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Jupiter 21

GPS receiver module

Data Sheet/
Integrator's manual

Related documents

- Jupiter 21 Product brief LA000515
- Jupiter 21 Development kit guide LA000572
- Low Power Operating Modes application note LA000513
- Navman NMEA reference manual MN000315
- SiRF Binary Protocol reference manual

Pb SiRF Powered

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1.0 Introduction

The Jupiter 21 is a GPS receiver module that provides mechanical and electrical backward compatibility with the Jupiter 12 product range. The Jupiter 21 continues to offer superior GPS performance and high navigation accuracy. Incorporating a Jupiter 20 receiver, the Jupiter 21 has very low power consumption and provides an advanced GPS receiver solution at a very affordable price.

2.0 Technical description

The Jupiter 21 is a single board GPS module solution intended for a wide range of OEM products, and provides an easy migration path from the Jupiter 12.

The highly integrated receiver incorporates and enhances the established technology of the SiRFstarIIe/LP chipset. With a high navigation sensitivity, Jupiter 21 is designed to meet the needs of the most demanding applications and environments. The interface configuration and form factor allows incorporation into many existing devices and legacy designs.

The Jupiter 21 receiver decodes and processes signals from all visible GPS satellites. These satellites, in various orbits around the Earth, broadcast RF (radio frequency) ranging codes, timing information, and navigation data messages. The receiver uses all available signals to produce a highly accurate navigation solution. The 12-channel architecture provides rapid TTFF (Time To First Fix) under all start-up conditions. Acquisition is guaranteed under all initialisation conditions as long as available satellites are not obscured.

Satellite-based augmentation systems, such as WAAS and EGNOS, are supported to improve position accuracy.

The Jupiter 21 is available in three core configurations:

- Jupiter 21 (standard) – GSW2 navigation software
- Jupiter 21S (high sensitivity) – with XTrac navigation software
- Jupiter 21D (Dead Reckoning) – with SiRFDRive software and gyro interface

Protocols supported are selected NMEA (National Marine Electronics Association) data messages and SiRF binary.

Note: Jupiter 21D (dead reckoning) is available only as a custom product.

2.1 Product applications

The Jupiter 21 is suitable for a wide range of modular OEM GPS design applications such as asset tracking, fleet management and marine and vehicle navigation products.

2.2 Architecture

A diagram of the Jupiter 21 architecture is shown in Figure 2-1.

2.3 Physical characteristics

The Jupiter 21 is compatible with the Jupiter 12 form factor. The receiver is available in several configurations (combination of core engine and antenna connector type). The configuration must be selected at the time of ordering and is not available for field retrofitting. Refer to Table 12-1 for Jupiter 21 part ordering information.

2.4 Mechanical specification

The physical dimensions of the Jupiter 21 are as follows:

length:	71.1 mm
width:	40.6 mm
thickness:	10.0 mm
weight:	25.0 g

Refer to Figure 9-1 for the Jupiter 21 mechanical drawing.

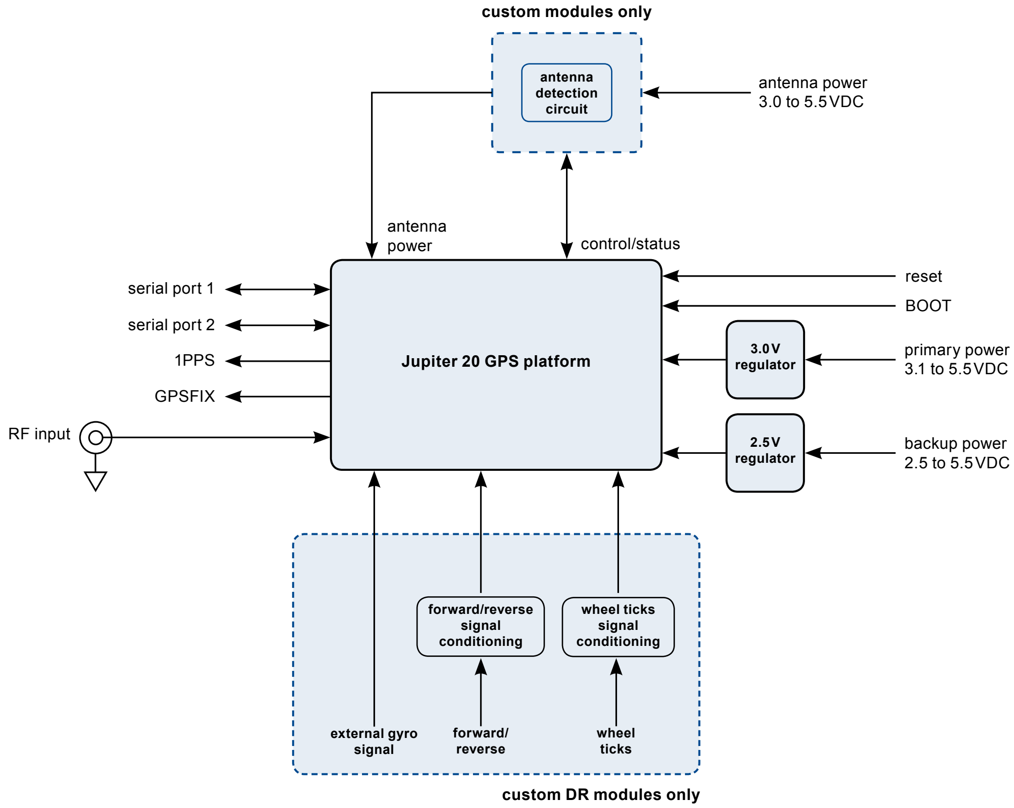

Figure 2-1: Jupiter 21 block diagram

2.5 Environmental

The environmental operating conditions of the Jupiter 21 are as follows:

temperature: –40°C to +85°C

humidity: up to 95% non-condensing or a wet bulb temperature of +35°C

altitude: –300 m to 18 000 m

vibration: random vibration IEC 68-2-64

shock (non-operating): 18 G peak, 5 ms

2.6 Compliances

The Jupiter 21 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
- Automotive standard TS 16949
- Manufactured in an ISO 9000 : 2000 accredited facility

2.7 Marking/Serialisation

The Jupiter 21 supports a 128 barcode indicating the unit serial number. The Navman 13-character serial number convention is:

characters 1 and 2: year of manufacture (e.g. 06 = 2006, 07 = 2007)

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

3.0 Performance characteristics

All parameters specified in this section are based on room temperature conditions (22±2°C) and a typical power supply voltage (3.3±0.1 V) unless otherwise stated.

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.

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

Table 3-1 shows the corresponding TTFF times for each of the acquisition modes.

Mode	J21		J21S	
	Typ	90%	Typ	90%
TTFF hot (valid almanac, position, time & ephemeris)	8 s	12 s	8 s	12 s
TTFF warm (valid almanac, position & time)	38 s	42 s	38 s	40 s
TTFF cold (valid almanac)	44 s	55 s	45 s	56 s
re-acquisition (<10 s obstruction with valid almanac, position, time & ephemeris)	100 ms	100 ms	100 ms	100 ms

Table 3-1: Acquisition times

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3.3 TricklePower™ mode

During normal operating mode the Jupiter 21 runs continuously, providing a navigation solution at the maximum rate of once per second. This continuous mode provides no power saving.

TricklePower mode can be enabled to reduce the average power consumption. Main power is supplied to the module continuously. An internal timer wakes the processor from sleep mode and a navigation position fix is computed, after which the processor reverts to sleep mode. The duty cycle is controlled by a user-configurable parameter.

If the ephemeris data become outdated, the TricklePower mode will attempt to refresh the data set within every 30 minute period, or for every new satellite that comes into view.

With TricklePower set to a 20% duty cycle, a power saving of 50% can easily be achieved with minimal degradation in navigation performance.

3.3.1 Adaptive TricklePower™ mode

In Adaptive TricklePower mode, the processor automatically returns to full power when signal levels are below the level at which they can be tracked in TricklePower mode. This is the default behaviour when TricklePower is active.

3.3.2 Push-To-Fix™ mode

Unlike TricklePower, the operation in this mode is not cyclic. This 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 reset 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 on the TricklePower and Push-To-Fix modes refer to the Low Power Operating Modes application note (LA000513).

3.4 Differential aiding

3.4.1 Differential GPS (DGPS)

DGPS specification improves the Jupiter 21 horizontal position accuracy to <4 m 2 dRMS.

3.4.2 Satellite Based Augmentation Systems (WAAS/EGNOS)

The Jupiter 21 is capable of receiving WAAS and EGNOS differential corrections. SBAS improves horizontal position accuracy by correcting GPS signal errors caused by ionospheric disturbances, timing and satellite orbit errors.

Both SBAS and DGPS should improve position accuracy. However, other factors can affect accuracy, such as GDOP, multipath, distance from DGPS reference station and latency of corrections. Note also that XTrac does not support differential aiding.

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3.5 Navigation modes

The Jupiter 21 GPS receiver supports 3D (three-dimensional) and 2D (two-dimensional) modes of navigation.

3D navigation: the receiver defaults to 3D navigation when at least four GPS satellites are being tracked. In 3D navigation, the receiver computes latitude, longitude, altitude, and time information from satellite measurements.

2D navigation: when less than four GPS satellite signals are available, or when a fixed altitude value can be used to produce an acceptable navigation solution, the receiver will enter 2D navigation using a fixed value of altitude determined by the host. Forced operation in 2D mode can be commanded by the host.

In 2D navigation, the navigational accuracy is primarily determined by the relationship of the fixed altitude value to the true altitude of the antenna. If the fixed value is correct, the specified horizontal accuracies apply. Otherwise, the horizontal accuracies will degrade as a function of the error in the fixed altitude.

3.6 Core processor performance

The standard Jupiter 21 with GSW2 software runs at a CPU clock speed of 12.28 MHz. Approximately 0.9 MIPS (Millions of Instructions Per Second) are executed for every 1 MHz of clock speed. Using XTrac software (Jupiter 21S), the clock speed increases to 24.5 MHz. An SDK (Software Development Kit) is available from SiRF to customise the Jupiter 21 firmware. Using the SiRF SDK the clock speed can be increased up to 49 MHz.

The processing power used by the navigation software is shown in Table 3-2.

Parameter	J21	J21S
typical use	2-3 MIPS	4-5 MIPS
peak use	6-7 MIPS	8-9 MIPS

Table 3-2: Software processing bandwidth

3.7 Sensitivity

The GPS receiver performance of the Jupiter 21 is shown in Table 3-3.

Parameter	J21		J21S	
acquisition sensitivity	–135 dBm	33 dBHz	–135 dBm	33 dBHz
navigation sensitivity	–141 dBm	28 dBHz	–152 dBm	17 dBHz
tracking sensitivity	–147 dBm	26 dBHz	–154 dBm	15 dBHz

Table 3-3: GPS receiver performance

3.8 Dynamic constraints

The Jupiter 21 receiver is programmed to deliberately lose track if any of the following limits is 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 Jupiter 21 are shown in Table 3-4, assuming full accuracy C/A code. These values are the same in normal operation and when TricklePower is active.

Parameter	J21	J21S
horizontal CEP	2.1 m	2.2 m
horizontal (2 dRMS)	5.2 m	5.5 m
vertical VEP	2.5 m	2.5 m
velocity 2D (2 sigma)*	0.1 m/s	0.15 m/s
**at a velocity greater than 5 km/h*		

Table 3-4: Position and velocity accuracy

4.0 Electrical requirements

All parameters specified in this section are based on room temperature conditions (22 ± 2°C) and a typical power supply voltage (3.3 ± 0.1 V) unless otherwise stated.

4.1 Power supply

4.1.1 Primary power

The Jupiter 21 GPS receiver is designed to operate from a single supply voltage, meeting the requirements shown in Table 4-1.

Parameter	J21	J21S
input voltage	3.1 to 5.5 VDC	3.1 to 5.5 VDC
current (typ) at full power	75 mA	85 mA
current (max)	100 mA	110 mA
current (typ) at 20% TricklePower	35 mA	60 mA
battery backup voltage	2.5 to 5.5 VDC	2.5 to 5.5 VDC
battery backup current	10 μA	10 μA
input capacitance	1 μF	1 μF
detector threshold 'brown out' system reset	< 2.85 V	< 2.85 V
minimum rise/fall time	unlimited	unlimited
ripple (max)	50 mV pp	50 mV pp

Table 4-1: Operating power for the Jupiter 21

CAUTION! If battery backup is not used, the Jupiter 21 receiver will revert to default settings if power is removed.

4.1.2 Low supply voltage detector

The module will enter a reset mode if the main supply drops below 2.8 V.

4.1.3 RF (Radio Frequency) input

RF input is 1575.42 MHz (L1 Band) at a level between –135 dBm and –152 dBm into a 50 Ω impedance. 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.

4.1.4 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 should be in the range of 20 to 30 dB.

4.1.5 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.

4.1.6 Jamming performance

The jamming performance of the receiver based upon a 3 dB degradation in C/N_0 performance is shown in Table 4-2. This is with reference to the external antenna. These results are determined using a CW (Continuous Wave) Jammer.

Frequency MHz	Jamming signal power dBm
121.5	–10
406.028	–12
800	–29
900	–14
1400	–19
1530	–27
1555	–69
1575.42	–114
1625.42	–33
1725.42	–19
1800	–17

Table 4-2: Jamming performance

4.2 Data input output specifications

The I/O connector voltage levels are shown in Table 4-3.

Signals	Parameter	Value
RXA*, RXB*, RESET†, BOOT†, W_TICKS, FWD/REV*	V_{IH} (min)	Greater of 0.7 x PWRIN or 2.5 V
	V_{IH} (max)	PWRIN (V)
	V_{IL} (min)	–0.3 V
	V_{IL} (max)	0.8 V
Gyro (DR only)	Vin max	5 V
	Vin min	0
TXA*, TXB*, TMARK, GPSFIX	V_{OH} (min)	0.8 x PWRIN (V)
	V_{OH} (max)	PWRIN
	V_{OL} (min)	0
	V_{OL} (max)	0.2 x PWRIN (V)
	Max rise and fall time	50 ns
	Max output load capacitance	25 pF

**Inputs pulled to PWRIN with 100kΩ*
†Pulled up by 10kΩ

Table 4-3: Interface voltage levels

5.0 Interfaces

5.1 External antenna interface

The Jupiter 21 is available with the following antenna connector configurations:

- OSX jack, straight (female)
- OSX jack, right angle (female)
- SMB jack, right angle (female)

Note that SMB connectors do not follow the same 'gender' convention as other RF connectors. The SMB right angle connector is classed female even though it has a pin and would be classed male in other variations of connectors.

5.2 External antenna voltage

The Jupiter 21 provides DC power to the external active antenna through the antenna power input pad (VANT). The DC supply in the coax cable is vulnerable to over current if a fault occurs in the antenna or if the antenna cable gets damaged.

The following is applicable to custom modules only:

The Jupiter 21 provides protection in this situation through short circuit detection and current limiting. Serial messages reporting the antenna status (open circuit, short circuit and normal operation) are provided for both the Jupiter 21 and 21S. The Jupiter 21D provides a current limit but no serial output is available.

Typical values for the external antenna are shown in Table 5-1.

Parameter	J21/J21S
voltage min	3.0 VDC
voltage (typ)	3.3 VDC
voltage max	5.5 VDC
supply resistance*	1 Ω†
antenna current limit**	50 mA
antenna open circuit detector current**	1 mA
antenna short circuit detector current**	50 mA
*not including external supply resistance **custom modules only †11Ω for antenna detection in custom modules	

Table 5-1: External antenna voltages

5.3 External I/O connector

The OEM communications interface is a dual row, straight 2 x 10-pin field connector header (J1). The pins are spaced on 2.0 mm centres and the pin lengths are 6.8 mm off the board surface with 1.3 mm at the base for plastic form. Figure 5-1 shows the 20-pin I/O connector. The mating female connector is an IDC receptacle.

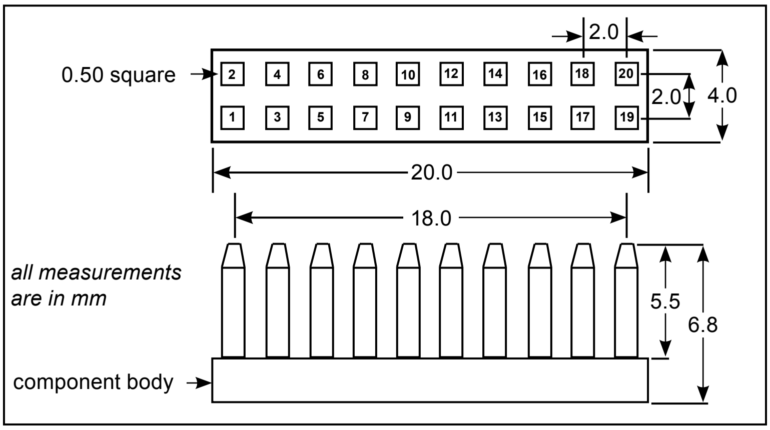

Figure 5-1: The 20-pin interface connector (J1)

5.3.1 I/O connector signals

Tables 5-2 and 5-3 show the name and function of each connector pin. A further description of each pin follows these tables.

Pad No.	Name	Type	Description
1	VANT	P	external power supply for active antenna
2	PWRIN	P	primary VDC power input
3	VBATT	P	backup battery input
4	PWRIN	P	primary VDC power input
5	RESET	I	master reset (active low)
6*	no connection	–	
7*	reserved	–	
8	BOOT	I	serial boot (active low; can be held high or open circuit for normal operation)
9*	no connection	–	
10	GND	P	ground
11	TXA	O	CMOS level asynchronous output for UART A
12	RXA	I	CMOS level asynchronous input for UART A
13	GND	P	ground
14	TXB	O	CMOS level asynchronous output for UART B
15	RXB	I	CMOS level asynchronous input for UART B
16	GND	P	ground
17	GND	P	ground
18	GND	P	ground
19	PPS	O	pulse per second output
20	GPSFIX	O	GPS fix indication (active low)
See also Table 5-3 for DR custom module pin functions			

Table 5-2: J1 connector pin functions (J21/J21S)

Pad No.	Name	Type	Description
6	GYRO_IN	I	gyro input (analogue 0–5 V)
7	FWD/REV	I	fwd/rev input (low=forward, high=reverse)
9	WHEEL_TICKS	I	wheel tick input

Table 5-3: J1 connector pin functions (J21D custom modules only)

Pin 1: VANT
This pin supplies DC power to the external antenna. Refer to Section 5.2 for more details.

Pins 2 and 4: PWRIN
Jupiter 21 supports 3.3 VDC and 5 VDC. The main power must be regulated and have maximum ripple of 50 mV.

Pin 3: VBATT
The VBATT (battery backup) pin can supply power to the SRAM and RTC (Real Time Clock) during ‘powered down’ conditions (refer to Table 4-1). The Jupiter 21 can accept slow VBATT supply rise time (unlike many SiRFstarII based receivers) due to an on-board voltage detector.

Pin 5: RESET
This active low input allows the user to restart the software from an external signal. It is also used to initiate a ‘push-to-fix’ navigation cycle. In normal operation this pin should be left floating or activated by an open drain driver. Active pull-up is not recommended.

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Pin 6: GYRO_IN (J21D custom modules only)
This pin is used for the heading rate gyro input on Jupiter 21D receivers. Characteristics of the input signal are:

- 0 to 5 V range
- 2.5 V output when gyro is not being rotated
- clockwise rotation of the gyro causes voltage to rise
- maximum voltage deviation due to rotation should occur with a turning rate of 90 degrees/second or less

The gyro should be mounted so its sensitive axis is as vertical as practical. Deviations from the vertical reduce sensitivity for heading changes in the horizontal direction. Acceptable performance can be achieved with mounting deviations of several degrees, but better performance is achieved when the gyro is mounted closer to vertical.

Pin 7: FWD/REV (J21D custom modules only)
The fwd/rev input sense is: low=forward, high=reverse. An external pull down is required if this input is not used.

Pin 8: BOOT
The firmware programmed in the Flash memory may be upgraded via the serial port. The user can control this by pulling the Serial BOOT pin (8) low at startup, then downloading the code from a PC with suitable software (e.g. SiRFFlash). In normal operation this pin should be left floating for minimal current drain. It is recommended that in a user application, the BOOT pin is connected to a test pad for use in future software upgrades.

Pin 9: WHEEL_TICKS (J21D custom modules only)
This pin is used to receive speed pulses (wheel ticks) from the vehicle with Jupiter 21D receivers. The input to this pin is a pulse train generated by the vehicle. The pulse frequency is proportional to the vehicle velocity. In most vehicles, the ABS (Anti-lock Braking System), transmission, or drive shaft generate these pulses, or wheel ticks.

System design must restrict the pulses between 0 and 12 V with a duty cycle near 50%. The system is capable of operating properly up to a maximum wheel tick rate of 4 kHz and to a minimum of 1 Hz. For vehicles with 48 pulses per metre, the upper limit is equivalent to 300 km/h. For vehicles with 2 pulses per metre, the minimum limit equates to 1.8 km/h. Wheel ticks must be available whenever the vehicle moves and the minimum resolution must be at least 0.5 metres per pulse. Failure to output wheel ticks at low speeds will cause incorrect calibration and result in poor performance. Note: Changes in conditions, such as road grade and variations in tyre size due to temperature, can have an effect on the accuracy of the wheel tick input.

To ensure minimum current when backup power is used, this input must be pulled to a CMOS low external to the board.

Pins 11, 12, 14 and 15: serial data ports
Serial port A (pins 11 and 12), also called the host port, is the primary communications port of the receiver. Commands to the receiver are entered through pin 12 (RXA) and data from the receiver is transmitted through pin 11 (TXA). Binary or NMEA messages are transmitted and received across the host port's serial I/O interface.

Serial port B (pins 14 and 15), also called the auxiliary port, is reserved for DGPS corrections sent to the receiver. By default serial port B input (pin 15) receives DGPS messages at 9600 baud (no parity, 8 data bits, 1 stop bit). These messages are in RTCM (Radio Technical Commission for Maritime services) SC-104 format. Note: Jupiter 21S does not support DGPS.

Pin 19: 1PPS time mark pulse
The Jupiter 21 receiver generates a 1PPS output signal of < 1 μs, typical ± 300 ns which is aligned to Universal Time Coordinated (UTC) second. The signal is a positive-going pulse of approximately 100ms duration. When the receiver has properly aligned the signal, the rising edge is within 88ns (1 sigma) of the UTC second. This feature is currently only available on the Jupiter 21 standard module.

Pin 20: GPSFIX
This pin is driven low whenever the unit has a 2D or 3D position fix (otherwise high).

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 shown in Table 6-1.

Port	J21 (GSW2)	J21S (XTrac v2)
Port A	NMEA, 4800	NMEA, 4800
Port B	DGPS, 9600	SiRF binary, 38400

Table 6-1: Jupiter 21 default baud rates

6.1 NMEA data messages

The output NMEA (0183 v2.3) messages and refresh rates of the Jupiter 21 receiver are listed in Table 6-2.

Message description	Message ID	J21	J21S
GPS fix data*	GPGGA	1 s	1 s
GPS DOP and active satellites*	GPGSA	1 s	1 s
GPS satellites in view*	GPGSV	2 s	2 s
recommended minimum specific GPS data*	GPRMC	1 s	1 s
track made good and ground speed	GPVTG	off	off
latitude, longitude, UTC of position fix and status	GPLL	off	off
PPS timing message	GPZDA	off	N/A
Navman proprietary Zodiac channel status*†	PRWIZCH	1 s	1 s
**enabled by default at power-up, †see Note below table N/A=not available, off=off by default*			

Table 6-2: NMEA output messages

Note: the output of PRWIZCH can be turned off using the following message:

$PSRF103,09,00,00,01,*2D<cr><lf>

To turn the output of PRWIZCH on:

$PSRF103,09,00,01,01,*2C<cr><lf>

On Power Up or Reset the GPS will output a debug header before the NMEA data appears. It will appear in the following format:

```
$Version 2.3.2-GSW2-2.05.024-C1Prod1.5
$TOW: 0
$WK: 2255
$POS: 6378137 0     0
$CLK: 96000
$CHNL: 12
$Baud rate: 4800 System clock: 12.277 MHz
$HW type: S2AM
$Asic version: 0x23
$Clock source: GPSCLK
$Internal beacon: None
$NAVMAN SW Version: Jupiter21 v1.9 build 2 (ST)
$PSRF150, 1*3E
```

Note: these fields are variable and are subject to change with device operation and software revision.

6.1.1 Jupiter 21 NMEA variations

The Jupiter 21 NMEA output messages have been adapted for backwards compatibility with the Jupiter 12. This has resulted in a number of variations to the message structure described in the Navman NMEA reference manual (MN000315). Table 6-3 highlights the differences in message structure (underlined text).

Message name	NMEA structure (defined in MN000315)	J21 NMEA structure (identical to J12)
GGA	$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M,1.0,M,0.0,0000*18	$GPGGA,161229,3723.2475,N,12158.3416,W,1,07,1.00,9.0,M,1.0,M, , *18
GSA	$GPGSA,A,3,07,02,26,27,09,04,15, , , , ,1.8,1.0,1.5*33	$GPGSA,A,3,07,02,26,27,09,04,15, , , , ,1.80,1.00,1.50*33
RMC	$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.130,309.62,120598,23.1,E*10	$GPRMC,161229,A,3723.2475,N,12158.3416,W,0.130,309.6,120598,23.1,E*10
VTG	$GPVTG,309.62,T,286.52,M,0.13,N,0.20,K,A*23	$GPVTG,309.6,T,286.5,M,0.130,N,0.200,K,A*23
ZDA	$GPZDA,181813,14,10,2003,00,00*4F	$GPZDA,181813.00,14,10,2003,00,00*4F

Table 6-3: Jupiter 21 NMEA message structure

A description of each NMEA message field is contained in the Navman NMEA reference manual (MN000315).

6.2 Navman proprietary NMEA messages

Navman has added a number of proprietary NMEA input messages to configure the TricklePower and Push-To-Fix modes.

6.2.1 Low power configuration

The following message sets the receiver to low power mode:

$PSRF151,a,bbbb,cccc*CS<cr><lf>

where:

Field	Description
a	Push-To-Fix* (1=on, 0=off)
b	TricklePower duty cycle (parts per thousand)
c	TricklePower on time (milliseconds)
*Note that Push-To-Fix™ does not require fields b and c so they may be left blank	

Table 6-4: Low power modes message values

This message is the NMEA equivalent of the SiRF Binary input message ID 151.

System response:

$PTTK,LPSET,a,bbbb,cccc*CS

The updated values returned by the system are as described in Table 6-4.

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6.2.2 Low power acquisition configuration

The following message sets the acquisition parameters of the low power mode:

$PSRF167,aaaa,bbbb,cccc,d*CS<cr><lf>

where:

Field	Description
a	maximum off time (milliseconds)
b	maximum search time (milliseconds)
c	Push-To-Fix period (seconds)
d	adaptive TricklePower (1=on, 0=off)

Table 6-5: Low power acquisition input values

This message is the NMEA equivalent of the SiRF Binary input message ID 167.

System response:

$PTTK,LPACQ,aaaa,bbbb,cccc,d*CS

The updated values returned by the system are as described in Table 6-5.

6.3 SiRF binary messages

A complete description of each binary message is contained in the SiRF Binary Protocol reference manual.

6.4 Software functions and capabilities

Table 6-6 shows the software features available with the Jupiter 21 configurations.

Feature	Description	J21 GSW2	J21S XTrac
SBAS capability	improves position accuracy by using freely available satellite-based correction services called SBAS (Satellite-Based Augmentation Systems)	A	
DGPS ready	accepts DGPS corrections in the RTCM SC-104 format	E	
TricklePower	improves battery life using this enhanced power management mode	A	A
Adaptive TricklePower	intelligently switches between TricklePower and full power depending on the current GPS signal level (when TricklePower is enabled)	E	yes
advanced power management	improves battery life using a software-based power management		A
Push-to-Fix	provides an on-demand position fix mode designed to further improve battery life	A	A
almanac to flash	improves cold start times by storing the most recent almanac to flash memory	yes	
low signal acquisition	acquires satellites in low signal environments		yes
low signal navigation	continues navigating in extremely low signal environments		yes
1 PPS	a timing signal generated every second on the second	yes	
ephemeris collection by word	improves speed of ephemeris collection in areas of periodic signal interruption by acquiring word-sized data portions rather than subframe-sized portions	yes	yes
yes = *always enabled* **A** = *available* **E** = *enabled by default in production units*			

Table 6-6: Jupiter 21 software capability

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7.0 Dead Reckoning input specifications

The gyro input specifications shown in Table 7-1 apply to Jupiter 21D custom modules only.

Characteristics	Value	Unit
input max voltage range	max +5, min 0	VDC
input resistance nominal	18.2	kΩ
nominal bias at zero angular velocity	2.5	VDC
nominal scale factor	22.2	mV per degree/s
linearity	±0.5 max	%
angular resolution	0.055	degrees/s
max gyro angular rate	±80	degrees/s
Note that clockwise rotation should cause the input to rise		

Table 7-1: Gyro input specifications

At the time of publication, recommended manufacturers of gyros are as follows:

Murata ENV series

Panasonic EWTS series

(Navman takes no responsibility for the use of these gyros in an application.)

A provision exists for Navman to supply a Jupiter 21 module with an on-board gyro fitted.

8.0 Jupiter 12/21 comparison

This section highlights the differences between the Jupiter 12 and Jupiter 21 to assist with substitution in legacy applications.

8.1 Receiver architecture

Feature	Jupiter 12	Jupiter 21	Performance issues
receiver design	SiRF Zodiac chipset	SiRFstarIIe/LP chipset	1) J21 has faster TTFF 2) J21 has lower power consumption

8.2 Antenna specification

Feature	Jupiter 12	Jupiter 21	Performance issues
antenna gain	best results achieved in the range 12 to 18 dB	active antenna gain should be in the range of 20 to 30 dB	–

8.3 Electrical interface

The following table highlights the differences between the electrical connector pin configurations.

Jupiter 12 pin no./name	Jupiter 21 pin no./name	Performance issues
pin 7: GPIO2	pin 7: reserved	J12: pin 7 used to select the NMEA messaging protocol at baud rate 4800
		J21: outputs the same messages at a baud rate of 4800 by default
pin 8: GPIO3 (active low)	pin 8: BOOT (active low)	J12: pulling pin 8 low at start-up obtains a known state of the module periodically
		J21: pulling pin 8 low at start-up sets the module to BOOT mode (enabling Flash memory to be upgraded). If BOOT mode not required, application will need to be modified.
pin 14: N/C	pin 14: TXB	J12: not connected
		J21: second serial data output port
pin 15: SDI2	pin 15: RXB	J12: second serial data input port. Receives DGPS messages in RTCM.
		J21: second serial data input port. J21/J21D only receives DGPS messages in RTCM (J21S does not support DGPS).
pin 20: 10kHz clock output	pin 20: GPSFIX (active low)	J12: outputs an accurate 10 kHz clock
		J21: outputs low when the receiver has a fix, high otherwise

8.4 NMEA messaging protocol

	Jupiter 12	Jupiter 21
NMEA input messages	Navman proprietary messages. Refer to the Jupiter 12 data sheet.	SiRF proprietary input messages. Refer to the Navman NMEA reference manual.
NMEA output messages	Navman proprietary and NMEA output messages. Refer to the Jupiter 12 data sheet.	Navman proprietary and NMEA output messages. Refer to section 6.1.1.

8.5 Binary messaging protocol

	Jupiter 12	Jupiter 21
Binary input messages	Navman binary input messages. Refer to the Jupiter 12 data sheet.	SiRF Binary input messages. Refer to the SiRF Binary Protocol reference manual.
Binary output messages	Navman binary output messages. Refer to the Jupiter 12 data sheet.	SiRF Binary output messages. Refer to the SiRF Binary Protocol reference manual.

8.6 Default baud rates

Port	J12	J21 (GSW2)	J21S (XTrac v2)
Port A	NMEA, 4800	NMEA, 4800	NMEA, 4800
Port B	RTCM, 9600	RTCM, 9600	SiRF binary, 38400*

**Jupiter 21S does not support DGPS*

8.7 Acquisition

Mode	J12		J21		J21S	
	Typ	90%	Typ	90%	Typ	90%
TTFF hot (valid almanac, position, time & ephemeris)	18 s	24 s	8 s	12 s	8 s	12 s
TTFF warm (valid almanac, position & time)	48 s	60 s	38 s	42 s	38 s	40 s
TTFF cold (valid almanac)	120 s	180 s	44 s	55 s	45 s	56 s
re-acquisition (<10 s obstruction with valid almanac, position, time & ephemeris)	2 s	2 s	100 ms	100 ms	100 ms	100 ms

9.0 Jupiter 21 mechanical drawing

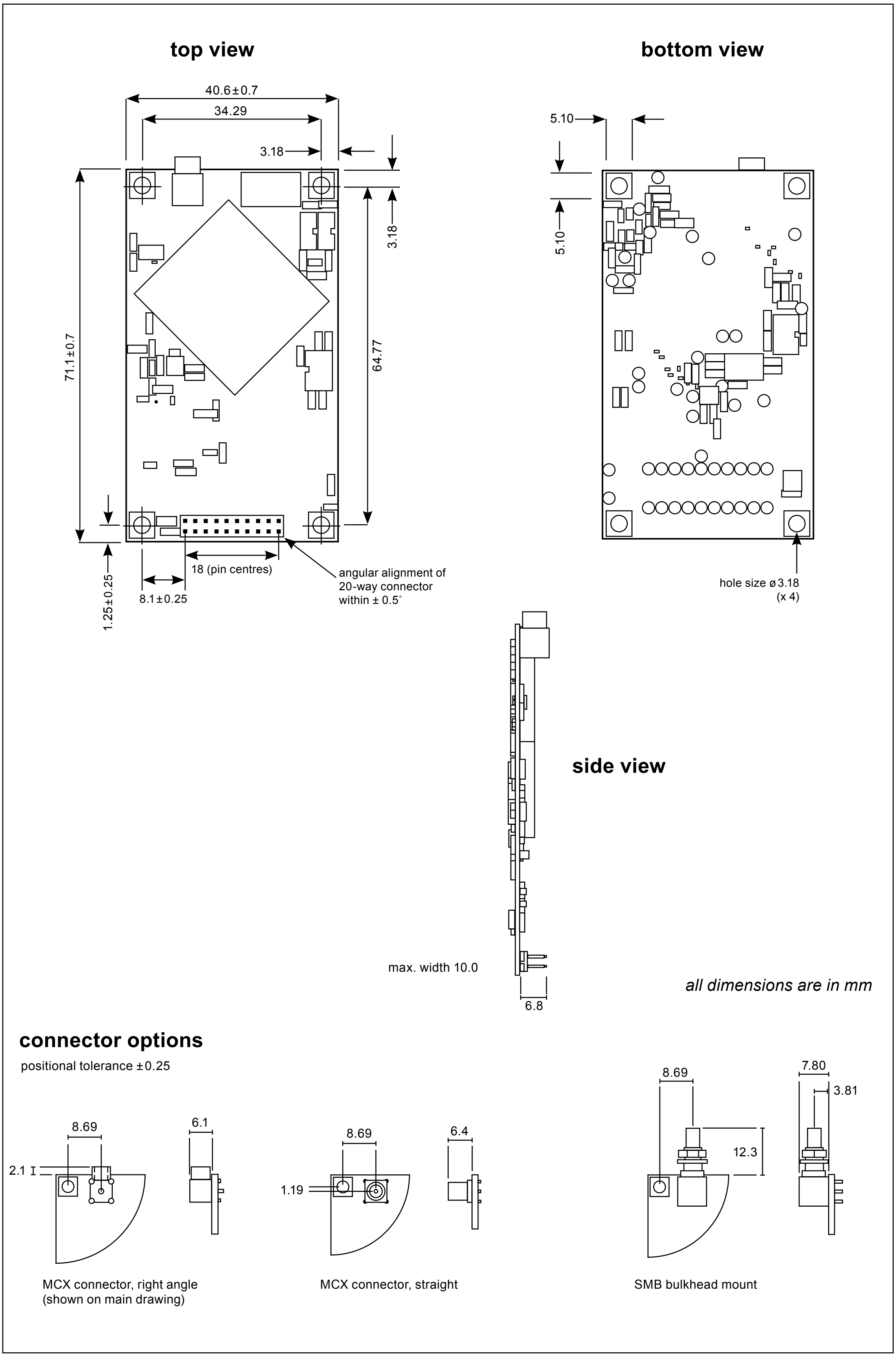


Figure 9-1: Jupiter 21 mechanical drawing

10.0 Jupiter 21 Development kit

The Jupiter 21 Development kit is available to assist in the integration of the Jupiter 21 module in custom applications. The Development kit contains all of the necessary hardware and software to carry out a thorough evaluation of the Jupiter 21 module.

11.0 Product handling

11.1 Packaging and delivery

The Jupiter 21 modules are packed in quantities of 10 in an anti-static tray with fitted lid. The lid is labelled with an ESD Caution. Five such trays are shipped in a box.

The MOQ (Minimum Order Quantity) is 50 units.

11.2 ESD sensitivity

The Jupiter 21 GPS receiver contains class 1 devices and is ESDS (ElectroStatic Discharge Sensitive). Navman recommends the two basic principles of protecting ESDS devices from damage:

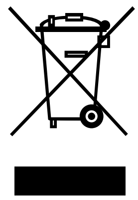
- Only handle sensitive components in an ESD Protected Area (EPA) under protected and controlled conditions
- Protect sensitive devices outside the EPA using ESD protective packaging

All personnel handling ESDS devices have the responsibility to be aware of the ESD threat to 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.

11.3 Safety

Improper handling and use of the Jupiter GPS receiver can cause permanent damage to the receiver and may even result in personal injury.



11.4 RoHS compliance

This product complies with Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

11.5 Disposal

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

12.0 Ordering information

The part numbers of the Jupiter 21 variants are shown in Table 12-1.

Part Number	Description
TU21-D410-021	Jupiter 21 (standard) with right angle OSX
TU21-D410-031	Jupiter 21 (standard) with straight OSX
TU21-D410-041	Jupiter 21 (standard) with right angle SMB
TU21-D510-021	Jupiter 21S (XTrac) with right angle OSX
TU21-D510-031	Jupiter 21S (XTrac) with straight OSX
TU21-D510-041	Jupiter 21S (XTrac) with right angle SMB
TU10-D007-403	Jupiter 21 (standard) Development kit
TU10-D007-404	Jupiter 21S (XTrac) Development kit

Table 12-1: Jupiter 21 ordering information

13.0 Glossary and acronyms

2dRMS: twice distance Root Mean Square

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: Coarse 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.

C/N: Carrier to Noise ratio
A measure of the received carrier strength relative to the strength of the received noise (measured in dB).

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: 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.

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

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.

SRAM: Static Random Access Memory

UTC: Universal Time Co-ordinated
The international time standard, a successor to GMT (Greenwich Mean Time).

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.