

SE868-A/-AS Family Product User Guide

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APPLICABILITY TABLE

PRODUCT
SE868-A
SE868-AS



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1.1. Introduction

1.2. Scope

This document provides the hardware specifications for the

- SE868-A GNSS module
- SE868-AS GPS only module

The information contained in the present document is applicable to both variant unless otherwise stated.

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-AMERICAS@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. 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.



1.5. Related Documents

- Telit Jupiter SE868-A Datasheet
- Telit Jupiter SE868-AS Datasheet
- SE868-A/AS Evaluation Kit User Guide
- Telit MT-GNSS Software User Guide
- Telit MT-GNSS Authorized Software User Guide



2. Product Description

The SE868-A GNSS antenna module family provides a navigation solution using either multiple GNSS constellations (SE868-A module) or just the GPS constellation (SE868-AS).

2.1. Product Overview

- Complete GNSS receiver modules including internal memory, TCXO, RTC, and a built-in SMT antenna
- Based on the MediaTek MT3333 (SE868-A) or MT3337 (SE868-AS)
- 99 search channels and 33 simultaneous tracking channels (66 search and 22 tracking channels for the SE868-AS)
- Uses GPS, QZSS, and GLONASS constellations (GPS and QZSS for SE868-AS)
- Galileo ready (for SE868-A)
- DGPS capable using the RTCM SC-104 protocol
- SBAS capable (WAAS, EGNOS, MSAS, GAGAN)
- AGPS support for extended ephemeris using server based or local¹ solutions
Embedded Assist System (EASY) and Extended Prediction Orbit (EPO)
- Jamming Rejection - Active Interference Cancellation (AIC)
- NMEA commands and data output over UART serial interface
- 8 Megabit built in flash (SE868-A) or ROM memory (for SE868-AS)
- Power management for extended battery life
- Less than 60 mW total power consumption
- Supported by evaluation kits
- -40°C to +85°C industrial temperature range
- Surface mountable by standard SMT equipment
- 11 mm by 11 mm QFN package
- RoHS compliant design



2.2. Product Configurations

The SE868-A family is available in the following configurations:

- SE868-A
- SE868-AS

Feature	SE868-A	SE868-AS
GNSS chip	MediaTek MT3333	MediaTek MT3337
Constellations Supported	GPS, Glonass, QZSS	GPS, QZSS
Memory	Flash	ROM
EASY	Yes	No
EPO	Yes	No
Host EPO	No	Yes
Force On	Yes	No
Software	Yes	No
I2C	Optional	No

Table 2-1 SE868-A Family Product Configurations

- The SE868-AS does not support locally-generated ephemeris (Embedded Assist System – EASY) since it does not have flash memory.
- The SE868-AS supports server-generated ephemeris (Extended Prediction Orbit – EPO) via a host system.



2.3. Block Diagram

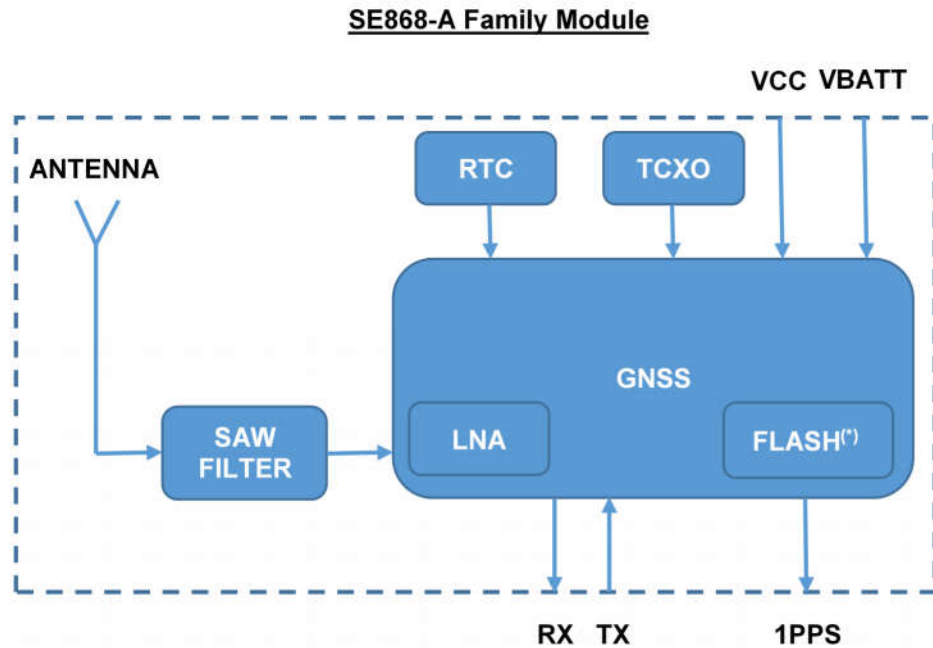


Figure 2-1 SE868-A Family Modules Block diagram

(*) Flash memory only in SE868-A. SE868-AS has ROM memory.

2.4. Product Compatibility

The SE868-A and SE868-AS modules have a unique form factor and are not mechanically nor pinout compatible with other Telit GNSS modules.



3. Evaluation Kit

The SE868-A Family Evaluation Kit (EVK) is available to assist in the evaluation and integration of the receiver module in custom applications. The EVK contains the module mounted on a PC Board to accommodate testing.

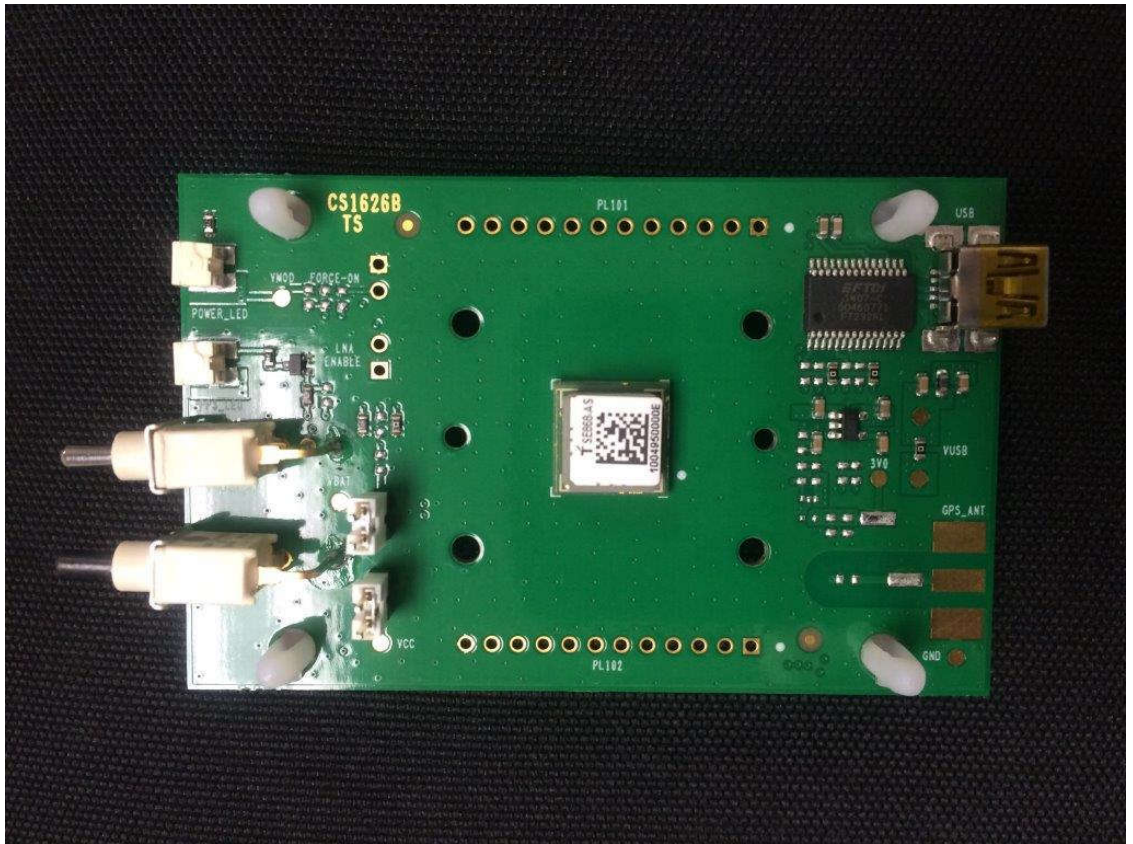


Figure 3-1 SE868-A/-AS EVK Board



4. Product Features

4.1. PPS

The SE868-A/AS provides a 1 pulse per second (PPS) output during 3D navigation. See section 8.4.48.4.4 for detailed information.

4.2. Static Navigation

Static Navigation is an operational mode in which the receiver will freeze the position fix when the speed falls below a threshold (indicating that the receiver is stationary). The course is also frozen, and the speed is reported as 0. The navigation solution is then unfrozen when the speed increases above a threshold or when the computed position exceeds a set distance from the frozen position (indicating that the receiver is again in motion). The speed threshold can be set via a command.

Static Navigation is disabled by default, but can be enabled by command. This feature is useful for applications in which very low dynamics are not expected, the classic example being an automotive application.

4.3. Assisted GPS (AGPS)

Assisted GPS (or Aided GPS) is a method by which TTFF is reduced using information from a source other than broadcast GPS signals. The necessary ephemeris data is calculated either by the receiver itself (locally-generated ephemeris) or a server (server-generated ephemeris) and stored in the module.

4.3.1. Locally-generated AGPS (Embedded Assist System – EASY)

Proprietary algorithms within the module perform ephemeris prediction locally from stored broadcast ephemeris data (received from tracked satellites). The algorithms predict ephemeris for up to three days. EASY is enabled by default for the SE868-A. EASY is not available for the SE868-AS since it requires flash memory.

4.3.2. Server-generated AGPS (Extended Prediction Orbit – EPO)

The SE868-A supports server-based AGPS as a standard feature. Contact Telit for support regarding this service. Server-based ephemeris predictions are generated by a third party and are maintained on Telit AGPS servers. The predicted ephemeris file is obtained from the AGPS server and is injected into the module over serial port 1 (RX1). These predictions do not require local broadcast ephemeris collection, and they are valid for up to 14 days.

See the next section regarding Host EPO support for the SE868-AS

Note:



- Only SE868-A is able to store the AGPS file in the onboard flash memory.
- The SE868-AS requires that host stores the AGPS file in its own memory.



4.3.3. Host EPO (SE868-AS only)

The SE868-AS does not have flash memory. However, it can still make use of EPO. If the system design includes a host processor, it can access server-generated data and send it to the SE868-AS over the primary serial port (which must be temporarily changed to binary mode). This data is valid for six hours. Contact Telit for support regarding this feature.

4.4. Quasi-Zenith Satellite System (QZSS)

The three satellites of the Japanese SBAS are in a highly-inclined elliptical orbit which is geosynchronous (not geostationary) and has analemma-like ground tracks. This orbit allows continuous coverage over Japan using only three satellites. Their primary purpose is to provide augmentation to the GPS system, but the signals may also be used for ranging. NMEA reporting for QZSS may be enabled/disabled by the user.

4.5. Satellite-Based Augmentation System (SBAS)

The SE868-A/AS receiver is capable of using Satellite-Based Augmentation System (SBAS) satellites as a source of both differential corrections and satellite range measurements. These systems (WAAS, EGNOS, MSAS, and GAGAN) use geostationary satellites to transmit regional differential corrections via a GNSS-compatible signal. The use of SBAS corrections can significantly improve position accuracy, and is enabled by default.

4.6. Differential GPS (DGPS)

DGPS is a Ground-Based Augmentation System (GBAS) for reducing position errors by applying corrections from a set of accurately-surveyed ground stations located over a wide area. These reference stations measure the range to each satellite and compare it to the known-good range. The differences can then be used to compute a set of corrections which are transmitted to a DGPS receiver, either by radio or over the internet. The DGPS receiver can then send them to the serial port 2 (RX1) using the RTCM SC-104 message protocol. The corrections can significantly improve the accuracy of the position reported to the user. The receiver can accept and apply either the RTCM SC-104 messages or SBAS differential data.

4.7. Jamming Rejection – Active Interference Cancellation (AIC)

The SE868-A family modules detect, track and removes narrow-band interfering signals (jamming signals) without the need for external components or tuning. It tracks and removes up to 12 CW (Continuous Wave) type signals up to -80 dBm (total power signal levels). By default, the jamming detection is enabled but can be disabled by command. This feature is useful both in the design stage and during the production stage for uncovering issues related to unexpected jamming. When enabled, AIC will increase current consumption by about 1 mA.

Impact on GNSS performance is minimal at low jamming levels, however at high jamming levels (e.g. -90 to -80 dBm), the RF signal sampling ADC starts to become saturated after which the GNSS signal levels start to diminish.



4.8. Serial I/O Port considerations

The SE868-A family module includes a full-duplex Universal Asynchronous Receiver Transmitter (UART) serial interface that supports configurable baud rates. The signal output and input levels are LVTTTL compatible (see Electrical Interface below).

Note that the idle state of the interface lines is logic high. Care must be used to prevent backdriving the RX line when the module is powered down.

4.9. Power Management Modes

The SE868-A/AS modules support operational modes that allow them to provide positioning information at reduced overall current consumption.

Availability of GNSS signals in the operating environment will also be a factor in choice of power management modes. The designer can choose a mode that provides the best trade-off of performance versus power consumption

The power management modes are described below, and can be enabled via command:

- Full Power Continuous
- Standby
- Periodic
- AlwaysLocate™

4.9.1. Full Power Continuous Mode

The modules start up in full power continuous mode. This mode uses the acquisition engine at full performance resulting in the shortest possible TTFF and the highest sensitivity. It searches for all possible satellites. The receiver then switches to the tracking engine to lower the power consumption when:

- A valid GPS/GNSS position is obtained
- The ephemeris for each satellite in view is valid

To return to Full Power mode (from a low power mode), send the following command:

\$PMTK225,0*2B

Just after the module wakes up from its previous sleep cycle.

4.9.2. Standby Mode

In this mode, the receiver stops navigation, the internal processor enters standby state, and the current drain at main supply (VCC) is reduced. Standby mode is entered by sending the following command:

\$PMTK161,0*28

The host can then wake up the module from Standby mode to Full Power mode by sending any byte to the serial port.



4.9.3. Periodic Mode

This mode allows autonomous power on/off with reduced fix rate to reduce average power consumption. In periodic mode, the main power supply VCC is still powered, but power distribution to internal circuits is controlled by the receiver..

Enter periodic mode by sending the following command:

\$PMTK225,<Type>,<Run_time>,<Sleep_time>,<2nd_run_time>,<2nd_sleep_time>*<checksum>
Where:

- Type = 1 for Periodic mode
- Run_time = Full Power period (ms)
- Sleep_time = Standby period (ms)
- 2nd_run_time = Full Power period (ms) for extended acquisition if GNSS acquisition fails during Run_time
- 2nd_sleep_time = Standby period (ms) for extended sleep if GNSS acquisition fails during Run_time

Example:

\$PMTK225,1,3000,12000,18000,72000*16

for periodic mode with 3 s navigation and 12 s sleep. The acknowledgement response for this command is:

\$PMTK001,225,3*35.

Periodic mode is exited by sending the command:

\$PMTK225,0*2B

just after the module wakes up from a previous sleep cycle.

4.9.4. AlwaysLocate™ Mode

AlwaysLocate™ is an intelligent controller of the Periodic mode; the main power supply VCC is still powered up, but power distribution is internally controlled. Depending on the environment and motion conditions, the module can autonomously and adaptively adjust the parameters of the Periodic mode, e.g. ON/OFF ratio and fix rate to achieve a balance in positioning accuracy and power consumption. The average current can vary based on conditions.

Enter AlwaysLocate™ mode by sending the following NMEA command:

\$PMTK225,<mode>*<checksum><CR><LF>

Where: mode=9 for AlwaysLocate™

Example:

\$PMTK225,9*22.

The acknowledgement response for the command is:

\$PMTK001,225,3*35.

The user can exit low power modes to Full Power by sending NMEA command:

\$PMTK225,0*2B

just after the module wakes up from its previous sleep cycle.



5. Product Specifications

5.1. Performance Specifications – SE868-A

5.1.1. Position Accuracy

Parameter	Constellation	CEP (m)
Horizontal Position Accuracy	GPS	2.5
Horizontal Position Accuracy	Glonass	2.6
Horizontal Position Accuracy	GPS + Glonass	2.5
Test conditions: 24 hr. static, -130 dBm, Full Power		

Table 5-1 SE868-A Position Accuracy



5.1.2. Time To First Fix – SE868-A

Constellation	Start Type	Max TTFF (s)
GPS	Hot	1.0
	Warm	32
	Cold	33
GLONASS	Hot	1.4
	Warm	32
	Cold	33
GPS + GLO	Hot	1.0
	Warm	28
	Cold	31

Test Conditions: -130 dBm, Full Power

Table 5-2 SE868-A Time to First Fix



5.1.3. Sensitivity – SE868-A

Constellation	State	Signal Level (dBm)
GPS	Acquisition	-148
	Navigation	-163
	Tracking	-165
Glonass	Acquisition	-145
	Navigation	-157
	Tracking	-161
GPS + GLO	Acquisition	-148
	Navigation	-163
	Tracking	-165

Table 5-3 SE868-A Receiver Sensitivity



5.2. Performance Specifications - SE868-AS

5.2.1. Position Accuracy

Parameter	Constellation	CEP (m)
Horizontal Position Accuracy	GPS	2.5
Test Conditions: 24 hr. static, -130 dBm, Full Power		

Table 5-4 SE868-AS Position Accuracy

5.2.2. Time to First Fix – SE868-AS

Constellation	Start Type	Max. TTFF (s)
GPS	Hot	1.0
	Warm	32
	Cold	33

Table 5-5 SE868-AS Time to First Fix

5.2.3. Sensitivity – SE868-AS

Constellation	State	Signal Level (dBm)
GPS	Acquisition	-148
	Navigation	-163
	Tracking	-165

Table 5-6 SE868-AS Sensitivity



6. Software Interface

The host serial I/O port (RX and TX pins) supports full duplex communication between the receiver module and the user.

The default serial configuration is: NMEA, 9600 bps, 8 data bits, no parity, 1 stop bit.



More information regarding the software interface can be found in the Software User Guide. Customers that have executed a Non-Disclosure Agreement (NDA) with Telit Wireless may obtain the Authorized Software User Guide, which contains additional proprietary information.

6.1. NMEA Output Messages

NMEA-0183 v4.10 is the default protocol.



In the current Firmware release, some sentences may exceed the NMEA length limitation of 80 characters.

By default, GPS and QZSS constellations are enabled.
For the SE868-A, GLONASS is also enabled by default.

By default, the following messages are output at 1 Hz.

Multiple GSA and GSV messages may be output on each cycle.

- **Standard Messages**

Message ID	Description
RMC	GNSS Recommended minimum navigation data
GGA	GNSS position fix data
VTG	Course Over Ground & Ground Speed
GSA	GNSS Dilution of Precision (DOP) and active satellites
GSV	GNSS satellites in view.
\$PMTK010	System messages (e.g. to report startup, etc.)

Table 6-1 Default NMEA output messages



The following messages can be enabled by command:

Message ID	Description
GLL	Geographic Position – Latitude & Longitude
ZDA	Time & Date

Table 6-2 Available Messages

Talker ID	Constellation
BD	BeiDou
GA	Galileo
GL	GLONASS
GP	GPS
QZ	QZSS

Table 6-3 NMEA Talker IDs

Proprietary Messages

The SE868-A/AS support several proprietary NMEA periodic output messages which report additional receiver data and status information

6.2. NMEA Input Commands

The SE868-A/AS use NMEA proprietary messages for commands and command responses. This interface provides configuration and control over selected firmware features and operational properties of the module.

The format of a command is:

\$<command-ID> [,<parameters>] *<cr><lf>

Commands are NMEA proprietary format and begin with “\$PMTK”. Parameters, if present, are comma-delimited as specified in the NMEA protocol.

Unless otherwise noted in the Software User Guide, commands are echoed back to the user after the command is executed.



6.2.1. Commands Description

Command ID	Description
\$PMTK000	Test. This command will be echoed back to the sender (for testing the communications link).
\$PMTK101	Perform a HOT start
\$PMTK102	Perform a WARM start
\$PMTK103	Perform a COLD start
\$PMTK104	Perform a system reset (erasing any stored almanac data) and then a COLD start
\$PMTK120	Erase aiding data stored in flash memory
\$PMTK127	Erase EPO data stored in flash memory
\$PMTK161,0	Standby - Stop mode
\$PMTK161,1	Standby - Sleep mode
\$PMTK251,Baudrate	Set NMEA Baudrate
\$PMTK313,0	Disable SBAS feature
\$PMTK313,1	Enable SBAS feature
\$PMTK353,1,0,0,0,0	Enable GPS only mode
\$PMTK353,0,1,0,0,0	Enable GLO only mode
\$PMTK353,0,0,0,0,1	Enable BDS only mode
\$PMTK353,1,1,0,0,0	Enable GPS and GLO mode
\$PMTK353,1,0,0,0,1	Enable GPS and BDS mode

Table 6-4 NMEA Input commands



7. Flash Upgradability (SE868-A only)

The firmware stored in the internal Flash memory may be upgraded via the serial port TX/RX pads. In order to update the FW, the following steps should be performed to perform re-programming of the module.

1. Remove all power to the module.
2. Connect serial port to a PC.
3. Apply main power.
4. Run the software utility to re-flash the module. Clearing the entire flash memory is strongly recommended prior to programming.
5. Upon successful completion of re-flashing, remove main power to the module for a minimum of 10 seconds.
6. Apply main power to the module.
7. Verify the module has returned to the normal operating state.



8. Electrical Interface

8.1. Module Pin-out

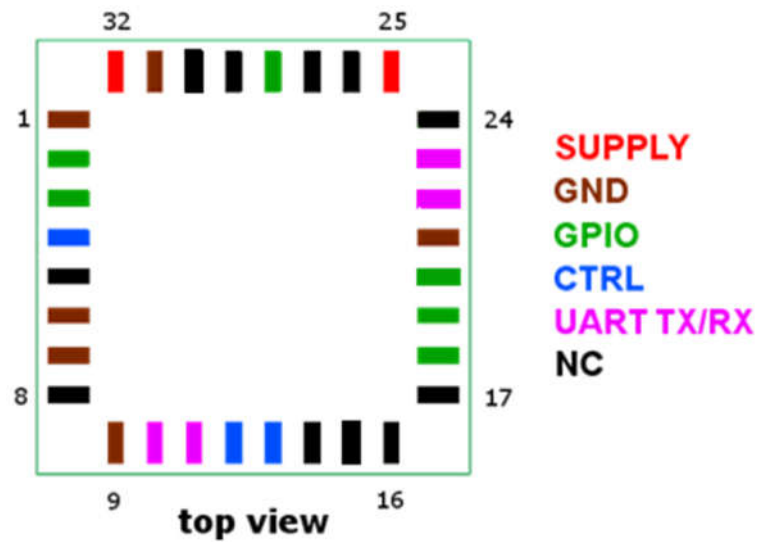


Figure 8-1 SE868-A/AS Modules Pinout



8.1.1. SE868-A Pin-out

PIN N.	SIGNAL	TYPE	DESCRIPTION	LOGIC LEVEL
1	GND	GND	Ground	
2	MM_I2CC	I/O	I2C_CLOCK	2V8
3	GIO9	I/O	GPIO	2V8
4	DR_IN	I	DR wake-up signal input	1V2
5	NC	NC	Not connected	-
6	GND	GND	Ground	
7	GND	GND	Ground	
8	NC	NC	Not connected	-
9	GND	GND	Ground	
10	TX0	O	Serial_Output_UART0	2V8
11	RX0	I	Serial_Input_UART0	2V8
12	HRST_B	I	System Reset – Active Low	2V8
13	FORCE_ON	I	Forced full-power mode signal – Active Low	1V2
14	NC	NC	Not connected	-
15	NC	NC	Not connected	-
16	NC	NC	Not connected	-
17	PPS	O	Pulse Per Second signal	2V8
18	ECLK	O	E_Clock	2V8
19	SYNC_PULSE	I	Sync_Pulse	2V8
20	GIO10	I/O	GPIO N.10	2V8
21	GND	GND	Ground	
22	TX1	O	Serial_Output_UART1	2V8
23	RX1	I	Serial_Input_UART1	2V8
24	NC	NC	Not connected	-
25	VCC	PWR	SMPS power supply	2.8V÷4.3V
26	NC	NC	Not connected	-
27	NC	NC	Not connected	-
28	MM_I2CD	I/O	I2C_DATA	2V8
29	NC	NC	Not connected	-
30	NC	NC	Not connected	-
31	GND	GND	Ground	
32	VBATT	PWR	RTC LDO Power supply	2.0V÷4.3V

Table 8-1 SE868-A Module Pinout



8.1.2. SE868-AS Pin-out

PIN N.	SIGNAL	TYPE	DESCRIPTION	LOGIC LEVEL
1	GND	GND	Ground	
2	NC	NC	Not connected	-
3	NC	O	Not connected	-
4	DR_IN	I	DR wake-up signal input	1V2
5	NC	NC	Not connected	-
6	GND	GND	Ground	
7	GND	GND	Ground	
8	NC	NC	Not connected	-
9	GND	GND	Ground	
10	TX0	O	Serial Output UART0	2V8
11	RX0	I	Serial Input UART0	2V8
12	HRST_B	I	System Reset – Active Low	2V8
13	NC	NC	Not connected	-
14	NC	NC	Not connected	-
15	NC	NC	Not connected	-
16	NC	NC	Not connected	-
17	PPS	O	Pulse Per Second signal	2V8
18	NC	NC	Not connected	-
19	SYNC_PULSE	I	Sync Pulse	2V8
20	NC	NC	Not connected	-
21	GND	GND	Ground	
22	TX1	O	Serial Output UART1	2V8
23	RX1	I	Serial Input UART1	2V8
24	NC	NC	Not connected	-
25	VCC	PWR	SMPS power supply	2.8V÷4.3V
26	NC	NC	Not connected	-
27	NC	NC	Not connected	-
28	NC	NC	Not connected	-
29	NC	NC	Not connected	-
30	NC	NC	Not connected	-
31	GND	GND	Ground	
32	VBATT	PWR	RTC LDO Power supply	2.0V÷4.3V

Table 8-2 SE868-A Module Pinout



8.2. Power Supply

The SE868-A/AS Modules have two power supply pins VCC and VBATT.

8.2.1. DC Electrical Characteristics

Main Supply Voltage & Backup Voltage					
Supply	Symbol	Min	Typ	Max	Unit
Main Voltage	VCC	2.8	3.3	4.3	V
Backup Voltage	VBAT	2.8	3.3	4.3	V

Table 8-3 DC Supply Voltage

The SE868-A/AS module can work with a single always on supply within the 2.8-4.3 voltage range (3.3V nominal). The module powers up automatically upon applying the power.

If the supply is removed from both VCC (pin 25) and VBAT (pin 32), the receiver loses contents of the internal SRAM and current RTC time.

To prevent RTC data losses, the module can be provided with a “split” design regarding VCC (SMPS power supply) and VBAT (RTC LDO Power supply); refer to § 8.2.3 **Implementing Pseudo battery Back-up** for the split design circuit implementation.

The SE868-A/AS family modules continuously monitor the VCC supply and issue an internal hardware reset if the voltage drops below 2.7 (± 0.1) V. This reset protects the memory from accidental writes during a power down condition. To prevent this, the supply must be regulated to be within the 2.8-4.3 voltage range, inclusive of load regulation and power supply noise and ripple. Noise and ripple outside of these limits can affect positioning sensitivity and risk tripping the internal voltage supervisors, thereby shutting down the SE868-A/AS unexpectedly.

Regulators with good load regulation are recommended in order to prevent power supply glitches as the receiver transitions between power states.

8.2.2. Capacitance

SE868-A/AS is designed to work without the need for additional filtering on the input supply, providing a convenient and easy design.

Regulators with good load compensation are recommended in order to prevent power supply glitches as the SE868-A/AS switches over its allowed power states.



8.2.3. Implementing Pseudo battery Back-up

In order to keep alive the RTC time, the following circuit implementation using a 3V coin battery, can be used.

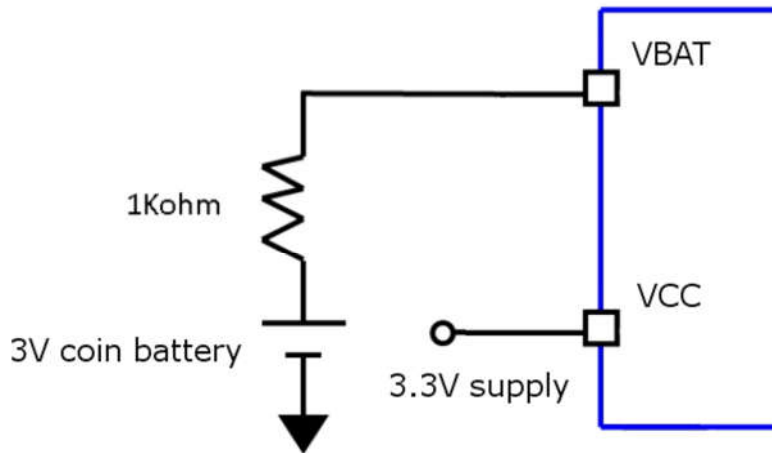


Figure 8-2 Battery backup implementation



Note:
SE868-A family will not turn on unless both supplies, VCC and VBAT, are present.



8.2.4. Current Consumption

8.2.4.1. SE868-A Current Consumption

State & Constellation	Symbol	Typ	Max	Unit
Navigation/Tracking				
GPS and Glonass	I _{cc}	24	31	mA
GPS Only	I _{cc}	17	22	mA
Glonass Only	I _{cc}	22	27.1	mA
Acquisition				
GPS and Glonass	I _{cc}	28	28.5	mA
GPS Only	I _{cc}	21	25.8	mA
Glonass Only	I _{cc}	24	23.6	mA
Navigation/Tracking				
GPS and Glonass		24	31	mA
GPS Only		17	22	mA
Glonass Only		22	27.1	mA
Low Power Modes				
GPS and Glonass Standby	I _{cc}	0.49		mA
GPS and Glonass Periodic	I _{cc}	6.76		mA
GPS Only Standby	I _{cc}	0.48		mA
GPS Only Periodic	I _{cc}	5.66		mA
Battery Backup	I _{BATT}	7		uA
Operating temperature: 25°C. Supply voltages: nominal 3.3 VDC. Low Power mode: 500 ms duty cycle Periodic Mode: default settings - asleep for 12 s, then awake for 3 s				

Table 8-4 SE868-A Module Operating Conditions



8.2.5. SE868-AS Current Consumption

State & Constellation	Symbol	Typ	Max	Unit
Navigation/Tracking				
GPS Only	I _{cc}	18	21	mA
Acquisition				
GPS Only	I _{cc}	17.5	28	mA
Low Power Mode				
GPS Only	I _{cc}	0.4		mA
Battery Backup				
	I _{BATT}	6.5	6.6	uA
Operating temperature: 25°C. Supply voltages: nominal 3.3 VDC. Low Power mode: 500 ms duty cycle				

Table 8-5 SE868-AS Operating Conditions

8.3. RF Considerations

8.3.1. Jamming Rejection-Active Interference Cancellation

Jamming Rejection can be used for solving narrow band (CW) EMI problems in the customer’s system. It is effective against narrow band clock harmonics. Jamming Rejection is not effective against wide band noise, e.g. from a host CPU memory bus or switching power supply because these sources typically cannot be distinguished from thermal noise. A wide band jamming signal effectively increases the noise floor and reduces GNSS signal levels.

8.3.2. Frequency Plan

Signal	Frequency (MHz)
TCXO Frequency	26.000
LO Frequency	1588.6

Table 8-6 Frequency Plan

8.3.3. Local Oscillator Leakage

Signal	Level
LO Leakage	-70 dBm (typical)

Table 8-7 LO Leakage



8.4. Digital Signal Interface

8.4.1. Operating Conditions

Several distinct logic levels are used by the digital signal interfaces of the SE868-A module family. The levels are shown below:

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDDIO	Supply voltage of IO power	2.52	2.8	3.08	V
VIL	Input low	-0.3	-	0.8	V
VIH	Input high	2.0	-	3.6	V
VOL	Output low	-0.3	-	0.4	V
VOH	Output high	2.4	-	VDDIO + 0.3	V
RPU	Internal pull-up equivalent resistor	40	-	190	kΩ
RPD	Internal pull-down equivalent resistor	40	-	190	kΩ

Table 8-8 2.8V logic level electrical characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDDIO	Supply voltage of IO power	1.08	1.2	1.32	V
VIL	Input low	-0.3	-	0.54	V
VIH	Input high	0.66	-	3.6	V
VOL	Output low	-	-	0.42	V
VOH	Output high	0.78	-	-	V
RPU	Internal pull-up equivalent resistor	130	-	560	kΩ
RPD	Internal pull-down equivalent resistor	130	-	560	kΩ

Table 8-9 1.2V logic level electrical characteristics



8.4.2. TX

The TX serial data line outputs NMEA serial data at a default bit rate of 9600 bps from the SE868-A/AS modules to the host.

When no serial data is being output the TX data line idles high.

8.4.3. RX

The RX data line accepts proprietary NMEA commands at a default bit rate of 9600 bps from the host CPU to the SE868-A/AS modules.

When the receiver is powered down, do not back drive this or any other GPIO line. The idle state for serial data from the host computer is logic 1.

8.4.4. 1PPS

The PPS (Pulse Per Second) signal is provided for many external applications. The pulse is configurable for required duration, frequency and active high/low via command. The pulse may vary 30 nS (1 σ). The relationship between the PPS signal and UTC is unspecified.

Use Proprietary Mediatek command PMTK255 to enable or disable this functionality:

- **PMTK255,1** => enable PPS
- **PMTK255,0** => disable PPS

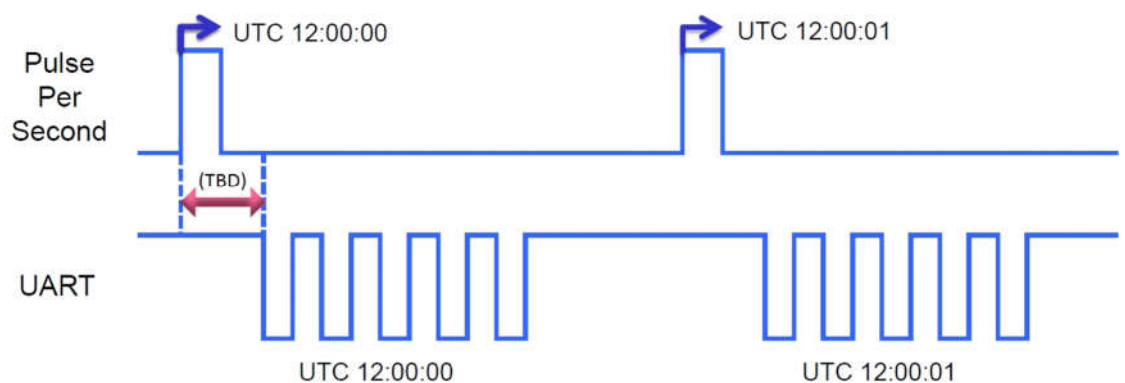


Figure 8-3 PPS signal



PPS supports 1Hz NMEA output, but at baud rate of 9600 bps, if there are many NMEA sentences output, per second transmission may exceed one second.

A schematic example for PPS signal connection to a led indicator is showed below:

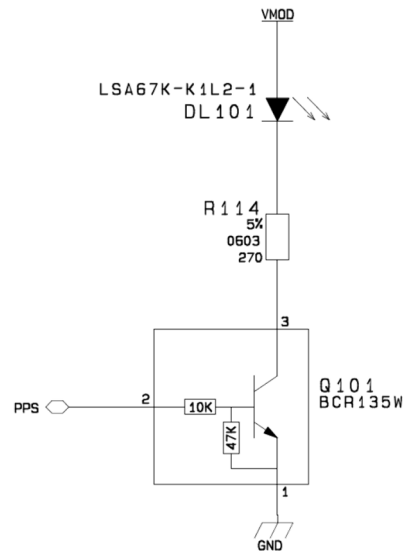


Figure 8-4 PPS signal connection to LED

8.4.5. FORCE-ON (Only SE868-A)

Force-ON is an input signal that can be used to wake up the SE868-A from the sleep mode. It is internally pulled-up. It has active-low logic, i.e. the module wakes up when FORCE_ON is tied to ground. When inactive, it should be left open drain or open collector.

Note:



Keeping FORCE_ON tied to ground will not prevent the SE868-A from going into sleep mode, since this signal is sensitive only to the high-low transition.



No pull-up circuits are allowed on the FORCE_ON pin, since the signal is already internally pulled up.



9. Reference Design

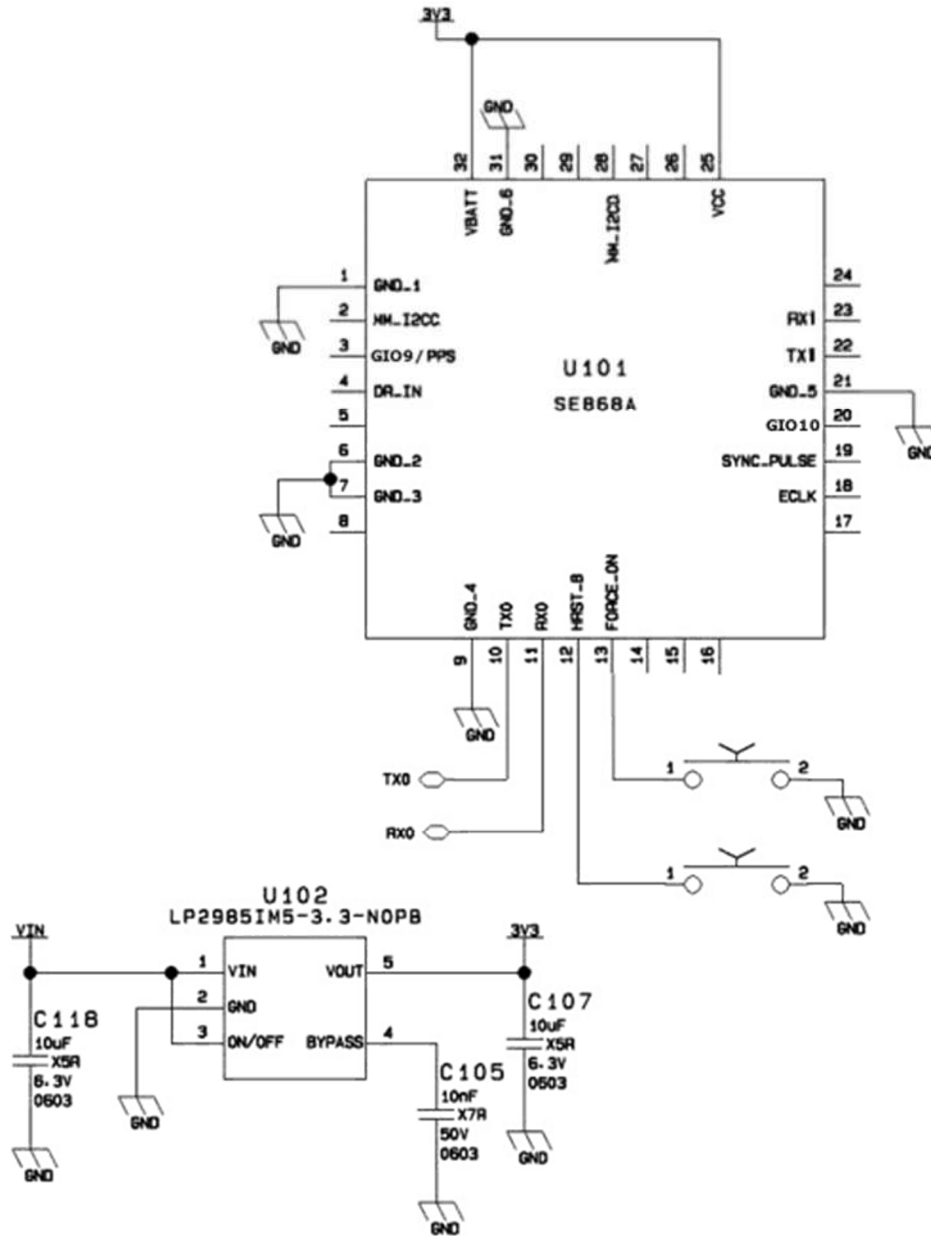


Figure 9-1 SE868-A/AS common Reference Design



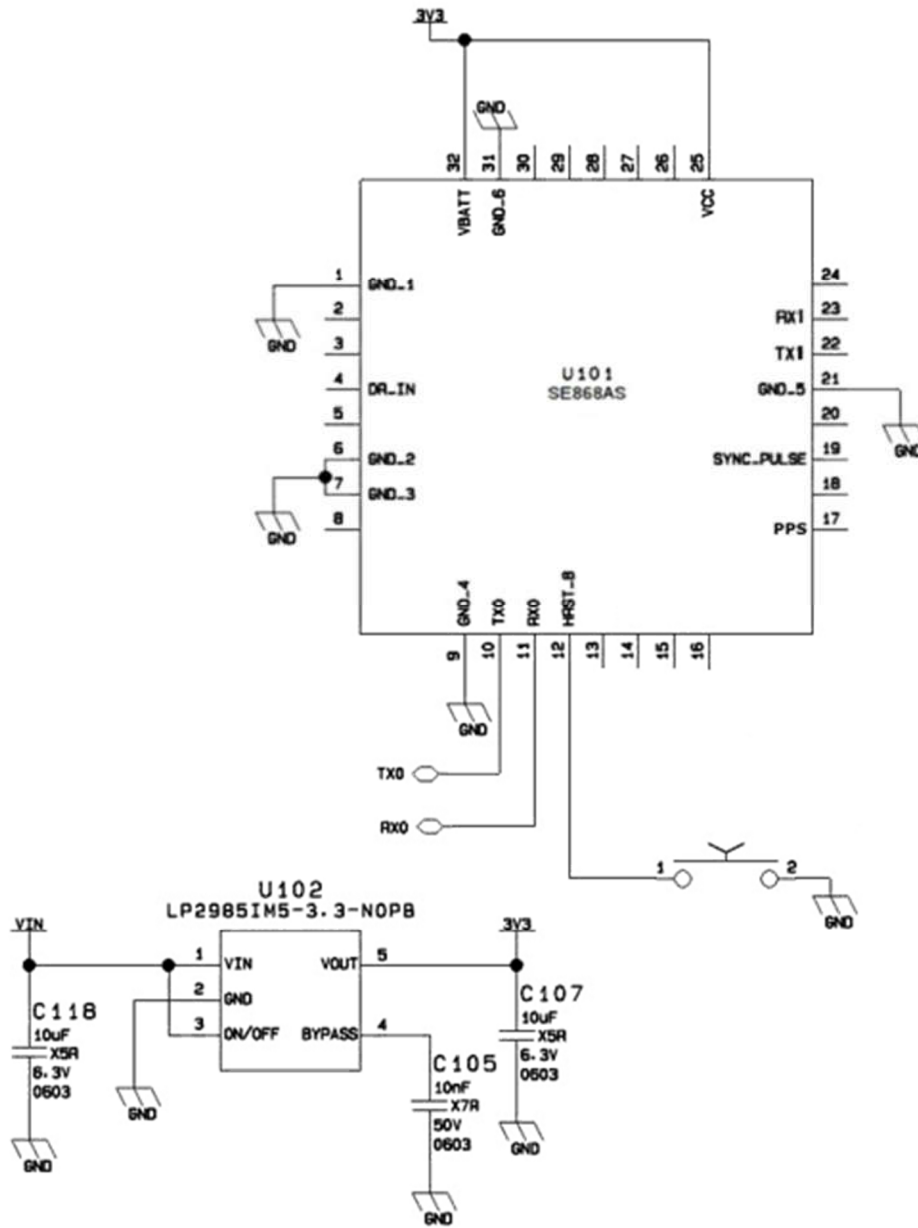


Figure 9-2 SE868-AS Reference Design



Power supply: VCC is shortened to VBAT and they are connected to 3.3V (nominal supply) generated by the external regulator U102. If a regulator with good load regulation has been chosen, no additional bypass capacitors are necessary.

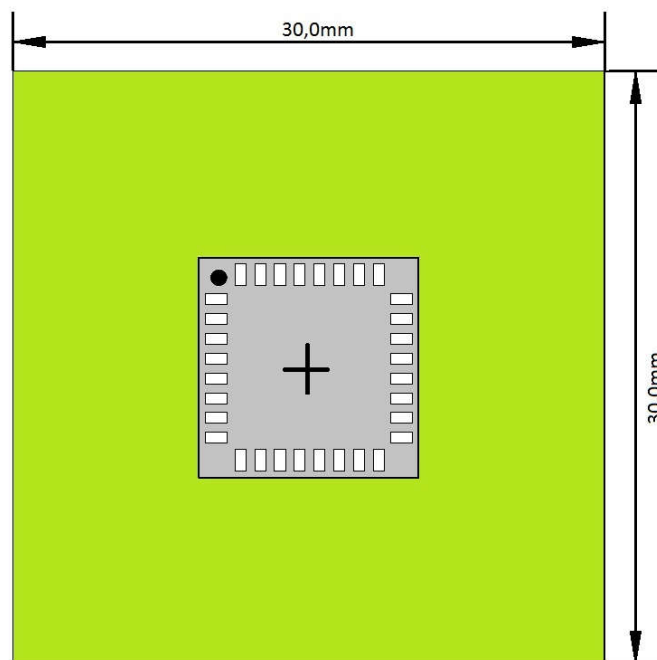
UART interface: baud rate is set, by default, to 9600 bps. TX is the normal digital output and RX is the normal digital input. TX and RX logic voltage level is 2.8V.

HRST_B (system reset): active low signal.

FORCE_ON (wakeup): active low signal.

9.1. Ground Plane

In order to optimize antenna performances it is recommended to design a 30mm by 30mm ground plane around the module into the application PCB as shown below.



■ suggested ground plane area

Figure 9-3 Recommended Ground Plane



10. RF Front End design

The SE868-A Family contains built-in RF front-end integrating GPS antenna, LNA and SAW filter. No external antenna is supported.

10.1. On-Board Antenna

The integrated antenna is a 9mm by 9mm ceramic patch.



In order to optimize antenna performances it is strongly recommended to design a 30mm by 30mm ground plane around the module into the application PCB.



If the ground plane size is smaller than 30x30mm an application center frequency detuning may occur.

Parameter	GPS Specification
Center frequency	1575.42 ± 3 MHz
Return Loss @ center freq.	15 dB min.
Gain @ center freq.	typ. -0.6 dBic @ Zenith
Axial ratio	Typ. 7.0 dB
Polarization	RHCP
Impedance	50 Ω
Operating temperature	-40°C to +90°C

Table 10-1 SE868-AS Antenna specifications

Parameter	Specification	
	GPS	GLONASS
Working frequency	1575.42 MHz	1598-1606 MHz
Bandwidth (Return Loss < -10dB)	5 MHz min.	5 MHz min.
Gain @ center freq.	Typ. -3.5 @ Zenith	Typ. -3.0 @ Zenith
Axial ratio	Typ. 16.0 (Measured on Module EVB)	Typ. 10.0 (Measured on Module EVB)
Polarization	RHCP	
Impedance	50 Ω	
Operating temperature	-40°C to +90°C	

Table 10-2 SE868-A Antenna specifications



11. Mechanical Drawing

The SE868-A family mechanical drawings and dimensions are reported in the pictures showed below.
All reported measures are expressed in millimeters.

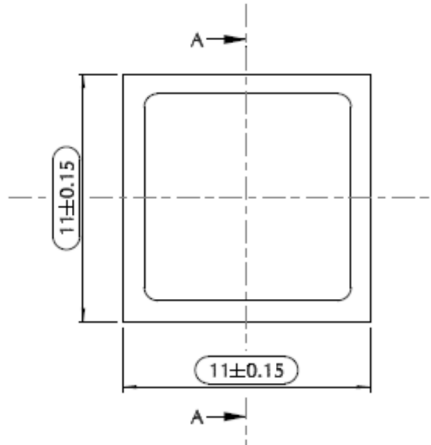


Figure 11-1 SE868-A Modules Top View

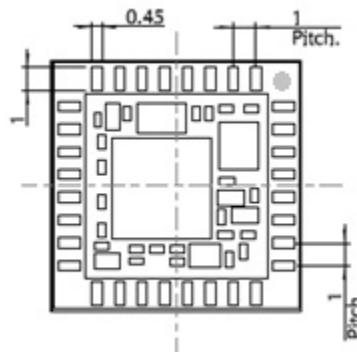


Figure 11-2 SE868-A Modules Bottom View



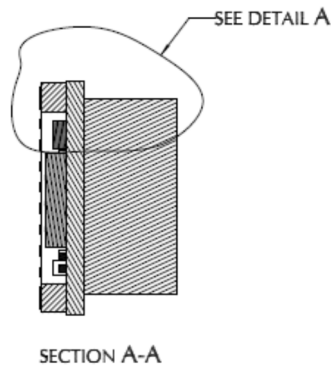


Figure 11-3 SE868-A Family Cross-sectional View

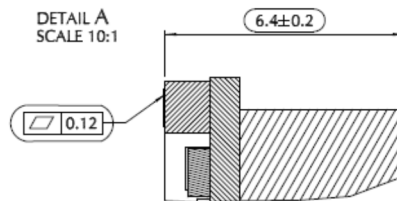
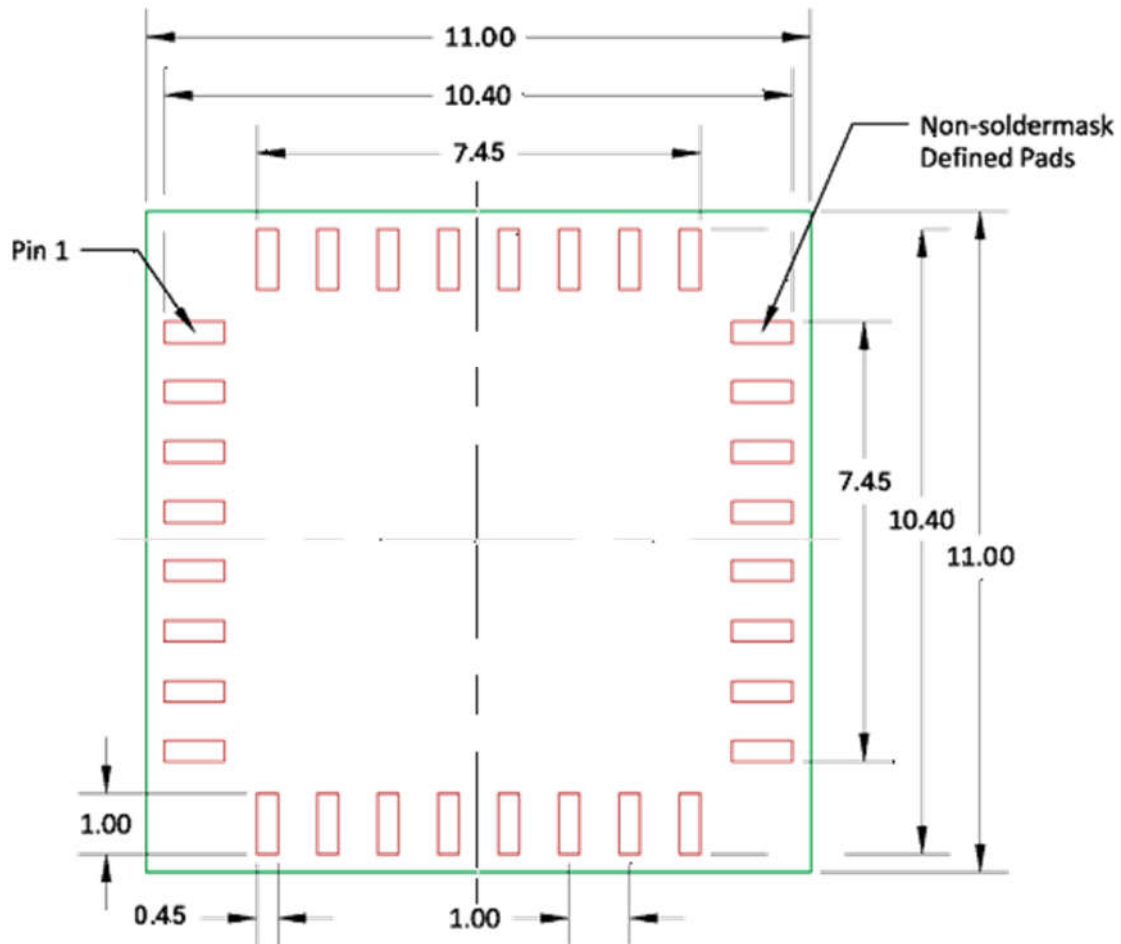


Figure 11-4 SE868-A Family Cross-sectional Detail



12. PCB Footprint

The PCB footprint on the receiving board should match the SE868-A/AS modules electrical pad design shown below.



All Dimensions are in mm.

Viewed from Top

Figure 12-1 Recommended PCB Footprint



13. Product Packaging and Handling

13.1. Product Marking and Serialization

The SE868-A/AS modules support Clear writing and Barcode type 2D datamatrix of the module serial number.

Contact a Telit representative for information on specific module serial numbers.

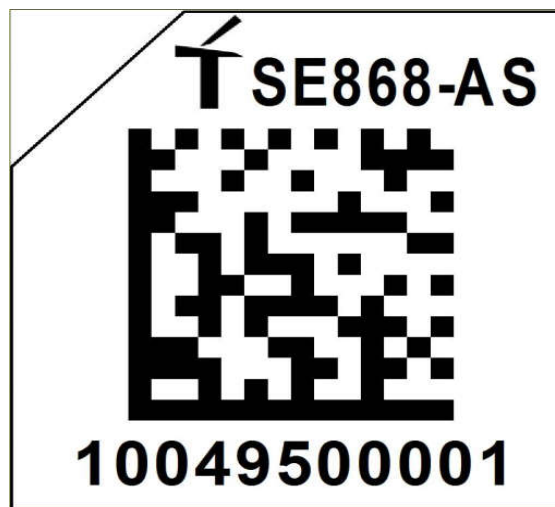


Figure 13-1 SE868-AS Label



13.2. Product Packaging and Delivery

SE868-A/AS modules are shipped in Tape and Reel form. The reeled modules are shipped in 24mm reels with 250 units per reel. Each reel is ‘dry’ packaged and vacuum sealed in a Moisture Barrier Bag (MBB) with two silica gel packs and placed in a carton.

The minimum order quantity for shipping is 250 units.

All packaging is ESD protective lined.

The SE868-A/AS receivers are Moisture Sensitive Devices (MSD). Please follow the MSD and ESD handling instructions on the labels of the MBB and exterior carton.

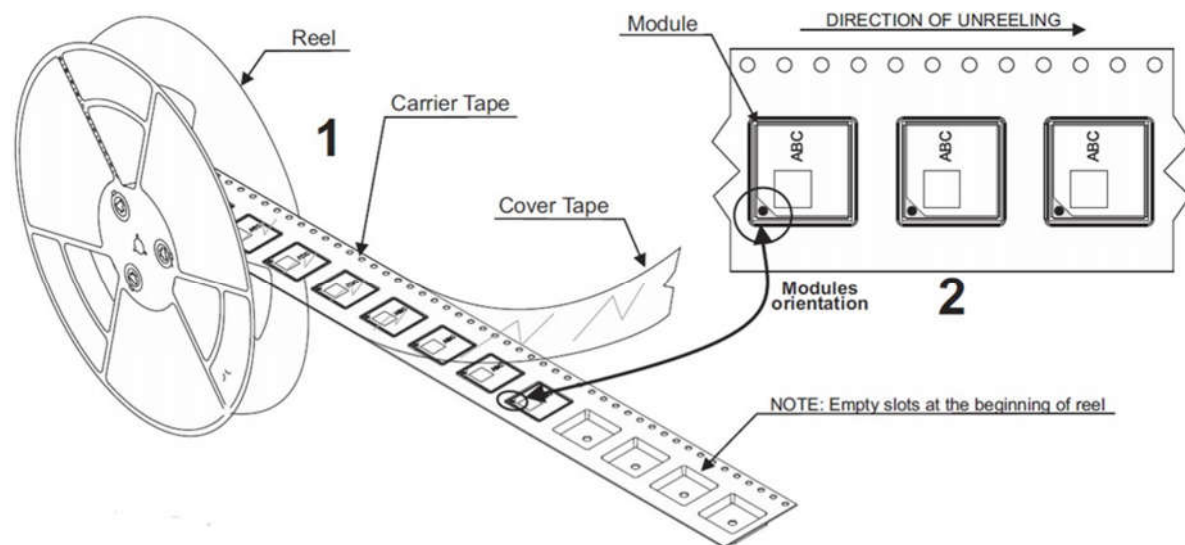


Figure 13-2 Tape and Reel Packaging

13.3. 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.

The SE868-A family have a moisture sensitivity level rating of 3 as defined by IPC/JEDEC J-STD-020. This rating is assigned due to some of the components used within the SE868-AS.

The SE868-A/AS modules are supplied in tape and reel and is hermetically sealed with desiccant and humidity indicator card. The SE868 parts must be placed and reflowed within 168 hours of first opening the hermetic seal provided the factory conditions are less than 30°C and less than 60% and the humidity indicator card indicates less than 10% relative humidity.

If the package has been opened or the humidity indicator card indicates above 10%, then the parts will need to be baked prior to reflow. The parts may be baked at +125°C ± 5°C for 48 hours. However, the trays, nor the tape and reel can withstand that temperature. Lower temperature baking is feasible if the humidity level is low and time is available. Please see IPC/JEDEC J-STD-033 for additional information.

Additional information can be found on the MSL tag affixed to the outside of the hermetical seal bag.



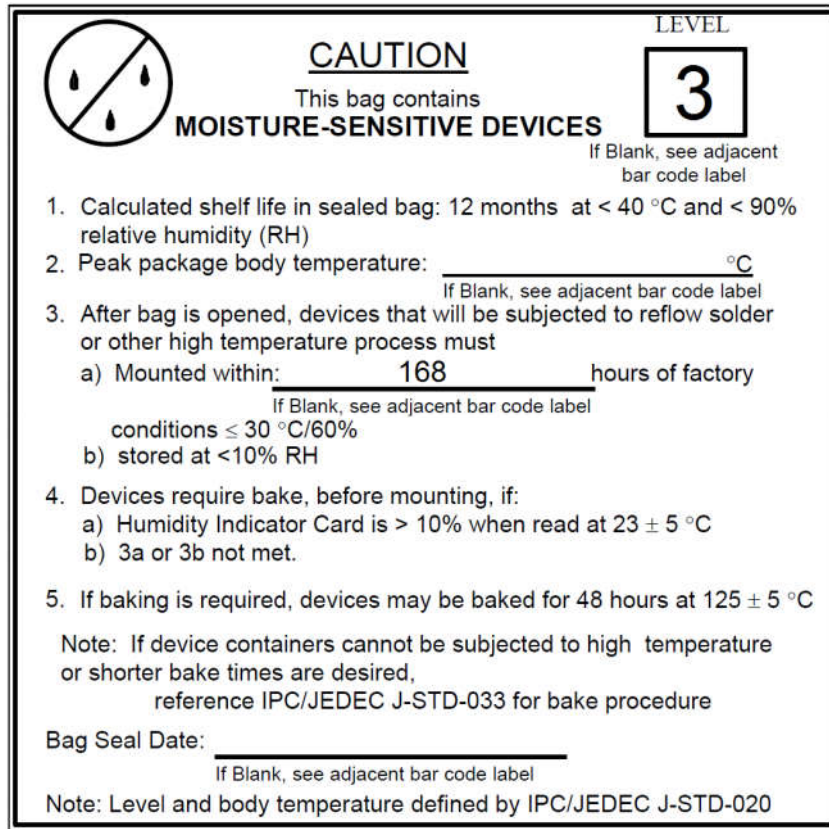


Figure 13-3 Label for Moisture Sensitive Devices

The SE868-A/AS Receivers are 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 JEDEC standard JESD625-A, Requirements for Handling Electrostatic Discharge Sensitive (ESDS) Devices.

13.4. ESD Sensitivity



These modules contain class 1 devices and are Electro-Static Discharge Sensitive (ESDS). Telit recommends two basic techniques for protecting ESD devices from damage:

- Handle sensitive components only 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 JEDEC standard JESD625-A “Requirements for Handling Electrostatic Discharge Sensitive (ESDS) Devices”, which can be downloaded free of charge from: www.jedec.org.

13.5. Reflow

The SE868-A/AS modules are compatible with lead free soldering processes as defined in IPC/JEDEC J-STD-020.

The reflow profile must not exceed the profile given IPC/JEDEC J-STD-020 Table 5-2, “Classification Reflow Profiles”.

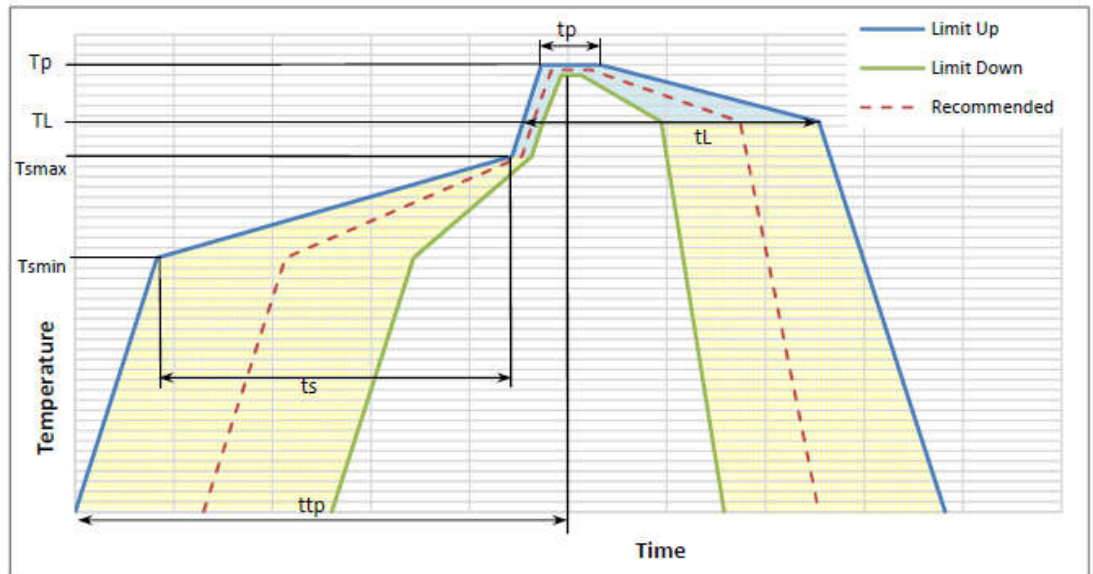


SE868-A modules customer assembly process is limited to one reflow.

In case of double-sided SMT customer process, it is mandatory reflowing the side containing the SE868 modules last.

The recommended reflow profile is shown in the following picture.





Profile Feature	Pb-Free Assembly
Average ramp-up rate (TL to Tp)	3°C/second max
Preheat	
- Temperature Min (Tsmin)	150°C
- Temperature Max (Tsmax)	200°C
- Time (Tsmin to Tsmax) ts	60-180 seconds
Tsmax to TL	
- Ramp-up rate	3°C/second max
Time maintained above:	
- Temperature (TL)	217°C
- Time (tL)	60-150 seconds
Peak Temperature (Tp)	245°C +0/-5 °C
Time within 5°C of actual Peak Temperature (tp)	10-30 seconds
Ramp-down Rate	6°C/second max
Time 25°C to Peak Temperature Tp (ttp)	8 minutes max

Figure 13-4 SE868-A/AS modules recommended reflow profile



13.6. Assembly Considerations

During board assembly and singulation process steps, pay careful attention to unwanted vibrations, resonances and mechanical shocks introduced by the board router.

13.7. Safety

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

13.8. 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.



14. Environmental Requirements

14.1. Operating

Temperature	-40°C to +85°C
Temperature Rate of Change	±1°C/min. maximum
Humidity	Up to 95% non-condensing or a wet bulb temperature of +35°C, whichever is less
Altitude	-1500 m to 100,000 m
Maximum Vehicle Dynamics	600 m/sec (acquisition and navigation) 2G acceleration
ITAR Limits	Speed: 515m/sec and Altitude: greater than 18,000 m

Table 14-1 Operating Environmental Limits

14.2. Storage

Temperature	-40°C to +85°C
Humidity	Up to 95% non-condensing or a wet bulb temperature of +35°C, whichever is less
Altitude	-1000 feet to 60,000 feet
Shock	18G peak, 5 millisecond duration
Shock (in shipping container)	10 drops from 75 cm onto concrete floor

Table 14-2 Storage Environmental Limits



15. Compliances

The SE868-A modules comply with the following:




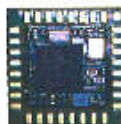
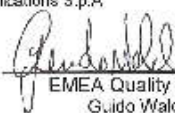

- Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- Manufactured in an ISO 9000: 2000 accredited facility
- Manufactured to TS 16949 requirement (upon request)

The SE868 modules module 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



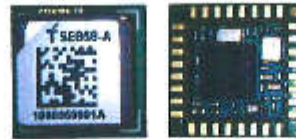
15.1. CE Declaration of Conformity

 					
<h3>EC DECLARATION OF CONFORMITY</h3>					
<p>1. SE868-AS (product name) 2. Telit Communications S.p.A - loc. Gallotta, S.S. 195, Km 2,300, 09122 Cagliari - ITALY (manufacturer) 3. This declaration of conformity is issued under the sole responsibility of the manufacturer 4. GPS Receiving Module</p>					
 					
<p>5. The object of the declaration described above is in conformity with the relevant Community harmonisation: European Directive 1999/05/EC (R&TTE) 6. The conformity with the essential requirements of the 1999/05/EC has been demonstrated against the following harmonized standards:</p>					
EN 60950-1:2008 + COR1R:2008 + A11:2009 + A1:2010 + A12:2011	For article 3.1 (a) Health and Safety of the User				
EN 301 488-1 V1 9.2 EN 301 488-3 V1 6.1	For article 3.1 (b): Electromagnetic Compatibility				
EN 300 440-2 V1 4.1	For article 3.2: Effective use of spectrum allocated				
<p>7. The conformity assessment procedure referred to in Article 10 and detailed in Annex IV of Directive 1999/05/EC has been followed with the involvement of the following Notified Body CEITECOM ICT Services GmbH Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany. Notified Body Number: 0682 Due to the equipment dimensions, the CE marking cannot be visibly and legibly affixed on the product itself. Thus, CE 0682 is affixed to the packaging, if it exists, and to the accompanying documents.</p>					
<p>8. The Technical Construction File (TCF) relevant to the product described above, and which supports this Declaration of Conformity, is held at: Telit Communications S.p.A Via Stivione di Prosecco, 6/b 34010 Sgonico (TRIFESTE) - ITALY</p>					
Signed for and on behalf of Telit Communications S.p.A					
Trieste, 2014-12-11	 EMEA Quality Director Guido Walcher				
	 Quality Manager Cesare Robelli				
<table border="1"> <tr> <td>Notified Body Catalog No.:</td> <td>0003/008-01-F0</td> </tr> <tr> <td>Technical Construction File:</td> <td>304321C000485</td> </tr> </table>		Notified Body Catalog No.:	0003/008-01-F0	Technical Construction File:	304321C000485
Notified Body Catalog No.:	0003/008-01-F0				
Technical Construction File:	304321C000485				
<small>Mod. 0211 2012-11 Rev.2. This declaration of conformity is issued in compliance with 759/2006/EC</small>					



EC DECLARATION OF CONFORMITY

- SE868-A (product name)
- Telit Communications S.p.A. - loc. Saffieta, S.S. 106, Km 2.300, 08122 Caglian - ITALY (manufacturer)
- This declaration of conformity is issued under the sole responsibility of the manufacturer.
- GPS Receiving Module



- The object of the declaration described above is in conformity with the relevant Community harmonisation: European Directive 1999/05/EC (R&TTE)
- The conformity with the essential requirements of the 1999/05/EC has been demonstrated against the following harmonized standards:

EN 60950-1:2006 + CORR:2006 + A11:2009 + A1:2010 + A12:2011	For article 3.1 (a) Health and Safety of the User
EN 301 489-1 V1 9.2 EN 301 489-3 V1 6.1	For article 3.1 (b): Electromagnetic Compatibility
EN 300 440-2 V1.4.1	For article 3.2: Effective use of spectrum allocated

- The conformity assessment procedure referred to in Article 10 and detailed in Annex IV of Directive 1999/05/EC has been followed with the involvement of the following Notified Body

CFTECOM ICI Services GmbH Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany.

Notified Body Number: 0682


Due to the equipment dimensions, the CE marking cannot be visibly and legibly affixed on the product itself.

Thus, **CE 0682** is affixed to the packaging, if it exists, and to the accompanying documents.

- The Technical Construction File (TCF) relevant to the product described above, and which supports this Declaration of Conformity, is held at: Telit Communications S.p.A, Via Stazione di Prosecco, 5/b - 34010 Sgonico (TRIESTE) - ITALY

Signed for and on behalf of Telit Communications S.p.A

Trieste, 2014-12-11


EMEA Quality Director
Guido Walcher


Quality Manager
Cesare Robell

Notified Body Opinion No: R0024489-01-EO
Technical Construction File: 304527C500645A

CETECOM ICT Services GmbH
Notified Body



CETECOM ICT Services GmbH • Postfach 10 04 45 • D-66004 Saarbrücken

Telit Communications S.p.A.
Via Stazione di Prosecco, 5/B
34010 Sgonico, Trieste
Italy

Your reference, your message from 4500014048 Order dated 2014-11-26	Our reference, our message from SCHM R000449B-01-EO	Phone / Fax +49 (0)2054 / 9519-0 +49 (0)2054 / 9519-997	Saarbrücken 2014-12-11
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• **Conformity Assessment acc. to Annex IV of Directive 1999/5/EC (R&TTE Directive)**

Registration Number: **R000449B-01-EO**
Applicant: **Telit Communications S.p.A., Italy**
Product Designation: **SE868-AS
GPS Module**

Dear Sir/Madam,
following your order we have performed the conformity assessment for your product given above. Please find enclosed the relating issue of the


Expert Opinion with the registration number : **R000449B-01-EO**

Notes: The EC conformity marking (CE mark) of products as designated in the above given Expert Opinion shall be accompanied by our notified body identification number 0682 and the equipment class identifier if applicable (class 2 devices only) before the placing on the market. Please pay attention to further formal provisions of Directive 1999/5/EC regarding product labelling, obligatory information to the user or to authorities that may apply. Guidance is available from the EC commission's R&TTE web pages. For other products than those designated in the related Expert Opinion our notified body identification number may not be used without our written permission.

The order is concluded herewith. We will charge for our services by a separate invoice.

Yours faithfully
CETECOM ICT Services GmbH

Enclosure
• Expert Opinion


i.A. Marc Schindt



CETECOM ICT Services GmbH
Notified Body



CETECOM ICT Services GmbH • Postfach 1004 45 • D-68004 Saarbrücken

Telit Communications S.p.A.
Via Stazione di Prosecco, 5/B
34010 Sgonico, Trieste
Italy

Your reference, your message from 4500014048 Order dated 2014-11-26	Our reference, our message from SCHM R000448B-01-EO	Phone / Fax +49 (0)2054 / 9519-0 +49 (0)2054 / 9519-997	Saarbrücken 2014-12-11
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• **Conformity Assessment acc. to Annex IV of Directive 1999/5/EC (R&TTE Directive)**

Registration Number: **R000448B-01-EO**
Applicant: **Telit Communications S.p.A., Italy**
Product Designation: **SE868-A
GNSS Module**

Dear Sir/Madam,
following your order we have performed the conformity assessment for your product given above. Please find enclosed the relating issue of the

Expert Opinion with the registration number : **R000448B-01-EO**


Notes: The EC conformity marking (CE mark) of products as designated in the above given Expert Opinion shall be accompanied by our notified body identification number 0682 and the equipment class identifier if applicable (class 2 devices only) before the placing on the market. Please pay attention to further formal provisions of Directive 1999/5/EC regarding product labelling, obligatory information to the user or to authorities that may apply. Guidance is available from the EC commission's R&TTE web pages. For other products than those designated in the related Expert Opinion our notified body identification number may not be used without our written permission.

The order is concluded herewith. We will charge for our services by a separate invoice.

Yours faithfully
CETECOM ICT Services GmbH

Enclosure
• Expert Opinion

i.A. Marc Schmidt



15.2. RoHS Certificate

The Telit SE868-A/AS modules are fully compliant with the EU RoHS Directives.



16. Glossary and Acronyms

AGPS: Assisted GPS

AGPS provides ephemeris data to the receiver to allow faster cold start times than would otherwise be possible.

This extended ephemeris data could be either server-generated or locally-generated.

Almanac:

A set of orbital parameters for all GPS satellites that allows calculation of approximate GPS satellite positions and velocities. The almanac is used by a receiver to determine satellite visibility and as an aid during acquisition of GPS satellite signals. The almanac is reduced-precision set of ephemeris data and is updated weekly by GPS Control. See

BeiDou (BDNS / formerly COMPASS)

BeiDou Satellite Navigation System (BDS), also known as COMPASS or BeiDou-2, Global satellite navigation system used by China and Asia Pacific region

Cold Start:

A cold start acquisition assumes that the receiver's position and time, along with ephemeris data, is unknown. Almanac information may be used to identify previously healthy satellites and their approximate position.

Cold Start Acquisition Sensitivity:

The lowest signal level at which a GNSS receiver is able to reliably acquire satellite signals and calculate a navigation solution from a Cold Start. Cold start acquisition sensitivity is limited by the data decoding threshold of the satellite messages.

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. Also see WAAS.

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 (normally every 2 hours) to maintain the accuracy of the position calculation.

ESD: Electro-Static Discharge

Large, momentary, unwanted electrical currents that cause damage to electronic equipment.

Galileo:

Global navigation satellite system (GNSS) currently being built by the European Union (EU) and European Space Agency (ESA), intended for civilian use.

GDOP: Geometric Dilution of Precision

A factor used to describe the effect of satellite geometry on the accuracy of the time and position solution of a GNSS receiver. A lower the value of GDOP indicates a smaller error in the solution. Related factors include PDOP, HDOP, TDOP and VDOP.

GLONASS: Global Navigation Satellite System

[Satellite navigation](#) system operated by the [Russian Aerospace Defense Forces](#)



GNSS: Global Navigation Satellite System

Term used for a satellite navigation system with global coverage

GPS: Global Positioning System

The U.S. GNSS space-based radio positioning system that provides accurate position, velocity, and time data.

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. All of the critical data (position, velocity, time, and satellite ephemeris) is current and available in memory.

LCC: Leadless Chip Carrier

A module design without pins. In place of the pins are pads of bare gold-plated copper that are soldered to the printed circuit board.

LNA: Low Noise Amplifier

An electronic amplifier used for very weak signals.

Local Ephemeris prediction data:

AGPS prediction of extended ephemeris from broadcast data (downloaded from satellites), which is stored in memory. Useful for up to three days.

MSD: Moisture sensitive device.

Navigation Sensitivity: The lowest signal level at which a GNSS receiver is able to reliably maintain navigation after the satellite signals have been acquired.

NMEA: National Marine Electronics Association

QZSS: Quasi-Zenith Satellite System

Satellite Based Augmentation System for GPS which is receivable within Japan and Oceania

RoHS: The Restriction of Hazardous Substances

Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment, was adopted in February 2003 by the European Union.

RTC: Real Time Clock

An electronic device (chip) that maintains time continuously while powered up.

SAW: Surface Acoustic Wave filter

Electromechanical device used in radio frequency applications. SAW filters are useful at frequencies up to 3 GHz.

SBAS: Satellite Based Augmentation System

A system that uses a network of ground stations and geostationary satellites to provide differential corrections to GNSS receivers. Current examples are EGNOS, WAAS, and MSAS.

Server-based Ephemeris prediction:

A prediction of GPS extended ephemeris accomplished on a server and provided to the receiver over a network. The data is generally usable for up to 14 days.

TCXO: Temperature-Compensated Crystal Oscillator



Tracking Sensitivity:

The lowest signal level at which a GNSS receiver is able to maintain tracking of a satellite signal after acquisition is complete.

TTFF: Time To First Fix

The elapsed time required by a receiver to achieve a valid position solution from a specified starting condition. This value 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. A standard reference level of -130 dBm is used.

UART: Universal Asynchronous Receiver/Transmitter

An integrated circuit (or part thereof) which provides a serial communication port for a computer or peripheral device.

WAAS: Wide Area Augmentation System

The system of satellites and ground stations developed by the FAA (Federal Aviation Administration) that provides DGPS corrections. WAAS satellite coverage is usable in North America. Also see EGNOS.

Warm Start:

A warm start typically results after a period of continuous navigation is followed by an extended period of 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.



17. Safety Recommendations

READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.
- Where there is risk of explosion such as gasoline stations, oil refineries, etc. It is responsibility of the user to enforce the country regulation and the specific environment regulation.

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. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue.. 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 European Community provides some Directives for the electronic equipment 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 equipment is available, while the applicable Directives (Low Voltage and EMC) are available at:

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



18. Document History

Revision	Date	Changes
0	2015-02-11	First edition
1	2015-10-19	Removed Beidou reference from §2.1, §2.2, §5.1, §5.2

