SE868SY-D
Hardware Design Guide
#Preliminary#

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TELIT
TECHNICAL
DOCUMENTATION

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APPLICABILITY TABLE

PRODUCTS

SE868SY-D

Contents

1. INTRODUCTION

1.1. Scope

This document introduces the SE868SY-D module and presents possible and recommended hardware solutions for developing a product based on this module. All the features and solutions detailed in this document are applicable to all the variants listed in the applicability table.

Obviously, this document cannot embrace every hardware solution or every product that can be designed. Where the suggested hardware configurations need not be considered mandatory, the information given should be used as a guide and a starting point for properly developing your product with the Telit module.

1.2. Audience

This document is intended for Telit customers, who are integrators, about to implement their applications using our SE868SY-D modules.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com

Alternatively, use:

http://www.telit.com/support

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

http://www.telit.com

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

2. GENERAL PRODUCT DESCRIPTION

2.1. Overview

The SE868SY-D module is a multi-frequency and multi constellation GNSS receiver, latest addition to the xE868 family.

The SE868SY-D product, exploiting the two GNSS bands L1 and L5, achieves sub-meter accuracy and reduces multipath effects typical of urban canyons.

The SE868SY-D operates in the 1.8 V voltage domain, minimizing power consumption even below L1-only products and making it ideally suited for battery powered and wearable device applications.

2.2. Product Variants and Frequency Bands

Product	L1/E1 Bands	L5/E5 Bands	Region
SE868SY-D	GPS, QZSS, GAL, GLO, BDS	GPS, QZSS, GAL, NAVIC, BDS	Worldwide

2.3. Target Market

SE868SY-D, with its improved accuracy and ultra low power consumption, can ideally be applied to all positioning verticals, like:

- Telemetry
- Fleet managements
- Insurance telematics / Dashcams
- Asset/personal tracking
- Sport equipment
- E-mobility
- Drones

2.4. Main features

Function	Features
GNSS	• Multi-constellation and Multi-bands • Low power consumption • High-Dynamics (25Hz update rate – in progress) • Geofence (in progress) • Real Time Clock

Interfaces	• Main UART • SPI / I2C (in progress) • 1PPS signal • Single Antenna pin • External Flash support (in progress)

2.5. Mechanical Specifications

2.5.1. Dimensions

The overall dimensions of SE868SY-D are:

- Length: 11 mm
- Width: 11 mm
- Thickness: 2.6 mm

2.5.2. Weight

The nominal weight of the module is TBD grams.

2.6. Temperature Range

		Note
Operating Temperature Range	–40°C ÷ +85°C	
Storage and non-operating Temperature Range	–40°C ÷ +85°C	

3. PINS ALLOCATION

3.1. Pin-out

Pin	Signal	I/O	Function	Type	Comment
Host Interface (HIF) UART					
10	UART_TX	I/O	1st function: UART-TX (HIF) 2nd function: I2C-SDA (HIF) 3rd function: SPI-MOSI (HIF)	DIGITAL 1.8V	
11	UART_RX	I/O	1st function: UART-RX (HIF) 2nd function: I2C-SCL (HIF) 3rd function: SPI-SCLK (HIF)	DIGITAL 1.8V	
23	UART_CTS	I/O	1st function: UART-CTS (HIF) 2nd function: SPI-CS (HIF) 3rd function: GPIO	DIGITAL 1.8V	
24	UART_RTS	I/O	1st function: UART-RTS (HIF) 2nd function: SPI-MISO (HIF) 3rd function: GPIO	DIGITAL 1.8V	
DIGITAL IO					
12	nRESET	I	Reset – active LOW	DIGITAL 1.8V	
19	HOST_SEL_0	I/O	Host Interface Protocol Selector	DIGITAL 1.8V	
20	HOST_SEL_1	I/O	Host Interface Protocol Selector	DIGITAL 1.8V	
26	LNA_EN	I/O	1st function: externalLNA enabler (active HIGH) 2nd function: GPIO	DIGITAL 1.8V	
28	PPS	I/O	1st function: PPS 2nd function: DRI (HIF)	DIGITAL 1.8V	

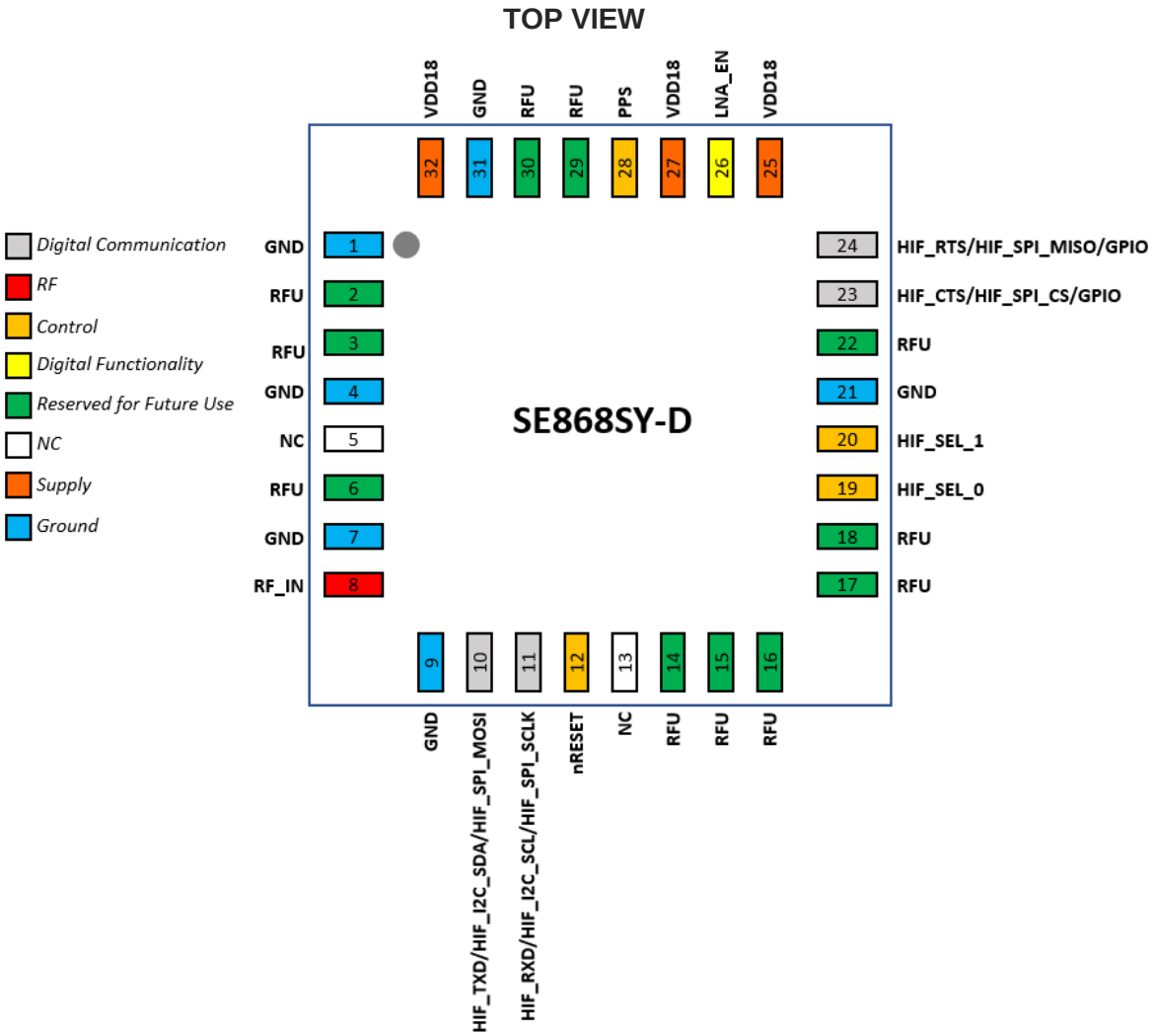
			3rd function: GPIO	
RF Section				
8	RF_IN	I	L1-L5 band RF signal input	ANALOG RF
Power Supply				
25	VDD18	-	Power supply	Power 1.8V
27	VDD18	-	Power supply	Power 1.8V (*)Alternative voltage level at 0V8 to support low power configurations will be supported on Enginering samples
32	VDD18	-	Power supply	Power 1.8V
1	GND	-	Ground	Power
4	GND	-	Ground	Power
7	GND	-	Ground	Power
9	GND	-	Ground	Power
21	GND	-	Ground	Power
31	GND	-	Ground	Power
RESERVED FOR FUTURE USE (RFU)				
2	RFU	-	RFU	
3	RFU	-	RFU	
6	RFU	-	RFU	
14	RFU	-	RFU	
15	RFU	-	RFU	

16	RFU	-	RFU
17	RFU	-	RFU
18	RFU	-	RFU
22	RFU	-	RFU
29	RFU	-	RFU
30	RFU	-	RFU
NOT CONNECTED			
5	NC	-	NOT CONNECTED
13	NC	-	NOT CONNECTED

WARNING:

Reserved pins must not be connected.

3.2. LGA Pads Layout



4. POWER SUPPLY

The power supply circuitry and board layout are a very important part in the full product design, and they strongly reflect on the product overall performances. Please read carefully the requirements and the guidelines that will follow for a proper design.

4.1. Power Supply Requirements

The external power supply must be connected to VDD18 pins, and it must fullfill the following requirements:

Power Supply	Value
Nominal Supply Voltage	1.8 V (*) (*)0V8 to support low power configurations will be supported on Enginering samples
Operating Voltage Range	1.71 ÷ 1.89 V

NOTE:

The Operating Voltage Range MUST never be exceeded at any time. This applies also to overshoots above the maximum allowed voltage, and drops below the minimum.

4.2. Power Consumption

Operative mode	PW in L1 only	PW in L1+L5
Acquisition (max)	65 mW	75 mW
Tracking (max)	30 mW	40 mW
Sleep (max)	2.16 mW	

NOTE:

It is recommended to reach the Sleep state only from Idle. Setting the device in Sleep mode directly from the Active mode could lead to higher-than-normal power consumption.

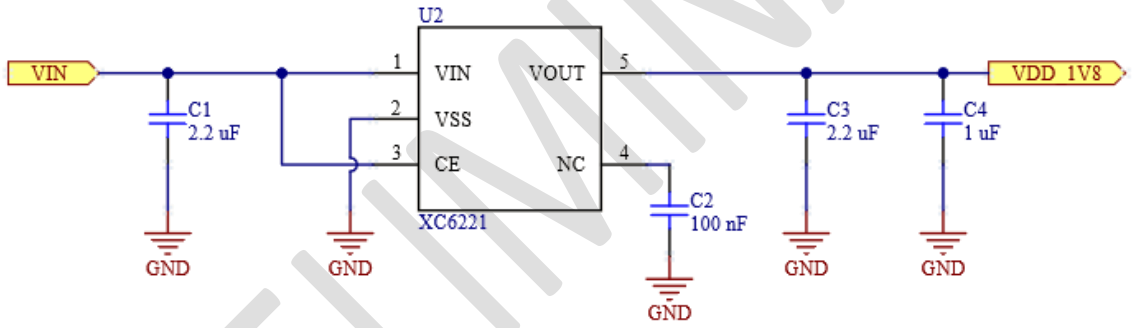
4.3. General Design Rules

The principal guidelines for the Power Supply Design embrace three different design steps:

- the electrical design
- the thermal design
- the PCB layout

4.3.1. Electrical Design Guidelines

The electrical design of the power supply depends strongly on the chosen power source. An example of a suitable linear voltage regulator is shown in the following picture:



Aluminum electrolytic capacitors are not recommended at the input to the module due to their high ESR. Whe Tantalum capacitors are chosen, a minimum value of 10uF is recommended, in parallel with a 0.1uF ceramic capacitor. Ceramic capacitors alone, for both input and output can be used, but ensure that the LDO is stable with such capacitors tied to the output.

4.3.2. Power Supply PCB layout Guidelines

As seen on the electrical design guidelines, the power supply shall have a low ESR capacitor on the output in order to cut the current peaks on the input and protect the module supply from spikes.

The placement of this component is crucial for the correct working of the circuitry. A misplaced component can be useless or can even decrease the power supply performance.

- The low ESR bypass capacitor must be placed close to the Telit SE868SY-D power input pads; in case the power supply is a switching type, the capacitor can be placed close to the switching inductor to cut the ripple.
- In case a switching power regulator is used, it is important to keep very small the involved current loop formed by the input capacitor, the output diode (if not embodied in the IC) and the regulator in order to reduce the radiated EMI at the switching frequency (100-500 kHz usually).
- A dedicated ground for the Switching regulator, separated from the common ground plane, is suggested.

5. DIGITAL SECTION

5.1. Logic Levels

Parameter	Min	Max
ABSOLUTE MAXIMUM RATINGS – NOT FUNCTIONAL		
Input level on any digital pin (CMOS 1.8) with respect to ground	-0.3V	2.2 V
Operating Range - Interface levels (1.8V CMOS)		
Input high level	0.7*VDD	VDD
Input low level	0 V	0.3*VDD
Output high level	VDD-0.45 V	VDD
Output low level	0 V	0.45 V

Parameter	AVG
CURRENT CHARACTERISTICS FOR DIGITAL PINS	
Output Current	TBD
Input Current	TBD

5.2. Communication ports

5.2.1. Communication interfaces to the Host MCU (HIF)

The SE868SY-D features three different Host Interfaces (HIF) for communicating with the host MCU that can be alternatively selected by means of Host Interface Selection pin (See Section 5.2.2):

- **HIF_UART**: serial interface, supporting speeds up to 10Mbps. Hardware flow control is mandatory for speeds above 115.2kbps.

Function	Pin on SE868SY-D
HIF_UART_TX	10
HIF_UART_RX	11
HIF_UART_CTS	23
HIF_UART_RTS	24

- **HIF_SPI**: slave SPI interface, speed up to 10Mbps.

Function	Pin on SE868SY-D
HIF_SPI_SCLK	11
HIF_SPI_CS	23
HIF_SPI_MISO	24
HIF_SPI_MOSI	10

- **HIF_I2C**: slave I^2C interface, speed up to 400kbps in Fast mode and up to 3.4 Mbps in High Speed Mode.

Function	Pin on SE868SY-D
HIF_I2C_SCL	11
HIF_I2C_SDA	10

5.2.2. Host interface selection

In the SE868SY-D the different Host Interface (HIF) options described in the previous section can be selected by means of two pins, namely HIF_SEL_0 and HIF_SEL_1, whose value is checked at the power ON. HIF_SEL_0 and HIF_SEL_1 are internally pulled down: this implies that the HIF is set to UART by default. SPI and I2C can be selected by externally pulling up HIF_SEL_1 or HIF_SEL_0 to VDD, as indicated n the following table:

HIF_SEL_1	HIF_SEL_0	Selected host interface
NC	NC	HIF_UART
NC	PULL UP	HIF_I2C
PULL UP	NC	HIF_SPI

NOTE:
The configuration with both HIF_SEL_x pins pulled up is reserved, and shall not be used.

5.3. Digital I/O

5.3.1. nRESET

The module will generate an internal reset as appropriate by means of a POR (Power on Reset) section. Therefore, no external signal is required for the module to operate properly and this pin may be left unconnected. Nevertheless, we recommend connecting it for debug purposes. The RTC section will not be reset by the external nRESET signal.

5.3.2. LNA enable

LNA_EN is an output signal, mapped on pin 26, that can be used as enable for external LNA. The SE868SY-D embeds an internal LNA with a 17 dB gain both for L1 and L5 band. If more gain is needed, an external LNA can be added to the RF path. We recommend a maximum external gain of 8 dB for better EMI performances, nevertheless a gain up to 33 dB can be accepted as indicated in the following table.

	Internal Gain	External Gain Range
SE868SY-D	17 dB*	0 to 33 dB (0 to 8 dB for better EMI performance) *

5.3.3. PPS

1 Pulse Per second signal is generated by the GNSS receiver for synchronization purposes. It is mapped on PIN 28 on SE868SY-D.

6. PRODUCT PERFORMANCE

6.1. Horizontal Position Accuracy

Constellation	Band	CEP (m)
GPS	L1	TBD
GPS	L1+L5	TBD
NAVIC	L5	TBD
Test Conditions: 24-hr Static, -130 dBm, Full Power mode		

Table 6-1 SE868SY-D - Horizontal Position Accuracy

Values for all the supported bands/constellations will be provided in the next document revisions.

6.2. Time to First Fix

Constellations(s)	Band	Start Type	Max TTFF (s)
GPS	L1	Hot	2(*) 1(**)
		Cold	30(*) 28(**)
GPS	L1+L5	Hot	TBD 1(**)
		Cold	TBD 28(**)
NAVIC	L5	Hot	TBD 1(**)
		Cold	TBD 28(**)
Test Conditions: Static scenario, -130 dBm, Full Power mode			
(*) Measured value on fist Marketing Samples (**) Target value on fist Mass Production Samples			

Table 6-2 SE868SY-D - Time to First Fix

Additional values for all the other supported bands/constellations will be provided in the next document revisions.

6.3. Sensitivity

Constellation(s)	Bands	State	Minimum Signal Level (dBm)
GPS	L1	Acquisition	-147 (*) -148 (**)
		Navigation	-161(*) -163(**)
		Tracking	-161(*) -167(**)
GPS	L1+L5	Acquisition	TBD -148 (**)
		Navigation	TBD -163(**)
		Tracking	TBD -167(**)
Navic	L5	Acquisition	TBD -147 (**)
		Navigation	TBD -156(**)
		Tracking	TBD -161(**)
Test conditions: Static scenario, Full Power mode			
(*) Measured value on fist Marketing Samples (**) Target value on fist Mass Production Samples			

Table 6-3 SE868SY-D - Sensitivity

Additional values for all the other supported bands/constellations will be provided in the next document revisions.

7. RF SECTION

SE868SY-D module includes a state-of-art 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, BeiDou, Galileo, and QZSS.

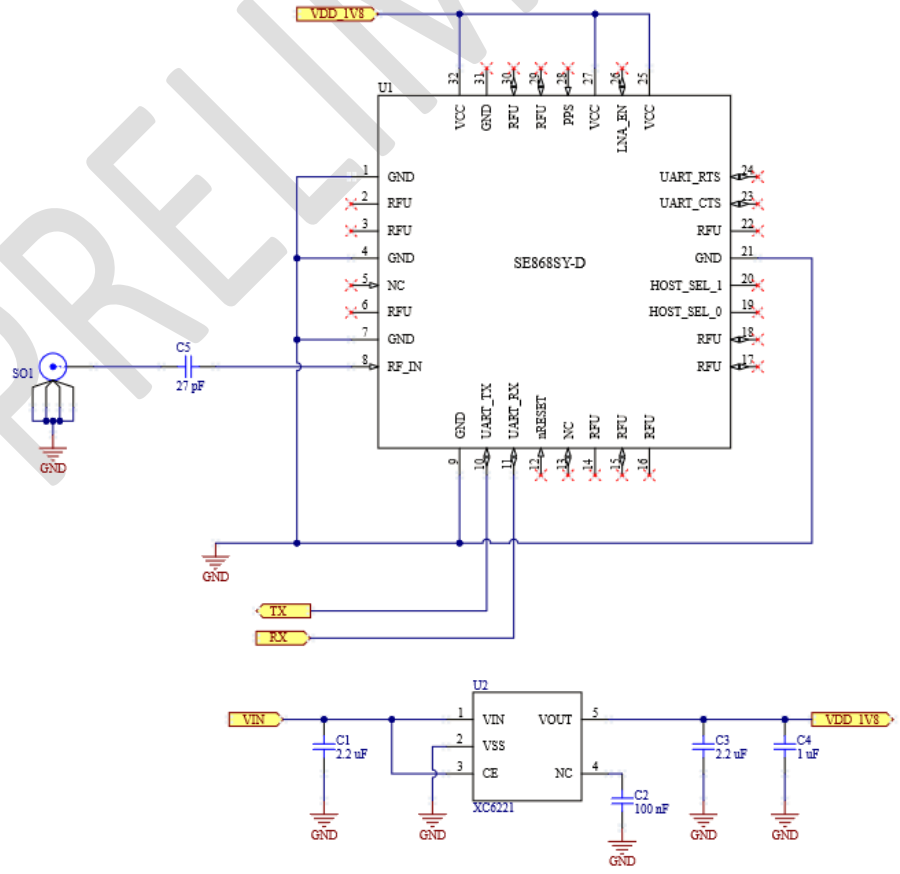
7.1. GNSS RF Signal Pin-out

Pin	Signal	I/O	Function	Type
8	RF_IN	I	L1-L5 RF signal input	Analog RF

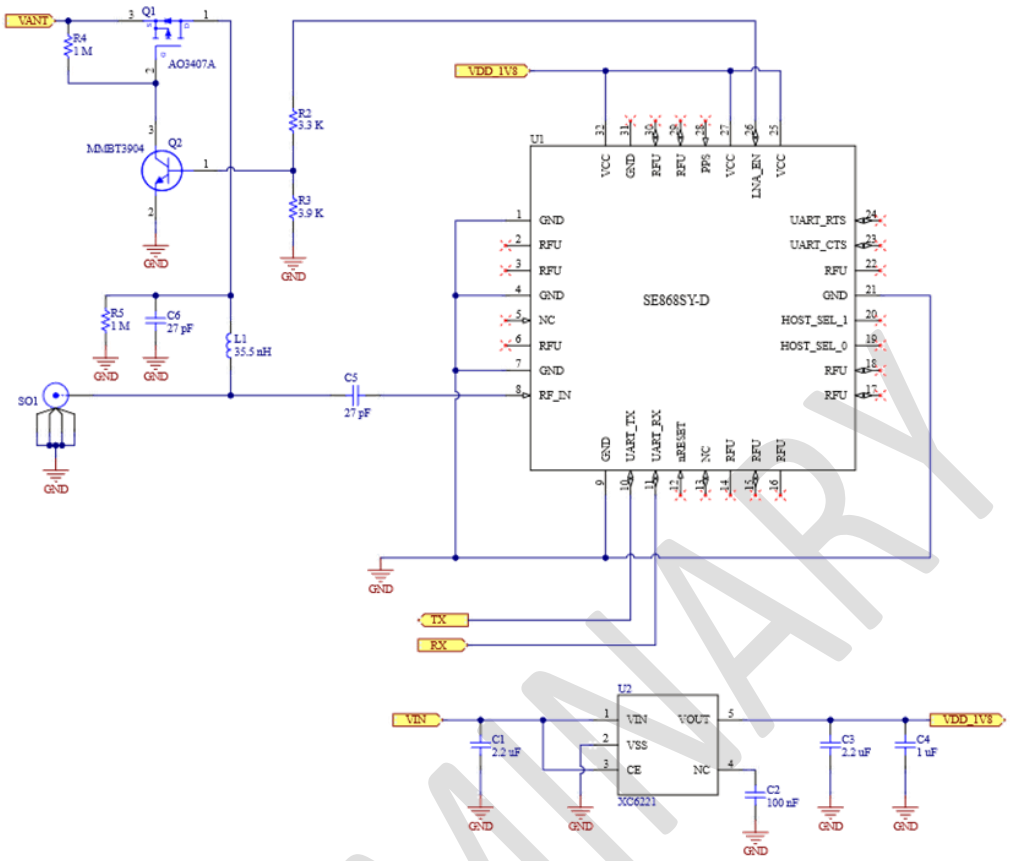
7.2. RF Front End Design

The SE868SY-D Module embeds an internal LNA but, at the same time, the device dynamic allows for higher external gain (Section 5.3.2). Therefore both passive and active antenna (antenna with a built-in low noise amplifier) can be used. In the latter case, the active antenna must be supplied with proper bias-tee circuit.

7.2.1. Reference design for passive Antenna



7.2.2. Reference design for active Antenna



7.2.3. Guidelines of PCB line for GNSS Antenna

When using the SE868SY-D, since there's no antenna connector on the module, the antenna must be connected to the SE868SY-D antenna pad by means of a transmission line implemented on the PCB.

- Ensure that the antenna line impedance is 50ohm.
- Keep the antenna line on the PCB as short as possible to reduce the loss.
- Antenna line must have uniform characteristics, constant cross section, avoid meanders and abrupt curves.
- Keep one layer of the PCB used only for the Ground plane, if possible.
- Surround (on both the sides, over and under) the antenna line on PCB with Ground, avoid having other signal tracks facing directly the antenna line of track.
- The ground around the antenna line on PCB has to be strictly connected to the Ground Plane by placing vias once per 2mm at least.
- Place EM noisy devices as far as possible from antenna line.
- Keep the antenna line far away from power supply lines.
- Keep the antenna line far away from GSM RF lines.
- If you have EM noisy devices around the PCB hosting the module, such as fast switching ICs, take care of the shielding of the antenna line by burying it inside the layers of PCB and surround it with Ground planes, or shield it with a metal frame cover.
- If you do not have EM noisy devices around the PCB hosting the module, use a strip-line on the superficial copper layer for the antenna line. The line attenuation will be lower than a buried one.

7.3. GNSS Antenna Requirements

7.3.1. GNSS Antenna specification

Item	Value
Frequency range	L1: 1559.0 ~ 1610.0 MHz L5: 1151.0 ~ 1214.0 MHz
Gain	0 ~ 30 dB (0 ~ 8 dB for better EMI performance)
Impedance	50 Ω
Noise Figure of LNA	< 1.5 (recommended)
VSWR	≤ 3:1 (recommended)

7.3.2. GNSS Antenna – Installation Guidelines

- The antenna must be installed according to the antenna manufacturer's instructions to obtain the maximum performance of GNSS receiver.
- The antenna location must be evaluated carefully if operating in conjunction with any other antenna or transmitter.
- The antenna must not be installed inside metal cases or near any obstacle that may degrade features like antenna lobes and gain.

7.3.3. Powering the External LNA (active antenna)

The LNA of active antenna needs a source of power because the DC voltage needed by active antenna is not supplied by the SE868SY-D module, but can be easily included by the host design.

The electrical characteristics of the LNA_EN signal are:

Level	Min	Max
Output High Level	VDD- 0.45 V	VDD
Output Low Level	0	0.45 V

Example of external antenna bias circuitry can be seen in the active antenna reference design in section 7.2.2.

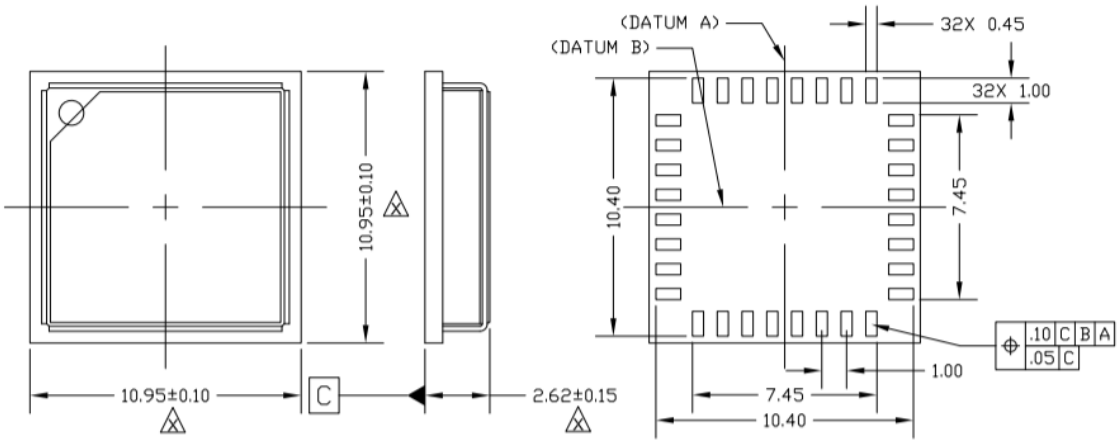
Be aware of max bias current in case of unwanted short on antenna cable, decoupling inductor may be demaged.

7.4. Co-existance

This section will be available in next document revisions.

8. MECHANICAL DESIGN

8.1. Drawing



NOTE:

Dimensions in mm.

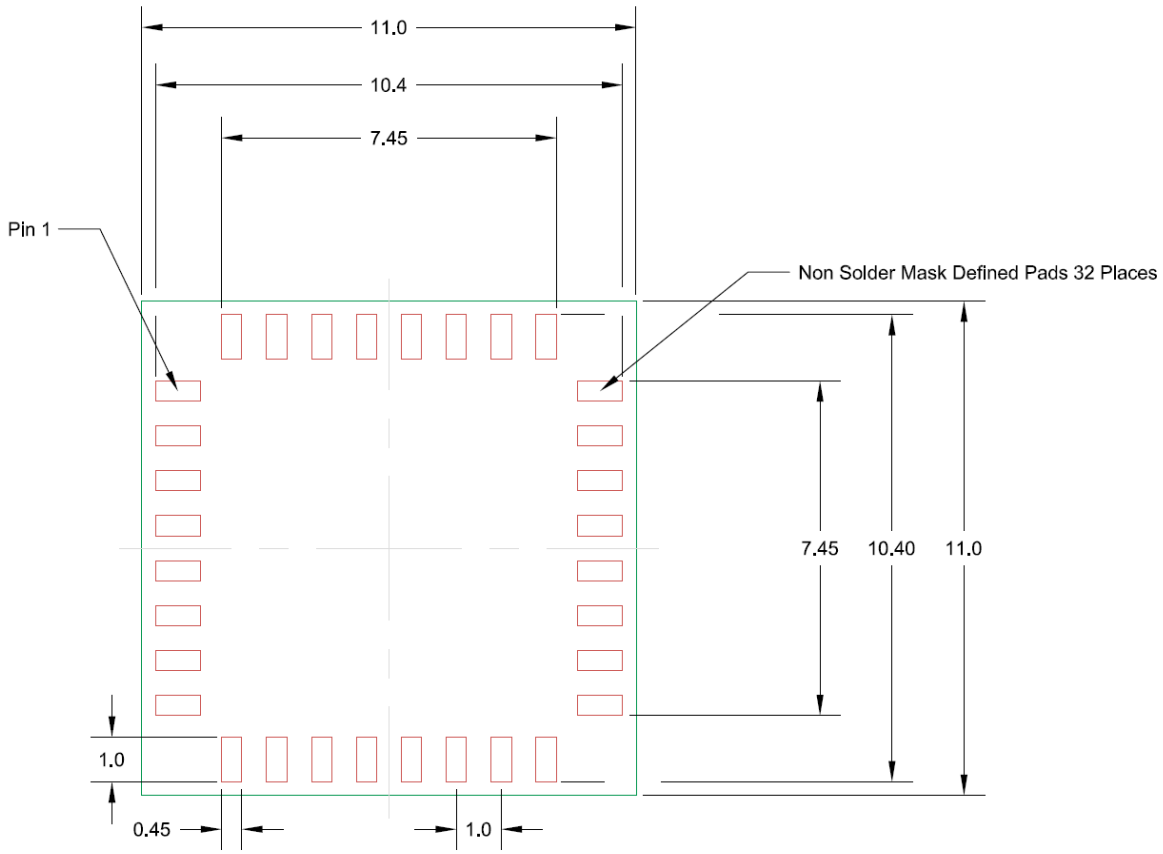
The tolerance is not cumulative.

9. APPLICATION PCB DESIGN

The SE868SY-D modules have been designed in order to be compliant with a standard lead-free SMT process.

9.1. Footprint

COPPER PATTERN (top view)

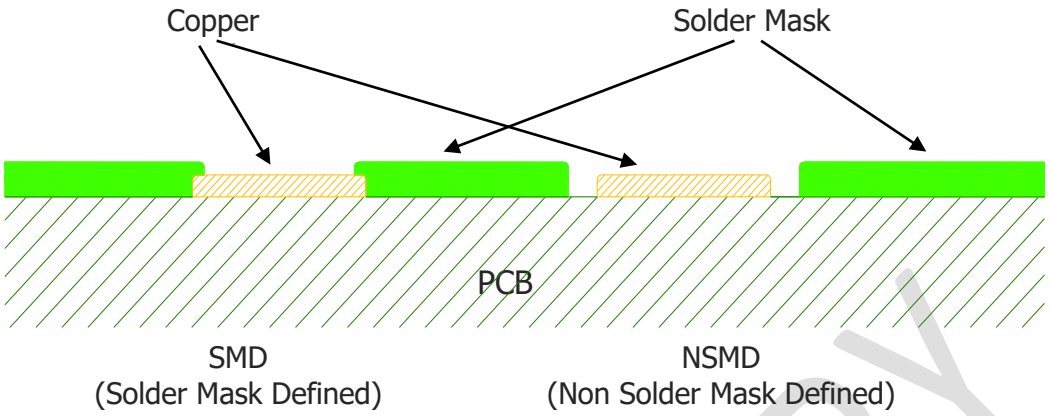


In order to easily rework the SE868SY-D is suggested to consider on the application a 2 mm placement inhibit area around the module.

It is also suggested, as common rule for an SMT component, to avoid having a mechanical part of the application in direct contact with the module.

9.2. PCB pad design

Non solder mask defined (NSMD) type is recommended for the solder pads on the PCB.



The recommendation for the PCB pads dimensions are 1:1 with module pads.

It is not recommended to place via or micro-via not covered by solder resist in an area of 0,3 mm around the pads unless it carries the same signal of the pad itself

Holes in pad are allowed only for blind holes and not for through holes.

Recommendations for PCB pad surfaces:

Finish	Layer Thickness (um)	Properties
Electro-less Ni / Immersion Au	3 –7 / 0.03 – 0.15	good solder ability protection, high shear force values

The PCB must be able to resist the higher temperatures which are occurring at the lead-free process. This issue should be discussed with the PCB-supplier. Generally, the wettability of tin-lead solder paste on the described surface plating is better compared to lead-free solder paste.

It is not necessary to panel the application's PCB, however in that case it is suggested to use milled contours and predrilled board breakouts; scoring or v-cut solutions are not recommended.

9.3. Stencil

Stencil's apertures layout can be the same of the recommended footprint (1:1), we suggest a thickness of stencil foil ≥ 120 µm.

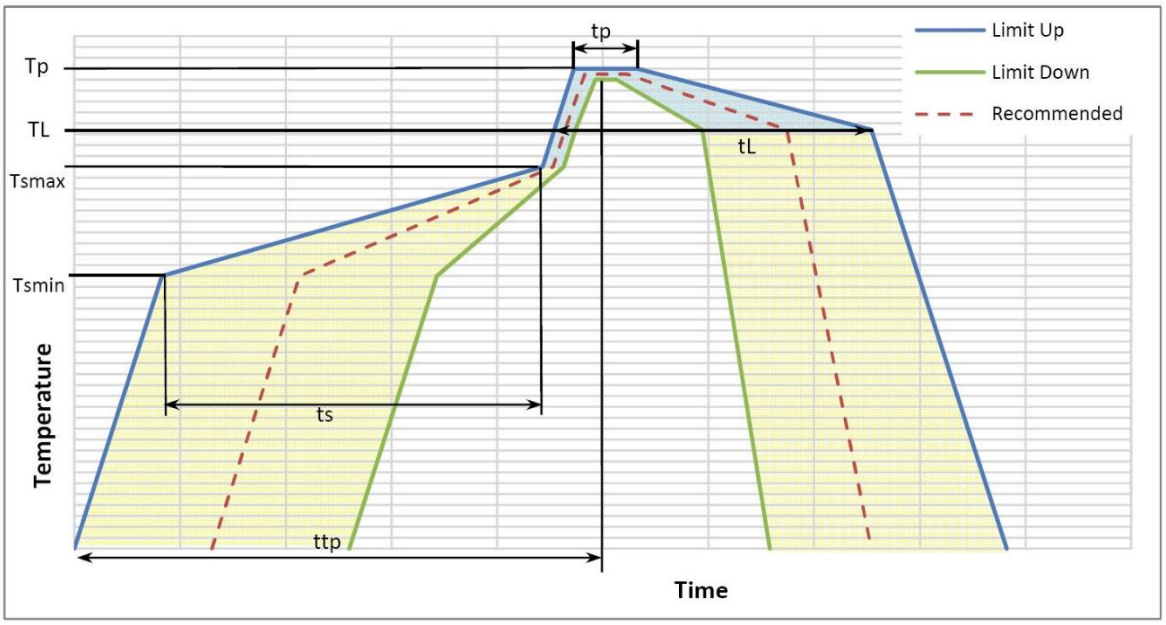
9.4. Solder paste

Item	Lead Free
Solder Paste	Sn/Ag/Cu

We recommend using only "no clean" solder paste in order to avoid the cleaning of the modules after assembly.

9.5. Solder Reflow

Recommended solder reflow profile:



WARNING:

The above solder reflow profile represents the typical SAC reflow limits and does not guarantee adequate adherence of the module to the customer application throughout the temperature range. Customer must optimize the reflow profile depending on the overall system taking into account such factors as thermal mass and warpage**.**

Profile Feature	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second max
Preheat **– Temperature Min (Tsmin)** **– Temperature Max (Tsmax)** **– Time (min to max) (ts)**	 150°C 200°C 60-180 seconds
Tsmax to TL **– Ramp-up Rate**	 3°C/second max
Time maintained above: **– Temperature (TL)** **– Time (tL)**	 217°C 60-150 seconds
Peak Temperature (Tp)	245 +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	8 minutes max.

NOTE:

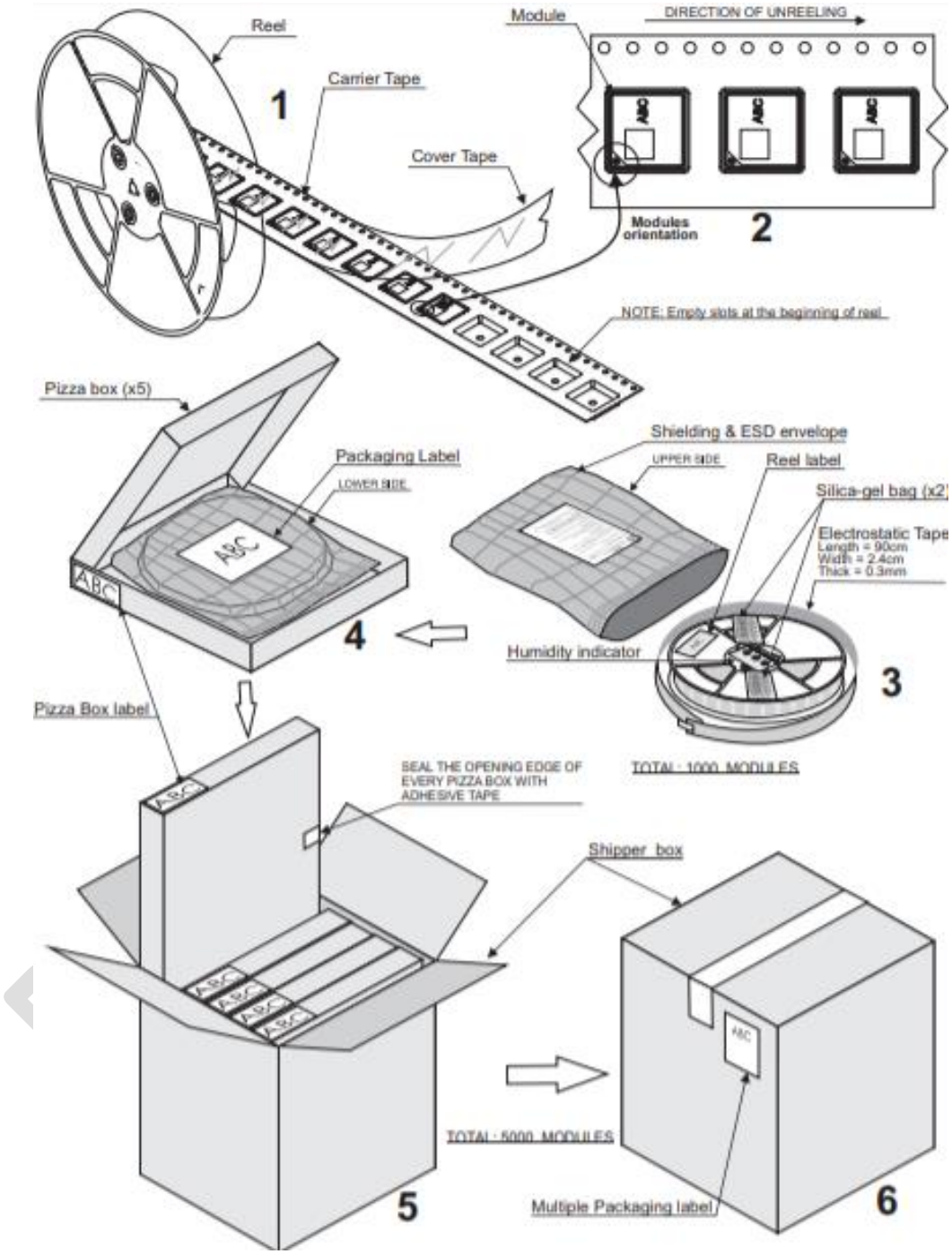
All temperatures refer to topside of the package, measured on the package body surface

WARNING:

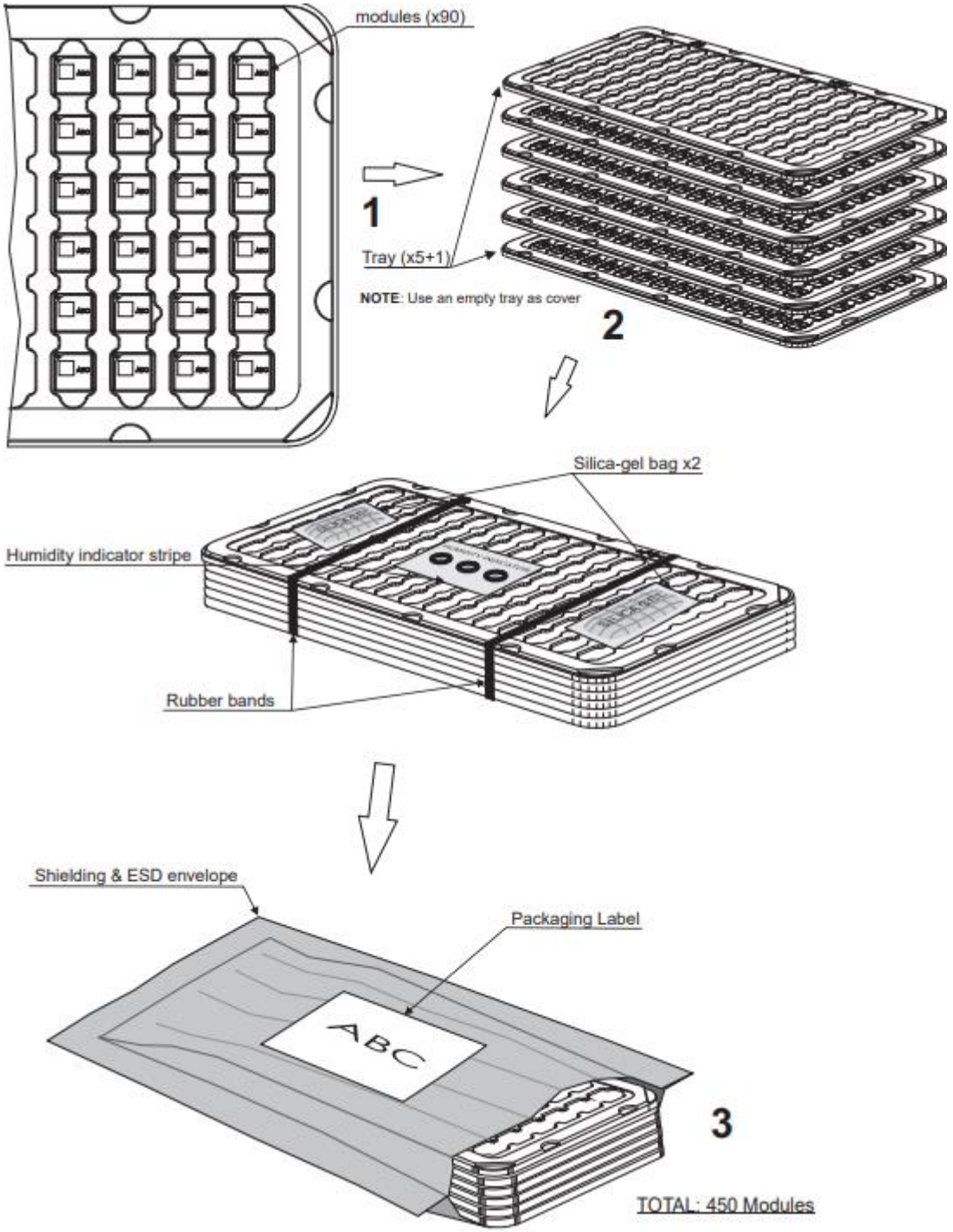
THE SE868SY-D MODULE WITHSTANDS ONE REFLOW PROCESS ONLY.

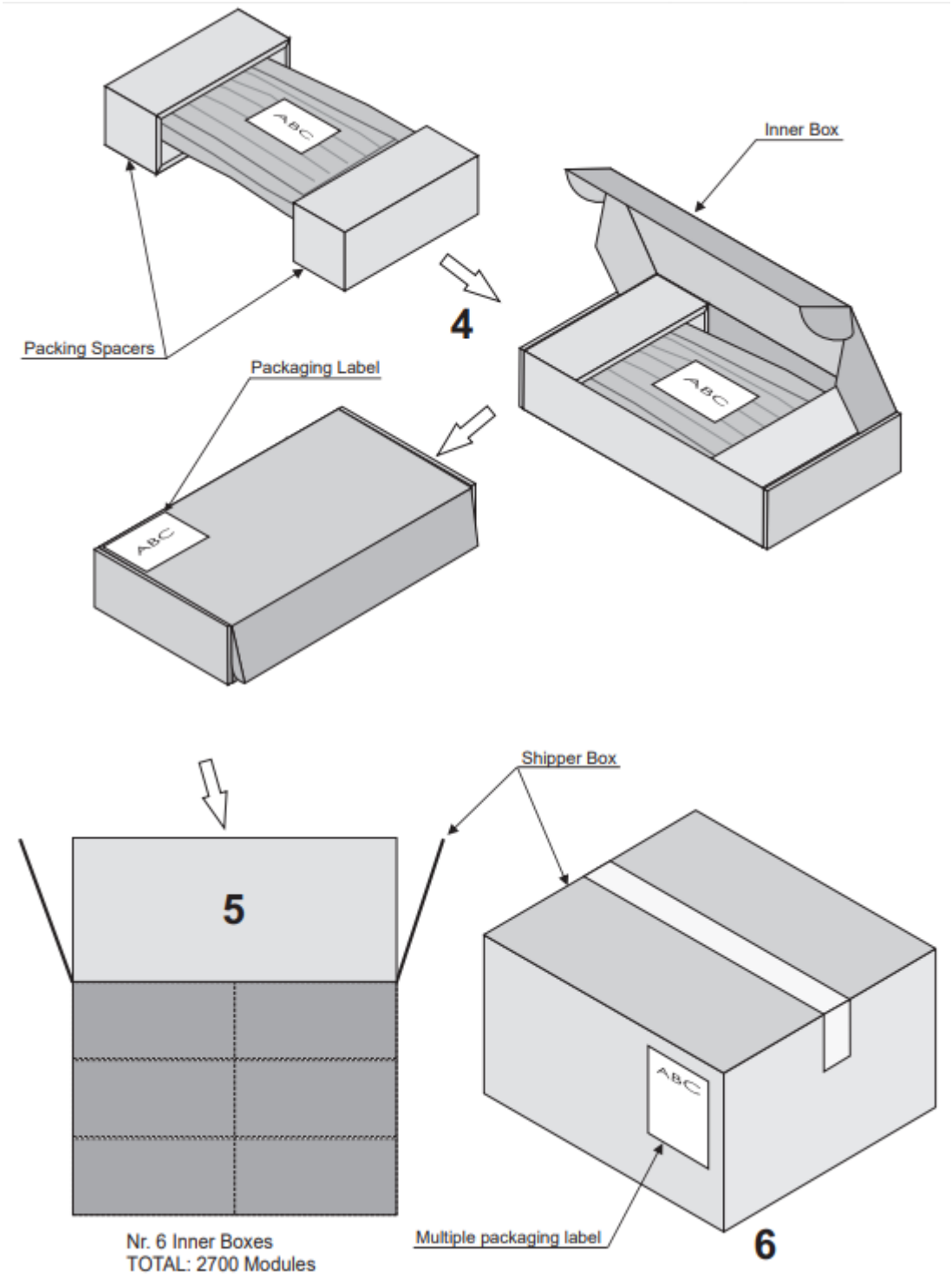
10. PACKAGING

10.1. Modules shipped in Reel form



10.2. Modules shipped in Tray form




Inner Box
Packing Spacers
4
Packaging Label
ABC
5
Shipper Box
Nr. 6 Inner Boxes
TOTAL: 2700 Modules
Multiple packaging label
6

11. CONFORMITY ASSESSMENT ISSUES

11.1. EU RED Declaration of Conformity

This section will be available in next document revisions.

12. SAFETY RECOMMENDATIONS

12.1. 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, because the risk of disturbing the network or external devices or having impact on the security. 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 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/

13. ACRONYMS

AGPS	Assisted (or Aided) GPS AGPS provides ephemeris data to the receiver to allow faster cold start times than would be possible using only broadcast data. This extended ephemeris data could be either server-generated or locally-generated. See Local Ephemeris prediction data and Server-based Ephemeris prediction data
Almanac	A reduced-precision set of orbital parameters for the entire GPS constellation that allows calculation of approximate satellite positions and velocities. The almanac may be used by a receiver to determine satellite visibility as an aid during acquisition of satellite signals. The almanac is updated weekly by the Master Control Station. See Ephemeris.
BeiDou (BDS / formerly COMPASS)	The Chinese GNSS, currently being expanded towards full operational capability.
Cold Start	A cold start occurs when a receiver begins operation with unknown position, time, and ephemeris data, typically when it is powered up after a period on inactivity. Almanac information may be used to identify previously visible satellites and their approximate positions. See Restart.
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 European SBAS system.
Ephemeris (plural ephemerides)	A set of precise orbital parameters that is used by a GNSS receiver to calculate satellite position and velocity. The satellite position is then used to calculate the navigation solution. Ephemeris data is updated frequently (normally every 2 hours for GPS) to maintain the accuracy of the position calculation. See Almanac.
ESD:	Electro-Static Discharge Large, momentary, unwanted electrical currents that can cause damage to electronic equipment.
GAGAN	The Indian SBAS system.
Galileo	The European GNSS currently being built by the European Union (EU) and European Space Agency (ESA).

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 value of GDOP indicates a smaller error in the solution. Related factors include PDOP, HDOP, VDOP and TDOP.
GLONASS	ГЛОбальная НАвигационная Спутниковая Система GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Global Navigation Satellite System) The Russian GNSS, which is operated by the Russian Aerospace Defense Forces
GNSS	Global Navigation Satellite System Generic term for a satellite-based navigation system with global coverage. The current or planned systems are: GPS, GLONASS, BDS, and Galileo.
GPS	Global Positioning System The U.S. GNSS, a satellite-based positioning system that provides accurate position, velocity, and time data. GPS is operated by the US Department of Defense.
Hot Start	A hot start occurs when a receiver begins operation with known time, position, and ephemeris data, typically after being sent a restart command. See Restart.
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 which is especially designed to add very little noise to the amplified signal.
Local Ephemeris prediction data	Extended Ephemeris (i.e. predicted) data, calculated by the receiver from broadcast data received from satellites, which is stored in memory. It is usually useful for up to three days. See AGPS.
MSAS	MTSAT Satellite Augmentation System The Japanese SBAS system.
MSD	Moisture sensitive device.
MTSAT	Multifunctional Transport Satellites The Japanese system of geosynchronous satellites used for weather and aviation control.

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 The Japanese Regional Navigation Satellite System.
Reacquisition	A receiver, while in normal operation, loses RF signal (perhaps due to the antenna cable being disconnected or a vehicle entering a tunnel), and re-establishes a valid fix after the signal is restored. Contrast with Reset and Restart.
Restart	A receiver beginning operation after being sent a restart command, generally used for testing rather than normal operation. A restart can also result from a power-up. See Cold Start, Warm Start, and Hot Start. Contrast with Reset and Reacquisition.
Reset	A receiver beginning operation after a (hardware) reset signal on a pin, generally used for testing rather than normal operation. Contrast with Restart and Reacquisition.
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. These corrections are transmitted on the same frequency as navigation signals, so the receiver can use the same front-end design to process them. Current examples are WAAS, EGNOS, MSAS, and GAGAN.
Server-based Ephemeris prediction data	Extended Ephemeris (i.e. predicted) data, calculated by a server and provided to the receiver over a network. It is usually useful for up to 14 days. See AGPS.
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 for testing.
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 North American SBAS system developed by the US FAA (Federal Aviation Administration).
Warm Start	A warm start occurs when a receiver begins operation with known (at least approximately) time and position, but unknown ephemeris data, typically after being sent a restart command. See Restart.

14. DOCUMENT HISTORY

Revision	Date	Changes
0	2021-01-20	First issue
1	2021-02-17	Updated Section 4.1

SUPPORT INQUIRIES

Link to **www.telit.com** and contact our technical support team for any questions related to technical issues.

www.telit.com

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

Telit IoT Platforms LLC
5300 Broken Sound Blvd, Suite 150
Boca Raton, FL 33487, USA

Telit Wireless Solutions Inc.
3131 RDU Center Drive, Suite 135
Morrisville, NC 27560, USA

Telit Wireless Solutions Co., Ltd.
8th Fl., Shinyoung Securities Bld.
6, Gukjegeumyung-ro8-gil, Yeongdeungpo-gu
Seoul, 150-884, Korea

Telit Wireless Solutions Ltd.
10 Habarzel St.
Tel Aviv 69710, Israel

Telit Wireless Solutions
Technologia e Servicos Ltda
Avenida Paulista, 1776, Room 10.C
01310-921 São Paulo, Brazil

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