Test Report issued under the responsibility of:

ITC ENGINEERING SERVICES, INC.

FCC PartB Subpart C & RSS-Gen Issue 3, RSS-210 Issue 8	
Report Reference No. .....:	20130327-01
Date of Issue.....:	07/03/2013
Total Number of Pages .....:	66
Testing Laboratory.....:	ITC Engineering Services, Inc.
Address .....:	9959 Calaveras Road, Box 543, Sunol CA 94586
Applicant's Name.....:	TopCon Positioning Systems
Address .....:	7400 National Dr, Livermore, CA 94550
Contact.....:	Ferdinand Riodique
Phone.....:	925-245-8300
Fax .....:	925-245-8599
Test Specification Standard .....:	FCC Part 15 Subpart C & RSS-Gen:2010; RSS-210:2010
Test Procedure .....:	ANSI C63.4:2009, ANSI C63.10:2009 (Test Procedures) & Public Notice DA 00-705:2000
Judgment .....:	Complies
Test Item Description.....:	MC-i3
Manufacturer Logo.....:	TOPCON
Manufacturer .....:	TopCon PositioningSystems
Model/Type Reference.....:	1000082-08 & 1000082-09 / MC-i3
RF Operating Frequency .....:	2.400- 2.483.5 GHz

ACCREDITED

ISO 17025 Accredited Laboratory Cert# 3382.01

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1 DOCUMENTATION

1.1 TESTING LOCATION

☒ ITC Testing Laboratory:	:	ITC Engineering Services, Inc.
Testing Location/Address	:	9959 Calaveras Road, PO Box 543, Sunol, CA 94586, USA
Prepared By (Name + Signature)	:	Danh Le
Tested By (Name + Signature)	:	Danh Le
Approved By (Name + Signature)	:	Michael Gbadebo, PE
☐ Manufacturer Facility	:	
Testing Location/Address	:	
Tested By (Name + Signature)	:	
Approved By (+ Signature)	:	
☐ 3rd Party Test Facility	:	
Testing Location/Address	:	
Tested By (Name + Signature)	:	
Approved By (+ Signature)	:	

1.2 REVISION HISTORY

#	Revision Date	Old Report Number	New Report Number	Revision
	N/A	N/A	N/A	N/A

1.3 SUMMARY OF TESTS

ITC Engineering Services, Inc. as an independent testing laboratory, declares that the equipment specified above was tested to the requirements of:

Section of FCC 15.247	Section of RSS-210	Test Description	Result
(a)(1)	A8.1	Carrier Frequency Seperation	Passed
(a)(1)	A8.1	20 dB Bandwidth	For reference
(a)(1)	A8.1	Number of Hopping Frequency	Passed
(a)(1)	A8.1	Time of Occupancy (Dwell Time)	Passed
(a)(1)/(b)(1)	A8.4(2)	Peak Conducted Output Power (2400-2483.5MHz)	Passed
(d)	A8.5	Band-Edge Measurement	Passed

Section of 15.xxx	Section of RSS-Gen	Test Description	Result
205/209	7.2.2	Restricted Band	Passed
209	6.0	Spurious Radiated Emissions (Out of Band)	Passed
207	7.2	Conducted emissions	NR

NOTE: NR (not required) according to FCC part15 section 15.207 (c) & RSS-Gen 7.2.2

1.4 DECLARATION/DISCLAIMER

It is the manufacturer's responsibility to assure that additional production units of these models are manufactured with identical electrical and mechanical characteristics. This report is the confidential property of the applicant. As a mutual protection to our applicants, the public, and ourselves, extracts from the test report shall not be reproduced except in full without ITC Engineering Service's written approval. The applicant/manufacturer shall not use this report to claim product endorsement by NIST, A2LA or any US Government agency.

1.5 CONDITION OF EUT

Equipment Under Test (EUT) was tested as it was received.

1.6 GENERAL DESCRIPTION OF EUT

Product	MC-I3 with Taiyo Yuden EYSF3CA Bluetooh Module Ver. 2.0 + EDR
Model No.	MC-I3 1000082-08 / MC-I3 100082-09
FCC ID	WR4-MC-I3
IC ID	6050B-MCI3
Power Supply	DC 12.0V for system; DC 3.3V for device
Modulation Type	GFSK; 8DPSK
Modulation Technology	FHSS
Transfer Rate	**Basic Data Rate:** 1Mbps **Enhanced Data Rate:** 3Mbps
Operating Frequency	2.400- 2.483.5 GHz
Number of Channels	79
Maximum Output Power	Ch 1 = 3.52 mW (8DPSK modulation)
Antenna Type	Patch , 2dBi Gain
Data Cable	RS-232
I/O Ports	Serial

The MC-i3 system has a dual multi frequency GPS/GLONASS receiver, spread spectrum FH 915+ receiver, HSPA cellular modem and Bluetooth transceiver. The MC-I3 1000082-09 has a full loaded configuration and was used as a representative model for testing. The MC-i3 1000082-08 is a breakdown version with only a single GPS/GLONASS receiver and the rest of the hardware system configuration is identical.

1.7 LIST OF APPLICANT PERIPHERALS/SUPPORTING EQUIPMENT USED DURING TEST

Description	Manufacturer	Model Name	Serial Number
DC Power Supply	BK Precision	1688	225-2558
Laptop	IBM/Lenovo	ThinkPad T42	91P8927
Laptop Power Adaptor	IBM/Lenovo	DCWP CM-2	91P1020
Valve Regulated Battery	Panasonic	LC-X1220P	YK168-041120C

1.8 GENERAL TEST REMARKS

The EUT was operated under the following conditions during the testing:

☐	Standby	☐	Test Program (H – Pattern)
☐	Test Program (Color Bar)	☐	Test Program (Applicant Specific)
☐	TV/VCR Signal Input	☐	Signal Generator Input
☐	Continuous Audio Tone (1kHz)	☐	Cycled Audio Tone (1kHz)
☐	Printer/Parallel Function	☐	Modem/Serial Function
☐	Serpentine Program with I/O	☐	Serpentine Program without I/O
☐	Practice Operation	☒	Normal Operating Mode
☐	Essential Operation (Functional Safety)	☐	Continuous Unmonitored Operation
☐	Continuous Monitored Operation	☐	Non-Continuous Operation

The requirements according to the technical regulations are:

☒	Met	☐	Not Met

The Equipment Under Test does:

☒	Fulfill the general approval requirements	☐	Not fulfill the general approval requirements

1.9 MEASUREMENT UNCERTAINTY

The measurement of uncertainty levels were estimated based on calculation in accordance with TR 100-028-1. Using the value k = 2 for expanded uncertainty, this provides a 95% level of confidence.

	Measurement Method	Calculated Uncertainty (dB)
1	RF Power, Conducted	± 1.5
2	Radiated emission of transmitter (30MHz-1 GHz) @ 3M	± 3.2
3	Radiated emission of transmitter (1 GHz -24 GHz) @ 3M	± 2.5

1.10 TEST SET UP PHOTOS

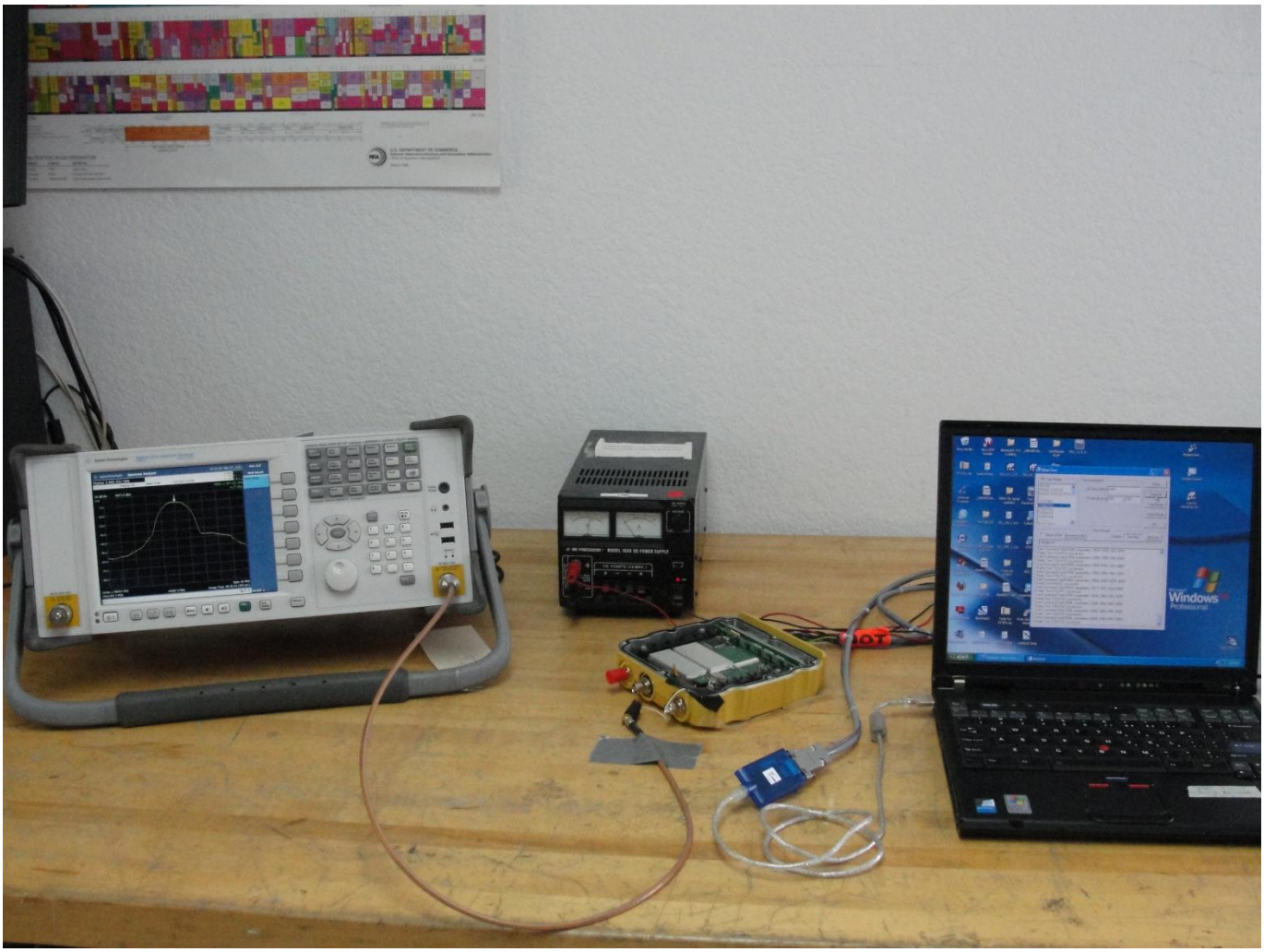


Figure 1: Conducted Test Set Up

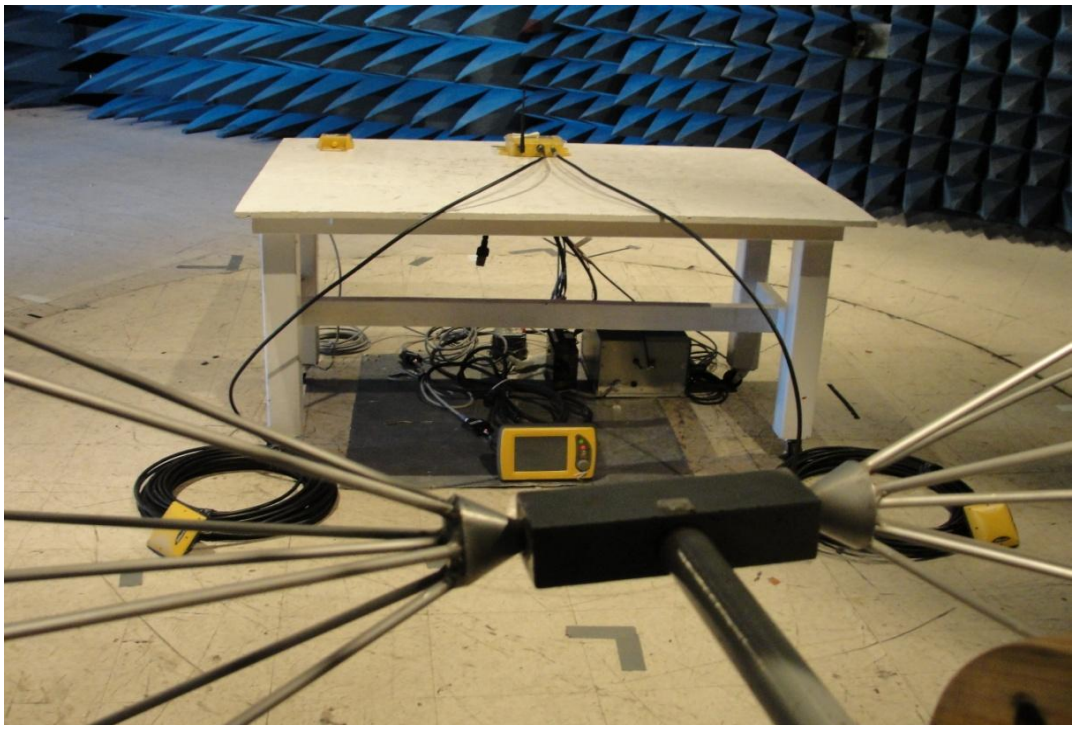


Figure 2: Radiated Test Set Up (30MHz – 200MHz) Biconical Antenna Horizontal

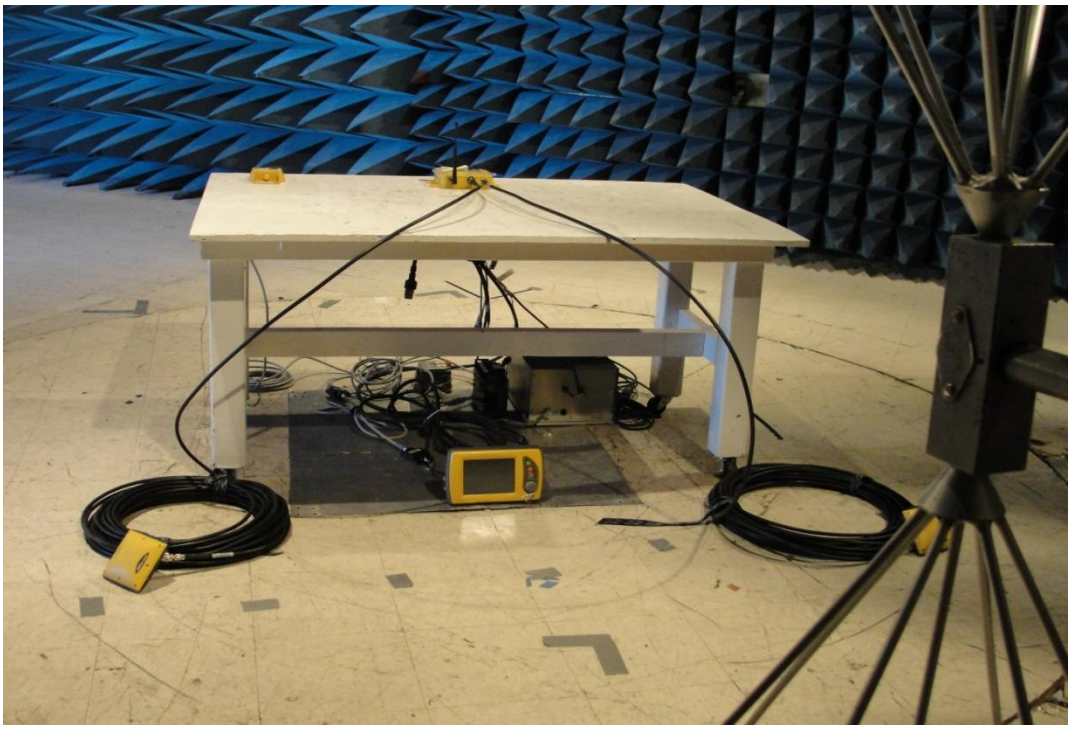


Figure 3: Radiated Test Set Up (30MHz – 200MHz) Biconical Antenna Vertical

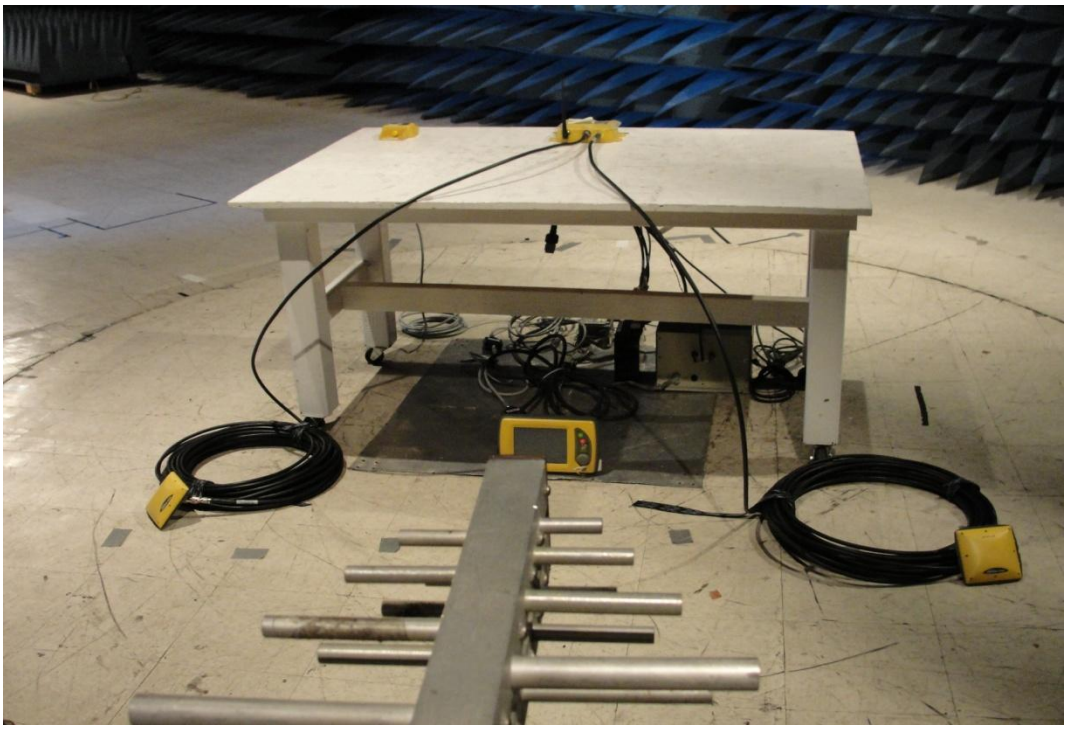


Figure 4: Radiated Test Set Up (200MHz – 1GHz) Log-Periodic Antenna Horizontal

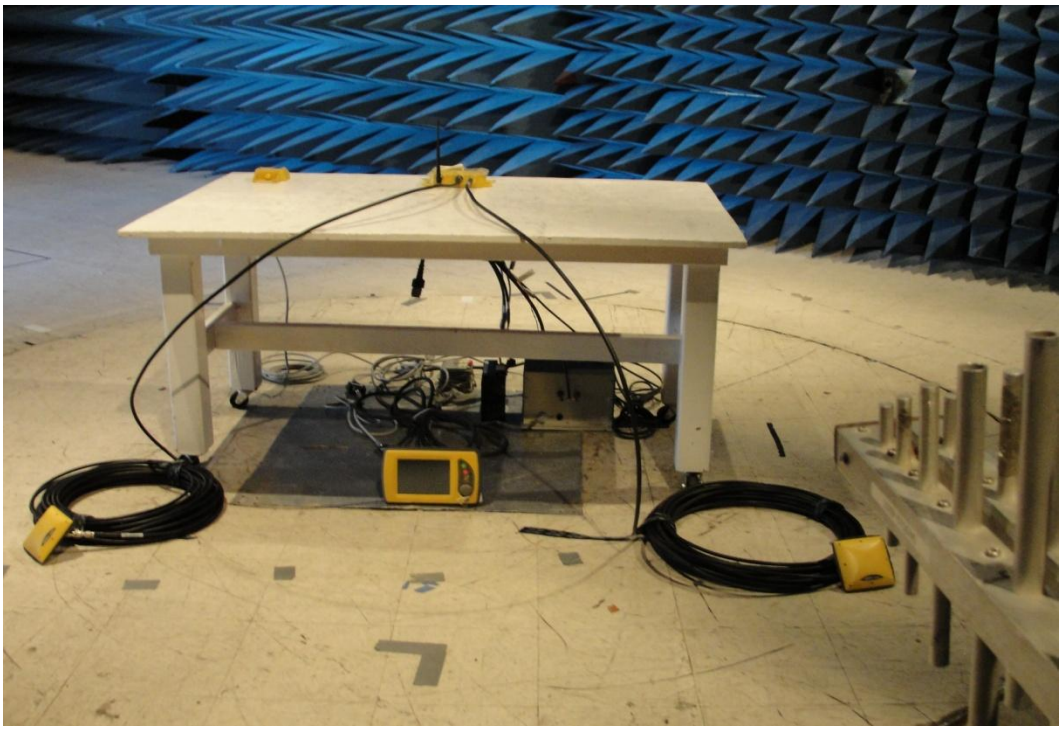


Figure 5: Radiated Test Set Up (200MHz – 1GHz) Log-Periodic Antenna Vertical

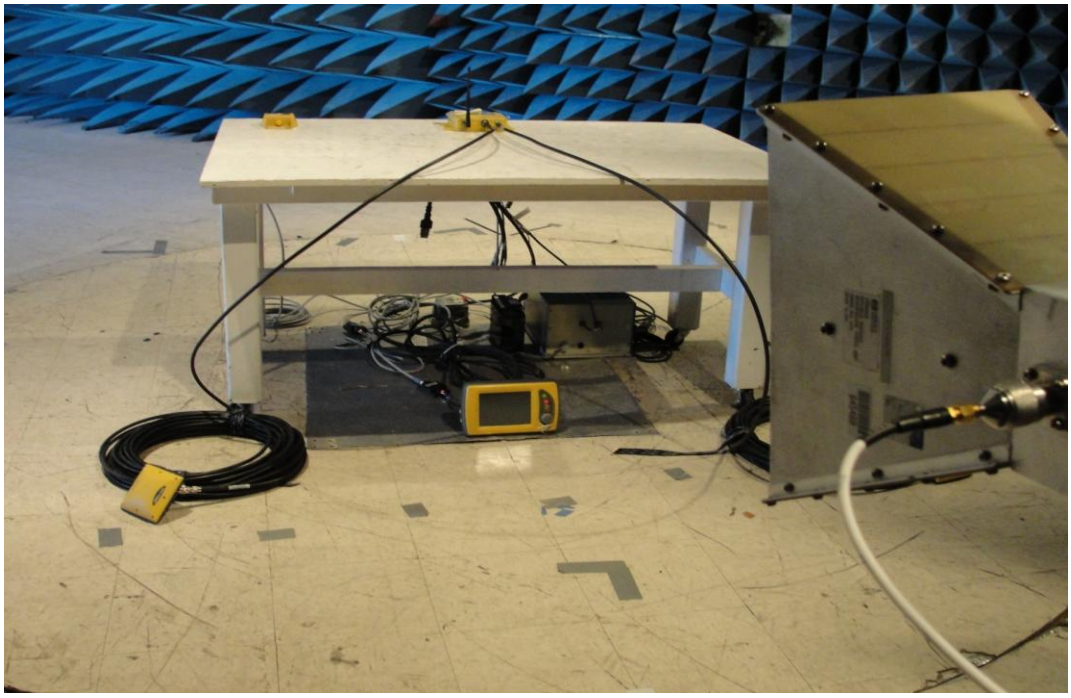


Figure 6: Radiated Test Set Up (1GHz – 18GHz) Horn Antenna Horizontal

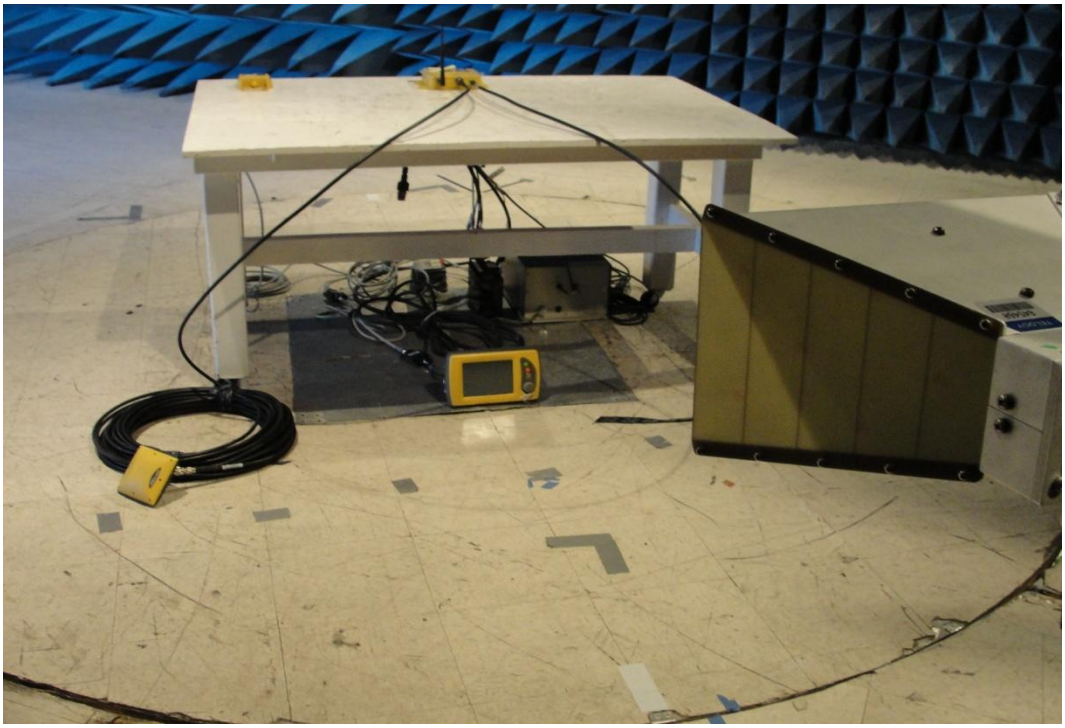


Figure 7: Radiated Test Set Up (1GHz – 18GHz) Horn Antenna Vertical

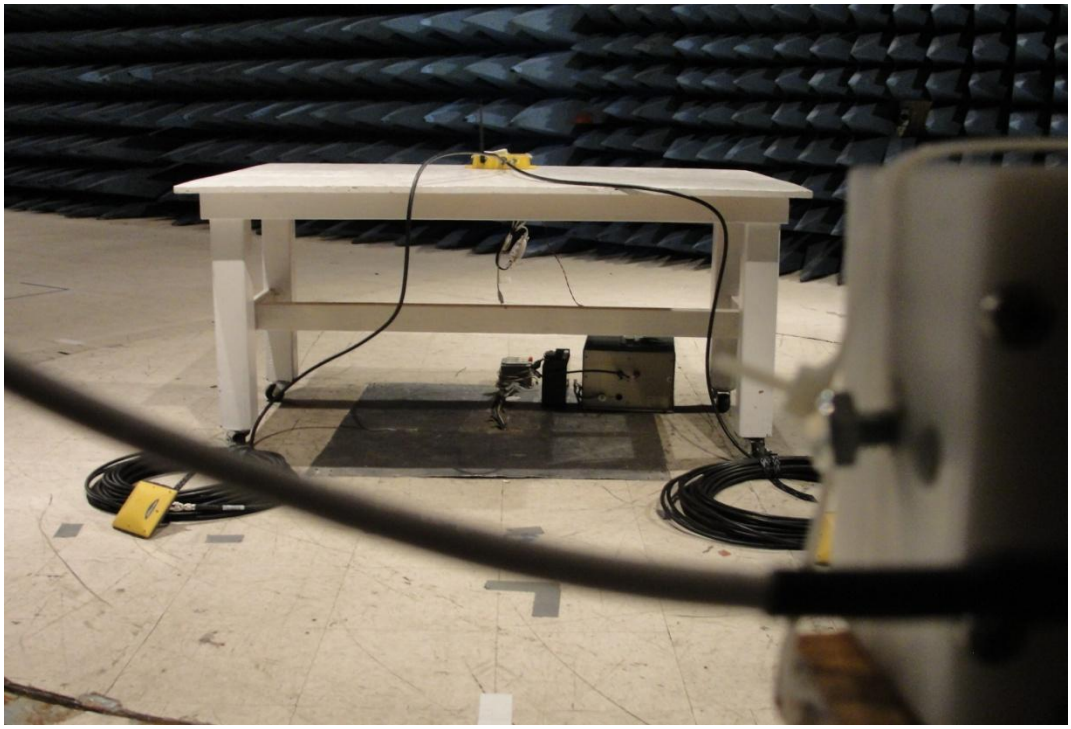


Figure 8: Radiated Test Set Up (18GHz – 24GHz) SHF-EHF Horn Antenna

2 20 DB BANDWIDTH & CHANNEL SEPARATION PER FCC PART 15.247 (A)(1) & RSS-210 A8.1

2.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	05/03/2013
Test Engineer:	Danh Le,
Temperature	21°C
Humidity:	48%
Pressure	29.85 inHg

2.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	01/17/2014

2.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figure1)

2.4 LIMITS/REQUIREMENTS

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or 20 dB bandwidth of the hopping channel, whichever is greater.

2.5 TEST DESCRIPTION AND PROCEDURE

The EUT's output antenna port is connected to the spectrum analyzer. The 20dB bandwidth is determined by measuring the width of the carrier signal between the lowest frequency and the highest frequency of the carrier signal where the level is 20dB below the maximun signal power. The test shall be performed at low, mid and high channel of the operating band. Test data shall be recorded.

The EUT's output antenna port is connected to the spectrum analyzer with the frequency hopping function enabled. Center frequency shall be set at the mid channel. The measurement is performed by using the marker-delta function to determine the separation between the peaks of the adjacent channels.

2.1 20dB Measurement Test Data

Operating Freq band: 2400 -2483.5 MHz
Mode: Frequency Hopping

Channel	Freq.	Measured Occupied BW	Limit	Result
	(MHz)	(kHz)	BW (kHz)	
40	2441	951	NR	Reference only

Note: NR (not regulated)

2.2 20 dB Measurement Plots

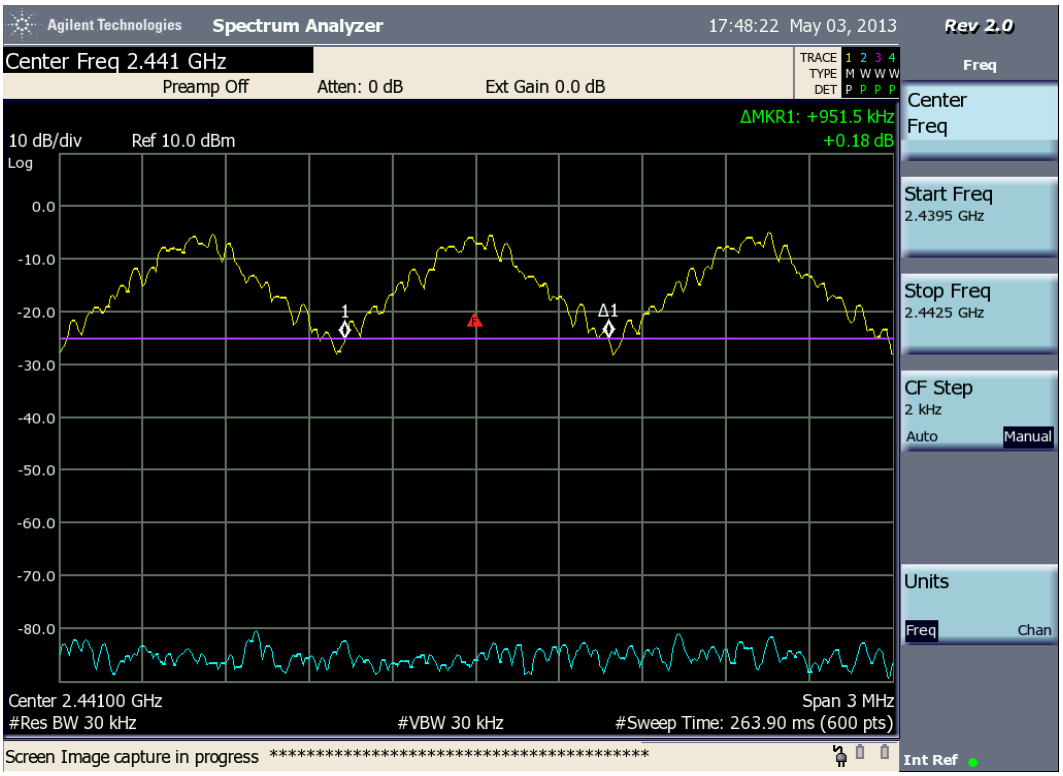


Figure 9: 20dB Bandwidth (ChMid)

2.3 CHANNEL SEPARATION TEST DATA

Operating Freq band: 2400-2483.5 MHz

Mode: Frequecy Hopping

Channels	Freq.	Channel Separation (Measured)	Limit	Result
	(MHz)	(KHz)	(KHz)	
42 & 43	2441 & 2442	1,0016	≥ 25 or 20dB BW	Passed

Note: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-third 20 dB bandwidth of hopping channel, whichever is greater.

2.4 CARRIER FREQUENCY SEPARATION PLOTS

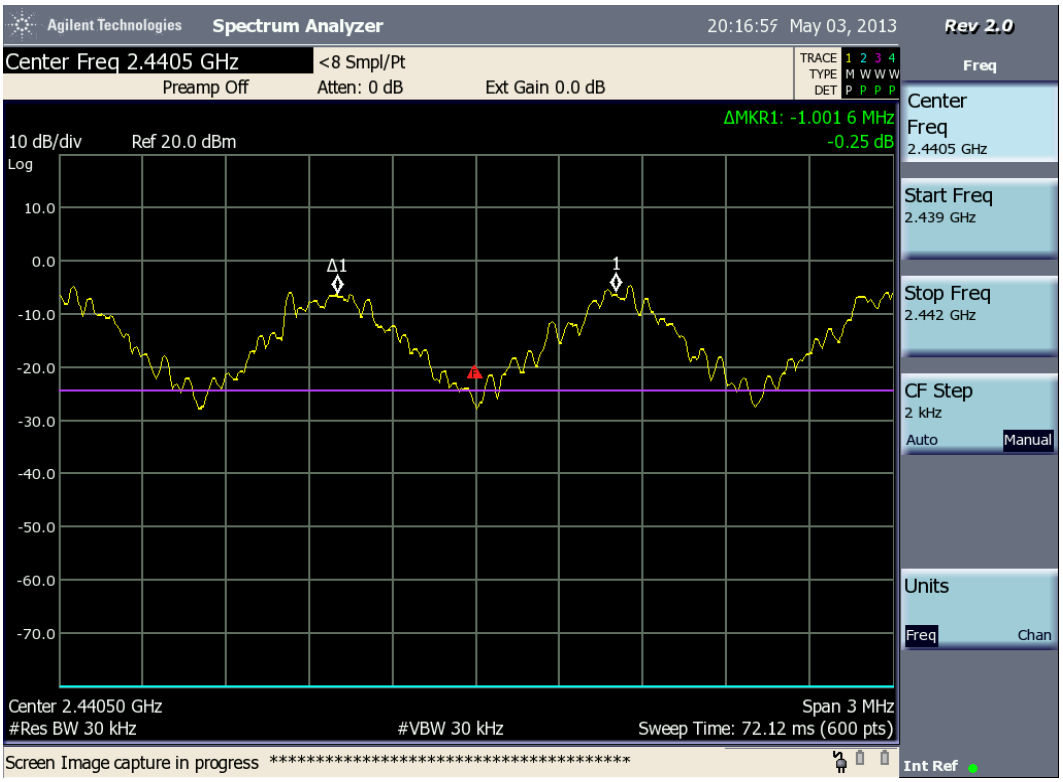


Figure 10: Carrier Frequency Separation

3 NUMBER OF HOPPING FREQUENCY PER FCC PART 15.247 (A)(1) & RSS-210 A8.1

3.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	05/09/2013
Test Engineer:	Danh Le
Temperature	21ºC
Humidity:	48%
Pressure	29.85 inHg

3.2 TEST EQUIPMENT USED

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

3.3 LIMITS/REQUIREMENTS

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW (21dBm) .

3.4 TEST SETUP PHOTO(S)

Refer to section 1.10 (Figure1)

3.5 TEST SETUP AND PROCEDURE

The EUT's output antenna port is connected to the spectrum analyzer with the frequency hopping function enabled. The measurement is performed by setting the span function wide enough to capture all available hopping frequency channels within the operating band.

3.1 TEST DATA

Frequency Band (MHz)	No. of frequency count
902 MHz – 928	xx
2.400 – 2.483.5	79

3.2 NUMBER OF HOPPING FREQUENCIES PLOTS

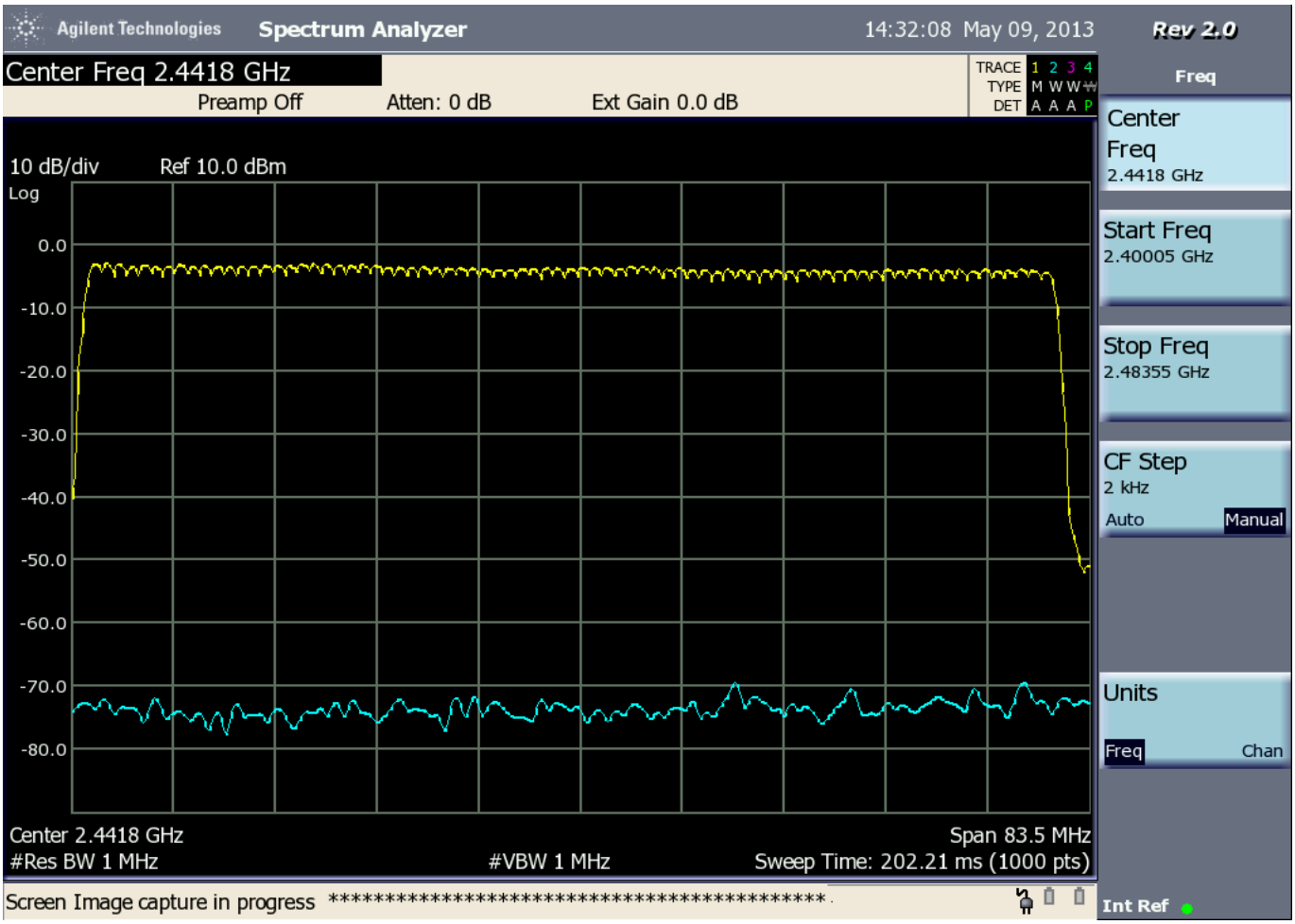


Figure 11: Number of hopping frequencies in 2.400 – 2.483.5 MHz band

Total number = 79

4 TIME OF OCCUPANCY PER FCC PART 15.247 (A)(1) & RSS-210 A8.1

4.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B	
Test Date:	05/06/2013	05/06/2013
Test Engineer:	Danh Le	
Temperature	23°C	21°C
Humidity:	41%	47%
Pressure	29.91 inHg	29.89 inHg

4.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

4.3 LIMITS/REQUIREMENTS

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter.

4.4 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1)

4.5 TEST DESCRIPTION

The EUT's output antenna port is connected to the spectrum analyzer. The time occupancy is to be measured the time during a single pulse width is on within a given period which depends on the number of hopping frequency available. Test data shall be recorded and compared to the limits and requirements specified in section 4.3 above to determine of compliance.

4.6 TEST DATA

Operating Freq band: 2400 -2483.5 MHz
Hopping Frequencies ≥ 15
Mode: GFSK
Power Setting: 64 (Max)

Channel	Frequency (MHz)	Occupancy Time (ms)	Limits (ms) in P(.4 x n)	Result
1	2402	2.882	≤ 400 in 31.6s	Passed
42	2441	2.902	≤ 400 in 31.6s	Passed
79	2478	2.902	≤ 400 in 31.6s	Passed

Note: n is the total number of hopping channel employed; P = 1 period of .4xn

Operating Freq band: 2400 -2483.5 MHz
Hopping Frequencies ≥ 15
Mode: 8DPSK
Power Setting: 100 (Max)

Channel	Frequency (MHz)	Occupancy Time (ms)	Limits (ms) in P(.4 x n)	Result
1	2402	2.897	≤ 400 in 31.6s	Passed
42	2441	2.912	≤ 400 in 31.6s	Passed
79	2478	2.912	≤ 400 in 31.6s	Passed

Note: n is the total number of hopping channel employed; P = 1 period of .4xn

4.7 Time Occupancy Measurement Plots

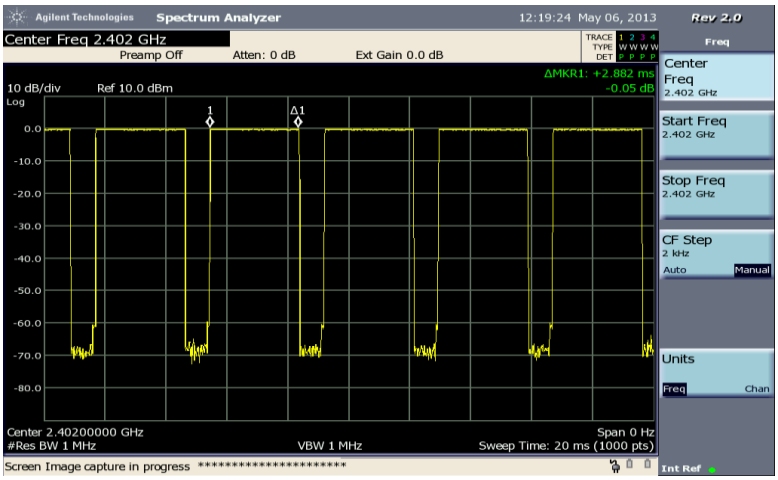


Figure 12: Time Occupancy Ch1 (GFSK)

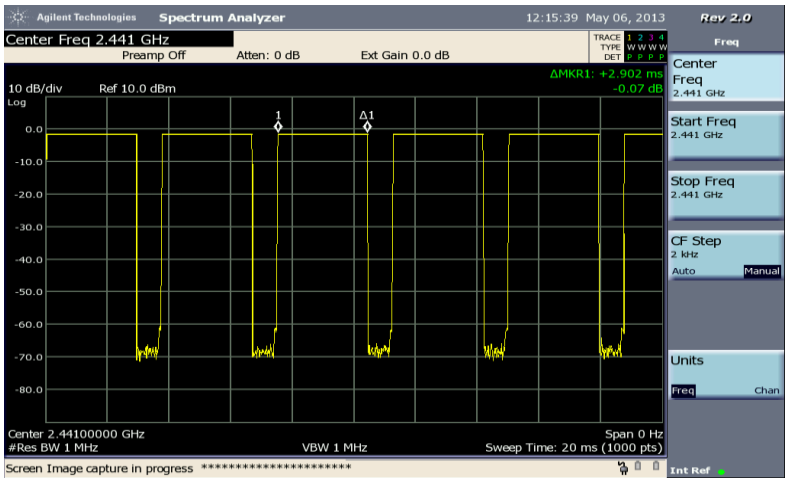


Figure 13: Time Occupancy Ch40 (GFSK)

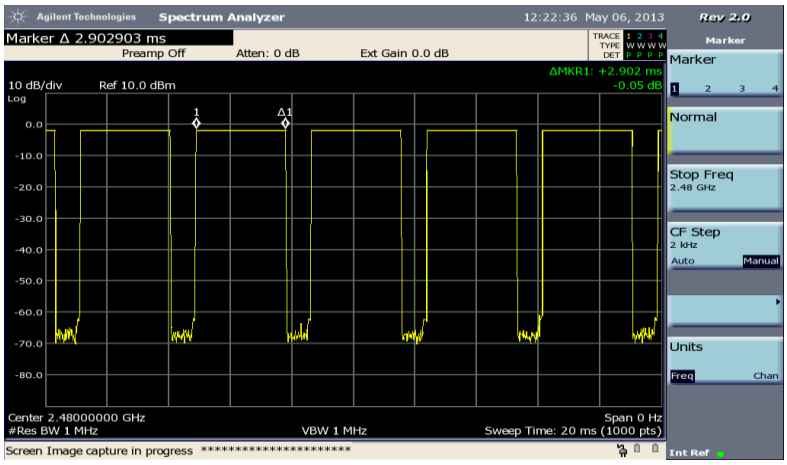


Figure 14: Time Occupancy Ch79 (GFSK)

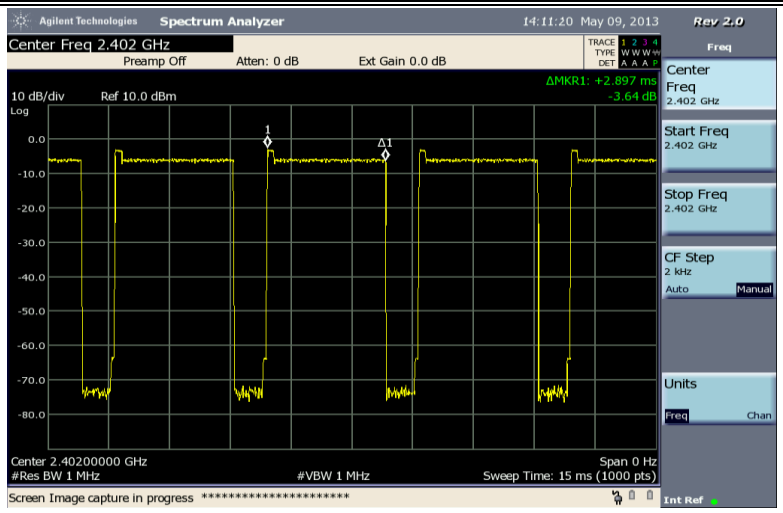


Figure 15: Time Occupancy Ch1 (8DPSK)

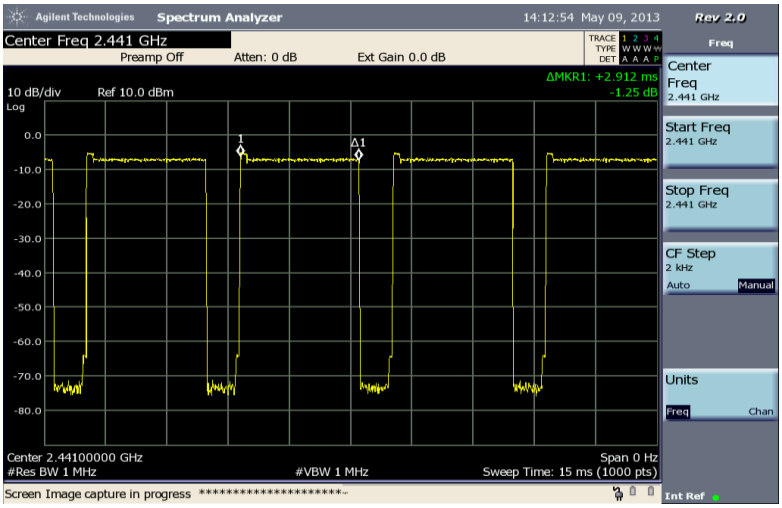


Figure 16: Time Occupancy Ch40 (8DPSK)

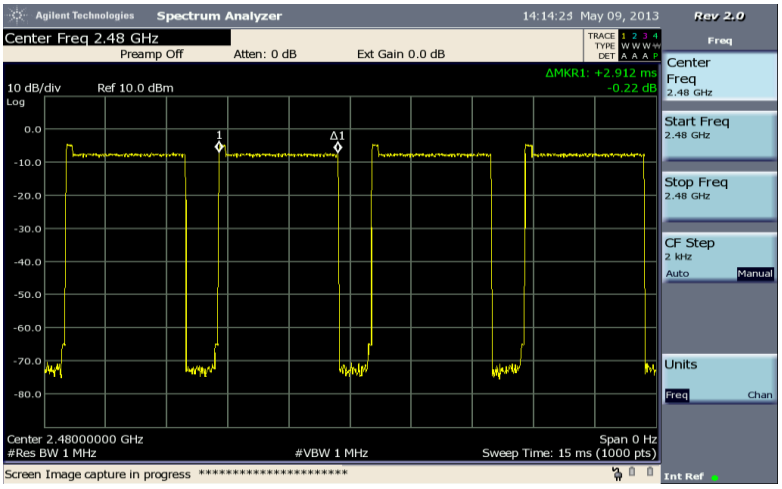


Figure 17: Time Occupancy Ch79 (8DPSK)

5 PEAK CONDUCTED OUTPUT POWER PER FCC PART 15.247 (B)(1), (B)(2) & RSS-210 A8.4 (1), (2)

5.1 ADMINISTRATIVE AND ENVIRNMENTAL DETAILS

Site Used:	EMC Lab 2B	
Test Date:	05/06/2013	05/21/2013
Test Engineer:	Danh Le	
Temperature	23°C	20%
Humidity:	41%	47%
Pressure	29.91 inHg	29.89 inHg

5.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

5.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1)

5.4 LIMITS/REQUIREMENTS

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Operating Frequency	No. of Channels Employed	Output Power Limits
2400 – 2483.5 MHz	≥ 75	1 W (30 dBm)
2400 – 2483.5 MHz	< 75	0.125 W (21 dBm)

5.5 TEST DESCRIPTION AND PROCEDURE

The EUT's output antenna port is connected to the spectrum analyzer. The Maximum peak conducted output power was measured at the center peak of a selected hopping channel by using the spectrum analyzer with a resolution bandwidth set greater than the 20 dB bandwidth of the emission being measured.

5.6 TEST DATA TABLES

Operating Freq band: 2400 -2483.5 MHz
Hopping Frequencies ≥ 75
Modulation Mode: GFSK
Power Setting: 64 (Max)

Channel	Freq.	Measured Peak Power	Correction (Cable loss)	Calculated Peak Power	Limit	Margin	Result
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
1	2402	0.07	5	5.07	30	-24.93	Passed
40	2441	-0.81	5	4.19	30	-25.81	Passed
79	2480	0.63	5	5.63	30	-24.37	Passed

Operating Freq band: 2400 -2483.5 MHz
Hopping Frequencies ≥ 75
Modulation Mode: 8DPSK
Power Setting: 100 (Max)

Channel	Freq.	Measured Peak Power	Correction (Cable loss)	Calculated Peak Power	Limit	Margin	Result
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
1	2402	0.46	5	5.46	30	-24.54	Passed
40	2441	-1.48	5	3.52	30	-26.48	Passed
79	2480	-2.05	5	2.95	30	-27.05	Passed

5.7 PEAK POWER PLOTS

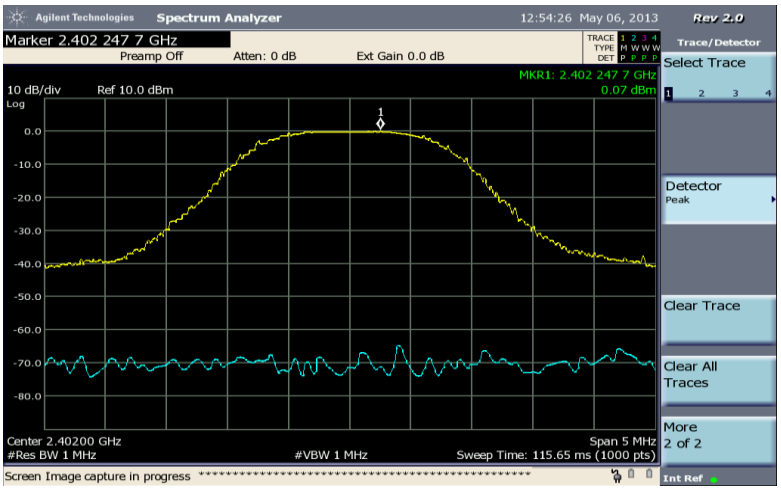


Figure 18: Ch1 Peak Power (GFSK)

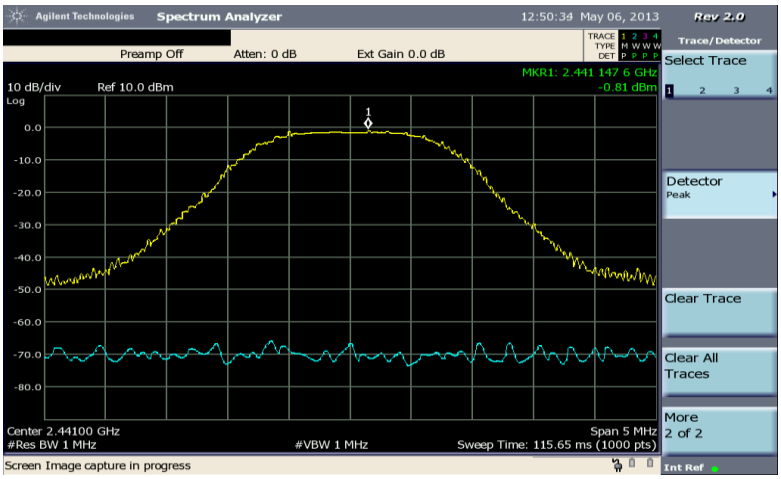


Figure 19: Ch40 Peak Power (GFSK)

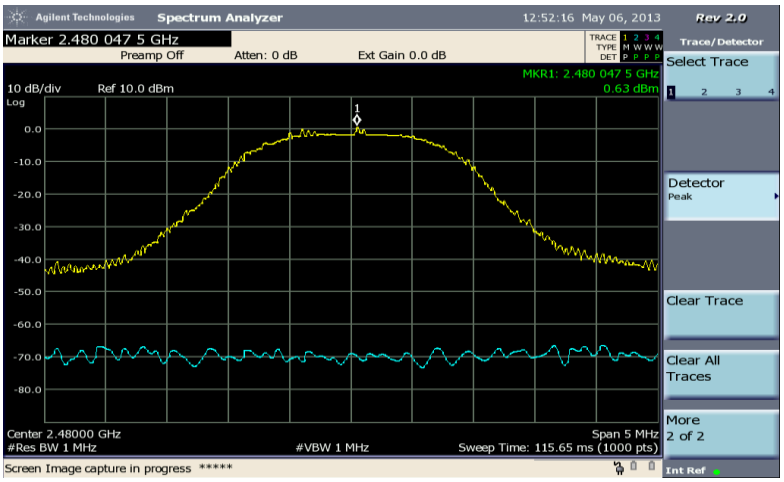


Figure 20: Ch79 Peak Power (GFSK)

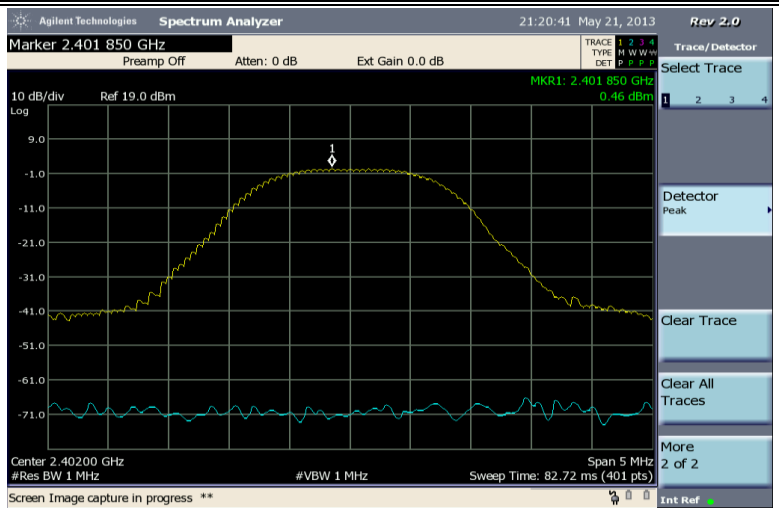


Figure 21: Ch1 Peak Power (8DPSK)

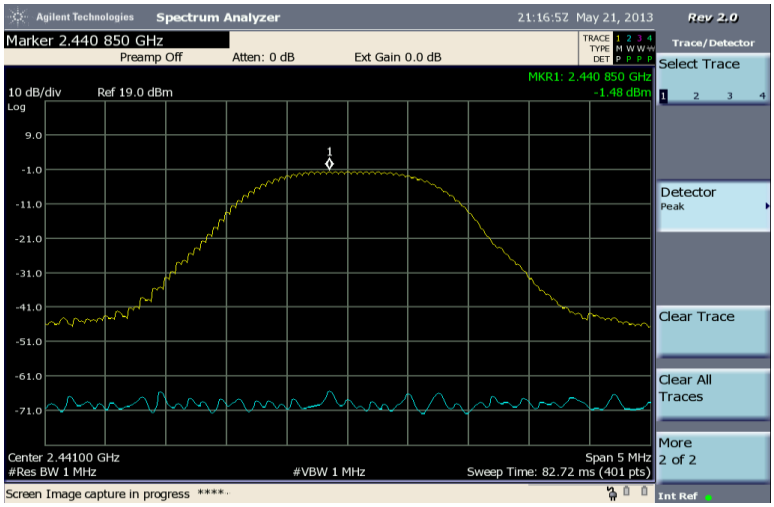


Figure 22: Ch40 Peak Power (8DPSK)

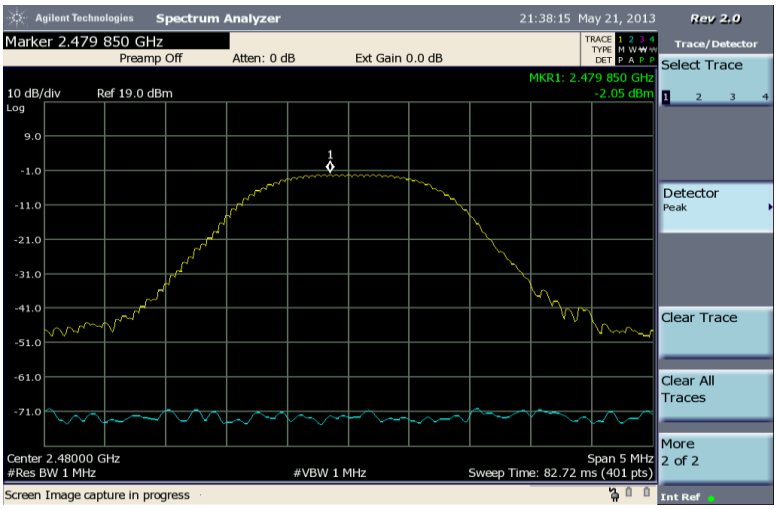


Figure 23: Ch79 Peak Power (8DPSK)

6 BAND-EDGE MEASUREMENT PER FCC PART 15 SECTION 15.247 (D) & RSS-210 ANNEX 8.5

6.1 ADMINISTRATIVE AND ENVIRNMENTAL DETAILS

Site Used:	EMC Lab 2B	
Test Date:	05/07/2013	05/28/2013
Test Engineer:	Danh Le	
Temperature	18°C	21°C
Humidity:	55%	22%
Pressure	29.88 inHg	29.85 inHg

6.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

6.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1)

6.4 LIMITS/REQUIREMENTS

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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB

6.5 TEST DESCRIPTION AND PROCEDURE

Using conducted test method, the band-edge measurement was made at the peak level of the emission at the band-edge (outside of the operating band) relative to the center peak of the operating frequency channel by using marker delta function. The span was set to be wide enough to capture the highest peak level of the operating channel to the bandedge. The power level difference must be atleast 20 dB in peak value or 30 dB in average value.

6.6 TEST PLOTS

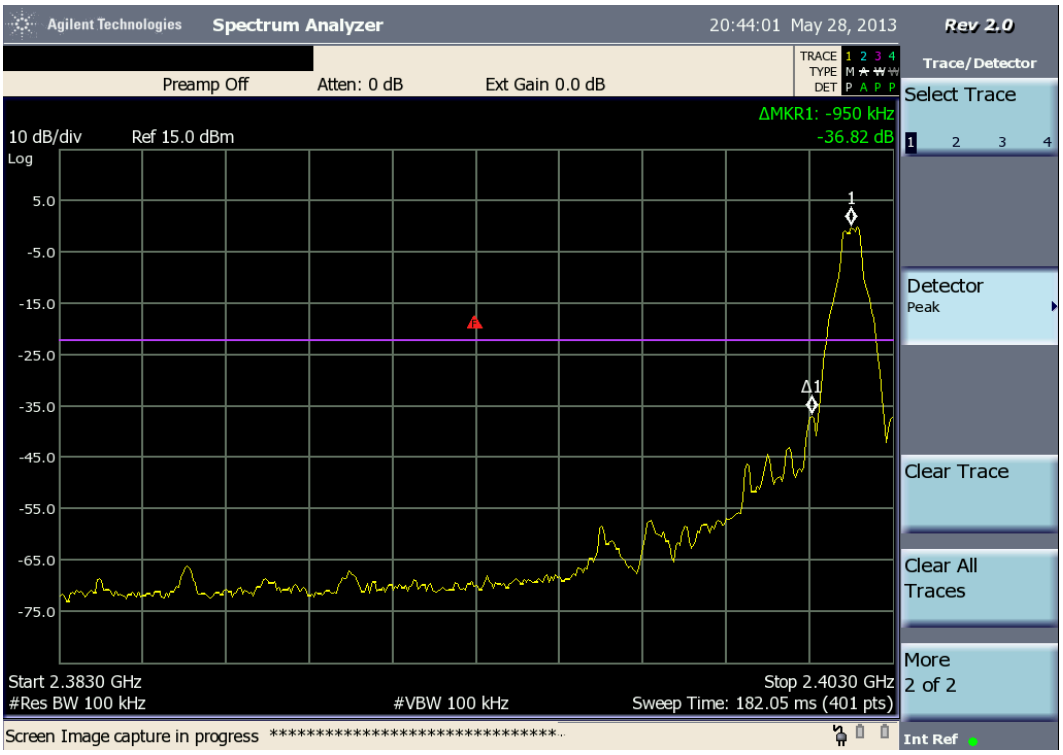


Figure 24: Ch1 BandEdge Peak (GFSK); Power Setting = 64 (Max)

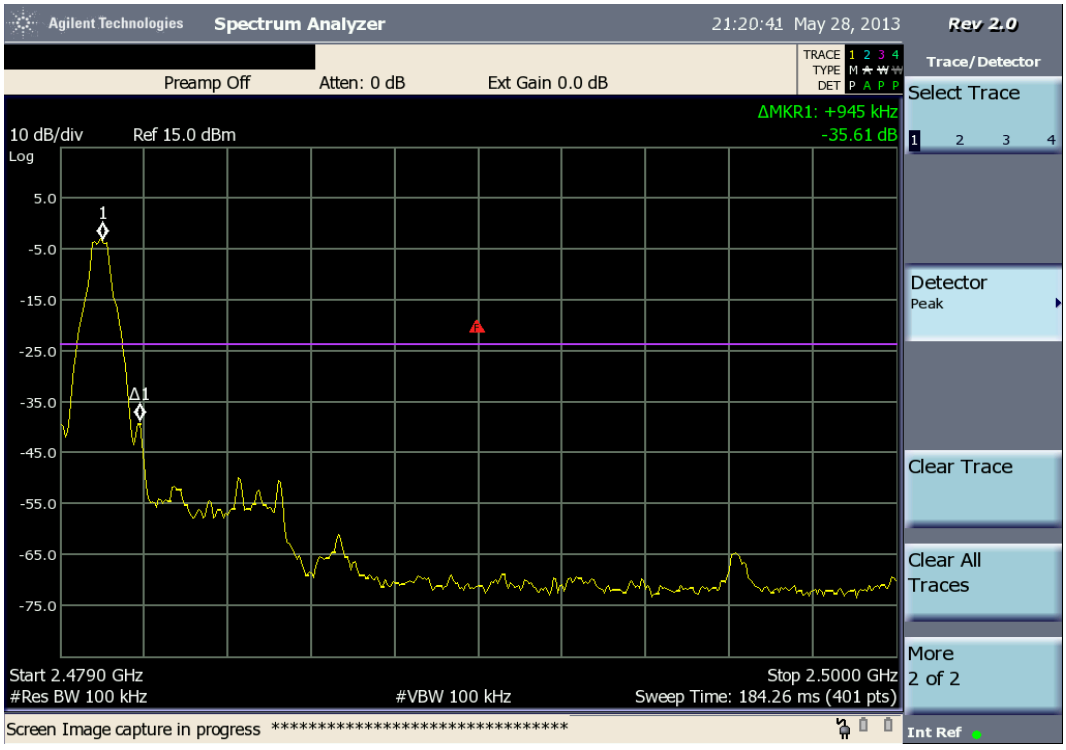


Figure 25: Ch79 BandEdge Peak (GFSK); Power Setting = 64 (Max)

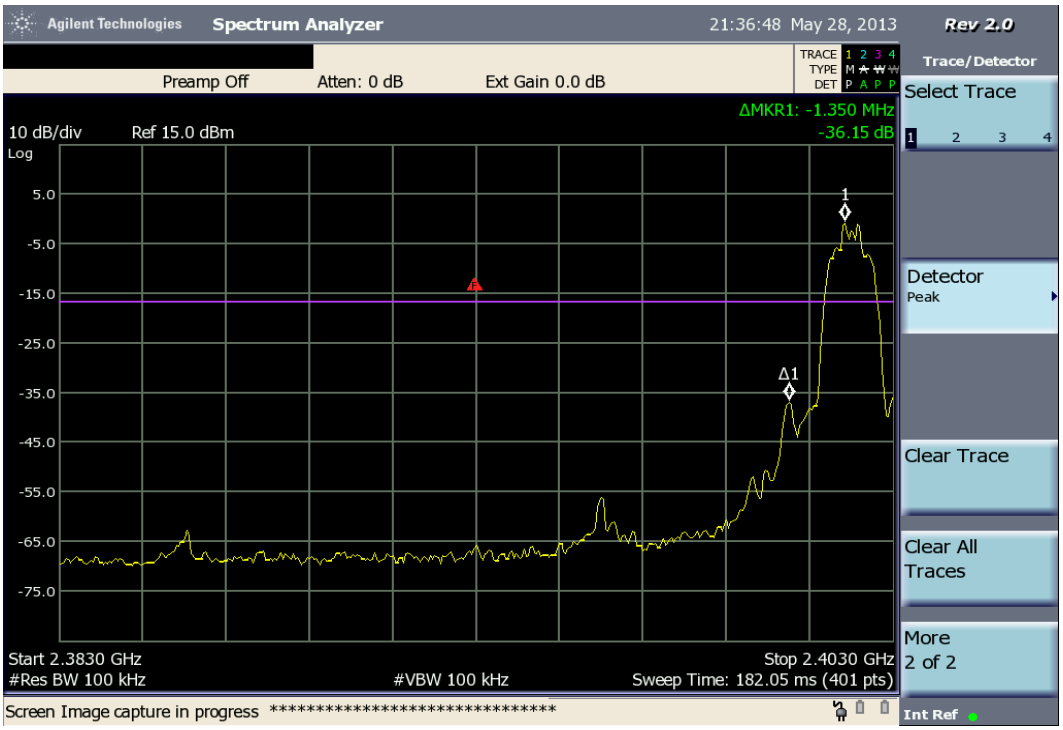


Figure 26: Ch1 BandEdge Peak (8DPSK); Power Setting = 100 (Max)

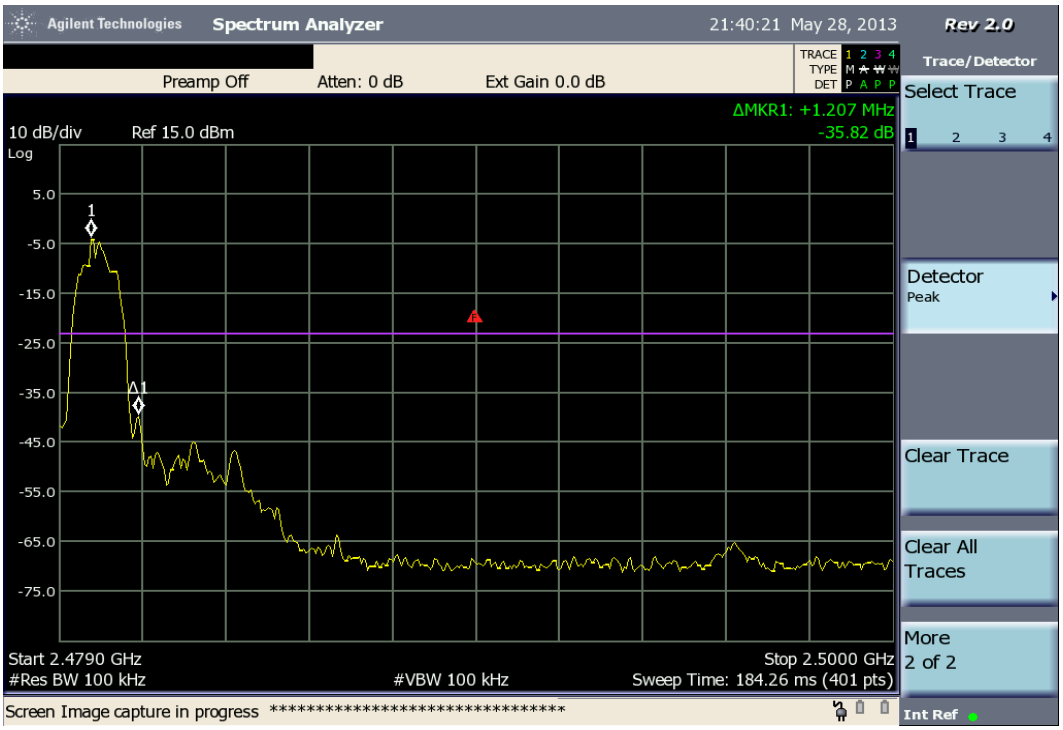


Figure 27: Ch79 BandEdge Peak (8DPSK); Power Setting = 100 (Max)

7 SPURIOUS EMISSIONS PER FCC PART 15 SECTION 15.247 (D), 15.209 & RSS-GEN 6.0

7.1 ADMINISTRATIVE AND ENVIRNMENTAL DETAILS

Site Used:	Semi-Anechoic Chamber			
Test Date:	05/14/2013	05/15/2013	05/23/2013	5/24/2013
Test Engineer:	Danh Le			
Temperature	20°C	18°C	22°C	23°C
Humidity:	47%	55%	45%	30%
Pressure	29.79 inHg	29.10 inHg	29.81 inHg	29.88 inHg

7.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
EMC Analyzer	Agilent	E7402A	MY45112375	03/14/2015
Spectrum Analyzer	HP	8565E	07017	01/28/2015
Biconical Antenna	EMCO	3104	3459	08/09/2013
Amplifier (10MHz-40GHz)	Giga-Tronics	GT-1040A	1116009	10/02/2013
L. P. Ant. (200-1000 MHz)	EMCO	3146	1596-1001	05/23/2014
Horn Antenna (700MHz-18GHz)	EMCO	3115	645460	04/12/2015
SHF-EHF Horn (15-40GHz)	Schwarzbeck	BBHA 9170	BBHA9170267	12/01/2013

7.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Fig.2 – Fig.8)

7.4 LIMITS/REQUIREMENTS

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)).

FCC Part 15 section 15.209 Radiated emission limits

Frequency (MHz)	Field strength (microvolts/meter)	Field strength (dB microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)		300
0.490-1.705	24000/F(kHz)		30
1.705-30.0	30	29.5	30
30-88	100 **	40	3
88-216	150 **	43.5	3
216-960	200 **	46	3
Above 960	500	54	3

7.5 TEST DESCRIPTION AND PROCEDURE

The EUT was placed 80 cm above ground plan on a non-conducted tabel. It was configured to activate the transmitting signal with selected channels and modulation modes by using the IBM laptop which was connected to the EUT with a USB to RS232 serial communication port .The unwanted emissions were being searched by scanning through the frequency range specified in the limit table in section 7.4 above. The tests were repeated with different modulation modes and channels as specified in the test data tables below.

In addition, 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)). The measurements were made at the lowest and highest available channel by using radiated test method. The test was repeated with all different available modulation modes.

7.6 TEST DATA

Modulation Mode: GFSK
Scanning Frequency Range: 30MHz – 1GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk	(dB)
1 (2402)	36.42	19.75 Pk	12.5	0	V	1	90	32.25 Pk	40 Pk	-07.75
1 (2402)	71.91	14.79 Pk	7.5	0	H	1	45	27.79 Pk	40 Pk	-17.71
1 (2402)	434.0	14.30 Pk	18.5	0	H	1	0	32.80 Pk	46 Pk	-13.20
1 (2402)	443.7	10.05 Pk	18.5	0	V	1	0	28.55 Pk	46 Pk	-17.45
1 (2402)	692.3	11.07 Pk	23	0	H	1	0	34.07 Pk	46 Pk	-11.93
1 (2402)	738.8	09.41 Pk	23	0	V	1	0	32.41 Pk	46 Pk	-13.59

Modulation Mode: GFSK
Scanning Frequency Range: 1GHz – 24GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (GHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk/ Av	(dB)
1 (2402)	1.121	30.79 Pk	29	22	H	1	45	37.79 Pk	74Pk / 54Av	-36.21
1 (2402)	1.162	31.39 Pk	29	22	H	1	45	38.39 Pk	74Pk / 54Av	-35.61
1 (2402)	2.123	36.80 Pk	31.5	22	H	1	45	46.30 Pk	74Pk / 54Av	-27.70
1 (2402)	2.345	31.20 Pk	32	22	H	1	45	41.20 Pk	74Pk / 54Av	-32.80
1 (2402)	2.287	31.25 Pk	31.5	22	V	2	45	40.75 Pk	74Pk / 54Av	-33.25
1 (2402)	2.345	32.21 pk	32	22	V	1	315	40.21 Pk	74Pk / 54Av	-31.79
1 (2402)	4.80	40.03 Pk/ 22.87 Av	39	21	H	1	0	58.03 Pk 40.87 Av	74Pk / 54Av	-15.97 -13.13
1 (2402)	4.80	38.83Pk/ 22.33Av	39	21	V	1	0	56.83 Pk 40.33 Av	74Pk / 54Av	-17.17 -13.67

Modulation Mode: GFSK
Scanning Frequency Range: 30MHz – 1GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk	(dB)
79 (2480)	36.14	20.13 Pk	12.5	0	V	1	0	32.63 Pk	40 Pk	-7.37
79 (2480)	53.62	14.62 Pk	12.5	0	H	1	270	27.12 Pk	40 Pk	-12.88
79 (2480)	51.63	17.51 Pk	12.5	0	V	1	0	30.01 Pk	40 Pk	-9.99
79 (2480)	72.09	13.22 Pk	7.5	0	H	1	270	20.72 Pk	40 Pk	-19.28
79 (2480)	443.7	09.40 Pk	18.5	0	V	1	315	27.90 Pk	46 Pk	-18.10
79 (2480)	602.3	09.55 Pk	23	0	H	1	315	32.55 Pk	46 Pk	-13.45
79 (2480)	739.0	10.17 Pk	23	0	H	1	0	33.17 Pk	46 Pk	-12.83
79 (2480)	864.2	12.64 Pk	26	0	V	1	45	38.64 Pk	46 Pk	-7.36

Modulation Mode: GFSK
Scanning Frequency Range: 1GHz – 24GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (GHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk/ Av	(dB)
79 (2480)	1.127	31.48 Pk	29	22	V	1	0	38.48 Pk	74Pk / 54Av	-35.52
79 (2480)	1.436	30.92 Pk	29	22	V	1	0	37.92 Pk	74Pk / 54Av	-36.08
79 (2480)	2.121	33.34 Pk	31.5	22	H	1	0	42.84 Pk	74Pk / 54Av	-31.16
79 (2480)	2.365	31.26 Pk	32	22	V	1	0	41.26 Pk	74Pk / 54Av	-32.74

Modulation Mode: 8-DPSK
Scanning Frequency Range: 30MHz – 1GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk	(dB)
1 (2402)	36.14	21.47 Pk/ 16.57 Qp	12.5	0	H	1	45	33.97 Pk/ 29.07 Qp	40 Pk	-6.03 -10.9
1 (2402)	41.79	18.19 Pk	12.5	0	H	1	45	25.69 Pk	40 Pk	-14.3
1 (2402)	51.91	17.18 Pk	12.5	0	H	1	45	29.68 Pk	40 Pk	-10.3
1 (2402)	53.77	13.78	12.5	0	V	1	45	26.28 PK	40 Pk	-13.7
1 (2402)	822.5	13.50 Pk	26	0	H	1	180	39.50 Pk	46 Pk	-6.50
1 (2402)	891.2	17.19 Pk 15.85 Qp	27	0	H	1	180	44.19 Pk 42.85 Qp	46 Pk	-1.81 -3.15

Modulation Mode: 8DPSK
Scanning Frequency Range: 1GHz – 24GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (GHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk/ Av	(dB)
1 (2402)	2.114	36.68 Pk	31.5	22	H	1	270	40.30 Pk	74Pk / 54Av	-33.7
1 (2402)	2.345	32.55 Pk	32	22	H	1	270	42.55 Pk	74Pk / 54Av	-31.5
1 (2402)	2.287	32.53 Pk	31.5	22	V	1	90	42.03 Pk	74Pk / 54Av	-32.0
1 (2402)	2.345	32.51 pk	32	22	V	1	90	42.51 Pk	74Pk / 54Av	-31.5
1 (2402)	4.80	40.03 Pk 22.87 Av	39	21	H	1	0	58.03 Pk 40.87 Av	74Pk / 54Av	-16.0 -13.1
1 (2402)	4.80	38.83Pk/ 22.33Av	39	21	V	1	0	56.83 Pk 40.33 Av	74Pk / 54Av	-17.2 -13.7

Modulation Mode: 8DPSK
Scanning Frequency Range: 30MHz – 1GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk	(dB)
79 (2480)	36.45	20.05 Pk	12.5	0	V	1	0	32.55 Pk	40 Pk	-7.45
79 (2480)	53.96	12.55 Pk	12.5	0	H	1	270	25.05 Pk	40 Pk	-14.9
79 (2480)	51.94	17.95 Pk	12.5	0	V	1	0	30.45 Pk	40 Pk	-9.60
79 (2480)	822.5	12.97 Pk	26	0	H	1	180	38.97 Pk	46 Pk	-7.03
79 (2480)	864.2	18.87 Pk 16.26 Qp	27	0	V	1	180	45.8 Pk 43.26 Qp	46 Pk	-0.13 -2.74
79 (2480)	891.1	16.92 Pk 15.43 Qp	27	0	V	1	180	43.92 Pk 42.43 Qp	46 Pk	-2.08 -3.57

Modulation Mode: 8DPSK
Scanning Frequency Range: 1GHz – 24GHz

Fundamental	Indicated (Out of band)		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (GHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Preamp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV) Pk/ Av	(dB)
79 (2480)	2.114	37.04 Pk	31.5	22	H	1	270	46.54 Pk	74Pk / 54Av	-27.5
79 (2480)	2.122	36.52 Pk	31.5	22	V	1	270	46.02 Pk	74Pk / 54Av	-28.0

7.7 SPURIOUS EMISSIONS PLOTS

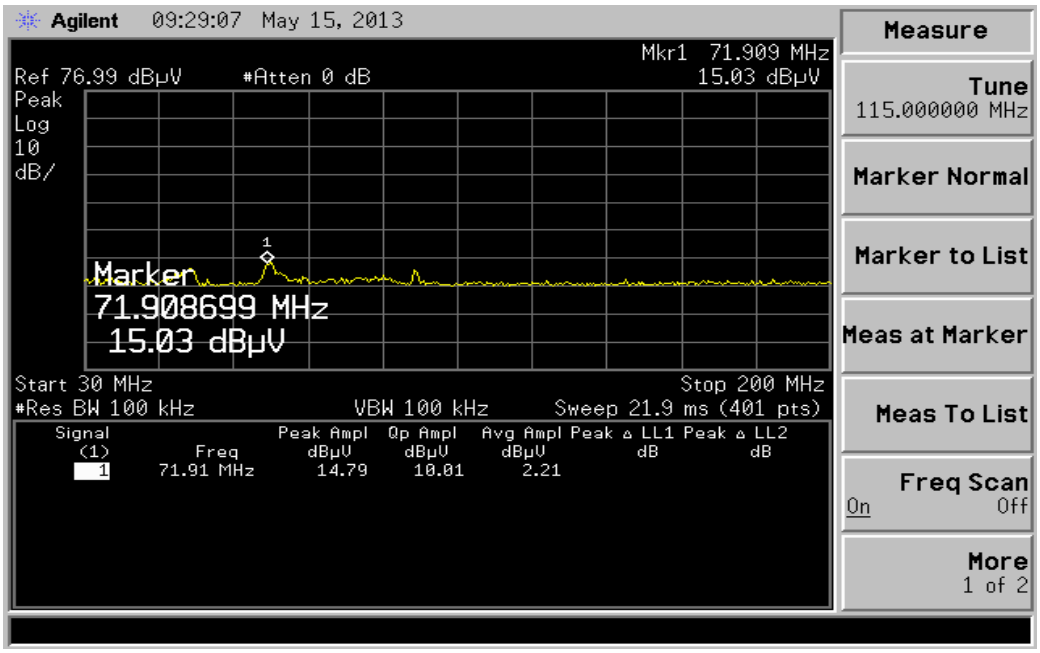


Figure 28: EMI (30MHz-200MHz) Horz / Ch1 (GFSK)

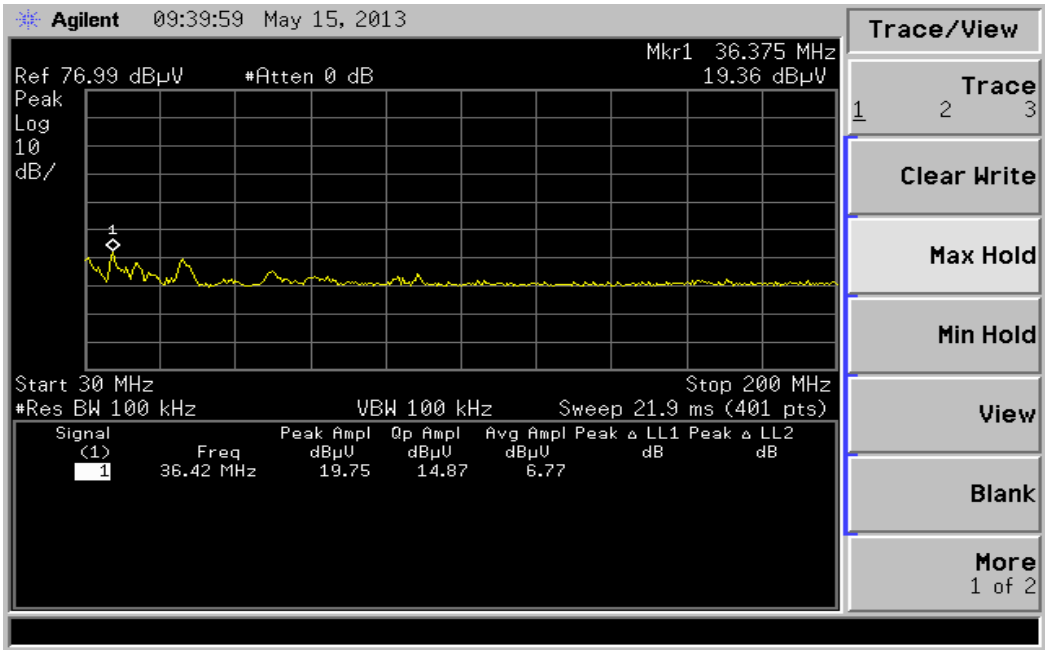


Figure 29: EMI (30MHz-200MHz) Vert / Ch1 (GFSK)

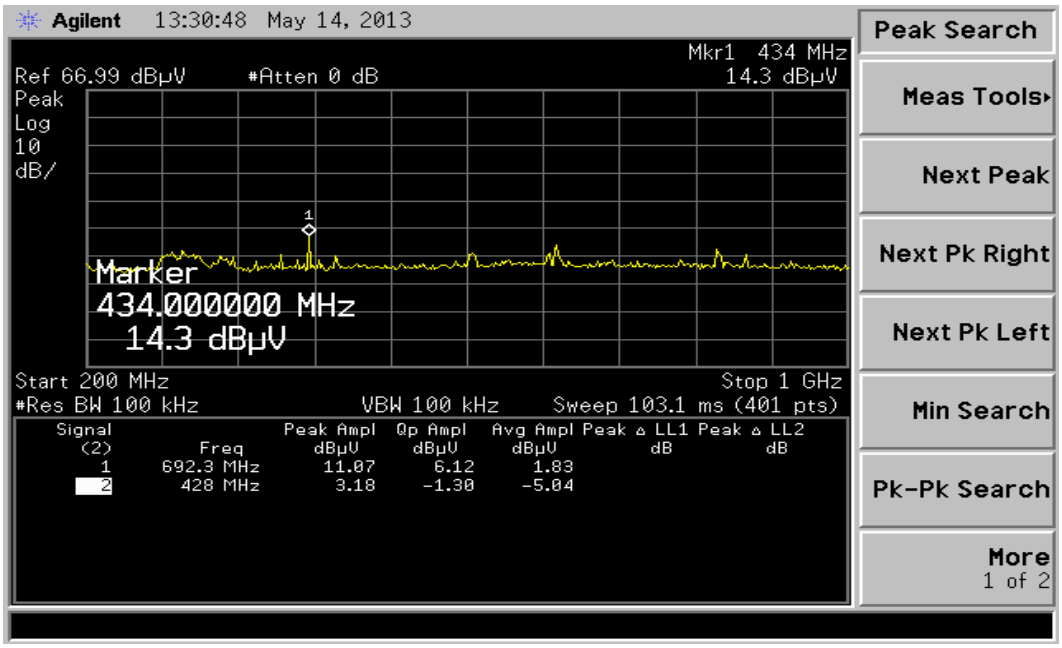


Figure 30: EMI (200MHz-1GHz) Horz / Ch1 (GFSK)

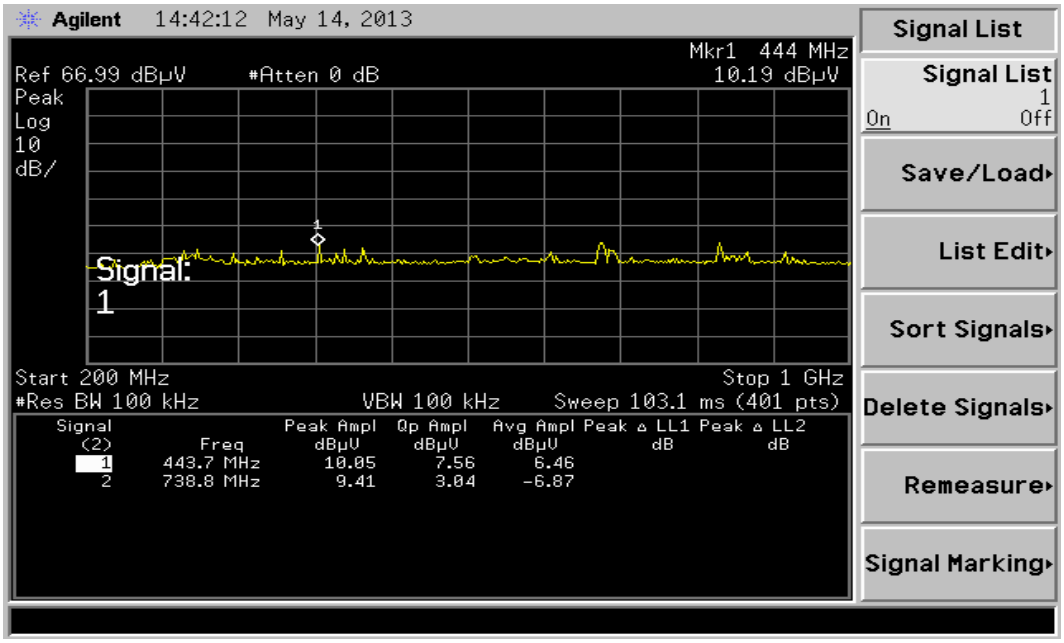


Figure 31: EMI (200MHz-1GHz) Vert / Ch1 (GFSK)

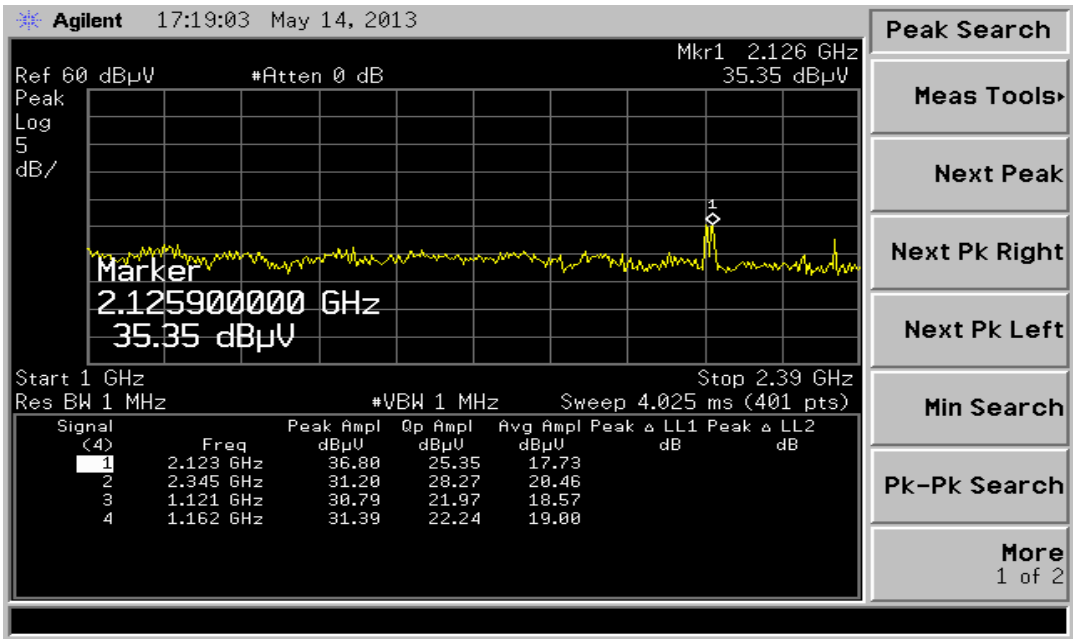


Figure 32: EMI (1GHz-2.39GHz) Horz / Ch1 (GFSK)

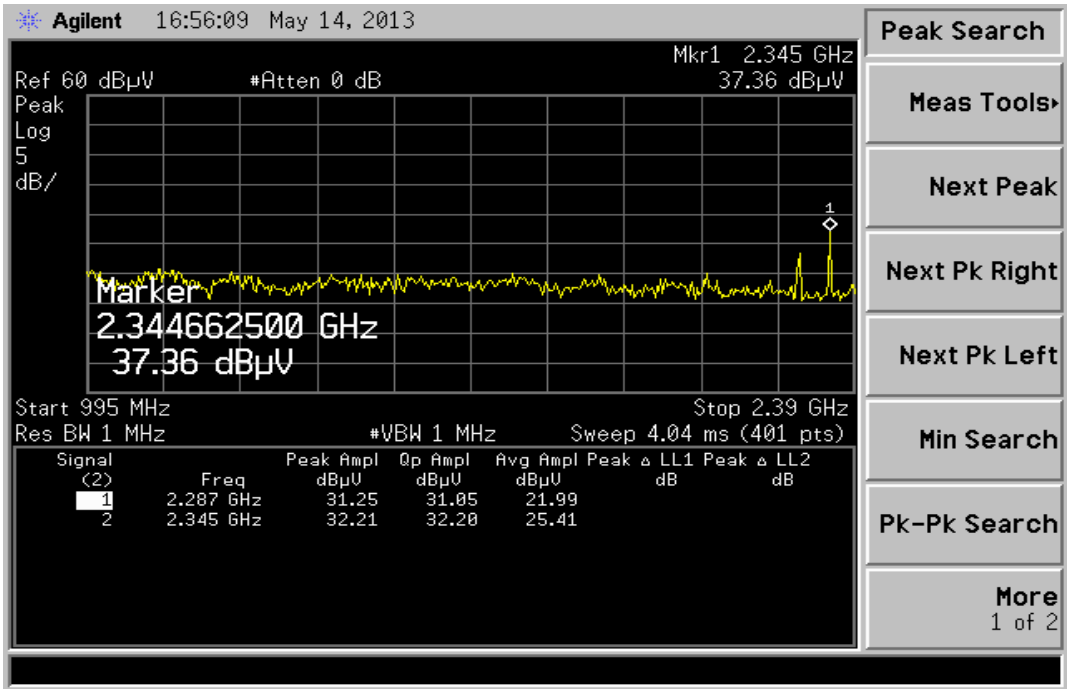


Figure 33: EMI (1GHz-2.39GHz) Vert / Ch1 (GFSK)

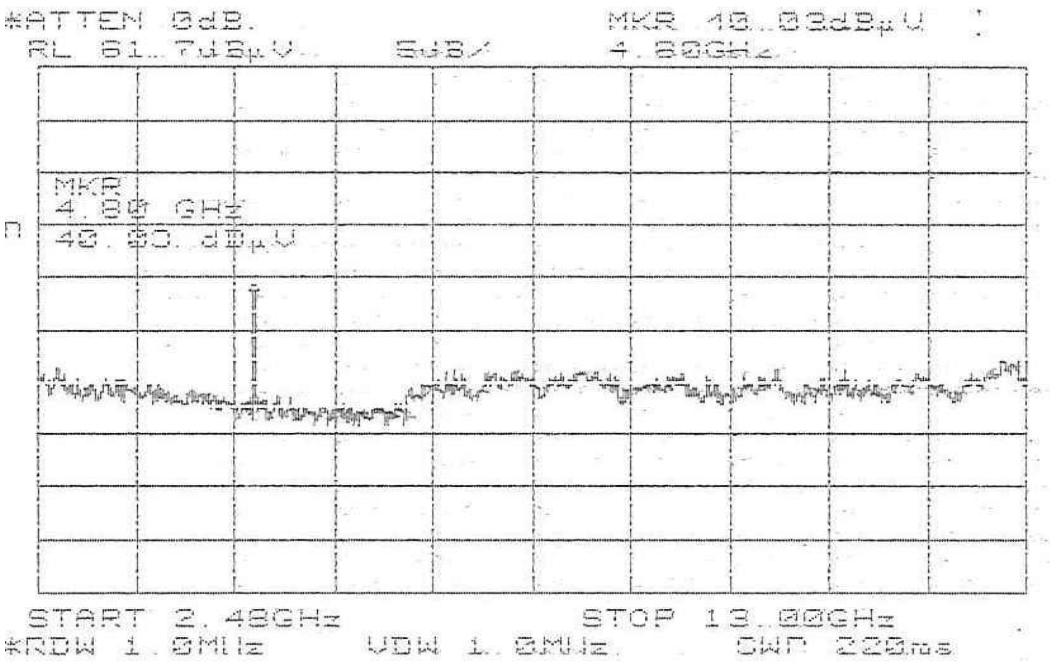


Figure 34: EMI (2.483GHz-13GHz) Horz / Ch1 (GFSK)

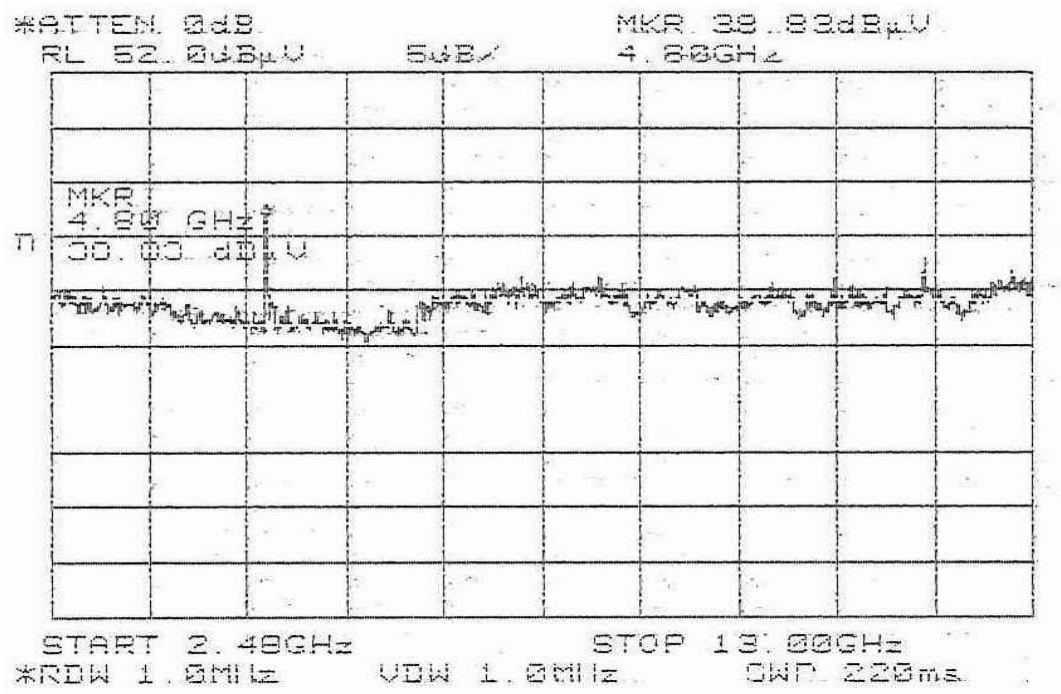


Figure 35: EMI (2.483GHz-13GHz) Vert / Ch1 (GFSK)

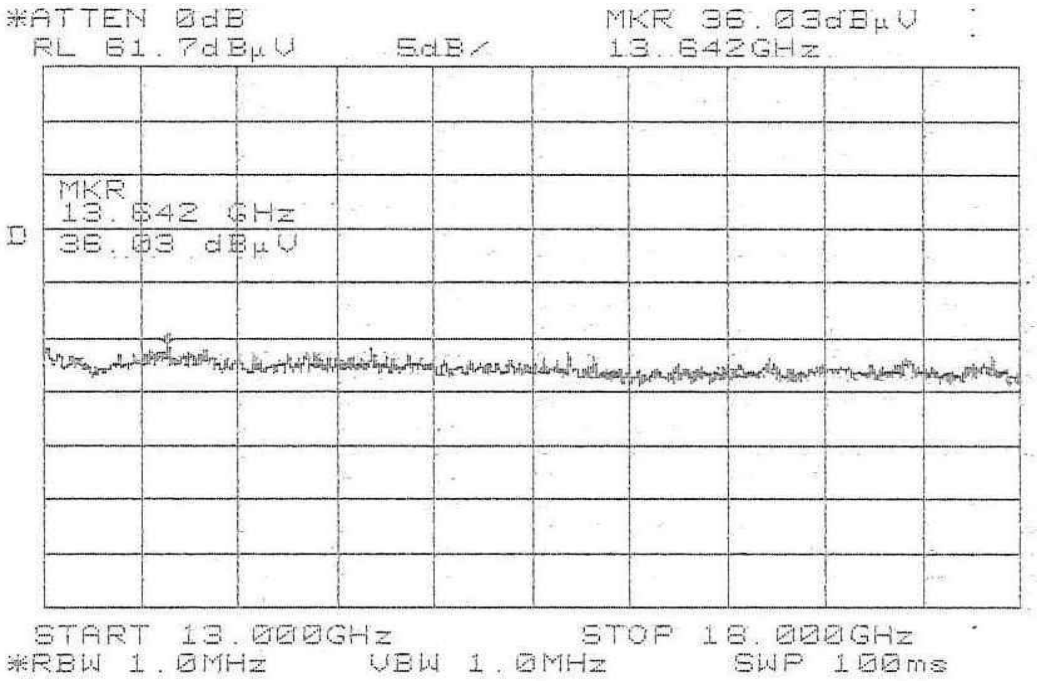


Figure 36: EMI (13GHz-18GHz) Horz / Ch1 (GFSK)

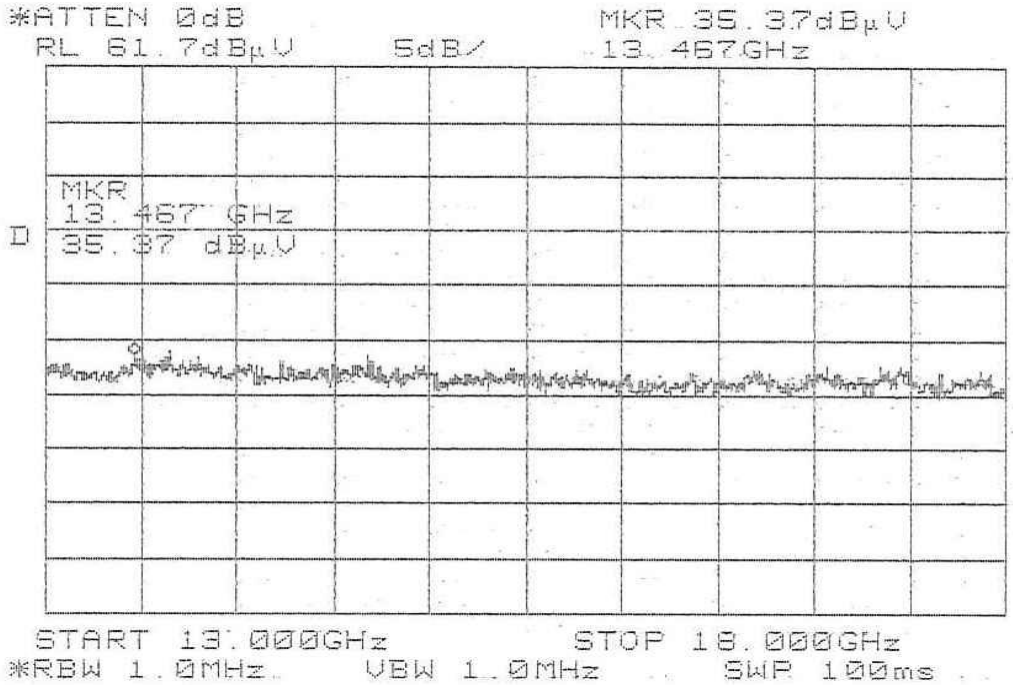


Figure 37: EMI (13GHz-18GHz) Vert / Ch1 (GFSK)

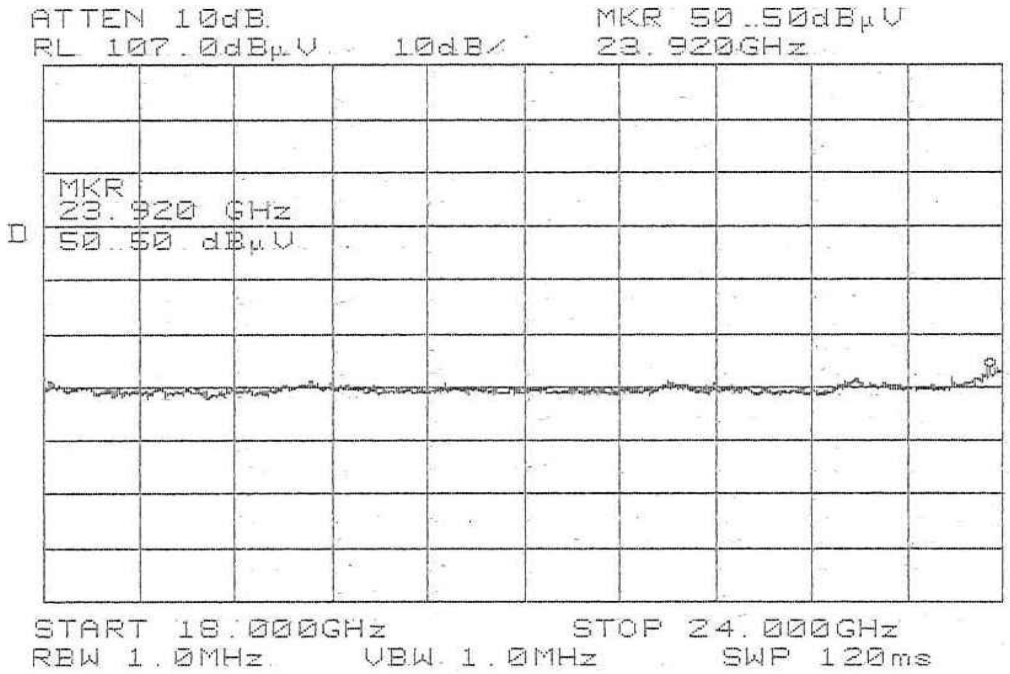


Figure 38: EMI (18GHz-24GHz) Horz / Ch1 (GFSK)

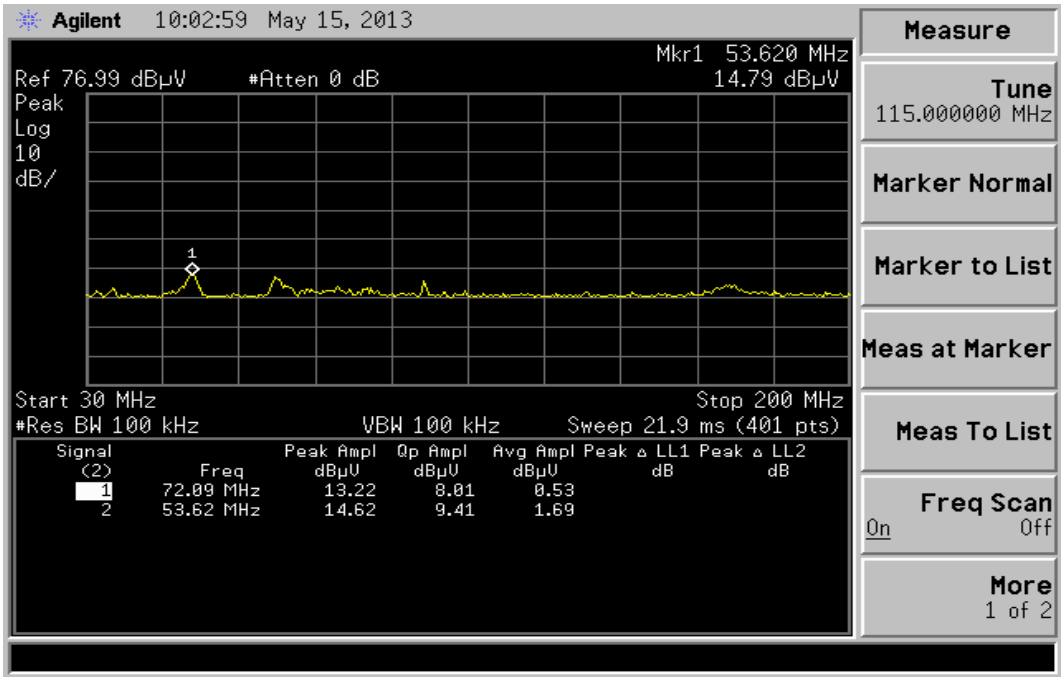


Figure 39: EMI (30MHz-200MHz) Horz / Ch79 (GFSK)

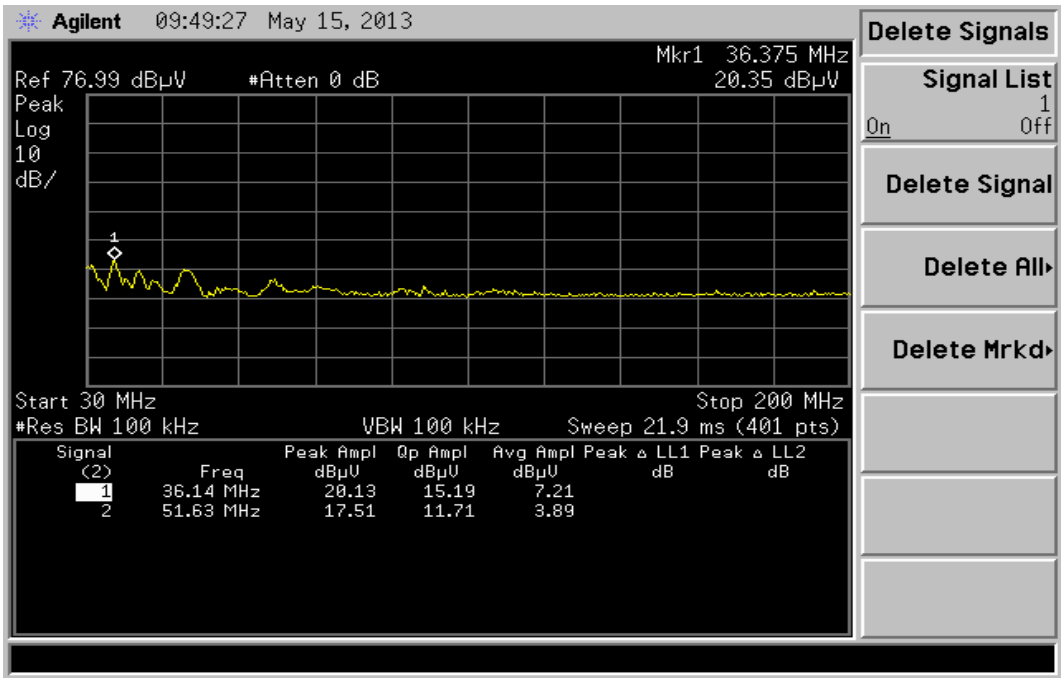


Figure 40: EMI (30MHz-200MHz) Vert / Ch79 (GFSK)

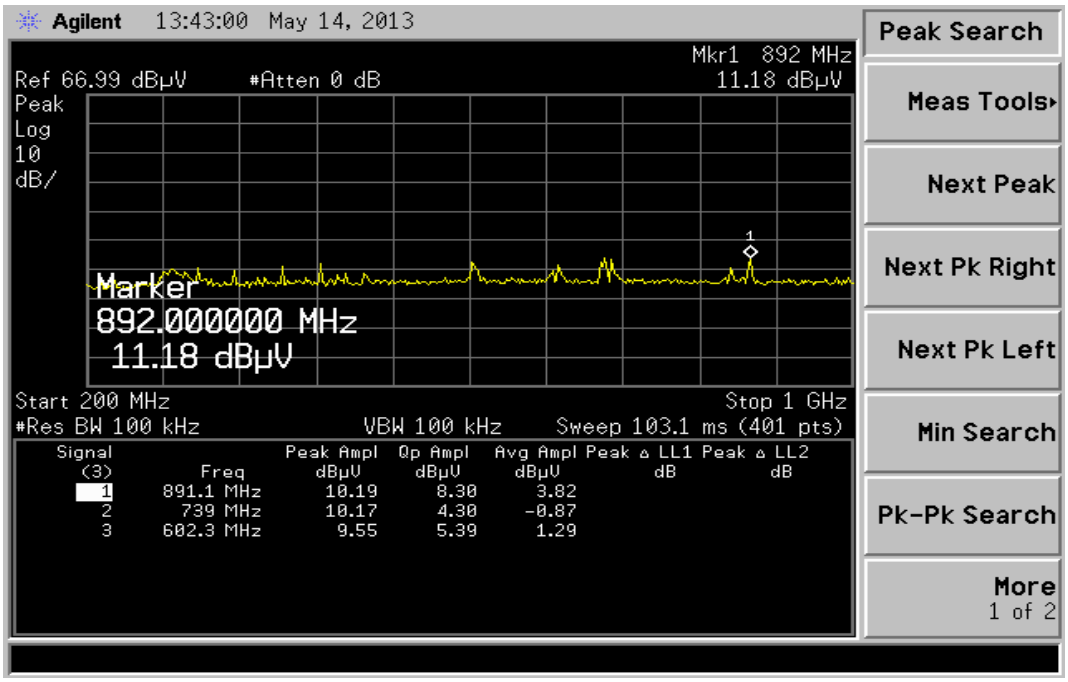


Figure 41: EMI (200MHz-1GHz) Horz / Ch79 (GFSK)

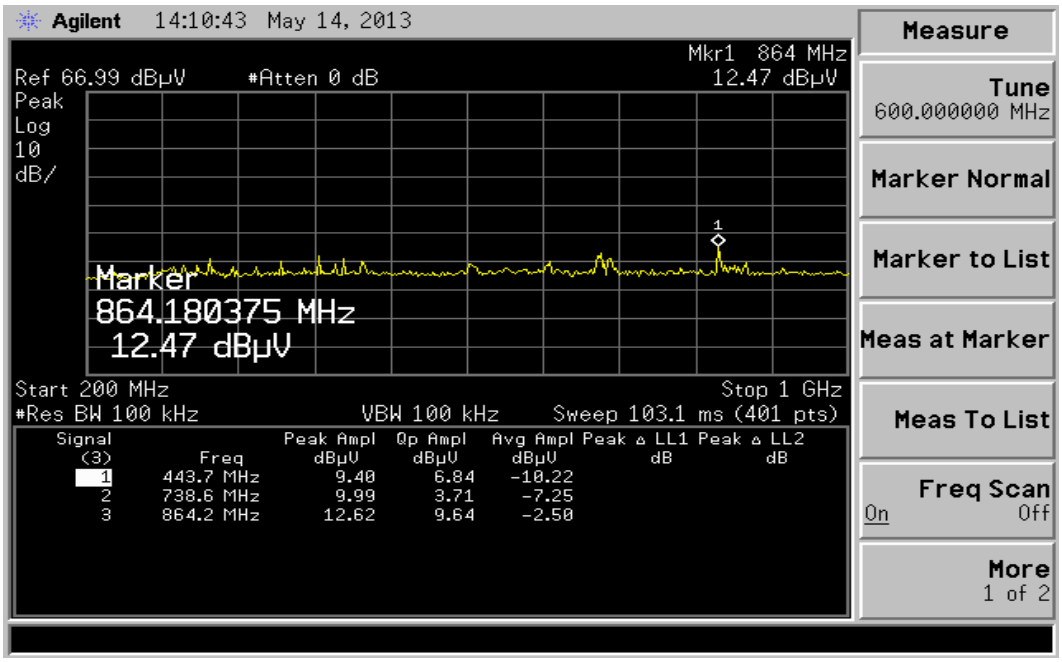


Figure 42: EMI (200MHz-1GHz) Vert / Ch79 (GFSK)

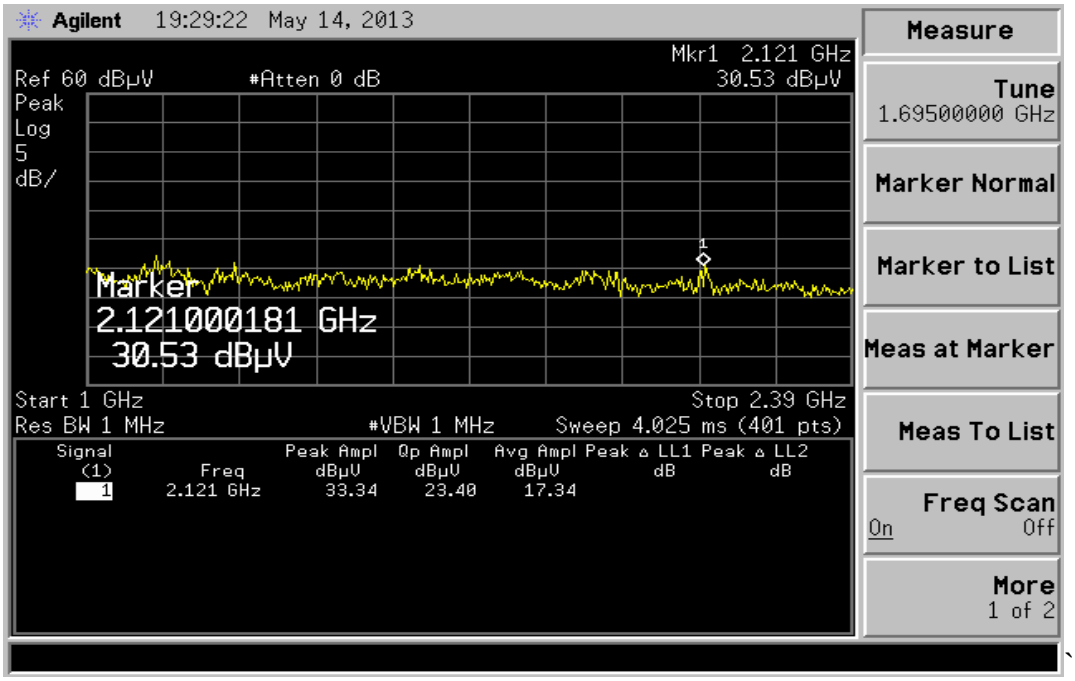


Figure 43: EMI (1GHz-2.39GHz) Horz / Ch79 (GFSK)

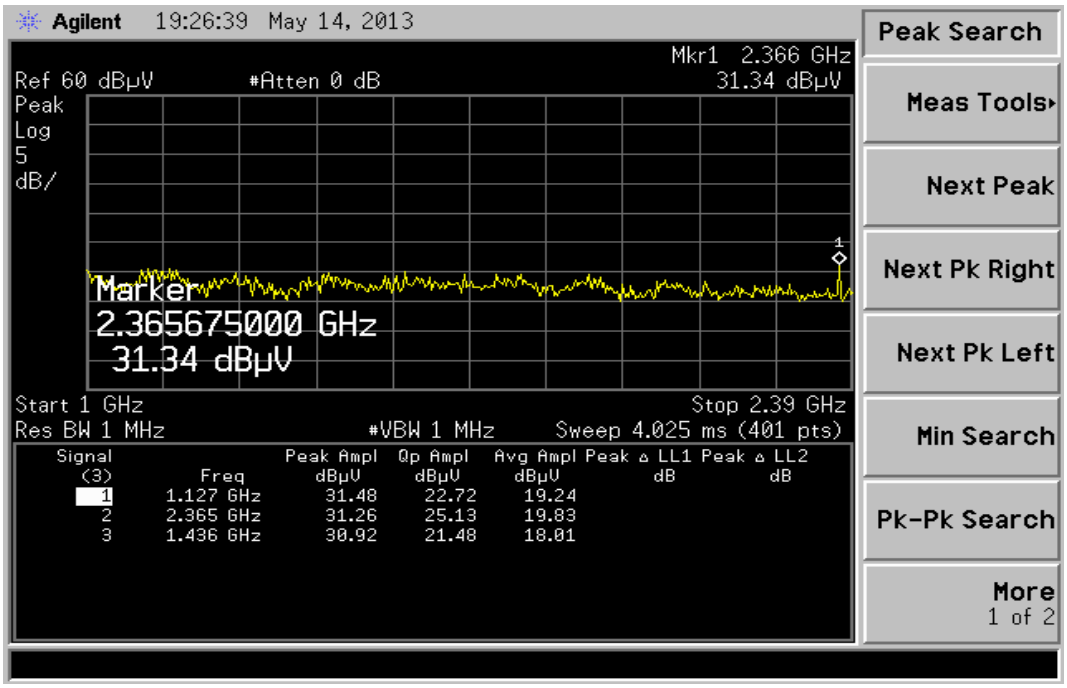


Figure 44: EMI (1GHz-2.39GHz) Vert / Ch79 (GFSK)

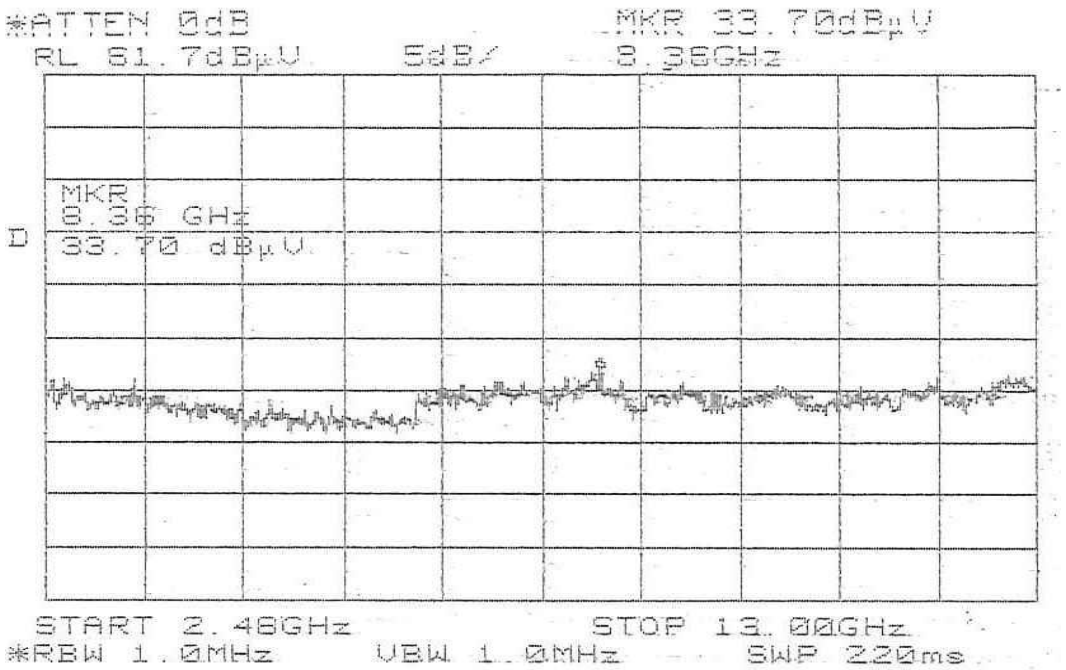


Figure 45: EMI (2.483GHz-13GHz) Horz / Ch79 (GFSK)

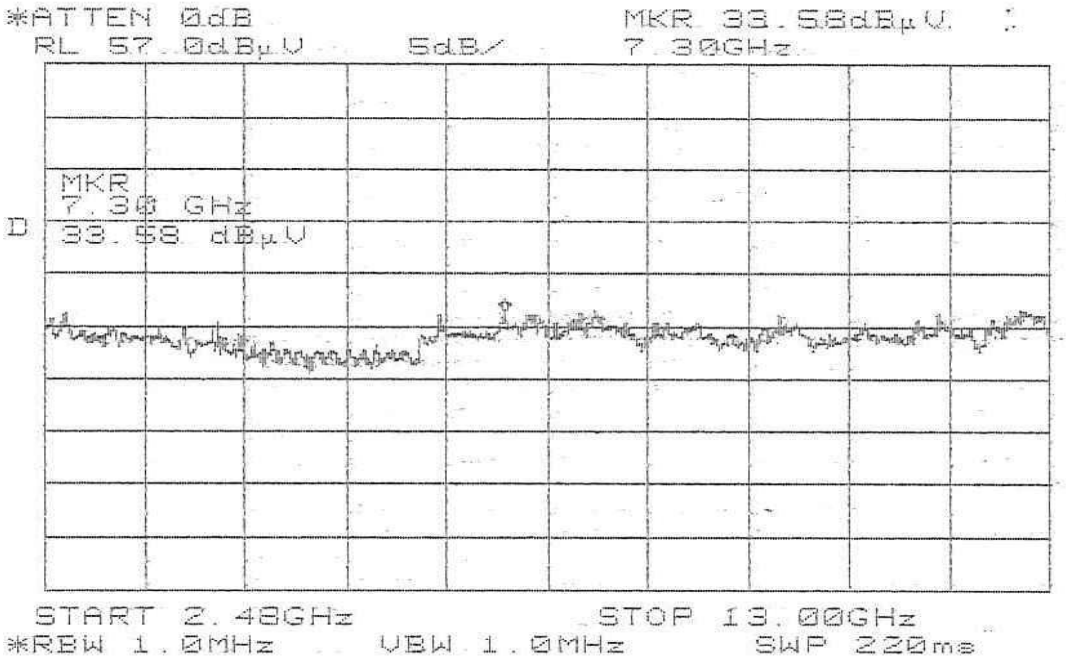


Figure 46: EMI (2.483GHz-13GHz) Vert / Ch79 (GFSK)

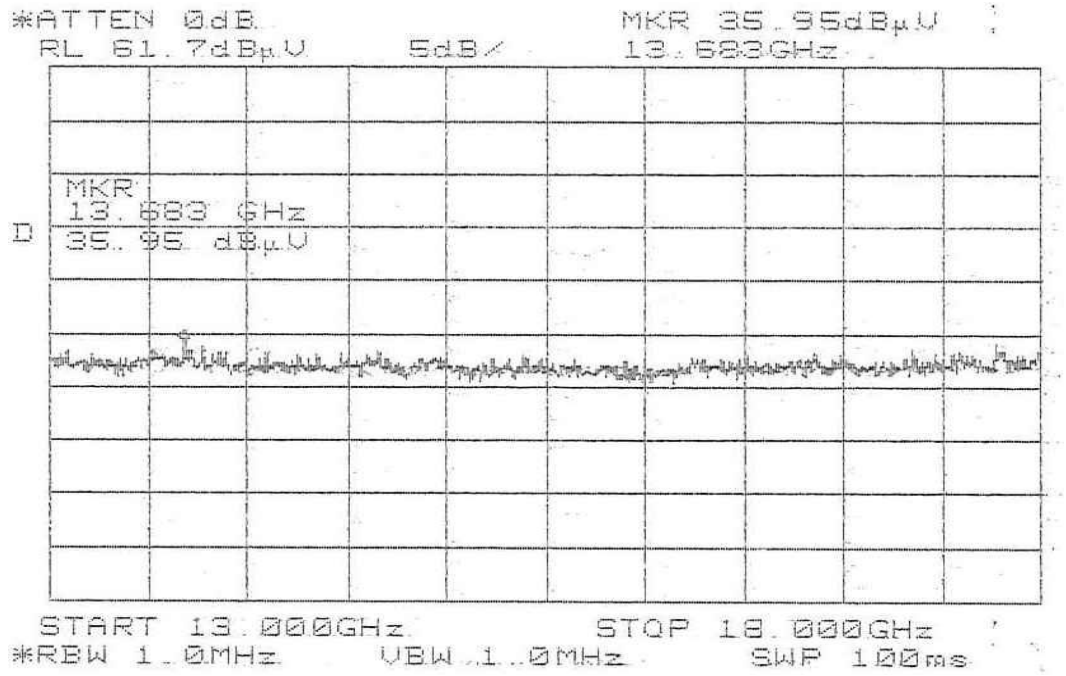


Figure 47: EMI (13GHz-18GHz) Horz / Ch79 (GFSK)

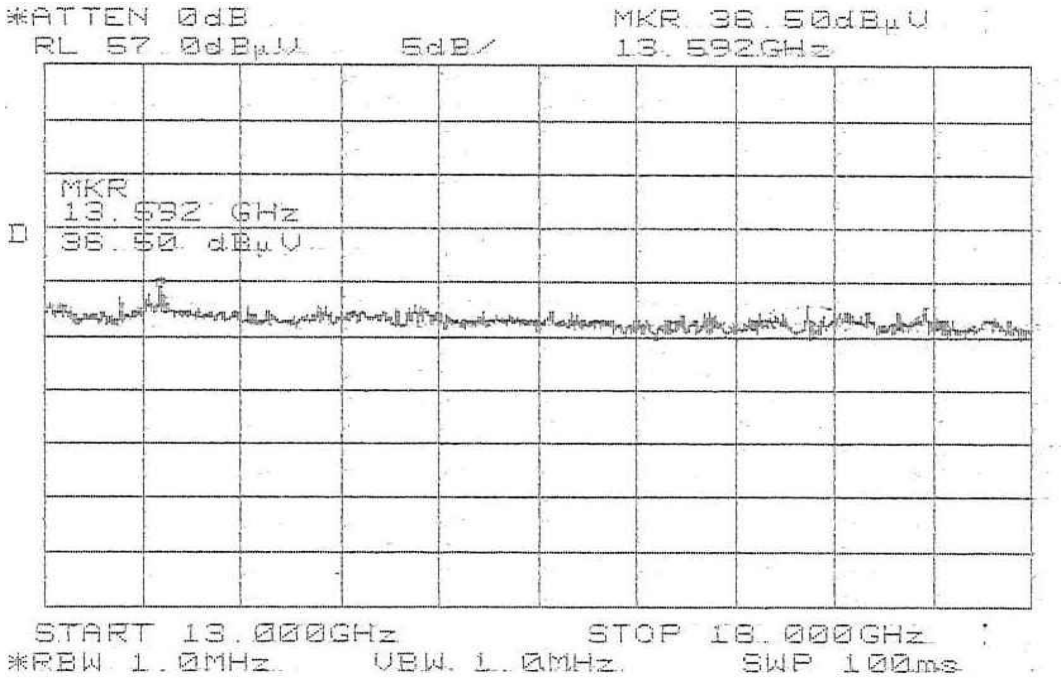


Figure 48: EMI (13GHz-18GHz) Vert / Ch79 (GFSK)

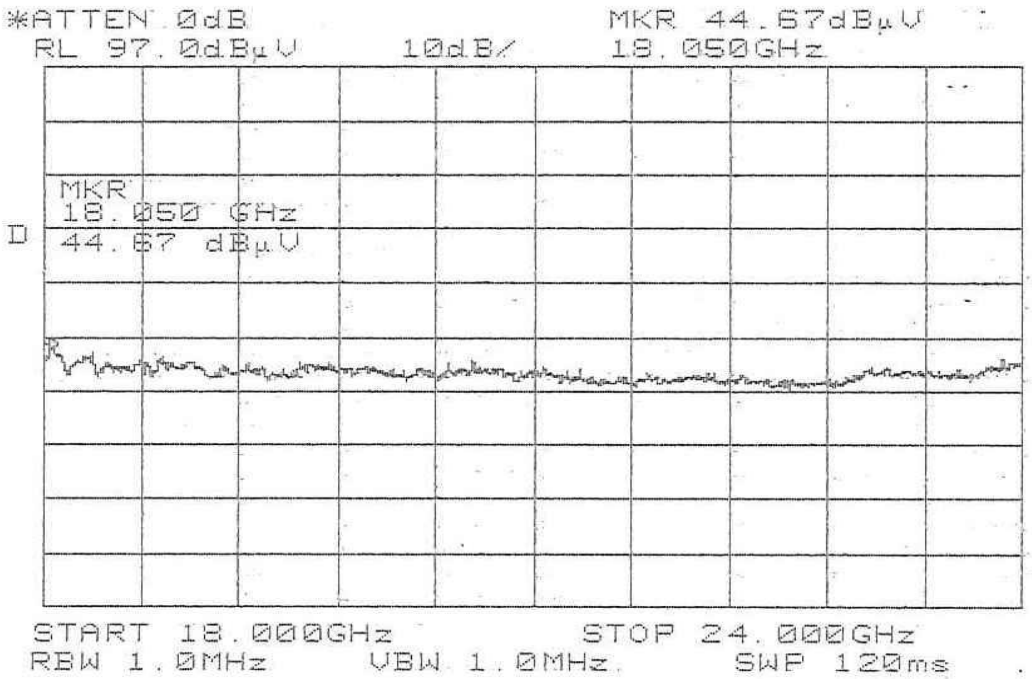


Figure 49: EMI (18GHz-24GHz) Vert / Ch79 (GFSK)

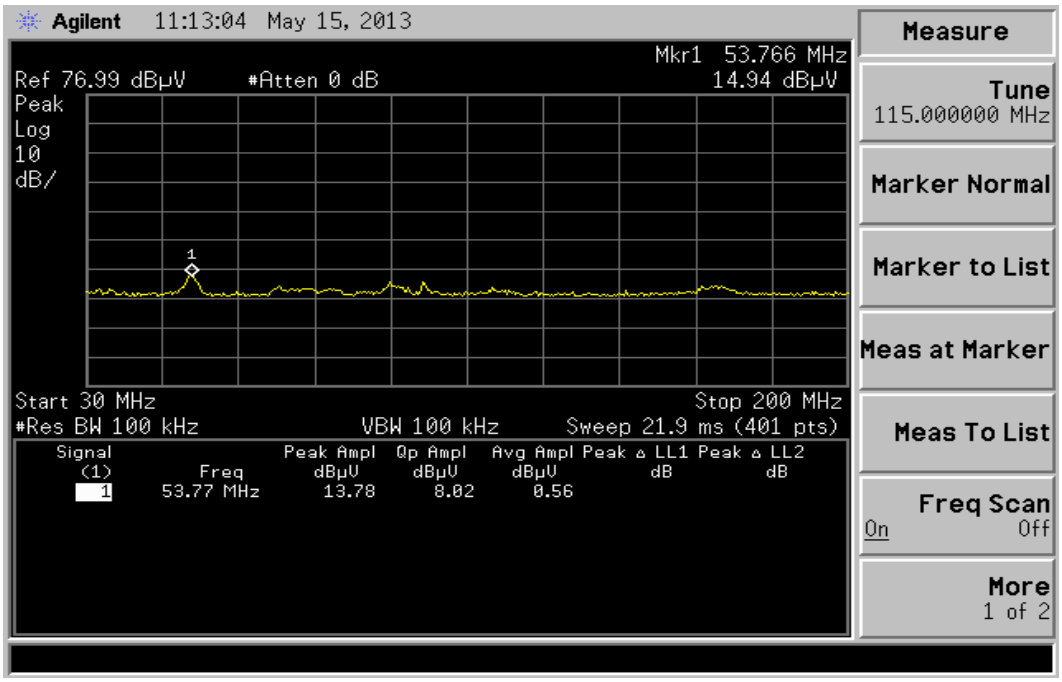


Figure 50: EMI (30MHz-200MHz) Horz / Ch1 (8DPSK)

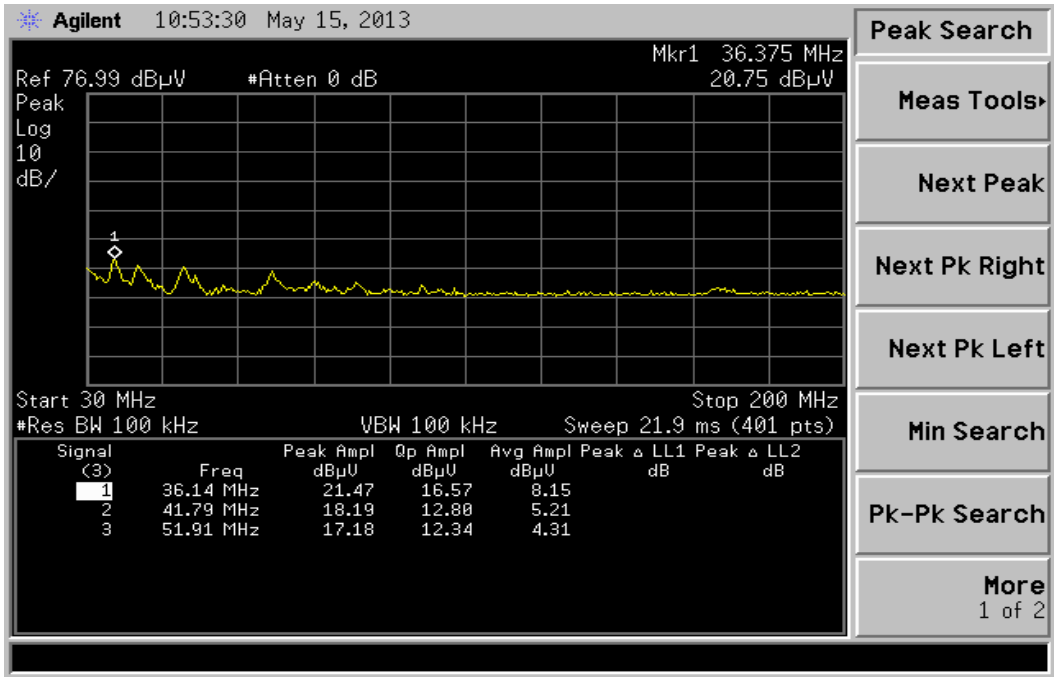


Figure 51: EMI (30MHz-200MHz) Vert / Ch1 (8DPSK)

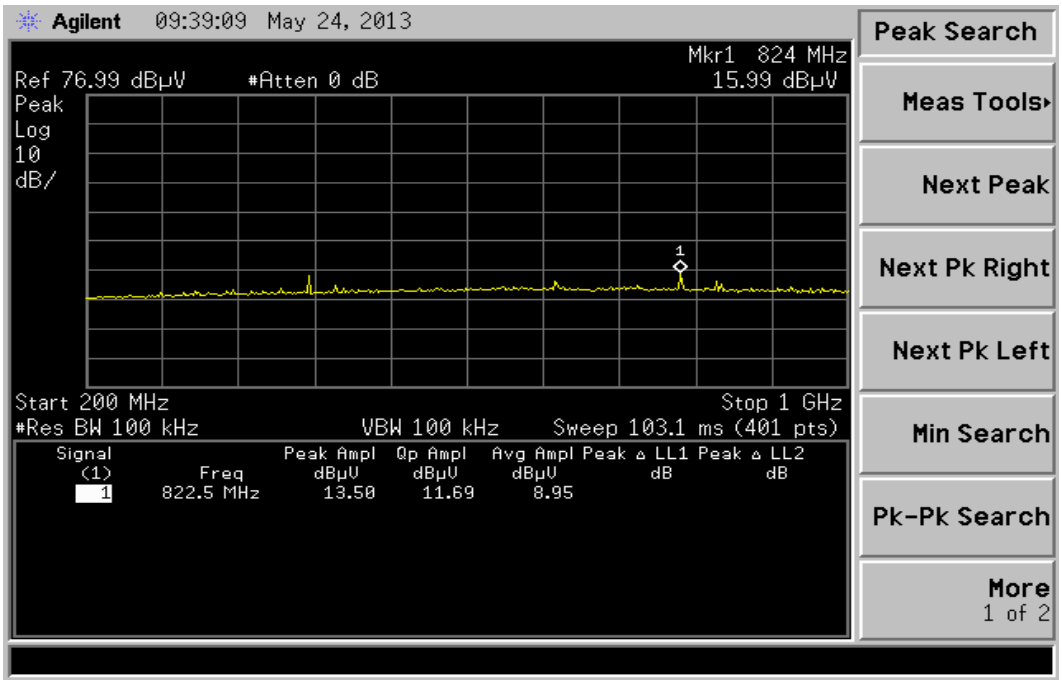


Figure 52: EMI (200MHz-1GHz) Horz / Ch1 (8DPSK)

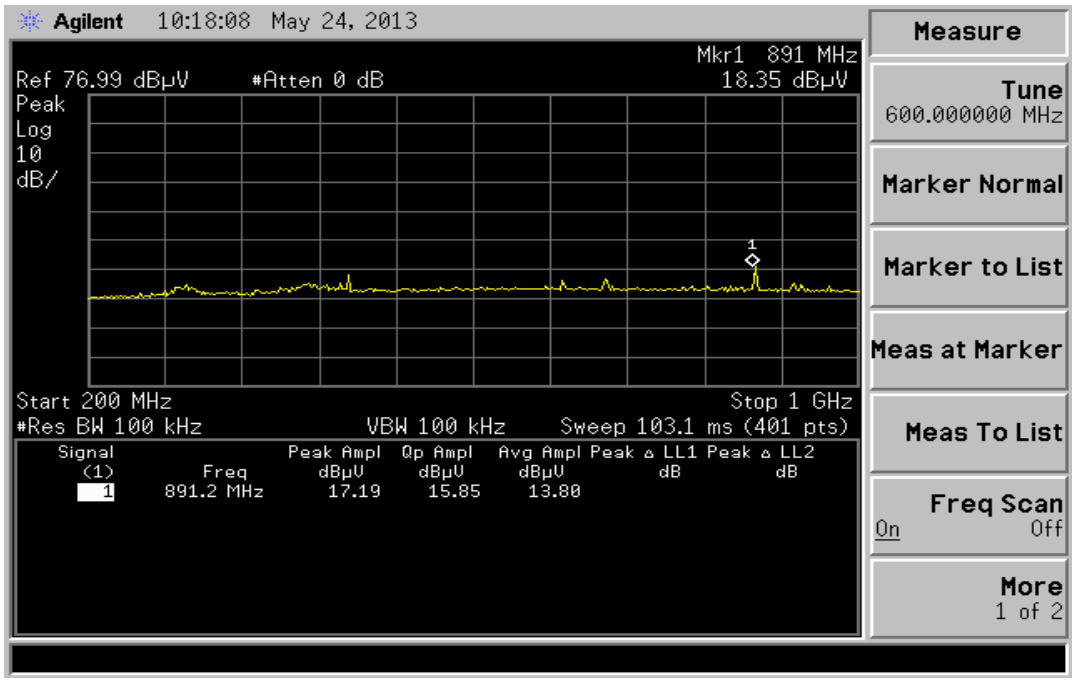


Figure 53: EMI (200MHz-1GHz) Vert / Ch1 (8DPSK)

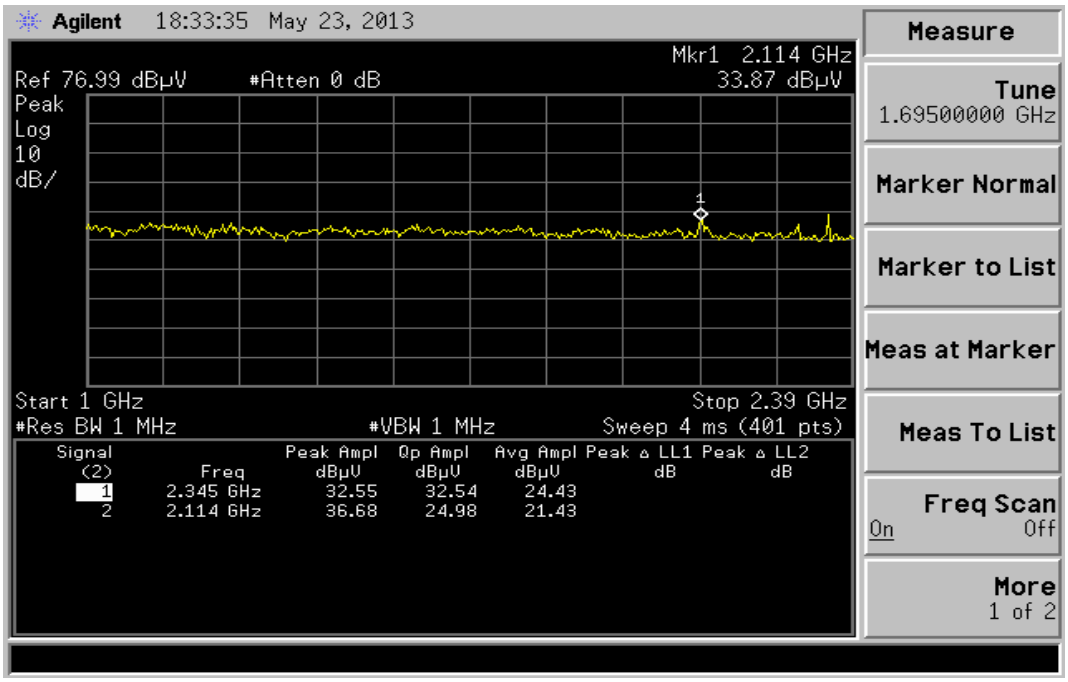


Figure 54: EMI (1GHz-2.390GHz) Horz / Ch1 (8DPSK)

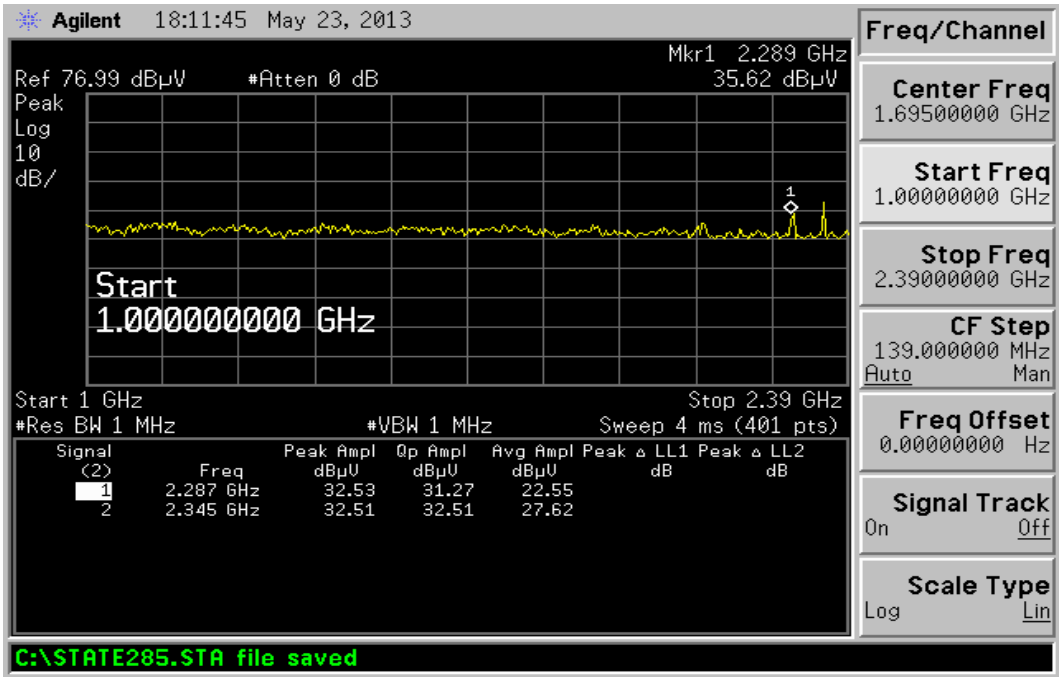


Figure 55: EMI (1GHz-2.390GHz) Vert / Ch1 (8DPSK)

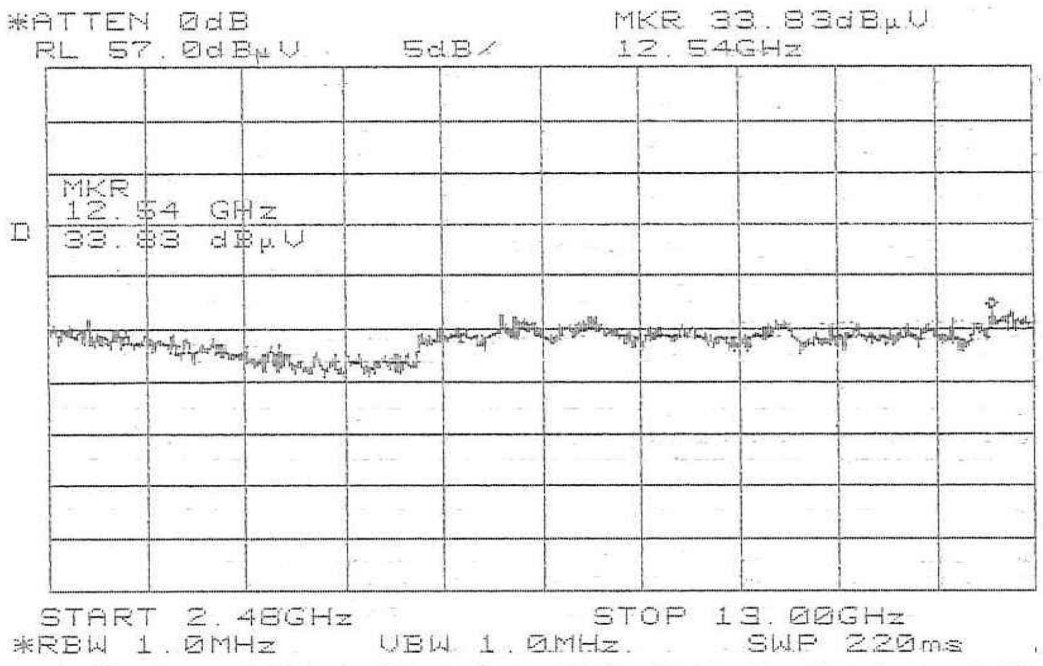


Figure 56: EMI (2.48GHz-13GHz) Horz / Ch1 (8DPSK)

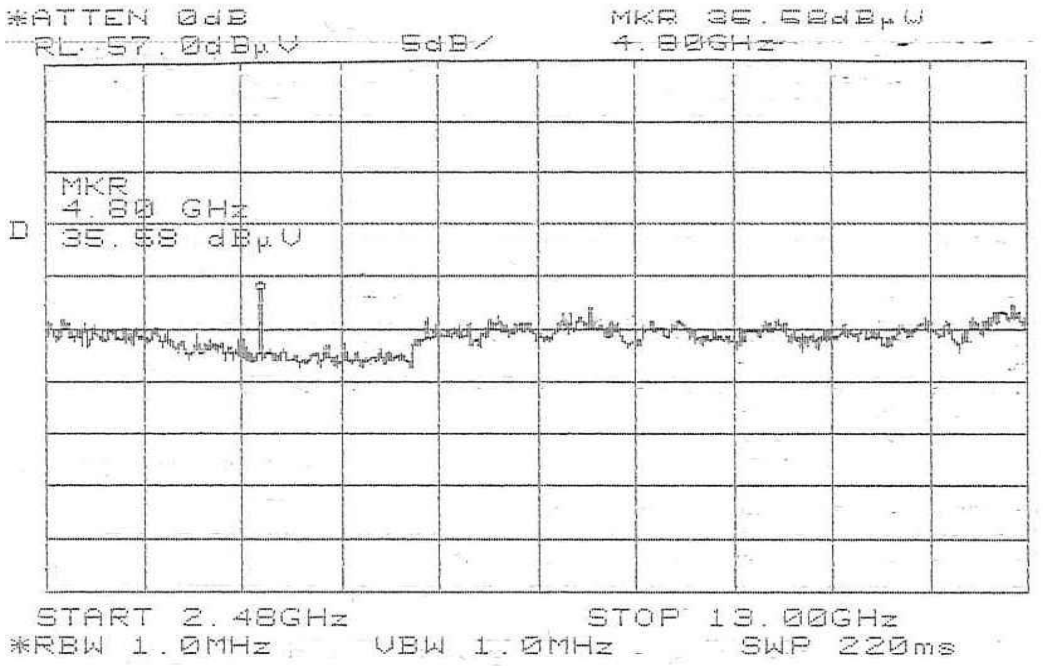


Figure 57: EMI (2.48GHz-13GHz) Vert / Ch1 (8DPSK)

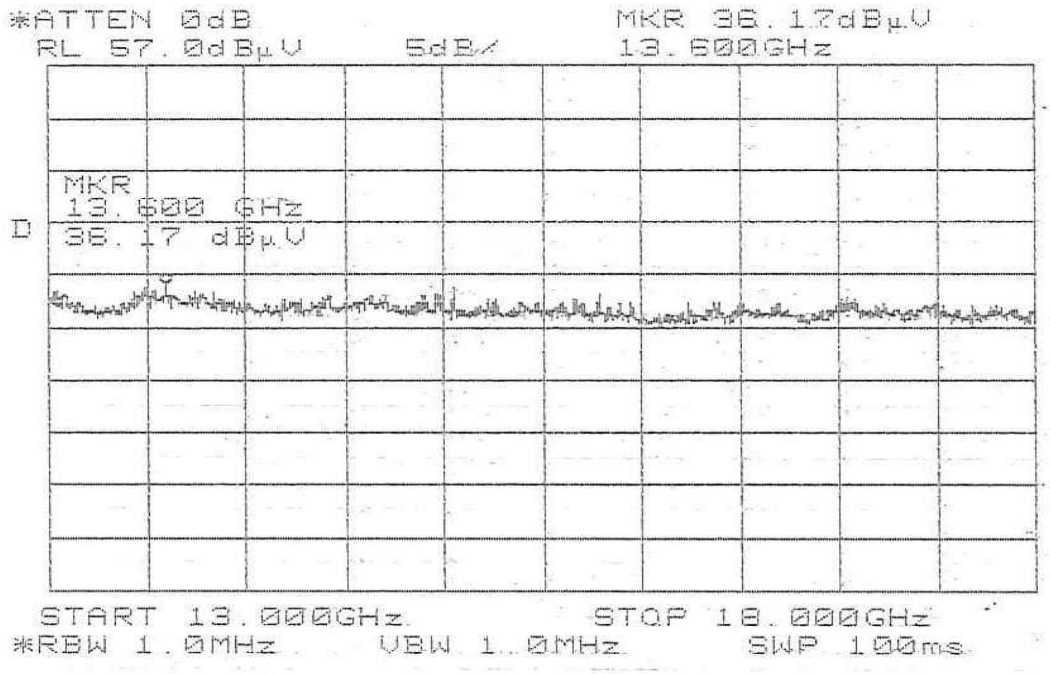


Figure 58: EMI (13GHz-18GHz) Horz / Ch1 (8DPSK)

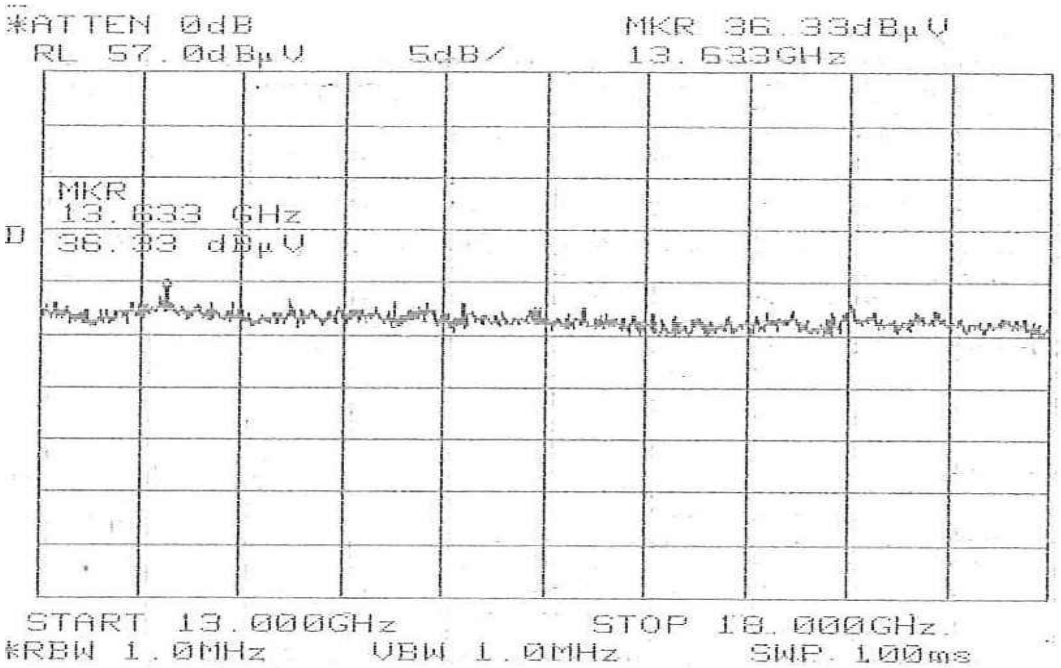


Figure 59: EMI (13GHz-18GHz) Vert / Ch1 (8DPSK)

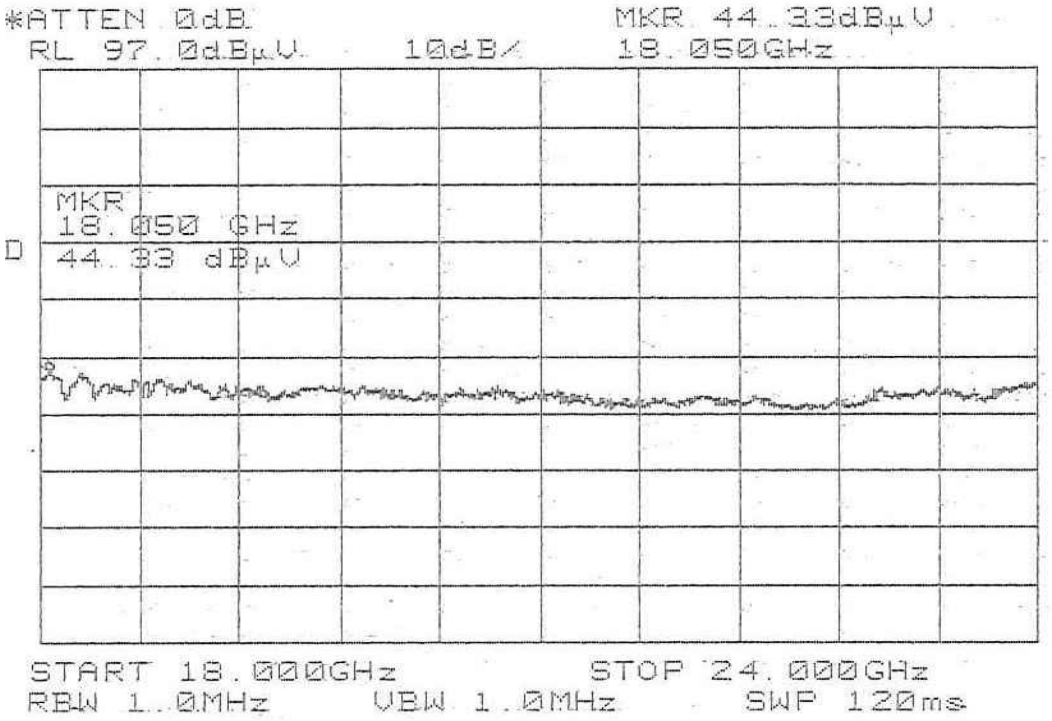


Figure 60: EMI (18GHz-24GHz) Horz / Ch1 (8DPSK)

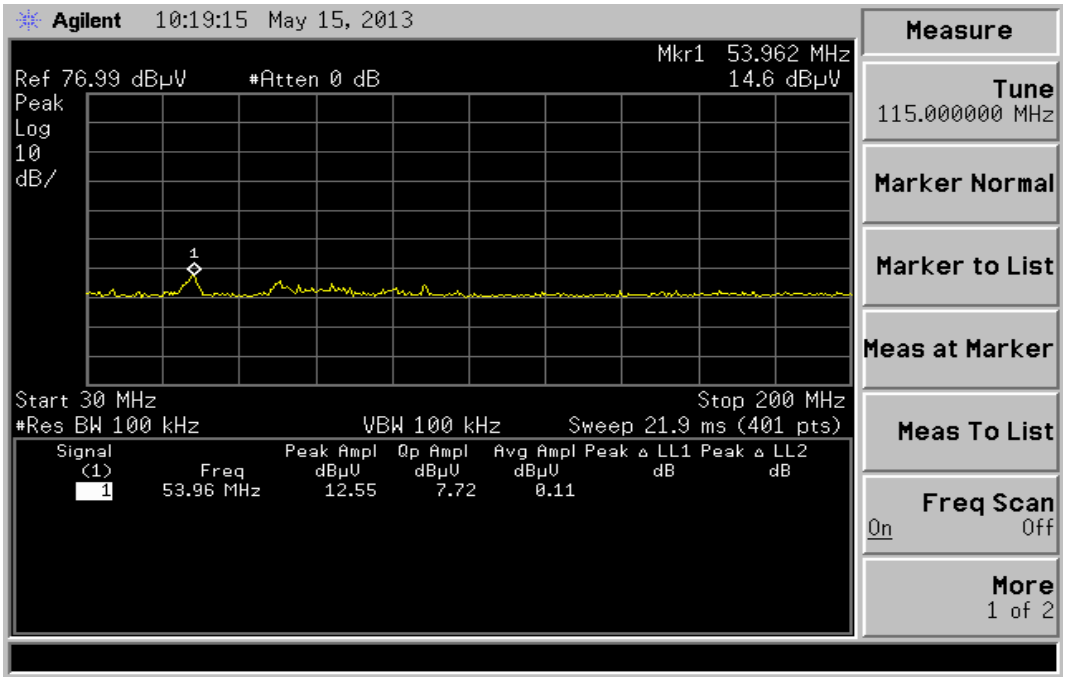


Figure 61: EMI (30MHz-200MHz) Horz / Ch79 (8DPSK)

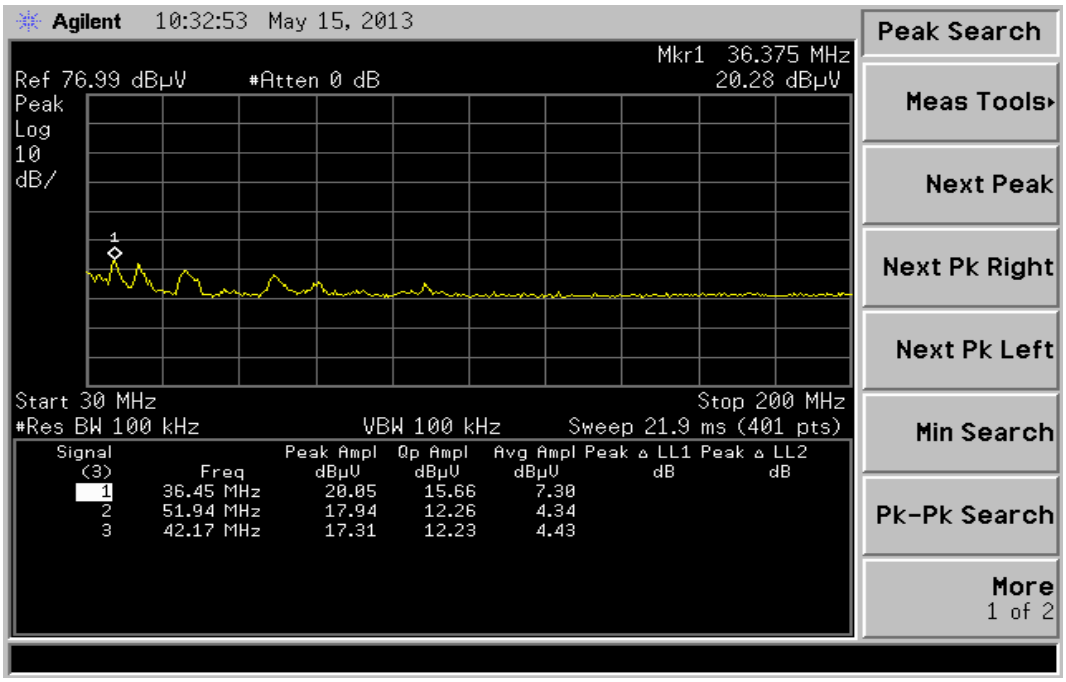


Figure 62: EMI (30MHz-200MHz) Vert / Ch79 (8DPSK)

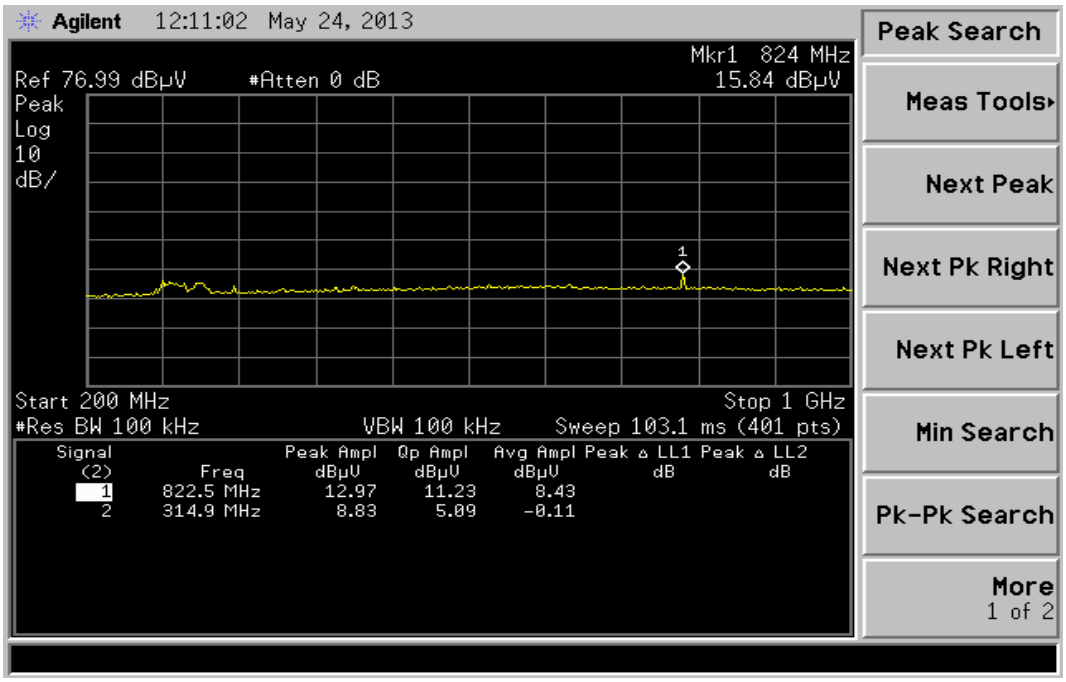


Figure 63: EMI (200MHz-1GHz) Horz / Ch79 (8DPSK)

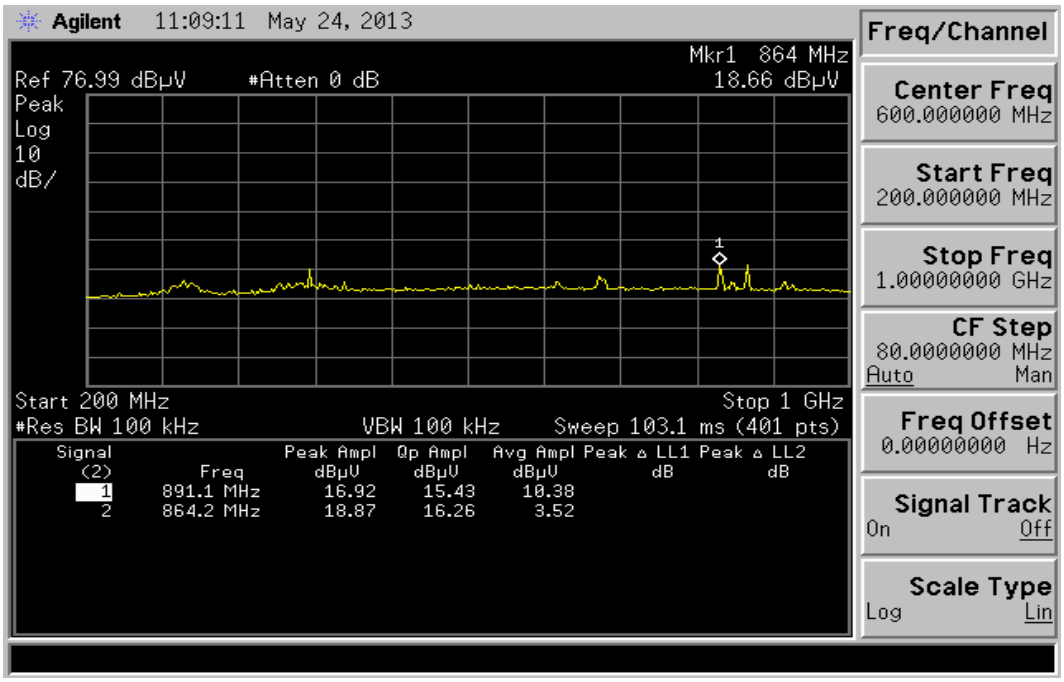


Figure 64: EMI (200MHz-1GHz) Vert / Ch79 (8DPSK)

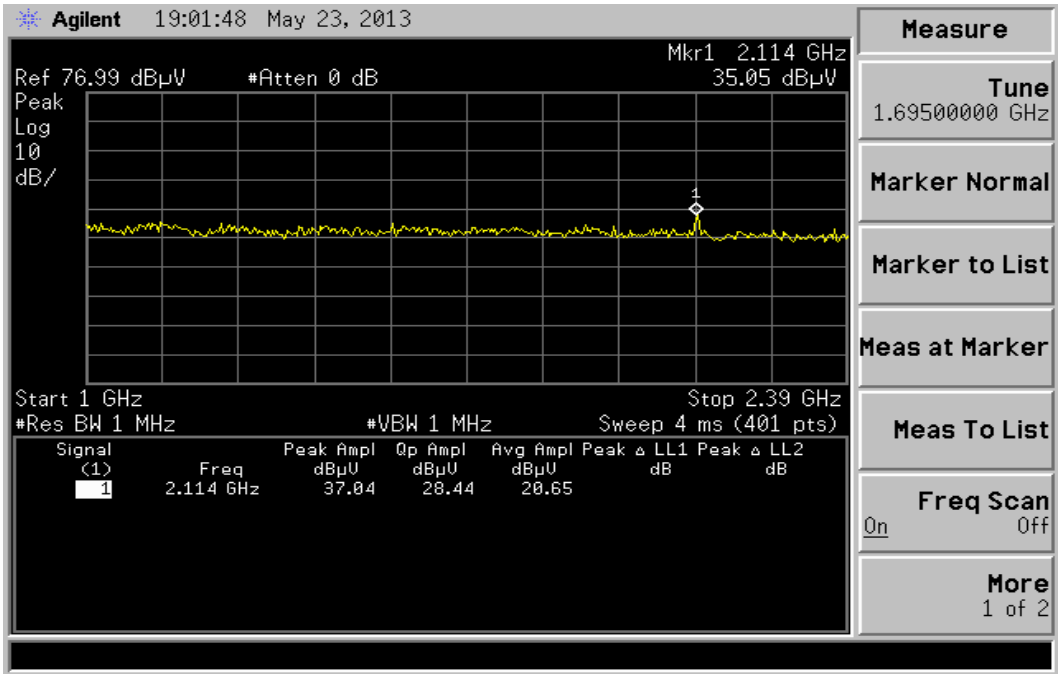


Figure 65: EMI (1GHz-2.390GHz) Horz / Ch79 (8DPSK)

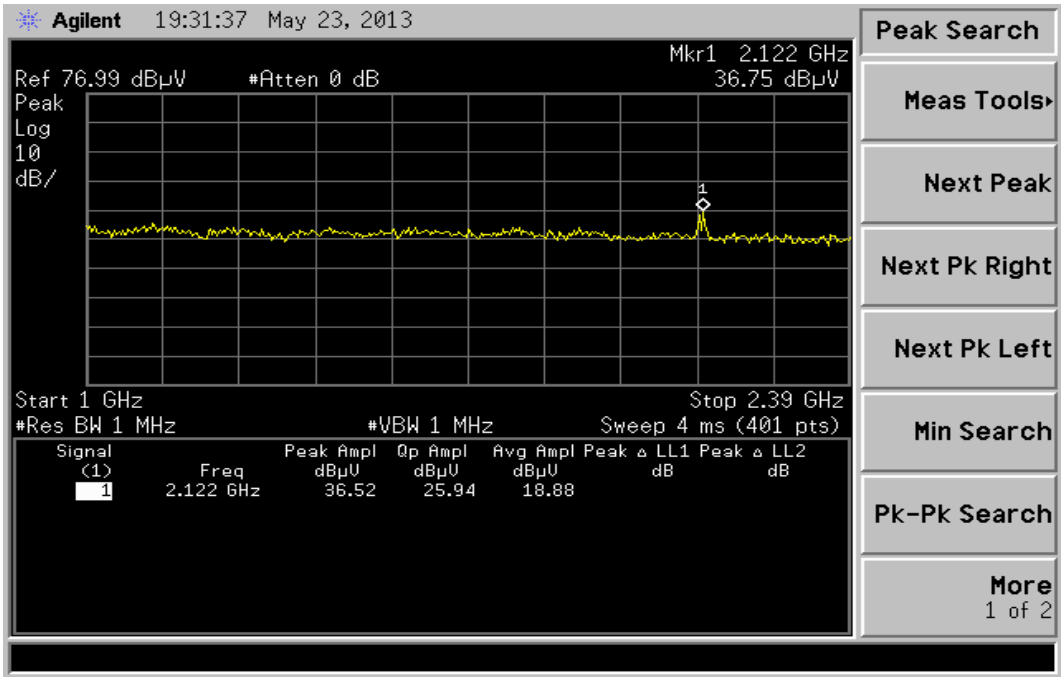


Figure 66: EMI (1GHz-2.390GHz) Vert / Ch79 (8DPSK)

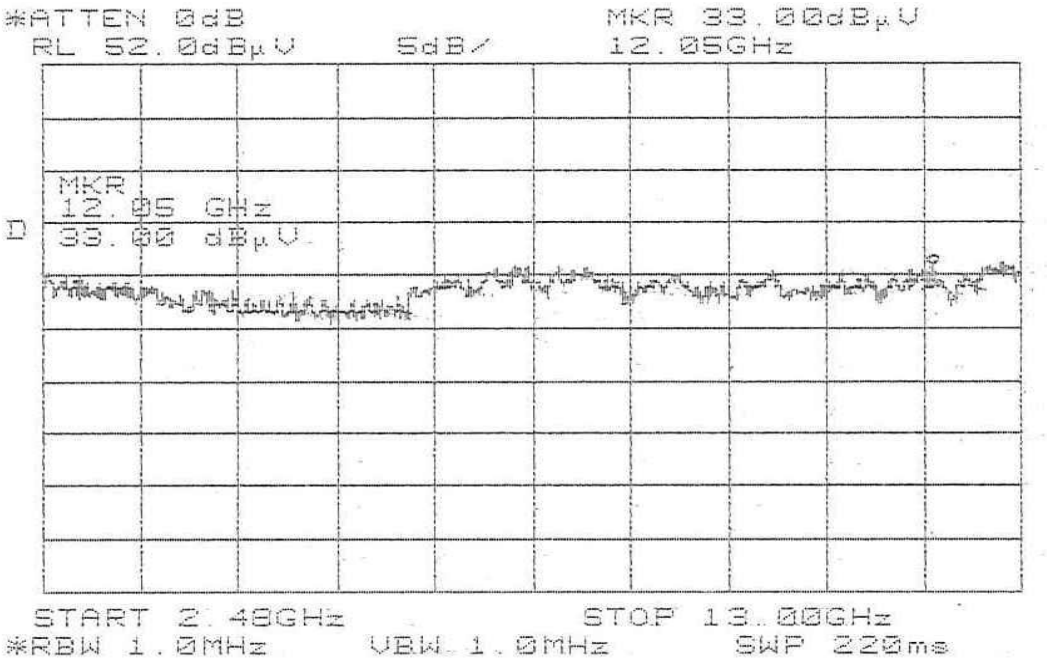


Figure 67: EMI (2.483GHz-13GHz) Horz / Ch79 (8DPSK)

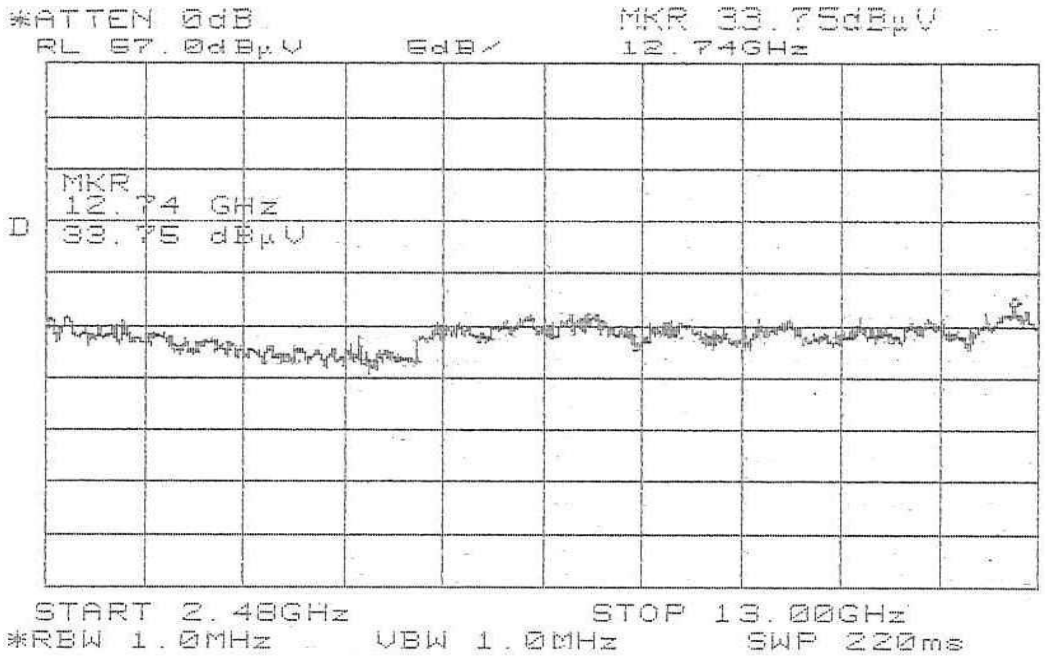


Figure 68: EMI (2.483GHz-13GHz) Vert / Ch79 (8DPSK)

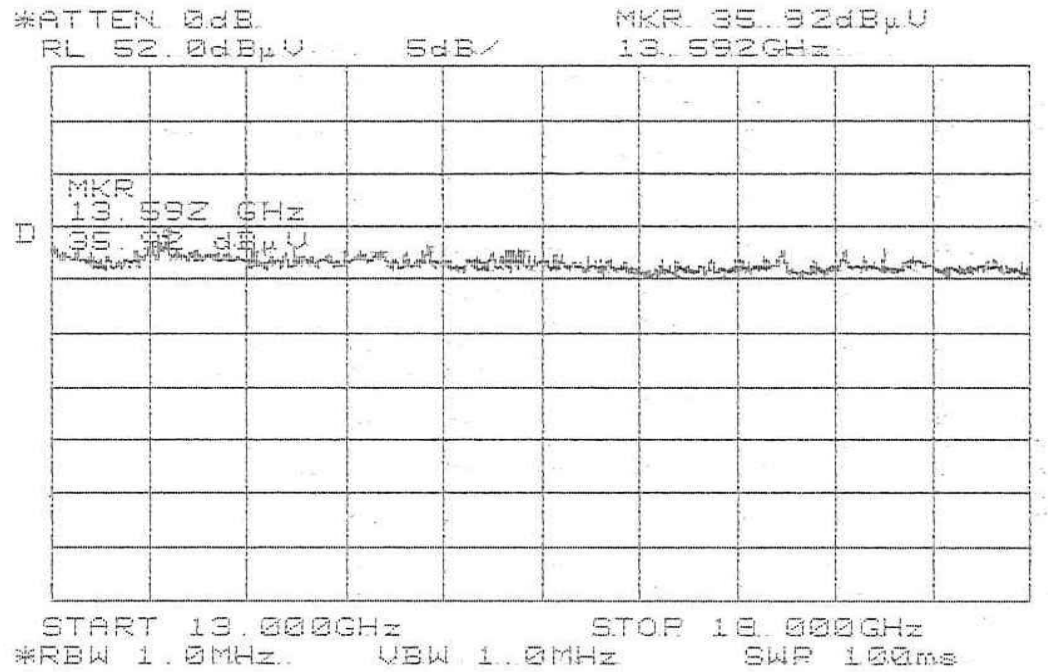


Figure 69: EMI (13GHz-18GHz) Horz / Ch79 (8DPSK)

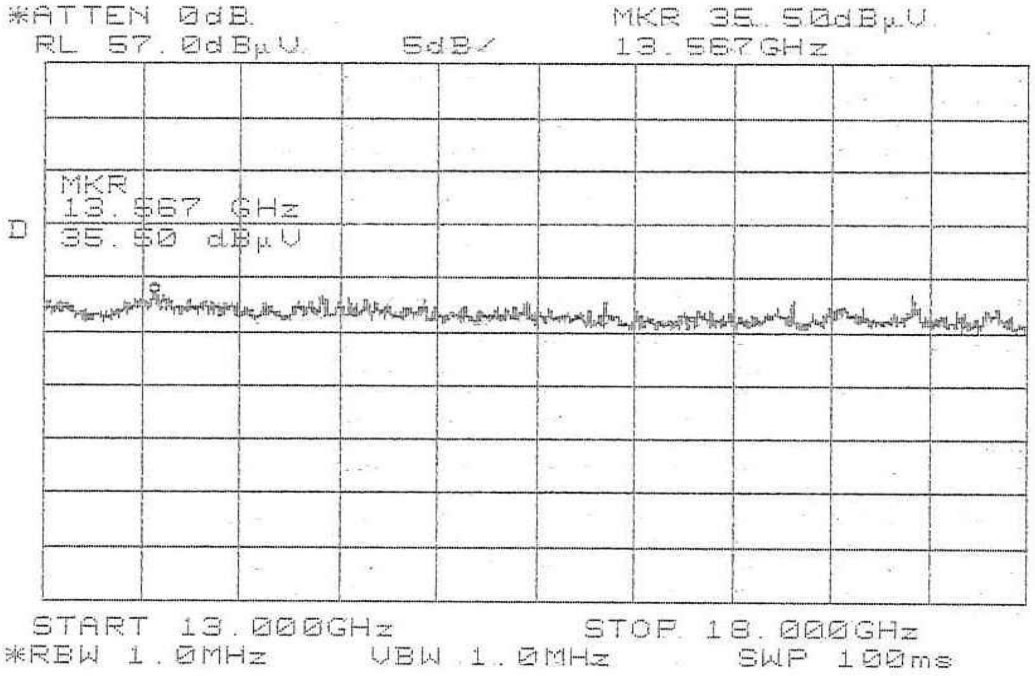


Figure 70: EMI (13GHz-18GHz) Vert / Ch79 (8DPSK)

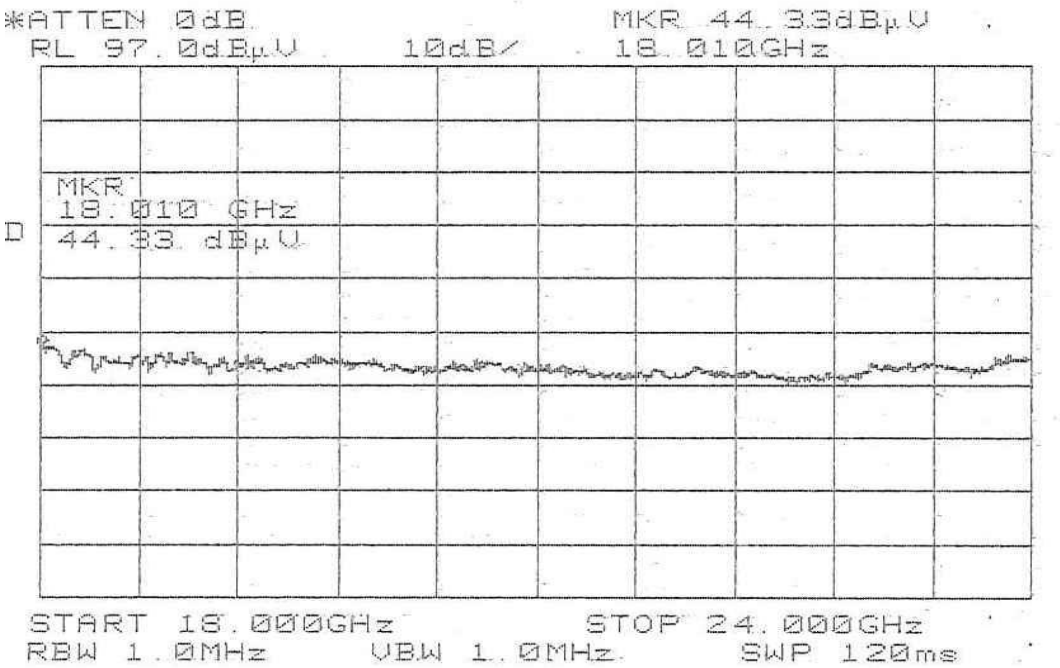


Figure 71: EMI (18GHz-24GHz) Vert / Ch79 (8DPSK)

8 RESTRICTED BANDS MEASUREMENT PER FCC PART 15 SECTION 15.205

8.1 ADMINISTRATIVE AND ENVIRNMENTAL DETAILS

Site Used:	Semi-Anechoic Chamber
Test Date:	07/02/2013
Test Engineer:	Danh Le
Temperature	41 °
Humidity:	30%
Pressure	29.82 inHg

8.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014
Amplifier (10MHz-40GHz)	Giga-Tronics	GT-1040A	1116009	10/02/2013
Horn Antenna (700MHz-18GHz)	EMCO	3115	645460	04/12/2015

8.3 TEST SET UP PHOTO (S)

Refer to section 1.10 (Fig.2 – Fig.8)

8.4 LIMITS/REQUIREMENTS

Only spurious emissions are permitted, in any of the frequency bands specified in table 2 below defined in section 15.205(a), and must also comply with the radiated emission limits specified in table 1 below defined in section 15.209(a).

FCC Part 15 section 15.209

Frequency (MHz)	Field strength Average (microvolts/meter)	Field strength Average (dBuV/meter)	Field strength Peak (dBuV/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)			300
0.490-1.705	24000/F(kHz)			30
1.705-30.0	30	29.5	49.5	30
30-88	100 **	40	60	3
88-216	150 **	43.5	63.5	3
216-960	200 **	46	66	3
Above 960	500	54	74	3

Table 1. Radiated Emission Limits

FCC Part 15 section 15.205

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1] 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	**2483.5-2500**	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Table 2. Restricted bands of operation.

8.5 TEST DESCRIPTION AND PROCEDURE

Using radiated test method, the EUT was placed 80 cm above ground plan on a non-conducted tabel. Test distance was 3 meters between the receiving antenna and the EUT. It was configured to activate the transmitting signal with selected lowest channel 1 and all available modulation modes. The restricted bands measurement was performed by taking the peak & average reading at the peak level of the emission at the band-edge & any other unwanted emissions that falls within the restricted bands (outside of the operating band) specified in the table 2 above. The test shall repeated with highest channel and all available modulation modes.

8.6 TEST DATA

Modulation Mode: GSFK

Scanning Frequency Range: 2.310 GHz – 2.390 GHz (lower band-edge)

Fundamental	Indicated		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Ext amp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV)	(dB)
1 (2402)	2344	13.4 Pk 3.69 Av	32.5	22	H	1.5	90	45.9 Pk 36.2 Av	74 Pk 54 Av	-28.1 -17.8
1 (2402)	2344	14.2 Pk 4.31 Av	32.5	22	V	2	0	46.7 Pk 36.8 Av	74 Pk 54 Av	-27.3 -17.2

Note: 22 dB was entered in the ext. gain function of the spectrum analyzer to compensate for the ext. amplifier gain.

Modulation Mode: 8DPSK

Scanning Frequency Range: 2.310 GHz – 2.390 GHz (lower band-edge)

Fundamental	Indicated		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Ext amp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV)	(dB)
1 (2402)	2344	11.5 Pk 2.34 Av	32.5	22	H	1.5	90	44.0 Pk 34.8 Av	74 Pk 54 Av	-30.0 -19.2
1 (2402)	2344	14.7 Pk 5.28 Av	32.5	22	V	2	0	47.2 Pk 37.8 Av	74 Pk 54 Av	-26.8 -16.2

Note: 22 dB was entered in the ext. gain function of the spectrum analyzer to compensate for the ext. amplifier gain.

Modulation Mode: GFSK
Scanning Frequency Range: 2.483 GHz – 2.500 GHz (upper band-edge)

Fundamental	Indicated		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Ext amp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV)	(dB)
80 (2479)	2483	15.2 Pk 2.52 Av	32.5	22	H	2	270	47.7 Pk 35.2 Av	74 Pk 54 Av	-26.3 -19.0
80 (2479)	2483	16.9 Pk 0.06 Av	32.5	22	V	2	0	49.4 Pk 32.5 Av	74 Pk 54 Av	-24.6 -21.4

Note: 22 dB was entered in the ext. gain function of the spectrum analyzer to compensate for the ext. amplifier gain.

Modulation Mode: 8DPSK
Scanning Frequency Range: 2.483 GHz – 2.500 GHz (upper band-edge)

Fundamental	Indicated		Correction		Ant. Polar	Ant. Height	Angle	Calculated Reading	Limits	Margin
Channel Freq(MHz)	Freq (MHz)	Reading (dBuV)	Ant F + Cab loss (dB)	Ext amp Gain (dB)	(Horz/ Vert)	(m)	Degree (°)	Reading (dBuV)	(dBuV)	(dB)
1 (2402)	2483	17.3 Pk 8.28 Av	32.5	22	H		90	49.8 Pk 40.8 Av	74 Pk 54 Av	-24.2 -13.2
1 (2402)	2483	21.3 Pk 11.6 Av	32.5	22	V		0	53.8 Pk 44.1 Av	74 Pk 54 Av	-20.2 -9.90

Note: 22 dB was entered in the ext. gain function of the spectrum analyzer to compensate for the ext. amplifier gain.

8.7 RESTRICTED BANDS PLOTS

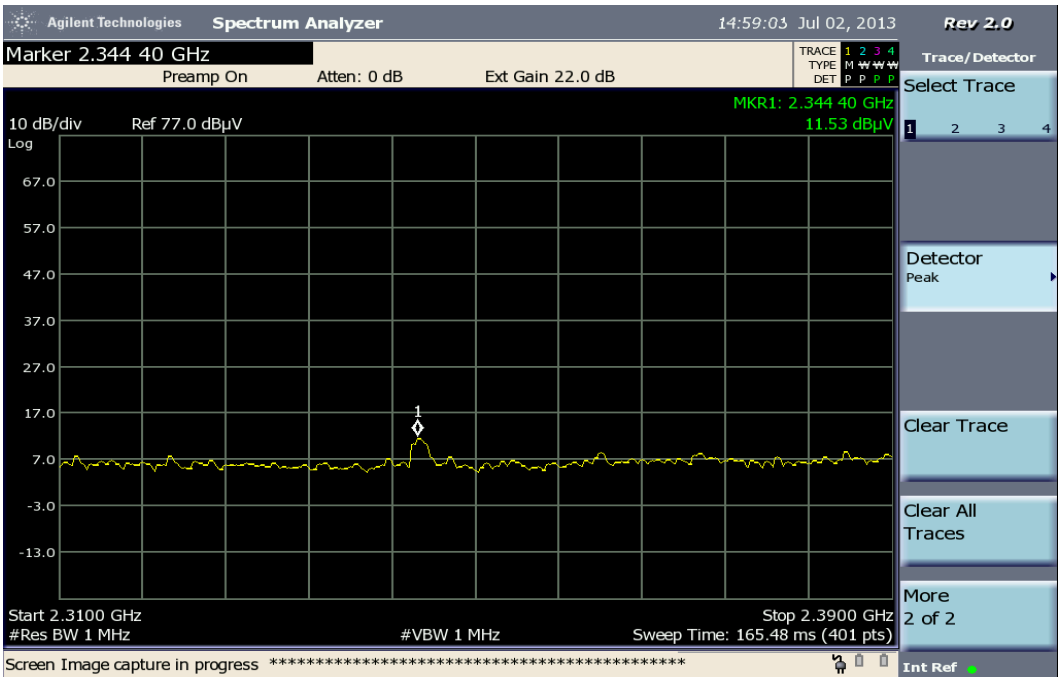


Figure 72: Restricted Band(2.310-2.390GHz)_8DPSK_Horz_Peak

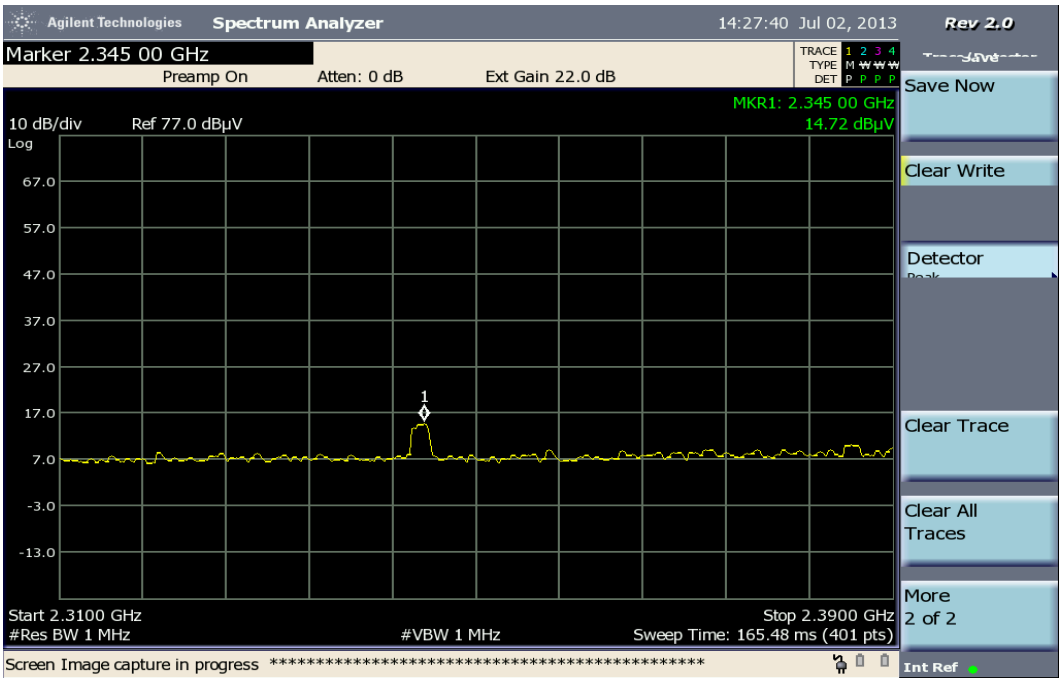


Figure 73: Restricted Band(2.310-2.390GHz)_8DPSK_Vert_Peak

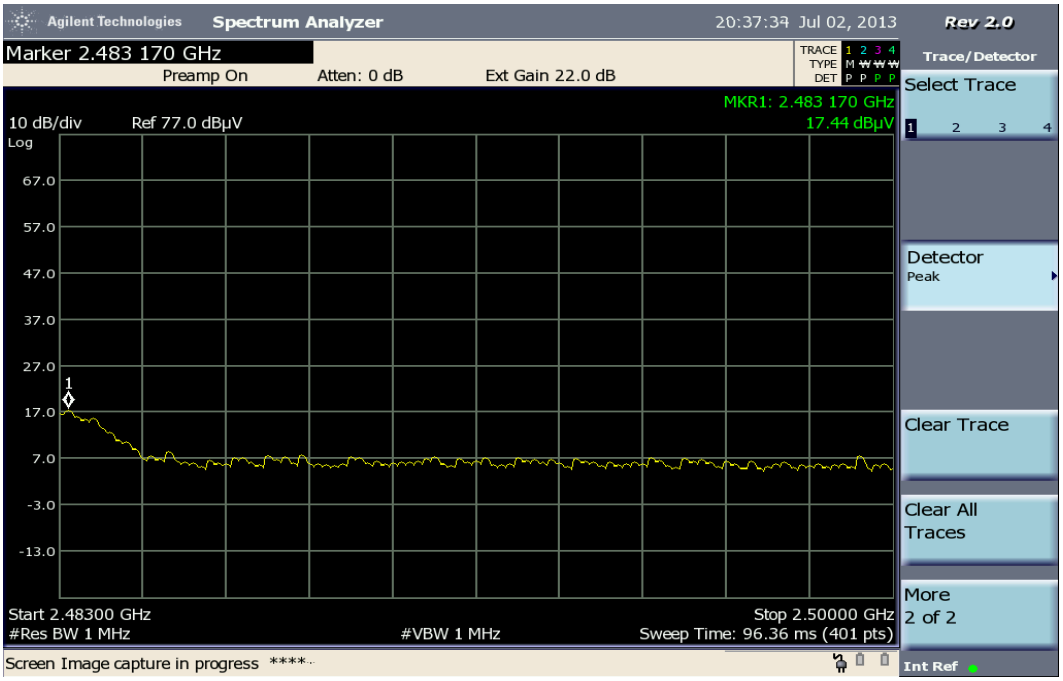


Figure 74: Restricted Band(2.483-2.5GHz)_8DPSK_Horz_Peak

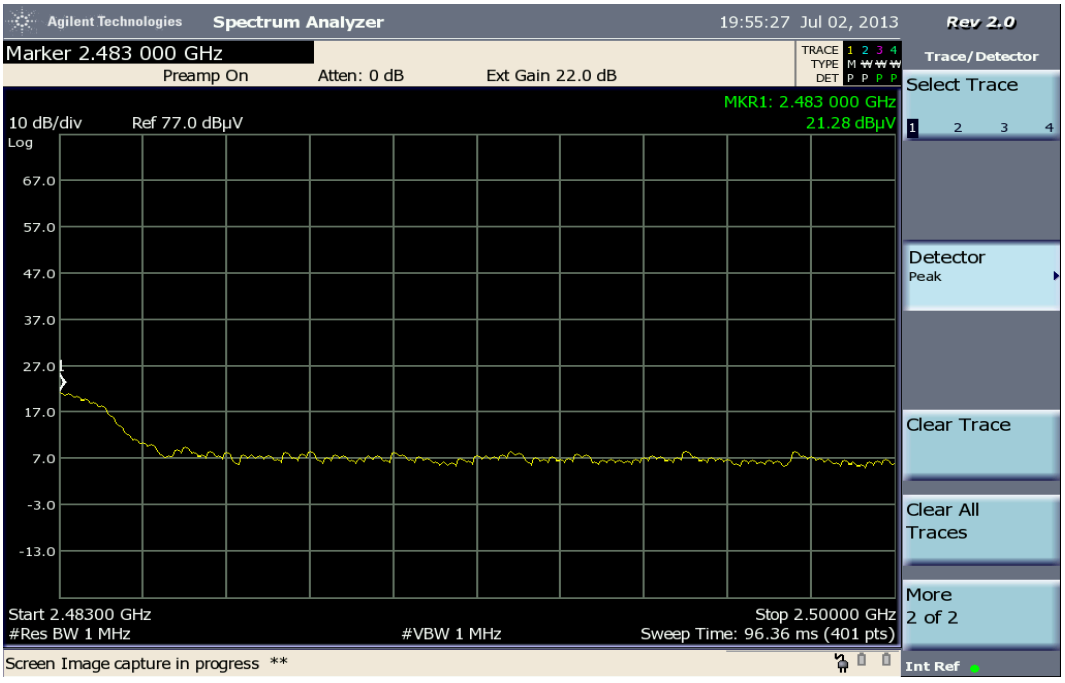


Figure 75: Restricted Band(2.483-2.5GHz)_8DPSK_Vert_Peak

9 APPENDIX

9.1 EUT TECHNICAL SPECIFICATIONS

Manufacturer:	TopCon Positioning Systems, Inc		
General Description:	The MC-i3 is developed as an add-on component to a standard Topcon 3D system with a rugged hardware that houses different combinations of GNSS, LPS, SiteLINK and RTK radio boards with cel modem and Bluetooth device for unique, stand alone , 3 D indicate systems.		
EUT Name:	MC-i3	**Model:**	MC-i3 1000082-08/ 1000082-09
Dimensions:	L=15.4mm W=10mm H=2mm	**Serial Number:**	002258 3A8A5D
Operating Frequency:	**2.400 GHz- 2.483.5 GHz**	**Power Cord Type:**	☐ Shielded ☒ Un-Shielded

9.2 EUT PHOTOS

Figure 76: MC-i3 Top View

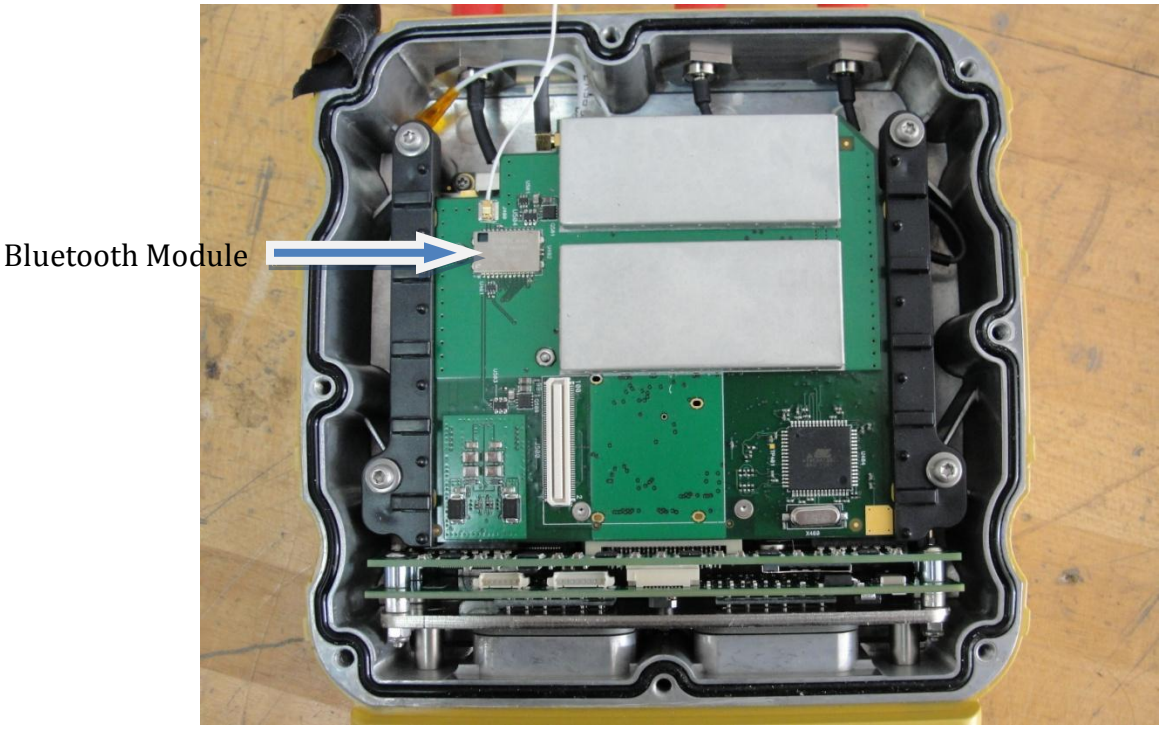


Figure 77: MC-i3 Internal View

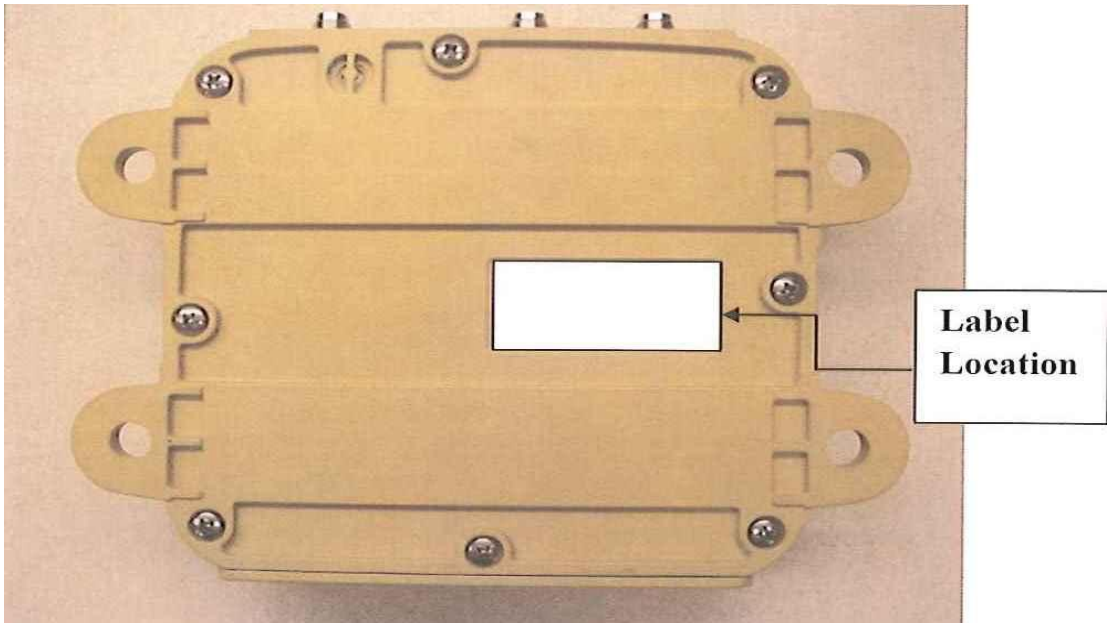
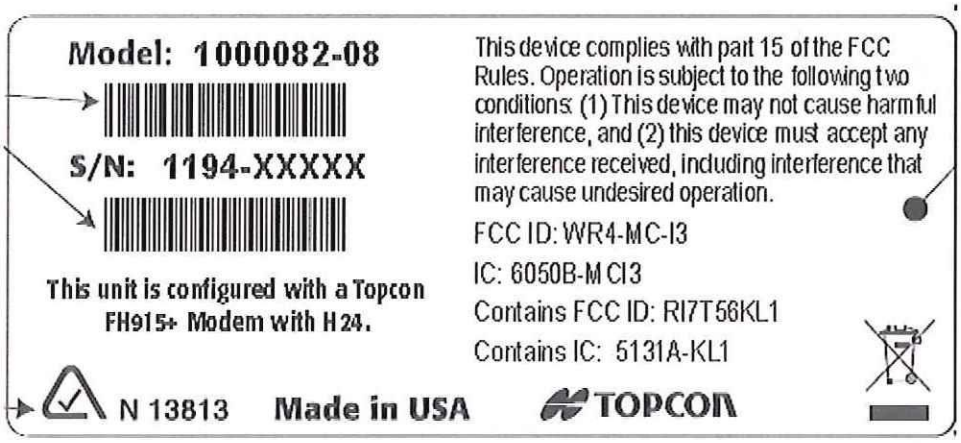


Figure 78: MC-i3 Bottom View & Label Location

MODEL 1000082-08



MODEL 1000082-09

Figure 79: EUT Labels