LTE / WCDMA Wireless Module

Cellular modem_LW-9880

Product Manual

Revision History

Revision	Date	Authors	Description
V1.0	04/20/19	Sung il Jeon	Initial Version

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1. Executive Summary

1.1. Device Introduction

Cellular modem_LW-9880 is a telecommunication (ELS61_US-R2) modem module that supports LTE / WCDMA with up to 10.2Mbps download, and 5.2Mbps upload.

2. Electrical Specifications

2.1. General Specifications

Main chipset	Intel XMM7160
Memory	1Gbit LPDDR2 SDRAM
Interface Type	High-speed USB 2.0
	UART serial interface
Common Air interface	FDD LTE / WCDMA
Frequency band (FDD LTE & WCDMA)	LTE Band 2, 4, 5, 12 / WCDMA 2, 4, 5
DC input operating voltage	Typical Input 5V, DC Converter output 3.8V
Maximum current @ +5VDC, Maximum TX Power (23dBm)	Under 1 A
Dimensions	140.0 x 45.0 x 13.8mm
Operating temperature(board temperature)	Normal operation: -30°C to +85°C Extended operation: -40°C to +90°C

Table 2-1 General Specifications

2.2. HW Specifications

ITEM		SPECIFICATION	
LTE	Standard	3GPP Release 9	
	UE Category	LTE / WCDMA	
	Frequency Range	Band 2 (UL: 1850 ~ 1910MHz, DL: 1930 ~ 1990MHz) Band 4	

		(UL: 1710 ~ 1755MHz, DL: 2110 ~ 2155MHz) Band 5 (UL: 824 ~ 849MHz, DL: 869 ~ 894MHz) Band 12 (UL: 699 ~ 716MHz, DL: 729 ~ 746MHz)	
	Duplex Mode	HD-FDD	
	RF Paths	2 x Rx / 1 x Tx	
	Reference Sensitivity	LTE 1900 Band 2 (ch.bandwidth10MHz) LTE AWS Band 4 (ch.bandwidth10MHz) LTE 850 Band 5 (ch.bandwidth10MHz) LTE 700 Band 12 (ch.bandwidth5MHz)	Band 2 : -97dBm Band 4 : -97dBm Band 5 : -97dBm Band 12 : -99dBm
	Maximum Tx Power	22.5dBm ±2.5 / -1.5dBm	@Antenna Port
	Transmit Data Rate	Downlink : 10.2Mbps, Uplink : 5.2Mbps	

ITEM		SPECIFICATION	
WCDMA	Standard	HSDPA(3GPP Release 8) UMTS(3GPP Release 4)	
	UE Category	WCDMA	
	Frequency Range	Band 2 (UL:1852.4~1907.6MHz,DL:1932.4~1987.6MHz) Band 4 (UL:1712.4~1752.6MHz,DL:2112.4~2152.6MHz) Band 5 (UL: 826 ~ 846.6MHz, DL: 871.4 ~ 891.6MHz)	
	Duplex Mode	HD-FDD	
	RF Paths	2 x Rx / 1 x Tx	
	Reference Sensitivity	UMTS 1900 BAND 2 UMTS AWS BAND 4 UMTS 850 BAND 5	Band 2 : -104.7dBm Band 4 : -106.7dBm Band 5 : -104.7dBm
	Maximum Tx Power	24dBm +1/-5dBm	@Antenna Port
	UMTSTransmit Data Rate	PS data rate – 384 kbps DL / 384 kbps UL CS data rate – 64 kbps DL / 64 kbps UL	
	HSDPA Transmit Data Rate	DL 7.2Mbps, UL 5.7Mbps	

Table 2-2 HW Specifications

2.3. Environmental Specifications

Parameter	Conditions	Min	Max	Unit
Operating Temperature		-30	+85	℃
Storage Temperature		-40	+90	℃
Automatic shutdown2 Temperature measured on ELS61-US Board	Non-condensing	<-40	>+90	℃

Table 2-3 Temperature & Humidity Specifications

3. Mechanical Specifications

Dimensions	140.0 mm(W) x 45.0 mm(H) x 13.8mm(T)
Weight	122.0g
Mounting Hole	2 holes (Φ4.5)

Table 3-1 Mechanical Specifications

3.1. Mechanical Appearance

Figure 3-1 Cellular modem_LW-9880 Top

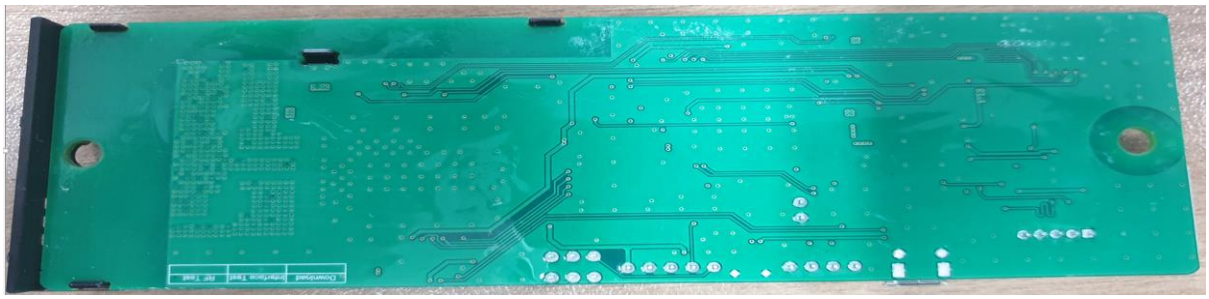


Figure 3-2 Cellular modem_LW-9880 Bottom

3.1.1. Mechanical Dimensions

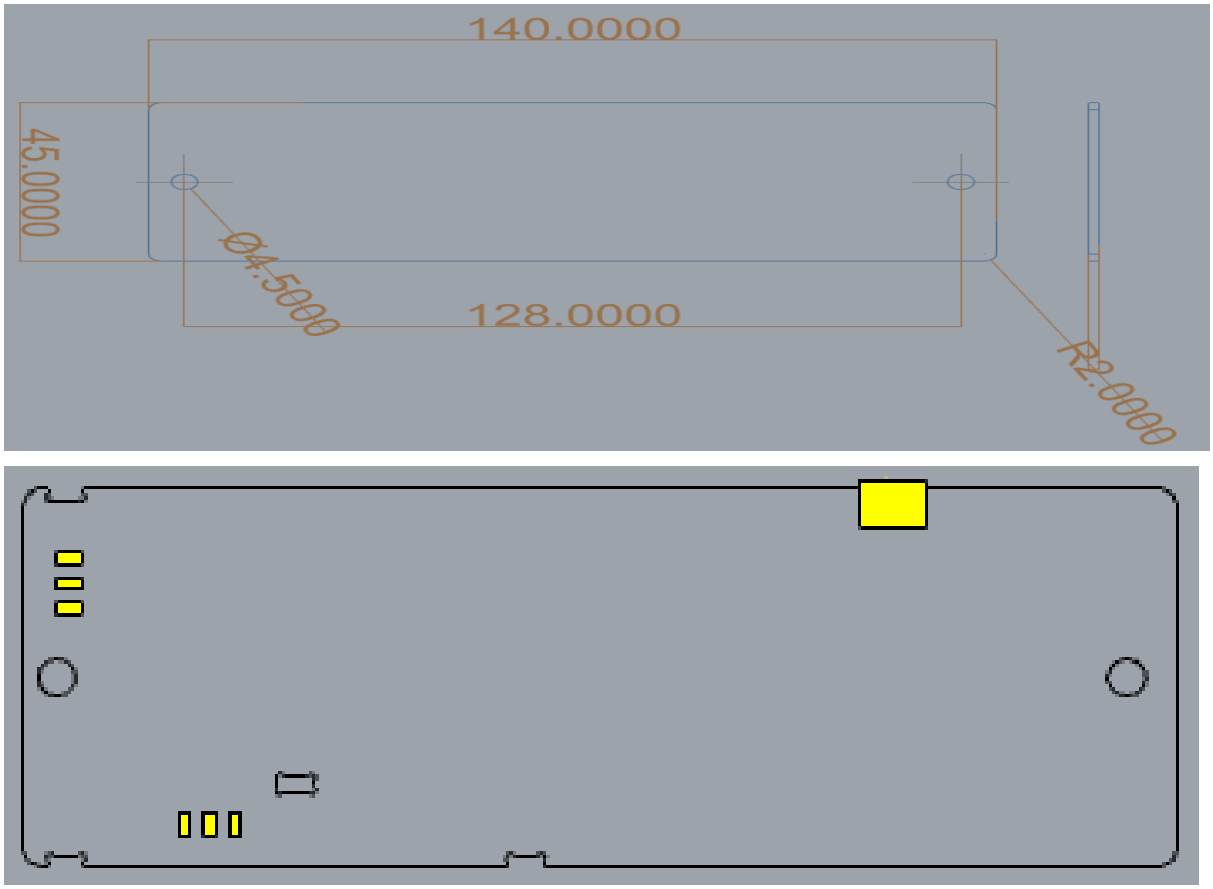


Figure 3-3 Cellular modem_LW-9880 Exterior Dimensions

4. Block Diagram Architecture

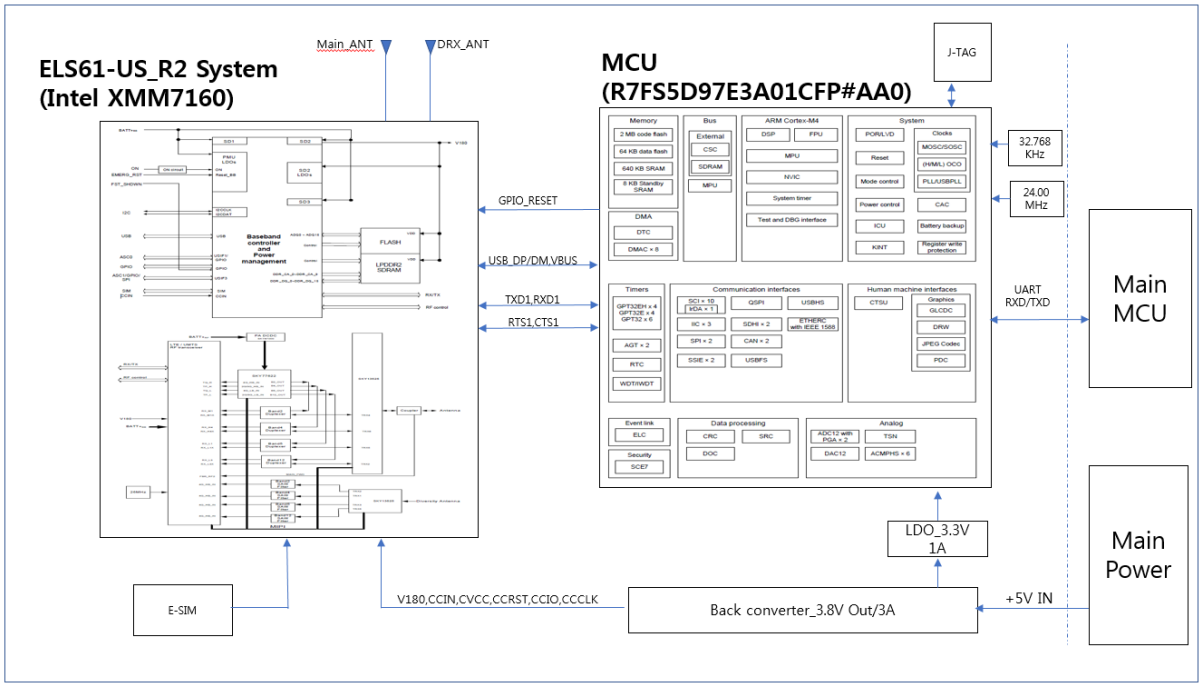


Figure4-1 Cellular modem_LW-9880 Block Diagram

5. Cellular modem_LW-9880 Interface

5.1 Application Note of Cellular modem_LW-9880 Interface

5.1.1 Power Supply

The input power of Cellular modem_LW-9880 is Typical DC+5.0V. (+5% / -5%)

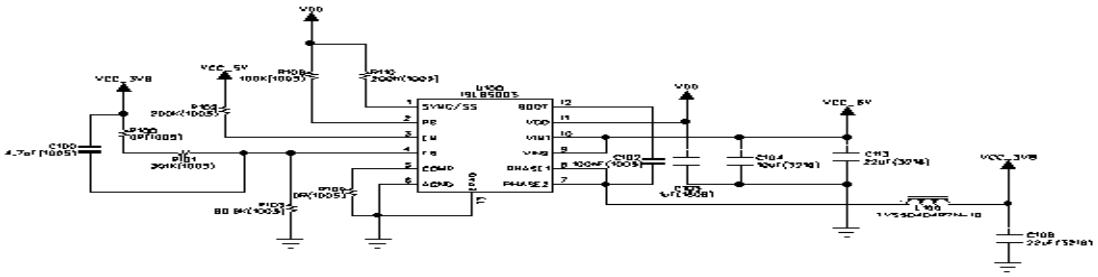


Table 5-1 Boot Control

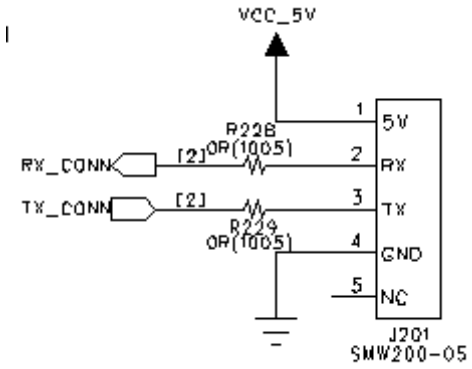


Figure 5-2 Main Power Reference Circuit

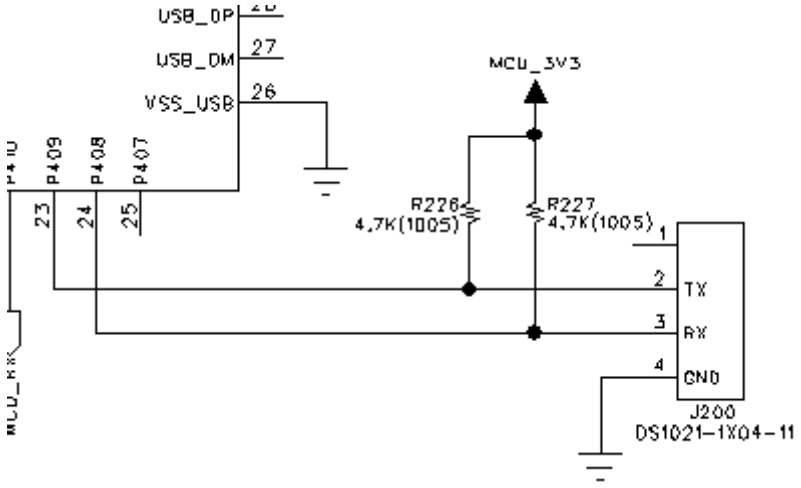
5.1.2 UART Signal

Data communication between HOST and Cellular modem_LW-9880 is through TTL Level (3.3V). The signals and specifications are as stated below.

Pin Function	Pin No.	Description	Direction
N.C	1	-	
TX_DATA	2	Transmit Data	H-to-M
RX_DATA	3	Receive Data	M-to-H
GND	4	GND	

* M : Module H : HOST * **Signal name is based on module**

Table 5-1 UART Interface description



5.1.3 USB Interface

Cellular modem_LW-9880 supports USB 2.0 High speed via 5 Pin Connector.

Signal Name	Pin No.	Description
USB_VBUS	1	USB_VBUS
USB_DM	2	USB Data -
USB_DP	3	USB Data +
USB_ID	4	-
GND	5	GND

Table 5-2 USB Interface description

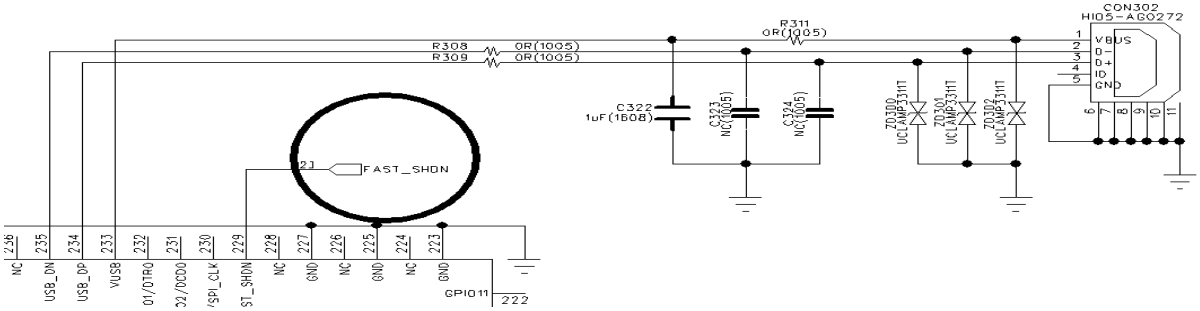


Figure 5-1.3 USB Reference Circuit

5.1.4 E-SIM Interface

Cellular modem_LW-9880 supports E-SIM interface via 8 Pin.

Pin Function	Pin No.	Description
E-SIM _GND	1	E-SIM GND
E-SIM _N.C	2	-
E-SIM _DATA	3	E-SIM DATA
E-SIM _N.C	4	-
E-SIM _N.C	5	-
E-SIM _CLK	6	E-SIM Clock
E-SIM _RST	7	E-SIM RESET
E-SIM _VDD	8	E-SIM VDD

Table 5-3 E-SIM Interface Description

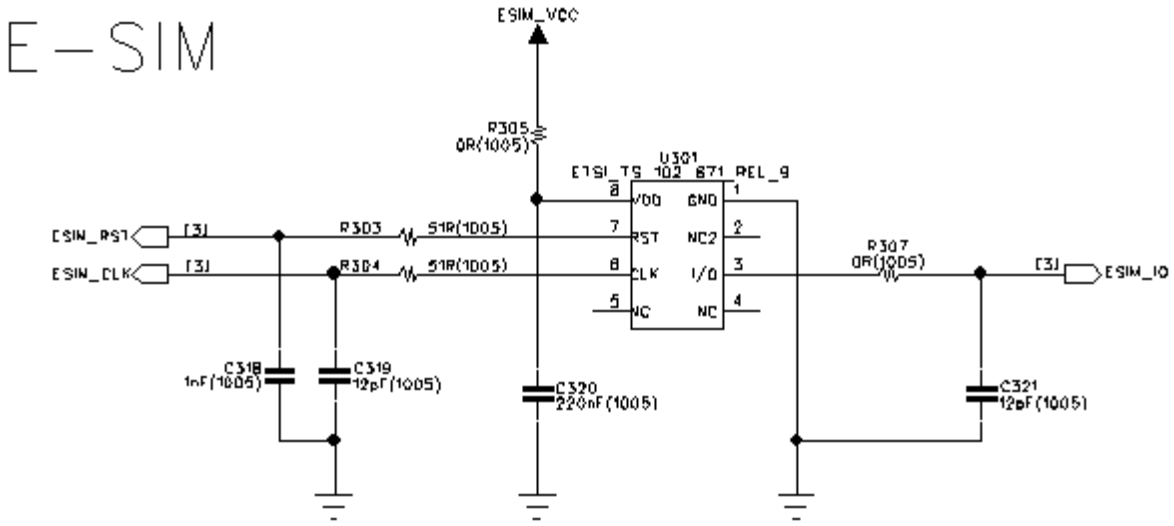


Figure 5-4 USIM Reference Circuit

6. PCB Layout Guide

6.1. PCB Layout

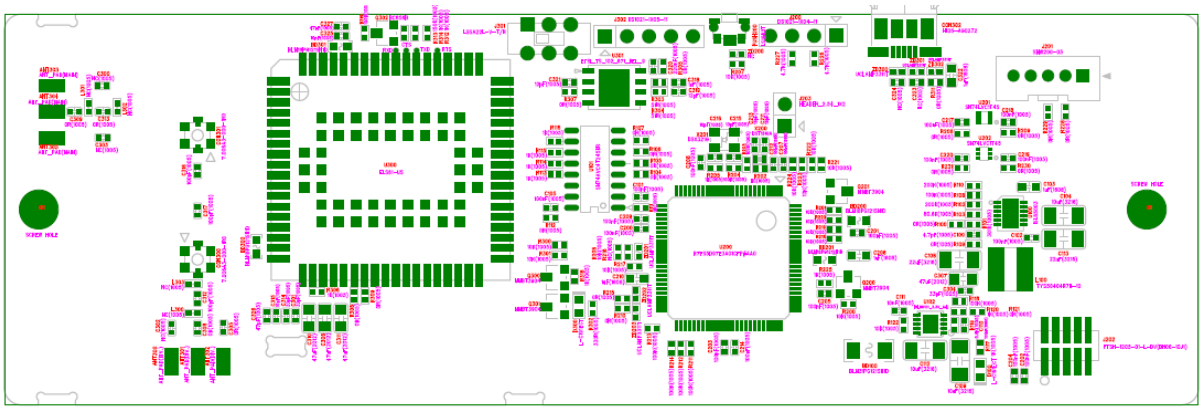


Figure 6-1 PCB Layout

7. Antenna Approved Source

7.1 Description

This is the product specification of Internal Antenna applied to Set

7.2 Electrical Properties

7.2.1 Specification

Item		Specifications
Antenna	Center Frequency	699~894, 1710~2170 ±1MHz
	Band Width	195, 460 MHz
	Polarization	Vertical
	Dimension	45.26 * 70.13 * 13.5 mm
	Working Temperature	-40~60°C
	Storage Temperature	-20~40°C

7.2.2 Impedance`

7.2.2.1 Nominal Impedance

- R = 50Ω

7.2.2.2 Measuring Method

By using Network analyzer , connect the antenna-installed handset to the reflection Point of Analyzer and measure the impedance value within the designated frequency band.

Testing is corresponded to the figure 7.2.1

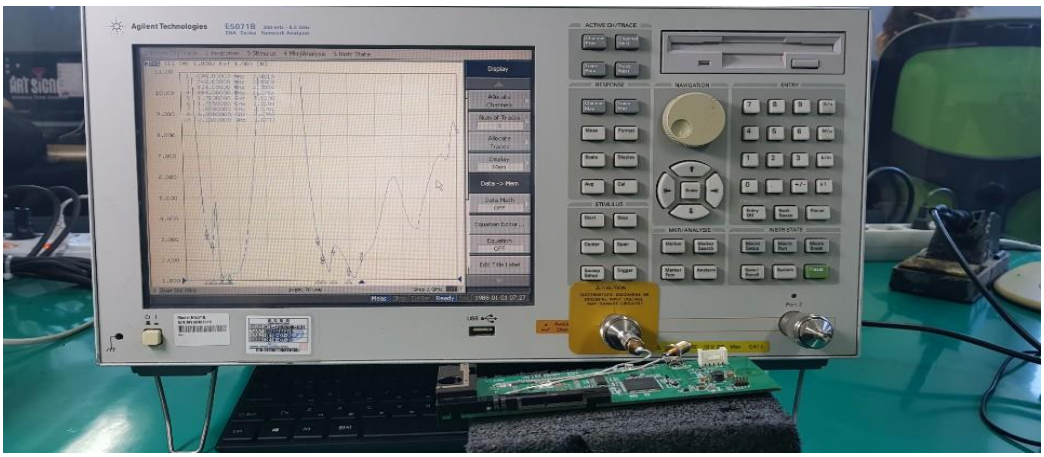


Figure 7.2.1 Test by network analyzer

7.2.2.3 Directive ness

Omni-directional

7.2.2.4 Gain(Free Space)

Service Mode(dBi)	Primary LTE Antenna									
Freq.(MHz)	699	746	824	894	1710	1755	1850	1990	2110	2155
PEAK	0.99	-0.58	-1.03	0.48	1.67	3.56	3.62	3.55	2.43	2.20
AVG	-1.13	-2.79	-3.17	-2.00	-3.22	-1.46	-1.34	-1.36	-2.62	-3.02
SPEC	-1.63	-3.29	-3.67	-2.50	-3.72	-1.96	-1.84	-1.86	-3.12	-3.52

Service Mode(dBi)	Diversity LTE Antenna									
Freq.(MHz)	699	746	824	894	1710	1755	1850	1990	2110	2155
PEAK	-11.61	-6.21	-5.56	-11.44	-9.33	-7.76	-4.85	-2.26	-0.88	-0.07
AVG	-14.86	-9.46	-8.75	-15.41	-11.95	-10.73	-9.00	-5.83	-4.10	-3.47
SPEC	-15.36	-9.96	-9.25	-15.91	-12.45	-11.23	-9.50	-6.33	-4.60	-3.97

7.2.2.5 Radiation Pattern (XY-Plane)

Primary	1	2	3	4	5	6	7	8	9	10
Frequency [MHz]	**699**	**746**	**824**	**894**	**1710**	**1755**	**1850**	**1990**	**2110**	**2155**
Efficiency [dB]	**-1.13**	**-2.79**	**-3.17**	**-2.00**	**-3.22**	**-1.46**	**-1.34**	**-1.36**	**-2.62**	**-3.02**
Efficiency [%]	**77.1**	**52.7**	**48.2**	**63.1**	**47.7**	**71.5**	**73.5**	**73.1**	**54.7**	**49.9**
TRG_{θ} [dB]	-1.37	-3.42	-3.56	-3.32	-6.39	-4.52	-4.19	-4.15	-5.22	-5.23
$Gain_{\theta\ Peak}$ [dB]	0.92	-0.77	-1.12	-0.69	-0.93	0.98	1.06	0.97	0.46	0.65
$Gain_{\theta\ Min}$ [dB]	-10.94	-16.86	-11.98	-21.19	-27.29	-26.31	-20.60	-27.69	-16.98	-20.99
TRG_{φ} [dB]	-13.85	-11.47	-13.76	-7.83	-6.06	-4.42	-4.51	-4.60	-6.08	-7.01
$Gain_{\varphi\ Peak}$ [dB]	-8.29	-6.30	-8.64	-2.22	-0.55	0.74	0.22	0.78	-0.85	-1.43
$Gain_{\varphi\ Min}$ [dB]	-44.68	-43.13	-32.25	-40.20	-25.74	-21.26	-32.68	-22.07	-23.51	-31.48
UHRG [dB]	-4.72	-6.95	-6.79	-5.74	-8.47	-6.83	-6.98	-6.64	-7.48	-8.09
UHRG/TRG [%]	43.8	38.3	43.4	42.3	29.8	29.0	27.3	29.7	32.7	31.2
H-Plane	0.64	-1.68	-1.99	-1.75	-11.47	-10.01	-9.01	-8.01	-8.53	-9.56
E1-Plane, AVG [dB]	-2.82	-5.17	-5.31	-5.42	-5.94	-4.17	-4.05	-4.33	-4.86	-4.52

E2-Plane, AVG [dB]	-2.45	-4.11	-4.44	-3.82	-7.09	-5.24	-5.03	-4.71	-5.92	-6.15
Peak Gain [dB]	0.99	-0.58	-1.03	0.48	1.67	3.56	3.62	3.55	2.43	2.20
Directivity [dB]	2.12	2.21	2.13	2.48	4.88	5.01	4.96	4.91	5.04	5.22
Minimum Gain [dB]	-10.94	-16.77	-9.59	-16.96	-12.25	-9.98	-8.38	-8.37	-8.89	-9.59

Diversity(DRX)	1	2	3	4	5	6	7	8	9	10
Frequency [MHz]	**699**	**746**	**824**	**894**	**1710**	**1755**	**1850**	**1990**	**2110**	**2155**
Efficiency [dB]	**-14.86**	**-9.46**	**-8.75**	**-15.41**	**-11.95**	**-10.73**	**-9.00**	**-5.83**	**-4.10**	**-3.47**
Efficiency [%]	**3.3**	**11.3**	**13.3**	**2.9**	**6.4**	**8.5**	**12.6**	**26.1**	**38.9**	**45.0**
TRG_{θ} [dB]	-16.26	-11.01	-9.91	-16.40	-16.36	-14.90	-12.45	-9.58	-8.04	-7.27
$Gain_{\theta\ Peak}$ [dB]	-11.96	-6.52	-5.70	-11.78	-9.43	-7.82	-5.20	-2.91	-2.32	-1.46
$Gain_{\theta\ Min}$ [dB]	-31.07	-26.31	-24.89	-38.99	-35.32	-37.38	-26.29	-26.19	-27.46	-28.25
TRG_{φ} [dB]	-20.45	-14.68	-15.04	-22.30	-13.91	-12.82	-11.60	-8.21	-6.35	-5.81
$Gain_{\varphi\ Peak}$ [dB]	-14.81	-9.19	-8.83	-18.26	-9.70	-9.24	-6.60	-3.91	-1.68	-0.82
$Gain_{\varphi\ Min}$ [dB]	-40.28	-34.76	-32.88	-44.83	-40.19	-37.95	-35.48	-24.84	-21.17	-22.97
UHRG [dB]	-17.44	-11.90	-11.55	-17.53	-14.90	-13.63	-12.50	-9.23	-7.10	-6.43
UHRG/TRG [%]	55.1	57.1	52.5	61.3	50.8	51.3	44.6	45.7	50.1	50.5
H-Plane	-14.75	-9.83	-8.68	-15.25	-17.41	-16.36	-14.19	-11.06	-10.51	-10.23
E1-Plane, AVG [dB]	-19.22	-13.66	-11.99	-18.32	-20.13	-17.48	-13.04	-9.79	-8.32	-7.38
E2-Plane, AVG [dB]	-15.96	-10.83	-10.02	-16.65	-14.69	-13.44	-11.62	-9.12	-7.68	-7.16
Peak Gain [dB]	-11.61	-6.21	-5.56	-11.44	-9.33	-7.76	-4.85	-2.26	-0.88	-0.07
Directivity [dB]	3.25	3.25	3.19	3.97	2.62	2.97	4.15	3.57	3.22	3.40
Minimum Gain [dB]	-20.95	-16.79	-18.58	-26.08	-28.14	-24.78	-17.46	-17.71	-16.44	-15.29

Compliance with FCC and IC Rules and Regulations

FCC Identifier: BEJ-LW-9880
Industry Canada Certification Number: 2703N-LW9880
Granted to LG Electronics USA./ LG Electronics Inc.
[EN] Manufacturers of mobile or fixed devices incorporating LW-9880 modules are authorized to use the FCC Grants and Industry Canada Certificates of the LW-9880 modules for their own final products according to the conditions referenced in these documents. In this case, an FCC/ IC label of the module shall be visible from the outside, or the host device shall bear a second label stating "Contains FCC ID: BEJ-LW-9880", and accordingly “Contains IC: 2703N-LW9880 “. The integration is limited to fixed or mobile categorized host devices, where a separation distance between the antenna and any person of min. 20cm can be assured during normal operating conditions.
The Equipment Authorization Certification reference application described in where a separation distance between the antenna and any person of min. 20cm can be assured during normal operating conditions.
The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed
[FR] Les fabricants d’appareils mobiles ou fixes intégrant des modules LW-9880 sont autorisés à utiliser les certificats FCC et Industrie Canada des modules LW-9880 pour leurs propres produits finis, conformément aux conditions mentionnées dans ces documents. Dans ce cas, une étiquette FCC / IC du module doit être visible de l'extérieur ou le périphérique hôte doit porter une seconde étiquette indiquant "Contient l'ID FCC: BEJ-LW-9880" et, en conséquence, "Contient IC: 2703N-LW9880 ". L'intégration est limitée aux dispositifs hôtes fixes ou mobiles classés, où une distance de séparation entre l'antenne et toute personne de min. 20 cm peuvent être assurés dans des conditions de fonctionnement normales.
La certification d’autorisation d’équipement pour l’application de référence dans la description d’une distance de séparation entre l’antenne et toute personne de min. 20 cm peuvent être assurés dans des conditions de fonctionnement normales.
Le produit hôte final nécessite toujours des tests de conformité de la partie 15, sous-partie B avec le transmetteur modulaire installé.

For mobile and fixed operation configurations the antenna gain, including cable loss will be registered under the following identifiers:
It does not operate with multiple, simultaneously transmitting modules or other transmitters in a host.
This device complies with FCC Part 22,24,27 and RSS-130, RSS-132, RSS-133, RSS-139 of the FCC rules.

FCC Identifier: BEJ-LW-9880
Industry Canada Certification Number: 2703N-LW9880
Granted to LG Electronics USA./ LG Electronics Inc.
IMPORTANT:
Manufacturers of portable applications incorporating *LW-9880* modules are required to have their final product certified and apply for their own FCC Grant and Industry Canada Certificate related to the specific portable mobile. This is mandatory to meet the SAR requirements for portable mobiles (see **Figure 3-1** for detail).
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This Class B digital apparatus complies with Canadian ICES-003.
If Canadian approval is requested for devices incorporating *LW-9880* modules the below

notes will have to be provided in the English and French language in the final user documentation. Manufacturers/OEM Integrators must ensure that the final user documentation does not contain any information on how to install or remove the module from the final product.

Notes

[EN] This Class B digital apparatus complies with Canadian ICES-003 and RSS-210. 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.

[FR] Cet appareil numerique de classe B est conforme aux normes canadiennes ICES-003 et RSS-210. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférence et (2) cet appareil doit accepter toute interférence, notamment les interférences qui peuvent affecter son fonctionnement.

Radio frequency (RF) Exposure Information

The radiated output power of the Wireless Device is below the Industry Canada (IC) radio frequency exposure limits. The Wireless Device should be used in such a manner such that the potential for human contact during normal operation is minimized.

This device has also been evaluated and shown compliant with the IC RF Exposure limits under mobile exposure conditions. (antennas at least 20cm from a person‘s body).

FCC Identifier: BEJ-LW-9880
Industry Canada Certification Number: 2703N-LW9880
Granted to LG Electronics USA./ LG Electronics Inc.

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[FR] Les fabricants d’appareils fixes ou mobiles intégrant des modules LW-9880sont autorisés à utiliser les certificats FCC et Industry Canada des modules LW-9880 pour leurs propres produits finis, conformément aux conditions mentionnées dans ces documents. Dans ce cas, une étiquette FCC / IC du module doit être visible de l'extérieur ou le périphérique hôte doit porter une deuxième étiquette indiquant "Contient l'ID FCC: BEJ-LW-9880" et, en conséquence, "Contient IC: 2703N-LW9880".

IMPORTANT:

Manufacturers of portable applications incorporating LW-9880 modules are required to have their final product certified and apply for their own FCC Grant and Industry Canada Certificate related to the specific portable mobile. This is mandatory to meet the SAR requirements for portable mobiles (see Section 5.2 for detail).

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