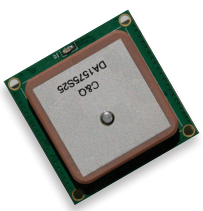
Datasheet

J3-A



Antenna

Back

Extra Low Power Fully Integrated Antenna and Receiver

August 3, 2010

Related Documents

- Navman Wireless OEM NMEA reference manual
- SiRF Binary Protocol reference manual

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1.0 Introduction

J3-A from Navman Wireless is a complete GPS smart antenna and high performance receiver, including embedded antenna and receiver circuits that provide superior location capabilities and eliminate the need for an external RF antenna. The 20-channel ultra-high sensitivity receiver is based on proven SiRFstar III technology. J3-A provides the fastest TTFF (Time to First Fix) possible for all weather conditions, in challenging environments such as densely built cities, heavy foliage, and enclosed spaces.

2.0 Technical description

Navman has enhanced the architecture of the SiRF GSC3f chipset by adding carefully selected key components including TCXO and LNA. This ensures frequency stability, improved sensitivity at chipset level down to –159 dBm, lower power consumption and a faster TTFF (Time To First Fix). The GSC3f chip integrates baseband, RF sections and Flash memory, thereby reducing power consumption and size. Integrated 4 Megabit flash memory gives the user the ability to store configurations permanently.

By providing on-board micro-battery, the J3-A allows rapid satellite acquisition times by preserving system data in SRAM and the power to the RTC section of the GSC3f chipset.

The 20 channel architecture, with more than 200 000+ effective correlators, provides rapid TTFF under all start-up conditions, due to higher sensitivity and the ability to use multi-mode aiding (see section 3.9).

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

2.1 Product applications

The J3-A 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 services

2.2 Receiver functional architecture

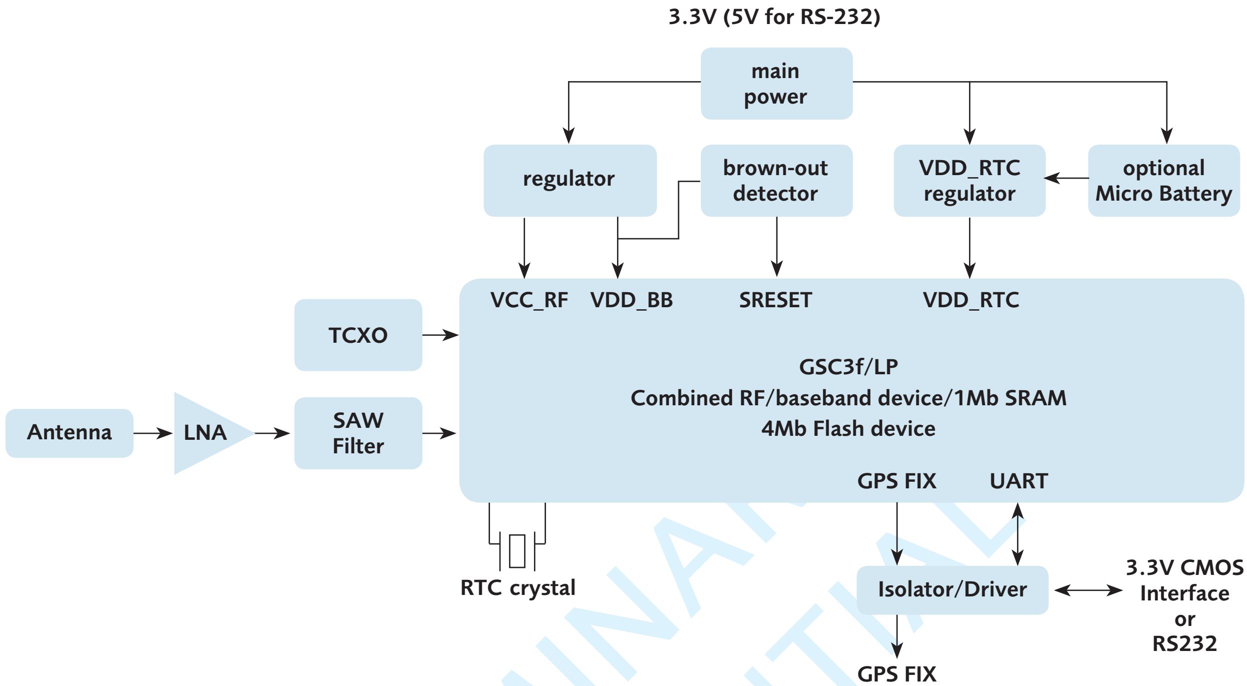


Figure 2-1: Receiver architecture

2.3 Physical characteristics

The J3-A is a complete GPS receiver with built-in patch antenna. The four mounting holes at the corners make it easy to install. There are five(5) electrical solder tabs on the underneath side of the board for electrical connections.

2.4 Mechanical specification

2.4.1 Antenna: Physical dimensions

Dimensions in mm:

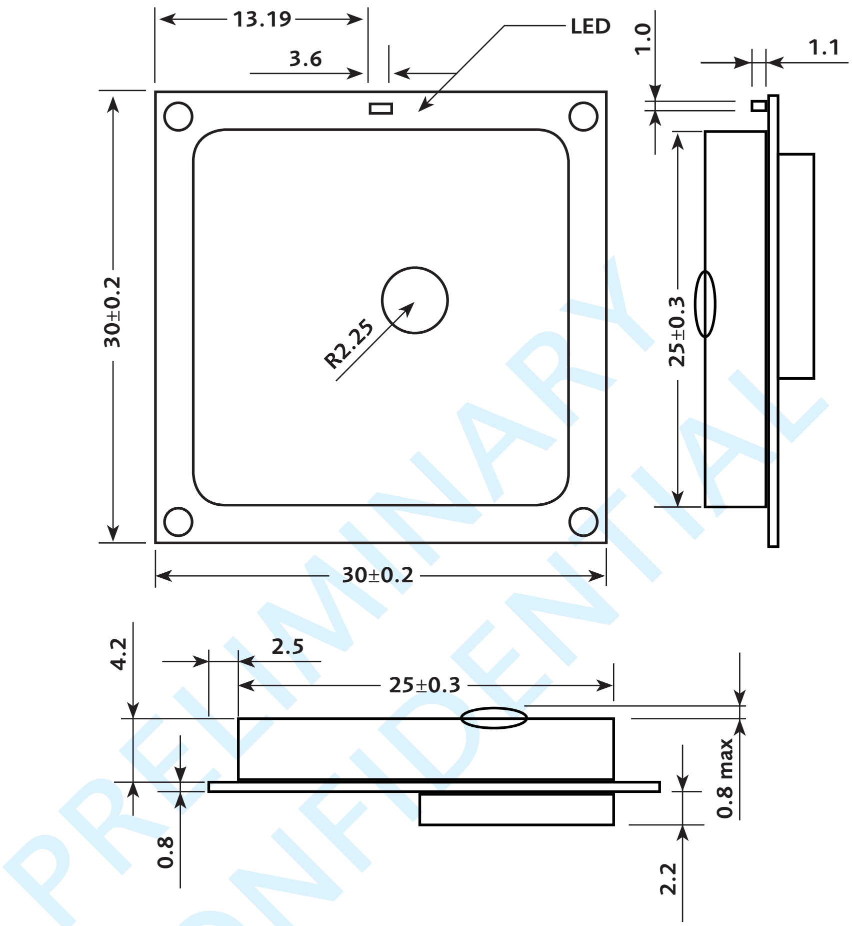
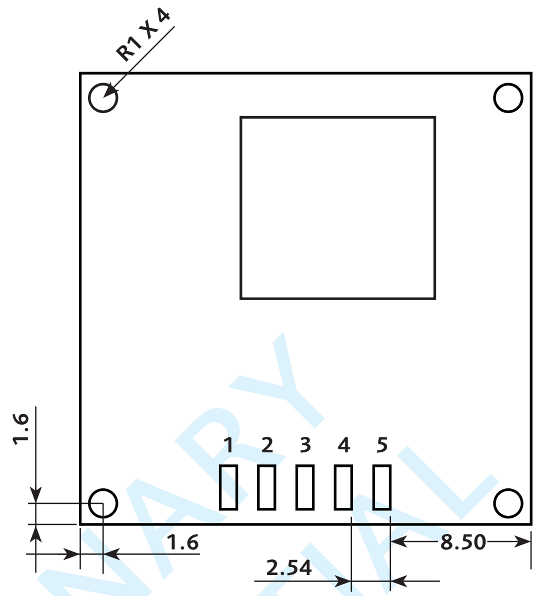
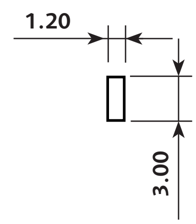


Figure 2-2: Antenna: Physical dimensions

2.4.2 Back: Physical dimensions and pin out assignments

Dimensions in mm





Pin#	Name	Type	Description
1	VCC	P	Power input
2	RX	I	Data input
3	TX	O	Data output
4	GND	P	Ground
5	GND	P	Ground

Figure 2-3: Back: Physical dimensions and pin-out

2.5 Environmental

Environmental operating conditions:

- operating temperature without micro battery (Topr): –40ºC to +85ºC
- operating temperature with micro battery (Topr): 0ºC to +60ºC
- storage temperature without micro battery (Tstg): –40ºC to +85ºC (25ºC typical)
- storage temperature with micro battery (Tstg): 0ºC to +60ºC (25ºC typical)
- humidity: up to 95% non-condensing or a wet bulb temperature of +35ºC
- altitude: –304 m to 55 000 m
- vibration: random vibration IEC 68-2-64
- max. vehicle dynamics: 500 m/s
- shock (non-operating): 18 G peak, 5 ms

2.6 Compliances

The J3-A is designed to the following specification:

- 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

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 initialization 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	@ –125 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 3-1: Acquisition times at –125 dBm

3.3 Optional Two Tones LED indicator

J3-A has an optional on-board LEDs on the antenna side for status indication. If installed, it indicates power on and GPS positioning fix status. In continuous power mode, it changes in color from red to orange once per second when position is fixed. When first powered on and searching for a fix, the LED will stay on as Red.

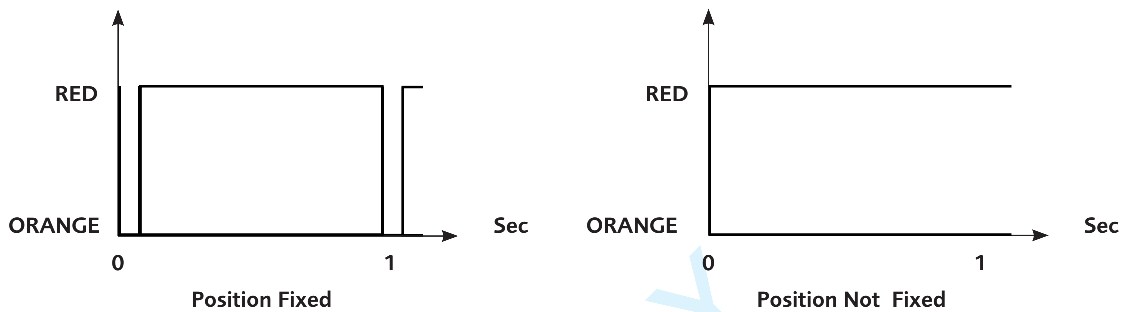


Figure 3-1: Optional LED indicator duty cycle

3.4 Power management

J3-A features a built-in micro-battery to preserve system data for rapid satellite acquisition times. This module also offers Adaptive TricklePower, which can be set using NMEA or SiRF Binary messages.

3.4.1 Adaptive TricklePower

J3-A can use the Adaptive TricklePower (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.

For further information refer to:

- Navman Wireless Low Power Operating Modes application note (LA000513)
- Navman Wireless OEM NMEA reference manual
- SiRF Binary Protocol reference manual

3.5 Differential aiding

3.5.1 Satellite Based Augmentation Systems (SBAS)

J3-A is capable of receiving SBAS differential corrections including WAAS and EGNOS. SBAS improves horizontal position accuracy by correcting GPS signal errors caused by ionospheric disturbances, timing and satellite orbit errors.

3.6 Sensitivity

Sensitivity of the J3-A at chipset level 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	25dBHz
acquisition – hot start	–155 dBm	15 dBHz
navigation	–158dBm	12dBHz
tracking	–159 dBm	10 dBHz

Table 3-2: Sensitivity

3.7 Dynamic constraints

The J3-A is programmed to deliberately lose track if any of the following limits is exceeded:

velocity 2D (2 sigma): 500 m/s max
acceleration: 4 G (39.2 m/s2) max
vehicle jerk: 5 m/s3 max
altitude: 55000 m max (referenced to MSL)

3.8 Position and velocity accuracy

Position and velocity accuracy are shown in Table 3-3, assuming full accuracy C/A code. These values are the same in normal operation and when Adaptive TricklePower is active.

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

Table 3-3: Position and velocity accuracy

3.9 Multi-mode aiding

Multi-mode aiding technology makes navigation information available to GPS devices when Satellite Vehicles (SVs) are not visible due to obstruction. In autonomous operation mode, the GPS receiver requires a signal level of 28 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 data is not received in full, the ephemeris data collection starts again at the next cycle.

Ephemeris Push is the multi-mode aiding currently supported by the J3-A (Binary mode only). This feature supports live ephemeris data download from application servers, which is then transmitted to the GPS receiver through a network connection. This feature facilitates hot start performance at all times, including weak conditions and moving start ups. The ephemeris is typically valid for 4 hours until the live ephemeris is downloaded or new ephemeris data is provided.

An application note about Ephemeris Push is in preparation and will be available at a later date.

4.0 Electrical requirements

4.1 Power consumption

See Table 4-1 for J3-A continuous mode power consumption details.

Parameter	Symbol	Product	Typ
input voltage	VCC	J3-A TTL	3.3V
input voltage	VCC	J3-A 232	5V
input voltage	Icc	J3-A TTL	35mA*
input voltage	Icc	J3-A 232	38mA*
*measured when position fix is available			

Table 4-1: Power consumption (continuous mode)

4.2 Electrical Connections

The J3-A module has five (5) electrical solder tabs for electrical connections on the underside of the board. Input supply voltage and serial transmit and receive data connections are shown in Figure 4-1 below.

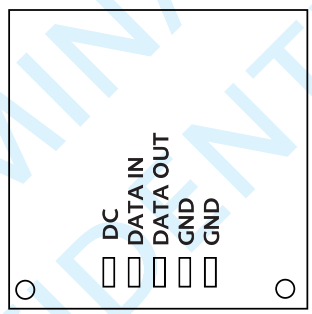


Figure 4-1: Electrical Connections view from solder side

The table below contains electrical properties for each of these connections.

Connection	Description	Notes
DC	Main supply voltage	3.3V for TTL / 5V for RS-232
Data in	Serial Data Input	CMOS 3.3V / RS-232
Data Out	Serial Data Output	CMOS 3.3V / RS-232
GND	Ground DC	Negative Supply
GND	Ground	Cable Shield (or blank)

Table 4-2: Electrical Connections

4.3 Back-up Battery

The J3-A has an optional micro-battery required for warm and hot starts. Battery charging occurs anytime the VCC supply is present. This battery is rated for hundreds of charging cycles where the battery has been completely discharged; however as long as the power is applied for a few hours every three to four days, a full discharge will not occur.

4.4 Data Input Output

The serial data input/output connections are standard 3V CMOS. Direct interface to a microprocessor requires normal caution with respect to CMOS levels and lead lengths. For driving a RS-232 Circuit, an alternative configuration with RS232 interface is available. The details are shown in the Section 7 Ordering Information.

5.0 Software interface

Protocols supported are selected NMEA (National Marine Electronics Association) -0183 and SiRF Binary messages: latitude, longitude, elevation, velocity, heading, time, satellite tracking status, command/control messages.

The default serial modes are as follows:

NMEA, 9600 bps, 8 data bits, no parity, 1 stop bit

5.1 NMEA output messages

NMEA is a standard protocol used by GPS receivers to transmit data. The output NMEA (0183 v3.0) messages for the J3-A are listed in Table 5-1. A complete description of each NMEA message is contained in the Navman Wireless OEM NMEA reference manual.

Message ID and description	Refresh rate
GGA – global positioning system fix data	1 s
GLL – geographic position - latitude, longitude	1 s
GSV – satellites in view	1 s
GSA – DOP and active satellites	1 s
RMC – recommended minimum specific GPS data	1 s
VTG – course over ground and ground speed	1 s
ZDA – PPS timing message	1 s

Table 5-1: Default NMEA messages

5.2 Proprietary NMEA messages

Table 5-2 shows the proprietary message parameters.

Start sequence	Payload	Checksum	End sequence
$PSRF<MID>[1]	Data[2]	CKSUM[3]	<CR><LF>[4]

1. Message Identifier consisting of three numeric characters. Input messages begin at MID 100.
2. Message specific data. Refer to a specific message section for <data>...<data> definition.
3. CKSUM is a two-hex character checksum as defined in the NMEA specification, NMEA-0183Standard For Interfacing Marine Electronic Devices. Use of checksums is required on all input messages.
4. Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Table 5-2: Proprietary message parameters

Note: All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

Table 5-3 shows the proprietary input message descriptions.

Message	MID*	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z**
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt**
Development Data On/Off	105	Development Data messages On/Off
Select Datum	106	Selection of datum to be used for coordinate transformations
Get Navman SW Version	200	Poll software version information
Store Config-to-Flash	220	Store receiver configuration parameters to Flash
Trickle-Power Mode Configuration	221	Configure Trickle-Power mode
User Configuration	223	Set user configuration
*Message Identification (MID) **Input coordinates must be WGS84		

Table 5-3: Proprietary NMEA input messages

6.0 Product handling

6.1 Packaging and delivery

The MOQ (Minimum Order Quantity) for shipping is 250 units.

6.2 Safety

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

6.3 Disposal

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 seller from whom you purchased the product.

7.0 Ordering information

The part numbers of J3-A are shown in Table 7.1.

Part Number	Configuration	Description
J3-A	J3-ATT0-00-350.14	TTL interface, with Micro Battery, with LED
J3-A	J3-ATT1-00-350.14	TTL without Micro Battery, without LED
J3-A	J3-ARS0-00-350.14	RS232 interface, with Micro Battery, with LED
J3-A	J3-ARS1-00-350.14	RS232 without Micro Battery, without LED

Note: Custom firmware for High Altitude application is available, please contact your sales manager for details

Table 7-1: Ordering information

8.0 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.

C/N0: Carrier to Noise ratio

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

SAW filter: Surface Acoustic Wave filter

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

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