



MEASUREMENT REPORT

LTE CAT-M Test Report

FCC ID: 2AEB4AMV01

IC: 20080-AMV01

APPLICANT: Connected Holdings LLC

Application Type: Certification

Product: LTE Cat-M GPS Tracker

Model No.: AR-4MA

Marketing Name: Arrow-M

FCC Classification: Licensed Non-Broadcast Station Transmitter (TNB)

FCC Rule Part(s): Part 2, Part 27 Subpart F, Part 27 Subpart L

IC Rule(s): RSS-130 Issue 1, RSS-139 Issue 3, RSS-GEN Issue 5

Test Procedure(s): ANSI C63.26-2015, ANSI/TIA-603-E-2016,
KDB 971168 D01v03

Test Date: June 14 ~ June 25, 2018

Reviewed By : Kevin Guo
(Kevin Guo)

Approved By : Robin Wu
(Robin Wu)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
1806RSU011-U1	Rev. 01	Initial report	07-12-2018	Valid

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§2.1033 General Information

Applicant:	Connected Holdings LLC
Applicant Address:	4740 Von Karman Suite 120, Newport Beach, CA 92660
Manufacturer:	Connected Holdings LLC
Manufacturer Address:	4740 Von Karman Suite 120, Newport Beach, CA 92660
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
FCC Registration No.:	893164
FCC designation No.:	CN1166
IC Registration No.:	11384A-1
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- MRT facility is a FCC registered (MRT Reg. No. 893164) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.
- MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.
- MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.



1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name:	LTE Cat-M GPS Tracker
Model No.:	AR-4MA
Marketing Name:	Arrow-M
Hardware Version:	P1
Software Version:	V1
LTE Cat-M Operation Band (s):	FDD Band 4 / 13
GPS:	1575.42MHz
Working Voltage	DC 12V

2.2. Product Specification Subjective to this Report

Tx Frequency Range	Band 4: 1710.7MHz ~ 1754.3MHz Band 13: 779.5MHz ~ 784.5MHz
Rx Frequency Range	Band 4: 2110.7MHz ~ 2154.3MHz Band 13: 748.5MHz ~ 753.5MHz
Bandwidth	Band 4: 1.4MHz Band 13: 1.4MHz
Type of Modulation	QPSK / 16-QAM

2.3. Description of Available Antennas

Antenna Type	Frequency Band	Max Peak Gain (dBi)
GPS Internal Antenna		
Chip	1575.42MHz	2
Cat-M Internal Antenna		
Chip	FDD-Band 4	1
	FDD- Band 13	1

2.4. Device Capabilities

This device contains the following capabilities:

Cat-M Band 4/13 and GPS.

2.5. Test Configuration

The device was tested per the guidance of ANSI C63.26-2015, ANSI/TIA-603-E-2016 and KDB 971168 D01v03. See section 3.0 of this report for a description of the radiated and antenna port conducted emissions tests.

2.6. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

2.7. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the “Land Mobile FM or PM - Communications Equipment - Measurements and Performance Standards” (ANSI/TIA-603-E-2016) and “Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems” (KDB 971168) were used in the measurement of the device.

Deviation from measurement procedure.....None

3.2. Occupied Bandwidth

§2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. The spectrum analyzers’ “occupied bandwidth” measurement function was used to record the occupied bandwidth in accordance with KDB 971168.

3.3. Spurious and Harmonic Emissions at Antenna Terminal

§2.1051§27.53(g) §27.53(h) §27.53(m)

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee’s frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log(P)$ dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1MHz or greater for Part 24 and Part 27. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

3.4. Radiated Power and Radiated Spurious Emissions

§2.1053 § 27.50(b.10) § 27.53(g)

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurement and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. A 80cm high PVC support structure is placed on top of the turntable.

The equipment under test was transmitting while connected to its integral antenna and is placed on a wooden turntable 80cm above the ground plane and 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer. Radiated power levels are also investigated with the receive antenna horizontally and vertically polarized. The maximized power level is recorded using the spectrum analyzer “Channel Power” function with the integration band set to the emissions’ occupied bandwidth, a RMS detector, RBW = 100kHz, VBW = 300kHz, and a 1 second sweep time over a minimum of 10 sweeps, per the guidelines of KDB 971168.

Per the guidance of ANSI/TIA-603-E-2016, a half-wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_d \text{ [dBm]} = P_g \text{ [dBm]} - \text{cable loss [dB]} + \text{antenna gain [dBd/dBi]}$$

Where, P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_g \text{ [dBm]} - \text{cable loss [dB]}$.

The calculated P_d levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of $43 + 10 \cdot \log_{10}(\text{Power [Watts]})$.

4. TEST EQUIPMENT CALIBRATION DATE

Radiated Emissions – AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/08/18
EXA Signal Analyzer	Keysight	N9020A	MRTSUE06106	1 year	2019/04/20
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2018/11/17
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2019/04/12
Broad Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2018/10/21
Wideband Radio Communication Tester	R&S	CMW500	MRTSUE06243	1 year	2018/11/17
Digital Thermometer & Hygrometer	testo	608-H1	MRTSUE06403	1 year	2018/08/14
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2019/05/08

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2019/04/20
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2018/11/17
DC Power Supply	GWINSTEK	DPS-3303C	MRTSUE06064	N/A	N/A
Temperature Humidity Chamber	BAOYT	BYH-150CL	MRTSUE06051	1 year	2018/12/06

Software	Version	Function
e3	V8.3.5	EMI Test Software

5. SAMPLE CALCULATIONS

QPSK Emission Designator

Emission Designator = 250KGXW

LTE BW = 250 kHz

G = Phase Modulation

X = Cases not otherwise covered

W = Combination (Audio/Data)

16-QAM Emission Designator

Emission Designator = 250KG7W

LTE BW = 250 kHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination (Audio/Data)

Spurious Radiated Emission

Example: Mid. CHLTE Mode 2nd Harmonic (1564 MHz)

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was -81.0dBm.

The gain of the substituted antenna is 8.1dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of -81.0dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564MHz. So 6.1 dB is added to the signal generator reading of -30.9dBm yielding -24.80dBm. The fundamental EIRP was 25.50dBm so this harmonic was 25.50dBm - (-24.80).

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement - SR2
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement - AC2
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB

7. TEST RESULT

7.1. Summary

Company Name: Connected Holdings LLC

Product Name: LTE Cat-M GPS Tracker

FCC Part Section(s)	IC Rules	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	RSS-GEN [6.6] RSS-130 [3.1] RSS-139 [3.1]	Occupied bandwidth	N/A	Conducted	Pass	Section 7.2
2.1051 & 27.53(c) & 27.53(h)	RSS-130 [4.6] RSS-139 [6.6]	Band Edge / Conducted Spurious emissions (Band 4 & 13)	$> 43 + \log_{10}$ (P[Watts]) at Band Edge and for all out-of-band emissions		Pass	Section 7.3 & Section 7.4
24.232(d)	RSS-130 [4.4] RSS-139 [6.5]	Peak-Average Ratio	< 13 dB		Pass	Section 7.5
2.1046	RSS-GEN [6.12]	Transmitter Conducted Output Power	N/A		Pass	Section 7.6
27.50(b)(10)	RSS-130 [4.4]	Effective Radiated Power (Band 13)	< 3 Watts max. ERP(FCC) < 5 Watts max. EIRP(IC)		Pass	
27.50(d)(4)	RSS-139 [6.5]	Equivalent Isotropic Radiated Power (Band 4)	< 1 Watts max. EIRP		Pass	
2.1055 & 27.54	RSS-GEN [6.11] RSS-130 [4.3] RSS-139 [6.4]	Frequency Stability	fundamental emissions stay within authorized frequency block (Part 27)		Pass	Section 7.8
2.1051 & 27.53(c) & 27.53(h)	RSS-130 [4.6] RSS-139 [6.6]	Undesirable Emissions (Band 4 & 13)	$> 43 + \log_{10}$ (P[Watts]) for all out-of-band emissions	Radiated	Pass	Section 7.7

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots shown in Section 7.2, 7.3, 7.4, 7.5 were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulation in exploratory test. Subsequently, only the worst case data are reported.

7.2. Occupied Bandwidth

7.2.1. Test Limit

N/A

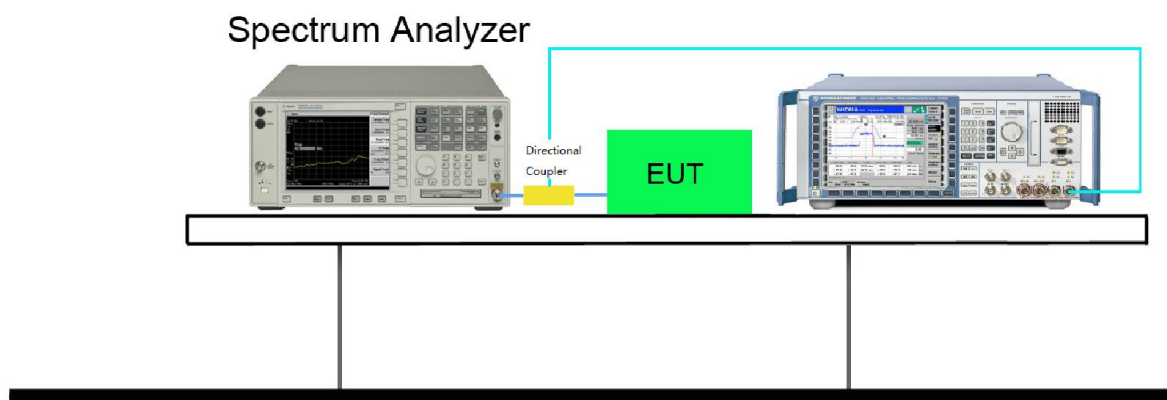
7.2.2. Test Procedure used

KDB 971168 D01v03 - Section 4.1 & ANSI/TIA-603-E-2016

7.2.3. Test Setting

1. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency.
The span range for the spectrum analyzer shall be between two and five times the anticipated OBW. RBW = approximately 1% of the emission bandwidth.
2. The nominal resolution bandwidth (RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.
3. Set the detection mode to peak, and the trace mode to max hold.
4. Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

7.2.4. Test Setup



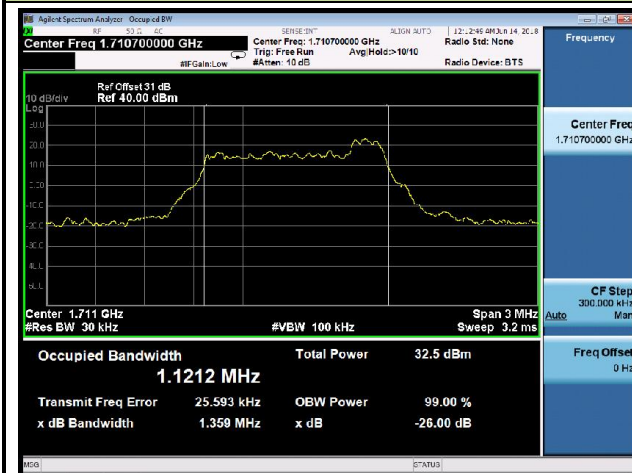
7.2.5. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	52%
Test Site	TR3	Test Date	2018/06/14

LTE Band 2 99% Occupied Bandwidth (MHz)				
BW	Band 4		Band 13	
Mod.	QPSK	16-QAM	QPSK	16-QAM
Low CH	1.12	1.13	1.13	1.13
Mid. CH	1.12	1.12	1.13	1.14
High CH	1.12	1.12	1.13	1.14

LTE Band 4 99% & 26dB Occupied Bandwidth

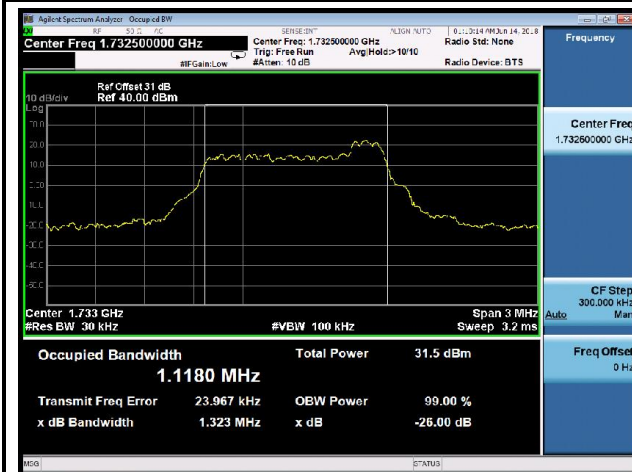
Low CH / 1.4MHz / QPSK



Low CH / 1.4MHz / 16-QAM



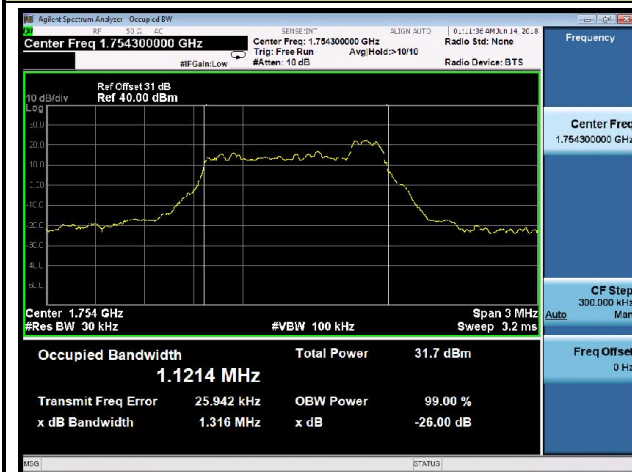
Mid. CH / 1.4MHz / QPSK



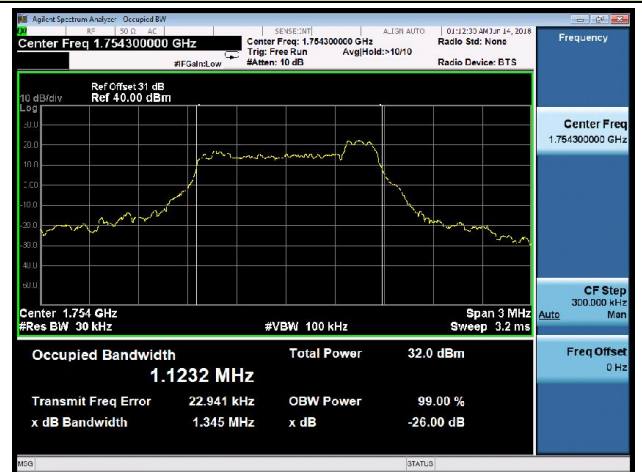
Mid. CH / 1.4MHz / 16-QAM



High CH / 1.4MHz / QPSK

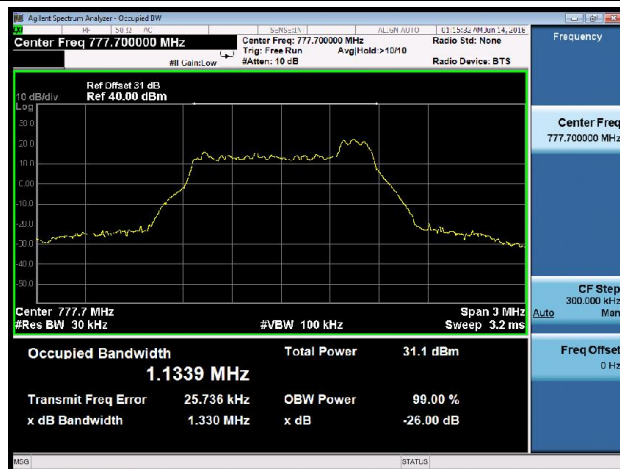


High CH / 1.4MHz / 16-QAM

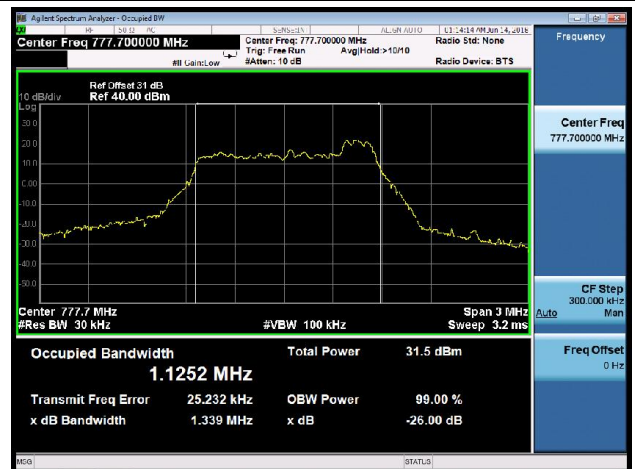


LTE Band 13 99% & 26dB Occupied Bandwidth

Low CH / 1.4MHz / QPSK



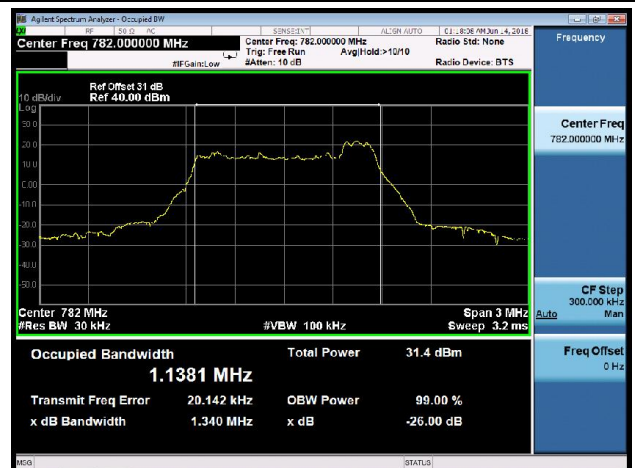
Low CH / 1.4MHz / 16-QAM



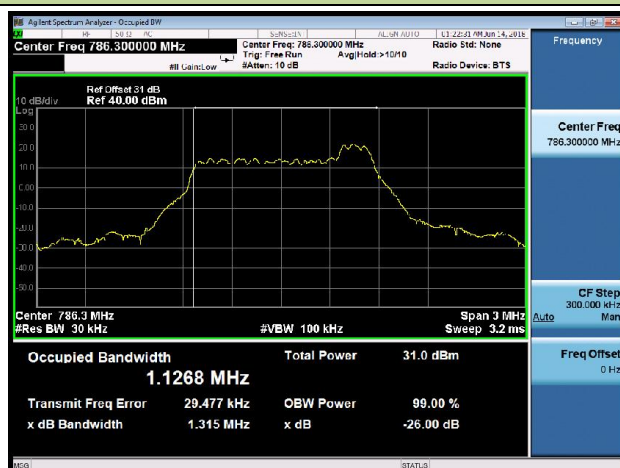
Mid. CH / 1.4MHz / QPSK



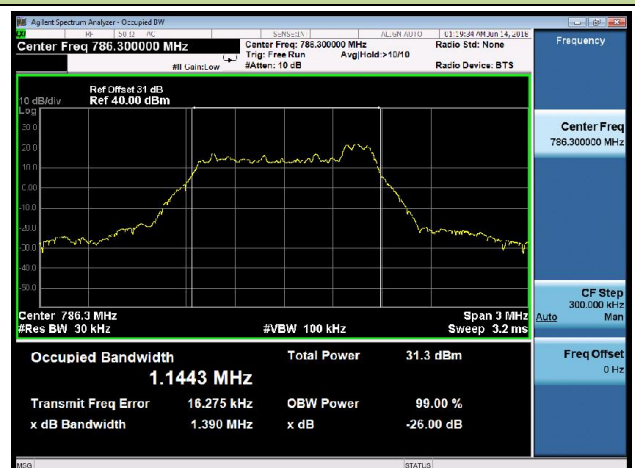
Mid. CH / 1.4MHz / 16-QAM



High CH / 1.4MHz / QPSK



High CH / 1.4MHz / 16-QAM



7.3. Band Edge Emissions at Antenna Terminal

7.3.1. Test Limit

27.53 (c)

For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB

27.53 (h)

For operations in the 1710 - 1755 MHz band, the FCC limit is $43 + 10 \log_{10} (P[\text{Watts}])$ dB below the transmitter power P(Watts) in a 1 MHz bandwidth. However, in the 1MHz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

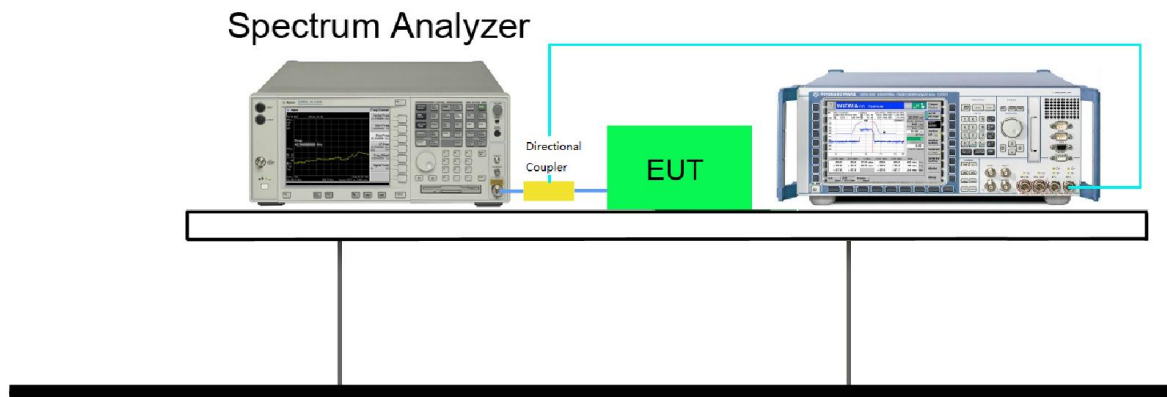
7.3.2. Test Procedure Used

KDB 971168 D01v03 - Section 6.0 & ANSI/TIA-603-E-2016

7.3.3. Test Setting

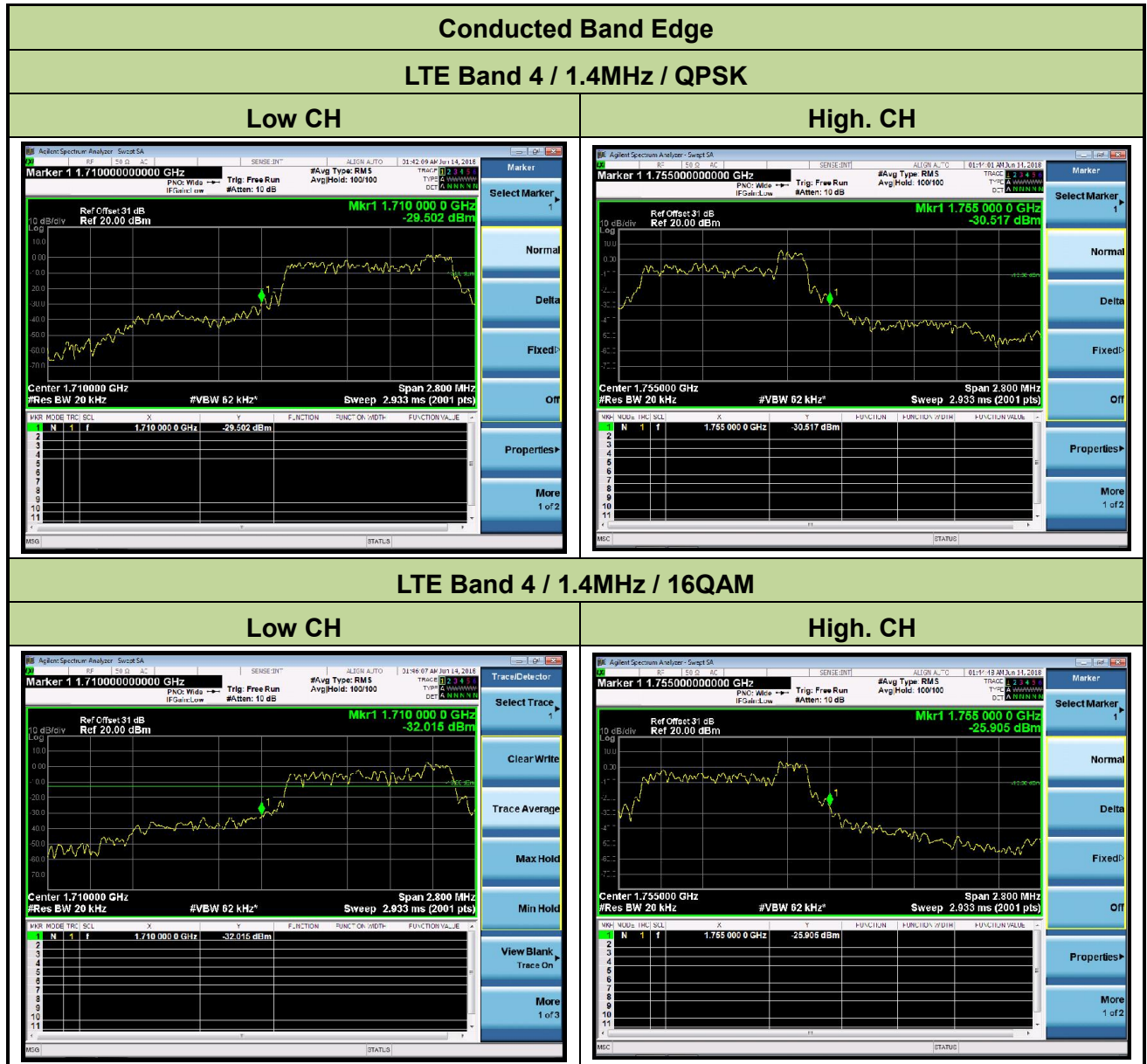
1. Start frequency was set to 30MHz and stop frequency was set to at least $10 \times$ the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

7.3.4. Test Setup



7.3.5. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Site	TR3	Test Date	2018/06/14



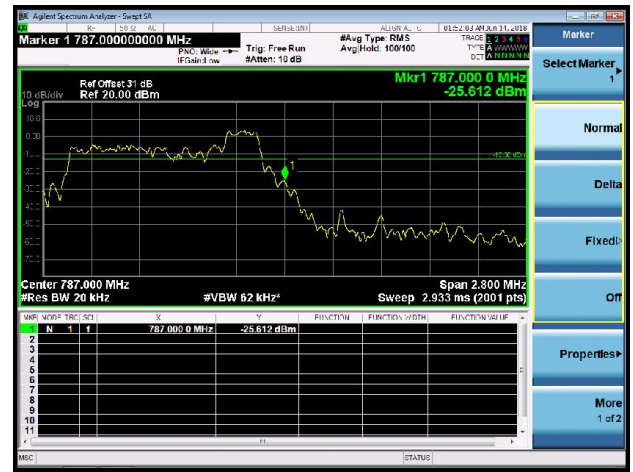
Conducted Band Edge

LTE Band 13 / 1.4MHz / QPSK

Low CH



High. CH



LTE Band 13 / 1.4MHz / 16QAM

Low CH



High. CH



7.4. Spurious and Harmonic Emissions at Antenna Terminal

7.4.1. Test Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \cdot \log(P)$ dB.

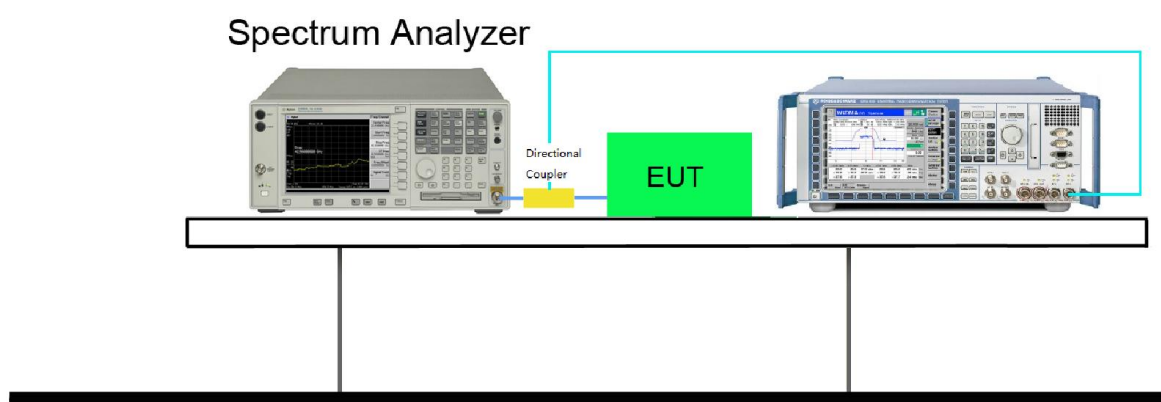
7.4.2. Test Procedure Used

KDB 971168 D01v03 - Section 6.0 & ANSI/TIA-603-E-2016

7.4.3. Test Setting

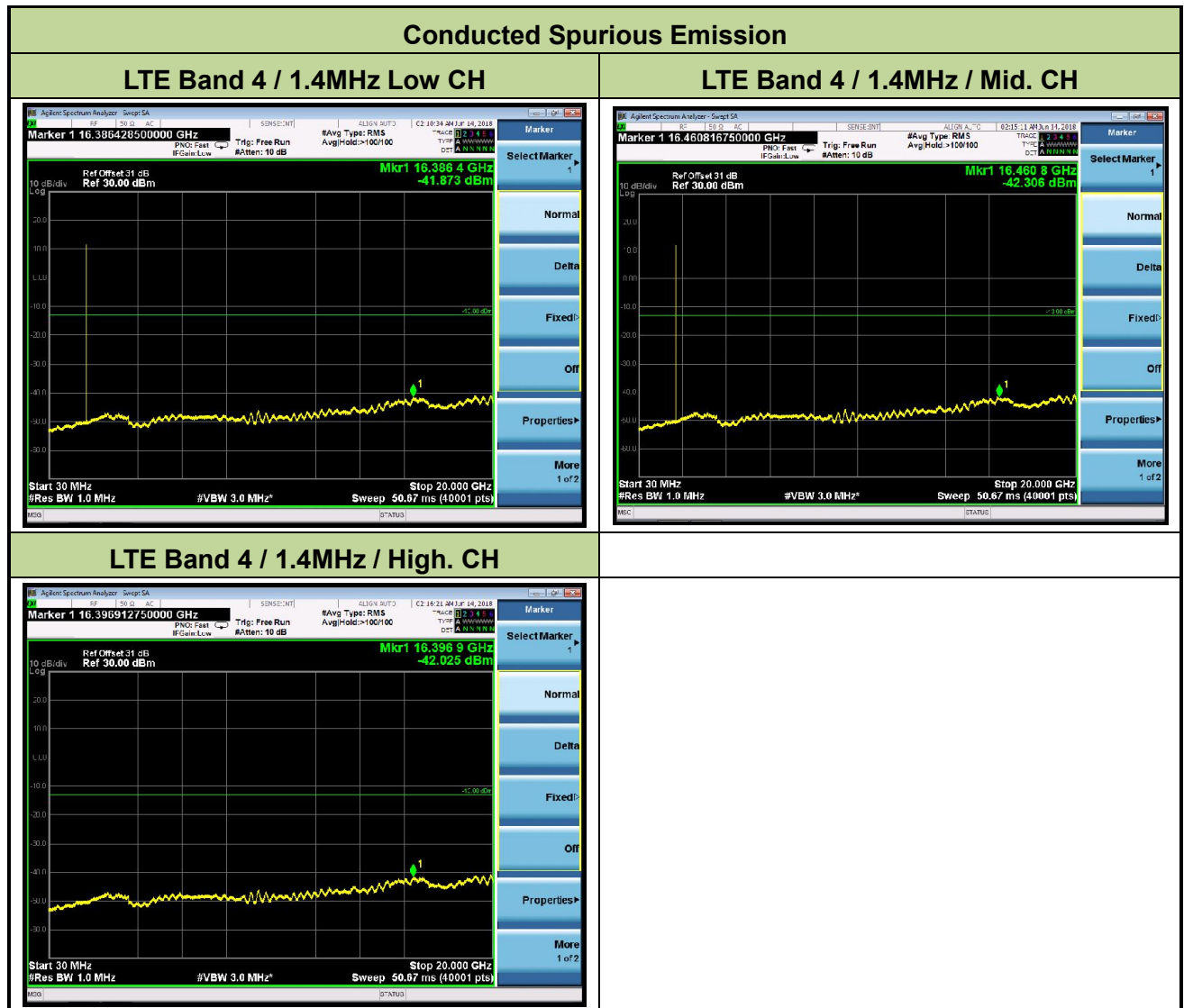
In the 1MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to measure the out of band Emissions.

7.4.4. Test Setup



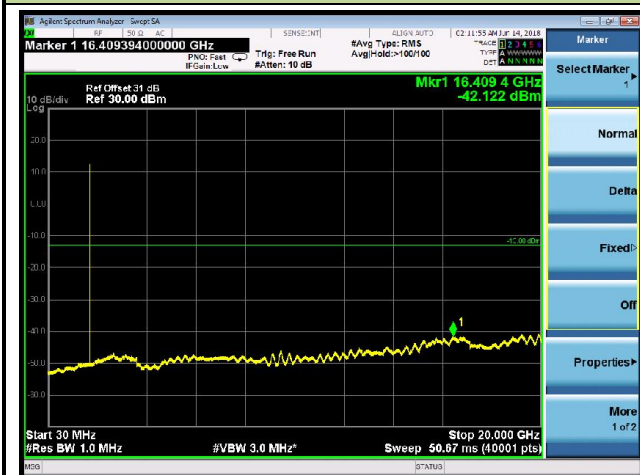
7.4.5. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	52%
Test Site	TR3	Test Date	2018/06/14



Conducted Spurious Emission

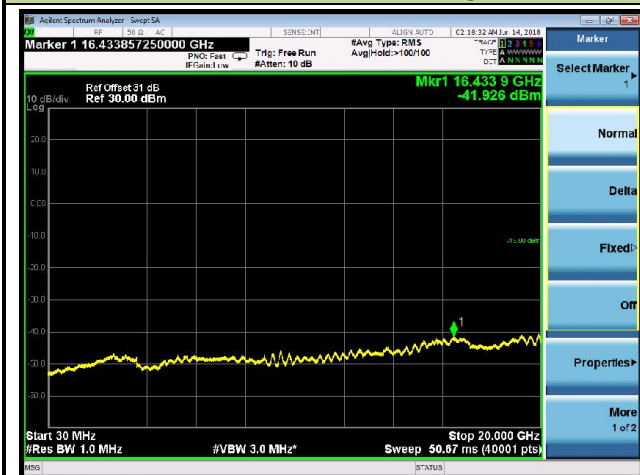
LTE Band 13 / 1.4MHz Low CH



LTE Band 13 / 1.4MHz / Mid. CH



LTE Band 13 / 1.4MHz / High. CH



7.5. Peak-Average Ratio

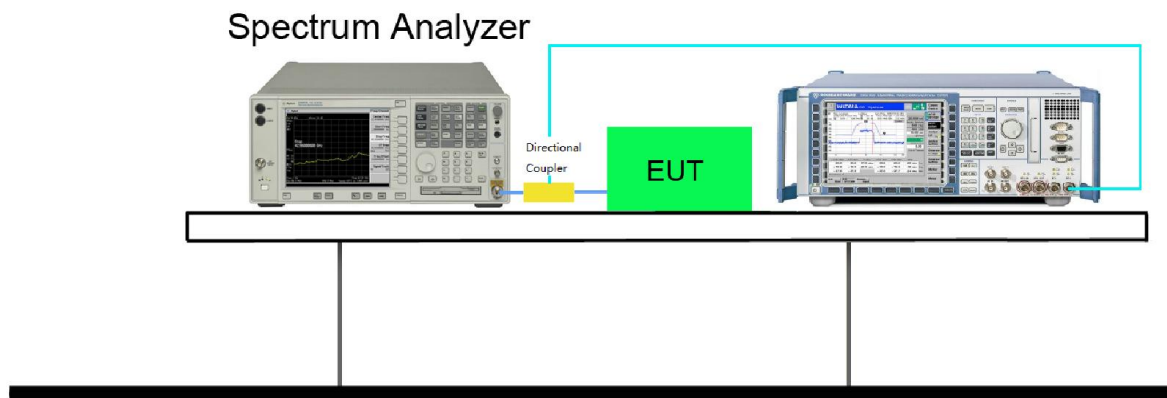
7.5.1. Test Limit

The transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

7.5.2. Test Procedure

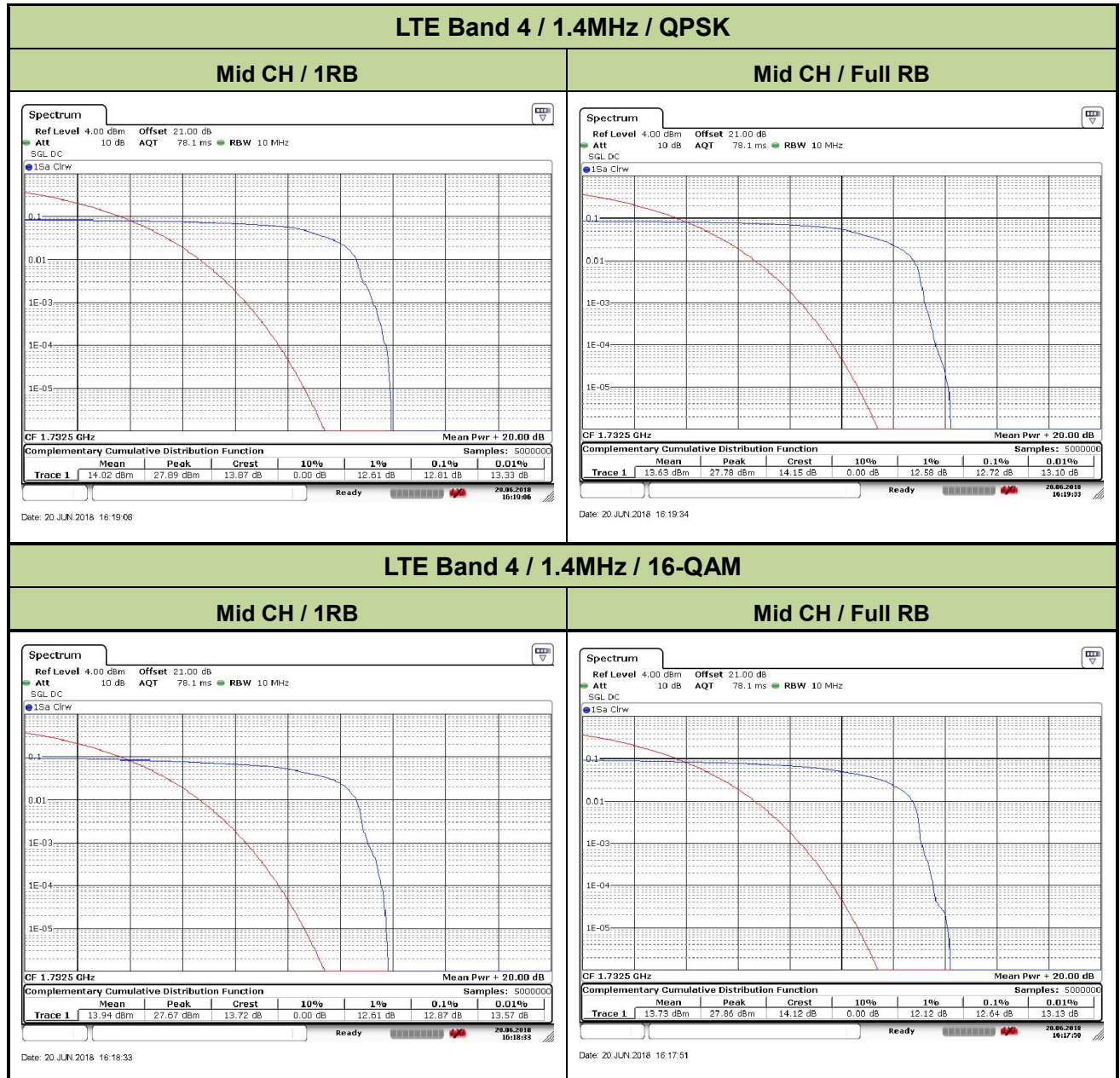
KDB 971168 D01v03 - Section 5.7 & ANSI/TIA-603-E-2016

7.5.3. Test Setup



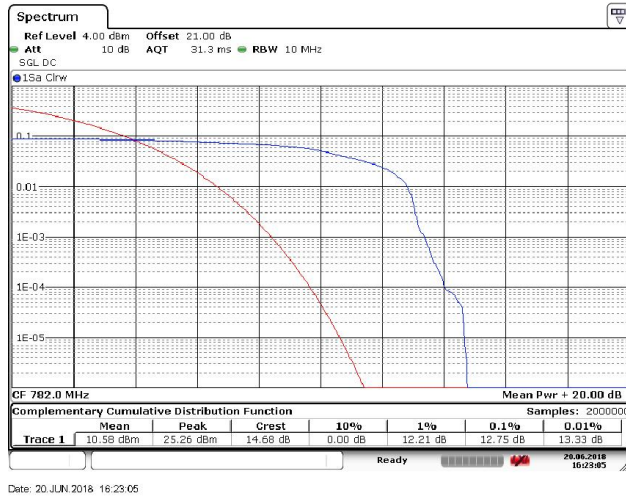
7.5.4. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	52%
Test Site	TR3	Test Date	2017/11/07

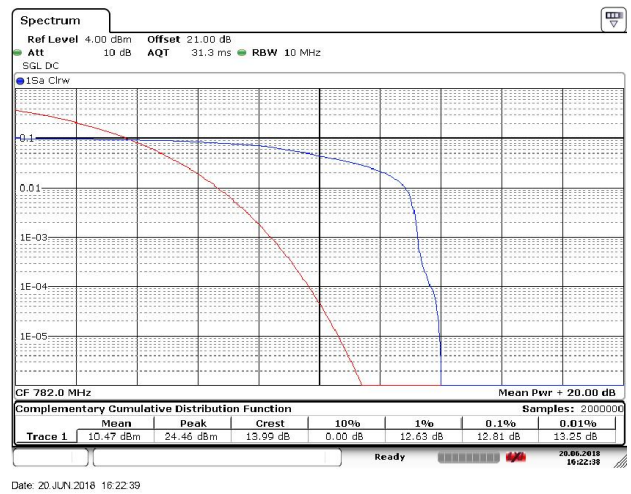


LTE Band 13 / 1.4MHz / QPSK

Mid CH / 1RB

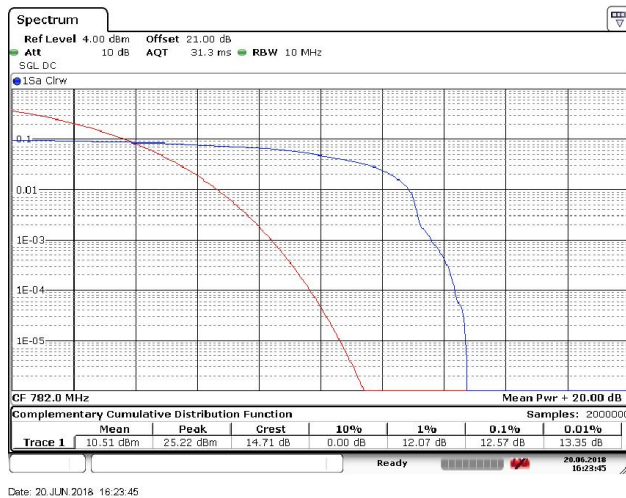


Mid CH / Full RB

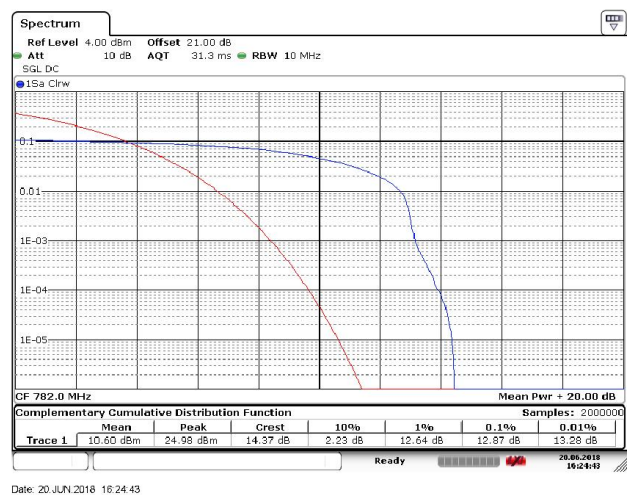


LTE Band 13 / 1.4MHz / 16-QAM

Mid CH / 1RB



Mid CH Full RB



7.6. Radiated Power (ERP/EIRP)

7.6.1. Test Limit

Radiated Power

For FCC Part 27.50(d): LTE Band 4

The EIRP of mobile transmitters and auxiliary test transmitters must not exceed 1 Watts.

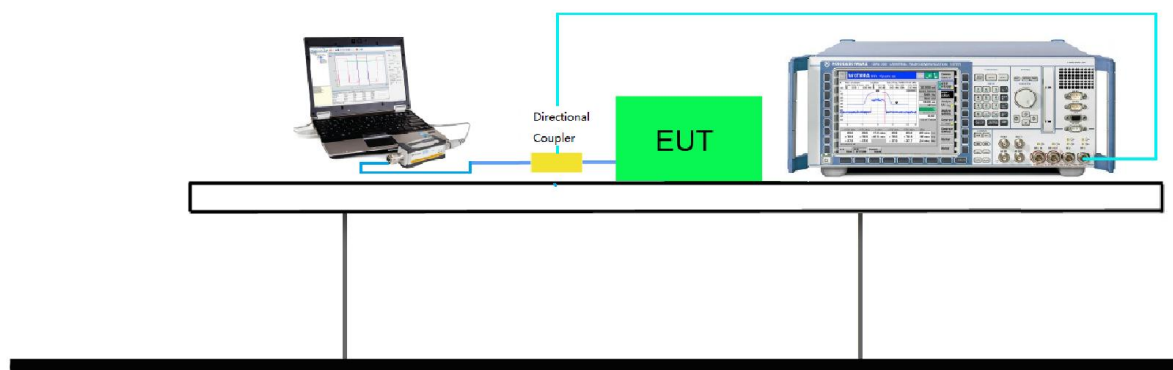
For FCC Part 27.50(b): LTE Band 13

The ERP of mobile transmitters and auxiliary test transmitters must not exceed 3 Watts.

7.6.2. Test Procedure Used

KDB 971168 D01v03 - Section 5.2.3 & ANSI/TIA-603-E-2016

7.6.3. Test Setting



7.6.4. Test Setup

1. The transmitter output port was connected to the system simulator.
2. Set EUT at maximum power through the system simulator.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record the power level from the system simulator.

According to KDB 412172 D01 Power Approach,

$EIRP = PT + GT - LC$, $ERP = EIRP - 2.15$, where

PT = transmitter output power in dBm

GT = gain of the transmitting antenna in dBi

LC = signal attenuation in the connecting cable between the transmitter and antenna in dB

7.6.5. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Polly Zong	Relative Humidity	52%
Test Site	TR3	Test Date	2018/06/14

FDD LTE Band 4							
Bandwidth (MHz)	RB Set	Power (dBm)					
	Channel	QPSK			16QAM		
		19957	20175	20393	19957	20175	20393
1.4MHz	1 (RB_Pos:0)	23.90	23.12	21.85	22.94	22.71	21.83
	3 (RB_Pos:0)	23.12	22.36	21.15	22.02	22.12	20.85
	6 (RB_Pos:0)	22.18	21.40	20.20	22.20	22.02	20.99

FDD LTE Band 13							
Bandwidth (MHz)	RB Set	Power (dBm)					
	Channel	QPSK			16QAM		
		23017	23095	23173	23017	23095	23173
1.4MHz	1 (RB_Pos:0)	23.11	23.16	23.0	22.04	21.78	21.93
	3 (RB_Pos:0)	22.25	22.38	22.10	21.62	21.38	21.52
	6 (RB_Pos:0)	21.48	21.55	21.37	21.56	21.39	21.26

ERP/EIRP

LTE Band 4 ($G_T - L_C = 1$ dB)						
Bandwidth	Modulation	Frequency (MHz)	Conducted Power (dBm)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1.4M	QPSK	1710.7	23.90	24.90	30.00	-5.10
		1732.5	23.12	24.12	30.00	-5.88
		1754.3	21.85	22.85	30.00	-7.15
1.4M	16QAM	1710.7	22.94	23.94	30.00	-6.06
		1732.5	22.71	23.71	30.00	-6.29
		1754.3	21.83	22.83	30.00	-7.17

ERP/EIRP

LTE Band 13 ($G_T - L_C = 1$ dB)						
Bandwidth	Modulation	Frequency (MHz)	Conducted Power (dBm)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1.4M	QPSK	777.7	23.11	24.11	34.77	-10.66
		782.0	23.16	24.16	34.77	-10.61
		786.3	23.0	24.0	34.77	-10.77
1.4M	16QAM	777.7	22.04	23.04	34.77	-11.73
		782.0	21.78	22.78	34.77	-11.99
		786.3	21.93	22.93	34.77	-11.84

7.7. Radiated Spurious Emissions Measurements

7.7.1. Test Limit

Out of band emissions: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

7.7.2. Test Procedure Used

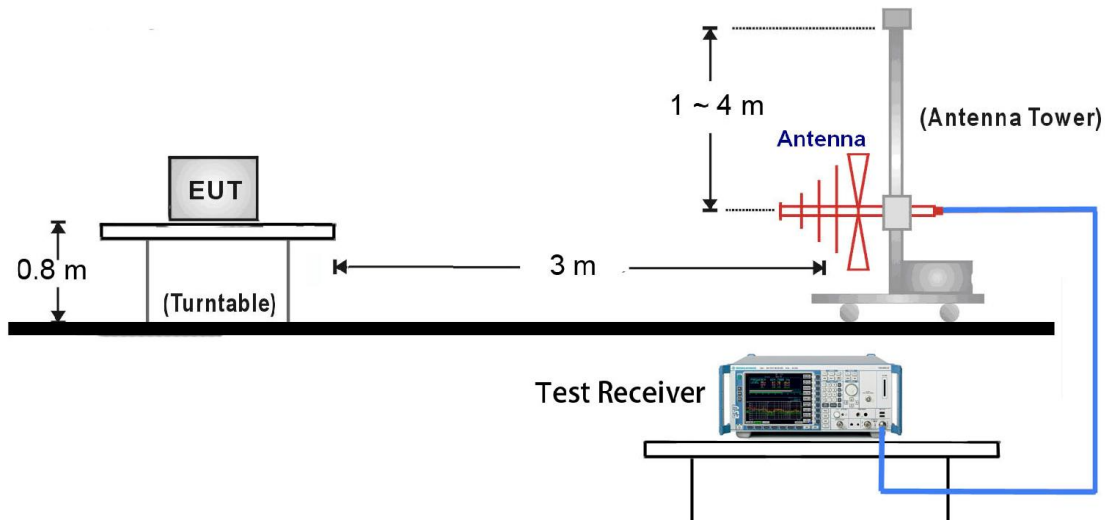
KDB 971168 D01 v02r02 - Section 5.8 & ANSI/TIA-603-E-2016 - Section 2.2.12

7.7.3. Test Setting

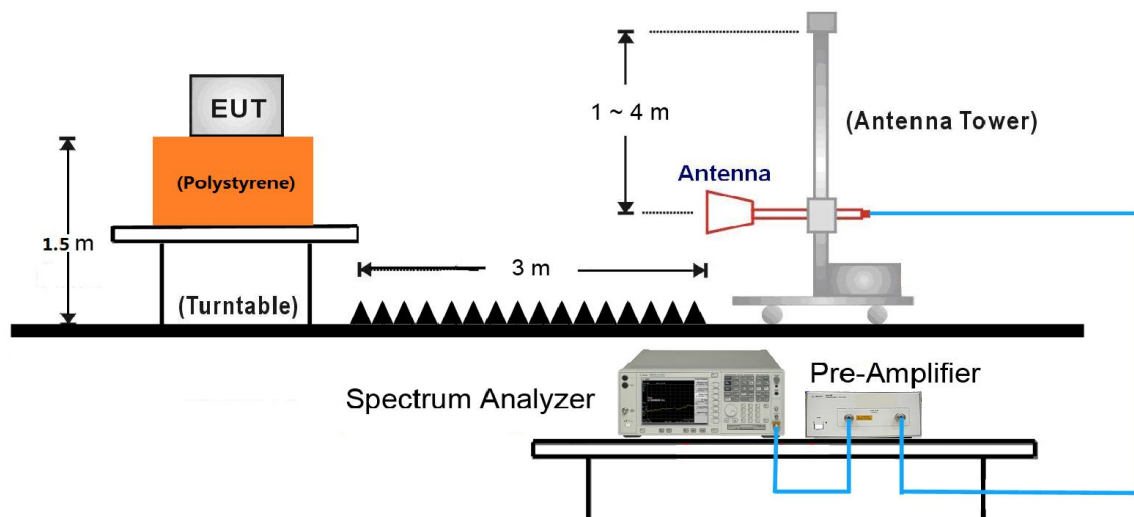
1. RBW = 100kHz for emissions below
2. VBW $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $> 2 \times$ span / RB
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

7.7.4. Test Setup

30MHz ~ 1GHz Test Setup:



1GHz ~ 25GHz Test Setup:



7.7.5. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Polly Zong	Relative Humidity	52%
Test Site	TR3	Test Date	2018/06/18

LTE Band 4							
Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Substitute Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low CH							
5148.00	V	-54.56	1.78	12.81	-43.53	-13.00	-30.53
13622.50	V	-43.66	2.10	12.49	-33.27	-13.00	-20.27
5131.00	H	-51.14	1.21	12.79	-39.55	-13.00	-26.55
10520.00	H	-44.54	1.72	11.65	-34.61	-13.00	-21.61
Mid. CH							
5190.50	V	-55.60	1.20	12.85	-43.95	-13.00	-30.95
10834.50	V	-45.94	1.78	11.57	-36.14	-13.00	-23.14
5190.50	H	-49.48	1.20	12.85	-37.83	-13.00	-24.83
10987.50	H	-44.91	1.80	11.52	-35.19	-13.00	-22.19
High CH							
5267.00	V	-56.27	1.21	12.95	-44.53	-13.00	-31.53
10545.50	V	-45.33	1.76	11.65	-35.44	-13.00	-22.44
5250.00	H	-51.59	1.22	12.93	-39.88	-13.00	-26.88
10511.50	H	-44.83	1.72	11.66	-34.89	-13.00	-21.89

Notes:

1. Spurious emissions within 30-1000MHz were found more than 20dB below limit line.
2. $ERP\ (dBm) = SG\ Reading\ (dBm) - Cable\ Loss\ (dB) + Substitute\ Antenna\ Gain\ (dBd)$.
3. All bandwidth and modulation of operation were investigated. The test results shown represent the worst case emissions.

LTE Band 13							
Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Substitute Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low CH							
1561.00	V	-58.52	0.65	9.21	-49.96	-40.00	-9.96
5088.50	V	-57.45	1.20	12.74	-45.91	-13.00	-32.91
1561.00	H	-54.69	0.65	9.21	-46.13	-13.00	-33.13
9134.50	H	-47.44	1.60	11.79	-37.24	-13.00	-24.24
Mid. CH							
1569.50	V	-59.36	0.65	9.26	-50.75	-40.00	-10.75
10341.50	V	-45.79	1.68	11.80	-35.67	-13.00	-22.67
1569.50	H	-54.12	0.65	9.26	-45.51	-13.00	-32.51
10027.00	H	-43.69	1.70	9.26	-36.12	-13.00	-23.12
High CH							
1561.00	V	-58.41	0.65	9.21	-49.85	-40.00	-9.85
10528.50	V	-45.52	1.73	11.65	-35.60	-13.00	-22.60
1569.50	H	-52.04	0.65	5.97	-46.72	-13.00	-33.72
10681.50	H	-46.39	1.71	11.61	-36.49	-13.00	-23.49

Notes:

1. Spurious emissions within 30-1000MHz were found more than 20dB below limit line.
2. $ERP\ (dBm) = SG\ Reading\ (dBm) - Cable\ Loss\ (dB) + Substitute\ Antenna\ Gain\ (dBd)$
3. All bandwidth and modulation of operation were investigated. The test results shown represent the worst case emissions.

7.8. Frequency Stability Under Temperature & Voltage Variations

7.8.1. Test Limit

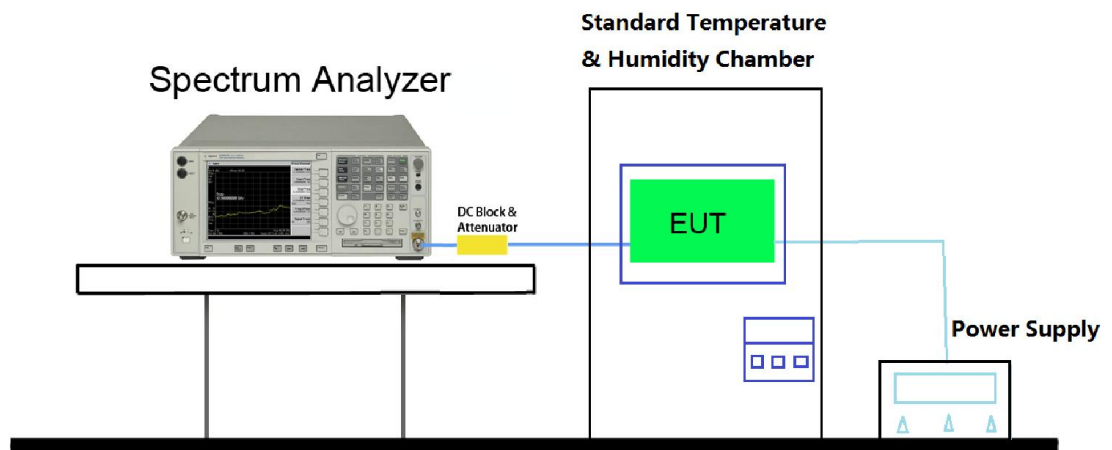
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

For Part 27, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7.8.2. Test Procedure

KDB 971168 D01v03 - Section 9.0 & ANSI/TIA-603-E-2016

7.8.3. Test Setup



7.8.4. Test Result

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Polly Zong	Relative Humidity	52%
Test Site	TR3	Test Date	2018/06/14
Test Mode	LTE Band 4 Mid. CH 20175 (1732.5MHz)		

Voltage (%)	Power (V _{DC})	TEMP (%)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)	Limit (%)	Result
QPSK							
100%	12.0	+20(Ref)	1732,500,000	69	0.000004	±0.00025	Pass
100%		-30	1732,500,000	-75	-0.000004	±0.00025	Pass
100%		-20	1732,500,000	-24	-0.000001	±0.00025	Pass
100%		-10	1732,500,000	69	0.000004	±0.00025	Pass
100%		0	1732,500,000	86	0.000005	±0.00025	Pass
100%		+10	1732,500,000	-8	0.000000	±0.00025	Pass
100%		+20	1732,500,000	-14	-0.000001	±0.00025	Pass
100%		+30	1732,500,000	-98	-0.000006	±0.00025	Pass
100%		+40	1732,500,000	89	0.000005	±0.00025	Pass
100%		+50	1732,500,000	-13	-0.000001	±0.00025	Pass
115%	20	+20	1732,500,000	45	0.000003	±0.00025	Pass
BAT.ENDPOINT	8.0	+20	1732,500,000	80	0.000005	±0.00025	Pass
16QAM							
100%	12.0	+20(Ref)	1732,500,000	-91	-0.000005	±0.00025	Pass
100%		-30	1732,500,000	-19	-0.000001	±0.00025	Pass
100%		-20	1732,500,000	-96	-0.000006	±0.00025	Pass
100%		-10	1732,500,000	-100	-0.000006	±0.00025	Pass
100%		0	1732,500,000	10	0.000001	±0.00025	Pass
100%		+10	1732,500,000	-99	-0.000006	±0.00025	Pass
100%		+20	1732,500,000	-6	0.000000	±0.00025	Pass
100%		+30	1732,500,000	-86	-0.000005	±0.00025	Pass
100%		+40	1732,500,000	26	0.000002	±0.00025	Pass
100%		+50	1732,500,000	-65	-0.000004	±0.00025	Pass
115%	20	+20	1732,500,000	71	0.000004	±0.00025	Pass
BAT.ENDPOINT	8.0	+20	1732,500,000	19	0.000001	±0.00025	Pass

Product	LTE Cat-M GPS Tracker	Temperature	25°C
Test Engineer	Polly Zong	Relative Humidity	52%
Test Site	TR3	Test Date	2018/06/14
Test Mode	LTE Band 13 Mid. CH 20230 (782.0MHz)		

Voltage (%)	Power (V _{DC})	TEMP (%)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)	Limit (%)	Result
QPSK							
100%	12.0	+20(Ref)	782,000,000	-50	-0.000006	±0.00025	Pass
100%		-30	782,000,000	34	0.000004	±0.00025	Pass
100%		-20	782,000,000	-29	-0.000004	±0.00025	Pass
100%		-10	782,000,000	-57	-0.000007	±0.00025	Pass
100%		0	782,000,000	19	0.000002	±0.00025	Pass
100%		+10	782,000,000	-56	-0.000007	±0.00025	Pass
100%		+20	782,000,000	-32	-0.000004	±0.00025	Pass
100%		+30	782,000,000	69	0.000009	±0.00025	Pass
100%		+40	782,000,000	-75	-0.000010	±0.00025	Pass
100%		+50	782,000,000	16	0.000002	±0.00025	Pass
115%	20.0	+20	782,000,000	27	0.000003	±0.00025	Pass
BAT.ENDPOINT	8.0	+20	782,000,000	93	0.000012	±0.00025	Pass
16QAM							
100%	12.0	+20(Ref)	782,000,000	59	0.000008	±0.00025	Pass
100%		-30	782,000,000	-15	-0.000002	±0.00025	Pass
100%		-20	782,000,000	49	0.000006	±0.00025	Pass
100%		-10	782,000,000	-27	-0.000003	±0.00025	Pass
100%		0	782,000,000	-29	-0.000004	±0.00025	Pass
100%		+10	782,000,000	-48	-0.000006	±0.00025	Pass
100%		+20	782,000,000	-38	-0.000005	±0.00025	Pass
100%		+30	782,000,000	-67	-0.000009	±0.00025	Pass
100%		+40	782,000,000	68	0.000009	±0.00025	Pass
100%		+50	782,000,000	91	0.000012	±0.00025	Pass
115%	20.0	+20	782,000,000	65	0.000008	±0.00025	Pass
BAT.ENDPOINT	8.0	+20	782,000,000	-61	-0.000008	±0.00025	Pass

8. CONCLUSION

The data collected relate only the item(s) tested and show that the device compliance with all the requirements of Parts 2, 27 of the FCC Rules and IC RSS-130, RSS 139 Rules.

The End