

ISM300F2 GPS Module

Functional Specification



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Contents

Overview.....	1
Architecture.....	2
Mechanical	3
Electrical	4
Power	6
Conserving Power	6
Controlling the GPS Engine	6
Antenna.....	7
Input/Output.....	8
Environmental	9
Performance	10
Firmware.....	11
References.....	12
Ordering Information	13
Figure 1 Block Diagram.....	2
Figure 2 Dimensions and PCB Footprint (Millimeters)	3
Figure 3 Typical Application.....	4
Figure 4 Pin 4 Suggested ON_OFF Timing	7
Table 1 Dimensions	3
Table 2 DC Characteristics	5
Table 3 Power Requirements	6
Table 4 On-Board Antenna Connector	7
Table 5 Serial Interface.....	8
Table 6 Environmental Parameters.....	9
Table 7 Performance Parameters.....	10
Table 8 Part Nos. by Firmware Release.....	11

Overview

Inventek's ISM300F2 comprises a 20-channel global positioning system (GPS) receiver in a compact surface-mountable module. Based on the fast and deep search capabilities of SiRFstarIII™, it features high sensitivity and high gain. Using the ultra low power GSC3f/LPx single chip GPS engine, the ISM300F2 uses ~30% less power than the ISM300F1.

The ISM300F2 lets you integrate GPS functionality into your product quickly and easily. It's suitable for a wide range of applications, including the most compact:

- Hand-held personal positioning and navigation
- PDAs, Pocket PCs and other hand-held computers
- Fleet management
- Asset tracking
- Automatic vehicle location

The ISM300F2's world class performance suits it to navigating urban canyons, as well as wide-open spaces. TTFF (time-to-first-fix) under open sky is just 35 s from a cold start, 1 s from a hot start. Reacquisition time is 1 s.

The ISM300F2 facilitates ease of design and manufacturing. Its surface mount technology (SMT) allows for fully automatic assembly and reflow soldering. Being ~1.9 mm thinner, the ISM300F2 fits into places where even the ISM300F1 can't go. It receives all of its data, power and RF signals through its surface mount pads. Being lead-free, it complies with the European Union's RoHS (Restriction of Hazardous Substances) directive. Its EMI/EMC shield not only lets it meet FCC/CE standards, but also assures peak performance in noisy environments.

The ISM300F2 provides two UARTs (universal asynchronous receiver/transmitters) for quick-and-easy I/O. It supports NMEA-0183 on UART B (at 4800 Bd) and SiRF binary on UART A (at 57600 Bd).

Architecture

Figure 1 depicts the functional sections of the ISM300F2.

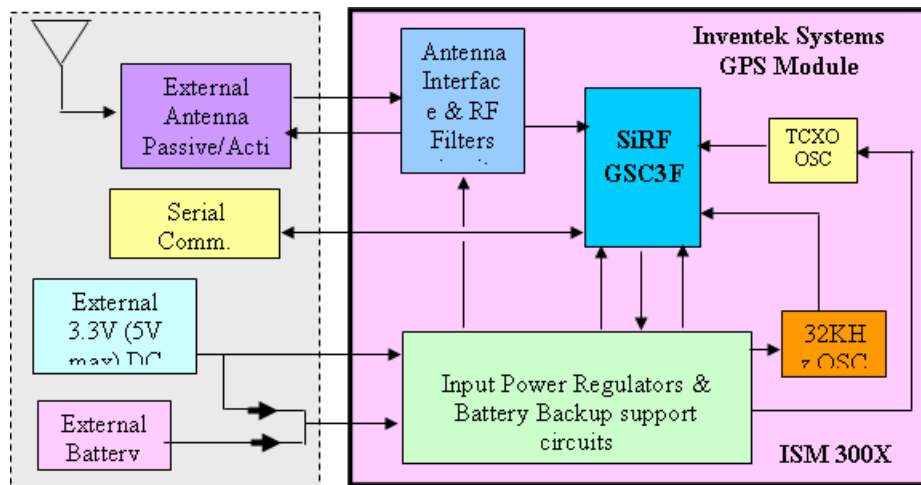


Figure 1 Block Diagram

SiRF GSC3F	SiRF GSC3f/LPx single chip GPS engine.
Power regulators	Power conditioning circuits.
Backup support	Circuits to support external power source to maintain the RTC (real-time clock), ephemeris, almanac and time data (in SRAM) when power to the GSC3f/LPx is turned off.
TCXO	Temperature compensated crystal oscillator.
Antenna interface	Antenna (RF) input.
External antenna	Inventek Systems offers several antennas that are immediately compatible with the ISM300F2's on-board U.FL connector.
Serial communications	Support for transmit and receive on two ports, each implemented by a UART (universal asynchronous receiver/transmitter). Default protocols include SiRF binary on port A and NMEA-0183 on port B.
External 3.3 V/battery	Power sources to maintain the RTC, ephemeris, almanac and time data when power to the GSC3f/LPx is turned off.

Mechanical

Table 1 summarizes the dimensions of the ISM300F2.

Parameter	Value
Length	18.0±0.1 mm
Width	18.0±0.1 mm
Height	3.1±0.05 mm
Weight	3.5 g

Table 1 Dimensions

Figure 2 gives the dimensions and PCB footprint of the ISM300F2 in millimeters.

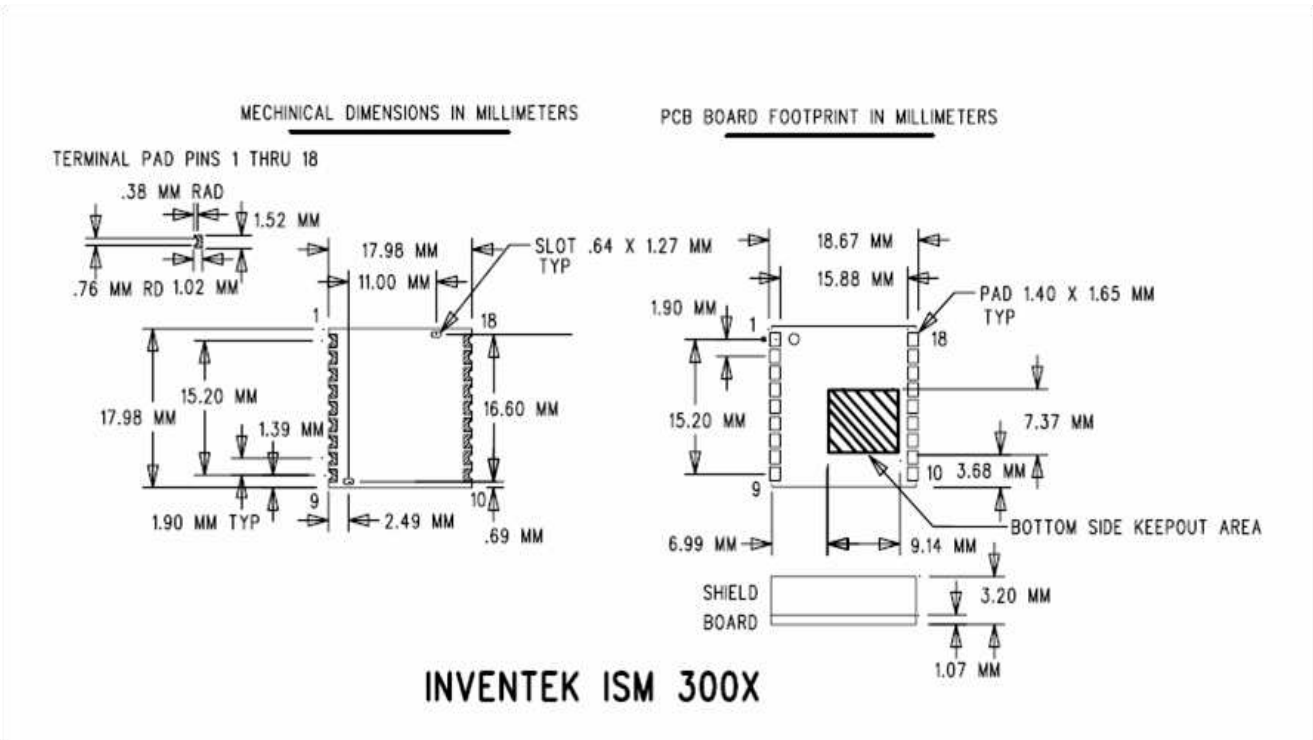


Figure 2 Dimensions and PCB Footprint (Millimeters)

Electrical

Power, antenna and input/output constitute your primary considerations when integrating the ISM300F2 into your product. Figure 3 depicts a typical application. The pins related to these functions are 2, 4 and 18 (power), 1 (antenna) and 5, 7, 12 and 14 (I/O). Subsequent sections address these topics in detail.

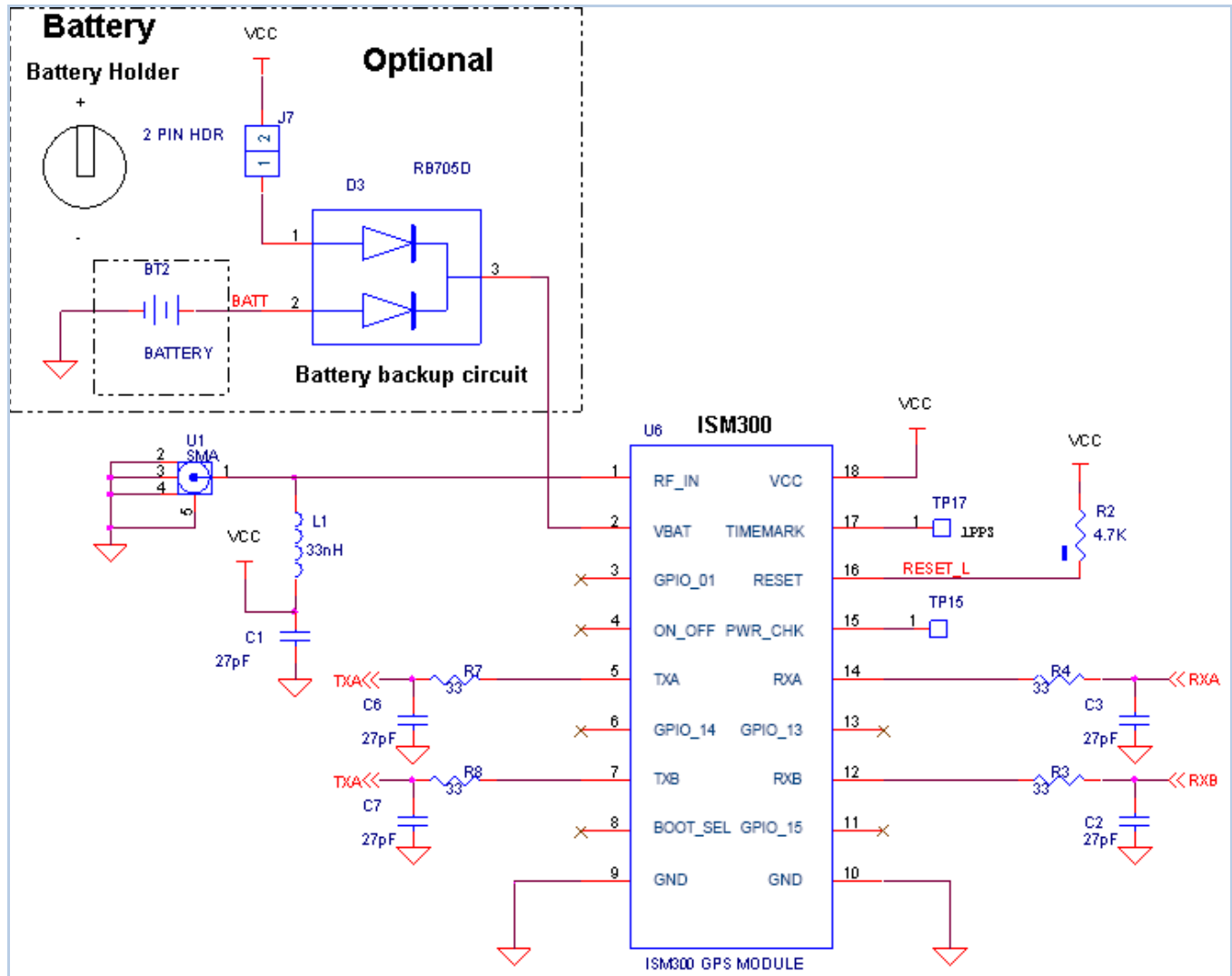


Figure 3 Typical Application

1. **RF_IN** – Antenna input. You must supply VCC to this pin. If using VCC to power an active antenna, make sure your circuit includes a coil or fuse to protect the ISM300F2 from a short circuit at the antenna or its cable.
2. **VBAT** – Backup power. Maintains the RTC and SRAM when power to the GPS engine is turned off, enabling a hot start when power to the GPS engine is restored. See “Conserving Power” and “Controlling the GPS Engine” for details. You must hold pin 2 above 1.65 V in order for the ISM300F2 to function.
3. **GPIO_01** – CTS (not used).
4. **ON_OFF** – Toggles power to the GPS engine (available only with firmware releases C3 and later). This is an LVCMOS-level input of 3.3 V.

5. **TXA** – Transmit (UART A). This is an LVCMOS-level output with maximum logical high of 2.85 V. This is the SiRF binary output port.
6. **GPIO_14** – CTS (not used).
7. **TXB** – Transmit (UART B). This is an LVCMOS-level output with maximum logical high of 2.85 V. This is the NMEA-0183 output port.
8. **BOOT_SEL** – When High, allows the SiRF GSC3F device internal FLASH to be programmed using the SiRFlash Software. High = Internal ROM (re-flash) Low = Normal operation (or an external flash)
9. **GND** – Ground.
10. **GND** – Ground.
11. **GPIO_15** – RTS (not used).
12. **RXB** – Receive (UART B). This is an LVCMOS-level input with maximum logical high of 3.3 V. This is the NMEA-0183 input port.
13. **GPIO_13** – RTS (not used).
14. **RXA** – Receive (UART A). This is an LVCMOS-level input with maximum logical high of 3.3 V. This is the SiRF binary input port.
15. **PWR_CHK** – Power check. This is an LVCMOS-level output with maximum logical high of 2.85 V. When >2.4 V, signifies the presents of power to the GPS engine. Use this signal to check the state of the ISM300F2 as toggled by pin 4 (ON_OFF).
16. **RESET** – Reset. This signal is active LOW. This signal is optional. IF NOT USED, PIN 16 MUST BE PULLED HIGH!
17. **TIMEMARK** – 1 PPS output .This is an LVCMOS-level output with maximum logical high of 2.85 V. Approximate width is 1 μ s.
18. **VCC** – Power in, 3–5 V dc.

Table 2 summarizes the ISM300F2’s DC characteristics.

Parameter	Min.	Max.
Input High Level	2.0 V	
Input Low Level		0.8 V
Output High Level	2.4 V	
Output Low Level		0.4 V
Input Leakage Current	2 μ A	2 μ A
Input Capacitance		5 pF
Output capacitance		5 pF

Table 2 DC Characteristics

Power

Table 3 summarizes the ISM300F2's power requirements.

Parameter	Value
Input voltage (VCC)	3.0–5.0 V dc
Current (acquisition)	29 mA (avg.)
Current (tracking)	25 mA (avg.)
VBAT voltage	1.6–5.0 V dc
VBAT current (GPS engine turned off)	10 μ A

Table 3 Power Requirements

The ISM300F2 receives power on pin 18. Optionally, you can use pin 2 to supply power to the RTC and SRAM when power to the GPS engine is turned off, enabling a hot start when you turn the engine back on.

Conserving Power

You can reduce your power consumption drastically by turning on the GPS engine only when needed to acquire a fix. The ISM300F2 has features that let you do this with negligible impact on performance.

Use pin 2 to maintain the RTC and SRAM when power to the GPS engine is turned off. In this state, the ISM300F2 draws less than 10 μ A. This makes it very economical to power down the GPS engine and yet have fully functional hot starts.

A hot start will be fully functional up to 2 hours from the last fix. It uses ephemeris, almanac, position, time and RTC data stored in the SRAM. If the last fix was less than 2 hours after powering down the engine, the TTFF will be one second or less when the GPS engine is turned back on in an open sky environment. An application requiring location information every minute will save 98% on power by turning off the GPS engine between acquisitions at an update rate of 1 Hz.

Controlling the GPS Engine

There are three ways to turn off power to the GPS engine: turn off VCC, toggle pin 4 or send a command in SiRF binary to port A. Figure 3 shows a backup circuit that accommodates all three methods.

Turning off VCC requires an external power source (not VCC) to maintain the RTC and SRAM. Figure 3 shows a battery, but you could also use a super capacitor.

Embedded applications using NMEA-0183 or SiRF binary can keep VCC on and turn off power to the GPS engine by toggling pin 4 (ON_OFF). In this case, no external backup circuit is required.

To toggle pin 4, your application must hold it high for at least 0.1 s. It must wait at least 1 s before toggling it again. See Figure 4. Be sure to mitigate contact bounce if mechanical switches are used.

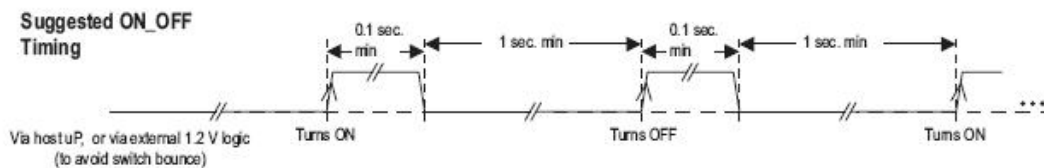


Figure 4 Pin 4 Suggested ON_OFF Timing

Non-embedded applications can turn off the GPS engine by sending a command in SiRF binary using port A. See “Software Commanded Off – Message ID 205 (Sub ID 16)” on p. 2-37 of the *SiRF Binary Protocol Reference Manual* (Revision 2.2).

Use pin 15 (PWR_CHK) to check the state of the GPS engine as toggled by pin 4. See Figure 3.

Use pin 17 (TIMEMARK) to determine when the GPS engine has a navigation solution. Pin 17 pulses once a second with a width of 1 μ s following an over-solved navigation solution (involving five satellites or more). Pin 17 continues to pulse until the GPS engine is reset or turned off, even if the engine can’t compute solutions on subsequent cycles. Pin 17 stays low after the GPS engine is turned back on, until the next over-solved navigation solution.

Antenna

The ISM300F2 is designed for use with an active antenna. Active antennas have an integrated LNA (low-noise amplifier) and SAW (surface acoustic wave) filter.

The ISM300F2 contains an on-board U.FL series antenna connector. See Table 4 for details.

Item	Description
Connector	U.FL series
Manufacturer	I-PEX Co., Ltd.
Part No.	20279-001E-01
Height	1.25 mm
Width	2 mm
Frequency	1575.42 \pm 1.023 MHz
DC	3.0–5.0 V

Table 4 On-Board Antenna Connector

Inventek Systems offers several antennas that are immediately compatible with the on-board connector. If you choose to use your own external RF connector, refer to Figure 3 for the pin 1 (RF_IN) circuitry. Follow these guidelines:

- Use a standard 50 ohm SMA or similar connector.
- Make RF_IN on your PCB a 50 ohm transmission line (microstrip). This matches the impedance of the connector pin for minimal transmission loss.
- Keep switching circuits as far away from RF_IN as possible.
- Protect the ISM300F2 from a short circuit with a coil (or fuse) between it and the antenna power source.

Whether using the on-board connector or your own, you must supply VCC to pin 1 (and protected with a coil or fuse, as mentioned above). Make sure the module is powered down while attaching or detaching your antenna. Choose an active antenna with at least 26 dB gain and 1.2 dB NF.

Input/Output

The ISM300F2 features two serial ports, each supporting one of two popular protocols. See Table 5.

TX Pin	RX Pin	UART	Protocol	Description
5	14	A	SIRF Binary	See <i>SiRF Binary Protocol Reference Manual</i>
7	12	B	NMEA-0183	GGA, GSA, GSV, GLL, RMC, VTG

Table 5 Serial Interface

Each port is implemented with a UART (universal asynchronous receiver/transmitter). The signal level on the related pins (14, 5, 12 and 7) is 3.3 V.

See Figure 3 for how to configure RXA, TXA, RXB and TXB. TXA and TXB can be tied directly to your microcontroller without the RC circuit. Eliminating the RC circuit, however, may affect performance in worst case reception areas by increasing EMI.

Environmental

The ISM300F2 complies with the European Union's RoHS (Restriction of Hazardous Substances) directive (is lead free) and meets FCC/CE standards for EMI/EMC. Table 6 provides other environmental parameters of interest.

Parameter	Value
Operating temp.	-40 deg. C to +85 deg. C
Storage temp.	-55 deg. C to +100 deg. C
Humidity	95% max. non-condensing
Altitude	18,000 m (60,000 ft) max.
Velocity	515 m/s (1000 knots) max.
Jerk	20 m/s ³ (max.)
Acceleration	4 g (max.)

Table 6 Environmental Parameters

Performance

The ISM300F2 has a tracking sensitivity of -159 dBm and an acquisition sensitivity of -142 dBm. It is capable of receiving SBAS (satellite-based augmentation system) differential corrections (both WAAS (Wide-Area Augmentation System) and EGNOS (European Geostationary Navigation Overlay Service)).

SBAS improves horizontal position accuracy by correcting GPS signal errors caused by ionosphere disturbances, timing and satellite orbit errors. This can cut 2DRMS¹ in half.

Table 7 provides other performance parameters of interest.

Parameter	Value
Position	10 m, 2DRMS ¹ (autonomous) 5 m, 2DRMS ¹ (SBAS corrected)
Velocity	0.1 m/s
Time	1 μ s synchronized to GPS time
TTFF ² Hot (valid almanac, position, time and ephemeris)	1 s
TTFF ² Warm (valid almanac, position, and time)	<35 s
TTFF ² Cold (valid almanac)	<35 s
Reacquisition (<10 s obstructed with valid almanac, position, time and ephemeris)	100 ms
Sensitivity	-159 dBm (tracking mode) -142 dBm (acquisition mode)

Table 7 Performance Parameters

¹ Twice the distance root mean squared: The radius from the actual location containing 98% of the computed locations.

² Open sky and stationary

Firmware

Table 8 describes the firmware options available for the ISM300F2.

Part No.	Description												
ISM300F2-C3	Based on SiRF firmware release 3.2.5.												
ISM300F2-C4	Same as C3, plus SBAS (WAAS/EGNOS) enabled.												
ISM300F2-C5-X	<p>The C5 series comprises custom firmware off-the-shelf. These are based on SiRF firmware release 3.2.5.</p> <table> <tr> <th>Item</th><th>X</th></tr> <tr> <td>Single UART with NMEA-0183 running at 57600 Bd on port A with only GGA messages</td><td>V0001</td></tr> <tr> <td>Single UART with NMEA-0183 running at 4800 Bd on port A with all NMEA messages</td><td>V0002</td></tr> <tr> <td>Dual UARTs with NMEA-0183 running at 4800 Bd on port B and SiRF binary running at 57600 Bd on port A with message 41 SBAS enabled</td><td>V0003</td></tr> <tr> <td>Single UART with NMEA-0183 running at 4800 Bd on port B with all NMEA messages with operating ceiling of 135,000 ft.</td><td>V0004</td></tr> <tr> <td>Single UART with SiRF binary running at 115200 Bd on port A with position, velocity and time updated 5 Hz</td><td>V0005</td></tr> </table>	Item	X	Single UART with NMEA-0183 running at 57600 Bd on port A with only GGA messages	V0001	Single UART with NMEA-0183 running at 4800 Bd on port A with all NMEA messages	V0002	Dual UARTs with NMEA-0183 running at 4800 Bd on port B and SiRF binary running at 57600 Bd on port A with message 41 SBAS enabled	V0003	Single UART with NMEA-0183 running at 4800 Bd on port B with all NMEA messages with operating ceiling of 135,000 ft.	V0004	Single UART with SiRF binary running at 115200 Bd on port A with position, velocity and time updated 5 Hz	V0005
Item	X												
Single UART with NMEA-0183 running at 57600 Bd on port A with only GGA messages	V0001												
Single UART with NMEA-0183 running at 4800 Bd on port A with all NMEA messages	V0002												
Dual UARTs with NMEA-0183 running at 4800 Bd on port B and SiRF binary running at 57600 Bd on port A with message 41 SBAS enabled	V0003												
Single UART with NMEA-0183 running at 4800 Bd on port B with all NMEA messages with operating ceiling of 135,000 ft.	V0004												
Single UART with SiRF binary running at 115200 Bd on port A with position, velocity and time updated 5 Hz	V0005												

Table 8 Part Nos. by Firmware Release

New firmware releases can be installed (flashed) with the help of special software running on a PC. You also need access to pin 8 (BOOT_SEL). Speak to your technical representative for more information.

References

The following are available from www.inventeksys.com and www.sirf.com:

- [InvenTek System GPS Modules](#)
- [Certificate of Compliance](#)
- [SiRFstarIII GSC3e/LP & GSC3f/LP](#)

The ISM300X Evaluation Kit contains other documents of interest. For example:

- SiRF Customer Prototype Evaluation Test Results
- SiRFstarIII Architecture
- *NMEA Reference Manual*
- *SiRF Binary Protocol Reference Manual*

See your sales representative for more details.

Ordering Information

The ISM300F2 is RoHS-compliant and surface mountable. It's packaged either in tubes or in an SMT tape and reel. Please specify the corresponding part number when ordering.

Part No.	Package
ISM300F2-C3	Tube
ISM300F2-C3-T	SMT tape and reel
ISM300F2-C4	Tube
ISM300F2-C4-T	SMT tape and reel
ISM300F2-C5	Tube
ISM300F2-C5-T	SMT tape and reel

