

Technical Specification (TM03LNNATY0)

History

Ver.	Date	Contents	Written by	Checked by	Approved by	Note
1.0	2018.09.04					
1.1	2018.09.18					

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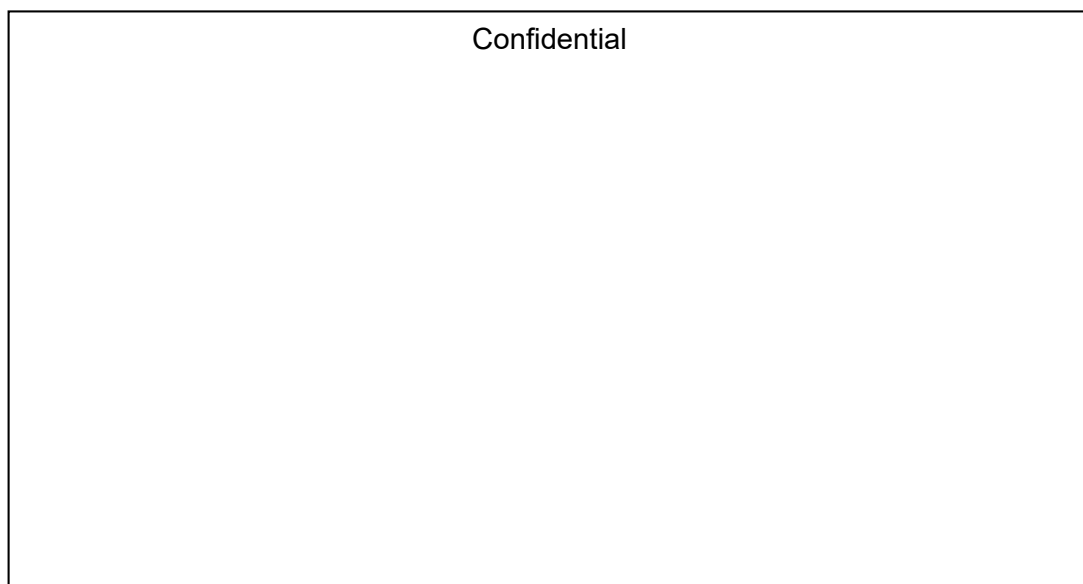
1. Product Introuction

The **TM03LNNATY0** are designed for the automotive industry. They support LTE and WCDMA air Interface standards. The **TM03LNNATY0** 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/ B13/B17/B26
	WCDMA	B2/B4/B5

1.1 Block Diagram



[Figure 1. TM03LNNATY0 Block diagram]

1.2 Environmental Specifications

The environmental specification for operating and storage of the **TM03LNNATY0** 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

1.3 Electrical Specifications

This section provides details for some of the key electrical specifications of the **TM03LNNATY0** embedded modules.

1.3.1 Absolute Maximum Rating and ESD Ratings

This section defines the Absolute Maximum and Electrostatic Discharge (ESD) Ratings of the **TM03LNNATY0** 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 **TM03LNNATY0** embedded modules are sensitive to Electrostatic Discharge. ESD countermeasures and handling methods must be used when handling the **TM03LNNATY0** devices.

1.3.2 Current Consumption

Table 4. **TM03LNNATY0** 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

1.4 Mechanical Specifications

1.4.1 Physical Dimensions and Connection Interface

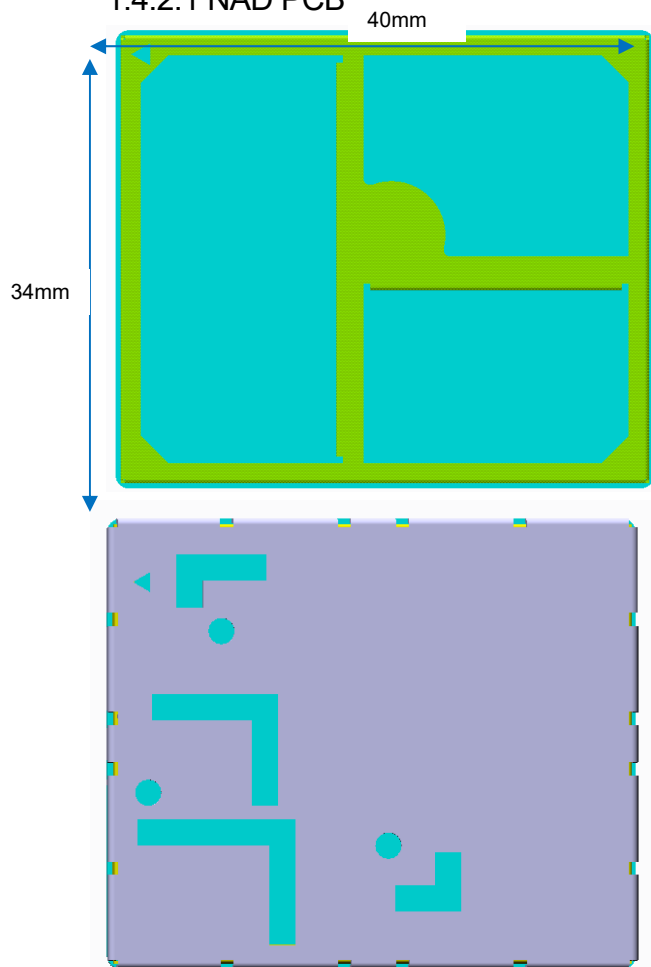
The **TM03LNNATY0** embedded modules are a Land Grid Array (LGA) form factor device. The device does not have a System or RF connectors. All electrical and mechanical connections are made via the 387 pad **TM03LNNATY0** on the underside of the PCB.

Table5. **TM03LNNATY0** Embedded Module Dimensions

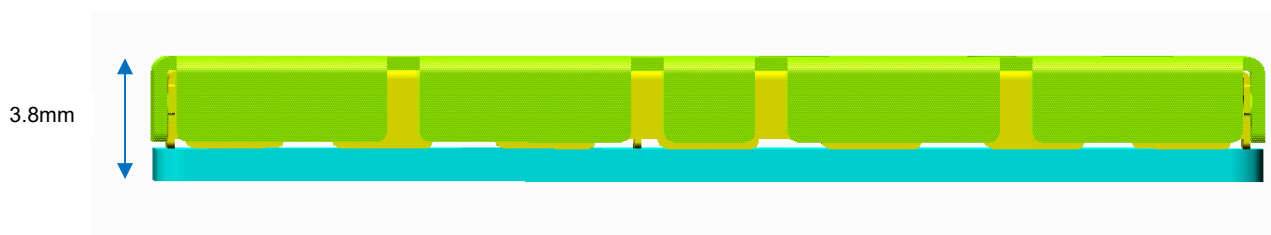
Parameter	Nominal	Max	Units
Overall Dimension	34 x 40	34.35 x 40.35	mm
Overall Module Height	3.8	4.0	mm
PCB Thickness	1.0	1.1	mm
Flatness Specification		0.1	mm
Weight	TBD		g

1.4.2 Mechanical Drawing

1.4.2.1 NAD PCB



[Figure 2. TOP View_Without shield Can cover] [Figure 3. TOP View_With shield Can cover]



[Figure 4. SIDE View_With shield Can cover]

2. RF Specification

The specifications for the LTE and WCDMA interfaces are defined.

TM03LNNATY0 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 **TM03LNNATY0** 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 13 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (5230) in Band13	sensitivity : ≤ -94 BLER : $\leq 5\%$
BAND 17 Reference sensitivity level(DUAL)	Measure BLER of Mid Channel (5790) in Band17	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 **TM03LNNATY0** are specified in the following table.

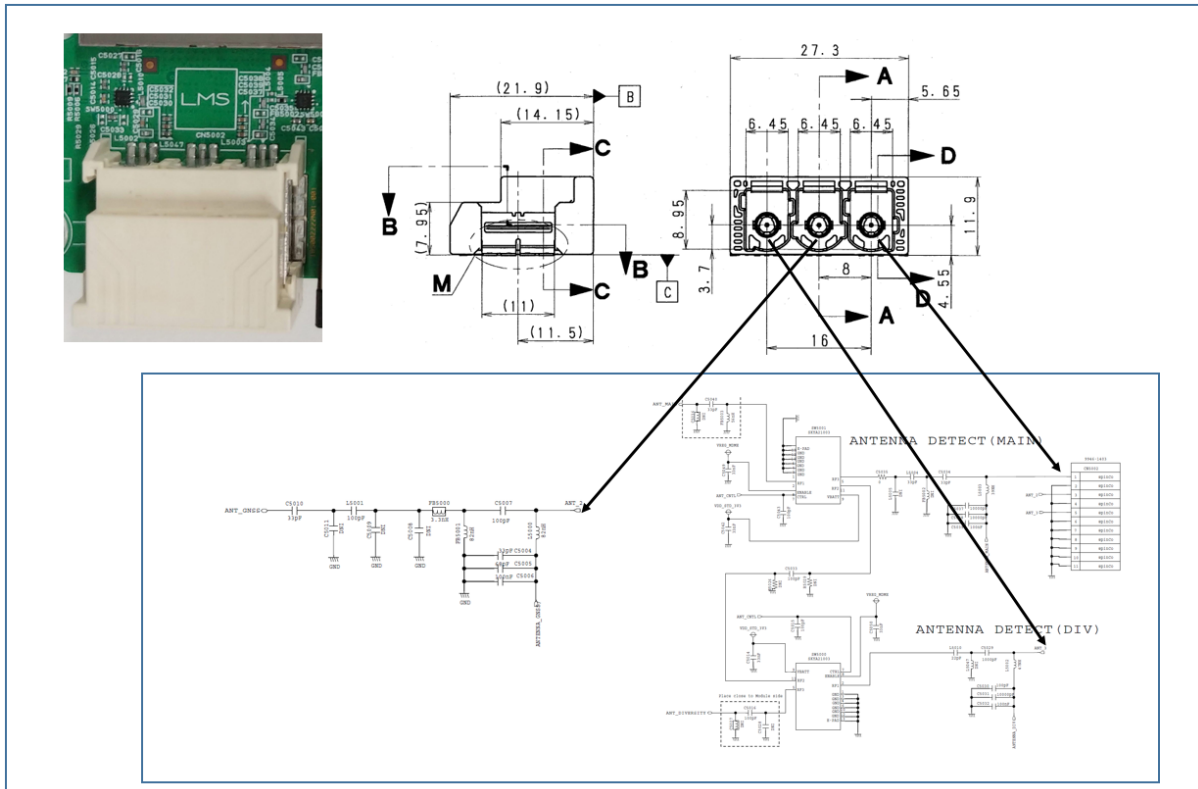
Table8. Conducted RX (Receive) Sensitivity – WCDMA Bands

Item	Method (DL CH)	Specification
BAND2 BER(Bit Error Rate)	Measure BER of Middle Channel (CH=9800) in Band2	0.1% @ $\leq$ -106.7dBm
BAND4 BER(Bit Error Rate)	Measure BER of Middle Channel (CH=1675) in Band4.	0.1% @ $\leq$ -106.7dBm
BAND5 BER(Bit Error Rate)	Measure BER of Middle Channel (CH=4400) in Band5	0.1% @ $\leq$ -106.7dBm

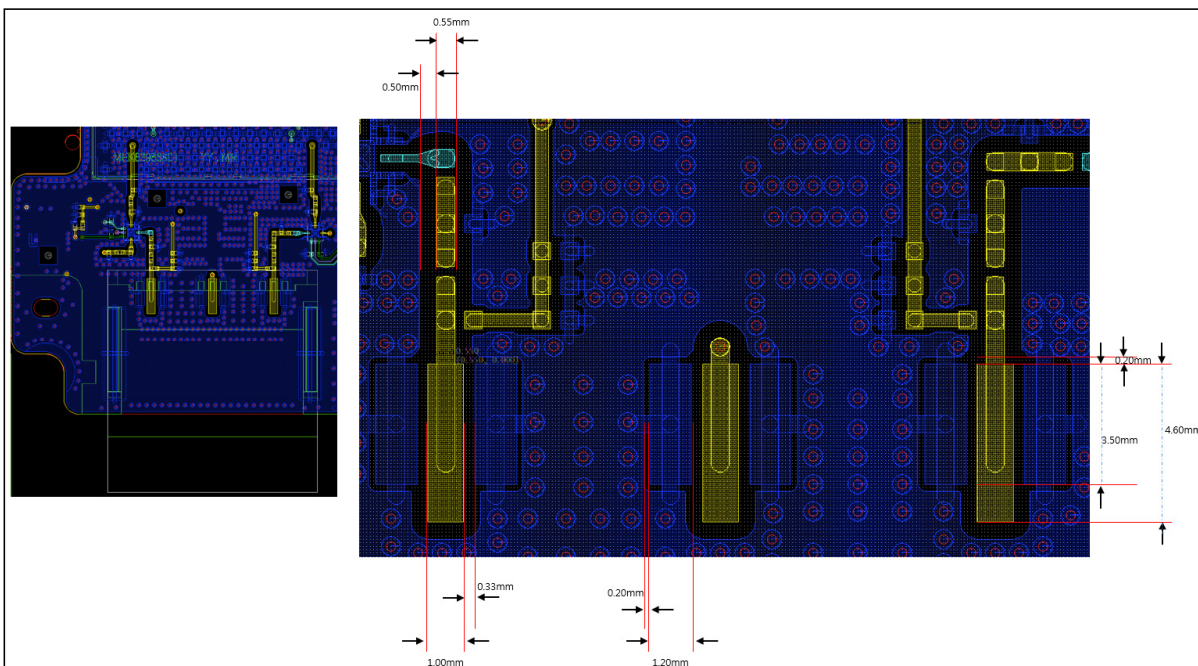
3. NAD Module installation guide

- TM03LNNATY0 Module is mounted with solder ball on the main TCU board.
- TM03LNNATY0 Module is the Limited single-modular transmitter and is used only on the Toyota TCU board.

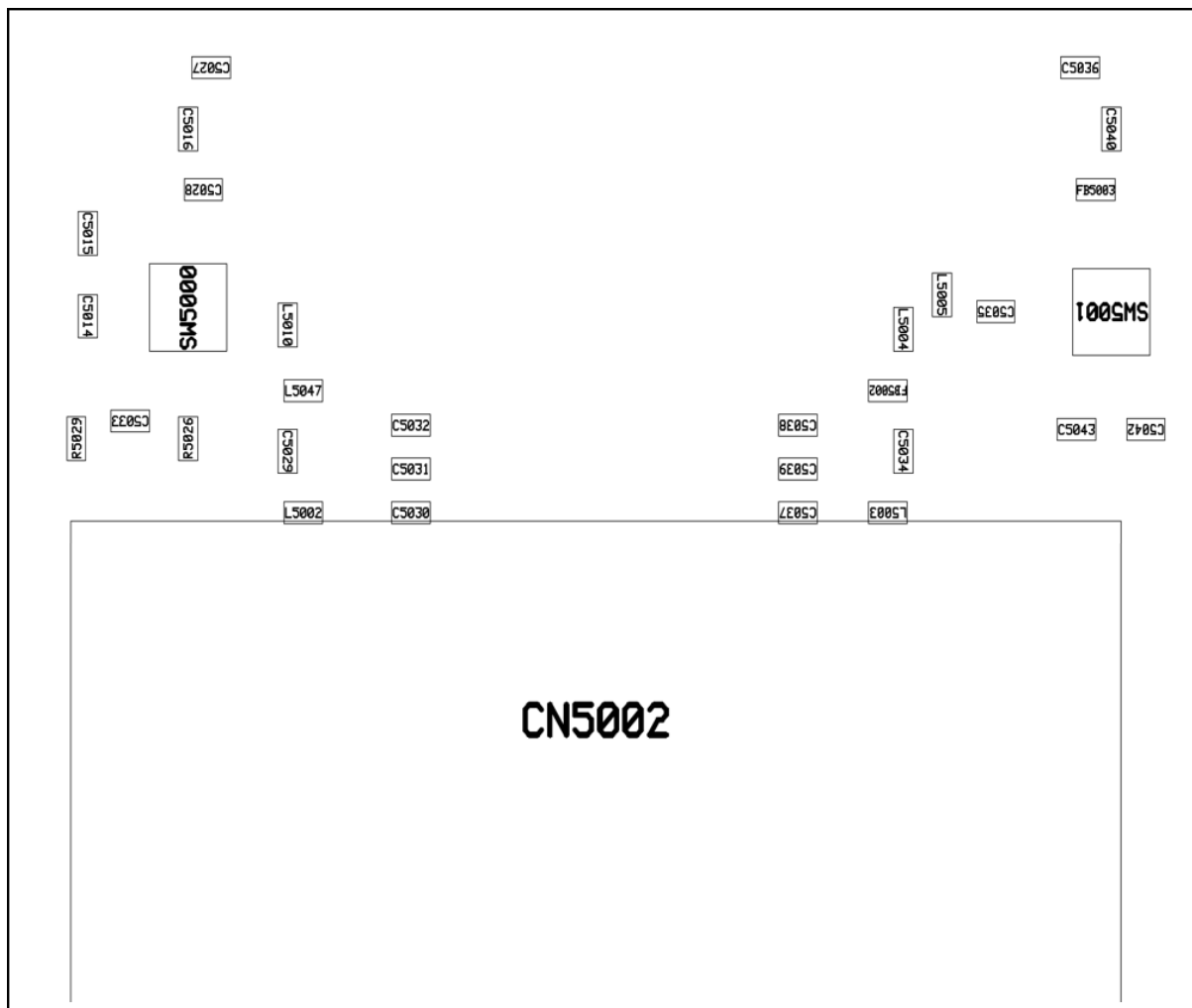
3.1. Antenna connector configuration and Circuit design



[Figure 5. Schematic and Antenna Configuration]



[Figure 6. Trace Layout]



[Figure 7. Placement]

Reference Designator	Part Name	Component Type	Mat	Value	Spec
L5002	EAP82807121	Coil	TDK CORPORATION	47uH	MLG1005547N1-TD25 47uH 5% - 250mA - - 1.20Hm 1.1GHz 8 SHIELD 1 1.0X0.5X0.5MM R/TP TDK CORPORATION
L5003	EAP82807127	Coil	TDK Electronics Korea CORPORATION	39uH	MLG1005539P1TD25 39uH 5% - 250mA - - 0.65OHm 1.2GHz - SHIELD 2 1.0X0.5X0.5MM R/TP TDK Electronics Korea CORPORATION
L5004	EA63461925	Capacitor	KOREA MURATA ELECTRONICS CO. LTD.	33pF	GCMI1555C11330FA16D 33pF - 1% 50V COG -S570+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	GCMI1555C1H220 22pF 5% 50V COG -S570+125C 1005 R/TP 0.5mm Automotive Type GM Gen10 NAD MURATA MANUFACTURING CO.LTD
L5047	DNI	DNI	DNI	DNI	DNI
S5014	EA63482902	Capacitor	SAMWHA CAPACITOR CO. LTD.	33nF	CQ1005X7R333K160NR 33nF 10% 16V X7R -S570+125C 1005 R/TP - - SAMWHA CAPACITOR CO. LTD.
S5015	EA63461601	Capacitor	KOREA TAIYO YUDEN.CO., LTD.	1000pF	RM UMK105 CG101JVFH 1000pF 5% 50V COG -S570+125C 1005 R/TP - - KOREA TAIYO YUDEN.CO., LTD.
S5016	EA63461601	Capacitor	KOREA TAIYO YUDEN.CO., LTD.	1000pF	RM UMK105 CG101JVFH 1000pF 5% 50V COG -S570+125C 1005 R/TP - - KOREA TAIYO YUDEN.CO., LTD.
S5017	DNI	DNI	DNI	DNI	DNI
S5028	DNI	DNI	DNI	DNI	DNI
S5029	EA63422301	Capacitor	MURATA MANUFACTURING CO.LTD.	1000pF	GCMI1557R11102K AEC-Q200(1) 1000pF 10% 50V X7R -S570+125C 1005 R/TP - - MURATA MANUFACTURING CO.LTD.
S5030	EA63461601	Capacitor	KOREA TAIYO YUDEN.CO., LTD.	1000pF	RM UMK105 CG101JVFH 1000pF 5% 50V COG -S570+125C 1005 R/TP - - KOREA TAIYO YUDEN.CO., LTD.
S5031	EA63422302	Capacitor	MURATA MANUFACTURING CO.LTD.	10000pF	GCMI1557R11103K AEC-Q200(Grade1) 10000pF 10% 50V X7R -S570+125C 1005 R/TP - - MURATA MANUFACTURING CO.LTD.
S5032	EA63461601	Capacitor	SAMWHA CAPACITOR CO. LTD.	100nF	CQ1005X7R104K250NR AEC-Q200(1) 100nF 10% 25V X7R -S570+125C 1005 R/TP - - SAMWHA CAPACITOR CO. LTD.
S5033	EA63461601	Capacitor	KOREA TAIYO YUDEN.CO., LTD.	1000pF	RM UMK105 CG101JVFH 1000pF 5% 50V COG -S570+125C 1005 R/TP - - KOREA TAIYO YUDEN.CO., LTD.
S5034	EA63461925	Capacitor	KOREA MURATA ELECTRONICS CO. LTD.	33pF	GCMI1555C1330FA16D 33pF - 1% 50V COG -S570+125C 1005 R/TP - AEC-Q200 KOREA MURATA ELECTRONICS CO. LTD.
S5035	0J00000678	Resistor	ABCO ELECTRONICS CO.,LTD	0	ACR0402T000 0OHM 5% 1/16W 1005 R/TP - ABCO ELECTRONICS CO.,LTD
S5036	DNI	DNI	DNI	DNI	DNI
S5037	EA63422302	Capacitor	MURATA MANUFACTURING CO.LTD.	10000pF	GCMI1557R1103K AEC-Q200(Grade1) 10000pF 10% 50V X7R -S570+125C 1005 R/TP - - MURATA MANUFACTURING CO.LTD.
S5038	EA63422302	Capacitor	MURATA MANUFACTURING CO.LTD.	10000pF	GCMI1557R1103K AEC-Q200(Grade1) 10000pF 10% 50V X7R -S570+125C 1005 R/TP - - MURATA MANUFACTURING CO.LTD.
S5039	EA63461601	Capacitor	SAMWHA CAPACITOR CO. LTD.	100nF	CQ1005X7R104K250NR AEC-Q200(1) 100nF 10% 25V X7R -S570+125C 1005 R/TP - - SAMWHA CAPACITOR CO. LTD.
S5040	EA63461925	Capacitor	KOREA MURATA ELECTRONICS CO. LTD.	33pF	GCMI1555C1330FA16D 33pF - 1% 50V COG -S570+125C 1005 R/TP - AEC-Q200 KOREA MURATA ELECTRONICS CO. LTD.
S5042	EA63482902	Capacitor	SAMWHA CAPACITOR CO. LTD.	33nF	CQ1005X7R333K160NR 33nF 10% 16V X7R -S570+125C 1005 R/TP - - SAMWHA CAPACITOR CO. LTD.
S5043	EA63461601	Capacitor	KOREA TAIYO YUDEN.CO., LTD.	1000pF	RM UMK105 CG101JVFH 1000pF 5% 50V COG -S570+125C 1005 R/TP - - KOREA TAIYO YUDEN.CO., LTD.
R5026	DNI	DNI	DNI	DNI	DNI
R5029	DNI	DNI	DNI	DNI	DNI
C15002	EAG65871301	Connector	TAIYANG 3C CO.,LTD	6098-8777	6098-8777 NONE ANGLE FAKRA SMD R/TP AU 0.0Hm 0.8m TAIYANG 3C CO.,LTD
B5002	DNI	DNI	DNI	DNI	DNI
FB503	EAP8287206	Coil	TAIYO YUDEN CO., LTD	56uH	MLG100556N1-TV AEC 56uH 5% - 200mA - - 100OHm 800MHz - SHIELD 1 1.0X0.5X0.5MM R/TP TAIYO YUDEN CO.,LTD
SW5000	EAM64650301	Switch	SKYWORKS SOLUTIONS INC.	SKYA21003	SKYA21003 +0.5 dBm at 2.5 GHz 40~42dB 0.01 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 40~42dB 0.01 to 6.0 GHz SPDT 70dBm QFN12L 2x6x5.5 SKYWORKS SOLUTIONS INC.

[Figure 8. Part List]

Surface Coplanar Line

Height (H):	295
Track (W):	550
(W1):	550
Ground (W2):	
Plane (W3):	
Thickness (T):	38
Separation (S):	500
Dielectric (Er):	4.06

Notes: ☒ Lower Ground Plane

Impedance Calculated

Impedance (Zo): 49.57

[Figure 8. 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 8. 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	
Layer	Type		Code	Width	Ref.	Width	Ref.	Width	Ref.
	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							

[Figure 9]

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 8. PCB stack-up]

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.

NOTE: 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.

The LG Electronics is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

The module is limited to OEM installation ONLY.

This module is limited to be installed in the specific final product(Model: TL19BNN).

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

The module is limited to installation in mobile or fixed applications.

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.

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	-5.2
B4	1710 ~ 1755	-2.9	-6.8
B26(5)	814 ~ 849	0.2	-4.9
B13	777 ~ 787	0.1	-3.9
B12(17)	699 ~ 716	-0.4	-5.4

(Impedance: 50Ω)

Main antenna - (Model: 86769-459B1)

Sub Antenna - (Model: 86880-245B0)

The satisfy FCC exterior labeling requirements, the following text must be placed on the exterior of the end product. Contains module FCC ID: BEJTM03NNATY0.