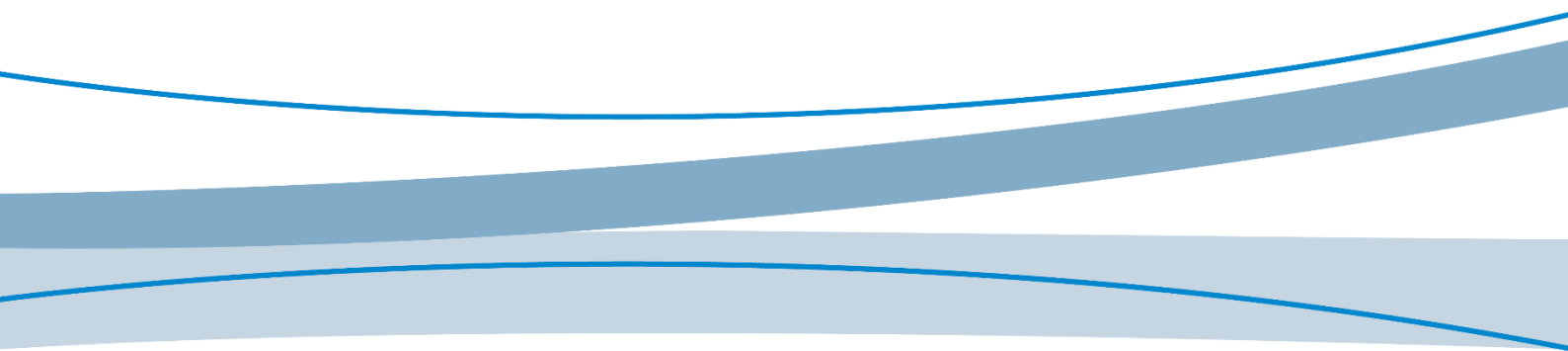# Fibocom
PERFECT WIRELESS EXPERIENCE

FG132-GL

Hardware Guide

V1.0

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Safety Instructions

Do not operate wireless communication products in areas where the use of radio is not recommended without proper equipment certification. These areas include environments that may generate radio interference, such as flammable and explosive environments, medical devices, aircraft or any other equipment that may be subject to any form of radio interference.

The driver or operator of any vehicle shall not operate wireless communication products while controlling the vehicle. Doing so will reduce the driver's or operator's control and operation of the vehicle, resulting in safety risks.

Wireless communication devices do not guarantee effective connection under any circumstances, such as when the (U) SIM card is invalid or the device is in arrears. In an emergency, please use the emergency call function when the device is turned on, and ensure that the device is located in an area with sufficient signal strength.

Contents

Applicable Models

No.	Applicable Model	Description
1	FG132-GL	5G Redcap, 2Gb FLASH, 2Gb DDR2, GL band, 3 ANT, 5G/4G, support GNSS

Change History

1 Foreword

1.1 Description

This document describes information on electrical characteristics, RF performance, structural dimensions and application environment of the FG132 series module. With the help of this document and other related documents, the application developer can quickly understand the hardware functions of the module and develop the hardware of the product.

1.2 Reference Standards

This product is designed with reference to the following standards:

- 3GPP TS 36.521-1 V15.0.0: User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing

- 3GPP TS 36.124V10.3.0: Electro Magnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment

- 3GPP TS 21.111 V10.0.0: USIM and IC card requirements

- 3GPP TS 51.011 V4.15.0：Specification of the Subscriber Identity Module -Mobile Equipment (SIM-ME) interface

- 3GPP TS 31.102 V10.11.0：Characteristics of the Universal Subscriber Identity Module (USIM) application

- 3GPP TS 31.11 V10.16.0: Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)

- 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）

- Universal Serial Bus Specification 2.0

2 Product Overview

2.1 Product Introduction

FG132 series products are packaged in LGA, which is a highly integrated 5G wireless communication module and supports LTE-FDD/LTE-TDD network modes. The module can provide stable and high-speed data transmission services, suitable for most mobile operator networks around the world, and can be used in IPC and Industrial gateway applications.

Table 1. Band introduction

Model	Number of Antennas	Network Type	Band Configuration
FG132-GL-00	3	5G NR LTE-FDD LTE-TDD GNSS	SA: n1/2/3/5/7/8/12/13/14/18/20/25/26/28/30/38/40/41/48/66/70/71/77/78 LTE: B1/2/3/4/5/7/8/12/13/14/17/18/19/20/25/26/28/30/34/38/39/40/41/42/43/48/66/71 NR-HPUE: n38/40/41/77/78 LTE-HPUE: B38/40/41/42/43 GPS/GLONASS/BDS/Galileo

2.2 Key Features

Table 2. Key features

Category	Function Description
Power supply	DC: 3.3V–4.3V, typical voltage: 3.8V
PC operating system	Linux/Windows

Network protocol	3GPP Release 17
SMS	Supported
Storage configuration	2Gb DDR2+2Gb NAND Flash
Function interface	USB×1: USB2.0, Used for AT command communication, data transmission, GNSS NMEA sentences output, software debugging, firmware upgrade and voice over USB
	I2C×1: Baud rate up to 1Mbps
	SPI×1: CLK frequency up to 50MHz
	ADCx2: Voltage range is 0~1.8V
	UART×3: Main UART: Used for AT command communication and data transmission; Baud rates reach up to 4Mbps, 115200 bps by default; Support RTS and CTS hardware flow control. Debug UART: Used for Linux console and log output; 115200bps baud rate. Coex UART: Only used for 5G/LTE and WLAN coexist
	SGMII×1: Support 10 Mbps/100 Mbps/1000 Mbps Ethernet work mode; Support maximum 150 Mbps (DL)/50 Mbps (UL) for 4G network
	SDIO×1: Support SD 3.0 protocol
	SIM×2: Support 1.8V and 3V SIM Card
	PCMx1: Used for audio function with external codec; Support 16-bit linear data format; Support long frame synchronization and short frame synchronization; Support master and slave modes, but must be the master in long frame synchronization

	PCIEx1: Complaint with PCIe Gen 2,1 lane; Supports RC (Root Complex) mode and EP (End Point) mode
Antenna	MAIN Antenna DIV Antenna GNSS Antenna
LTE features	UL supports QPSK, 16QAM and 64QAM modulations DL supports QPSK, 16QAM and 64QAM modulations LTE: A maximum uplink rate of 50Mbps and a maximum downlink rate of 150Mbps
5G NR features	Both UL and DL support QPSK, 16QAM, 64QAM and 256QAM modulations A maximum uplink rate of TBD Mbps and a maximum downlink rate of TBD Gbps
GNSS features	Supports dual-band GNSS: L1/L5 Supports GPS, GLONASS, BDS, Galileo Gen8C Lite of Qualcomm Protocol: NMEA 0183 Data update rate: 1 Hz by default
Physical features	Dimensions: 32mm x 29mm x 2.4 mm Package: LGA Weight: TBD g±0.5g
Temperature features	Operating temperature: -35℃ to +75℃, Expansion temperature: -40℃ to +85℃, When the ambient temperature is within the range of -35~-40℃ at low temperatures and 75~85℃ at high temperatures, some indexes may exceed 3GPP standard

Storage temperature: –40°C to +90°C

2.3 Hardware Block Diagram
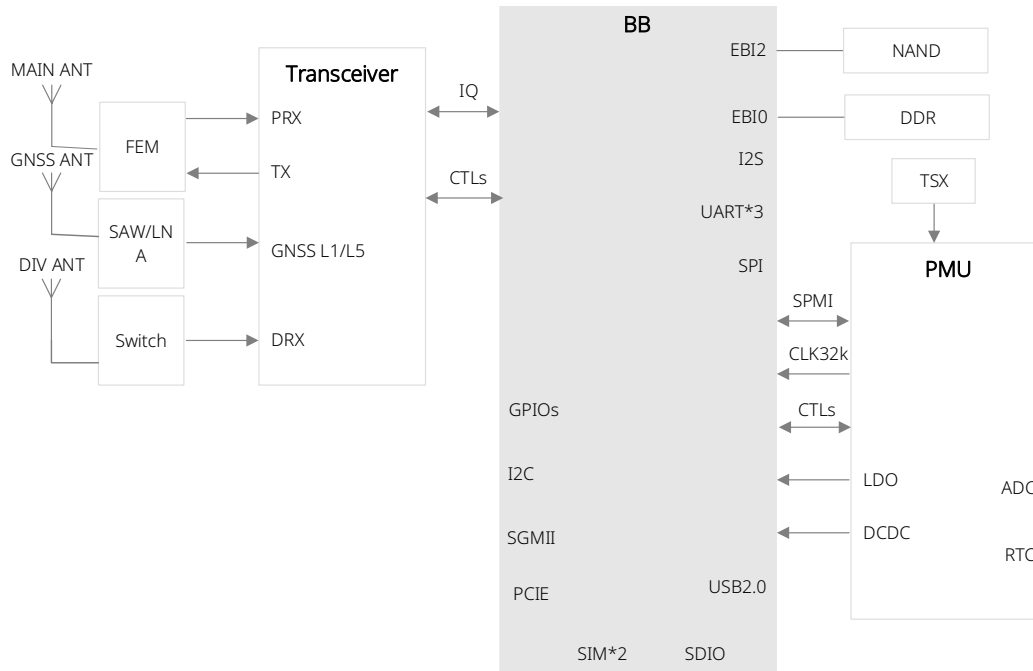
Figure 1. Hardware block diagram

The above figure is the hardware block diagram of the module, which mainly introduces the key components and functions of the baseband and RF parts.

- PMU: power management chip.

- CPU: which is mainly responsible for processing instructions, executing operations, controlling time, processing data and other functions.

- MCP: DDR2 and NAND Flash memory, which combines the high density of EPROM with the flexibility of EEPROM structure to hold data after power failure.

- WTR: RF transceiver IC, which supports 5G NR.

- RF PA: Transmitting RF signals amplification

- RF SWITCH: RF signals switch

- APT: Average Power Tracker, which optimizes RF power consumption and prolongs battery working time.

2.4 Description of Development Kit

Fibocom configures a complete development board kit for the module, which makes it convenient for users to quickly understand the module performance. Refer to *Fibocom_FG132_ADP User Guide* and *Fibocom_EVB-LGA-F01_User Guide* for the usage of development board.

3 Pin Definition

3.1 Pin Distribution

The FG132 series modules are in LGA package, with a total of 204 pins. The following figure is a TOP perspective view.

Figure 2. Pin distribution

3.2 Pin Description

Table 3. I/O type definition

Type	Description	Type	Description
PI	Power input	AIO	Analog input and output
PO	Power output	OD	Open drain
DI	Digital input	PU	Pull-up high level
DO	Digital output	PD	Pull-down low level
DIO	Digital input and output	T	Tristate, that is, high resistance state, which is determined by the peripheral circuit
AI	Analog input	G	Ground
AO	Analog output	NP	No pull

Table 4. Power interfaces

Pin	Pin Name	I/O	Reset Value[1]	Pin Description	DC Feature
7	VDD_EXT	PO	- -	1.8V power output	1.8V
16	USIM1_VDD	PO	- -	USIM1 power output	1.8V/2.95V
98	USIM2_VDD	PO	- -	USIM2 power output	1.8V/2.95V
8	VDD_WIFI_VH	PO	- -	WIFI power output	1.95V
9	VDD_WIFI_VML	PO	- -	WIFI power output	1.35V
63	VBAT_RF	PI	- -	RF power input	3.3V~4.3V
64	VBAT_RF	PI	- -	RF power input	3.3V~4.3V
65	VBAT_BB	PI	- -	Baseband power input	3.3V~4.3V
66	VBAT_BB	PI	- -	Baseband power input	3.3V~4.3V

Pin	Pin Name	I/O	Reset Value[1]	Pin Description	DC Feature
10~12, 23, 26, 33, 35, 38, 40, 50, 52, 54, 56~60, 62, 78, 109, 115, 125, 126, 135, 137, 140, 141,143, 149, 151, 163, 169~204					GND

Table 5. Control interfaces

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
1	WAKEUP_IN	DI	- -	Input signal for peripherals to wake up module	1.8V
4	W_DISABLE#	DI	- -	Flight mode control signal	1.8V
2	AP_READY	DI	- -	Application Processor ready	1.8V
5	NET_MODE	DO	- -	Module network mode indicator	1.8V
6	NET_STATUS	DO	- -	Module network status indicator	1.8V
67	STATUS	OD	- -	Module working status indicator	1.8V
3	SLEEP_IND	DO	- -	Module sleep status output signal	1.8V
24	RESET_N	DI	- -	Reset control signal	1.5V
25	PWRKEY	DI	- -	Power on/off control signal, Pulled up internally to 1.8V	1.5V
133	CBL_PWR_N	DI	- -	Auto power-on, which can be used to initiate the power-on sequence when grounded; pulled up internally.	1.8V
22	USB_BOOT	DI	- -	USB download mode boot signal, Cannot be pulled up before startup. A test point is recommended to reserve.	1.8V

Table 6. BB interfaces

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
15	USIM1_DET	DI	- -	USIM1 card hot-plug detection	1.8V
17	USIM1_DATA	DIO	- -	USIM1 data signal	1.8V/2.95V
18	USIM1_CLK	DO	- -	USIM1 clock signal	1.8V/2.95V
19	USIM1_RST	DO	- -	USIM1 reset signal	1.8V/2.95V
96	USIM2_DET	DI	- -	USIM2 card hot-plug detection	1.8V
95	USIM2_DATA	DIO	- -	USIM2 data signal	1.8V/2.95V
97	USIM2_CLK	DO	- -	USIM2 clock signal	1.8V/2.95V
99	USIM2_RST	DO	- -	USIM2 reset signal	1.8V/2.95V
27	MCLK	DO	- -	I2S clock output signal, reserved	1.8V
28	PCM_DIN	DI	- -	PCM data transmission	1.8V
29	PCM_DOUT	DO	- -	PCM data reception	1.8V
30	PCM_SYNC	DO	- -	PCM synchronization signal	1.8V
31	PCM_CLK	DO	- -	PCM clock signal	1.8V
82	SDIO_DATA3	DIO	- -	SDIO DATA3 signal	1.8V
81	SDIO_DATA2	DIO	- -	SDIO DATA2 signal	1.8V
84	SDIO_DATA1	DIO	- -	SDIO DATA1 signal	1.8V
83	SDIO_DATA0	DIO	- -	SDIO DATA0 signal	1.8V
79	SDIO_CLK	DO	- -	SDIO clock signal	1.8V
80	SDIO_CMD	DO	- -	SDIO command signal	1.8V
167	SD_DET	DI	- -	SD card hot-plug detection	1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
41	SPI_CS	DI	- -	SPI chip selection signal	1.8V
42	SPI_MOSI	DO	- -	SPI data output	1.8V
43	SPI_MISO	DI	- -	SPI data input	1.8V
44	SPI_CLK	DO	- -	SPI clock signal	1.8V
45	I2C_SCL	OD	- -	I2C clock signal	1.8V
46	I2C_SDA	OD	- -	I2C data signal	1.8V
49	ADC0	AI	- -	Analog-to-digital input port 0	1.8V
48	ADC1	AI	- -	Analog-to-digital input port 1	1.8V
68	RI	DO	- -	UART ringing prompt, reserved default as module wake-up host signal	1.8V
69	DCD	DO	- -	UART output carrier detection signal, reserved	1.8V
70	RTS	DO	- -	UART request to send signal, reserved	1.8V
71	CTS	DI	- -	UART clear to send signal, reserved	1.8V
72	DTR	DI	- -	UART module wake-up, reserved	1.8V
73	TXD	DO	- -	UART transmitting signal	1.8V
74	RXD	DI	- -	UART receiving signal	1.8V
13	DBG_RXD	DI	- -	Debug UART data reception	1.8V
14	DBG_TXD	DO	- -	Debug UART data transmission	1.8V
75	USB_DP	AIO	- -	USB 2.0 differential data signal	- -

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
				(+)	
76	USB_DM	AIO	- -	USB 2.0 differential data signal (-)	- -
77	USB_VBUS	DI	- -	USB insertion detection	5V
37	SGMII_RST_N	DO	- -	Reset output for external PHY	1.8V
123	SGMII_INT_N	DI	- -	SGMII interrupt	1.8V
128	SGMII_WOL_INT_N	DI	- -	Wake-on-LAN interrupt input	1.8V
130	SGMII_PWR_EN	DO	- -	Enable external power for SGMII PHY	1.8V
121	SGMII_MDC	DO	- -	SGMII Management Data Input/Output clock	1.8V
36	SGMII_MDIO	DIO	- -	SGMII Management Data Input/Output data	1.8V
34	SGMII_TX_M	AO	- -	SGMII transmission (-)	- -
119	SGMII_TX_P	AO	- -	SGMII transmission (+)	- -
32	SGMII_RX_M	AI	- -	SGMII receive (-), Connect with a 0.1µF capacitor, and be close to the PHY side	- -
117	SGMII_RX_P	AI	- -	SGMII receive (+), Connect with a 0.1µF capacitor, and be close to the PHY side	- -
105	PCIe_REFCLK_P	AIO	- -	Positive end of PCIe reference clock signal. In root complex mode, it is an input signal. In endpoint mode, it is an output	- -

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
				signal	
107	PCIe_REFCLK_M	AIO	- -	Negative end of PCIe reference clock signal	- -
103	PCIe_TX_P	AO	- -	Positive end of PCIe data transmitting signal	- -
104	PCIe_TX_M	AO	- -	Negative end of PCIe data transmitting signal	- -
101	PCIe_RX_P	AI	- -	Positive end of PCIe data receiving signal	- -
102	PCIe_RX_M	AI	- -	Negative end of PCIe data receiving signal	- -
20	PCIe_RST_N	DIO	- -	PCIe reset signal. In root complex mode, it is an input signal. In endpoint mode, it is an output signal	1.8V
21	PCIe_CLKREQ_N	OD/IO	- -	PCIe clock request signal	1.8V
100	PCIe_WAKE_N	OD/IO	- -	PCIe wake-up signal	1.8V

Table 7. Tuner interfaces

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
39	ANT_DIV	AI	- -	DIV Antenna	- -
55	ANT_MAIN	AIO	- -	MAIN Antenna	- -
51	ANT_GNSS	AI	- -	GNSS Antenna	- -
53	GRFC1	DO	- -	Generic RF Controller1	1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
139	GRFC2	DO	- -	Generic RF Controller2	1.8V
138	RFFE_DATA	DIO	- -	RFFE data signal	1.8V
136	RFFE_CLK	DO	- -	RFFE clock signal	1.8V

Table 8. WLAN/BT control interfaces

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
91	WLAN_PWR_EN	DO	- -	WLAN power supply enable control	1.8V
87	WLAN_WAKE	DI	- -	WLAN wake-up module	1.8V
89	WLAN_EN	DO	- -	WLAN enable control	1.8V
132	BT_EN	DO	- -	BT enable control	1.8V
92	N79_TX_EN_TO_WLAN	DO	- -	Notify n79 transmission from SDR transceiver to WLAN	1.8V
93	WLAN_TX_EN_TO_N79	DI	- -	Notify WLAN transmission from WLAN to SDR transceiver	1.8V
94	WLAN_PA_MUTING	DO	- -	To disable WLAN 2.4GHz chain 1PA	1.8V
86	WLAN_SW_CTRL	DI	- -	WIFI VDD_FEM Power control	1.8V
90	COEX_UART_RXD	DI	- -	5G/LTE and WLAN coexistence receive	1.8V
88	COEX_UART_TXD	DO	- -	5G/LTE and WLAN coexistence transmit	1.8V
85	WLAN_SLP_CLK	DO	- -	WLAN sleep clock	1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	DC Feature
168	RF_CLK_WLAN	DO	- -	WLAN main clock	1.8V

Table 9. NC & Reserved interfaces

Pin	DC Feature
47, 61, 106, 108, 110~112, 114, 116, 118, 120, 122, 127, 129, 131, 145~148, 150, 152~162, 164~166	Reserved
124, 134, 142, 144	NC

1. Reset Value: The state during pin initialization.

2. Pins marked with "*" are reserved or under development.

4 Application Interfaces

4.1 Power Interfaces

Table 10. Electrical Parameter

Parameter		Min	Typical	Max	Unit
Power supply	VBAT	3.3	3.8	4.3	V
	VBUS	3	5	5.25	V

Table 11. Absolute Maximum Ratings

Parameter		Min	Max	Unit
Power supply	VBAT	-0.3	4.7	V
	VBUS	-0.3	5.5	V
Analog level	ADC	0	VBAT	V
Digital level	GPIO	-0.3	2.3	V

5 Antenna Interfaces

5.1 Definition of Antenna Interfaces

Please read the antenna interface definition carefully and select the correct antenna interface for connection. For assistance, please contact the Fibocom technical personnel.

5.2 Operating Frequency

Tables 12. Cellular frequency

Operating Band	Standard	Tx (MHz)	Rx (MHz)
5G NR	n1	1920~1980	2110~2170
	n2	1850~1910	1930~1990
	n3	1710~1785	1805~1880
	n5	824~849	869~894
	n7	2500~2570	2620~2690
	n8	880~915	925~960
	n12	699~716	729~746
	n13	777~787	746~756
	n14	788~798	758~768
	n18	815~830	860~875
	n20	832~862	791~821
	n25	1850~1915	1930~1995
	n26	814~849	859~894
	n28	703~748	758~803
	n30	2305~2315	2350~2360

Operating Band	Standard	Tx (MHz)	Rx (MHz)
	n66	1710~1780	2110~2180
	n70	1695~1720	1995~2020
	n71	663~698	617~652
	n38	2570~2620	2570~2620
	n40	2300~2400	2300~2400
	n41	2496~2690	2496~2690
	n48	3550~3700	3550~3700
	n53*	2483.5~2495	2483.5~2495
	n77	3300~4200	3300~4200
	n78	3300~3800	3300~3800
	n79	4400~5000	4400~5000
	Band 1	1920~1980	2110~2170
	Band 2	1850~1910	1930~1990
	Band 3	1710~1785	1805~1880
	Band 4	1710~1755	2110~2155
	Band 5	824~849	869~894
LTE FDD	Band 7	2500~2570	2620~2690
	Band 8	880~915	925~960
	Band 12	699~716	729~746
	Band 13	777~787	746~756
	Band 14	788~798	758~768
	Band 17	704~716	734~746

Operating Band	Standard	Tx (MHz)	Rx (MHz)
	Band 18	815~830	860~875
	Band 19	830~845	875~890
	Band 20	832~862	791~821
	Band 25	1850~1915	1930~1995
	Band 26	814~849	859~894
	Band 28	703~748	758~803
	Band 30	2305~2315	2350~2360
	Band 66	1710~1780	2110~2180
	Band 71	663~698	617~652
LTE TDD	Band 34	2010~2025	2010~2025
	Band 38	2570~2620	2570~2620
	Band 39	1880~1920	1880~1920
	Band 40	2300~2400	2300~2400
	Band 41	2496~2690	2496~2690
	Band 42	3400~3600	3400~3600
	Band 43	3600~3800	3600~3800
	Band 48	3550~3700	3550~3700

Table 13. GNSS frequency point

Satellite Type	Center Frequency Point (MHz)	Modulation
GPS/Galileo/QZSS	1575.42	CDMA
GLONASS	1597.5 to 1605.8	FDMA
BeiDou	1561.098	CDMA

5.3 Antenna Design Circuit

According to the transceiver function, the antenna includes the following types:

- Main antenna: use for sending and receiving RF signals

- DIV antenna: only use for receiving signals, used to obtain diversity gain

- GNSS antenna: use for receiving GNSS signals

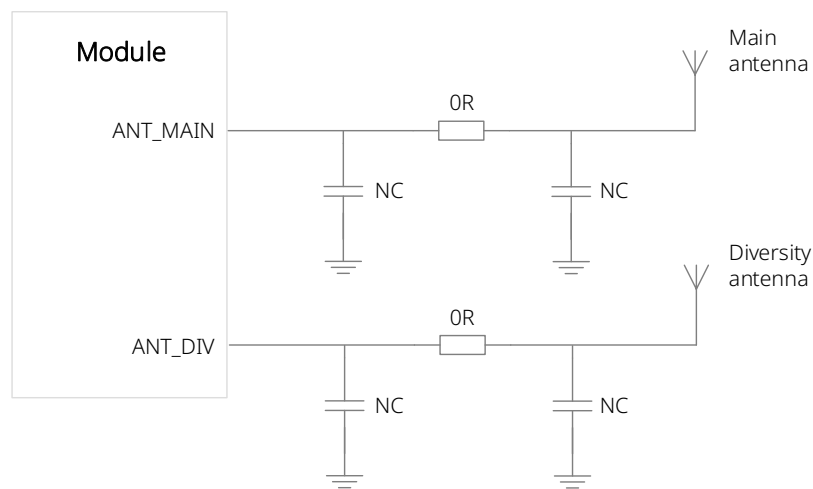The following figure shows an antenna circuit for a cellular network:

Figure 3. Cellular network antenna reference circuit

The following figure shows the GNSS active antenna. If the active antenna is not required, the dotted line part can be deleted. The circuit diagram of GNSS antenna is as follows:
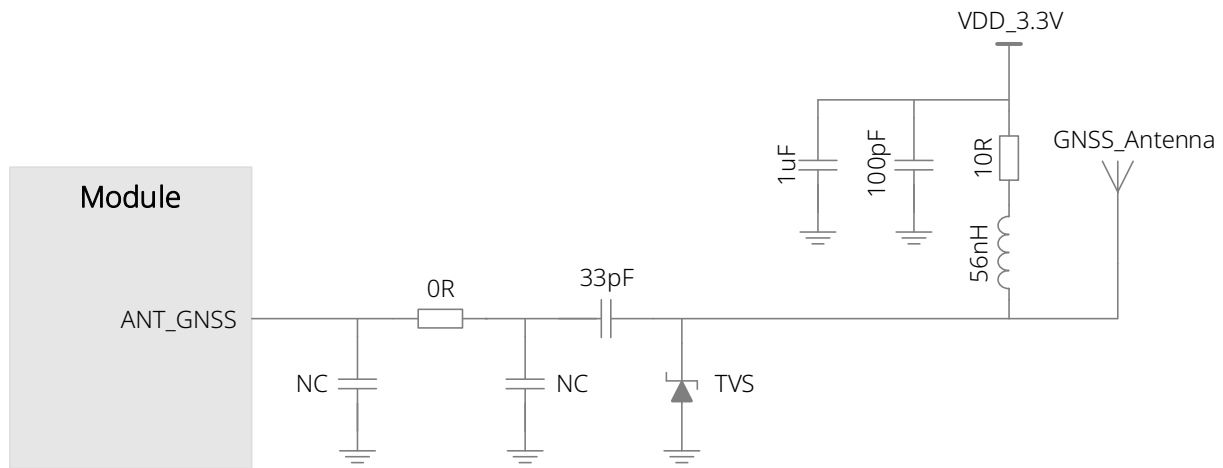
Figure 4. GNSS antenna reference circuit

The TVS on GNSS antenna is recommended ESDSU5V0A1

5.4 Antenna Performance Requirements

- Input impedance: 50Ω

- Input power: > 28dBm

- VSWR: < 2:1

- Antenna gain: < 3.6dBi

- Antenna isolation: > 25dB

- Insertion loss of antenna cable: LB (< 1GHz) < 0.3dB, MB (1GHz to 2.7GHz) < 0.8dB, HB (> 2.7GHz) < 1.2dB

5.5 PCB Layout Reference Design

In practical applications, the shorter the RF microstrip trace, the better. Impedance is usually closely related to the width (W) and thickness of the trace, the height (H) of the reference layer, the spacing (S) between the trace and the left and right sides of the ground, and the dielectric constant of the material. The impedance control model of RF microstrip line is divided into planar reference model and coplanar impedance model. Generally, if the planar reference model can meet the requirements, the coplanar impedance model should
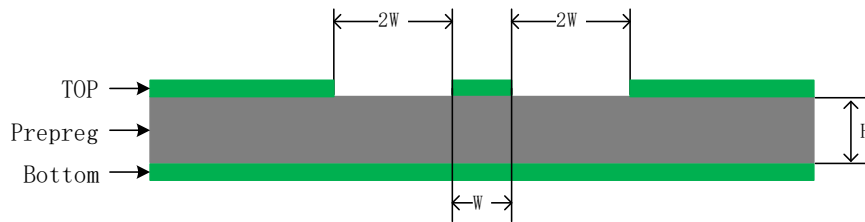
not be used.

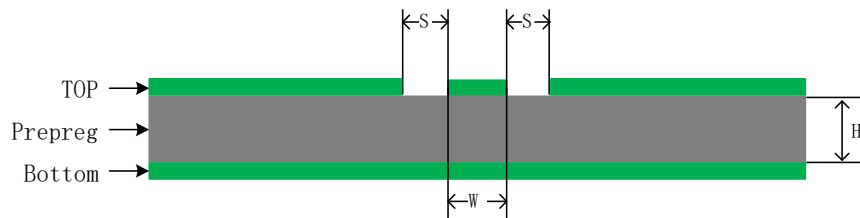Figure 5. Planar reference model for a two-layer board

Figure 6. Coplanar impedance model for a two-layer board
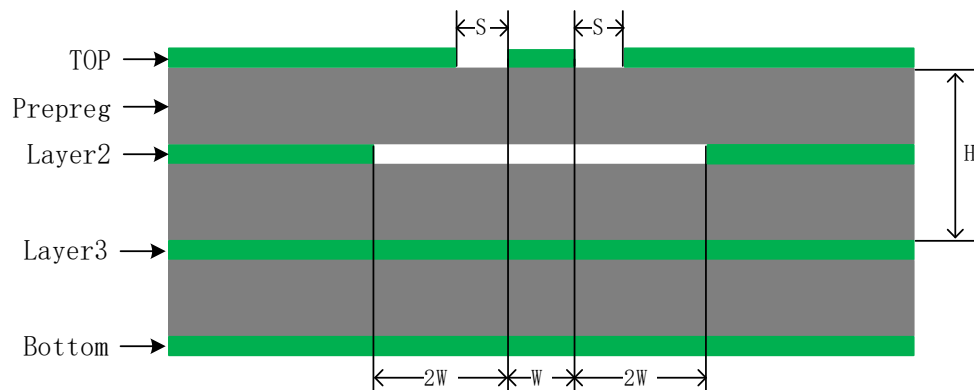
Figure 7. Coplanar impedance model for a four-layer board

The design rules are as follows:

- The RF trace impedance is controlled to 50Ω, and the reference ground must be kept intact.

- The RF routing should be curved as far as possible, and both sides of the routing should be protected by vias. The distance between vias and traces should be greater than 2 times the line width.

- There should be clearance below the RF connector, and the RF routing should be far away from the interference source to avoid crossing and paralleling with the interference source.

6 Electrical Characteristics

6.1 Logic Level

Table 14. Logic level (V)

Description	Level	Min.	Typical	Max.
1.8V logic level	High level	TBD	1.8	TBD
	Low level	TBD	0	TBD
PWR_ON logic Level	High level	TBD	1.8	TBD
	Low level	0	0	TBD

6.2 Electrostatic Protection

The module is a precise electronic product. If electrostatic protection measures are not taken, permanent damage may be caused to the module. In the process of R & D, debugging, production, assembly, testing and other links, ESD protection measures should be taken. The ESD protection level at 25℃ ambient temperature and 45% humidity is described in the following table.

Table 15. ESD protection level

Location	Air Discharge	Contact Discharge
GND	±15KV	±8KV
Antenna interface	N/A	±8KV

🛈
1. The data is tested based on the development board of Fibocom.

2. ESD performance is strongly related to PCB design, and key control signals should be protected.

3. When designing the whole machine, pay attention to maintaining the integrity and connectivity of GND.

6.3 Reliability

The reliability test of Fibocom is carried out at industrial level, and the test results of each item are as follows:

Table 16. Reliability test result

Test Item	Test Condition	Result
High temperature aging	85℃, 168H/504H/1008H	PASS
High temperature and humidity	85℃ , 85%RH, 168H/504H/1008H	PASS
Corner test	High and low temperature, high and low humidity, high and low voltage, six groups of combinations, and each combination runs for 24 hours	PASS
Temperature shock	90/-45℃, 200C	PASS
Random vibration	Frequency range: 200Hz to 2000Hz, PSD=0.04 g2/Hz, one hour for X/Y/Z axis	PASS
Monomer drop	1m, 6 sides and 2 wheels	PASS
Mechanical collision	Peak acceleration: 180m/s2 Pulse duration: 6ms Number of collisions: 1000	PASS
Low temperature boot	-40℃, 30 minutes off/5 minutes idle, 3 days	PASS
Condensation test	3 days (3 cycles): ・First and second cycles with cold cycle	PASS

Test Item	Test Condition	Result
	· Third cycle without cold cycle	
Temperature cycle	85°C/-40°C; 10°C/min; 10min; 240 cycles	PASS
Sinusoidal vibration	Amplitude: 3.0G peak to peak Frequency: 5Hz to 500Hz Sweep frequency: 0.5 Octave/min, linear Each axis: 2H	PASS
Salt spray	Neutral salt spray, 48H	PASS

6.4 Thermal Design

When using LGA packaged module for thermal design of the whole machine, the main suggestions are as follows:

- For the LGA packaged module, the module will be soldered on the customer motherboard. At this time, the whole machine shell is preferred for heat dissipation, and the thermal interface material is used between the module and the shell for connection.

- The corresponding position of the module below the customer motherboard can be selectively filled with the thermal interface material according to the actual situation.

- When selecting the shell material, the metal shell is preferred, and the aluminum alloy material has better heat dissipation effect.

- When plastic shell is selected, graphite sheet can be pasted on the inner side for temperature equalization to eliminate local hot spots.

- When the shell is far away from the module, the radiator can be added to the module for heat dissipation.

For more thermal design guidance, refer to Fibocom_General Thermal Design Guide for Modules.
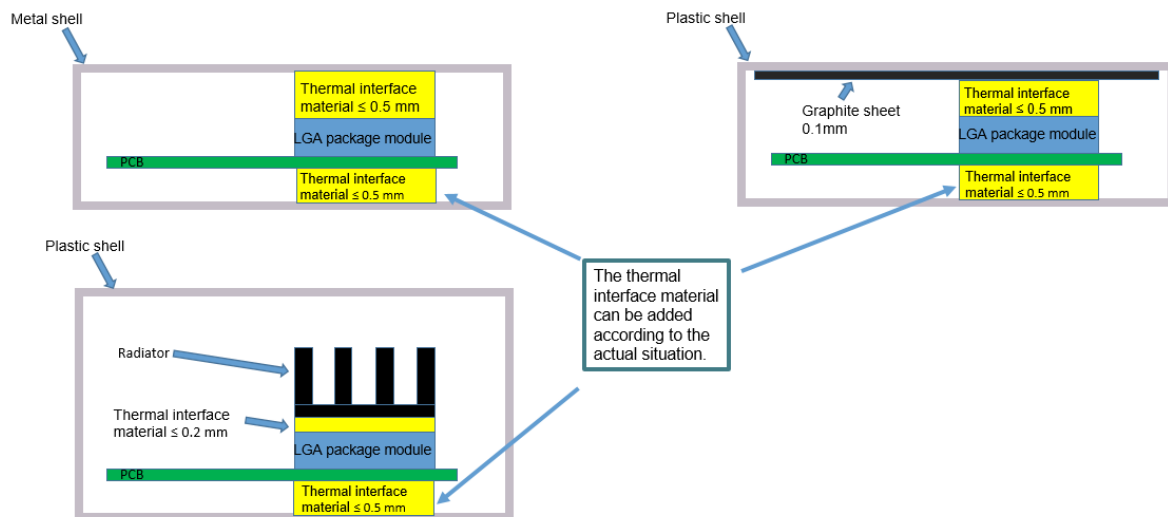
Figure 8. Heat dissipation structure stack

7 Structure Specifications

7.1 Physical Appearance

Module physical appearance is shown in the following figures.
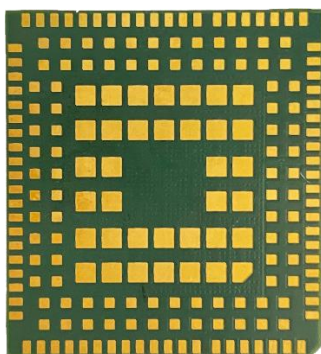

Figure 9. Top view

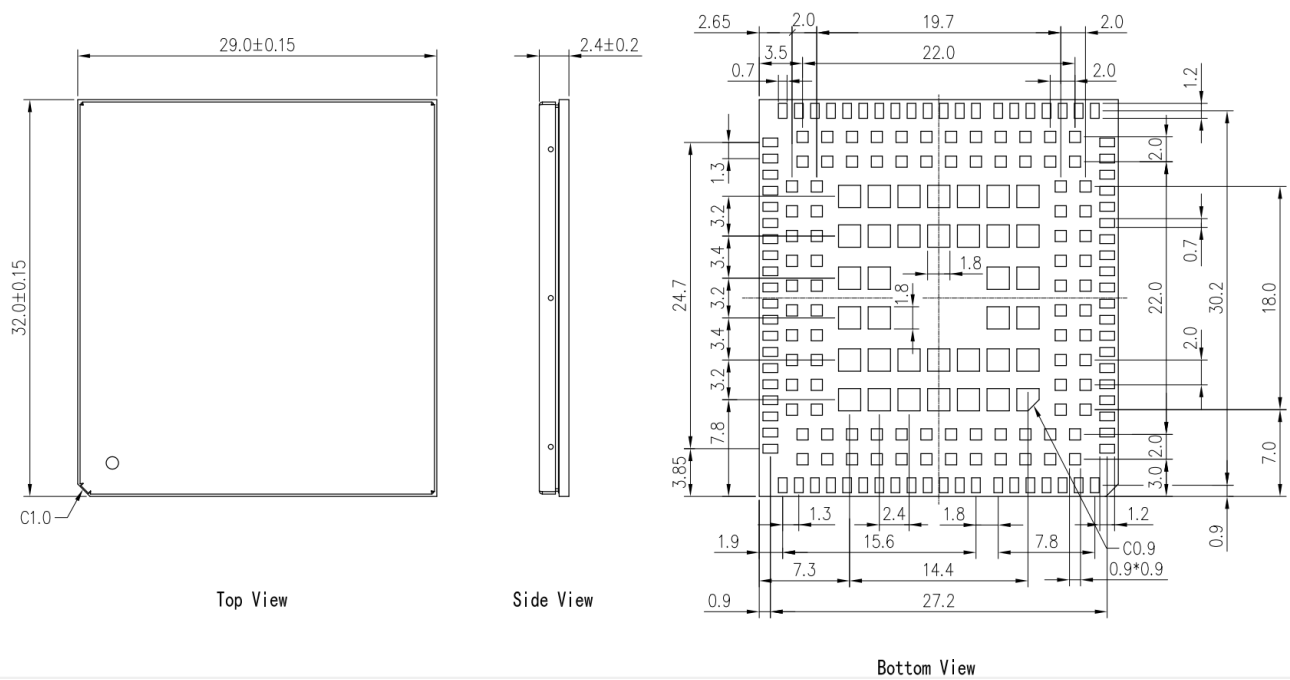Figure 10. Bottom view

7.2 Structure Dimensions

Figure 11. Structure dimensions (unit: mm)

7.3 PCB Package

When user design module PCB package, it is recommended that users refer to the *Fibocom.FG132_Package* file provided by our company

8 Storage, Production and Packaging

8.1 Storage Conditions

Modules are shipped in vacuum sealed bags. The module has a humidity sensitivity level of 3 (MSL 3) and its storage is subject to the following conditions:

1. Recommended storage conditions: The temperature is 23±5°C, and the relative humidity is 35% to 70%.

2. Storage period of sealed vacuum packaging: 12 months.

3. Under workshop conditions with a temperature of 23±5°C and relative humidity below 60%, the shelf life of the module after unpacking is 168 hours. Under these conditions, the module can be directly used for reflow production or other high temperature operations. Otherwise, the module needs to be stored in an environment with a relative humidity of less than 10% to keep the module dry.

4. If the module is in the following conditions, pre-baking is required to prevent moisture-sensitive modules from experiencing PCB bubbling, cracking, and delamination during high-temperature soldering:

- The storage temperature and humidity do not meet the recommended storage conditions.

- Failure to complete production or storage in accordance with clause 3 above after unpacking of the module.

- Vacuum packaging leakage, bulk materials.

- Before module repair.

- Baking treatment of modules:

- Baking at 120±5°C for 8 hours;

- The module of secondary baking must be soldered within 24 hours after baking,

otherwise it still needs to be stored in the drying oven.

8.2 SMT Production

Module steel mesh design, solder paste and furnace temperature control please refer to *FIBOCOM FG132 SMT Application Design Notes*

8.3 Packaging Specifications

The module adopts tape packaging, so that the storage, transportation and the usage of the module can be protected to the greatest extent. Please read the packing instructions carefully to avoid damaging the product.

The product package is divided into three layers:

- Outer packaging

Hard card box

- Vacuum packaging

Anti-static sealed vacuum bag

- Inner packaging

Tape packaging

> The module is a precise electronic product, and may be permanently damaged if you do not take correct ESD measures.
>
> The module is moisture sensitive, please avoid moistening the product to prevent permanent damage.

Each roll is packed with 200 pcs, each box is packed with 1 rolls, and each hard carton box is packed with 4 boxes.

Packaging process

❶ Place the module on the tape.	❷ Put into the carrier slot.	❸ Place accessories.
❹ Put into a vacuum bag.	❺ Put into a white box.	❻ Put into an outer box.
❼ Seal the outer box.		
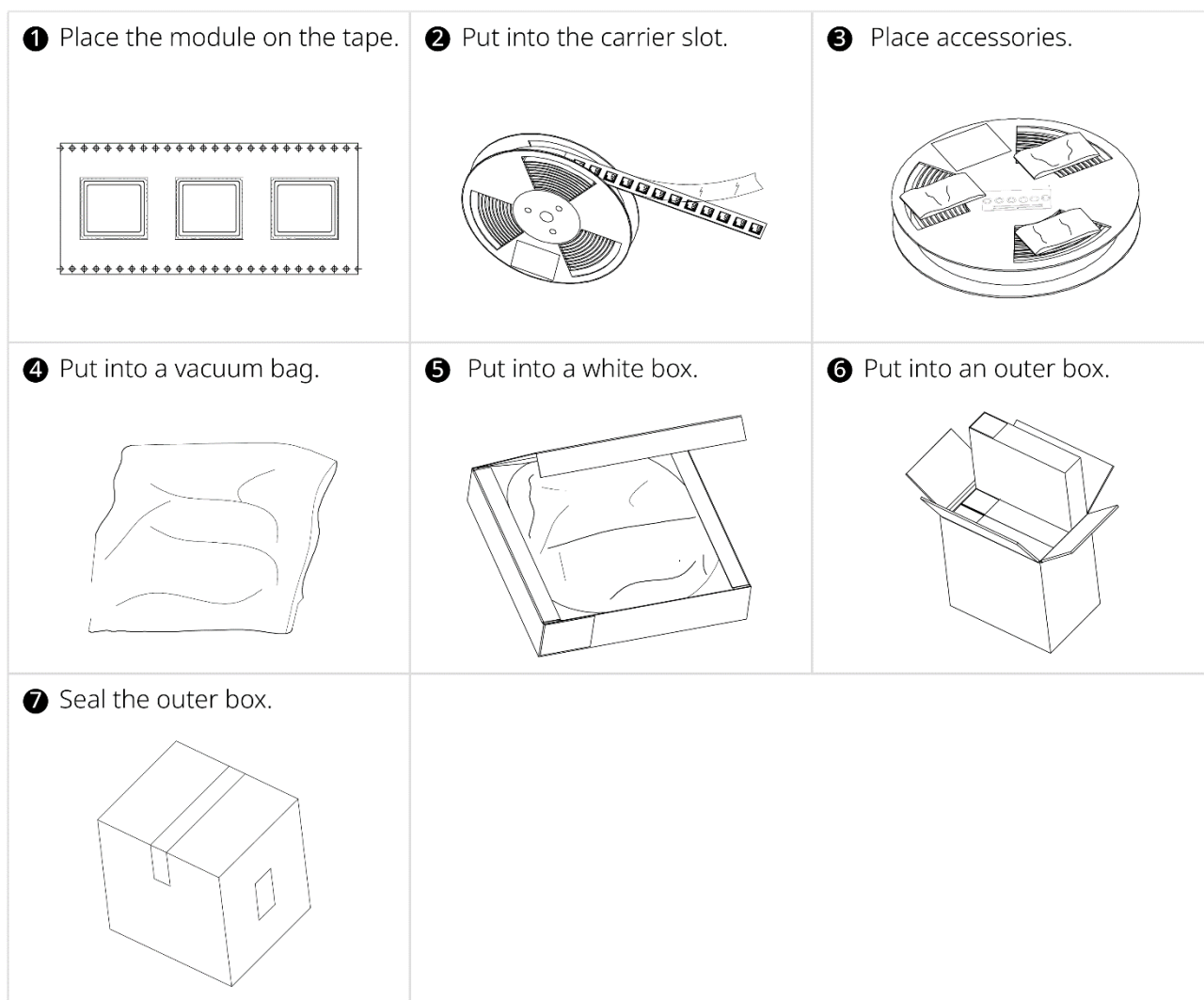
Figure 12. Tape packaging process

1. Place each module into the carrier slot frame in the same direction as specified, and sealing the heat-sealing film.

2. Place the specified number of module tapes as shown in the figure.

3. Before vacuuming, place 3 bags of desiccant and a humidity card above the tape, and paste the label of the carrier tape.

4. Put the whole into a vacuum bag and vacuuming.

5. Put the vacuum electrostatic bag into a white box, only one electrostatic bag is put into a single white box. Buckle the white box and paste the label.

6. Seal the bottom of the outer box, and put the 4 PCS white boxes into the outer box as shown in the figure.

7. Seal the top of the outer box in an I-shape, paste an outer box label in the rectangular frame on the side, and paste a box sealing label on the top and bottom of the outer box respectively.

Tape size

- Tape size:
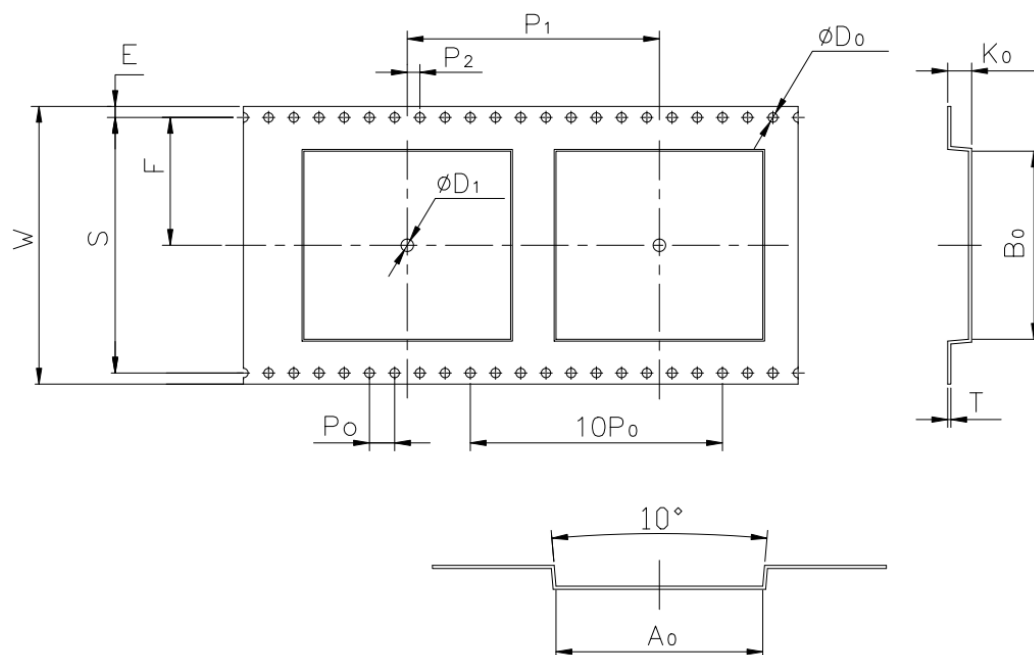
ITEM	A_0	B_0	K_0	P_0	P_1	P_2	T
DIM	32.8±0.1	29.8±0.1	3.8±0.1	4.0±0.1	40.0±0.1	2.0±0.15	0.5±0.05
ITEM	E	F	D_0	D_1	W	$10P_0$	S
DIM	1.75±0.1	20.2±0.3	$1.50^{+0.10}_{-0.00}$	0.0	$44.0^{+0.30}_{-0.10}$	40.0±0.2	40.4±0.1

Figure 13. Carrier tape size

- Reel size:

Figure 14. Reel size

Appendix A Reference Documents

Category	Document Name
Software	*Fibocom_FG132_AT_Commands*
Hardware	*Fibocom_FG132_SCH&PCB_design checklist*
	Fibocom_FG132_Package
	Fibocom_FG132_3D_Module Diagram
	Fibocom_FG132_Reference_Design
Development kit	*Fibocom_FG132_ADP User Guide*
	Fibocom_EVB-LGA-F01_User Guide
User Guide	*Fibocom_FG132_SMT Design Guide*
	Fibocom_General Thermal Design Guide for Modules

Appendix B Acronyms and Abbreviations

Acronym and Abbreviation	Description
ADC	Analog to Digital Converter
ADP	Application Development Platform
BT	Bluetooth
IPC	IP Camera
DCDC	Direct Current to Direct Current
DDR	Double Data Rate
ESD	Electronic Static Discharge
FDD	Frequency Division Duplexing
FEM	Front End Module
GNSS	Global Navigation Satellite System
NR	New Radio
LDO	Low Dropout Regulator
LTE	Long Term Evolution
I2C	Inter Integrated Circuit
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PMU	Power Manager Unit
RF	Radio Frequency
RTC	Real Time Clock
SGMII	Serial Gigabit Media Independent Interface
SDIO	Secure Digital Input and Output

SIM	Subscriber Identification Module
SPI	Serial Peripheral Interface
TDD	Time Division Duplexing
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Network

Appendix C RED Conformance information

Exposure

The device could beused with aseparation distance of 20 cm to the human body.

Declaration of conformity

Hereby, [Fibocom Wireless Inc.] declares that the radio equipment type [Model Name: FG132-GL] is in compliance with Directive 2014/53/EU.

For the declaration of conformity, visit the Web site www.fibocom.com/certification.

Appendix D FCC Conformance information

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.

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 from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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,
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.

Radiation Exposure Statement

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

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.

2. This module is limited to installation in mobile applications, according to Part 2.1091(b).

3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations

4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part

15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be

transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).

The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note
notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Fibocom Wireless Inc. that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID:ZMOFG132GL"

The FCC ID can be used only when all FCC compliance requirements are met.

Antenna Installation

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,

(2) The transmitter module may not be co-located with any other transmitter or antenna.

(3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require

additional authorization for operation.

Band	Antenna Gain (dBi)
LTE band 2/N2	2.85
LTE band 4	2.98
LTE band 5/N5	1.32
LTE band 7/N7	2.21
LTE band 12/N12	1.61
LTE band 13/N13	1.83
LTE band 14/N14	2.19
LTE band 17	1.61
LTE band 25/N25	2.85
LTE band 26/N26	1.32
LTE band 30/N30	0.22
LTE band 38/N38	1.71
LTE band 41/N41	2.21
LTE band 42	-0.13
LTE band 43	-0.13
LTE band 48/N48	-0.13
LTE band 66	2.98
LTE band 71	1.61
N70	2.86
N77	2.95
N78	-0.13

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot 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/IC authorization.

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.

Information to user

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

- List of applicable FCC rules:

47CFRPart 22, 24, 27, 90, 96

- Summarize the specific operational use conditions:

This module can be used in IOT devices, the input voltage to the module is nominally 3.8V.

- Limited module procedures:

This module is a single module.

- Trace antenna designs:

The antenna is not a trace antenna.

- RF exposure considerations:

This Module complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

- Antennas:

If you desire to increase antenna gain and either change antenna type or use same antenna type certified, a Class II permissive change application is required to be filed by us, or you (host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

- Label and compliance information:

Please notice that if the FCC identification number 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. This exterior label can use wording such as the following: "Contains FCC ID: ZMOFG132GL" any similar wording that expresses the same meaning may be used.

§ 15.19 Labelling requirements shall be complied on end user device.

Labelling rules for special device, please refer to §2.925, § 15.19 (a)(5) and relevant KDB publications. For E-label, please refer to §2.935.

- Information on test modes and additional testing requirements:

The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

The module is limited to installation in mobile application, a separate approval is required for all other operating configurations, including portable configurations with respect to §2.1093 and difference antenna configurations.