



FN980 Family HW Design Guide

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APPLICABILITY TABLE

PRODUCTS

- ■ FN980 - 3G / 4G / 5G Sub-6 cellular module
- ■ FN980m - 3G / 4G / 5G Sub-6 / 5G mmWave cellular module

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1. INTRODUCTION

1.1. Scope

This document introduces the Telit FN980 Family module and presents possible and recommended hardware solutions for developing a product based on this module. All the features and solutions detailed in this document are applicable to all FN980 Family variants, where 'FN980 Family' refers to the variants listed in the applicability table.

If a specific feature is applicable to a specific product only, it will be clearly marked.



Information – FN980 Family refers to all modules listed in the Applicability Table.

This document takes into account all the basic functions of a wireless module; a valid hardware solution is suggested for each function, and incorrect solutions and common errors to be avoided are pointed out.

Obviously, this document cannot embrace every hardware solution or every product that can be designed. Where the suggested hardware configurations need not be considered mandatory, the information given should be used as a guide and a starting point for properly developing your product with the Telit FN980 Family module.



Information – The integration of the 3G/4G/5G FN980 Family cellular module within a user application must be done according to the design rules described in this manual.

1.2. Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using the Telit FN980 Family module.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

<http://www.telit.com>

To register for product news and announcements or for product questions contact Telit's Technical Support Center (TTSC).

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Text Conventions



Danger – This information **MUST** be followed or catastrophic equipment failure or bodily injury may occur.



Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.



Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5. Related Documents

- FN980 Family SW User Guide, 1VV0301615
- FN980 Family AT Commands Reference Guide, 80624ST10996A
- Generic EVB HW User Guide, 1VV0301249
- FN980 Family Interface Board HW User Guide, 1VV0301651
- FN980 Family Thermal Design Guide, 1VV0301610

2. GENERAL PRODUCT DESCRIPTION

2.1. Overview

The aim of this document is to present possible and recommended hardware solutions useful for developing a product with the Telit FN980 Family M.2 module.

FN980 Family is Telit's platform for M.2 module for applications, such as M2M applications and industrial IoT device platforms, based on the following technologies:

- 5G mmWave and sub-6/4G/3G networks for data communication
- Designed for industrial grade quality

In its most basic use case, FN980 Family can be applied as a wireless communication front-end for mobile products, offering mobile communication features to an external host CPU through its rich interfaces.

FN980m is available in hardware variants as listed in [APPLICABILITY TABLE](#)

The designated RF band sets per each variant are detailed in Section 2.2, [Frequency Bands and CA combinations](#)

2.2. Frequency Bands and CA combinations

2.2.1. Frequency bands

The operating frequencies in 5G, LTE and WCDMA modes conform to the 3GPP specifications.

Following the list of operating frequencies on 5G, LTE and WCDMA mode.

5G NR Sub 6 Bands supportive

NR BAND	Duplex Mode	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channels	SCS (kHz)
n1 - 2100	FDD	1920 - 1980	2110 - 2170	Tx: 384000 - 396000 Rx: 422000 - 434000	15
n2 - 1900 PCS	FDD	1850 - 1910	1930 - 1990	Tx: 370000 - 382000 Rx: 386000 - 398000	15
n3 - 1800	FDD	1710 - 1785	1805 - 1880	Tx: 342000 - 357000 Rx: 361000 - 376000	15
n5 - 850	FDD	824 - 849	869 - 894	Tx: 164800 - 169800 Rx: 173800 - 178800	15
n7 - 2600	FDD	2500 - 2570	2620 - 2690	Tx: 500000 - 514000 Rx: 524000 - 538000	15
n8 - 900	FDD	880 - 915	925 - 960	Tx: 176000 - 183000 Rx: 185000 - 192000	15

n12 - 700 a	FDD	699 - 716	729 - 746	Tx: 139800 - 143200 Rx: 145800 - 149200	15
n20 - 800	FDD	832 - 862	791 - 821	Tx: 166400 - 172400 Rx: 158200 - 164200	15
n25 -1900+	FDD	1850 - 1915	1930 - 1995	Tx: 370000 - 383000 Rx: 386000 - 399000	15
n28 - 700 APT	FDD	703 - 748	758 - 803	Tx: 140600 - 149600 Rx: 151600 - 160600	15
n38 - 2600	TDD	2570 - 2620		T/Rx: 514000 - 524000	30
n40 - 2300	TDD	2300 - 2400		T/Rx: 460000 - 480000	30
n41 - 2600+	TDD	2496 - 2690		T/Rx: 499200 - 537996	30
n48 - 3600	TDD	3550 - 3700		T/Rx: 636668 - 646666	30
n66 - AWS-4	FDD	1710 - 1800	2110 - 2200	Tx: 342000 - 356000 Rx: 422000 - 440000	15
n71 - 600	FDD	663 - 698	617 - 652	Tx: 132600 - 139600 Rx: 123400 - 130400	15
n77 - 3700	TDD	3300 - 4200		T/Rx: 620000 - 680000	30
n78 - 3500	TDD	3300 - 3800		T/Rx: 620000 - 653332	30
n79 - 4500	TDD	4400 - 5000		T/Rx: 693334 - 733332	30

5G NR mmWave Bands supportive (Supported by FN980m)

NR BAND	Duplex Mode	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channels	SCS (kHz)
n257- 28 GHz	TDD	26500 - 29500		T/Rx: 2054167 - 2104168	120
n258 - 26 GHz	TDD	24250 - 27500		T/Rx: 2016667 - 2070831	120
n260 - 39 GHz	TDD	37000 - 40000		T/Rx: 2229167 - 2279165	120
n261- 28 GHz US	TDD	27500 - 28350		T/Rx: 2070833 - 2084999	120

LTE Bands supportive

E-UTRA BAND	Duplex Mode	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channels
B1 - 2100	FDD	1920 - 1980	2110 - 2170	Tx: 18000 - 18599 Rx: 0 - 599
B2 - 1900 PCS	FDD	1850 - 1910	1930 - 1990	Tx: 18600 - 19199

				Rx: 600 - 1199
B3 - 1800+	FDD	1710 - 1785	1805 - 1880	Tx: 19200 - 19949 Rx: 1200 - 1949
B4 - AWS-1	FDD	1710 - 1755	2110 - 2155	Tx: 19950 - 20399 Rx: 1950 - 2399
B5 - 850	FDD	824 - 849	869 - 894	Tx: 20400 - 20649 Rx: 2400 - 2649
B7 - 2600	FDD	2500 - 2570	2620 - 2690	Tx: 20750 - 21449 Rx: 2750 - 3449
B8 - 900 GSM	FDD	880 - 915	925 - 960	Tx: 21450 - 21799 Rx: 3450 - 3799
B12 - 700 a	FDD	699 - 716	729 - 746	Tx : 23010 - 23179 Rx : 5010 - 5179
B13 - 700 c	FDD	777 - 787	746 - 756	Tx : 27210 - 27659 Rx : 9210 - 9659
B14 - 700 PS	FDD	788 - 798	758 - 768	Tx : 23280 - 23379 Rx : 5280 - 5379
B17 - 700 b	FDD	704 - 716	734 - 746	Tx: 23730 - 23849 Rx: 5730 - 5849
B18 - 800 Lower	FDD	815 - 830	860 - 875	Tx: 23850 - 23999 Rx: 5850 - 5999
B19 - 800 Upper	FDD	830 - 845	875 - 890	Tx: 24000 - 24149 Rx: 6000 - 6149
B20 - 800 DD	FDD	832 - 862	791 - 821	Tx: 24150 - 24449 Rx: 6150 - 6449
B25 - 1900+	FDD	1850 - 1915	1930 - 1995	Tx: 8040 - 8689 Rx: 26040 - 26689
B26 - 850+	FDD	814 - 849	859 - 894	Tx: 8690 - 9039 Rx: 26690 - 27039
B28 - 700 APT	FDD	703 - 748	758 - 803	Tx: 9210 - 9659 Rx: 27210 - 27659
B29 - 700 d	FDD	N/A	717 - 728	Rx: 9660 - 9769
B30 - 2300 WCS	FDD	2305 - 2315	2350 - 2360	Tx: 9770 - 9869 Rx: 27660 - 27759
B32 - 1500 L	FDD	N/A	1452 - 1496	Rx: 9920 - 10359
B34 - 2000	TDD	2010 – 2025		T/Rx: 36200 - 36349
B38 - 2600	TDD	2570 - 2620		T/Rx: 37750 - 38250
B39 - 1900+	TDD	1880 - 1920		T/Rx: 38250 - 38649
B40 - 2300	TDD	2300 - 2400		T/Rx: 38650 - 39650
B41 - 2600+	TDD	2496 - 2690		T/Rx: 39650 - 41589
B42 - 3500	TDD	3400 - 3600		T/Rx: 41590 - 43589

B43 - 3700	TDD	3600 – 3800		T/Rx: 43590 – 45589
B46 - 5200	TDD	5150 – 5925 (DL only)		Rx: 46790 - 54539
B48 - 3600	TDD	3550 - 3700		T/Rx: 55240 - 56739
B66 - AWS-3	FDD	1710 - 1780	2110 - 2200	Tx: 66436 - 67335 Rx: 131972 - 132671
B71 - 600	FDD	663 - 698	617 - 652	Tx: 133122 - 133471 Rx: 68586 - 68935

WCDMA Bands supportive

UTRA BAND	Duplex Mode	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Channels
B1 - 2100	FDD	1920 - 1980	2110 - 2170	Tx: 9612 - 9888 Rx: 10562 - 10838
B2 - 1900 PCS	FDD	1850 - 1910	1930 - 1990	Tx: 9262 - 9538 Rx: 9662 - 9938
B4 - AWS-1	FDD	1710 - 1755	2110 - 2155	Tx: 1537 - 1738 Rx: 1312 - 1513
B5 - 850	FDD	824 - 849	869 - 894	Tx: 4132 - 4233 Rx: 4357 - 4458
B6 - 850 Japan	FDD	830 - 840	875 - 885	Tx: 4162 - 4188 Rx: 4387 - 4413
B8 - 900 GSM	FDD	880 - 915	925 - 960	Tx: 2712 - 2863 Rx: 2937 - 3088
B9 - 1800 Japan	FDD	1750 - 1785	1845 - 1880	Tx: 8762 - 8912 Rx: 9237 - 9387
B19 - 800 Japan	FDD	830 - 845	875 - 890	Tx: 312 - 363 Rx: 712 - 763

2.2.2. CA / MIMO / EN-DC

The FN980 Family supports CA/MIMO/EN-DC configuration.

2.3. Target market

FN980 Family can be used for telematics applications where tamper-resistance, confidentiality, integrity, and authenticity of end-user information are required, for example:

- Industrial equipment
- Home network
- Internet connectivity

2.4. Main features

The FN980 Family of industrial grade cellular modules features 5G mmWave/Sub-6, LTE and multi-RAT module together with an on-chip powerful application processor and a rich set of interfaces.

Main functions and features are listed below:

Main Features

Function	Features
Physical	M.2 Type 3050-D2-B
Cellular technology	5G: FR1(Sub 6G), optional FR2(mmWave), Rel 15 4G: CAT. 20 (2Gbps) on DL, CAT. 18 (211Mbps) on UL, Rel 14 3G: HSPA+ Rel8 up to 42/5.7Mbps in DL/UL
4x4 MIMO	5G: n1/n2/n3/n7/n25/n38/n40/n41/n48/n66/n77/n78/n79 4G: B1/B2/B3/B4/B7/B25/B30/B66/B38/B39/B40/B41/B42/B43/B48/B46
Diversity/2nd Rx	4G: all operating bands 3G: all operating bands
GNSS	Dual-Frequency GNSS Upper L-band: GPS/Glonass/Beidou/Galileo Lower L-band: GPS/Galileo
USIM port – dual voltage	Support for SIM Class B and Class C support Clock rates up to 4 MHz
Application processor	Application processor to run customer application code 32 bit ARM Cortex-A7 up to 1.5 GHz running the Linux operating system 4Gbit NAND Flash + 4Gbit LPDDR4 MCP is supported
Main Interfaces	PCIe Gen3 x 1-lane USB 3.1 Gen 2 Peripheral Ports – GPIOs
Antenna connection	4 x MHF-4 type Cellular/GNSS antenna connectors 1 x MHF-4 type Dedicated GNSS antenna connector

Function	Features
	4 x mmWave 2 in 1 IF connectors
Form factor	M.2 Form factor (30 * 50 * 3.4 mm), accommodating the multiple RF bands
Environment and quality requirements	The device is designed and qualified by Telit to satisfy environmental and quality requirements.
Single supply module	The module internally generates all its required internal supply voltages.
RTC	Real-time clock is supported.
Operating temperature	Range -40 °C to +85 °C (conditions as defined in Section 2.8.1, Temperature Range)

2.4.1. Configurations Pins

Telit M.2 module indicates the main serial interface applicable on the combination of 4 configuration pins. FN980 Family is configured as an USB 3.1 Gen 2.

Pin	Signal	State	Interface Type
21	CONFIG_0	GND	USB 3.1 Gen 2 Port Configuration 0 (Applicable to WWAN only)
69	CONFIG_1	GND	
75	CONFIG_2	GND	
1	CONFIG_3	NC	



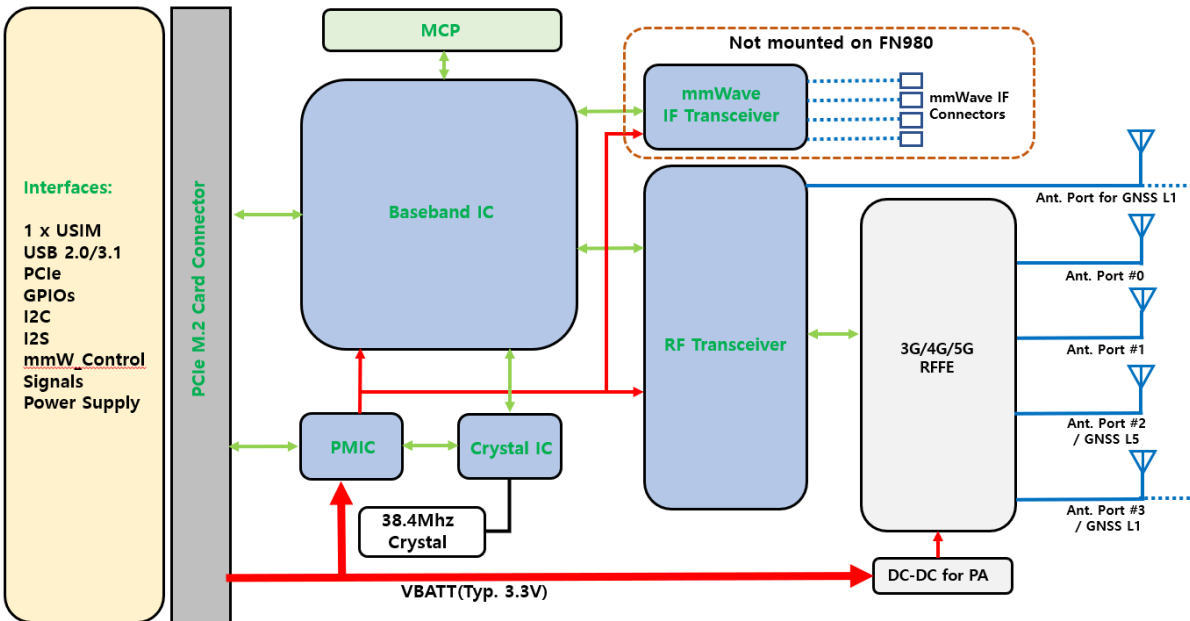
Information – On the platform side, each of the CONFIG_0 to CONFIG_4 signals needs to be fitted with a pull-up resistor. Based on the state of the configuration pins on the Add-in Card, being tied to GND or left No Connect (NC), the sensed pins will create a 4-bit logic state that required decoding.

For more details, please refer to PCI Express M.2 Specification document.

2.5. Block Diagram

Below figure shows an overview of the internal architecture of the FN980 Family module.

FN980 Family Block Diagram



2.6. RF performance

The RF performance in 5G, LTE and WCDMA modes conform to the 3GPP specifications.

2.6.1. Conducted Transmit Output Power

TX power follows the measurement conditions and specifications defined in 3GPP.

Band	Power class	RF Power (dBm)
5G NR Sub-6		
n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79	3 (0.2W)	23 (+2dB / -2dB)
5G NR Sub-6 n41 Supports Power Class 2	2 (0.4W)	26 (+2dB / -2dB)
5G NR mmWave (OTA) _ Supported by FN980m n257, n258, n260, n261	3 (0.2W)	23 (+2dB / -2dB)

LTE All Bands		
B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B30, B34, B38, B39, B40, B41, B42, B43, B48, B66, B71	3 (0.2W)	23 (+2dB / -2dB)
LTE B41 Supports Power Class 2	2 (0.4W)	26 (+2dB / -2dB)
3G WCDMA		
B1, B2, B3, B4, B5, B6, B8, B9, B19	3 (0.2W)	23 (+2dB / -2dB)

2.6.2. Conducted Receiver Sensitivity

Receiver Sensitivity follows the measurement conditions and specifications defined in 3GPP.

Technology	3GPP Compliance
5G NR Sub-6	Throughput >95%
5G NR mmWave	Throughput >95%
4G LTE	Throughput >95%
3G WCDMA	BER <0.1% 12.2 Kbps

E-UTRA Band	Conductive typical Rx Sensitivity (dBm) *				
Antenna Configuration	PRx	DRx	MIMO 0	MIMO 1	Combined
LTE FDD B1	-97	-98	-97	-97	-103
LTE FDD B2	-97	-97	-97	-97	-103
LTE FDD B3	-97	-98	-97	-97	-103
LTE FDD B4	-97	-98	-97	-97	-103
LTE FDD B5	-99	-99	NA	NA	-102
LTE FDD B7	-96	-97	-97	-97	-102
LTE FDD B8	-99	-99	NA	NA	-102
LTE FDD B12	-99	-99	NA	NA	-102
LTE FDD B13	-99	-99	NA	NA	-102
LTE FDD B14	-99	-99	NA	NA	-102

LTE FDD B17	-99	-99	NA	NA	-102
LTE FDD B18	-99	-99	NA	NA	-102
LTE FDD B19	-99	-99	NA	NA	-102
LTE FDD B20	-99	-99	NA	NA	-102
LTE FDD B25	-97	-97	-97	-97	-103
LTE FDD B26	-99	-99	NA	NA	-102
LTE FDD B28	-99	-99	NA	NA	-102
LTE FDD B29 (DL only)	-99	-99	NA	NA	-102
LTE FDD B30	-96	-98	-97	-97	-102
LTE FDD B32	-97	-98	-97	-97	-102
LTE TDD B34	-97	-98	NA	NA	-100
LTE TDD B38	-97	-97	-96	-96	-102
LTE TDD B39	-97	-98	-97	-97	-103
LTE TDD B40	-96	-98	-96	-96	-102
LTE TDD B41	-96	-97	-96	-96	-102
LTE TDD B42	-96	-97	-96	-96	-102
LTE TDD B43	-96	-97	-96	-96	-102
LTE TDD B46 (DL only)	-93	-92	-92	-93	-98
LTE TDD B48	-96	-97	-96	-97	-102
LTE FDD B66	-97	-97	-97	-97	-103
LTE FDD B71	-99	-99	NA	NA	-102

UTRA Band	Conductive typical Rx Sensitivity (dBm) *				
Antenna Configuration	PRx	DRx	MIMO 0	MIMO 1	Combined
WCDMA FDD B1	-110	-110	NA	NA	NA
WCDMA FDD B2	-110	-110	NA	NA	NA
WCDMA FDD B3	-110	-110	NA	NA	NA
WCDMA FDD B4	-110	-110	NA	NA	NA
WCDMA FDD B5	-110	-110	NA	NA	NA

WCDMA FDD B6	-110	-110	NA	NA	NA
WCDMA FDD B8	-110	-110	NA	NA	NA
WCDMA FDD B9	-110	-110	NA	NA	NA
WCDMA FDD B19	-110	-110	NA	NA	NA

* 3.3 Voltage / Room temperature



Information – The sensitivity level has a deviation about +/- <2dB, device and channel because the level shows typical value.

LTE level is measured at BW 10 MHz except Band46

B46 BW = 20 MHz

2.7. Mechanical specifications

2.7.1. Dimensions

FN980 Family module overall dimensions are:

- Length: 50.00 mm, +/- 0.15 mm tolerance
- Width: 30.00 mm, +/- 0.15 mm tolerance
- Thickness: 3.40 mm, +/- 0.15 mm tolerance

2.7.2. Weight

The nominal weight of the FN980 module is 10.4 grams.

The nominal weight of the FN980m module is 10.5 grams.

2.8. Environmental Requirements

2.8.1. Temperature Range

Note		
Operating Temperature Range	–20°C ~ +55°C	This range is defined by 3GPP (the global standard for wireless mobile communication). Telit guarantees its modules to comply with all 3GPP requirements and to have full functionality of the module within this range.
	–40°C ~ +85°C	Telit guarantees full functionality within this range as well. However, there may possibly

Note	
	be some performance deviations in this extended range relative to 3GPP requirements, which means that some RF parameters may deviate from the 3GPP specification in the order of a few dB. For example: receiver sensitivity or maximum output power may be slightly degraded. Even so, all the functionalities, such as call connection, SMS, USB communication, UART activation etc., will be maintained, and the effect of such degradations will not lead to malfunction.
Storage and non-operating Temperature Range	–40°C ~ +85°C



Warning – The temperature of application processor which is in FN980 Family must be kept below 95°C for the best performance. Depending on the various application, it can be required a heat sink, thermal pad or other cooling system to dissipate heat well.

There is the large solder resist opening area on the bottom side of the module. Adding a TIM on that area with a heatsink is one of the best way to dissipate heat well.

The temperature can be read via AT commands.

For more details, please refer to SW user guide or thermal design guideline.

2.8.2. RoHS Compliance

As a part of the Telit corporate policy of environmental protection, the FN980 Family complies with the RoHS (Restriction of Hazardous Substances) directive of the European Union (EU directive 2011/65/EU).

3. PINS ALLOCATION

3.1. Pin-out

FN980 Family Pin-out

Pin	Signal	I/O	Function	Type	Comment
USB Communication Port					
7	USB_HS_DP	I/O	USB 2.0 Data Plus	Analog	
9	USB_HS_DM	I/O	USB 2.0 Data Minus	Analog	
29	USB_SS_TX_M	O	USB 3.0 super-speed transmit - Minus	Analog	
31	USB_SS_TX_P	O	USB 3.0 super-speed transmit - Plus	Analog	
35	USB_SS_RX_M	I	USB 3.0 super-speed receive - Minus	Analog	
37	USB_SS_RX_P	I	USB 3.0 super-speed receive - Plus	Analog	
PCIe Communication Port					
43	PCIE_TX0_P	O	PCIe transmit 0 – plus	Analog	
41	PCIE_TX0_M	O	PCIe transmit 0 – minus	Analog	
49	PCIE_RX0_P	I	PCIe receive 0 – plus	Analog	
47	PCIE_RX0_M	I	PCIe receive 0 – minus	Analog	
55	PCIE_REFCLK_P	I	PCI Express differential reference clock – plus	Analog	
53	PCIE_REFCLK_M	I	PCI Express differential reference clock – minus	Analog	
52	PCIE_CLKREQ_N	I/O	PCIe reference clock request signal.	3.3V	

50	PCIE_RESET_N	I	Functional reset to the PCIe bus	3.3V	
54	PCIE_WAKE_N	I/O	PCIe wake-up	3.3V	
SIM Card Interface 1					
36	UIM1_VCC	O	Supply output for an external UIM1 card	1.8V / 2.85V	Power
34	UIM1_DATA	I/O	Data connection with an external UIM1 card	1.8V / 2.85V	
32	UIM1_CLK	O	Clock output to an external UIM1 card	1.8V / 2.85V	
30	UIM1_RESET_N	O	Reset output to an external UIM1 card	1.8V / 2.85V	
66	UIM1_PRESENT	I	UIM1 Card Present Detect	1.8V	
mmWave control Signal					
40	QTM0_PON	O	External mmW module control	1.8V	
42	QTM1_PON	O	External mmW module control	1.8V	
44	QTM2_PON	O	External mmW module control	1.8V	
46	QTM3_PON	O	External mmW module control	1.8V	
48	VREG_S4E_1P904	O	External mmW Voltage	1.9V	Power
Miscellaneous Functions					
6	FULL_CARD_POWER_OFF_N	I	Module On/Off	1.8V/3.3V	Open Drain 3.3V Tolerance
8	W_DISABLE_N	I	RF disable	3.3V	Active Low

10	LED	O	LED control	Open Drain
23	WAKE_ON_WAN	O	Wake Host	1.8V
59	HST_WL_TX_EN	I	Notification pin from external Wireless LAN to modem	1.8V
65	VDD_1P8_DIG_L6	O	Reference Voltage	1.8V Power
67	SYS_RESIN_N	I	Reset Input	1.8V
68	TGPIO_01	I/O	General Purpose I/O	1.8V
25	DPR	I/O	Dynamic power control Can be TGPIO_02	1.8V
62	TGPIO_03	I/O	General Purpose I/O Can be COEX_RX	1.8V
64	TGPIO_04	I/O	General Purpose I/O Can be COEX_TX	1.8V
56	I2C_SDA	I/O	I2C Data Can be TGPIO_09	1.8V
58	I2C_SCL	I/O	I2C Clock Can be TGPIO_10	1.8V
20	TGPIO_05	I/O	General Purpose I/O Can be I2S_CLK	1.8V
22	TGPIO_06	I/O	General Purpose I/O Can be I2S_DIN	1.8V
24	TGPIO_07	I/O	General Purpose I/O Can be I2S_DOUT	1.8V
28	TGPIO_08	I/O	General Purpose I/O Can be I2S_WS	1.8V

60	TGPIO_11	I/O	General Purpose I/O	1.8V
38	TGPIO_12	I/O	General Purpose I/O	1.8V
26	TGPIO_13	I/O	General Purpose I/O Can be W_DISABLE2_N	1.8V
MIPI Control				
63	RFFE0_CLK	O	Clock	1.8V
61	RFFE0_DATA	I/O	Data	1.8V
Power Supply				
2	VPH_PWR	I	Power supply	Power
4	VPH_PWR	I	Power supply	Power
70	VPH_PWR	I	Power supply	Power
72	VPH_PWR	I	Power supply	Power
74	VPH_PWR	I	Power supply	Power
GROUND				
3	GND	-	Ground	Ground
5	GND	-	Ground	Ground
11	GND	-	Ground	Ground
27	GND	-	Ground	Ground
33	GND	-	Ground	Ground
39	GND	-	Ground	Ground
45	GND	-	Ground	Ground

51	GND	-	Ground	Ground
57	GND	-	Ground	Ground
71	GND	-	Ground	Ground
73	GND	-	Ground	Ground
Config				
21	CONFIG_0	-	GND	
69	CONFIG_1	-	GND	
75	CONFIG_2	-	GND	
1	CONFIG_3	-	Floating	



Information – If I2C interfaces are used, pull-up registers in a customer board are required.



Information – Unless otherwise specified, RESERVED pins must be left unconnected (Floating).

3.2. FN980 Family Signals That Must be Connected

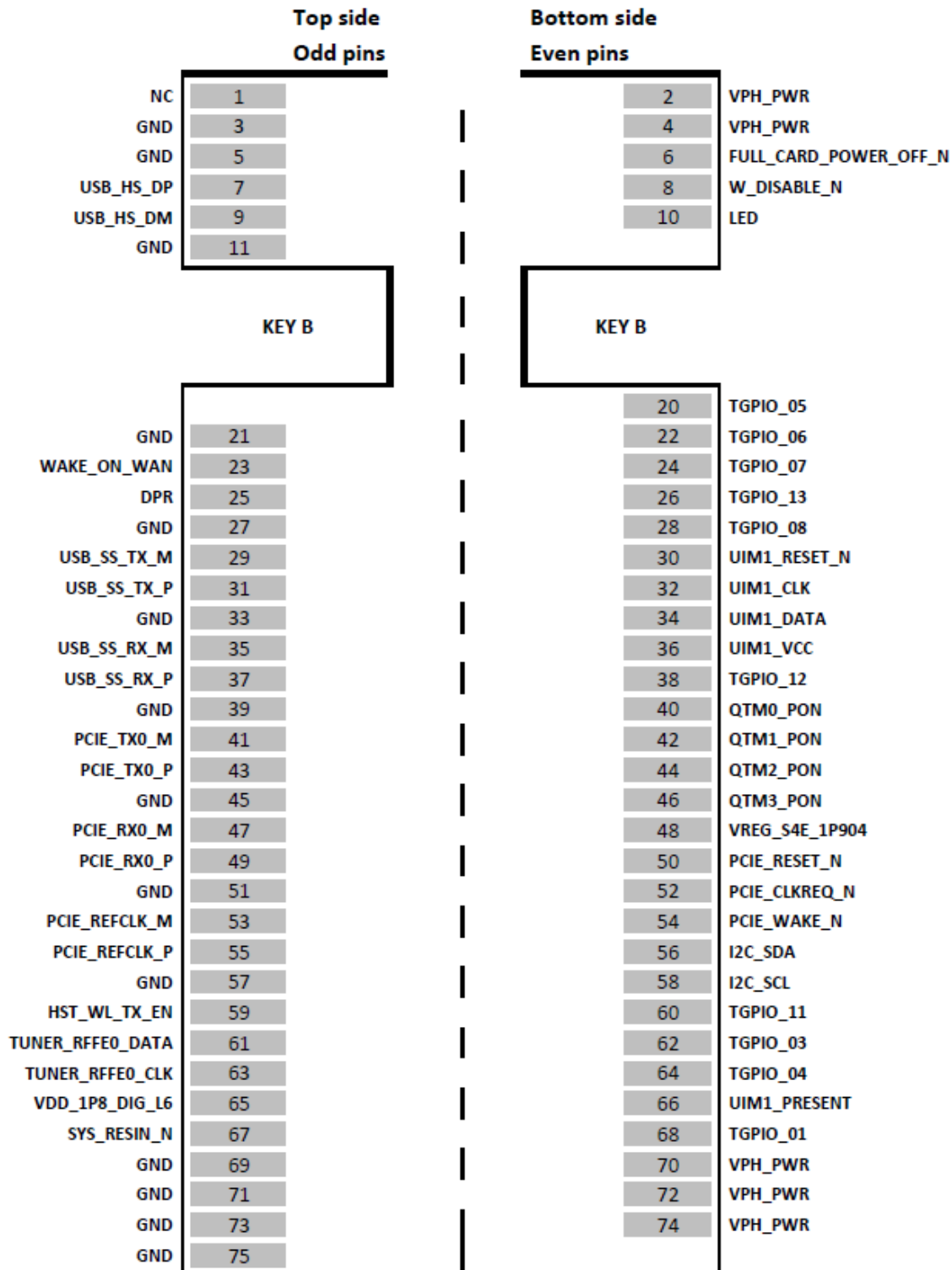
Below table specifies the FN980 Family signals that must be connected for a debugging purpose even if not used by the end application:

Mandatory Signals

Pin	Signal	Notes
2, 4, 70, 72, 74	VBATT	
3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73	GND	

Pin	Signal	Notes
7	USB_D+	If not used, connect to a test point or an USB connector
9	USB_D-	If not used, connect to a test point or an USB connector

3.3. Pin Layout



4. POWER SUPPLY

The power supply circuitry and board layout are very important parts of the full product design, with critical impact on the overall product performance. Read the following requirements and guidelines carefully to ensure a good and proper design.

4.1. Power Supply Requirements

The FN980 Family power requirements are as follows:

Power Supply Requirements

Nominal supply voltage	3.3V
Supply voltage range	3.1V – 3.6V
Maximum ripple on module input supply	30 mV
Peak current consumption without mmWave antenna module	3.3V @ 4 A

4.2. Power Consumption

Below table provides typical current consumption values of FN980 Family for various operation modes.

FN980 Family Current Consumption

Mode	Average [Typ.]	Mode Description
IDLE Mode		
CFUN=1	35mA	No call connection USB2.0 is connected to a host
Airplane Mode (PSMWDISACFG=1, W_DISABLE_N: Low)		
CFUN=4	< 4mA	Tx and Rx are disabled; module is not registered on the network (Airplane mode) USB is disconnected
Sleep Mode (PSMWDISACFG=1, W_DISABLE_N: Low)		
CFUN=1	< 5mA	Module cycles between wake and sleep USB is disconnected
Operative Mode (WCDMA)		
WCDMA Voice	930mA	WCDMA B1 voice call (Tx=23dBm)

Mode	Average [Typ.]	Mode Description
WCDMA HSPA	850mA	WCDMA data call (DC-HSDPA up to 42Mbps, Max through-put)
Operative Mode (LTE)		
Single mode (1DL/1UL SISO)	800mA	Non-CA ,B2 BW 5MHz, 1 RB, 23dBm, QPSK DL / QPSK UL
2DLCA(4x4MIMO) with 2ULCA(SISO)	1300mA	CA_2A-66A, BW 20MHz, Full RB, 256QAM DL / 256QAM UL(800Mbps DL / 170Mbps UL)
7DLCA(2x2MIMO) with 1UL(SISO)	1500mA	CA_2A-13A-46D-66A-66A, Full RB, 256QAM DL/ 64QAM UL(1300Mbps DL / 75Mbps UL)
5DLCA (4x4MIMO) With 1UL(SISO)	1900mA	CA_1A-3C-7C, Full RB, 256QAM DL/ 64QAM UL(2Gbps DL / 75Mbps UL)
Operative Mode (NR-FR1)		
NSA mode 1CC+1FR1	1000mA	EN-DC_1A(1DL/UL SISO)-n78A(1DL/1UL SISO) LTE : BW 20MHz, 1 RB, QPSK DL / QPSK UL, 23dBm FR1 : BW 100MHz, Inner RB 137(Number)@64(Position), QPSK DL / QPSK UL, 23 dBm
NSA mode 5CC+1FR1	2300mA	EN-DC_1A-3C-7C(5DL 4x4MIMO/1UL SISO)-n78(1DL 4x4MIMO/1UL SISO) LTE : BW 20MHz, Full RB, 256QAM DL / 64QAM UL(2Gbps DL / 75Mbps UL) FR1 : BW100MHz, Full RB, 256QAM DL / 256QAM UL(1.6Gbps DL/118Mbps)
Operative Mode (NR-FR2)		
TBD	TBD	TBD

* Worst/best case current values depend on network configuration - not under module control.

** Loop-back mode in call equipment

*** 3.3 voltage / room temperature



Information – The current consumption of FN980m can be too much different according to mmWave antenna module.

The budget of power supply chain should be over 4A@3.3V without mmWave antenna module to operate FN980m without any malfunction caused by the power supply.

The peak current of FN980m with mmWave antenna will be addressed later.

4.3. General Design Rules

The principal guidelines for the Power Supply Design embrace three different design steps:

- Electrical design
- Thermal design
- PCB layout

4.3.1. Electrical Design Guidelines

The electrical design of the power supply strongly depends on the power source from which power is drained.

4.3.1.1. +5V Source Power Supply Design Guidelines

- The desired output for the power supply is 3.3V. Being the difference between the input source and the desired output moderate, a linear regulator can be used. A switching power supply is preferred to reduce power consumption.
- When using a linear regulator, a proper heat sink must be provided to dissipate the power generated.
- A bypass low ESR capacitor of adequate capacity must be provided to cut the current absorption peaks close to the FN980 Family module. A 100 µF tantalum capacitor is usually suitable on VBATT.
- Make sure that the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input to protect the FN980 Family module from power polarity inversion.

4.3.2. Thermal Design Guidelines

The aim of this chapter is to provide thermal design guidelines useful for developing a product with the Telit FN980 Family.

Proper thermal protection design protects against human or component damage for worst-case conditions.

And it reduces the probability of failure and does not adversely affect the use of the module, and greatly extends the operation time with maximum performance.

For more details, please refer to thermal design guideline.



Information – FN980 Family supports various RAT such as 3G, 4G, 5G Sub6 and mmW.

Based on RF transmission mode, FN980 Family can consumes a lot of current. Therefore proper thermal designs to dissipate heat well is essential.



Information – There is the large solder resist opening area on the bottom side of the module. Adding a TIM on that area with a heatsink is one of the best way to dissipate heat well.

The temperature can be read via AT commands.



Information – The FN980 Family must be connected to the ground and metal chassis of the host board for best RF performance, thermal dispersion and also fixing the module.

- The two holes at the top of the module and the main ground of the host board must be fastened together.
- The module shield and the host device main board or the metal chassis of the host device should be connected by means of conductive materials.

4.3.3. Power Supply PCB layout Guidelines

As described in the electrical design guidelines, the power supply must have a low ESR capacitor on the output to cut current peaks and a protection diode on the input to protect the supply from spikes and polarity inversion. Placement of these components is crucial for the correct operation of the circuitry: a misplaced component can be useless or can even decrease the power supply performances.

- The bypass low ESR capacitor must be placed close to the FN980 Family power input pins or - if the power supply is of a switching type - it can be placed close to the inductor to reduce ripple, as long as the PCB trace from the capacitor to FN980 Family is wide enough to ensure a drop-less connection even during the 4A current peaks.

- The protection diode must be placed close to the input connector where the power source is drained.
- The PCB traces from the input connector to the power regulator IC must be wide enough to ensure that no voltage drops occur during the 4A current peaks.
- The PCB traces to FN980 Family and the bypass capacitor must be wide enough to ensure that no significant voltage drops occur when the 4A current peaks are absorbed. This is needed for the same above-mentioned reasons. These traces should be kept as short as possible.
- The PCB traces connecting the switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the diode very close to the power switching IC (only for the switching power supply). This is done to reduce the radiated field (noise) at the switching frequency (usually 100-500 kHz).
- Use a good common ground plane.
- Place the power supply on the board in a way to guarantee that the high current return paths in the ground plane do not overlap any noise sensitive circuitry, such as the microphone amplifier/buffer or earphone amplifier.
- The power supply input cables must be kept separate from noise sensitive lines, such as microphone/earphone cables.

4.4. RTC

The RTC within the FN980 Family module does not have a dedicated RTC supply pin. The RTC block is supplied by the VBATT supply.

If VBATT power is removed, RTC is not maintained so if maintaining an internal RTC is needed, VBATT must be supplied continuously.

4.5. Reference Voltage

1.8V regulated power supply output is provided as the reference voltage to a host board. This output is active when the module is ON and goes OFF when the module is shut down.

This table lists the VDD_1P8_DIG_L6 signal of FN980 Family.

FN980 Family Reference Voltage

PIN	Signal	I/O	Function	Type	Comment
65	VDD_1P8_DIG_L6	O	Reference Voltage	power	1.8V

4.6. Internal LDO for GNSS bias

The LDO for GNSS bias is applied inside the FN980 Family model.

The voltage supply come from FN980 Family's LDO to GNSS active antenna.

This table lists the LDO for GNSS bias of FN980 Family.

FN980 Family Reference Voltage when VBATT is 3.3

Symbol	Parameter	Min	Typ	Max	Unit
$V_{\text{GNSS DC bias}}$	Voltage of Internal LDO for GNSS bias	2.9	3.1	3.15	[V]
$I_{\text{GNSS DC bias}}$	Current of Internal LDO for GNSS bias	-	-	100	[mA]

5. ELECTRICAL SPECIFICATIONS

5.1. Absolute Maximum Ratings – Not Optional



Caution – A deviation from the value ranges listed below may harm the FN980 Family module.

Absolute Maximum Ratings – Not Operational

Symbol	Parameter	Min	Max	Unit
VBATT	Battery supply voltage on pin VBATT	-0.5	+4.2	[V]

5.2. Recommended Operating Conditions

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
T _{amb}	Ambient temperature	-40	+25	+85	[°C]
VBATT	Battery supply voltage on pin VBATT	3.1	3.3	3.6	[V]
I _{VBATT}	Peak current on pin VBATT Without mmW antenna module	-	-	4	[A]

6. DIGITAL SECTION

6.1. Logic levels

Unless otherwise specified, all the interface circuits of the FN980 Family are 1.8V CMOS logic.

Only USIM interfaces are capable of dual voltage I/O.

The following tables show the logic level specifications used in the FN980 Family interface circuits. The data specified in the tables below is valid throughout all drive strengths and the entire temperature ranges.



Caution – Do not connect FN980 Family’s digital logic signal directly to OEM’s digital logic signal with a level higher than 2.3V for 1.8V CMOS signals.

6.1.1. 1.8V Pins – Absolute Maximum Ratings

Absolute Maximum Ratings – Not Functional

Parameter	Min	Max
Input level on any digital pin when on	--	+2.13V
Input voltage on analog pins when on	--	+2.13 V

6.1.2. 1.8V Standard GPIOs

Operating Range – Interface Levels (1.8V CMOS)

Parameter	Min	Max	Unit	Comment
V _{IH} Input high level	1.17V	2.1V	[V]	
V _{IL} Input low level	-0.3V	0.63V	[V]	
V _{OH} Output high level	1.35V	1.8V	[V]	
V _{OL} Output low level	0V	0.45V	[V]	
I _{IL} Low-level input leakage current	-1	--	[uA]	No pull-up
I _{IH} High-level input leakage current	--	1	[uA]	No pull-down
I _{ILPU} Low-level input leakage current	-97.5	-27.5	[uA]	With pull-up

	Parameter	Min	Max	Unit	Comment
I _{IHPD}	High-level input leakage current	27.5	97.5	[uA]	With pull-down
C _{I/O}	I/O capacitance	--	5	[pF]	

6.1.3. 1.8V SIM Card Pins

Operating Range – SIM Pins Working at 1.8V

	Parameter	Min	Max	Unit	Comment
V _{IH}	Input high level	1.26V	2.1V	[V]	
V _{IL}	Input low level	-0.3V	0.36V	[V]	
V _{OH}	Output high level	1.44V	1.8V	[V]	
V _{OL}	Output low level	0V	0.4V	[V]	
I _{IL}	Low-level input leakage current	--	1000	[uA]	No pull-up
I _{IH}	High-level input leakage current	-20	20	[uA]	No pull-down

6.1.4. 2.85V Pins – Absolute Maximum Ratings

Absolute Maximum Ratings – Not Functional

Parameter	Min	Max
Input level on any digital pin when on	--	+3.42V
Input voltage on analog pins when on	--	+3.42 V

6.1.5. SIM Card Pins @2.85V

Operating Range – For SIM Pins Operating at 2.85V

	Parameter	Min	Max	Unit	Comment
V _{IH}	Input high level	1.995V	3.15V	[V]	
V _{IL}	Input low level	-0.3V	0.57V	[V]	

Parameter	Min	Max	Unit	Comment
V _{OH} Output high level	2.28V	2.85V	[V]	
V _{OL} Output low level	0V	0.4V	[V]	
I _{IL} Low-level input leakage current	--	1000	[uA]	No pull-up
I _{IH} High-level input leakage current	-20	20	[uA]	No pull-down

6.2. Power On

To turn on the FN980 Family, the FULL_CARD_POWER_OFF_N pin must be asserted high.



Information – To turn on the FN980 Family module, the SYS_RESIN_N pin must not be asserted low.

6.2.1. Initialization and Activation State

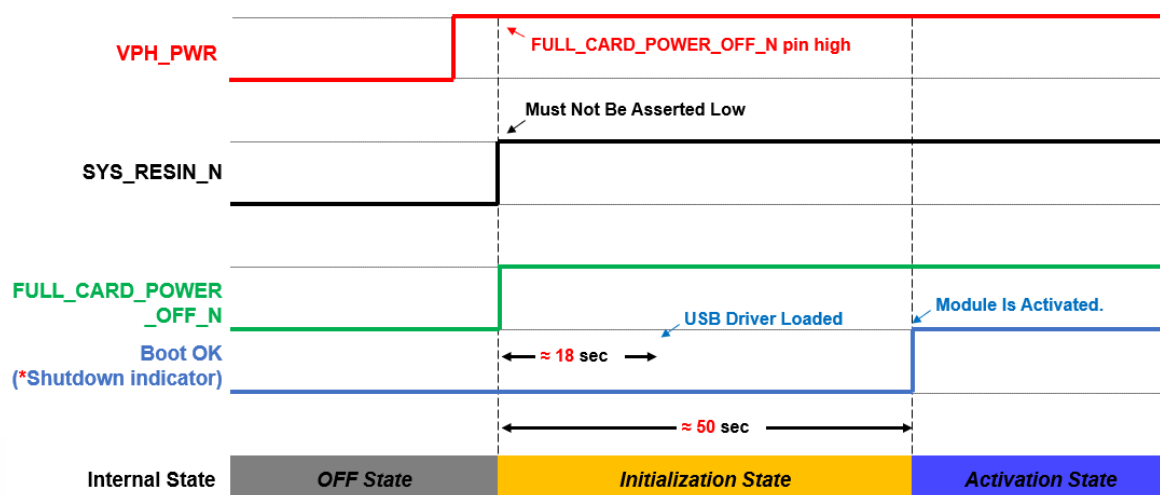
After turning on the FN980 Family module, the FN980 Family is not yet activated because the SW initialization process takes some time to complete.

For this reason, it is recommended not to communicate with the FN980 Family during the Initialization phase.

The AT command interface is accessible via USB port, but this does not mean that it works fully.

In general, as shown in below figure, the FN980 Family becomes fully operational (in the Activation state) at least 50 seconds after the FULL_CARD_POWER_OFF_N is asserted.

FN980 Family Initialization and Activation





Information – To verify if the FN980 Family has powered up properly, please check through below explanation:

* Monitoring BOOT_OK(Shutdown indicator) pin. When the status translates to high, module is completely boot. To use Boot OK (Shutdown indicator), shutdown indication function must be enabled through AT#SHDNIND command (Refer to the AT Reference guide document).

Information – Active low signals are labeled with a name that ends with “_N”



Information – To avoid a back-powering effect, it is recommended to avoid having any HIGH logic level signal applied to the digital pins of the module when it is powered OFF or during an ON/OFF transition.

6.3. Power off

Power off the device can be done in three different ways:

- Graceful Shutdown by FULL_CARD_POWER_OFF_N
- Fast Shutdown by GPIO triggered

6.3.1. Graceful Shutdown

To shutdown the FN980 Family module safely, host can use the graceful shutdown function.

The graceful shutdown can be triggered by:

- FULL_CARD_POWER_OFF_N

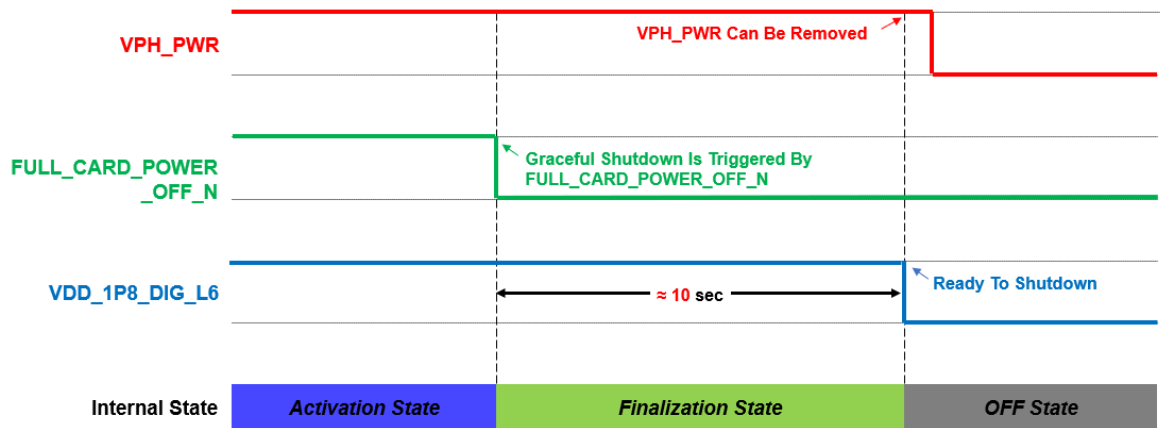
6.3.1.1. Graceful Shutdown by FULL_CARD_POWER_OFF_N

To gracefully shutdown the FN980 Family module, FULL_CARD_POWER_OFF_N should be asserted to Low.

Once FULL_CARD_POWER_OFF_N should be asserted to Low, the FN980 Family module enters finalization state, terminates active processes and prepares to turn off safely.

As shown in the diagram below, VDD_1P8_DIG_L6 will indicate when the module is ready to be turned off.

Graceful Shutdown by FULL_CARD_POWER_OFF_N



6.3.2. Fast Shutdown

For a quicker shutdown of the FN980 Family module, the host can use the fast shutdown function.

Fast shutdown can be triggered by:

- GPIO

6.3.2.1. Fast Shutdown by GPIO

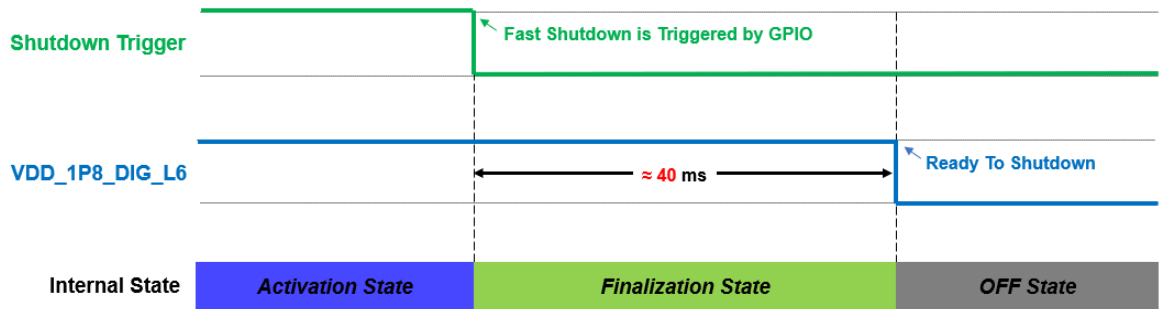
If properly configured, one of GPIO lines can be used as Fast Shutdown Trigger.

Once the Fast Shutdown Trigger senses a HIGH to LOW transition, fast shutdown is triggered.

Then the FN980 Family module enters finalization state, terminates active processes and prepares to turn off safely. As shown in below figure, when the module is ready to be turned off, it will be indicated via VDD_1P8_DIG_L6.

Please refer to the AT User Guide for more detail about enable Shutdown Indicator and Fast Shutdown Trigger.

Fast Shutdown by GPIO

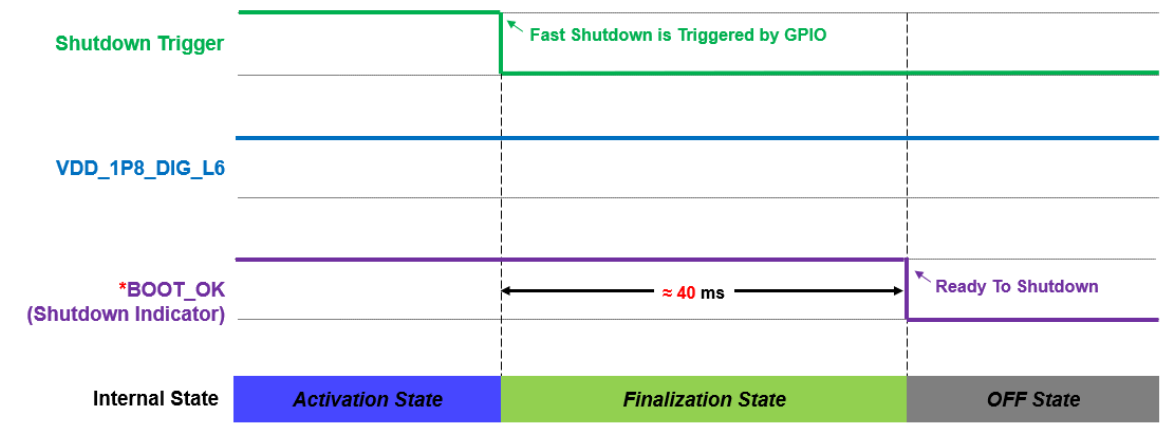




Information – Using a Fast shutdown without shutdown indicator function, FULL_CARD_POWER_OFF_N pin should be controlled to prevent the FN980 Family module rebooting.

For more information, please refer to AT Commands Reference Guide and SW User Guide document.

Fast Shutdown by GPIO (*SHDNIND Enable, Optional)



Information – *Shutdown Indicator is optional function and disabled by default. Host can verify the module entered OFF state by Shutdown Indicator pin. To turn on the module after using a fast shutdown with shutdown indicator function, should be re-powered or reboot.

For more information, please refer to AT Commands Reference Guide and SW User Guide document.



Information – Fast shutdown function is default disabled. To use Fast shutdown function, please refer to AT Commands Reference Guide and SW User Guide document.



Warning – If the VPH_PWR remains to be maintained a high status, module will be re-booting.(Not Applicable to SHDNIND function)



Warning – Not following the recommended shut-down procedures might damage the device and consequently void the warranty.

6.4. Reset

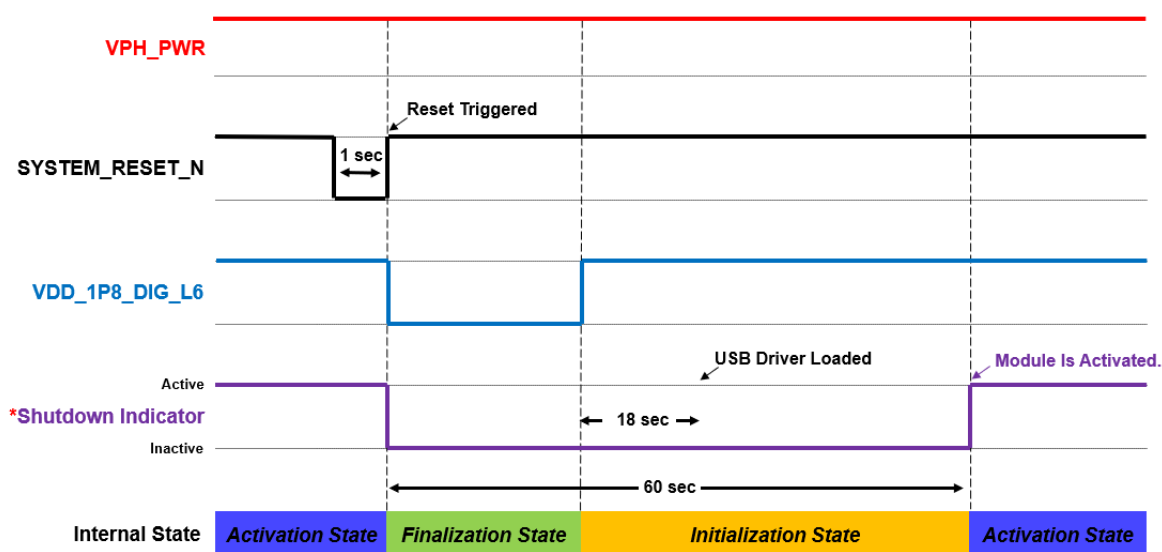
Device reset can be achieved as follows:

- Unconditional Reset using the SYS_RESIN_N

6.4.1. Unconditional Hardware Reset

To unconditionally restart the FN980 Family module, the SYS_RESIN_N pin must be asserted low more than 1 second and then released.

Unconditional Hardware Reset by SYS_RESIN_N Pad



Information – *Shutdown Indicator is optional function. If SHDNIND is enable, can verify the status via SHDNIND function.

Please refer to AT commands user guide document.



Information – Unconditional Hardware Reset must be used only as an emergency exit procedure, and not as a normal power-off operation.

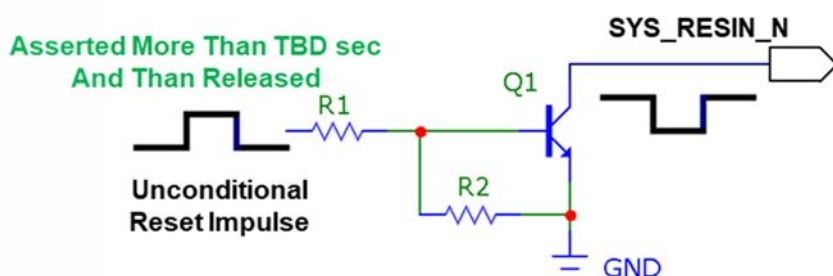


Information – Do not use any pull-up resistor on the RESET_N line or any totem pole digital output. Using a pull-up resistor may cause latch-up problems on the FN980 Family power regulator and improper functioning of the module.

The RESET_N line must be connected only in an open-collector configuration.

Below figure shows a simple circuit for this action.

Circuit for RESET by SYSTEM_RESET_N



6.5. Communication ports

Below table summarizes all the hardware interfaces of the FN980 Family module.

FN980 Family Hardware Interfaces

Interface	FN980 Family
PCIe	Peripheral Component Interconnect Express Gen 3.0
USB	USB3.1 Gen 2 interface
USIM	x1 dual voltage each (1.8V/2.85V)
eSIM	Embedded SIM
I2C	I2C
I2S	I2S

mmWave	x4 mmWave antenna interface
Antenna ports	x4 Cellular, 1 for GNSS

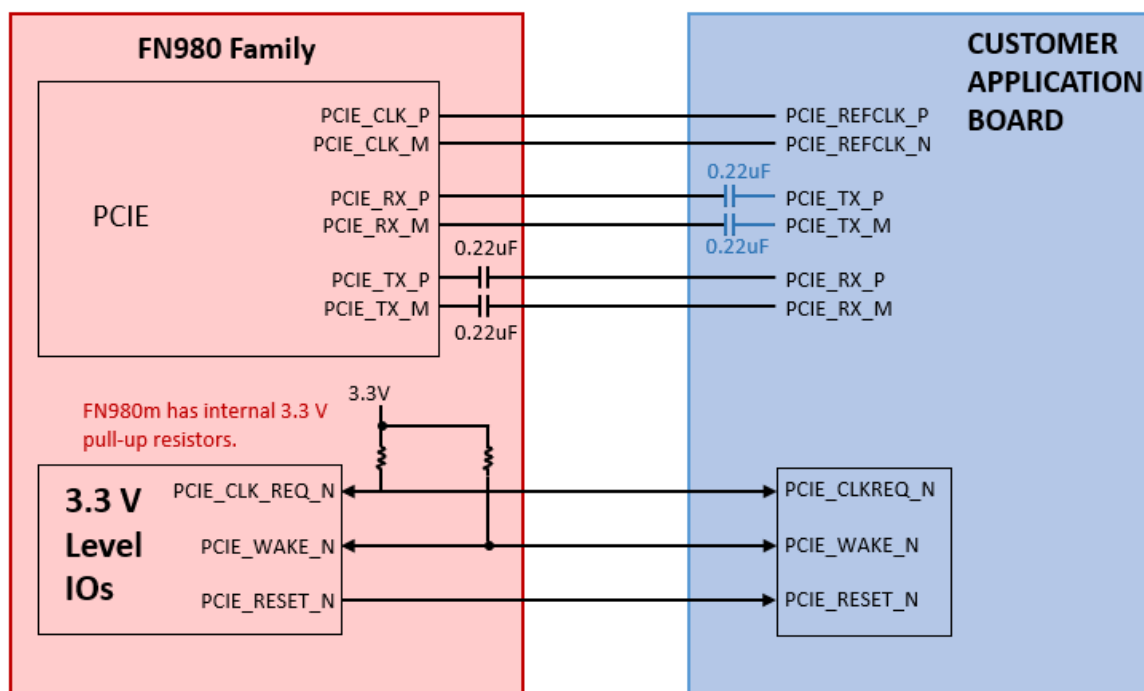
6.5.1. PCIe interface

The FN980 Family module includes PCIe interface.

PCIe needs AC coupling series capacitors on the TX lines in both directions. In order to interface PCIe with the application board controlling the modem, 0.22uF capacitors should be installed on PCIE_RX_P/M lines of the FN980 Family. Series capacitors are already placed on PCIE_TX_P/M lines inside FN980 Family module.

The PCIe interface suggested connection is the following:

Connection for PCIe Interface



*CUSTOMER : Need to series capacitor (0.22uF) at PCIE_TX_P/M Lines



Information – The PCIe signal traces must be carefully routed: minimize trace lengths, number of vias, and capacitive loading. The impedance value should be as close as possible to 90 Ohms differential.

Below table lists the PCIe interface signals.

PCIe Interface Signals

PIN	Signal	I/O	Function	Type	Comment
43	PCIE_TX0_P	O	PCIe transmit 0 – plus	Analog	
41	PCIE_TX0_M	O	PCIe transmit 0 – minus	Analog	
49	PCIE_RX0_P	I	PCIe receive 0 – plus	Analog	
47	PCIE_RX0_M	I	PCIe receive 0 – minus	Analog	
52	PCIE_CLKREQ_N	I/O	PCIe reference clock request signal.	3.3V	
53	PCIE_REFCLK_M	I	PCI Express differential reference clock – minus		
55	PCIE_REFCLK_P	I	PCI Express differential reference clock – plus		
50	PCIE_RESET_N	I	Functional reset to the PCIe bus	3.3V	
54	PCIE_WAKE_N	I/O	PCIe wake-up	3.3V	



Information – Consider placing a low-capacitance ESD protection component to protect FN980 Family against ESD strikes

6.5.2. SIM Interface

The FN980 Family supports an external SIM interfaces (1.8V or 2.85V).

Below table lists the SIM interface signals.

SIM Interface Signals

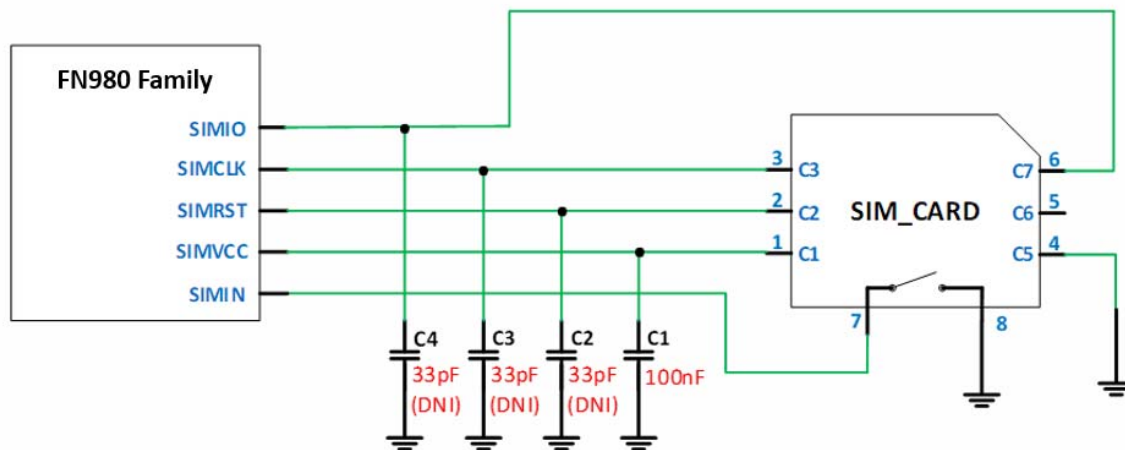
PIN	Signal	I/O	Function	Type	Comment
SIM Card Interface 1					
36	UIM1_1P8	O	Supply output for an external UIM1 card	1.8V / 2.85V	Power
34	UIM1_DATA	I/O	Data connection with an external UIM1 card	1.8V / 2.85V	

32	UIM1_CLK	O	Clock output to an external UIM1 card	1.8V / 2.85V
30	UIM1_RESET_N	O	Reset output to an external UIM1 card	1.8V / 2.85V
66	UIM1_PRESEN	I	SIM detect signal	1.8V

6.5.2.1. SIM Schematic Example

The following Figures illustrate in particular how the application interface should be designed.

SIM Schematics



Information – FN980 Family contains an internal pull-up resistor on SIMIO. It is not necessary to install external pull – up resistor.

6.5.3. eSIM interface

There is an embedded SIM on FN980 Family.

If you want to use the embedded SIM which is mounted on FN980 Family, please contact Telit Technical Support at

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com

6.5.3.1. W_DISABLE_N_3.3V

The W_DISABLE_N_3.3V signal is provided to trigger the FN980 Family to switch to airplane mode:

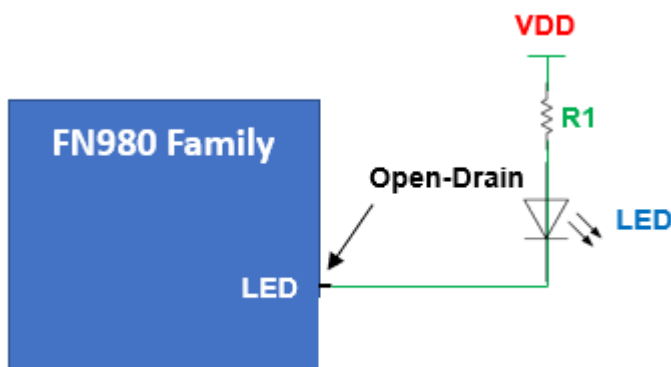
- Enter into the airplane mode: Low
- Normal operating mode: High or Leave the W_DISABLE_N not connected

6.5.3.2. LED

The LED signal drives the LED output.

The recommended LED connection is the following:

Recommended LED connection



R1 and VDD determine the brightness of LED and forward current.

When VDD is 3.3V and LED's forward voltage is 2.0V, it is recommended to use the value of R1 from 66 ohm to 250 ohm.

However, resistor value must be calculated considering the specification of the LED to use.



Information – If enable the LED function and connect the LED to the LED_N pin, current consumption may be increased.

6.5.4. General Purpose I/O

The general-purpose I/O pins can be configured to act in three different ways:

- Input
- Output
- Dedicate Function (Customer Requirement)

Input pins can only be read and report digital values (high or low) present on the pin at the read time.

Output pins can only be set or the pin level can be queried.

PIN	Signal	I/O	Function	Type	Comment
General Purpose I/O					
68	TGPIO_01	I/O	TGPIO_01	1.8V	
25	DPR	I/O	It can be TGPIO_02	1.8V	
62	TGPIO_03	I/O	It Can be COEX_RX	1.8V	
64	TGPIO_04	I/O	It Can be COEX_TX	1.8V	
20	TGPIO_05	I/O	It Can be I2S_CLK	1.8V	
22	TGPIO_06	I/O	It Can be I2S_DIN	1.8V	
24	TGPIO_07	I/O	It Can be I2S_DOUT	1.8V	
28	TGPIO_08	I/O	It can be I2S_WS	1.8V	
56	I2C_SDA	I/O	It can be TGPIO_09	1.8V	
58	I2C_SCL	I/O	It can be TGPIO_10	1.8V	
60	TGPIO_11	I/O	TGPIO_11	1.8V	
38	TGPIO_12	I/O	TGPIO_12	1.8V	
26	TGPIO_13	I/O	It can be W_DISABLE2_N	1.8V	

6.5.4.1. Using a GPIO Pin as Input

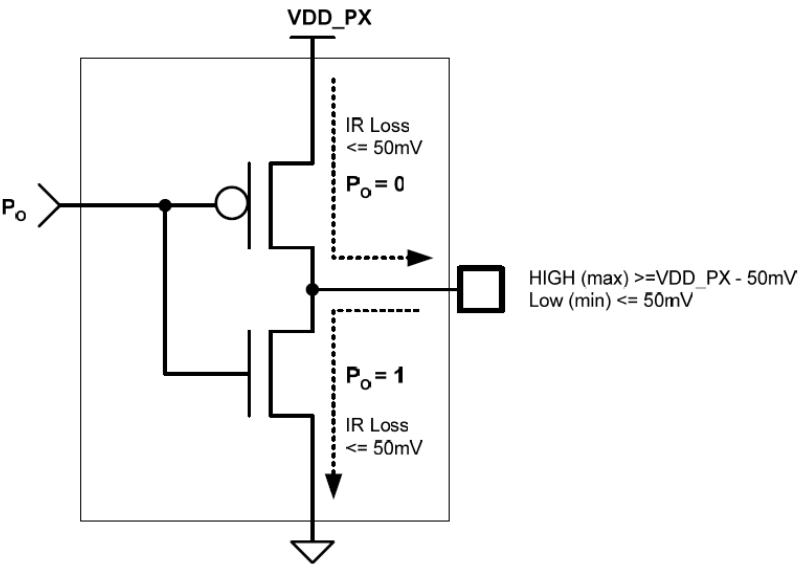
GPIO pins, when used as inputs, can be tied to a digital output of another device and report its status, provided the device interface levels are compatible with the GPIO 1.8V CMOS levels.

If a digital output of a device is tied to GPIO input, the pin has interface levels different than 1.8V CMOS. It can be buffered with an open collector transistor with a 47 k Ω pull-up resistor to 1.8V.

6.5.4.2. Using a GPIO Pin as Output

GPIO pins, when used as outputs, can drive 1.8V CMOS digital devices or compatible hardware. When set as outputs, the pins have a push-pull output, and therefore the pull-up resistor can be omitted.

GPIO Output Pin Equivalent Circuit



6.5.5. I2C – Inter-integrated circuit

The FN980 Family supports an I2C interface on the following pins:

Below table lists the I2C signals of FN980 Family.

Module I2C Signal

PIN	Signal	I/O	Function	Type	Comment
56	I2C_SDA	I/O	I2C Data	CMOS 1.8V	
58	I2C_SCL	O	I2C Clock	CMOS 1.8V	

The I2C interface is used for controlling peripherals inside the module (such as codec, etc.).



Information – If I2C interface are used, pull-up registers are required in the customer board.

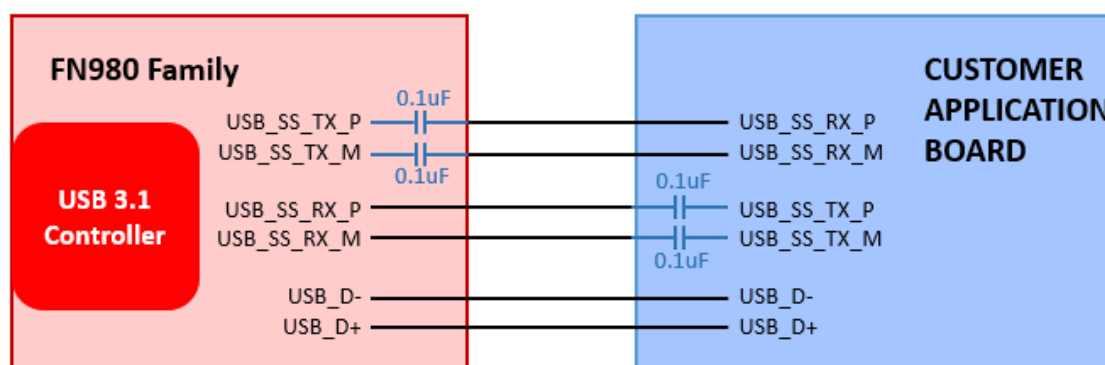
6.5.6. USB 3.1 Interface

The FN980 Family module includes super-speed USB3.1 Gen2 with high-speed USB2.0 backward compatibility. It is compliant with Universal Serial Bus Specification, Revision 3.0 and can be used for control and data transfers as well as for diagnostic monitoring and firmware update.

The USB port is typically the main interface between the FN980 Family module and OEM hardware. USB 3.1 needs AC coupling series capacitors on the TX lines in both directions. In order to interface USB3.1 with the application board controlling the modem, 0.1uF capacitors should be installed on USB_SS_RX_P/M lines of the FN980 Family. Series capacitors are already placed on USB_SS_TX_P/M lines inside FN980 Family Module.

The USB interface suggested connection is the following:

Connection for USB Interface



***CUSTOMER : Need series capacitors (0.1uF) on USB_SS_RX_P/M**



Information – The USB signal traces must be carefully routed: minimize trace lengths, number of vias, and capacitive loading. The impedance value should be as close as possible to 90 Ohms differential.

Below table lists the USB interface signals.

USB Interface Signals

PIN	Signal	I/O	Function	Type	Comment
7	USB_HS_DP	I/O	USB 2.0 DATA Plus	Analog	
9	USB_HS_DM	I/O	USB 2.0 DATA Minus	Analog	
29	USB_SS_TX_M	O	USB3.0 super-speed transmit-Minus	Analog	
31	USB_SS_TX_P	O	USB3.0 super-speed transmit-Plus	Analog	
35	USB_SS_RX_M	I	USB3.0 super-speed receive-Minus	Analog	
37	USB_SS_RX_P	I	USB3.0 super-speed receive-Plus	Analog	



Information – Consider placing a low-capacitance ESD protection component to protect FN980 Family against ESD strikes

7. RF SECTION

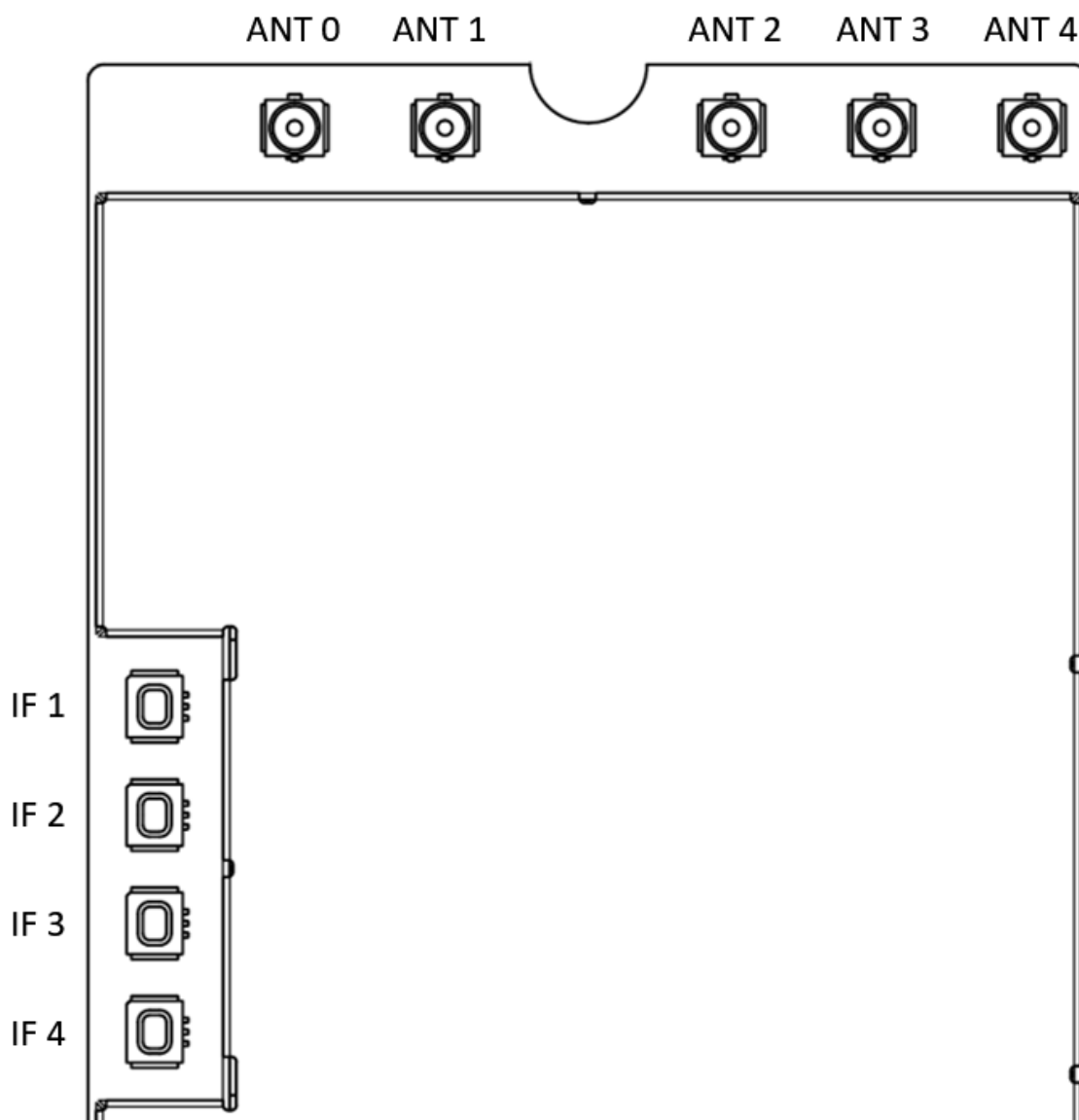
7.1. Antenna Interface

The antenna connection is one of the most important aspect in the entire application design as it strongly affects the overall radio performance. Hence, please read carefully and follow the requirements and the guidelines as much as possible.

FN980 Family provides four MHF-4 type RF connectors covering the 5G FR1/LTE/WCDMA bands including GNSS, one MHF-4 type RF connector for dedicated GNSS and four 2in1mmWave IF connectors for 5G FR2.

7.1.1. Antenna configuration

See the picture on the below for their position on the interface.



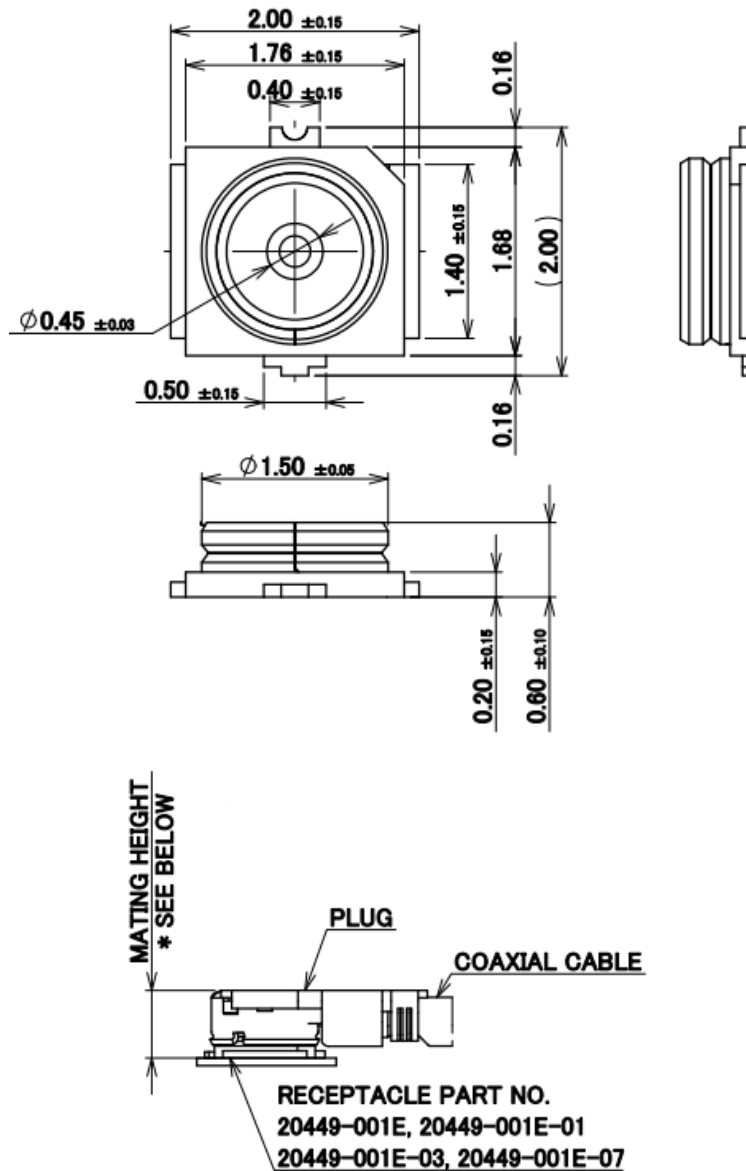
Refer to the following antenna configuration assigned.

Antenna port	Technology	Tx	Rx	GNSS
ANT 0	WCDMA	B1, B2, B4, B5, B6, B8, B9, B19	B1, B2, B4, B5, B6, B8, B9, B19	-
	LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B30, B34, B38, B39, B40, B41, B66, B71	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66, B71	-
	5G NR FR1	n1, n2, n3, n5, n7, n8, n12, n20, n28, n38, n40, n41, n66, n71	n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79	-
ANT 1	WCDMA	-	B1, B2, B4, B5, B6, B8, B9, B19	-
	LTE	B5, B20, B42, B43, B48, B71	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66, B71	-
	5G NR FR1	n5, n48, n77, n78, n79	n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79	-
ANT 2	WCDMA	-	-	-
	LTE	B1, B2, B3, B4, B7, B41, B66	B1, B2, B3, B4, B7, B25, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66	GPS L5, Galileo E5a
	5G NR FR1	n1, n2, n3, n7, n25, n41 n66, n77, n78, n79	n1, n2, n3, n7, n25, n38, n40, n41, n48, n66, n77, n78, n79	-
ANT 3	WCDMA	-	-	-
	LTE	-	B1, B2, B3, B4, B7, B25, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66	GPS L1, Galileo E1, Beidou B1, Glonass G1
	5G NR FR1	-	n1, n2, n3, n7, n25, n38, n40, n41, n48, n66, n77, n78, n79	-
ANT 4	GNSS	-	-	GPS L1, Galileo E1, Beidou B1, Glonass G1

7.2. Antenna Connector

The FN980 Family is equipped with a set of 50 Ω RF MHF-4 Receptacle from I-PEX 20449-001E.

For more information about mating connectors, please <https://www.i-pex.com>



* MATING HEIGHT

- 1.2 MAX. WITH 20611-001R, 20572-001R-08,
20448-00*R-081, 20448-001R-081E
- 1.4 MAX. WITH 20565-001R-**
- 1.7 MAX. WITH 20632-001R-37

MATING CONDITION
WITH MHF 4/MHF 4L PLUG

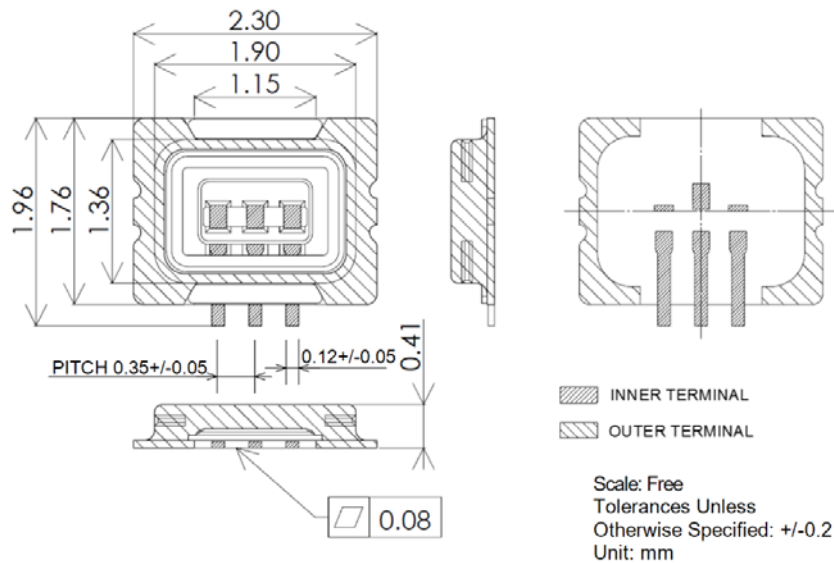
7.3. mmWave Antenna connector

The FN980m provides intermediate-frequency(IF) signal to use external 5G mmWave antenna modules.

7.3.1. mmWave IF connector

The FN980m is equipped with a set of 50 Ω RF Multi Line Connectors(MLC) of Murata, MM3929-2701A03.

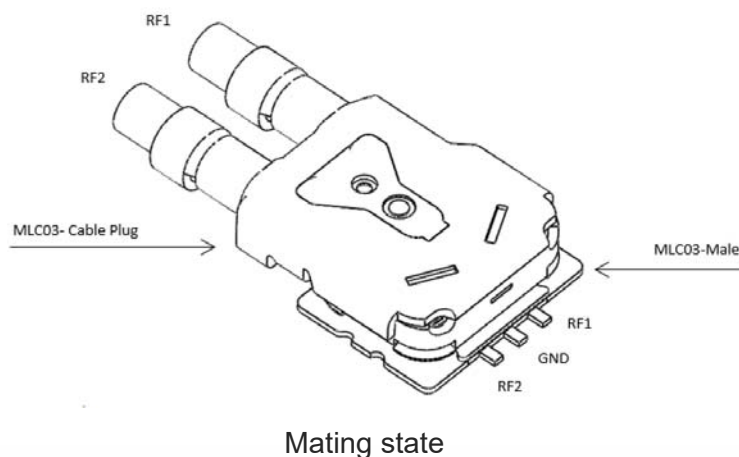
For more information about Multi line connectors, please <https://www.murata.com>

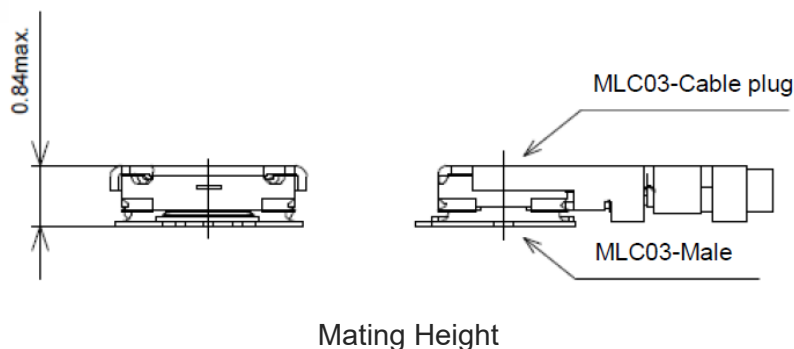


7.3.2. Cable for mmWave IF

Connecting cables between the FN980m and the antenna modules must use mating cables of Murata, MXCG series.

For more information about mating connectors, please <https://www.murata.com>





7.3.3. mmWave Antenna Assembly

FN980m supports Low Power mode (7.3.3.1. QTM525) and High Power mode (7.3.3.2. QTM527)

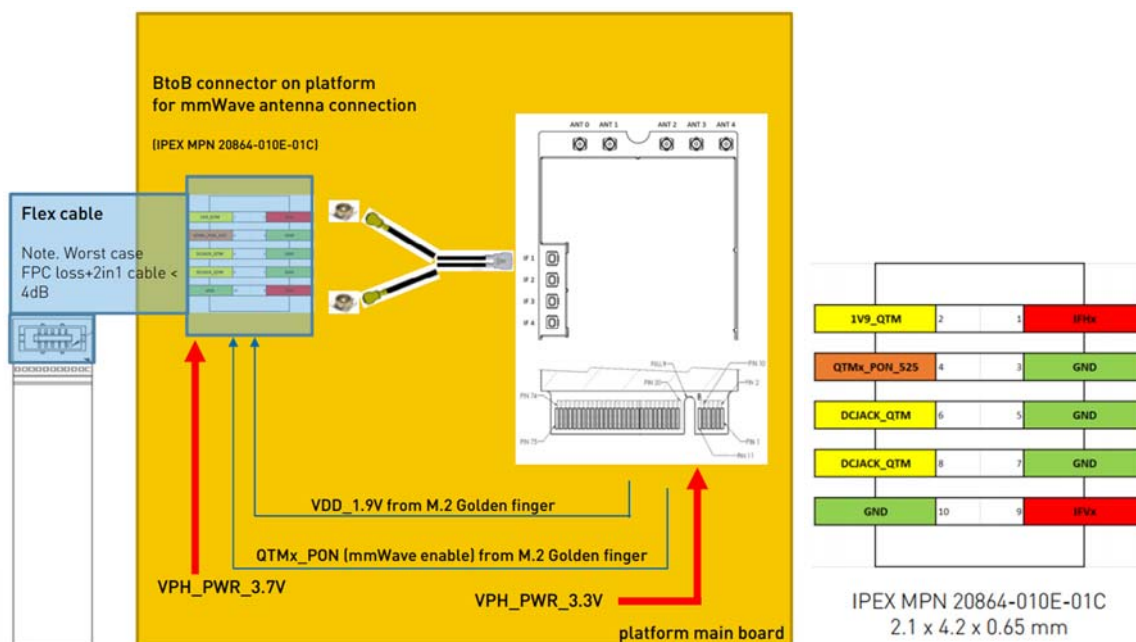


Warning – Because mmWave has too short wavelength, several characteristics are affected by surrounding environments and device position.

7.3.3.1. QTM525

We recommend 3.3 Vdc for FN980m and 3.7 Vdc for QTM525 modules from customer's main board. 2in1 cable between FN980m and QTM525 modules carries intermediate frequency signal about 8GHz. Customers have to use MURATA MXCG series 2in1 cable and for more details, please refer to 7.3.2. Cable for mmWave IF.

Total loss with 2in1 cable and FPCB between FN980m to QTM525 must be under 4dB.



FPCB assembly to QTM525 modules, design and routing with related signals as below table for FN980m IF connector.

FN980m IF connector	IF1	IF2	IF3	IF4
Pin No.	QTM525#0	QTM525#2	QTM525#3	QTM525#1
1	IFV4	IFV3	IFV2	IFV1
3	IFH1	IFH2	IFH3	IFH4
mmWave Control pin No.	PON_0 (M.2 pin40)	PON_2 (M.2 pin44)	PON_3 (M.2 pin46)	PON_1 (M.2 pin42)

7.3.3.2. QTM527

QTM527 carrier board has to be connected via the FPCB using the 30-pin connector we recommend.

GND	1	2	GND
GND	3	4	1V9_QTM_527_M2
QTM0/3_PON_527	5	6	N.C
GND	7	8	GND
GND	9	10	GND
DCJACK_QTM_M2	11	12	DCJACK_QTM_M2
DCJACK_QTM_M2	13	14	DCJACK_QTM_M2
DCJACK_QTM_M2	15	16	DCJACK_QTM_M1
DCJACK_QTM_M1	17	18	DCJACK_QTM_M1
DCJACK_QTM_M1	19	20	DCJACK_QTM_M1
GND	21	22	GND
GND	23	24	GND
QTM1/2_PON_527	25	26	N.C
1V9_QTM_527_M1	27	28	GND
GND	29	30	GND

Recommended vendor/model:

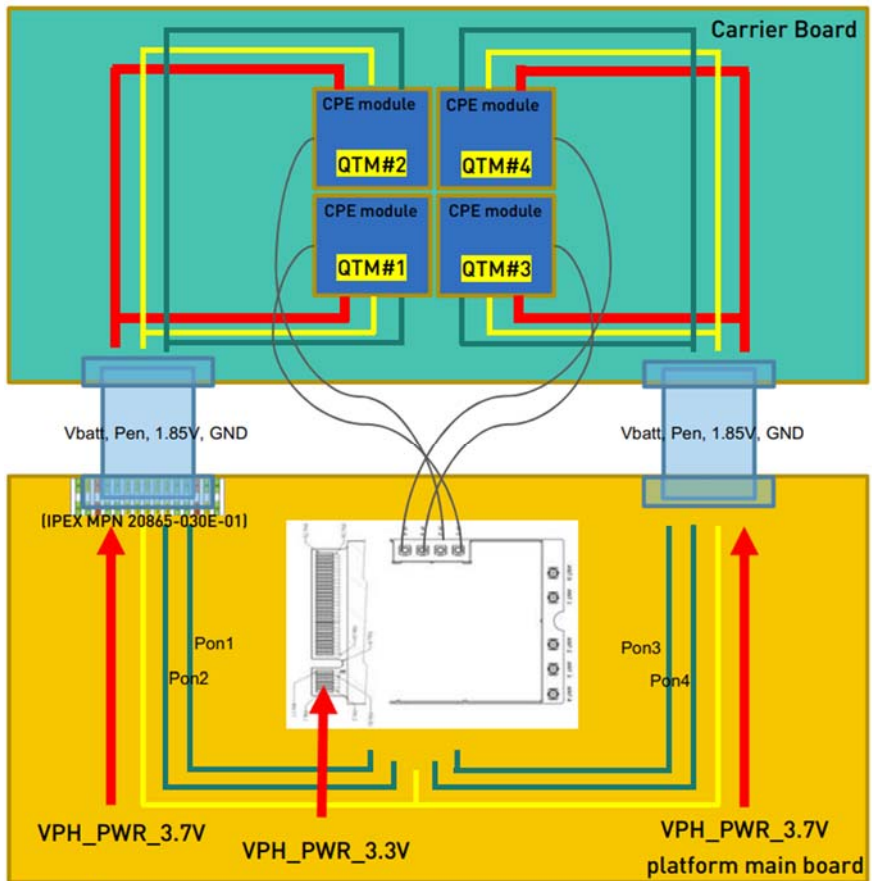
IPEX MPN 20865-030E-01: 2.1 x 7.2 x 0.58 mm

(receptacle mounted on module)

IPEX MPN 20864-030E-01: 2.1 x 7.9 x 0.65 mm

QTM527 modules on the carrier board are assembled with 2in1 cable and FPCB.

Total loss with 2in1 cable between FN980m to QTM527 must be under 1dB.



Customers have to design and routing related signals as below table.



Information –IF connector configuration between QTM525 and QTM527 is different from PON and IF port.

FN980m IF connector	IF1	IF2	IF3	IF4
Pin No.	QTM527#1	QTM527#2	QTM527#3	QTM527#4
1	IFV4	IFV3	IFV2	IFV1
3	IFH1	IFH2	IFH3	IFH4
mmWave Control pin No.	PON_0 (M.2 pin40)	PON_1 (M.2 pin42)	PON_2 (M.2 pin44)	PON_3 (M.2 pin46)

7.4. Antenna Requirements

The antenna for the FN980 Family device must meet the following requirements:

WCDMA / LTE / 5G Sub-6 Antenna Requirements

Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s) The bands supported by the FN980 Family is provided in Section 2.2, Frequency Bands and CA combinations
Impedance	50 Ohm
Input power	> 24 dBm average power in WCDMA & LTE & 5G Sub-6
VSWR absolute max	<= 10:1
VSWR recommended	<= 2:1

7.4.1. Antenna Cable

Connecting cables between the module and the antenna of LTE/SUB6 must have 50 Ω impedance.

If the impedance of the module is mismatched, RF performance is reduced significantly.

Minimize Antenna Cable Requirements

Impedance	50 Ohm
Max cable loss	Less than 0.5 dB
Avoid coupling with other signals.	

7.4.2. Antenna Installation Guidelines

- Each antenna must be installed with 20dB isolation.
- Install the antenna in a location with access to the network radio signal.
- The antenna must be installed such that it provides a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
- The antenna must not be installed inside metal cases.
- The antenna must be installed according to the antenna manufacturer's instructions.

Furthermore, if the device is developed for the US and/or Canada market, it must comply with the FCC and/or ISED approval requirements.



Information

This device is to be used only for mobile and fixed application. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-Users must be provided with transmitter operation conditions for satisfying RF exposure compliance. OEM integrators must ensure that the end user has no manual instructions to remove or install the FN980 Family module. Antennas used for this OEM module must not exceed gain of below table for mobile and fixed operating configurations.

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

7.5. GNSS Receiver

The FN980 Family integrates a GNSS receiver that could be used in Standalone mode and in A-GPS (assisted GPS), according to the different configurations.

FN980 Family supports an active antenna.

Frequency range	• Wide-band GNSS: 1559–1606 MHz recommended • GPS: 2.046 MHz BW NB GPS (centered on 1575.42 MHz) • Glonass (GLO): ~ 8.3 MHz BW (1597–1606 MHz) • BeiDou (BDS): 4.092 MHz BW (1559.05 – 1563.14 MHz) • Galileo (GAL): 4.092 MHz BW (centered on 1575.42 MHz)
-----------------	---

Gain	1.5 dBi < Gain < 3 dBi
Impedance	50 Ohm
Amplification	18 dB < Gain < 21 dB
Supply Voltage	3.1 V

7.5.1. GNSS RF Front End Design

The FN980 Family contains an integrated LNA and pre-select SAW filter. This allows the module to work well with a passive GNSS antenna. If the antenna cannot be located near the FN980 Family, then an active antenna (that is, an antenna with a low noise amplifier built in) can be used with an external dedicated power supply circuit.

GNSS receive path uses either the dedicated GNSS connector #4 or the shared antenna connector #3.



NOTE – Please refer to the FN980 Family AT Commands Reference Guide,—80624ST10996A for detailed information about GNSS operating modes and GNSS Antenna selection.

8. MECHANICAL DESIGN

8.1. General

The FN980 Family module was designed to be compliant with a standard lead-free SMT process.

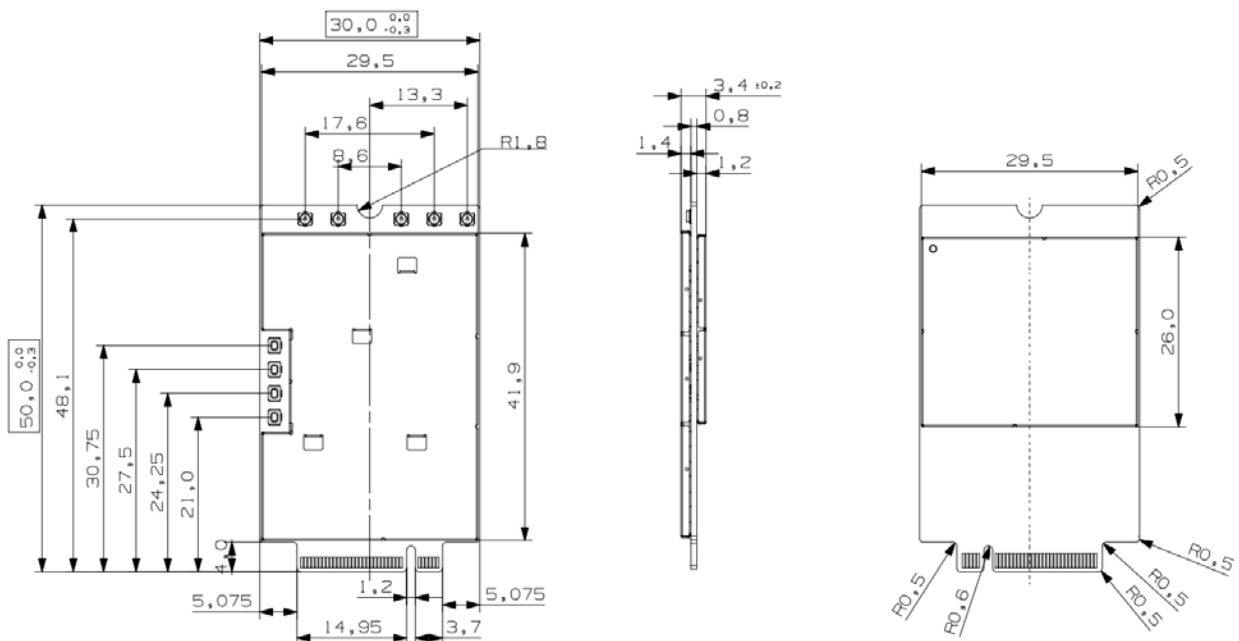
8.2. Finishing & Dimensions

The FN980 Family module's overall dimensions are:

- Length: 50.00 mm
- Width: 30.00 mm
- Thickness: 3.40 mm

8.3. Drawing

This figure shows the mechanical dimensions of the FN980 Family module.



9. APPLICATION GUIDE

9.1. Debug of the FN980 Family Module in Production

To test and debug the FN980 Family module integration, we strongly recommend to add several test pins on the host PCB for the following purposes:

- Checking the connection between the FN980 Family itself and the application
- Testing the performance of the module by connecting it with an external computer

Depending on the customer application, these test pins include, but are not limited to the following signals:

- SYSTEM_RESET_N, W_DISABLE_N, PCIE_WAKE_N
- VBATT, GND
- VREG_L6_1P8
- USB_D-, USB_D+
- USB_SS_TX_M, USB_SS_TX_P, USB_SS_RX_M, USB_SS_RX_P
- PCIE_TX_M, PCIE_TX_P, PCIE_RX_M, PCIE_RX_P

9.2. Bypass Capacitor on Power Supplies

When a sudden voltage step is asserted to or a cut from the power supplies, the steep transition causes effects such as overshoot and undershoot. This abrupt voltage transition can affect the device causing it to not operate or to malfunction.

Bypass capacitors are needed to alleviate this behavior, which can appear differently depending on the various applications. Customers must pay special attention to this issue when they design their application board.

The length and width of the power lines must be considered carefully, and capacitors value must be selected accordingly.

The capacitor will also prevent power supplies ripple and the switching noise caused in TDMA systems, such as GSM.

Most important, a suitable bypass capacitor must be mounted on the following lines on the application board:

- VBATT

Recommended values are:

- 100uF for VBATT

considerate must be kept into account that the capacitance mainly depends on the application board.

Generally, additional capacitance is required when the power line is longer. And if fast power down function is used, additional bypass capacitors should be mounted on the application board.

9.3. EMC Recommendations

EMC protection on all the pins of FN980 Family should be designed by application side according to the customer's requirement.

ESD rating on all pins of FN980 Family :

Human Body Model (HBM): ± 1000 V

Charged Device Model (CDM): ± 250 V

All Antenna pins up to ± 4 kV

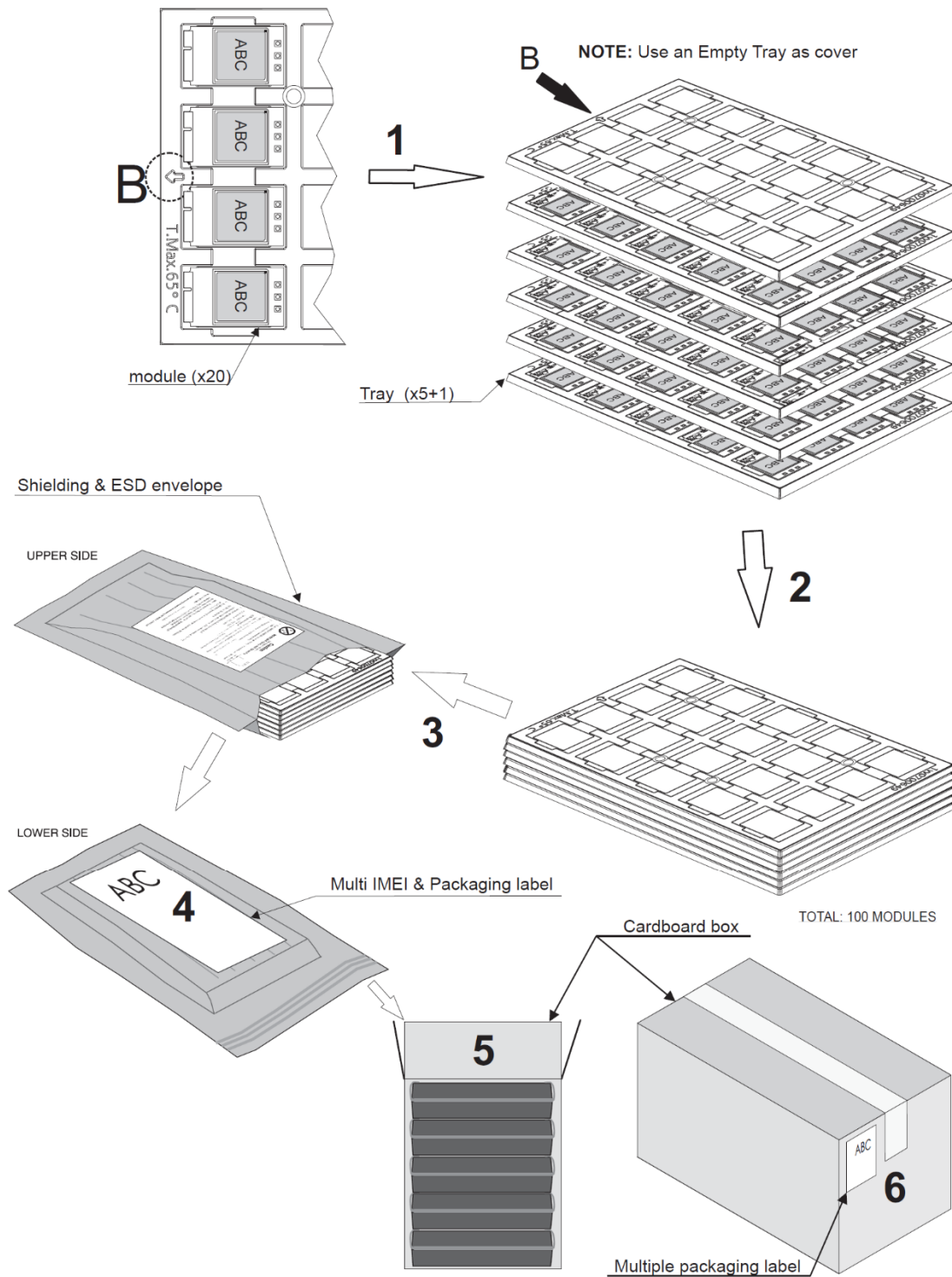


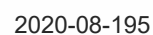
Warning – Do not touch without proper electrostatic protective equipment. The product must be handled with care, avoiding any contact with the pins because electrostatic discharge may damage the product itself.

10. PACKAGING

10.1. Tray

The FN980 Family modules are packaged on trays of 20 pieces each. These trays can be used in SMT processes for pick & place handling.





11. CONFORMITY ASSESSMENT ISSUES

11.1. Approvals

Type Approval	FN980	FN980m
EU RED	Yes	Yes
US FCC	Yes	Yes
CA ISED	Yes	Yes

11.2. FCC certificates

The FCC Certificate is available here: <https://www.fcc.gov/oet/ea/fccid>

11.3. IC/ISED certificates

The ISED Certificate is available here:

<https://sms-sgs.ic.gc.ca/equipmentSearch/searchRadioEquipments?execution=e1s1&lang=en>

11.4. FCC/ISED Regulatory notices

Modification statement

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Telit n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

Interference statement

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Wireless notice

This device complies with FCC/ISED radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the ISED radio frequency (RF) Exposure rules. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body.

Le présent appareil est conforme à l'exposition aux radiations FCC / ISED définies pour un environnement non contrôlé et répond aux directives d'exposition de la fréquence de la FCC radiofréquence (RF) et RSS-102 de la fréquence radio (RF) ISED règles d'exposition. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur. *L'antenne doit être installée de façon à garder une distance minimale de 20 centimètres entre la source de rayonnements et votre corps.*

FCC Class B digital device notice

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 or more 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.

CAN ICES-3 (B) / NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme canadienne ICES-003.

Antennas / Antennes

This radio transmitter has been approved by FCC and ISED to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio a été approuvé par ISDE pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Model Modèle	Antenna Type Type d'Antenne
FN980	Omnidirectional Dipole Antenna <i>Antenne dipolaire omnidirectionnelle</i>
FN980m	

Max Gain for FCC (dBi) Gain maximum pour ISED (dBi)				
UMTS	Max Gain to meet FCC ERP/EIRP and MPE limit	Max Gain to meet IC ERP/EIRP and MPE limit	Max Gain to consider the same Frequency	Max gain allowed
B2	8.0	8.0	5.9	5.9
B4	5.0	5.0	5.5	5.0
B5	9.9	6.6	3.5	3.5

Max Gain for FCC (dBi) Gain maximum pour ISED (dBi)				
LTE	Max Gain to meet FCC ERP/EIRP and MPE limit	Max Gain to meet IC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Transmit with WLAN	Max gain allowed
B2	9.5	9.5	5.9	5.9
B4	6.5	6.5	5.5	5.5
B5	10.4	7.1	3.5	3.5
B7	9.5	9.5	4.9	4.9
B12	9.2	6.1	2.6	2.6
B13	9.7	6.4	2.9	2.9

B14	9.7	6.5	3.0	3.0
B17	9.2	6.2	2.6	2.6
B25	9.5	9.5	5.9	5.9
B26	10.9	7.6	4.1	4.1
B30	0.5	0.5	0.5	0.5
B38	9.5	9.5	4.9	4.9
B41	7.0	7.0	4.9	4.9
B42	0.5	0.5	0.5	0.5
B43	1.0	Not applicable	1.0	1.0
B48	0.5	0.5	0.5	0.5
B66	6.5	6.5	5.5	5.5
B71	9.0	6.0	2.6	2.6

Max Gain for FCC (dBi) Gain maximum pour ISSED (dBi)				
NR	Max Gain to meet FCC ERP/EIRP and MPE limit	Max Gain to meet IC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Transmit with WLAN	Max gain allowed
n2	9.0	9.0	5.9	5.9
n5	10.4	6.0	3.5	3.5
n7	9.0	9.0	4.9	4.9
n12	9.7	6.6	2.6	2.6
n25	11.3	10.0	5.9	5.9
n41	7.0	7.0	4.7	4.7
n66	6.5	9.8	5.5	5.5
n71	9.5	6.5	2.6	2.6

Label and compliance information FCC

The product has a FCC ID label on the device itself. Also, the OEM host end product manufacturer will be informed to display a label referring to the enclosed module. The exterior label will read as follows: "Contains Transmitter Module FCC ID: RI7FN980" or "Contains FCC ID: RI7FN980M".

Below list of all the models and related FCC ID:

Model	FCC ID
FN980	RI7FN980
FN980m	RI7FN980M

Label and compliance information ISED

The host product shall be properly labelled to identify the modules within the host product.

The ISED certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the ISED certification number for the module, preceded by the word "contains" or similar wording expressing the same meaning, as follows:

Contains IC: XXXXXX-YYYYYYYYYYYY

In this case, XXXXXX-YYYYYYYYYYYY is the module's certification number.

Le produit hôte devra être correctement étiqueté, de façon à permettre l'identification des modules qui s'y trouvent.

L'étiquette d'homologation d'un module d'ISDE devra être apposée sur le produit hôte à un endroit bien en vue, en tout temps. En l'absence d'étiquette, le produit hôte doit porter une étiquette sur laquelle figure le numéro d'homologation du module d'ISDE, précédé du mot « contient », ou d'une formulation similaire allant dans le même sens et qui va comme suit :

Contient IC : XXXXXX-YYYYYYYYYYYY

Dans ce cas, XXXXXX-YYYYYYYYYYYY est le numéro d'homologation du module.

Model	ISED Certification Number
FN980	5131A-FN980
FN980m	5131A-FN980

Information on test modes and additional testing requirements

The module has been evaluated in mobile stand-alone conditions. For different operational conditions from a stand-alone modular transmitter in a host (multiple, simultaneously transmitting modules or other transmitters in a host), additional testing may be required (collocation, retesting...)

If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093 and IC RSS-102.

Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. The end product with an embedded module may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

11.5. Declaration of Conformity

Hereby, Telit Communications S.p.A declares that the FM980 and FN980m Modules are in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address:

<http://www.telit.com/red>

Text of 2014/53/EU Directive (RED) can be found here:

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0053>

Antennas

This radio transmitter has been approved under RED to operate with the antenna types listed below with the maximum permissible gain indicated. The usage of a different antenna in the final hosting device may need a new assessment of host conformity to RED.

Model	Antenna Type
FN980	Omnidirectional
FN980m	Dipole Antenna

Max Gain for RED (dBi)				
UMTS	Ant Gain to meet CE MPE limit	Max Gain to consider same Frequency with LTE	Max Gain to consider EN-DC Transmit with WLAN	Max gain allowed
B1	11.1	8.8	8.5	8.5
B3	10.6	8.3	8.0	8.0
B8	7.8	5.4	5.0	5.0

Max Gain for RED (dBi)				
LTE	Ant Gain to meet CE MPE limit	Max Gain to consider EN-DC Active	Max Gain to consider EN-DC Transmit with WLAN	Max gain allowed
B1	11.8	8.8	8.5	8.5
B3	11.3	8.3	8.0	8.0
B7	12.0	9.0	8.6	8.6
B8	8.5	5.4	5.0	5.0
B20	8.2	5.1	4.8	4.8
B28	7.5	4.4	4.0	4.0
B38	12.0	9.0	8.6	8.6
B40	12.0	9.0	8.6	8.6
B42	12.0	9.0	8.6	8.6
B43	15.0	12.0	11.0	11.0

Max Gain for RED (dBi)				
NR	Ant Gain to meet CE MPE limit	Max Gain to consider EN-DC Active	Max Gain to consider EN-DC Transmit with WLAN	Max gain allowed
n1	11.84	8.8	8.5	8.5
n3	11.33	8.3	8	8.0
n7	12.01	9	8.6	8.6
n8	8.5	5.4	5.0	5.0
n20	8.2	5.1	4.8	4.8
n28	7.5	4.4	4.0	4.0
n38	12.0	9.0	8.6	8.6
n40	12.0	9.0	8.6	8.6
n41	9.0	6.0	5.6	5.6
n77	12.0	9.0	8.6	8.6
n78	90.1	6.0	5.6	5.6

12. SAFETY RECOMMENDATIONS

12.1. READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.
- Where there is risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as any project or installation issue, because the risk of disturbing the cellular network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess again the final product against the regulation about exposure to electromagnetic fields.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1:2014.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

https://ec.europa.eu/growth/sectors/electrical-engineering_en

13. ACRONYMS

TTSC	Telit Technical Support Centre
USB	Universal Serial Bus
HS	High Speed
DTE	Data Terminal Equipment
UMTS	Universal Mobile Telecommunication System
WCDMA	Wideband Code Division Multiple Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
LTE	Long term evolution
NR	New Radio
CA	Carrier aggregation
EN-DC	E-UTRA-NR Dual Connectivity
E-UTRA	Evolved UMTS Terrestrial Radio Access
UART	Universal Asynchronous Receiver Transmitter
PCIE	Peripheral Component Interconnect Express
SIM	Subscriber Identification Module
I2S	Inter-IC Sound
I/O	Input Output
GPIO	General Purpose Input Output
CMOS	Complementary Metal – Oxide Semiconductor
CLK	Clock

RTC	Real Time Clock
PCB	Printed Circuit Board
ESR	Equivalent Series Resistance
VSWR	Voltage Standing Wave Ratio
VNA	Vector Network Analyzer
FDD	Frequency division duplex
TDD	Time division duplex
I2C	Inter-integrated circuit
SOC	System-on-Chip

14. DOCUMENT HISTORY

Revision	Date	Changes
0	2019-07-03	First draft
1	2019-12-13	Section 2.2 – Updated Frequency Bands and CA combinations Section 2.4 – Updated Main features Section 2.4.1 – Added Configurations pins Section 2.5 – Updated Block Diagram Section 2.6 – Updated RF performance Section 2.8.1 – Updated Dimensions Section 2.9.1 – Added Warning message for operating temperature Section 3.1 – Updated Pin-out Section 3.3 – Updated Pin Layout Section 4.2 – Added Warning message about power supply Section 4.5 – Updated Pin number of reference Voltage Section 6.5 – Updated Communication ports Section 6.5.1 – Updated PCIe interface Section 6.5.2 – Modified typo Section 6.5.2.1 – Modified SIM schematics Section 6.5.3 – Modified typo Section 6.5.3.2 – Updated LED guidelines Section 6.5.4 – Updated General Purpose I/O table Section 7 – Updated RF SECTION Section 8.2 – Updated Finishing & Dimensions Section 9.3 – Updated EMC Recommendations Section 14 – Updated Acronyms
2	2020-02-19	Section 2.4 – Updated Main features Section 3.1 – Updated Pin-out Section 3.3 – Updated Pin Layout Section 6.2.1 – Updated Initialization and Active Status

		Section 6.3.1 – Updated Graceful Shutdown by FULL_CARD_POWER_OFF_N Section 6.3.1.2 – Removed Graceful Shutdown by AT command Section 6.3.2.1 – Removed Fastshutdown by AT command, Updated figure and Added Warning comment Section 6.4.1 – Removed Graceful Reset and Updated Unconditional Hardware Reset Section 6.5.4 – Updated General Purpose I/O Section 7.3.4 – Updated Antenna Installation Guidelines
3	2020-04-29	Section 3.1 – Updated Pin-out
4	2020-06-22	Section 3.1 – Updated Pin-out comments Separated FN980 and FN980m
5	2020-06-29	Section 6.5.6 – Updated USB pin number Section 7.5.1 – Updated GNSS antenna #
6	2020-08-19	Section 1.5 – Updated Related Documents Section 4.1 – Updated Power Supply level Section 4.2 – Updated Power Consumption Section 6.1 – Updated Logic levels Section 6.5.1 – Updated PCIe Interface Signal table Section 11 – Updated Conformity Assessment Issues



SUPPORT INQUIRIES

Link to www.telit.com and contact our technical support team for any questions related to technical issues.

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