FM160-NA Hardware Guide

Version: V1.1

Date: 2023-09-20

Fibocom

Applicability Type

NO.	Product Model	Description	2/27

Fibocom

Copyright

Notice

The document is subject to update from time to time owing to the product version upgrade or other reasons. Unless otherwise specified, the document only serves as the user guide. All the statements, information and suggestions contained in the document do not constitute any explicit or implicit guarantee.

Trademark

Fibocom   The trademark is registered and owned by Fibocom Wireless Inc.

Change History

Version	Author	Update Date	Remark
V1.0.0	Emily Su	2022-02-28	Initial version
V1.1.0	Shelly .xu	2023-09-20	Add LTE B14

Contents

Fibocom

1 Foreword

1.1 Introduction

The document describes the electrical characteristics, RF performance, dimensions and application environment, etc. of FM160-NA (hereinafter referred to as FM160). With the assistance of the document and other instructions, the developers can quickly understand the hardware functions of FM160 modules and develop products.

2 Overview

2.1 Introduction

The FM160 series module is a 5G module which supports NSA and SA network architectures. The FM160 integrates core devices such as Baseband, Memory, PMU, Transceiver, and PA. It supports 5G NR Sub6, FDD-LTE, TDD-LTE, long-distance communication modes. Supports uplink 2×2 MIMO and downlink 4×4 MIMO multi-antenna configuration in SA mode. It also reserved GNSS wireless positioning technology. The FM160 is designed in M.2 form factor interface, and is suitable for a variety of eMBB scenarios, such as CPE, VR/AR, gateway, TV box, and intelligent monitoring.

2.1.1 Key Features

Table 2-1 Key features

Performance	Description
Operating Band	LTE FDD: Band 2/4/5/12/13/14/29/30/66/71
	LTE TDD: Band 41/48^3/46（LAA）
	NR: n2/5/12/14/25/30/41/48^3/66/70/71/77
NR	3GPP Release 16
LTE	3GPP Release 16
Feature	NR: DL 4×4 MIMO: n2/5/14/25/30/41/66/71/77 UL 2×2MIMO: n41/77 LTE: DL 4×4MIMO: Band B2/4/5/12/13/14/30/41/48/66

	NSA and SA supported	
	SRS: n41, n77 Support: 1T2R, 1T4R, 2T4R	
	HPUE: B41, n41, n77	
Data Transmission	SA 5G/NR Sub-6 Peak	DL 2.47Gbps/UL 900Mbps
	NSA Peak	DL 3.47Gbps/UL 555Mbps
	LTE	DL 1.6Gbps (CAT19)/UL 211Mbps (CAT18)
	UMTS/HSPA+	NA
		NA
Power Supply	DC: 3.135~4.4V, typical voltage: 3.8V	
Antenna Type:	External	
Antenna Gain:	<4dBi	
Temperature	Normal operating temperature: -30~75℃[1]	
	Extended operating temperature: -40~85℃[2]	
	Storage temperature: -40~85℃	
Physical characteristics	Dimension: 30 mm×52mm×2.3 mm Package: M.2 Weight: about 7.8 g	
CPU	ARM Cortex-A7, quad core, up to 1.5 GHz	
Memory	4Gb LPDDR4X+4Gb NAND Flash	
Interface		
USB Interface	USB 3.0, rate up to 10Gbps	
PCIe Interface	PCIe interface：PCIe Gen 3 1-lane or PCIe Gen 4 1-lane(RC only)	
SIM Interface	Dual SIM: 1.8V/3V SIM1: USIM SIM2: ESIM/USIM	
I2C	One set of I2C interface, data transmission rate up to 400Kbit/s	
ADCs	A/D conversion channel, Voltage Range: 0~1.45V	
Software		
Firmware update	USB/PCIe/FOTA	
Operating System	Linux/Android/Windows	

🔺 **Note：**

1. When temperature keeps in the range of -30~75°C, the module can work normally. Module performance meets the 3GPP specifications.

2. When temperature keeps in the range of -40~85°C, module performance may be slightly out of 3GPP specifications.

3. For IC, B48/N48 are disabled by software.

![Fibocom]

2.2 Application Framework

The application framework below shows the main hardware functions of the FM160 module:

● Baseband

● RF transceiver

● PMU

● Memory

● Peripheral interface
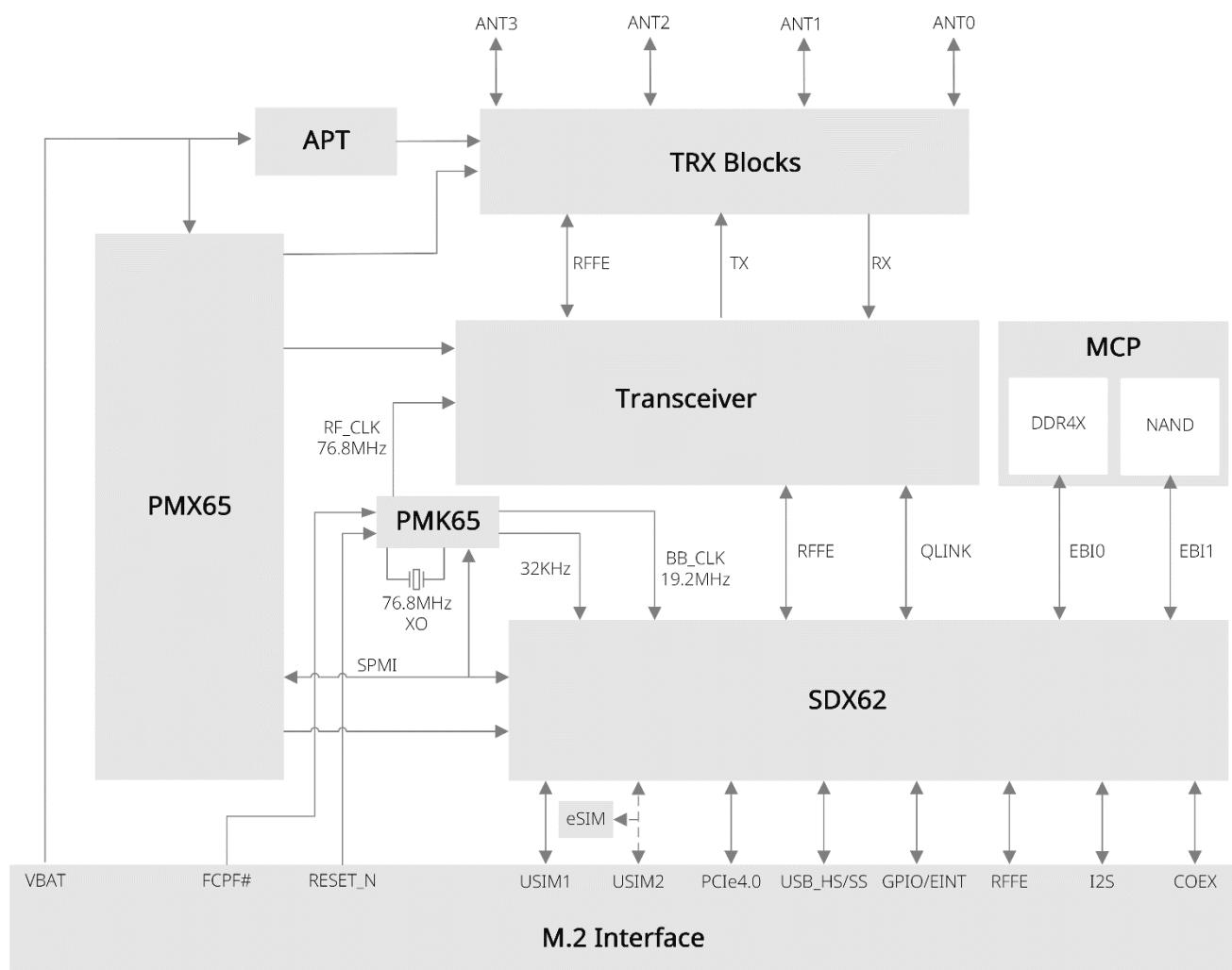
Figure 2-1 Hardware block diagram

2.3 Antenna Configuration

FM160 module supports four antennas and the configuration is as below table:

Antenna Connector	Function	Band Description	Frequency Range (MHz)
ANT0	PRX (Main TX)	LTE: B2/4/7/30/66/41/48 NR: n2/25/30/41/48/66/70/77	617-960 1427-2690 3300-4200
	MIMO PRX	LTE:B5/12/13/14/71 NR:n5/12/14/71	
	Secondary TX	LTE: B5 NR: n5	
ANT1	PRX	LTE: B46 (LAA)	617-2690 3300-4200 5150-5925
	DRX	LTE: B2/4/5/12/13/14/29(SDL)/30/41/66/71 NR: n2/5/12/14/25//30/41/66/70/71	
	MIMO PRX	LTE : B48 NR : n48/77	
	GNSS	L1	
ANT2	DRX	LTE: B46 (LAA)	617-2690 3300-4200 5150-5925
	MIMO DRX	LTE: B2/4/5/12/13/14/30/41/48/66/71 NR: n2/5/12/14/25/30/41/48/66/70/71/77	
ANT3	PRX (Main TX)	LTE: B5/12/13/14/29(SDL)/71 NR: n5/12/14/71	617-960 1427-2690 3300-4200
	DRX	LTE : 48 NR : n48/77	
	MIMO PRX	LTE : B2/4/30/41/66 NR : n2/25/30/41/66/70	

Secondary TX	LTE: B2/4/41/48/66
	NR: n2/25/41/48/66/77

2.4 Waring

2.4.1 Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.

2. This module is limited to installation in fixed 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/IC 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: ZMOFM160NA"

"Contains IC: 21374-FM160NA "

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

Fibocom

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.

(4)The max allowed antenna gain is 3.76dBi for external monopole antenna.

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.

2.4.2 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.

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: (For module device use)

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

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.

2.4.3 IC Statement

Industry Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. 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."

Radiation Exposure Statement

Fibocom

This equipment complies with IC 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.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

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

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC 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 Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

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: 21374-FM160NA".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 21374-FM160NA ".

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.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

3 M.2 Connector

The FM160 module connects to AP via M.2 connector. It is recommended to use M.2 connector from LOTES Corporation with the model APCI0026-P001A as shown in the following figure. For the package of connector, please refer to the specification.
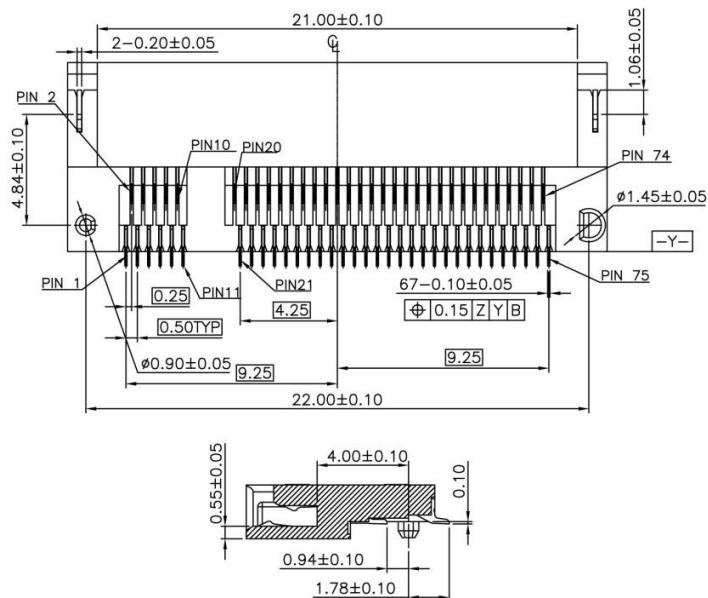
Figure 3-1 M.2 connector dimensions

3.1.1 Pin Map

Table 3-1 Table of pin no. and pin name

No.	Name	Name	No.
74	VCC	CONFIG_2	75
72	VCC	NC	73
70	VCC	GND	71
68	FORCE_USB_BOOT(1.8V)	CONFIG_1	69
66	SIM1_DETECT(1.8V)	RESET#(3.3V/1.8V)	67
64	COEX_1(1.8V)	ANTCTL3(1.8V)	65
62	COEX_2(1.8V)	ANTCTL2(1.8V)	63
60	WLAN_TX_EN(1.8V)	ANTCTL1(1.8V)	61
58	RFFE_SDATA(1.8V)	LAA_TX_EN(1.8V)	59
56	RFFE_SCLK(1.8V)	GND	57
54	PEWAKE# (3.3/1.8V)	REFCLKP	55
		REFCLKN	53

Pin	Left Signal		Right Signal	Pin
			GND	51
50	PERST# (3.3/1.8V)		PERp0	49
48	UIM2_PWR		PERn0	47
46	UIM2_RESET		GND	45
44	UIM2_CLK		PETp0	43
42	UIM2_DATA		PETn0	41
40	SIM2_DETECT1.8V		GND	39
38	NC		USB_SS-Rx+	37
36	UIM1_PWR		USB_SS-Rx-	35
34	UIM1_DATA		GND	33
32	UIM1_CLK		USB_SS-Tx+	31
30	UIM1_RESET		USB_SS-Tx-	29
28	I2S_WA (1.8V)		GND	27
26	W_DISABLE2#(3.3/1.8V)		DPR(3.3/1.8V)	25
24	I2S_TX (1.8V)		WOWWAN#(1.8V)	23
22	I2S_RX (1.8V)		CONFIG_0	21
20	I2S_CLK (1.8V)		Notch	
	Notch		Notch	
	Notch		Notch	
	Notch		Notch	
	Notch		GND	11
10	LED1#(OD)		USB D-	9
8	W_DISABLE1#(3.3/1.8V)		USB D+	7
6	FULL_CARD_POWER_OFF#		GND	5
4	VCC		GND	3
2	VCC		CONFIG_3	1

Fibocom

3.1.2 Pin Definition

Table 3-2 Pin definition

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
1	CONFIG_3	O	NC	NC, FM160 M.2 module is configured as the WWAN – PCIe with the USB_SS interface type	-
2	VCC	PI	-	Power input	Power Supply
3	GND	-	-	GND	Power Supply
4	VCC	PI	-	Power input	Power Supply
5	GND	-	-	GND	Power Supply
6	FULL_CARD_POWER_OFF#	I	PU	Module power-on/off control, the module is powered off when the pin is at low level, and the module is powered on when the pin is floating or at high level. Pulled up through Internal 390KΩ resistor.	3.3V/1.8V
7	USB D+	I/O	-	USB 2.0 Data+	0.3V-3V
8	W_DISABLE1#	I	PU	Disable flight mode of WWAN module, active low	3.3V/1.8V
9	USB D-	I/		USB 2.0 Data–	0.3V-3V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
		O			
10	LED1#	O	T	System status LED driving pin, OD-gate output.	-
11	GND	-	-	GND	Power Supply
12	Notch	-	-	Notch	-
13	Notch	-	-	Notch	-
14	Notch	-	-	Notch	-
15	Notch	-	-	Notch	-
16	Notch	-	-	Notch	-
17	Notch	-	-	Notch	-
18	Notch	-	-	Notch	-
19	Notch	-	-	Notch	-
20	I2S_CLK	O	PD	I2S Serial clock	1.8V
21	CONFIG_0	-	NC	NC, FM160 M.2 module is configured as the WWAN – PCIe with the USB_SS interface type	-
22	I2S_RX	I	PD	I2S Serial receive data	1.8V
23	WOWWAN#	O	PD	Wake up host	1.8V
24	I2S_TX	O	PD	I2S Serial transmit data	1.8V
25	DPR	I	PU	Dynamic power control for SAR interrupt detection, active low,	3.3V/1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
				Reserved	
26	W_DISABLE2#	I	PU	Disable GNSS, active low	3.3V/1.8V
27	GND	-	-	GND	Power Supply
28	I2S_WA	O	PD	I2S Word selection, left/right channel	1.8V
29	USB_SS -TX-	O	-	Negative end of USB super speed data transmitting	-
30	UIM1_RESET	O	L	SIM1 reset signal	1.8V/3V
31	USB_SS -TX+	O	-	Positive end of USB super speed data transmitting	-
32	UIM1_CLK	O	L	SIM card 1 clock	1.8V/3V
33	GND	-	-	GND	Power Supply
34	UIM1_DATA	I/O	L	SIM card 1 data	1.8V/3V
35	USB_SS-RX -	I	-	Negative end of USB super speed data receiving	-
36	UIM1_PWR	PO	-	SIM card 1 power supply, 3V/1.8V	1.8V/3V
37	USB_SS-RX+	I	-	Positive end of USB super speed data receiving	1.8V
38	NC	-	-	-	-

![Fibocom]

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
39	GND	-	-	GND	Power Supply
40	SIM2_DETECT	I	PU	SIM card 2 detection, internally pulled up through 390KΩ resistor, Active high by default	1.8V
41	PETn0	O	-	Negative end of PCIe data TX	-
42	UIM2_DATA	I/O	L	SIM card 2 data	3V/1.8V
43	PETp0	O	-	Positive end of PCIe data TX	-
44	UIM2_CLK	O	L	SIM card 2 clock	3V/1.8V
45	GND	-	-	GND	Power Supply
46	UIM2_RESET	O	L	SIM card 2 reset	3V/1.8V
47	PERn0	I	-	Negative end of PCIe data RX	-
48	UIM2_PWR	PO	-	SIM card 2 power supply	3V/1.8V
49	PERp0	I	-	Positive end of PCIe data RX	-
50	PERST#	I	PD	Module PCIe interface reset. Active low, internally pulled up through 10KΩ resistor	3.3V/1.8V
51	GND	-	-	GND	Power Supply
52	CLKREQ#	I/	T	Device requests a PCIe	3.3V/1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
		O		reference clock to transmit data. It is also used by L1 power management status mechanism. Host or device initiates an L1 exit. Active low, open drain output, An external pull-up resistor must be reserved.	
53	REFCLKN	I	-	PCIe Reference Clock signal Differential Negative	-
54	PEWAKE#	O	T	Wake up system and restore PCIe link from L2 to L0, depending on whether the system supports wakeup functionality. Active low, open drain output. An external pull-up resistor must be reserved	3.3V/1.8V
55	REFCLKP	I	-	PCIe Reference Clock signal Differential Positive	-
56	RFFE_SCLK	O	PD	RFFE-MIPI serial clock signal	1.8V
57	GND	-	-	GND	Power Supply
58	RFFE_SDATA	I/O	PD	RFFE-MIPI serial data signal	1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
59	LAA_TX_EN	O	PD	A high level is output to disable 5 GHz WLAN LNAs when n79 transmitting power exceeds TBD dBm	1.8V
60	WLAN_TX_EN	I	-	A high level on this pin disables n79 LNAs. Normally this signal is from external 5 GHz WLAN when its transmitting power exceeds a threshold.	1.8V
61	ANTCTL1	O	PD	Tunable antenna control bit 1	1.8V
62	COEX_2	I	PD	BT-SIG based module public network RF and WiFi/BT wireless coexistence management. This function is used specifically for UART receiving.	1.8V
63	ANTCTL2	O	PD	Tunable antenna control bit 2	1.8V
64	COEX_1	O	PD	BT-SIG based module public network RF and WiFi/BT wireless coexistence management. This function is used specifically for UART receiving.	1.8V
65	ANTCTL3	O	PD	Tunable antenna control bit 3	Power Supply
66	SIM1_DETECT	I	PU	SIM card 1 Detection, pulled up through 390KΩ internal resistor, Active high by default, indicating	1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
				SIM card available	
67	RESET#	I	PU	Module reset, pulled up through 390KΩ internal resistor, active low.	3.3V/1.8V
68	FORCE_USB_BOOT	I	-	After the pin is pulled up to 1.8V during power-on, the module will enter the USB download mode. The pin is used for updating the software of module. If it is floating or pulled to low level, the module will enter the normal mode.	1.8V
69	CONFIG_1	O	GND	GND, FM160 M.2 module is configured as the WWAN – PCIe with the USB_SS interface type	-
70	VCC	PI	-	Power input	Power Supply
71	GND	-	-	GND	Power Supply
72	VCC	PI	-	Power input	Power Supply
73	NC	-	-	-	-
74	VCC	PI	-	Power input	Power Supply

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
75	CONFIG_2	O	NC	NC, FM160 M.2 module is configured as the WWAN – PCIe with the USB_SS interface type	-

Reset Value: The initial status after module reset, not the status when working.

H: High Level

L: Low Level

PD: Pull-Down

PU: Pull-Up

T: Tri-state, high impedance

OD: Open Drain

PI: Power Input

PO: Power Output

⚠ **Note：**

1. The unused pins can be left floating.

2. All interfaces that support 3.3V voltage are based on the input voltage of +3.3V power supply. When the input voltage range of the power supply changes from 3.135V to 4.4V, the corresponding interface voltage changes accordingly.

4 Structural Specification

4.1 Product Appearance

The appearance of the FM160 module product is as shown:

Figure 4-1 Module product appearance

4.2 Dimension of Structure

The structural dimensions of the FM160 module are shown in the figure:

![FIBOCOM]
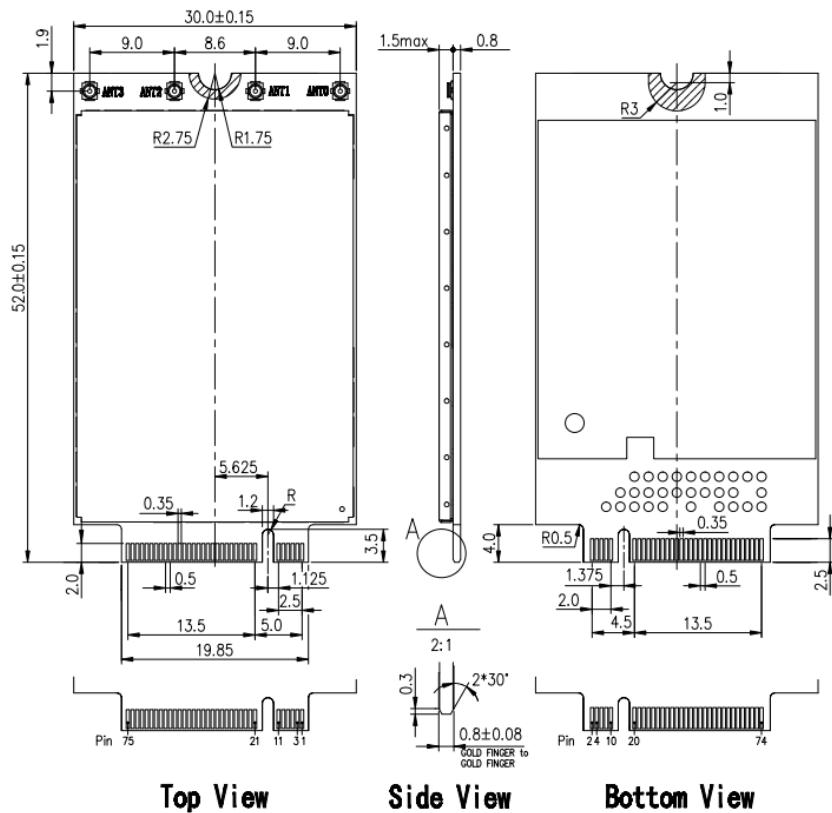
Figure 4-2 Structure size chart

⚠️ **Note：**

Unmarked dimensional tolerances are 0.1mm.

4.3 Storage

Storage Conditions (recommended): Temperature is 23±5ºC, relative humidity less than RH 60%.

Storage period: Under the recommended storage conditions, the storage life is 12 months.

.

4.4 Packing

The FM160 module uses the tray sealed package, combined with the outer packing method using the

hard cartoon box, the modules can be protected to the greatest extent during storage, transportation and

use.

⚠️ **Note：**

The module is a precision electronic product, and may suffer permanent damage if no correct electrostatic protection measures are taken.