ISP1807
Built-in Antenna Low Energy Module BT 5 Long Range, Zigbee, Thread, ANT+

Revision History

Revision	Date	Change Description
A	9/14/2023	Initial Revision
B	11/27/2023	Revision to Section 8.5

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1.0 Contact

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Manufactured by:
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2.0 Specifications

2.1 Important Notice

The electrical specifications of the module are directly related to the Nordic Semiconductor specifications for the nRF52840 chipset. Below information is only a summary of the main parameters. For more detailed information, especially about current consumption, please refer to the up-to-date specification of the chipset available on Nordic Semi website.

2.2 Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit
Main Supply Voltage respect to ground – VCC_nRF	-0.3		3.9	V
USB Supply Voltage respect to ground – VBUS	-0.3		5.8	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 PRECAUTIONFOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES
Human Body Model Class 3A

2.3 Operating Conditions

Parameter	Min	Typ	Max	Unit
VCC_nRF Supply Voltage, independent of DCDC enable	1.7	3.0	3.6	V
VBUS Supply Voltage	4.35	5.0	5.5	V
Extended Industrial Operating Temperature Range	-40	+25	+85	°C

2.4 Power Consumption

Parameter	Min	Typ	Max	Unit
Peak Current, Transmitter +8 dBm, VCC 3V + DCDC		16.4		mA
Peak Current, Transmitter 0 dBm, VCC 3V + DCDC		6.4		mA
Peak Current, Receiver 1 Mbps, VCC 3V + DCDC		6.26		mA
System OFF, no RAM retention		0.4		µA
System ON, no RAM retention, wake on RTC		1.5		µA
Additional RAM retention current per 4 KB block		30		nA

2.5 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			+/- 40	ppm

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

2.6 Radio Specifications

Parameter	Min	Typ	Max	Unit
Frequency Range	2402		2480	Mhz
Maximum Output Power, Transmitter 1 Mbps (1)		+8	+8.38	dBm
Maximum Output Power, Transmitter 2 Mbps (1)		+8	+8.35	dBm
Rx Sensitivity Level, BLE1 Mbps		-95		dBm
Rx Sensitivity Level, BLE Long Range 125 kbps		-103		dBm
Antenna Gain		0.6		dBi
EIRP	-19.4		8.6	dBm
Data Rate	125		2000	kbps

(1) maximum measured values

2.7 Range Measurement

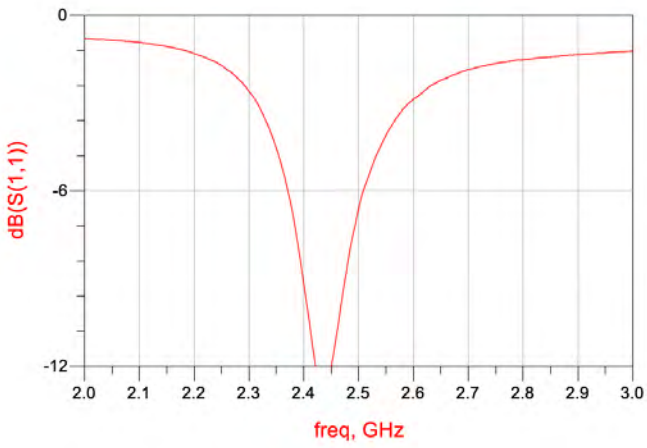
Range measurement between ISP1807-LR test board (configured as Central) and ISP1807-LR test board (configured as Peripheral).

Parameter	Min	Typ	Max	Unit
Range Open field @1m height (0 dBm, 1 Mbps)		150		m
Range Open field @1m height (0 dBm, 125 Kbps)		175		m
Range Open field @1m height (8 dBm, 1 Mbps)		230		m
Range Open field @1m height (8 dBm, 125 Kbps)		450		m

2.8 Antenna Performance

Typical Antenna Return Loss

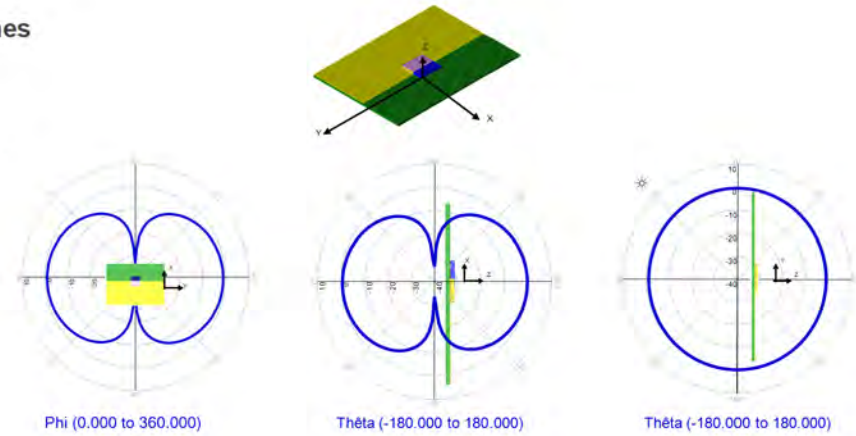
Module mounted on a
USB dongle ground plane



Radiation Pattern in 3 planes

Module mounted on a USB
dongle ground plane

Gain measurement
in dBi @ 2.45 GHz.



Ground Plane Effect Simulation

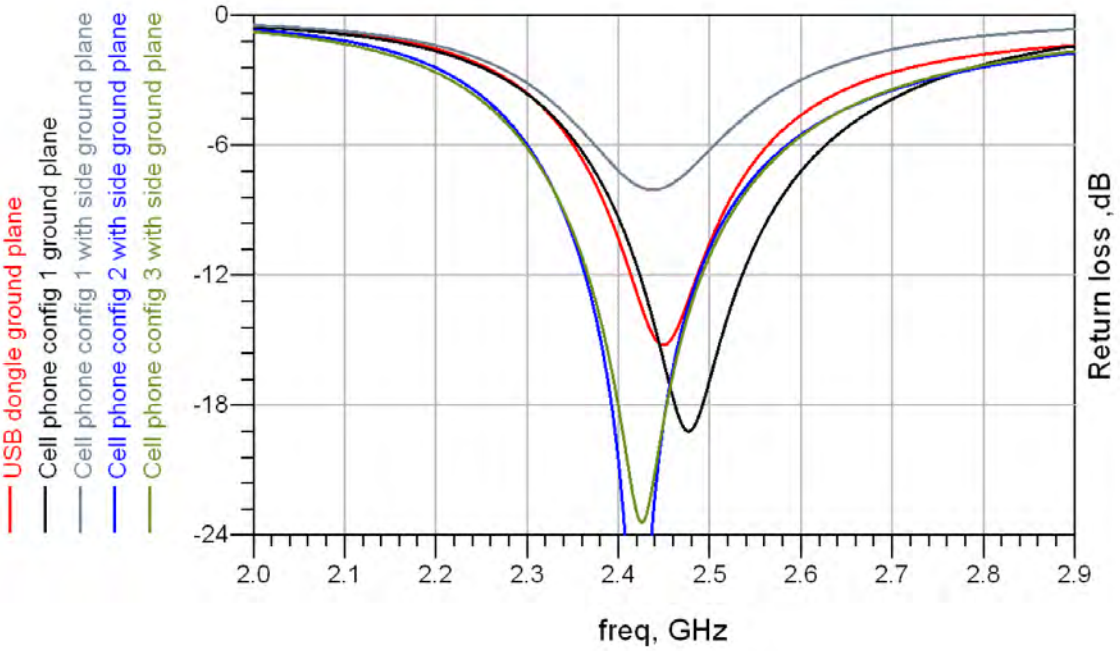
USB dongle
ground plane
(size: 18 x 30 mm²)

Cell phone config 1
ground plane
(size: 40 x 100 mm²)

Cell phone config 1 with
side ground plane
(size: 40 x 100 mm²)

Cell phone config 2 with
side ground plane
(size: 40 x 100 mm²)

Cell phone config 3 with
side ground plane
(size: 40 x 100 mm²)

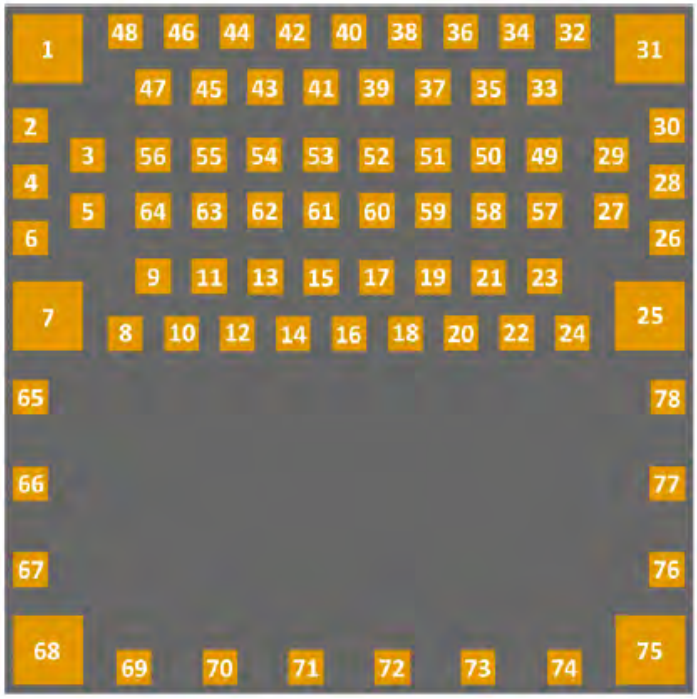


3.0 Pin Description

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	VSS	Ground	Should be connected to ground plane on application PCB
2	P0_09 NFC1	Digital I/O NFC Input	General purpose I/O pin NFC antenna connection
3	P0_12 TRACEDATA1	Digital I/O	General purpose I/O pin Trace port output
4	P0_10 NFC2	Digital I/O NFC Input	General purpose I/O pin NFC antenna connection
5	P0_14	Digital I/O	General purpose I/O pin
6	P0_26	Digital I/O	General purpose I/O pin
7	VSS	Ground	Should be connected to ground plane on application PCB
8	D+	Digital I/O	USB D+
9	P0_16	Digital I/O	General purpose I/O pin
10	D-	Digital I/O	USB D-
11	P0_21	Digital I/O	General purpose I/O pin
12	VBUS	Power	5V input for USB 3.3V regulator
13	P0_18 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	Digital I/O	General purpose I/O pin
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_ANT	Antenna I/O	This pin is connected to the internal antenna It should be connected to Pin 22 OUT_MOD for normal operation
21	VSS	Ground	Should be connected to ground plane on application PCB
22	OUT_MOD	Antenna I/O	This pin is the RF I/O pin of the BLE module It should be connected to Pin 20 OUT_ANT 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	VSS	Ground	Should be connected to ground plane on application PCB
26	VCC_nRF	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	VSS	Ground	Should be connected to ground plane on application PCB
32	P0_08	Digital I/O	General purpose I/O pin
33	P0_07 TRACECLK	Digital I/O	General purpose I/O pin Trace port clock output

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	Digital I/O	General purpose I/O pin
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 TRACEDATA2	Digital I/O	General purpose I/O pin Trace port output
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	P1_02	Digital I/O	General purpose I/O pin
50	P1_06	Digital I/O	General purpose I/O pin
51	P1_15	Digital I/O	General purpose I/O pin
52	P1_14	Digital I/O	General purpose I/O pin
53	P1_13	Digital I/O	General purpose I/O pin
54	P1_05	Digital I/O	General purpose I/O pin
55	P1_08	Digital I/O	General purpose I/O pin
56	P1_09 TRACEDATA3	Digital I/O	General purpose I/O pin Trace port output
57	P1_00 TRACEDATA0	Digital I/O	General purpose I/O pin Trace port output
58	P1_03	Digital I/O	General purpose I/O pin
59	P1_12	Digital I/O	General purpose I/O pin
60	P1_10	Digital I/O	General purpose I/O pin
61	P1_11	Digital I/O	General purpose I/O pin
62	P1_07	Digital I/O	General purpose I/O pin
63	P1_04	Digital I/O	General purpose I/O pin
64	P1_01	Digital I/O	General purpose I/O pin
65 to 78	NC	Not Connected	Isolated pad on application PCB for mechanical stability



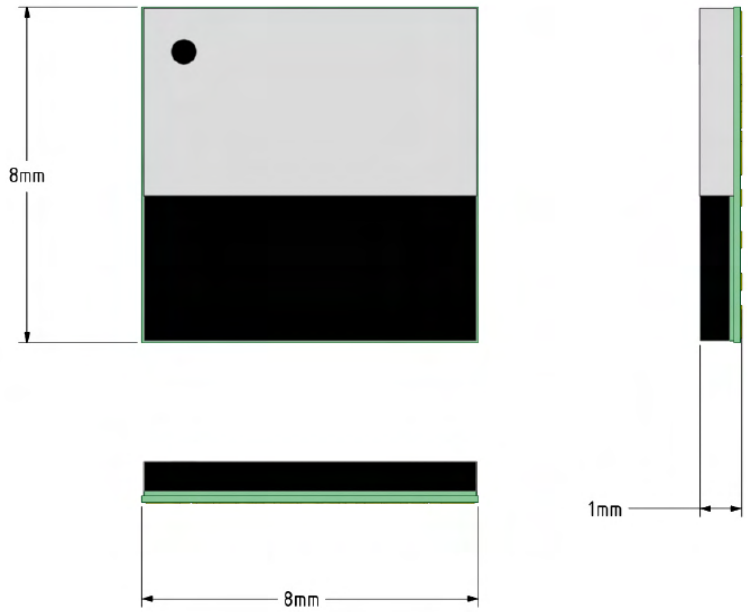
ISP1807
pad placement and pin assignment
for the LGA QFN package

TOP VIEW

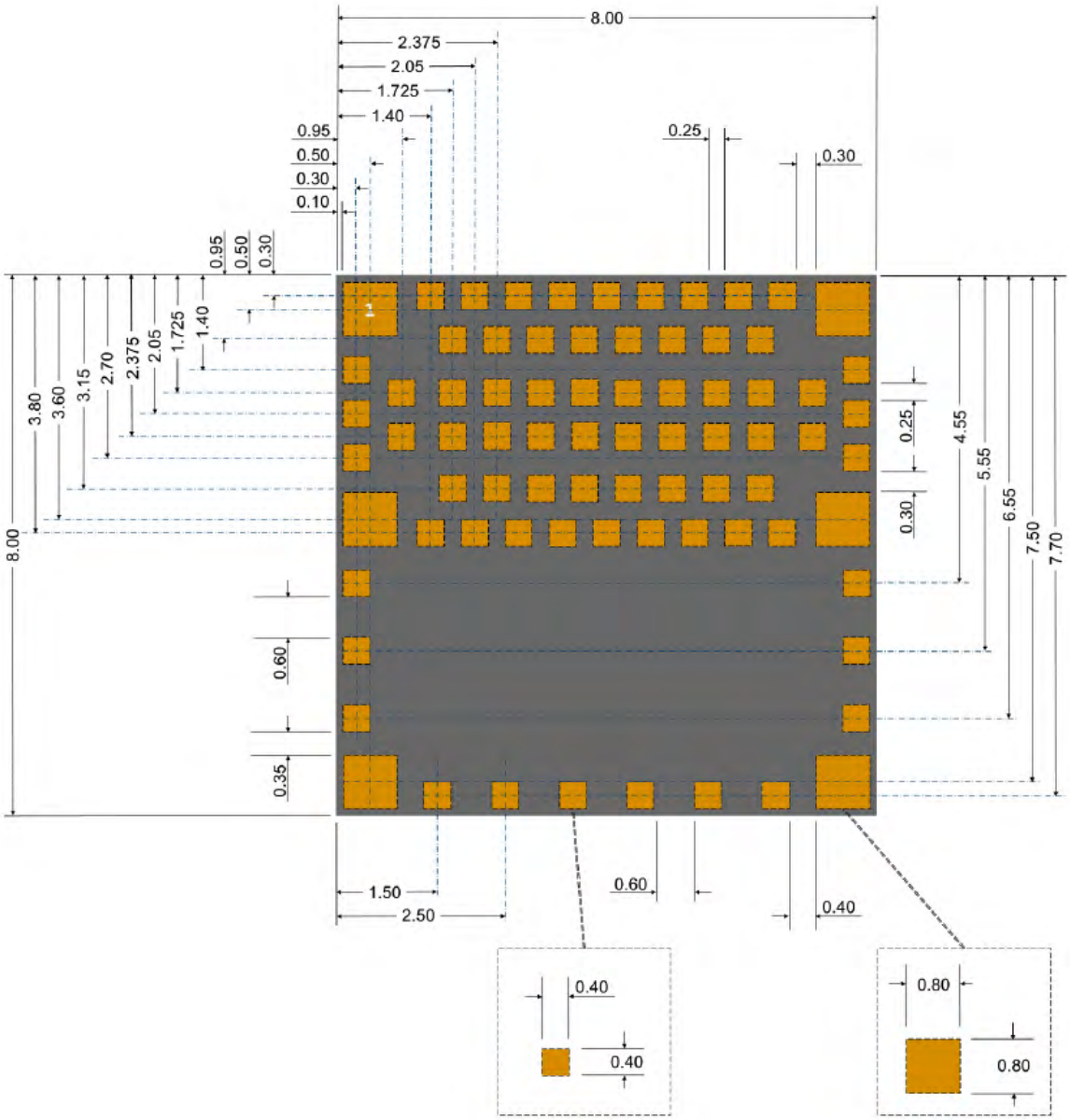
4.0 Mechanical Outlines

4.1 Mechanical Dimensions

Package dimensions



Dimensional drawing for 62-Pad LGA Package

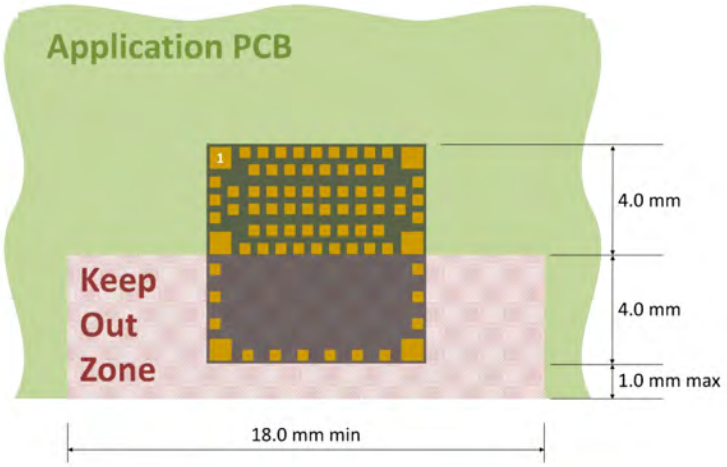


4.2 SMT Assembly Guidelines

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

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.



5. Product Development Tools

5.1 Hardware

In order to assist clients in developing their Bluetooth Smart solutions based on the ISP1807, 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 ISP1807 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/ISP1807/isp_ble_DS1807_DK.pdf

5.2 Firmware

ISP1807supports Bluetooth Low Energy protocol stacks. It also provides extensive software support for ANT, ZIGBEE and THREAD applications as well as 2.4 GHz protocol stacks, including Gazell. All are available as downloads at www.nordicsemi.com.

- The S140 SoftDevice is a Bluetooth low energy (BLE) Central and Peripheral protocol stack solution. The S140 SoftDevice supports up to twenty connections with an additional observer and a broadcaster all running concurrently.

The S140 SoftDevice integrates a Bluetooth low energy Controller and Host, and provides a full and flexible API for building Bluetooth low energy nRF52 System on Chip (SoC) solutions:

- Bluetooth 5.0 compliant low energy single-mode protocol stack suitable for Bluetooth low energy products.
- Concurrent central, observer, peripheral, and broadcaster roles with up to 20 concurrent connections along with one Observer and one Broadcaster.
- Link layer supporting LE 1M PHY and LE 2M PHY
- LL Privacy
- LE Data Packet Length Extension
- LE Secure Connections pairing model

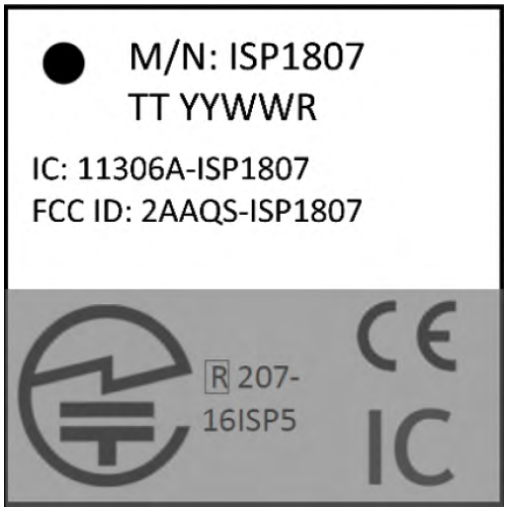
5.3 Development Tools

The following development tools and software are recommended for using and testing ISP1807 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 examples of source codes applications (C language):
  - Precompiled HEX files
  - Source code
  - Keil ARM project files
  - IAR project files

6.0 Packaging Information

6.1 Marking



ISP 1807	Part Number
TT	2 letters module type (see 6.5 below)
YY	2 digits year number
WW	2 digits week number
R	1 letter Hardware revision

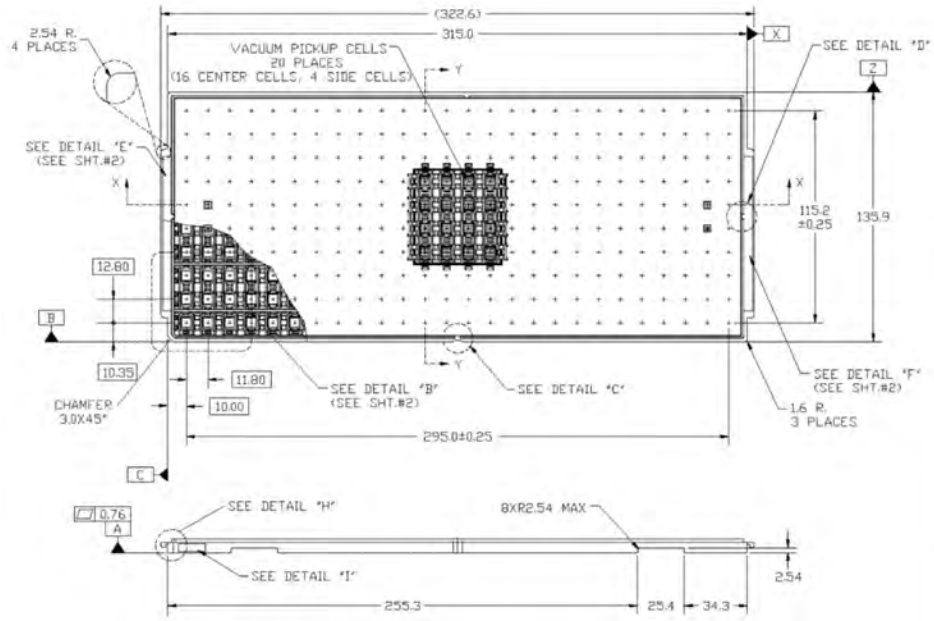
6.2 Prototype Packaging

For engineering samples and prototype quantities up to 99 units, deliveries are provided in thermoformed trays or cut tapes. They are delivered in sealed pack with desiccant pack and humidity sensors. Please see section 7.2 for more information on moisture sensitivity. Please order with “ST” code packaging suffix.

6.3 Jedec Trays

For pre-production volumes, ISP1807 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. Please order with “JT” code packaging suffix.

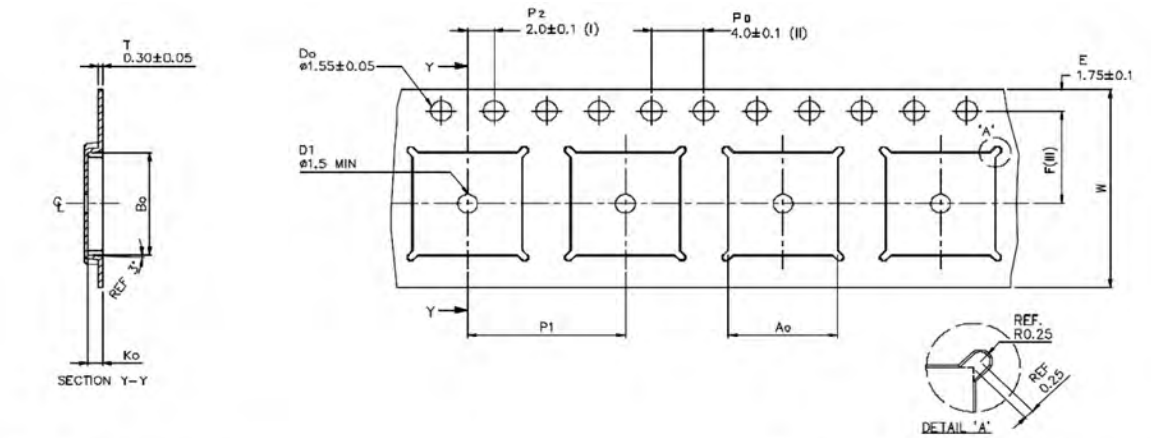
Refer to tray sizes below. Complete information on Jedec trays is available on request.



Top view position of modules within the tray.

6.4 Tape and Reel

ISP1807 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.

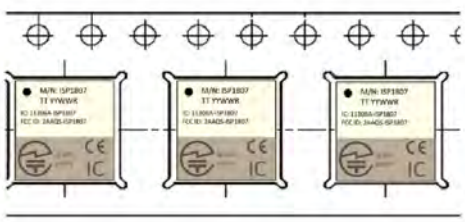


Ao	8.30 +/−0.1
Bo	8.30 +/−0.1
Ko	1.10 +/−0.1
F	7.50 +/−0.1
P1	12.00 +/−0.1
W	16.00 +/−0.3

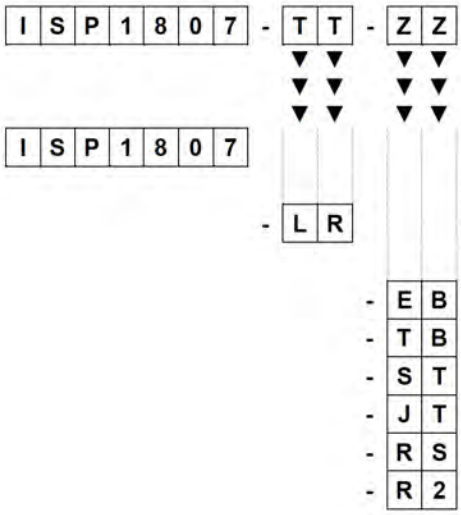
(I) Measured from centreline of sprocket hole to centreline of pocket.
(II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .
(III) Measured from centreline of sprocket hole to centreline of pocket.
(IV) Other material available.

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

Top view position of modules within the reel.



6.5 Ordering Information



ISP1807	Part Number
-LR	Long range version
-EB	Evaluation Board(1)
-TB	Test board (1)
-ST	Standard Tray or Cut Tape
-JT	Jedec Tray Packaging
-RS	Reel of 500 units
-R2	Reel of 2000 units

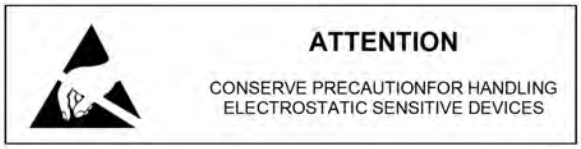
Refer to the following documentation for more information on development kit and test board:

http://www.insightsip.com/fichiers_insightsip/pdf/ble/ISP1807/isp_ble_DS1807_DK.pdf
http://www.insightsip.com/fichiers_insightsip/pdf/ble/ISP1807/isp_ble_ANXXXXX.pdf

7. Storage and 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 CI2, 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

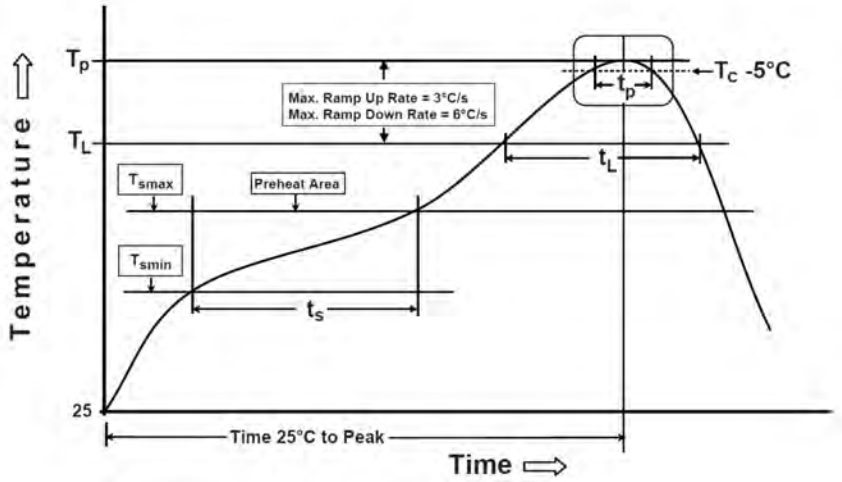
All plastic packages absorb moisture. During typical solder reflow operations when SMDs are mounted onto a PCB, the entire PCB and device population are exposed to a rapid change in ambient temperature. Any absorbed moisture is quickly turned into superheated steam. This sudden change in vapor pressure 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.

ISP1807 has been tested MSL-3 according to standards. After baking, modules can be exposed to ambient room conditions (approximately 30°C/60%RH) during 168 hours before assembly on the PCB.

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

8. Quality and User Information

8.1 Certifications

- Bluetooth SIG Declaration ID n° D046560
- CE Certified, DoC Insight SiP Ref TR190901
- TELEC Certified n° pending
- KCC Certification n° R-C-iNs-ISP1807
- FCC Certification FCC ID: 2BCQV-12056
- IC certification IC: 31164-BLE1807001
- RoHS and Reach compliant

- Conflict Mineral Declaration available

8.2 EC - CE Certification

This device can be operated in at least one Member State without infringing applicable requirements on the use of radio spectrum.

8.3 USA - User information

FCC Part 15.19(a)
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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Part 15.105
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.

FCC Part 15.21
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

OEM Responsibilities to comply with FCC

- This module is limited to OEM installation only.
- The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install module.

- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.
- Separate approval will be required for all other operating configurations, including different antenna configurations other than the supplied antennas.

As long as the condition above is met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). Also, the OEM integrator is responsible to provide to the host manufacturer for compliance with the Part 15B requirements.

Host User Manual

The host manual shall include the following regulatory statement:

> Part 15.19: 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, and (2) this device must accept any interference received, including interference that may cause undesired operation.
> Part 15.21 Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Host Product Labeling

The module is labeled with its own FCC. If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

> “Contains FCC ID: 2BCQV-12056”

8.4 Canada - User information

This intends to inform how to specify the IC ID of our module “ISP1807” 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 below example wording or any similar wording that expresses the same meaning:

> “Contains IC: 31164-BLE1807001”

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:

> This device complies with Industry Canada license-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.

8.5 RF Exposure Information

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF)Exposure Guidelines in Supplement C toOET65 and RSS-102 of the IC radio frequency (RF) Exposure rules. When the module is used in operation in portable RF exposure condition, installation in the non-authorized host requires SAR evaluation.

8.6 Informations concernant l'exposition aux fréquences radio (RF)

La puissance de sortie émise par l'appareil de sans-fil est inférieure à la limite d'exposition aux fréquences radio d'Industry Canada (IC). Ce module a également été évalué et démontré conforme aux limites d'exposition aux RF d'IC dans des conditions d'exposition à des appareils mobiles et/ou portables.

8.7 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 Insight SiP's 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.

8.8 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.