



2.4 FREQUENCY STABILITY

2.4.1 Specification Reference

FCC Part 15 Subpart C §15.253(f) and RSS-251 Issue 1 Sec. 5.4

2.4.2 Standard Applicable

(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

2.4.3 Equipment Under Test and Modification State

Serial No: 5194300131 / Default Test Configuration

2.4.4 Date of Test/Initial of test personnel who performed the test

September 21 and September 29, 2016/NS

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions

Ambient Temperature	25.0-25.6°C
Relative Humidity	41.6-45.6%
ATM Pressure	100.0-100.3 kPa

2.4.7 Additional Observations

- EUT has no antenna port available. The measurements under this section were performed using radiated measurement method.
- Extreme temperature range used is -40°C to +85°C as declared by the manufacturer.
- Extreme test source voltage used is 10.2 VDC and 13.8 VDC (85 % and 115 % of nominal voltage).
- An offset of 44.35dB was added to account for the test setup loss.
- RBW is 1 MHz while VBW is 3 MHz
- Detector is Peak
- Trace is Max Hold
- During the test low and high frequencies (f_L and f_H) of the signal spectrum were monitored. The applicable spurious emissions limit was used to define f_L and f_H .

2.4.8 Test Results

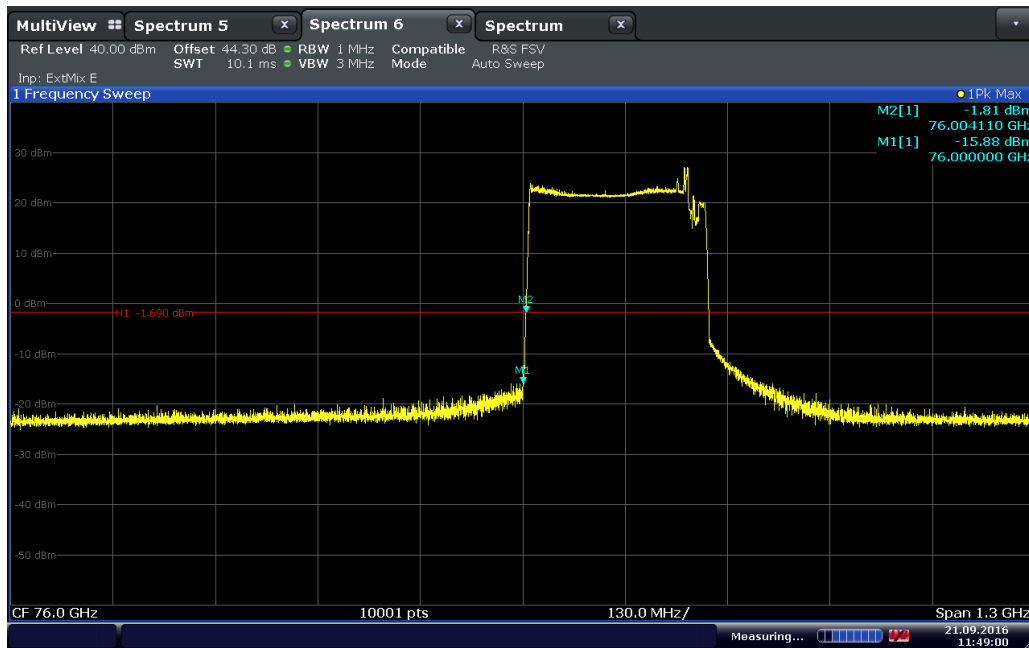
Temperature variation

Modulation BW	Temperature	Frequency Low f_L (GHz)	Frequency High f_H (GHz)
175 MHz	85°C	76.002550	76.950860
	25°C	76.001770	76.958140
	-40°C	76.004110	76.958790
300 MHz	85°C	76.002680	76.957100
	25°C	76.002030	76.974130
	-40°C	76.003900	76.991810
425 MHz	85°C	76.003720	76.948660
	25°C	76.003200	76.971790
	-40°C	76.004770	76.995970
$f_L=76.001770 \text{ GHz} > 76.0 \text{ GHz}$ $f_H=76.995970 \text{ GHz} < 77.0 \text{ GHz}$ EUT Complies			

Voltage variation

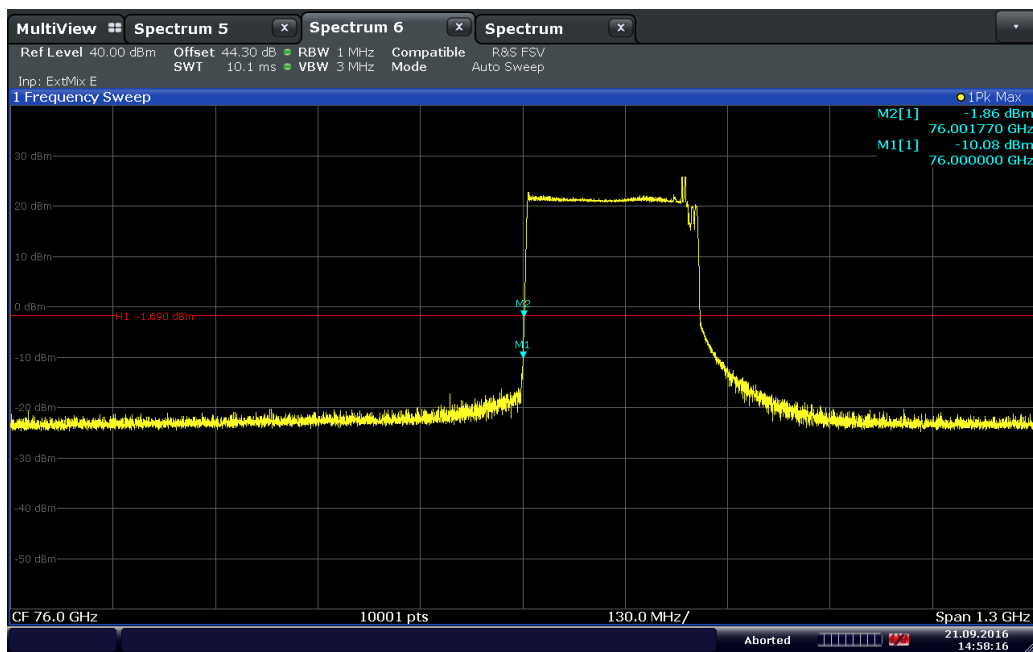
Modulation BW	Input Voltage (VDC)	Frequency Low f_L (GHz)	Frequency High f_H (GHz)
175 MHz	13.8	76.001770	76.958010
	12.0	76.001770	76.958140
	10.2	76.001770	76.958010
300 MHz	13.8	76.002160	76.973870
	12.0	76.002030	76.974130
	10.2	76.001770	76.974000
425 MHz	13.8	76.003070	76.971530
	12.0	76.003200	76.971790
	10.2	76.003200	76.972310
$f_L=76.001770 \text{ GHz} > 76.0 \text{ GHz}$ $f_H=76.974130 \text{ GHz} < 77.0 \text{ GHz}$ EUT Complies			

2.4.9 Test Plots



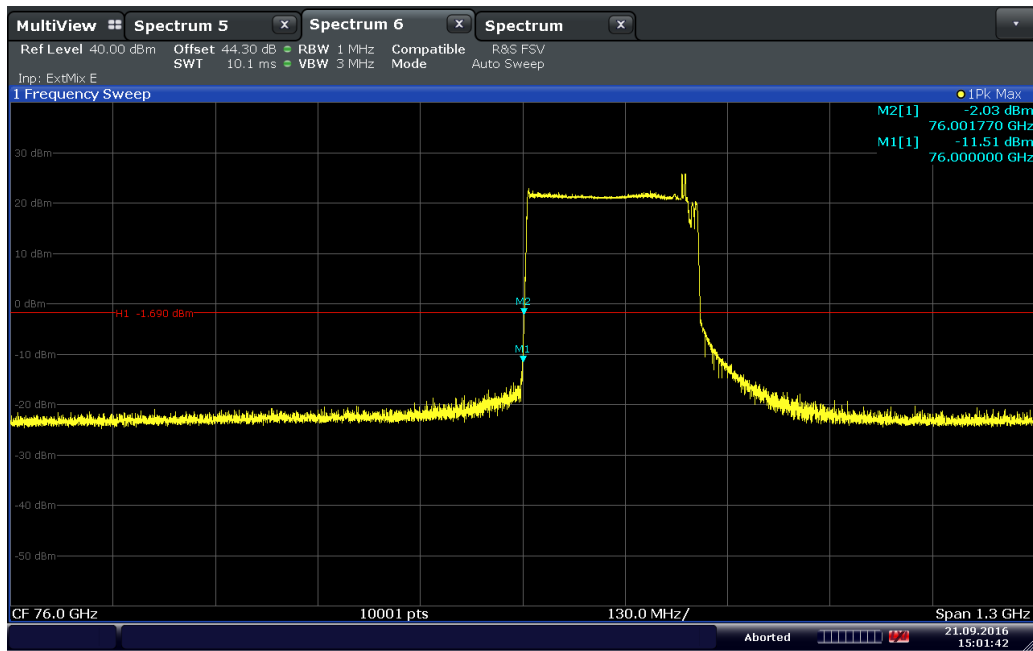
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-40 DEG 12.0 VDC Low channel 175 MHz BW



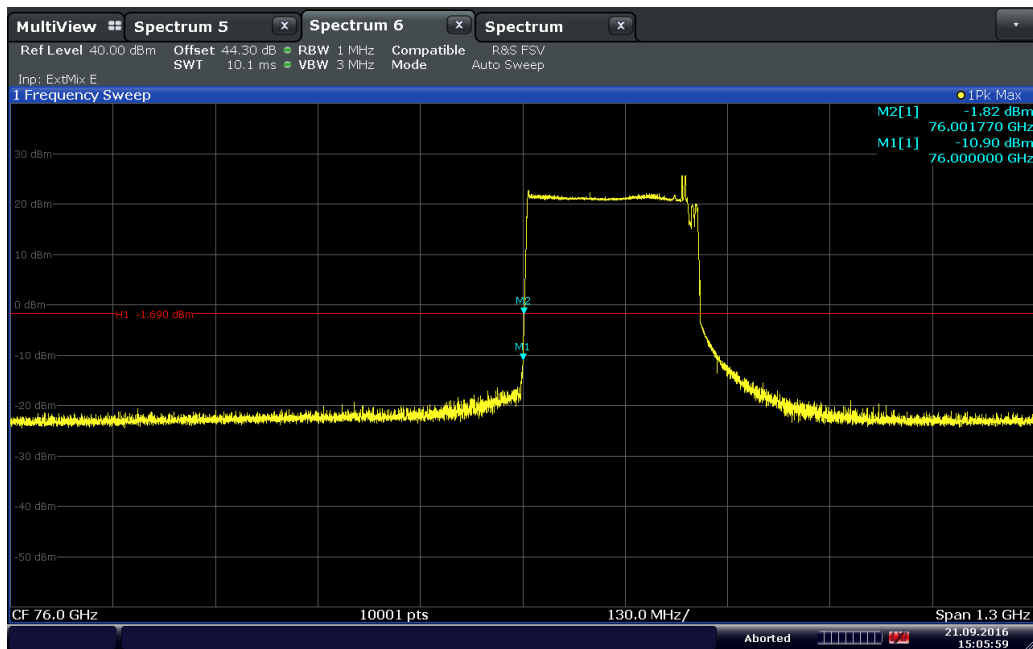
14:58:17 21.09.2016

25 DEG 12.0 VDC Low channel 175 MHz BW



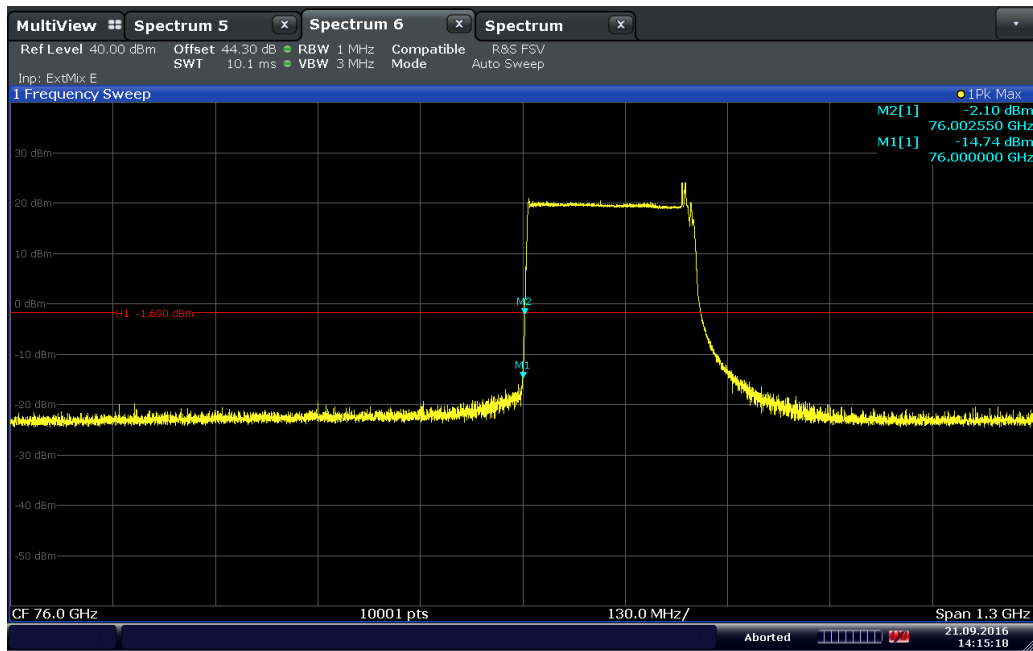
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25 DEG 10.2 VDC Low channel 175 MHz BW



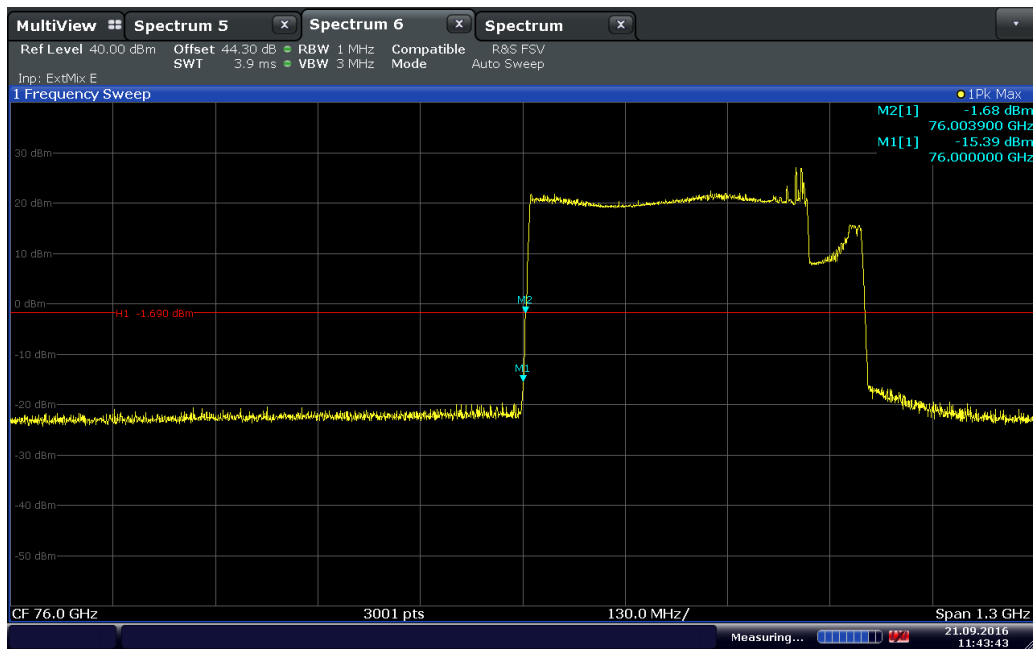
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25 DEG 13.8 VDC Low channel 175 MHz BW



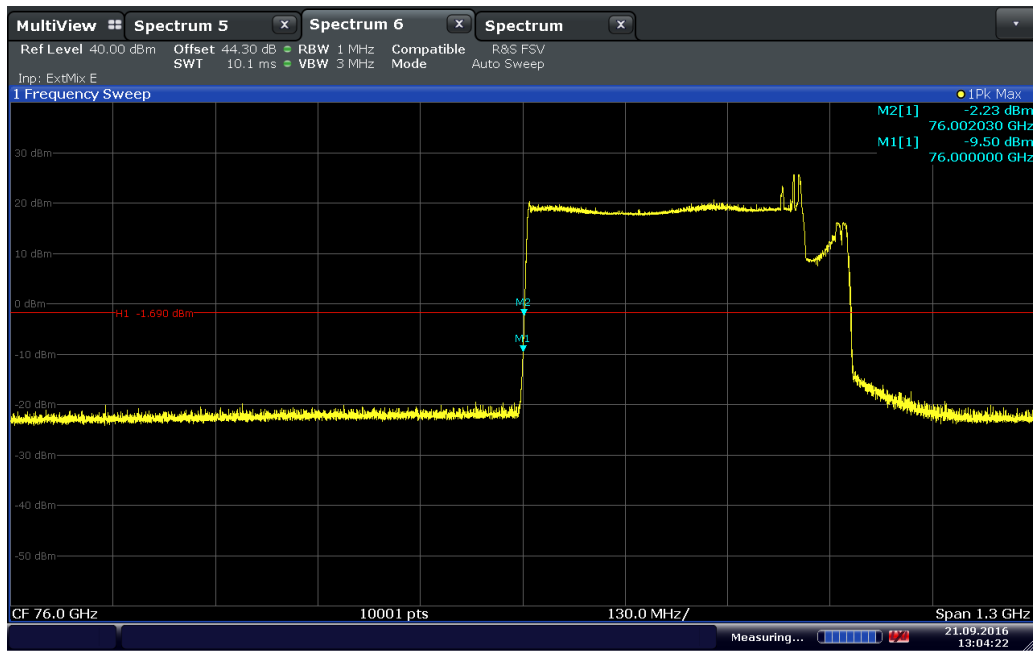
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85 DEG 12.0 VDC Low channel 175 MHz BW



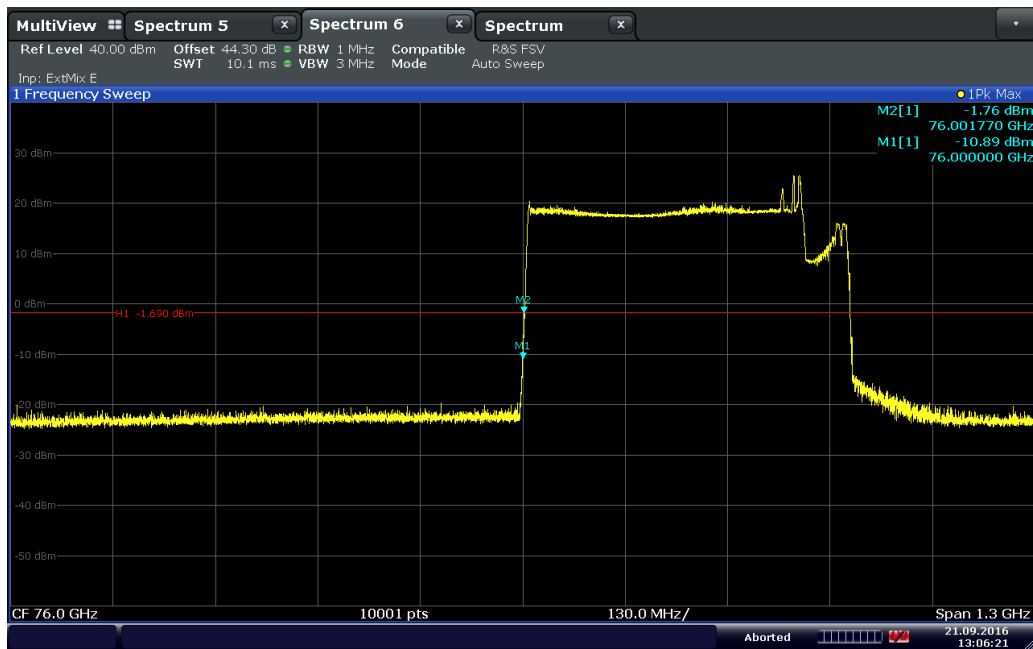
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-40 DEG 12 VDC Low channel 300 MHz BW



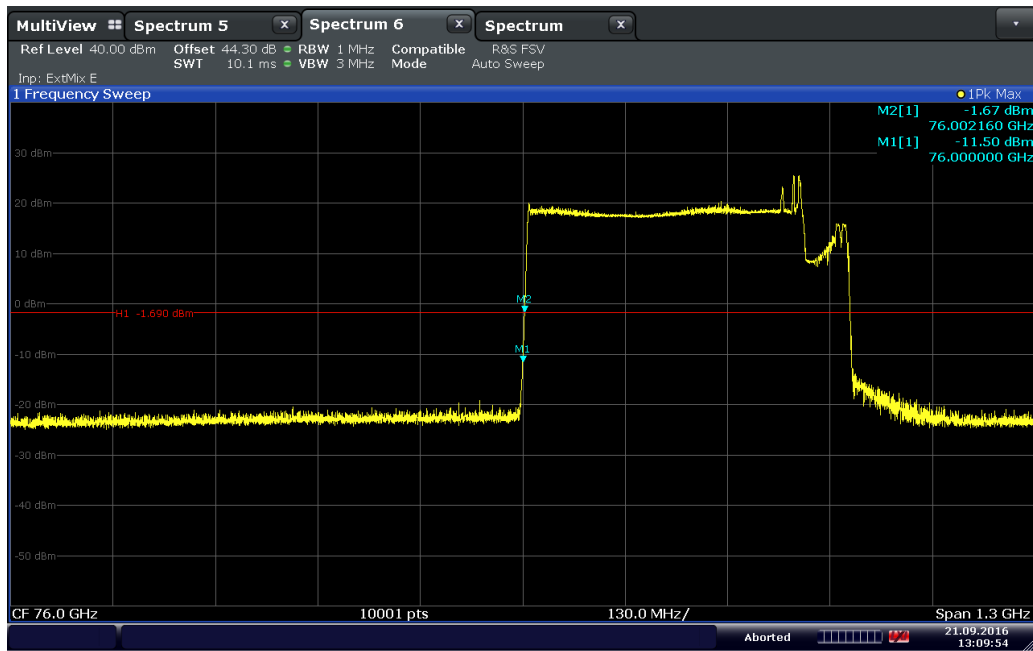
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25 DEG 12.0 VDC Low channel 300 MHz BW



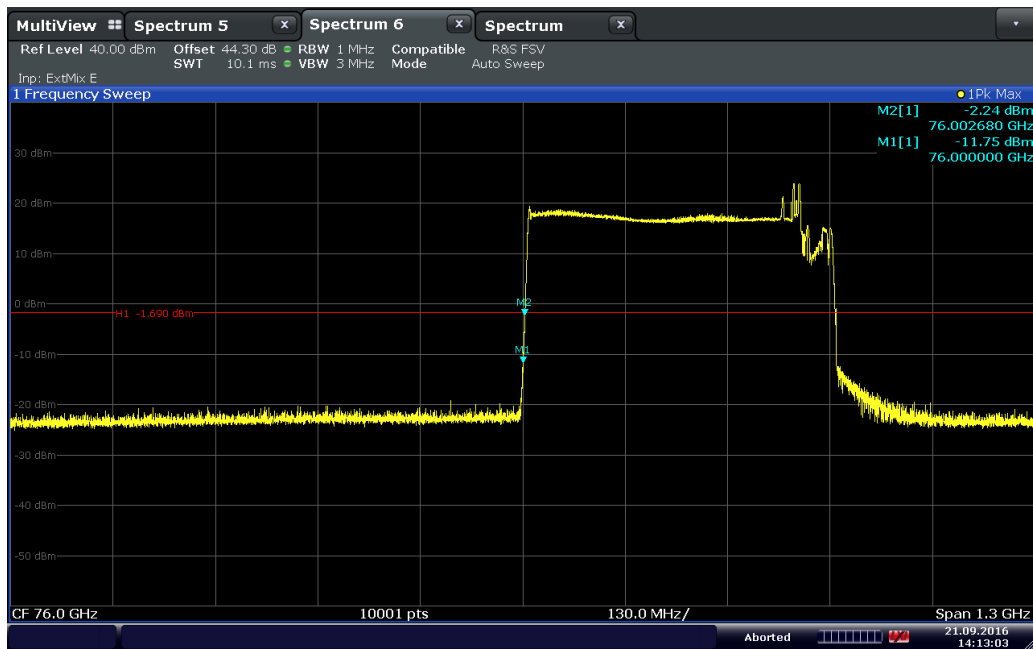
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25 DEG 10.2 VDC Low channel 300 MHz BW



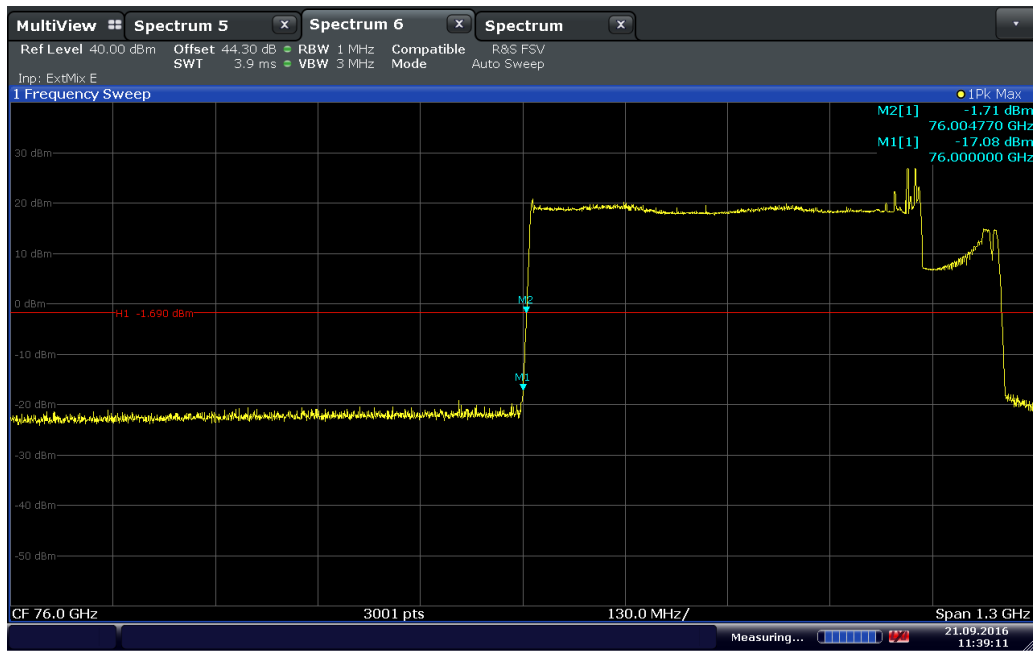
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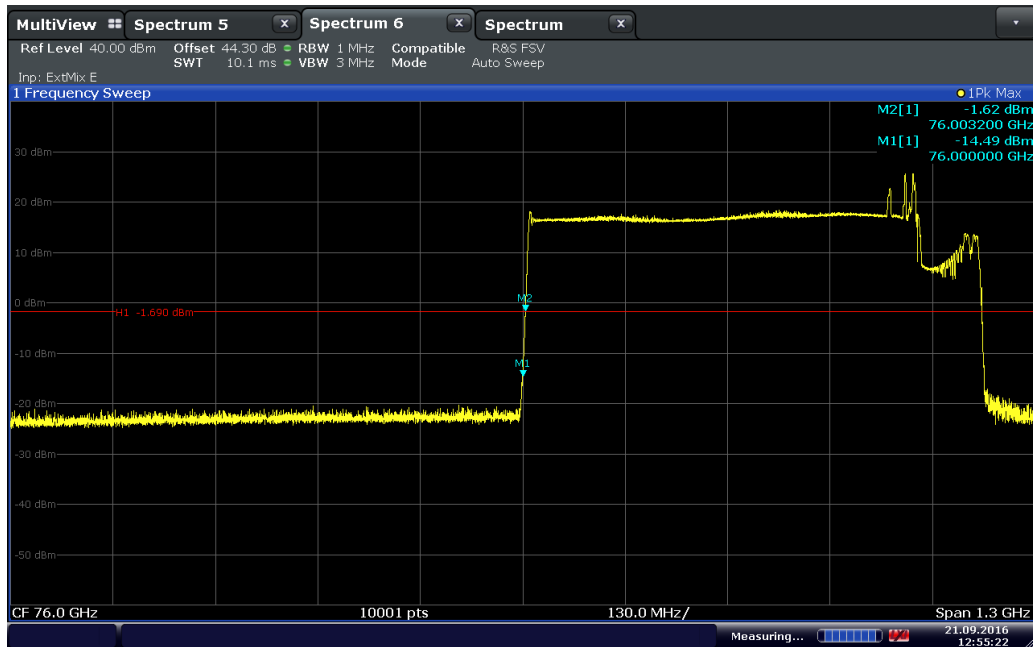
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85 DEG 12.0 VDC Low channel 300 MHz BW



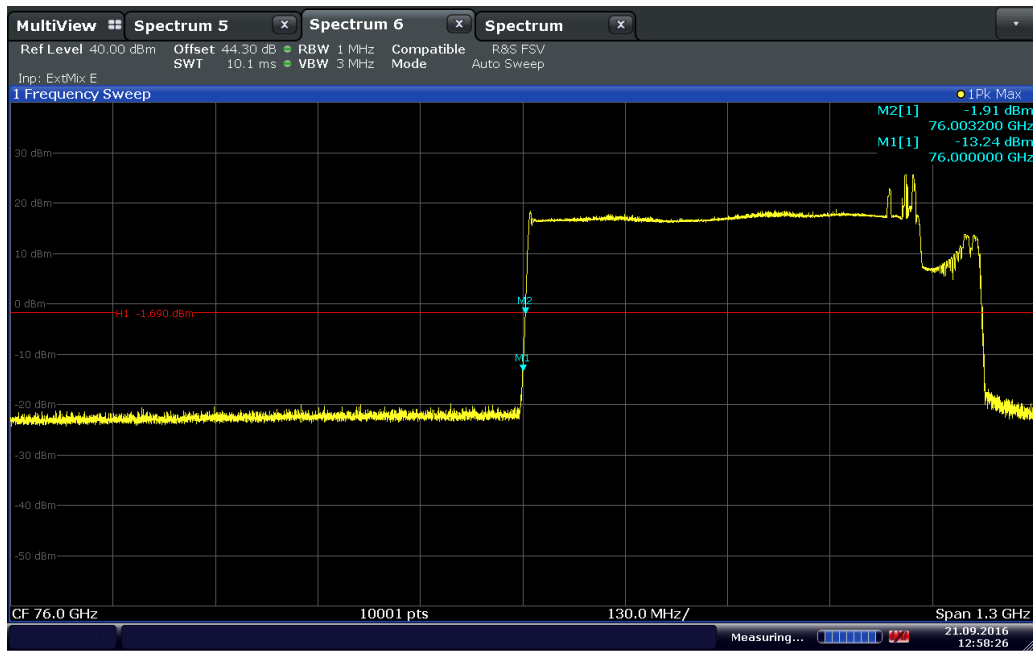
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-40 DEG 12.0 VDC Low channel 425 MHz BW



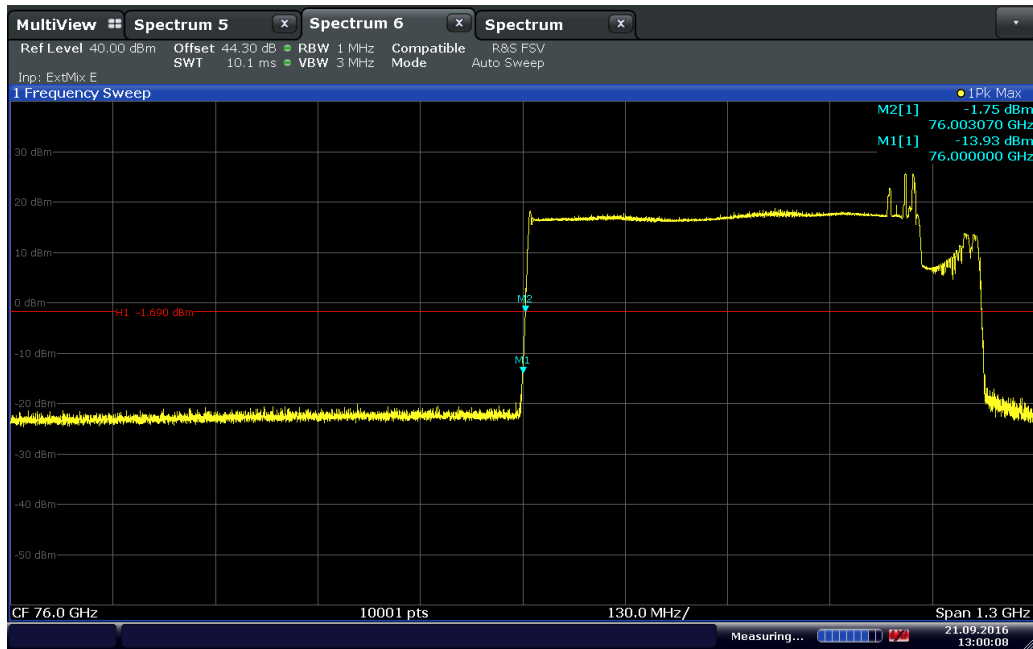
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25 DEG 12.0 VDC Low channel 425 MHz BW



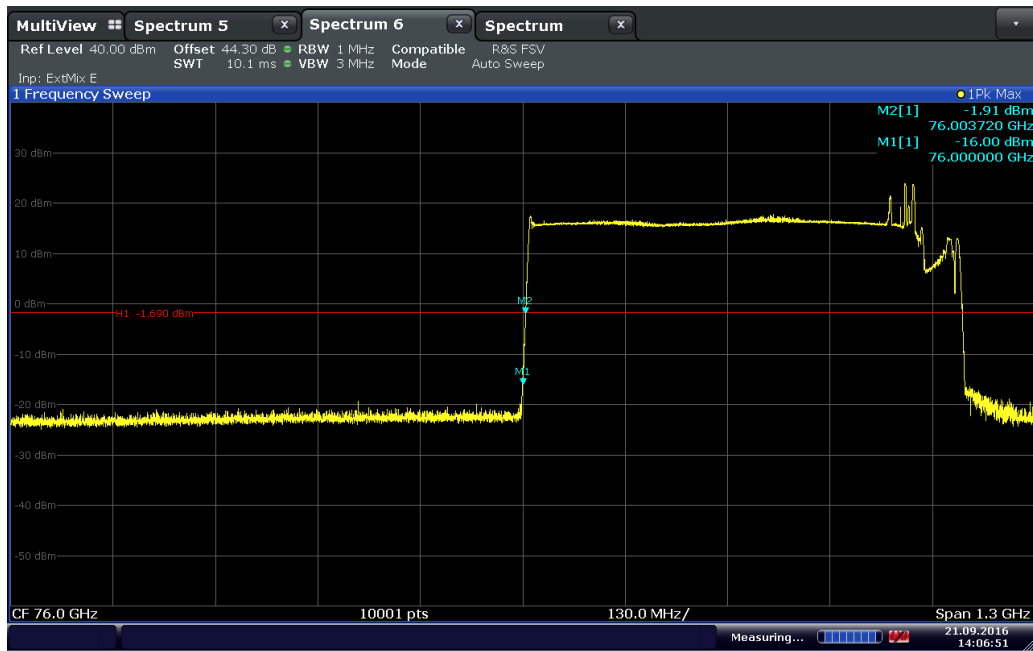
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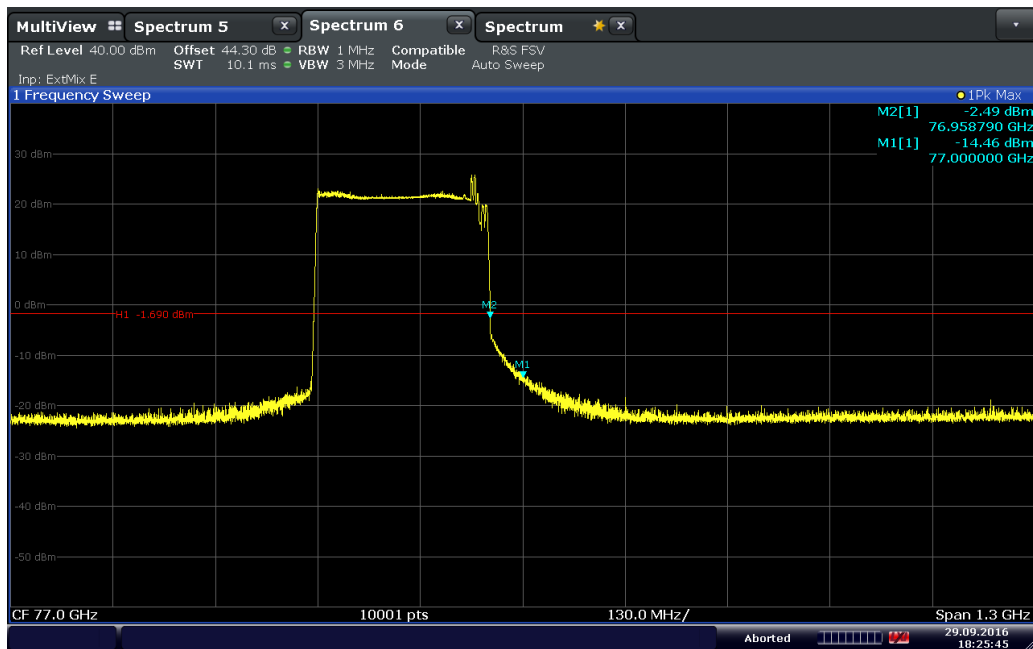
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25 DEG 13.8 VDC Low channel 425 MHz BW



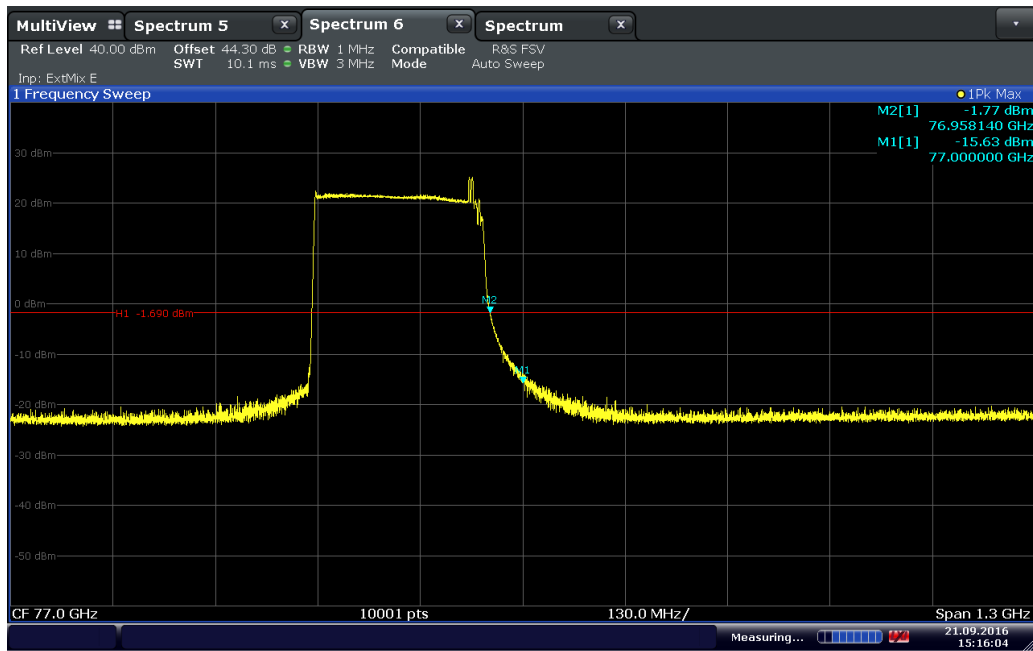
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85 DEG 12.0 VDC Low channel 425 MHz BW



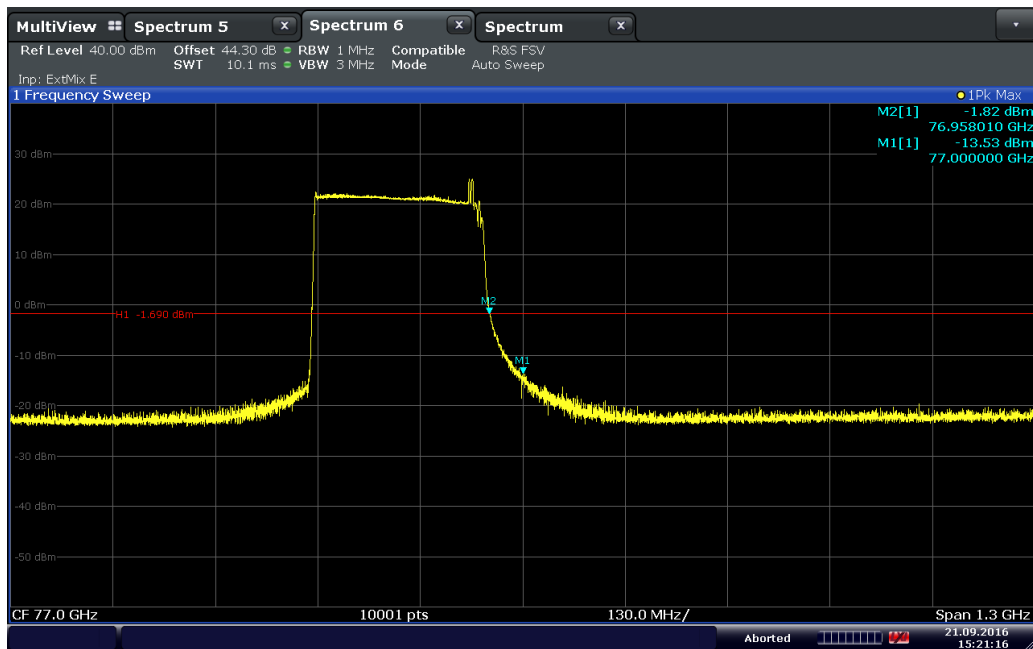
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-40 DEG 12.0 VDC High channel 175 MHz BW



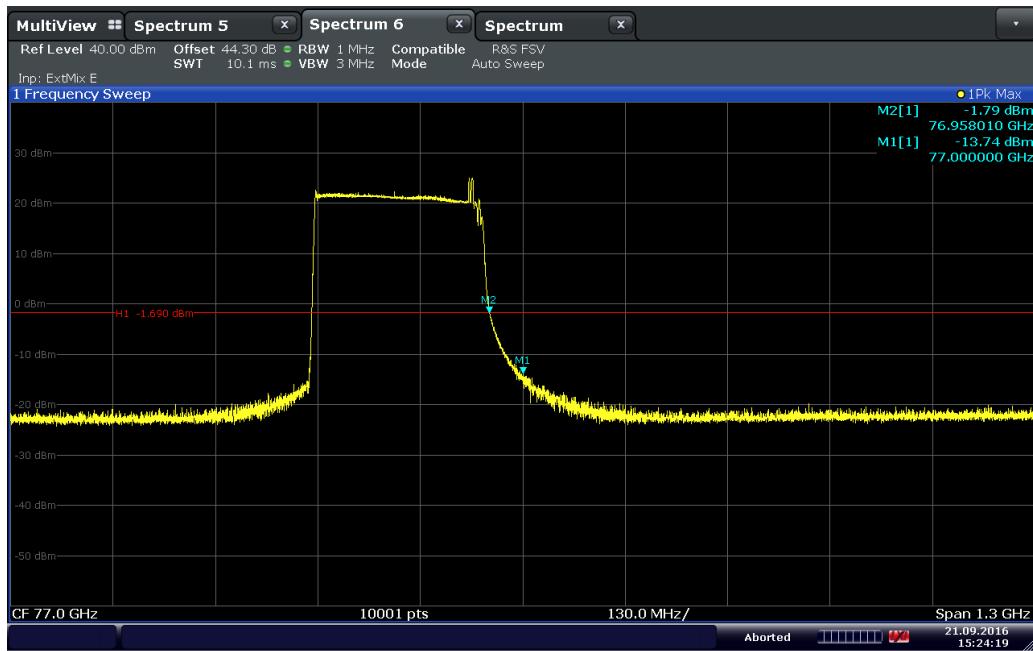
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25 DEG 12.0 VDC High channel 175 MHz BW



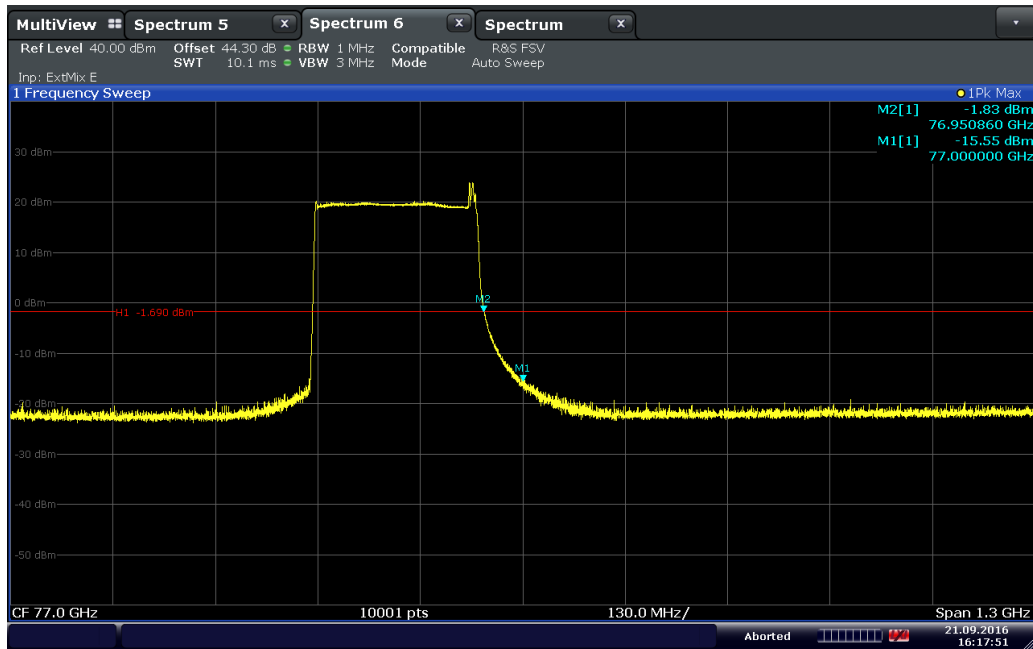
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25 DEG 10.2 VDC High channel 175 MHz BW



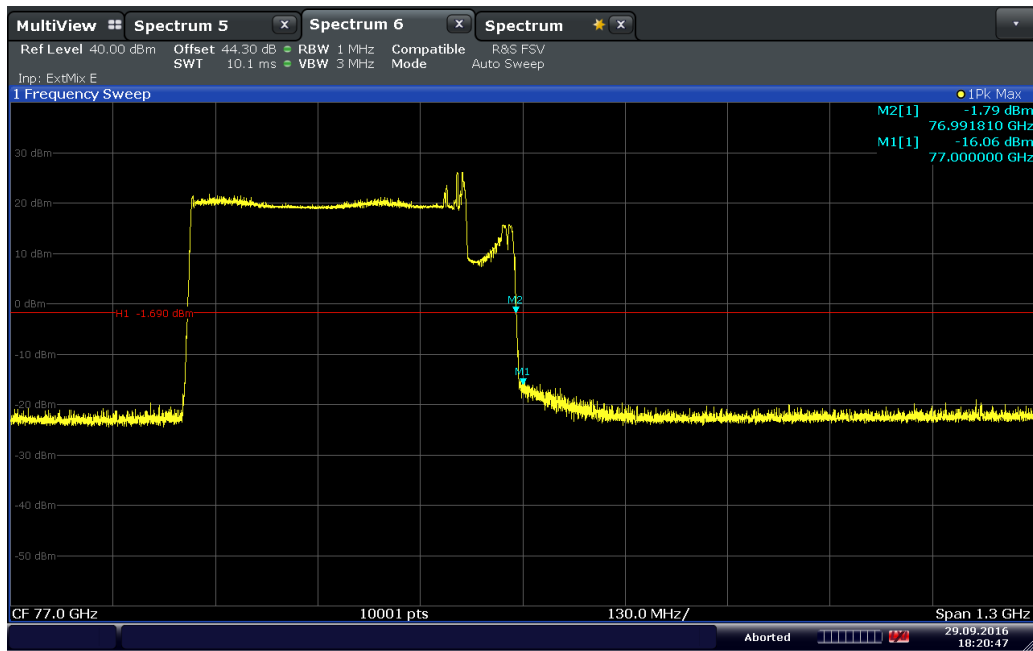
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25 DEG 13.8 VDC High channel 175 MHz BW



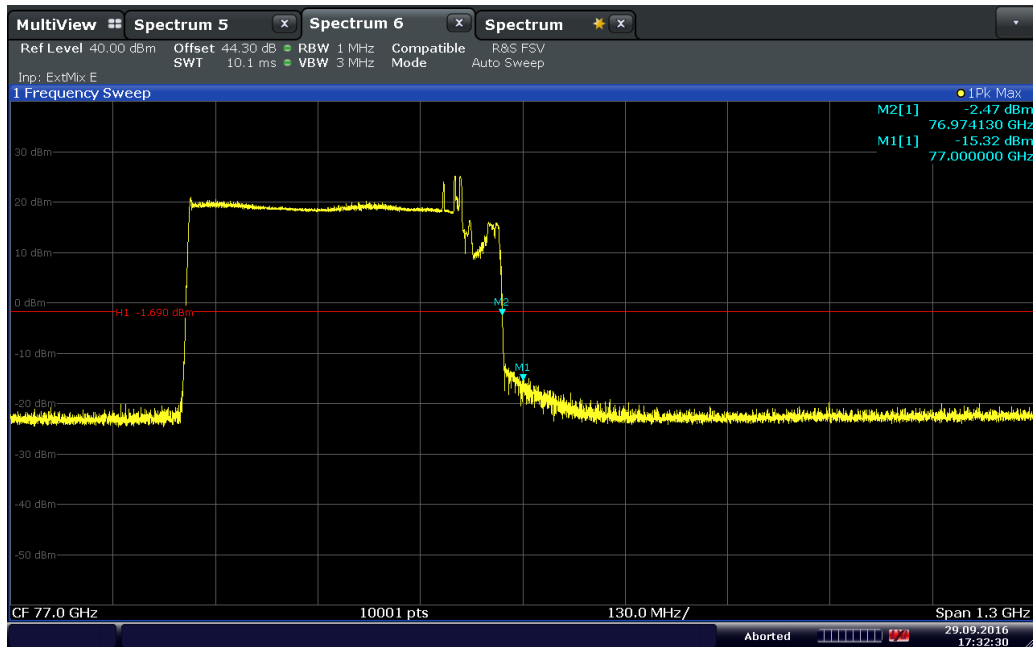
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85 DEG 12.0 VDC High channel 175 MHz BW



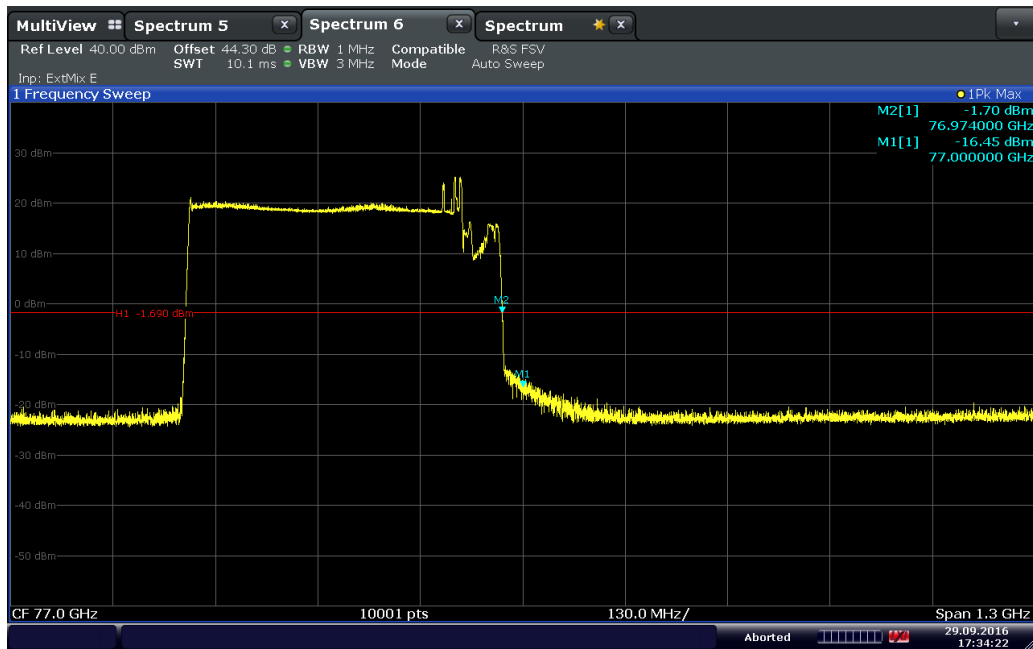
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-40 DEG 12.0 VDC High channel 300 MHz BW



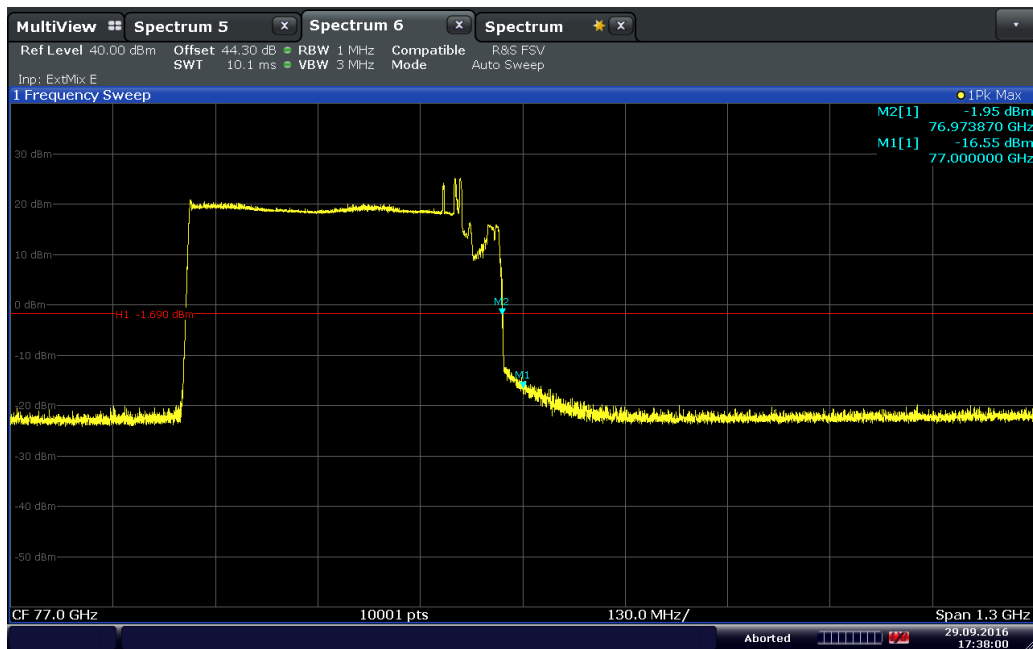
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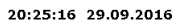
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25 DEG 10.2 VDC High channel 300 MHz BW



17:38:01 29.09.2016

25 DEG 13.8 VDC High channel 300 MHz BW



MultiView Spectrum 5 Spectrum 6 Spectrum

Ref Level 40.00 dBm Offset 44.30 dB RBW 1 MHz Compatible P&S FSV
SWT 10.1 ms VBW 3 MHz Mode Auto Sweep

Inp: ExtMix E

1 Frequency Sweep

1Pk Max
M2[1] -2.35 dBm
76.995970 GHz
M1[1] -18.79 dBm
77.000000 GHz

30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm

H1 -1.690 dBm

M2

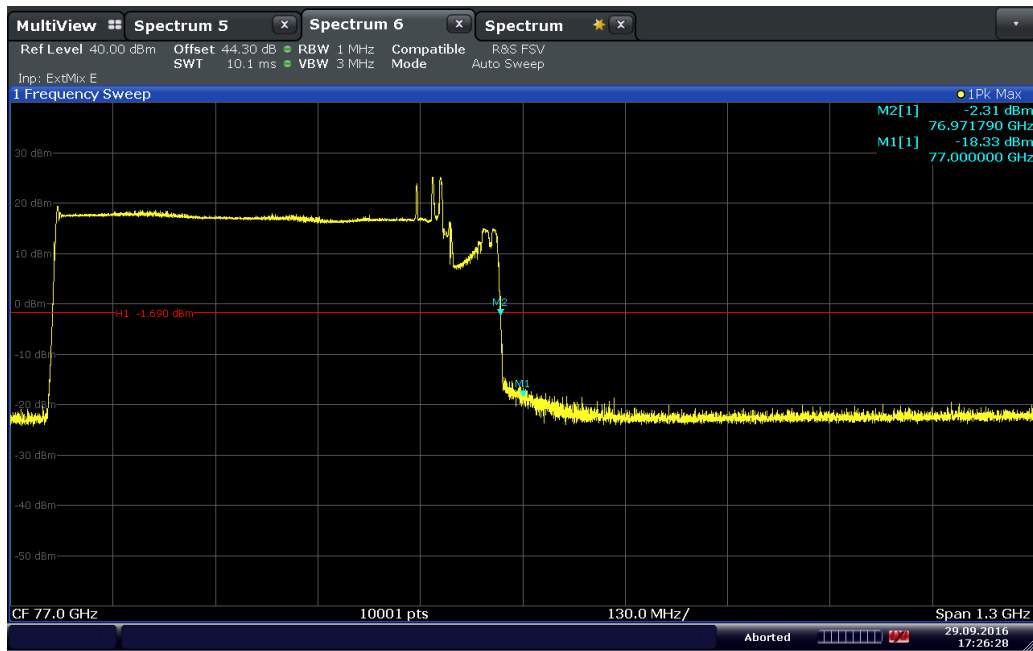
M1

CF 77.0 GHz 10001 pts 130.0 MHz/ Span 1.3 GHz

Aborted 29.09.2016 18:23:51

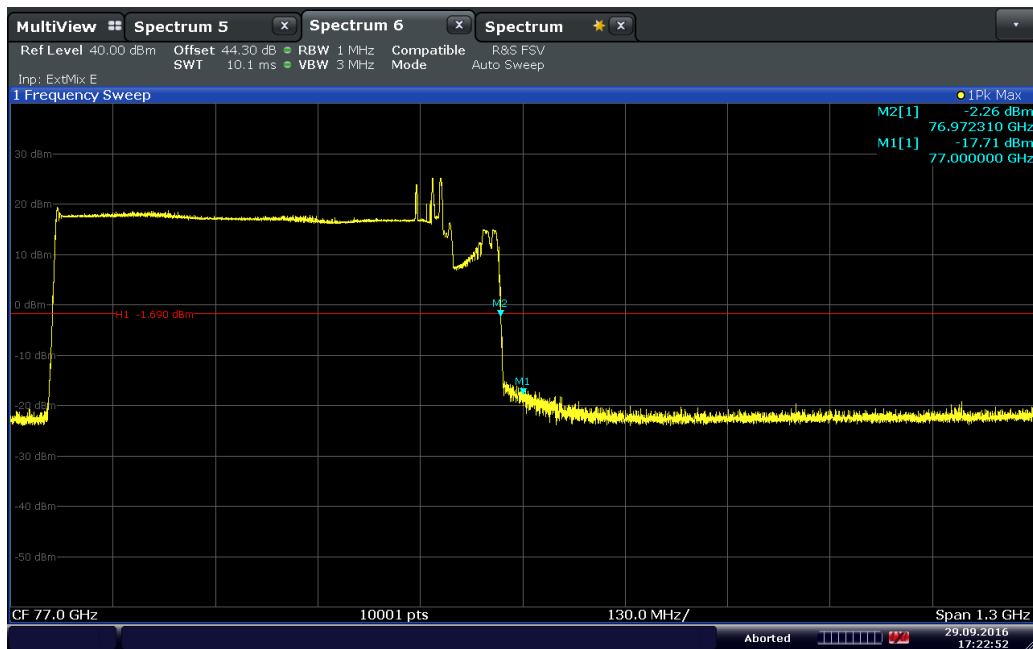
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TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364 Page 87 of 98



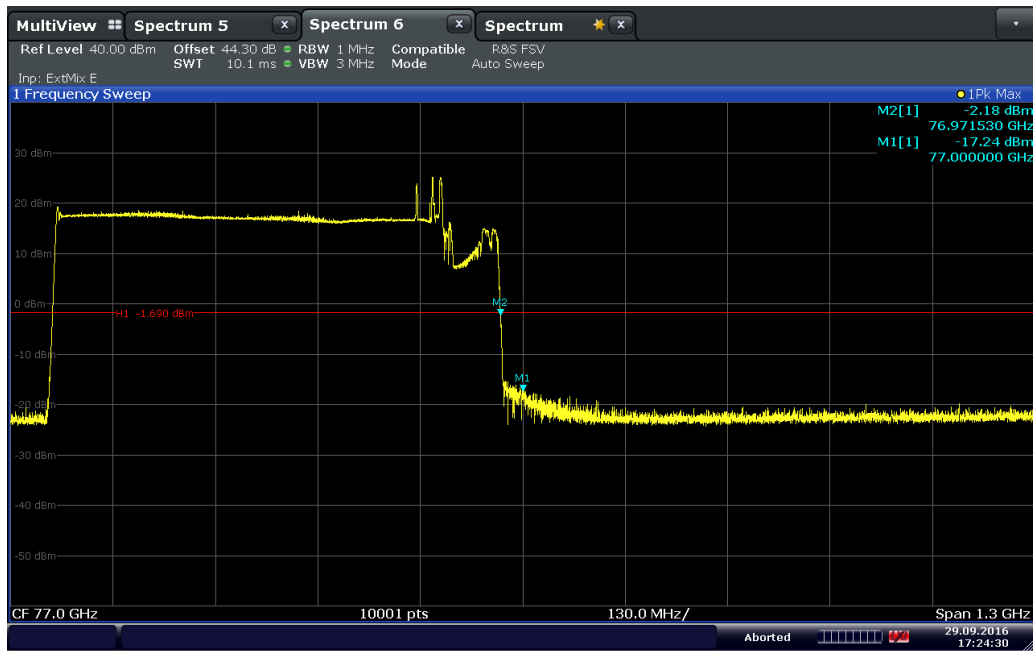
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25 DEG 12.0 VDC High channel 425 MHz BW



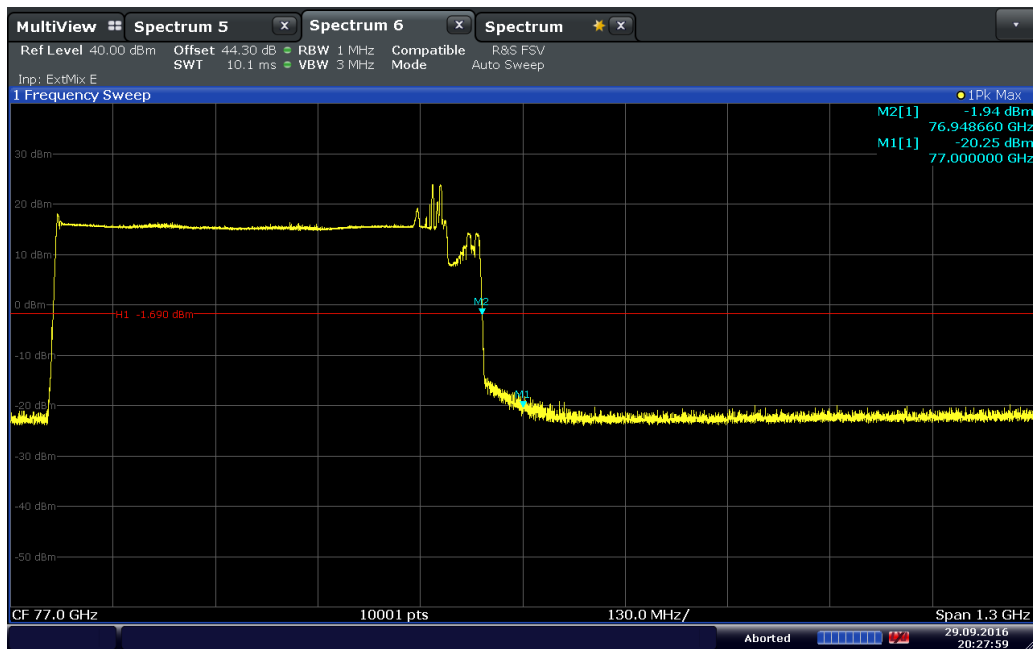
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25 DEG 10.2 VDC High channel 425 MHz BW



17:24:31 29.09.2016

25 DEG 13.8 VDC High channel 425 MHz BW



20:28:00 29.09.2016

85 DEG 12.0 VDC High channel 425 MHz BW



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Test Setup						
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/16	05/16/17
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
1033	Bilog Antenna	3142C	00044556	EMCO	09/25/15	09/25/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	03/21/16	03/21/17
1054	Horn antenna (18-40 GHz)	3116	9407-2233	EMCO	12/22/2015	12/22/2017
9003	Horn antenna (40-60 GHz)	HO19R	103	Custom Microwaves	04/18/2016	04/18/2017
9004	Horn antenna (50-75 GHz)	HO15R	104	Custom Microwaves	04/18/2016	04/18/2017
9005	Horn antenna (75-110 GHz)	HO10R	105	Custom Microwaves	04/27/2016	04/27/2017
9081	Horn antenna (110-170 GHz)	HO6R	N/A	Custom Microwaves	Verified	
9082	Horn antenna (140-220 GHz)	HO5R	N/A	Custom Microwaves	Verified	
9080	Horn antenna (220-325 GHz)	HO3R	N/A	Custom Microwaves	Verified	
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	01/11/16	01/11/17
8893	Pre-amplifier (18-40 GHz)	SLKKA-30-6	15G27	Spacek Labs	Verified by 1003 and 7611	
7637	Harmonics mixer (40-60 GHz)	FS-Z60	100009	Rhode & Schwarz	01/26/16	01/26/18
7636	Harmonics mixer (60-90 GHz)	FS-Z90	100092	Rhode & Schwarz	10/26/15	10/26/17
7633	Harmonics mixer (75-110 GHz)	HM-110-7	101000	Radiometer Physics	Verified	
7634	Harmonics mixer (110-170 GHz)	HM-170	0062	Radiometer Physics	Verified	
7635	Harmonics mixer (170-220 GHz)	HM-220	020022	Radiometer Physics	Verified	
7632	Harmonics mixer (220-325 GHz)	HM-325	020075	Radiometer Physics	Verified	
8872	Direct Reading Attenuator	STA-60-19-D1	11875-01	Sage Millimeter, Inc.	Verified	
8860	Direct Reading Attenuator	STA-60-15-D1	11466-01	Sage Millimeter, Inc.	Verified	
8861	Direct Reading Attenuator	STA-60-10-D1	11466-01	Sage Millimeter, Inc.	Verified	
8873	Active Multiplier (40-60 GHz)	AMC-19-RFH00	124	Millitech, Inc.	Verified	
8914	Active Multiplier (50-75 GHz)	AMC-15-RFH00	283	Millitech, Inc.	Verified	
8915	Active Multiplier (75-110 GHz)	AMC-10-RFH00	606	Millitech, Inc.	Verified	
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 1003 and 7611	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 1003 and 7611	
8879	High-frequency cable	084-0505-10	16-02-401	Teledyne	03/16/16	03/16/17
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	04/09/16	04/09/17
118208	DC Power Supply	Pad 250-4.5L	29051058	Kikusui Electronics Corp.	Verified by 6792	
1072	DC Power Supply	E3610A	2529	HP	Verified by 6792	
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Radiated Emission Measurements (Below 1 GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.55	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57

3.2.2 Radiated Emission Measurements (1 GHz to 40 GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.55	2.05	4.20
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.22
Coverage Factor (k):					2
Expanded Uncertainty:					4.44

3.2.3 Radiated Emission Measurements (Above 40 GHz)

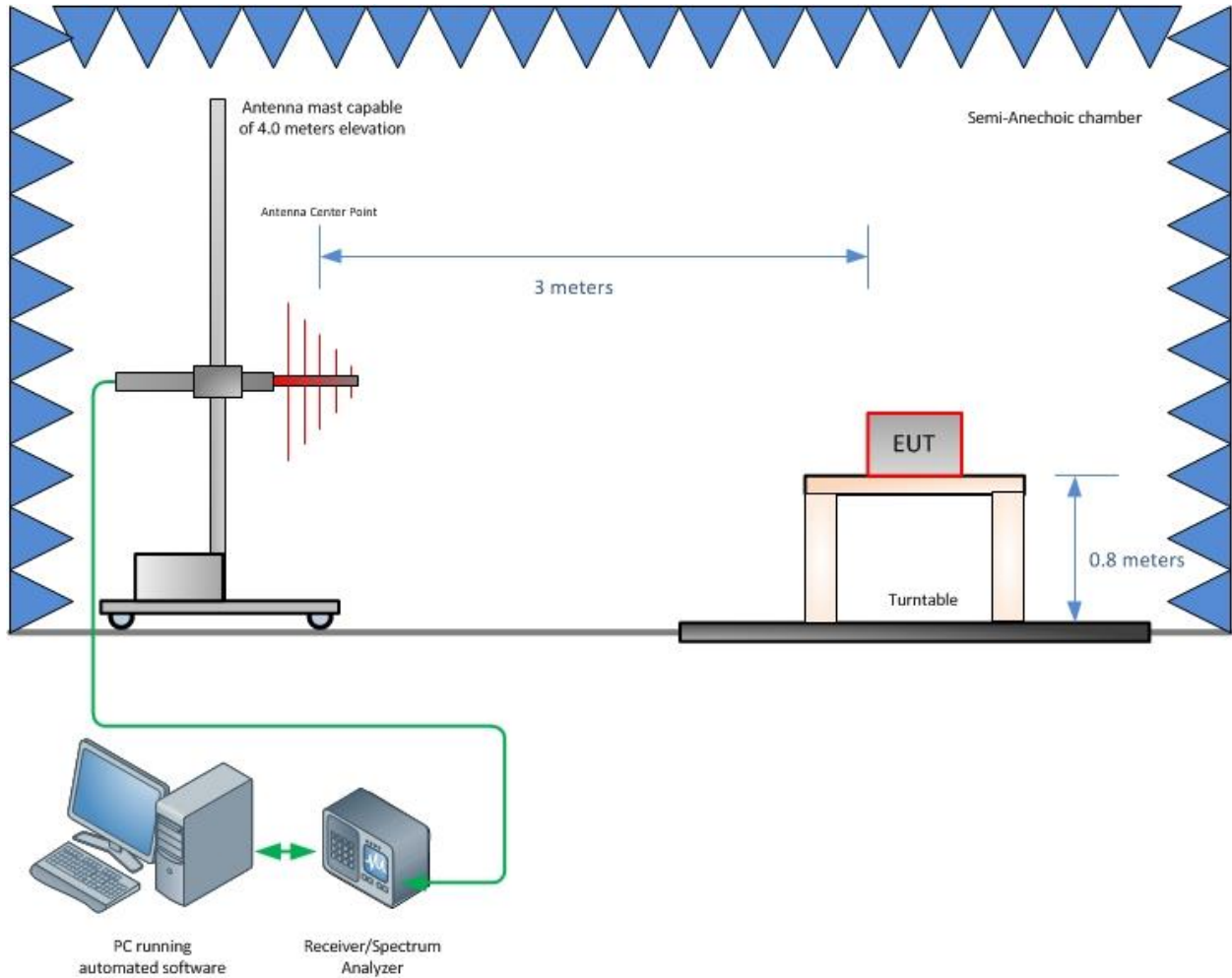
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Spectrum Analyzer/External Mixer	Rectangular	3.34	1.93	3.72
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamplifier	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.50	0.87	0.75
Combined Uncertainty (u_c):					2.67
Coverage Factor (k):					2
Expanded Uncertainty:					5.35



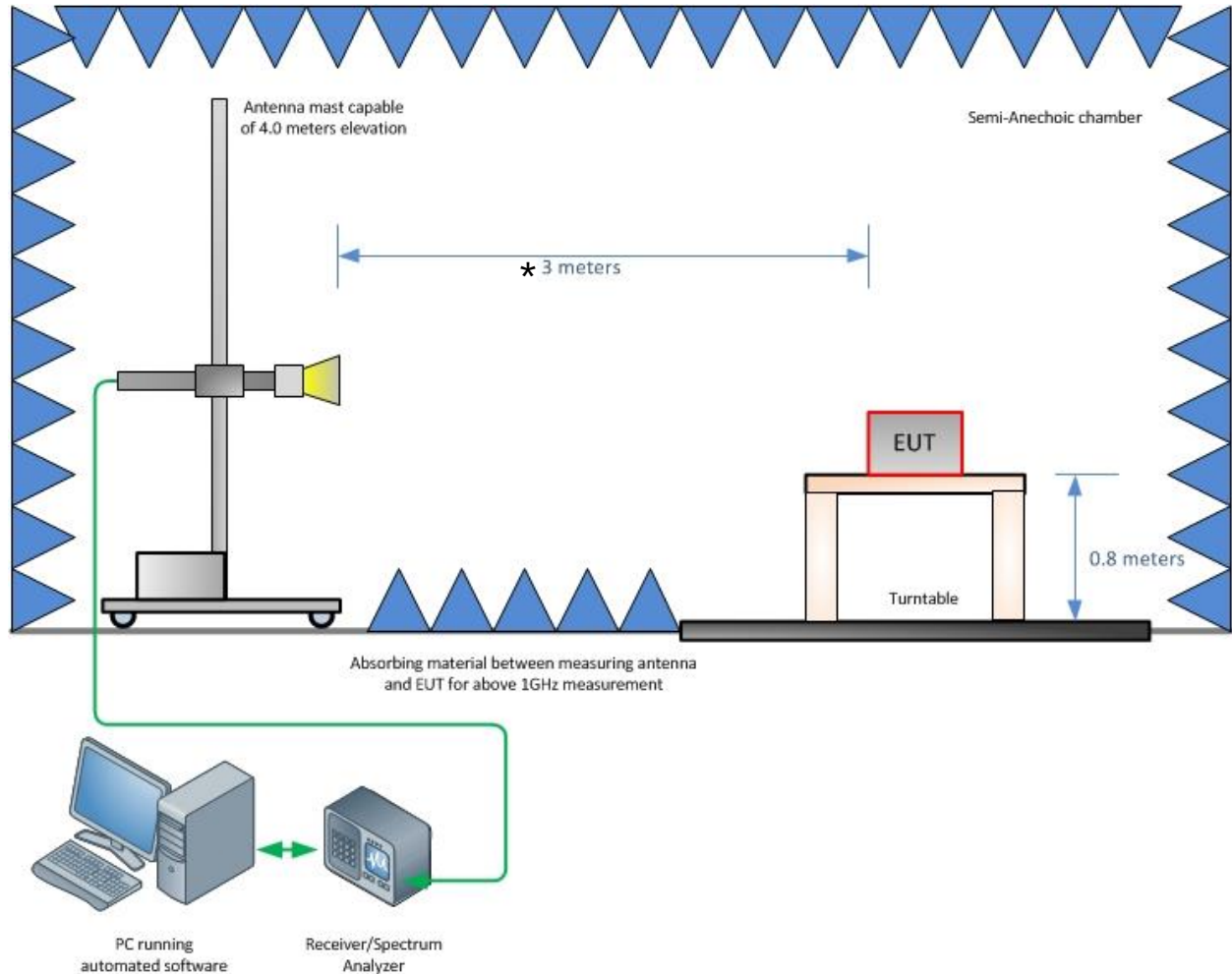
SECTION 4

DIAGRAM OF TEST SETUP

4.1 RADIATED EMISSION TEST SETUP (BELOW 1 GHZ)



4.2 RADIATED EMISSION TEST SETUP (ABOVE 1 GHz)



*A test distance of 3 m was used for measurements below 75 GHz. The emissions in the range from 75 GHz to 160 GHz were evaluated at 1.0 m distance. For the measurements from 160 GHz to 220 GHz, the test distance was reduced to 0.5 m to assure that the noise floor is at least 10 dB below the applicable limit. Measurements above 220 GHz were taken at 0.2 m distance.



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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