

Figure 441: Spurious Emissions at Antenna Terminal QPSK, 2115MHz, B.W. 10MHz, Sub Carrier 15kHz

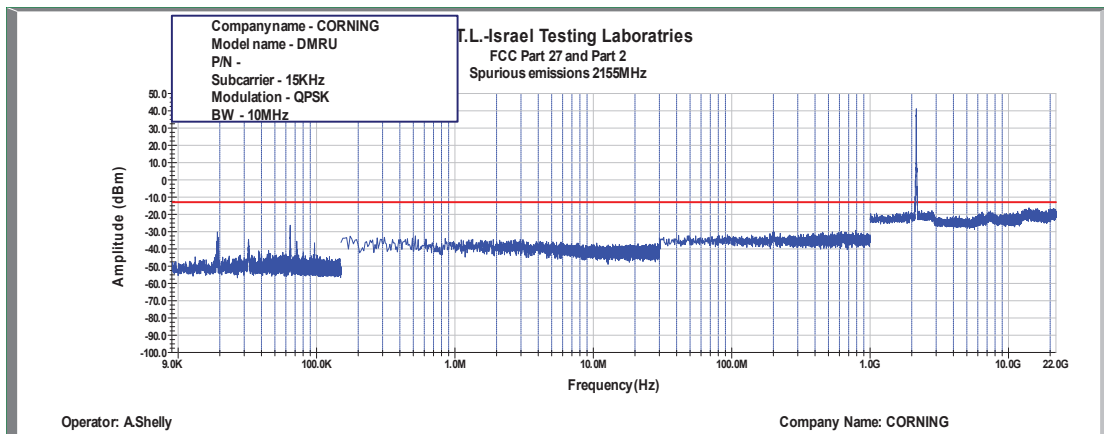


Figure 442: Spurious Emissions at Antenna Terminal QPSK, 2155MHz, B.W. 10MHz, Sub Carrier 15kHz

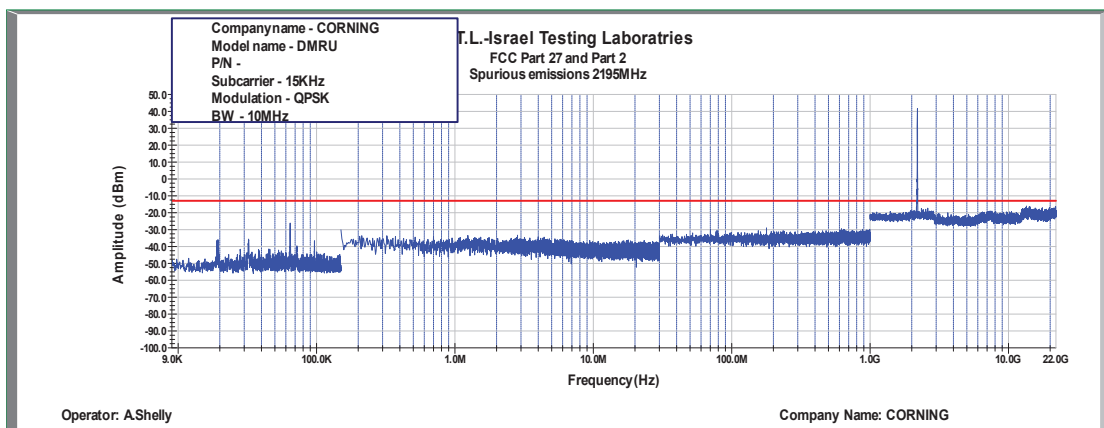


Figure 443: Spurious Emissions at Antenna Terminal QPSK, 2195MHz, B.W. 10MHz, Sub Carrier 15kHz

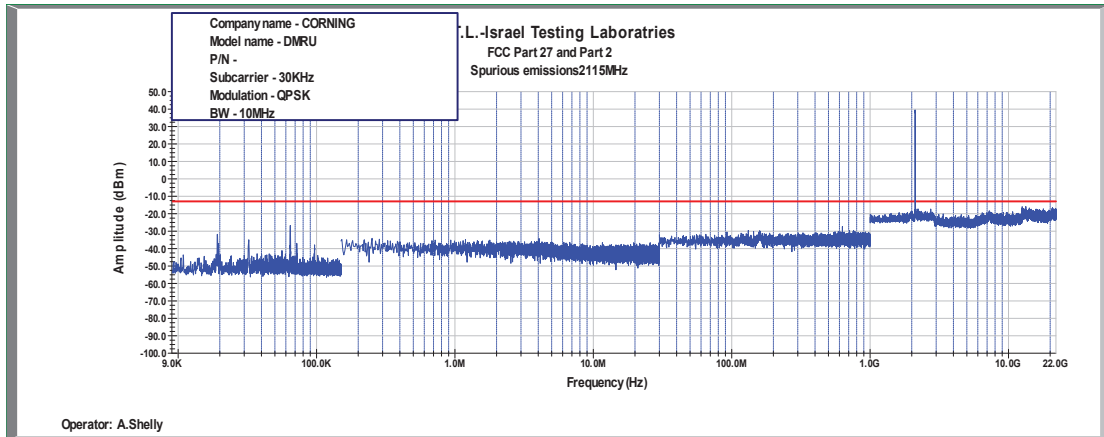


Figure 444: Spurious Emissions at Antenna Terminal QPSK, 2115MHz, B.W. 10MHz, Sub Carrier 30kHz

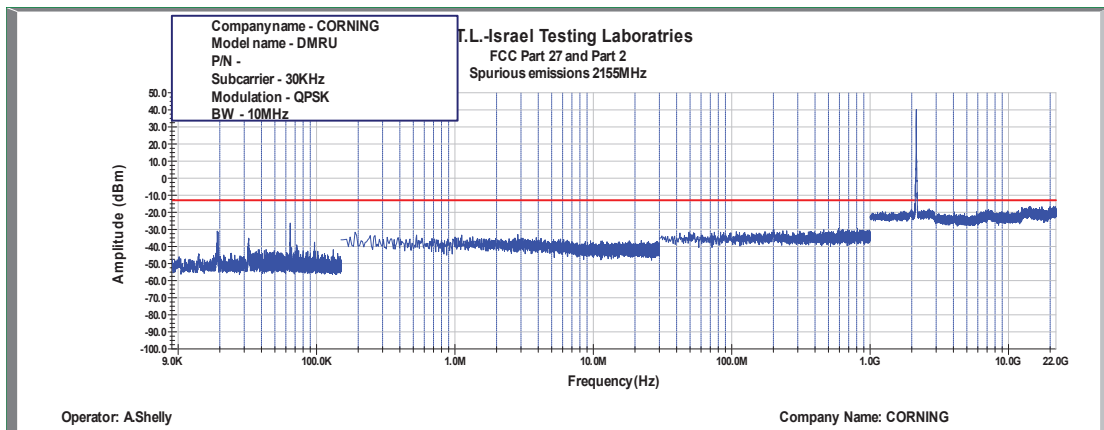


Figure 445: Spurious Emissions at Antenna Terminal QPSK, 2155MHz, B.W. 10MHz, Sub Carrier 30kHz

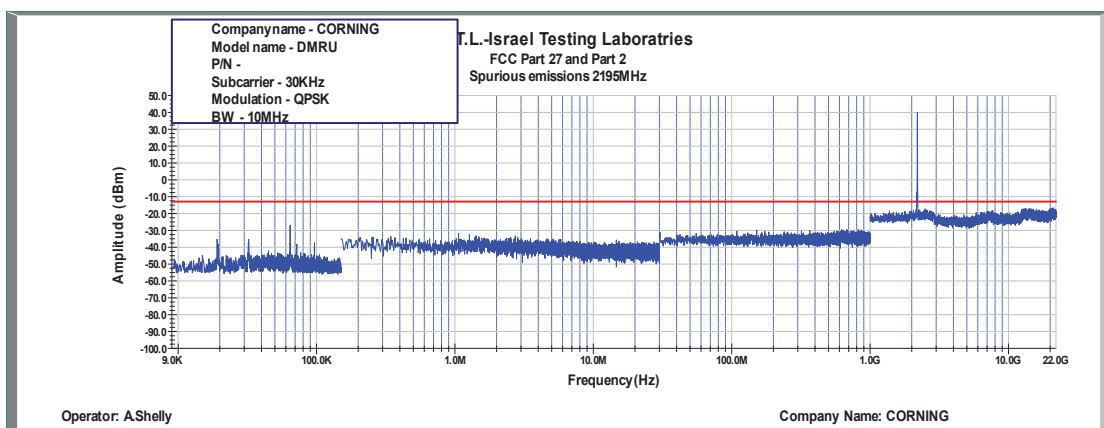


Figure 446: Spurious Emissions at Antenna Terminal QPSK, 2195MHz, B.W. 10MHz, Sub Carrier 30kHz

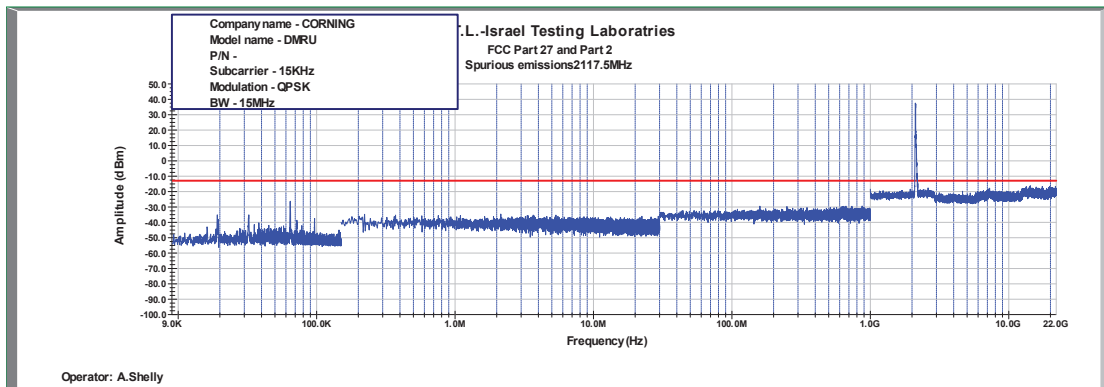


Figure 447: Spurious Emissions at Antenna Terminal QPSK, 2117.5MHz, B.W. 15MHz, Sub Carrier 15kHz

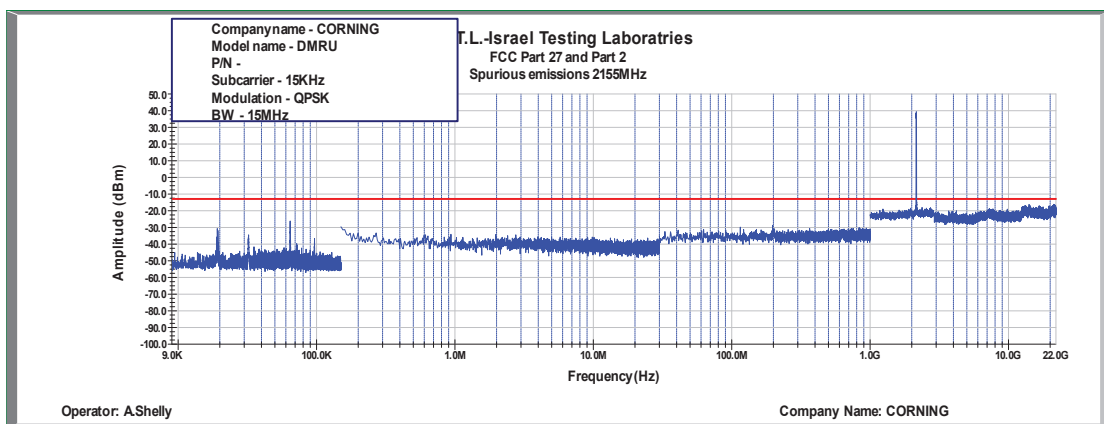


Figure 448: Spurious Emissions at Antenna Terminal QPSK, 2155MHz, B.W. 15MHz, Sub Carrier 15kHz

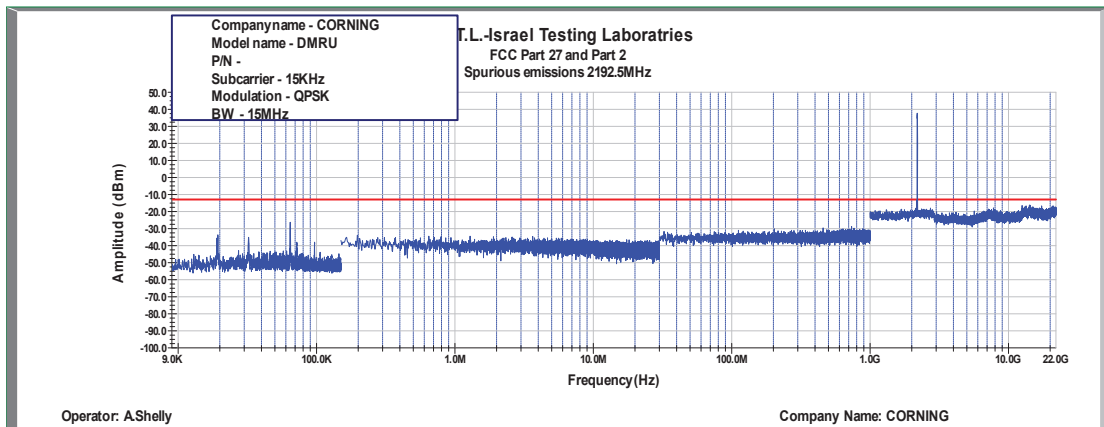


Figure 449: Spurious Emissions at Antenna Terminal QPSK, 2192.5MHz, B.W. 15MHz, Sub Carrier 15kHz

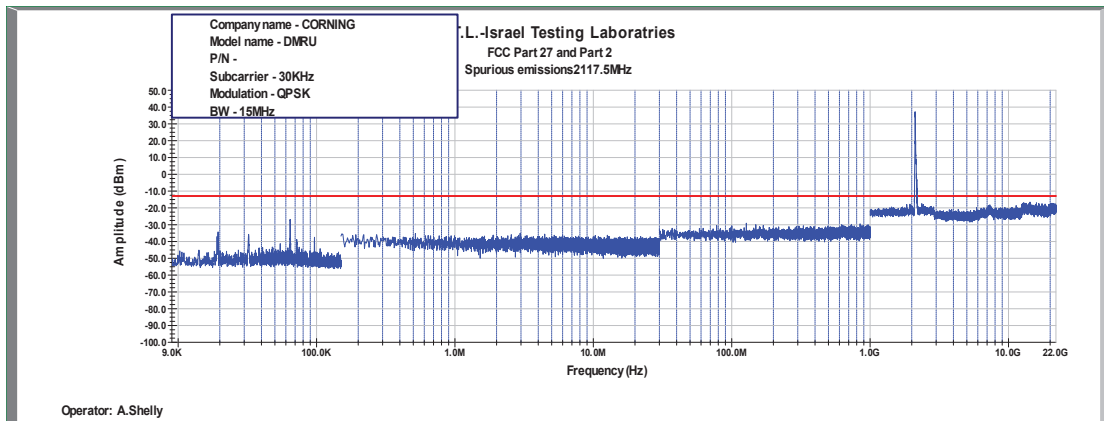


Figure 450: Spurious Emissions at Antenna Terminal QPSK, 2117.5MHz, B.W. 15MHz, Sub Carrier 30kHz

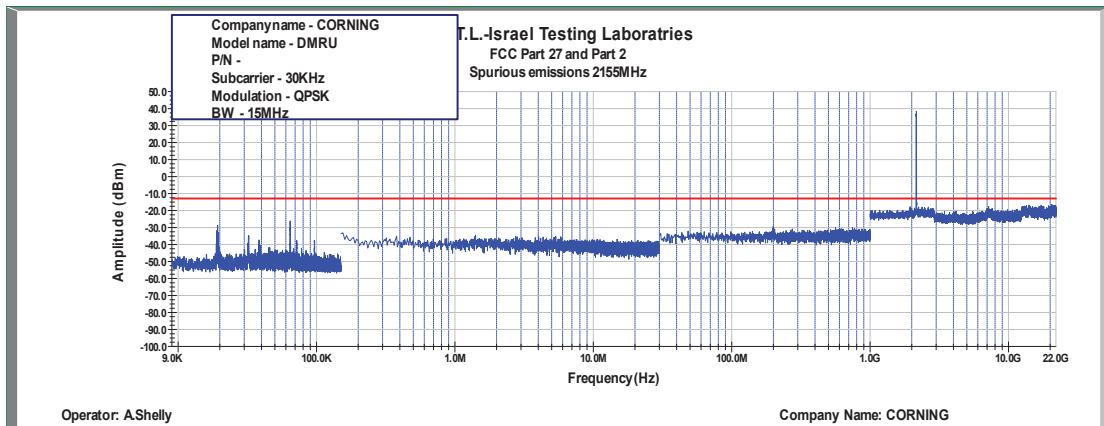


Figure 451: Spurious Emissions at Antenna Terminal QPSK, 2115MHz, B.W. 15MHz, Sub Carrier 30kHz

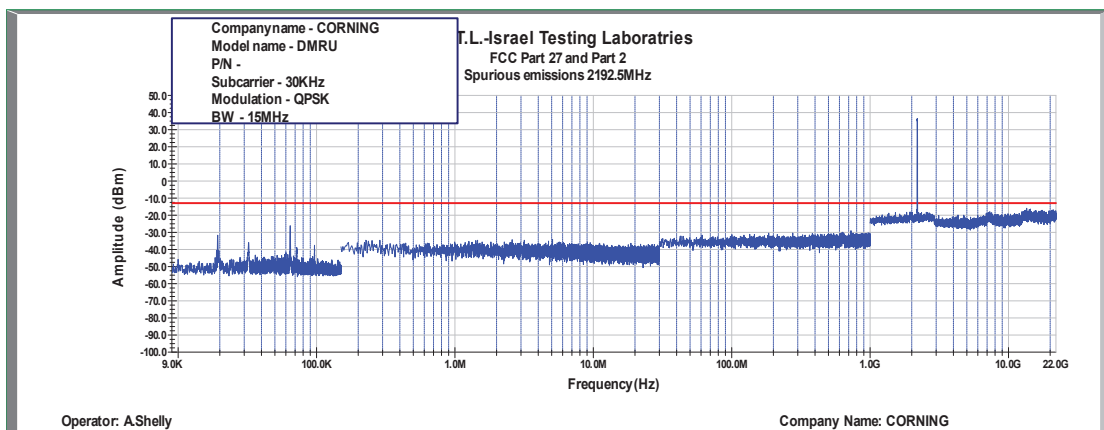


Figure 452: Spurious Emissions at Antenna Terminal QPSK, 2192.5MHz, B.W. 15MHz, Sub Carrier 30kHz



### 10.5 Test Equipment Used; Spurious Emissions at Antenna Terminals

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EXA signal Analyzer	Keysight	UXA N9040B	MY56080119	January 31, 2020	January 31, 2022
EXG Vector Signal Generator	Agilent Technologies	N5172B	MY53051952	January 17, 2019	January 17, 2022
40 dB Attenuator	Weinschel Associates	WA 39-40-33	-	November 1, 2020	November 1, 2021
RF Coaxial Cable	Huber-Suner	SLLS210B	-	November 1, 2020	November 1, 2021

**Table 39 Test Equipment Used**



## 11 Spurious Emissions at Antenna Terminals – 3G and 4G

### 11.1 Test Specification

FCC Part 27, Subpart C, Sections 27.53(h)

### 11.2 Test Procedure

(Temperature (20°C)/ Humidity (48%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max loss=44dB). scanning was performed until 22GHz

### 11.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges (2110-2200 MHz) must be attenuated below the transmitting power (P) by a factor of  $43 + 10 \log (P)$  dB.

### 11.4 Test Results

JUDGEMENT: Passed

See additional information in Figure 453 to Figure 482.

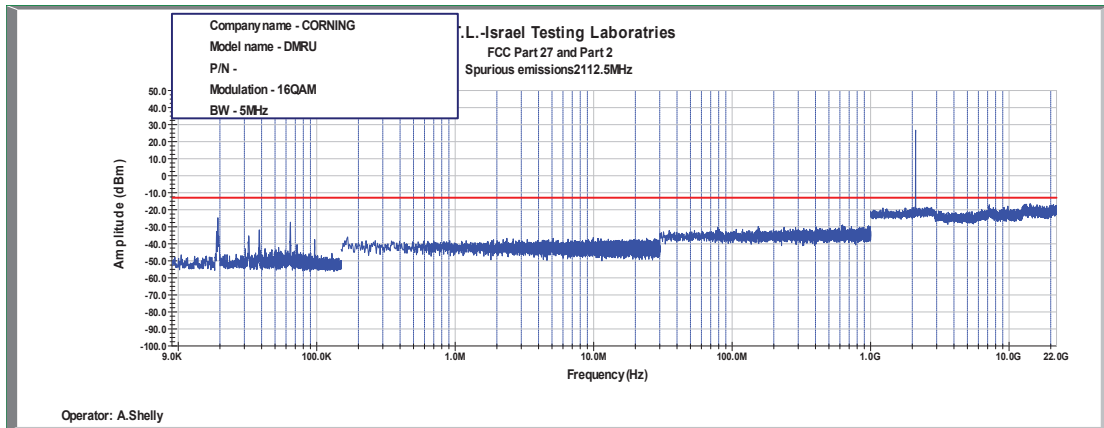


Figure 453: Spurious Emissions at Antenna Terminal 16QAM, 2112.5MHz, B.W. 5MHz

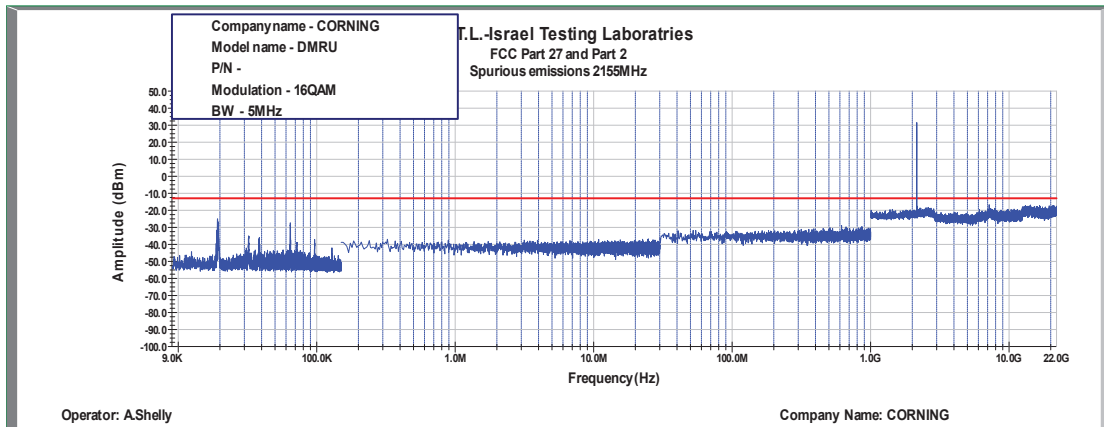


Figure 454: Spurious Emissions at Antenna Terminal 16QAM, 2155MHz, B.W. 5MHz

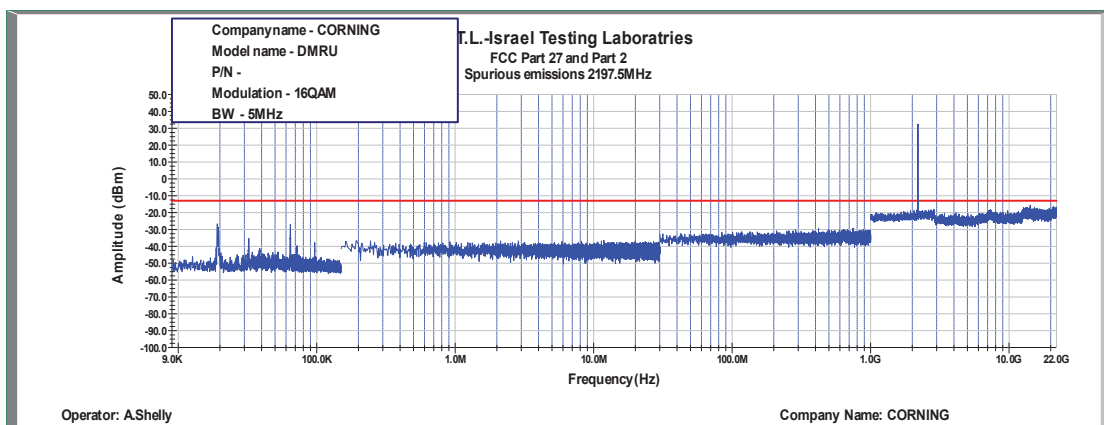


Figure 455: Spurious Emissions at Antenna Terminal 16QAM, 2197.5MHz, B.W. 5MHz

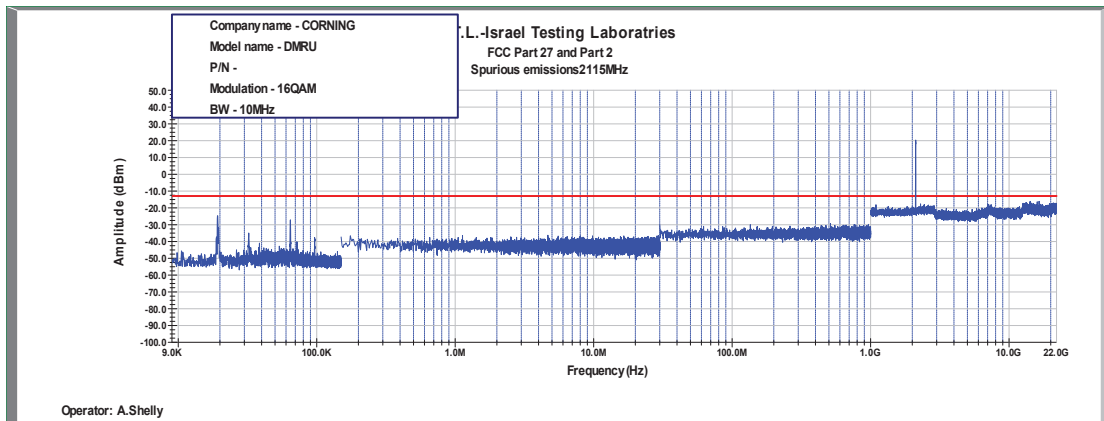


Figure 456: Spurious Emissions at Antenna Terminal 16QAM, 2115MHz,  
B.W. 10MHz

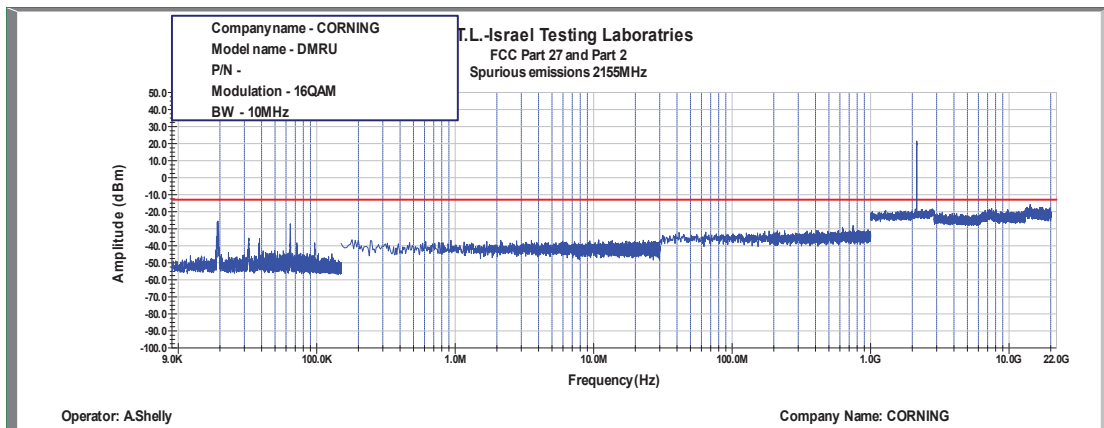


Figure 457: Spurious Emissions at Antenna Terminal 16QAM, 2155MHz,  
B.W. 10MHz

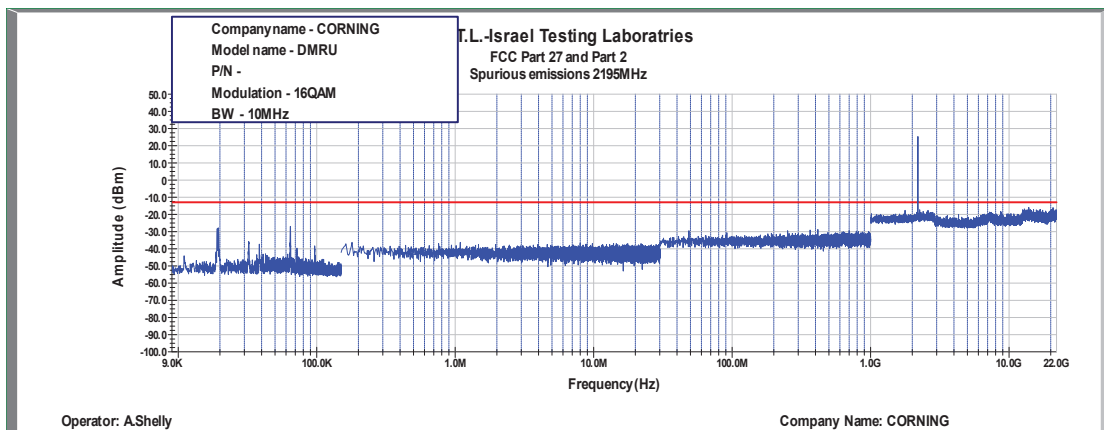


Figure 458: Spurious Emissions at Antenna Terminal 16QAM, 2195MHz,  
B.W. 10MHz



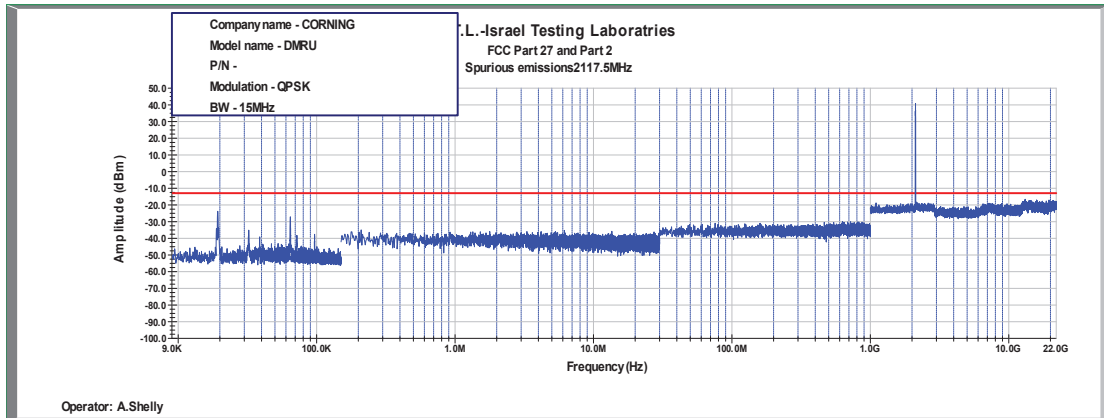


Figure 459: Spurious Emissions at Antenna Terminal 16QAM, 2117.5MHz,  
B.W. 15MHz

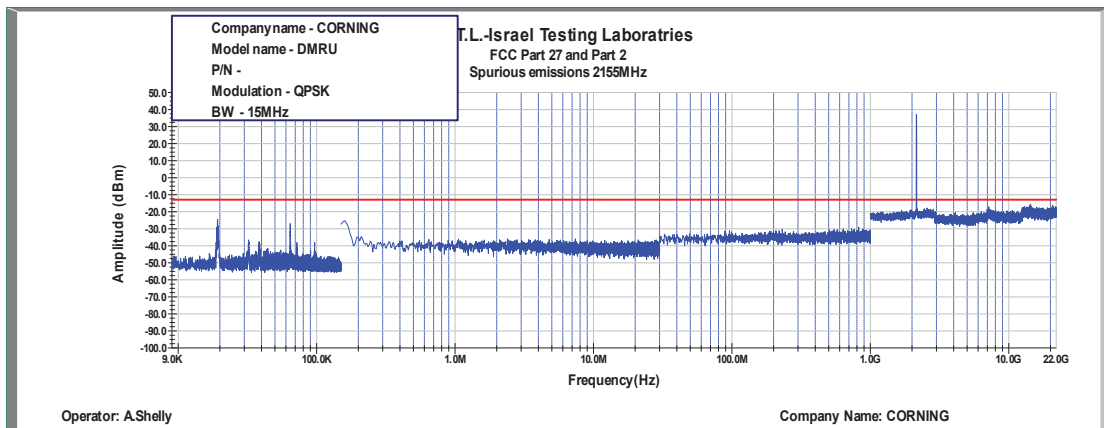


Figure 460: Spurious Emissions at Antenna Terminal 16QAM, 2155MHz,  
B.W. 15MHz

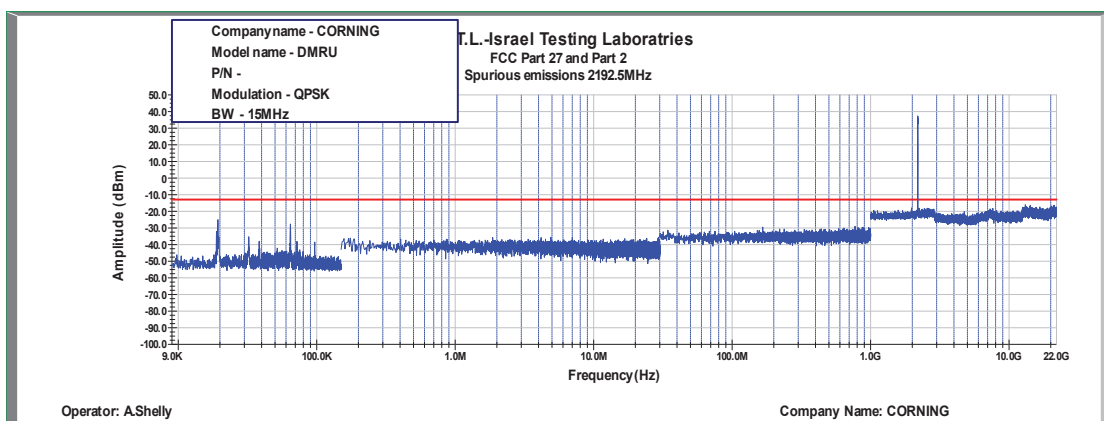


Figure 461: Spurious Emissions at Antenna Terminal 16QAM, 2192.5MHz,  
B.W. 15MHz

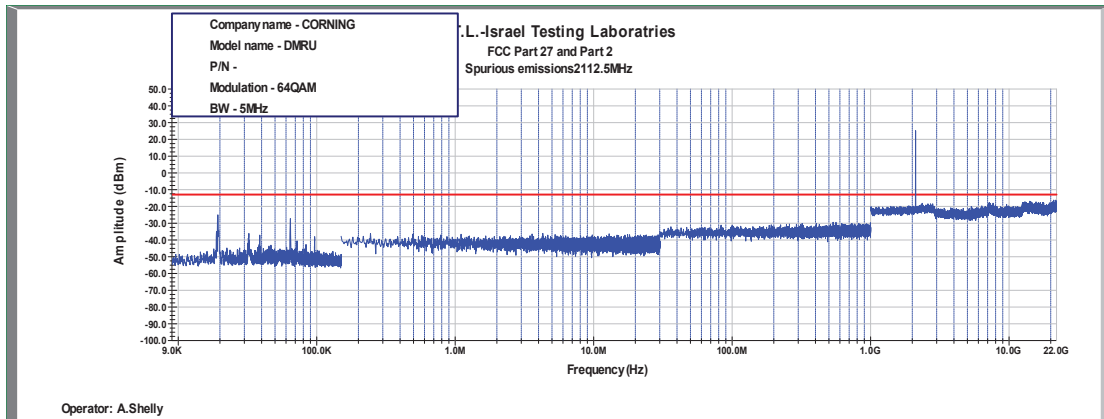


Figure 462: Spurious Emissions at Antenna Terminal 64QAM, 2112.5MHz, B.W. 5MHz

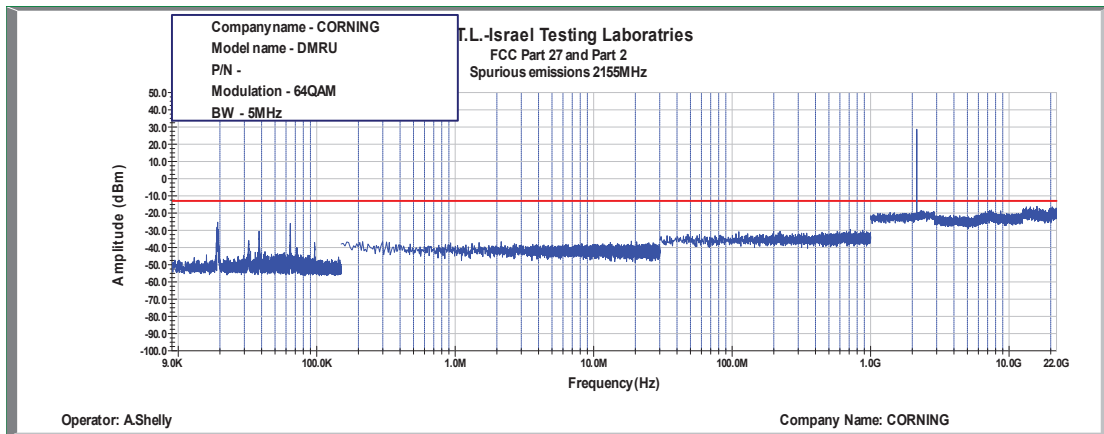


Figure 463: Spurious Emissions at Antenna Terminal 64QAM, 2155MHz, B.W. 5MHz

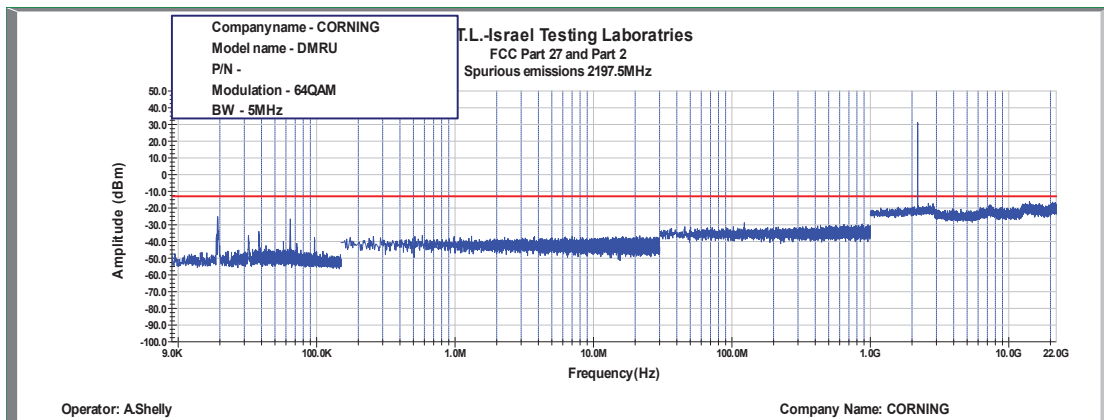


Figure 464: Spurious Emissions at Antenna Terminal 64QAM, 2197.5MHz, B.W. 5MHz

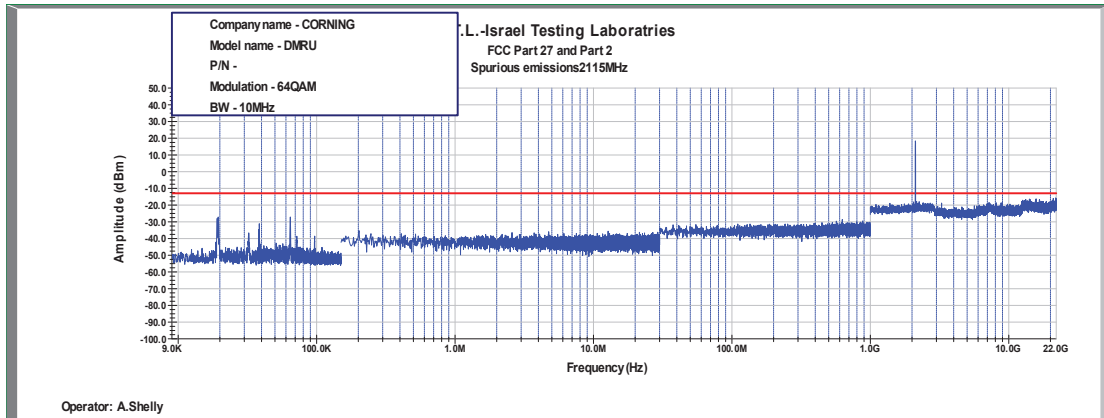


Figure 465: Spurious Emissions at Antenna Terminal 64QAM, 2115MHz,  
B.W. 10MHz

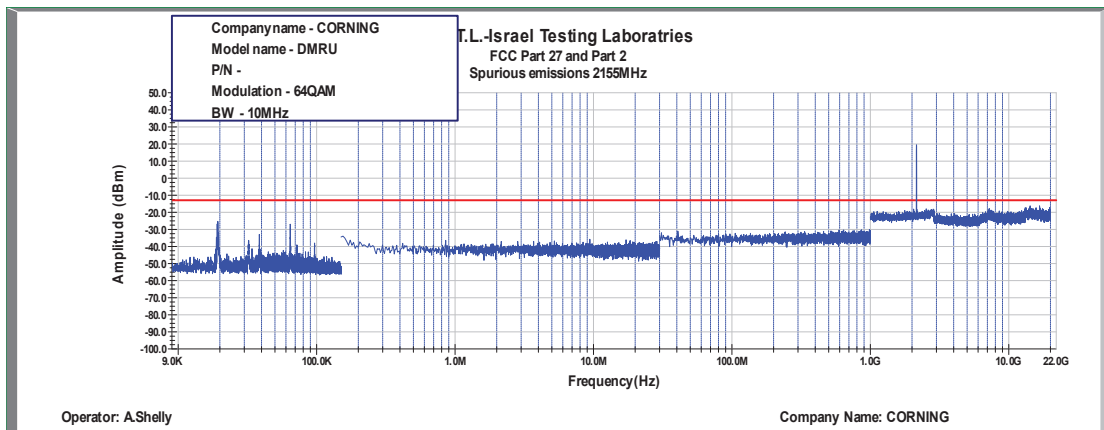


Figure 466: Spurious Emissions at Antenna Terminal 64QAM, 2155MHz,  
B.W. 10MHz

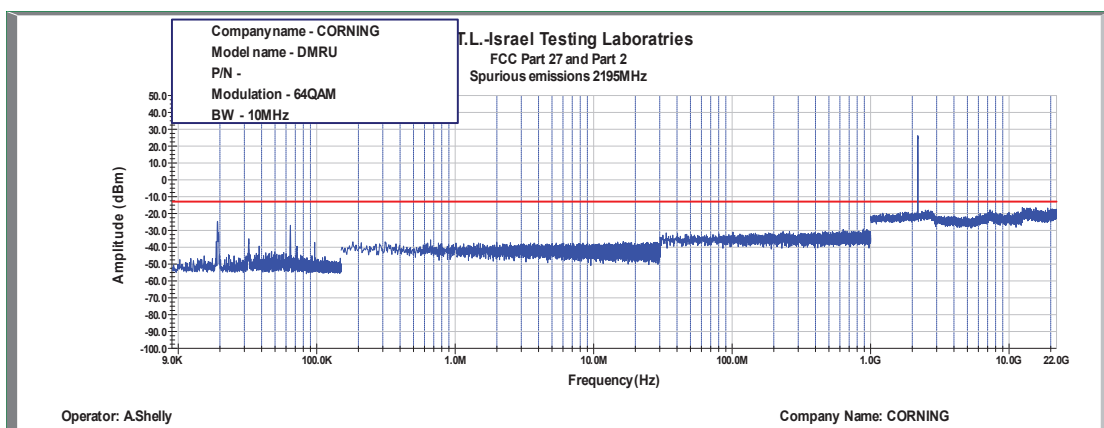


Figure 467: Spurious Emissions at Antenna Terminal 64QAM, 2195MHz,  
B.W. 10MHz

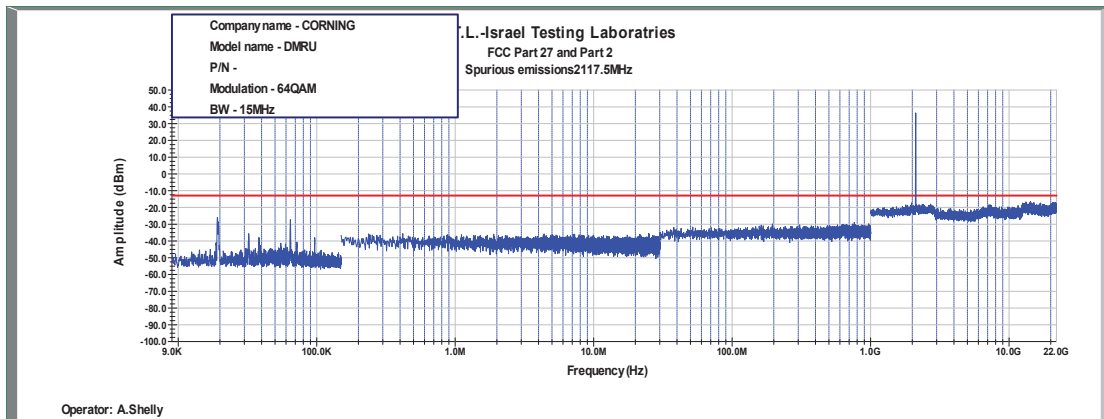


Figure 468: Spurious Emissions at Antenna Terminal 64QAM, 2117.5MHz, B.W. 15MHz

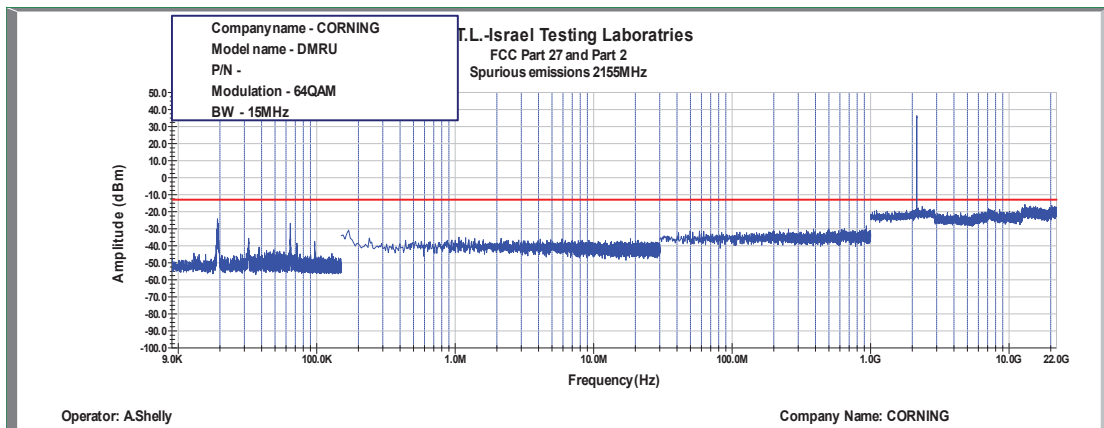


Figure 469: Spurious Emissions at Antenna Terminal 64QAM, 2155MHz, B.W. 15MHz

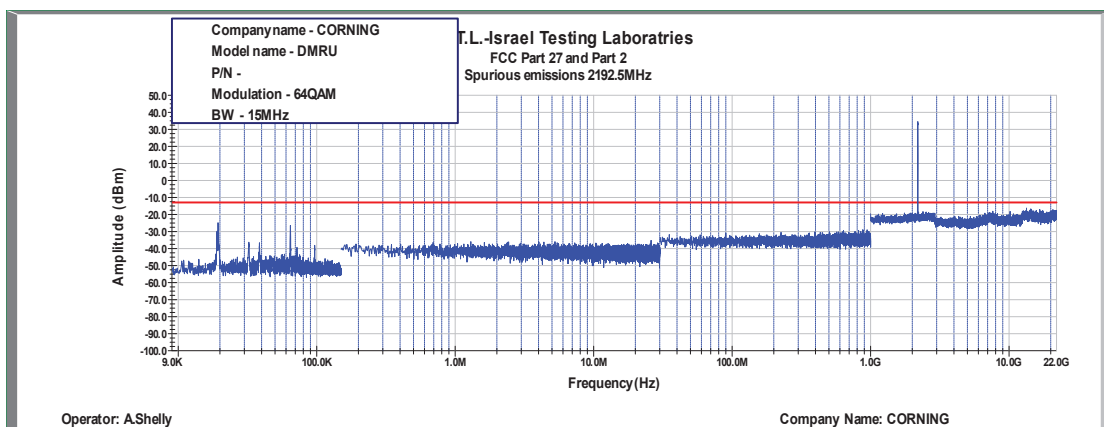


Figure 470: Spurious Emissions at Antenna Terminal 64QAM, 2192.5MHz, B.W. 15MHz

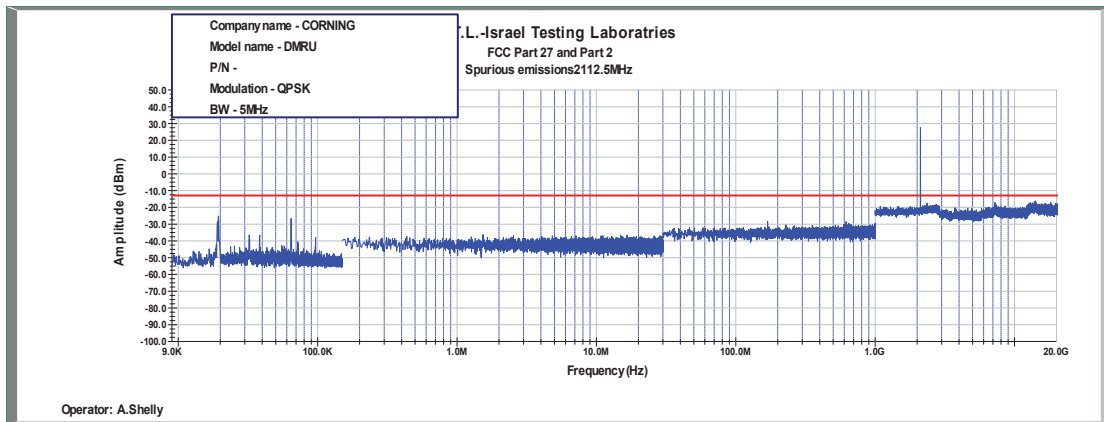


Figure 471: Spurious Emissions at Antenna Terminal QPSK, 2112.5MHz, B.W. 5MHz

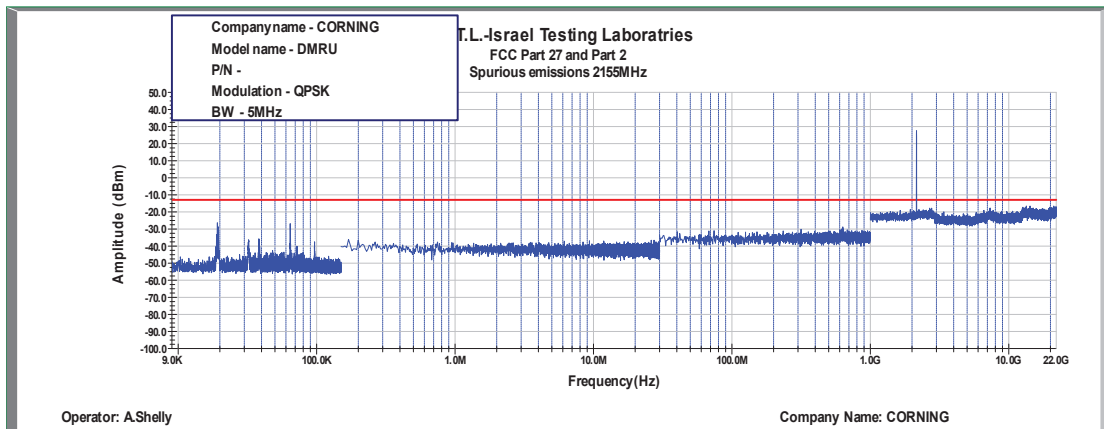


Figure 472: Spurious Emissions at Antenna Terminal QPSK, 2155MHz, B.W. 5MHz

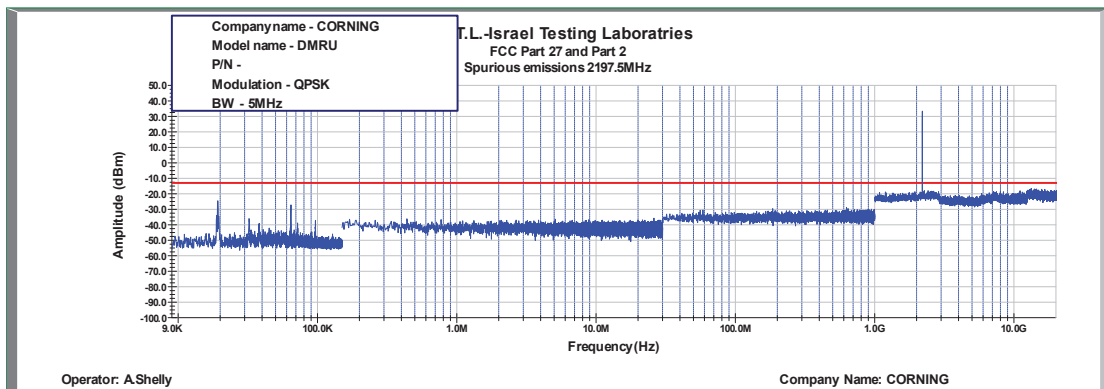


Figure 473: Spurious Emissions at Antenna Terminal QPSK, 2197.5MHz, B.W. 5MHz

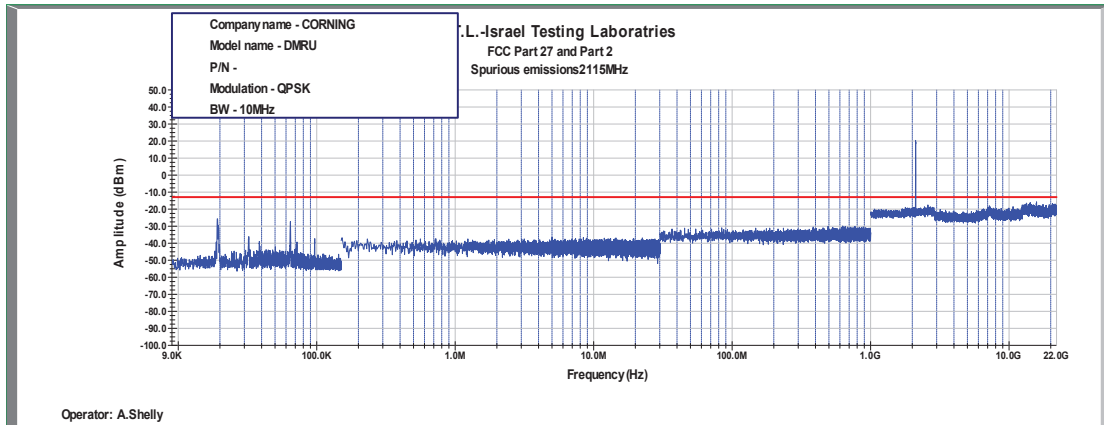


Figure 474: Spurious Emissions at Antenna Terminal QPSK, 2115MHz, B.W. 10MHz

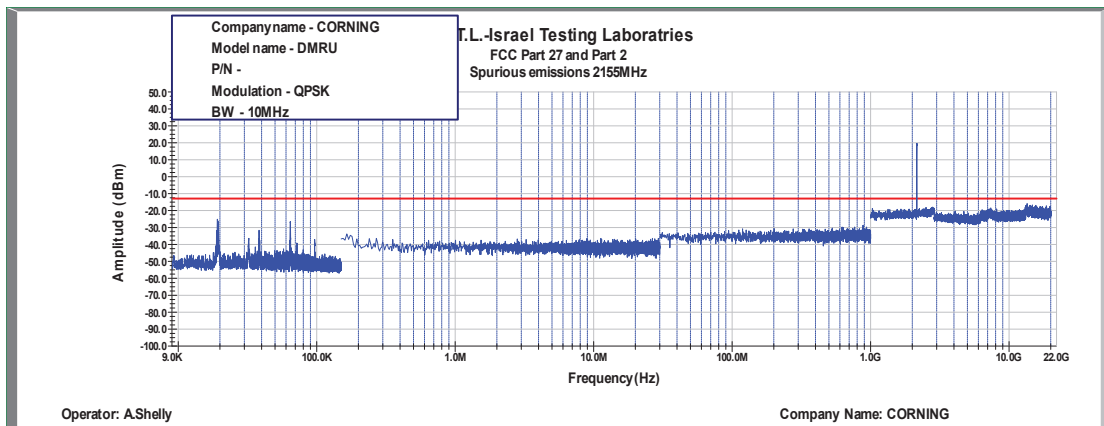


Figure 475: Spurious Emissions at Antenna Terminal QPSK, 2155MHz, B.W. 10MHz

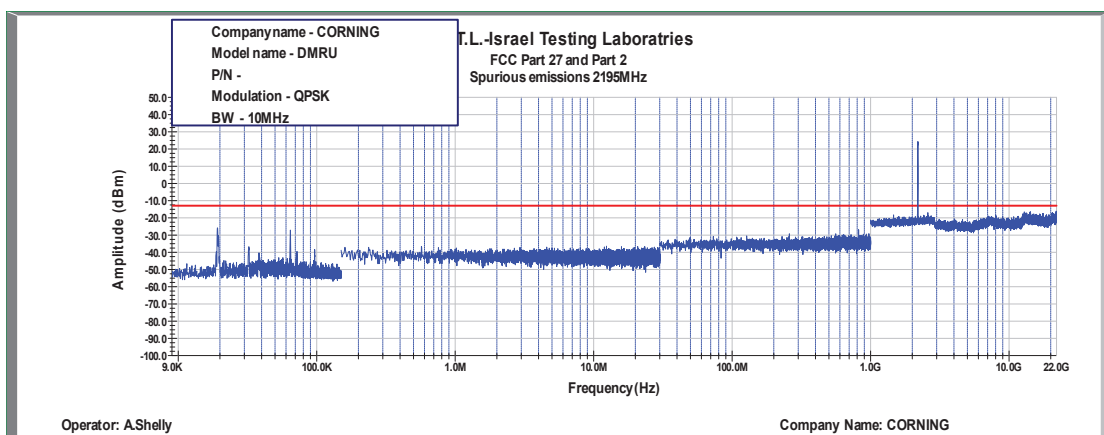


Figure 476: Spurious Emissions at Antenna Terminal QPSK, 2195MHz, B.W. 10MHz

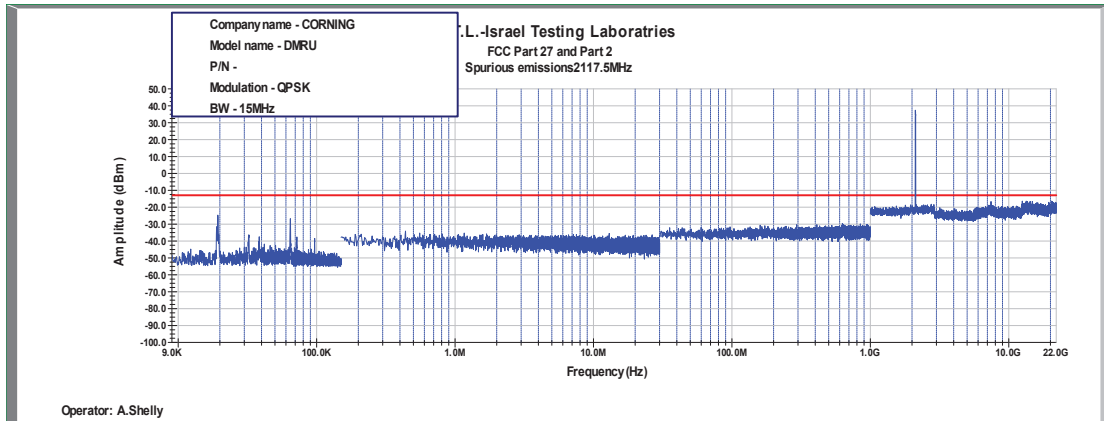


Figure 477: Spurious Emissions at Antenna Terminal QPSK, 2117.5MHz, B.W. 15MHz

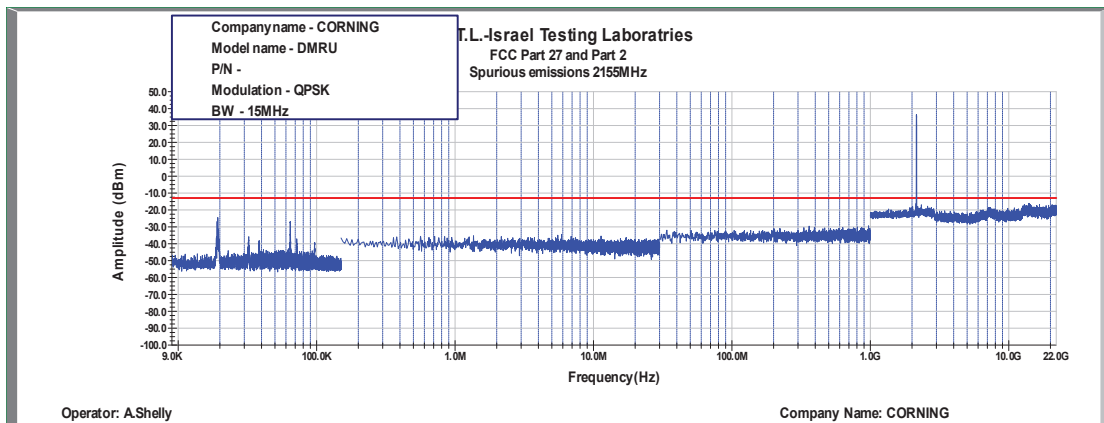


Figure 478: Spurious Emissions at Antenna Terminal QPSK, 2155MHz, B.W. 15MHz

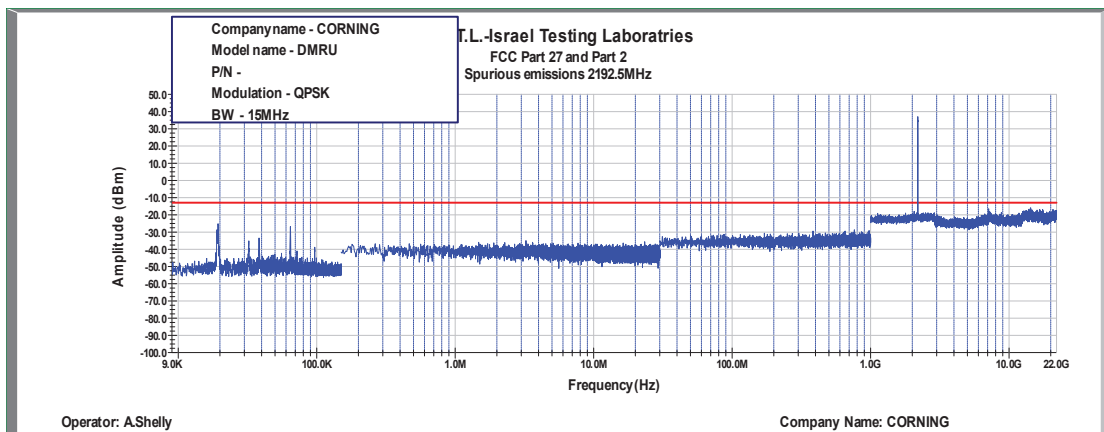


Figure 479: Spurious Emissions at Antenna Terminal QPSK, 2192.5MHz, B.W. 15MHz



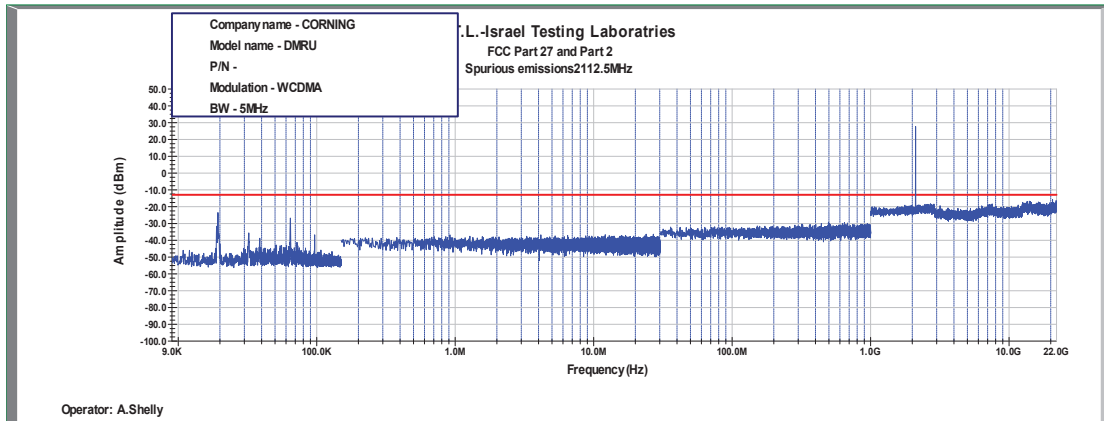


Figure 480: Spurious Emissions at Antenna Terminal WCDMA, 2112.5MHz, B.W. 5MHz

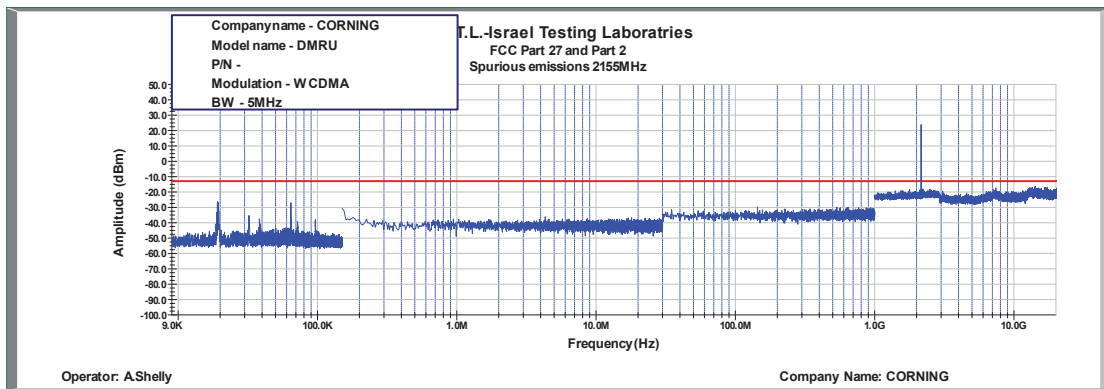


Figure 481: Spurious Emissions at Antenna Terminal WCDMA, 2155MHz, B.W. 5MHz

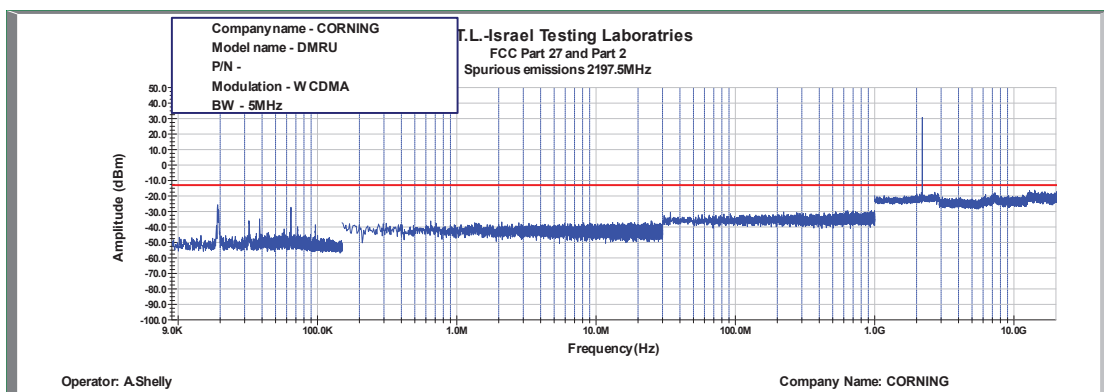


Figure 482: Spurious Emissions at Antenna Terminal WCDMA, 2197.5MHz, B.W. 5MHz





**11.5 Test Instrumentation Used; Spurious Emissions at Antenna Terminals**

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EXA signal Analyzer	Keysight	UXA N9040B	MY56080119	January 31, 2020	January 31, 2022
EXG Vector Signal Generator	Agilent Technologies	N5172B	MY53051952	January 17, 2019	January 17, 2022
40 dB Attenuator	Weinschel Associates	WA 39-40-33	-	November 1, 2020	November 1, 2021
RF Coaxial Cable	Huber-Suner	SLLS210B	-	November 1, 2020	November 1, 2021

**Table 40 Test Equipment Used**



## 12 Spurious Radiated Emission

### 12.1 Test Specification

FCC, Part 27, Subpart C, Section 27.53 (h)

### 12.2 Test Procedure

(Temperature (18°C)/ Humidity (40%RH))

The test method was based on ANSI/TIA-603-D: 2010, Section 2.2.12 Unwanted Emissions: Radiated Spurious.

#### **For measurements between 0.009MHz-30MHz:**

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

#### **For measurements between 30.0MHz-1.0GHz:**

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

#### **For measurements between 1.0GHz-22.0GHz:**

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 -22.0GHz 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.

RMS detector was used for this test.

Testing was performed when the RF port was connected to 50 Ω termination. Evaluation was performed for all possible modulations, bandwidths, and sub carriers.

Only the highest spurious radiation value describes in the table results



### 12.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges (2110-2200MHz) must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB, yielding  $-13\text{dBm}$

### 12.4 Test Results

JUDGEMENT: Passed

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)	(dB $\mu$ V/m)	(dBm)	(dB)	(dBd)	(dBm)	(dBm)	(dB)
2112.5 (WCDMA/5M)	4225.0	V	80.2	-25.0	1.0	7.4	-18.6	-13.0	-5.6
	4225.0	H	72.1	-33.0	1.0	7.4	-26.6	-13.0	-13.6
	6337.5	V	71.7	-35.0	1.0	7.4	-28.6	-13.0	-15.6
	6337.5	H	64.6	-36.0	1.0	7.4	-29.6	-13.0	-16.6
2155.0 (WCDMA/5M)	4310.0	V	82.1	-23.0	1.0	7.4	-16.6	-13.0	-3.6
	4310.0	H	74.0	-30.0	1.0	7.4	-23.6	-13.0	-10.6
	6465.0	V	69.4	-37.0	1.0	7.4	-30.6	-13.0	-17.6
	6465.0	H	64.4	-36.0	1.0	7.4	-29.6	-13.0	-16.6

Figure 483 Spurious Emission tabular, 3G mode

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)	(dB $\mu$ V/m)	(dBm)	(dB)	(dBd)	(dBm)	(dBm)	(dB)
2112.5 (QPSK/5M)	4225.0	V	83.7	-22.0	1.0	7.4	-15.6	-13.0	-2.6
	4225.0	H	75.0	-30.0	1.0	7.4	-23.6	-13.0	-10.6
	6337.5	V	75.4	-32.0	1.0	7.4	-25.6	-13.0	-12.6
	6337.5	H	68.7	-32.0	1.0	7.4	-25.6	-13.0	-12.6
2155.0 (QPSK/5M)	4310.0	V	84.0	-21.0	1.0	7.4	-14.6	-13.0	-1.6
	4310.0	H	75.6	-30.0	1.0	7.4	-23.6	-13.0	-10.6
	6465.0	V	73.6	-33.0	1.0	7.4	-26.6	-13.0	-13.6
	6465.0	H	67.8	-33.0	1.0	7.4	-26.6	-13.0	-13.6
2115 (16QAM/5M)	4310.0	V	81.2	-23.0	1.0	7.4	-16.6	-13.0	-3.6
	4310.0	H	73.5	-31.0	1.0	7.4	-24.6	-13.0	-11.6
	6465.0	V	73.2	-33.0	1.0	7.4	-26.6	-13.0	-13.6
	6465.0	H	61.4	-39.0	1.0	7.4	-32.6	-13.0	-19.6

Figure 484 Spurious Emission tabular, 4G mode



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)
2155.0 (QPSK/5M)	4310.0	V	83.1	-22.0	1.0	7.4	-15.6	-13.0	-2.6
	4310.0	H	74.0	-31.0	1.0	7.4	-24.6	-13.0	-11.6
	6465.0	V	73.9	-33.0	1.0	7.4	-26.6	-13.0	-13.6
	6465.0	H	69.3	-32.0	1.0	7.4	-25.6	-13.0	-12.6
2112.5 (QPSK/5M)	4225.0	V	82.8	-22.0	1.0	7.4	-15.6	-13.0	-2.6
	4225.0	H	73.2	-28.0	1.0	7.4	-21.6	-13.0	-8.6
	6337.5	V	72.5	-34.0	1.0	7.4	-27.6	-13.0	-14.6
	6337.5	H	69.2	-32.0	1.0	7.4	-25.6	-13.0	-12.6
2155.0 (16QAM/5M)	4310.0	V	81.0	-25.0	1.0	7.4	-18.6	-13.0	-5.6
	4310.0	H	73.9	-31.0	1.0	7.4	-24.6	-13.0	-11.6
	6465.0	V	78.0	-29.0	1.0	7.4	-22.6	-13.0	-9.6
	6465.0	H	64.0	-36.0	1.0	7.4	-29.6	-13.0	-16.6

**Figure 485 Spurious Emission tabular, 5G mode**

*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*



**12.5 Test Instrumentation Used; Radiated Measurements**

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	March 11, 2020	March 31, 2021
RF Filter Section	HP	85420E	3705A00248	March 11, 2020	March 31, 2021
EMI Receiver	R&S	ESCI7	100724	March 9, 2020	March 31, 2021
Spectrum Analyzer	HP	8593EM	3826A00265	March 9, 2020	March 31, 2021
Active Loop Antenna	EMCO	6502	9506-2950	February 5, 2019	February 28, 2021
Antenna Biconical	EMCO	3110B	9912-3337	May 21, 2019	May 31, 2021
Antenna Log Periodic	EMCO	3146	9505-4081	May 31, 2018	May 31, 2021
Horn Antenna 1G-18G	ETS	3115	29845	May 31, 2018	May 31, 2021
Horn Antenna 18-26GHz	ARA	SWH-28	1007	December 13, 2017	June 30, 2021
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 23, 2020	August 31, 2021
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 24, 2020	August 31, 2021
Vector Signal Generator	VIAVI	MTS 5800	WMNK0071690263	July 1, 2018	July 1, 2021
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

**Table 41 Test Equipment Used**



## 13 Out-of-Band Rejection

### 13.1 Test Specification

KDB 935210 D05 v01r04, Section 3.3

### 13.2 Test Procedure

(Temperature (20°C)/ Humidity (49%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max Loss= 41.6 dB).

The signal and spectrum analyzer frequency range was set to  $\pm 250\%$  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  $\geq 3 \times \text{RBW}$ .

### 13.3 Test Limit

N/A

### 13.4 Test Results

JUDGEMENT: Passed

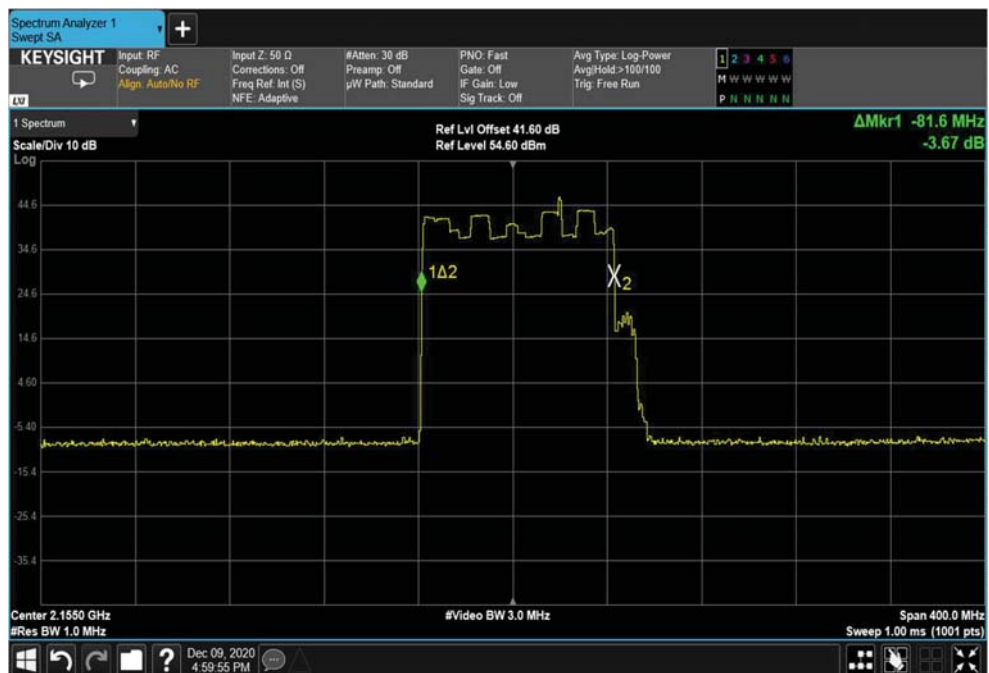


Figure 486. — Out-of-Band Rejection Plot



**13.5 Test Equipment Used; Out-of-Band Rejection**

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EXA signal Analyzer	Keysight	UXA N9040B	MY56080119	January 31, 2020	January 31, 2022
EXG Vector Signal Generator	Agilent Technologies	N5172B	MY53051952	January 17, 2019	January 17, 2022
40 dB Attenuator	Weinschel Associates	WA 39-40-33	-	November 1, 2020	November 1, 2021
RF Coaxial Cable	Huber-Suner	SLLS210B	-	November 1, 2020	November 1, 2021

**Table 42 Test Equipment Used**



## 14 APPENDIX A - CORRECTION FACTORS

### 14.1 Correction factors for RF OATS Cable 35m ITL #1784

Frequency ( MHz)	Cable loss (dB)
10.0	0.3
20.0	0.2
50.0	-0.1
100.0	-0.6
200.0	-1.2
500.0	-2.3
1000.0	-3.6





**14.2 Correction factors for RF OATS Cable 10m**  
**ITL #1794**

Frequency(MHz)	Cable loss(dB)
10.0	-0.3
20.0	-0.3
50.0	-0.5
100.0	-0.7
200.0	-1.1
500.0	-1.8
1000.0	-2.7



**14.3 Correction factors for**

**Horn Antenna**

**Model: SWH-28  
at 1 meter range.**

<b>FREQUENCY (GHz)</b>	<b>AFE (dB /m)</b>	<b>Gain (dB1)</b>
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4



#### 14.4 Correction factors for Horn Antenna

Model: 3115

Antenna serial number: 29845

3 meter range

f(GHz)	AF(dB/m)	GA(dB)
0.75	25	3
1G	23.5	7
1.5G	26	8
2G	29	7
2.5G	27.5	10
3G	30	10
3.5G	31.5	10
4G	32.5	9.5
4.5G	32.5	10.5
5G	33	10.5
5.5G	35	10.5
6G	36.5	9.5
6.5G	36.5	10
7G	37.5	10
7.5G	37.5	10
8G	37.5	11
8.5G	38	11
9G	37.5	11.5
9.5G	38	11.5
10G	38.5	11.5
10.5G	38.5	12
11G	38.5	12.5
11.5G	38.5	13
12G	38	13.5
12.5G	38.5	13
13G	40	12
13.5G	41	12
14G	40	13
14.5G	39	14
15G	38	15.5
15.5G	37.5	16
16G	37.5	16
16.5G	39	15
17G	40	15
17.5G	42	13.5
18G	42.5	13



**14.5 Correction factors for Log Periodic Antenna**  
**EMCO, Model 3146,**  
**Serial #9505-4081**

Frequency [MHz]	AF [dB/m]
200.0	11.47
250.0	12.06
300.0	14.77
400.0	15.77
500.0	18.01
600.0	18.84
700.0	20.93
800.0	21.27
900.0	22.44
1000.0	24.10



**14.6 Correction factors for Biconical Antenna**  
**EMCO, Model 3110B,**  
**Serial #9912-3337**

Frequency [MHz]	AF [dB/m]
30.0	14.18
35.0	13.95
40.0	12.84
45.0	11.23
50.0	11.10
60.0	10.39
70.0	9.34
80.0	9.02
90.0	9.31
100.0	8.95
120.0	11.53
140.0	12.20
160.0	12.56
180.0	13.49
200.0	15.27



**14.7 Correction factors for ACTIVE LOOP ANTENNA**  
**Model 6502**  
**S/N 9506-2950**

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