SL869 Product Description

80405ST10105a r.1 – 2012-07-25

Making machines talk.

APPLICABILITY TABLE

PRODUCT
SL869

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Contents

1. Introduction

1.1. Scope

Scope of this document is to give an overview of new standalone GNSS module SL869.

1.2. Audience

This document is intended for customers developing applications using SL869.

1.3. Contact Information, Support

For general contact, technical support, to report documentation errors and to order manuals, contact Telit Technical Support Center (TTSC) at:

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
TS-APAC@telit.com

Alternatively, use:

http://www.telit.com/en/products/technical-support-center/contact.php

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

To register for product news and announcements or for product questions contact Telit Technical Support Center (TTSC).

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Document Organization

This document contains the following chapters:

"Chapter 1: "Introduction" provides a scope for this document, target audience, contact and support information, and text conventions.

"Chapter 2: "Overview" gives an overview of the features of the product.

"Chapter 3: "Technical Description" describes the features of the product.

"Chapter 4: "Performance Characteristics" describes in details the characteristics of the product.

"Chapter 5: "Electrical Requirements" describes in details the electrical characteristics of the product.

"Chapter 6: "Software Interface" provides information on default serial configuration.

"Chapter 7: "Mechanical Drawings" provides info about Hardware interfaces.

"Chapter 8: "Evaluation Kit" provides some fundamental hints about evaluation Kit.

"Chapter 9: "Product Compatibility" describes the compatibility between SL869 and JN3.

"Chapter 10: "Product Handling" describes the packaging and mounting of the module

"Chapter 11: "Glossary and Acronyms" contain the explanation of acronyms used in the present document

"Chapter 12: "Safety Recommendation" provides some safety recommendations that must be follow by the customer in the design of the application that makes use of the SL869.

"Chapter 13: "Document History" provides the history of the present document.

1.5. Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.6. Related Documents

- SL869 Hardware User Guide,
- SL869 EVK User Guide,

2. Overview

The SL869 is a new age of receiver that can simultaneously search and track satellite signals from multiple satellite constellations. This multi-GNSS receiver uses the entire spectrum of GNSS systems available: GPS, Glonass, Galileo and QZSS.

The SL869 features high sensitivity, low power consumption and fast time to first fix. It also offers an accurate timing pulse and jamming immunity.

Operation in a high interference signal environment is common practice in today's electronic age. By incorporating 3-stage rejection architecture, the SL869 is able to remove interfering signals pre- and post-correlation.

Operating on a single 3.3V power supply, this module combines a GNSS engine, TCXO, SAW Filter, RTC and LDO. Communication is done over a UART serial port using NMEA message format.

The SL869 shares the same form factor as the Telit Jupiter JN3 (JN3) family, 16mm x 12.2mm, commonly used in the industry.

3. Technical Description

High-speed Location Engine – An ARM9 core with embedded Flash memory offers enhanced sensitivity, fast time to first fix and improved position accuracy.

Battery Backup is supported via a separate pin for applications that use a battery backup source.

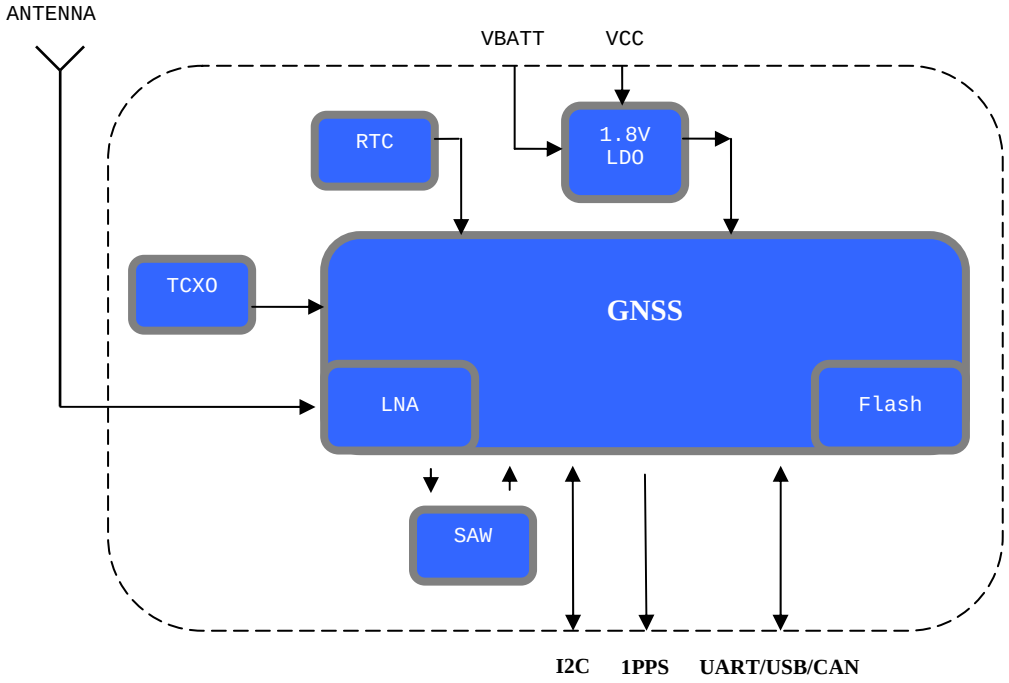
Jammer Immunity – Three stage jamming rejection approaches, actively identify and remove jammers pre- and post-correlation. This feature maximizes GPS performance.

High Performance Solution:

- High sensitivity navigation engine (PVT) tracks as low as -162dBm
- 32 track verification channels
- SBAS: WAAS, EGNOS, and MSAS

3.1. Receiver Architecture

The functional architecture of the SL869 receiver is shown in Figure 1.



Note: LNA is included in the GNSS chip for passive antenna operation.

Figure 1 – SL869 Architecture

3.2. Major Components

All power supply components are on board including capacitors.

3.2.1. GNSS Chip

This single chip GNSS device includes an integrated Baseband and RF sections. The LNA amplifies the GPS signal and provides enough gain for the receiver to use a passive antenna. A very low noise design is utilized to provide maximum sensitivity. Flash memory is integrated so external memory is not required.

3.2.2. RF_IN

GNSS RF signal input. Support a passive antenna. Requires an external BIAS-T and antenna voltage supply for active antenna.

3.2.3. VCC

This is the primary 3.0V to 3.6V supply voltage for the module. The SL869 includes an LDO that supplies 1.8V to the GNSS device.

3.2.4. VBATT

The Battery Backup supply voltage is 2.5V to 3.6V. A typical low current supply for ensuring the RTC is kept running to enable HOT/WARM starts.

3.2.5. Host Port

The SL869 has up to three serial communications ports -- UART. See the HW User Guide for more details.

3.2.6. SAW Filter

This filters the GNSS signal and removes unwanted signals caused by external influences that would corrupt the operation of the receiver. The integrated LNA outputs to the SAW filter which then feeds the GNSS receiver.

3.2.7. TCXO

This highly stable 26 MHz oscillator controls the down conversion process for the RF block.

3.2.8. RTC

The 32KHz Real Time Clock allows Hot/Warm starts.

3.2.9. Memory

The SL869 has an integrated 2Mbyte Flash device for operational software and satellite data storage.

3.3. Physical Characteristics

The SL869 receiver has advanced miniature packaging with a base metal of copper and an Electroless Nickel Immersion Gold (ENIG) finish.

It has a tin-plated shield and 24 interface pads. These pads are castellated edge contacts.

3.4. Mechanical Specification

The physical dimensions of the SL869 are as follows:

- length: 16.0 mm ± 0.1 mm
- width: 12.2 mm ± 0.1 mm
- thickness: 2.4 mm ± 0.2 mm
- weight: 1 g max

Refer to Figure 2 for the SL869 mechanical layout drawing.

3.5. External Antenna Connection

The RF connection for the external antenna has a characteristic impedance of 50 ohms.

3.6. Input/Output and Power Connections

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

3.7. Environmental

The environmental operating conditions of the SL869 are as follows:

- temperature: –40°C to +85°C (measured on the shield)
- humidity: up to 95% non-condensing or a wet bulb temperature of +35°C

3.8. Compliances

The SL869 complies with the following:

- Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- Manufactured in an ISO 9000: 2000 accredited facility
- Manufactured to TS 16949 requirement (upon request)

Moreover, The SL869 module is conform to the following European Union Directives:

- Low Voltage Directive 2006/95/EEC and product safety
- Directive EMC 2004/108/EC for conformity for EMC

3.9. Marking/Serialization

The SL869 supports a 2D barcode indicating the unit serial number below. The Telit 13-character serial number convention is:

- characters 1 and 2: year of manufacture (e.g. 11 = 2011, 12 = 2012)
- characters 3 and 4: week of manufacture (01 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

4. Performance Characteristics

4.1. TTFF (Time to First Fix)

TTFF is the actual time required by a GPS receiver to achieve a valid 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.

4.1.1. 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 memory.

4.1.2. 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.

4.1.3. Cold Start

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

Please refer to section 3.6 for performance data.

4.2. AGPS

GPS aiding comes in several forms. For the purposes of this document, we will focus on extended ephemeris data as a form of assisted GPS data.

Ephemeris predictions is a method of GPS aiding that effectively reduces the TTFF by making every start a Hot or Warm start, through the use of predicted ephemeris data.

Local ephemeris prediction data captures ephemeris data from satellites locally and predicts ephemeris for up to 3 days.

Server ephemeris predictions do not require local ephemeris collection from satellites; it receives the extended ephemeris data from a server. These predictions are valid for up to 7 days.

The module supports AGPS as standard. Contact TELIT for support regarding this service.

4.3. Time Mark Pulse (1PPS)

A 1PPS time mark pulse is provided as an output with a -93ns offset and 15ns standard deviation.

4.4. Differential Aiding

4.4.1. Satellite Based Augmentation Systems (SBAS)

The SL869 is capable of receiving WAAS, EGNOS, and MSAS 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.

4.4.2. Differential GPS (DGPS)

The SL869 is capable of receiving differential corrections from RTCM beacons. Much higher accuracies can be achieved by using data from reference stations at precisely known locations. The SL869 supports RTCM SC-104 messages 1 and 9.

4.5. Performance Data

Parameter	Description	Performance			
		Min	Typical	Max	Units
Horizontal Position Accuracy[1]	Autonomous	-	<1.5	-	m
Velocity Accuracy	Speed	-	-	<0.05	m/s
	Heading	-	-	<0.01	0
Time to First Fix	Hot Start	-	<1	-	s
	Warm Start	-	<35	-	s
	Cold Start	-	<35	-	s
Sensitivity	Acquisition	-146		-	dBm
	Tracking	-162	-	-	dBm
	Navigation	-157	-	-	dBm
50%, 24 hr static, -130 dBm					

Table 1 – SL869 Performance Data

4.6. Dynamic Constraints

The SL869 receiver will lose track if any of the following limits are exceeded:

- ITAR limits: velocity greater than 515 m/s AND altitude above 18,000 m
- altitude: 100,000 m (max) or -1500 m (min)
- velocity: 600 m/s (max)
- acceleration: 2 G (max)

5. Electrical Requirements

5.1. Power Supply

5.1.1. VCC

Main power input. Reference the HW User Guide for additional details.

Supply voltage: 3.0V to 3.6V.

5.1.2. VBATT

Battery backup power input range 2.5V to 3.6V. Required for HOT/WARM starts and retention of GPS data.

5.2. External Antenna Voltage

The SL869 requires an external antenna Bias-T to provide the voltage to the antenna. This is detailed in the HW User Guide.

5.3. RF (Radio Frequency) Input

RF input is 1575.42 MHz (L1 Band) at a level between –135 dBm and –165 dBm into 50 Ohm impedance.

5.4. Antenna Gain

The receiver will operate with a passive antenna with Isotropic gain down to a minimum of -6dBi. Active antennas are supported.

An active antenna between 20dB to 25dB (exiting the cable) will offer the best performance. 35dB exiting the antenna cable is maximum useable active antenna gain.

Note that recommended external gain range is total any external gain, such as antenna or external LNA and any passive loss due to cables, connectors, filters, matching network, etc.

Contact TELIT for in depth passive antenna design support.

5.5. 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.

5.6. Jamming Performance

In band jammers can be detected and removed using a 3-stage approach (RF, DSP and SW) pre- and post-correlation. This is over and above the excellent SAW filter response that exists before the GPS LNA input.

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.

5.7. Flash Upgradability

The firmware programmed in the Flash memory may be upgraded via the serial port TX/RX pads. The user can control this by driving the Serial BOOT select line low at startup, then downloading the code from a PC with suitable software. 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. Refer to the HW User Guide for additional information.

5.8. Data Input/Output Specifications

All communications between the SL869 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 the following sections.

5.8.1. Voltages and Currents

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	VCC	3.0	3.3	3.6	V
Operating Temperature	T_{OPR}	-40		85	^{0}C
Current Consumption: Tracking (GPS) Tracking (GNSS) Acquisition (GNSS)			 55 65 98		 mA mA mA
Battery Backup Supply	VBATT	2.2	3	3.6	V
Battery Backup Current			75		uA
Operating temperature is ambient.					

Table 2 – Power Requirements

Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Power Supply Voltage	VCC	3.6	V
Input Pin Voltage	VIO_IN	3.6	V
Output Pin Voltage	VIO_OUT	3.6	V
Storage Temperature	T_{stg}	-40°C to +85°C	^{0}C
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.			

Table 3 – Digital Core and I/O Voltage (Volatile)

5.8.2. DC Electrical Characteristics

5.8.2.1. TX and 1PPS

TXA and 1PPS outputs at TRISTATE until Active VCC is reached. Active VCC min is 1V.

These outputs TRISTATE if VCC reaches Ground. Maximum stress voltage on these pins is 4.5V and there is OVT protection.

V_{OL} = 0.3V-0.4V MAX.

V_{OH} = 0.75 x VCC typical MIN, 3.6V MAX pull up.

Typical MAX current = + 12mA, -12mA.

Normal current = +100uA to +6mA (V_{OL}), -100uA to -6mA (V_{OH})

VCC = 2.85V to 3.3V typical, 3.6V MAX.

Internal 10K pull-up to VCC

5.8.2.2. RX

V_{IL} = 0.45V MAX.

V_{IH} = 1.26V MIN. MAX 3.6V pull up.

Internal pull up resistance 90k ohm nominal to internal 1.8V. MAX 3.6V pull up.

INPUT/TRISTATE leakage = -10uA, +10uA.

5.8.2.3. SDA2 and SCL2

SDA2 and SCL2 outputs are in a high-impedance state until Active VCC is reached.

V_{OL} = 0.55V MAX.

V_{OH} = 2.4V MIN.

5.8.2.4. BOOT

For normal operation, leave this pin floating. To place the SL869 into BOOT mode, tie this pin to Ground through a 1K pullup resistor.

5.8.3. Pinout Description

Details of the LGA pad functions are shown in Table 5.

Pad Number	Pad Function	Type	Description
1	CAN0TX	O	CAN BUS TX
2	CAN0RX	I	CAN BUS RX
3	1PPS	O	Timemark Pulse, 500ms active high
4	EXT_INT	I	Reserved
5	TX1	O	UART1 TX
6	RX1	I	UART1 RX
7	NC	-	Reserved
8	**NC**	**-**	**No connection**
9	VCC	PWR	VCC
10	GND	PWR	Ground
11	RF_IN	I	GPS RF Input, 50 Ohm
12	GND	PWR	Ground
13	GND	PWR	Ground
14	TX2/BOOT	O/I	UART2 TX / BOOT (at power up)
15	RX2	I	UART2 RX
16	NC	-	No connection
17	NC	-	No connection
18	SDA2	I/O	Sensor I2C Data Port
19	SCL2	I/O	Sensor I2C Clock Port
20	TX	O	UART TX
21	RX	I	UART RX
22	VBATT	PWR	Battery Backup Voltage
23	VCC	PWR	Main Supply Voltage
24	GND	PWR	Ground

Table 4 – LGA Pad Functions

6. 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 configuration is as follows: NMEA, 9600 bps, 8 data bits, no parity, and 1 stop bit.

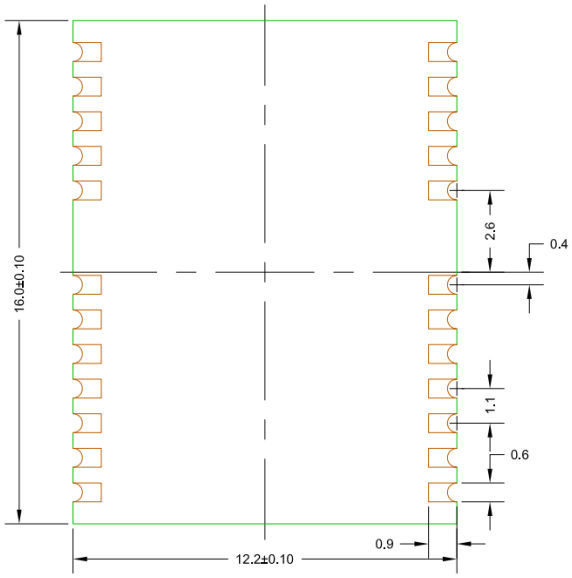
6.1. NMEA Output Messages

NMEA v3.01 is the default protocol. The following messages are output by default:

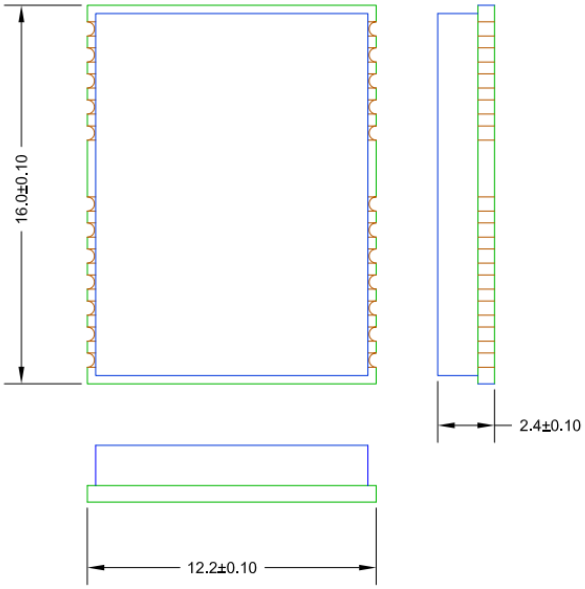
- GPRMC = 1 second update
- GPGGA = 1 second update
- GPGSA = 1 second update
- GLGSA = 1 second update
- GPGSV = 5 second update
- GLGSV = 5 second update

Reference the NMEA protocol manual for additional message details.

7. Mechanical Drawing



Bottom Side Pads (as seen from Top)



Package Outline Drawing

Figure 2 – Mechanical Layout

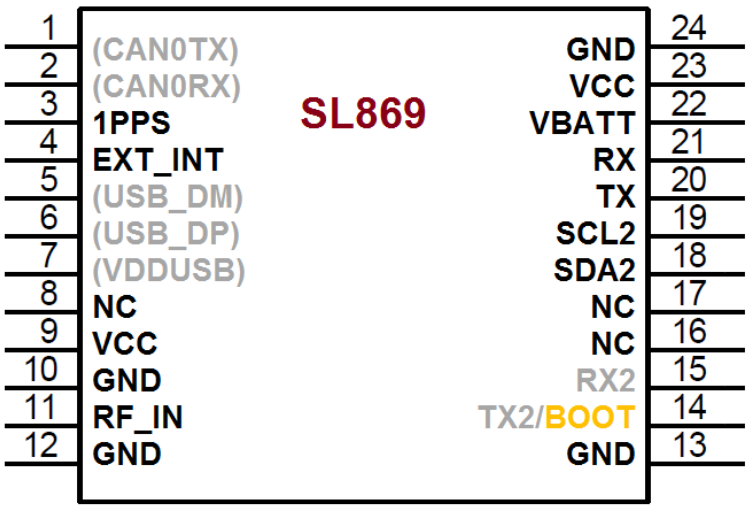


Figure 3 – Pinout (Top View)

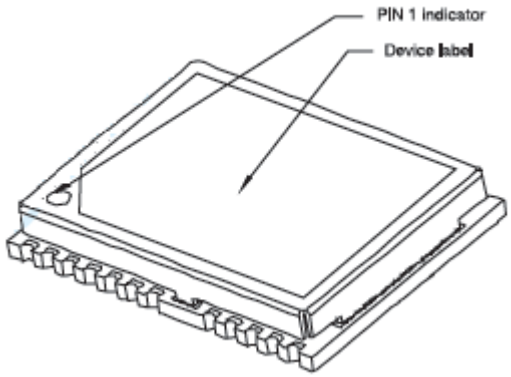


Figure 4 – 3D Model

Warning:

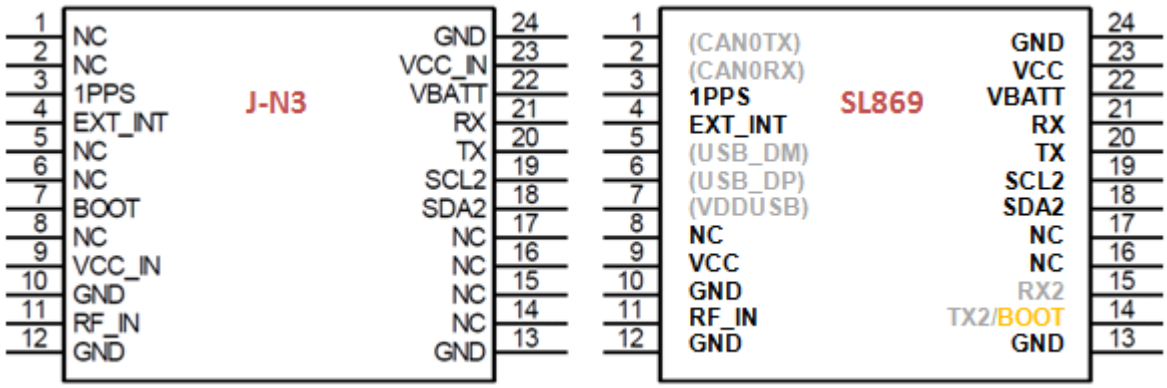
Figure 4, pins displayed in light gray are features that will be supported in future releases.

8. Evaluation Kit

The SL869 Development Kit is available to assist in the evaluation and integration of the SL869 module in custom applications. The Development Kit contains all of the necessary hardware and software to carry out a thorough evaluation of the SL869 module.

9. Product Compatibility

The SL869 offers the same footprint as the JN3 Product Family with the following pinout differences.



Main difference between J-N3 and SL869 is Glonass System capability available on SL869.

SL869 is Pin2Pin compatible with J-N3 family product. The only difference is BOOT pin location on SL869 module. If reprogramming support is not required, this is not an issue.

Conclusion: If the specifications called out in this document support your customer's design, J-N3 GPS module can be switched to SL869, a GPS/Glonass/Galileo module.

Figure 5 – J-N3 vs. SL869 Pinout Differences

Note: Power Supply and Battery Back-up ranges differ as well. Refer to HW Designer Notes for more details.

Note:

In Figure 5, the features of the pins displayed in light gray will be supported in SL869 future variants.

Refer to §5.8.3 "pin-put description" for current features and wiring.

Warning:

In the current SL869 variant USB is not supported. Pin7 (USBVDD) must be NC.

10. Product Handling

10.1. Product Packaging and Delivery

SL869 modules are shipped in Tape and Reel form. The reeled modules are shipped in 24mm reels with 1000 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 1000 units. Refer to the HW User Guide for additional details.

All packaging is ESD protective lined. The SL869 GPS receiver is a 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 8.2 and 8.3).

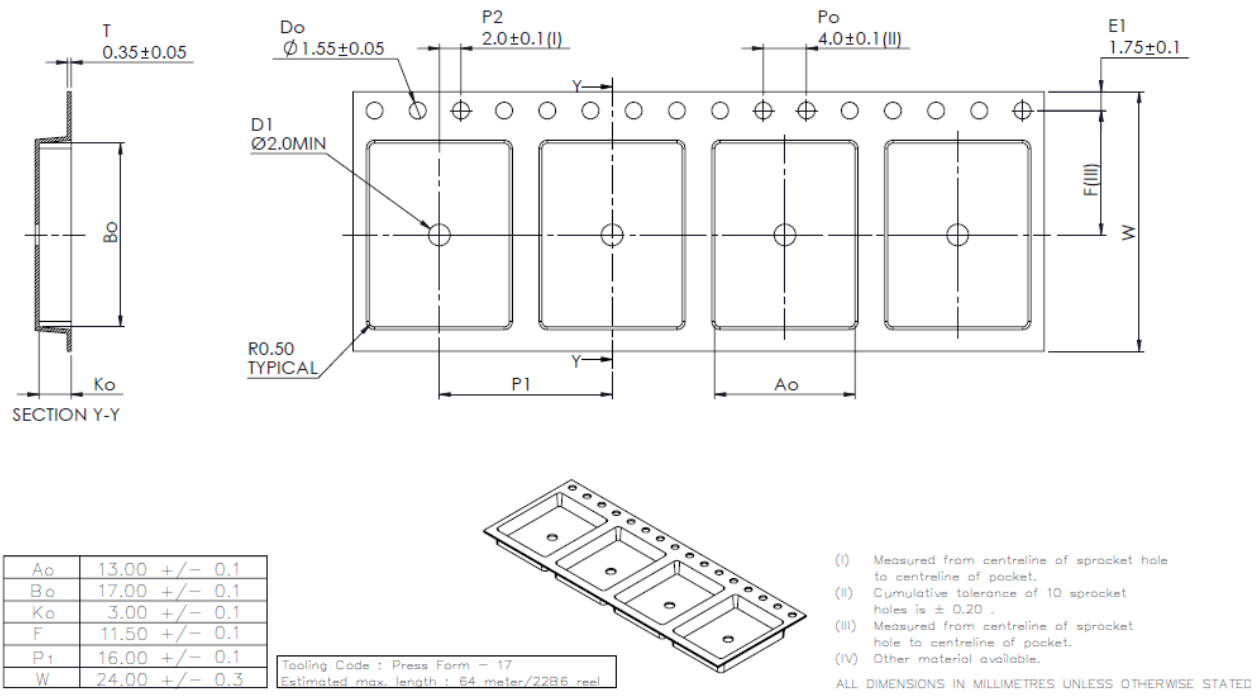


Figure 6 – Tape and Reel Packaging

10.2. Moisture Sensitivity

Precautionary measures are required in handling, storing and using such devices to avoid damage from moisture absorption. If localized 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.

10.3. ESD Sensitivity

The SL869 GNSS receiver contains class 1 devices and is Electro-Static Discharge Sensitive (ESDS). Telit recommends the two basic principles of protecting ESD 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 JESD625-A requirements for Handling Electrostatic Discharge Sensitive (ESDS) Devices.

10.4. Safety

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

10.5. 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.

11. Glossary and Acronyms

AGPS: Assisted GPS. AGPS uses additional resources to locate the satellites faster and better in poor signal conditions.

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.

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.

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.

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

LGA: Land Grid Array.
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.

Local Ephemeris prediction data. AGPS using prediction of ephemeris from live (downloaded from satellites), ephemeris stored in memory. Useful for up to three days.

MSD: Moisture sensitive device.

NMEA: National Marine Electronics Association

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.

Server-based Ephemeris prediction data. Eliminates the initial delay of obtaining GPS satellite location data from the satellites themselves by using algorithms to predict seven days of satellite location data.

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.

12. Safety Recommendations

READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself.
The system integrator is responsible of the functioning of the final product. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has
to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments introduced on the market. All the relevant information's are available on the European Community website:

http://ec.europa.eu/enterprise/sectors/rtte/documents/

The text of the Directive 99/05 regarding telecommunication equipments is available, while the applicable Directives (Low Voltage and EMC) are available at:

http://ec.europa.eu/enterprise/sectors/electrical/

13. Document History

Revision	Date	Changes
0	2012-04-26	First issue
1	2012-07-25	§5.8.3 and §9 added warning about USB functionality on SL869 variants.