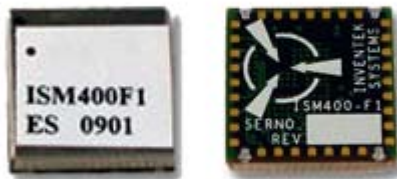


ISM400F1 GPS Module Functional Specification



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Overview

Inventek's ISM400F1 comprises a 20-channel global positioning system (GPS) receiver in a compact surface-mountable module. Based on the fast and deep search capabilities of SiRFstar III, it features high sensitivity, and low power.

The ISM400F1 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 ISM400F1'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 typically 35 s from a cold start, 1 s from a hot start. Reacquisition time is 1 s.

The ISM400F1 is compatible with SiRFloc Client, SiRF's in-network, wireless, aided GPS location software solution. SiRFloc Client makes the ISM400F1 ideal for E911-mandated services. The ISM400F1 is also compatible with SiRFInstantFix, SiRF's technology for delivering extended ephemeris data over the Internet. SiRFInstantFix enables fast start times in applications with poor or intermittent satellite connectivity.

The ISM400F1 facilitates ease of design and manufacturing. Its surface mount technology (SMT) allows for fully automatic assembly and reflow soldering. It receives all of its data, power and RF signals through its surface mount pads (land grid array). 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 ISM400F1 provides both a UART (universal asynchronous receiver/transmitter) and SPI (service processor interface) for quick-and-easy I/O.

Mechanical

Table 1 summarizes the dimensions of the ISM400F1.

Parameter	Value
Length	12.9±0.1 mm
Width	12.9±0.1 mm
Height	3 mm

Table 1 Dimensions

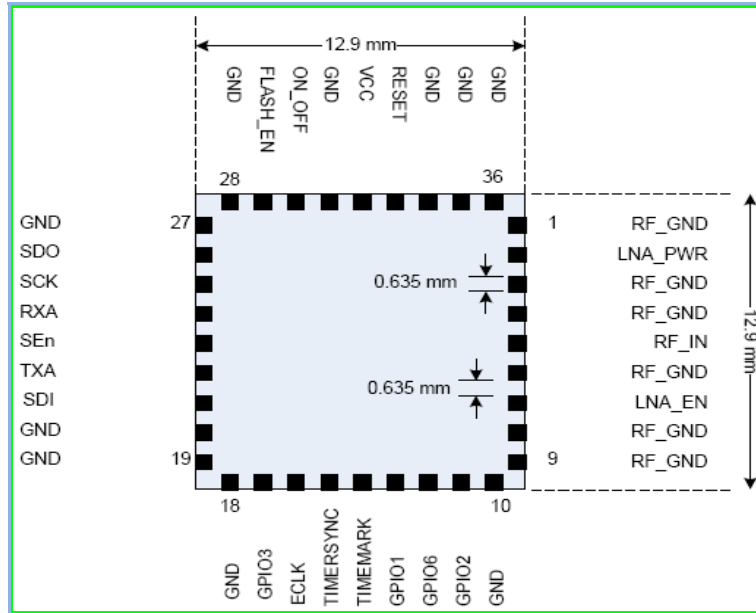


Figure 1 Pin Assignments (Bottom View)

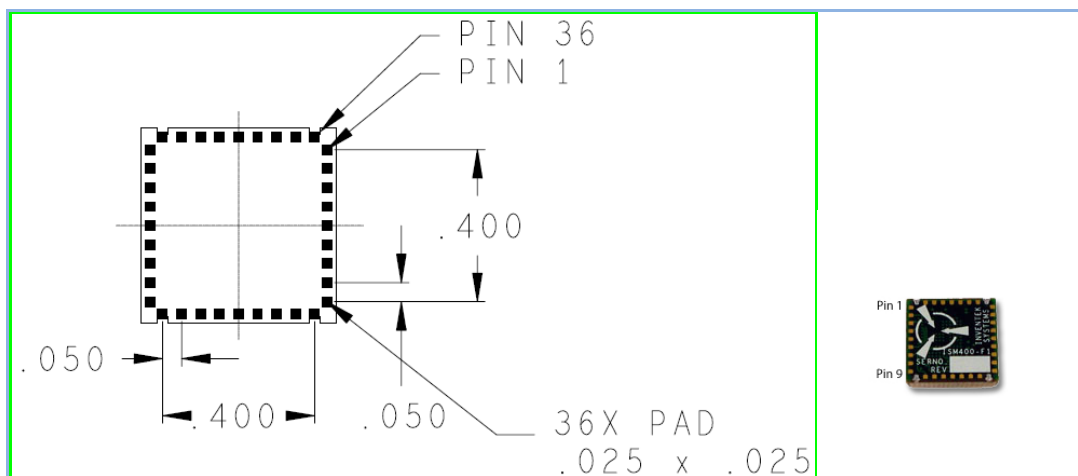


Figure 2 LGA Dimensions (Inches)

Electrical

Power, antenna and input/output constitute your primary considerations when integrating the ISM400F1 into your product. Table 2 describes the ISM400F1 pin assignments.

Pin	Name	I/O	V dc	Description
1	RF_GND	O		Antenna ground.
2	LNA_PWR	I	2.85	LNA power, (20 mA max)
3	RF_GND	O		Antenna ground.
4	RF_GND	O		Antenna ground.
5	RF_IN	I		GPS L1 RF signal input.
6	RF_GND	O		Antenna ground.
7	LNA_EN	O	1.2	Enable external LNA.
8	RF_GND	O		Antenna ground.
9	RF_GND	O		Antenna ground.
10	GND	O		Module ground.
11	GPIO2	I/O	1.8	No connect
12	GPIO6	I/O	1.8	No connect
13	GPIO1	I/O	1.8	No connect
14	TIMEMARK	O	1.8	1 PPS (or 5 PPS with custom order 5 Hz build)
15	TIMERSYNC	I	1.8	External AGPS time synchronization.
16	ECLK	I	1.8	External time reference.
17	GPIO3	I/O	1.8	No connect
18	GND	O		Module ground.
19	GND	O		Module ground.
20	GND	O		Module ground.
21	SD	I	1.8	No connect
22	TXA	O	1.8	UART transmit.
23	SEn	I	1.8	SPI Enable requires pull-up if using UART.
24	RXA	I	1.8	UART receive, internal pull-up.
25	SCK	I	1.8	No connect
26	SDO	O	1.8	No connect
27	GND	O		Module ground.
28	GND	O		Module ground.
29	FLASH_EN	I	1.2	Flash chip enable (active high).
30	ON_OFF	I	1.2	Power On and Request Power Off. (See figure 1)
31	GND	O		Module ground.
32	VCC	I	3.25	Power.(3.25-5.5V)
33	RESET	I	1.2	System reset (active low) Do not force High. (CAUTION: 1.2 V maximum!) .
34	GND	O		Module ground.
35	GND	O		Module ground.
36	GND	O		Module ground.

Table 2 ISM400F1 Pin Assignments

Power

Table 3 summarizes the ISM400F1's power requirements.

Parameter	Value
VCC	3.25–5.5 V dc
Continuous tracking	50 mW
Energy/fix	40 mW-s
Standby current	5 μ A

Table 3 Power Requirements

The ISM400F1 receives power on pin 32. Figure 4 depicts typical power circuitry.

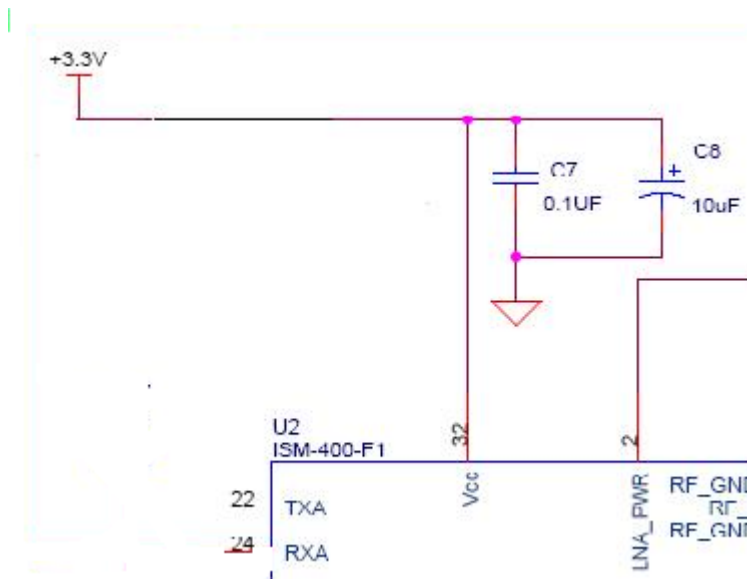


Figure 3 Typical Power Circuitry

You can reduce power consumption by turning on the GPS engine only when needed to acquire a fix. Use pin 30 (ON_OFF) to toggle power to the GPS engine. The pulse must be at least 63 μ s wide.

ON_OFF: On_OFF input is a 1.2V-1.5V level direct hardware connection to the Finite state machine/ The RTC clock must be on and stable for this control to be functional. The minimum on pulse duration is two RTC ticks, about 63 us. Minimum interpulse is one second. Minimum off duration is two RC ticks, about 63 us. A critical item is to avoid contact bounce is mechanical switches are being used.

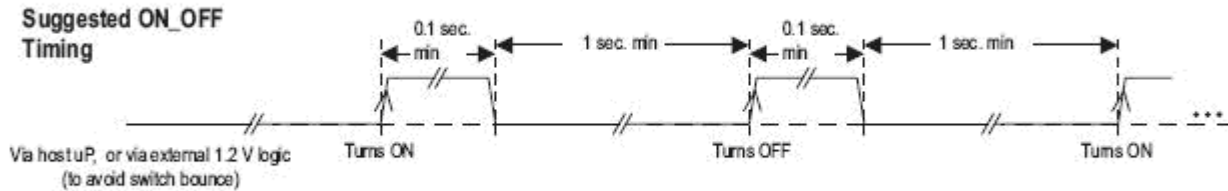


Figure 4 On_Off Timing Diagram

Use pin 14 (TIMEMARK) to determine when the GPS engine has a navigation solution. Pin 14 goes high following an over-solved navigation solution (involving five satellites or more). Pin 14 stays high until the GPS engine is reset or turned off, even if the engine can't compute solutions on subsequent cycles. Pin 14 stays low after the GPS engine is turned back on, until the next over-solved navigation solution.

See the section for how to control LNA power.

Antenna

The ISM400F1 is designed for use with an active antenna. Active antennas have an integrated low-noise amplifier and SAW (surface acoustic wave) filter. Refer to Figure 5 for typical RF circuitry.

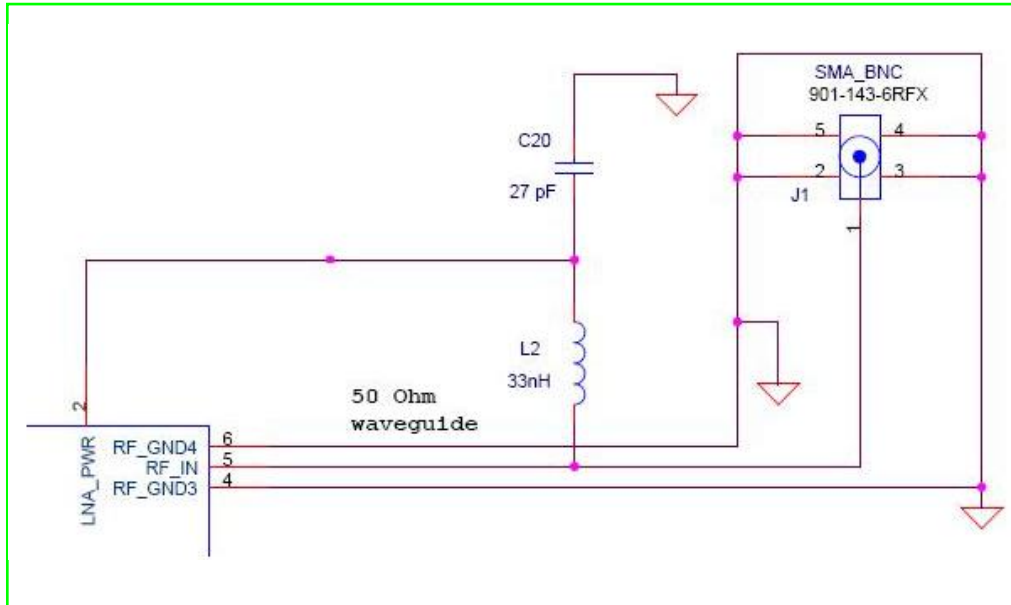


Figure 5 Typical RF Circuitry

Follow these guidelines:

- Use an antenna with a 15 dB minimum and 25 dB maximum gain.
- Use pre- and post-LNA SAW filters to protect against external interference.
- 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 both the antenna and RF_IN as possible.
- Protect the ISM400F1 from a short circuit with a coil (or fuse) between it and the antenna power source.

Use pin 2 (LNA_PWR) to supply power to the external LNA.

Input/Output

The ISM400F1 enables I/O by way of either a UART (universal asynchronous receiver/transmitter) The UART supports the NMEA-0183 protocol at either 4800 Baud or SSB (SiRF Standard Binary) protocol at 57600 Baud.

When the UART is enabled, I/O occurs on pins 22 (TXA) and 24 (RXA).

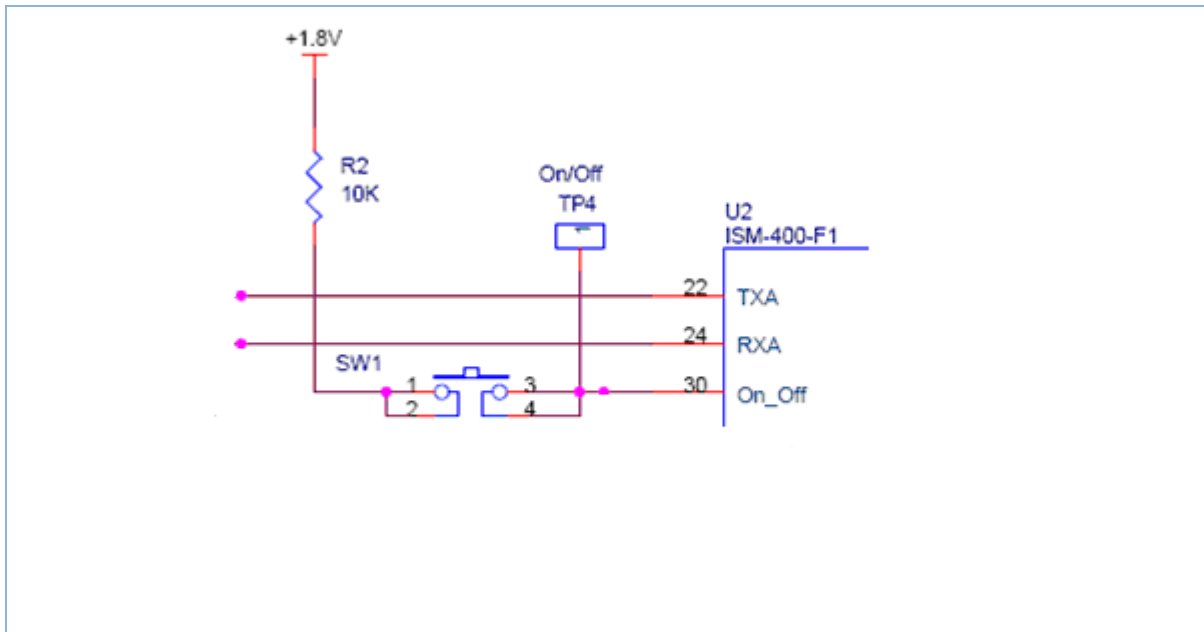


Figure 6 Typical UART Circuitry

Environmental

The ISM400F1 complies with the European Union’s RoHS (Restriction of Hazardous Substances) directive (is lead free) and meets FCC/CE standards for EMI/EMC. Table 1 provides other environmental parameters of interest.

Parameter	Value
Operating temp.	-20° C to +70° C
Storage temp.	-65° C to +150° C
Altitude	18,000 m (60,000 ft) max.
Velocity	515 m/s (1000 knots) max.

Table 4 Environmental Parameters

Performance

The ISM400F1 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 significantly.

Item	Value
Hot start–Autonomous	< 1 s
Warm start–Autonomous	< 35 s
Cold start–Autonomous	< 35 s
MS (mobile station) based–GSM coarse time	<0.6 s
MS assisted–GSM coarse time	<5.3 s
Horizontal (autonomous) ²	< 2.5 m
Horizontal (with SBAS) ²	< 2.0 m
Speed ³	< 0.01 m/s
Heading ³	< 0.01°

Table 5 Performance Parameters

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

² 50% 24 hr static, -130 dBm

³ 50% @ 30 m/s

Solder Profile

Here is an example of a solder profile used for the ISM400F1 . This is a good profile for a starting point when setting up a reflow profile for an assembly. All board assemblies are not the same and please work with your manufacturing department to come up with the ideal profile. Use a of no clean soldering paste is recommended.

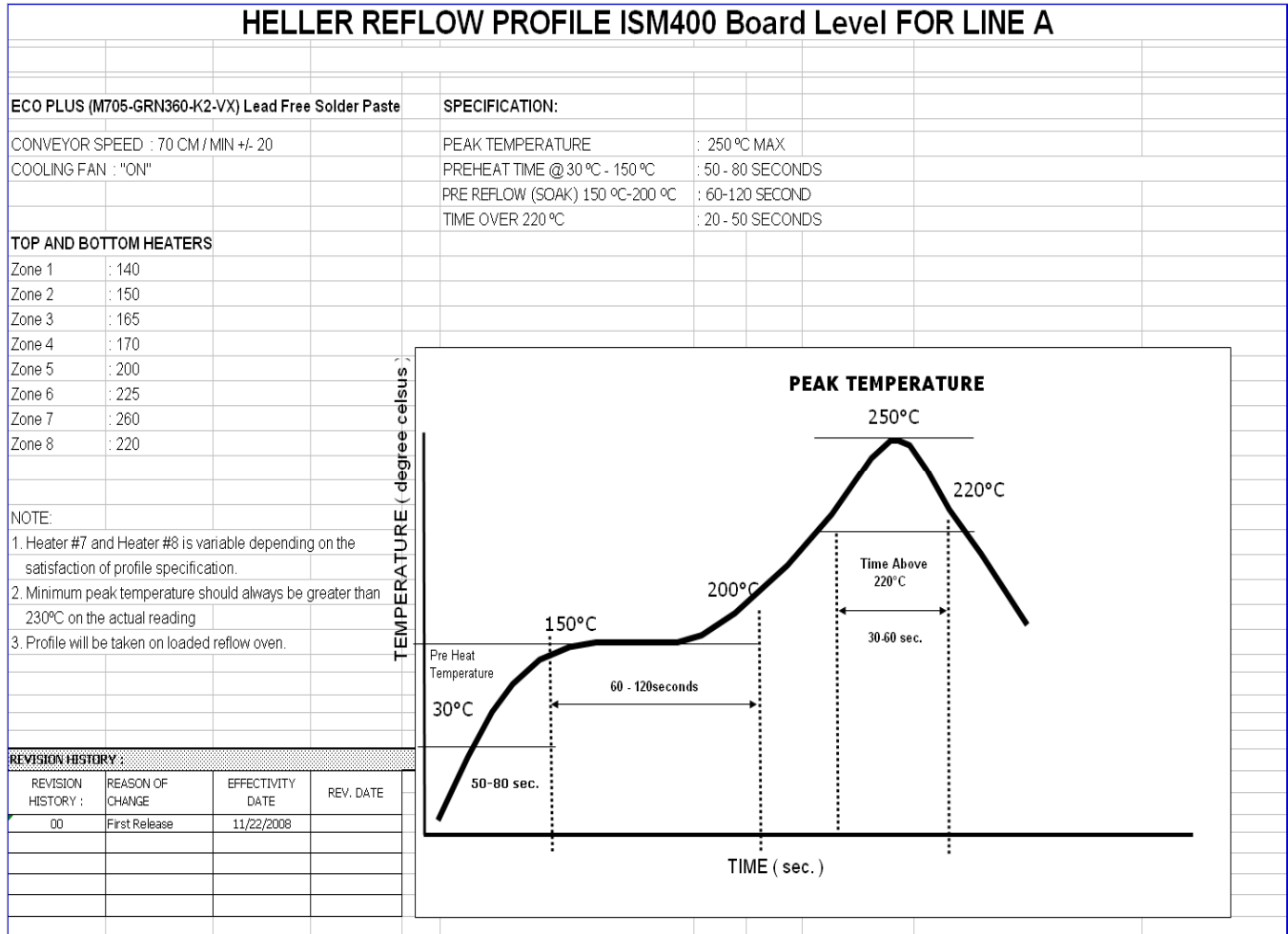


Figure 3 Reflow Profile Example

Firmware

The ISM400F1 runs GSWLT3, the SiRF standard software for SiRFstarIII–LT™ receivers. Table 9 describes the firmware options available for the ISM400F1.

Part No.	Description										
ISM400F1-N4	NMEA-0183 @ 4800 Baud, SBAS enabled										
ISM400F1-S5	SiRF Binary, @ 57,600 , SBAS enabled										
ISM400F1-C5-Vxxx	The C5 series comprises custom firmware off-the-shelf. These are firmware release available <table border="1"> <thead> <tr> <th>Item</th> <th>X</th> </tr> </thead> <tbody> <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 SiRF binary running at 115200 Bd on port A with position, velocity and time updated 5 Hz</td> <td>V0005</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>	Item	X	Single UART with NMEA-0183 running at 57600 Bd on port A with only GGA messages	V0001	Single UART with SiRF binary running at 115200 Bd on port A with position, velocity and time updated 5 Hz	V0005				
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Single UART with NMEA-0183 running at 57600 Bd on port A with only GGA messages	V0001										
Single UART with SiRF binary running at 115200 Bd on port A with position, velocity and time updated 5 Hz	V0005										

Table 6 Part Nos. by Firmware Release

Ordering Information

The ISM400F1 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
ISM400F1-N4	Tube
ISM400F1-N4-T	SMT tape and reel
ISM400F1-S5	Tube
ISM400F1-S5-T	SMT tape and reel
ISM400F1-C5-V0001	Tube
ISM400F1-C5-V0001-T	SMT tape and reel
ISM400F1-C5-V0005	Tube
ISM400F1-C5-V005-T	SMT tape and reel