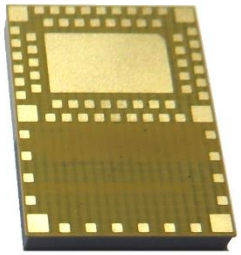
ISP130301
Bluetooth Low Energy Module with Integrated Antenna

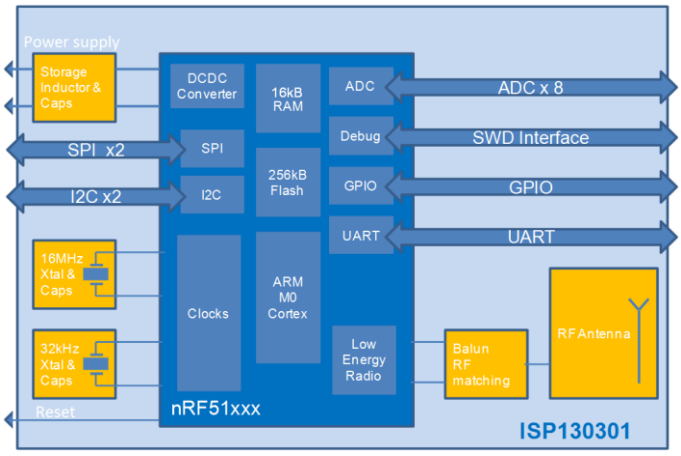


Key Features

- Single Mode BLE v4.1 Slave or Master
- Based on Nordic Semiconductor nRF51 family
- 2.4GHz low energy RF Transceiver
- 32bit ARM Cortex M0 CPU
- 256kB Flash and 16 kB SRAM
- Analog and Digital peripherals
- Ultra Low Power Consumption
- Single 1.8 to 3.6 V supply
- Very small size 8.0 x 11.0 x 1.2 mm
- Temperature -40 to 75 °C
- Fully integrated RF matching and Antenna
- Integrated 16 MHz and 32.768 kHz Clocks

Certifications

- Complies with FCC
- Complies with CE
- Complies with IC
- Complies with TELEC
- Bluetooth SIG certified
- RoHS compliant



Applications

- Space constrained BLE Slave Devices
- Sport and fitness sensors
- Health care sensors
- Out of Range (OOR) sensors
- Personal User Interface Devices (PUID)
- Remote controls

General Description

This module is based on nRF51822 Nordic Semiconductor 2.4GHz wireless System on Chip (SoC) integrating a 2.4 GHz transceiver, a 32 bit ARM Cortex™-M0 CPU, a flash memory, and analog and digital peripherals. It can support BLE and a range of proprietary 2.4 GHz protocols, such as Gazell from Nordic Semiconductor.

Fully qualified BLE stacks for nRF51822 are implemented in the S100 series of SoftDevices which can be freely downloaded. ISP130301 can then be used in Master and Slave modes for BLE and for both ends of other proprietary protocols. The ANT protocol can be handled on request.

The module is specifically designed for both PC peripherals and ultra low power applications such as sports and wellness sensors. 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 8x11x1.2mm, the module integrates decoupling capacitors, 16 MHz and 32 kHz crystals, load capacitors, DC-DC converter, RF matching circuit and antenna in addition to the wireless SoC.

The module forms a standalone BLE node for which only the addition of a suitable DC power source is necessary for proximity or Out of Range applications. Sensor applications require only the further addition of the appropriate sensors. As the module has several end applications, the antenna was designed to be compatible with several ground plane sizes such as USB dongle or cell phone.

Contents

1. Electrical Specifications

Electrical Performance

The specifications of the module follow those of the nRF51822. The following high level parameters are given for the module.

The operating temperature range is -40 to +75 °C with the following performances.

Parameter	Value	Unit
Supply Voltage	1.8 to 3.6	V
Peak current, receiver active (supply at 2.1V)	12.6	mA
Peak current, transmitter active +4 dBm Output Power	16	mA
Peak current, transmitter active 0 dBm Output Power	10.5	mA
Current drain, connection-less state, no RAM retention	0.6	µA
Current drain between connection events	2.6	µA
Crystal stability 32.768 kHz	+/- 20 ppm	

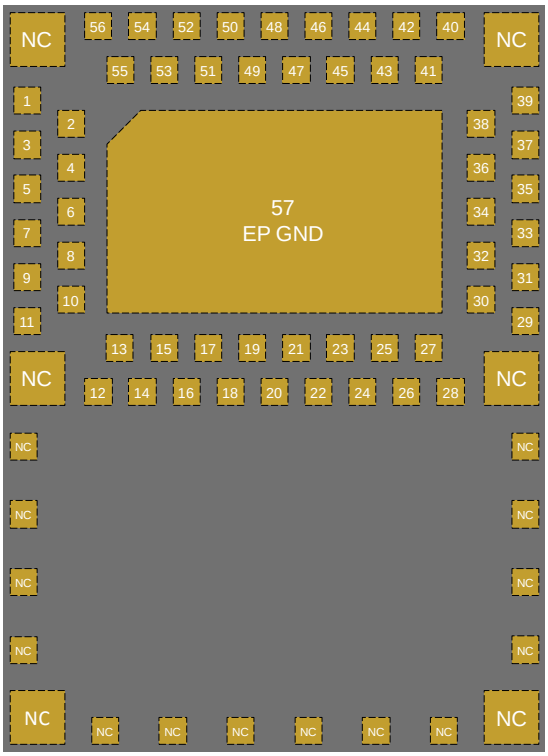
Pin Assignment

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.

Pads 1 thru 56 are signal pins 0.4 x 0.4 mm, Pad 57 is an exposed metal pad that is connected to ground. The NC pads are 0.8 x 0.8 or 0.4 x 0.4 mm and 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	P0_07	Digital I/O	General purpose I/O pin
2	NC	Not Connected	Isolated pad on application PCB for mechanical stability
3	P0_09	Digital I/O	General purpose I/O pin
4	NC	Not Connected	Isolated pad on application PCB for mechanical stability
5	P0_13	Digital I/O	General purpose I/O pin
6	NC	Not Connected	Isolated pad on application PCB for mechanical stability
7	P0_19	Digital I/O	General purpose I/O pin
8	NC	Not Connected	Isolated pad on application PCB for mechanical stability
9	P0_17	Digital I/O	General purpose I/O pin
10	NC	Not Connected	Isolated pad on application PCB for mechanical stability
11	P0_20	Digital I/O	General purpose I/O pin
12	VSS	Ground	Should be connected to ground plane on application PCB
13	NC	Not Connected	Isolated pad on application PCB for mechanical stability
14	VSS	Ground	Should be connected to ground plane on application PCB
15	NC	Not Connected	Isolated pad on application PCB for mechanical stability
16	VSS	Ground	Should be connected to ground plane on application PCB
17	NC	Not Connected	Isolated pad on application PCB for mechanical stability
18	VSS	Ground	Should be connected to ground plane on application PCB
19	NC	Not Connected	Isolated pad on application PCB for mechanical stability
20	VSS	Ground	Should be connected to ground plane on application PCB
21	NC	Not Connected	Isolated pad on application PCB for mechanical stability
22	VSS	Ground	Should be connected to ground plane on application PCB
23	VSS	Ground	Should be connected to ground plane on application PCB
24	OUT_MOD	Module I/O	This pin is the RF I/O pin of the BLE module. It should be connected to Pin 26 OUT_ANT for normal operation. During certification the pin may be connected via to an RF connector for module measurement using a Bluetooth test setup.
25	VDD_PA	PA supply	PA supply indicates Transmit mode (Active High)
26	OUT_ANT	Antenna I/O	This pin is connected to the internal antenna. It should be connected to Pin 24 OUT_MOD for normal operation. During certification the pin may be connected to an RF connector for antenna measurement
27	VSS	Ground	Should be connected to ground plane on application PCB
28	VSS	Ground	Should be connected to ground plane on application PCB
29	VCC_nRF	Power	Power supply (1.8 – 3.6V). VDD in nRF51822 doc.
30	VSS	Ground	Should be connected to ground plane on application PCB
31	SWDCLK	Digital Output	HW debug and flash programming I/O
32	P0_18	Digital I/O	General purpose I/O pin
33	SWDIO-nRESET	Digital I/O	System reset (active low). Also HW debug and flash programming I/O
34	P0_16	Digital I/O	General purpose I/O pin
35	P0_15	Digital I/O	General purpose I/O pin
36	P0_14	Digital I/O	General purpose I/O pin
37	P0_12	Digital I/O	General purpose I/O pin
38	P0_10	Digital I/O	General purpose I/O pin
39	P0_11	Digital I/O	General purpose I/O pin
40	P0_05-AIN6	Digital I/O Analog input	General purpose I/O pin ADC input 6

Pin	Name	Pin function	Description
41	P0_06-AIN7-AREF1	Digital I/O Analog input Analog input	General purpose I/O pin ADC input 7 ADC Reference voltage
42	P0_03-AIN4	Digital I/O Analog input	General purpose I/O pin ADC input 4
43	P0_04-AIN5	Digital I/O Analog input	General purpose I/O pin ADC input 5
44	P0_01-AIN2	Digital I/O Analog input	General purpose I/O pin ADC input 2
45	P0_31	Digital I/O	General purpose I/O pin
46	P0_02-AIN3	Digital I/O Analog input	General purpose I/O pin ADC input 3
47	P0_30	Digital I/O	General purpose I/O pin
48	P0_00-AREF0	Digital I/O Analog input	General purpose I/O pin ADC Reference voltage
49	P0_29	Digital I/O	General purpose I/O pin
50	P0_28	Digital I/O	General purpose I/O pin
51	P0_24	Digital I/O	General purpose I/O pin
52	P0_23	Digital I/O	General purpose I/O pin
53	P0_21	Digital I/O	General purpose I/O pin
54	P0_22	Digital I/O	General purpose I/O pin
55	P0_25	Digital I/O	General purpose I/O pin
56	P0_08	Digital I/O	General purpose I/O pin
57	GND_EP	Ground	Exposed metal pad. Should be connected to ground plane on application PCB

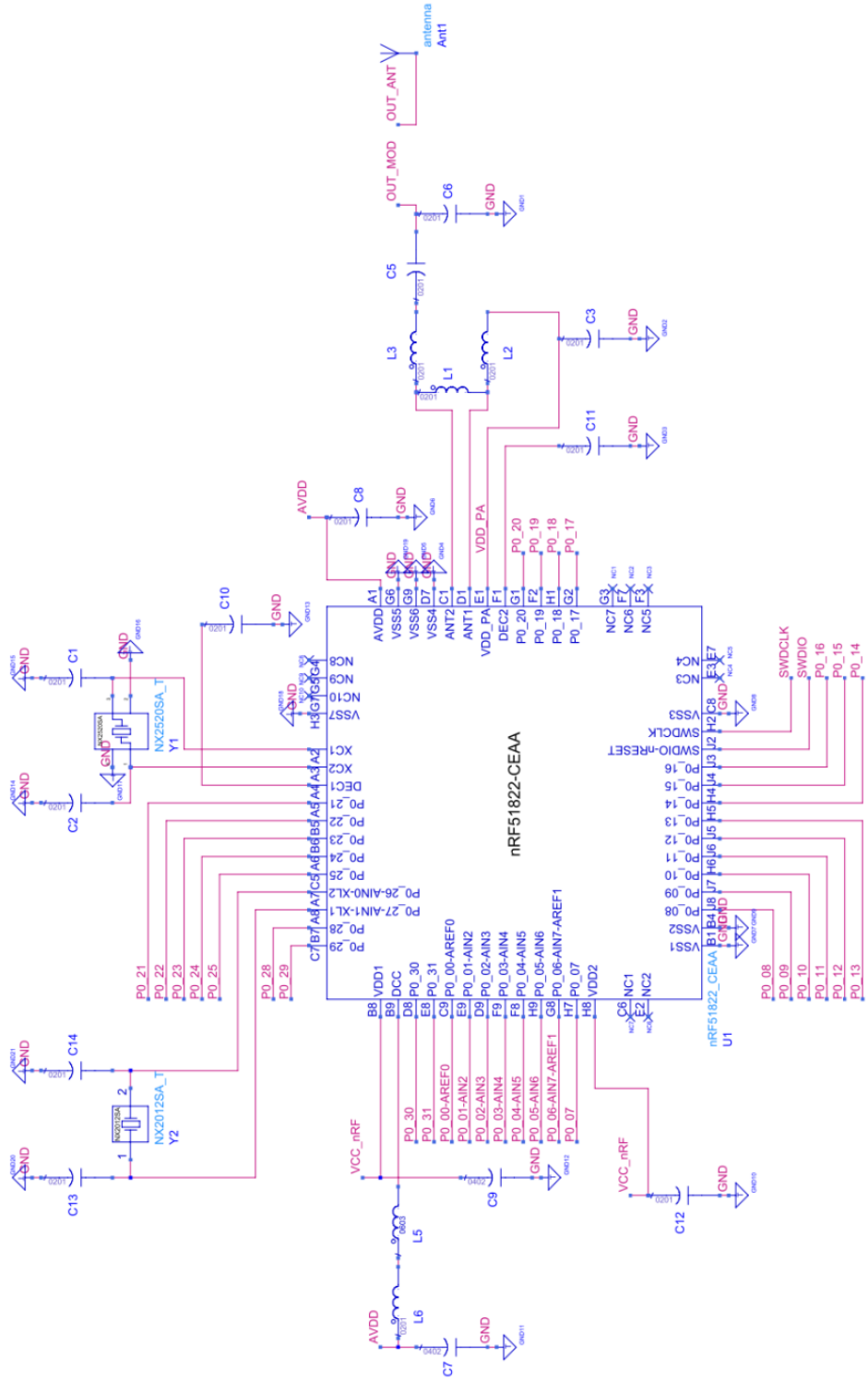


ISP130301pad placement and pin assignment for the LGA QFN package

TOP VIEW

Electrical Schematic

Electrical schematic showing ISP130301 module connections



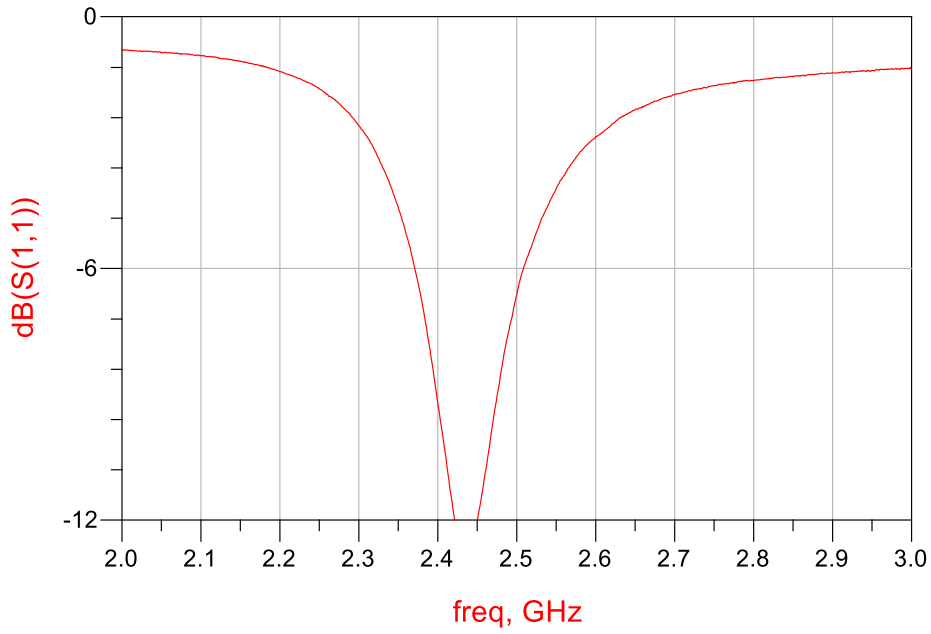
2. RF Performances

RF Specifications according to standards

Parameter	Value	BT V4 Std limit	Unit	Condition
Output Power	-20 to +4	-20 to 10	dBm	Channels 0 to 39
RF Frequency tolerance	Better than +/-20	+/- 50	Hz	Channels 0 to 39
Rx sensitivity	-93	-70	dBm	Level for BER <0,1% ideal Tx
Max range	> 200		m	Open field @1m height
EIRP	4.6		dBm	
Antenna Gain	0.6		dBi	
Rx sensitivity	51.4		dBµV/m	

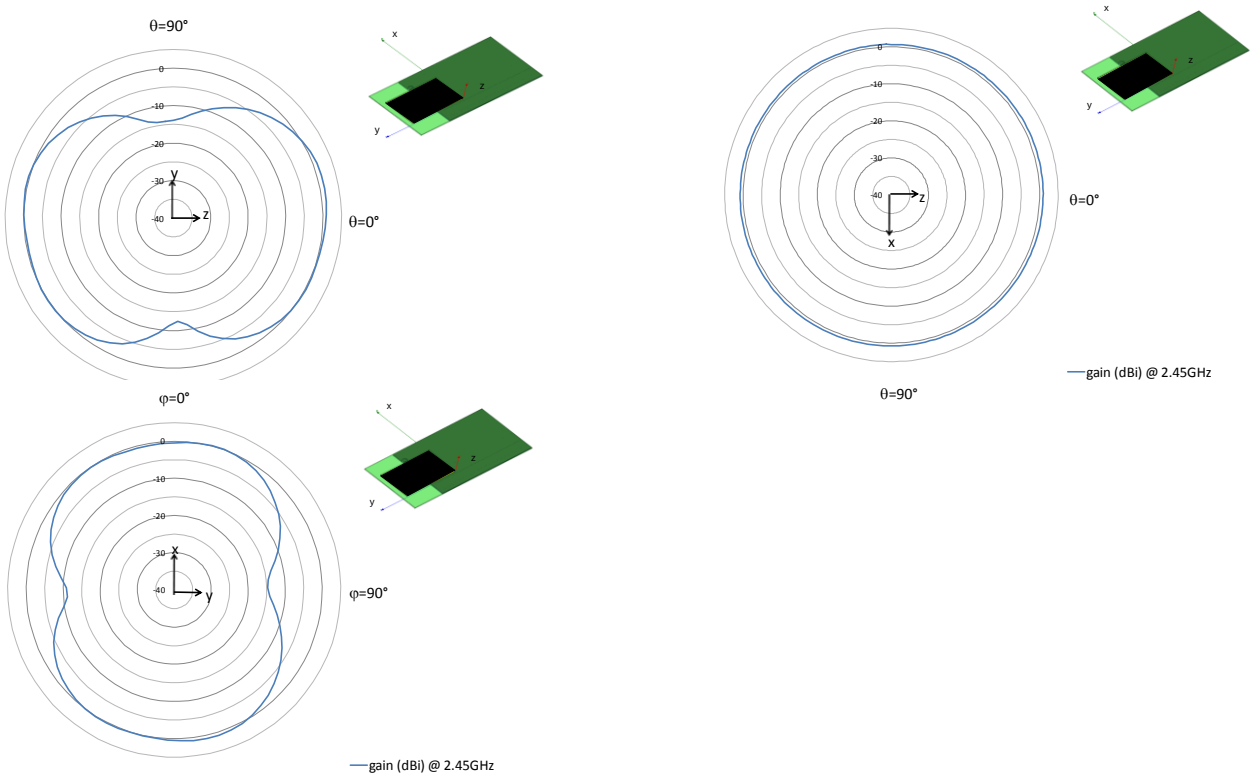
Typical Antenna Return Loss

Module mounted on a USB dongle ground plane

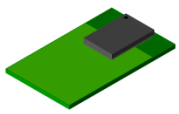


Radiation Pattern in 3 planes

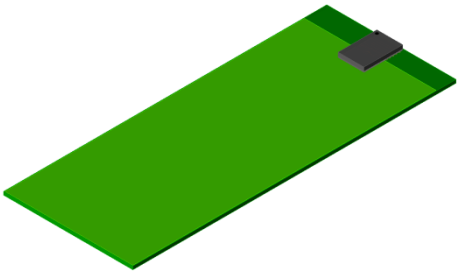
Module mounted on a USB dongle ground plane



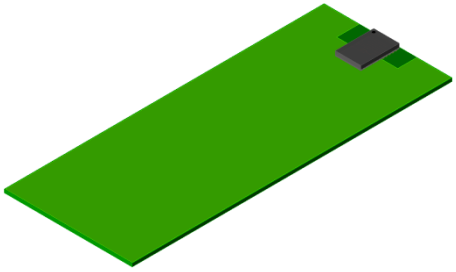
Ground Plane Effect Simulation



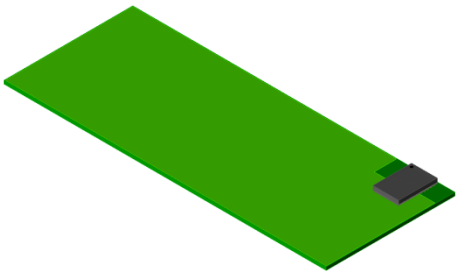
USB dongle
ground plane
(size : 18 x 30 mm²)



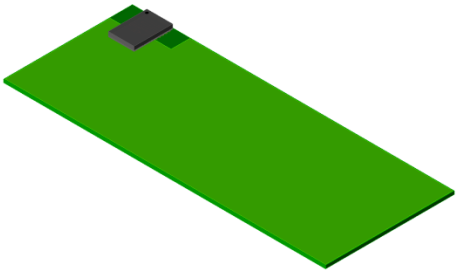
Cell phone config 1
ground plane
(size : 40 x 100 mm²)



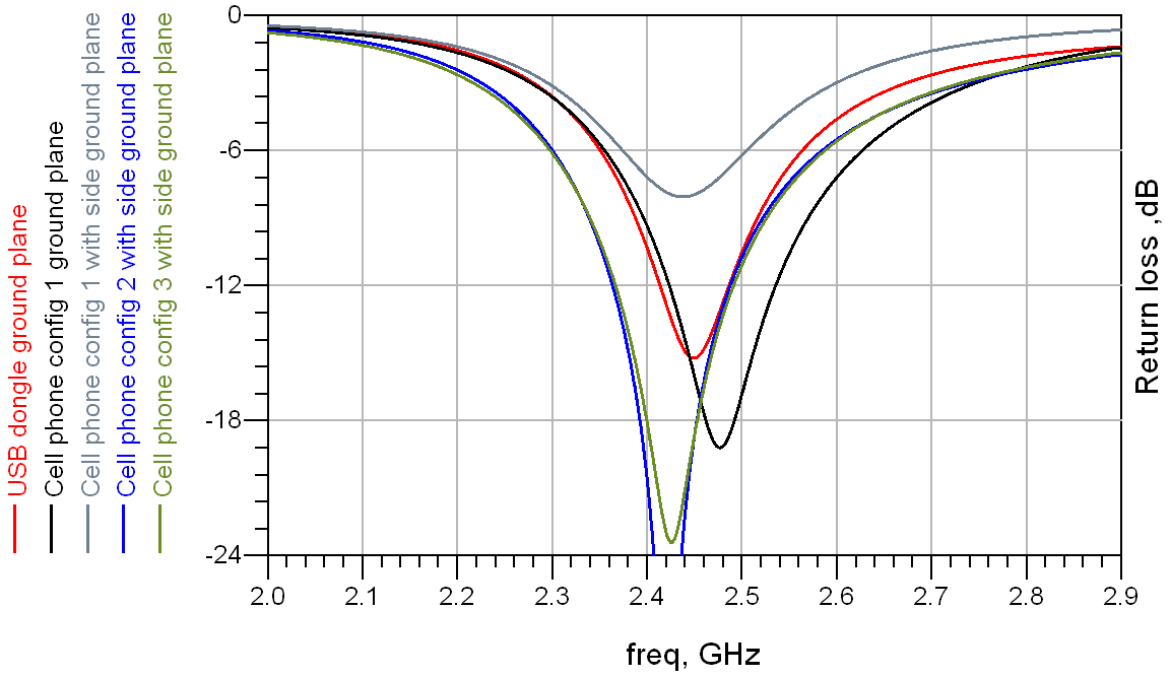
Cell phone config 1 with
side ground plane
(size : 40 x 100 mm²)



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. Product Development Tools

Interface

ISP130301 integrates a full microprocessor interface with up to 32 General Purpose I/O pins (GPIO) and several functions (2 x SPI, 2 x I2C, UART, 8 x ADC, SWDIO interface).

Hardware

The following development kit is recommended for using and testing ISP130301 module:

- Insight SiP Development Kit (ISP130301-DK1), need to be purchased separately

Development Tools and Software

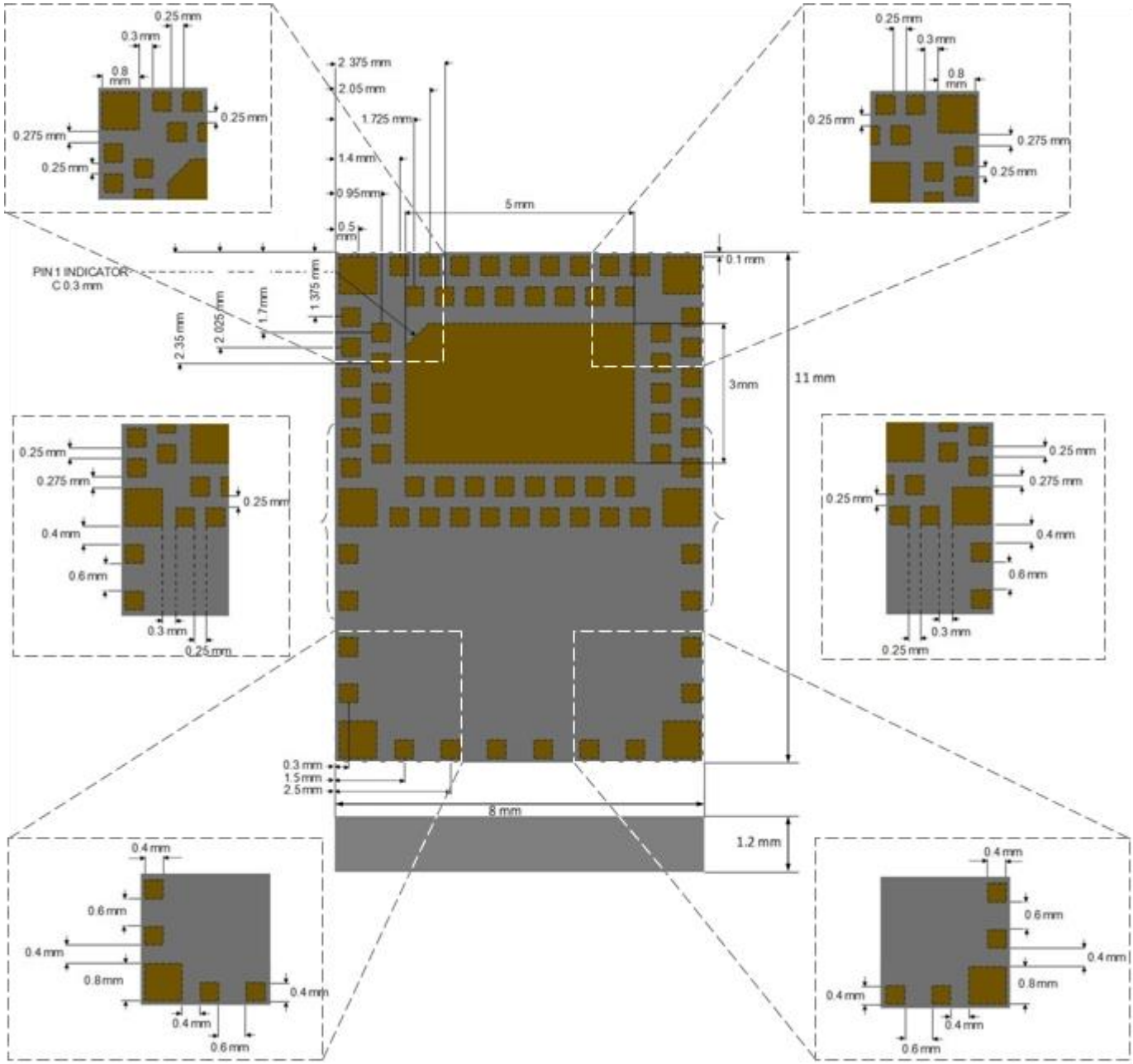
The following development tools and software are recommended for using and testing ISP130301 module:

- Nordic Semiconductor nRFgo Studio (downloadable from www.nordicsemi.com after purchasing ISP130301-DK1)
- Nordic Semiconductor Master Control Panel (downloadable from www.nordicsemi.com after purchasing ISP130301-DK1)
- 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)
- S100 nRF51822 SoftDevice: fully qualified Bluetooth low energy stacks for nRF51822 integrated in ISP130301 module. The S100 series of SoftDevices (object code, no source) can be downloaded from www.nordicsemi.com after purchasing ISP130301-DK1
- nRF51 Software Development Kit (SDK): nRF51 SDK can be downloaded from www.nordicsemi.com after purchasing ISP130301-DK1. It contains example of source codes applications (C language):
  - Precompiled HEX files
  - Source code
  - Keil ARM project files
  - IAR project files
  - GCC project files

4. Mechanical Outlines

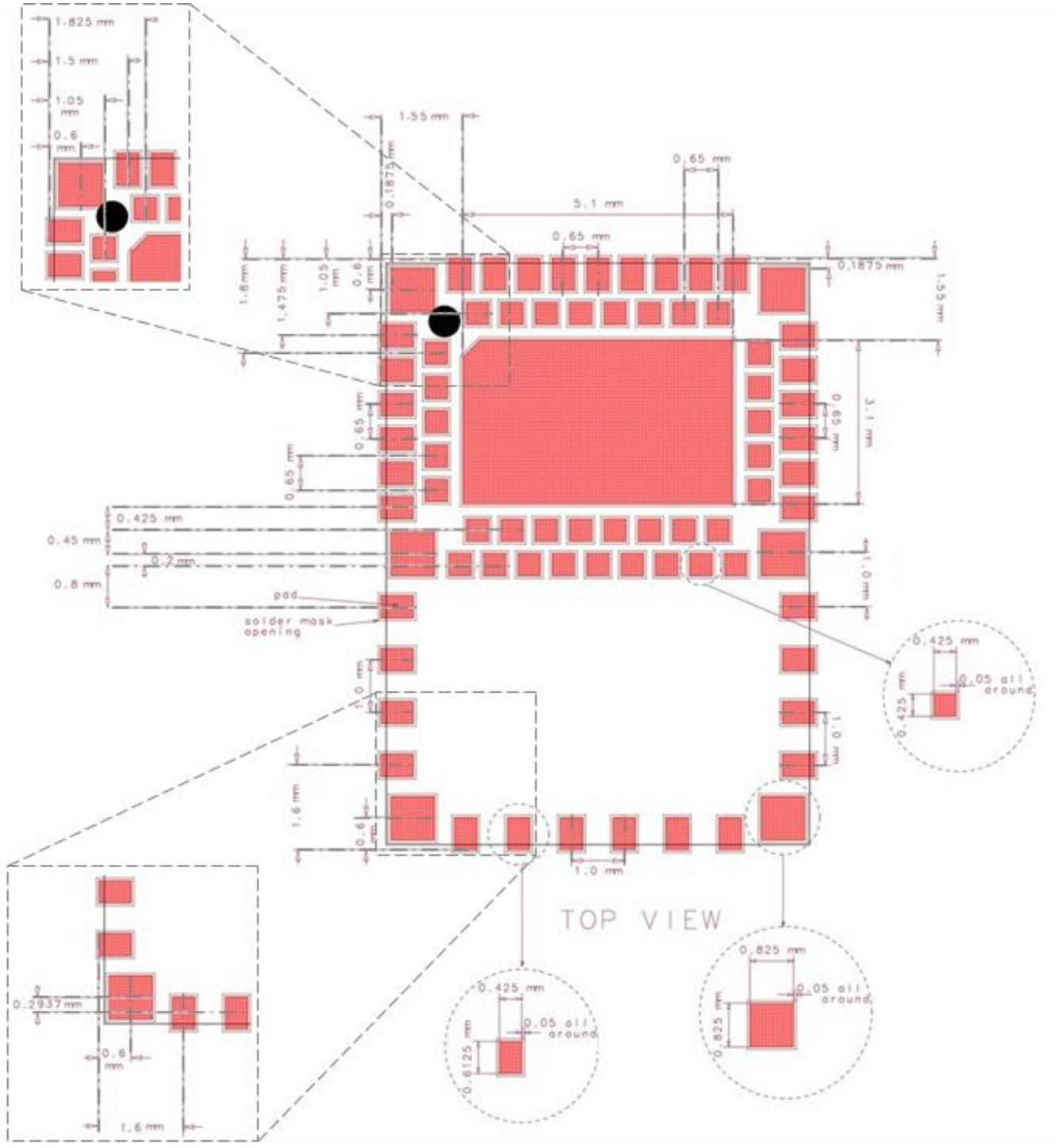
Mechanical Dimensions

Dimensional drawing for 8 x 11 x 1.2 mm, 57-Pad LGA Package



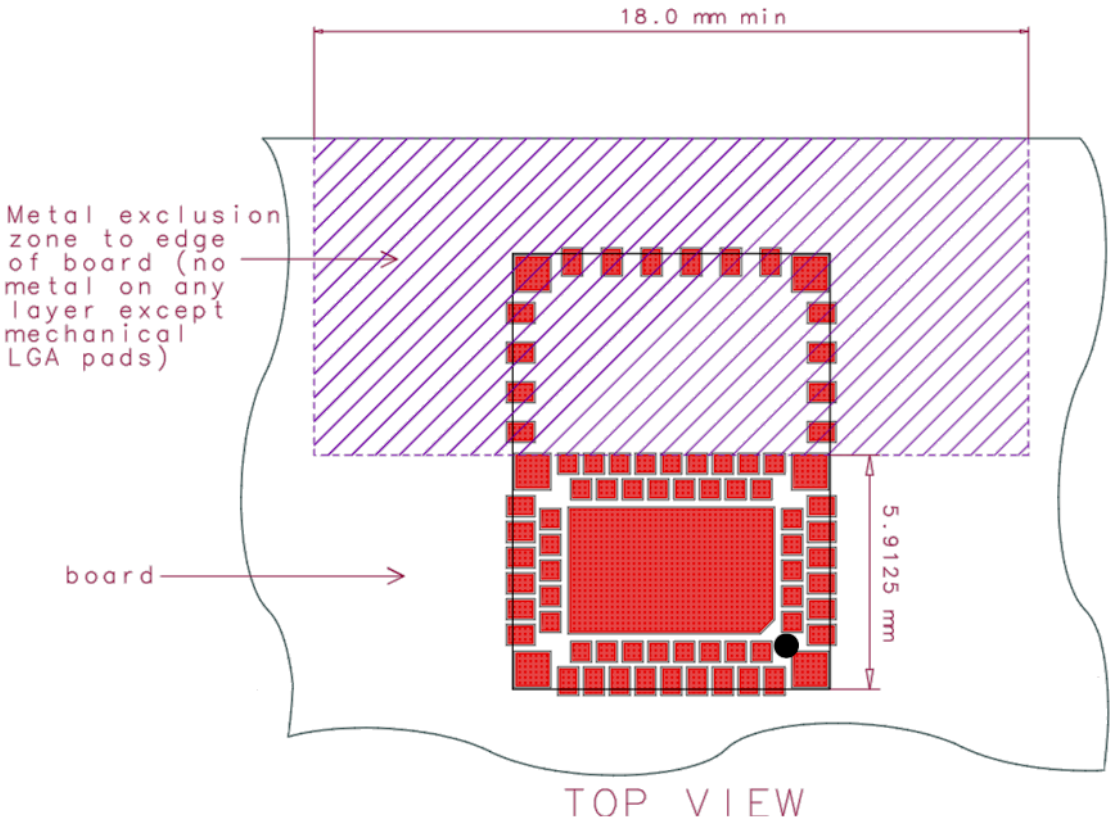
SMT Assembly Guidelines

Recommended PCB Land Pattern and Solder Mask layout. Complete information is available on request.



Antenna Keep-Out Zone

Recommended metal keep out areas for optimal antenna performance:
no metal, no traces and no components on any layer except mechanical LGA pads.

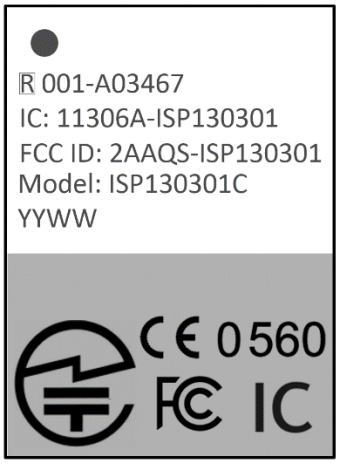


5. Packaging

Marking

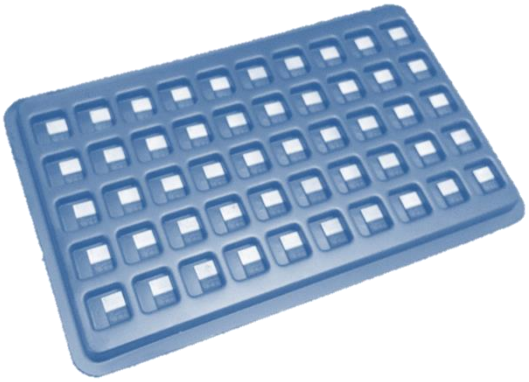
I	S	P	1	3		0	3	0	1	C
Y	Y	W	W							

ISP130301	Product number
C	Hardware version
YY	Two digit year number
WW	Two digit week number



Prototype Packaging

For engineering samples and prototype quantities up to 99 units, deliveries are provided in thermoformed trays.

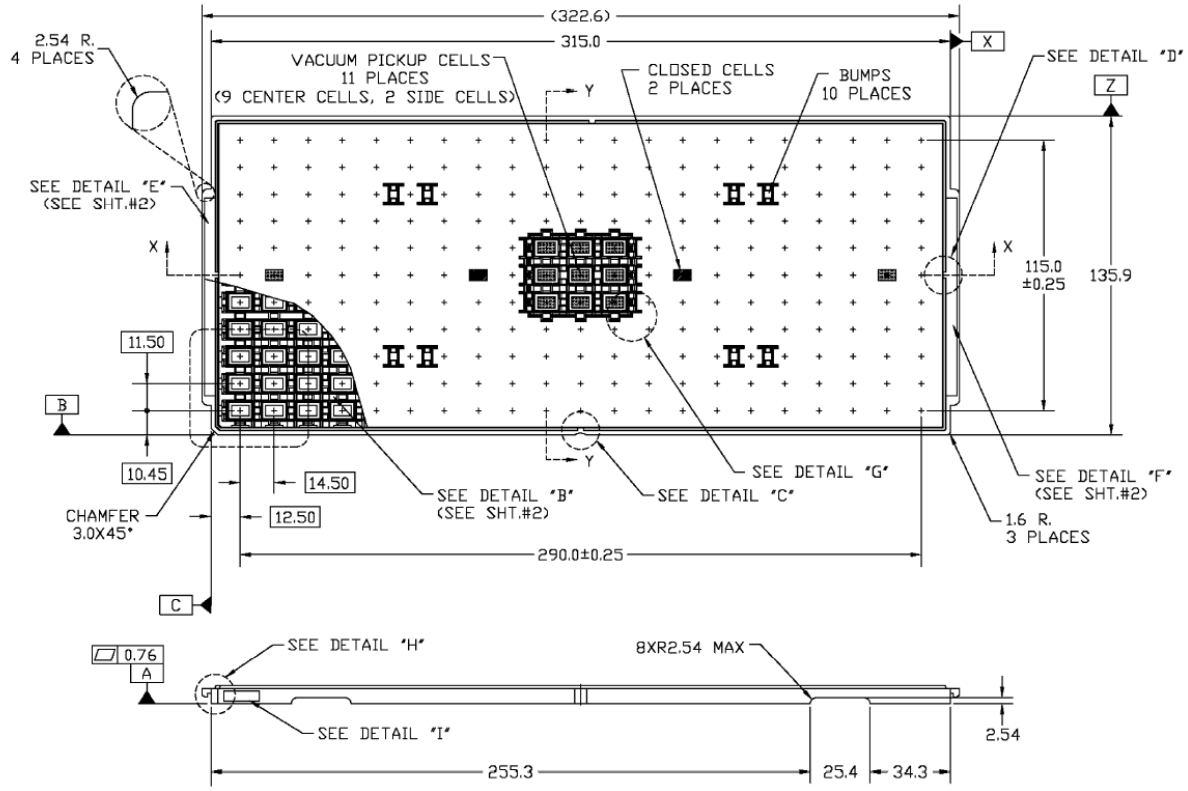


Trays

For higher quantities and volume production, ISP130301 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 6 for more information on moisture sensitivity.

Jedec trays are proposed in standard quantities of 100 units, 200 units and multiples of 200 units only.

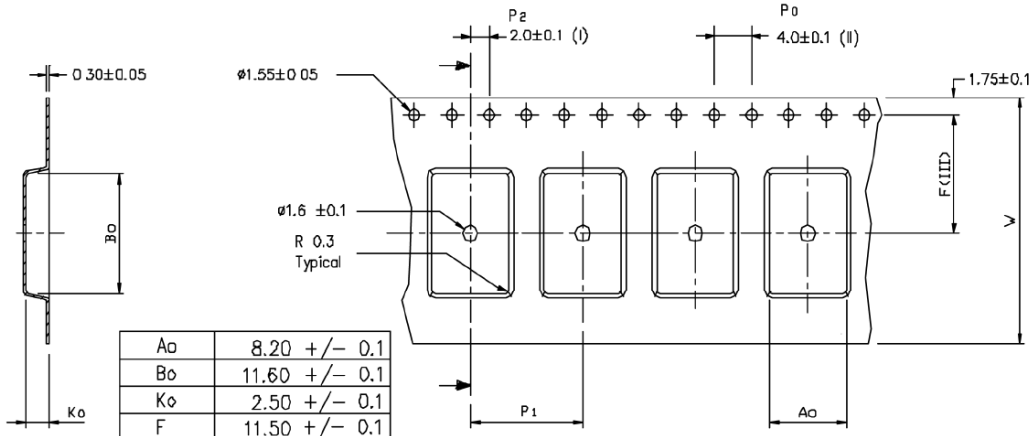
Please refer to tray sizes and module positioning below. Complete information on Jedec trays is available on request.



Tape and Reel

ISP130301 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 / 15" reel) only.

Please refer to tape size below. Complete information is available on request.



Ao	8.20 +/− 0.1
Bo	11.60 +/− 0.1
Ko	2.50 +/− 0.1
F	11.50 +/− 0.1
P1	12.00 +/− 0.1
W	24.00 +/− 0.3

6. Storage & Soldering information

Moisture Sensitivity

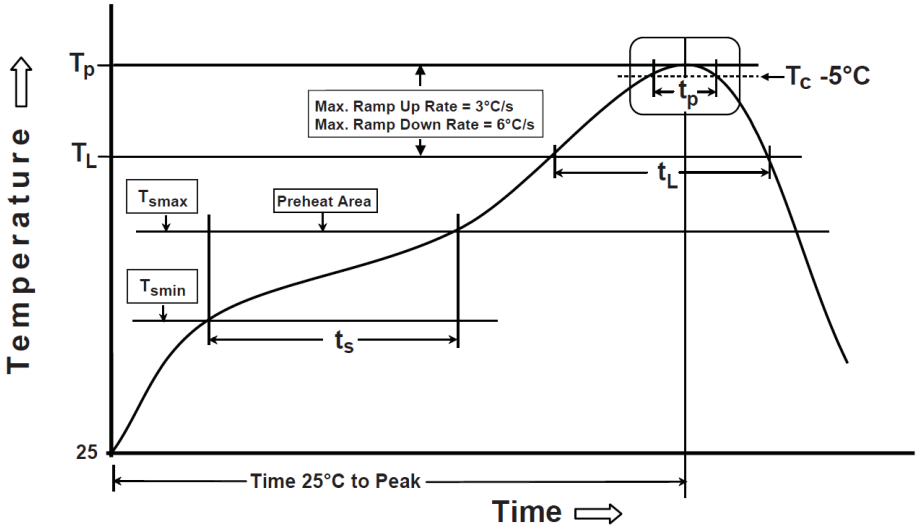
All plastic packages absorb moisture. During typical solder reflow operations when SMDs are mounted onto a PCB, the entire PCB and device population are exposed to a rapid change in ambient temperature. Any absorbed moisture is quickly turned into superheated steam. This sudden change in vapor pressure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

ISP130301 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.

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

7. Quality & User information

Certifications

- FCC Identifier 2AAQS-ISP130301 – Certificate N° 142180643/AA/00
- CE: Complies with 1999/5/EC, EN300328 V1.8.1, Statement N° 142140199/AA/00
- IC Certification N° 11306A-ISP130301 – Telefication N° 142170180/AA/00
- TELEC certification N° 001 – A03467
- Bluetooth SIG certified N° D024444
- RoHS compliant

USA – User information

This intends to inform how to specify the FCC ID of our module “ISP130301” 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-ISP130301”.
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.”

CANADA – User information

This intends to inform how to specify the IC ID of our module “ISP130301” 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-ISP130301”.
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:

“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.”

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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.

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.

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