

ISP2554

Preliminary Data Sheet

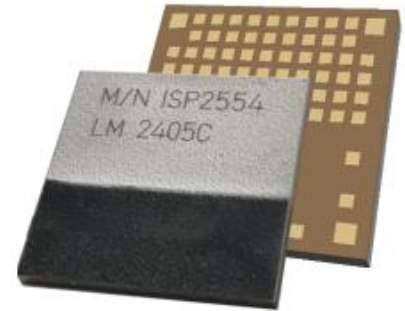


Bluetooth 6.0 Low Energy Module

Supporting Bluetooth Mesh, Thread and Matter

With built-in MCU & Antenna

This ultra-compact LGA module, 8 x 8 x 1.2 mm, is based on the ultra-low power nRF54LM20B chip, with integrated Axon NPU, that offers a multi-protocol radio and advanced security features. With its powerful Cortex-M33 processor, expanded memory and new set of peripherals, combined with Insight SiP capability for best-in-class antenna design, this module provides the perfect solution for drop-in Bluetooth connectivity.



Key Features

- Multi-protocol 2.4GHz Ultra Low Power
- Bluetooth 6.0 Mesh, Thread, Matter
- Very small-size 8.0 x 8.0 x 1.2 mm
- NFC-A Tag for OOB pairing in option
- Fully integrated RF matching and Antenna
- RF Transceiver based on Nordic Semiconductor nRF54LM20B
- Integrated 32 MHz, 32 kHz Clock
- Enhanced edge AI capabilities thanks to integrated Axon NPU
- Arm Cortex-M33 128MHz with TrustZone technology
- NVM 2MB / RAM 512 KB
- Up to 47 GPIOs with wide range of peripherals including High speed USB, QDEC
- -40° to +85°C
- +8dBm Tx power / -95.5dBm Rx sensitivity
- DC/DC converter with load circuit
- Single 1.7 to 3.6 V supply
- Interfaces SPI, QSPI, I2C, I2S, UART, PWM, PDM, USB



Applications

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

Pending Certifications

- Bluetooth SIG
- CE
- FCC, IC
- TELEC, KCC
- RoHS and Reach compliant
- Conflict Mineral Declaration



Document Revision History

Revision	Date	Ref	Change Description
R0	10/09/2026	pj cr	Preliminary release

Contents

1.	Block Diagram & Features	4
2.	Specifications.....	5
2.1.	General Notice	5
2.2.	Absolute Maximum Ratings.....	5
2.3.	Operating Conditions.....	5
2.4.	Power Consumption.....	6
2.5.	Clock Sources.....	6
2.6.	Radio Specifications.....	6
2.7.	Antenna Performance	7
2.8.	Electrical Schematic.....	9
3.	Pin Description	11
4.	Mechanical Outlines	14
4.1.	Mechanical Dimensions	14
4.2.	SMT Assembly Guidelines.....	15
4.3.	Antenna Performance	15
5.	Product Development Tools	16
5.1.	Hardware.....	16
5.2.	Firmware.....	16
5.3.	Development Tools	16
6.	Package & Ordering Information.....	17
6.1.	Marking.....	17
6.2.	Package Labelling.....	17
6.3.	Prototype Packaging.....	18
6.4.	Jedec Trays.....	18
6.5.	Tape and Reel.....	18
6.6.	Ordering Information.....	19
7.	Storage and Soldering Information.....	20
7.1.	Storage and Handling.....	20
7.2.	Moisture Sensitivity.....	20
7.3.	Soldering information	21
8.	Quality and User information.....	22
8.1.	Pending Certifications.....	22
8.2.	Disclaimer	22

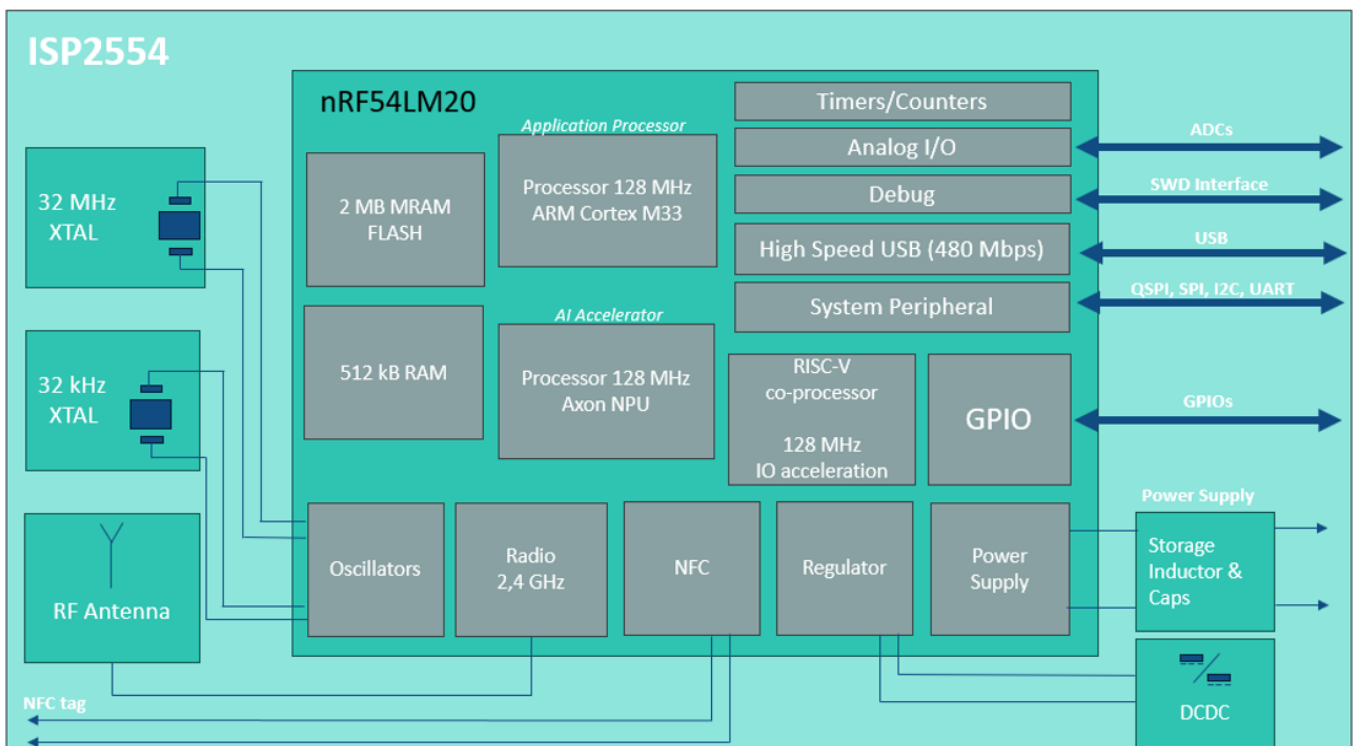
1. Block Diagram & Features

This module is based on nRF54LM20B Nordic Semiconductor 2.4GHz wireless System on Chip (SoC) integrating a 2.4 GHz transceiver, an ARM Cortex -M33 with TrustZone technology, RRAM and RAM memory, analog and digital peripherals.

The Axon NPU AI Accelerator is available on the ISP2554.

It can support BLE, Mesh and a range of proprietary 2.4 GHz protocols. Fully qualified stacks for nRF54 are freely available for operating in Central role, Peripheral role, Scanning and Advertising.

The Cyber Resilience Act (CRA) is embodied in the EU regulation 2024/2847. ISP2554 rely on microprocessors that have been designed with Platform Security Architecture (PSA) certification in mind. It is certified to PSA Level 3. This level of platform security reduces the risks of vulnerabilities occurring. Ultra-low power consumption and advanced power management enable battery lifetimes up to several years on a coin cell battery. Even though its very small-size 8 x 8 x 1.2 mm, the module integrates, in addition to the wireless SoC, all required decoupling and load capacitors, DC-DC converter, 32 MHz crystal, 32.768 kHz crystal, RF matching circuit and antenna.



Only the addition of a suitable DC power source is necessary for module connectivity. Sensor applications require the further addition of appropriate sensors. The antenna was designed to be optimized with several standard ground plane sizes. When NFC function is available, the NFC tag antenna can be connected externally.

2. Specifications

2.1. General Notice

The electrical specifications of the module are directly related to the Nordic Semiconductor specifications for nRF54LM20 chipset. The information below is only a summary of the main parameters. For more detailed information, especially concerning current consumption, please refer to the up-to-date specifications of the chipset available from Nordic Semiconductor.

Note that the current Nordic Semiconductor datasheet is preliminary and many parameters are still to be defined (TBD):

[nRF54LM20B ultra-low-power wireless SoC - nordicsemi.com](https://www.nordicsemi.com)

2.2. Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit
Supply Voltage respect to ground - VCC	-0.3		3.9	V
USB Supply Voltage respect to ground – VBUS	-0.3		6.0	V
IO Pin Voltage VIO VCC ≤3.6V	-0.3		VCC+0.3	V
IO Pin Voltage VIO VCC >3.6V	-0.3		3.9	V
RF Input Level			10	dBm
NFC Antenna pin current		80	130	mA
Storage Temperature	-40		+125	°C
Moisture Sensitivity Level			1	-
ESD Human Body Model			2	kV
ESD Charged Device Model			250	V
Flash Endurance			10000	Cycles
Retention at 85°C			10	years

2.3. Operating Conditions

Parameter	Min	Typ	Max	Unit
Operating Supply Voltage, independent of DCDC enable	1.7		3.6	V
VBUS Supply Voltage	3.67	5.0	5.5	V
Industrial Operating Temperature Range	-40	+25	+85	°C

2.4. Power Consumption

Parameter	Min	Typ	Max	Unit
RX only run current, 1 Mbps/1 Mbps Bluetooth LE mode ⁽¹⁾		3.3		mA
TX current, Transmitter active 0 dBm Output Power ⁽²⁾		5.0		mA
TX current, Transmitter active +8 dBm Output Power ⁽²⁾		10.9		mA
System OFF, no RAM retention, wake on Pin		0.7		μA
System ON, 32 KB RAM retention, wake on Pin		1.1		μA
System OFF, GRTC and LFXO active, no RAM retention, wake on Pin		1.0		μA
System ON, GRTC and LFXO active, 512 KB RAM retention, wake on Pin		4.3		μA

(1) DCDC enable, Power supply 3V, 1 Mbps

(2) DCDC enable, Power supply 3V

2.5. Clock Sources

Reference clocks	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	+/- 40	ppm
Internal Low Frequency Clock for BLE Synchronization: RC Oscillator (2)	+/- 40	ppm

(1) Including initial tolerance, drift, aging, and frequency pulling

(2) Frequency tolerance after calibration assuming frequent calibration

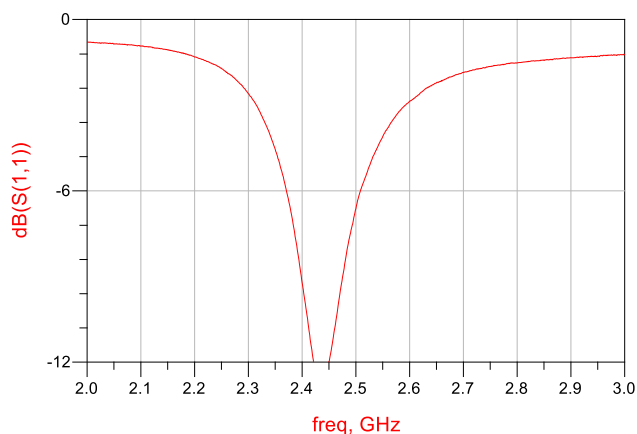
2.6. Radio Specifications

Transmit Frequency Error	Min	Typ	Max	Unit
Frequency Range	2400		2500	Mhz
Output Power Channels 0 to 39	-8		+8	dBm
Rx Sensitivity Level, BLE1 Mbps		-95.5		dBm
Rx Sensitivity Level, BLE125 kbps		-103		dBm
Antenna Gain		0.6		dBi
EIRP	-7.4		8.6	dBm
Range Open field @1m height 1Mbps no coding		60		m
Data Rate	1000 / 2000 / 500 and 125			kbps

2.7. Antenna Performance

Typical Antenna Return Loss

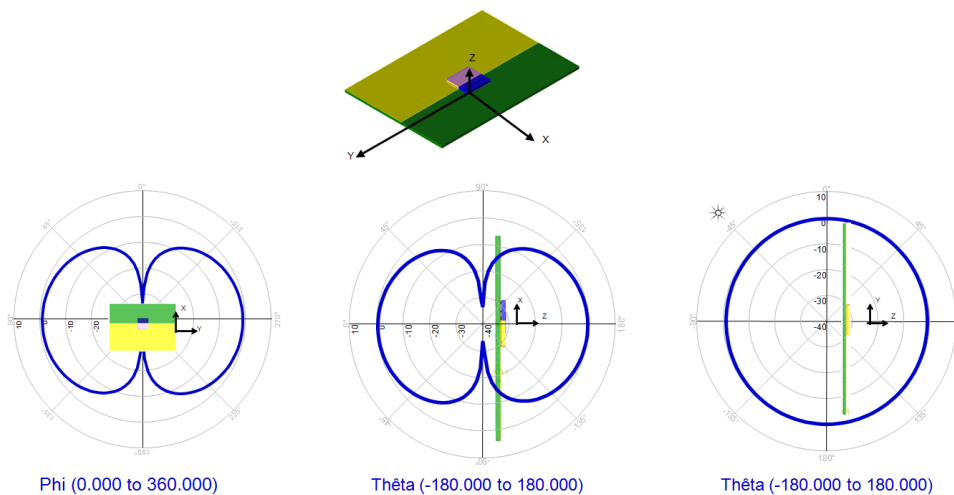
Module mounted on a
USB dongle ground plane



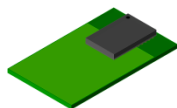
Radiation Pattern in 3 planes

Module mounted on a USB
dongle ground plane

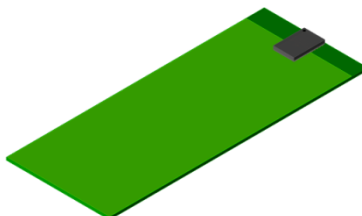
Gain measurement
in dBi in the BLE band
from 2.4 to 2.5 GHz.



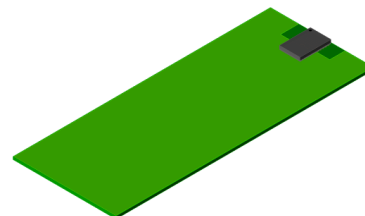
Ground Plane Effect Simulation



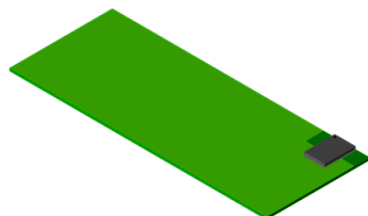
USB dongle
ground plane
(size: 18 x 30 mm²)



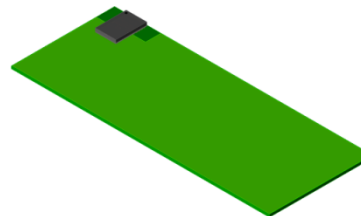
Cell phone config 1
ground plane
(size: 40 x 100 mm²)



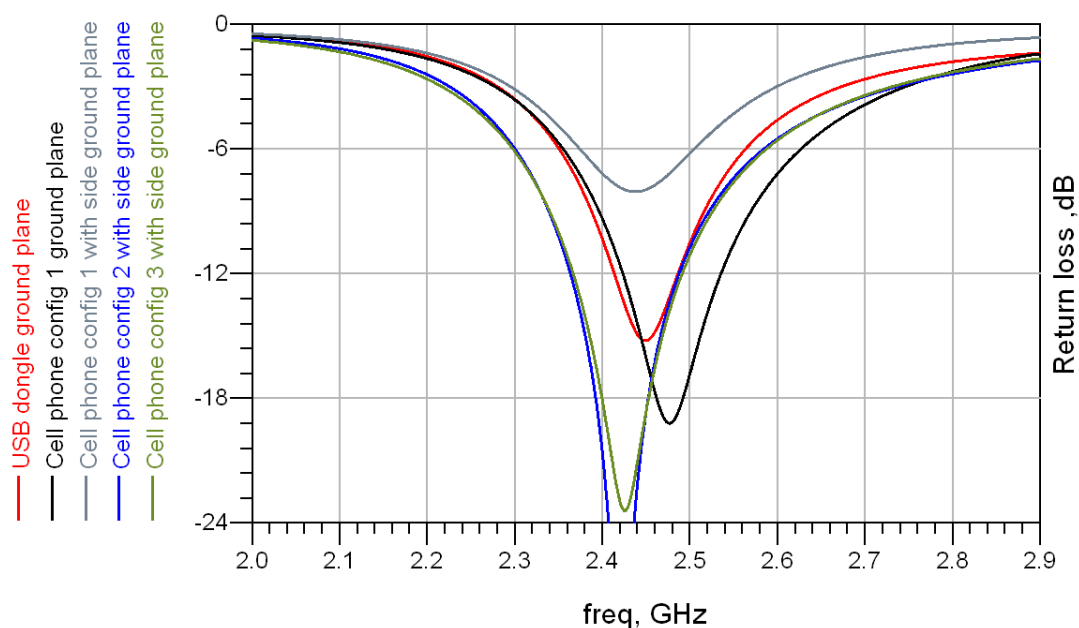
Cell phone config 1 with
side ground plane
(size: 40 x 100 mm²)



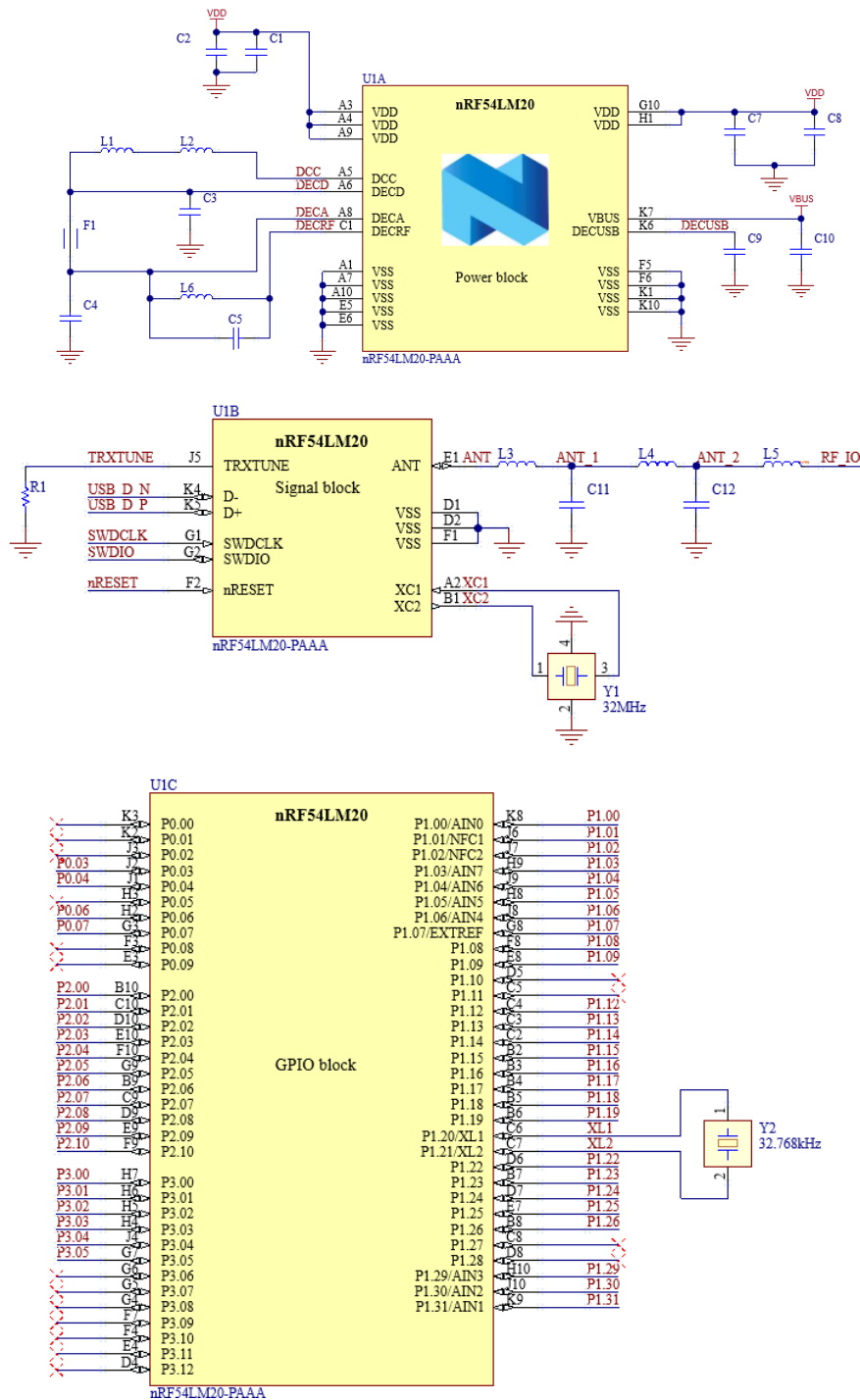
Cell phone config 2 with
side ground plane
(size: 40 x 100 mm²)



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

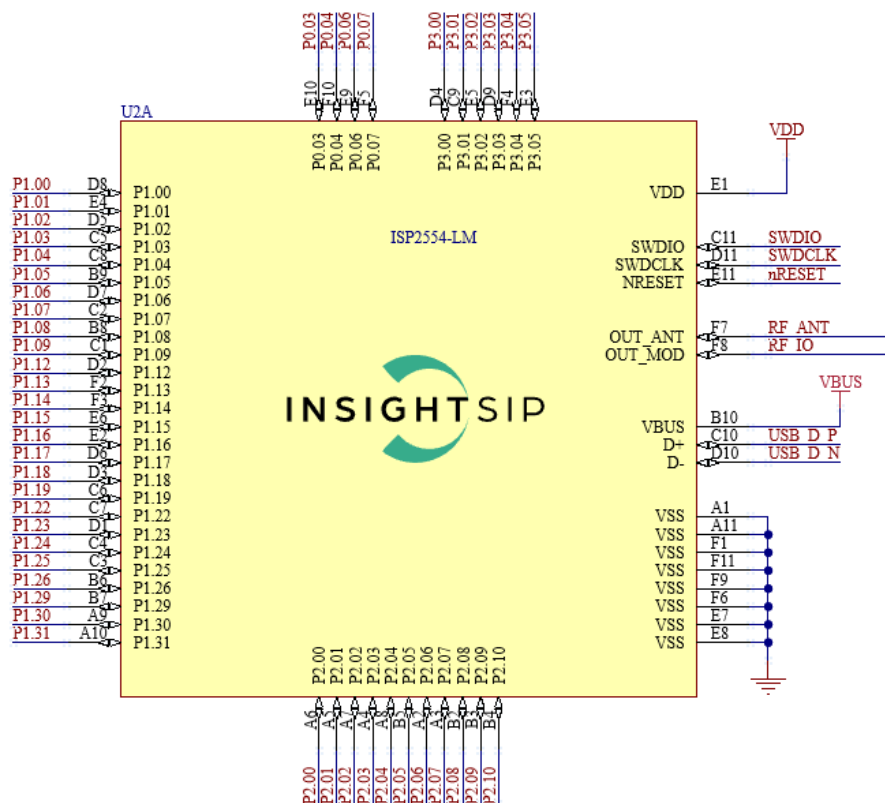


2.8. Electrical Schematic



ISP2554

Preliminary Data Sheet



Normal
Operation
F7 connected to
F8



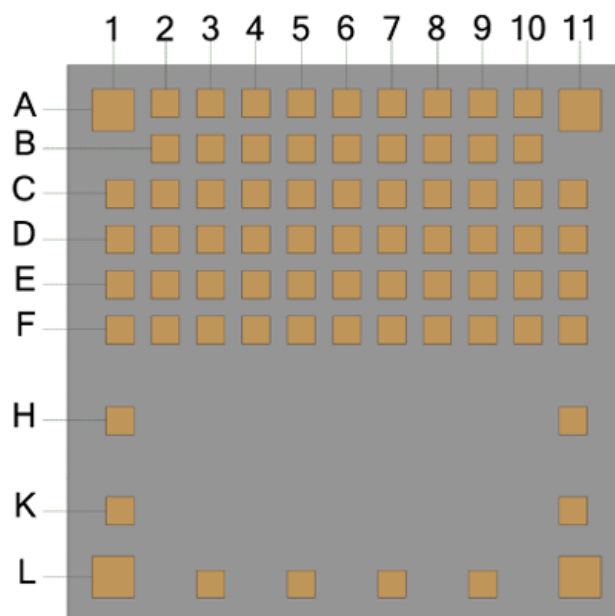
3. Pin Description

The module uses an LGA format with a full matrix of 8 x 8 pads on a 0.65mm pitch, large corner pads for mechanical attachment and non-connected pins at the periphery of the antenna zone. Non-Connected pads must be connected to isolated metal pads on the application PCB.

Pin	Name	Pin Function	Description
A1	GND	Ground	Pin should be connected to PCB ground
A2	P2.06	Digital I/O	General purpose I/O
A3	P2.07	Digital I/O	General purpose I/O
A4	P2.03	Digital I/O	General purpose I/O
A5	P2.01	Digital I/O	General purpose I/O
A6	P2.00	Digital I/O	General purpose I/O
A7	P2.02	Digital I/O	General purpose I/O
A8	P2.04	Digital I/O	General purpose I/O
A9	P1.30	Digital I/O	General purpose I/O with analog functionality
A10	P1.31	Digital I/O	General purpose I/O with analog functionality
A11	GND	Ground	Pin should be connected to PCB ground
B2	P2.08	Digital I/O	General purpose I/O
B3	P2.09	Digital I/O	General purpose I/O
B4	P2.10	Digital I/O	General purpose I/O
B5	P2.05	Digital I/O	General purpose I/O
B6	P1.26	Digital I/O	General purpose I/O
B7	P1.29	Digital I/O	General purpose I/O with analog functionality
B8	P1.08	Digital I/O	General purpose I/O
B9	P1.05	Digital I/O	General purpose I/O with analog functionality
B10	VBUS	Power	Power input to VREGUSB 5V
C1	P1.09	Digital I/O	General purpose I/O
C2	P1.07	Digital I/O	General purpose I/O with analog functionality
C3	P1.25	Digital I/O	General purpose I/O
C4	P1.24	Digital I/O	General purpose I/O
C5	P1.03	Digital I/O	General purpose I/O with analog functionality
C6	P1.19	Digital I/O	General purpose I/O
C7	P1.22	Digital I/O	General purpose I/O
C8	P1.04	Digital I/O	General purpose I/O with analog functionality
C9	P3.01	Digital I/O	General purpose I/O
C10	D_P	USB	USB +
C11	SWDIO	Debug	Serial wire debug I/O for debug and programming

Pin	Name	Pin Function	Description
D1	P1.23	Digital I/O	General purpose I/O
D2	P1.12	Digital I/O	General purpose I/O
D3	P1.18	Digital I/O	General purpose I/O
D4	P3.00	Digital I/O	General purpose I/O
D5	P1.02	Digital I/O	General purpose I/O
D6	P1.17	Digital I/O	General purpose I/O
D7	P1.06	Digital I/O	General purpose I/O with analog functionality
D8	P1.00	Digital I/O	General purpose I/O
D9	P3.03	Digital I/O	General purpose I/O
D10	D_N	USB	USB -
D11	SWDCLK	Debug	Serial wire debug clock input for debug and programming
E1	VDD	Power	Power supply. Module is supplied with 1.8V
E2	P1.16	Digital I/O	General purpose I/O
E3	P3.05	Digital I/O	General purpose I/O
E4	P1.01	Digital I/O	General purpose I/O
E5	P3.02	Digital I/O	General purpose I/O
E6	P1.15	Digital I/O	General purpose I/O
E7	GND	Ground	Pin should be connected to PCB ground
E8	GND	Ground	Pin should be connected to PCB ground
E9	P0.06	Digital I/O	General purpose I/O
E10	P0.03	Digital I/O	General purpose I/O
E11	nRESET	Reset	Pin RESET with internal pull-up resistor
F1	GND	Ground	Pin should be connected to PCB ground
F2	P1.13	Digital I/O	General purpose I/O
F3	P1.14	Digital I/O	General purpose I/O
F4	P3.04	Digital I/O	General purpose I/O
F5	P0.07	Digital I/O	General purpose I/O
F6	GND	Ground	Pin should be connected to PCB ground
F7	OUT_ANT	Antenna	Antenna connection. This pin should be connected to OUT_MOD for normal operation.
F8	OUT_MOD	RF In/Out	Connection to RF. This pin should be connected to OUT_ANT for normal operation.
F9	GND	Ground	Pin should be connected to PCB ground
F10	P0.04	Digital I/O	General purpose I/O
F11	GND	Ground	Pin should be connected to PCB ground
H1-L11	Not Connected	Floating	Isolated pad on application PCB for mechanical stability

ISP2554 Pinout Top View

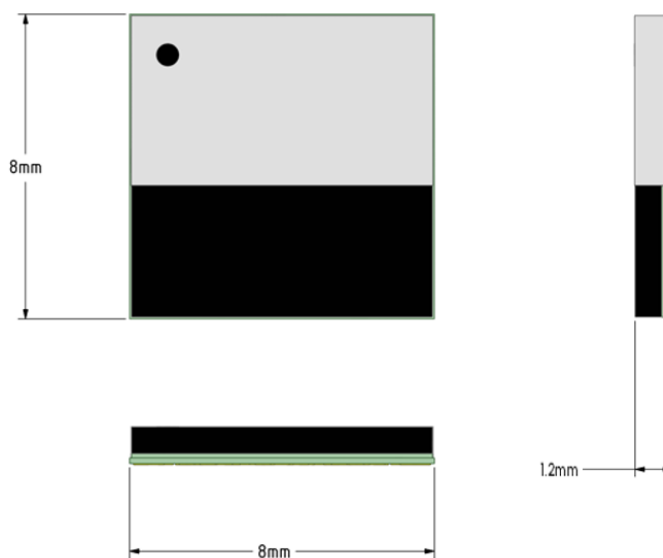


ISP2554 pad placement and pin assignment for the LGA QFN package TOP VIEW

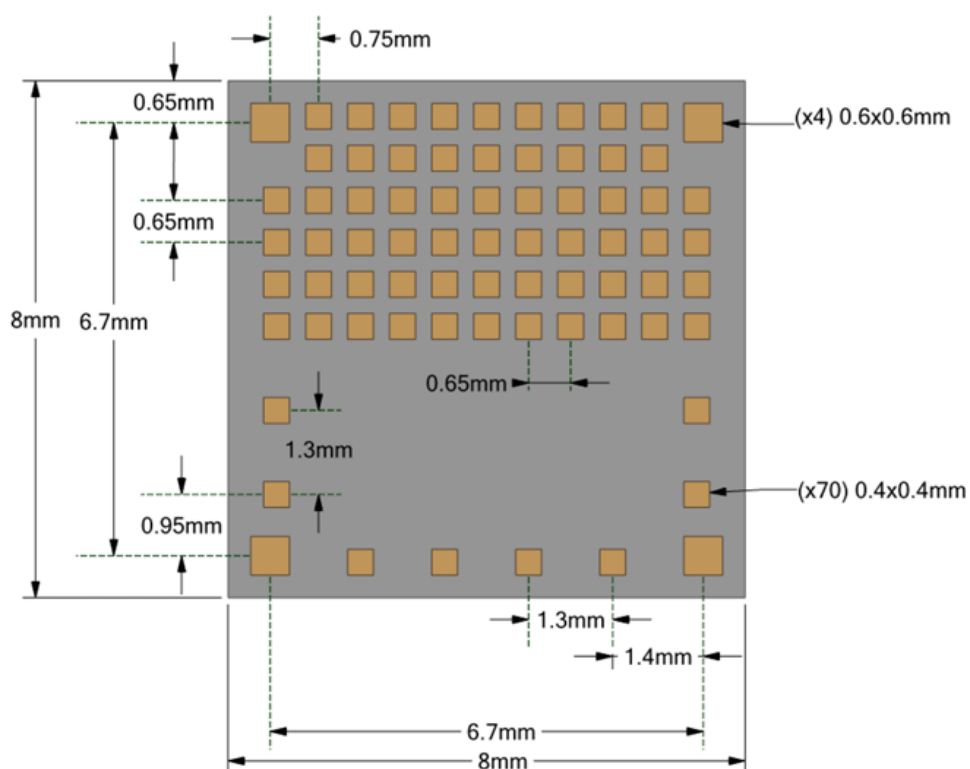
4. Mechanical Outlines

4.1. Mechanical Dimensions

Package dimensions



Dimensional drawing for 74-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.

For implementations in which most or all of the inner pads are used Insight SiP recommends the use of capped vias placed in the center of each pad.

For standard PCB types (no micro vias - all vias are top to bottom): we use nominal 0.4mm catch pads with 0.2mm vias. The vias should be plugged and capped to avoid solder wicking.

For HDI PCB types having micro vias on a layer-by-layer basis: we use 0.25mm catch pads and 0.1mm copper filled laser vias. Ideally the via is centered in the pad.

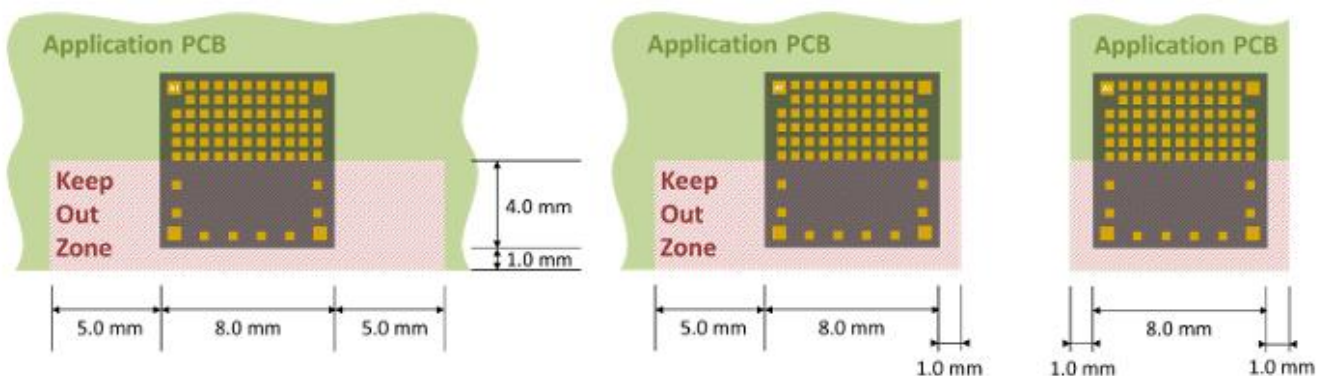
For reduced pinout implementations we recommend using external pads only. The use of a small number of internal pads can be accommodated by placing normal vias in the center of the device. In this case only the required pads should be Solder Mask opened and the vias tented with solder mask to prevent short circuits.

Please contact Insight SiP for more detailed information.

4.3. Antenna Performance

For optimal antenna performance, the module should be placed 1 mm from the PCB edge. And 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.

When the module is placed on a large PCB dimension, 5mm lateral keep out zone is recommended. But when the PCB size is smaller, it is possible to place the module in either corner and reduce the lateral keep out zone as described below.



5. Product Development Tools

5.1. Hardware

In order to assist clients in developing their Bluetooth Smart solutions based on the ISP2554, Insight SiP offers an Evaluation Board containing:

- One Interface Board with an integrated Segger J-Link.
- One Test Board

Using this evaluation board, product developers have a working solution as a starting point to develop their own products. Time to market is saved by avoiding starting from a blank sheet of paper.

5.2. Firmware

ISP2554 uses the nRFConnect SDK from Nordic Semiconductor running zephyr RTOS. The SDK supplies examples and is an ideal starting point for firmware development. More information can be found on Nordic Semiconductor website.

5.3. Development Tools

The following development tools and software are recommended for using and testing ISP2554 module:

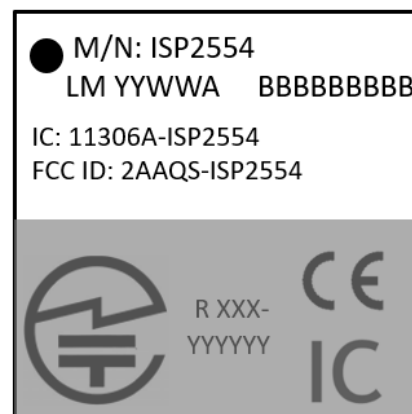
- nRFConnect SDK
- Microsoft Visual Studio Code.

6. Package & Ordering Information

6.1. Marking

M	/N	:	I	S	P	2	5	5	4										
T	T		Y	Y	W	W	R		B	B	B	B	B	B	B	B	B	B	B

ISP2554	Part Number
TT	2 letters Module Version
YY	2 digits year number
WW	2 digits week number
R	1 letter Hardware revision
BBBBBBBBBB	10 characters Build code

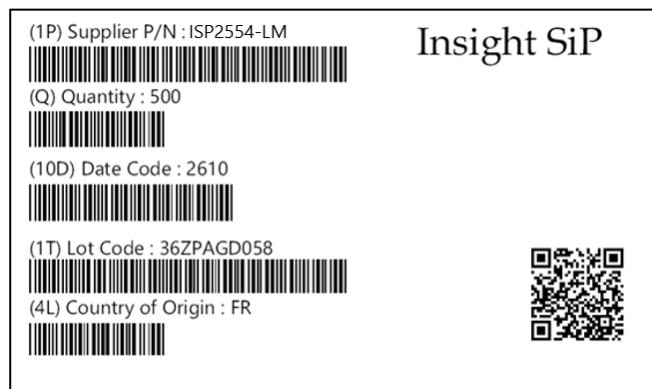


Certification labels for CE, FCC, IC and Telec are printed directly on the module when applicable.

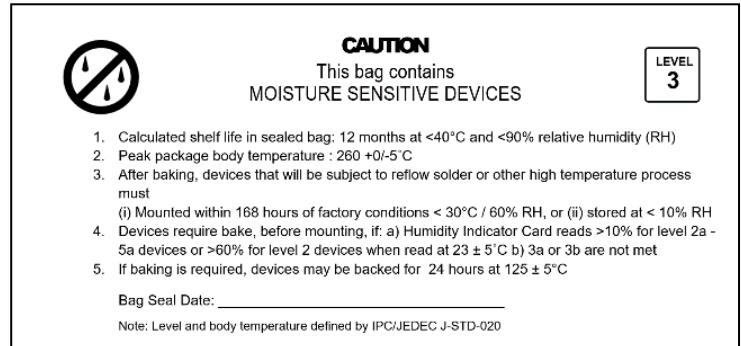
6.2. Package Labelling

A label indicating the Module Part Number, Quantity, Date Code, Lot Code and Country of Origin is applied to the bag, the reel and the box, whichever is applicable.

Information is available with bar code 1D according to Code 39 and bar code 2D according to Data Matrix ECC 200 from ECIA standard.



A second label on the bag is present to indicate the MSL level and packaging date.



6.3. Prototype Packaging

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

They are delivered in vacuumed 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.

6.4. Jedec Trays

For pre-production volumes, ISP2554 are available in Jedec trays.

They are delivered in vacuumed sealed pack with desiccant pack and humidity sensors. These Jedec trays are also suitable for further baking at 125°C. Please see section 7.2 for more information on moisture sensitivity. Please order with "JT" code packaging suffix.

Complete information on Jedec trays is available on request.

6.5. Tape and Reel

ISP2554 are also available in Tape & Reel. They are delivered in vacuumed sealed pack with desiccant pack and humidity sensors. Reels are proposed in standard quantities of 500 units (180mm / 7" reel). Please order with "RS" code packaging suffix for 500-unit reel.

This packaging is not suitable for high temperature baking.

Reels are packed in a box of approximately 220 x 220 x 50 mm.

Tape and reel drawings are available on request.

6.6. Ordering Information

I

S

P

2

5

5

4

-

T

T

-

Z

Z

I

S

P

2

5

5

4

-

L

M

E

B

-

T

B

-

S

T

-

J

T

-

R

S

Part Number

Version based on nRF54LM20B

Evaluation Board

Test board

Standard Tray

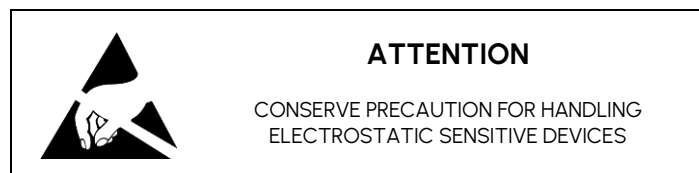
Jedec Tray Packaging

Reel of 500 units

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 Cl₂, H₂S, NH₃, SO₂, or NO_X
 - 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

ISP2554 has been tested MSL-3 according to standards

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.

To prevent such failures, baking is mandatory before assembly under the following conditions (per JEDEC standards J-STD-033 and J-STD-020):

- The vacuum-sealed moisture barrier bag has been stored for more than 12 months from the date of sealing.
- The moisture barrier bag seems to be damaged or the humidity indicator card shows humidity levels above the acceptable threshold.
- The bag has been opened, and the components have been exposed to ambient conditions (approximately <=30°C/60% RH) for more than 168 hours.

In case one the above condition is true, please follow the baking instructions below before assembly:

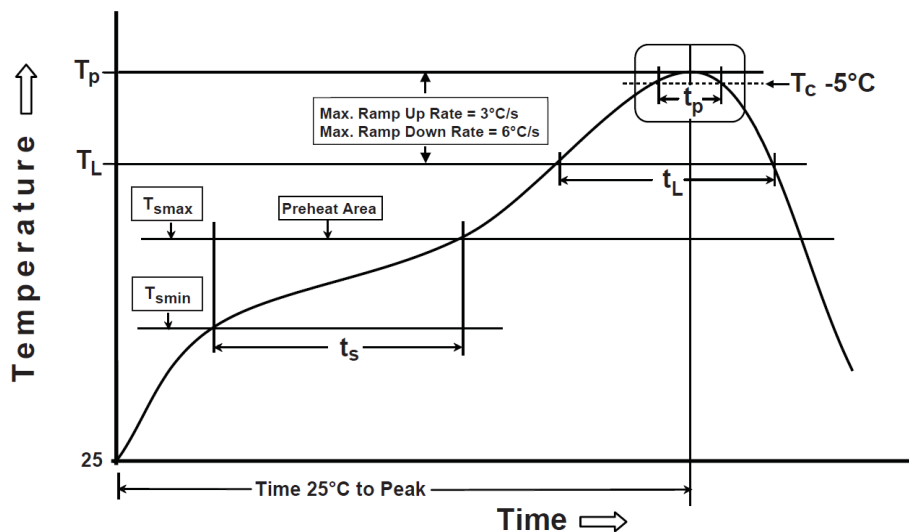
- Remove the modules from the reels, place them in trays or plates capable of withstand elevated temperatures
- Bake them at 125°C for 24 hours (Minimum required bake time for MSL3 components with 1 mm thickness before assembling is 8 hours according to JEDEC J-STD-033D in table 4-1)

After baking, modules can be handled at room conditions (approximately $\leq 30^{\circ}\text{C}/60\% \text{ RH}$) for up to 168 hours before assembly.



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

Peak package body temperature (T_p)	260°C (+0/-5°C)
Classification Temperature (T_c)	260 °C
Time (t_p) maintained above $T_c - 5^{\circ}\text{C}$	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. Pending Certifications

The following certifications are planned:

- Bluetooth SIG
- CE
- EN300328 V2.2.2
- FCC Certified (Part 15.247)
- ISED Certified (RSS-247)
- Japan: TELEC
- RoHS3 compliant
- Reach compliant
- Minerals responsible initiative compliant

8.2. 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.