



DATE: 8 March 2017

I.T.L. (PRODUCT TESTING) LTD.

FCC/IC Radio Test Report
for
Cardo Systems, Inc.

Equipment under test:
Bluetooth Communication System for
Motorcycles

scala rider FREECOM1

Tested by:


A. Yizhak

Approved by:


D. Shidlowsky

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Measurement/Technical Report for Cardo Systems, Inc.

Bluetooth Communication System for Motorcycles scala rider FREECOM1

FCC ID: Q95ER23

IC: 4668A-ER23

| | |
|-----------------------|---|
| This report concerns: | Original Grant: X |
| | Class I Change: |
| | Class II Change: |
| Equipment type: | Digital Transmission System IC: Spread Spectrum Digital Device (2400-2483.5) |
| Limits used: | 47CFR15 Section 15.247 RSS-247, Issue 1, May 2015 RSS Gen, Issue 4, November 2014 |

Measurement procedure used is KDB 558074 D01 v03r05 and ANSI C63.10:2013.

Application for Certification
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1. General Information

1.1 Administrative Information

| | |
|--------------------------------|---|
| Manufacturer: | Cardo Systems, Inc. |
| Manufacturer's Address: | 1204 Parkway View Drive Pittsburgh, Pennsylvania, 15205 USA Tel: +972-3-735-3111 Fax: +972-3-562-3360 |
| Manufacturer's Representative: | Avi Moato |
| Equipment Under Test (E.U.T): | Bluetooth Communication System for Motorcycles |
| Product Marketing Name (PMN): | scala rider FREECOM1 |
| Equipment Serial No.: | F163791355 |
| HVIN: | 1 |
| Date of Receipt of E.U.T: | November 1, 2016 |
| Start of Test: | November 2, 2016 |
| End of Test: | November 21, 2016 |
| Test Laboratory Location: | I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101 |
| Test Specifications: | FCC Part 15, Subpart C RSS-247, Issue 1, May 2015 RSS Gen Issue 4, November 2014 |



1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site Nos. IC 4025A-1, IC 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 **Product Description**

This product is a class 1 Bluetooth headset, Bluetooth intercom for motorbikes.

- Audio streaming via devices supporting Bluetooth Stereo A2DP and AVRCP
- profiles, Music Sharing: Rider and Passenger can enjoy the same stereo music (via A2DP)
- Built-in FM Radio with 6 station presets and automatic tuning

| | |
|---------------------------|---------------------------------|
| Model Name | FREECOM1 |
| Working voltage | Li Polymer battery 600mA 4.2V |
| Mode of operation | Transmitter |
| Modulation | Bluetooth Ver. 3.0, EDR class 1 |
| Assigned Frequency Range | 2400-2483.5MHz |
| Operating Frequency Range | 2402-2480MHz |
| Transmit power | ~8dBm |
| Antenna Gain | -2dBi |

1.4 **Test Methodology**

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v03r05 and ANSI C63.10: 2013. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 **Test Facility**

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

1.6 **Measurement Uncertainty**

Conducted Emission

(CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.44 dB

Radiated Emission

(CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.98 dB

2. System Test Configuration

2.1 Justification

Exploratory emission testing was performed in 3 orthogonal polarities to determine the worst case.

According to below fundamental results the worst case was the Y axis.

| Frequency | X | | | | Y | | | | Z | | | |
|-----------|----------------|-------------------|-------------------|-----------|----------------|-------------------|-------------------|-----------|----------------|-------------------|-------------------|-----------|
| | Field Strength | 2 nd H | 3 th H | Band Edge | Field Strength | 2 nd H | 3 th H | Band Edge | Field Strength | 2 nd H | 3 th H | Band Edge |
| | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) | (dBuV/m) |
| 2402.0 | 64.5 | 40.9 | 41.9 | 33.7 | 63.8 | 42.5 | 47.4 | 34.1 | 62.9 | 41.1 | 42.3 | 35.6 |
| 2440.0 | 64.6 | 37.2 | 44.2 | - | 67.1 | 38.1 | 46.0 | - | 64.8 | 42.4 | 45.0 | - |
| 2480.0 | 65.4 | 38.2 | 39.7 | 33.6 | 67.4 | 39.0 | 44.5 | 35.0 | 64.7 | 38.9 | 46.1 | 35.0 |

Figure 1. Screening Results

The unit was evaluated while transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz) in BLE technology.

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

No special accessories were needed to achieve compliance.

2.4 Equipment Modifications

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System

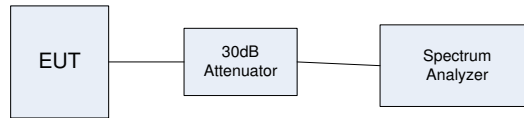


Figure 2. Configuration of Tested System – Conducted Emission on Antenna Ports

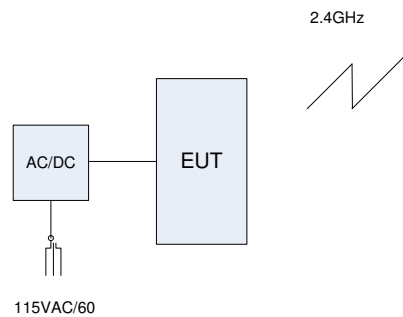


Figure 3. Configuration of Tested System Conducted Emission on AC Line

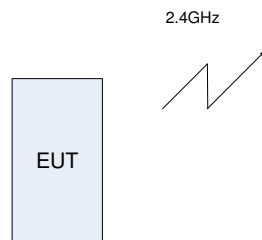


Figure 4. Configuration of Tested System Radiated

3. Conducted & Radiated Measurement Test Set-Up Photos

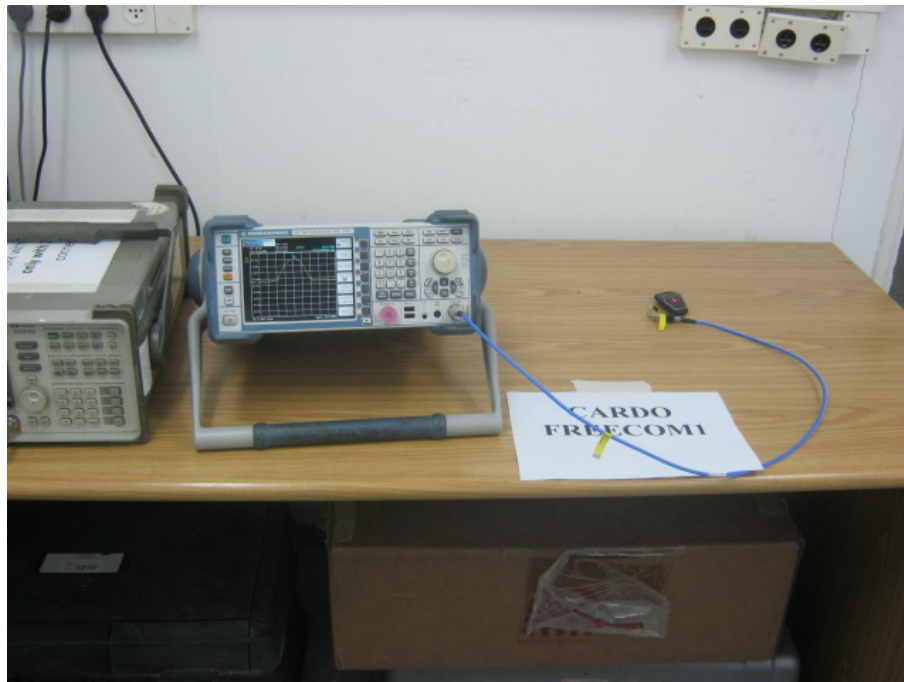


Figure 5. Conducted Emission from Antenna Ports Test Set-Up



Figure 6. Conducted Emission From AC Mains



Figure 7. Radiated Emission Test

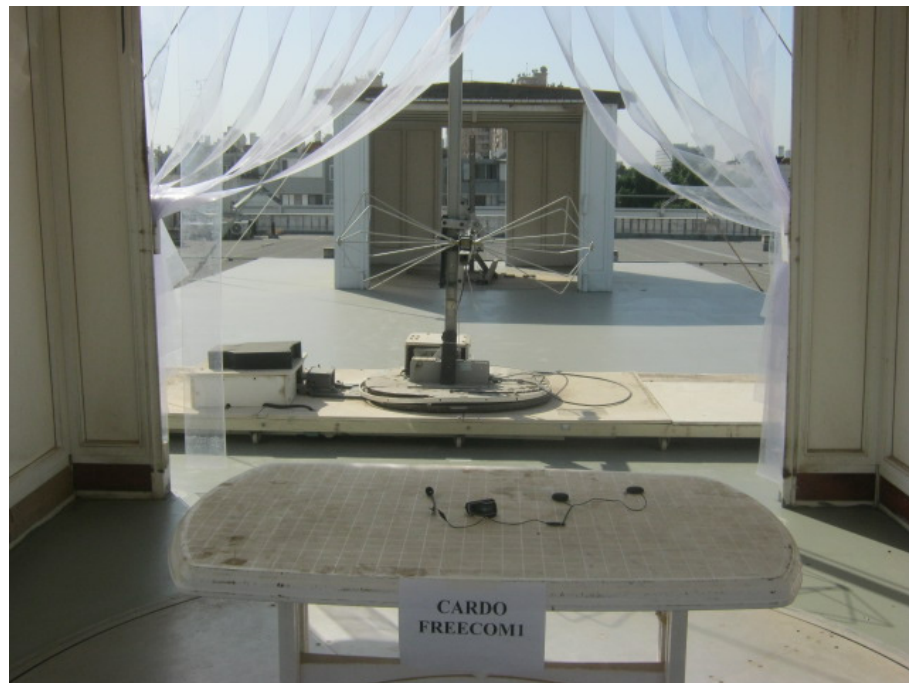


Figure 8. Radiated Emission Test

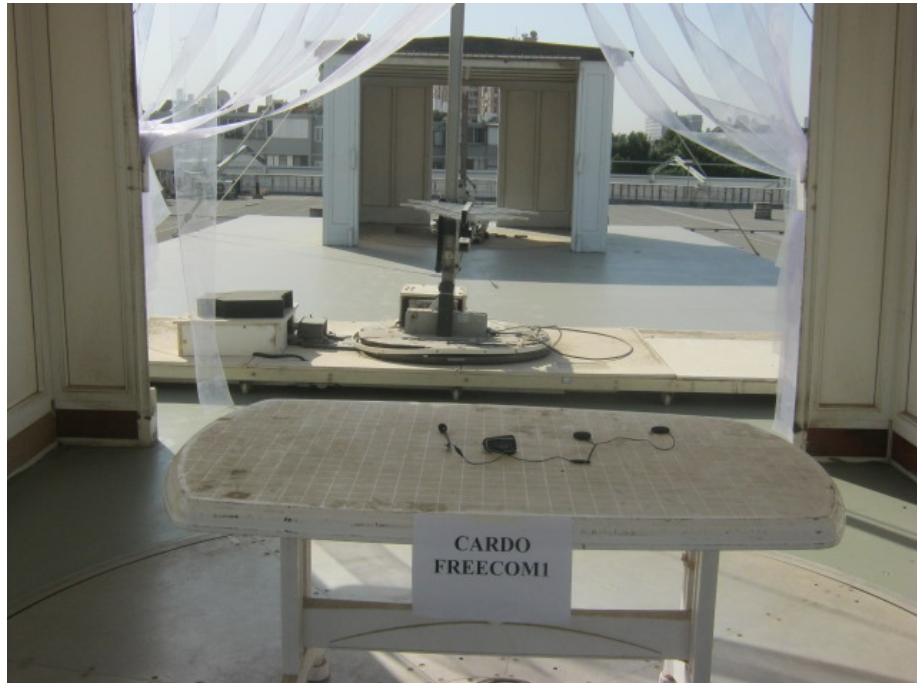


Figure 9. Radiated Emission Test

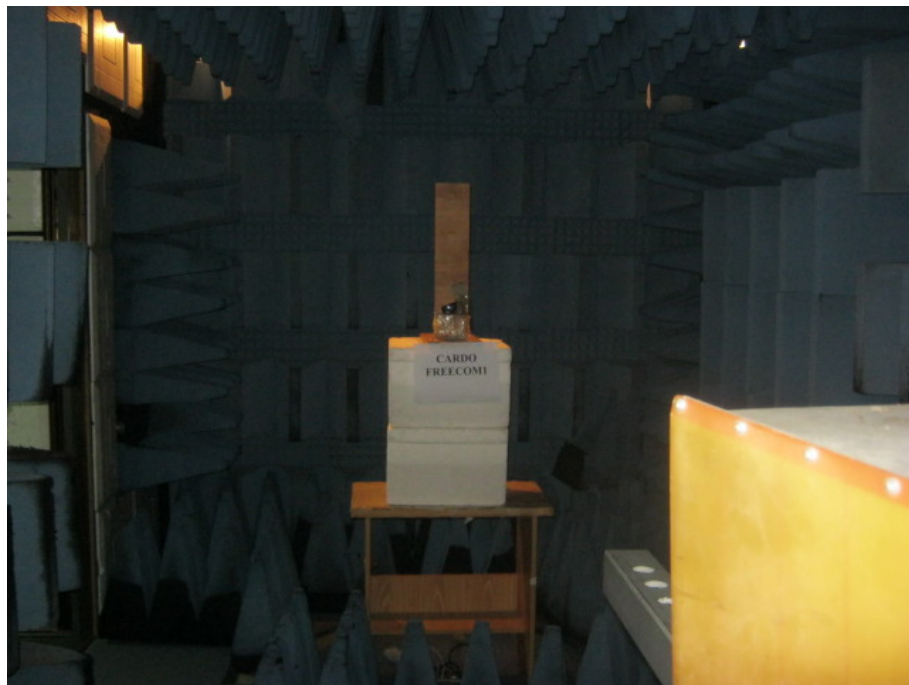


Figure 10. Radiated Emission Test

4. Conducted Emission From AC Mains

4.1 Test Specification

FCC Part 15, Subpart C, Section 15.207
RSS Gen, Issue 4, Clause 8.8

4.2 Test Procedure

(Temperature (24°C)/ Humidity (40%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on a 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 μ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in the photograph, *Figure 6. Conducted Emission From AC Mains*.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was evaluated in TX operation mode

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

4.3 Test Limit

| Frequency of emission (MHz) | Conducted limit (dB μ V) | |
|-----------------------------|------------------------------|-----------|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.



4.4 Test Results

JUDGEMENT: Passed by 32.72dB

The margin between the emission levels and the specification limit is, in the worst case, 32.72 dB for the phase line at 0.330 MHz and 36.24 dB at 1.546 MHz for the neutral line.

The EUT met the F.C.C. Part 15, Subpart C specification requirements.

The details of the highest emissions are given in *Figure 11* to *Figure 14*.

Conducted Emission

E.U.T Description Bluetooth Communication
System for Motorcycles
Type scala rider FREECOM1
Serial Number: F163791355

Specification: FCC Part 15, Subpart C
Lead: Phase
Detectors: : Peak, Quasi-peak, Average
Power Operation AC/DC adapter

| EDIT PEAK LIST (Final Measurement Results) | | | |
|--|------------|------------|----------------|
| Trace1: | CE22BQP | | |
| Trace2: | CE22BAP | | |
| Trace3: | --- | | |
| TRACE | FREQUENCY | LEVEL dBμV | DELTA LIMIT dB |
| 2 Average | 194 kHz | 11.09 | -42.76 |
| 1 Quasi Peak | 234 kHz | 21.47 | -40.83 |
| 1 Quasi Peak | 330 kHz | 26.72 | -32.72 |
| 2 Average | 414 kHz | 8.26 | -39.30 |
| 1 Quasi Peak | 434 kHz | 20.68 | -36.48 |
| 2 Average | 734 kHz | 7.91 | -38.08 |
| 1 Quasi Peak | 738 kHz | 14.88 | -41.11 |
| 2 Average | 890 kHz | 9.53 | -36.46 |
| 2 Average | 1.546 MHz | 9.36 | -36.64 |
| 1 Quasi Peak | 1.63 MHz | 12.76 | -43.23 |
| 1 Quasi Peak | 2.49 MHz | 12.16 | -43.83 |
| 2 Average | 3.062 MHz | 7.18 | -38.81 |
| 1 Quasi Peak | 4.102 MHz | 11.69 | -44.30 |
| 2 Average | 4.446 MHz | 6.81 | -39.18 |
| 2 Average | 8.89 MHz | 8.76 | -41.23 |
| 1 Quasi Peak | 10.038 MHz | 11.37 | -48.62 |
| 2 Average | 16.002 MHz | 6.69 | -43.30 |
| 1 Quasi Peak | 17.238 MHz | 12.51 | -47.49 |
| 2 Average | 22.222 MHz | 11.31 | -38.68 |
| 1 Quasi Peak | 29.194 MHz | 19.50 | -40.49 |

Date: 21.NOV.2016 16:14:11

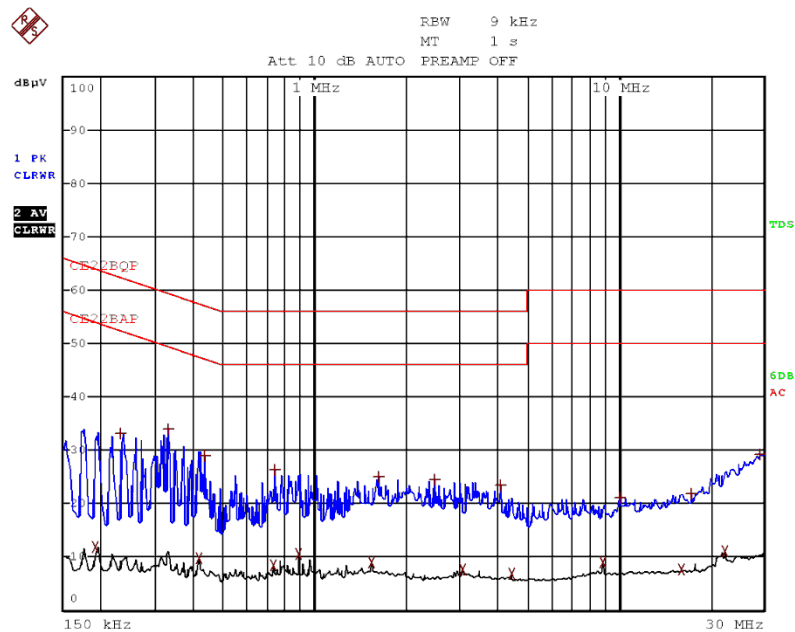
Figure 11. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description Bluetooth Communication
System for Motorcycles
Type scala rider FREECOM1
Serial Number: F163791355

Specification: FCC Part 15, Subpart C
Lead: Phase
Detectors: Peak, Quasi-peak, Average
Power Operation AC/DC adapter



Date: 21.NOV.2016 16:12:33

Figure 12. Detectors: Peak, Quasi-peak, Average

Conducted Emission

E.U.T Description Bluetooth Communication
System for Motorcycles
Type scala rider FREECOM1
Serial Number: F163791355

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation AC/DC adapter

| EDIT PEAK LIST (Final Measurement Results) | | | | |
|--|------------|------------|--------|----------|
| Trace1: | CE22BQF | | | |
| Trace2: | CE22BAP | | | |
| Trace3: | --- | | | |
| TRACE | FREQUENCY | LEVEL dBμV | DELTA | LIMIT dB |
| 1 Quasi Peak | 242 kHz | 19.89 | -42.13 | |
| 2 Average | 246 kHz | 8.78 | -43.10 | |
| 1 Quasi Peak | 378 kHz | 21.20 | -37.12 | |
| 2 Average | 386 kHz | 8.58 | -39.56 | |
| 1 Quasi Peak | 550 kHz | 19.61 | -36.38 | |
| 2 Average | 550 kHz | 7.93 | -38.06 | |
| 2 Average | 966 kHz | 8.93 | -37.06 | |
| 1 Quasi Peak | 1.214 MHz | 17.42 | -38.57 | |
| 2 Average | 1.546 MHz | 9.75 | -36.24 | |
| 1 Quasi Peak | 1.99 MHz | 16.17 | -39.82 | |
| 2 Average | 3.094 MHz | 7.31 | -38.68 | |
| 1 Quasi Peak | 3.506 MHz | 18.65 | -37.34 | |
| 1 Quasi Peak | 3.642 MHz | 18.52 | -37.47 | |
| 2 Average | 3.77 MHz | 6.33 | -39.66 | |
| 2 Average | 8.89 MHz | 8.56 | -41.43 | |
| 1 Quasi Peak | 10.046 MHz | 14.01 | -45.98 | |
| 2 Average | 14.338 MHz | 6.66 | -43.33 | |
| 1 Quasi Peak | 17.142 MHz | 16.14 | -43.85 | |
| 2 Average | 22.222 MHz | 11.96 | -38.03 | |
| 1 Quasi Peak | 28.142 MHz | 18.67 | -41.32 | |

Date: 21.NOV.2016 19:56:13

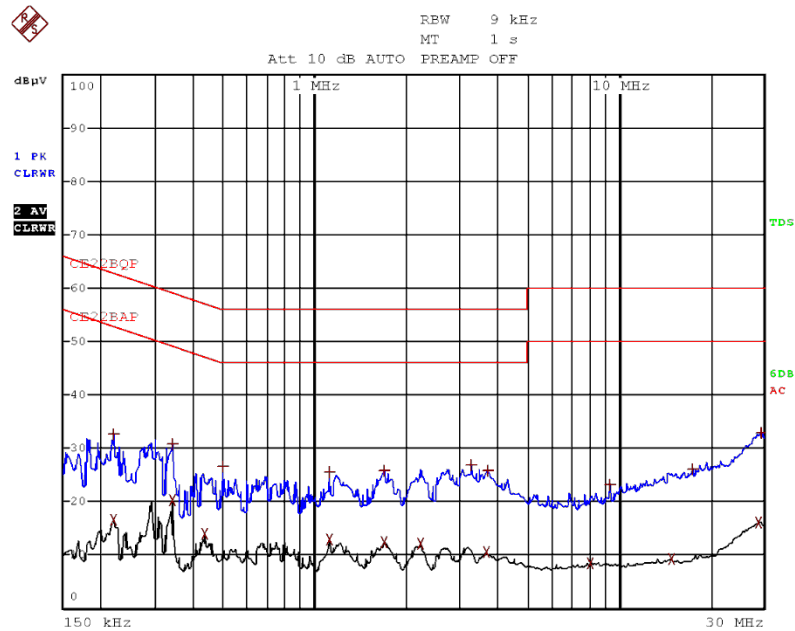
Figure 13. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description Bluetooth Communication
System for Motorcycles
Type scala rider FREECOM1
Serial Number: F163791355

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation AC/DC adapter



Date: 21.NOV.2016 16:04:13

Figure 14 Detectors: Peak, Quasi-peak, Average



4.5 *Test Equipment Used; Conducted Emission*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-------------------|---------------------|--------------|-------------------|------------------------------|-----------------------------|
| LISN | Fischer | FCC-LISN-25A | 127 | June 23, 2016 | June 23, 2017 |
| Transient Limiter | HP | 11947A | 3107A03041 | June 15, 2016 | June 15, 2017 |
| EMI Receiver | Rohde & Schwarz | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Low Loss Cable | Huber Suner | - | 705A009301 EIM | May 30, 2016 | May 30, 2017 |

Figure 15 Test Equipment Used

5. 6 dB Minimum Bandwidth

5.1 Test Specification

FCC Part 15, Subpart C, Section 247(a)(2)
RSS 247, Issue 1, 2015, Section 5.2

5.2 Test Procedure

(Temperature (23°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=20.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

5.3 Test Results

| Operation Frequency (MHz) | Reading (MHz) | Specification (MHz) |
|---------------------------|---------------|---------------------|
| 2402 | 0.712 | >0.5 |
| 2440 | 0.700 | >0.5 |
| 2480 | 0.719 | >0.5 |

Figure 16 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 17* to *Figure 19*.

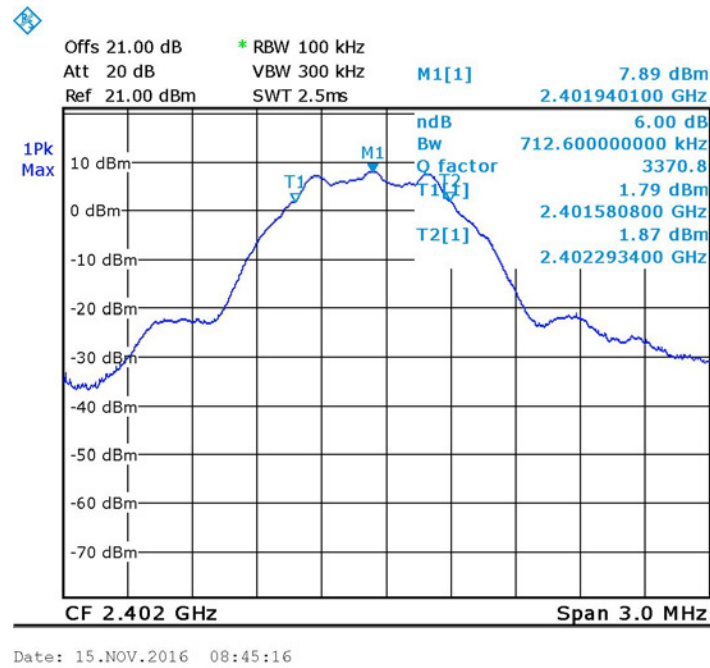


Figure 17. 2402.0 MHz

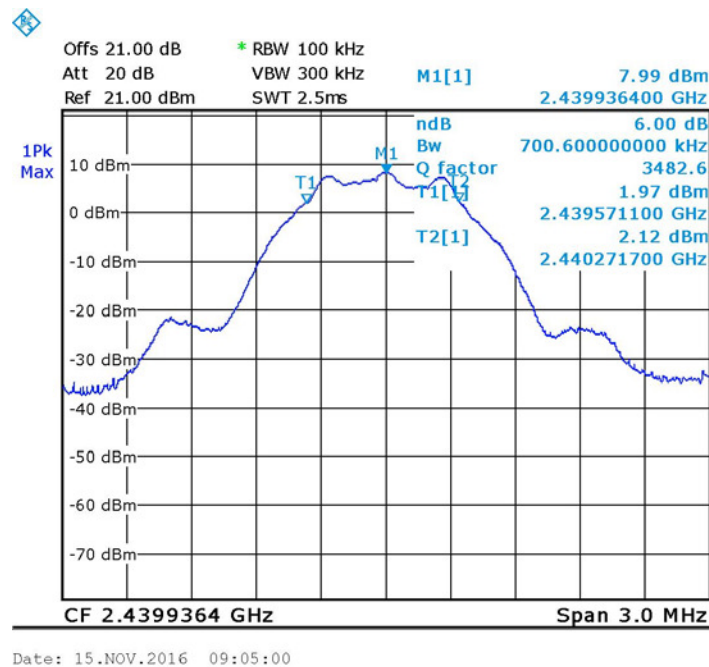


Figure 18. 2440.0 MHz

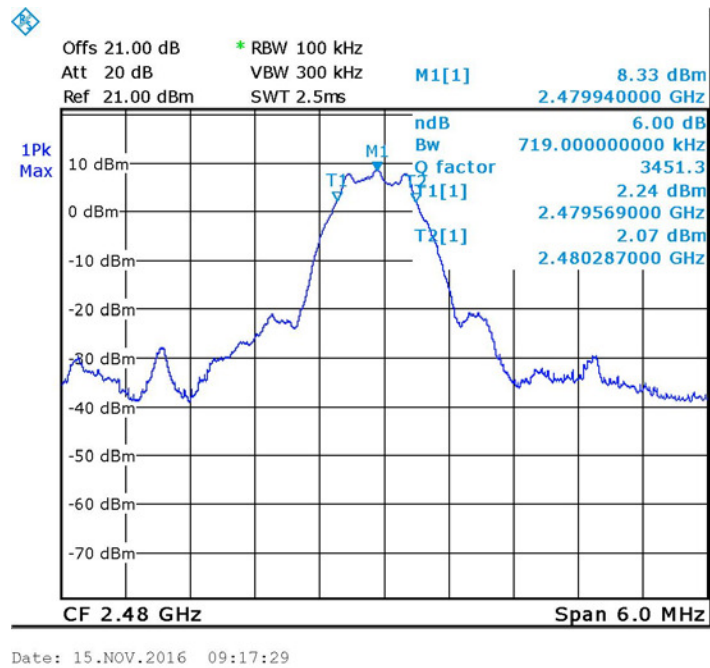


Figure 19. 2480.0 MHz

5.4 Test Equipment Used; 6dB Bandwidth

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-------------------|--------------|-----------|------------|-----------------------|----------------------|
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| 20 dB Attenuator | MCL | VAT-20W2+ | 848 | July 5, 2016 | July 5, 2017 |

Figure 20 Test Equipment Used

6. 99% Occupied Bandwidth

6.1 Test Specification

RSS Gen, Issue 4, Section 6.6

6.2 Test Procedure

(Temperature (23°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=31.0 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW was set to 100 kHz.

6.3 Test Results

| Operation Frequency (MHz) | Reading (MHz) |
|---------------------------|---------------|
| 2402 | 1.07 |
| 2440 | 1.11 |
| 2480 | 1.07 |

Figure 21 Occupied Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 22* to *Figure 24*.

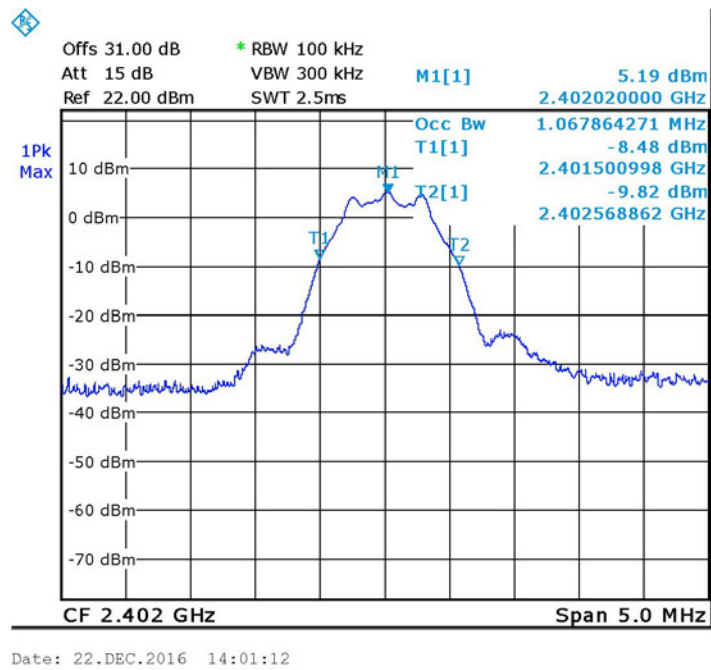


Figure 22. 2402.0 MHz – Occupied Bandwidth

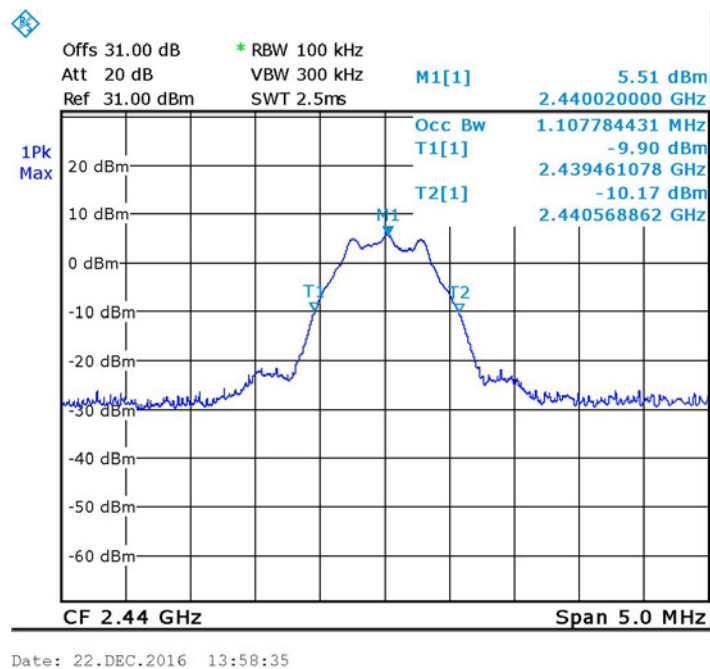


Figure 23. 2440.0 MHz - Occupied Bandwidth

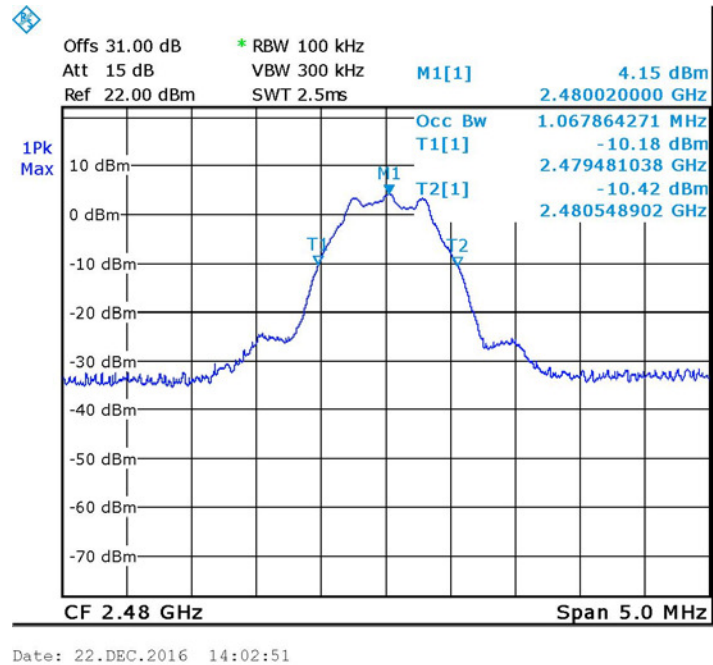


Figure 24. 2480.0 MHz – Occupied Bandwidth

6.4 Test Equipment Used; Occupied Bandwidth

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-------------------|--------------|------------|------------|-----------------------|----------------------|
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| 30dB Attenuator | Bird | 8304-N30DB | 533 | June 1, 2016 | June 1, 2017 |

Figure 25 Test Equipment Used

7. Maximum Transmitted Peak Power Output

7.1 Test Specification

FCC, Part 15, Subpart C, Section 247(b)(3)
RSS-247, Issue 1, May 2015, Section 5.4.4

7.2 Test Procedure

(Temperature (23°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=20.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The E.U.T was evaluated in 3 channels: Low (2402.0 MHz), Mid (2440.0 MHz) and High (2480 MHz).

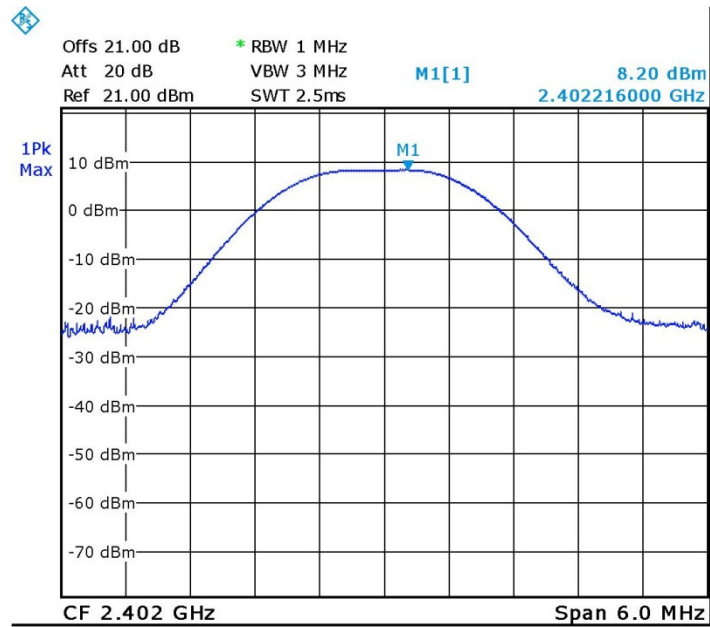
7.3 Test Results

| Operation Frequency (MHz) | Power (dBm) | Power (mW) | Limit (mW) | Margin (mW) |
|---------------------------|-------------|------------|------------|-------------|
| 2402.0 | 8.20 | 6.61 | 1000.0 | -993.39 |
| 2440.0 | 8.11 | 6.47 | 1000.0 | -993.53 |
| 2480.0 | 8.63 | 7.30 | 1000.0 | -992.70 |

Figure 26 Maximum Peak Power Output

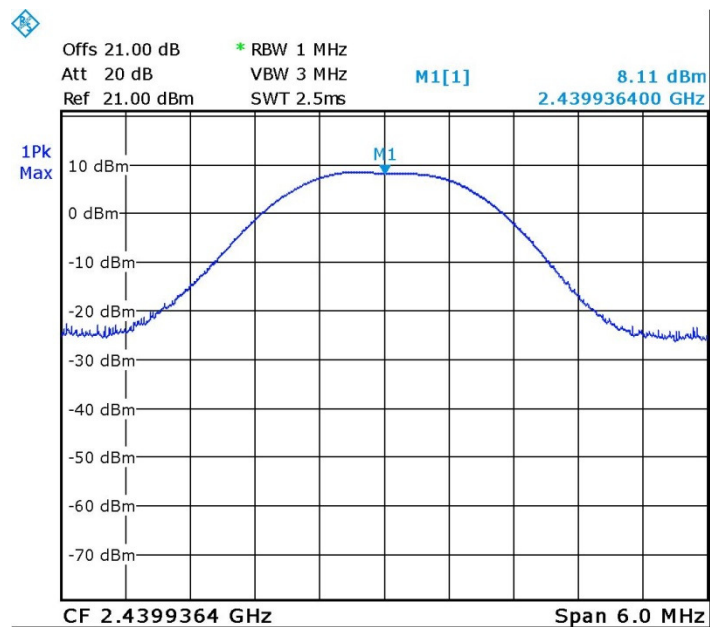
JUDGEMENT: Passed by 992.7 mW

For additional information see *Figure 27* to *Figure 29*.



Date: 15.NOV.2016 08:47:40

Figure 27 2402.0 MHz



Date: 15.NOV.2016 09:06:23

Figure 28 2440.0 MHz

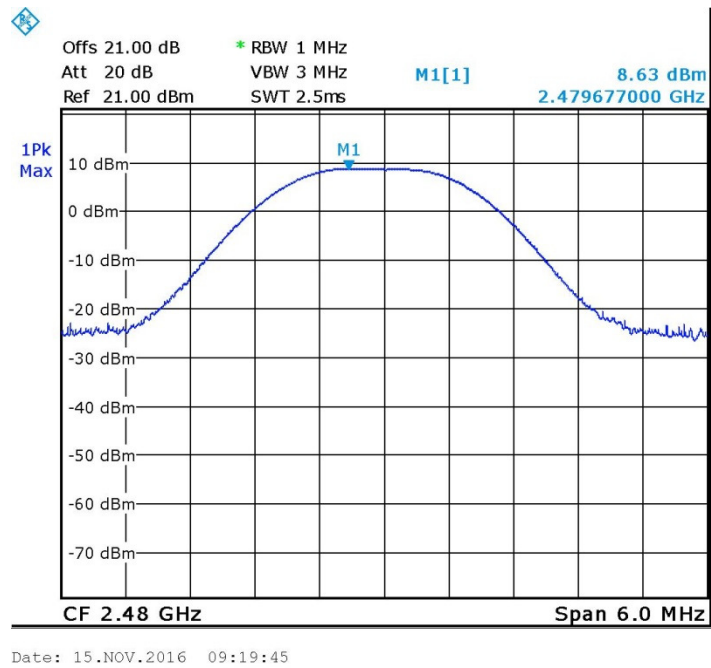


Figure 29 2480.0 MHz

7.4 Test Equipment Used; Maximum Peak Power Output

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-------------------|--------------|-----------|------------|-----------------------|----------------------|
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| 20 dB Attenuator | MCL | VAT-20W2+ | 848 | July 5, 2016 | July 5, 2017 |

Figure 30 Test Equipment Used

8. Band Edge Spectrum

8.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)
RSS-247, Issue 1, May 2015, Section 5.5

8.2 Test Procedure

(Temperature (23°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=20.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The E.U.T was evaluated in 2 channels: Low and High.

The RBW was set to 100 kHz.

8.3 Test Results

| Operation Frequency (MHz) | Modulation | Band Edge Frequency (MHz) | Spectrum Level (dBm) | Limit (dBm) | Margin (dB) |
|---------------------------|------------|---------------------------|----------------------|-------------|-------------|
| Low | BLE | 2399.94 | -32.63 | -12.10 | -20.53 |
| High | BLE | 2483.5 | -39.76 | -11.65 | -28.11 |

Figure 31 Band Edge Spectrum

JUDGEMENT: Passed by 20.53 dB

For additional information see *Figure 32* and *Figure 33*.

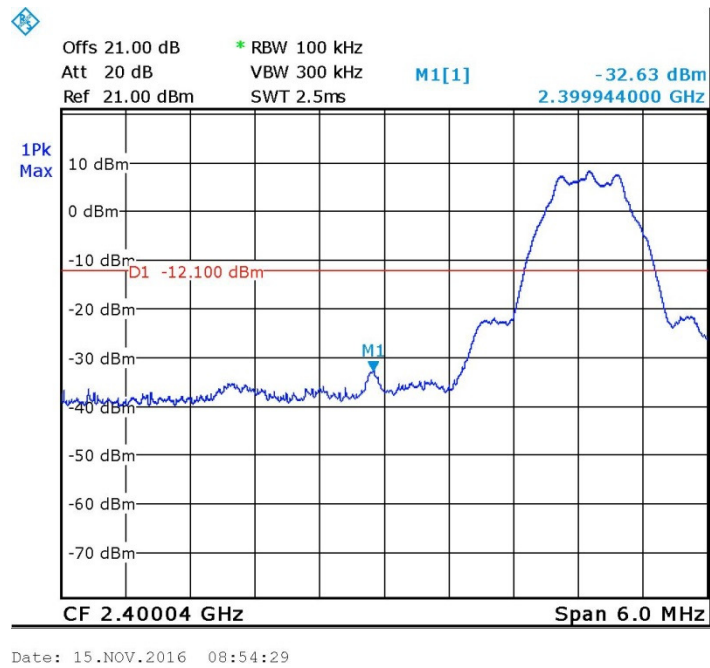


Figure 32 —Lower Band Edge

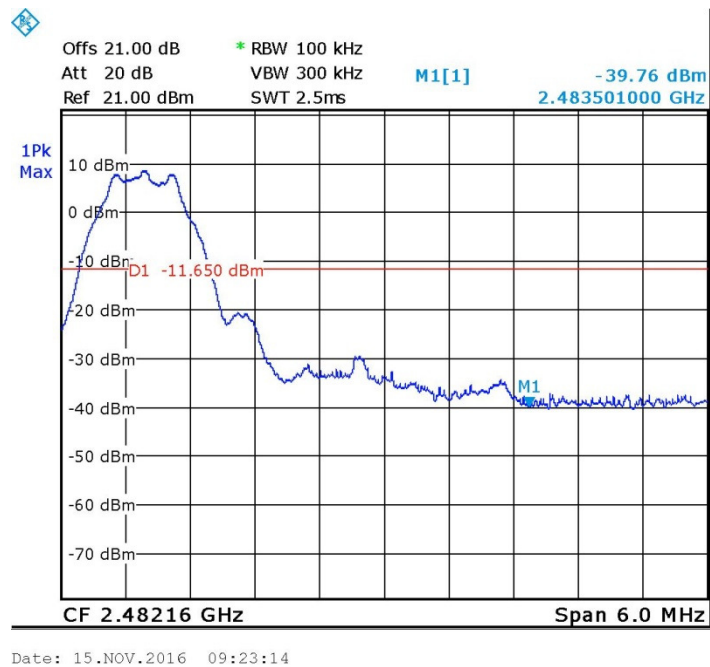


Figure 33 —Upper Band Edge



8.4 *Test Equipment Used; Band Edge Spectrum*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-------------------|---------------------|--------------|-------------------|------------------------------|-----------------------------|
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| 20 dB Attenuator | MCL | VAT-20W2+ | 848 | July 5, 2016 | July 5, 2017 |

Figure 34 Test Equipment Used

9. Emissions in Non-Restricted Frequency Bands

9.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

RSS 247, Issue 1, Section 5.5

9.2 Test Procedure

(Temperature (24°C)/ Humidity (40%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

The frequency range 0.009-25,000.0 MHz was scanned to find other emissions that don't fall in the restricted band

RBW was set to 100 kHz, detector set to max peak and trace to "max hold".

The E.U.T. was operated at the following frequencies: Low (2402 MHz), Mid (2440 MHz) and High (2480 MHz).

These frequencies were measured using a peak detector.

9.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

9.4 Test Results

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247 (d) specification.

For additional information see *Figure 35* to *Figure 37*.

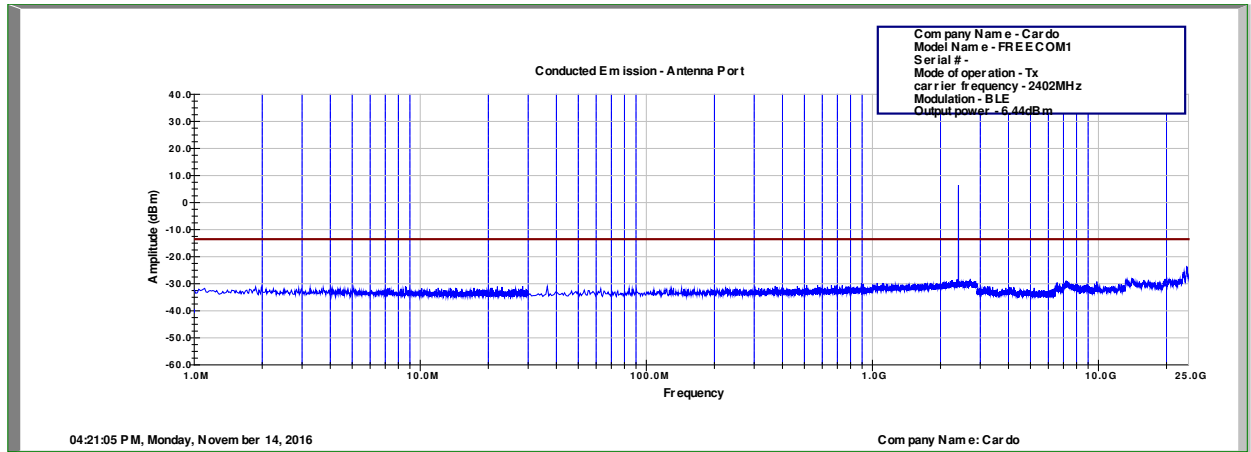


Figure 35 Conducted Spurious Emission – 2402 MHz

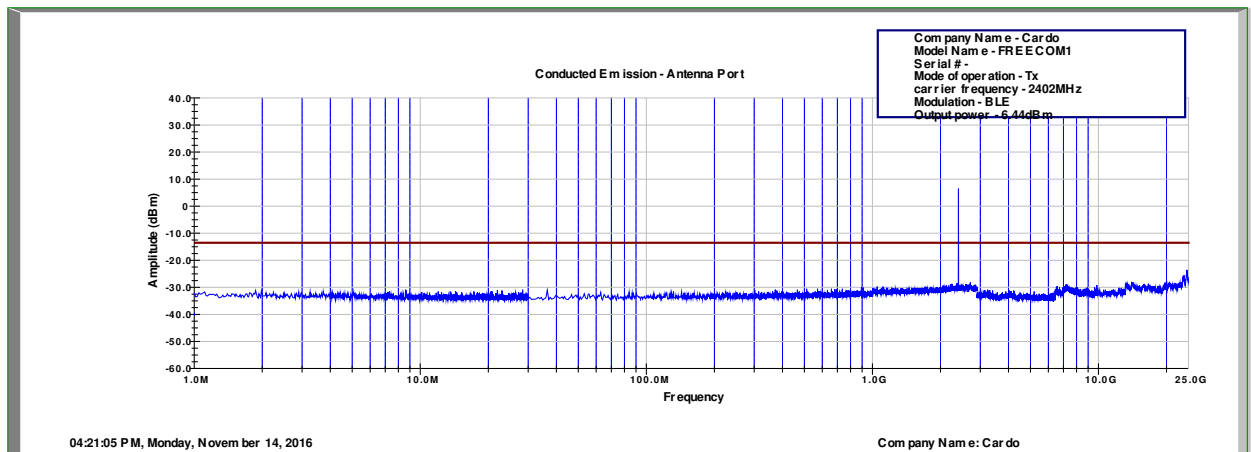


Figure 36 Conducted Spurious Emission - 2440 MHz

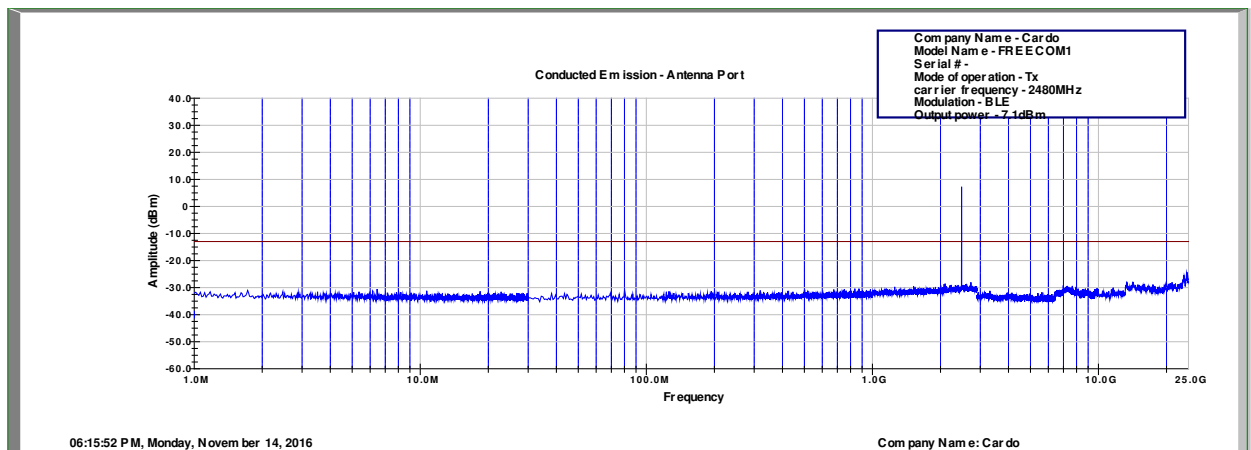


Figure 37 Conducted Spurious Emission – 2480 MHz



9.5 *Test Equipment Used, Emissions in Non-Restricted Frequency Bands*

| Instrument | Manufacturer | Model | Serial Number | Last Calibration Date | Next Calibration Due |
|-------------------|-----------------|-----------|---------------|-----------------------|----------------------|
| Spectrum Analyzer | Rodhe & Schwarz | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| 20 dB Attenuator | MCL | VAT-20W2+ | 848 | July 5, 2016 | July 5, 2017 |

Figure 38 Test Equipment Used

10. Emissions in Restricted Frequency Bands

10.1 Test Specification

FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)
RSS GEN, Issue 4: 2014, Clause 8.9; 8.10

10.2 Test Procedure

(Temperature (23°C)/ Humidity (60%RH))

For measurements between 0.009MHz-30.0MHz:

The E.U.T was tested inside the chamber at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

For 1000.0MHz-25,000.0MHz range:

The E.U.T was placed in the chamber and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure 4*.

The frequency range 1000 MHz-25000 MHz was scanned.

The readings were maximized by adjusting the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

The E.U.T. was operated at the low, mid and high channels.
(2402, 2440, 2480 MHz).

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) | Field strength* (dB μ V/m) | Field strength* (dB μ V/m)@3m |
|-----------------|-----------------------------------|-------------------------------|--------------------------------|-----------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 | 48.5-13.8 | 128.5-73.8 |
| 0.490-1.705 | 24000/F(kHz) | 30 | 33.8-23.0 | 73.8-63.0 |
| 1.705-30.0 | 30 | 30 | 29.5 | 69.5 |
| 30-88 | 100 | 3 | 40.0 | 40.0 |
| 88-216 | 150 | 3 | 43.5 | 43.5 |
| 216-960 | 200 | 3 | 46.0 | 46.0 |
| Above 960 | 500 | 3 | 54.0 | 54.0 |

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 39 Table of Limits

10.3 Test Results

JUDGEMENT: Passed by 23.4 dB

For the operation frequency of 2402 MHz, the margin between the emission level and the specification limit is in the worst case 31.0 dB at the frequency of 4804.0MHz, vertical polarization.

For the operation frequency of 2440 MHz, the margin between the emission level and the specification limit is in the worst case 30.9 dB at the frequency of 4880.0 MHz, horizontal polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is in the worst case 23.4 dB at the frequency of 2483.5 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C specification.

The details of the highest emissions are given in *Figure 40*.



Radiated Emission

E.U.T Description Bluetooth Communication
System for Motorcycles
Type scala rider FREECOM1
Serial Number: F163791355

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 9KHz to 25.0 GHz
Test Distance: 3 meters Detector: Peak

| Operation Frequency | Freq. | Polarity | Peak Reading | Average Limit | Peak Margin |
|------------------------|--------|----------|-----------------|------------------|----------------|
| (MHz) | (MHz) | (H/V) | (dB μ V/m) | (dB μ V/m) | (dB) |
| 2402.0 | 2390.0 | H | 33.7 | 54.0 | -20.3 |
| 2402.0 | 2390.0 | V | 36.2 | 54.0 | -17.8 |
| 2402.0 | 4804.0 | H | 41.5 | 54.0 | -12.5 |
| 2402.0 | 4804.0 | V | 43.0 | 54.0 | -11.0 |
| 2440.0 | 4880.0 | H | 41.6 | 54.0 | -12.4 |
| 2440.0 | 4880.0 | V | 43.1 | 54.0 | -10.9 |
| 2480.0 | 4960.0 | H | 44.0 | 54.0 | -10.0 |
| 2480.0 | 4960.0 | V | 42.2 | 54.0 | -11.8 |
| 2480.0 | 7440.0 | H | 50.0 | 54.0 | -4.0 |
| 2480.0 | 7440.0 | V | 50.6 | 54.0 | -3.4 |
| 2480.0 | 2483.5 | H | 33.3 | 54.0 | -20.7 |
| 2480.0 | 2483.5 | V | 33.7 | 54.0 | -20.3 |

**Figure 40. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

10.4 Test Instrumentation Used; Emissions in Restricted Frequency Bands

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-----------------------------|-----------------|--------------|-------------------|-----------------------|----------------------|
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | March 13, 2016 | March 13, 2017 |
| EMI Receiver | HP | 8542E | 3906A00276 | March 3, 2016 | March 3, 2017 |
| RF Filter Section | HP | 85420E | 3705A00248 | March 3, 2016 | March 3, 2017 |
| Spectrum Analyzer | HP | 8564E | 3442A00275 | March 10, 2016 | March 10, 2017 |
| Biconical Antenna | EMCO | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 |
| Log Periodic Antenna | EMCO | 3146 | 9505-4081 | April 23, 2016 | April 23, 2017 |
| Horn Antenna | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Horn Antenna | ARA | SWH-28 | 1007 | March 3, 2014 | September 30, 2016 |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | November 4, 2015 | November 30, 2016 |
| Low Noise Amplifier | Narda | DBS-0411N313 | 13 | August 8, 2016 | August 8, 2017 |
| Low Noise Amplifier | Sophia Wireless | LNA28-B | 232 | August 8, 2016 | August 8, 2017 |
| Spectrum Analyzer | HP | 8593EM | 3536A00120 ADI | March 10, 2016 | March 10, 2017 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |
| Antenna Mast | ETS | 2070-2 | 9608-1497 | N/A | N/A |
| Turntable | ETS | 2087 | - | N/A | N/A |
| Mast & Table Controller | ETS/EMCO | 2090 | 9608-1456 | N/A | N/A |

Figure 41 Test Equipment Used

11. Transmitted Power Density

11.1 Test Specification

FCC, Part 15, Subpart C, Section 247(e)
RSS-247, Issue 1:2015, Clause 5.2(2)

11.2 Test Procedure

(Temperature (23°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=20.5 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The spectrum analyzer was set to 3 kHz RBW and VBW to 10 kHz.

The E.U.T was evaluated in 3 channels: Low (2402.0MHz), Mid (2440.0MHz) and High (2480.0MHz).

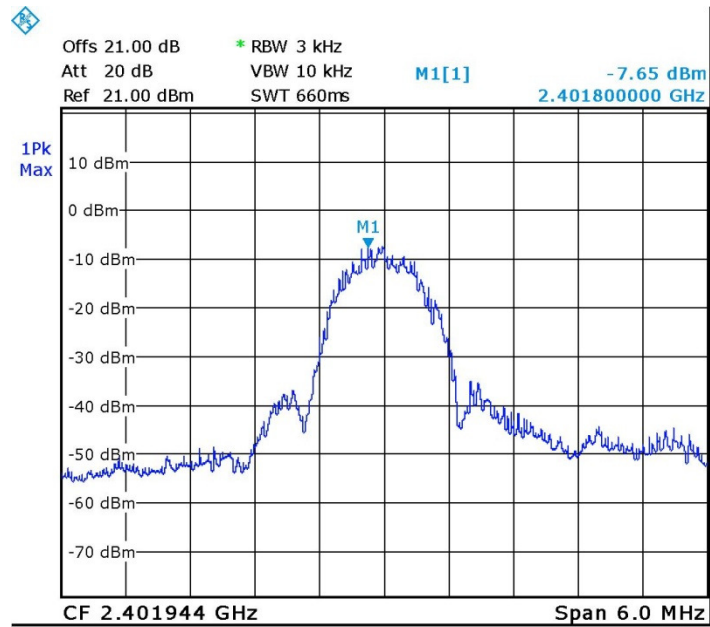
11.3 Test Results

| Operation Frequency (MHz) | Reading Spectrum Analyzer (dBm) | Limit (dBm) | Margin (dB) |
|------------------------------|------------------------------------|----------------|----------------|
| 2402.0 | -7.65 | 8.0 | -15.65 |
| 2440.0 | -7.56 | 8.0 | -15.56 |
| 2480.0 | -7.18 | 8.0 | -15.18 |

Figure 42 Test Results

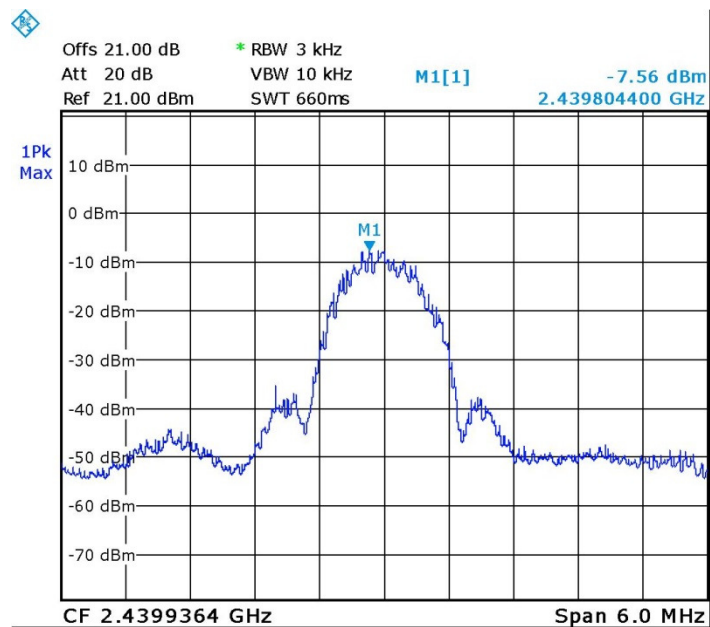
JUDGEMENT: Passed by 15.18 dB

For additional information see *Figure 43* to *Figure 45*.



Date: 15.NOV.2016 08:58:54

Figure 43 — 2402.0 MHz



Date: 15.NOV.2016 09:11:34

Figure 44 — 2440.0 MHz

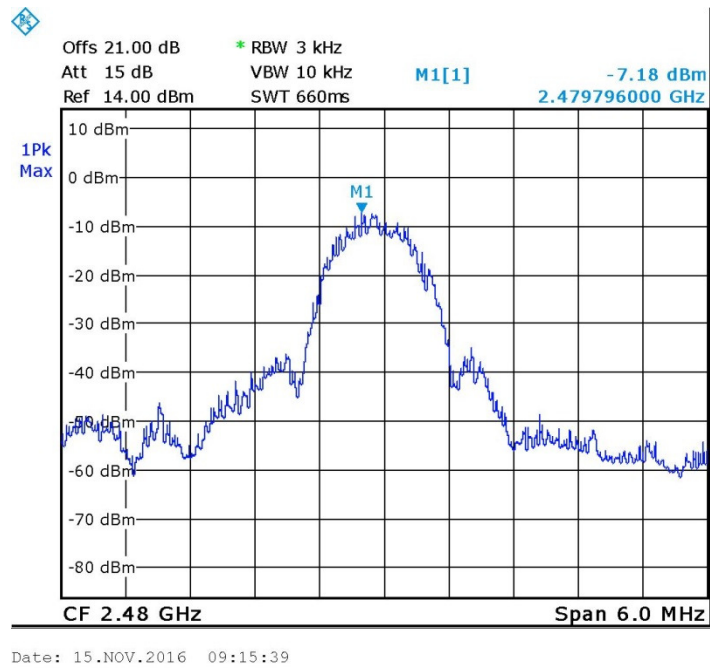


Figure 45 — 2480.0 MHz

11.4 Test Equipment Used; Transmitted Power Density

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Next Calibration Due |
|-------------------|--------------|-----------|------------|-----------------------|----------------------|
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| 20 dB Attenuator | MCL | VAT-20W2+ | 848 | July 5, 2016 | July 5, 2017 |

Figure 46 Test Equipment Used



12. AVG. Factor Calculation

1. Pulse period = 1msec (worst scenario)
2. Pulse duration = 1msec (worst scenario)
3. Burst duration = 0.3971msec
4. Time between bursts = 0.24msec
5. Average Factor = $20 \log \left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within 100msec} \right]$

$$\text{Average Factor} = 20 \log \left[1 * \frac{0.397}{100} * 150 \right] = -4.5dB$$

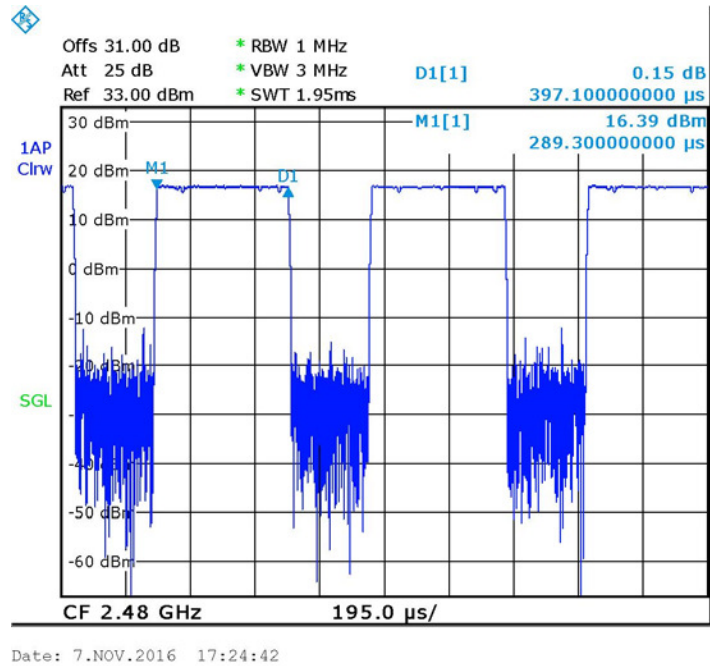


Figure 47. Burst Duration

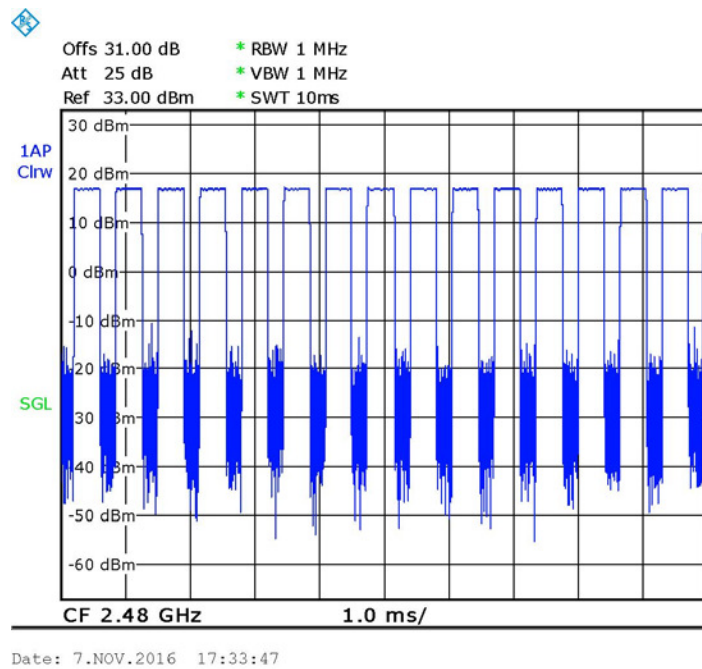


Figure 48. Number of bursts in 10msec=15



13. Antenna Gain/Information

The antenna gain is -2.0 dBi, integral.



14. R.F Exposure/Safety

The typical placement of the E.U.T. is on a motorcycle helmet. The minimal distance between the E.U.T. and the user is 1.5cm. See photo on following page.

SAR Testing Exclusion Based on Section 4.3.1 and Appendix A of KDB447498 D01 V05 and RSS 102, Issue 5, Section 2.5.2 Requirements

For FCC

Section 4.3.1 and Appendix A of KDB447498 D01 V05 was used as the guidance as follows:

Peak power output (standard) = 8.63dBm=7.30mW.

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * \sqrt{f(\text{GHz})}$$

= $7.30/15 * 1.55 = 0.754$ this value is less than 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR.

The SAR measurement is not necessary

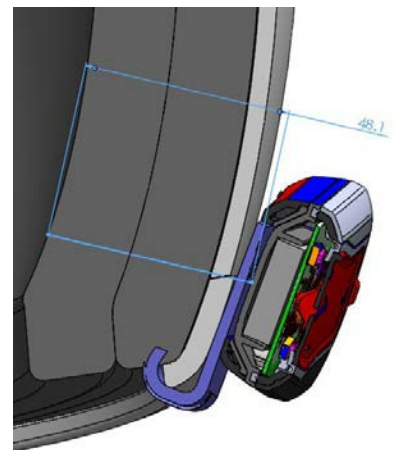
For IC

For IC per Table 1 of RSS 102 Issue 5, SAR exemption based on IC limit of 15mW at a separation distance of 15mm= 1.5cm at 2450 MHz.

EUT power transmission is 8.63dBm=7.30mW.

This is below the 15mW SAR exemption limits.

See next page for photos.





15. APPENDIX A - CORRECTION FACTORS

15.1 *Correction factors for CABLE Correction factors for RF OATS Cable 35m*

ITL #1784

| Frequency (MHz) | Cable loss (dB) |
|------------------|-----------------|
| 10.0 | 0.3 |
| 20.0 | 0.2 |
| 50.0 | -0.1 |
| 100.0 | -0.6 |
| 200.0 | -1.2 |
| 500.0 | -2.3 |
| 1000.0 | -3.6 |



15.2 *Correction factors for RF OATS Cable 10m*
ITL #1794

| Frequency(MHz) | Cable loss(dB) |
|----------------|----------------|
| 10.0 | -0.3 |
| 20.0 | -0.3 |
| 50.0 | -0.5 |
| 100.0 | -0.7 |
| 200.0 | -1.1 |
| 500.0 | -1.8 |
| 1000.0 | -2.7 |



15.3 **Correction factor for RF CABLE for Semi Anechoic Chamber**

ITL # 1841

| FREQ (MHz) | LOSS (dB) |
|---------------|--------------|
| 1000.0 | 1.5 |
| 2000.0 | 2.1 |
| 3000.0 | 2.7 |
| 4000.0 | 3.1 |
| 5000.0 | 3.5 |
| 6000.0 | 4.1 |
| 7000.0 | 4.6 |
| 8000.0 | 4.9 |
| 9000.0 | 5.7 |
| 10000.0 | 5.7 |
| 11000.0 | 6.1 |
| 12000.0 | 6.1 |
| 13000.0 | 6.2 |
| 14000.0 | 6.7 |
| 15000.0 | 7.4 |
| 16000.0 | 7.5 |
| 17000.0 | 7.9 |
| 18000.0 | 8.1 |
| 19000.0 | 8.8 |
| 20000.0 | 9.1 |

NOTES:

- 1. The cable is manufactured by Commscope*
- 2. The cable type is 0623 WBC-400, serial # G020132 and 10m long*



15.4 Correction factors for biconical antenna – ITL # 1356

Model: EMCO 3110B

Serial No.:9912-3337

| Frequency [MHz] | AF [dB/m] |
|-----------------|--------------|
| 30.0 | 14.18 |
| 35.0 | 13.95 |
| 40.0 | 12.84 |
| 45.0 | 11.23 |
| 50.0 | 11.10 |
| 60.0 | 10.39 |
| 70.0 | 9.34 |
| 80.0 | 9.02 |
| 90.0 | 9.31 |
| 100.0 | 8.95 |
| 120.0 | 11.53 |
| 140.0 | 12.20 |
| 160.0 | 12.56 |
| 180.0 | 13.49 |
| 200.0 | 15.27 |



15.5 Correction factors for log periodic antenna – ITL # 1349

Model: EMCO 3146

Serial No.:9505-4081

| Frequency [MHz] | AF [dB/m] |
|-----------------|--------------|
| 200.0 | 11.47 |
| 250.0 | 12.06 |
| 300.0 | 14.77 |
| 400.0 | 15.77 |
| 500.0 | 18.01 |
| 600.0 | 18.84 |
| 700.0 | 20.93 |
| 800.0 | 21.27 |
| 900.0 | 22.44 |
| 1000.0 | 24.10 |



**15.6 Correction factors for ACTIVE LOOP ANTENNA ITL # 1075:
Model 6502 S/N 9506-2950**

| f(MHz) | MAF(dBs/m) | AF(dB/m) |
|--------|------------|----------|
| 0.01 | -33.1 | 18.4 |
| 0.02 | -37.2 | 14.3 |
| 0.03 | -38.2 | 13.3 |
| 0.05 | -39.8 | 11.7 |
| 0.1 | -40.1 | 11.4 |
| 0.2 | -40.3 | 11.2 |
| 0.3 | -40.3 | 11.2 |
| 0.5 | -40.3 | 11.2 |
| 0.7 | -40.3 | 11.2 |
| 1 | -40.1 | 11.4 |
| 2 | -40 | 11.5 |
| 3 | -40 | 11.5 |
| 4 | -40.1 | 11.4 |
| 5 | -40.2 | 11.3 |
| 6 | -40.4 | 11.1 |
| 7 | -40.4 | 11.1 |
| 8 | -40.4 | 11.1 |
| 9 | -40.5 | 11 |
| 10 | -40.5 | 11 |
| 20 | -41.5 | 10 |
| 30 | -43.5 | 8 |



15.7

Correction factors for Horn ANTENNA

Model: 3115 ITL # 1352
Antenna serial number: 6142
3 meter range

| f(GHz) | AF(dB/m) | GA(dB) |
|--------|----------|--------|
| 0.75 | 25 | 3 |
| 1G | 23.5 | 7 |
| 1.5G | 26 | 8 |
| 2G | 29 | 7 |
| 2.5G | 27.5 | 10 |
| 3G | 30 | 10 |
| 3.5G | 31.5 | 10 |
| 4G | 32.5 | 9.5 |
| 4.5G | 32.5 | 10.5 |
| 5G | 33 | 10.5 |
| 5.5G | 35 | 10.5 |
| 6G | 36.5 | 9.5 |
| 6.5G | 36.5 | 10 |
| 7G | 37.5 | 10 |
| 7.5G | 37.5 | 10 |
| 8G | 37.5 | 11 |
| 8.5G | 38 | 11 |
| 9G | 37.5 | 11.5 |
| 9.5G | 38 | 11.5 |
| 10G | 38.5 | 11.5 |
| 10.5G | 38.5 | 12 |
| 11G | 38.5 | 12.5 |
| 11.5G | 38.5 | 13 |
| 12G | 38 | 13.5 |
| 12.5G | 38.5 | 13 |
| 13G | 40 | 12 |
| 13.5G | 41 | 12 |
| 14G | 40 | 13 |
| 14.5G | 39 | 14 |
| 15G | 38 | 15.5 |
| 15.5G | 37.5 | 16 |
| 16G | 37.5 | 16 |
| 16.5G | 39 | 15 |
| 17G | 40 | 15 |
| 17.5G | 42 | 13.5 |
| 18G | 42.5 | 13 |