7. Spurious Emissions at Antenna Terminals

7.1 Test Specification

FCC Part 27, Subpart C, Section: 53(m)(2)

7.2 Test Procedure

(Temperature (22°C)/ Humidity (70%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max loss =44.0 dB). The spectrum analyzer was set to 300Hz RBW for the frequency range 9.0-150.0 kHz, 10kHz for the frequency range 150.0kHz–30.0MHz, 100kHz for the frequency range 30.0–1000.0MHz, and 1MHz for the frequency range 1.0- 27.0 GHz.

7.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges (2496.0-2690.0MHz) must be attenuated below the transmitting power (P) by a factor of at least 43 +10 log (P) dB , yielding –13dBm.

7.4 Test Results

JUDGEMENT: Passed

See additional information in *Figure 50* to *Figure 58.*
Note: The peaks appearing the plots are the fundamental transmissions.

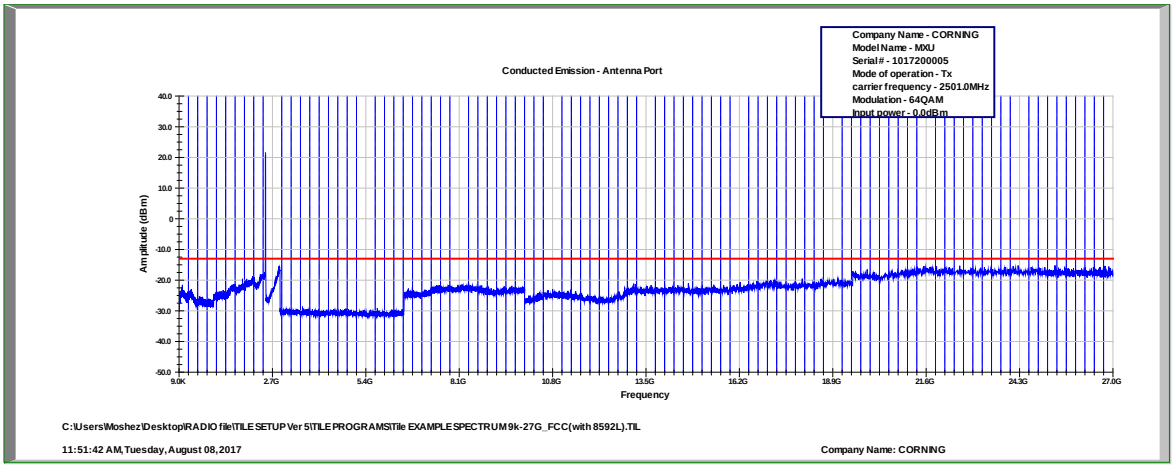

Figure 50 Spurious Emissions at Antenna Terminals 64QAM, 2501.0MHz

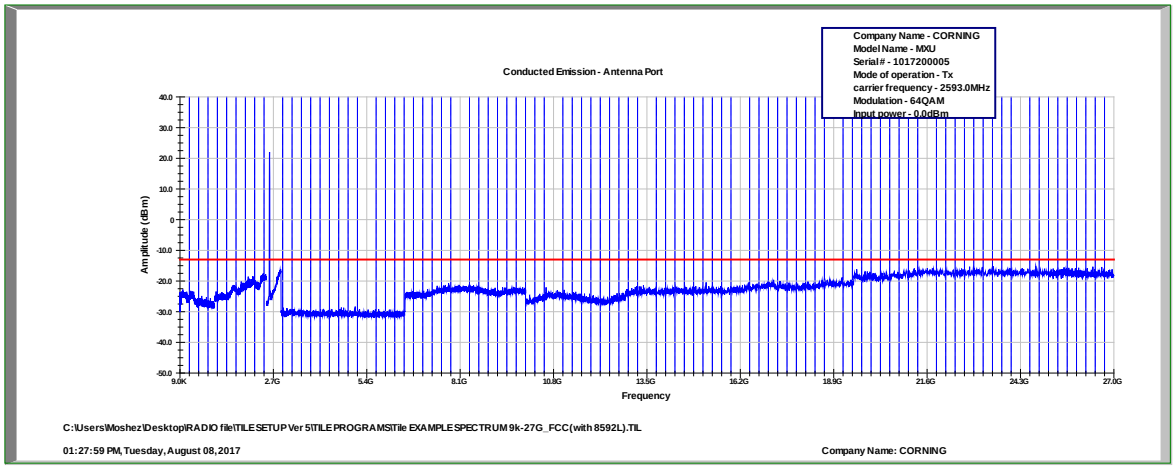

Figure 51 Spurious Emissions at Antenna Terminals 64QAM, 2593.0MHz

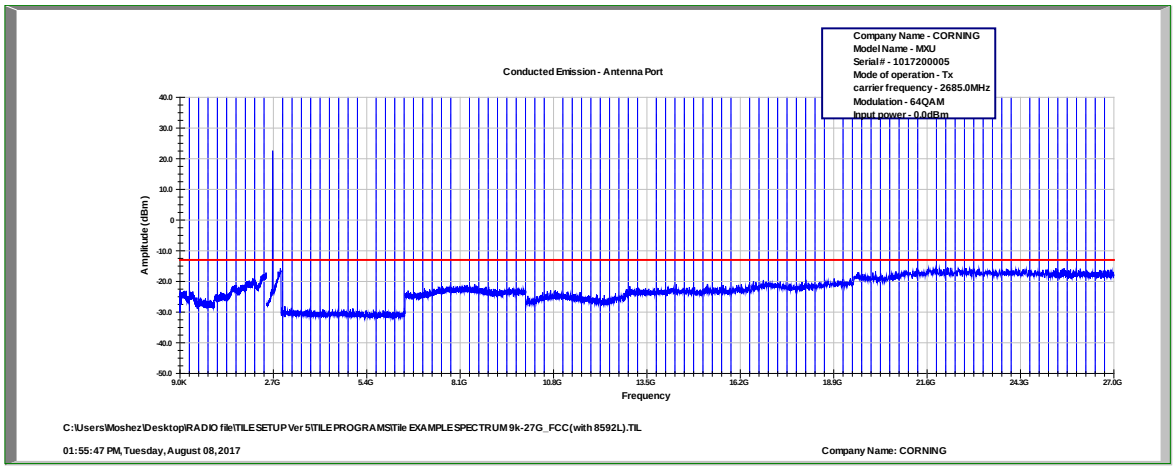

Figure 52 Spurious Emissions at Antenna Terminals 64QAM, 2685.0MHz

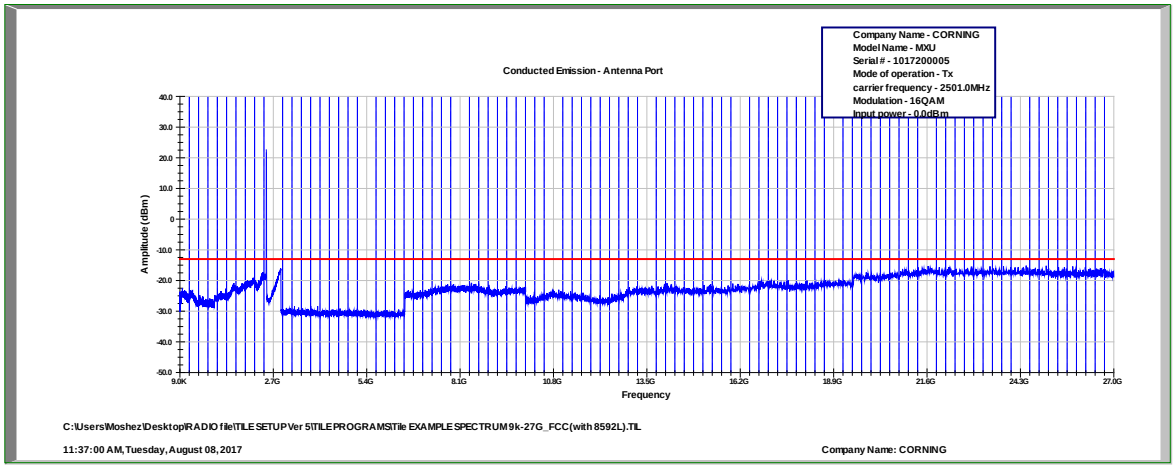

Figure 53 Spurious Emissions at Antenna Terminals 16QAM, 2501.0MHz

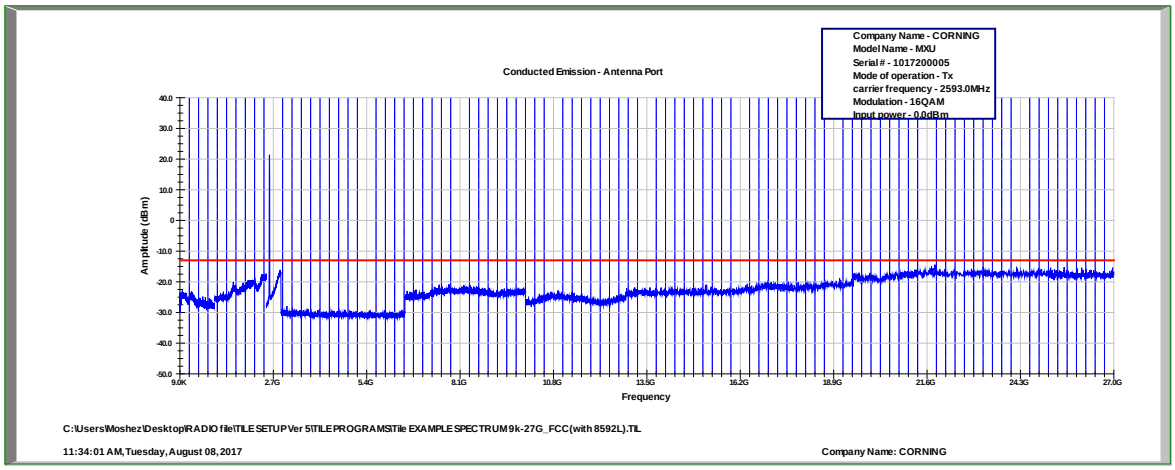

Figure 54 Spurious Emissions at Antenna Terminals 16QAM, 2593.0MHz

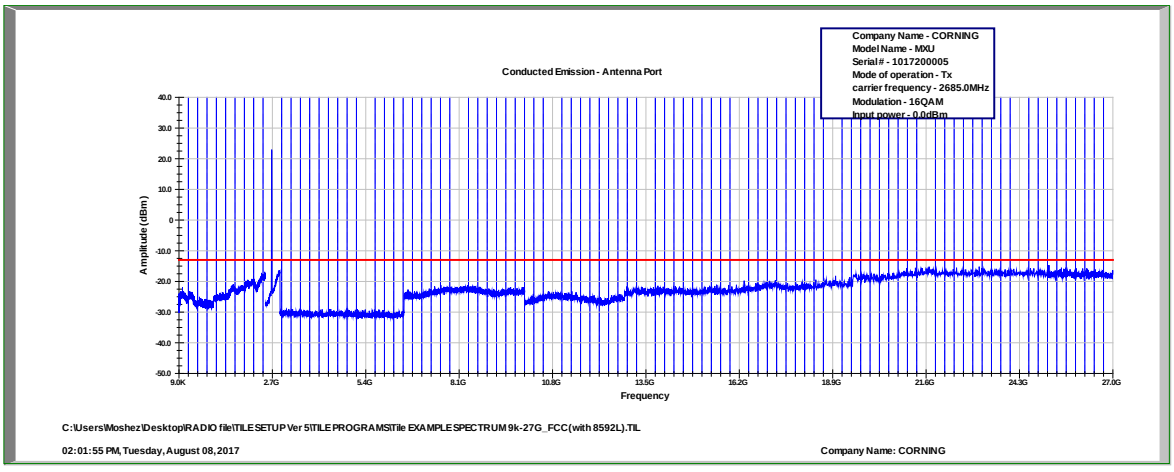

Figure 55 Spurious Emissions at Antenna Terminals 16QAM, 2685.0MHz

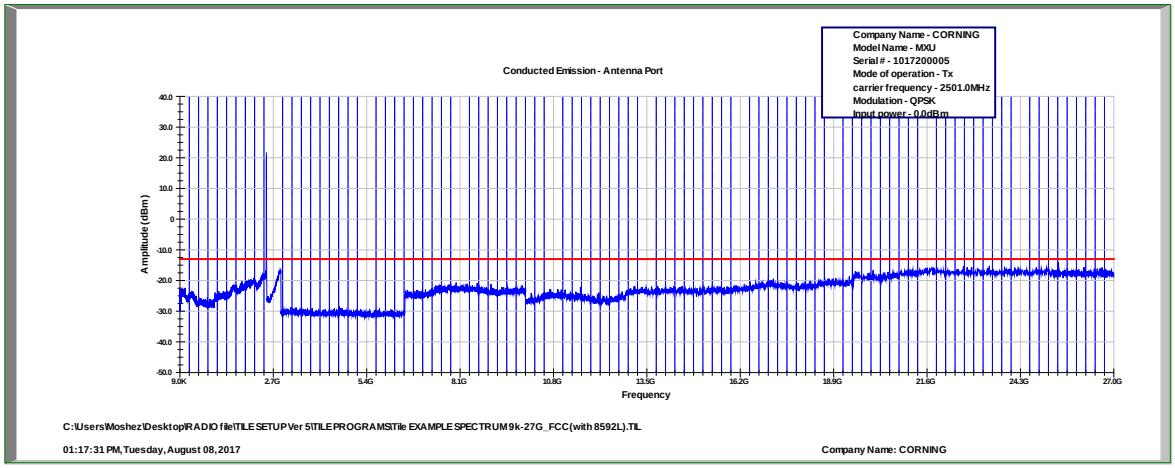

Figure 56 Spurious Emissions at Antenna Terminals QPSK, 2501.0MHz

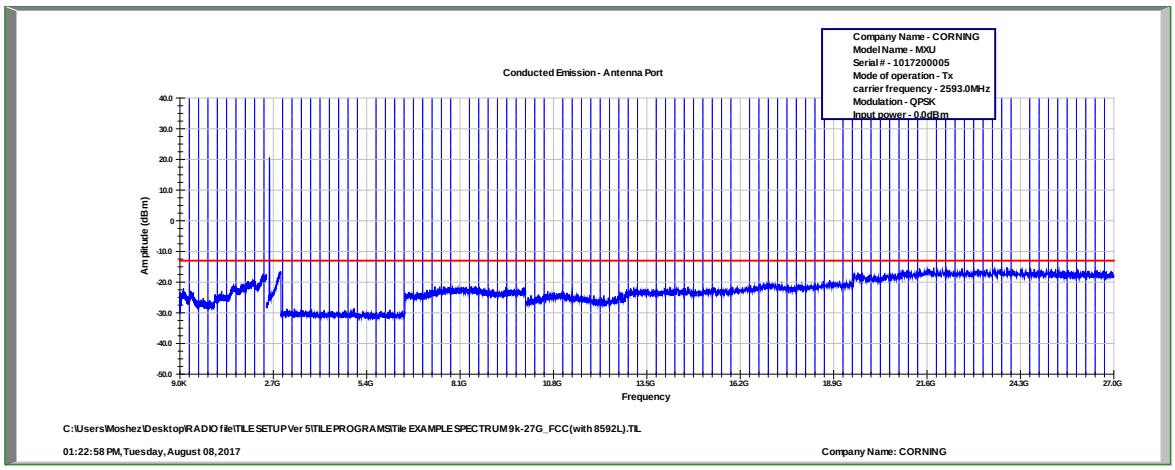

Figure 57 Spurious Emissions at Antenna Terminals QPSK, 2593.0MHz

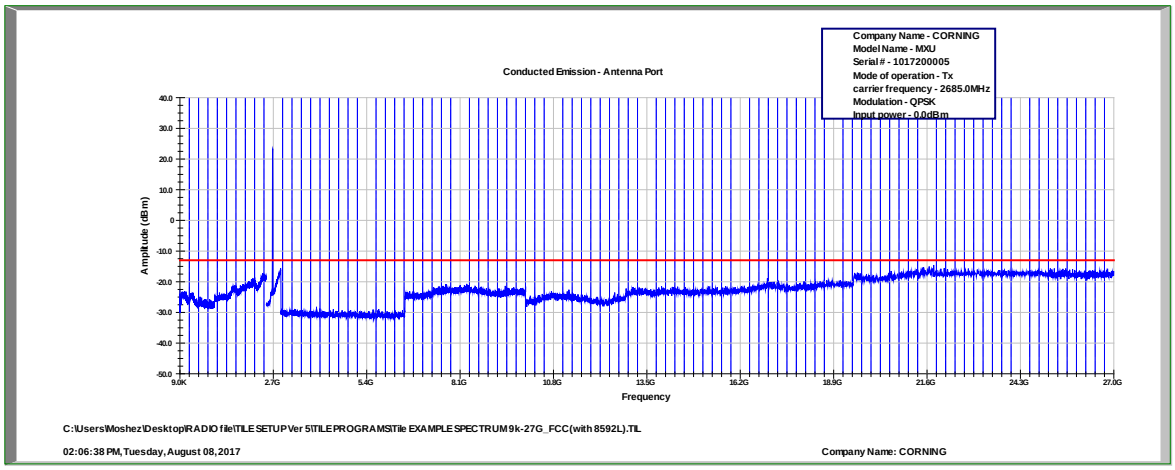

Figure 58 Spurious Emissions at Antenna Terminals QPSK, 2685.0MHz

7.5 Test Equipment Used; Out of Band Emission at Antenna Terminals

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	HP	8592L	3826A01204	March 1, 2017	March 1, 2018
Vector Signal Generator	Agilent	N5182A	MY48180244	August 2 , 2016	Nov 2, 2019
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	August 8, 2016	August 8, 2017

Figure 59 Test Equipment Used

8. Band Edge Spectrum

8.1 Test Specification

FCC Part 27, Subpart C, Section: 53(m)(2)

8.2 Test Procedure

(Temperature (22°C)/ Humidity (35%RH))
The E.U.T. antenna terminal was connected to the spectrum analyzer through an External attenuator and an appropriate coaxial cable (41.0 dB).
The spectrum analyzer RBW was set to 1% from OBW The evaluation was Repeated for all modulations.

8.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by factor of at least 43 +10 log (P) dB , yielding –13dBm.

8.4 Test Results

Modulation	Operation Frequency	Band Edge Frequency	Reading	Limit	Margin
	(MHz)	(MHz)	(dBm)	(dBm)	(dB)
64QAM	2501.0	2496.0	-21.6	-13.0	-8.6
	2685.0	2690.0	-21.5	-13.0	-8.5
16QAM	2501.0	2496.0	-22.4	-13.0	-9.4
	2685.0	2690.0	-21.4	-13.0	-8.4
QPSK	2501.0	2496.0	-21.6	-13.0	-8.6
	2685.0	2690.0	-21.4	-13.0	-8.4

Figure 60 Band Edge Spectrum Results

JUDGEMENT: Passed by 8.4dB

See additional information in *Figure 61* to *Figure 66.*

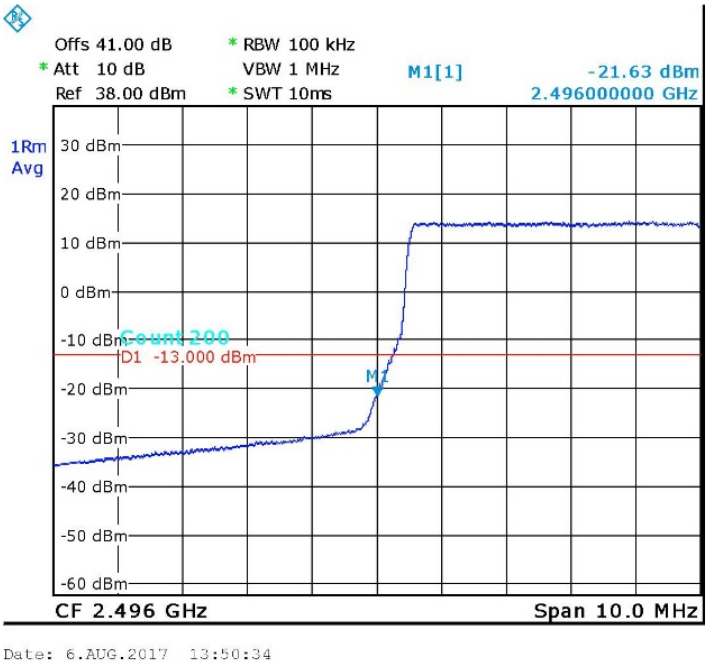

Figure 61. — Band Edge – Low, 64QAM

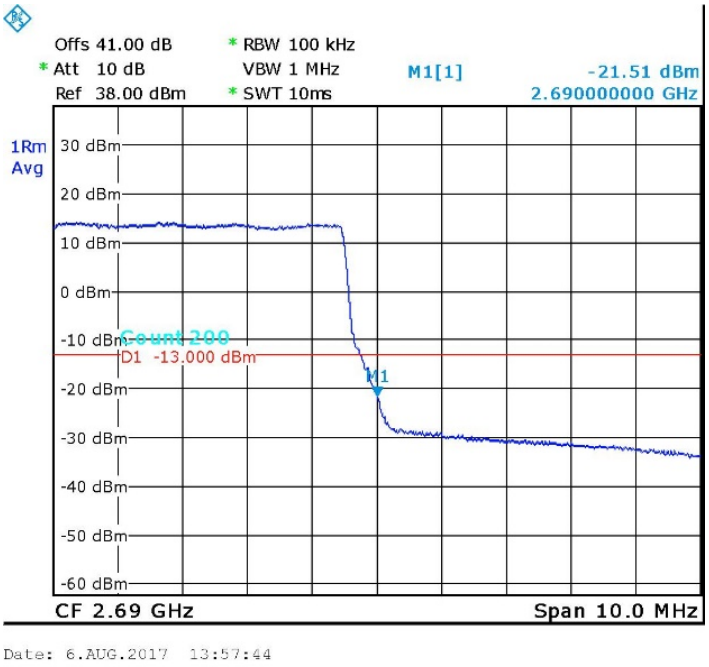

Figure 62. — Band Edge – High, 64QAM

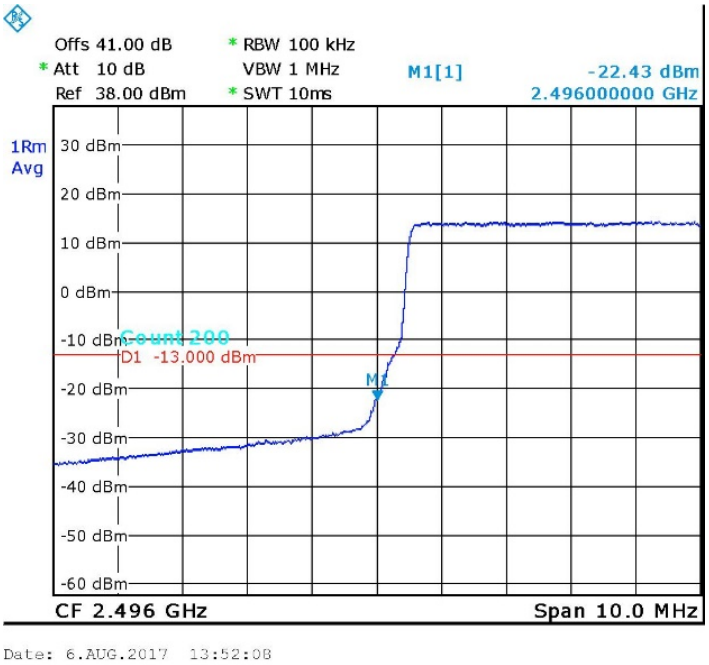

Figure 63. — Band Edge – Low, 16QAM

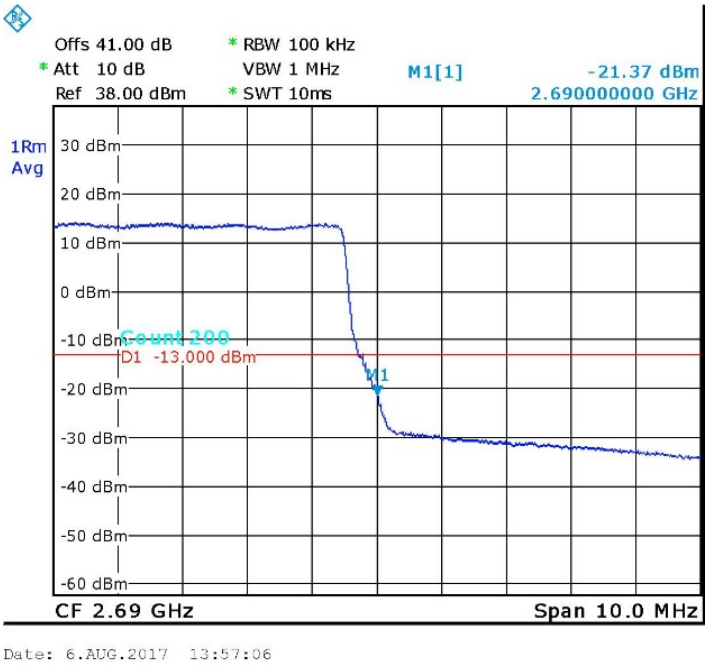

Figure 64. — Band Edge – High, 16QAM

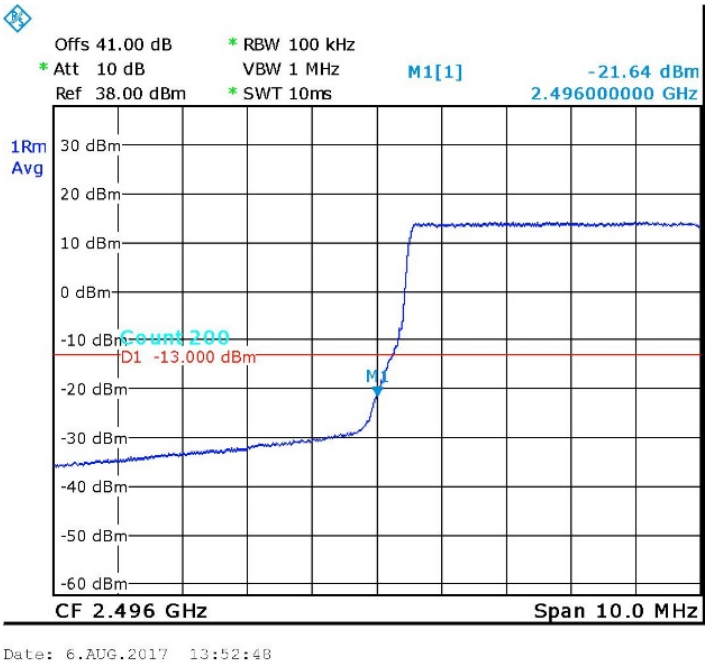

Figure 65. — Band Edge – Low, QPSK

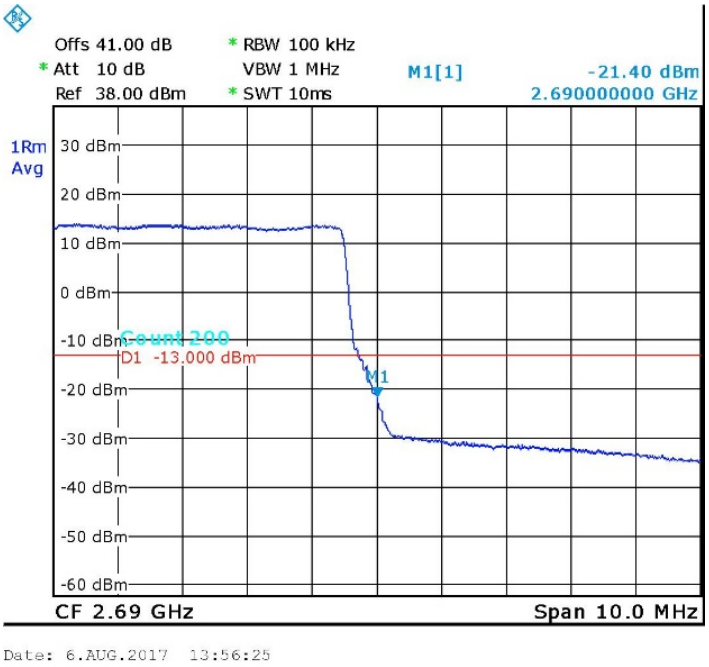

Figure 66. — Band Edge – High, QPSK

8.5 Test Equipment Used; Band Edge Spectrum

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	R&S	FSL6	100194	March 2, 2017	March 2, 2018
Vector Signal Generator	Agilent	N5182A	MY48180244	August 2 , 2016	Nov 2, 2019
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	August 8, 2016	August 8, 2017

Figure 67 Test Equipment Used

9. Spurious Emissions (Radiated)

9.1 Test Specification

FCC Part 27.53

9.2 Test Procedure

(Temperature (23°C)/ Humidity (70%RH))

The test method was based on ANSI/TIA-603-D: 2010, Section 2.2.12 Unwanted Emissions: Radiated Spurious.
The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009MHz-30.0MHz:

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 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 frequency range 0.009MHz-30MHz was scanned

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 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.

The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1.0GHz-27.0GHz:

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 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 frequency range 1.0GHz -27.0GHz was scanned.

The E.U.T. was replaced by a substitution antenna driven by a signal generator. The height was readjusted for maximum reading. The signal generator level was adjusted to obtain the same reading on the EMI receiver as in step (a).
The signals observed in step (a) were converted to radiated power using:

P_d(dBm) = P_g(dBm) – Cable Loss (dB) + Substitution Antenna Gain (dBd)

P_d = Dipole equivalent power (result).

P_g = Signal generator output level.

A Peak detector was used for this test.

Testing was performed at 3 modulations (64QAM, 16QAM, QPSK) in 3 operational frequencies: low, mid and high.

Testing was performed with the RF port connected to 50 Ω termination.

The table below describe only results with the highest radiation.

9.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by factor of at least 43 +10 log (P) dB, yielding –13dBm.

9.4 Test Results

Carrier Channel	Freq.	Antenna Pol.	Maximum Peak Level	Signal Generator RF Output	Cable Loss	Antenna Gain	Effective Radiated Power Level	Limit	Margin
(MHz)	(MHz)	(V/H)	(dBµV/m)	(dBm)	(dB)	(dBd)	(dBm)	(dBm)	(dB)
2501.0	5002.0	V	43.2	-62.0	1.0	10.5	-52.5	-13.0	-39.5
	5002.0	H	43.3	-61.2	1.0	10.5	-51.7	-13.0	-38.7
2593.0	5186.0	V	43.4	-62.0	1.0	10.5	-52.5	-13.0	-39.5
	5186.0	H	43.5	-61.2	1.0	10.5	-51.7	-13.0	-38.7
2685.0	5370.0	V	43.2	-62.0	1.0	10.5	-52.5	-13.0	-39.5
	5370.0	H	43.9	-60.5	1.0	10.5	-51.0	-13.0	-38.0

Figure 68 Spurious Emission (Radiated)

JUDGEMENT; Passed by 38.0 dB

The E.U.T met the requirements of the FCC Part 27, Section 53 specification.

9.5 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	March 1, 2017	March 1, 2018
RF Filter Section	HP	85420E	3705A00248	March 1, 2017	March 1, 2018
EMI Receiver	R&S	ESCI7	100724	February 28, 2017	February 28, 2018
Spectrum Analyzer	HP	8593EM	3536A00120ADI	February 28, 2017	February 28, 2018
Active Loop Antenna	EMCO	6502	9506-2950	September 12, 2016	September 12, 2017
Antenna Biconical	EMCO	3110B	9912-3337	May 15, 2017	May 15, 2019
Antenna Log Periodic	EMCO	3146	9505-4081	May 15, 2017	May 15, 2018
Horn Antenna 1G-18G	ETS	3115	29845	May 19, 2015	May 19, 2018
Horn Antenna 18G-26G	ARA	SWH-28	1007	March 30, 2014	December 31, 2017
Vector Signal Generator	Agilent	N5182A	MY48180244	August 2, 2016	November 2, 2019
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	-	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

Figure 69 Test Equipment Used

10. Out-of-Band Rejection (TDD)

10.1 Test Specification

KDB 935210 D05 v01r01, Section 3.3

10.2 Test Procedure

(Temperature (22°C)/ Humidity (37%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max Loss= 41.0 dB).

The signal and spectrum analyzer frequency range was set to ±250% of the passband, Dwell time set to approximately 10msec.

RBW was set between 1% to 5% of the E.U.T passband and VBW set to ≥3*RBW.

10.3 Test Limit

N/A

10.4 Test Results

JUDGEMENT: N/A

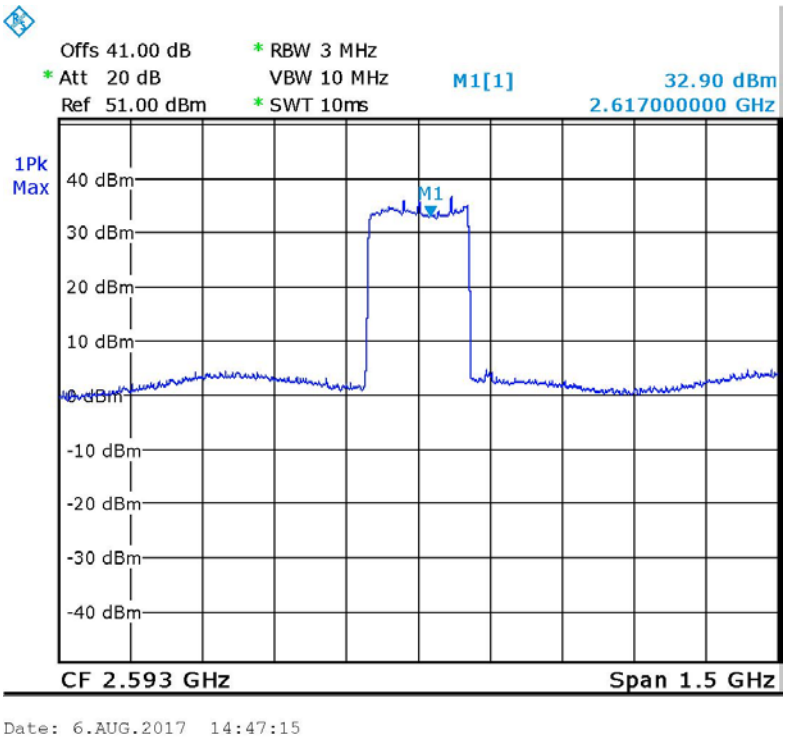

Figure 70. — Out-of-Band Rejection Plot

10.5 Test Equipment Used; Out-of-Band Rejection

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	R&S	FSL6	100194	March 2, 2017	March 2, 2018
Vector Signal Generator	Agilent	N5182A	MY48180244	August 2 , 2016	Nov 2, 2019
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	August 8, 2016	August 8, 2017

Figure 71 Test Equipment Used

11. APPENDIX A - CORRECTION FACTORS

11.1 Correction factors for RF OATS Cable 35m ITL #1879

Frequency (MHz)	Cable loss (dB)
30.0	1.1
50.0	1.1
100.0	1.7
150.0	2.1
200.0	2.5
250.0	2.7
300.0	2.9
350.0	3.1
400.0	3.5
450.0	3.7
500.0	3.9
550.0	4.0
600.0	4.2
650.0	4.4
700.0	4.9
750.0	5.0
800.0	5.0
850.0	4.9
900.0	5.0
950.0	5.1
1000.0	5.4

11.2 Correction factor for RF CABLE for Semi Anechoic Chamber

ITL # 1841

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

NOTES:

1. The cable is manufactured by Commscope

2. The cable type is 0623 WBC-400, serial # G020132 and 10m long

11.3 Correction factors for biconical antenna – ITL # 1356

Model: EMCO 3110B
Serial No.:9912-3337

Frequency [MHz]	**ITL 1356 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

11.4 Correction factors for log periodic antenna – ITL # 1349

Model: EMCO 3146

Serial No.:9505-4081

Frequency [MHz]	**ITL 1349 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

11.5 Correction factors for Active Loop Antenna

Model 6502 S/N 9506-2950

ITL # 1075:

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

11.6 Correction factors for Horn ANTENNA

Model: 3115
Serial number:29845
3 meter range; 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

11.7 Correction factors for Horn Antenna

Model: SWH-28
at 1 meter range.
ITL #:1353

Frequency, MHz	Measured antenna factor, dB/m [1)]
18000	33.0
18500	32.9
19000	33.1
19500	33.3
20000	33.6
20500	33.6
21000	33.4
21500	33.8
22000	33.7
22500	33.9
23000	34.8
23500	34.5
24000	34.2
24500	34.8
25000	34.4
25500	35.2
26000	35.9
26500	36.0