LINX TECHNOLOGIES

RM Series
GPS Receiver Module
Data Guide

Wireless made simple®

Warning: Some customers may want Linx radio frequency ("RF") products 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 ("Life and Property Safety Situations").

NO OEM LINX REMOTE CONTROL OR FUNCTION MODULE SHOULD EVER BE USED IN LIFE AND PROPERTY SAFETY SITUATIONS. No OEM Linx Remote Control or Function Module should be modified for Life and Property Safety Situations. Such modification cannot provide sufficient safety and will void the product's regulatory certification and warranty.

Customers may use our (non-Function) Modules, Antenna and Connectors as part of other systems in Life Safety Situations, but only with necessary and industry appropriate redundancies and in compliance with applicable safety standards, including without limitation, ANSI and NFPA standards. It is solely the responsibility of any Linx customer who uses one or more of these products to incorporate appropriate redundancies and safety standards for the Life and Property Safety Situation application.

Do not use this or any Linx product to trigger an action directly from the data line or RSSI lines without a protocol or encoder/decoder to validate the data. Without validation, any signal from another unrelated transmitter in the environment received by the module could inadvertently trigger the action.

All RF products are susceptible to RF interference that can prevent communication. RF products without frequency agility or hopping implemented are more subject to interference. This module does not have a frequency hopping protocol built in.

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.

Ordering Information

Ordering Information	
Part Number	**Description**
RXM-GPS-RM-x	RM Series GPS Receiver Module
MDEV-GPS-RM	RM Series GPS Receiver Master Development System
EVM-GPS-RM	RM Series Evaluation Module
x = “T” for Tape and Reel, “B” for Bulk	
Reels are 1,000 pieces. Quantities less than 1,000 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
VCC_RF 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

RM Series GPS 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				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

Pin Assignments

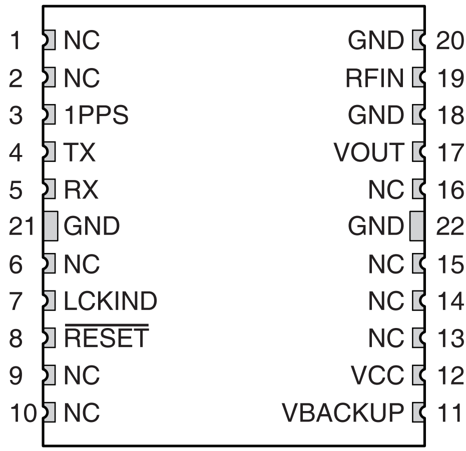

Figure 5: RM Series GPS Receiver Pinout (Top View)

Pin Descriptions

Pin Descriptions			
Pin Number	**Name**	**I/O**	**Description**
1, 2, 6, 9, 10, 13, 14, 15, 16	NC	–	No electrical connection
3	1PPS	O	1 Pulse Per Second
4	TX	O	Serial output (default NMEA)
5	RX	I	Serial input (default NMEA)
7	LCKIND	O	Lock Indicator. Outputs a 100ms pulse every second when a GPS fix is available.
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: RM 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 RM Series GPS Receiver module is based on the MediaTek MT3337E 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 RM 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 RM 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.

The 1PPS Output

The 1PPS line outputs 1 pulse per second on the rising edge of the GPS second when the receiver has an over-solved navigation solution from five or more satellites. The pulse has a duration of 100ms by default with the rising edge on the GPS second. This line is low until the receiver acquires a 3D fix. The pulse width can be adjusted with a serial command.

The GPS second is based on the atomic clocks in the satellites, which are monitored and set to Universal Time master clocks. This output and the time calculated from the satellite transmissions can be used as a clock feature in an end product. It has a ±11ns accuracy relative to other RM Series GPS receiver modules.

Power Control

The RM Series GPS Receiver module offers several ways to control the module's power. A serial command puts the module into a low-power standby mode that consumes only 135µA of current. An external processor can be used to power the module on and off to conserve battery power. Standby mode is configured by command 161.

> Note: The receiver duty cycle mode was removed from modules with date code 1612 and later.

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, 1 start bit, 1 stop bit, and no parity.

Six messages are output at a 1Hz rate by default. The ZDA message is supported, but disabled 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
ZDA	Contains the date and time

Figure 8: NMEA Output Messages

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

> Note: The GLL and VTG messages are enabled by default on modules with date code 1612 and later. They were disabled by default on earlier modules.

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, 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 13
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 GPS 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 GPS 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, E=DR, N= Data not valid, R=Coarse Position, S=Simulator
Checksum	*53		
<CR> <LF>			End of message termination

Figure 15: Recommended Minimum Specific GPS Data Example

ZDA – Universal Time and Date

Figure 17 contains the values for the following example:

*$GPZDA,183746.000,22,08,2014,,*56*

Universal Time and Date Example			
Name	**Example**	**Units**	**Description**
Message ID	$GPZDA		ZDA protocol header
UTC Time	183746.000		hhmmss.sss
Day	22		01 to 31
Month	08		01 to 12
Year	2014		1980 to 2079
Local Zone Hour			Offset from UTC; set to null
Local Zone Minutes			Offset from UTC; set to null
Checksum	*56		
<CR> <LF>			End of message termination

Figure 17: Universal Time and Date Example

Start-up Response

The module outputs a message when it starts up to indicate its state. The normal start-up message is shown below and the message formatting is shown in Figure 18.

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

Start-up Response Example		
Name	**Example**	**Description**
Message ID	$PMTK010	Message header
Message	MSG	System Message 0 = Unknown 1 = Start-up 2 = Notification for the host supporting EPO 3 = Transition to Normal operation is successful
Checksum	CKSUM	
End Sequence	<CR> <LF>	End of message termination

Figure 18: Start-up Response Example

The write and read messages are shown in Figure 21. A write message triggers an acknowledgement from the module. A read message triggers a response message containing the requested information.

Input Write and Read Messages			
Description	**Write ID**	**Read ID**	**Response ID**
Set NMEA Output Messages	314	414	514
Set Datum	330	430	530
Static Navigation Threshold	386	447	527
Enable Ephemeris Prediction	869	869	869

Figure 21: Input Write and Read Messages

The module responds to commands with response messages. The acknowledge message is formatted as shown in Figure 22.

Acknowledge Message		
Name	**Example**	**Description**
Start Sequence	$PMTK	
Message ID	001	Acknowledge Identifier
Command	CMD	The command that triggered the acknowledge
Flag	Flg	Flag indicating the outcome of the command 0 = Invalid Command 1 = Unsupported Command 2 = Valid command, but action failed 3 = Valid command and action succeeded
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 22: Acknowledge Message

220 – Position Fix Interval

This command sets the position fix interval. This is the time between when the module calculates its position.

Position Fix Interval Command and Response

Command

Start	Msg ID	Interval	Checksum	End
$PMTK	220	,Ival	*Cksum	<CR><LF>

Response

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,220	,Flg	*Cksum	<CR><LF>

Figure 23: Position Fix Interval Command and Response

Ival = the interval time in milliseconds.

The interval must be larger than 100ms. Faster rates require that the baud rate be increased, the number of messages that are output be decreased or both. The module automatically calculates the required data bandwidth and returns an action failed response (Flg = 2) if the interval is faster than the module can output all of the required messages at the current baud rate. The following example sets the interval to 1 second.

*$PMTK220,1000*1F<CR><LF>*

It is recommended to use interval rates of 100ms, 200ms, 500ms, 1,000ms and 2,000ms. Although permissible, non-standard intervals are not guaranteed or recommended.

255 – Sync 1PPS and NMEA Messages

This command enables or disables synchronization between the 1PPS pulse and the NMEA messages. When enabled, the beginning of the NMEA message on the UART is fixed to between 170 and 180ms after the rising edge of the 1PPS pulse. The NMEA message describes the position and time as of the rising edge of the 1PPS pulse.

Sync 1PPS and NMEA Messages Command and Response

Command

Start	Msg ID	Enable	Checksum	End
$PMTK	255	,Enable	*Cksum	<CR><LF>

Response

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,255	,Flg	*Cksum	<CR><LF>

Figure 25: Sync 1PPS and NMEA Messages Command and Response

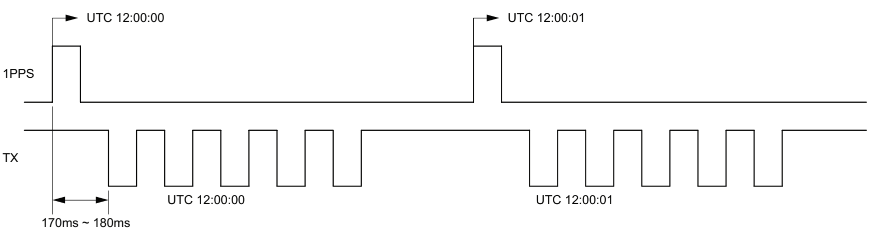

Figure 26: 1PPS and NMEA Message Synchronization

This is only supported at a 1Hz NMEA message rate. It is disabled by default.

The following examples show the use of this command.

Enable Sync: *$PMTK255,1*2D<CR><LF>*
Disable Sync: *$PMTK255,0*2C<CR><LF>*

286 – Enable Active Interference Cancellation

This command enables or disables active interference cancellation. This feature helps remove jamming and narrow-band interference to enable a position fix.

Enable Active Interference Cancellation Command and Response

Command

Start	Msg ID	Enable	Checksum	End
$PMTK	286	,Enable	*Cksum	<CR><LF>

Response

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,286	,Flg	*Cksum	<CR><LF>

Figure 29: Enable Active Interference Cancellation Messages Command and Response

By default, this is enabled after the first fix is acquired.

The following examples show the use of this command.

Enable: *$PMTK286,1*23<CR><LF>*
Disable: *$PMTK286,0*22<CR><LF>*

Set Datum

This configures the current datum that is used.

Set Datum Command and Response

Write Message

Start	Msg ID	Datum	Checksum	End
$PMTK	330	,Datum	*Cksum	<CR><LF>

Acknowledge Response Message

Start	Msg ID	CMD	Flag	Checksum	End
$PMTK	001	,330	,Flg	*Cksum	<CR><LF>

Read Message

Start	Msg ID	Checksum	End
$PMTK	430	*35	<CR><LF>

Response Message

Start	Msg ID	Datum	Checksum	End
$PMTK	530	,Datum	*Cksum	<CR><LF>

Figure 31: Set Datum Command and Response

Datum = the datum number to be used.

Reference datums are data sets that describe the shape of the Earth based on a reference point. There are many regional datums based on a convenient local reference point. Different datums use different reference points, so a map used with the receiver output must be based on the same datum. WGS84 is the default world referencing datum.

The module supports 223 different datums. These are listed in Appendix A.

The following example sets the datum to WGS84.

*$PMTK330,0*2E<CR><LF>*

The following example reads the current datum and the module replies with datum 0, which is WGS84.

*$PMTK430*35<CR><LF>*
*$PMTK530,0*28<CR><LF>*

EASY™ Ephemeris Prediction

EASY™ is a function to generate orbit predictions for faster cold and warm starts. It does this without the need for Internet connectivity or assistance from the host processor. The predictions are good for up to 3 days and are automatically updated when the module obtains a good position fix.

EASY™ Ephemeris Prediction Command and Response

Write Message

Start	Msg ID	Type	Enable	Checksum	End
$PMTK	869	,Type	,Enable	*Cksum	<CR><LF>

Figure 33: Ephemeris Prediction Command and Response

Figure 34 shows the Type values.

Ephemeris Prediction Type Values

Value	Description
0	Query the current state of prediction (enabled or disabled)
1	Set the state of prediction
2	Result of a query

Figure 34: Ephemeris Prediction Type Values

The Enable field is 0 to disable or 1 to enable. It is not used in a query.

The response to a set command is a standard acknowledgement packet.

EASY™ is enabled by default. **This is only supported with a 1Hz NMEA output rate.**

The following show examples of this command.

Enable prediction: *$PMTK869,1,1*35<CR><LF>*
Response: *$PMTK001,869,3*37<CR><LF>*

Disable prediction: *$PMTK869,1,0*34<CR><LF>*
Response: *$PMTK001,869,3*37<CR><LF>*

Query prediction: *$PMTK869,0*29<CR><LF>*
Disabled response: *$PMTK869,2,0*37<CR><LF>*
Enabled response: *$PMTK869,2,1*36<CR><LF>*

Master Development System

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

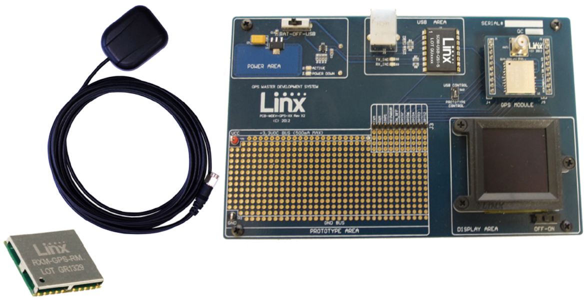

Figure 37: The RM Series Master Development System

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.

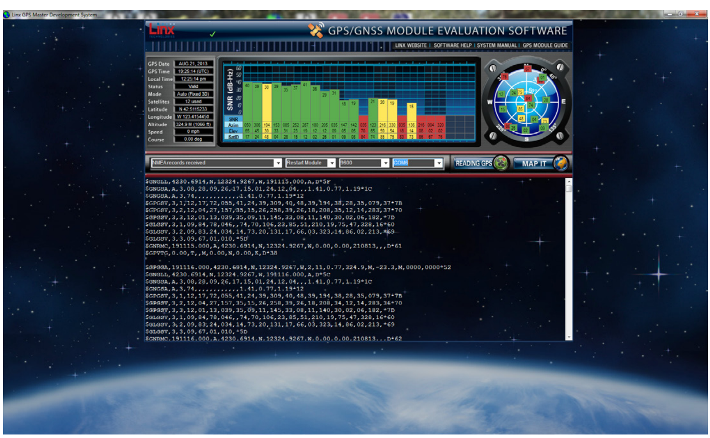

Figure 38: The Master Development System Software

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.

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 42). 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 43.

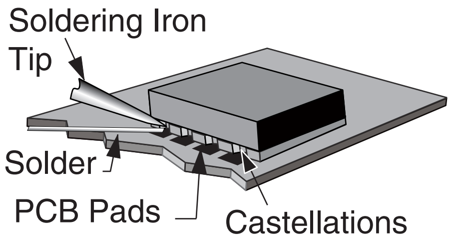

Figure 42: Soldering Technique

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 44)

Figure 43: 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.

Appendix A

The following datums are supported by the RM Series.

RM 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

RM 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

RM 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

RM 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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