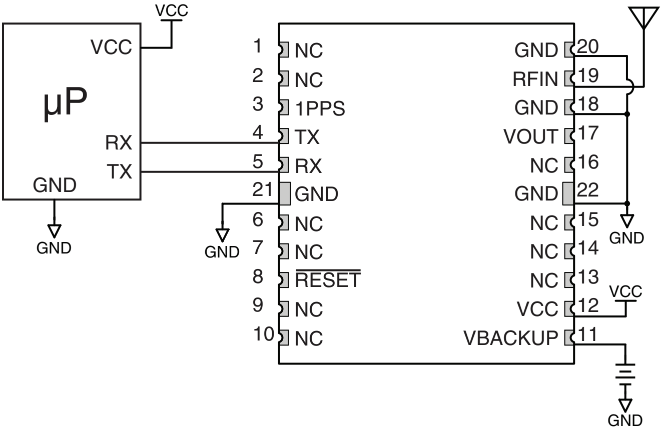

Figure 35: Circuit Using the FM Series Module with a Passive Antenna

A microcontroller UART is connected to the receiver's UART for passing data and commands. A 3.3V coin cell battery is connected to the VBACKUP line to provide power to the module's memory when main power is turned off.

Figure 36 shows the module using an active antenna.

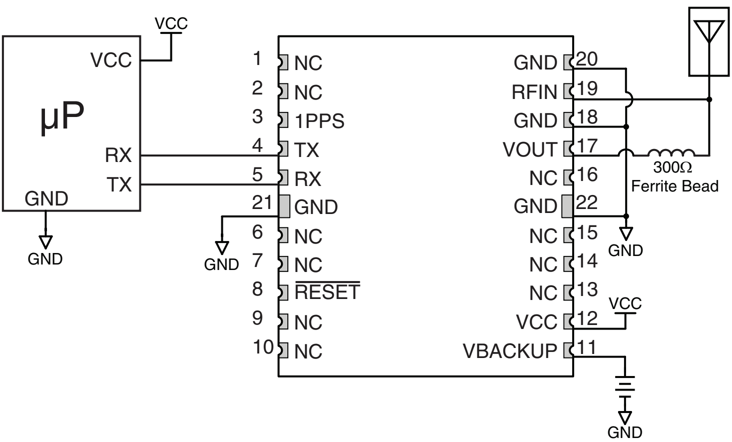

Figure 36: Circuit Using the FM Series Module with a an Active Antenna

A 300Ω ferrite bead is used to put power from VOUT onto the antenna line to power the active antenna.

Board Layout Guidelines

The module's design makes integration straightforward; however, it is still critical to exercise care in PCB layout. Failure to observe good layout techniques can result in a significant degradation of the module's performance. A primary layout goal is to maintain a characteristic 50-ohm impedance throughout the path from the antenna to the module. Grounding, filtering, decoupling, routing and PCB stack-up are also important considerations for any RF design. The following section provides some basic design guidelines which may be helpful.

During prototyping, the module should be soldered to a properly laid-out circuit board. The use of prototyping or "perf" boards will result in poor performance and is strongly discouraged.

The module should, as much as reasonably possible, be isolated from other components on your PCB, especially high-frequency circuitry such as crystal oscillators, switching power supplies, and high-speed bus lines.

When possible, separate RF and digital circuits into different PCB regions. Make sure internal wiring is routed away from the module and antenna, and is secured to prevent displacement.

Do not route PCB traces directly under the module. There should not be any copper or traces under the module on the same layer as the module, just bare PCB. The underside of the module has traces and vias that could short or couple to traces on the product's circuit board.

The Pad Layout section shows a typical PCB footprint for the module. A ground plane (as large and uninterrupted as possible) should be placed on a lower layer of your PC board opposite the module. This plane is essential for creating a low impedance return for ground and consistent stripline performance.

Use care in routing the RF trace between the module and the antenna or connector. Keep the trace as short as possible. Do not pass under the module or any other component. Do not route the antenna trace on multiple PCB layers as vias will add inductance. Vias are acceptable for tying together ground layers and component grounds and should be used in multiples.

Production Guidelines

The module is housed in a hybrid SMD package that supports hand and automated assembly techniques. Since the modules contain discrete components internally, the assembly procedures are critical to ensuring the reliable function of the modules. The following procedures should be reviewed with and practiced by all assembly personnel.

Hand Assembly

Pads located on the bottom of the module are the primary mounting surface (Figure 40). Since these pads are inaccessible during mounting, castellations that run up the side of the module have been provided to facilitate solder wicking to the module's underside. This allows for very quick hand soldering for prototyping and small volume production. If the recommended pad guidelines have been followed, the pads will protrude slightly past the edge of the module. Use a fine soldering tip to heat the board pad and the castellation, then introduce solder to the pad at the module's edge. The solder will wick underneath the module, providing reliable attachment. Tack one module corner first and then work around the device, taking care not to exceed the times in Figure 41.

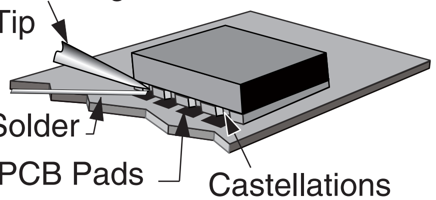

Figure 40: Soldering Technique

Warning: Pay attention to the absolute maximum solder times.

Absolute Maximum Solder Times
Hand Solder Temperature: +427ºC for 10 seconds for lead-free alloys
Reflow Oven: +240°C max (see Figure 42)

Figure 41: Absolute Maximum Solder Times

Automated Assembly

For high-volume assembly, the modules are generally auto-placed. The modules have been designed to maintain compatibility with reflow processing techniques; however, due to their hybrid nature, certain aspects of the assembly process are far more critical than for other component types. Following are brief discussions of the three primary areas where caution must be observed.

Master Development System

The FM Series Master Development System provides all of the tools necessary to evaluate the FM Series GPS receiver module. The system includes a fully assembled development board, an active antenna, development software and full documentation.

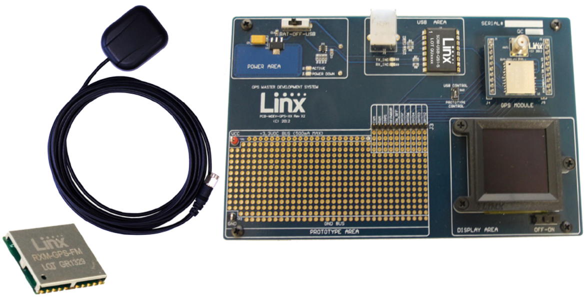

Figure 43: The FM Series Master Development System

The development board includes a power supply, a prototyping area for custom circuit development, and an OLED display that shows the GPS data without the need for a computer. A USB interface is also included for use with a PC running custom software or the included development software.

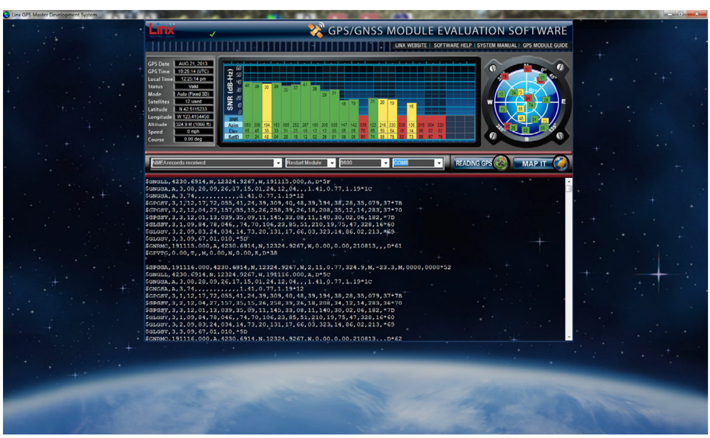

Figure 44: The Master Development System Software

The Master Development System software enables configuration of the receiver and displays the satellite data output by the receiver. The software can select from among all of the supported NMEA protocols for display of the data.

Full documentation for the board and software is included in the development system, making integration of the module straightforward.

Appendix A

The following datums are supported by the FM Series.

FM Series GPS Receiver Supported Datums		
Number	**Datum**	**Region**
0	WGS1984	International
1	Tokyo	Japan
2	Tokyo	Mean for Japan, South Korea, Okinawa
3	User Setting	User Setting
4	Adindan	Burkina Faso
5	Adindan	Cameroon
6	Adindan	Ethiopia
7	Adindan	Mali
8	Adindan	Mean for Ethiopia, Sudan
9	Adindan	Senegal
10	Adindan	Sudan
11	Afgooye	Somalia
12	Ain El Abd1970	Bahrain
13	Ain El Abd1970	Saudi Arabia
14	American Samoa1962	American Samoa Islands
15	Anna 1 Astro1965	Cocos Island
16	Antigua Island Astro1943	Antigua(Leeward Islands)
17	Arc1950	Botswana
18	Arc1950	Burundi
19	Arc1950	Lesotho
20	Arc1950	Malawi
21	Arc1950	Mean for Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe
22	Arc1950	Swaziland
23	Arc1950	Zaire
24	Arc1950	Zambia
25	Arc1950	Zimbabwe
26	Arc1960	Mean For Kenya Tanzania
27	Arc1960	Kenya
28	Arc1960	Tanzania
29	Ascension Island1958	Ascension Island
30	Astro Beacon E 1945	Iwo Jima

FM Series GPS Receiver Supported Datums		
Number	**Datum**	**Region**
64	European 1950	Italy (Sardinia)
65	European 1950	Italy (Sicily)
66	European 1950	Malta
67	European 1950	Mean For Austria, Belgium, Denmark, Finland, France, W Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland
68	European 1950	Mean For Austria, Denmark, France, W Germany, Netherland, Switzerland
69	European 1950	Mean For Iraq, Israel, Jordan, Lebanon, Kuwait, Saudi Arabia, Syria
70	European 1950	Portugal, Spain
71	European 1950	Tunisia,
72	European 1979	Mean For Austria, Finland ,Netherlands ,Norway, Spain, Sweden, Switzerland
73	Fort Thomas 1955	Nevis St Kitts (Leeward Islands)
74	Gan 1970	Republic Of Maldives
75	Geodetic Dataum 1970	New Zealand
76	Graciosa Base SW1948	Azores (Faial, Graciosa, Pico, Sao, Jorge, Terceria)
77	Guam1963	Guam
78	Gunung Segara	Indonesia (Kalimantan)
79	Gux I Astro	Guadalcanal Island
80	Herat North	Afghanistan
81	Hermannskogel Datum	Croatia-Serbia, Bosnia-Herzegoivna
82	Hjorsey 1955	Iceland
83	Hongkong 1963	Hong Kong
84	Hu Tzu Shan	Taiwan
85	Indian	Bangladesh
86	Indian	India, Nepal
87	Indian	Pakistan
88	Indian 1954	Thailand
89	Indian 1960	Vietnam (Con Son Island)
90	Indian 1960	Vietnam (Near 16 deg N)
91	Indian 1975	Thailand
92	Indonesian 1974	Indonesian

FM Series GPS Receiver Supported Datums		
Number	Datum	Region
126	North American 1927	Canada (New Brunswick, Newfoundland, Nova Scotia, Quebec)
127	North American 1927	Canada (Northwest Territories, Saskatchewan)
128	North American 1927	Canada (Yukon)
129	North American 1927	Canal Zone
130	North American 1927	Cuba
131	North American 1927	Greenland (Hayes Peninsula)
132	North American 1927	Mean For Antigua, Barbados, Barbuda, Caicos Islands, Cuba, Dominican, Grand Cayman, Jamaica, Turks Islands
133	North American 1927	Mean for Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua
134	North American 1927	Mean for Canada
135	North American 1927	Mean for Conus
136	North American 1927	Mean for Conus (East of Mississippi, River Including Louisiana, Missouri, Minnesota)
137	North American 1927	Mean for Conus (West of Mississippi, River Excluding Louisiana, Minnesota, Missouri)
138	North American 1927	Mexico
139	North American 1983	Alaska (Excluding Aleutian Ids)
140	North American 1983	Aleutian Ids
141	North American 1983	Canada
142	North American 1983	Conus
143	North American 1983	Hawaii
144	North American 1983	Mexico, Central America
145	North Sahara 1959	Algeria
146	Observatorio Meteorologico 1939	Azores (Corvo and Flores Islands)
147	Old Egyptian 1907	Egypt
148	Old Hawaiian	Hawaii
149	Old Hawaiian	Kauai
150	Old Hawaiian	Maui
151	Old Hawaiian	Mean for Hawaii, Kauai, Maui, Oahu
152	Old Hawaiian	Oahu
153	Oman	Oman

FM Series GPS Receiver Supported Datums

Number	Datum	Region
188	Santo (Dos) 1965	Espirito Santo Island
189	Sao Braz	Azores (Sao Miguel, Santa Maria Ids)
190	Sapper Hill 1943	East Falkland Island
191	Schwarzeck	Namibia
192	Selvagem Grande 1938	Salvage Islands
193	Sierra Leone 1960	Sierra Leone
194	South American 1969	Argentina
195	South American 1969	Bolivia
196	South American 1969	Brazil
197	South American 1969	Chile
198	South American 1969	Colombia
199	South American 1969	Ecuador
200	South American 1969	Ecuador (Baltra, Galapagos)
201	South American 1969	Guyana
202	South American 1969	Mean For Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad and Tobago, Venezuela
203	South American 1969	Paraguay
204	South American 1969	Peru
205	South American 1969	Trinidad and Tobago
206	South American 1969	Venezuela
207	South Asia	Singapore
208	Tananarive Observatory 1925	Madagascar
209	Timbalai 1948	Brunei, E Malaysia (Sabah Sarawak)
210	Tokyo	Japan
211	Tokyo	Mean for Japan, South Korea, Okinawa
212	Tokyo	Okinawa
213	Tokyo	South Korea
214	Tristan Astro 1968	Tristam Da Cunha
215	Viti Levu 1916	Fiji (Viti Levu Island)
216	Voirol 1960	Algeria
217	Wake Island Astro 1952	Wake Atoll
218	Wake-Eniwetok 1960	Marshall Islands
219	WGS 1972	Global Definition

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