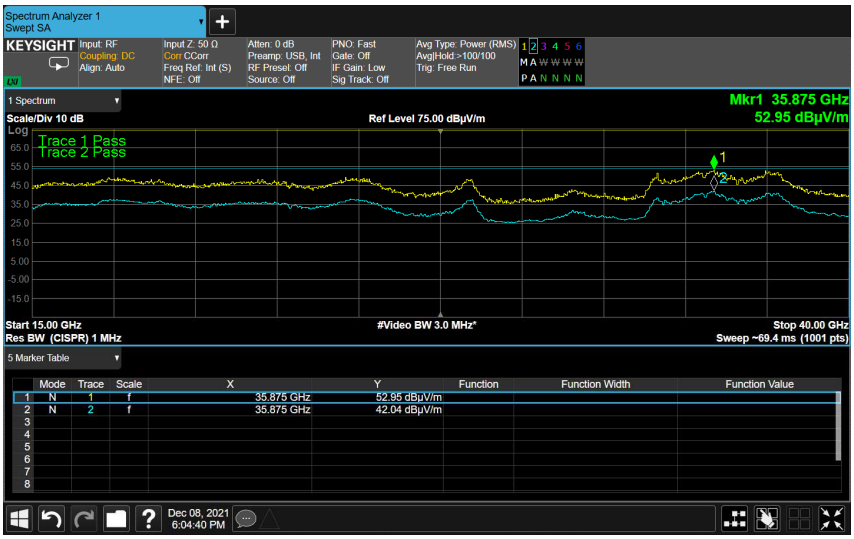


Figure 36 Fundamental: 6.175 GHz ,20 MHz, band 5

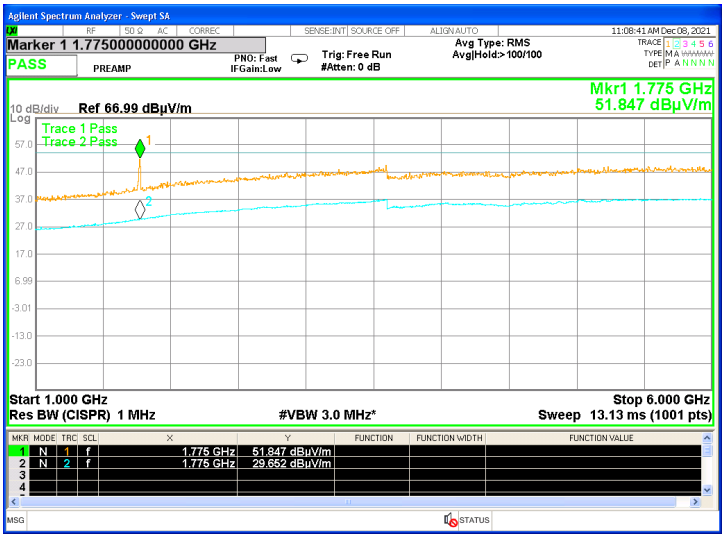


Figure 37 Fundamental: 6.415 GHz ,20 MHz, band 1

Figure 38 Fundamental: 6.415 GHz ,20 MHz, band 2

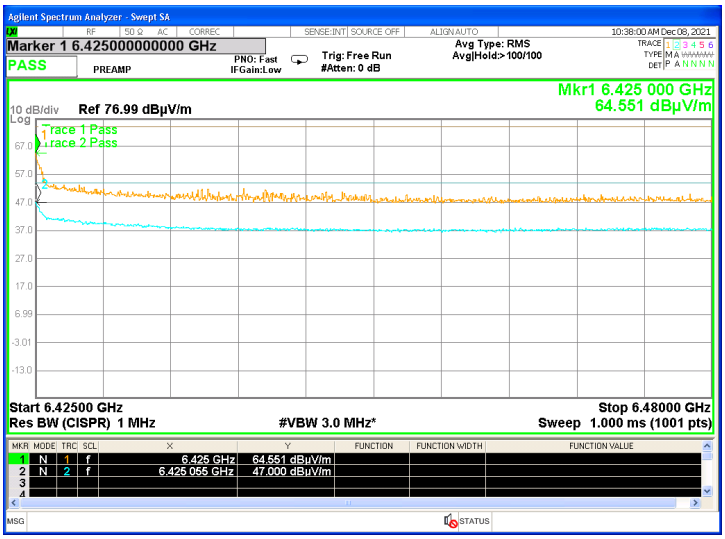


Figure 39 Fundamental: 6.415 GHz ,20 MHz, band 3

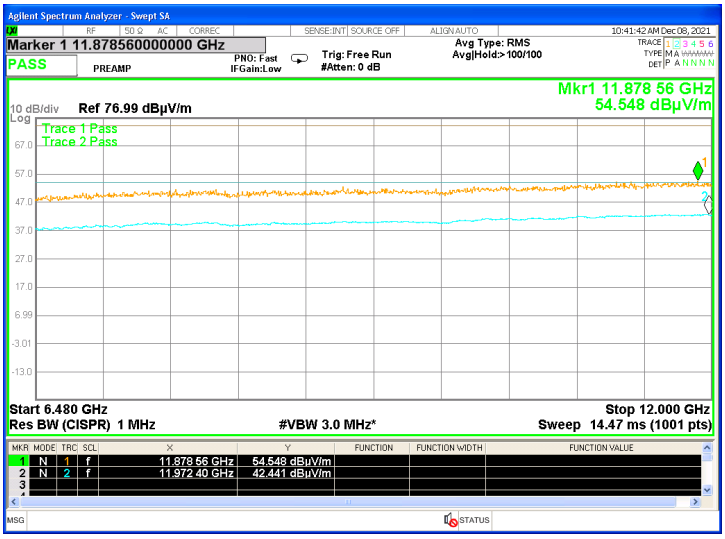


Figure 40 Fundamental: 6.415 GHz ,20 MHz, band 4

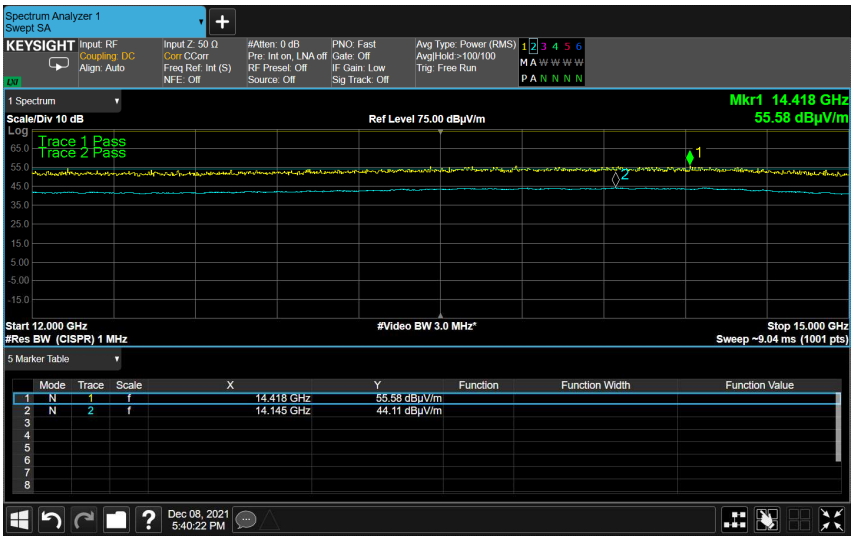


Figure 41 Fundamental: 6.415 GHz ,20 MHz, band 5

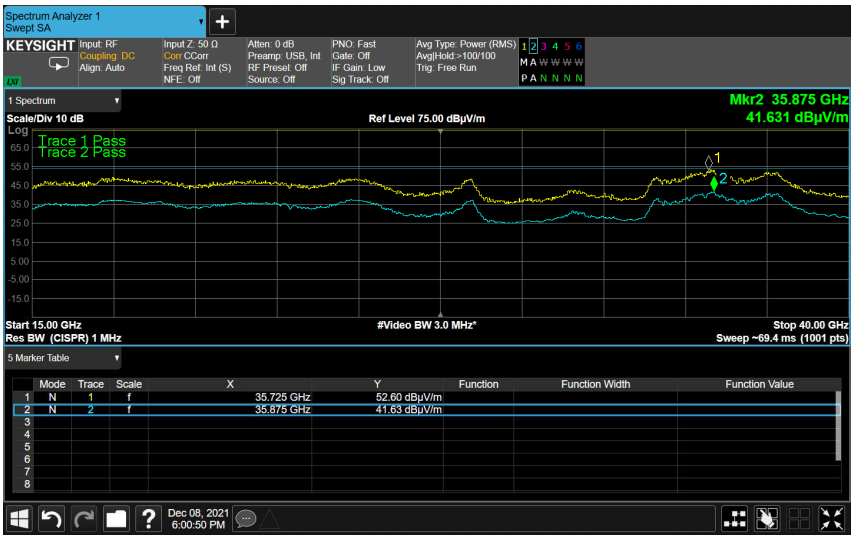


Figure 42 Fundamental: 6.415 GHz ,20 MHz, band 6

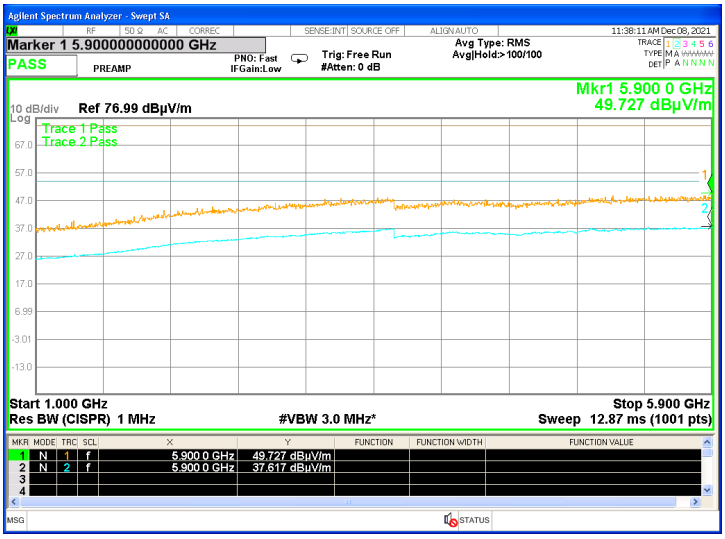


Figure 43 Fundamental: 5.945 GHz ,40 MHz, band 1

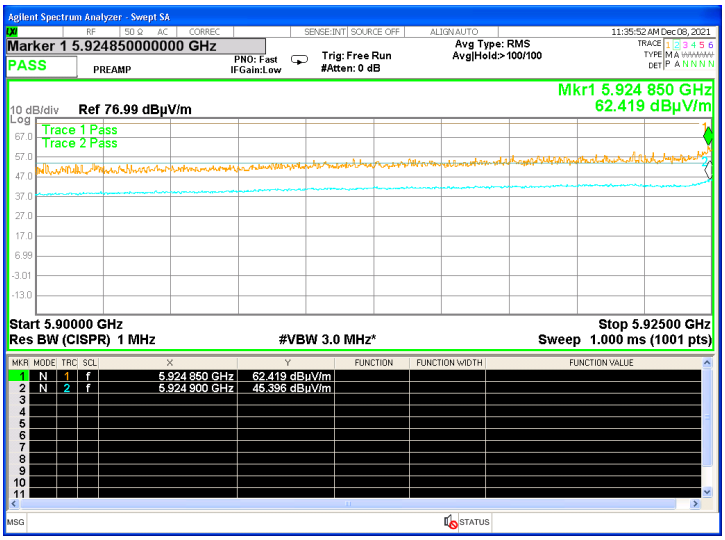


Figure 44 Fundamental: 5.945 GHz ,40 MHz, band 2

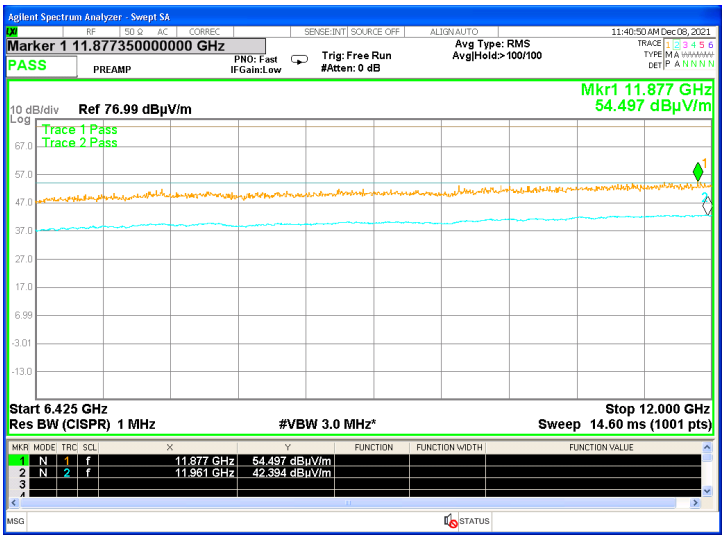


Figure 45 Fundamental: 5.945 GHz ,40 MHz, band 3

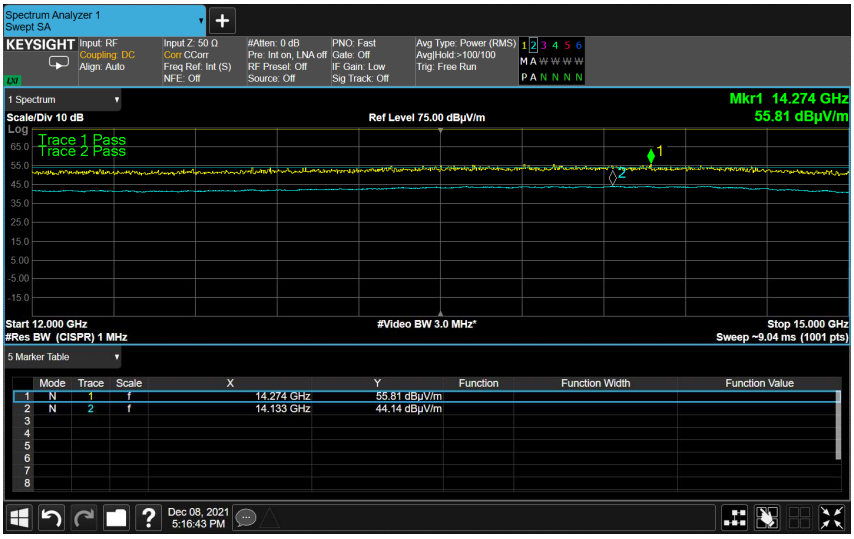


Figure 46 Fundamental: 5.945 GHz ,40 MHz, band 4

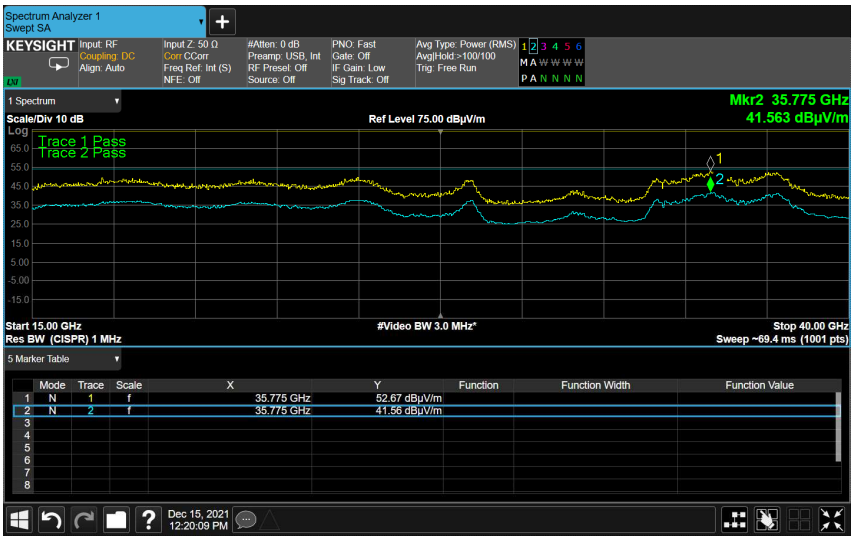


Figure 47 Fundamental: 5.945 GHz ,40 MHz, band 5

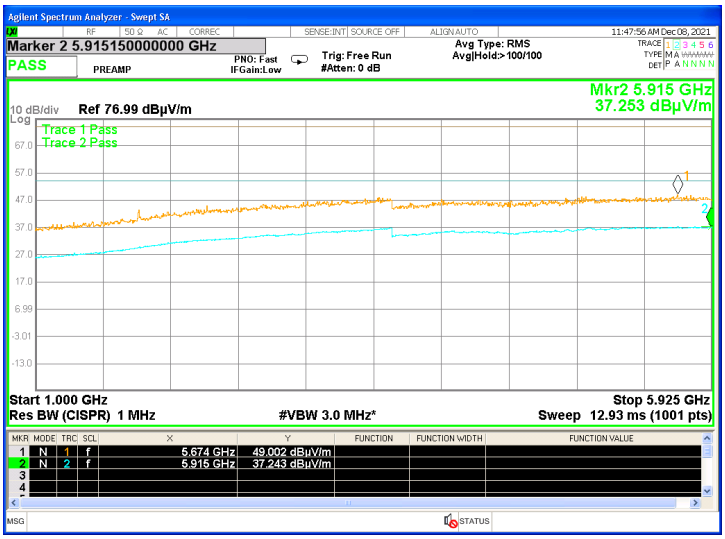


Figure 48 Fundamental: 6.185 GHz ,40 MHz, band 1

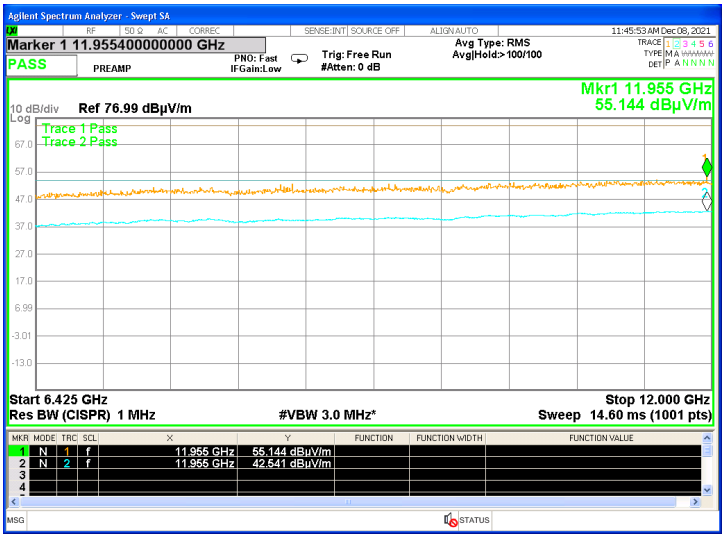


Figure 49 Fundamental: 6.185 GHz ,40 MHz, band 2

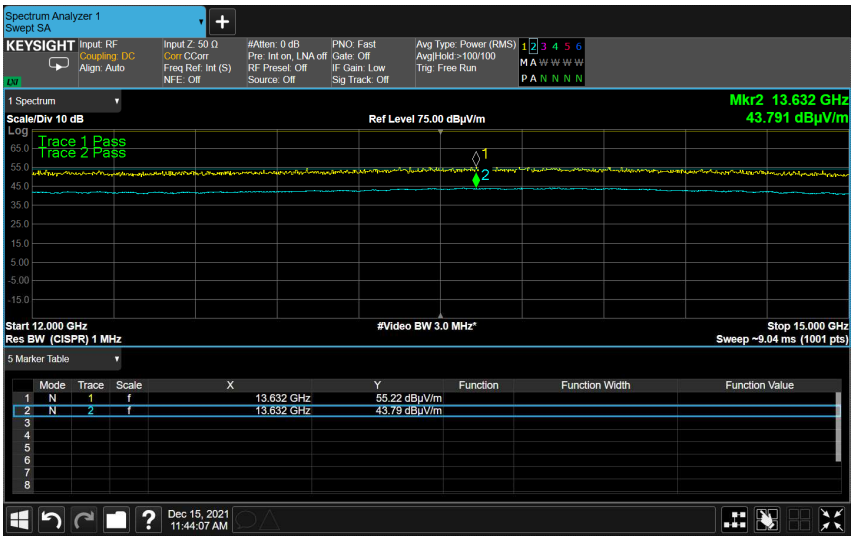


Figure 50 Fundamental: 6.185 GHz ,40 MHz, band 3

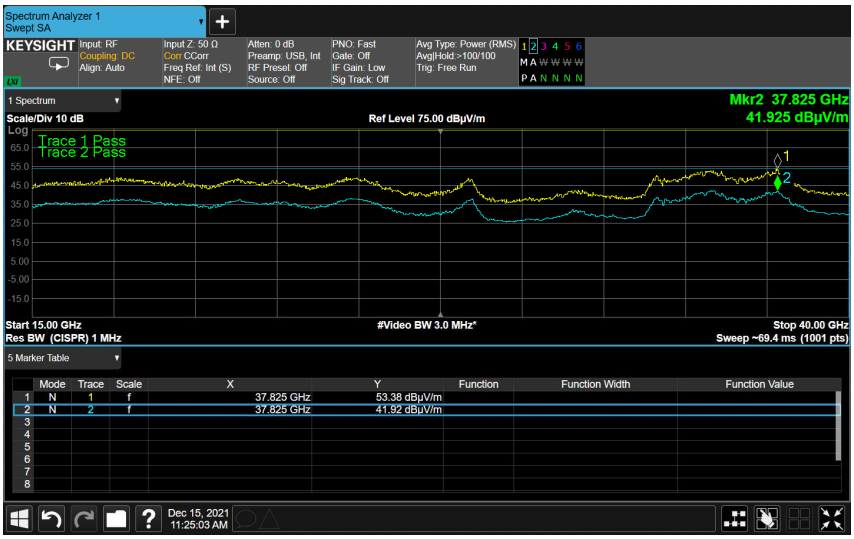


Figure 51 Fundamental: 6.185 GHz ,40 MHz, band 4

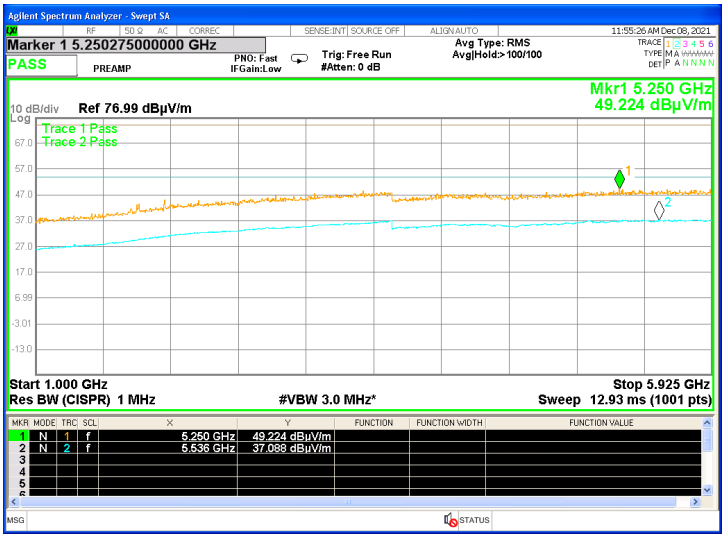


Figure 52 Fundamental: 6.405 GHz ,40 MHz, band 1

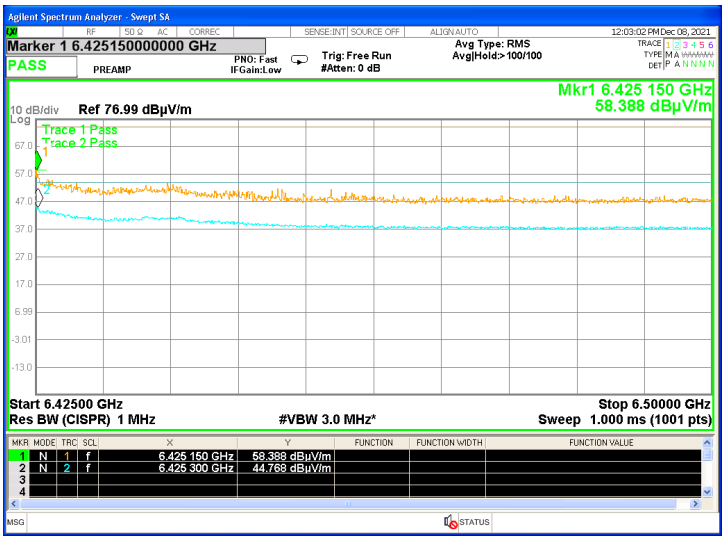


Figure 53 Fundamental: 6.405 GHz ,40 MHz, band 2

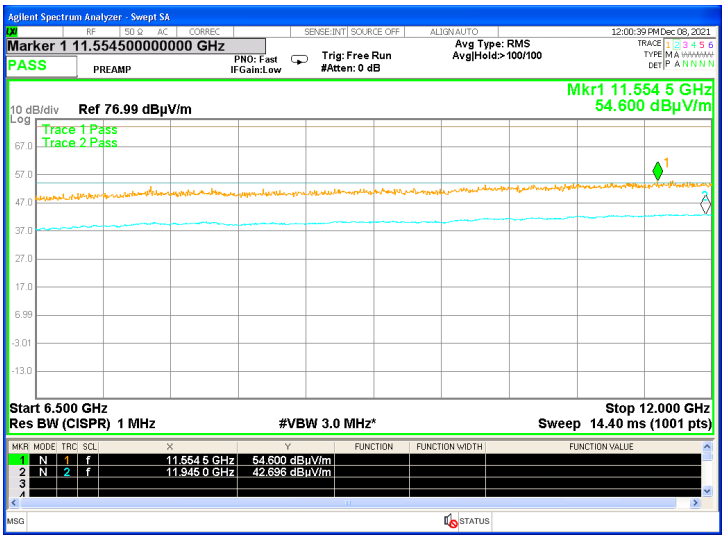


Figure 54 Fundamental: 6.405 GHz ,40 MHz, band 3

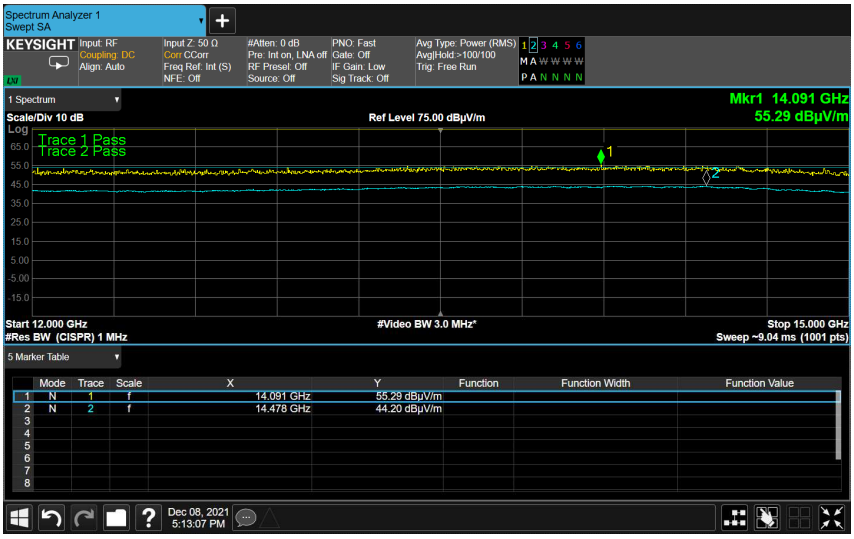


Figure 55 Fundamental: 6.405 GHz ,40 MHz, band 4

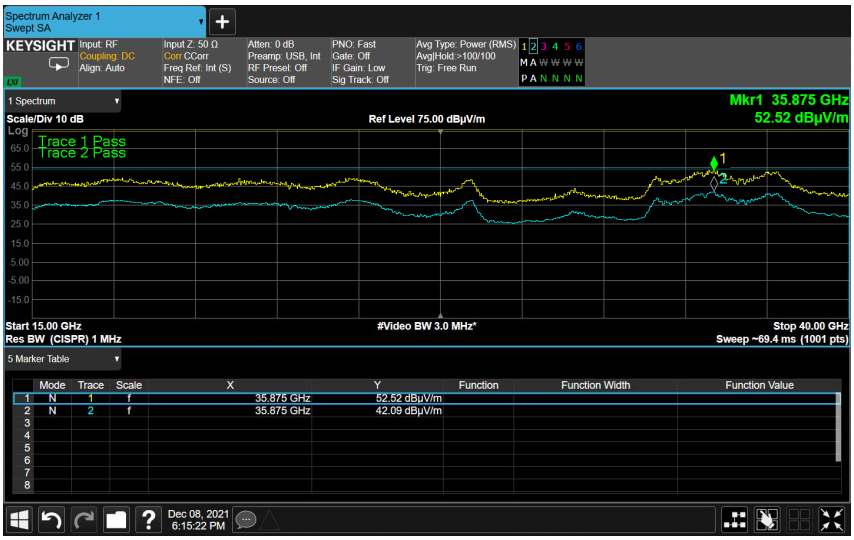


Figure 56 Fundamental: 6.405 GHz ,40 MHz, band 5

8.5 Test Instrumentation Used, Emissions in Non Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	March 9, 2020	March 31, 2021
EMI Receiver	HP	8542E	3906A00276	March 11, 2020	March 31, 2021
RF Filter Section	HP	85420E	3705A00248	March 11, 2020	March 31, 2021
EMC Analyzer	HP	8593 EM	3826A00265	March 9, 2020	March 31, 2021
Active Loop Antenna	EMCO	6502	9506-2950	February 5, 2019	February 28, 2023
Biconical Antenna	EMCO	3110B	9912-3337	May 21, 2019	May 31, 2021
Log Periodic Antenna	EMCO	3146	9505-4081	May 31, 2018	May 31, 2021
RF Cable Oats	EIM	RG214-11N(X2)		August 4, 2020	August 31, 2021
Filter Band Pass 4-20 GHz	Meuro	MFL040120H50	902252	November 2, 2020	November 30, 2021
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR
RECEIVER EMI MXE 20Hz-26.5 GHz	Keysight Technologies (AGILENT)	N9038A	6501147	10/21	10/22
EMI RECEIVER 3 Hz-44 GHz	Keysight Technologies	PXE N9048B	MY59500021	11/21	12/21
PREAMPLIFIER USB 2 - 40 GHz	Keysight Technologies	U7227F	6503045	12/20	12/21
Double Ridged Waveguide Antenna 1-18 GHz	EMCO	3115	0143138	07/21	07/23

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Antenna Broad-Band Horn; 14 - 40 GHz	SCHWARBECK MESS-ELEKTRONIK	BBHA 9170	5854	07/21	07/23
CABLE RF 0.5 TO 40 GHz	EMERSON / Semflex	X116LCS X10079	605340	09/21	09/22
Antenna MiniMast up to 1 GHz	ETS LINDGREN	--	2175	N/A	N/A
Metallic turntable	ETS LINDGREN	--	2188	N/A	N/A
Multi-Device Controller	ETS LINDGREN	--	2090	N/A	N/A

Figure 57 Test Equipment Used

8.6 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 [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.

9. 99% Occupied Bandwidth

9.1 Test Specification

FCC, Part 2, Sub part J, Section 2.1049
FCC Part 15, Subpart E, Section 15.407(a)(10)
RSS 248 Issue 1 November 19, 2021, Section 4.4

9.2 Test Procedure

(Temperature (22°C)/ Humidity (56%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report. The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.0dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW set to range of 1%-5% of the OBW.

9.3 FCC and IC Test Limit

The maximum transmitter channel bandwidth for U-NII devices in the 5.925-7.125 GHz band is 320 megahertz.

9.4 Test Results

BW (MHz)	Operation Frequency (MHz)	Reading (MHz)
20.0	5935.0	17.58
	6175.0	17.59
	6415.0	17.57
40.0	5945.0	33.12
	6185.0	33.11
	6405.0	33.18

Figure 58. Bandwidth Test Results

JUDGEMENT: Passed

See additional information in *Figure 59* to *Figure 64.*

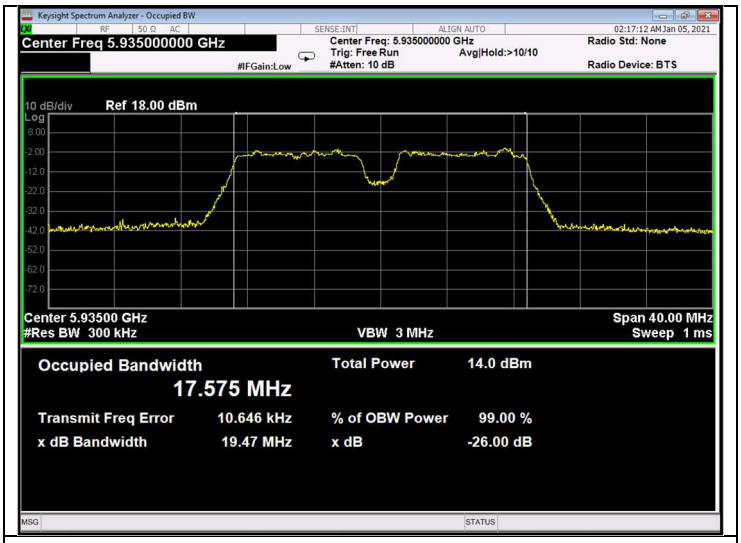


Figure 59. 5935.0MHz, 20MHz BW

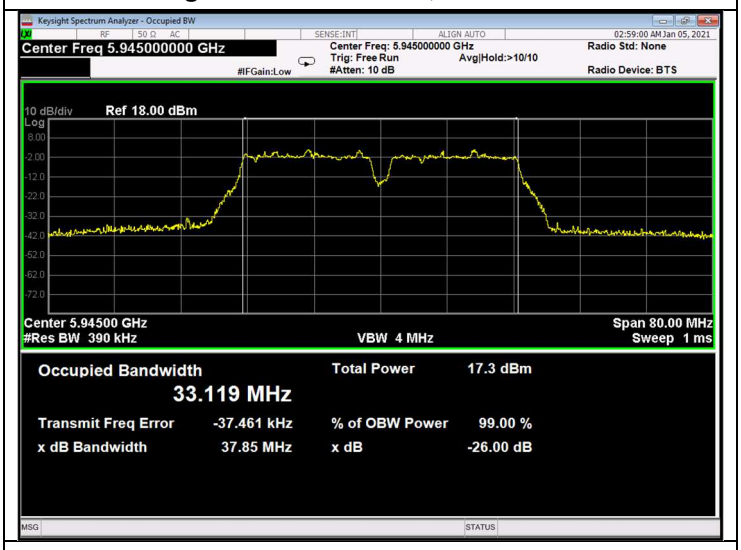


Figure 60. 5945.0MHz, 40MHz BW

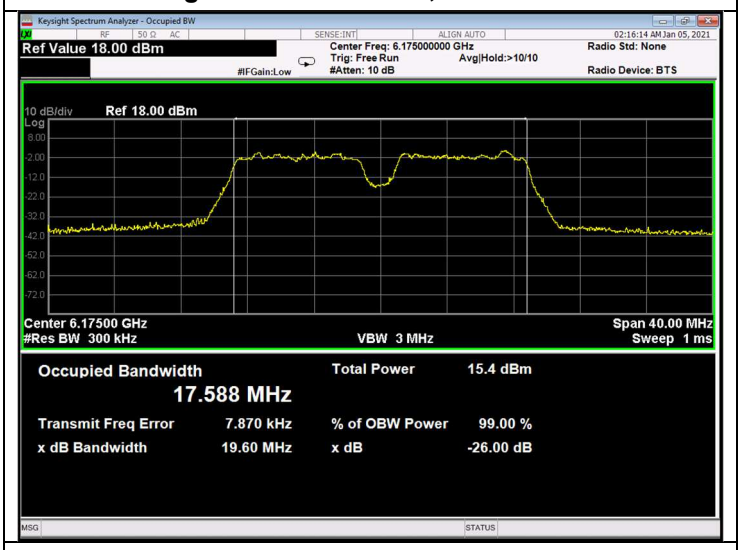


Figure 61. 6175.0MHz, 20MHz BW

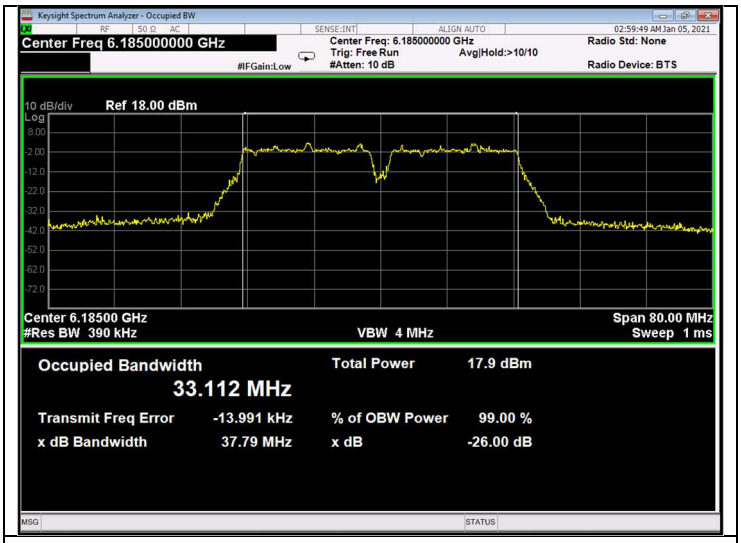


Figure 62. 6185.0MHz, 40MHz BW

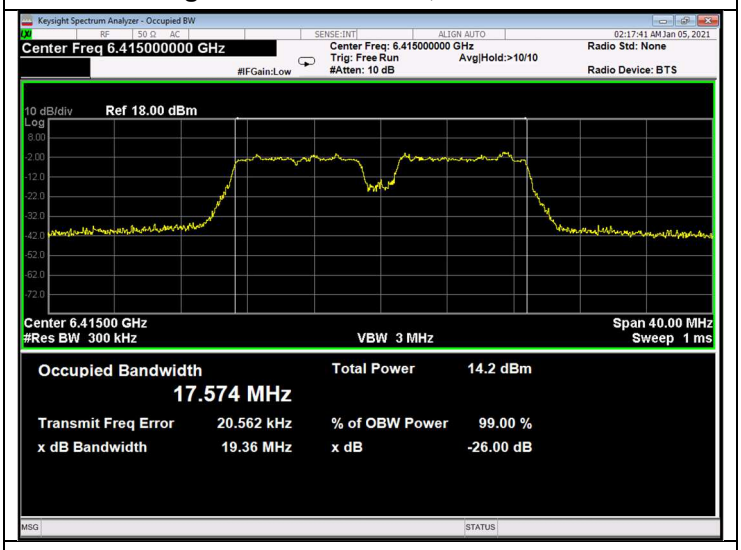


Figure 63. 6415.0MHz, 20MHz BW

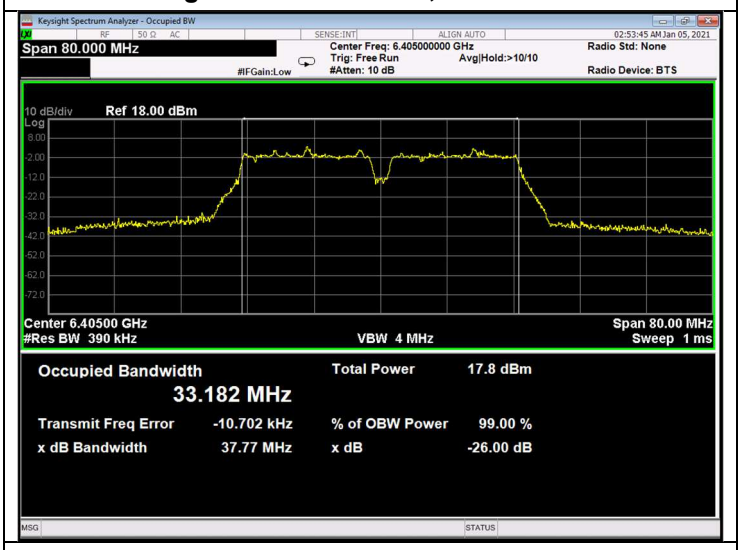


Figure 64. 6405.0MHz, 40MHz BW

9.5 Test Equipment Used; Occupied Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EXA Signal Analyzer	Agilent Technologies	N9010A	902A000401	March 1, 2019	March 31, 2021
30dB Attenuator	MCL	BW-S30W5	533	August 23, 2020	August 31, 2021
RF Cable	Huber Suhner	Sucofelex	28239/4PEA	August 23, 2020	August 31, 2021

Figure 65 Test Equipment Used

10. 26dB Bandwidth

10.1 Test Specification

FCC, Part 2, Sub part J, Section 2.1049

10.2 Test Procedure

(Temperature (22°C)/ Humidity (56%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report. The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.0dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW set to the range of 1% of the EBW.

10.3 Test Limit

N/A

10.4 Test Results

BW	Operation Frequency	Reading
(MHz)	(MHz)	(MHz)
20.0	5935.0	17.58
	6175.0	17.59
	6415.0	17.57
40.0	5945.0	33.12
	6185.0	33.11
	6405.0	33.18

Figure 66. 26dB Bandwidth Test Results

JUDGEMENT: Passed

See additional information in *Figure 67* to *Figure 72.*

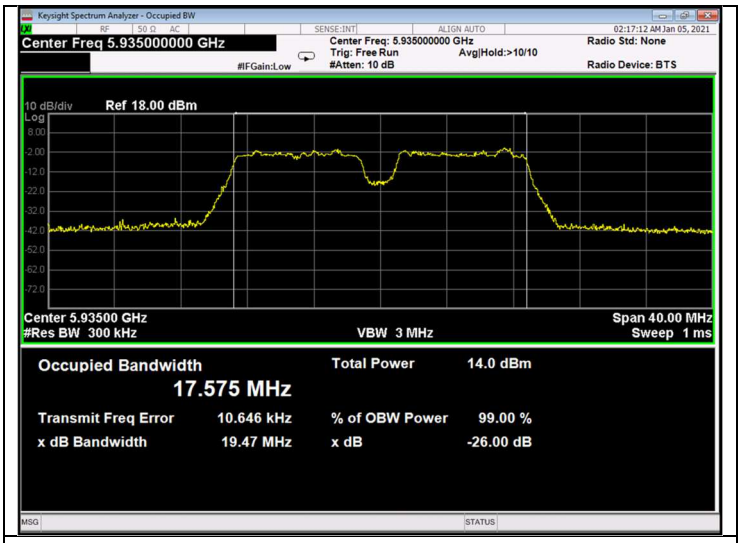


Figure 67. 5935.0MHz, 20MHz BW

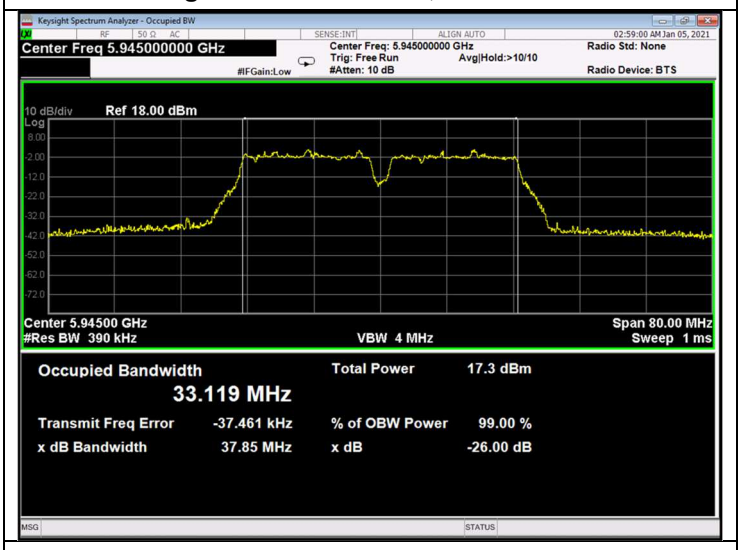


Figure 68. 5945.0MHz, 40MHz BW

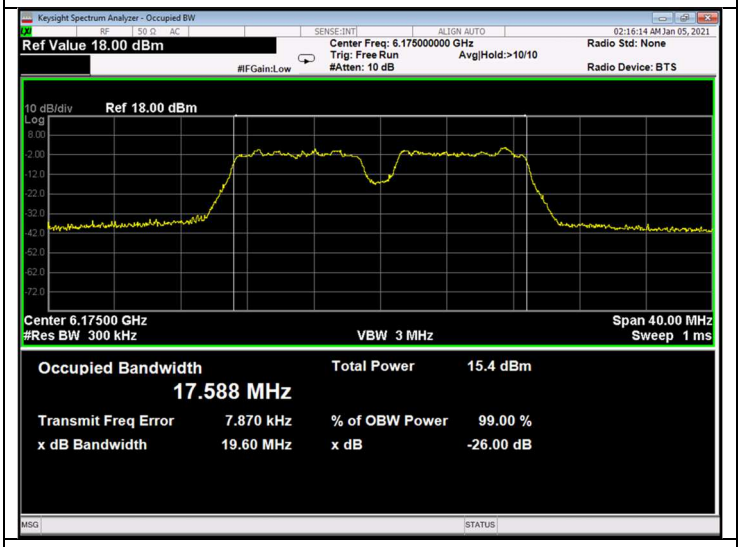


Figure 69. 6175.0MHz, 20MHz BW

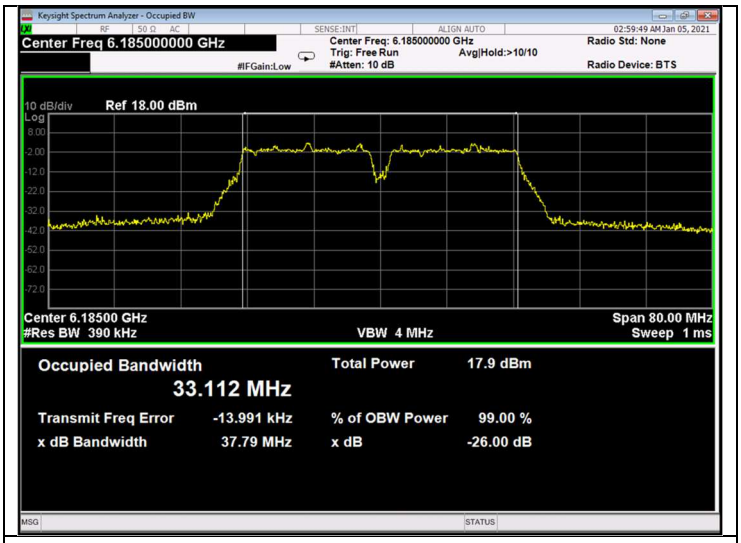


Figure 70. 6185.0MHz, 40MHz BW

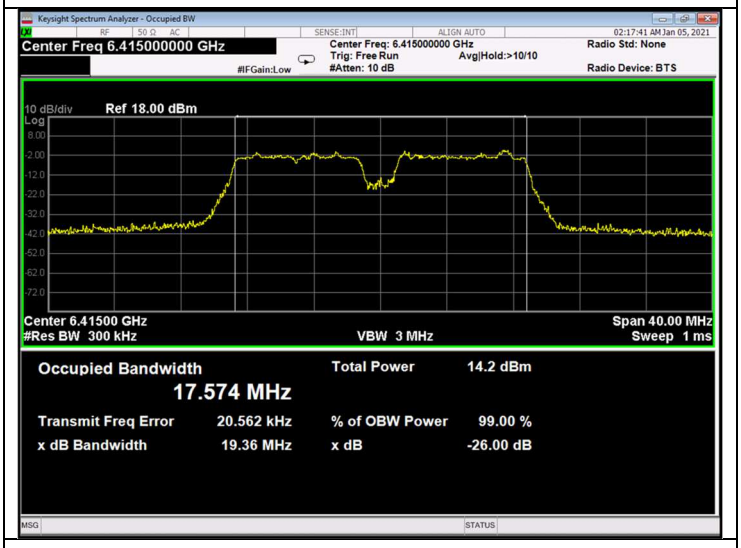


Figure 71. 6415.0MHz, 20MHz BW

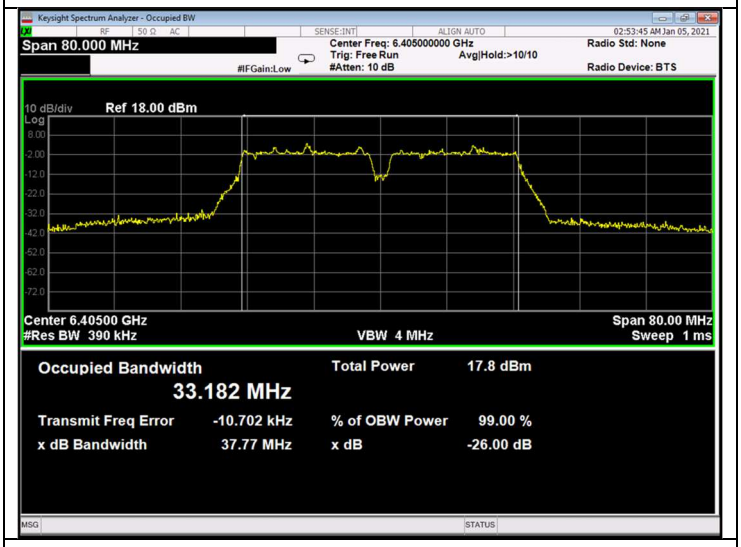


Figure 72. 6405.0MHz, 40MHz BW

10.5 Test Equipment Used; 26dB Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EXA Signal Analyzer	Agilent Technologies	N9010A	902A000401	March 1, 2019	March 31, 2021
30dB Attenuator	MCL	BW-S30W5	533	August 23, 2020	August 31, 2021
RF Cable	Huber Suhner	Sucofelex	28239/4PEA	August 23, 2020	August 31, 2021

Figure 73 Test Equipment Used

11. In-band Emission Mask

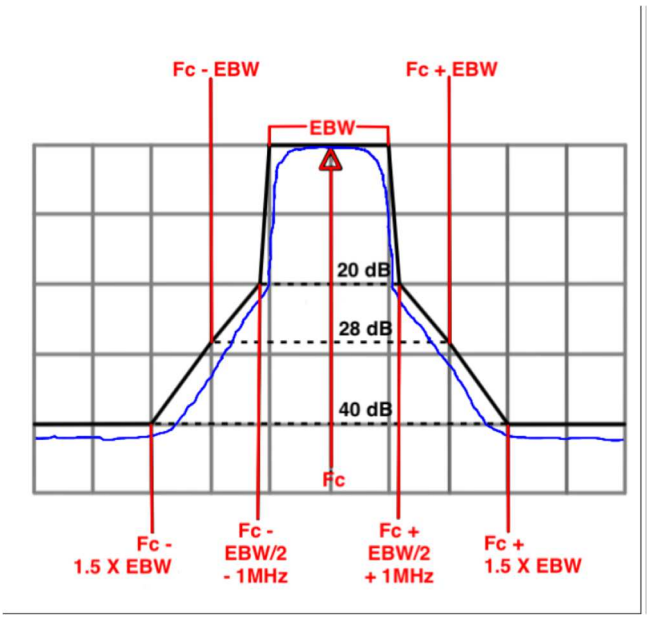
11.1 Test Specification

FCC, Part 2, Sub part J, Section 2.1049

11.2 Test Procedure

(Temperature (22°C)/ Humidity (56%RH))
The E.U.T. operation mode and test set-up are as described in Section 2 of this report. The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 31.0dB). Special attention was taken to prevent Spectrum Analyzer RF input overload. Test procedure was performed according to Section J of KDB 987594.

11.3 FCC and IC Test Limit



11.4 Test Results

JUDGEMENT: Passed

See additional information in *Figure 74* to *Figure 79*.

Figure 74. 5935.0MHz, 20MHz BW

Figure 75. 5945.0MHz, 40MHz BW

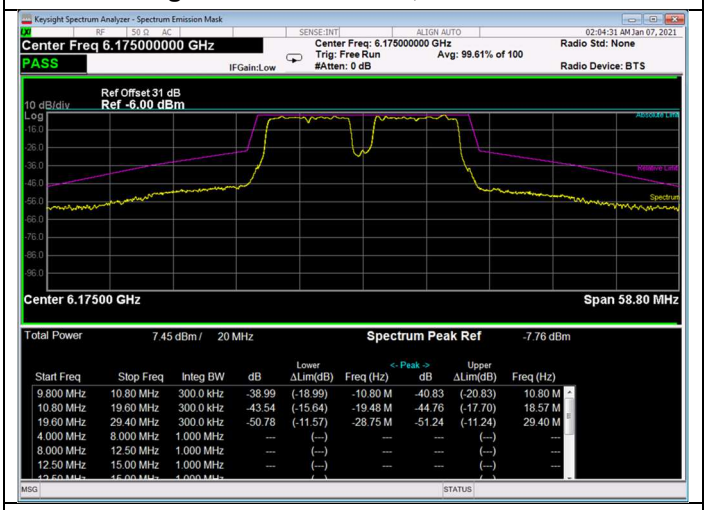


Figure 76. 6175.0MHz, 20MHz BW

Figure 77. 6185.0MHz, 40MHz BW

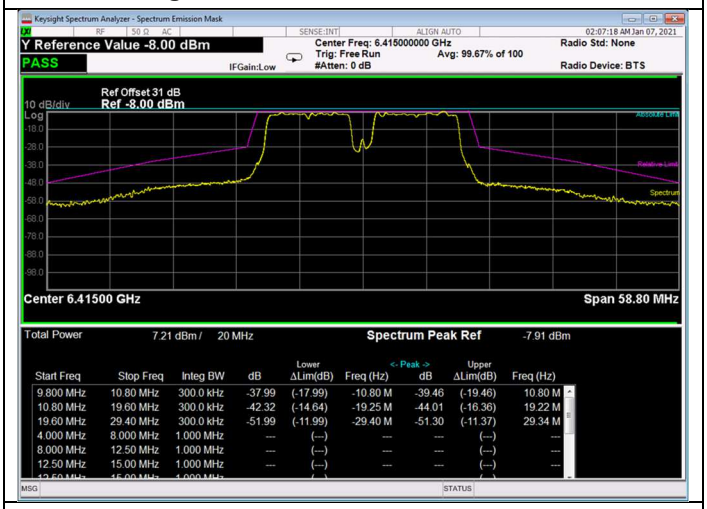


Figure 78. 6415.0MHz, 20MHz BW

Figure 79. 6405.0MHz, 40MHz BW

11.5 Test Equipment Used; In-band Emission Mask

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EXA Signal Analyzer	Agilent Technologies	N9010A	902A000401	March 1, 2019	March 31, 2021
30dB Attenuator	MCL	BW-S30W5	533	August 23, 2020	August 31, 2021
RF Cable	Huber Suhner	Sucofelex	28239/4PEA	August 23, 2020	August 31, 2021

Figure 80 Test Equipment Used

12. Contention Based Protocol

12.1 Test Specification

KDB 987594 D02 U-NII 6GHz EMC Measurement v01
RSS 248 Issue 1 November 19, 2021, Section 4.8

12.2 Test Procedure

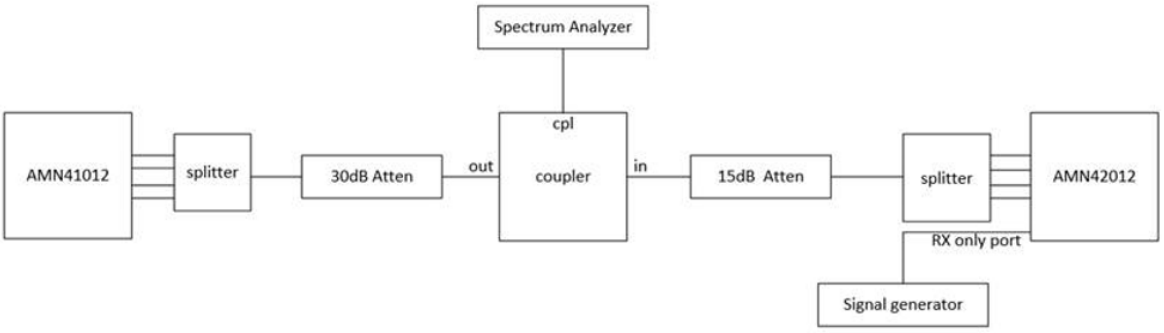
(Temperature (22°C)/ Humidity (56%RH))
Test procedure was performed according to Section I in KDB 987594.

1. The EUT was configured to transmit with a constant duty cycle at the power level, frequency, BW listed in the result table.
2. An AWGN signal of 10 MHz-wide was generated and the AWGN power injected was calibrated to -60dBm at the EUT RF connector assuming 0dBi antenna gain
3. The setup shown below per KDB 851776 was connected to the setup.
4. The EUT was set to 20MHz BW and was set to transmit at 5935MHz, as shown in figure 105.
5. The AWGN signal was set to the center frequencies 5930MHz (according to table 1 of KDB987594 D02) at AWGN signal power of -85dBm (which is 25 dB below the -62 dBm threshold when assuming 0dBi antenna gain).
6. The AWGN signal source was turned ON.
7. The AWGN signal was increased until the EUT stopped transmitting. The level of the AWGN signal is listed in the results table.
8. The procedure was repeated 10 times to verify the EUT can detect an AWGN signal at the same level.
9. The process was repeated for 40MHz BW performance: at the AWGN signal center frequencies of 5930MHz and 5960MHz for a 40MHz wide EUT signal transmitting at 5945MHz (according to table 1 of KDB987594 D02).
10. The procedure was repeated 10 times to verify the EUT can detect an AWGN signal at the same level.

12.3 Test Procedure Modification

Contention based protocol setup was done in link mode, which was approved by the FCC in KDB851776. The setup is shown in the following scheme.

AMN42012 – UNII5 – Contention Based Protocol Setup



12.4 Test Limit

Unlicensed low-power indoor devices must detect co-channel radio frequency power that is at least -62 dBm or lower. The -62 dBm (or lower) threshold is referenced to a 0 dBi antenna gain.

12.5 Test Results

EUT frequency	BW_{EUT}	Incumbent frequency	BW_{inc}	AWGN Power	Ant gain	Adjusted AWGN Power	Detection Limit	Number success/ Number of trials	Verdict
F_{c1}[MHz]	[MHz]	F_{c2}[MHz]	[MHz]	[dBm]	[dBi]	[dBm]	[dBm]		p/f
5935	20	5930	10	-61.5	2	-63.5	-62	10/10	pass
5945	40	5930	10	-63.5	2	-65.5	-62	10/10	pass
5945	40	5960	10	-63.5	2	-65.5	-62	10/10	pass

Figure 81. Contention Based Protocol Test Results

BW_{EUT}: Transmission bandwidth of EUT signal

BW_{INC}: Transmission bandwidth of the simulated incumbent signal (10 MHz wide AWGN signal)

Fc1: Center frequency of EUT transmission

Fc2: Center frequency of simulated incumbent signal

AWGN Power:

- AWGN power turned ON at -85dBm = no impact on transmission, starting from -85dBm, which is 25dB below the -62dBm defined threshold assuming 0dBi antenna gain
- Minimal = this condition is not supported due to technical design
- AWGN power listed in the table = detection of incumbent signal and transmitter evacuated of the center frequency

JUDGEMENT: Passed

The channel was vacated at every trial.

See additional information in *Figure 83* to *Figure 88.*

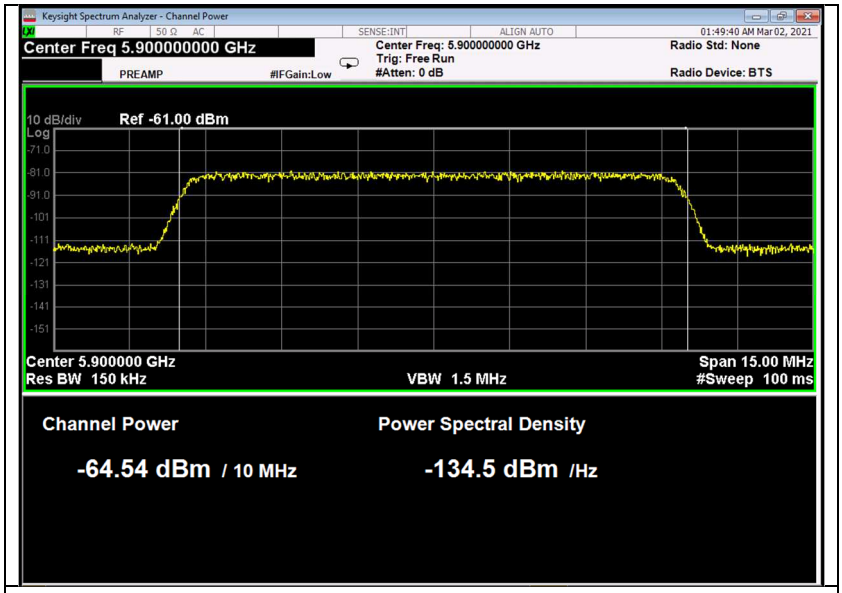


Figure 82. AWGN Signal

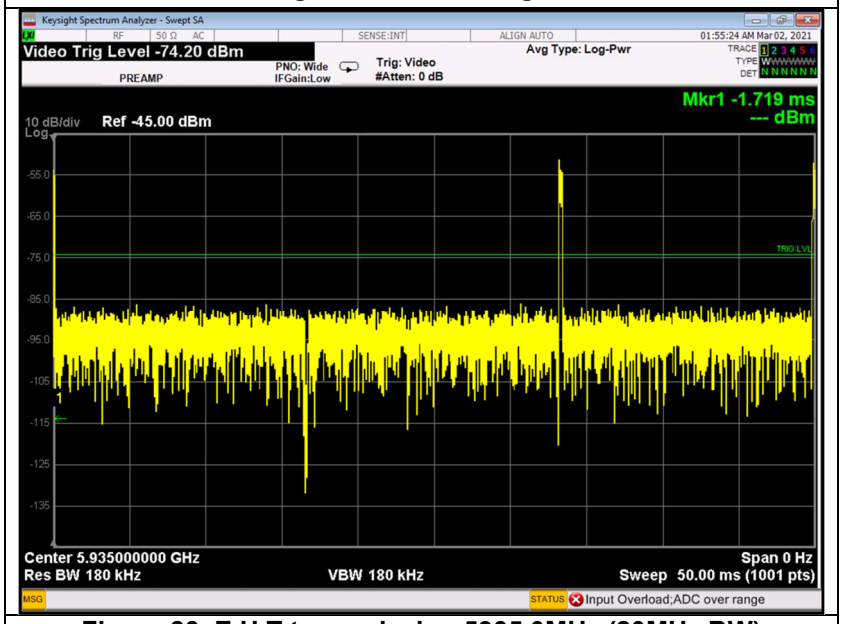


Figure 83. E.U.T transmission 5935.0MHz (20MHz BW) incumbent signal 5930.0MHz OFF

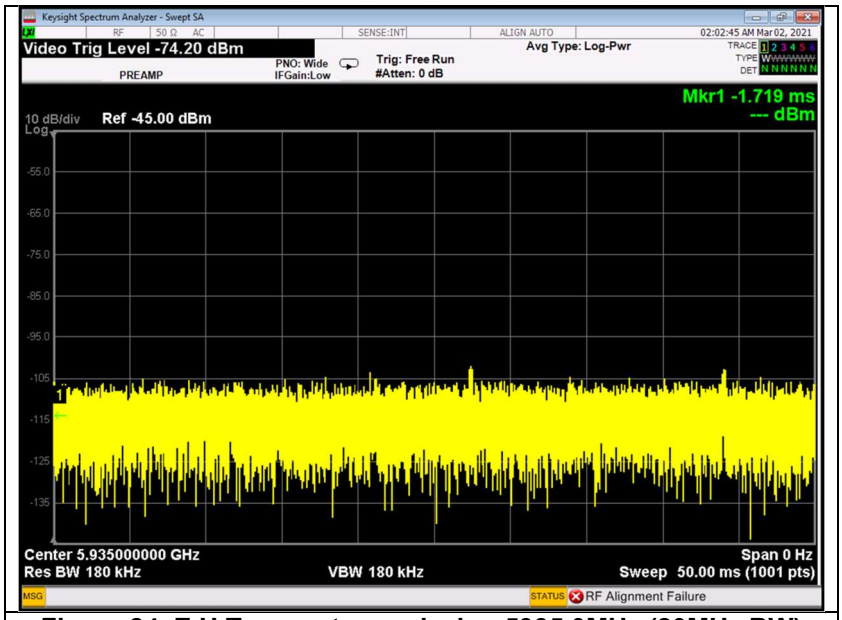


Figure 84. E.U.T cease transmission 5935.0MHz (20MHz BW) incumbent signal 5930.0MHz ON

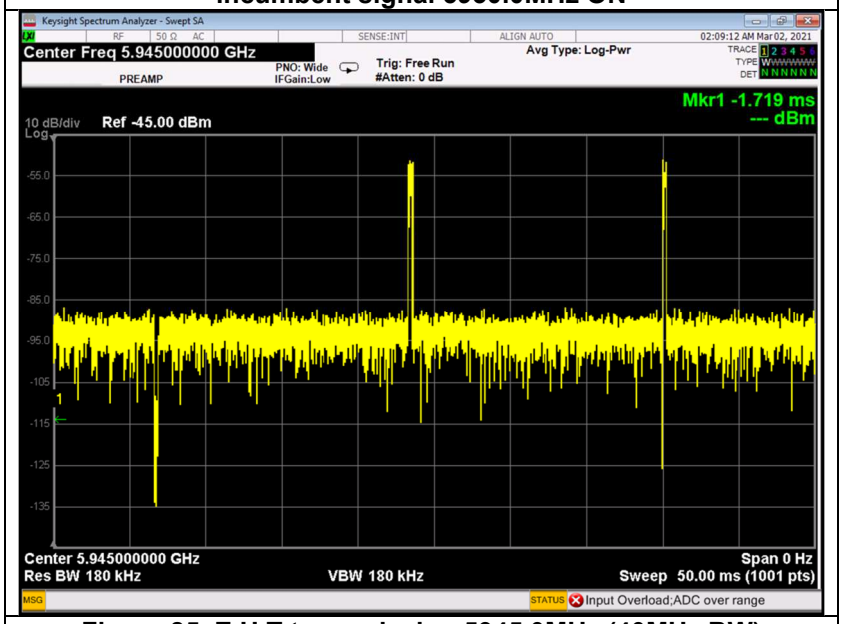


Figure 85. E.U.T transmission 5945.0MHz (40MHz BW) incumbent signal 5930.0MHz OFF

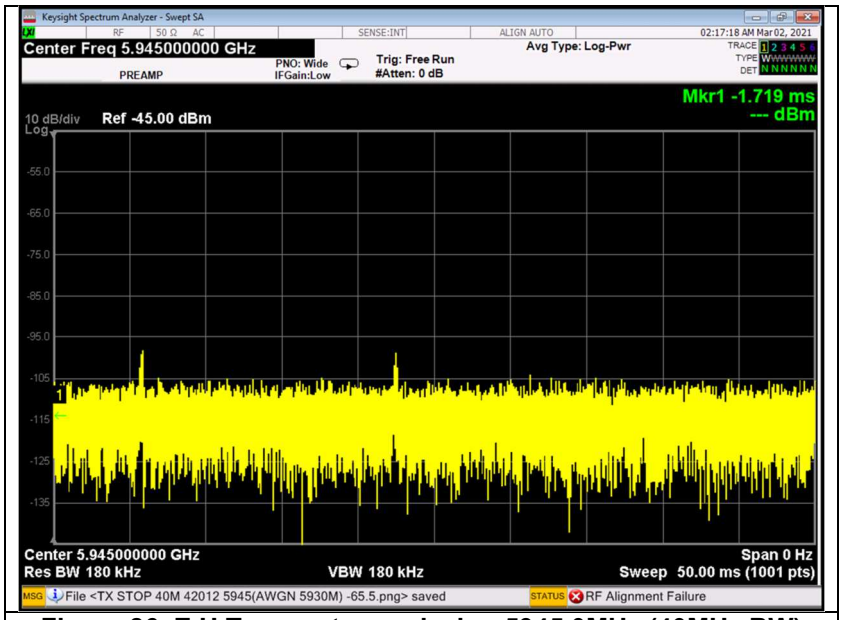


Figure 86. E.U.T cease transmission 5945.0MHz (40MHz BW) incumbent signal 5930.0MHz ON

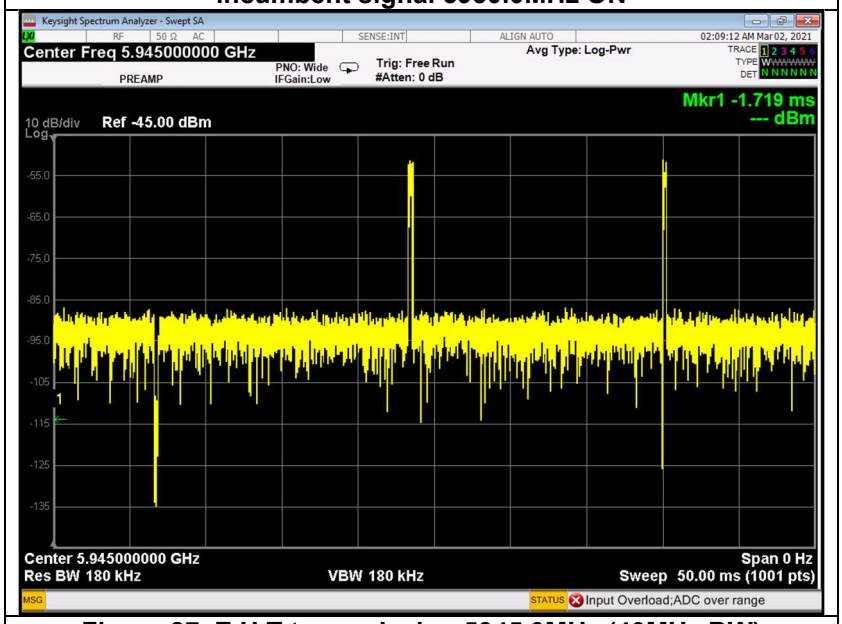


Figure 87. E.U.T transmission 5945.0MHz (40MHz BW) incumbent signal 5960.0MHz OFF

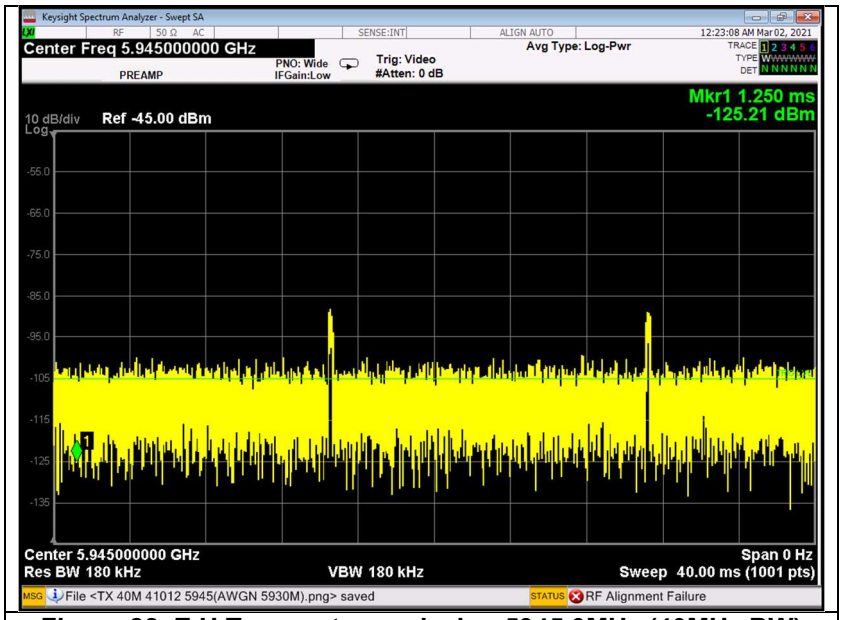


Figure 88. E.U.T cease transmission 5945.0MHz (40MHz BW) incumbent signal 5960.0MHz ON

12.6 Test Equipment Used; Contention Based Protocol

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EXA Signal Analyzer	Agilent Technologies	N9010A	902A000401	March 1, 2019	March 31, 2021
MXG Vector Signal Generator	Agilent Technologies	N5182A	MY47070174	October 10, 2020	October 10, 2023
Power Splitter	Mini-Circuits	ZB8PD-622-S+	SF423600840	NCR	NCR
Coupler	Mini-Circuits	ZADC-10-63-S+	SF985401442	NCR	NCR
Power Splitter	Mini-Circuits	ZN4PD1-63-S+	SF472000905	NCR	NCR

Figure 89 Test Equipment Used

13. Antenna Gain/Information

13.1 Test Specification

FCC, Part 15, Subpart B. section 212 (a)(iv)

13.2 Test Limit

The modular transmitter must comply with the antenna and transmission system requirements of §§15.203, 15.204(b) and 15.204(c). The antenna must either be permanently attached or employ a "unique" antenna coupler (at all connections between the module and the antenna, including the cable).

13.3 Test Results

Judgment: Passed

The table below describes the antennae used for testing the device:

Antenna Model	Type	Antenna Gain	Impedance
AMN_ANT_1010	dipole	2dBi	50Ω
AMN_ASM_1011	mushroom	2dBi	50Ω

2dBi antenna with RP-SMA connector

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 For ITL #1840 Anechoic Chamber RF Cable

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 For ITL # 1075 Active Loop Antenna

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 For ITL # 1349 Log Periodic Antenna

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

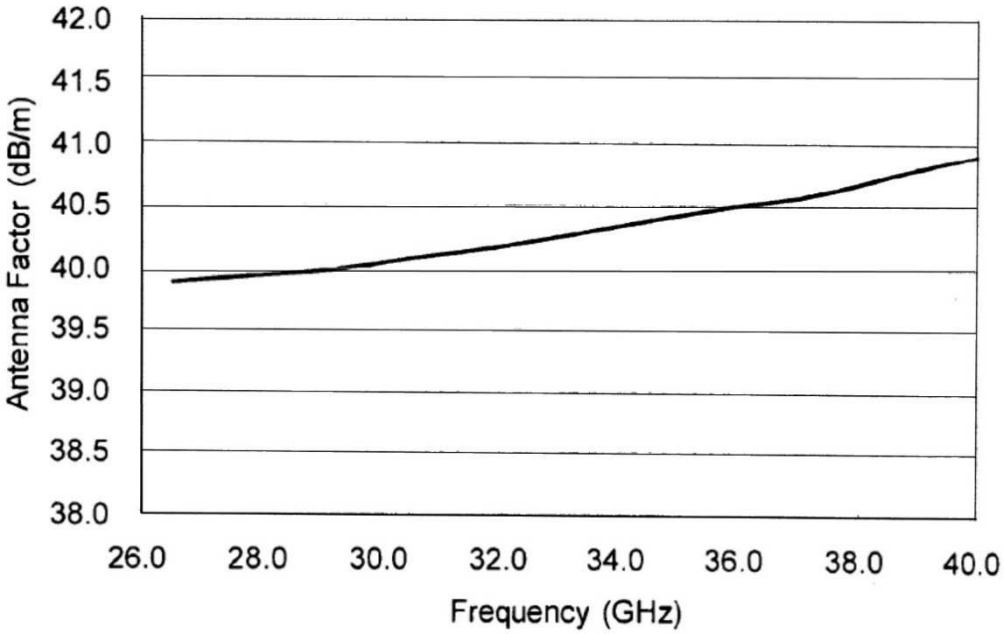
Frequency (GHz)	AF (dB/m)		Frequency (GHz)	AF (dB/m)
0.75	25		9.5	38
1.0	23.5		10.0	38.5
1.5	26.0		10.5	38.5
2.0	29.0		11.0	38.5
2.5	27.5		11.5	38.5
3.0	30.0		12.0	38.0
3.5	31.5		12.5	38.5
4.0	32.5		13.0	40.0
4.5	32.5		13.5	41.0
5.0	33.0		14.0	40.0
5.5	35.0		14.5	39.0
6.0	36.5		15.0	38.0
6.5	36.5		15.5	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 dBµV to obtain field strength in dBµ V/m.

14.8 For ITL # 1777 26.5-40 GHz Horn Antenna



14.9 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 dBµV to obtain field strength in dBµV/m.

End of Test Report