



Date: 1 March 2022

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

FCC Radio Test Report

for

Aquestia Ltd.

Equipment under test:

Electronic Hydraulic Controller Device

ConDor

Tested by:

M. Zohar

Approved by:

D. Shidlowsky

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Measurement/Technical Report for

Aquestia Ltd.

Electronic Hydraulic Controller Device

ConDor

FCC ID: 2ASHC-AQUESTIA2X

This report concerns:

Original Grant: X

Class I Change:

Class II Change:

Equipment type:

FCC: (DTS) Digital Transmission System

Limits used:

47CFR15 Section 15.247

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

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1. General Information

1.1 Administrative Information

Manufacturer:	Aquestia Ltd.
Manufacturer's Address:	Kfar Haruv, Golan Heights, Kfar Haruv 1293200, Israel Tel: +972.4.6761980
Manufacturer's Representative:	Amir Chapnik
Equipment Under Test (E.U.T):	Electronic Hydraulic Controller Device
Equipment Model:	ConDor
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	January 04, 2022
Start of Test:	January 04, 2022
End of Test:	January 06, 2022
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod 7120101, Israel
Test Specifications:	FCC Part 15, Subpart C, 47 CFR § 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

The Condor is an electronic hydraulic controller device, focused on automatic operation in hydraulic infrastructures (hydraulic and mechanical valves) in order to achieve hydraulic Setpoints (pressure, level, salinity, flow, etc.)

The Condor has a CC2541F128RHAT Bluetooth chipset, implemented in the main Condor PCB.

Equipment Type							
☒	Stand Alone (Equipment with/without its own control provisions)						
Intended Use				Condition of use			
☒	Fixed			Always of distance >20 cm from the people			
Assigned frequency band				2400-2483.5 MHz			
Operational frequencies				2402-2480 MHz			
Antenna Connection							
☐	Unique Coupling	☐	Standard Connection	☒	Integral	☐	With temporary RF connector
						☒	Without temporary RF connector
Antenna Gain				3.3 dB			
Operating Channel Bandwidth				Programmable, 1-MHz steps, 2379-2496 MHz			
Transmitter Power Source							
☒	AC			Nominal /rated voltage		115V/ 110-240VAC	
☐	DC			Nominal rated voltage			
☒	Rechargeable Battery (backup)			Nominal /rated voltage		12 V/ 12-24VDC, via AC/DC Adapter	
AC/DC adapter details :							
Manufactory:				MEAN WELL			
Part number:				GST25A12			

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v03r05, ANSI C63.10: 2013 and RSS-Gen, Issue 5, April 2018. 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):
 ± 3.44 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 transceivers: IEEE 802.15.1 standard (BLE)
2. For BLE - 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 while the E.U.T was connected to typical AC/DC adapter for charge mode as the “worst case”.
4. Final radiated emission tests were performed after exploratory emission testing that was performed in 3 orthogonal polarities to determine the “worst case” radiation.
5. According to screening results below, the “worst case” for BLE protocol was the Y axis

Orientation	Frequency	Field Strength	2 nd Harmonic	3 rd Harmonic	Band Edge
	(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)
X axis	2402.0	81.8	61.0	47.3	52.0
	2440.0	83.2	62.7	49.7	-
	2480.0	80.3	60.9	48.2	52.2
Y axis	2402.0	82.0	61.6	47.8	52.3
	2440.0	83.6	63.5	50.2	-
	2480.0	80.6	61.2	48.7	53.0
Z axis	2402.0	80.1	59.2	45.1	50.1
	2440.0	81.8	61.4	47.5	-
	2480.0	79.7	59.5	46.3	50.4

Figure 1. Screening Results BLE mode

2.2 EUT Exercise Software

No special exercise software was used.

2.3 *Special Accessories*

No special accessories was used.

2.4 *Equipment Modifications*

Initial the E.U.T failed in radiated spurious emission in restricted band test . the customer reduce the power level from 0dBm to -4dBm and passed the tests

2.5 *Configuration of Tested System*

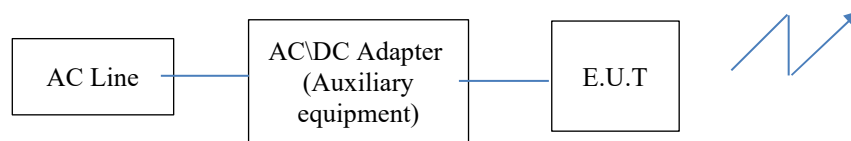


Figure 2. Configuration of Tested System



3. Conducted and Radiated Measurement Test Setup Photos

See a separate file.

4. Conducted Emission from AC Mains

4.1 Test Specification

FCC Part 15, Subpart C, Section 15.207

4.2 Test Procedure

(Temperature (22°C)/ Humidity (56%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 emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

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

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

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

4.3 Test Limit

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

* Decreases with the logarithm of the frequency.



4.4 Test Results

JUDGEMENT: Passed by -17.77 dB

The margin between the emission levels and the specification limit is, in the worst case, -19.90 dB for the phase line at 446 kHz and -17.77 dB at 470 kHz for the neutral line.

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

The details of the highest emissions are given in Figure 3 to Figure 6.



Conducted Emission

E.U.T Description Electronic Hydraulic
Controller Device
Type ConDor
Serial Number: Not designated

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
1	Quasi Peak	154 kHz	40.33	-25.45
2	Average	246 kHz	23.16	-28.72
1	Quasi Peak	418 kHz	29.40	-28.08
2	Average	422 kHz	22.71	-24.69
2	Average	446 kHz	27.04	-19.90
1	Quasi Peak	454 kHz	36.07	-20.73
2	Average	1.042 MHz	16.61	-29.39
1	Quasi Peak	1.122 MHz	24.10	-31.89
2	Average	1.27 MHz	17.48	-28.51
1	Quasi Peak	1.398 MHz	23.20	-32.79
1	Quasi Peak	2.422 MHz	24.57	-31.42
2	Average	2.55 MHz	18.60	-27.39
2	Average	3.63 MHz	13.22	-32.77
1	Quasi Peak	3.646 MHz	18.15	-37.84
2	Average	9.73 MHz	22.51	-27.48
1	Quasi Peak	9.738 MHz	26.35	-33.64
1	Quasi Peak	10.886 MHz	25.78	-34.22
2	Average	13.938 MHz	29.62	-20.38
1	Quasi Peak	18.694 MHz	22.71	-37.29
2	Average	18.698 MHz	19.79	-30.20

Date: 6.JAN.2022 18:58:18

Figure 3. 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 Electronic Hydraulic
Controller Device

Type ConDor

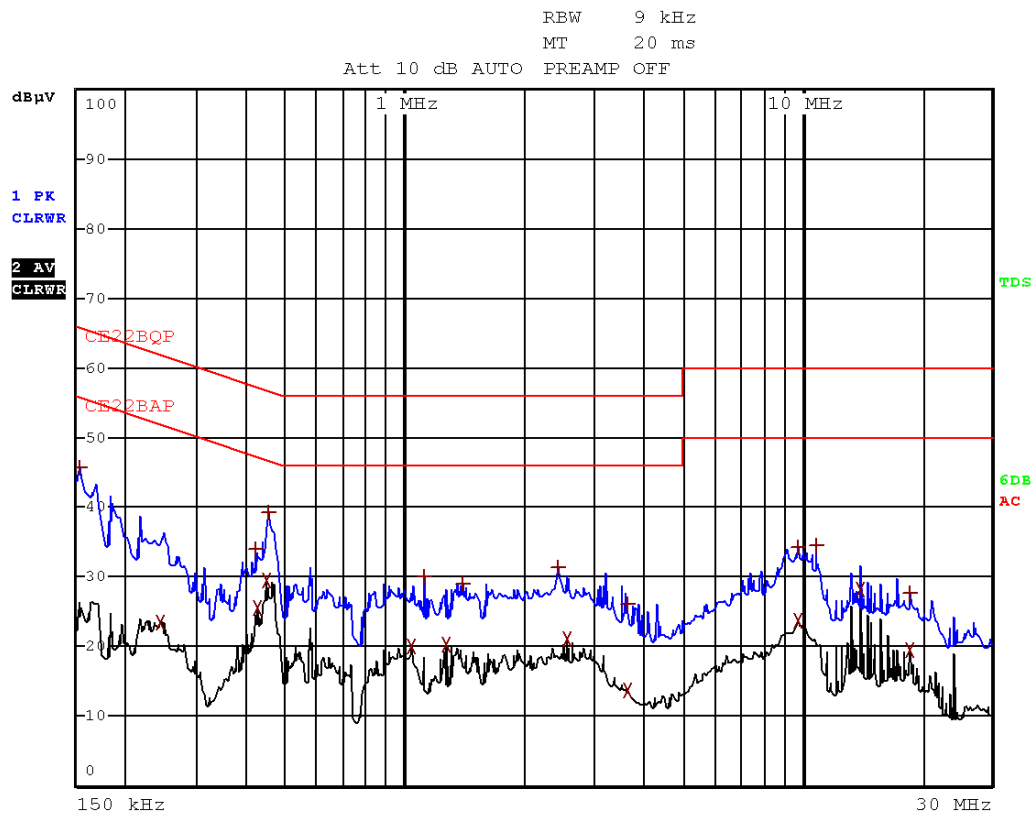
Serial Number: Not designated

Specification: FCC Part 15, Subpart C;

Lead: Phase

Detectors: Peak, Quasi-peak, Average

Power Operation AC/DC Adapter



Date: 6.JAN.2022 18:57:05

Figure 4. Detectors: Peak, Quasi-peak, Average



Conducted Emission

E.U.T Description Electronic Hydraulic
Controller Device
Type ConDor
Serial Number: Not designated

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	162 kHz	40.35	-25.00	
2 Average	162 kHz	23.62	-31.73	
2 Average	422 kHz	22.58	-24.82	
1 Quasi Peak	426 kHz	28.23	-29.09	
1 Quasi Peak	470 kHz	35.38	-21.12	
2 Average	470 kHz	28.73	-17.77	
1 Quasi Peak	886 kHz	24.05	-31.94	
2 Average	890 kHz	17.29	-28.70	
1 Quasi Peak	1.654 MHz	22.56	-33.44	
2 Average	1.934 MHz	15.65	-30.34	
2 Average	3.066 MHz	23.58	-22.41	
1 Quasi Peak	3.418 MHz	27.47	-28.52	
2 Average	3.63 MHz	19.59	-26.40	
1 Quasi Peak	4.15 MHz	23.63	-32.36	
2 Average	10.27 MHz	21.80	-28.19	
1 Quasi Peak	10.39 MHz	25.93	-34.07	
2 Average	10.658 MHz	20.61	-29.38	
1 Quasi Peak	11.006 MHz	25.98	-34.01	
1 Quasi Peak	18.022 MHz	18.68	-41.31	
2 Average	18.022 MHz	13.23	-36.76	

Date: 6.JAN.2022 19:26:08

Figure 5. 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

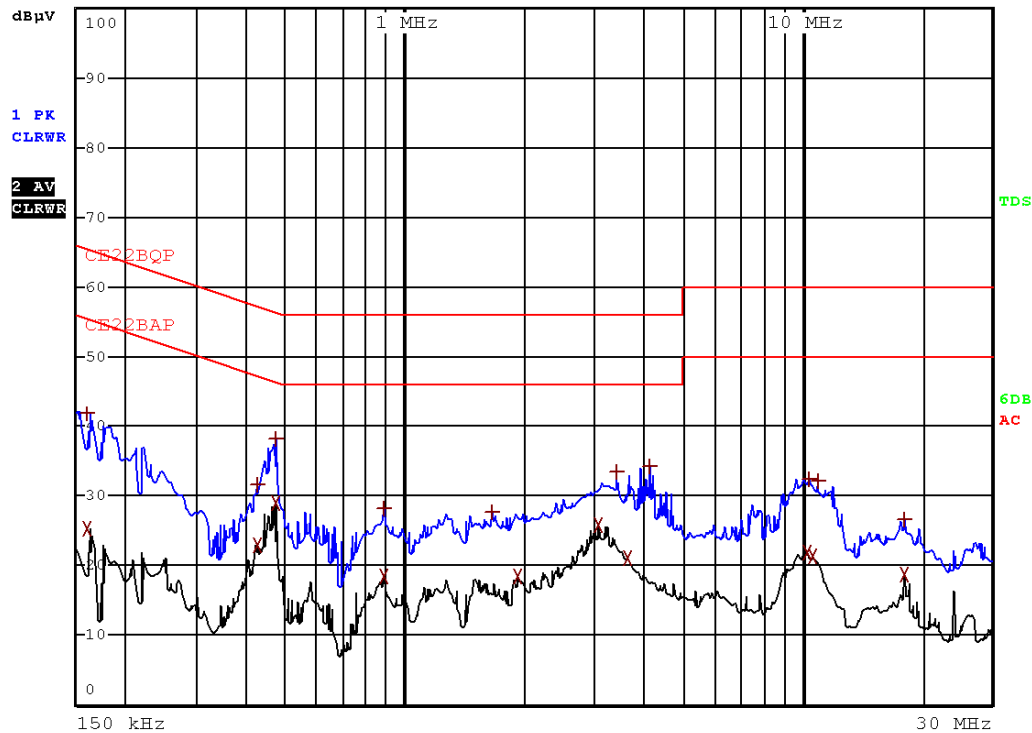
E.U.T Description Electronic Hydraulic
Controller Device
Type ConDor
Serial Number: Not designated

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



RBW 9 kHz
MT 10 ms

Att 10 dB AUTO PREAMP OFF



Date: 6.JAN.2022 19:18:44

Figure 6 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	128	January 1, 2022	January 18, 2023
Transient Limiter	HP	11947A	3107A01308	September 14, 2021	September 14, 2022
EMI Receiver	Rohde & Schwarz	ESCI7	100724	February 23, 2021	February 23, 2022
Cable	Telrad	RJ214	-	April 25, 2021	April 25, 2022

Figure 7 Test Equipment Used

5. 6 dB Minimum Bandwidth

5.1 Test Specification

FCC Part 15, Subpart C, Section 247(a)(2)

5.2 Test Procedure

(Temperature (22°C)/ Humidity (57%RH))

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

The E.U.T was tested in the chamber and was placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters.

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

5.3 Test Limit

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.4 Test Results

Protocol Type	Operation Frequency	Reading	Limit
	(MHz)	(kHz)	(kHz)
BLE	2402.0	689.0	>500.0
	2440.0	669.0	>500.0
	2480.0	709.0	>500.0

Figure 8 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see Figure 9 to Figure 11.

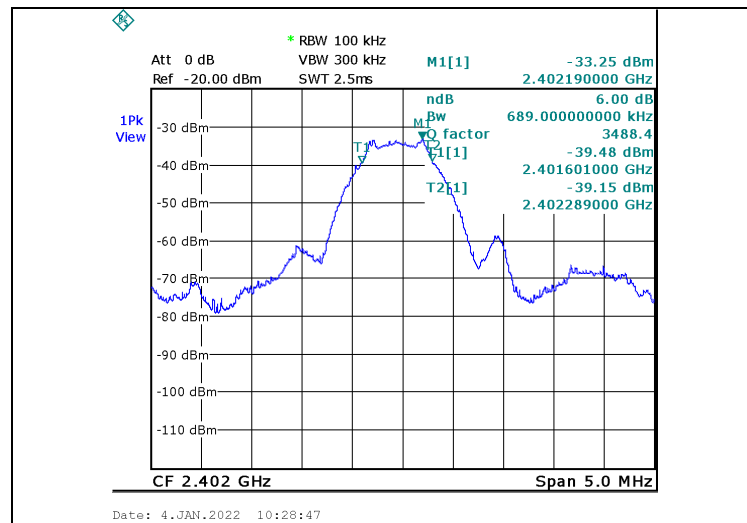


Figure 9. 2402.0 MHz, BLE

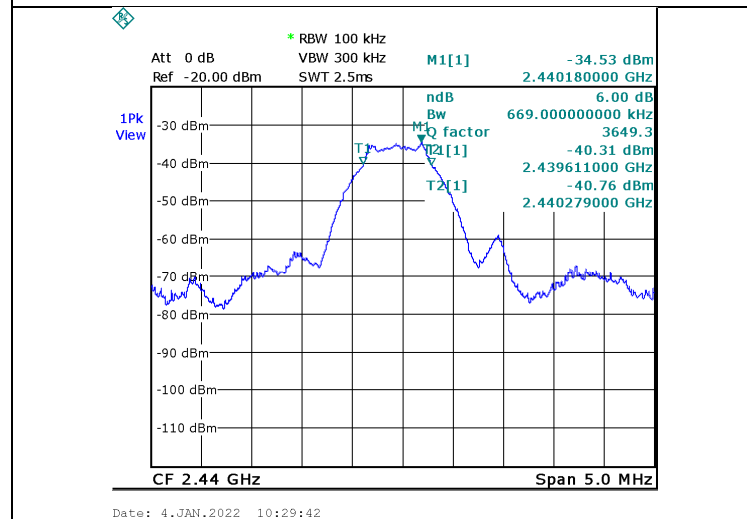


Figure 10. 2440.0 MHz, BLE

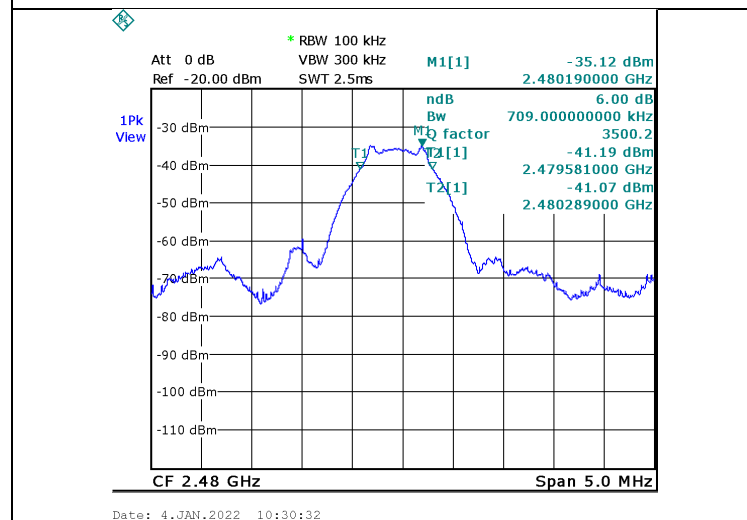


Figure 11. 2480.0 MHz, BLE



5.5 Test Equipment Used

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	February 23, 2021	February 23, 2022
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020132	May 25, 2021	May 25, 2022
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 12 Test Equipment Used

6. Maximum Conducted Output Power

6.1 Test Specification

FCC, Part 15, Subpart C, Section 247(b)(3)

6.2 Test Procedure

(Temperature (22°C)/ Humidity (58%RH))

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

The E.U.T was tested in the chamber and was placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of three meters.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \quad [W]$$

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

6.3 Test Limit

The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

6.4 Test Results

Protocol Type	Operation Frequency	Pol.	Field Strength	EIRP	Ant. Gain	Power	Power	Limit	Margin
	(MHz)	(V/H)	(dBuV/m)	(dBm)	(dBi)	(dBm)	(mW)	(mW)	(mW)
BLE	2402.0	V	81.9	-13.3	3.3	-16.6	0.02	1000.0	-999.98
		H	81.0	-14.2	3.3	-17.5	0.02	1000.0	-999.98
	2440.0	V	83.6	-11.6	3.3	-14.9	0.03	1000.0	-999.97
		H	76.9	-18.3	3.3	-21.6	0.01	1000.0	-999.99
	2480.0	V	80.6	-14.6	3.3	-17.9	0.02	1000.0	-999.98
		H	77.7	-17.5	3.3	-20.8	0.01	1000.0	-999.99

Figure 13 Maximum Peak Power Output

JUDGEMENT: Passed by ___ -0.01 mW

For additional information see Figure 14 to Figure 19.

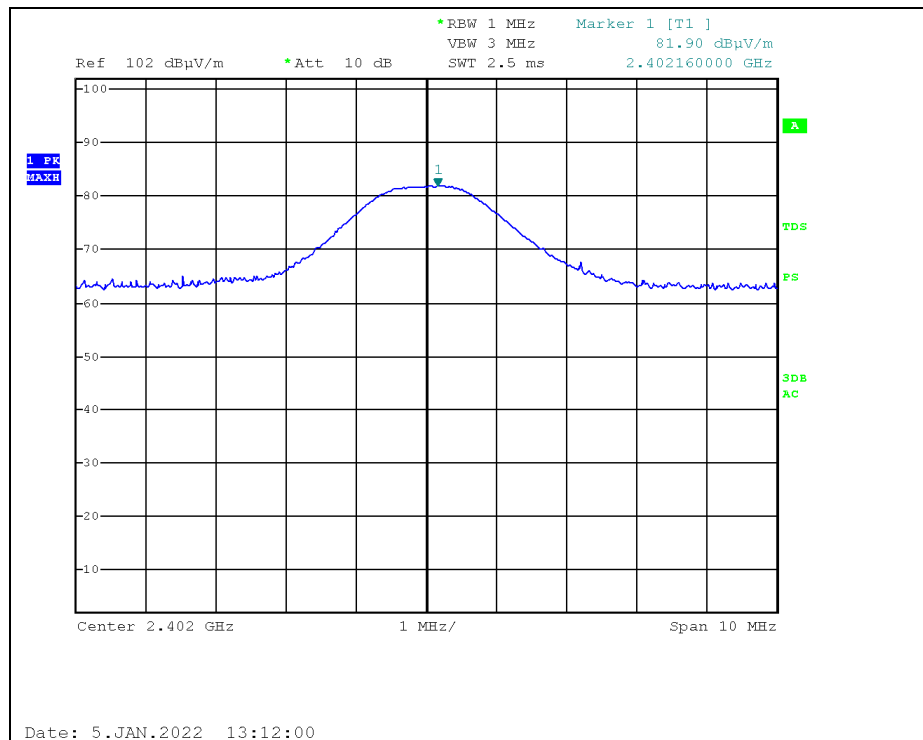


Figure 14. 2402.0 MHz, BLE, Vertical

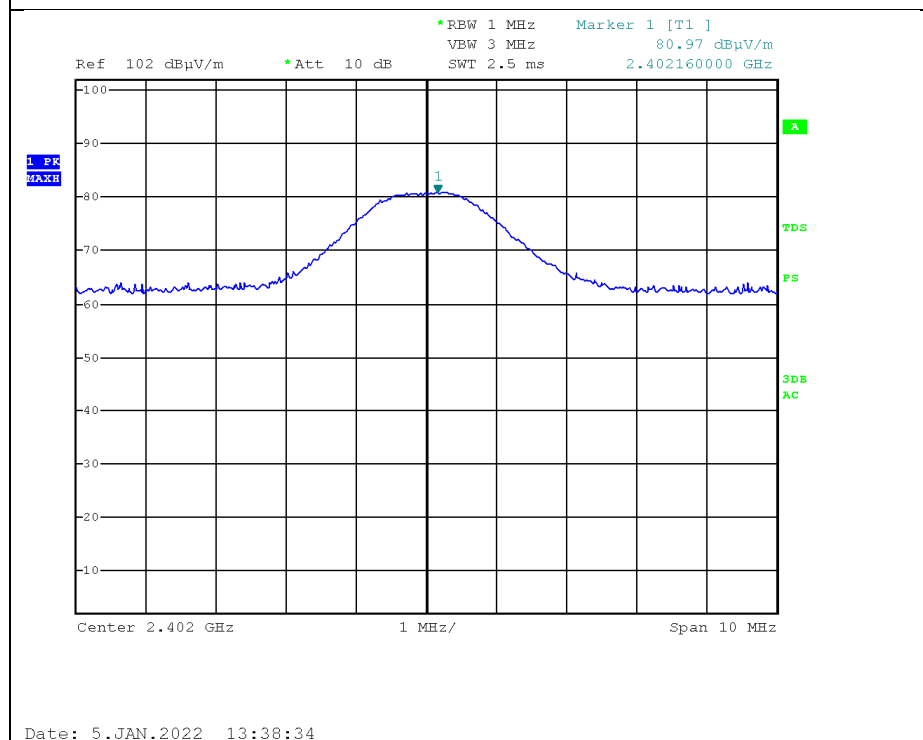


Figure 15. 2402.0 MHz, BLE, Horizontal

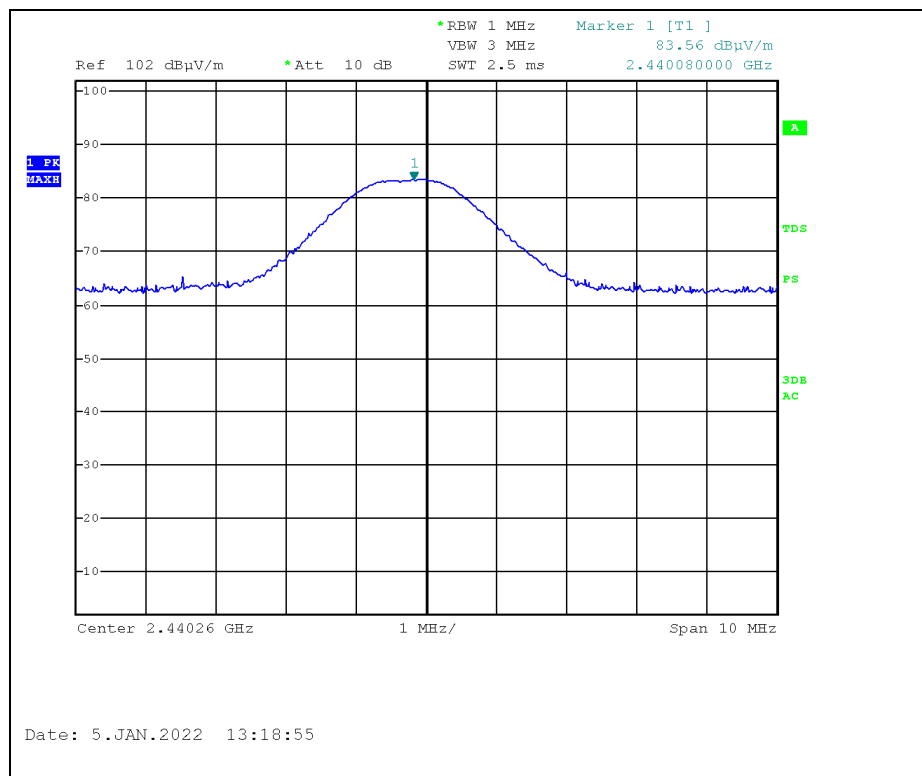


Figure 16. 2440.0 MHz, BLE, Vertical

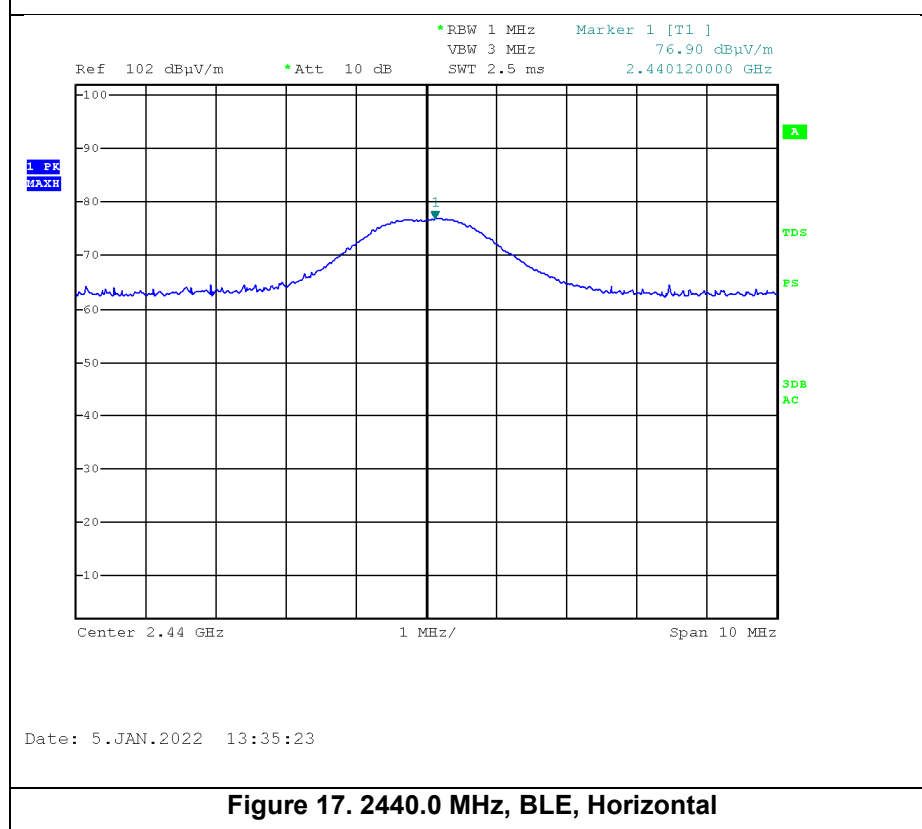


Figure 17. 2440.0 MHz, BLE, Horizontal

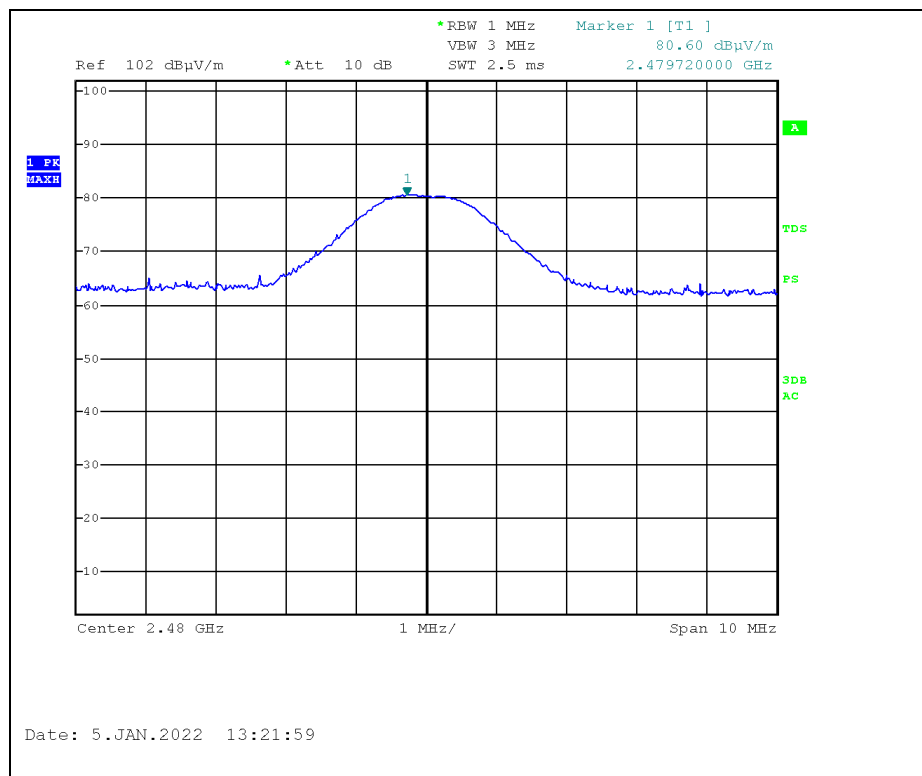


Figure 18. 2480.0 MHz, BLE, Vertical

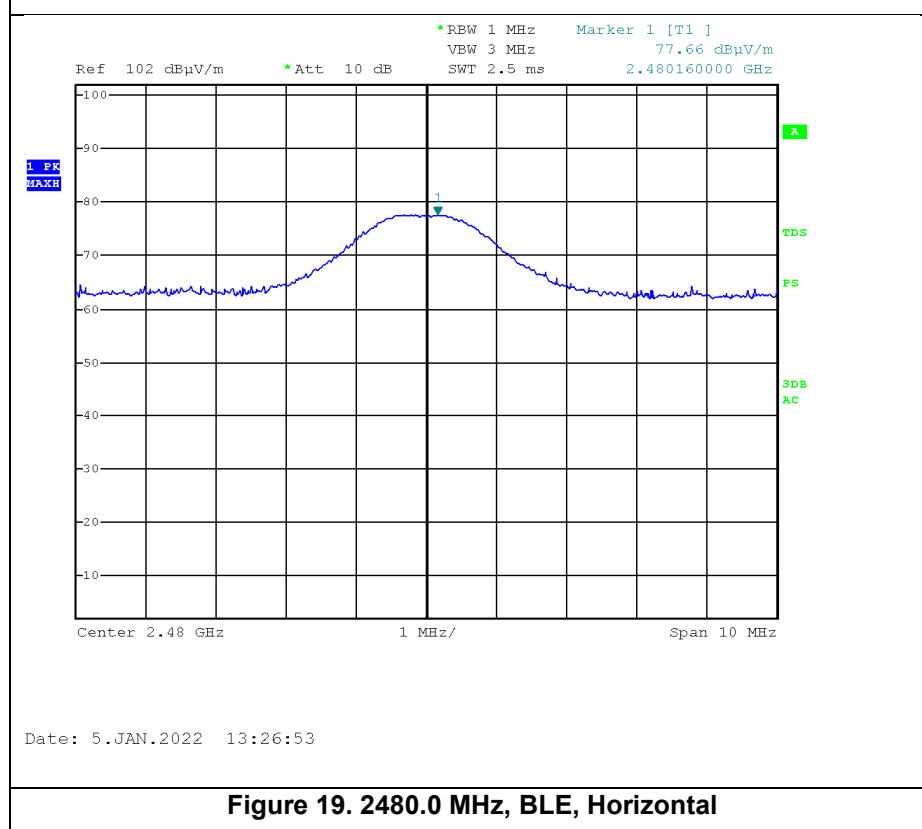


Figure 19. 2480.0 MHz, BLE, Horizontal



6.5 Test Equipment Used

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 23, 2022
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020132	May 25, 2021	May 25, 2022
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 20 Test Equipment Used

7. Band Edge Spectrum

7.1 Test Specification

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

7.2 Test Procedure

(Temperature (22°C)/ Humidity (59%RH))

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

The E.U.T was tested in the chamber and was placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. 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 RBW was set to 100 kHz.

7.3 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.

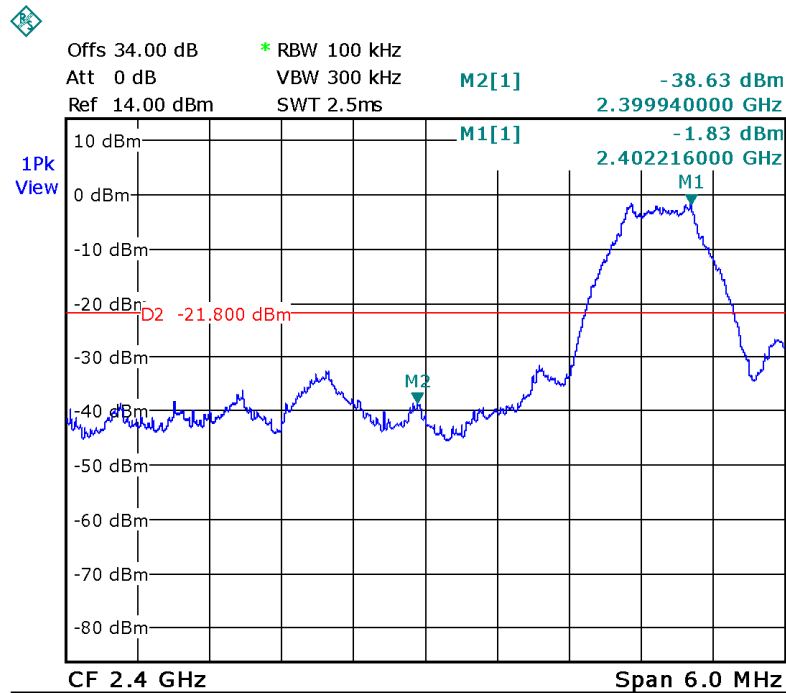
7.4 Test Results

Protocol Type	Operation Frequency	Band Edge Frequency	Spectrum Level	Limit	Margin
	(MHz)	(MHz)	(dBuV/m)	(dBuV/m)	(dB)
BLE	2402.0	2400.0	-38.6	-21.8	-16.8
	2480.0	2483.5	-39.8	-23.3	-16.5

Figure 21 Band Edge Spectrum

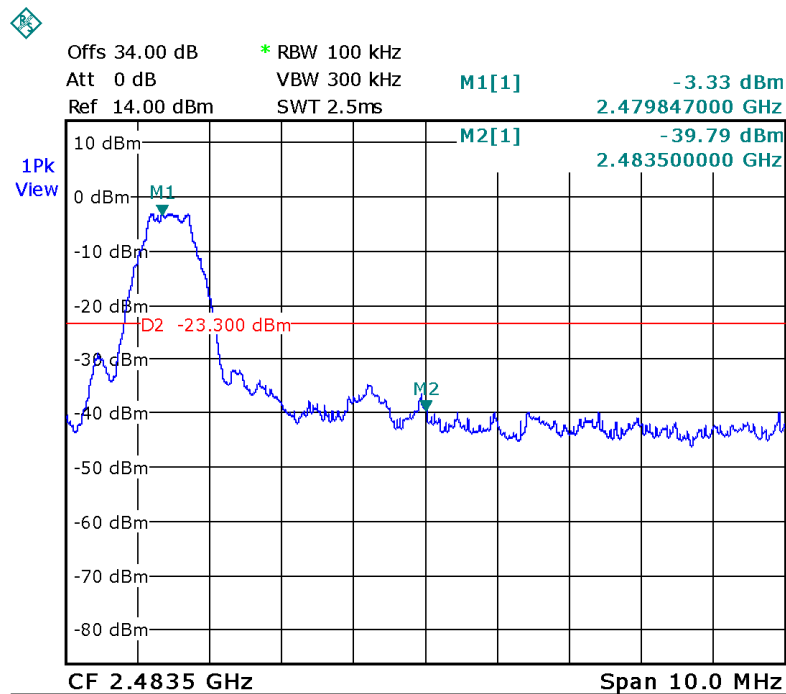
JUDGEMENT: Passed by -16.5dB

For additional information see Figure 22 to Figure 23.



Date: 4.JAN.2022 11:32:54

Figure 22 Band Edge Low, BLE



Date: 4.JAN.2022 11:34:35

Figure 23 Band Edge High, BLE



7.5 Test Equipment Used

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 23, 2022
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020132	May 25, 2021	May 25, 2022
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 24 Test Equipment Used

8. Transmitted Power Density

8.1 Test Specification

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

8.2 Test Procedure

(Temperature (22°C)/ Humidity (58%RH))

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

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

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 spectrum analyzer was set to 100kHz RBW .

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \quad [W]$$

E: Field Strength (V/m)

d: Distance from transmitter (m)

G: Antenna gain

P: Peak power (W)

8.3 Test Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

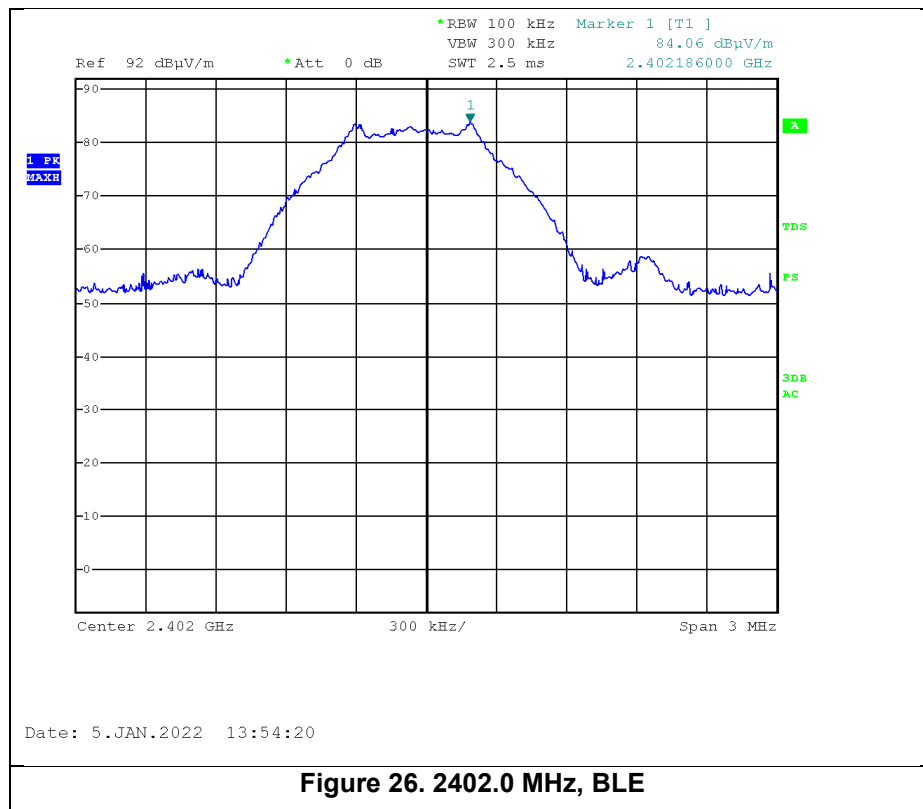
8.4 Test Results

Protocol Type	Operation Frequency	Reading Spectrum Analyzer	Reading Spectrum Analyzer	Antenna gain	Conducted PSD	Limit	Margin
	(MHz)	(dBμV/m)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
BLE	2402.0	84.0	-11.2	3.3	-14.5	8.0	-22.5
	2440.0	81.4	-13.8	3.3	-17.1	8.0	-25.1
	2480.0	79.3	-15.9	3.3	-19.2	8.0	-27.2

Figure 25 Test Results

JUDGEMENT: Passed by __-22.5 dB

For additional information see Figure 26 to Figure 28.



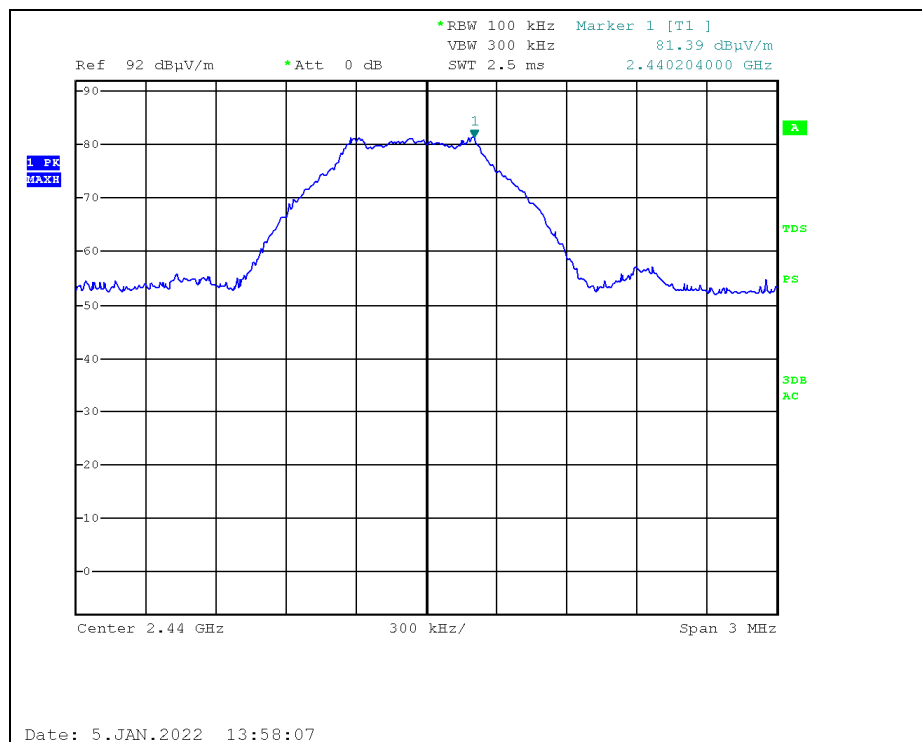


Figure 27. 2440.0 MHz, BLE

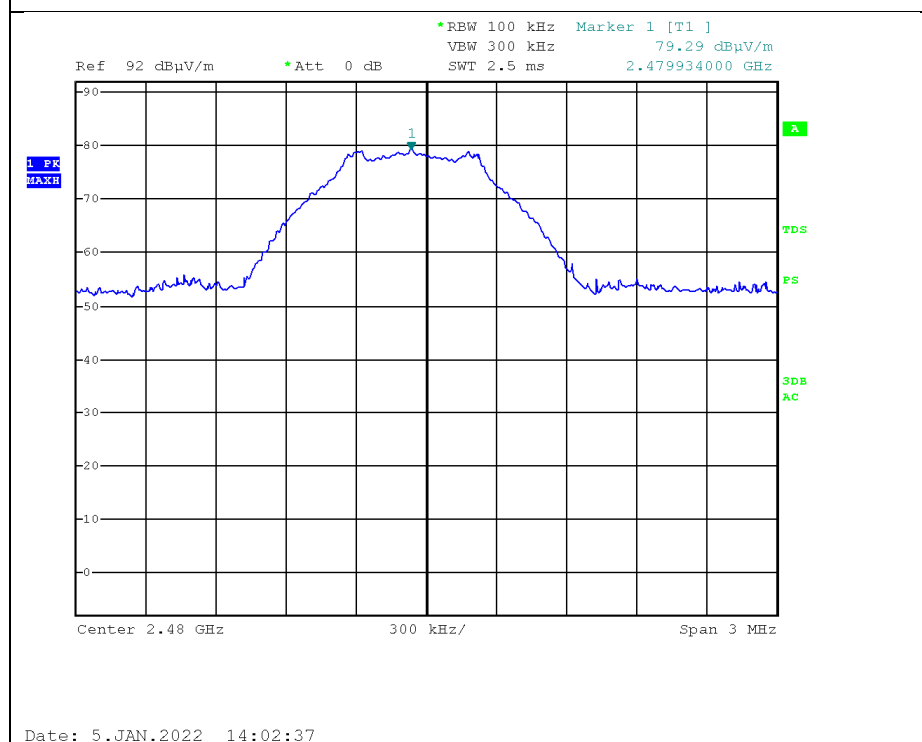


Figure 28. 2480.0 MHz, BLE



8.5 Test Equipment Used

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 23, 2022
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC- 400	G020132	May 25, 2021	May 25, 2022
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 29 Test Equipment Used

9. Occupied Bandwidth

9.1 Test Specification

FCC, Part 2, Sub part J, Section 2.1049

9.2 Test Procedure

(Temperature (22°C)/ Humidity (58%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report. The E.U.T. was placed in the chamber on a non-conductive table, 0.8 meters above the ground.

The distance between the E.U.T. and test antenna was 3 meters.

The transmitter unit was operated with normal modulation. The RBW set to the range of 1% to 5% of the OBW.

The span was set between 1.5 to 5 times of the OBW.

99% occupied bandwidth function was set on.

9.3 Test Limit

N/A

9.4 Test Results

Protocol Type	Operation Frequency	Reading
	(MHz)	(kHz)
BLE	2402.0	1053.9
	2440.0	1059.8
	2480.0	1065.8

Figure 30. Bandwidth Test Results

JUDGEMENT: N/A

See additional information in Figure 31 to Figure 33.

Occupied Bandwidth

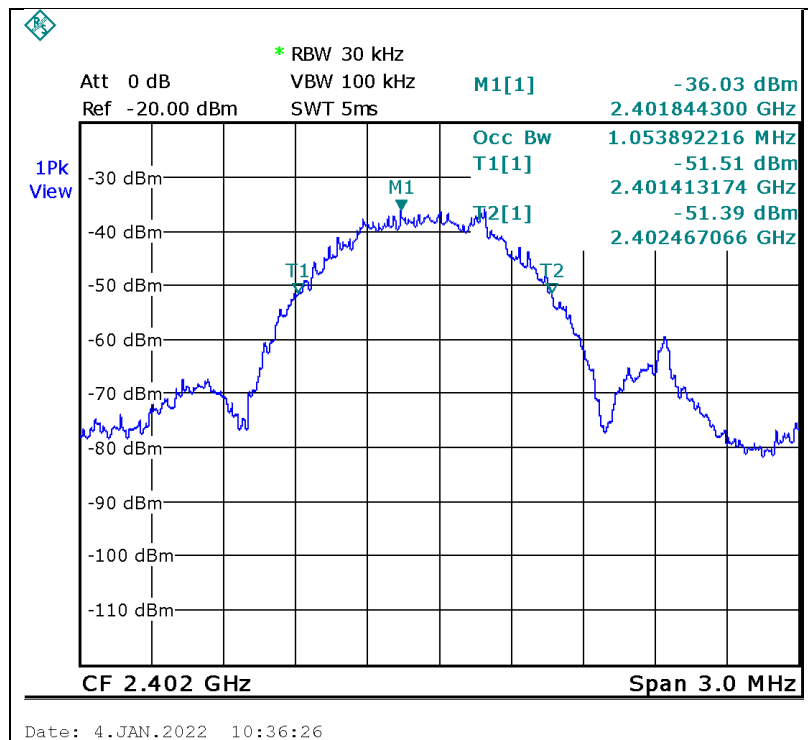


Figure 31. 2402.0 MHz, BLE

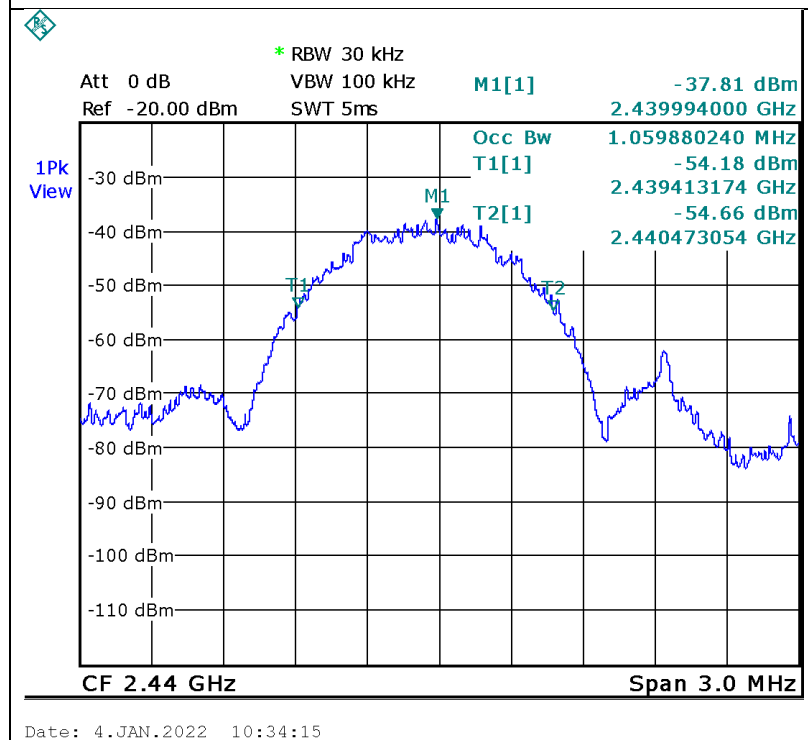
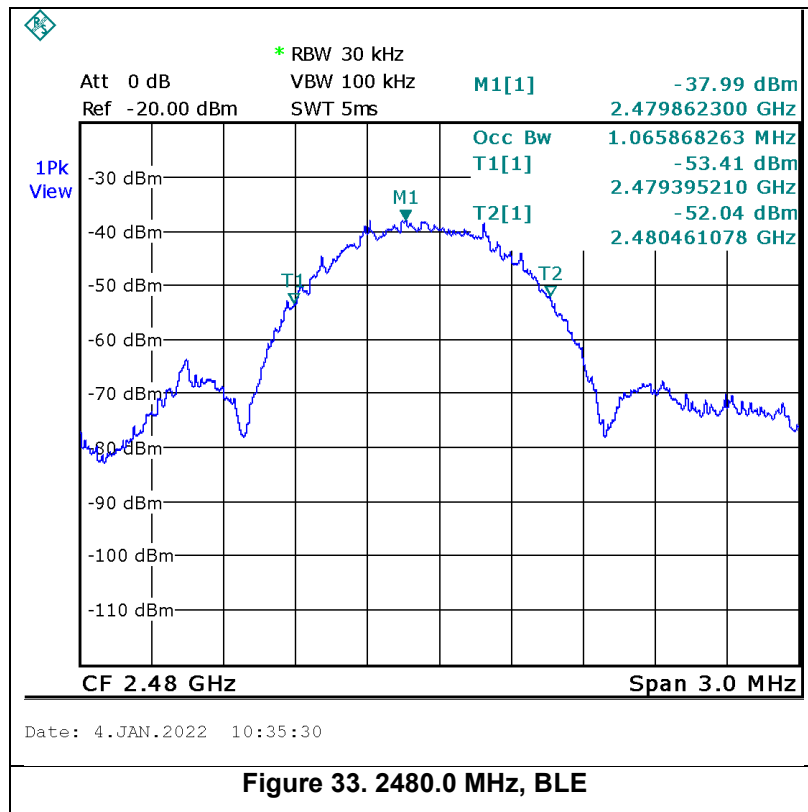


Figure 32. 2440.0 MHz, BLE



9.5 Test Equipment Used

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 23, 2022
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020132	May 25, 2021	May 25, 2022
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 34 Test Equipment Used

10. Emissions in Non-Restricted Frequency Bands

10.1 Test Specification

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

10.2 Test Procedure

(Temperature (21°C)/ Humidity (59%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 and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30MHz-1GHz:

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 emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1GHz-25GHz:

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

The frequency range 1.0GHz -25.0GHz was scanned.

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

10.3 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.



10.4 Test Results

JUDGEMENT: Passed

All detected emissions were greater than 20dBc below the fundamental level.

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



10.5 Test Instrumentation Used, Emission in Non- Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 23, 2022
EMI Receiver	HP	8542E	3906A00276	February 24, 2021	February 24, 2022
RF Filter Section	HP	85420E	3705A00248	February 24, 2021	February 24, 2022
Spectrum Analyzer	HP	8593 EM	3826A00265	February 22, 2021	February 22, 2022
Active Loop Antenna	EMCO	6502	9506-2950	May 03, 2021	May 03, 2022
Biconical Antenna	EMCO	3110B	9912-3337	January 18, 2022	January 18, 2024
Log Periodic Antenna	EMCO	3146	9505-4081	January 20, 2022	January 20, 2024
Horn Antenna	EMCO	3115	29845	May 25, 2021	May 25, 2024
Horn Antenna	ARA	SWH-28	1007	November 02, 2021	November 02, 2024
Wideband Low Noise Amplifier 150KHz-26GHz	OSR	-	-	May 24, 2021	May 24, 2022
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132	May 25, 2021	May 25, 2022
RF Cable Oats	EIM	RG214-11N(X2)	-	August 04, 2020	August 04, 2021
Filter Band Pass 4-20 GHz	Meuro	MFL040120H50	902252	May 24, 2021	May 24, 2022
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 35 Test Equipment Used



10.6 **Field Strength Calculation**

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

$$FS = RA + AF + CF$$

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

Example: $FS = 30.7 \text{ dB}\mu\text{V (RA)} + 14.0 \text{ dB (AF)} + 0.9 \text{ dB (CF)} = 45.6 \text{ dB}\mu\text{V}$

No external pre-amplifiers are used.

11. Emissions in Restricted Frequency Bands

11.1 Test Specification

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

11.2 Test Procedure

(Temperature (22°C)/ Humidity (59%RH))

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

For measurements between 0.009-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30-1000MHz:

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 emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30MHz -1000MHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1GHz-25GHz:

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

The frequency range 1GHz -25GHz was scanned.

11.3 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.

Figure 36 FCC Table of Limits

11.4 Test Results

JUDGEMENT: Passed by -0.2dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C Sections 15.209, 15.205, 15.247(d) specifications.

The details of the highest emissions are given in Figure 37.



Radiated Emission

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

Antenna Polarization: Horizontal/Vertical Frequency Range: 9kHz to 25.0 GHz

Protocol Type: BLE

Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2402.0	2390.0	V	52.3	74.0	-21.7	-	54.0	-
	2390.0	H	52.5	74.0	-21.5	-	54.0	-
	4804.0	V	61.6	74.0	-12.4	51.7	54.0	-2.3
	4804.0	H	58.9	74.0	-15.1	48.7	54.0	-5.3
2440.0	4880.0	V	63.5	74.0	-10.5	53.8	54.0	-0.2
	4880.0	H	60.0	74.0	-14.0	50.5	54.0	-3.5
2480.0	4960.0	V	61.2	74.0	-12.8	51.2	54.0	-2.8
	4960.0	H	58.0	74.0	-16.0	48.1	54.0	-5.9
	2483.5	V	52.9	74.0	-21.1	-	54.0	-
	2483.5	H	53.0	74.0	-21.0	-	54.0	-

Figure 37. Radiated Emission Results

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



11.5 Test Instrumentation Used; Emissions in Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 23, 2022
EMI Receiver	HP	8542E	3906A00276	February 24, 2021	February 24, 2022
RF Filter Section	HP	85420E	3705A00248	February 24, 2021	February 24, 2022
Spectrum Analyzer	HP	8593 EM	3826A00265	February 22, 2021	February 22, 2022
Active Loop Antenna	EMCO	6502	9506-2950	May 03, 2021	May 03, 2022
Biconical Antenna	EMCO	3110B	9912-3337	January 18, 2022	January 18, 2024
Log Periodic Antenna	EMCO	3146	9505-4081	January 20, 2022	January 20, 2024
Horn Antenna	EMCO	3115	29845	May 25, 2021	May 25, 2024
Horn Antenna	ARA	SWH-28	1007	November 02, 2021	November 02, 2024
Wideband Low Noise Amplifier 150KHz-26GHz	OSR	-	-	May 24, 2021	May 24, 2022
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132	May 25, 2021	May 25, 2022
RF Cable Oats	EIM	RG214-11N(X2)	-	August 04, 2020	August 04, 2021
Filter Band Pass 4-20 GHz	Meuro	MFL040120H50	902252	May 24, 2021	May 24, 2022
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 38 Test Equipment Used



12. Antenna Gain/Information

The antenna gain is 3.3 dBi; Type: integral.

13. R.F Exposure/Safety

See a separate file.



14. APPENDIX A - CORRECTION FACTORS

14.1 For ITL #1911 OATS RF Cable

Frequency (MHz)	Cable Loss (dB)		Frequency (MHz)	Cable Loss (dB)
1.0	0.5		450.00	5.83
10.00	1.0		500.00	6.33
20.00	1.34		550.00	6.67
30.00	1.5		600.00	6.83
50.00	1.83		650.00	7.17
100.00	2.67		700.00	7.66
150.00	3.17		750.00	7.83
200.00	3.83		800.00	8.16
250.00	4.17		850.00	8.5
300.00	4.5		900.00	8.83
350.00	5.17		950.00	8.84
400.00	5.5		1000.00	9.0



14.2

Frequency (MHz)	Cable Loss (dB)		Frequency (MHz)	Cable Loss (dB)
1000.0	-1.4		10000.0	-6.0
1500.0	-1.7		10500.0	-6.2
2000.0	-2.0		11000.0	-6.2
2500.0	-2.3		11500.0	-6.0
3000.0	-2.6		12000.0	-6.0
3500.0	-2.8		12500.0	-6.1
4000.0	-3.1		13000.0	-6.3
4500.0	-3.3		13500.0	-6.5
5000.0	-3.6		14000.0	-6.7
5500.0	-3.7		14500.0	-7.0
6000.0	-4.0		15000.0	-7.3
6500.0	-4.4		15500.0	-7.5
7000.0	-4.7		16000.0	-7.6
7500.0	-4.8		16500.0	-8.0
8000.0	-5.0		17000.0	-8.0
8500.0	-5.1		17500.0	-8.1
9000.0	-5.6		18000.0	-8.2
9500.0	-5.8			



14.3

Frequency (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	-40.0	11.5
3	-40.0	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	11.0
10	-40.5	11.0
20	-41.5	10.0
30	-43.5	8.0

14.4 For ITL #1356 Biconical Antenna

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



14.5

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

14.6 For ITL # 1352 1-18 Horn Antenna

Frequency (GHz)	AF (dB/m)		Frequency (GHz)	AF (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



14.7 For ITL # 1353 18-26.5 GHz Horn Antenna

Frequency (MHz)	Measured antenna factor dB/m
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

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



14.8 For Horn Antenna Model: SWH-28

CALIBRATION DATA

3 m distance

Frequency MHZ	Measured antenna factor dB/m
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.