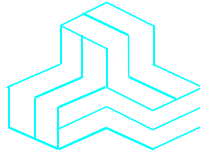


ENGINEERING TEST REPORT



UHF LO/700/800 RF MODULE

Model No.: T3048

FCC ID: IMA-T3048

Applicant:

Technisonic Industries Limited

240 Traders Blvd. E.
Mississauga, Ontario
Canada L4Z 1W7

Tested in Accordance With

Federal Communications Commission (FCC)

47 CFR, Parts 2 and 90

UltraTech's File No.: TIL-094F90R01

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: July 2, 2013

Report Prepared by: Dan Huynh

Tested by: Wei Wu

Issued Date: July 2, 2013

Test Dates: March 8 - April 8, , 2013

- The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
- This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.

UltraTech

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FCC

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NVLAP LAB CODE 200093-0



SL2-IN-E-1119R



Korea KCC-RRL

CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 90
Title:	Code of Federal Regulations (CFR), Title 47 –Telecommunication, Part 90 Private land mobile radio services
Purpose of Test:	To gain FCC Equipment Authorization for Radio operating in Part 90.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA-603-D – Land Mobile FM or PM Communications Equipment Measurement and performance Standards.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2013	Code of Federal Regulations, Title 47 – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA/EIA 603, Edition D	2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Technisonic Industries Ltd.
Address:	240 Traders Blvd. E. Mississauga, Ontario Canada L4Z 1W7
Contact Person:	Mr. Steve McIntosh Phone #: 905-890-2113 ext 205 Fax #: 905-890-5338 Email Address: stevem@til.ca

MANUFACTURER	
Name:	Technisonic Industries Ltd.
Address:	240 Traders Blvd. E. Mississauga, Ontario Canada L4Z 1W7
Contact Person:	Mr. Steve McIntosh Phone #: 905-890-2113 ext 205 Fax #: 905-890-5338 Email Address: stevem@til.ca

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Technisonic Industries Limited
Product Name:	UHF LO/700/800 RF MODULE
Model Name or Number:	T3048
Serial Number:	655CMX0735
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Power Supply Requirement:	7.5 VDC Nominal
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	RF Transceiver Module

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2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	7.5 VDC Nominal
RF Output Power Rating:	UHF: 1 W to 5 W 764 - 776 MHz and 793 - 806 MHz: 1 W to 2.5 W 806 - 824 MHz and 851 - 869 MHz: 1 W to 3 W
Operating Frequency Range:	380 - 470 MHz, 764 - 776 MHz, 793 - 806 MHz, 806 - 824 MHz and 851 - 869 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	25 kHz, 12.5 kHz, 6.25 kHz (2 SLOT TDMA)
Modulation Employed:	FM W/N, C4FM, CQPSK, 2 SLOT TDMA
Emission Designation*:	16K0F3E, 11K0F3E, 8K38F1E, 8K30F1D and 8K22F1W
Antenna Connector Type:	MCX

*Necessary bandwidth determined using the Carson's formula: $B_n = 2M + 2DK$

where: B_n = Necessary bandwidth in hertz

M = Maximum modulation frequency in hertz

D = Peak frequency deviation

K = An overall numerical factor which varies according to the emission and which depends upon the allowable signal distortion.

Standard Audio Modulation (12.5 kHz Channelization, Analog Voice):

M = 3 kHz; D = 2.5 kHz; K = 1

$B_n = 2M + 2DK = 2(3 \text{ kHz}) + 2(2.5 \text{ kHz})(1) = 11 \text{ kHz}$

Emission Designator: 11K0F3E.

Standard Audio Modulation (25 kHz Channelization, Analog Voice):

M = 3 kHz; D = 5 kHz

$B_n = 2M + 2DK = 2(3 \text{ kHz}) + 2(5 \text{ kHz})(1) = 16 \text{ kHz}$

Emission Designator: 16K0F3E

For Digital Modulation the measured 99% occupied bandwidth was used instead of Carson's rule.

Digital (12.5 kHz Channelization, Digital Data):

Emission Designator: 8K30F1D

Digital (12.5 kHz Channelization, Digital Voice):

Emission Designator: 8K38F1E

Digital (12.5 kHz Channelization, Digital TDMA):

Emission Designator: 8K22F1W

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	J1 Main Audio and Control Interface	1	Molex Surface Mount FM	Molex, PCB Surface Mount, 60 Pins, Male
2	M101 DC Power Terminals	1	Custom Brass pins	PCB mounted pins
3	J101 Antenna Connector	1	Surface Mount MCX FM	MCX Male Plug Shielded

2.5. ANCILLARY EQUIPMENT

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	TECHNISONIC INDUSTRIES LIMITED
Model Name or Number:	N/A
Connected to EUT's Port:	I/O Port

Ancillary Equipment # 2	
Description:	Tx Switch and Audio Input Box
Brand name:	TECHNISONIC INDUSTRIES LIMITED
Model Name or Number:	N/A
Connected to EUT's Port:	Connected to Test Jig, DB 15

Ancillary Equipment # 3	
Description:	Motorola Handset
Brand name:	Motorola
Model Name or Number:	HMN 4104B
Connected to EUT's Port:	Connected to Test Jig, DB 9

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EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	7.5 VDC nominal

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	Test Jig
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ω Load.

Transmitter Test Signals	
Frequency Band(s):	380 - 470 MHz 764 - 776 MHz, 793 - 806 MHz 806 - 824 MHz and 851 - 869 MHz
Test Frequency(ies):	406.2 MHz, 429.9 MHz & 469.9 MHz 764.1 MHz, 769.5 MHz and 774.9 MHz 794.1 MHz, 798.5 MHz and 804.9 MHz 806.1 MHz, 815.0 MHz and 823.9 MHz 851.1 MHz, 860.0 MHz and 868.9 MHz
Transmitter Wanted Output Test Signals:	
Transmitter Power (measured maximum output power):	UHF band: 37.26 dBm 764 – 776 MHz & 793 - 806 MHz bands: 34.02 dBm 806 - 824 MHz & 851 - 869 MHz bands: 34.91 dBm
Normal Test Modulation:	F3E, F1E, F1D and F1W
Modulating signal source:	External for analog mode/Internal for digital mode

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EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 90.205	RF Power Output	Yes
2.1047(a)	Modulation Characteristics - Audio Frequency Response	Yes
2.1047(b)	Modulation Characteristics - Modulation Limiting	Yes
2.1049, 90.209 & 90.210	Occupied Bandwidth and Emission Limitations/Masks	Yes
2.1051, 2.1057 & 90.210	Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057 & 90.210	Field Strength of Spurious Emissions	Yes
2.1055, 90.213 & 90.539	Frequency Stability	Yes
90.214	Transient Frequency Behavior	Yes
90.543(a)	Adjacent Channel Power	Yes
1.1307, 1.1310 & 2.1091	RF Exposure Limit	Yes
15.207	AC Power Line Conducted Emissions	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

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EXHIBIT 5. TEST DATA

5.1. RF POWER OUTPUT [§§ 2.1046 & 90.205]

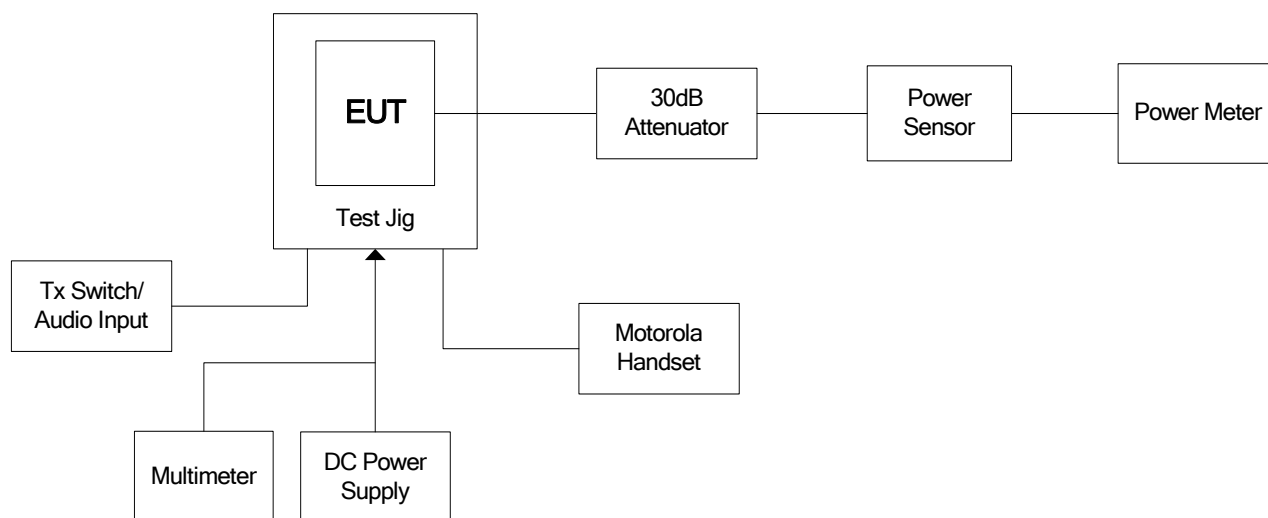
5.1.1. Limits

Please refer to FCC 47 CFR § 90.205 for specification details.

5.1.2. Method of Measurements

Refer to Section 8.1 of this report for measurement details.

5.1.3. Test Arrangement



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5.1.4. Test Data

Power Setting	Frequency (MHz)	Measured Conducted Power Output		Power Output Rating	
		(dBm)	(W)	(dBm)	(W)
380 - 470 MHz Band					
High	406.2	36.94	4.94	36.99	5
	429.9	37.26	5.32	36.99	5
	469.9	37.21	5.26	36.99	5
Low	406.2	30.23	1.05	30.00	1
	429.9	30.40	1.10	30.00	1
	469.9	30.23	1.05	30.00	1
764 - 776 MHz Band					
High	764.1	33.98	2.50	33.98	2.5
	769.5	33.96	2.49	33.98	2.5
	774.9	33.99	2.51	33.98	2.5
Low	764.1	30.43	1.10	30.00	1
	769.5	30.41	1.10	30.00	1
	774.9	30.41	1.10	30.00	1
793 - 806 MHz Band					
High	794.1	33.97	2.49	33.98	2.5
	798.5	34.02	2.52	33.98	2.5
	804.9	34.01	2.52	33.98	2.5
Low	794.1	30.42	1.10	30.00	1
	798.5	30.46	1.11	30.00	1
	804.9	30.45	1.11	30.00	1
806 - 824 MHz Band					
High	806.1	34.91	3.10	34.77	3
	815.0	34.89	3.08	34.77	3
	823.9	34.88	3.08	34.77	3
Low	806.1	30.44	1.11	30.00	1
	815.0	30.42	1.10	30.00	1
	823.9	30.42	1.10	30.00	1
851 - 869 MHz Band					
High	851.1	34.89	3.08	34.77	3
	860.0	34.89	3.08	34.77	3
	868.9	34.88	3.08	34.77	3
Low	851.1	30.16	1.04	30.00	1
	860.0	30.15	1.04	30.00	1
	868.9	30.28	1.07	30.00	1

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5.2. MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE [§ 2.1047(a)]

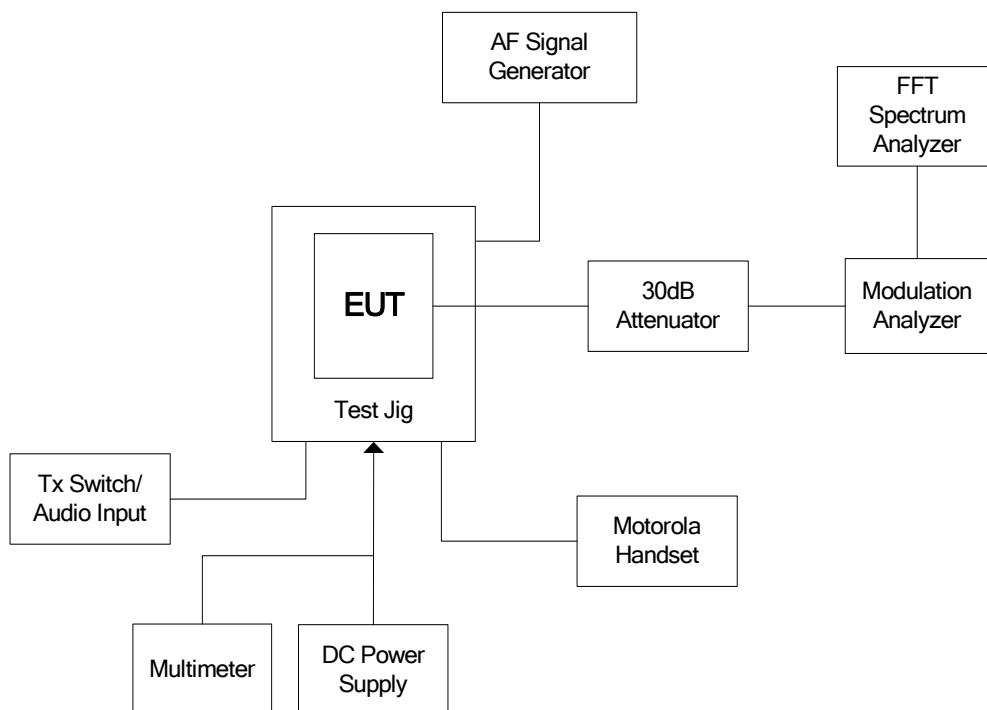
5.2.1. Limits

§ 2.1047(a): Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

5.2.2. Method of Measurements

The rated audio input signal was applied to the input of the audio low-pass filter (or of all modulation stages) using an audio oscillator, this input signal level and its corresponding output signal were then measured and recorded using the FFT Digital Spectrum Analyzer. Tests were repeated at different audio signal frequencies from 0 to 50 KHz.

5.2.3. Test Arrangement



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5.2.4. Test Data

5.2.4.1. 12.5 kHz Channel Spacing, 406.2 MHz, F3E, Frequency of All Modulation States

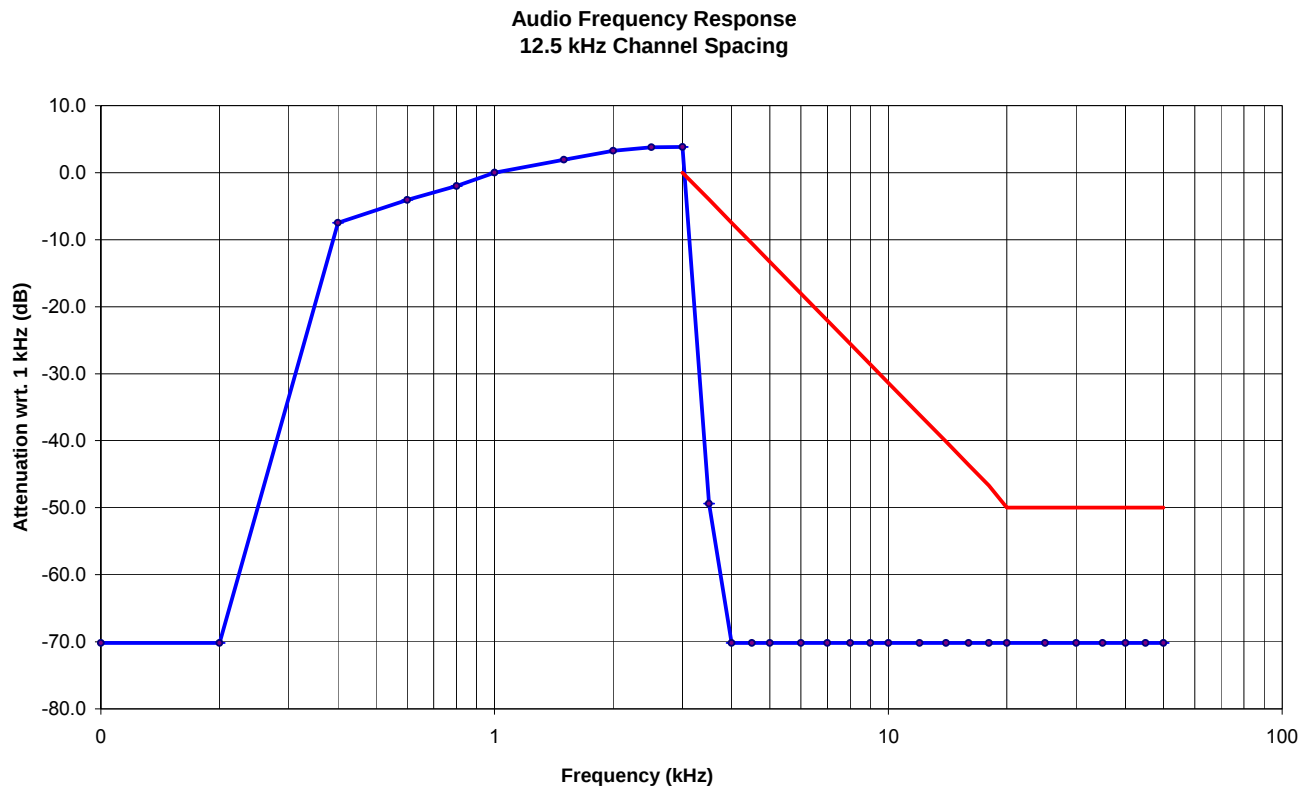
Remark: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 kHz in comparison with the recommended audio filter attenuation.					
Frequency (kHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-6.47	-70.00	-63.5	-70.2	--
0.2	-6.47	-70.00	-63.5	-70.2	--
0.4	-6.47	-7.31	-0.8	-7.5	--
0.6	-6.47	-3.90	2.6	-4.1	--
0.8	-6.47	-1.82	4.7	-2.0	--
1.0	-6.47	0.17	6.6	0.0	--
1.5	-6.47	2.10	8.6	1.9	--
2.0	-6.47	3.42	9.9	3.3	--
2.5	-6.47	3.96	10.4	3.8	--
3.0	-6.47	3.99	10.5	3.8	0
3.5	-6.47	-49.21	-42.7	-49.4	-4
4.0	-6.47	-70.00	-63.5	-70.2	-7
4.5	-6.47	-70.00	-63.5	-70.2	-11
5.0	-6.47	-70.00	-63.5	-70.2	-13
6.0	-6.47	-70.00	-63.5	-70.2	-18
7.0	-6.47	-70.00	-63.5	-70.2	-22
8.0	-6.47	-70.00	-63.5	-70.2	-26
9.0	-6.47	-70.00	-63.5	-70.2	-29
10.0	-6.47	-70.00	-63.5	-70.2	-31
12.0	-6.47	-70.00	-63.5	-70.2	-36
14.0	-6.47	-70.00	-63.5	-70.2	-40
16.0	-6.47	-70.00	-63.5	-70.2	-44
18.0	-6.47	-70.00	-63.5	-70.2	-47
20.0	-6.47	-70.00	-63.5	-70.2	-50
25.0	-6.47	-70.00	-63.5	-70.2	-50
30.0	-6.47	-70.00	-63.5	-70.2	-50
35.0	-6.47	-70.00	-63.5	-70.2	-50
40.0	-6.47	-70.00	-63.5	-70.2	-50
45.0	-6.47	-70.00	-63.5	-70.2	-50
50.0	-6.47	-70.00	-63.5	-70.2	-50

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5.2.4.2. 25 kHz Channel Spacing, 406.2 MHz, F3E, Frequency of All Modulation States

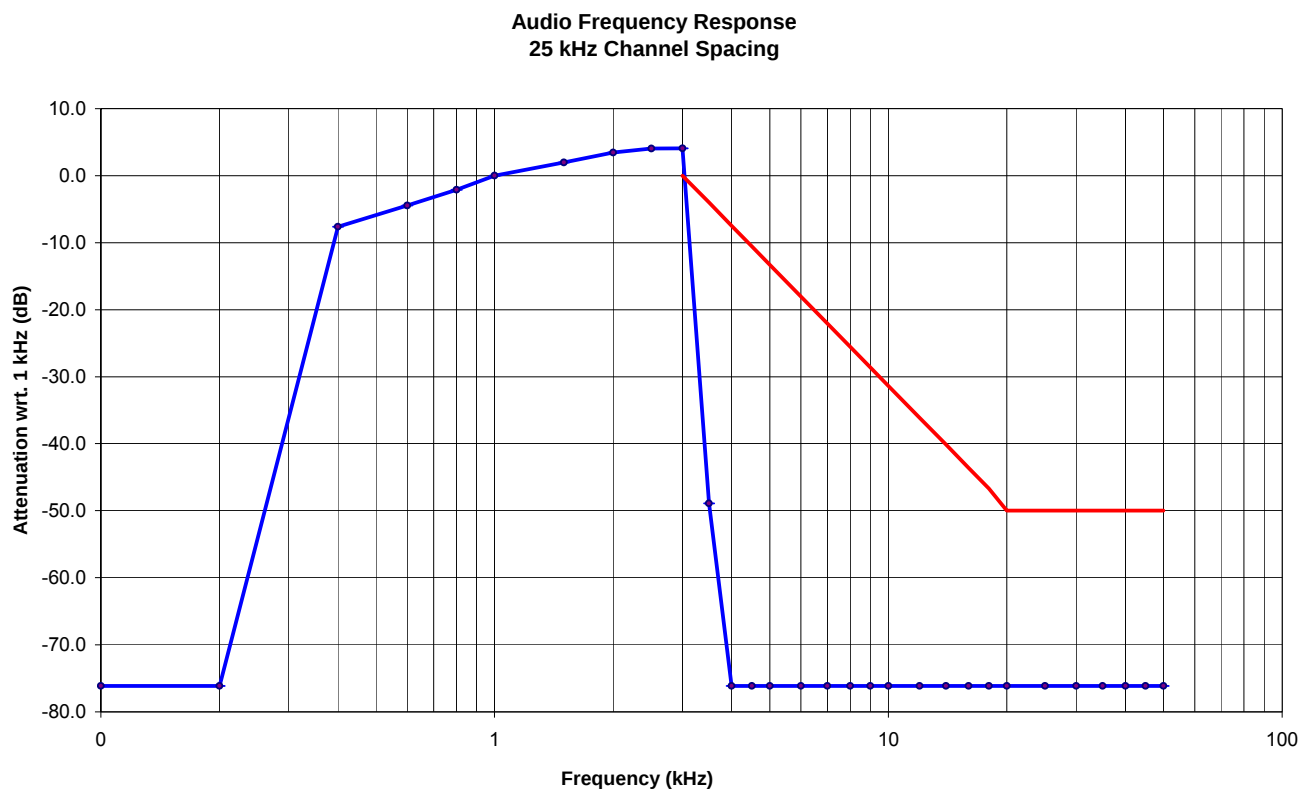
Remark: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 kHz in comparison with the recommended audio filter attenuation.					
Frequency (kHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-6.56	-70.00	-63.4	-76.1	--
0.2	-6.56	-70.00	-63.4	-76.1	--
0.4	-6.56	-1.47	5.1	-7.6	--
0.6	-6.56	1.68	8.2	-4.5	--
0.8	-6.56	4.04	10.6	-2.1	--
1.0	-6.56	6.14	12.7	0.0	--
1.5	-6.56	8.11	14.7	2.0	--
2.0	-6.56	9.56	16.1	3.4	--
2.5	-6.56	10.17	16.7	4.0	--
3.0	-6.56	10.22	16.8	4.1	0
3.5	-6.56	-42.77	-36.2	-48.9	-4
4.0	-6.56	-70.00	-63.4	-76.1	-7
4.5	-6.56	-70.00	-63.4	-76.1	-11
5.0	-6.56	-70.00	-63.4	-76.1	-13
6.0	-6.56	-70.00	-63.4	-76.1	-18
7.0	-6.56	-70.00	-63.4	-76.1	-22
8.0	-6.56	-70.00	-63.4	-76.1	-26
9.0	-6.56	-70.00	-63.4	-76.1	-29
10.0	-6.56	-70.00	-63.4	-76.1	-31
12.0	-6.56	-70.00	-63.4	-76.1	-36
14.0	-6.56	-70.00	-63.4	-76.1	-40
16.0	-6.56	-70.00	-63.4	-76.1	-44
18.0	-6.56	-70.00	-63.4	-76.1	-47
20.0	-6.56	-70.00	-63.4	-76.1	-50
25.0	-6.56	-70.00	-63.4	-76.1	-50
30.0	-6.56	-70.00	-63.4	-76.1	-50
35.0	-6.56	-70.00	-63.4	-76.1	-50
40.0	-6.56	-70.00	-63.4	-76.1	-50
45.0	-6.56	-70.00	-63.4	-76.1	-50
50.0	-6.56	-70.00	-63.4	-76.1	-50

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5.2.4.3. 12.5 kHz Channel Spacing, 764.1 MHz, F3E, Frequency of All Modulation States

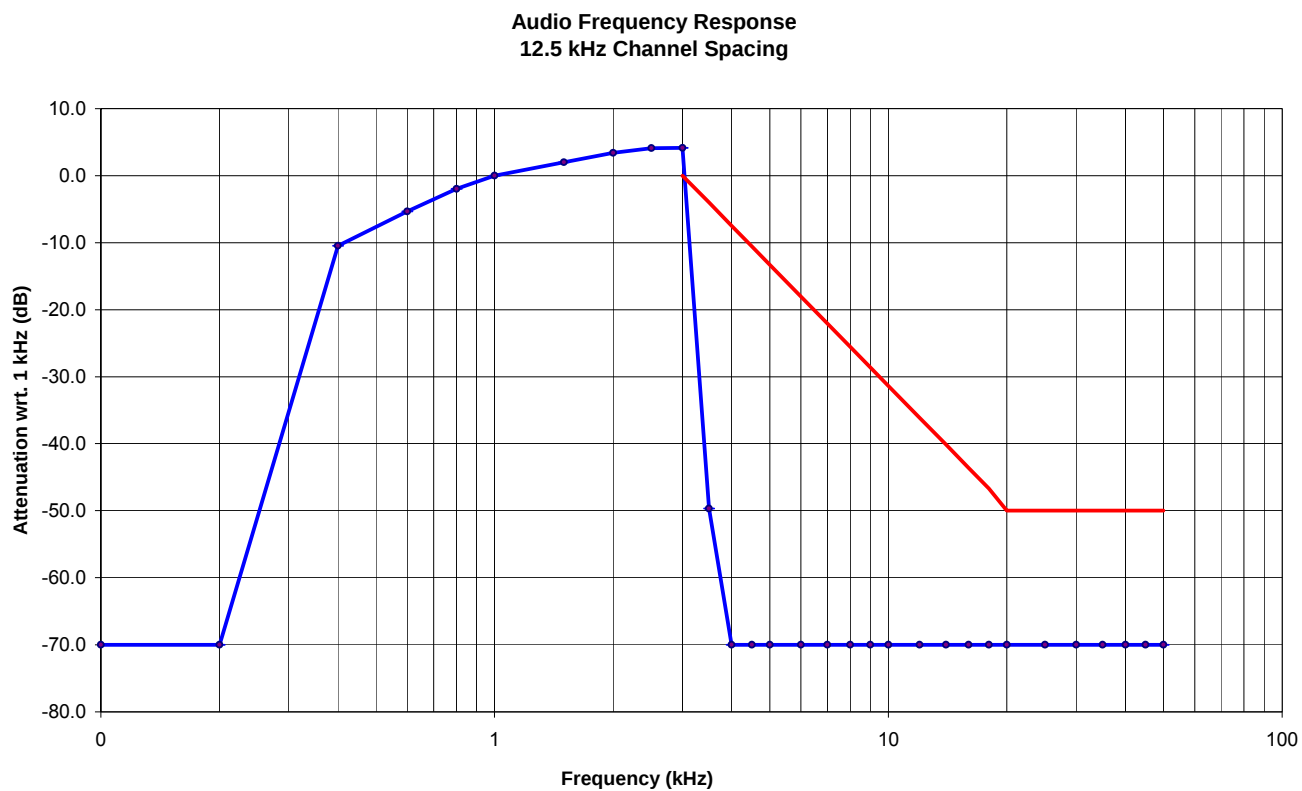
Remark: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 kHz in comparison with the recommended audio filter attenuation.					
Frequency (kHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-6.65	-70.00	-63.4	-70.0	--
0.2	-6.65	-70.00	-63.4	-70.0	--
0.4	-6.65	-10.45	-3.8	-10.5	--
0.6	-6.65	-5.33	1.3	-5.3	--
0.8	-6.65	-1.96	4.7	-2.0	--
1.0	-6.65	0.01	6.7	0.0	--
1.5	-6.65	2.02	8.7	2.0	--
2.0	-6.65	3.42	10.1	3.4	--
2.5	-6.65	4.13	10.8	4.1	--
3.0	-6.65	4.16	10.8	4.2	0
3.5	-6.65	-49.65	-43.0	-49.7	-4
4.0	-6.65	-70.00	-63.4	-70.0	-7
4.5	-6.65	-70.00	-63.4	-70.0	-11
5.0	-6.65	-70.00	-63.4	-70.0	-13
6.0	-6.65	-70.00	-63.4	-70.0	-18
7.0	-6.65	-70.00	-63.4	-70.0	-22
8.0	-6.65	-70.00	-63.4	-70.0	-26
9.0	-6.65	-70.00	-63.4	-70.0	-29
10.0	-6.65	-70.00	-63.4	-70.0	-31
12.0	-6.65	-70.00	-63.4	-70.0	-36
14.0	-6.65	-70.00	-63.4	-70.0	-40
16.0	-6.65	-70.00	-63.4	-70.0	-44
18.0	-6.65	-70.00	-63.4	-70.0	-47
20.0	-6.65	-70.00	-63.4	-70.0	-50
25.0	-6.65	-70.00	-63.4	-70.0	-50
30.0	-6.65	-70.00	-63.4	-70.0	-50
35.0	-6.65	-70.00	-63.4	-70.0	-50
40.0	-6.65	-70.00	-63.4	-70.0	-50
45.0	-6.65	-70.00	-63.4	-70.0	-50
50.0	-6.65	-70.00	-63.4	-70.0	-50

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5.2.4.4. 25 kHz Channel Spacing, 764.1 MHz, F3E, Frequency of All Modulation States

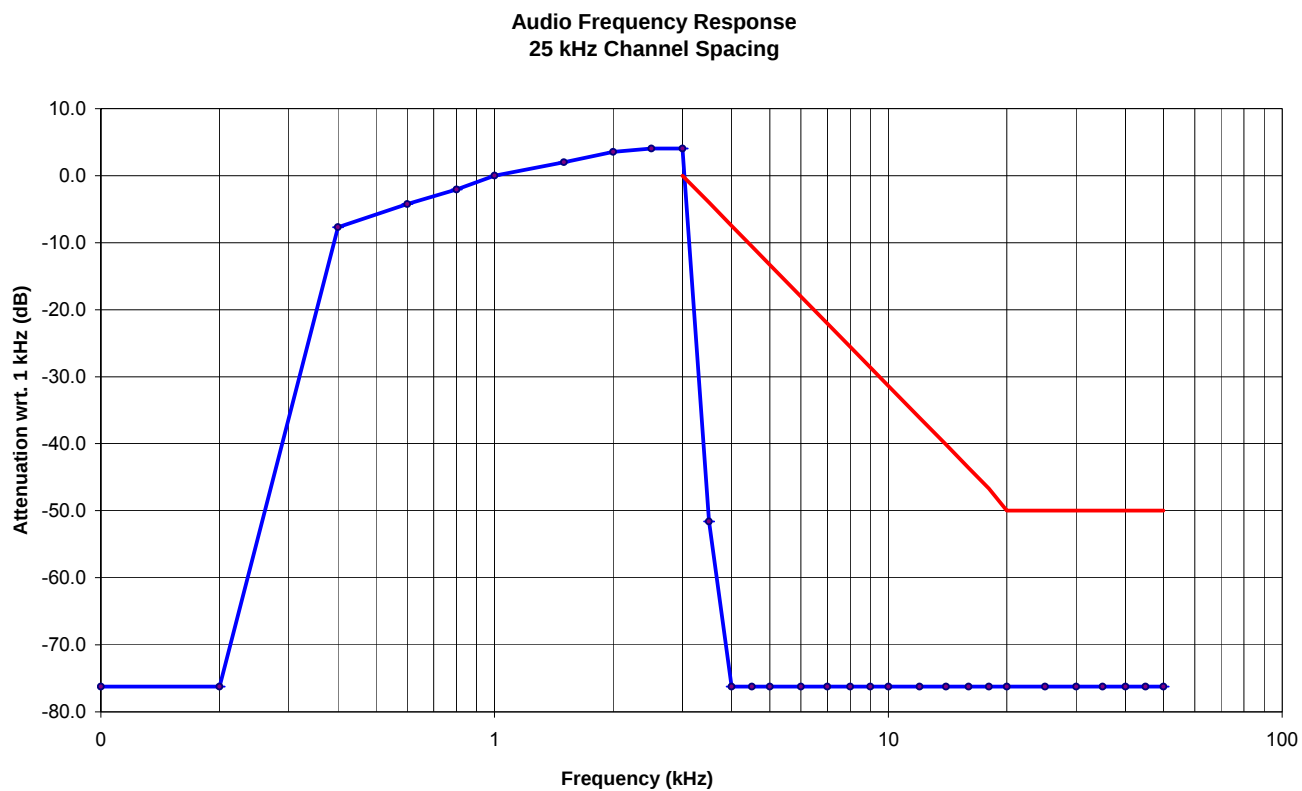
Remark: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 kHz in comparison with the recommended audio filter attenuation.					
Frequency (kHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-6.43	-70.00	-63.6	-76.2	--
0.2	-6.43	-70.00	-63.6	-76.2	--
0.4	-6.43	-1.45	5.0	-7.7	--
0.6	-6.43	1.97	8.4	-4.3	--
0.8	-6.43	4.16	10.6	-2.1	--
1.0	-6.43	6.23	12.7	0.0	--
1.5	-6.43	8.23	14.7	2.0	--
2.0	-6.43	9.77	16.2	3.5	--
2.5	-6.43	10.25	16.7	4.0	--
3.0	-6.43	10.27	16.7	4.0	0
3.5	-6.43	-45.36	-38.9	-51.6	-4
4.0	-6.43	-70.00	-63.6	-76.2	-7
4.5	-6.43	-70.00	-63.6	-76.2	-11
5.0	-6.43	-70.00	-63.6	-76.2	-13
6.0	-6.43	-70.00	-63.6	-76.2	-18
7.0	-6.43	-70.00	-63.6	-76.2	-22
8.0	-6.43	-70.00	-63.6	-76.2	-26
9.0	-6.43	-70.00	-63.6	-76.2	-29
10.0	-6.43	-70.00	-63.6	-76.2	-31
12.0	-6.43	-70.00	-63.6	-76.2	-36
14.0	-6.43	-70.00	-63.6	-76.2	-40
16.0	-6.43	-70.00	-63.6	-76.2	-44
18.0	-6.43	-70.00	-63.6	-76.2	-47
20.0	-6.43	-70.00	-63.6	-76.2	-50
25.0	-6.43	-70.00	-63.6	-76.2	-50
30.0	-6.43	-70.00	-63.6	-76.2	-50
35.0	-6.43	-70.00	-63.6	-76.2	-50
40.0	-6.43	-70.00	-63.6	-76.2	-50
45.0	-6.43	-70.00	-63.6	-76.2	-50
50.0	-6.43	-70.00	-63.6	-76.2	-50

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5.2.4.5. 12.5 kHz Channel Spacing, 806.1 MHz, F3E, Frequency of All Modulation States

Remark: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 kHz in comparison with the recommended audio filter attenuation.					
Frequency (kHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-6.54	-70.00	-63.5	-70.1	--
0.2	-6.54	-70.00	-63.5	-70.1	--
0.4	-6.54	-10.43	-3.9	-10.5	--
0.6	-6.54	-5.33	1.2	-5.4	--
0.8	-6.54	-2.06	4.5	-2.2	--
1.0	-6.54	0.09	6.6	0.0	--
1.5	-6.54	2.13	8.7	2.0	--
2.0	-6.54	3.52	10.1	3.4	--
2.5	-6.54	4.11	10.7	4.0	--
3.0	-6.54	4.12	10.7	4.0	0
3.5	-6.54	-48.53	-42.0	-48.6	-4
4.0	-6.54	-70.00	-63.5	-70.1	-7
4.5	-6.54	-70.00	-63.5	-70.1	-11
5.0	-6.54	-70.00	-63.5	-70.1	-13
6.0	-6.54	-70.00	-63.5	-70.1	-18
7.0	-6.54	-70.00	-63.5	-70.1	-22
8.0	-6.54	-70.00	-63.5	-70.1	-26
9.0	-6.54	-70.00	-63.5	-70.1	-29
10.0	-6.54	-70.00	-63.5	-70.1	-31
12.0	-6.54	-70.00	-63.5	-70.1	-36
14.0	-6.54	-70.00	-63.5	-70.1	-40
16.0	-6.54	-70.00	-63.5	-70.1	-44
18.0	-6.54	-70.00	-63.5	-70.1	-47
20.0	-6.54	-70.00	-63.5	-70.1	-50
25.0	-6.54	-70.00	-63.5	-70.1	-50
30.0	-6.54	-70.00	-63.5	-70.1	-50
35.0	-6.54	-70.00	-63.5	-70.1	-50
40.0	-6.54	-70.00	-63.5	-70.1	-50
45.0	-6.54	-70.00	-63.5	-70.1	-50
50.0	-6.54	-70.00	-63.5	-70.1	-50

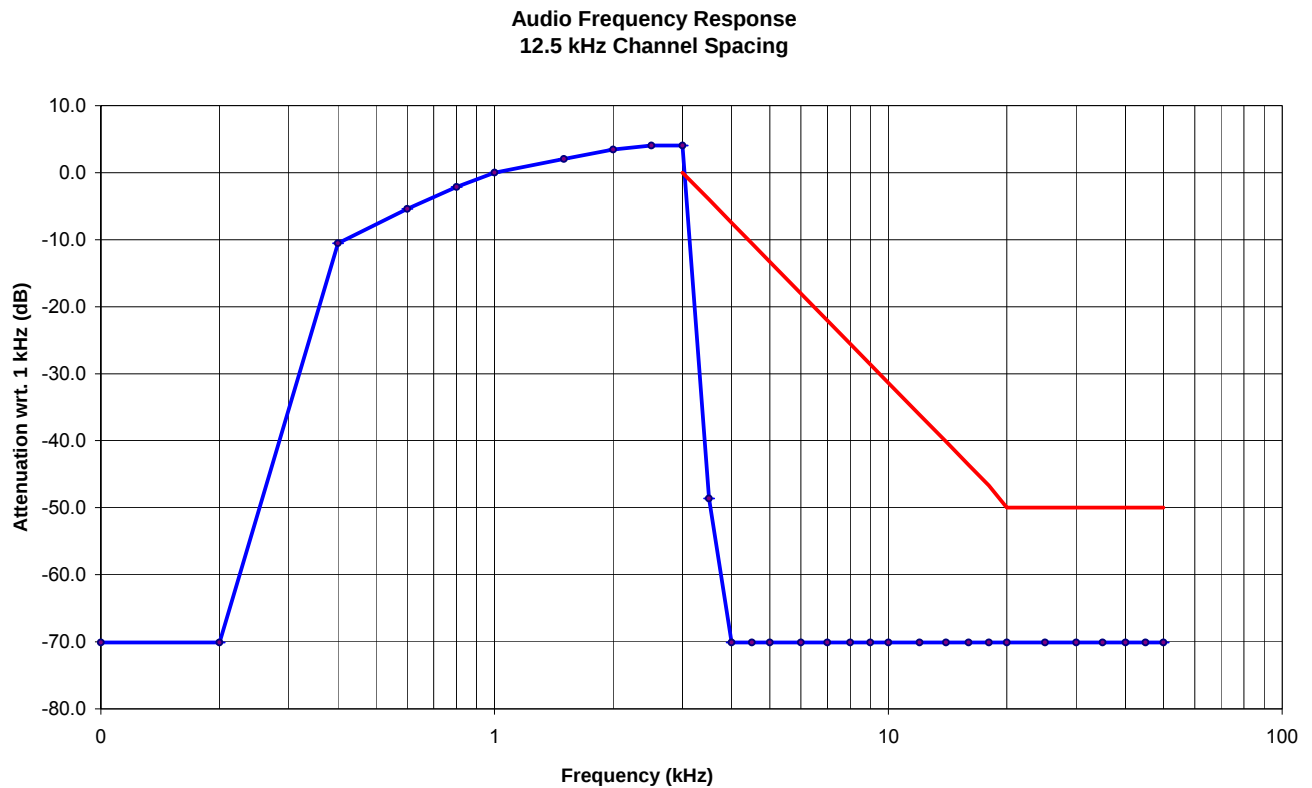
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5.2.4.6. 25 kHz Channel Spacing, 806.1 MHz, F3E, Frequency of All Modulation States

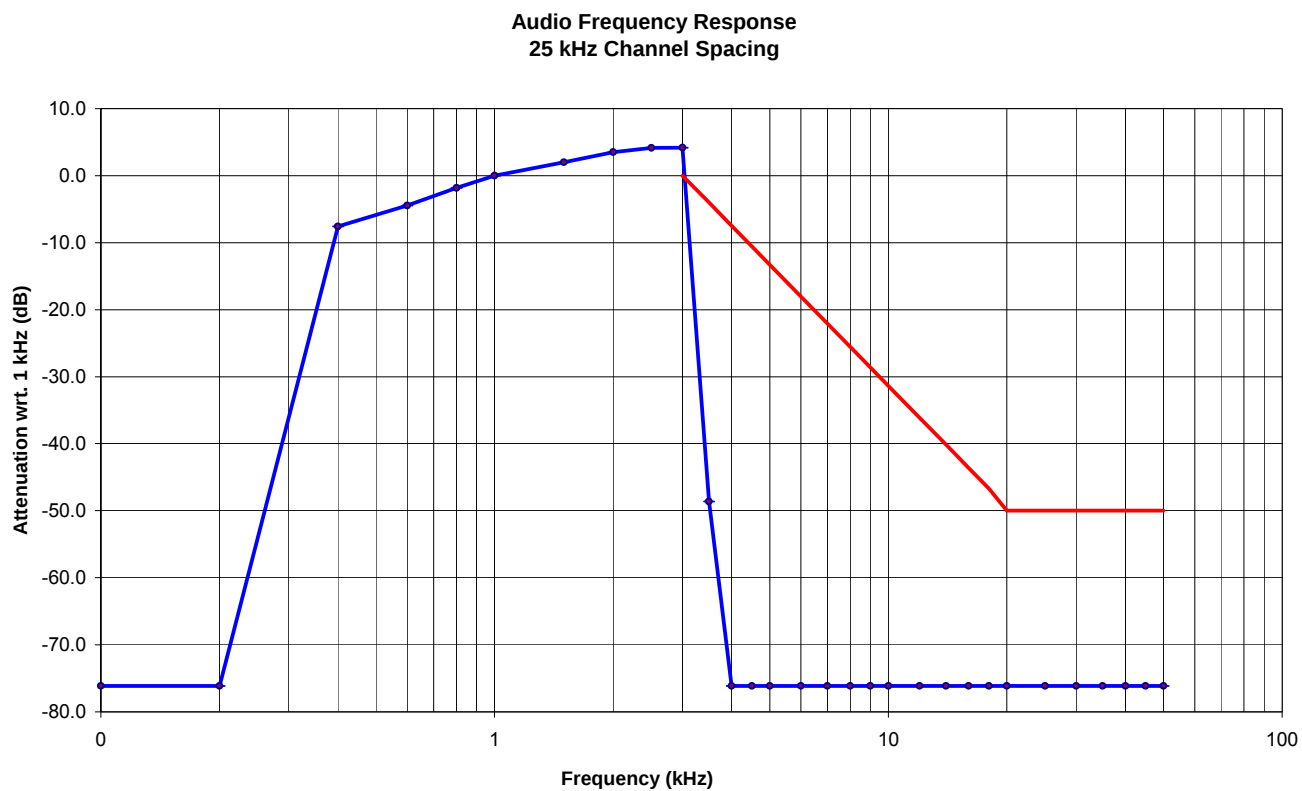
Remark: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 kHz in comparison with the recommended audio filter attenuation.					
Frequency (kHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-6.56	-70.00	-63.4	-76.1	--
0.2	-6.56	-70.00	-63.4	-76.1	--
0.4	-6.56	-1.47	5.1	-7.6	--
0.6	-6.56	1.68	8.2	-4.5	--
0.8	-6.56	4.31	10.9	-1.8	--
1.0	-6.56	6.13	12.7	0.0	--
1.5	-6.56	8.14	14.7	2.0	--
2.0	-6.56	9.63	16.2	3.5	--
2.5	-6.56	10.27	16.8	4.1	--
3.0	-6.56	10.29	16.9	4.2	0
3.5	-6.56	-42.49	-35.9	-48.6	-4
4.0	-6.56	-70.00	-63.4	-76.1	-7
4.5	-6.56	-70.00	-63.4	-76.1	-11
5.0	-6.56	-70.00	-63.4	-76.1	-13
6.0	-6.56	-70.00	-63.4	-76.1	-18
7.0	-6.56	-70.00	-63.4	-76.1	-22
8.0	-6.56	-70.00	-63.4	-76.1	-26
9.0	-6.56	-70.00	-63.4	-76.1	-29
10.0	-6.56	-70.00	-63.4	-76.1	-31
12.0	-6.56	-70.00	-63.4	-76.1	-36
14.0	-6.56	-70.00	-63.4	-76.1	-40
16.0	-6.56	-70.00	-63.4	-76.1	-44
18.0	-6.56	-70.00	-63.4	-76.1	-47
20.0	-6.56	-70.00	-63.4	-76.1	-50
25.0	-6.56	-70.00	-63.4	-76.1	-50
30.0	-6.56	-70.00	-63.4	-76.1	-50
35.0	-6.56	-70.00	-63.4	-76.1	-50
40.0	-6.56	-70.00	-63.4	-76.1	-50
45.0	-6.56	-70.00	-63.4	-76.1	-50
50.0	-6.56	-70.00	-63.4	-76.1	-50

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5.3. MODULATION CHARACTERISTICS - MODULATION LIMITING [§ 2.1047 (b)]

5.3.1. Limits

§ 2.1047(b): Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

Recommended frequency deviation characteristics are given below:

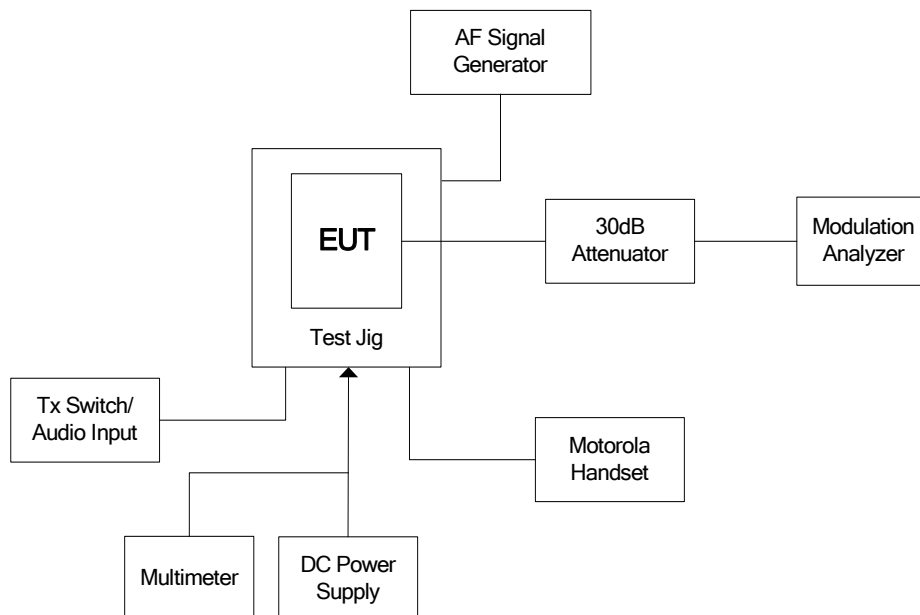
- 1.25 kHz for 6.25 kHz Channel Spacing System
- 2.5 kHz for 12.5 kHz Channel Spacing System
- 5 kHz for 25 kHz Channel Spacing System

5.3.2. Method of Measurements

For Audio Transmitter: The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

For Data Transmitter with Maximum Frequency Deviation set by Factory: The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

5.3.3. Test Arrangement



5.3.4. Test Data

5.3.4.1. Voice Modulation Limiting for 12.5 kHz Channel Spacing Operation, 406.2 MHz

Modulating Signal Level (mVrms)	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit (kHz)
	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	
20	0.05	0.07	0.11	0.58	0.05	2.5
40	0.05	0.10	0.18	0.88	0.05	2.5
60	0.05	0.12	0.23	1.81	0.05	2.5
80	0.05	0.15	0.28	1.92	0.05	2.5
100	0.05	0.18	0.32	2.02	0.05	2.5
150	0.05	0.22	0.49	2.32	0.05	2.5
200	0.05	0.28	0.66	2.32	0.05	2.5
300	0.05	0.42	0.97	2.32	0.05	2.5
400	0.05	0.52	1.28	2.32	0.05	2.5
500	0.05	0.66	1.58	2.32	0.05	2.5
600	0.05	0.77	1.59	2.32	0.05	2.5
700	0.05	0.79	1.59	2.32	0.05	2.5
800	0.05	0.80	1.60	2.32	0.05	2.5
900	0.05	0.80	1.60	2.32	0.05	2.5
1000	0.05	0.80	1.61	2.32	0.05	2.5
1500	0.05	0.80	1.61	2.32	0.05	2.5
2000	0.05	0.80	1.61	2.32	0.05	2.5
3000	0.06	0.83	1.91	2.32	0.14	2.5
4000	0.06	1.17	2.11	2.32	0.18	2.5
5000	0.06	1.83	2.11	2.32	0.18	2.5

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Voice Signal Input Level = STD MOD Level + 16 dB = 53.53 dB(mVrms) + 16 dB = 69.53 dB(mVrms) = 2997.05 mVrms		
Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
0.1	0.06	2.5
0.2	0.06	2.5
0.4	0.65	2.5
0.6	1.36	2.5
0.8	1.47	2.5
1.0	1.87	2.5
1.2	1.82	2.5
1.4	2.31	2.5
1.6	2.12	2.5
1.8	2.33	2.5
2.0	2.35	2.5
2.5	2.26	2.5
3.0	2.32	2.5
3.5	1.85	2.5
4.0	0.45	2.5
4.5	0.14	2.5
5.0	0.14	2.5
6.0	0.14	2.5
7.0	0.12	2.5
8.0	0.12	2.5
9.0	0.14	2.5
10.0	0.10	2.5

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5.3.4.2. Voice Modulation Limiting for 25 kHz Channel Spacing Operation, 406.2 MHz

Modulating Signal Level (mVrms)	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit (kHz)
	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	
20	0.05	0.11	0.18	0.84	0.05	5.0
40	0.05	0.16	0.28	1.61	0.05	5.0
60	0.05	0.28	0.41	2.45	0.05	5.0
80	0.05	0.49	0.55	3.29	0.05	5.0
100	0.05	0.63	0.66	4.04	0.05	5.0
150	0.05	0.99	0.96	4.65	0.05	5.0
200	0.05	1.42	1.30	4.65	0.05	5.0
300	0.05	1.51	1.94	4.65	0.05	5.0
400	0.05	1.51	2.52	4.65	0.05	5.0
500	0.05	1.27	3.15	4.65	0.05	5.0
600	0.05	1.51	3.18	4.65	0.05	5.0
700	0.05	1.51	3.18	4.65	0.05	5.0
800	0.05	1.51	3.18	4.65	0.05	5.0
900	0.05	1.51	3.18	4.65	0.05	5.0
1000	0.05	1.51	3.18	4.65	0.05	5.0
1500	0.05	1.51	3.18	4.65	0.05	5.0
2000	0.05	1.51	3.18	4.65	0.05	5.0
3000	0.05	1.62	3.78	4.65	0.23	5.0
4000	0.06	2.28	4.22	4.65	0.27	5.0
5000	0.07	2.85	4.25	4.65	0.31	5.0

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Voice Signal Input Level = STD MOD Level + 16 dB = 53.44 dB(mVrms) + 16 dB = 69.44 dB(mVrms) = 2965.50 mVrms		
Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
0.1	0.05	5.0
0.2	0.06	5.0
0.4	1.29	5.0
0.6	2.69	5.0
0.8	2.94	5.0
1.0	3.65	5.0
1.2	3.67	5.0
1.4	4.65	5.0
1.6	4.71	5.0
1.8	4.70	5.0
2.0	4.70	5.0
2.5	4.56	5.0
3.0	4.65	5.0
3.5	3.68	5.0
4.0	0.77	5.0
4.5	0.27	5.0
5.0	0.27	5.0
6.0	0.26	5.0
7.0	0.23	5.0
8.0	0.22	5.0
9.0	0.27	5.0
10.0	0.22	5.0

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5.3.4.3. Voice Modulation Limiting for 12.5 kHz Channel Spacing Operation, 764.1 MHz

Modulating Signal Level (mVrms)	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit (kHz)
	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	
20	0.07	0.08	0.14	0.48	0.06	2.5
40	0.07	0.11	0.19	1.18	0.06	2.5
60	0.07	0.17	0.25	1.77	0.06	2.5
80	0.07	0.24	0.32	2.00	0.06	2.5
100	0.07	0.32	0.38	2.33	0.06	2.5
150	0.07	0.53	0.52	2.33	0.06	2.5
200	0.07	0.78	0.69	2.33	0.06	2.5
300	0.07	0.78	1.00	2.33	0.06	2.5
400	0.07	0.78	1.29	2.33	0.06	2.5
500	0.07	0.78	1.59	2.33	0.06	2.5
600	0.07	0.78	1.62	2.33	0.06	2.5
700	0.07	0.78	1.62	2.33	0.06	2.5
800	0.07	0.78	1.62	2.33	0.06	2.5
900	0.07	0.78	1.62	2.33	0.06	2.5
1000	0.07	0.78	1.62	2.35	0.06	2.5
1500	0.07	0.78	1.62	2.35	0.06	2.5
2000	0.07	0.78	1.62	2.35	0.06	2.5
3000	0.07	0.83	1.84	2.35	0.14	2.5
4000	0.07	1.15	2.14	2.35	0.17	2.5
5000	0.07	1.42	2.14	2.35	0.17	2.5

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Voice Signal Input Level = STD MOD Level + 16 dB = 53.35 dB(mVrms) + 16 dB = 69.35 dB(mVrms) = 2933.95 mVrms		
Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
0.1	0.07	2.5
0.2	0.08	2.5
0.4	0.69	2.5
0.6	1.35	2.5
0.8	1.53	2.5
1.0	1.85	2.5
1.2	1.85	2.5
1.4	2.35	2.5
1.6	2.13	2.5
1.8	2.38	2.5
2.0	2.39	2.5
2.5	2.33	2.5
3.0	2.32	2.5
3.5	1.88	2.5
4.0	0.51	2.5
4.5	0.15	2.5
5.0	0.16	2.5
6.0	0.17	2.5
7.0	0.15	2.5
8.0	0.16	2.5
9.0	0.15	2.5
10.0	0.13	2.5

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5.3.4.4. Voice Modulation Limiting for 25 kHz Channel Spacing Operation, 764.1 MHz

Modulating Signal Level (mVrms)	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit (kHz)
	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	
20	0.09	0.14	0.19	0.97	0.09	5.0
40	0.09	0.18	0.31	1.63	0.09	5.0
60	0.09	0.28	0.44	2.47	0.09	5.0
80	0.09	0.48	0.57	3.35	0.09	5.0
100	0.09	0.65	0.68	4.02	0.09	5.0
150	0.09	1.02	0.99	4.64	0.09	5.0
200	0.09	1.43	1.39	4.63	0.09	5.0
300	0.09	1.55	1.41	4.64	0.09	5.0
400	0.09	1.55	2.56	4.64	0.09	5.0
500	0.09	1.55	3.13	4.64	0.09	5.0
600	0.09	1.55	3.17	4.65	0.09	5.0
700	0.09	1.55	3.17	4.65	0.09	5.0
800	0.09	1.55	3.17	4.65	0.09	5.0
900	0.09	1.55	3.17	4.65	0.09	5.0
1000	0.09	1.55	3.17	4.66	0.09	5.0
1500	0.09	1.55	3.17	4.65	0.09	5.0
2000	0.09	1.55	3.17	4.65	0.09	5.0
3000	0.09	1.61	3.53	4.65	0.30	5.0
4000	0.09	2.25	4.13	4.66	0.30	5.0
5000	0.09	2.64	4.21	4.66	0.30	5.0

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Voice Signal Input Level = STD MOD Level + 16 dB = 53.57 dB(mVrms) + 16 dB = 69.57 dB(mVrms) = 3009.67 mVrms		
Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
0.1	0.06	5.0
0.2	0.07	5.0
0.4	1.26	5.0
0.6	2.66	5.0
0.8	2.98	5.0
1.0	3.80	5.0
1.2	3.74	5.0
1.4	4.65	5.0
1.6	4.67	5.0
1.8	4.67	5.0
2.0	4.67	5.0
2.5	4.52	5.0
3.0	4.53	5.0
3.5	3.71	5.0
4.0	0.08	5.0
4.5	0.25	5.0
5.0	0.23	5.0
6.0	0.22	5.0
7.0	0.22	5.0
8.0	0.23	5.0
9.0	0.23	5.0
10.0	0.21	5.0

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5.3.4.5. Voice Modulation Limiting for 12.5 kHz Channel Spacing Operation, 806.1 MHz

Modulating Signal Level (mVrms)	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit (kHz)
	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	
20	0.09	0.11	0.15	0.48	0.09	2.5
40	0.09	0.13	0.19	1.24	0.09	2.5
60	0.09	0.15	0.26	1.39	0.09	2.5
80	0.09	0.17	0.31	1.71	0.09	2.5
100	0.09	0.19	0.38	2.10	0.09	2.5
150	0.09	0.24	0.53	2.35	0.09	2.5
200	0.09	0.30	0.69	2.35	0.09	2.5
300	0.09	0.43	0.99	2.35	0.09	2.5
400	0.09	0.56	1.29	2.35	0.09	2.5
500	0.09	0.67	1.61	2.35	0.09	2.5
600	0.09	0.79	1.64	2.35	0.09	2.5
700	0.09	0.82	1.64	2.35	0.09	2.5
800	0.09	0.82	1.64	2.35	0.09	2.5
900	0.09	0.82	1.64	2.35	0.09	2.5
1000	0.09	0.82	1.64	2.35	0.09	2.5
1500	0.09	0.82	1.64	2.35	0.09	2.5
2000	0.09	0.82	1.64	2.35	0.09	2.5
3000	0.10	0.87	1.81	2.35	0.17	2.5
4000	0.10	1.18	2.15	2.35	0.17	2.5
5000	0.10	1.34	2.15	2.35	0.17	2.5

Voice Signal Input Level = STD MOD Level + 16 dB = 53.46 dB(mVrms) + 16 dB = 69.46 dB(mVrms) = 2971.81 mVrms		
Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
0.1	0.10	2.5
0.2	0.10	2.5
0.4	0.69	2.5
0.6	1.35	2.5
0.8	1.50	2.5
1.0	1.87	2.5
1.2	1.89	2.5
1.4	2.33	2.5
1.6	2.35	2.5
1.8	2.36	2.5
2.0	2.38	2.5
2.5	2.13	2.5
3.0	2.32	2.5
3.5	1.88	2.5
4.0	0.39	2.5
4.5	0.16	2.5
5.0	0.17	2.5
6.0	0.14	2.5
7.0	0.15	2.5
8.0	0.15	2.5
9.0	0.16	2.5
10.0	0.13	2.5

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5.3.4.6. Voice Modulation Limiting for 25 kHz Channel Spacing Operation, 806.1 MHz

Modulating Signal Level (mVrms)	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit (kHz)
	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	
20	0.06	0.11	0.19	1.13	0.06	5.0
40	0.06	0.16	0.32	1.63	0.06	5.0
60	0.06	0.29	0.45	2.59	0.06	5.0
80	0.06	0.52	0.68	4.60	0.06	5.0
100	0.06	0.64	0.98	4.60	0.06	5.0
150	0.06	1.01	1.31	4.60	0.06	5.0
200	0.06	1.49	1.93	4.60	0.06	5.0
300	0.06	1.53	2.52	4.60	0.06	5.0
400	0.06	1.55	3.14	4.60	0.06	5.0
500	0.06	1.55	3.18	4.60	0.06	5.0
600	0.06	1.55	3.18	4.60	0.06	5.0
700	0.06	1.55	3.18	4.60	0.06	5.0
800	0.06	1.55	3.18	4.60	0.06	5.0
900	0.06	1.55	3.18	4.60	0.06	5.0
1000	0.06	1.55	3.18	4.60	0.06	5.0
1500	0.06	1.55	3.18	4.60	0.06	5.0
2000	0.06	1.55	3.18	4.62	0.06	5.0
3000	0.06	1.58	3.71	4.62	0.25	5.0
4000	0.07	2.26	4.15	4.62	0.25	5.0
5000	0.07	2.49	4.15	4.62	0.35	5.0

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Voice Signal Input Level = STD MOD Level + 16 dB = 53.44 dB(mVrms) + 16 dB = 69.44 dB(mVrms) = 2965.50 mVrms		
Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
0.1	0.09	5.0
0.2	0.10	5.0
0.4	1.27	5.0
0.6	2.66	5.0
0.8	2.97	5.0
1.0	3.74	5.0
1.2	3.72	5.0
1.4	4.63	5.0
1.6	4.56	5.0
1.8	4.71	5.0
2.0	4.73	5.0
2.5	4.58	5.0
3.0	4.63	5.0
3.5	3.74	5.0
4.0	0.77	5.0
4.5	0.24	5.0
5.0	0.25	5.0
6.0	0.26	5.0
7.0	0.26	5.0
8.0	0.26	5.0
9.0	0.25	5.0
10.0	0.20	5.0

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5.3.4.7. Data Modulation Limiting for 12.5 kHz Channel Spacing Operation (Factory Setting)

Operating Mode	Data Rate	Peak Frequency Deviation (kHz)
406.2 MHz, Digital C4FM, 12.5 kHz channel spacing	Factory default setting	3.16
406.2 MHz, Digital CQPSK, 12.5 kHz channel spacing	Factory default setting	3.05
764.1 MHz, Digital C4FM, 12.5 kHz channel spacing	Factory default setting	3.05
764.1 MHz, Digital CQPSK, 12.5 kHz channel spacing	Factory default setting	3.03
806.1 MHz, Digital C4FM, 12.5 kHz channel spacing	Factory default setting	3.08
806.1 MHz, Digital CQPSK, 12.5 kHz channel spacing	Factory default setting	3.03

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5.4. OCCUPIED BANDWIDTH & EMISSION MASK [§§ 2.1049, 90.209 & 90.210]

5.4.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)	Applicable Emission Masks	
			Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
^{2,4} 421-512	¹ 6.25	^{1,3} 20/11.25/6	B, D, or E	C, D, or E
806-809/ 851-854	12.5	20	B	H
809-824/ 854-869 ⁵	25	20	B	G

¹ For stations authorized on or after August 18, 1995.

² Bandwidths for radiolocation stations in the 420-450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.

³ Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013, unless the operations meet the efficiency standard of § 90.203(j)(3).

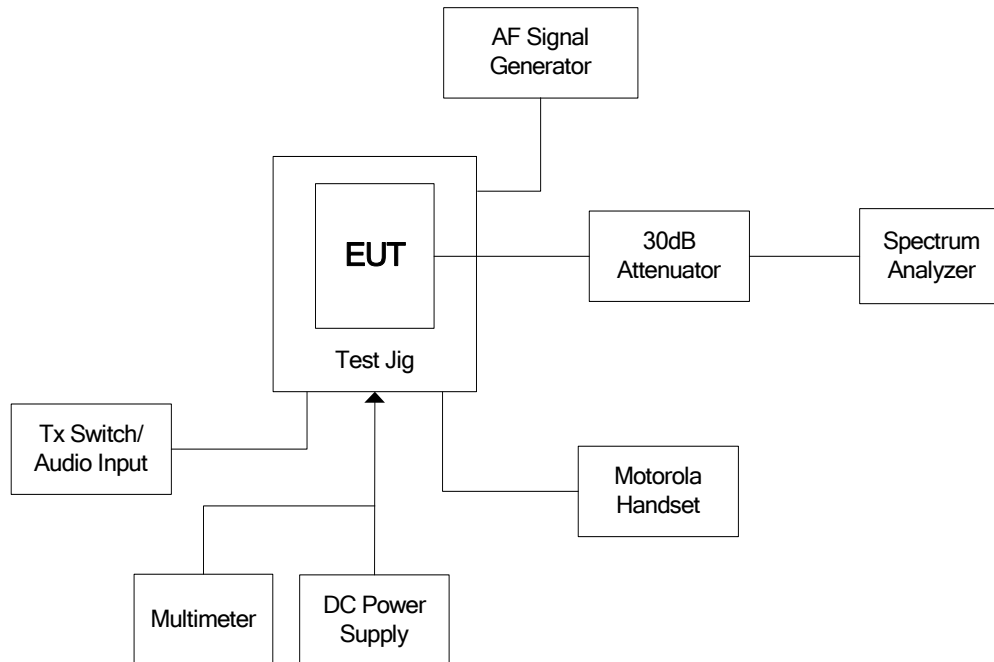
⁴ Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

⁵ Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.

5.4.2. Method of Measurements

Refer to Section 8.4 of this report for measurement details.

5.4.3. Test Arrangement



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5.4.4. Test Data

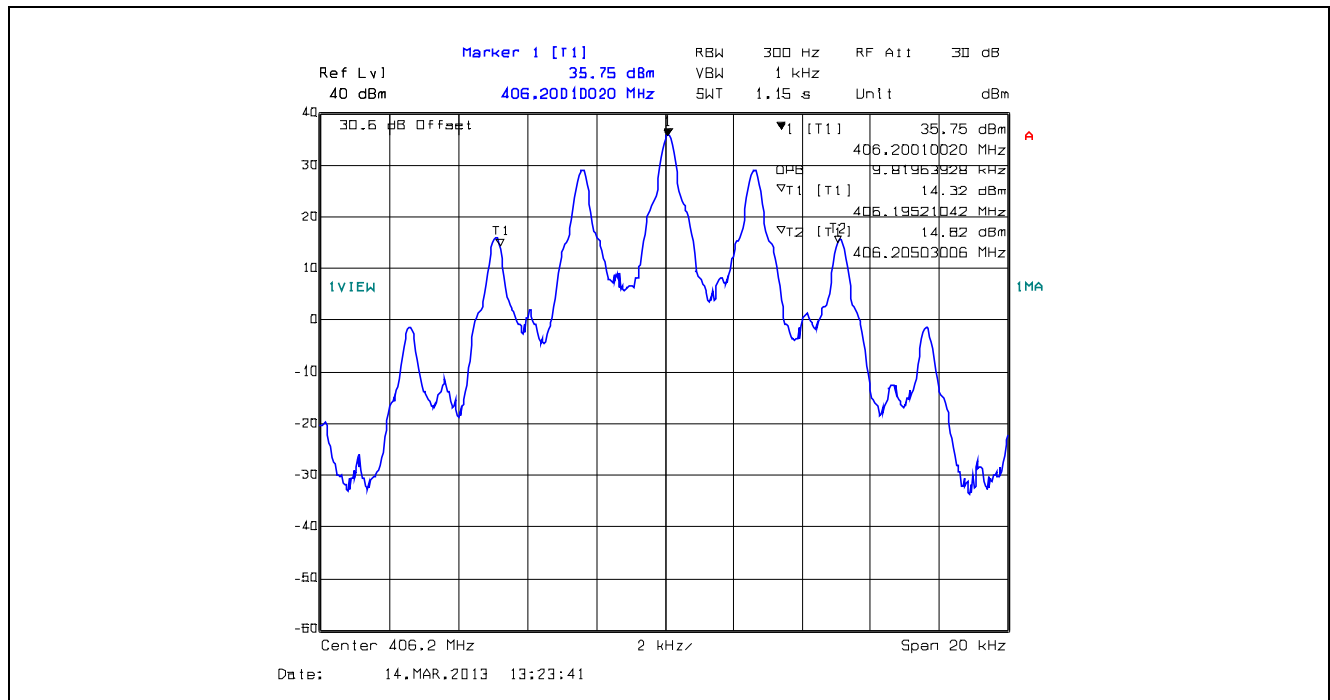
5.4.4.1. 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (kHz)				
	Analog NB 12.5 kHz Channelization F3E	Analog WB 25 kHz Channelization F3E	Digital C4FM 12.5 kHz Channelization F1E	Digital CQPSK 12.5 kHz Channelization F1D	2 Slot TDMA 12.5 kHz Channelization F1W
380 - 470 MHz Band					
406.2	9.82	14.85	8.14	8.14	7.78
429.9	9.82	--	7.98	7.94	8.10
469.9	9.86	--	8.14	8.06	8.14
764 - 776 MHz Band					
764.1	9.90	14.85	8.14	8.22	8.06
769.5	9.86	14.85	7.90	8.10	8.14
774.9	9.90	14.97	8.10	8.18	8.06
793 - 806 MHz Band					
794.1	9.90	14.85	8.22	8.14	8.22
798.5	9.90	14.85	8.10	8.26	8.14
804.9	9.90	14.85	8.10	8.02	8.18
806 - 824 MHz Band					
806.1	9.90	14.91	8.38	8.14	8.10
815.0	9.90	14.91	8.14	8.30	8.18
823.9	9.86	14.91	8.14	8.06	8.10
851 - 869 MHz Band					
851.1	9.94	14.97	8.26	8.26	8.18
860.0	9.86	14.85	8.18	8.14	8.02
868.9	9.86	14.85	8.34	7.94	8.10

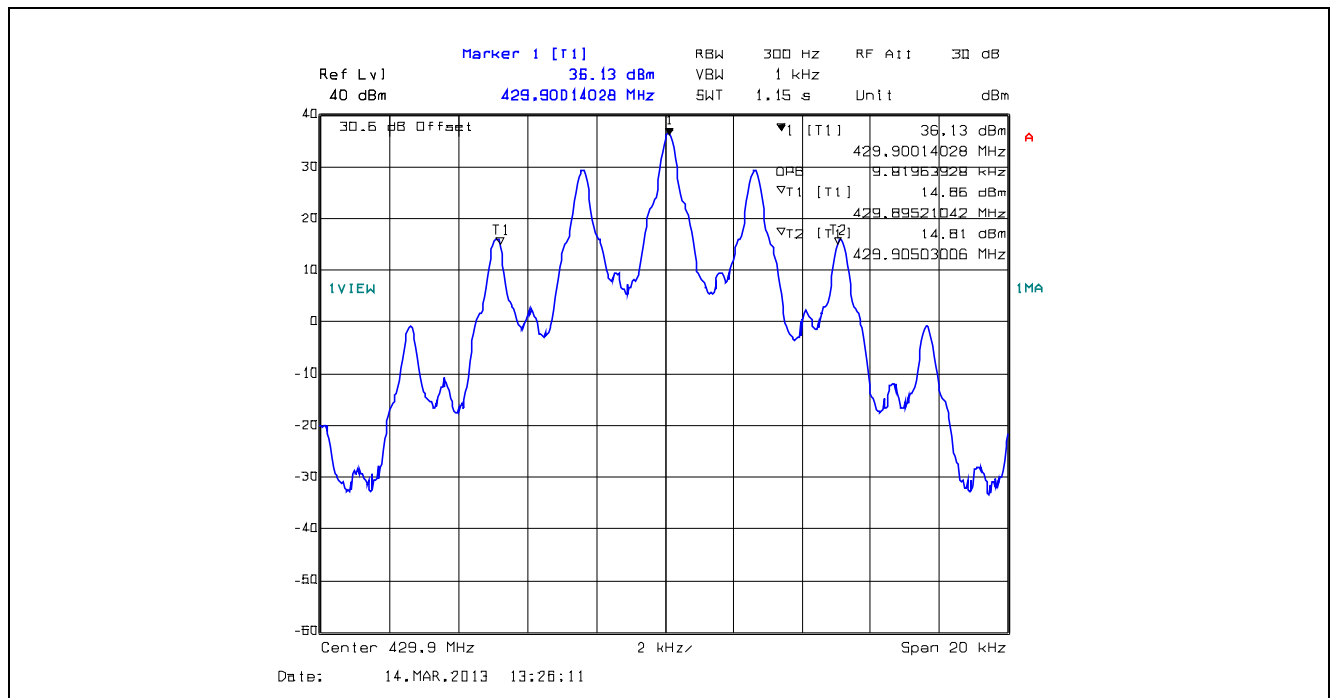
Note: 99% Occupied Bandwidth measurements were done using the built-in auto function of the analyzer.

See the following plots for detailed measurements.

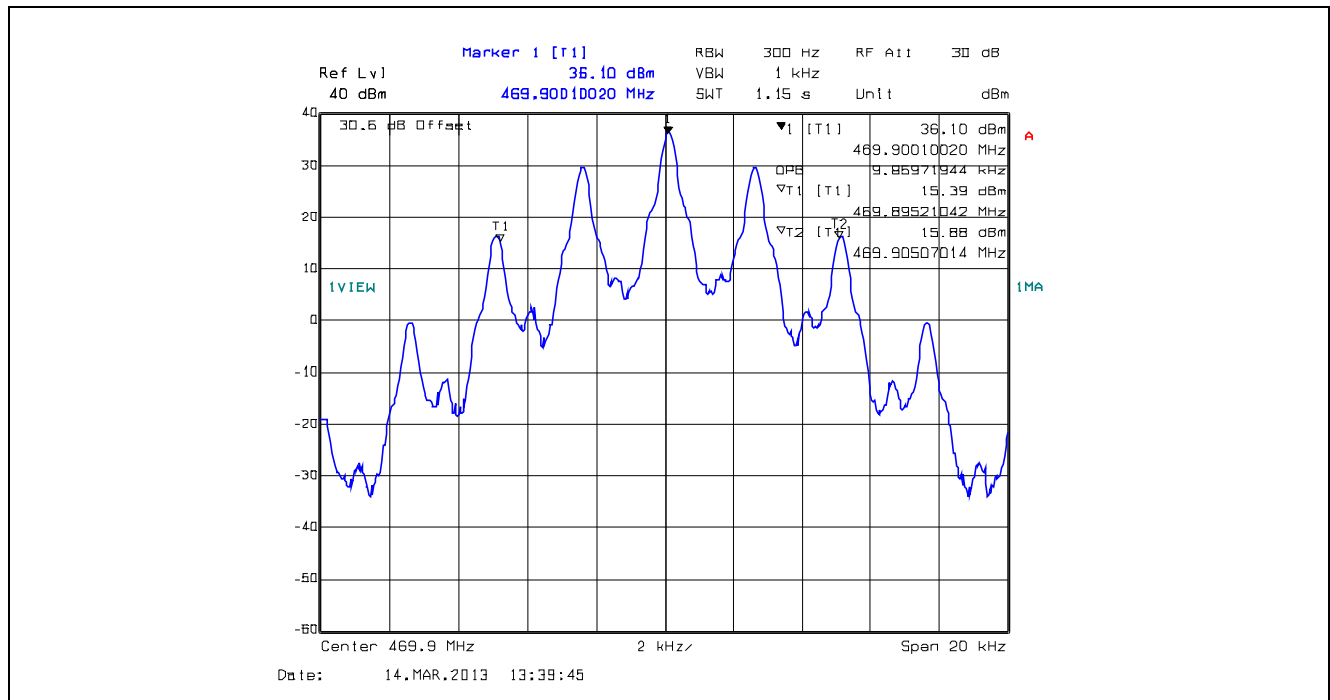
Plot 5.4.4.1.1. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 406.2 MHz



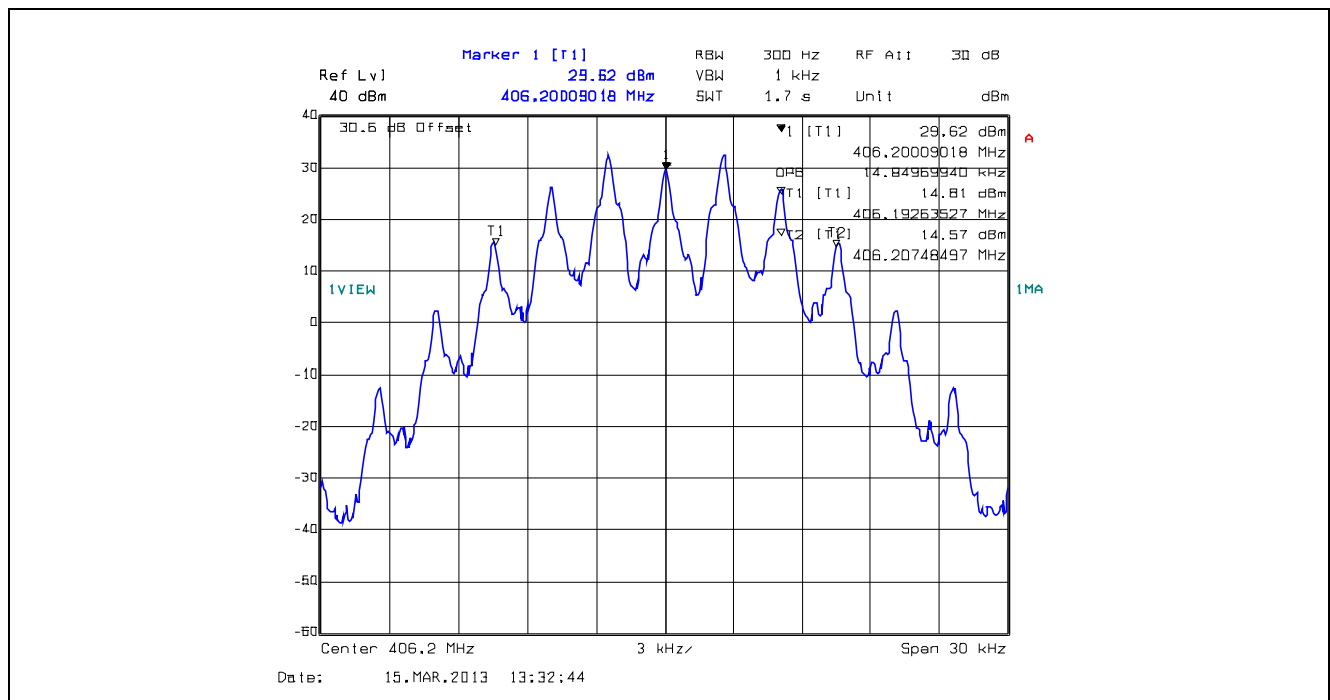
Plot 5.4.4.1.2. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 429.9 MHz



Plot 5.4.4.1.3. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 469.9 MHz



Plot 5.4.4.1.4. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 406.2 MHz



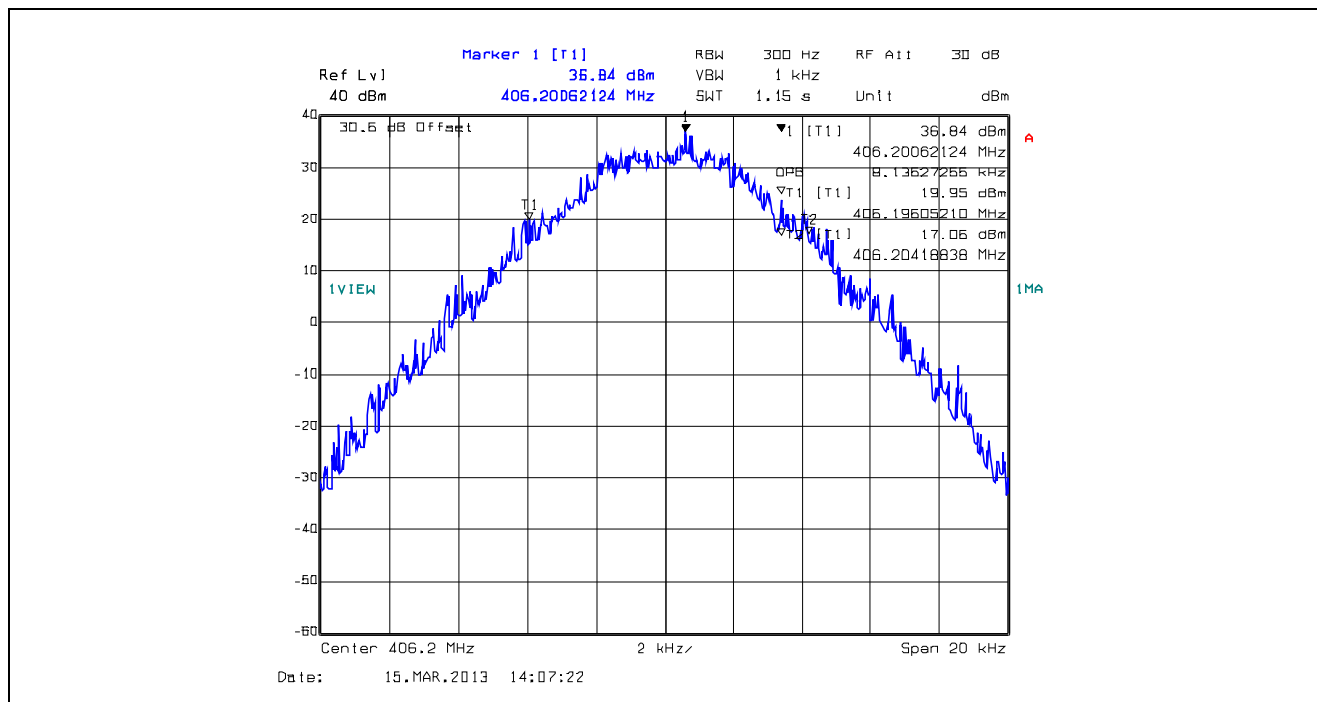
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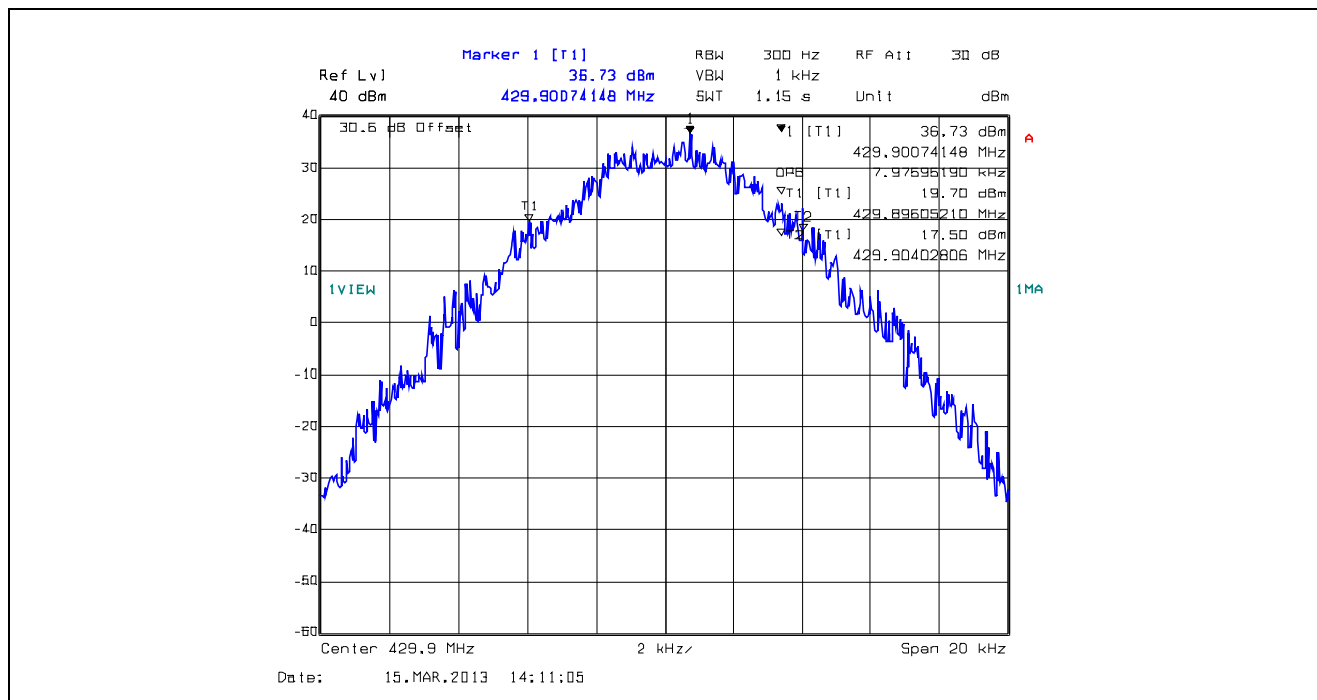
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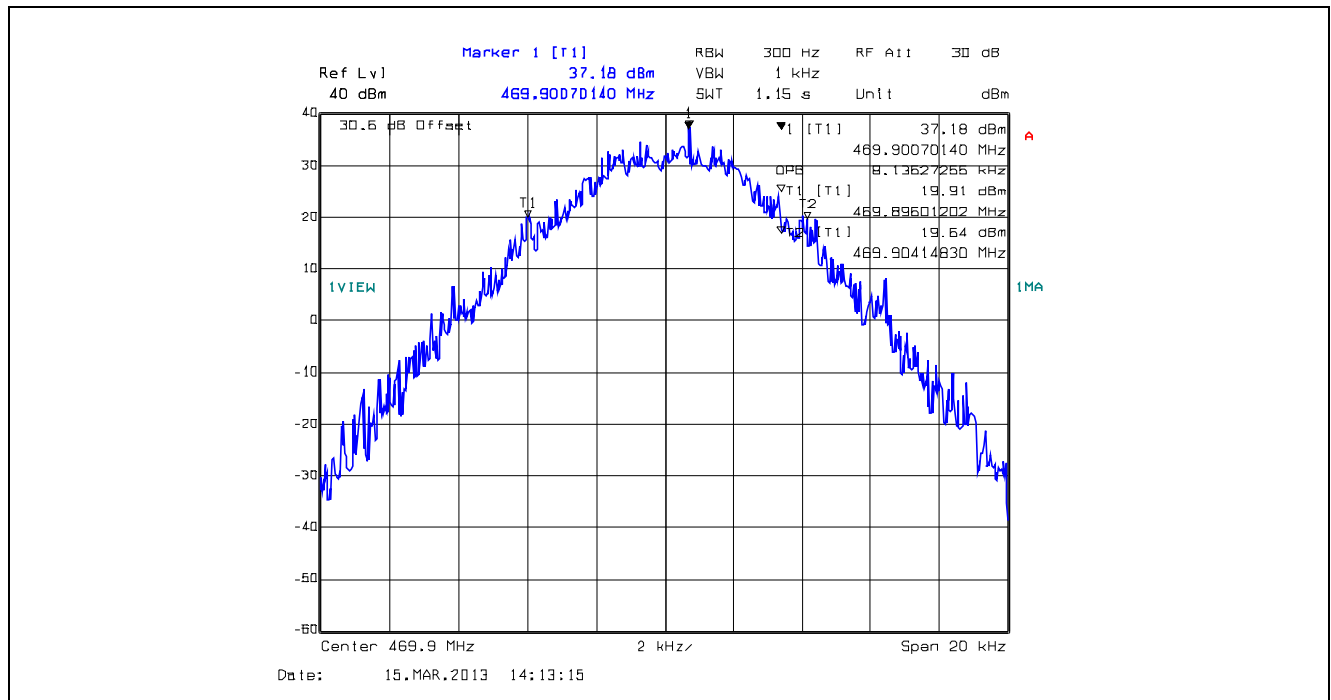
Plot 5.4.4.1.5. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 406.2 MHz



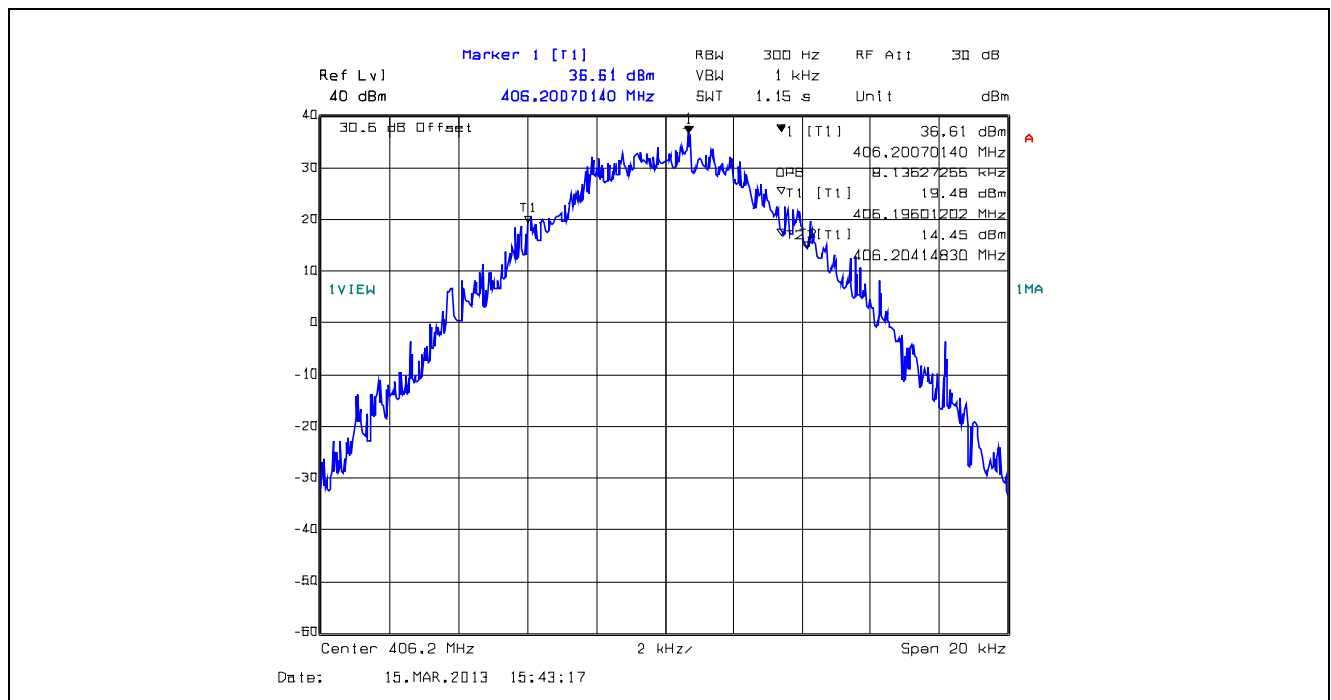
Plot 5.4.4.1.6. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 429.9 MHz



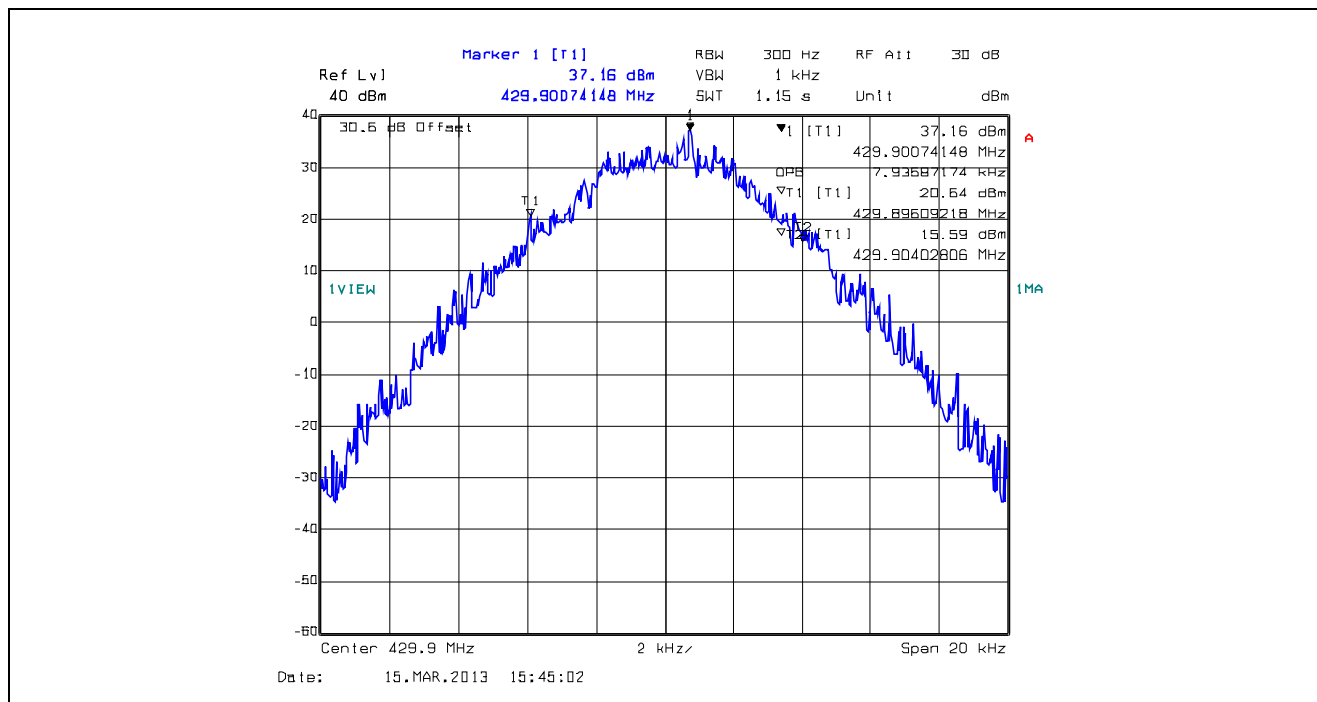
Plot 5.4.4.1.7. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 469.9 MHz



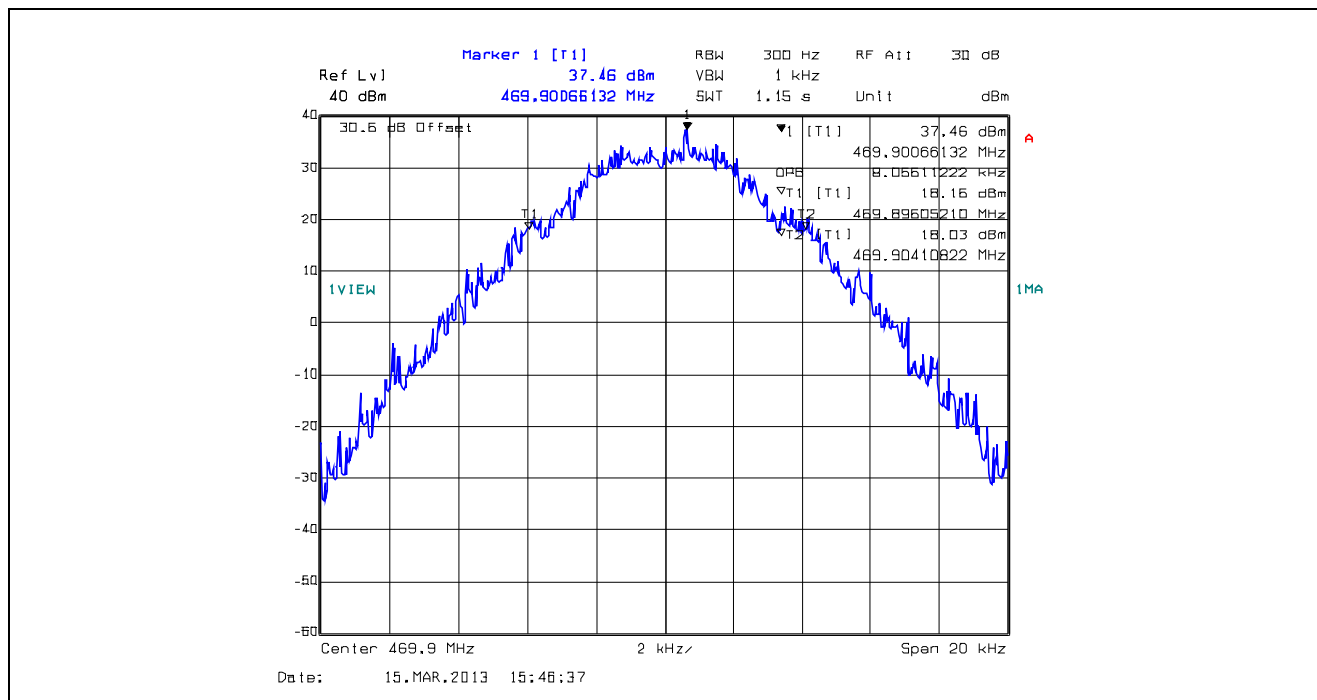
Plot 5.4.4.1.8. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 406.2 MHz



Plot 5.4.4.1.9. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 429.9 MHz



Plot 5.4.4.1.10. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 469.9 MHz



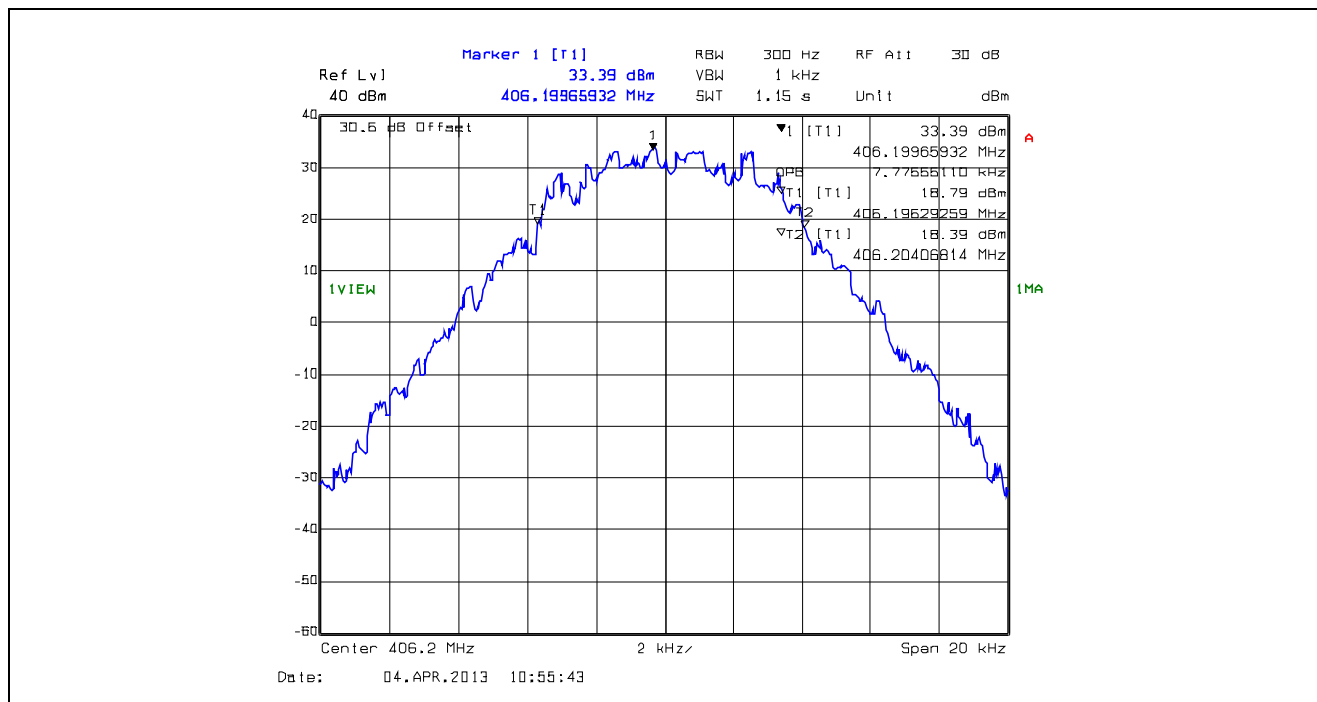
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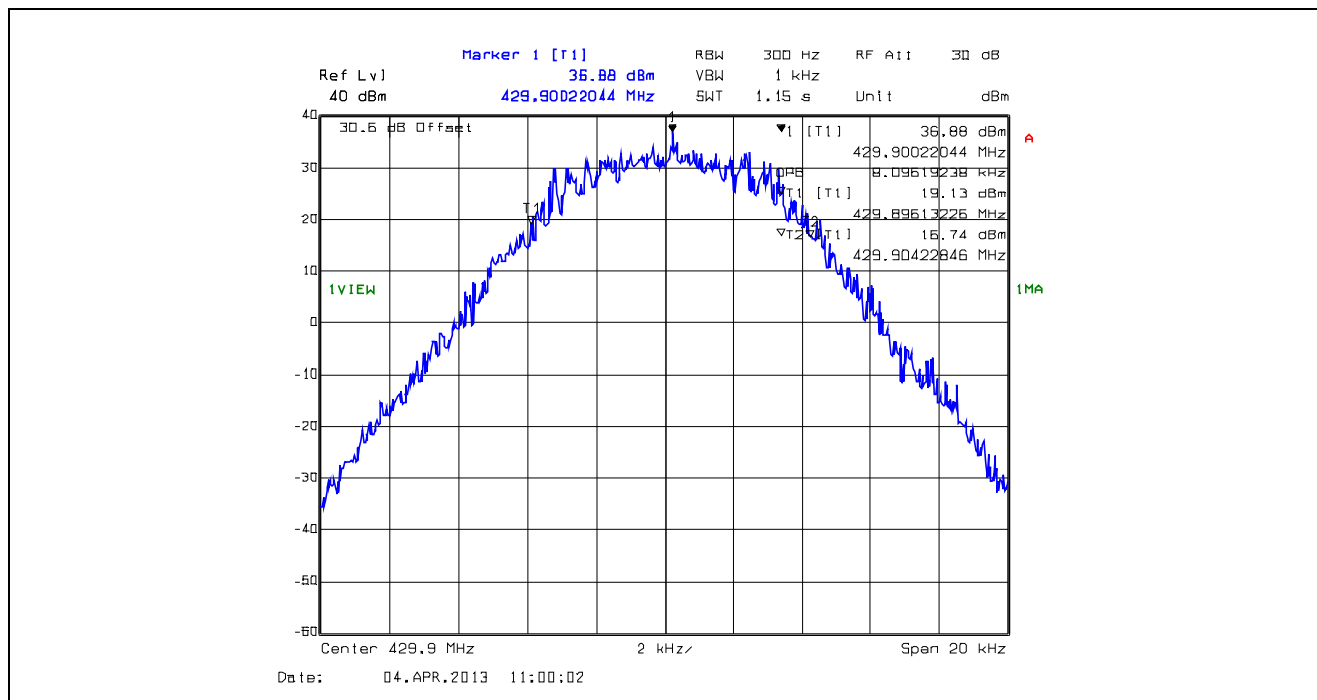
File #: TIL-094F90R01
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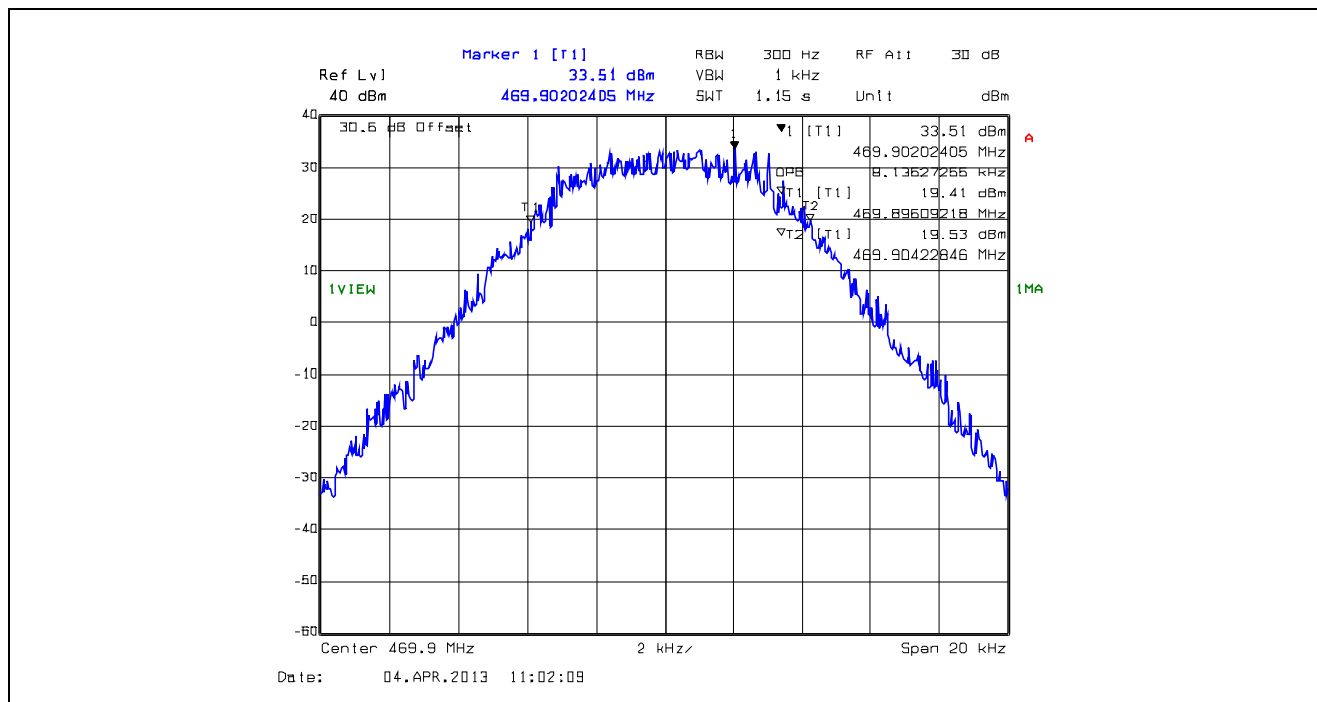
Plot 5.4.4.1.11. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 406.2 MHz



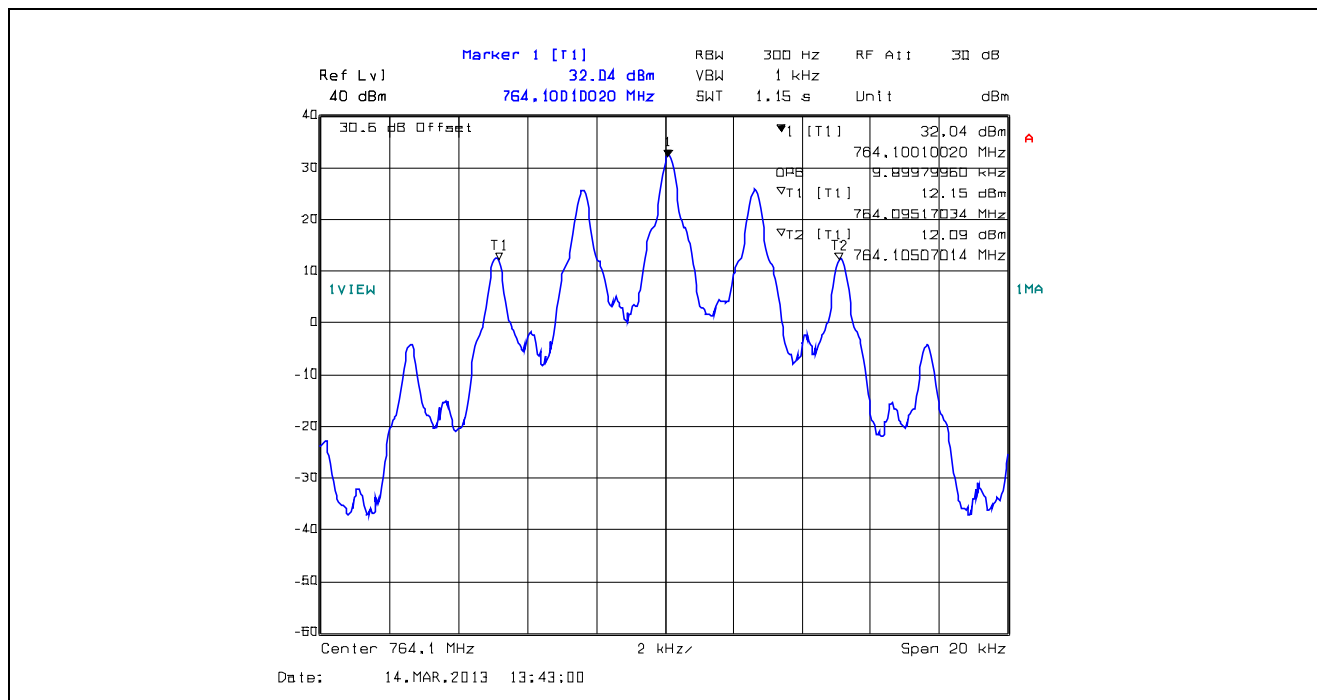
Plot 5.4.4.1.12. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 429.9 MHz



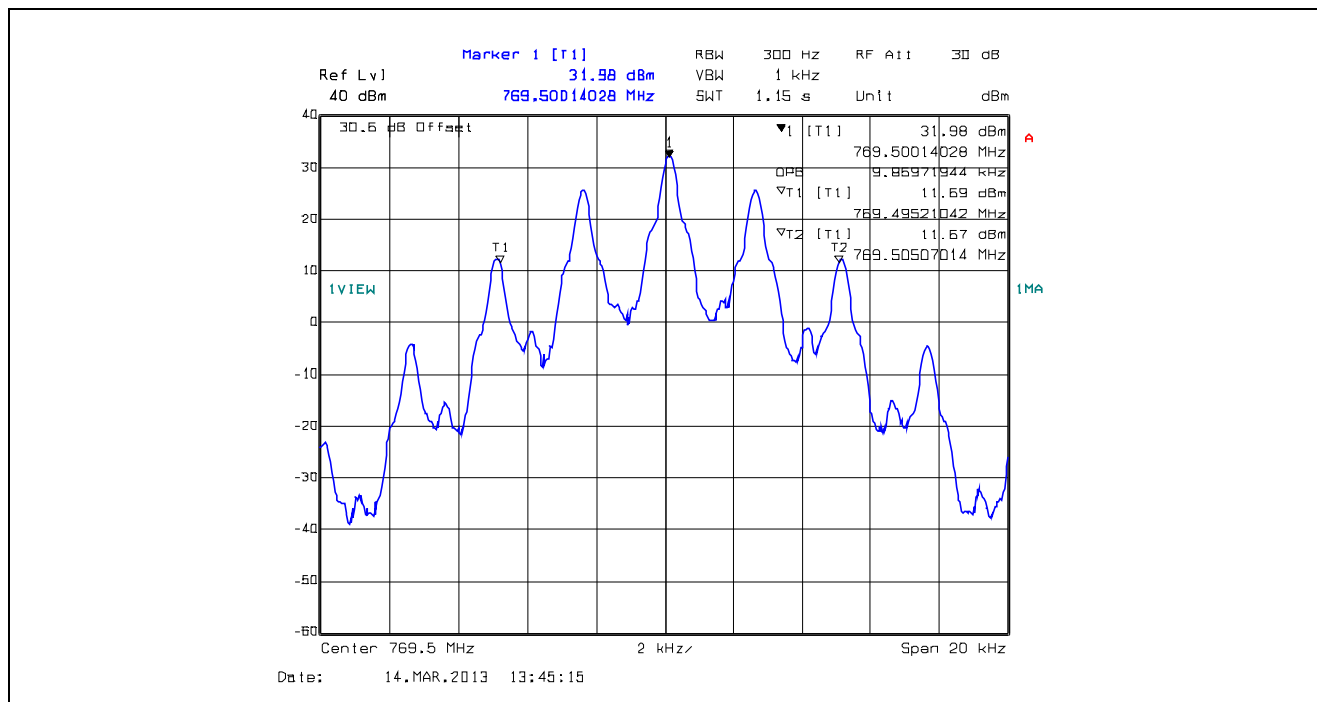
Plot 5.4.4.1.13. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 469.9 MHz



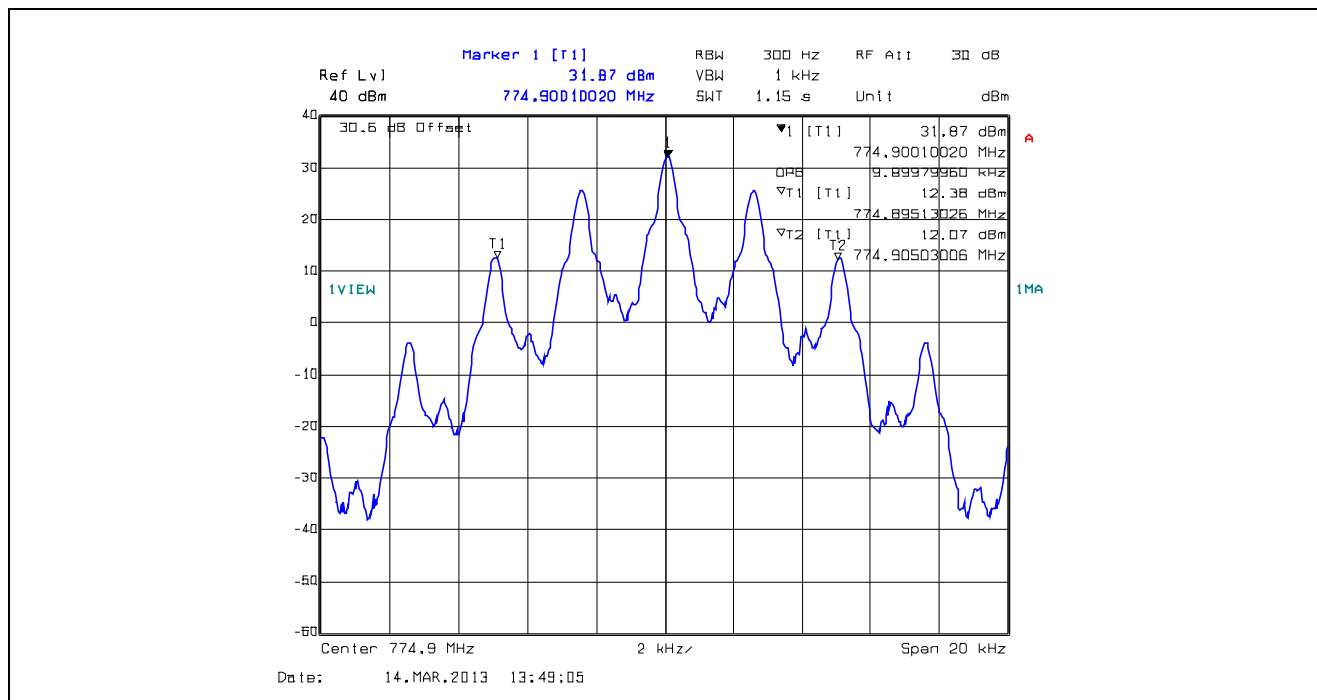
Plot 5.4.4.1.14. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 764.1 MHz



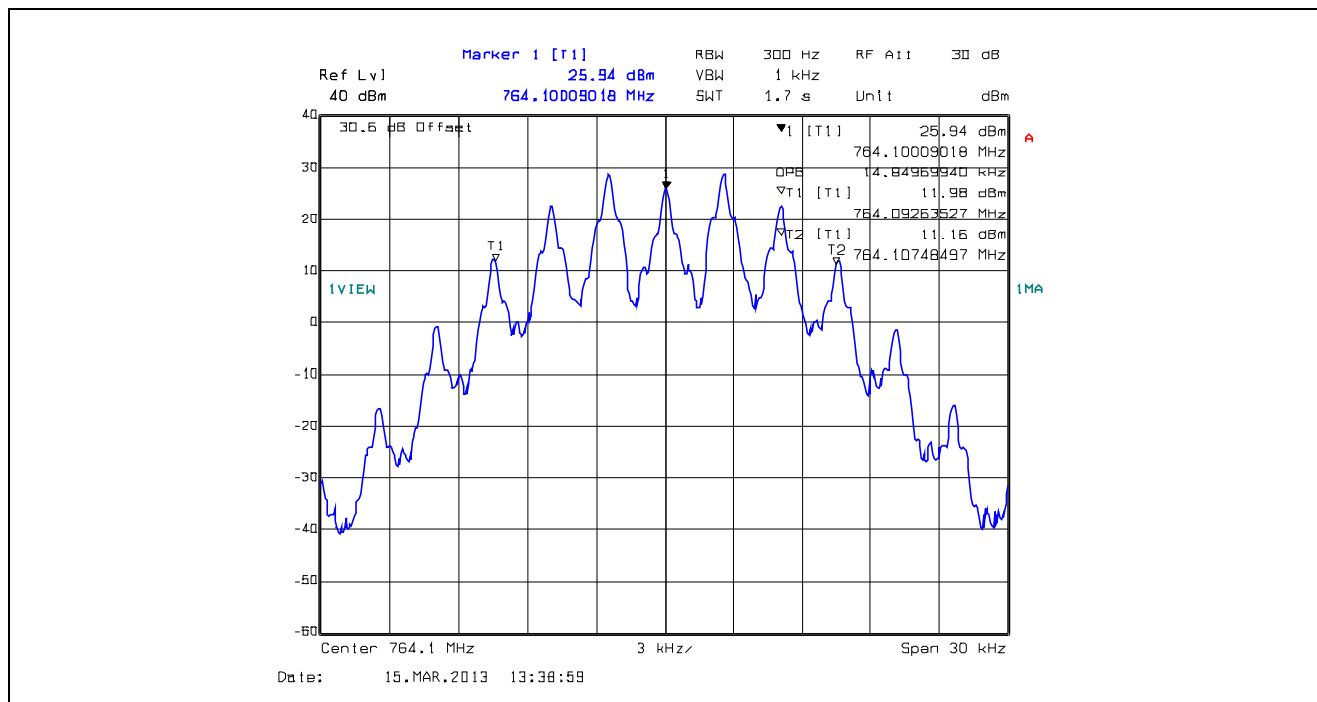
Plot 5.4.4.1.15. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 769.5 MHz



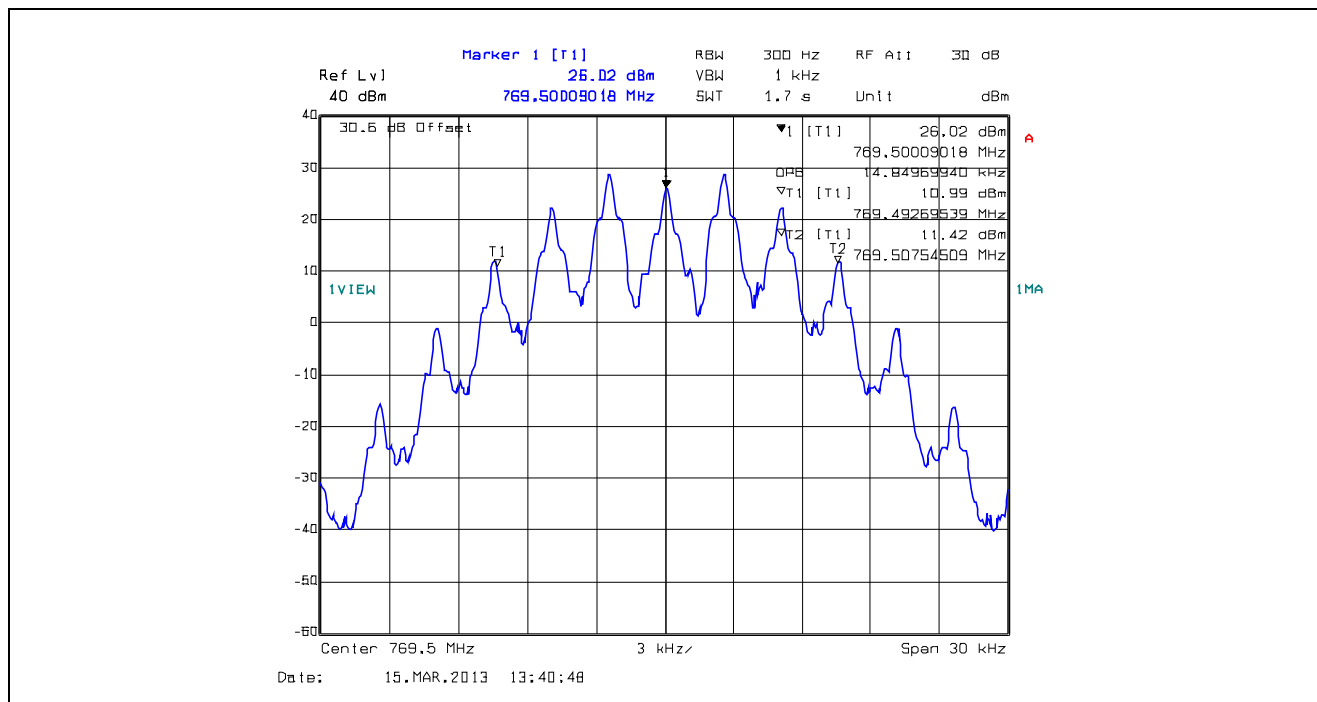
Plot 5.4.4.1.16. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 774.9 MHz



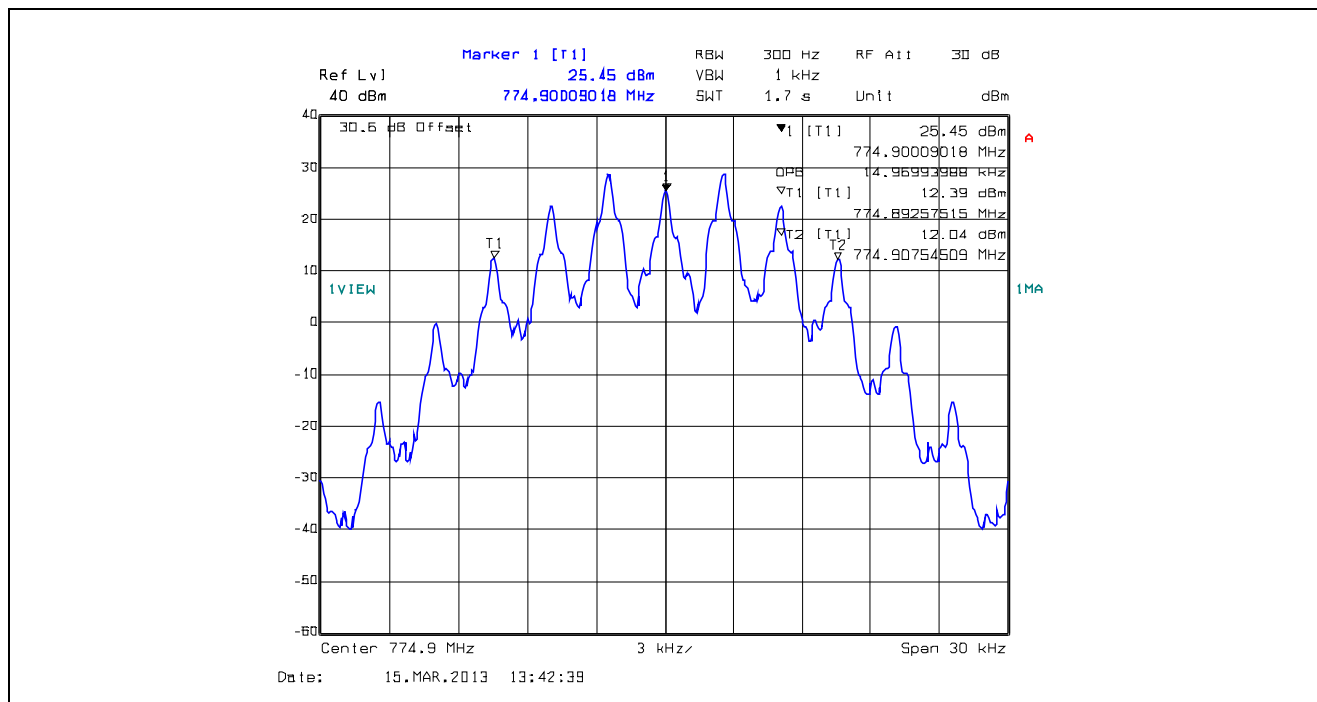
Plot 5.4.4.1.17. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 764.1 MHz



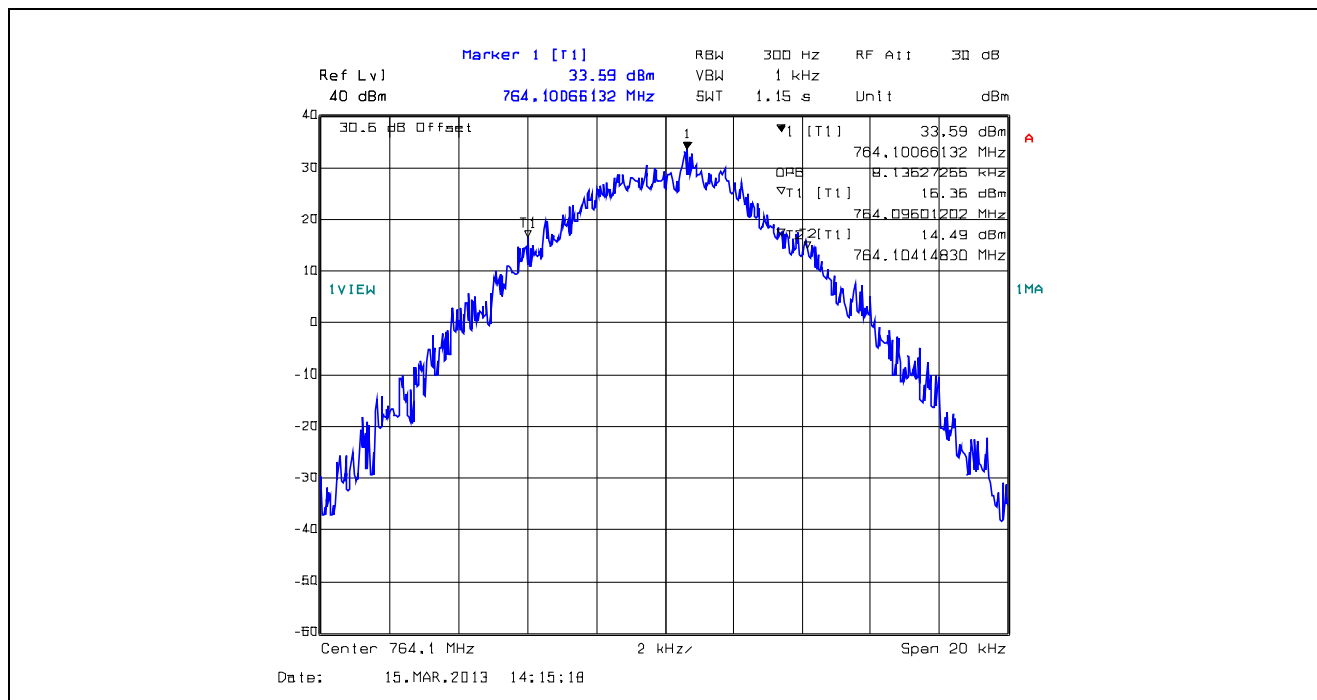
Plot 5.4.4.1.18. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 769.5MHz



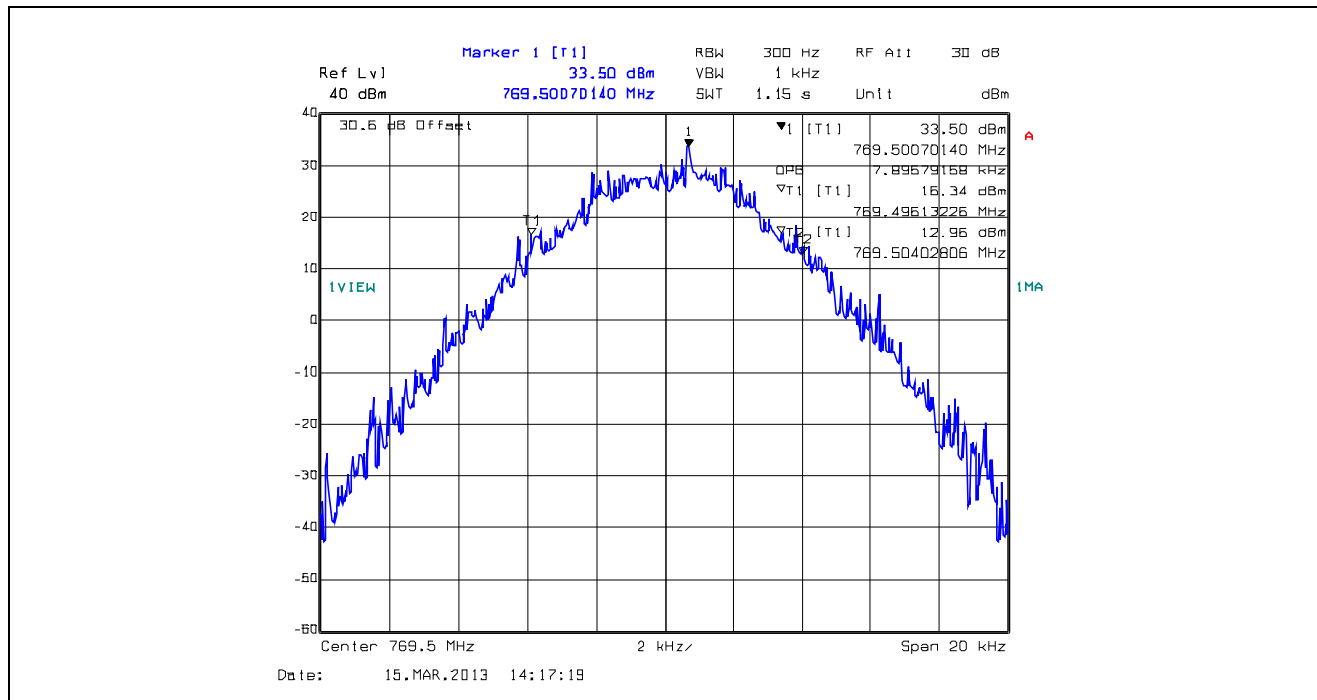
Plot 5.4.4.1.19. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 774.9MHz



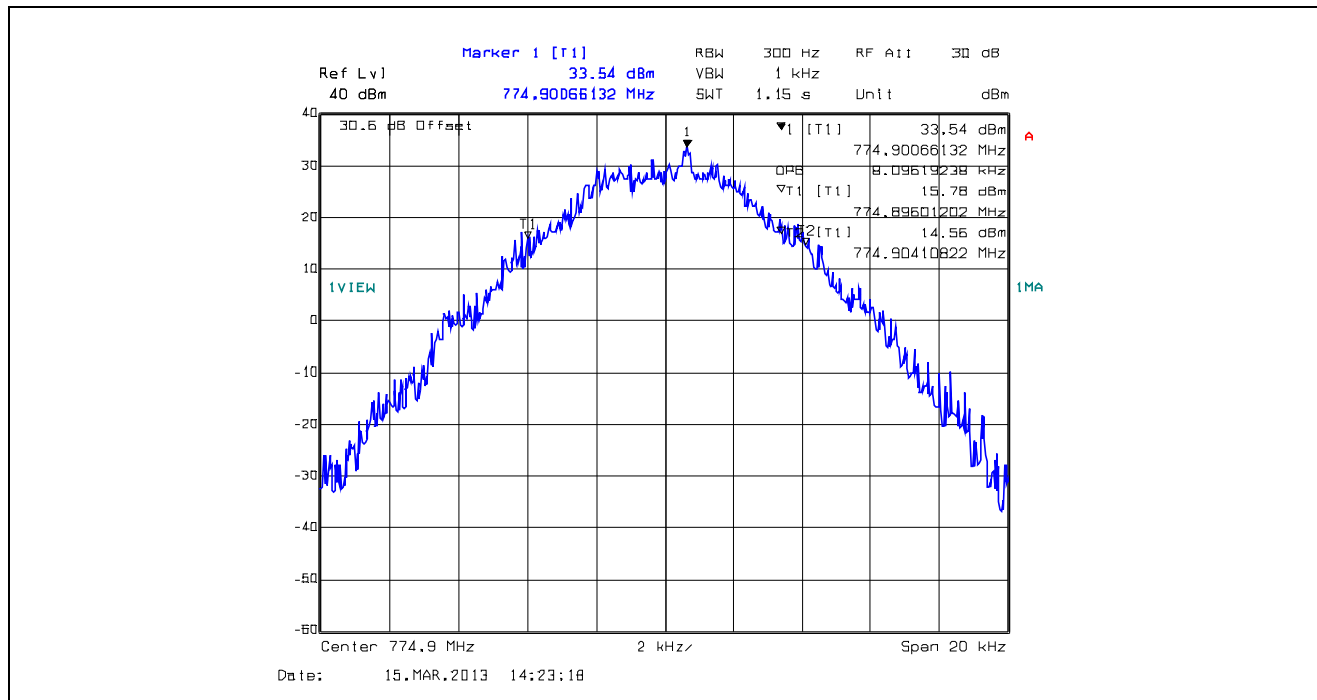
Plot 5.4.4.1.20. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 764.1 MHz



Plot 5.4.4.1.21. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 769.5 MHz



Plot 5.4.4.1.22. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 774.9 MHz



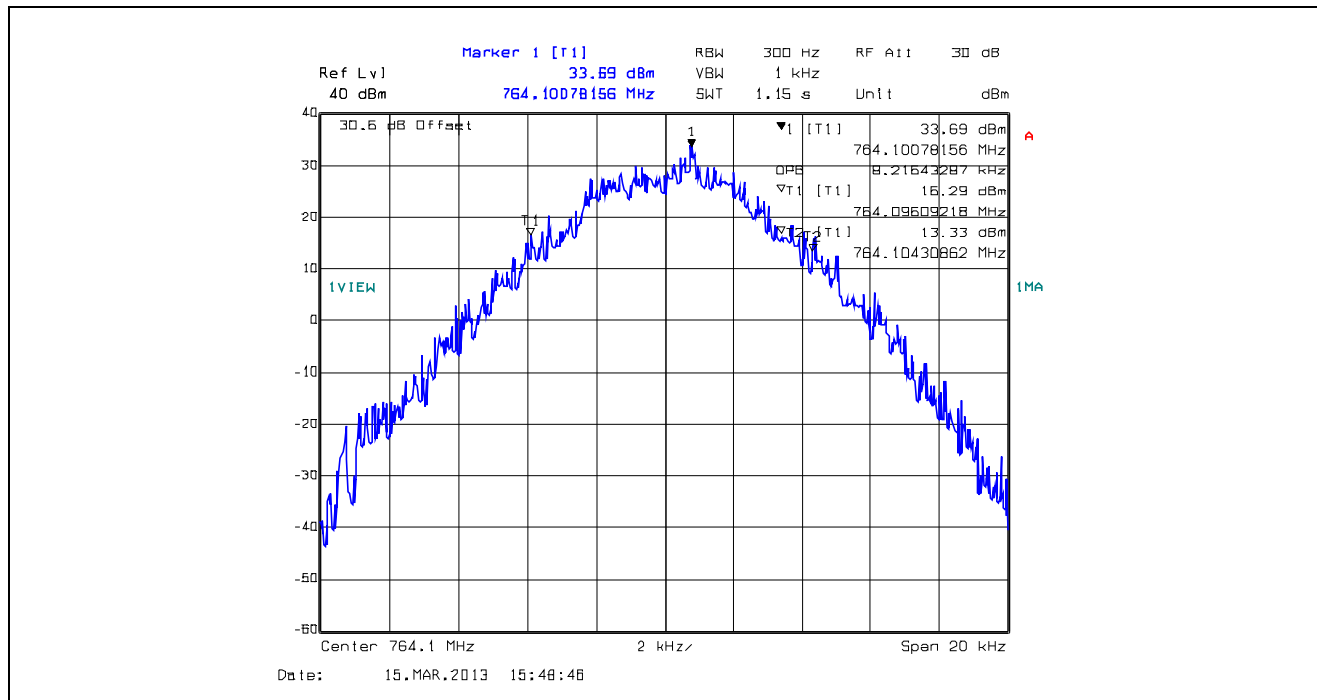
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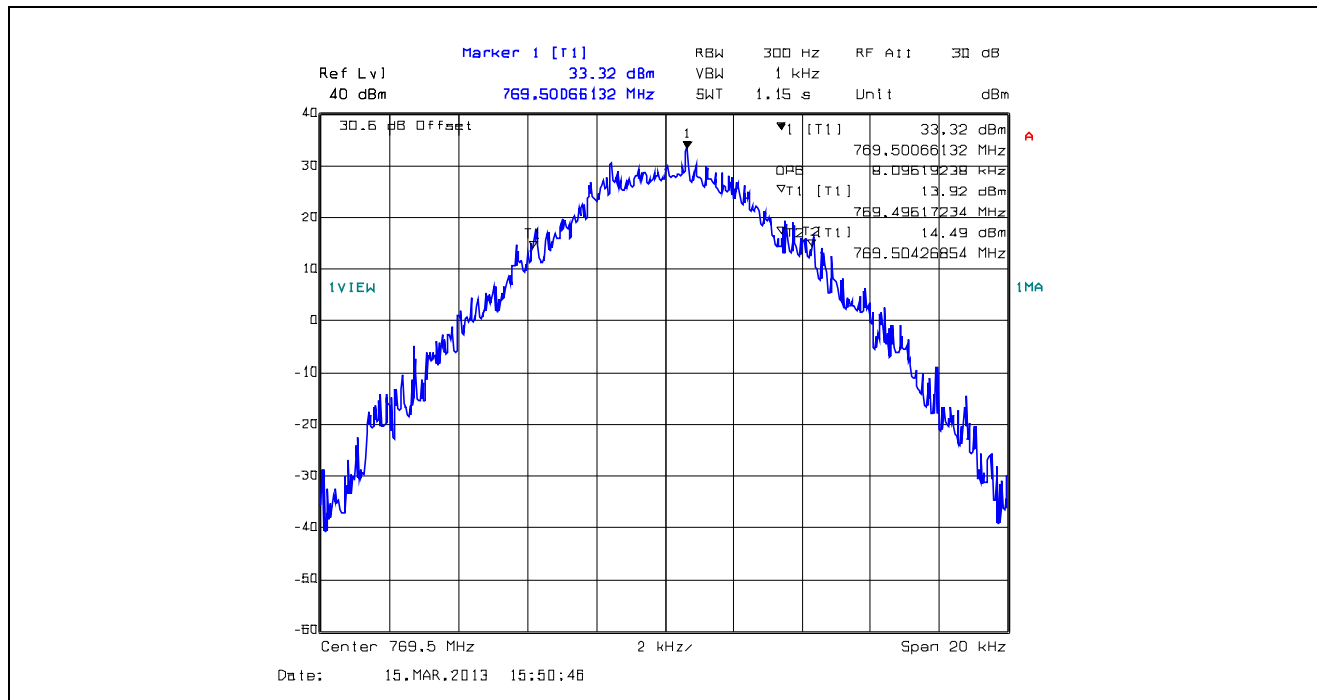
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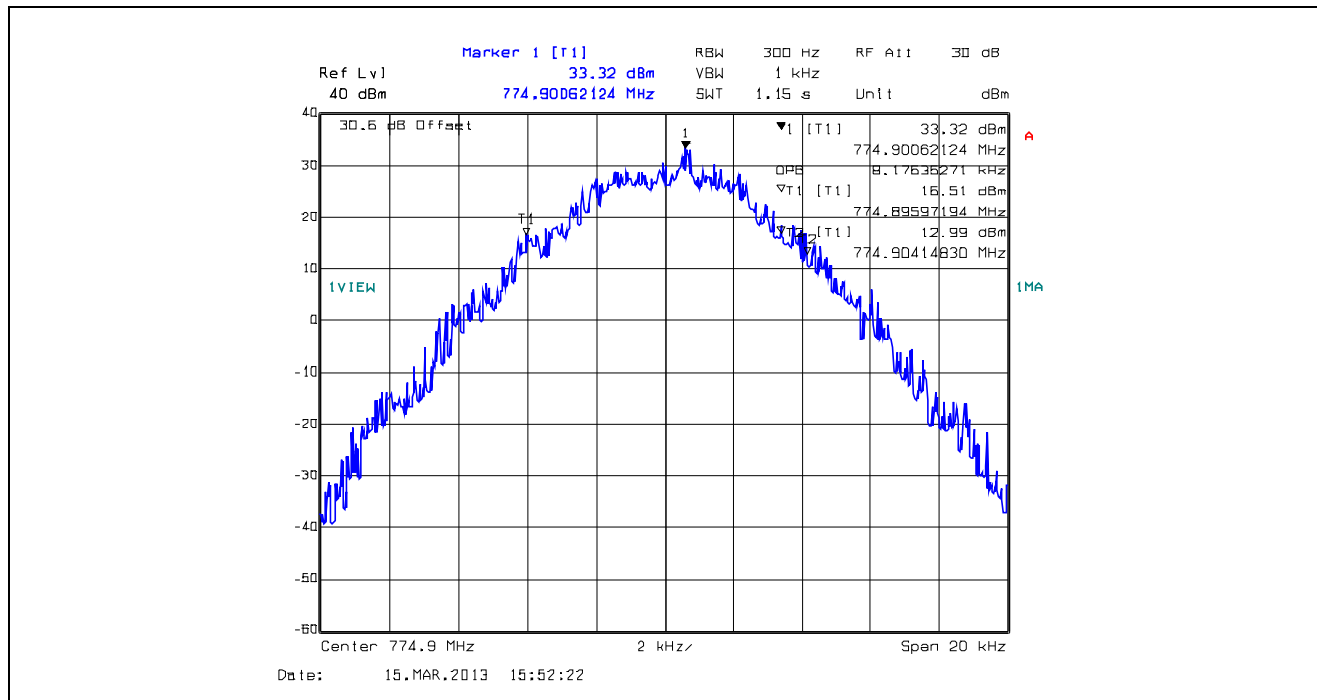
Plot 5.4.4.1.23. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 764.1 MHz



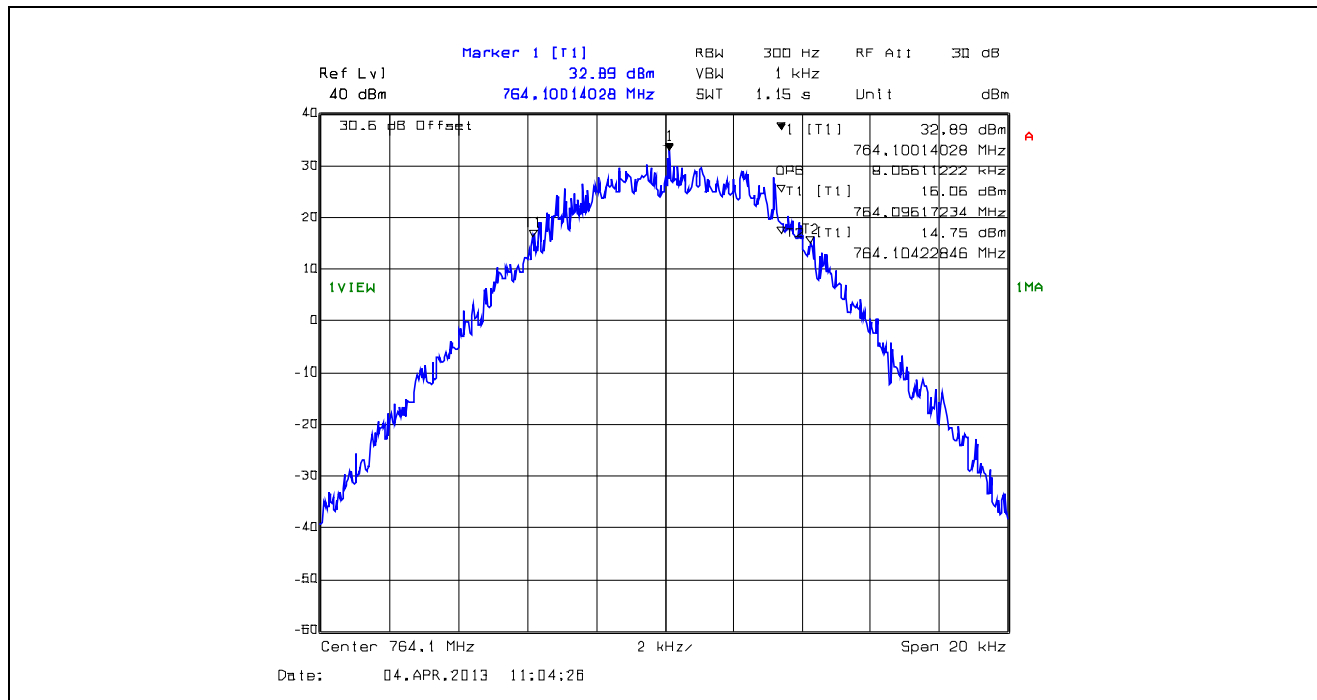
Plot 5.4.4.1.24. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 769.5 MHz



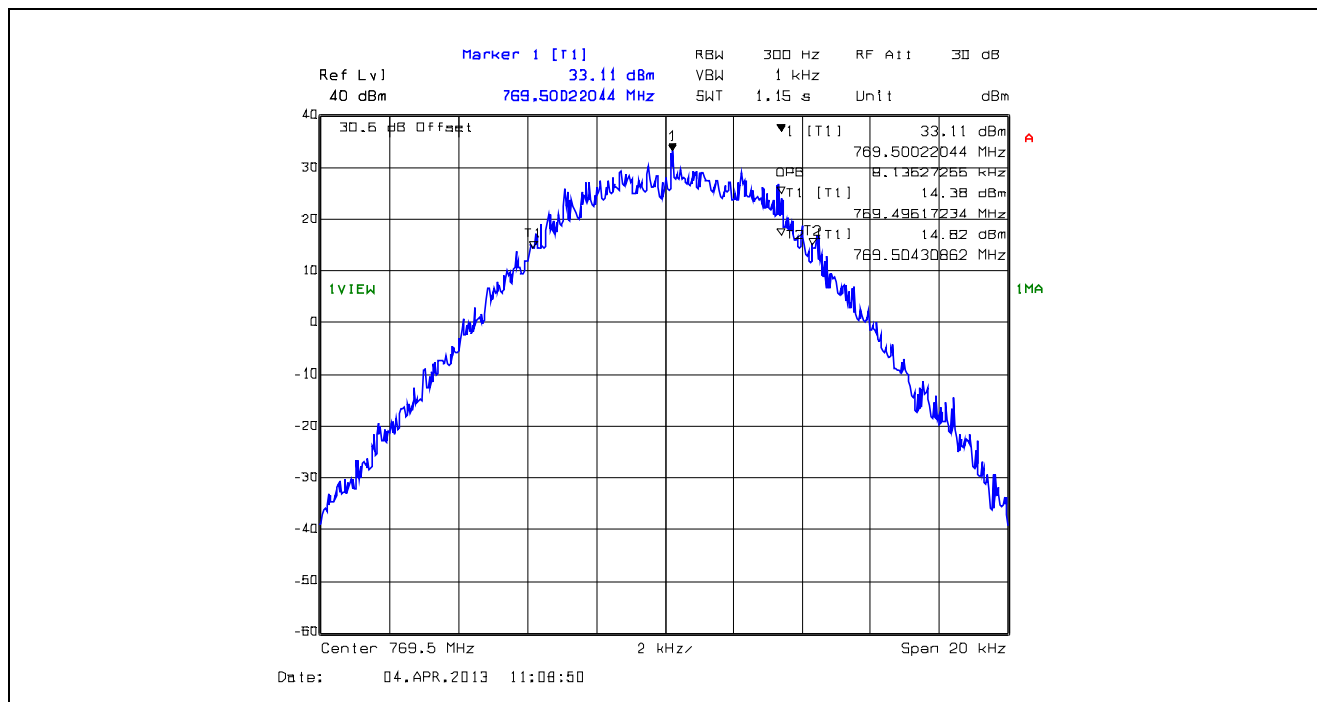
Plot 5.4.4.1.25. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 774.9 MHz



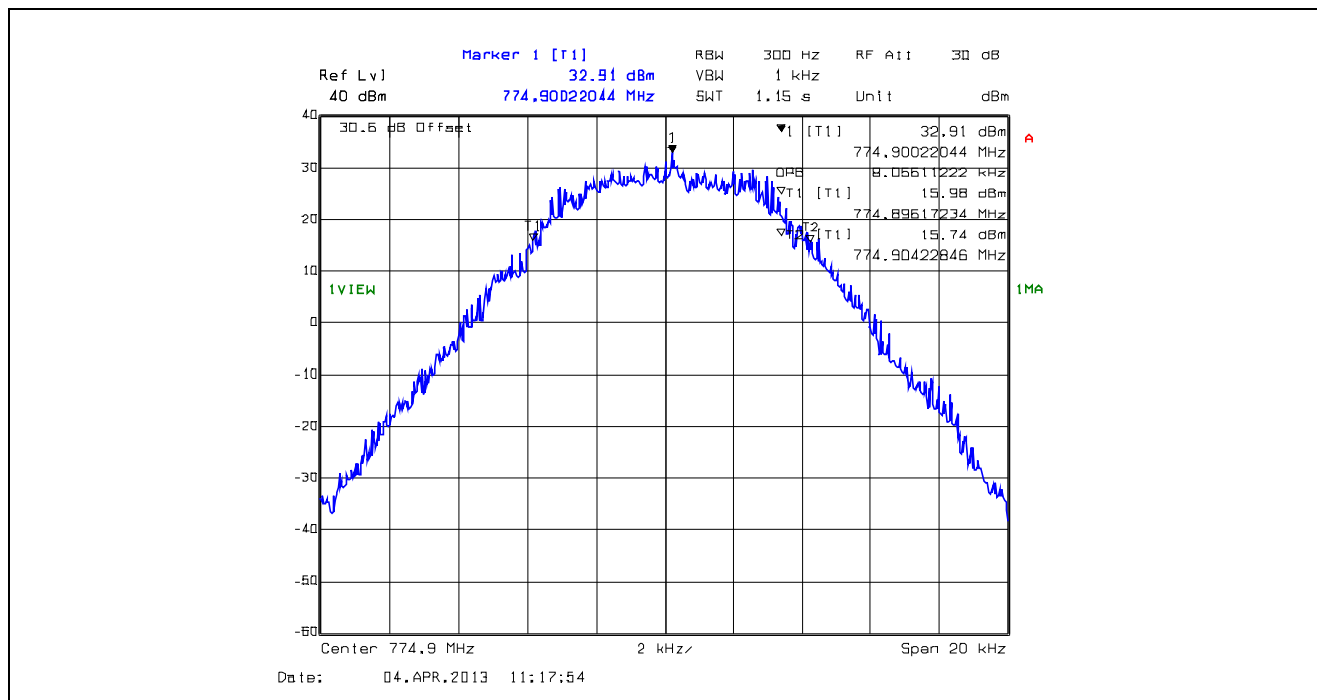
Plot 5.4.4.1.26. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 764.1 MHz



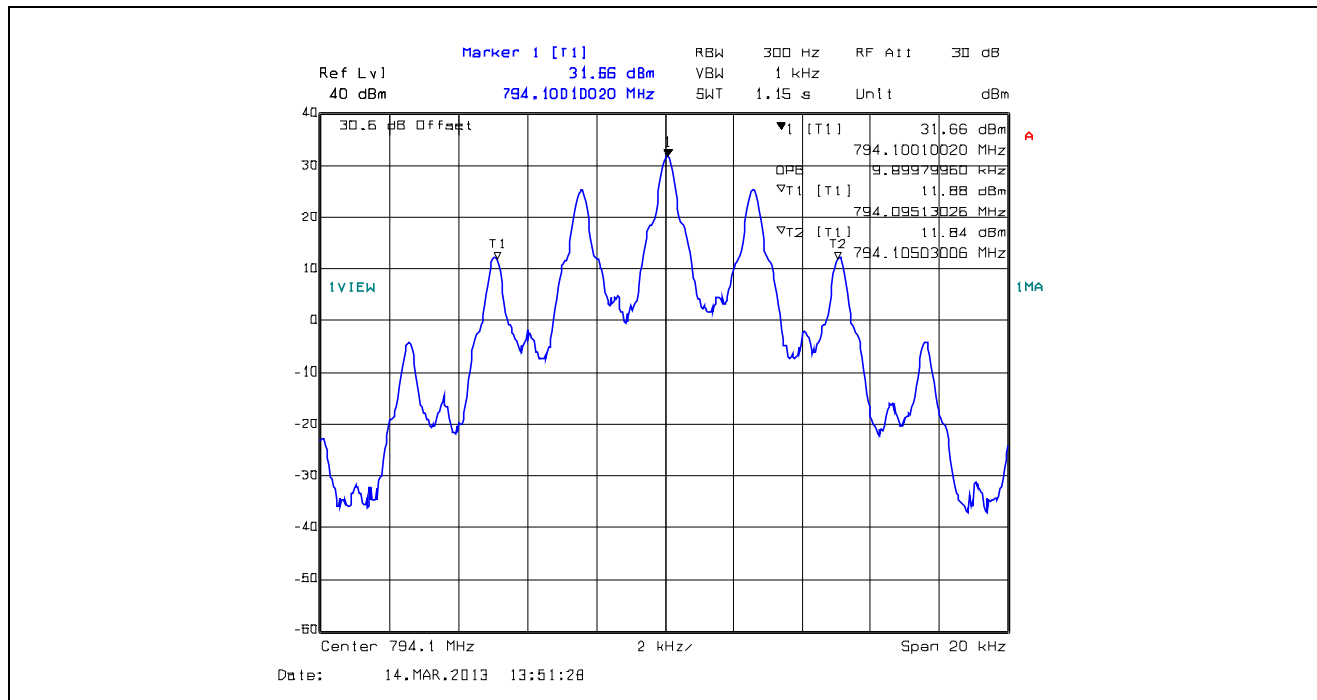
Plot 5.4.4.1.27. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 769.5 MHz



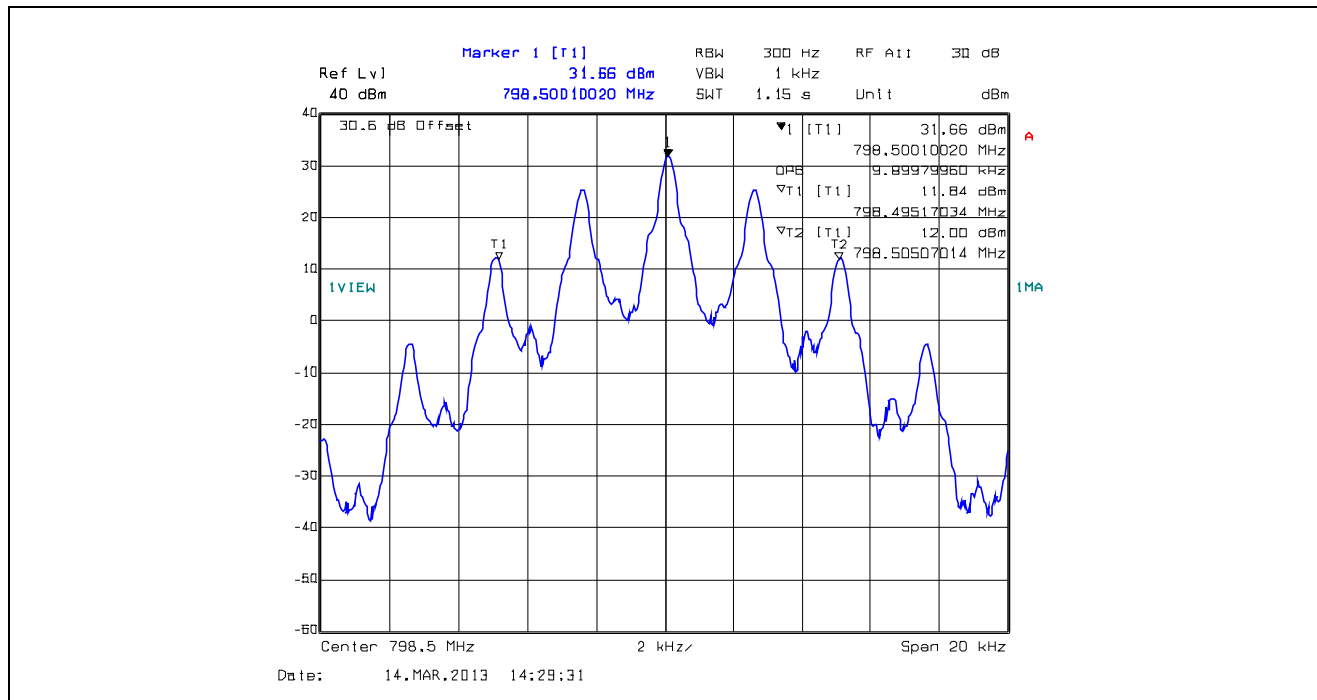
Plot 5.4.4.1.28. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 774.9 MHz



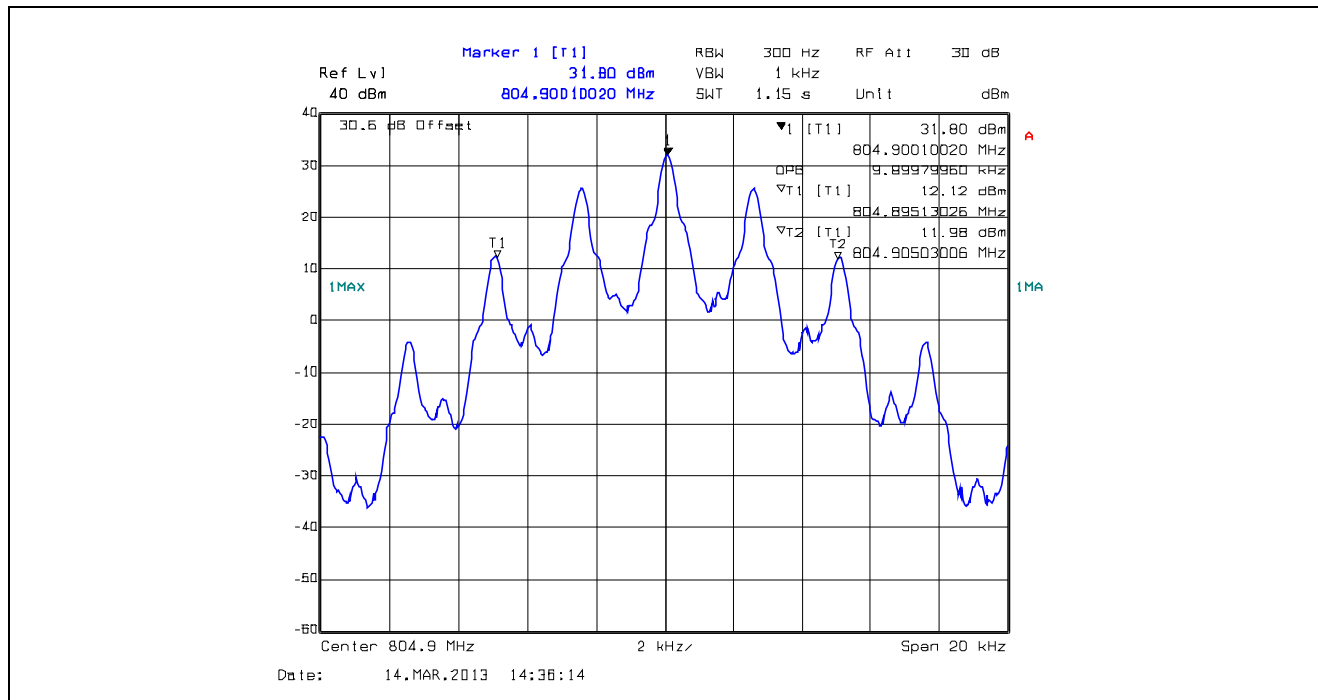
Plot 5.4.4.1.29. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 794.1 MHz



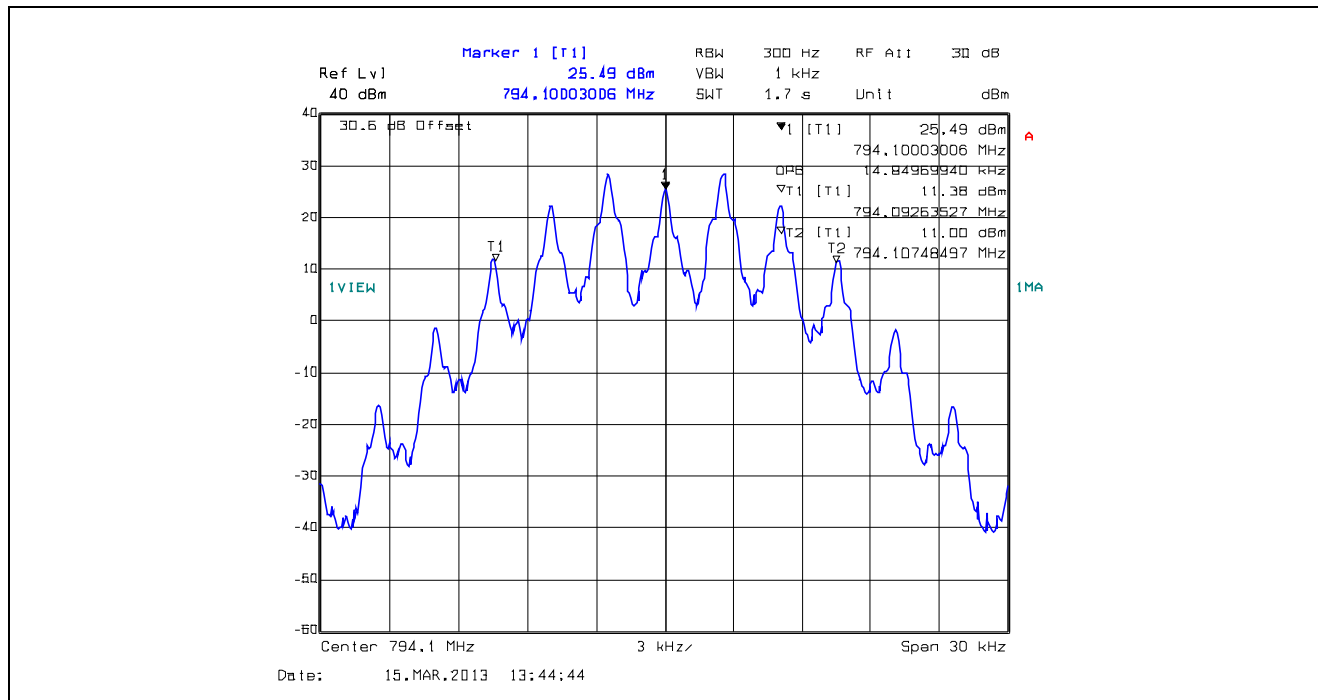
Plot 5.4.4.1.30. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 798.5 MHz



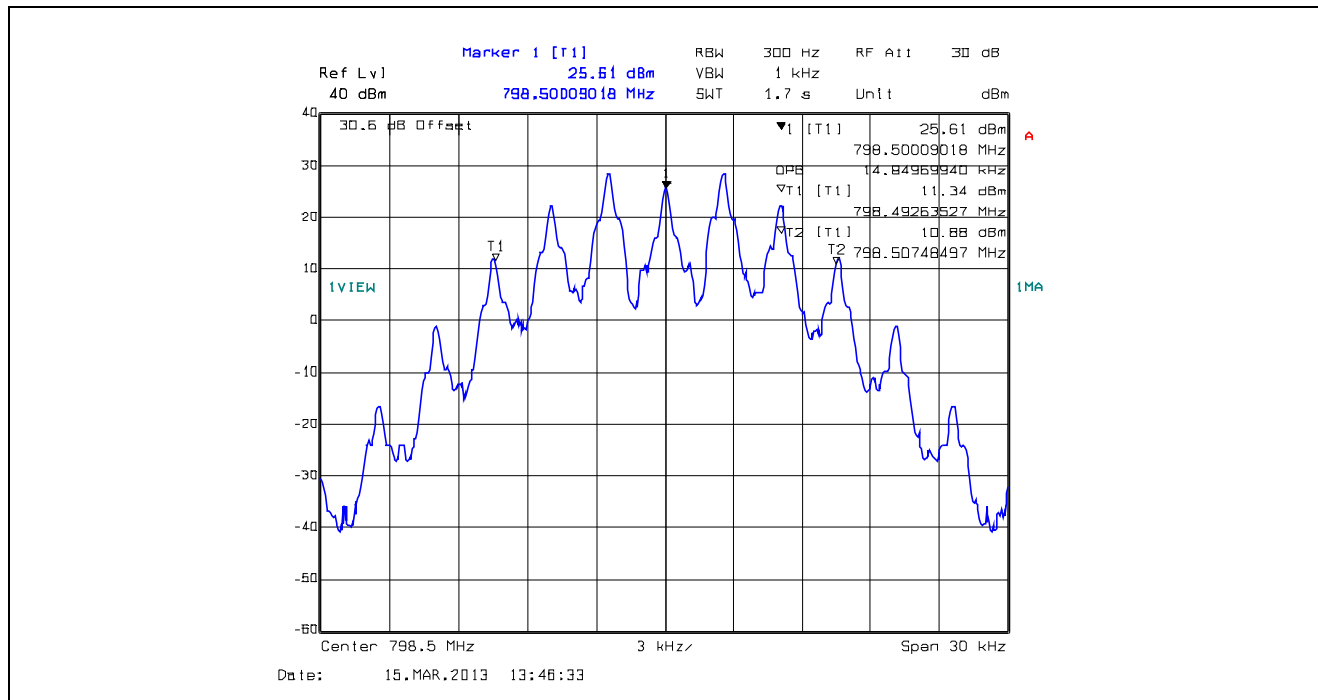
Plot 5.4.4.1.31. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 804.9 MHz



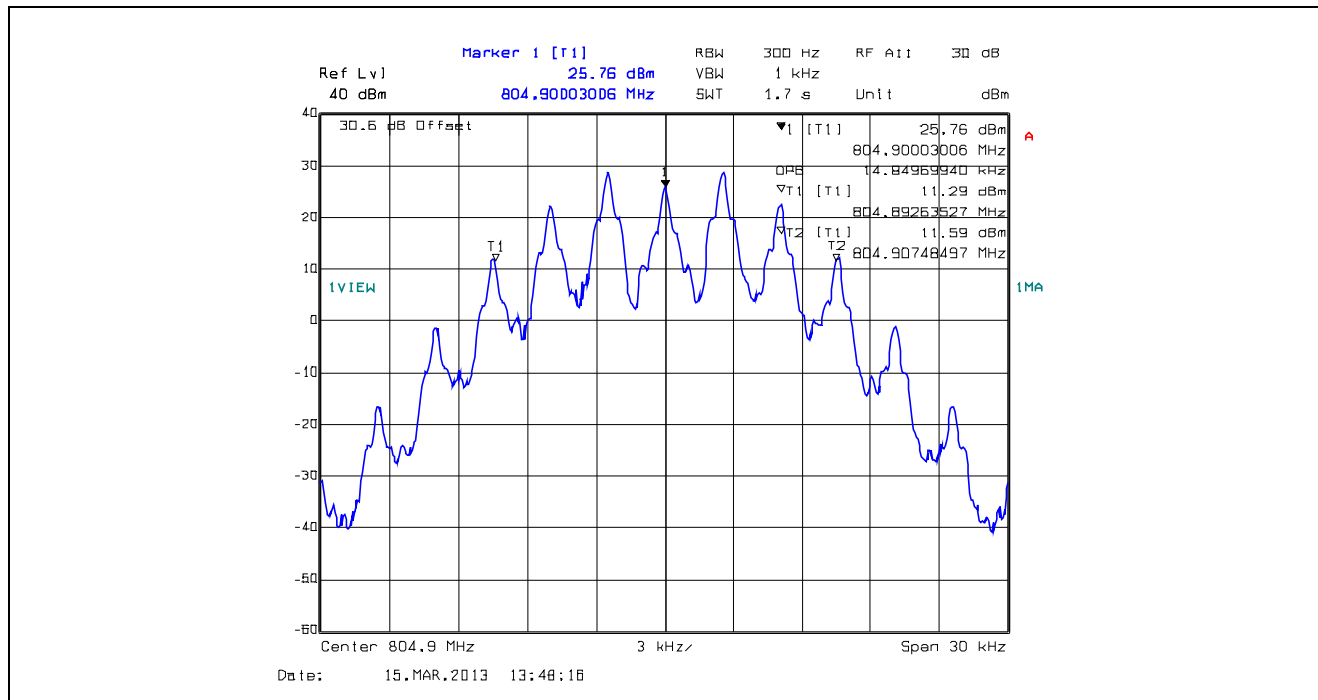
Plot 5.4.4.1.32. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 794.1MHz



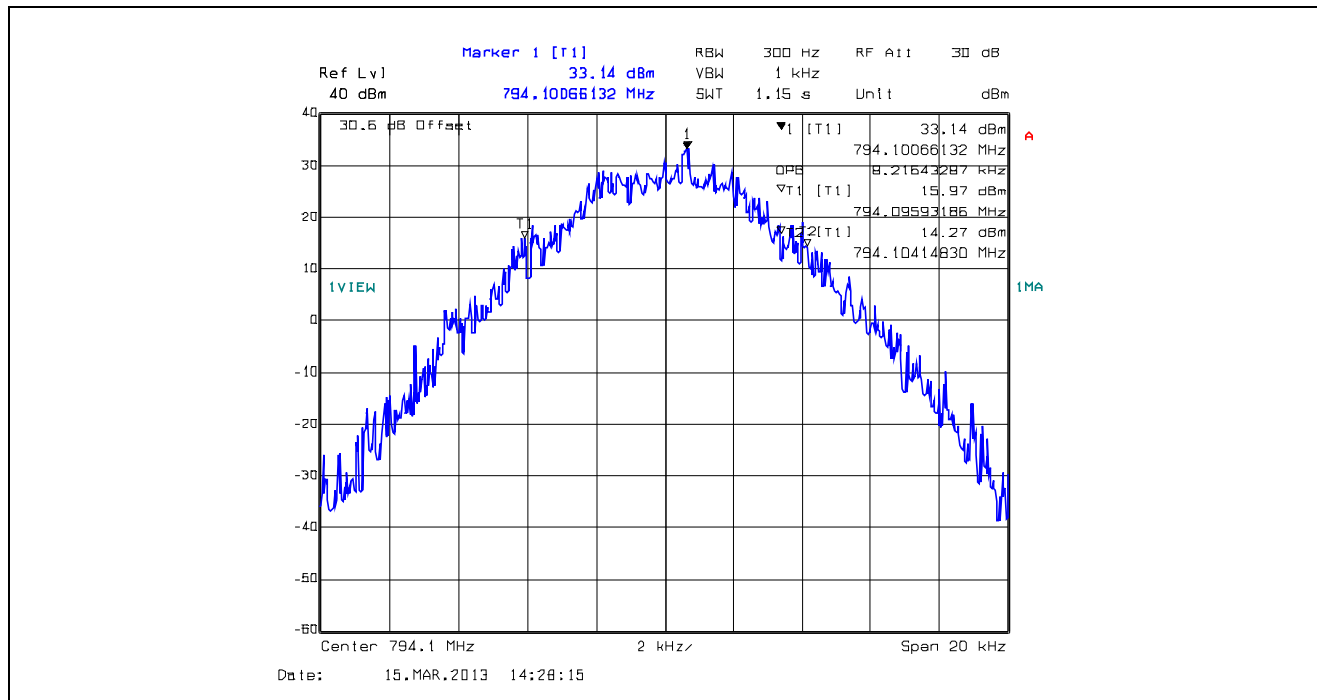
Plot 5.4.4.1.33. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 798.5 MHz



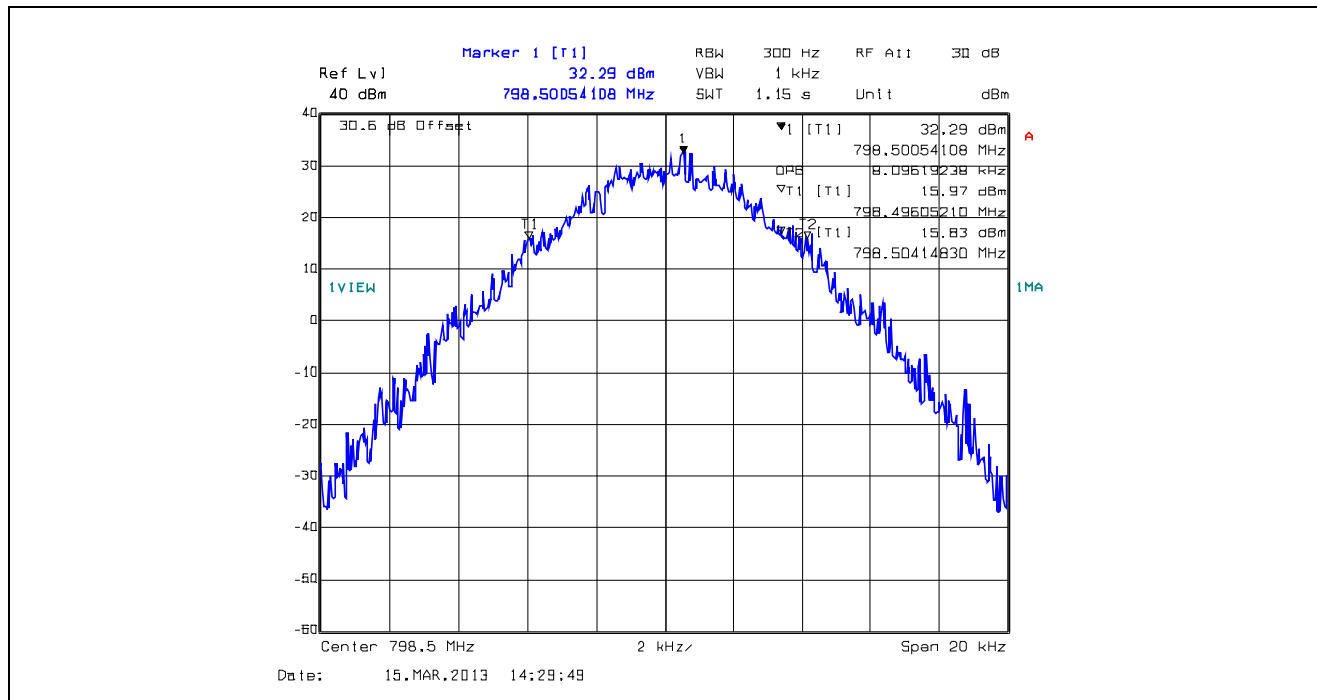
Plot 5.4.4.1.34. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 804.9 MHz



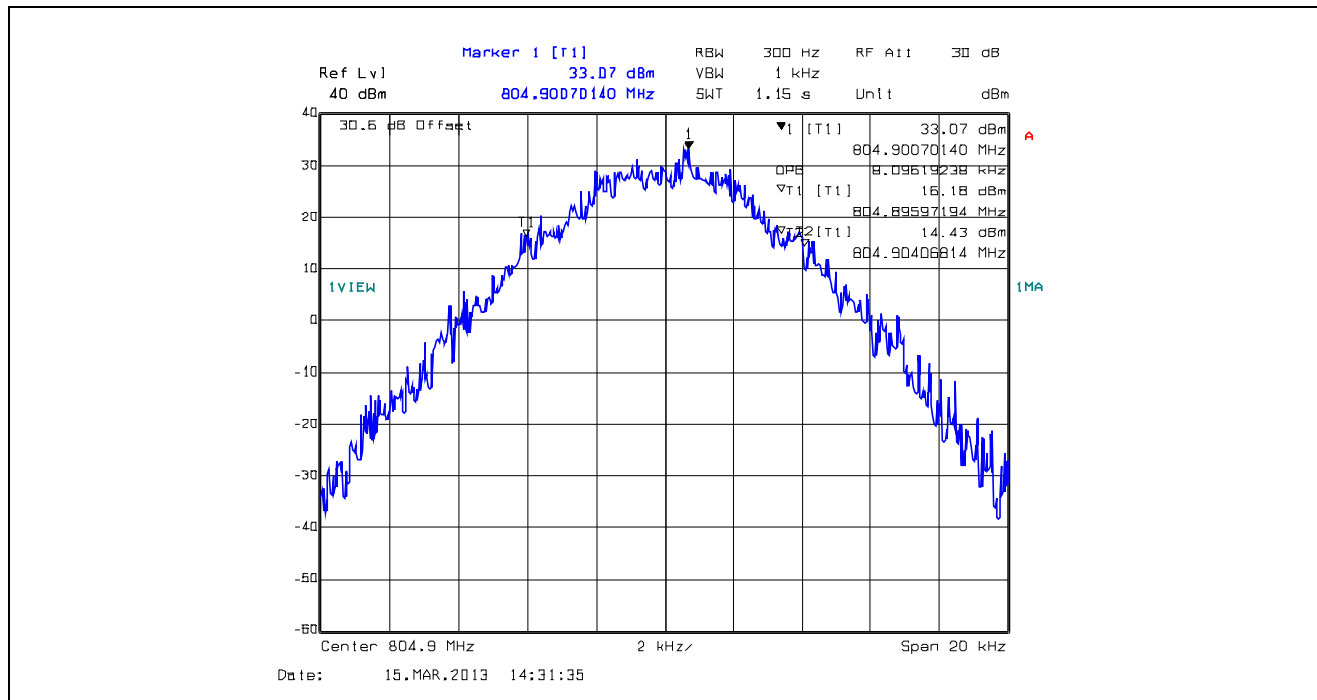
Plot 5.4.4.1.35. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 794.1 MHz



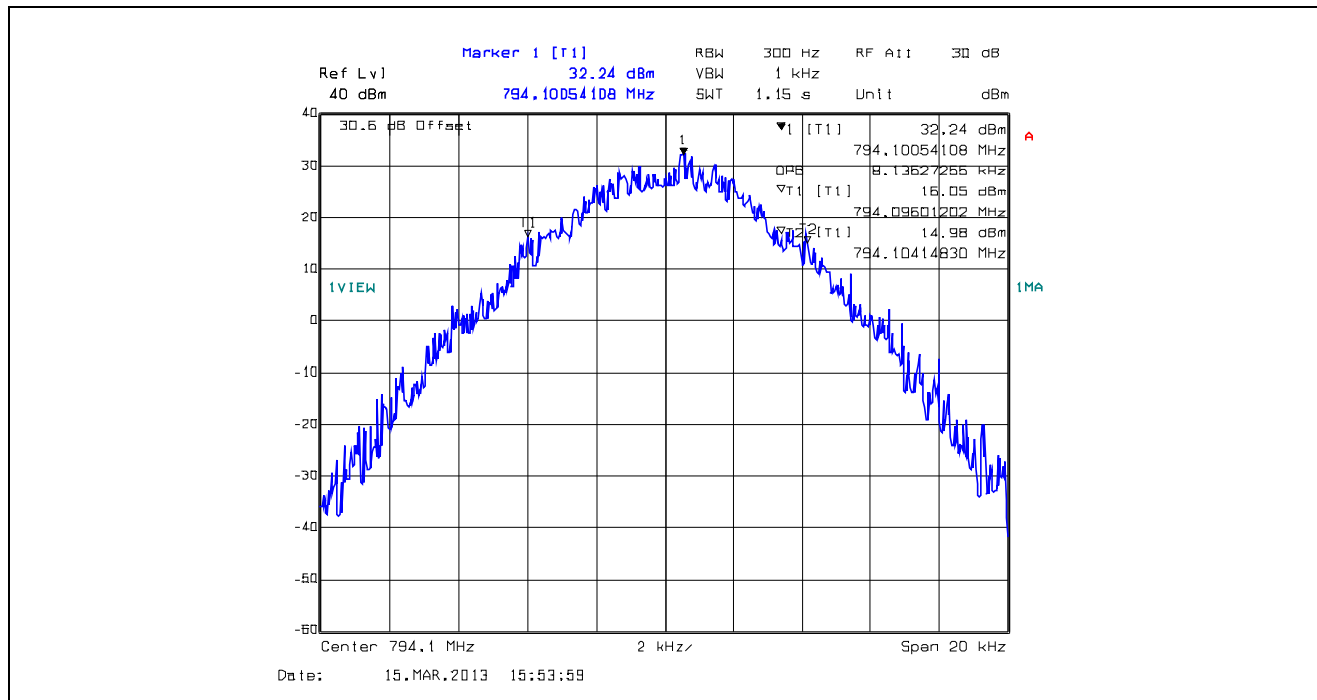
Plot 5.4.4.1.36. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 798.5 MHz



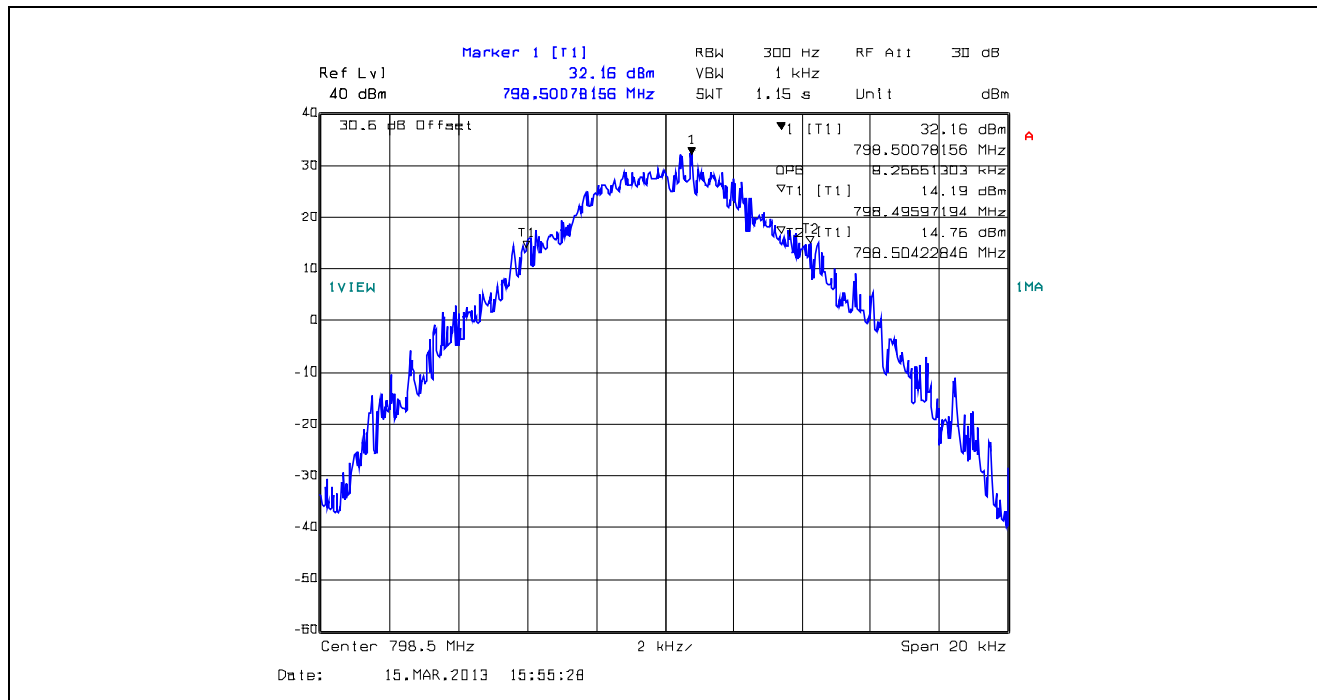
Plot 5.4.4.1.37. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 804.9 MHz



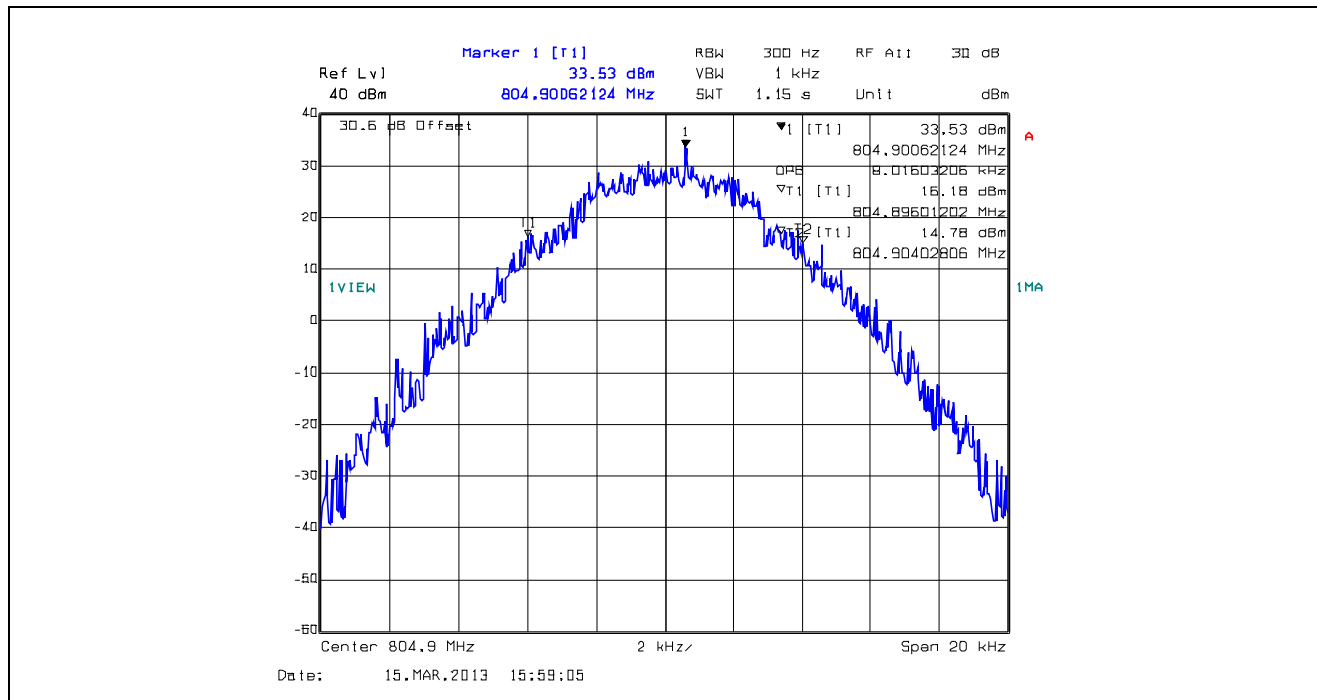
Plot 5.4.4.1.38. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 794.1 MHz



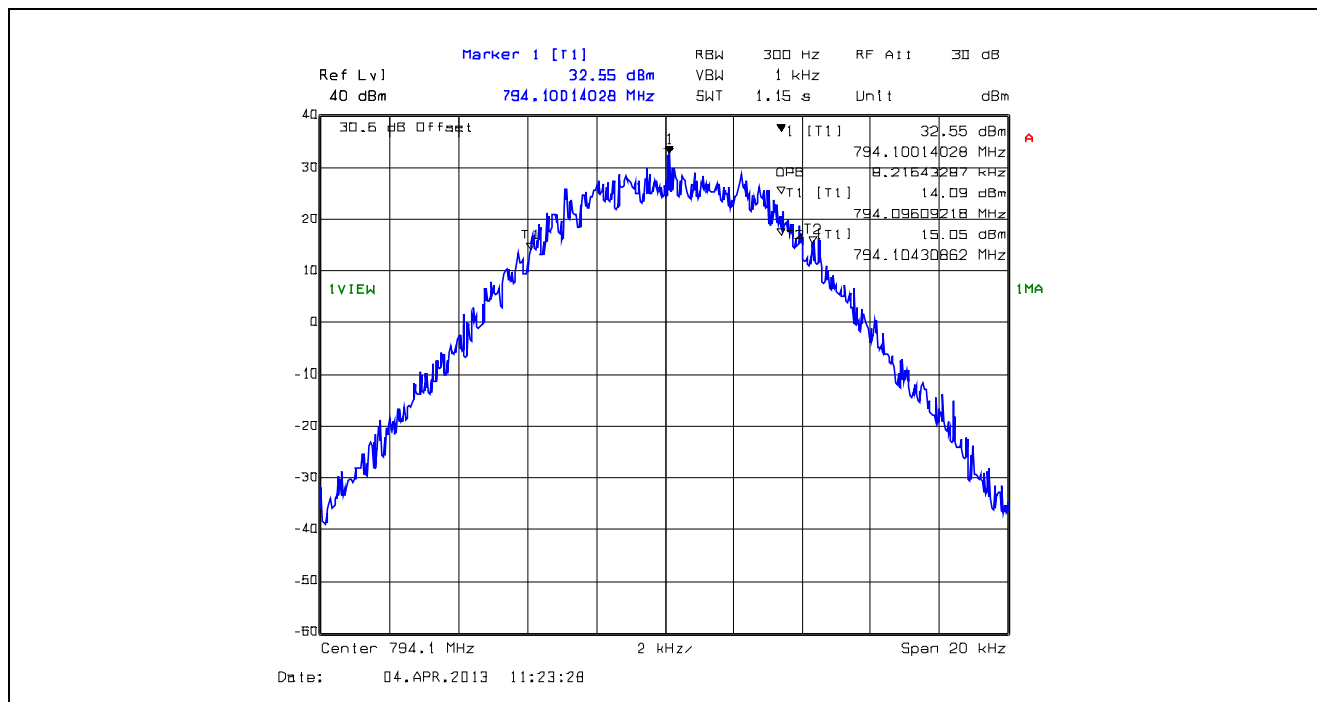
Plot 5.4.4.1.39. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 798.5 MHz



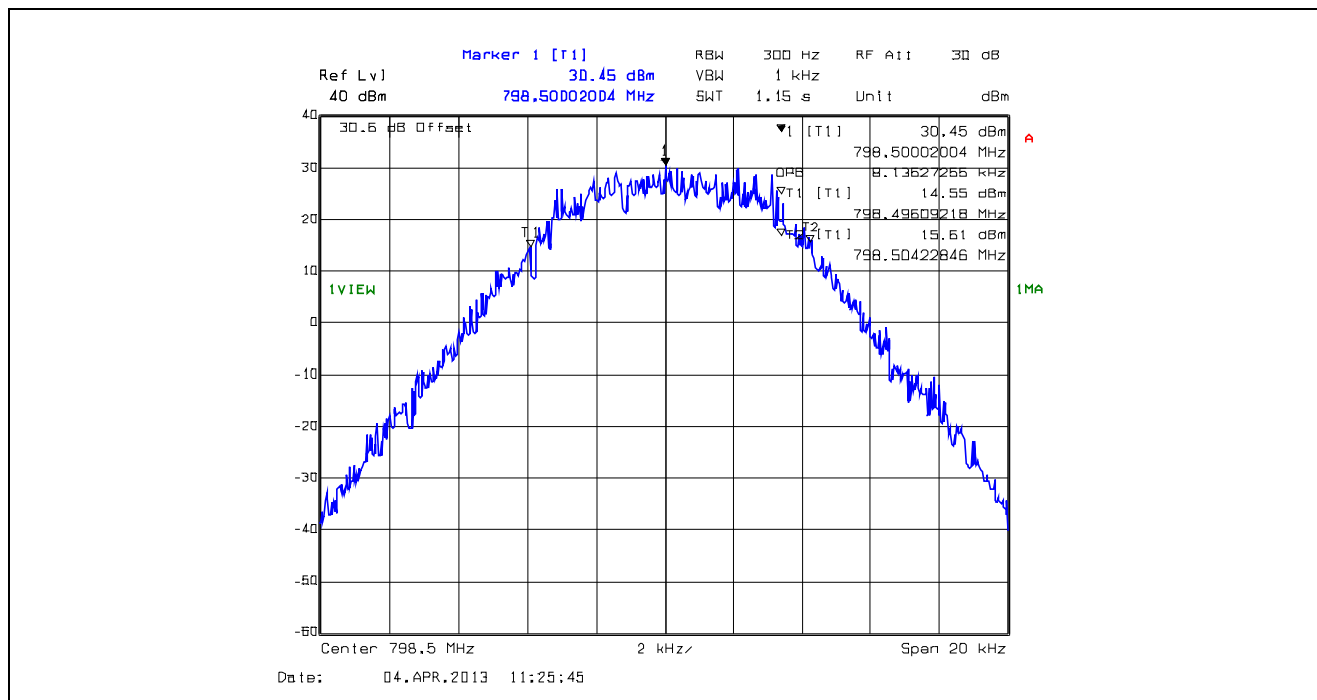
Plot 5.4.4.1.40. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 804.9 MHz



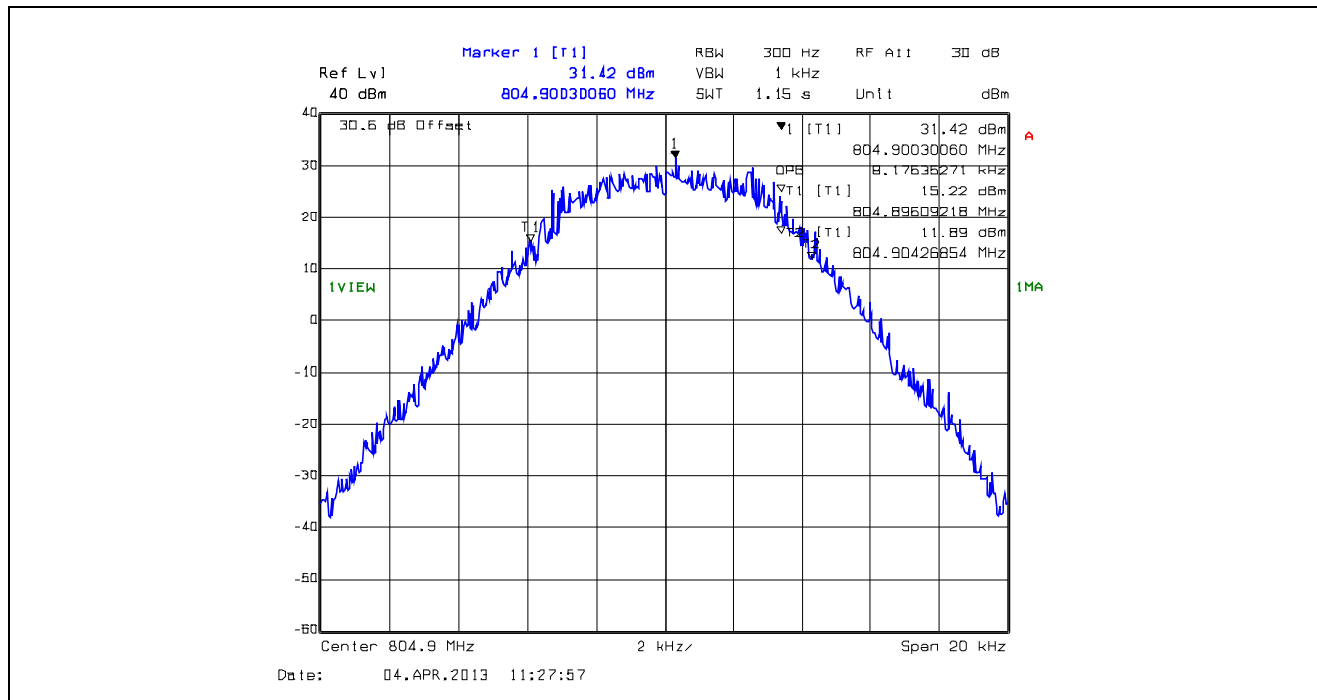
Plot 5.4.4.1.41. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 794.1 MHz



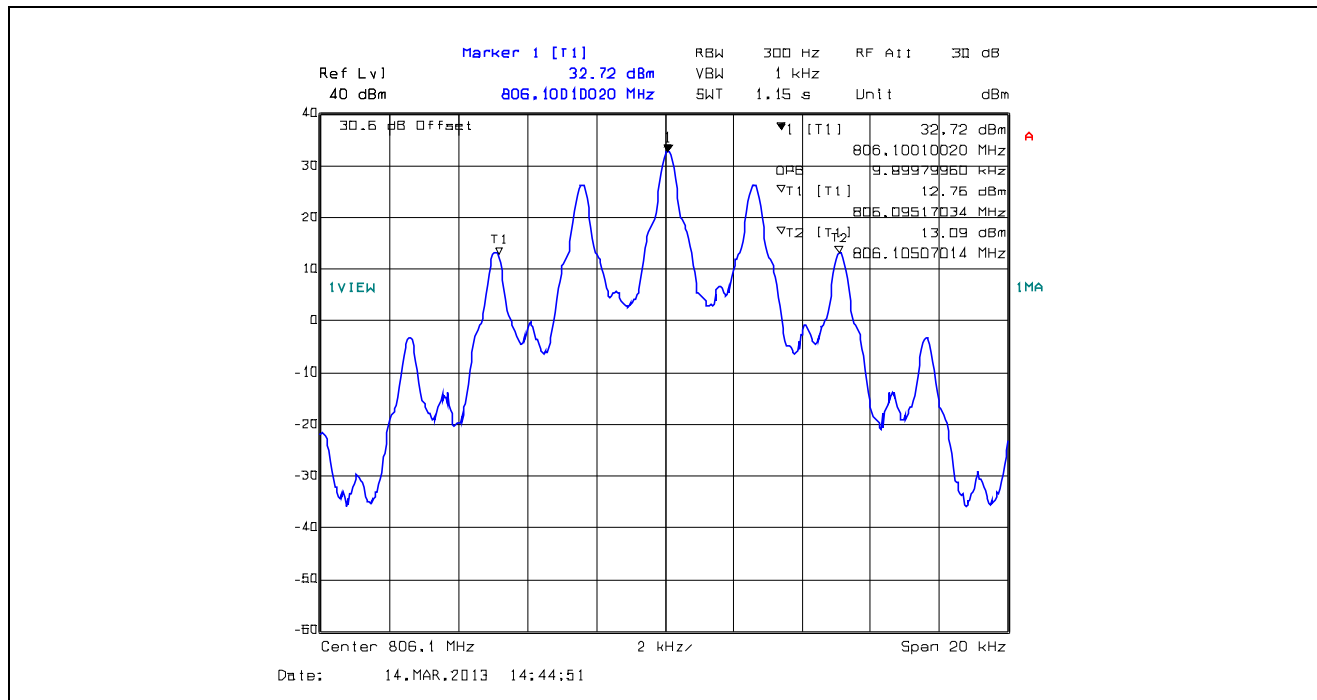
Plot 5.4.4.1.42. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 798.5 MHz



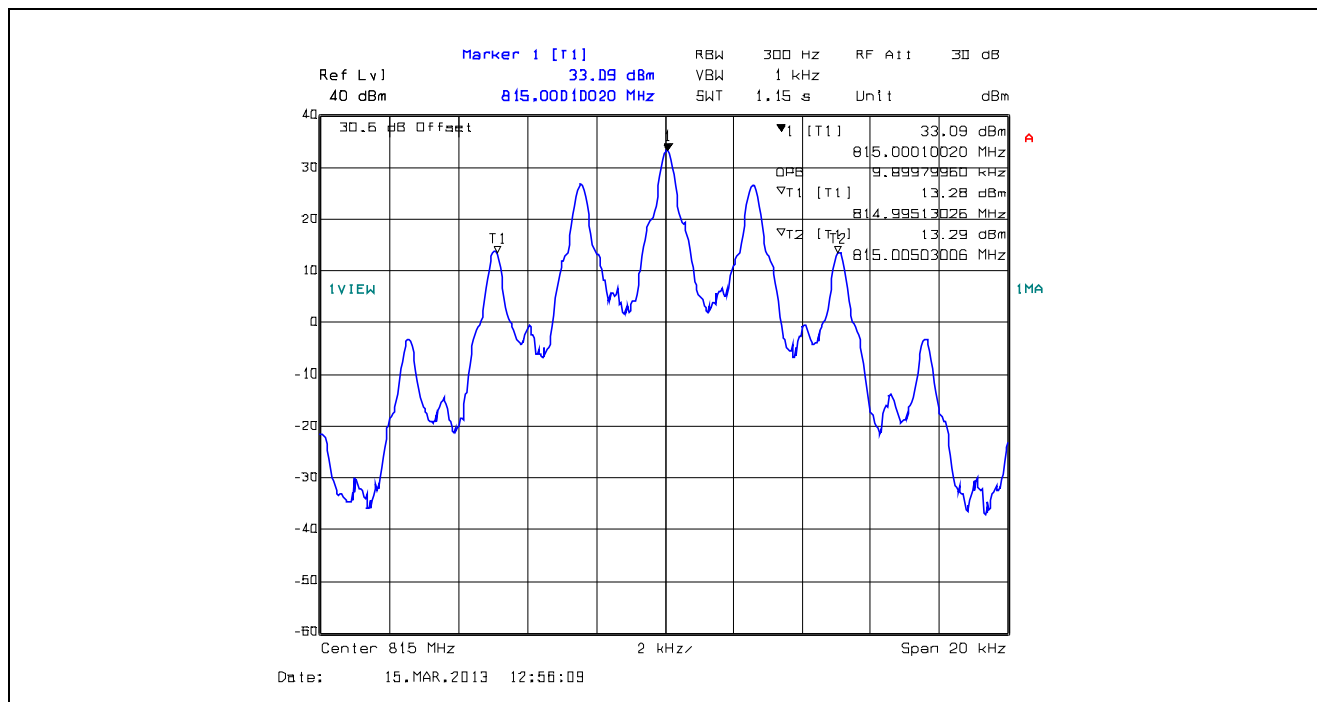
Plot 5.4.4.1.43. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 804.9 MHz



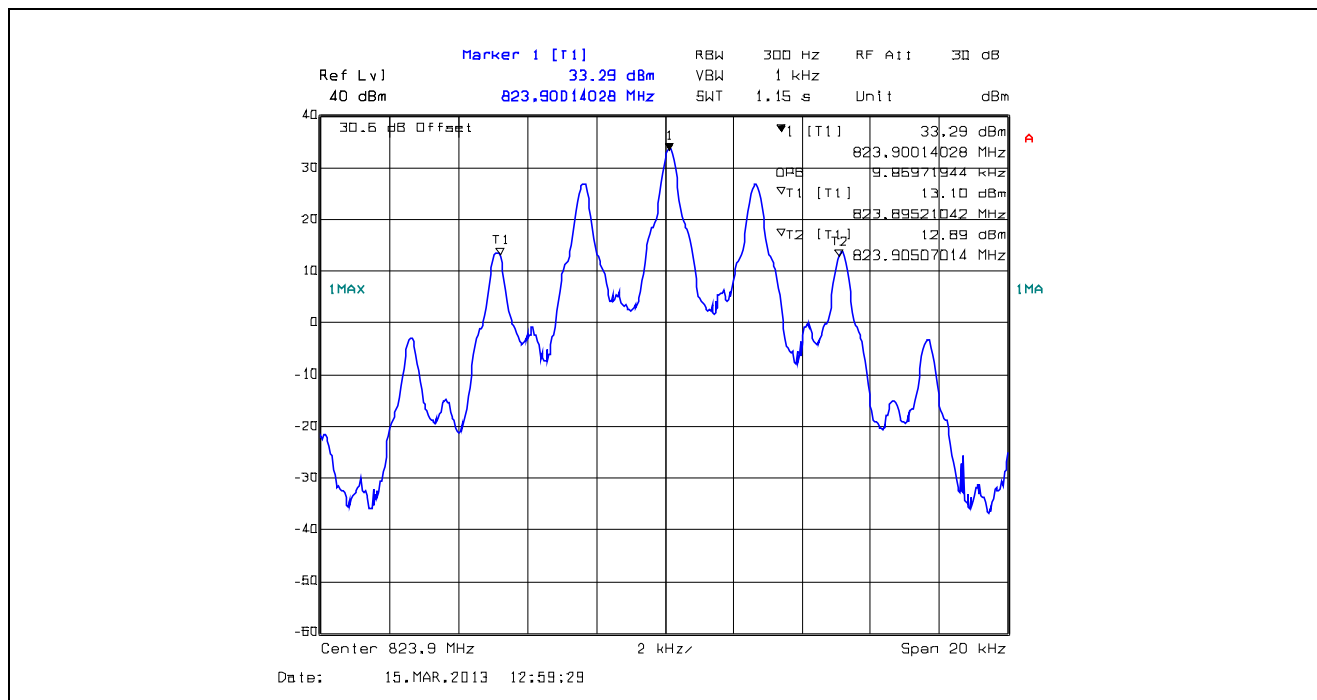
Plot 5.4.4.1.44. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 806.1 MHz



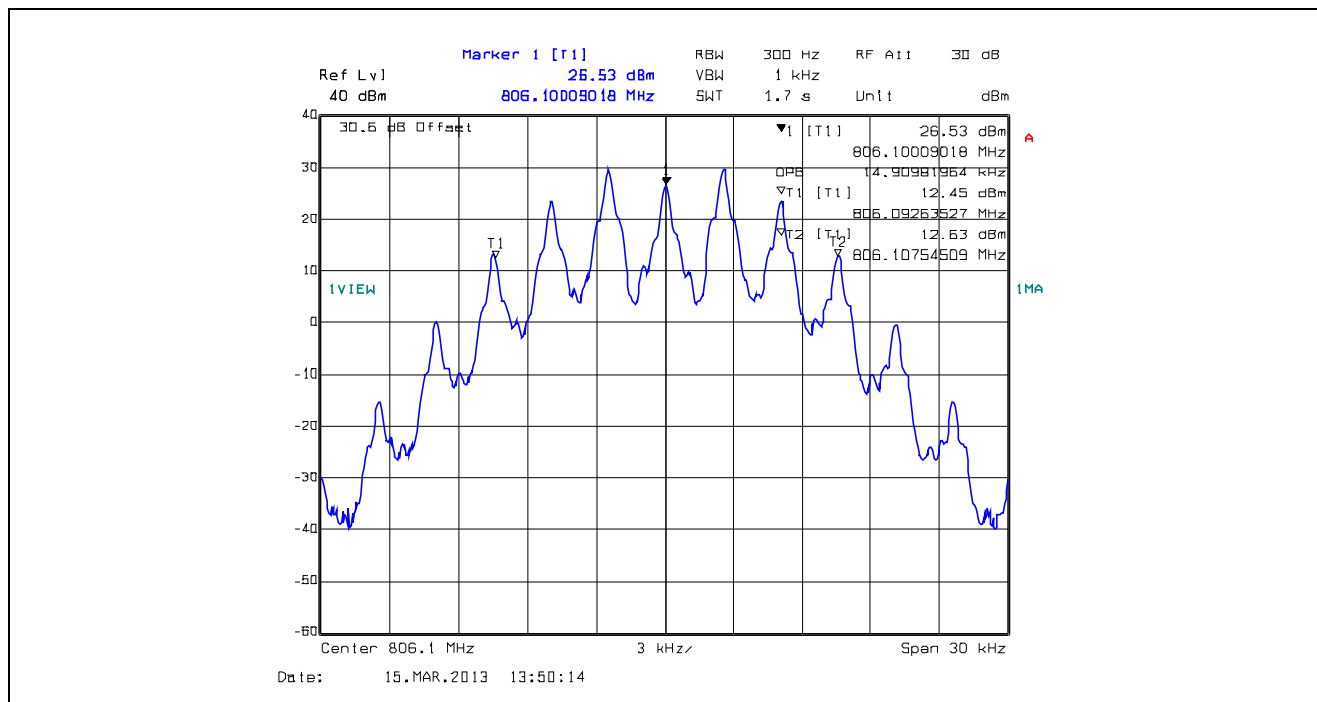
Plot 5.4.4.1.45. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 815.0 MHz



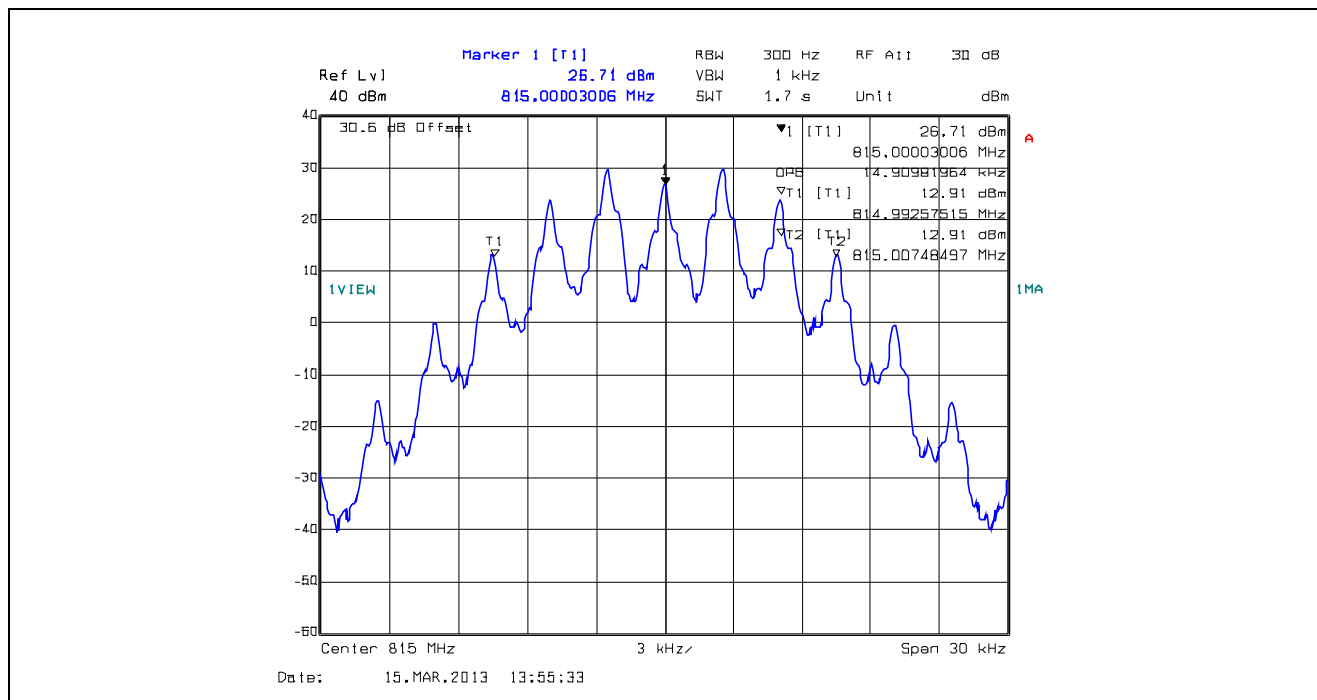
Plot 5.4.4.1.46. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 823.9 MHz



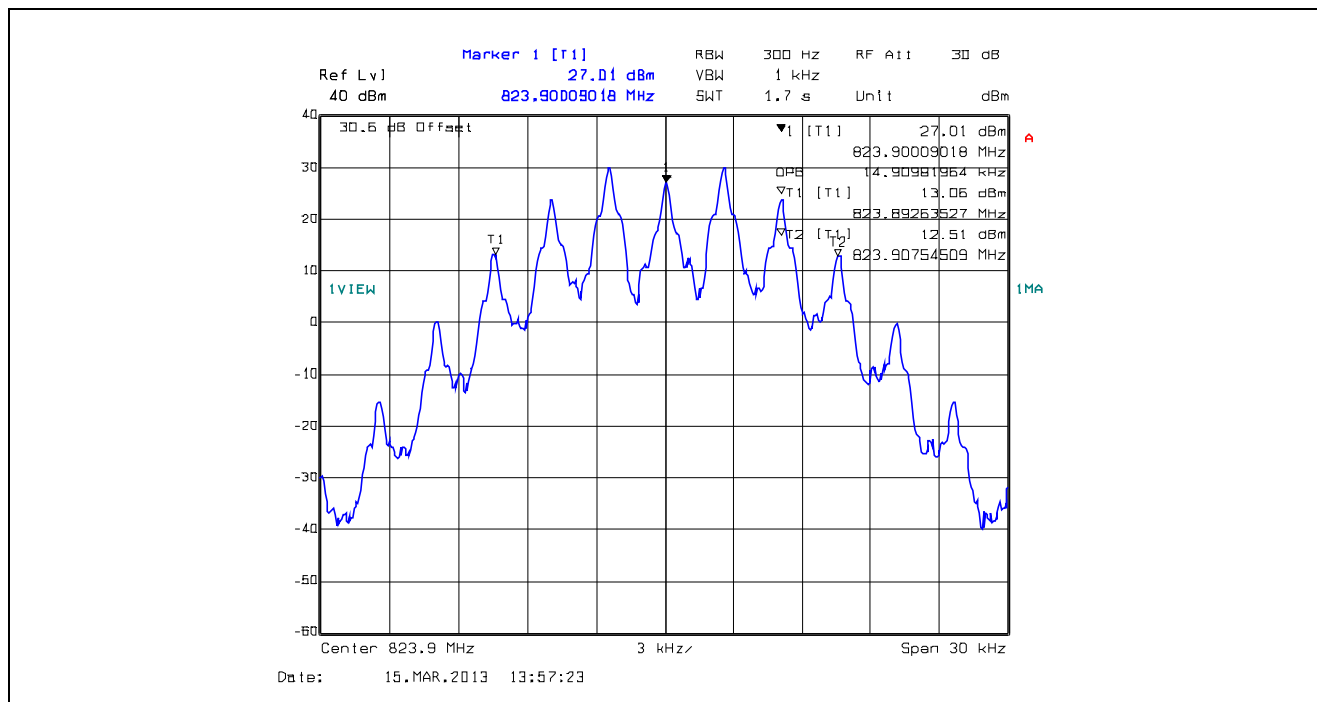
Plot 5.4.4.1.47. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 806.1 MHz



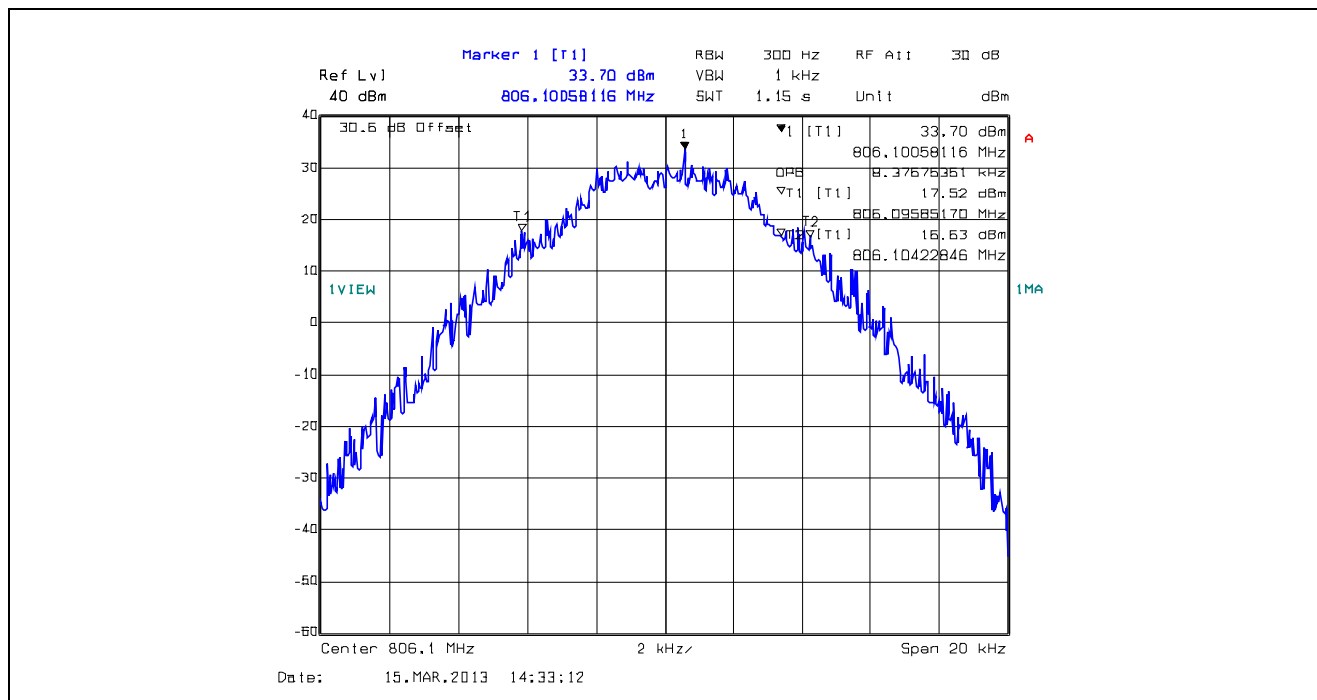
Plot 5.4.4.1.48. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 815.0MHz



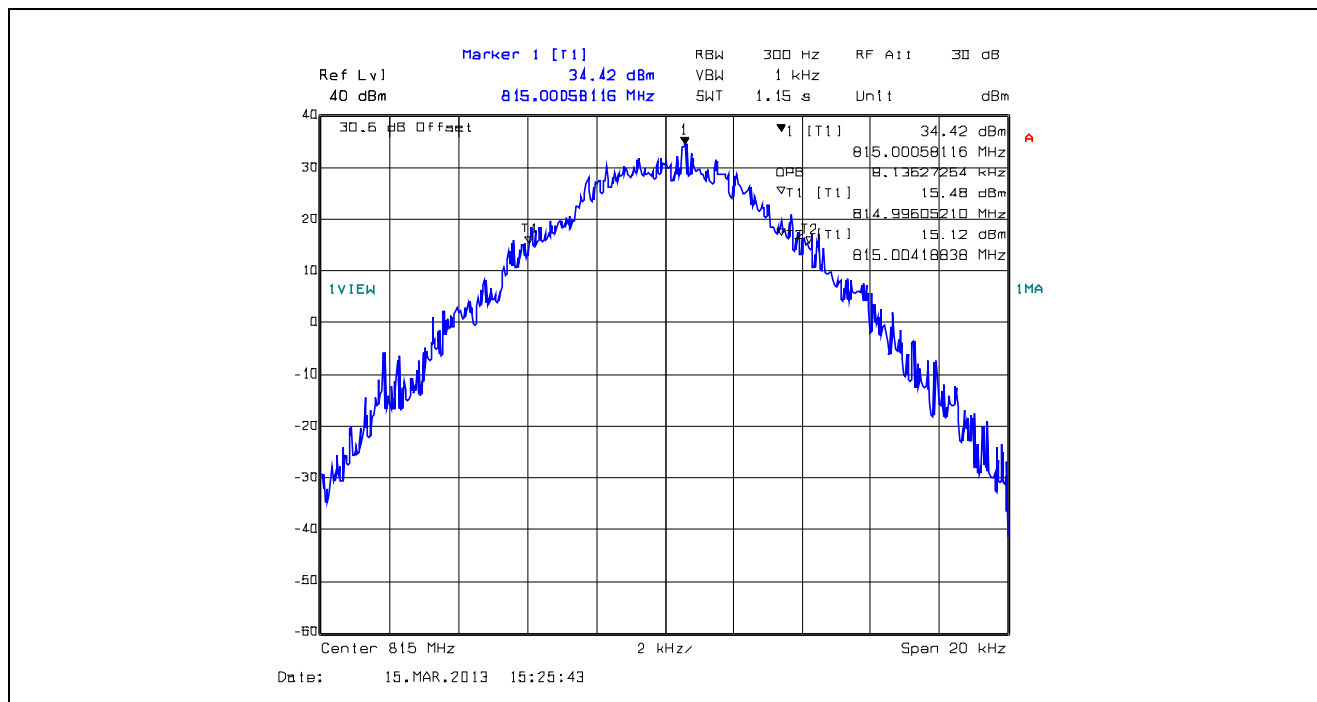
Plot 5.4.4.1.49. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 823.9 MHz



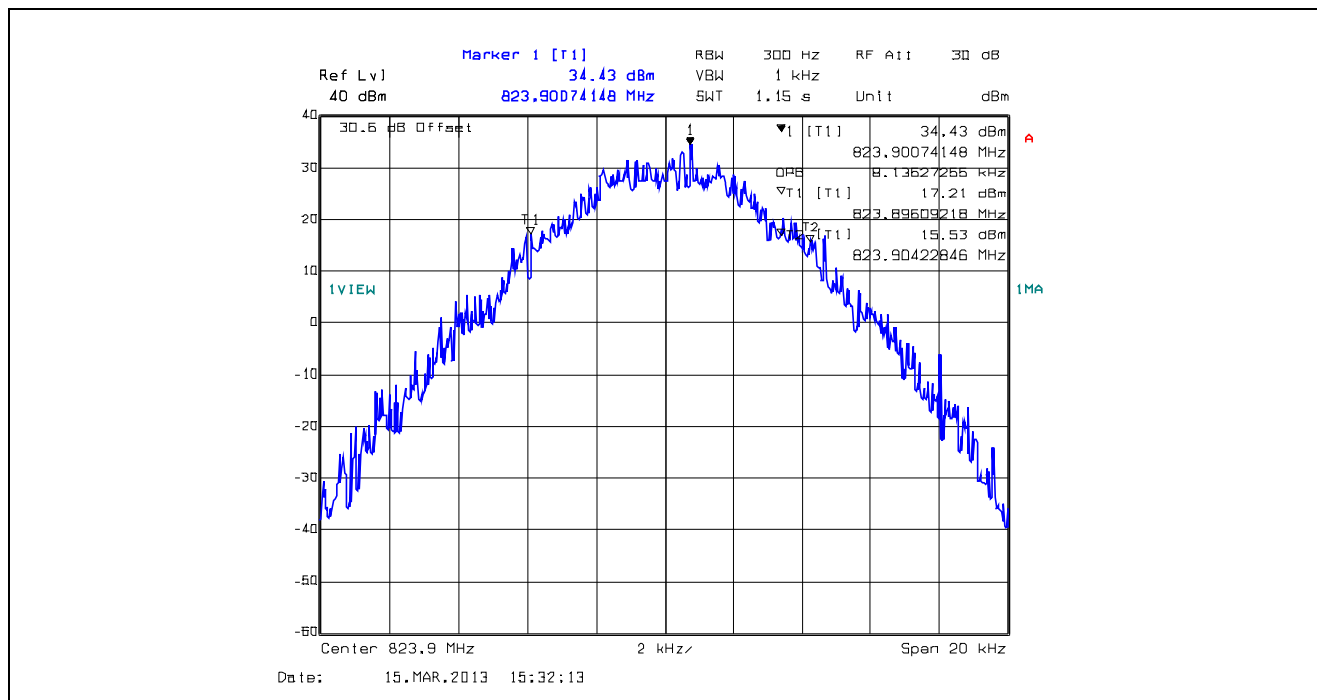
Plot 5.4.4.1.50. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 806.1 MHz



Plot 5.4.4.1.51. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 815.0 MHz



Plot 5.4.4.1.52. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 823.9 MHz



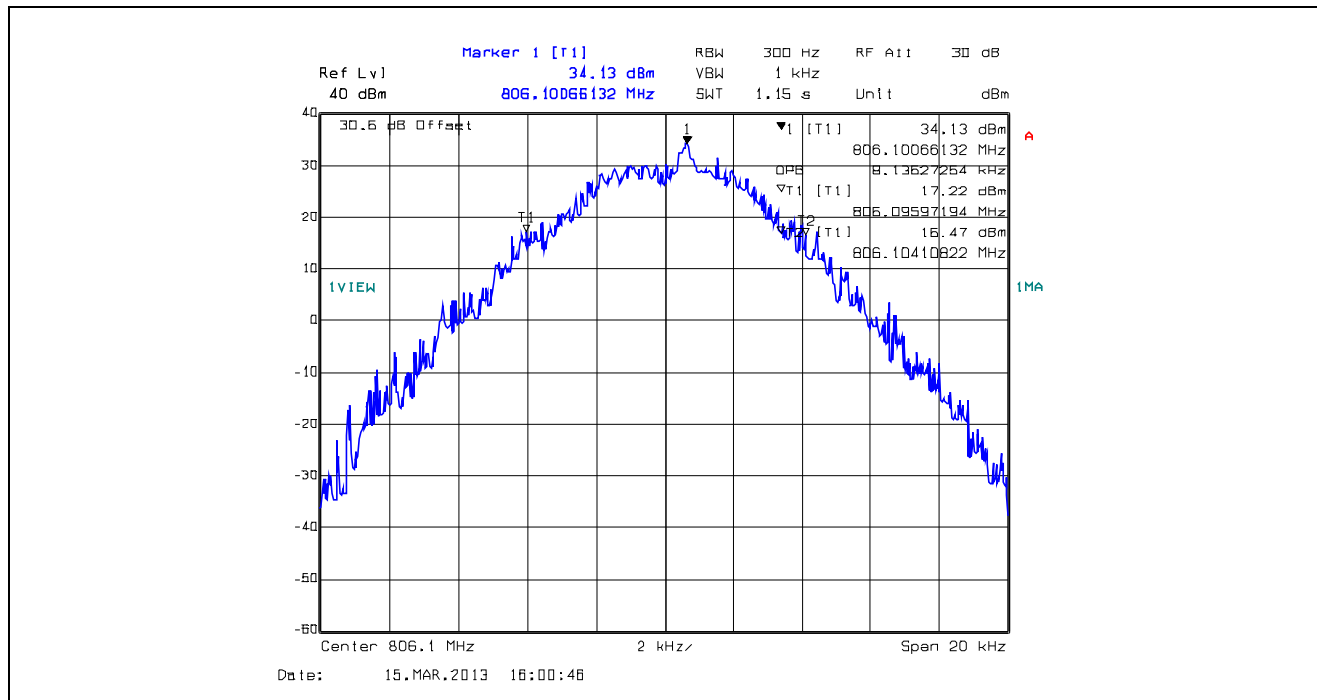
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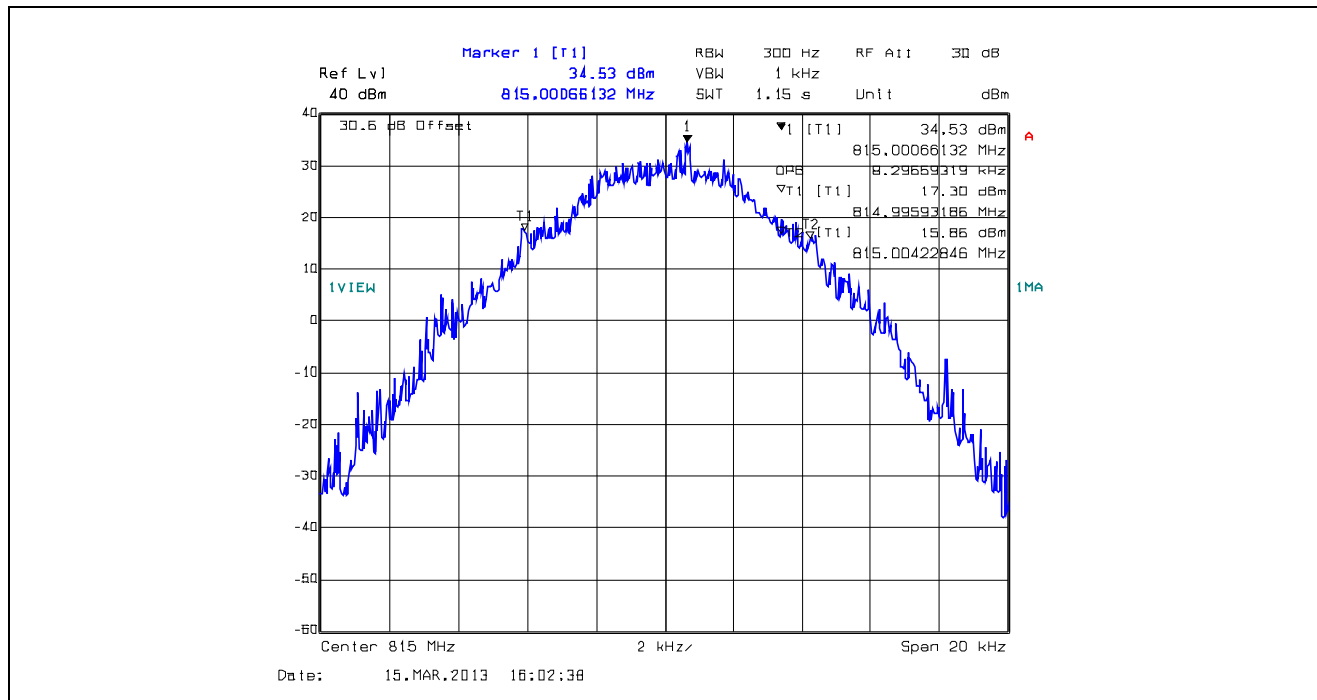
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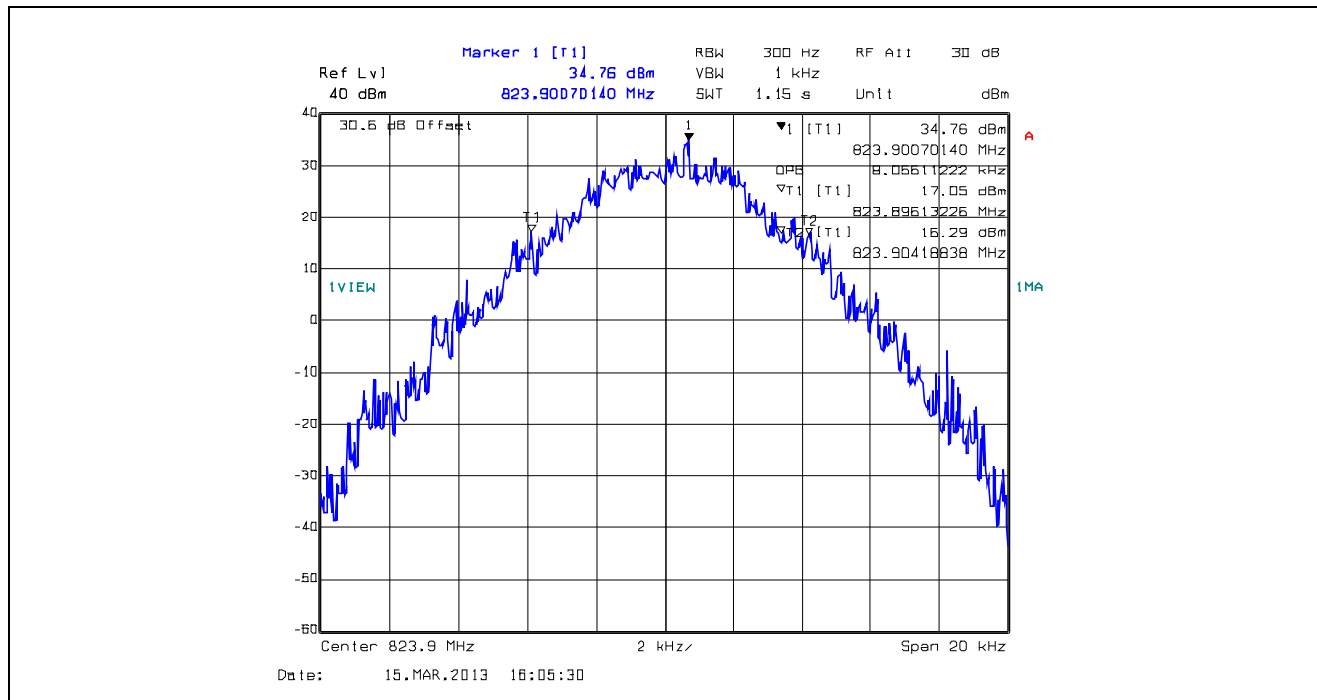
Plot 5.4.4.1.53. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 806.1 MHz



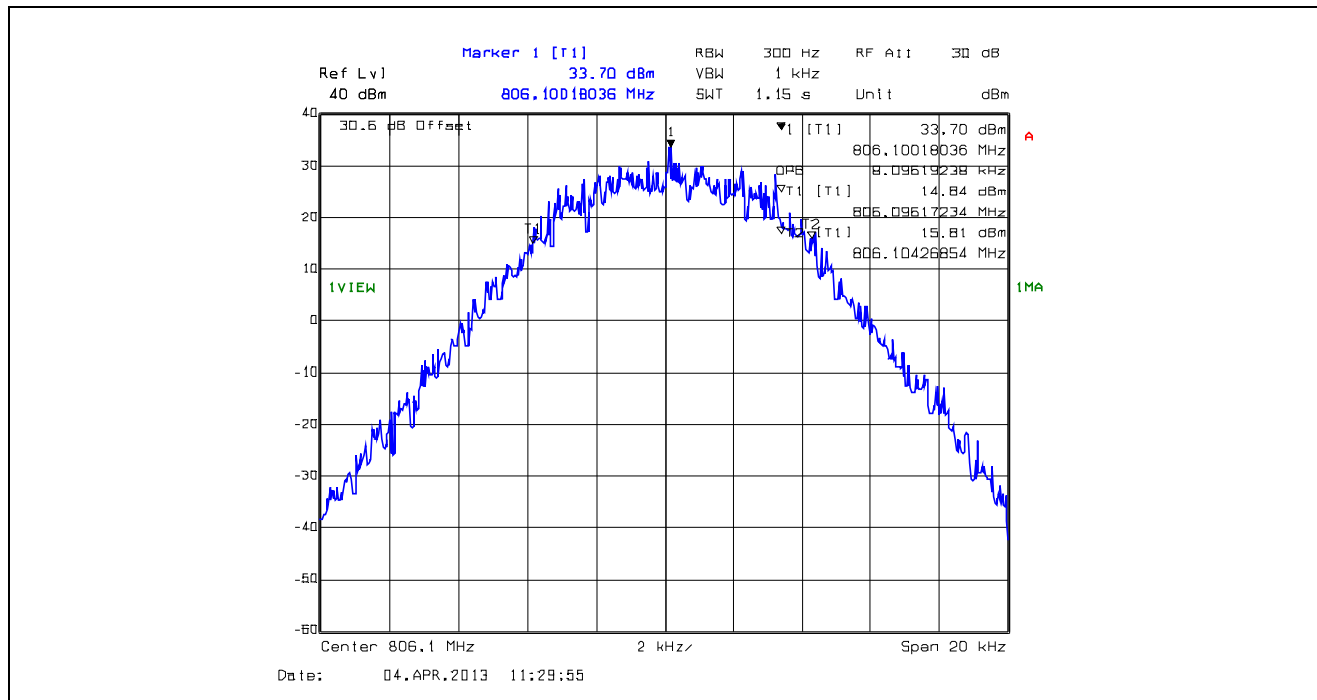
Plot 5.4.4.1.54. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 815.0 MHz



Plot 5.4.4.1.55. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 823.9 MHz



Plot 5.4.4.1.56. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 806.1 MHz



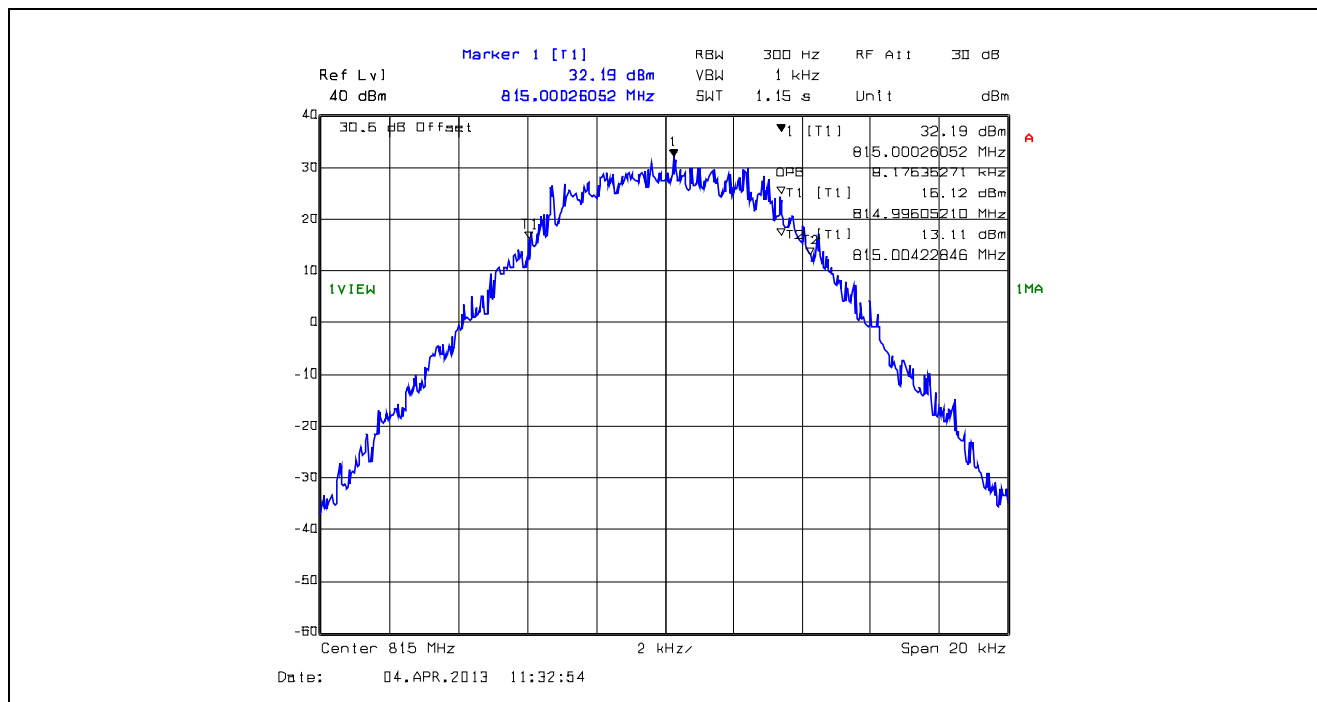
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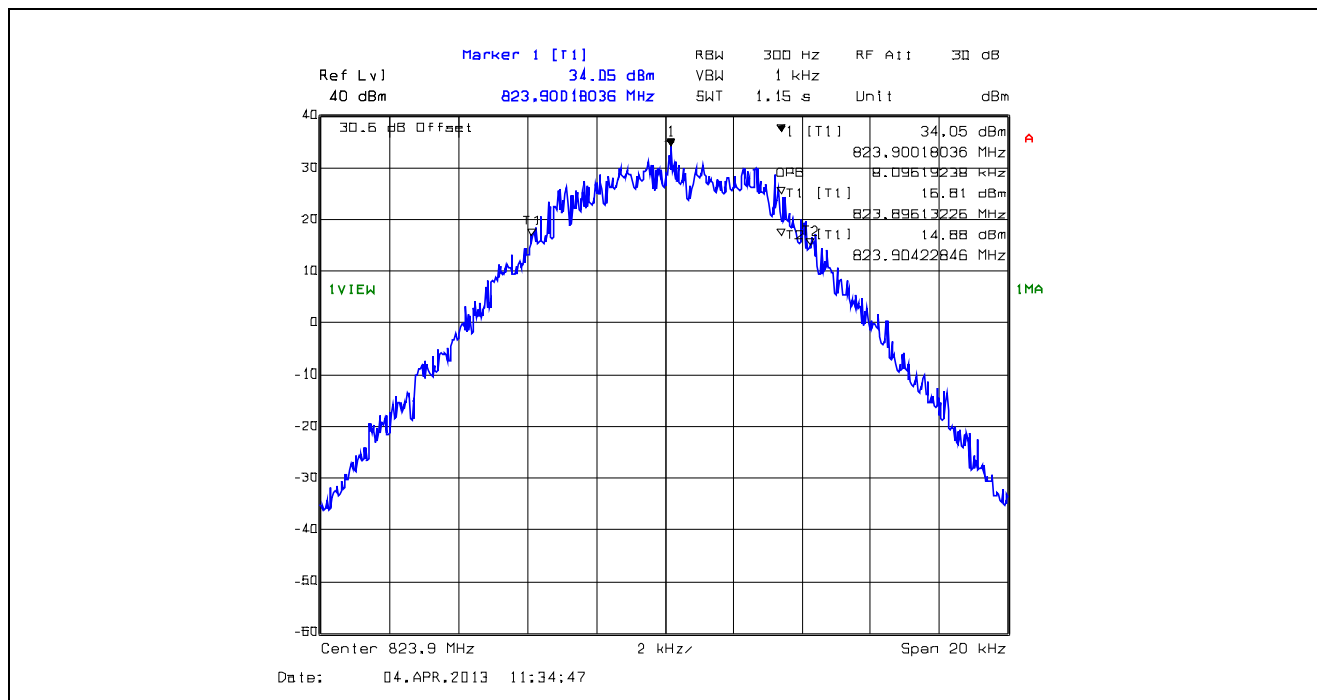
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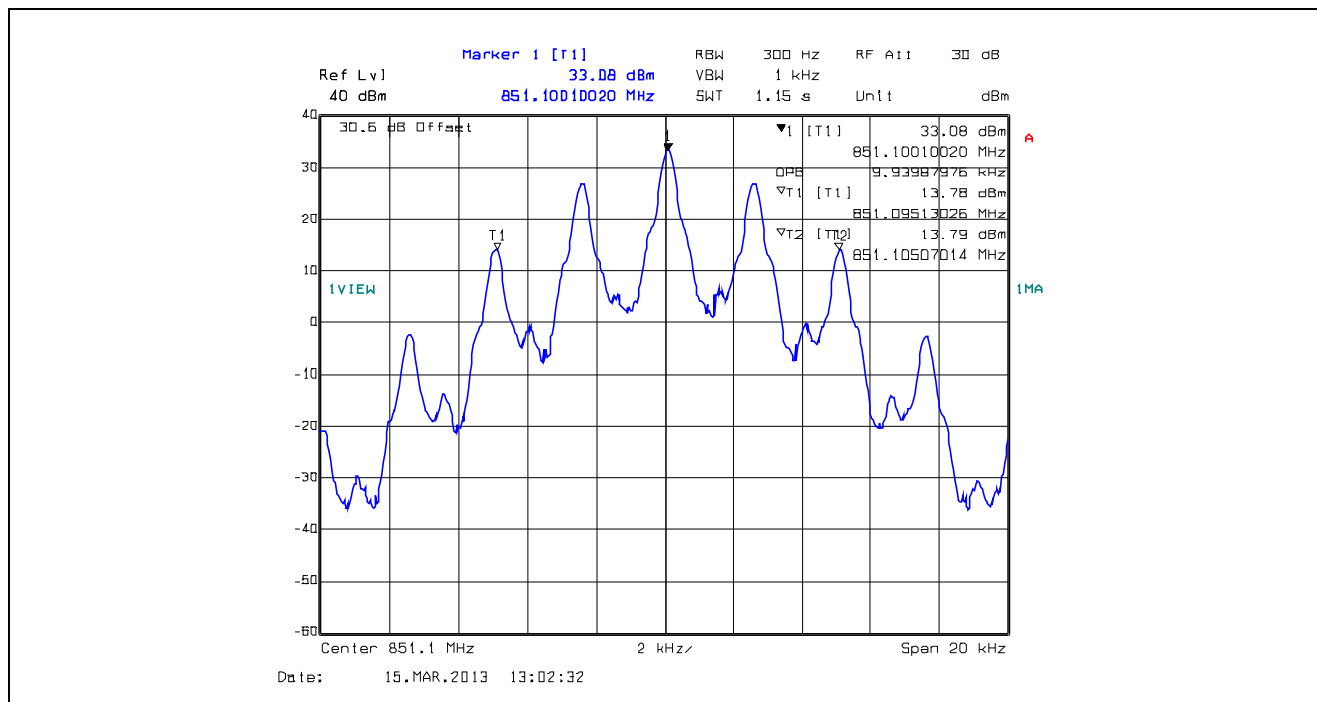
Plot 5.4.4.1.57. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 815.0 MHz



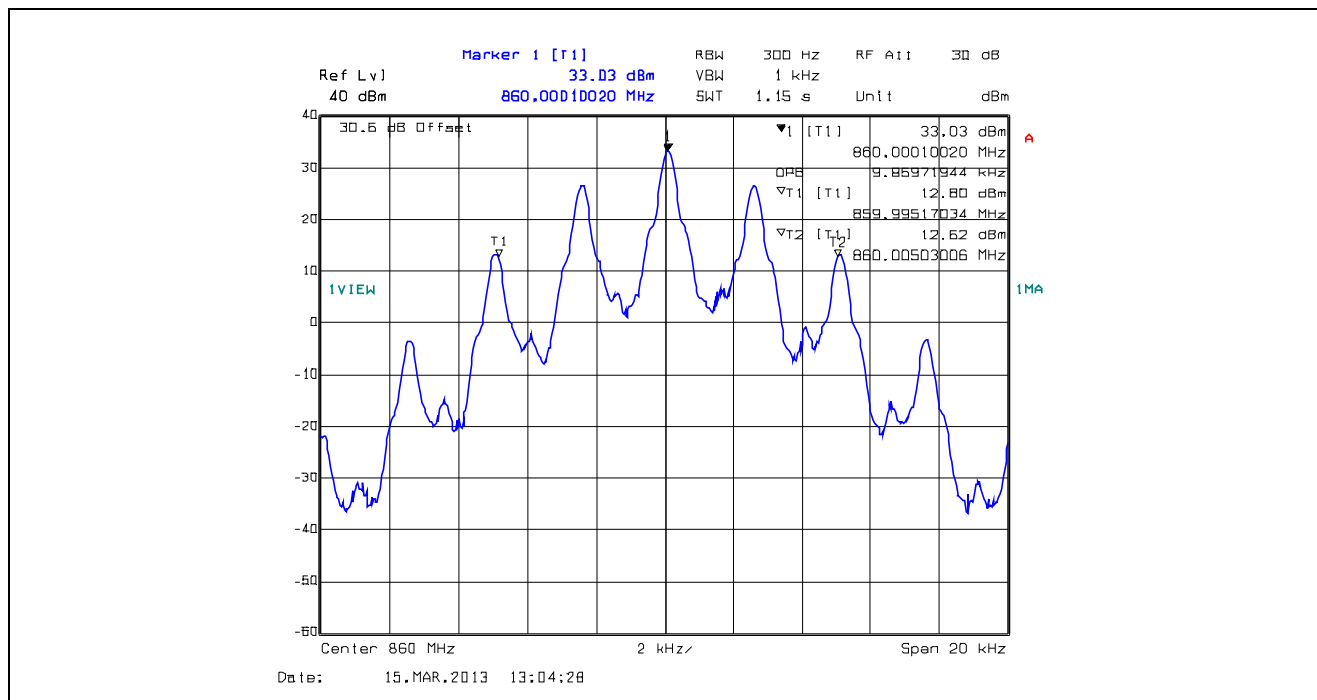
Plot 5.4.4.1.58. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 823.9 MHz



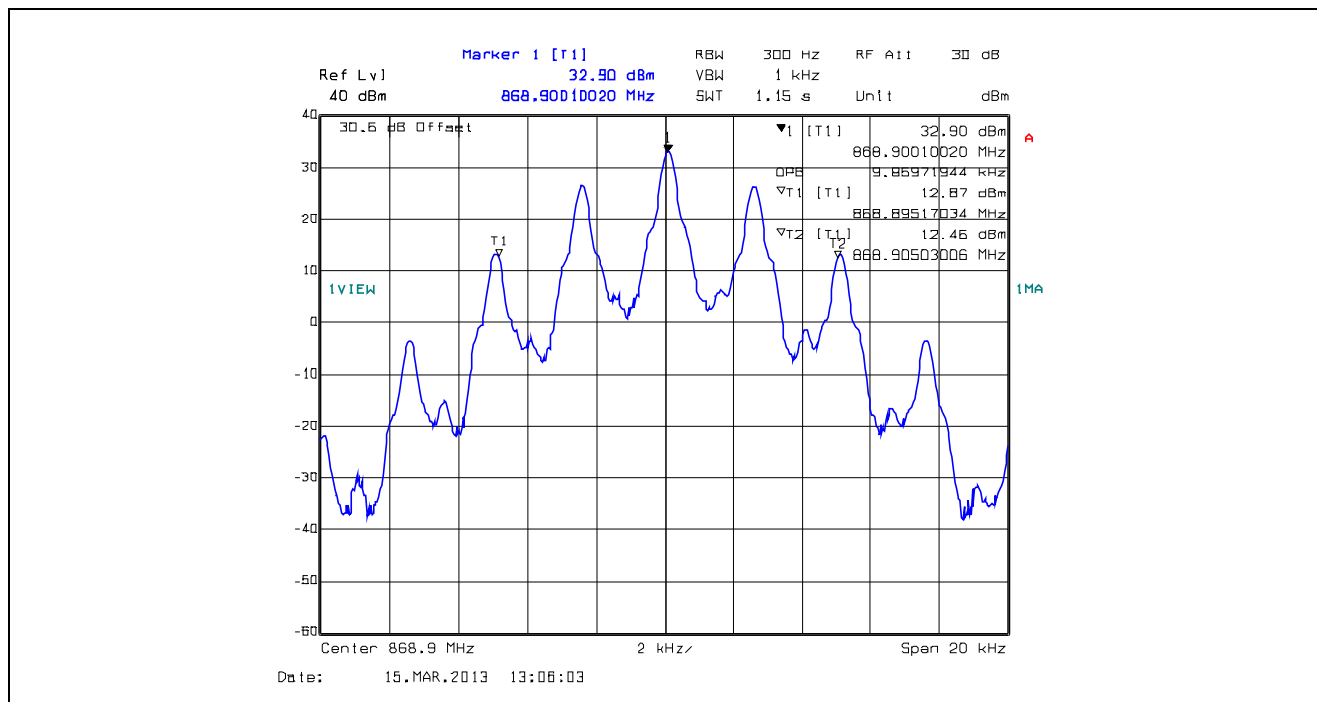
Plot 5.4.4.1.59. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 851.1 MHz



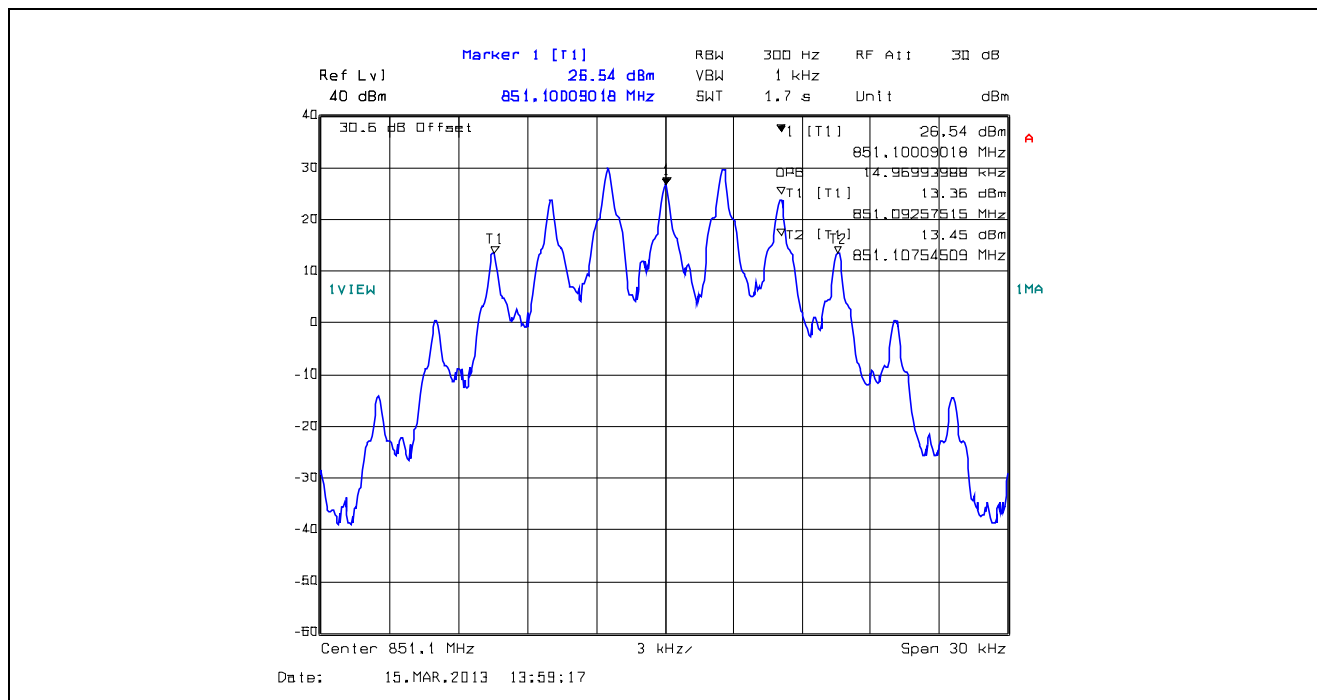
Plot 5.4.4.1.60. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 860.0 MHz



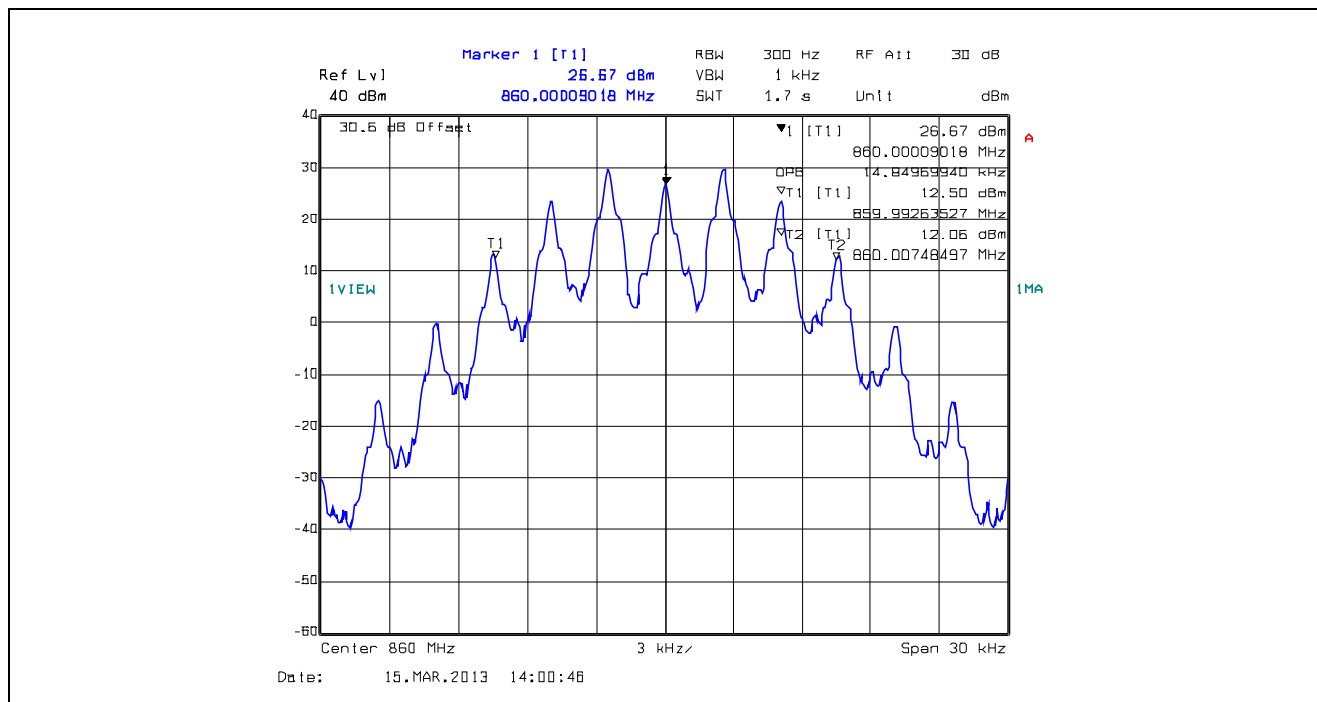
Plot 5.4.4.1.61. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F3E, 868.9 MHz



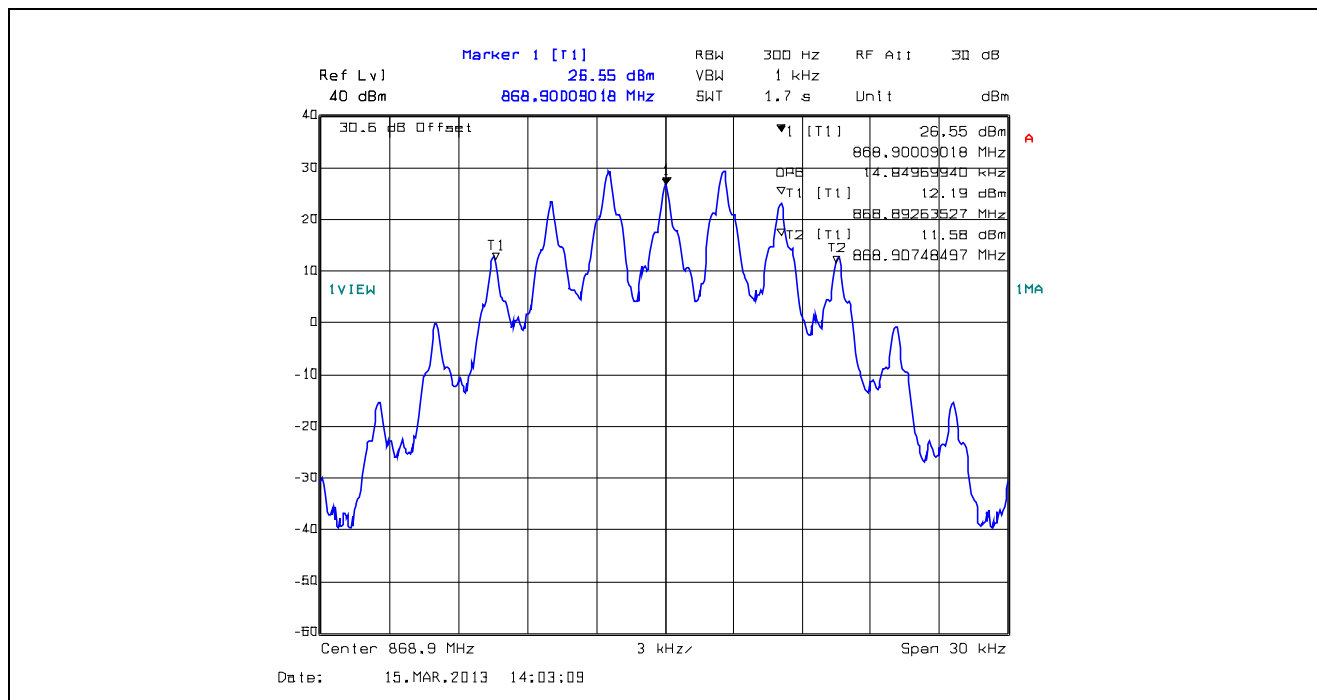
Plot 5.4.4.1.62. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 851.1 MHz



Plot 5.4.4.1.63. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 860.0 MHz



Plot 5.4.4.1.64. 99% Occupied Bandwidth, 25 kHz Channel Spacing, F3E, 868.9 MHz



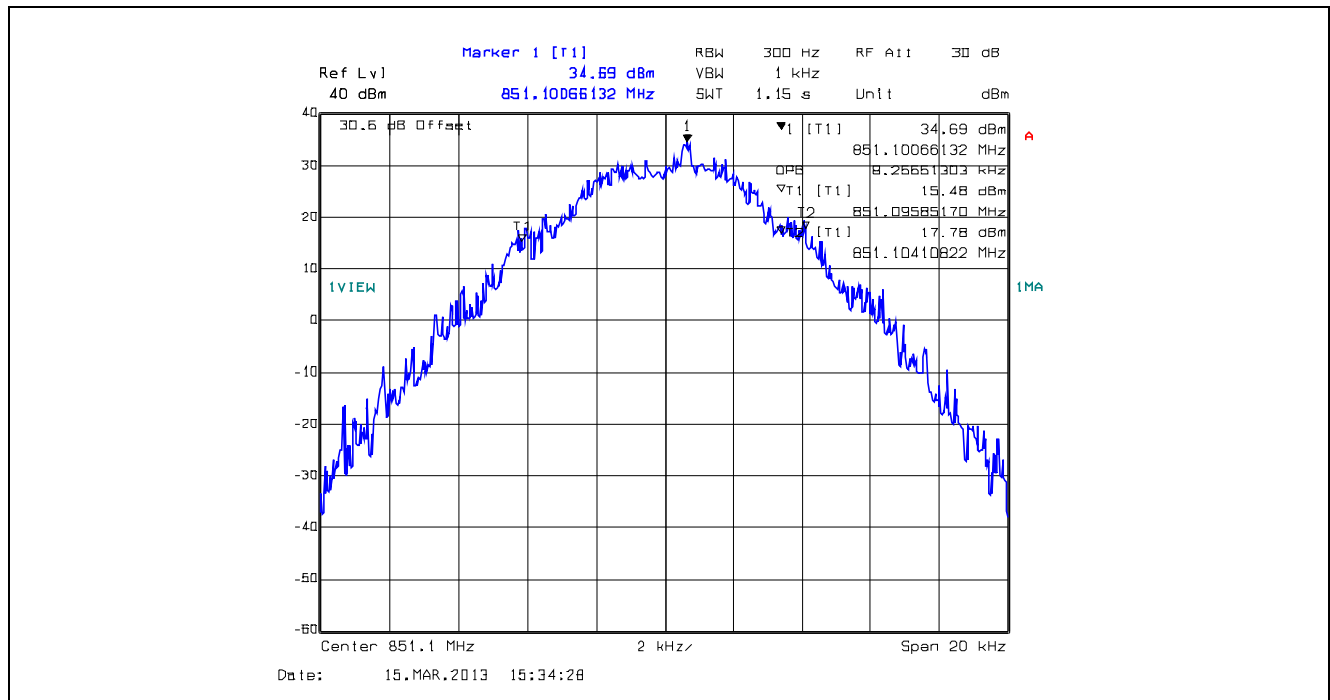
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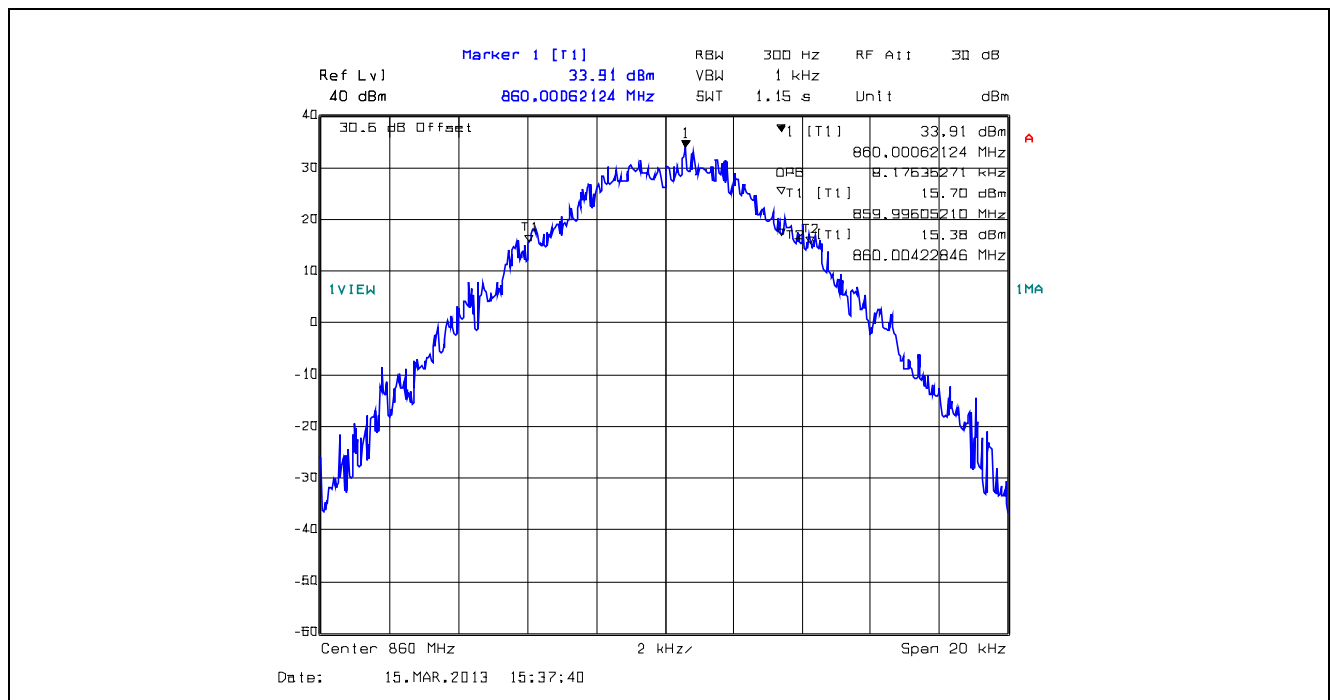
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Plot 5.4.4.1.65. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 851.1 MHz



Plot 5.4.4.1.66. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 860.0 MHz



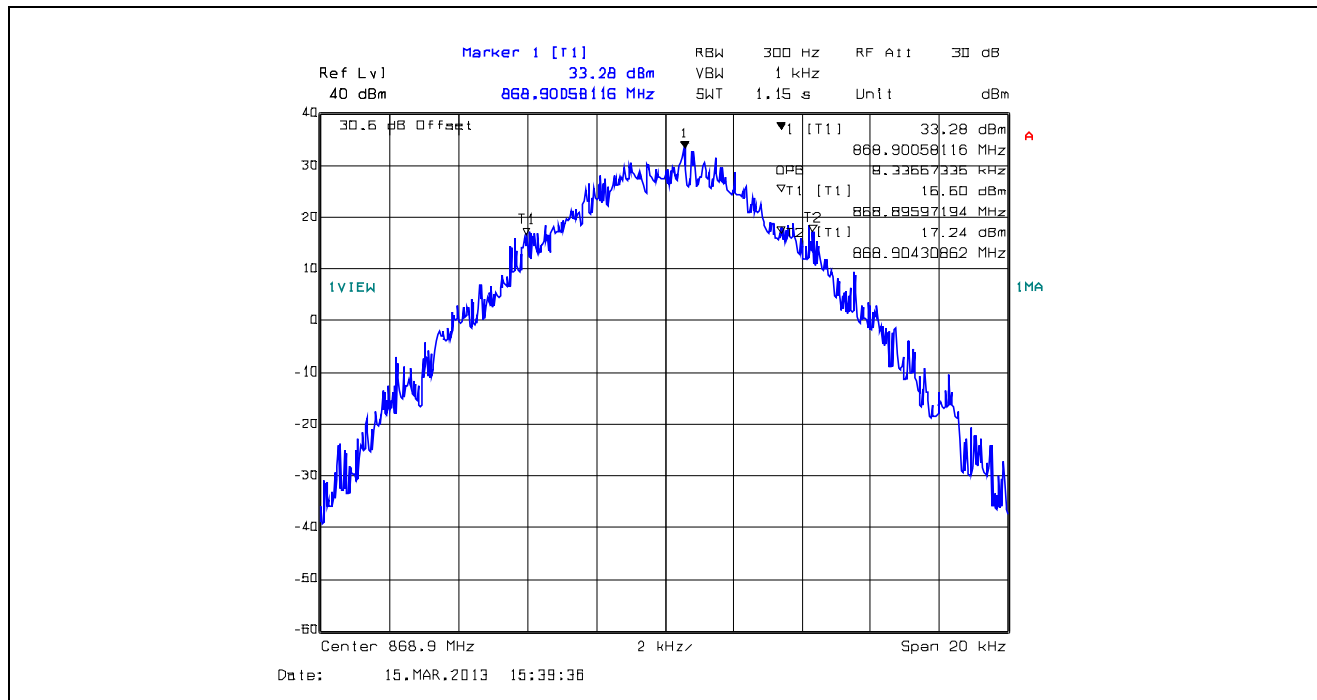
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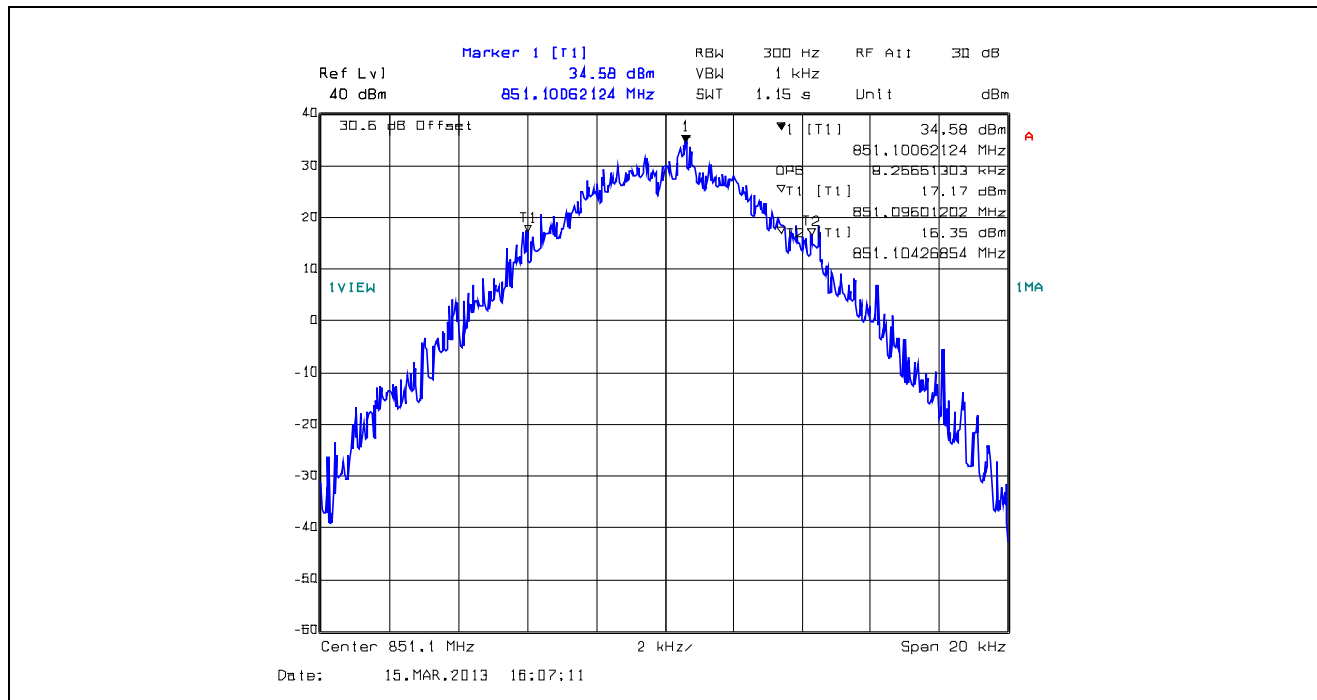
File #: TIL-094F90R01
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Plot 5.4.4.1.67. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1E, 868.9 MHz



Plot 5.4.4.1.68. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 851.1 MHz



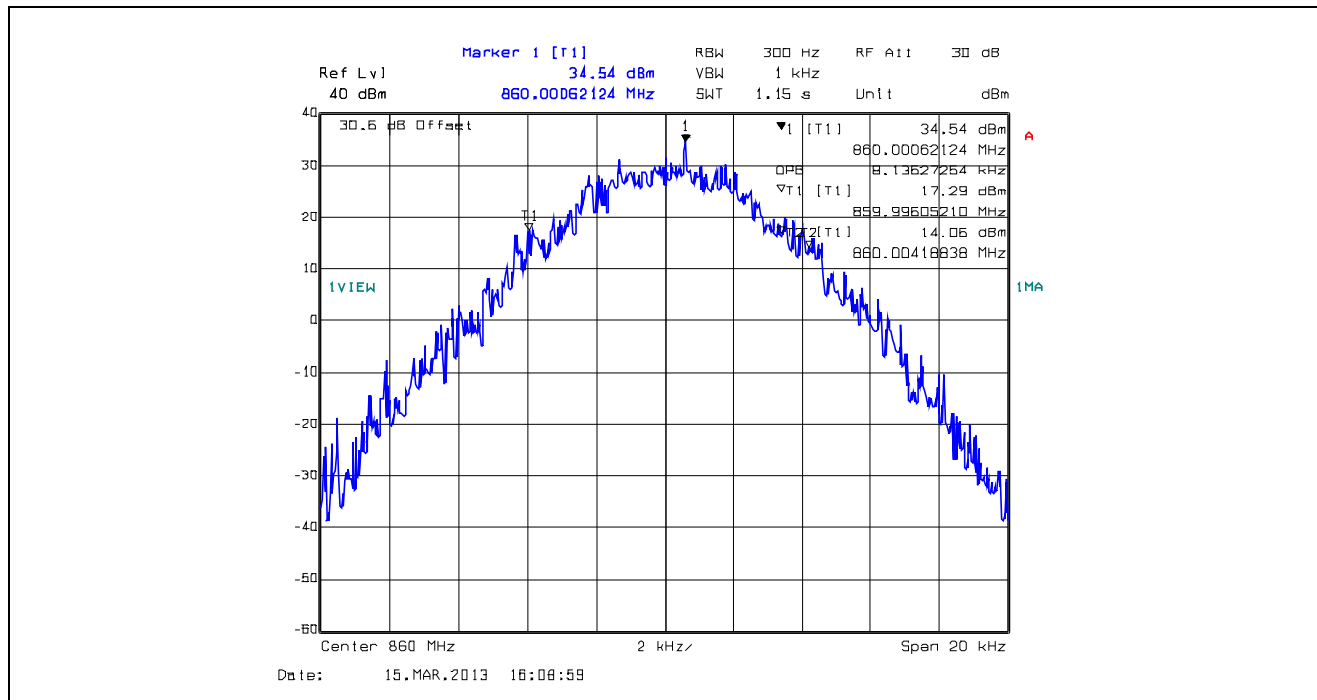
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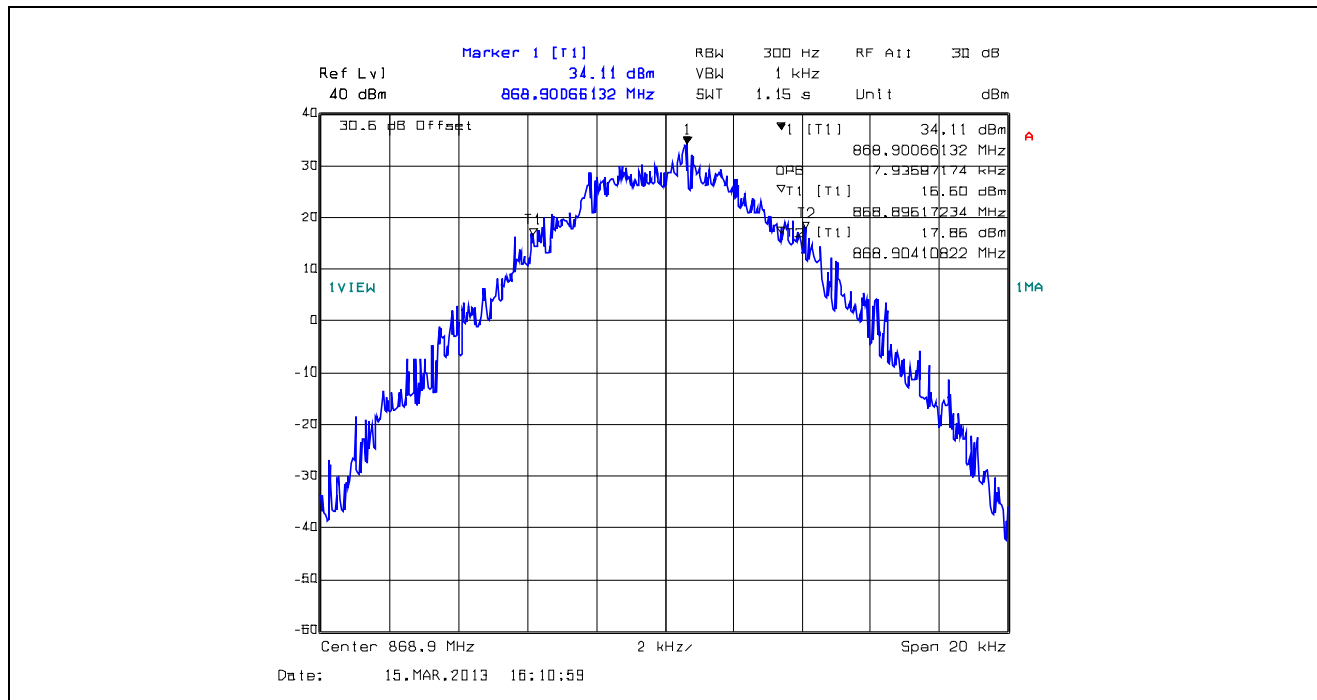
File #: TIL-094F90R01
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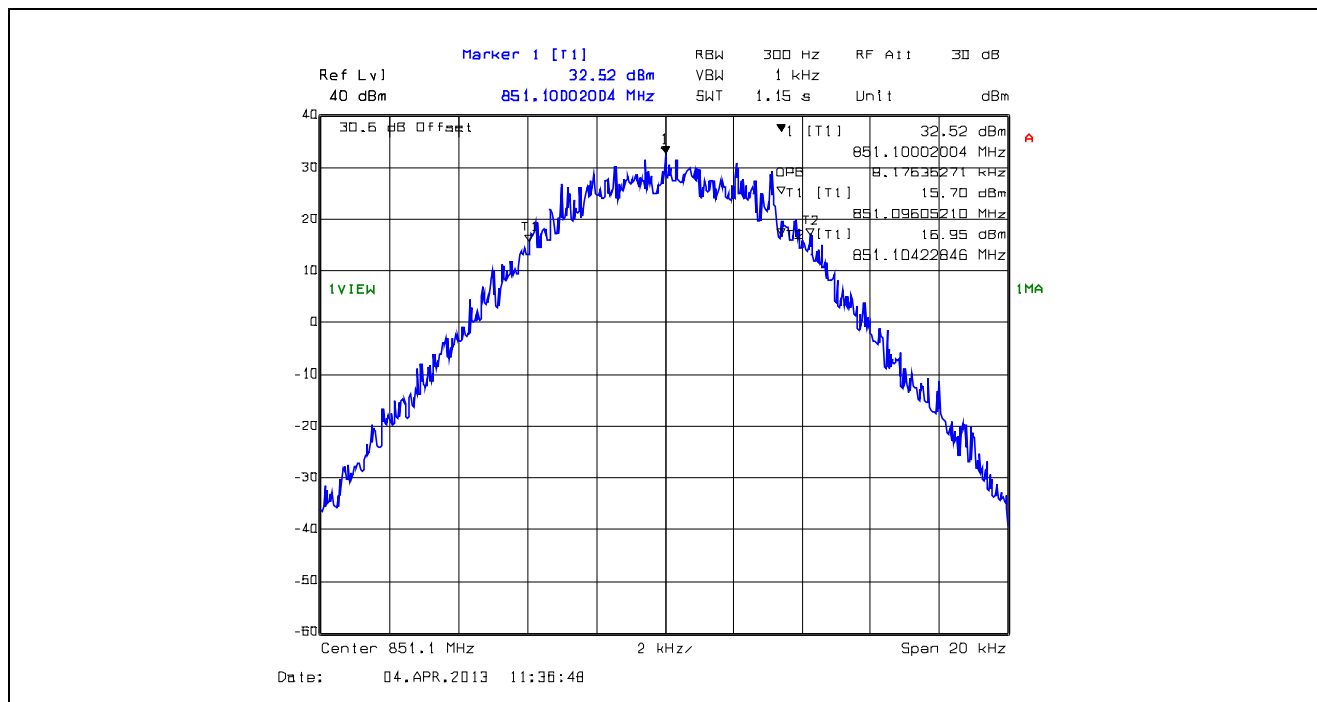
Plot 5.4.4.1.69. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 860.0 MHz



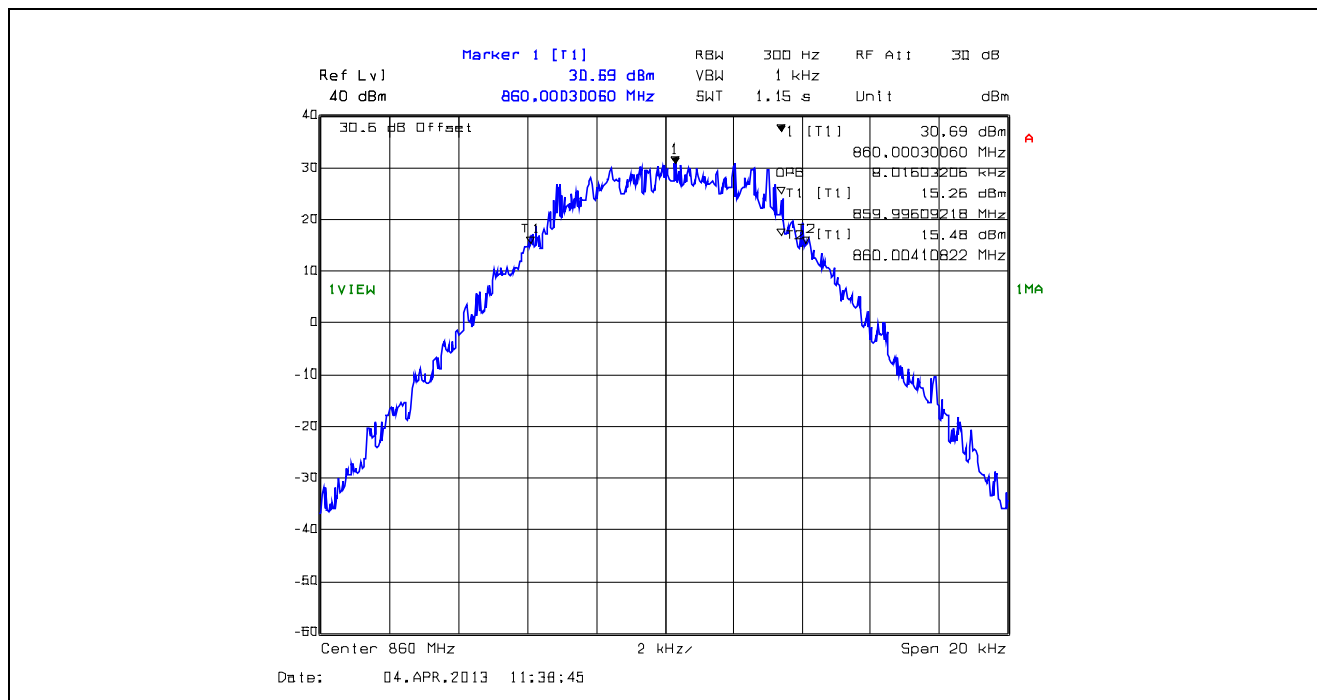
Plot 5.4.4.1.70. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1D, 868.9 MHz



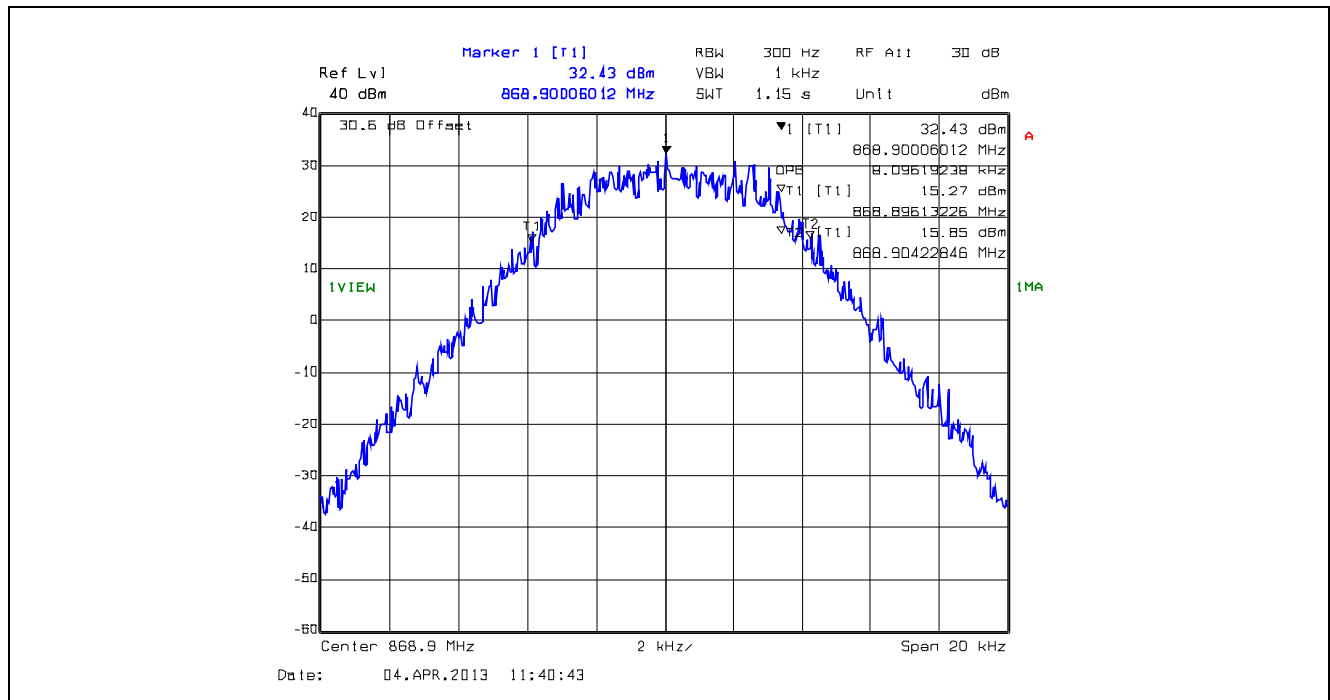
Plot 5.4.4.1.71. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 851.1 MHz



Plot 5.4.4.1.72. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 860.0 MHz



Plot 5.4.4.1.73. 99% Occupied Bandwidth, 12.5 kHz Channel Spacing, F1W, 868.9 MHz



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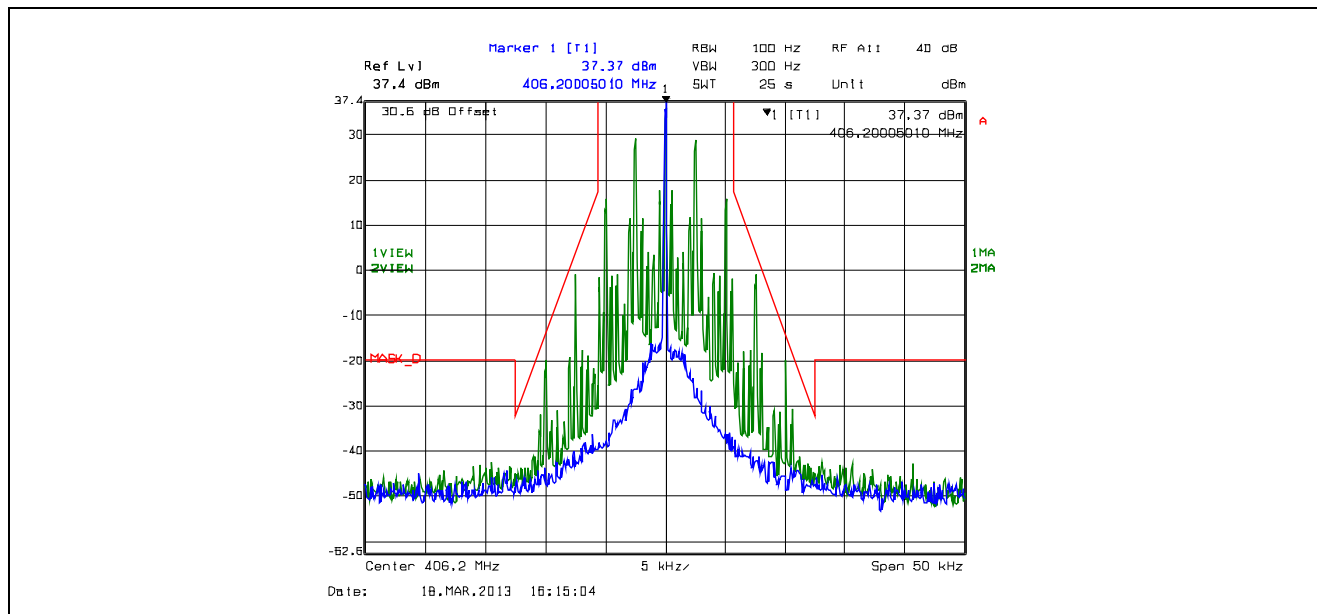
File #: TIL-094F90R01
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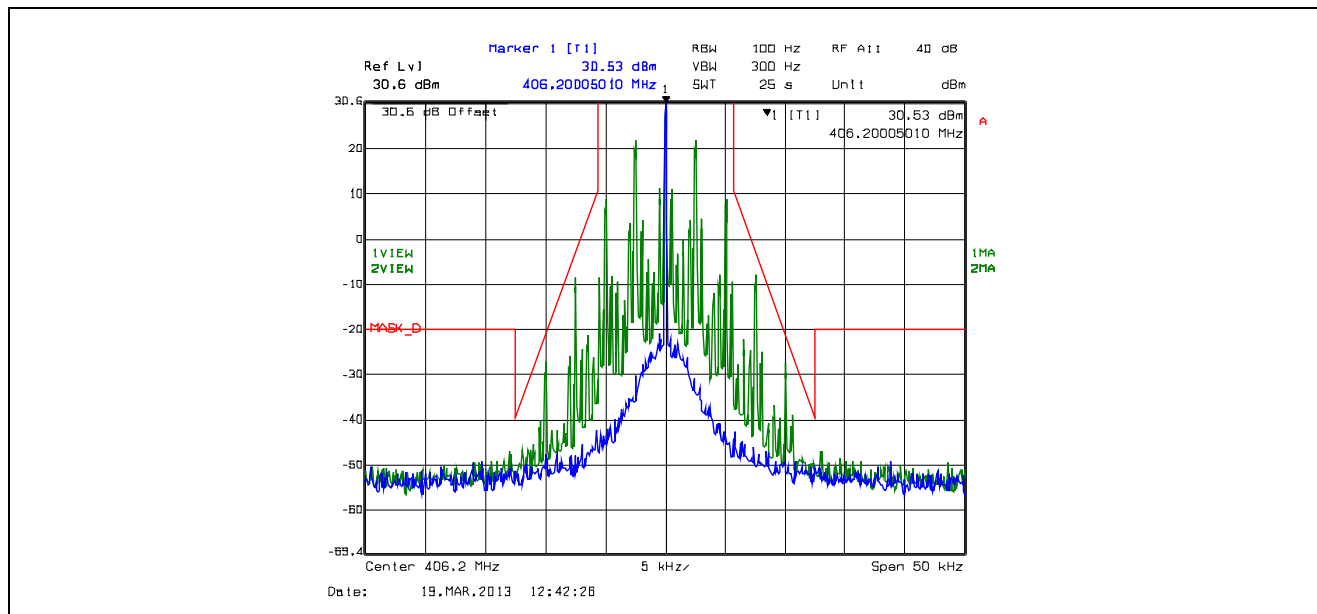
5.4.4.2. Emission Masks

Remark: For 806-809/851-854 MHz and 809-824/854-869 MHz bands, emission mask D was applied for 12.5 kHz channelization and emission mask B was applied 25 kHz channelization.

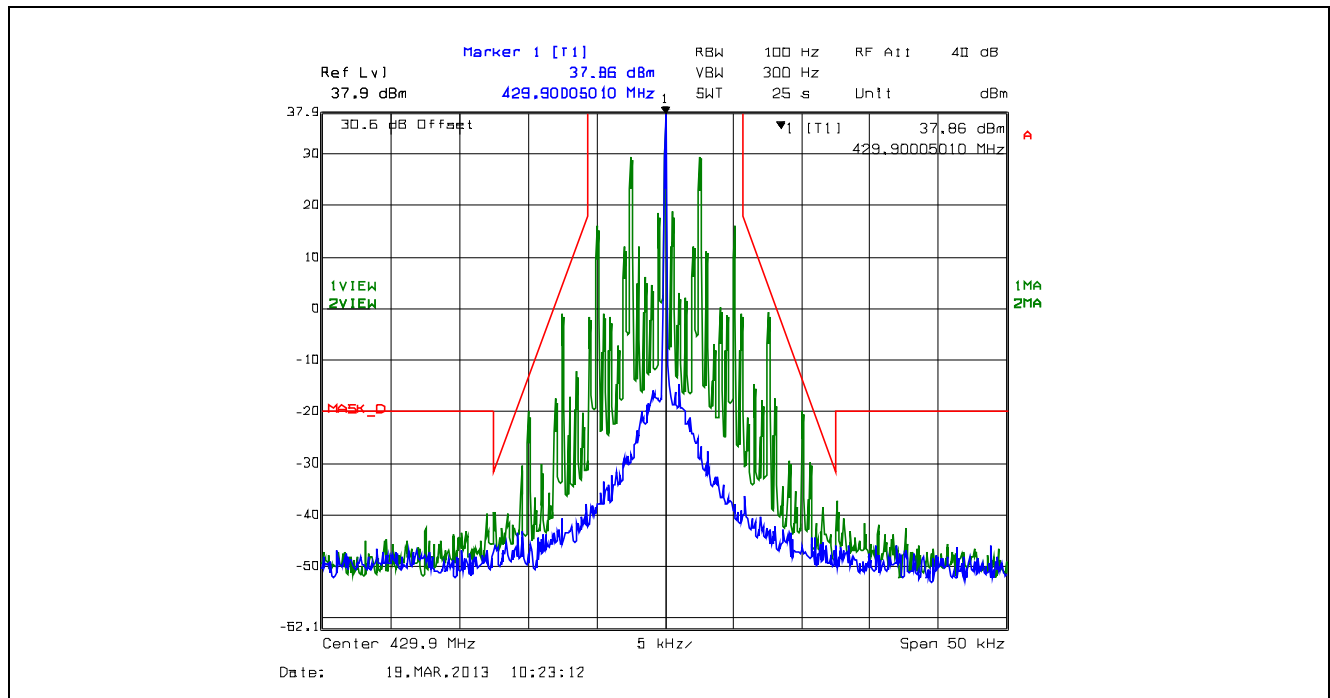
Plot 5.4.4.2.1. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 406.2 MHz



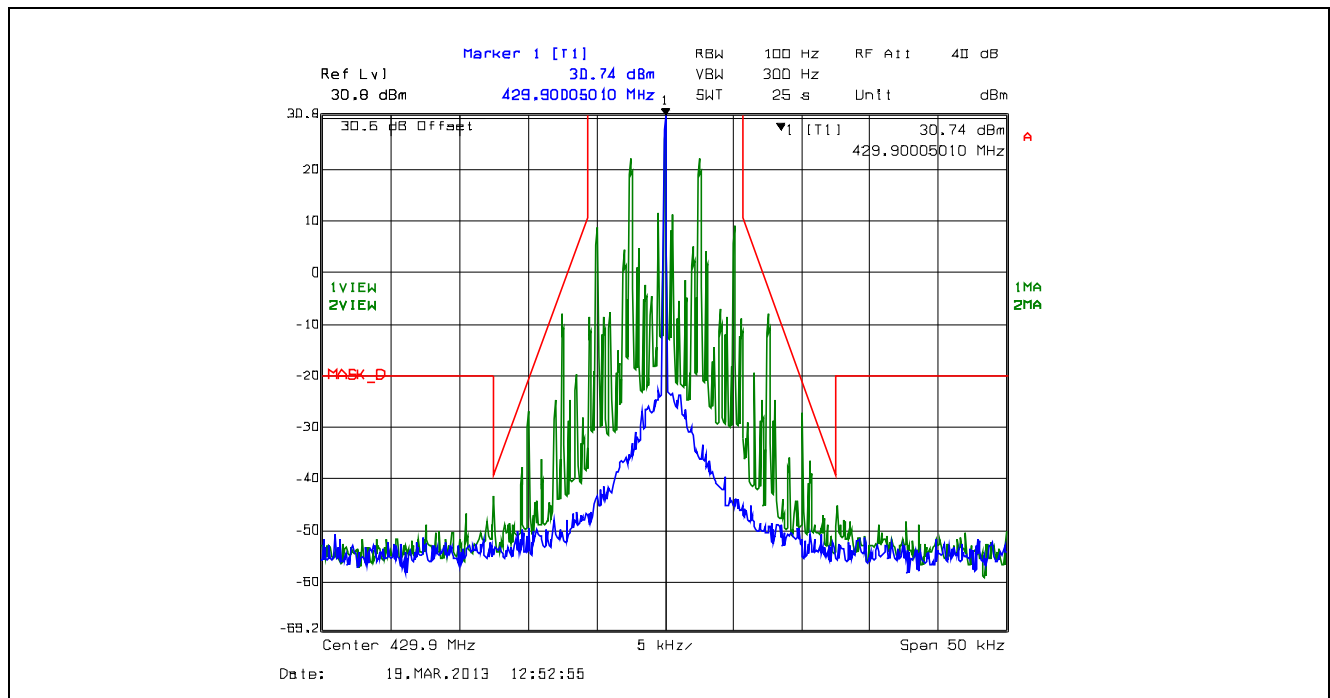
Plot 5.4.4.2.2. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 406.2 MHz



Plot 5.4.4.2.3. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 429.9 MHz



Plot 5.4.4.2.4. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 429.9 MHz



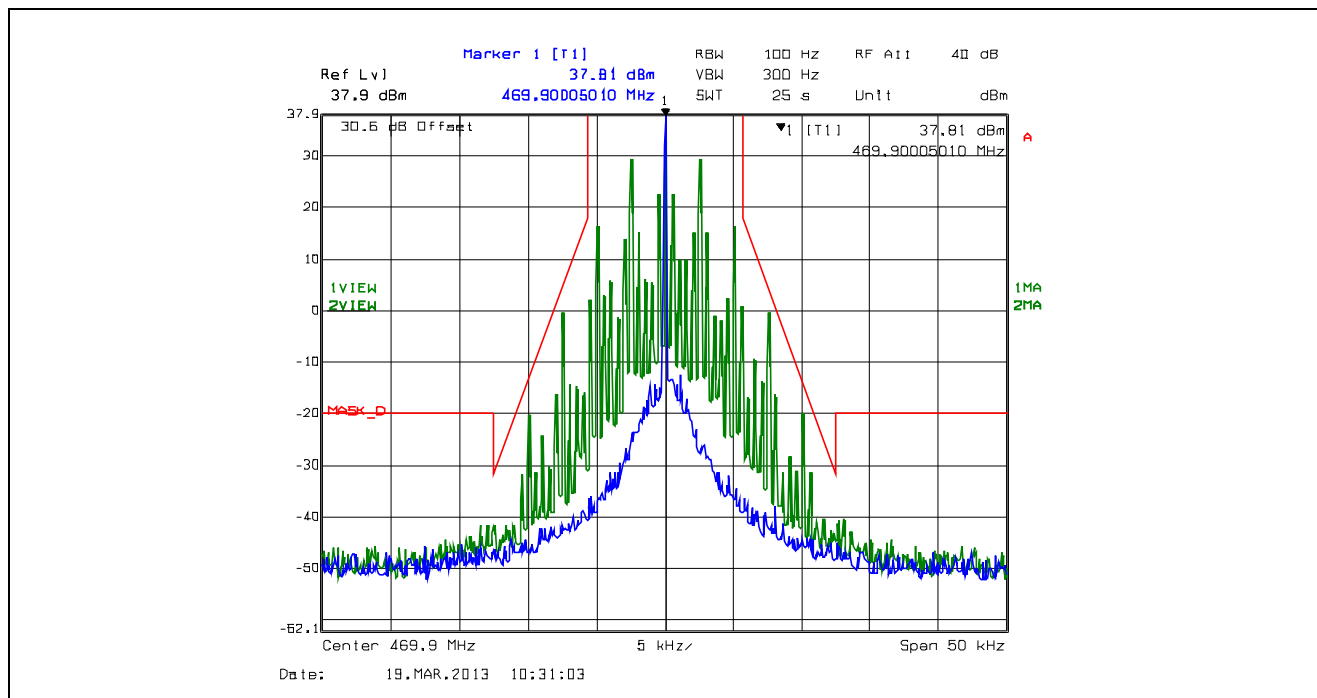
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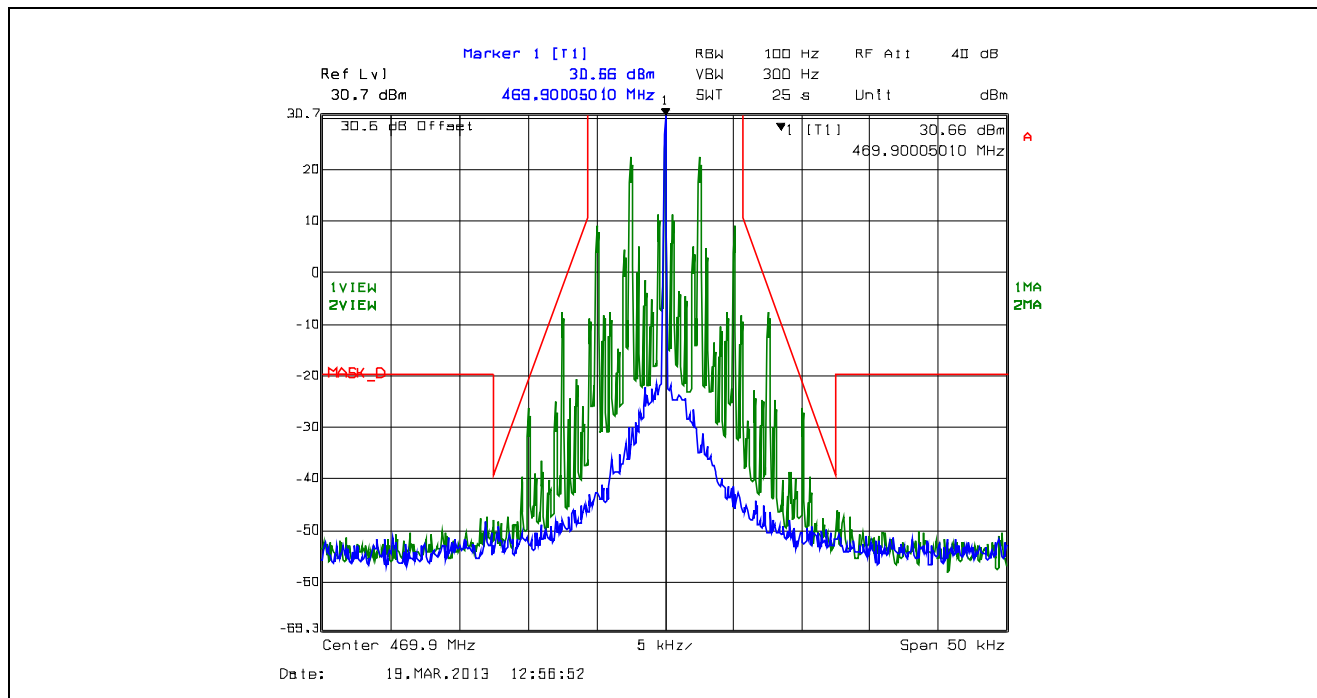
File #: TIL-094F90R01
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Plot 5.4.4.2.5. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 469.9 MHz



Plot 5.4.4.2.6. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 469.9 MHz



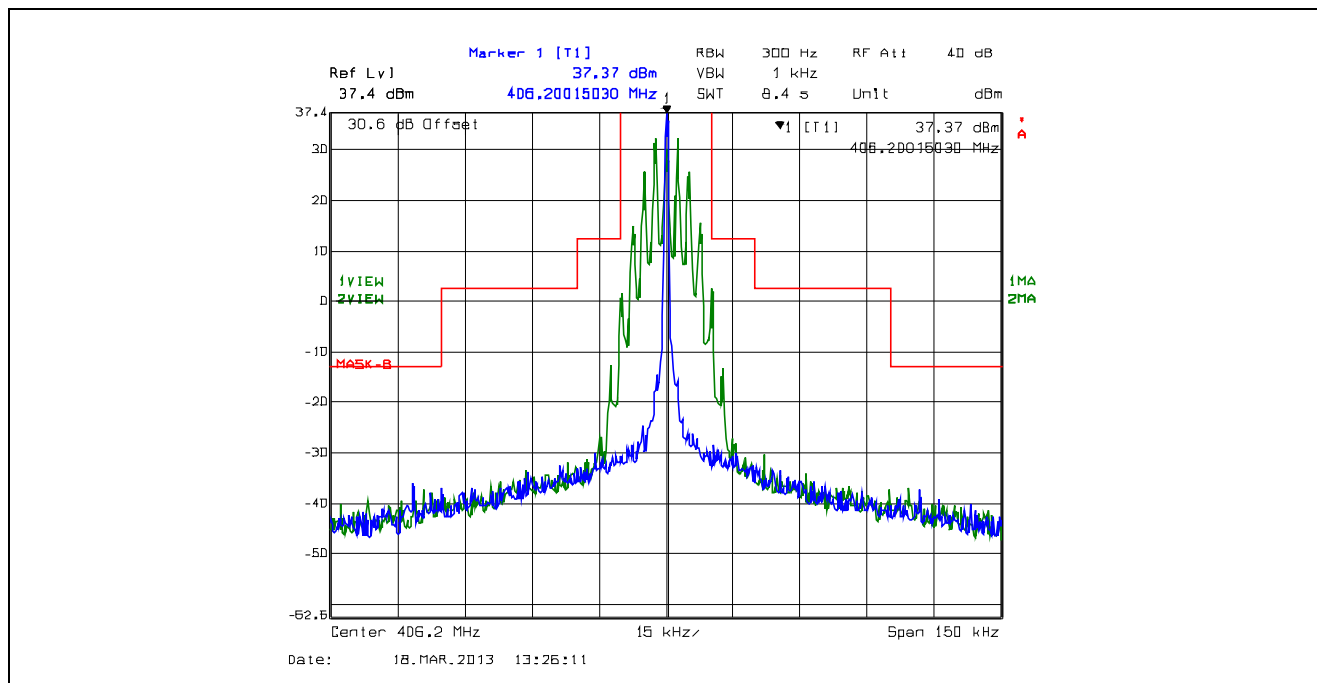
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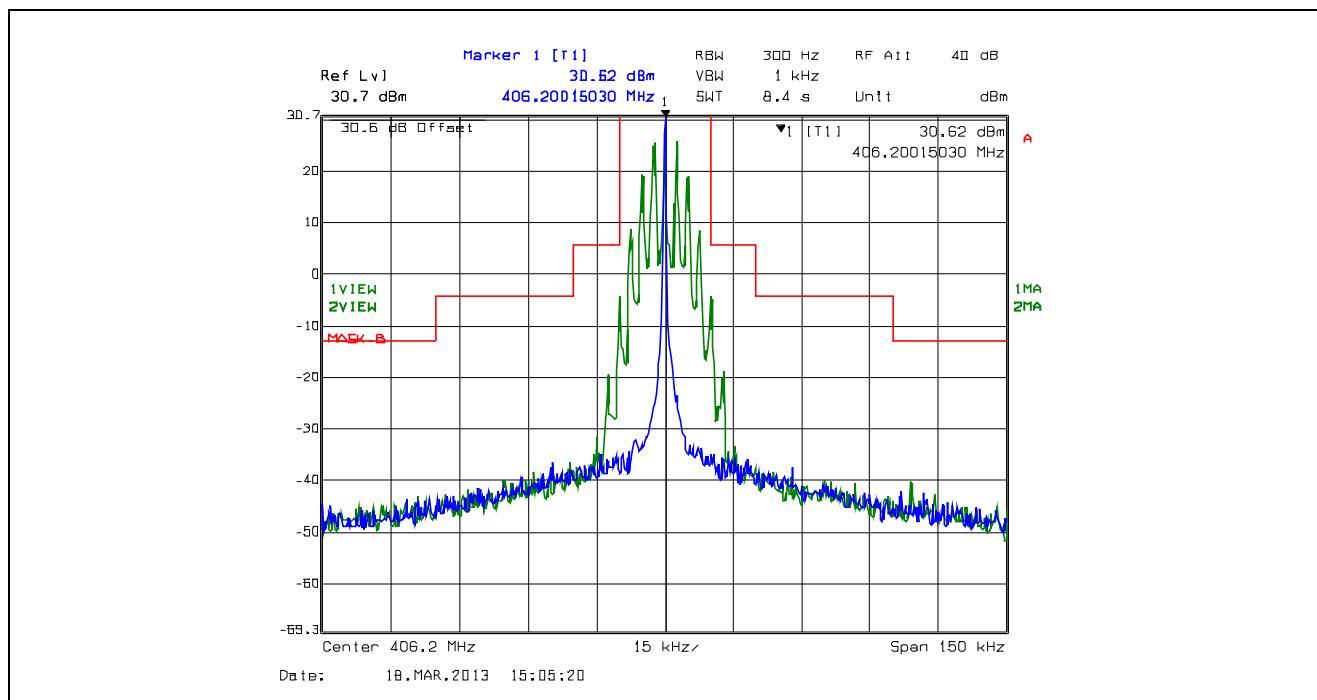
File #: TIL-094F90R01
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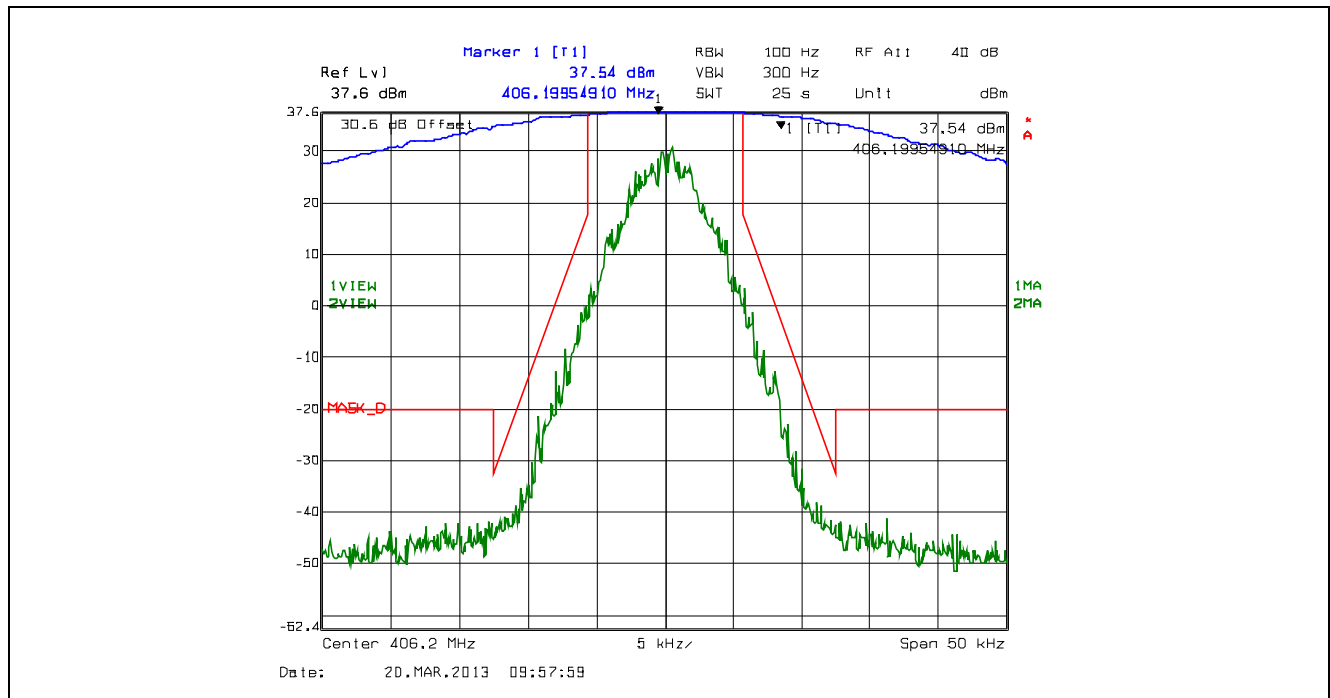
Plot 5.4.4.2.7. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 406.2 MHz



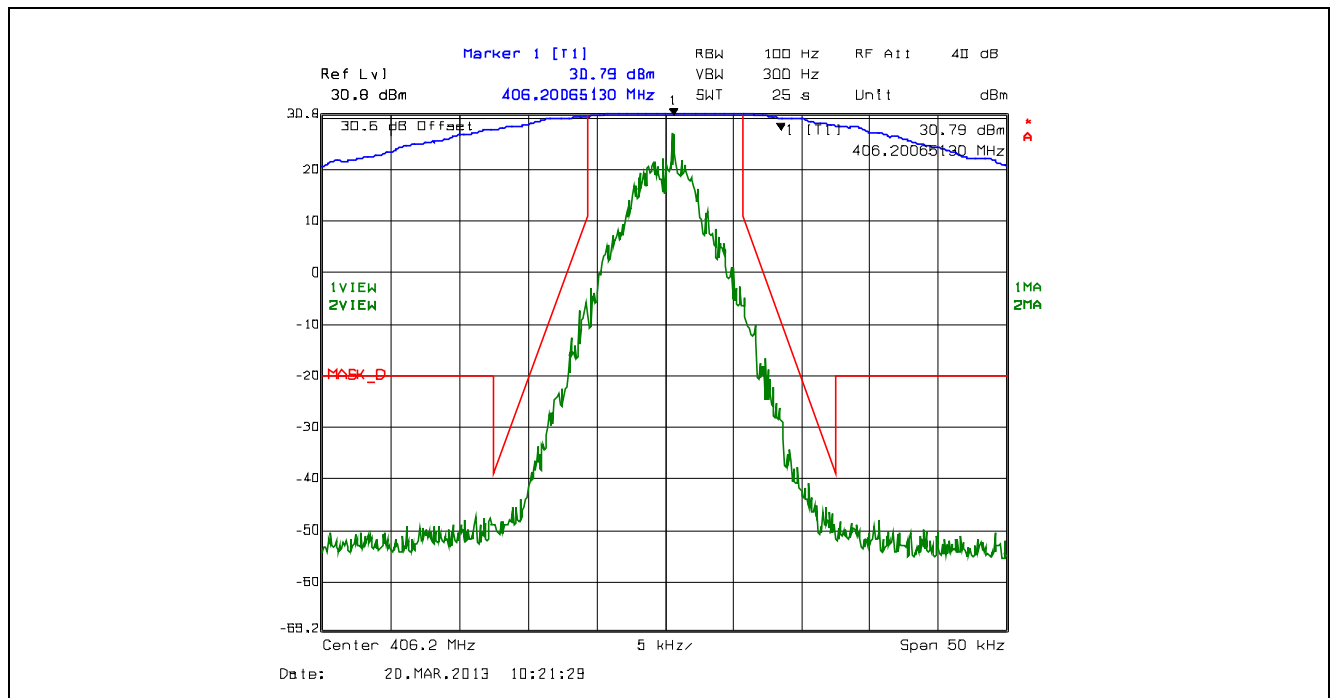
Plot 5.4.4.2.8. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 406.2 MHz



Plot 5.4.4.2.9. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 406.2 MHz



Plot 5.4.4.2.10. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 406.2 MHz



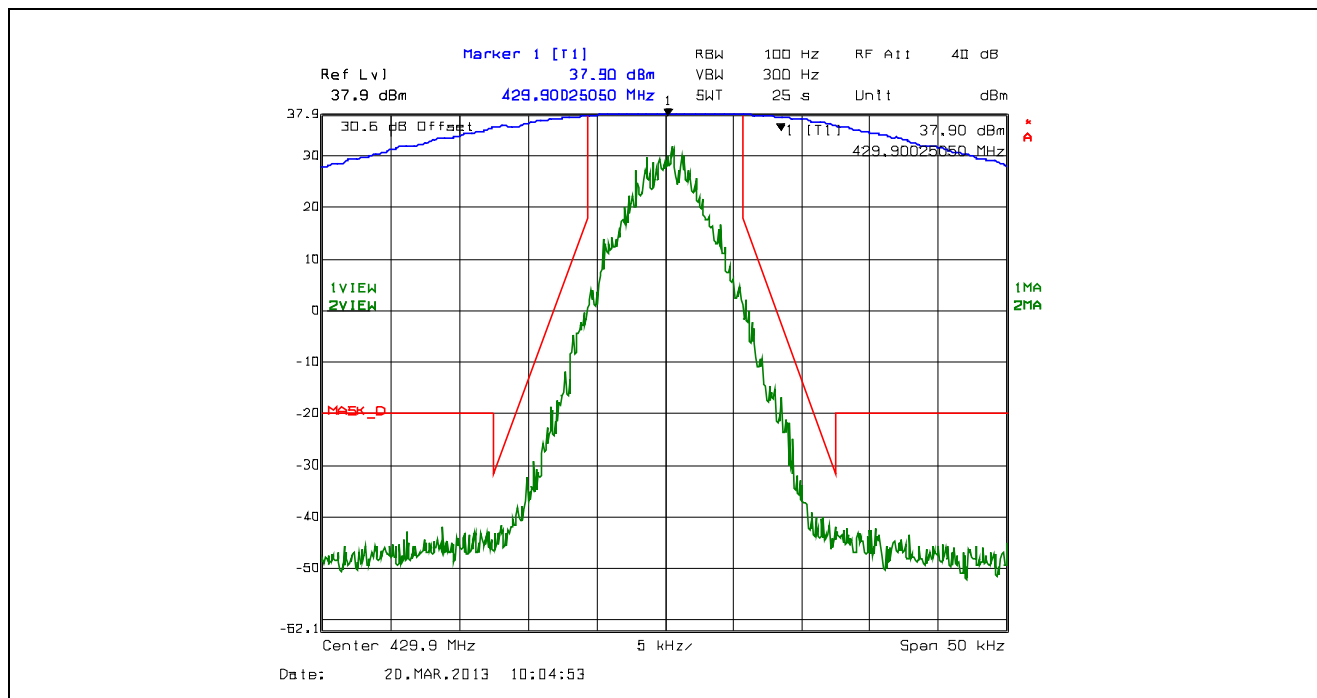
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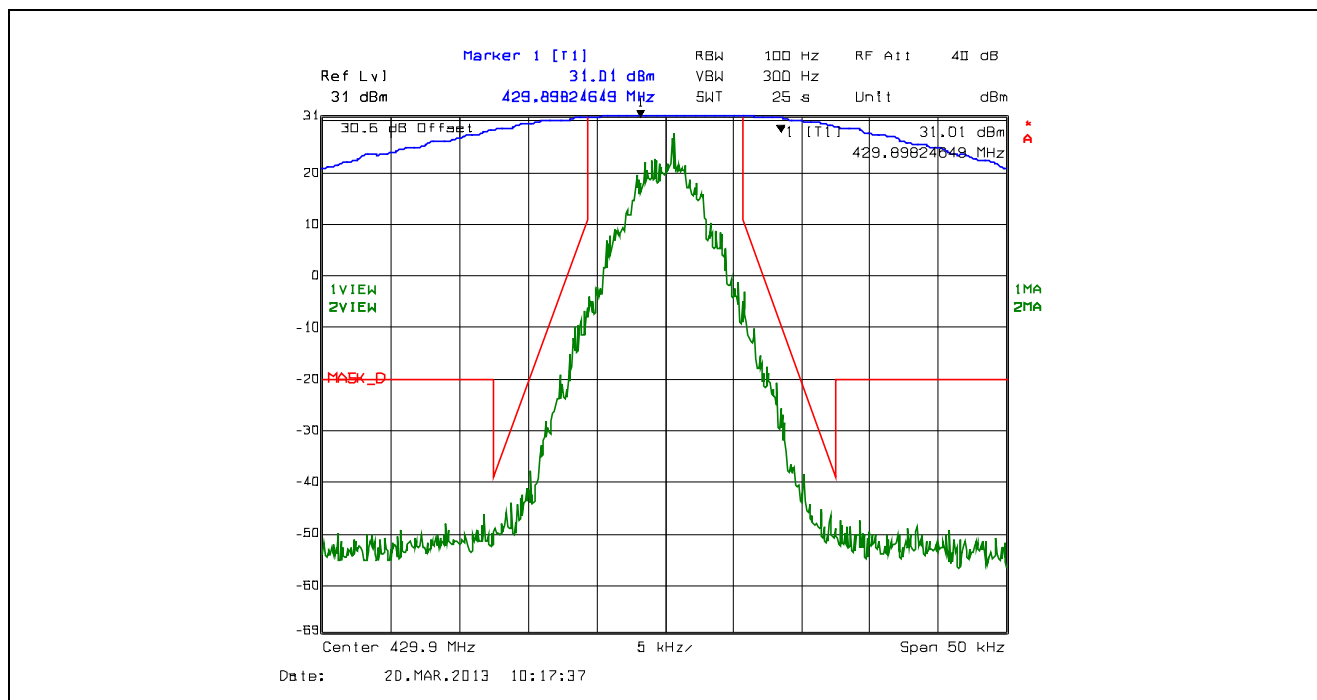
File #: TIL-094F90R01
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Plot 5.4.4.2.11. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 429.9 MHz



Plot 5.4.4.2.12. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 429.9 MHz



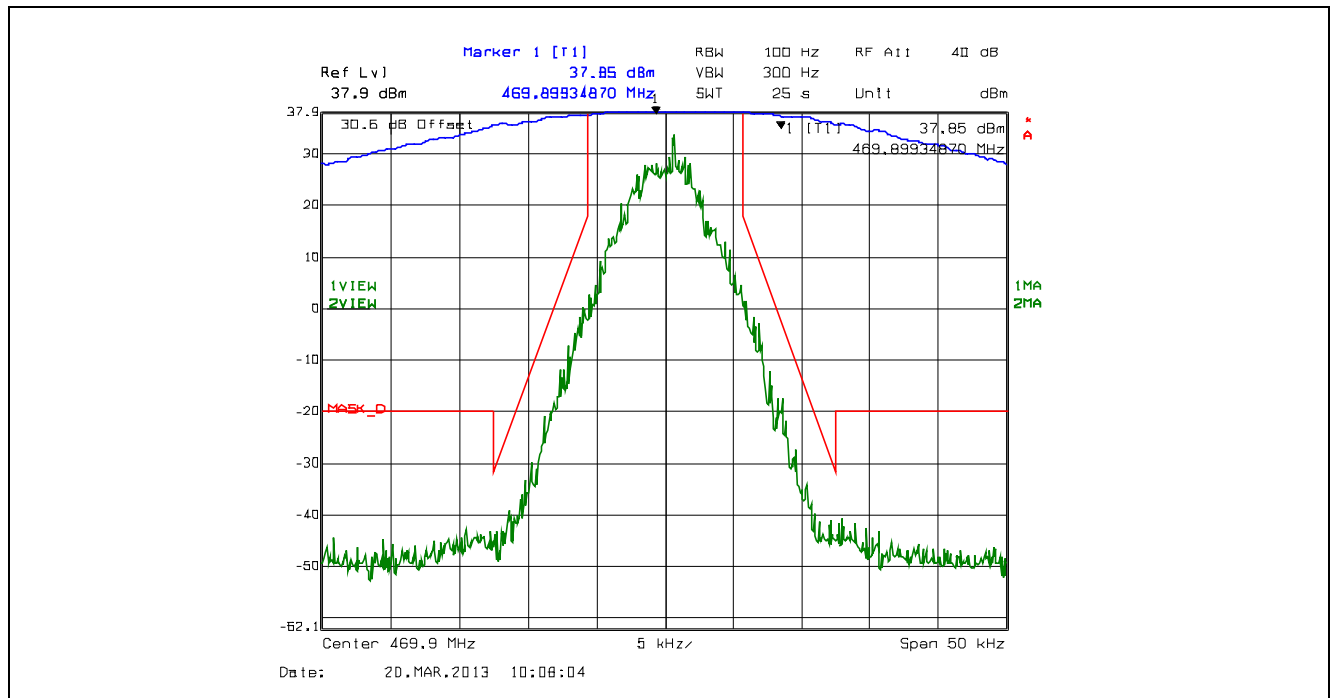
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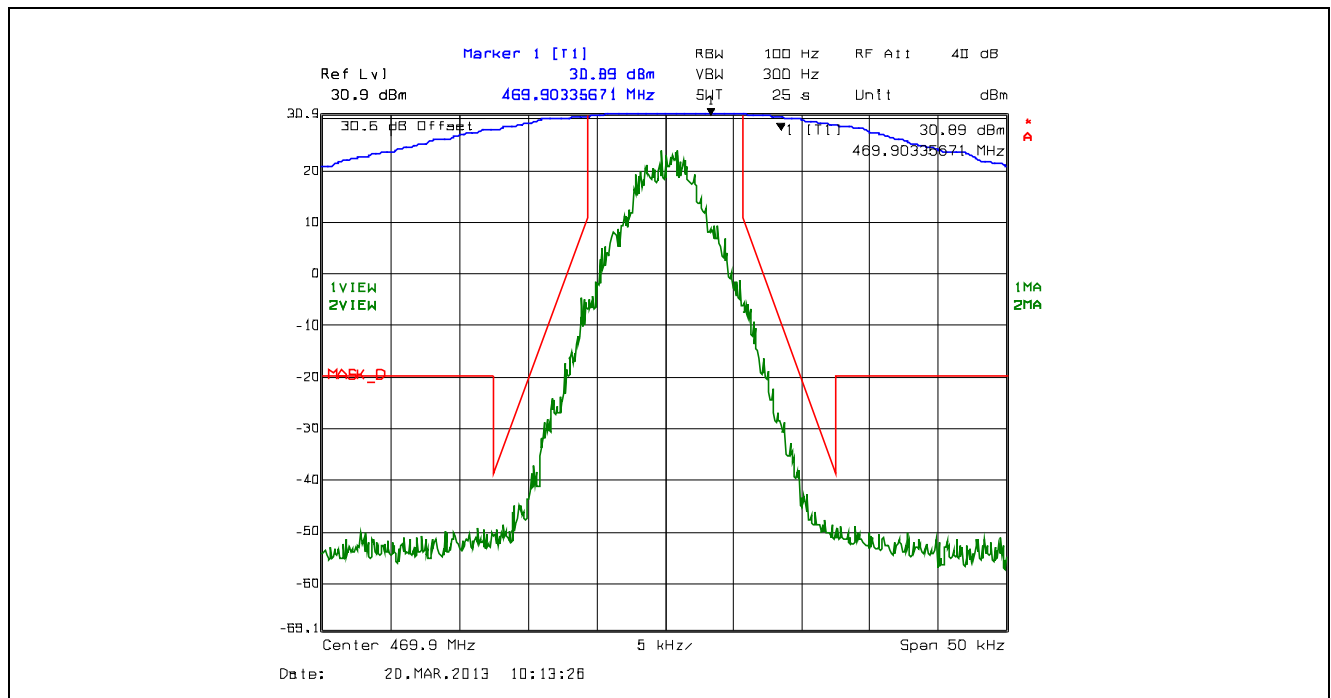
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.4.4.2.13. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 469.9 MHz



Plot 5.4.4.2.14. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 469.9 MHz



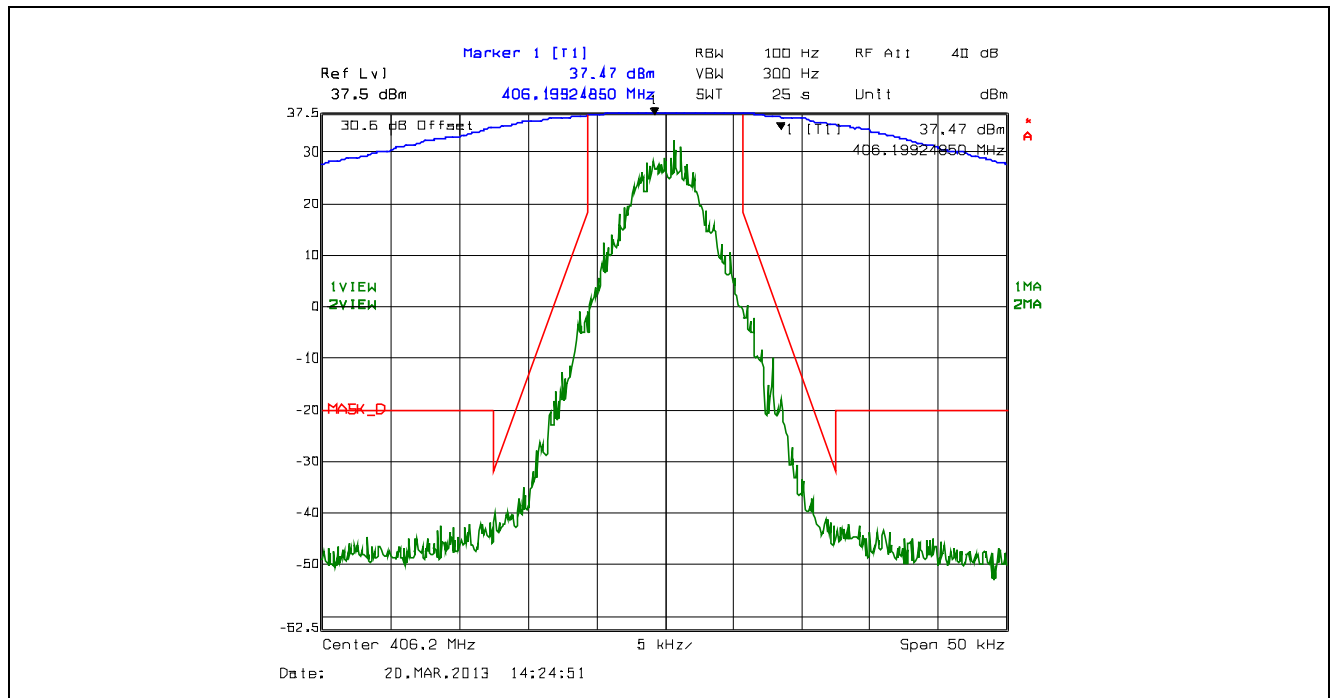
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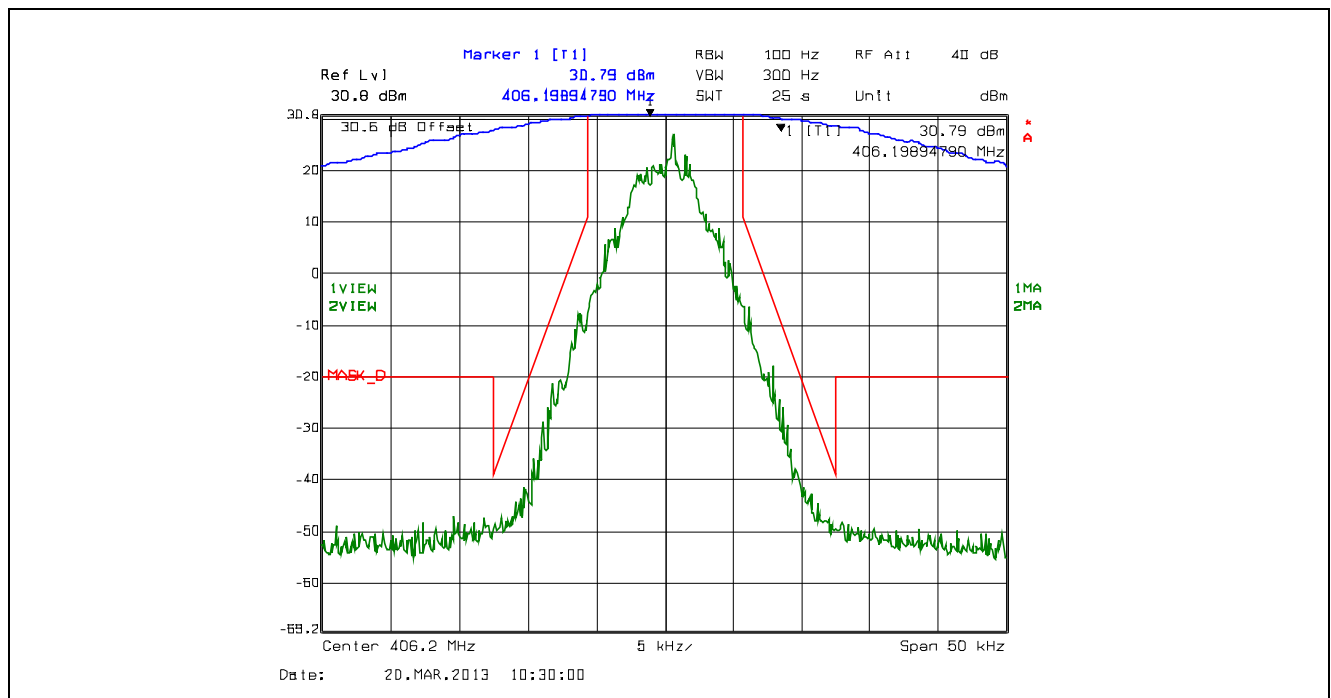
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

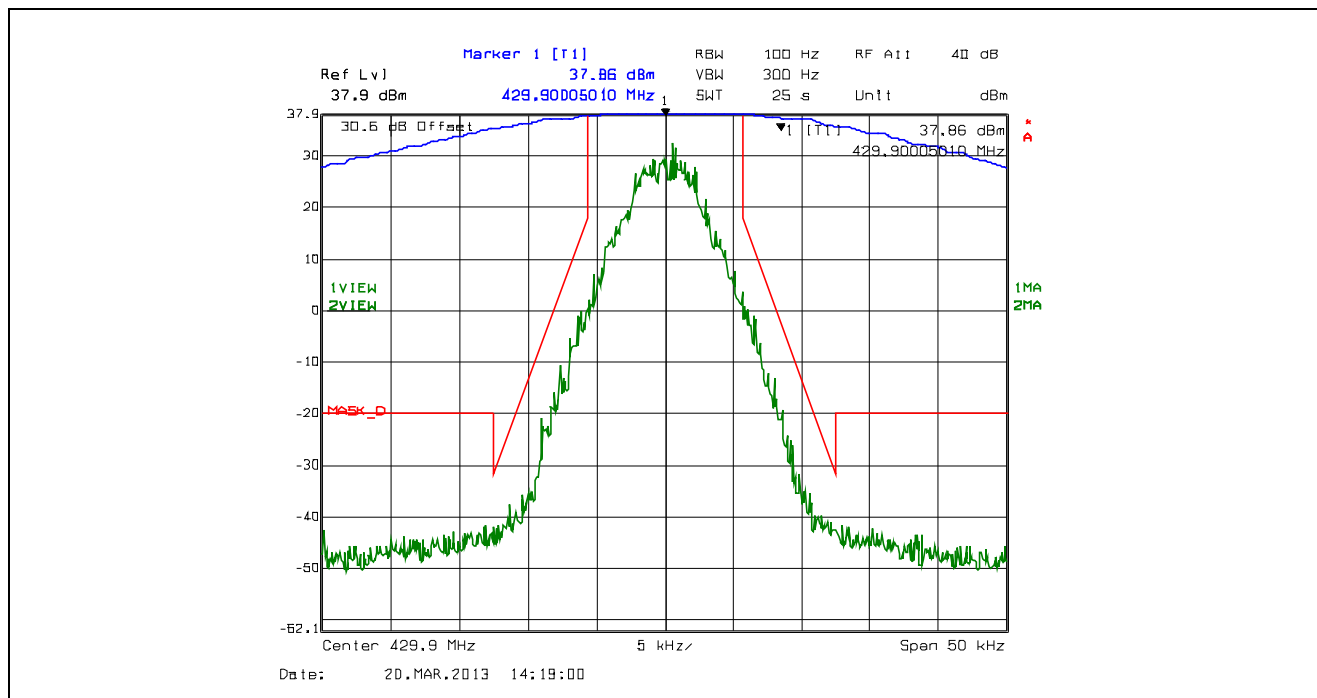
Plot 5.4.4.2.15. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 406.2 MHz



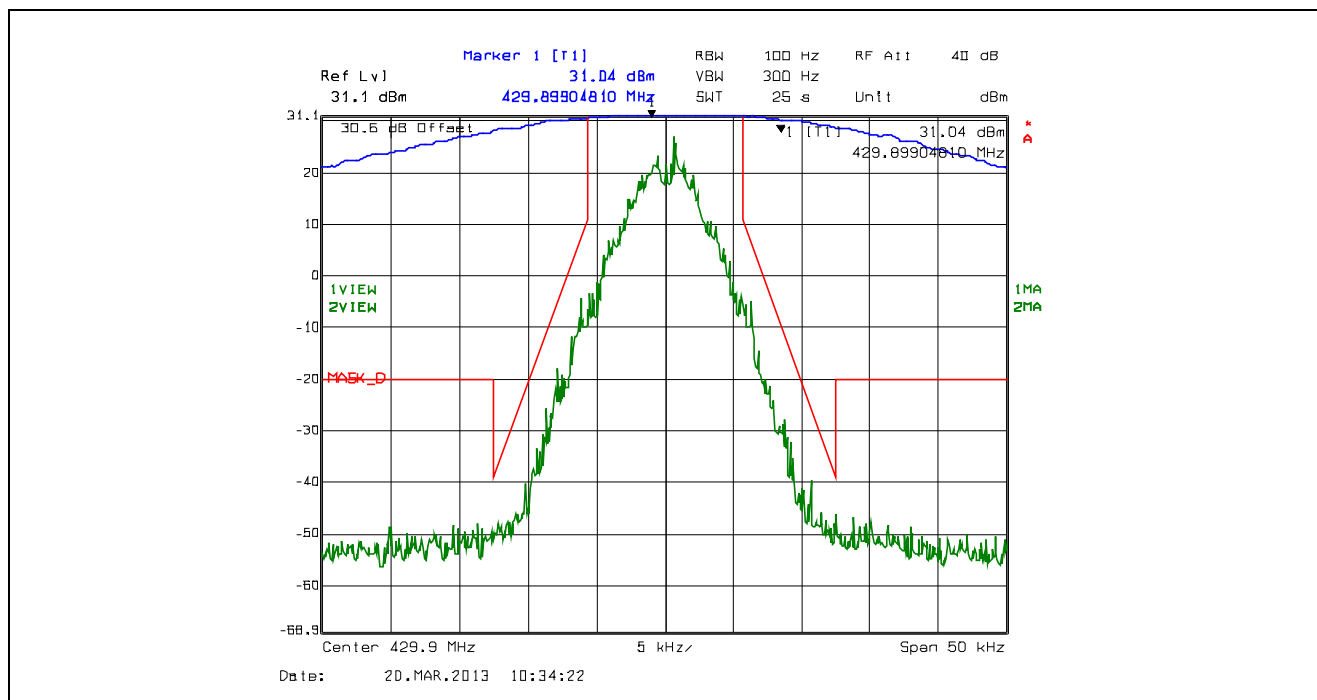
Plot 5.4.4.2.16. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 406.2 MHz



Plot 5.4.4.2.17. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 429.9 MHz



Plot 5.4.4.2.18. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 429.9 MHz



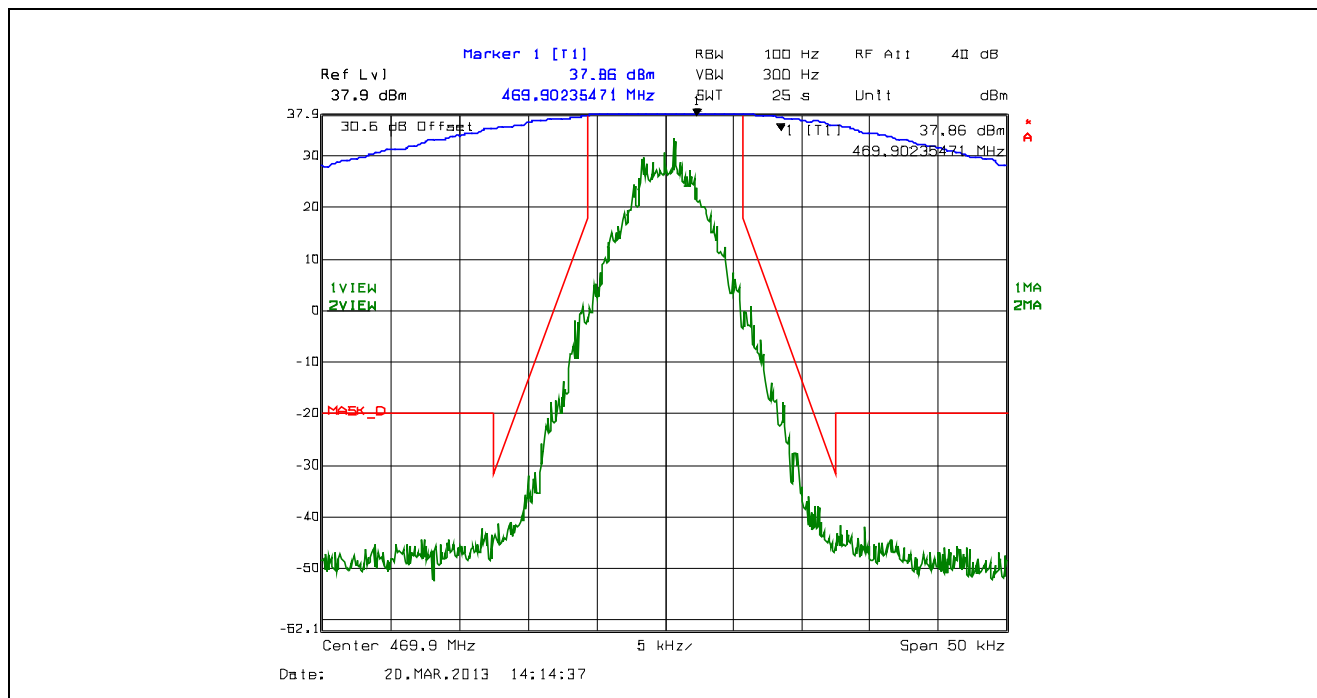
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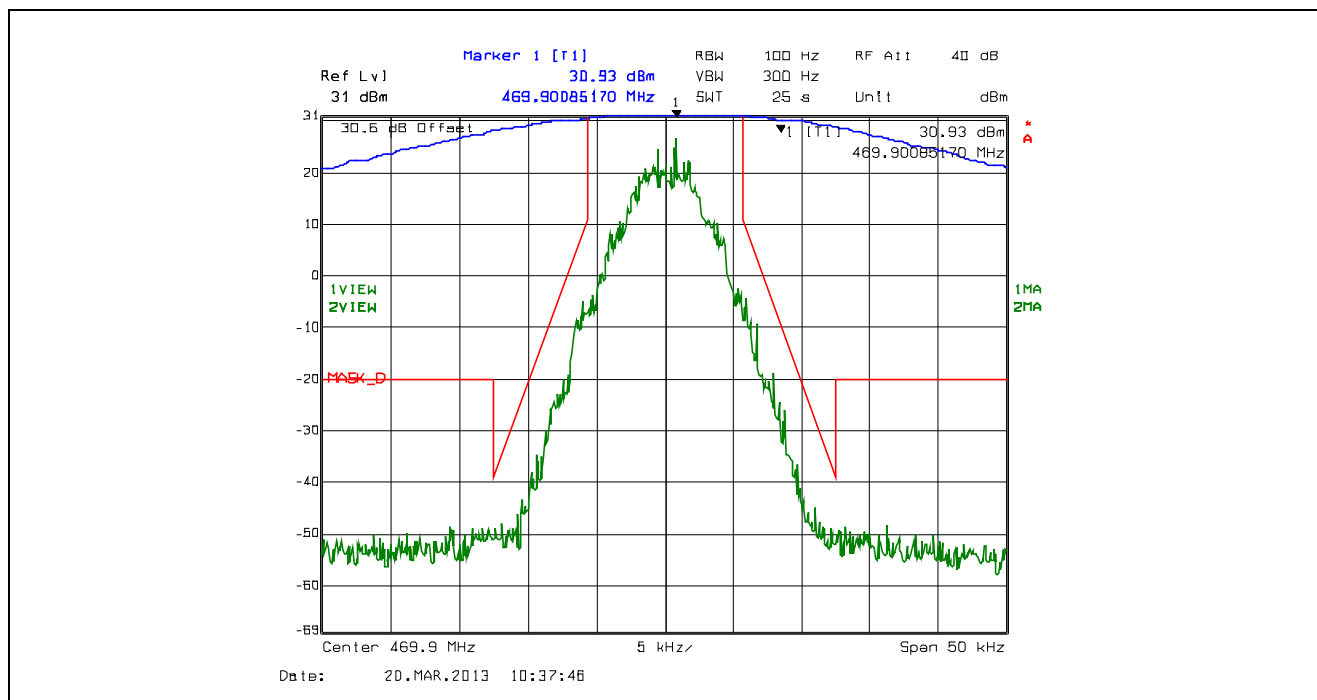
File #: TIL-094F90R01
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Plot 5.4.4.2.19. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 469.9 MHz



Plot 5.4.4.2.20. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 469.9 MHz



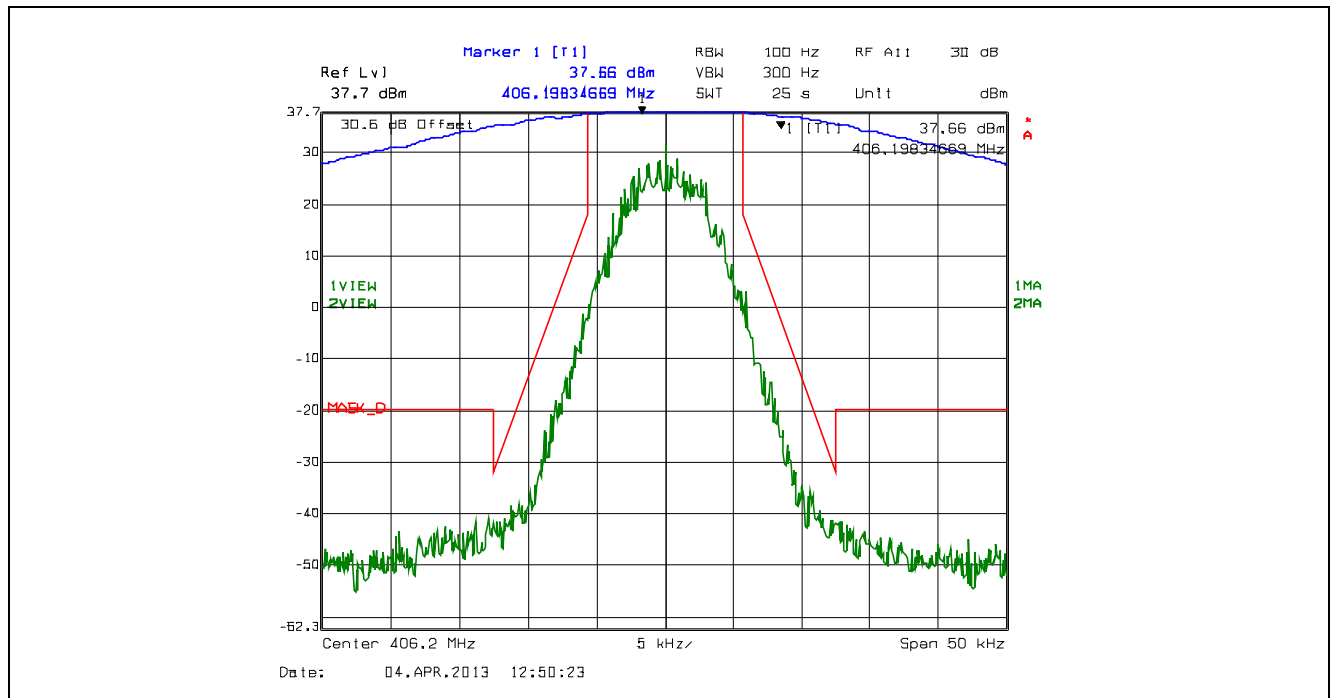
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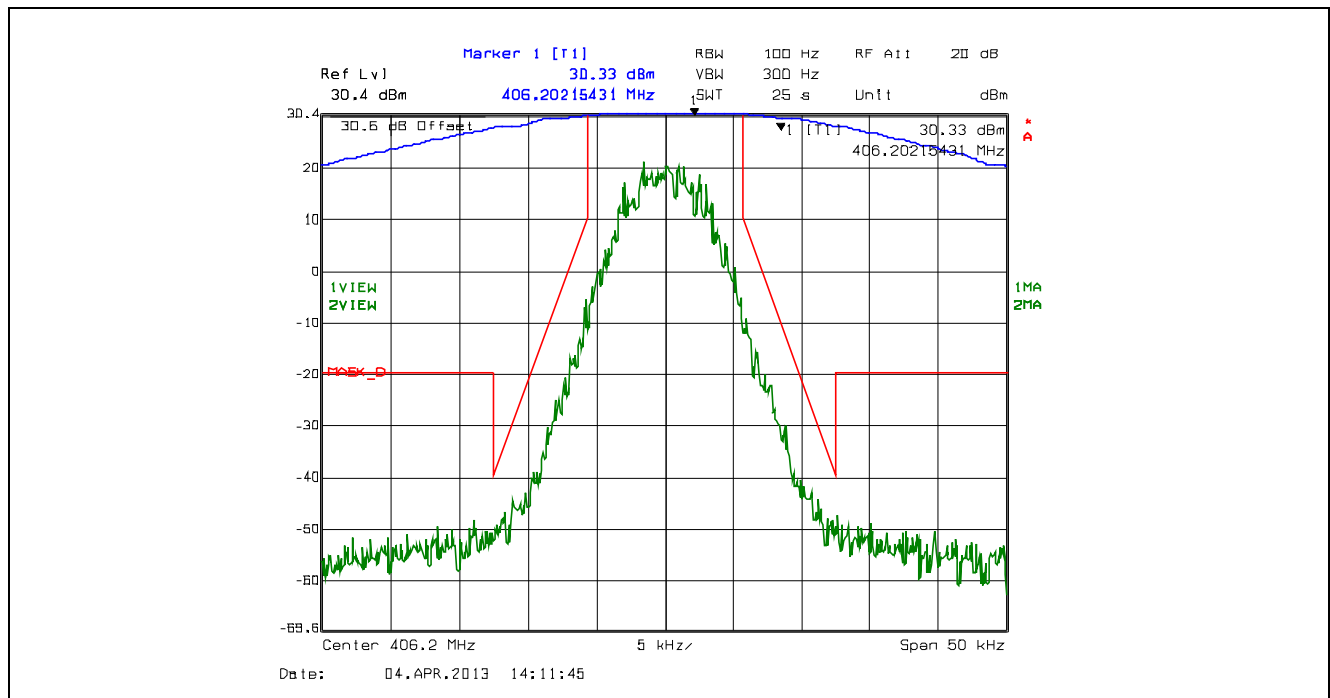
File #: TIL-094F90R01
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Plot 5.4.4.2.21. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 406.2 MHz



Plot 5.4.4.2.22. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 406.2 MHz



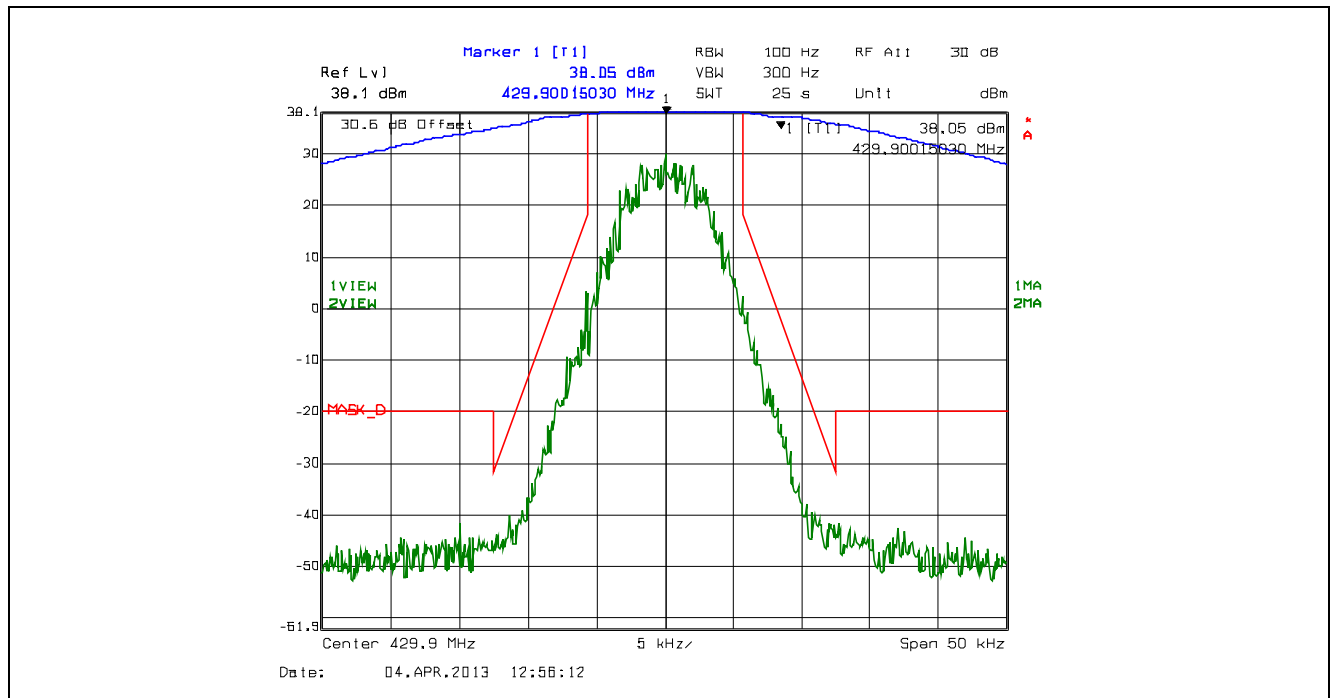
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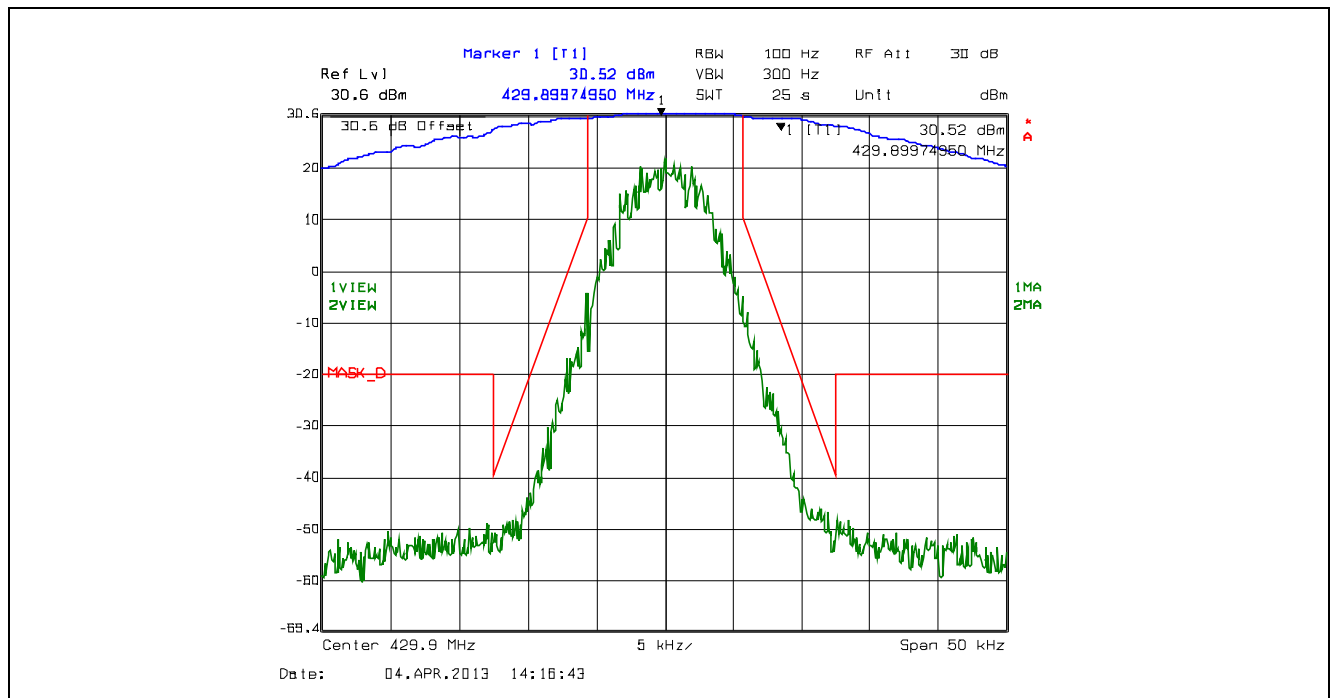
File #: TIL-094F90R01
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Plot 5.4.4.2.23. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 429.9 MHz



Plot 5.4.4.2.24. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 429.9 MHz



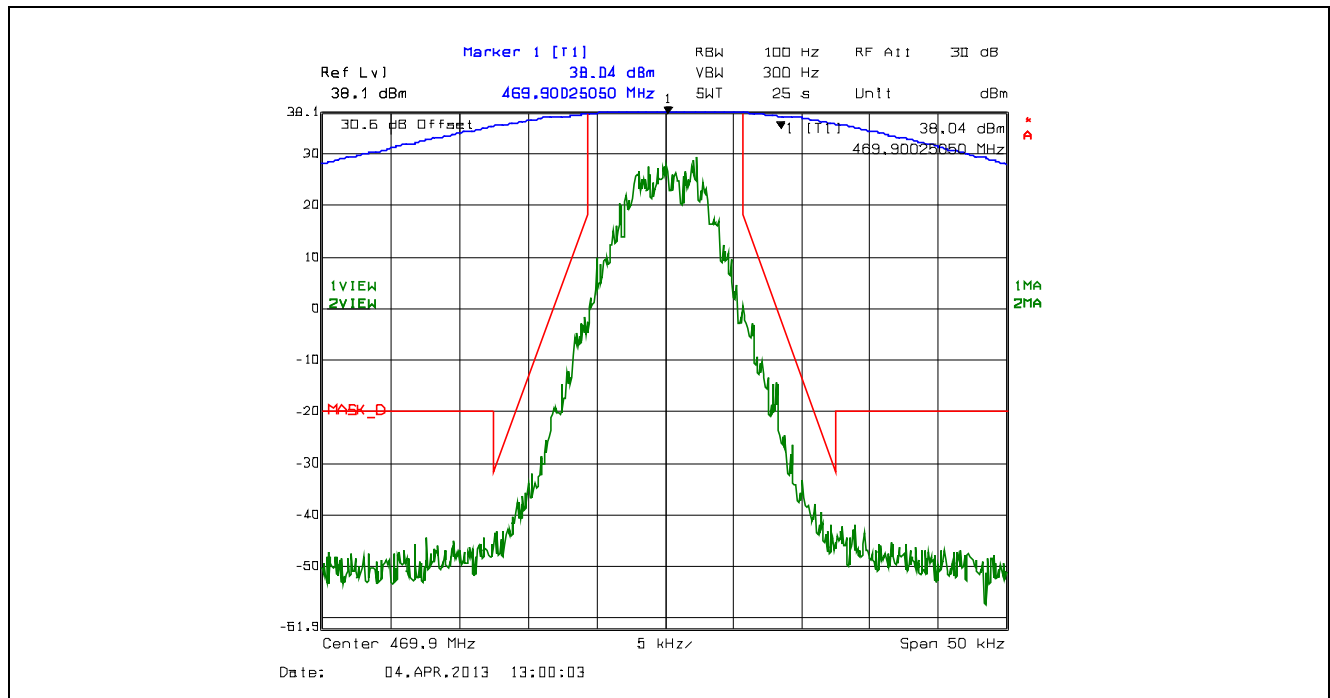
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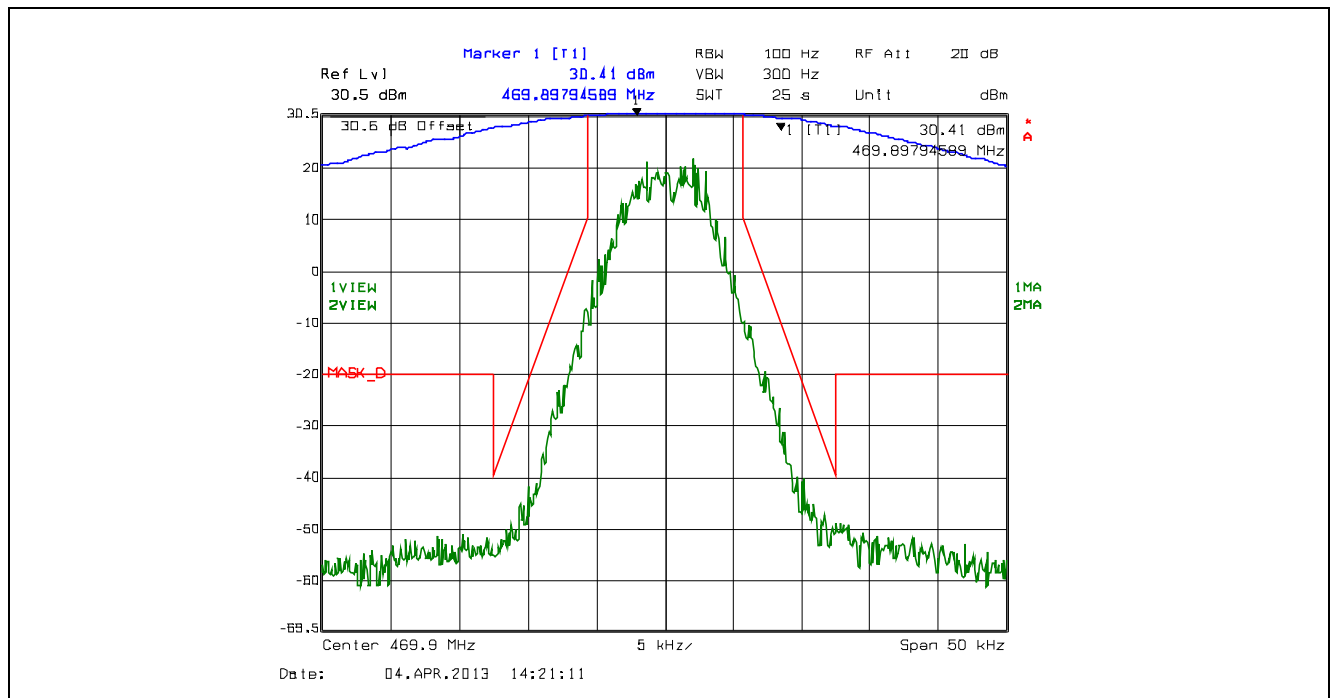
File #: TIL-094F90R01
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Plot 5.4.4.2.25. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 469.9 MHz



Plot 5.4.4.2.26. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 469.9 MHz



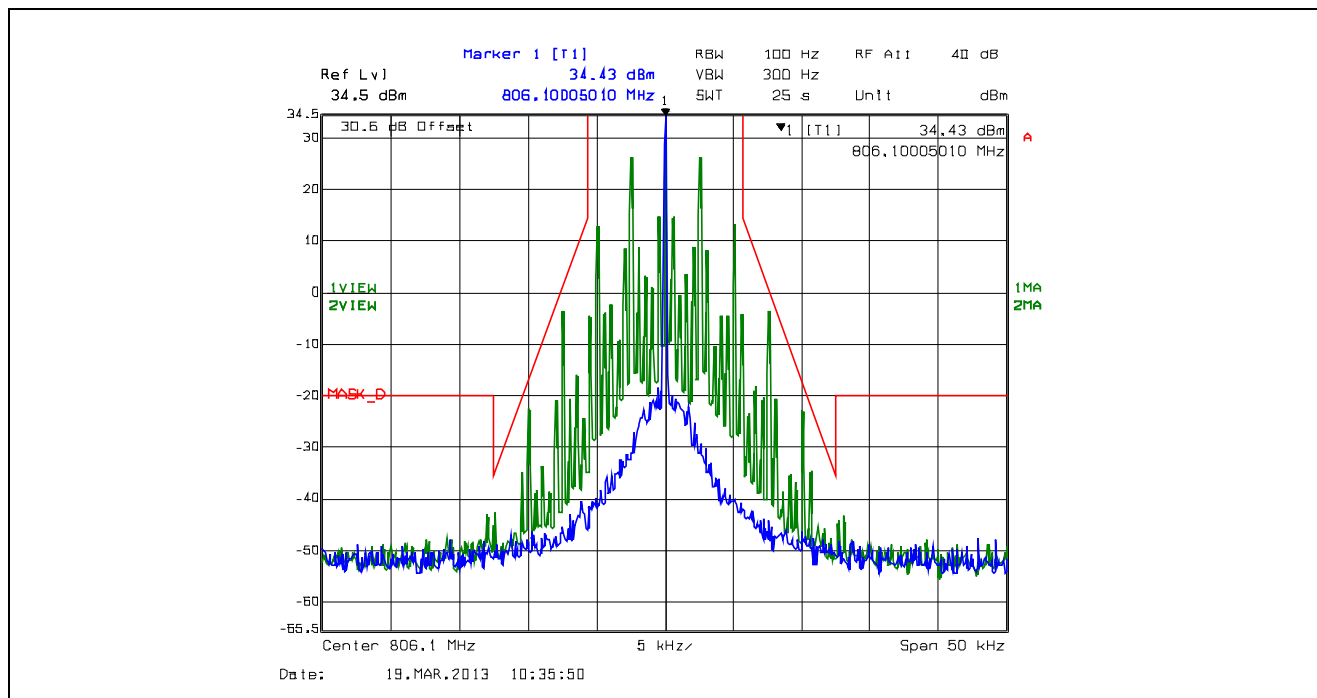
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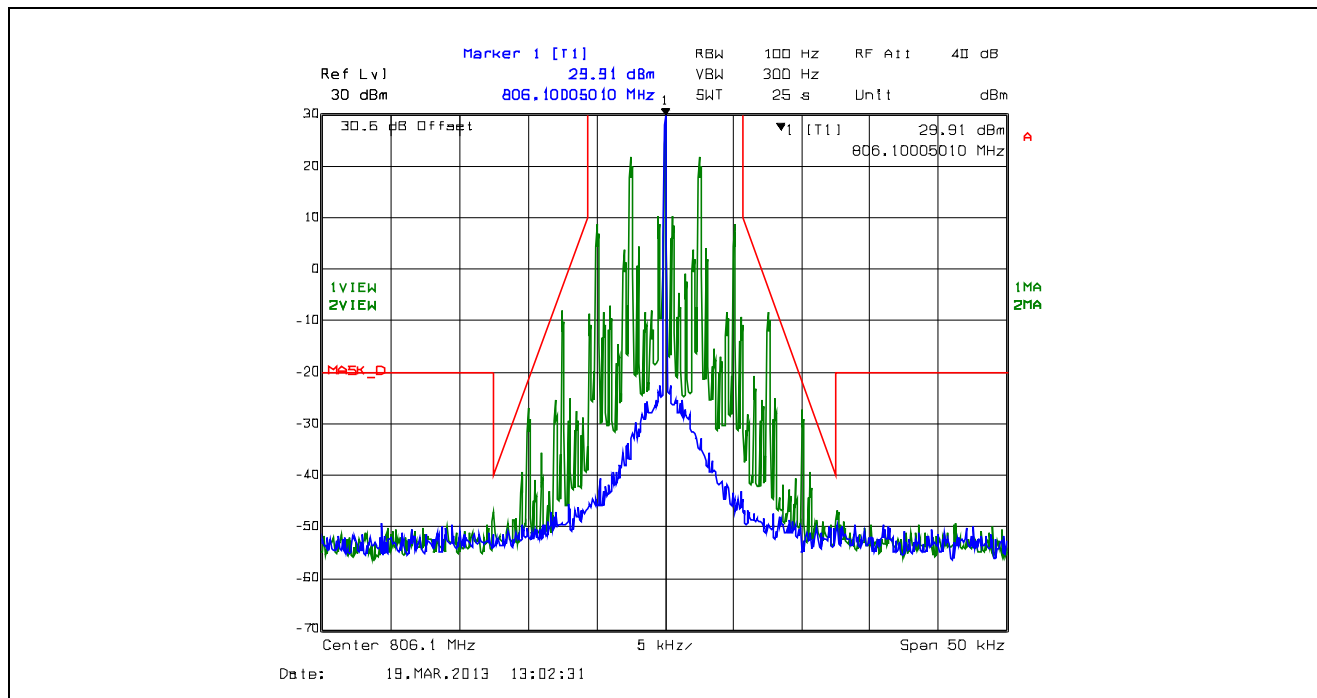
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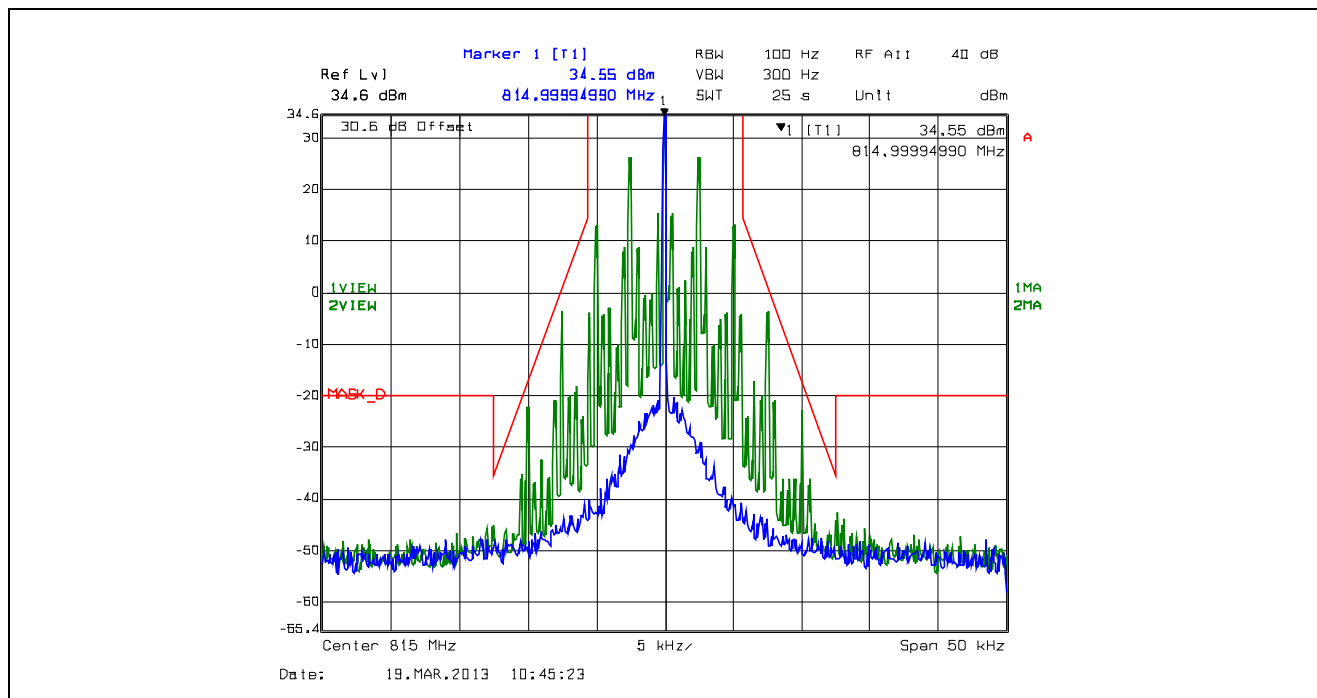
Plot 5.4.4.2.27. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 806.1 MHz



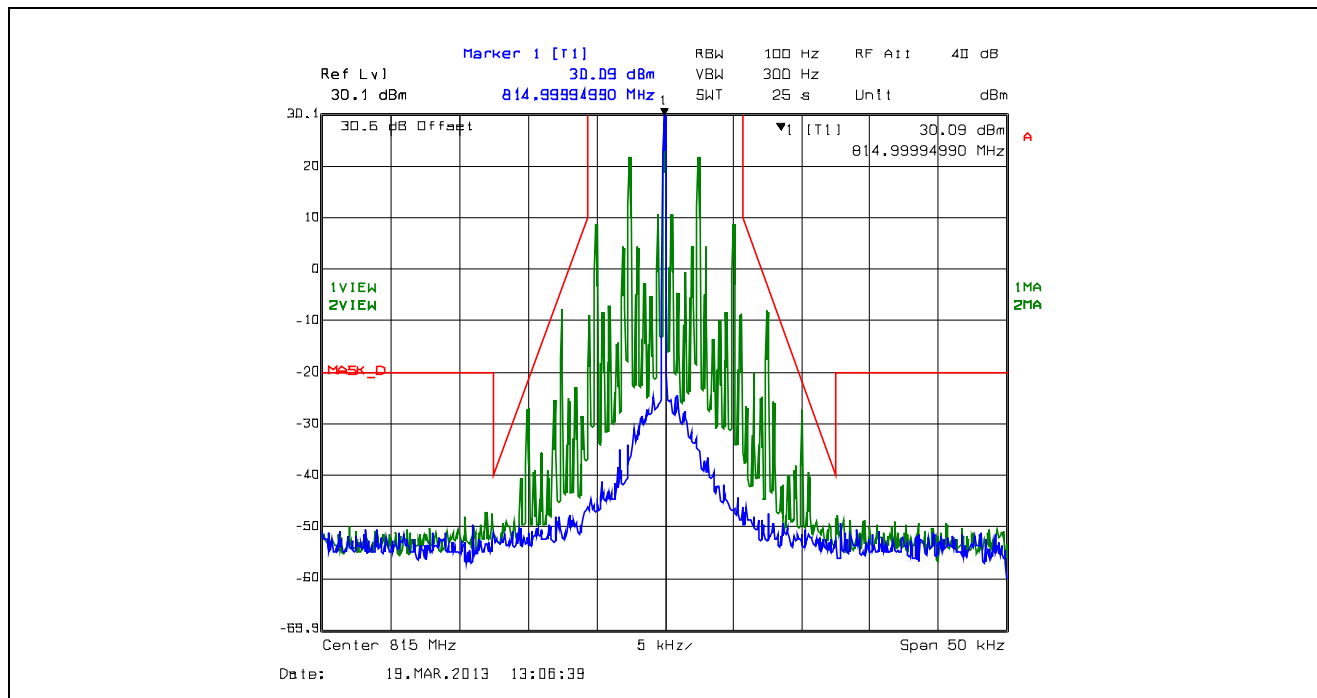
Plot 5.4.4.2.28. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 806.1 MHz



Plot 5.4.4.2.29. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 815.0 MHz



Plot 5.4.4.2.30. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 815.0 MHz



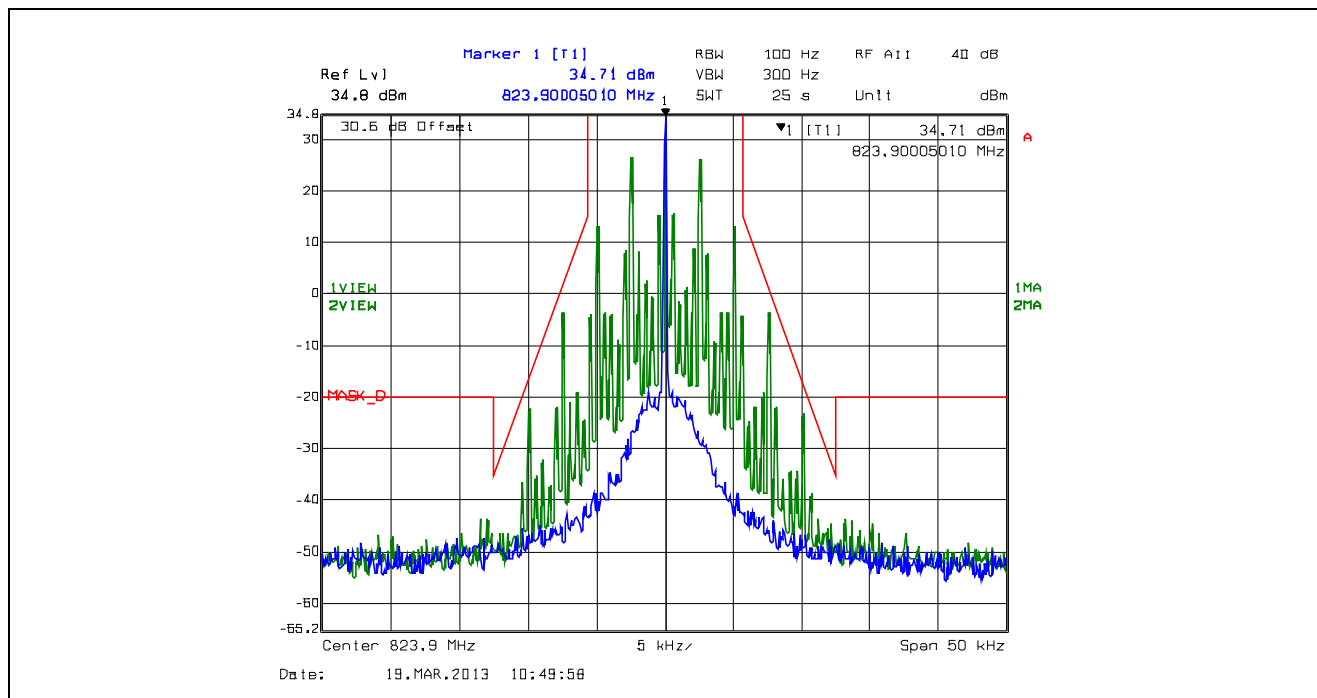
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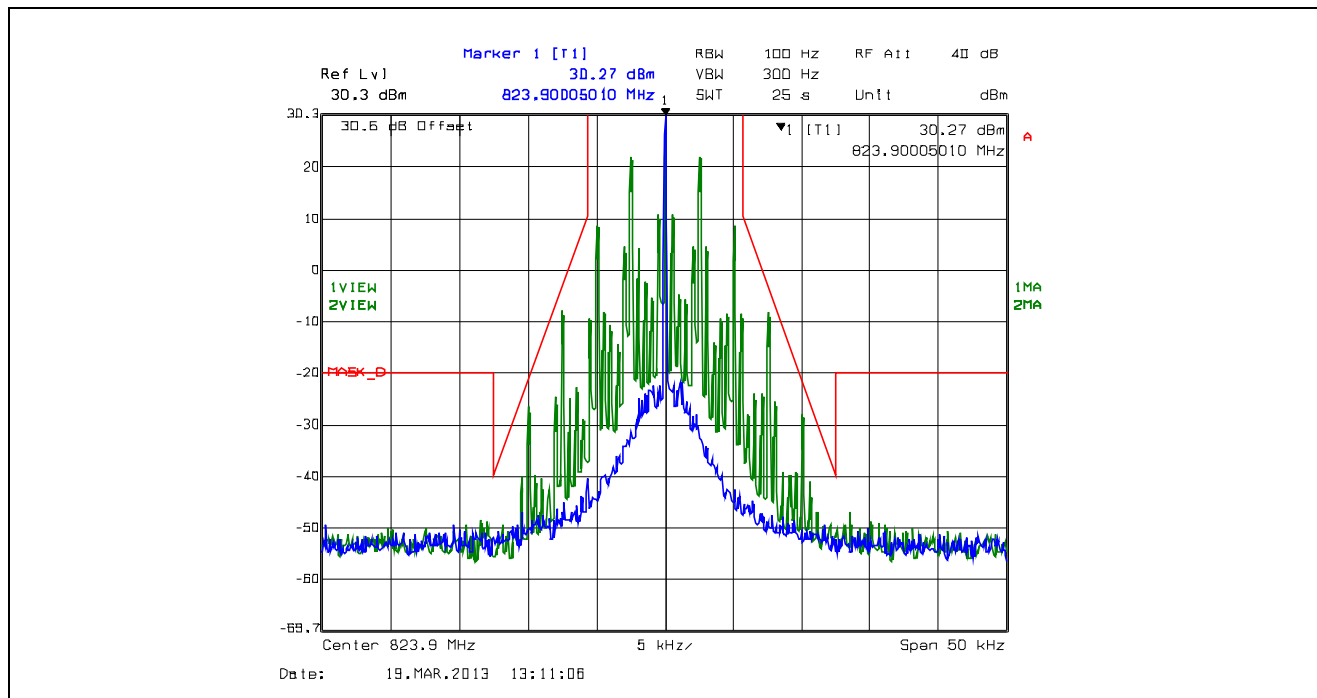
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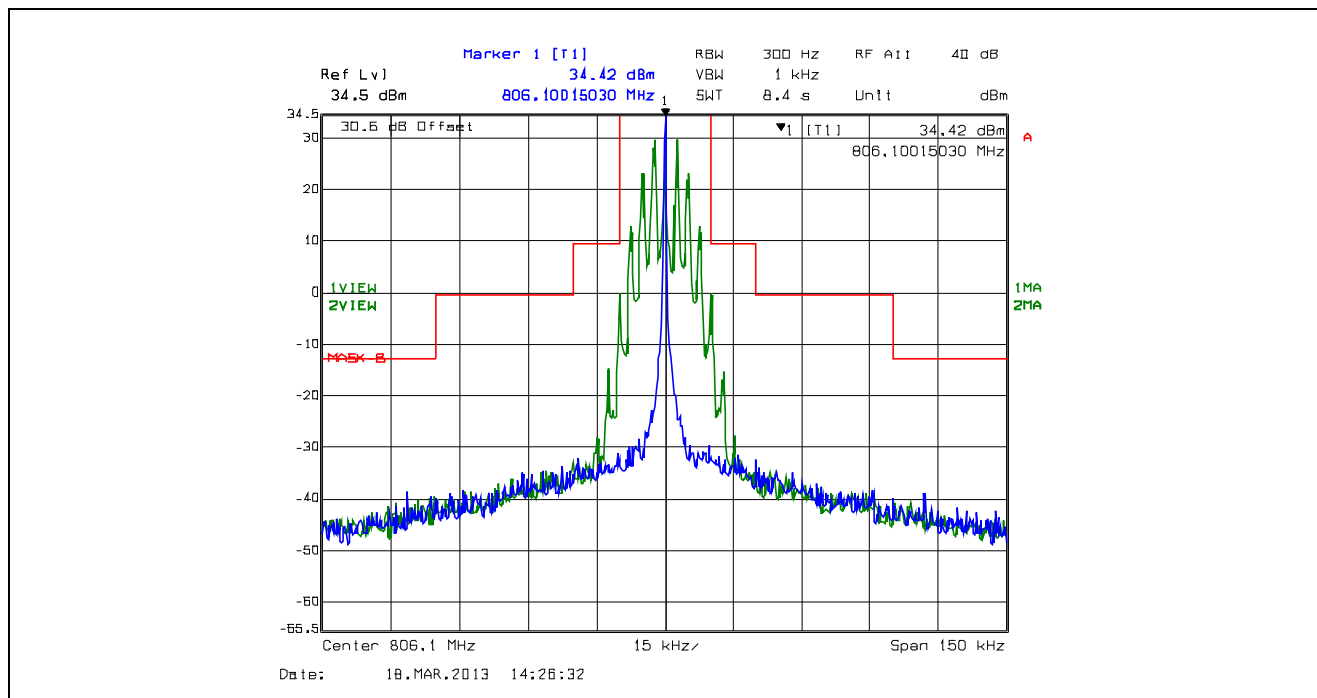
Plot 5.4.4.2.31. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 823.9 MHz



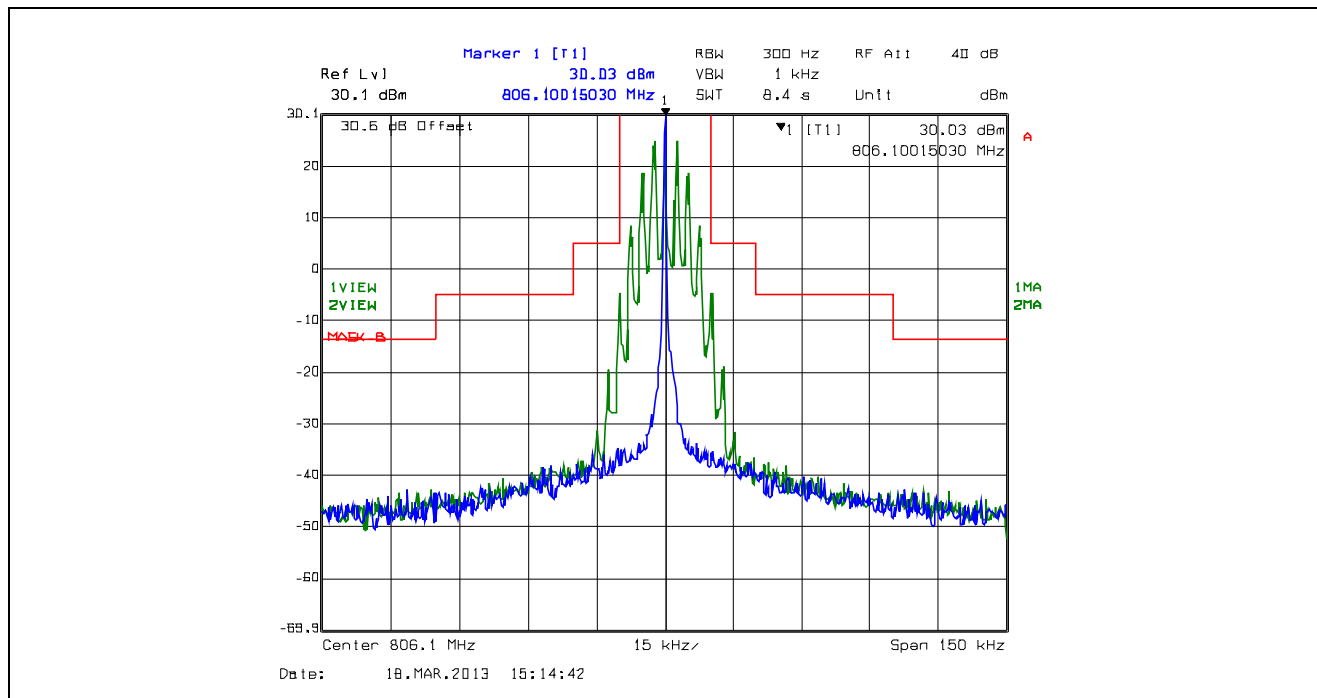
Plot 5.4.4.2.32. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 823.9 MHz



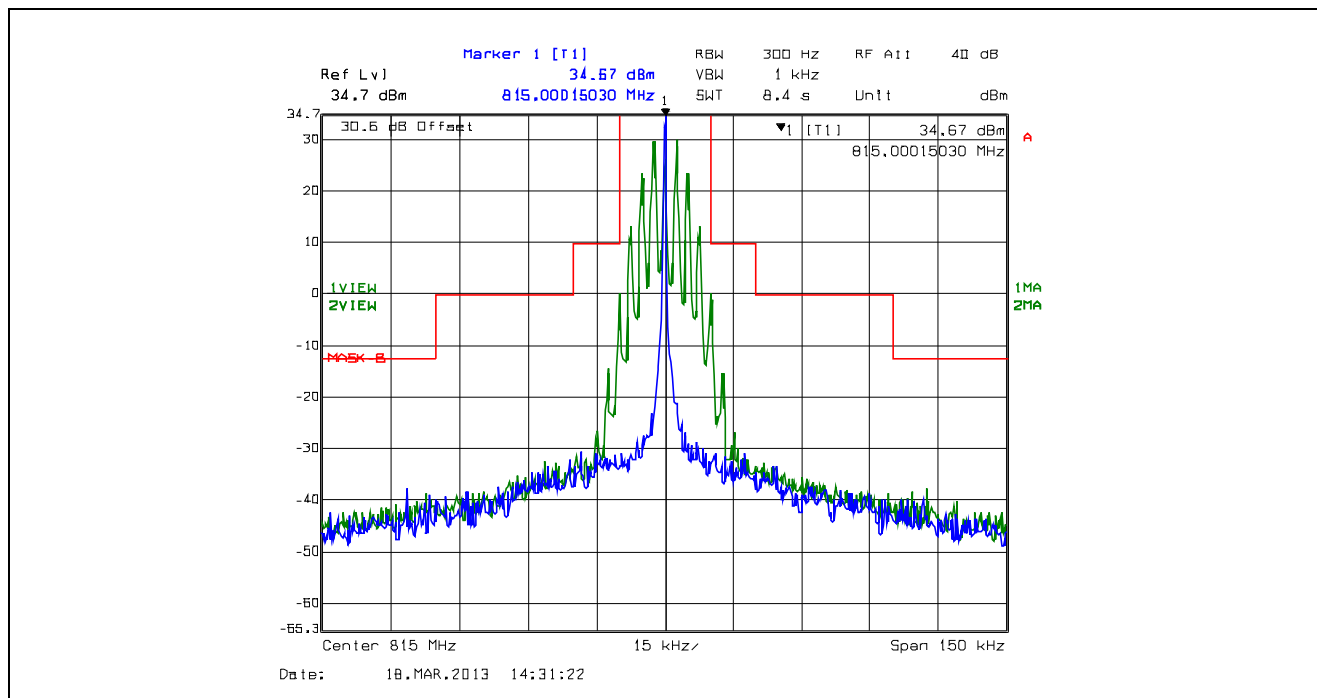
Plot 5.4.4.2.33. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 806.1 MHz



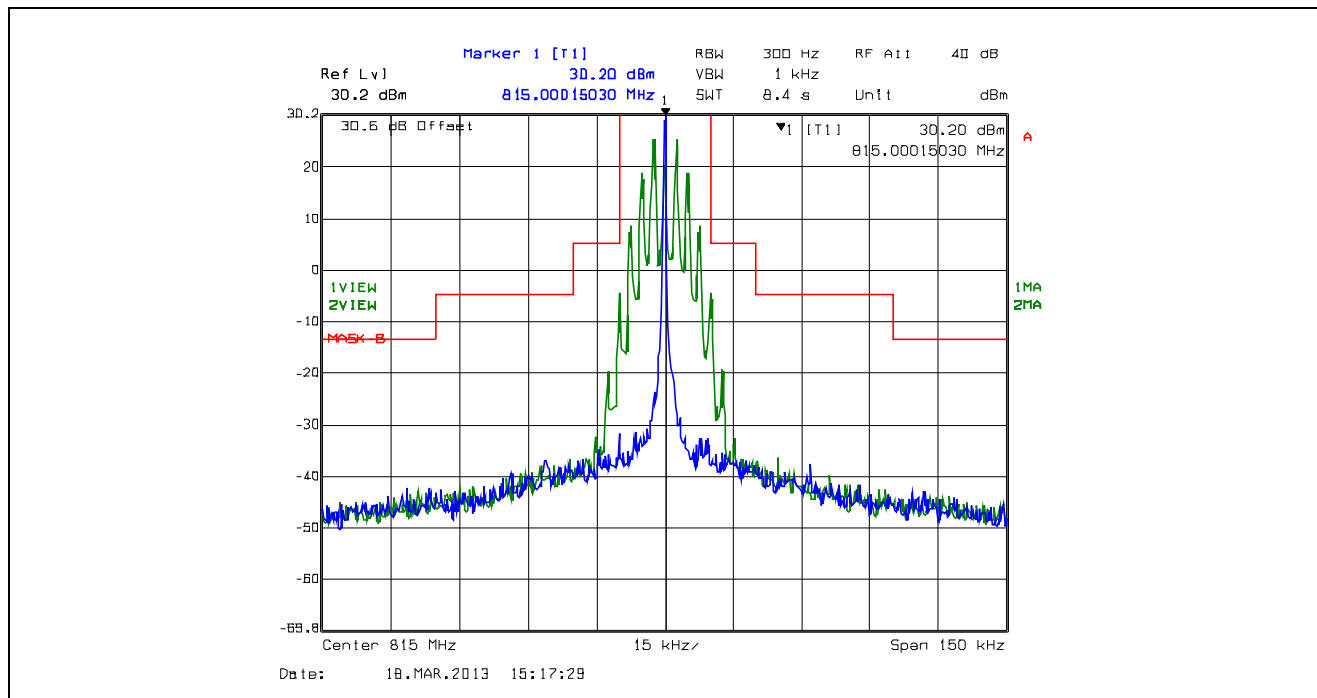
Plot 5.4.4.2.34. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 806.1 MHz



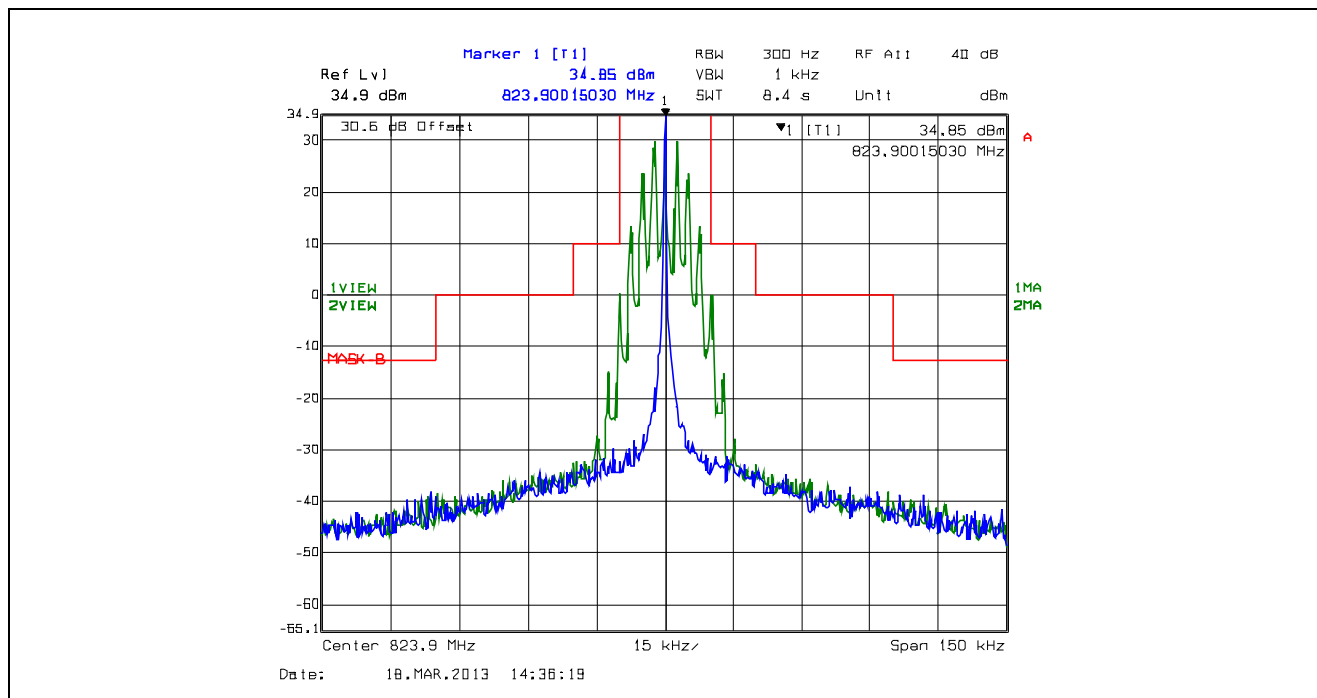
Plot 5.4.4.2.35. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 815.0 MHz



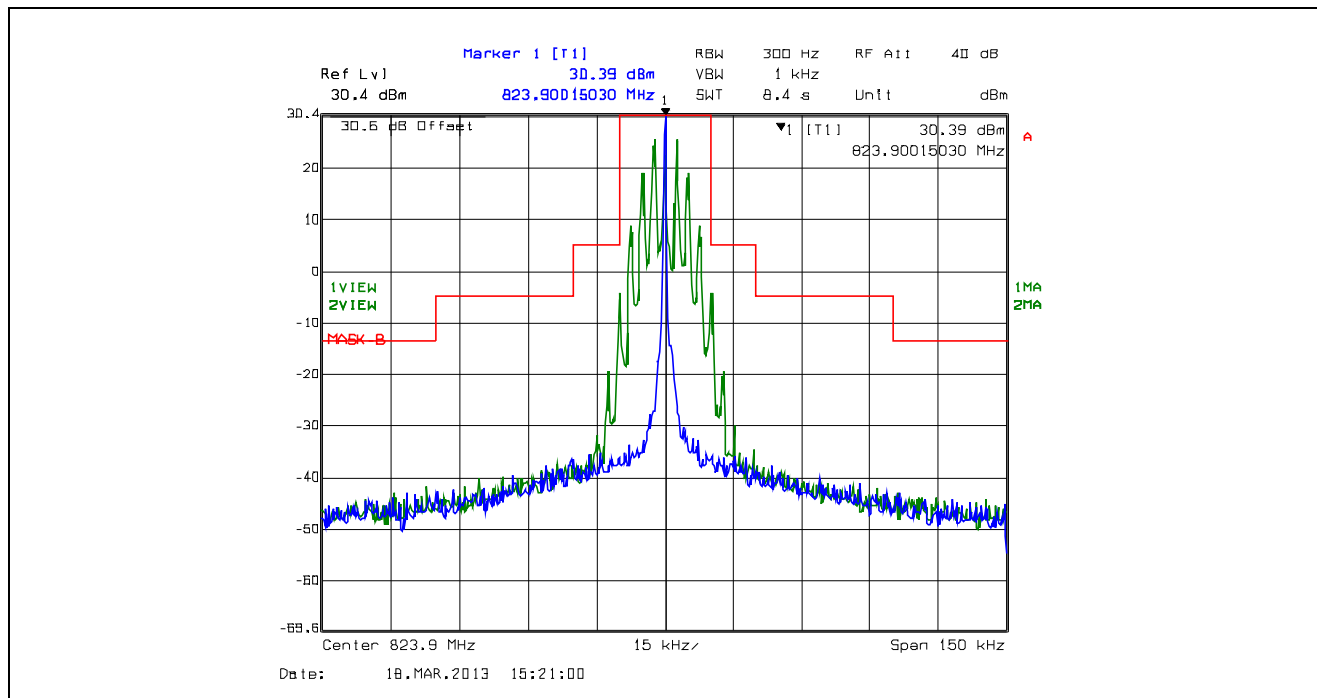
Plot 5.4.4.2.36. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 815.0 MHz



Plot 5.4.4.2.37. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 823.9 MHz



Plot 5.4.4.2.38. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 823.9 MHz



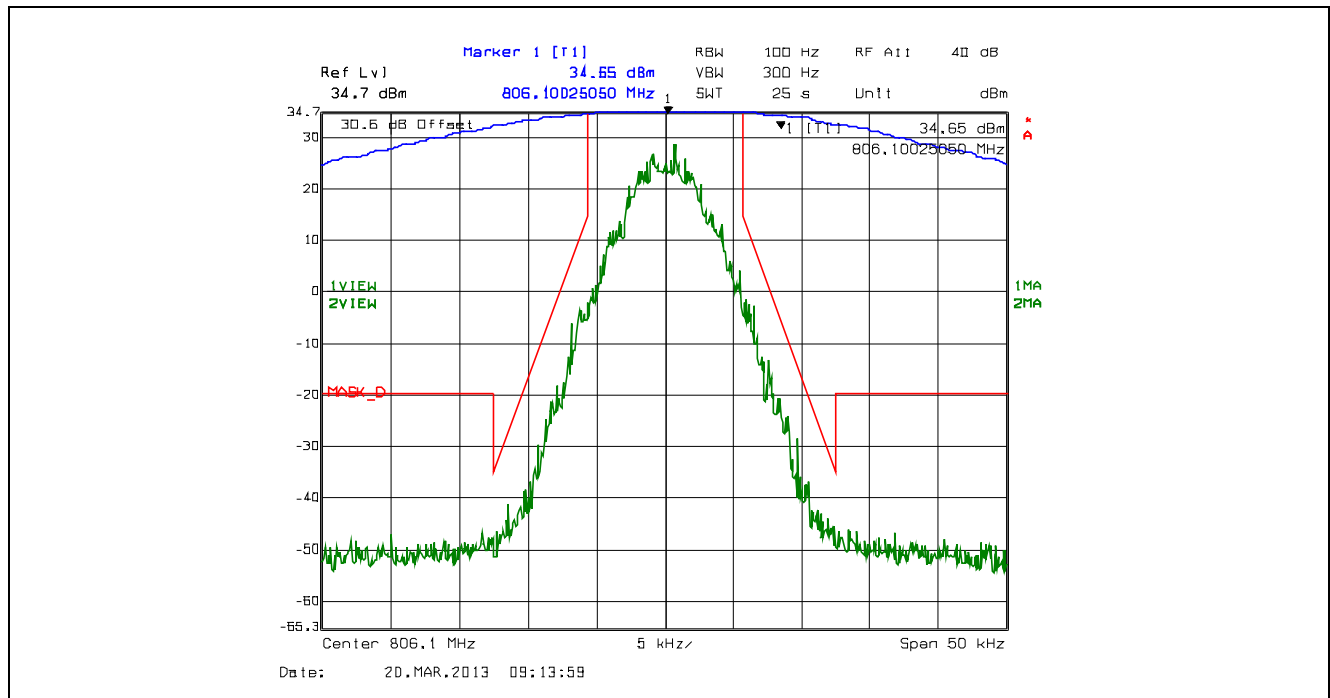
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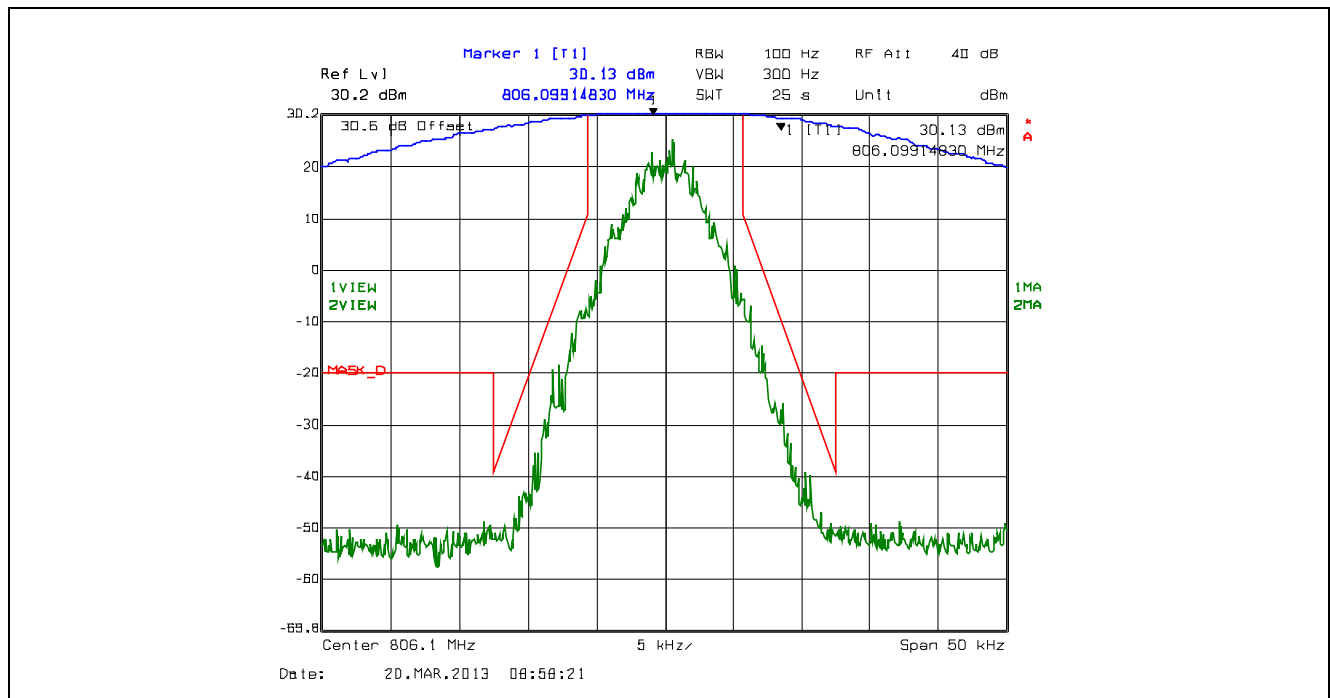
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Plot 5.4.4.2.39. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 806.1 MHz



Plot 5.4.4.2.40. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 806.1 MHz



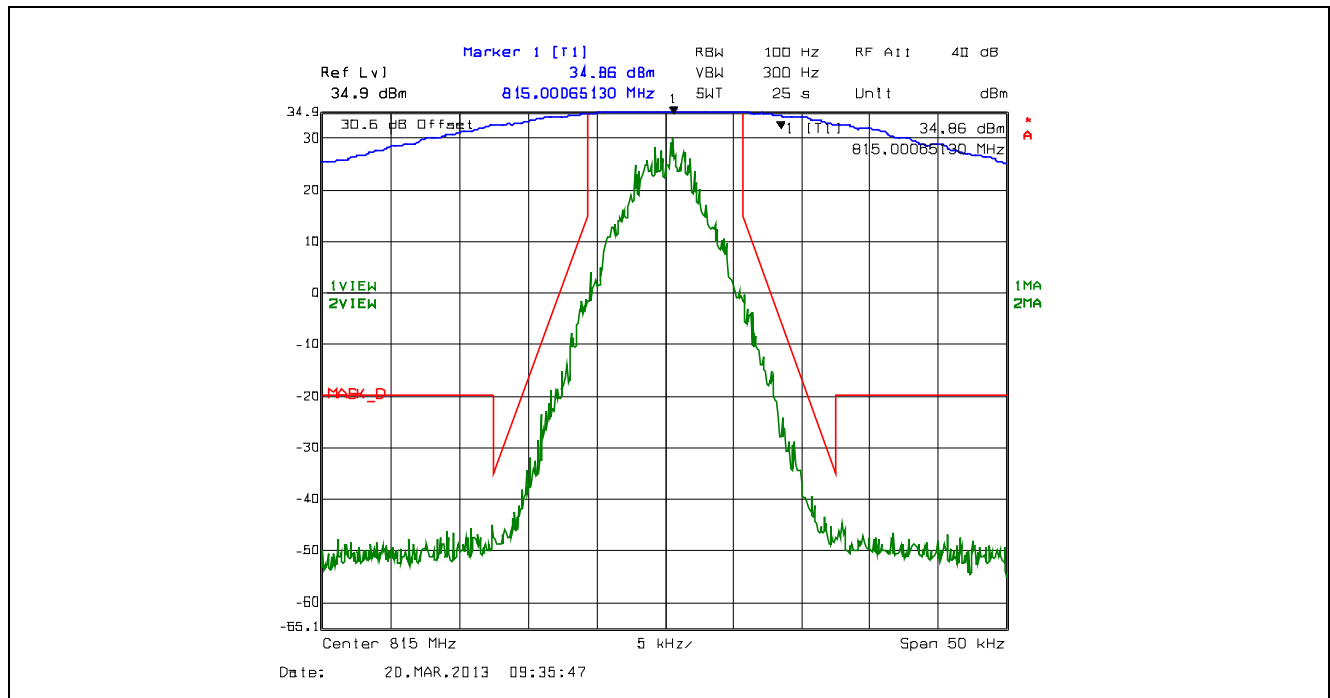
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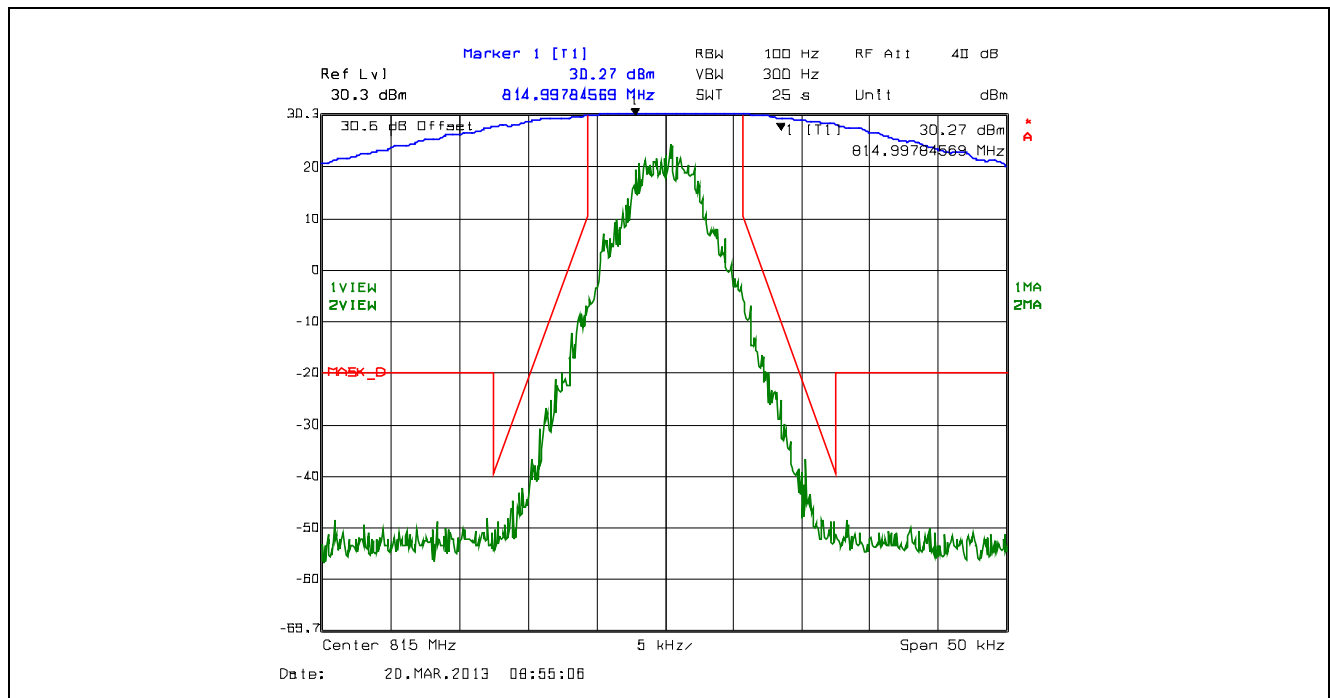
File #: TIL-094F90R01
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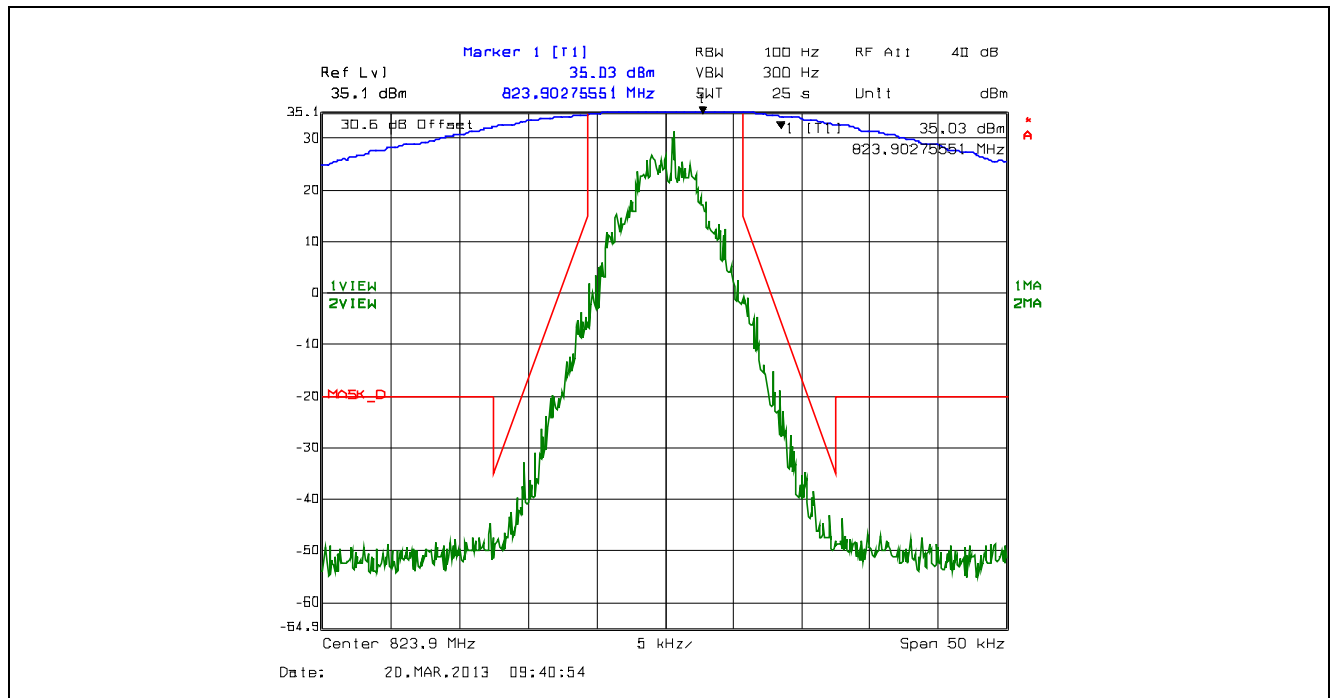
Plot 5.4.4.2.41. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 815.0 MHz



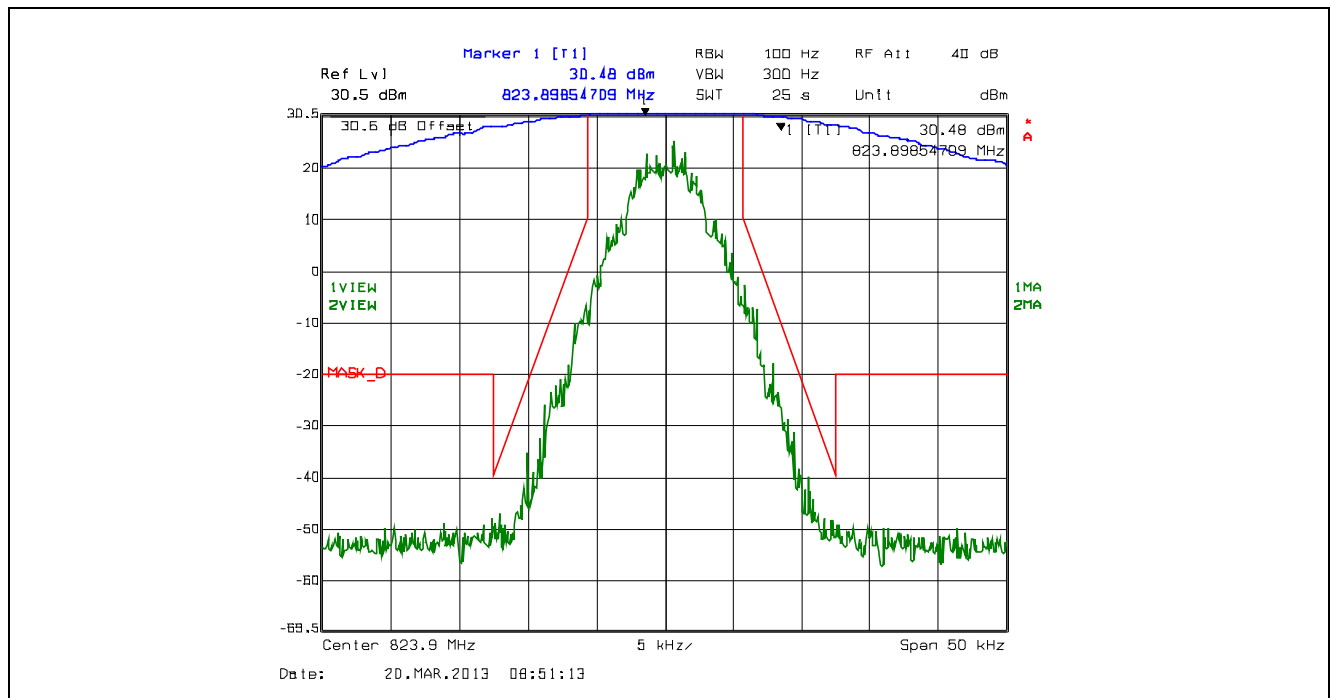
Plot 5.4.4.2.42. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 815.0 MHz



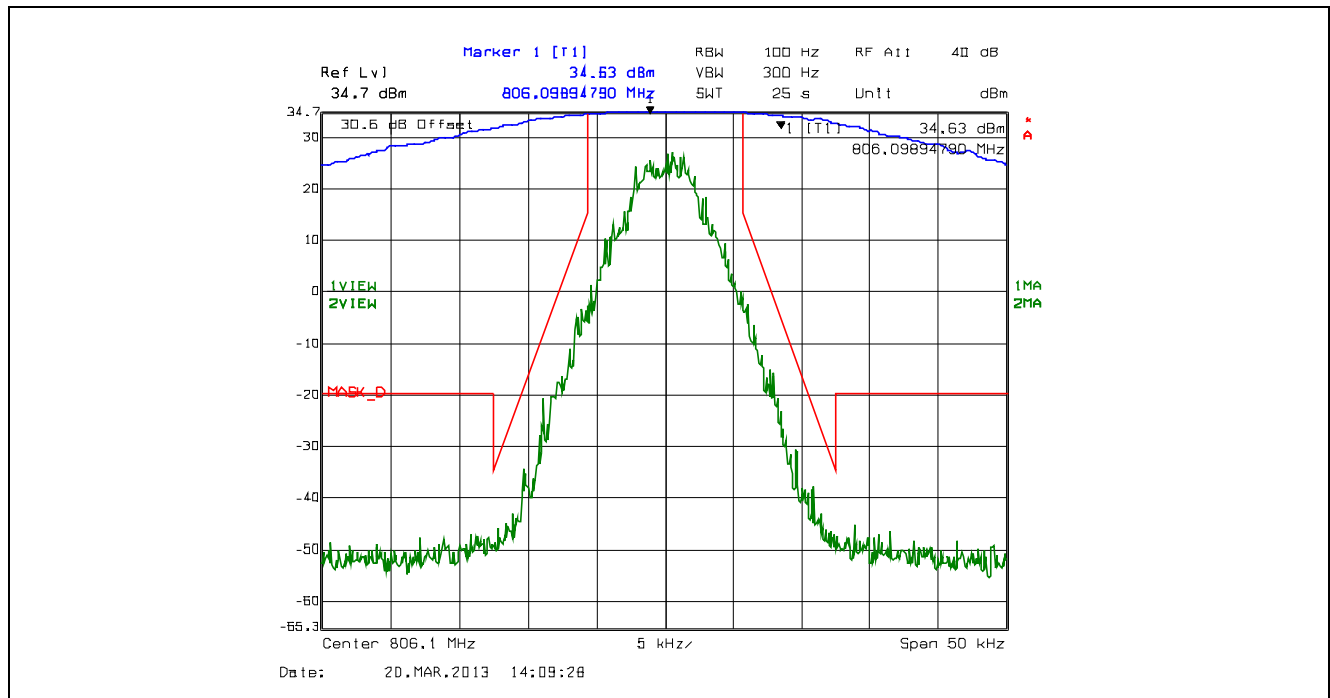
Plot 5.4.4.2.43. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 823.9 MHz



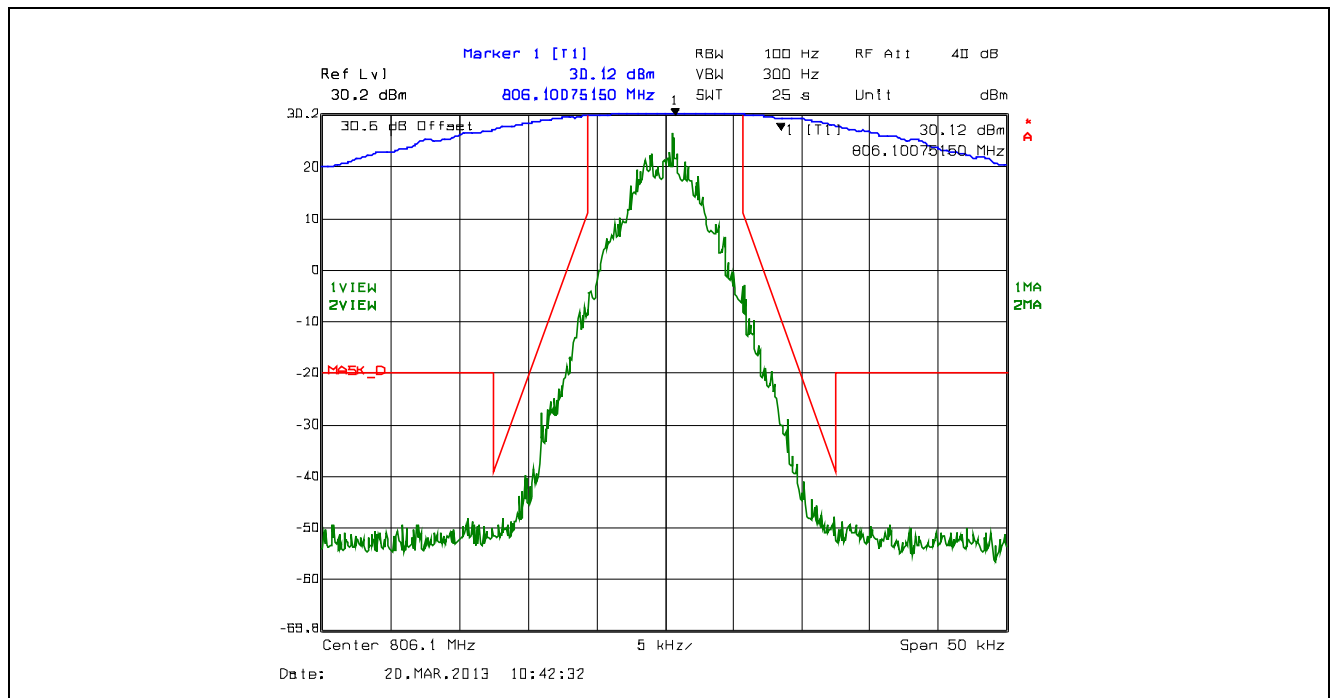
Plot 5.4.4.2.44. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 823.9 MHz



Plot 5.4.4.2.45. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 806.1 MHz



Plot 5.4.4.2.46. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 806.1 MHz



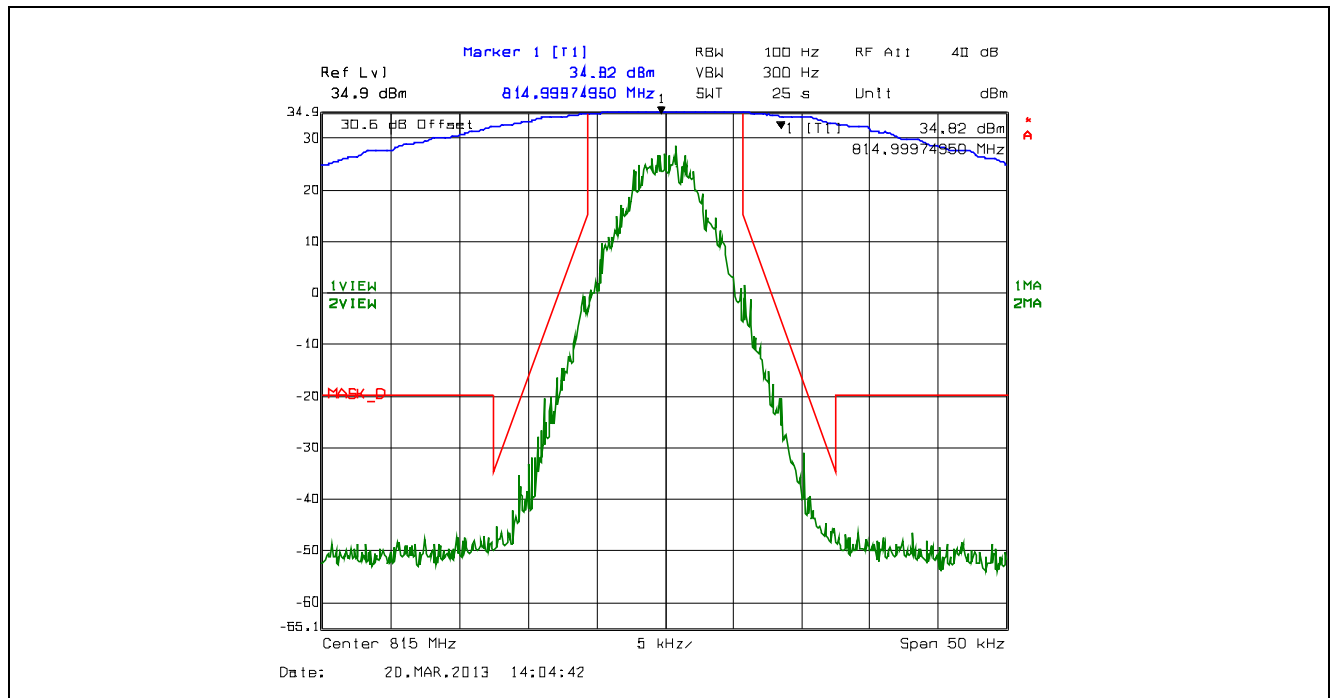
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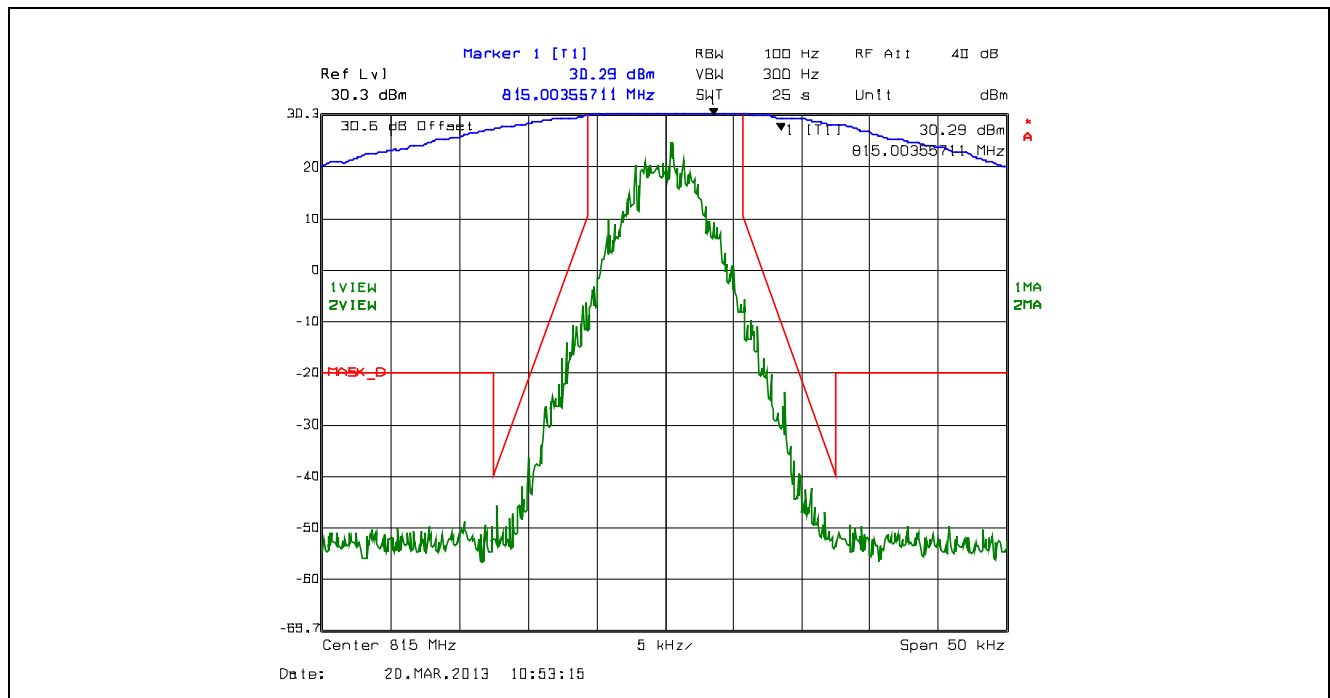
File #: TIL-094F90R01
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Plot 5.4.4.2.47. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 815.0 MHz



Plot 5.4.4.2.48. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 815.0 MHz



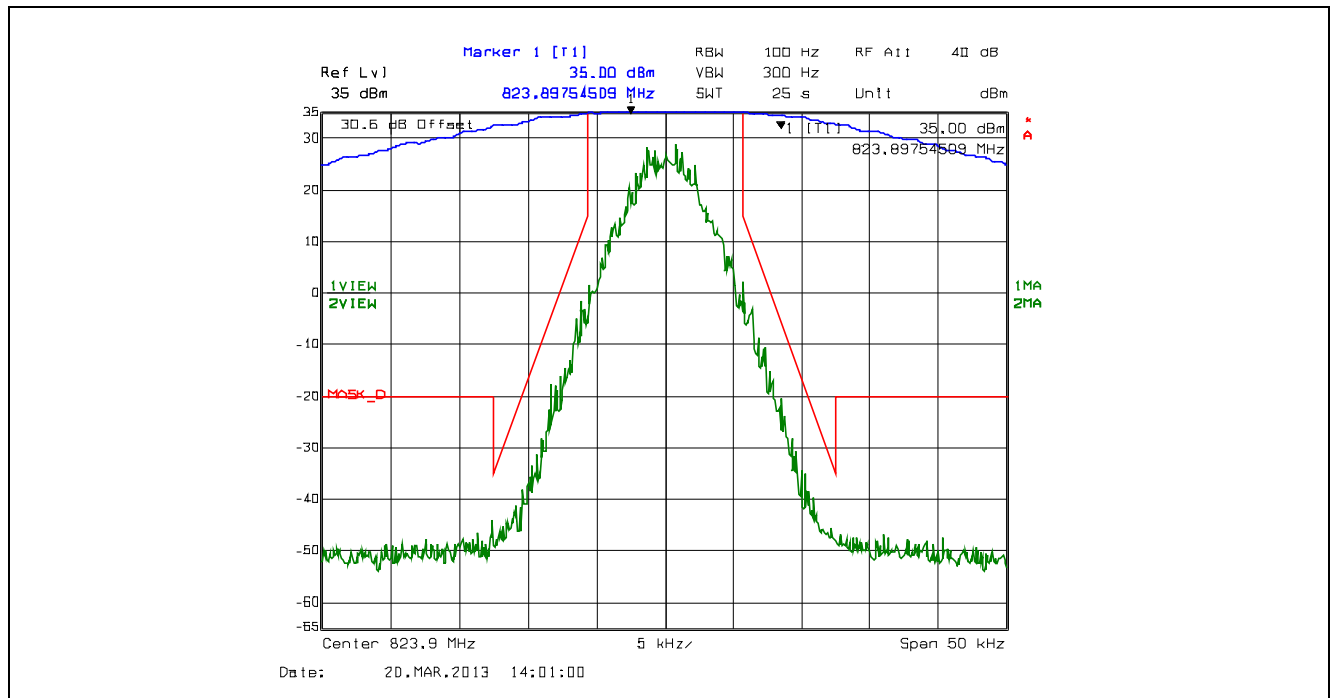
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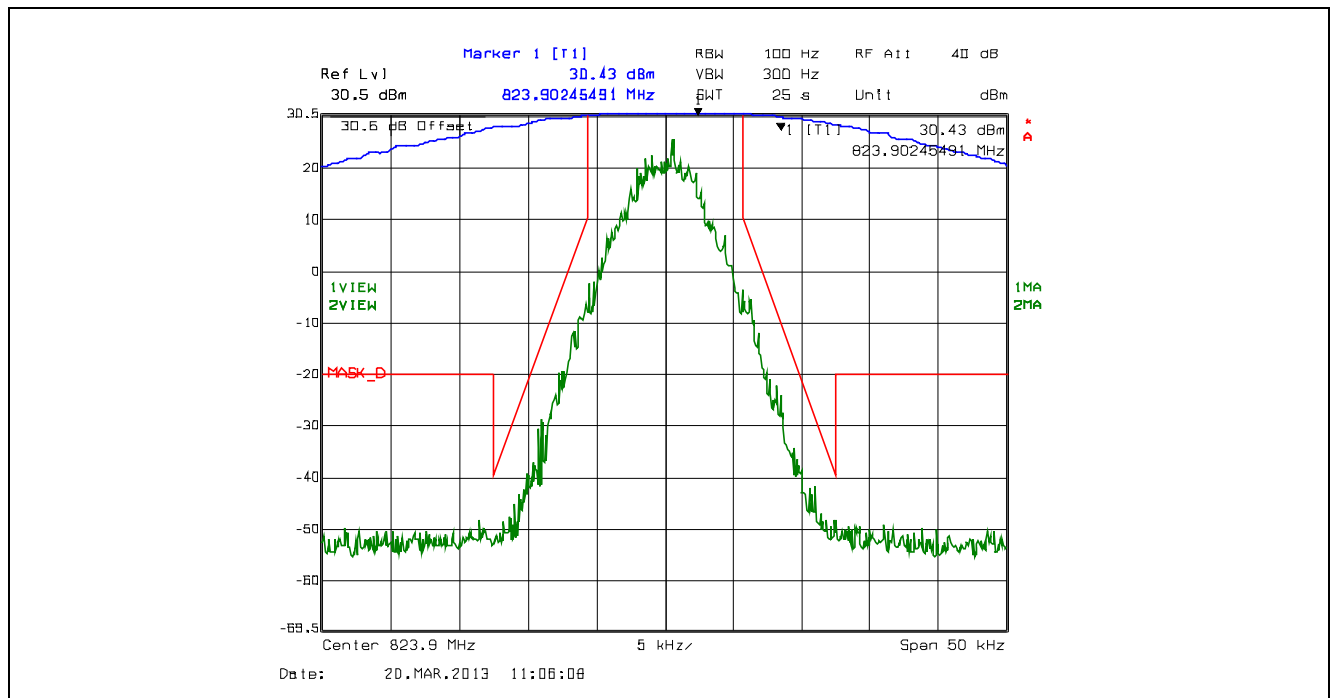
File #: TIL-094F90R01
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Plot 5.4.4.2.49. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 823.9 MHz



Plot 5.4.4.2.50. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 823.9 MHz



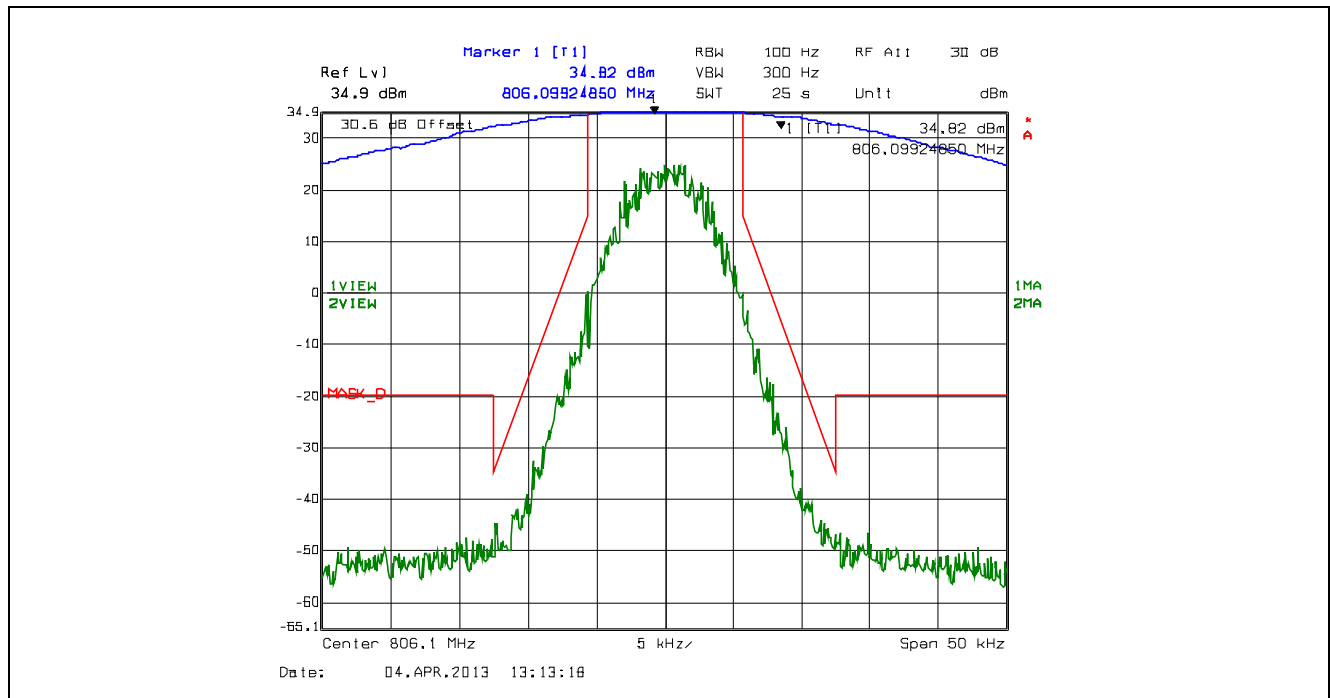
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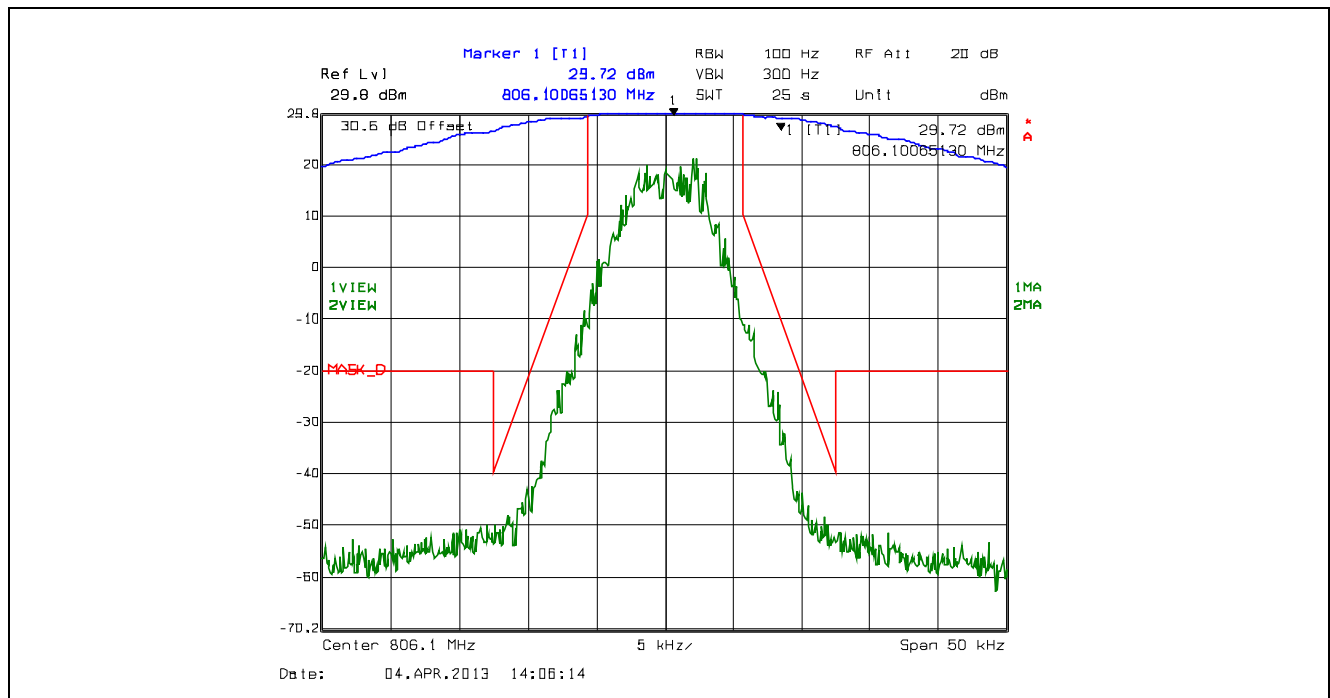
File #: TIL-094F90R01
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Plot 5.4.4.2.51. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 806.1 MHz



Plot 5.4.4.2.52. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 806.1 MHz



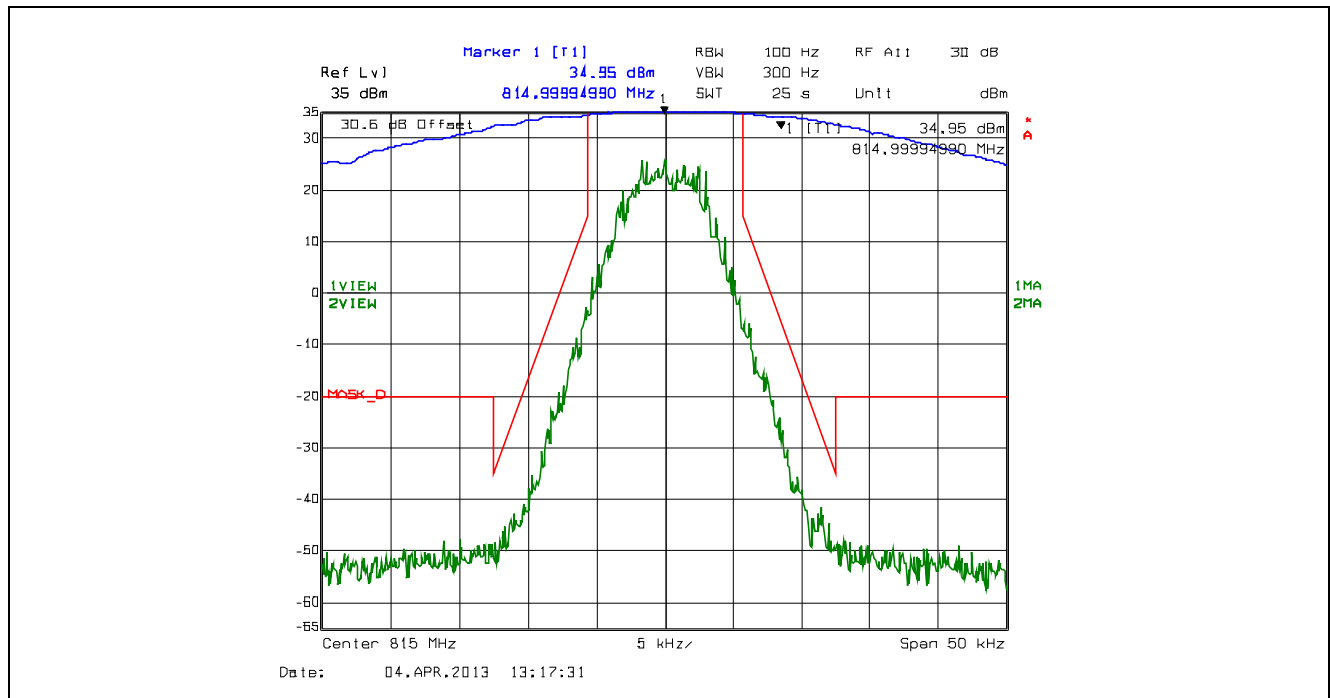
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

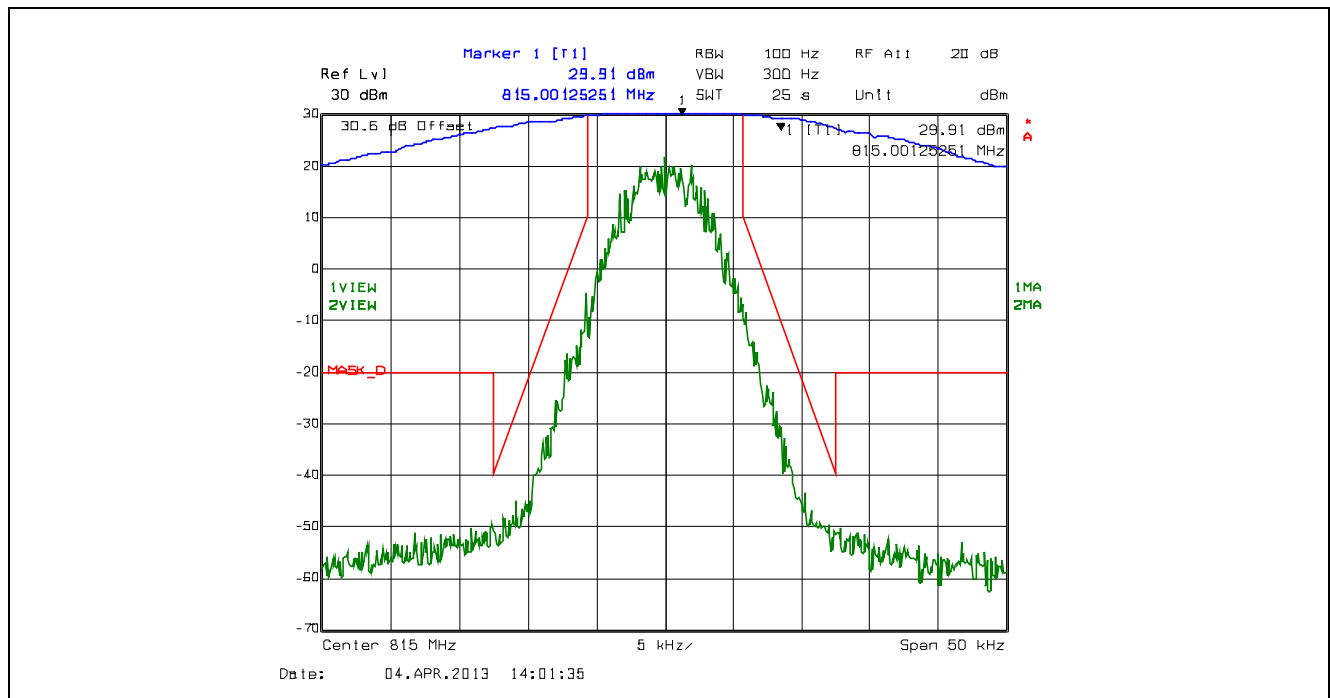
File #: TIL-094F90R01
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Plot 5.4.4.2.53. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 815.0 MHz



Plot 5.4.4.2.54. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 815.0 MHz



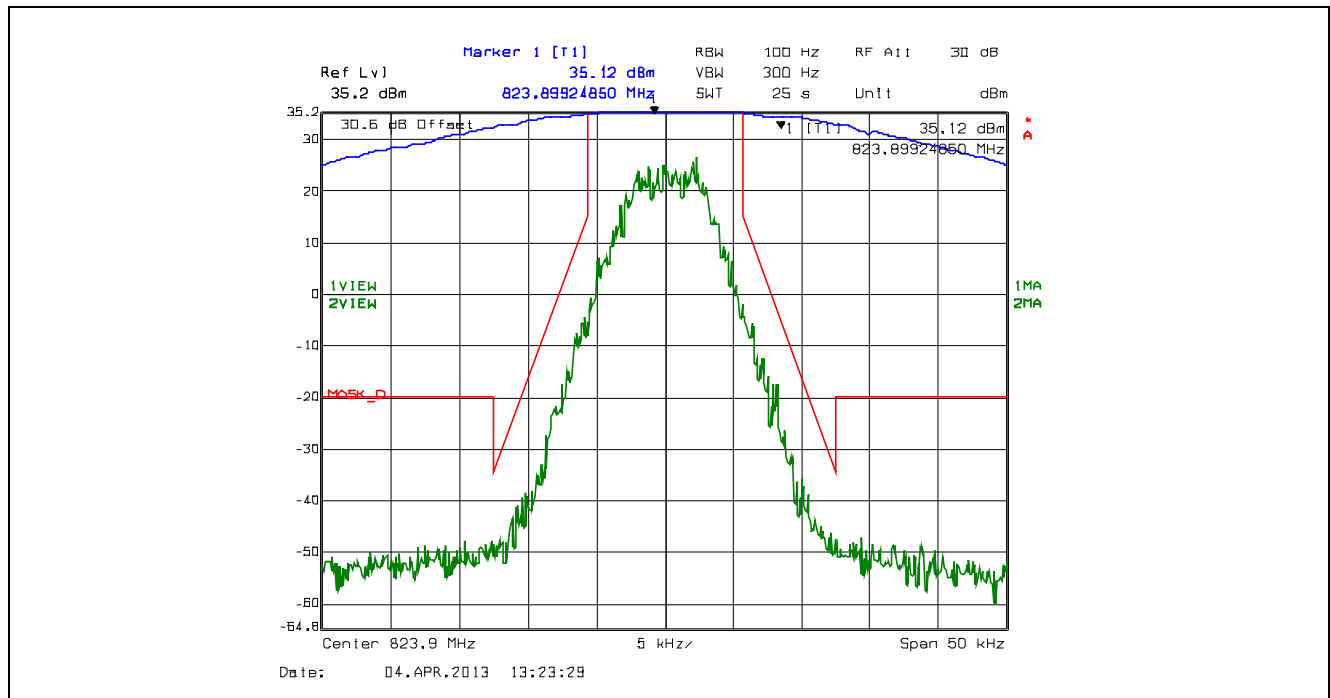
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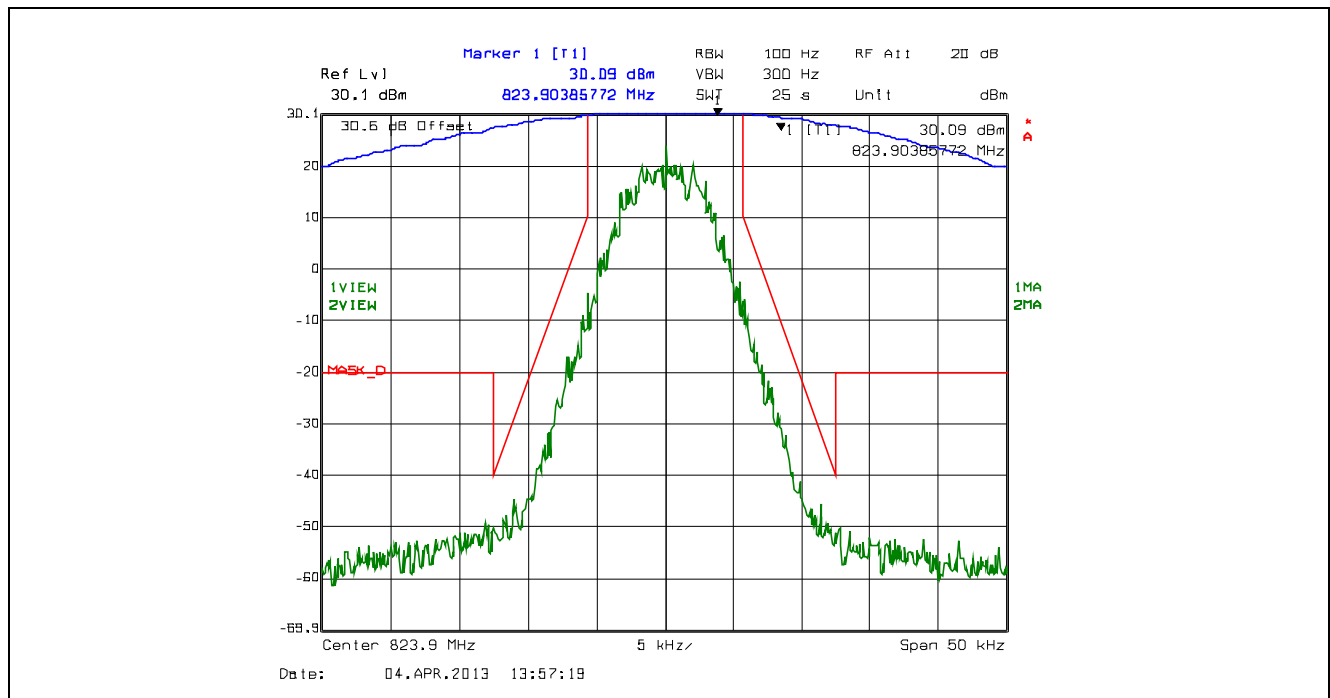
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.4.4.2.55. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 823.9 MHz



Plot 5.4.4.2.56. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 823.9 MHz



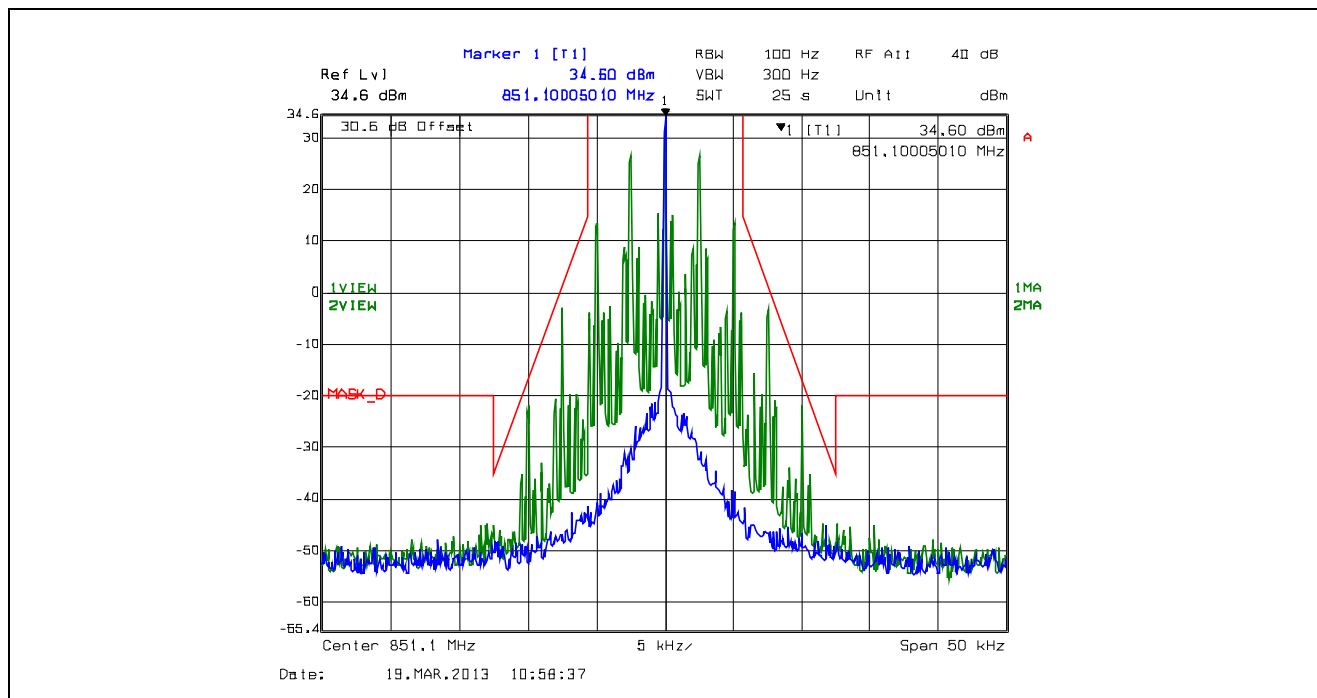
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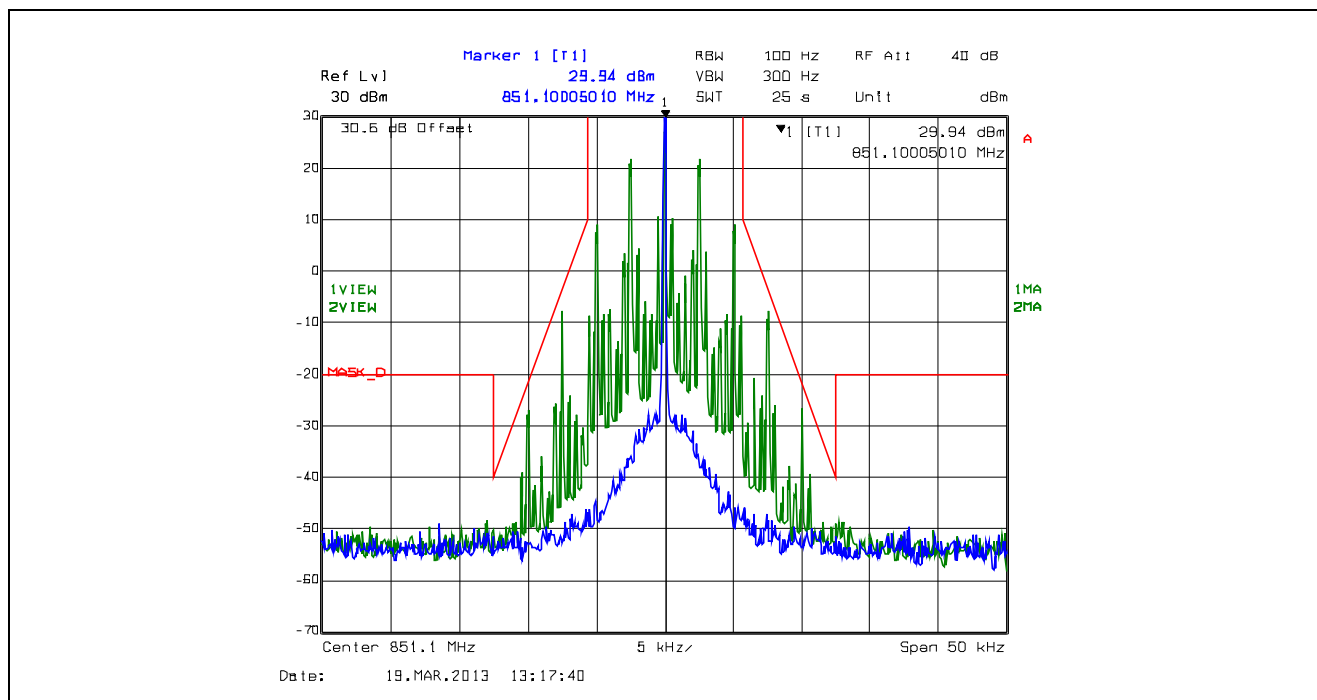
File #: TIL-094F90R01
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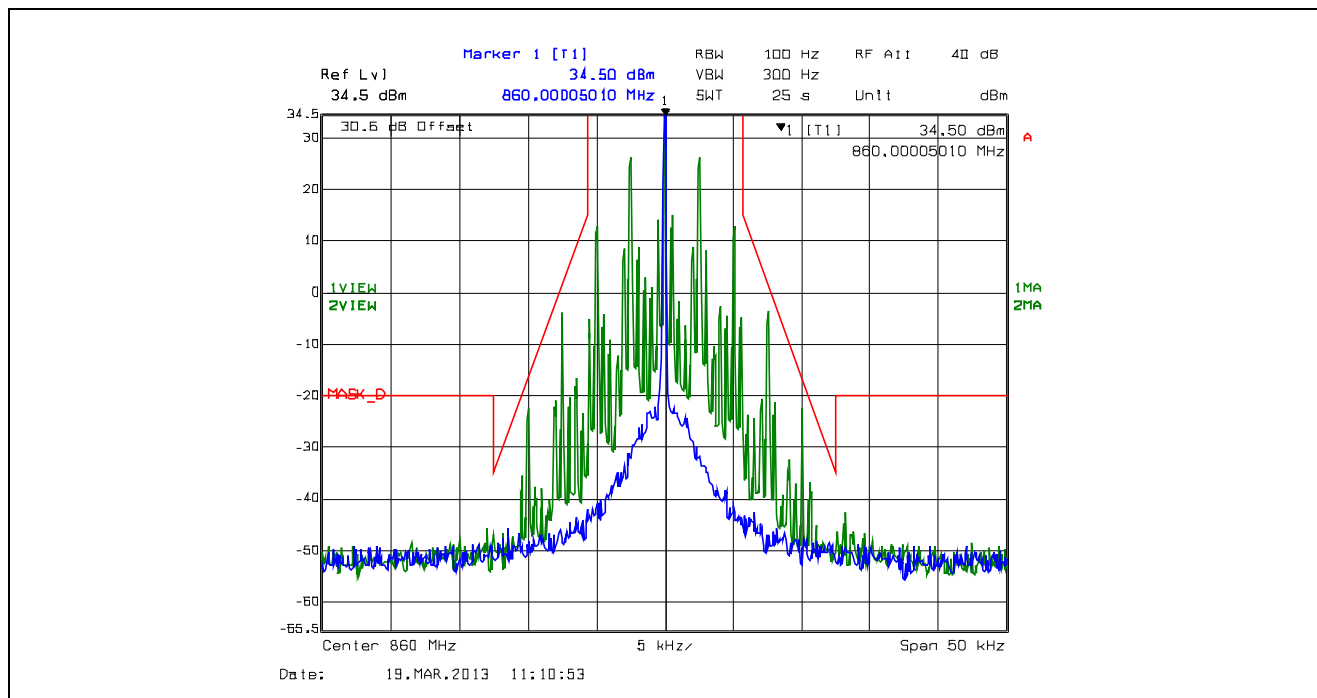
Plot 5.4.4.2.57. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 851.1 MHz



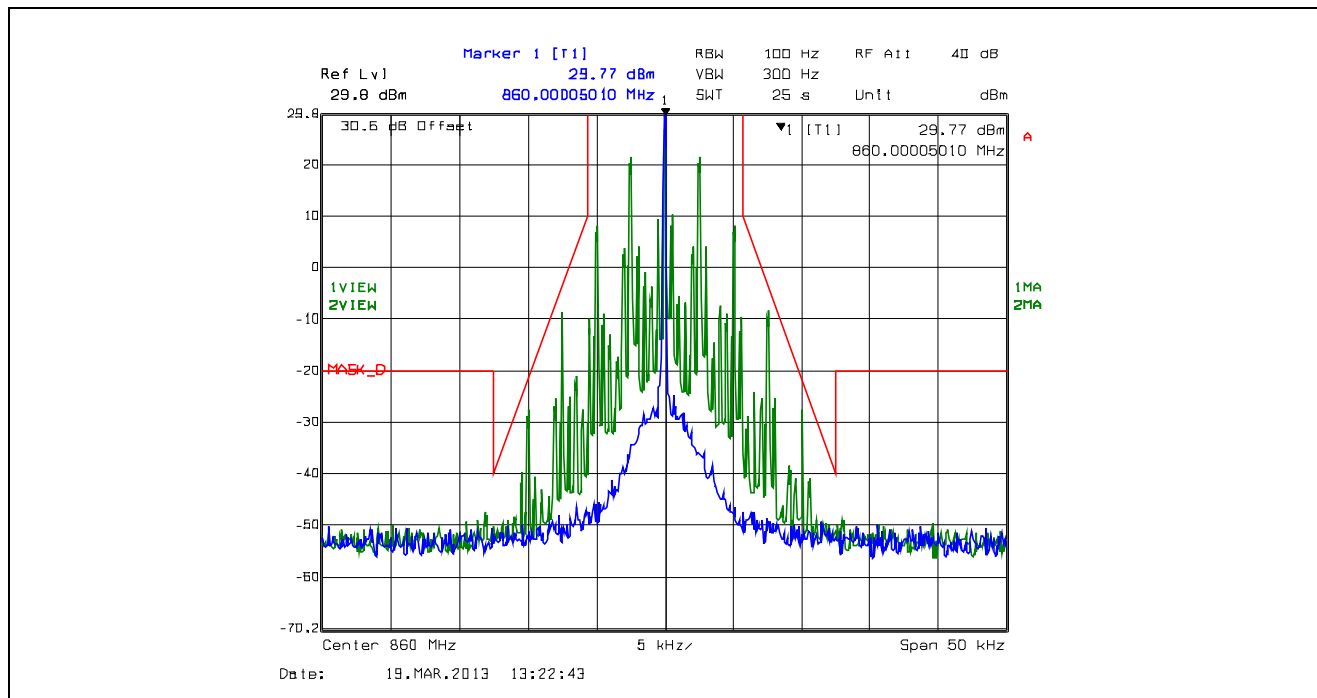
Plot 5.4.4.2.58. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 851.1 MHz



Plot 5.4.4.2.59. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 860.0 MHz



Plot 5.4.4.2.60. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 860.0 MHz



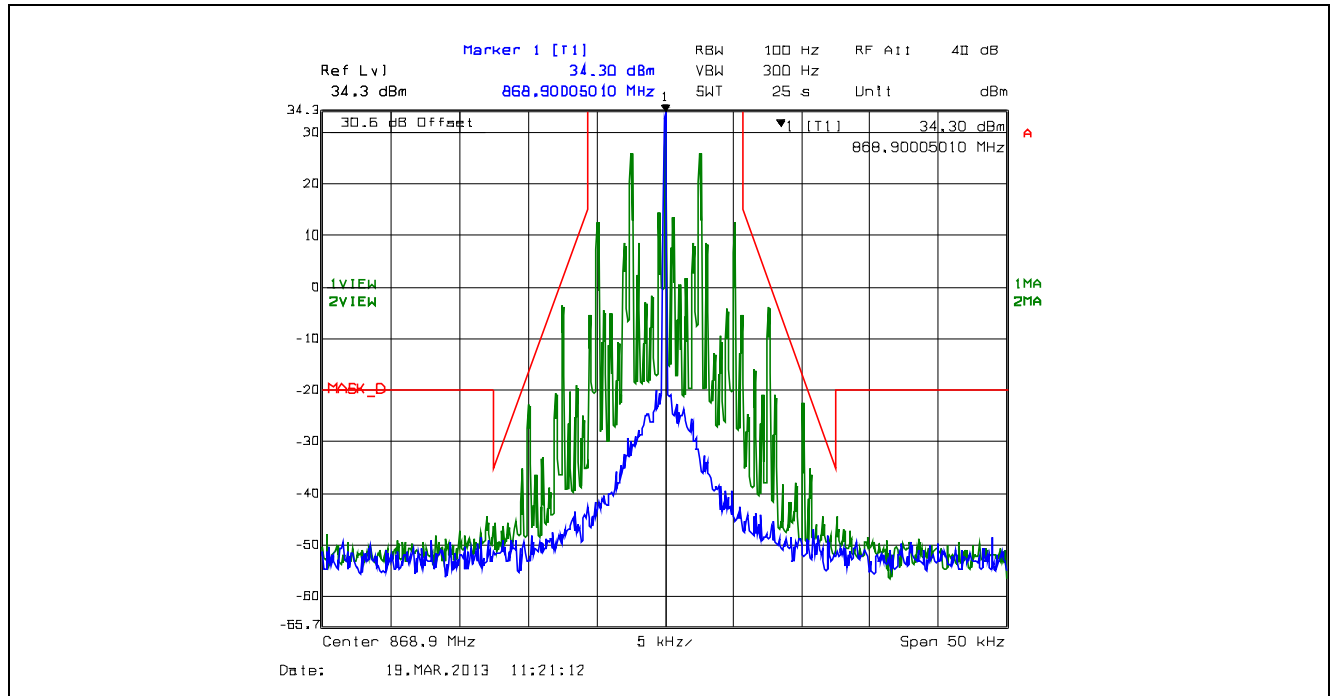
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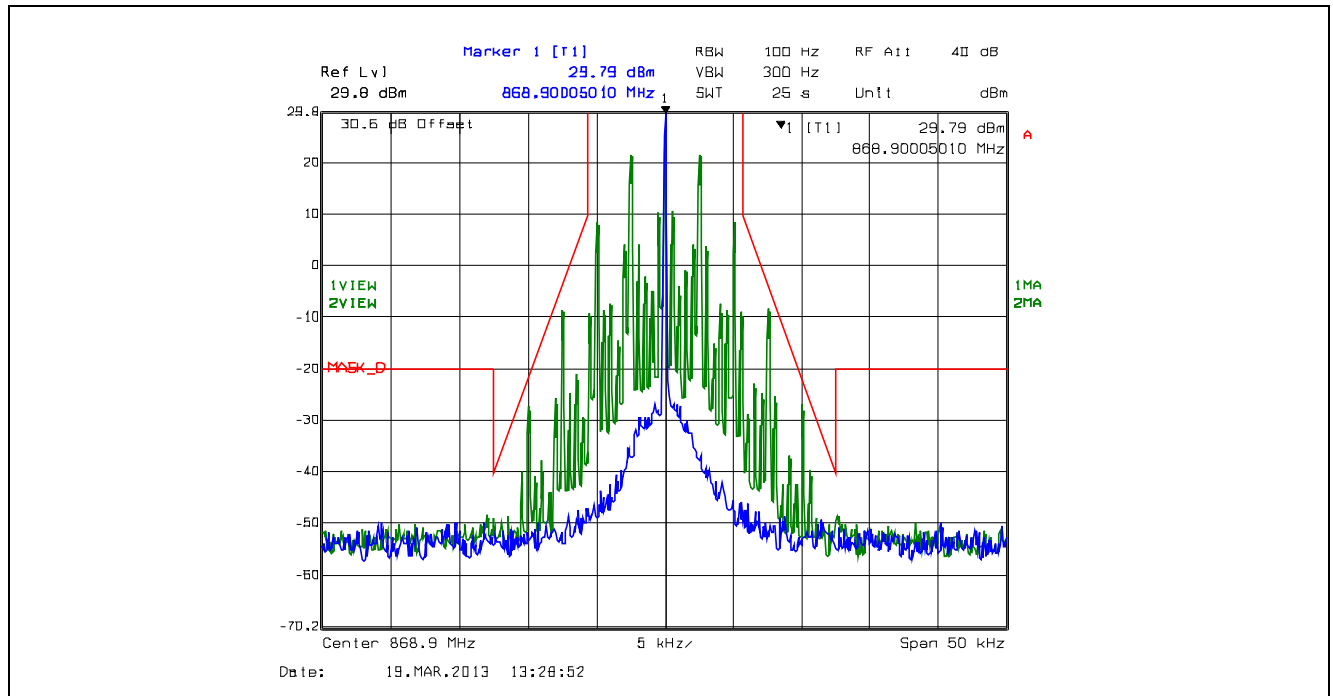
File #: TIL-094F90R01
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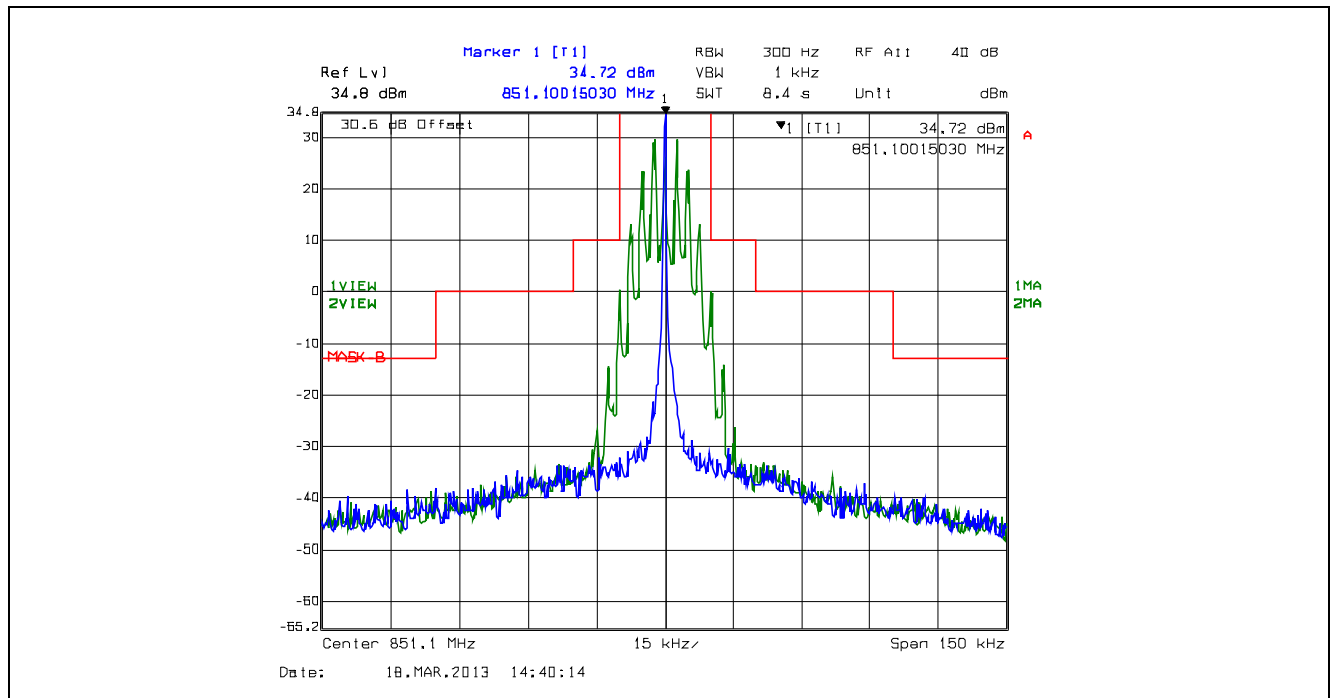
Plot 5.4.4.2.61. Emission Mask D, 12.5 kHz Channel Spacing, F3E, High Power, 868.9 MHz



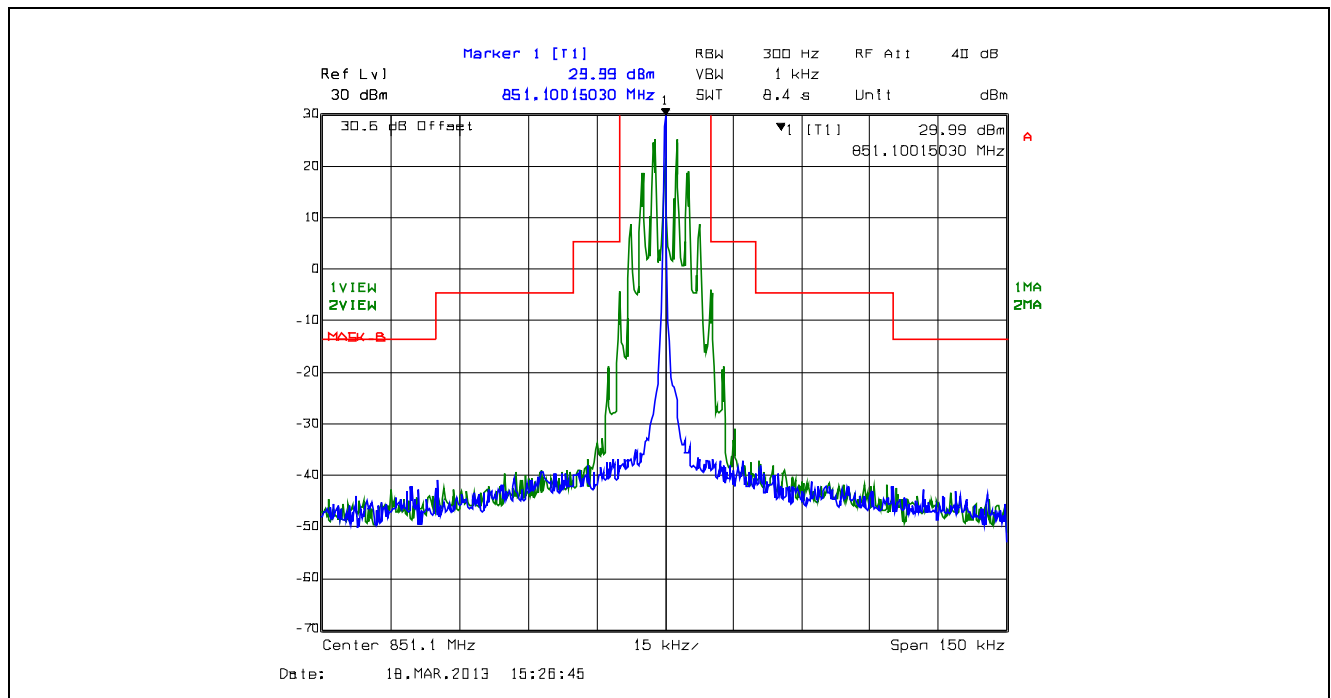
Plot 5.4.4.2.62. Emission Mask D, 12.5 kHz Channel Spacing, F3E, Low Power, 868.9 MHz



Plot 5.4.4.2.63. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 851.1 MHz



Plot 5.4.4.2.64. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 851.1 MHz



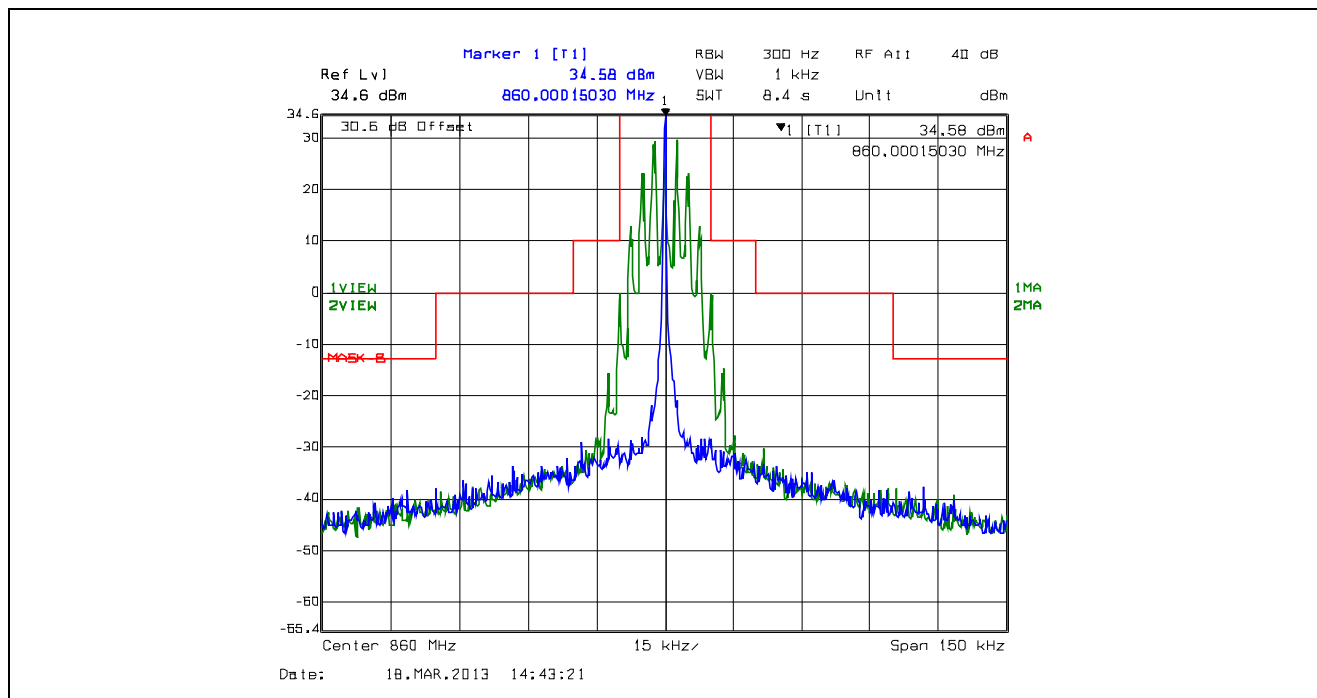
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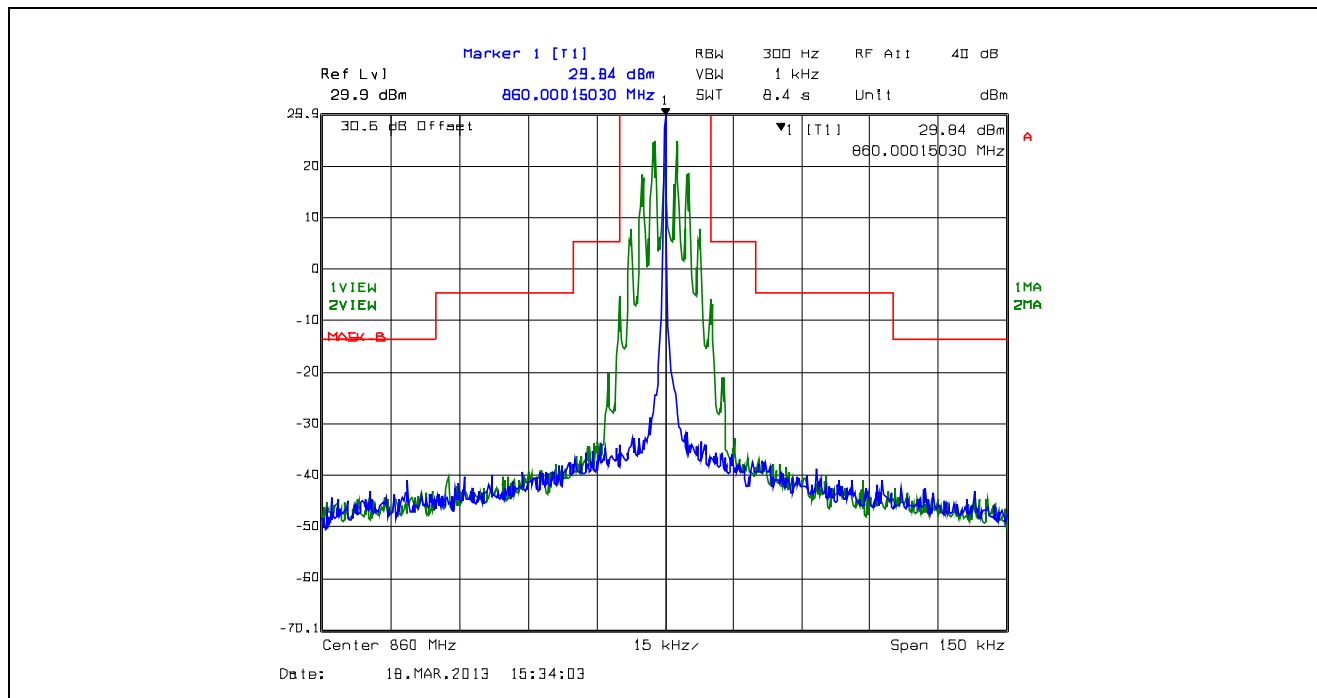
File #: TIL-094F90R01
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Plot 5.4.4.2.65. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 860.0 MHz



Plot 5.4.4.2.66. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 860.0 MHz



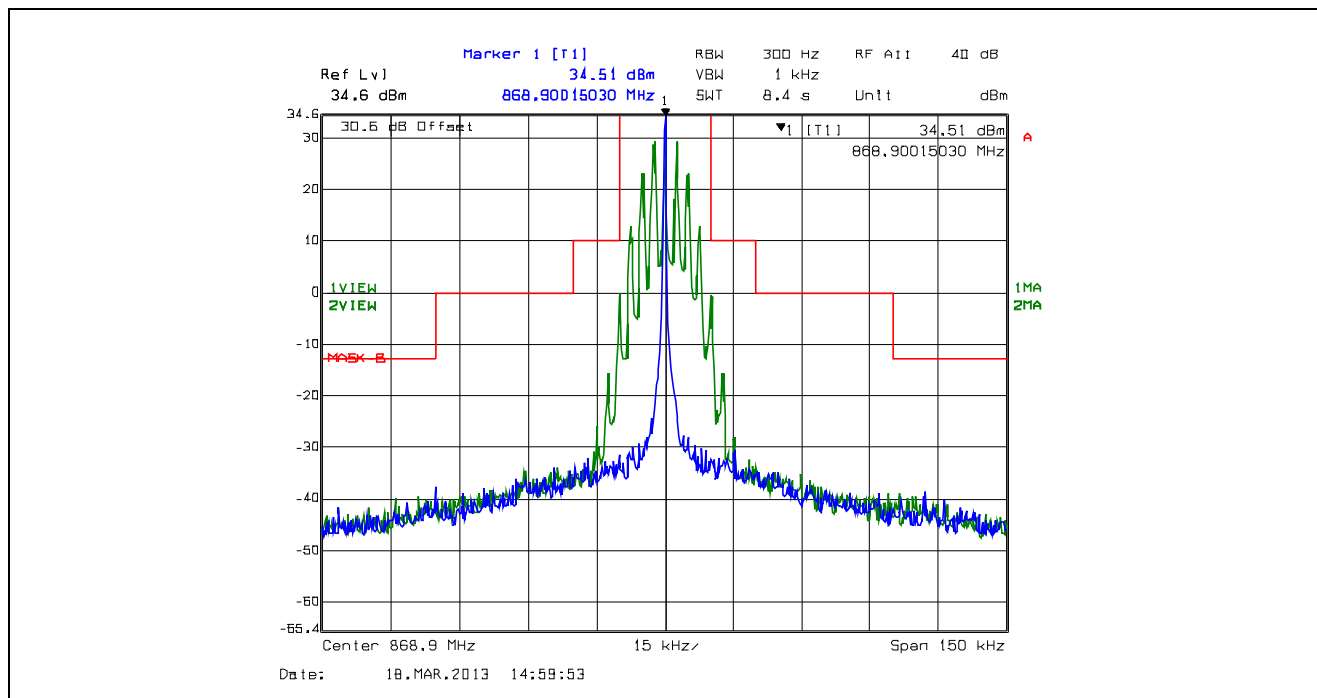
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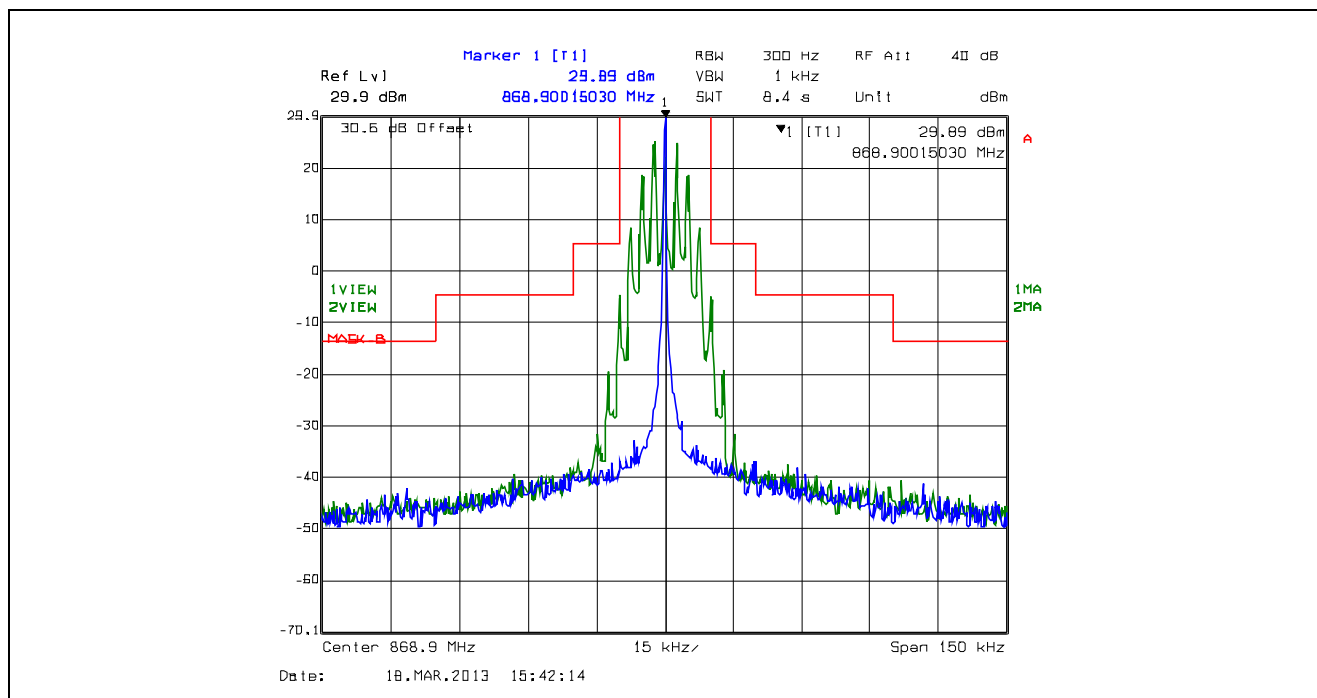
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

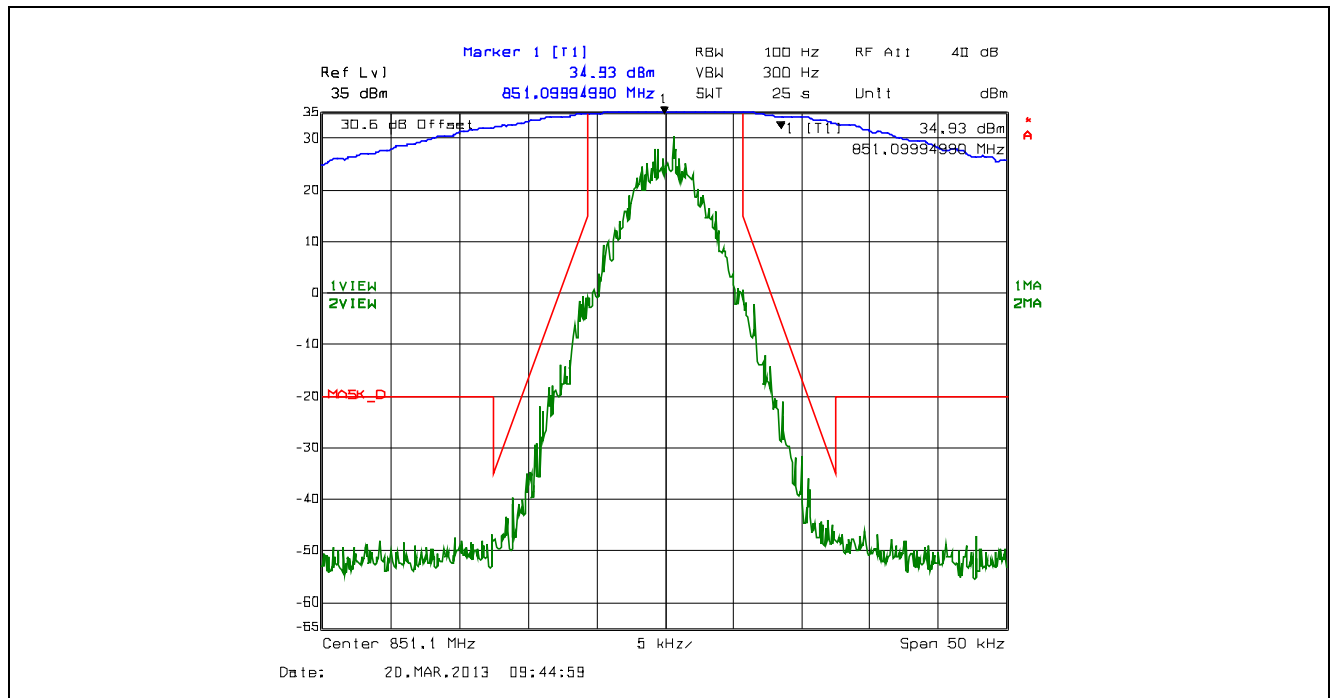
Plot 5.4.4.2.67. Emission Mask B, 25 kHz Channel Spacing, F3E, High Power, 868.9 MHz



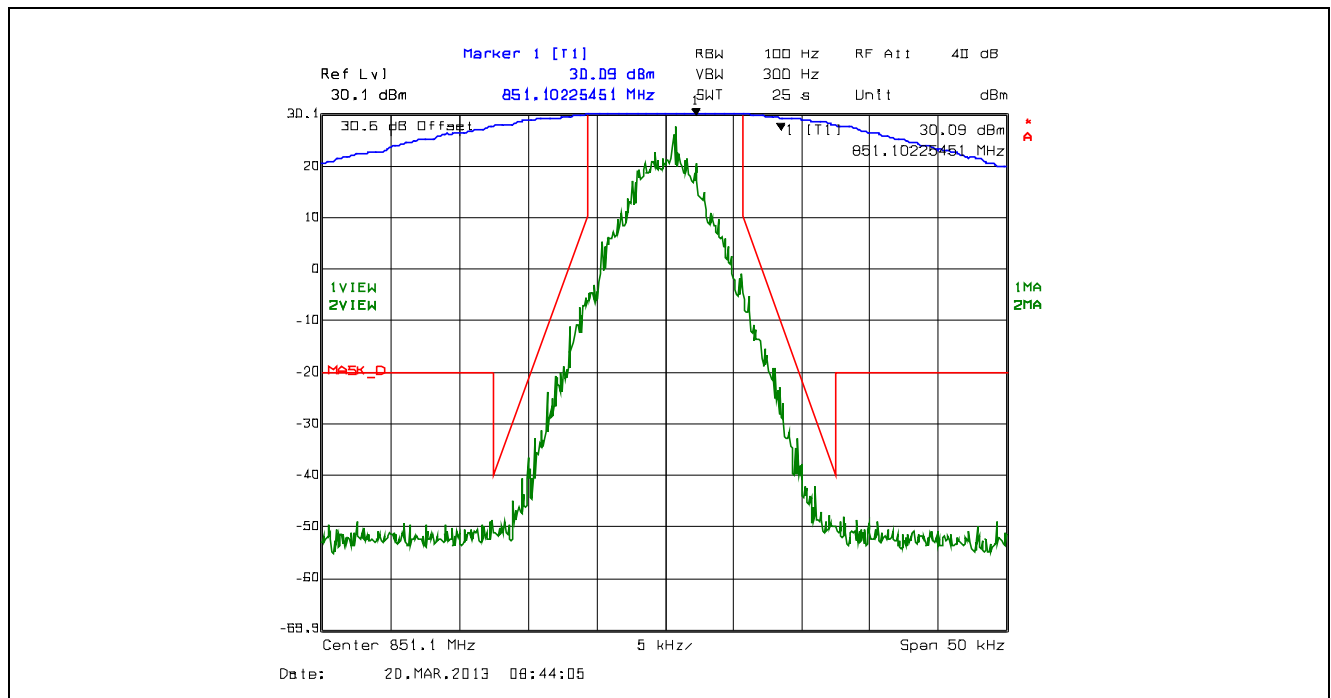
Plot 5.4.4.2.68. Emission Mask B, 25 kHz Channel Spacing, F3E, Low Power, 868.9 MHz



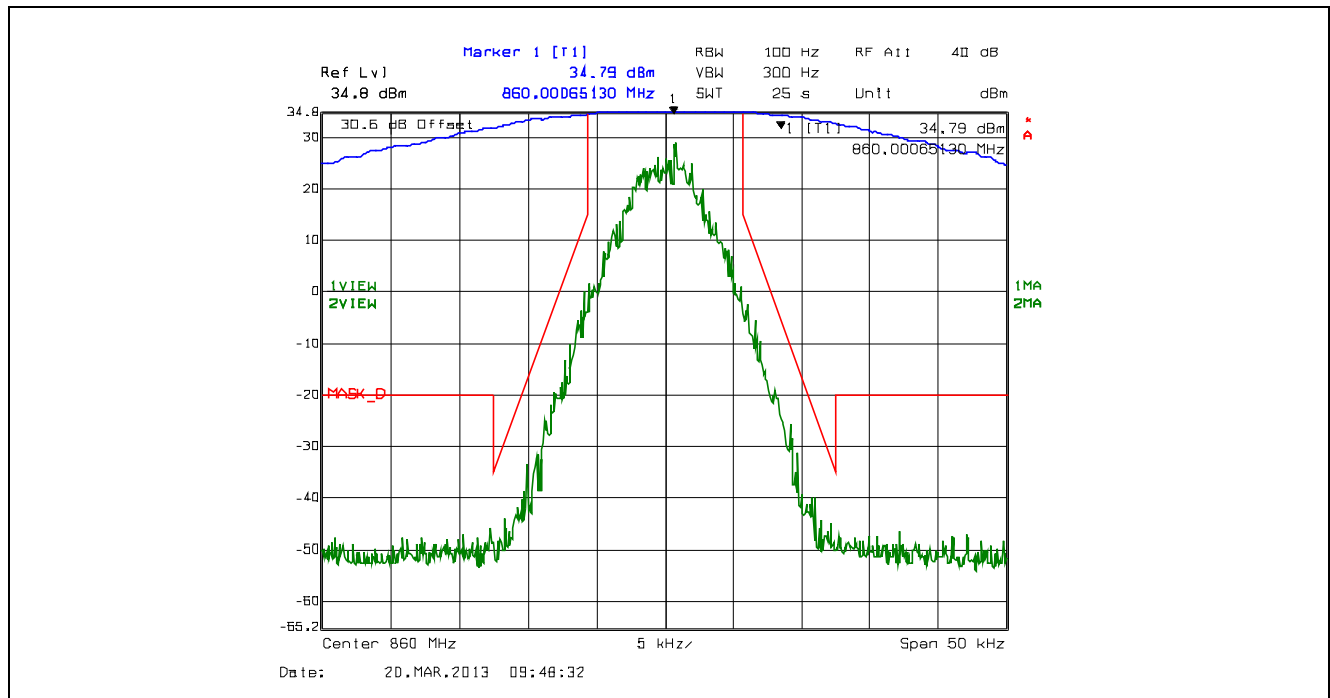
Plot 5.4.4.2.69. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 851.1 MHz



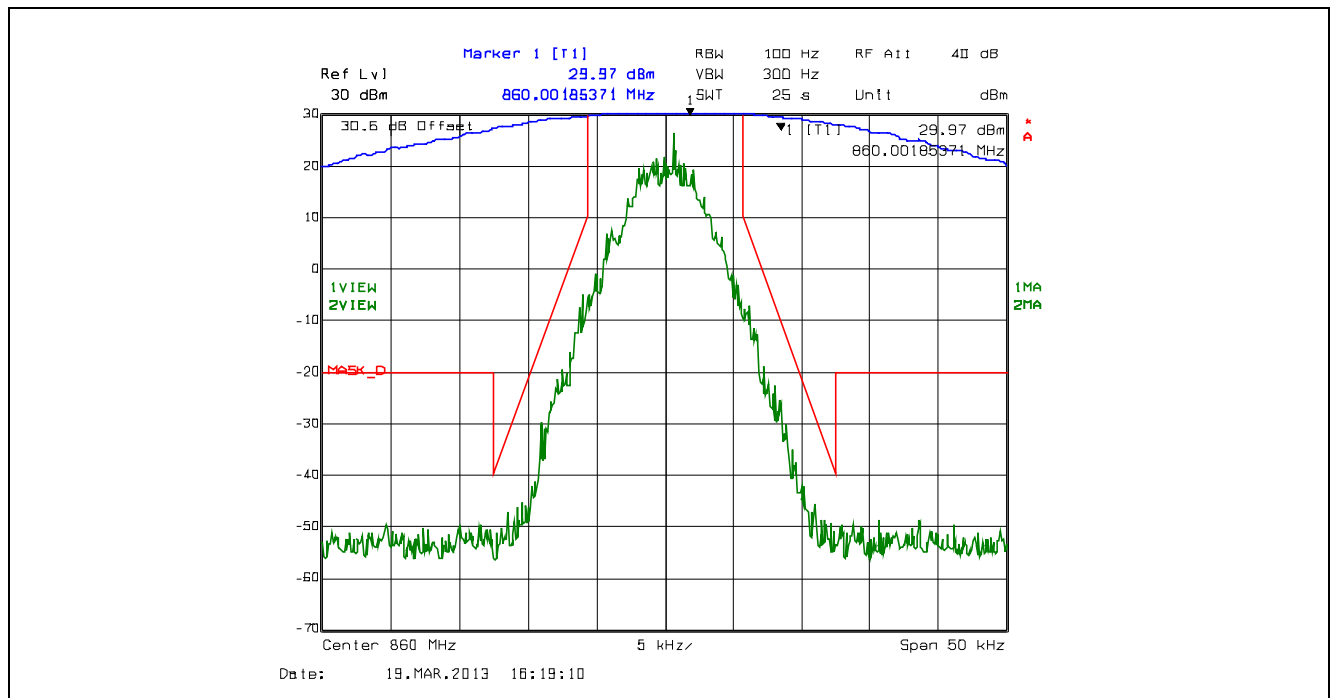
Plot 5.4.4.2.70. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 851.1 MHz



Plot 5.4.4.2.71. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 860.0 MHz



Plot 5.4.4.2.72. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 860.0 MHz



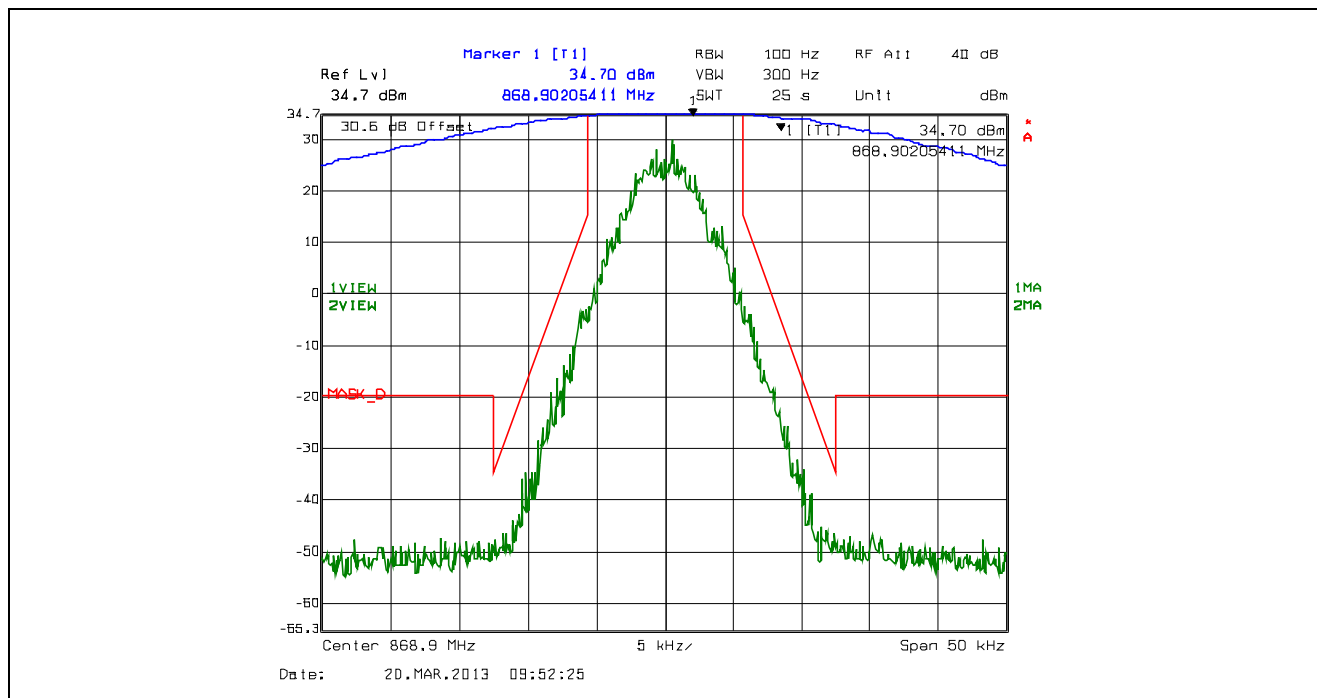
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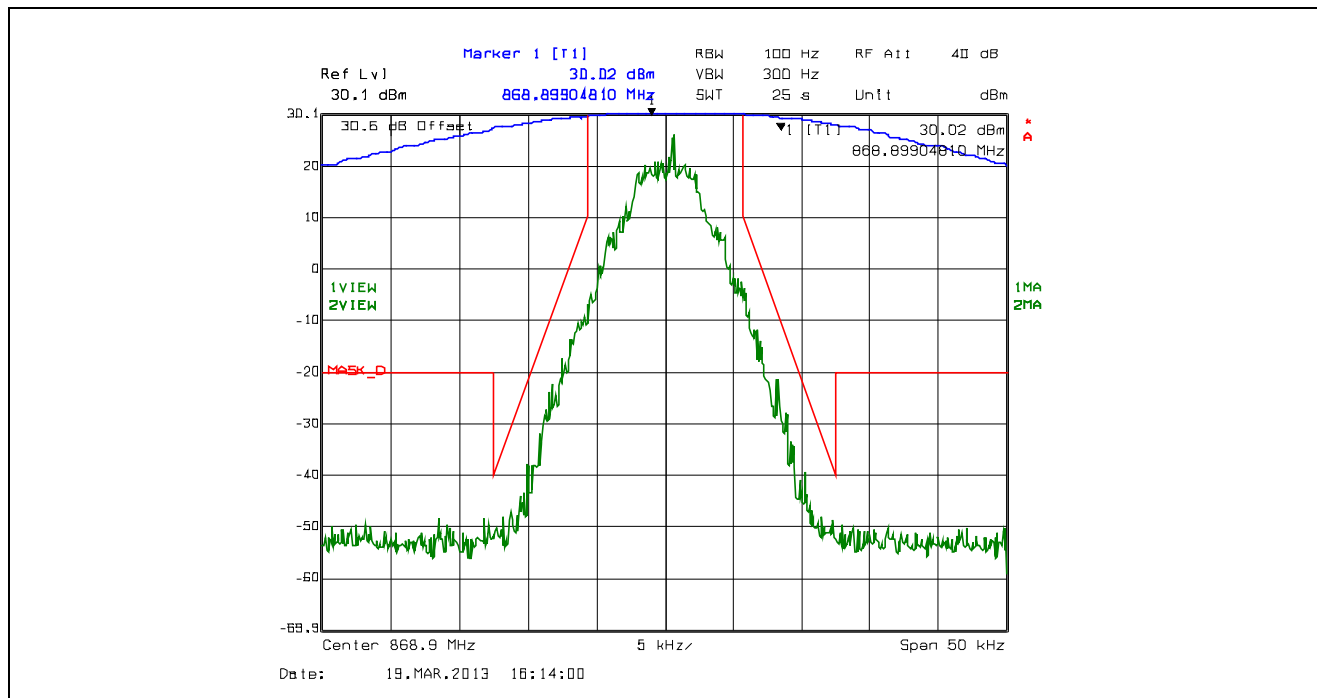
File #: TIL-094F90R01
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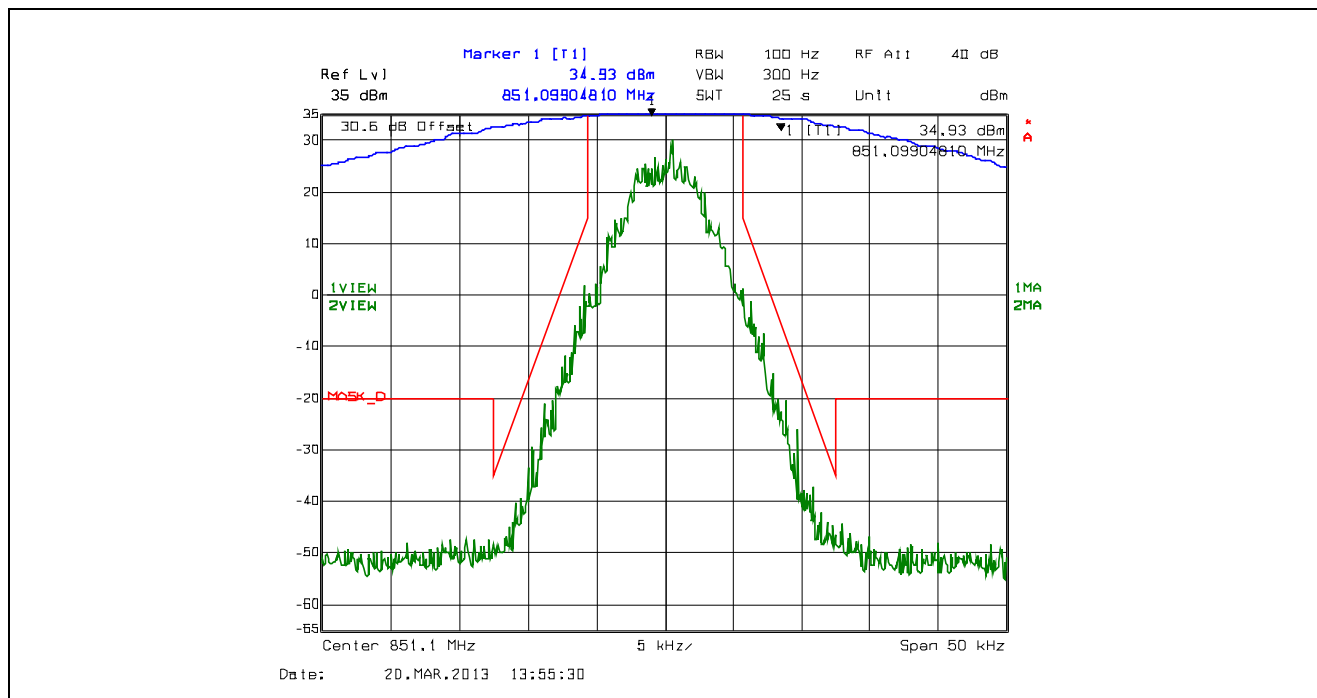
Plot 5.4.4.2.73. Emission Mask D, 12.5 kHz Channel Spacing, F1E, High Power, 868.9 MHz



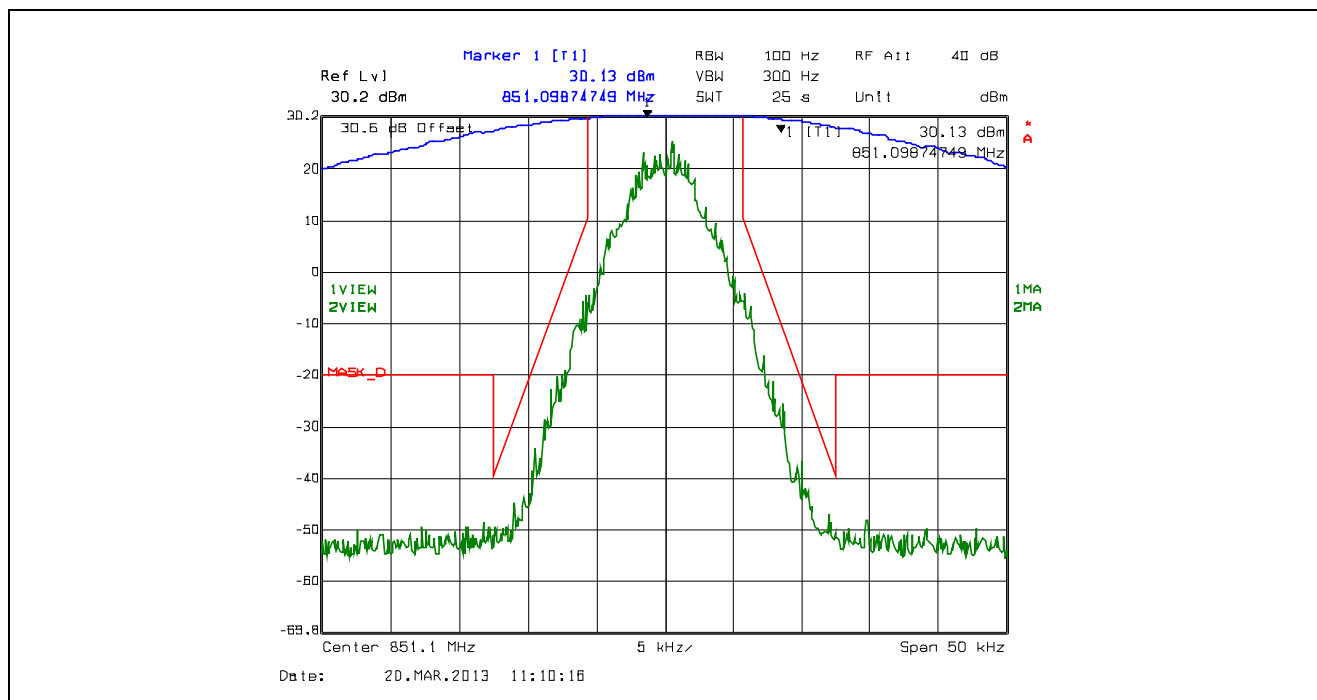
Plot 5.4.4.2.74. Emission Mask D, 12.5 kHz Channel Spacing, F1E, Low Power, 868.9 MHz



Plot 5.4.4.2.75. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 851.1 MHz



Plot 5.4.4.2.76. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 851.1 MHz



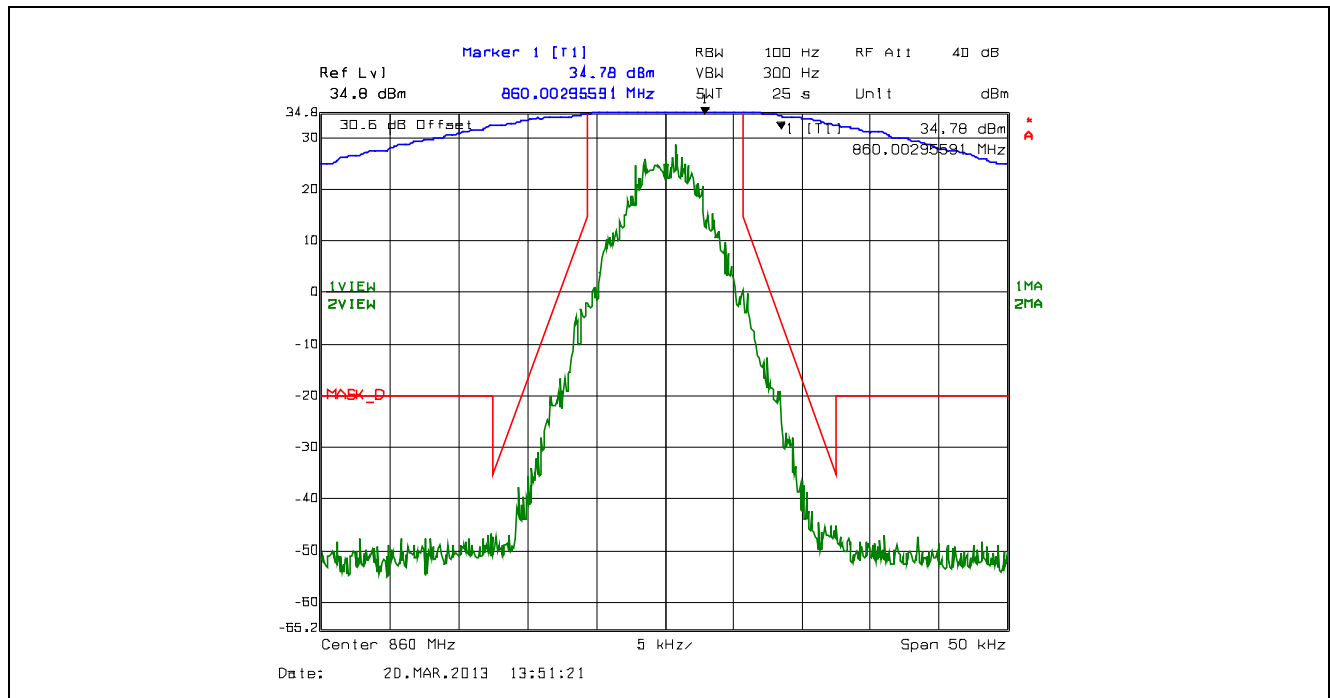
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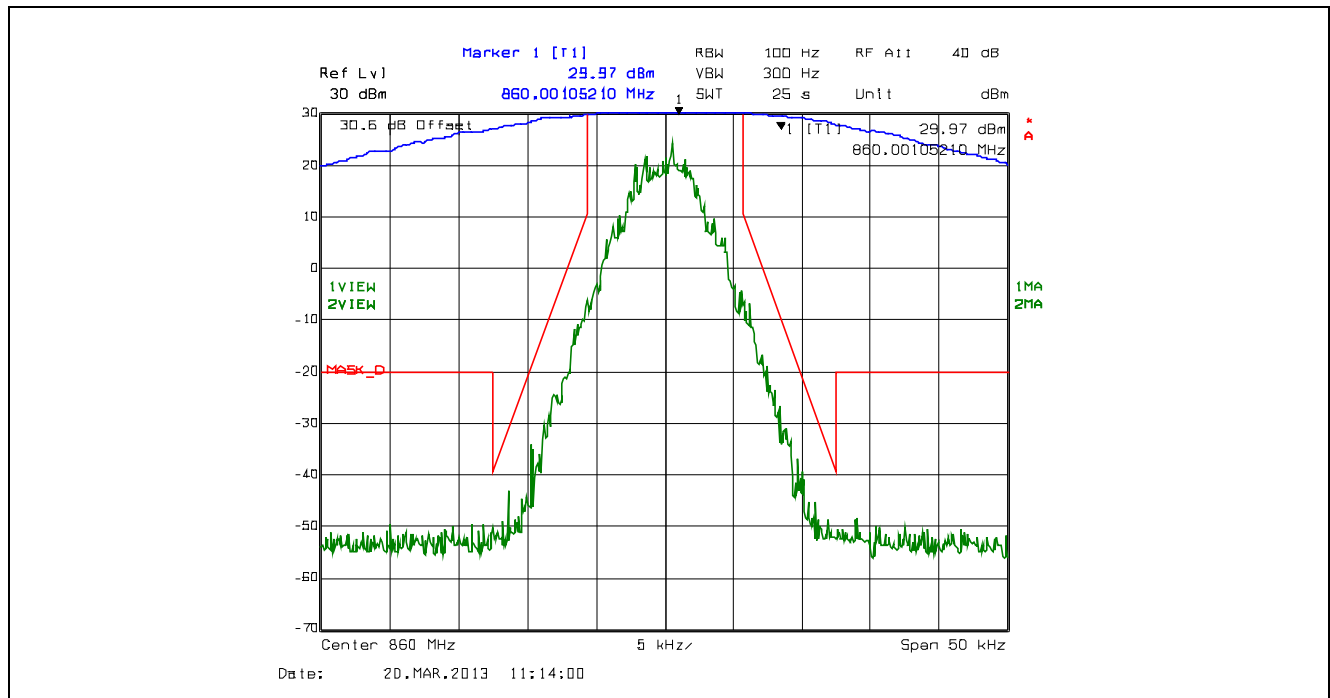
File #: TIL-094F90R01
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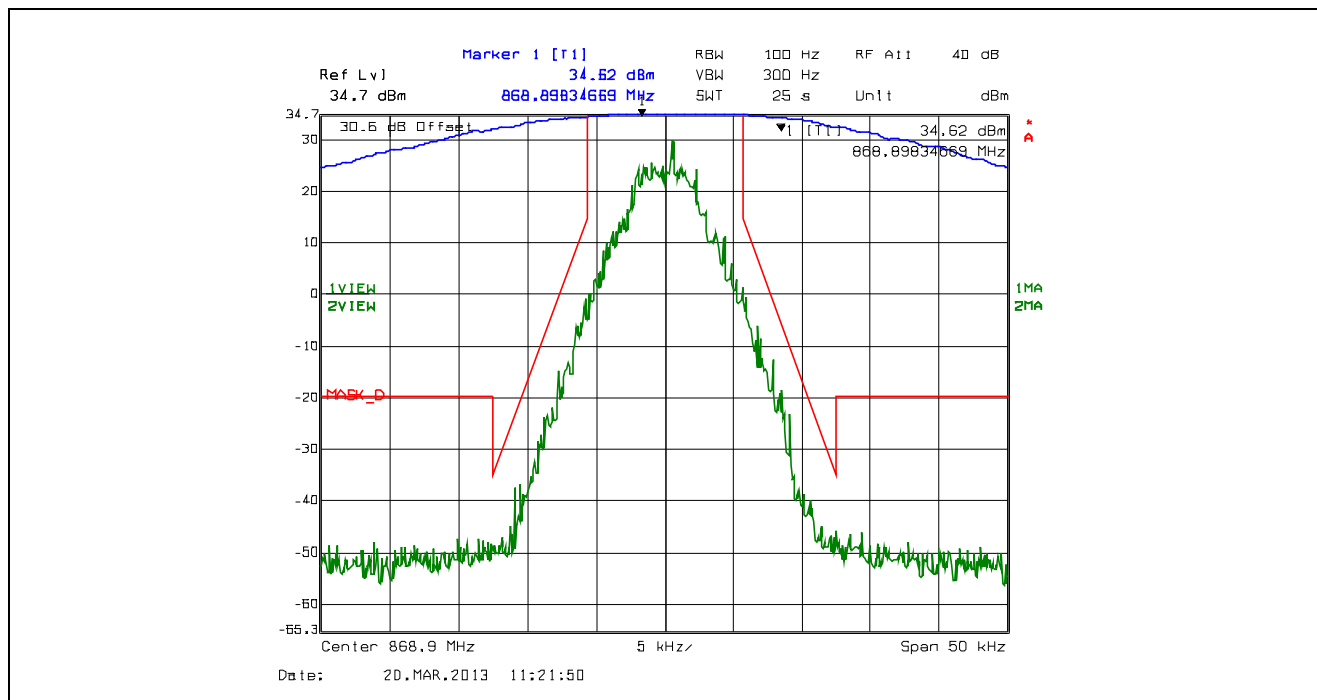
Plot 5.4.4.2.77. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 860.0 MHz



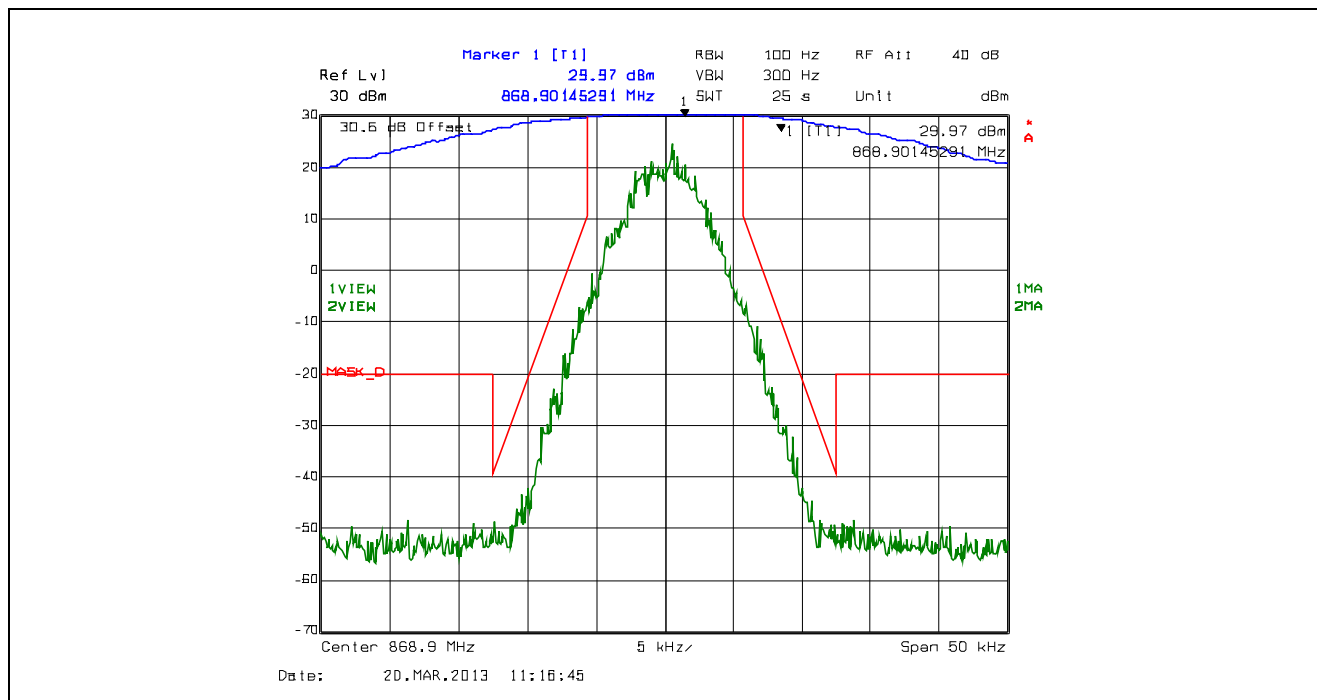
Plot 5.4.4.2.78. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 860.0 MHz



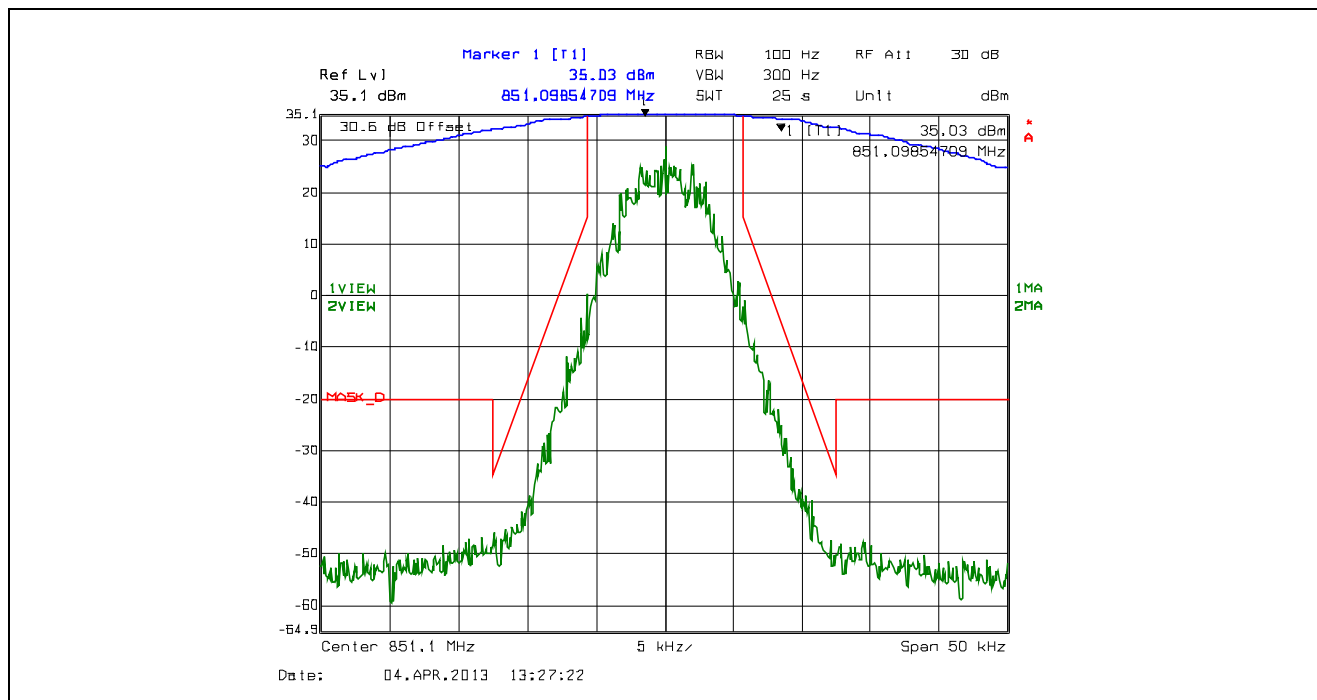
Plot 5.4.4.2.79. Emission Mask D, 12.5 kHz Channel Spacing, F1D, High Power, 868.9 MHz



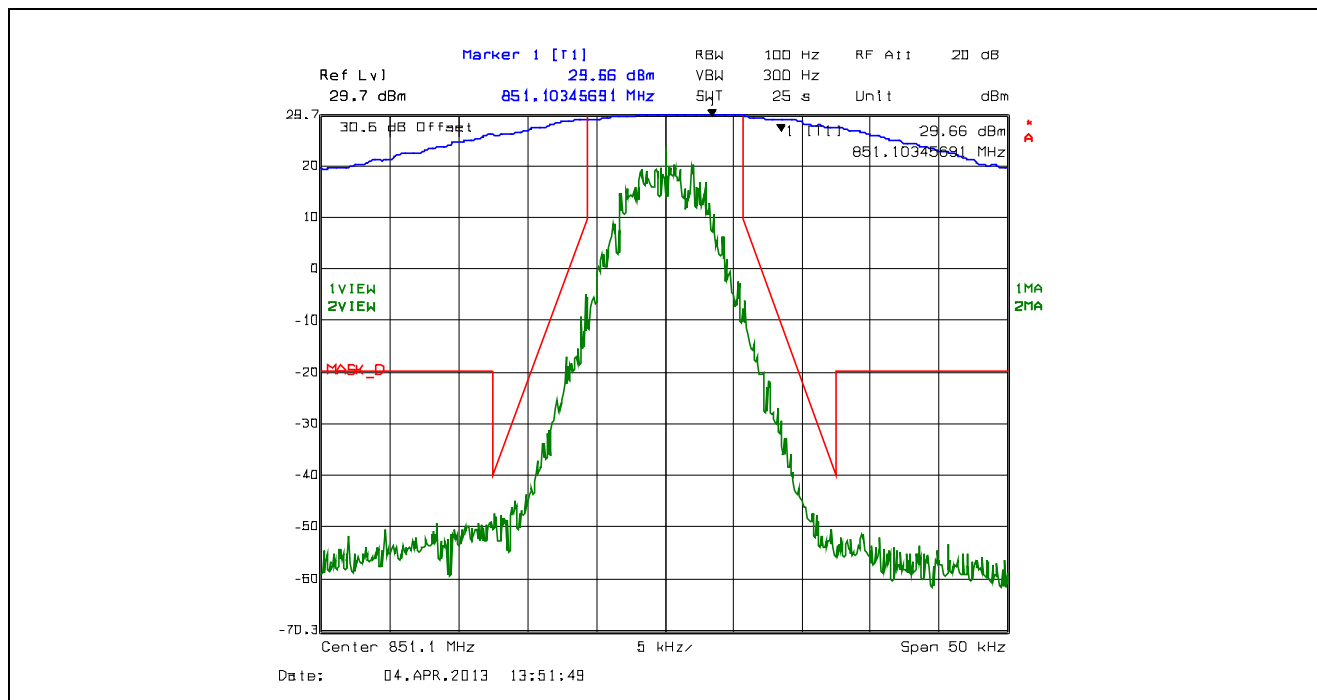
Plot 5.4.4.2.80. Emission Mask D, 12.5 kHz Channel Spacing, F1D, Low Power, 868.9 MHz



Plot 5.4.4.2.81. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 851.1 MHz



Plot 5.4.4.2.82. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 851.1 MHz



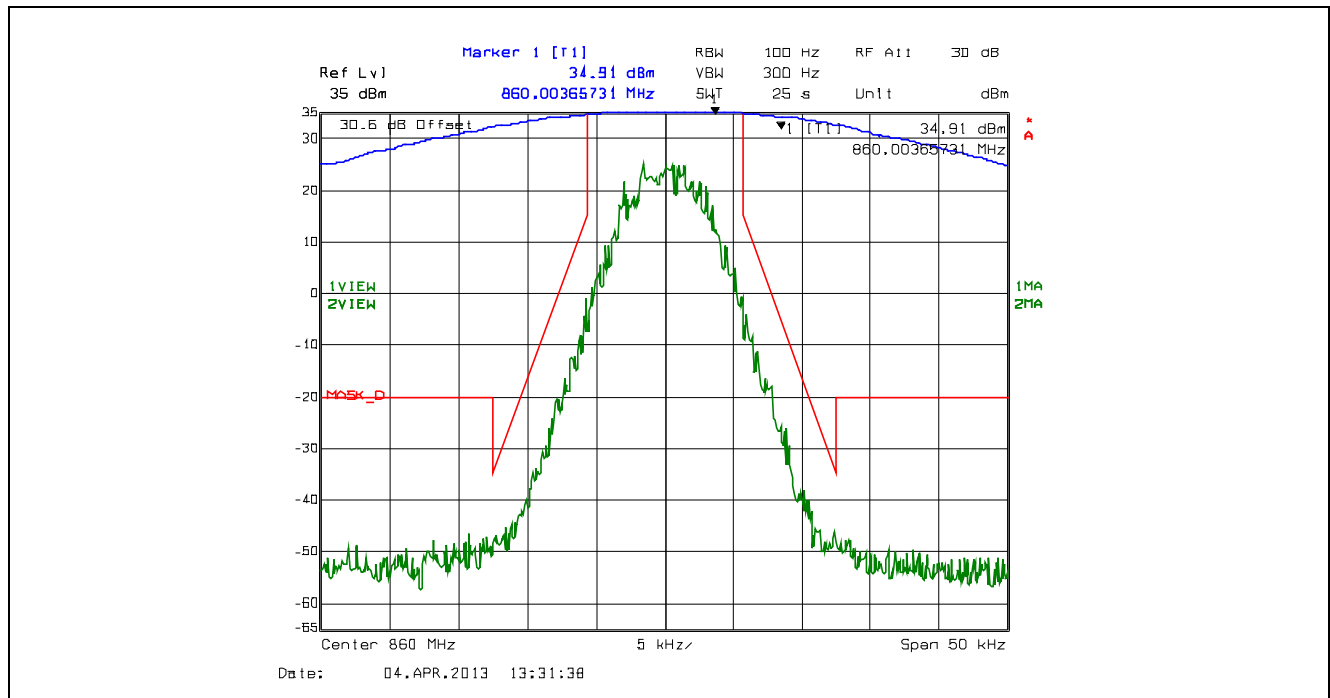
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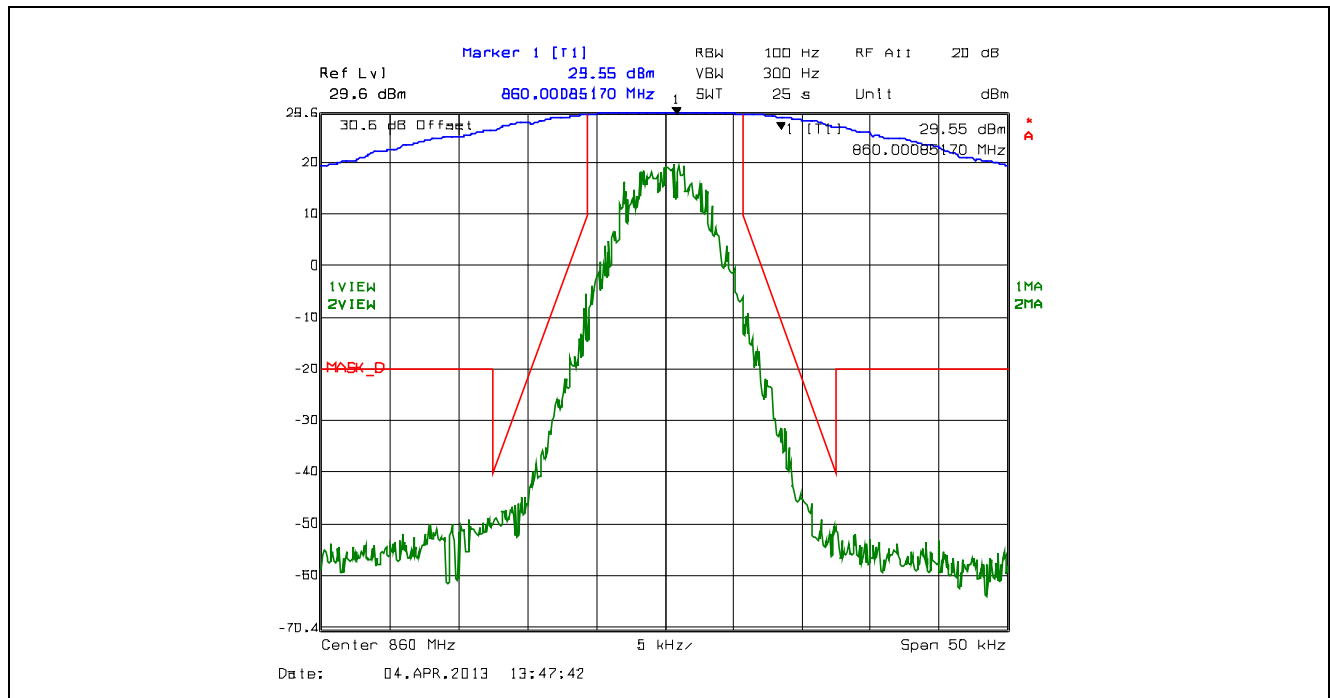
File #: TIL-094F90R01
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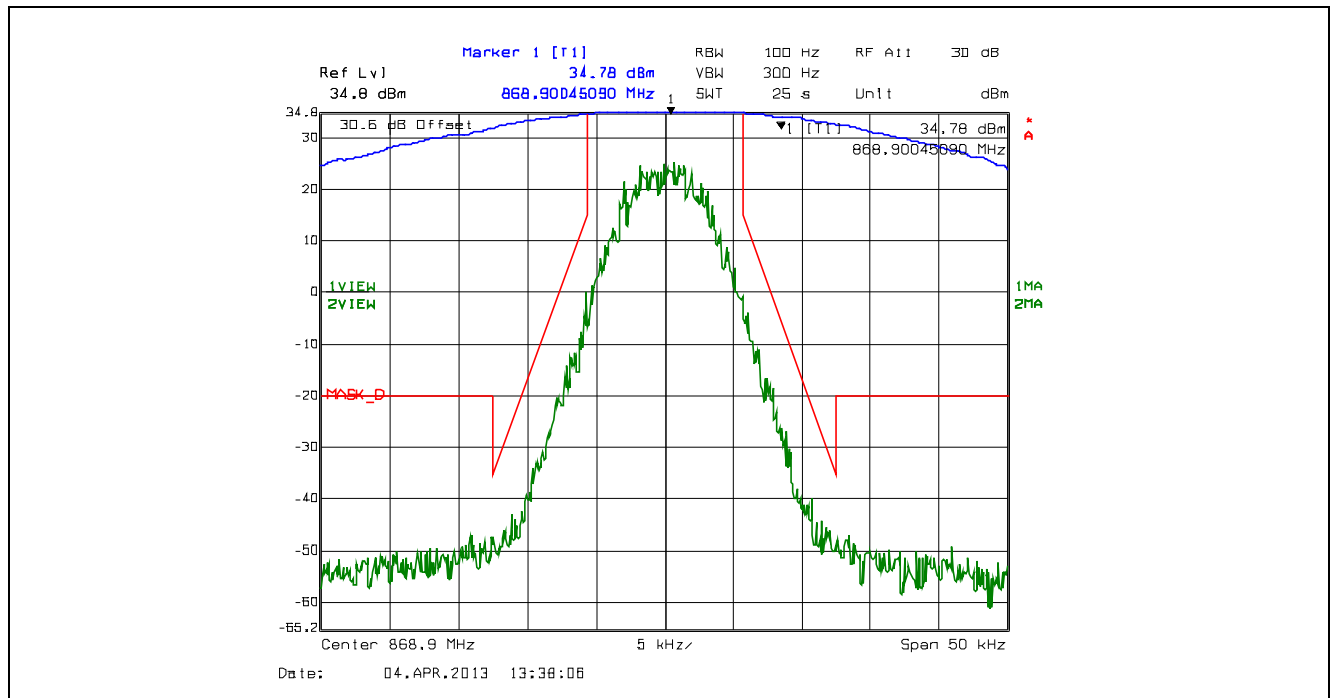
Plot 5.4.4.2.83. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 860.0 MHz



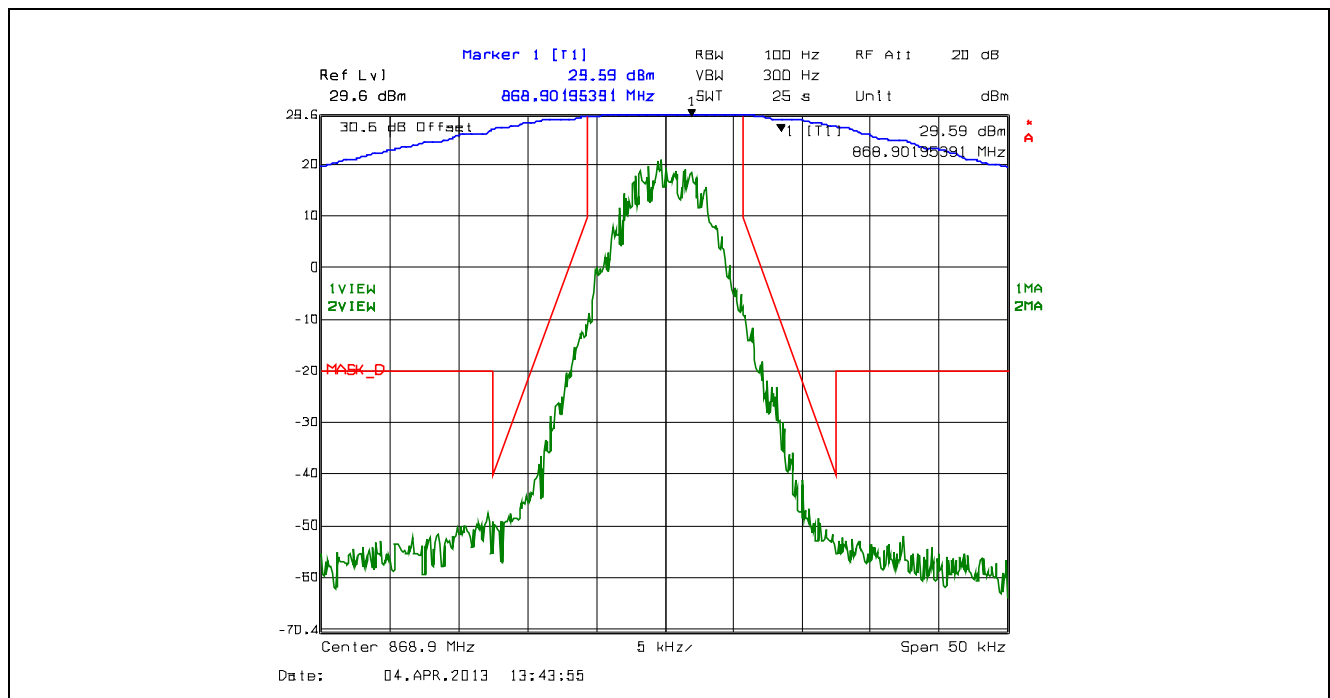
Plot 5.4.4.2.84. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 860.0 MHz



Plot 5.4.4.2.85. Emission Mask D, 12.5 kHz Channel Spacing, F1W, High Power, 868.9 MHz



Plot 5.4.4.2.86. Emission Mask D, 12.5 kHz Channel Spacing, F1W, Low Power, 868.9 MHz



5.5. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§§ 2.1051, 2.1057 & 90.210]

5.5.1. Limits

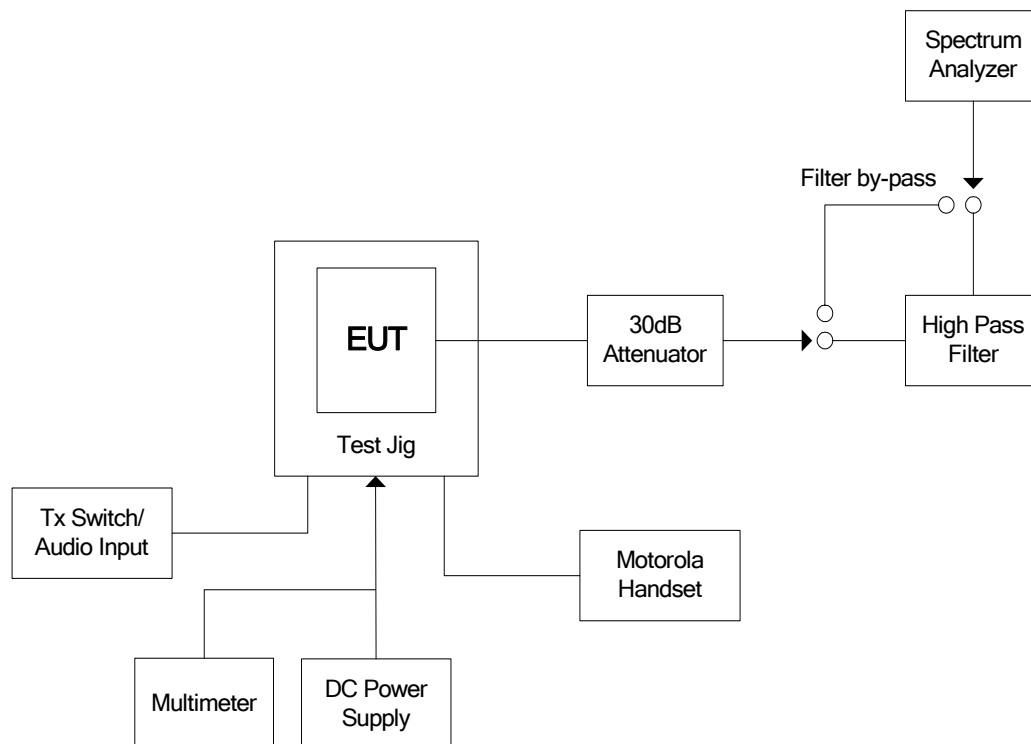
Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Frequency Range	Attenuation Limit (dBc)
§ 90.210(b)	10 MHz to Lowest frequency of the radio to 10 th harmonic of the highest frequency of the radio	At least $43 + 10 \log (P)$ dB.
§ 90.210(d)	10 MHz to Lowest frequency of the radio to 10th harmonic of the highest frequency of the radio	At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

5.5.2. Method of Measurements

Refer to Section 8.5 of this report for measurement details

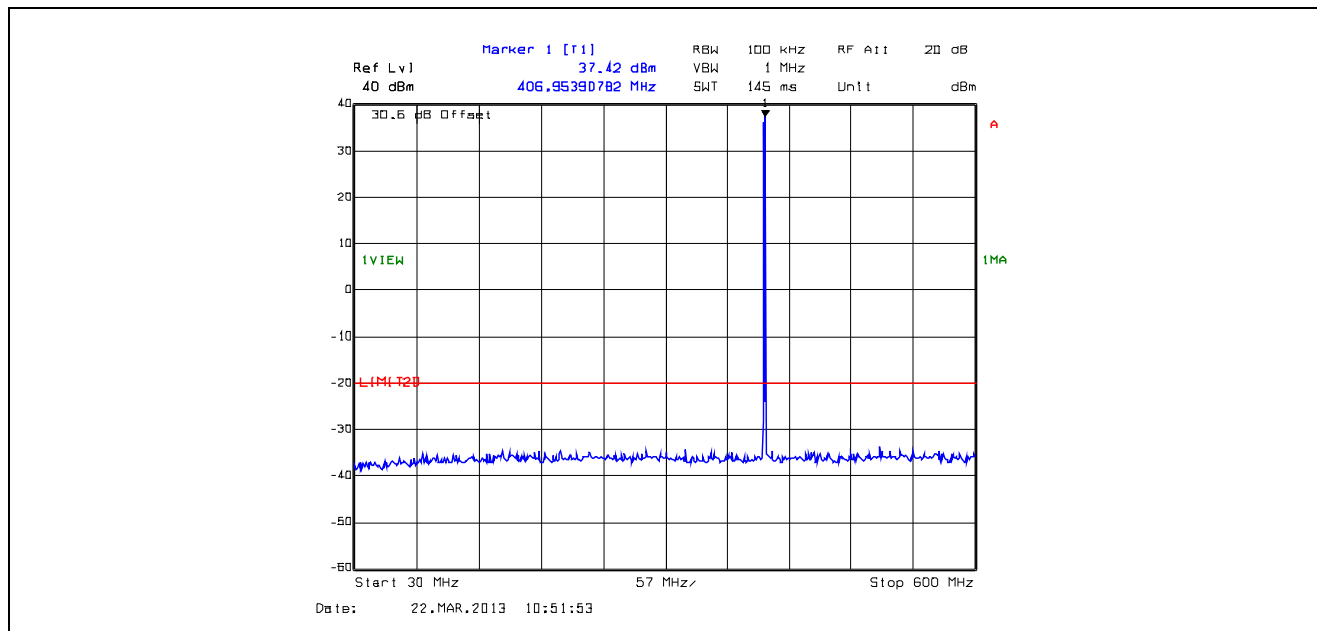
5.5.3. Test Arrangement



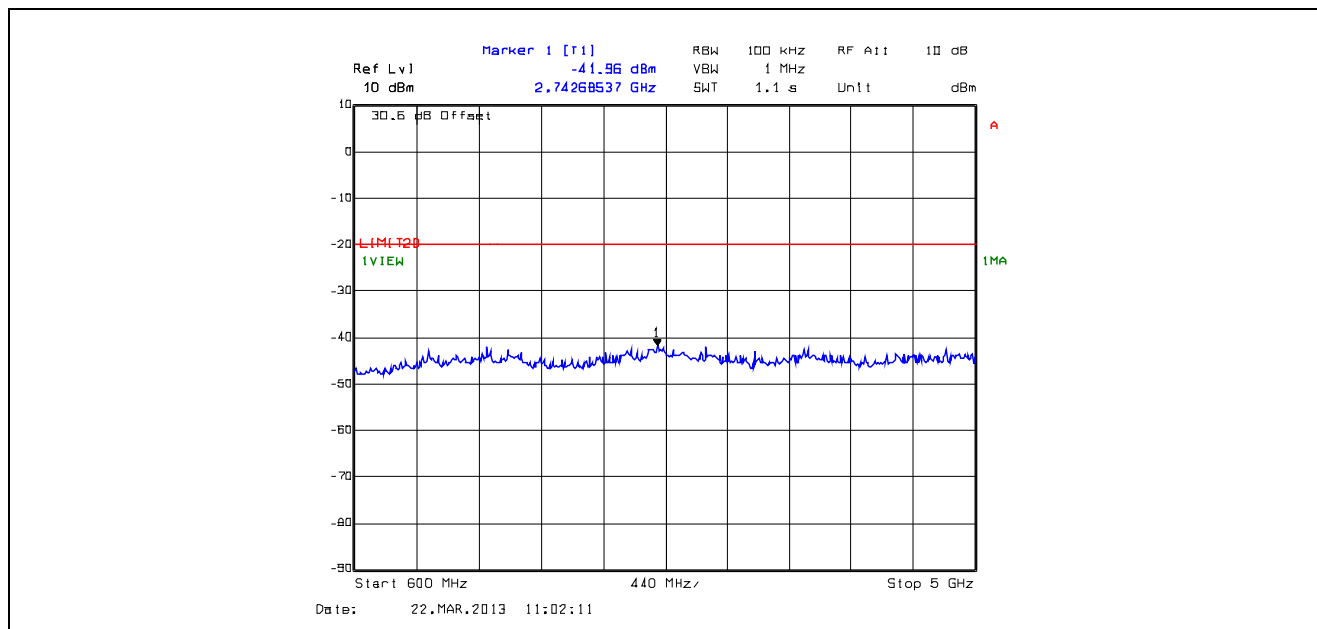
5.5.4. Test Data

Remark: Exploratory tests were conducted with modulations in the range of typical modes of operation to identify the worst-case modulation. There were no discernable differences detected. The analog mode, operating at 12.5 kHz channel spacing was used to represent the worst-case test configuration for the final measurement.

Plot 5.5.4.1. Conducted Transmitter Spurious Emissions, High Power, 406.2 MHz, 30 MHz - 600 MHz



Plot 5.5.4.2. Conducted Transmitter Spurious Emissions, High Power, 406.2 MHz, 600 MHz - 5 GHz



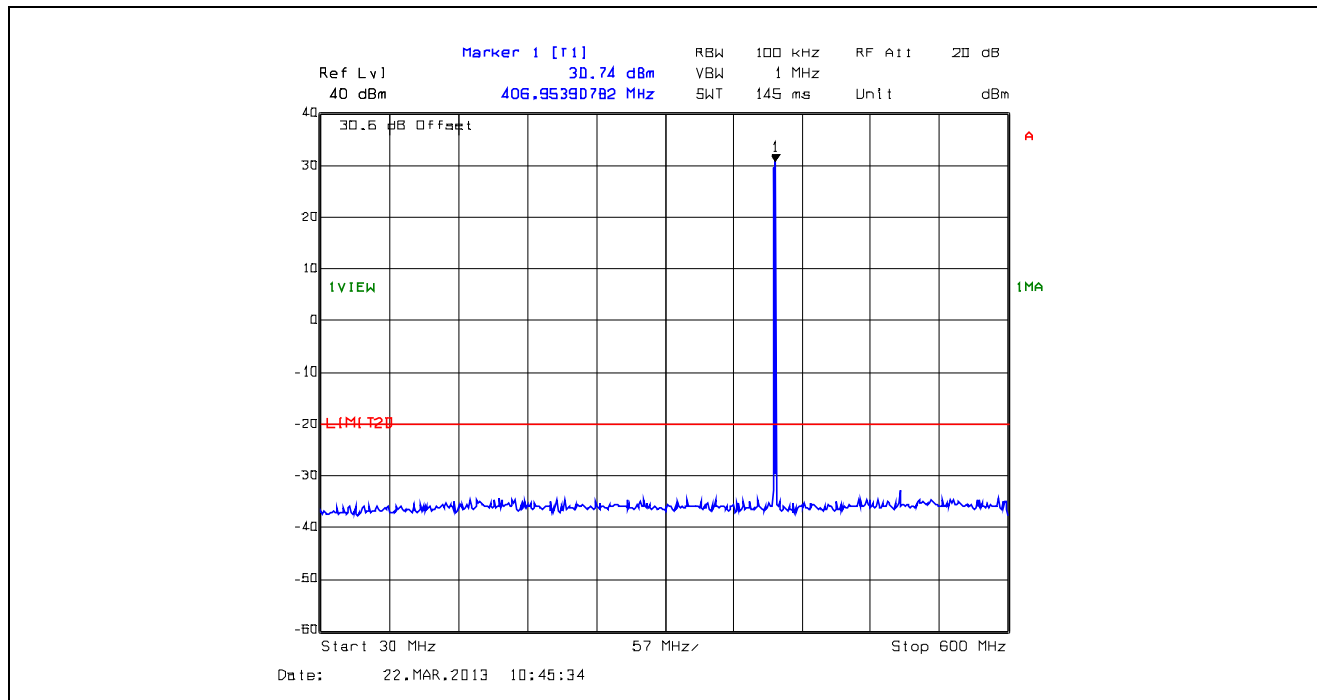
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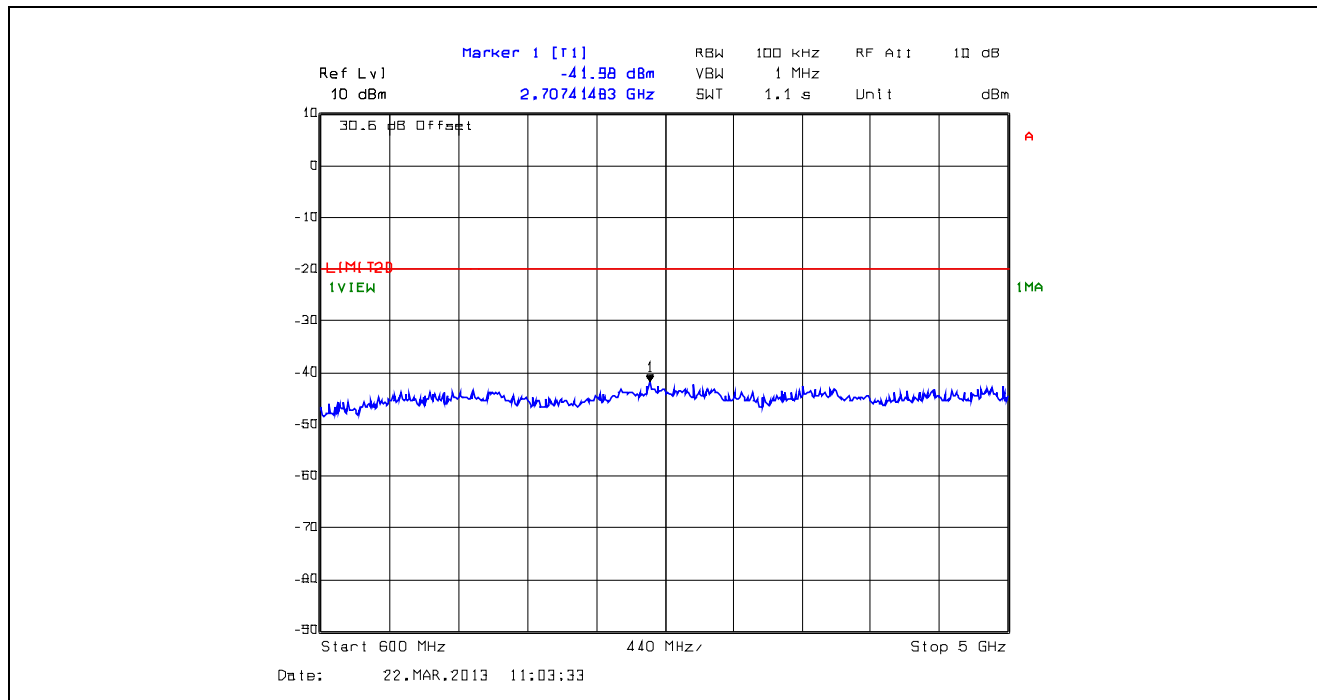
File #: TIL-094F90R01
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Plot 5.5.4.3. Conducted Transmitter Spurious Emissions, Low Power, 406.2 MHz, 30 MHz - 600 MHz



Plot 5.5.4.4. Conducted Transmitter Spurious Emissions, Low Power, 406.2 MHz, 600 MHz -5 GHz



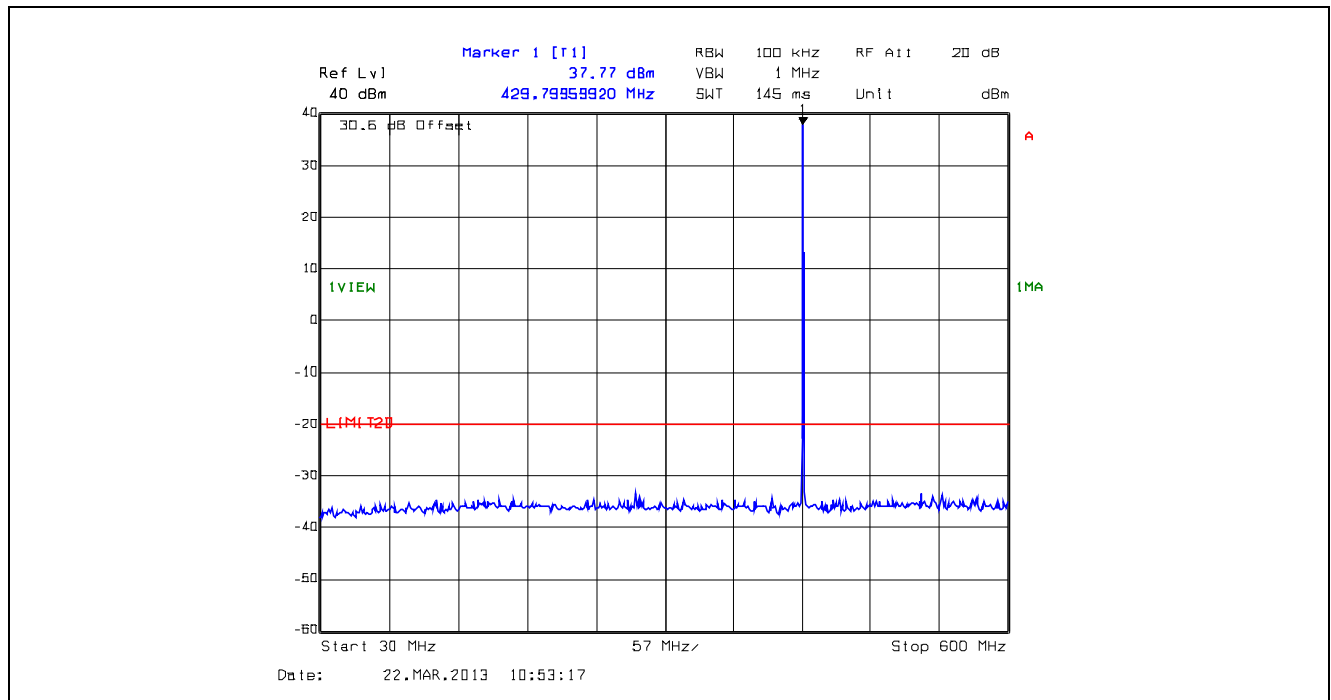
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

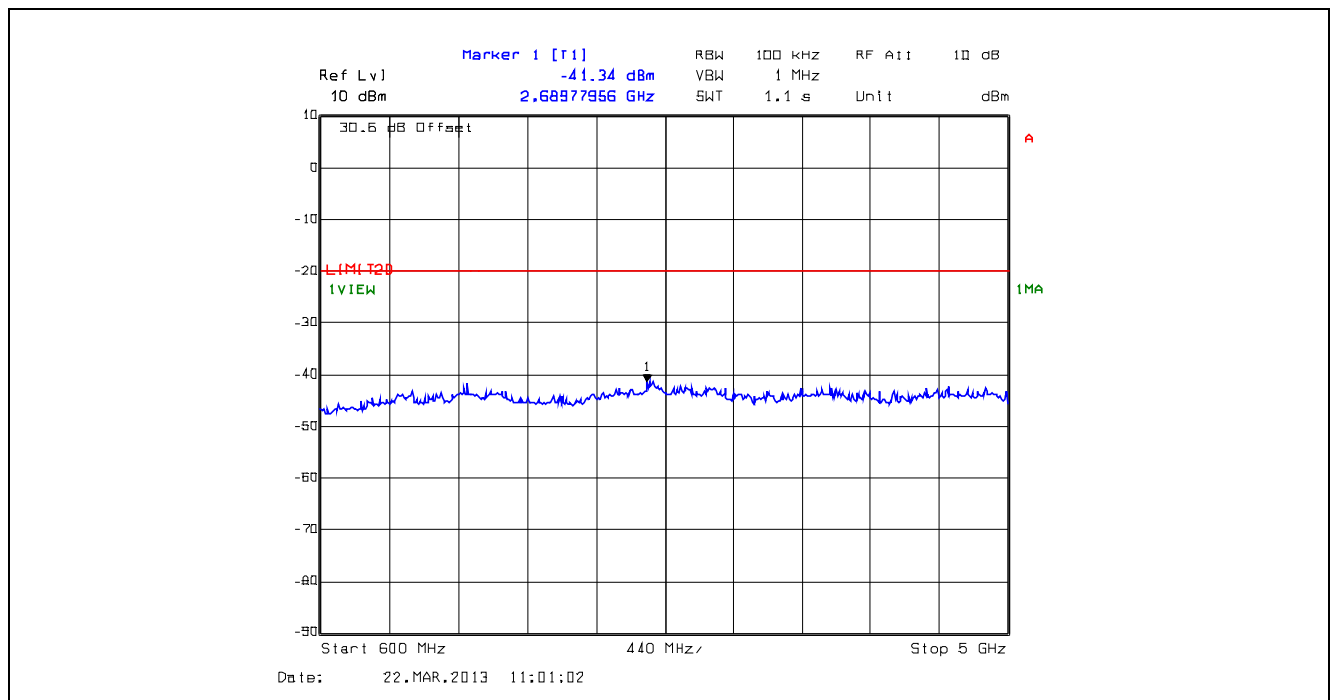
File #: TIL-094F90R01
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Plot 5.5.4.5. Conducted Transmitter Spurious Emissions, High Power, 429.9 MHz, 30 MHz - 600 MHz



Plot 5.5.4.6. Conducted Transmitter Spurious Emissions, High Power, 429.9 MHz, 600 MHz -5 GHz



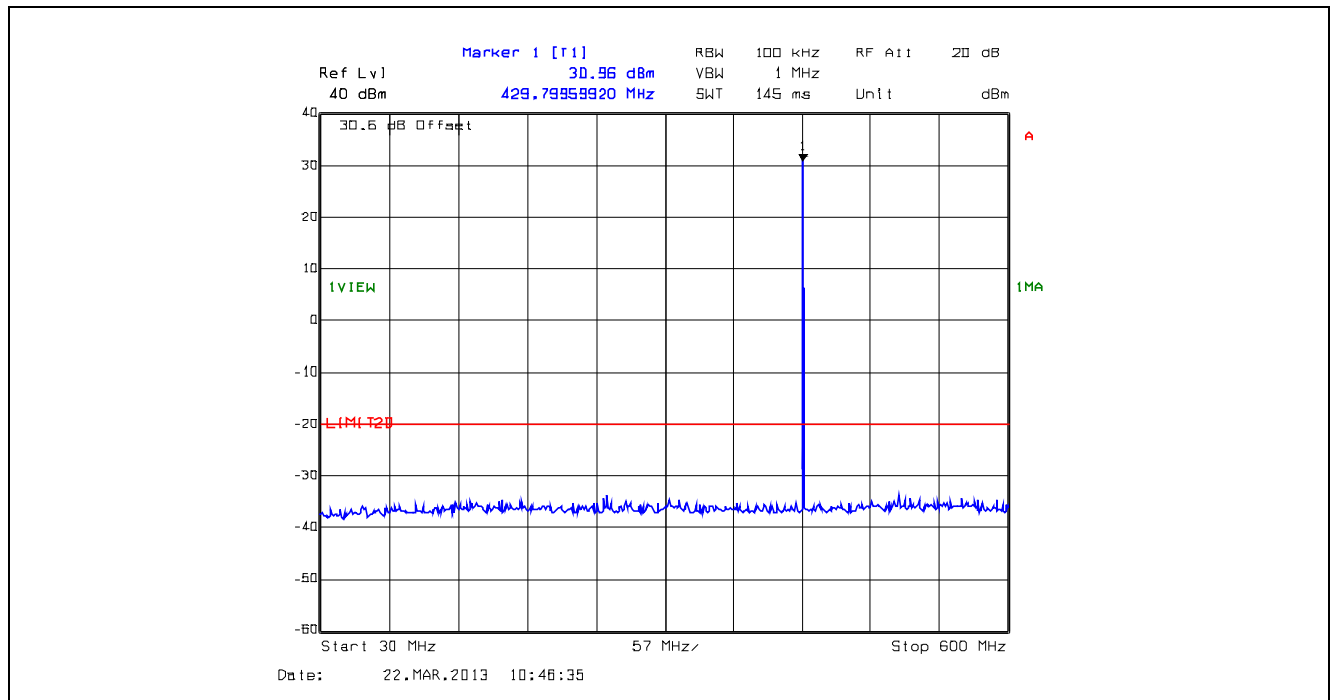
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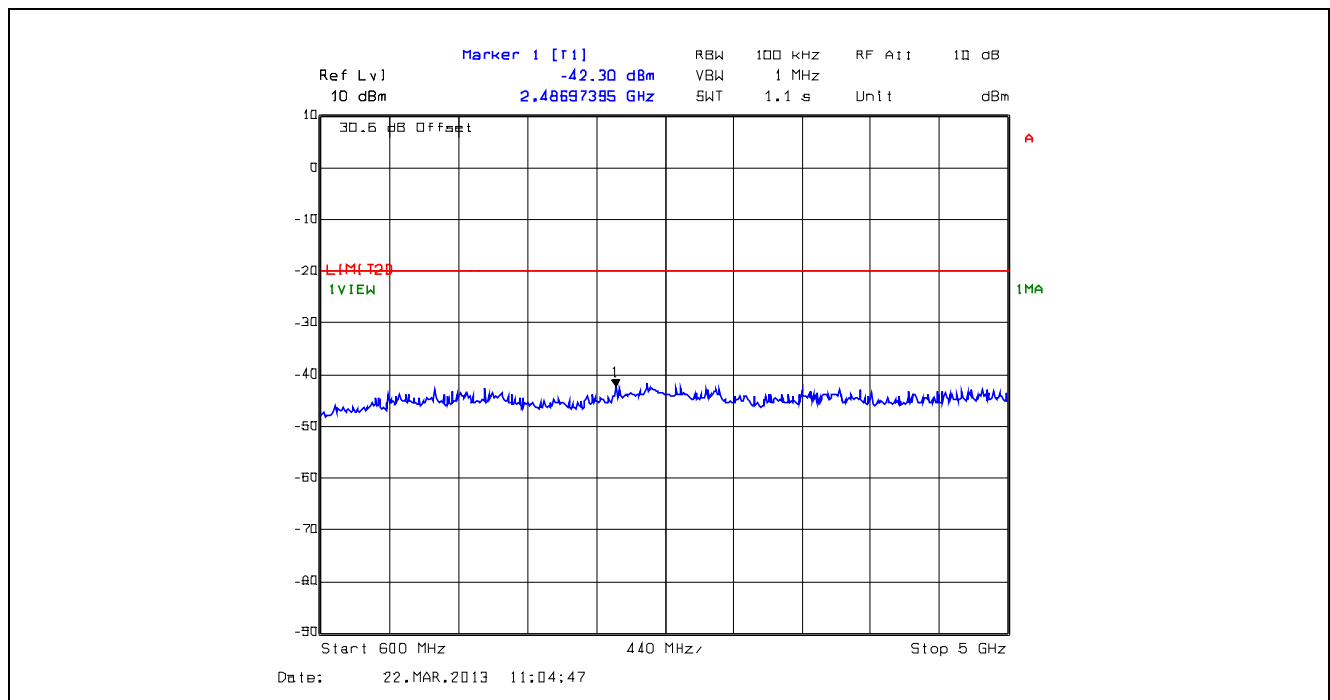
File #: TIL-094F90R01
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Plot 5.5.4.7. Conducted Transmitter Spurious Emissions, Low Power, 429.9 MHz, 30 MHz - 600 MHz



Plot 5.5.4.8. Conducted Transmitter Spurious Emissions, Low Power, 429.9 MHz, 600 MHz -5 GHz



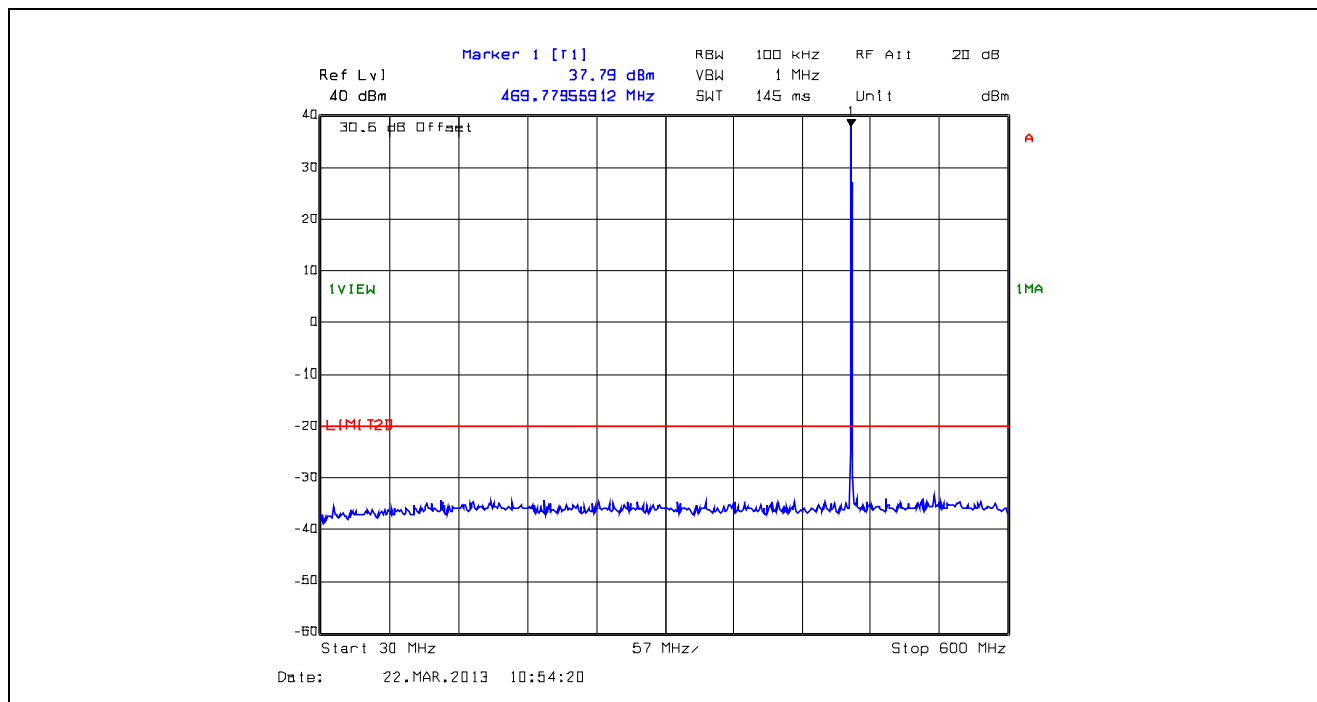
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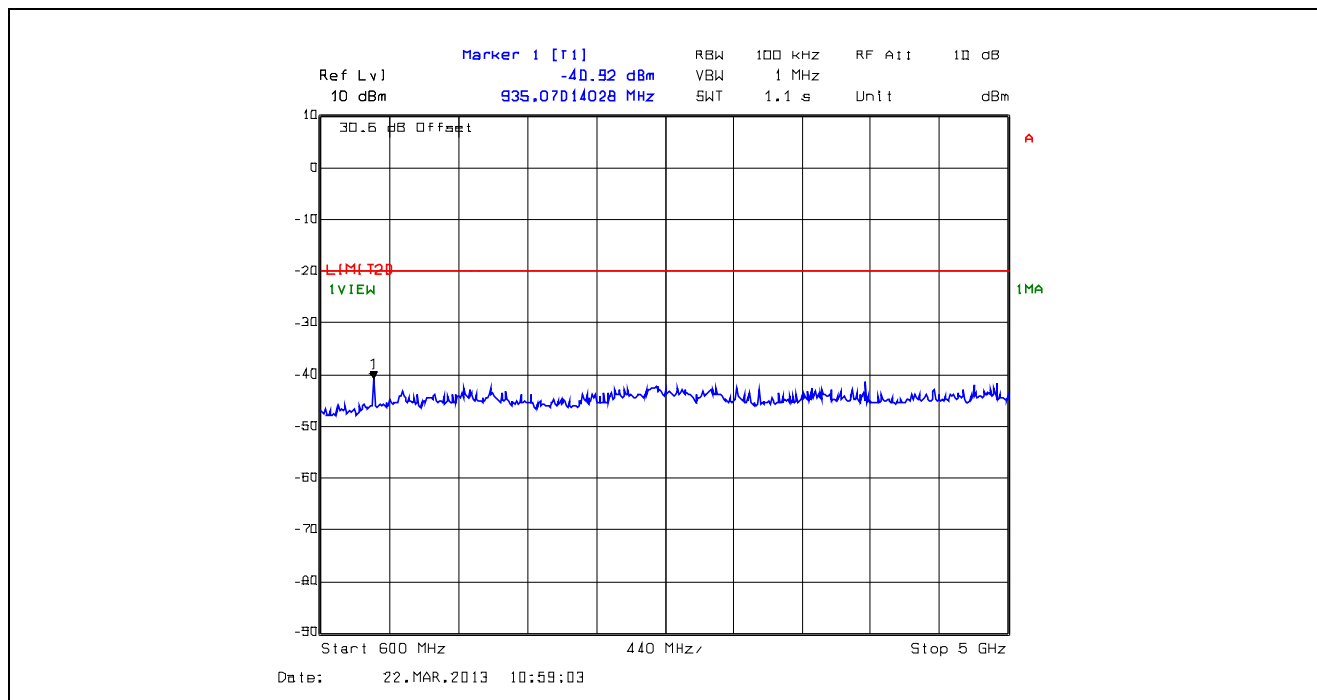
File #: TIL-094F90R01
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Plot 5.5.4.9. Conducted Transmitter Spurious Emissions, High Power, 469.9 MHz, 30 MHz - 600 MHz



Plot 5.5.4.10. Conducted Transmitter Spurious Emissions, High Power, 469.9 MHz, 600 MHz - 5 GHz



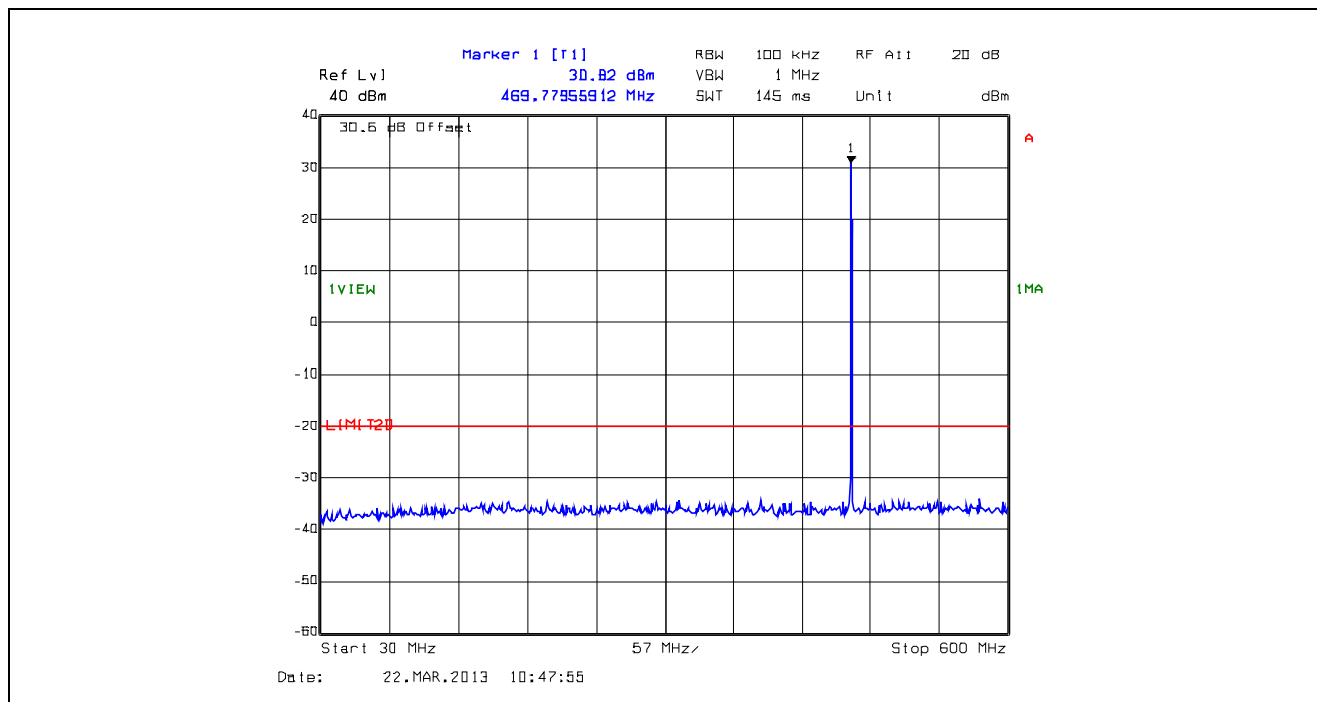
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

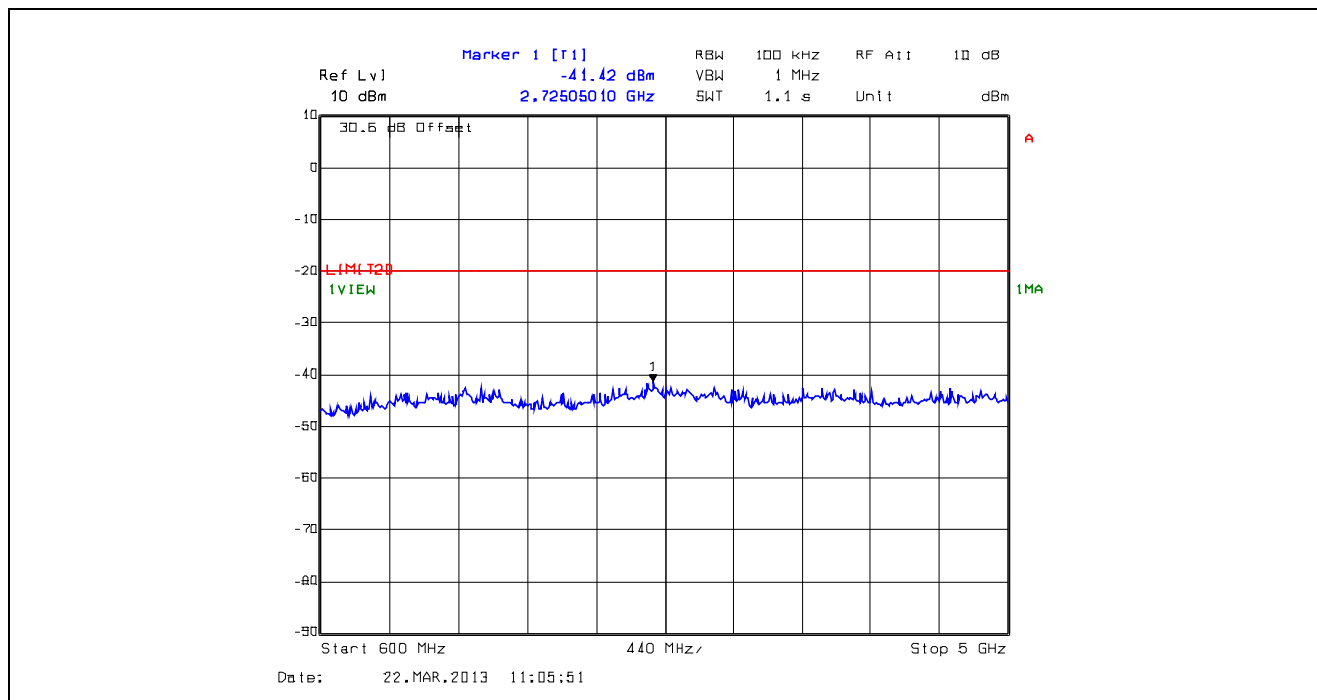
File #: TIL-094F90R01
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Plot 5.5.4.11. Conducted Transmitter Spurious Emissions, Low Power, 469.9 MHz, 30 MHz - 600 MHz



Plot 5.5.4.12. Conducted Transmitter Spurious Emissions, Low Power, 469.9 MHz, 600 MHz - 5 GHz



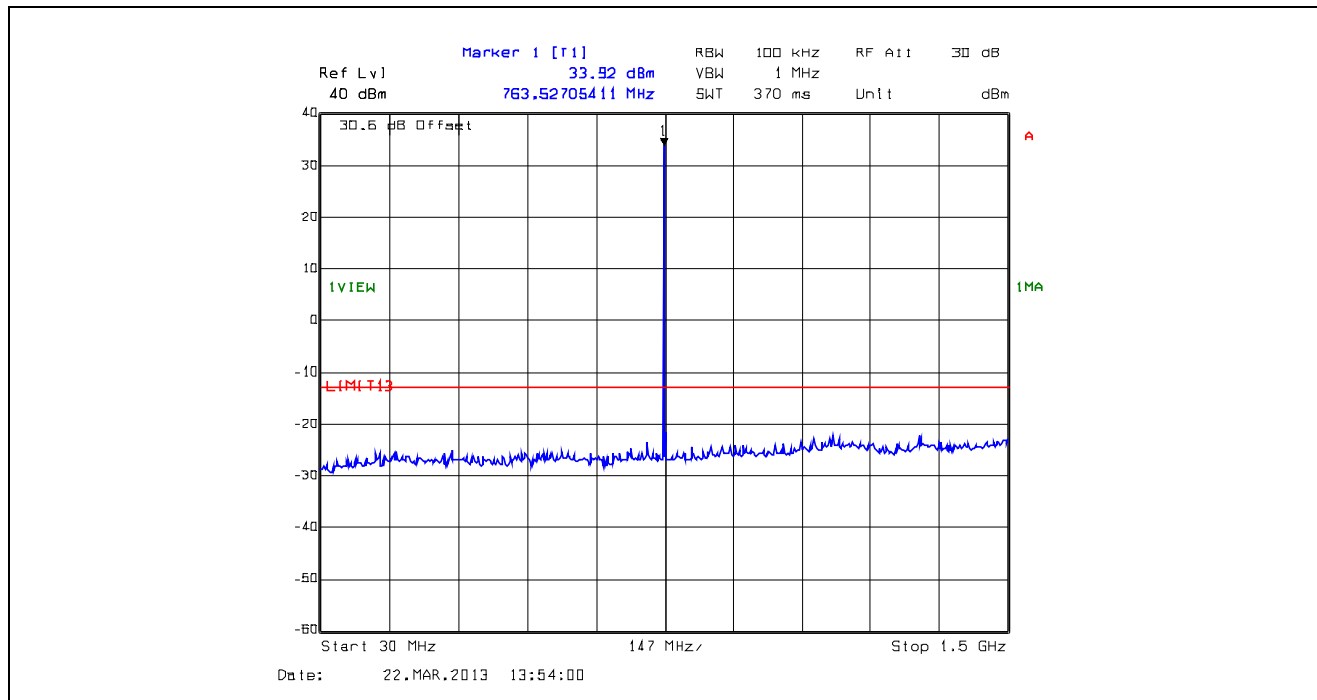
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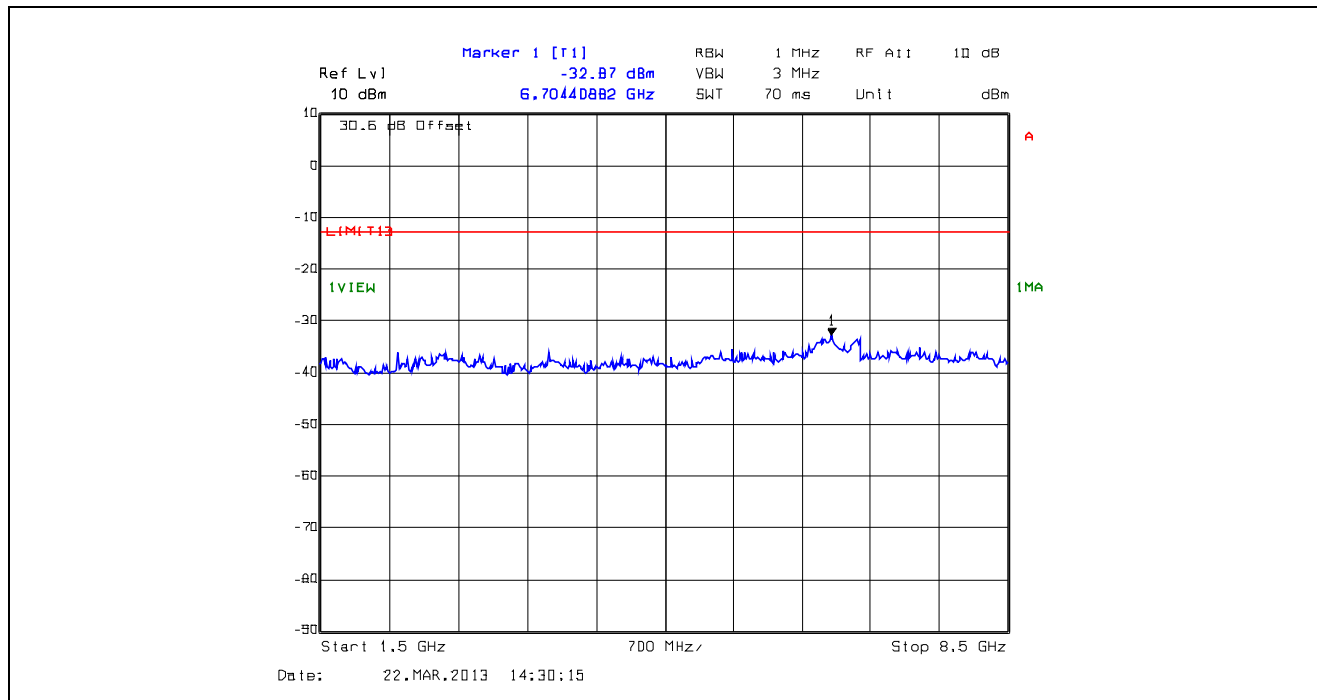
File #: TIL-094F90R01
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Plot 5.5.4.13. Conducted Transmitter Spurious Emissions, High Power, 764.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.14. Conducted Transmitter Spurious Emissions, High Power, 764.1 MHz, 1.5 GHz - 8.5 GHz



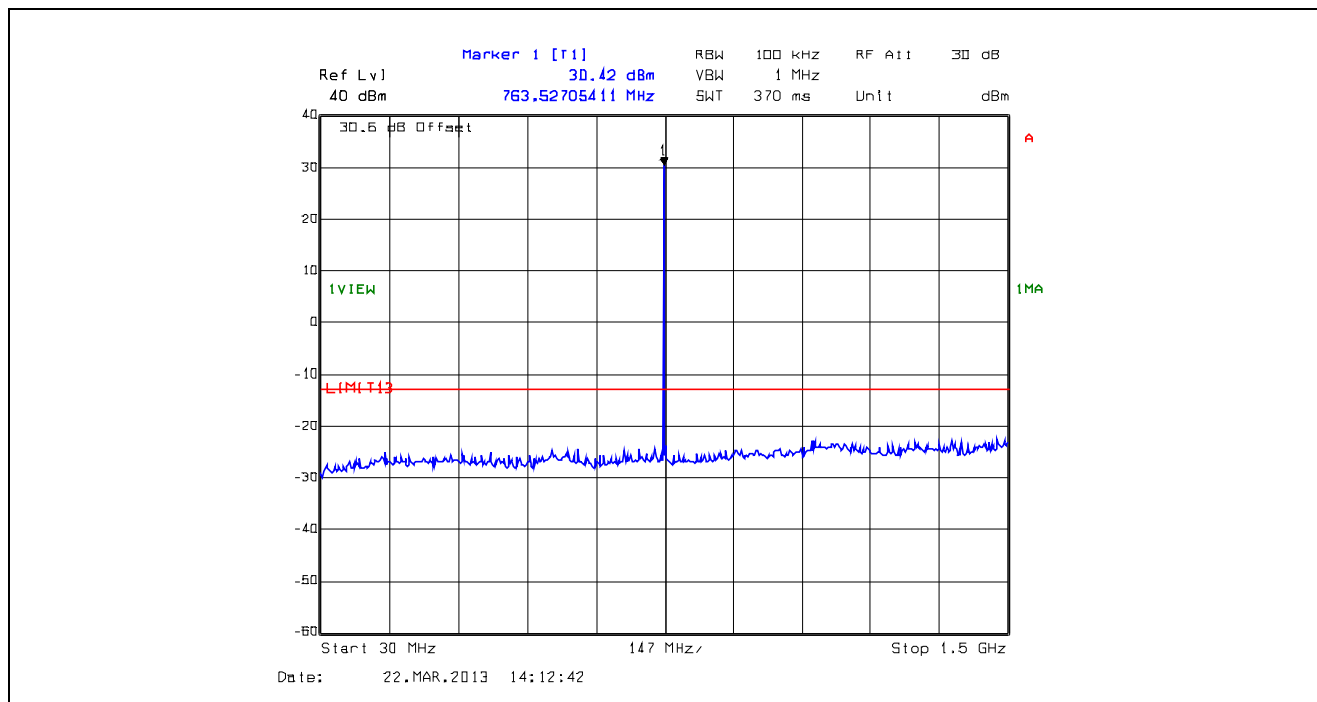
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

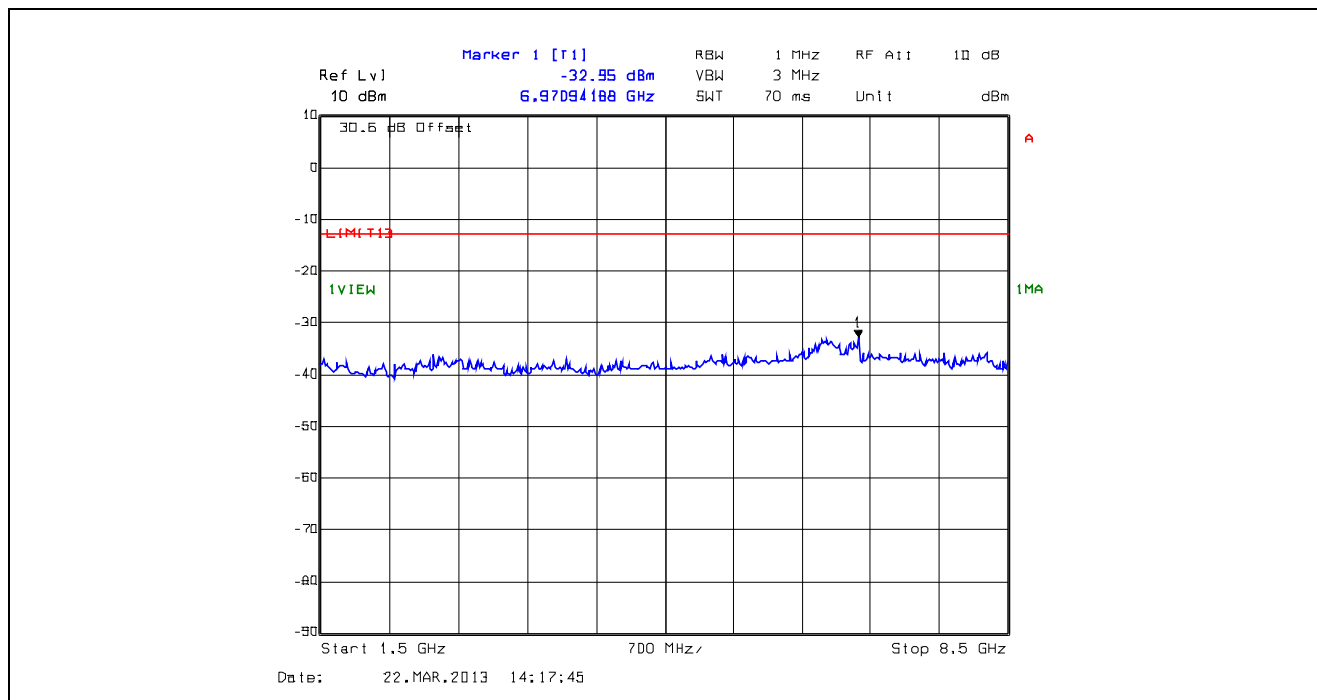
File #: TIL-094F90R01
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Plot 5.5.4.15. Conducted Transmitter Spurious Emissions, Low Power, 764.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.16. Conducted Transmitter Spurious Emissions, Low Power, 764.1 MHz, 1.5 GHz - 8.5 GHz



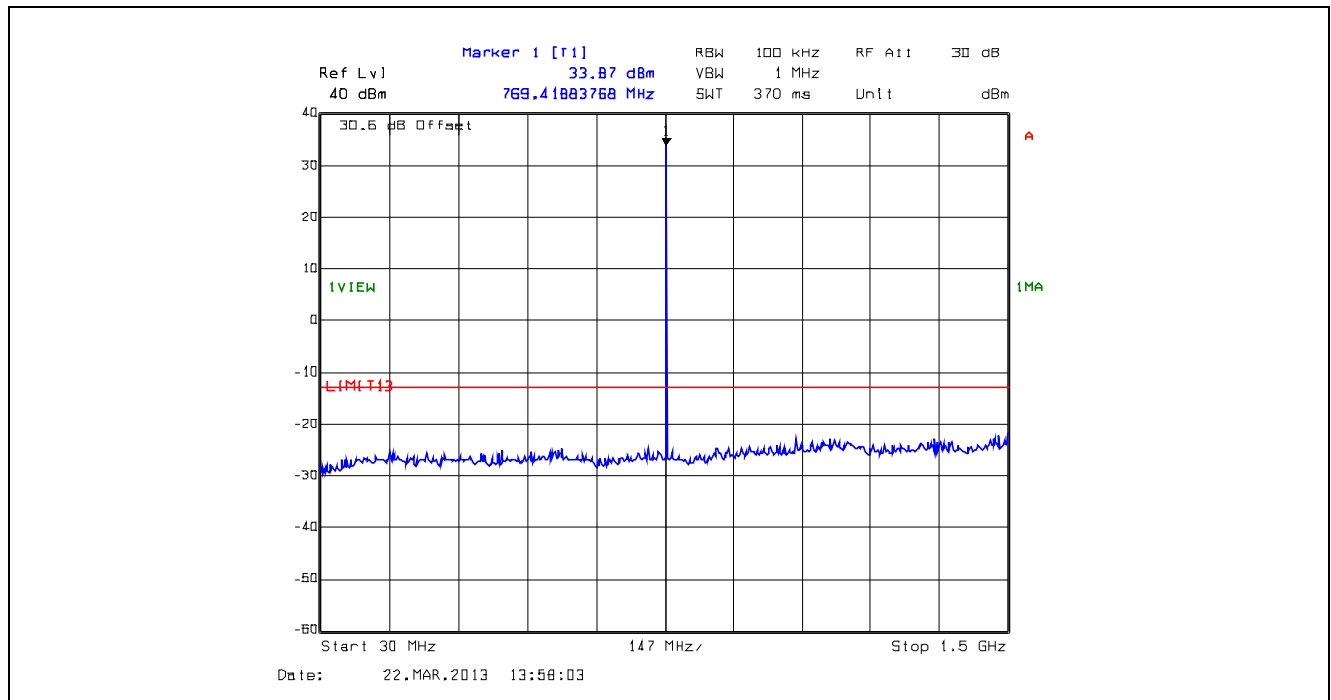
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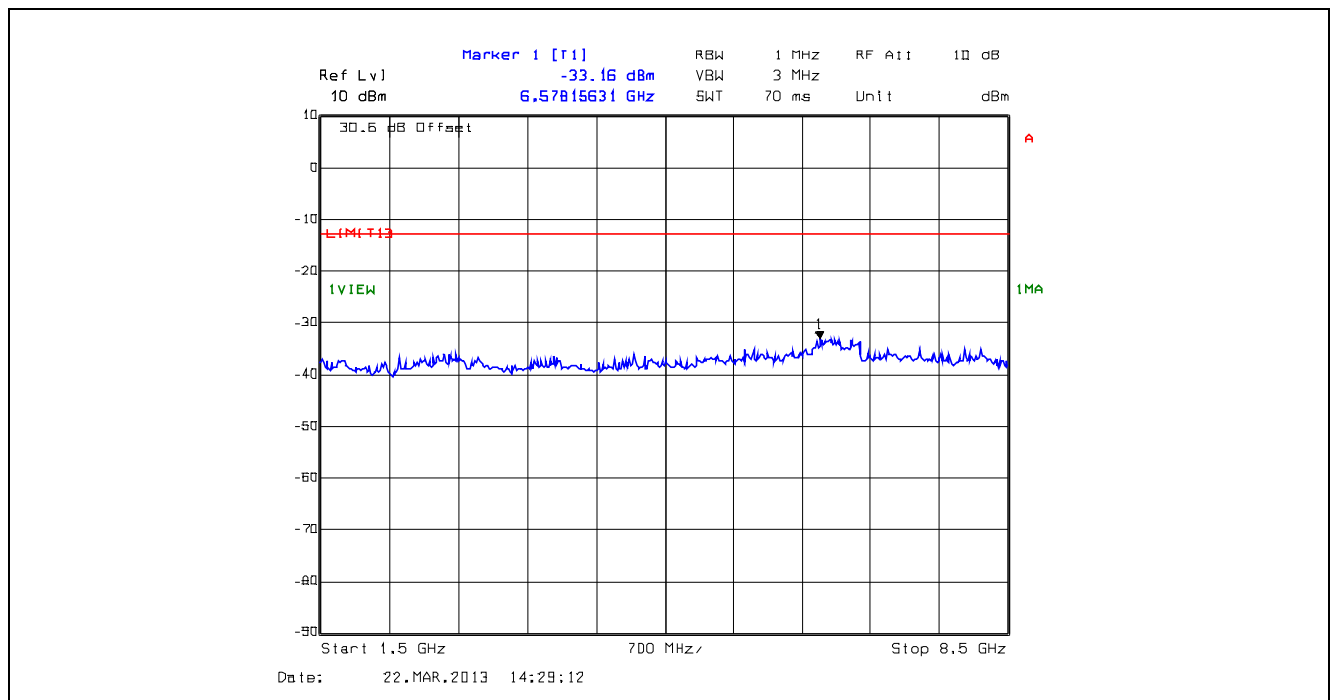
File #: TIL-094F90R01
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Plot 5.5.4.17. Conducted Transmitter Spurious Emissions, High Power, 769.5 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.18. Conducted Transmitter Spurious Emissions, High Power, 769.5 MHz, 1.5 GHz - 8.5 GHz



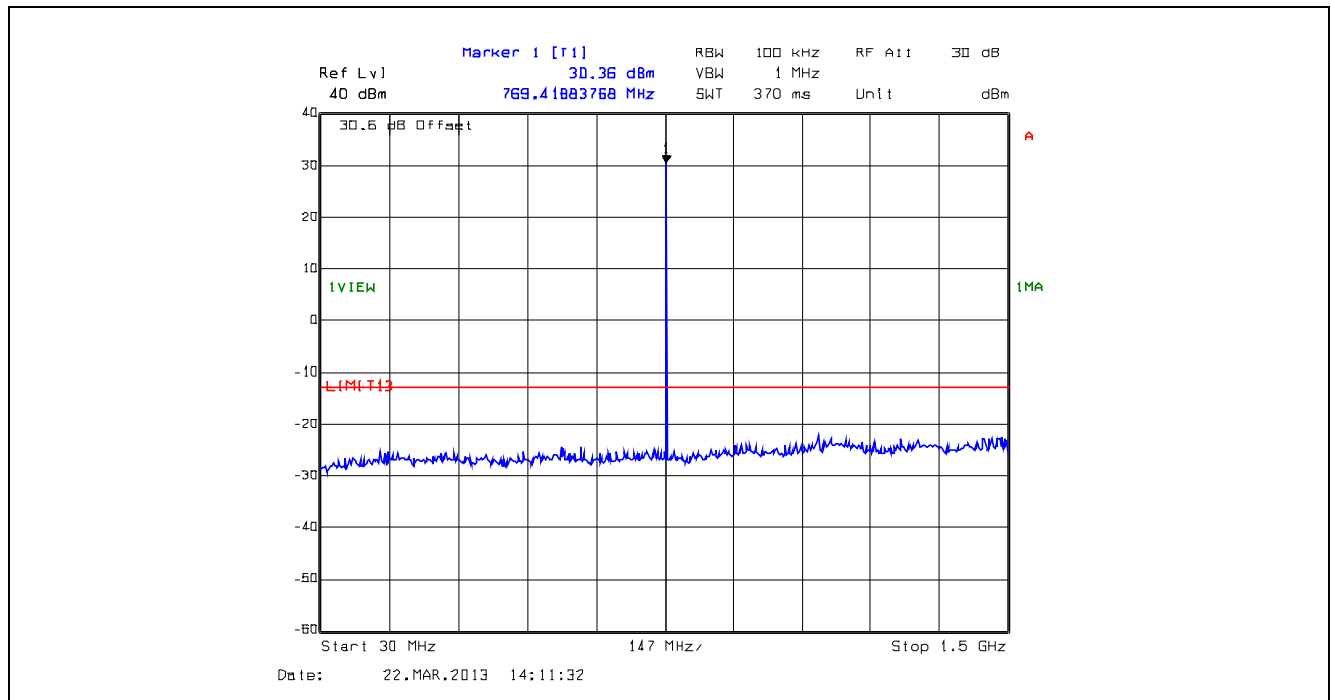
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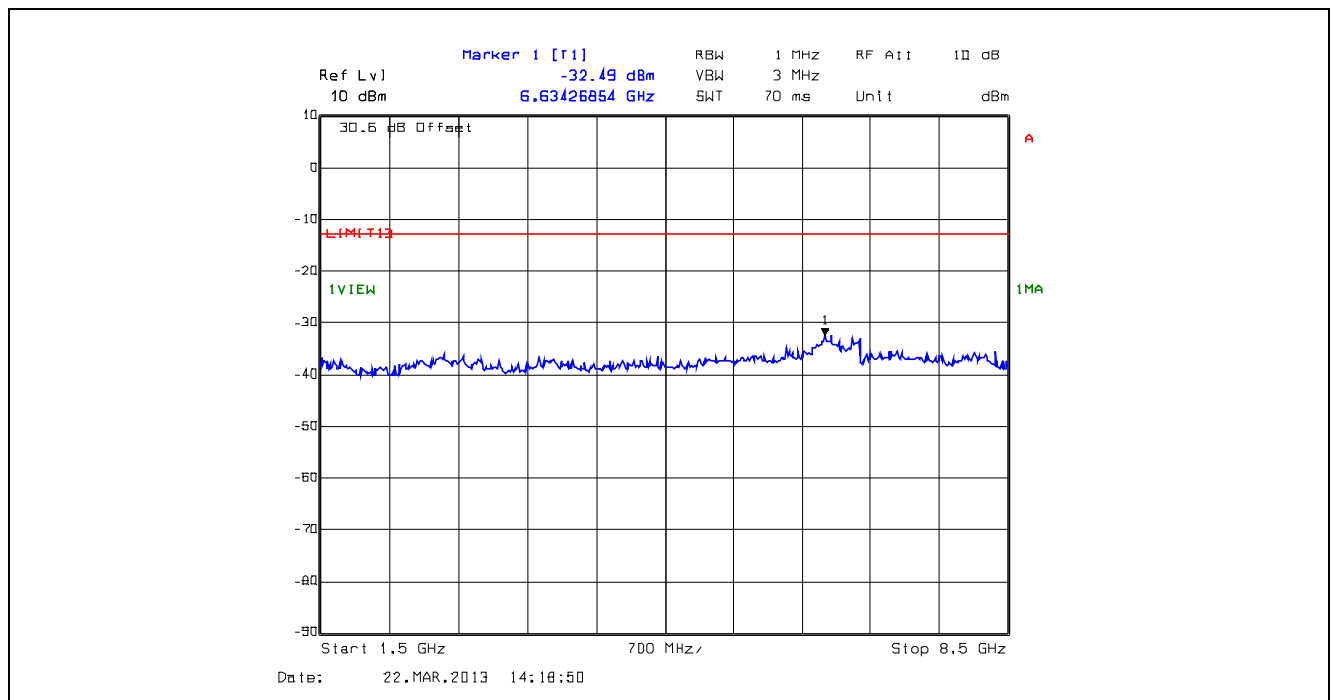
File #: TIL-094F90R01
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Plot 5.5.4.19. Conducted Transmitter Spurious Emissions, Low Power, 769.5 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.20. Conducted Transmitter Spurious Emissions, Low Power, 769.5 MHz, 1.5 GHz - 8.5 GHz



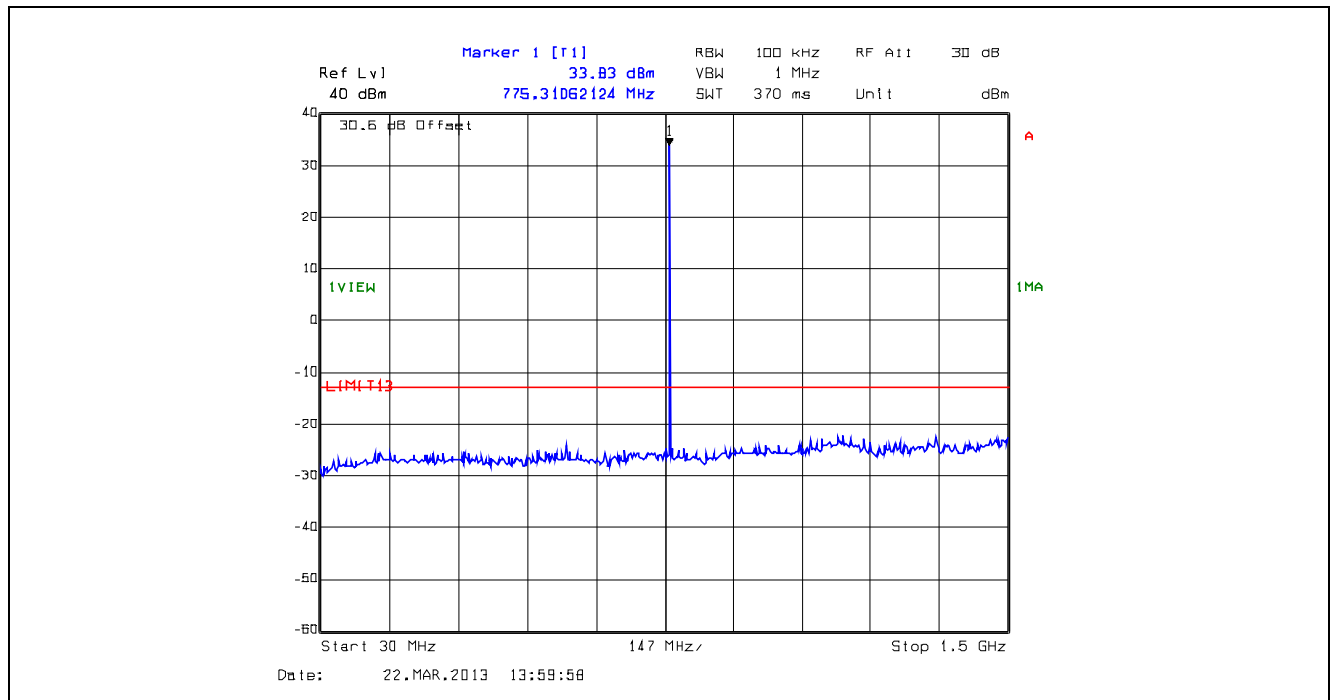
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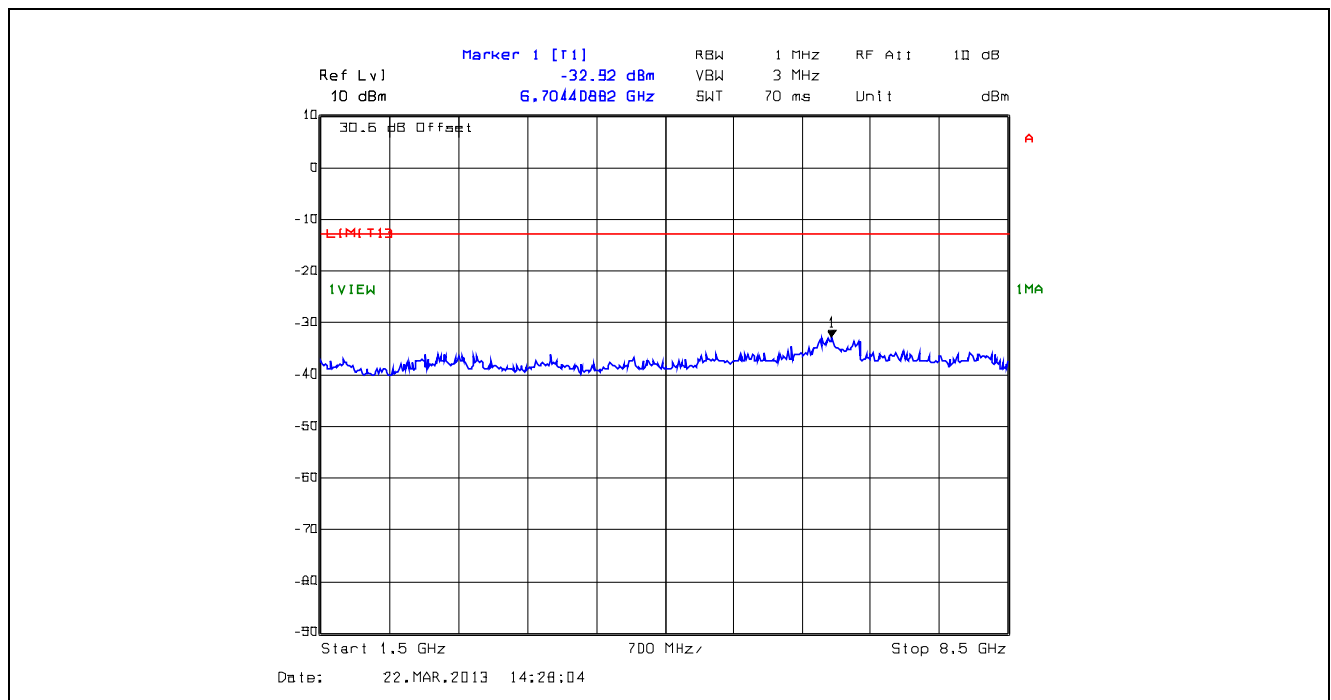
File #: TIL-094F90R01
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Plot 5.5.4.21. Conducted Transmitter Spurious Emissions, High Power, 774.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.22. Conducted Transmitter Spurious Emissions, High Power, 774.9 MHz, 1.5 GHz - 8.5 GHz



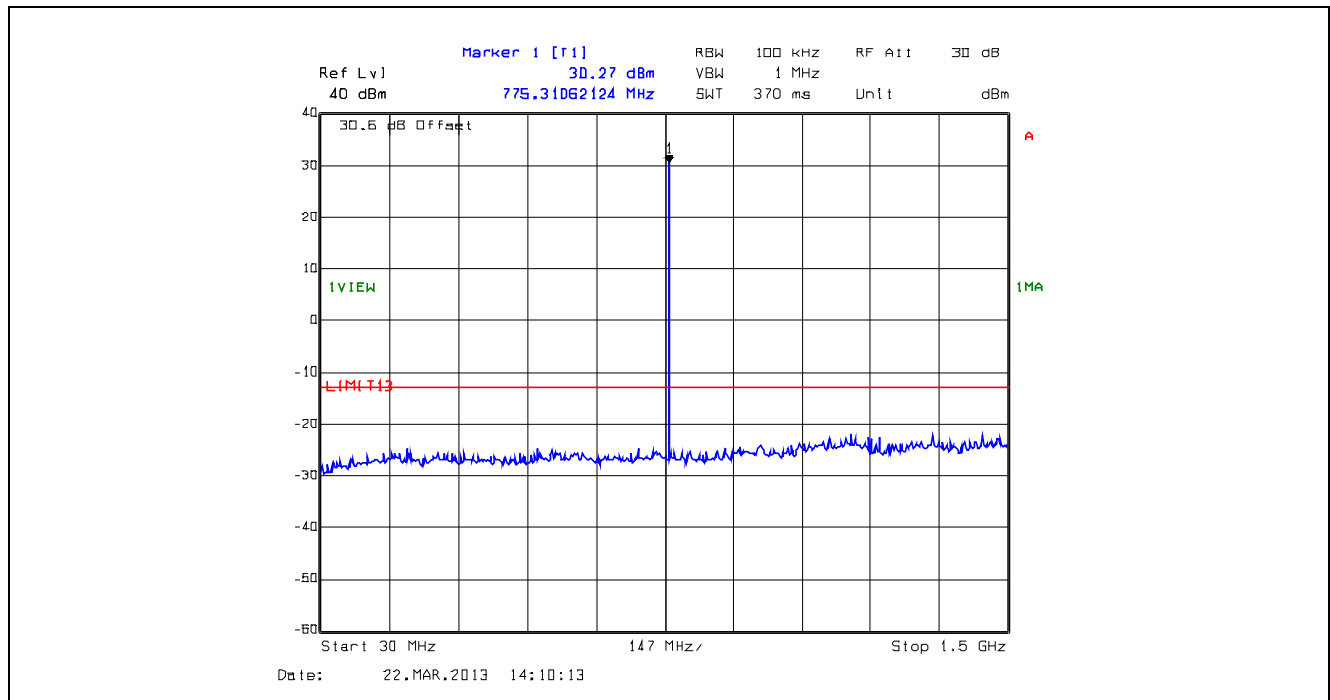
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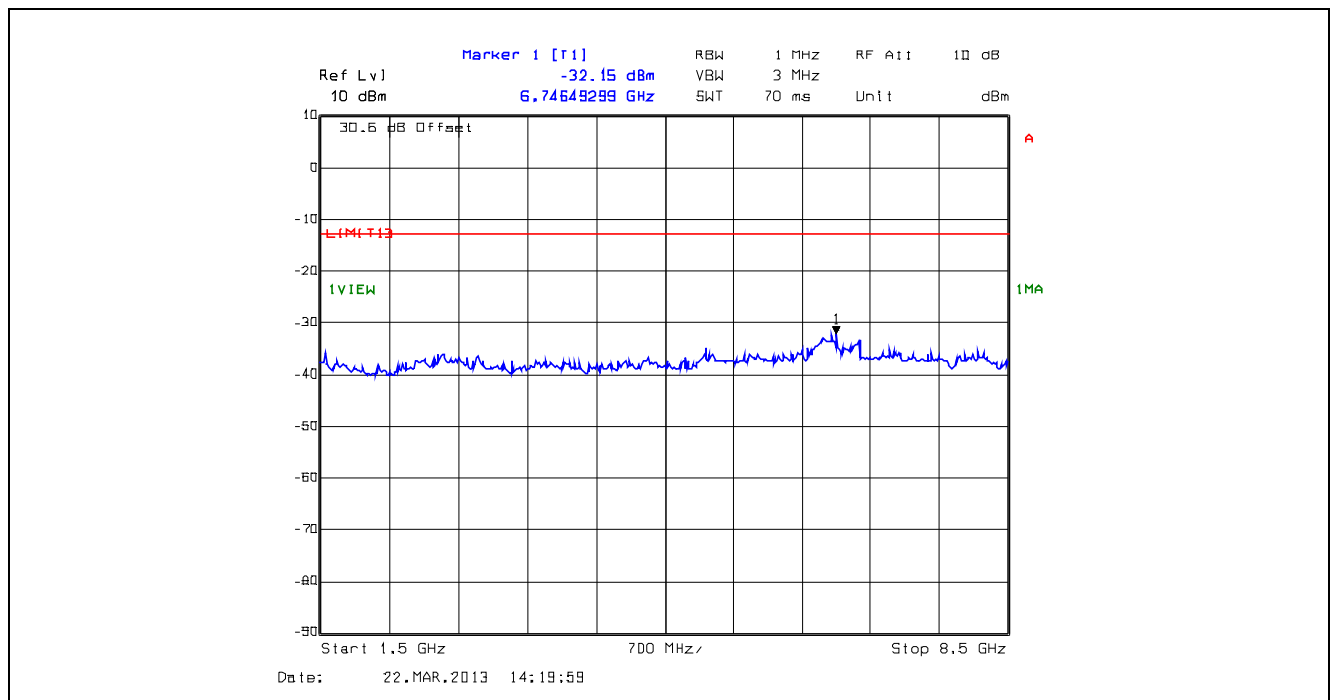
File #: TIL-094F90R01
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Plot 5.5.4.23. Conducted Transmitter Spurious Emissions, Low Power, 774.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.24. Conducted Transmitter Spurious Emissions, Low Power, 774.9 MHz, 1.5 GHz - 8.5 GHz



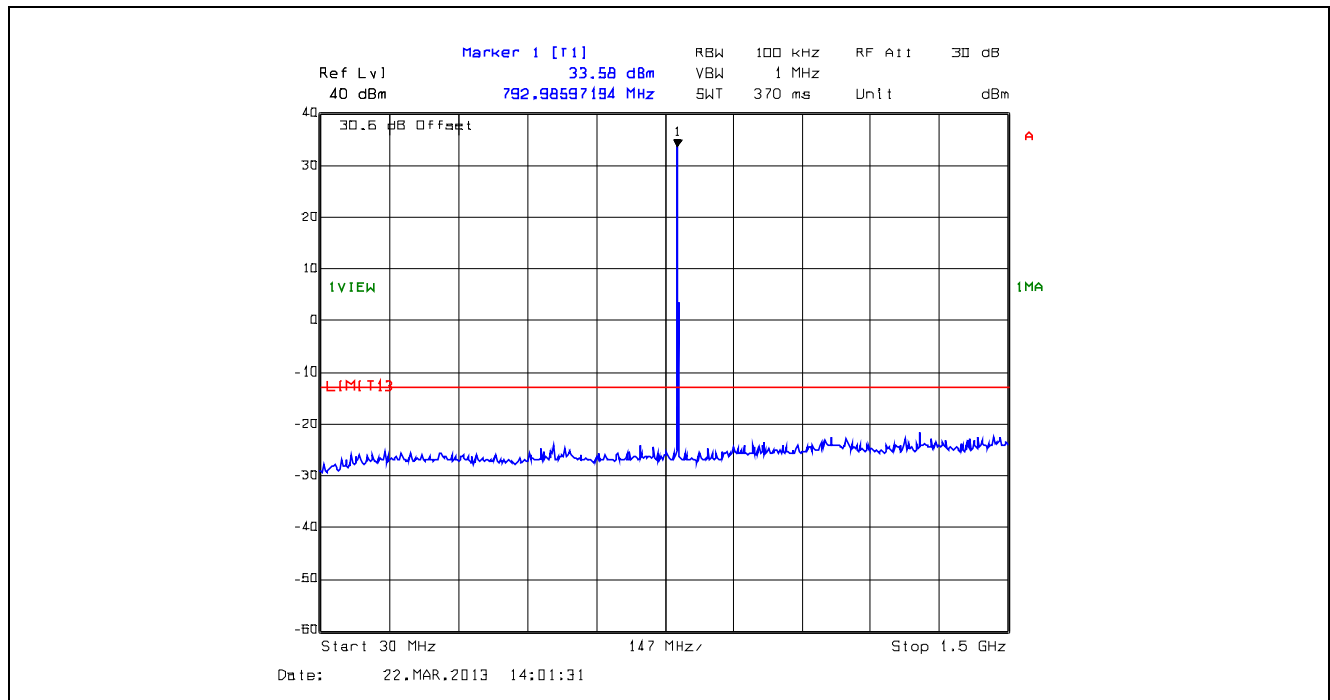
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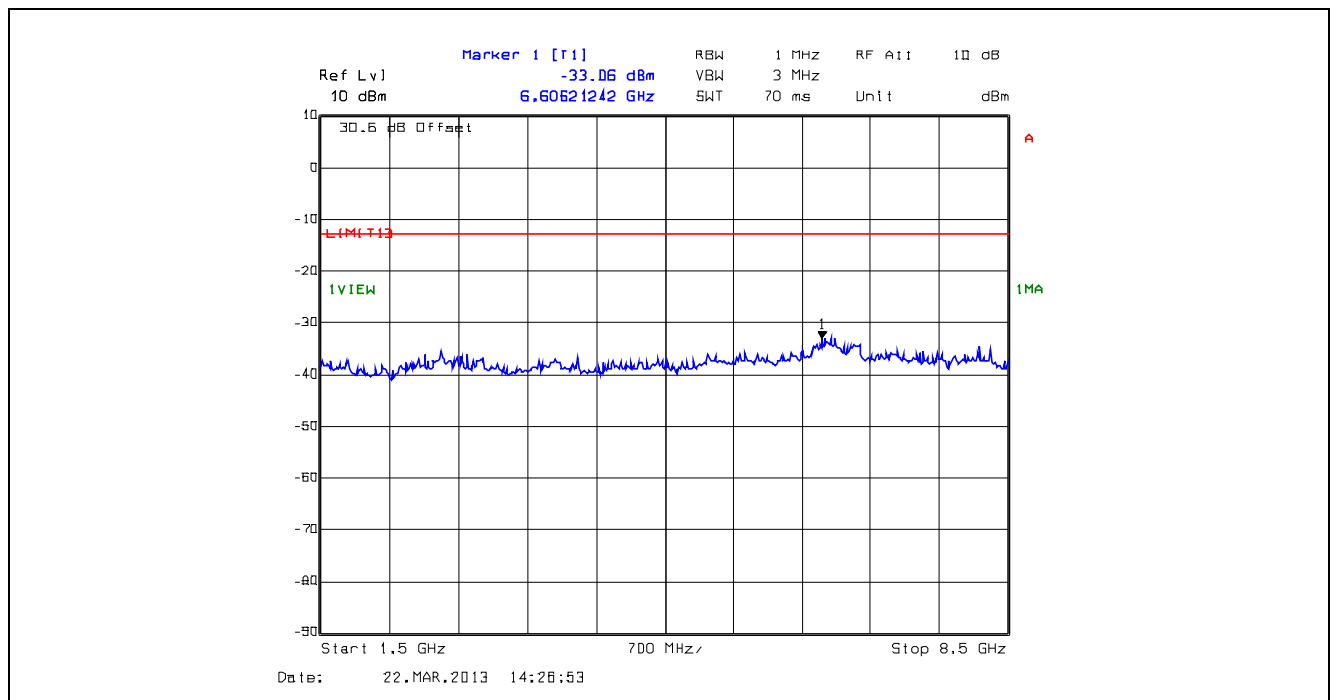
File #: TIL-094F90R01
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Plot 5.5.4.25. Conducted Transmitter Spurious Emissions, High Power, 794.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.26. Conducted Transmitter Spurious Emissions, High Power, 794.1 MHz, 1.5 GHz - 8.5 GHz



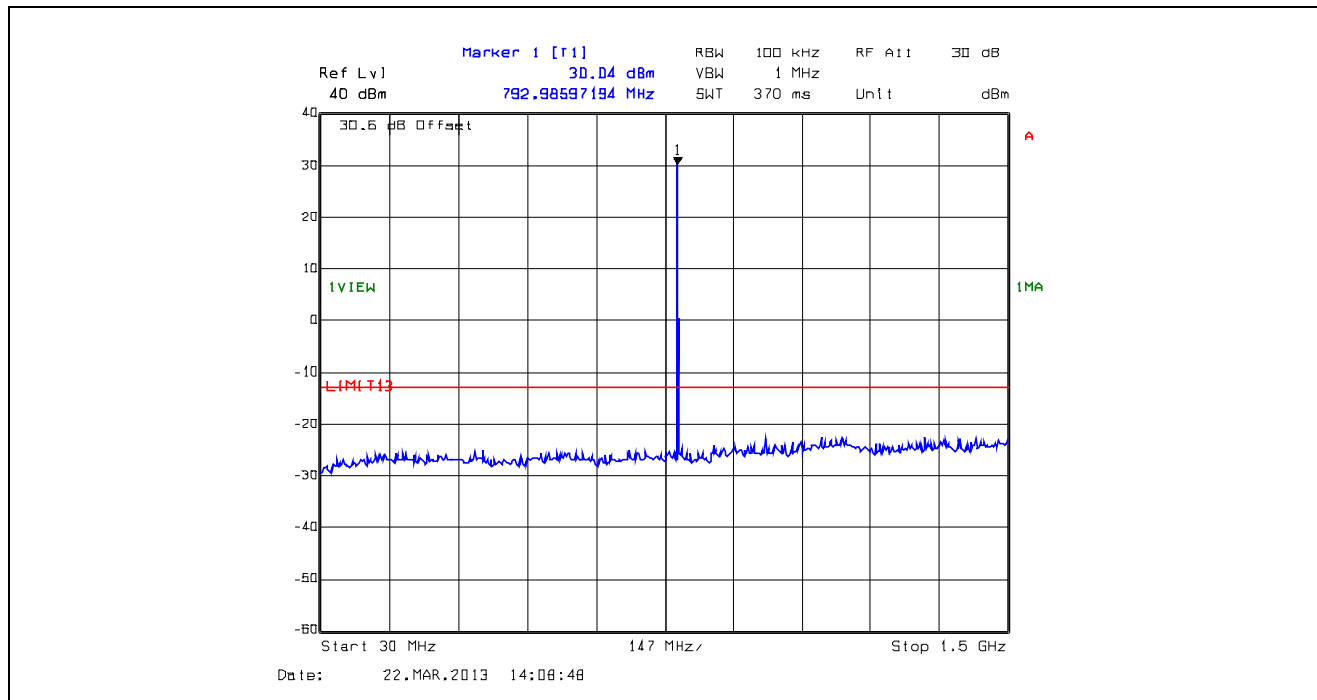
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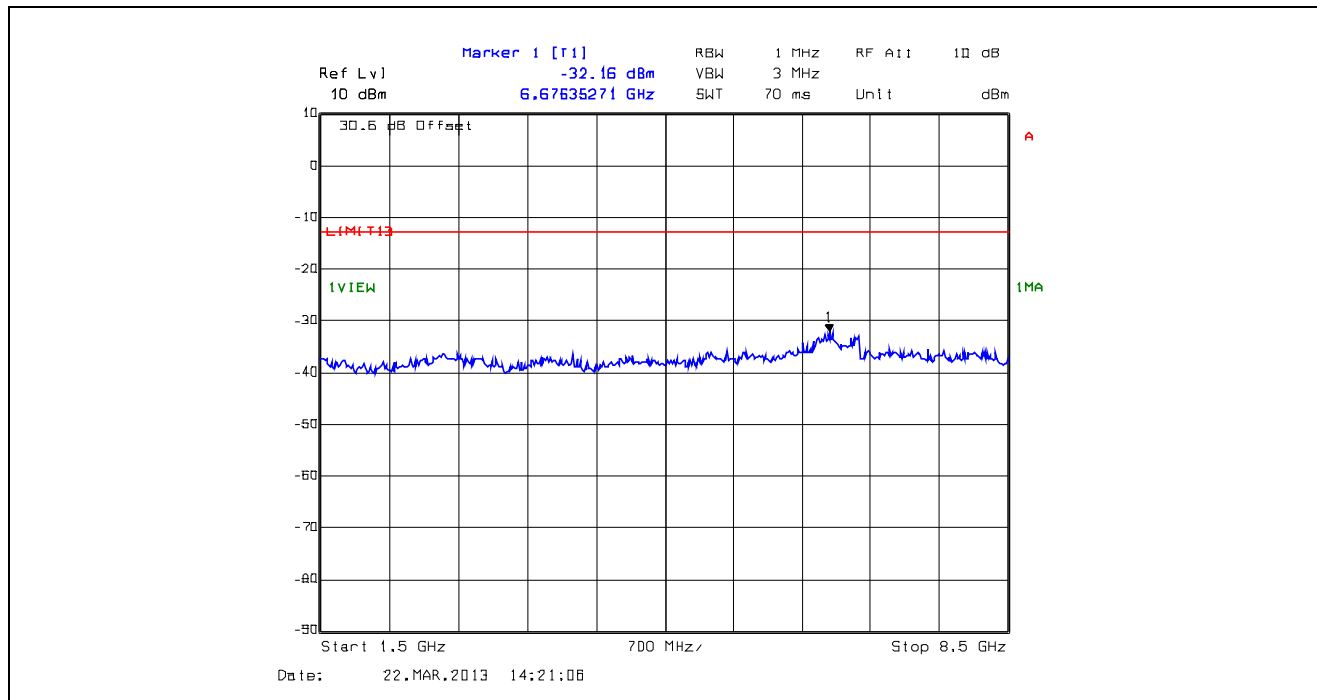
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

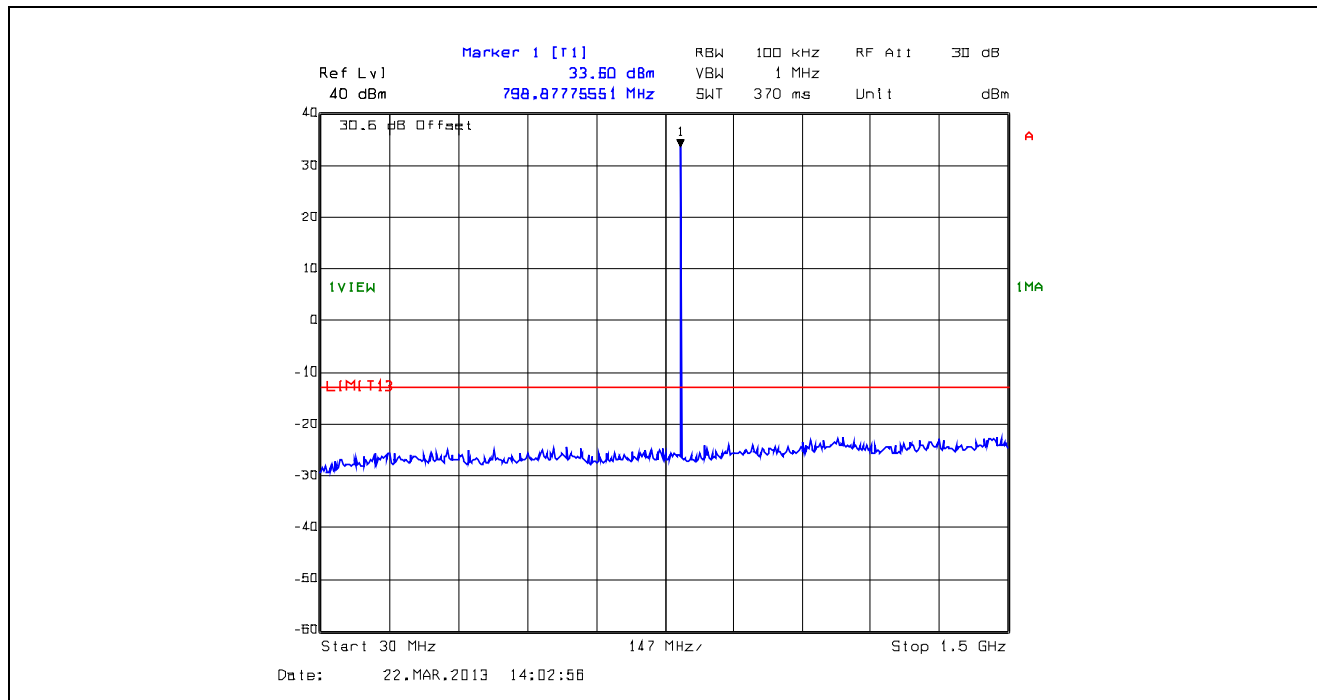
Plot 5.5.4.27. Conducted Transmitter Spurious Emissions, Low Power, 794.1 MHz, 30 MHz - 1.5 GHz



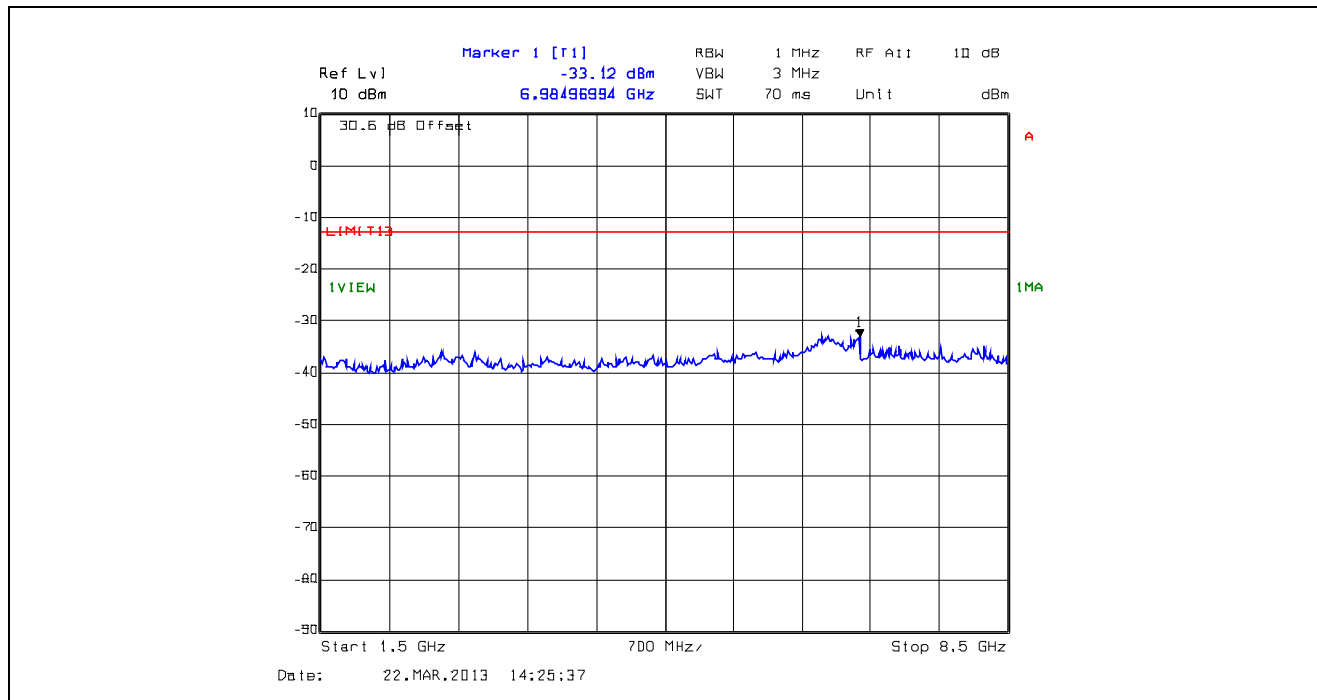
Plot 5.5.4.28. Conducted Transmitter Spurious Emissions, Low Power, 794.1 MHz, 1.5 GHz - 8.5 GHz



Plot 5.5.4.29. Conducted Transmitter Spurious Emissions, High Power, 798.5 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.30. Conducted Transmitter Spurious Emissions, High Power, 798.5 MHz, 1.5 GHz - 8.5 GHz



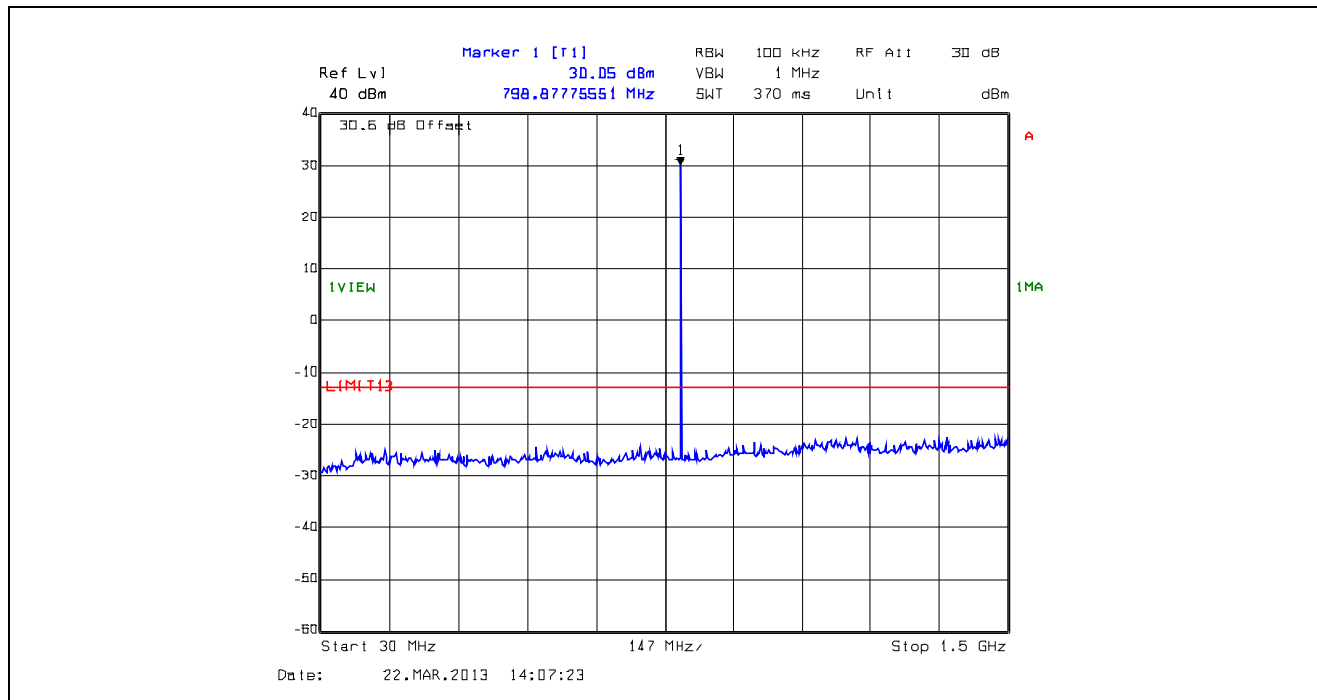
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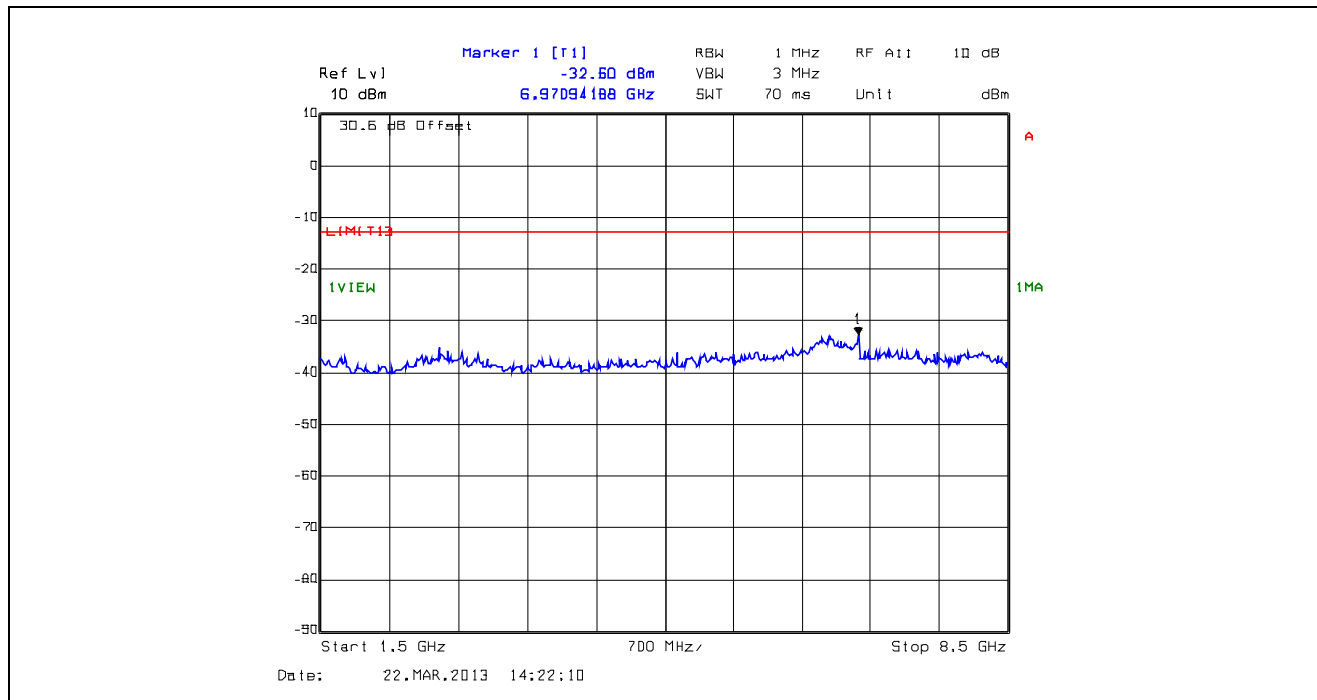
File #: TIL-094F90R01
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Plot 5.5.4.31. Conducted Transmitter Spurious Emissions, Low Power, 798.5 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.32. Conducted Transmitter Spurious Emissions, Low Power, 798.5 MHz, 1.5 GHz - 8.5 GHz



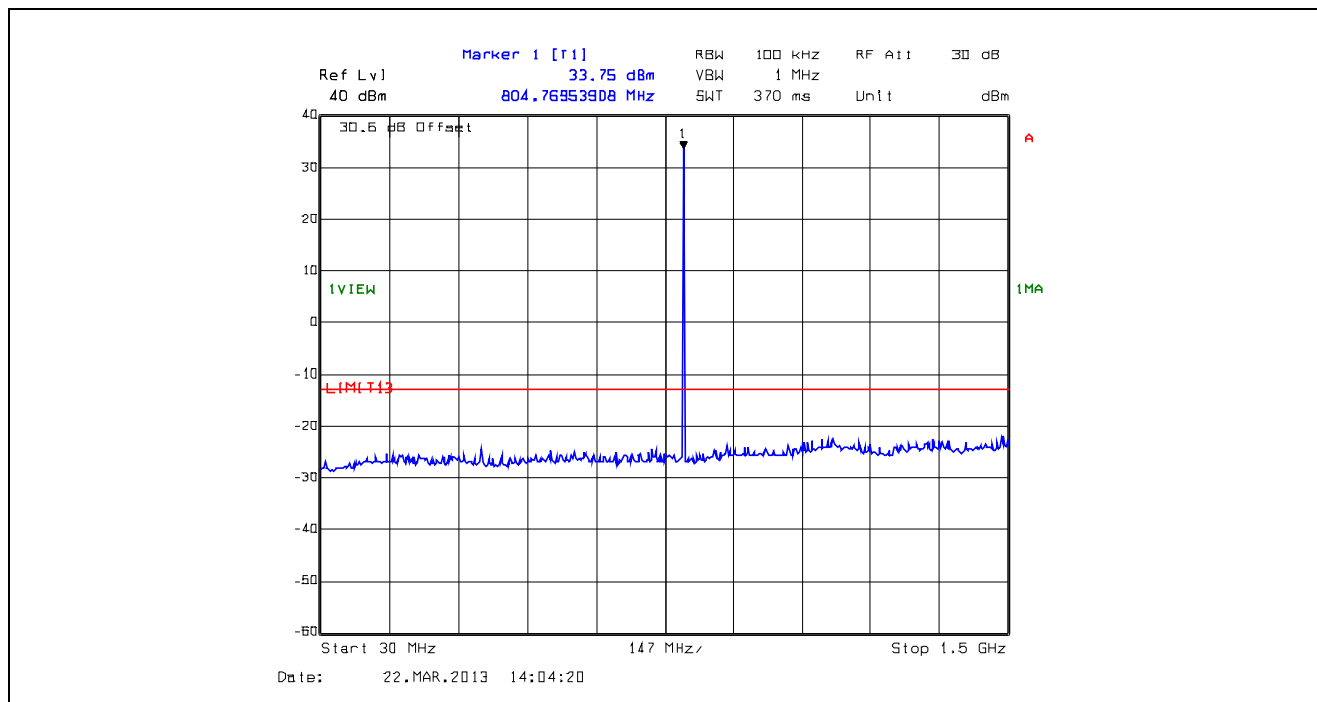
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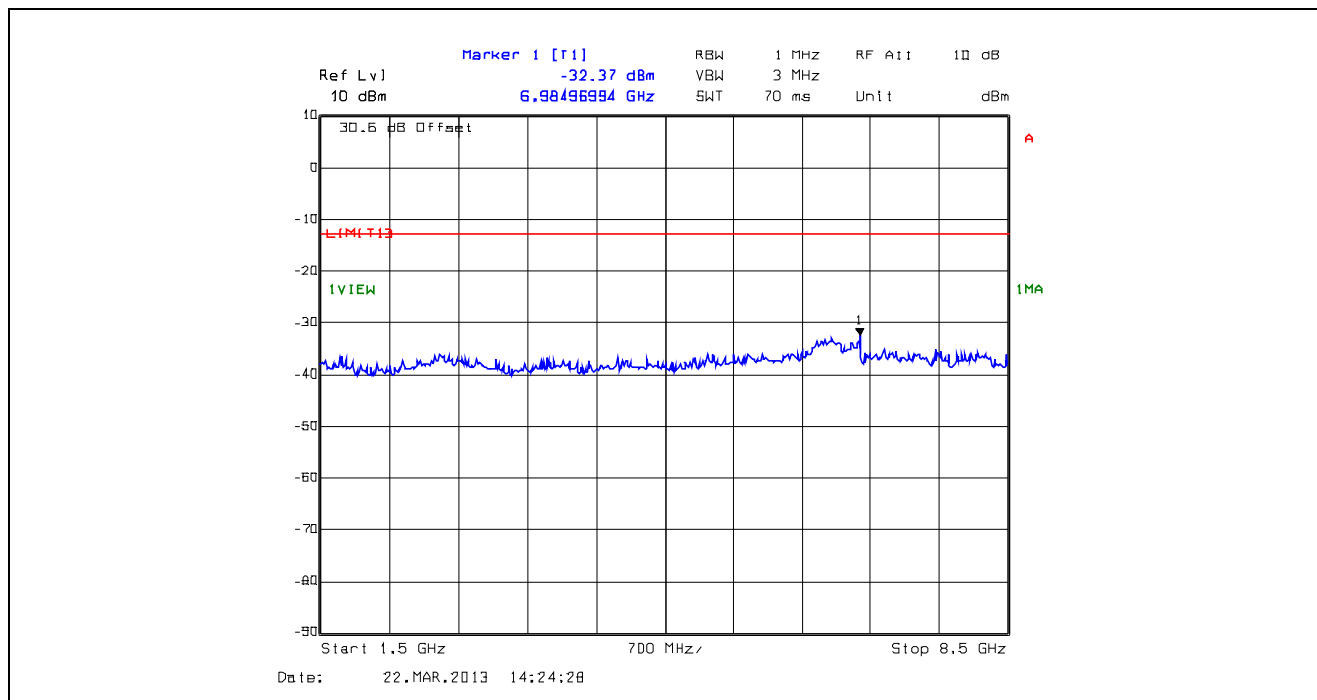
File #: TIL-094F90R01
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Plot 5.5.4.33. Conducted Transmitter Spurious Emissions, High Power, 804.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.34. Conducted Transmitter Spurious Emissions, High Power, 804.9 MHz, 1.5 GHz - 8.5 GHz



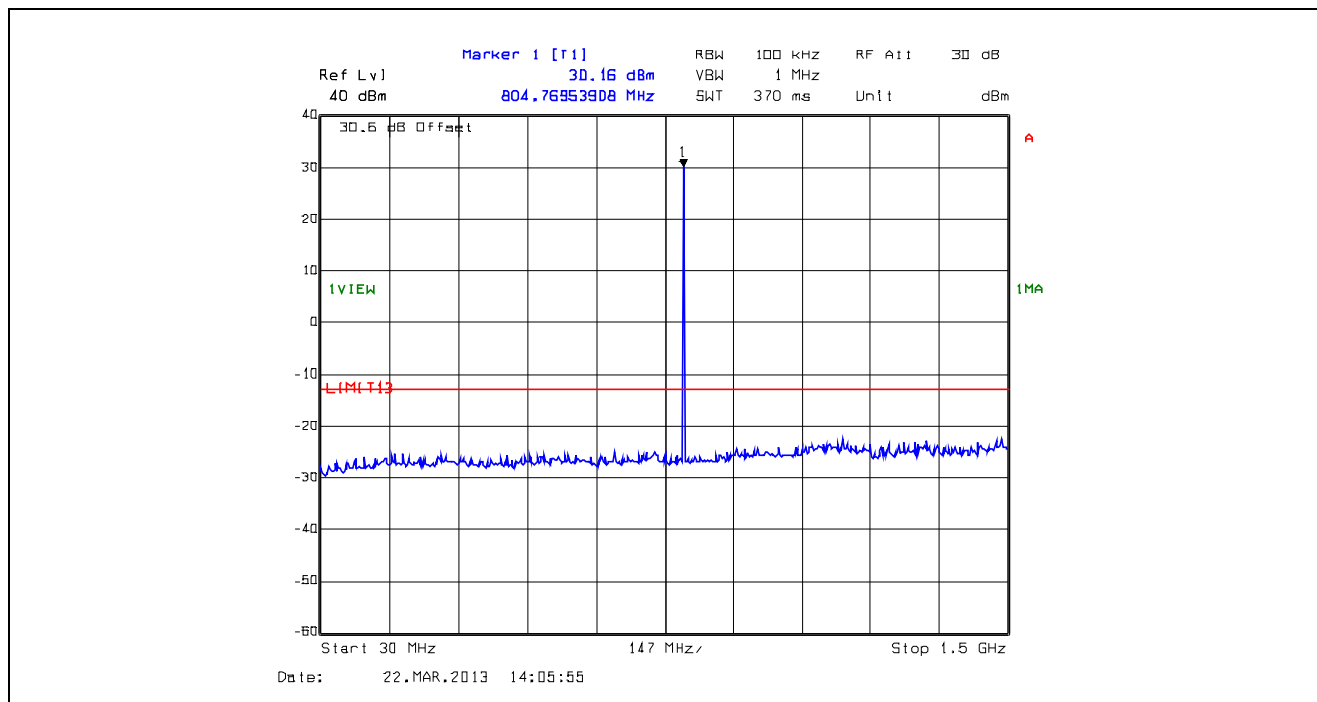
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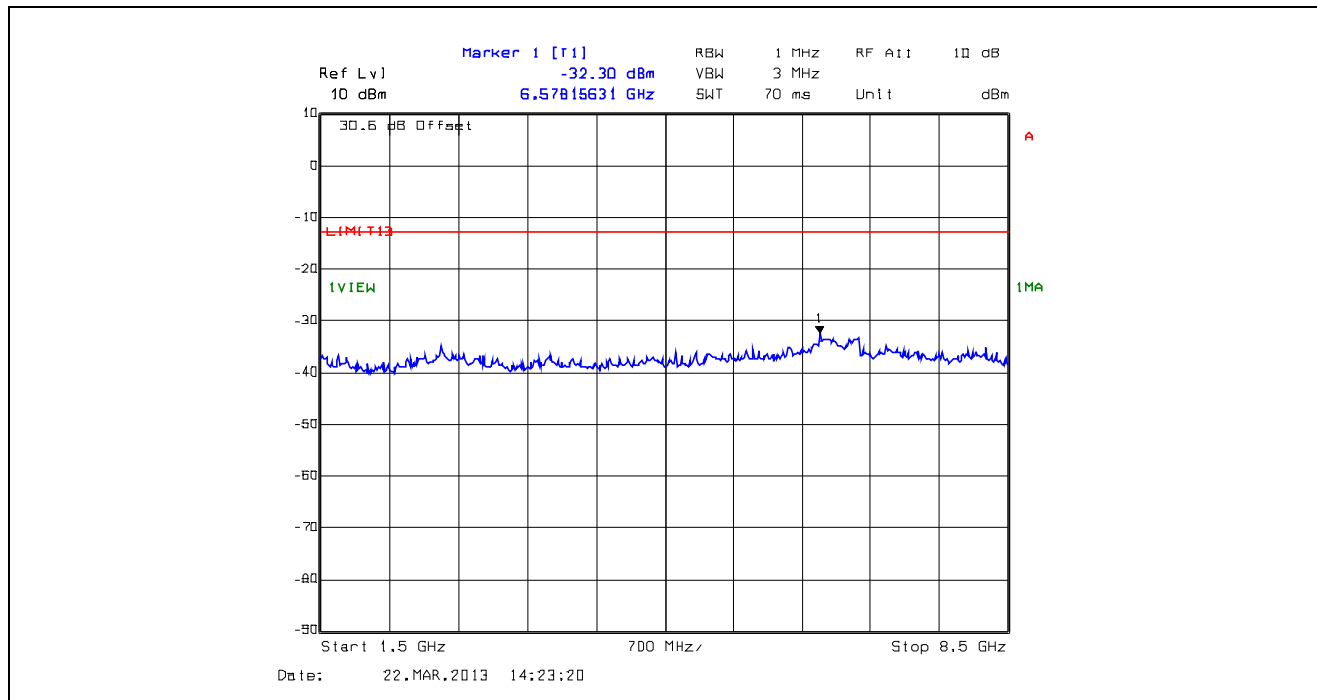
File #: TIL-094F90R01
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Plot 5.5.4.35. Conducted Transmitter Spurious Emissions, Low Power, 804.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.36. Conducted Transmitter Spurious Emissions, Low Power, 804.9 MHz, 1.5 GHz - 8.5 GHz



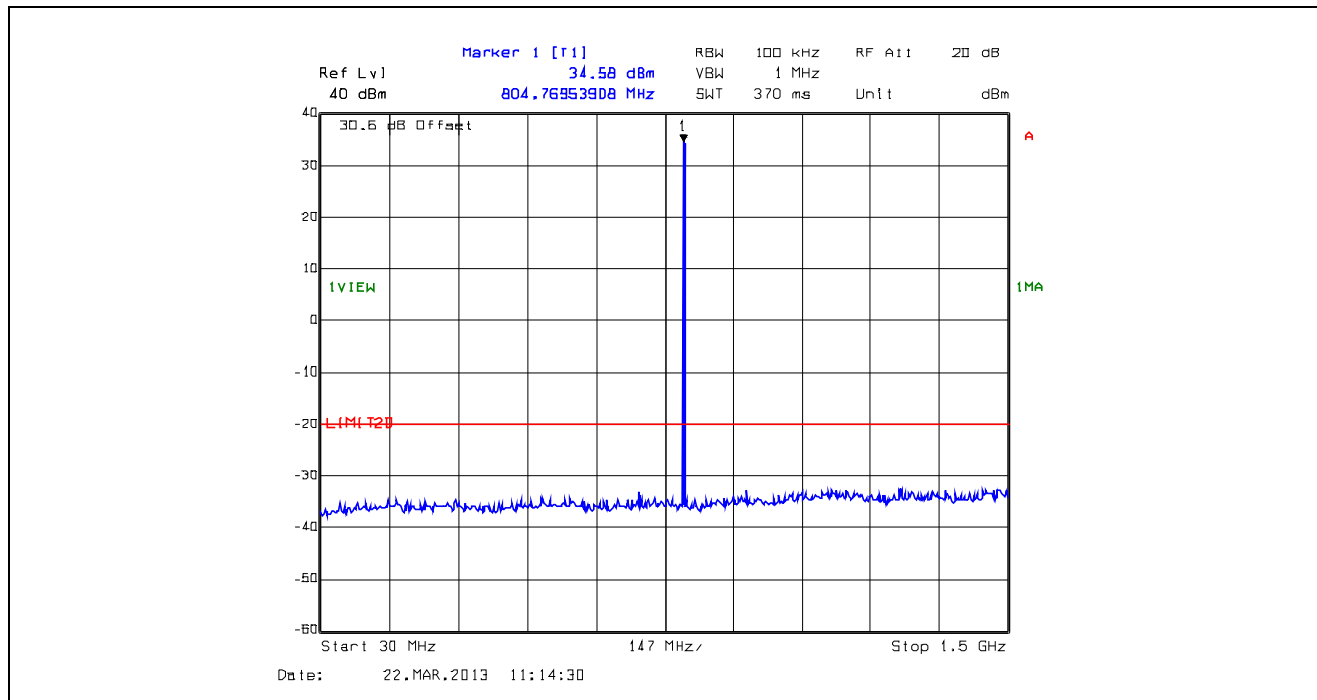
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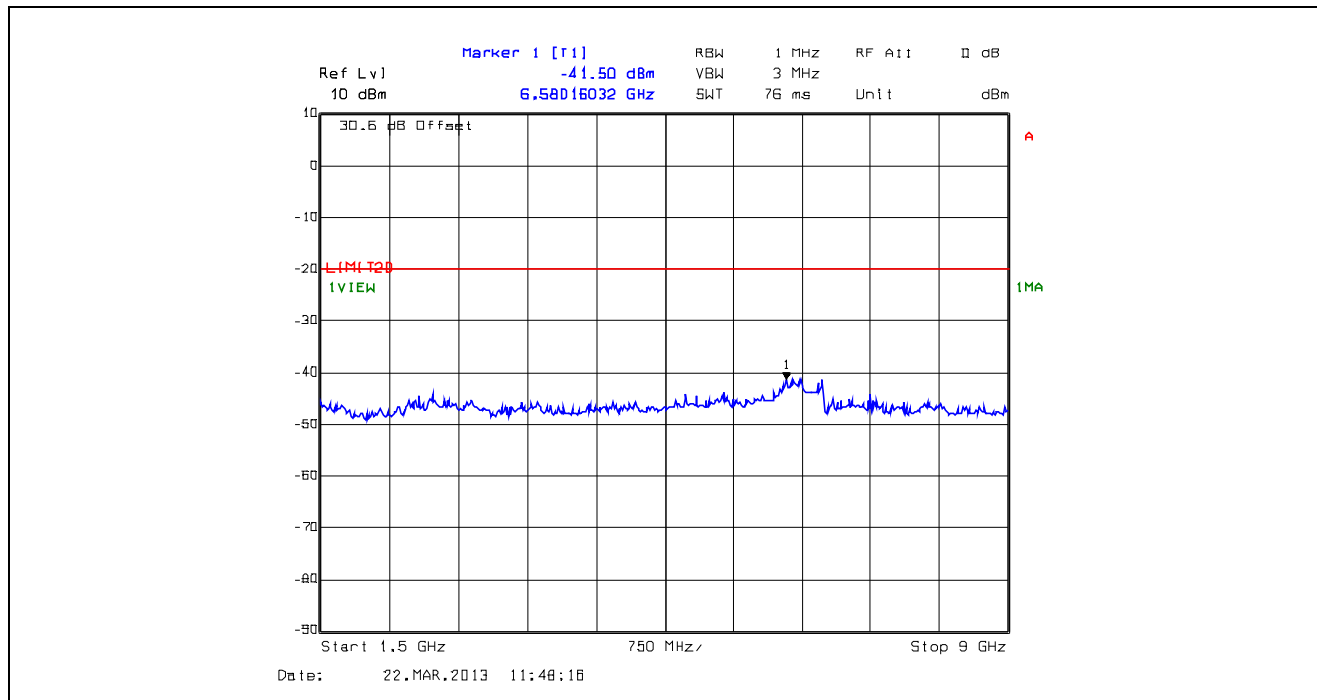
File #: TIL-094F90R01
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Plot 5.5.4.37. Conducted Transmitter Spurious Emissions, High Power, 806.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.38. Conducted Transmitter Spurious Emissions, High Power, 806.1 MHz, 1.5 GHz - 9 GHz



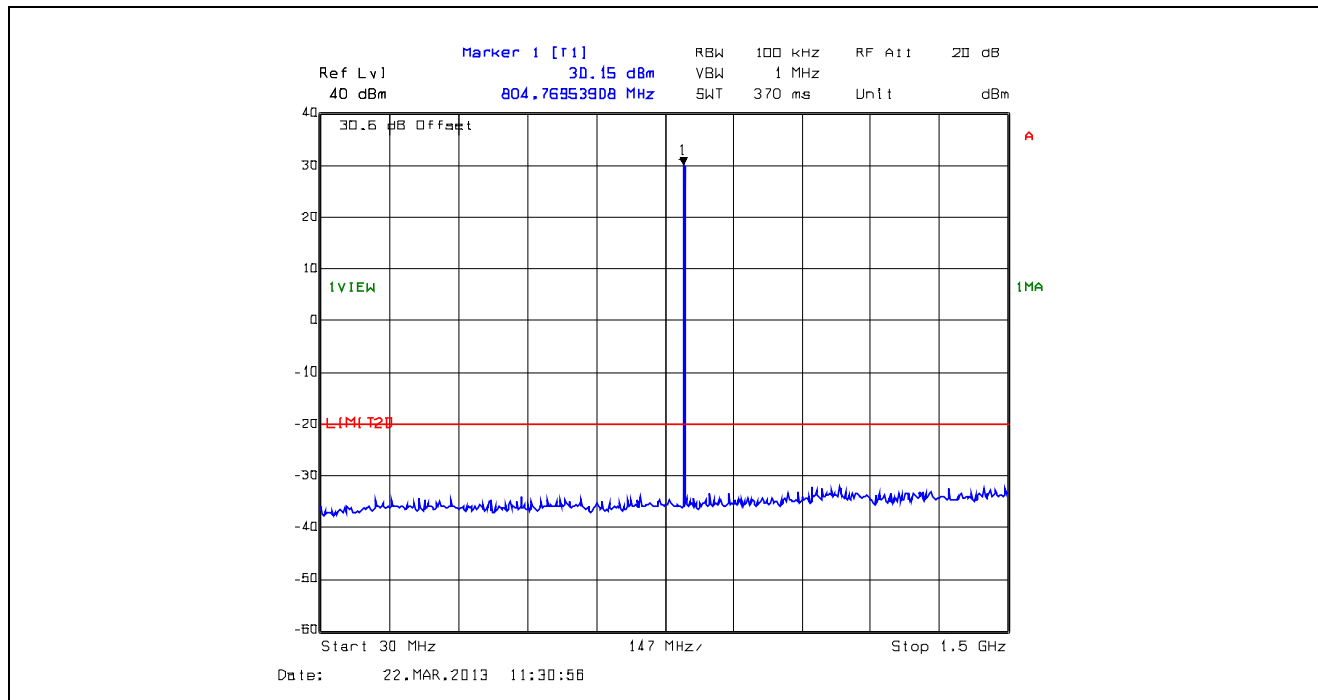
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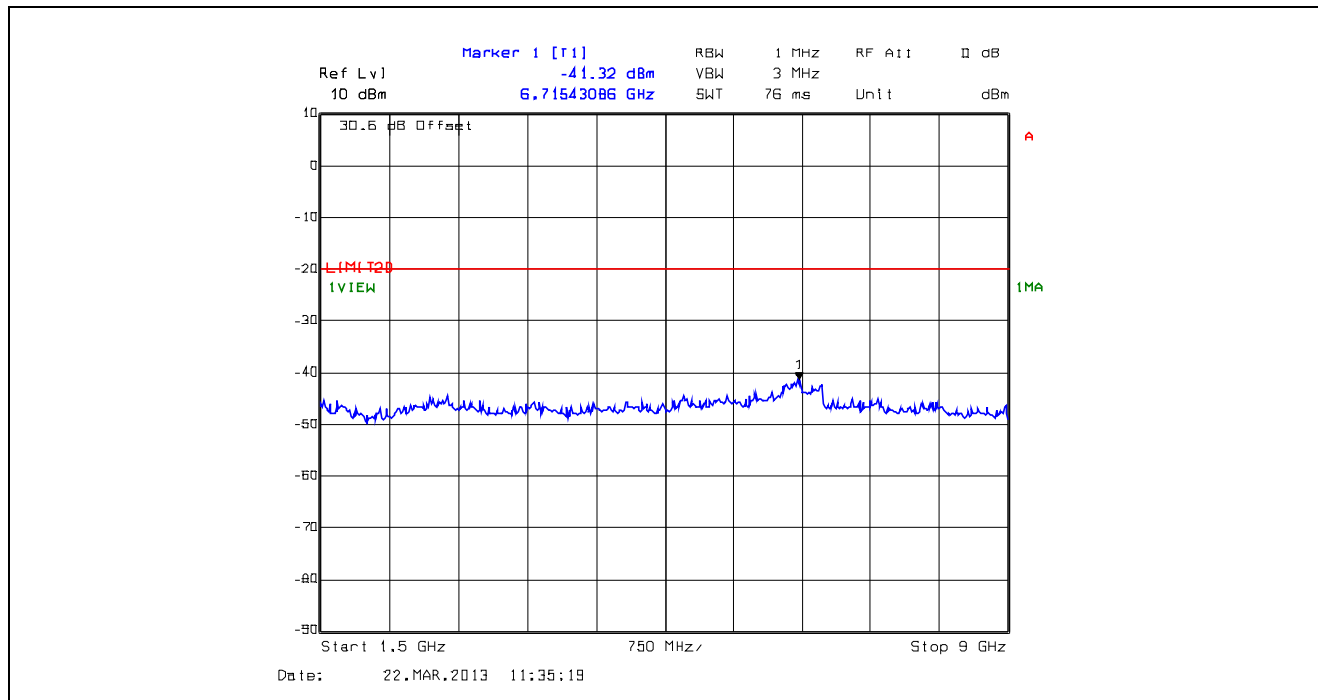
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.5.4.39. Conducted Transmitter Spurious Emissions, Low Power, 806.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.40. Conducted Transmitter Spurious Emissions, Low Power, 806.1 MHz, 1.5 GHz - 9 GHz



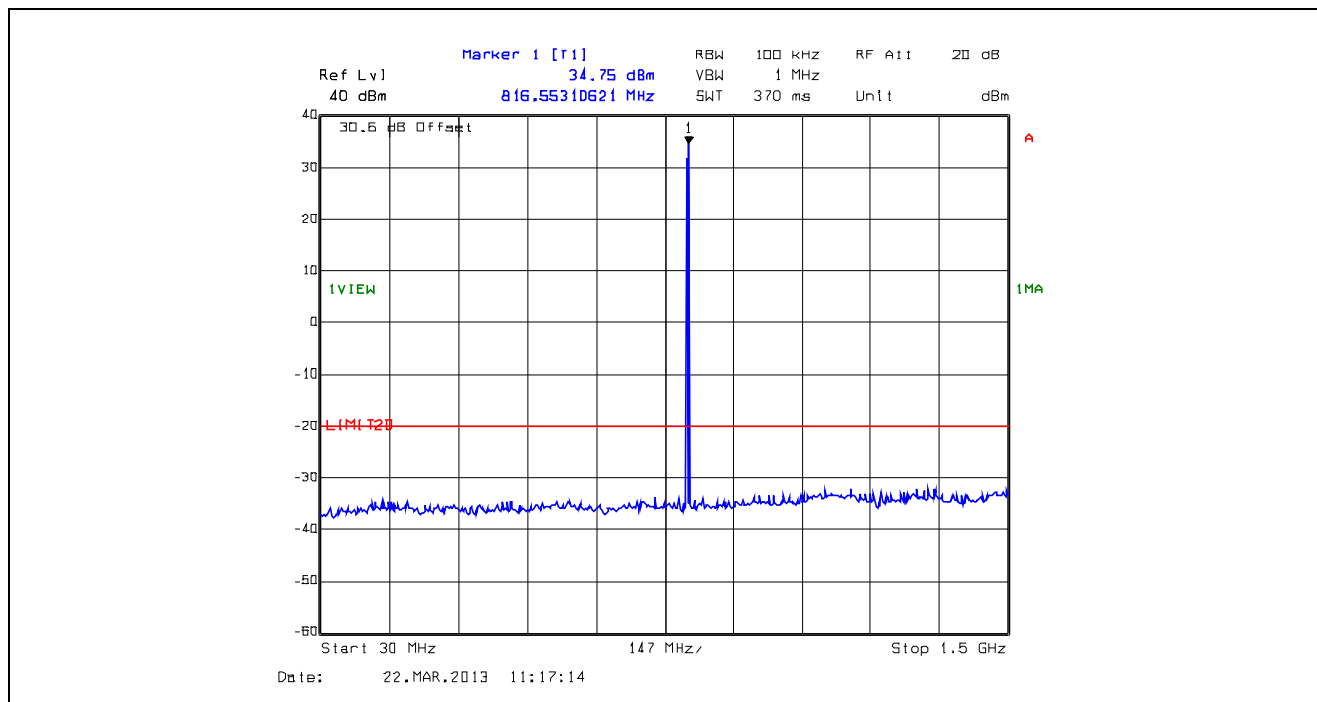
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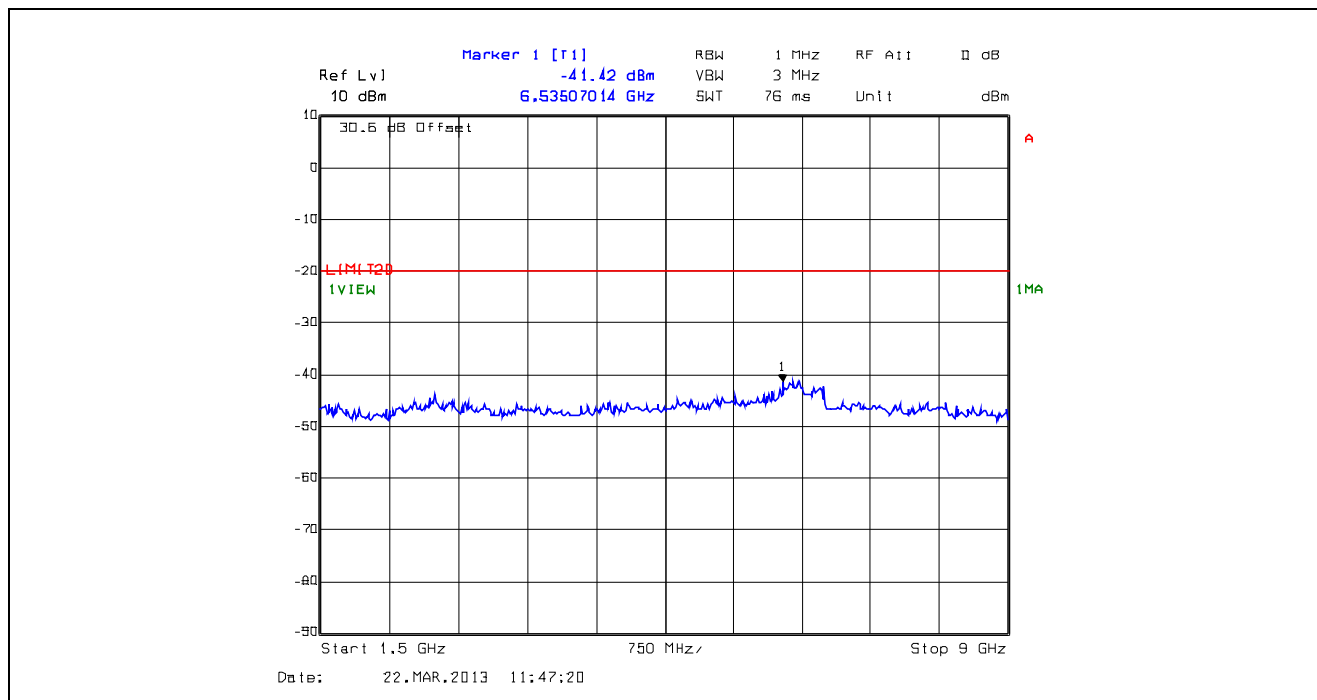
File #: TIL-094F90R01
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Plot 5.5.4.41. Conducted Transmitter Spurious Emissions, High Power, 815.0 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.42. Conducted Transmitter Spurious Emissions, High Power, 815.0 MHz, 1.5 GHz - 9 GHz



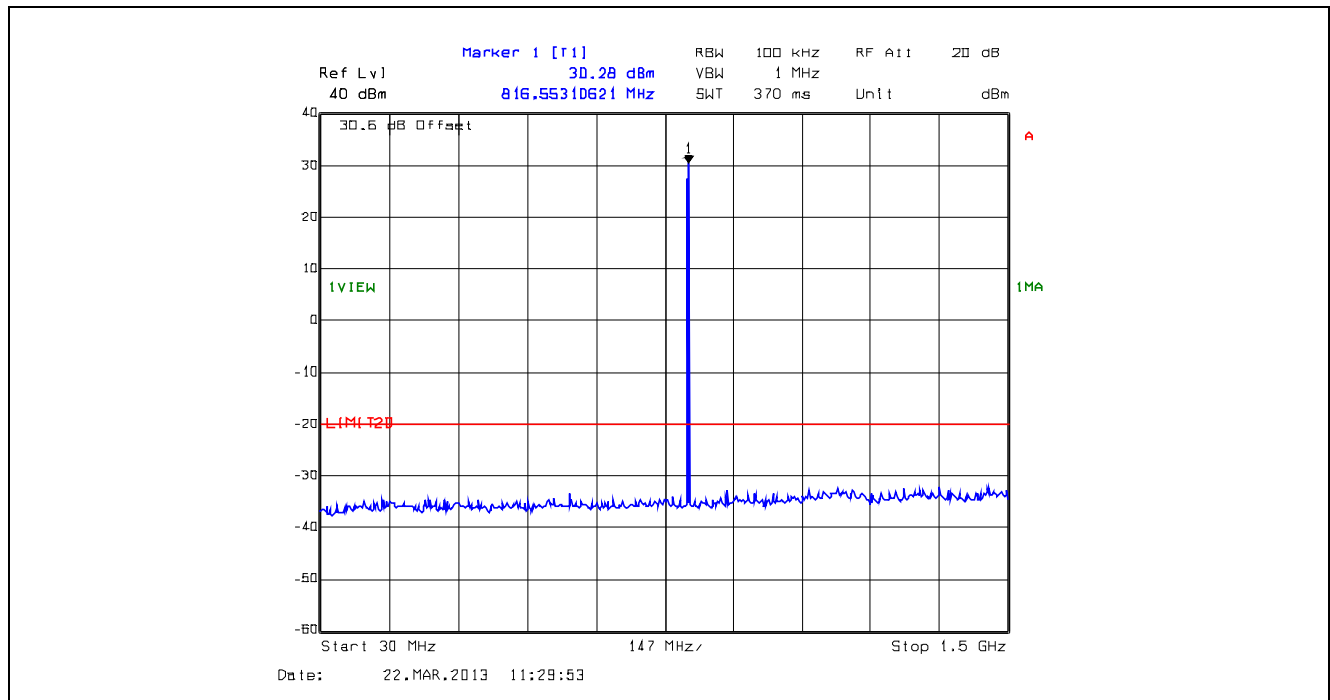
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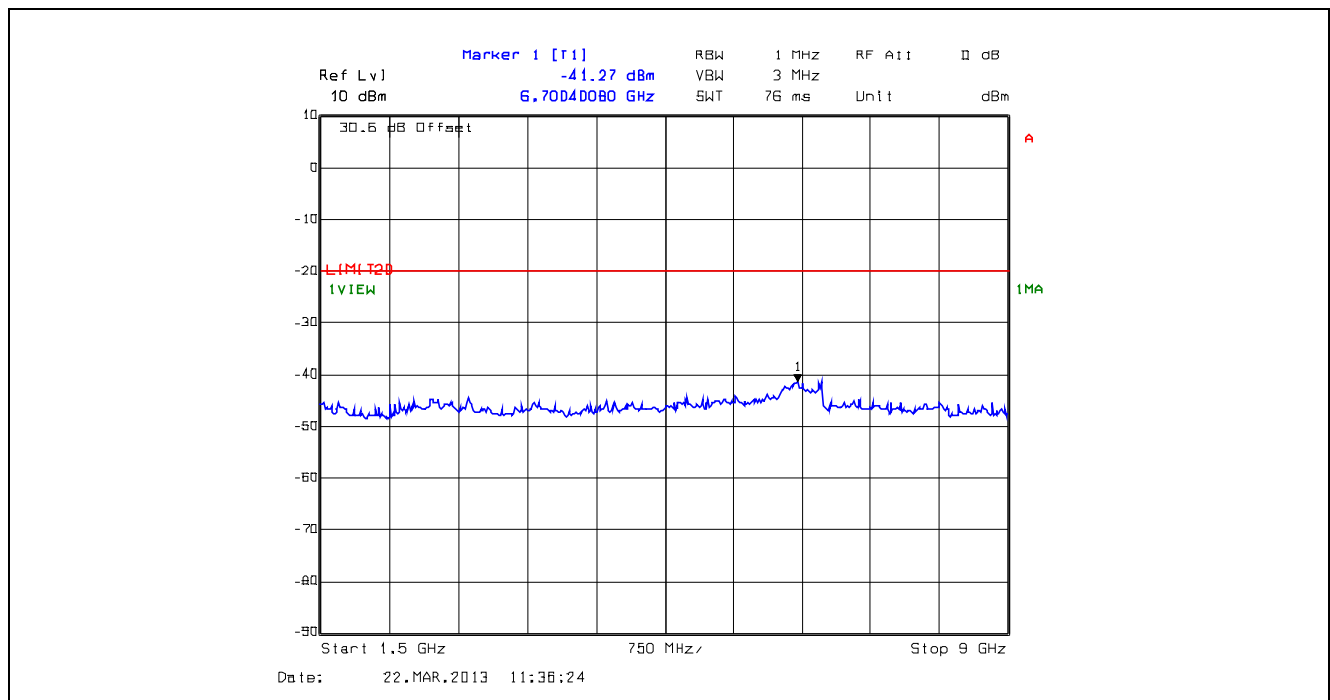
File #: TIL-094F90R01
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Plot 5.5.4.43. Conducted Transmitter Spurious Emissions, Low Power, 815.0 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.44. Conducted Transmitter Spurious Emissions, Low Power, 815.0 MHz, 1.5 GHz - 9 GHz



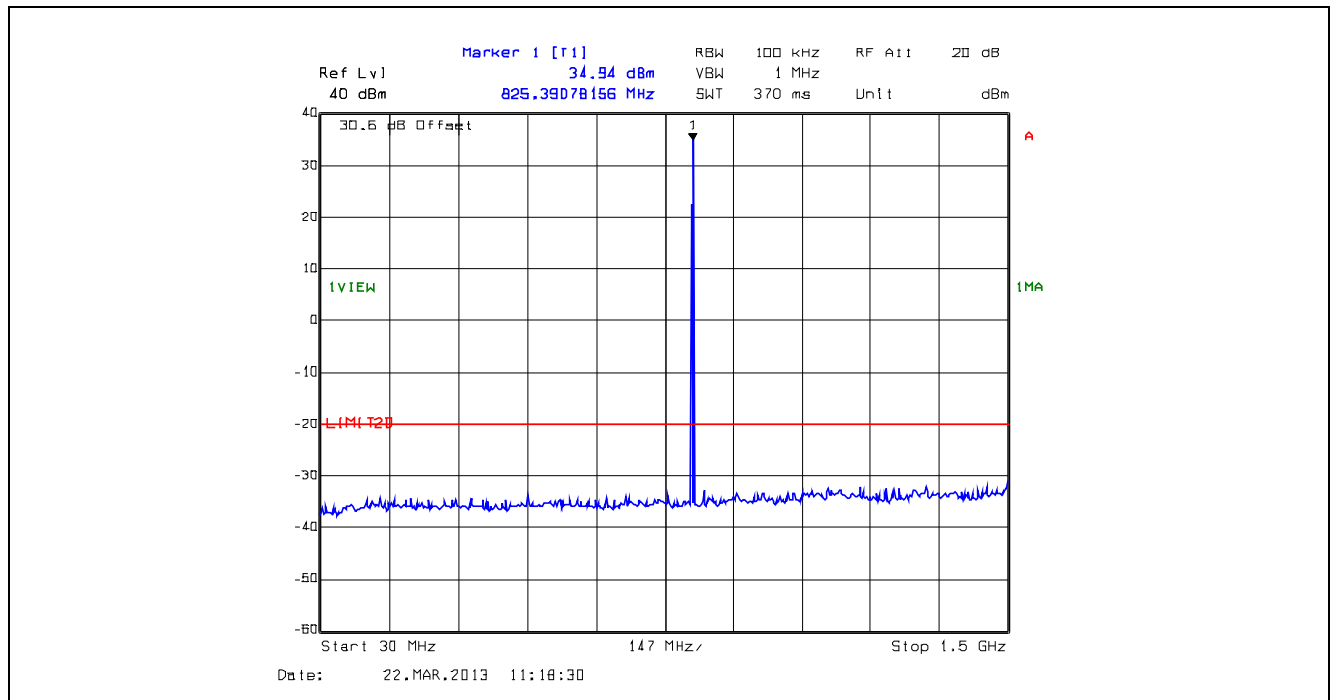
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

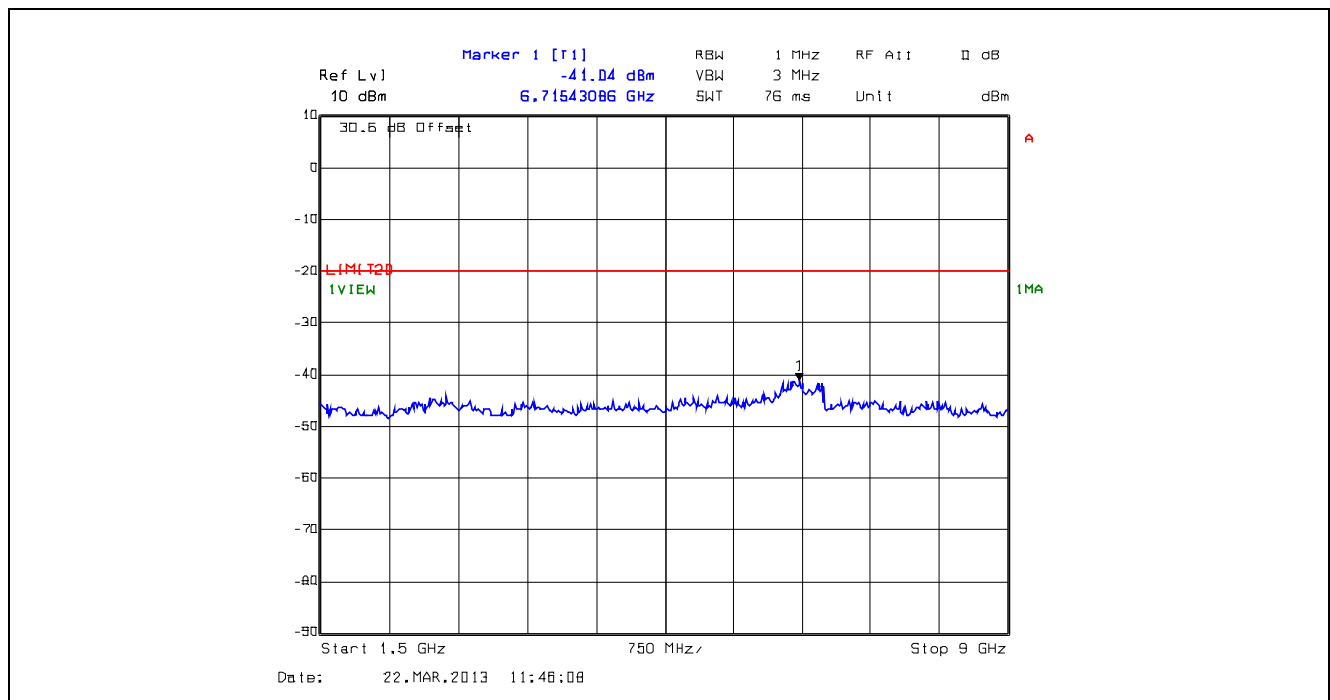
File #: TIL-094F90R01
July 2, 2013

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.5.4.45. Conducted Transmitter Spurious Emissions, High Power, 823.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.46. Conducted Transmitter Spurious Emissions, High Power, 823.9 MHz, 1.5 GHz - 9 GHz



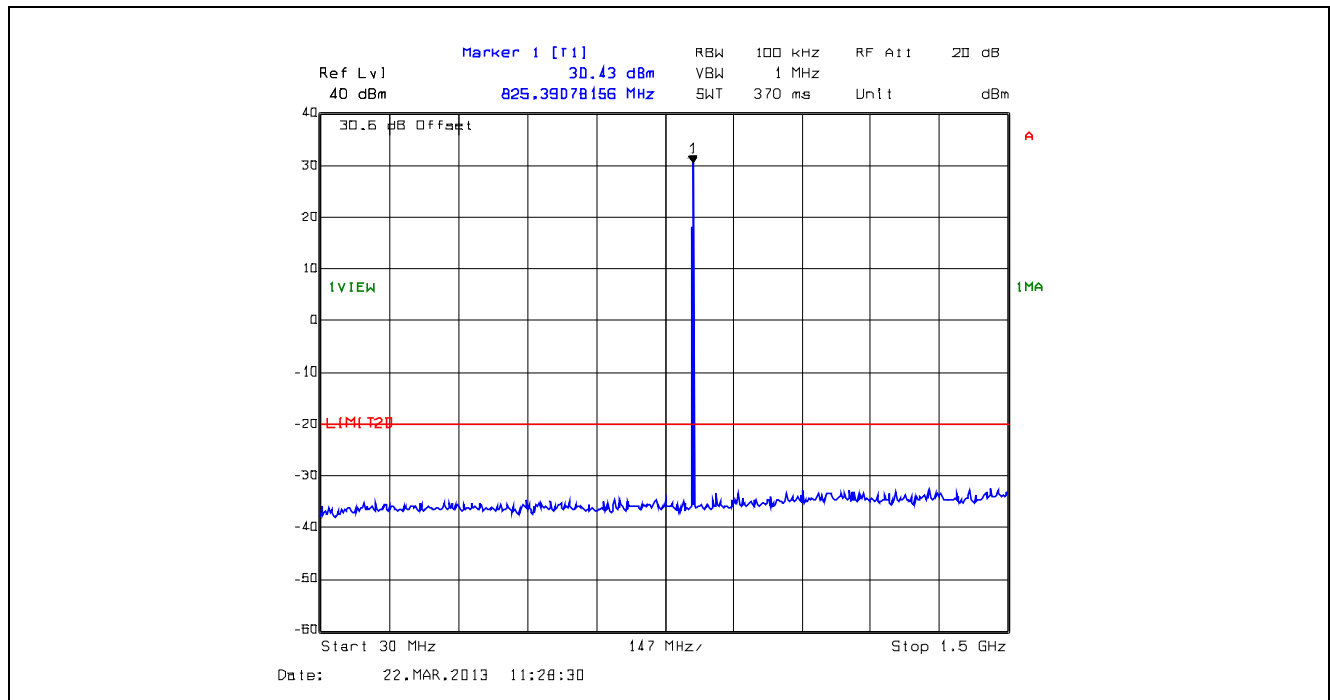
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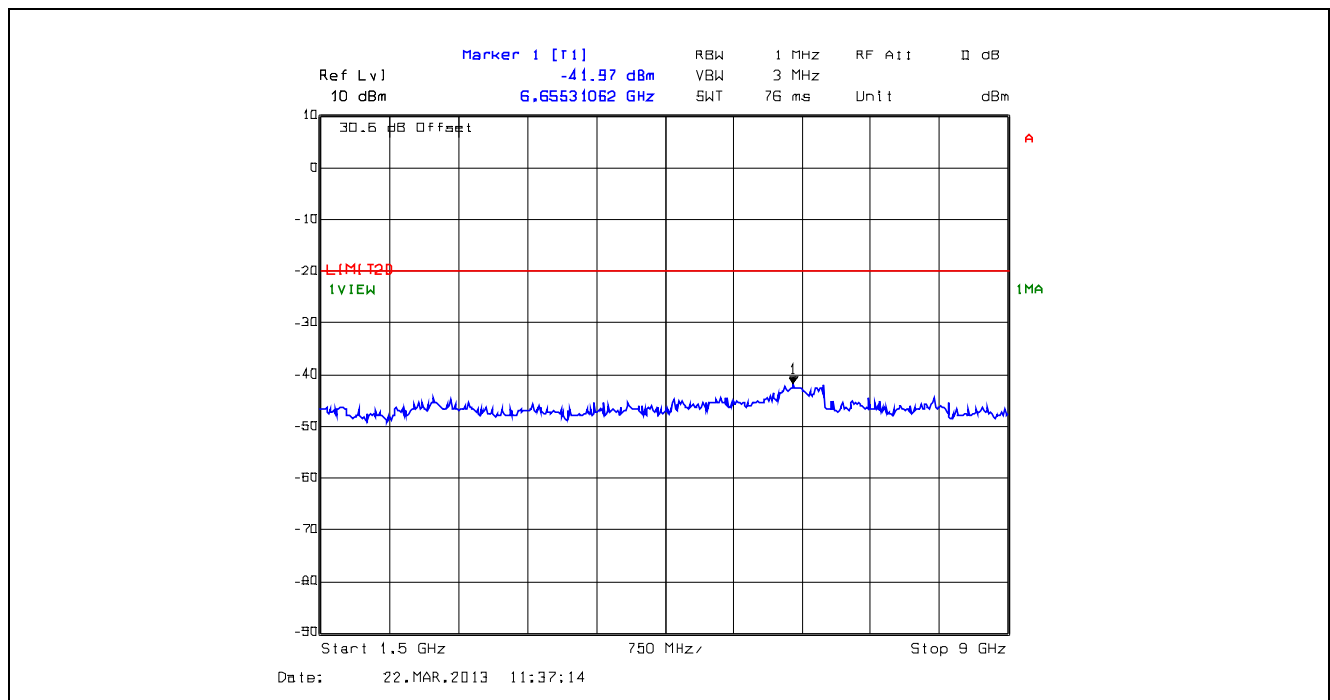
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.5.4.47. Conducted Transmitter Spurious Emissions, Low Power, 823.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.48. Conducted Transmitter Spurious Emissions, Low Power, 823.9 MHz, 1.5 GHz - 9 GHz



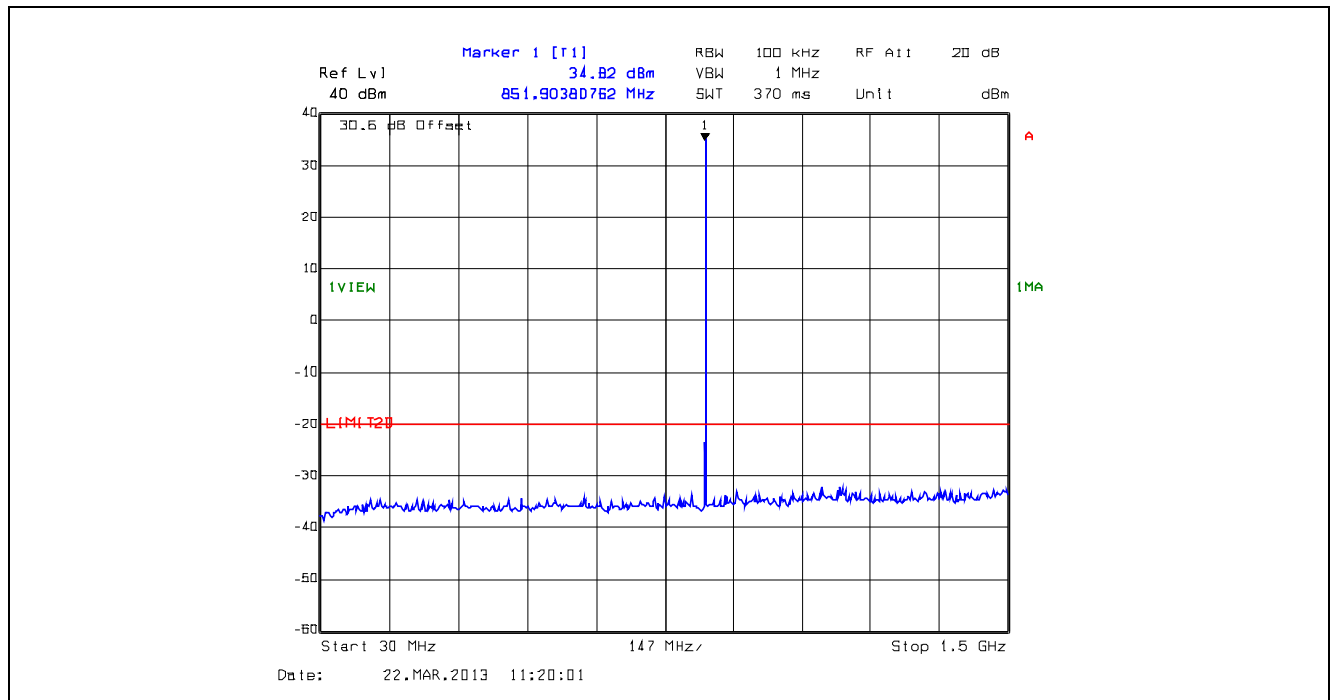
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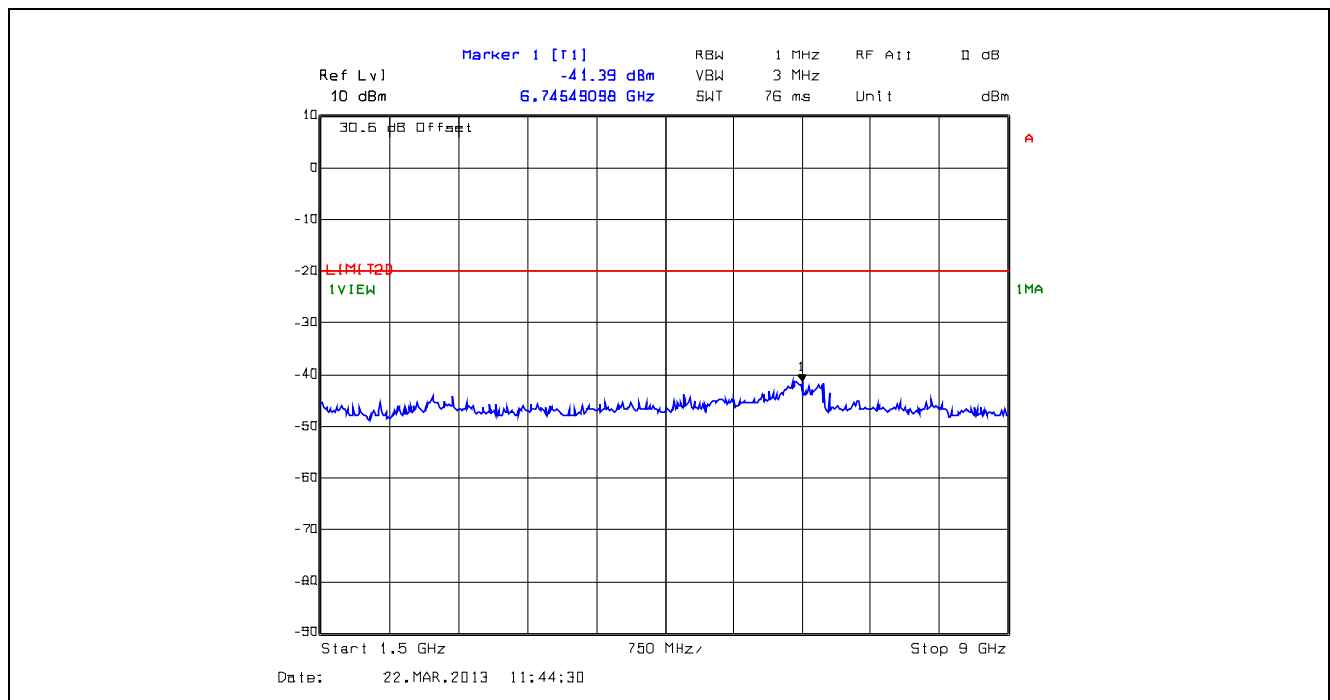
File #: TIL-094F90R01
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Plot 5.5.4.49. Conducted Transmitter Spurious Emissions, High Power, 851.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.50. Conducted Transmitter Spurious Emissions, High Power, 851.1 MHz, 1.5 GHz - 9 GHz



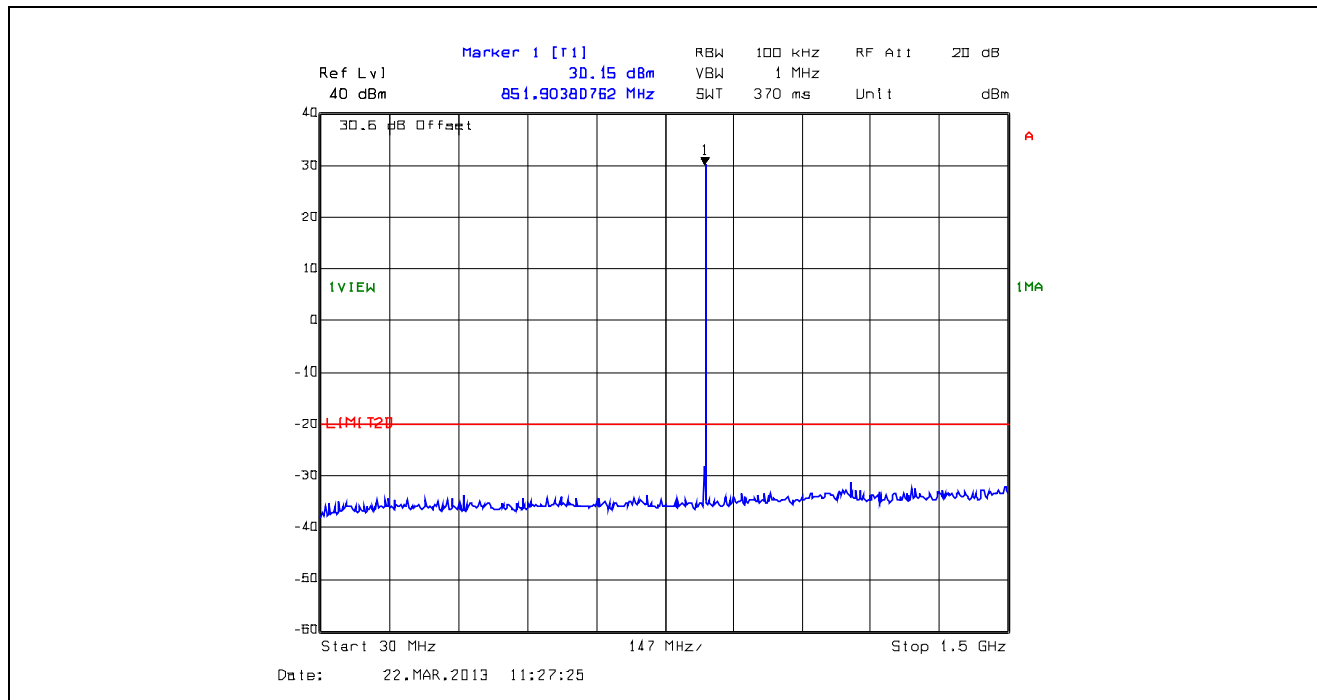
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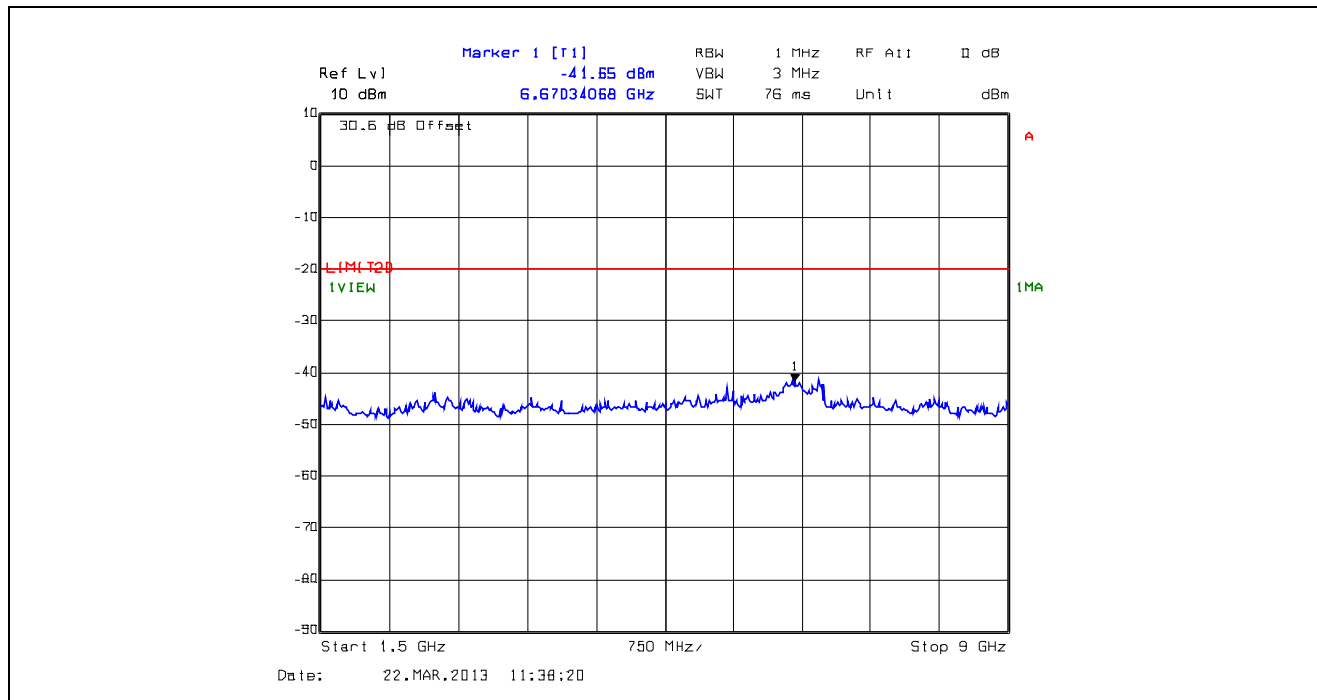
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Plot 5.5.4.51. Conducted Transmitter Spurious Emissions, Low Power, 851.1 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.52. Conducted Transmitter Spurious Emissions, Low Power, 851.1 MHz, 1.5 GHz - 9 GHz



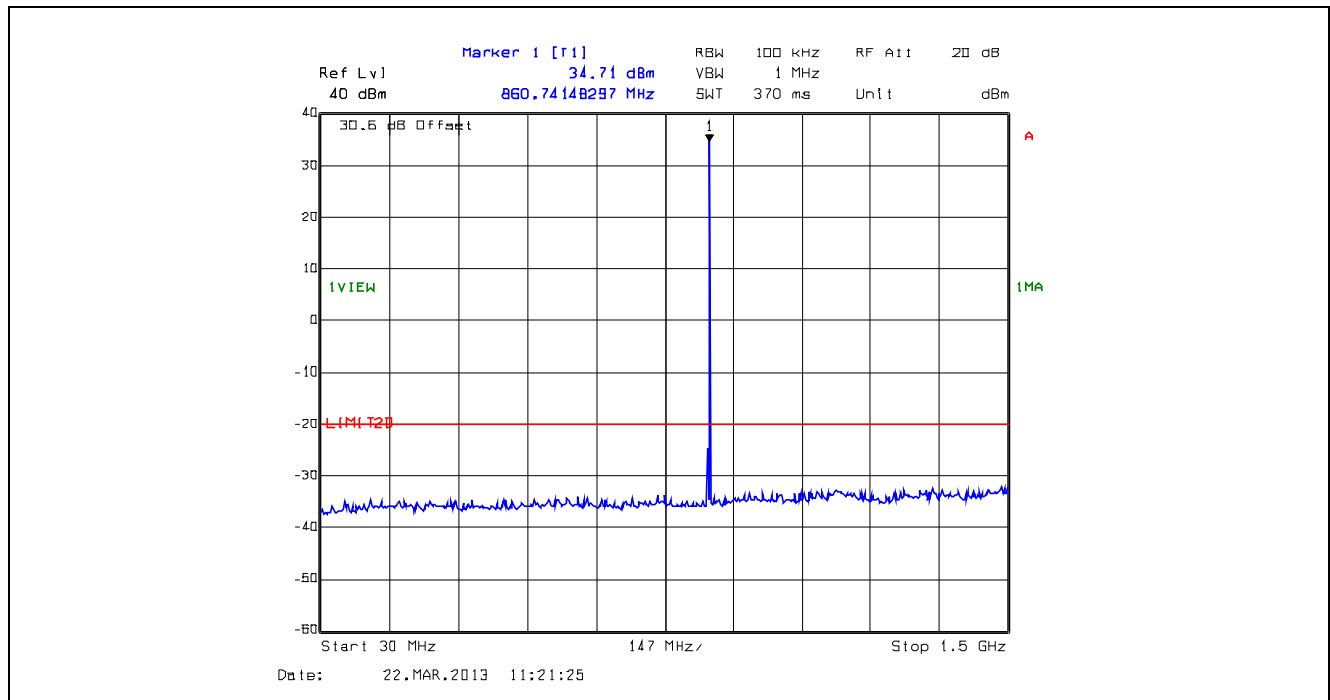
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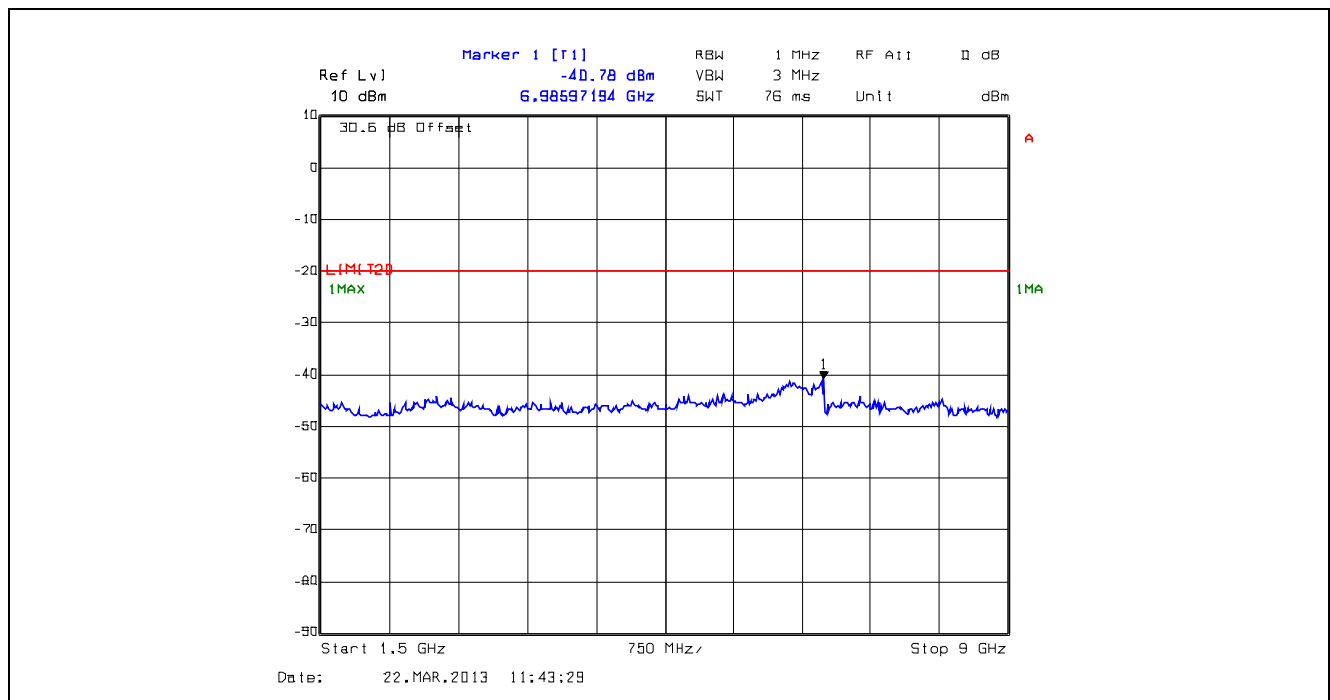
File #: TIL-094F90R01
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Plot 5.5.4.53. Conducted Transmitter Spurious Emissions, High Power, 860.0 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.54. Conducted Transmitter Spurious Emissions, High Power, 860.0 MHz, 1.5 GHz - 9 GHz



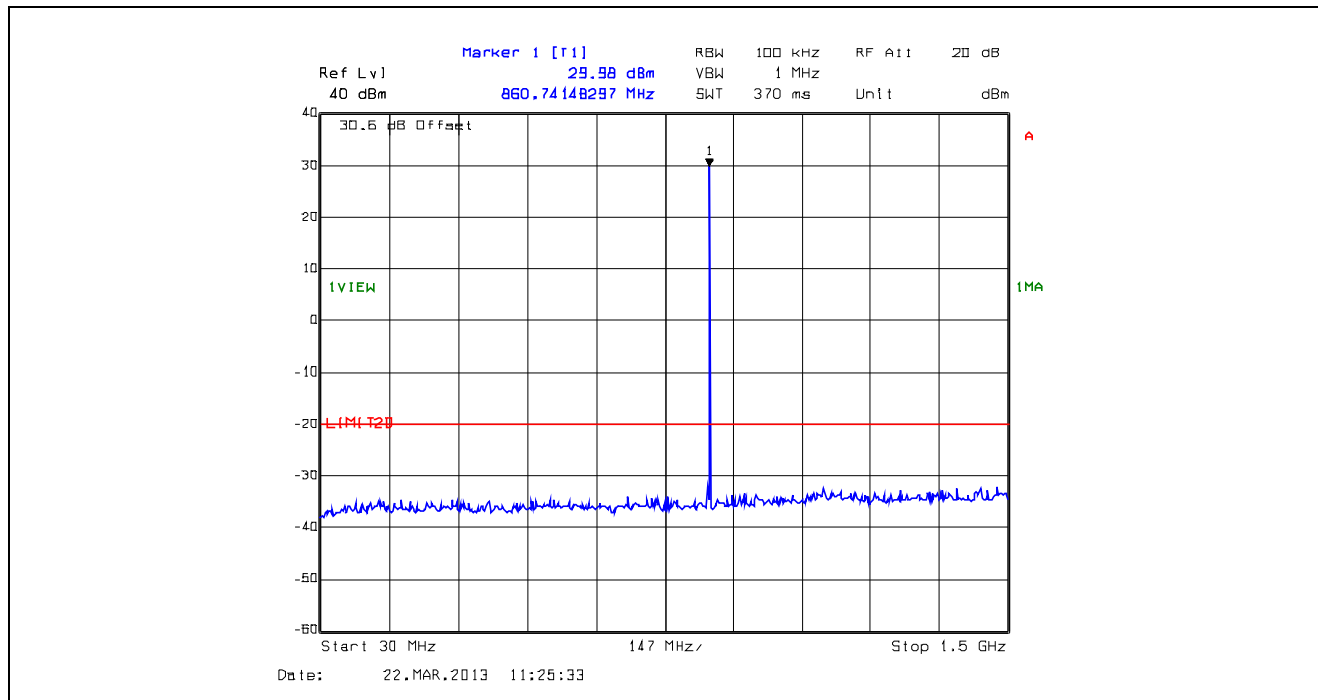
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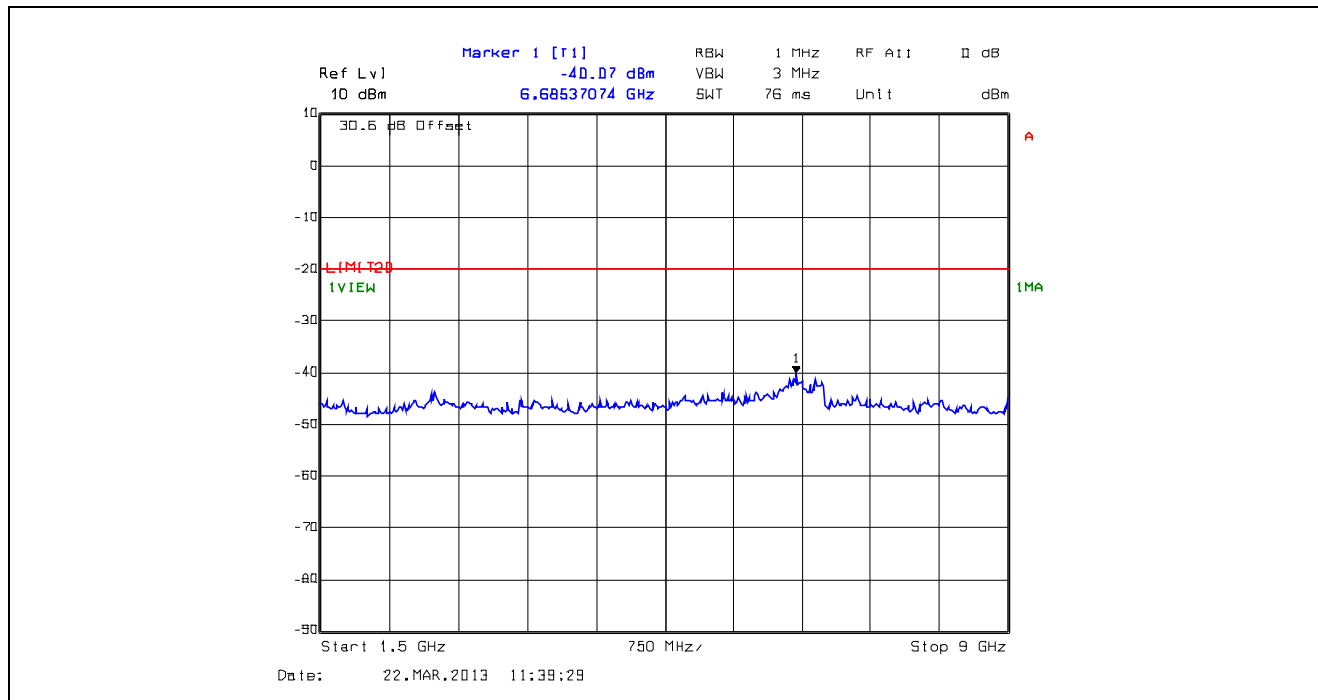
File #: TIL-094F90R01
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Plot 5.5.4.55. Conducted Transmitter Spurious Emissions, Low Power, 860.0 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.56. Conducted Transmitter Spurious Emissions, Low Power, 860.0 MHz, 1.5 GHz - 9 GHz



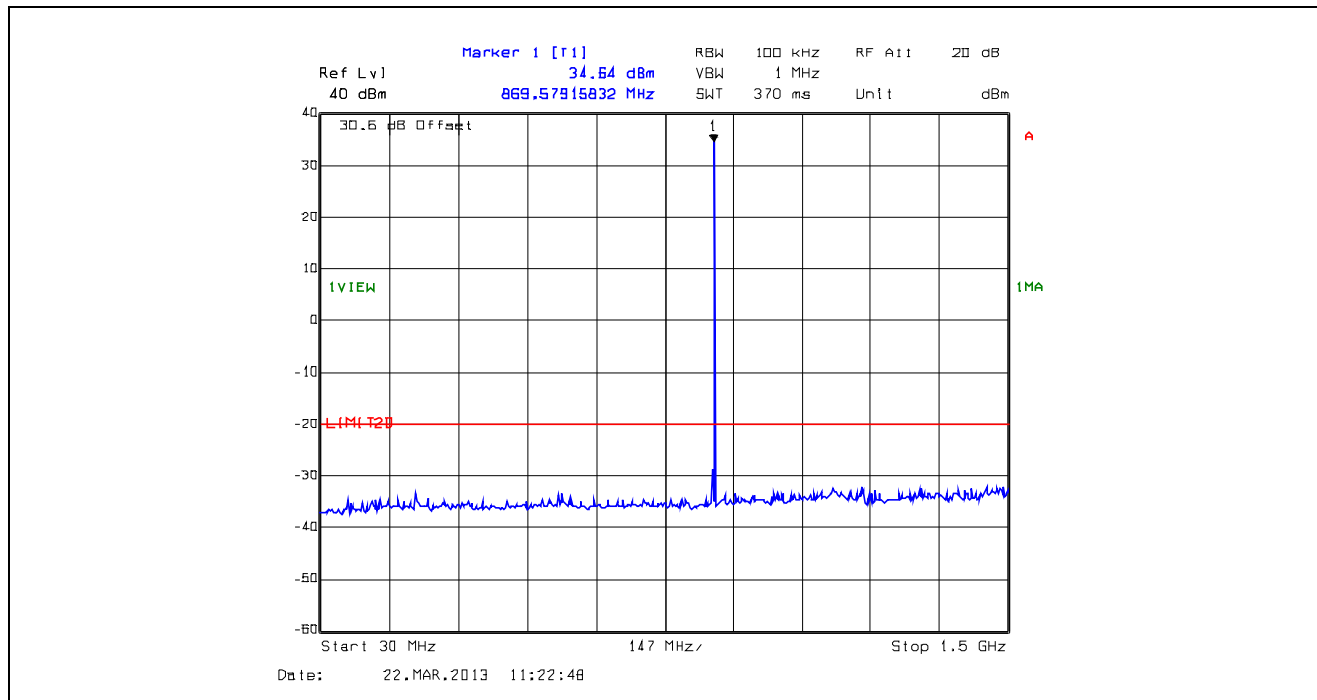
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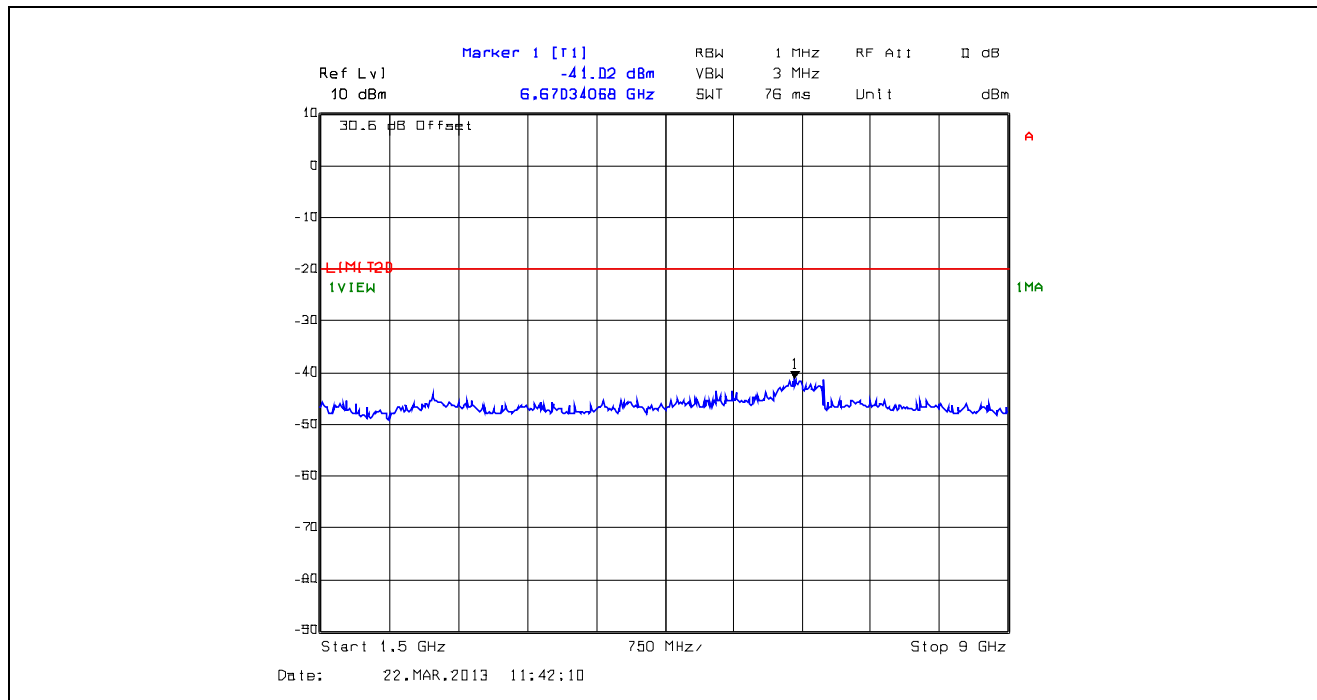
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Plot 5.5.457. Conducted Transmitter Spurious Emissions, High Power, 868.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.458. Conducted Transmitter Spurious Emissions, High Power, 868.9 MHz, 1.5 GHz - 9 GHz



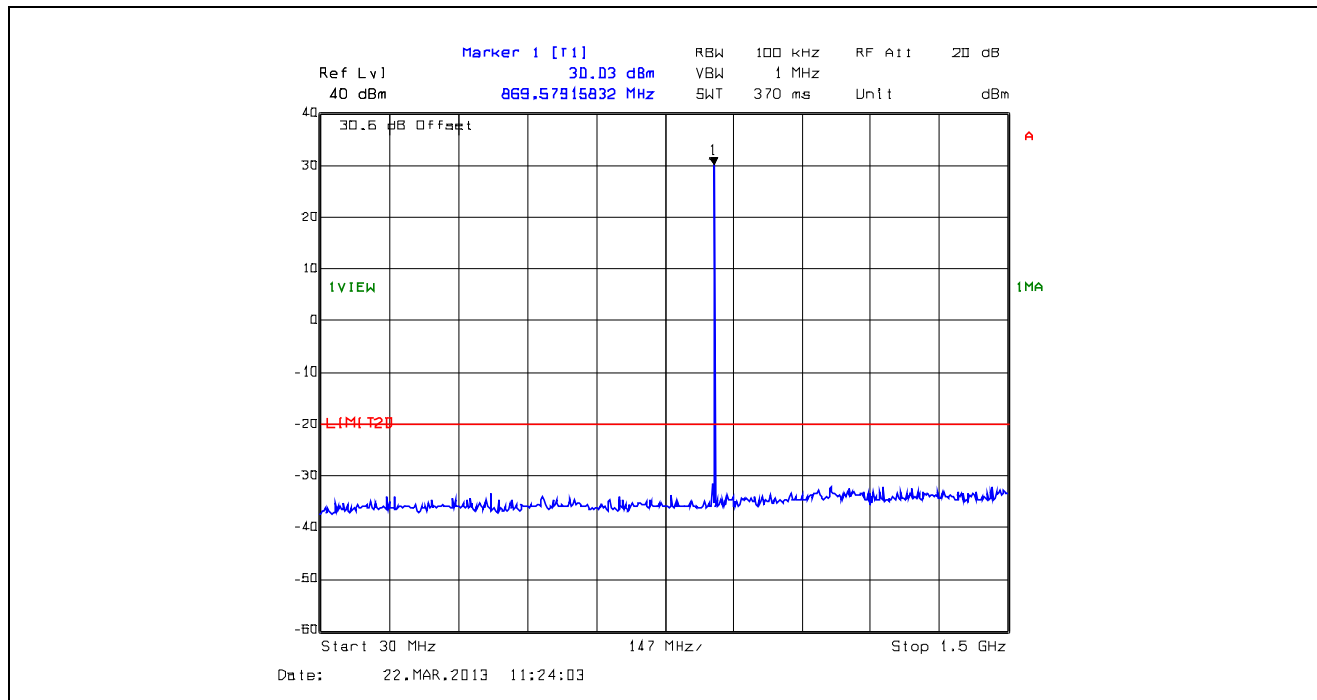
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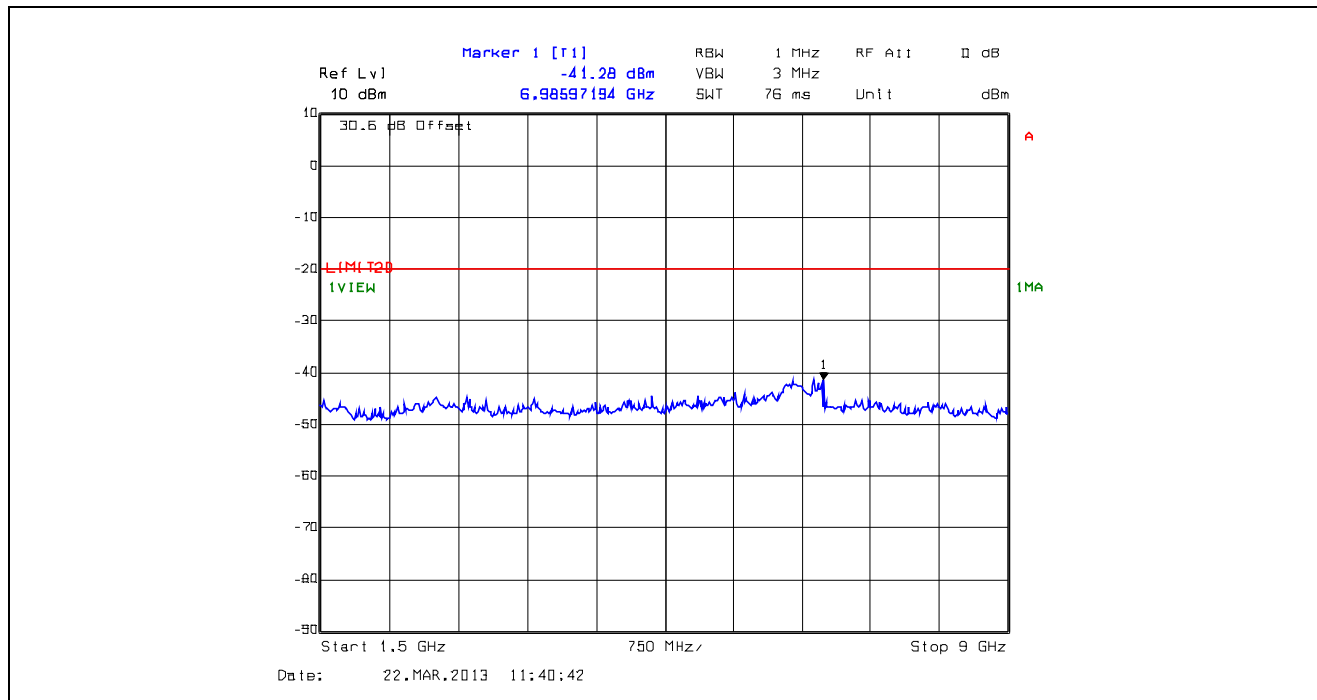
File #: TIL-094F90R01
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.5.4.59. Conducted Transmitter Spurious Emissions, Low Power, 868.9 MHz, 30 MHz - 1.5 GHz



Plot 5.5.4.60. Conducted Transmitter Spurious Emissions, Low Power, 868.9 MHz, 1.5 GHz - 9 GHz



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5.6. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053, 2.1057 & 90.210]

5.6.1. Limits

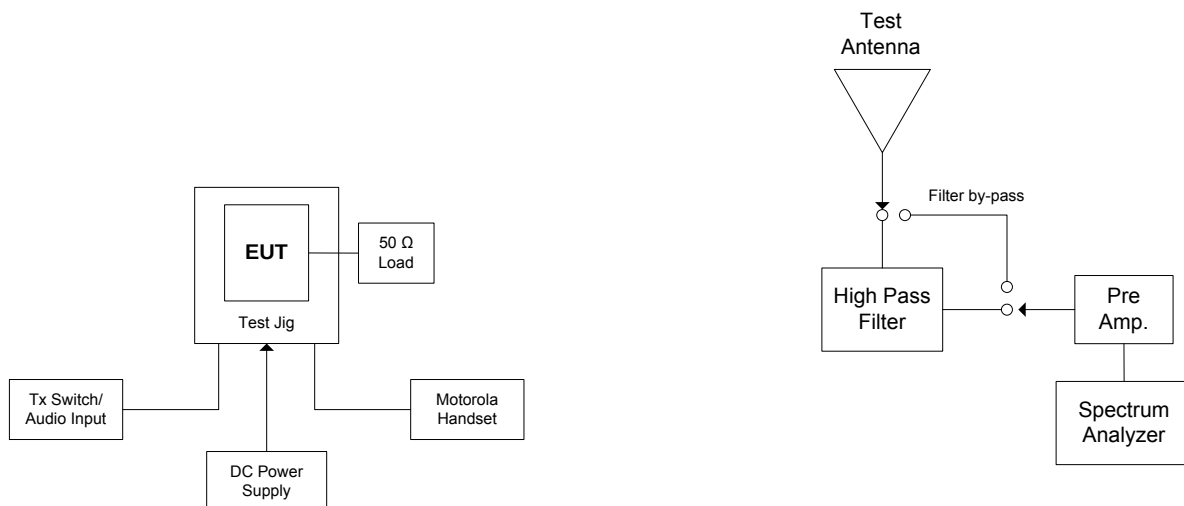
Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(b)	At least $43 + 10 \log (P)$ dB
§ 90.210(d)	At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

5.6.2. Method of Measurements

See substitution test method specified in Section 8.2 of this report

5.6.3. Test Arrangement



5.6.4. Test Data

Remarks:

- The emissions were scanned from 30 MHz to 10th harmonics; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.
- Exploratory tests were conducted with modulations in the range of typical modes of operation to identify the worst-case modulation. There were no discernable differences detected. The high power setting was used to represents the worst-case test configuration for the final measurement.
- The more stringent limit will be applied for compliance.

Test Frequency (MHz):		406.2				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 5000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		429.9				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 5000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		469.9				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 5000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

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Test Frequency (MHz):		764.1				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 8500	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		769.5				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 8500	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		774.9				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 8500	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		794.1				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 8500	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		798.5				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 8500	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		804.9				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 8500	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

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Test Frequency (MHz):		806.1				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		815.0				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		823.9				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		851.1				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		860.0				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):		868.9				
Limit (dBm):		-20				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-20	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.7. FREQUENCY STABILITY [§§ 2.1055, 90.213 & 90.539]

5.7.1. Limits

See § 90.213 - Minimum Frequency Stability

Frequency range (MHz)	Minimum Frequency Stability (ppm)		
	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
421-512	^{1,3,4} 2.5	² 5	² 5
806-809	⁴ 1.0	1.5	1.5
809-824	⁴ 1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5

¹ In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

² In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

³ Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

⁴ Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

§ 90.539 Transmitters designed to operate in 769-775 MHz and 799-805 MHz frequency bands must meet the frequency stability requirements in this section.

(a) Mobile, portable and control transmitters must normally use automatic frequency control (AFC) to lock on to the base station signal.

(b) The frequency stability of base transmitters operating in the narrowband segment must be 100 parts per billion or better.

(c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).

(d) The frequency stability of base transmitters operating in the wideband segment must be 1 part per million or better.

(e) The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

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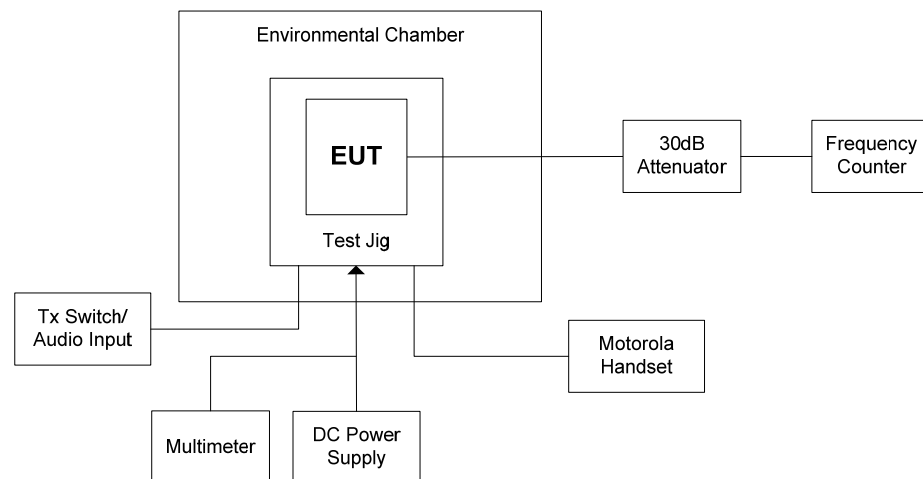
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5.7.2. Method of Measurements

Refer to Section 8.3 of this report for measurement details.

5.7.3. Test Arrangement



5.7.4. Test Data

Center Frequency:		406.2 MHz	
Full Power Level:		5 W	
Frequency Tolerance Limit (Worst Case):		±2.5 ppm or 1016 Hz	
Max. Frequency Tolerance Measured:		+62 Hz or 0.15 ppm	
Input Voltage Rating:		7.5 VDC	
Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage 7.5 VDC (Nominal)	Supply Voltage 6.375 VDC (85% of Nominal)	Supply Voltage 8.625 VDC (115% of Nominal)
-30	-46	--	--
-20	-75	--	--
-10	-32	--	--
0	-64	--	--
10	-15	--	--
20	-18	-16	-15
30	-24	--	--
40	+31	--	--
50	+24	--	--
60	+62	--	--

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Center Frequency:		769.5 MHz	
Full Power Level:		2.5 W	
Frequency Tolerance Limit (Worst Case):		±1.5 ppm or 1154 Hz	
Max. Frequency Tolerance Measured:		-121 Hz or 0.16 ppm	
Input Voltage Rating:		7.5 VDC	
Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage 7.5 VDC (Nominal)	Supply Voltage 6.375 VDC (85% of Nominal)	Supply Voltage 8.625 VDC (115% of Nominal)
-30	-77	--	--
-20	-121	--	--
-10	-48	--	--
0	-108	--	--
10	+37	--	--
20	-25	-19	-25
30	-66	--	--
40	-79	--	--
50	+41	--	--
60	+59	--	--

Center Frequency:		806.1 MHz	
Full Power Level:		3 W	
Frequency Tolerance Limit (Worst Case):		±1.5 ppm or 1209 Hz	
Max. Frequency Tolerance Measured:		-121 Hz or 0.15 ppm	
Input Voltage Rating:		7.5 VDC	
Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage 7.5 VDC (Nominal)	Supply Voltage 6.375 VDC (85% of Nominal)	Supply Voltage 8.625 VDC (115% of Nominal)
-30	-79	--	--
-20	-121	--	--
-10	-49	--	--
0	-110	--	--
10	+39	--	--
20	-27	-23	-25
30	-71	--	--
40	-84	--	--
50	+40	--	--
60	+60	--	--

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5.8. TRANSIENT FREQUENCY BEHAVIOR [§ 90.214]

5.8.1. Limits

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Time intervals ^{1, 2}	Maximum frequency difference ³	All equipment	
		150 to 174 MHz	421 to 512MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t ₁ ⁴	± 25.0 KHz	5.0 ms	10.0 ms
t ₂	± 12.5 KHz	20.0 ms	25.0 ms
t ₃ ⁴	± 25.0 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t ₁ ⁴	± 12.5 KHz	5.0 ms	10.0 ms
t ₂	± 6.25 KHz	20.0 ms	25.0 ms
t ₃ ⁴	± 12.5 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t ₁ ⁴	±6.25 KHz	5.0 ms	10.0 ms
t ₂	±3.125 KHz	20.0 ms	25.0 ms
t ₃ ⁴	±6.25 KHz	5.0 ms	10.0 ms

- t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
 t_1 is the time period immediately following t_{on} .
 t_2 is the time period immediately following t_1 .
 t_3 is the time period from the instant when the transmitter is turned off until t_{off} .
 t_{off} is the instant when the 1 kHz test signal starts to rise.
- During the time from the end of t_2 to the beginning of t_3 , the frequency difference must not exceed the limits specified in § 90.213.
- Difference between the actual transmitter frequency and the assigned transmitter frequency.
- If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

5.8.2. Method of Measurements

Refer to Section 8.6 of this test report and ANSI/TIA/EIA-603-D-2010, Section 2.2.19.

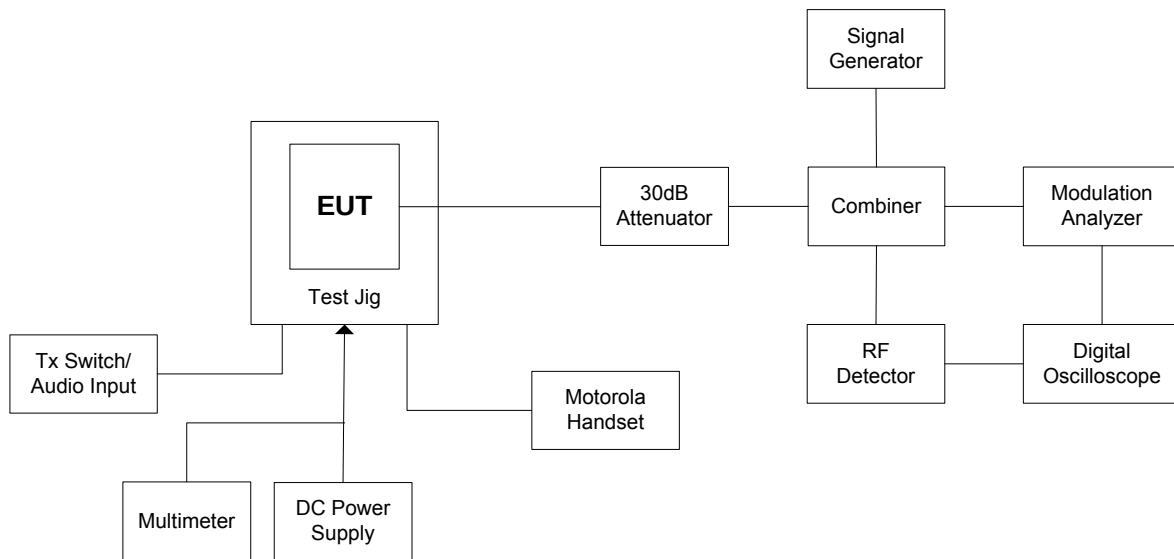
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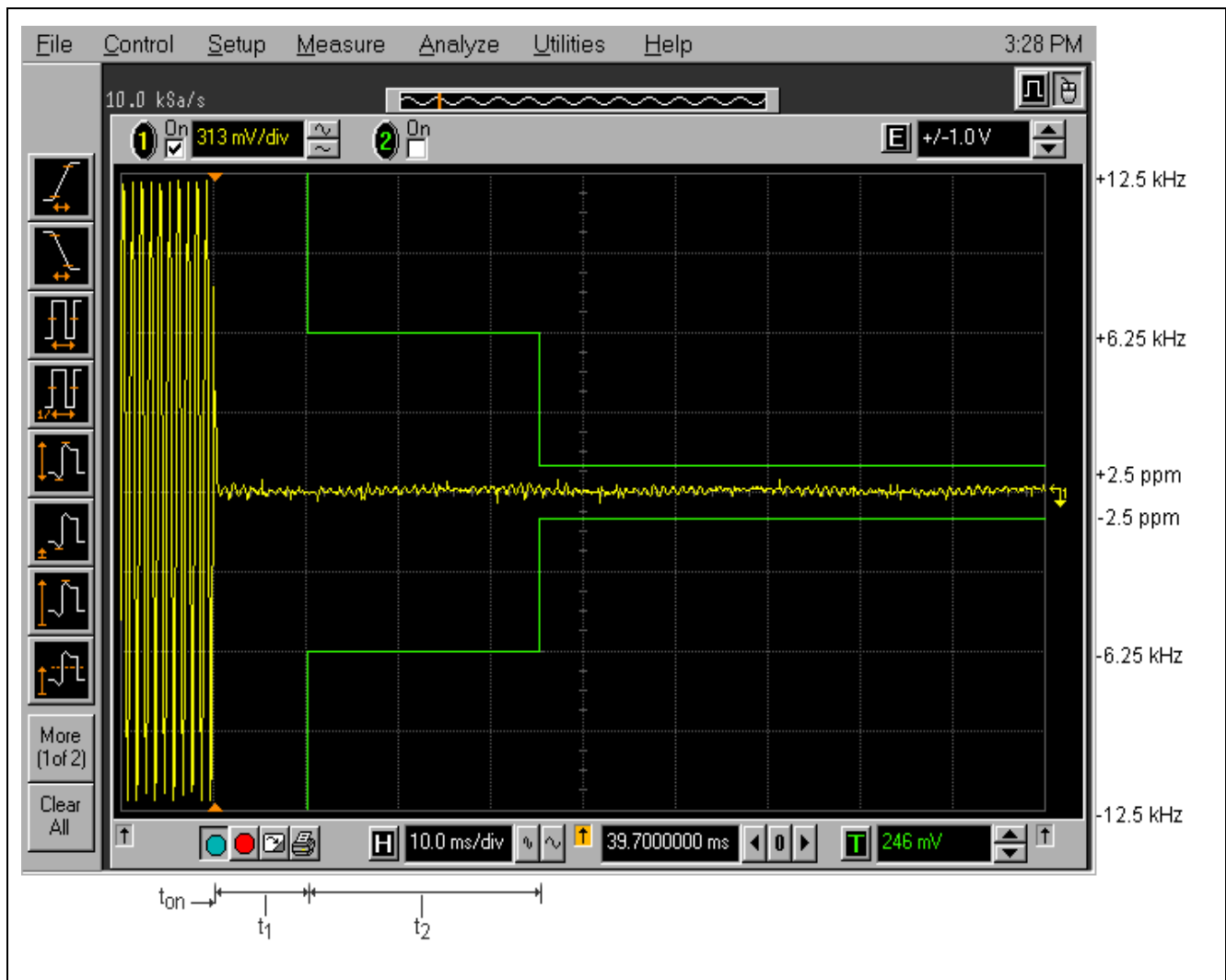
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5.8.3. Test Arrangement



5.8.4. Test Data

Plot 5.8.4.1. Transient Frequency Behavior on 12.5 kHz Channels
Test Frequency: 406.2 MHz; Power: 5 W; Test Conditions: Switch on condition t_{on} , t_1 , and t_2



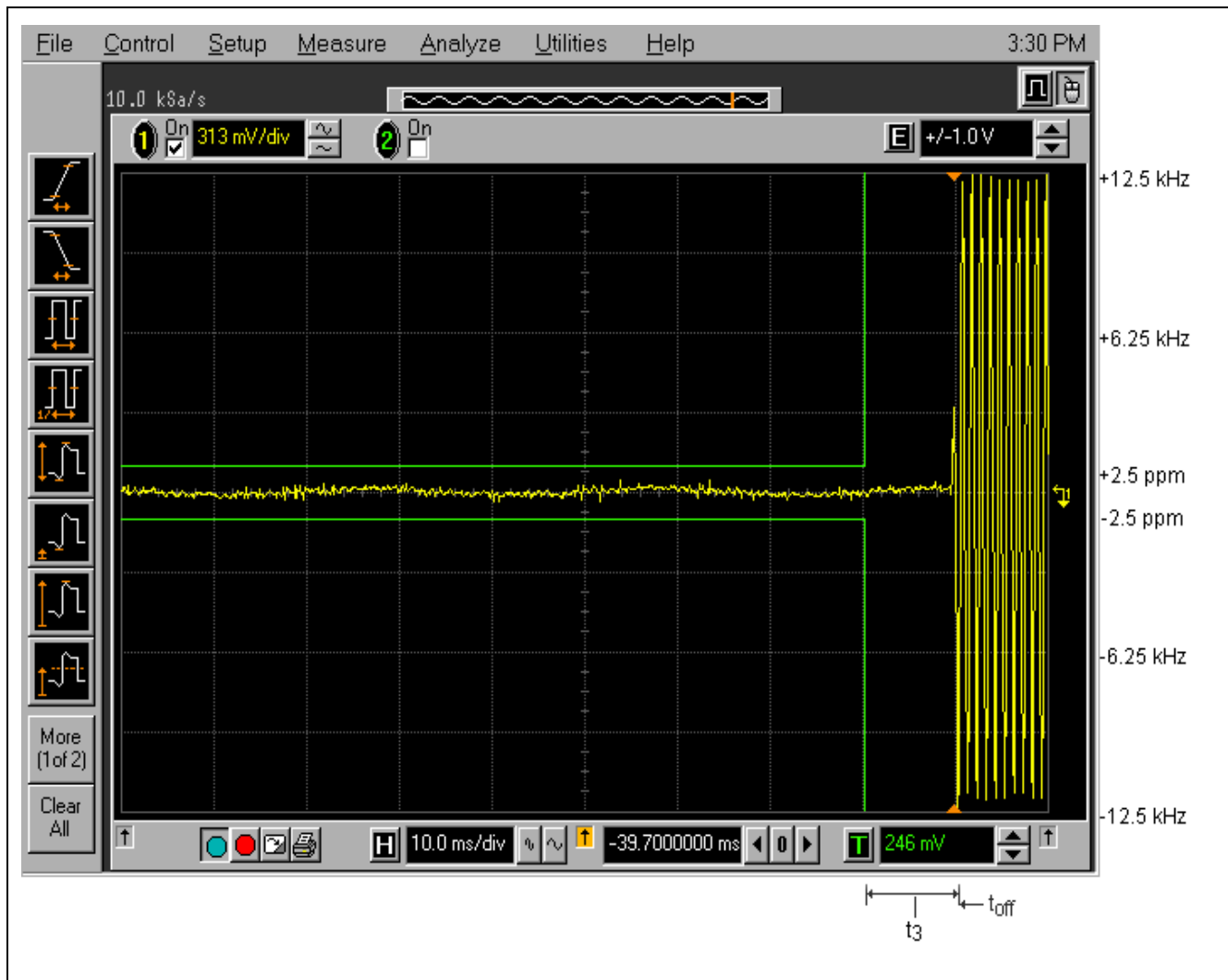
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Plot 5.8.4.2. Transient Frequency Behavior on 12.5 kHz Channels
Test Frequency: 406.2 MHz; Power: 5 W; Test Conditions: Switch off condition t_3 , t_{off}



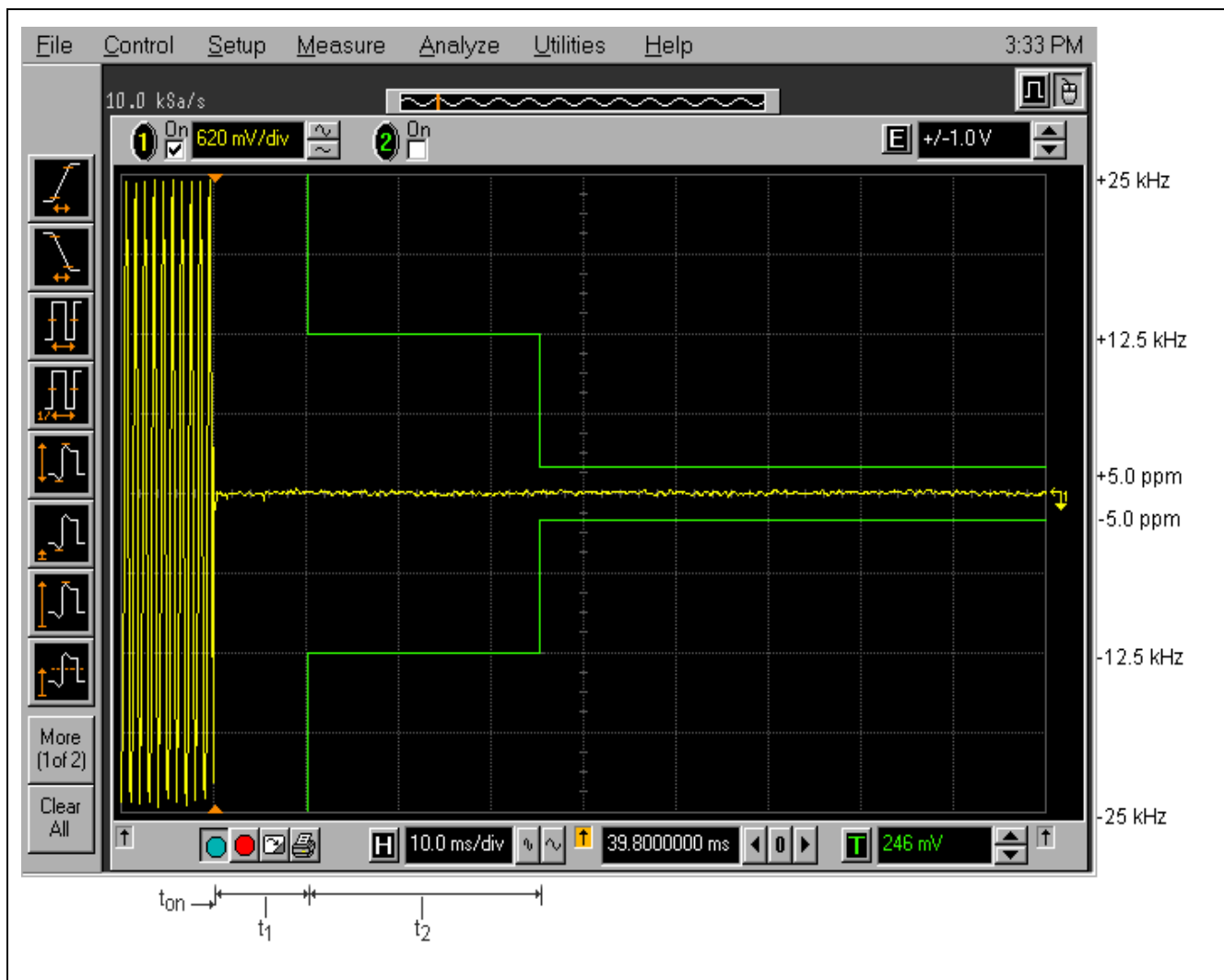
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Plot 5.8.4.3. Transient Frequency Behavior on 25 kHz Channels
Test Frequency: 406.2 MHz; Power: 5 W; Test Conditions: Switch on condition t_{on} , t_1 , and t_2



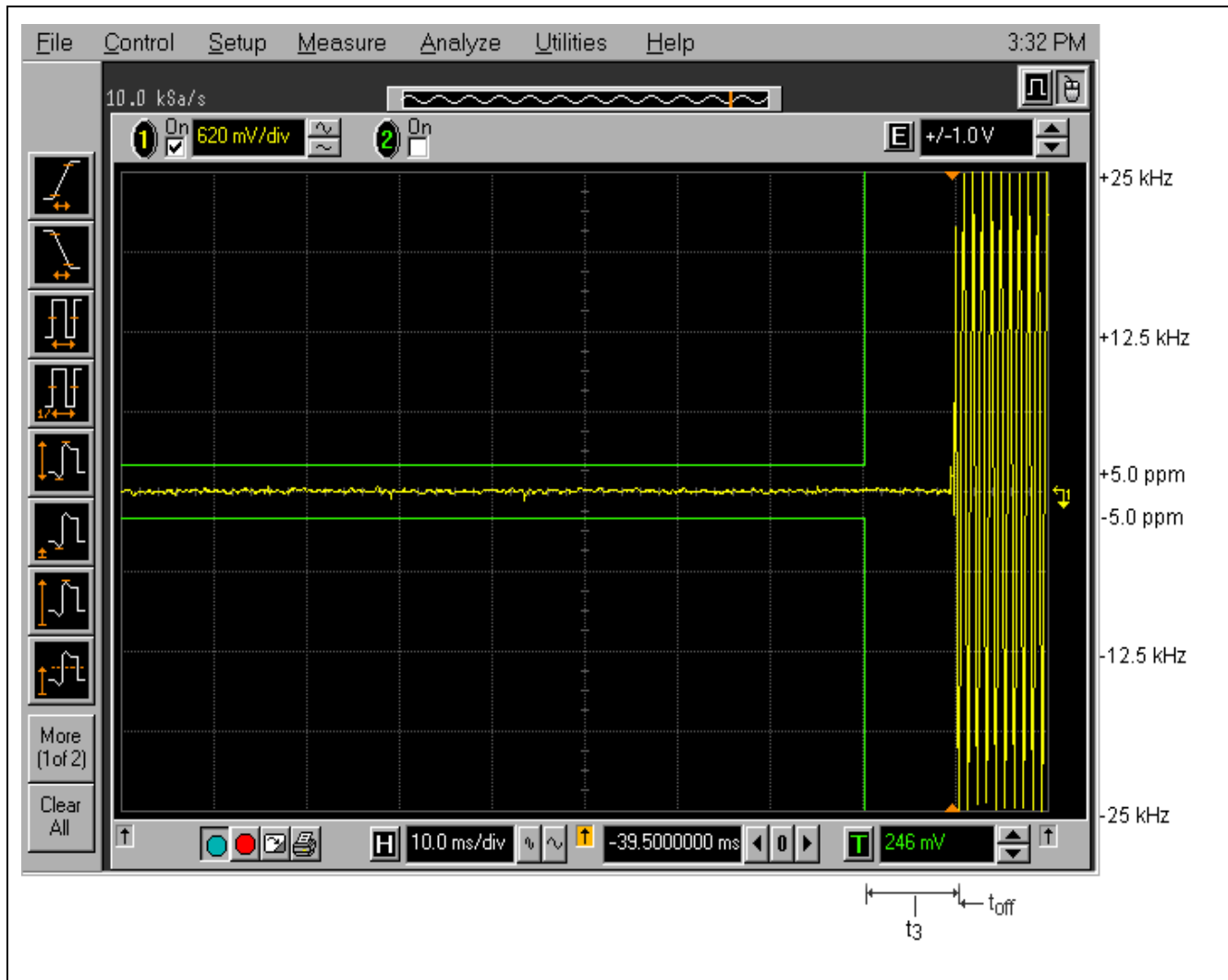
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Plot 5.8.4.4. Transient Frequency Behavior on 25 kHz Channels
Test Frequency: 406.2 MHz; Power: 5 W; Test Conditions: Switch off condition t_3 , t_{off}



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5.9. ADJACENT CHANNEL POWER [§ 90.543]

5.9.1. Limits

§ 90.543 (a) The adjacent channel power (ACP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a value for the ACP as a function of the displacement from the channel center frequency and measurement bandwidth. In the following tables, “(s)” indicates a swept measurement may be used.

12.5 kHz Mobile Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP relative (dBc)
9.375	6.25	-40
15.625	6.25	-60
21.875	6.25	-60
37.50	25.00	-60
62.50	25.00	-65
87.50	25.00	-65
150.00	100	-65
250.00	100	-65
350.00	100	-65
>400 to 12 MHz	30 (s)	-75
12 MHz to paired receive band	30 (s)	-75
In the paired receive band	30 (s)	-100

25 kHz Mobile Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP relative (dBc)
15.625	6.25	-40
21.875	6.25	-60
37.50	25	-60
62.50	25	-65
87.50	25	-65
150.00	100	-65
250.00	100	-65
350.00	100	-65
>400 kHz to 12 MHz	30 (s)	-75
12 MHz to paired receive band	30 (s)	-75
In the paired receive band	30 (s)	-100

5.9.2. Method of Measurements

TIA-603-D 2.2.14 and § 90.543

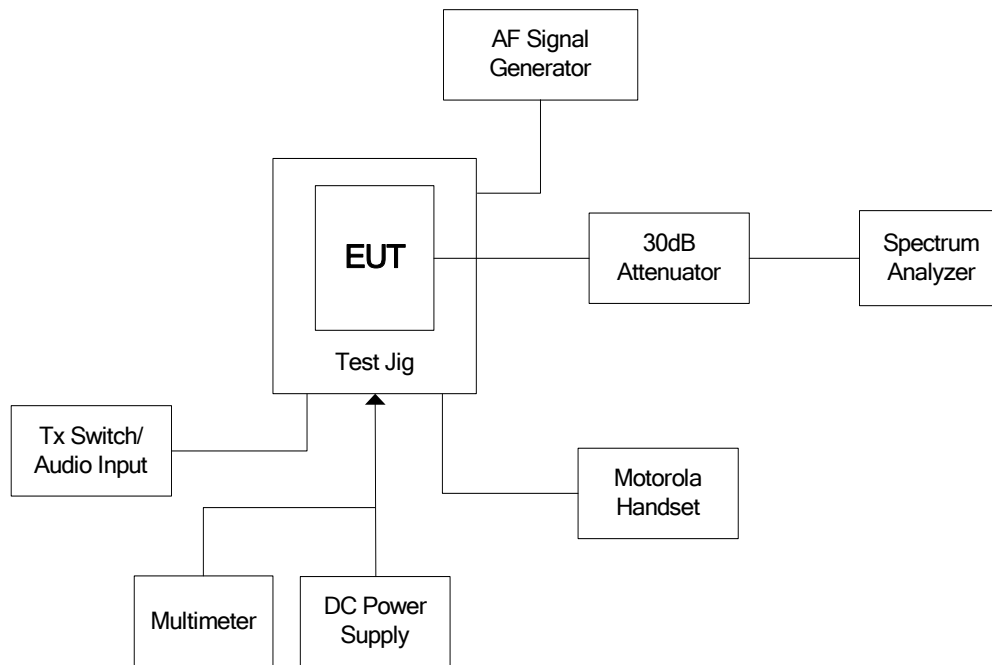
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5.9.3. Test Arrangement



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5.9.4. Test Data

Analog Voice, 12.5 kHz Channel Spacing, 764.1 MHz				
Ref. Power Level = 34.00 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-61.62	-58.94	-40
15.625	6.25	-76.77	-77.10	-60
21.875	6.25	-77.66	-77.59	-60
37.500	25.00	-73.77	-74.91	-60
62.500	25.00	-72.88	-72.95	-65
87.500	25.00	-68.10	-69.05	-65
150.000	100.00	-70.01	-69.70	-65
250.000	100.00	-72.29	-72.60	-65
350.000	100.00	-76.84	-76.28	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Analog Voice, 12.5 kHz Channel Spacing, 769.5 MHz				
Ref. Power Level = 34.00 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-61.18	-59.36	-40
15.625	6.25	-78.24	-79.14	-60
21.875	6.25	-79.95	-80.18	-60
37.500	25.00	-74.54	-75.05	-60
62.500	25.00	-73.32	-73.29	-65
87.500	25.00	-70.33	-70.26	-65
150.000	100.00	-70.45	-70.55	-65
250.000	100.00	-74.36	-73.70	-65
350.000	100.00	-77.33	-77.51	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Analog Voice, 12.5 kHz Channel Spacing, 774.9 MHz, Ref. Power Level = 33.92 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-60.17	-58.98	-40
15.625	6.25	-79.05	-79.36	-60
21.875	6.25	-79.36	-79.36	-60
37.500	25.00	-74.50	-75.45	-60
62.500	25.00	-73.80	-75.13	-65
87.500	25.00	-71.46	-72.06	-65
150.000	100.00	-69.66	-69.58	-65
250.000	100.00	-73.71	-73.32	-65
350.000	100.00	-76.80	-76.51	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Analog Voice, 12.5 kHz Channel Spacing, 794.1 MHz Ref. Power Level = 33.61 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-61.72	-58.97	-40
15.625	6.25	-78.05	-77.69	-60
21.875	6.25	-78.94	-79.04	-60
37.500	25.00	-74.25	-71.56	-60
62.500	25.00	-74.30	-75.19	-65
87.500	25.00	-72.42	-74.87	-65
150.000	100.00	-69.16	-69.70	-65
250.000	100.00	-73.59	-73.50	-65
350.000	100.00	-78.14	-75.68	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Analog Voice, 12.5 kHz Channel Spacing, 798.5 MHz				
Ref. Power Level = 33.36 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-60.15	-58.91	-40
15.625	6.25	-78.09	-78.17	-60
21.875	6.25	-79.40	-79.29	-60
37.500	25.00	-74.30	-74.46	-60
62.500	25.00	-73.33	-73.06	-65
87.500	25.00	-70.49	-70.61	-65
150.000	100.00	-70.87	-69.40	-65
250.000	100.00	-73.84	-73.02	-65
350.000	100.00	-77.37	-78.80	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Analog Voice, 12.5 kHz Channel Spacing, 804.9 MHz				
Ref. Power Level = 33.76 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-60.60	-59.30	-40
15.625	6.25	-77.73	-78.46	-60
21.875	6.25	-80.11	-79.31	-60
37.500	25.00	-75.24	-75.79	-60
62.500	25.00	-74.54	-75.43	-65
87.500	25.00	-72.75	-73.52	-65
150.000	100.00	-70.75	-70.10	-65
250.000	100.00	-73.34	-73.60	-65
350.000	100.00	-76.92	-78.38	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Analog Voice, 25 kHz Channel Spacing, 764.1 MHz				
Ref. Power Level = 33.97 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
15.625	6.25	-72.29	-67.11	-40
21.875	6.25	-80.59	-80.14	-60
37.500	25.00	-74.08	-74.73	-60
62.500	25.00	-74.15	-73.83	-65
87.500	25.00	-75.77	-75.77	-65
150.000	100.00	-72.14	-71.94	-65
250.000	100.00	-73.73	-73.85	-65
350.000	100.00	-77.32	-77.09	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Analog Voice, 25 kHz Channel Spacing, 769.5 MHz				
Ref. Power Level = 34.88 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
15.625	6.25	-71.95	-67.81	-40
21.875	6.25	-80.54	-80.09	-60
37.500	25.00	-74.15	-74.50	-60
62.500	25.00	-74.59	-75.50	-65
87.500	25.00	-77.33	-76.11	-65
150.000	100.00	-72.83	-72.90	-65
250.000	100.00	-73.99	-74.05	-65
350.000	100.00	-78.19	-78.34	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Analog Voice, 25 kHz Channel Spacing, 774.9 MHz				
Ref. Power Level = 33.80 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
15.625	6.25	-71.67	-67.54	-40
21.875	6.25	-80.24	-80.47	-60
37.500	25.00	-73.92	-74.62	-60
62.500	25.00	-74.53	-74.13	-65
87.500	25.00	-76.60	-76.45	-65
150.000	100.00	-72.47	-71.95	-65
250.000	100.00	-73.93	-73.74	-65
350.000	100.00	-78.40	-77.08	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Analog Voice, 25 kHz Channel Spacing, 794.1 MHz				
Ref. Power Level = 33.56 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
15.625	6.25	-72.03	-66.81	-40
21.875	6.25	-79.99	-79.17	-60
37.500	25.00	-73.83	-74.18	-60
62.500	25.00	-74.75	-74.00	-65
87.500	25.00	-76.19	-75.44	-65
150.000	100.00	-72.67	-71.96	-65
250.000	100.00	-73.82	-73.11	-65
350.000	100.00	-78.21	-78.21	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Analog Voice, 25 kHz Channel Spacing, 798.5 MHz				
Ref. Power Level = 33.61 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
15.625	6.25	-71.47	-67.10	-40
21.875	6.25	-79.40	-79.40	-60
37.500	25.00	-74.16	-74.40	-60
62.500	25.00	-73.45	-73.53	-65
87.500	25.00	-75.54	-75.54	-65
150.000	100.00	-72.68	-72.65	-65
250.000	100.00	-74.00	-74.17	-65
350.000	100.00	-79.37	-79.37	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Analog Voice, 25 kHz Channel Spacing, 804.9 MHz				
Ref. Power Level = 33.68 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
15.625	6.25	-72.07	-67.41	-40
21.875	6.25	-80.34	-80.11	-60
37.500	25.00	-74.12	-74.36	-60
62.500	25.00	-74.47	-73.73	-65
87.500	25.00	-76.07	-75.94	-65
150.000	100.00	-72.24	-72.89	-65
250.000	100.00	-74.09	-74.67	-65
350.000	100.00	-77.81	-79.51	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital C4FM, 12.5 kHz Channel Spacing, 764.1 MHz				
Ref. Power Level = 33.94 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.49	-41.01	-40
15.625	6.25	-79.07	-78.39	-60
21.875	6.25	-79.39	-79.56	-60
37.500	25.00	-75.50	-75.54	-60
62.500	25.00	-72.82	-74.10	-65
87.500	25.00	-71.50	-71.52	-65
150.000	100.00	-69.85	-69.62	-65
250.000	100.00	-74.00	-74.44	-65
350.000	100.00	-79.92	-79.92	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital C4FM, 12.5 kHz Channel Spacing, 769.5 MHz				
Ref. Power Level = 34.14 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.43	-42.33	-40
15.625	6.25	80.07	-78.54	-60
21.875	6.25	-80.38	-80.30	-60
37.500	25.00	-74.50	-76.09	-60
62.500	25.00	-74.16	-74.02	-65
87.500	25.00	-71.24	-70.94	-65
150.000	100.00	-69.28	-69.44	-65
250.000	100.00	-73.29	-73.90	-65
350.000	100.00	-79.19	-79.19	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital C4FM, 12.5 kHz Channel Spacing, 774.9 MHz				
Ref. Power Level = 33.39 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-44.58	-42.79	-40
15.625	6.25	-79.66	-79.35	-60
21.875	6.25	-81.11	-80.49	-60
37.500	25.00	-74.89	-75.73	-60
62.500	25.00	-73.98	-75.26	-65
87.500	25.00	-72.45	-73.03	-65
150.000	100.00	-69.76	-69.62	-65
250.000	100.00	-73.90	-73.47	-65
350.000	100.00	-78.24	-77.45	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital C4FM, 12.5 kHz Channel Spacing, 794.1 MHz				
Ref. Power Level = 33.50 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-44.97	-42.07	-40
15.625	6.25	-77.29	-76.17	-60
21.875	6.25	-79.40	-79.07	-60
37.500	25.00	-76.09	-76.16	-60
62.500	25.00	-76.37	-76.59	-65
87.500	25.00	-74.62	-74.92	-65
150.000	100.00	-70.54	-70.01	-65
250.000	100.00	-75.47	-74.74	-65
350.000	100.00	-79.18	-77.93	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital C4FM, 12.5 kHz Channel Spacing, 798.5 MHz				
Ref. Power Level = 33.93 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-41.38	-42.24	-40
15.625	6.25	-77.37	-76.29	-60
21.875	6.25	-79.09	-79.20	-60
37.500	25.00	-73.97	-74.07	-60
62.500	25.00	-71.99	-73.66	-65
87.500	25.00	-69.59	-69.72	-65
150.000	100.00	-72.86	-73.39	-65
250.000	100.00	-74.20	-74.73	-65
350.000	100.00	-79.21	-78.78	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital C4FM, 12.5 kHz Channel Spacing, 804.9 MHz				
Ref. Power Level = 33.61 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-43.68	-41.36	-40
15.625	6.25	-78.79	-77.65	-60
21.875	6.25	-79.75	-80.31	-60
37.500	25.00	-74.86	-75.10	-60
62.500	25.00	-74.47	-74.46	-65
87.500	25.00	-72.79	-73.06	-65
150.000	100.00	-69.64	-69.05	-65
250.000	100.00	-73.07	-74.69	-65
350.000	100.00	-78.30	-79.49	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital CQPSK, 12.5 kHz Channel Spacing, 764.1 MHz				
Ref. Power Level = 33.35 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-43.42	-42.05	-40
15.625	6.25	-78.30	-78.63	-60
21.875	6.25	-79.27	-79.27	-60
37.500	25.00	-74.58	-76.09	-60
62.500	25.00	-73.12	-73.81	-65
87.500	25.00	-70.92	-70.74	-65
150.000	100.00	-69.40	-69.64	-65
250.000	100.00	-74.46	-74.34	-65
350.000	100.00	-79.71	-79.71	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital CQPSK, 12.5 kHz Channel Spacing, 769.5 MHz				
Ref. Power Level = 33.36 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-44.32	-44.36	-40
15.625	6.25	-78.99	-78.90	-60
21.875	6.25	-80.41	-80.41	-60
37.500	25.00	-75.07	-75.04	-60
62.500	25.00	-74.77	-74.06	-65
87.500	25.00	-71.76	-71.36	-65
150.000	100.00	-69.53	-69.64	-65
250.000	100.00	-74.46	-74.46	-65
350.000	100.00	-79.71	-79.71	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital CQPSK, 12.5 kHz Channel Spacing, 774.9 MHz				
Ref. Power Level = 33.29 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.28	-44.34	-40
15.625	6.25	-78.79	-78.35	-60
21.875	6.25	-79.68	-80.33	-60
37.500	25.00	-74.06	-74.64	-60
62.500	25.00	-72.78	-74.13	-65
87.500	25.00	-70.31	-71.47	-65
150.000	100.00	-69.04	-69.24	-65
250.000	100.00	-74.21	-73.34	-65
350.000	100.00	-78.45	-78.45	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital CQPSK, 12.5 kHz Channel Spacing, 794.1 MHz				
Ref. Power Level = 33.07 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.12	-41.16	-40
15.625	6.25	-77.67	-76.73	-60
21.875	6.25	-79.47	-79.36	-60
37.500	25.00	-74.88	-75.20	-60
62.500	25.00	-74.06	-74.91	-65
87.500	25.00	-72.01	-73.04	-65
150.000	100.00	-70.41	-70.11	-65
250.000	100.00	-75.00	-74.13	-65
350.000	100.00	-79.32	-77.48	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital CQPSK, 12.5 kHz Channel Spacing, 798.5 MHz				
Ref. Power Level = 33.34 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-43.15	-42.45	-40
15.625	6.25	-78.13	-77.55	-60
21.875	6.25	-79.30	-79.32	-60
37.500	25.00	-72.51	-73.09	-60
62.500	25.00	-72.23	-72.69	-65
87.500	25.00	-68.00	-68.96	-65
150.000	100.00	-69.98	-69.64	-65
250.000	100.00	-74.05	-74.56	-65
350.000	100.00	-78.62	-78.84	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital CQPSK, 12.5 kHz Channel Spacing, 804.9 MHz				
Ref. Power Level = 33.85 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-44.95	-42.26	-40
15.625	6.25	-78.59	-77.05	-60
21.875	6.25	-79.73	-79.35	-60
37.500	25.00	-74.31	-74.27	-60
62.500	25.00	-74.28	-74.16	-65
87.500	25.00	-72.45	-72.18	-65
150.000	100.00	-69.27	-69.74	-65
250.000	100.00	-74.71	-74.76	-65
350.000	100.00	-78.36	-79.16	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital TDMA, 12.5 kHz Channel Spacing, 764.1 MHz				
Ref. Power Level = 33.54 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.40	-41.14	-40
15.625	6.25	-77.25	-77.14	-60
21.875	6.25	-80.51	-80.07	-60
37.500	25.00	-74.60	-74.93	-60
62.500	25.00	-73.65	-74.60	-65
87.500	25.00	-70.87	-71.37	-65
150.000	100.00	-69.59	-70.17	-65
250.000	100.00	-73.71	-73.51	-65
350.000	100.00	-77.67	-77.50	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital TDMA, 12.5 kHz Channel Spacing, 769.5 MHz				
Ref. Power Level = 33.56 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.59	-41.08	-40
15.625	6.25	-77.33	-77.39	-60
21.875	6.25	-80.29	-80.66	-60
37.500	25.00	-74.49	-74.52	-60
62.500	25.00	-73.83	-73.92	-65
87.500	25.00	-71.82	-71.34	-65
150.000	100.00	-70.72	-70.78	-65
250.000	100.00	-74.73	-74.08	-65
350.000	100.00	-79.26	-78.83	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital TDMA, 12.5 kHz Channel Spacing, 774.9 MHz				
Ref. Power Level = 33.44 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.22	-42.01	-40
15.625	6.25	-77.17	-78.02	-60
21.875	6.25	-80.07	-80.27	-60
37.500	25.00	-73.58	-74.54	-60
62.500	25.00	-73.97	-74.07	-65
87.500	25.00	-72.21	-72.44	-65
150.000	100.00	-70.02	-70.11	-65
250.000	100.00	-74.00	-73.81	-65
350.000	100.00	-78.19	-77.55	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital TDMA, 12.5 kHz Channel Spacing, 794.1 MHz				
Ref. Power Level = 33.22 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-41.78	-40.75	-40
15.625	6.25	-75.50	-74.19	-60
21.875	6.25	-79.39	-79.50	-60
37.500	25.00	-73.23	-73.48	-60
62.500	25.00	-72.85	-72.77	-65
87.500	25.00	-71.08	-70.93	-65
150.000	100.00	-70.98	-71.21	-65
250.000	100.00	-74.55	-74.08	-65
350.000	100.00	-79.61	-78.36	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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Digital TDMA, 12.5 kHz Channel Spacing, 798.5 MHz				
Ref. Power Level = 33.18 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-42.20	-41.69	-40
15.625	6.25	-75.94	-74.36	-60
21.875	6.25	-79.12	-79.70	-60
37.500	25.00	-71.48	-71.90	-60
62.500	25.00	-70.67	-70.36	-65
87.500	25.00	-68.62	-67.54	-65
150.000	100.00	-69.19	-69.48	-65
250.000	100.00	-74.15	-74.30	-65
350.000	100.00	-79.38	-78.92	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

Digital TDMA, 12.5 kHz Channel Spacing, 804.9 MHz				
Ref. Power Level = 33.33 dBm				
Offset from Center Frequency (kHz)	Measurement Bandwidth (kHz)	Measured Maximum ACP (dBc)		Maximum ACP (dBc)
		Lower	Upper	
9.375	6.25	-41.61	-40.64	-40
15.625	6.25	-76.42	-76.46	-60
21.875	6.25	-80.61	-80.55	-60
37.500	25.00	-73.31	-73.17	-60
62.500	25.00	-72.34	-73.24	-65
87.500	25.00	-70.50	-70.11	-65
150.000	100.00	-70.29	-69.81	-65
250.000	100.00	-74.37	-74.40	-65
350.000	100.00	-78.82	-77.20	-65
>400 kHz to 12 MHz	30 (Swept)	<-75	<-75	-75
12 MHz to paired receive band	30 (Swept)	<-75	<-75	-75
In the paired receive band	30 (Swept)	<-100	<-100	-100

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5.10. EXPOSURE OF HUMANS TO RF FIELD [[§§ 1.1310 & 2.1091]

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

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5.10.1. Method of Measurements

Calculation Method of RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where,
P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm²
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$$r = \sqrt{\frac{PG}{4\pi \cdot S}} = \sqrt{\frac{EIRP}{4\pi \cdot S}}$$

5.10.2. Evaluation of RF Exposure Compliance Requirements

Maximum RF Power conducted, P_{conducted}[dBm]:	37.26
Maximum Antenna Gain, G[dBi]:	3
Maximum EIRP, P_{EIRP}[dBm]:	40.26
MPE Limit for General Population/Uncontrolled Exposure, S_{controlled}[mW/cm²]:	0.25
Calculated RF Safety Distance for General Population/Uncontrolled Exposure, r_{safety_controlled}[cm]:	58.1

5.11. POWER LINE CONDUCTED EMISSIONS [§ 15.207]

5.11.1. Limits

The equipment shall meet the limits of the following table:

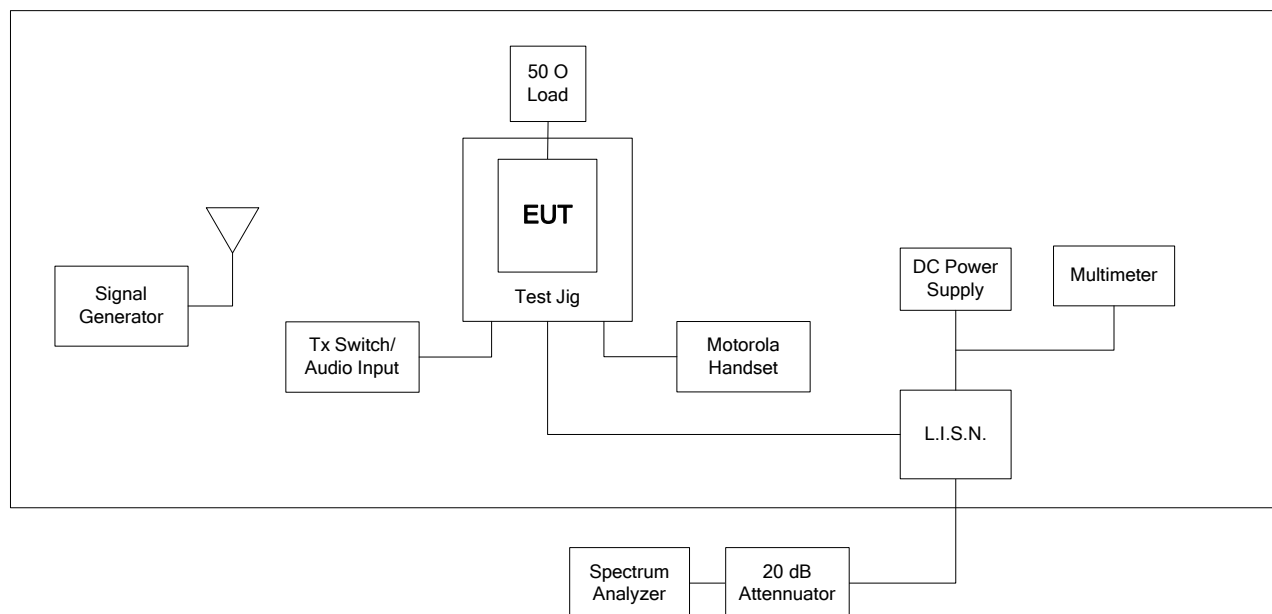
Frequency of emission (MHz)	Conducted Limits (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

5.11.1.1. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4-2009 for method of measurements.

5.11.2. Test Arrangement



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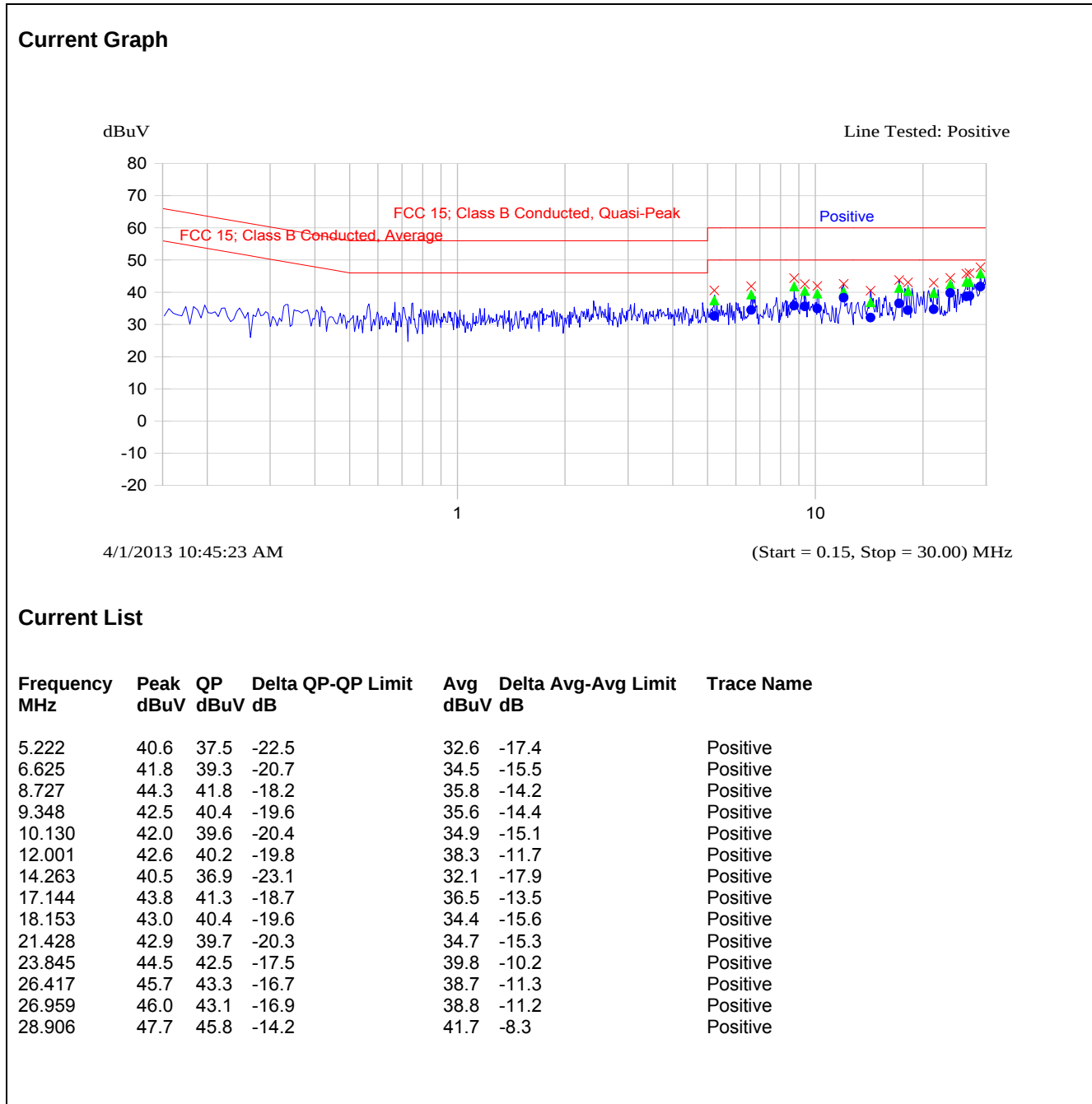
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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5.11.3. Test Data

Plot 5.11.3.1. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 7.5 VDC; Line Tested: Positive



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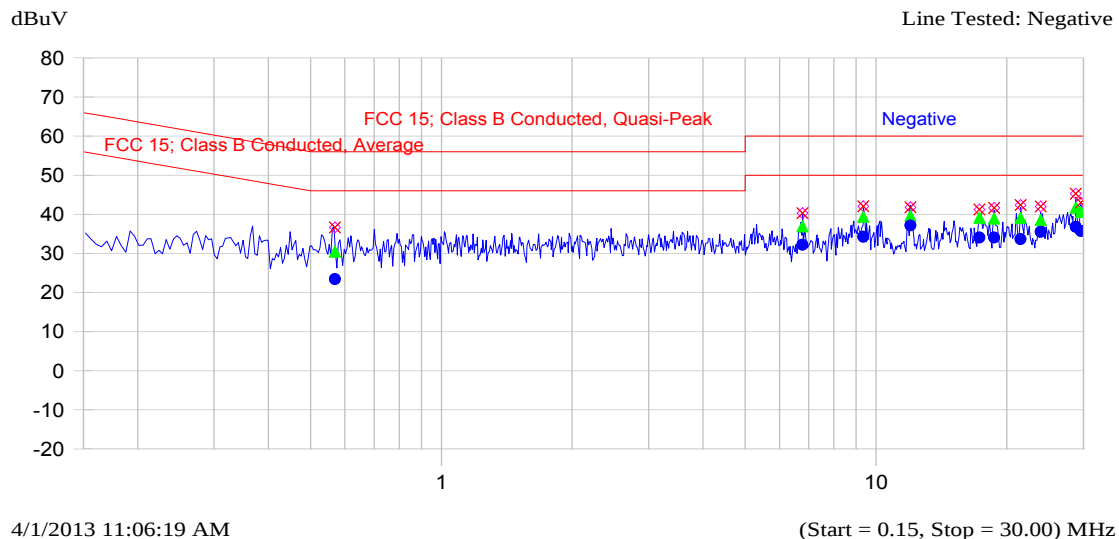
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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Plot 5.11.3.2. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 7.5 VDC; Line Tested: Negative

Current Graph

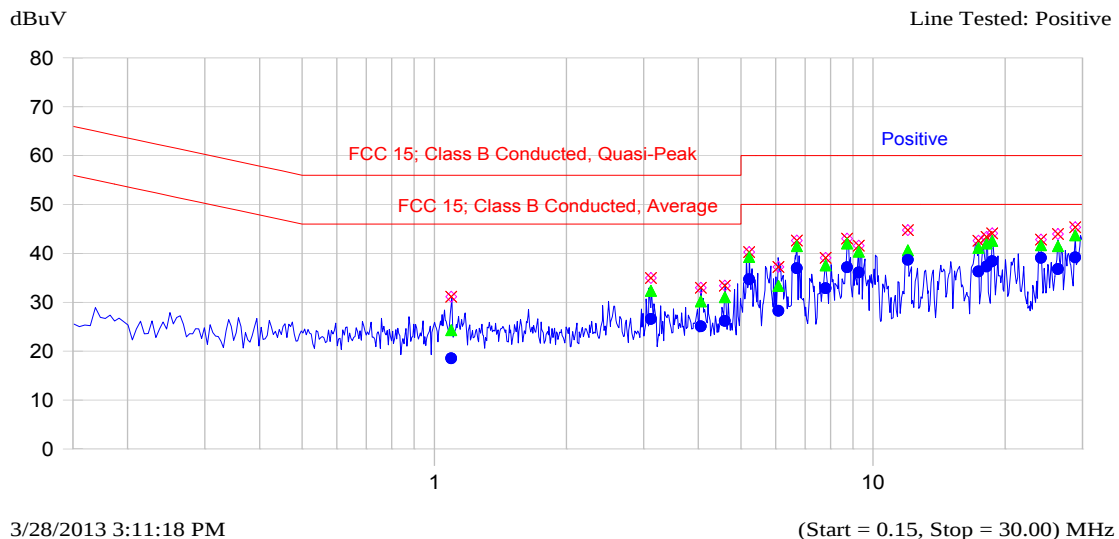


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.569	36.6	30.4	-25.6	23.4	-22.6	Negative
6.777	40.3	36.9	-23.1	32.2	-17.8	Negative
9.350	42.0	39.4	-20.6	34.2	-15.8	Negative
11.997	41.8	39.6	-20.4	37.2	-12.8	Negative
17.301	41.2	39.1	-20.9	34.1	-15.9	Negative
18.698	41.6	38.9	-21.1	34.1	-15.9	Negative
21.506	42.4	39.0	-21.0	33.6	-16.4	Negative
23.923	42.0	38.5	-21.5	35.5	-14.5	Negative
28.826	45.3	41.7	-18.3	36.8	-13.2	Negative
29.587	43.0	40.6	-19.4	35.7	-14.3	Negative

Plot 5.11.3.3. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 7.5 VDC; Line Tested: Positive

Current Graph

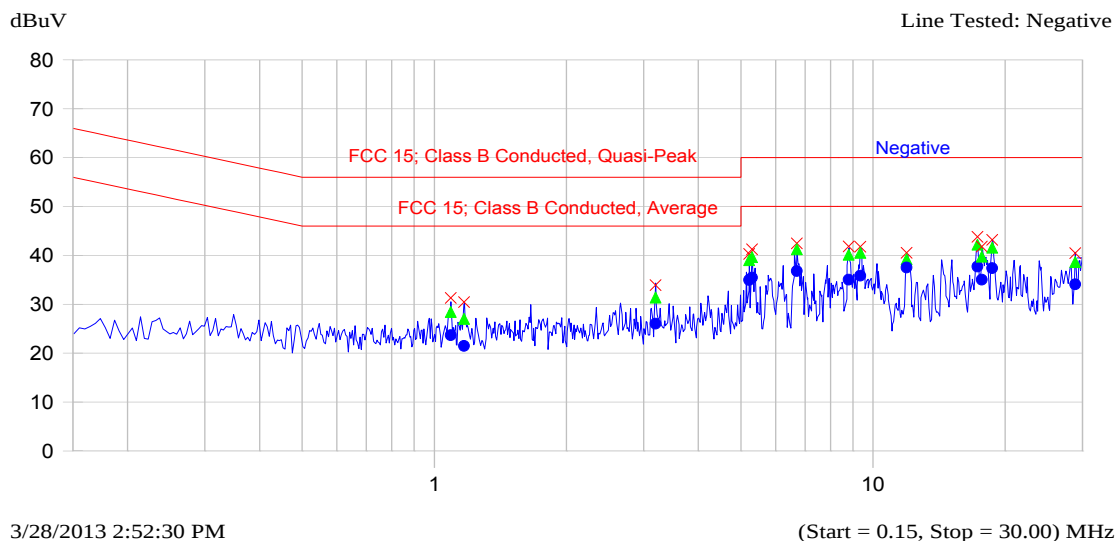


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
1.093	31.1	24.3	-31.7	18.5	-27.5	Positive
3.116	35.0	32.4	-23.6	26.6	-19.4	Positive
4.051	33.0	30.2	-25.8	25.1	-20.9	Positive
4.596	33.4	31.0	-25.0	26.2	-19.8	Positive
5.220	40.3	39.3	-20.7	34.7	-15.3	Positive
6.085	37.2	33.4	-26.6	28.2	-21.8	Positive
6.703	42.6	41.5	-18.5	37.0	-13.0	Positive
7.792	39.1	37.6	-22.4	32.9	-17.1	Positive
8.725	43.0	42.0	-18.0	37.2	-12.8	Positive
9.273	41.6	40.4	-19.6	36.1	-13.9	Positive
12.000	44.7	40.6	-19.4	38.7	-11.3	Positive
17.375	42.6	41.1	-18.9	36.3	-13.7	Positive
18.154	43.4	42.0	-18.0	37.3	-12.7	Positive
18.700	44.1	42.6	-17.4	38.4	-11.6	Positive
24.153	42.8	41.7	-18.3	39.1	-10.9	Positive
26.412	44.0	41.5	-18.5	36.8	-13.2	Positive
28.907	45.3	43.7	-16.3	39.2	-10.8	Positive

Plot 5.11.3.4. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 7.5 VDC; Line Tested: Negative

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
1.091	31.3	28.4	-27.6	23.7	-22.3	Negative
1.169	30.5	27.0	-29.0	21.5	-24.5	Negative
3.194	33.9	31.4	-24.6	26.0	-20.0	Negative
5.221	40.3	39.0	-21.0	35.0	-15.0	Negative
5.298	41.3	39.7	-20.3	35.5	-14.5	Negative
6.703	42.5	41.3	-18.7	36.8	-13.2	Negative
8.805	41.9	40.1	-19.9	35.0	-15.0	Negative
9.351	41.8	40.5	-19.5	35.8	-14.2	Negative
11.923	40.5	39.2	-20.8	37.5	-12.5	Negative
17.298	43.8	42.2	-17.8	37.7	-12.3	Negative
17.687	41.8	39.8	-20.2	35.0	-15.0	Negative
18.700	43.2	41.6	-18.4	37.4	-12.6	Negative
28.908	40.5	38.6	-21.4	34.1	-15.9	Negative

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	R&S	FSEK	834157/005	9KHz-40G	30 Jul 2014
Attenuator (30dB)	Aeroflex/Weinschel	46-30-34	BR9127	DC-18 GHz	Cal. on use
High Pass Filter	Mini Circuit	SHP 250	--	Cut off 250 MHz	Cal. on use
Power Sensor	Hewlett Packard	8482A	US37295944	0.1 - 4 GHz	28 Feb 2014
Modulation Analyzer	Hewlett Packard	8901B	3226A04606	150KHz-1300MHz	20 Jan 2014
Frequency Counter	EIP	545A	2683	10Hz - 18 GHz	25 Mar 2014
Combiner	Mini Circuit	ZFSC-3-4	15542	1MHz - 1GHz	Cal. on use
RF Detector	Pasternack	PE8000-50	--	10M--1G Hz	Cal. on use
Infinium Digital Oscilloscope	Hewlett-Packard	54801A	US38380192	DC--500M Hz 1G sampling	12 Jun 2013
Envirment Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	16 Aug 2013
RF Synthesized signal Generator	HP	8648C	3343U00391	100K-3200M Hz AM/ FM/ PM	03 Jan 2014
Power supply	Tenma	72-7295	490300297	1-40V DC 5A	Cal. on use
FFT Digital Spectrum Analyzer	Advantest	R9211E	8202336	10mHz--100KHz	25 Jan 2014
RF Communication Test Set	Hewlett Packard	8920B	US39064699	30MHz-1GHz	17 Jan 2015
Horn antenna	ETS-LINDGREN	3117	119425	1-18GHz	25 Apr 2014
Preamplifier	Hewlett Packard	8449B	3008A00769	1-26.5GHz	01 Dec 2013
High Pass Filter	Mini Circuit	SHP 600	--	Cut off 560 MHz	Cal. on use
Power supply	XANTREX	XKW 60-50	26509	0-60V 0-50A DC	Cal. on use
High Pass Filter	Mini Circuit	SHP 800	--	Cut off 750 MHz	Cal. on use
Attenuator	Aeroflex/Weinschel	23-20-34	BH7876	DC-18 GHz	Cal. on use
Antenna	ETS	3148	1101	200-2000 MHz	22 Mar 2014
Antenna	EMCO	3142B	1575	26-3000MHz	04 May 2013
EMI Receiver	R/S	ESU 40	100037	20 Hz-40 GHz	07 Mar 2014
Preamplifier	AH System	Pam-0118	225	20MHz-18GHz	25 Mar 2014
Power Meter	Hewlett Packard	438A	3008A06729	100K--50G sensor dependent	25 Mar 2014
Antenna	EMCO	3115	9701-5061	1-18GHz	18 Feb 2014
Spectrum Analyzer	Hewlett Packard	8593EM	3710A00223	9KHz-22GHz	11 May 2013
Attenuator	Pasternack	PE7010-20	--	DC-2 GHz	11 Jan 2014
LISN	Schwarzbeck	NSLK 8127	8127276	10KHz-30MHz	24 Apr 2013
Multi-meter	Tenma	72-6202	2080027	DC - 1000V AC - 250 V	28 Aug 2013

ULTRATECH GROUP OF LABS

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File #: TIL-094F90R01
July 2, 2013

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	Measured	Limit
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 1.44	± 1.8
U	Expanded uncertainty U: $U = 2u_c(y)$	± 2.89	± 3.6

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured (dB)	Limit (dB)
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 2.39	± 2.6
U	Expanded uncertainty U: $U = 2u_c(y)$	± 4.79	± 5.2

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured (dB)	Limit (dB)
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 2.39	± 2.6
U	Expanded uncertainty U: $U = 2u_c(y)$	± 4.78	± 5.2

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	Measured (dB)	Limit (dB)
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 1.87	Under consideration
U	Expanded uncertainty U: $U = 2u_c(y)$	± 3.75	Under consideration

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EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- If the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, $x = \text{Tx on} / (\text{Tx on} + \text{Tx off})$ with $0 < x < 1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

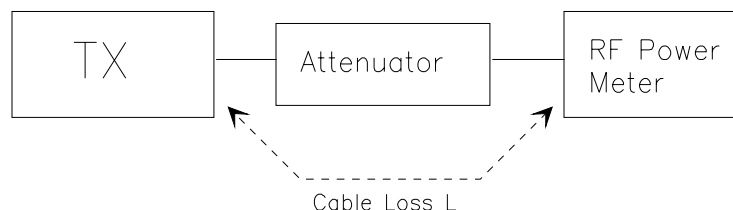
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

$$\text{EIRP} = A + G + 10\log(1/x)$$

{X = 1 for continuous transmission => $10\log(1/x) = 0$ dB}

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. MAXIMIZING RF EMISSION LEVEL (E-FIELD)

- (a) The measurements were performed with full rf output power and modulation.
- (b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
- (c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
- (d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
- (e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
 $E \text{ (dB}\mu\text{V/m)} = \text{Reading (dB}\mu\text{V)} + \text{Total Correction Factor (dB/m)}$

- (f) Set the EMI Receiver and #2 as follows:

Center Frequency: test frequency
Resolution BW: 100 KHz
Video BW: same
Detector Mode: positive
Average: off
Span: 3 x the signal bandwidth

- (g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
- (h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- (i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
- (j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
- (k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
- (l) Repeat for all different test signal frequencies.

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

- (a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency: equal to the signal source
Resolution BW: 100 KHz
Video BW: VBW > RBW
Detector Mode: positive
Average: off
Span: 3 x the signal bandwidth

- (b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

- (c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
 - ◆ DIPOLE antenna for frequency from 30-1000 MHz or
 - ◆ HORN antenna for frequency above 1 GHz }.(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
 - ◆ DIPOLE antenna for frequency from 30-1000 MHz or
 - ◆ HORN antenna for frequency above 1 GHz }.(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

$$P = P1 - L1 = (P2 + L2) - L1 = P3 + A + L2 - L1$$

$$\text{EIRP} = P + G1 = P3 + L2 - L1 + A + G1$$

$$\text{ERP} = \text{EIRP} - 2.15 \text{ dB}$$

$$\text{Total Correction factor in EMI Receiver \# 2} = L2 - L1 + G1$$

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

- (o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

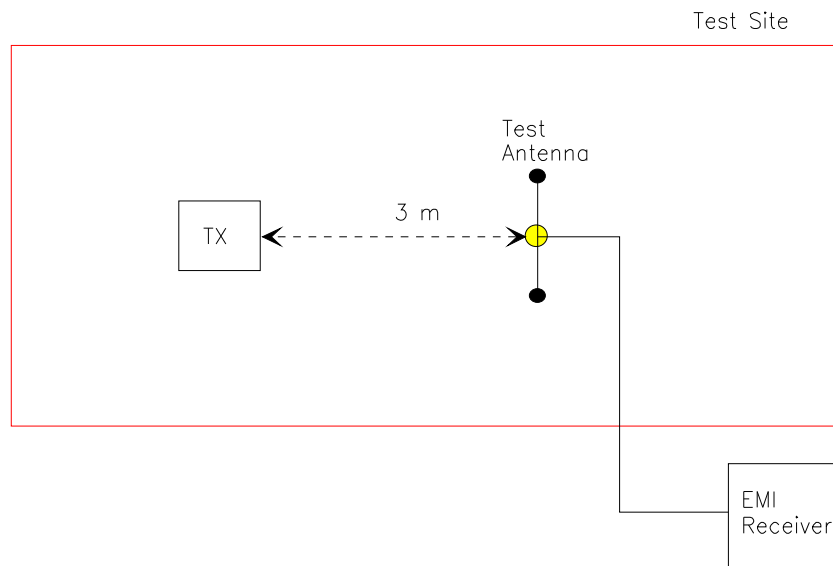
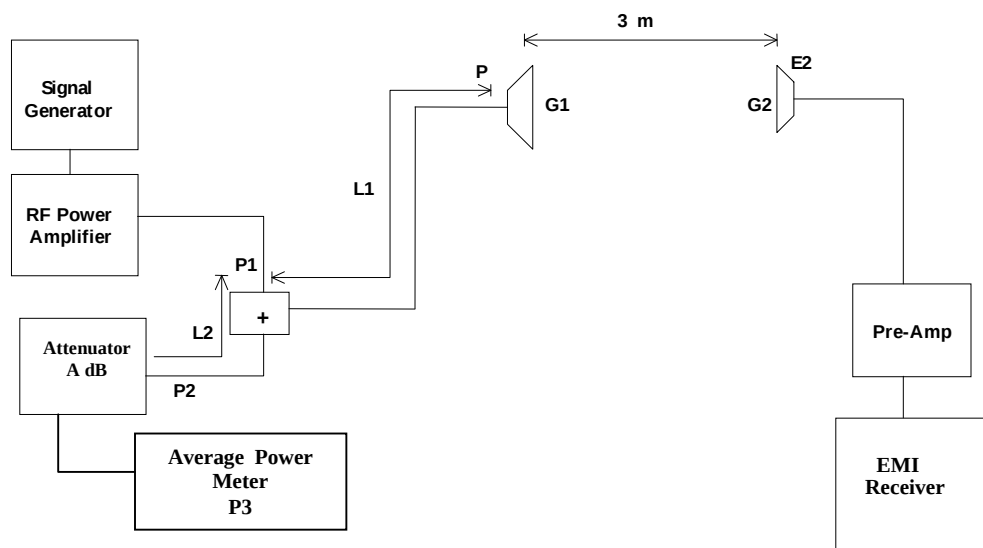


Figure 3



8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

- (a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.
- (b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.
- (d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:
 - (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
 - (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
 - (3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.
- (e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. EMISSION MASK

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i): The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ± 2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h): Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

- (1) For 25 KHz Channel Spacing: RBW = 300 Hz
- (2) For 12.5 KHz or 6.25 KHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 KHz minimum, VBW $\geq$ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC 47 CFR 2.1057 - Frequency spectrum to be investigated: The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10th harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC 47 CFR 2.1051 - Spurious Emissions at Antenna Terminal: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions, which are attenuated more than 20 dB below the permissible value, need not be specified.

8.6. TRANSIENT FREQUENCY BEHAVIOR

1. Connect the transmitter under tests as shown in the above block diagram
2. Set the signal generator to the assigned frequency and modulate with a 1 KHz tone at ± 12.5 KHz deviation and its output level to be 50 dB below the transmitter rf output at the test receiver end.
3. Set the horizontal sweep rate on the storage scope to 10 milliseconds per division and adjust the display to continuously view the 1000 Hz tone from the Demodulator Output Port (DOP) of the Test Receiver. Adjust the vertical scale amplitude control of the scope to display the 1000 Hz at ± 4 divisions vertical Center at the display.
4. Adjust the scope so it will trigger on an increasing magnitude from the RF trigger signal of the transmitter under test when the transmitter was turned on. Set the controls to store the display.
5. The output at the DOP, due to the change in the ratio of the power between the signal generator input power and transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it will show the 1 KHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1 KHz test signal is completely suppressed (including any capture time due to phasing) is considered to be t_{on} . The trace should be maintained within the allowed divisions during the period t_1 and t_2 .
6. During the time from the end of t_2 to the beginning of t_3 the frequency difference should not exceed the limits set by the FCC in Part 90.214 and the outlined in the Carrier Frequency Stability sections. The allowed limit is equal to FCC frequency tolerance limits specified in FCC 90.213.
7. Repeat the above steps when the transmitter was turned off for measuring t_3 .