Low-Power High-Performance and Low-Cost 65 Channel GPS Engine Board (Flash based)

Data Sheet

Version 1.3

Abstract
Technical data sheet describing the cost effective, high-performance **GPS610F** based series of ultra high sensitive GPS modules.

The **GPS610F** is a GPS module that is sensitive to ***electrostatic dis- charge*** **(ESD)**. Please handle with appropriate care.

The Acceptability of Electronic Assemblies of the **GPS610F** has been under **IPC-A-610D** specification

Version History

Rev.	Date	Description
1.1	01-04-09	Initial Draft – preliminary information
1.2	15-04-09	Preliminary
1.3	10-05-09	Minor corrections

Note

Flash version supports the features ;

1. Binary code (Configuration command programmable)
2. Selectable NMEA output data sentences
3. Selectable Serial Port Settings. (4800/9600/38400/115200bps. Default : 9600)
4. Selectable update rate (1 / 2 / 4 / 5 / 8 / 10 Hz update rate)
5. Firmware upgrade

1 Functional Description

1.1 Introduction

The GPS610F module is small, single-board, 65 parallel-channels receiver intended for Original Equipment Manufacturer (OEM) products.

The receiver continuously tracks all satellites in view and provides accurate satellite positioning data. The GPS610F is optimized for applications requiring good performance, low cost, and maximum flexibility; suitable for a wide range of OEM configurations including handhelds, asset tracking, marine and vehicle navigation products.

Its 65 parallel channels provide fast satellite signal acquisition and short startup time. Acquisition sensitivity of –148 dm and tracking sensitivity of –161dBm offers good navigation performance even in urban canyons having limited sky view.

Satellite-based augmentation systems, such as WAAS and EGNOS, are supported to yield improved accuracy. Users can modify the NMEA sentences and Binary code

1.2 Features

- 65 Channel GPS L1 C/A Code
- Perform 8 million time-frequency hypothesis testing per second
- Open sky hot start 1 sec, cold start 29 sec
- Signal detection better than -161dBm
- Multipath detection and suppression
- Accuracy 2.5m CEP
- Maximum update rate 10Hz
- Tracking current ~23mA
- Provides a 10pin header to easily connect to PCB
- 5m CEP Accuracy
- RoHS compliance

1.3 Applications

- Automotive and Marine Navigation
- Automotive Navigator Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation

2 Characteristics

2.1 General Specification

Parameter	Specification	
Receiver Type	65 Channels GPS L1 frequency, C/A Code	
Time-To-First-Fix	Cold Start (Autonomous)	29s (Average, under open sky)
	Warm Start (Autonomous)	5s (Average, under open sky)
	Hot Start (Autonomous)	1s (Average, under open sky)
Sensitivity	Tracking & Navigation	-161 dBm
	Reacquisition	-161 dBm
	Cold Start (Autonomous)	-145 dBm
Accuracy	Autonomous	2.5 m CEP
	Velocity	0.1 m/sec (without aid)
	Time	300 ns
	RMS	30 ns
	99%	<60 ns
	Compensated[5]	15 ns
Max Update Rate	Supports 1 / 2 / 4 / 5 / 8 / 10 Hz update rate (1Hz default)	
Velocity Accuracy	0.1m/s	
Heading Accuracy	0.5 degrees	
Dynamics	□ 4 G (39.2 m/sec)	
Operational Limits	Velocity	515 m/s (1000 knots)
	Altitude	<18000 meters
	(COCOM limit, either may be exceeded but not both)	
RF connector	MMCX	
Serial Interface	3.3V LVTTL level, 10 pin 2mm male header	
Datum	Default WGS-84 User definable	
Input Voltage	3.3V / 5V DC +/-10%	
Input Current	~36 mA tracking	
Dimension	43L x 31W x 6H (mm)	
Weight	10g	

Table 1: GPS610F general specification

*: GPGGA, GPGSA, GPGSV, GPRMC, GPVTG are default output message

2.2 Serial Port Settings

The default configuration within the standard GPS firmware is the Standard configuration of serial port:

- Supporting 4800/9600 baud rate (**Default Value : 9600**), 8 data bits, no parity, 1 stop bit, no flow control

2.3 Improved TTFF

In order to improve the TTFF (Time To First Fix), GPS-610F has been built with the back-up battery (SEIKO) to support the RTC with a back-up power when no system power is available.

2.4 GPS Status Indicator

- Non-Fixed mode : LED is always on
- Fixed mode : LED toggle every second

6. Communication Specifications

Item	Description
Interface	Full duplex serial interface
Bit rate	4800/9600/38400/115200bps (Optional, Default 9600),
Start bit	1bit
Stop bit	1bit
Data bit	8bit
Parity	None
Transmission data	SACII NMEA0183 Ver:3.01
Update rate	1Hz
Output sentence	GGA/GSA/GSV/RMC/VTG (typ)

Table 2: Communication specifications

2.6 Multi-path Mitigation

Multipath refers to the existence of signals reflected from objects in the vicinity of a receiver's antenna that corrupt the direct line-of-sight signals from the GPS satellites, thus degrading the accuracy of both code-based and carrier phase–based measurements. Particularly difficult is close-in multipath in which the reflected secondary signals arrive only slightly later (within about 100 nanoseconds) than does the direct-path signal, having been reflected from objects only a short distance from the receiver antenna.

GPS610F deploys the advanced multi-path detection and suppression algorithm to reduce multipath errors, the GPS signals themselves can be designed to provide inherent resistance to multipath errors

2.7 Operating Conditions

Description	Min	Typical	Max
V_{CC}	2.7v 4.5V	3.3v 5 V	3.6v 5.5V
Enhanced-mode Acquisition Low power Acquisition Current Tracking Current		70 mA 50mA 23mA	

Table 3: Operating Conditions

2.8 1PPS Output

The GPS receiver is in navigation mode upon power-up, with 1PPS output free running. After 3 minutes of valid position fix and remaining under static-mode, the receiver changes to timing-mode, with 1PPS output signal synchronized to the UTC second. The receiver will change to navigation-mode, with 1PPS output free running, if the receiver is in motion. The 1PPS output will become synchronized to the UTC second again after the receiver had remained in static mode for 3 minutes.

2.9 Antenna

A numbers of important properties of GNSS antennas affect functionality and performance, including;

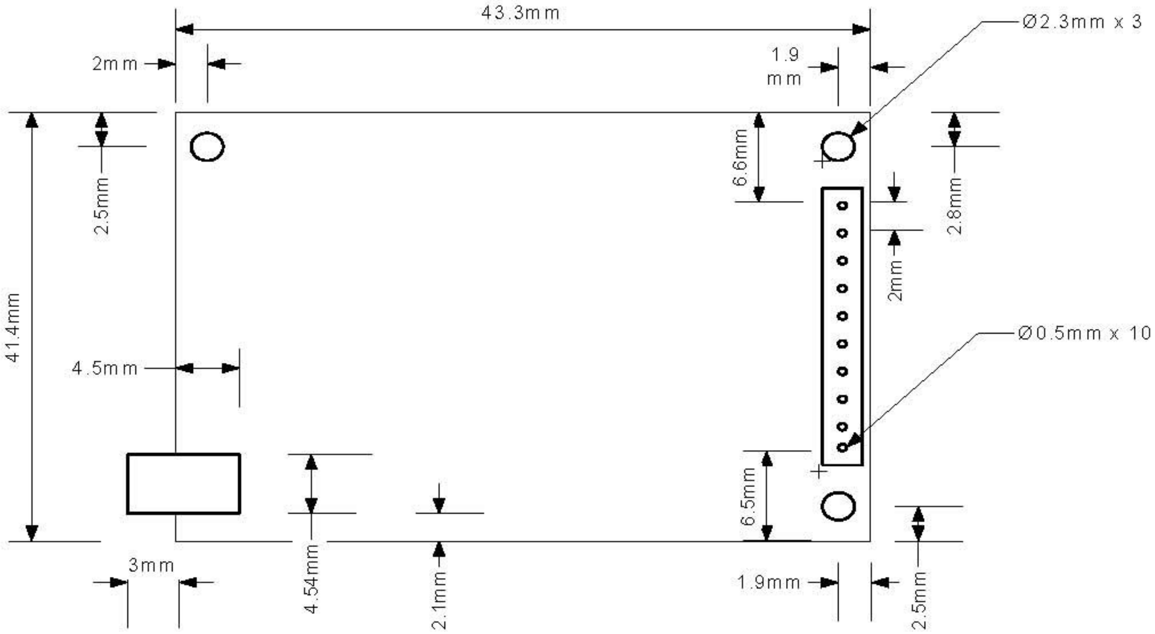
- Frequency coverage
- Gain pattern
- Circular polarization
- Multipath suppression
- Phase Center
- Impact on receiver sensitivity
- Interference handling

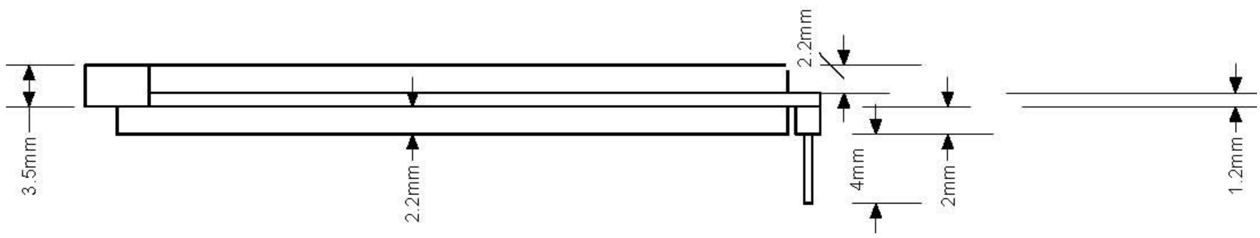
The GPS610F module is designed to work both active and passive antenna. Active antenna with gain in range of 10 ~ 30dB and noise figure less than 2dB can be used.

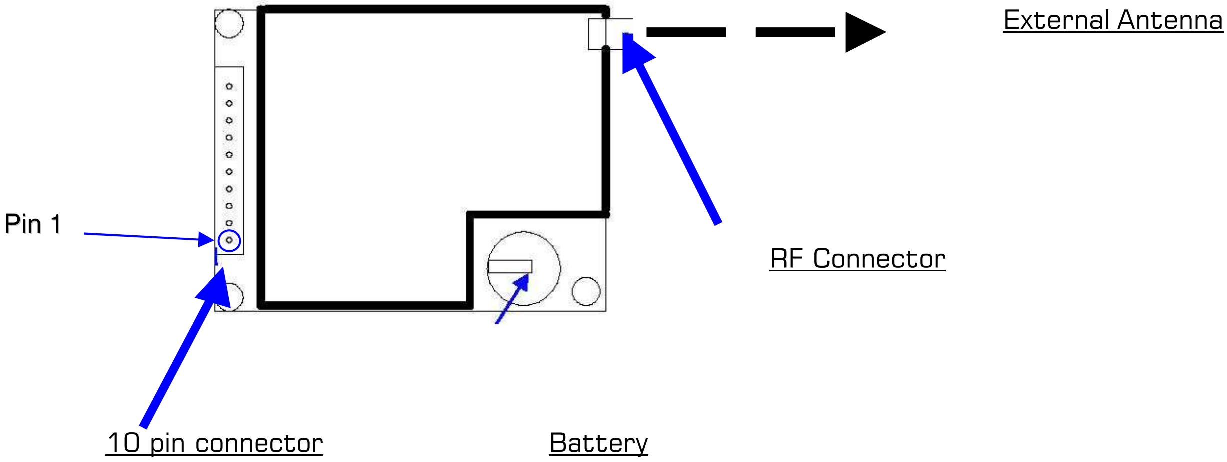
2.10 Mechanical Characteristics

Mechanical dimensions	Length Width Height	43 mm 31 mm 6 mm
Weight		30g (may vary)

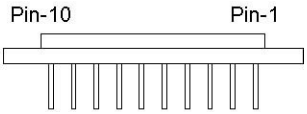
3. Mechanical Characteristics


43.3mm
2mm
1.9 mm
Ø2.3mm x 3
2.5mm
6.6mm
2.8mm
2mm
41.4mm
Ø0.5mm x 10
4.5mm
6.5mm
3mm
4.54mm
2.1mm
1.9mm
2.5mm


2.2mm
3.5mm
2.2mm
4mm
2mm
1.2mm


External Antenna
Pin 1
RF Connector
10 pin connector
Battery

3.2 PINOUT DESCRIPTION



GPS-610F Lateral View

Pin Number	Signal Name	Description
1	Serial Data	Asynchronous serial output at LVTTL level, to output NMEA
2	Serial Data In 1	Asynchronous serial input at LVTTL level, to input commands Pull high if not used
3	VCC	Regulated 3.3V power input (3.3V version)
4	GND	Ground
5	PIO Output	PIO output, default used for GPS status indication
6	1PPS	1 pulse per second time mark
7	RESET IN	Reset input, active LOW
8	Serial Data In 2	Asynchronous serial input at LVTTL level, Pull high if not used
9	VBAT	3.3V backup power input to sustain RTC and SRAM data Must be connected for module to work.
10	Antenna Power	Power input for active antenna

Table 4: Pin definition

4. Environmental Conditions

Parameter		Specification
Temperature	Operating	-20℃~+65℃
	Storage	-55℃~+100℃
Humidity		5%~95%
Storage		6 months in original vacuum package.

Table 5: Environmental conditions

5. NMEA protocol

The serial interface protocol is based on the National Marine Electronics Association's NMEA 0183 ASCII interface specification. This standard is fully define in "NMEA 0183, Version 3.01" The standard may be obtained from NMEA, www.nmea.org

5.1 GGA-GLOBAL POSITIONING SYSTEM FIX DATA

Time, position and fix related data for a GPS receiver.

Structure:

$GPGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13

Example:

$GPGGA,060932.448,2447.0959,N,12100.5204,E,1,08,1.1,108.7,M,,,,0000*0E<CR><LF>

Field	Name	Example	Description
1	UTC Time	060932.448	UTC of position in hhmmss.sss format, (000000.00 ~ 235959.99)
2	Latitude	2447.0959	Latitude in ddmm.mmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, 'N' = North, 'S' = South
4	Longitude	12100.5204	Longitude in dddmm.mmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
6	GPS quality indicator	1	GPS quality indicator 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential GPS mode 3: GPS PPS Mode, fix valid 4: Real Time Kinematic. System used in RTK mode with fixed integers 5: Float RTK. Satellite system used in RTK mode. Floating integers

			6: Estimated (dead reckoning) Mode 7: Manual Input Mode 8: Simulator Mode
7	Satellites Used	08	Number of satellites in use, (00 ~ 12)
8	HDOP	1.1	Horizontal dilution of precision, (00.0 ~ 99.9)
9	Altitude	108.7	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	Geoid Separation		Geoid separation in meters according to WGS-84 ellipsoid (-999.9 ~ 9999.9)
11	DGPS Age		Age of DGPS data since last valid RTCM transmission in xxx format (seconds) NULL when DGPS not used
12	DGPS Station ID	0000	Differential reference station ID, 0000 ~ 1023 NULL when DGPS not used
13	Checksum	0E	

Note: The checksum field starts with a '*' and consists of 2 characters representing a hex number. The checksum is the exclusive OR of all characters between '$' and '*'.

5.2 GLL - LATITUDE AND LONGITUDE, WITH TIME OF POSITION FIX AND STATUS

Latitude and longitude of current position, time, and status.

Structure:

$GPGLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.sss,A,a*hh<CR><LF>

1 2 3 4 5 6 7 8

Example:

$GPGLL,4250.5589,S,14718.5084,E,092204.999,A,A*2D<CR><LF>

Field	Name	Example	Description
1	Latitude	4250.5589	Latitude in ddmm.mmmm format Leading zeros transmitted
2	N/S Indicator	S	Latitude hemisphere indicator 'N' = North 'S' = South
3	Longitude	14718.5084	Longitude in dddmm.mmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	092204.999	UTC time in hhmmss.sss format (000000.00 ~ 235959.99)
6	Status	A	Status, 'A' = Data valid, 'V' = Data not valid
7	Mode Indicator	A	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode
8	Checksum	2D	

5.3 GSA - GPS DOP AND ACTIVE SATELLITES

GPS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence and DOP values.

Structure:

$GPGSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x*hh<CR><LF>

1 2 3 3 3 3 3 3 3 3 3 3 3 3 4 5 6 7

Example:

$GPGSA,A,3,01,20,19,13,,,,,,,,,40.4,24.4,32.2*0A<CR><LF>

Field	Name	Example	Description
1	Mode	A	Mode 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
2	Mode	3	Fix type 1 = Fix not available 2 = 2D 3 = 3D
3	Satellite used 1~12	01,20,19,13,,,,,,,,,	Satellite ID number, 01 to 32, of satellite used in solution, up to 12 transmitted
4	PDOP	40.4	Position dilution of precision (00.0 to 99.9)
5	HDOP	24.4	Horizontal dilution of precision (00.0 to 99.9)
6	VDOP	32.2	Vertical dilution of precision (00.0 to 99.9)
7	Checksum	0A	

5.4 GSV - GPS SATELLITE IN VIEW

Numbers of satellites in view, PRN number, elevation angle, azimuth angle, and C/No. Four satellites details are transmitted per message. Additional satellite in view information is send in subsequent GSV messages.

Structure:

$GPGSV,x,x,xx,xx,xx,xxx,xx,…,xx,xx,xxx,xx *hh<CR><LF>

1 2 3 4 5 6 7 4 5 6 7 8

Example:

$GPGSV,3,1,09,28,81,225,41,24,66,323,44,20,48,066,43,17,45,336,41*78<CR><LF>

$GPGSV,3,2,09,07,36,321,45,04,36,257,39,11,20,050,41,08,18,208,43*77<CR><LF>

Field	NaME	Example	Description
1	Number of message	3	Total number of GSV messages to be transmitted (1-3)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	09	Total number of satellites in view (00 ~ 12)
4	Satellite ID	28	Satellite ID number, GPS: 01 ~ 32, SBAS: 33 ~ 64 (33 = PRN120)
5	Elevation	81	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	225	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	41	C/No in dB (00 ~ 99) Null when not tracking
8	Checksum	78	

5.5 RMC - RECOMMANDED MINIMUM SPECIFIC GPS/TRANSIT DATA

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:

$GPRMC,hhmmss.sss,A,dddmm.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,x.x,a,a*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13

Example:

$GPRMC,092204.999,A,4250.5589,S,14718.5084,E,0.00,89.68,211200,,A*25<CR><LF>

Field	NaME	Example	Description
1	UTC time	092204.999	UTC time in hhmmss.sss format (000000.00 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	4250.5589	Latitude in dddmm.mmmm format Leading zeros transmitted
4	N/S indicator	S	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	14718.5084	Longitude in dddmm.mmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
7	Speed over ground	000.0	Speed over ground in knots (000.0 ~ 999.9)
8	Course over ground	000.0	Course over ground in degrees (000.0 ~ 359.9)
9	UTC Date	211200	UTC date of position fix, ddmmyy format
10	Magnetic variation		Magnetic variation in degrees (000.0 ~ 180.0)
11	Magnetic Variation		Magnetic variation direction 'E' = East 'W' = West
12	Mode indicator	A	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode
13	checksum	25	

5.6 VTG - COURSE OVER GROUND AND GROUND SPEED

The Actual course and speed relative to the ground.

Structure:

GPVTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

1 2 3 4 5 6

Example:

$GPVTG,89.68,T,,M,0.00,N,0.0,K,A*5F<CR><LF>

Field	Name	Example	Description
1	Course	89.68	True course over ground in degrees (000.0 ~ 359.9)
2	Course		Magnetic course over ground in degrees (000.0 ~ 359.9)
3	Speed	0.00	Speed over ground in knots (000.0 ~ 999.9)
4	Speed	0.00	Speed over ground in kilometers per hour (0000.0 ~ 1800.0)
5	Mode	A	Mode indicator 'N' = not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode 'M' = Manual input mode 'S' = Simulator mode
6	Checksum	5F	

5.7 ZDA- TIME AND DATE

Structure:

$GPRMC,hhmmss.sss,dd,mm.yyyy, , ,xxx<CR><LF>

1 2 3 4 5 6 7

Example:

$GPZDA,104548.04,25,03,2004,,*6C<CR><LF>

Field	Name	Example	Description
1	UTC time	104548.04	UTC time in hhmmss.ss format, 000000.00 ~ 235959.99
2	UTC time: day	25	UTC time day (01 ... 31)
3	UTC time: month	03	UTC time: month (01 ... 12)
4	UTC time: year	2004	UTC time: year (4 digit year)
5			Local zone hour Not being output by the receiver (NULL)
6			Local zone minutes Not being output by the receiver (NULL)
7	6C	6C	Checksum

6. Contact Information

We hope this datasheet will be helpful to the user to get the most out of the GPS module, furthermore feedback inputs about errors or mistakable verbalizations and comments or proposals to **RF Solutions Ltd.**. for further improvements are highly appreciated.