Datasheet

# Jupiter3


## Extra Low Power Ultra Miniature 20-channel GPS receiver module



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## 1.0 Introduction

The Jupiter3 is Navman's smallest form-factor module and is the basis of Navman's next generation GPS receiver solutions. The Jupiter3, based on SiRF's GSC3f/LPx chipset, offers low power and high sensitivity at a competitive price. The Jupiter3 is designed with low cost in mind, enabling products that have existing voltage regulation, real time clock and supervisory circuit functions. The Jupiter3 integrates select key components including TCXO, LNA and SAW filter. Minimizing RF layout design issues offers faster time to market. Offering customers the flexibility in external BoM component selection. Offering the same software messaging as the current Jupiter xLP products, Jupiter3 enables a risk free upgrade path for any customer currently using Jupiter-based products.

## 2.0 Technical description

The Jupiter3 offers the ultimate in high sensitivity GPS performance, capable of both autonomous and aided modes of operation. The module has advanced miniature packaging and a Land Grid Array (LGA) footprint with unique integration features for high volume, low cost and low power applications where tighter integration is required. Incorporating the highest specification components available, the Jupiter3 can track down to –159 dBm and offers unparalleled accuracy and extremely fast fixes even under attenuated conditions such as in built-up urban areas, dense foliage, indoors or while subject to challenging temperature profiles. The module provides a miniature 20-channel receiver that continuously tracks all satellites in view and provides accurate positioning data. Featuring active or passive antenna support, power saving Modes and antenna supervisor software, SiRFInstantFix support and full multi-mode aiding capability, the Jupiter3 is highly suited for all battery powered applications or high-end track and trace applications.



### 2.1 Product applications

The Jupiter3 is designed specifically for applications where rapid TTFF and operation under low signal levels along with a small form factor are primary requirements. The module offers high performance and maximum flexibility in a wide range of OEM configurations.

The high sensitivity of the module makes it ideal for:

**Navigation systems** – where athermic glass, or an unsuitably positioned antenna inside the vehicle will reduce visibility and signal strength vehicle and people tracking devices – where satellites are obstructed by partially covered car parks and walkways, tracking even continues indoors.

**Marine buoys –** where multipath and unstable sea conditions make satellite visibility irregular asset tracking – where construction machinery is located in covered yards and areas of dense foliage people tracking - home detention and house arrest applications, emergency location ervices.

**Mobile platforms** where size and power consumption are critical along with maximum flexibility of integration and performance.

**Security applications** where an ultra compact design and high performance is required along with maximum integration flexibility.

**Toll Collection** systems for vehicles.

**People Tracking** applications for health, security and safety.

#### 2.1.1 Compatibility

The Jupiter3 is NOT backwards compatible to J32. It is similar in functionality, but it must be noted that the NMEA message protocol has been updated to version 3.0 (from version 2.2). NMEA version 3.0 incorporates a Mode indicator bit in the following messages: GLL, RMC and VTG. Jupiter3 has advanced miniature packaging, with a smaller form factor (11.0mm x 11.0mm)

## 2.2 Receiver architecture

The functional architecture of the Jupiter$^3$ receiver is shown in Figure 1.

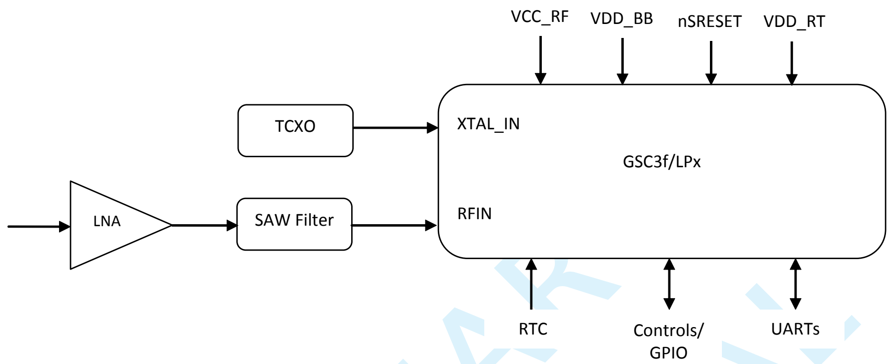


**Figure 1: Model architecture**



## 2.3 Major components of the Jupiter$^3$

**SAW filter (1.575 GHz):** This filters the GPS signal and removes unwanted signals caused by external influences that would corrupt the operation of the receiver. The filtered signal is fed to the RF input of GSC3f chipset for further processing. The filter has a bandwidth of 2 MHz.

**VDD_RTC:** This supplies the RTC core and system FSM (Finite State Machine). It also supplies the BBRAM that maintains system and user variables.

**GS3f/LPx RTC crystal controls/GPIO (General Purpose Input Output):** This single chip GPS device includes an integrated Baseband, RF section and integrated Flash which stores software, long term and user configuration data.

**LNA (Low Noise Amplifier):** This amplifies the GPS signal and provides enough gain for the receiver to use a passive antenna. A very low noise design is utilised to provide maximum sensitivity.

**VDD_BB:** The primary supply voltage for the Digital and DSP section its range is 2.7V to 3.0V.

**VCC_RF:** The primary supply voltage for the RF section and its range is 2.7V to 3.0V.

**RTC Clock interface:** This supports a low cost RTC crystal or a shared 32KHz clock.

**SRESET (NSRESET):** This is the system Reset input for POR and Reset control.

**Controls:** These signals allow Power Save modes and correct GPS shutdown.  They also allow an ON_PFF pulse to be used for controlled shut downs and start ups. Note that a serial message can also be used to shut down the GPS.

**UART ports:** These are the primary serial communications ports for NMEA or SiRF Binary protocols.

**SPI (not shown):** This is a high speed serial communication port used for DR.

**TCXO (Temperature Compensated Crystal Oscillator 0.5ppM):** This highly stable 16.369 MHz oscillator controls the down conversion process for the RFIC block.

## 2.4 Physical characteristics

The Jupiter$^3$ receiver has advanced miniature packaging and a LGA footprint and is smaller than the Jupiter 32. It is a surface mount device packaged on a miniature printed circuit board, with a metallic RF enclosure on one side. There are 32 surface mount connection pads with a base metal of copper and an Electroless Nickel Immersion Gold (ENIG) finish.

## 2.5 Mechanical specification

The physical dimensions of the Jupiter3 are as follows:

- **length:** 11.0 mm ± 0.1 mm
- **width:** 11.0 mm ± 0.1 mm
- **thickness:** 2.25 mm max
- **weight:** 1 g max

Refer to Figure 3 on page 16 for the Jupiter3 mechanical layout drawing.

## 2.6 External antenna surface mount pads

The RF surface mount pad for the external antenna has a characteristic impedance of 50 ohms.

## 2.7 I/O and power connections

The I/O (Input Output) and power connections use surface mount pads.

## 2.8 Environmental

The environmental operating conditions of the Jupiter3 are as follows:

**Note: Temperature measured on Jupiter3 shield.**

- **temperature:** –40° C to +85° C
- **humidity:** up to 95% non-condensing or a wet bulb temperature of +35°C
- **altitude:** –304 m to 18 000 m
- **vibration:** random vibration IEC 68-2-64
- **max. vehicle dynamics:** 500 m/s
- **shock (non-operating):** 18 G peak, 5 ms

## 2.9 Compliances

The Jupiter3 complies with the following:

- Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- CISPR22 and FCC: Part 15, Class B for radiated emissions
- Manufactured in an ISO 9000 : 2000 accredited facility
- Manufactured to TS 16949 requirement (upon request)

## 2.10 Marking/Serialisation

The Jupiter3 supports a 2D barcode indicating the unit serial number below. The Navman 13-character serial number convention is:

- **characters 1 and 2:** year of manufacture (e.g. 09 = 2009, 10 = 2010)
- **characters 3 and 4:** week of manufacture (1 to 52, starting first week in January)
- **character 5:** manufacturer code
- **characters 6 and 7:** product and type
- **character 8:** product revision
- **characters 9-13:** sequential serial number

## 2.11 Active antenna gain requirements

The Jupiter3 is designed to operate with an ideal active antenna again of 16dB on the input of the GPS RF input. The active antenna gain must not exceed 19dB on the input of the GPS RF in.

**Antenna gain typical:** 16dB

**Max:** 19dB

NOTE: measured at GPS RF input.

# 3.0 Performance characteristics

## 3.1 TTFF (Time To First Fix)

TTFF is the actual time required by a GPS receiver to achieve a position solution. This specification will vary with the operating state of the receiver, the length of time since the last position fix, the location of the last fix, and the specific receiver design. Aiding is a method of effectively reducing the TTFF by making every start Hot or Warm.

### 3.1.1 Hot start

A hot start results from a software reset after a period of continuous navigation, or a return from a short idle period (i.e. a few minutes) that was preceded by a period of continuous navigation. In this state, all of the critical data (position, velocity, time, and satellite ephemeris) is valid to the specified accuracy and available in SRAM. Battery backup of the SRAM and RTC during loss of power is required to achieve a hot start.

### 3.1.2 Warm start

A warm start typically results from user-supplied position and time initialisation data or continuous RTC operation with an accurate last known position available in memory. In this state, position and time data are present and valid but ephemeris data validity has expired.

### 3.1.3 Cold start

A cold start acquisition results when either position or time data is unknown. Almanac information is used to identify previously healthy satellites.

## 3.2 Acquisition times

Acquisition time is also affected by strength of the signal received, as per the tables below. Table 1 shows the corresponding TTFF times for each of the acquisition modes.

| Mode | @ –130 dBm | |
|---|---|---|
| | Typ | 90% |
| hot start TTFF | 500 ms | <1 s |
| warm start TTFF | 31 s | 36 s |
| cold start TTFF | 33 s | 38 s |
| re-acquisition (<10 s obstruction) | 1 s | |

**Table 1: Acquisition times**

NOTE: These are true Times to Fix, not affected by serial port latency and speeds. Serial Protocol and serial port speed must be optomised to obtain sub 1 second HOT TTFF via serial port.

## 3.3 Timing 1 PPS output

The 1 PPS output of the Jupiter$^3$ receiver is 100 ms positive going pulse accurate to ± 200 ns with 450 ns offset, referenced to UTC. Refer to Table 14 for the default status on the Jupiter$^3$.

## 3.4 Power management

The Jupiter$^3$ offers two kinds of power saving mode: Adaptive Trickle Power and Push-To-Fix (refer to Table 14 for the default status on the Jupiter$^3$). These modes can be set using NMEA or SiRF Binary messages.

### 3.4.1 Adaptive Trickle Power

The Jupiter$^3$ can use the Adaptive Trickle Power (ATP) feature, which reduces power consumption by intelligently switching between full power in tough GPS environments and low power in strong GPS signal areas. When signal levels drop, the receiver returns to full power so that message output rates remain constant. This results in variable power savings but much more reliable performance for a fixed output rate. Applications using ATP should give performance very similar to full power, but with significant power savings in strong signal conditions. ATP is best suited for applications that require solutions at a fixed rate as well as low power consumption and still maintain the ability to track weak signals. With ATP at a 1 second update, a power saving of 50% can easily be achieved with minimal degradation in navigation performance.

### 3.4.2 Push-To-Fix mode

Push-To-Fix mode always forces the GPS software to revert to a continuous sleep mode after a navigation position fix. It will stay in sleep mode until woken by activation of the WAKEUP input , and compute a fresh position. If the ephemeris data become invalid, the RTC has the ability to self activate and refresh the data, thus keeping the restart TTFF very short. This mode yields the lowest power consumption of the module, and is ideal where a battery powered application requires very few position fixes. For further information refer to the Low Power Operating Modes application note, Navman NMEA reference manual and the SiRF Binary Protocol reference manual.

## 3.5 Differential aiding

### 3.5.1 Differential GPS (DGPS)

RTCM DGPS is not available on the Jupiter$^3$.

### 3.5.2 Satellite Based Augmentation Systems (SBAS)

The Jupiter$^3$ is capable of receiving WAAS and EGNOS differential corrections which are regional implementations of SBAS. SBAS improves horizontal position accuracy by correcting GPS signal errors caused by ionospheric disturbances, timing and satellite orbit errors. Refer to Table 14 for the default status on the Jupiter$^3$.

## 3.6 Core processor performance

The standard Jupiter$^3$ with GSW3 software runs at a CPU clock speed of 49 MHz. An SDK (Software Development Kit) is available from SiRF to customise the Jupiter$^3$ firmware.

## 3.7 Sensitivity

Sensitivity of the Jupiter$^3$ is measured assuming a system noise value of 3 dB. The sensitivity values are as follows

| Parameter | Signal Strength | $C/N_0$ |
|---|---|---|
| acquisition – cold start | –145 dBm | 25 dbHz |
| acquisition – hot start | –155 dBm | 15 dBHz |
| navigation | –157 dBm | 13 dBHz |
| tracking | –159 dBm | 11 dBHz |

**Table 2: Sensitivity**

## 3.8 Dynamic constraints

The Jupiter$^3$ receiver is programmed to deliberately suppress the output if the velocity and altitude limits are exceeded.

- **velocity:** 500 m/s max
- **acceleration:** 4 G (39.2 $m/s^2$) max
- **vehicle jerk:** 5 $m/s^3$ max
- **altitude:** 18 000 m max (referenced to MSL)

### 3.9 Position and velocity accuracy

The position and velocity accuracy of the Jupiter3 are shown in Table 3, assuming full accuracy C/A code. These values are the same in normal operation and slightly degraded when Adaptive Trickle Power is active.

NOTE: Static accuracy in ideal conditions using industry standard statistical calculations.

| Parameter | Value |
|---|---|
| horizontal CEP* | 2.5 m |
| horizontal (2 dRMS) | 5.5 m |
| vertical VEP* | 2.0 m |
| velocity (speed)** | $<$ 0.1m/s |
| velocity (heading)** | $<$ 0.1° |
| * position error 50% and under normal open sky conditions<br>** In 3D Kalman filtered mode in steady state open sky conditions | |

**Table 3: Position and velocity accuracy**



## 4.0 Multi-mode aiding

Multi-mode aiding technology makes navigation information available to GPS devices when enough Satellite Vehicles (SVs) are not visible due to obstruction. In autonomous operation mode, the GPS receiver requires a signal level of 26 dBHz or higher in four or more SVs to download ephemerides. This requires an uninterrupted full 30 seconds of data reception from each SV. If the data isn't received in full, the ephemeris data collection has to start again at the next cycle. The type of multi-mode aiding currently supported by the Jupiter3 is Ephemeris Push and InstantFix.

Instantfix uses predictive technology to provide the global ephemeris to the GPS.

## 5.0 Electrical requirements

### 5.1 Power supply

#### 5.1.1 VDD_BB power supply

Controlled by nWakeup control line.

The Jupiter3 GPS receiver is designed to operate with separate or a single power supply for VDD_BB and VCC_RF. Meeting the requirements shown in Section 5.2.1.

NOTE: Following design guidelines detailed in the Jupiter3 Integrators Manual.

#### 5.1.2 Battery backup (SRAM/RTC backup)

During 'powered down' conditions, the SRAM and RTC core (Real Time Clock) may be kept operating by supplying power to VCC_RTC. Meeting the requirements of Section 5.2.1.

#### 5.1.3 VCC_RF power supply

Controlled by RFPWRUP control line. Meeting the requirements of Table 5.2.1.

NOTE: Following design guidelines detailed in the Jupiter3 Integrator's Manual.

### 5.1.4 External antenna voltage

The Jupiter3 requires an external Bias-T to provide the antenna voltage.

NOTE: Following design guidelines detailed in the Jupiter3 Integrator's Manual.

### 5.1.5 RF (Radio Frequency) input

RF input is 1575.42 MHz (L1 Band) at a level between –125 dBm and –159 dBm into a 50 ohm impedance, with a passive antenna. This input may have a DC voltage impressed upon it to supply power to an active antenna. The maximum input return loss is –9 dB.

### 5.1.6 Antenna gain

The receiver will operate with a passive antenna with unity gain. However, GPS performance will be optimum when an active antenna is used. The gain of this antenna at the input of the module should be no greateer than 16 dB.

For recommendations on antenna use and testing see the Jupiter3-30 Integrator's manual.

### 5.1.7 Reset input

This active low input to NRESET allows the user to restart the software from an external signal. It requires a POR pulse of 150ms minimum, starting when the main power is within specification and stable.

NOTE: Following design guidelines detailed in the Jupiter3 Integrator's Manual.

### 5.1.8 Burnout protection

The receiver accepts without risk of damage a signal of +10 dBm from 0 to 2 GHz carrier frequency, except in band 1560 to 1590 MHz where the maximum level is –10 dBm.

### 5.1.9 Jamming performance.

Table 4 shows the amount of CW signal needed to degrade the GPS signal by 1 dB for different frequencies of jamming signal.

NOTE: This signal level is as received at the GPS RF input, set at -135dBm.

| Jamming Frequency (MHz) | Jamming Signal Power (dBm) |
|---|---|
| 1550 | -22 |
| 1555 | -25 |
| 1560 | -38 |
| 1565 | -45 |
| 1570 | -65 |
| 1574 | -85 |
| 1575.42 | -90 |
| 1576 | -85 |
| 1580 | -77 |
| 1585 | -70 |
| 1590 | -55 |
| 1595 | -37 |
| 1600 | -23 |

**Table 4: Jamming signal levels**

NOTE: The spectral purity of oscillators and RF transmitters in the host system will determine if harmonics are formed that are equal to the frequencies above.

Compact wireless product design requires close monitoring of jamming issues. Please contact Navman for assistance especially if designing with a passive GPS antenna.

## 5.2 Interface specifications

All communications between the Jupiter$^3$ receiver and external devices are through the I/O surface mount pads. These provide the contacts for power, ground, serial I/O and control. Power requirements are discussed in Section 5.1.

### 5.2.1 Voltages and currents

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Power Supply Voltage | VDD_(all) | 2.7 | 2.85 | 3 | V |
| Power Supply Voltage | VCC_(all) | 2.7 | 2.85 | 3 | V |
| RTC Supply Voltage[1] | VDD_RTC | 1.1 | 1.2 | 1.3 | V |
| Battery Backed SRAM | VDD_RTC | 1.1 | 1.2 | 1.3 | V |
| Operating Temperature[2] | T OPR | -40 | | 85 | °C |
| Peak Acquisition Current[3] | IDD | | 34mA | | |
| Avg. Acquisition Current[4] | IDD | | 30mA | | |
| Tracking Current[5] | IDD | | 27mA | | |
| Standby Current[6] | IDD | | 1.5 mA | | |

**Table 5: Power supply**

NOTES
1. RTC must always be powered during chip operation.
2. Max operating temperature is measured on shield of the Jupiter$^3$.
3. Peak acquisition current is characterized by millisecond bursts above average acquisition current.
4. Avg acq. current is typically only the first two seconds of TTFF.
5. Tracking current typically includes tracking and the post-acquisition portion of TTFF.
6. During standby state: RTC block and core remain powered on.



| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| RTC Supply[3] | VDD_RTC | 1.1 | 1.2 | 1.3 | V |
| Supply Current[1,2] | IDDRTC | 3 | 7 | 100 | uA |
| Power Supply[2] | VDD | 0 | 0 | 0 | V |

**Table 6: Battery Supply**

NOTES
1. Jupiter$^3$ includes a HIBERNATE state where the chip can restart itself from the raw power RTC battery state.
2. All external I/O lines must be driven low or disabled during battery back-up or HIBERNATE state.
3. BBRAM writes can cause short duration RTC supply currents of 100uA at power down. Ref design will eliminate peak currents. Please follow Integrators Manual.

## Absolute Maximum Ratings

| Parameter | Symbol | Rating | Units |
|---|---|---|---|
| Power Supply Voltage | VDD_BB | 3.15 | V |
| Input Pin Voltage | VIN | 5.25 | V |
| Output Pin Voltage | VOUT | 5.25 | V |
| Latch-up Current (includes internal flash die) | ILATCH | plus minus 200 | mA |
| Storage Temperature | TSTG | -50 to 90 | °C |

**Table 7: I/O voltage**

## RF Section

| Parameter | Symbol | Rating | Units |
|---|---|---|---|
| Maximum Supply Voltage | VCC_RF | 3.15 | V |
| Maximum RF Input | (RFA) | 10 | dBm |
| Minimum DC Voltage on Any Pin | GND | -0.5 | V |
| Maximum DC Voltage on Any Pin | | 3.15 | V |

**Table 8: Battery Block**

WAKEUP (ON_OFF) pin must be limited to 1.5V.

**WARNING – Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.**

| Symbol | Min. | Typ | Max | Conditions | Units |
|---|---|---|---|---|---|
| VIH | 0.8*VDDRTC | VDDRTC +0.3[1] | | | V |
| VIL | | 0.2*VDDRTC | | | V |
| VT | | 0.5*VDDRTC | | | V |
| IIH | -10 | | 10 | VIN = VDD | uA |
| | | 60 | | with pull-down | |
| IIL | -10 | | 10 | VIN = VSS | uA |
| | | -60 | | with pull-up | |
| e VOH | 0.75*VDDRTC | | | IOH = -2 mA | V |
| VOL | | | 0.25*VDDRTC | IOL = 2 mA | V |
| | | | | IOL = 1 mA for WAKEUP and RESET | |
| CIN | | | 5 | Input or Bi-directional | pF |
| COUT | | | 5 | Output Buffer | pF |

**Table 9: Electrical Characteristics for RTC Block (Pins: RIN, ROUT, WAKEUP, ON_OFF, SRESET)**

NOTES:
1. The signals in RTC power domain are 3.3 V tolerant,
VDD_RTC is between 1.1V and 1.3V. WAKEUP (ON_OFF) pin must be limited to 1.5V.



| Parameter | Symbol | Min | Typ | Max | Conditions | Units |
|---|---|---|---|---|---|---|
| High Level Input Voltage | VIH | 0.7*VDD | | VDD+0.3 | | V |
| Low Level Input Voltage | VIL | -0.3 | | 0.3*VDD | | V |
| Switching Threshold | VT | | 0.5*VDD | | | V |
| High Level Input Current | IIH | -10 | | 10 | VIN = VDD | |
| | | | | -60 | with pull-down | uA |
| Low Level Input Current | IIL | -10 | | 10 | VIN = VSS | |
| | | | | -60 | with pull-up | uA |
| High Level Output Voltage | VOH | 0.75*VDD | | | IOH = -2 mA for GPIOs,TX pins. IOH = -4 mA for all other pins | V |
| Low Level Output Voltage | VOL | | | 0.25*VDD | IOL = 2 mA for GPIOs, TX pins. IOL = 4 mA for all other pins. | V |
| Tri-State Output Leakage | IOZ | -10 | | 10 | VOUT = VSS or VDD | Ua |
| Input Capacitance | CIN | | | 4 | Input or Bi-directional | pF |
| Output Capacitance | COUT | | | 4 | Output Buffer | pF |

**Table 10: DC Electrical Characteristics**

NOTE: VDD is between 2.7V and 3.3V.

## Low power mode power consumption

The measured average current waveform during an Adaptive Trickle Power mode is as follows:

| ATP ON time = 200ms 1Hz navigation update | Current Consumption |
|---|---|
| 15ms | 10mA |
| 87ms | 20mA |
| 226ms | 26.5mA |
| 58ms | 18mA |
| 750ms | 1mA |
| Average current | 11.5mA (31mW @ 2.75V) |

**Table 11: ATP power consumption**

Push-To-Fix Mode Hibernate current = 0uA

*Only if VBATT supply is present (reference Jupiter$^3$-30 Designer's Notes).

Otherwise Hibernate mode current = 6uA typical.

Please refer to the Low Power modes application note for additional information on configuration and performance of the Low Power modes.

The total ATP power consumption is a function of the serial port speed and the number of serial messages selected. This will extend the time that the CPU is operational and will add to the total power consumption during ATP mode.

It is recommend that the minimum amount of serial messages are selected during low power modes and if possible the serial port speed is run at the highest possible baud rate to reduce time that CPU is operational.

### 5.2.2 I/O surface mount pads

Details of the LGA pad functions are shown in Table 12.

| Pad No. | Pad Names | Type | Description |
|---|---|---|---|
| 1 | RXB | I | Serial Port B Receive - CMOS - levels affected by supply voltage |
| 2 | TXB | O | Serial Port B Transmit - CMOS - levels affected by supply voltage |
| 3 | TXA | O | Serial Port A Transmit - CMOS - levels affected by supply voltage |
| 4 | RXA | I | Serial Port A Receive - CMOS - levels affected by supply voltage |
| 5 | ANT_CTRL | O | External Active antenna power control - Active High |
| 6 | TIME_MARK | O | 1PPS pulse |
| 7 | WTICK | I | DR version Wheel tick input |
| 8 | ANT_SC | I | External Active antenna Short Circuit detect sense line - Active Low |
| 9 | SPI_CS | O | SPI Chip select for DR version. |
| 10 | GND | PWR | RF Ground |
| 11 | RF_IN | I | GPS signal input |
| 12 | GND | PWR | RF Ground |
| 13 | RFPWRUP | O | RF Power enable - Active High |
| 14 | VCC_RF | I | RF power input (2.7V to 3.0V) |
| 15 | ANT_OC | I | External active antenna Open Circuit detect sense line - Active High |
| 16 | GND | PWR | Power Ground |
| 17 | BOOT | I | Boot pin for firmware update - Active High |
| 18 | GPIO2 | I/O | General purpose I/O |
| 19 | GPS_FIX | O | GPS Fix Indication - Active Low |
| 20 | SI | O | SPI IN - Connect to SO for GPS only firmware |
| 21 | SO | I | SPI OUT - Connect to SI for GPS only firmware |
| 22 | GND | PWR | Power Ground |
| 23 | SPI_CLCK | O | DR version SPI CLOCK output. |
| 24 | VDD_RTC | I | RTC/BBRAM voltage input (1.1V to 1.3V) |
| 25 | RTC_XI | I | RTC 32 KHz signal input - connect also to RTC crystal if no external clock (2.8V SiGe input) |
| 26 | RTC_XO | O | RTC 32 KHz signal output - connect only to RTC crystal |
| 27 | nSRESET | I | System Reset input - 200mSec low pulse as detailed |
| 28 | VDD_BB | I | Digital and DSP power in (2.7V to 3.0V) |
| 29 | ON-OFF | I | ON-OFF power control and PTF WAKEUP line |
| 30 | nWAKEUP | O | Digital and DSP power enable - Active Low. |
| 31 | FWD/REV | I | DR version Forward/Reverse input |
| 32 | GND | PWR | Power Ground |

**Table 12: I/O surface mount pads**

NOTE: Follow design guidelines detailed in the Jupiter3 Integrator's Manual.

NOTE: GPIO/RX-TX voltages and levels affected by supply voltage.

## 6.0 Software interface

The host serial I/O port of the receiver's serial data interface supports full duplex communication between the receiver and the user. The default serial modes are as follows:

**Port A:** NMEA, 9600 bps, 8 data bits, no parity, 1 stop bit

**Port B:** SiRF Binary, 38 400 bps, 8 data bits, no parity, 1 stop bit

### 6.1 NMEA output messages

NMEA is a standard protocol used by GPS receivers to transmit data. Output NMEA (0183 v3.0) messages for the Jupiter3 are listed in Table 13 complete description of each NMEA message is contained in the Navman NMEA reference manual.

| Message ID and description | Refresh rate |
|---|---|
| GGA – global positioning system fix data | 1s |
| GSA – DOP and active satellites | 1s |
| GSV – satellites in view | 1s |
| RMC – recommended minimum specific GPS data | 1s |
| VTG – track made good and ground speed | 1s |
| GLL – latitude, longitude, UTC of position fix and status | 1s |
| ZDA – PPS timing message | 1s |
| DTM – Datum reference | off |

**Table 13: Default NMEA messages**

### 6.2 SiRF Binary

SiRF Binary is the proprietary interface protocol of SiRF. It allows the Jupiter 3 a greater level of configurability and a more standardised message set than NMEA. A complete description of each binary message is contained in the SiRF Binary Protocol reference manual.

## 6.3 Software functions and capabilities

Table 14 shows the software features available to the Jupiter3.

| Feature | Description | Availability |
|---|---|---|
| SBAS capability | Improves position accuracy by using freely available satellitebased correction services called SBAS (Satellite Based Augmentation System) | A |
| Adaptive TricklePower | Improves battery life by using enhanced power management and intelligently switching between low and full power depending on the current GPS signal level. Refer to the Low Power Operating Modes application note. | A |
| Push-To-Fix | Provides an on-demand position fix mode designed to further improve battery life. Refer to the Low Power Operating Modes application note. | A |
| Ephemeris Push | Allows hot start performance at all times including in weak conditions and moving start ups yes | Yes |
| Almanac to Flash | Improves cold start times by storing the most recent almanac to flash memory. | Yes |
| Low signal acquisition | Acquires satellites and continues tracking in extremely low signal environments. | Yes |
| Low signal navigation | Continues navigating in extremely low signal environments. | Yes |
| PPS | A timing signal generated every second on the second. | Yes |
| DR | Sensor based Dead Reckoning without valid GPS signals | A |
| Antenna Supervison | Active antenna short circuit and open circuit detection and control software. | Yes |
| Instant Fix | AGPS using predicted ephemeris data. | Yes |
| Configuration to Flash | Allows storage of user commanded receiver configuration changes to Flash memory. | Yes |

**Yes = always enabled** **A = available, but not enabled by default**

**Table 14: Software functions**



## 6.4 Flash programming

The firmware programmed in the Flash memory may be upgraded via the serial port RXA pad D5. The user can control this by driving the Serial BOOT SELECT high at startup, then downloading the code from a PC with suitable software (SiRFFlash). In normal operation this pad should be left floating for minimal current drain. It is recommended that in the user's application, the BOOT SELECT pad is connected to a test pad for use in future software upgrades.

## 7.0 Jupiter³ mechanical drawing

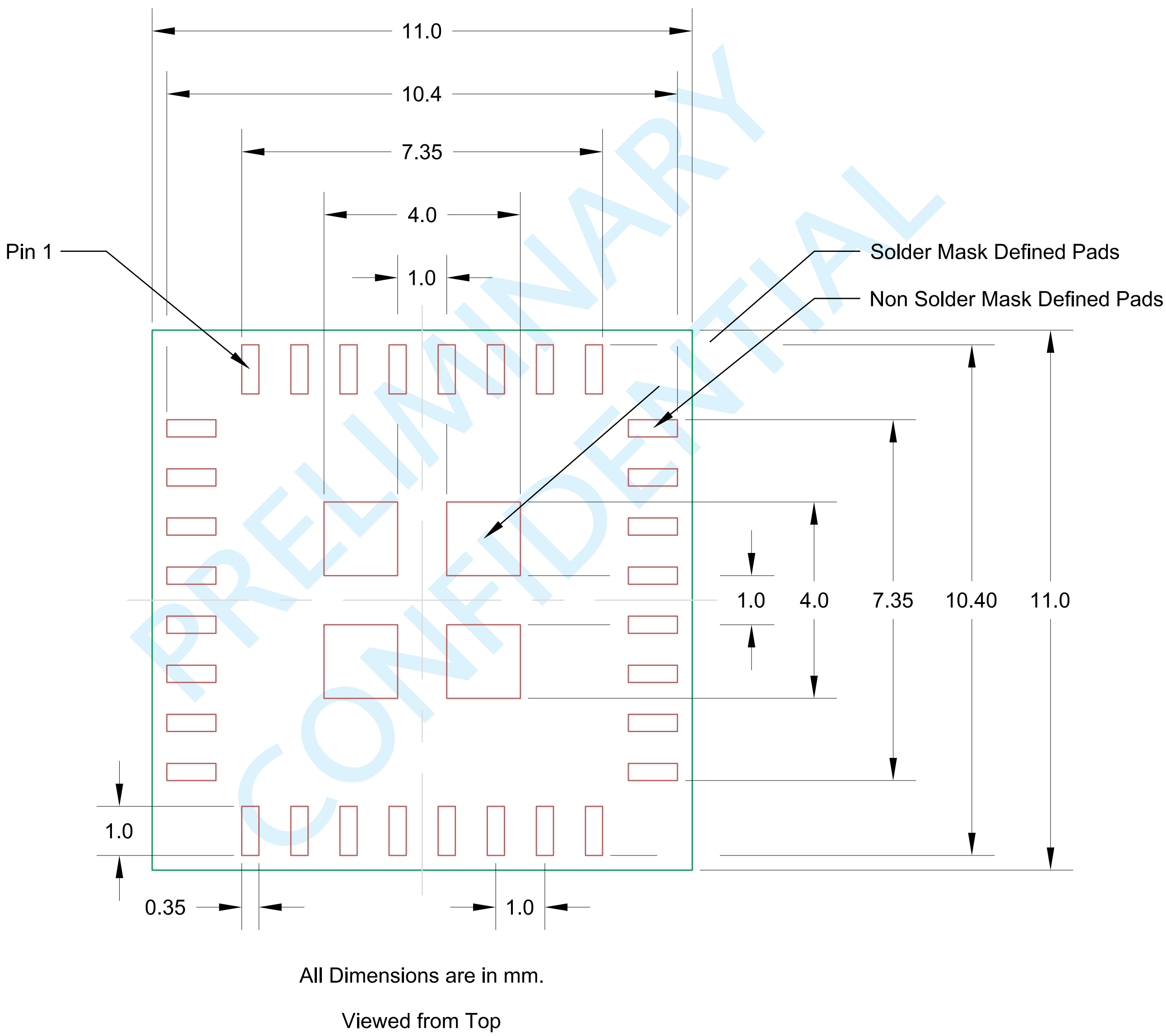


**Figure 2: Footprint**

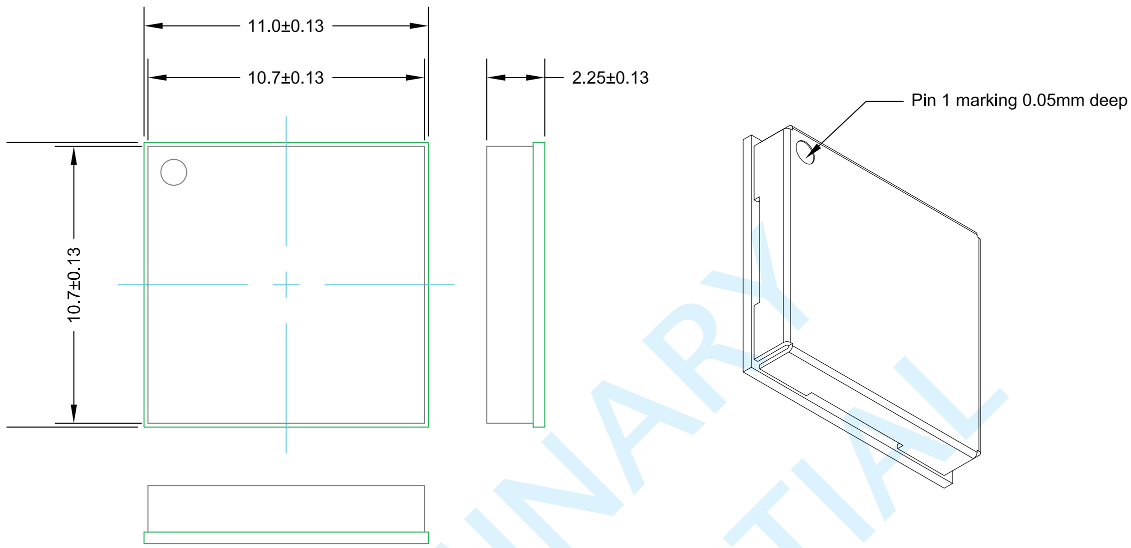


**Figure 3: Mechanical Drawing (units in mm)**



## 8.0 Jupiter3 evaluation kit

The Jupiter3 Development Kit (Part number J3,30DK,00,3.5) is available to assist in the evaluation and integration of the Jupiter3 module in custom applications. The Development Kit contains all of the necessary hardware and software to carry out a thorough evaluation of the Jupiter3 module.

## 9.0 Product handling

### 9.1 Product packaging and delivery

Jupiter3 modules are shipped in Tape and Reel form. The reeled modules are shipped with 250 units per reel. Each reel is 'dry' packaged and vacuum sealed in an Moisture Barrier Bag (MBB) with two silica gel packs and placed in a carton.

The minimum order quantity for shipping is 250 units. Refer to the Jupiter3 Designer's Notes for details on this.

All packaging is ESD protective lined. The Jupiter3 GPS receiver is an Moisture Sensitive Device (MSD) level 3. Please follow the MSD and ESD handling instructions on the labels of the MBB and exterior carton (refer to sections 9.2 and 9.3).

### 9.2 Moisture sensitivity

Precautionary measures are required in handling, storing and using such devices to avoid damage from moisture absorption. If localised heating is required to rework or repair the device, precautionary methods are required to avoid exposure to solder reflow temperatures that can result in performance degradation.

Further information can be obtained from the IPC/JEDEC standard J-STD-033: Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices.

### 9.3 ESD sensitivity

The Jupiter³ GPS receiver contains class 1 devices and is Electro-Static Discharge Sensitive (ESDS). Navman recommends the two basic principles of protecting ESDS devices from damage:

Only handle sensitive components in an ESD Protected Area (EPA) under protected and controlled conditions

Protect sensitive devices outside the EPA using ESD protective packaging. All personnel handling ESDS devices have the responsibility to be aware of the ESD threat to the reliability of electronic products.

Further information can be obtained from the IEC Technical Report IEC61340-5-1 & 2:

Protection of electronic devices from electrostatic phenomena.

### 9.4 Safety

Improper handling and use of the Jupiter GPS receiver can cause permanent damage to the receiver. There is also the possible risk of personal injury from mechanical trauma or choking hazard.

### 9.5 Disposal

We recommend that this product should not be treated as household waste. For more detailed information about recycling this product, please contact your local waste management authority or the reseller from whom you purchased the product.



## 10.0 Ordering information

SKU#: J3,0000,00,3.5

The Firmware (3.5.0.14) is constantly upgraded and subject to change without prior notice

## 11.0 Glossary and acronyms

**2dRMS:** twice-distance Root Mean Square
A horizontal measure of accuracy representing the radius of a circle within which the true value lies at least 95% of the time.

**Almanac:** A set of orbital parameters that allows calculation of approximate GPS satellite positions and velocities. The almanac is used by a GPS receiver to determine satellite visibility and as an aid during acquisition of GPS satellite signals. The almanac is a subset of satellite ephemeris data and is updated weekly by GPS Control.

**C/A code:** Course Acquisition code
A spread spectrum direct sequence code that is used primarily by commercial GPS receivers to determine the range to the transmitting GPS satellite.

**DGPS:** Differential GPS
A technique to improve GPS accuracy that uses pseudo-range errors recorded at a known location to improve the measurements made by other GPS receivers within the same general geographic area.

**GDOP:** Geometric Dilution of Precision
A factor used to describe the effect of the satellite geometry on the position and time accuracy of the GPS receiver solution. The lower the value of the GDOP parameter, the less the error in the position solution. Related indicators include PDOP, HDOP, TDOP and VDOP.

**EGNOS:** European Geostationary Navigation Overlay Service
The system of geostationary satellites and ground stations developed in Europe to improve the position and time calculation performed by the GPS receiver.

**Ephemeris plural ephemerides**
A set of satellite orbital parameters that is used by a GPS receiver to calculate precise GPS satellite positions and velocities. The ephemeris is used to determine the navigation solution and is updated frequently to maintain the accuracy of GPS receivers.

**ESD:** Electro-Static Discharge
large momentary unwanted currents that cause damage to electronic equipment.

**GPS:** Global Positioning System
A space-based radio positioning system that provides accurate position, velocity, and time data.

**LGA:** Land Grid Array
A physical interface for microprocessors. There are no pins on the chip; in place of the pins are pads of bare gold-plated copper that touch pins on the motherboard.

**NMEA:** National Marine Electronics Association

**OEM:** Original Equipment Manufacturer

**Re-acquisition**
The time taken for a position to be obtained after all satellites have been made invisible to the receiver.

**SBAS:** Satellite Based Augmentation System
Any system that uses a network of geostationary satellites and ground stations to improve the performance of a Global Navigation Satellite System (GNSS). Current examples are EGNOS and WAAS.

**SiRFInstantFix**
Eliminates the initial delay of obtaining GPS satellite location data from the satellites themselves by using algorithms to predict up to seven days of satellite location data.

**SRAM:** Static Random Access Memory

**WAAS:** Wide Area Augmentation System
The system of satellites and ground stations developed by the FAA (Federal Aviation Administration) that provides GPS signal corrections. WAAS satellite coverage is currently only available in North America.