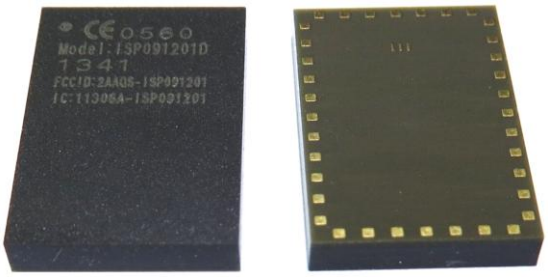
ISP091201
Bluetooth Low Energy Module with Integrated Antenna

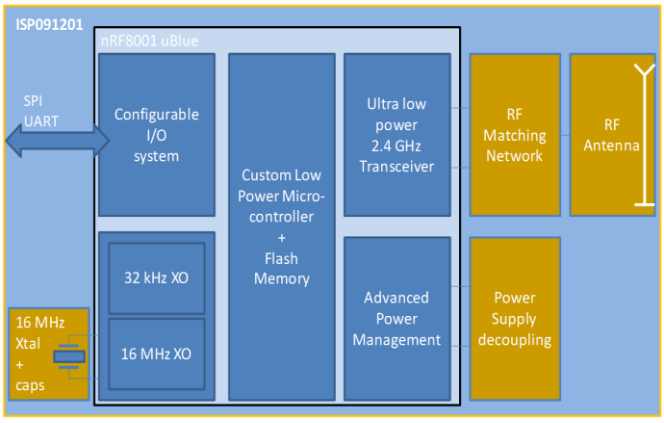


Key Features

- Single Mode BLE v4.0 Slave
- Nordic Semiconductor µBlue products based
- Includes transceiver, baseband, software stack
- Ultra Low Power Consumption
- Single 1.9 to 3.6 V supply
- Very small size 8.0 x 12.0 x 1.5 mm
- Temperature -40 to 85 °C
- Fully integrated RF matching and Antenna
- Integrated 16 MHz Crystal Clock

Certifications

- FCC Limited Modular Certification
- Complies with CE
- Complies with IC
- 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 Nordic Semiconductor nRF8001 µBlue Bluetooth Low Energy Platform. The nRF8001 is a single chip transceiver with an embedded baseband protocol engine, suitable for ultra low power wireless applications conforming to the Bluetooth Low Energy Specification contained within v4.0 of the overall Bluetooth specification. The nRF8001, used in the current revision of ISP091201, is a production product using a RoM for the baseband protocol engine.

The µBlue transceiver is specifically designed for both PC peripherals and ultra low power applications such as sports and wellness sensors. For sensor applications, the ultra low power consumption and advanced power management enables battery lifetimes up to several years on a coin cell battery.

The ISP091201 module size measures 8 x 12 x 1.5 mm. The module integrates all the decoupling capacitors, the 16 MHz crystal and load capacitors plus the RF matching circuit and antenna in addition to the transceiver. As the module has several end applications, the antenna was designed to be compatible with several ground plane sizes including that of a USB dongle and a cell phone. The module can operate as a standalone Bluetooth sensor node with the addition of a transducer, a small external microprocessor to run application software, a 32 kHz crystal and a DC power source.

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Contents

1. Electrical Specifications

Electrical Performance

Temperature range -40 to +85 °C

Parameter	Value	Unit
Supply voltage		
Min. Supply Voltage	1.9	V
Current consumption		
Static levels		
Peak current, receiver active	14.6	mA
Peak current, transmitter active	12.7	mA
Current drain, connection-less state	0.5	µA
Current drain between connection events	2	µA

Pin Assignment

Pin	Name	Pin function	Description
1 – 5	NC	Not Connected	Isolated pad on application PCB for mechanical stability
6	OUT_ANT	Antenna In/Out	This pin is connected to the internal antenna. It should be connected to Pin 7 OUT_MOD for normal operation. During certification the pin may be connected to an RF connector for antenna measurement
7	OUT_MOD	Module In/Out	This pin is the RF I/O pin of the BLE module. It should be connected to Pin 6 OUT_ANT for normal operation. During certification the pin may be connected to an RF connector for module measurement using a Bluetooth test setup
8	GND	Ground	Should be connected to ground plane on application PCB
9	NC	Not Connected	Isolated pad on application PCB for mechanical stability
10	MOSI	Digital input	ACI Master Out Slave In

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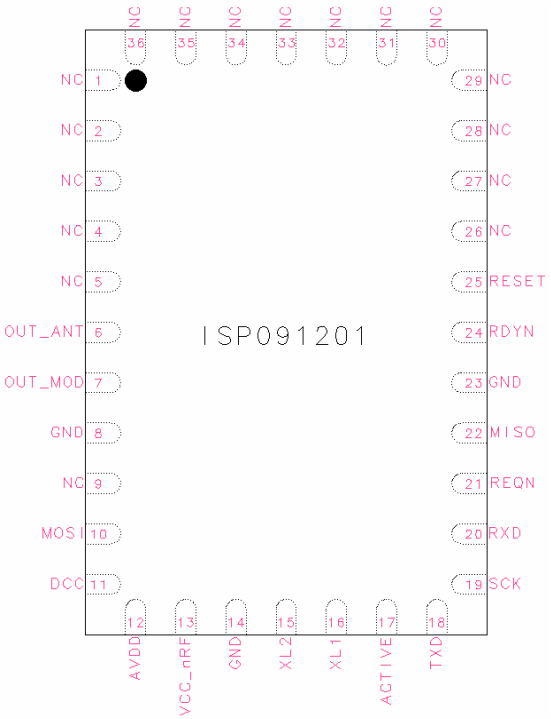
Pin	Name	Pin function	Description
11	DCC	PWM driver	PWM driver for the external LC filter if the DC/DC converter is enabled. If the DC/DC converter is disabled this pin shall be not connected
12	AVDD	Power	Analog power supply (1.9 – 3.6V DC)
13	VCC_nRF	Power	Power supply (1.9 – 3.6V) Supplies the DC/DC converter and GPIOs. VDD in nRF8001 doc
14	GND	Ground	Should be connected to ground plane on application PCB
15	XL2	Analog output	Connect to external 32.768kHz crystal oscillator (if internal RC oscillator is enabled then leave not connected)
16	XL1	Analog output	Connect to external 32.768kHz crystal oscillator (if internal RC oscillator is enabled then leave not connected)
17	ACTIVE	Digital output	Device RF front end activity indicator
18	TXD	Digital output	UART (transmit) for Bluetooth low energy Direct Test Mode
19	SCK	Digital input	ACI clock input
20	RXD	Digital output	UART (receive) for Bluetooth low energy Direct Test Mode
21	REQN	Digital input	ACI request pin (handshaking, active low)
22	MISO	Digital output	ACI Master In Slave Out
23	GND	Ground	Should be connected to ground plane on application PCB
24	RDYN	Digital output	ACI device ready indication (handshaking)
25	RESET	Digital Input	Reset (Active Low)
26-36	NC	Not Connected	Isolated pad on PCB for mechanical stability



ISP091201 pin assignment
for the LGA QFN package

TOP VIEW

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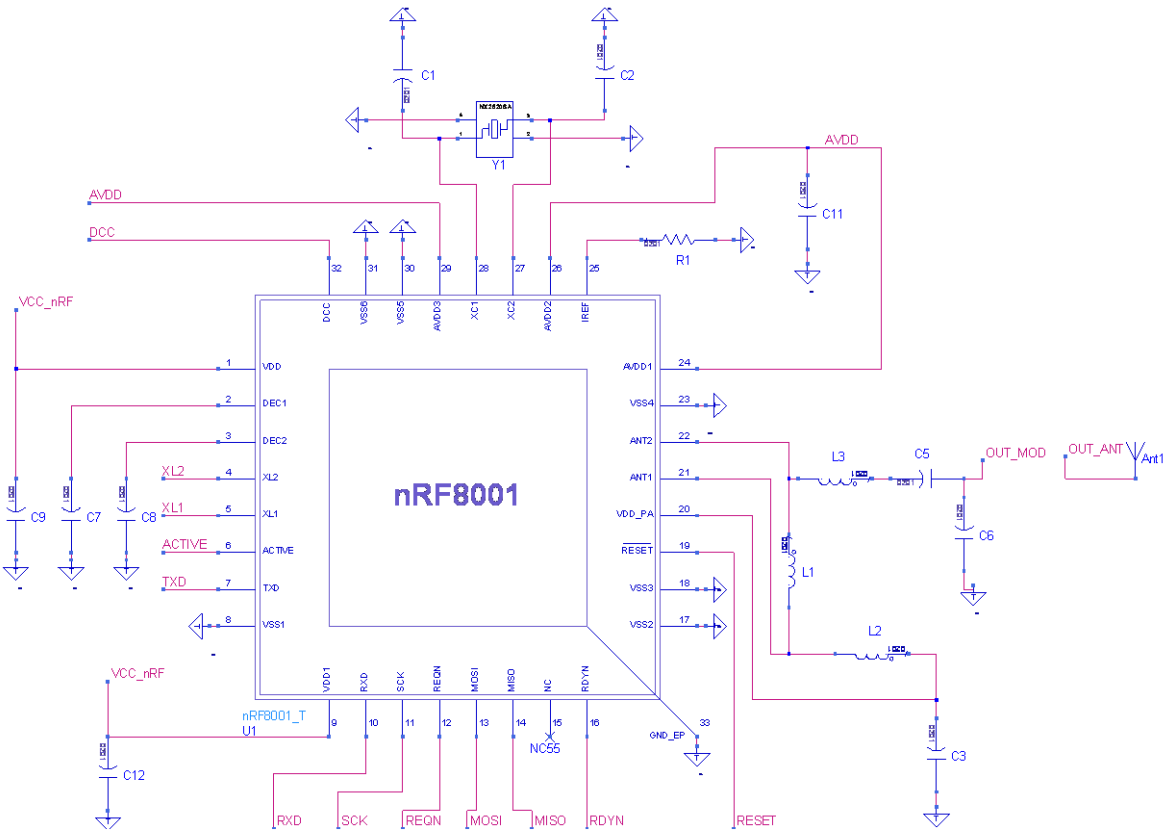
Electrical Schematic

Electrical schematic showing ISP091201 module connections



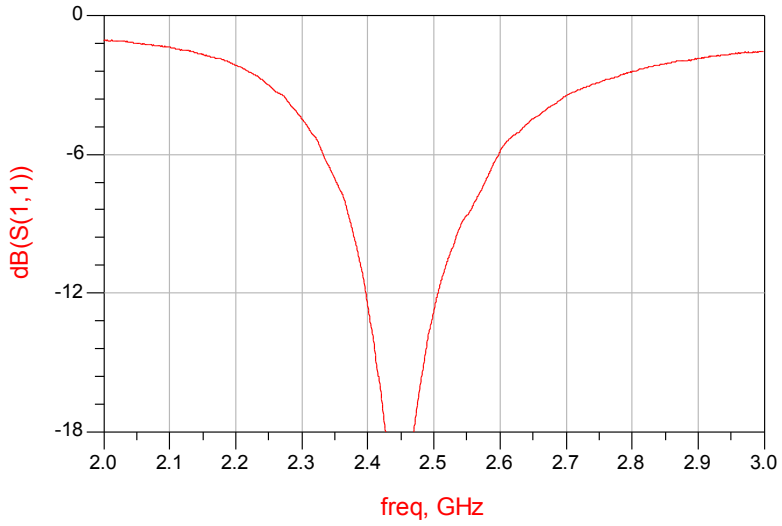
2. RF Performances

RF Specifications according to standards

Parameter	Value	BT V4 Std limit	Unit	Condition
Output Power	-0.9	-20 to 10	dBm	Channels 0 to 39
RF Frequency tolerance	Better than +/-20	+/- 50	Hz	Channels 0 to 39
Rx sensitivity	-87	-70	dBm	Level for BER <0,1% ideal Tx
Max range	> 20		m	Open field @1m height
EIRP	0.3		dBm	
Antenna Gain	1.2		dBi	
Rx sensitivity	56.8		dBµV/m	

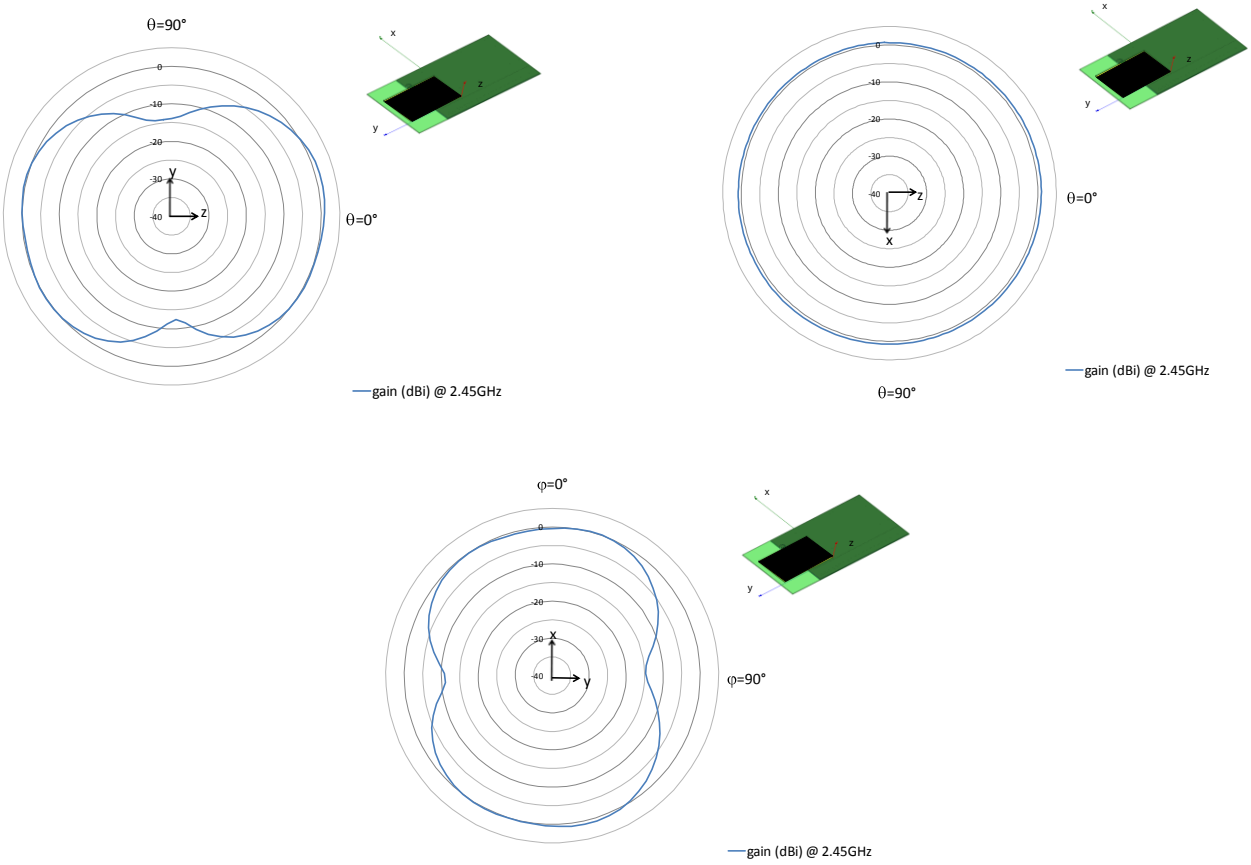
Typical Antenna Return Loss

Module mounted on a USB dongle ground plane

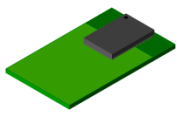


Radiation Pattern in 3 planes

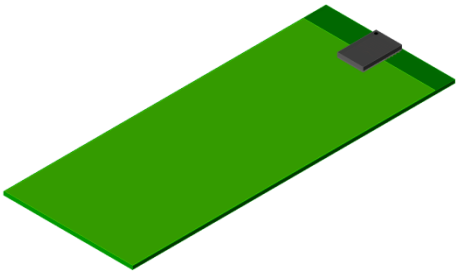
Module mounted on a USB dongle ground plane



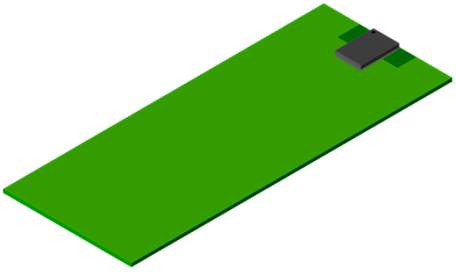
Ground Plane Effect Simulation



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)

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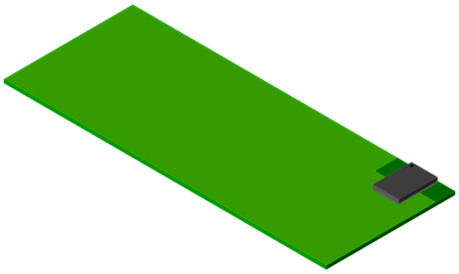
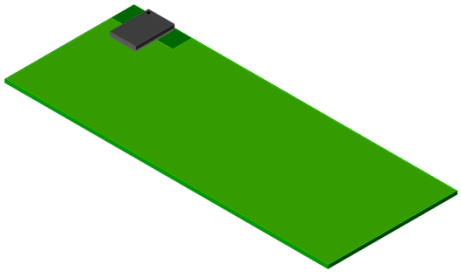
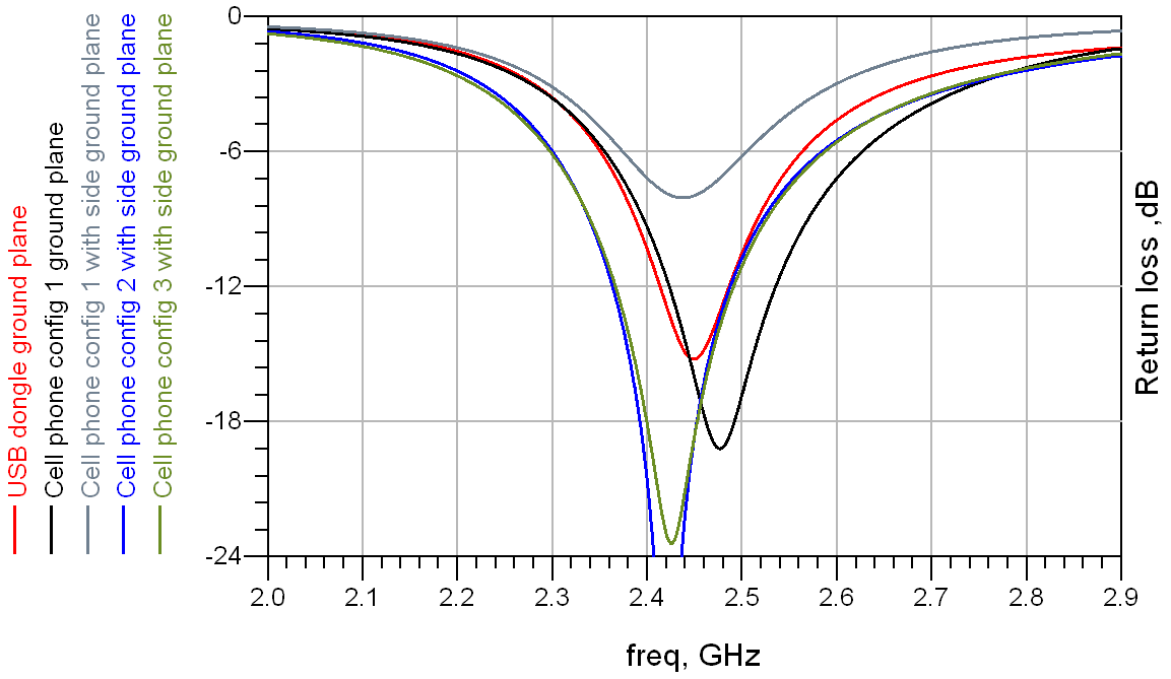


Cell phone config 2 with side ground plane
(size : 40 x 100 mm²)



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



3. Product Development Tools

Interface

As ISP091201 is designed for operation in the peripheral role, it offers you an easy way to add Bluetooth low energy connectivity to your application. ISP091201 integrates a serial interface (ACI) for configuration and control from your microcontroller. In the following, the microcontroller is referred to as the application controller.

The Application Controller Interface (ACI) is the logical interface between ISP091201 and your application. ACI is a bidirectional serial interface that enables generic application controllers to set up and operate nRF8001 integrated in ISP091201.

Hardware

The following development kits are recommended for using and testing ISP091201 module:

- Nordic Semiconductor nRFgo Starter Kit (nRF6700), need to be purchased separately
- Nordic Semiconductor nRF80001 Development Kit (nRF8001-DK), need to be purchased separately
- Insight SiP Development Kit (ISP091201-DK1), need to be purchased separately

Development Tools and Software

The following development tools and software are recommended for using and testing ISP091201 module:

- ACI commands and events are defined in nRF8001 Data Sheet downloadable for free from www.nordicsemi.com
- Nordic Semiconductor Software Development Kit for nRF8001 (nRF8001-SDK, downloadable from www.nordicsemi.com after purchasing nRF8001-DK): give access to software source code examples
- Nordic Semiconductor nRFgo Studio (downloadable from www.nordicsemi.com after purchasing nRFgo Starter Kit nRF6700)
- Nordic Semiconductor Master Control Panel (downloadable from www.nordicsemi.com after purchasing nRF8001-DK)
- IDE compatible with your chosen microprocessor. As ISP091201 is designed for operation in the peripheral role, it offers you an easy way to add Bluetooth low energy connectivity to your application. ISP091201 integrates a serial interface (ACI) for configuration and control from your microcontroller. In the following, the microcontroller is referred to as the application controller.

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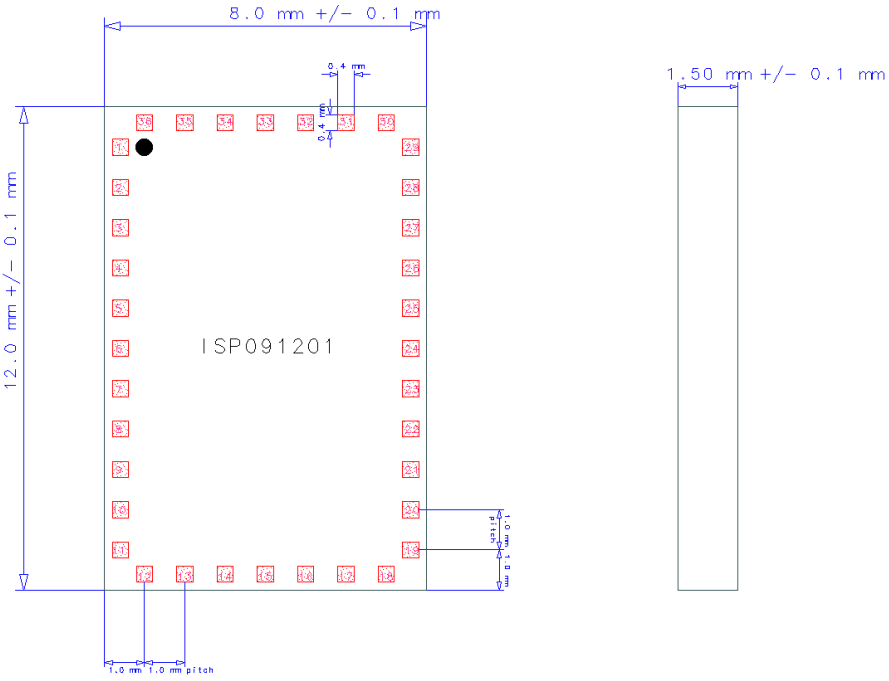
4. Mechanical Outlines

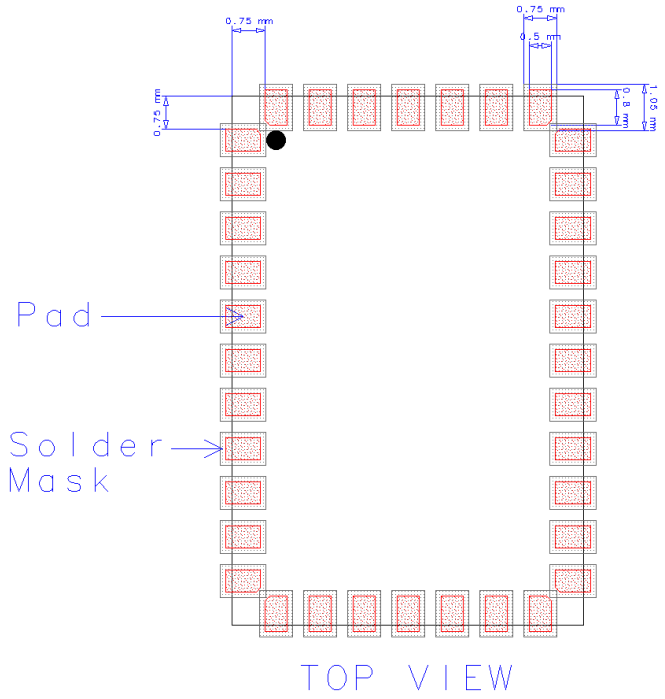
Mechanical Dimensions

Dimensional drawing for 8 x 12 x 1.5 mm, 36-Pad LGA Package



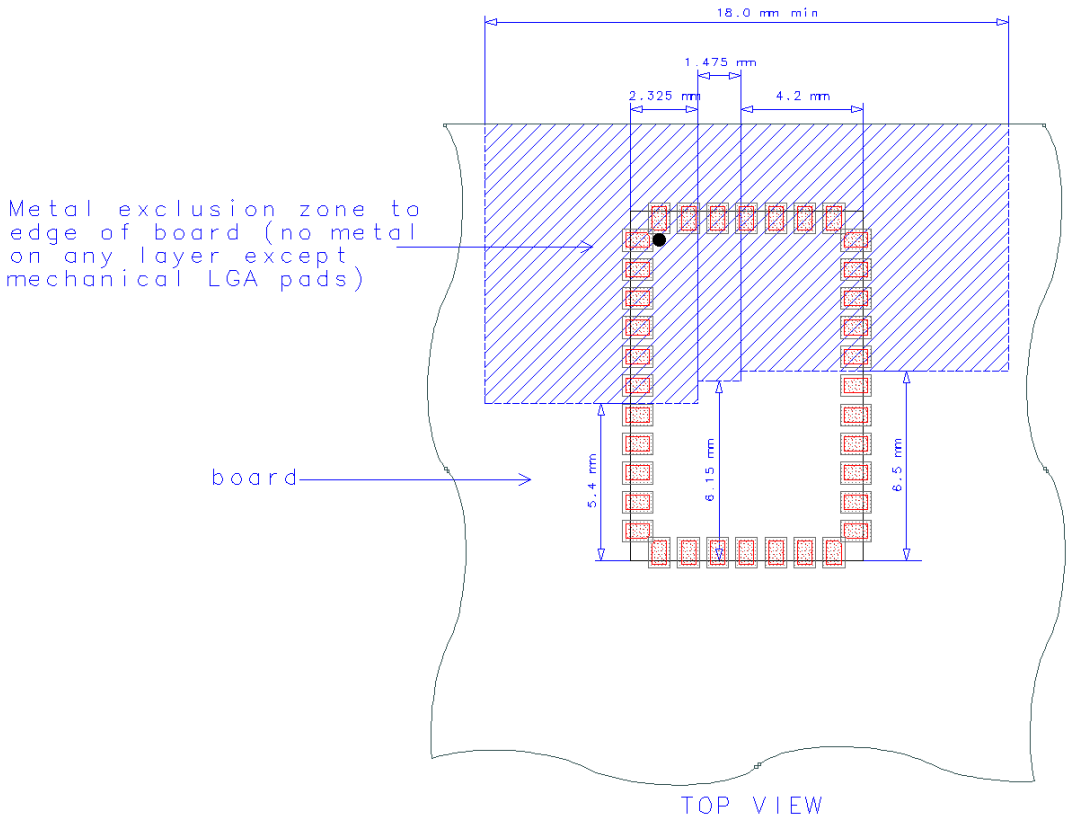
SMT Assembly Guidelines

Recommended PCB Land Pattern and Solder Mask layout



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. Quality & User information

Certifications

- FCC Limited Modular Certification 15.212 FCC #2AAQS-ISP091201
- CE: Complies with Directive 1999/5/EC statement N° 13214144/AA/00
- Canada: IC # 11306A-ISP091201
- Bluetooth SIG certified #B017595
- RoHS compliant

FCC grant conditions

ISP091201 is certified under FCC part 15.212 with “Limited Modular Approval”.

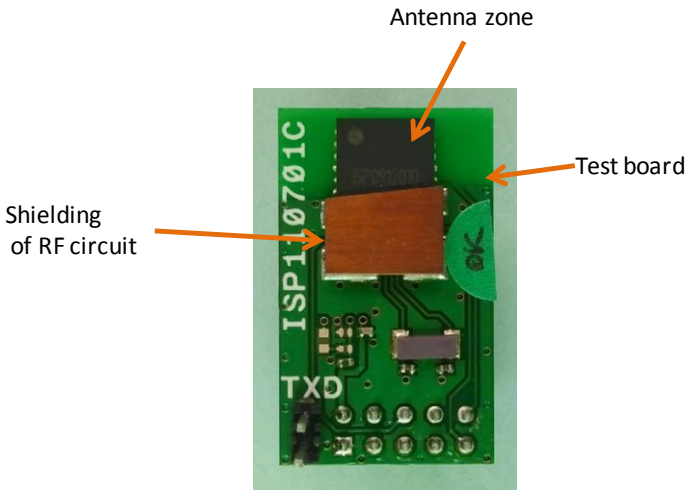
This approval is limited to hosts that use the additional metal shield ISP091205 that is delivered with ISP091201, since certification has been carried out in this way. This ensures that the radio portion of the circuit is fully shielded on all sides with the exception of the antenna access. The module itself contains the lower ground plane so it is not necessary to have a continuous plane under the module in the host.

The ISP091201 is labeled with its own FCC identification number: FCC ID: xxx-ISP091201, when installed into host the outside of the host must display a label with the wording:

“Contains FCC ID xxx-ISP091201” as specified by the CFR47 part15.212 (a – VI)

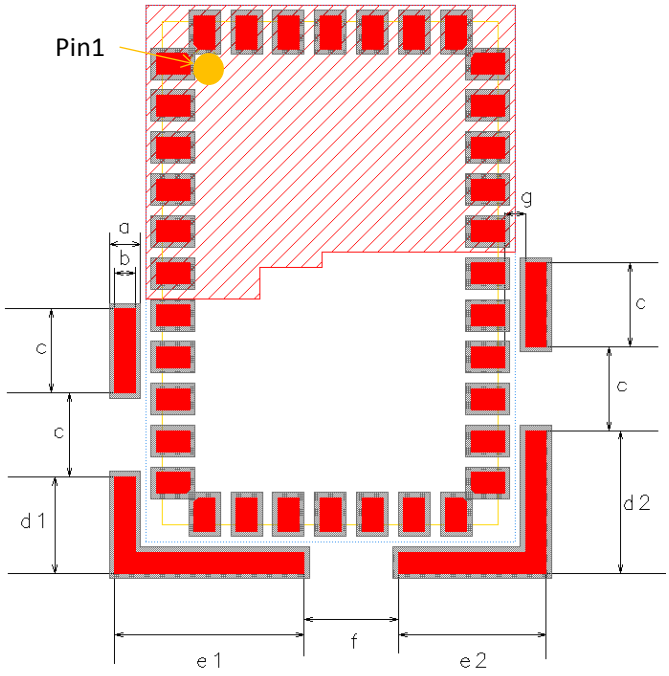
In order to respect FCC regulation, additional metal shield ISP091205 must be implemented following the recommendation below. Note that shield installation is only related to FCC compliance. It has absolutely no influence on the module performance and the ISP091201 can operate according to the present specification with or without the shield.

- Shield installation as used for FCC part 15.212 certification tests

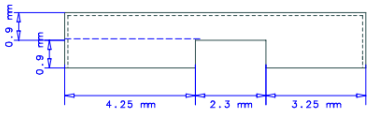


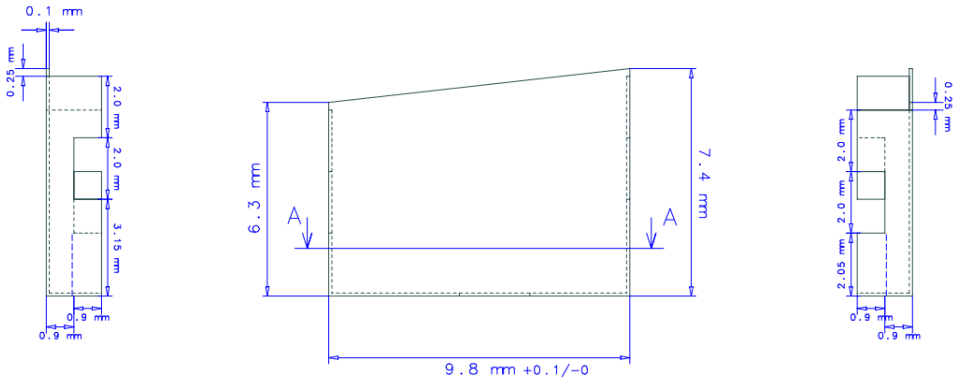
Shield installation land pattern

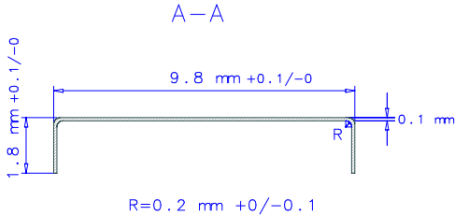
Para-meter	Description	Value in µm
a	Shield SM aperture	750
b	Shield metal trace width	500
	SM registration (a-b)/2	125
g	Module pad edge to shield trace edge	500
c		2000
d1		2300
d2		3400
e1		4525
e2		3525
f		2250



Mechanical drawing of the shield ISP091205







USA – User information

This intends to inform how to specify the FCC ID of our module “ISP091201” 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-ISP091201”.
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 “ISP091201” 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-ISP091201”.
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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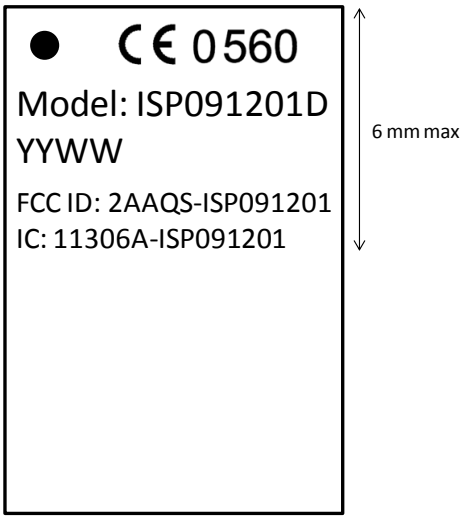
6. Packaging & Storage

Label location

The labels are permanently laser marked following the nearby figure:



Package marking

I	S	P	0	9	1	2	0	1	D
Y	Y	W	W						

ISP091201	Product number
D	Hardware version
YY	Two digit year number
WW	Two digit week number

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.