Insight SiP
It's all in the package

Preliminary Data Sheet

ISP1507

High Performance Bluetooth+ANT+NFC Low Energy Module with MCU and Antenna

This ultra-small LGA module, 8 x 8 x 1 mm, is based on the nRF52832 Chip. Its powerful Cortex™ M4 CPU, flash and RAM memory combined with an optimized antenna offers the perfect solution for Bluetooth connectivity. The solution is best in class for RF performance and low power consumption. Multiple digital and analogue interfaces give optimum flexibility for sensor integration.

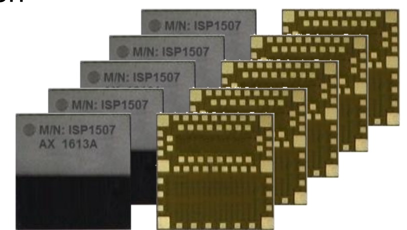
Key Features

- Multi-protocol 2.4GHz Ultra Low Power RF Transceiver
- Single Mode BLE V4.2 stack
  ANT/ANT+ stack
  2.4 GHz proprietary stack
- NFC-A Tag for OOB pairing
- Fully integrated RF matching and Antenna
- Integrated 32 MHz & 32kHZ Clock
- DC/DC converter with loading circuit
- Based on Nordic Semiconductor nRF52
- 32-bit ARM Cortex M4 CPU
- 512 kB Flash
- 64 kB SRAM
- Configurable 30 GPIOs including 8 ADC
- Many interfaces SPI, UART, PDM, I2C
- Single 1.7 to 3.6 V supply
- Very small size 8.0 x 8.0 x 1.0 mm
- Temperature -40 to +85 °C

Applications

- Connected sensors for medical devices, healthcare, sport, fitness, industrial …
- IoT applications, connected objects
- Wearable technology
- Home automation
- Beacons

ANT+



Certifications

- Fully FCC pre-certified module
- Fully CE pre-certified module
- Fully IC pre-certified module
- Bluetooth SIG certified QDL listing
- RoHS compliant

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1. Block Diagram

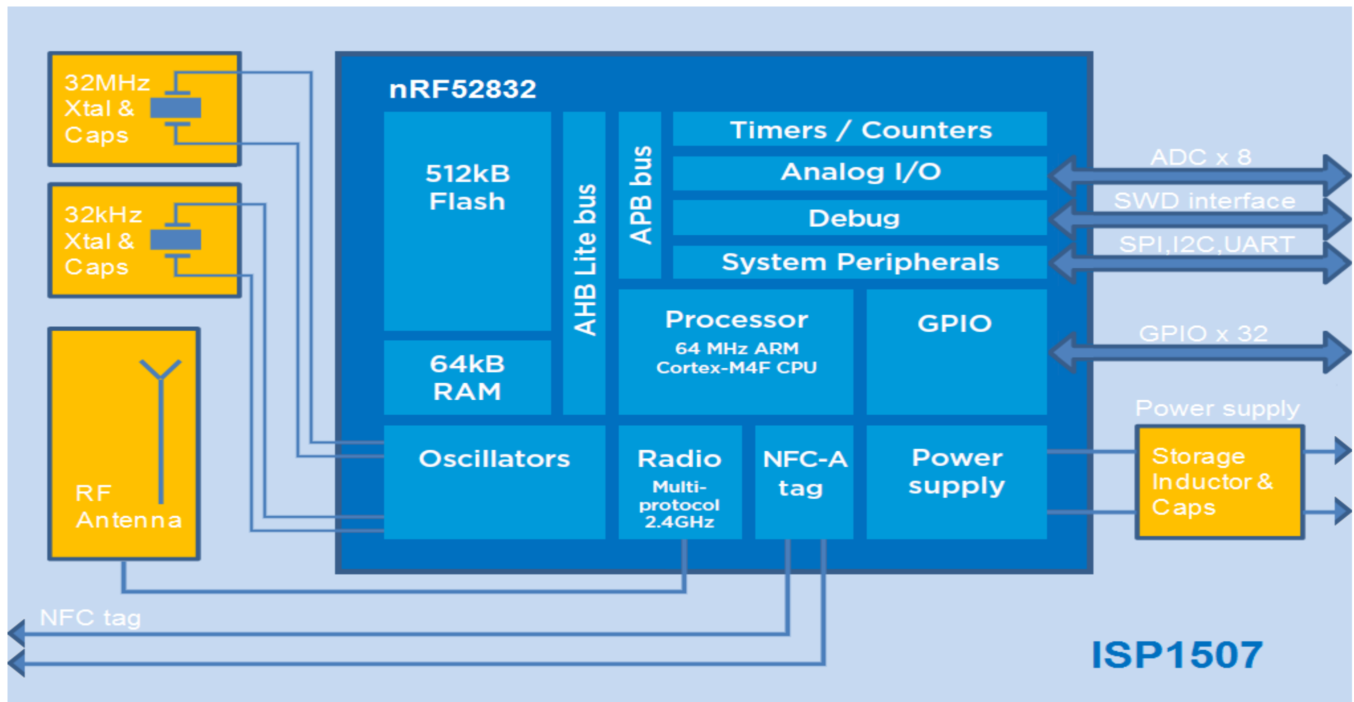
This module is based on nRF52832 Nordic Semiconductor 2.4GHz wireless System on Chip (SoC) integrating a 2.4 GHz transceiver, a 32-bit ARM Cortex™-M4 CPU, a 512 kB flash memory, a 64 kB RAM and analog and digital peripherals.

It can support BLE, ANT/ANT+ and a range of proprietary 2.4 GHz protocols, such as Gazell from Nordic Semiconductor.

Fully qualified BLE stacks for nRF52832 are implemented in the S132 SoftDevices which can be freely downloaded. ISP1507 can then be used in Central, Peripheral or both roles for BLE and for both ends of other proprietary protocols. nRF52832 platform also provides extensive software support for ANT applications with S212 SoftDevices and dual ANT/BLE stack S332 SoftDevices.

Ultra low power consumption and advanced power management enables battery lifetimes up to several years on a coin cell battery. Even though its very small size 8 x 8 x 1.0 mm, the module integrates decoupling capacitors, 32 MHz and 32.768 kHz crystals, load capacitors, DC-DC converter, RF matching circuit and antenna in addition to the wireless SoC.

Only the addition of a suitable DC power source is necessary for BLE and/or ANT connectivity. Sensor applications require the further addition of appropriate sensors. The antenna was designed to be optimized with several standard ground plane sizes. The NFC tag antenna can be connected externally.



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2. Specifications

The specifications of the module follow those of the nRF52832. The following high level parameters are given for the module.

2.1. Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit
Supply Voltage respect to ground - VCC	-0.3		3.9	V
IO Pin Voltage	-0.3		3.9	V
RF Input Level			10	dBm
NFC Antenna pin current			80	mA
Storage Temperature	-40		+125	°C
Moisture Sensitivity Level			5	-
ESD Human Body Model			4000	V
ESD Charged Device Model			750	V
Flash Endurance			10000	cycles

ATTENTION

CONSERVE PRECAUTION FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES
Human Body Model Class 3A

2.2. Operating Conditions

Parameter	Min	Typ	Max	Unit
Operating Supply Voltage, internal LDO setup	1.7	3.0	3.6	V
Operating Supply Voltage, DCDC converter setup	2.1	3.0	3.6	V
Extended Industrial Operating Temperature Range	-40	+25	+85	°C

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2.3. Power Consumption

Parameter	Min	Typ	Max	Unit
Peak current, Receiver active (1)		6.1		mA
Peak current, Transmitter active +4 dBm Output Power (2)		7.9		mA
Peak current, Transmitter active 0 dBm Output Power (2)		5.4		mA
System OFF current, no RAM retention		0.4		µA
System ON base current, no RAM retention		1.2		µA
Additional RAM retention current per 4 KB block		40		nA

(1) DCDC enable, Power supply 3V, 1 Msps
(2) DCDC enable, Power supply 3V

2.4. Clock Sources

Parameter	Min	Typ	Max	Unit
Internal High Frequency Clock for RF Stability: 32 MHz Crystal Frequency Tolerance (1)			+/- 40	ppm
Internal Low Frequency Clock for BLE Synchronization: 32.768 kHz Crystal Frequency Tolerance (1)			+/- 40	ppm
Internal Low Frequency Clock for BLE Synchronization: RC Oscillator (2)			+/- 250	ppm
RF Frequency tolerance: For BLE operation Channels 0 to 39			+/- 40	ppm

(1) including initial tolerance, drift, aging, and frequency pulling
(2) Frequency tolerance after calibration

2.5. Radio Specifications

Parameter	Min	Typ	Max	Unit
Frequency Range	2402		2480	Mhz
Channel 0 to 39 Spacing		2		Mhz
Output Power Channels 0 to 39	-20		+4	dBm
Rx sensitivity Level for BER <0,1% ideal Tx	-96			dBm
Antenna Gain		0.6		dBi
EIRP	-19.4		4.6	dBm
Range Open field @1m height		100		m
Data Rate		1000 / 2000		kbps

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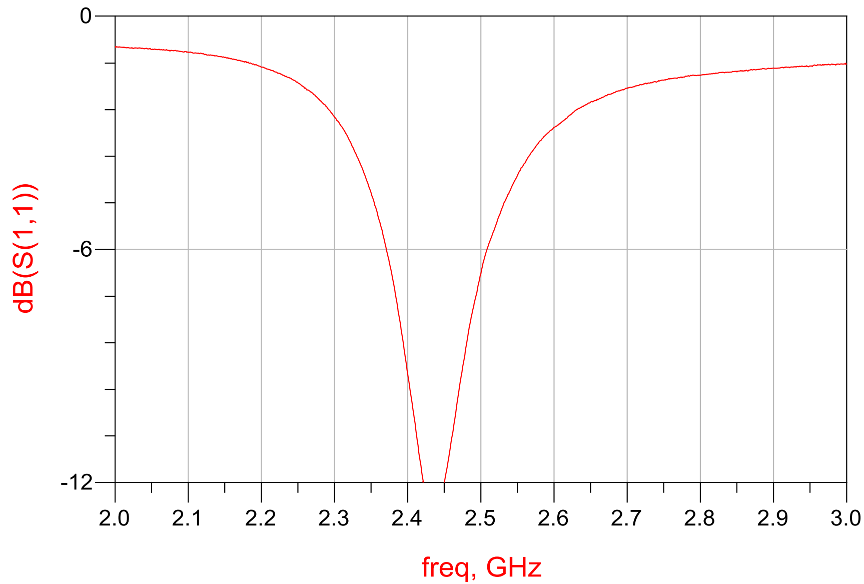
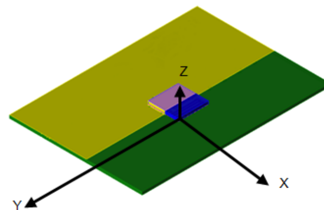
Typical Antenna Return Loss

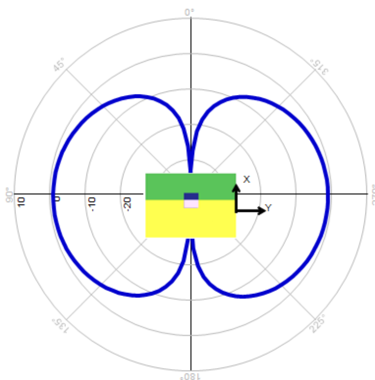
Module mounted on a USB dongle ground plane



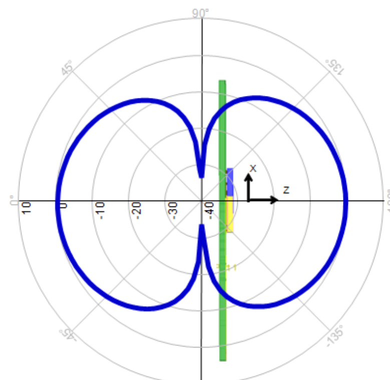
Radiation Pattern in 3 planes

Module mounted on a USB dongle ground plane

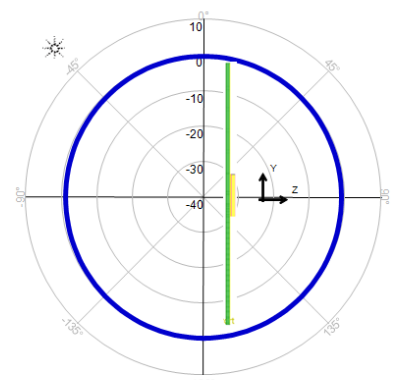




Phi (0.000 to 360.000)



Thêta (-180.000 to 180.000)



Thêta (-180.000 to 180.000)

Gain measurement in dBi @ 2.45 GHz.

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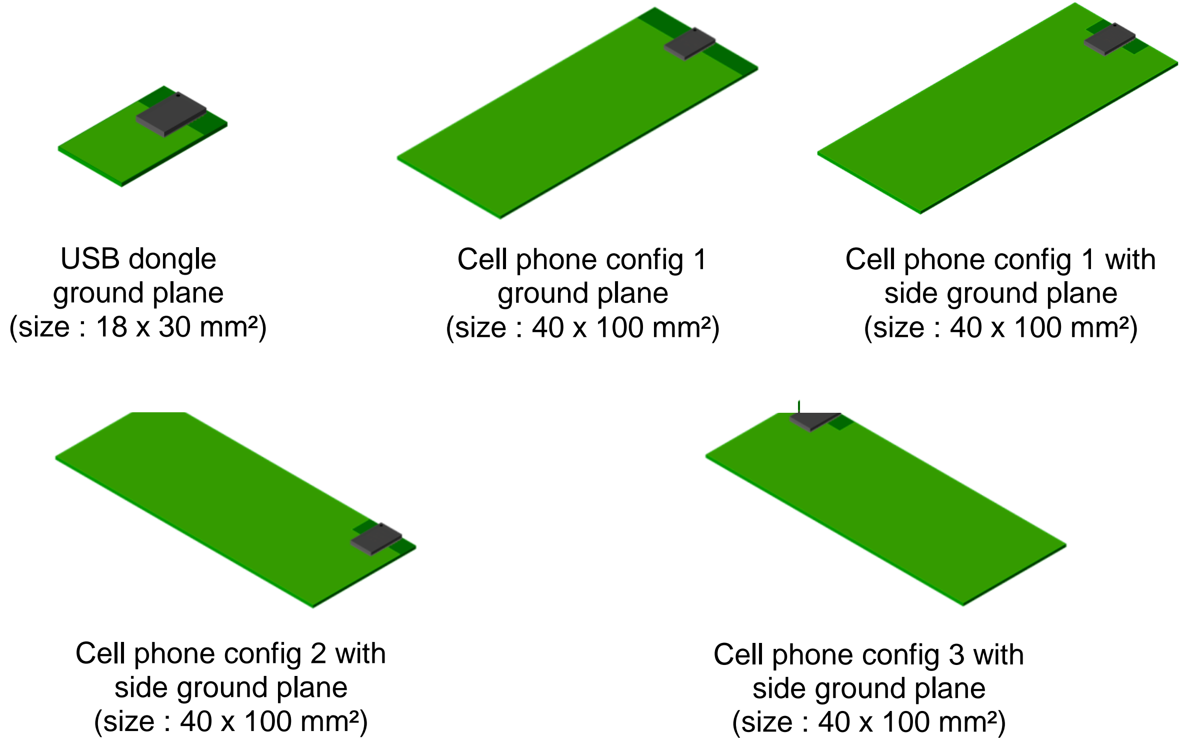
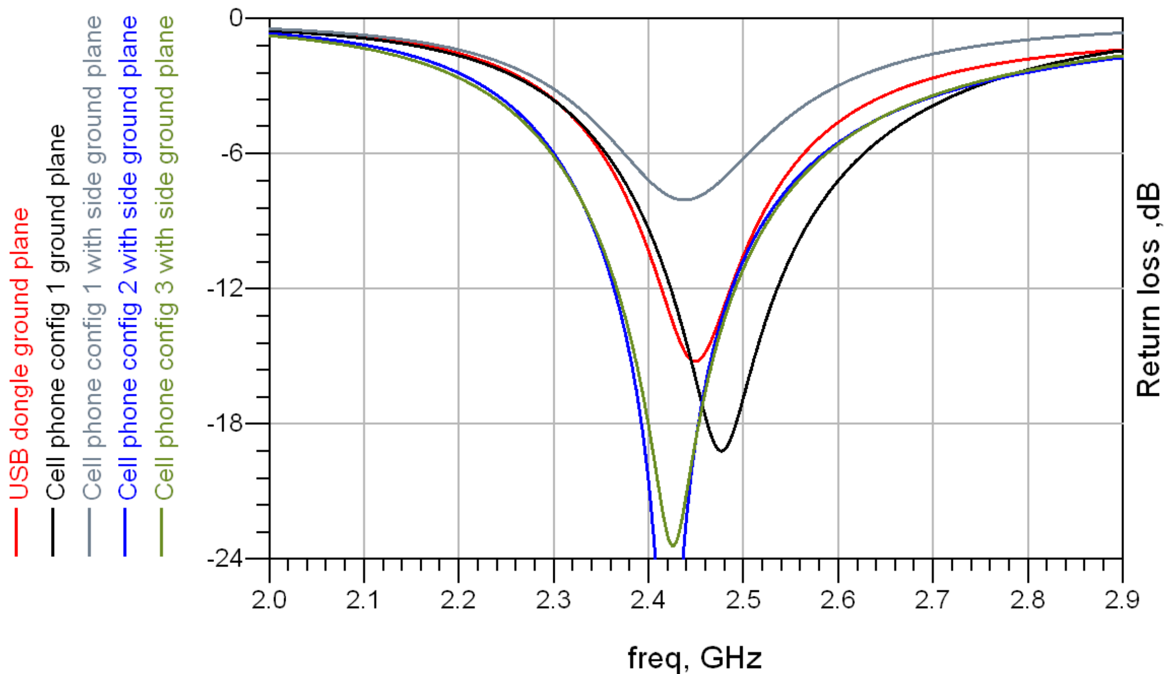
Ground Plane Effect Simulation





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2.6. Electrical Schematic

Electrical schematic showing ISP1507 module connections

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3. Pin Description

The module uses an LGA format with a double row of pads on a 0.65 mm pitch. The pad layout follows the QFN Jedec standard for 2 row LGA parts. The NC pads are to be connected to isolated metal pads on the application PCB for mechanical stability and reliability (drop test).

Pin	Name	Pin function	Description
1	NC	Not Connected	Isolated pad on application PCB for mechanical stability
2	P0_09 NFC1	Digital I/O NFC Input	General purpose I/O pin NFC antenna connection
3	P0_12	Digital I/O	General purpose I/O pin
4	P0_10 NFC2	Digital I/O NFC Input	General purpose I/O pin NFC antenna connection
5	P0_14 TRACEDATA3	Digital I/O	General purpose I/O pin Trace port output
6	P0_26	Digital I/O	General purpose I/O pin
7	NC	Not Connected	Isolated pad on application PCB for mechanical stability
8	VSS	Ground	Should be connected to ground plane on application PCB
9	P0_16 TRACEDATA1	Digital I/O	General purpose I/O pin Trace port output
10	VSS	Ground	Should be connected to ground plane on application PCB
11	P0_18 TRACEDATA0	Digital I/O	General purpose I/O pin Trace port output
12	VSS	Ground	Should be connected to ground plane on application PCB
13	P0_21 RESET	Digital I/O	General purpose I/O pin Configurable as system RESET pin
14	VSS	Ground	Should be connected to ground plane on application PCB
15	P0_20 TRACECLK	Digital I/O	General purpose I/O pin Trace port clock output
16	VSS	Ground	Should be connected to ground plane on application PCB
17	P0_22	Digital I/O	General purpose I/O pin
18	VSS	Ground	Should be connected to ground plane on application PCB
19	P0_24	Digital I/O	General purpose I/O pin
20	OUT_MOD	Antenna I/O	This pin is the RF I/O pin of the BLE module It should be connected to Pin 22 OUT_ANT for normal operation
21	VSS	Ground	Should be connected to ground plane on application PCB
22	OUT_ANT	Antenna I/O	This pin is connected to the internal antenna It should be connected to Pin 20 OUT_MOD for normal operation
23	VSS	Ground	Should be connected to ground plane on application PCB
24	VSS	Ground	Should be connected to ground plane on application PCB
25	NC	Not Connected	Isolated pad on application PCB for mechanical stability
26	VCC	Power	Power supply (1.7 – 3.6V)
27	P0_17	Digital I/O	General purpose I/O pin
28	SWDIO	Digital I/O	Serial Wire Debug I/O for debug and programming
29	P0_13	Digital I/O	General purpose I/O pin
30	SWDCLK	Digital Input	Serial Wire Debug clock input for debug and programming
31	NC	Not Connected	Isolated pad on application PCB for mechanical stability
32	P0_08	Digital I/O	General purpose I/O pin
33	P0_07	Digital I/O	General purpose I/O pin

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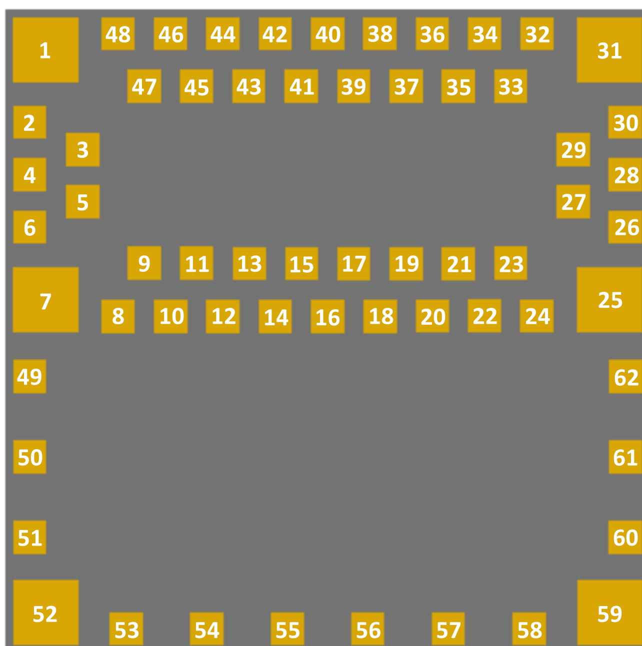
Pin	Name	Pin function	Description
34	P0_06	Digital I/O	General purpose I/O pin
35	P0_04 AIN2	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
36	P0_05 AIN3	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
37	P0_15 TRACEDATA2	Digital I/O	General purpose I/O pin Trace port output
38	P0_03 AIN1	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
39	P0_27	Digital I/O	General purpose I/O pin
40	P0_02 AIN0	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
41	P0_25	Digital I/O	General purpose I/O pin
42	P0_31 AIN7	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
43	P0_11	Digital I/O	General purpose I/O pin
44	P0_30 AIN6	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
45	P0_19	Digital I/O	General purpose I/O pin
46	P0_29 AIN5	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
47	P0_23	Digital I/O	General purpose I/O pin
48	P0_28 AIN4	Digital I/O Analog Input	General purpose I/O pin SAADC/COMP/LPCOMP input
49 to 62	NC	Not Connected	Isolated pad on application PCB for mechanical stability



ISP1507
pad placement and pin assignment
for the LGA QFN package

TOP VIEW

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4. Mechanical Outlines

4.1. Mechanical Dimensions

Dimensional drawing for 8 x 8 x 1 mm, 62-Pad LGA Package

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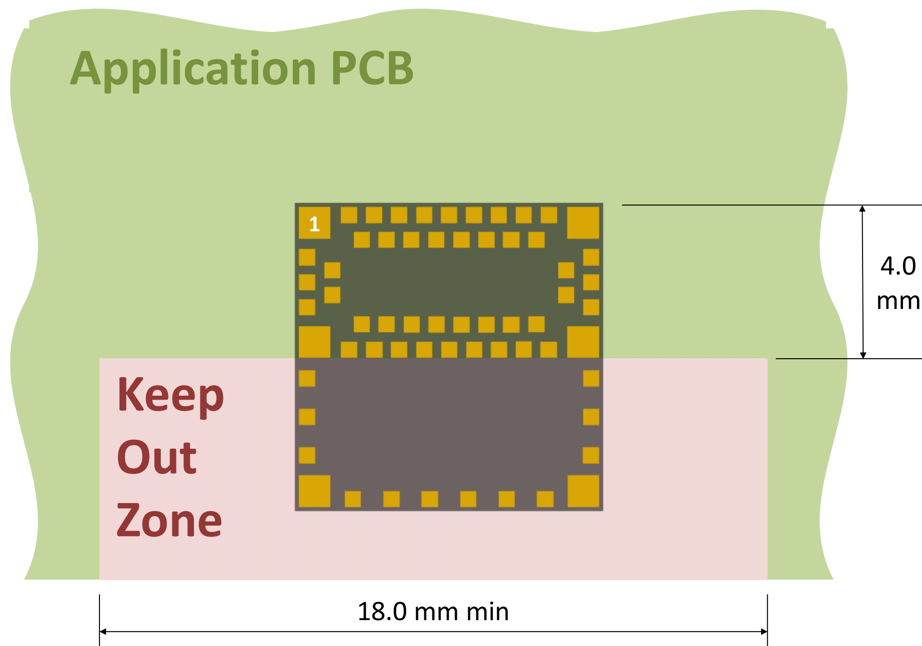
4.2. SMT Assembly Guidelines

For PCB Land Patterns and Solder Mask layout, Insight SiP recommends to use the same dimensions as module pads, ie 0.4 x 0.4 mm for standard pads and 0.8 x 0.8 mm for corner pads.

Please contact Insight SiP for more detailed information.

4.3. Antenna Keep-Out Zone

For optimal antenna performance, it is recommended to respect a metal exclusion zone to the edge of the board: no metal, no traces and no components on any application PCB layer except mechanical LGA pads.



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5. Product Development Tools

5.1. Hardware

In order to assist clients in developing their Bluetooth Smart solutions based on the ISP1507, Insight SIP offers a Development Kit containing:
- One Interface Board
- J-Link Lite CortexM-9 JTAG/SWD Emulator
- One Test Board
- A Development Dongle
- 5 ISP1507 module samples
- Cables, power supply and coin battery holder

Using this development kit, product developers can use a working solution as starting point to develop their own products. Time to market is saved by avoiding starting from a blank sheet of paper. In addition, there may be some applications that use the hardware as is.

Please refer to the documentation for more information:
http://www.insightsip.com/fichiers_insightsip/pdf/ble/isp_ble_DS1507_DK.pdf

5.2. Firmware

1507 supports Bluetooth Low Energy protocol stacks, ANT protocol stacks as well as 2.4 GHz protocol stacks, including Gazell. All are available as downloads at www.nordicsemi.com.

- The S132 SoftDevice is a Bluetooth® low energy (BLE) Central and Peripheral protocol stack solution supporting up to three Central and one Peripheral simultaneous connections and concurrent Observer and Broadcaster roles. It integrates a low energy Controller and Host, and provides a full and flexible API for building Bluetooth low energy System on Chip (SoC) solutions.

- The S212 SoftDevice is an ANT protocol stack solution that provides a full and flexible Application Programming Interface (API) for building ANT System on Chip (SoC) solutions for the nRF52832 chip. The S212 SoftDevice simplifies combining the ANT protocol stack and an application on the same CPU.

- The S332 SoftDevice is a concurrent ANT/Bluetooth® Low Energy (BLE) SoftDevice

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5.3. Development Tools

The following development tools and software are recommended for using and testing ISP1507 module:

- Nordic Semiconductor nRFgo Studio:
  Downloadable after registering at www.nordicsemi.com.

- Nordic Semiconductor Master Control Panel:
  Downloadable after registering at www.nordicsemi.com.

- Keil MDK-ARM Lite:
  Downloadable from https://www.keil.com/demo/eval/arm.htm.

- Segger J-Link Lite:
  Downloadable from http://www.segger.com/jlink-software.html.

- nRF52 Software Development Kit (SDK):
  nRF52 SDK can be downloaded after registering at www.nordicsemi.com. It contains example of source codes applications (C language):
  - Precompiled HEX files
  - Source code
  - Keil ARM project files
  - IAR project files

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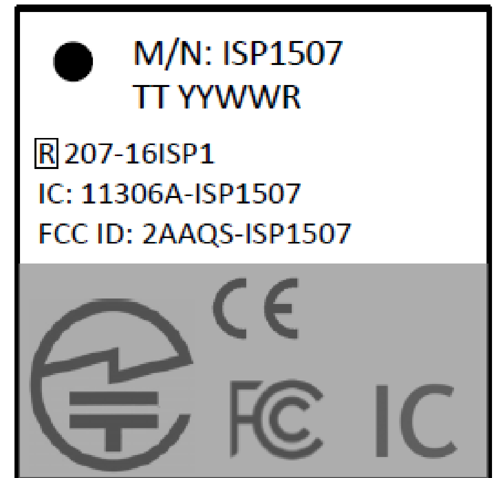
6. Packaging & Ordering information

6.1. Marking

M	/N	:	I	S	P	1	5	0	7
T	T		Y	Y	W	W	R		

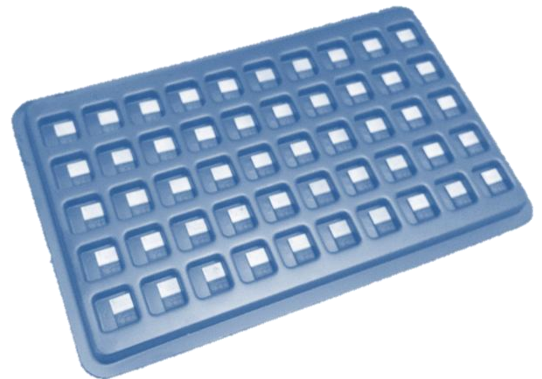
ISP1507	Part Number
TT	2 letters Module Type (see section 6.5)
YY	2 digits year number
WW	2 digits week number
R	1 letter Hardware revision



6.2. Prototype Packaging

For engineering samples and prototype quantities up to 99 units, deliveries are provided in thermoformed trays. Please order with “ST” code packaging suffix.

These parts must be backed prior to assembly (see section 7.2).



6.3. Jedec Trays

For higher quantities and volume production, ISP1507 are available in Jedec trays. They are delivered in sealed pack with desiccant pack and humidity sensors. These Jedec trays are also suitable for further baking. Please see section 7.2 for more information on moisture sensitivity.

Jedec trays are proposed in standard quantities of 100 units, 200 units and multiples of 200 units only. Please order with “J1” code packaging suffix for 100-unit tray and “J2” for 200 and multiple unit trays.

Complete information on Jedec trays is available on request.

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6.4. Tape and Reel

ISP1507 are also available in Tape & Reel. They are delivered in sealed pack with desiccant pack and humidity sensors. Reels are proposed in standard quantities of 500 units (180mm / 7” reel) or 2000 units (330mm / 13” reel) only. Please order with “RS” code packaging suffix for 500-unit reels and “R2” for 2000-unit reels.

Complete information is available on request.

6.5. Ordering Information

ISP1507 - TT - ZZ

Code	Description
ISP1507	Part Number
-A	ANT & BLE protocol type
- X	512 kB Flash / 64 kB RAM memory type
- DK	Development kit (1)
- TB	Test board (1)
- ST	Unsealed Tray Packaging
- J1	Jedec Tray with less than 100 units
- J2	Jedec Tray with multiple of 200 units
- RS	Reel of 500 units
- R2	Reel of 2000 units

(1) Please see section 5.1 and refer to the following documentation for more information on development kit and test board:
http://www.insightsip.com/fichiers_insightsip/pdf/ble/isp_ble_DS1507_DK.pdf

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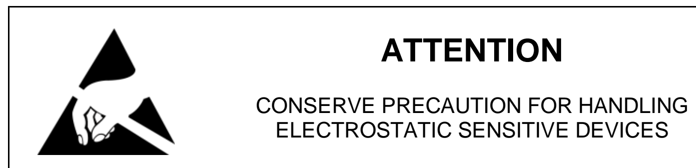
7. Storage & Soldering information

7.1. Storage and Handling

- Keep this product away from other high frequency devices which may interfere with operation such as other transmitters and devices generating high frequencies.
- Do not expose the module to the following conditions:
  - Corrosive gasses such as Cl2, H2S, NH3, SO2, or NOX
  - Extreme humidity or salty air
  - Prolonged exposure to direct Sunlight
  - Temperatures beyond those specified for storage
- Do not apply mechanical stress
- Do not drop or shock the module
- Avoid static electricity, ESD and high voltage as these may damage the module



7.2. Moisture Sensitivity

All plastic packages absorb moisture. During typical solder reflow operations when SMDs are mounted onto a PCB, the entire PCB and device population are exposed to a rapid change in ambient temperature. Any absorbed moisture is quickly turned into superheated steam. This sudden change in vapor pressure can cause the package to swell. If the pressure exerted exceeds the flexural strength of the plastic mold compound, then it is possible to crack the package. Even if the package does not crack, interfacial delamination can occur.

Since the device package is sensitive to moisture absorption, it is recommended to bake the product before assembly. The baking process for dry packing is 24 hours at 125°C.

ISP1507 has been tested MSL-5 according to standards. After baking, modules can be exposed to ambient room conditions (approximately 30 °C/60%RH) during 48 hours before assembly on the PCB.

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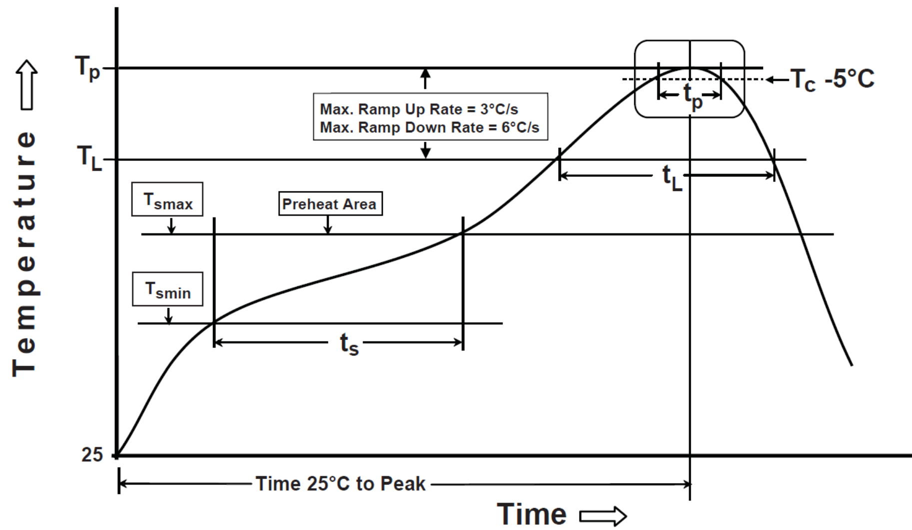
7.3. Soldering information

Recommendation for RoHS reflow process is according to Jedec J–STD-020 and 033 standard profiles.



Preheat/Soak Temperature Min (T_{smin}) Temperature Max (T_{smax}) Time (t_s) from (T_{smin} to T_{smax})	 150 °C 200 °C 60-120 sec
Ramp-up rate (T_L to T_p)	3 °C/sec max
Liquidous temperature (T_L) Time (t_L) maintained above T_L	217 °C 60-150 sec

Peak package body temperature (T_p)	260°C (+0/-5°C)
Classification Temperature (T_c) Time (t_p) maintained above T_C-5 °C	260 °C 30 sec
Ramp-down rate (T_p to T_L)	6 °C/sec max
Time 25 °C to peak temperature	8 mn max

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8. Quality & User information

8.1. Certifications

- FCC – Certification pending
- CE – Certification pending
- IC – Certification pending
- Bluetooth SIG – Certification pending
- RoHS compliant

8.2. USA – User information

This intends to inform how to specify the FCC ID of our module "ISP1507" on the product. Based on the Public Notice from FCC, the host device should have a label which indicates that it contains our module. The label should use wording such as:

"Contains FCC ID: 2AAQS-ISP1507"

Any similar wording that expresses the same meaning may be used.

The label of the host device should also include the below FCC Statement. When it is not possible, this information should be included in the User Manual of the host device:

> *"This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions.*
> *(1) This device may not cause harmful interference*
> *(2) This device must accept any interference received, including interference that may cause undesired operation.*
> *Caution: Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."*

8.3. Canada – User information

This intends to inform how to specify the IC ID of our module "ISP1507" on the product. According to Canadian standards "RSS-210" and "RSS-Gen", the host device should have a label which indicates that it contains our module. The label should use wording such as:

"Contains IC: 11306A-ISP1507"

Any similar wording that expresses the same meaning may be used.

The label of the host device should also include the below IC Statement. When it is not possible, this information should be included in the User Manual of the host device:

Insight SiP – Green Side – 400 avenue Roumanille – BP 309 – 06906 Sophia-Antipolis Cedex – France – www.insightsip.com
The information contained in this document is the property of Insight SiP and should not be disclosed to any third party without written permission. Specification subject to change without notice.

"This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

8.4. Discontinuity

Normally a product will continue to be manufactured as long as all of the following are true:
- The manufacturing method is still available.
- There are no replacement products.
- There is demand for it in the market.

In case of obsolescence, Insight SiP will follow Jedec Standard JSD-48. A Product Discontinuation Notice (PDN) will be sent to all distributors and made available on our website. After this, the procedure goes as follows:
- Last Order Date will be 6 months after the PDN was published.
- Last Shipment Date will be 6 months after Last Order Date, i.e. 12 months after PDN.

8.5. Disclaimer

Insight SiP's products are designed and manufactured for general consumer applications, so testing and use of the product shall be conducted at customer's own risk and responsibility. Please conduct validation and verification and sufficient reliability evaluation of the products in actual condition of mounting and operating environment before commercial shipment of the equipment. Please also pay attention (i) to apply soldering method that don't deteriorate reliability, (ii) to minimize any mechanical vibration, shock, exposure to any static electricity, (iii) not to overstress the product during and after the soldering process.

The products are not designed for use in any application which requires especially high reliability where malfunction of these products can reasonably be expected to result in personal injury or damage to the third party's life, body or property, including and not limited to (i) aircraft equipment, (ii) aerospace equipment, (iii) undersea equipment, (iv) power plant control equipment, (v) medical equipment, (vi) transportation equipment, (vii) traffic signal equipment, (viii) disaster prevention / crime prevention equipment.

The only warranty that Insight SiP provides regarding the products is its conformance to specifications provided in datasheets. Insight SiP hereby disclaims all other warranties regarding the products, express or implied, including without limitation any warranty of fitness for a particular purpose, that they are defect-free, or against infringement of intellectual property rights. Insight SiP customers agree to indemnify and defend Insight SiP against all claims, damages, costs and expenses that may be incurred, including without any limitation, attorney fees and costs, due to the use of products.

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