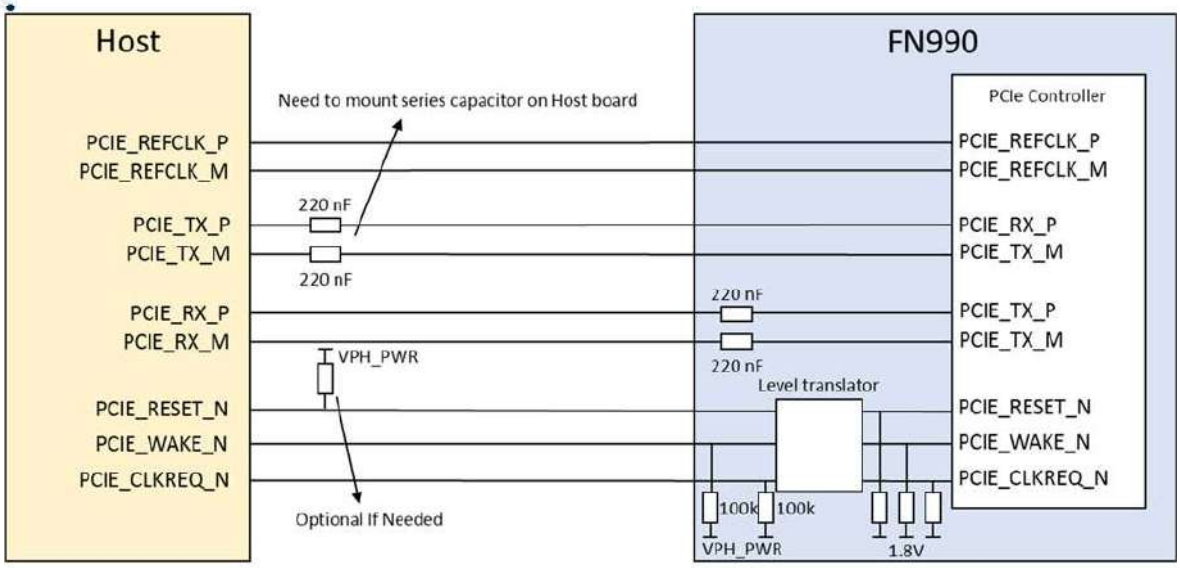

Figure 12: Connection for PCIe Interface

Note: The PCIe signals traces must be routed carefully: minimize trace lengths, number of vias, and capacitive loading. The impedance value should be as close as possible to 85 Ohm differential.

Pin	Signal	I/O	Function	Type	Comment
41	PCIE_TX0_M	O	PCIe transmit 0 – Minus	Analog	
43	PCIE_TX0_P	O	PCIe transmit 0 – Plus	Analog	
47	PCIE_RX0_M	I	PCIe receive 0 – Minus	Analog	
49	PCIE_RX0_P	I	PCIe receive 0 – Plus	Analog	
53	PCIE_REFCLK_M	I	PCIe differential reference clock – Minus	Analog	
55	PCIE_REFCLK_P	I	PCIe differential reference clock – Plus	Analog	
50	PCIE_RESET_N	I	Functional reset to PCIe bus	VPH_PWR	Default PU
52	PCIE_CLKREQ_N	O	PCIe reference clock request signl	VPH_PWR	Internal 100k PU
54	PCIE_WAKE_N	O	PCIe wake-up	VPH_PWR	Internal 100k PU

Table 30: PCIe Interface Signals

Note: Consider placing a low-capacitance ESD protection component to protect the FN990 against ESD strikes

Warning: FN990 data cards are not designed or intended to support Hot-Swap or Hot-Plug connection. Performing How-Swap or Hot-Plug may pose danger to the FN990 Family module, to the host device, and to the person handling the device.

6.3.1.2.1. PCIe Layout Guidelines

This guidelines will provide general guidelines for PCIe interface to improve signal integrity.

- All other sensitive/high-speed signals and cicuits must be protected from PCIe corruption
- PCIe signals must be protected from noisy signals (clocks, SMPS, and so forth)
- Pay extra attention to crosstalk, ISI, and intralane skew and impedance discontinuities.
- PCIe Tx AC copling capacitors are better placed close to the source or receiver side to keep good SI of route on PCB.
- To maintain impedance balance, maintain positive and negative traces as balanced as possible in terms of the signal and its return path.
- Trace length matching between the reference clock, Tx, and Rx pairs are not required.
- External capacitors also should keep differential traces. Ensure not to stagger the capacitors. This can affect the differential integrity of the design and can create EMI.

Type of guidance	Guideline	Requirement
General	Data rate	8 Gbps*
	Insertion loss at 4 GHz (dB)	-10 dB
	Impedance	85 ohms differential
	Bus length	285 mm**
Length matching	Intra pair match	< 0.7mm
Spacing	To all other signals	> 4 x line width
	Tx lane to Rx lane	> 4 x line width
Component	AC capacitance	220 nF

Table 31: PCIe Routing Constraints

**Actual throughput at the system level could be lower due to overheads.*

***PCIe trace length in FN990 Family: about 15 mm.*

6.3.1.3. USB 3.1 Interface

The FN990 Family modules include super-speed USB 3.1 Gen 2 with high-speed USB 2.0 backward compatibility. It complies with the Universal Serial Bus Specification, revision 3.1 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 FN990 Family module and application hardware. USB 3.1 needs AC coupling series capacitors on the TX lines in both directions.

To interface USB 3.1 with the application board controlling the modem, it is necessary to install 220 nF capacitor on the USB_SS_RX_P/M lines of the FN990 Family. The series capacitors are already placed on USB_SS_TX_P/M lines inside FN990 module.

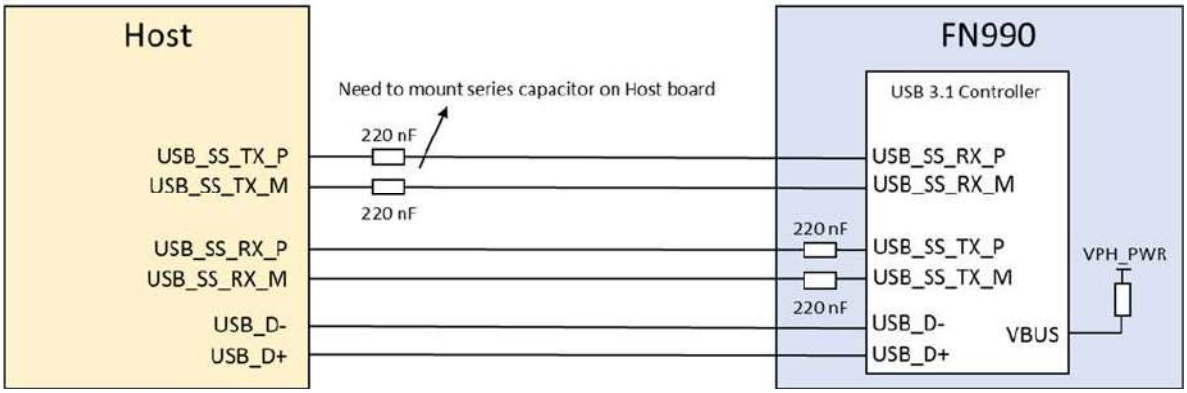

Figure 13: Connection for USB Interface

Note: 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 85 Ohm differential.

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	USB 3.1 super-speed transmit – Minus	Analog	
31	USB_SS_TX_P	O	USB 3.1 super-speed transmit – Plus	Analog	
35	USB_SS_RX_M	I	USB 3.1 super-speed receive – Minus	Analog	
37	USB_SS_RX_P	I	USB 3.1 super-speed receive – Plus	Analog	

Table 32: USB Interface Signals

Note: Consider placing a low-capacitance ESD protection component to protect FN990 Family against ESD strikes.

6.3.1.3.1. USB Layout Guidelines

- If third-party components are required for signal improvement, place them closer to the USB connector.
- There are relatively fast edge rates, so must be routed away from sensitive circuits and signals (RF, audio and XO).
- Maintain good isolation between the USB connector and RF antennas (especially 2.4 GHz).
- Route the RF signals operating at a 2.4 GHz frequency with the highest isolation possible from USB_SS_TX/RX traces.
- USB SS Tx AC coupling capacitors are better placed close to source or the ESD/connector side to keep good SI of main route on PCB.
- Route differential pairs in the inner layers with a solid GND reference to have good impedance control and to minimize discontinuities.
- Keep isolation between the Tx pair, Rx pair, and DP/DM to avoid crosstalk.
- The SS-USB Tx and Rx differential pair maximum length is recommended to be less than 136 mm.
- For USB 2.0 signal, maximum trace length should be less than 234 mm.

Type of guidance	Guideline	Requirement	
		USB 3.1 Gen 2	USB 2.0
General	Data rate	10 Gbps	480Mbps
	Insertion loss at 5 GHz (dB)	-7 dB	N/A
	Impedance	85 ohms differential	
	Bus length	136 mm	234 mm
Length matching	Intra pair match	< 0.7mm	< 2mm
Spacing	To all other signals	> 4 x line width	> 3 x line width
	Tx lane to Rx lane	> 4 x line width	N/A
Component	AC capacitance	220 nF	N/A

Table 33: USB Routing Constraints

6.3.2. SIM Interface

The FN990 modem family supports an external SIM interface. (1.8 V or 2.95 V)

Note: UIM2 can be assigned as optional eSIM. In that case, UIM2 can't be used as an external SIM interface.

Pin	Signal	I/O	Function	Type	Comment
SIM Card Interface 1					
36	UIM1_VCC	O	Supply output for an external UIM1 card	1.8V / 2.95V	Power
34	UIM1_DATA	I/O	Data connection with an external UIM1 card	1.8V / 2.95V	Internal 20k PU
32	UIM1_CLK	O	Clock output to an external UIM1 card	1.8V / 2.95V	
30	UIM1_RESET_N	O	Reset output to an external UIM1 card	1.8V / 2.95V	
66	UIM1_PRESENT	I	UIM1 Card Present Detect	1.8V	Internal 100k PU Active LOW*
SIM Card Interface 2					
48	UIM2_VCC	O	Supply output for an external UIM2 card	1.8V / 2.95V	Power
42	UIM2_DATA	I/O	Data connection with an external UIM2 card	1.8V / 2.95V	Internal 20k PU
44	UIM2_CLK	O	Clock output to an external UIM2 card	1.8V / 2.95V	
46	UIM2_RESET_N	O	Reset output to an external UIM2 card	1.8V / 2.95V	
40	UIM2_PRESENT	I	UIM2 Card Present Detect	1.8V	Internal 100k PU Active LOW*

Table 34: SIM Interface Signals

Note: * Unlike the M.2 specicifcation, the UIM_PRESENT pin is set to active low (Inserted) by default for the Telit unified function.
So FN990 will detect the SIM card insertion when UIM_PRESENT input is changed from a logic 1 to a logic 0.

If user wants to change UIM_PRESENT pin to active high (inserted), please refer to AT#SIMINCFG of FN990 AT Commands Reference Guide.

But if user wants to change the default value of the firmware itself to reduce unnecessary input of AT commands, please contact Telit technical support or sales.

6.3.2.1. SIM Schematic Example

The diagram below shows in particular how the SIM part of the application interface should be designed.

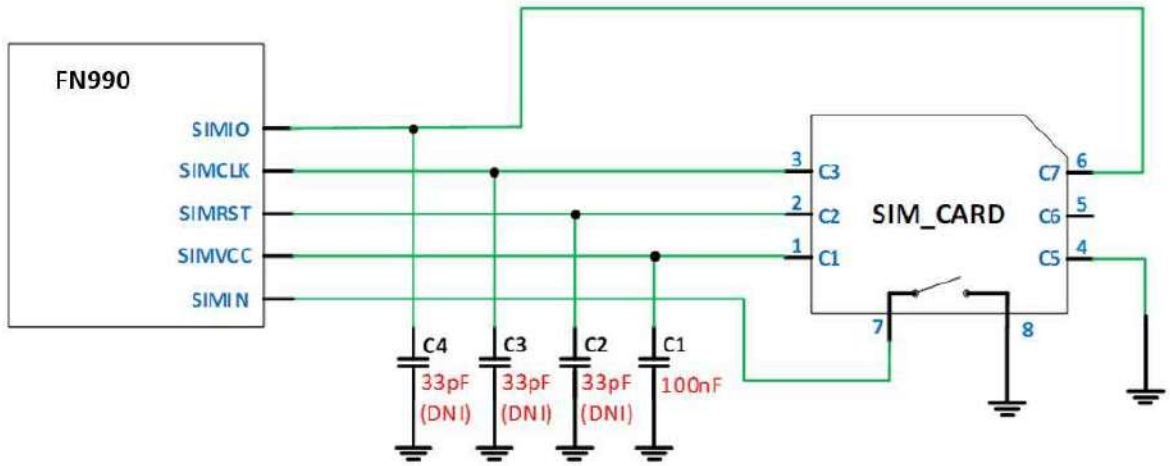

Figure 14: SIM Schematic Example

Note: FN990 Family modems contain an internal pull-up resistor on SIMIO. It is not necessary to install external pull-up resistor.

6.3.3. eSIM Interface

FN990 modems include pads for an optional embedded SIM (WLCSP package).

Customers interested in using an embedded SIM mounted on the FN990 can contact Telit Techical Support at:

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

6.3.4. I2C – Inter-integrated Circuit

The FN990 Family supports an I2C interface: the the table below lists the I2C signals of the modem.

Pin	Signal	I/O	Function	Type	Comment
56	I2C_SDA	I/O	I2C Data Can be TGPIO_08	1.8V	Internal 2.2k PU
58	I2C_SCL	I/O	I2C Clock Can be TGPIO_09	1.8V	Internal 2.2k PU

Table 35: I2C Signal

6.3.5. Control Interface

Pin	Signal	I/O	Function	Type	Comment
8	W_DISABLE_N	I	WLAN disable	VPH_PWR	Internal 100k PU
26	W_DISABLE2_N	I	GNSS disable	VPH_PWR	Internal 100k PU
10	LED_N	O	LED control		Open Drain
23	WAKE_ON_WAN_N	O	Wake Host	1.8V	Default PU
25	TGPIO_02	I/O	General Purpose I/O Can be DPR	1.8V	

Table 36: Control Interface Pins

6.3.5.1. WLAN/GNSS Disable

The W_DISABLE_N signal is provided to disable the WLAN/GNSS function:

- W_DISABLE_N

  Low: Airplane mode

  High or Floating: Normal operation

- W_DISABLE2_N

  Low: GNSS Disable

High or Floating: Normal operation

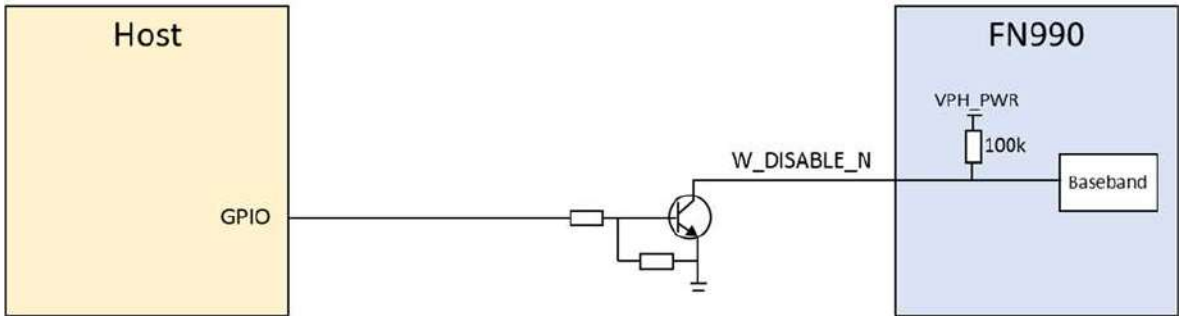

Figure 15: Example Circuit for WLAN/GNSS Disable Function

Please refer to the AT commands guide for setting the WLAN/GNSS disable function.

6.3.5.2. LED

The LED signal drives the LED output. The recommended LED connection is the following:

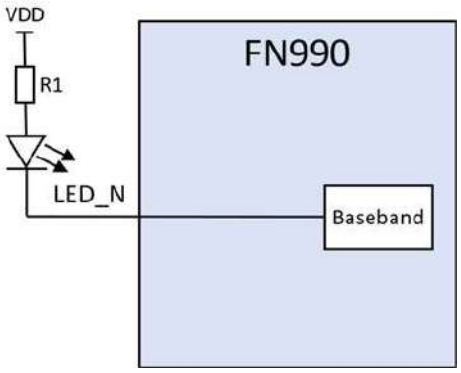

Figure 16: Recommended LED Connection

R1 and VDD determine the LED brightness and forward current.

When VDD is 3.3V and LED's forward voltage is 2.0V, the recommended R1 value ranges from 66 to 250 Ohm.

However, the resistor value must be calculated considering the LED specifications. It is recommended to use VDD below VPH_PWR level.

Note: If the LED function is enabled and a LED is connected to the LED_N pin, current consumption may be slightly increased. And current sinking mode (up to 10mA) can be supported.

6.3.5.3. Wake Host

WAKE_ON_WAN_N is active low signal and used to wake the Host when specific events occur.

- SMS
- Network de-registration
- Voice Call

Please refer to the AT commands guide for setting Wake function.

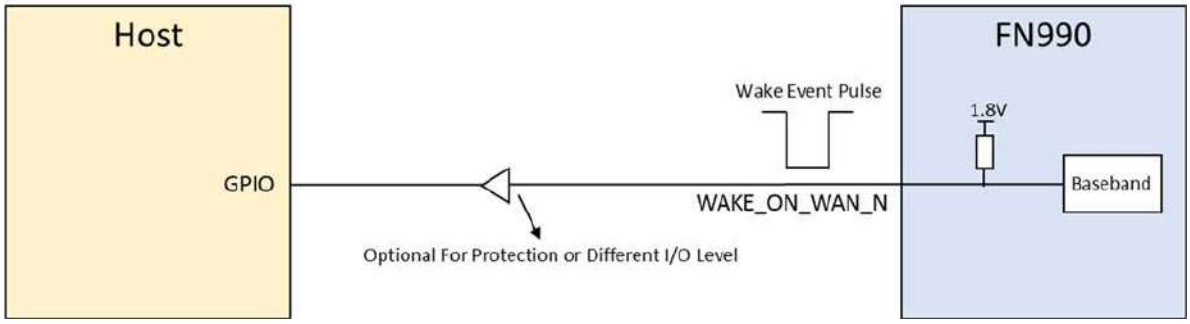

Figure 17: Recommended LED Connection

6.3.5.4. DPR

This signal is an input directly to the FN990 module from a suitable SAR sensor. Then FN990 Family module will reduce output tx power.

DPR function is not available yet: specific implementation will be determined on customer request.

For further information on the DPR function on FN990 modem family, please contact Telit Techical Support at:

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

6.4. General Purpose I/O

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

- Input
- Output
- Fast shutdown
- Dedicate function (Customer requirement)

Input pins can only 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	General Purpose I/O Can be I2S_CLK	1.8V	
25	TGPIO_02	I/O	General Purpose I/O Can be DPR	1.8V	
62	TGPIO_03	I/O	General Purpose I/O	1.8V	
64	TGPIO_04	I/O	General Purpose I/O	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	
56	I2C_SDA	I/O	I2C Data Can be TGPIO_09	1.8V	Internal 2.2k PU
58	I2C_SCL	I/O	I2C Clock Can be TGPIO_10	1.8V	Internal 2.2k PU

Table 37: General Purpose I/O

6.4.1. Using a GPIO 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 47K ohm pull-up resistor to 1.8V.

6.4.2. Using a GPIO as OUTPUT

GPIO pins, when used as output, 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.

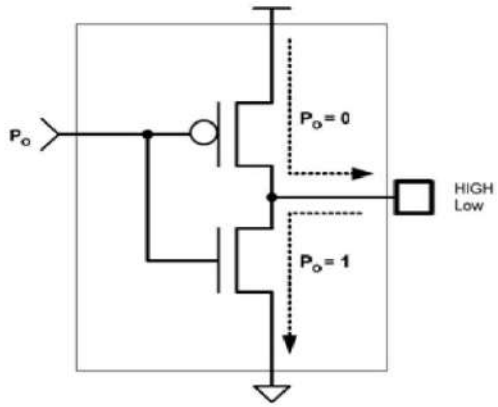

Figure 18: GPIO Output Pin Equivalent Circuit

7. RF SECTION

7.1. Antenna Interface

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

FN990 Family modules provide four MHF-4 type RF connectors covering the 5G FR1/LTE/WCDMA bands including GNSS and one MHF-4 type RF connector dedicated to GNSS.

Warning: When connecting cellular and GNSS antennas to the module, pay special attention not to damage RF connectors.

7.1.1. Antenna Configuration

Please refer to the picture below for connector position.

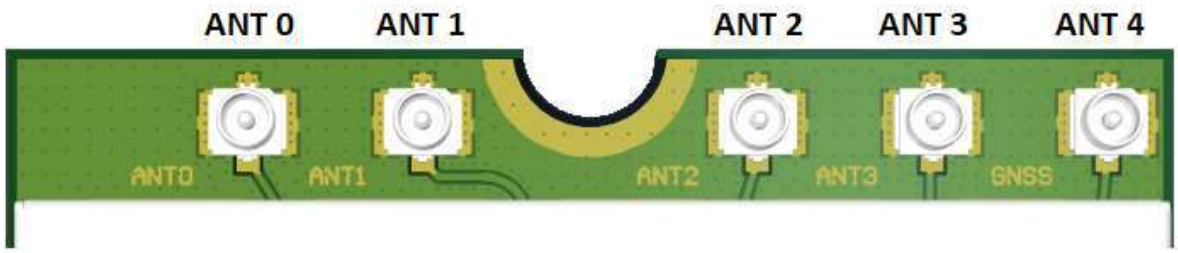

Figure 19: Antenna Configration

Refer to the following antenna configuration assigned.

Antenna port	Technology	Tx	Rx	GNSS
ANT 0	WCDMA	B1, B2, B4, B5, B6, B8, B19	B1, B2, B4, B5, B6, B8, 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(DL), B30, B32(DL), B34, B38, B39, B40, B41, B42, B43, B46(DL), B48, B66, B71	
	5G NR FR1	n1, n2, n3, n5, n7, n8, n20, n25, n28, n30, n38, n40, n41, n66, n71	n1, n2, n3, n5, n7, n8, n20, n25, n28, n29(DL), n30, n38, n40, n41, n48, n66, n71, n75(DL), n77, n78, n79	

Antenna port	Technology	Tx	Rx	GNSS
ANT 1	WCDMA	-	-	GPS L1, Galileo E1, Beidou B1, Glonass G1
	LTE	-	B1, B2, B3, B4, B7, B25, B30, B32(DL), B34, B38, B39, B40, B41, B42, B43, B48, B66	
	5G NR FR1	n48, n77, n78, n79	n1, n2, n3, n7, n25, n30, n38, n40, n41, n48, n66, n75(DL), n77, n78, n79	
ANT 2	WCDMA	-	B1, B2, B4, B5, B6, B8, B19	-
	LTE	-	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29(DL), B30, B32(DL), B34, B38, B39, B40, B41, B42, B43, B46(DL), B48, B66, B71	
	5G NR FR1	n38, n41	n1, n2, n3, n7, n25, n30, n38, n40, n41, n48, n66, n75, n77, n78, n79	
ANT 3	WCDMA	-	-	-
	LTE	B42, B43, B48	B1, B2, B3, B4, B7, B25, B30, B32(DL), B34, B38, B39, B40, B41, B42, B43, B48, B66	
	5G NR FR1	n48, n77, n78, n79	n1, n2, n3, n7, n25, n30, n38, n40, n41, n48, n66, n75(DL), n77, n78, n79	
ANT 4	GNSS	-	-	GPS L1, Galileo E1, Beidou B1, Glonass G1

Table 38: Antenna Configuration

Please refer to the tables below for antenna port on each supported band:

NR Band				
	ANT0	ANT1	ANT2	ANT3
NR FDD n1	PRx/Tx0	MIMO1	DRx	MIMO2
NR FDD n2	PRx/Tx0	MIMO1	DRx	MIMO2
NR FDD n3	PRx/Tx0	MIMO1	DRx	MIMO2
NR FDD n5	PRx/Tx0	NA	DRx	NA
NR FDD n7	PRx/Tx0	MIMO1	DRx	MIMO2
NR FDD n8	PRx/Tx0	NA	DRx	NA
NR FDD n20	PRx/Tx0	NA	DRx	NA
NR FDD n25	PRx/Tx0	MIMO1	DRx	MIMO2

NR Band				
NR FDD n28	PRx/Tx0	NA	DRx	NA
NR FDD n30	PRx/Tx0	MIMO1	DRx	MIMO2
NR TDD n38	DRx/Tx1	MIMO1	PRx/Tx0	MIMO2
NR TDD n40	PRx/Tx0	MIMO1	DRx	MIMO2
NR TDD n41	DRx/Tx1	MIMO1	PRx/Tx0	MIMO2
NR TDD n48	DRx	MIMO2/Tx1	MIMO1	PRx/Tx0
NR FDD n66	PRx/Tx0	MIMO1	DRx	MIMO2
NR FDD n71	PRx/Tx0	NA	DRx	NA
NR TDD n75 (DL only)	PRx	MIMO1	DRx	MIMO2
NR TDD n77	DRx	MIMO2/Tx1	MIMO1	PRx/Tx0
NR TDD n78	DRx	MIMO2/Tx1	MIMO1	PRx/Tx0
NR TDD n79	DRx	MIMO2/Tx1	MIMO1	PRx/Tx0

Table 39: 5G NR Sub-6 bands for Antenna Configuration

E-UTRA Band				
	ANT0	ANT1	ANT2	ANT3
LTE FDD B1	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B2	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B3	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B4	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B5	PRx/Tx0	NA	DRx	NA
LTE FDD B7	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B8	PRx/Tx0	NA	DRx	NA
LTE FDD B12	PRx/Tx0	NA	DRx	NA
LTE FDD B13	PRx/Tx0	NA	DRx	NA
LTE FDD B14	PRx/Tx0	NA	DRx	NA
LTE FDD B17	PRx/Tx0	NA	DRx	NA
LTE FDD B18	PRx/Tx0	NA	DRx	NA

E-UTRA Band				
LTE FDD B19	PRx/Tx0	NA	DRx	NA
LTE FDD B20	PRx/Tx0	NA	DRx	NA
LTE FDD B25	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B26	PRx/Tx0	NA	DRx	NA
LTE FDD B28	PRx/Tx0	NA	DRx	NA
LTE FDD B29 (DL only)	PRx	NA	DRx	NA
LTE FDD B30	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B32 (DL only)	PRx	MIMO1	DRx	MIMO2
LTE TDD B34	PRx/Tx0	MIMO1	DRx	MIMO2
LTE TDD B38	PRx/Tx0	MIMO1	DRx	MIMO2
LTE TDD B39	PRx/Tx0	MIMO1	DRx	MIMO2
LTE TDD B40	PRx/Tx0	MIMO1	DRx	MIMO2
LTE TDD B41	PRx/Tx0	MIMO1	DRx	MIMO2
LTE TDD B42	DRx	MIMO2	MIMO1	PRx/Tx0
LTE TDD B43	DRx	MIMO2	MIMO1	PRx/Tx0
LTE TDD B46 (DL only)	PRx	NA	DRx	NA
LTE TDD B48	DRx	MIMO2	MIMO1	PRx/Tx0
LTE FDD B66	PRx/Tx0	MIMO1	DRx	MIMO2
LTE FDD B71	PRx/Tx0	NA	DRx	NA

Table 40: LTE for Antenna Configuration

UTRA Band				
	ANT0	ANT1	ANT2	ANT3
WCDMA FDD B1	PRx/Tx0	NA	DRx	NA
WCDMA FDD B2	PRx/Tx0	NA	DRx	NA
WCDMA FDD B4	PRx/Tx0	NA	DRx	NA
WCDMA FDD B5	PRx/Tx0	NA	DRx	NA
WCDMA FDD B6	PRx/Tx0	NA	DRx	NA

UTRA Band				
WCDMA FDD B8	PRx/Tx0	NA	DRx	NA
WCDMA FDD B19	PRx/Tx0	NA	DRx	NA

Table 41: WCDMA for Antenna Configuration

7.2. Antenna Connector

The FN990 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 consult https://www.i-pex.com

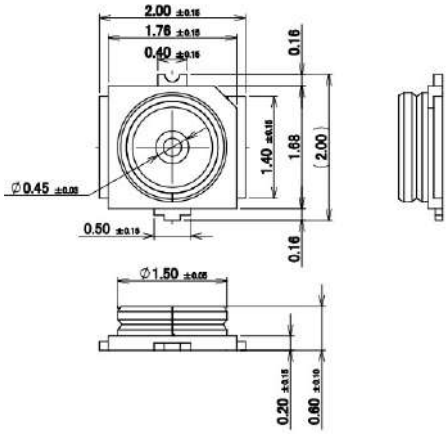

Figure 20: MHF-4 RF connector

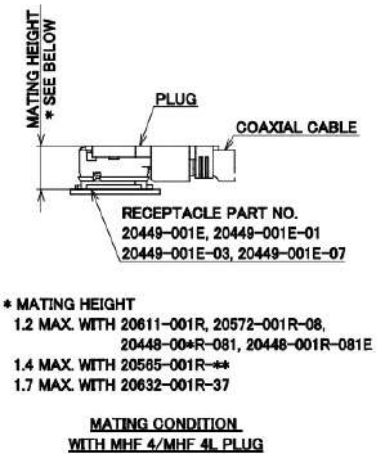

Figure 21: MHF-4 Receptacle

7.3. Antenna Requirements

Antennas for FN990 Family modules must meet the requirements listed in the table below.

WCDMA/LTE/5G Sub-6 Antenna Requirements

Item	Value
Frequency range	Depending on the frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s). The bands supported by the FN990 Family is provided in Section 2.2 Frequency Bands and CA / EN-DC 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

Table 40: WCDMA / LTE / 5G Sub-6 Antenna Requirements

7.3.1. Antenna Cable

Connecting cables between the module and LTE/Sub-6 antenna must have 50 Ohm impedance.

If the impedance of the module does not match, RF performance is significantly reduced.

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

Table 413: Minimize Antenna Cable Recommendations

Warning: Impedance of antenna connector and RF cable must be matched to 50 Ohm: mismatch will affect RF performance, especially high insertion loss of RF cable will cause Tx power and Rx sensitivity degradation.

Warning: The FN990 should be located away from noise sources: RF cables and antennas should be installed away from noise sources such as SMPS, USB/PCIe interfaces, etc.

7.3.2. 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 not be installed inside metal cases.
- The Antenna must be installed according to Antenna manufacturer instructions.
- Antenna integration should optimize the Radiation Efficiency. Efficiency values > 50% are recommended on all frequency bands.
- Antenna integration should not perturb the radiation pattern described in the Antenna manufacturer documentation.
- It is preferable to get an omnidirectional radiation pattern.
- To meet the related EIRP limitations, antenna gain must not exceed the values indicated in regulatory requirements, where applicable. The Typical antenna Gain in most M2M applications does not exceed 2dBi.
- If the device antenna is located farther than 20 cm from the human body and there are no co-located transmitters, then the Telit FCC/IC approvals can be re-used by the end product.
- If the device antenna is located closer than 20 cm from the human body or there are co-located transmitters, then additional FCC/IC testing may be required for the end product (Telit FCC/IC approvals cannot be reused).

Note: GNSS receive path uses either the dedicated GNSS connector or the shared Secondary AUX antenna connector.

7.4. GNSS Receiver

The FN990 Family integrates a GNSS receiver that can be used either in Standalone or in A-GPS (assisted GPS) mode.

FN990 modems support active GNSS antennas.

Item	Value
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 (1597.05 ~ 1606 MHz) • BeiDou (BDS): 4.092 MHz BW (1559.05 ~ 1563.14 MHz) • Galileo (GAL): 4.092 MHz BW (centered on 1575.42 MHz)
Passive Antenna Gain	1.5 dBi < Gain < 3dBi[1]
Impedance	50 Ohm
External Amlification Gain	7.5 dB < Gain < 26 dB for nominal performance[2,3] 1.5 dB < Gain < 7.5 dB for nominal performance[4,5]
Supply Voltage	3.1 V

Table 424: GNSS Receiver

Notes:

[1] Configured as AT$GPSANTPORT= 1 or 2 (Internal LNA Active in either configuration)

[2] Configured as AT$GPSANTPORT= 3 (Internal LNA bypassed)

[3] Must not exceed 26 dB

[4] Configured as AT$GPSANTPORT= 4 (Internal LNA active)

[5] Must not exceed 7.5 dB

Total gain applied at FN990 RF input connector (Passive Antenna gain + External LNA gain-losses)

7.4.1. GNSS RF Front End Design

The FN990 Family contains an integrated LNA and pre-select SAW filter.

This allows the module to operate properly with a passive GNSS antenna. If the antenna cannot be located near the FN990, then an active antenna (that is, an antenna with a built-in low noise amplifier) 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 #1.

Note: Please refer to the FN990 Family AT Commands Reference Guide, 80691ST11097A for detailed information about GNSS operating modes and GNSS antenna selection.

7.5. GNSS Characteristics

The below table specifies the GNSS characteristics and expected performance:

Parameters		Typical Measurement	Notes
Sensitivity	Tracking Sensitivity	-161 dBm	Standalone or MS based
	Acquisition	-148 dBm	
	Cold Start	-146 dBm	
TTFF	Hot	1 sec	Open Sky, mean TTFF
	Warm	27 sec	Open Sky, mean TTFF
	Cold	28 sec	Open Sky, mean TTFF
Min update rate		1Hz	
CEP		<2m	Open sky conditions. Standalone

Table 435: GNSS Characteristics

8. MECHANICAL DESIGN

8.1. General

The FN990 Family module was designed to be compliant with a standard lead-free SMT process.

8.2. Finishing & Dimensions

The FN990 Family module's overall dimensions are:

- Length: 52.00 mm
- Width: 30.00 mm
- Thickness: 2.25 mm

8.3. Drawing

This figure shows the mechanical dimensions of the FN990 Family module.

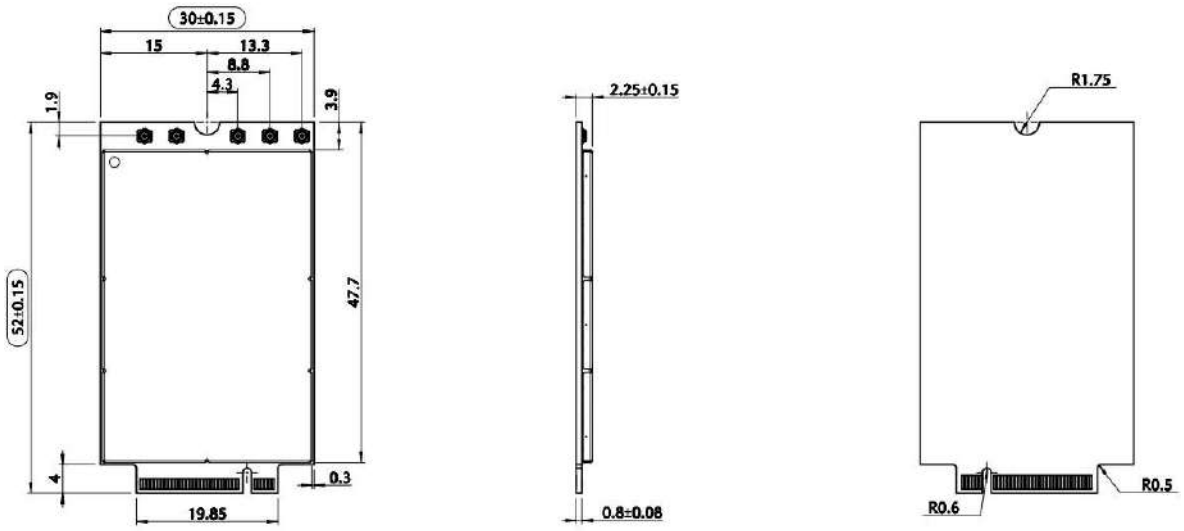

Figure 22: FN990 Family Module Mechanical Dimensions

8.4. Solder Resist Opening Area and Keepout Area

The figure below shows the solder resist opening area and keep out area location on the FN990 bottom side.

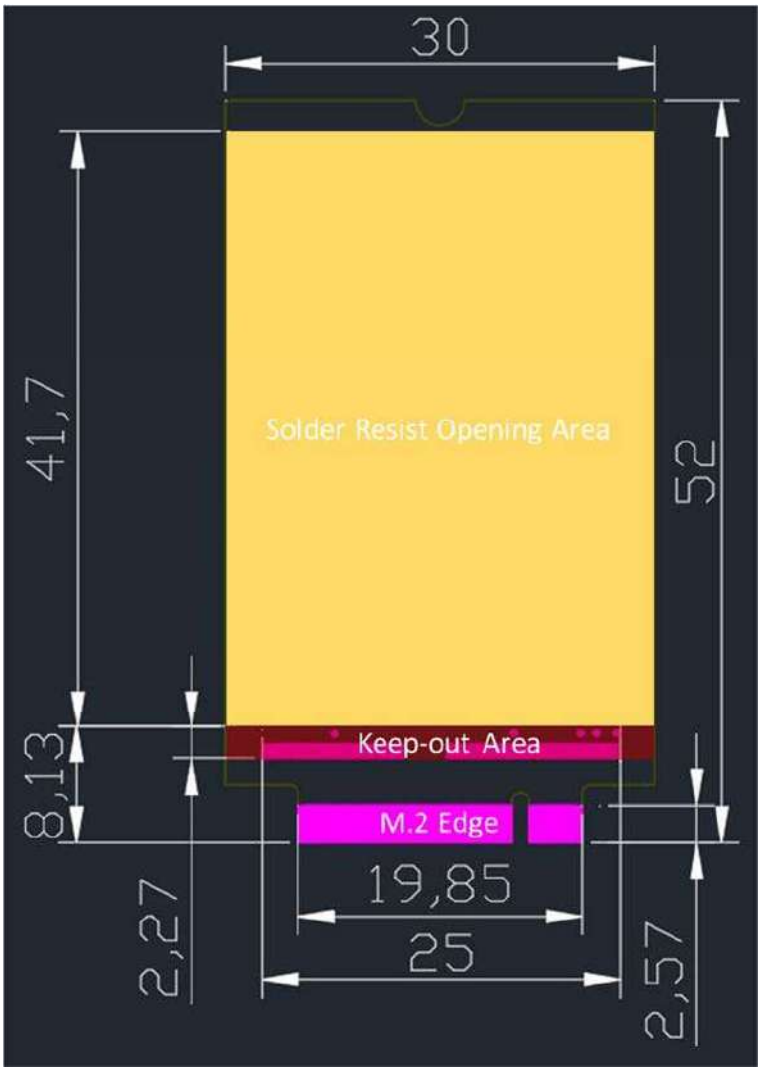

Figure 23: Solder Resist Opening Area and Keep Out Area on Bottom Side

In order to guarantee performance and longevity of the end product, the heat generated by the FN990 module must be dissipated.

A large solder resist opening area (30*41.7 mm) is provided on the bottom of the FN990 modems for better heat dissipation. The addition of a TIM on the back of the FN990 Family is the most important factor from the thermal dissipation point of view.

The recommended TIM size is 29 x 38 x 1.5 mm .

Note: For more information on thermal design, refer to the FN990 Family Thermal Design Guide.

Warning: The keep out area (30*2.27 mm) on the bottom side is only for debugging purposes. Please do not use this area for hardware design.

9. APPLICATION GUIDE

9.1. Debug of the FN990 Family Module in Production

To test and debug the FN990 Family module integration, it is strongly recommended to add test pins on the host PCB for the following purposes:

- Checking the connection between the FN990 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:

- FULL_CARD_POWER_N, SYS_RESET_N, W_DISABLE_N, PCIE_WAKE_N
- VPH_PWR, GND
- VREG_L6B_1P8
- USB_D +/-
- USB_SS_TX/RX_M/P
- PCIE_TX/RX_M/P

9.2. Bypass Capacitor on Power Supplies

When a sudden voltage step is asserted to or a cut from the power supplies, the step transition causes effects such as overshoot and undershoot. This abrupt voltage transition can affect the device causing it to fail or to malfunction.

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

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

The capacitor will also prevent power supplies ripple and the swiching 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:

- VPH_PWR

Recommended value:

- 100 uF for VPH_PWR

It must be taken into account that the capacitance mainly depends on the application board.

Generally, additional capacitance is required when the power line is longer.

Furthermore, if the fast power down function is used, additional bypass capacitor should be mounted on the application board.

9.3. EMC Recommendations

EMC protection on all FN990 pins should be designed on the application side according to customer's requirement.

ESD rating on all pins of FN990 Family:

Human Body Model (HBM): +/- 1000 V

Charged Device Model (CDM): +/- 250 V

All antenna pins up to +/- 4 kV

Electro-static Discharge: 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 FN990 Family modules are packaged on trays of 15 pieces each. These trays can be used in SMT processes for pick & place handling.

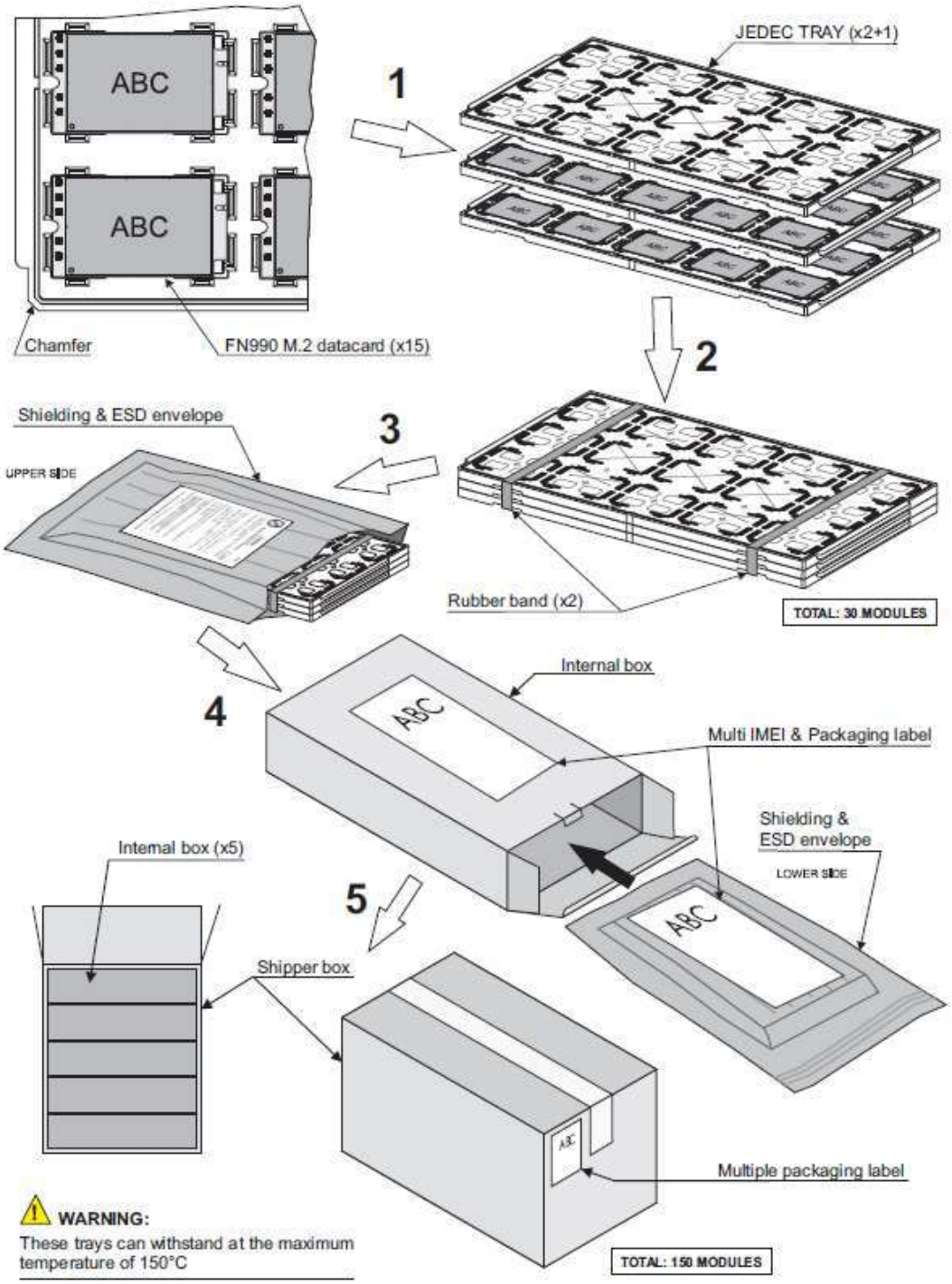

Figure 24: Tray Packaging

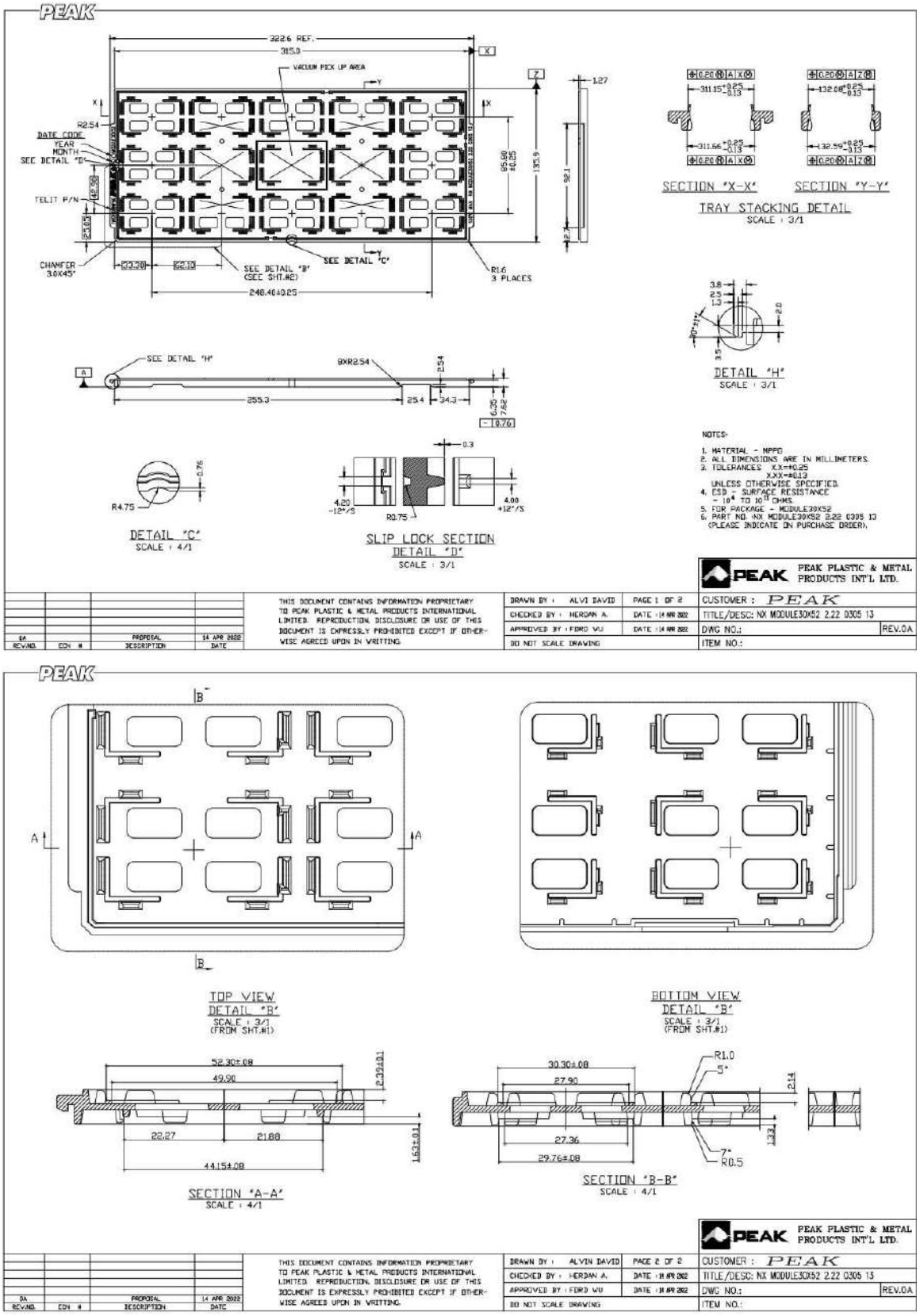

Figure 25: Tray Construction

11. CONFORMITY ASSESSMENT ISSUES

11.1. Approvals Compliance Summary

Region	Americas						
Country & Type Approval	AR ENACOM	BR ANATEL	CA ISED	CO CRC	MX IFETEL	PE MTC	US FCC
FN990A28			●				●
FN990A40			●				●

Table 44: Americas Approvals Compliance Summary

Region	APAC				
Country & Type Approval	AU RCM	CH CCC	JP JRL / JTBL	SG IMDA	TW NCC
FN990A28		●	●		
FN990A40		●	●		

Table 47: APAC Approvals Compliance Summary

Region	EMEA	
Country & Type Approval	EU RED	UK UKCA
FN990A28	●	
FN990A40	●	

Table 48: EMEA Approvals Compliance Summary

● The equipment is compliant

● Type approval is in progress

☐ The equipment is not compliant

11.2. Americas Approvals

11.2.1. USA FCC

11.2.1.1. FCC Certificates

The FCC Grants can be found here: *https://www.fcc.gov/oet/ea/fccid*

11.2.1.2. Applicable FCC Rules

Model	Applicable FCC Rules
FN990A28	47 CFR Part 2, 22, 24, 27, 90, 96
FN990A40	

Table 45: Applicable FCC Rules

11.2.1.3. FCC 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.

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 interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Wireless Notice

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

FCC Class B digital device notice

This equipment has been tested and found to comply with the limits for a Class B digital device, according 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 per 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 taking one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the 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.

Information for the OEMs and Integrators

The following statement must be included with all versions of this document supplied to an OEM or integrator but should not be distributed to the end user.

1. This device is intended for OEM integrators only.
2. Please see the full Grant of Equipment document for other restrictions

Manual Information to the End User

The OEM integrator should be aware not to provide information to the end user on 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/warming as shown in this manual

Information on test modes and additional testing requirement

The module has been evaluated in mobile stand-alone conditions. For operational conditions other than 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.

Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only authorized by the FCC for the specific rule parts (for example, 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 circuity), 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.

11.2.1.4. FCC Antenna info

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

Model	Antenna Type
FN990A28	Omnidirectional Monopole Antenna
FN990A40	

Table 49: FCC Antenna Type

Max Gain for FCC (dBi)			
UMTS	Max Gain to meet FCC ERP/EIPP and MPE limit	Max Gain to consider the same Frequency with LTE	Max gain allowed
B2	8.5	5.9	5.9
B4	5.5	5.5	5.5
B5	9.9	3.5	3.5

Table 5046: Max Antenna Gain for FCC in dBi – WCDMA bands

Max Gain for FCC (dBi)			
LTE	Max Gain to meet FCC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Active	Max gain allowed
B2	9.0	5.9	5.9
B4	6.0	5.5	5.5
B5	10.4	3.5	3.5
B7	9.0	3.8	3.8
B12	9.7	3.6	3.6

Max Gain for FCC (dBi)			
LTE	Max Gain to meet FCC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Active	Max gain allowed
B13	10.2	3.9	3.9
B14	10.2	3.9	3.9
B17	9.7	3.6	3.6
B25	9.0	5.9	5.9
B26	10.4	3.5	3.5
B30	1.0	1.0	1.0
B38	9.0	3.8	3.8
B41	5.5	3.8	3.8
B42	0.5	0.5	0.5
B43	0.5	0.5	0.5
B48	0.5	0.5	0.5
B66	6.0	5.5	5.5
B71	9.0	2.9	2.9

Table 51: Max Antenna Gain for FCC in dBi – LTE bands

Max Gain for FCC (dBi)			
NR	Max Gain to meet FCC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Active	Max gain allowed
n2	8.5	5.9	5.9
n5	9.9	3.5	3.5
n7	8.5	3.8	3.8
n25	8.5	5.9	5.9
n30	1.0	1.0	1.0
n38	8.0	3.8	3.8
n41	5.5	3.8	3.8
n48	0.5	0.5	0.5
n66	5.5	5.5	5.5
n71	9.0	2.9	2.9
n77	2.5	2.5	2.5
n78	2.5	2.5	2.5

Table 52: Max Antenna Gain for FCC in dBi – NR bands

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

Labelling requirements for the host device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the FCC ID of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as in the below table.

Model	Host device FCC label
FN990A28	Contains FCC ID: RI7FN990A28
FN990A40	Contains FCC ID: RI7FN990A40

Table 53: Host device FCC Label

11.2.2. Canada ISED

11.2.2.1. ISED Database

The products ISED certified can be found here:

Les produits certifiés ISED peuvent être trouvés ici :

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

11.2.2.2. Applicable ISED Rules / *Liste des Règles ISDE Applicables*

Model	Applicable ISED rules / *Règles ISDE applicables*
FN990A28	RSS: 130 Issue 2, 132 Issue 3, 133 Issue 6, 139 Issue 3, 140 Issue 1, 192 Issue 4, 195 Issue 2, 199 Issue 3; RSS-102 Issue 5, RSS-Gen Issue 5
FN990A40	

Table 47: Applicable ISED rules / Règles ISDE applicables

11.2.2.3. ISED Regulatory Notices / *Avis réglementaires d'ISDE*

Modification Statement / *Déclaration de modification*

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 / *Déclaration d'interférence*

This device complies with 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 applicables RSS standards d'Industrie Canada. 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.

Radio Exposure Notice / *Avis d'exposition radio*

This device complies with ISED radiation exposure limits set forth for an uncontrolled environment and meets the RSS-102 of the ISED radio frequency (RF) Exposure rules. Antenna gain must be less than the values reported in the table below:

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. Gain de l'antenne doit être ci-dessous:

Modèle	*Type d'Antenne*
FN990A28	*Antenne monopôle omnidirectionnelle*
FN990A40	

Table 55: ISED Antenna Type

Gain maximum pour ISED (dBi) */ Gain maximum pour ISDE (dBi)*			
UMTS	Max Gain to meet IC ERP/EIPP and MPE limit	Max Gain to consider the same Frequency with LTE	Max gain allowed
B2	8.5	5.9	5.9
B4	5.5	5.5	5.5
B5	6.6	3.5	3.5

Table 5648: Max antenna gain for ISED in dBi / Gain d'antenne max pour ISED en dBi – WCDMA bands

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*			
LTE	Max Gain to meet IC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Active	Max gain allowed
B2	9.0	5.9	5.9
B4	6.0	5.5	5.5
B5	7.1	3.5	3.5
B7	9.0	3.8	3.8
B12	6.6	3.6	3.6
B13	6.9	3.9	3.9
B14	7.0	3.9	3.9
B17	6.7	3.6	3.6
B25	9.0	5.9	5.9
B26	7.1	3.5	3.5
B30	1.0	1.0	1.0
B38	9.0	3.8	3.8
B41	5.5	3.8	3.8
B42	0.5	0.5	0.5
B43	0.5	0.5	0.5
B48	0.5	0.5	0.5
B66	6.0	5.5	5.5
B71	6.0	2.9	2.9

Table 57: Max antenna gain for ISED in dBi / Gain d'antenne max pour ISED en dBi – LTE bands

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*			
NR	Max Gain to meet IC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Active	Max gain allowed
n2	8.5	5.9	5.9
n5	6.6	3.5	3.5
n7	8.5	3.8	3.8
n25	8.5	5.9	5.9
n30	1.0	1.0	1.0
n38	8.0	3.8	3.8
n41	5.5	3.8	3.8
n48	0.5	0.5	0.5

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*			
NR	Max Gain to meet IC ERP/EIRP and MPE limit	Max Gain to consider EN-DC Active	Max gain allowed
n66	5.5	5.5	5.5
n71	6.0	2.9	2.9
n77	0.5	0.5	0.5
n78	0.5	0.5	0.5

Table 58: Max antenna gain for ISED in dBi / Gain d'antenne max pour ISED en dBi

– *NR bands*

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

L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

This equipment must be installed and operated in accordance with provided instructions and 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 and installers must be provided with antenna installation instructions and consider removing the no-collocation statement.

Cet équipement doit être installé et utilisé conformément aux instructions fournies et la ou les antennes utilisées pour cet émetteur doivent être installées pour fournir une distance de séparation d'au moins 20 cm de toutes les personnes et ne doivent pas être co-localisées ou fonctionner en conjonction avec toute autre antenne ou émetteur. Les utilisateurs finaux et les installateurs doivent recevoir les instructions d'installation de l'antenne et envisager de supprimer la déclaration de non-collocation.

Information on test modes and additional testing requirement / *Informations sur les modes de test et exigences de test supplémentaires*

The module has been evaluated in mobile stand-alone conditions. For operational conditions other than 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 IC RSS-102.

Le module a été évalué dans des conditions mobiles autonomes. Pour des conditions de fonctionnement autres qu'un émetteur modulaire autonome dans un hôte (plusieurs modules transmettant simultanément ou d'autres émetteurs dans un hôte), des tests supplémentaires peuvent être nécessaires (colocalisation, retest…) Si ce module est destiné à être utilisé dans un appareil portable , vous êtes responsable de l'approbation séparée pour satisfaire aux exigences SAR IC RSS-102.

Labelling requirements for the host device / *Exigences d'étiquetage pour le périphérique hôte*

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as in the following table.

L'appareil hôte doit être étiqueté comme il faut pour permettre l'identification des modules qui s'y trouvent. L'étiquette de certification du module donné doit être posée sur l'appareil hôte à un endroit bien en vue en tout temps. En l'absence d'étiquette, l'appareil hôte doit porter une étiquette donnant le IC du module, précédé des mots « Contient un module d'émission », du mot « Contient » ou d'une formulation similaire exprimant le même sens, comme en tableau suivant.

Model / HVIN	Host device IC label / Ètiquette IC du dispositif hôte
FN990A28	Contains IC: 5131A-FN990A28
FN990A40	Contains IC: 5131A-FN990A40

Table 59: Host device IC label / Ètiquette IC du dispositif hôte

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.

11.3. APAC Approvals

11.3.1. Japan Approvals

Telit strongly recommends to customers, deploying the module to Japan, the usage of AT#FWSWITCH command to select the right Japanese carrier profile. The carrier profile has been designed to enable the right LTE and WCDMA bands and also the required carrier settings.

11.3.1.1. JRL/JTBL Regulatory Notices

Antenna info

According to Japan regulatory rule, module certification is valid only with the specific antennas registered to and approved by Japan Radio Law (JRL) certified body in relation to module certification. Customers who are going to use modules under JRL are responsible to contact Telit technical support or sales to get the list of these antennas.

11.4. EMEA Approvals

11.4.1. EU RED

11.4.1.1. EU Declaration of Conformity

In accordance with the above Approval Compliance Summary table, where applicable (green ball), hereby, Telit Communications S.p.A declares that the equipment is in compliance with the Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: *https://www.telit.com/red*

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

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

11.4.1.2. RED 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
FN990A28	Omnidirectional Monopole Antenna
FN990A40	

Table 60: RED Antenna Type

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

Table 61: Max Antenna Gain for RED in dBi – WCDMA bands

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

Table 62: Max Antenna Gain for RED in dBi – LTE bands

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

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
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

Table 63: Max Antenna Gain for RED in dBi – NR bands

11.5. RoHS and REACH Info

11.5.1. RoHS Info

Any requests on information related to RoHS certifications can be addressed to *Chemical.Certifications@telit.com.*

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Any requests on information related to REACH certifications can be addressed to *Chemical.Certifications@telit.com.*

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12.3. Safety Recommendations

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

- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.
- there is a 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, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. 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 carefully 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 the final product against the SAR regulation.

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. GLOSSARY

CA	Carrier aggregation
CLK	Clock
CMOS	Complementary Metal – Oxide Semiconductor
DTE	Data Terminal Equipment
EN-DC	E-UTRA – NR Dual Connectivity
ESR	Equivalent Series Resistance
E-UTRA	Evolved UMTS Terrestrial Radio Access
FDD	Frequency Division Duplex
GPIO	General Purpose Input Output
HS	High Speed
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
I/O	Input Output
I2C	Inter-integrated Circuit
I2S	Inter-IC Sound
LTE	Long Term Evolution
NR	New Radio
PCB	Printed Circuit Board
PCIE	Peripheral Component Interconnect Express
RTC	Real Time Clock
SIM	Subscriber Identification Module
SOC	System-on-Chip
SMPS	Switching Mode Power Supply
TDD	Time Division Duplex
TTSC	Telit Technical Support Center
UART	Universal Asynchronous Receiver Transmitter
UMTS	Universal Mobile Telecommunication System
USB	Univeral Serial Bus
VNA	Vector Network Analyzer
VSWR	Voltage Standing Wave Radio

WDMA	Wideband Code Division Muliple Access

14. DOCUMENT HISTORY

Revision	Date	Changes
3	2022-10-07	Section 2.2.1 Updated Frequency Bands Section 2.6 Updated RF Performance Section 2.4 PCIe Gen 4 -> PCIe Gen 3 Section 3.1 Updated 3.1 Pin-out Section 3.3 Updated 3.3 Pin Layout Section 4.2 Updated Power consumption Section 6.3.1.2.1 Added PCIe Layout Guidelines Section 6.3.1.3.1 Added USB Layout Guidelines Section 6.4 Updated General Purpose I/O Section 7.1.1 Updated Antenna Configuration Section 7.2 Updated Antenna Connector Section 8.4 Solder Resist Opening Area and Keepout Area added Section 11. Updated CONFORMITY ASSESTMENT ISSUES Section 13. Updated Glossary
2	2022-06-09	Section 6.2 Updated Power ON/OFF/RESET Section 2.4, 6.3.2, 6.3.3 Updated eSIM description Section 4.2 Updated Power consumption Section 2.6.2 Conducted Receiver Sensitivity
1	2022-04-22	Section 2.4 Updated Processor Clock Section 3.1 Updated Pin-out Section 3.3 Updated Pin Layout Section 4.1 Updated Power Supply Requirements Section 4.2 Updated LPM Power Consumption Section 6.1 Updated I/O Operating Range Section 6.2 Updated Power ON/OFF/RESET Section 6.3 Added and updated information about interfaces
0	2021-12-16	First Draft

From Mod.0818 rev.2

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