



FCC Part 1 Subpart I
FCC Part 2 Subpart J

RF EXPOSURE REPORT

FOR

GSM/WCDMA/LTE Cellular Module

MODEL NUMBER : LTM100, LTM100D

FCC ID: 2ABA2LTM100

REPORT NUMBER: 16K23790-E2V2

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	09/19/16	Initial Issue	Junwhan Lee
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: WISOL CO., LTD.
EUT DESCRIPTION: GSM/WCDMA/LTE Cellular Module
MODEL NUMBER: LTM100, LTM100D
IMEI NUMBER: 351777080000084, 351777080000092 (RADIATED);
351777080000076, 351777080000100 (CONDUCTED)
DATE TESTED: AUG 04, 2016 - SEP 20, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 1 SUBPART I & PART 2 SUBPART J	Pass

UL Korea, Ltd. calculated the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
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2. TEST METHODOLOGY

All calculations were made in accordance with FCC OET Bulletin 65 Edition 97-01.

3. REFERENCES

All measurements were made as documented in test report UL Korea, Ltd. Document 16K23790-E1V1 FCC Report WWAN for operation in the 850, 1700 and 1900 MHz bands.

Output power, Duty cycle and Antenna gain data is excerpted from product documentation provided by the applicant.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea.

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

5. MAXIMUM PERMISSIBLE RF EXPOSURE

5.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Notes:

- (1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
- (2) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure

5.2. EQUATIONS

POWER DENSITY

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

Where

S = Power density in mW/cm²

EIRP = Equivalent Isotropic Radiated Power in mW

D = Separation distance in cm

Power density in units of mW/cm² is converted to units of W/m² by multiplying by 10.

DISTANCE

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

Where

D = Separation distance in cm

EIRP = Equivalent Isotropic Radiated Power in mW

S = Power density in mW/cm²

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

$$\text{Source-based time-averaged EIRP} = (\text{DC} / 100) * \text{EIRP}$$

Where

DC = Duty Cycle in %, as applicable

EIRP = Equivalent Isotropic Radiated Power in W

MIMO AND COLOCATED TRANSMITTERS (IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple chain devices, and colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the EIRP (in linear units) of each transmitter.

$$\text{Total EIRP} = (\text{EIRP1}) + (\text{EIRP2}) + \dots + (\text{EIRPn})$$

where

EIRPx = Source-based time-averaged EIRP of chain x or transmitter x

The total EIRP is then used to calculate the Power Density or the Distance as applicable.

MIMO AND COLOCATED TRANSMITTERS

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply:

The Power Density at the specified separation distance is calculated for each transmitter chain or transmitter.

The fraction of the exposure limit is calculated for each chain or transmitter as
(Power Density of chain or transmitter) / (Limit applicable to that chain or transmitter).

The fractions are summed.

Compliance is established if the sum of the fractions is less than or equal to one.

6. RF EXPOSURE RESULTS

6.1. RF Exposure results for MPE

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

Band	Mode	Separation Distance (cm)	Tune-up tolerance Limit (dBm)	Antenna Gain (dBi)	Duty cycle (%)	Source-based time-averaged EIRP (mW)	FCC Power Density (mW/cm ²)	FCC Power Density Limit (mW/cm ²)
GSM850	GMSK	20	33.5	2.151	12.5	459.21	0.091	0.55
GPRS850	Time slot 1	20	33.5	2.151	12.5	459.21	0.091	0.55
GPRS850	Time slot 2	20	31.5	2.151	25	579.48	0.115	0.55
GPRS850	Time slot 3	20	30.5	2.151	37.5	690.45	0.137	0.55
GPRS850	Time slot 4	20	29.5	2.151	50	731.26	0.145	0.55
GSM1900	GMSK	20	30.5	3.196	12.5	292.76	0.058	1
GPRS1900	Time slot 1	20	30.5	3.196	12.5	292.76	0.058	1
GPRS1900	Time slot 2	20	28.5	3.196	25	369.44	0.073	1
GPRS1900	Time slot 3	20	27.5	3.196	37.5	440.18	0.088	1
GPRS1900	Time slot 4	20	26.5	3.196	50	466.20	0.093	1
WCDMA B5	Rel.99	20	24.5	2.151	100	462.49	0.092	0.55
WCDMA B5	HSDPA	20	24.5	2.151	100	462.49	0.092	0.55
WCDMA B5	HSUPA	20	24.5	2.151	100	462.49	0.092	0.55
WCDMA B5	DC-HSDPA	20	24.5	2.151	100	462.49	0.092	0.55
WCDMA B4	Rel.99	20	24.5	3.964	100	702.10	0.140	1
WCDMA B4	HSDPA	20	24	3.964	100	625.75	0.124	1
WCDMA B4	HSUPA	20	24	3.964	100	625.75	0.124	1
WCDMA B4	DC-HSDPA	20	24	3.964	100	625.75	0.124	1
WCDMA B2	Rel.99	20	24.5	3.196	100	588.30	0.117	1
WCDMA B2	HSDPA	20	24	3.196	100	524.32	0.104	1
WCDMA B2	HSUPA	20	24.3	3.196	100	561.82	0.112	1
WCDMA B2	DC-HSDPA	20	24	3.196	100	524.32	0.104	1
LTE B5	QPSK	20	23.5	2.151	100	367.37	0.073	0.55
LTE B4	QPSK	20	23.5	3.964	100	557.70	0.111	1
LTE B2	QPSK	20	23.5	3.196	100	467.30	0.093	1

Notes:

- 1) For MPE the new KDB 447498 requires the calculations to use the maximum rated power; that power should be declared by the manufacturer, and should not be lower than the measured power. If the power has a tolerance then we also need to check that the measured power is within the tolerance.
- 2) The manufacturer configures output power so that the maximum power, after accounting for manufacturing tolerances, will never exceed the maximum power level measured.
- 3) This EUT didn't support simultaneous-transmission operations for each band.

END OF REPORT