FCC PART 24E, PART 27

TEST REPORT

For

M-Labs Technologies, LLC

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FCC ID: 2AAQ6MLTE001T

Report Type:	Product Type:
Original Report	GPS Tracker

Report Number:	RSZ170322005-00B
Report Date:	2017-04-13
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *M-Labs Technologies, LLC's* product, model number: *LTE (FCC ID: 2AAQ6MLTE001T, marketing name: T5000)* in this report is a *GPS Tracker* which was measured approximately: 105 mm (L) × 47 mm (W) × 13 mm (H), rated with input voltage: DC 12 V.

Notes: This series products model: LTE, LTE-B, LTE-B-BA and LTE-BA are identical schematics and only are different for model name. Model LTE was selected for fully testing, the detailed information can be referred to the attached declaration which was stated and guaranteed by the applicant.

** All measurement and test data in this report was gathered from production sample serial number: 1700473 (Assigned by BACL, Kunshan). The EUT supplied by the applicant was received on 2017-03-22.*

Objective

This test report is prepared on behalf of *M-Labs Technologies, LLC* in accordance with Part 2-Subpart J, Part 24-Subpart E and Part 27 of the Federal Communication Commissions rules.

The objective is to determine the compliance of the EUT with FCC rules for output power, modulation characteristic, occupied bandwidth, and spurious emission at antenna terminal, spurious radiated emission, frequency stability and band edge.

Related Submittal(s)/Grant(s)

No related submittal.

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2-Subpart J as well as the following parts:

Part 24 Subpart E - Personal Communication Services
Part 27 – Miscellaneous wireless communications services

Applicable Standards: TIA/EIA 603-D, ANSI C63.4-2014.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
RF conducted test with spectrum		±0.9dB
RF Output Power with Power meter		±0.5dB
Radiated emission	30MHz~1GHz	±5.91dB
	Above 1G	±4.92dB
Occupied Bandwidth		±0.5kHz
Temperature		±1.0℃
Humidity		±6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on November 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The EUT was configured for testing according to TIA/EIA-603-D.

The final qualification test was performed with the EUT operating at normal mode.

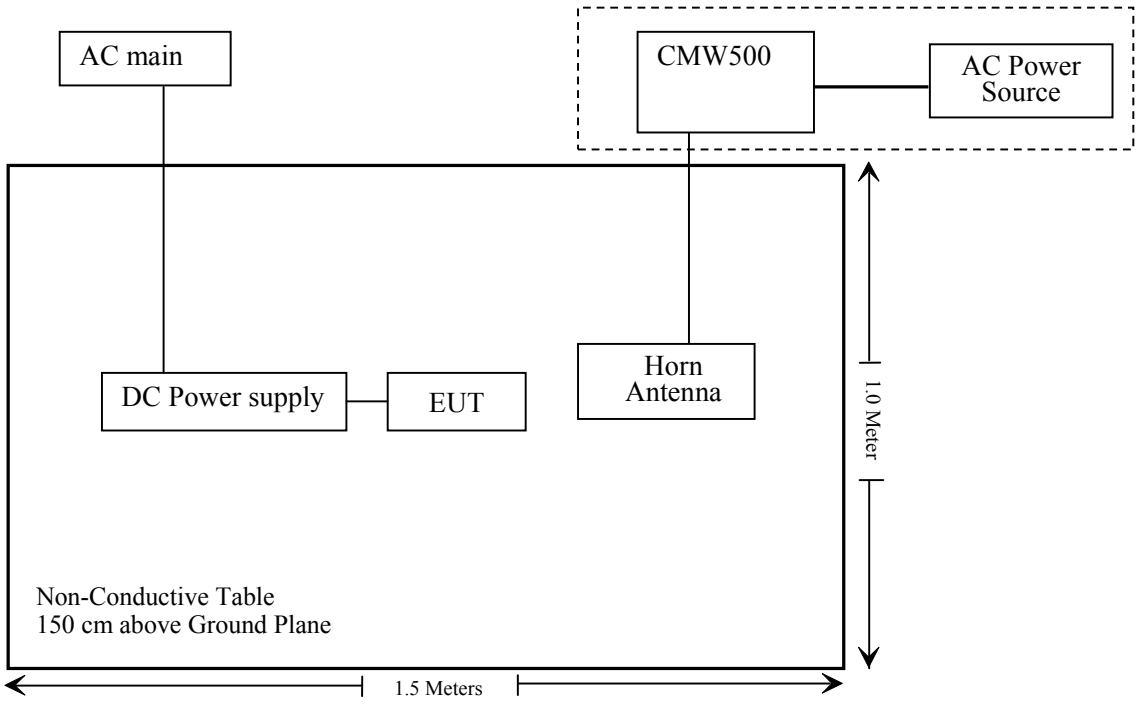
Equipment Modifications

No modification was made to the EUT.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	1201.002K50-116218-UY
EST	DC Power supply	MCH-303D-II	14070562

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§2.1046; § 22.913 (a); § 24.232 (c); §27.50 (c) (d) (h)	RF Output Power	Compliance
§ 2.1047	Modulation Characteristics	Not Applicable
§ 2.1049; § 22.905; § 22.917; § 24.238; §27.53	Occupied Bandwidth	Compliance*
§ 2.1051; § 22.917 (a); § 24.238 (a); §27.53 (h)(m)	Spurious Emissions at Antenna Terminal	Compliance*
§ 2.1053; § 22.917 (a); § 24.238 (a); §27.53 (h)(m)	Field Strength of Spurious Radiation	Compliance
§ 22.917 (a); § 24.238 (a); §27.53 (h)(m)	Band Edge	Compliance*
§ 2.1055; § 22.355; § 24.235; §27.54;	Frequency stability	Compliance*

Compliance*: the device built in a certified LTE module, model: US130Q LTE E-UTRA, FCC ID: 2AAGMUS130Q, which has been certified on 2016-08-31, this test items please refer to the module`s report, report No.: 102594044LEX-001, which was tested by Intertek Testing Services NA, Inc.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Sonoma Instrunent	Amplifier	330	171377	2016-12-12	2017-12-12
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-25
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2016-01-09	2019-01-08
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-09-08	2017-09-08
EMCO	Horn Antenna	3116	9510-2384	2015-11-07	2018-11-06
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2016-11-25	2017-11-25
ETS	Horn Antenna	3115	6229	2016-01-11	2017-01-10
ETS	Horn Antenna	3115	9311-4159	2016-01-11	2017-01-10
R&S	Auto test Software	EMC32	V 09.10.0	NCR	NCR
haojintech	Coaxial Cable	Cable-1	001	2016-12-12	2017-12-12
haojintech	Coaxial Cable	Cable-2	002	2016-12-12	2017-12-12
haojintech	Coaxial Cable	Cable-3	003	2016-12-12	2017-12-12
MICRO-COAX	Coaxial Cable	Cable-4	004	2016-12-12	2017-12-12
MICRO-COAX	Coaxial Cable	Cable-5	005	2016-12-12	2017-12-12
MICRO-COAX	Coaxial Cable	Cable-7	007	2016-12-12	2017-12-12
HP	Signal Generator	8341B	2624A00116	2016-08-29	2017-08-29

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) & §2.1091 –Maximum Permissible exposure (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
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
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

MPE Calculated :

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

MPE Results

Tune-Up Power Including Tolerance:

Frequency (MHz)	**Antenna Gain**		**Max Tune-up Power**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
701.5-713.5	1.32	1.36	23.29	213.30	20	0.06	0.47
1712.5-1752.5	1.39	1.38	23.38	217.77	20	0.06	1.0
1852.5-1907.5	1.61	1.45	23.28	212.81	20	0.06	1.0

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

FCC §2.1047 - MODULATION CHARACTERISTIC

According to FCC § 2.1047(d), Part 24E & Part 27 there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

FCC § 2.1046, § 24.232 (c); §27.50 (c) (d) - RF OUTPUT POWER

Applicable Standard

According to FCC §2.1046 and §24.232 (c), mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

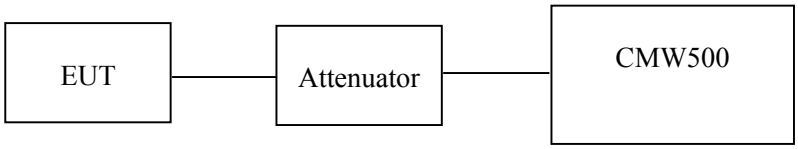
According to §27.50(d), the maximum EIRP must not exceed 1Watts (30dBm) for 1710-1755MHz.
The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

According to §27.50(c),Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

Test Procedure

Conducted method:

The RF output of the transmitter was connected to the CMW500 through sufficient attenuation.



Radiated method:

TIA 603-D section 2.2.17

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Nefertari Xu on 2017-03-27.

LTE Band 2

QPSK:

Frequency (MHz)	Receiver Reading (dBμV)	Turn table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		
Middle Channel									
5 MHz Bandwidth									
1880.00	79.29	81	1.6	H	17.8	0.45	8.84	26.19	33
1880.00	80.12	112	1.7	V	16.4	0.45	8.84	24.79	33
10 MHz Bandwidth									
1880.00	77.19	272	2.3	H	15.7	0.45	8.84	24.09	33
1880.00	79.12	260	2.4	V	15.4	0.45	8.84	23.79	33
15 MHz Bandwidth									
1880.00	76.59	327	1.1	H	15.1	0.45	8.84	23.49	33
1880.00	78.82	94	1.8	V	15.1	0.45	8.84	23.49	33
20 MHz Bandwidth									
1880.00	75.59	226	2.4	H	14.1	0.45	8.84	22.49	33
1880.00	77.42	252	2.5	V	13.7	0.45	8.84	22.09	33

16QAM:

Frequency (MHz)	Receiver Reading (dBμV)	Turn table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		
Middle Channel									
5 MHz Bandwidth									
1880.00	77.39	197	1.9	H	15.9	0.45	8.84	24.29	33
1880.00	75.92	278	2.5	V	12.2	0.45	8.84	20.59	33
10 MHz Bandwidth									
1880.00	79.49	258	1.5	H	18.0	0.45	8.84	26.39	33
1880.00	79.32	86	2.3	V	15.6	0.45	8.84	23.99	33
15 MHz Bandwidth									
1880.00	75.69	224	1.4	H	14.2	0.45	8.84	22.59	33
1880.00	74.82	160	1.3	V	11.1	0.45	8.84	19.49	33
20 MHz Bandwidth									
1880.00	74.89	244	1.3	H	13.4	0.45	8.84	21.79	33
1880.00	74.52	183	1.2	V	10.8	0.45	8.84	19.19	33

LTE Band 4:

QPSK:

Frequency (MHz)	Receiver Reading (dBμV)	Turn table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		
Middle Channel									
5 MHz Bandwidth									
1732.50	80.37	141	2.4	H	16.8	0.40	8.52	24.92	30
1732.50	78.74	183	1.2	V	13.2	0.40	8.52	21.32	30
10 MHz Bandwidth									
1732.50	80.19	135	1.2	H	16.6	0.40	8.52	24.72	30
1732.50	78.16	27	1.8	V	12.6	0.40	8.52	20.72	30
15 MHz Bandwidth									
1732.50	77.67	211	1.2	H	14.1	0.40	8.52	22.22	30
1732.50	76.34	127	1.8	V	10.8	0.40	8.52	18.92	30
20 MHz Bandwidth									
1732.50	79.47	279	1.2	H	15.9	0.40	8.52	24.02	30
1732.50	76.44	38	1.5	V	10.9	0.40	8.52	19.02	30

16QAM:

Frequency (MHz)	Receiver Reading (dBμV)	Turn table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		
Middle Channel									
5 MHz Bandwidth									
1732.50	79.97	174	1.6	H	16.4	0.40	8.52	24.52	30
1732.50	80.44	255	2.1	V	14.9	0.40	8.52	23.02	30
10 MHz Bandwidth									
1732.50	81.97	78	1.4	H	18.4	0.40	8.52	26.52	30
1732.50	83.74	21	2.5	V	18.2	0.40	8.52	26.32	30
15 MHz Bandwidth									
1732.50	80.07	235	1.3	H	16.5	0.40	8.52	24.62	30
1732.50	81.64	122	2.1	V	16.1	0.40	8.52	24.22	30
20 MHz Bandwidth									
1732.50	79.87	322	1.3	H	16.3	0.40	8.52	24.42	30
1732.50	81.14	282	1.3	V	15.6	0.40	8.52	23.72	30

LTE Band 12:

QPSK:

Frequency (MHz)	Receiver Reading (dBµV)	Turn table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		
Middle Channel									
5 MHz Bandwidth									
707.50	95.96	221	1.6	H	17.7	0.26	4.25	21.69	30
707.50	94.80	81	1.9	V	19.5	0.26	4.25	23.49	30
10 MHz Bandwidth									
707.50	95.56	200	2.3	H	17.3	0.26	4.25	21.29	30
707.50	94.18	139	1.8	V	18.9	0.26	4.25	22.89	30

16QAM:

Frequency (MHz)	Receiver Reading (dBµV)	Turn table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		
Middle Channel									
5 MHz Bandwidth									
707.5	94.85	77	1.1	H	16.5	0.26	4.25	20.49	38.45
707.5	93.96	28	2.4	V	18.7	0.26	4.25	22.69	38.45
10 MHz Bandwidth									
707.5	93.03	336	2.3	H	14.7	0.26	4.25	18.69	38.45
707.5	91.44	148	1.2	V	16.2	0.26	4.25	20.19	38.45

Note:
All above data were tested with no amplifier
Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

Conducted output power at antenna, please refer to the modulle certification (FCC ID: **2AAGMUS130Q**)

FCC § 2.1053;§ 24.238 (a); §27.53 (h)(m) SPURIOUS RADIATED EMISSIONS

Applicable Standard

FCC § 2.1053, § 24.238(a) and § 27.53(h)(m)

For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the receiving antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TX pwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log_{10} (power out in Watts)

Spurious attenuation limit in dB = 55 + 10 Log_{10} (power out in Watts)

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	46 %
ATM Pressure:	101.0 kPa

The testing was performed by Layne Li on 2017-04-13.

EUT operation mode: transmitting

Pre-scan with Low, Middle and High channel, the worst case as below:

LTE Band:

Test mode: Transmitting (Pre-scan with all the bandwidth, and worse case as below)

Frequency	Receiver	Turntable	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
(MHz)	Reading (dBμV)	Angle Degree	Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)			
Band 2 (20MHz bandwidth QPSK)										
Test frequency range:30 MHz ~ 20 GHz										
246.27	58.86	178	1.4	H	-49.2	0.14	2.05	-47.29	-13	34.29
246.27	61.70	169	1.0	V	-46.8	0.14	2.05	-44.89	-13	31.89
3760.00	40.72	251	1.7	H	-55.3	0.59	9.72	-46.17	-13	33.17
3760.00	42.81	356	1.3	V	-54.3	0.59	9.72	-45.17	-13	32.17
Band 4 (20MHz bandwidth QPSK)										
Test frequency range:30 MHz ~ 20 GHz										
246.27	58.16	203	1.4	H	-49.9	0.14	2.05	-47.99	-13	34.99
246.27	60.50	109	2.0	V	-48.0	0.14	2.05	-46.09	-13	33.09
3465.00	43.13	334	1.2	H	-53.9	0.54	9.90	-44.54	-13	31.54
3465.00	44.83	273	1.2	V	-53.5	0.54	9.90	-44.14	-13	31.14
Band 12 (10MHz bandwidth QPSK)										
Test frequency range: 30 MHz ~ 10 GHz										
246.27	58.16	120	1.1	H	-49.9	0.14	2.05	-47.99	-13	34.99
246.27	59.70	229	2.5	V	-48.8	0.14	2.05	-46.89	-13	33.89
1415.00	39.37	242	2.0	H	-64.7	0.34	7.92	-57.12	-13	44.12
1415.00	40.30	315	2.5	V	-65.5	0.34	7.92	-57.92	-13	44.92

Note:
1) Absolute Level = SG Level - Cable loss + Antenna Gain
2) Margin = Limit- Absolute Level

******* END OF REPORT *******