



DATE: 17 December 2019

I.T.L. (PRODUCT TESTING) LTD.
FCC Radio Test Report
For

Orcam Technologies Ltd.

Equipment under test:

**Portable, Pocket- Sized Smart Pen
Scanner**

Orcam Read

Tested by:

M. Zohar

Approved by:

D. Shidlowsky

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This report relates only to items tested.



Measurement/Technical Report for Orcam Technologies Ltd.

Portable, Pocket- Sized Smart Pen Scanner

Orcam Read

FCC ID: 2AAWI-READ

This report concerns:	Original Grant: <input checked="" type="checkbox"/> X
	Class I Change:
	Class II Change:
Equipment type:	FCC: DSS Part 15 Spread Spectrum Transmitter
Limits used:	47CFR15 Section 15.247
Measurement procedures used are KDB 558074 D01 v05r02 and ANSI C63.10: 2013.	
Application for Certification prepared by: R. Pinchuck ITL (Product Testing) Ltd. 1 Bat Sheva St. Lod 7116002 e-mail Rpinchuck@itlglobal.org	Applicant for this device: (different from "prepared by") Ram Ben Yehuda 3 Kiryat Mada St. PO Box 45157 Jerusalem, 9777603, Israel Tel: +972-2-591-7805 Fax: +972-2-586-0121 e-mail: Rami.Ben-Yehuda@orcam.com



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1. General Information

1.1 *Administrative Information*

Manufacturer: Orcam Technologies Ltd.

Manufacturer's Address: 3 Kiryat Mada St.
P.O. Box 45157
Jerusalem, 9777603, Israel
Tel: +972-2-591-7805
Fax: +972-2-586-0121

Manufacturer's Representative: Ram Ben-Yehuda

Equipment Under Test (E.U.T.): Portable, Pocket- Sized Smart Pen Scanner

Model: Orcam Read

Equipment Serial No.: 19350032

Date of Receipt of E.U.T.: November 10, 2019

Start of Test: November 10, 2019

End of Test: November 27, 2019

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



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. Department of Innovation, Science and Economic Development (ISED) Canada, CAB identifier: IL1002

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***

Orcam Read is a portable, pocket- sized smart pen scanner.

Orcam Read provides the most advanced solution for those who suffer from reading difficulties such as dyslexia.

Working voltage	5.0VDC Rechargeable battery operated via AC/DC adapter
Mode of operation	Transceiver
Modulation	STD(Basic)/EDR
Assigned Frequency Range	2400.0-2483.5MHz
Operating Frequency Range	2402.0-2480.0MHz
Transmit power	~10.0dBm
Antenna Gain	-0.87 dBi
Modulation BW	~1MHz

1.4 ***Test Methodology***

Radiated testing was performed according to the procedures in KDB 558074 D01 v05r02 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

1 GHz to 6 GHz

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

± 5.19 dB

>6 GHz

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

± 5.51 dB



2. System Test Configuration

2.1 Justification

1. The E.U.T contains an IEEE 802.15.1 standard (STD/EDR) transceiver.
2. The unit was evaluated while transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz).
3. The evaluation was performed with the E.U.T connected to an AC/DC adapter in charge mode as the “worst case”.
5. Final radiated emission test was performed after exploratory emission testing that was performed in 3 orthogonal polarities to determine the “worst case” radiation.
6. According to the below results the “worst case” was the X axis.

Orientation	Frequency	2 nd Harmonic	3 rd Harmonic	Band Edge
	(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)
X axis	2402.0	47.4	55.2	61.2
	2440.0	48.0	55.9	-
	2480.0	47.1	55.6	73.8
Y axis	2402.0	47.0	53.8	59.8
	2440.0	47.1	54.2	-
	2480.0	46.9	54.0	73.5
Z axis	2402.0	45.2	47.6	57.4
	2440.0	45.1	48.0-	-
	2480.0	45.5	50.0	71.3

Figure 1. Screening Results

7. Conducted emission tests were performed with the E.U.T. antenna terminal connected by a RF cable to the Spectrum Analyzer through a 30dB external attenuator.

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

Equipment	Manufacturer	Part Number	Serial Number
AC/DC power supply	Shenzhen Super Eagle Technology Co. Ltd	CH06-050200-EU	N/A



2.4 ***Equipment Modifications***

No modifications were needed in order to achieve compliance.

2.5 ***Configuration of Tested System***

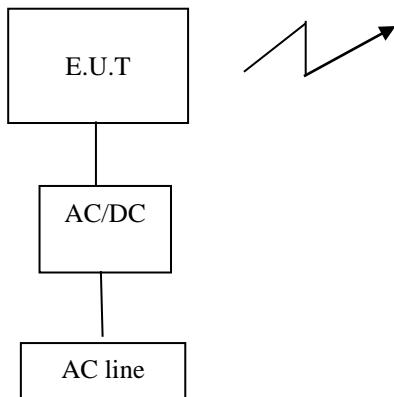


Figure 2. Configuration of Tested System – Radiated

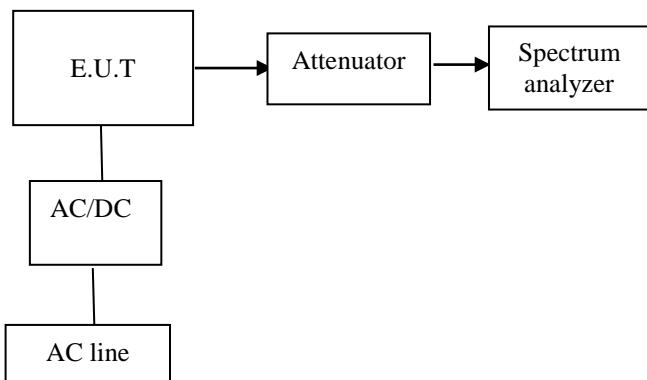


Figure 3. Configuration of Tested System – Conducted



3. Conducted & Radiated Measurement Test Set-Up Photos



Figure 4. Conducted Emission from AC line Test

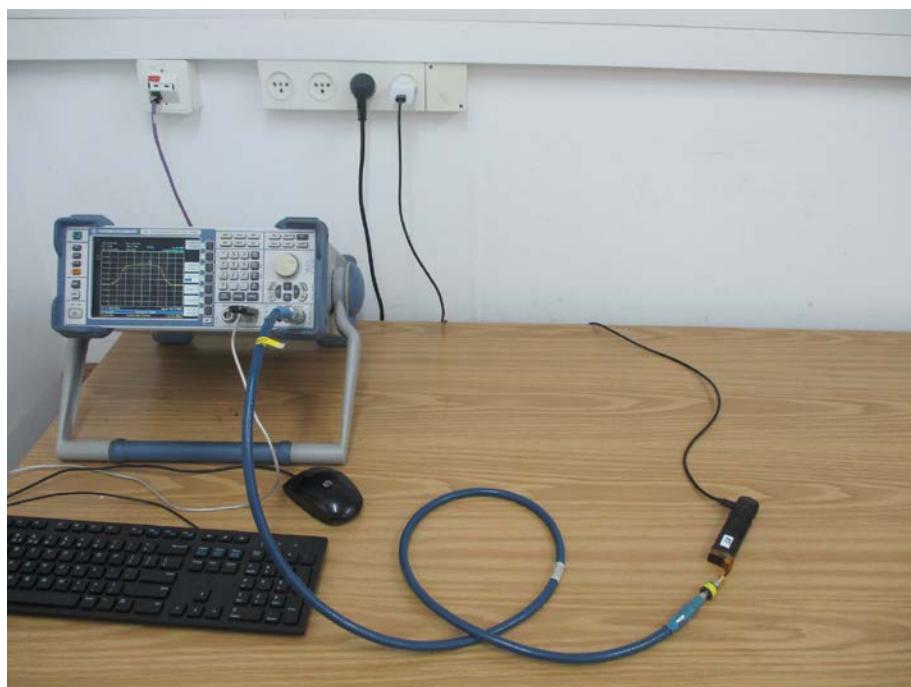


Figure 5. Conducted Emission Test



Figure 6. Radiated Emission Test, 0.009-30MHz



Figure 7. Radiated Emission Test, 30-200MHz



Figure 8. Radiated Emission Test, 200-1000MHz



Figure 9. Radiated Emission Test, 1-18GHz



Figure 10. Radiated Emission Test, 18-25GHz



4. Conducted Emission From AC Mains

4.1 Test Specification

FCC Part 15, Subpart C, Section 15.207

4.2 Test Procedure

(Temperature (20°C)/ Humidity (60%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 4. Conducted Emission from AC line Test*.

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 (EDR modulation).

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 4.75 dB

The margin between the emission levels and the specification limit is, in the worst case, -17.75 dB for the phase line at 0.578MHz and -4.75 dB at 0.578 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 Portable, Pocket- Sized Smart Pen Scanner

Type Orcam Read

Serial Number: 19350032

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 dB μ V	DELTA	LIMIT dB
1 Quasi Peak	174 kHz	40.03	-24.73	
2 Average	242 kHz	21.74	-30.28	
1 Quasi Peak	406 kHz	38.73	-18.99	
2 Average	426 kHz	27.49	-19.83	
2 Average	446 kHz	27.52	-19.42	
1 Quasi Peak	578 kHz	38.24	-17.75	
1 Quasi Peak	746 kHz	34.53	-21.46	
2 Average	1.042 MHz	27.04	-18.95	
1 Quasi Peak	1.394 MHz	24.02	-31.97	
2 Average	1.582 MHz	19.43	-26.56	
1 Quasi Peak	2.51 MHz	29.35	-26.64	
2 Average	2.51 MHz	20.03	-25.97	
1 Quasi Peak	3.65 MHz	24.92	-31.07	
2 Average	4.462 MHz	14.51	-31.48	
1 Quasi Peak	8.966 MHz	28.89	-31.10	
2 Average	9.35 MHz	18.93	-31.06	
1 Quasi Peak	14.274 MHz	29.63	-30.36	
2 Average	14.274 MHz	23.79	-26.20	
2 Average	17.694 MHz	27.59	-22.41	
1 Quasi Peak	23.142 MHz	30.02	-29.97	

Date: 24.NOV.2019 15:20:03

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 Portable, Pocket- Sized Smart Pen Scanner

Type Orcam Read

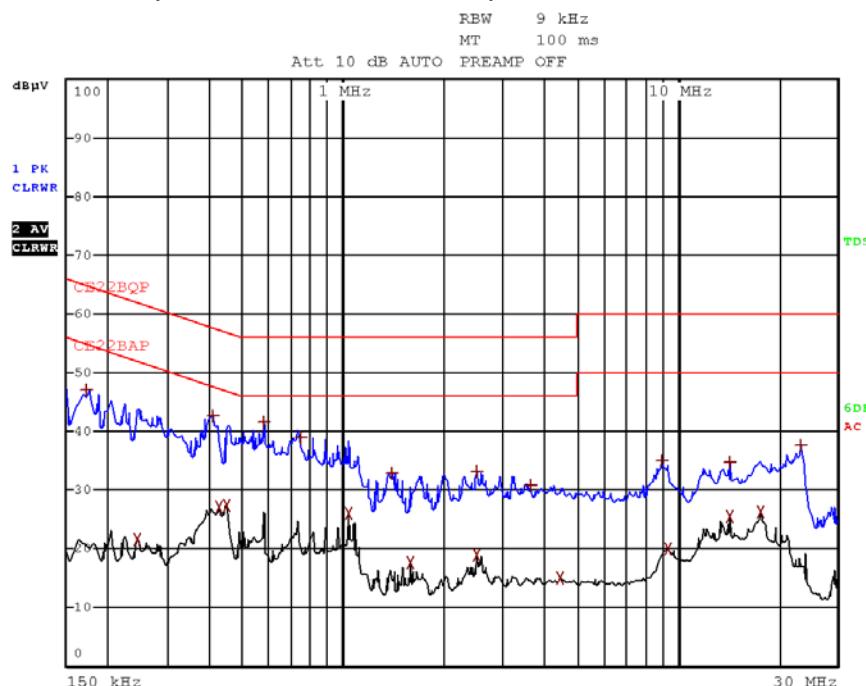
Serial Number: 19350032

Specification: FCC Part 15, Subpart C

Lead: Phase

Detectors: Peak, Quasi-peak, Average

Power Operation AC/DC adapter



Date: 24.NOV.2019 15:18:49

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



Conducted Emission

E.U.T Description Portable, Pocket- Sized Smart Pen Scanner

Type Orcam Read

Serial Number: 19350032

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 dB μ V	DELTA	LIMIT dB
1	Quasi Peak 194 kHz	39.77	-24.08	
2	Average 194 kHz	32.81	-21.05	
1	Quasi Peak 426 kHz	39.84	-17.48	
2	Average 426 kHz	31.71	-15.61	
1	Quasi Peak 578 kHz	50.99	-5.00	
2	Average 578 kHz	41.24	-4.75	
1	Quasi Peak 1.042 MHz	51.06	-4.93	
2	Average 1.042 MHz	35.51	-10.49	
1	Quasi Peak 1.582 MHz	41.90	-14.10	
2	Average 1.582 MHz	26.25	-19.74	
1	Quasi Peak 2.51 MHz	40.15	-15.84	
2	Average 2.51 MHz	27.39	-18.60	
1	Quasi Peak 3.67 MHz	25.20	-30.79	
2	Average 4.53 MHz	14.05	-31.94	
1	Quasi Peak 9.142 MHz	28.02	-31.98	
2	Average 9.314 MHz	17.27	-32.72	
1	Quasi Peak 11.97 MHz	27.14	-32.85	
2	Average 13.418 MHz	22.85	-27.14	
2	Average 17.694 MHz	25.30	-24.69	
1	Quasi Peak 23.158 MHz	27.52	-32.47	

Date: 24.NOV.2019 15:32:40

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 Portable, Pocket- Sized Smart Pen Scanner

Type Orcam Read

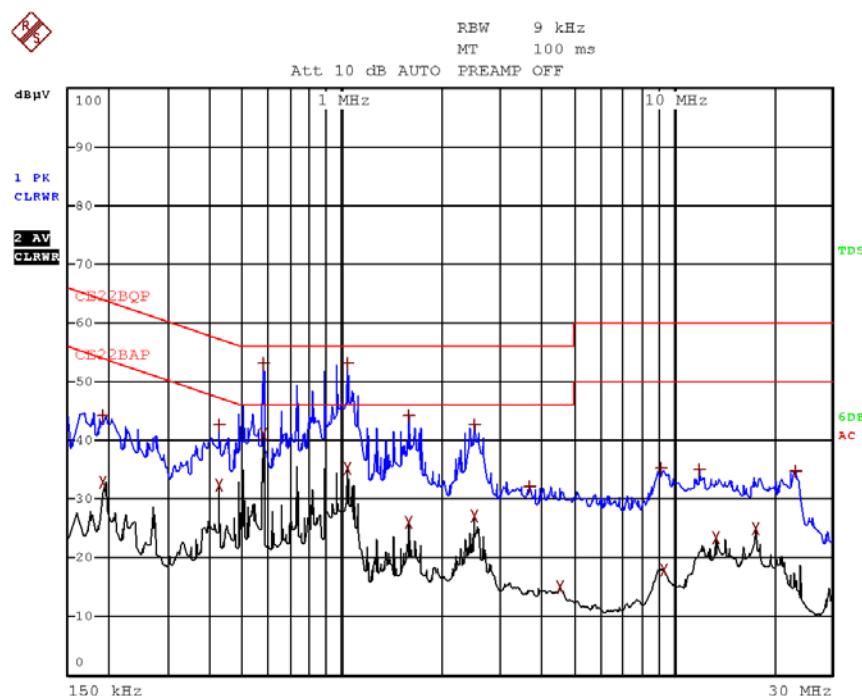
Serial Number: 19350032

Specification: FCC Part 15, Subpart C

Lead: Neutral

Detectors: Peak, Quasi-peak, Average

Power Operation AC/DC adapter



Date: 24.NOV.2019 15:31:24

Figure 14 Detectors: Peak, Quasi-peak, Average



4.5 Test Equipment Used; Conducted Emission from AC Mains

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
LISN	Fischer	FCC-LISN-25A	127	September 8, 2019	September 30, 2020
Transient Limiter	HP	11947A	3107A01308	September 16, 2019	September 30, 2020
EMI Receiver	Rohde & Schwarz	ESCI7	100724	February 27, 2019	February 28, 2020
Cable CE Chamber 3M + 3M	Testline 18 + RJ214	11556	-	March 31, 2019	March 31, 2020

Figure 15 Test Equipment Used



5. 20dB Minimum Bandwidth

5.1 Test Specification

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

5.2 Test Procedure

(Temperature (20°C)/ Humidity (60%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 20dB bandwidth, centered on a hopping channel

RBW \geq 1% of the 20dB bandwidth

Detector Function: Peak, Trace: Maximum Hold.

5.3 Test Limit

N/A

5.4 Test Results

Modulation	Operation Frequency	Bandwidth Reading
(STD/EDR)	(MHz)	(kHz)
STD	2402.0	868.3
	2440.0	880.2
	2480.0	880.2
EDR	2402.0	1309.4
	2440.0	1309.4
	2480.0	1309.4

Figure 16 Test Results

JUDGEMENT: Passed

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

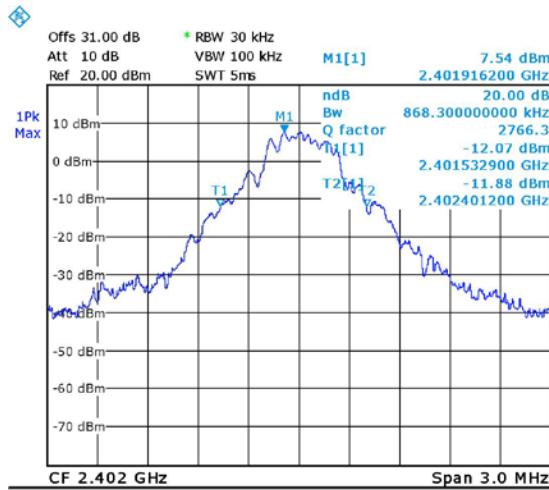


Figure 17. 2402MHz, STD



Figure 18. 2440MHz, STD

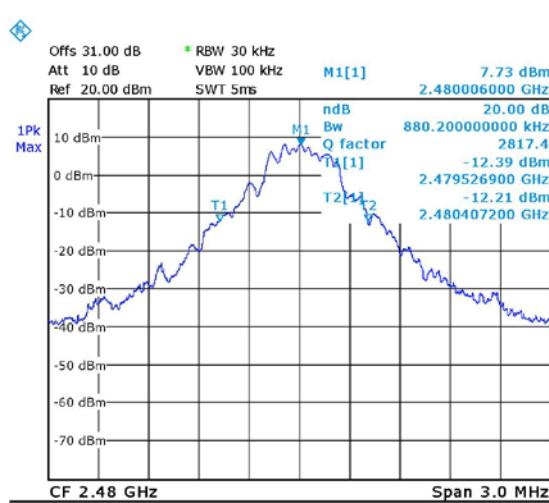


Figure 19. 2480MHz, STD

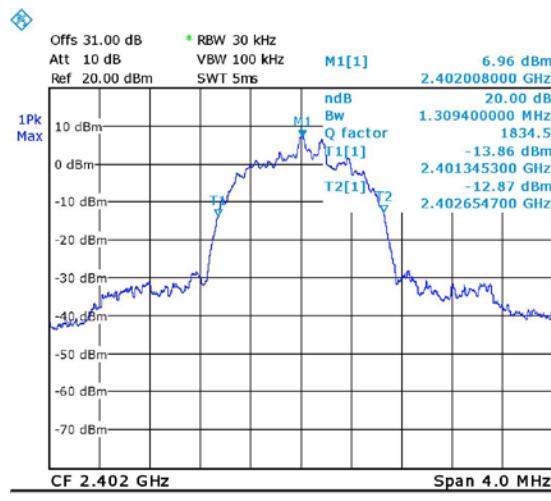


Figure 20. 2402MHz, EDR

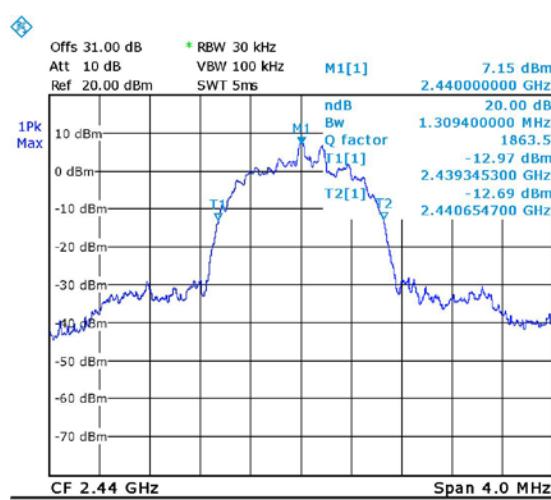


Figure 21. 2440MHz, EDR

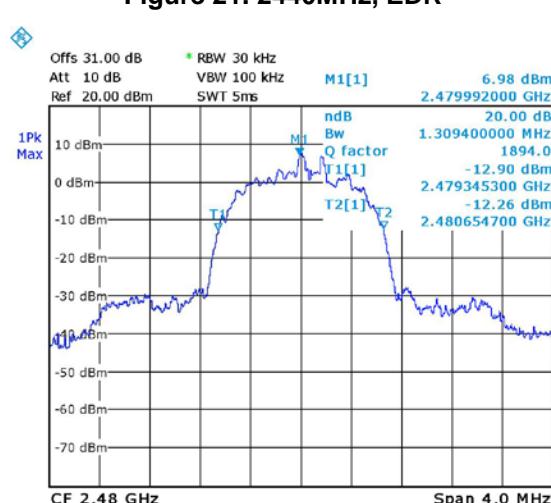


Figure 22. 2480MHz, EDR



5.5 **Test Equipment Used, 20 dB Minimum Bandwidth**

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 23 Test Equipment Used



6. Occupied Bandwidth

6.1 Test Specification

FCC, Part 15, Subpart C, Section 2.1048

6.2 Test Procedure

(Temperature (20°C)/ Humidity (60%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 = ~ 3 times the Occupied bandwidth, centered on a hopping channel.

RBW = 1% -5% of the Occupied bandwidth

Detector Function: Peak, Trace: Maximum Hold.

6.3 Test Limit

N/A

6.4 Test Results

Modulation (STD/EDR)	Operation Frequency (MHz)	Bandwidth Reading (kHz)
STD	2402.0	868.2
	2440.0	874.2
	2480.0	874.2
EDR	2402.0	1185.0
	2440.0	1185.0
	2480.0	1191.0

Figure 24 Test Results

JUDGEMENT: Passed

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

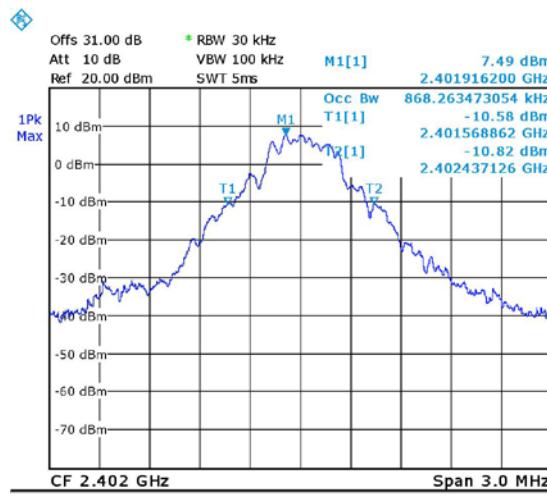


Figure 25. 2402MHz, STD

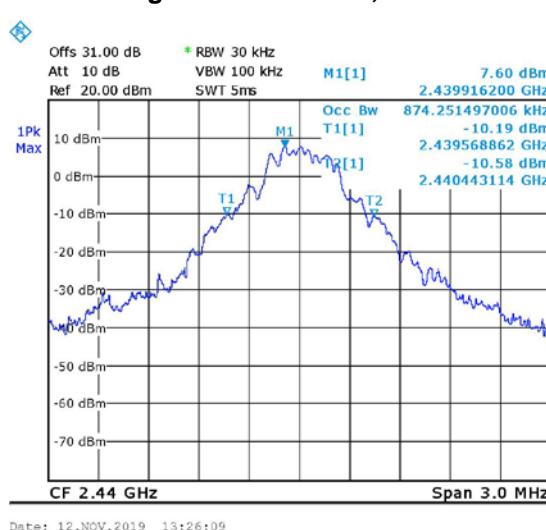


Figure 26. 2440MHz, STD

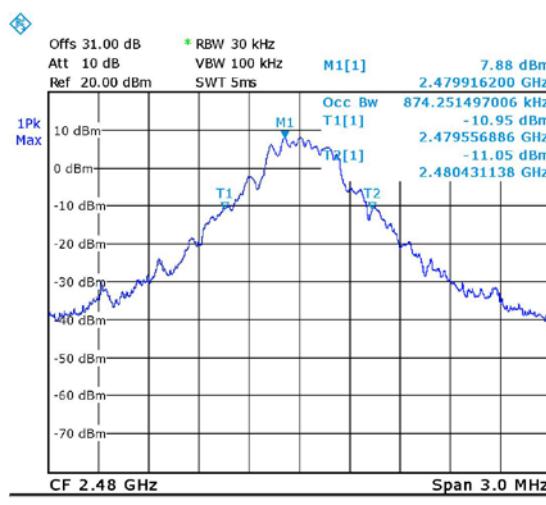


Figure 27. 2480MHz, STD

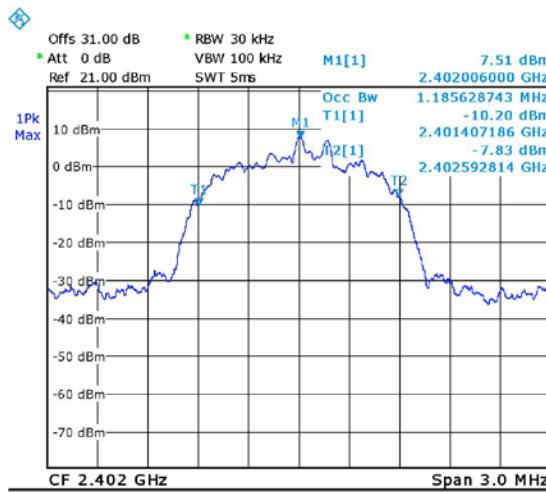


Figure 28. 2402MHz, EDR

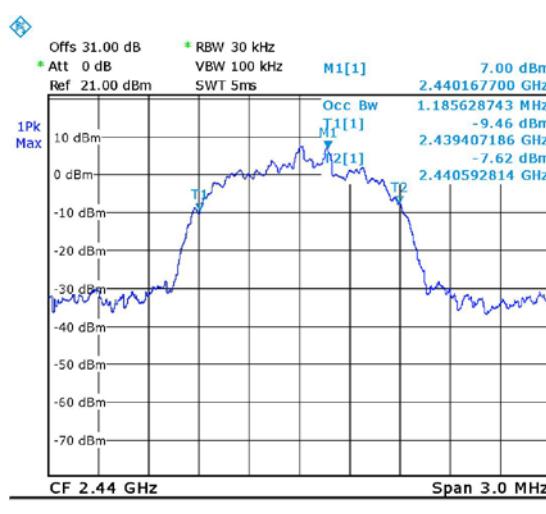


Figure 29. 2440MHz, EDR

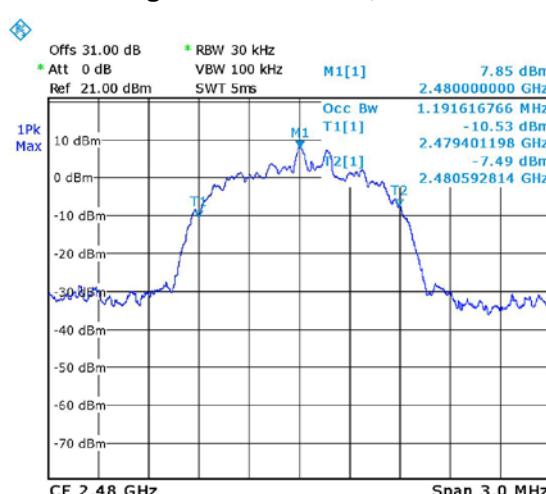


Figure 30. 2480MHz, EDR



6.5 *Test Equipment Used, Occupied Bandwidth*

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 31 Test Equipment Used



7. Number of Hopping Frequencies

7.1 Test Specification

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

7.2 Test Procedure

(Temperature (20°C)/ Humidity (60%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 15/75 Channels.

7.4 Test Results

Modulation	Number of Hopping Frequencies	Limit
STD	79	≥15/75
EDR	79	≥15/75

Figure 32 Test Results

JUDGEMENT: Passed

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

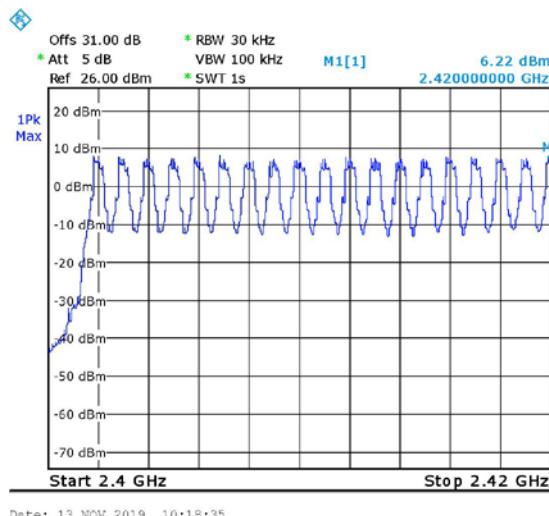


Figure 33. Number of Channels, Band 1, STD

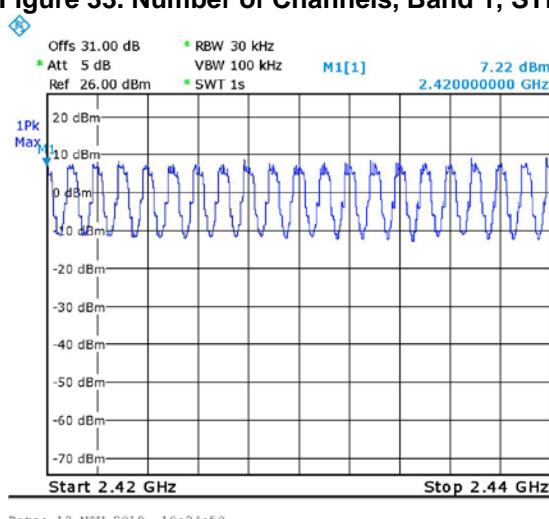


Figure 34. Number of Channels, Band 2, STD

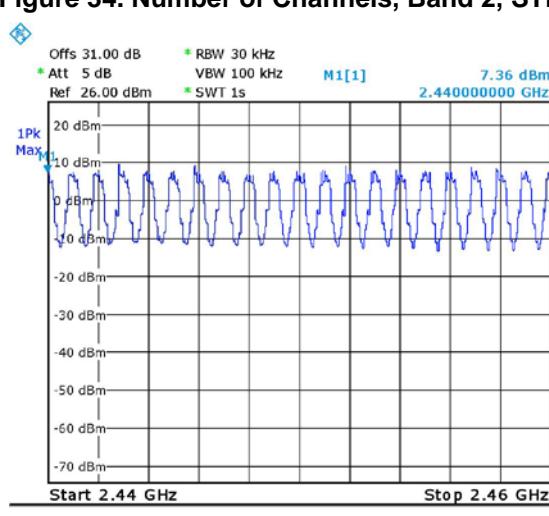


Figure 35. Number of Channels, Band 3, STD

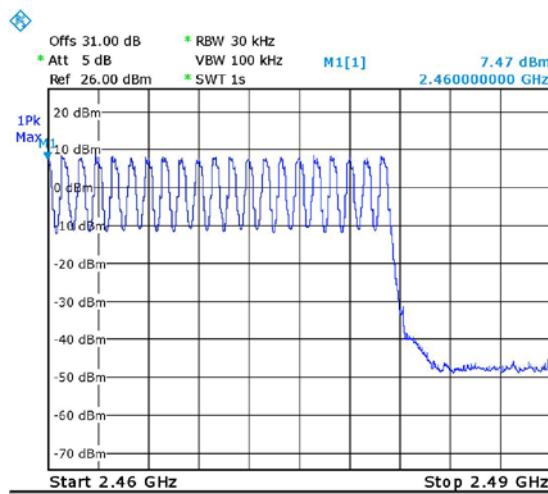


Figure 36. Number of Channels, Band 4, STD

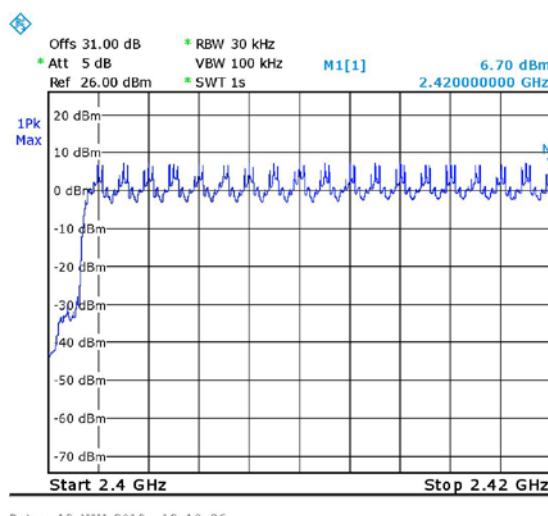


Figure 37. Number of Channels, Band 1, EDR

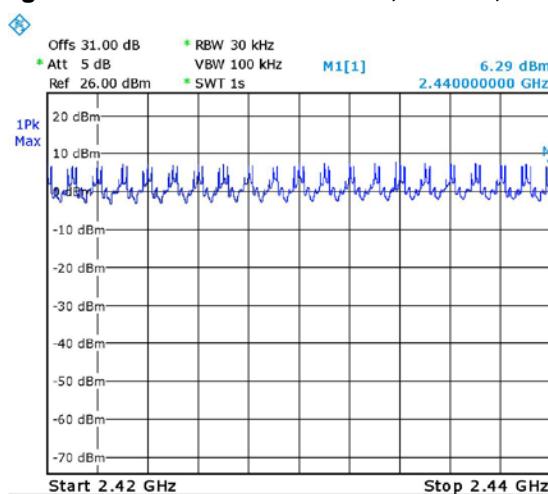


Figure 38. Number of Channels, Band 2, EDR

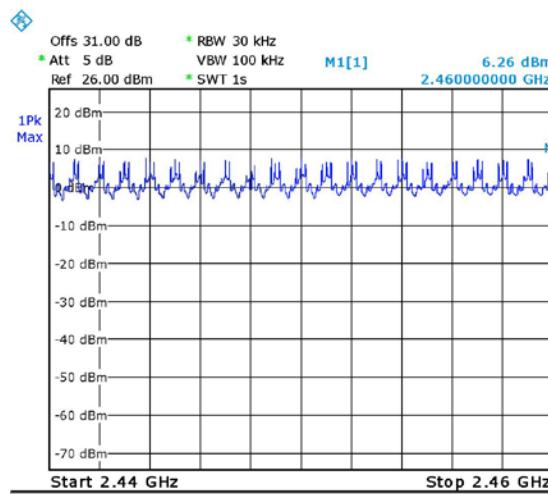


Figure 39. Number of Channels, Band 3, EDR

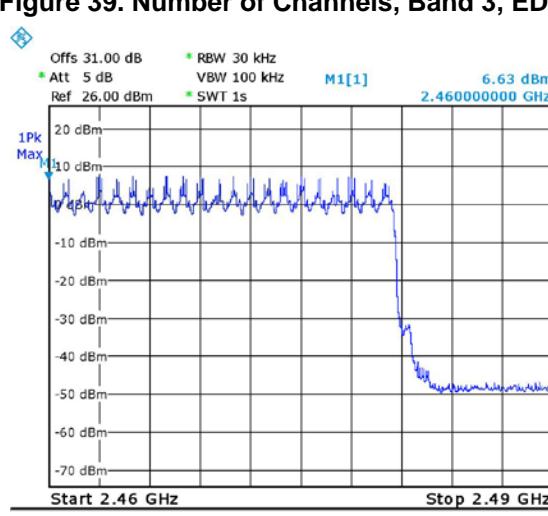


Figure 40. Number of Channels, Band 4, EDR

7.5 Test Equipment Used, Number of Hopping Frequencies

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 41 Test Equipment Used



8. Channel Frequency Separation

8.1 Test Specification

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

8.2 Test Procedure

(Temperature (20°C)/ Humidity (60%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 \geq 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 20dB 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 20dB 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

Modulation	Channel Frequency Separation	Limit
(STD/EDR)	(kHz)	(kHz)
STD	1006.0	\geq 880.2
EDR	1000.0	\geq 2/3*(1309.4)=872.0

Figure 42 Test Results

JUDGEMENT: Passed

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

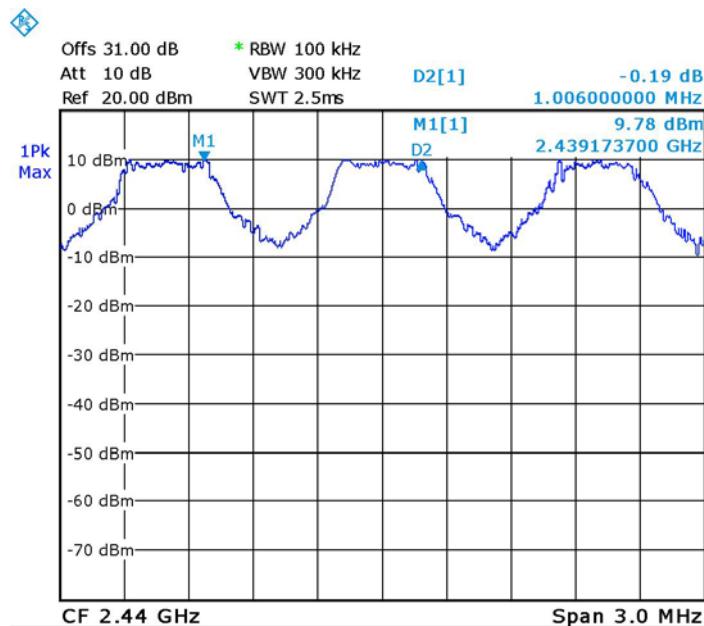


Figure 43. Channel Frequency Separation, STD

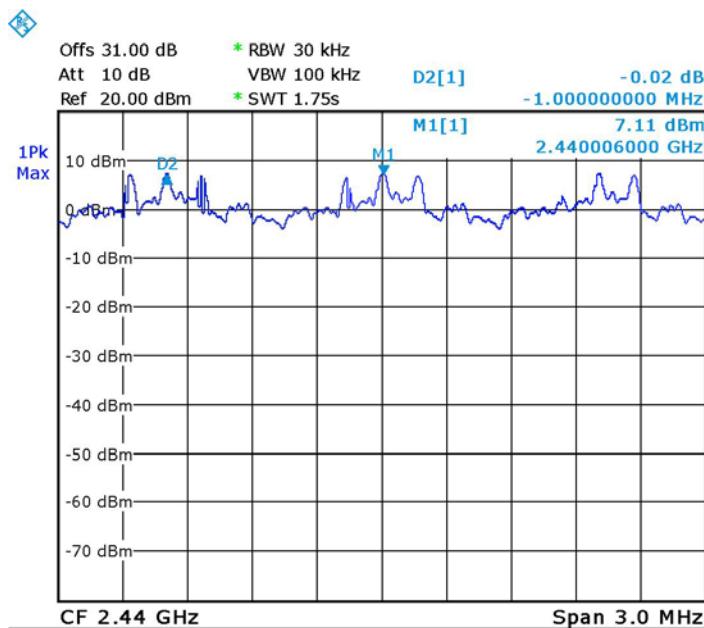


Figure 44. Channel Frequency Separation, EDR



8.5 **Test Equipment Used, Channel Frequency Separation Test**

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 45 Test Equipment Used



9. Peak Output Power

9.1 Test Specification

FCC Part 15, Subpart C: section 15.247(b)(1)

9.2 Test Procedure

(Temperature (20°C)/ Humidity (60% RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.0dB).

The spectrum analyzer was set to the following parameters:

Span = ~5 times the 20dB bandwidth, centered on a hopping channel

RBW \geq of the 20dB bandwidth of the emission being measured

Detector Function: Peak, Trace: Maximum Hold.

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 Watts. (The limits above applies to antenna gain until 6dBi).

9.4 Test Results

Modulation	Operation Frequency	Power (dBm)	Power (mW)	Limit (mW)	Margin (mW)
(STD/EDR)	(MHz)	(dBm)	(mW)	(mW)	(mW)
STD	2402.0	10.1	10.2	1000.0	-989.8
	2440.0	10.3	10.7	1000.0	-989.3
	2480.0	10.5	11.2	1000.0	-988.8
EDR	2402.0	10.4	11.0	125.0	-114.0
	2440.0	10.6	11.5	125.0	-113.5
	2480.0	10.8	12.0	125.0	-113.0

Figure 46 Radiated Power Output Test Results

JUDGEMENT: Passed by 113.0mW

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



Peak Output Power

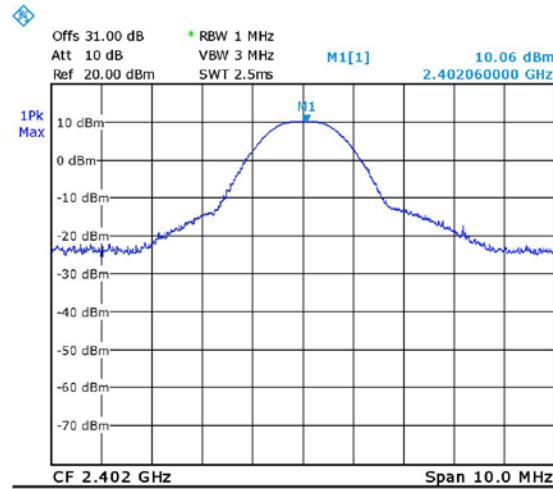


Figure 47. 2402MHz, STD

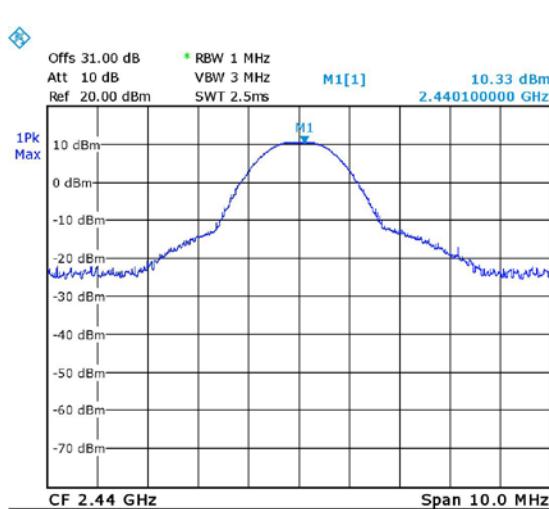


Figure 48. 2440MHz, STD

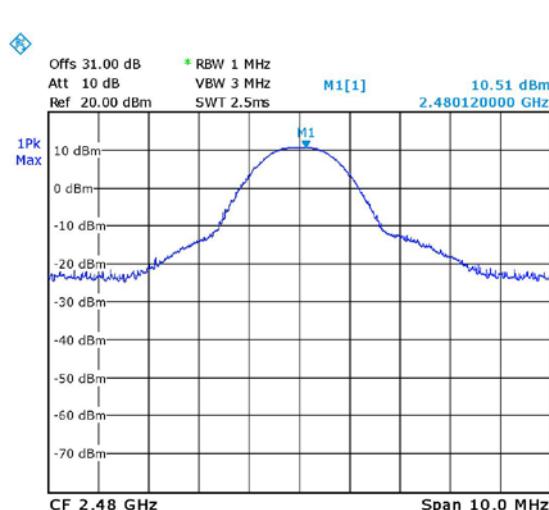


Figure 49. 2480MHz, STD



Peak Output Power

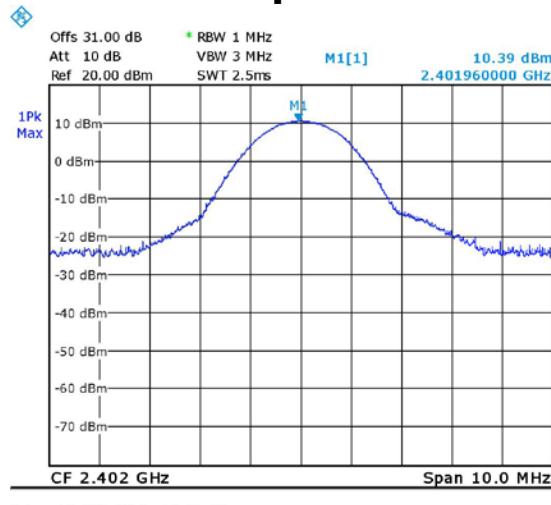


Figure 50. 2402MHz, EDR

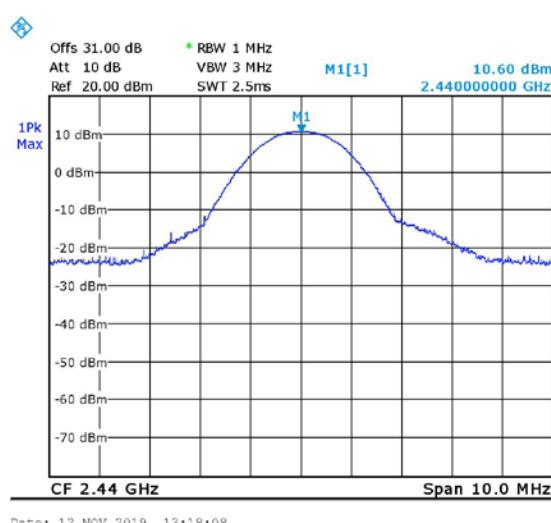


Figure 51. 2440MHz, EDR

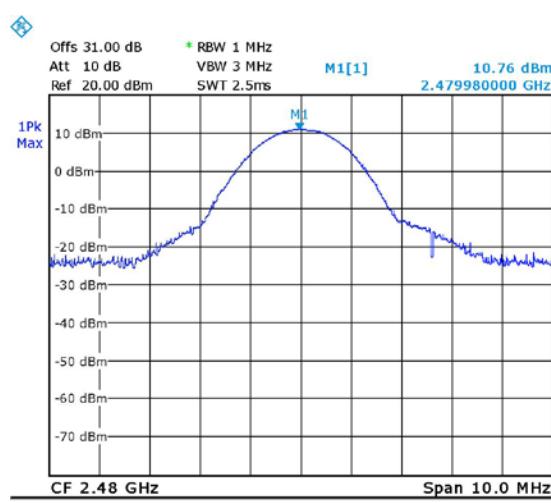


Figure 52. 2480MHz, EDR



9.5 *Test Equipment Used, Peak Output Power*

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 53 Test Equipment Used



10. Dwell Time on Each Channel

10.1 Test Specification

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

10.2 Test Procedure

(Temperature (20°C)/ Humidity (60%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

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(d).

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



Results for STD:

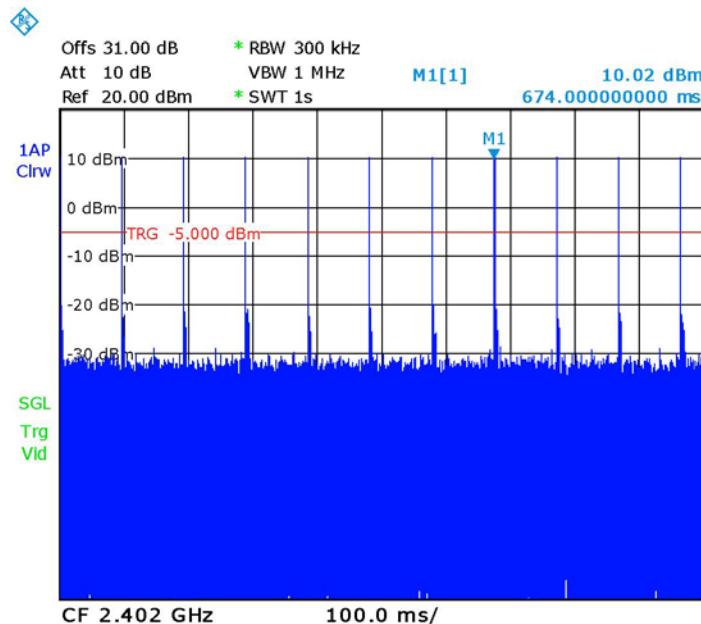


Figure 54 Number of Bursts in 1 sec=11

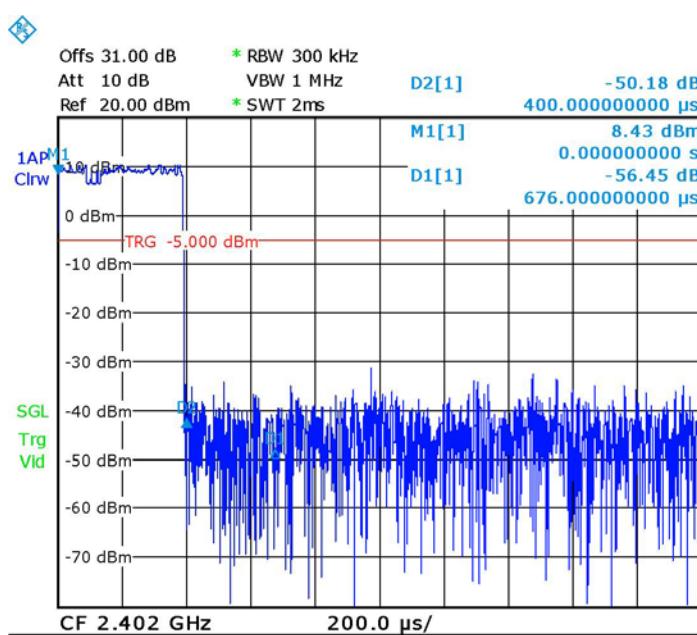
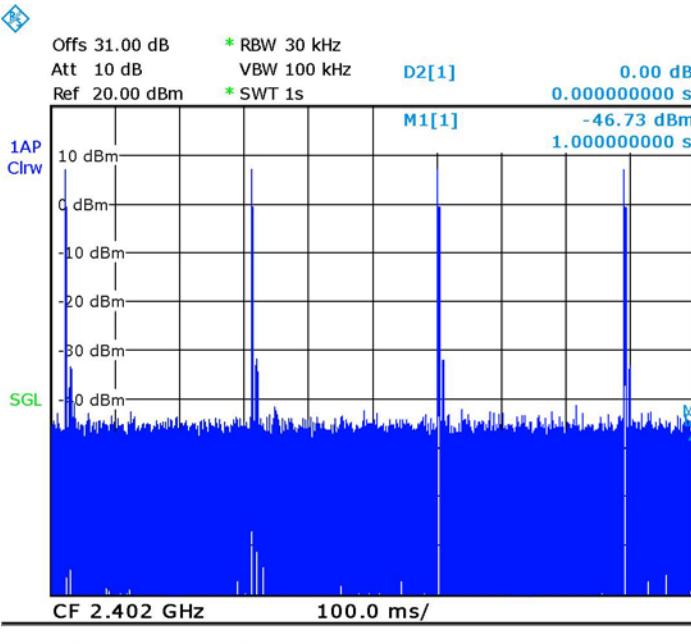


Figure 55 Burst Duration =0.4msec
DWELL TIME (31.6*11)*0.4m= 139msec<400msec

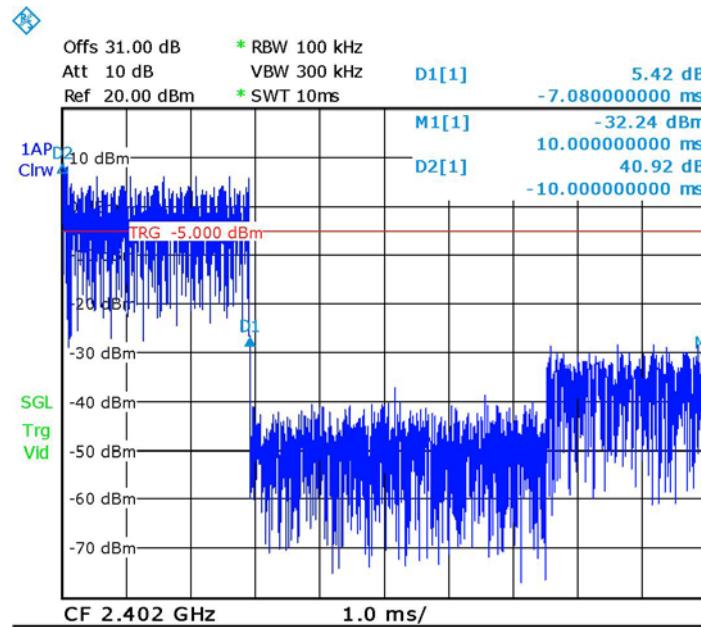


Results for EDR:



Date: 12.NOV.2019 14:06:17

Figure 56 — Number of Bursts in 1 sec=4



Date: 12.NOV.2019 14:07:49

Figure 57 — Burst Duration =3msec
DWELL TIME = $(31.6^*4)^*3\text{m} = 379\text{msec} < 400\text{msec}$



10.5 *Test Equipment Used, Dwell Time on Each Channel*

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 58 Test Equipment Used



11. Band Edge

11.1 ***Test Specification***

FCC Part 15, Section 15.247(d)

11.2 ***Test Procedure***

(Temperature (20°C)/ Humidity (60% 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.



11.4 Test Results

Modulation (STD/EDR)	Mode	Operation Frequency	Band Edge Frequency	Spectrum Level	Limit	Margin
		(MHz)	(MHz)	(dBm)	(dBm)	(dB)
STD	Hopping	2402-2480	2400.0	-39.1	-10.5	-28.6
			2483.5	-37.5	-10.2	-27.3
	Non- Hopping	2402	2400.0	-34.4	-10.5	-23.9
		2480	2483.5	-10.1	-39.1	29.0
EDR	Hopping	2402-2480	2400.0	-11.6	-37.6	26.0
			2483.5	-11.2	-38.4	27.2
	Non- Hopping	2402	2400.0	-11.4	-31.9	20.5
		2480	2483.5	-11.0	-38.6	27.6

Figure 59 Band Edge Test Results

JUDGEMENT: Passed by 20.5dB

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

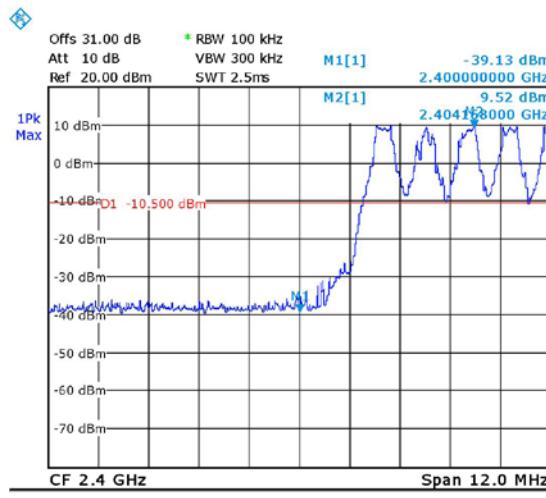


Figure 60 Hopping, Band Edge Low, STD

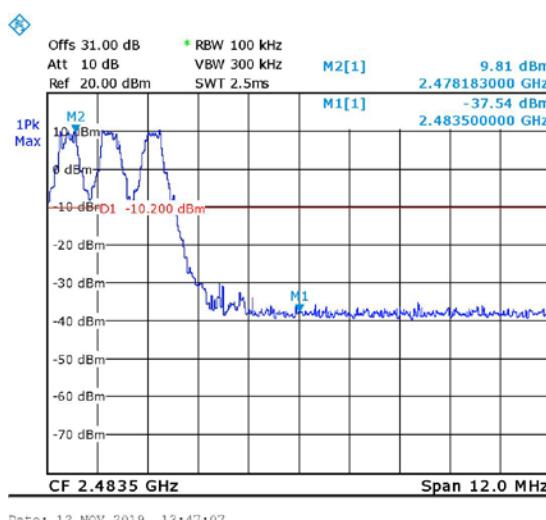


Figure 61 Hopping, Band Edge High, STD

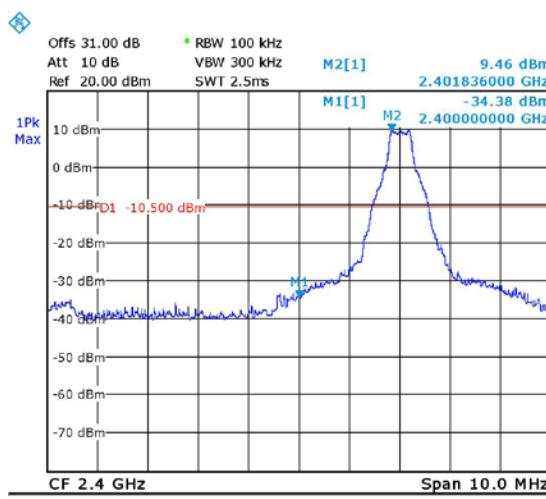
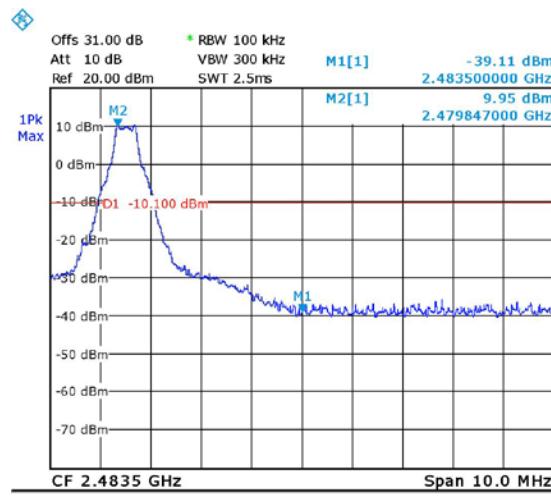
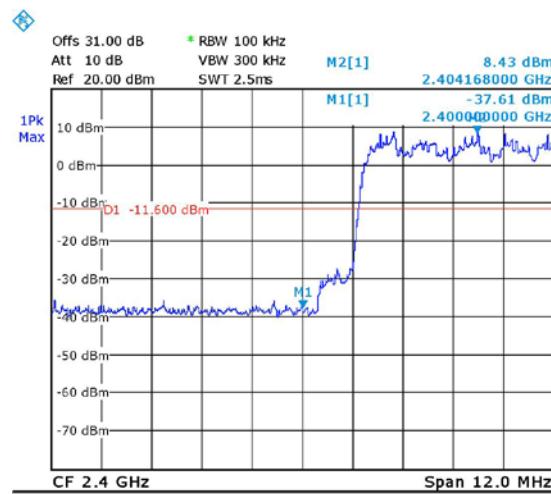


Figure 62 Non-Hopping, Band Edge Low, STD



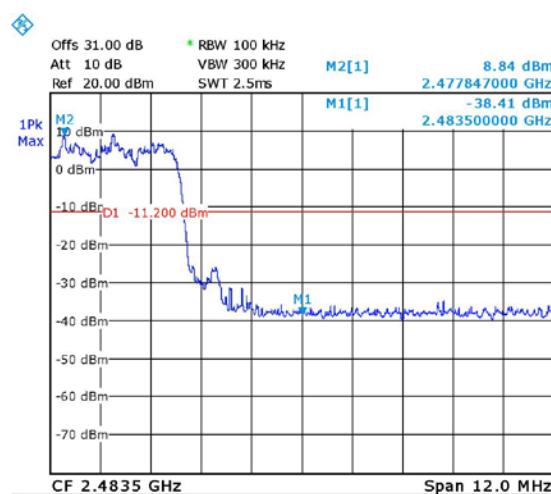
Date: 12.NOV.2019 13:45:26

Figure 63 Non-Hopping, Band Edge High, STD



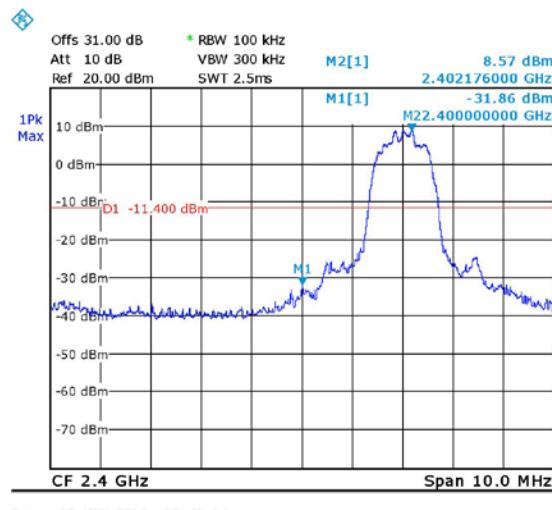
Date: 12.NOV.2019 13:42:01

Figure 64 Hopping, Band Edge Low, EDR



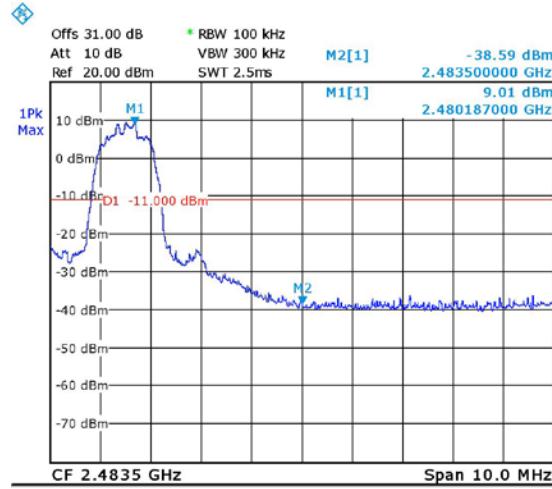
Date: 12.NOV.2019 13:40:34

Figure 65 Hopping, Band Edge High, EDR



Date: 12.NOV.2019 13:43:14

Figure 66 Non-Hopping, Band Edge Low, EDR



Date: 12.NOV.2019 13:38:24

Figure 67 Non-Hopping, Band Edge High, EDR



11.5 *Test Equipment Used, Band Edge*

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

Figure 68 Test Equipment Used



12. Emissions in Non-Restricted Frequency Bands

12.1 Test Specification

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

12.2 Test Procedure

(Temperature (20°C)/ Humidity (60% RH)

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (max loss=44.0dB).

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".

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 20 dB 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) specification.

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

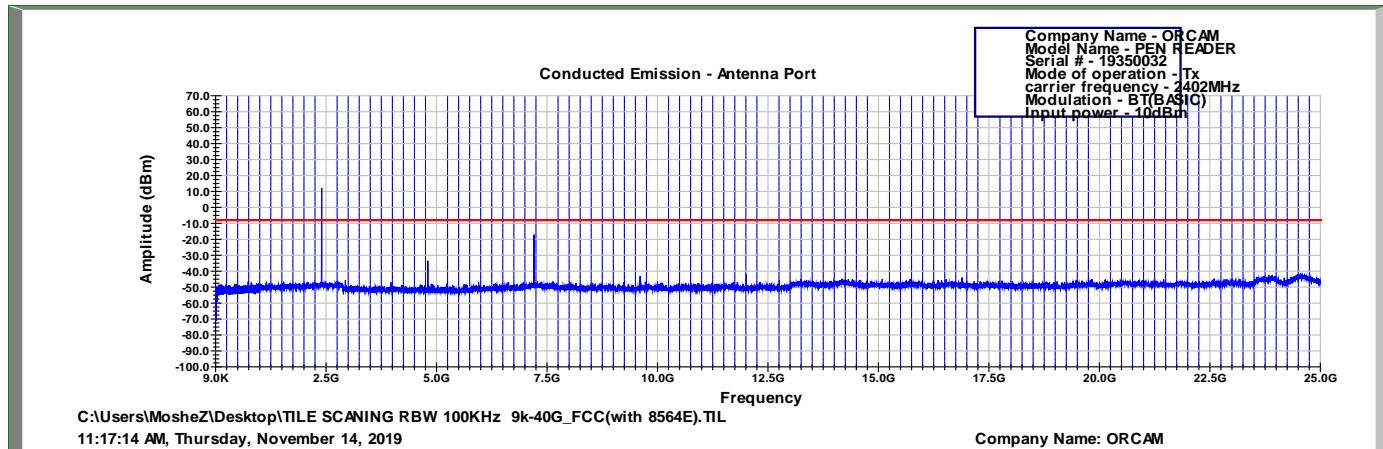


Figure 69. Conducted Emissions 2402MHz, STD

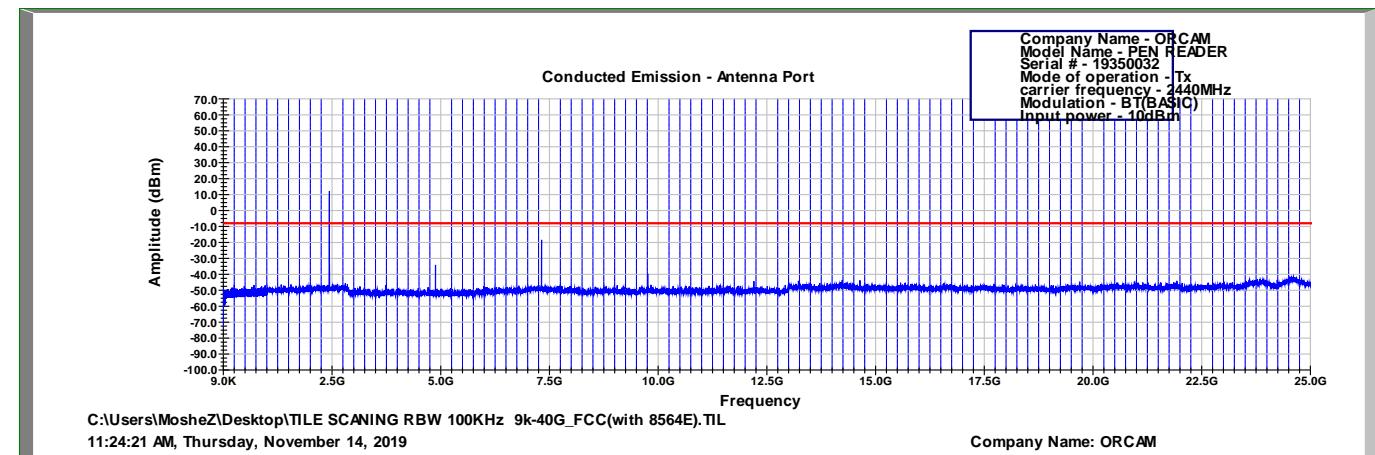


Figure 70. Conducted Emissions 2440MHz, STD

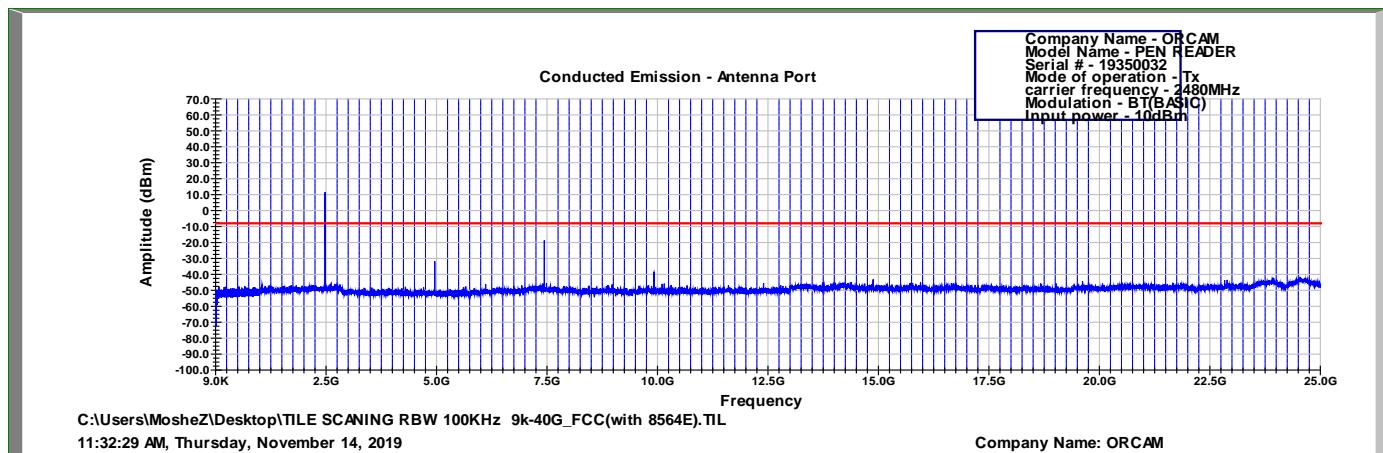


Figure 71. Conducted Emissions 2480MHz, STD

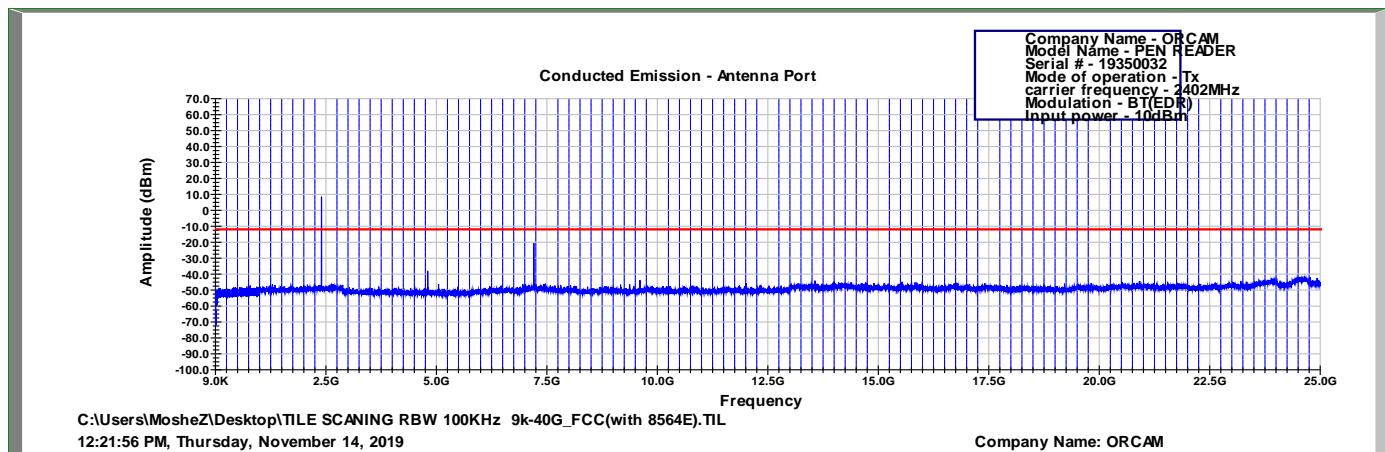


Figure 72. Conducted Emissions 2402MHz, EDR

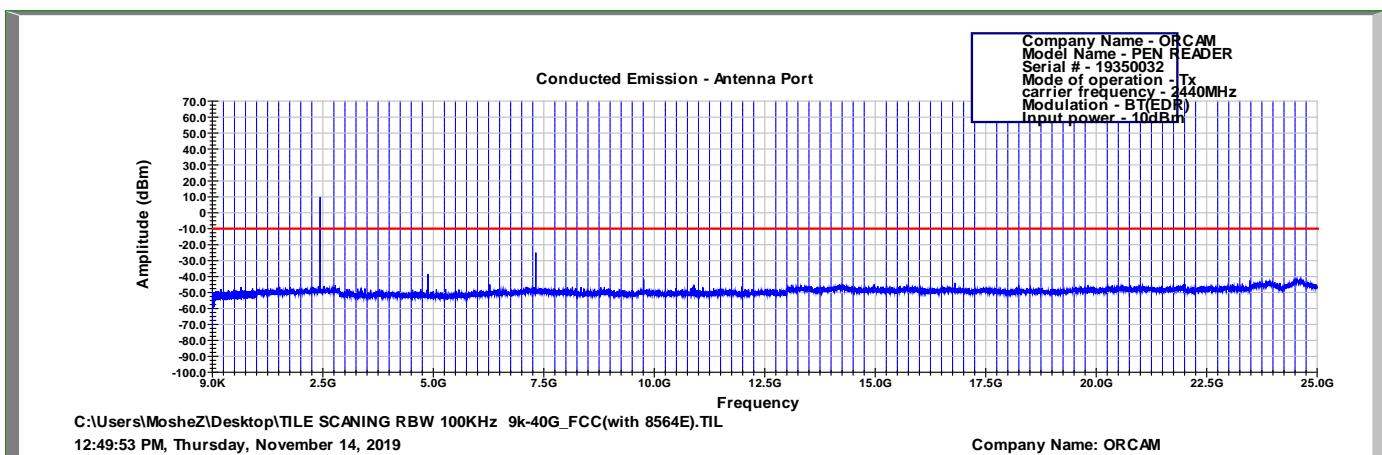


Figure 73. Conducted Emissions 2440MHz, EDR

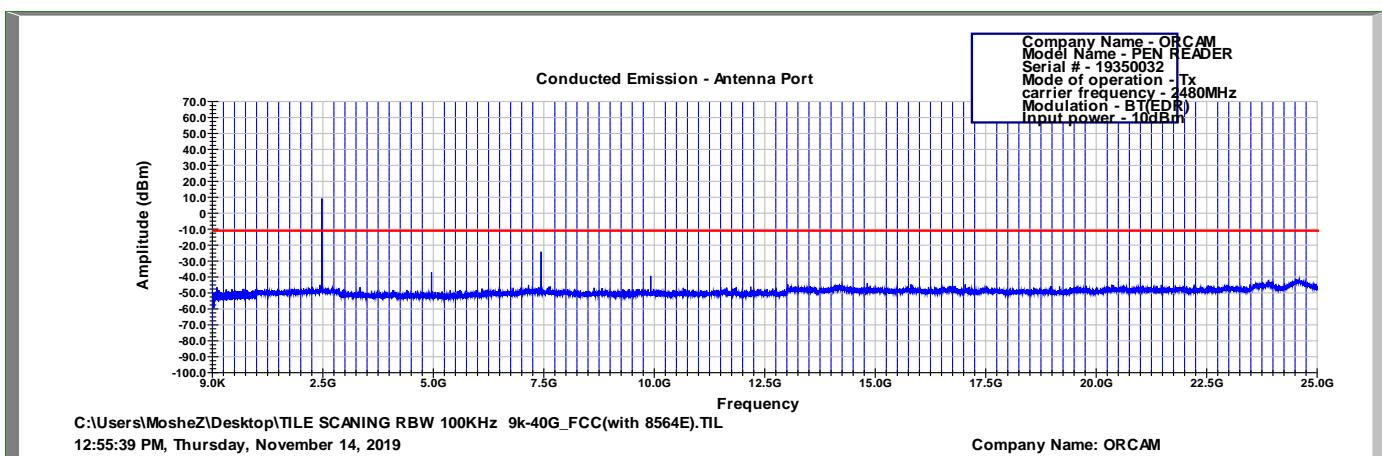


Figure 74. Conducted Emissions 2480MHz, EDR



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

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 24, 2019	March 31, 2020
30dB Attenuator	MCL	BW-S30W5	533	December 24, 2018	December 31, 2019
RF Cable	Huber Suner	Sucofelex	27502/4PEA	December 24, 2018	December 31, 2019

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

13.2 ***Test Procedure***

(Temperature (20°C)/ Humidity (40%RH))

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

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, 0.8 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 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* (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.

13.4 Test Results

JUDGEMENT: Passed

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

For additional information see *Figure 76* and *Figure 77*.



Radiated Emission

E.U.T Description Portable, Pocket- Sized Smart Pen Scanner
Type Orcam Read
Serial Number: 19350032

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9 kHz to 25.0 GHz
Modulation: STD Detector: Peak, Average

Operation Frequency	Freq.	Pol.	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
2402.0	2390.0	V	56.7	74.0	-17.3	14.4	54.0	-39.6
	2390.0	H	53.3	74.0	-20.7	11.0	54.0	-43.0
	7206.0	V	55.1	74.0	-18.9	12.8	54.0	-41.2
	7206.0	H	49.0	74.0	-25.0	6.7	54.0	-47.3
2440.0	4880.0	V	47.7	74.0	-26.3	5.4	54.0	-48.6
	4880.0	H	47.9	74.0	-26.1	5.6	54.0	-48.4
	7320.0	V	55.8	74.0	-18.2	13.5	54.0	-40.5
	7320.0	H	51.2	74.0	-22.8	8.9	54.0	-45.1
2480.0	7440.0	V	56.1	74.0	-17.9	13.8	54.0	-40.2
	7440.0	H	51.0	74.0	-23.0	8.7	54.0	-45.3
	2483.5	V	63.2	74.0	-10.8	20.9	54.0	-33.1
	2483.5	H	73.8	74.0	-0.2	31.5	54.0	-22.5

Figure 76. Radiated Emission Results - STD

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



Radiated Emission

E.U.T Description Portable, Pocket- Sized Smart Pen Scanner
Type Orcam Read
Serial Number: 19350032

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency range: 9 kHz to 25.0 GHz
Modulation: EDR Detector: Peak, Average

Operation Frequency	Freq.	Pol.	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
2402.0	2390.0	V	55.4	74.0	-18.6	24.7	54.0	-29.3
	2390.0	H	53.1	74.0	-20.9	22.4	54.0	-31.6
	7206.0	V	55.0	74.0	-19.0	24.3	54.0	-29.7
	7206.0	H	50.8	74.0	-23.2	20.1	54.0	-33.9
2440.0	4880.0	V	49.0	74.0	-25.0	18.3	54.0	-35.7
	4880.0	H	48.1	74.0	-25.9	17.4	54.0	-36.6
	7320.0	V	54.6	74.0	-19.4	23.9	54.0	-30.1
	7320.0	H	51.8	74.0	-22.2	21.1	54.0	-32.9
2480.0	7440.0	V	55.2	74.0	-18.8	24.5	54.0	-29.5
	7440.0	H	49.3	74.0	-24.7	18.6	54.0	-35.4
	2483.5	V	63.2	74.0	-10.8	32.5	54.0	-21.5
	2483.5	H	73.4	74.0	-0.6	42.7	54.0	-11.3

Figure 77. Radiated Emission Results - EDR

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



13.5 Test Equipment Used, Emissions in Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 27, 2019	February 28, 2020
EMI Receiver	HP	8542E	3906A00276	February 28, 2019	February 28, 2020
RF Filter Section	HP	85420E	3705A00248	February 28, 2019	February 28, 2020
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	February 26, 2019	February 280, 2020
Active Loop Antenna	EMCO	6502	9506-2950	February 5, 2019	February 28, 2020
Biconical Antenna	EMCO	3110B	9912-3337	May 21, 2019	May 31, 2021
Log Periodic Antenna	EMCO	3146	9505-4081	May 31, 2018	May 31, 2020
Horn Antenna	ETS	3115	29845	May 31, 2018	May 31, 2021
Horn Antenna	ARA	SWH-28	1007	December 31, 2017	December 31, 2020
MicroWave System Amplifier	HP	83006A	3104A00589	December 24, 2018	December 31, 2019
Low Noise Amplifier 1GHz-18GHz	Miteq	AFSX4-02001800-50-8P	-	December 24, 2018	December 31, 2019
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132	December 24, 2018	December 31, 2019
RF Cable Oats	EIM	RG214-11N(X2)		May 26, 2019	May 31, 2020
Filter Band Pass 4-20 GHz	Meuro	MFL040120H50	902252	December 24, 2018	December 24, 2019
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

Figure 78 Test Equipment Used



14. Avg. Factor Calculation

1. Pulse period = 1 (worst scenario)
2. Pulse duration = 1 (worst scenario)
3. STD Burst duration = 0.4msec
4. EDR Burst duration= 3msec

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

6. STD Average factor = -42.3
7. EDR Average factor = -30.7

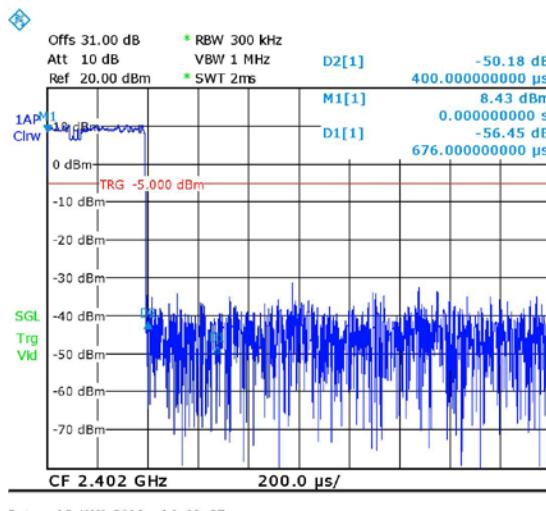


Figure 79. Burst Duration, STD

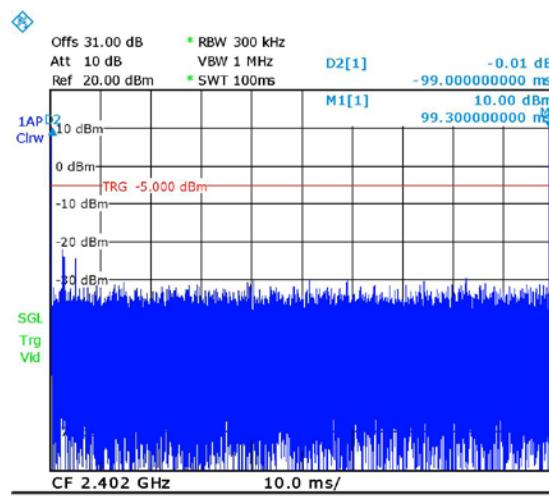
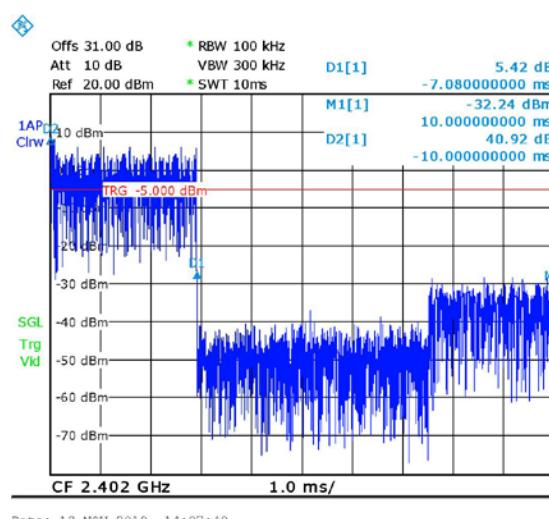
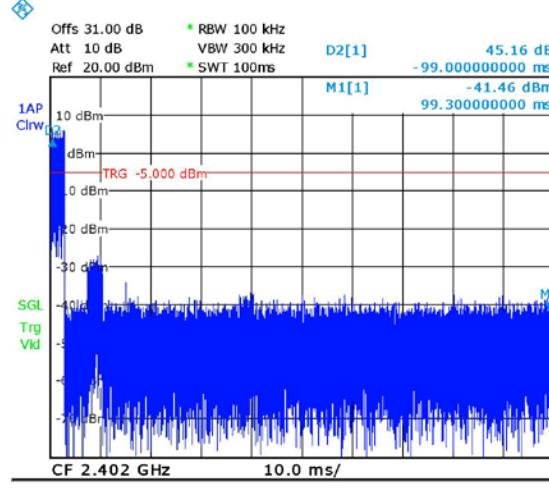


Figure 80. Number of Bursts in 100msec=2, STD



Date: 12.NOV.2019 14:07:49

Figure 81. Burst Duration, EDR



Date: 12.NOV.2019 14:13:48

Figure 82. Number of Bursts in 100msec=1, EDR



14.1 *Test Equipment Used, Average Factor*

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	March 24, 2019	March 31, 2020

Figure 83 Test Equipment Used



15. Antenna Gain/Information

The antenna gain is – 0.87dBi, PCB printed type.



16. R.F Exposure/Safety

Typical use of the E.U.T. is as a pen scanner.

The typical distance between the E.U.T. and the user is 0.4 cm.

SAR Testing Exclusion Based on Section 4.3.1 and Appendix A of KDB 447498 D01 V06 Requirements

For FCC

Section 4.3.1 and Appendix A of KDB447498 D01 V06 was used as the guidance as follows:

Conducted power output = 10.8dBm = 12.02mW

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

= $12.02/4 * 1.55=4.66$ this value is less than 7.5 for 10-g extremity SAR.

The SAR measurement is not necessary.



17. APPENDIX A - CORRECTION FACTORS

17.1 *Correction factors for RF OATS Cable 35m ITL #1911*

Frequency (MHz)	loss (dB)
30.0	1.3
50.0	1.7
100.0	2.6
200.0	3.7
300.0	4.7
400.0	5.5
500.0	6.3
600.0	7.0
700.0	7.6
800.0	8.4
900.0	9.0
1000.0	9.6



17.2 Correction factor for RF CABLE for Semi Anechoic Chamber

ITL # 1840

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



**17.3 Correction factors for Active Loop Antenna
ITL # 1075:**

f(MHz)	AF(dB/m)
0.01	18.4
0.02	14.3
0.03	13.3
0.05	11.7
0.1	11.4
0.2	11.2
0.3	11.2
0.5	11.2
0.7	11.2
1	11.4
2	11.5
3	11.5
4	11.4
5	11.3
6	11.1
7	11.1
8	11.1
9	11
10	11
20	10
30	8



17.4 Correction factors for biconical antenna – ITL # 1356

Frequency [MHz]	AF [dB/m]
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17



17.5 Correction factors for log periodic antenna – ITL # 1349

Frequency [MHz]	AF [dB/m]
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22



17.6 Correction factors for Double -Ridged Waveguide Horn ANTENNA

ITL # 1352

FREQUENCY (GHz)	AFE (dB/m)	FREQUENCY (GHz)	AFE (dB/m)
0.75	25	9.5	38
1.0	23.5	10.0	38.5
1.5	26.0	10.5	38.5
2.0	29.0	11.0	38.5
2.5	27.5	11.5	38.5
3.0	30.0	12.0	38.0
3.5	31.5	12.5	38.5
4.0	32.5	13.0	40.0
4.5	32.5	13.5	41.0
5.0	33.0	14.0	40.0
5.5	35.0	14.5	39.0
6.0	36.5	15.0	38.0
6.5	36.5	15.5	37.5
7.0	37.5	16.0	37.5
7.5	37.5	16.5	39.0
8.0	37.5	17.0	40.0
8.5	38.0	17.5	42.0
9.0	37.5	18.0	42.5



17.7 Correction factors for

Horn Antenna

ITL #:1353

CALIBRATION DATA

3 m distance

Frequency, MHz	Measured antenna factor, dB/m ¹⁾
18000	32.4
18500	32.0
19000	32.3
19500	32.4
20000	32.3
20500	32.8
21000	32.8
21500	32.7
22000	33.1
22500	33.0
23000	33.1
23500	33.8
24000	33.5
24500	33.5
25000	33.8
25500	33.9
26000	34.2
26500	34.7

¹⁾ The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.