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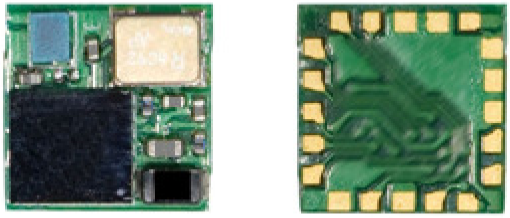
Product name	Description	Version
S4-0606	Datasheet of S4-0606 ROM-based standalone GPS module	1.2



1 Introduction

LOCOSYS S4-0606 GPS module features high sensitivity, low power and ultra small form factor. This GPS module is powered by SiRF Star IV, which can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment. User can add a serial EEPROM (or use the host CPU's memory) to get SiRF CGEE (Client Generated Extended Ephemeris) function that predicts satellite positions for up to 3 days and delivers CGEE-start time of less than 15 seconds under most conditions, without any network assistance. Besides, Micro Power Mode allows GPS module to stay in a hot-start condition nearly continuously while consuming very little power.

2 Features

- SiRF Star IV high sensitivity solution
- Support 48-channel GPS
- Fast TTFF at low signal level
- Built-in active jammer remover to track up to 8 CW jammers
- Free CGEE technology to get faster location fix (optional with an external EEPROM)
- Support 3 communication interfaces: UART, SPI and I2C
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Support Japan QZSS
- Micro Power Mode
- Built-in LNA and SAW filter
- Small form factor 6 x 6 x 1.35 mm
- SMD type; RoHS compliant

3 Application

- Personal positioning and navigation
- Automotive navigation
- Marine navigation

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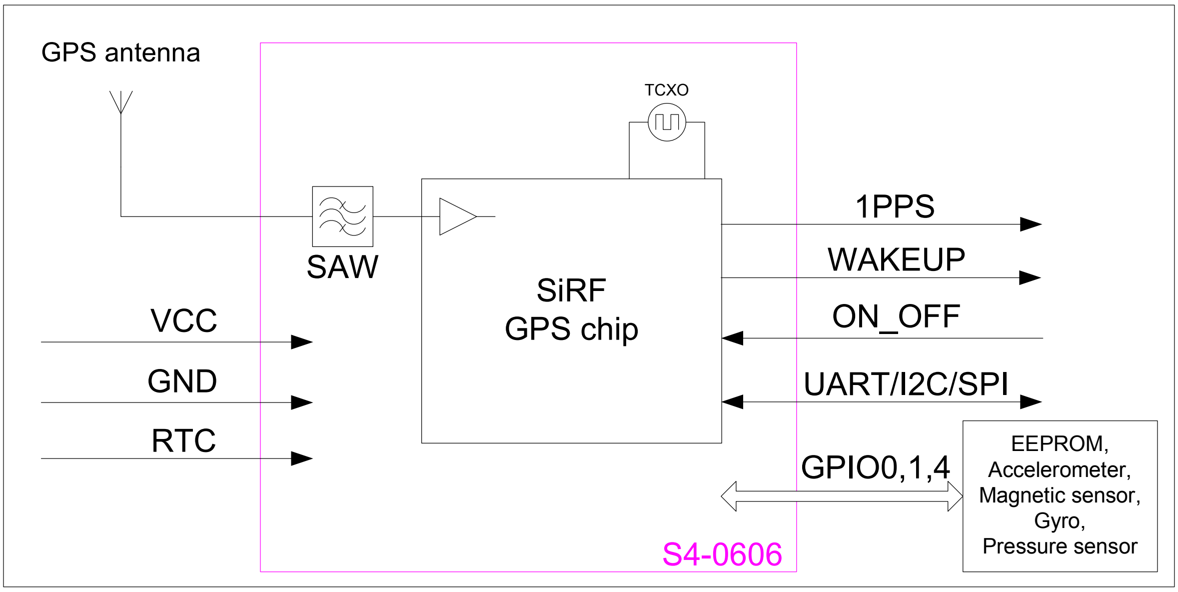

Fig 3-1 System block diagram.

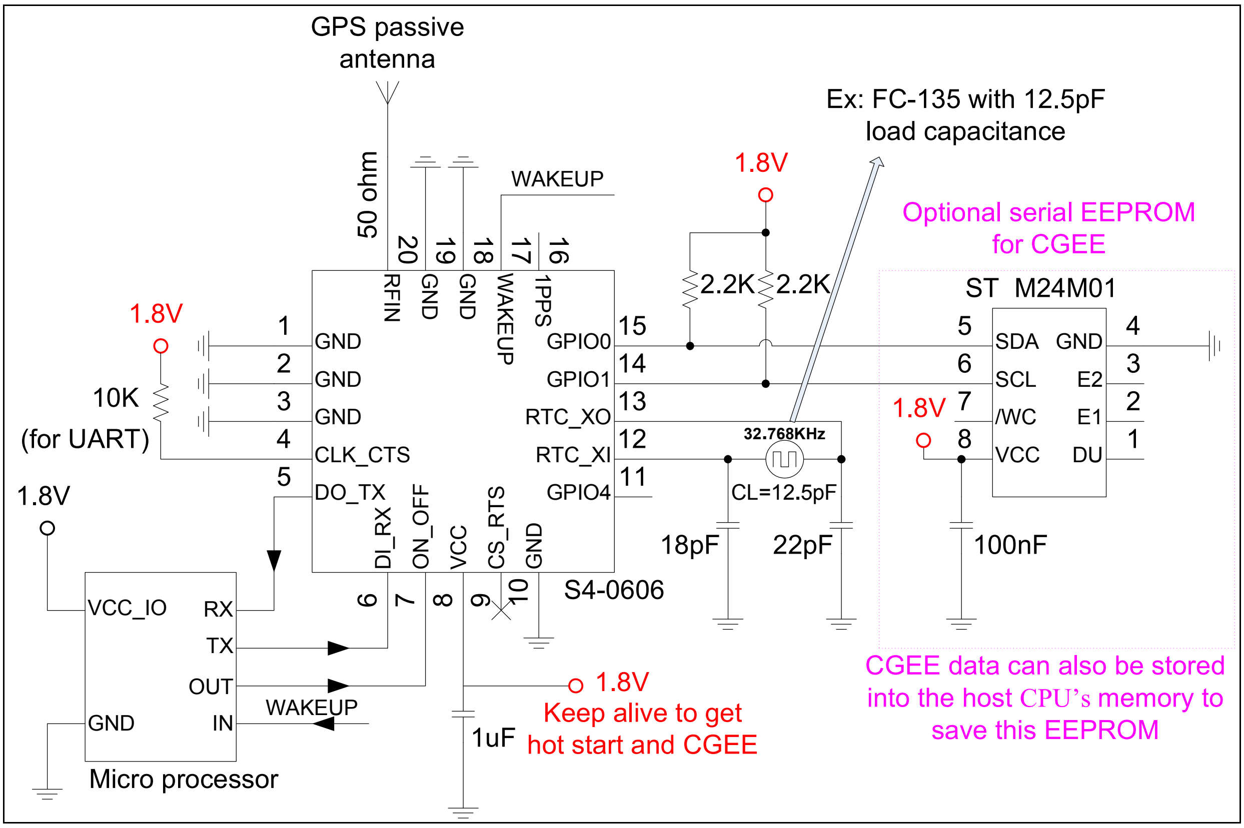

Fig 3-2 Typical application circuit that uses a passive antenna.

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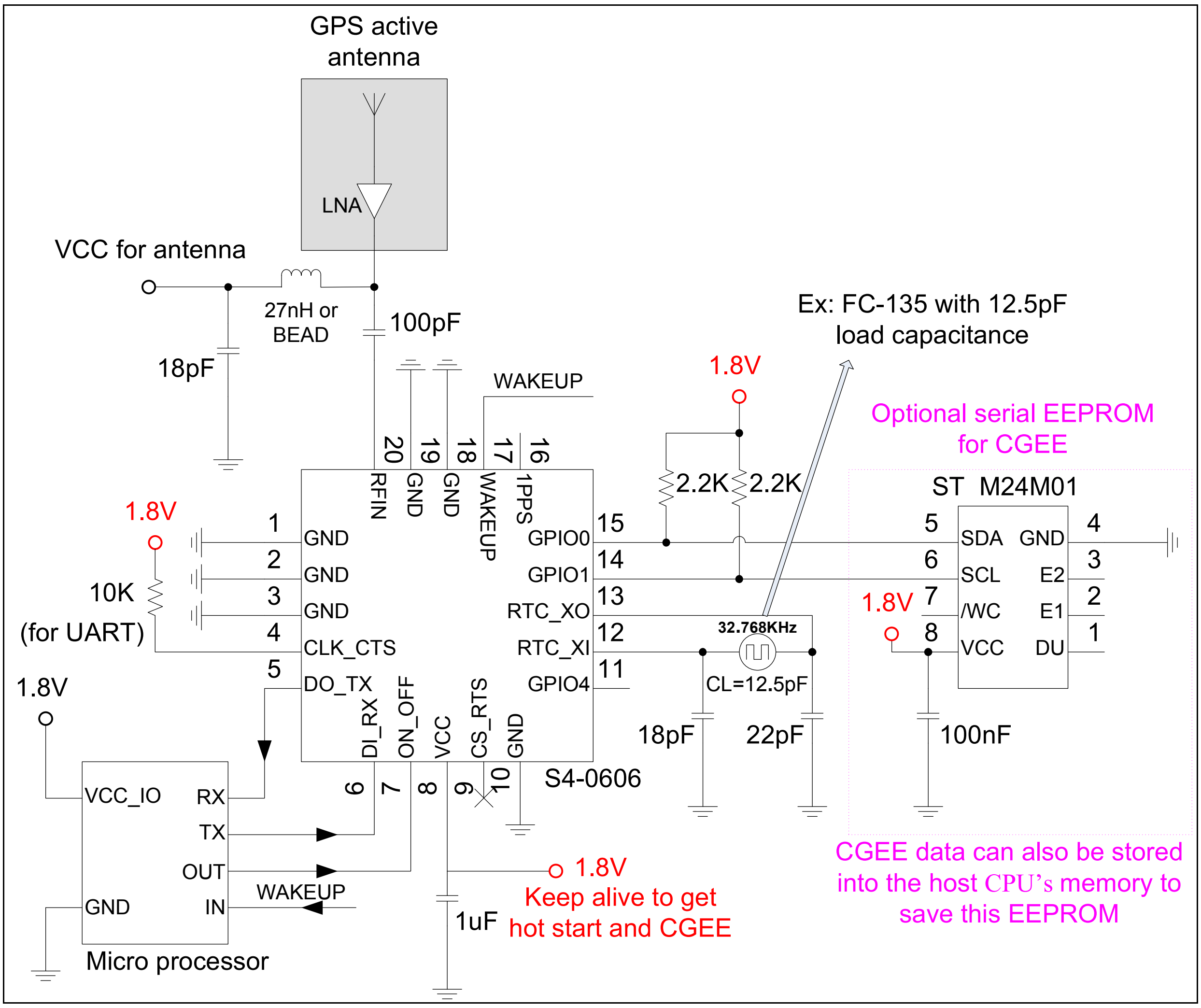

Fig 3-3 Typical application circuit that uses an active antenna

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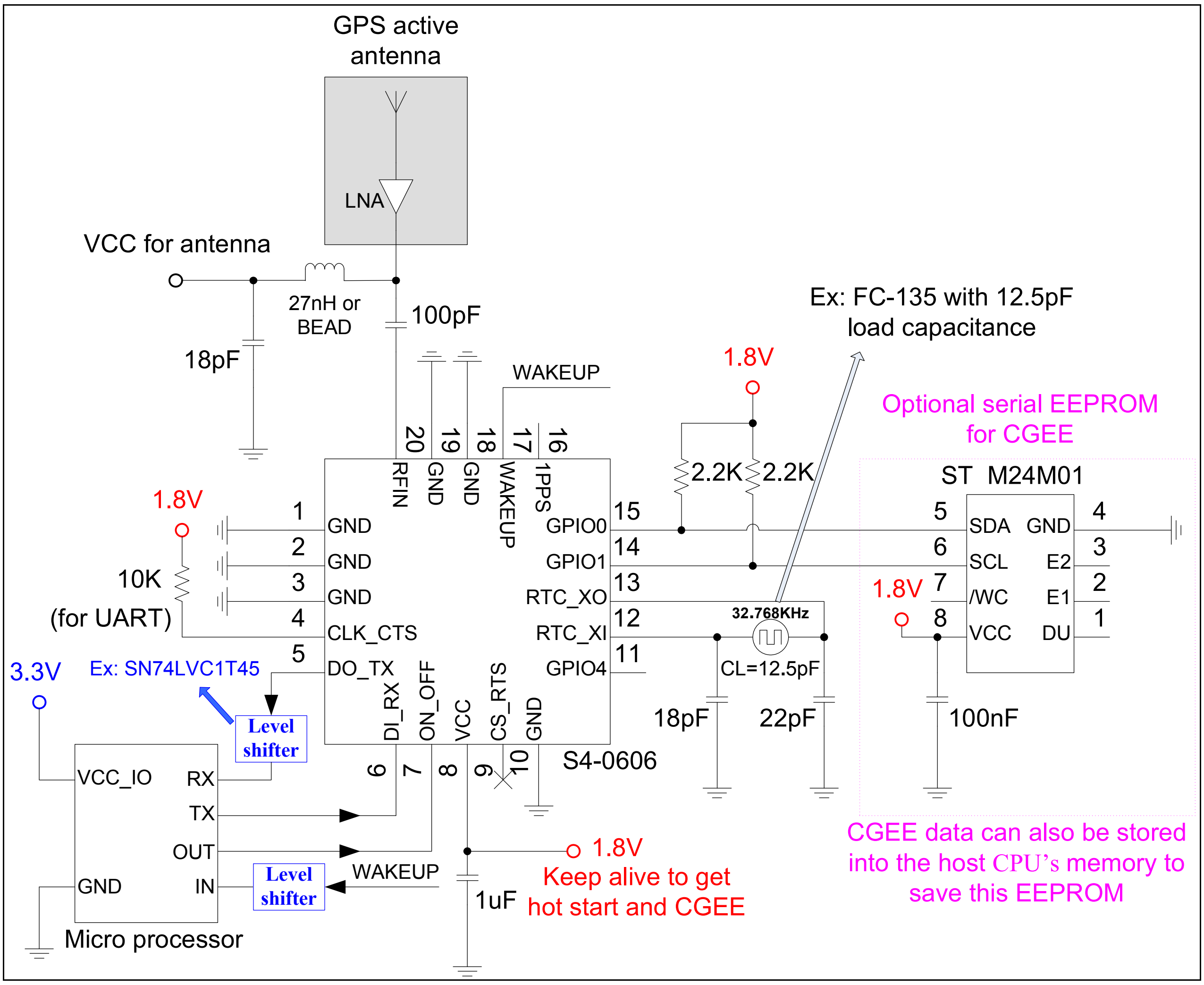

Fig 3-4 Use a level shifter for a micro processor of 3.3V IO voltage to communicate with S4-0606.

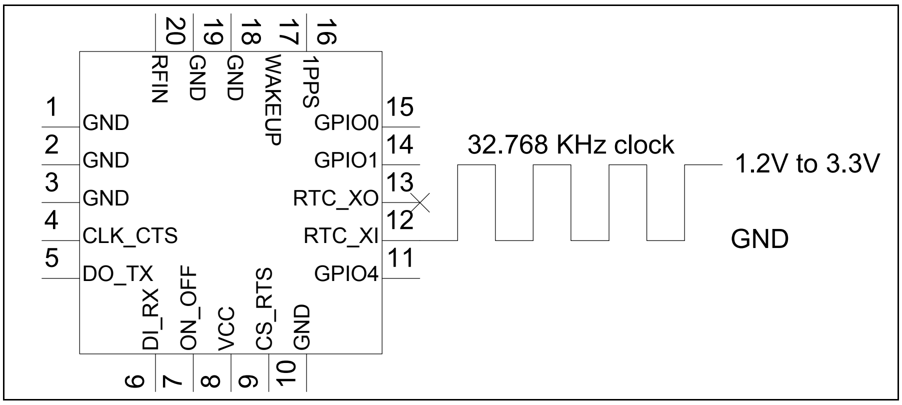

Fig 3-5 Use a clock instead of a crystal for RTC of S4-0606.

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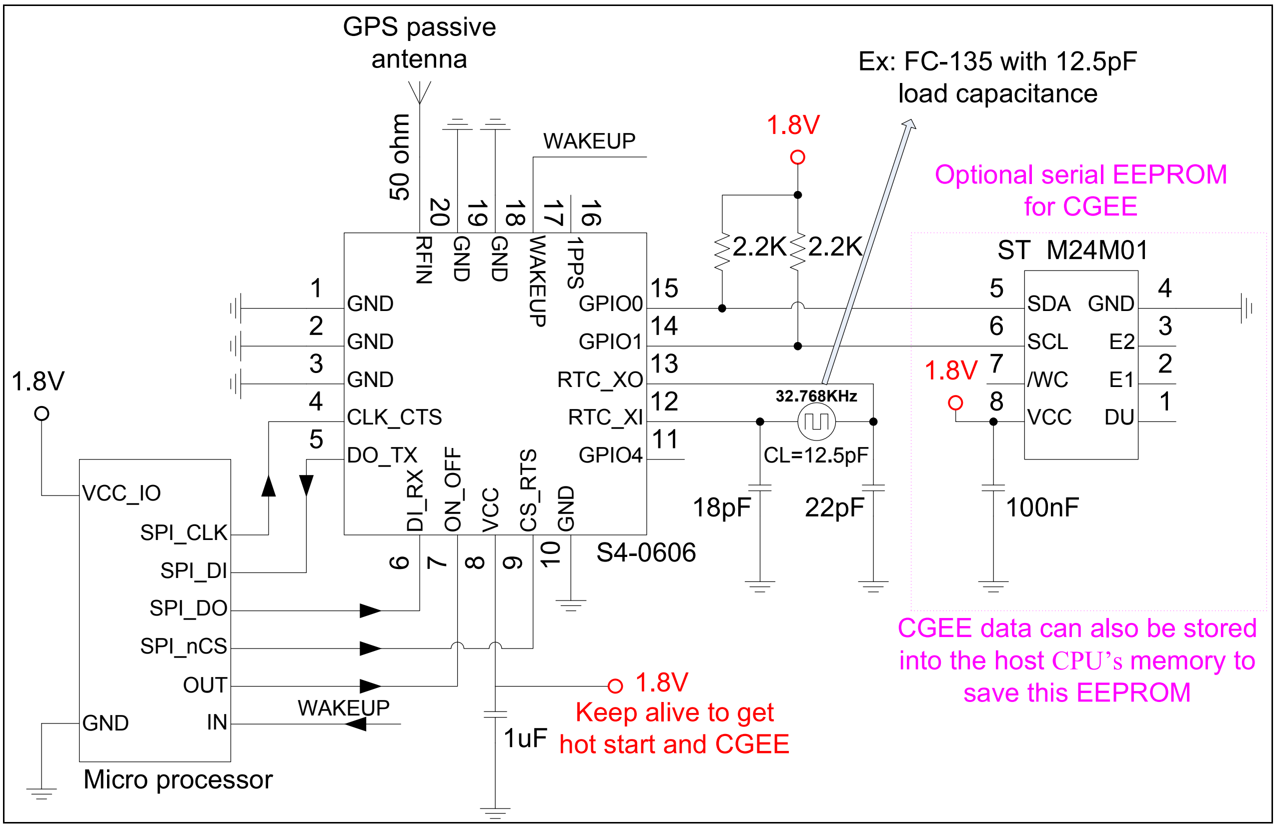

Fig 3-6 Use SPI interface to communicate with S4-0606.

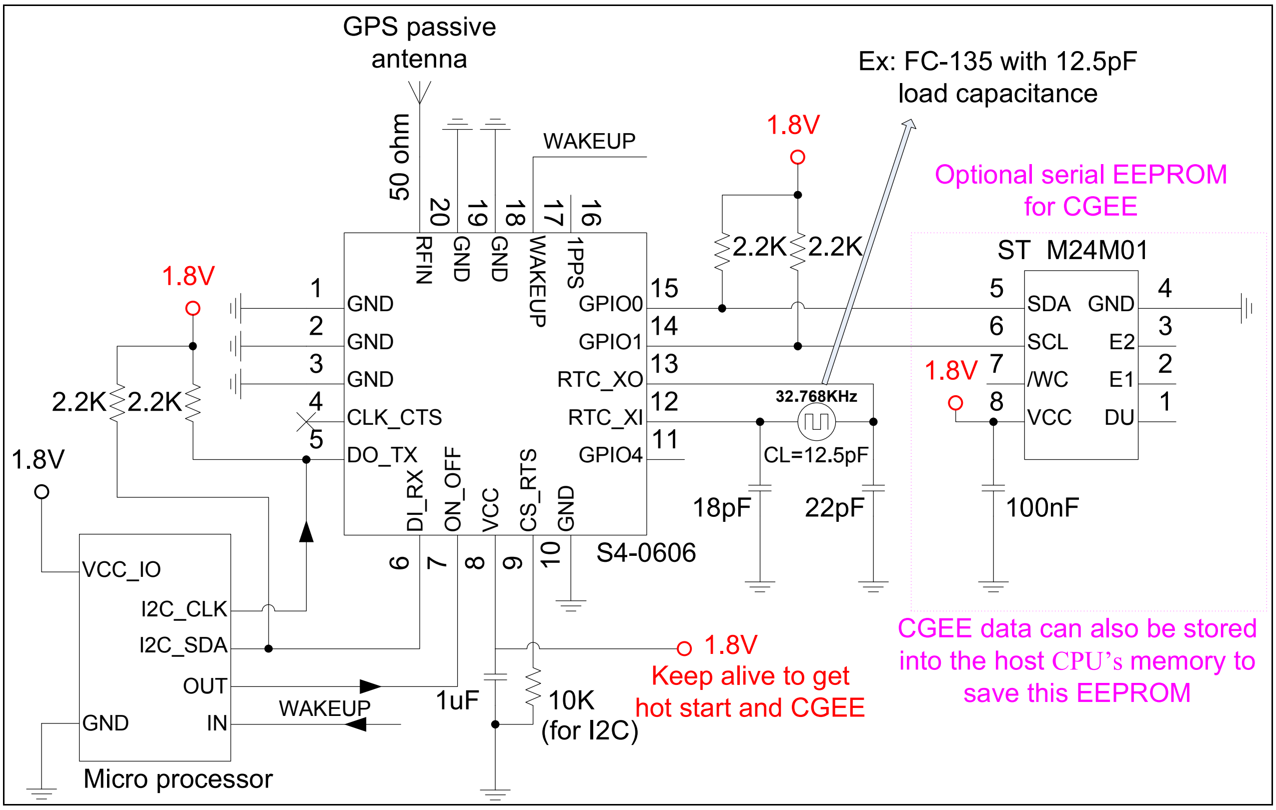

Fig 3-7 Use I2C interface to communicate with S4-0606.

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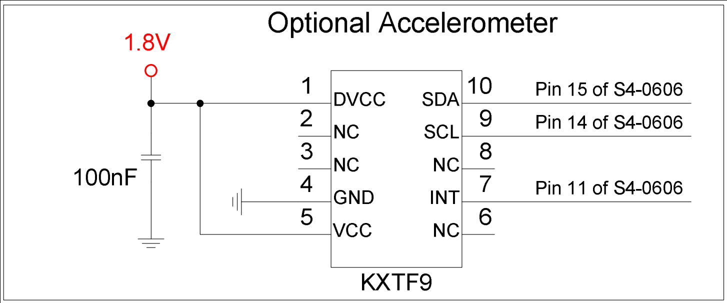
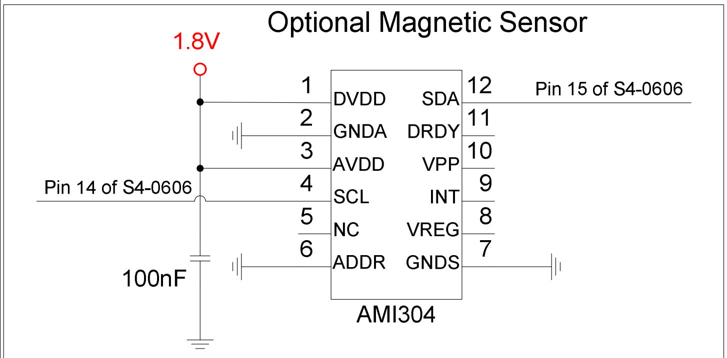
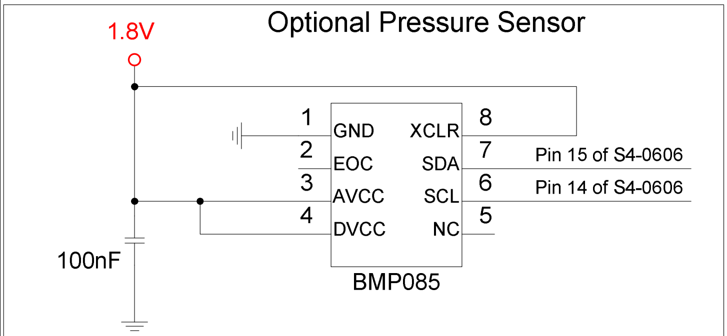
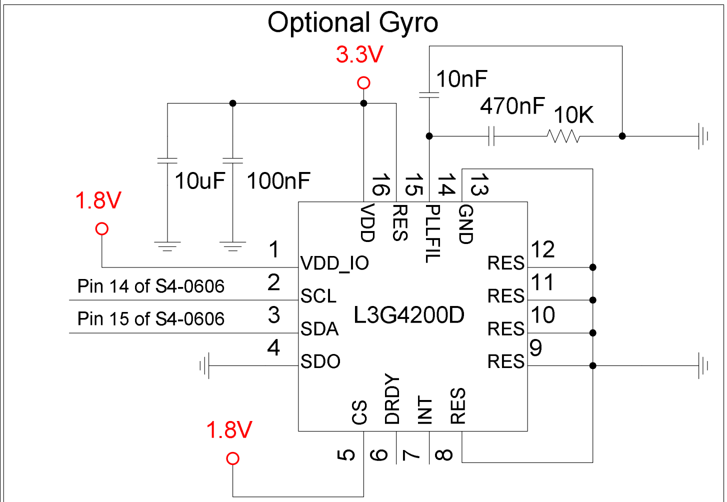




Used in conjunction with Accelerometer for Point and Tell.
Used in conjunction with Accelerometer, Gyro and Pressure Sensor for pedestrian DR.



Used in conjunction with Accelerometer, Magnetic Sensor and Gyro for pedestrian DR.



Used in conjunction with Accelerometer, Magnetic and Pressure Sensor for pedestrian DR.

Fig 3-8 Optional MEMS sensor.

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4 GPS receiver

Chip	SiRF Star IV, GSD4e CSRG39333 (B03) ROM	
Frequency	L1 1575.42MHz, C/A code	
Channels	48	
Update rate	1Hz	
Sensitivity	Tracking	-160dBm, up to -163dBm (with external LNA)
	Navigation	-157dBm, up to -160dBm (with external LNA)
	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)	32s (typical)
		< 15s (typical), CGEE-start
Position Accuracy	Autonomous	3m (2D RMS)
	SBAS	2.5m (depends on accuracy of correction data)
Max. Altitude	< 18,000 m	
Max. Velocity	< 515 m/s	
Protocol Support	NMEA 0183 ver 3.0	4800 bps (1), 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GSA, RMC 0.2Hz: GSV
	OSP Binary	115200 bps, 8 data bits, no parity, 1 stop bits

Note 1: Both baud rate and output message rate are configurable.

5 Software interface

5.1 NMEA output message

Table 5.1-1 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

- **GGA--- Global Positioning System Fixed Data**

Table 5.1-2 contains the values for the following example:

$GPGGA,053740.000,2503.6319,N,12136.0099,E,1,08,1.1,63.8,M,15.2,M,,0000*64

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Table5.1- 2 GGA Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPGGA		GGA protocol header
UTC Time	053740.000		hhmmss.sss
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
Position Fix Indicator	1		See Table 5.1-3
Satellites Used	08		Range 0 to 12
HDOP	1.1		Horizontal Dilution of Precision
MSL Altitude	63.8	meters	
Units	M	meters	
Geoid Separation	15.2	meters	
Units	M	meters	
Age of Diff. Corr.		Second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*64		
<CR> <LF>			End of message termination

Table 5.1-3 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 5.1-4 contains the values for the following example:

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

Table 5.1-4 GLL Data Format

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

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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, E=DR, N = data not valid, R=Coarse Position, S=Simulator
Checksum	*52		
<CR> <LF>			End of message termination

● GSA---GNSS DOP and Active Satellites

Table 5.1-5 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

Table 5.1-5 GSA Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 5.1-6
Mode 2	3		See Table 5.1-7
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 12
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

Table 5.1-6 Mode 1

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

Table 5.1-7 Mode 2

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

● GSV---GNSS Satellites in View

Table 5.1-8 contains the values for the following example:

$GPGSV,3,1,12,28,81,285,42,24,67,302,46,31,54,354,,20,51,077,46*73

$GPGSV,3,2,12,17,41,328,45,07,32,315,45,04,31,250,40,11,25,046,41*75

$GPGSV,3,3,12,08,22,214,38,27,08,190,16,19,05,092,33,23,04,127,*7B

Table 5.1-8 GSV Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPGSV		GSV protocol header
Total number of messages[1]	3		Range 1 to 3
Message number[1]	1		Range 1 to 3
Satellites in view	12		
Satellite ID	28		Channel 1 (Range 01 to 196)
Elevation	81	degrees	Channel 1 (Range 00 to 90)
Azimuth	285	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	42	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
Satellite ID	20		Channel 4 (Range 01 to 196)
Elevation	51	degrees	Channel 4 (Range 00 to 90)
Azimuth	077	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	46	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*73		
<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 5.1-9 contains the values for the following example:

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

Table 5.1-9 RMC Data Format

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	

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

- **VTG---Course Over Ground and Ground Speed**

Table 5.1-10 contains the values for the following example:

$GPVTG,79.65,T,,M,2.69,N,5.0,K,A*38

Table 5.1-10 VTG Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPVTG		VTG protocol header
Course over ground	79.65	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	2.69	knots	Measured speed
Units	N		Knots
Speed over ground	5.0	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	A		A=autonomous, D=DGPS, E=DR, N = data not valid, R=Coarse Position, S=Simulator
Checksum	*38		
<CR> <LF>			End of message termination

5.2 Proprietary NMEA input message

Table 5.2-1 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.

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Table 5.2-2 Proprietary NMEA input messages

Message	MID[1]	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z[2]
SetDGPSPort	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt[3]
Development Data On/Off	105	Development Data messages On/Off
Select Datum	106	Selection of datum to be used for coordinate transformations
Poll SW Version String	125	Query SW and customer-specific version

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, data bits, stop bits, and parity). Generally, this 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 the Evaluation Receiver restarts using the saved parameters.

Table 5.2-3 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

Table 5.2-3 Set Serial Port Data Format

Name	**Example**	**Units**	**Description**
Message ID	$PSRF100		PSRF100 protocol header
Protocol	0		0=SiRF binary, 1=NMEA
Baud	9600		4800,9600,19200,38400,57600,115200
DataBits	8		8,7[1]
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
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---NavigationInitialization

This command is used to initialize the Evaluation Receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the Evaluation Receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the Evaluation Receiver to acquire signals quickly.

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Table 5.2-4 contains the input values for the following example:

Start using known position and time

$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*1C

Table 5.2-4 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 Offset of the Evaluation 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, a default value of 96000 is used.

Table 5.2-5 Reset Configuration

Hex	Description
0x01	Hot Start – All data valid
0x02	Warm Start – Ephemeris cleared
0x03	Warm Start (with Init) – Ephemeris cleared, initialization data loaded
0x04	Cold Start – Clears all data in memory
0x08	Clear Memory – Clears all data in memory and resets the receiver back to factory defaults

- ## 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 5.2-6 contains the input values for the following example:

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

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

Table 5.2-6 Set GPS Port Data Format

Name	**Example**	**Units**	**Description**
Message ID	$PSRF102		PSRF102 protocol header

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Baud	9600		4800,9600,19200,38400
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.

- ### 103---Query/Rate Control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. 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 5.2-7 contains the input values for the following example:

1. Query the GGA message with checksum enabled

   $PSRF103,00,01,00,01*25

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

   $PSRF103,05,00,01,01*20

3. Disable VTG message

   $PSRF103,05,00,00,01*21

Table 5.2-7 Query/Rate Control Data Format (See example 1)

Name	Example	Units	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See Table 5.2-8
Mode	01		0=SetRate, 1=Query
Rate	00	seconds	Output – off=0, max=255
CksumEnable	01		0=Disable Checksum, 1=Enable Checksum
Checksum	*25		
<CR><LF>			End of message termination

Table 5.2-8 Messages

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG

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6	MSS (If internal beacon is supported)
7	Not defined
8	ZDA (if 1PPS output is supported)
9	Not defined

- **104---LLANavigationInitialization**

This command is used to initialize the Evaluation Receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

Table 5.2-9 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

Table 5.2-9 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)
Lon	-121.97232	degrees	Longitude position (Range 180 to –180)
Alt	0	meters	Altitude position
ClkOffset	96000	Hz	Clock Offset of the Evaluation 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 96000 is used.

Table 5.2-10 Messages

Hex	**Description**
0x01	Hot Start – All data valid
0x02	Warm Start – Ephemeris cleared
0x03	Warm Start (with Init) – Ephemeris cleared, initialization data loaded
0x04	Cold Start – Clears all data in memory
0x08	Clear Memory – Clears all data in memory and resets receiver back to factory defaults

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105---Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables you to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

Table 5.2-11 contains the input values for the following example:

1. Debug On

   $PSRF105,1*3E

2. Debug Off

   $PSRF105,0*3F

Table 5.2-11 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

$PSGPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. The default datum is WGS 84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. (Local map datums are a best fit to the local shape of the earth and not valid worldwide.)

Table 5.2-12 contains the input values for the following example:

Datum select TOKYO_MEAN

$PSRF106,178*32

Table 5.2-12 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

117---System Turn Off

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

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Table 5.2-13 contains the values for the following example:

$PSRF117,16*0B

Table 5.2-13 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

- ## 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 will generate two PSRF195, one with the SW Version String, and the second one with the customer-specific version string.

Table 5.2-14 contains the values for the following example:

$PSRF125*21

Table 5.2-14 Poll SW Version String

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

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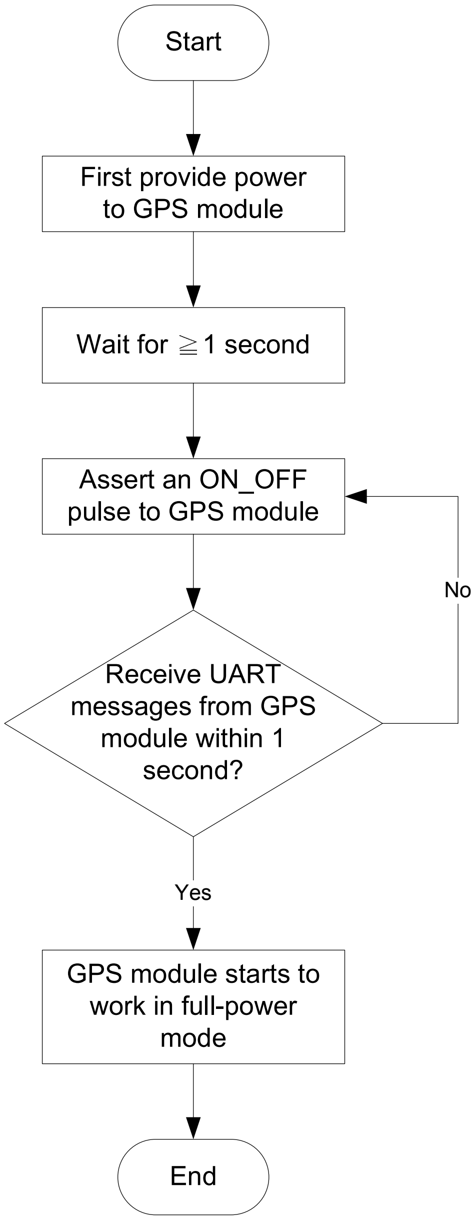
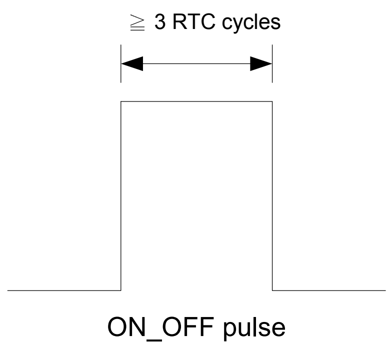
5.3 Supply voltage control and sequencing

5.3.1 Initial power up

When power is first applied, the module goes into a low-power mode while RTC starts. The host is not required to control /RESET pin (pin 8 of GPS module) since the module's internal reset circuitry handles detection of application of power. After that, the module is in "ready-to-start" state and awaits an ON_OFF input pulse to start.

Since RTC startup time is variable, detection of when the module is ready to accept an ON_OFF pulse requires the host to either wait for a fixed interval or to monitor a pulse on WAKEUP output (pin 9 of GPS module) to assert a pulse on the ON_OFF input. An example flow chart is shown below.





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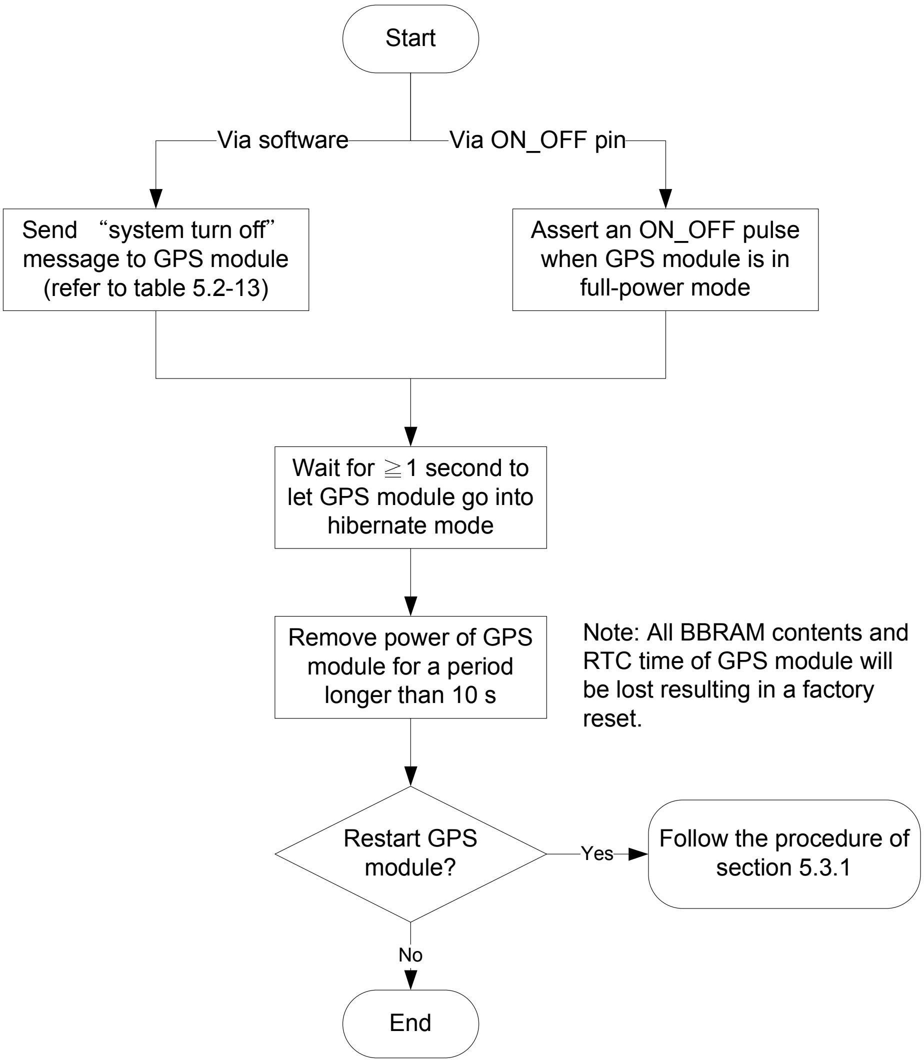
5.3.2 Procedure for removing power of GPS module

Abrupt, uncontrolled removal of power while GPS module is operating carries the risk of data corruption. The consequences of corruption range from longer TimeToFirstFix to complete system failure. The appropriate procedure to remove power is shown as below.



6 Communication interface

6.1 UART

The GPS module has a 4-wire UART port. The hardware flow control, CTS and RTS, is default disabled. The default baud rate is 4800bps, 8-N-1.

6.2 SPI

The SPI interface of the GPS module is slave mode SPI. The transmitter and receiver each have independent 1024-byte FIFO buffers and individual software-defined 2-byte idle patterns of 0xA7 0xB4. The maximum clock is 6.8MHz.

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6.3 I2C

The I2C interface of the GPS module has default address 0x60 for receiving and 0x62 for transmitting. The operation speed is up to 400kbps with individual transmit and receive FIFO of 64 bytes. The I2C bus is a multi-master bus which means any number of master nodes can be present. Additionally, master and slave roles may be changed between messages (after a STOP is sent). For example, when GPS module detects the bus is idle, it seizes the I2C bus and starts to transmit data by sending a start bit followed by the 7-bit address, i.e. 0x62. When another master seizes bus and transmits GPS module's receiving address, i.e. 0x60, GPS module operates as a slave.

7 Pin assignment and descriptions

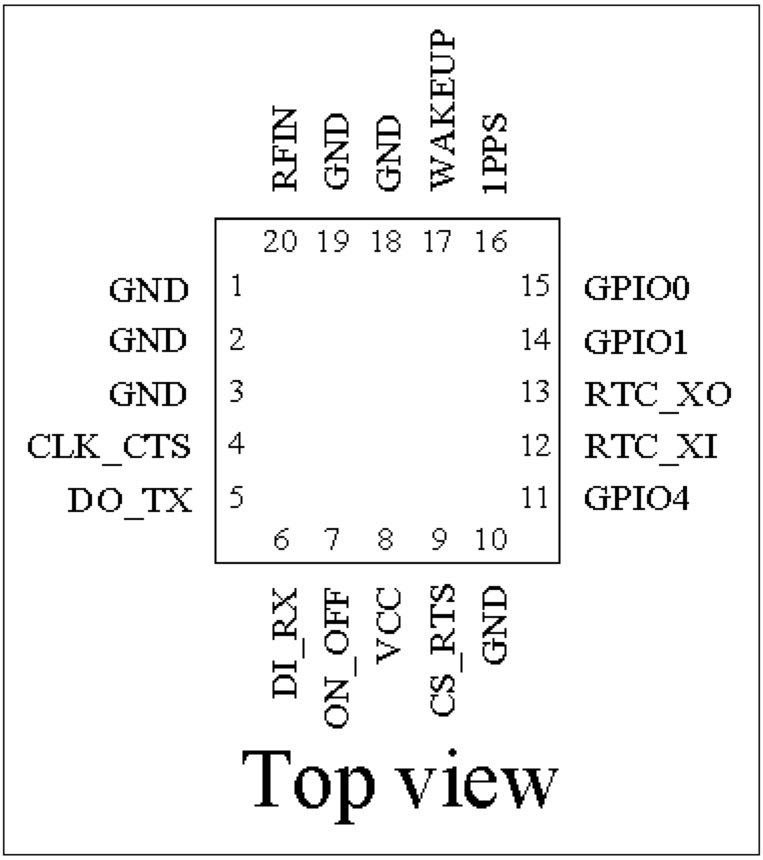

Table 7-1 Pin descriptions

Pin #	Name	Type	Description	Note
1	GND	P	Ground	
2	GND	P	Ground	
3	GND	P	Ground	
4	CLK_CTS	I/O	CTS: clear to send, active low SPI_CLK: slave SPI clock input	1,2
5	DO_TX	I/O	TX: UART data transmit SPI_DO: Slave SPI data output	1

			I2C_CLK: I2C bus clock	
6	DI_RX	I/O	RX: UART data receive SPI_DI: Slave SPI data input I2C_SDA: I2C bus data	1
7	ON_OFF	I	Power control pin.	1,3
8	VCC	P	DC supply voltage	4
9	CS_RTS	I/O	RTS: UART ready to send, active low SPI_CS: slave SPI chip select, active low	1,2
10	GND	P	Ground	
11	GPIO4	I/O	General purpose I/O or external interrupt input	1
12	RTC_XI	I	RTC crystal or CMOS RTC clock input	5
13	RTC_XO		RTC crystal or open if no crystal	
14	GPIO1	I/O	General purpose I/O Please connect a 2.2KΩ pull-up resistor to VCC	1
15	GPIO0	I/O	General purpose I/O Please connect a 2.2KΩ pull-up resistor to VCC	1
16	1PPS	O	Pulse per second (200ms pulse/sec)	
17	WAKEUP	O	Wake up output. A high on this output indicates that GPS module is in operational mode. A low on this output indicates that GPS module is in low power state (standby, hibernate and ready-to-start). User can also use this pin to control external power supply or LNA.	
18	GND	P	Ground	
19	GND	P	Ground	
20	RFIN	I	GPS RF signal input	

<Note>

1. Input voltage is 3.6V tolerant.
2. CLK_CTS and CS_RTS are used to select communication interface at system reset.

Interface	CLK_CTS	CS_RTS
UART	External pull-up 10K ohm resistor	Not connect
SPI	Not connect	Not connect
I2C	Not connect	External pull-down 10K ohm resistor

3. Input pulse to start the module, and 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 three cycles of the RTC clock.

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- If the module is first powered, i.e. in "ready-to-start" state, an ON_OFF pulse will start the module.
- If the module is in hibernate state, an ON_OFF pulse will move it to full-power mode.
- If the module is in Micro Power mode, an ON_OFF pulse will move it to full-power mode.
- If the module is in AdvancedPower mode, an ON_OFF pulse will initiate one AdvancedPower cycle.
- If the module is in TricklePower mode, an ON_OFF pulse will initiate one TricklePower cycle.
- If the module is in Push-To-Fix mode, an ON_OFF pulse will initiate one Push-To-Fix cycle.
- If the module is already in full-power mode, an ON_OFF pulse will initiate orderly shutdown.

4. The input voltage to the GPS module must be additionally filtered and decoupled. The allowable ripple is 54mV below 3MHz frequency and 15mV above 3MHz frequency.
5. Please refer to Fig 3-5 for using RTC clock. The logic high level of RTC clock can be from 1.2V to 3.3V. RTC clock must be continuously running in order for the GPS module to start-up and to perform power-cycling correctly.

8 Ordering information

Model	GPS chip	SBAS	QZSS	Micro Power Mode	Remark
S4-0606-3	9333B03	Yes	Yes	Yes	

9 DC & Temperature characteristics

9.1 Absolute maximum ratings

Parameter	Symbol	Ratings	Units
DC Supply Voltage	VCC	1.95	V
I/O Pin Voltage	VIO	3.6	V
Operating Temperature Range	Topr	-40 ~ 85	℃
Storage Temperature Range	Tstg	-40 ~ 85	℃

9.2 DC Electrical characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
DC Supply Voltage	VCC		1.71	1.8	1.89	V
Supply Current	Iss	VIN = 1.8V				
		Peak			80	mA
		Acquisition		53		mA
		Tracking		30		mA
		Standby(1)		67		uA
		Hibernate		14		uA
		Ready-to-start(2)		8		uA
		MPM(3)		300		uA
High Level Input Voltage	V_{IH}		0.7*VCC		3.6	V
Low Level Input Voltage	V_{IL}		-0.4		0.45	V

High Level Output Voltage	V_{OH}		0.75*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
Input Capacitance	C_{IN}			5		pF
Load Capacitance	C_{LOAD}				8	pF

<Note>

1. Transitional state when GPS module is in TricklePower mode.
2. When power is first applied, the module goes into a “ready-to-start” state. Please refer to the section 5.3.
3. MicroPowerMode. MPM average current reduces by approximately 50% when there is valid ephemeris.

9.3 Temperature characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	Topr	-40	-	85	℃
Storage Temperature	Tstg	-40	25	85	℃

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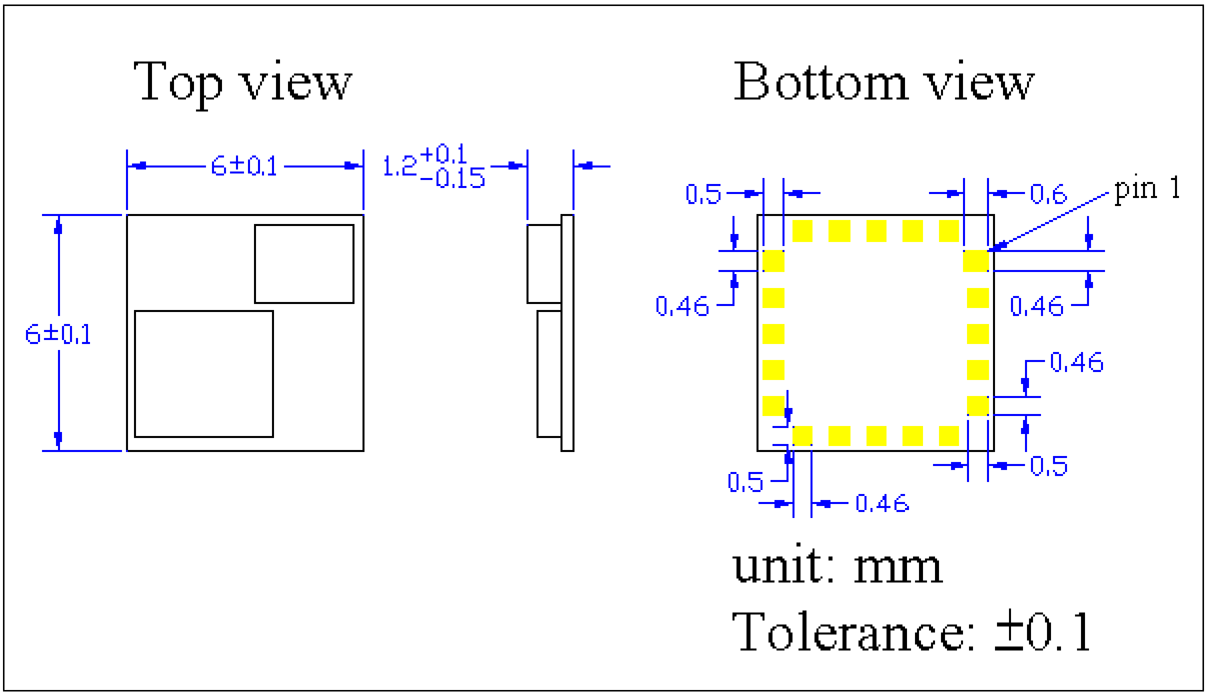
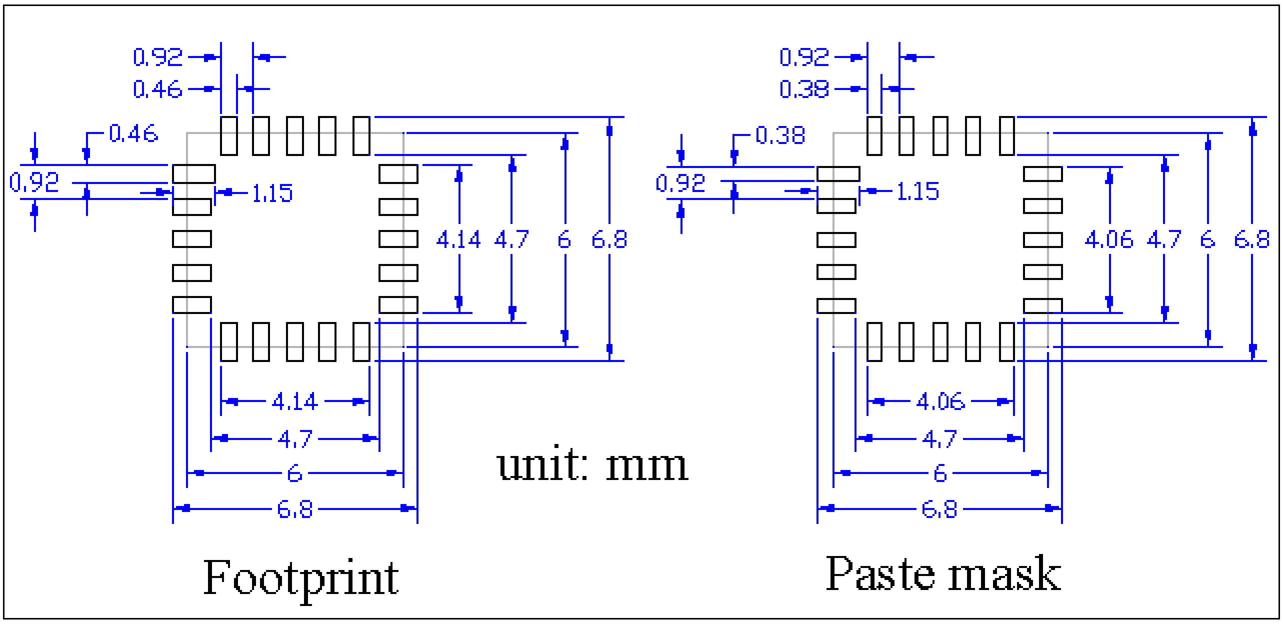
10 Mechanical specification

10.1 Outline dimensions



10.2 Recommended land pattern dimensions



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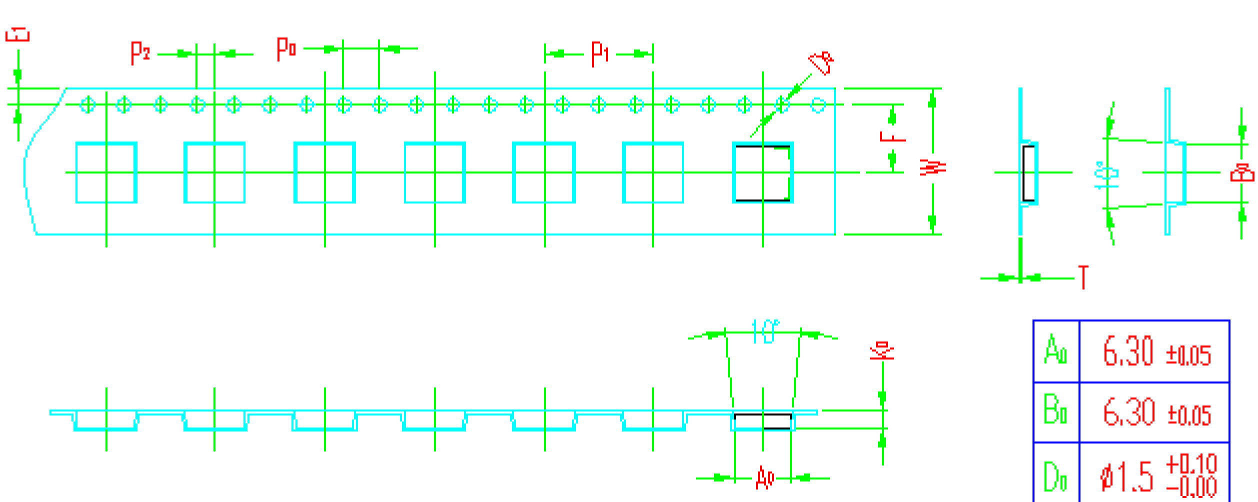
11 Reel Packing information



1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Camber not to exceed 1mm in 250 mm
3. A0 and B0 measured on a plane 0.30 mm above the bottom of the pocket
4. K0 measured from a plane on the inside bottom of the pocket to the top surface of the carrier .
5. pocket position relative to sprocket hole measured as true position of pocket,not pocket hole.
6. Component load per 13"reel: 3000 pcs
7. All dimensions meet EIA−481−D requirements.

A_0	6.30 ±0.05
B_0	6.30 ±0.05
D_0	ϕ1.5 $^{+0.10}_{-0.00}$
E_1	1.75 ±0.10
F	7.50 ±0.10
K_0	1.80 ±0.05
P_0	4.00 ±0.10
P_1	12.00 ±0.10
P_2	2.00 ±0.10
T	0.30 ±0.05
W	16.00 ±0.30

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Document change list

Revision 1.0

- First release on June 1, 2011.

Revision 1.0 to Revision 1.1 (June 11, 2012)

- Changed GPS chip to 9333 on page 4
- Added "Support Japan QZSS" in the section 2
- Changed the range of satellite ID in GSV message from 32 to 196 on page 9.
- Added "N = data not valid, R=Coarse Position, S=Simulator" in GLL, RMC and VTG message.
- Added new model S4-0606-2 of 9333 chip in the section 8
- Changed the tracking current from 35mA to 30mA in the section 9.2
- Changed the MPM current from 500uA to 300uA in the section 9.2
- Changed the minimum operation temperature from -30℃ to -40℃ in the section 9.3

Revision 1.2 (July 22, 2016)

- Upgraded GPS chip to 9333B03 on page 7
- Added proprietary NMEA input message 125 for querying SW Version on page 17
- Remove previous model and added the upgraded model S4-0606-3 of 9333B03 chip in the section 8