

July 13, 2020

Mobilogix, Inc.  
5500 Trabuco Rd., Suite 150  
Irvine, California 92620

Dear Ramy Mourad,

Enclosed is the EMC Wireless test report for compliance testing of the Mobilogix, Inc., Mobilogix Global Asset Tracker (GAT) as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 22 Subpart H for Cellular Devices and FCC Part 24 Subpart E for Broadband PCS Devices.

Thank you for using the services of Eurofins E&E North America. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,  
EUROFINS E&E NORTH AMERICA



Jennifer Warnell  
Documentation Department

Reference: (\Mobilogix, Inc.\WIRS108597-FCC22\_24 Rev. 2)



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## **Electromagnetic Compatibility Criteria Test Report**

for the

**Mobilogix, Inc.  
Mobilogix Global Asset Tracker (GAT)**

**Tested under  
FCC Certification Rules  
Title 47 of the CFR,  
Part 22 Subpart H for Cellular Devices  
&  
Part 24 Subpart E for Broadband PCS Devices**

**Report: WIRS108597-FCC22\_24 Rev. 2**

July 13, 2020

**Prepared For:**

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**Prepared By:  
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FCC Certification Rules  
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Part 22 Subpart H for Cellular Devices  
&  
Part 24 Subpart E for Broadband PCS Devices



Arsalan Hasan  
Project Engineer, Electromagnetic Compatibility Lab

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 22 Subpart H and Part 24 Subpart E of the FCC Rules under normal use and maintenance.



Sandeep Brar,  
Manager, Electromagnetic Compatibility Lab

## Report Status Sheet

Revision	Report Date	Reason for Revision
∅	July 9, 2020	Initial Issue.
1	July 10, 2020	Corrected customer company name to manufacturer.
2	July 13, 2020	TCB Review Updates.

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## List of Terms and Abbreviations

<b>AC</b>	<b>Alternating Current</b>
<b>ACF</b>	<b>Antenna Correction Factor</b>
<b>Cal</b>	<b>Calibration</b>
<b><i>d</i></b>	<b>Measurement Distance</b>
<b>dB</b>	<b>Decibels</b>
<b>dB<math>\mu</math>A</b>	<b>Decibels above one microamp</b>
<b>dB<math>\mu</math>V</b>	<b>Decibels above one microvolt</b>
<b>dB<math>\mu</math>A/m</b>	<b>Decibels above one microamp per meter</b>
<b>dB<math>\mu</math>V/m</b>	<b>Decibels above one microvolt per meter</b>
<b>DC</b>	<b>Direct Current</b>
<b>E</b>	<b>Electric Field</b>
<b>DSL</b>	<b>Digital Subscriber Line</b>
<b>ESD</b>	<b>Electrostatic Discharge</b>
<b>EUT</b>	<b>Equipment Under Test</b>
<b><i>f</i></b>	<b>Frequency</b>
<b>FCC</b>	<b>Federal Communications Commission</b>
<b>GRP</b>	<b>Ground Reference Plane</b>
<b>H</b>	<b>Magnetic Field</b>
<b>HCP</b>	<b>Horizontal Coupling Plane</b>
<b>Hz</b>	<b>Hertz</b>
<b>IEC</b>	<b>International Electrotechnical Commission</b>
<b>kHz</b>	<b>kilohertz</b>
<b>kPa</b>	<b>kilopascal</b>
<b>kV</b>	<b>kilovolt</b>
<b>LISN</b>	<b>Line Impedance Stabilization Network</b>
<b>MHz</b>	<b>Megahertz</b>
<b><math>\mu</math>H</b>	<b>microhenry</b>
<b><math>\mu</math></b>	<b>microfarad</b>
<b><math>\mu</math>s</b>	<b>microseconds</b>
<b>NEBS</b>	<b>Network Equipment-Building System</b>
<b>PRF</b>	<b>Pulse Repetition Frequency</b>
<b>RF</b>	<b>Radio Frequency</b>
<b>RMS</b>	<b>Root-Mean-Square</b>
<b>TWT</b>	<b>Traveling Wave Tube</b>
<b>V/m</b>	<b>Volts per meter</b>
<b>VCP</b>	<b>Vertical Coupling Plane</b>

# I. Executive Summary



**A. Purpose of Test**

An EMC evaluation was performed to determine compliance of the Mobilogix, Inc. Mobilogix Global Asset Tracker (GAT), with the requirements of Part 22 Subpart H and Part 24 Subpart E. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Mobilogix Global Asset Tracker (GAT). Mobilogix, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Mobilogix Global Asset Tracker (GAT), has been **permanently** discontinued.

**B. Executive Summary**

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 22 Subpart H and Part 24 Subpart E, in accordance with Mobilogix, Inc., purchase order number MOB2012-1.

FCC Reference	Description	Compliance
§2.1049; §22.917; §24.232(d)	Occupied Bandwidth	Data valid from module original certification FCC-ID: XMR201707BG96
§2.1049, §22.355, §24.238	Frequency stability	Data valid from module original certification FCC-ID: XMR201707BG96
§22.913(d), §24.323(d)	Peak to Average Ratio	Data valid from module original certification FCC-ID: XMR201707BG96
§2.1051; §22.917, §24.238	Conducted Spurious Emissions at Antenna Terminals and Band Edge	Data valid from module original certification FCC-ID: XMR201707BG96
§2.1046; §22.913(a); §24.232	RF Power Output	Data valid from module original certification FCC-ID: XMR201707BG96
§2.1046; §22.913(a)(2); §24.232	Effective Radiated Power	Compliant
§2.1053; §22.917(a), §24.238	Radiated Spurious Emissions from the Cabinet	Compliant

**Table 1. Executive Summary of EMC Compliance Testing**

**Rationale:** Per KDB KDB 996369 D04 “Modular Transmitter Integration Guide – Guidance for Host Product Manufacturers” only worst-case radiated measurements are reported in this filing.

## **II. Equipment Configuration**

**A. Overview**

Eurofins E&E North America was contracted by Mobilogix, Inc. to perform testing on the Mobilogix Global Asset Tracker (GAT), under Mobilogix, Inc.’s purchase order number MOB2012-1.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Mobilogix, Inc., Mobilogix Global Asset Tracker (GAT).

The results obtained relate only to the item(s) tested.

<b>Model(s) Tested:</b>	Mobilogix Global Asset Tracker (GAT)		
<b>Model(s) Covered:</b>	Mobilogix Global Asset Tracker (GAT)		
<b>Filing Status:</b>	Original		
<b>EUT Specifications:</b>	Primary Power: 3.8V DC		
	FCC ID: 2AH4HVZGATCM1		
	Module Original Report Number(s): RXA1706-0199RF01R1, RXA1706-0199RF02R1		
	Type of Modulations:	GMSK, 8PSK, QPSK, 16QAM	
	Equipment Code:	PCB	
	Technology	Frequency Range	RF Power Output
	GSM 850	824 – 849 MHz	30.65 dBm ERP
	GSM 1900	1850 – 1910 MHz	30.28 dBm EIRP
	LTE CAT-M1 Band 2	1850 – 1910 MHz	28.44 dBm EIRP
	LTE CAT-M1 Band 5	824 – 949 MHz	27.32 dBm ERP
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.		
<b>Environmental Test Conditions:</b>	Temperature: 15-35° C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
<b>Evaluated by:</b>	Arsalan Hasan		
<b>Date(s):</b>	July 13, 2020		

**Table 2. EUT Summary Table**

**Note:** LTE Band 26 is not supported by EUT firmware. This has been confirm by bring up the LTE Bands profiles in CMW500 while the EUT is connected to the callbox.

**Rationale:** LTE CAT-M1 bands were chosen over NB-IoT since CAT-M1 has higher output powers and presents itself as the worst case for testing purposes.

**B. References**

<b>CFR 47, Part 22, Subpart H</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 22: Rules and Regulations for Cellular Devices.
<b>CFR 47, Part 24, Subpart E</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 24: Rules and Regulations for Personal Communications Services
<b>KDB 996369 D04</b>	Modular Transmitter Integration Guide – Guidance For Host Product Manufacturers
<b>ANSI C63.4:20014</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ANSI C63.26: 2015</b>	Compliance Testing of Transmitters Used in Licensed Radio Services
<b>ISO/IEC 17025:2017</b>	General Requirements for the Competence of Testing and Calibration Laboratories
<b>EIA/TIA-603-D-2010</b>	Land Mobile FM or PM Communication Equipment Measurement and Performance Standards
<b>KDB 971168 v02r02</b>	Measurement Guidance For Certification Of Licensed Digital Transmitters

**Table 3. References**

**C. Test Site**

All testing was performed at Eurofins E&E North America, 3162 Belick St. Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

MET Laboratories is a ISO/IEC 17025 accredited site by A2LA, California #0591.02.

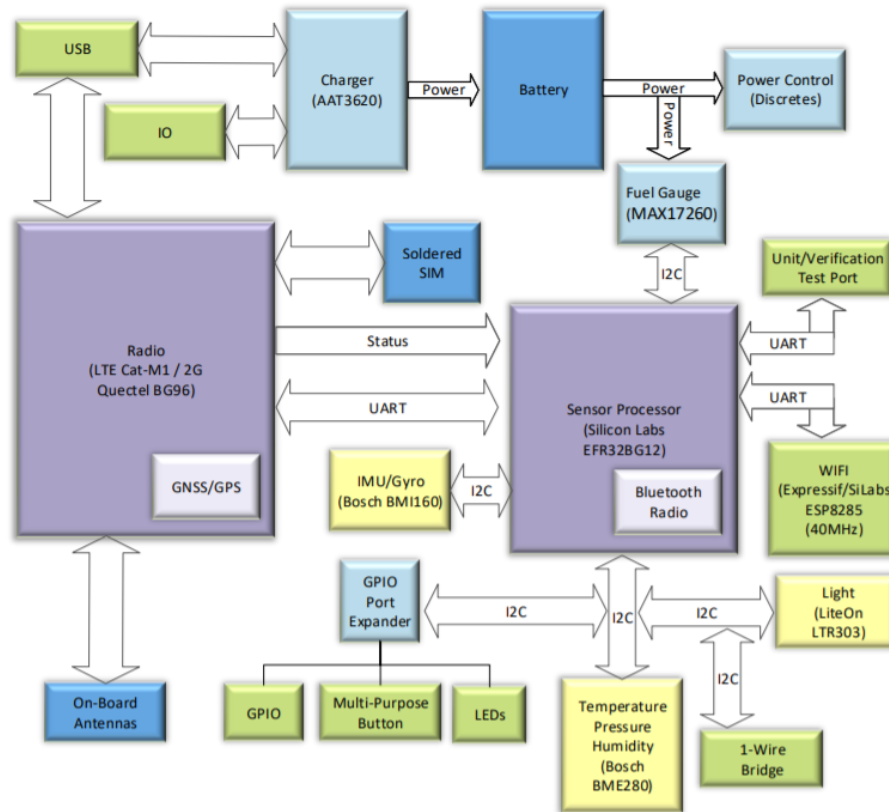
**D. Measurement Uncertainty**

Test Method	Typical Expanded Uncertainty	K	Confidence Level
<b>RF Frequencies</b>	±4.52 Hz	2	95%
<b>RF Power Conducted Emissions</b>	±2.32 dB	2	95%
<b>RF Power Conducted Spurious Emissions</b>	±2.25 dB	2	95%
<b>RF Power Radiated Emissions</b>	±3.01 dB	2	95%
<b>Radiated Emissions, (30 MHz – 1 GHz)</b>	±3.24	2	95%
<b>Radiated Emissions, (1 - 6 GHz)</b>	±3.92	2	95%
<b>Conducted Emission</b>	±3.53	2	95%
<b>CEV Telecom Port</b>	±2.44	2	95%

**Table 4. Uncertainty Calculations Summary**

**E. Description of Test Sample**

The Mobilogix Global Asset Tracker (GAT), Equipment Under Test (EUT), is a multi-purpose LTE CAT-M1 / NB1 and 2G (GSM/GPRS/EDGE), IP67 rated mobile asset tracking and monitoring device with various onboard sensors including temperature, pressure, humidity, light, a 3-axis IMU/Gyroscope, and GNSS/GPS. It also boasts WIFI LAAS and BLE (Bluetooth Low-Energy) connectivity. It is designed for applications such as critical asset tracking and cold-chain, with the ability to periodically report sensor data and location data per configurable intervals, and report near-real-time events or alarms, based on configurable intervals and configurable thresholds.



**Figure 1. Block Diagram of Equipment Configuration**

## F. Equipment Configuration

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
1	NA	Global Asset Tracker	VZGAT-CM1-001	ATD210S	A210S2024000 36S	NA
2	NA	AC/DC Adapter	ASUC62a-050200	NA	NA	NA

**Table 5. Equipment Configuration**

## G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
3	USB Power Port	USB Power Cable	1	1	1	N	NA

**Table 6. Ports and Cabling Information**

## H. Mode of Operation

In Normal Mode, the default GAT profile periodically monitors and provides sensor reports for temperature, humidity, pressure, light, accelerometer, tilt/orientation, battery-level, location, and LTE signal strength (RSRP). A user may disable or decrease the reporting frequency (granularity) of any sensor for which the use case does not apply. Furthermore, alarms can be enabled for near real-time detection and reporting of environmental excursions, motion or tilt alarms.

The GAT supports indoor location using Wi-Fi access points and RSSI trilateration, in addition to location based on enhanced cell ID (eCID), in scenarios where visibility to the sky for GNSS location is compromised or not possible.

The GAT can be configured as a cellular gateway or scanner of remote Bluetooth environmental sensors, such as the Mobilogix BTM250.

## I. Method of Monitoring EUT Operation

A CMW500 will connect to the Asset Tracker on a desired GSM / LTE band over the air. CMW500 will be monitored for any dropped calls.

### RADIO LEDs

Slow short blinks → Attempting to register on network.

Slow long blinks → Registered and Idle.

Rapid blink → Data transfer in progress.

The Radio LED will not blink while GAT is not performing its intended functions

The Radio LED will blink when GAT is performing its intended functions

**J. Modifications****a) Modifications to EUT**

No modifications were made to the EUT.

**b) Modifications to Test Standard**

No modifications were made to the test standard.

**K. Disposition of EUT**

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Mobilogix, Inc. upon completion of testing.

### **III. Electromagnetic Compatibility Criteria for Intentional Radiators**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 2.1046 Radiated Output Power

**Test Requirements:** § 22.913(a)(2): Extend coverage on a secondary basis into cellular unserved areas, as those areas are defined in §22.949, the ERP of base transmitters and cellular repeaters of such systems must not exceed 1000 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

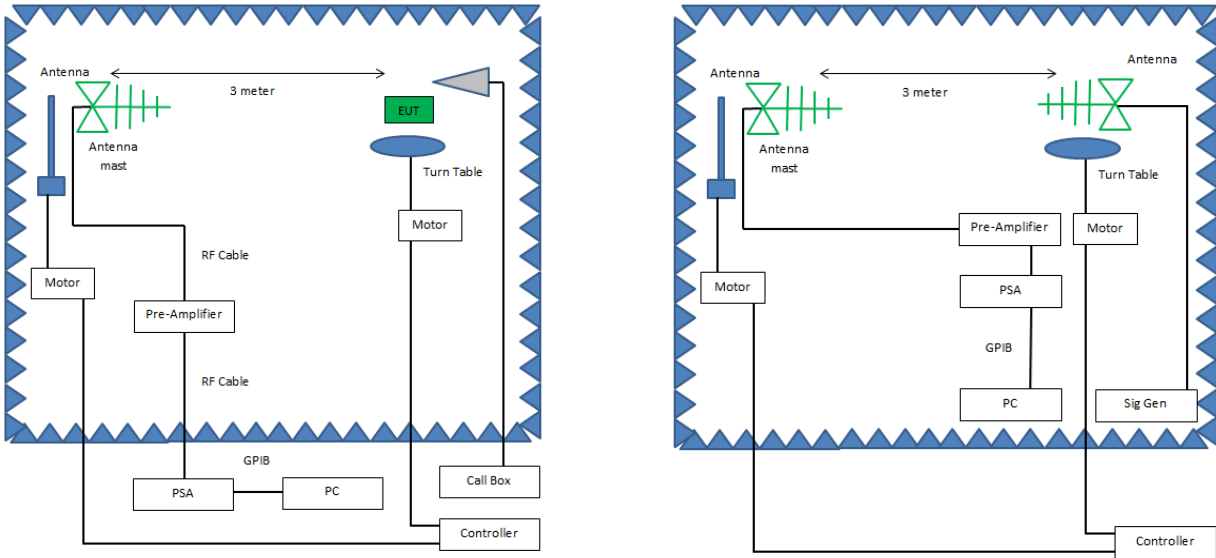
§ 24.232 (c): Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

**Test Procedures:** The EUT was tested according to the average power integration procedures of ANSI C63.26 (2015) 5.5.3.

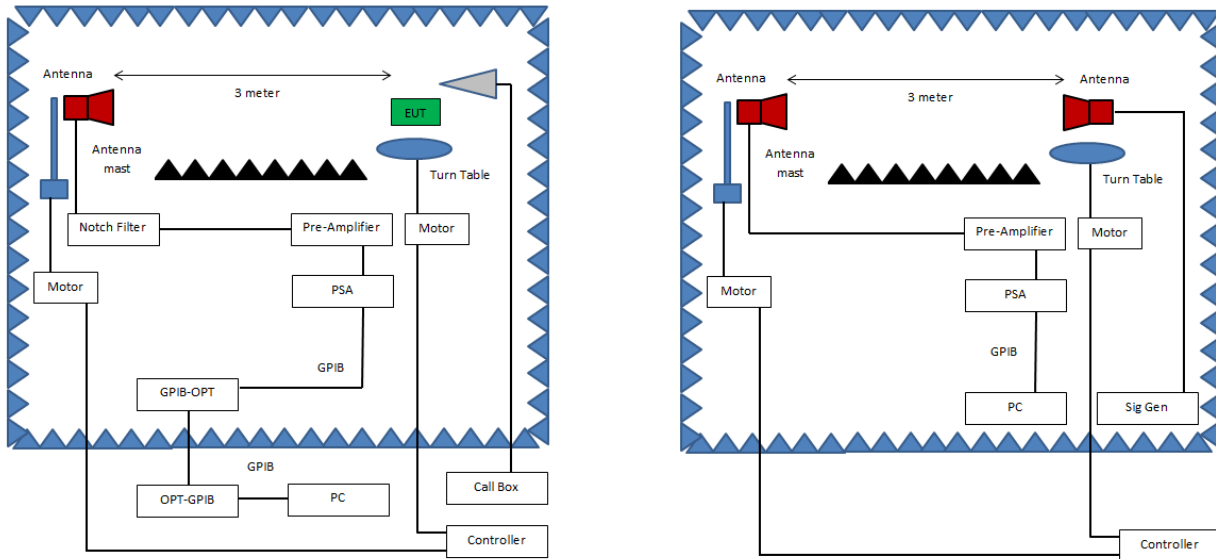
Radiated measurements shall be performed using the test arrangement shown in Figure . After a direct field strength measurement of the maximum emission amplitude level (maximized as described previously), a signal generator and transmit antenna are substituted in place of the EUT, as shown in Figure 7. The output power of the signal generator is adjusted to replicate the maximized signal amplitude measured in the direct field strength measurement. The signal generator power setting is then used to determine the ERP or EIRP of the EUT spurious emission(s). These measurements shall be performed in accordance with the common requirements specified in 5.5.2 and the specific requirements provided in this subclause.

A step-by-step procedure is as follows.

- a) Place the EUT in the center of the turntable. The EUT shall be configured to transmit into the standard non-radiating load (for measuring radiated spurious emissions), connected with cables of minimal length unless specified otherwise. If the EUT uses an adjustable antenna, the antenna shall be positioned to the length that produces the worst case emission at the fundamental operating frequency.
- b) Each emission under consideration shall be evaluated:
  - 1) Raise and lower the measurement antenna in accordance 5.5.2, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.
  - 2) Rotate the EUT through 360° to determine the maximum emission level relative to the axial position.
  - 3) Return the turntable to the azimuth where the highest emission amplitude level was observed.
  - 4) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.
  - 5) Record the measured emission amplitude level and frequency using the appropriate RBW.
- c) Repeat step b) for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.
- d) Set-up the substitution measurement with the reference point of the substitution a antenna located as near as possible to where the center of the EUT radiating element was located during the initial EUT measurement.



**Figure 2. ERP / EIRP, Block Diagram, Test Setup Below 1GHz**



**Figure 3. ERP / EIRP, Block Diagram, Test Setup Above 1GHz**

- e) Maintain the previous measurement instrument settings and test set-up, with the exception that the EUT is removed and replaced by the substitution antenna.
- f) Connect a signal generator to the substitution antenna; locate the signal generator so as to minimize any potential influences on the measurement results. Set the signal generator to the frequency where emissions are detected, and set an output power level such that the radiated signal can be detected by the measurement instrument, with sufficient dynamic range relative to the noise floor.
- g) For each emission that was detected and measured in the initial test [i.e., in step b) and step c)]:
  - 1) Vary the measurement antenna height between 1 m to 4 m to maximize the received (measured) signal amplitude.
  - 2) Adjust the signal generator output power level until the amplitude detected by the measurement instrument equals the amplitude level of the emission previously measured directly in step b) and step c).
  - 3) Record the output power level of the signal generator when equivalence is achieved in step 2).
- h) Repeat step e) through step g) with the measurement antenna oriented in the opposite polarization.
- i) Calculate the emission power in dBm referenced to a half-wave dipole using the following equation:

$$P_e = P_s(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

where

$P_e$  = equivalent emission power in dBm

$P_s$  = source (signal generator) power in dBm

NOTE—dBd refers to the measured antenna gain in decibels relative to a half-wave dipole.

- j) Correct the antenna gain of the substitution antenna if necessary to reference the emission power to a half-wave dipole. When using measurement antennas with the gain specified in dBi, the equivalent dipole-referenced gain can be determined from:  
 $\text{gain (dBd)} = \text{gain (dBi)} - 2.15 \text{ dB}$ . If necessary, the antenna gain can be calculated from calibrated antenna factor information

**Test Results:** The EUT was found compliant with the requirements of this section.

**Test Engineer(s):** Felix Huang, Arsalan Hasan

**Test Date(s):** 07/03/2020

### Test Results

Mode	Channel	Frequency (MHz)	Polarization	ERP (dBm)	Limit (dBm)	Result
GSM 850	Mid	848.8	Vertical	30.65	38.45	Pass
LTE Band 5	Mid	836.5	Vertical	27.32	38.45	Pass

**Table 7. ERP, Test Results, Part 22, GSM 850/LTE Band 5**

Mode	Channel	Frequency (MHz)	Polarization	EIRP (dBm)	Limit (dBm)	Result
GSM 1900	Mid	1850.2	Vertical	30.28	33	Pass
LTE Band 2	High	1905.0	Vertical	28.44	33	Pass

**Table 8. EIRP, Test Results, Part 24, GSM 1900/LTE Band 2**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 2.1053 Radiated Spurious Emissions

**Test Requirement(s): § 2.1053 Measurements required: Field strength of spurious radiation.**

**§ 2.1053 (a)** Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

**§ 2.1053 (b):** The measurements specified in paragraph (a) of this section shall be made for the following equipment:

- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

**§ 22.917 Emission limitations Cellular equipment:** The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

**§ 22.917 (a):** 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  $43 + 10 \log(P)$ . Limit is -13 dBm.

**§ 24.238 (a):** 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. Limit is -13 dBm.

**Test Procedures:**

The EUT was tested according to the average power integration procedures of ANSI C63.26 (2015) 5.5.3.

Radiated measurements shall be performed using the test arrangement shown in Figure. After a direct field strength measurement of the maximum emission amplitude level (maximized as described previously), a signal generator and transmit antenna are substituted in place of the EUT, as shown in Figure 7. The output power of the signal generator is adjusted to replicate the maximized signal amplitude measured in the direct field strength measurement. The signal generator power setting is then used to determine the ERP or EIRP of the EUT spurious emission(s). These measurements shall be performed in accordance with the common requirements specified in 5.5.2 and the specific requirements provided in this subclause.

A step-by-step procedure is as follows.

- k) Place the EUT in the center of the turntable. The EUT shall be configured to transmit into the standard non-radiating load (for measuring radiated spurious emissions), connected with cables of minimal length unless specified otherwise. If the EUT uses an adjustable antenna, the antenna shall be positioned to the length that produces the worst case emission at the fundamental operating frequency.
- l) Each emission under consideration shall be evaluated:
  - 6) Raise and lower the measurement antenna in accordance 5.5.2, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.
  - 7) Rotate the EUT through 360° to determine the maximum emission level relative to the axial position.
  - 8) Return the turntable to the azimuth where the highest emission amplitude level was observed.
  - 9) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.
  - 10) Record the measured emission amplitude level and frequency using the appropriate RBW.
- m) Repeat step b) for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.
- n) Set-up the substitution measurement with the reference point of the substitution a antenna located as near as possible to where the center of the EUT radiating element was located during the initial EUT measurement.

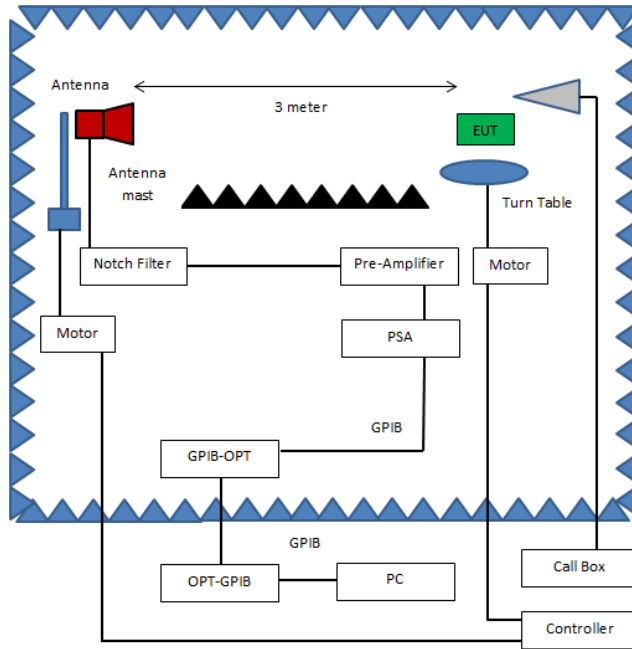


Figure 4. Radiated Spurious Emissions, Block Diagram, Test Setup

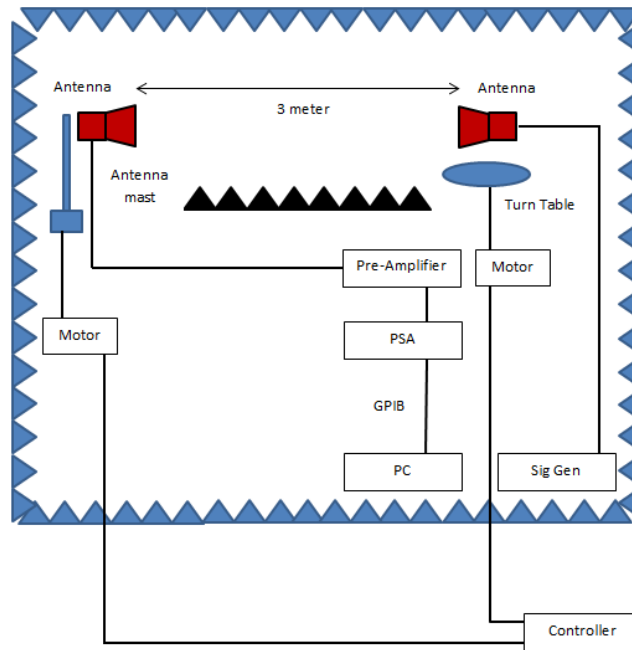


Figure 5. Radiated Spurious Emissions, Block Diagram, Test Setup

- o) Maintain the previous measurement instrument settings and test set-up, with the exception that the EUT is removed and replaced by the substitution antenna.
- p) Connect a signal generator to the substitution antenna; locate the signal generator so as to minimize any potential influences on the measurement results. Set the signal generator to the frequency where emissions are detected, and set an output power level such that the radiated signal can be detected by the measurement instrument, with sufficient dynamic range relative to the noise floor.
- q) For each emission that was detected and measured in the initial test [i.e., in step b) and step c)]:
  - 4) Vary the measurement antenna height between 1 m to 4 m to maximize the received (measured) signal amplitude.
  - 5) Adjust the signal generator output power level until the amplitude detected by the measurement instrument equals the amplitude level of the emission previously measured directly in step b) and step c).
  - 6) Record the output power level of the signal generator when equivalence is achieved in step 2).
- r) Repeat step e) through step g) with the measurement antenna oriented in the opposite polarization.
- s) Calculate the emission power in dBm referenced to a half-wave dipole using the following equation:

$$P_e = P_s(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

where

$P_e$  = equivalent emission power in dBm

$P_s$  = source (signal generator) power in dBm

NOTE—dBd refers to the measured antenna gain in decibels relative to a half-wave dipole.

- t) Correct the antenna gain of the substitution antenna if necessary to reference the emission power to a half-wave dipole. When using measurement antennas with the gain specified in dBi, the equivalent dipole-referenced gain can be determined from:  $\text{gain (dBd)} = \text{gain (dBi)} - 2.15 \text{ dB}$ . If necessary, the antenna gain can be calculated from calibrated antenna factor information

**Test Results:** The EUT was found compliant with the requirements of this section.

Measurements were made in each configuration. Data is presented for the worse case configuration.

**Test Engineer:** Felix Huang, Arsalan Hasan

**Test Date(s):** 07/04/2020



**Radiated Spurious Emissions Test Results,**

GSM 850								
Harmonic	Freq. (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Ant. Pol.	ERP Level (dBm)	Limit (dBm)	Margin
2	1698.0	-64	1.25	29.78	Vertical	-37.62	-13	24.62
3	2546.0	-63	1.56	33.03	Vertical	-33.69	-13	20.69
4	3395.0	-82	1.82	33.14	Vertical	-52.83	-13	39.83
5	4244.0	-68	2.03	33.91	Vertical	-38.27	-13	25.27
6	5093.0	-82	2.34	34.56	Vertical	-51.93	-13	38.93
7	5942.0	-78	2.82	35.63	Vertical	-47.35	-13	34.35
8	6790.0	-80	2.91	35.98	Vertical	-49.08	-13	36.08
9	7639.0	-80	3.20	36.00	Vertical	-49.35	-13	36.35
10	8488.0	-75	3.57	36.11	Vertical	-44.61	-13	31.61

**Table 9. Radiated Spurious Emissions, Test Results, Part 22, GSM 850**

LTE Band 5								
Harmonic	Freq. (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Ant. Pol.	ERP Level (dBm)	Limit (dBm)	Margin
2	1673.0	-80	1.21	29.77	Vertical	-53.59	-13	40.59
3	2509.5	-78	1.53	32.85	Vertical	-48.83	-13	35.83
4	3346.0	-77	1.80	33.16	Vertical	-47.79	-13	34.79
5	4182.5	-76	2.00	33.90	Vertical	-46.25	-13	33.25
6	5019.0	-75	2.33	34.55	Vertical	-44.93	-13	31.93
7	5855.5	-75	2.65	35.36	Vertical	-44.44	-13	31.44
8	6692.0	-78	2.88	35.89	Vertical	-47.14	-13	34.14
9	7528.0	-78	3.22	35.94	Vertical	-47.43	-13	34.43
10	8365.0	-80	3.41	36.14	Vertical	-49.42	-13	36.42

**Table 10. Radiated Spurious Emissions, Test Results, Part 22, LTE Band 5**

GSM 1900								
Harmonic	Freq. (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Ant. Pol.	EIRP Level (dBm)	Limit (dBm)	Margin
2	3700.0	-64	1.89	33.61	Vertical	-32.28	-13	19.28
3	5551.0	-64	2.50	35.04	Vertical	-31.46	-13	18.46
4	7401.0	-63	3.29	35.89	Vertical	-30.39	-13	17.39
5	9251.0	-63	3.74	36.82	Vertical	-29.92	-13	16.92
6	11101.0	-62	3.90	38.54	Vertical	-27.36	-13	14.36
7	12951.0	-62	4.75	39.37	Vertical	-27.38	-13	14.38
8	14802.0	-61	4.52	40.08	Vertical	-25.44	-13	12.44
9	16652.0	-61	5.00	42.30	Vertical	-23.70	-13	10.70
10	18502.0	x	x	x	x	x	x	x

Table 11. Radiated Spurious Emissions, Test Results, Part 24, GSM 1900

LTE Band 2								
Harmonic	Freq. (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Ant. Pol.	EIRP Level (dBm)	Limit (dBm)	Margin
2	3810.0	-86	1.89	33.56	Vertical	-54.34	-13	41.34
3	5715.0	-84	2.70	35.18	Vertical	-51.52	-13	38.52
4	7620.0	-82	3.26	35.98	Vertical	-49.28	-13	36.28
5	9525.0	-81	3.73	37.06	Vertical	-47.67	-13	34.67
6	11430.0	-79	4.10	38.83	Vertical	-44.27	-13	31.27
7	13335.0	-76	4.85	39.28	Vertical	-41.57	-13	28.57
8	15240.0	-75	4.42	40.26	Vertical	-39.16	-13	26.16
9	17145.0	-73	4.87	41.86	Vertical	-36.01	-13	23.01
10	19050.0	x	x	x	x	x	x	x

Table 12. Radiated Spurious Emissions, Test Results, Part 24, LTE Band 2

## IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S4075	RADIO COMMUNICATION TESTER	ROHDE & SCHWARZ	CMW500	09/18/2018	09/18/2020
1S2399	TURNTABLE/MAST CONTROLLER	SUNOL SCIENCES	SC99V	SEE NOTE 1	
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	03/19/2019	03/19/2021
1S3826	DRG HORN ANTENNA	ETS-LINDGREN	3117	12/03/2018	12/03/2020
1S2000	SPECTRUM ANALYZER	AGILENT	E4448A	11/06/2019	11/06/2020
1S2587	PRE AMPLIFIER	AML COMMUNICATIONS	AML0126L3801	SEE NOTE 1	
1S2653	AMPLIFIER	SONOMA INSTRUMENT	310 N	SEE NOTE 1	
1S2486	5 METER CHAMBER	PANASHIELD - ETS	5M	SEE NOTE 2	
1S3824	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMA100B	11/06/2019	05/06/2021

**Table 13. Test Equipment List**

Note 1: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Note 2: Latest NSA and VSWR data available upon request.

# End of Report