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INGE808-NA Smart Module

INGENICO INGE808-NA Smart Module User Guide

Contents

INGENICO INGE808-NA Smart Module

Applicability Type

NO.	Product Model	Description
1	INGE808-NA	2GB+16GB eMCP, Applicable to North America

FCC Statement

Federal Communication Commission Interference Statement

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.
3. Since FCC Rule §15.203, requires the use of a permanently attached antenna or of an antenna that uses a unique coupling.

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 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 fromthat to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution:

1. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and the maximum antenna gain allowed for use with this device is 5dBi.

2. The transmitter module may not be co-located with any other transmitter or antenna.As long as 2 conditions above are met, further transmitter test 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.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: XKB-INGE808NA". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Innovation, Science and Economic Development Statement

1. 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.
2. This Class B digital apparatus complies with Canadian ICES-003.
3. This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter, except tested built-in radios.
4. The County Code Selection feature is disabled for products marketed in the US/ Canada.

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

End Product Labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC: 2586D-INGE808NA". The grantee's IC can be used only when all ISED compliance requirements are met.

Antenna Requirements

This transmitter module(IC: 2586D-INGE808NA) requires antennas of specifications of Chapter 7.5 Antenna Design of this document.Generally,50 ohm impedance is required and S11 is recommended less than -10 dB,the recommended antenna gain should be no bigger than 5 dBi.Antenna types that do not meet these requirement are strictly prohibited for use with this device.

Introduction

Instruction

This document describes the electrical characteristics, RF performance, structure size, application environment, etc. of the module. With the assistance of this document and other instructions, the developers can quickly understand the hardware functions of the module and develop products.

Reference Standards

- 3GPP TS 51.010-1 V10.5.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification
- 3GPP TS 34.121-1 V10.8.0: User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification
- 3GPP TS 36.521-1 V10.6.0: User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing
- 3GPP TS 21.111 V10.0.0: (U)SIMand IC card requirements
- 3GPP TS 51.011 V4.15.0: Specification of the Subscriber IdentityModule -Mobile Equipment ((U)SIM-ME) interface
- 3GPP TS 31.102 V10.11.0: Characteristics of the Universal Subscriber IdentityModule ((U)SIM) application
- 3GPP TS 31.11 V10.16.0: Universal Subscriber Identity Module ((U)SIM) Application Toolkit (USAT)
- 3GPP TS 36.124V10.3.0: Electro Magnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment
- 3GPP TS 27.007 V10.0.8: AT command set for User Equipment (UE)
- 3GPPTS27.005 V10.0.1: Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
- IEEE 802.11nWLAN MAC and PHY, October 2009+ IEEE 802.11-2007WLAN MAC and PHY, June 2007
- IEEE Std 802.11b, IEEE Std 802.11d, IEEE Std 802.11e, IEEE Std 802.11g, IEEE Std 802.11i:
- IEEE 802.11-2007WLAN MAC and PHY, June 2007
- Bluetooth Radio Frequency TSS and TP Specification 1.2/2.0/2.0+EDR/2.1/2.1+EDR/3.0/3.0+HS, August 6,

2009

- Bluetooth Low Energy RF PHY Test Specification, RF-PHY.TS/4.0.0, December 15, 2009

Product Overview

Product Introduction

The smart module integrates core components such as Baseband, eMCP, PMU, Transceiver, PA. It supports long multimode communication such as FDD/TDD-LTE,WCDMA, andWIFI/BT short- distance radio transmission technology, as well as GNSS wireless positioning technology. The module is embedded with Android operating system and supports various interfaces such as MIPI/USB/UART/SPI/I2C. It is the optimal solution for the core system of wireless smart products. Its corresponding network modes and frequency bands are as follows:

Table 2-1 Support bands

Mode	Band
GSM/GPRS/EDGE	GSM850/EGSM900/PCS1900
WCDMA	Band 1/2/4/5/8
FDD-LTE	Band 2/4/5/7/12/13/17/25/26/66
TDD-LTE	Band 41(2496-2690MHz)
WIFI	2402-2482 MHz;5170-5835MHz
BT	2402-2480 MHz
GNSS	GPS

Product Specification

The module is available in 232 LCC+LGA package that includes 148 LCC pins and 84 LGA pins. The dimension is 41mm×41mm×2.80mm. It can be embedded in various M2M applications. It is suitable for the development of smart devices such as smart POS, cash registers, robots, UAVs, smart homes, security monitoring and multimedia terminals. Its detailed performance is shown in the following table:

Table 2-2 Main performance

Performance	Description	
Power	DC 3.5~4.2V, typical voltage: 3.8V	
Application CPU	Arm Cortex-A53 microprocessor cores, 64-bit processor, Quad-core (1.3 GHz)	
Memory	2GB LPDDR3+16 GB eMMC flash	INGE808-NA
Power class	Class 4 (33dBm±2dB) for GSM850/900 Class 1 (30dBm±2dB) for PCS 1900 Class E2 (27dBm±3dB) for GSM850/900 8-PSK Class E2 (26dBm+3/-4dB) for PCS 1900 8-PSK Class 3 (24dBm+1/-3dB) for WCDMA bands Class 3 (23dBm±2dB) for LTE FDD bands Class 3 (23dBm±2dB) for LTE TDD bands	
GSM/GPRS/EDGE features	R99: CSD transmission rate: 9.6kbps, 14.4kbps GPRS: Support GPRS multi-slot class 33 Coding formats: CS-1/CS-2/CS-3 and CS-4 5 Rx time slots per frame maximum EDGE: Support EDGE multi-slot class 33 Support GMSK and 8-PSK Uplink encoding format: CS 1-4 and MCS 1-9 Downlink encoding format: CS 1-4 and MCS 1-9	
WCDMA features	Support 3GPP R8 DC-HSPA+ Support 16-QAM, 64-QAM and QPSK modulation CAT6 HSUPA: Maximum uplink rate 5.76Mbps CAT24 DC-HSPA+: Maximum downlink rate 42Mbps	
LTE features	Support FDD/TDD CAT4 Support 1.4-20M RF bandwidth Downlink support multi-user MIMO Maximum uplink rate 50Mbps, maximum downlink rate 150Mbps	

Performance	Description
WLAN features	Support 2.4G and 5G WLAN wireless communication, support 802.11a, 802.11b, 802.11g, 802.11n and 802.11ac, the maximum rate up to 433Mbps
Bluetooth features	BT4.2 (BR/EDR+BLE)
Satellite positioning	GPS
Physical characteristics	Dimension: 41mm×41mm×2.80mm Encapsulation: 148 LCC pin + 84 LGA pin Weight: About 9.3g
Temperature range	Operating temperature: -25°C~75°C 1) Storage temperature: -40°C~85°C
Software update	USB/OTA/SD
RoHS	RoHS Compliant

Note:

1. When the module is operating within this temperature range, the functions of it are normal and the relevant performance meets the 3GPP standard.

WIFI and Bluetooth

WIFI Overview

The module supports 2.4G and 5GWLAN wireless communications and 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac standards, with a maximum speed up to 433Mbps. Its characteristics are as follows:

- SupportWake-on-WLAN (WoWLAN)
- Support ad hoc mode
- SupportWAPI
- Support AP mode
- SupportWi-Fi Direct
- Support MCS 0-7 for HT20 and HT40 (If you need to open 2.4GWIFI 40M, you need to configure the ini file, it is not recommended to use)
- Support MCS 0-8 for VHT20
- SupportMCS 0-9 for VHT40 and VHT80

WIFI Performance

Test condition 3.8V power supply, environment temperature 25°C

Table 6-1WIFI transmits power

Frequency	Mode	Date Rate	Bandwidth(MHz)	TX Power(dBm)
2.4G	802.11b	1Mbps	20	17.0±3
		11Mbps	20	17.0±3
	802.11g	6Mbps	20	16.0±3
		54Mbps	20	13.0±3
	802.11n	MCS0	20	15.0±3
		MCS7	20	12.0±3
		MCS0	40	15.0±3
		MCS7	40	12.0±3

Frequency	Mode	Date Rate	Bandwidth(MHz)	TX Power(dBm)
5G	802.11a	6Mbs	20	19.0±3
		54Mbps	20	16.0±3
	802.11n	MCS0	20	18.0±3
		MCS7	20	15.0±3
		MCS0	40	17.0±3
		MCS7	40	14.0±3
	802.11ac	MCS0	20	17.0±3
		MCS8	20	14.0±3
		MCS0	40	16.0±3
		MCS9	40	13.0±3
		MCS0	80	15.0±3
		MCS9	80	12.0±3

Table 6-2WIFI RX sensitivity

Frequency	Mode	Date Rate	Bandwidth (MHz)	Sensitivity(dBm) 2)
2.4G	802.11b	1Mbps	20	-92.0
		11Mbps	20	-88.0
	802.11g	6Mbps	20	-89.0
		54Mbps	20	-72.0
	802.11n	MCS0	20	-85.0
		MCS7	20	-70.0
		MCS0	40	-82.0
		MCS7	40	-67.0
5G	802.11a	6Mbps	20	-89.0

Frequency	Mode	Date Rate	Bandwidth (MHz)	Sensitivity(dBm) 2)
		54Mbps	20	-72.0
	802.11n	MCS0	20	-86.0
		MCS7	20	-70.0
		MCS0	40	-83.0
		MCS7	40	-67.0
	802.11ac	MCS0	20	-88.0
		MCS8	20	-66.0
		MCS0	40	-85.0
		MCS9	40	-61.0
		MCS0	80	-82.0
		MCS9	80	-55.0

Note:

- The sensitivity here is a typical value

Bluetooth Overview

The module supports BT4.2 (BR/EDR+BLE) standards. The modulation method supports GFSK, 8- DPSK and π/4-DQPSK.BR/EDR. Channel bandwidth is 1MHz and can accommodate 79 channels. The BLE channel bandwidth is 2MHz and can accommodate 40 channels. Its main features are as follows:

- BT 4.2+BR/EDR+BLE

- Support for ANT protocol
- Support for BT-WLAN coexistence operation, including optional concurrent receive
- Up to 3.5 piconets (master, slave and page scanning)

Table 6-3 BT rate and version information

Version	Date Rate	Throughput	Note
BT1.2	1Mbit/s	> 80Kbit/s	NA

Version	Date Rate	Throughput	Note
BT2.0+EDR	3Mbit/s	> 80Kbit/s	NA
BT3.0+HS	24Mbit/s	Refer to 3.0+HS	NA
BT4.2 LE	24Mbit/s	Refer to 4.2 LE	NA

Bluetooth Performance

Table 6-4 BT performance index

Type	DH-5	2-DH5	3-DH5	Unit
Transmitter	9±2.5	8±2.5	8±2.5	dBm
Sensitivity	-88	-88	-84	dBm

GNSS

Overview

The smartmodule supports multiple positioning systems including GPS. The module is embedded with LNA which can effectively improve the sensitivity of GNSS.

GNSS Performance

Test condition 3.8V power supply, environment temperature 25°C.

Table 7-1 GNSS positioning performance

Parameter	Description	Type Result	Unit
Sensitivity	Acquisition	-145	dBm
	Tracking	-156	dBm
C/N	-130dBm	39	dB-Hz
TTFF	Cold Start	44	s
	Warm Start	40	s
	Hot Start	2.5	s
CEP	Static accuracy(95%@- 130dBm)	5	m

Antenna Interface

The module supports 2G/3G/4G main antenna/diversity reception antenna,WIFI/BT antenna and GNSS antenna.

TRX/DRX Antenna

The module provides two 2G/3G/4G antenna interfaces. The ANT_TRX is used to receive and transmit RF signal, the ANT_DRX is used for diversity reception.

Table 4-1 TRX/DRX antenna interface definition

Pin Name	Pin #	I/O	Description	Note
ANT_TRX	94	AI/AO	2G/3G/4G antenna	NA
ANT_DRX	132	AI	Diversity reception antenna	NA

Operating Band

Table 4-2 Module operating band

Mode	Band	Tx (MHz)	Rx (MHz)
GSM	850	824~849	869~894
	900	880~915	925~960
	1900	1850~1910	1930~1990
WCDMA	Band 1	1920~1980	2110~2170
	Band 2	1850~1910	1930~1990
	Band 4	1710~1755	2110~2155
	Band 5	824~849	869~894
	Band 8	880~915	925~960
LTE FDD	Band 2	1850~1910	1930~1990
	Band 4	1710~1755	2110~2155

Mode	Band	Tx (MHz)	Rx (MHz)
	Band 5	824~849	869~894
	Band 7	2500~2570	2620~2690
	Band 12	698~716	728~746
	Band 13	777~787	746~756
	Band 17	704~716	734~746
	Band 25	1850~1915	1930~1995
	Band 26	814~849	859~894
	Band 66	1710~1780	2110~2180
LTE TDD	Band 41	2496~2690	2496~2690

Circuit Reference Design

When use the module, it is necessary to connect the antenna pin with the RF connector or antenna feed point on the main board via an RF trace. Microstrip trace is recommended for RF trace, with insertion loss within 0.2dB and impedance at 50ohms. A π-type circuit is reserved between the module and the antenna connector (or feed point) for antenna debugging. Two parallel components are directly connected across the RF trace and should not pull out a branch, as the figure shows:
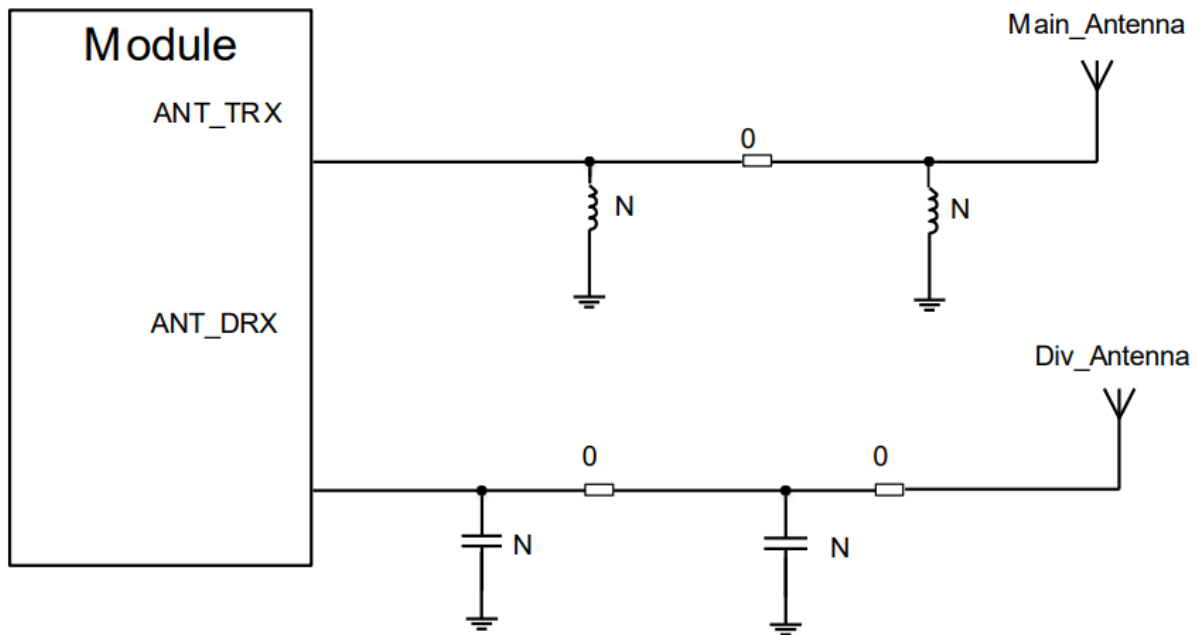
Figure 4-1 TRX/DRX antenna reference design

WIFI/BT Antenna

Microstrip trace is recommended for theWIFI/BT RF route, with insertion loss within 0.2dB and impedance at 50ohms.

Table 4-3WIFI/BT antenna interface definition

Pin Name	Pin #	I/O	Description	Note
ANT-WIFI/BT	78	AI/AO	WIFI/BT antenna	NA

Operating Frequency

Table 4-4WIFI/BT operating frequency

Mode	Frequency	Unit
WIFI	2402~2482	MHz
	5170~5835	MHz
BT4.2	2402~2480	MHz

WIFI/BT Antenna Reference Design

WIFI/BT antenna reference design is shown as follows
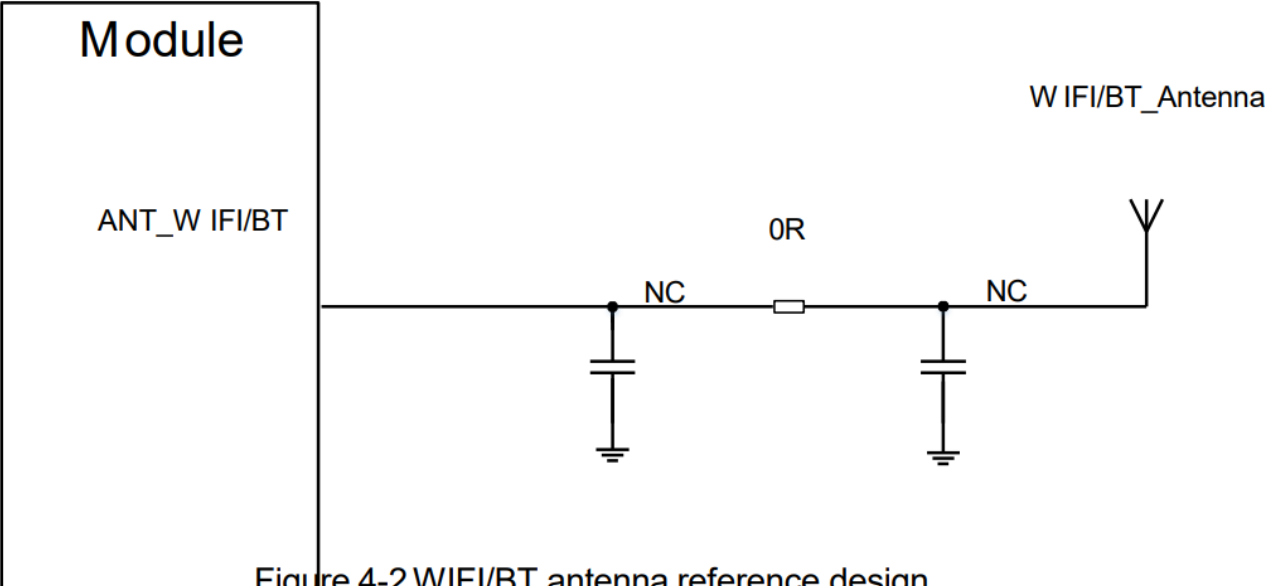
Figure 4-2 WIFI/BT antenna reference design

GNSS Antenna

GNSS supports GPS.

Table 4-5 GNSS antenna interface definition

Pin Name	Pin #	I/O	Description	Note
ANT_GNSS	120	AI	GNSS antenna	NA

Operating Frequency

Table 4-6 GNSS operating frequency

GNSS Antenna Reference Design

Themodule has a built-in LNA. The passive antenna is used in the design of the device. Microstrip trace is recommended for the GNSS RF route, with insertion loss within 0.2dB and impedance at 50ohms. The GNSS antenna reference design is shown as follows:
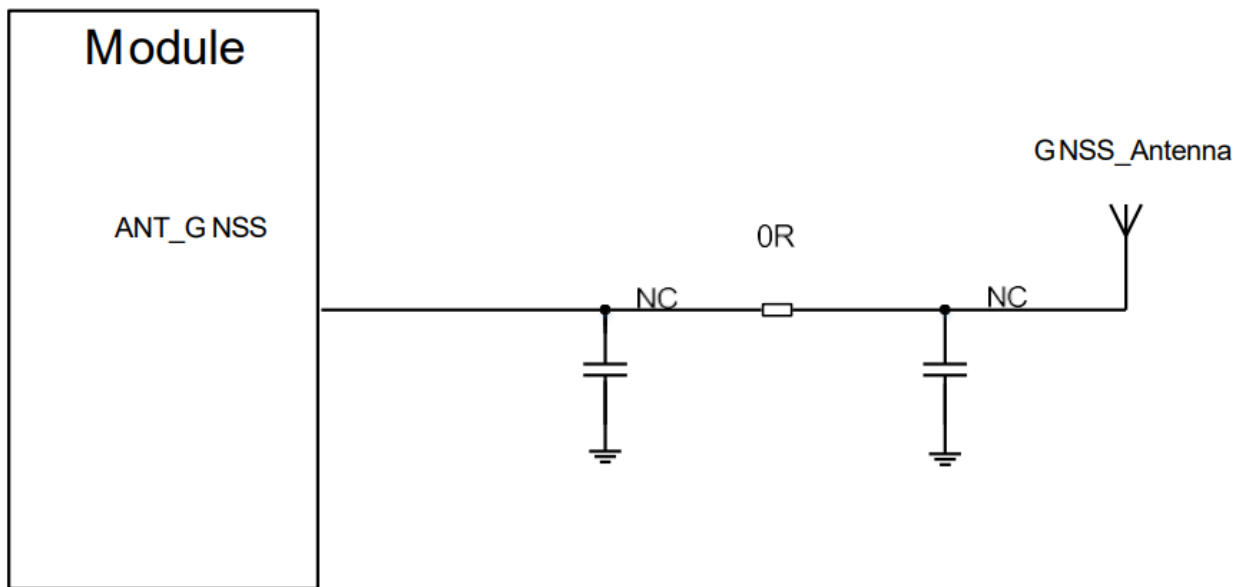
Figure 4-3-1 GNSS passive antenna reference circuit

The active antenna reference circuit is shown in the following figure:
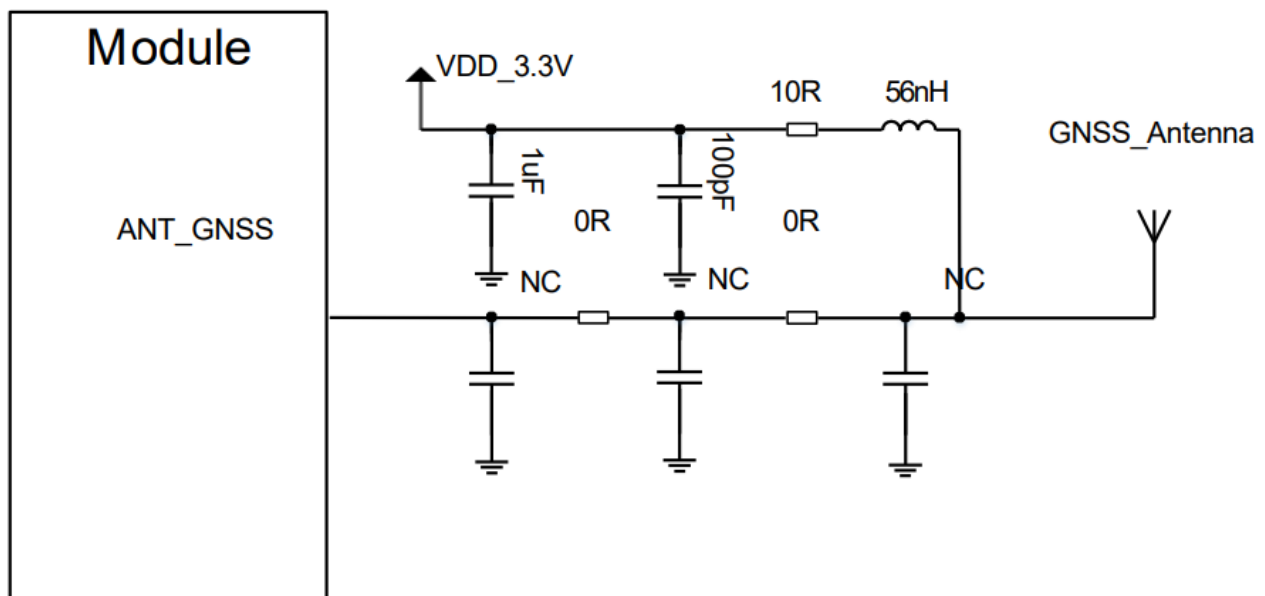
Figure 28-2 GNSS active antenna connection diagram

The power of the active antenna is fed from the antenna's signal line through a 56nH inductor. Common active antennas supply power from 3.3V to 5.0V. The active antenna itself consumes very little power, but requires a stable and clean power supply. It is recommended that a high-performance LDO be used to power the antenna. The active antenna gain requirement is <17db. If the gain is> 17db, the reserved π-type matching needs to be used to increase the attenuation network.

Antenna Requirement

Themodule provides four antenna interfaces: main, diversity,WIFI/BT and GNSS. The antenna requirements are as follows:

Table 4-7 Antenna requirements

Module Antenna Requirements	
Standard	**Antenna requirements**
GSM/WCDMA /LTE	VSWR: ≤ 2 Gain (dBi): 1 Max input power (W): 5 Input impedance (Ω): 50 Polarization type: vertical direction Insertion loss: < 1dB (0.6-1GHz) Insertion loss: < 1.5dB(1.4-2.2GHz) Insertion loss: < 2dB (2.3-2.7GHz)
WIFI/BT	VSWR: ≤ 2 Gain (dBi): 1

Module Antenna Requirements	
Standard	**Antenna requirements**
	Max input power (W): 5 Input impedance (Ω): 50 Polarization type: vertical direction Insertion loss: < 1dB
GNSS	Frequency range: 1559MHz~1607MHz Polarization type: right-circular or linear polarization VSWR: < 2 (typical) Passive antenna gain: > 0dBi Active antenna noise figure: <1.5dB (typical) Active antenna gain:> -2dBi Built-in LNA gain of active antenna: <17dB (typical)

FAQ

- **Q: What should I do if I encounter interference issues with the device?**
  - A: If you experience interference problems, ensure that the antennas are properly connected and positioned according to the provided reference designs. Additionally, avoid co-locating the device with other transmitters or antennas.
- **Q: How can I ensure FCC compliance when using the device?**
  - A: To maintain FCC compliance, follow the guidelines provided inthe manual regarding equipment modifications and antenna usage. Always refer to the FCC ID XKB-INGE808NA for authorized use.

Documents / Resources

INGE808-NA Hardware Guide

Version: V1.11
Date: 2024-09-26

INGENICO INGE808-NA Smart Module [pdf] User Guide
INGE808NA, XKB-INGE808NA, XKBINGE808NA, INGE808-NA Smart Module, INGE808-NA, Smart Module, Module

References

- **User Manual**