

Technical Specification (TM03LNNATY1)

History

Ver.	Date	Contents	Written by	Checked by	Approved by	Note
1.0	2020.09.08					

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1. Product Introuction

The **TM03LNNATY1** are designed for the automotive industry. They support LTE and WCDMA air Interface standards. The **TM03LNNATY1** are based on the Qualcomm MDM9628 wireless chipsets and support the following bands.

Table 1. Supported Band

Region		US
Band	LTE	B2/B4/B5/B12/B26
	WCDMA	B2/B4/B5

1.1 Environmental Specifications

The environmental specification for operating and storage of the **TM03LNNATY1** are defined in the the table below.

Table 2. Environmental Specifications

Parameter	Temperature Range
Operating Temperature	-40°C to 85°C
Storage Temperature	-40°C to +90°C
Humidity	95% or less

1.2 Electrical Specifications

This section provides details for some of the key electrical specifications of the **TM03LNNATY1** embedded modules.

1.2.1 Absolute Maximum Rating and ESD Ratings

This section defines the Absolute Maximum and Electrostatic Discharge (ESD) Ratings of the **TM03LNNATY1** embedded modules.

Warning: If these parameters are exceeded, even momentarily, damage may occur to the device.

Table 3. Absolute Maximum Ratings

Parameter		Min	Max	Units
+12.0_VPWR	Power Supply Input	-	16.0V	V
VIN	Voltage on any digital input or output pin	-	VREG_MDME+0.5	V
ESD Ratings				
ESD ¹⁾	Primary, Diversity antenna pads - Contact		10	kV

1) The ESD Simulator configured with 330pF, 2000Ω.

Caution: The **TM03LNNATY1** embedded modules are sensitive to Electrostatic Discharge. ESD countermeasures and handling methods must be used when handling the **TM03LNNATY1** devices.

1.2.2 Current Consumption

Table 4. **TM03LNNATY1** Current Consumption (TBD)

Mode	Parameter	Typical	Max	Units
LTE	Max TX Output /Full RB	600	650	mA
WCDMA	Max TX Output /Full RB	600	650	mA
LTE	Idle, Registered	3.6	4.0	mA
WCDMA	Idle, Registered	3.6	4.0	mA
LTE	Sleep Mode, Average Current	1.8	2.2	mA
WCDMA	Sleep Mode, Average Current	1.8	2.2	mA

1.3 Mechanical Specifications

1.3.1 Physical Dimensions and Connection Interface

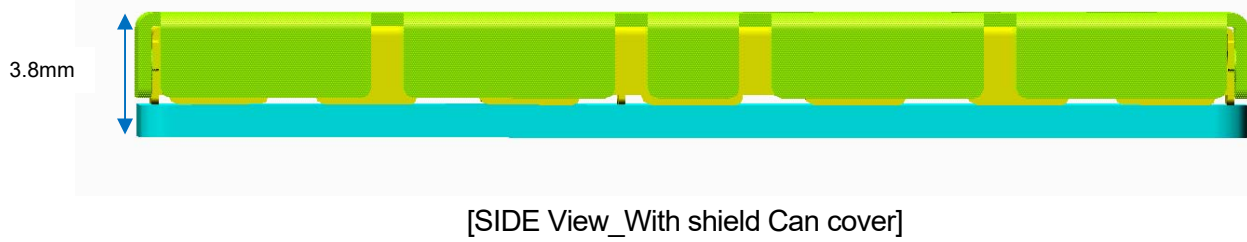
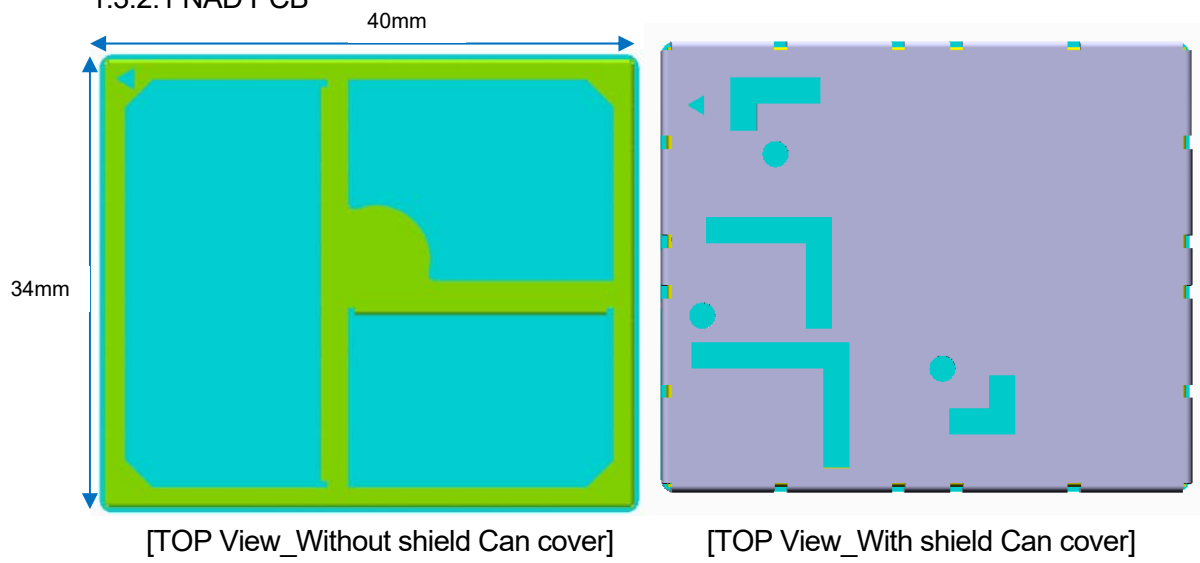
The **TM03LNNATY1** embedded modules are a Land Grid Array (LGA) form factor device. The device does not have a System or RF connectors. All electrical and mechanical connections are made via the 387 pad **TM03LNNATY1** on the underside of the PCB.

Table5. **TM03LNNATY1** Embedded Module Dimensions

Parameter	Nominal	Max	Units
Overall Dimension	34 x 40	34.35 x 40.35	mm
Overall Module Height	3.8	4.0	mm
PCB Thickness	1.0	1.1	mm
Flatness Specification		0.1	mm
Weight	TBD		g

1.3.2 Mechanical Drawing

1.3.2.1 NAD PCB



2. RF Specification

The specifications for the LTE and WCDMA interfaces are defined.

TM03LNNATY1 is designed to be compliant with the standard shown in the table below.

Table6. Standards Compliance

Technology	Standards
LTE	• 3GPP Release 8
WCDMA	• 3GPP Release 9

2.1 LTE Specification

2.1.1 LTE RX Sensitivity

The Receiver Sensitivity of the **TM03LNNATY1** are specified in the following table.

Table7. Conducted RX (Receive) Sensitivity – LTE Bands

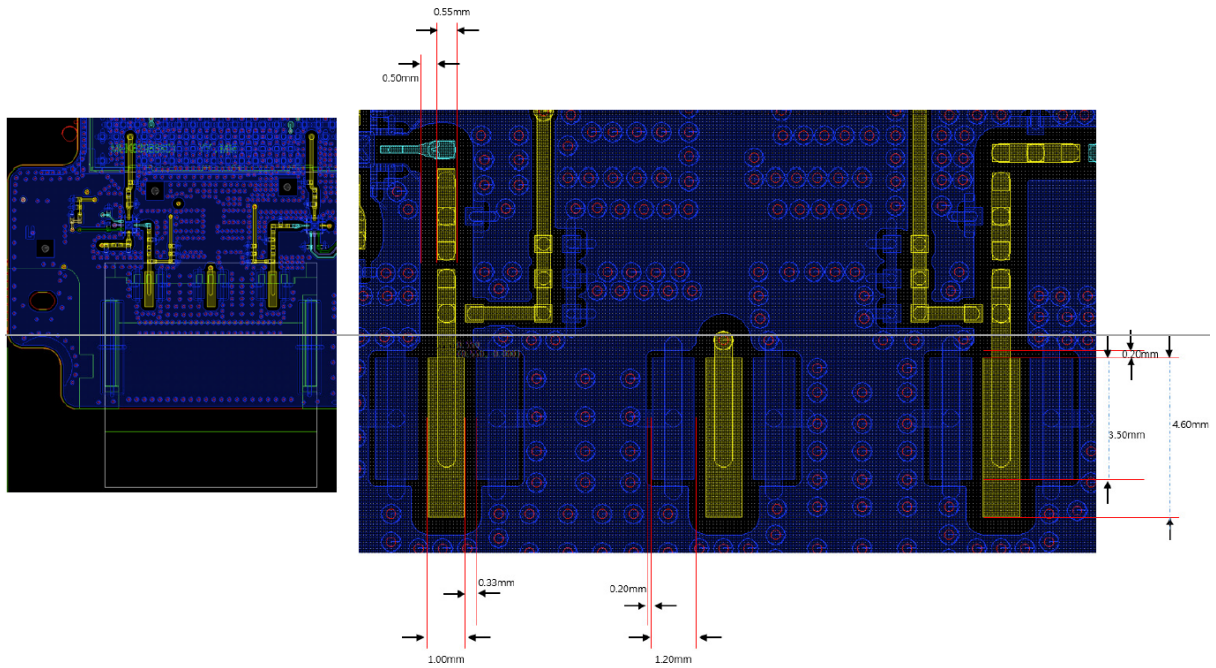
BAND	Method (DL CH)	Specification
BAND 2 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (900) in Band2	sensitivity : ≤ -95 BLER : $\leq 5\%$
BAND 4 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (2175) in Band4	sensitivity : ≤ -97 BLER : $\leq 5\%$
BAND 5 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (2525) in Band5	sensitivity : ≤ -95 BLER : $\leq 5\%$
BAND 12 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (5095) in Band12	sensitivity : ≤ -94 BLER : $\leq 5\%$
BAND 26 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (8865) in Band26	sensitivity : ≤ -94.5 BLER : $\leq 5\%$

2.2 WCDMA Specification

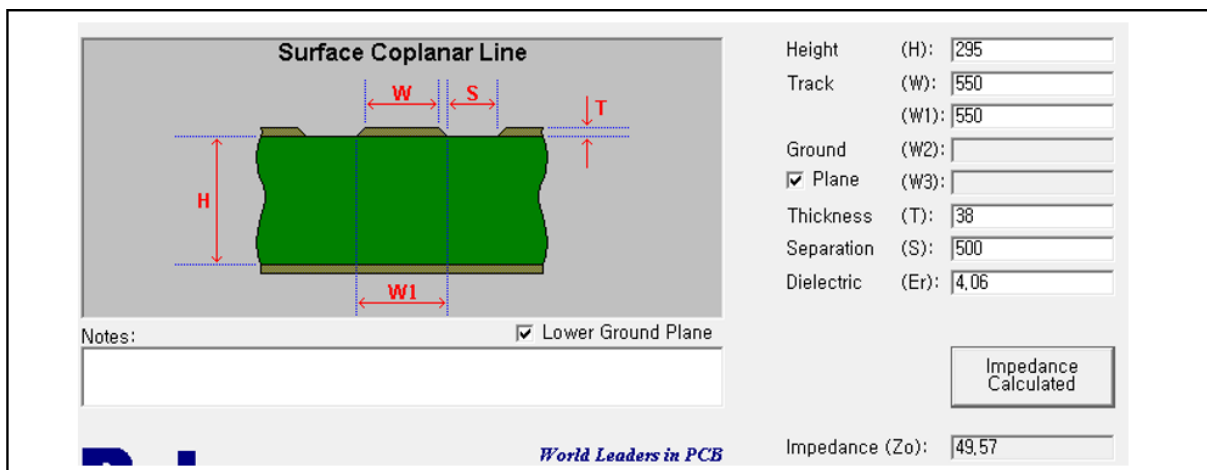
2.2.1 WCDMA RX Sensitivity

The Receiver Sensitivity of the **TM03LNNATY1** are specified in the following table.

Table8. Conducted RX (Receive) Sensitivity – WCDMA Bands



[Figure 2. Trace Layout]



[Figure 3. 50ohms calculatoin(mm) trace width : 0.55mm, Copper clearance : 0.5mm]

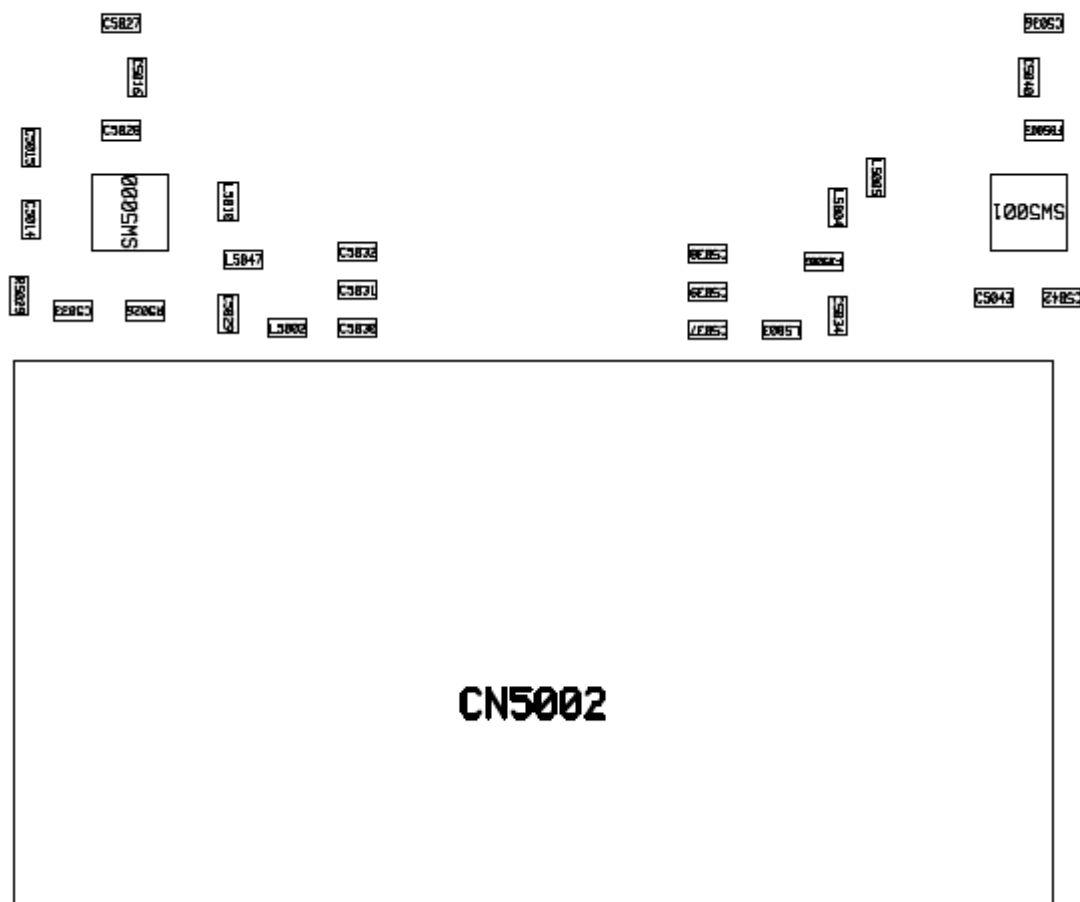
3.2 Design validation & production procedures

To verify compliance of the reference trace, a coupon must be requested with every manufacturing panel form and for which the characteristics are described in the Gerber files. Part of these characteristic are shown in Figure 3. Then a network analyzer is used to measure the impedance of this coupon in order to validate the antenna trace.

FR4-6L 1.6T				Single Impedance					
				50ohm		50ohm		50ohm	
				Width	Ref.	Width	Ref.	Width	Ref.
Layer	Type		Code						
	S/M	0.020							
1	TOP	0.038		0.195	2L	0.195	2L	0.55	3L
	prepreg	0.110	2116						
2	SIG	0.035							
	CORE	0.150	0.15T						
3	SIG	0.035		0.212	2L/4L	0.208	2L/5L	0.208	2L/4L
	prepreg	0.740	7628*4						
4	SIG	0.035		0.212	3L/5L	0.208	2L/5L	0.208	3L/5L
	CORE	0.150	0.15T						
5	SIG	0.035							
	prepreg	0.110	2116						
6	BOT	0.038		0.195	5L	0.195	5L	0.555	4L
	S/M	0.020							
	Total T	1.516							

Note1. Measurement results delivered with boards. Controlled impedance shall be 50 Ohms +/- 15% on layer TOP 0.55mm microstrip traces referenced to layer 3 plane and with a copper clearance of 0.50mm.

[Figure 4. PCB stack-up]



[Figure 5. Placement]

Reference Designator	Part Name	Component Type	Material	Value	Spec.
L5002	EA62807121	Coil	TDK CORPORATION	47uH	MLG100547N1-TD25 470H ±5% -250mA - 1.20OHM 11GHz 8 SHIELD 1 1.0X0.5X0.5MM R/TP TDK CORPORATION
L5003	EA62807127	Coil	TDK ELECTRONICS KOREA CORPORATION	399H	MLG10055339F1D25 39H ±5% -250mA - 0.65OHM 12GHz - SHIELD 2 1.0X0.5X0.5MM R/TP TDK Electronics KOREA CORPORATION
L5004	EA63461925	Capacitor	KOREA MURATA ELECTRONICS CO. LTD.	33pF	GC1M555C33F0A16D 33pF ±.1% 50V COG -S5T0-125C 1005 R/TP - AEC-Q200 KOREA MURATA ELECTRONICS CO. LTD.
L5005	DNI	DNI	DNI	DNI	DNI
L5010	EA63461910	Capacitor	MURATA MANUFACTURING CO.,LTD.	22pF	GC1M555C3H201 22pF 5% 50V COG -S5T0-125C 1005 R/TP 0.5mm Automotive Type GM Gen10 NAD MURATA MANUFACTURING CO.,LTD.
L5047	DNI	DNI	DNI	DNI	DNI
CS014	EA664382902	Capacitor	SAMWHA CAPACITOR CO. LTD.	33nF	CQ1005X7R333K160NR 33nF 10% 16V X7R -S5T0-125C 1005 R/TP - SAMWHA CAPACITOR CO. LTD.
CS015	EA664361601	Capacitor	KOREA TAYO YUDENCO, LTD.	100pF	RM UMK105 CG101/VHF 100pF 5% 50V COG -S5T0-125C 1005 R/TP - KOREA TAYO YUDENCO, LTD.
CS016	EA664361601	Capacitor	KOREA TAYO YUDENCO, LTD.	100pF	RM UMK105 CG101/VHF 100pF 5% 50V COG -S5T0-125C 1005 R/TP - KOREA TAYO YUDENCO, LTD.
CS027	DNI	DNI	DNI	DNI	DNI
CS028	DNI	DNI	DNI	DNI	DNI
CS029	EA63422301	Capacitor	MURATA MANUFACTURING CO.,LTD.	1000pF	GC1M55R71H102K AEC-Q2001 1000pF 10% 50V X7R -S5T0-125C 1005 R/TP - MURATA MANUFACTURING CO.,LTD.
CS030	EA664361601	Capacitor	KOREA TAYO YUDENCO, LTD.	100pF	RM UMK105 CG101/VHF 100pF 5% 50V COG -S5T0-125C 1005 R/TP - KOREA TAYO YUDENCO, LTD.
CS031	EA63422302	Capacitor	MURATA MANUFACTURING CO.,LTD.	10000pF	GC1M55R71H103K AEC-Q200(Grade1) 10000pF 10% 50V X7R -S5T0-125C 1005 R/TP - MURATA MANUFACTURING CO.,LTD.
CS032	EA664984501	Capacitor	SAMWHA CAPACITOR CO. LTD.	100nF	CQ1005X7R104K250NR AEC-Q2001 100nF 10% 25V X7R -S5T0-125C 1005 R/TP - SAMWHA CAPACITOR CO. LTD.
CS033	EA664361601	Capacitor	KOREA TAYO YUDENCO, LTD.	100pF	RM UMK105 CG101/VHF 100pF 5% 50V COG -S5T0-125C 1005 R/TP - KOREA TAYO YUDENCO, LTD.
CS034	EA664361925	Capacitor	KOREA MURATA ELECTRONICS CO. LTD.	33pF	GC1M555C33F0A16D 33pF ±.1% 50V COG -S5T0-125C 1005 R/TP - AEC-Q200 KOREA MURATA ELECTRONICS CO. LTD.
CS035	0R00000678	Resistor	ABCO ELECTRONICS CO.,LTD	DNI	ACR0402T001 00HM 5% 1/16W 1005 R/TP - ABCO ELECTRONICS CO.,LTD
CS036	DNI	DNI	DNI	DNI	DNI
CS037	EA63422302	Capacitor	MURATA MANUFACTURING CO.,LTD.	10000pF	GC1M55R71H103K AEC-Q200(Grade1) 10000pF 10% 50V X7R -S5T0-125C 1005 R/TP - MURATA MANUFACTURING CO.,LTD.
CS038	EA63422302	Capacitor	MURATA MANUFACTURING CO.,LTD.	10000pF	GC1M55R71H103K AEC-Q200(Grade1) 10000pF 10% 50V X7R -S5T0-125C 1005 R/TP - MURATA MANUFACTURING CO.,LTD.
CS039	EA664984501	Capacitor	SAMWHA CAPACITOR CO. LTD.	100nF	CQ1005X7R104K250NR AEC-Q2001 100nF 10% 25V X7R -S5T0-125C 1005 R/TP - SAMWHA CAPACITOR CO. LTD.
CS040	EA664361925	Capacitor	KOREA MURATA ELECTRONICS CO. LTD.	33pF	GC1M555C33F0A16D 33pF ±.1% 50V COG -S5T0-125C 1005 R/TP - AEC-Q200 KOREA MURATA ELECTRONICS CO. LTD.
CS042	EA664382902	Capacitor	SAMWHA CAPACITOR CO. LTD.	33nF	CQ1005X7R333K160NR 33nF 10% 16V X7R -S5T0-125C 1005 R/TP - SAMWHA CAPACITOR CO. LTD.
CS043	EA664361601	Capacitor	KOREA TAYO YUDENCO, LTD.	100pF	RM UMK105 CG101/VHF 100pF 5% 50V COG -S5T0-125C 1005 R/TP - KOREA TAYO YUDENCO, LTD.
RS026	DNI	DNI	DNI	DNI	DNI
RS029	DNI	DNI	DNI	DNI	DNI
CN5002	EAG65817301	Connector	TAIYANG 3C CO.,LTD	6958-8777	6958-8777 NONE ANGLE FAKRA SMD R/TP AU 00HM 00B TAIYANG 3C CO.,LTD
FB5002	DNI	DNI	DNI	DNI	DNI
FB5003	LAP62887206	Coil	TAIYO YUDEN CO.,LTD	56nH	MLG100556N1-TN4 E 56H ±5% -200mA - 100OHM 800MHz - SHIELD 1 1.0X0.5X0.5MM R/TP TAYO YUDEN CO.,LTD
SW5000	EAM64650301	Switch	SKYWORKS SOLUTIONS INC.	SKYA21003	SKYA21003 +0.5 dBm at 2.5 GHz -40-dBm 01 to 6.0 GHz SPDT 70dBm QFN12L 2x6x5.5 SKYWORKS SOLUTIONS INC.
SW5001	EAM64650301	Switch	SKYWORKS SOLUTIONS INC.	SKYA21003	SKYA21003 +0.5 dBm at 2.5 GHz -40-dBm 01 to 6.0 GHz SPDT 70dBm QFN12L 2x6x5.5 SKYWORKS SOLUTIONS INC.

Notice

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. This device should be installed and operated with minimum distance 20cm between the radiating element of this device and the user.

Integration instructions

The module complies with Part 22/24/27 of the FCC rules.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

This module is limited to be installed in the specific final product(Model: TL19BNN2, TL19BNN1).

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.

The module is authorized with trace antenna design type.

The trace antenna design must be performed as specified in the manual.

The use of any changes to the reference trace design is subject to additional testing and authorization through a Class II permissive change

The maximum antenna gain including cable loss must not exceed the table below;

Band	Frequency Range[MHz]	Maximum antenna gain (including cable loss)[dBi]	
		Main	Sub
B2	1850 ~ 1910	-3.5	-7.5
B4	1710 ~ 1755	-2.9	-9.1
B26(5)	814 ~ 849	0.35	-6.25
B12	699 ~ 716	-0.35	-7.95

The module is limited to installation in mobile or fixed applications. At least 20 cm of separation distance between the transmitting antenna device and the user's body must be maintained at all times.

The OEM integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

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

The module is labeled with its own FCC ID. If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

"Contains FCC ID: BEJTM03LNNATY1"

Host User Manual

The host manual shall include the following regulatory statement;

Part 15.19: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The antenna(s) must be installed such that a minimum separation distance of at least 20 cm is maintained between the radiator (antenna) and all persons at all times.