

Product name	Description	Version
S5-1010-2R	Datasheet of S5-1010-2R standalone GNSS module	1.1



1 Introduction

LOCOSYS S5-1010-2R GNSS module features high sensitivity, low power and ultra small form factor. This module can track multiple satellite constellations that include GPS, GLONASS, QZSS and SBAS. It is powered by SiRFstarV, and can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment.

2 Features

- SiRFstarV high sensitivity solution
- Support GPS, GLONASS and QZSS
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Support 52-channel GNSS
- Fast TTFF at low signal level
- Multiple interference mitigation strategies
- Support TricklePower Mode
- Built-in LNA (on chip) and SAW filter
- Small form factor 10.1 x 9.7 x 2 mm
- SMD type with stamp hole; RoHS compliant

3 Application

- Personal positioning and navigation
- Automotive navigation
- Marine navigation

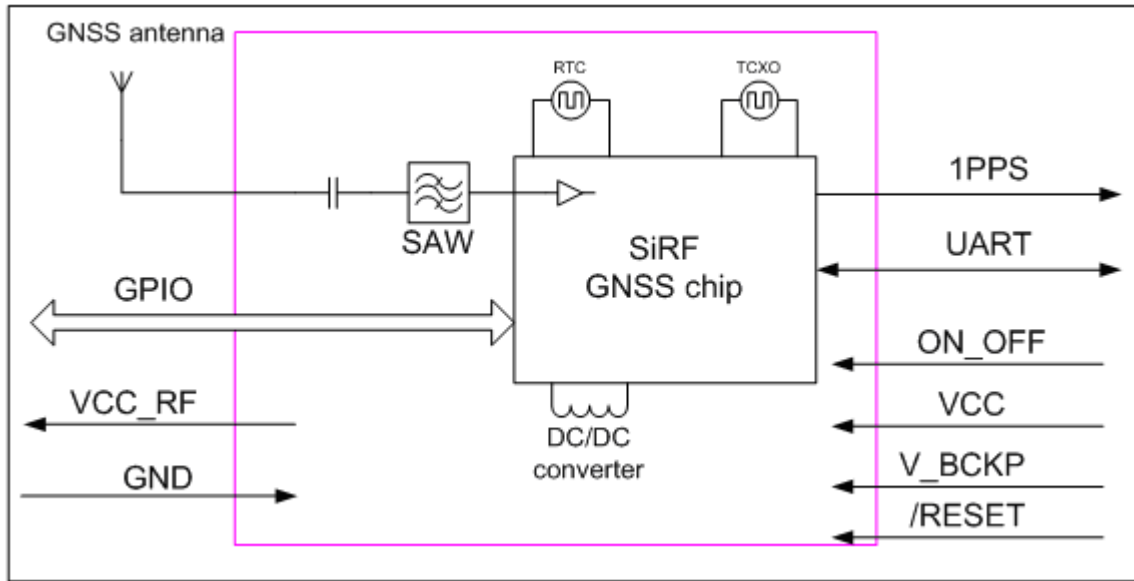


Fig 3-1 System block diagram.

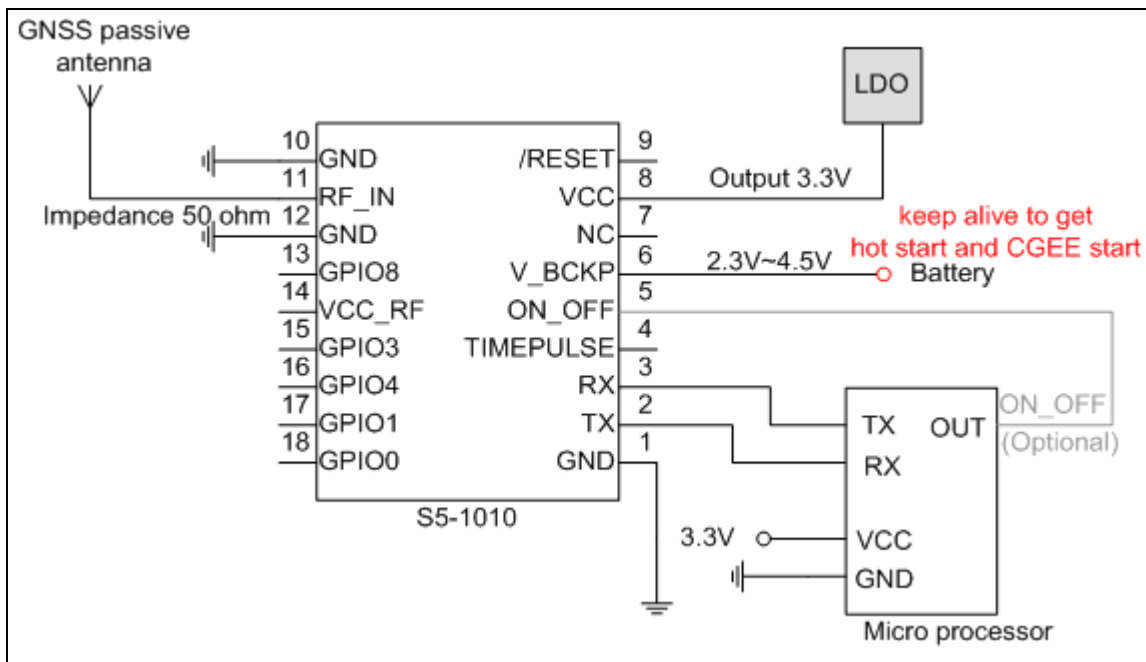


Fig 3-2 Typical application circuit that uses a passive antenna.

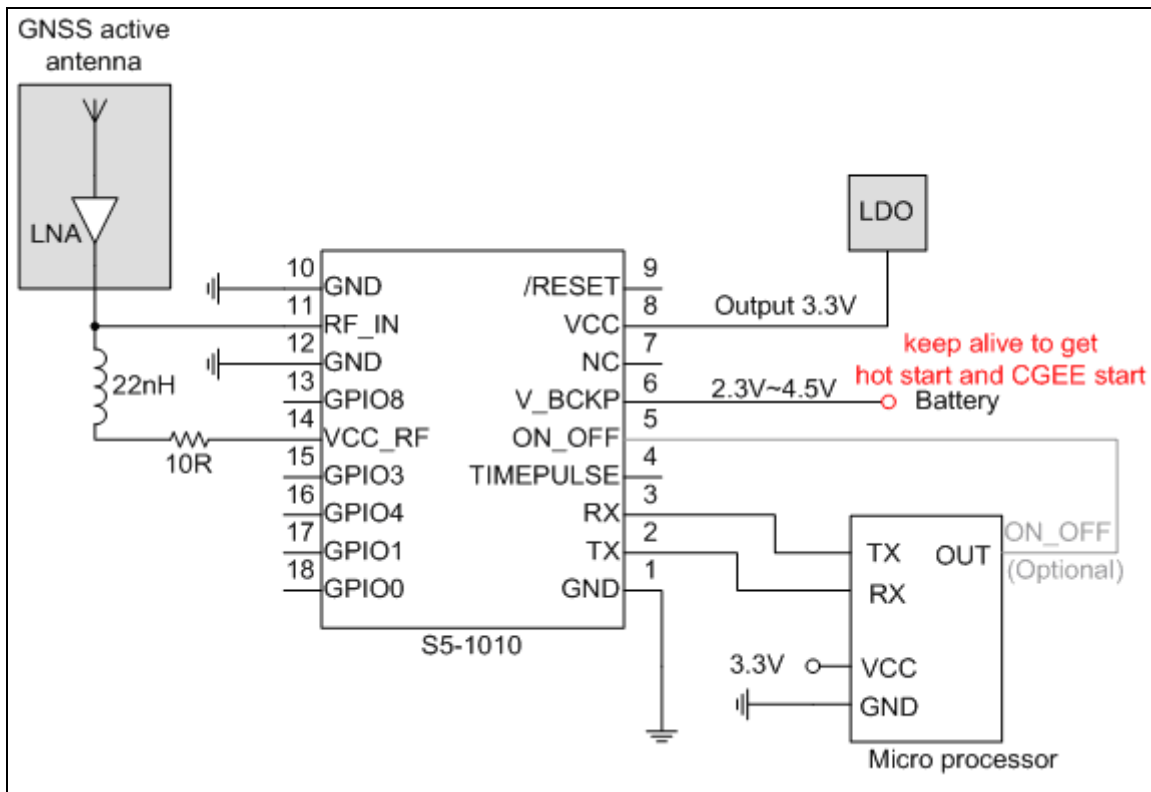


Fig 3-3 Typical application circuit that uses an active antenna

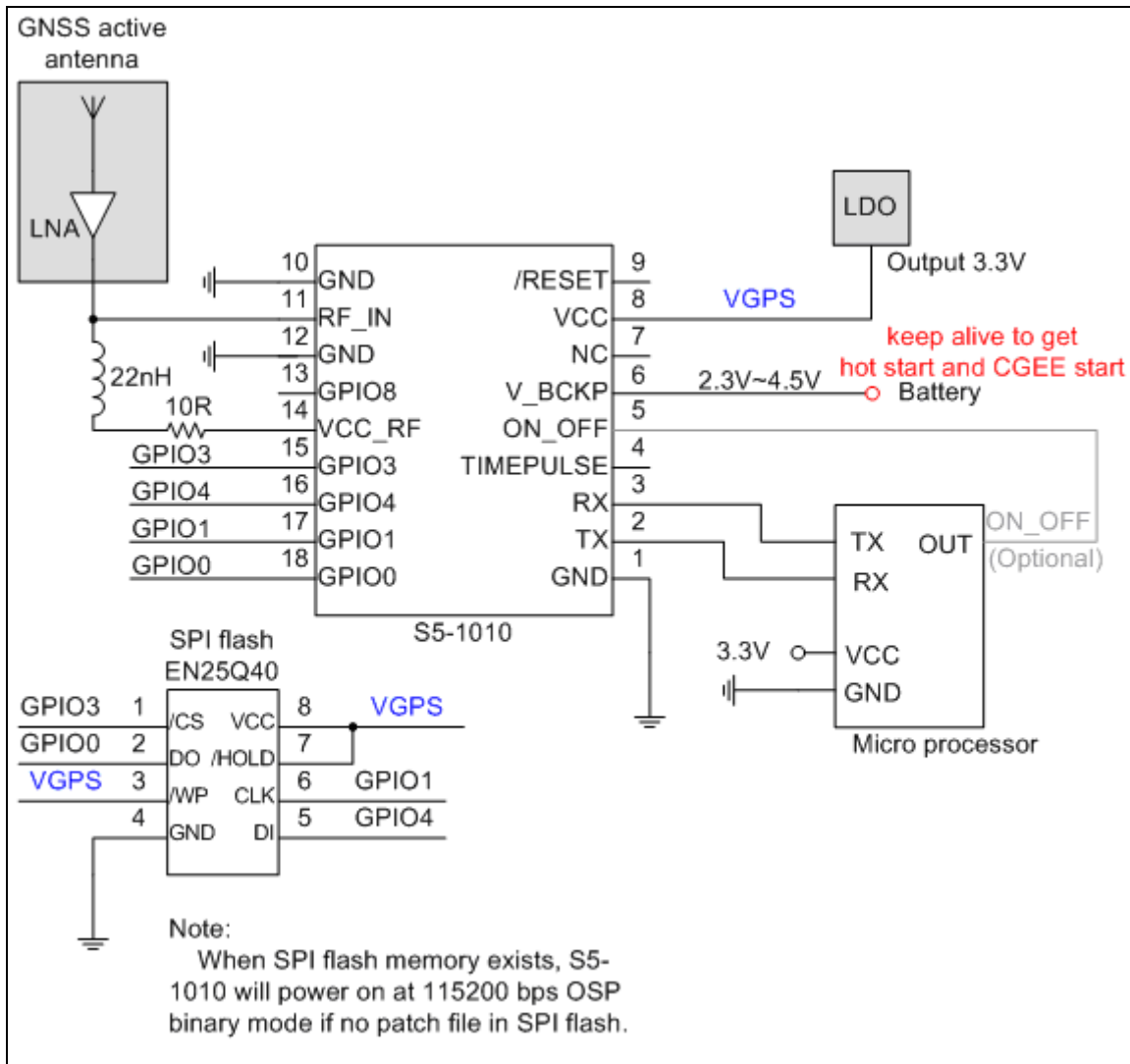


Fig 3-4 Typical application circuit that connects an external SPI flash memory.

4 GNSS receiver

Chip	SiRFstarV, CSRG0530	
Frequency	GPS, QZSS: L1 1575.42MHz, C/A code GLONASS: L1 1598.0625MHz ~ 1605.375MHz, C/A code	
Channels	52	
Update rate	1Hz, up to 5Hz	
Sensitivity	Tracking	-159dBm, up to -162dBm (with external LNA)
	Navigation	-157dBm, up to -160dBm (with external LNA) ⁽¹⁾
	Cold start	-145dBm, up to -148dBm (with external LNA)
Acquisition Time	Hot start (Open Sky)	< 1s (typical)
	Hot start (Indoor)	< 15s
	Cold Start (Open Sky)	30s (typical)
< 15s (typical), CGEE-start		
Position Accuracy	Autonomous	< 2.5m CEP
	SBAS ⁽³⁾	2.5m (depends on accuracy of correction data)
Max. Altitude	< 18,000 m	
Max. Velocity	< 515 m/s	
Protocol Support	NMEA 0183 ver 4.0	9600 bps ⁽²⁾ , 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GSA, RMC, GNS 0.2Hz: GSV
	OSP Binary	115200 bps, 8 data bits, no parity, 1 stop bits

Note 1: For GPS mode.

Note 2: Both baud rate and output message rate are configurable.

Note 3: GNSS mode can't support SBAS.

5 Pin assignment and descriptions

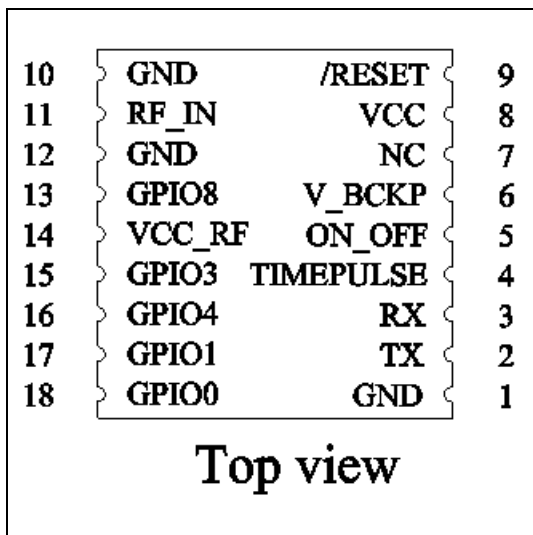
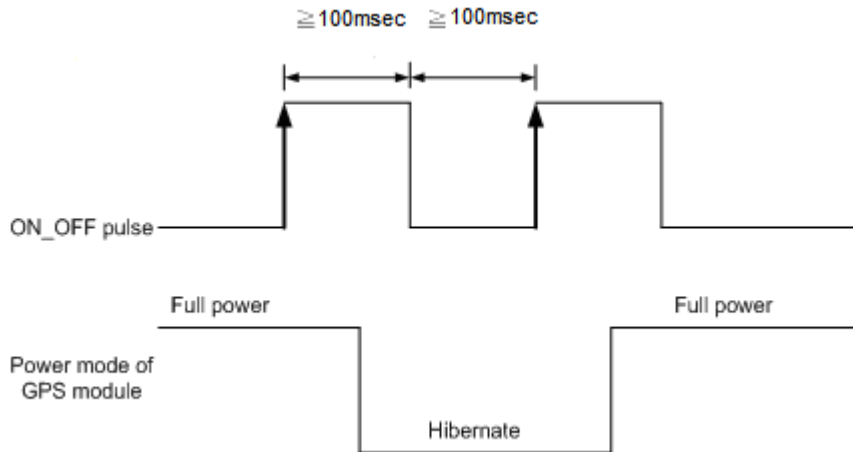


Table 5-1 Pin descriptions

Pin #	Name	Type	Description	Note
1	GND	P	Not connected	
2	TX	O	Serial output (Default NMEA)	
3	RX	I	Serial input (Default NMEA)	
4	TIMEPULSE	O	Time pulse (1PPS, 250 ms pulse/sec)	
5	ON_OFF	I	Power control pin. If this pin is not used, leave it floating. GNSS module can start to work when DC power (VCC) is supplied.	1
6	V_BCKP	P	Backup battery supply voltage This pin must be powered to enable the module.	2
7	NC		Not connected	
8	VCC	P	DC supply voltage	
9	/RESET	I	Reset input, active low. GNSS module has internal power-on reset circuit, user can leave this pin floating if not used.	
10	GND	P	Ground	
11	RF_IN	I	GNSS RF signal input	
12	GND	P	Ground	
13	GPIO8	I/O	General purpose I/O	
14	VCC_RF	O	Output voltage for active antenna	3
15	GPIO3	I/O	General purpose I/O	
16	GPIO4	I/O	General purpose I/O	
17	GPIO1	I/O	General purpose I/O	4
18	GPIO0	I/O	General purpose I/O	4

<Note>

1. Input pulse to switch the module between different power modes.
 - ON_OFF pulse requires a rising edge and high level that persists for three cycles of the RTC clock in order to be detected. Resetting the ON_OFF detector requires that ON_OFF goes to logic low for at least 100 msec.
 - If the module is in hibernate state, an ON_OFF high will move it to full-power mode.
 - If the module is in TricklePower mode, an ON_OFF pulse will initiate one TricklePower cycle.
 - If the module is already in full-power mode, an ON_OFF pulse will initiate orderly shutdown.



2. In order to get the advantage of CGEE, this pin must be always powered during the period of effective ephemeris prediction.
3. VCC_RF does not have short circuit protection.
4. If no external SPI flash (see [Fig 3-4](#)) is connected, GPIO0 and GPIO1 pins are used to select baud rate of UART at power-on. User can connect GPIO1 with a 2K ohm pull-up resistor to change baud rate to 4800bps.

6 DC & Temperature characteristics

6.1 Absolute maximum ratings

Parameter	Symbol	Ratings	Units
DC Supply Voltage	VCC	4.5	V
Input Backup Battery Voltage	V_BCKP	4.5	V
Operating Temperature Range	Topr	-40 ~ 85	°C
Storage Temperature Range	Tstg	-40 ~ 85	°C

6.2 DC Electrical characteristics

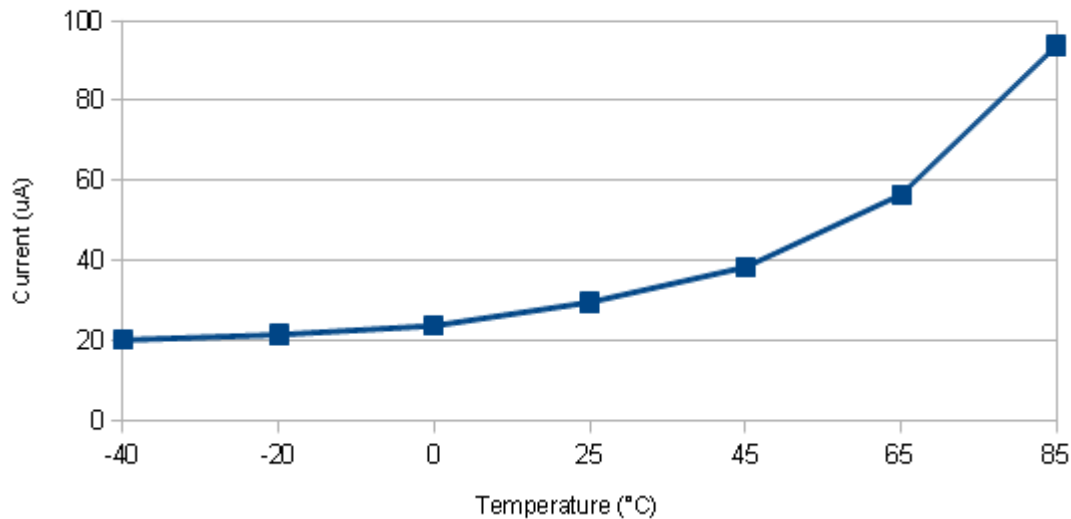
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Voltage	VCC		3.0	3.3	3.6	V
Input Backup Battery Voltage	V_BCKP		2.3		4.5	V
VCC_RF Output Voltage	VCC_RF			VCC		V
Supply	Iss	VCC = 3.3V, w/o active antenna, Peak			56	mA
		Acquisition		26		mA
		Tracking		19		mA
		Hibernate		3 ⁽¹⁾		uA

Backup Battery Current	I _{bat}	Remove the power of VCC		29 ⁽²⁾		uA
High Level Input Voltage	V _{IH}		0.7*VCC		3.6	V
Low Level Input Voltage	V _{IL}		-0.3		0.4	V
High Level Output Voltage	V _{OH}		0.7*VCC		VCC	V
Low Level Output Voltage	V _{OL}				0.4	V
High Level Output Current	I _{OH}			2		mA
Low Level Output Current	I _{OL}			2		mA

<Note>

1. At hibernate mode, the current through V_BCKP is about 58uA.
2. Backup current is related to the temperature as below chart.

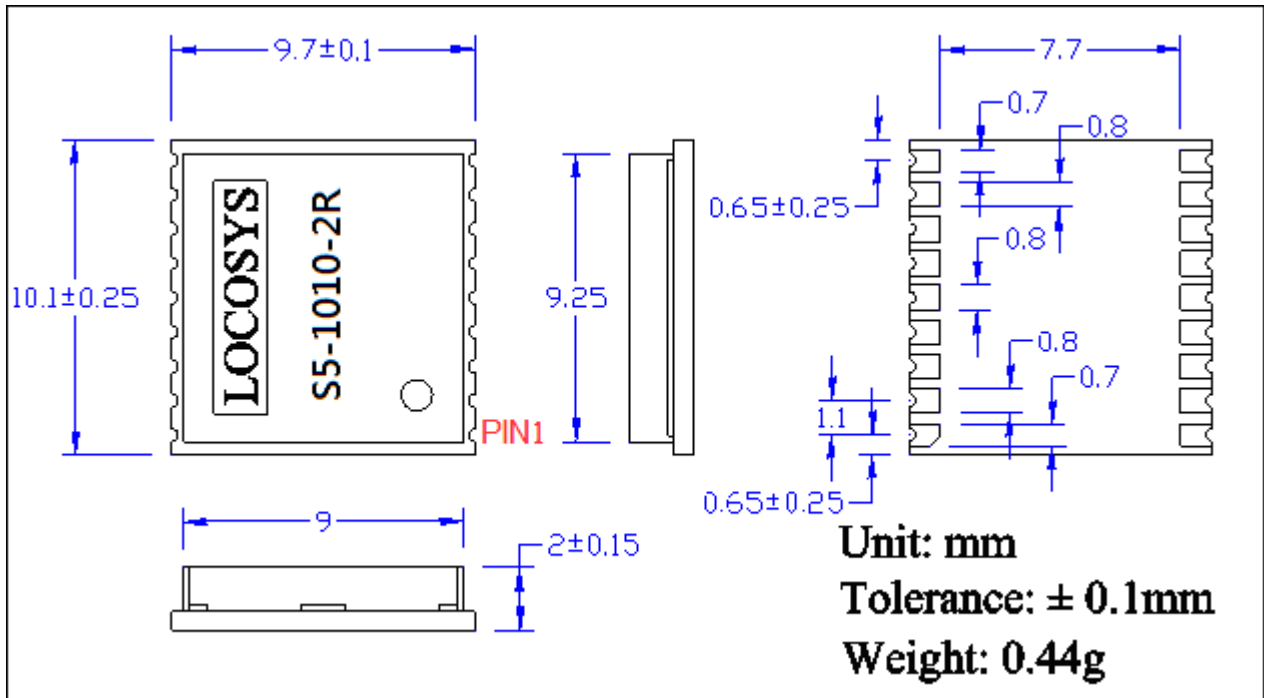
Backup current & temperature



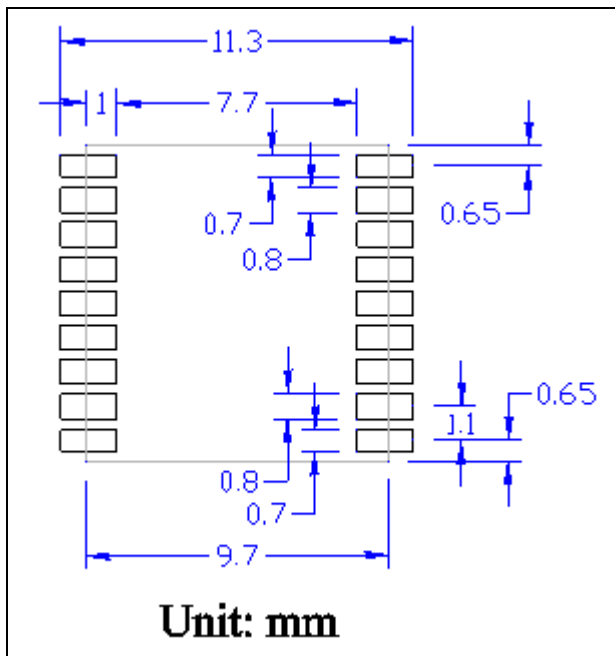
6.3 Temperature characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	T _{opr}	-40	-	85	°C
Storage Temperature	T _{stg}	-40	25	85	°C

7 Mechanical specification
 7.1 Outline dimensions



7.2 Recommended land pattern dimensions



8 Software interface

8.1 NMEA output message

Table 8.1-1 NMEA output message

NMEA record	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed
GNS	GNSS fix data

● GGA--- Global Positioning System Fixed Data

Table 8.1-2 contains the values for the following example:

\$GPGGA,085006.000,2503.7227,N,12138.7296,E,1,11,0.6,81.5,M,15.3,M,,0000*6D

Table 8.1- 2 GGA Data Format

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Time	085006.000		hhmmss.sss
Latitude	2503.7227		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7296		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 8.1-3
Satellites Used	11		Range 0 to 12
HDOP	0.6		Horizontal Dilution of Precision
MSL Altitude	81.5	mters	
Units	M	mters	
Geoid Separation	15.3	mters	Geoid-to-ellipsoid separation. Ellipsoid altitude = MSL Altitude + Geoid Separation
Units	M	mters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*6D		
<CR> <LF>			End of message termination

Table 8.1-3 Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3-5	Not supported
6	Dead Reckoning Mode, fix valid

● GLL--- Geographic Position – Latitude/Longitude

Table 8.1-4 contains the values for the following example:

\$GNGLL,2503.7227,N,12138.7296,E,085006.000,A,A*4B

Table 8.1-4 GLL Data Format

Name	Example	Units	Description
Message ID	\$GNGLL		GLL protocol header
Latitude	2503.7227		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7296		dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	085006.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position ⁽¹⁾ , S=Simulator
Checksum	*4B		
<CR> <LF>			End of message termination

(1) Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

● GSA---GNSS DOP and Active Satellites

Table 8.1-5 contains the values for the following example:

\$NGGSA,A,3,26,15,05,02,57,18,24,09,29,08,21,,1.2,0.6,1.0*2B

\$NGGSA,A,3,66,76,82,88,65,75,77,,,,,1.2,0.6,1.0*22

Table 8.1-5 GSA Data Format

Name	Example	Units	Description
Message ID	\$NGGSA		GSA protocol header
Mode 1	A		See Table 8.1-6
Mode 2	3		See Table 8.1-7
ID of satellite used	26		Sv on Channel 1

ID of satellite used	15		Sv on Channel 2
....		
ID of satellite used			Sv on Channel 12
PDOP	1.2		Position Dilution of Precision
HDOP	0.6		Horizontal Dilution of Precision
VDOP	1.0		Vertical Dilution of Precision
Checksum	*2B		
<CR> <LF>			End of message termination

Table 8.1-6 Mode 1

Value	Description
M	Manual- forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

Table 8.1-7 Mode 2

Value	Description
1	Fix not available
2	2D
3	3D

● GSV---GNSS Satellites in View

Table 8.1-8 contains the values for the following example:

```
$GPGSV,3,1,11,26,54,023,43,15,67,284,42,05,40,057,41,02,32,140,39*7F
$GPGSV,3,2,11,57,74,091,37,18,08,291,36,24,28,179,36,09,15,044,36*75
$GPGSV,3,3,11,29,34,247,35,08,12,043,34,21,20,318,33*42
$GLGSV,3,1,09,66,38,342,39,76,35,117,37,82,15,325,36,88,33,201,35*64
$GLGSV,3,2,09,65,25,043,33,75,24,054,32,77,10,168,31,81,47,277,*6E
$GLGSV,3,3,09,67,14,289,*5B
```

Table 8.1-8 GSV Data Format

Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header (GPGSV and GLGSV)
Total number of messages ¹	3		Range 1 to 8
Message number ¹	1		Range 1 to 8
Satellites in view	11		
Satellite ID	26		Channel 1 (Range 01 to 196)
Elevation	54	degrees	Channel 1 (Range 00 to 90)
Azimuth	023	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	43	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
....		

Satellite ID	02		Channel 4 (Range 01 to 196)
Elevation	32	degrees	Channel 4 (Range 00 to 90)
Azimuth	140	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	39	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*7F		
<CR> <LF>			End of message termination

1. Depending on the number of satellites tracked multiple messages of GSV data may be required.

● RMC---Recommended Minimum Specific GNSS Data

Table 8.1-9 contains the values for the following example:

\$GNRMC,085006.000,A,2503.7227,N,12138.7296,E,0.00,0.00,191113,,,A*76

Table 8.1-9 RMC Data Format

Name	Example	Units	Description
Message ID	\$GNRMC		RMC protocol header
UTC Time	085006.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.7227		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.7296		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.00	knots	True
Course over ground	0.00	degrees	
Date	191113		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west (Not shown)
Mode	A		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse position ⁽¹⁾ , S=Simulator
Checksum	*76		
<CR> <LF>			End of message termination

(1) Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides

● VTG---Course Over Ground and Ground Speed

Table 8.1-10 contains the values for the following example:

\$GNVTG,0.00,T,,M,0.00,N,0.0,K,A*13

Table 8.1-10 VTG Data Format

Name	Example	Units	Description
------	---------	-------	-------------

Message ID	\$GNVTG		VTG protocol header
Course over ground	0.00	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.00	knots	Measured speed
Units	N		Knots
Speed over ground	0.0	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	A		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse position ⁽¹⁾ , S=Simulator
Checksum	*13		
<CR> <LF>			End of message termination

(1) Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides

● GNS---GNSS Fix Data

Table 8.1-11 contains the values for the following example:

\$GNGNS,064411.000,2503.7136,N,12138.7427,E,AA,16,0.7,130.5,15.3,,0000*66

Table 8.1-11 GNS Data Format

Name	Example	Units	Description
Message ID	\$GNGNS		GNS protocol header
UTC of position fix	064411.000		hhmmss.sss
Latitude	2503.7136		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.7427		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Mode indicator	AA		Variable character field with one character for each supported constellation. First character is for GPS, second character is for GLONASS, subsequent characters will be added for new constellation. Each character will be one of Table 8.1-12
Satellites Used	16		Range 0 to 99
HDOP	0.7		Horizontal Dilution of Precision
Orthometric height	130.5	mters	Orthometric height in meters (MSL reference)
Geoid Separation	15.3	mters	Geoid-to-ellipsoid separation.

			Ellipsoid altitude = MSL Altitude + Geoid Separation
Age of differential data		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*13		
<CR> <LF>			End of message termination

Table 8.1-12 mode

Value	Description
N	No fix. Satellite system not used in position fix, or fix not valid
A	Autonomous. Satellite system used in non-differential mode in position fix
D	Differential
P	Precise. Satellite system used in precision mode.
R	Real Time Kinematic. Satellite system used in RTK mode with fixed integers
F	Float RTK. Satellite system used in real time kinematic mode with floating integers
E	Estimated (dead reckoning) Mode
M	Manual Input Mode
S	Simulator Mode

8.2 Proprietary NMEA input message

Table 8.2-1 Message Parameters

Start Sequence	Payload	Checksum	End Sequence
\$PSRF<MID> ¹	Data ²	*CKSUM ³	<CR><LF> ⁴

1. Message Identifier consisting of three numeric characters. Input messages begin at MID 100.
2. Message specific data. Refer to a specific message section for <data>...<data> definition.
3. CKSUM is a two-hex character checksum as defined in the NMEA specification, *NMEA-0183Standard For Interfacing Marine Electronic Devices*. Use of checksums is required on all input messages.
4. Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Note: All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

Table 8.2-2 Proprietary NMEA input messages

MID ¹	Description
100	Set PORT A parameters and protocol
101	Parameters required for start using X/Y/Z ²
102	Set PORT B parameters for DGPS input
103	Query standard NMEA message and/or set output rate

104	Parameters to start using Lat/Lon/Alt ³
105	Development Data messages On/Off
106	Selection of datum for coordinate transformation
112	Set message rate
117	System turn off
120	Storage configuration setting
121	Data logging command
122	Data logging interval command
123	Data logging threshold command
124	Data logging memory management command
125	Poll SW version string

1. Message Identification (MID).
2. Input coordinates must be WGS84.
3. Input coordinates must be WGS84

● 100---SetSerialPort

This command message is used to set the protocol (SiRF binary or NMEA) and/or the communication parameters (Baud rate, data bits, stop bits, and parity). The command is used to switch the module back to SiRF binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and, after a reset, the receiver resumes using the saved parameters.

Table 8.2-3 contains the input values for the following example:

Switch to SiRF binary protocol at 9600,8,N,1

```
$PSRF100,0,9600,8,1,0*0C<CR><LF>
```

Table 8.2-3 Set Serial Port Data Format

Name	Example	Units	Description
Message ID	\$PSRF100		PSRF100 protocol header
Protocol	0		0=SiRF binary, 1=NMEA
Baud	9600		4800,9600,19200,38400,57600, or 115200
DataBits	8		8 only
StopBits	1		1 only
Parity	0		0 = None only
Checksum	*0C		
<CR><LF>			End of message termination

1. SiRF protocol is only valid for 8 data bits, 1 stop bit, and no parity.

● 101---Navigation Initialization

This command message restarts the receiver, as well as, specifies the type of restart. Optionally, it may also initialize

position (in X, Y, Z ECEF coordinates), clock drift, GPS Time Of Week and GPS Week Number. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to quickly acquire signals.

Table 8.2-4 contains the input values for the following example:

Start using known position and time

```
$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*1C<CR><LF>
```

Table 8.2-4 Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	\$PSRF101		PSRF101 protocol header
ECEF X	-2686700	meters	X coordinate position
ECEF Y	-4304200	meters	Y coordinate position
ECEF Z	3851624	meters	Z coordinate position
ClkOffset	96000	Hz	Clock Drift of the Receiver ⁽¹⁾
TimeOfWeek	497260	seconds	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See Table 5.2-5
Checksum	*1C		
<CR><LF>			End of message termination

(1) Use 0 for last saved value if available. If this is unavailable, use a default value of 96250.

Table 8.2-5 Reset Configuration

Value	Description
1	Hot Start
2	Warm Start (no init)
3	Warm Start (with Init)
4	Cold Start
8	Factory start

● **102---SetDGPSPort**

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used that has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and the receiver restarts using the saved parameters.

Table 8.2-6 contains the input values for the following example:

Set DGPS Port to be 9600,8,N,1.

```
$PSRF102,9600,8,1,0*12
```

Table 8.2-6 Set GPS Port Data Format

Name	Example	Units	Description
Message ID	\$PSRF102		PSRF102 protocol header
Baud	9600		4800,9600,19200,38400, 57600 or 115200
DataBits	8		8,7
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*12		
<CR><LF>			End of message termination

Note: RTCM is not supported, i.e. this command is not supported.

● 103---Query/Rate Control

This command is used to control the output of only standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. It also controls the ZDA message in software that supports it. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

Table 8.2-7 contains the input values for the following example:

1. Query the GGA message with checksum enabled

```
$PSRF103,00,01,00,01*25<CR><LF>
```

2. Enable VTG message for a 1 Hz constant output with checksum enabled

```
$PSRF103,05,00,01,01*20<CR><LF>
```

3. Disable VTG message

```
$PSRF103,05,00,00,01*21<CR><LF>
```

Table 8.2-7 Query/Rate Control Data Format (See example 1)

Name	Example	Units	Description
Message ID	\$PSRF103		PSRF103 protocol header
Msg	00		See Table 8.2-8 ⁽¹⁾
Mode	01		0 = Set Rate 1 = Query one time 2 = ABP On 3 = ABP Off 4 = Reverse EE On 5 = Reverse EE Off 6 = 5Hz Navigation On 7 = 5Hz Navigation Off 8 = SBAS Ranging On 9 = SBAS Ranging Off

			10 = FTS (Fast Time Sync) Mode On 11 = FTS Mode Off
Rate	00	seconds	Output Rate, 0 = Off 1 to 255 = seconds between messages ⁽²⁾
CksumEnable	01		0=Disable Checksum, 1=Enable Checksum
Checksum	*25		
<CR><LF>			End of message termination

(1) The Msg field is ignored if the Mode field has values other than 1 (query).

(2) The Rate field is ignored unless the Mode field is set to 0 (Set Rate).

Table 8.2-8 Messages

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG
6	MSS (If internal beacon is supported)
7	Not defined
8	ZDA (if 1PPS output is supported)
9	Not defined

Note: In TricklePower mode, the update rate specifies TricklePower cycles rather than seconds. If the TricklePower cycle is set at 5 seconds, then an update rate of 2 indicates to output the message every 2 cycles, or 10 seconds.

● 104---LLANavigationInitialization

This command is used to cause a restart of the receiver, and to specify the type of restart. Optionally, it may also initialize position (in latitude, longitude, and altitude), clock drift, GPS Time Of Week and GPS Week Number. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to quickly acquire signals.

Table 8.2-9 contains the input values for the following example:

Start using known position and time.

\$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1*07<CR><LF>

Table 8.2-9 LLA Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	\$PSRF104		PSRF104 protocol header

Lat	37.3875111	degrees	Latitude position (Range 90 to -90), +: North, -: South
Lon	-121.97232	degrees	Longitude position (Range 180 to -180), +: East, -: West
Alt	0	meters	Altitude position
ClkOffset	96000	Hz	Clock Drift of the Receiver ⁽¹⁾
TimeOfWeek	237759	seconds	GPS Time Of Week
WeekNo	1946		Extended GPS Week Number (1024 added)
ChannelCount	12		Range 1 to 12
ResetCfg	1		See Table 5.2-10
Checksum	*07		
<CR><LF>			End of message termination

(1) Use 0 for last saved value if available. If this is unavailable, a default value of 96250 is used.

Table 8.2-10 Messages

Value	Description
1	Hot Start
2	Warm Start (no init)
3	Warm Start (with Init)
4	Cold Start
8	Factory start

● 105---Development Data On/Off

This command turns development data (debug messages) on and off. Development data can be used to help diagnose system problems since many parts of the software contain messages that are output when problems are detected.

Table 8.2-11 contains the input values for the following example:

1. Debug On

\$PSRF105,1*3E

2. Debug Off

\$PSRF105,0*3F

Table 8.2-11 Development Data On/Off Data Format

Name	Example	Units	Description
Message ID	\$PSRF105		PSRF105 protocol header
Debug	1		0=Off, 1=On
Checksum	*3E		
<CR><LF>			End of message termination

● 106---Select Datum

This message allows the selection of an alternate map datum. The receiver software may contain one or more alternate

datums in addition to WGS84, the default GPS datum.

Table 8.2-12 contains the input values for the following example:

```
Datum selects TOKYO_MEAN
$PSRF106,178*32<CR><LF>
```

Table 8.2-12 Development Data On/Off Data Format

Name	Example	Units	Description
Message ID	\$PSRF106		PSRF106 protocol header
Datum	178		21=WGS84 178=TOKYO_MEAN 179=TOKYO_JAPAN 180=TOKYO_KOREA 181=TOKYO_OKINAWA
Checksum	*32		
<CR><LF>			End of message termination

● 112---Set Message Rate

This message is intended only for SiRFInstantFix and must not be used otherwise.

Table 8.2-13 contains the values for the following example:

```
$PSRF112,140,1,1*3B<CR><LF>
```

Table 8.2-13 Development Data On/Off Data Format

Name	Example	Units	Description
Message ID	\$PSRF112		PSRF112 protocol header
MID to set	140		This is the only NMEA MID supported
Message rate	1	sec	140 = valid rate is 1 (i.e. occurring once at every periodic EE event, in every 6 seoncds) or 0 (to disable)
Send Now	1		Poll NMEA MID once
Checksum	*3B		
<CR><LF>			End of message termination

● 117---System Turn Off

This message requests that the GPS receiver perform an orderly shutdown and switch to hibernate mode.

Table 8.2-14 contains the values for the following example:

```
$PSRF117,16*0B<CR><LF>
```

Table 8.2-14 System Turn Off

Name	Example	Units	Description
Message ID	\$PSRF117		PSRF117 protocol header
Sub ID	16		16: System turn off

Checksum	*0B		
<CR><LF>			End of message termination

● 120---Storage Configuration Setting

This command sets storage configuration options to determine on which storage media the different types of system data are physically stored.

Table 8.2-15 contains the values for the following example:

Store both firmware patches and extended ephemeris (EE) data on SPI flash.

```
$PSRF120,F,F*24<CR><LF>
```

Table 8.2-15 Store patches and EE on SPI flash

Name	Example	Units	Description
Message ID	\$PSRF120		PSRF120 protocol header
FW Patch Storage Setting	F		N = Do not store to SPI flash F = Store to SPI flash (default) 0 = No change applied to patch
EE Data Storage Setting	F		H = Storage available on host R = I ² C EEPROM provided for access F = Store to SPI flash (default) or parallel flash N = No storage 0 = No change applied to patch storage settings
Checksum	*24		
<CR><LF>			End of message termination

● 121---Data Logging Command

This message controls the state of the data logger allowing it to be started, stopped, cleared, retrieve logged data, and retrieve general status. The minimum logging interval is specified as a parameter of the start command. Current position data is logged if the interval and other threshold criteria are met.

Table 8.2-16 contains the values for the following examples:

1. Start log with 2-second interval

```
$PSRF121,0,2*27<CR><LF>
```
2. Ask to retrieve data

```
$PSRF121,3,0*26<CR><LF>
```
3. Ask to retrieve data log status

```
$PSRF121,4,0*21<CR><LF>
```

Table 8.2-16 Start log with 2-second interval

Name	Example	Units	Description
Message ID	\$PSRF121		PSRF121 protocol header
Command	0		0 = Start ⁽¹⁾

			1 = Stop ⁽¹⁾ 2 = Clear ⁽¹⁾ 3 = Retrieve Data ⁽²⁾ 4 = Retrieve Status ⁽³⁾
Logging Interval	2		Minimum seconds between logging each record. Only applicable to the Start command. Range: 1 to 65535.
Checksum	*27		
<CR><LF>			End of message termination

- (1) No response message. Please issue command \$PSRF121,4,0*21<CR><LF> to get status.
- (2) The response is PSRF190 and PSRF191. Requesting this message while the data logger is active stops data logging. To start data logging again, issue a new Start Log command.
- (3) The response is PSRF192.

● **122---Data Logging Interval Command**

This message sets the minimum data logging interval and overrides the ‘minimum logging interval’ value set in the Data Logger Command Message. When this time is exceeded, data records are logged if other threshold criteria are also met. This interval can be changed at any time even while data logging is active.

Table 8.2-17 contains the values for the following example:

```
$PSRF122,10*0B<CR><LF>
```

Table 8.2-17 Set 10 seconds logging interval

Name	Example	Units	Description
Message ID	\$PSRF122		PSRF122 protocol header
Logging Interval	10	second	Minimum seconds between logging each record. Range: 0 to 65535.
Checksum	*0B		
<CR><LF>			End of message termination

● **123---Data Logging Threshold Command**

This message sets the minimum distance and speed thresholds that must be met before logging a record. The data are logged when:

- ◆ The distance change from the last logged record exceeds the distance threshold or
- ◆ The current record’s speed over ground exceeds the speed threshold and the minimum time interval has been exceeded

These thresholds can be changed at any time even while data logging is active. Zero threshold values are always exceeded. Threshold results are OR'ed with each other. When any threshold is exceeded, logging occurs at the interval controlled rate. Default distance threshold is 0 meters. Default speed threshold is 0 m/s.

Table 8.2-18 contains the values for the following example:

```
$PSRF123,15,2*11<CR><LF>
```

Table 8.2-18 Set 15 meter and 2 m/s as threshold

Name	Example	Units	Description
Message ID	\$PSRF123		PSRF123 protocol header
Distance Threshold	15	Meter	Distance between current record and the previously logged record that must be exceeded to log the current record. Range: 0 to 65535.
Speed Threshold	2	m/s	The speed the current record must exceed to be logged. Range: 0 to 65535.
Checksum	*11		
<CR><LF>			End of message termination

● **124---Data Logging Memory Management Command**

This message sets the type of memory management and format of the data record to be stored. The command must be issued when the data logger is NOT active in order to have any effect.

The memory management types include:

- ◆ circular data buffering: the oldest data is over written by the new data for continuous logging
- ◆ stop-on-memory-full

Logged data is stored and read back using the specified record type. Changing the record type invalidates all stored data and logging starts from the beginning of the allocated area. Default management type is circular buffering. Default record type is type 0.

Table 8.2-19 contains the values for the following example:

\$PSRF124,1,4*25<CR><LF>

Table 8.2-19 Set record type 4 and stop record on memory full.

Name	Example	Units	Description
Message ID	\$PSRF124		PSRF124 protocol header
Stop On Memory Full	1		0 = Circular Buffering (default) 1 = Stop on memory full (one pass)
Data Record Type ⁽¹⁾	4		0 = Compatibility format (default) 1 = Position 2 = Position + Altitude 3 = Position + Altitude + Speed 4 = Position + Altitude + Speed + Accuracy
Checksum	*25		
<CR><LF>			End of message termination

(1) Each record occupies 24, 20, 24, 28 and 36 bytes of memory for record type 0, 1, 2, 3 and 4, respectively.

● **125---Poll SW Version String**

This message polls the version string when in NMEA mode. The response is PSRF195. If a customer version string is

defined, this request generates two PSRF195, one with the SW Version String, and the second one with the customer-specific version string.

Table 8.2-20 contains the values for the following example:

\$PSRF125*21<CR><LF>

Table 8.2-20 Poll SW Version String

Name	Example	Units	Description
Message ID	\$PSRF125		PSRF125 protocol header
Checksum	*21		
<CR><LF>			End of message termination

8.3 Proprietary NMEA output message

Table 8.3-1 Proprietary NMEA output messages

MID ¹	Description
150	OkToSend
190	Data Log Record Output
191	Data Log Terminator Output
192	Data Log Status Output
195	Response to Poll SW Version String

● 150---OkToSend

This message is sent out during power-saving mode, such as TricklePower™ and Push-to-Fix™, to indicate when the receiver is ready to receive messages or when it is going into low-power mode. When power is restored, it is the first message sent, and when it is going to be reduced, it is the last message sent.

Table 5.3-1 contains values for the following examples:

- ◆ OkToSend
\$PSRF150,1*3E<CR><LF>
- ◆ not OkToSend
\$PSRF150,0*3F<CR><LF>

Table 8.3-2 OkToSend

Name	Example	Units	Description
Message ID	\$PSRF150		PSRF150 protocol header
OkToSend	1		1 = OK to send 0 = not OK to send
Checksum	*3F		
<CR><LF>			End of message termination

● 190---Data Log Record Output

This message consists of data read from the data log store using a single record type of 0 through 4, and is a subset of

fields from OSP MID 41 and uses the same units, precision, and ranges for all values. Not all fields are populated for all record types. Applicable fields that are empty are indicated by adjacent commas.

These fields are not included in the CRC. Record type one is the smallest, and each subsequent type includes the previous with additional fields. All fields within the message remain in the same position. Record type 0 is for previous compatibility. Longer record types (e.g. types 0 and 4) are split into multi-sentence messages to maintain length limits. Total sentences and unique sequence number fields in each sentence facilitate multi-part management. Requesting this message while the data logger is active stops data logging before output begins. No other NMEA messages are outputted while retrieving logged data.

Table 8.3-3 and 8.3-4 contains values for the following examples:

```
$PSRF190,2,1,4,131125,101745,2503.7153,N,12138.7443,E,119.8,M,0.0,.*65<CR><LF>
$PSRF190,2,2,10,0.6,2.8,M,123481000,570212894*64<CR><LF>
```

Table 8.3-3 Data Log Record Output. Sentence number 1.

Name	Example	Units	Description
Message ID	\$PSRF190		PSRF190 protocol header
Total Sentences	2		Number of sentences for full data. (Range: 1 to 255)
Sentence Number	1		Sentence sequence number out of total sentences. (Range: 1 to 255)
Record Type	4		Record Type (rec type 0 to 4)
UTC Date	131125	Year Month Day	YYMMDD Date (rec type 0 to 4)
UTC Time	101745	Hour Minute Second	HHMMSS Time (rec type 0 to 4)
Latitude	2503.7153	Degree Minute	DDMM.mmm (rec type 0 to 4), range: 0.0 to 8959.999
Latitude Direction	N		N or S (rec type 0 to 4)
Longitude	12138.7443	Degree Minute	DDDMM.mmm (rec type 0 to 4), range: 0.0 to 17959.999
Longitude Direction	E		E or W (rec type 0 to 4)
Altitude	119.8	Meter	Altitude from man sea level (rec type 0, 2 to 4)
Altitude Units	M		Meters (rec type 0, 2 to 4)
Speed	0.0	m/s	(rec type 3 to 4)
CRC-32			CRC-32 value of non-zero-padded payload (rec type 1 to 3). Not populated for multi-part rec type 0 or 4.
Checksum	*65		
<CR><LF>			End of message termination

Table 8.3-4 Data Log Record Output. Sentence number 2.

Name	Example	Units	Description
Message ID	\$PSRF190		PSRF190 protocol header
Total Sentences	2		Number of sentences for full data. (Range: 1 to 255)
Sentence Number	2		Sentence sequence number out of total sentences. (Range: 1 to 255)
SV Count	10		Count of SVs in fix (rec type 0, 4), range: 1 to 255.
HDOP	0.6		
EHPE	2.8		
EHPE Units	M		
TOW	123481000	ms	Time of Week (rec type 4)
CRC	570212894		CRC-32 value of non-zero-padded payload for rec type 4; CRC-16 for rec type 0.
Checksum	*64		
<CR><LF>			End of message termination

\$PSRF190,2,2,10,0.6,2.8,M,123481000,570212894*64

● 191---Data Log Terminator Output

This message indicates data log output is complete and outputs once after all valid data records have been read from the data log store and sent out. When the log output is complete, regular NMEA messaging resumes. This message contains no payload data. To start data logging again, issue a new Start Log command.

Table 8.3-5 contains values for the following example:

\$PSRF191*2E<CR><LF>

Table 8.3-5 Data Log Terminator Output

Name	Example	Units	Description
Message ID	\$PSRF191		PSRF191 protocol header
Checksum	*2E		
<CR><LF>			End of message termination

● 192---Data Log Status Output

This message provides the current data logger status including; threshold settings, memory usage, record type, and activity. It can be requested at anytime even while the data logger is active. Memory used indicates the amount of memory written to that has not yet been read back. It is valid only for stop-on-memory-full management and zero. When all data has been read or the data logger is restarted after a memory full condition, memory used returns to zero. Memory available as with memory used, indicates memory available for writing. It is used for stop-on-memoryfull management and shows the full store size. When all data has been read or the data logger is restarted, after a memory full condition, memory available returns to the full store size.

Table 8.3-6 contains values for the following example:

\$PSRF192,0,0,10,0,0,86016,0,0,0,0,0,0,0,0*15<CR><LF>

Table 8.3-6 Data Log Status Output

Name	Example	Units	Description
Message ID	\$PSRF192		PSRF192 protocol header
Active	0		0 = Not Active (default) 1 = Logging Active
Record Type	0		Record Type
Logging Interval	10		Minimum seconds between logging each record. Range: 1 to 65535.
Distance Threshold	0	m	Current distance threshold setting. Range: 0 to 65535.
Speed Threshold	0	m/s	Current speed threshold setting. Range: 0 to 65535.
Memory Available	86016	Bytes	Size of the data store, or if stopping on full, unused memory.
Memory Used	0	Bytes	If stopping on full, indicates memory used, zero otherwise.
Stop On Memory Full	0		0 = Circular buffering 1 = Stop logging at end of first pass through store.
Memory Full	0		0 = Not full. If stopping on full. 1 = memory is full (logging stopped).
Reserved	0		Always zero.
Reserved	0		Always zero.
Reserved	0		Always zero.
Reserved	0		Always zero.
Reserved	0		Always zero.
Reserved	0		Always zero.
Reserved	0		Always zero.
Checksum	*15		
<CR><LF>			End of message termination

● **195---Response to Poll SW Version String**

This message is the response to the Poll SW version message (PSRF125).

Table 8.3-7 contains values for the following example:

\$PSRF195,5xp__5.5.2-R32+5xpt_5.5.2-R32*06<CR><LF>

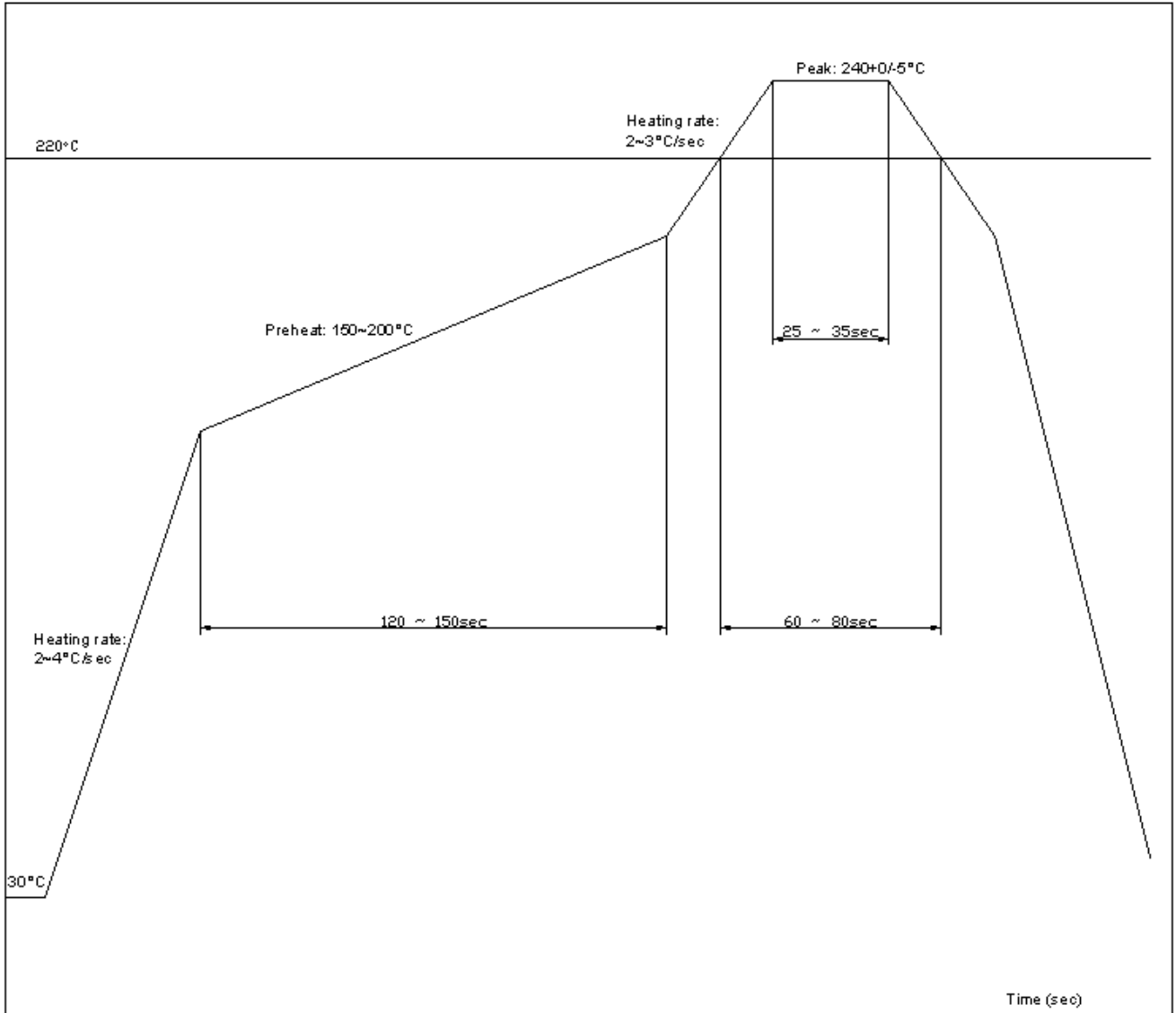
Table 8.3-7 Response to Poll SW Version String

Name	Example	Units	Description
Message ID	\$PSRF195		PSRF195 protocol header
Version Sting	5xp__5.5.2-R32+5xpt_5.5.2-R32		
Checksum	*06		
<CR><LF>			End of message termination

9 Recommended Soldering Temperature Profile

The module belongs to RoHS compliant. The maximum of peak temperature, real on top of PCB, is not over 240 Celsius.

Lead-free Processes



Lead-Free Solder Paste (Sn 96.5-Ag 3.0-Cu 0.5)

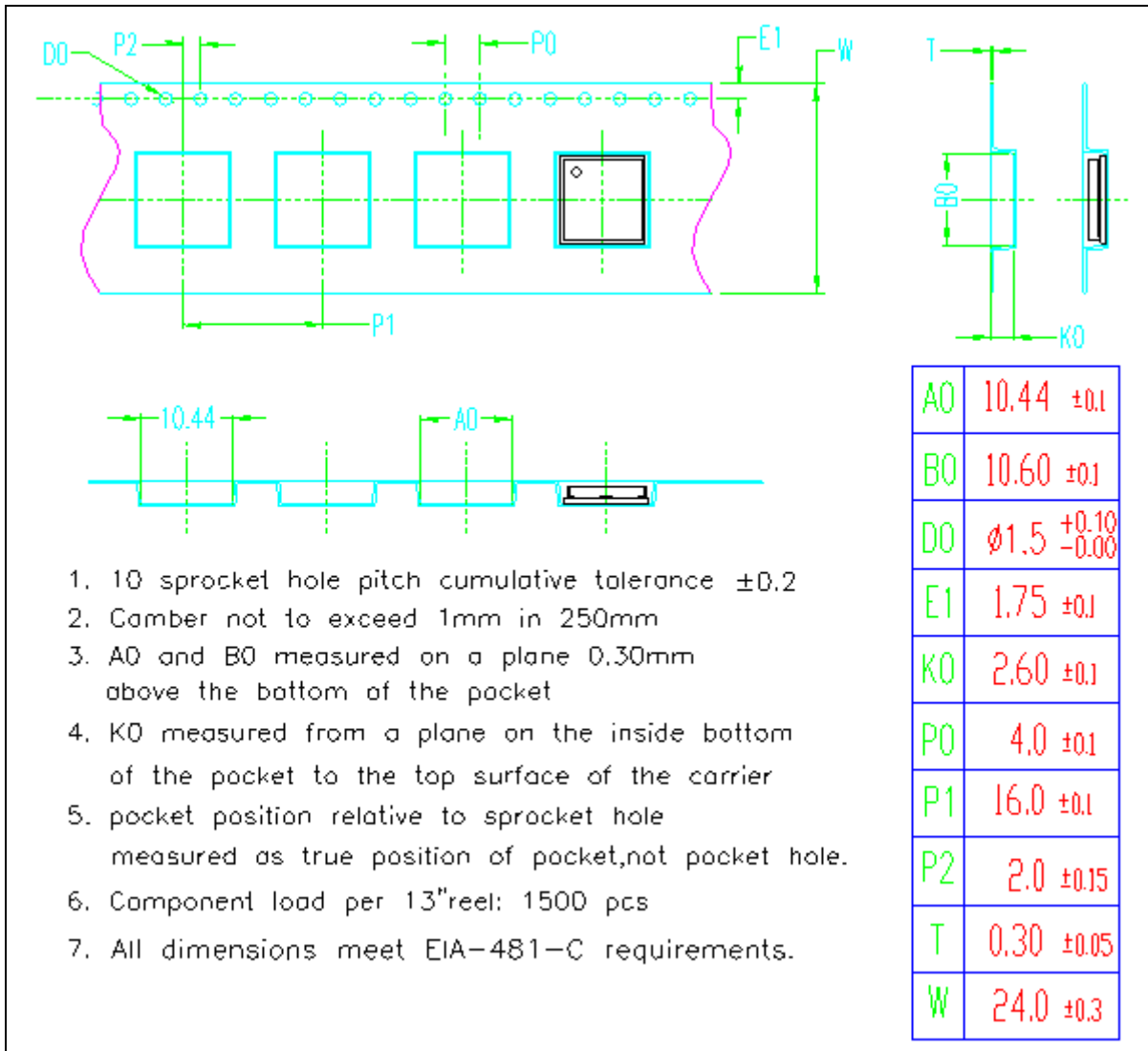
Cycle Interval: 300 sec

Note:

The S5-1010-2R module should be soldered on the topside in the soldering process to prevent from falling down.

10 Reel Packing information

S5-1010-2R modules are deliverable in quantities of 1500 pcs on a reel.



11 Packing and Handling

GNSS modules, like any other SMD devices, are sensitive to moisture, electrostatic discharge, and temperature. By following the description sketched in the document for LOCOSYS GNSS module storage and handling, it is possible to reduce the chances of them being damaged during production.

11.1 Moisture Sensitivity

The module belongs to moisture sensitive device (IPC/JEDEC J-STD-020C Level III). If it is not used by then, we strong recommended storing the GNSS modules in dry places such as dry cabinet. The approximate shelf life for LOCOSYS GNSS modules packages is 6 months from the bag seal date, when store in a non-condensing storage environment (<30°C/60% RH)

11.2 ESD Handling



Please carefully follow the following precautions to prevent severe damage to GNSS modules.

LOCOSYS GNSS modules are sensitive to electrostatic discharges, and thus are Electrostatic Sensitive Devices (ESD). Careful handling of the GNSS modules and in particular RF_IN pin must follow the standard ESD safety protections:

- Unless there is a galvanic coupling between the local GND and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- Before working with RF_IN pin, please make sure the GND is connected
- When working with RF_IN pin, do not contact any charges capacitors or materials that can easily develop or store charges such as patch antenna, coax cable, soldering iron.
- When soldering RF_IN pin, please make sure to use an ESD safe soldering iron (tip).

Document change list

Revision 1.0

- First release on June 20, 2014

Revision 1.1 (January 06, 2015)

- Revised product introduction