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DATE: 8 March 2017

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

IC/FCC Radio Test Report

for

Cardo Systems, Inc.

Equipment under test:

Bluetooth Communication System for Motorcycles

scala rider FREECOM1
(2.4GHz Bluetooth Standard/EDR)

Tested by: _____
A. Yizhak

Approved by: _____
D. Shidlowsky

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: DSS Part 15 Spread Spectrum Transmitter

Limits used: FCC Part 15, Sub-part C, Section 15.247
RSS 247, Issue 1: 2015
RSS Gen, Issue 4: 2014

Measurement procedures used are FCC Public Notice DA-00-705 and ANSI C63.10: 2013.

Application for Certification prepared by:

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Applicant for this device: (different from "prepared by")

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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 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, Section 15.247 RSS 247, Issue 1: 2015 RSS Gen, Issue 4: 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-2245.
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

Radiated testing was performed according to the procedures in FCC Public Notice DA 00-705 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

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) 0.15 – 30 MHz:

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

± 3.6 dB

Radiated Emission

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

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

± 4.96 dB

2. System Test Configuration

2.1 Justification

Exploratory emission testing was performed in 3 orthogonal polarities to determine the "worst case" polarity for full testing. Based on the below results the Y axis was the "worst case".

Frequency	X				Y				Z			
	Field Strength	**2rd H**	**3th H**	**Band Edge**	**Field Strength**	**2rd H**	**3th H**	**Band Edge**	**Field Strength**	**2rd H**	**3th 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	65.7	43.4	48.8	35.1	68.43	40.9	42.9	34.1	67.07	41.1	47.3	35.6
2441.0	64.73	37.8	45.1	-	69.88	35.2	46.2	-	67.98	41.4	48.0	-
2480.0	63.88	39.5	46.0	36.0	68.37	43.1	36.7	34.0	46.1	48.9	35.1	68.19

Figure 1. Screening Results

The E.U.T. was evaluated when transmitting at the Low (2402MHz), Mid (2441 MHz) and High (2480MHz) channels in the installation position.
All tests, other than spurious radiated emissions, were performed conducted.

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

No special accessories were needed in order to achieve compliance.

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance.

2.5 Configuration of Tested System

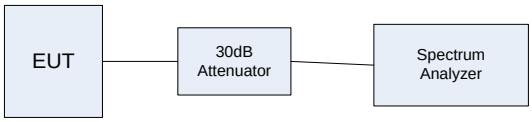


Figure 2. Configuration of Tested System – Conducted Emission on Antenna Ports

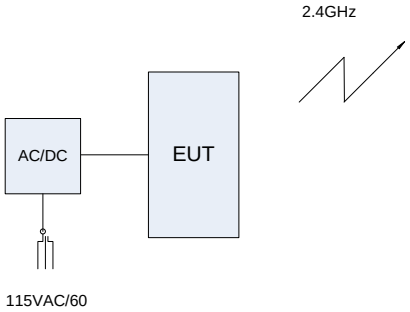


Figure 3. Configuration of Tested System – Conducted Emission on AC Line

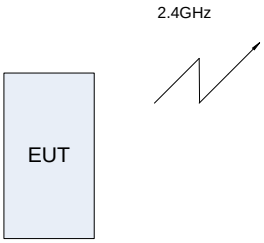


Figure 4. Configuration of Tested System – Radiated Emission

3. Conducted & Radiated Measurement Test Set-Up Photos

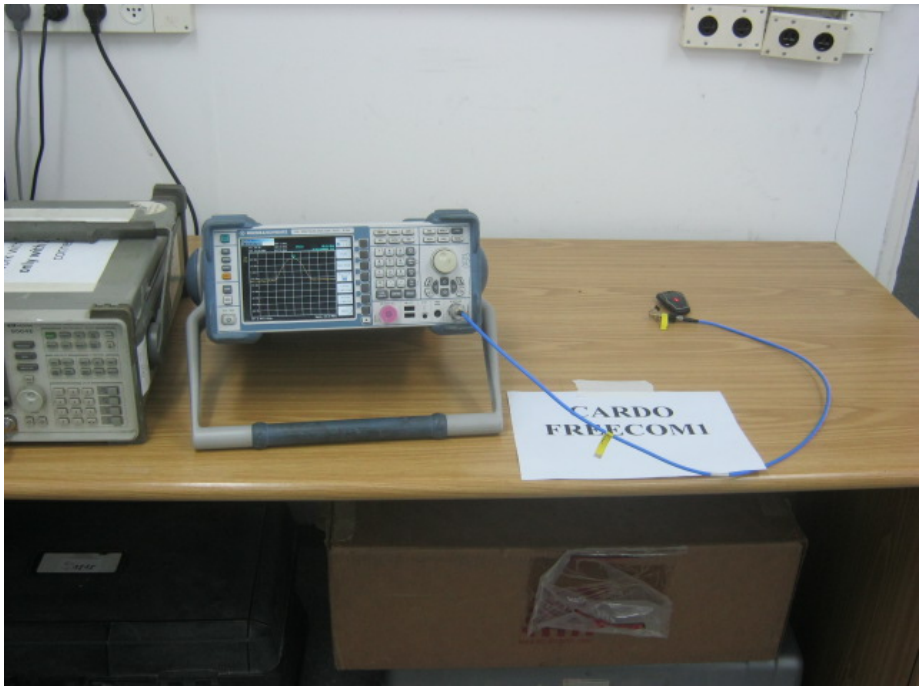


Figure 5. Conducted Emission From Antenna Ports Test Set-Up

Figure 6. Conducted Emission From AC Mains

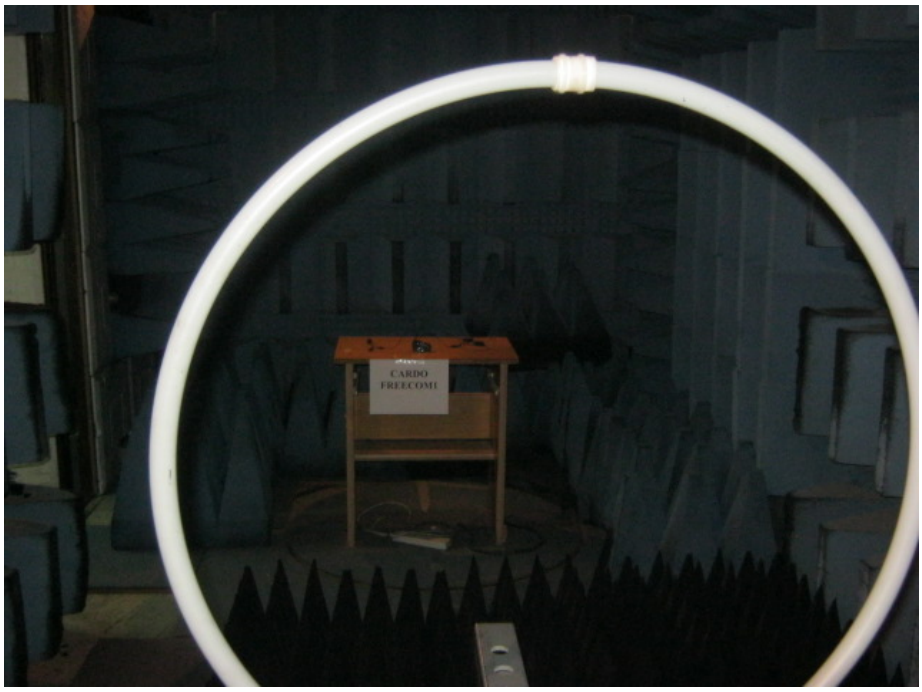


Figure 7. Radiated Emission Test

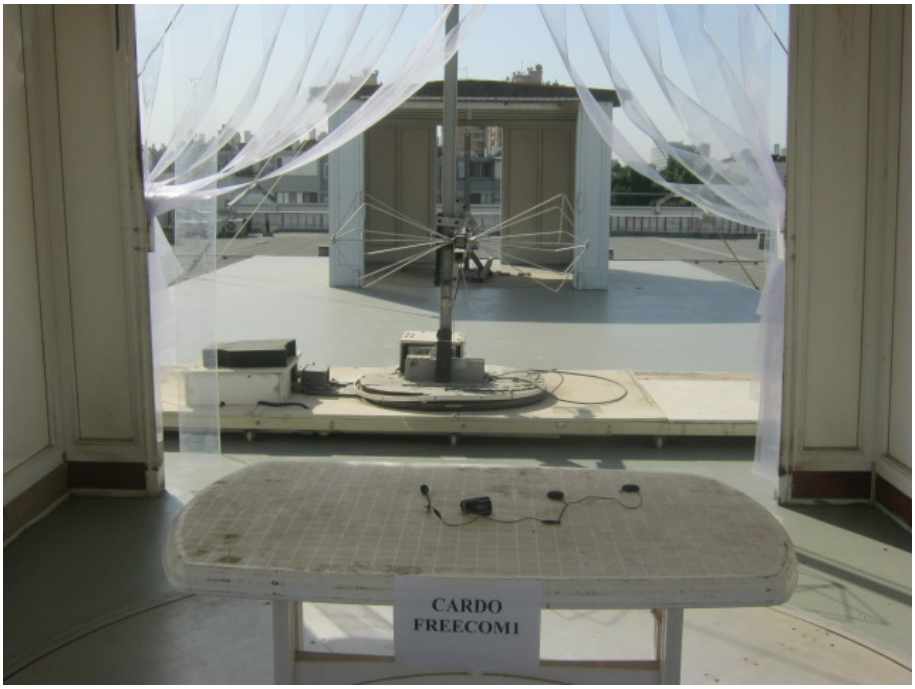


Figure 8. Radiated Emission Test

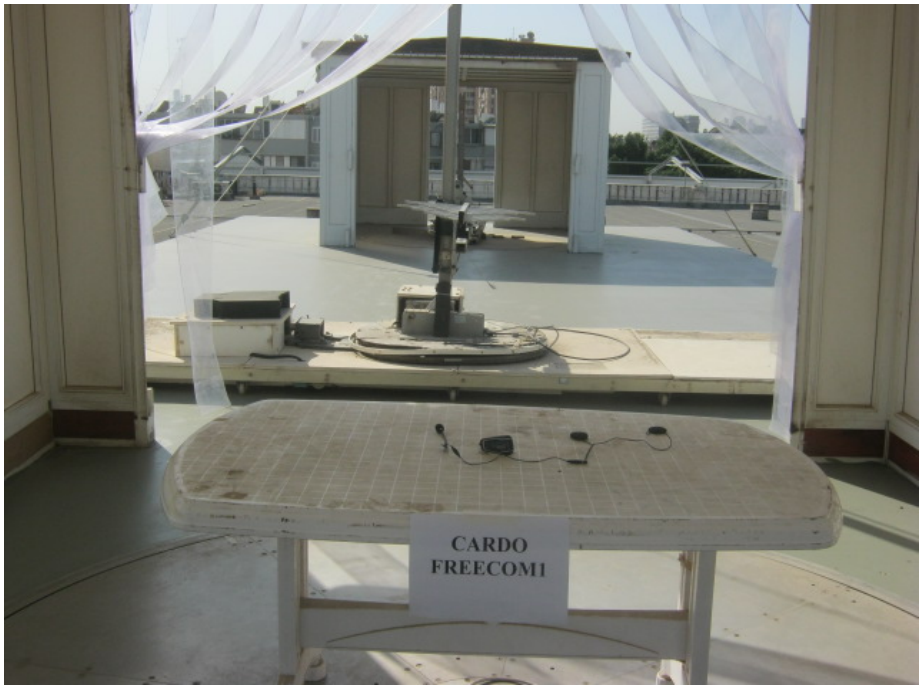


Figure 9. Radiated Emission Test

Figure 10. Radiated Emission Test Above 1GHz

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 µHn 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 (dBµV)**	
	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

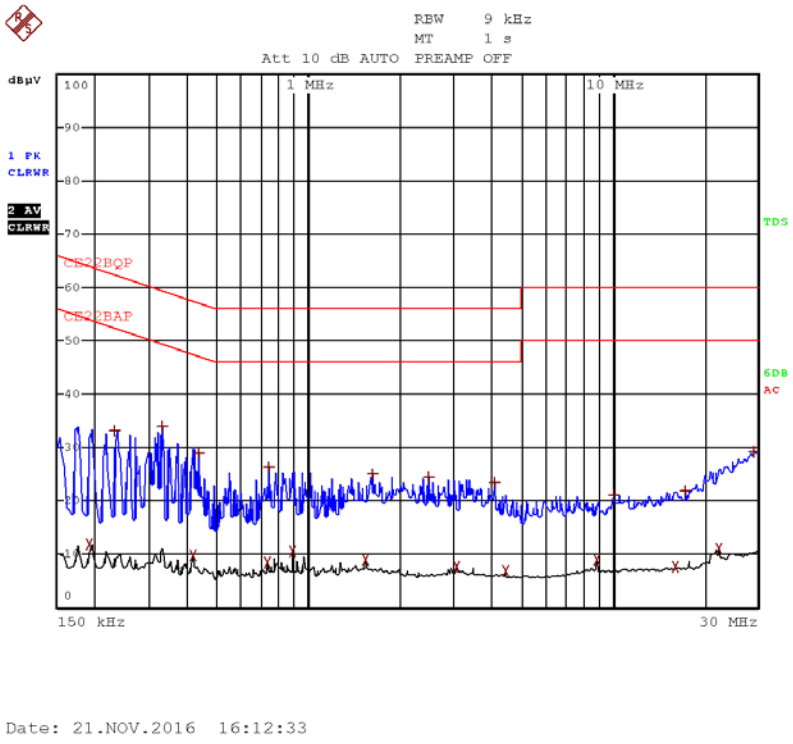


Figure 12. Detectors: Peak, Quasi-peak, Average

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: CE22BQP
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

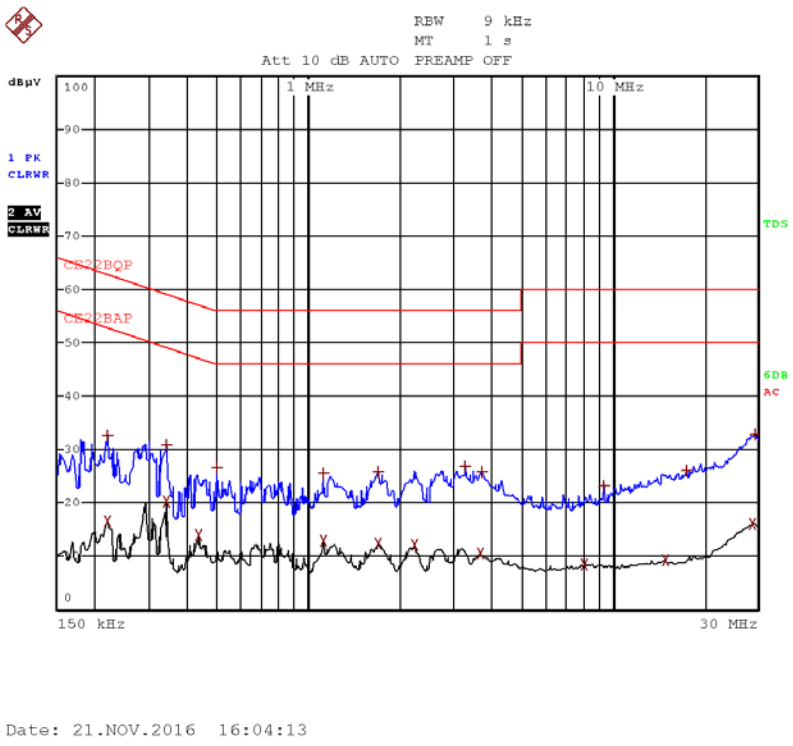


Figure 14 Detectors: Peak, Quasi-peak, Average

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. 20dB Minimum Bandwidth

5.1 Test Specification

F.C.C. Part 15, Subpart C: section 15.247(a)(1)
RSS 247 Section 5.1(1)

5.2 Test Procedure

(Temperature (22°C)/ Humidity (41%RH))
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable .The transmitter unit operated with normal modulation. The spectrum analyzer was set to the following parameters:
Span = ~ 2 to 3 times the 20 dB bandwidth, centered on a hopping channel RBW ≥ 1% of the 20 dB bandwidth
Detector Function: Peak, Trace: Maximum Hold.
The E.U.T. was tested at Low, Mid and High channels.

5.3 Test Limit

N/A

5.4 Test Results

Operation Frequency	Modulation	Bandwidth Reading
(MHz)		(MHz)
2402	Standard	1.1198
2441	Standard	1.1018
2480	Standard	1.1138
2402	EDR	1.3832
2441	EDR	1.3772
2480	EDR	1.3892

Figure 16 — Test Results

JUDGEMENT: Passed

For additional information see *Figure 17* to *Figure 22*.

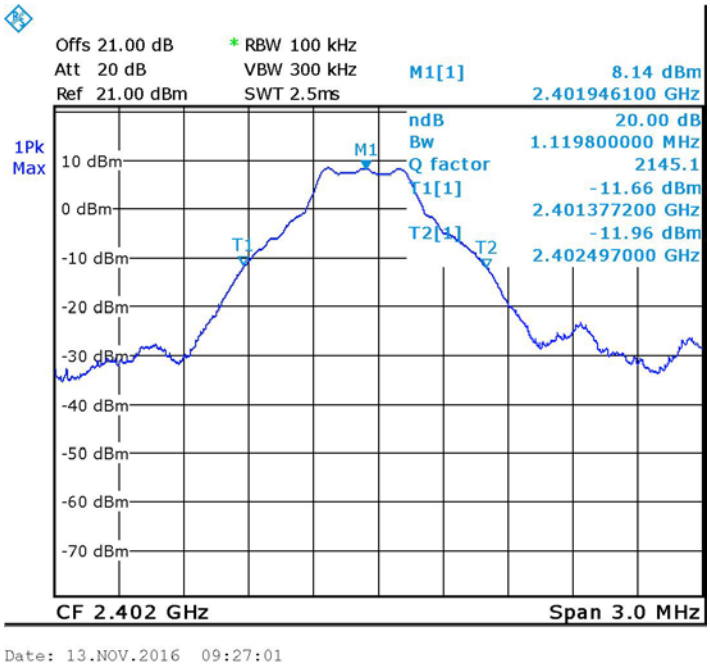


Figure 17. —2402 MHz – Low - Standard Modulation

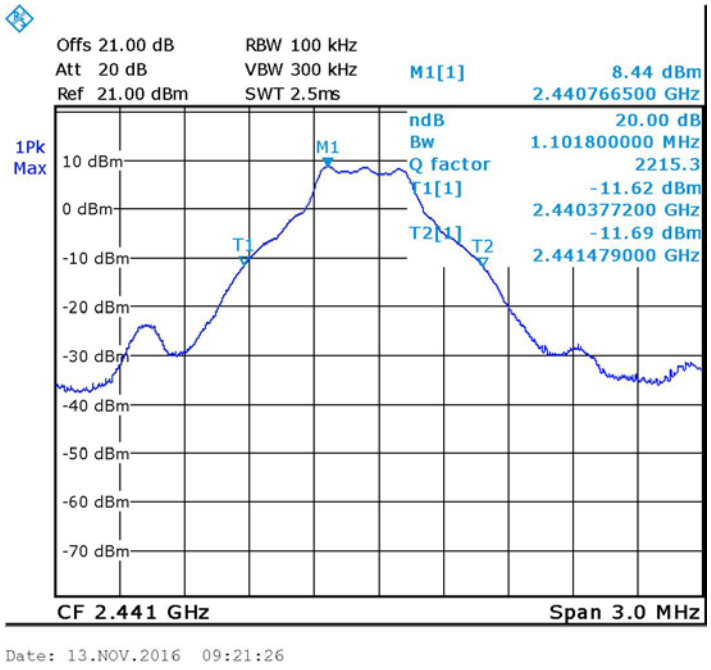


Figure 18. 2441 MHz - Mid - Standard Modulation

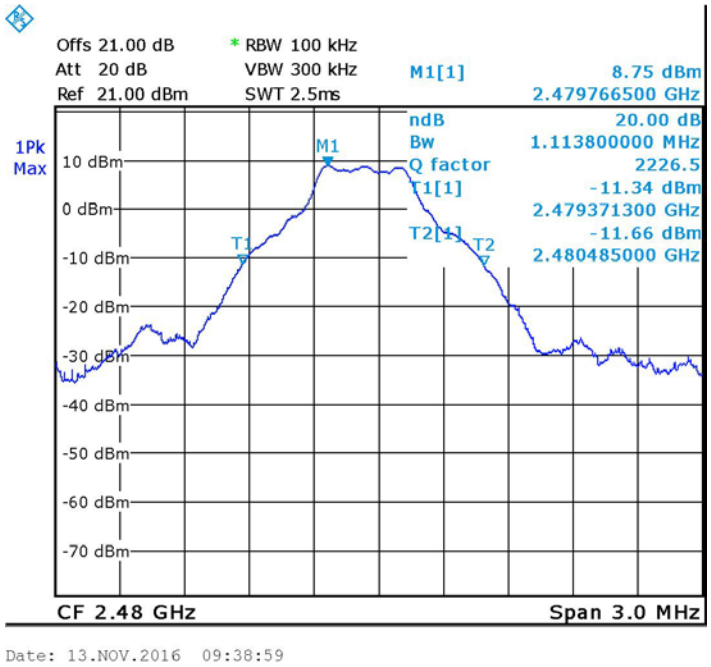


Figure 19. 2480- High - Standard Modulation

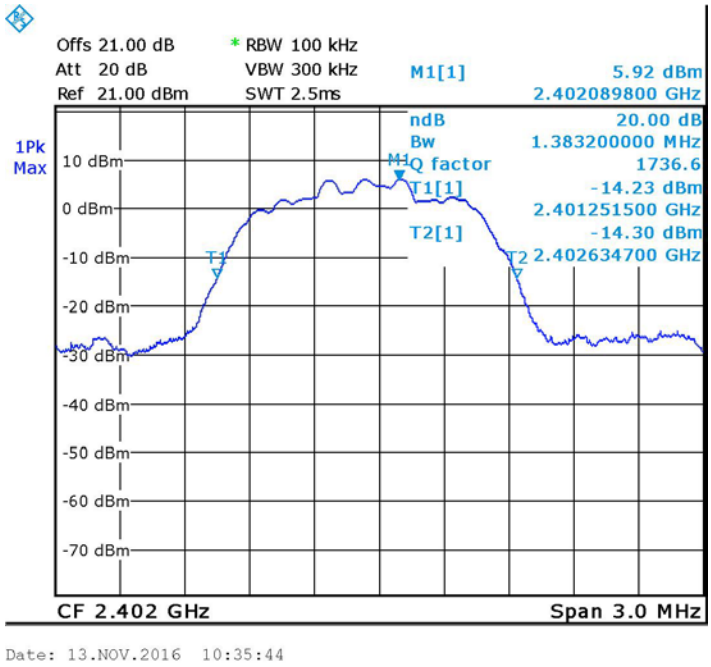


Figure 20. —2402 MHz – Low - EDR Modulation

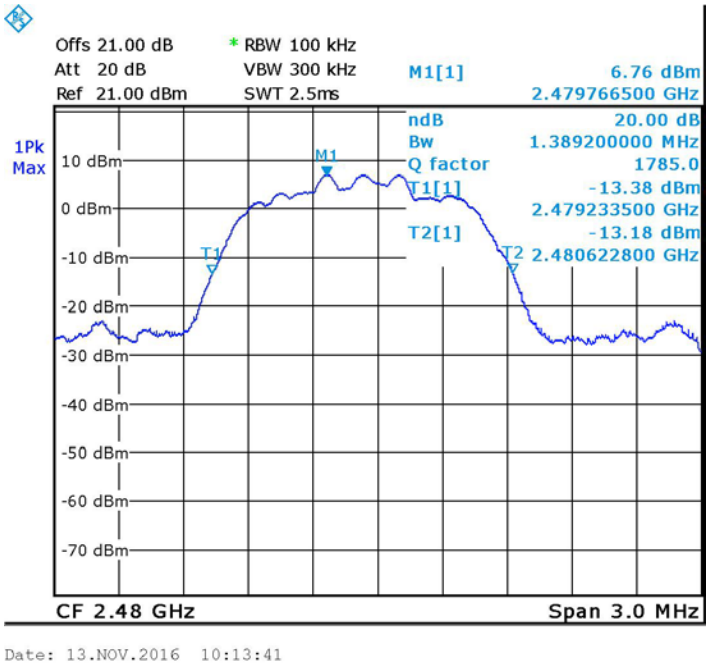


Figure 21. 2441 MHz - Mid - EDR Modulation

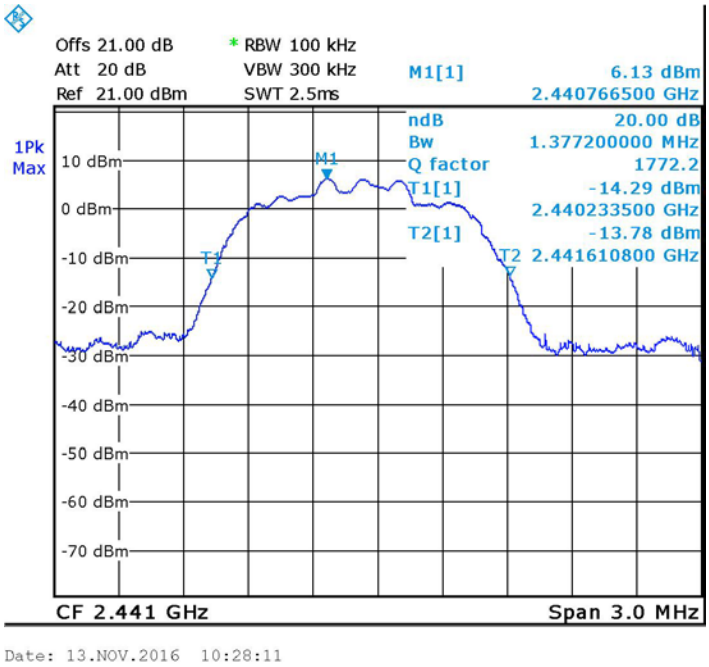


Figure 22. 2480- High - EDR Modulation

5.5 Test Equipment Used, 20 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
20dB Attenuator	MCL	VAT-20W2+	848	April 3, 2016	April 3, 2017

Figure 23 Test Equipment Used

6. 26dB Minimum Bandwidth

6.1 Test Specification

F.C.C. Part 15, Subpart C, Section 15.247(a)
RSS Gen, Issue 4: 2014, Section 6.6

6.2 Test Procedure

(Temperature (24°C)/ Humidity (41%RH))
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable .The transmitter unit operated with normal modulation. The spectrum analyzer was set to the following parameters:
Span = ~ 2 to 3 times the 20 dB bandwidth, centered on a hopping channel RBW ≥ 1% of the 20 dB bandwidth
Detector Function: Peak, Trace: Maximum Hold.
The E.U.T. was tested at Low, Mid and High channels.

6.3 Test Limit

N/A

6.4 Test Results

Operation Frequency	Modulation	Bandwidth Reading
(MHz)		(MHz)
2402	Standard	1.2814
2441	Standard	1.2754
2480	Standard	1.2814
2402	EDR	1.497
2441	EDR	1.491
2480	EDR	1.491

Figure 24 — Test Results

JUDGEMENT: Passed

For additional information see *Figure 25* to *Figure 30*.

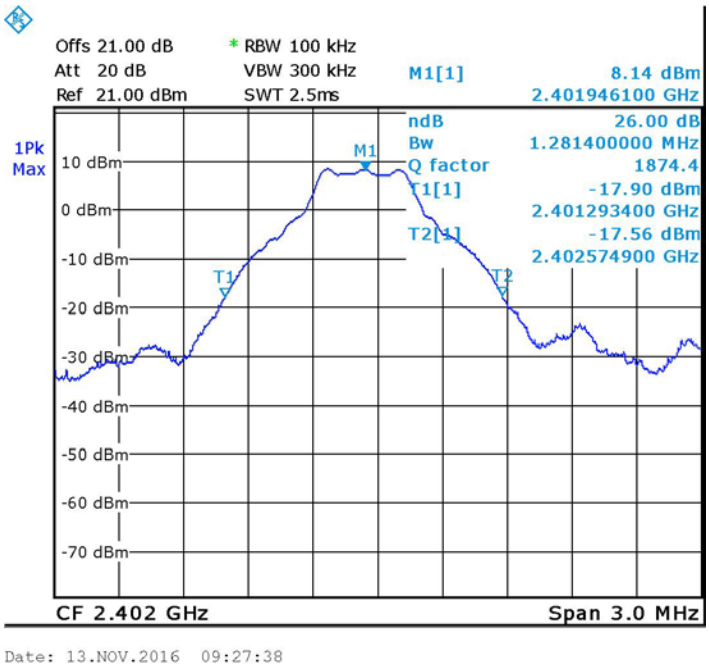


Figure 25. —2402 MHz - Low - Standard Modulation

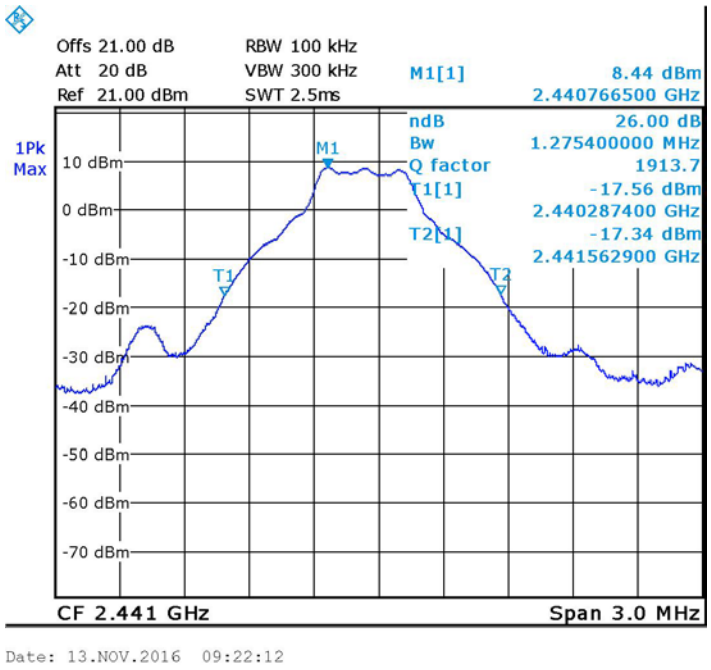


Figure 26. 2441 MHz - Mid - Standard Modulation

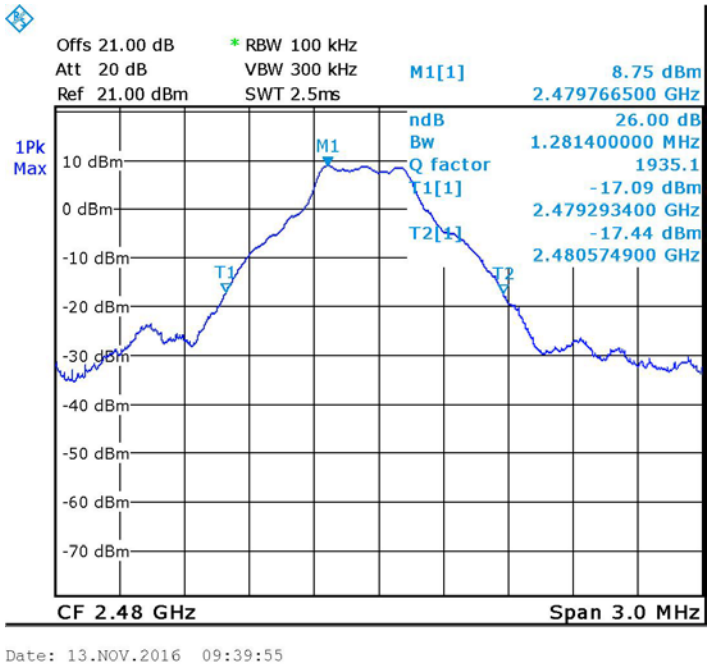


Figure 27. 2480- High - Standard Modulation

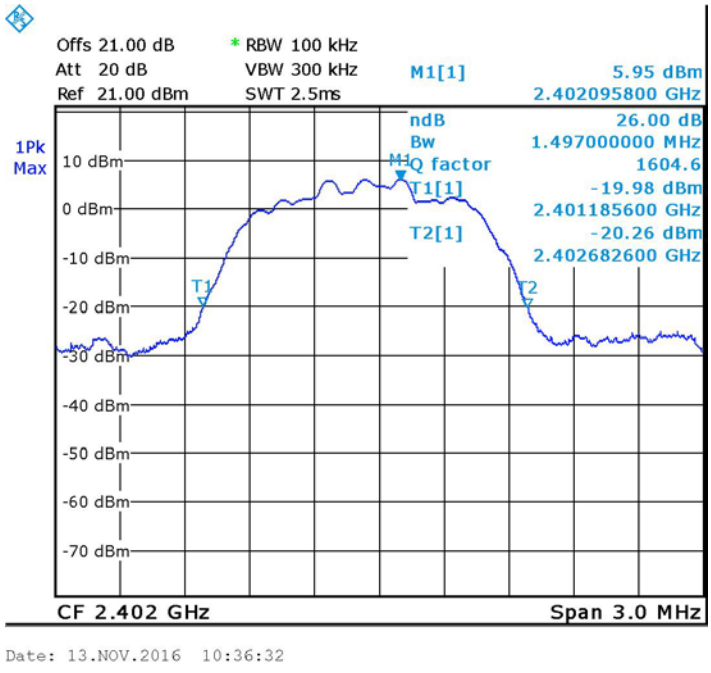


Figure 28. —2402 MHz - Low - EDR Modulation

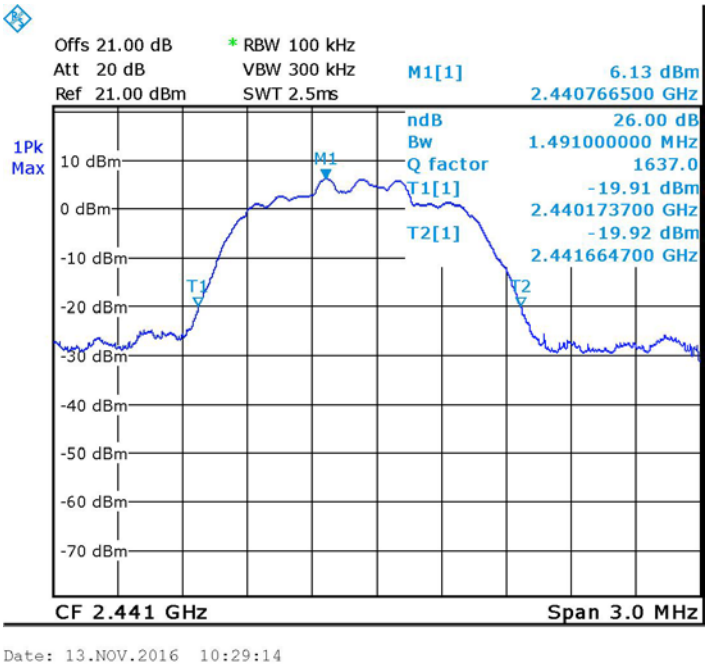


Figure 29. 2441 MHz – Mid - EDR Modulation

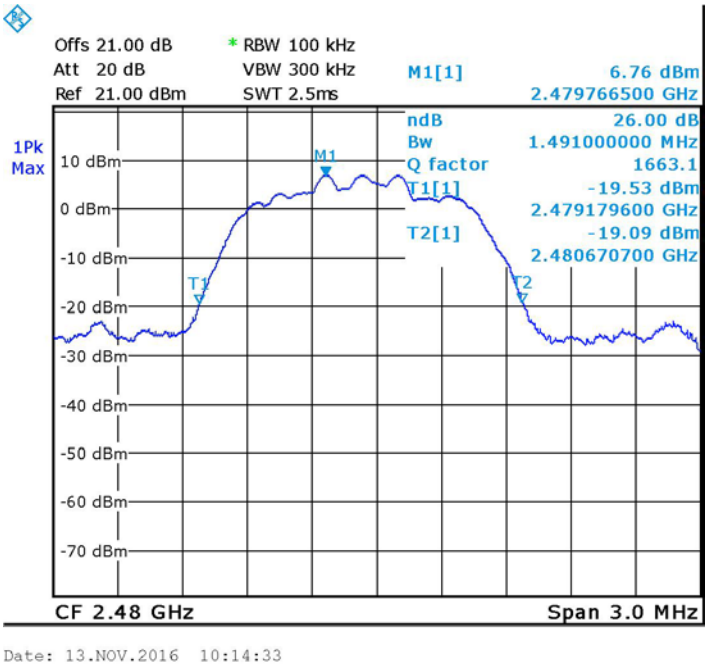


Figure 30. 2480- High - EDR Modulation

6.5 Test Equipment Used, 26 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
20dB Attenuator	MCL	VAT-20W2+	848	April 3, 2016	April 3, 2017

Figure 31 Test Equipment Used

7. Number of Hopping Frequencies

7.1 Test Specification

F.C.C., Part 15, Subpart C Section 15.247(a)(1)(iii)

RSS Section 5.1(4)

7.2 Test Procedure

(Temperature (23°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 E.U.T. was set to hopping mode.
The spectrum analyzer was set to the following parameters:

Band of Operation: 2400M-2483.5 MHz
RBW: 30 kHz, VBW: 100 kHz
Detector Function: Peak, Trace: Maximum Hold

7.3 Test Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

7.4 Test Results

Number of Hopping Frequencies	Specification
79	≥75

Figure 32 Test Results

JUDGEMENT: Passed

For additional information see *Figure 33* to *Figure 40.*

Number of Hopping Frequencies

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

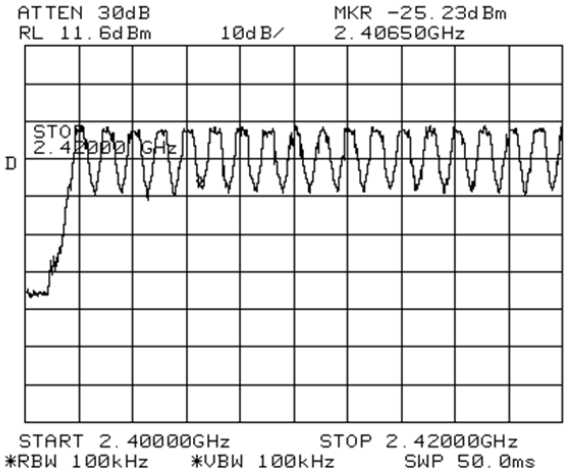


Figure 33. Number of Channels - Standard Modulation

Number of Hopping Frequencies

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

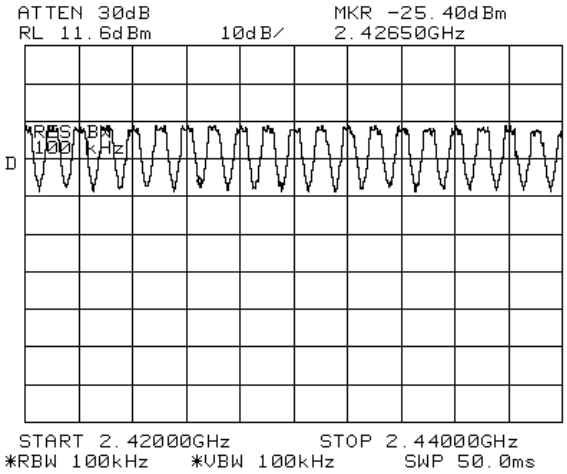


Figure 34. Number of Channels - Standard Modulation

Number of Hopping Frequencies

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

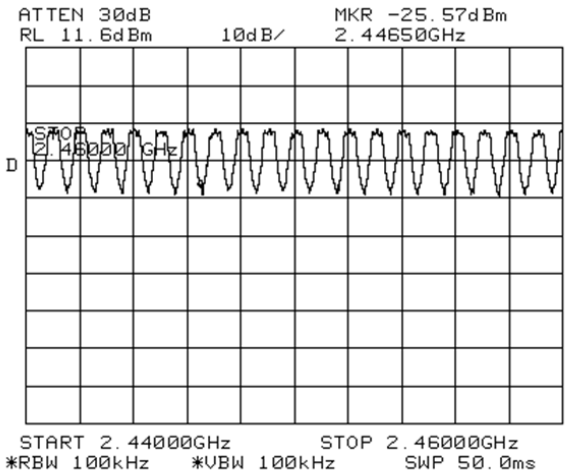


Figure 35. Number of Channels - Standard Modulation

Number of Hopping Frequencies

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

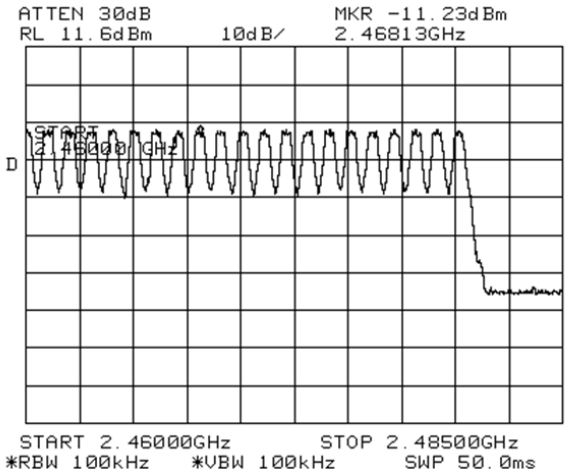


Figure 36. Number of Channels Standard Modulation

Number of Hopping Frequencies

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

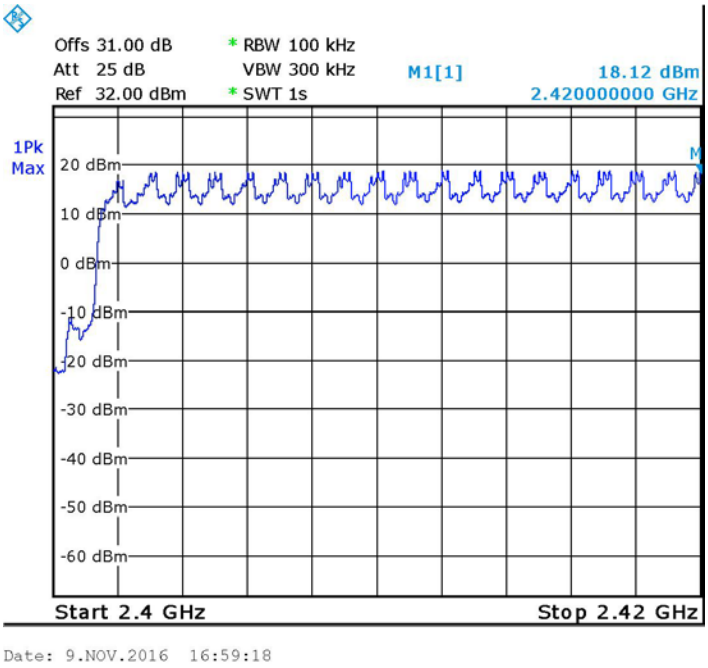


Figure 37. Number of Channels EDR Modulation

Number of Hopping Frequencies

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

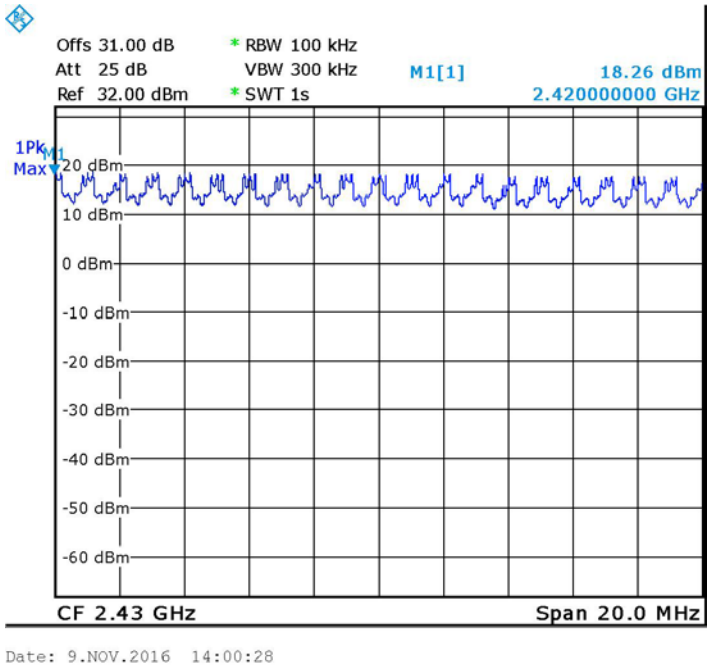


Figure 38. Number of Channels EDR Modulation

Number of Hopping Frequencies

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

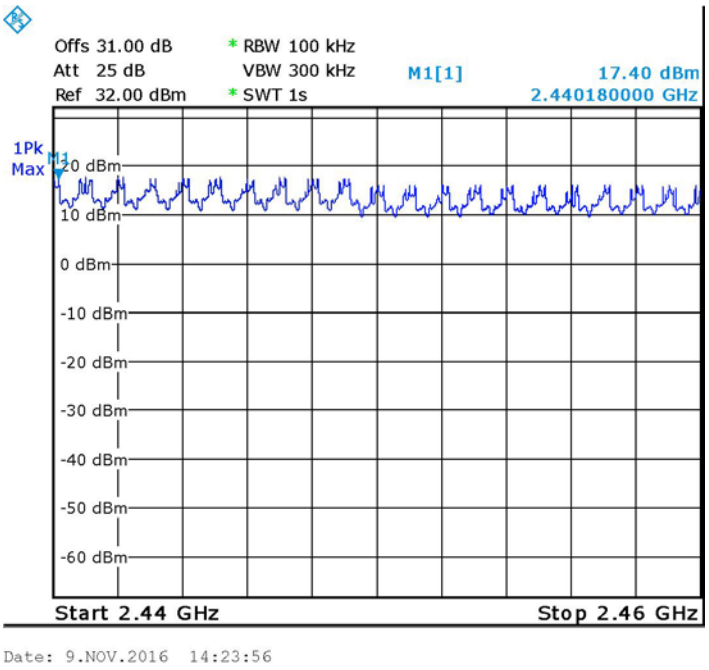


Figure 39. Number of Channels EDR Modulation

Number of Hopping Frequencies

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

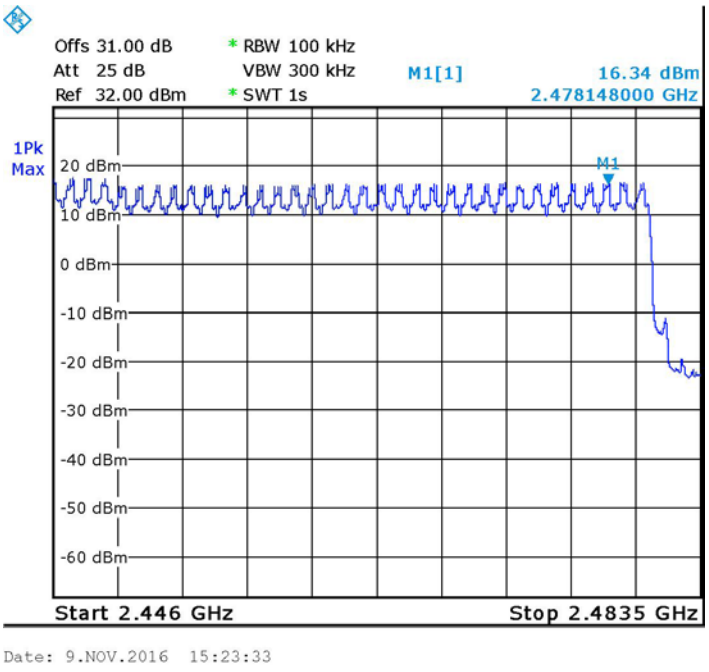


Figure 40. Number of Channels - EDR Modulation

7.5 Test Equipment Used, Number of Hopping Frequencies

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
Spectrum Analyzer	HP	8564E	3442A00275	February 29, 2016	March 10, 2017
30dB Attenuator	Bird	8304-N30DB	533	June 1, 2016	June 1, 2017

Figure 41 Test Equipment Used

8. Channel Frequency Separation

8.1 Test Specification

FCC Part 15, Subpart C, 15.247(a) (1)

RSS 247, Issue 1, Section 5.1(2)

8.2 Test Procedure

(Temperature (25°C)/ Humidity (42%RH))
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.

The E.U.T. was set to hopping mode.

The spectrum analyzer was set to the following parameters:
Span = wide enough to capture two adjacent channels, RBW≥ 1% of the span
Detector Function: Peak, Trace: Maximum Hold.

8.3 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

8.4 Test Results

Channel Frequency Separation	Specification	Modulation	Margin
(MHz)	(MHz)		(kHz)
1.010	>0.745	Standard	-251.3
1.038	>0.926	EDR	-112.0

Figure 42 Test Results

JUDGEMENT: Passed by 112.0 kHz

For additional information see *Figure 43* to *Figure 44.*

Channel Frequency Separation

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

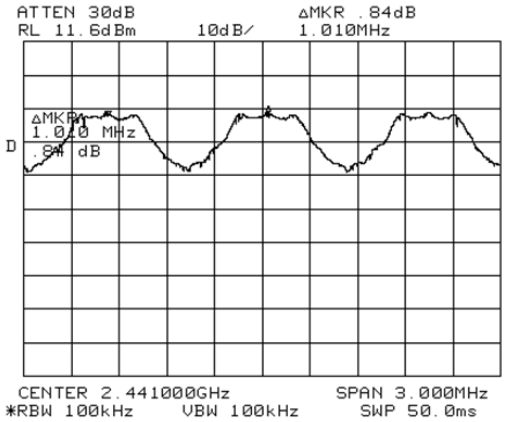


Figure 43. Channel Frequency Separation - Standard Modulation

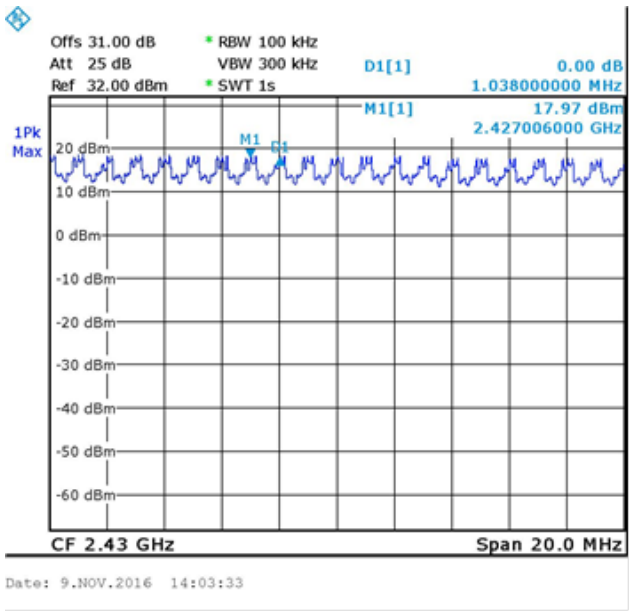


Figure 44. Channel Frequency Separation - EDR Modulation

8.5 Test Equipment Used, Channel Frequency Separation Test

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
Spectrum Analyzer	HP	8564E	3442A00275	February 29, 2016	March 10, 2017
30dB Attenuator	Bird	8304-N30DB	533	June 1, 2016	June 1, 2017

Figure 45 Test Equipment Used

9. Peak Output Power

9.1 Test Specification

F.C.C. Part 15, Subpart C: section 15.247(b)(1)
RSS 247, Issue 1, Section 5.4(2)

9.2 Test Procedure

(Temperature (23°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 (total loss= 30.5dB).
The spectrum analyzer was set to the following parameters:
Span = ~5 times the 20 dB bandwidth, centered on a hopping channel RBW ≥ of the 20 dB bandwidth of the emission being measured
Detector Function: Peak, Trace: Maximum Hold.

The E.U.T. was tested at the Low (2402MHz), Mid (2441MHz) and High (2480 MHz) channels with modulation.

9.3 Test Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following:
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 W
(The limits above applies to antenna gain until 6dBi).

9.4 Test Results

Operation Frequency	Modulation	Power	Power	Specification	Margin
(MHz)		(dBm)	(mW)	(mW)	(mW)
2402	Standard	8.38	6.89	125.0	-118.11
2441	Standard	8.34	6.82	125.0	-118.18
2480	Standard	8.87	7.71	125.0	-117.29
2402	EDR	6.98	4.99	125.0	-120.01
2441	EDR	6.90	4.90	125.0	-120.10
2480	EDR	7.67	5.85	125.0	-119.15

Figure 46 Radiated Power Output Test Results

JUDGEMENT: Passed by 117.29mW

For additional information see *Figure 47* to *Figure 52*.

Peak Output Power

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

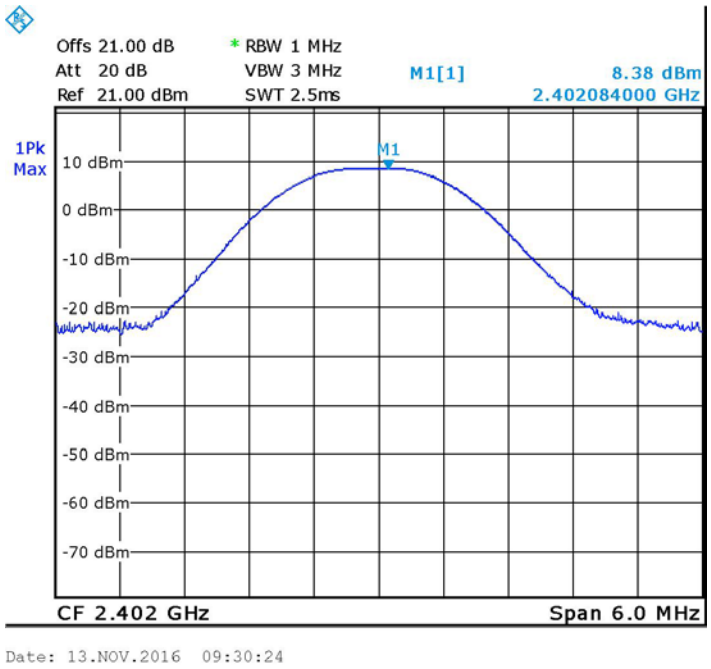


Figure 47 — 2402 MHz - Low - Standard Modulation

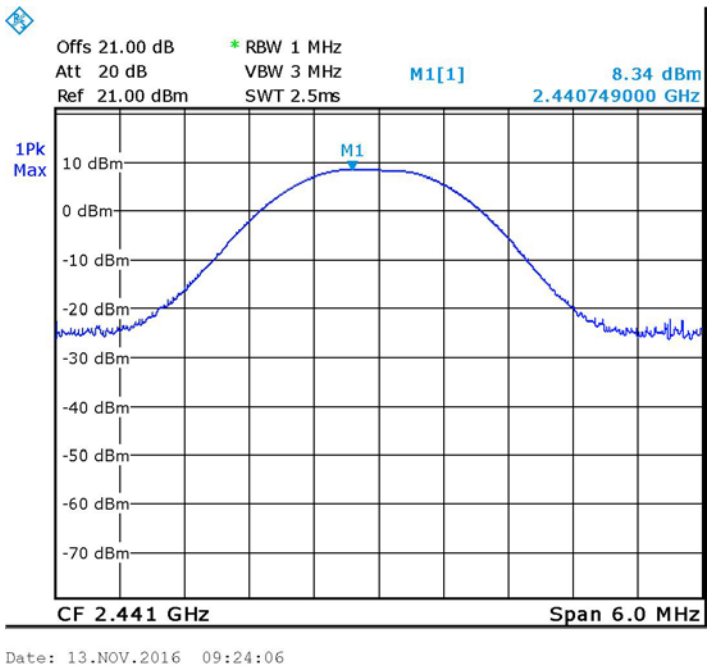


Figure 48 — 2441 - Mid - Standard Modulation

Peak Output Power

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

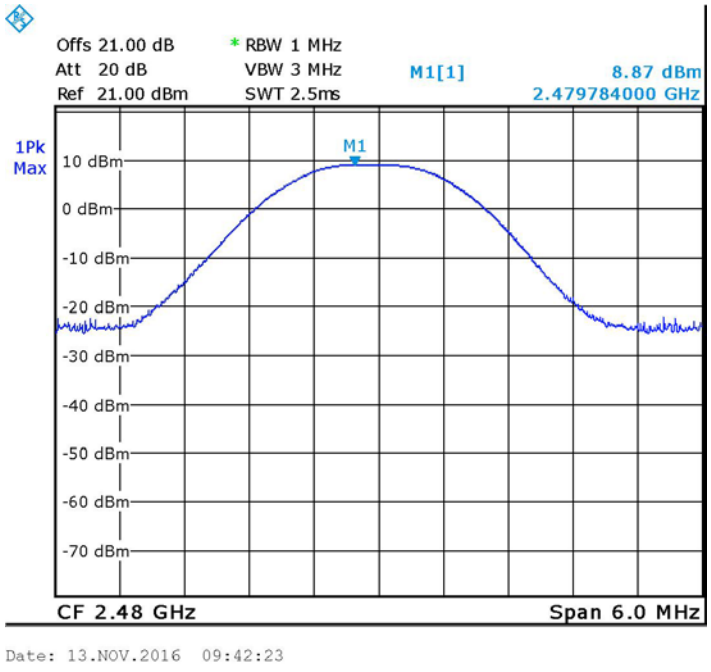


Figure 49 — 2480MHz - High - Standard Modulation

Peak Output Power

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

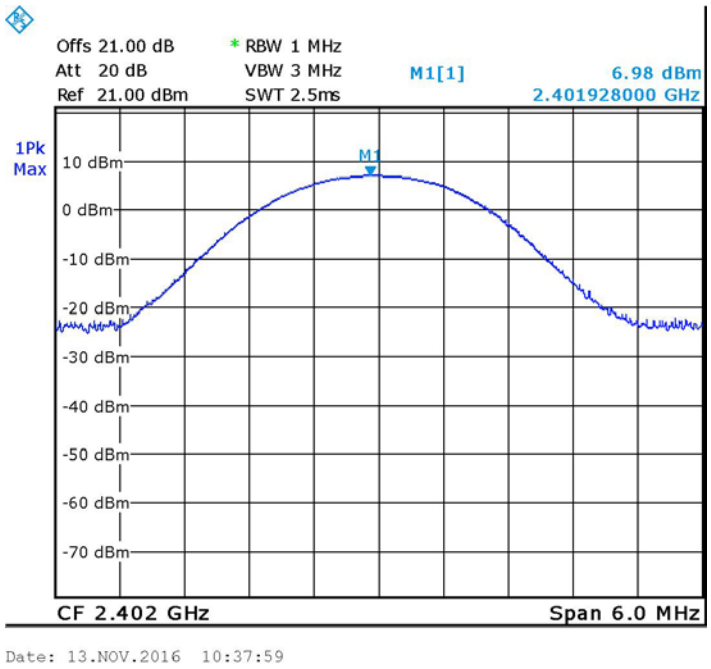


Figure 50 — 2402 MHz - Low - EDR Modulation

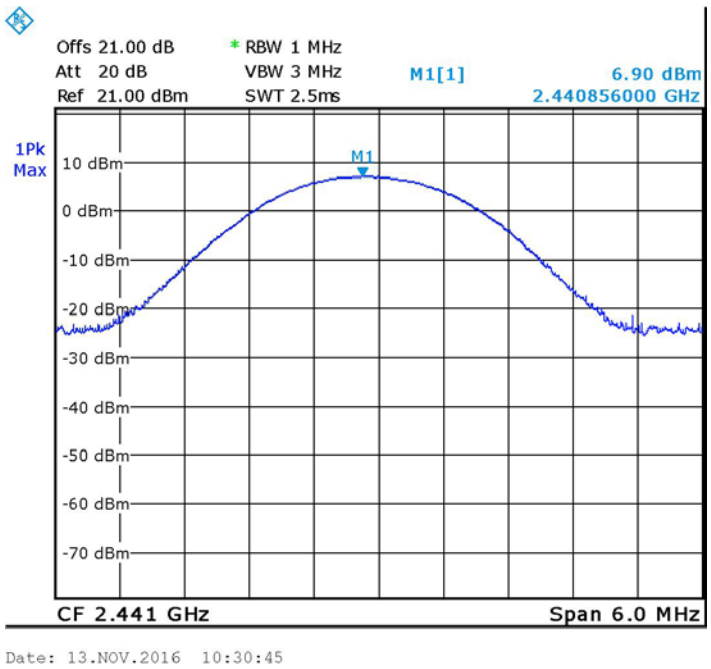


Figure 51 — 2441 - Mid - EDR Modulation

Peak Output Power

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

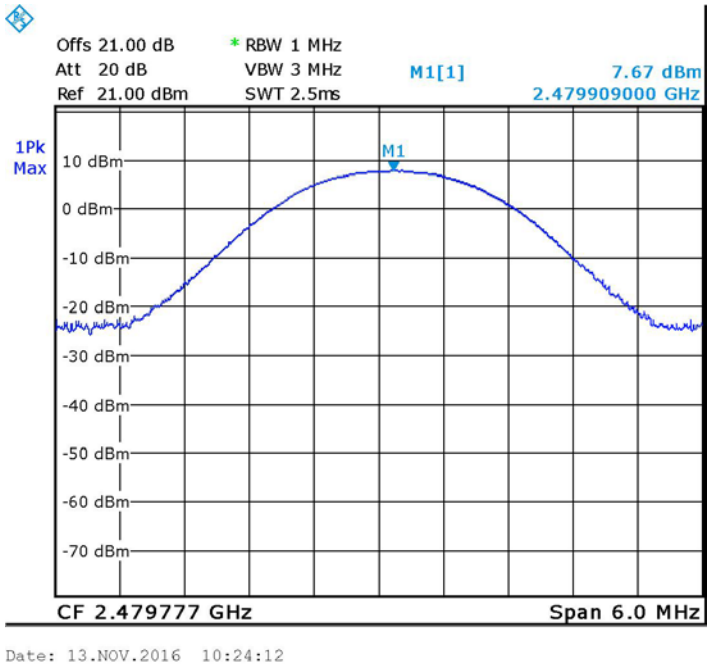


Figure 52 — 2480MHz - High - EDR Modulation

9.5 Test Equipment Used, Radiated Maximum Power Output

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
30dB Attenuator	Bird	8304-N20DB	-	April 3, 2016	April 3, 2017

Figure 53 Test Equipment Used

10. Dwell Time on Each Channel

10.1 Test Specification

FCC Part 15, sub part C, Section 15.247(a)(1)(iii)

RSS-247, Issue 1, Section 5.1(4)

10.2 Test Procedure

(Temperature (25°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 spectrum analyzer was set to the following parameters:
Span = zero span, centered on a hopping channel, RBW≥ 1MHz.
Detector Function: Peak, Trace: Maximum Hold

10.3 Test Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

10.4 Test Results

JUDGEMENT: Passed

The E.U.T met the requirements of the FCC Part 15, Section 15.247(a)(1)(i) and RSS-247, Issue 1, Section 5.1(4).

Additional information of the results is given in *Figure 54* to *Figure 57.*

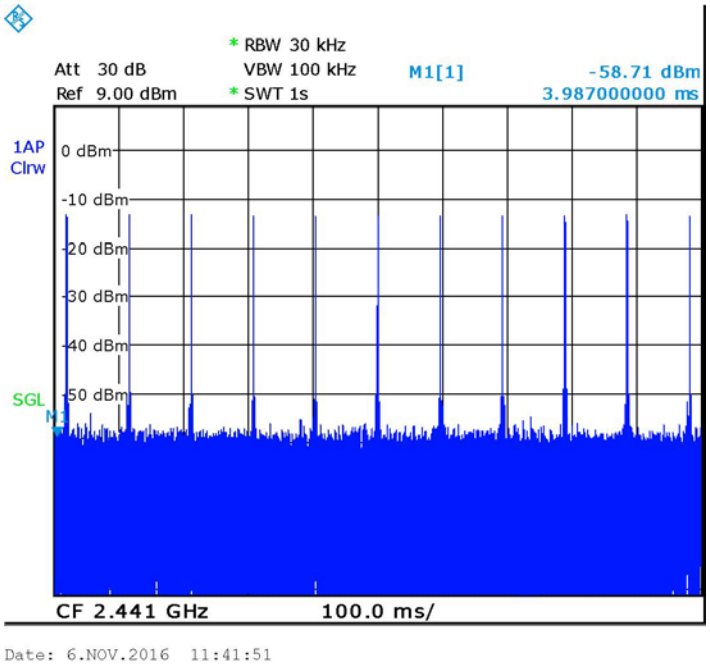


Figure 54 — Number of Bursts in 1 sec=11 standard modulation

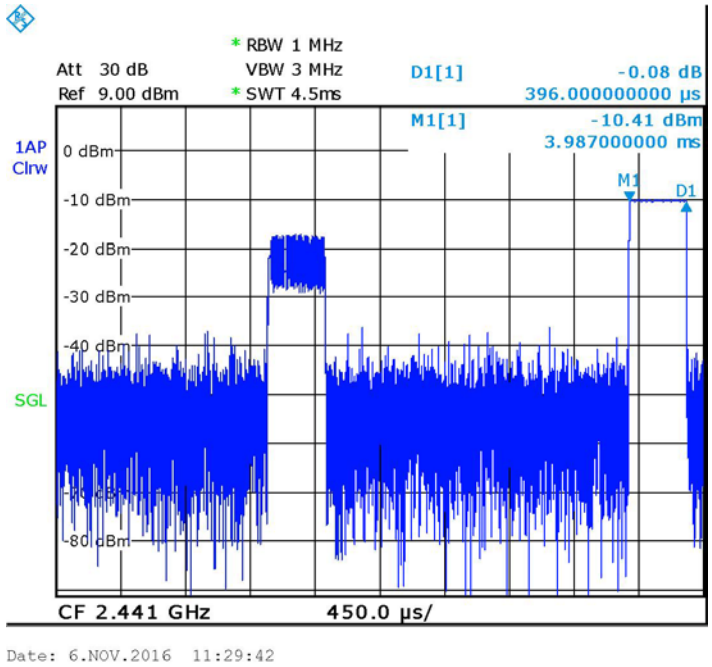


Figure 55 — Burst Duration =.396mS standard modulation

DWELL TIME = 0.396m *11*31.6= 137.65msec=0.14s<0.4s

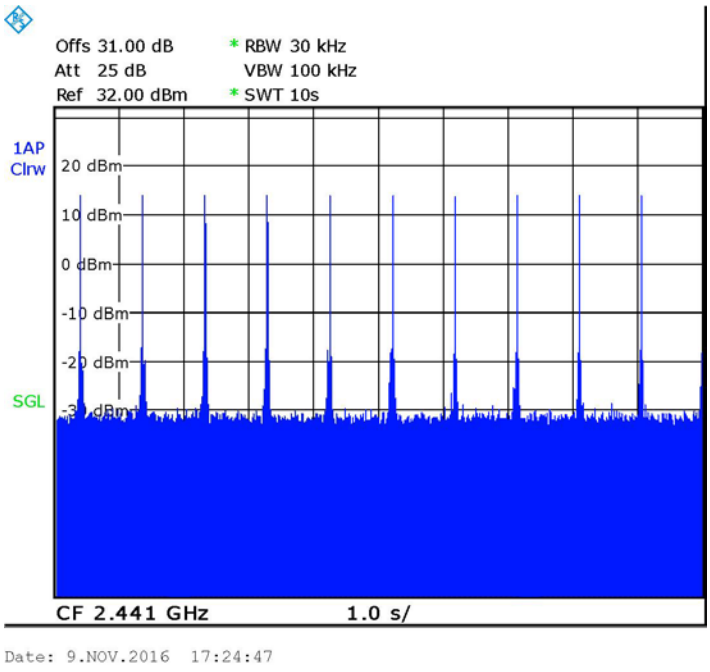


Figure 56 — Number of Bursts in 10 sec=10 EDR modulation

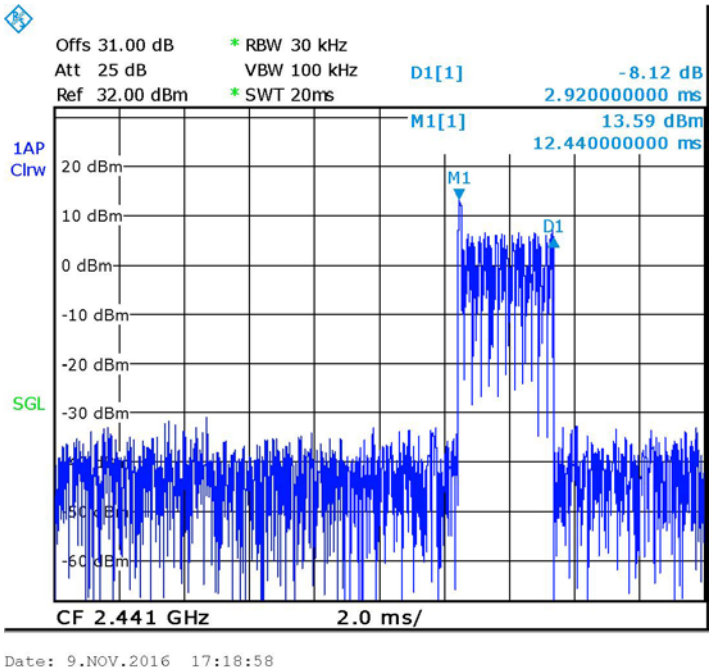


Figure 57 — Burst Duration =2.92ms EDR modulation

DWELL TIME = 2.92m *1*31.6=92.27msec=0.09<0.4s

10.5 Test Equipment Used, Dwell Time on Each Channel

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	HP	8564E	3442A00275	February 29, 2016	March 1, 2017
30dB Attenuator	Bird	8304-N30DB	533	June 1, 2016	June 1, 2017

Figure 58 Test Equipment Used

11. Band Edge

11.1 Test Specification

FCC Part 15, Section 15.247(d)

RSS-247, Issue 1, Section 5.5

11.2 Test Procedure

(Temperature (23°C)/ Humidity (41%RH))
The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable.
The transmitter unit operated in 2 modes: hopping enabled and hopping disabled.
The RBW was set to 100 kHz.

The EMI receiver was adjusted to the transmission channel at the maximum level. The display line was set to 20 dBc and the EMC analyzer was set to the band edge frequencies.

The E.U.T. was tested at the lower and the upper channels.

11.3 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 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

11.4 Test Results

Mode	Operation Frequency	Band Edge Frequency	Modulation	Spectrum Level	Limit	Margin
	(MHz)	(MHz)		(dBm)	(dBm)	(dB)
Hopping	Low	2398.92	Standard	-29.38	-11.52	-17.9
	High	2483.65	Standard	-36.22	-11.19	-25.0
Non-Hopping	Low	2399.60	Standard	-32.96	-11.40	-21.6
	High	2483.501	Standard	-37.25	-11.28	-26.0
Hopping	Low	2398.94	EDR	-32.67	-13.86	-18.8
	High	2483.49	EDR	-37.08	-13.40	-23.7
Non-Hopping	Low	2400.1	EDR	-35.54	-14.1	-21.4
	High	2483.5	EDR	-38.95	-13.26	-25.7

Figure 59 Band Edge Test Results

JUDGEMENT: Passed by 17.9 dB

For additional information see *Figure 60* to *Figure 67*.

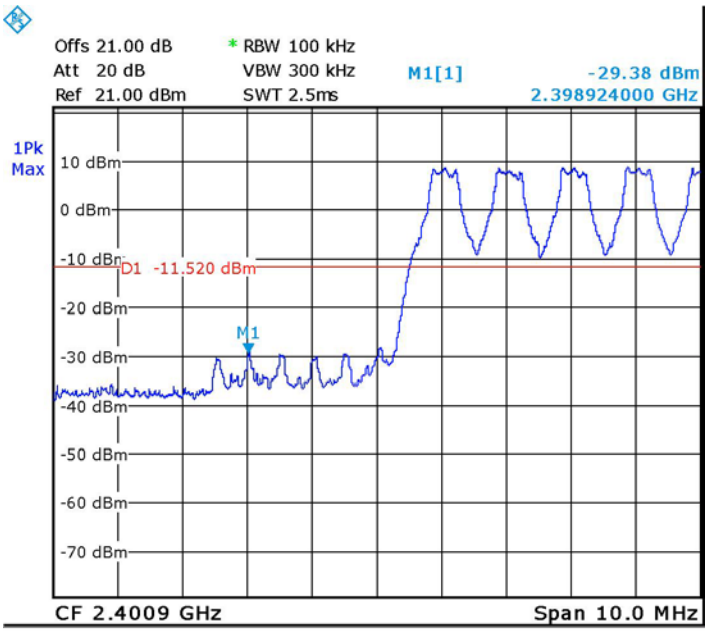


Figure 60 — Hopping - Low - Standard Modulation

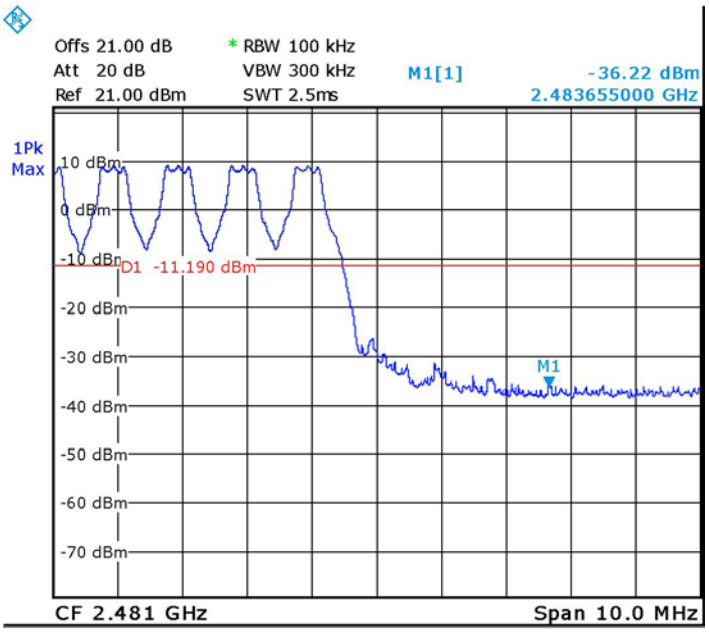


Figure 61 — Hopping - High - Standard Modulation

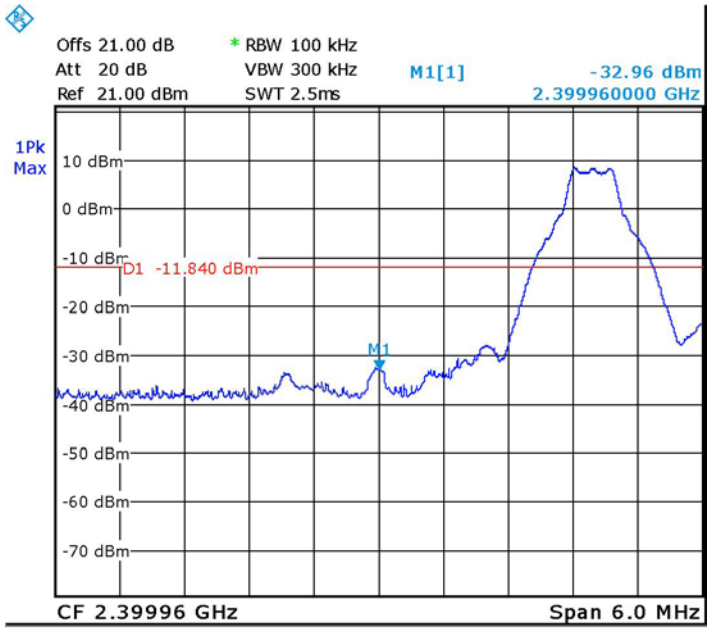


Figure 62 — Non-Hopping - Low - Standard Modulation

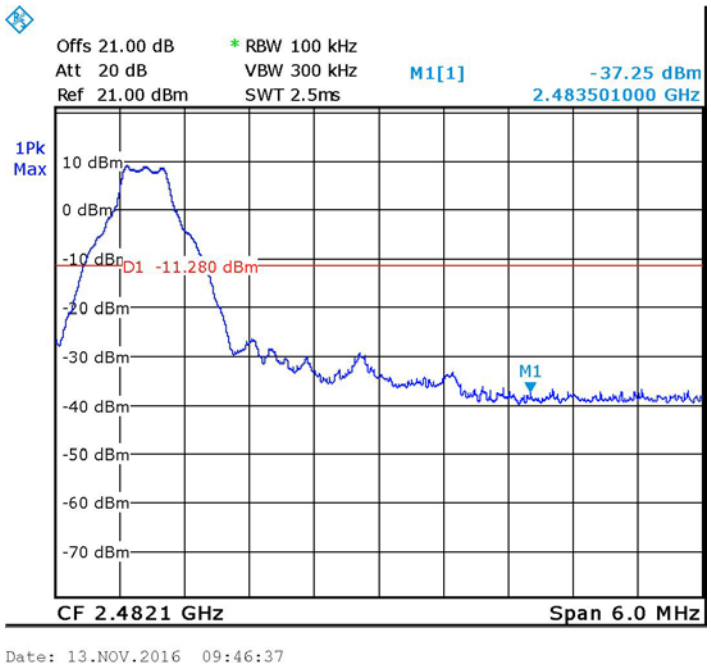


Figure 63 — Non-Hopping – High - Standard Modulation

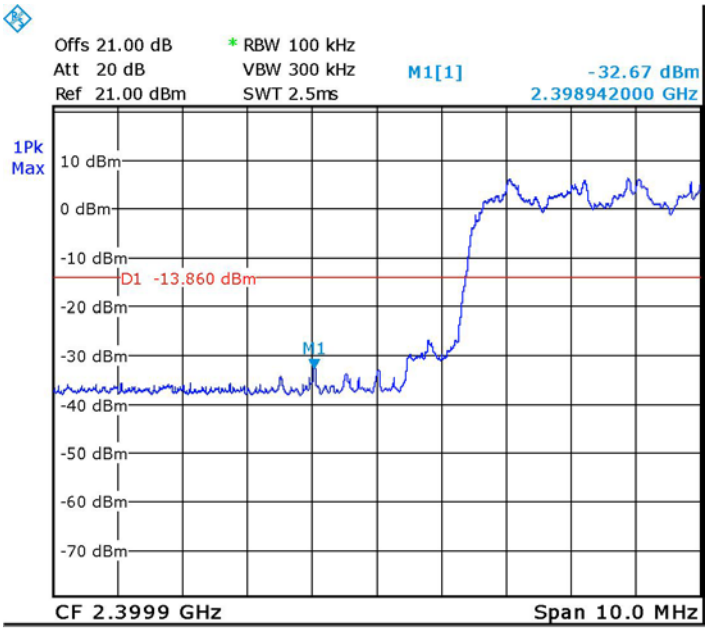


Figure 64 — Hopping - Low - EDR Modulation

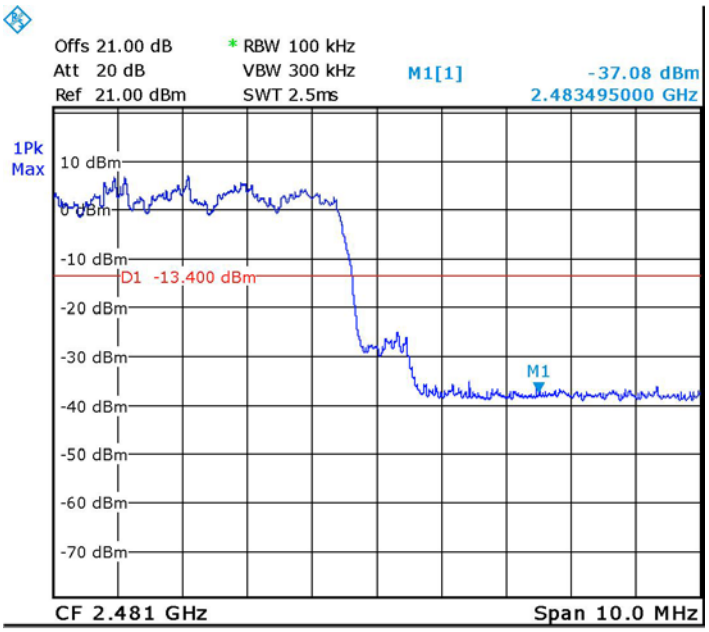


Figure 65 — Hopping - High - EDR Modulation

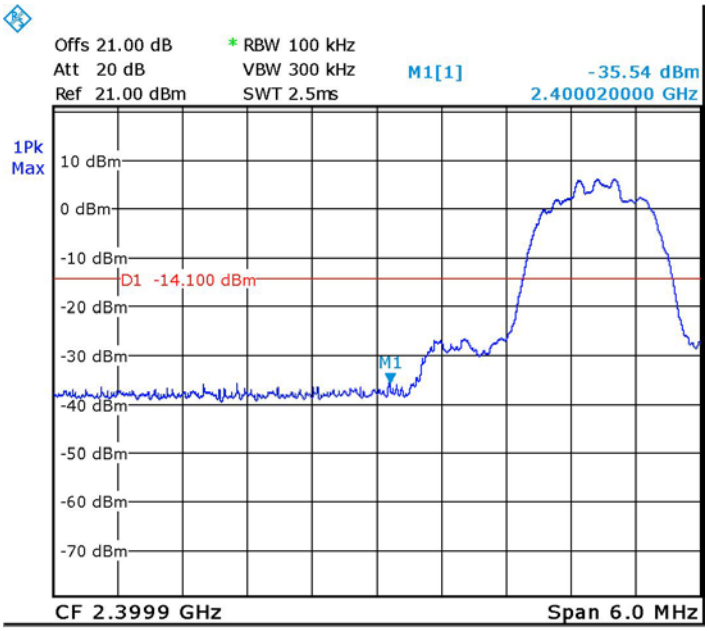


Figure 66 — Non-Hopping - Low - EDR Modulation

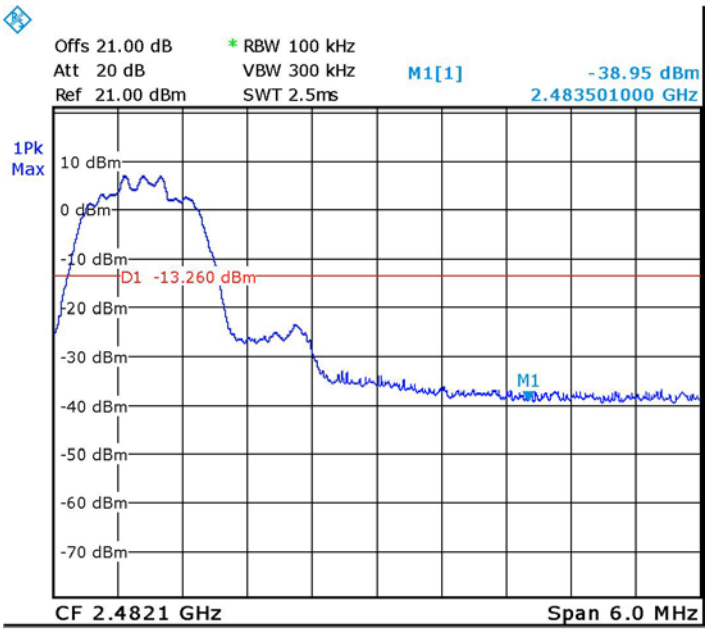


Figure 67 — Non-Hopping – High - EDR Modulation

11.5 Test Equipment Used, Band Edge Spectrum

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
20dB Attenuator	MCL	VAT-20W2+	848	April 3, 2016	April 3, 2017

Figure 68 Test Equipment Used

12. Emissions in Non-Restricted Frequency Bands

12.1 Test Specification

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

RSS 247, Issue 1, Section 5.5

12.2 Test Procedure

(Temperature (24°C)/ Humidity (41%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.

12.3 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 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

12.4 Test Results

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247 (d) and RSS 247, Issue 1, Section 5.5 specification.

For additional information see *Figure 69* to *Figure 74.*

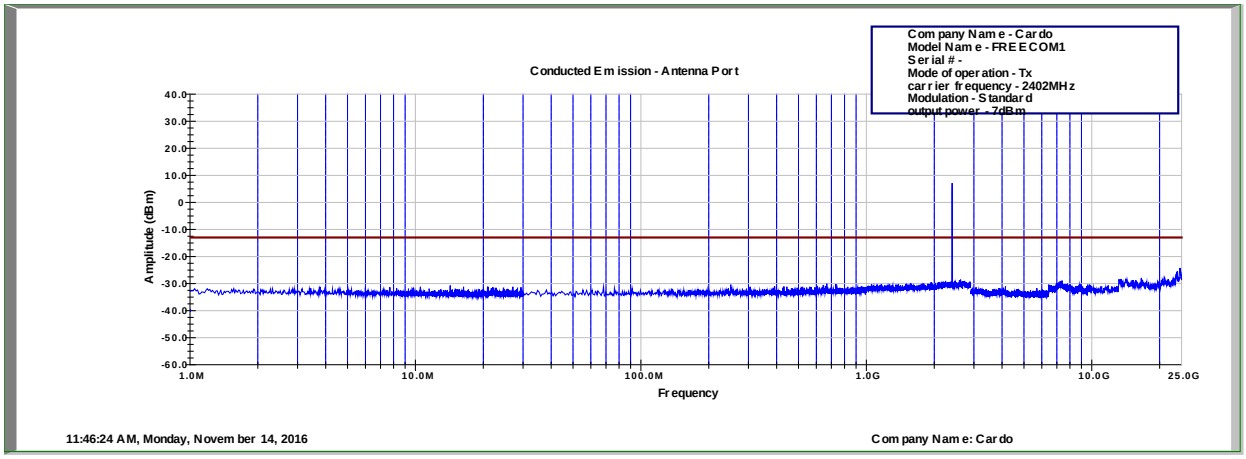


Figure 69 Conducted Spurious Emission – 2402 MHz Standard modulation

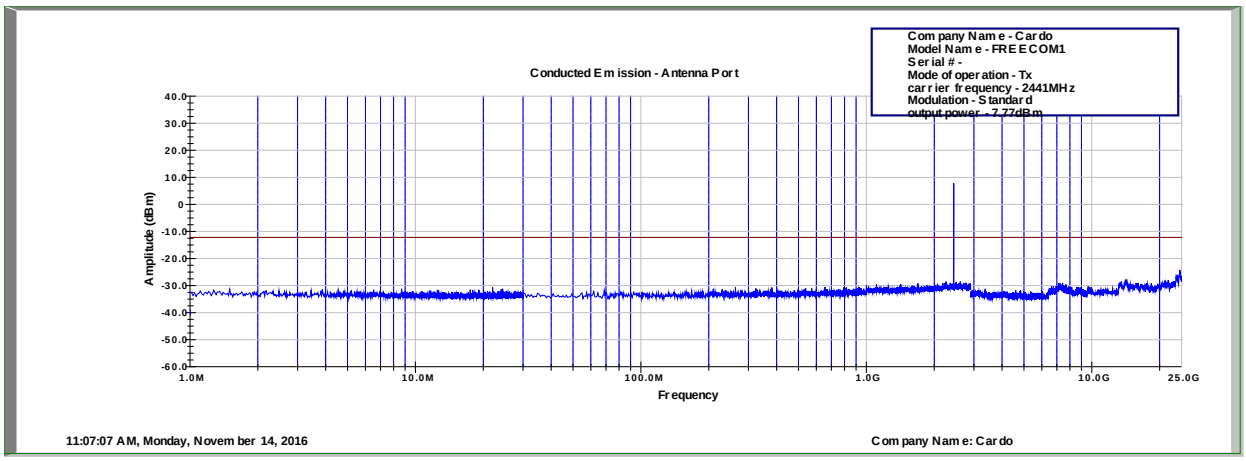


Figure 70 Conducted Spurious Emission - 2441 MHz Standard modulation

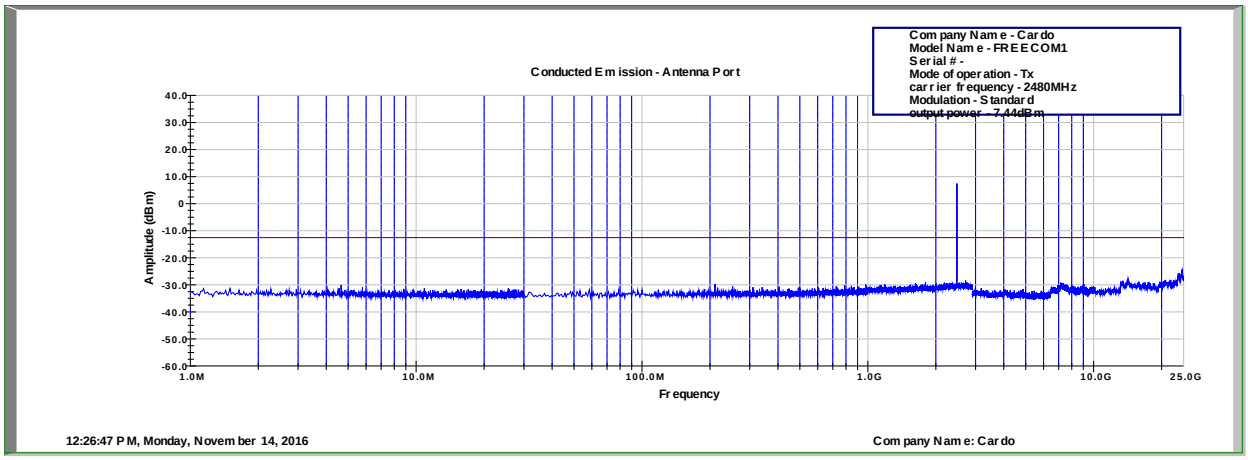


Figure 71 Conducted Spurious Emission – 2480 MHz Standard modulation

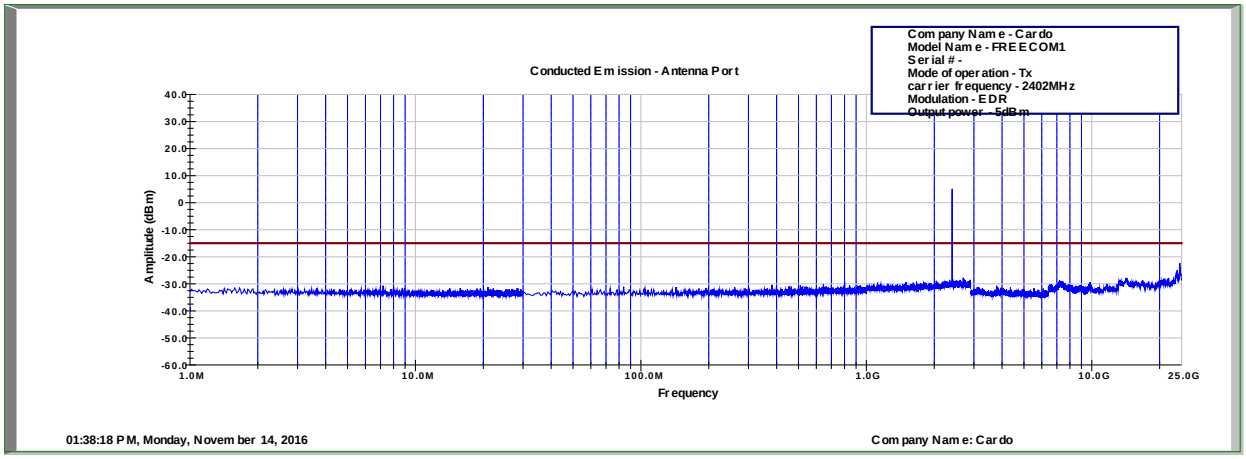


Figure 72 Conducted Spurious Emission – 2402 MHz EDR modulation

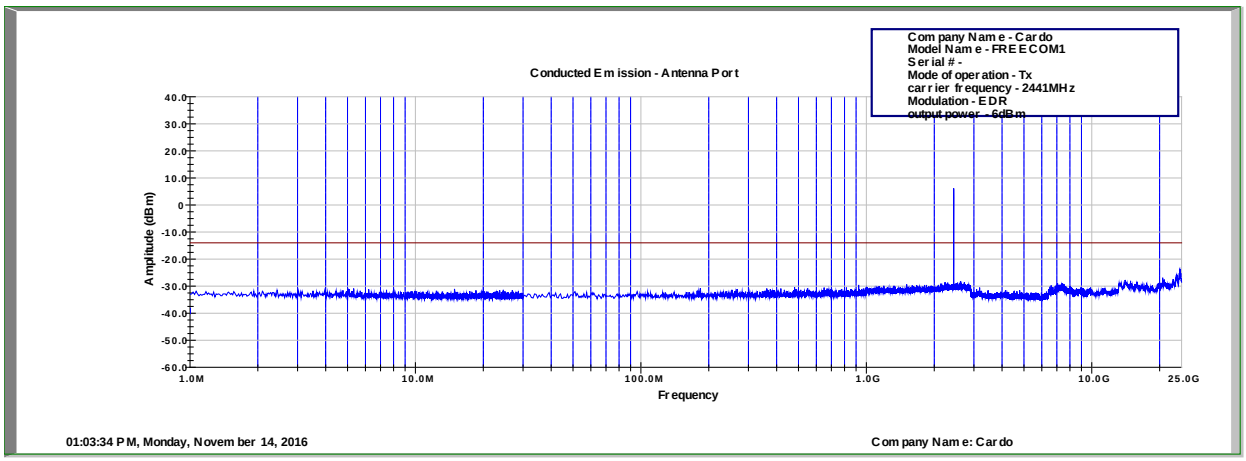


Figure 73 Conducted Spurious Emission - 2441 MHz EDR modulation

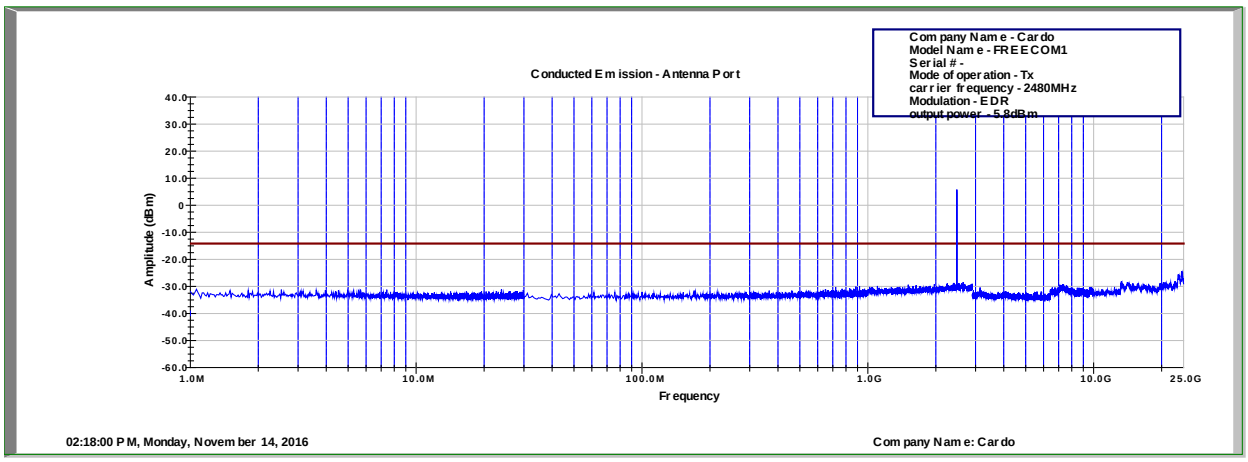


Figure 74 Conducted Spurious Emission - 2480 MHz EDR modulation

12.5 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
20dB Attenuator	MCL	VAT-20W2+	848	June 1, 2016	June 1, 2017

Figure 75 Test Equipment Used

13. Emissions in Restricted Frequency Bands

13.1 Test Specification

FCC, Part 15, Subpart C, Sections 247(d), 15.205, 15.209
RSS Gen, Issue 4: 2014 Section 8.9, 8.10

13.2 Test Procedure

(Temperature (23°C)/ Humidity (41%RH))

For measurements between 0.009MHz-30MHz:

The E.U.T was tested inside the shielded room 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 measurements between 1.0GHz-25.0GHz:

The E.U.T was tested inside the shielded room 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 1.0GHz -25.0GHz 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.

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.

13.3 Test Limit

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* (dBµV/m)	Field strength* (dBµV/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.

13.4 Test Results

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, 209 specification.

For additional information see *Figure 76.*

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: 9 kHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak

Operation Frequency	**Freq.**	**Polarity**	**Peak Reading**			**Average Limit**	**Peak Margin**
(MHz)	(MHz)	(H/V)	(dBµV/m)			(dBµV/m)	(dB)
			X axis	Y axis	Z axis		
2402.0	2390.0	H	35.5	34.1	**35.6**	54.0	-18.4
2402.0	2390.0	V	**35.1**	34.8	34.5	54.0	-18.9
2402.0	4804.0	H	**43.4**	40.9	41.1	54.0	-10.6
2402.0	4804.0	V	**42.4**	40.1	40.1	54.0	-11.6
2402.0	7206.0	H	**48.8**	42.9	47.3	54.0	-5.2
2402.0	7206.0	V	46.2	41.3	**48.4**	54.0	-5.6
2441.0	4882.0	H	37.8	35.2	**41.8**	54.0	-12.2
2441.0	4882.0	V	37.1	37.3	**41.3**	54.0	-12.7
2441.0	7323.0	H	45.1	46.2	**48.0**	54.0	-6.0
2441.0	7323.0	V	43.0	47.1	**49.2**	54.0	-4.8
2480.0	4960.3	H	39.5	36.7	**43.1**	54.0	-10.9
2480.0	4960.0	V	38.3	36.95	**42.4**	54.0	-11.6
2480.0	7440.0	H	46.0	46.1	**48.9**	54.0	-5.1
2480.0	7440.0	V	41.7	42.7	**49.1**	54.0	-4.9
2480.0	2483.5	H	**36.0**	34.0	35.1	54.0	-18.0
2480.0	2483.5	V	34.0	**34.7**	33.8	54.0	-19.3

Figure 76. Radiated Emission, 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 Reading" includes correction factor.

"Correction Factor" = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

13.5 Field Strength Calculation

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[dB\mu v/m]\ \ FS = RA + AF + CF$$

FS:	Field Strength [dBμv/m]
RA:	Receiver Amplitude [dBμv]
AF:	Receiving Antenna Correction Factor [dB/m]
CF:	Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

13.6 Test Equipment Used, Emissions in Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial Number	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
Horn Antenna	ETS	3115	29845	May 19, 2015	May 19, 2018
Log Periodic Antenna	EMCO	3146	9505-4081	April 23, 2016	April 23, 2017
Biconical Antenna	EMCO	3110B	9912-3337	March 24, 2016	March 24, 2018
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2015	November 30, 2016
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	August 8, 2016	August 8, 2017
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 8, 2016	August 8, 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 77 Test Equipment Used

14. Avg. Factor Calculation

1. Pulse period = 1msec (worst scenario)
2. Pulse duration = 1 msec (worst scenario)
3. Burst duration of Standard modulation =.396msec
4. Burst duration of EDR modulation =2.92msec

5. $$\text{Average Factor} = 20\log\left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within } 100\text{msec}\right]$$

$$\text{Average Factor} = 20\log\left[1 * \frac{.369}{100} * 2\right] = -42.6dB \text{ for Standard modulation}$$

$$\text{Average Factor} = 20 * \log\left[\frac{2.92}{100} * 1\right] = -30.69dB \text{ for EDR modulation}$$

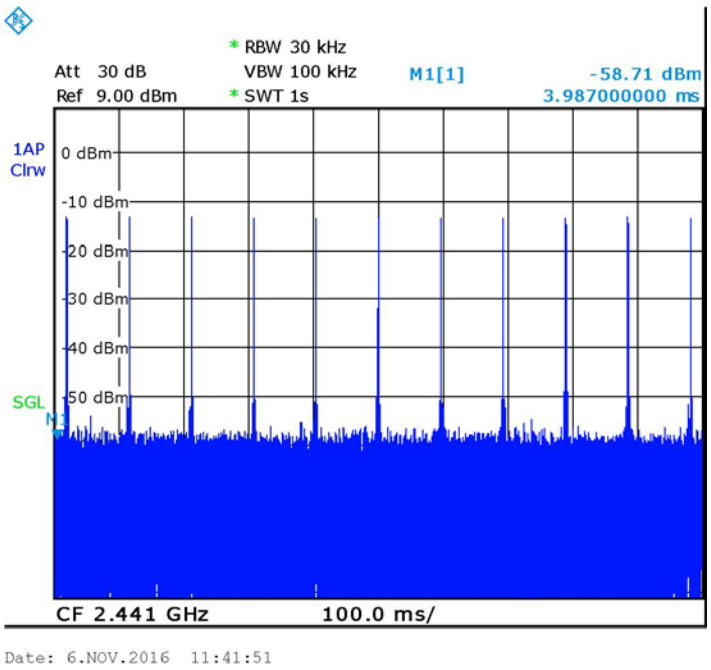


Figure 78 — Number of Bursts in 100m sec=2 standard modulation

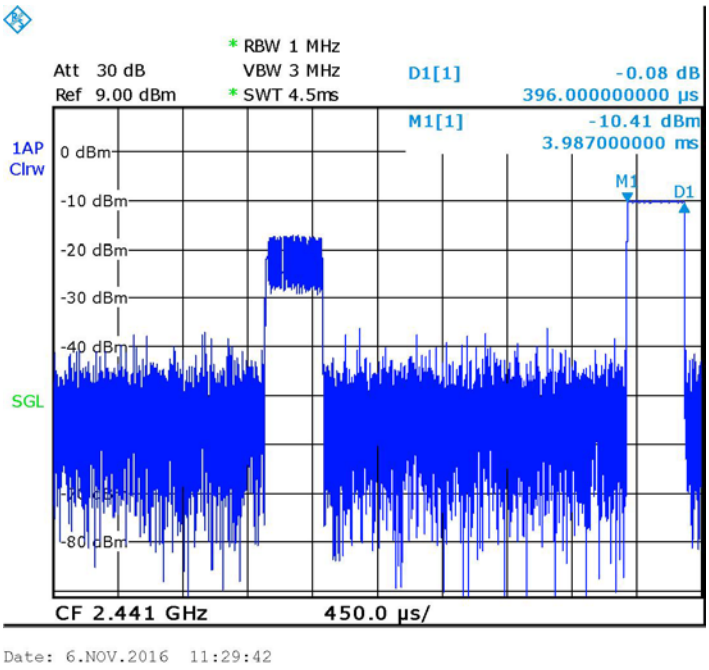


Figure 79 — Burst Duration =.396mS standard modulation

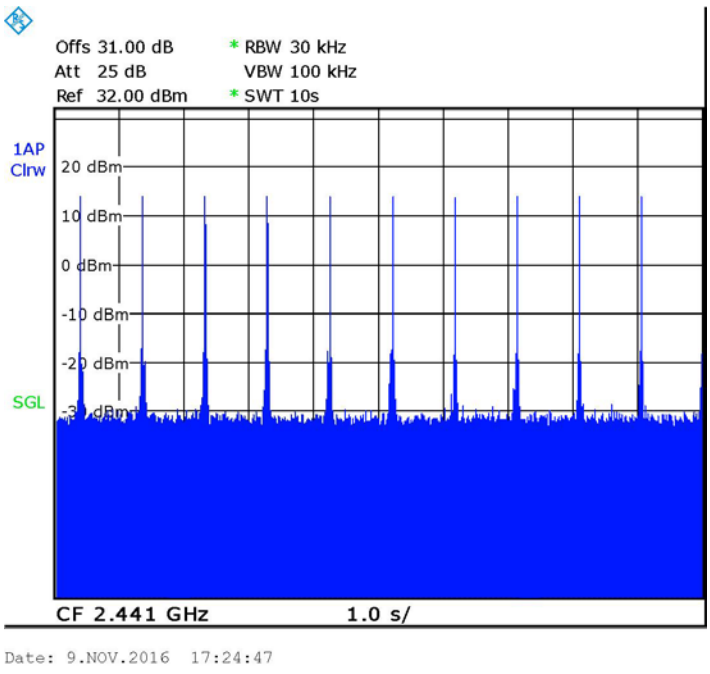


Figure 80 — Number of Bursts in 10 sec=10 EDR modulation

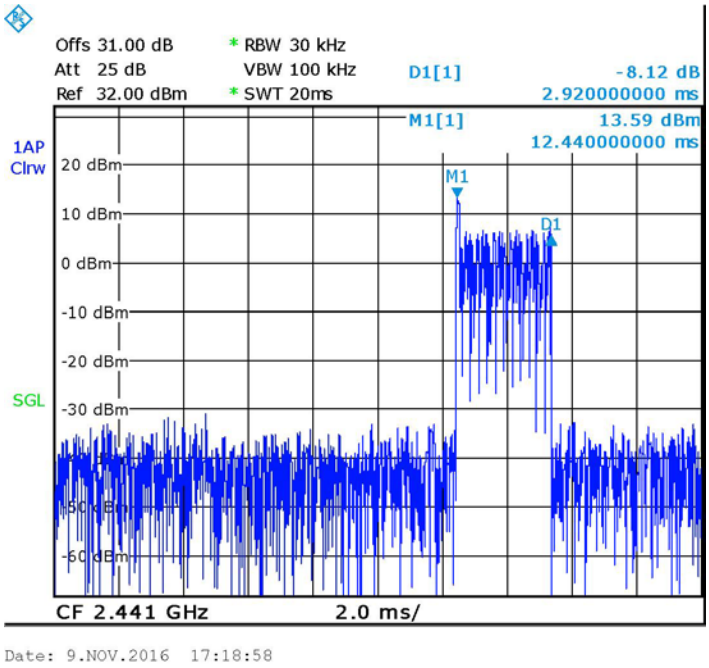


Figure 81 — Burst Duration =2.92ms EDR modulation

14.1 Test Equipment Used, Average Factor

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	February 29, 2016	March 1, 2017
30dB Attenuator	Bird	8304-N30DB	533	June 1, 2016	June 1, 2017

Figure 82 Test Equipment Used

15. Antenna Gain/Information

The antenna gain is -2 dBi.

16. 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) = 8.87 dBm=7.71mW.

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *· [√f(GHz)]

=7.71/15 * 1.55=0.796 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

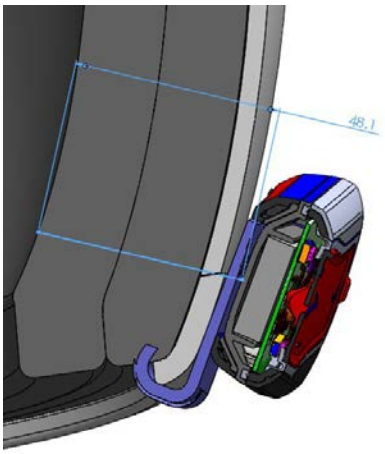
For IC

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 8.87 dBm= 7.71mW.

This is below the 15mW SAR exemption limits.

See next page for photos.


48.1


48.1

17. APPENDIX A - CORRECTION FACTORS

17.1 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

17.2 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

17.3 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*

17.4 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

17.5 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

17.6 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

17.7 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