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United States of America
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CERTIFICATION TEST REPORT

Manufacturer:	**Elster Solutions, LLC** **208 South Rogers Lane** **Raleigh, North Carolina 27610-2144 USA**
Applicant:	**Same As Above**
Product Name:	**Wireless Light Control Module**
Product Description:	The Elster Model ELIR1 wireless light control module contains a frequency hopping spread spectrum (FHSS) radio operating in the 902-928 MHz ISM frequency band. The ELI NIC (Elster Lighting Intelligence Network Interface Card) PCB is installed on top of the Logic PCB. These two PCB are combined on top of additional PCB that controls power functions. These boards together form the model ELIR1 module which can be mounted on a light fixture to form a complete setup. Some installations of the module can comprise part of an Advanced Metering Infrastructure (AMI) system that utilizes a proprietary network architecture and protocol devised by Elster Electricity LLC., referred to here as the Energy Axis (EA) network. Other installations of the module can comprise a Smart Metering Utility Network (SUN) using a network architecture and protocol conforming to the IEEE 802.15.4g LR_WPAN Standard, referred to as Next Generation Communications (NGC) network.
Model:	**ELIR1**
FCC ID:	**QZC-ELIR1**
Testing Commenced:	Mar. 24, 2016
Testing Ended:	Mar. 28, 2016
Summary of Test Results:	**In Compliance** The EUT complies with the FCC requirements when manufactured identically as the unit tested in this report, including any required modifications. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Standards:

- **FCC Part 15 Subpart C, Section 15.247**
- **FCC15.207(a) - Conducted Limits**
- **FCC Part 15.31(e)**
- **ANSI C63.10:2013**

Evaluation Conducted by:

Joe Knepper, EMC Proj. Eng.

Report Reviewed by:

Ken Littell, Director of EMC & Wireless Operations

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1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

1.2 Measurement Procedure:

All measurements were performed according to the 2013 version of ANSI C63.10 and recommended FCC procedure of measurement of DTS operating under Section 15.247. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data, and are expressed with a 95% confidence factor. Note: Only measurements listed below which relate to tests included in this Test Report are applicable to it.

Measurement Range	Expanded Uncertainty	Combined Uncertainly
Radiated Emissions <1 GHz @ 3m	±5.07dB	±2.54
Radiated Emissions <1 GHz @ 10m	±5.09dB	±2.55
Radiated Emissions 1 GHz to 2.7 Hz	±3.62dB	±1.81
Radiated Emissions 2.7 GHz to 18 GHz	±3.10dB	±1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	±2.76dB	±1.38

This Uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.4 Document History

Document Number	Description	Issue Date	Approved By
F2LQ8116-03E	First Issue	Mar. 30, 2016	K. Littell

2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
-20dB Occupied Bandwidth	CFR 47 Part 15.247(a)(2): 50FSK 50GFSK 150FSK 150GFSK 200FSK 200GFSK	 Complies Complies Complies Complies Complies Complies
Conducted Output Power	CFR 47 Part 15.247(b)(3): 50FSK 50GFSK 150FSK 150GFSK 200FSK 200GFSK	 Complies Complies Complies Complies Complies Complies
Voltage Variations	CFR 47 Part 15.31: 50FSK 50GFSK 150FSK 150GFSK 200FSK 200GFSK	 Complies Complies Complies Complies Complies Complies
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.207: 200FSK, All Channels 50FSK, High Channel	 Complies Complies
Radiated Spurious Emission with 1.5dBi Integral Antenna	CFR 47 Part 15.247(d) / Part 15.209: 200FSK, All Channels 50FSK, High Channel	 Complies Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e)	Not Required
Frequency Separation	ANSI 63.10 2013 (7.8.2): 50FSK 50GFSK 150FSK 150GFSK 200FSK 200GFSK	 Complies Complies Complies Complies Complies Complies

Test Name	Standard(s)	Results
Number of Hopping Frequencies	ANSI 63.10 2013 (7.8.3): 50FSK 50GFSK 150FSK 150GFSK 200FSK 200GFSK	 Complies Complies Complies Complies Complies Complies
Dwell Time	ANSI 63.10 2013 (7.8.4): 50FSK 50GFSK 150FSK 150GFSK 200FSK 200GFSK	 Complies Complies Complies Complies Complies Complies
Conducted Emissions	CFR 47 Part 15.207(a): 200FSK Hopping	 Complies

Modifications Made to the Equipment
None

3 TABLE OF MEASURED RESULTS

Test	Low Channel 902.4 MHz	Mid Channel 914.8 MHz	High Channel 927.6 MHz
-20dB Occupied Bandwidth (kHZ)			
50FSK	122.60	120.99	120.99
50GFSK	96.15	96.15	96.15
150FSK	200.32	200.32	200.32
150GFSK	185.90	185.90	185.90
200FSK	258.01	258.01	258.01
200GFSK	249.99	249.99	248.40
Limit	<500kHz	<500kHz	<500kHz
Conducted Output Power			
50FSK	787.05mW 28.96dBm	796.16mW 29.01dBm	803.53mW 29.05dBm
50GFSK	783.43mW 28.94dBm	794.33mW 29.0dBm	801.68mW 29.04dBm
150FSK	783.43mW 28.94dBm	794.33mW 29.0dBm	801.68mW 29.04dBm
150GFSK	783.43mW 28.94dBm	794.33mW 29.0dBm	801.68mW 29.04dBm
200FSK	783.43mW 28.94dBm	794.33mW 29.0dBm	801.68mW 29.04dBm
200GFSK	783.43mW 28.94dBm	794.33mW 29.0dBm	801.68mW 29.04dBm
Limit	1W 30dBm	1W 30dBm	1W 30dBm
E.I.R.P. (W)			
50FSK	1.112	1.125	1.135
50GFSK	1.107	1.122	1.132
150FSK	1.107	1.122	1.132
150GFSK	1.107	1.122	1.132
200FSK	1.107	1.122	1.132
200GFSK	1.107	1.122	1.132
Limit	4W	4W	4W

Test		Low Channel 902.4 MHz	Mid Channel 914.8 MHz	High Channel 927.6 MHz
Extreme Voltages				
50FSK	100V(dBm)	28.83	28.81	28.89
	100V(mW)	763.8357836	760.3262769	774.4617978
	140V(dBm)	28.77	28.84	28.93
	140V(mW)	753.355564	765.596607	781.627805
50GFSK	100V(dBm)	28.85	28.81	28.88
	100V(mW)	767.3614894	760.3262769	772.6805851
	140V(dBm)	28.75	28.84	28.98
	140V(mW)	749.894209	765.596607	790.678628
150FSK	100V(dBm)	28.85	28.82	28.94
	100V(mW)	767.3614894	762.07901	783.4296428
	140V(dBm)	28.76	28.84	28.98
	140V(mW)	751.622894	765.596607	790.678628
150GFSK	100V(dBm)	28.86	28.82	28.88
	100V(mW)	769.1304403	762.07901	772.6805851
	140V(dBm)	28.76	28.84	29.01
	140V(mW)	751.622894	765.596607	796.15935
200FSK	100V(dBm)	28.85	28.82	28.88
	100V(mW)	767.3614894	762.07901	772.6805851
	140V(dBm)	28.76	28.84	29.02
	140V(mW)	751.622894	765.596607	797.994687
200GFSK	100V(dBm)	28.84	28.81	28.9
	100V(mW)	765.5966069	760.3262769	776.2471166
	140V(dBm)	28.76	28.84	29.02
	140V(mW)	751.622894	765.596607	797.994687
Limit		1W 30dBm	1W 30dBm	1W 30dBm

4 ENGINEERING STATEMENT

This report has been prepared on behalf of Elster Solutions, LLC to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.247 of the FCC Rules using ANSI C63.10 2013 standard. The test results found in this test report relate only to the items tested.

5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: **Wireless Light Control Module**
Model: **ELIR1**
Serial Nos.: 42, 20
FCC ID: **QZC-ELIR1**

5.2 Trade Name:

Elster Solutions, LLC

5.3 Power Supply:

EUT was powered 120V 60Hz

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Frequency Hopping Spread Spectrum

5.6 Antenna:

1.5 dBi Integral Antenna

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set up in a test mode, constantly transmitting at Low (902.4 MHz), Mid (914.8 MHz) and High (927.6 MHz) channels. The EUT had three different bit rates and two different modulations – 50kbps, 150kbps, and 200kbps each with a FSK and GFSK modulation. Emissions were checked loaded and unloaded with a light bar. EUT worst case was determined to be unloaded. All tests were performed at worst case voltage levels.

6 LIST OF MEASUREMENT INSTRUMENTATION

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166	AlbatrossProjects	B83117-DF435-T261	US140023	Apr. 30, 2016
Temp/Hum. Recorder	CL137	Extech	RH520	CH16992	May 7, 2016
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 25, 2016
Receiver	0105	Sunol Sciences	JB1	A101101	July 13, 2017
Horn Antenna	CL098	Emco	3115	9809-5580	Dec. 10, 2016
Pre-Amplifier	CL045	Hewlett-Packard	8447D	2944A08445	Nov. 2, 2016
Preamplifier	CL153	Keysight Technologies	83006A	MY39500791	May 6, 2016
Amplifier w/Monopole & 18" Loop	CL163	A.H. Systems, Inc.	EHA-52B	100	Apr. 20, 2016
Software:	Tile Version 1.0		Software Verified: Mar. 24 & 28, 2016		
Software:	EMC 32, Version 5.20.2		Software Verified: Mar. 24, 2016		
Spectrum Analyzer	CL138	Agilent Technologies	E4407B	US41192779	Nov. 13, 2016
Temp/Hum. Rec.	CL119	Extech	RH520	H005869	Jan. 29, 2017
Spectrum Analyzer	0141	Hewlett Packard	8591E	3520A04145	Feb. 1, 2017
Transient Limiter	CL102	Hewlett Packard	11947A	3107A03325	Feb. 1, 2017
LISN	CL181	Com-Power	LI-125A	191226	June 24, 2016
LISN	CL182	Com-Power	LI-125A	191225	June 24, 2016

7 FCC PART 15.247(a)(2) – OCCUPIED BANDWIDTH

7.1 Requirements:

The -20dB bandwidth shall be greater than 500 kHz.

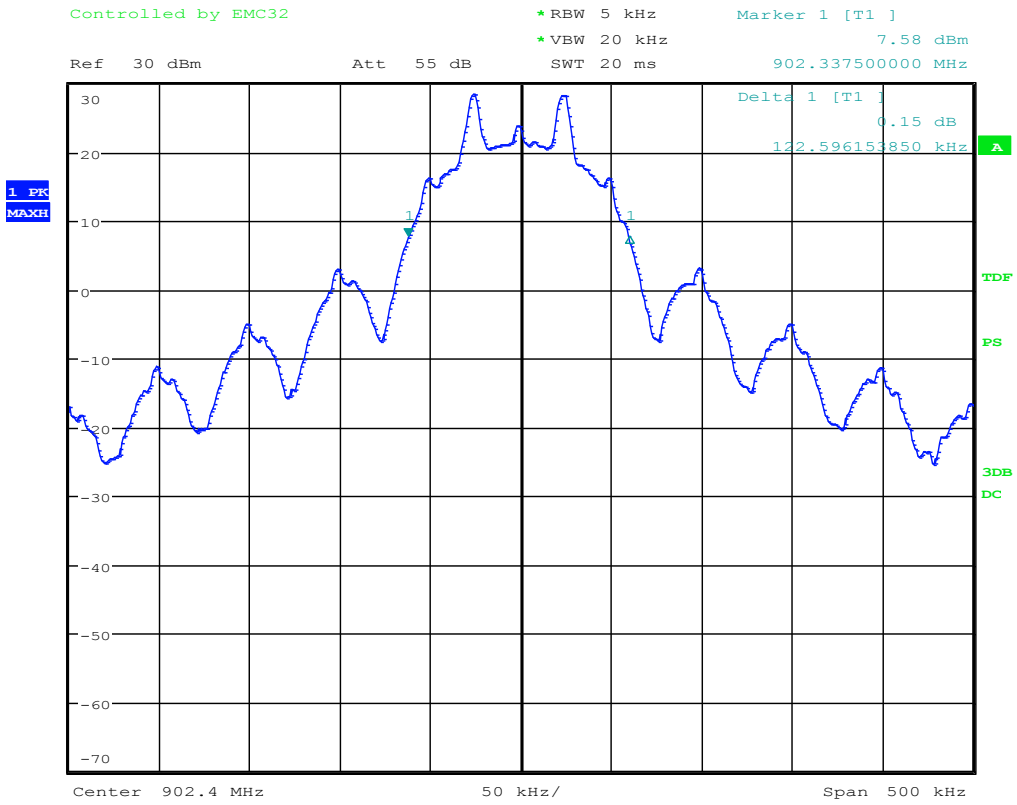
Bandwidth measurements were made at the low (902.4 MHz), mid (914.8 MHz) and upper (927.6 MHz) frequencies while the span was set at 500 kHz/1MHz. The bandwidth was measured using the analyzer's marker function.

The client states that the receiver bandwidth matches the Transmitter bandwidth per 15.247(a)(i) requirement.

7.2 Occupied Bandwidth Test Data

Test Date(s):	Mar. 24, 2016	**Test Engineer:**	J. Knepper
Standards:	CFR 47 Part 15.247(a)(2)	**Air Temperature:**	20.4ºC
		Relative Humidity:	41%

50FSK: Low Channel



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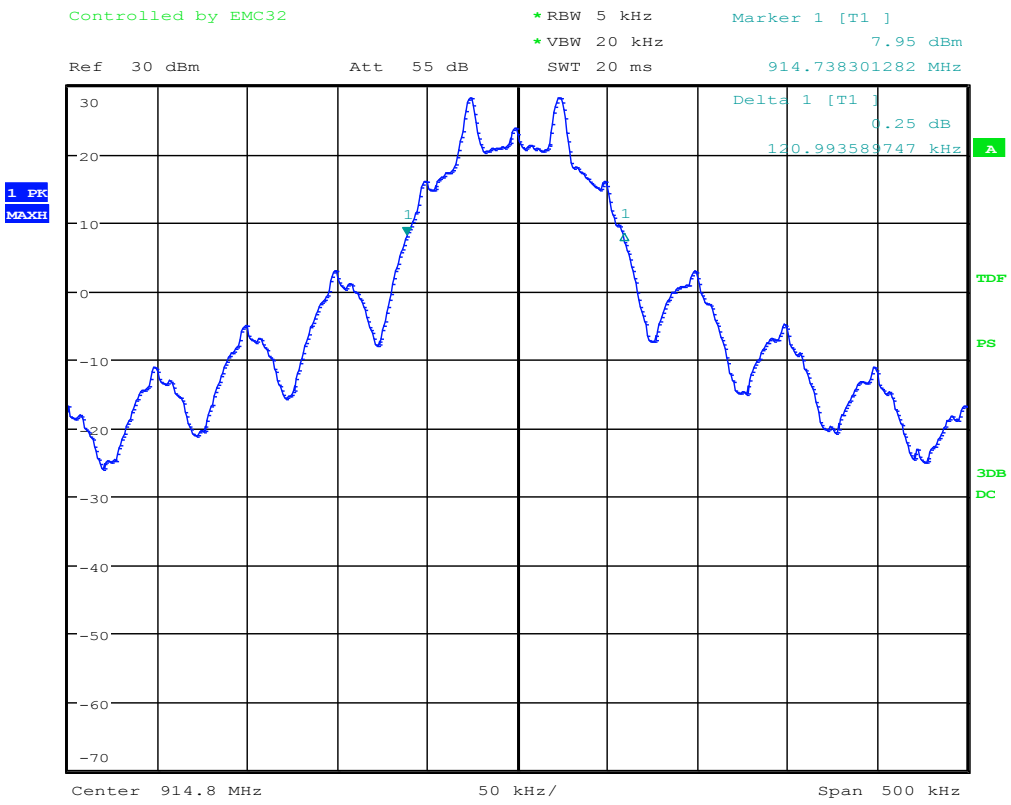

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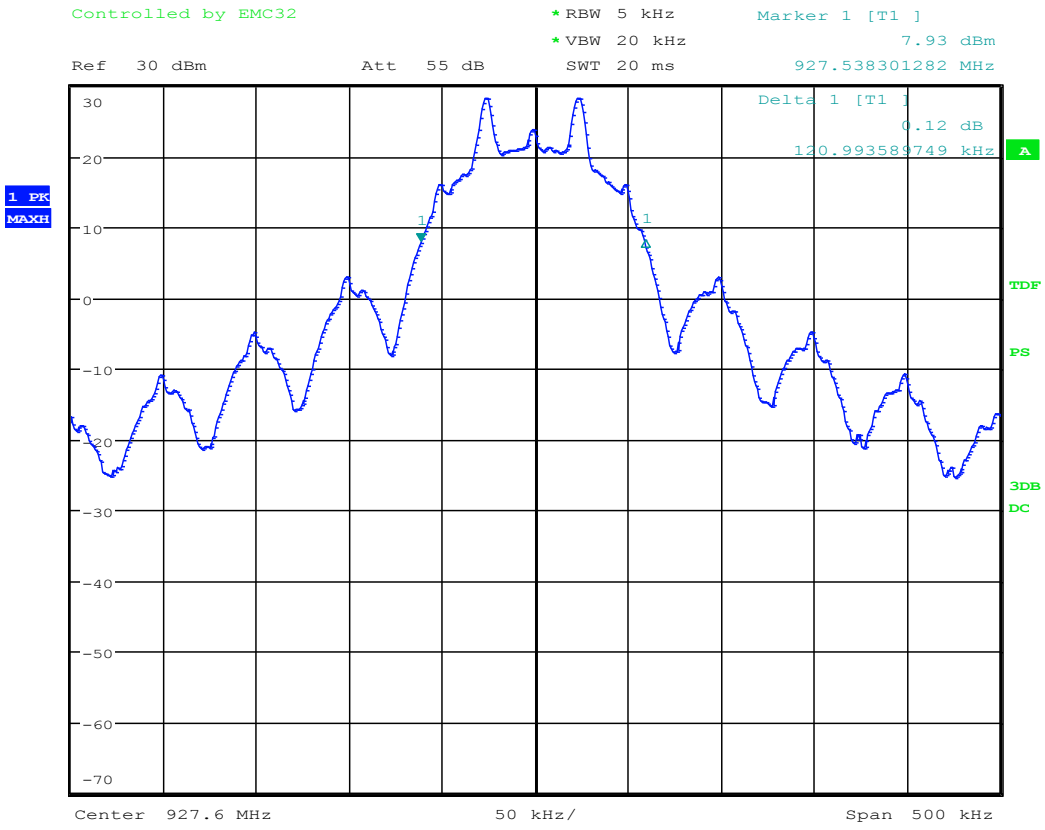
50FSK: High Channel



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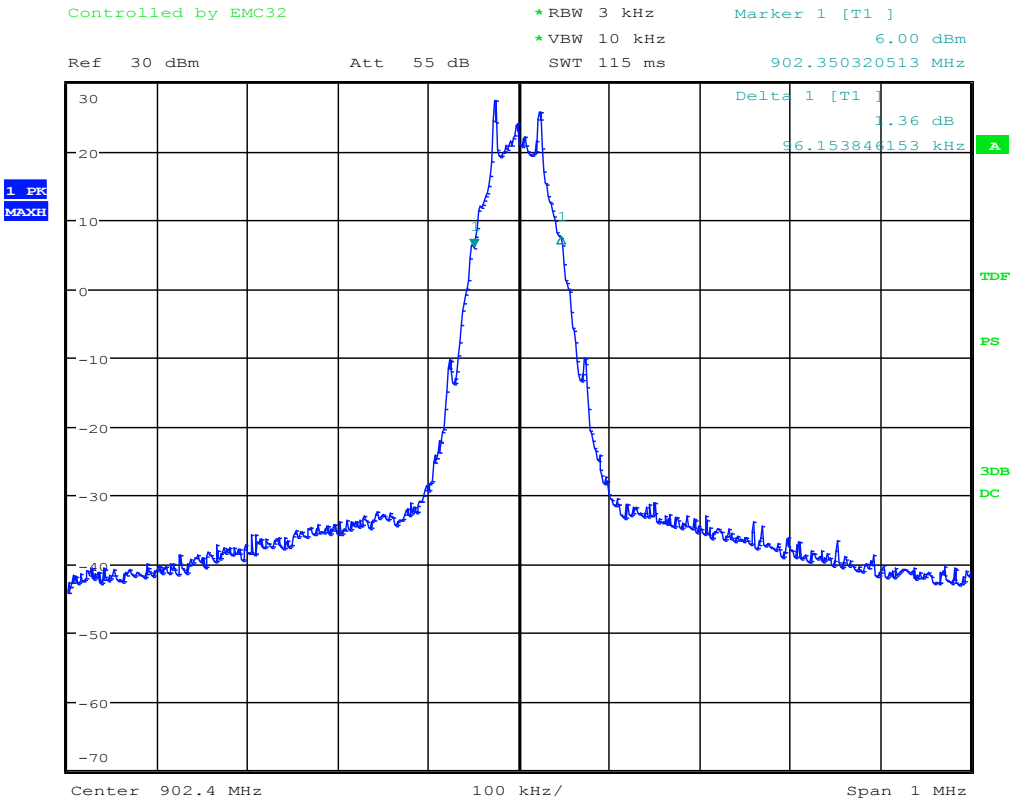
50GFSK: Low Channel



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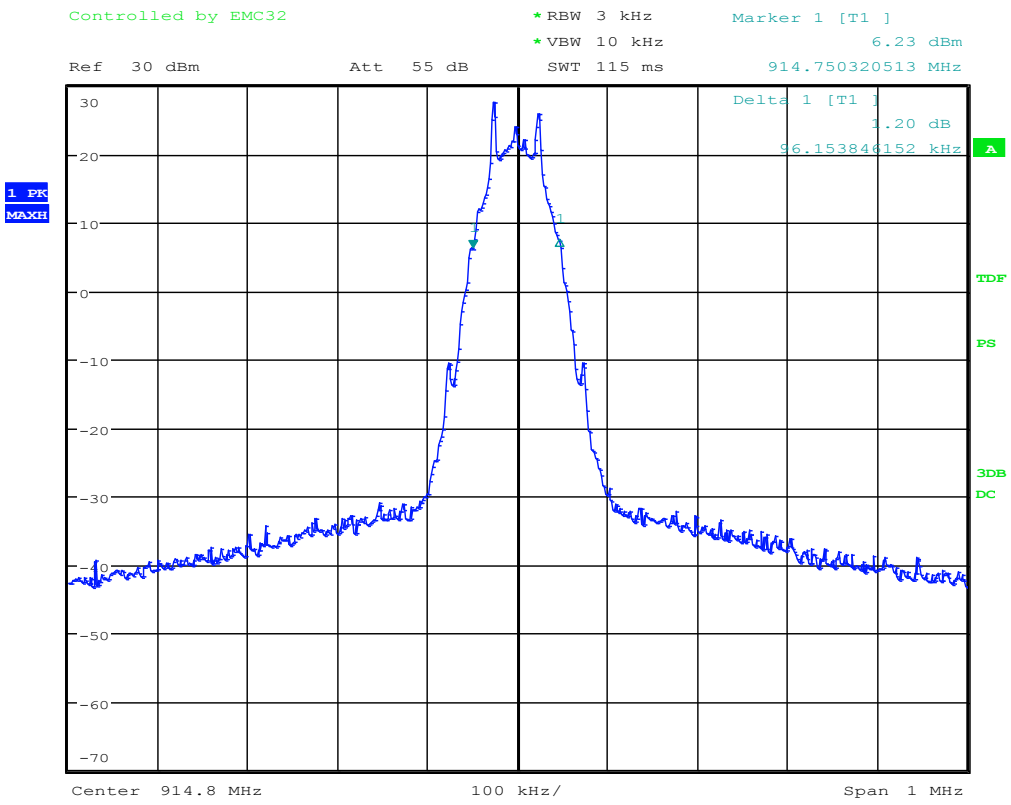

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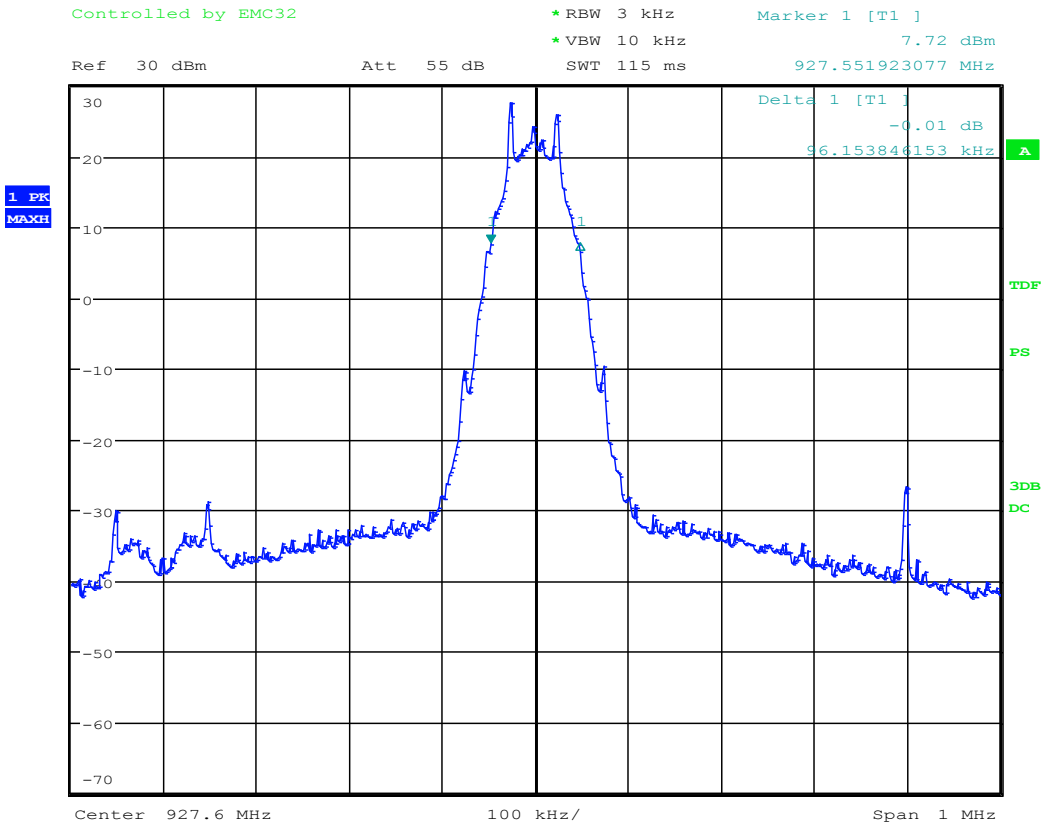

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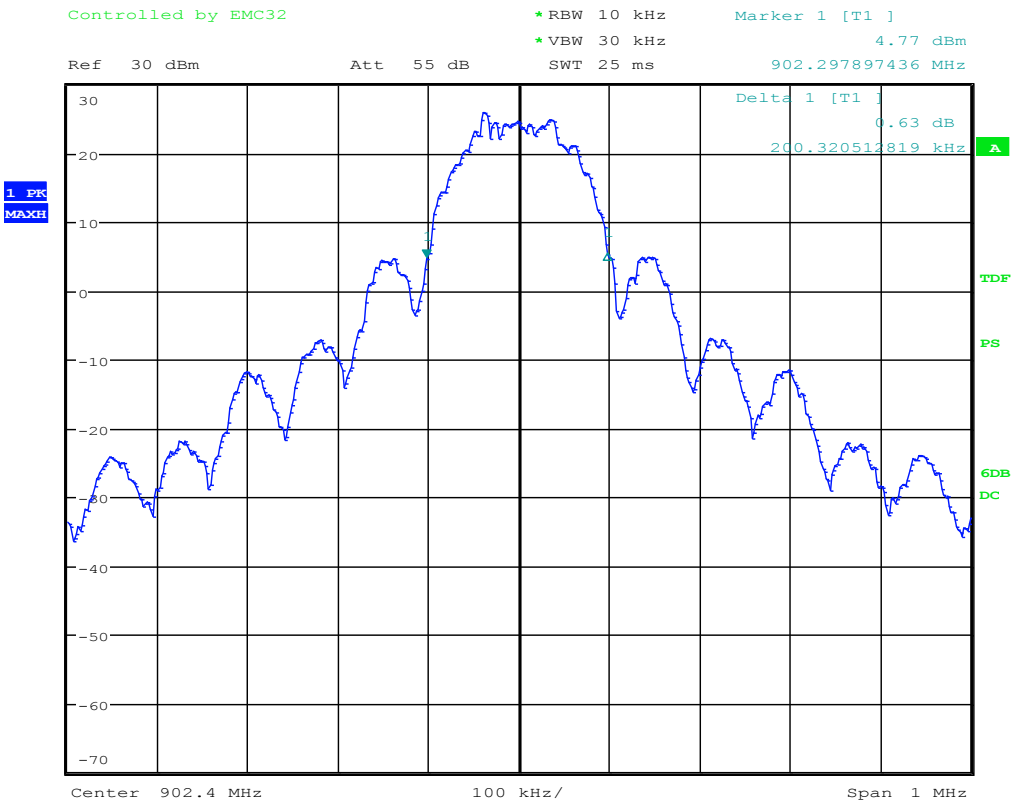

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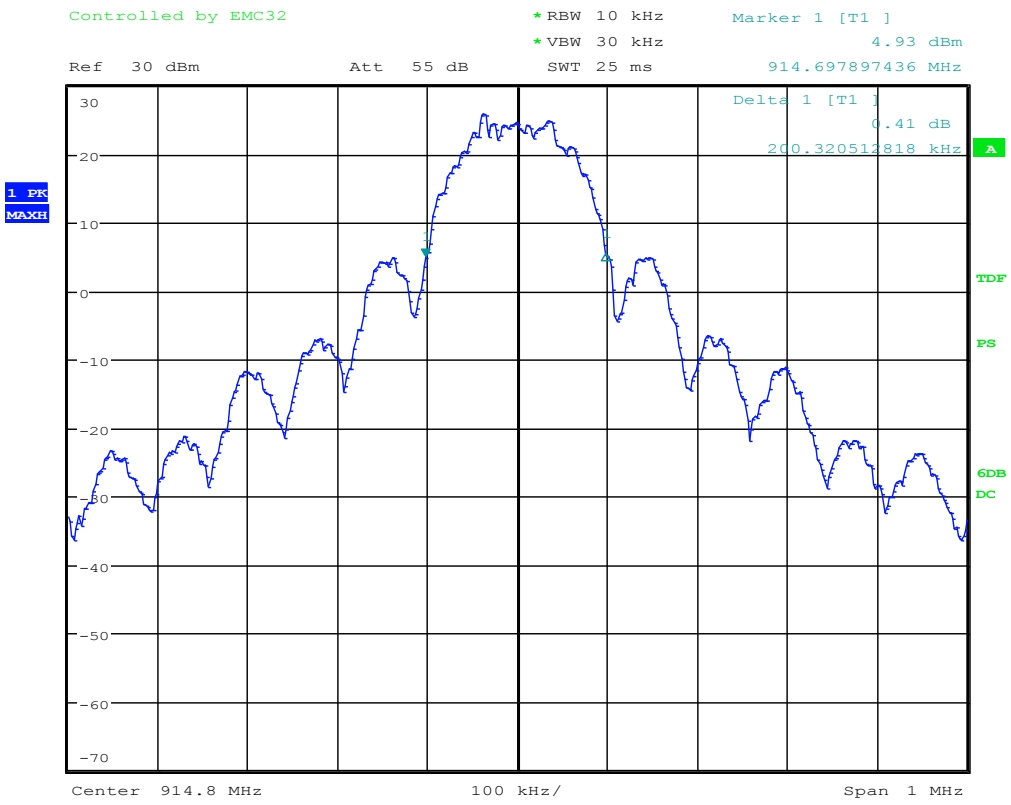

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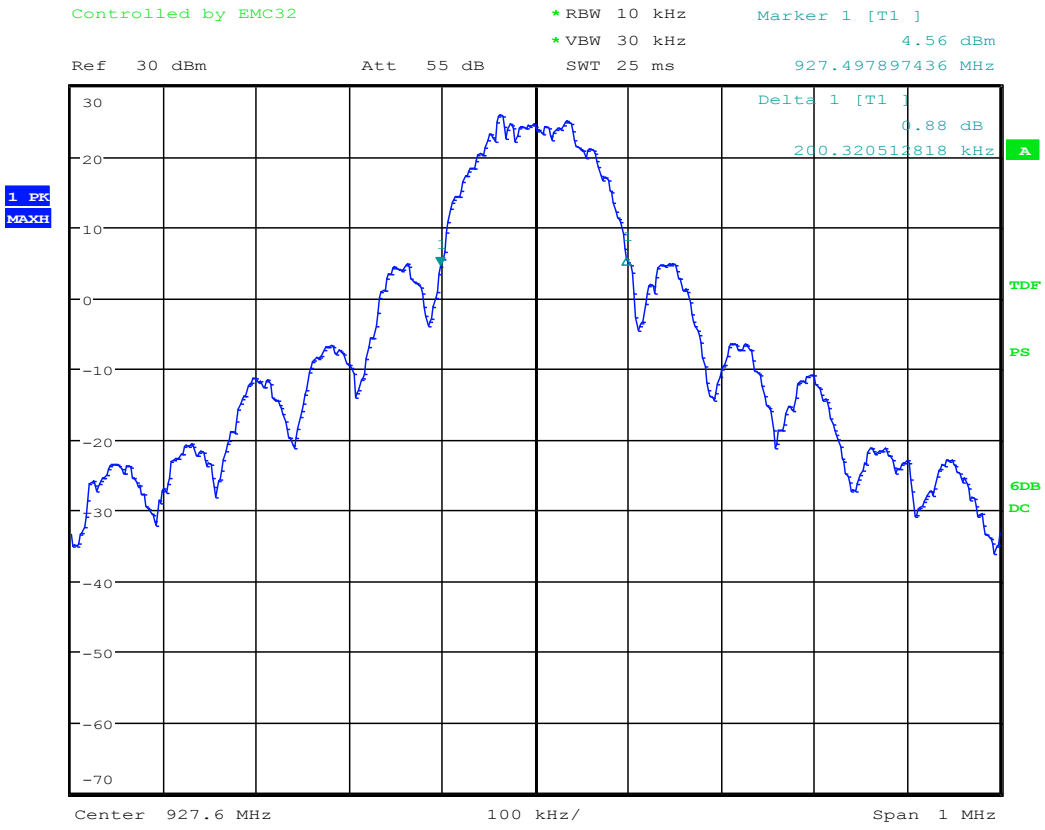

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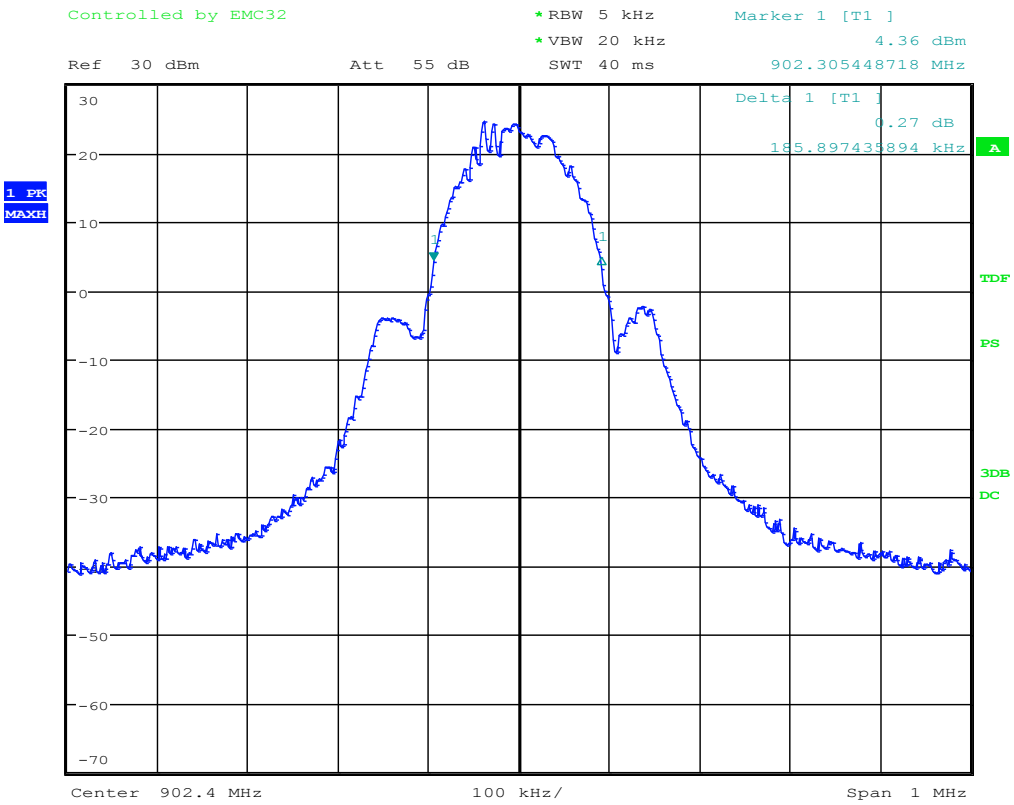

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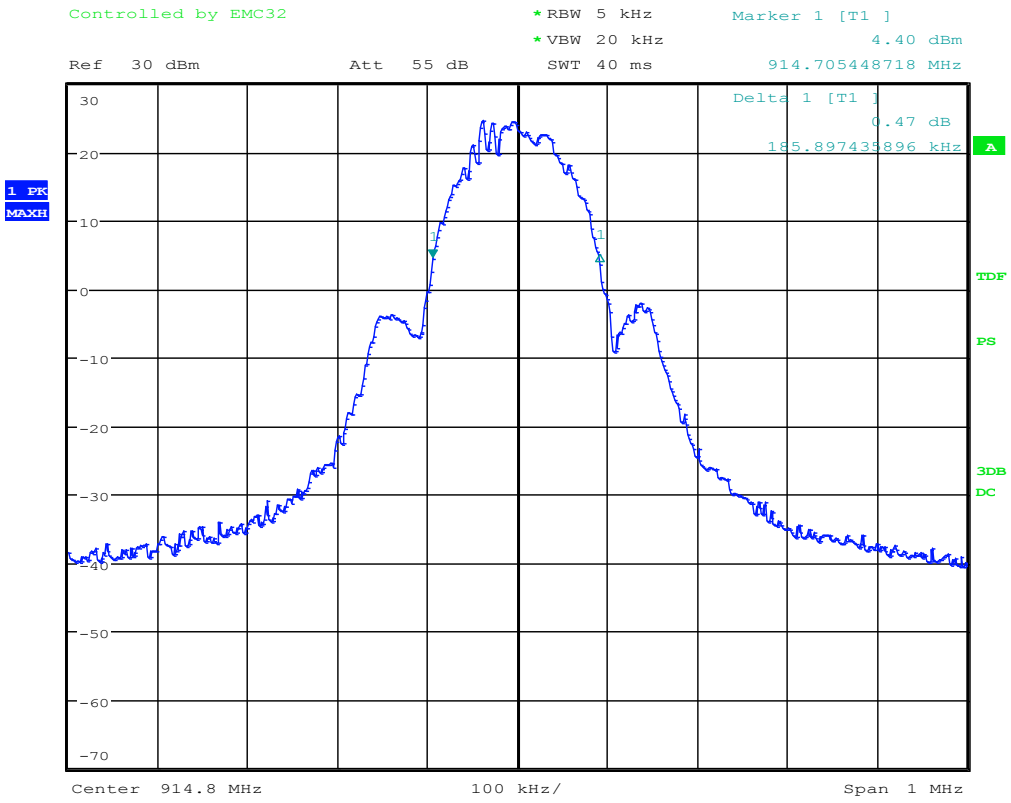

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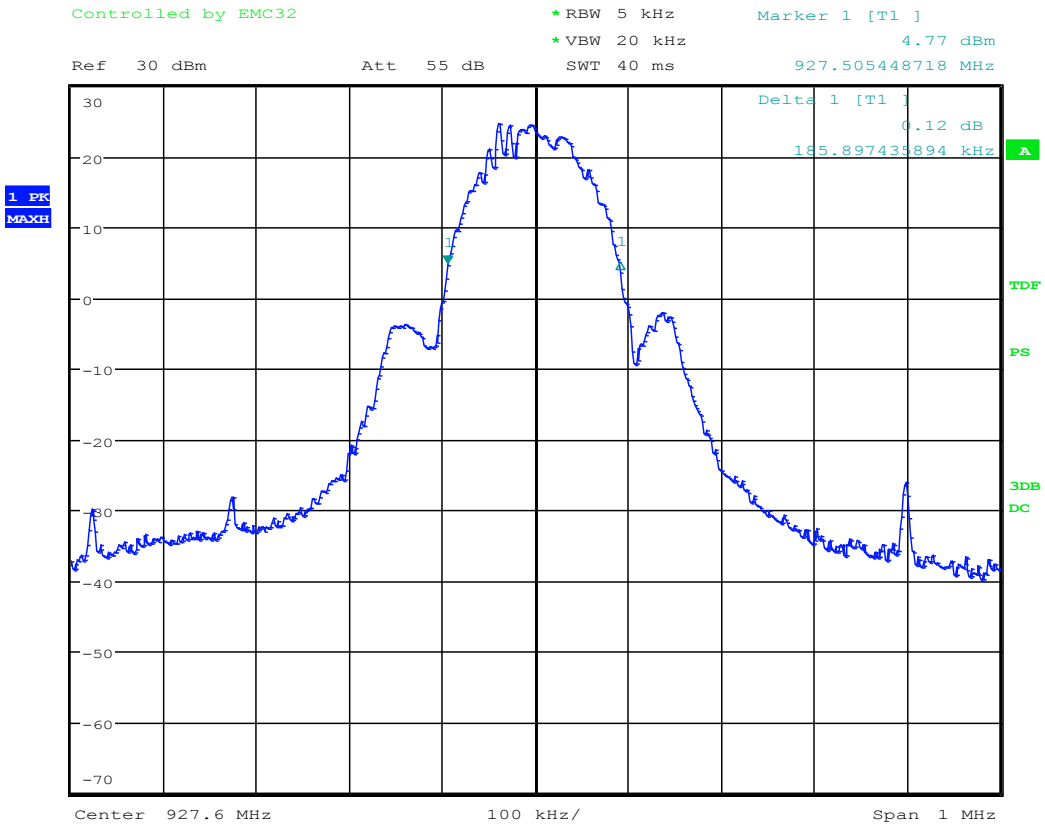

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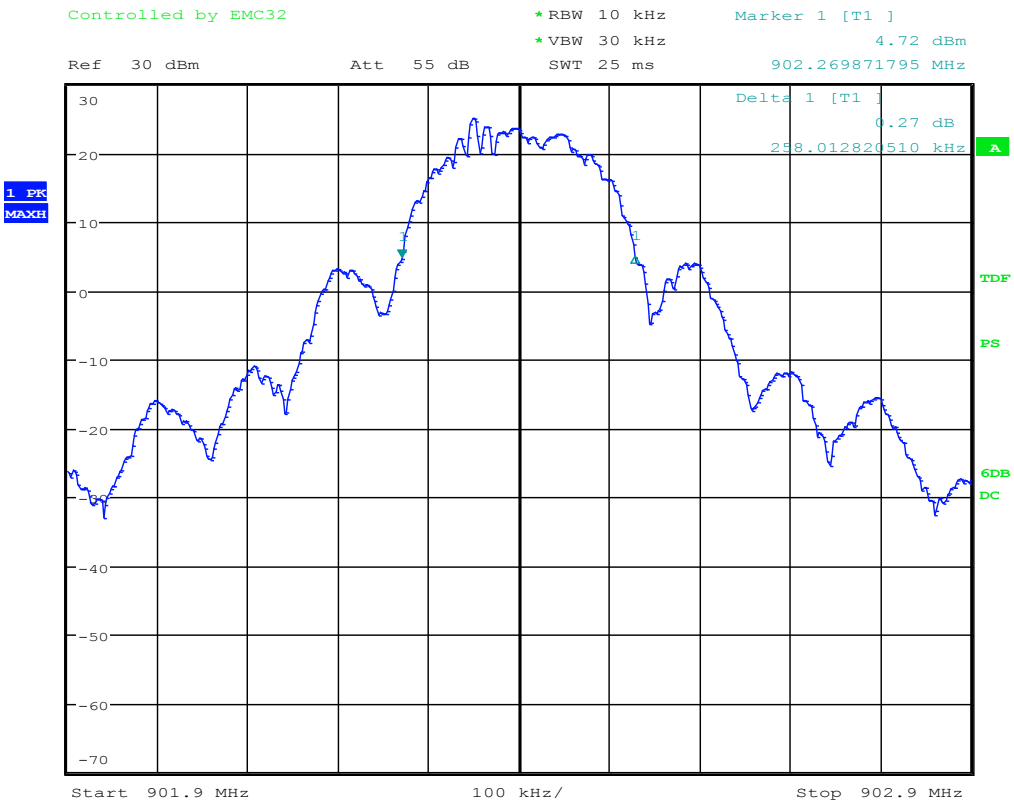

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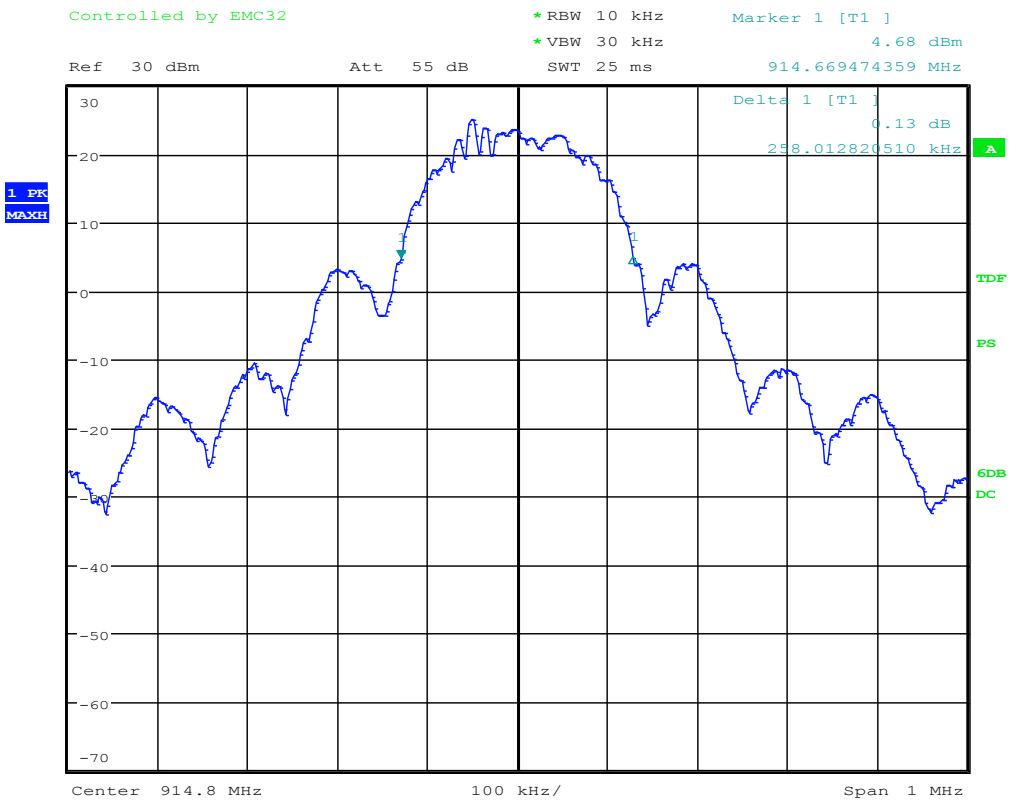

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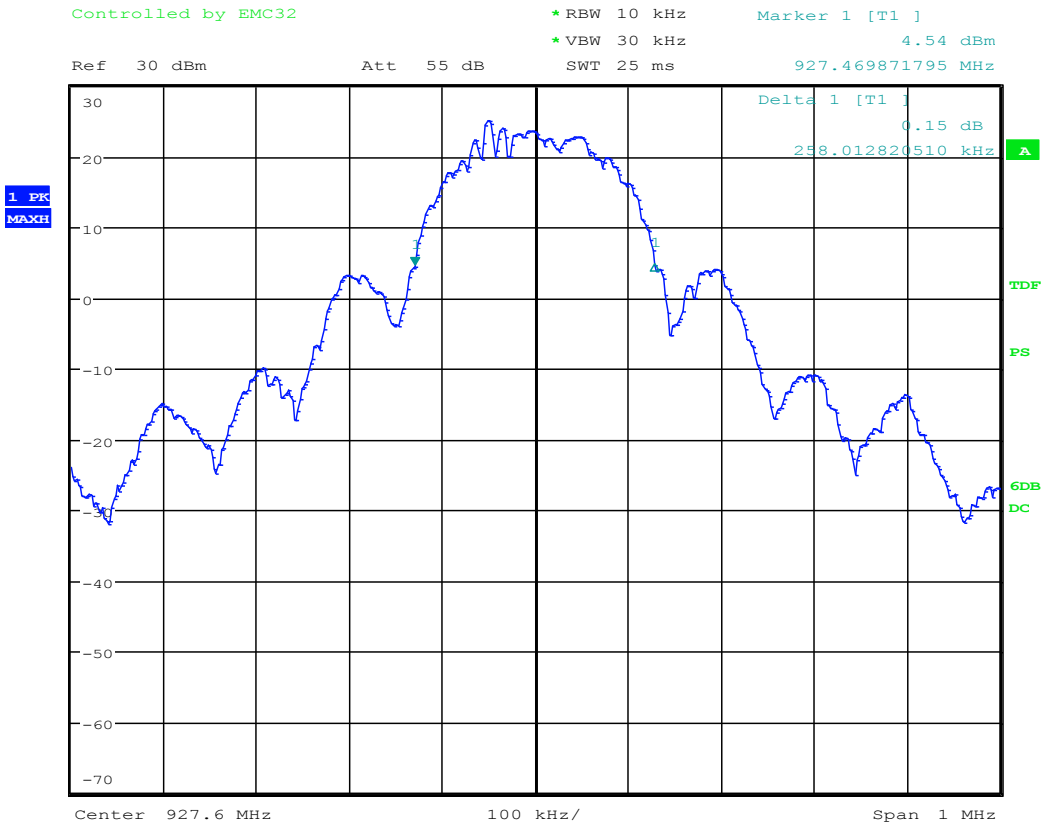

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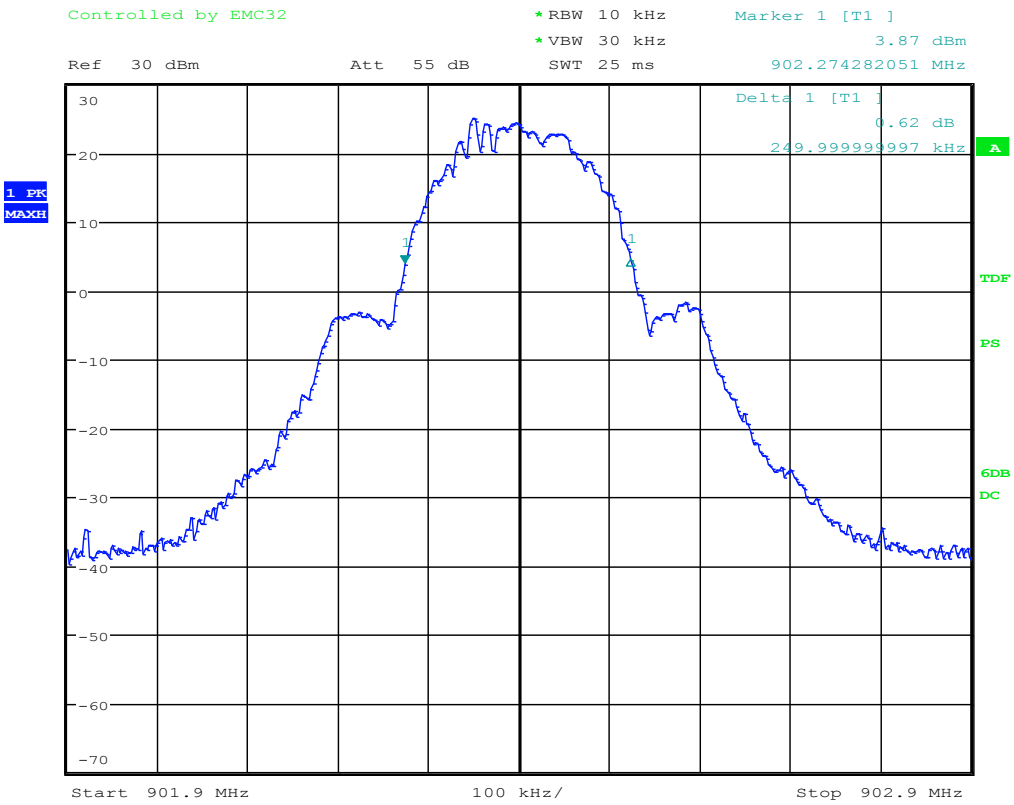

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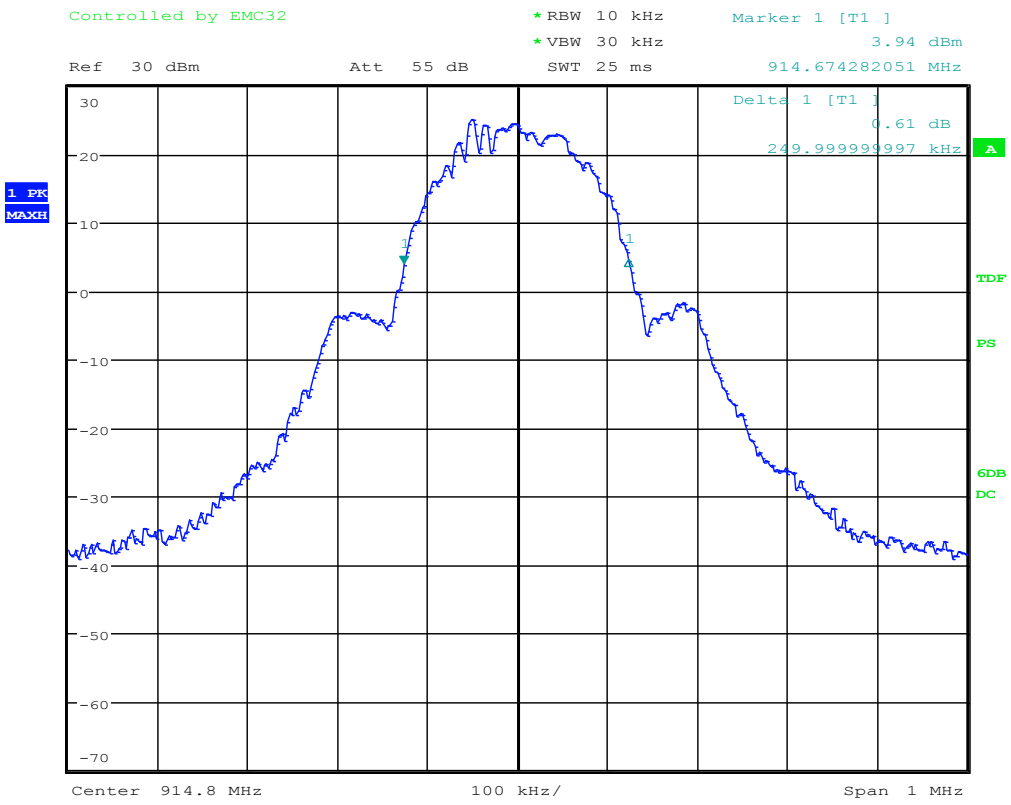

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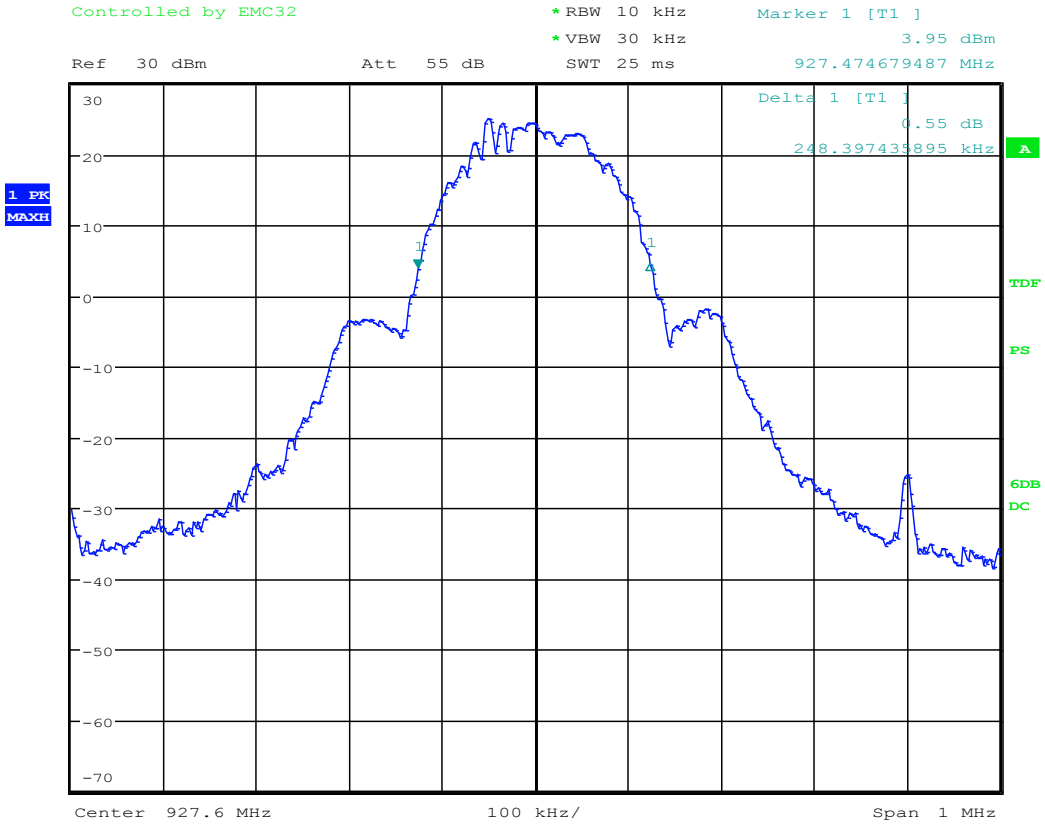

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8 FCC PART 15.247(b)(3) – CONDUCTED OUTPUT POWER

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

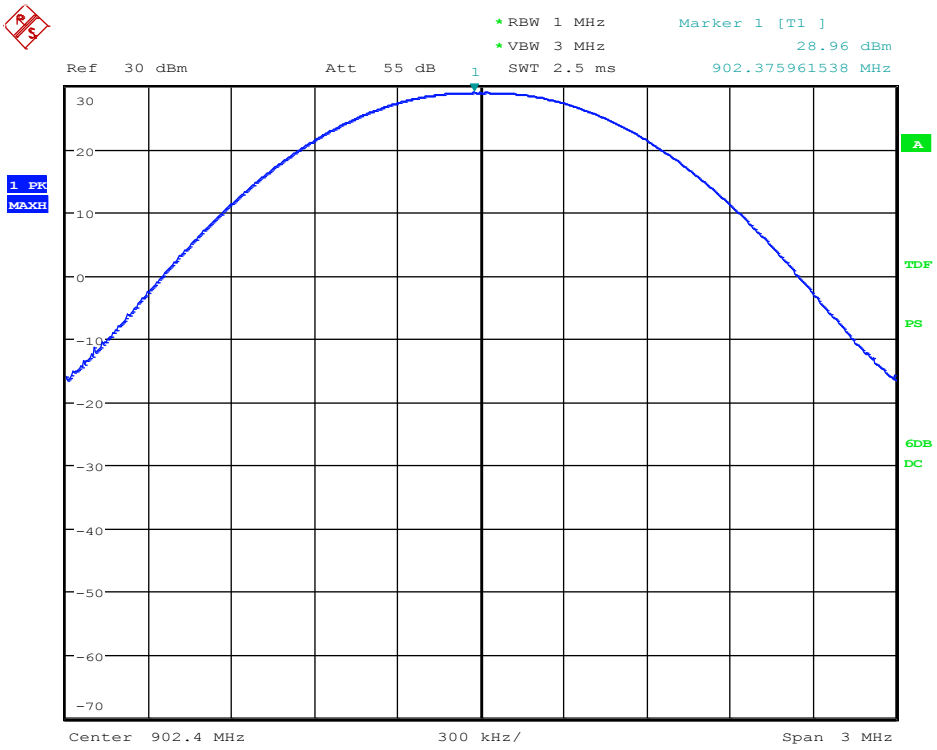
8.1 Requirements:

The peak power output shall be 1Watt (30dBm) or less when using an antenna with a gain of less than 6dBi. For antennas having a gain of more than 6dBi, the limit is reduced by 1dB for every dB the antenna gain is over 6dBi.

8.2 Conducted Output Power Test Data

Test Date(s)	Mar. 24, 2016	**Test Engineer:**	J. Knepper
Standards:	CFR 47 Part 15.247(b)(3)	**Air Temperature:**	20.2ºC
		Relative Humidity:	40%

50FSK: Low Channel



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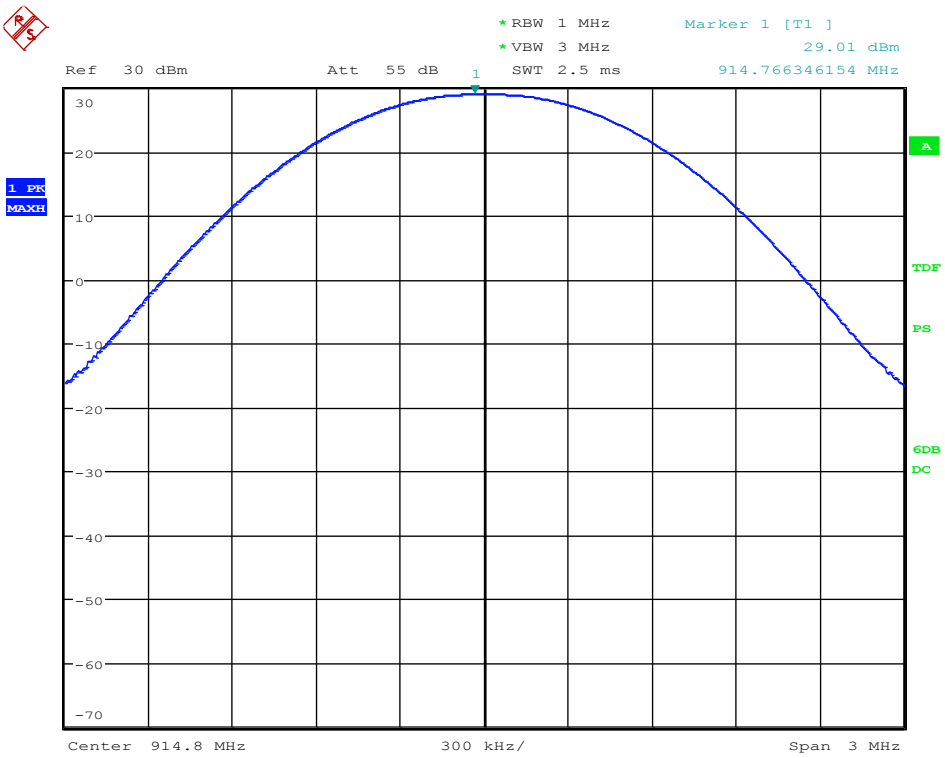

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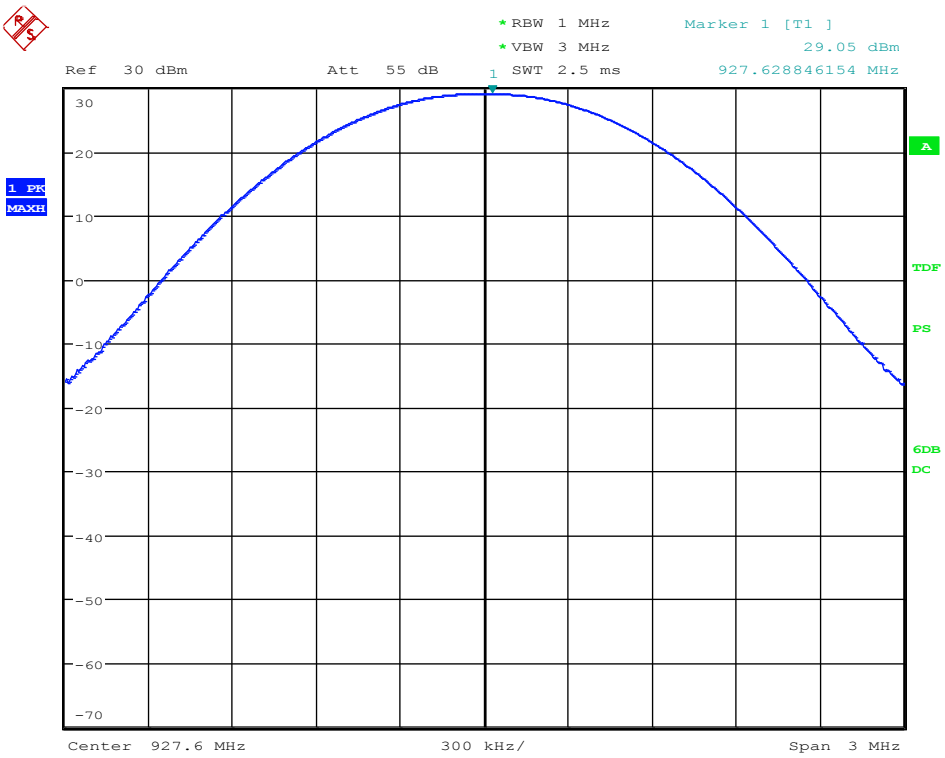

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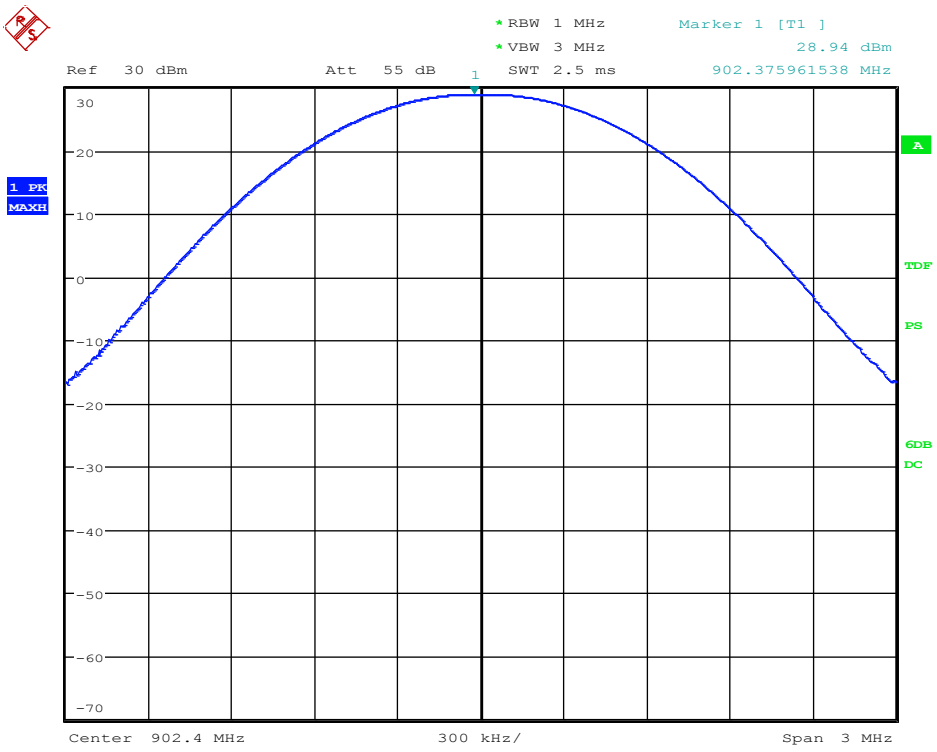

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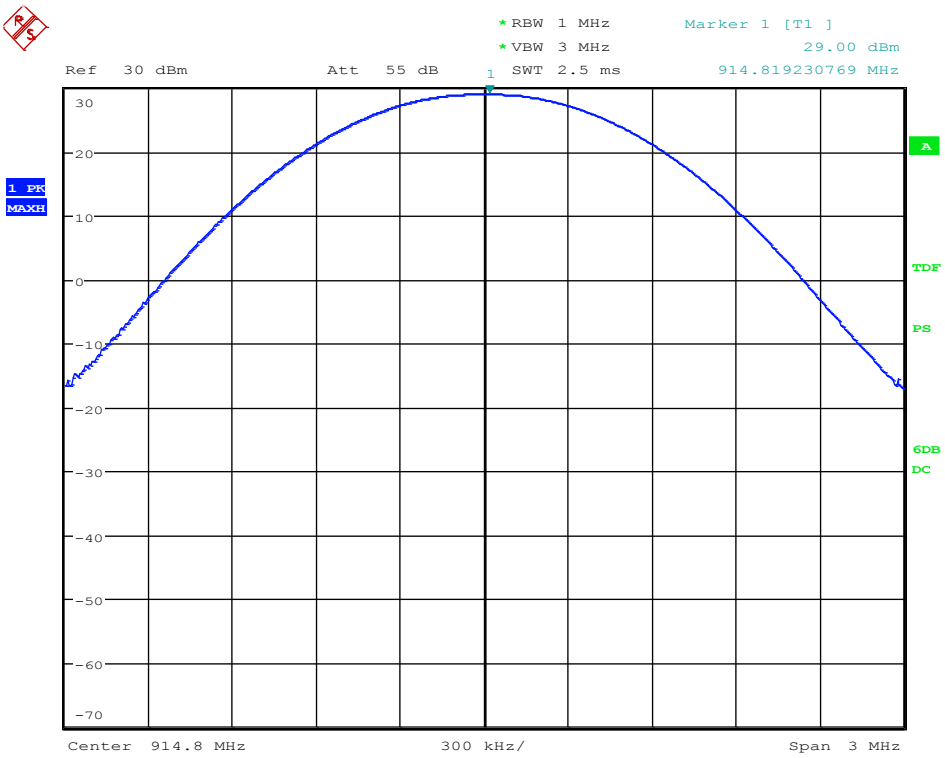

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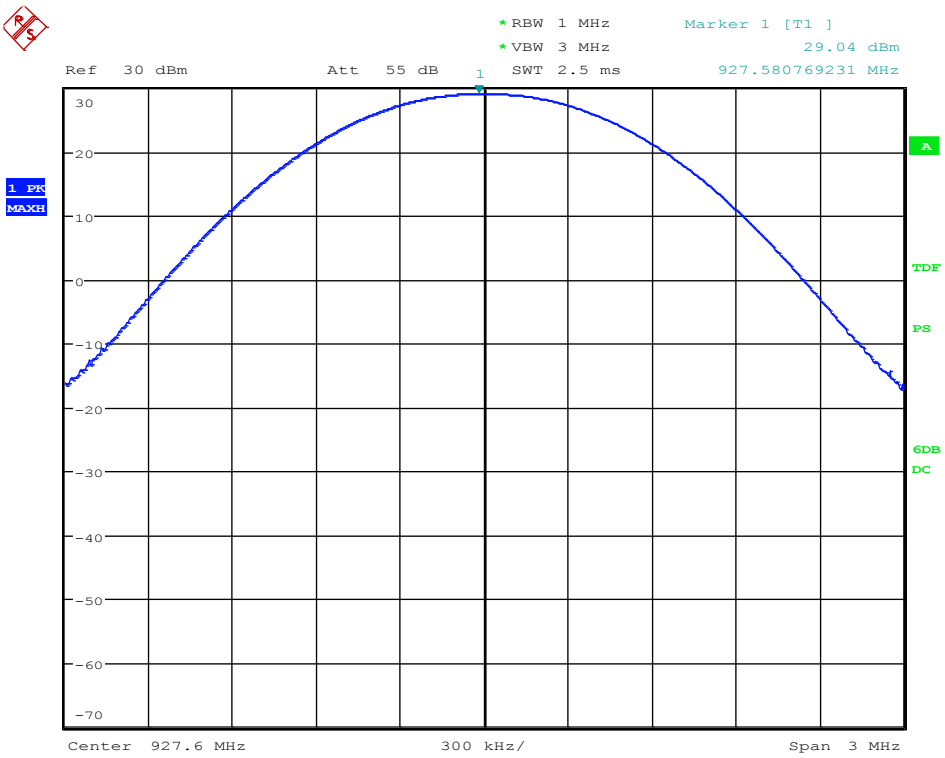

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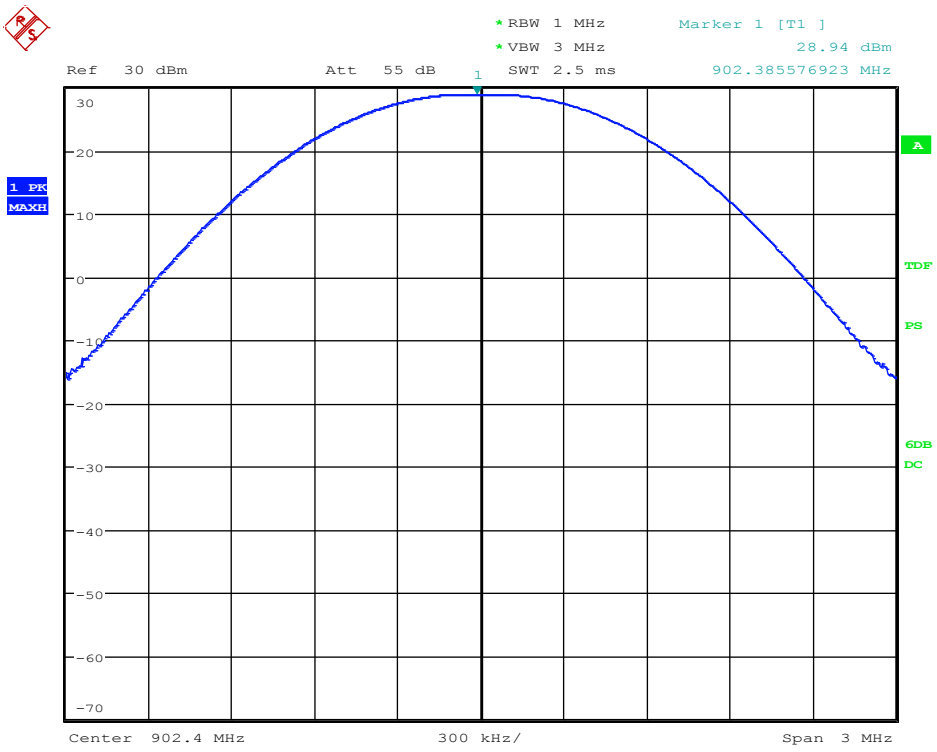

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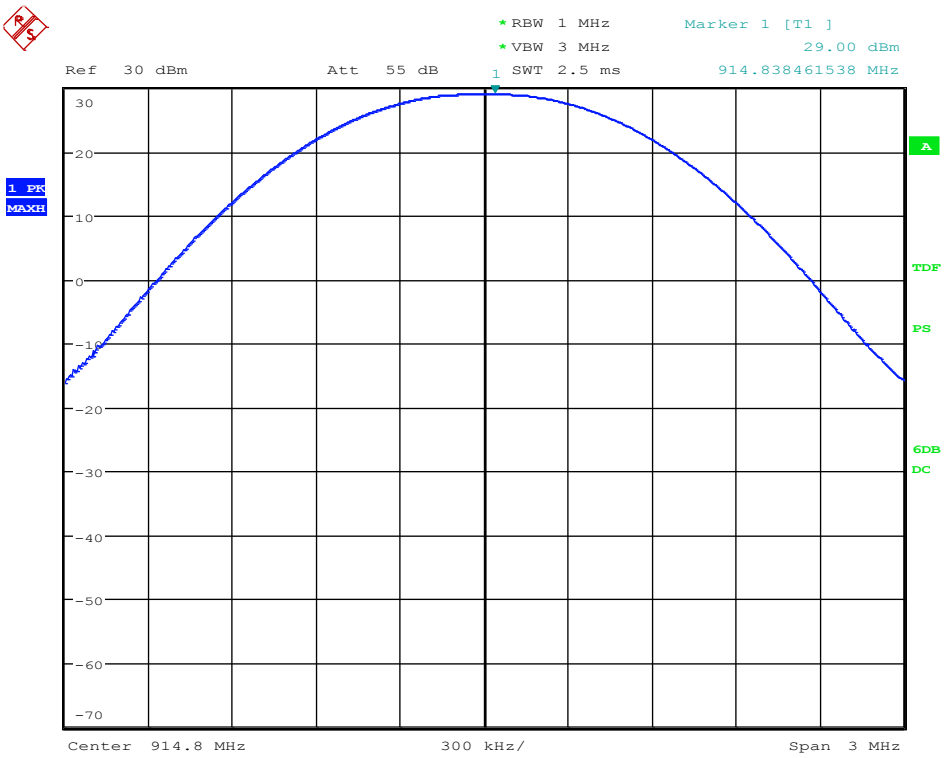

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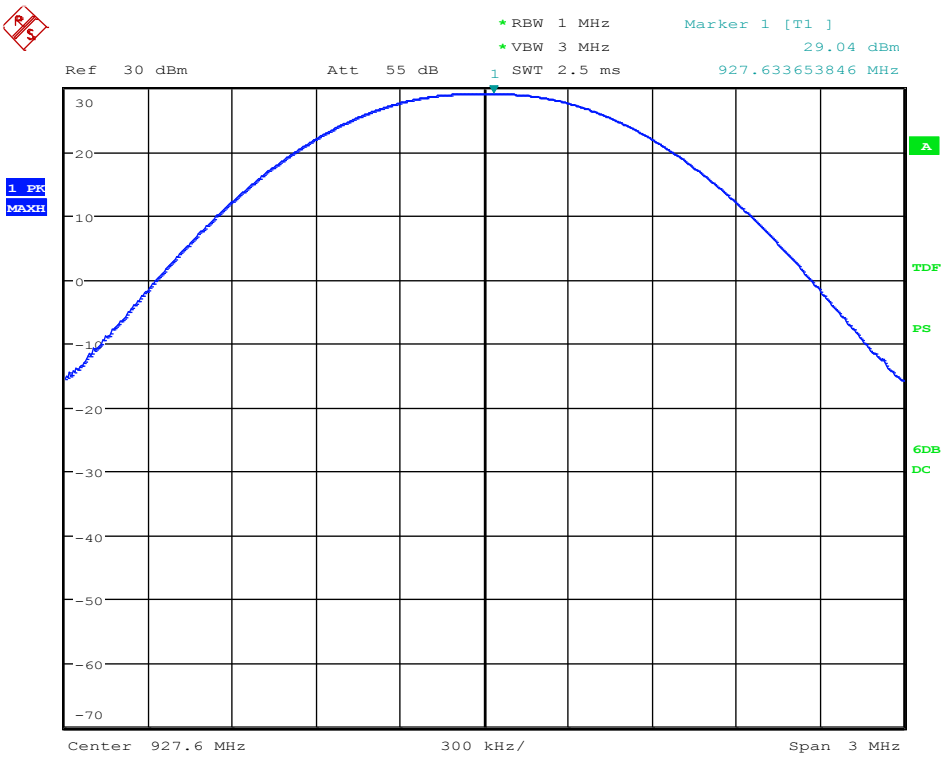

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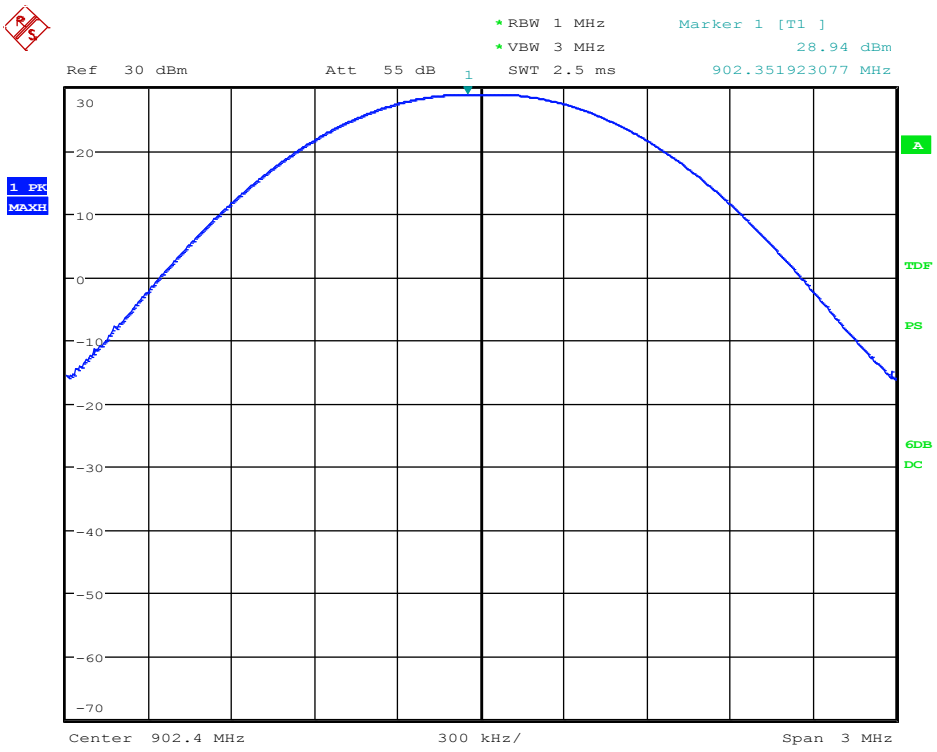
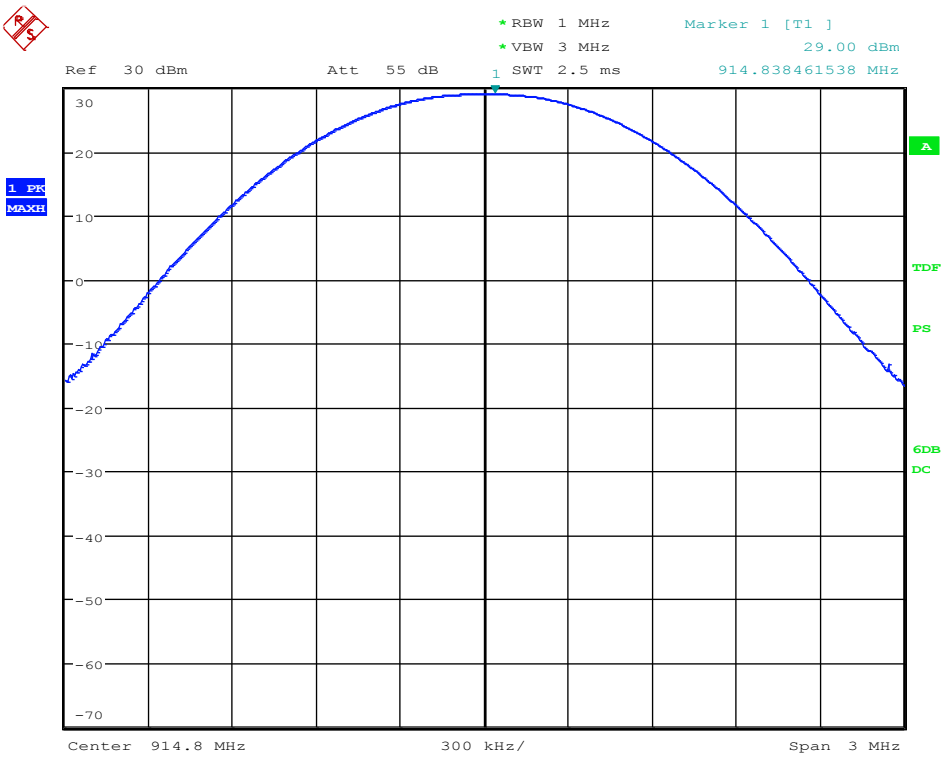


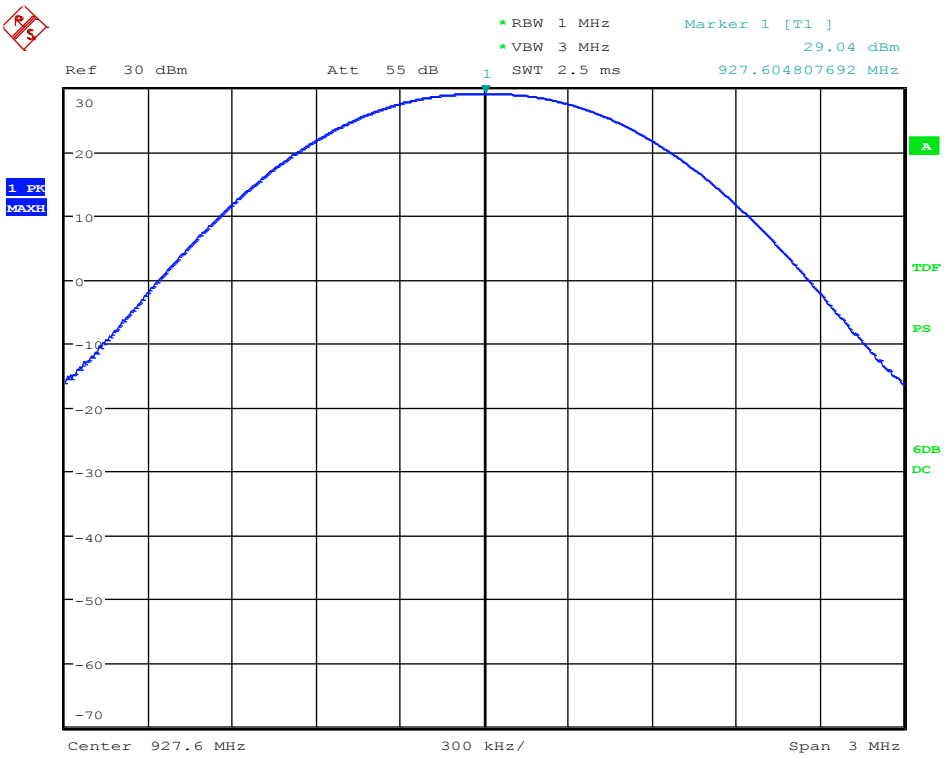
Date: 24.MAR.2016 09:12:56

150GFSK: Mid Channel



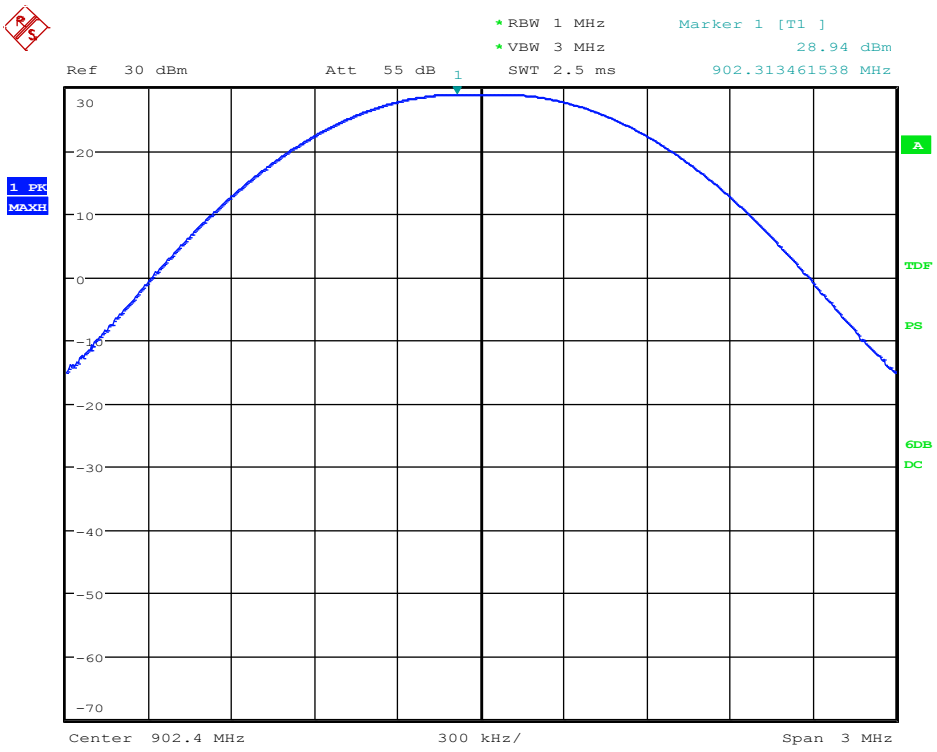
Date: 24.MAR.2016 09:16:34

150GFSK: High Channel



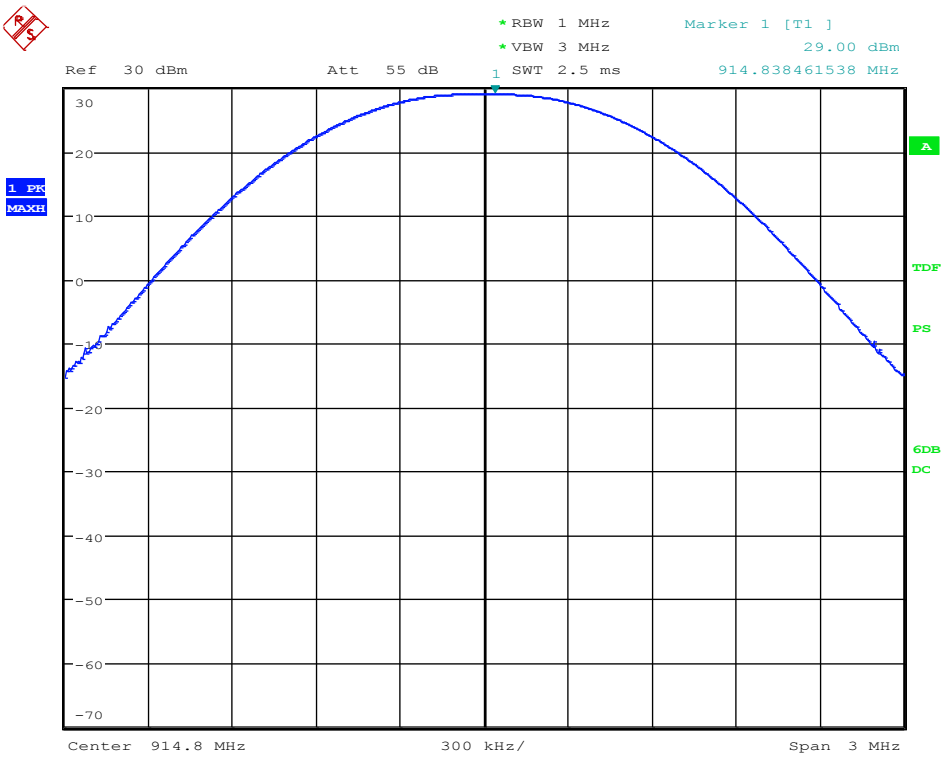
Date: 24.MAR.2016 09:19:57

200FSK: Low Channel



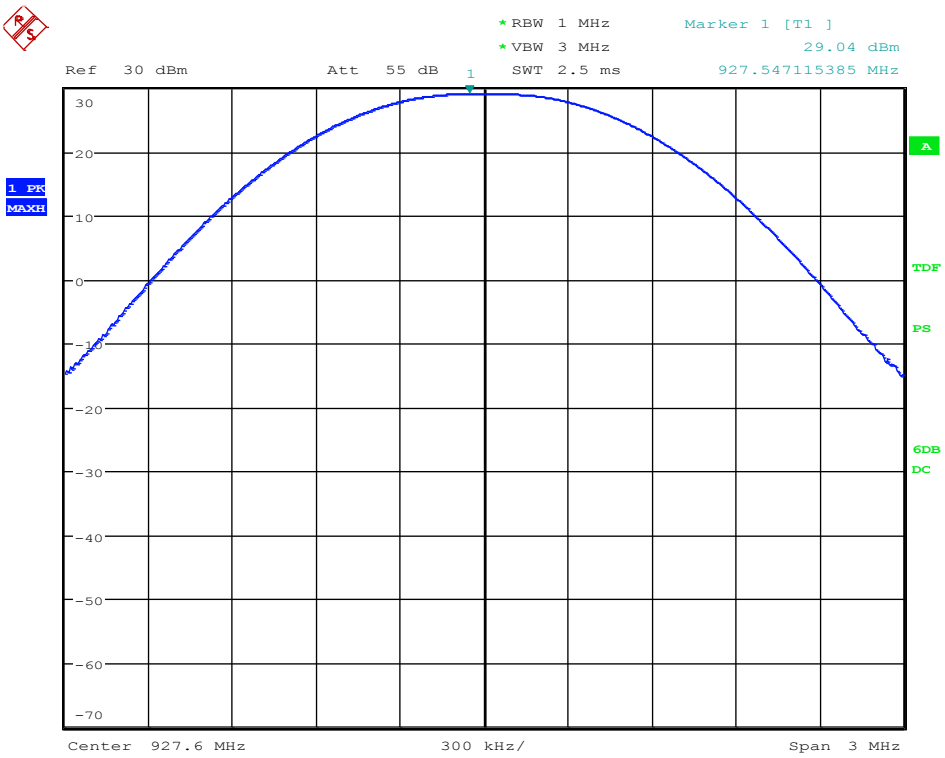
Date: 24.MAR.2016 09:13:43

200FSK: Mid Channel

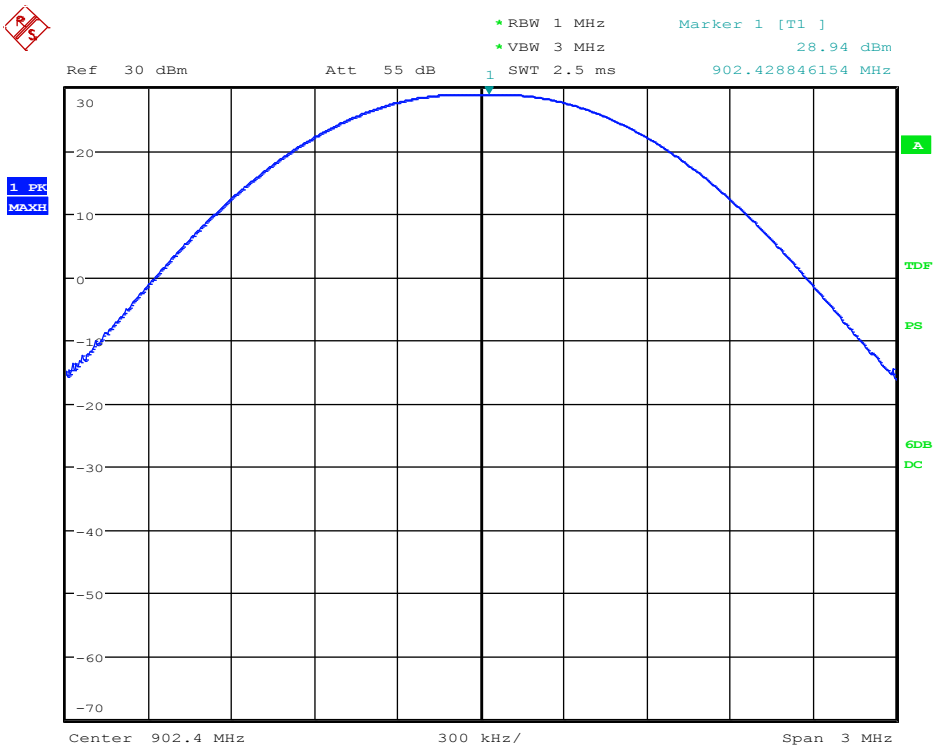


Date: 24.MAR.2016 09:17:06

200FSK: High Channel

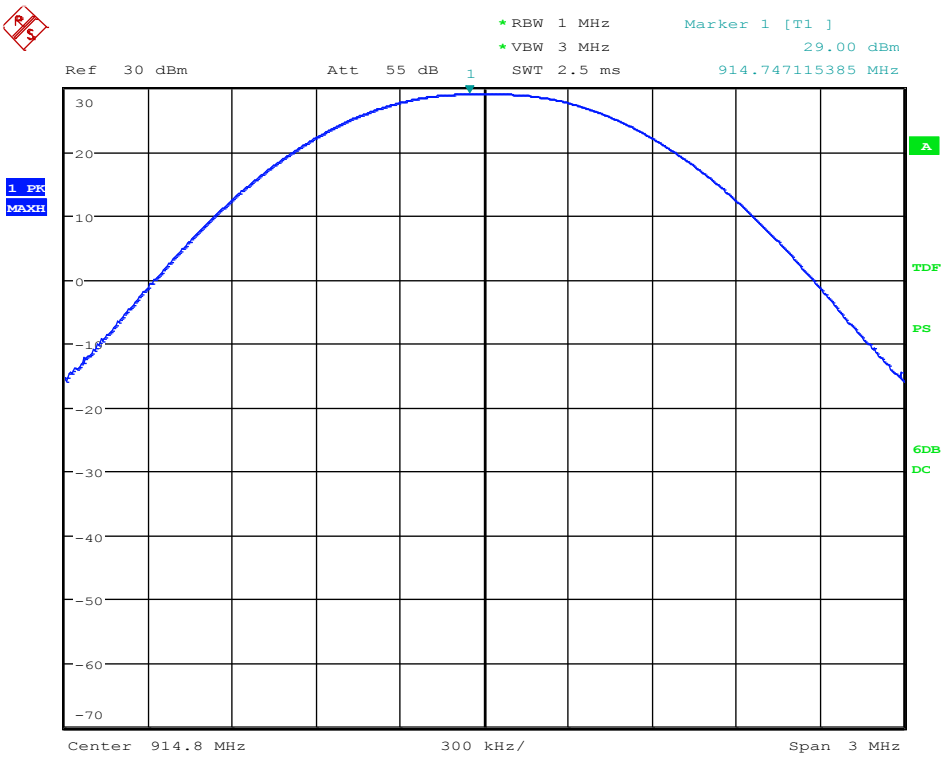


200GFSK: Low Channel



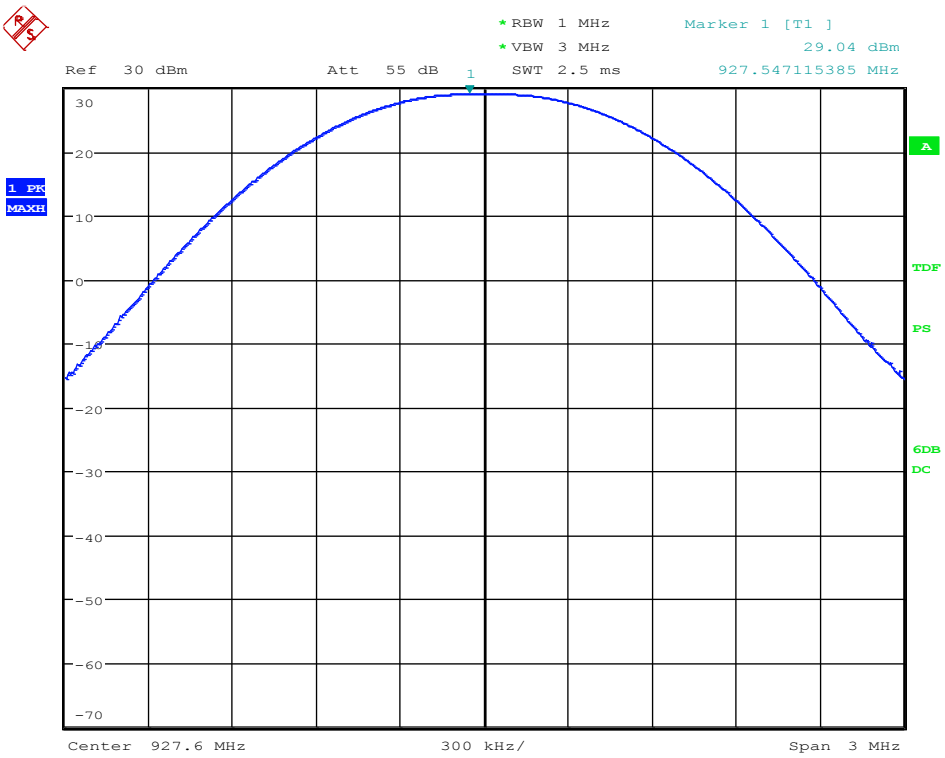
Date: 24.MAR.2016 09:14:14

200GFSK: Mid Channel



Date: 24.MAR.2016 09:17:34

200GFSK: High Channel



9 FCC PART 15.31(e) – EXTREME VOLTAGES

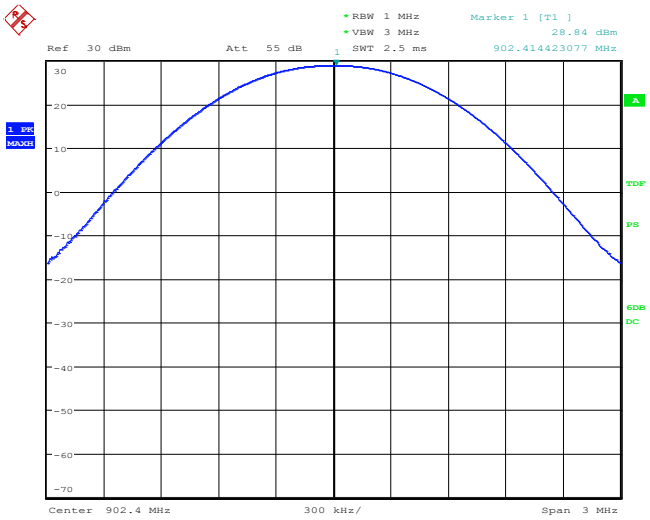
9.1 Requirements

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery-operated equipment, the equipment tests shall be performed using a new battery.

9.2 Extreme Voltages Test Data

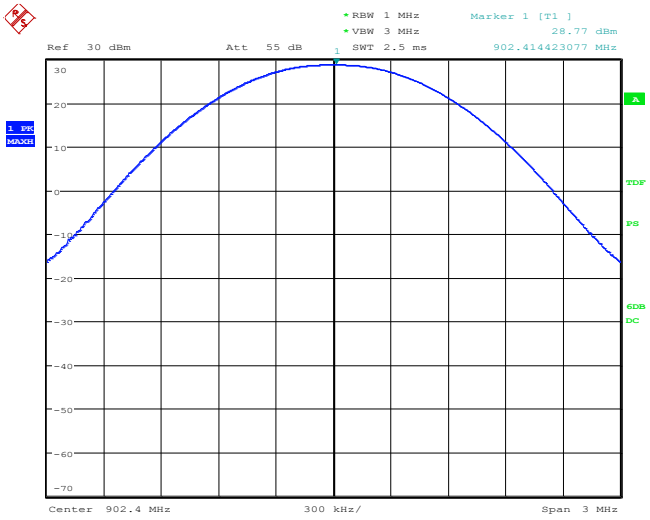
Test Date(s):	Mar. 24, 2016	Test Engineer:	J. Knepper
Rule:	15.31(e)	Air Temperature:	20.2º C
Test Results:	Complies	Relative Humidity:	40%

50FSK: Low Channel, 100V



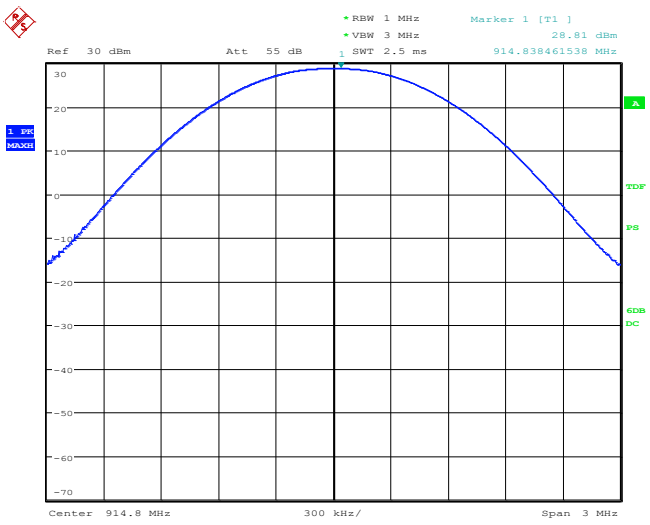
Date: 24.MAR.2016 07:58:12

50FSK: Low Channel, 140V



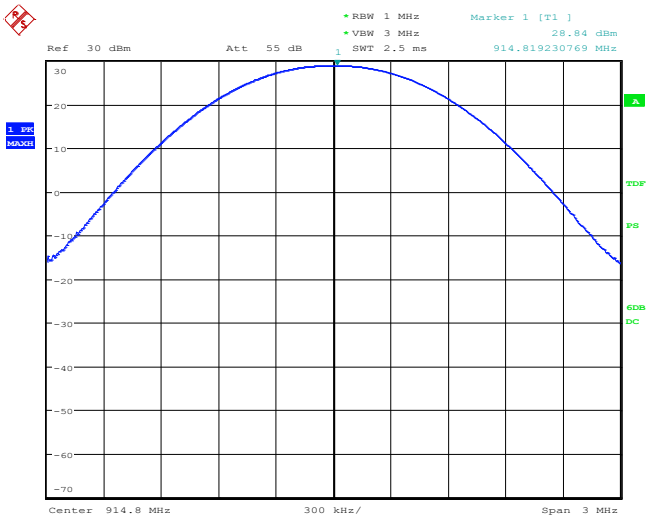
Date: 24.MAR.2016 08:13:18

50FSK: Mid Channel, 100V



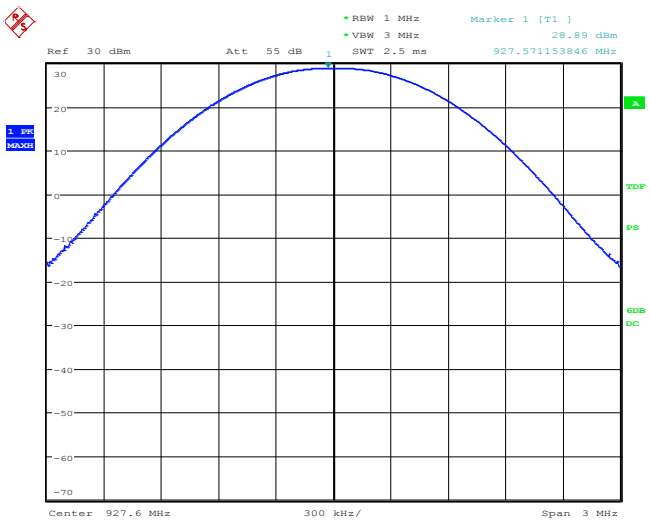
Date: 24.MAR.2016 08:35:13

50FSK: Mid Channel, 140V



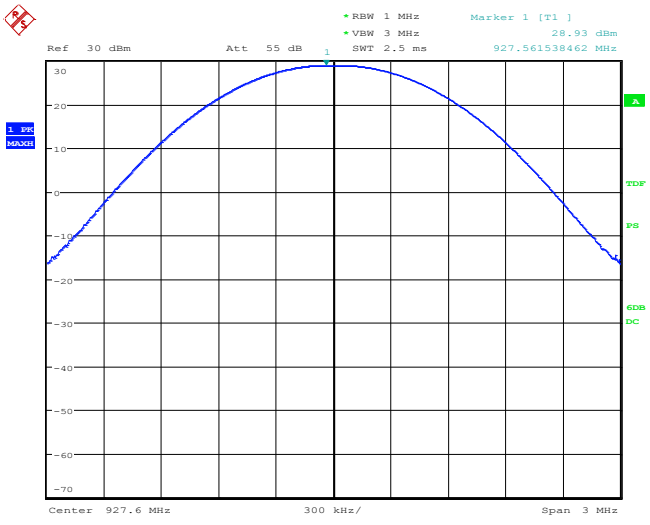
Date: 24.MAR.2016 08:25:16

50FSK: High Channel, 100V



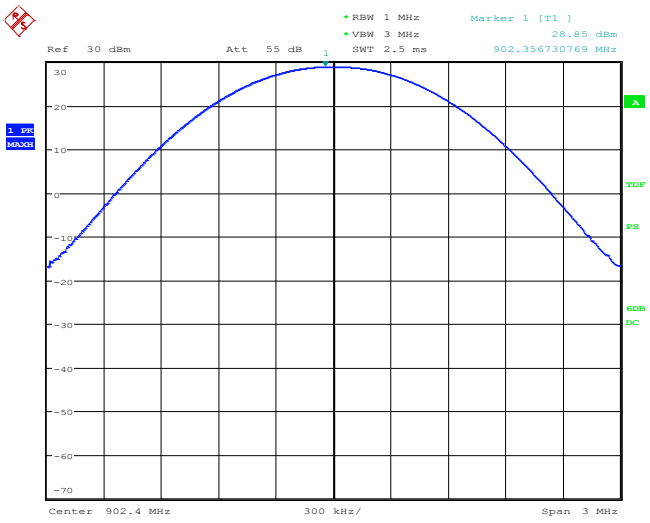
Date: 24.MAR.2016 08:44:00

50FSK: High Channel, 140V



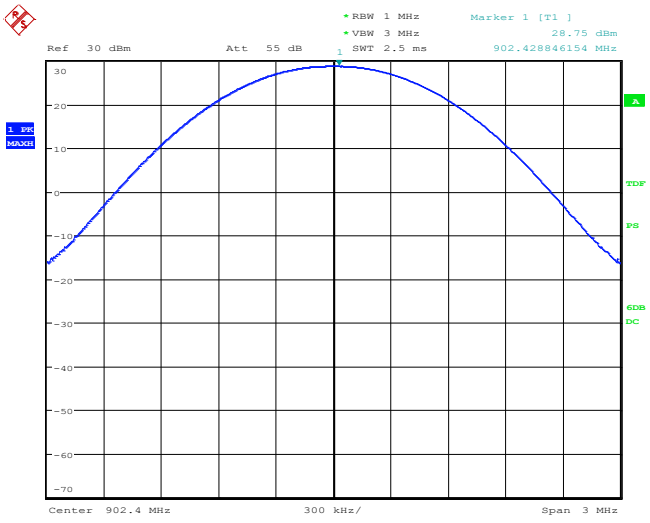
Date: 24.MAR.2016 08:53:35

50GFSK: Low Channel, 100V



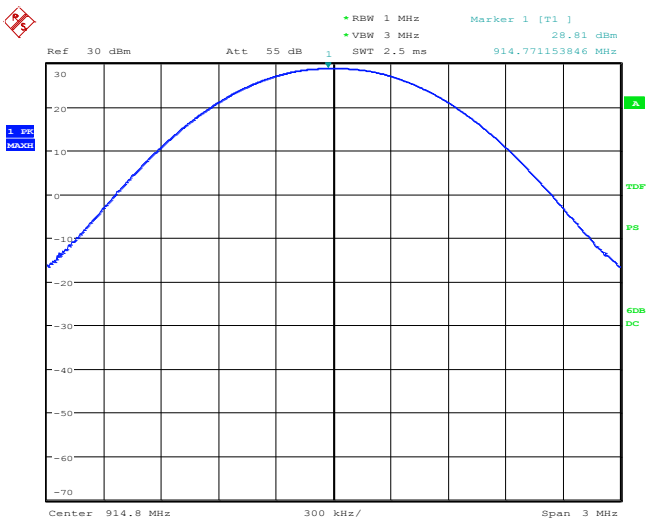
Date: 24.MAR.2016 07:58:44

50GFSK: Low Channel, 140V



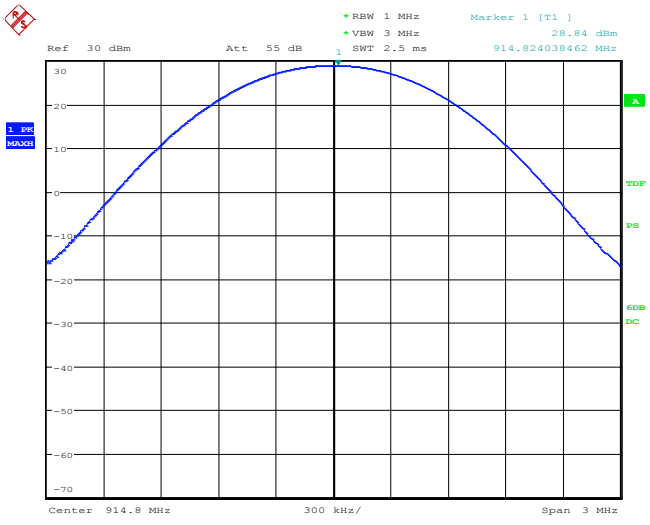
Date: 24.MAR.2016 08:15:34

50GFSK: Mid Channel, 100V



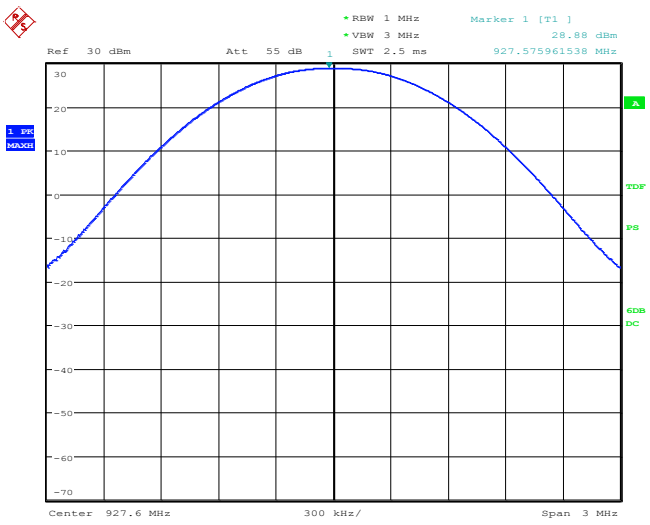
Date: 24.MAR.2016 08:36:10

50GFSK: Mid Channel, 140V



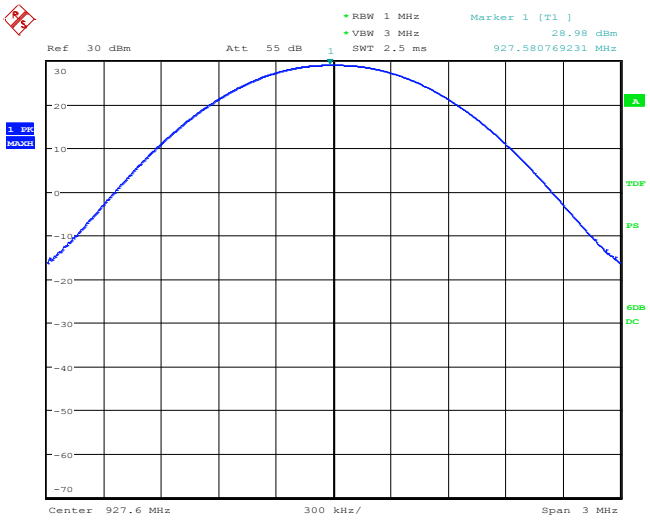
Date: 24.MAR.2016 08:26:23

50GFSK: High Channel, 100V



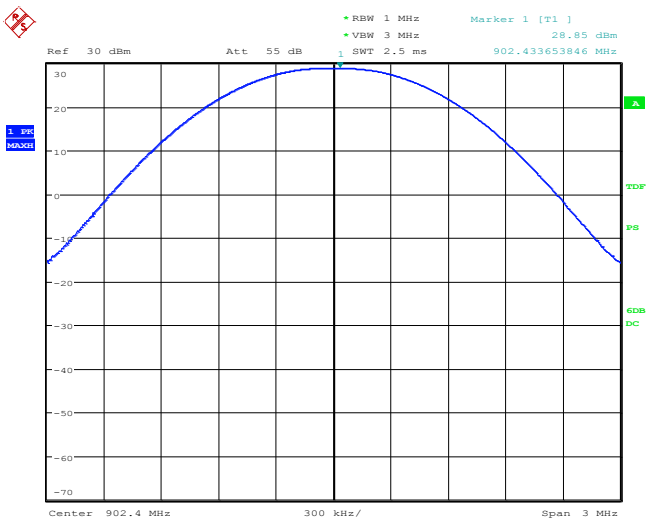
Date: 24.MAR.2016 08:44:50

50GFSK: High Channel, 140V



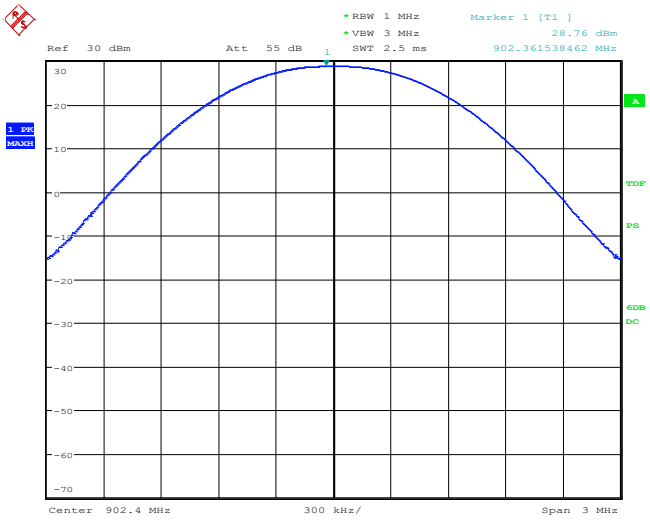
Date: 24.MAR.2016 08:55:27

150FSK: Low Channel, 100V



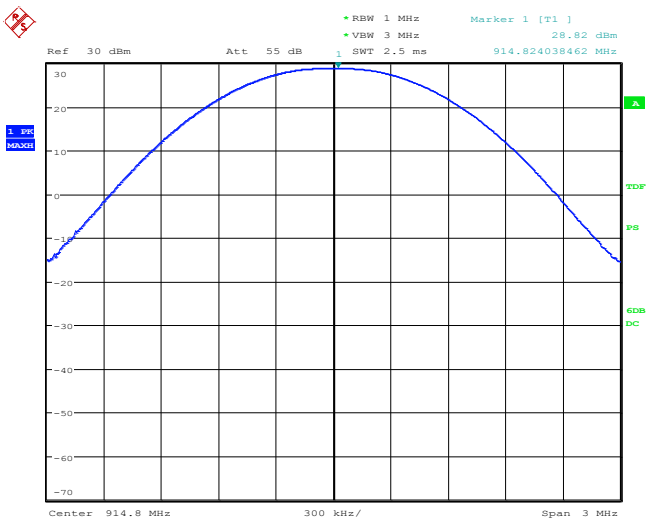
Date: 24.MAR.2016 07:59:52

150FSK: Low Channel, 140V



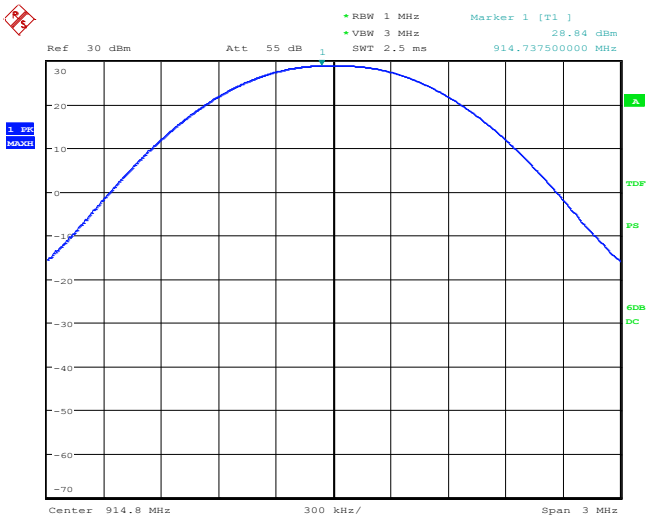
Date: 24.MAR.2016 08:19:02

150FSK: Mid Channel, 100V



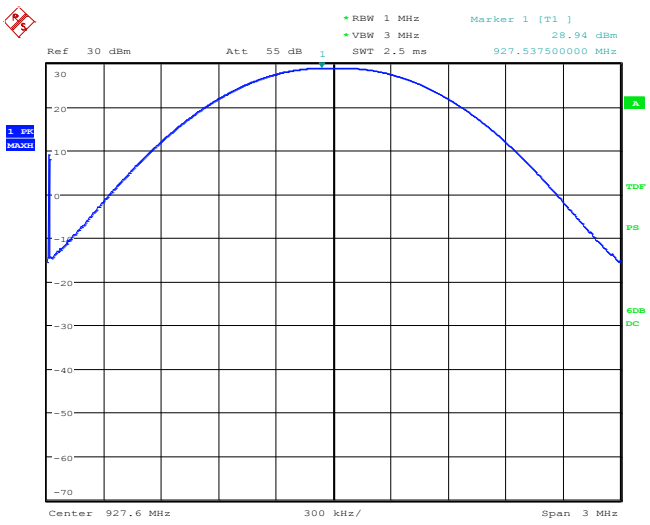
Date: 24.MAR.2016 08:37:54

150FSK: Mid Channel, 140V



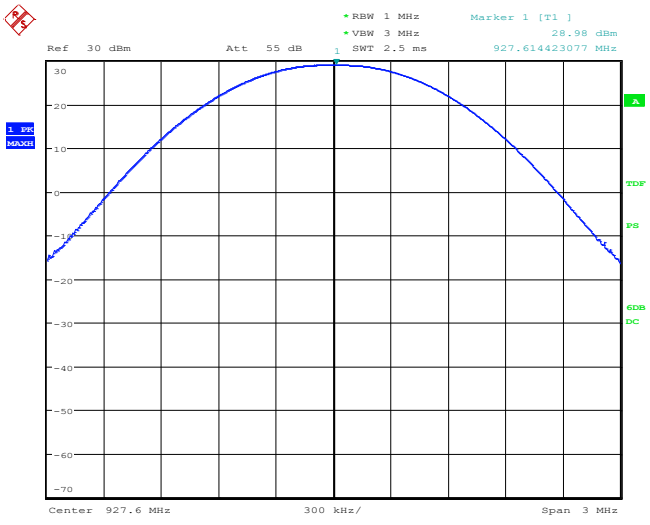
Date: 24.MAR.2016 08:27:22

150FSK: High Channel, 100V



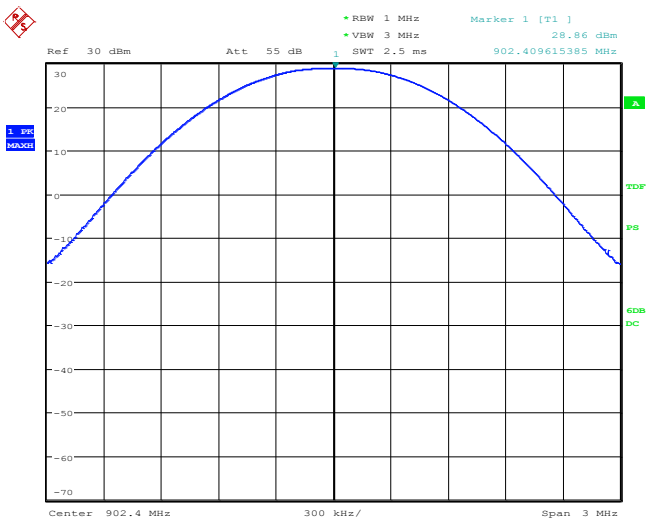
Date: 24.MAR.2016 08:45:49

150FSK: High Channel, 140V



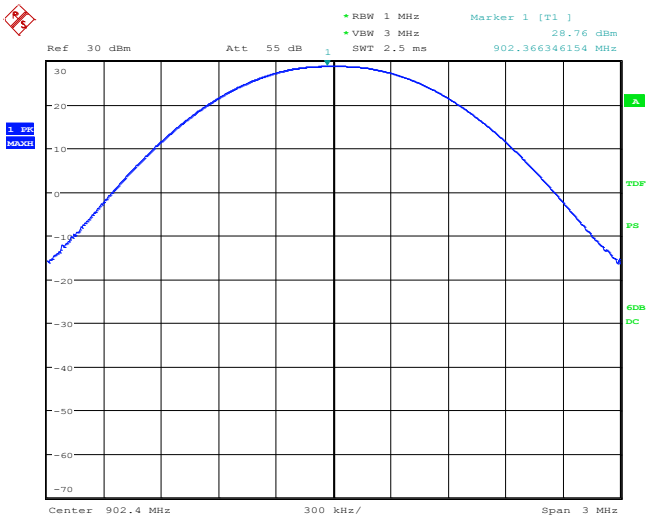
Date: 24.MAR.2016 08:56:07

150GFSK: Low Channel, 100V



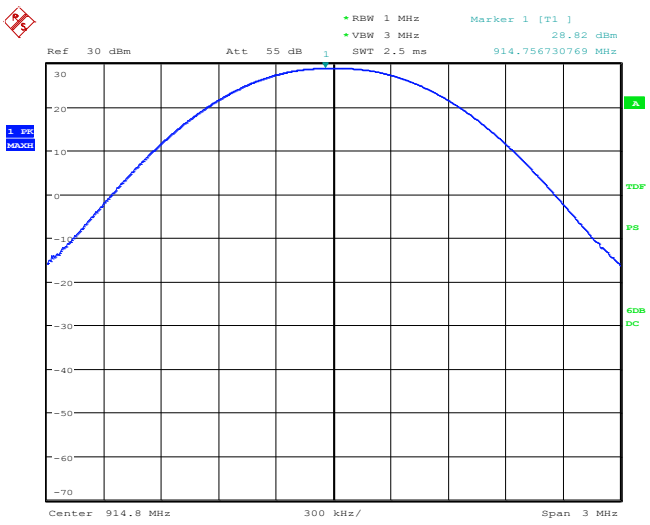
Date: 24.MAR.2016 08:01:37

150GFSK: Low Channel, 140V



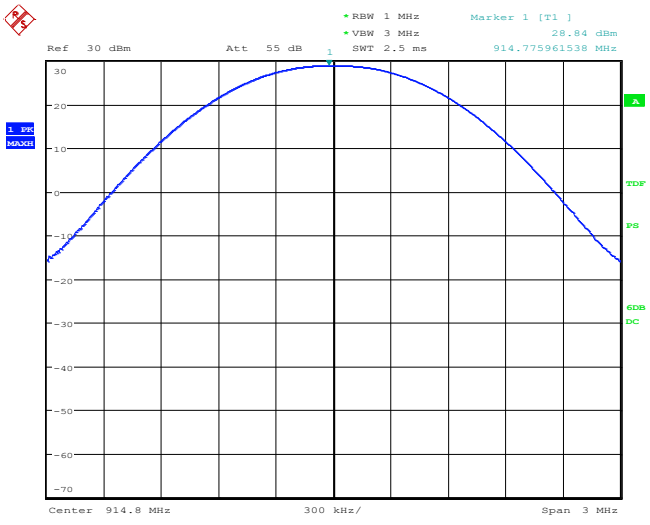
Date: 24.MAR.2016 08:20:15

150GFSK: Mid Channel, 100V



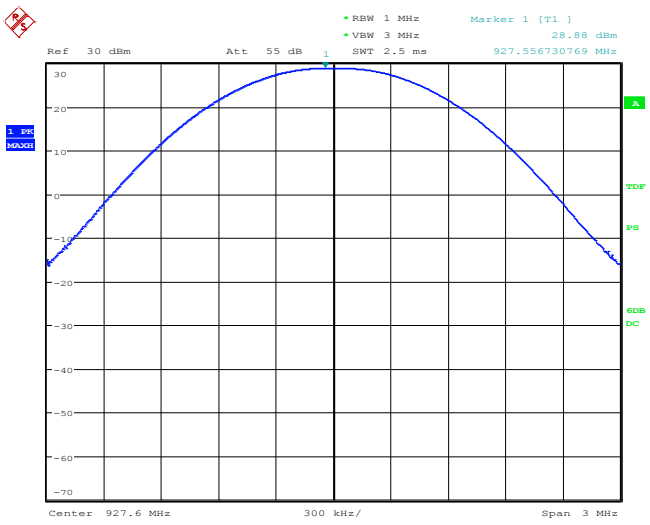
Date: 24.MAR.2016 08:39:13

150GFSK: Mid Channel, 140V



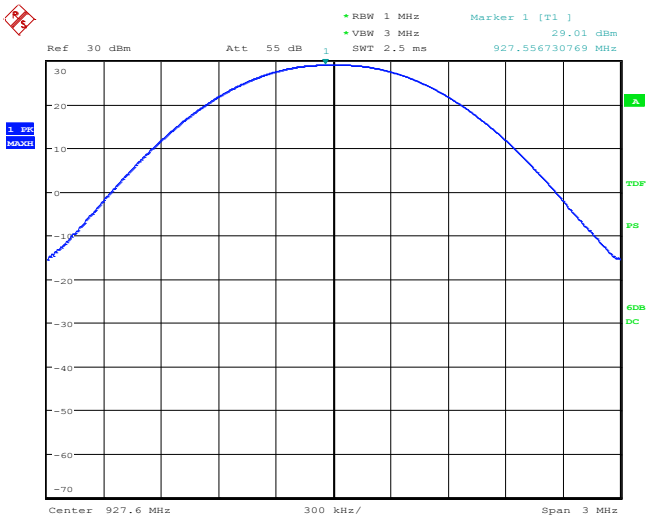
Date: 24.MAR.2016 08:28:31

150GFSK: High Channel, 100V



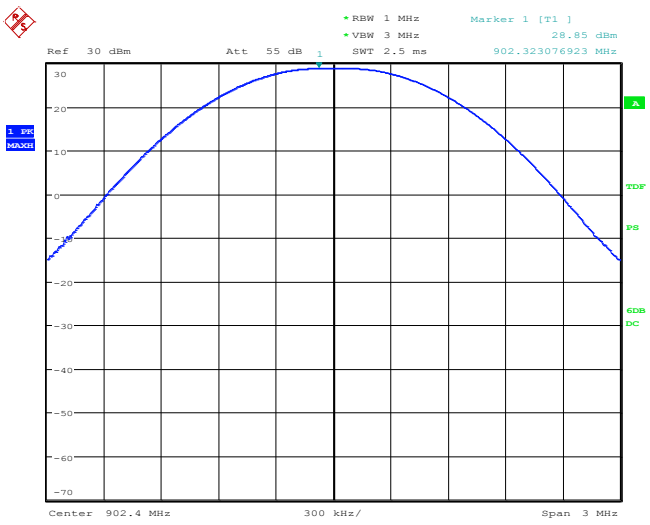
Date: 24.MAR.2016 08:47:45

150GFSK: High Channel, 140V



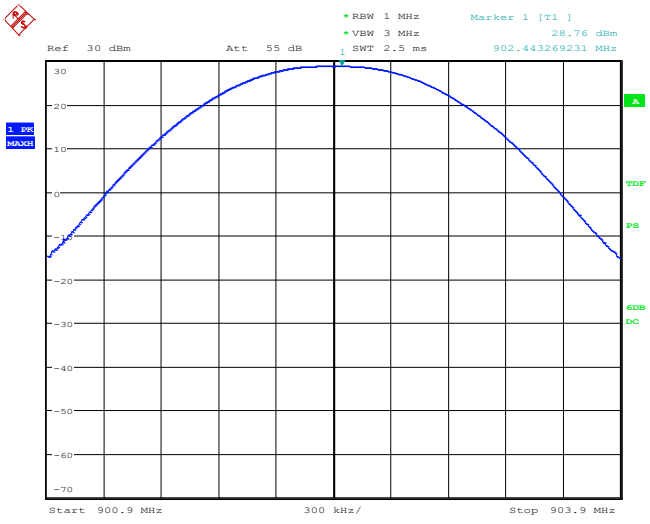
Date: 24.MAR.2016 08:58:11

200FSK: Low Channel, 100V



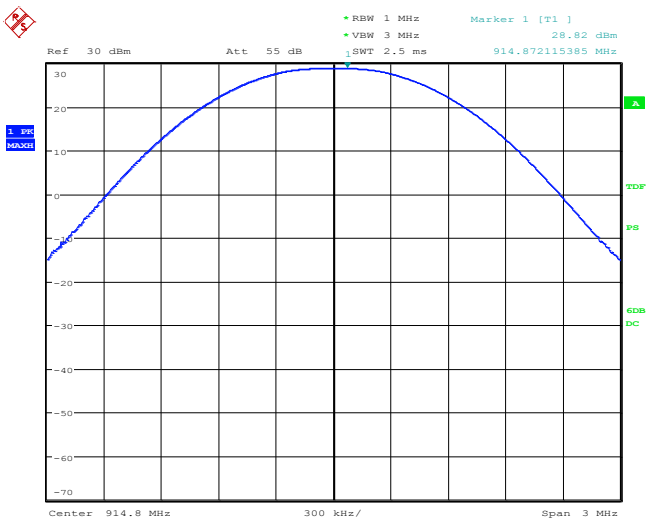
Date: 24.MAR.2016 08:03:23

200FSK: Low Channel, 140V



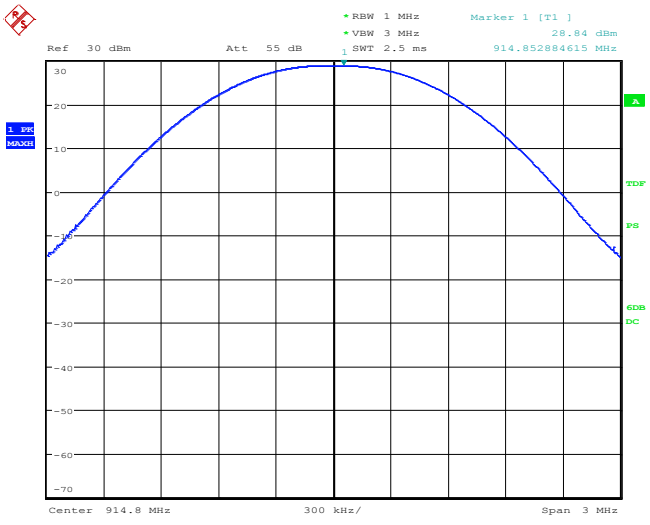
Date: 24.MAR.2016 08:21:36

200FSK: Mid Channel, 100V



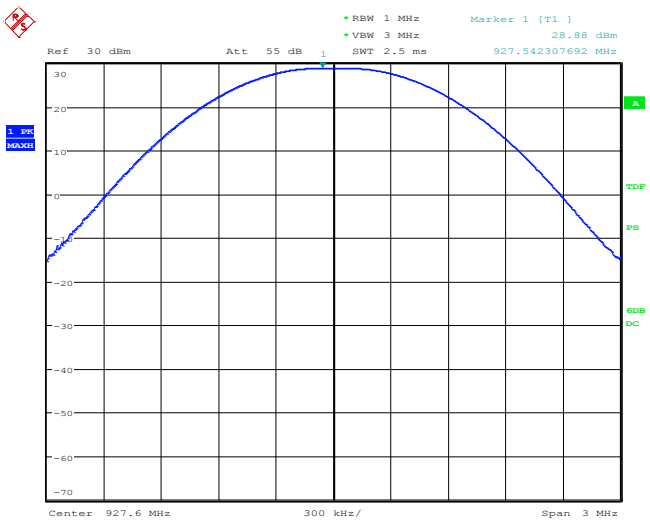
Date: 24.MAR.2016 08:40:20

200FSK: Mid Channel, 140V



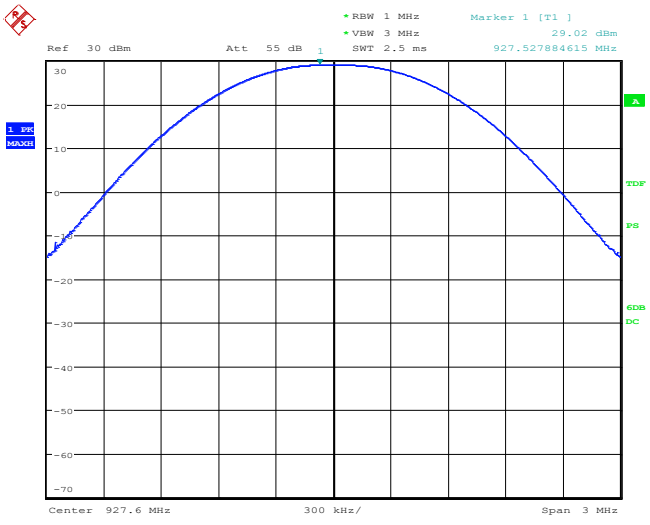
Date: 24.MAR.2016 08:29:57

200FSK: High Channel, 100V



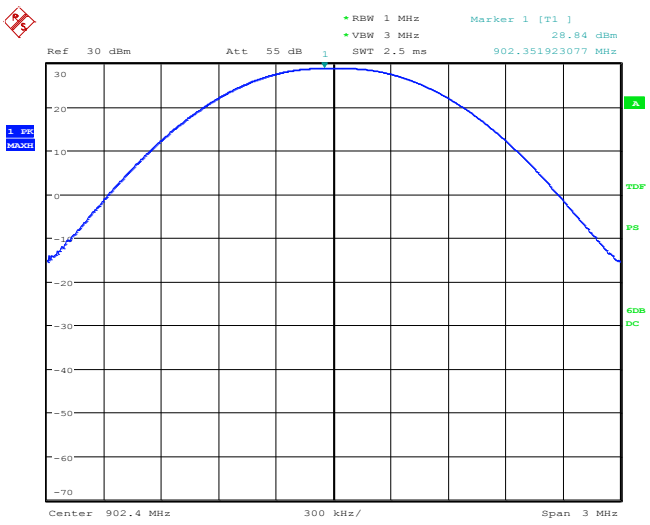
Date: 24.MAR.2016 08:48:31

200FSK: High Channel, 140V



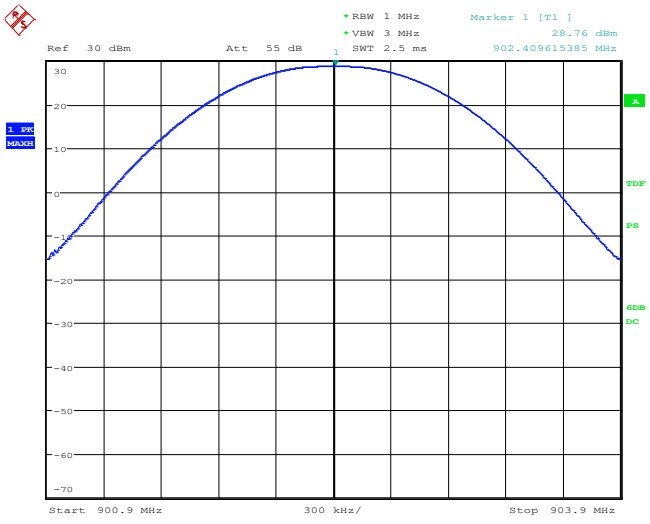
Date: 24.MAR.2016 08:58:56

200GFSK: Low Channel, 100V



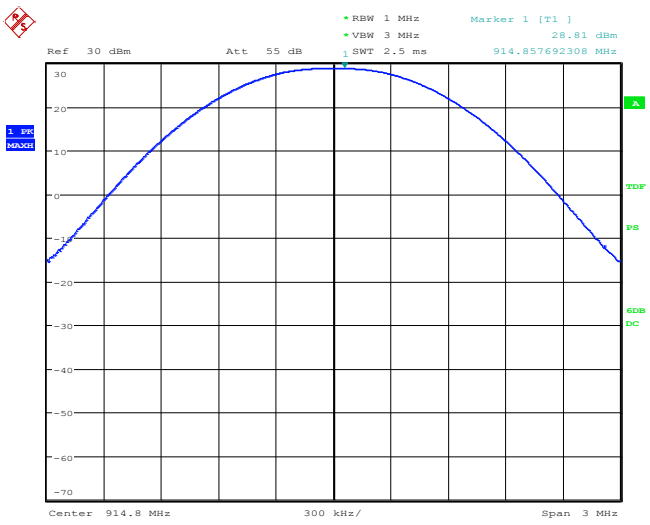
Date: 24.MAR.2016 08:04:00

200GFSK: Low Channel, 140V



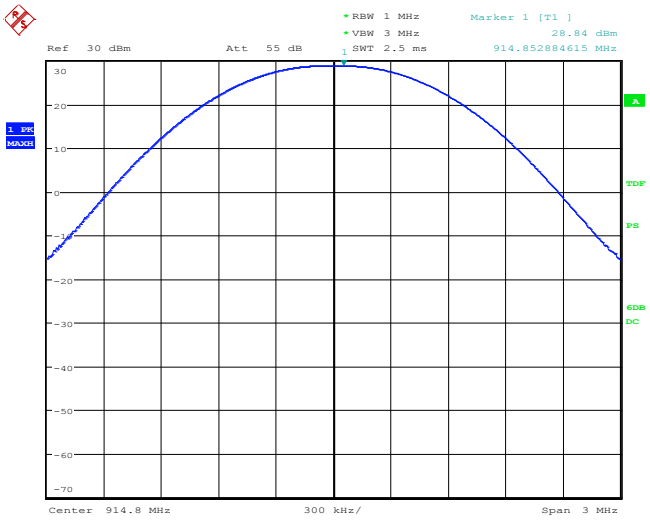
Date: 24.MAR.2016 08:22:36

200GFSK: Mid Channel, 100V



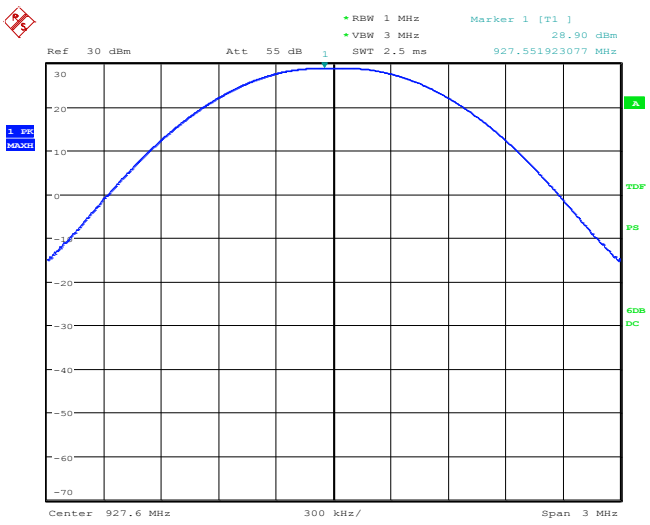
Date: 24.MAR.2016 08:42:29

200GFSK: Mid Channel, 140V



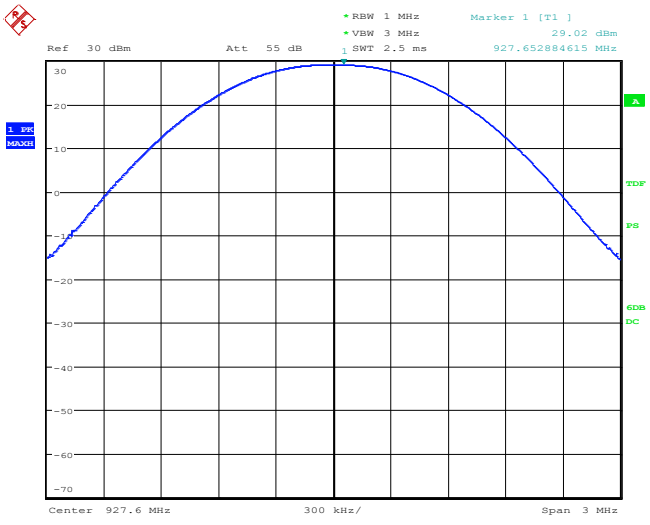
Date: 24.MAR.2016 08:31:34

200GFSK: High Channel, 100V



Date: 24.MAR.2016 08:49:55

200GFSK: High Channel, 140V



Date: 24.MAR.2016 08:59:45

10 FCC Part 15.247(d) – CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Antenna Conducted Test

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the spectrum analyzer.

10.1 Requirements:

All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic.

Spurious emissions measurements were made at the low, mid, and upper channels with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the low and high channels to verify band edge compliance.

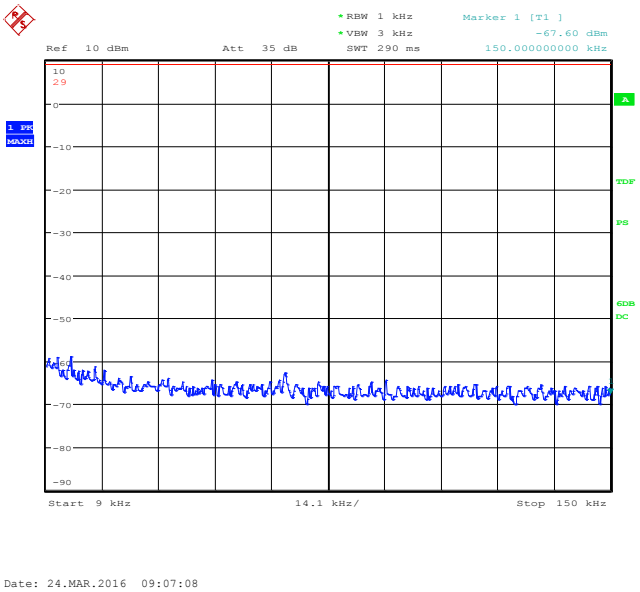
Per 5.6.2.2(a) of ANSI 63.10, measurements were made on the modulation with highest output power and widest bandwidth. 200FSK met these requirements for all except 50FSK High Channel.

10.2 Test Data – Conducted Spurious Emissions

Test Date(s):	Mar. 24, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d) / Part 15.207	Air Temperature:	20.5ºC
		Relative Humidity:	40%

200FSK: Low Channel, 9kHz to 150kHz

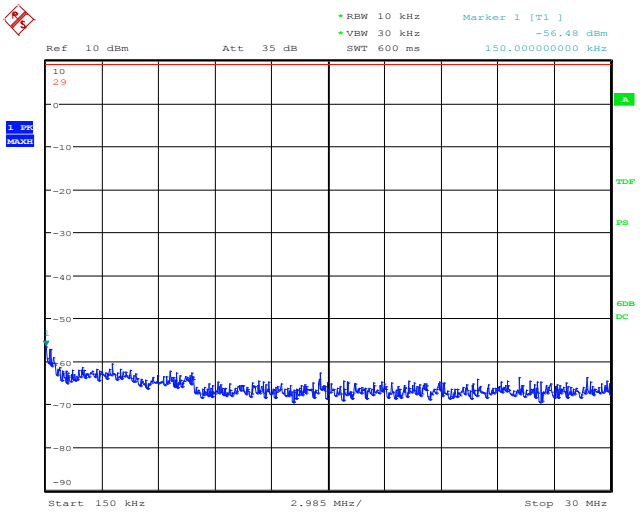
.



Date: 24.MAR.2016 09:07:08

200FSK: Low Channel, 150kHz to 30 MHz

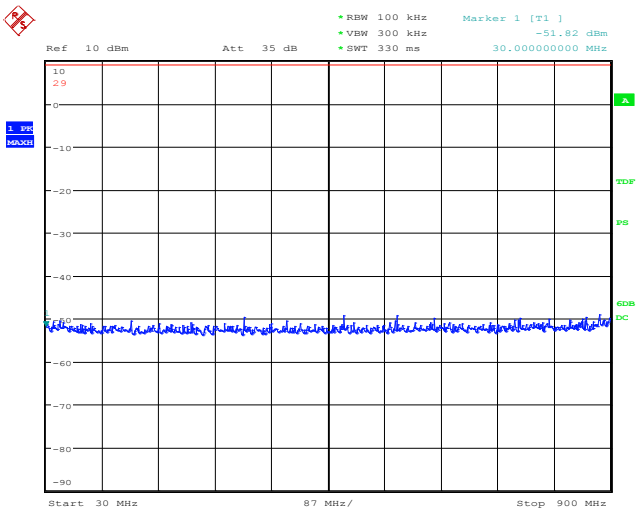
.



Date: 24.MAR.2016 09:07:30

200FSK: Low Channel, 30 MHz to 900 MHz

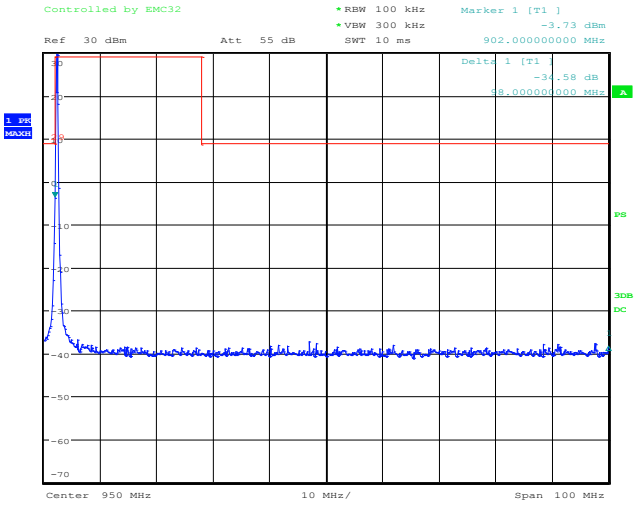
.



Date: 24.MAR.2016 09:07:49

200FSK: Low Channel, 900 MHz to 1 GHz

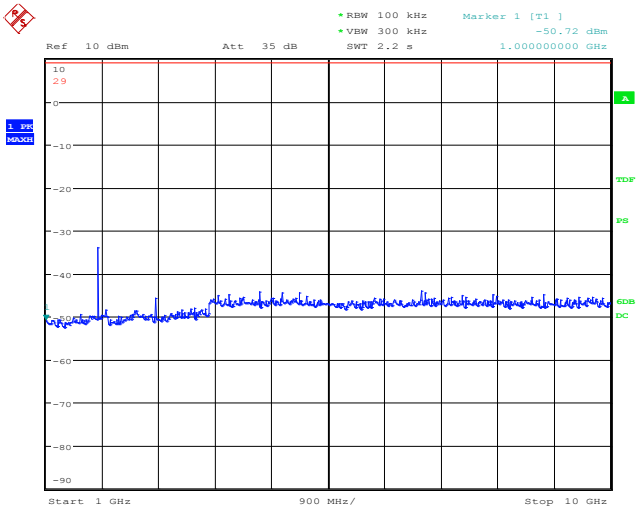
.



Date: 4.APR.2016 13:18:45

200FSK: Low Channel, 1 GHz to 10 GHz

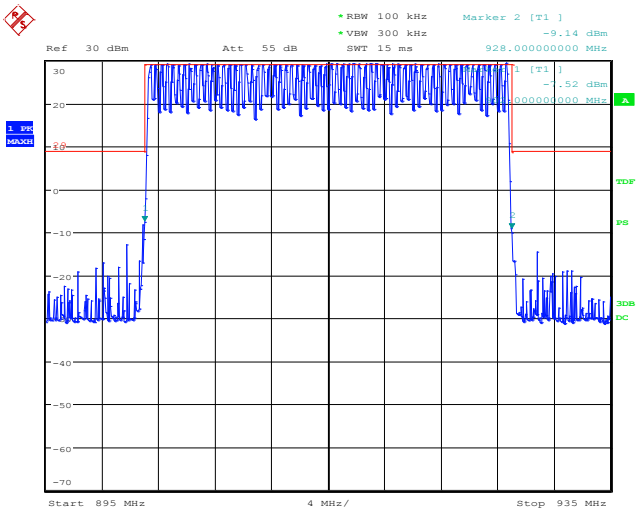
.



Date: 24.MAR.2016 09:08:54

200FSK: Low Channel, 895 MHz to 935 MHz (Hopping)*

.

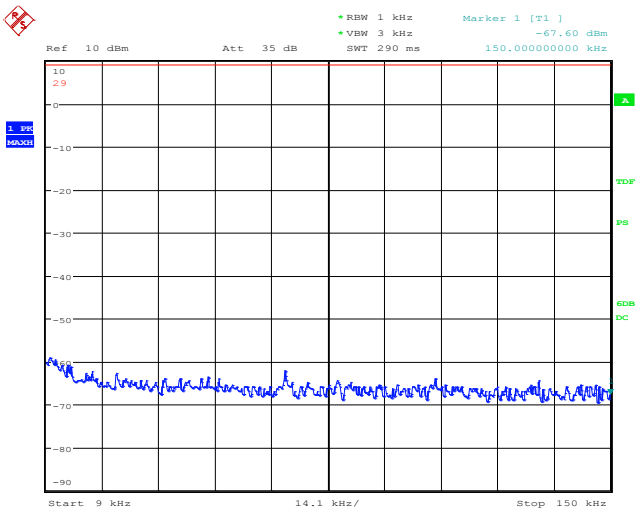


Date: 24.MAR.2016 11:37:35

** Demonstrates that while hopping, EUT does not leave the authorized band.*

200FSK: Mid Channel, 9kHz to 150kHz

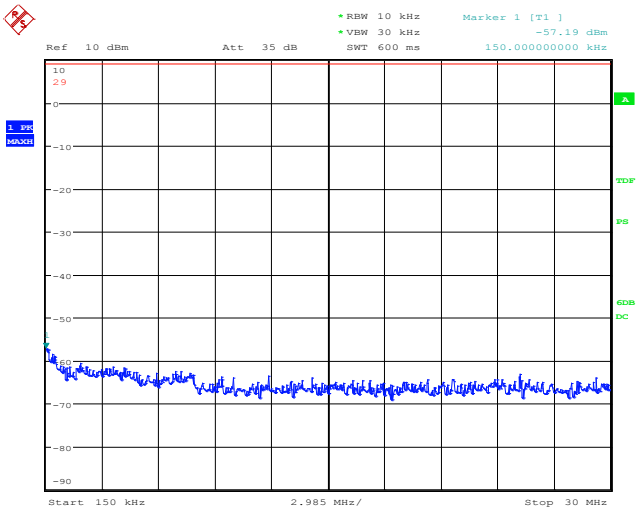
.



Date: 24.MAR.2016 09:04:11

200FSK: Mid Channel, 150kHz to 30 MHz

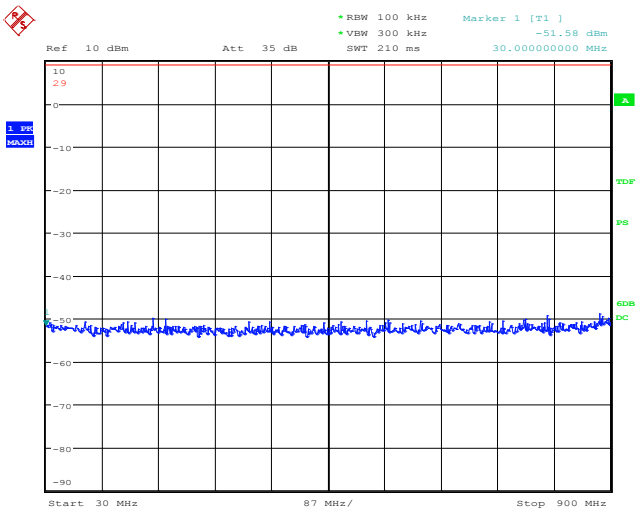
.



Date: 24.MAR.2016 09:04:40

200FSK: Mid Channel, 30 MHz to 900 MHz

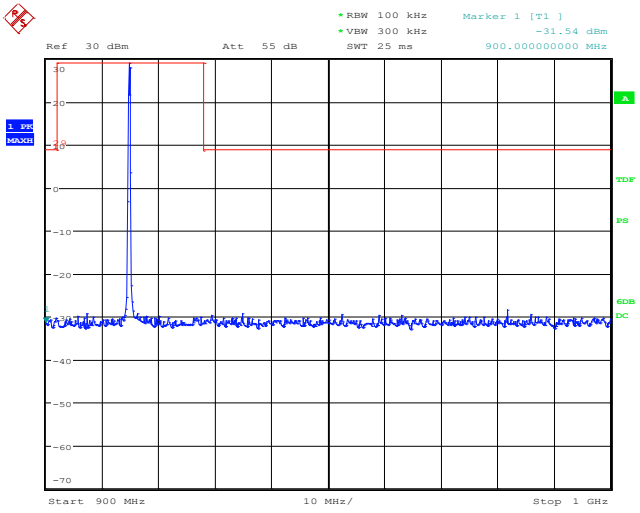
.



Date: 24.MAR.2016 09:04:59

200FSK: Mid Channel, 900 MHz to 1 GHz

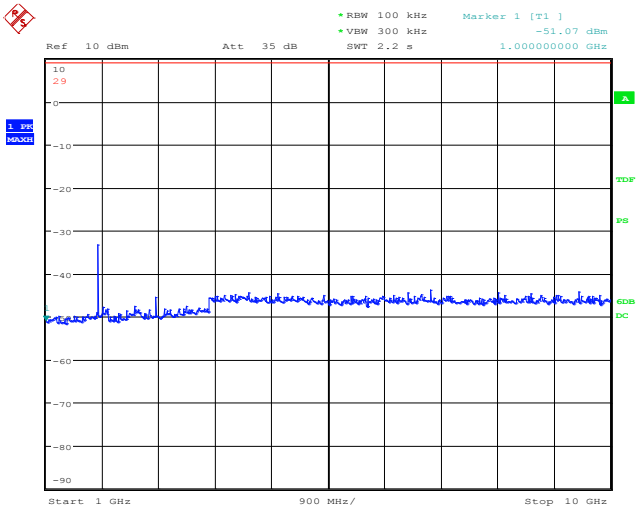
.



Date: 24.MAR.2016 09:05:21

200FSK: Mid Channel, 1 GHz to 10 GHz

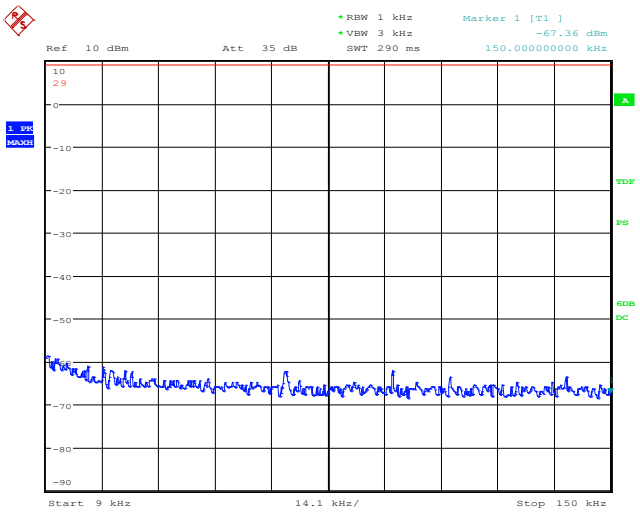
.



Date: 24.MAR.2016 09:06:26

200FSK: High Channel, 9kHz to 150kHz

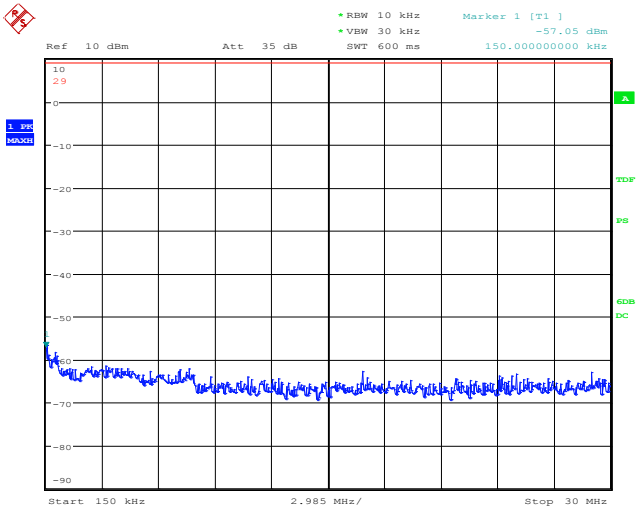
.



Date: 24.MAR.2016 09:01:28

200FSK: High Channel, 150kHz to 30 MHz

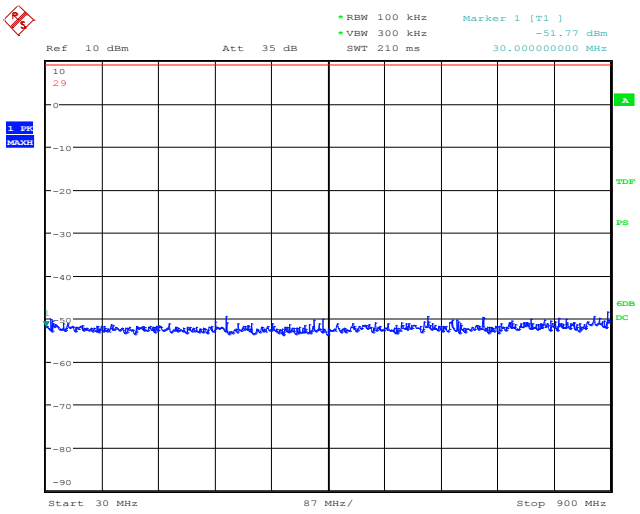
.



Date: 24.MAR.2016 09:01:58

200FSK: Mid Channel, 30 MHz to 900 MHz

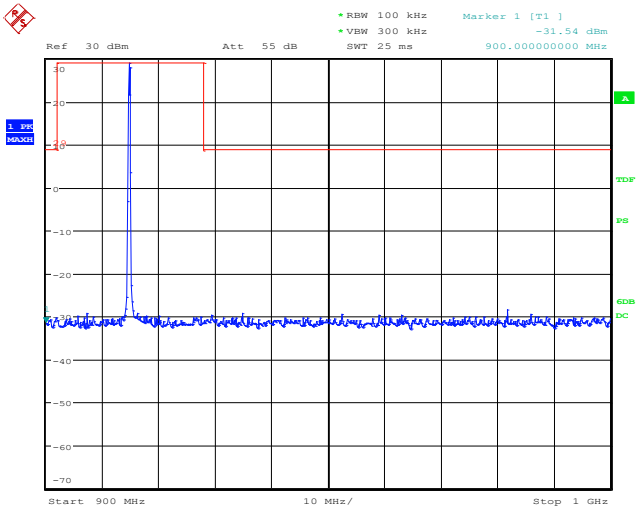
.



Date: 24.MAR.2016 09:02:22

200FSK: Mid Channel, 900 MHz to 1 GHz

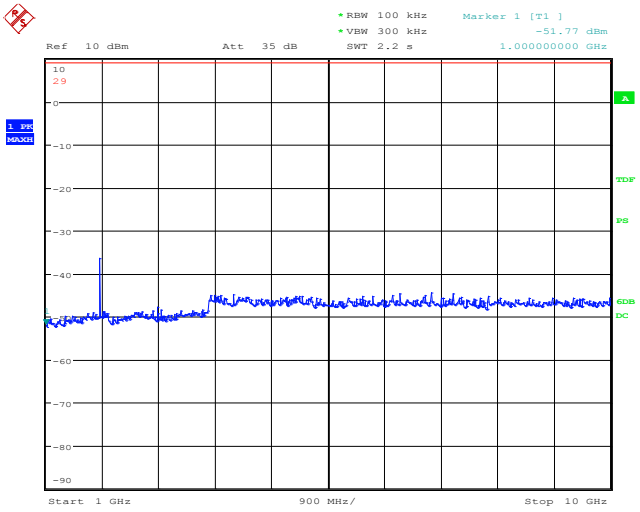
.



Date: 24.MAR.2016 09:05:21

200FSK: Mid Channel, 1 GHz to 10 GHz

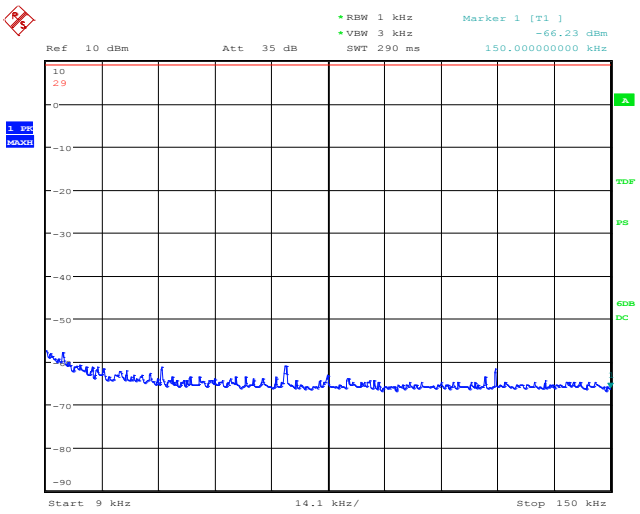
.



Date: 24.MAR.2016 09:03:17

50FSK: High Channel, 9kHz to 150kHz

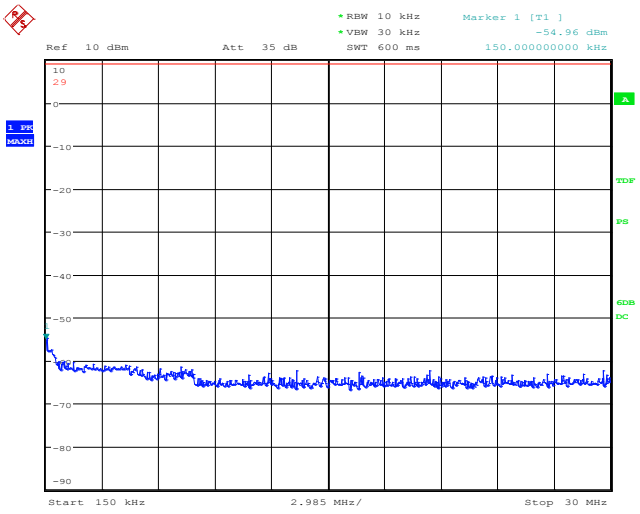
.



Date: 24.MAR.2016 07:43:51

50FSK: High Channel, 150kHz to 30 MHz

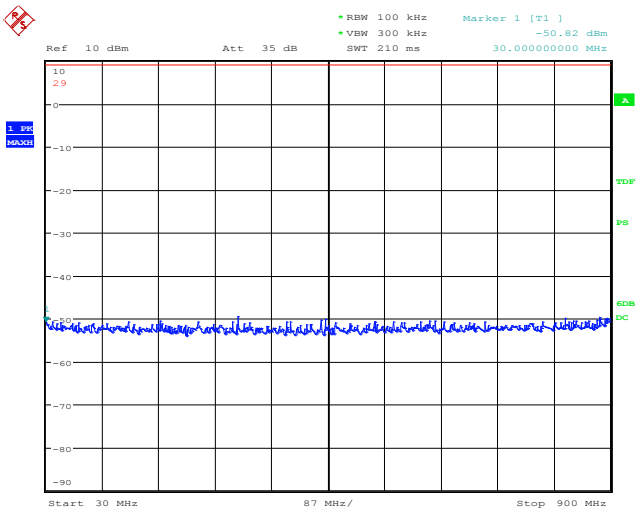
.



Date: 24.MAR.2016 07:45:51

50FSK: High Channel, 30 MHz to 900 MHz

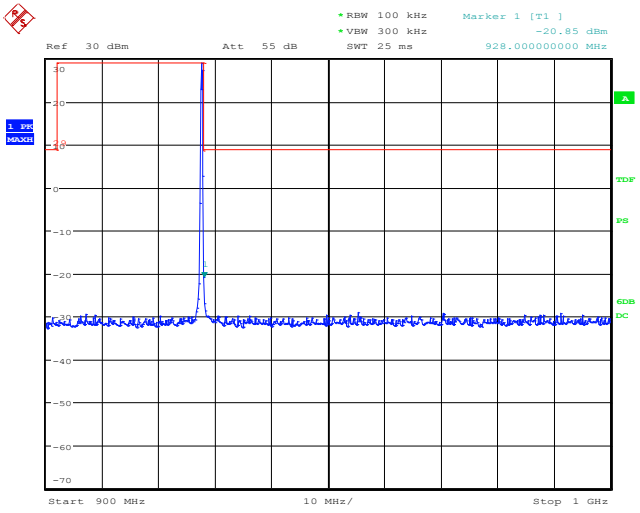
.



Date: 24.MAR.2016 07:46:26

50FSK: High Channel, 900 MHz to 1 GHz

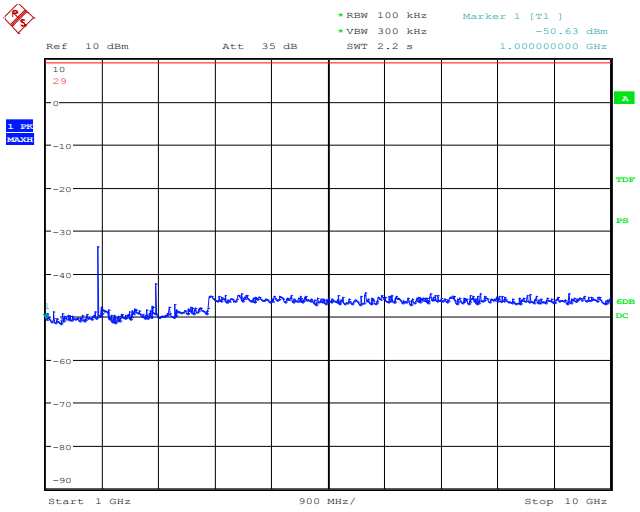
.



Date: 24.MAR.2016 09:02:49

50FSK: High Channel, 1 GHz to 10 GHz

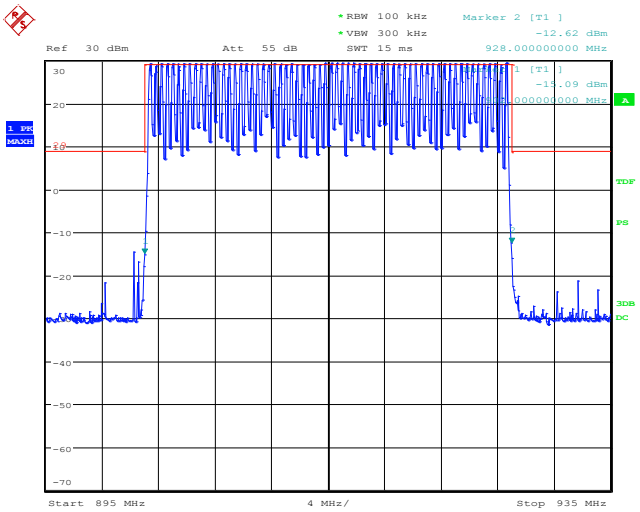
.



Date: 24.MAR.2016 07:49:27

50FSK: High Channel, 895 MHz to 935 MHz (Hopping)*

.



Date: 24.MAR.2016 11:35:13

** Demonstrates that while hopping, EUT does not leave the authorized band.*

11 RADIATED SPURIOUS EMISSION

The EUT antenna port was fitted with its integral/internal chip antenna. Radiated emissions were measured in a Semi-Anechoic Chamber. All emissions generated that fall in the restricted bands per FCC Part 15.205 were examined.

11.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).

11.2 Radiated Spurious Emission Test Data

Test Date(s):	Mar. 24, 2016	**Test Engineer:**	J. Knepper
Standards:	CFR 47 Part 15.247(d); Part 15.209	**Air Temperature:**	21.2ºC
		Relative Humidity:	40%

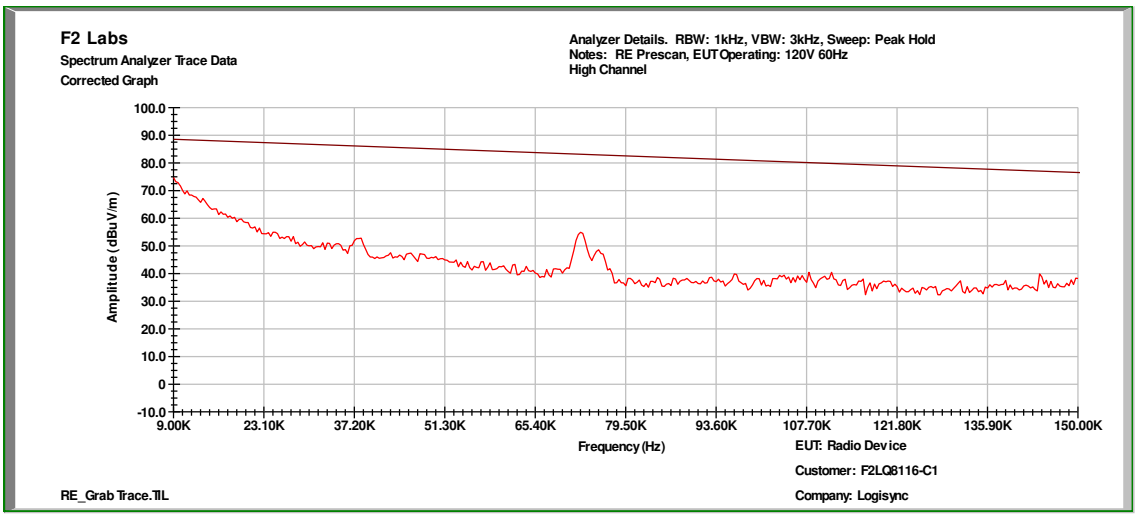
Notes: Plots are peak, max hold prescan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs are shown below.

The equipment was fully exercised with all cabling attached to the EUT and was positioned in a semi-anechoic chamber for maximum emissions. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results can be found below.

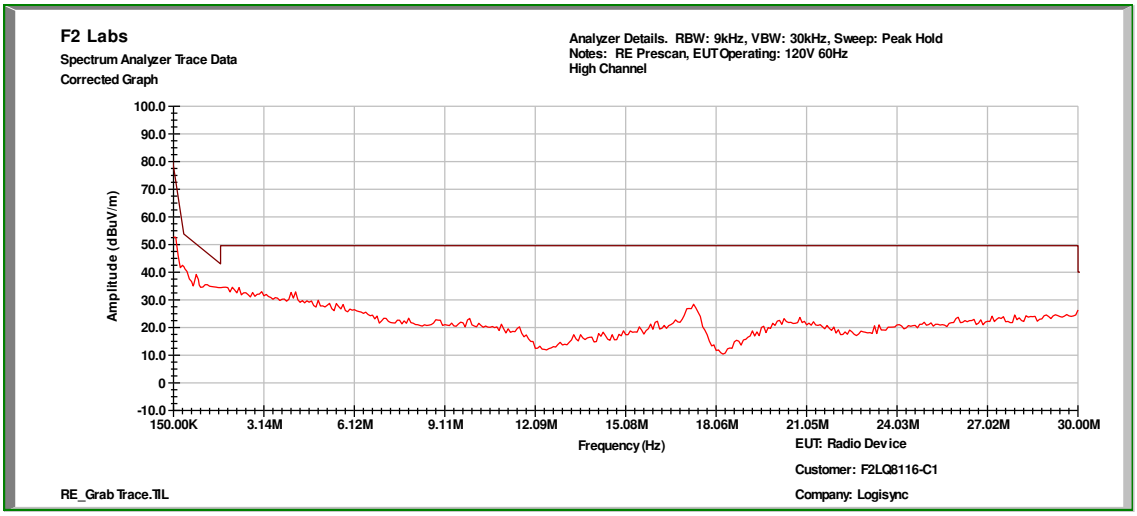
Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit.

In the following plots, the black line indicates ambient noise and the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables. The plots are for reference only and the limit lines are not actual limit lines but merely a guide.

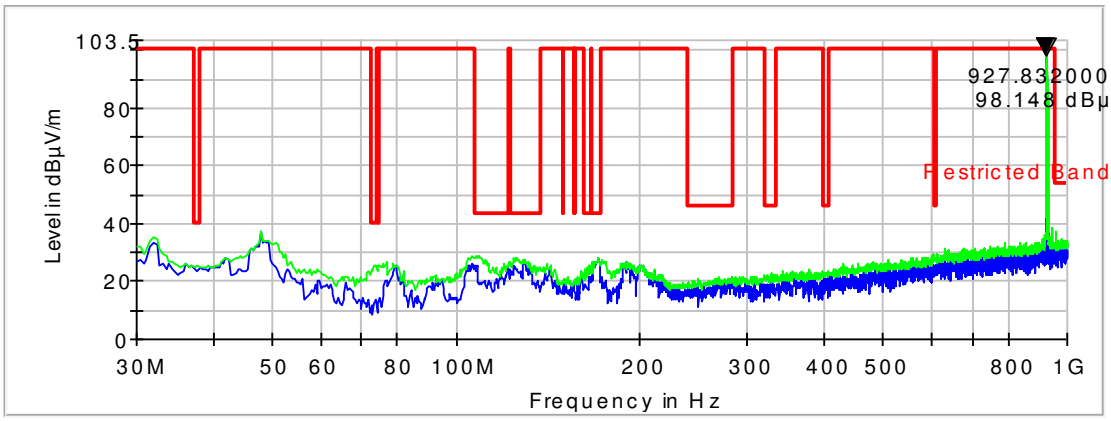
50FSK: High Channel, 9kHz to 150kHz



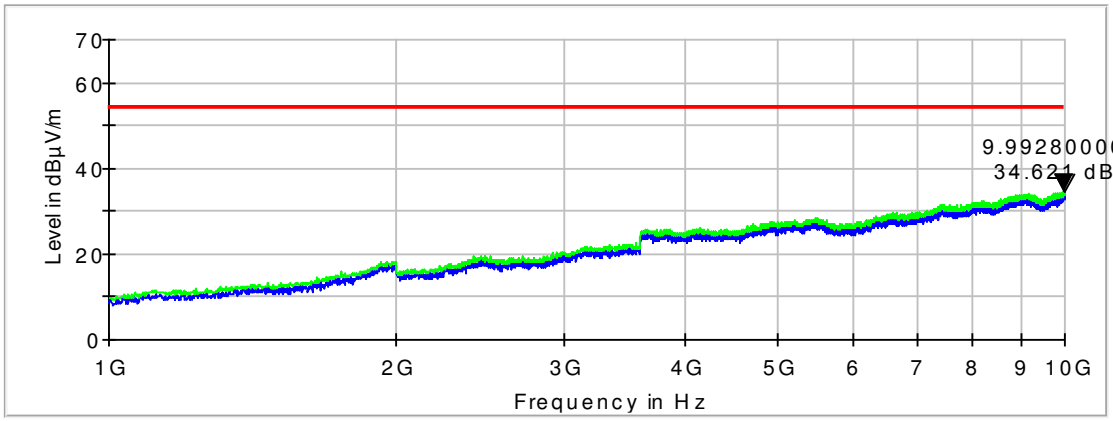
50FSK: High Channel, 150kHz to 30 MHz



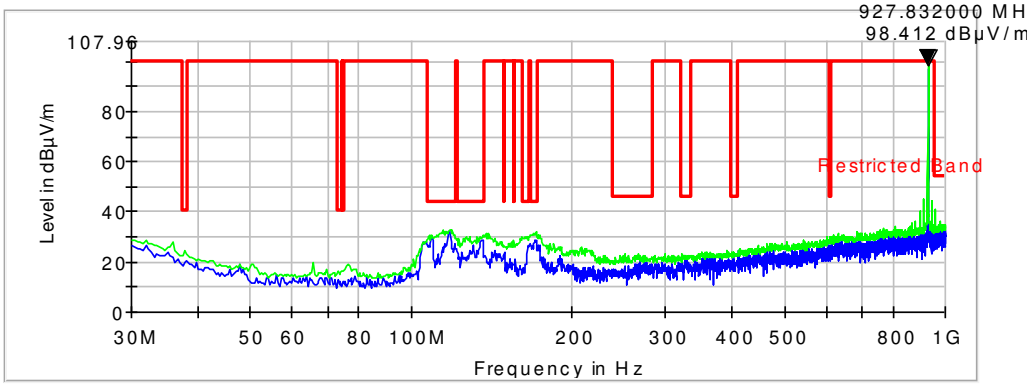
50FSK: High Channel, 30 MHz to 1 GHz, Vertical



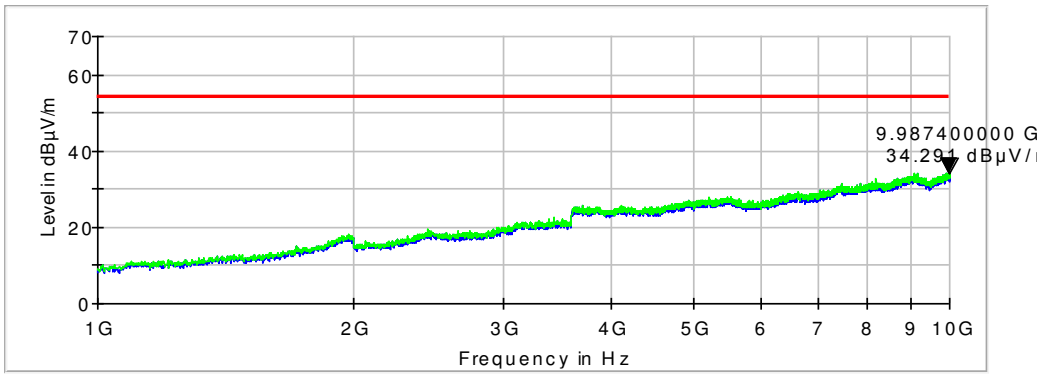
50FSK: High Channel, 1 GHz to 10 GHz, Vertical



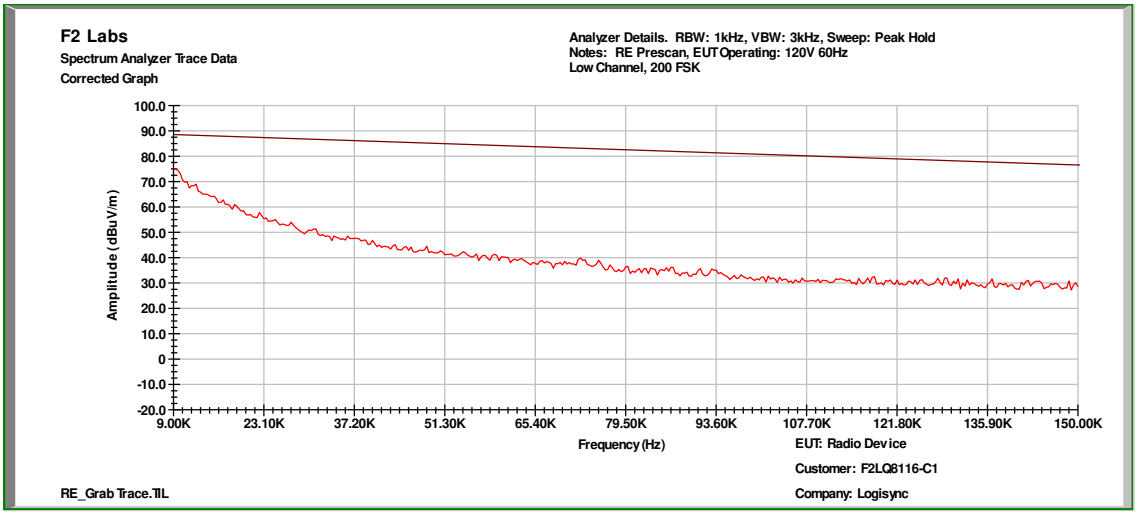
50FSK: High Channel, 30 MHz to 1 GHz, Horizontal



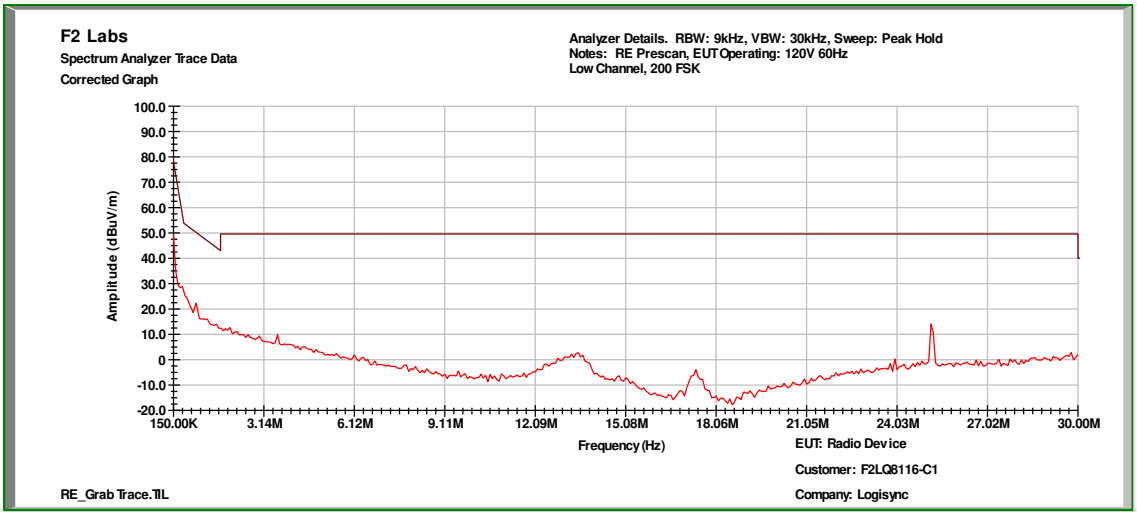
50FSK: High Channel, 1 GHz to 10 GHz, Horizontal



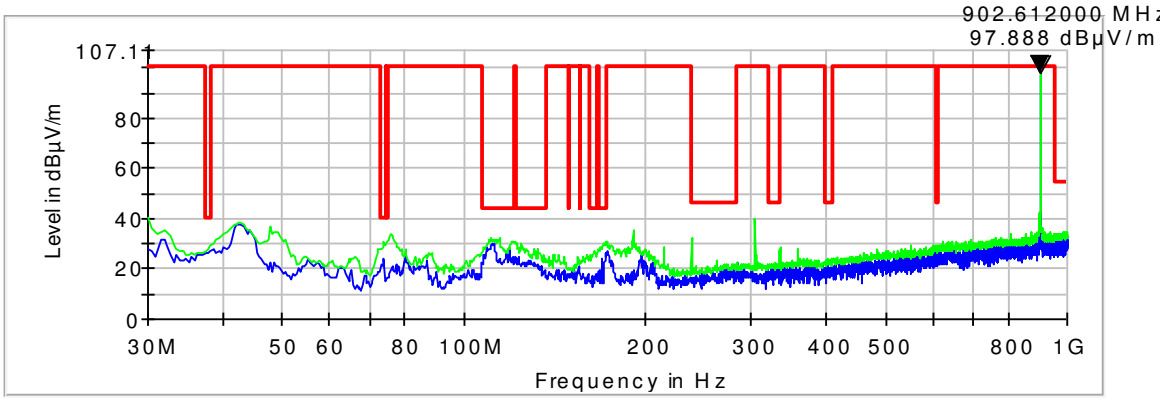
200FSK: Low Channel, 9kHz to 150kHz



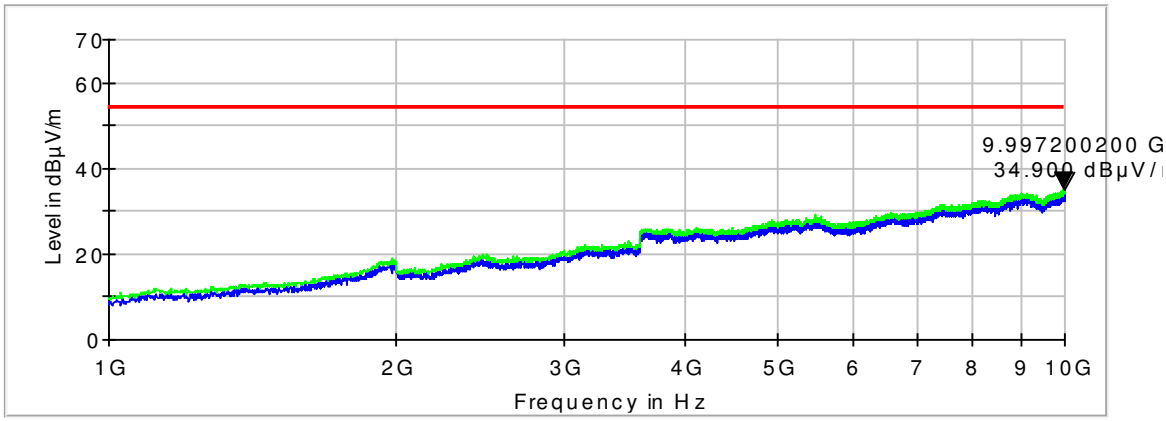
200FSK: Low Channel, 150kHz to 30 MHz



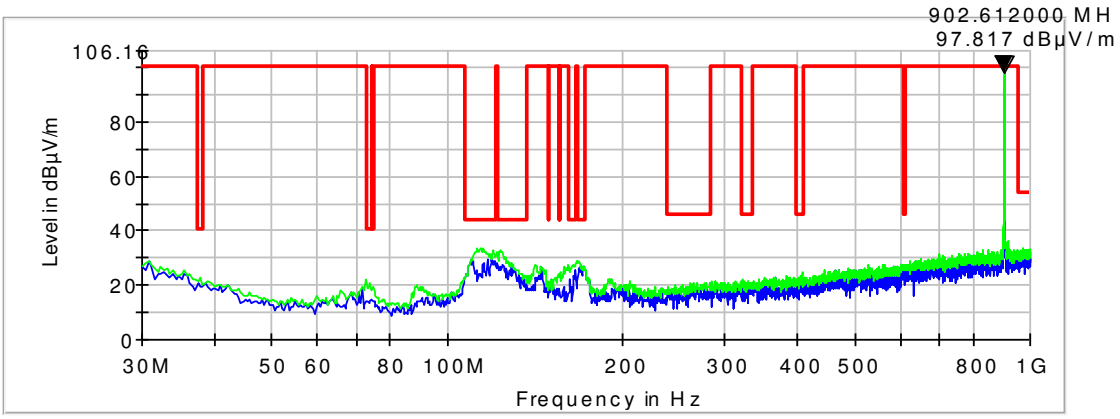
200FSK: Low Channel, 30 MHz to 1 GHz, Vertical



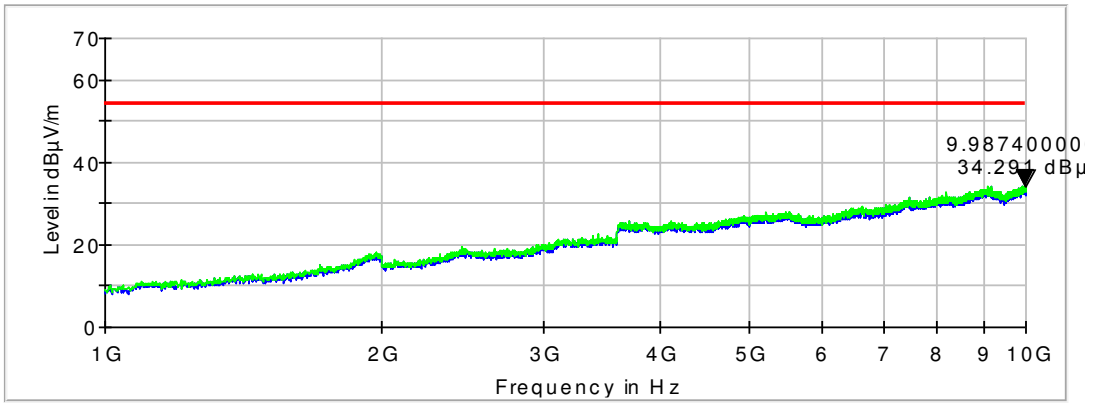
200FSK: Low Channel, 1 GHz to 10 GHz, Vertical



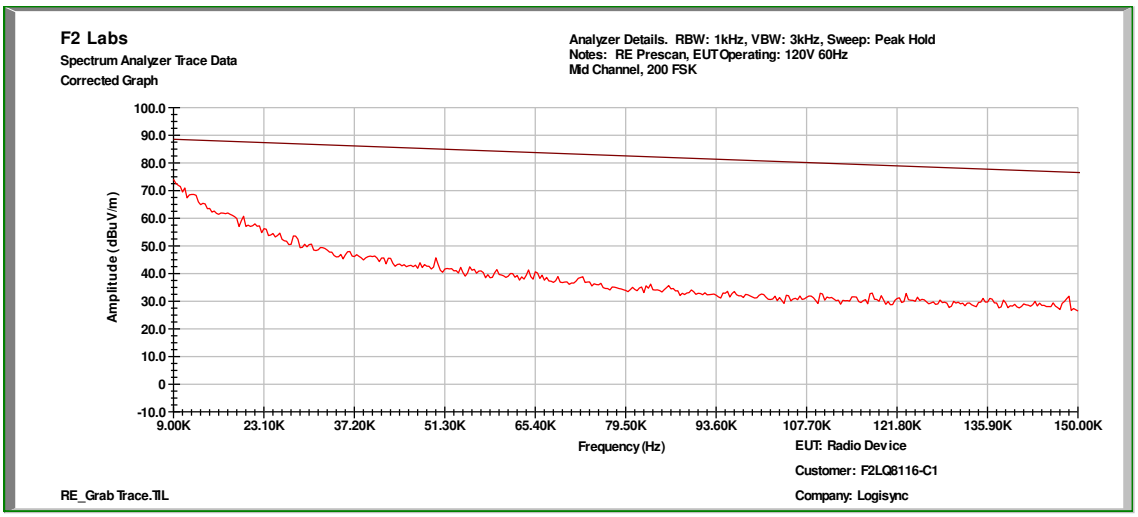
200FSK: Low Channel, 30 MHz to 1 GHz, Horizontal



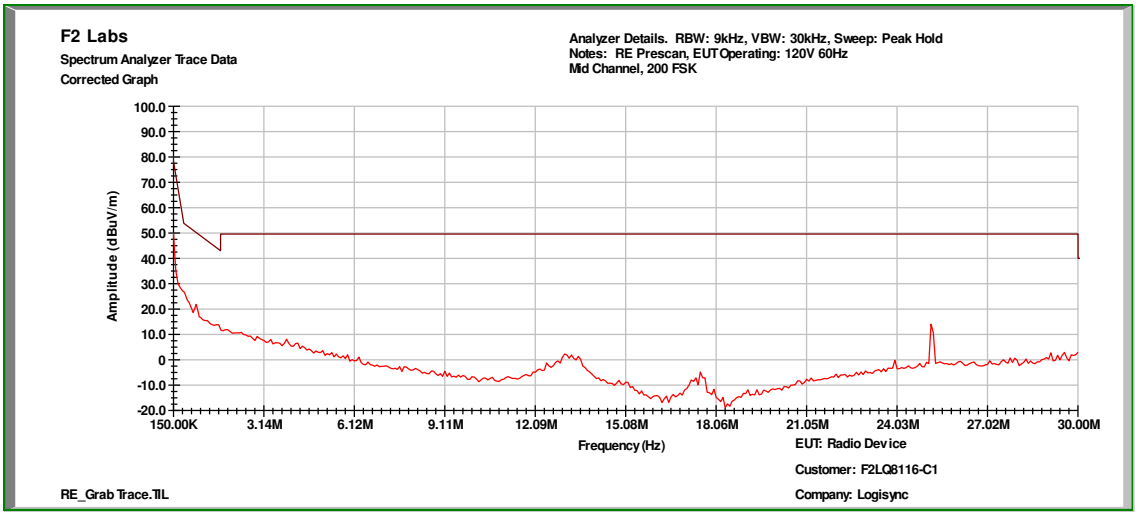
200FSK: Low Channel, 1 GHz to 10 GHz, Horizontal



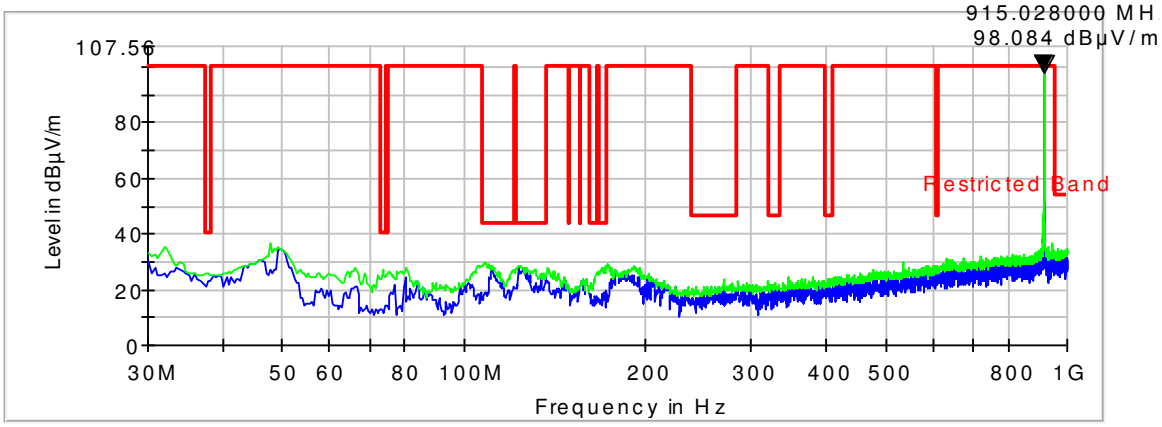
200FSK: Mid Channel, 9kHz to 150kHz



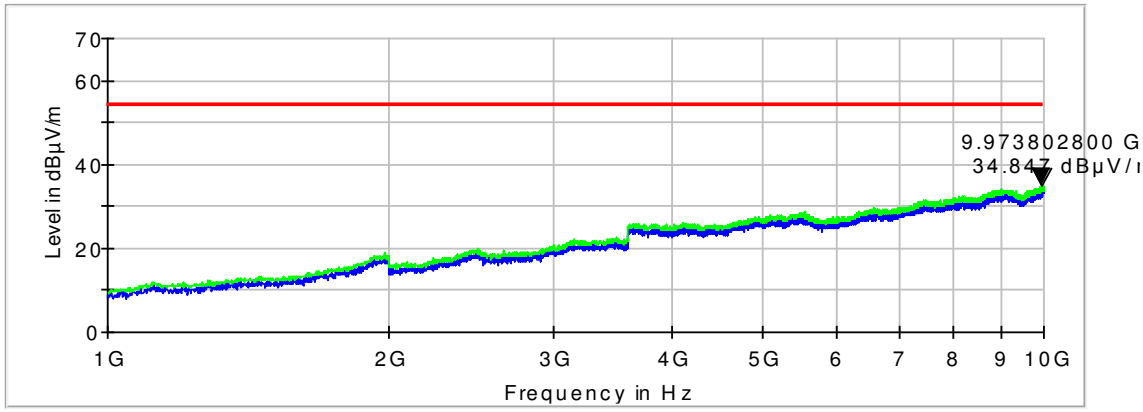
200FSK: Mid Channel, 150kHz to 30 MHz



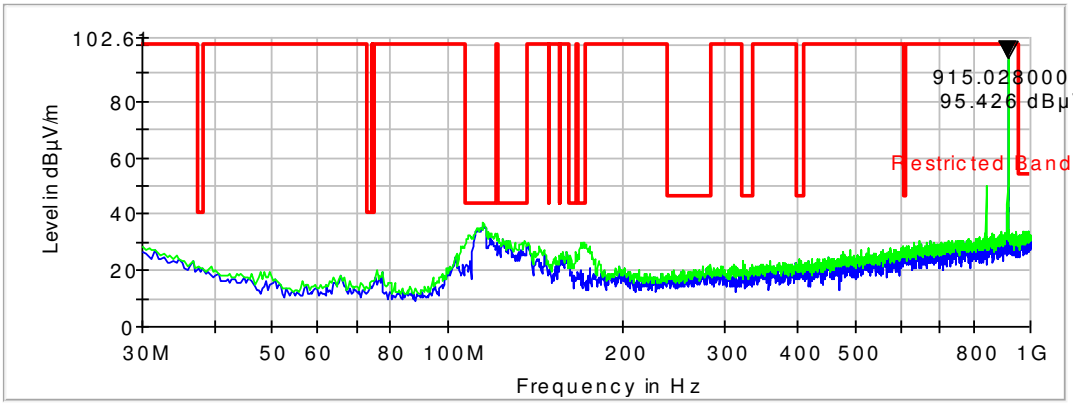
200FSK: Mid Channel, 30 MHz to 1 GHz, Vertical



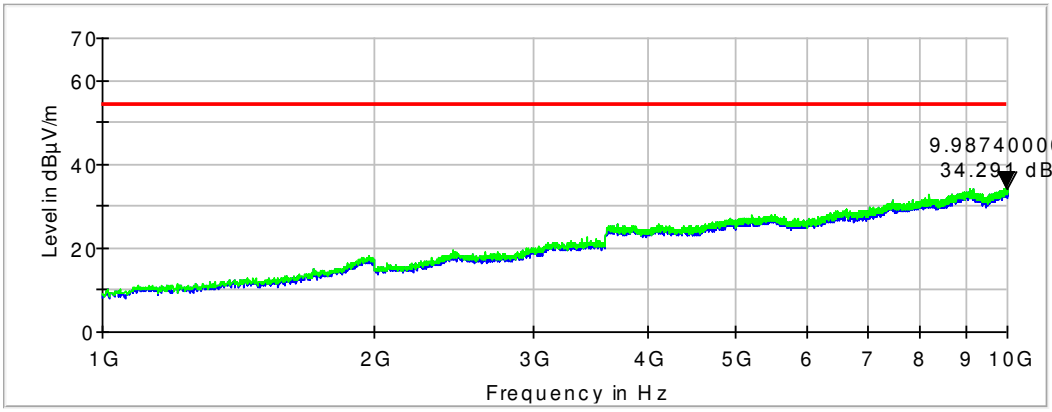
200FSK: Mid Channel, 1 GHz to 10 GHz, Vertical



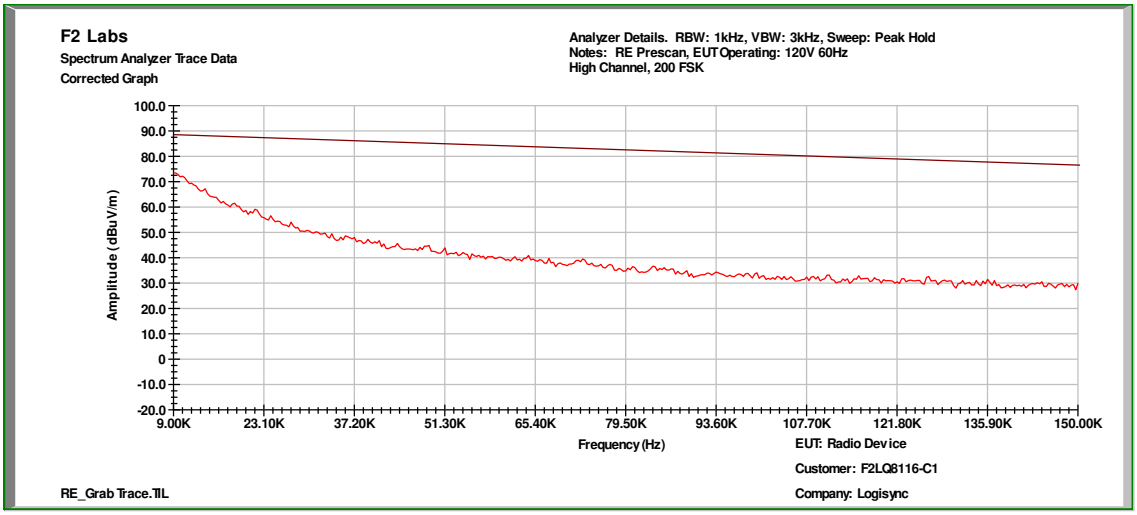
200FSK: Mid Channel, 30 MHz to 1 GHz, Horizontal



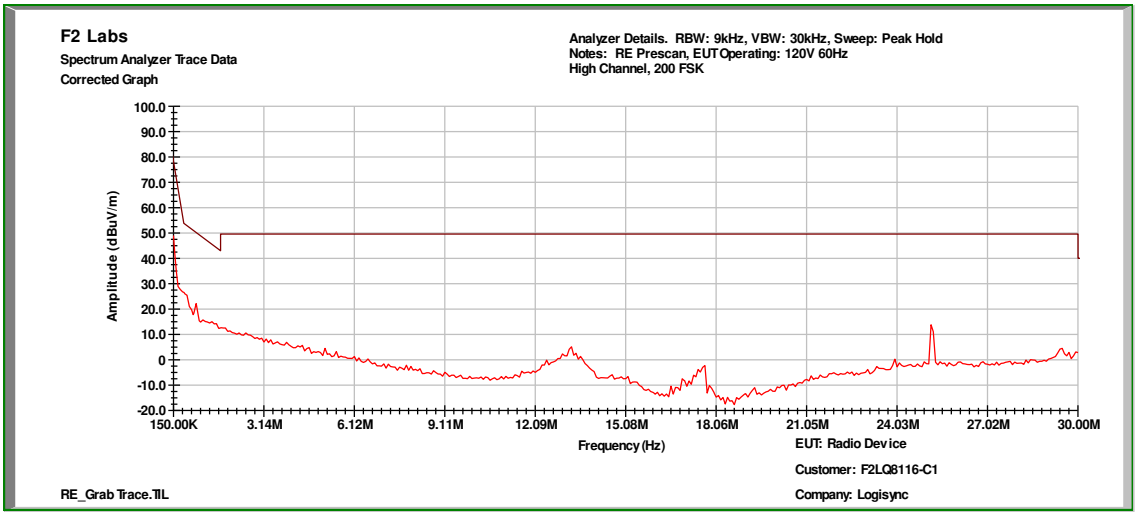
200FSK: Mid Channel, 1 GHz to 10 GHz, Horizontal



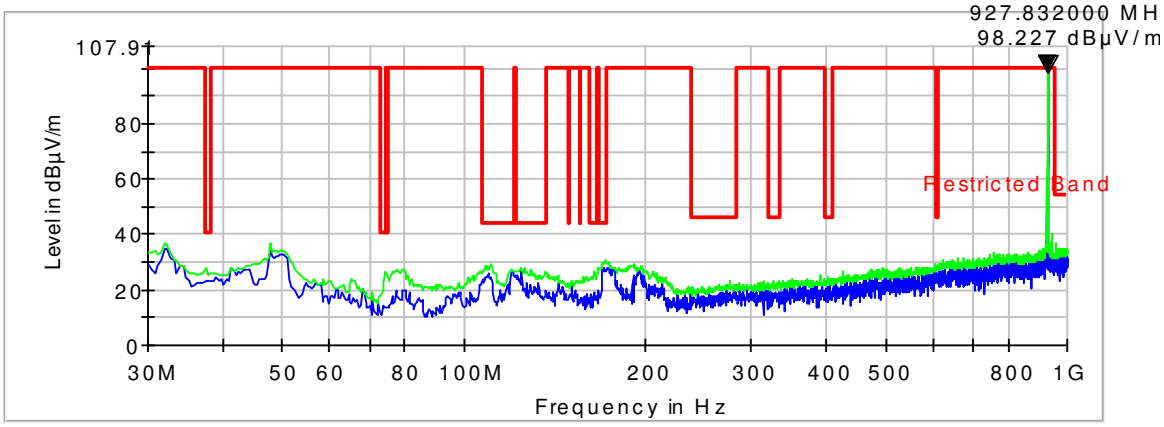
200FSK: High Channel, 9kHz to 150kHz



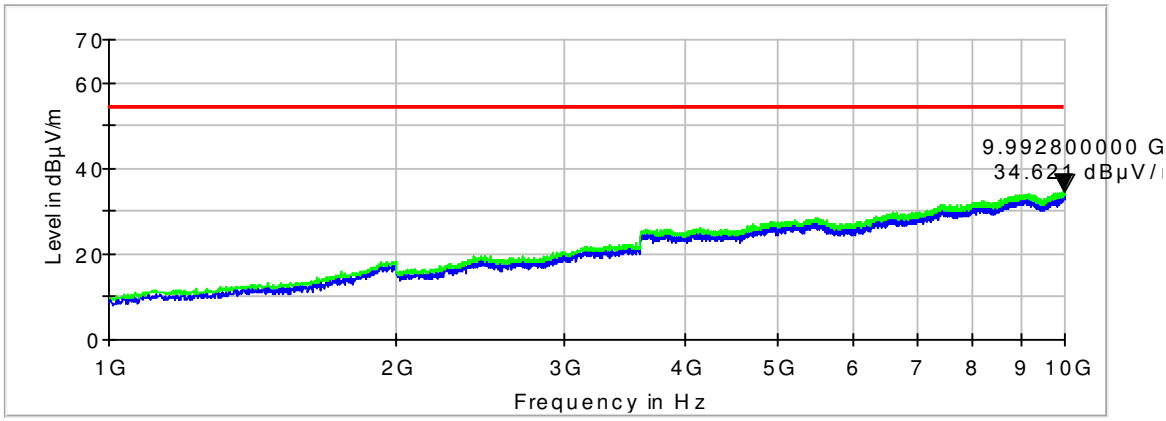
200FSK: High Channel, 150kHz to 30 MHz



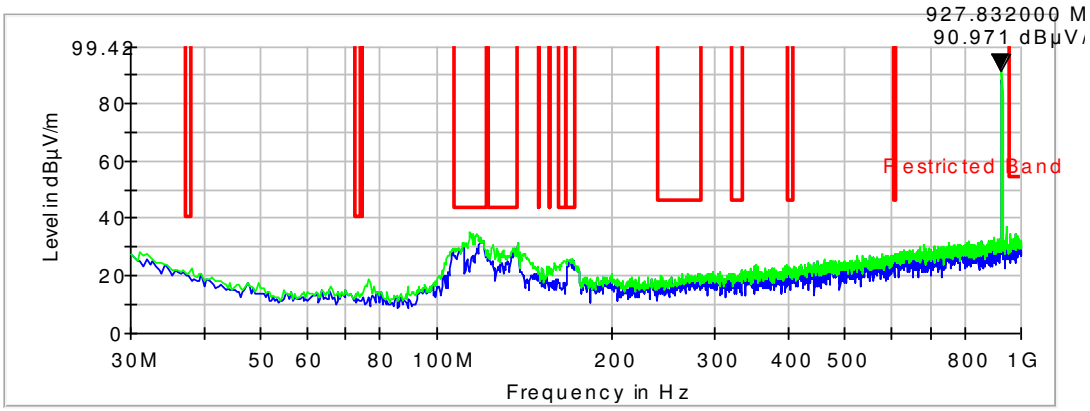
200FSK: High Channel, 30 MHz to 1 GHz, Vertical



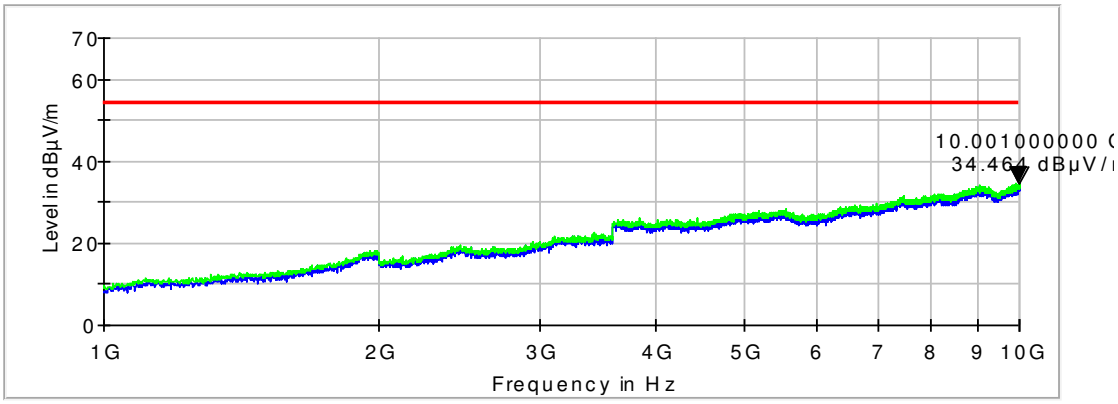
200FSK: High Channel, 1 GHz to 10 GHz, Vertical



200FSK: High Channel, 30 MHz to 1 GHz, Horizontal



200FSK: High Channel, 1 GHz to 10 GHz, Horizontal



Measurements

50FSK: High Channel – QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
37.760000	V	7.9	16.1	24.00	40.0	-16.0
73.456000	V	6.6	8.4	15.00	40.0	-25.0
108.764000	V	10.3	12.7	23.00	43.52	-20.5
109.540000	H	16.0	12.8	28.80	43.52	-14.7
118.076000	H	14.0	14.5	28.50	43.52	-15.0
133.208000	H	10.0	14.0	24.00	43.52	-19.5
166.964000	H	11.9	12.6	24.50	43.52	-19.0
170.844000	V	12.9	12.3	25.20	43.52	-18.3
171.620000	H	13.7	12.2	25.90	43.52	-17.6
960.000000	H	8.6	23.4	32.00	46.0	-14.0
960.036000	V	8.8	23.4	32.20	54.0	-21.8

200FSK: Low Channel – QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
38.148000	V	10.5	15.8	26.30	40.0	-13.7
72.292000	H	11.0	8.4	19.40	40.0	-20.6
111.092000	V	14.1	13.1	27.20	43.52	-16.3
112.644000	H	16.4	13.3	29.70	43.52	-13.8
114.584000	V	10.6	13.7	24.30	43.52	-19.2
115.748000	H	16.7	13.9	30.60	43.52	-12.9
168.128000	H	12.8	12.5	25.30	43.52	-18.2
172.396000	V	10.9	12.2	23.10	43.52	-20.4
283.364000	V	6.8	13.8	20.60	46.0	-25.4
960.000000	H	8.9	23.4	32.30	46.0	-13.7
960.000000	V	8.9	23.4	32.30	46.0	-13.7

200FSK: Mid Channel – QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
37.372000	V	6.6	16.4	23.00	40.0	-17.0
37.372000	H	8.0	16.4	24.40	40.0	-15.6
73.456000	V	6.7	8.4	15.10	40.0	-24.9
108.764000	V	11.6	12.7	24.30	43.52	-19.2
112.256000	H	15.5	13.3	28.80	43.52	-14.7
117.688000	V	7.3	14.4	21.70	43.52	-21.8
121.180000	H	8.5	14.3	22.80	43.52	-20.7
127.388000	V	10.3	14.2	24.50	43.52	-19.0
171.620000	H	8.1	12.2	20.30	43.52	-23.2
960.000000	V	8.8	23.4	32.20	46.0	-13.8
960.000000	H	8.7	23.4	32.10	46.0	-13.9

200FSK: High Channel – QuasiPeak

Frequency (MHz)	Antenna Polarization	Reading (dBµV)	Cable Loss & Antenna Factor (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
37.372000	V	7.6	16.4	24.00	40.0	-16.0
74.232000	V	9.6	8.4	18.00	40.0	-22.0
111.092000	V	9.3	13.1	22.40	43.52	-21.1
114.196000	H	16.5	13.6	30.10	43.52	-13.4
115.748000	H	16.3	13.9	30.20	43.52	-13.3
119.240000	H	15.0	14.6	29.60	43.52	-13.9
129.328000	V	8.0	14.2	22.20	43.52	-21.3
129.328000	V	8.0	14.2	22.20	43.52	-21.3
137.864000	H	12.0	13.6	25.60	43.52	-17.9
172.008000	H	10.6	12.2	22.80	43.52	-20.7
172.008000	V	13.7	12.2	25.90	43.52	-17.6
960.000000	H	8.6	23.4	32.00	46.0	-14.0
960.000000	V	8.8	23.4	32.20	46.0	-13.8

12 FCC PART 15.247(e) – PEAK POWER SPECTRAL DENSITY (PSD)

Not Required

12.1 This unit is FHSS and is neither a DHSS device nor a Hybrid device that would fall under (e) or (f) of FCC 15.247.

13 ANSI 63.10 7.8.2 - FREQUENCY SEPARATION

EUT was directly connected to the analyzer with the Hopping function on.

13.1 Requirements:

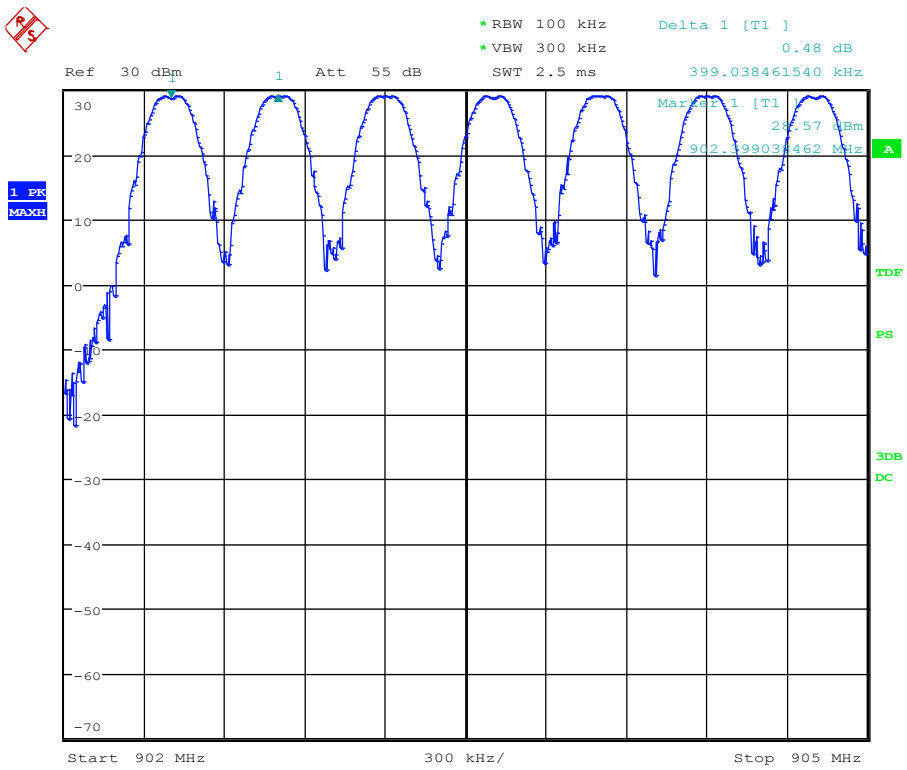
Frequency separation must be greater than 25kHz or 20dB bandwidth of the Hopping Channel, whichever is greater.

13.2 Frequency Separation Test Data

Test Date(s):	Mar. 24, 2016	Test Engineer:	J. Knepper
Standards:	ANSI 63.10 7.8.2	Air Temperature:	20.3ºC
		Relative Humidity:	40%

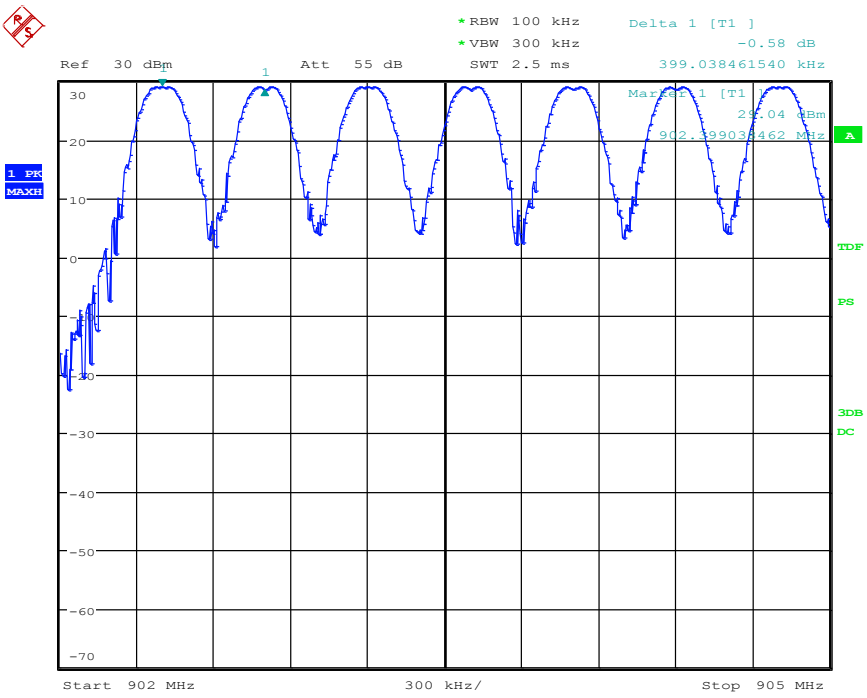
Limit: >317.3kHz

50FSK



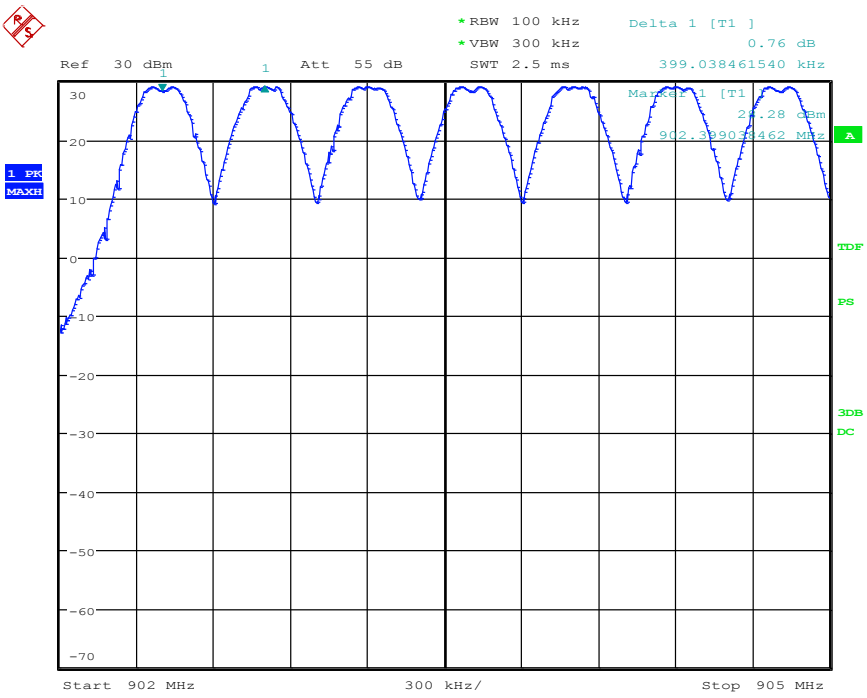
Date: 24.MAR.2016 10:09:21

50GFSK



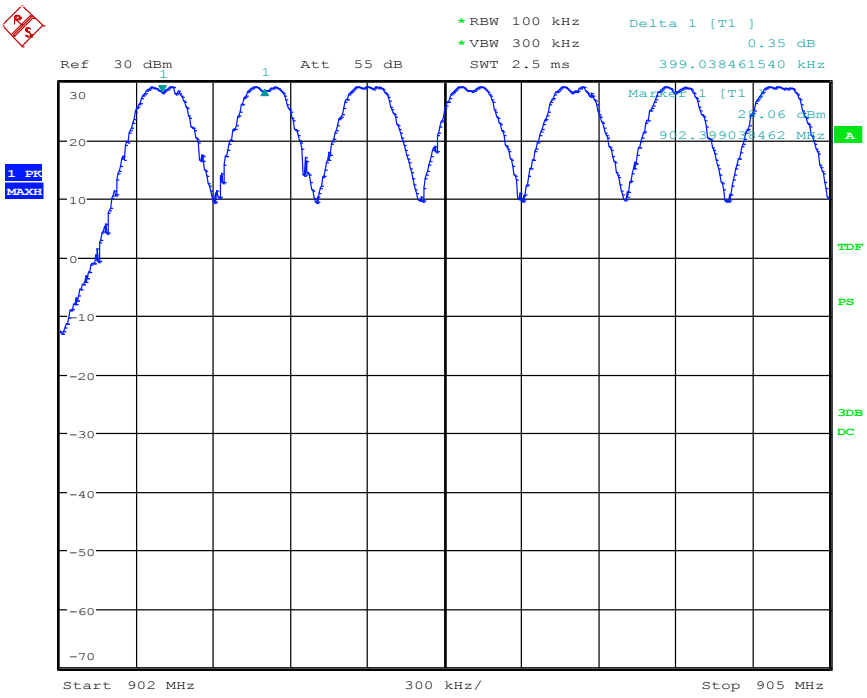
Date: 24.MAR.2016 10:10:17

150FSK



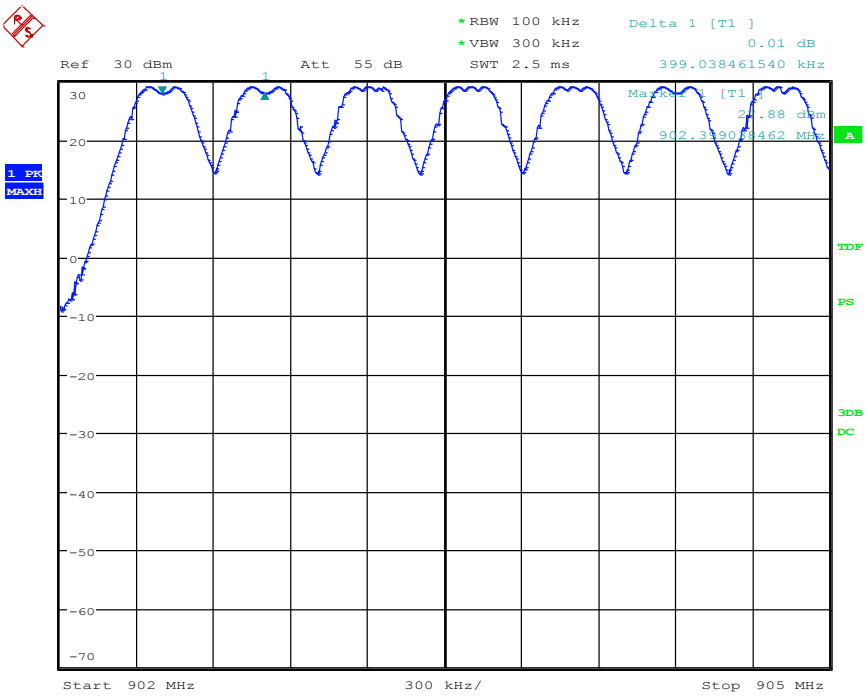
Date: 24.MAR.2016 10:11:58

150GFSK



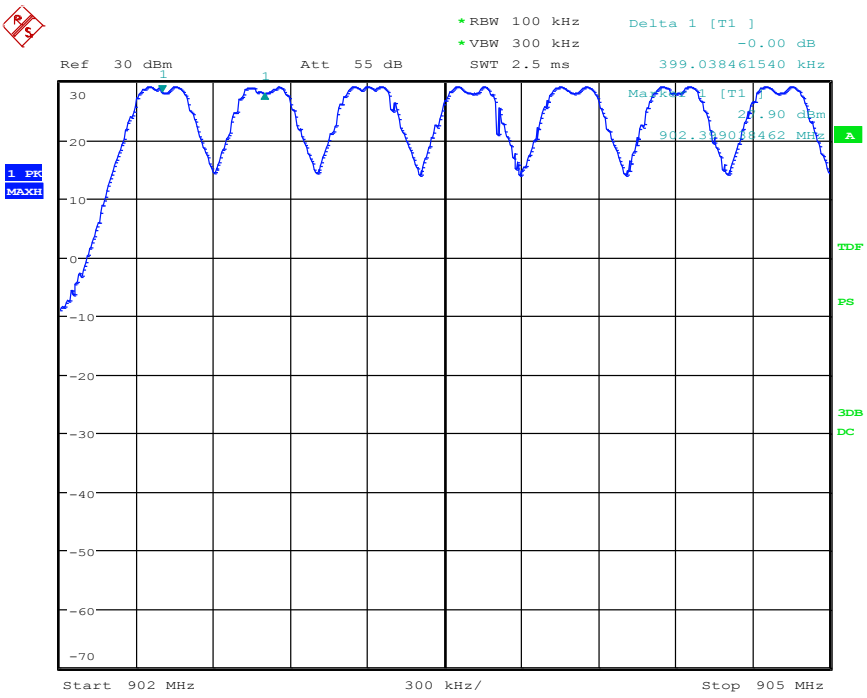
Date: 24.MAR.2016 10:12:51

200FSK



Date: 24.MAR.2016 10:14:29

200GFSK



Date: 24.MAR.2016 10:16:43

14 ANSI 63.10 7.8.3 – NUMBER OF HOPPING FREQUENCIES

The EUT was directly connected to the measurement device through a SMA connector. With the hopping enabled, the EUT was checked to ensure all of the hopping channels were present.

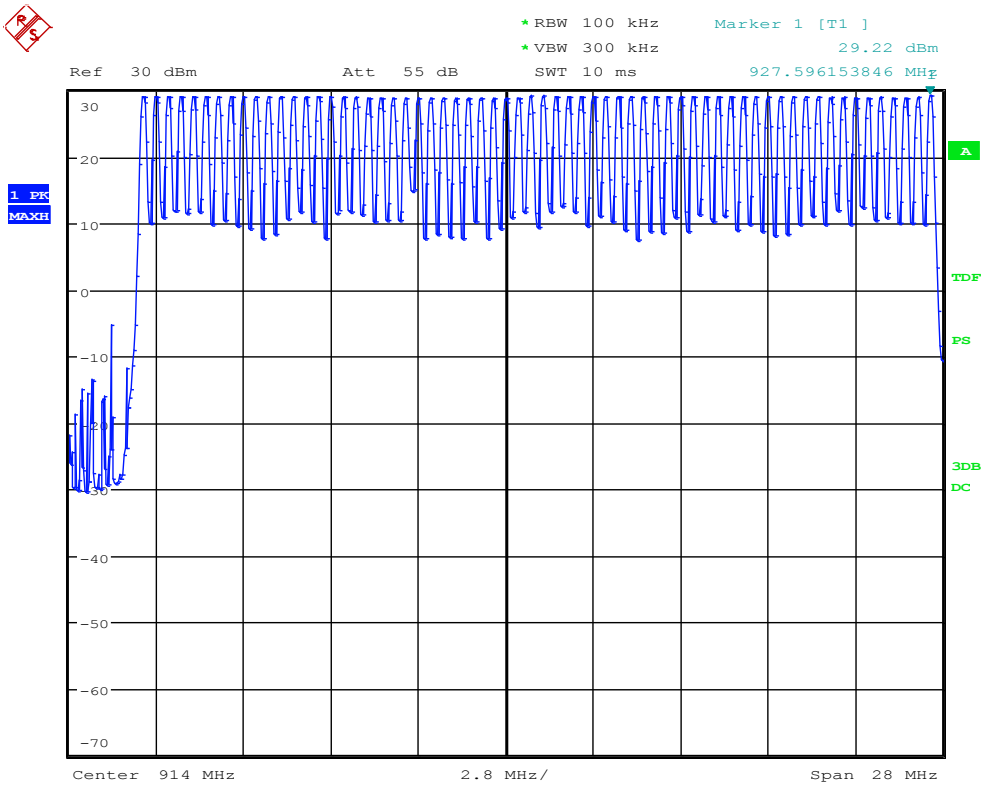
14.1 Requirements:

Verify that all channels are present.

14.2 Number of Hopping Frequencies Test Data

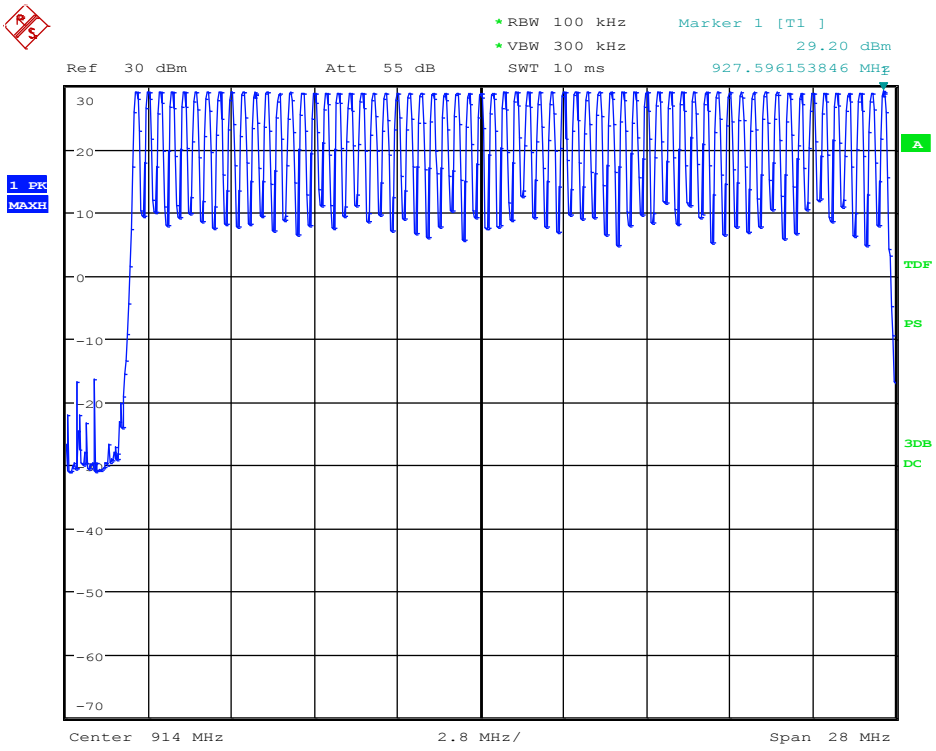
Test Date(s):	Mar. 24, 2016	Test Engineer:	J. Knepper
Standards:	ANSI 63.10 7.8.3	Air Temperature:	20.3ºC
		Relative Humidity:	40%

50FSK



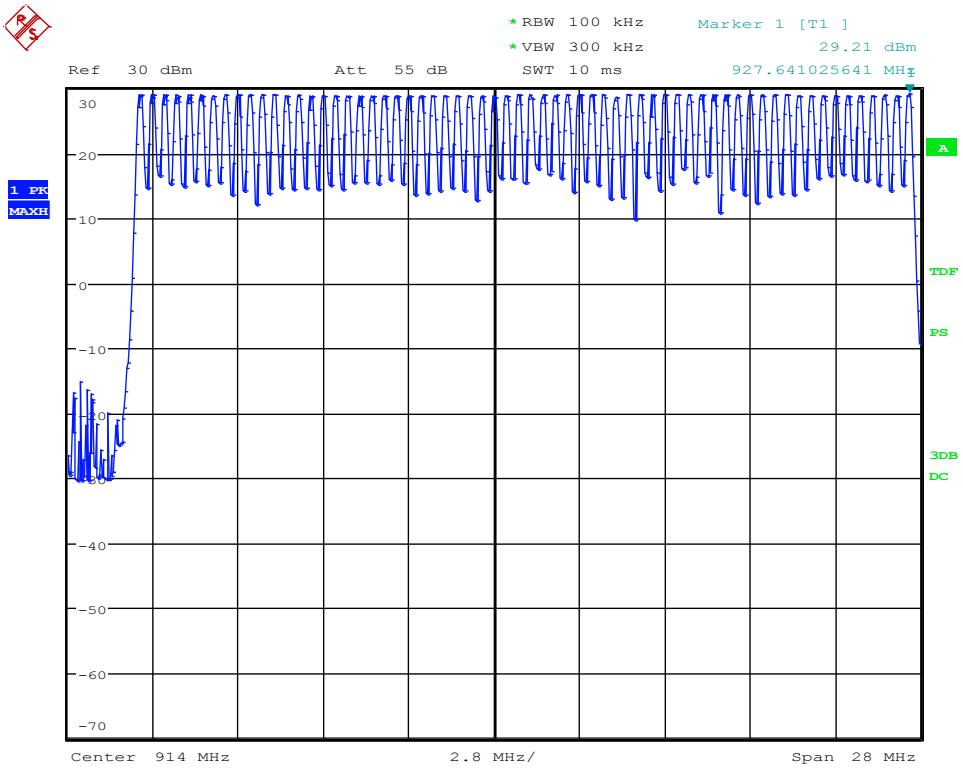
Date: 24.MAR.2016 10:37:24

50GFSK



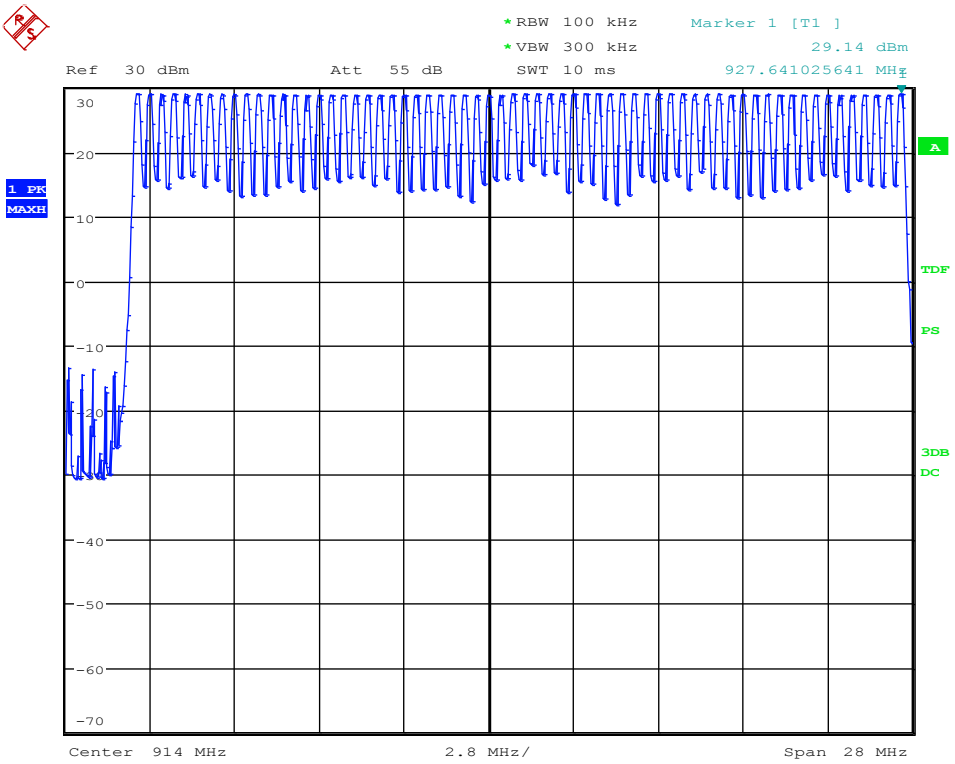
Date: 24.MAR.2016 10:39:26

150FSK



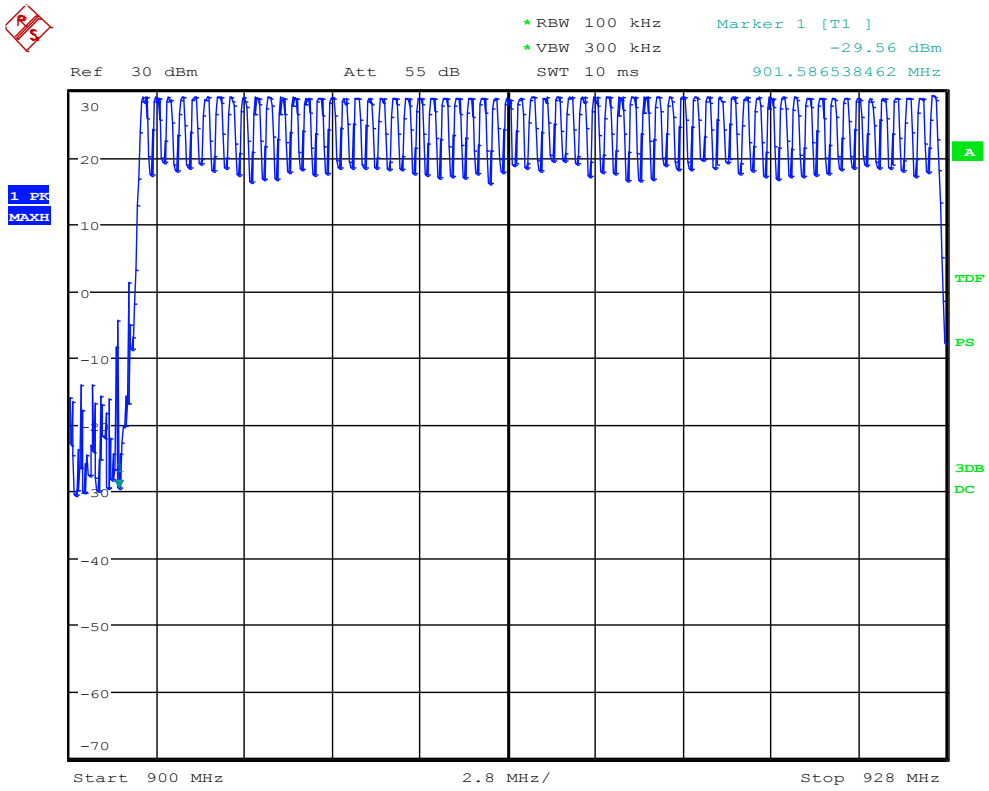
Date: 24.MAR.2016 10:42:24

150GFSK



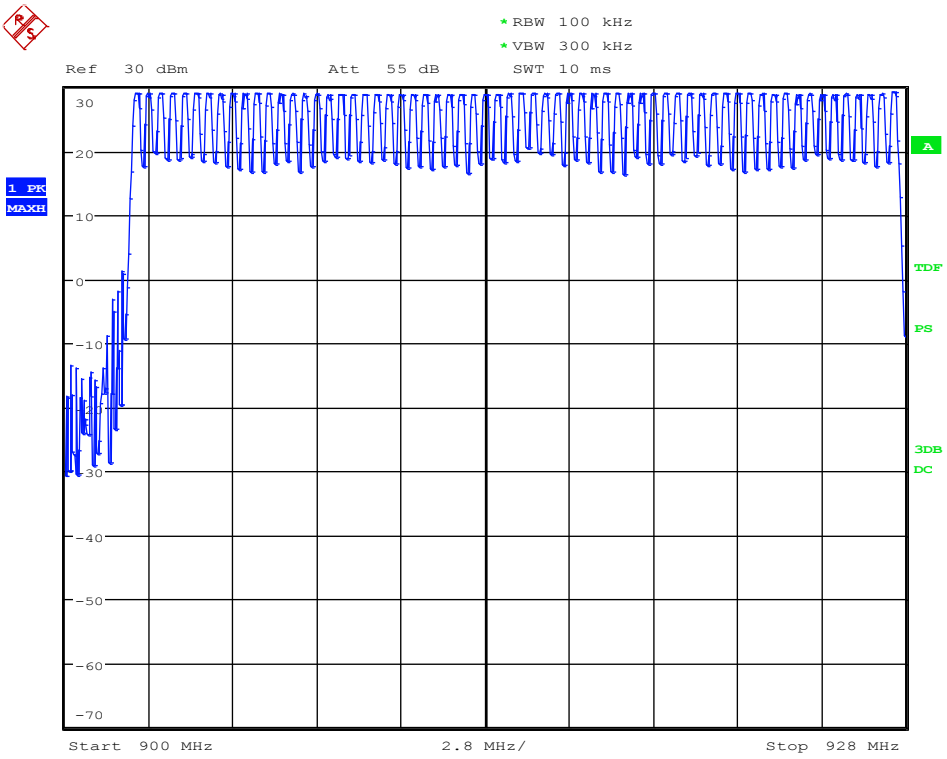
Date: 24.MAR.2016 10:45:46

200FSK



Date: 24.MAR.2016 10:22:20

200GFSK



Date: 24.MAR.2016 10:27:32

15 ANSI 63.10 7.8.4 – DWELL TIME

Test was to verify the dwell time on any channel while Hopping was on. EUT was directly connected to analyzer. The plots on the following page show how long a transmission is, and the transmissions in ten seconds.

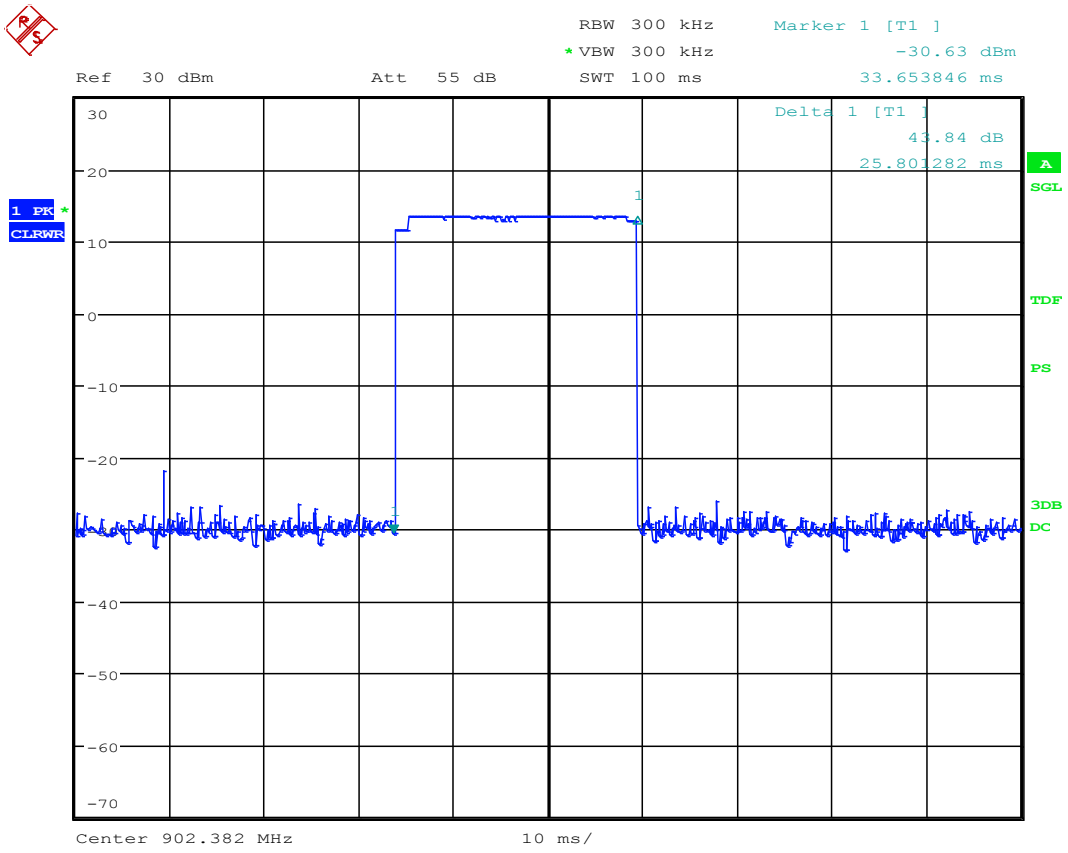
15.1 Requirements:

Limit of 0.4 seconds in a 10-second period for OBW exceeding 250 kHz. Limit of 0.4 seconds in a 20-second period for OBW less than 250 kHz.

15.2 Dwell Time Test Data

Test Date(s):	Mar. 24, 2016	**Test Engineer:**	J. Knepper
Standards:	ANSI 63.10 7.8.4	**Air Temperature:**	20.1ºC
		Relative Humidity:	40%

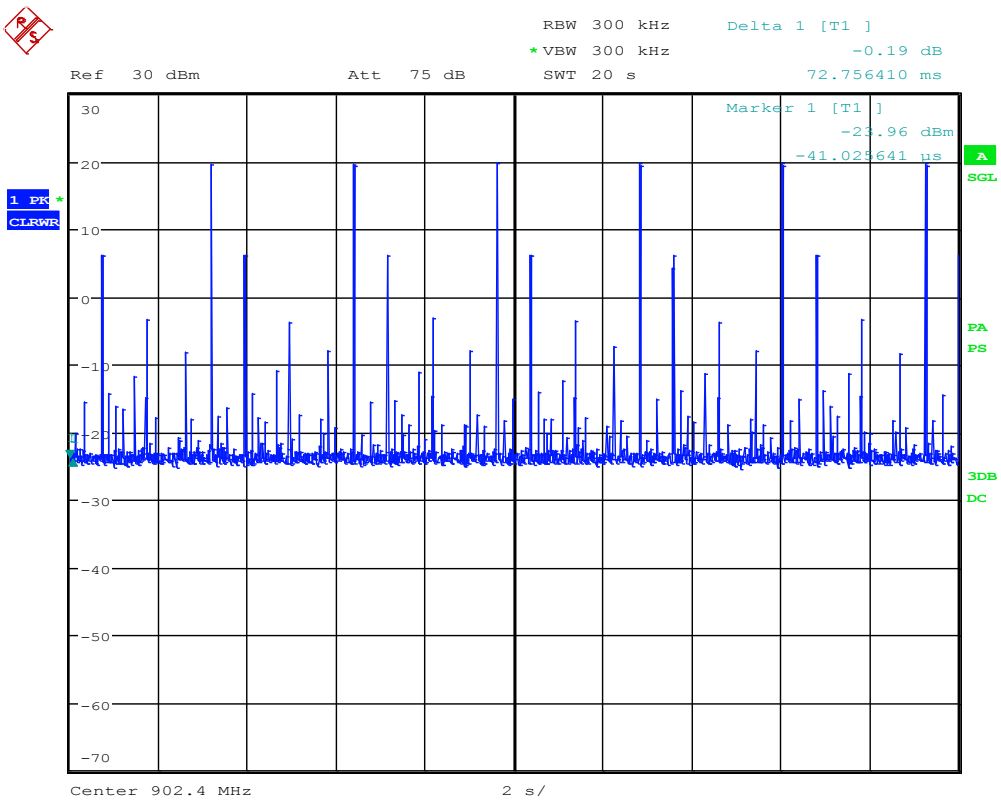
50FSK: Length of Transmission



Date: 24.MAR.2016 09:46:04

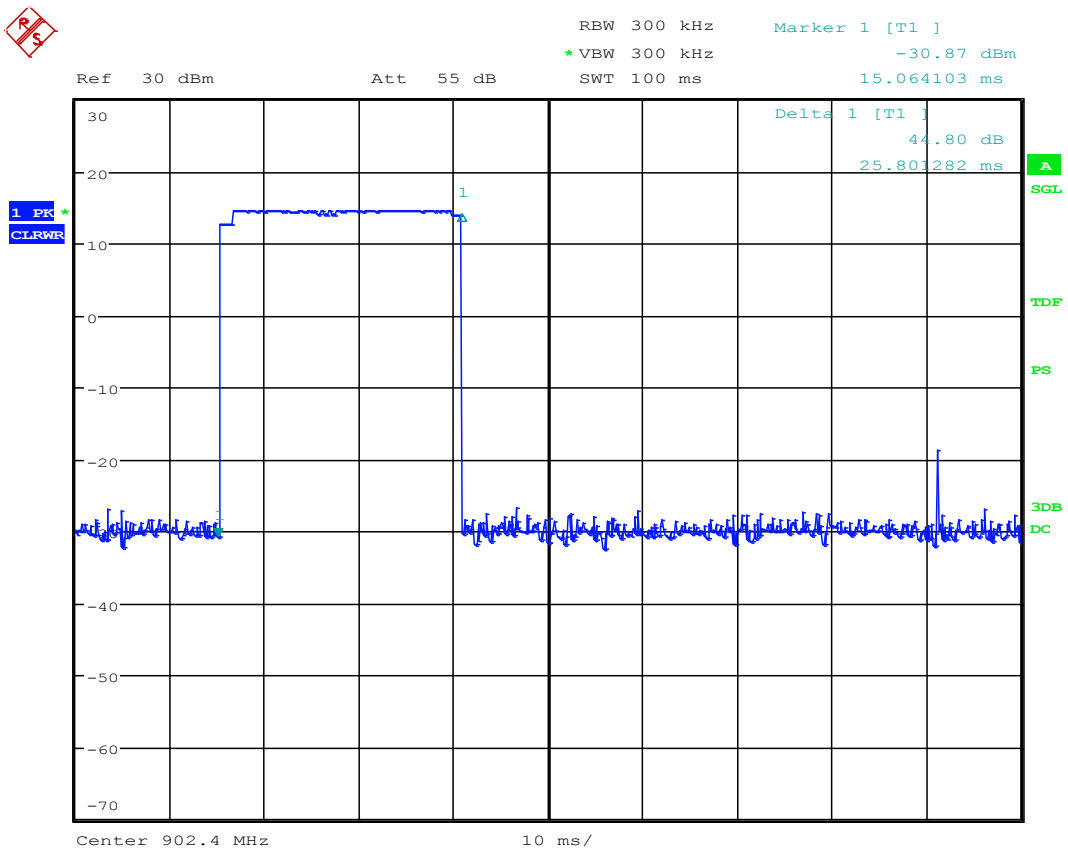
25.8mS pulse x 6 pulses = 154.8mS

50FSK: Transmissions in Twenty Seconds



Date: 8.APR.2016 09:33:42

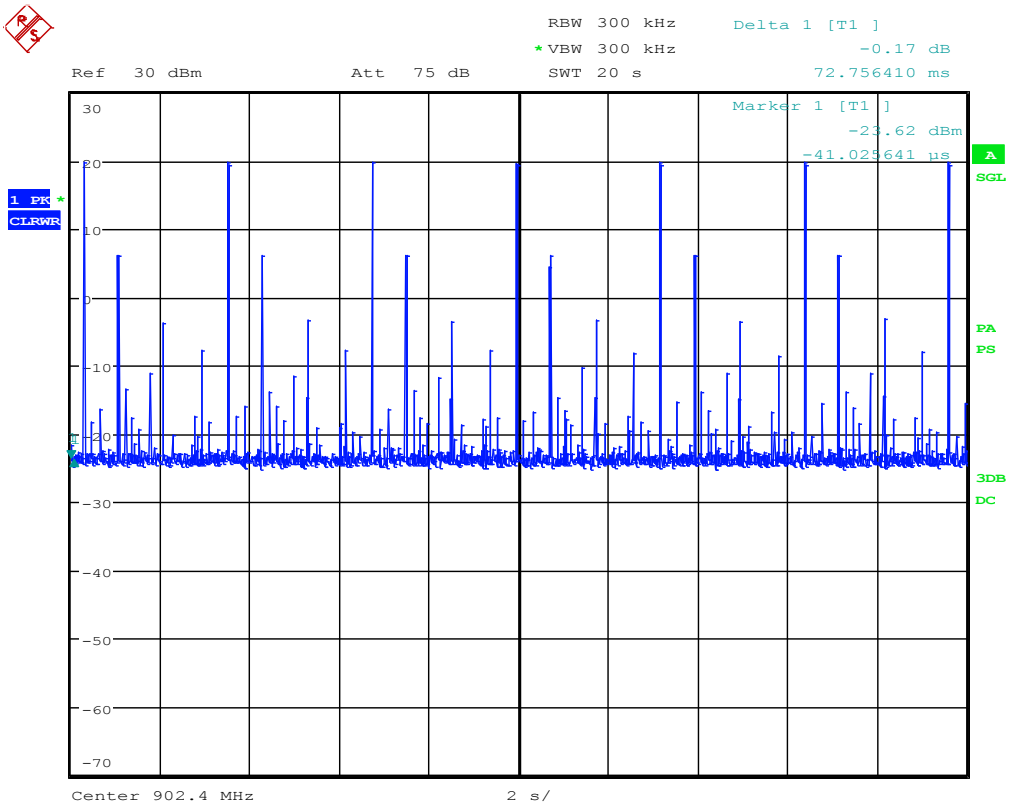
50GFSK: Length of Transmission



Date: 24.MAR.2016 09:49:41

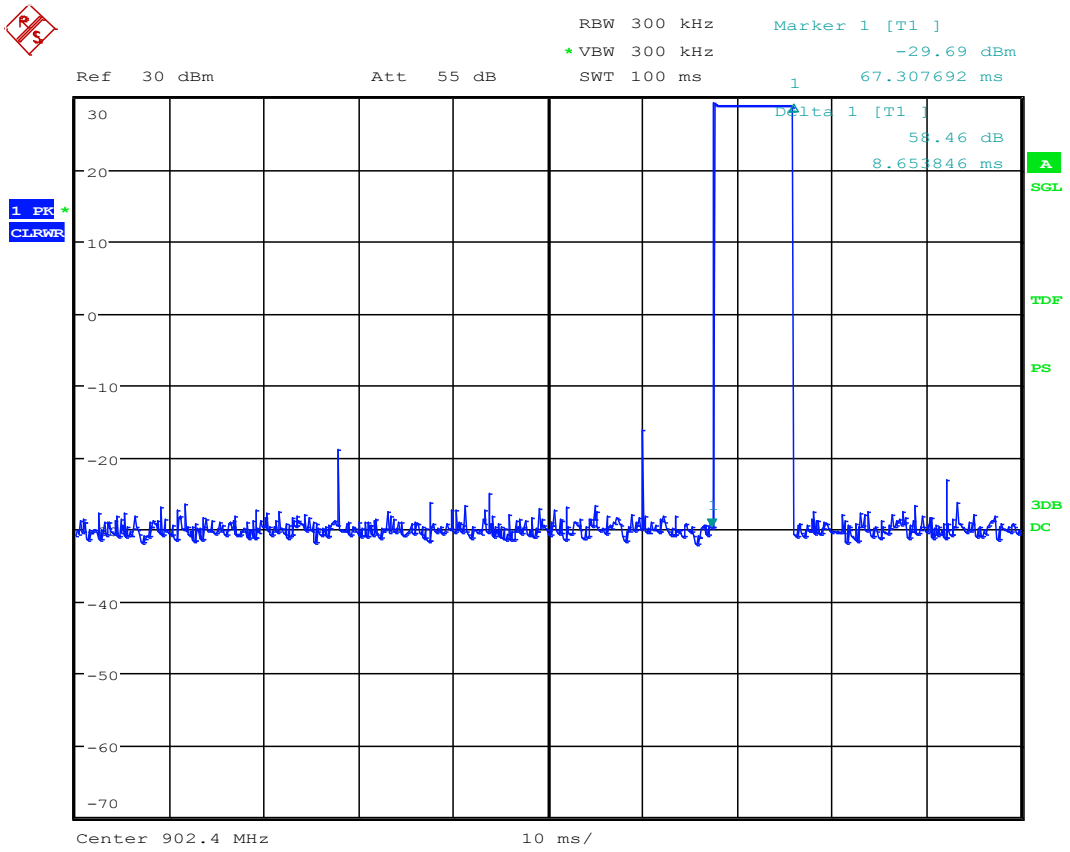
25.8mS pulse x 7 pulses = 180.6mS

50GFSK: Transmissions in Twenty Seconds



Date: 8.APR.2016 09:34:44

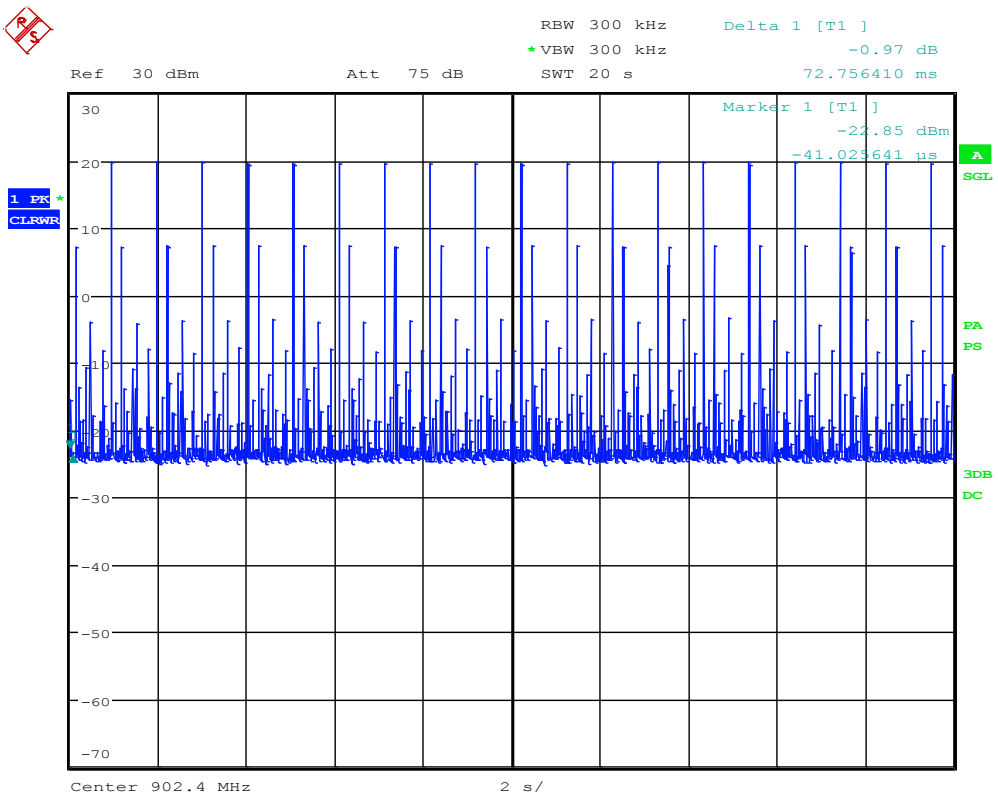
150FSK: Length of Transmission



Date: 24.MAR.2016 09:50:35

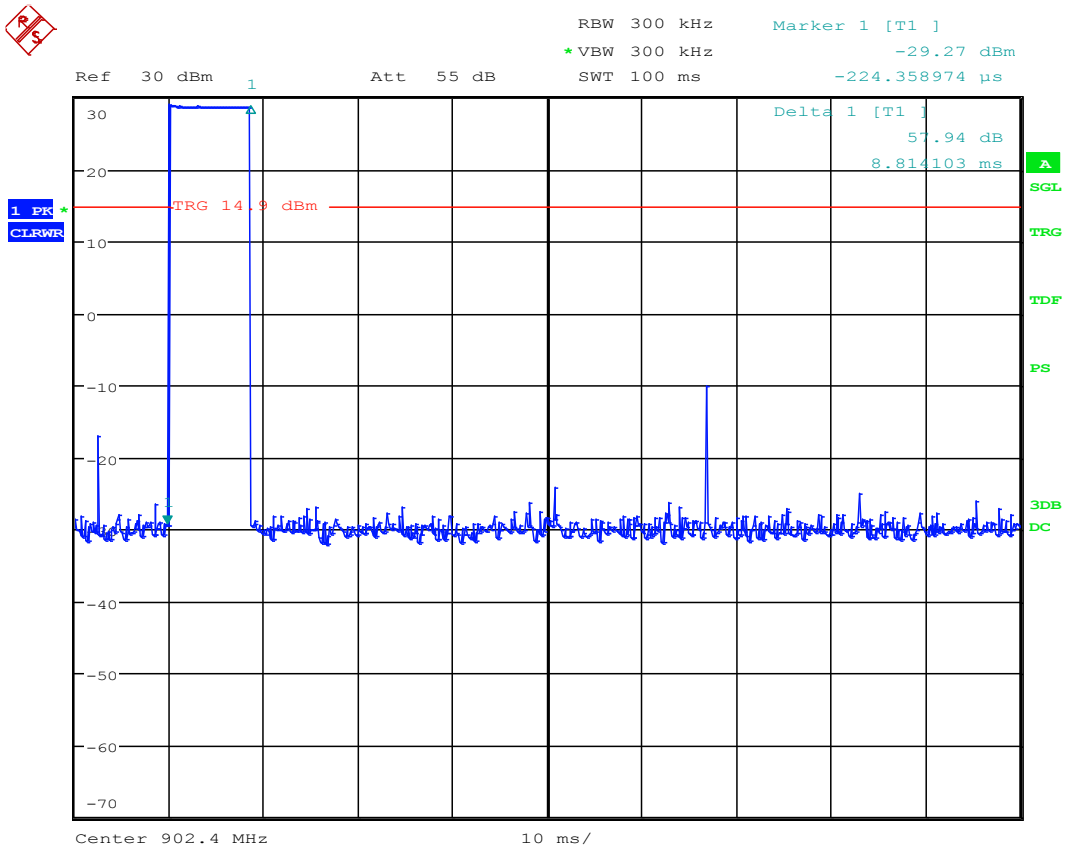
8.65mS pulse x 19 pulses = 164.35mS

150FSK: Transmissions in Twenty Seconds



Date: 8.APR.2016 09:40:06

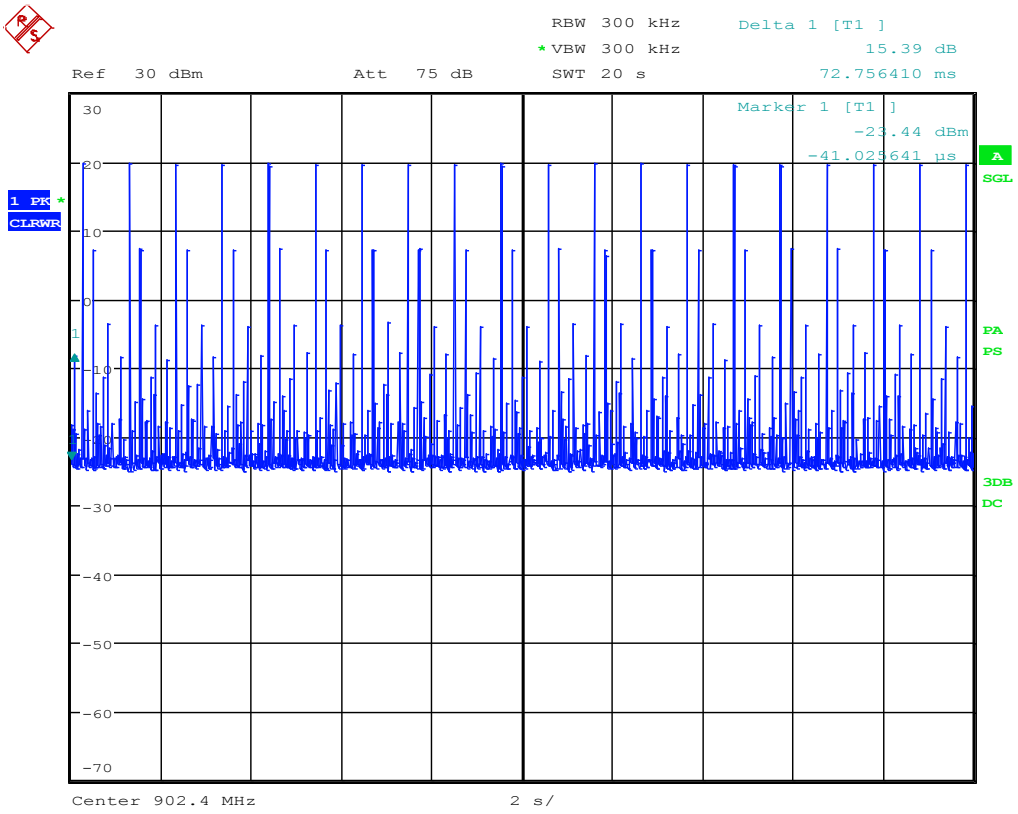
150GFSK: Length of Transmission



Date: 24.MAR.2016 10:01:43

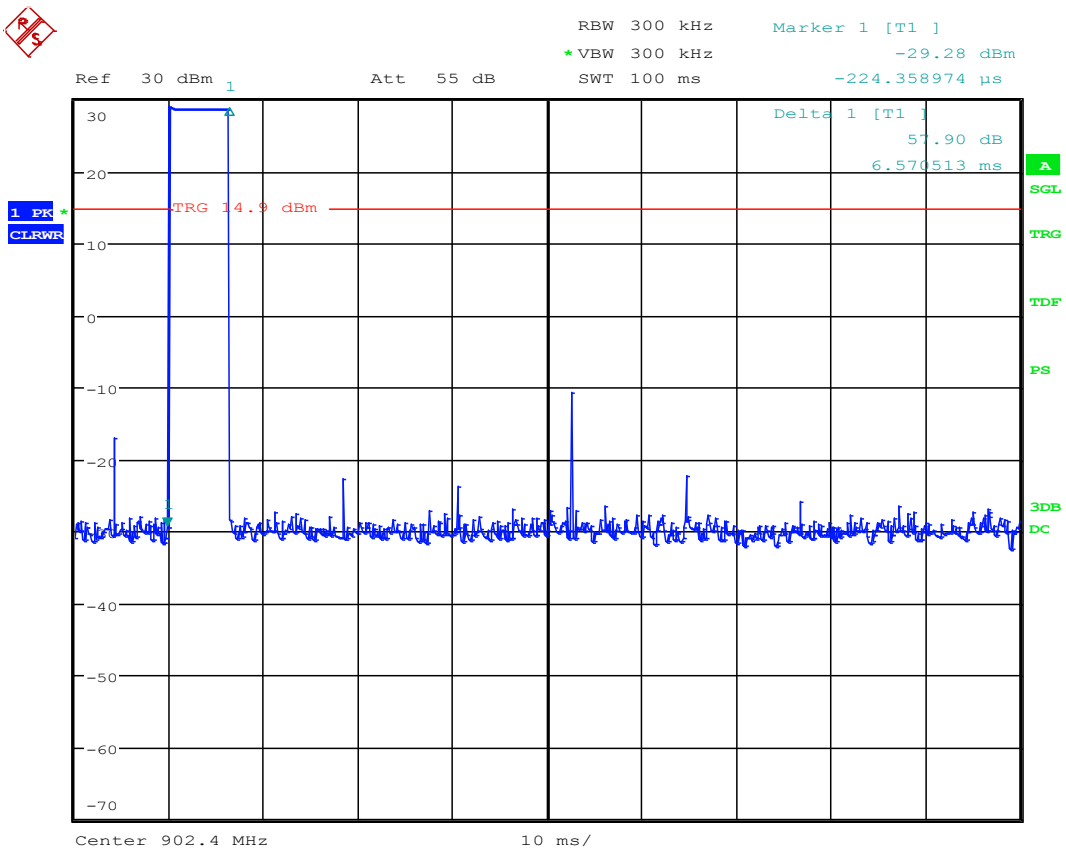
8.81mS pulse x 20 pulses = 176.2mS

150GFSK: Transmissions in Twenty Seconds



Date: 8.APR.2016 09:42:42

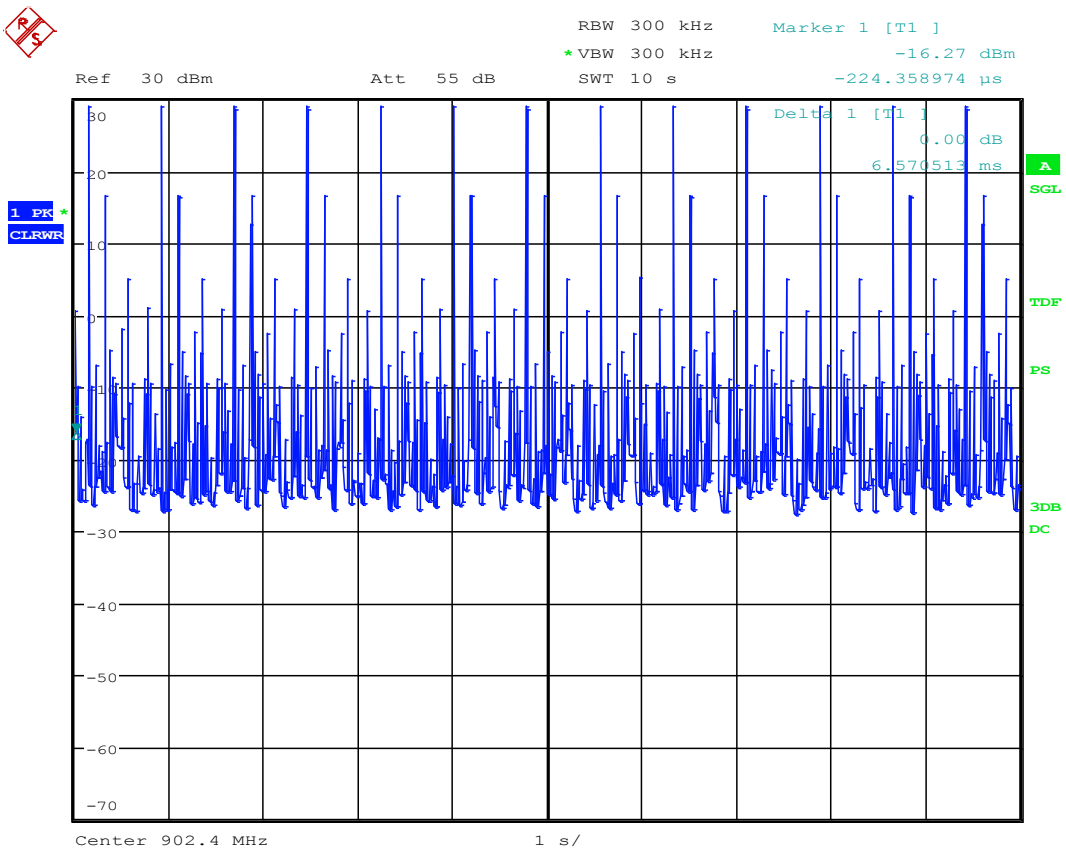
200FSK: Length of Transmission



Date: 24.MAR.2016 10:03:22

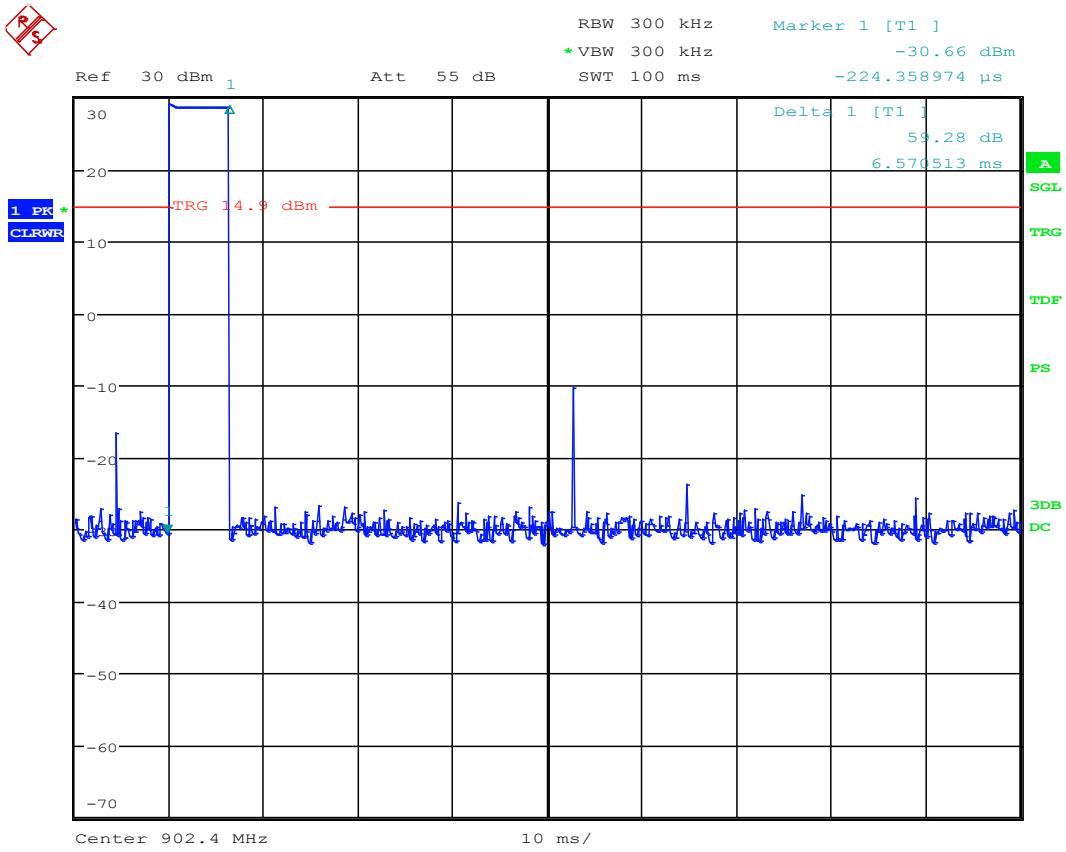
6.57mS pulse x 13 pulses = 85.41mS

200FSK: Transmissions in Ten Seconds



Date: 24.MAR.2016 10:04:34

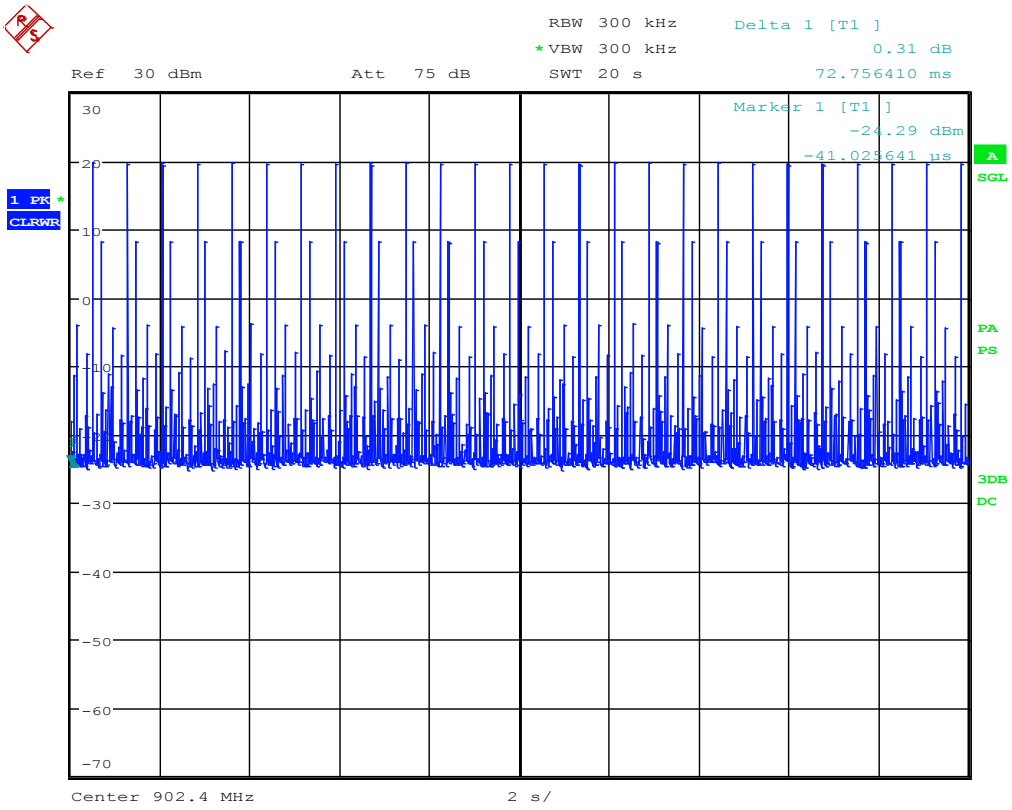
200GFSK: Length of Transmission



Date: 24.MAR.2016 10:05:16

6.57mS pulse x 26 pulses = 170.82mS

200GFSK: Transmissions in Twenty Seconds



Date: 8.APR.2016 09:44:42

16 CONDUCTED EMISSIONS

16.1 Requirements

In accordance with FCC CFR 47 Part 15.207(a), “Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

*Decreases with the logarithm of the frequency.

16.2 Procedure

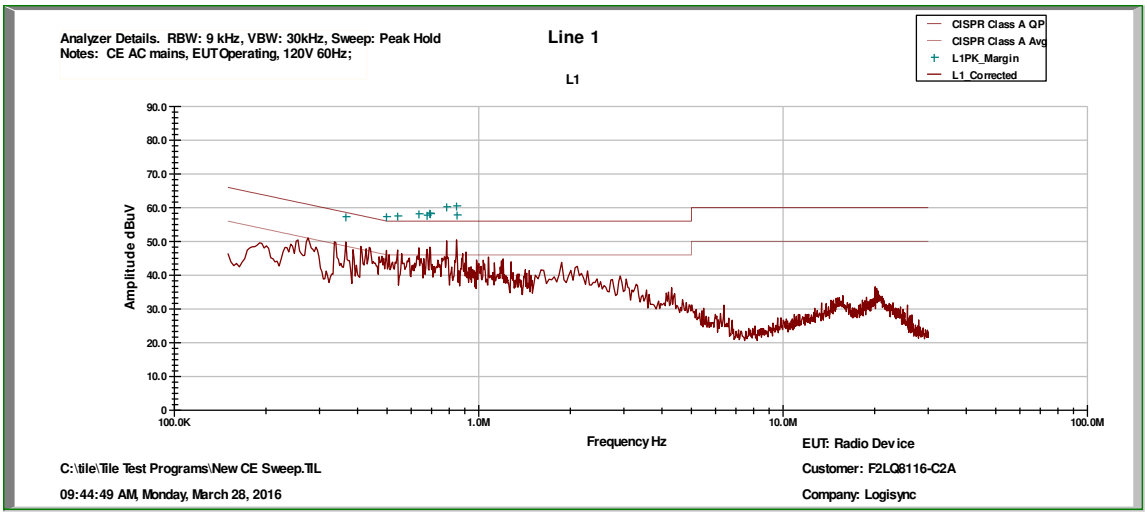
The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver via a transient limiter, and emissions in the range 150 kHz to 30 MHz were measured. The measurements were recorded using the quasi-peak and average detectors as directed by the standard, and the resolution bandwidth during testing was 9 kHz. The raw measurements were corrected to allow for attenuation from the LISN, transient limiter and cables.

16.3 Conducted Emissions Test Data

Test Date:	Mar. 28, 2016	**Test Engineer:**	J. Knepper
Rule:	15.207(a)	**Air Temperature:**	19.9º C
Test Results:	Pass	**Relative Humidity:**	46%

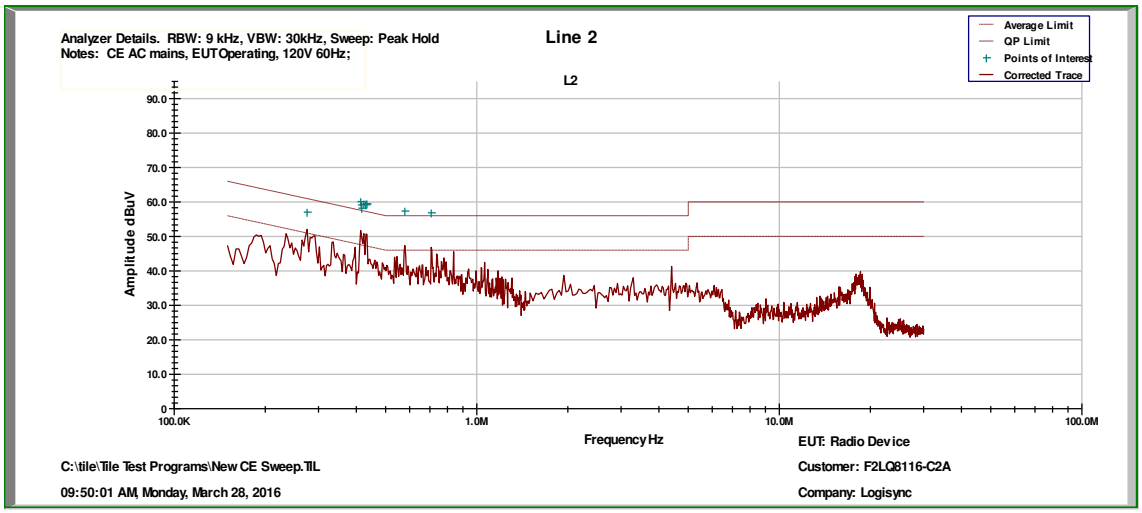
Note: 200FSK Hopping Mode was determined to be worst case.

200FSK, Conducted Test – Line 1: 0.15 MHz to 30.0 MHz



Top Discrete Measurements								
No.	**Conductor**	**Frequency (MHz)**	**Detector**	**Level (dBµV)**	**Adjustment (dB)**	**Results (dBµV)**	**Limit (dBµV)**	**Margin (dB)**
1	Line 1	0.366	Quasi-Peak	34.110	10.434	44.544	58.6	-14.047
		0.366	Average	20.913	10.434	31.347	48.6	-17.244
2	Line 1	0.497625	Quasi-Peak	32.470	10.333	42.803	56.0	-13.237
		0.497625	Average	20.142	10.333	30.475	46.0	-15.565
3	Line 1	0.5415	Quasi-Peak	31.180	10.313	41.493	56.0	-14.507
		0.5415	Average	17.645	10.313	27.958	46.0	-18.042
4	Line 1	.6t36	Quasi-Peak	30.600	10.272	40.872	56.0	-15.128
		0.636	Average	19.535	10.272	29.807	46.0	-16.193
5	Line 1	0.6765	Quasi-Peak	29.790	10.252	40.042	56.0	-15.96
		0.6765	Average	17.615	10.252	27.867	46.0	-18.133
6	Line 1	0.69	Quasi-Peak	29.730	10.245	39.975	56.0	-16.025
		0.69	Average	17.852	10.245	28.097	46.0	-17.903
7	Line 1	0.693375	Quasi-Peak	29.430	10.243	39.673	56.0	-16.327
		0.693375	Average	17.895	10.243	28.138	46.0	-17.862
8	Line 1	0.7845	Quasi-Peak	30.620	10.240	40.860	56.0	-15.140
		0.7845	Average	18.095	10.240	28.335	46.0	-17.665
9	Line 1	0.84525	Quasi-Peak	28.820	10.240	39.060	56.0	-16.940
		0.84525	Average	17.502	10.240	27.742	46.0	-18.258
10	Line 1	0.848625	Quasi-Peak	28.360	10.240	38.600	56.0	-17.400
		0.848625	Average	17.160	10.240	27.400	46.0	-18.600

200FSK, Conducted Test – Line 2: 0.15 MHz to 30.0 MHz

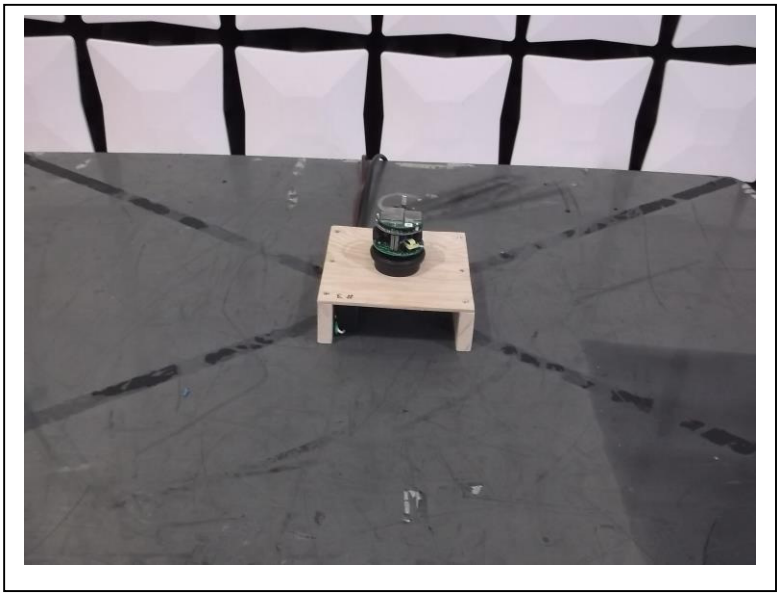


Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBµV)	Adjustment (dB)	Results (dBµV)	Limit (dBµV)	Margin (dB)
1	Line 2	0.274875	Quasi-Peak	36.190	10.630	46.820	60.960	-14.140
		0.274875	Average	36.190	10.630	46.820	50.960	-4.140
2	Line 2	0.41325	Quasi-Peak	35.090	10.400	45.490	57.950	-12.460
		0.41325	Average	35.090	10.400	45.490	47.950	-2.460
3	Line 2	0.415	Quasi-Peak	35.730	10.400	46.130	57.548	-11.418
		0.415	Average	35.730	10.400	46.130	47.548	-1.418
4	Line 2	0.416625	Quasi-Peak	35.720	10.400	46.120	57.516	-11.396
		0.416625	Average	35.720	10.400	46.120	47.516	-1.396
5	Line 2	0.423375	Quasi-Peak	35.400	10.400	45.800	57.382	-11.58
		0.423375	Average	35.400	10.400	45.800	47.382	-1.582
6	Line 2	0.43	Quasi-Peak	36.180	10.400	46.580	57.253	-10.673
		0.43	Average	36.180	10.400	46.580	47.253	-0.673
7	Line 2	0.430125	Quasi-Peak	36.150	10.400	46.550	57.251	-10.701
		0.430125	Average	36.150	10.400	46.550	47.251	-0.701
8	Line 2	0.4335	Quasi-Peak	35.110	10.400	45.510	57.186	-11.676
		0.4335	Average	35.110	10.400	45.510	47.186	-1.676
9	Line 2	0.578625	Quasi-Peak	27.720	10.299	38.019	56.0	-17.981
		0.578625	Average	27.720	10.299	38.019	46.0	-7.981
10	Line 2	0.706875	Quasi-Peak	26.200	10.240	36.440	56.0	-19.560
		0.706875	Average	26.200	10.240	36.440	46.0	-9.560

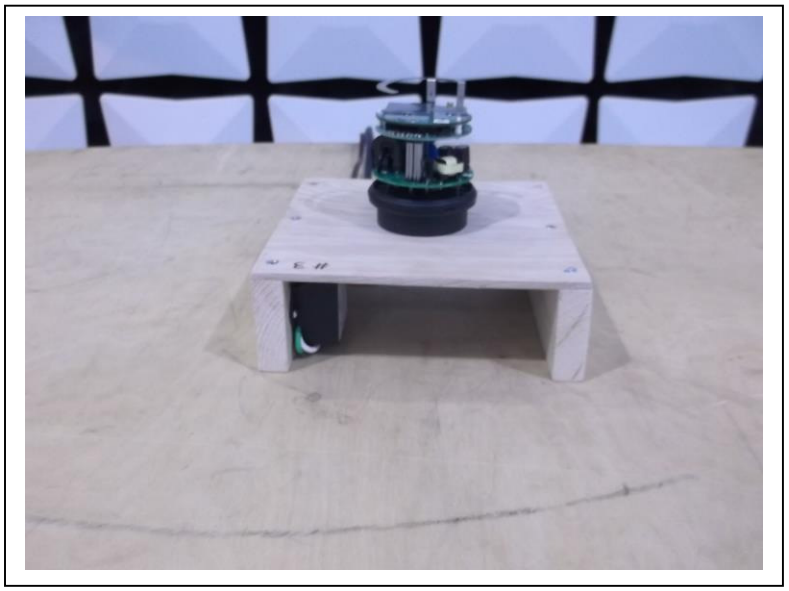
17 PHOTOGRAPHS/EXHIBITS – PRODUCT PHOTOS, TEST SETUPS

Radiated Spurious Emission with 1.5dBi Integral Antenna

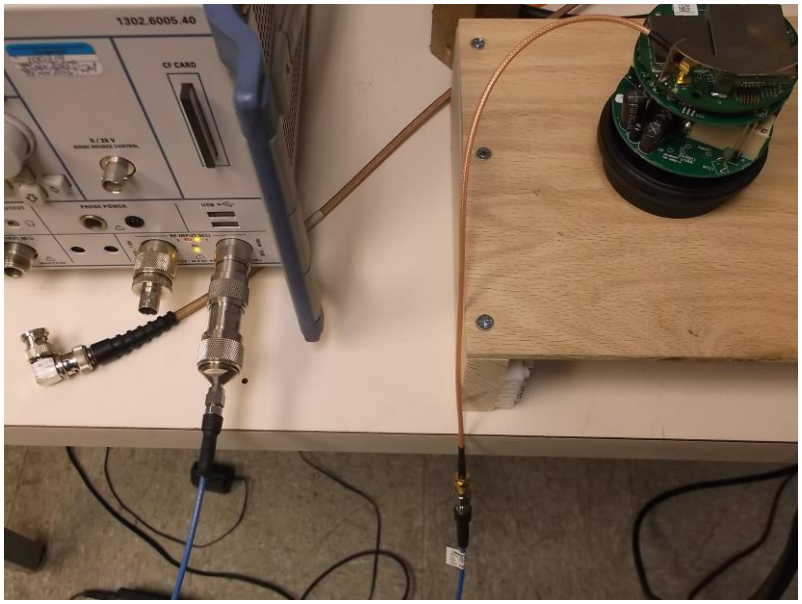
<1 GHz



>1 GHz



Conducted Output Power, Voltage Variations, -20dB Occupied Bandwidth, Conducted Spurious Emissions, Frequency Separation and Number of Channels



Conducted Emissions