ENGINEERING TEST REPORT

MOBEXCOM DVR Vehicular Repeater
Model No.: MOBEXCOM DVRS 800

FCC ID: LO6-DVRS800

Applicant:

Futurecom Systems Group Inc
3277 Langstaff Road
Concord, Ontario
Canada, L4K 5P8

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, PARTS 2 and 90 (Subpart S)

UltraTech's File No.: FSG-049F90S REV1.0

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: March 7, 2006	
Report Prepared by: Dharmajit Solanki Issued Date: March 7, 2006	Tested by: Mr. Hung Trinh, RFI/EMC Technician Test Dates: December 9, 2005 - February 16, 2006

- *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

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	▪ Exhibit 1: Submittal Check lists ▪ Exhibit 2: Introduction ▪ Exhibit 3: Performance Assessment ▪ Exhibit 4: EUT Operation and Configuration during Tests ▪ Exhibit 5: Summary of Test Results ▪ Exhibit 6: Measurement Data ▪ Exhibit 7: Measurement Uncertainty ▪ Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Test Setup Photos	OK
2	External Photos of EUT	External Photos	OK
3	Internal Photos of EUT	External Photos	OK
4	Cover Letters	▪ Letter from Ultratech Requesting for Certification ▪ Letter from the Applicant to Appoint Ultratech to Act as an Agent ▪ Letter from the Applicant to Request for Confidentiality Filing	OK
5	Attestation Statements	Applicant Part 90 Attestation	OK
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	▪ Parts List ▪ MOBEXCOM DVR Repeater Adjustment and Programming	OK
10	Operational Description	MOBEXCOM DVR Operational Description	OK
11	RF Exposure Info	See RF Exposure Report for MPE evaluation	OK
12	Users Manual	MOBEXCOM DVRS 800MHz Vehicular Repeater User's Manual	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 90 (Subpart S)
Title:	Code of Federal Regulations (CFR) Title 47 Telecommunication, Parts 2 & 90
Purpose of Test:	To obtain FCC Certification Authorization for Radio operating in the frequency bands 806-825 MHz and 851-870 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - 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.

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

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2005	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	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 C	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Futurecom Systems Group Inc.
Address:	3277 Langstaff Road Concord, Ontario Canada L4K 5P8
Contact Person:	Mr. Adam Kolanski Phone #: 905-660-5548 Fax #: 905-660-1380 Email Address: adamk@futurecom.com

MANUFACTURER	
Name:	Futurecom Systems Group Inc.
Address:	3277 Langstaff Road Concord, Ontario Canada, L4K 5P8
Contact Person:	Mr. Adam Kolanski Phone #: 905-660-5548 Fax #: 905-660-1380 Email Address: adamk@futurecom.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Brand Name:	Futurecom Systems Group Inc.
Product Name:	MOBEXCOM DVR Vehicular Repeater
Model Name or Number:	MOBEXCOM DVRS 800
Serial Number:	Preproduction
Type of Equipment:	Non-broadcast Radio Communication Equipment
External Power Supply:	None
Transmitting/Receiving Antenna Type:	Non-integral
Operational Description:	The Futurecom MOBEXCOM DVR Vehicular Repeater is designed to interface to a range of mobile radios. It permits expanded operation of portable radios. The MOBEXCOM DVR Vehicular Repeater communicates with the mobile radio using a serial data protocol.

3.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	[x] Commercial [x] Light Industry & Heavy Industry
Power Supply Requirement:	13.8 Vdc
RF Output Power Rating:	1 to 20 W (programmable per channel)
Operating Frequency Range:	806-825 MHz, 851-870 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	12.5 kHz & 25.0 kHz
Type Of Modulation:	Analog Voice and P25 Digital (voice, data)
Occupied Bandwidth (99%):	▪ 6.54 kHz for 12.5 kHz channel spacing ▪ 10.89 kHz for 25 kHz channel spacing ▪ 7.06 kHz for 12.5 kHz & 25 kHz channel spacing (digital)
Emission Designation*:	▪ 11K0F3E for 12.5 kHz channel spacing (Analog Voice) ▪ 16K0F3E for 25 kHz channel spacing (Analog Voice) ▪ 8K10F1E, 8K10F2E, 8K10F1D & 8K10F2D for 12.5kHz & 25kHz Channel spacing (Digital Voice, Data)
Oscillator Frequencies:	Digital signal frequencies: 32.768 kHz, 16.0 MHz, 29.4912 MHz, 144.0 MHz and 120 MHz Analogue signal frequency: LO1: Rx Freq - 109.65 MHz (Rx), LO2: 107.85 MHz & LO3: Tx Freq + 110.51875 MHz Reference Oscillator: 14.4 MHz
Antenna Connector Type:	TNC female

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

For FM Voice Modulation:

Channel Spacing = 12.5 KHz, D = 2.5 KHz max., K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(2.5)(1) = **11 KHz**
emission designation: 11K0F3E

Channel Spacing = 25 KHz, D = 5 KHz max., K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(5)(1) = **16 KHz**
emission designation: 16K0F3E

For P25 Digital Modulation:

Emission Designation: Voice: 8K10F1E, 8K10F2E & Data: 8K10F1D, 8K10F2D

3.3.1. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	DC Input Port	1	6 pin male circular	Non-shielded
2	RF IN/OUT Port	2	TNC female	Shielded
3	AUX Port (RS-232)	1	9 pin male circular	Non-shielded
4	Mobile Radio Port	1	20 pin male circular	Non-shielded
5	USB Port	1	USB	Non-shielded

3.4. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Laptop Computer
Brand name:	IBM
Model Name or Number:	2625
Serial Number:	78-WWM48
Cable Length & Type:	6 feet shielded cable
Connected to EUT's Port:	Aux (RS-232)

3.5. TEST ARRANGEMENT

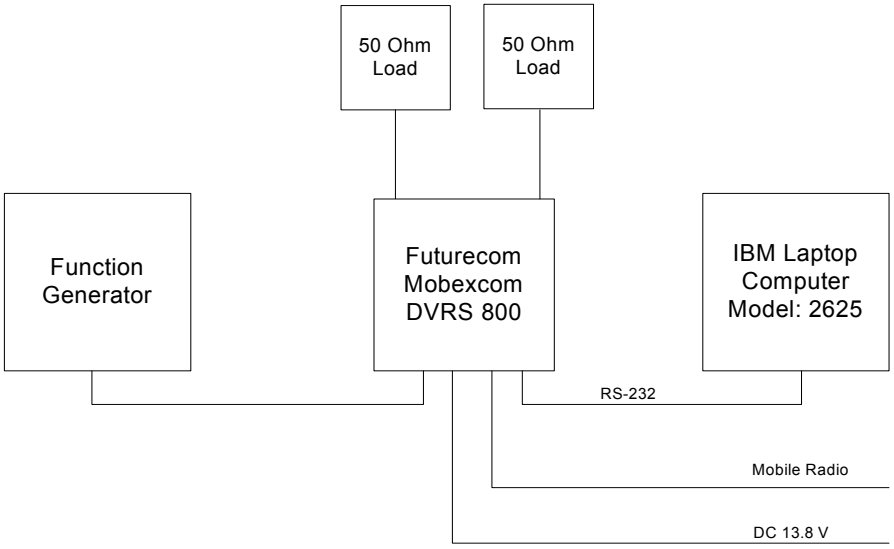


EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	13.8 Vdc

4.2. 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:	Operating software provided by Futurecom for selecting operating channel frequency and power
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s):	▪ 806-809 & 809-824 MHz ▪ 851-854 & 854-869 MHz
Frequency(ies) Tested: (near top, near middle and near bottom in the frequency range of operation.)	▪ 806, 809, 816.5 and 824 MHz ▪ 851, 854, 861.5 and 869 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	23.5 W
▪ Normal Test Modulation:	FM Voice & Data
▪ Modulating signal source:	External

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. 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.

- Radiated Emissions were performed at the Ultratech's 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.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: June. 20, 2005.

5.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
90.635 & 2.1046	RF Power Output	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
90.213 & 2.1055	Frequency Stability	Yes
2.1047(a)	Audio Frequency Response	Yes
2.1047(b)	Modulation Limiting	Yes
90.209, 90.210 & 2.1049	99% OBW & Emissions Mask	Yes
90.210, 90.669, 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
90.210, 90.669, 2.1057 & 2.1051	Emission Limits - Field Strength of Spurious Emissions	Yes
MOBEXCOM DVR Vehicular Repeater, Model No.: MOBEXCOM DVRS 800, by Futurecom Systems Group Inc. has been tested and found to comply with FCC Part 15, Subpart B - Radio Receivers and Class A Digital Devices. The engineering test report is kept in file and it is available upon request.		

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

5.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report.

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to correctly communicate data/voice to and from radios over RF link.

6.5. RF POWER OUTPUT [§§ 2.1046 & 90.635]

6.5.1. Limits

(d) § 90.635 : limitations on power and antenna heights: The maximum output power of the transmitter for mobile station is 100 watts (20 dBw).

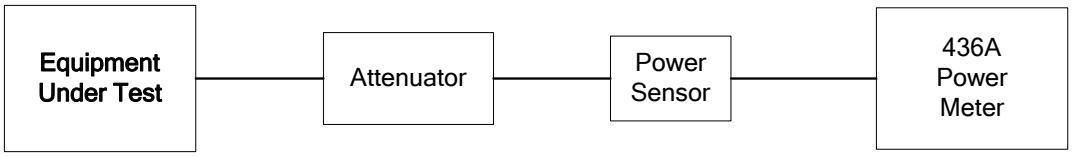
6.5.2. Method of Measurements

Refer to Exhibit 8, Sections 8.1 (Conducted) and 8.2 (Radiated) of this report for measurement details

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Attenuator(s)	Weinschel Corp	48-30-34	Bm5354	DC – 8.5 GHz
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz

6.5.4. Test Arrangement



6.5.5. Test Data

Fundamental Frequency (MHz)	Measured Power in Tx Mode (dBm)	Measured Power in Tx Mode (Watts)	Output Power Limits (Watts)
RF Output Power Setting (High) : 42.31 dBm			
806	43.23	21.03	100.00
816.5	43.71	23.49	100.00
824	43.06	20.23	100.00
851	43.01	19.99	100.00
861.5	43.69	23.38	100.00
869	43.03	20.09	100.00
RF Output Power Setting (Low) : 30.0 dBm			
806	29.99	0.99	100.00
816.5	30.26	1.06	100.00
824	29.63	0.92	100.00
851	29.87	0.97	100.00
861.5	30.16	1.03	100.00
869	29.99	0.99	100.00

6.6. RF EXPOSURE REQUIREMENT [§§ 1.1310 & 2.1091]

The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in RSS-102

FCC 47 CFR 1.1310:

TABLE 1—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 TO TABLE 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 TO TABLE 1: 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.

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2 \Rightarrow r = \sqrt{PG/4\Pi S} = \sqrt{EIRP/4\Pi S}$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to center of radiation in cm

MPE Evaluation

Please refer to a separate MPE evaluation report attached with application.

6.7. FREQUENCY STABILITY [§§ 2.1055 & 90.213]

6.7.1. Limits

Refer to FCC 47 CFR 90.213 for specification details.

Frequency Range	Mobile Stations (Over 2 Watts Output Power)	
(MHz)	(ppm)	(ppm)
806-809/ 851-854	1.5	1.5
809-824/854-869	2.5	2.5

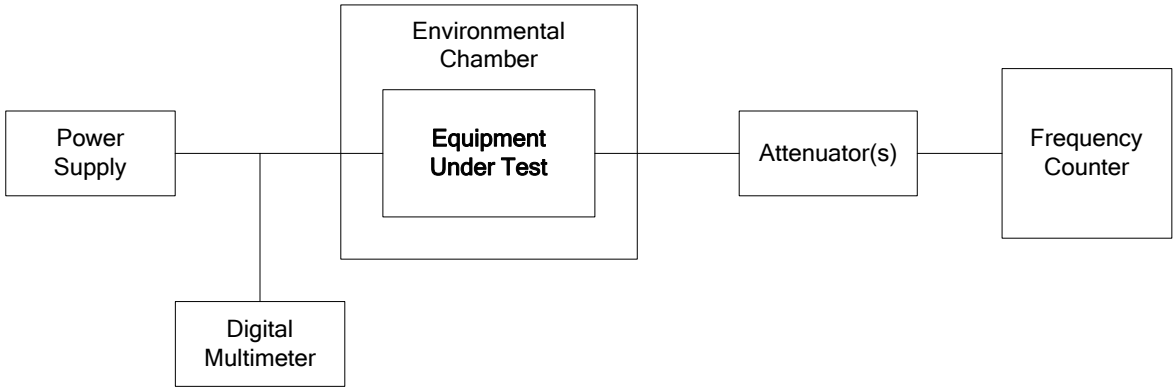
6.7.2. Method of Measurements

Refer to Exhibit 8, Section 8.3 of this report for measurement details

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Frequency Counter	EIP	545A	2683	10 Hz-18 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Temperature & Humidity Chamber	Tenney	T5	9723B	-40°C to +60°C range
Digital Multimeter	Tenma	72-6202	2080027	DC-100 kHz
Power Supply	Tenma	72-6153	--	DC 0-20 V, 0-10A.

6.7.4. Test Arrangement



6.7.5. Test Data

Product Name: Model No.:	MOBEXCOM DVR Vehicular Repeater MOBEXCOM DVRS 800
Center Frequency:	806.0 MHz
Full Power Level:	20 W
Frequency Tolerance Limit:	1.5 ppm or 1209 Hz
Max. Frequency Tolerance Measured:	+1144 Hz (1.42 ppm)
Input Voltage Rating:	13.8 Vdc

CENTER FREQUENCY & RF POWER OUTPUT VARIATION			
Ambient Temperature (^{o}C)	**Supply Voltage (Nominal) 13.8 Volts**	**Supply Voltage (85% of Nominal) 11.73 Volts**	**Supply Voltage (115% of Nominal) 15.87 Volts**
	Hz	**Hz**	**Hz**
-30	1144	n/a	n/a
-20	1031	n/a	n/a
-10	907	n/a	n/a
0	366	n/a	n/a
+10	186	n/a	n/a
+20	0	-24	-22
+30	22	n/a	n/a
+40	-329	n/a	n/a
+50	-275	n/a	n/a
+60	-375	n/a	n/a

6.8. AUDIO FREQUENCY RESPONSE [§ 2.1047(a)]

6.8.1. Limits @ FCC 2.1047(a)

Recommended audio filter attenuation characteristics are given below:

RF Band	Audio band	Minimum Attenuation Rel. to 1 kHz Attenuation
406.1 – 960 MHz	3 –20 kHz 20 – 30 kHz	60 $\log_{10}$(f/3) dB where f is in kHz 50dB

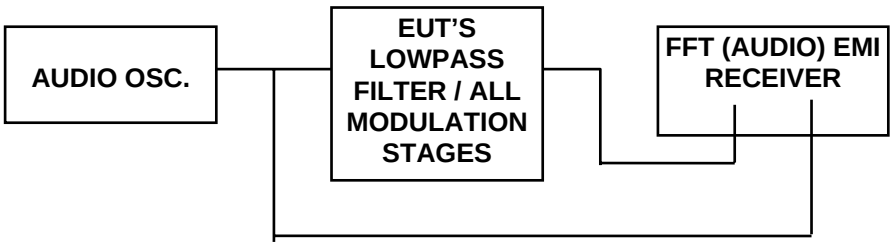
6.8.2. Method of Measurements

The rated audio input signal was applied to the input of the audio lowpass 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 (Audio) EMI Receiver. Tests were repeated at different audio signal frequencies from 0 to 50 kHz.

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
FFT (audio) EMI Receiver	Advantest	R9211E	…	10 mHz – 100 kHz, 1 MHz Input Impedance
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz

6.8.4. Test Arrangement



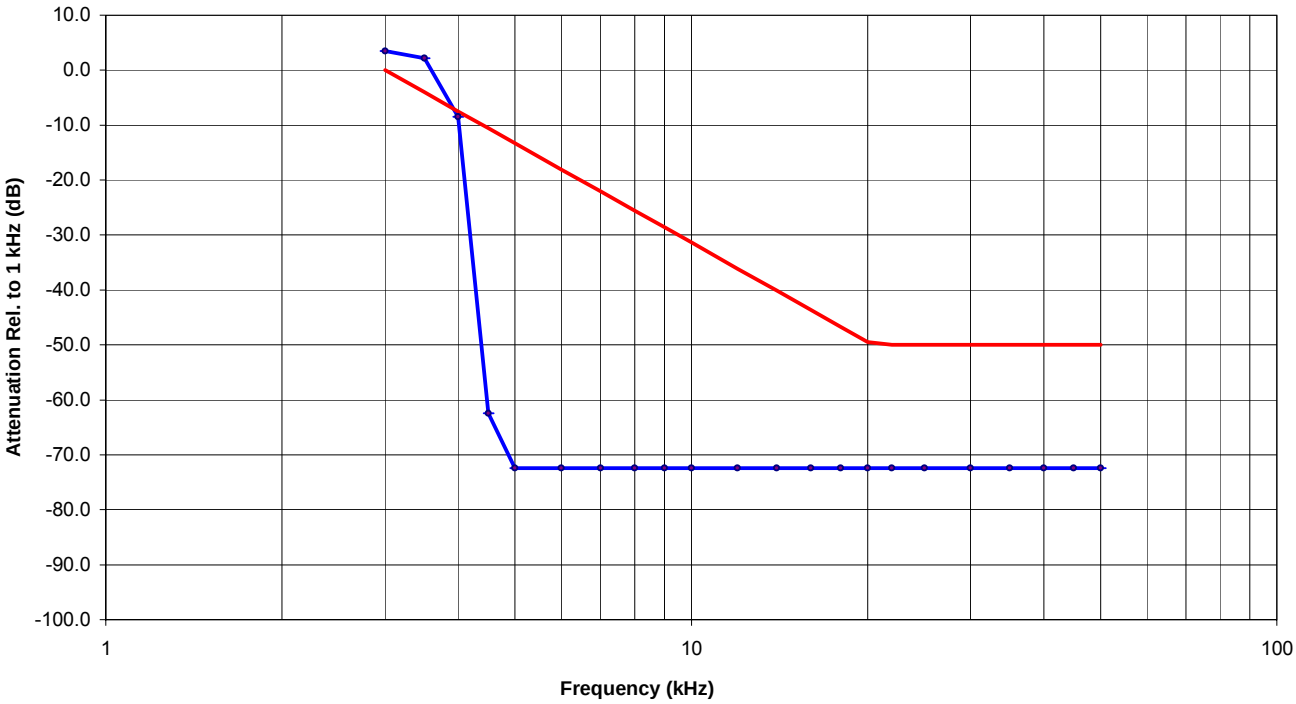
6.8.5. Test Data

*6.8.5.1. 12.5 kHz Channel Spacing, F3E, Frequency of All Modulation States**

Note: Because of the difficulty of measuring the Frequency Response of the internal lowpass filter, the Frequency Response of All Modulation States are performed to show the roll-off at 3 kHz in comparison with FCC Limit for audio low-pass filter.

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation Rel. 1 kHz (dB)	Recommended Attenuation (dB)
0.1	-18.30	-70.00	-51.7	-62.4	--
0.2	-18.30	-70.00	-51.7	-62.4	--
0.4	-18.30	-15.98	2.3	-8.4	--
0.6	-18.30	-12.41	5.9	-4.8	--
0.8	-18.30	-9.56	8.7	-2.0	--
1.0	-18.30	-7.59	10.7	0.0	--
1.5	-18.30	-3.86	14.4	3.7	--
2.0	-18.30	-3.14	15.2	4.5	--
2.5	-18.30	-3.41	14.9	4.2	--
3.0	-18.30	-4.15	14.2	3.4	0
3.5	-18.30	-5.39	12.9	2.2	-4
4.0	-18.30	-16.07	2.2	-8.5	-7
4.5	-18.30	-70.00	-51.7	-62.4	-11
5.0	-18.30	-80.00	-61.7	-72.4	-13
6.0	-18.30	<-80.00	<-61.7	<-72.4	-18
7.0	-18.30	<-80.00	<-61.7	<-72.4	-22
8.0	-18.30	<-80.00	<-61.7	<-72.4	-26
9.0	-18.30	<-80.00	<-61.7	<-72.4	-29
10.0	-18.30	<-80.00	<-61.7	<-72.4	-31
12.0	-18.30	<-80.00	<-61.7	<-72.4	-36
14.0	-18.30	<-80.00	<-61.7	<-72.4	-40
16.0	-18.30	<-80.00	<-61.7	<-72.4	-44
18.0	-18.30	<-80.00	<-61.7	<-72.4	-47
20.0	-18.30	<-80.00	<-61.7	<-72.4	-49
25.0	-18.30	<-80.00	<-61.7	<-72.4	-50
30.0	-18.30	<-80.00	<-61.7	<-72.4	-50
35.0	-18.30	<-80.00	<-61.7	<-72.4	-50
40.0	-18.30	<-80.00	<-61.7	<-72.4	-50
45.0	-18.30	<-80.00	<-61.7	<-72.4	-50
50.0	-18.30	<-80.00	<-61.7	<-72.4	-50

Audio Frequency Response
12.5 kHz Channel Spacing

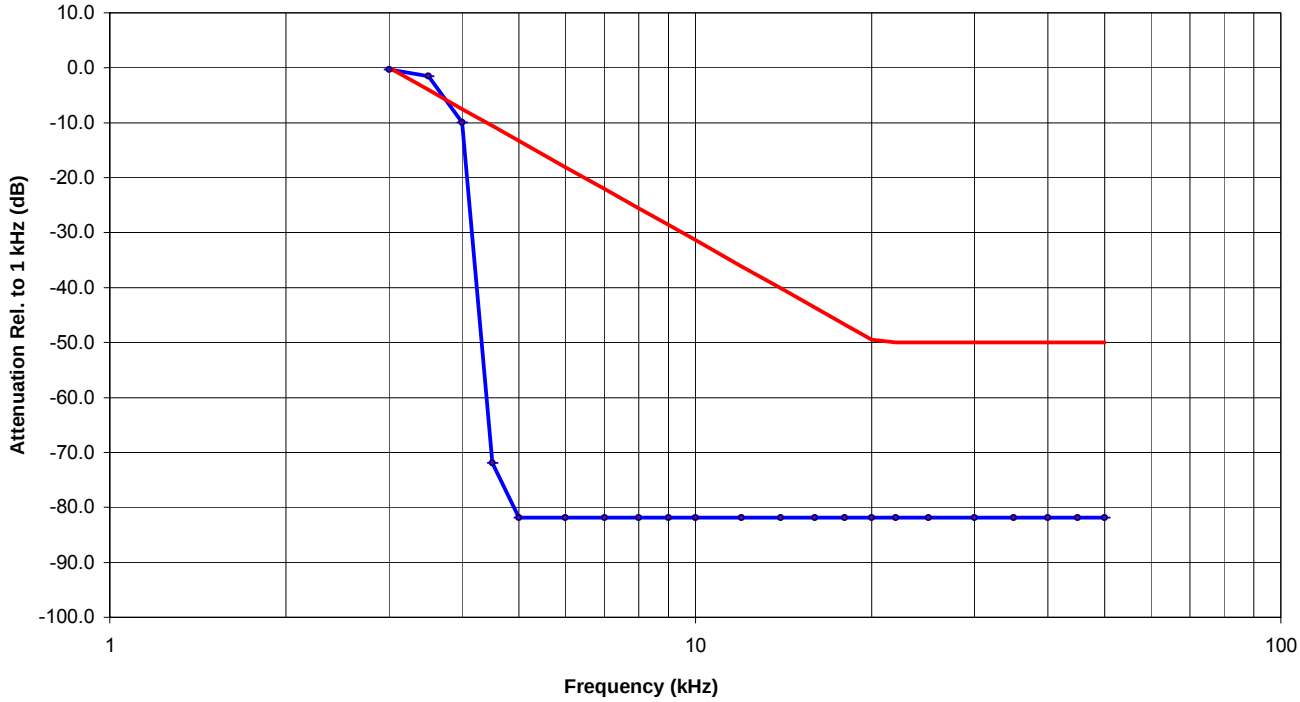


*6.8.5.2. 25 kHz Channel Spacing, F3E, Frequency of All Modulation States**

Note: Because of the difficulty of measuring the Frequency Response of the internal lowpass filter, the Frequency Response of All Modulation States are performed to show the roll-off at 3 kHz in comparison with FCC Limit for audio lowpass filter.

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation Rel. 1 kHz (dB)	Recommended Attenuation (dB)
0.1	-9.50	-80.00	-70.5	-81.9	--
0.2	-9.50	-55.07	-45.6	-57.0	--
0.4	-9.50	-6.04	3.5	-8.0	--
0.6	-9.50	-2.65	6.9	-4.6	--
0.8	-9.50	-0.11	9.4	-2.0	--
1.0	-9.50	1.91	11.4	0.0	--
1.5	-9.50	2.91	12.4	1.0	--
2.0	-9.50	2.98	12.5	1.1	--
2.5	-9.50	3.21	12.7	1.3	--
3.0	-9.50	1.59	11.1	-0.3	0
3.5	-9.50	0.36	9.9	-1.6	-4
4.0	-9.50	-8.00	1.5	-9.9	-7
4.5	-9.50	-70.00	-60.5	-71.9	-11
5.0	-9.50	-80.00	-70.5	-81.9	-13
6.0	-9.50	<-80.00	<-70.5	<-81.9	-18
7.0	-9.50	<-80.00	<-70.5	<-81.9	-22
8.0	-9.50	<-80.00	<-70.5	<-81.9	-26
9.0	-9.50	<-80.00	<-70.5	<-81.9	-29
10.0	-9.50	<-80.00	<-70.5	<-81.9	-31
12.0	-9.50	<-80.00	<-70.5	<-81.9	-36
14.0	-9.50	<-80.00	<-70.5	<-81.9	-40
16.0	-9.50	<-80.00	<-70.5	<-81.9	-44
18.0	-9.50	<-80.00	<-70.5	<-81.9	-47
20.0	-9.50	<-80.00	<-70.5	<-81.9	-49
25.0	-9.50	<-80.00	<-70.5	<-81.9	-50
30.0	-9.50	<-80.00	<-70.5	<-81.9	-50
35.0	-9.50	<-80.00	<-70.5	<-81.9	-50
40.0	-9.50	<-80.00	<-70.5	<-81.9	-50
45.0	-9.50	<-80.00	<-70.5	<-81.9	-50
50.0	-9.50	<-80.00	<-70.5	<-81.9	-50

Audio Frequency Response
25 kHz Channel Spacing



6.9. MODULATION LIMITING [§ 2.1047(b)]

6.9.1. Limits

Recommended frequency deviation characteristics are given below:

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

6.9.2. Method of Measurements

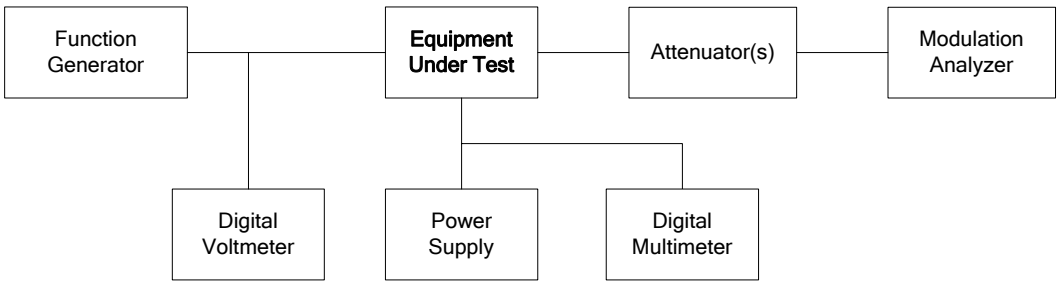
For Audio Transmitter:- The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

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.

6.9.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Function Generator	Stanford Research Systems	DS345	34591	1 μHz – 30.2 MHz
Digital Voltmeter	Hewlett-Packard	3456A	2015A04523	DC-250 KHz
Modulation Analyzer	Hewlett Packard	8901B	3226A04606	150 kHz-1.3 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Digital Multimeter	Tenma	72-6202	2080027	DC-100 kHz
Power Supply	Tenma	72-6153	--	DC 0-20 V, 0-10A.

6.9.4. Test Arrangement



6.9.5. Test Data

6.9.5.1. Voice Modulation Limiting – 12.5 kHz Channel Spacing

MODULATING SIGNAL LEVEL	PEAK FREQUENCY DEVIATION (kHz) at the following modulating frequency:					MAXIMUM LIMIT
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(kHz)
10	0.65	0.67	0.71	0.84	0.66	2.5
20	0.65	0.72	0.78	1.02	0.66	2.5
30	0.65	0.75	0.85	1.22	0.66	2.5
40	0.65	0.78	0.91	1.43	0.66	2.5
50	0.65	0.81	0.95	1.64	0.66	2.5
100	0.65	0.99	1.32	1.94	0.66	2.5
150	0.65	1.15	1.68	1.95	0.66	2.5
200	0.65	1.33	1.92	2.00	0.66	2.5
250	0.65	1.53	2.02	2.05	0.66	2.5
300	0.65	1.68	2.02	2.05	0.66	2.5
350	0.65	1.86	2.02	2.05	0.66	2.5
400	0.65	1.94	2.02	2.05	0.66	2.5
450	0.65	1.94	2.02	2.05	0.66	2.5
500	0.65	1.94	2.02	2.05	0.66	2.5
600	0.65	1.94	2.02	2.05	0.66	2.5
700	0.65	1.94	2.02	2.05	0.66	2.5
800	0.65	1.94	2.02	2.05	0.66	2.5
900	0.65	1.94	2.02	2.05	0.66	2.5
1000	0.65	1.94	2.02	2.05	0.66	2.5

Voice Signal Input Level = STD MOD Level + 16 dB
= 57.66 dBmVrms + 16
= 73.66 dBmVrms
= 763.46 mVrms

MODULATING FREQUENCY (KHz)	PEAK FREQUENCY DEVIATION (KHz)	MAXIMUM LIMIT (KHz)
0.1	0.65	2.5
0.2	0.66	2.5
0.4	1.93	2.5
0.6	1.95	2.5
0.8	1.97	2.5
1.0	2.02	2.5
1.2	2.04	2.5
1.4	2.03	2.5
1.6	2.02	2.5
1.8	2.05	2.5
2.0	2.03	2.5
2.5	2.04	2.5
3.0	2.05	2.5
3.5	1.93	2.5
4.0	1.71	2.5
4.5	0.65	2.5
5.0	0.66	2.5
6.0	0.66	2.5
7.0	0.66	2.5
8.0	0.66	2.5
9.0	0.66	2.5
10.0	0.66	2.5

6.9.5.2. Voice Modulation Limiting – 25 kHz Channel Spacing

MODULATING SIGNAL LEVEL	PEAK FREQUENCY DEVIATION (kHz) at the following modulating frequency:					MAXIMUM LIMIT
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(kHz)
10	0.66	0.68	0.71	0.83	0.66	5.0
20	0.66	0.72	0.78	1.04	0.66	5.0
30	0.66	0.75	0.84	1.24	0.66	5.0
40	0.66	0.78	0.93	1.43	0.66	5.0
50	0.66	0.82	0.97	1.63	0.66	5.0
100	0.66	0.98	1.33	2.68	0.66	5.0
150	0.66	1.16	1.67	3.25	0.66	5.0
200	0.66	1.33	2.03	3.37	0.66	5.0
250	0.66	1.50	2.41	3.37	0.66	5.0
300	0.66	1.67	2.73	3.37	0.66	5.0
350	0.66	1.84	3.10	3.52	0.66	5.0
400	0.66	2.02	3.24	3.52	0.66	5.0
450	0.66	2.18	3.29	3.52	0.66	5.0
500	0.66	2.33	3.31	3.52	0.66	5.0
600	0.66	2.71	3.31	3.52	0.66	5.0
700	0.66	3.04	3.31	3.52	0.66	5.0
800	0.66	3.22	3.31	3.52	0.66	5.0
900	0.66	3.22	3.31	3.52	0.66	5.0
1000	0.66	3.22	3.31	3.52	0.66	5.0

Voice Signal Input Level = STD MOD Level + 16 dB
= 66.50 dBm Vrms + 16
= 82.50 dBm Vrms
= 2113.71 mVrms

MODULATING FREQUENCY (KHz)	PEAK FREQUENCY DEVIATION (KHz)	MAXIMUM LIMIT (KHz)
0.1	1.21	5.0
0.2	2.14	5.0
0.4	3.27	5.0
0.6	3.24	5.0
0.8	3.29	5.0
1.0	3.31	5.0
1.2	3.45	5.0
1.4	3.35	5.0
1.6	3.41	5.0
1.8	3.43	5.0
2.0	3.44	5.0
2.5	3.35	5.0
3.0	3.47	5.0
3.5	3.28	5.0
4.0	2.56	5.0
4.5	0.81	5.0
5.0	0.66	5.0
6.0	0.92	5.0
7.0	1.65	5.0
8.0	2.32	5.0
9.0	2.70	5.0
10.0	0.66	5.0

6.10. OCCUPIED BANDWIDTH & EMISSION MASK [§§ 2.1049, 90.209, 90.210 & 90.691]

6.10.1. Limits

§ 90.209 Bandwidth limitations: Transmitters designed to operate in 806-824 MHz and 851-869 MHz frequency band must meet the bandwidth limitations in this section.

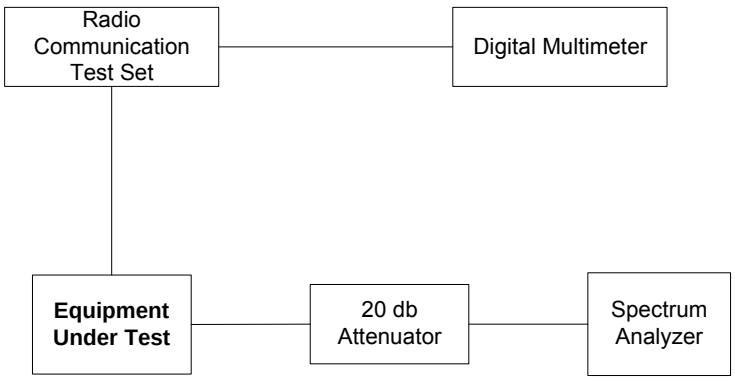
Emissions shall be attenuated below the mean output power of the transmitter as follows:

Frequency Range (MHz)	Channel Spacing (KHz)	Maximum Authorized BW (KHz)	Recommended Frequency Deviation (KHz)	FCC Applicable Mask
809-824/854-869	25.0	20.0	5.0	As per § 90.691
806-809/851-854	12.5	20.0	2.5	Mask B & H

6.10.2. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	HP	8953EM	3710A00237	9 kHz – 22 GHz
Attenuator(s)	Weinschel Corp	23-20-34	BH7876	DC – 18 GHz
Radio Communication Test Set	Marconi	2955	132037/226	20Hz – 20kHz
Digital Multimeter	Rohde & Schwarz	UDS-5	8729841067	DC-100 kHz

6.10.3. Test Arrangement



6.10.4. Test Data

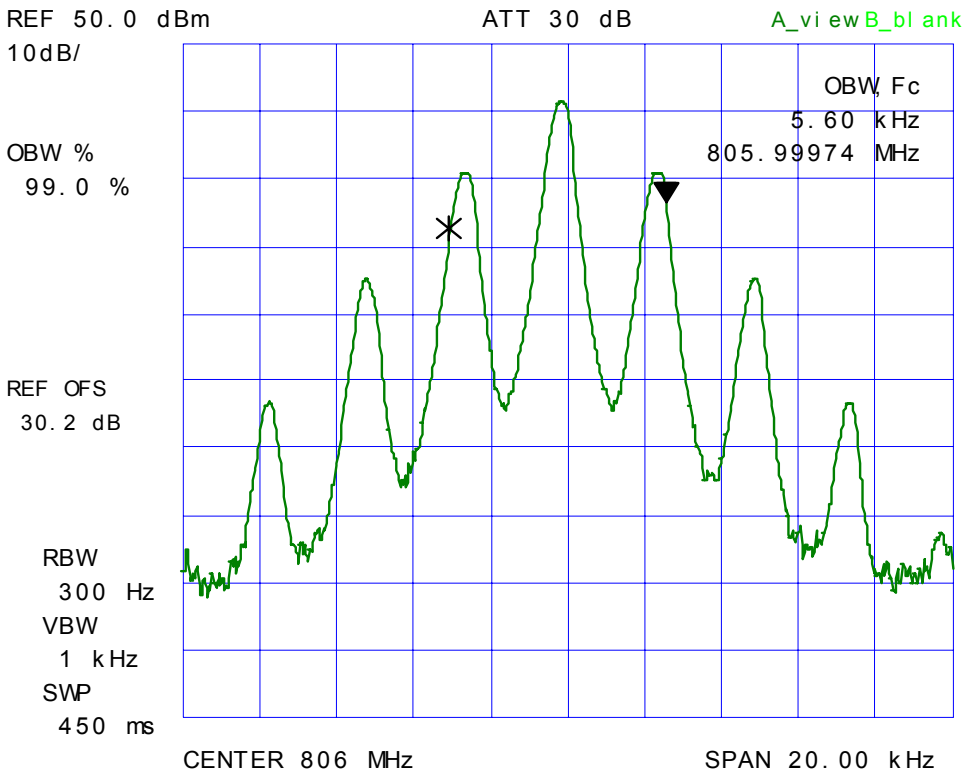
6.10.4.1. 99% Occupied Bandwidth

Frequency (MHz)	Channel Spacing (kHz)	*Measured 99% OBW (kHz)	Recommended 99% OBW (kHz)
Modulation: FM with 2.5 kHz sine wave signal			
806.0	12.5	6.49	< 12.5
809.0	12.5	6.54	< 12.5
851.0	12.5	6.46	< 12.5
854.0	12.5	6.49	< 12.5
809.0	25	10.89	< 25.0
816.5	25	10.89	< 25.0
824.0	25	10.89	< 25.0
854.0	25	10.84	< 25.0
861.5	25	10.80	< 25.0
869.0	25	10.84	< 25.0

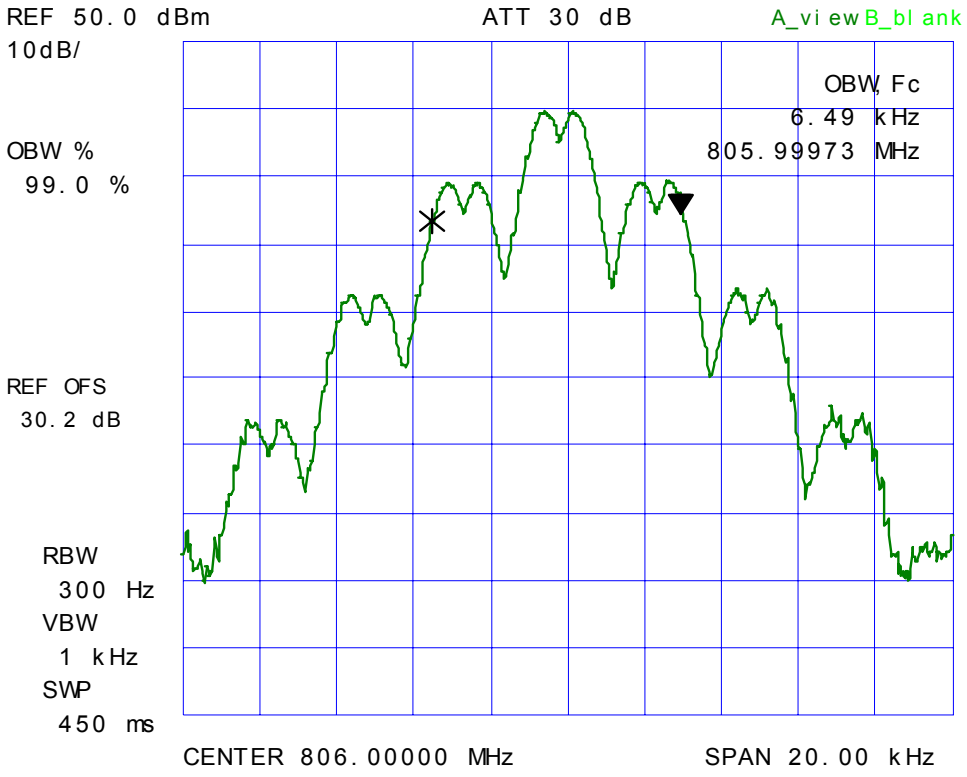
Frequency (MHz)	Channel Spacing (kHz)	*Measured 99% OBW (kHz)	Recommended 99% OBW (kHz)
Modulation: Digital			
806.0	12.5	6.91	< 12.5
809.0	12.5	7.03	< 12.5
851.0	12.5	6.91	< 12.5
854.0	12.5	6.97	< 12.5
809.0	25	6.97	< 25.0
816.5	25	6.94	< 25.0
824.0	25	6.94	< 25.0
854.0	25	7.06	< 25.0
861.5	25	7.00	< 25.0
869.0	25	6.91	< 25.0

* See the following plots (1 to 40) for detailed measurements.

Plot 1: 99% Occupied Bandwidth
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



Plot 2: 99% Occupied Bandwidth
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



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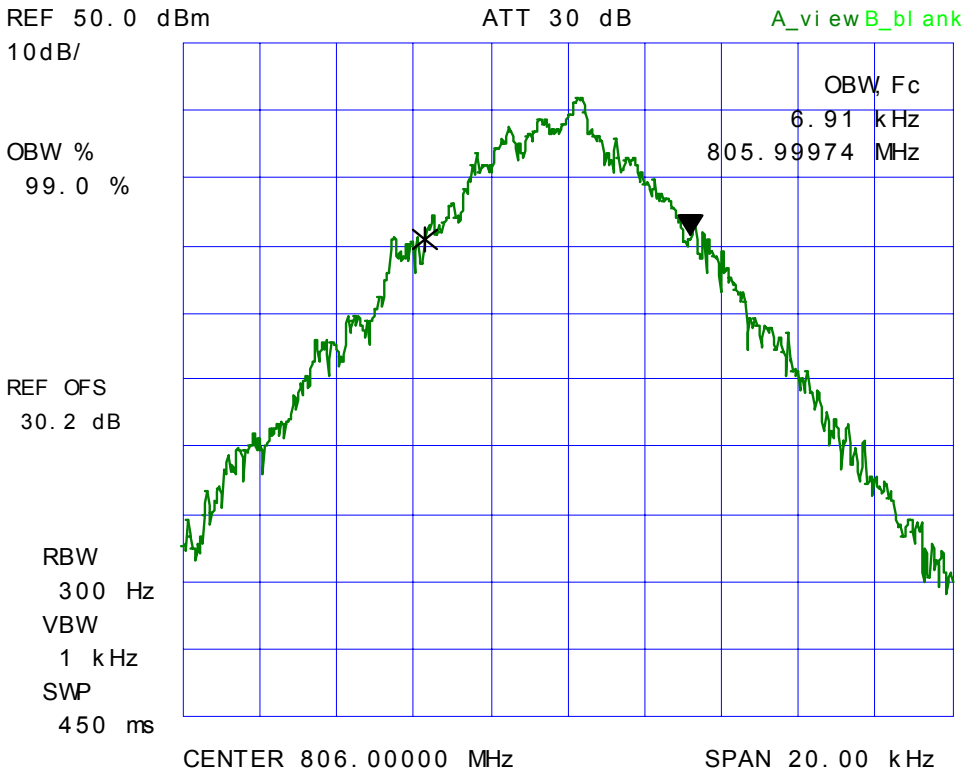
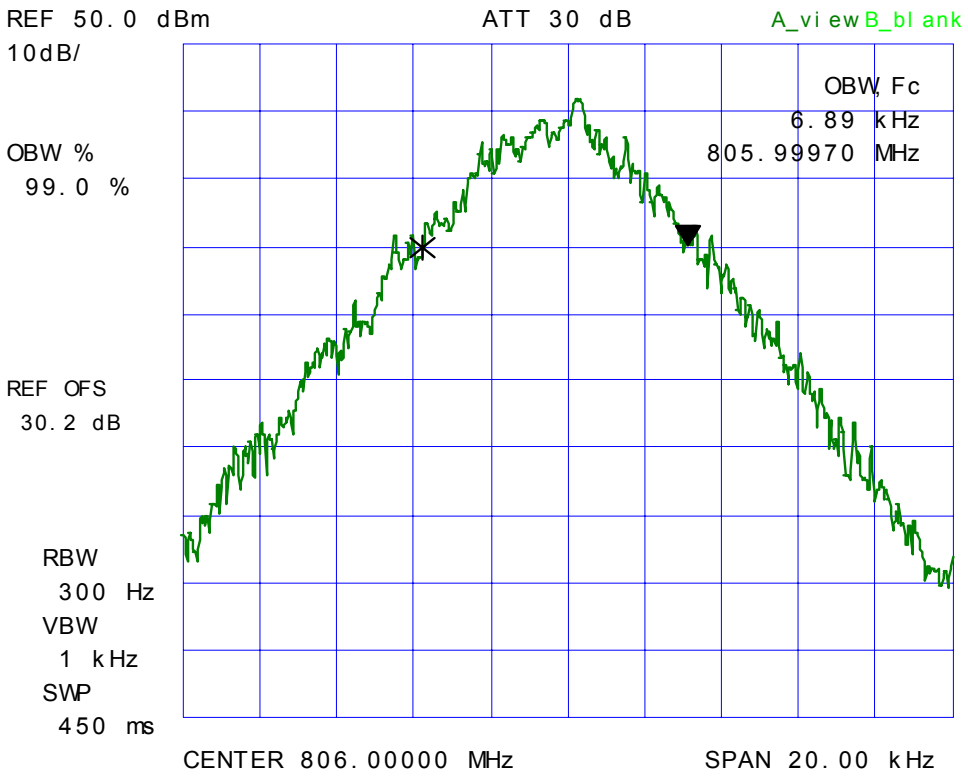
Plot 3: 99% Occupied Bandwidth
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power



Plot 4: 99% Occupied Bandwidth
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



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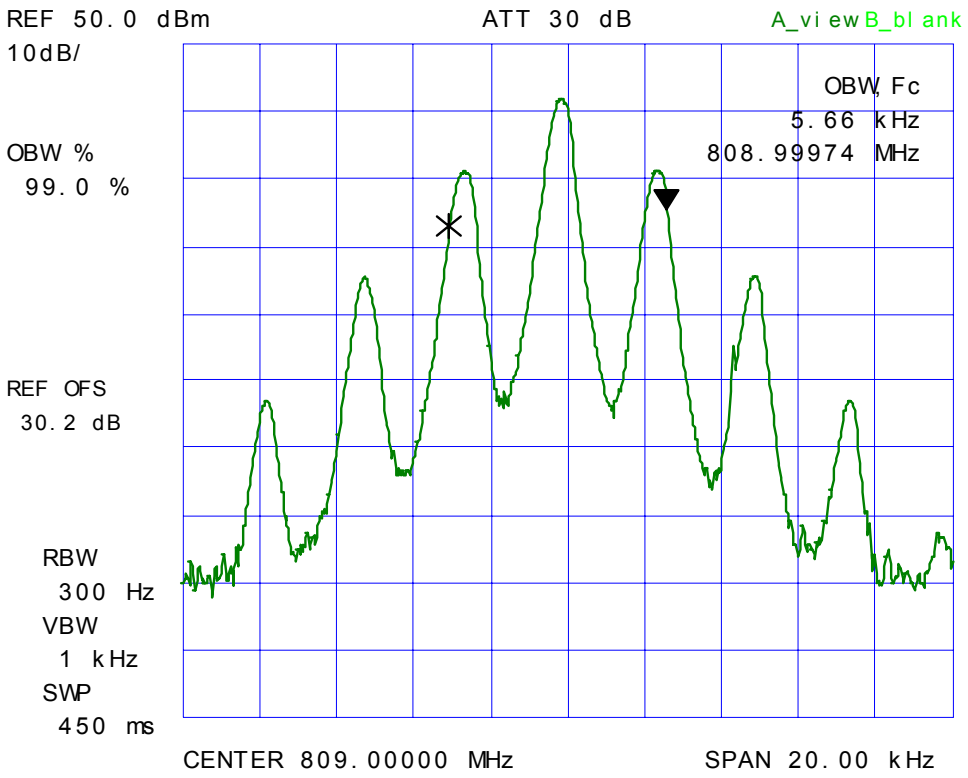
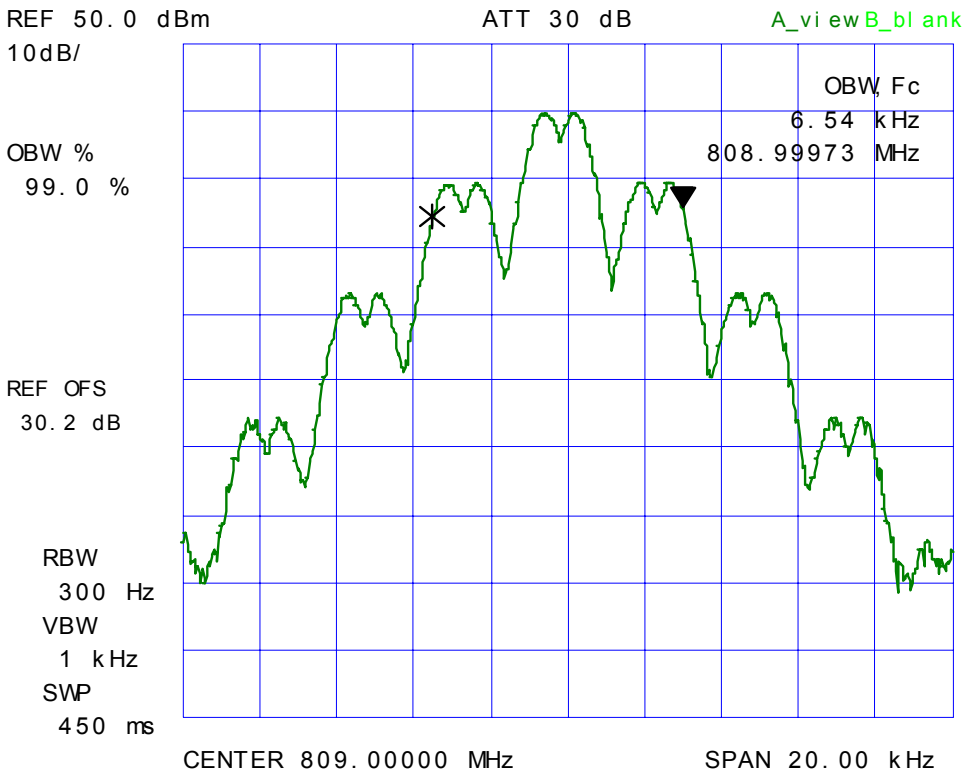
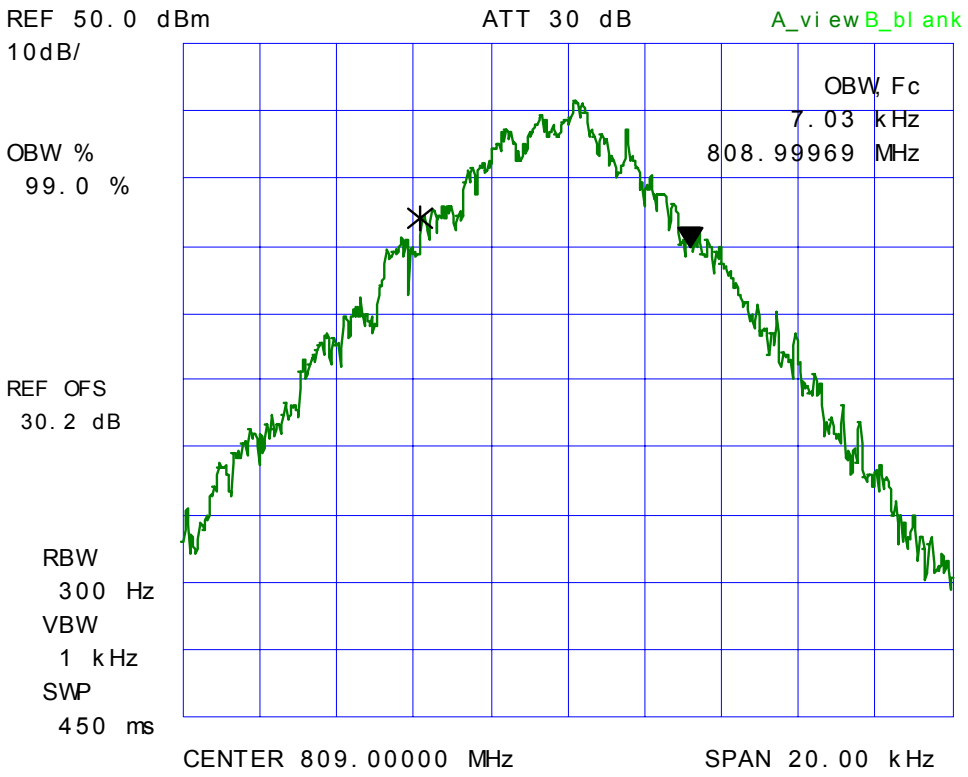
Plot 5: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



Plot 6: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal

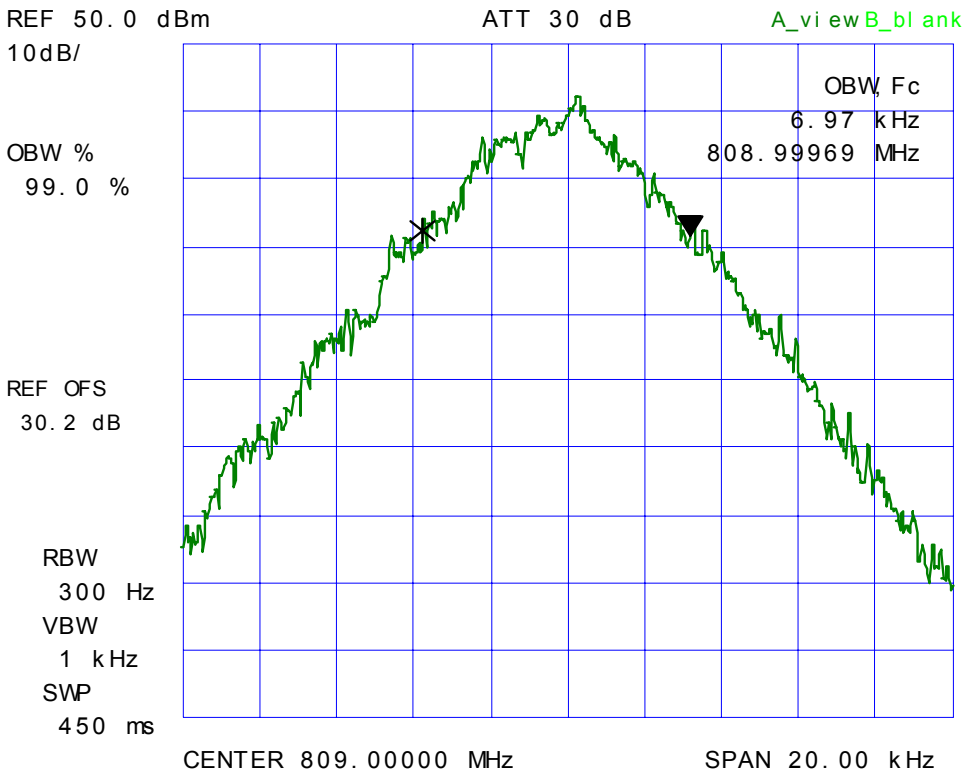


Plot 7: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power

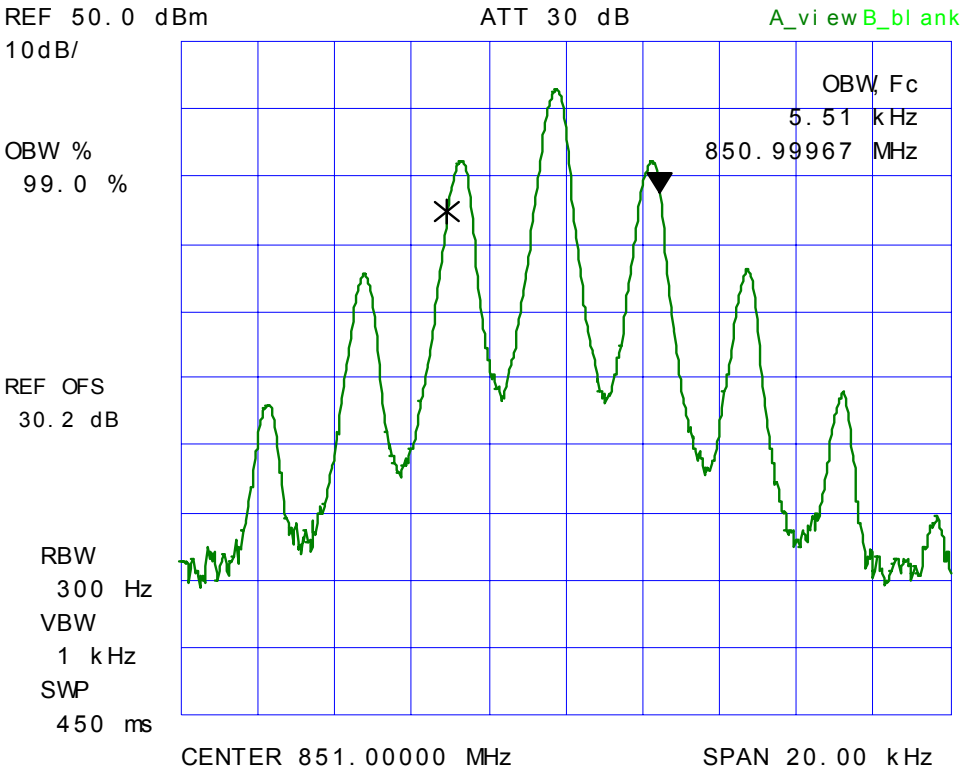


Plot 8: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754

.



Plot 9: 99% Occupied Bandwidth
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



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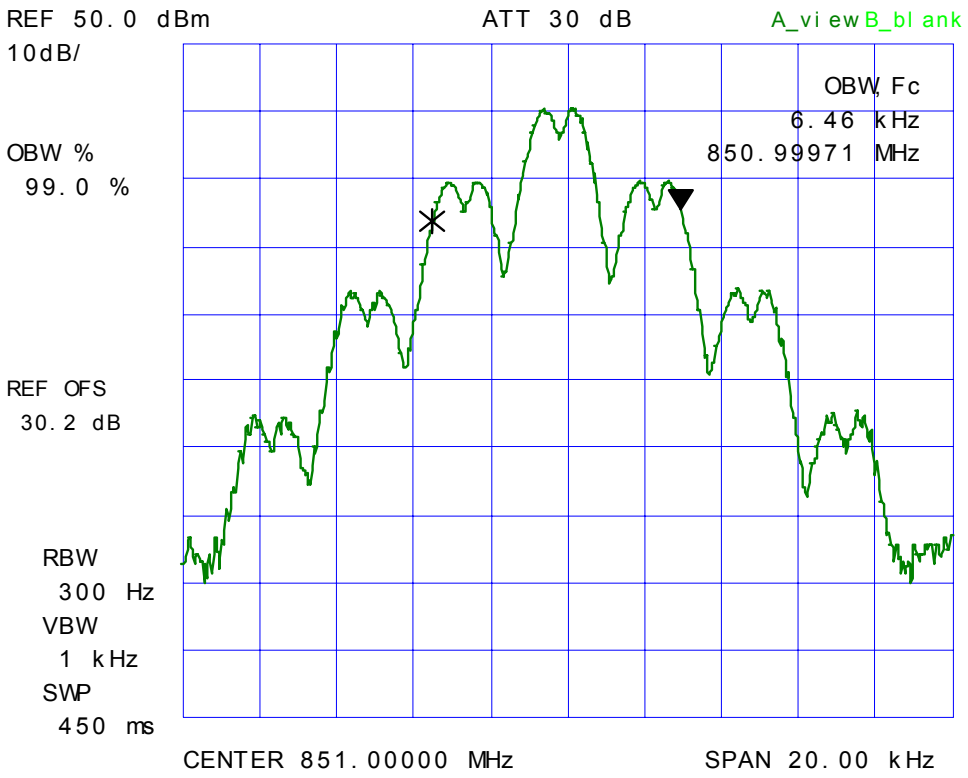
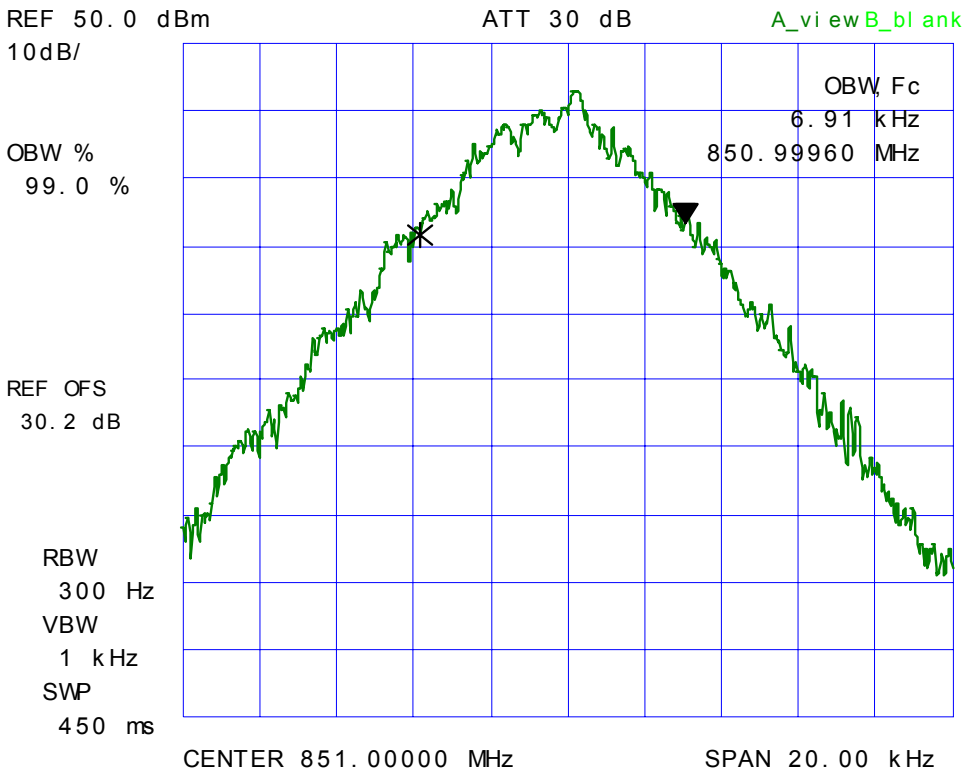
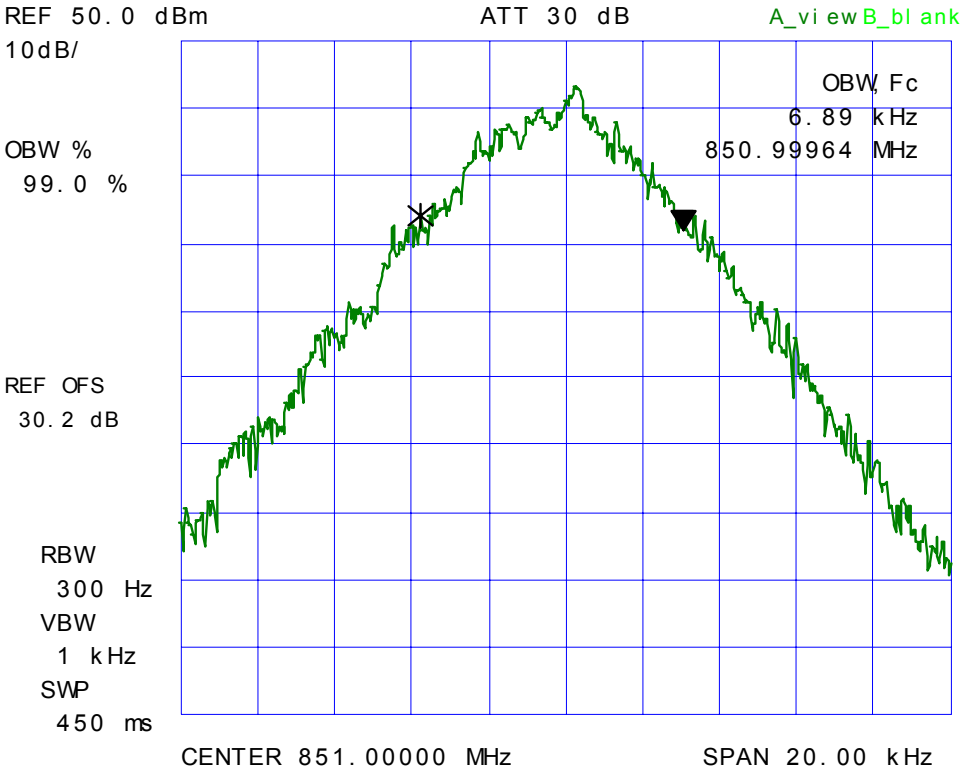
Plot 10: 99% Occupied Bandwidth
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



Plot 11: 99% Occupied Bandwidth
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power



Plot 12: 99% Occupied Bandwidth
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



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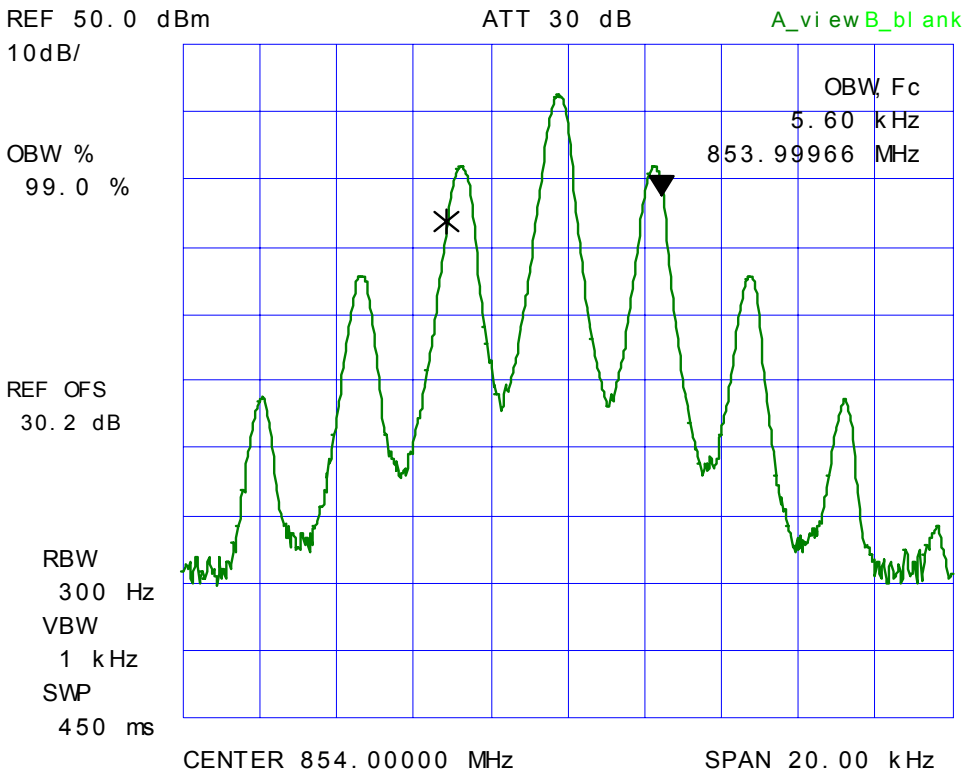
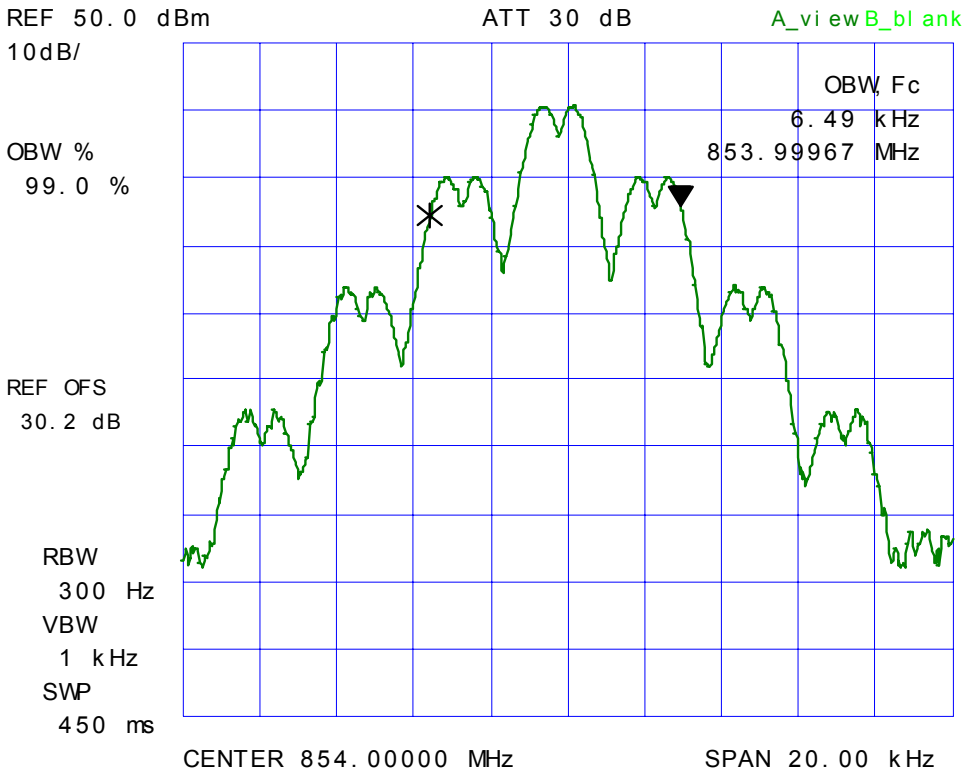
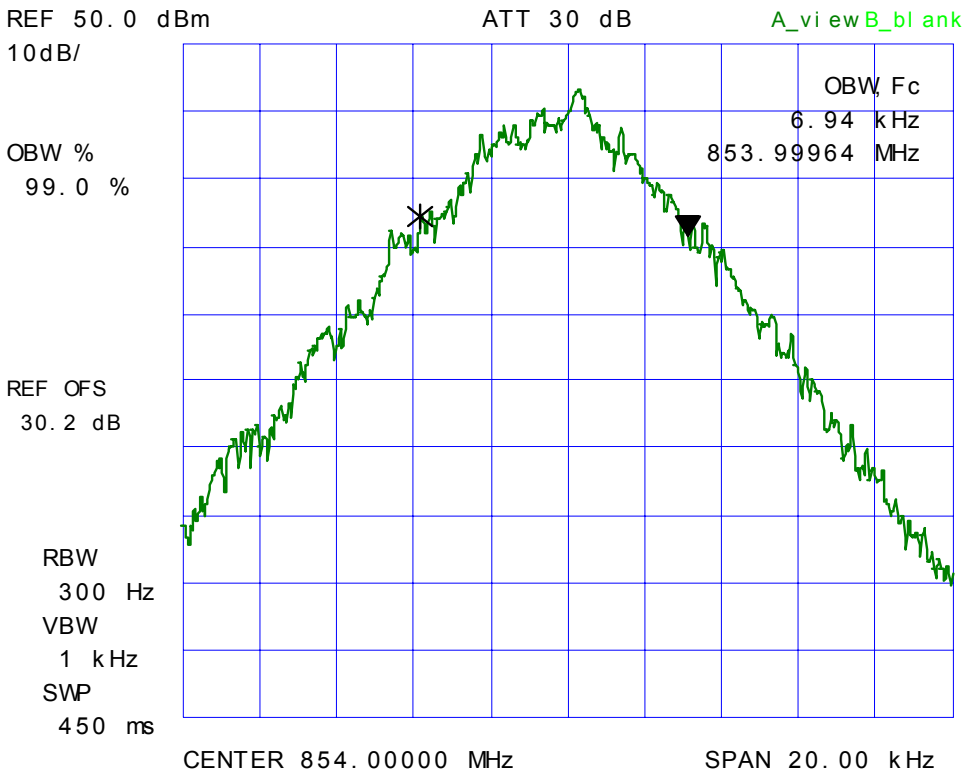
Plot 13: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



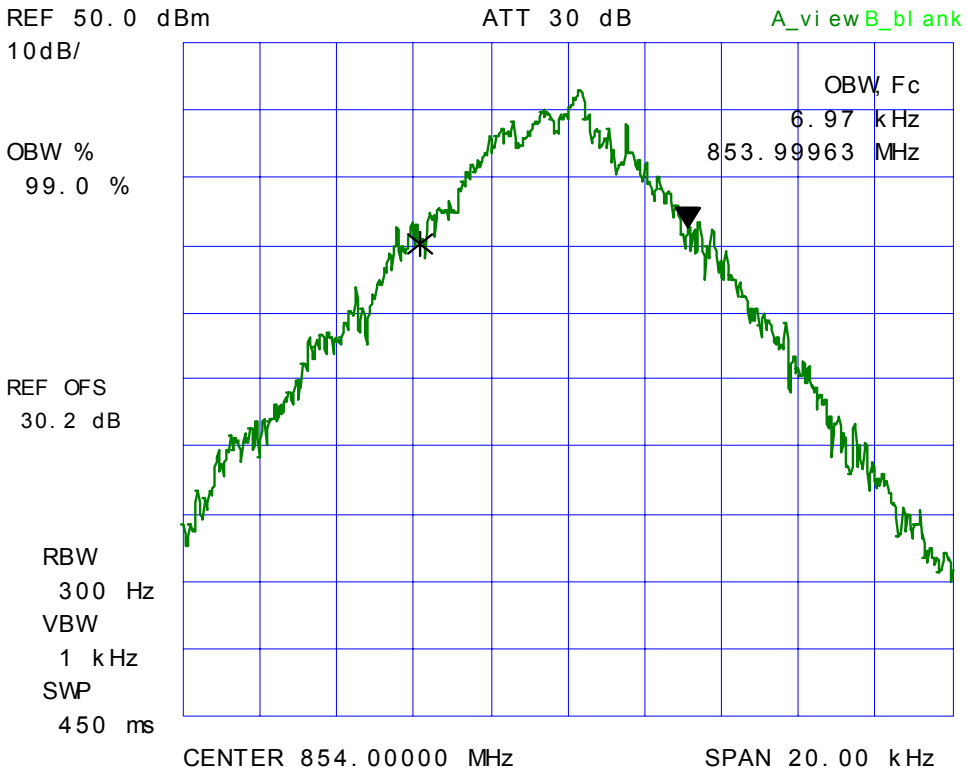
Plot 14: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



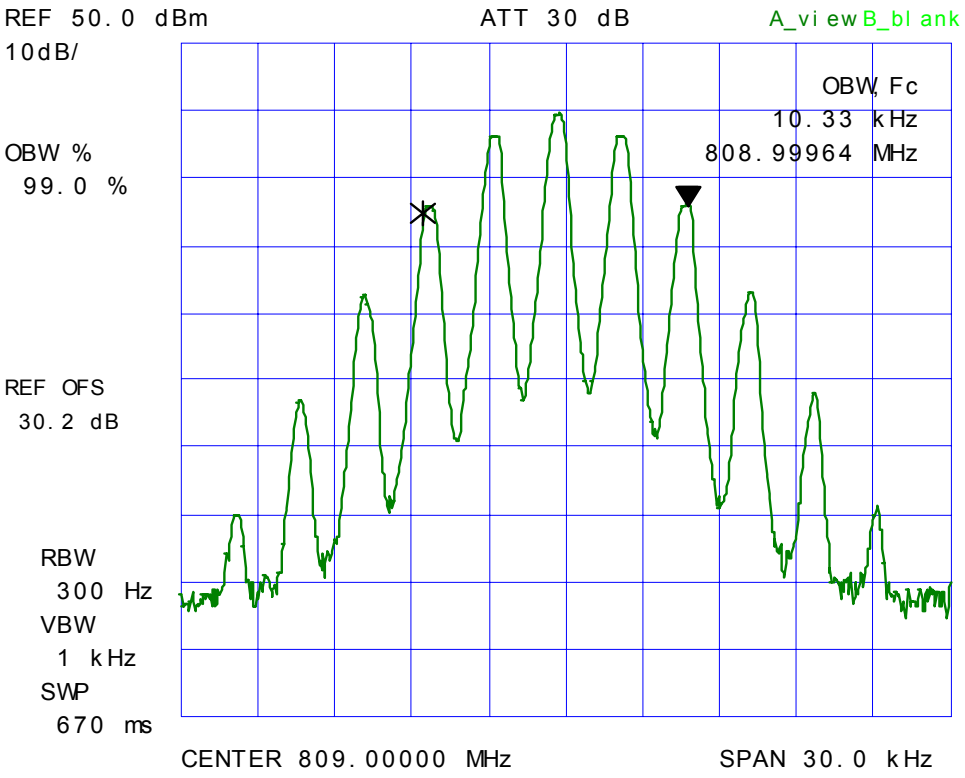
Plot 15: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power



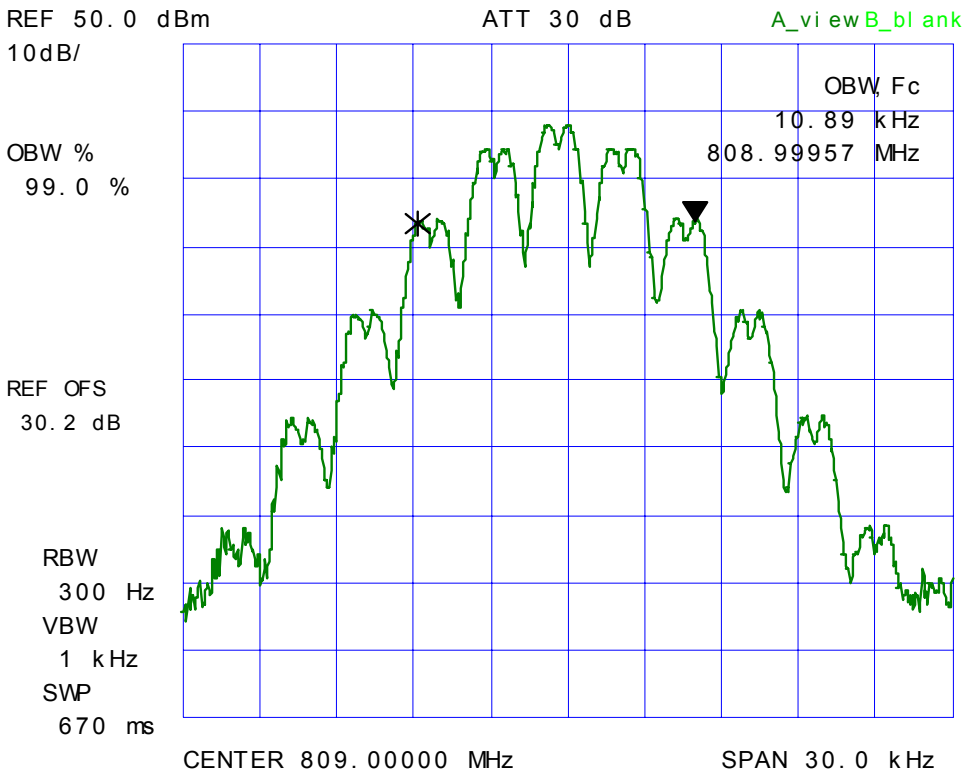
Plot 16: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



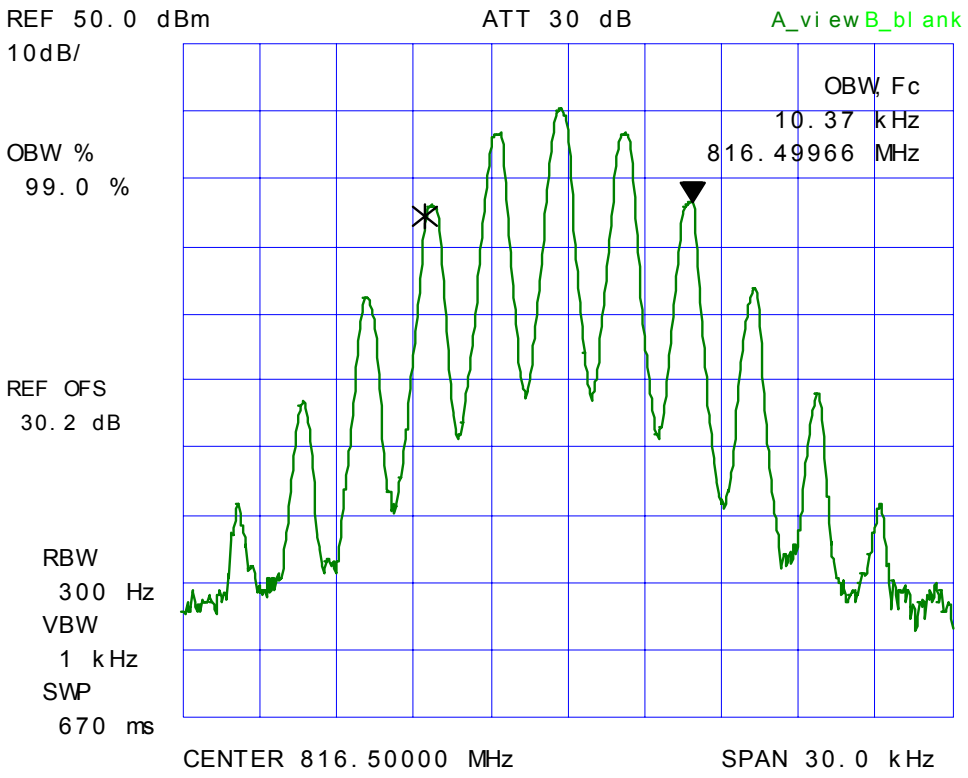
Plot 17: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 25 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



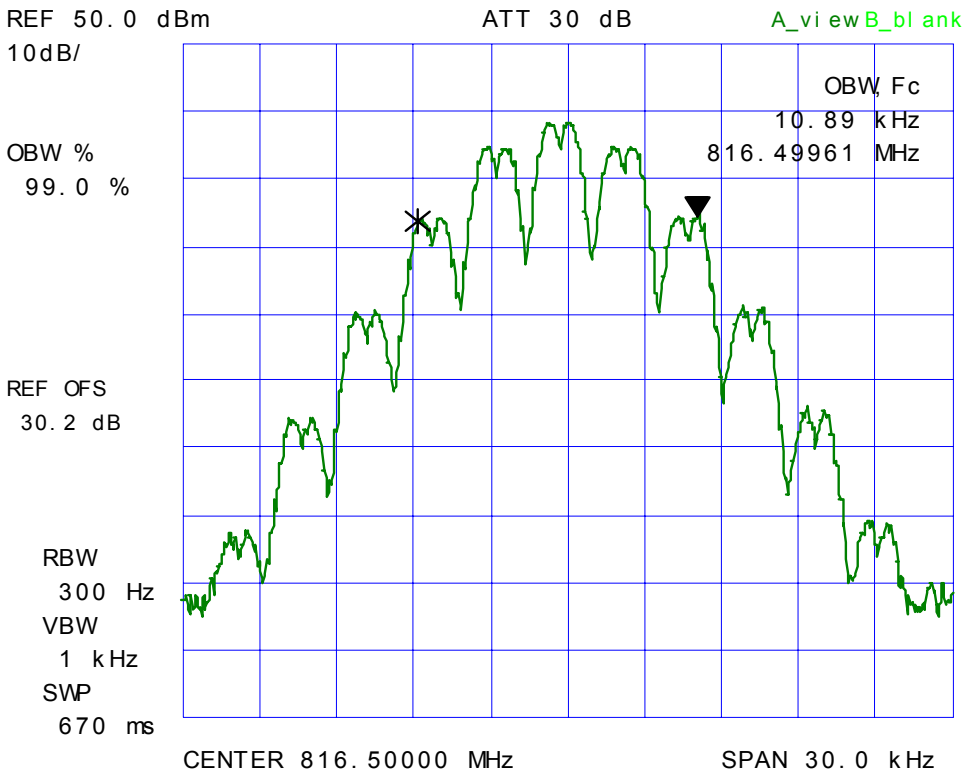
Plot 18: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



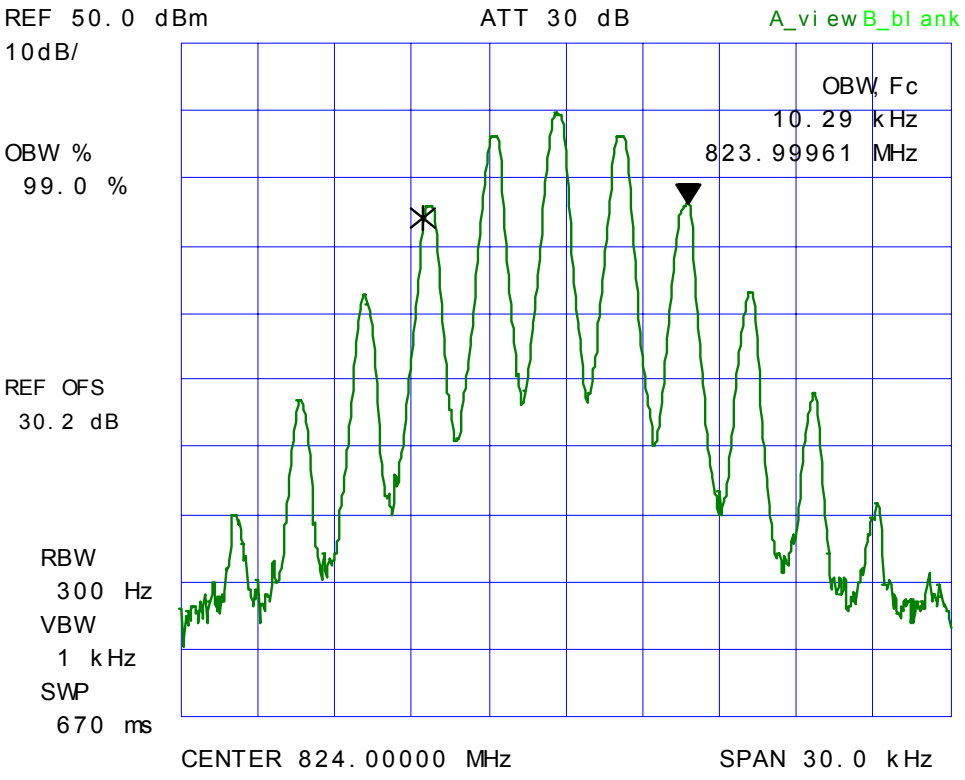
Plot 19: 99% Occupied Bandwidth
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



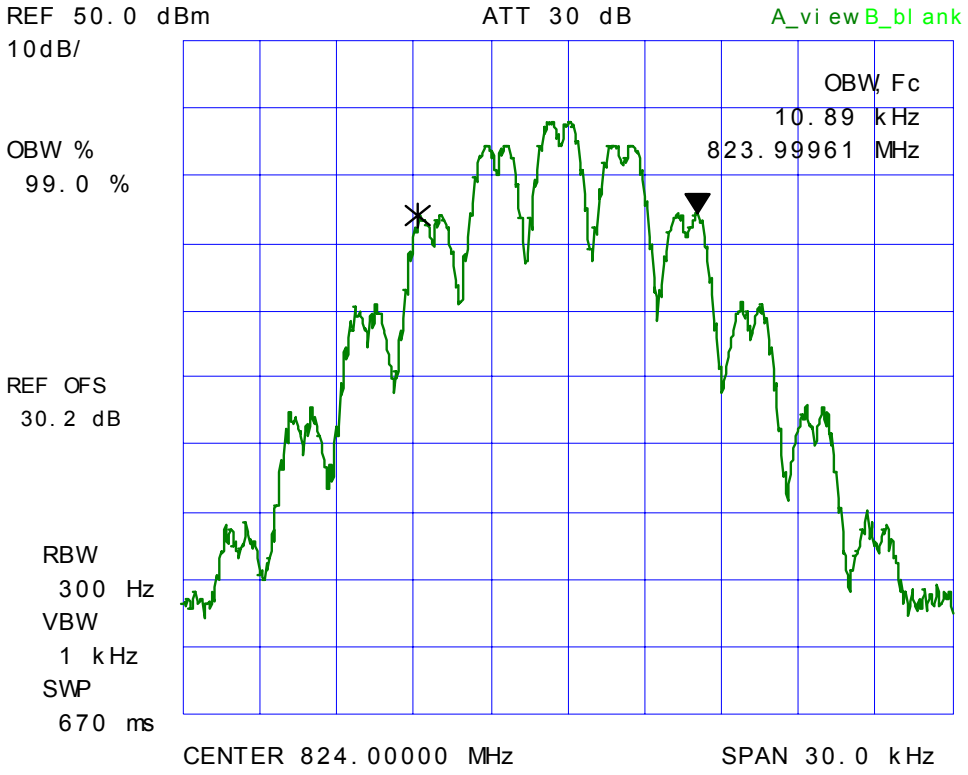
Plot 20: 99% Occupied Bandwidth
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



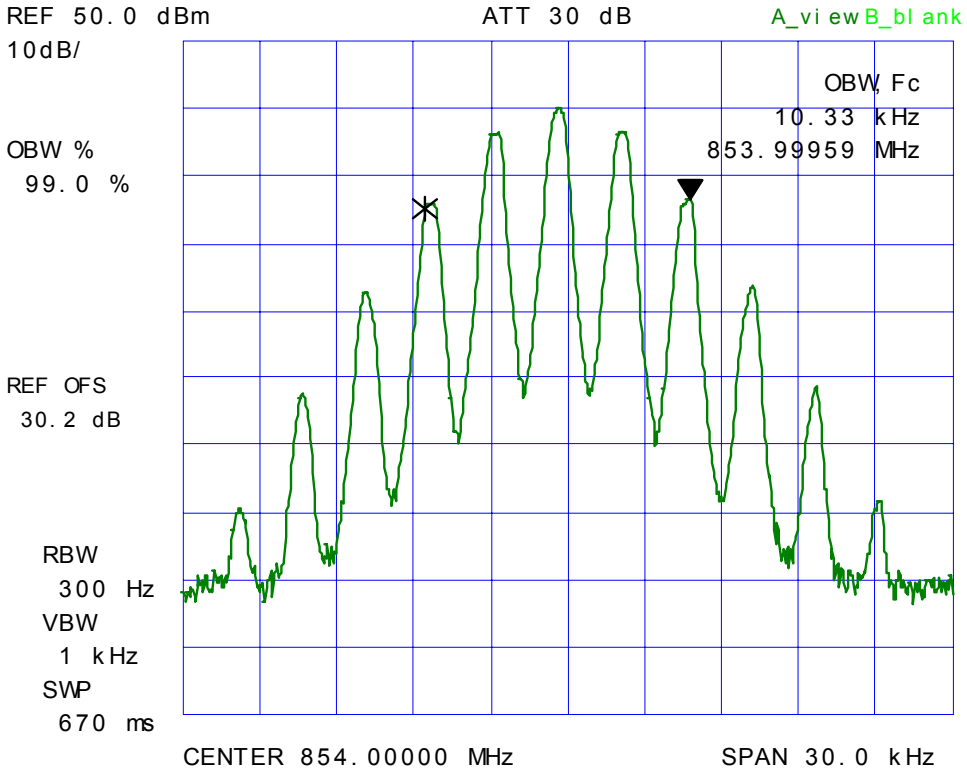
Plot 21: 99% Occupied Bandwidth
Test Frequency: 824 MHz, 25 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



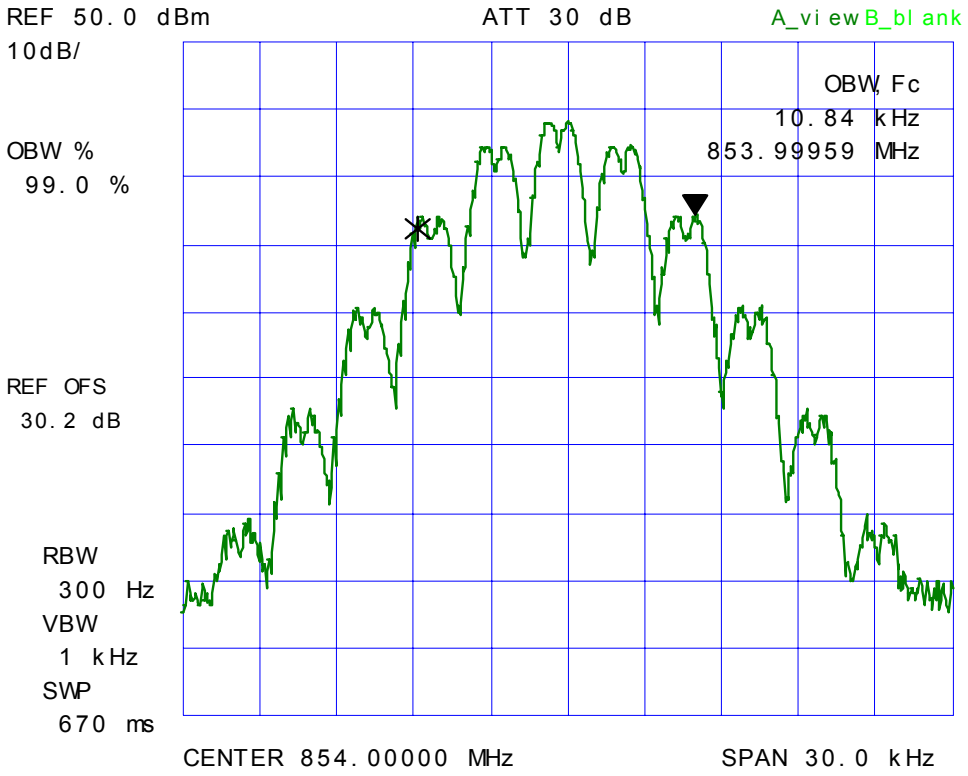
Plot 22: 99% Occupied Bandwidth
Test Frequency: 824 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



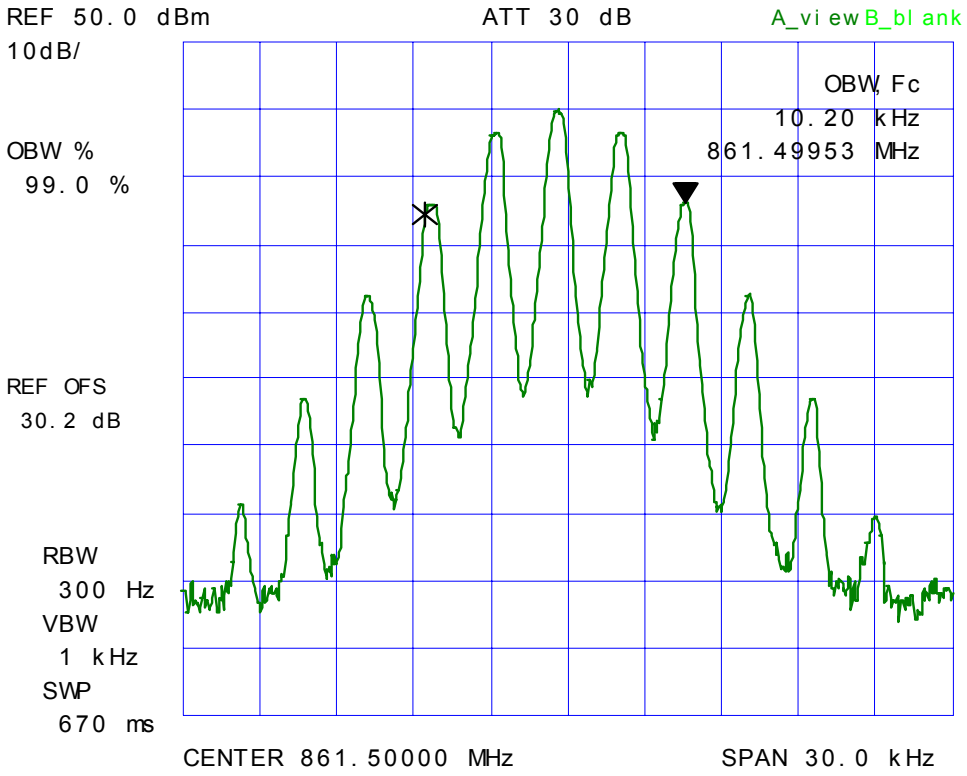
Plot 23: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 25 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



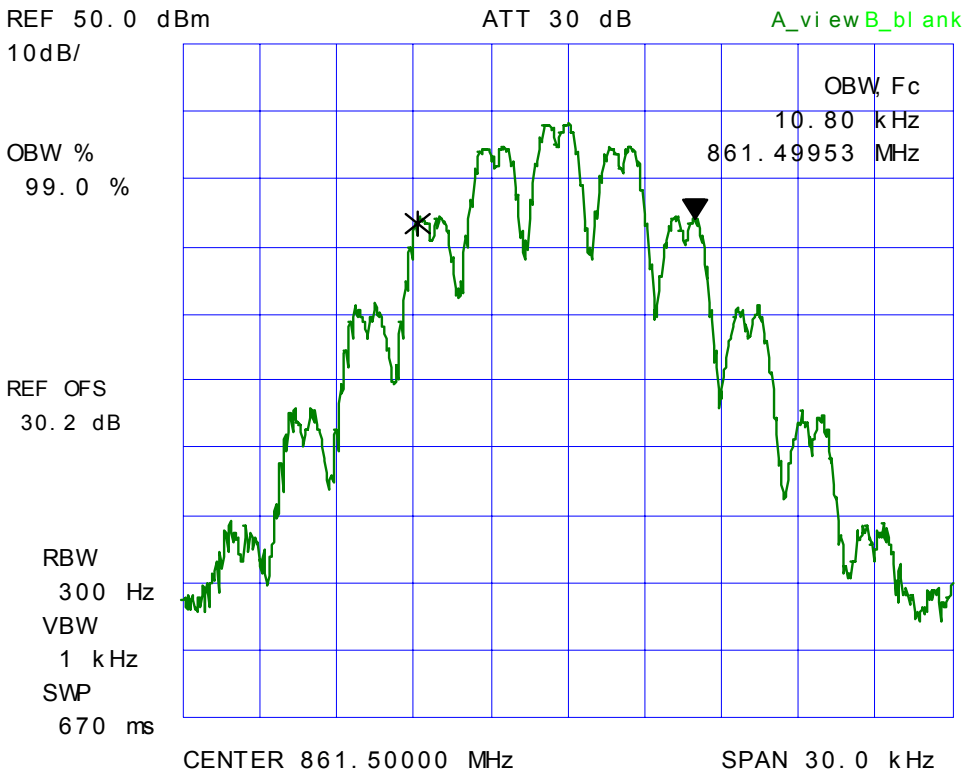
Plot 24: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



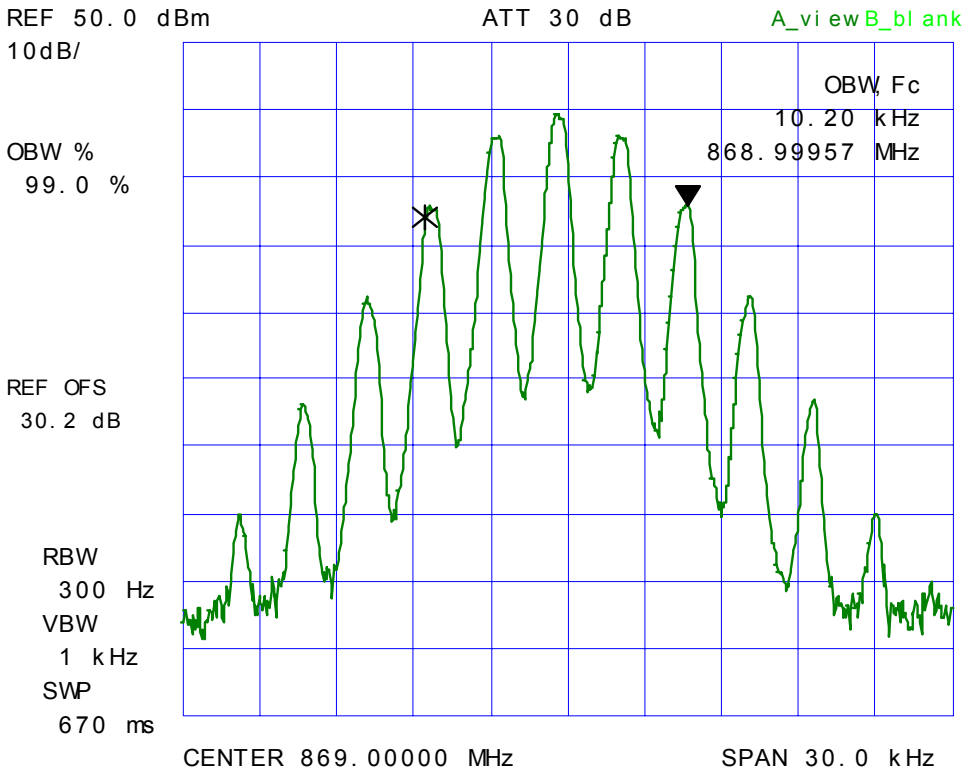
Plot 25: 99% Occupied Bandwidth
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



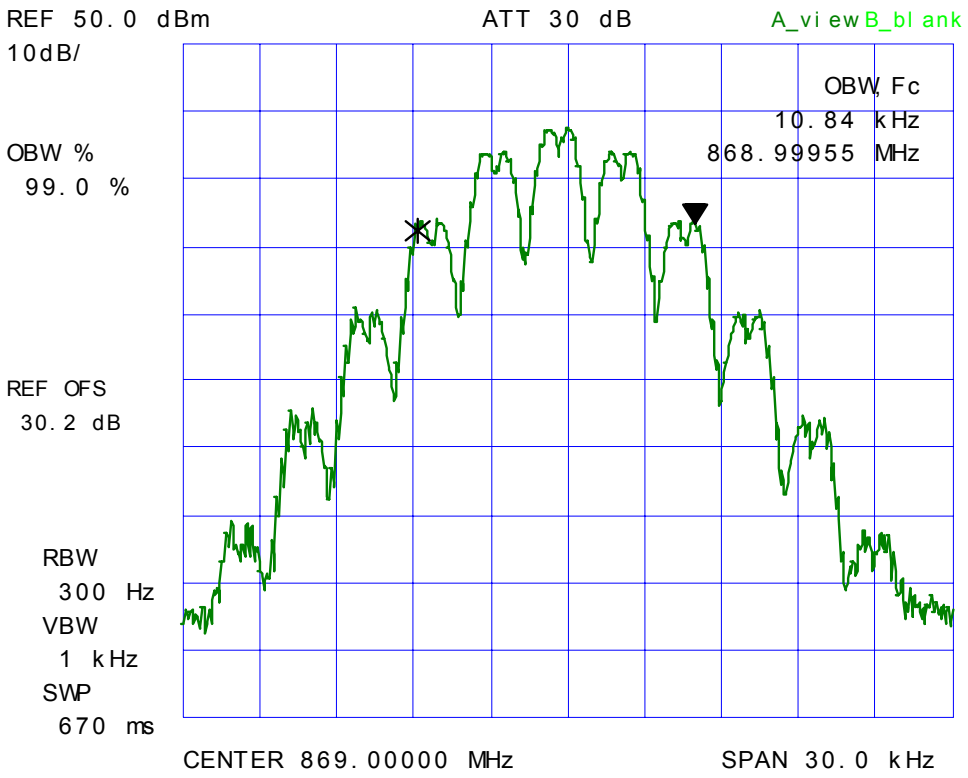
Plot 26: 99% Occupied Bandwidth
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



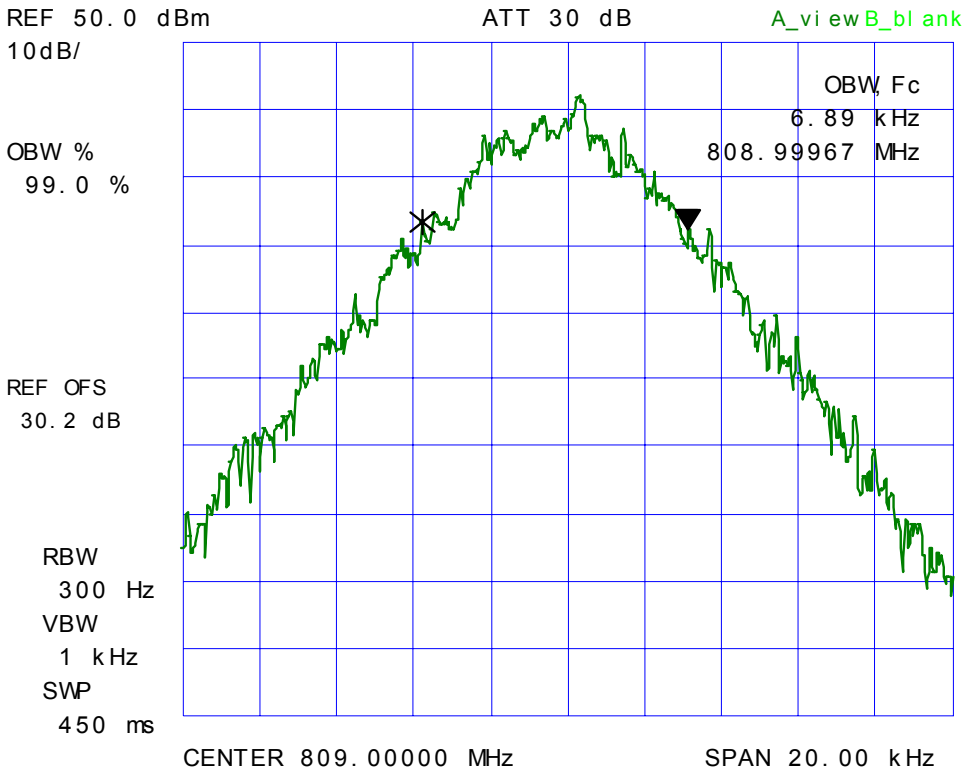
Plot 27: 99% Occupied Bandwidth
Test Frequency: 869 MHz, 25 kHz Channel Spacing, High Power
Modulation: FM modulation with 2.5 kHz sine wave signal



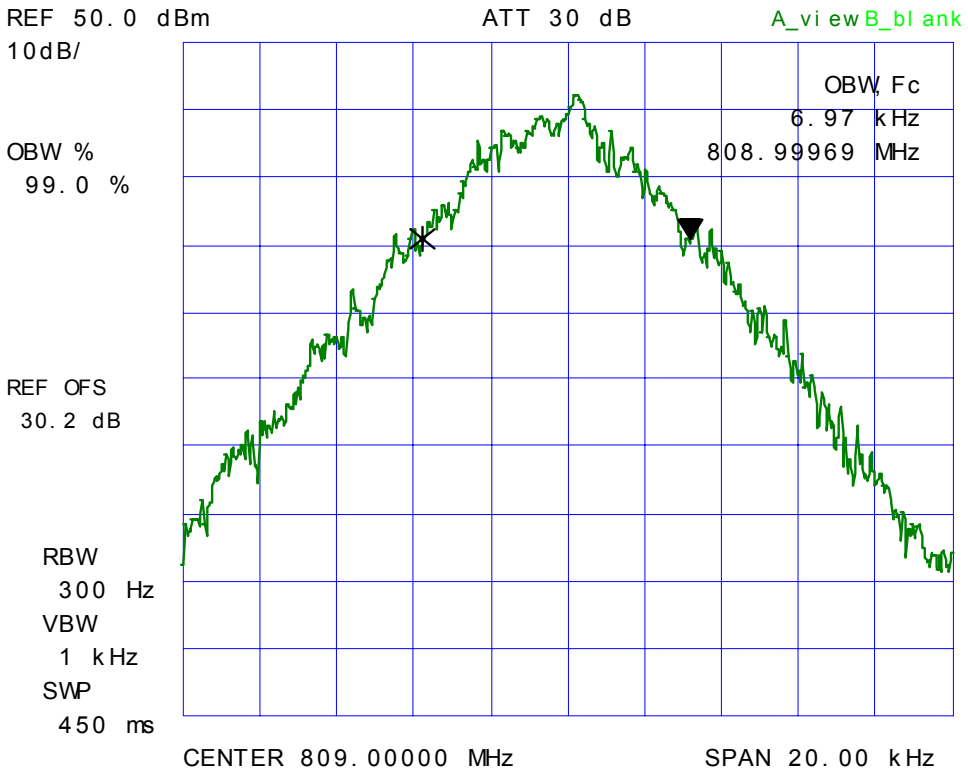
Plot 28: 99% Occupied Bandwidth
Test Frequency: 869 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



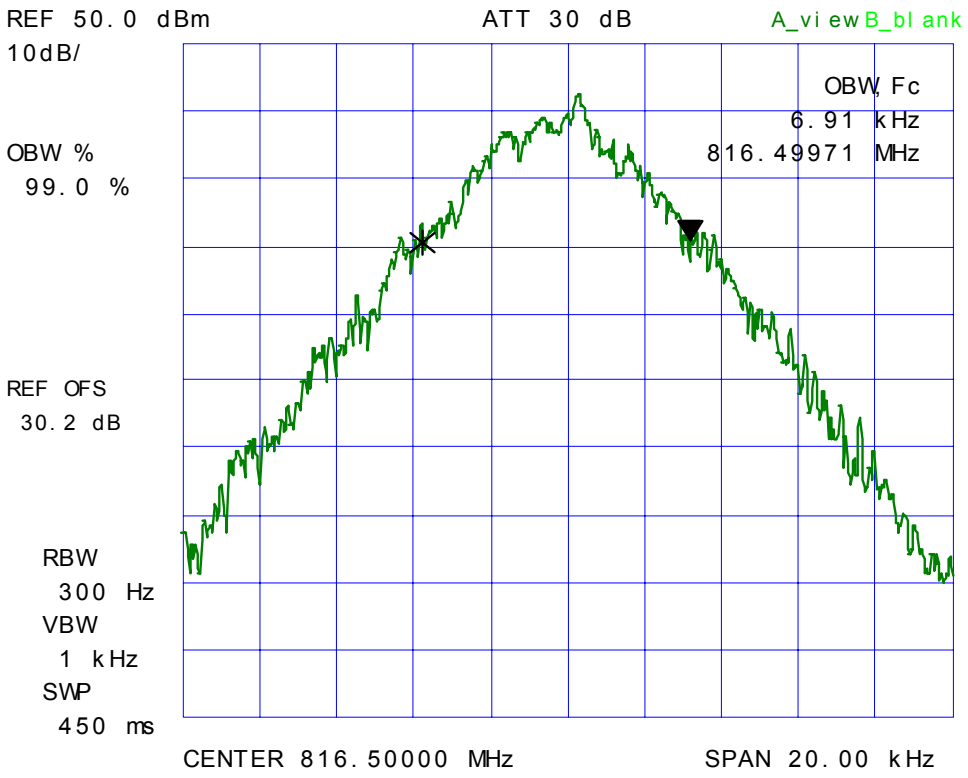
Plot 29: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power



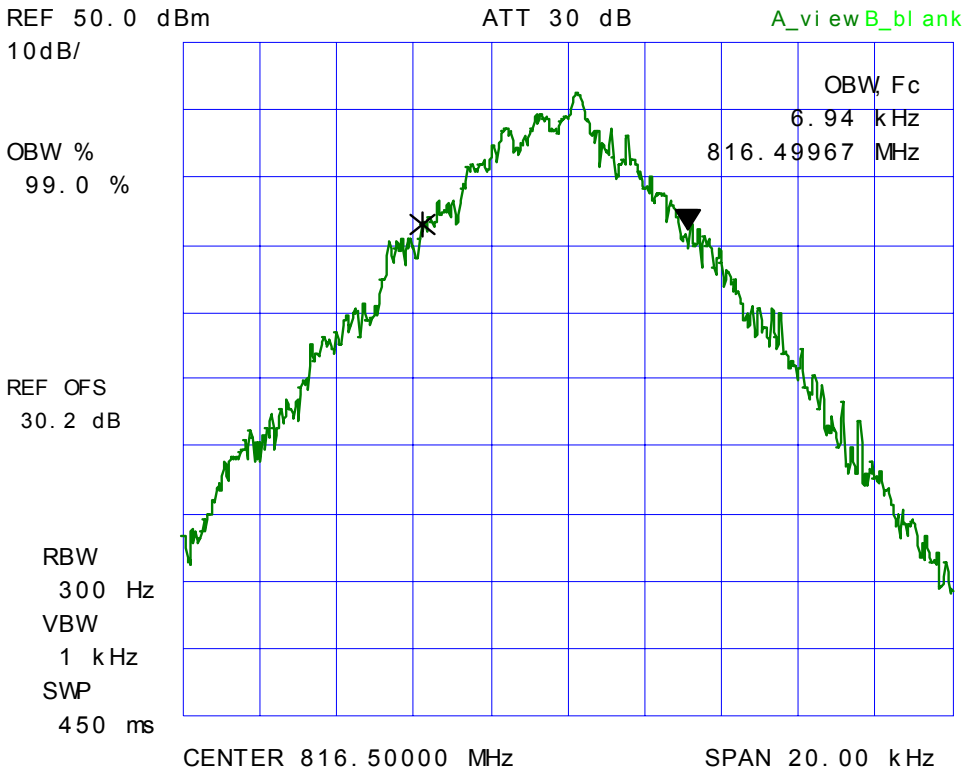
Plot 30: 99% Occupied Bandwidth
Test Frequency: 809 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



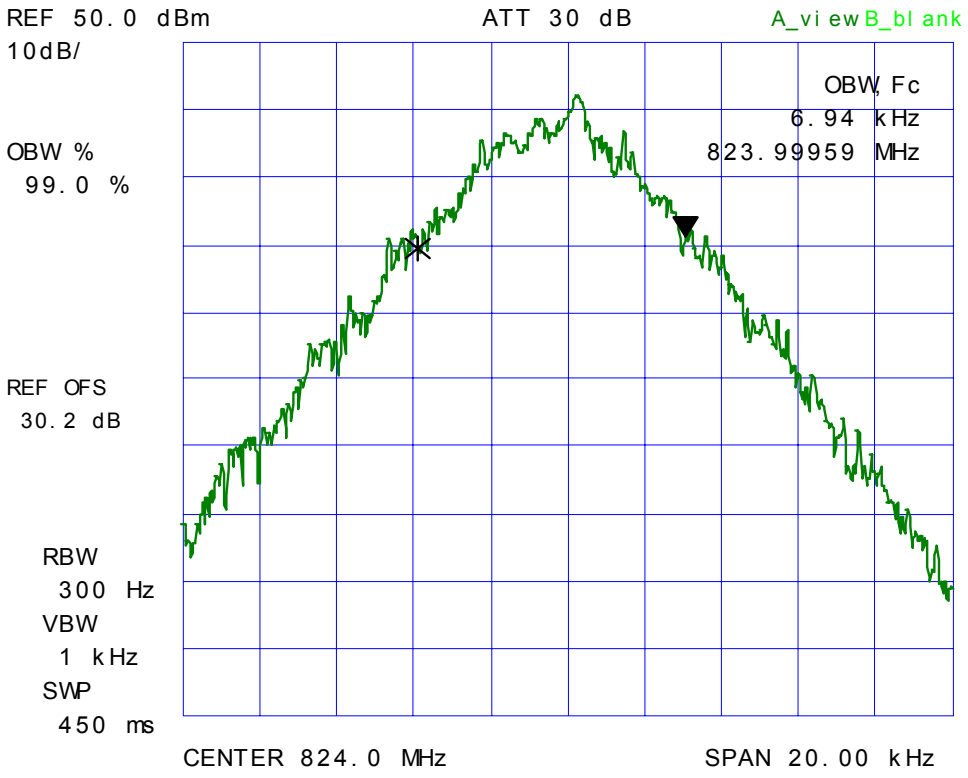
Plot 31: 99% Occupied Bandwidth
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power



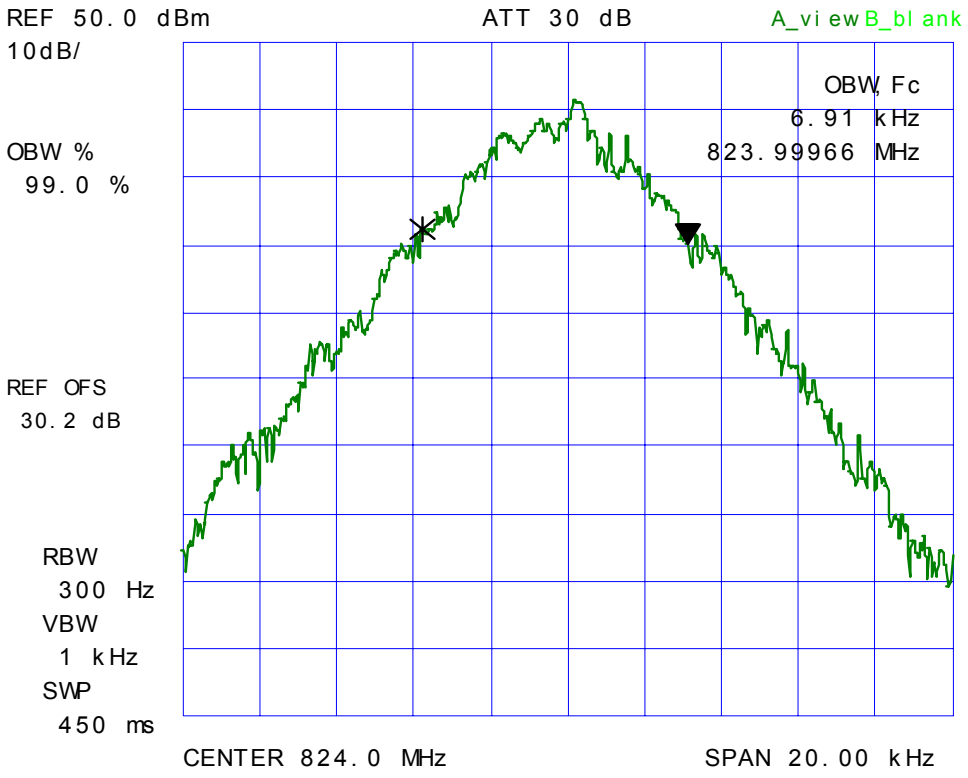
Plot 32: 99% Occupied Bandwidth
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



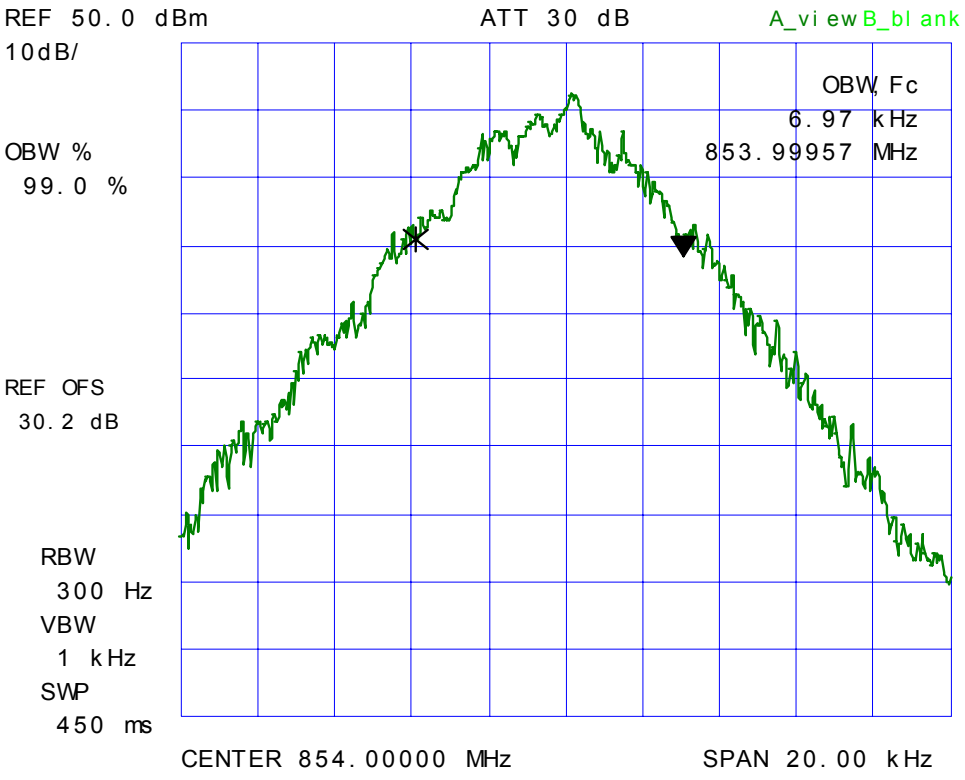
Plot 33: 99% Occupied Bandwidth
Test Frequency: 824 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power



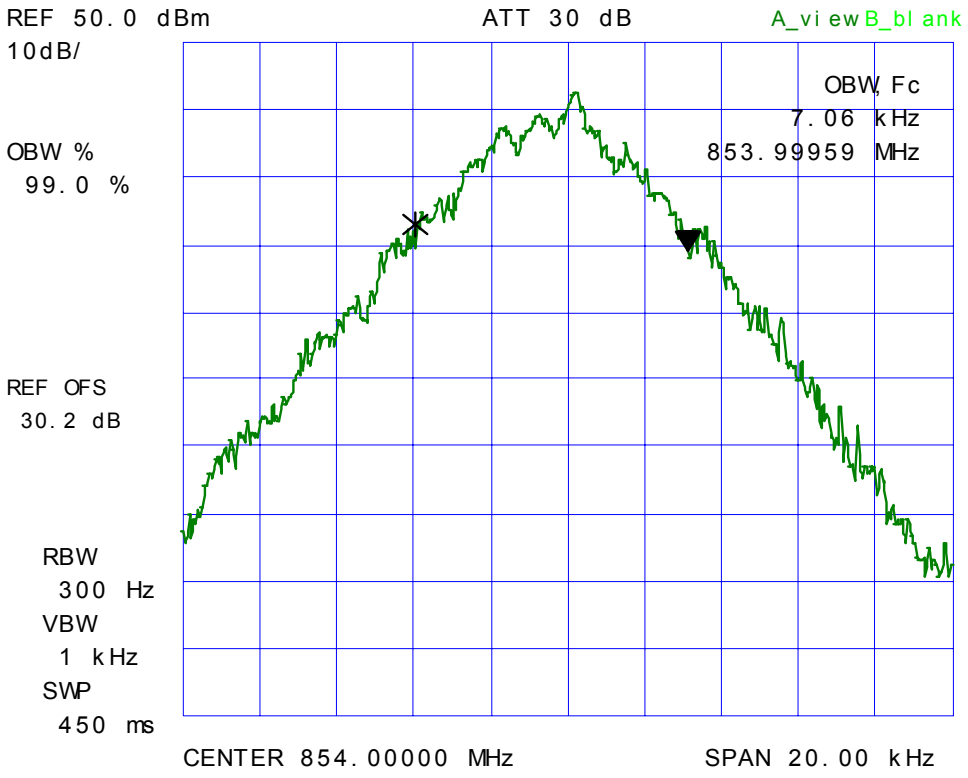
Plot 34: 99% Occupied Bandwidth
Test Frequency: 824 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



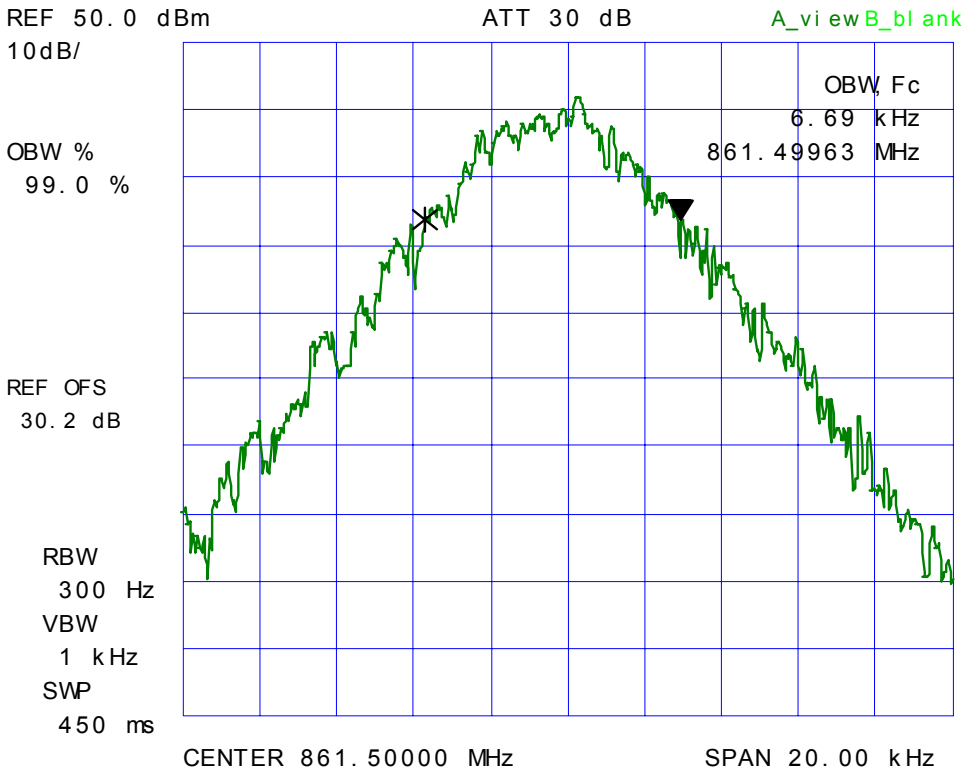
Plot 35: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power



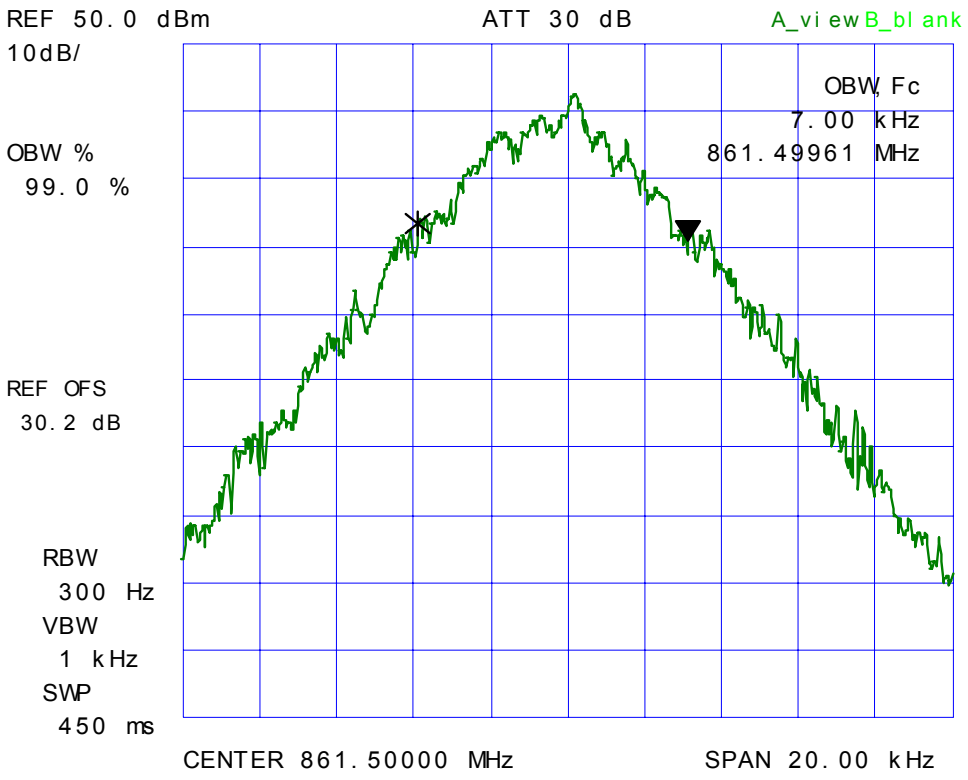
Plot 36: 99% Occupied Bandwidth
Test Frequency: 854 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



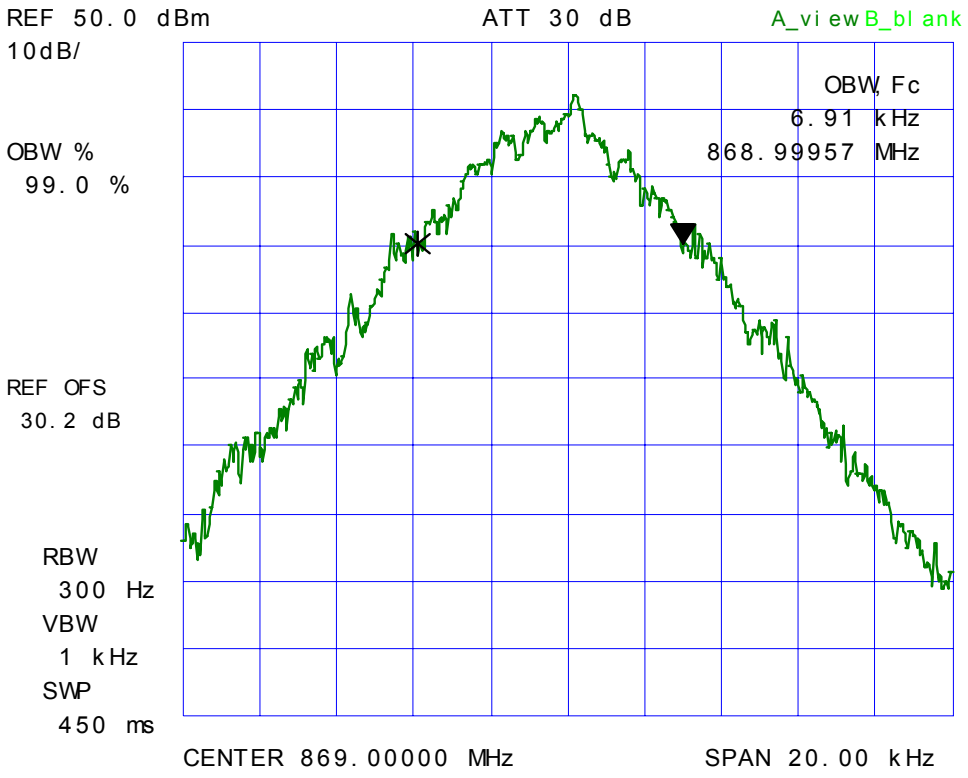
Plot 37: 99% Occupied Bandwidth
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power



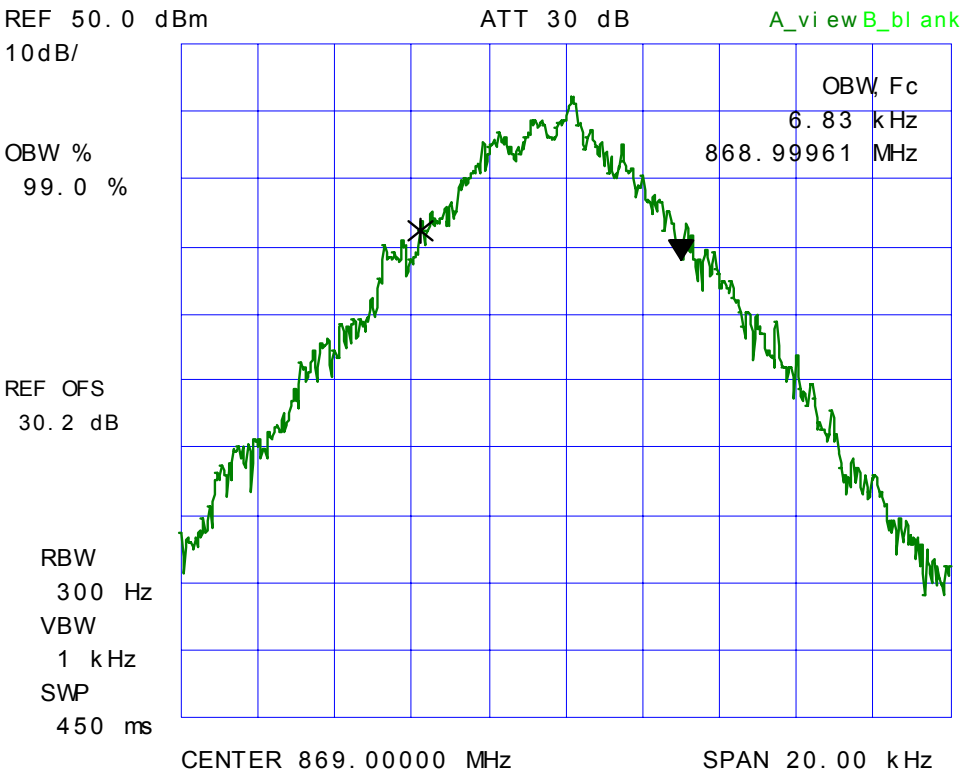
Plot 38: 99% Occupied Bandwidth
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



Plot 39: 99% Occupied Bandwidth
Test Frequency: 869 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power



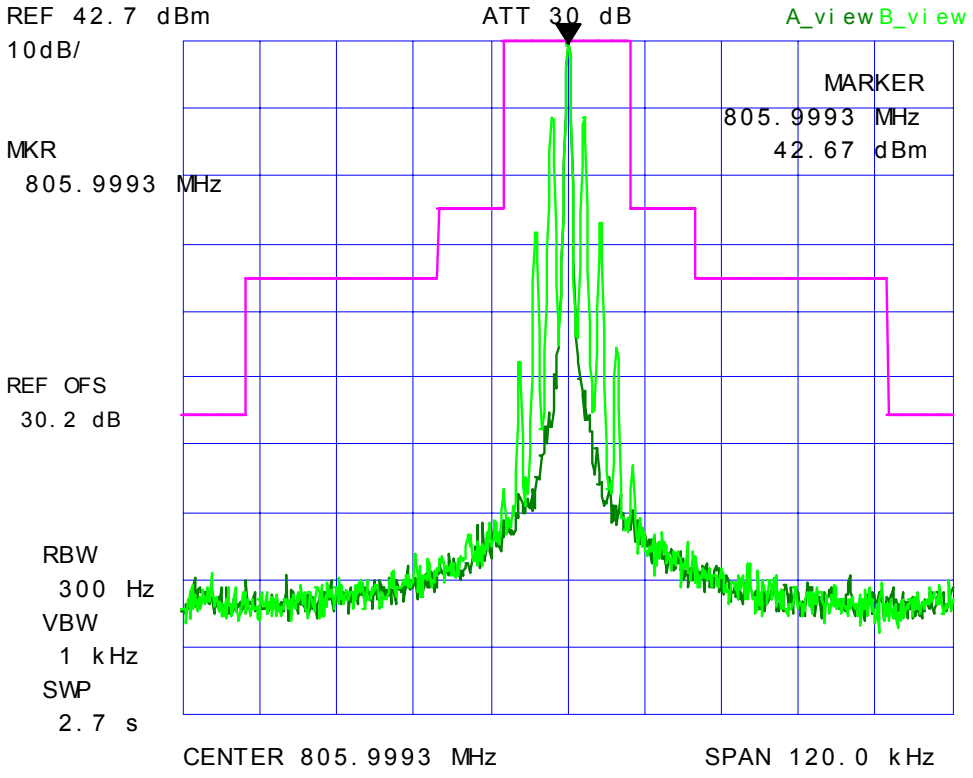
Plot 40: 99% Occupied Bandwidth
Test Frequency: 869 MHz, 25 kHz Channel Spacing
Modulation: Digital modulation, High Power, Sub-carrier D-754



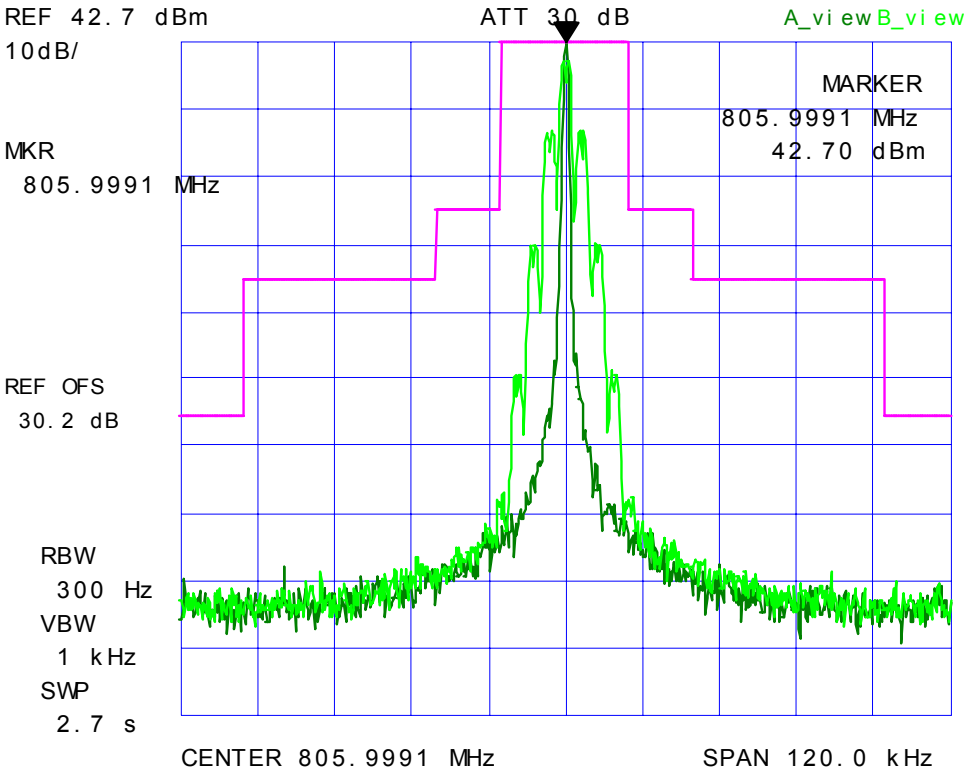
6.10.4.2. Emission Masks

See the following plots (40 to 96) for detailed measurements

Plot 41: Emission Mask B
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



Plot 42: Emission Mask B
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



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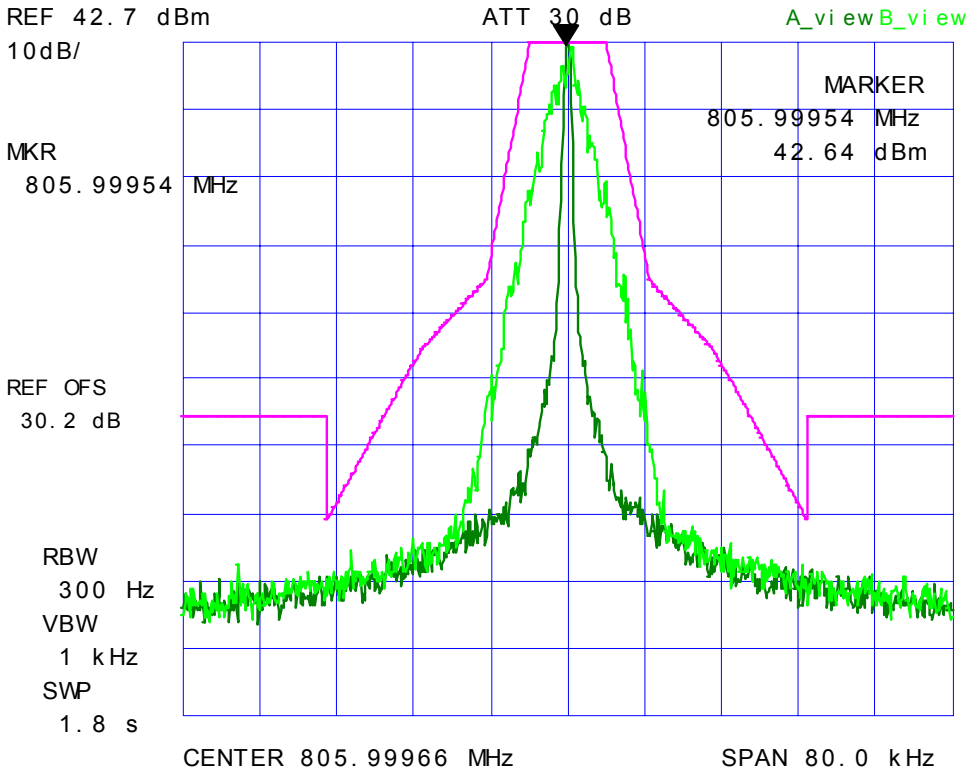
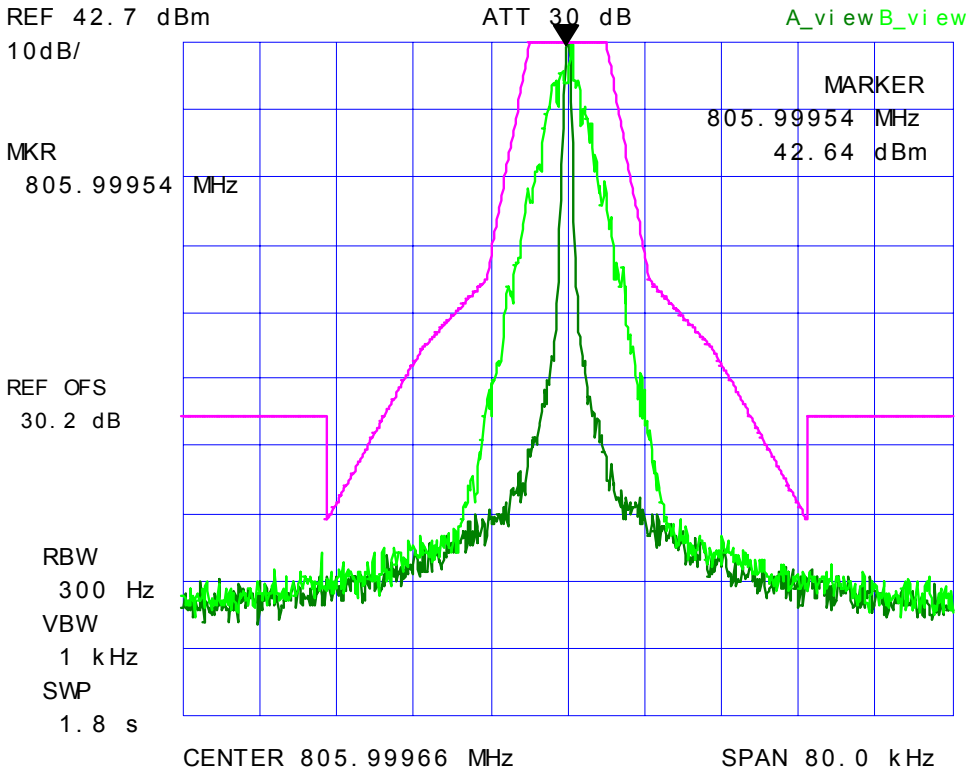
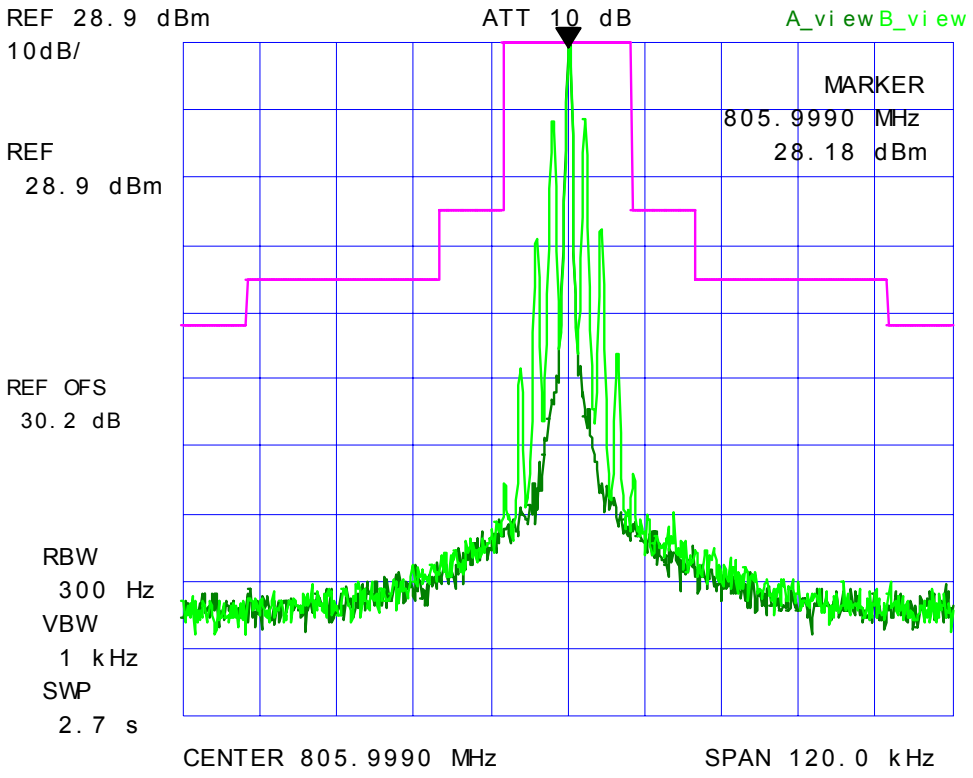
Plot 43: Emission Mask H
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing,
Modulation: Digital modulation, High Power



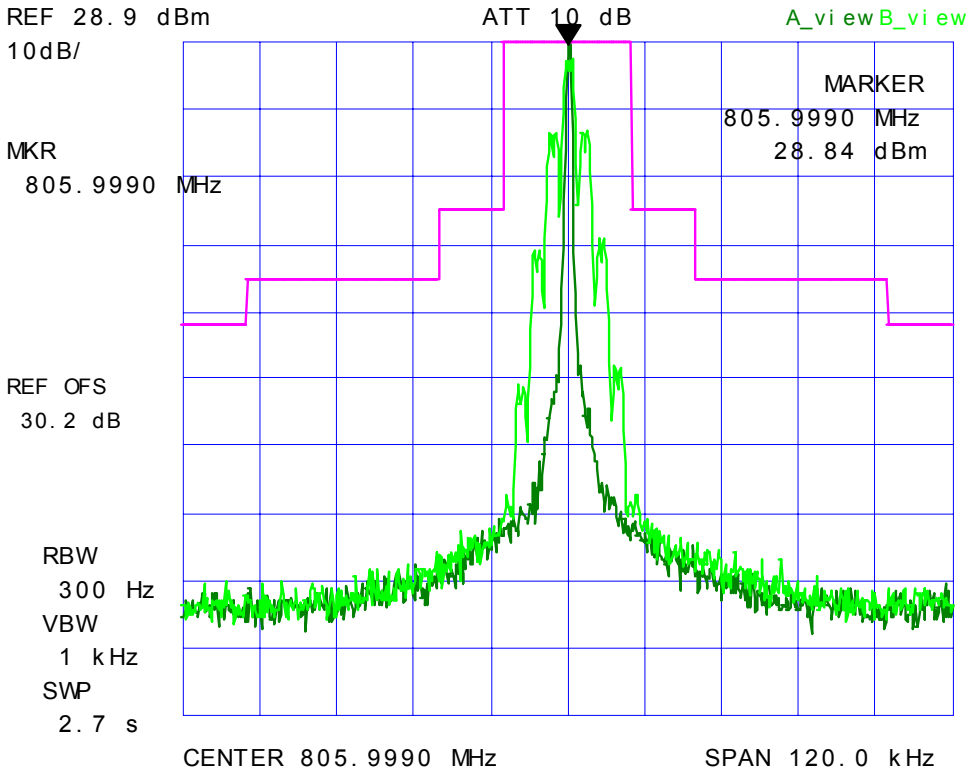
Plot 44: Emission Mask H
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing
Digital modulation, High Power, Sub-carrier D-754



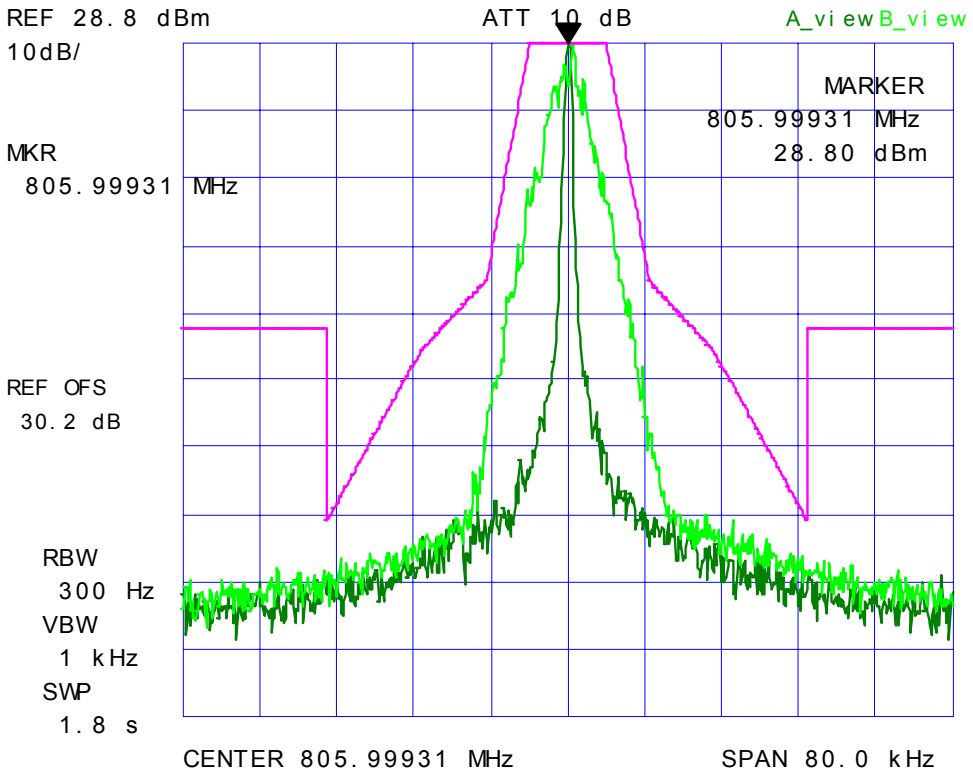
Plot 45: Emission Mask B
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



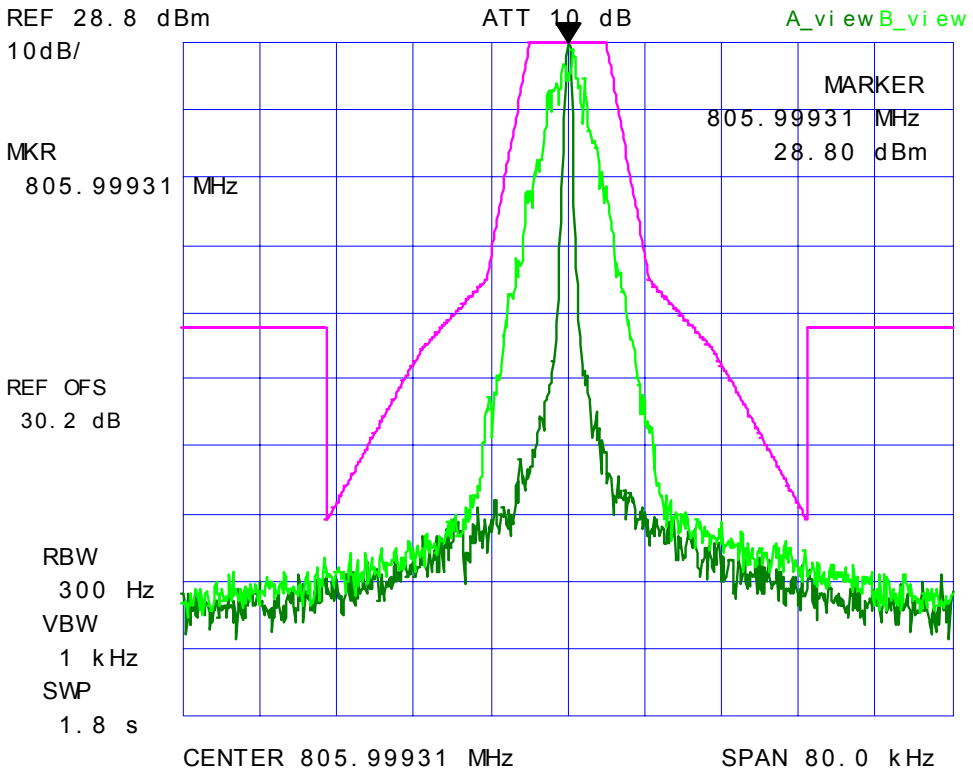
Plot 46: Emission Mask B
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



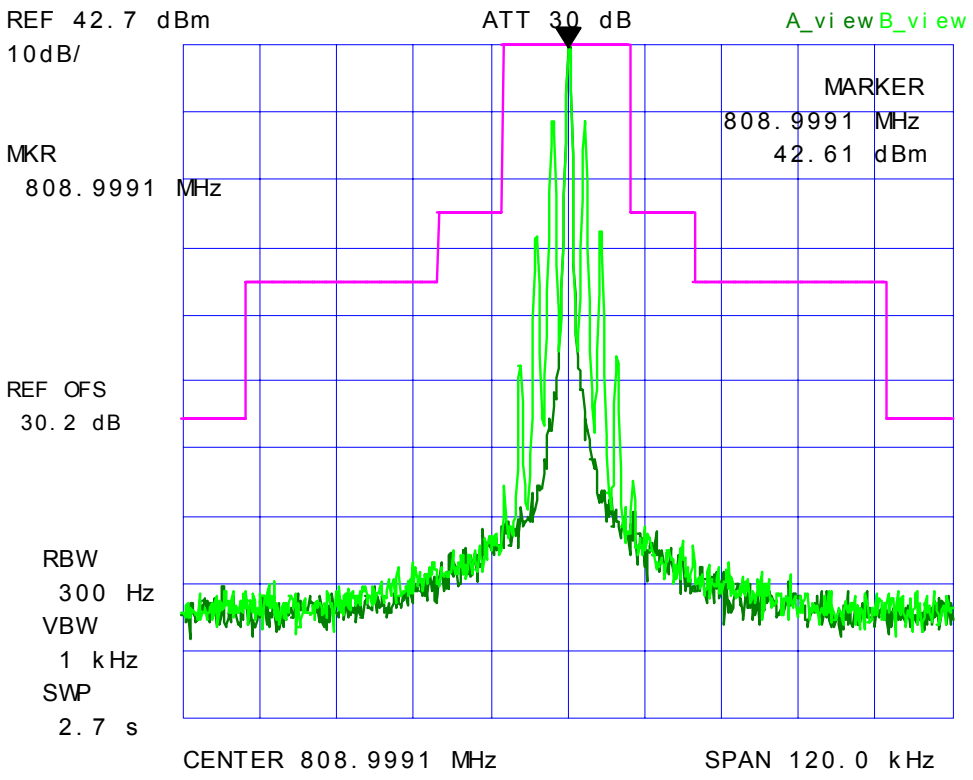
Plot 47: Emission Mask H
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing,
Modulation: Digital modulation, Low Power



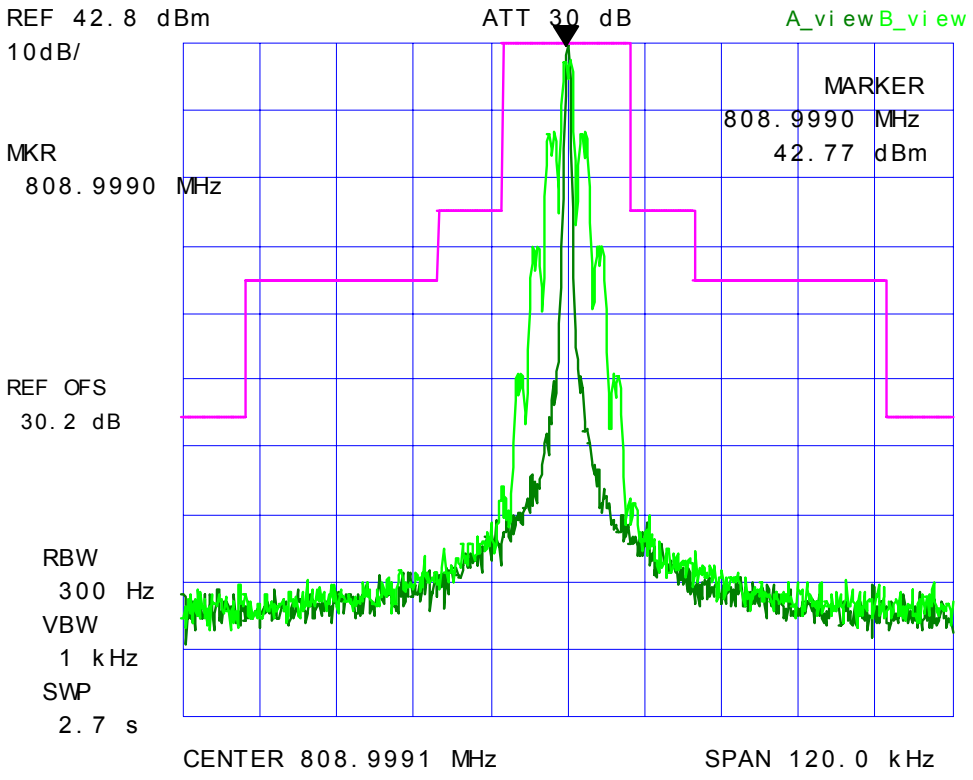
Plot 48: Emission Mask H
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing
Digital modulation, Low Power, Sub-carrier D-754



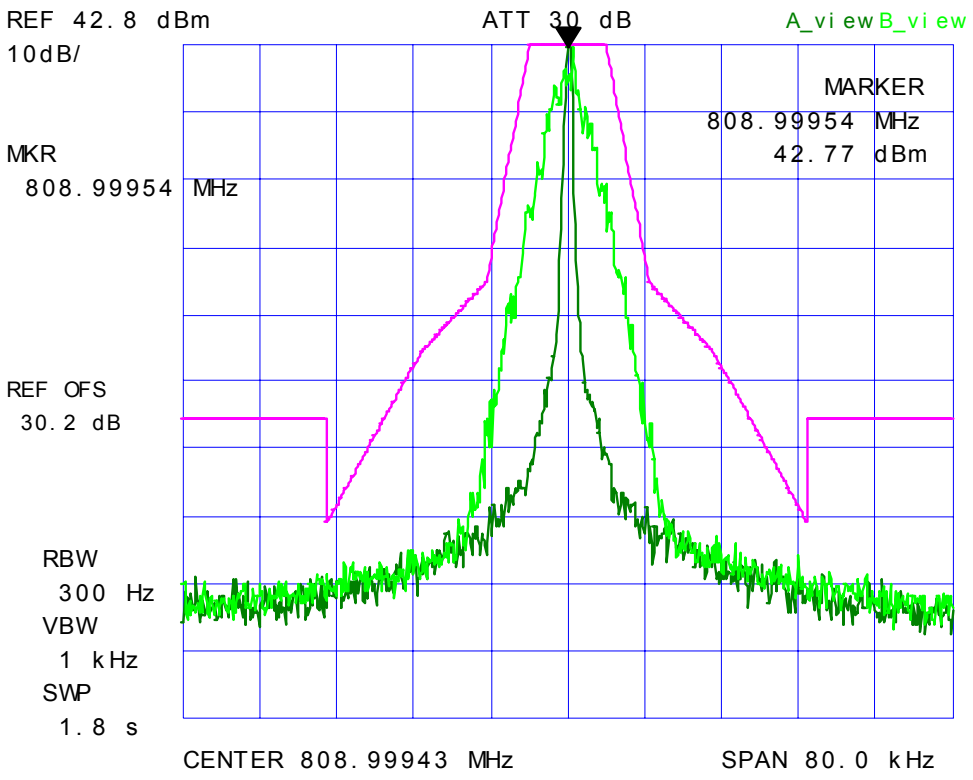
Plot 49: Emission Mask B
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



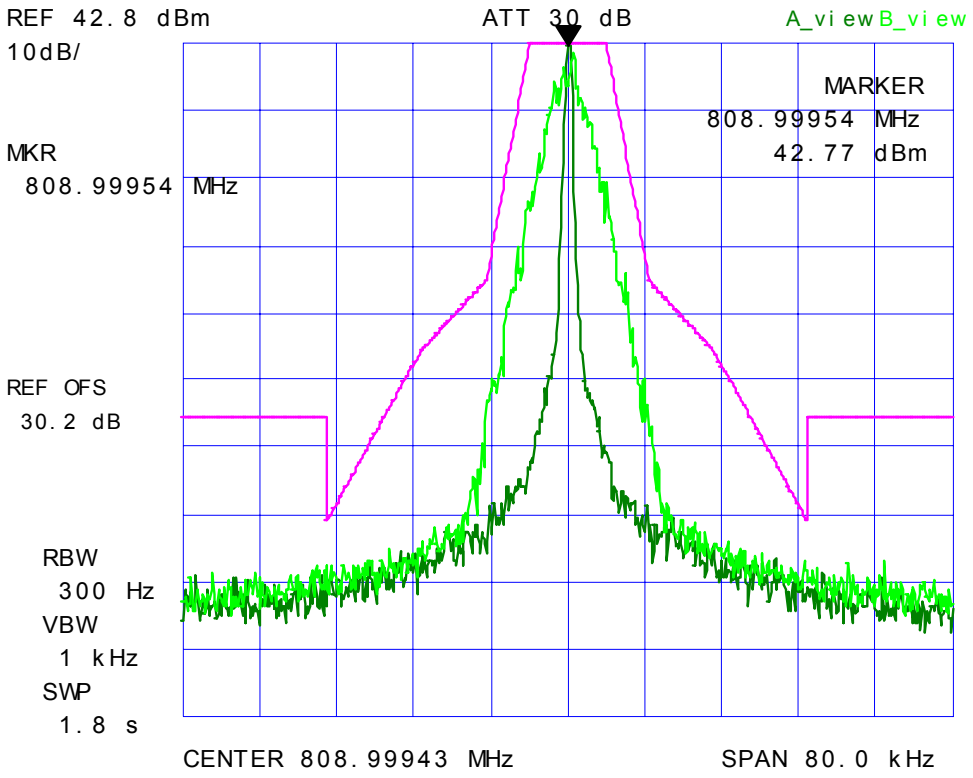
Plot 50: Emission Mask B
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



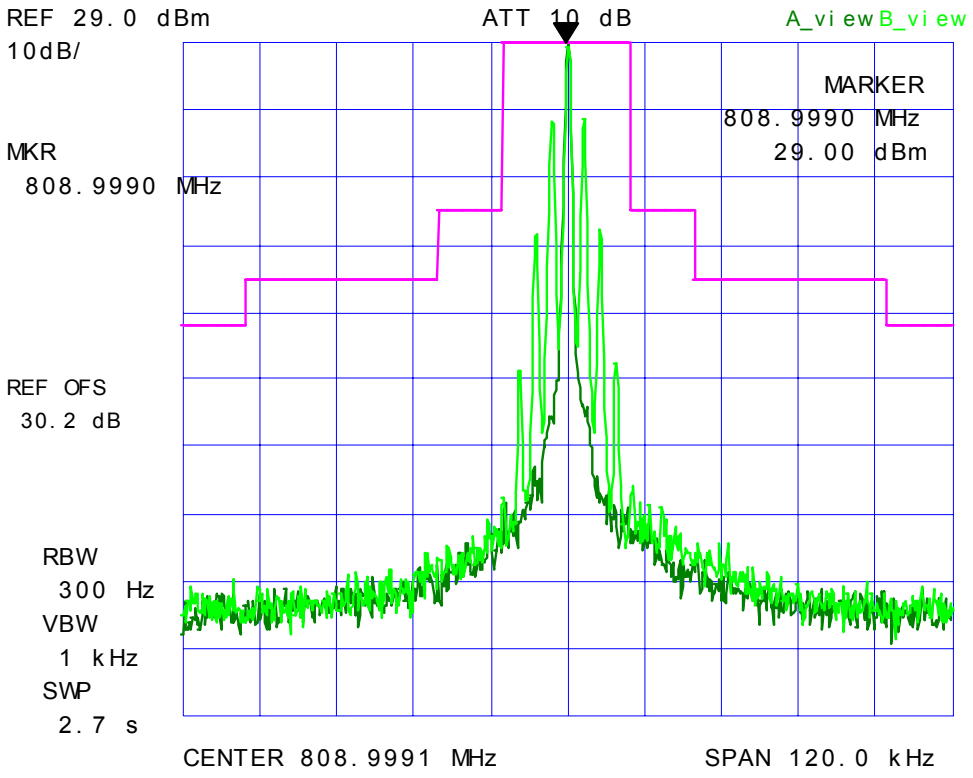
Plot 51: Emission Mask H
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing,
Modulation: Digital modulation, High Power



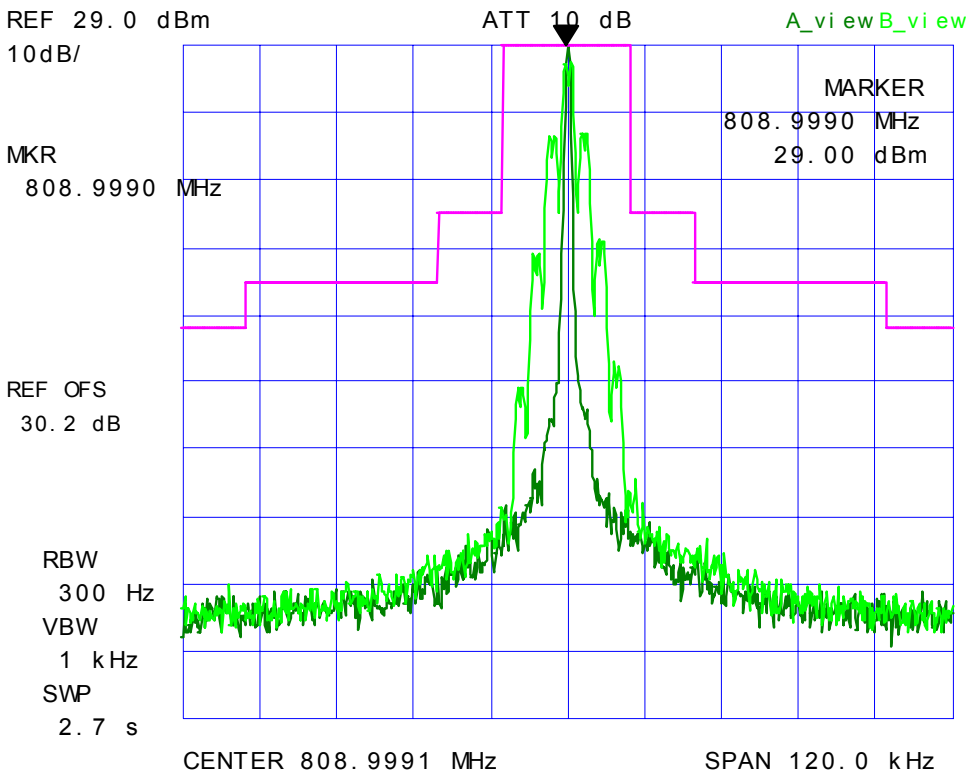
Plot 52: Emission Mask H
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing
Digital modulation, High Power, Sub-carrier D-754



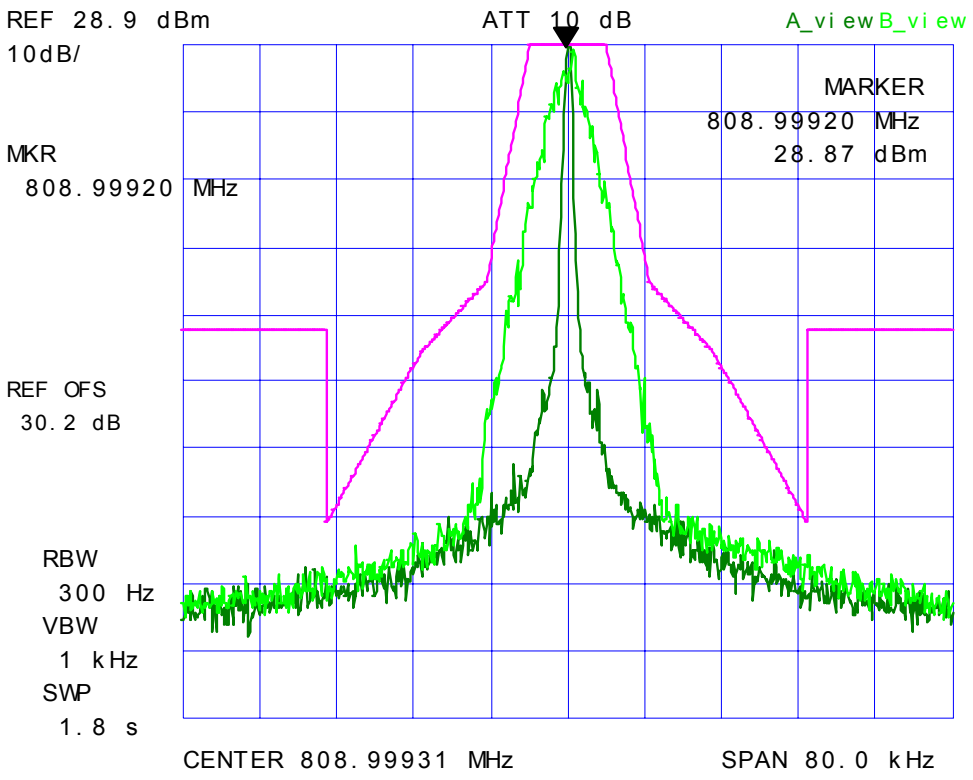
Plot 53: Emission Mask B
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



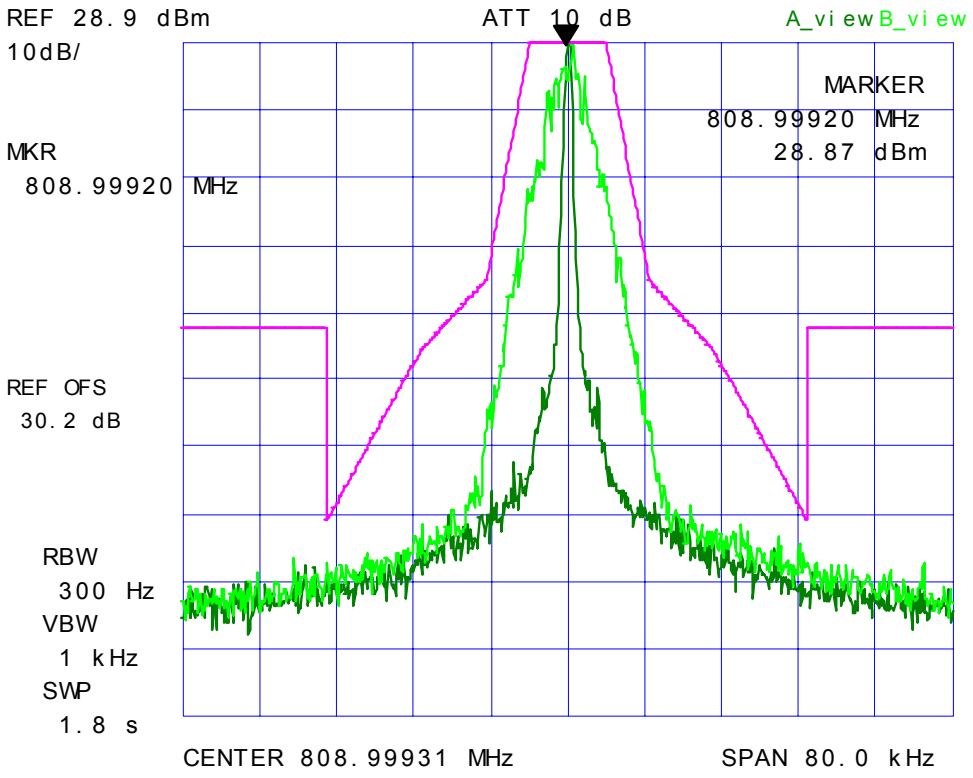
Plot 54: Emission Mask B
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



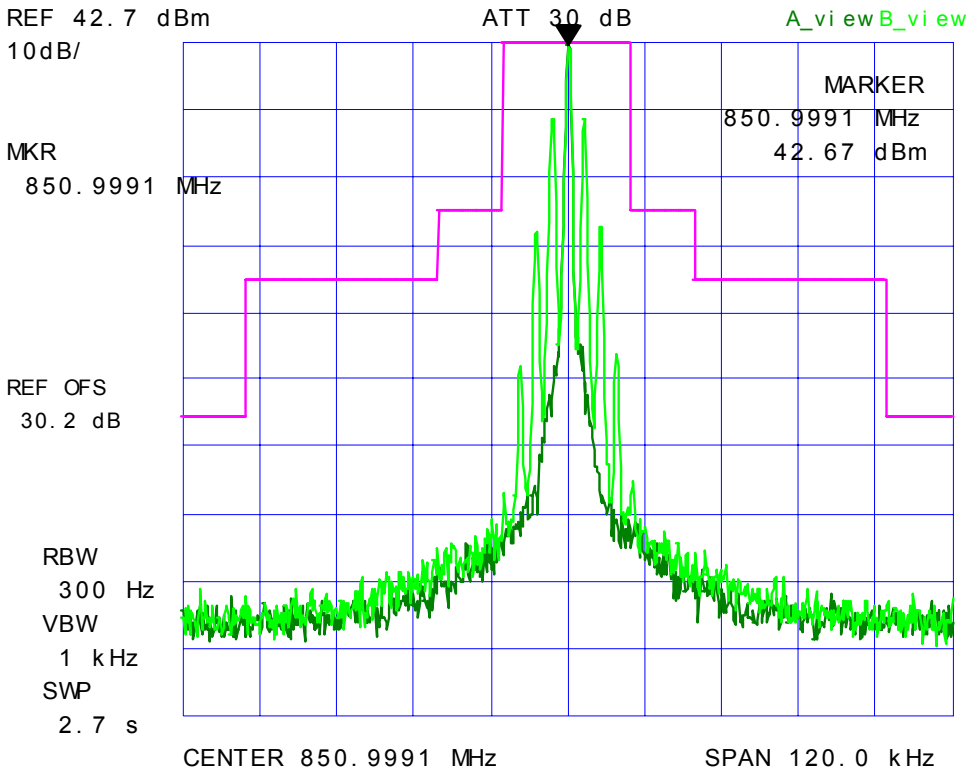
Plot 55: Emission Mask H
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, Low Power



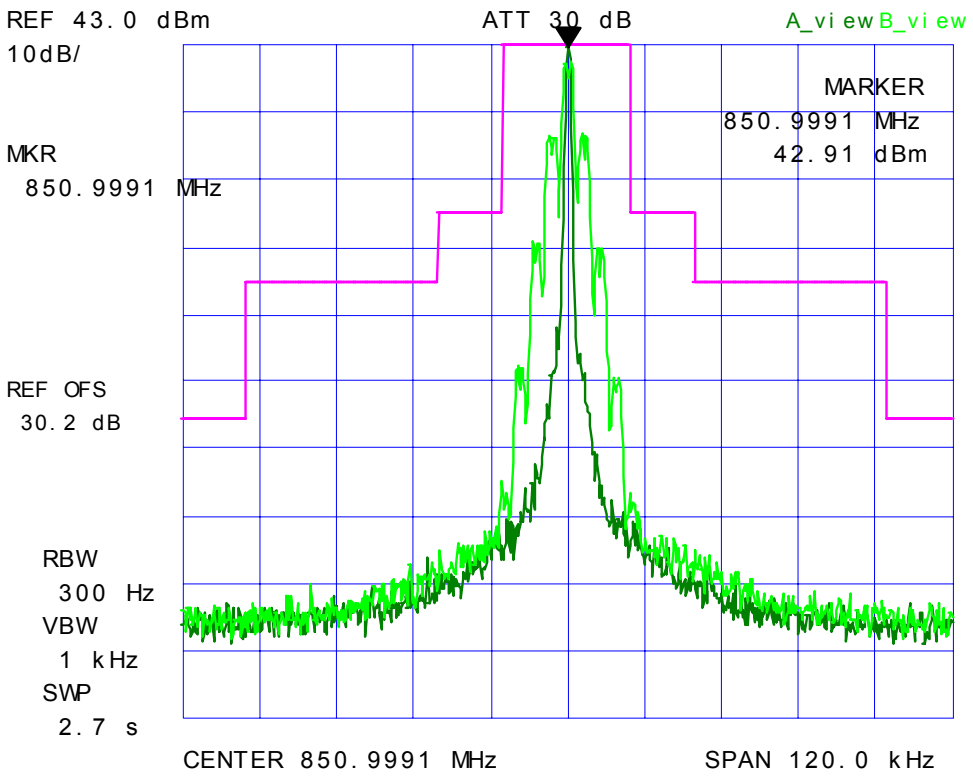
Plot 56: Emission Mask H
Test Frequency: 809 MHz, 12.5 kHz Channel Spacing
Digital modulation, Low Power, Sub-carrier D-754



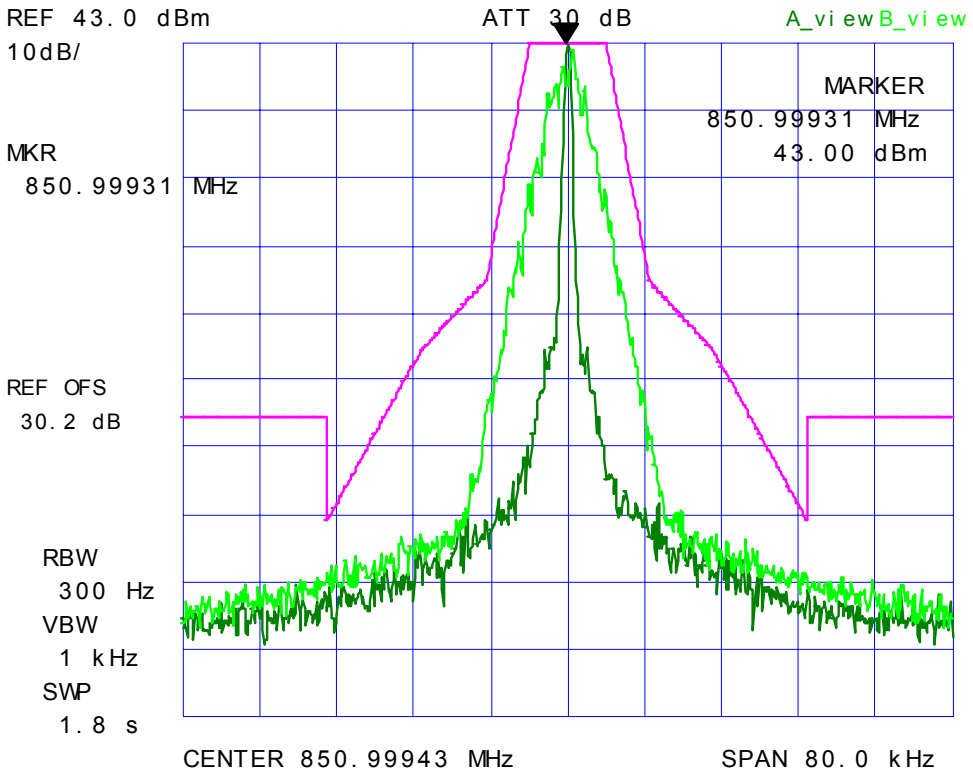
Plot 57: Emission Mask B
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



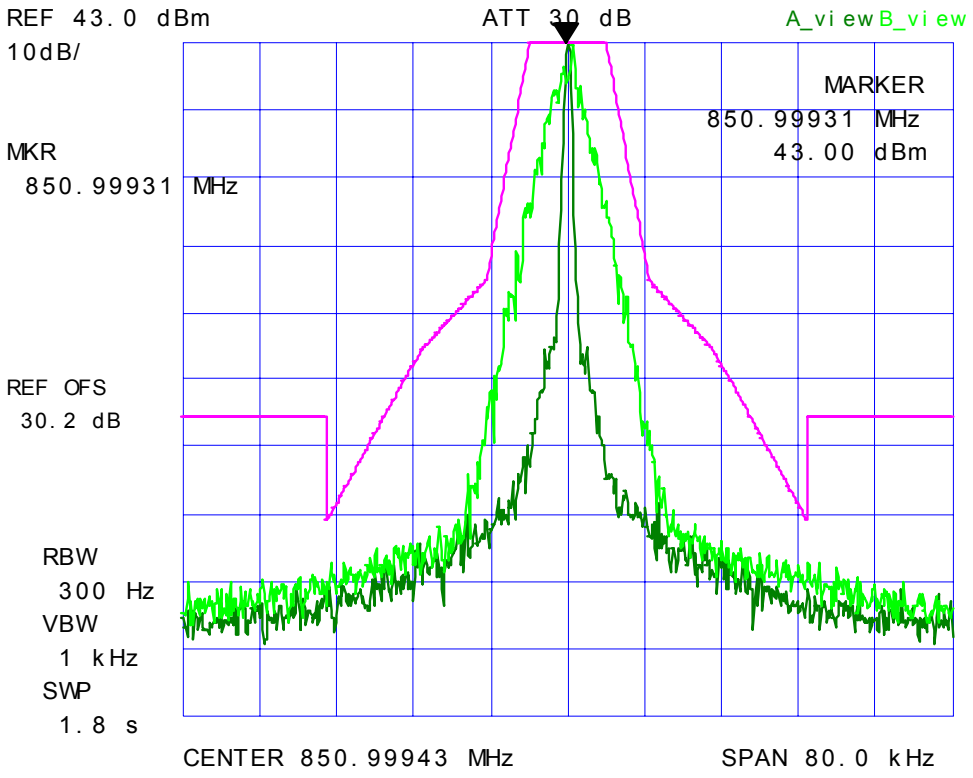
Plot 58: Emission Mask B
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



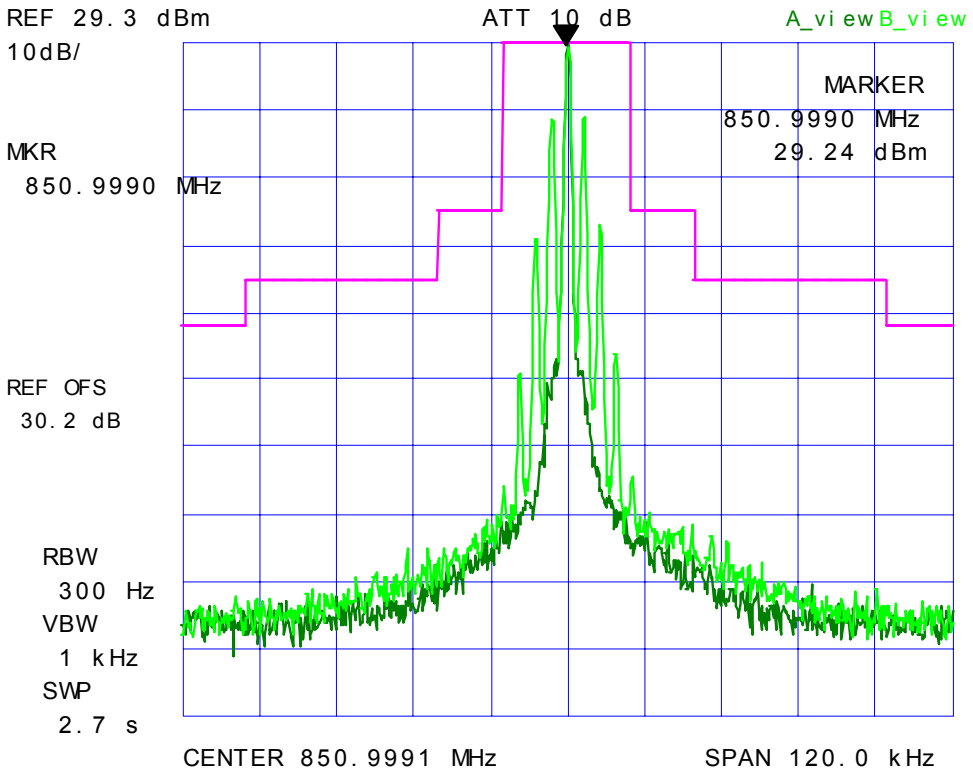
Plot 59: Emission Mask H
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power



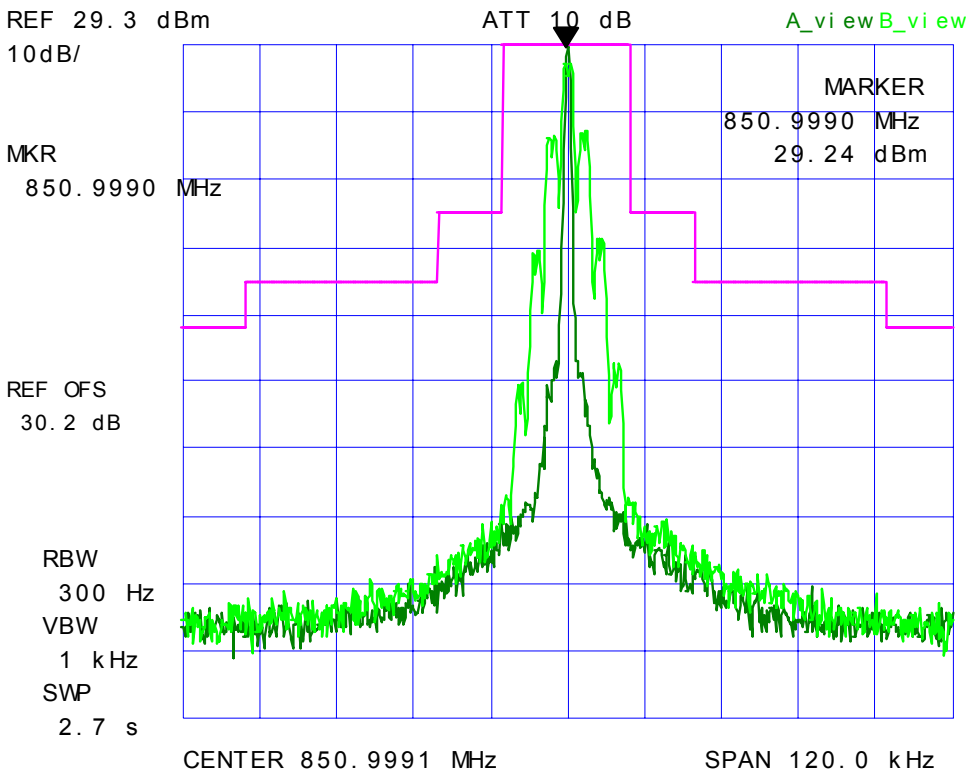
Plot 60: Emission Mask H
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing
Digital modulation, High Power, Sub-carrier D-754



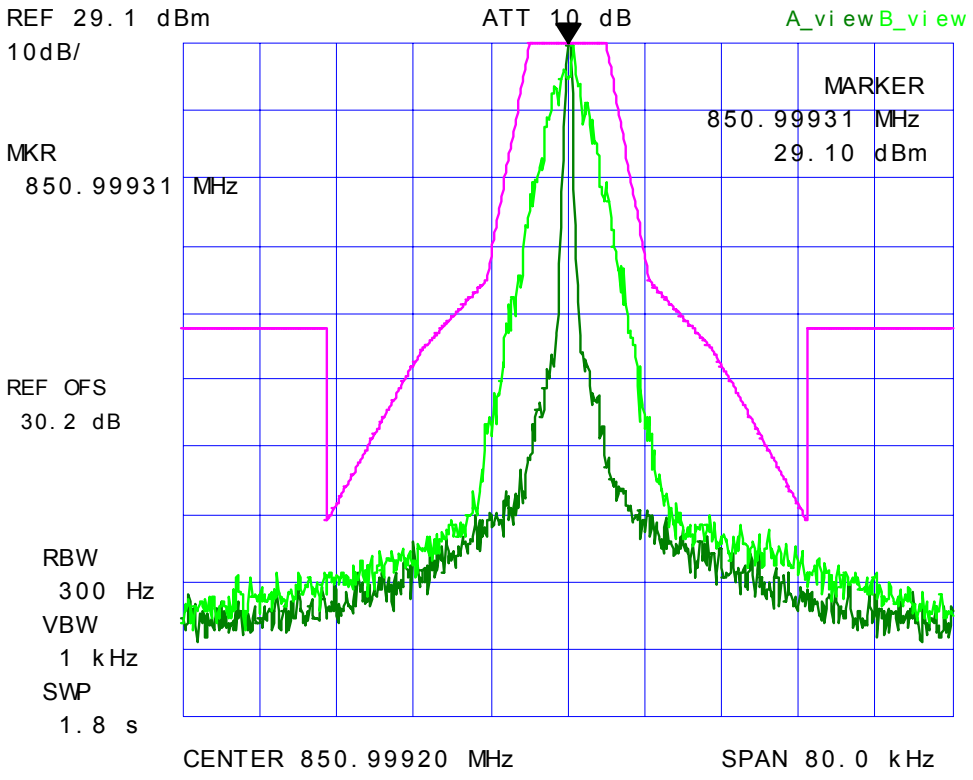
Plot 61: Emission Mask B
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



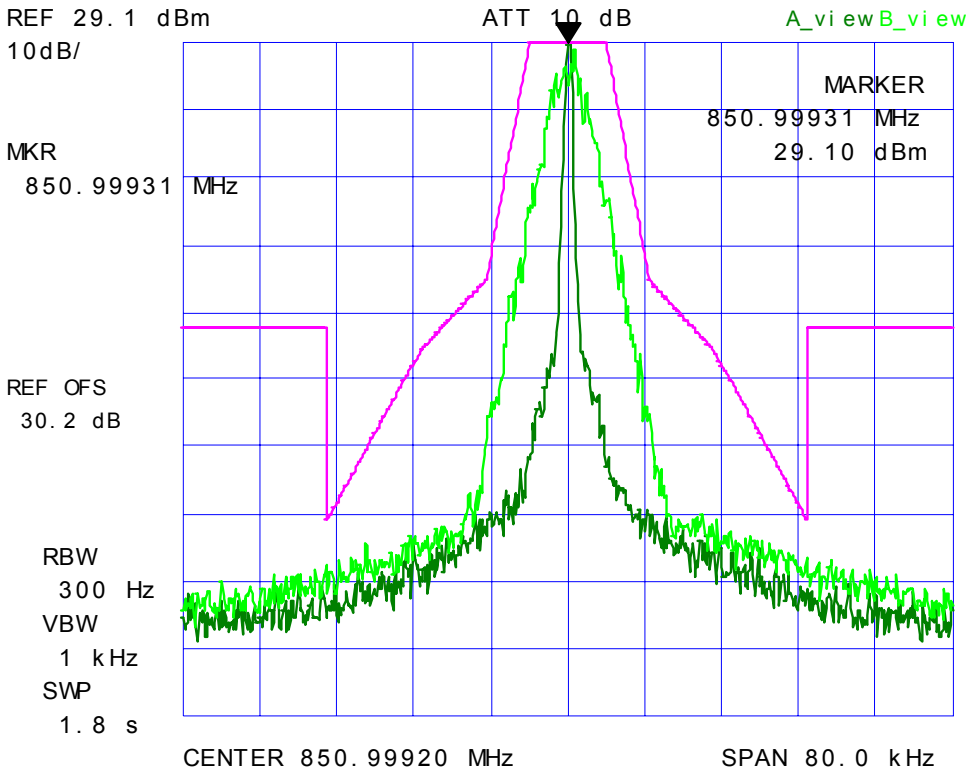
Plot 62: Emission Mask B
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



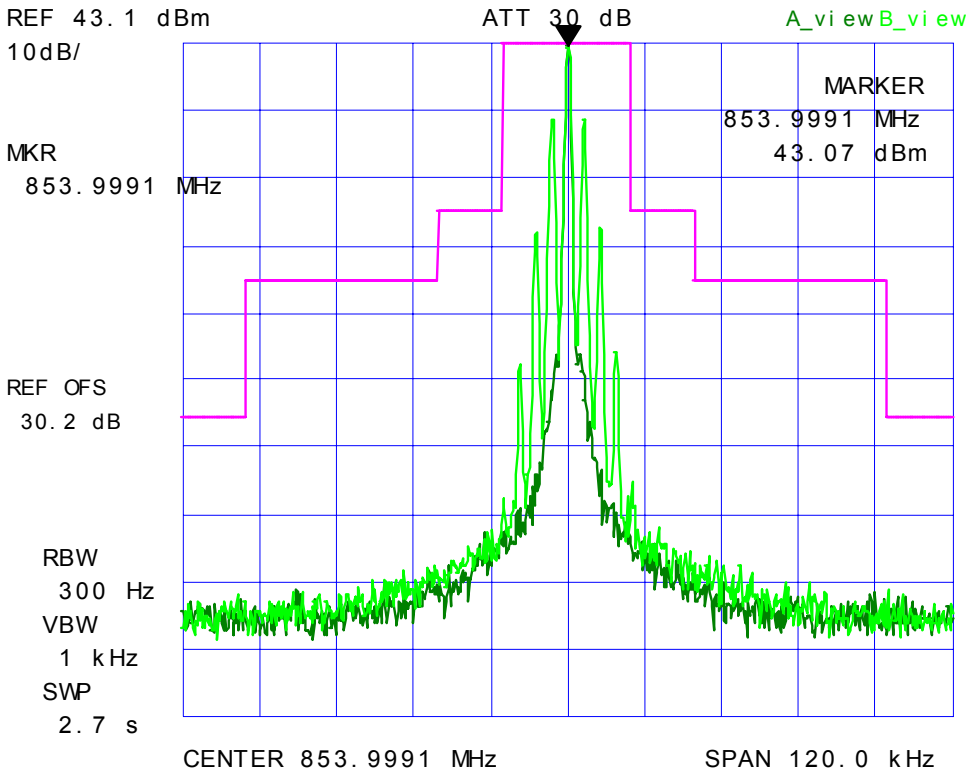
Plot 63: Emission Mask H
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, Low Power



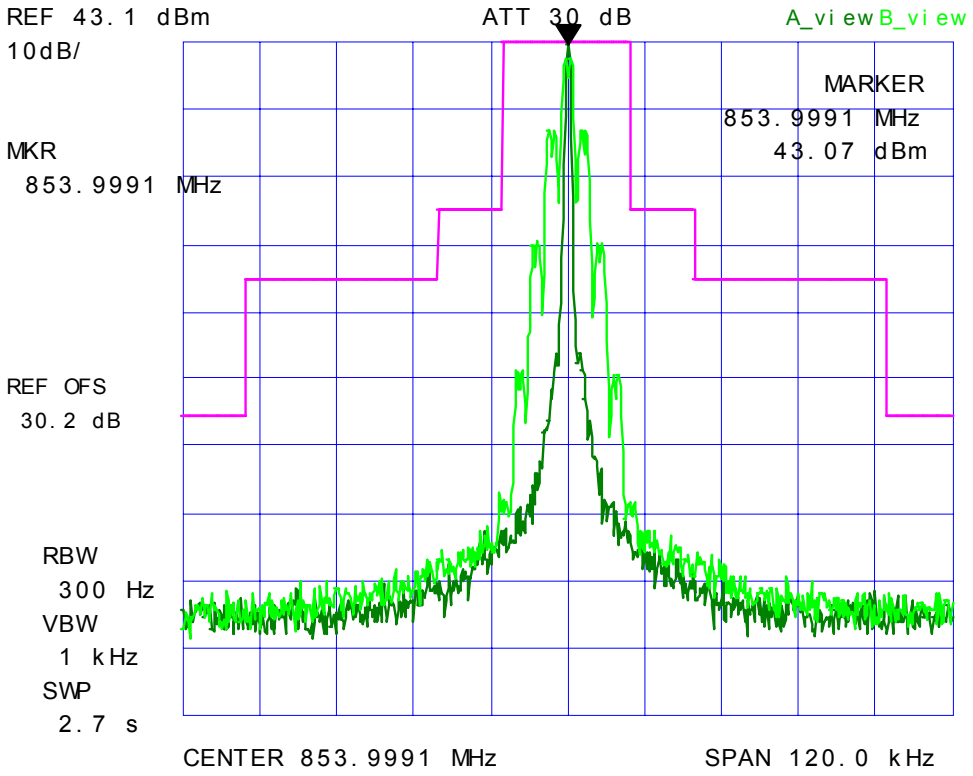
Plot 64: Emission Mask H
Test Frequency: 851 MHz, 12.5 kHz Channel Spacing
Digital modulation, Low Power, Sub-carrier D-754



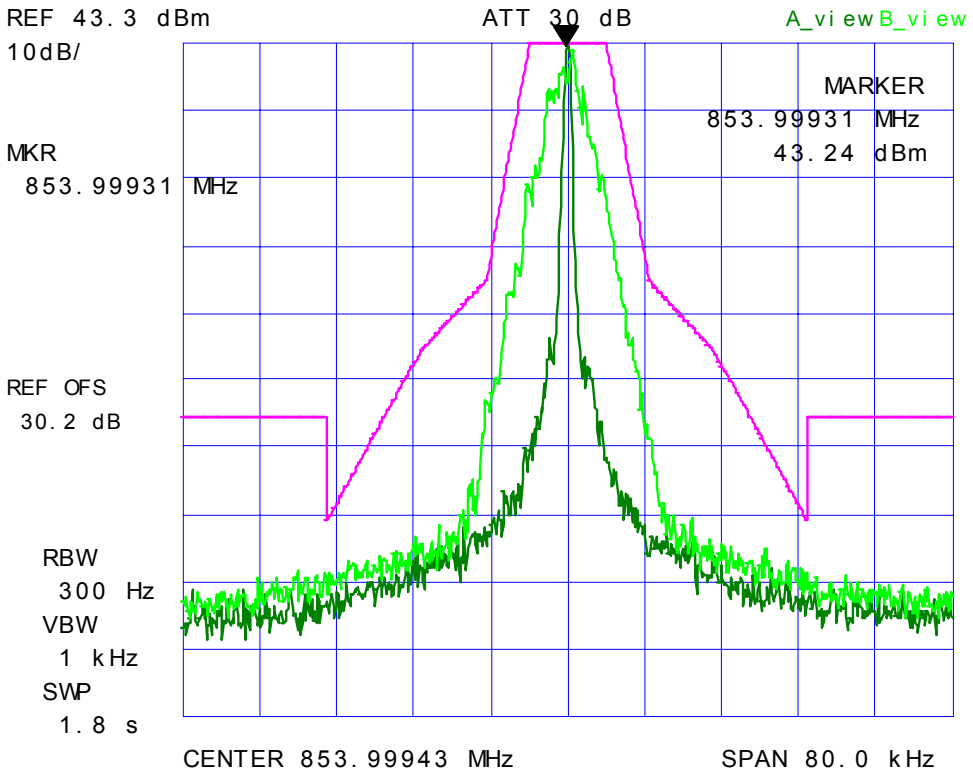
Plot 65: Emission Mask B
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



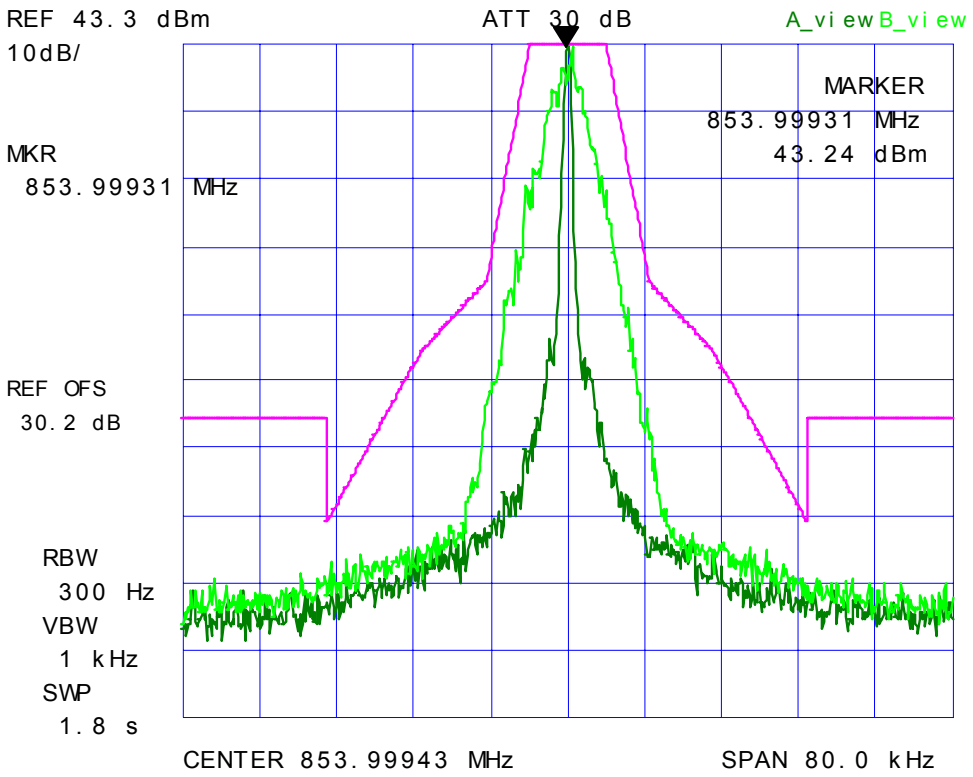
Plot 66: Emission Mask B
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



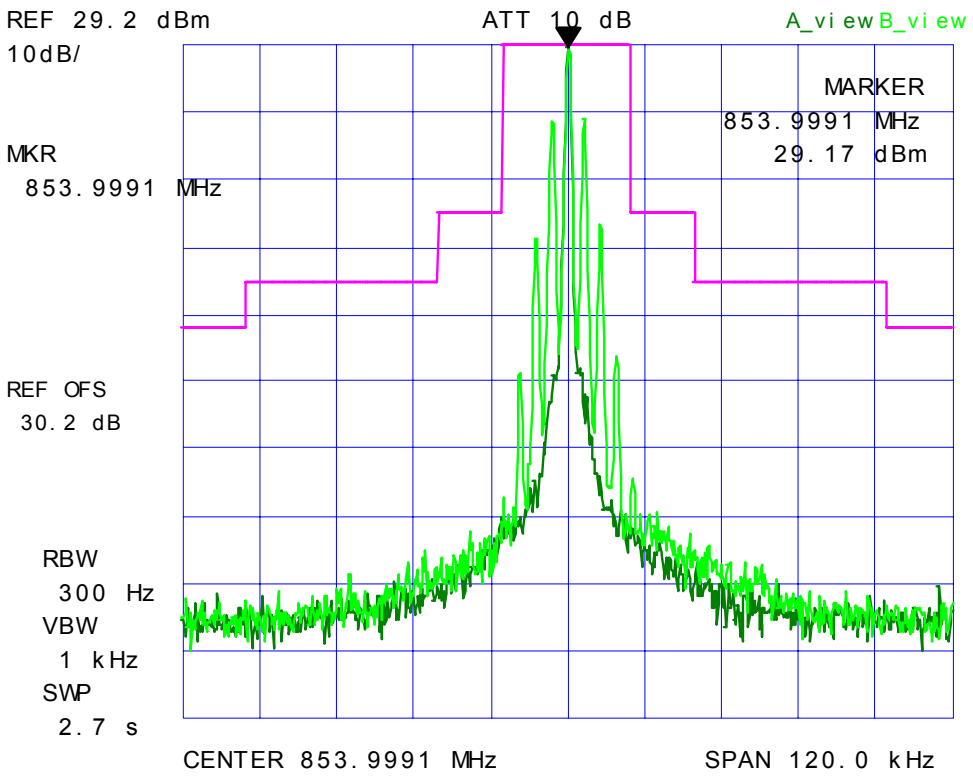
Plot 67: Emission Mask H
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, High Power



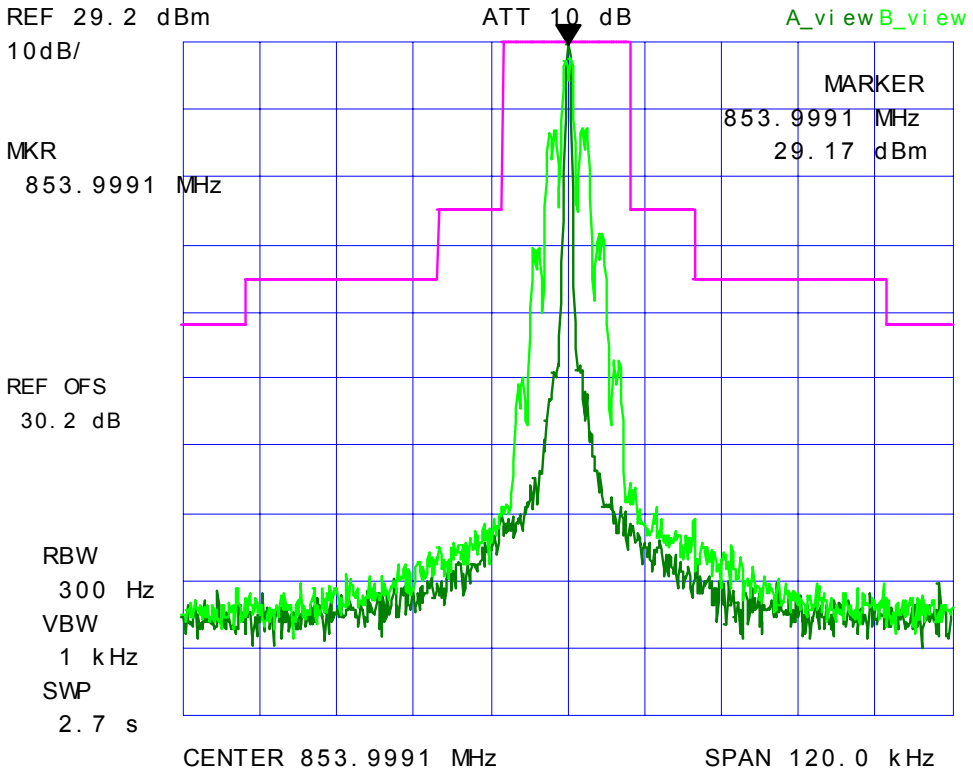
Plot 68: Emission Mask H
Test Frequency: 806 MHz, 12.5 kHz Channel Spacing
Digital modulation, High Power, Sub-carrier D-754



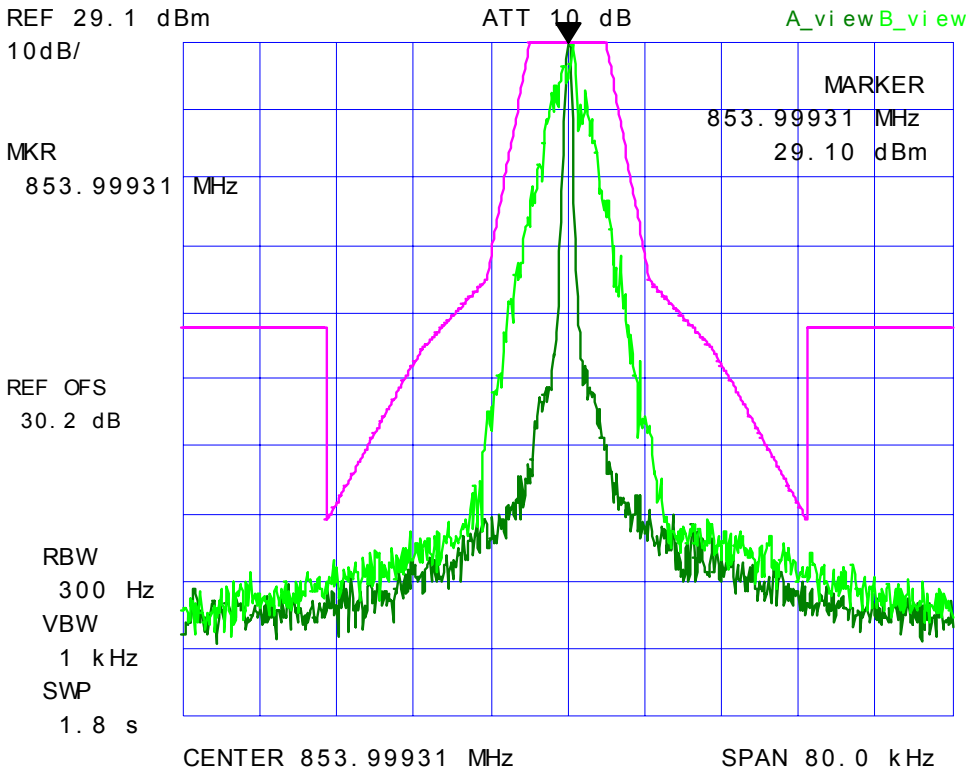
Plot 69: Emission Mask B
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



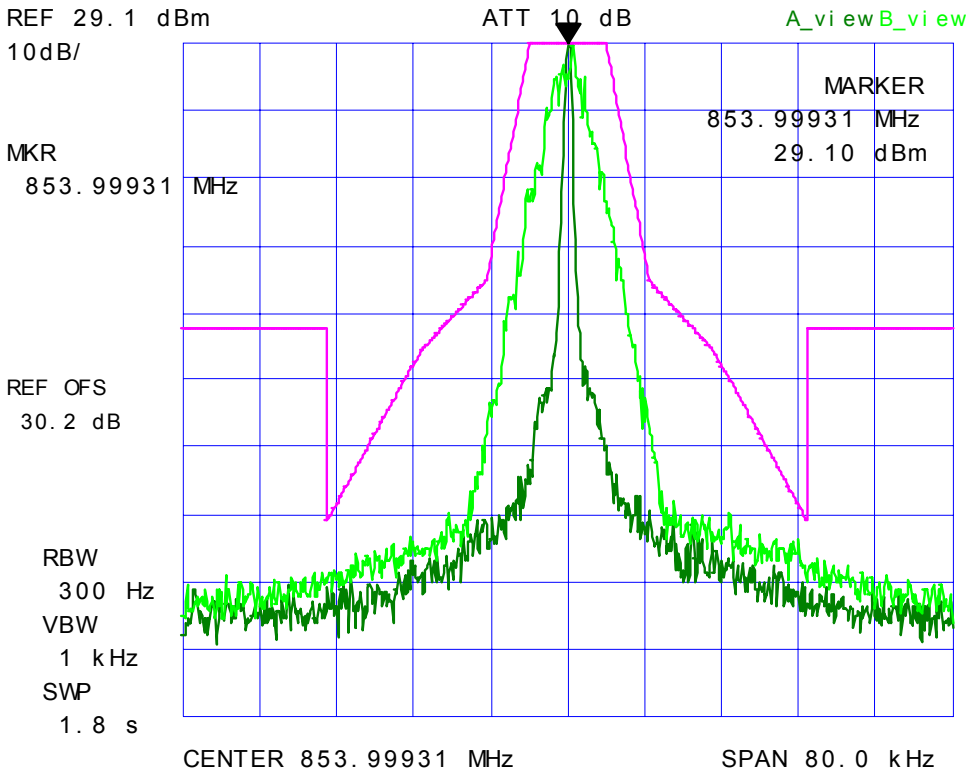
Plot 70: Emission Mask B
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



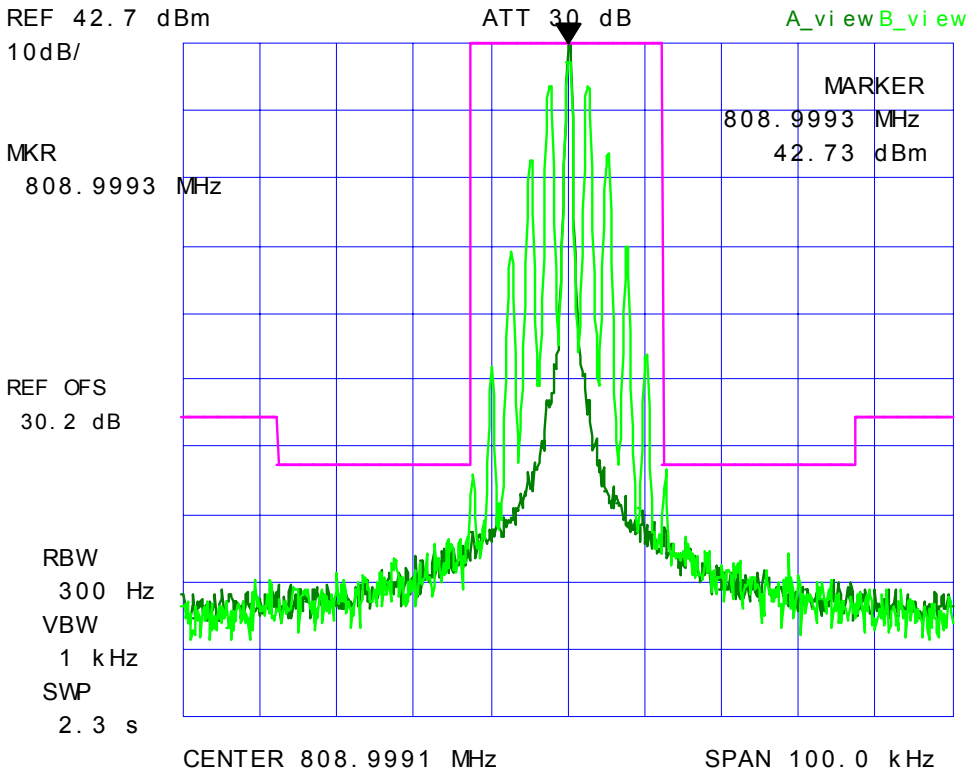
Plot 71: Emission Mask H
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing
Modulation: Digital modulation, Low Power



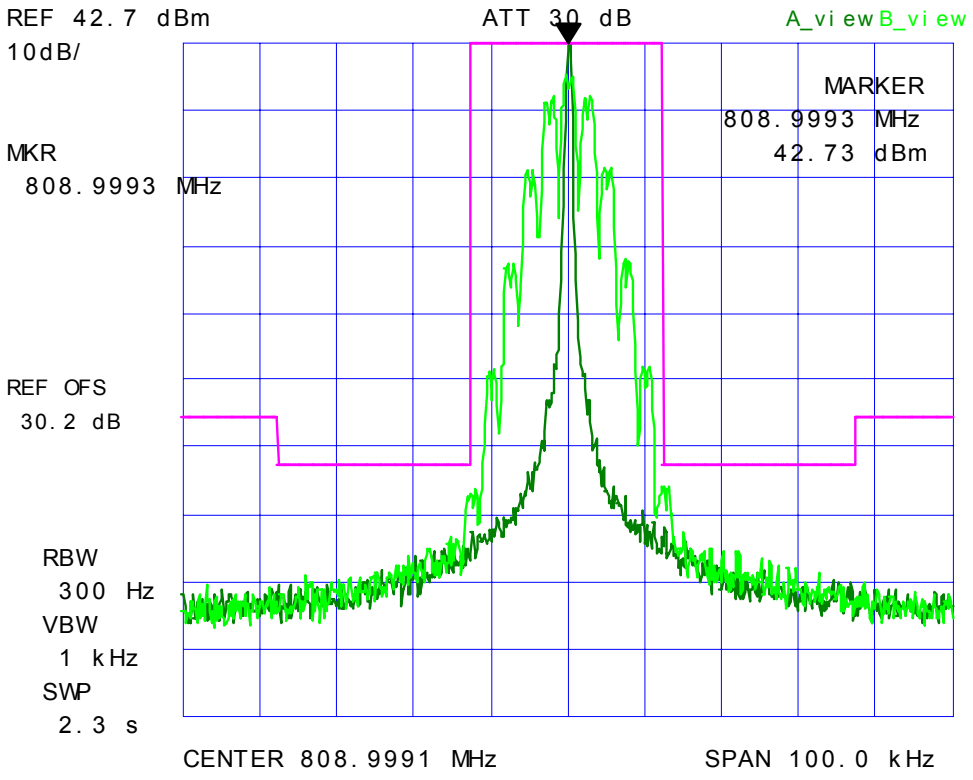
Plot 72: Emission Mask H
Test Frequency: 854 MHz, 12.5 kHz Channel Spacing
Digital modulation, Low Power, Sub-carrier D-754



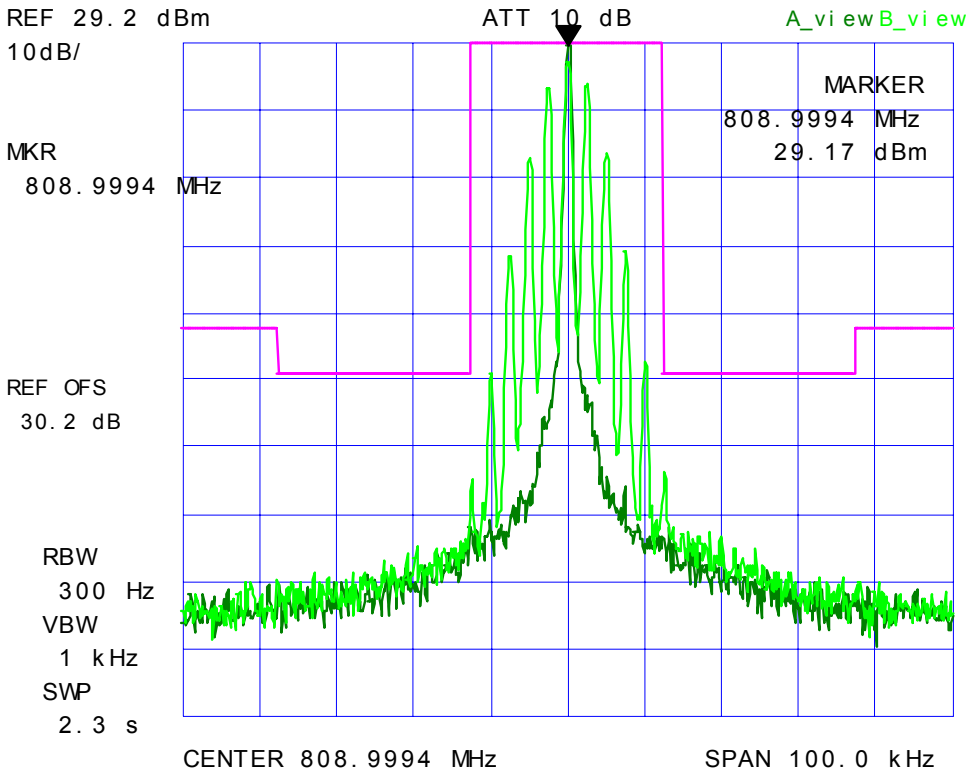
Plot 73: Emission Mask § 90.691
Test Frequency: 809 MHz, 25 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



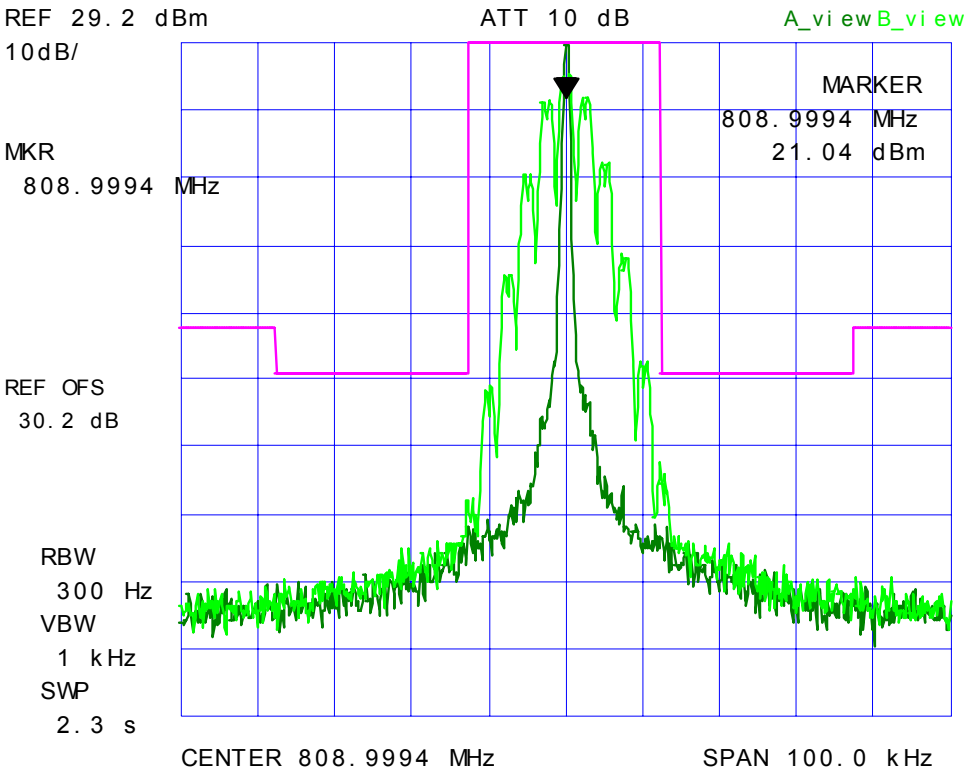
Plot 74: Emission Mask § 90.691
Test Frequency: 809 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



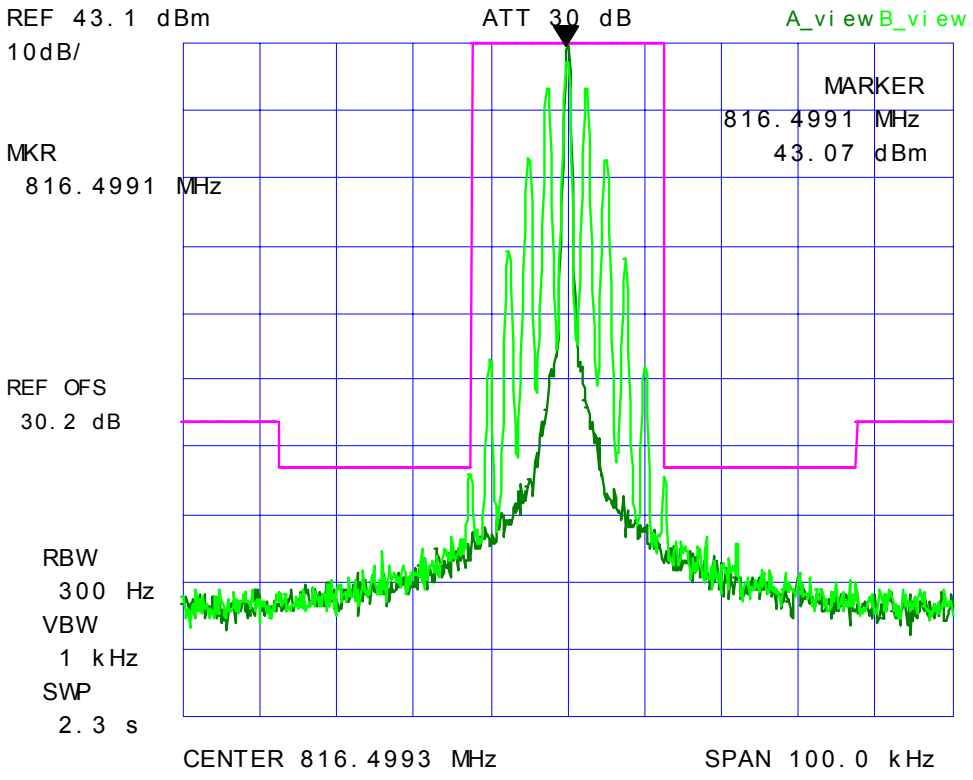
Plot 75: Emission Mask § 90.691
Test Frequency: 809 MHz, 25 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



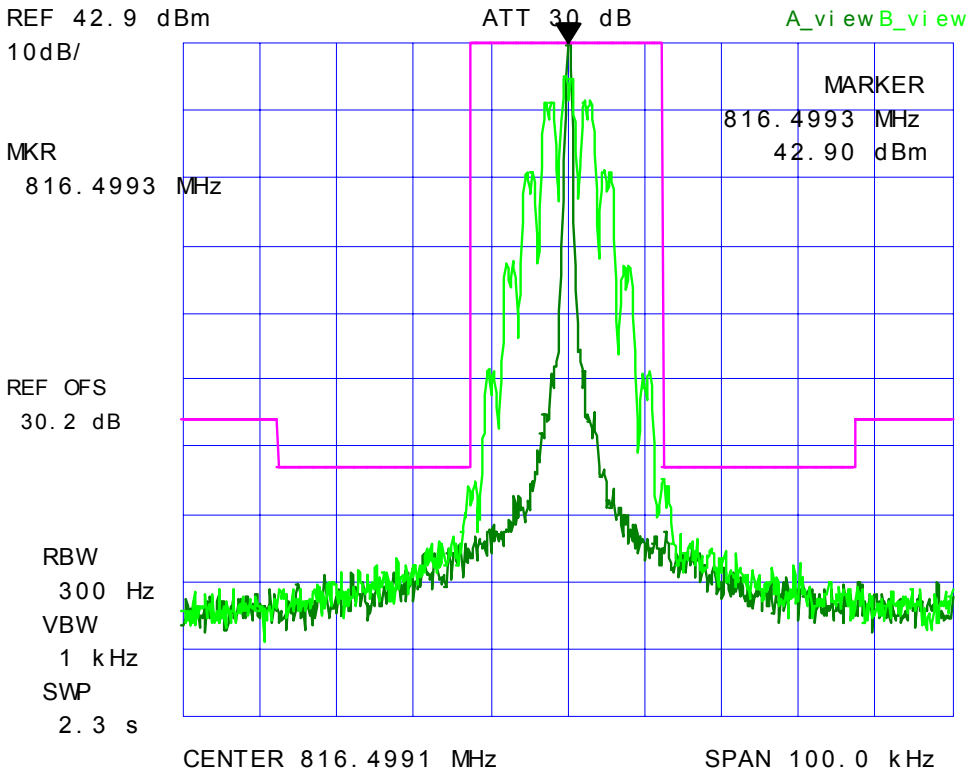
Plot 76: Emission Mask § 90.691
Test Frequency: 809 MHz, 25 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



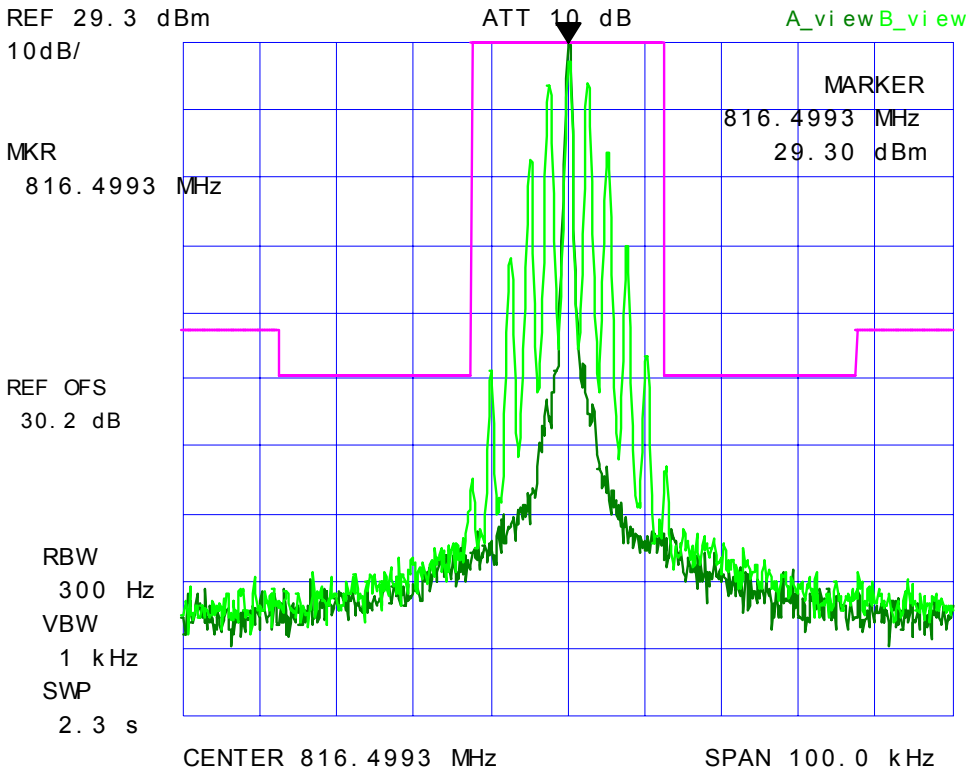
Plot 77: Emission Mask § 90.691
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



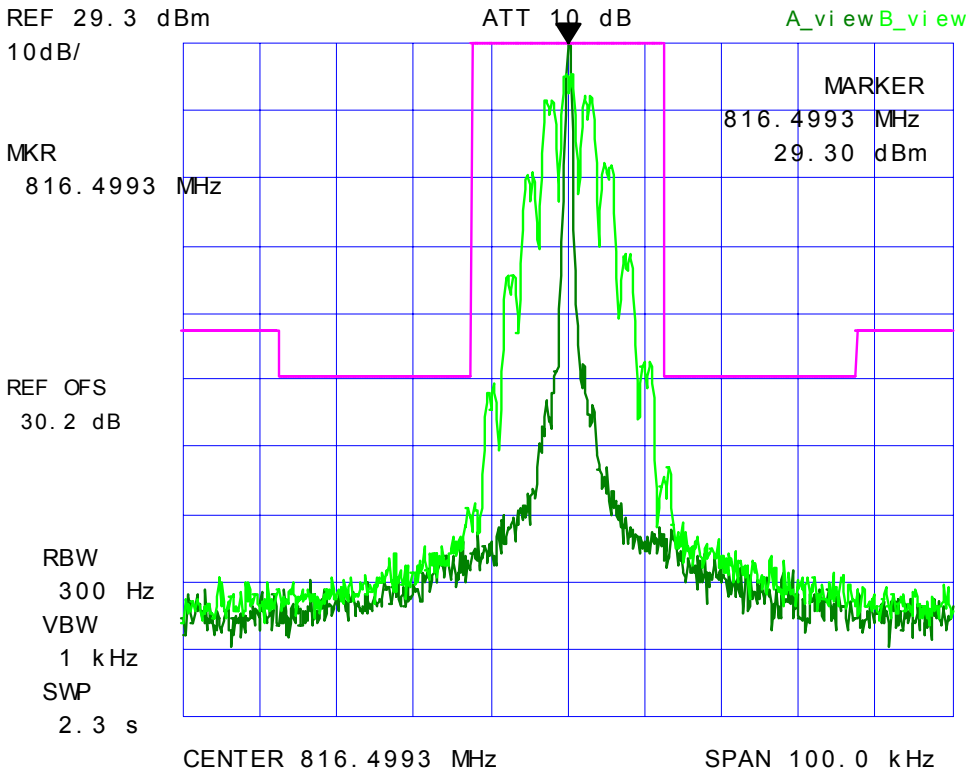
Plot 78: Emission Mask § 90.691
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



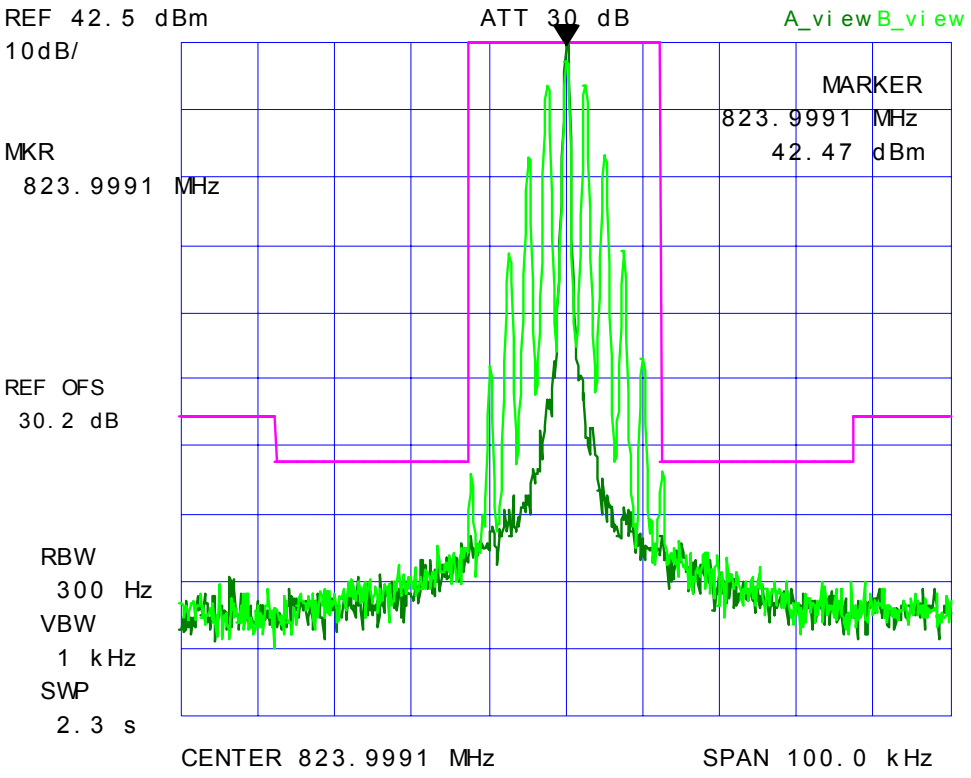
Plot 79: Emission Mask § 90.691
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



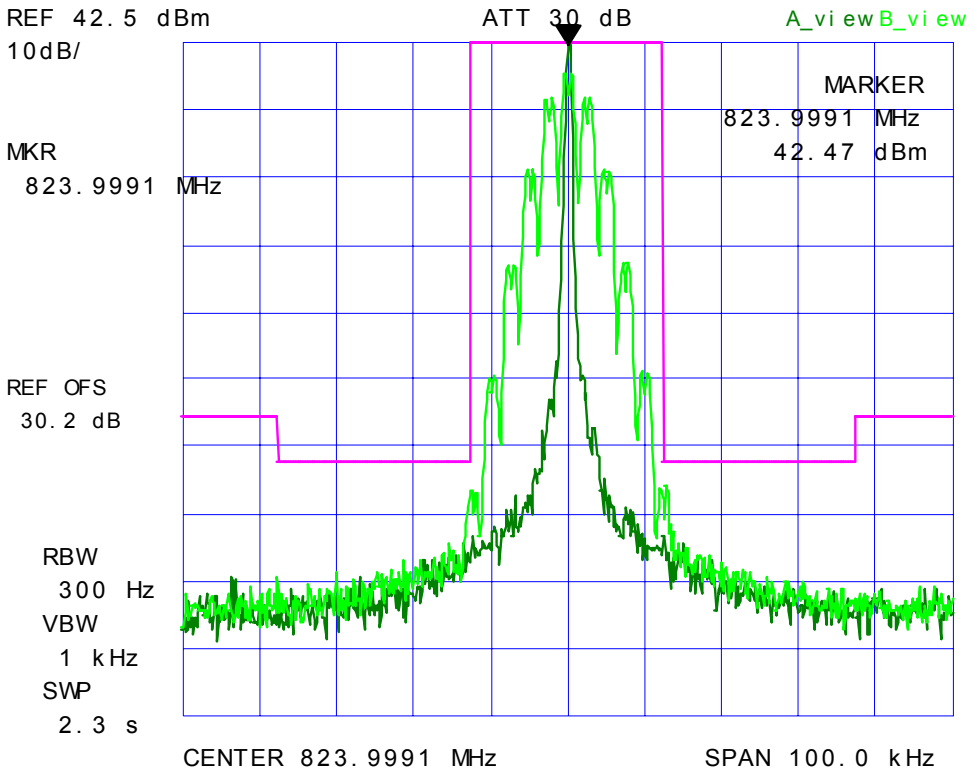
Plot 80: Emission Mask § 90.691
Test Frequency: 816.5 MHz, 25 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



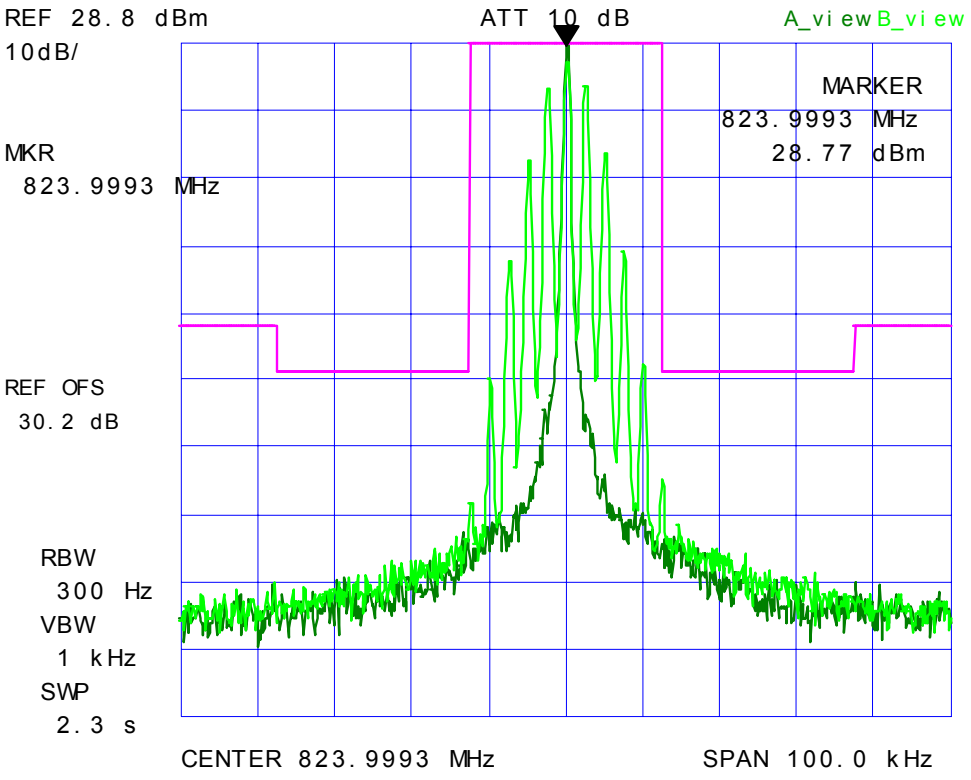
Plot 81: Emission Mask § 90.691
Test Frequency: 824 MHz, 25 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



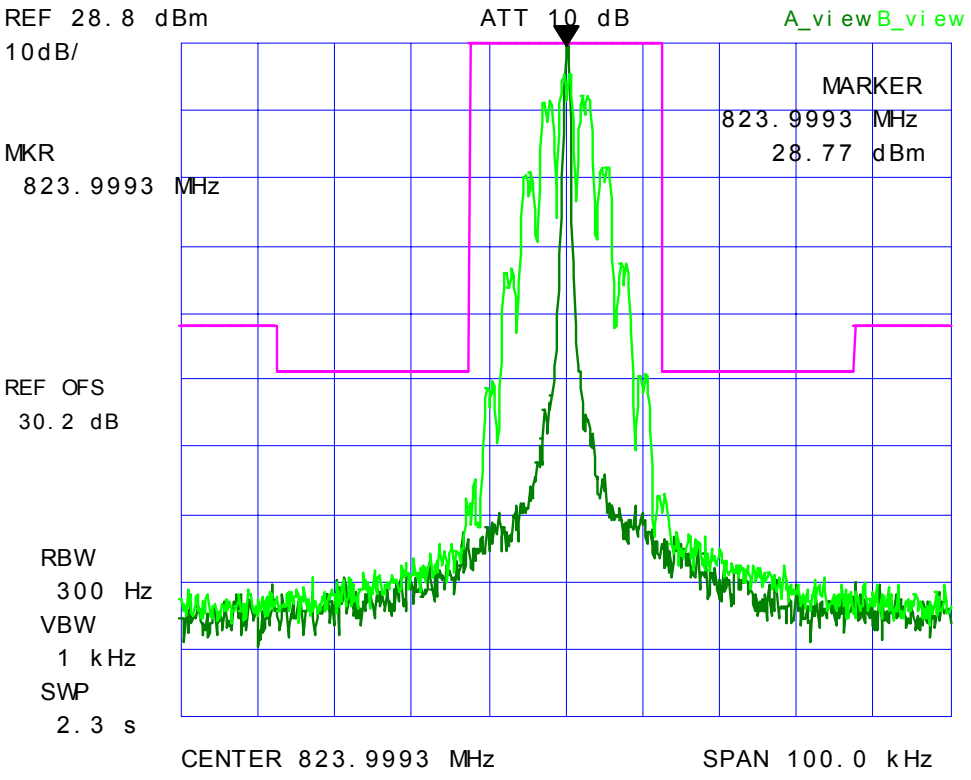
Plot 82: Emission Mask § 90.691
Test Frequency: 824 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



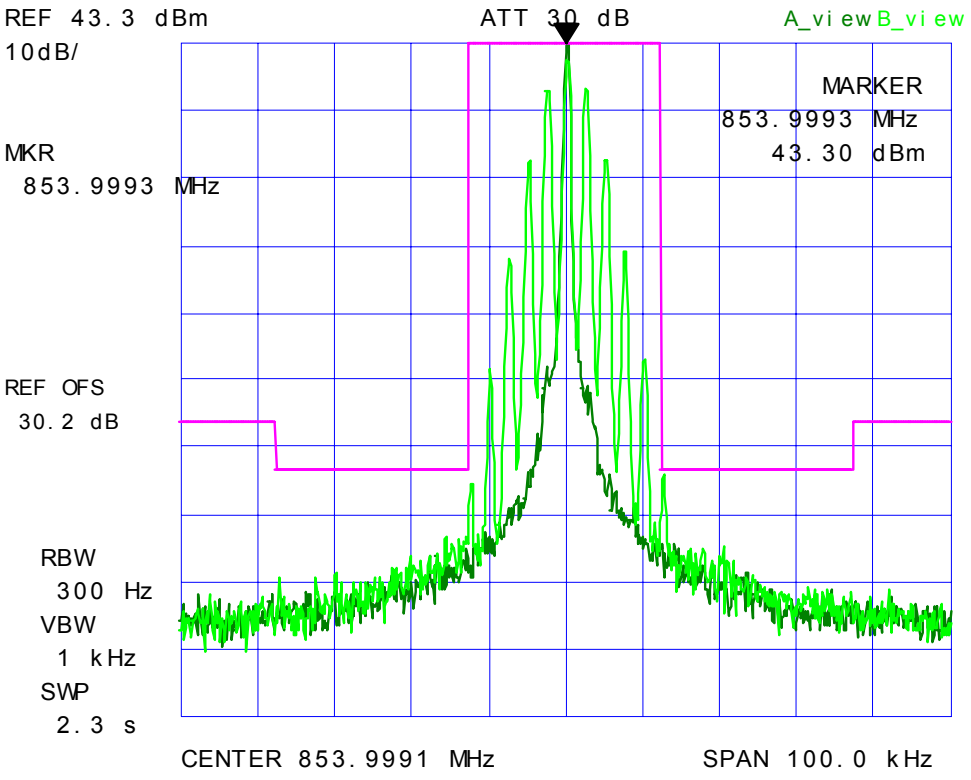
Plot 83: Emission Mask § 90.691
Test Frequency: 824 MHz, 25 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



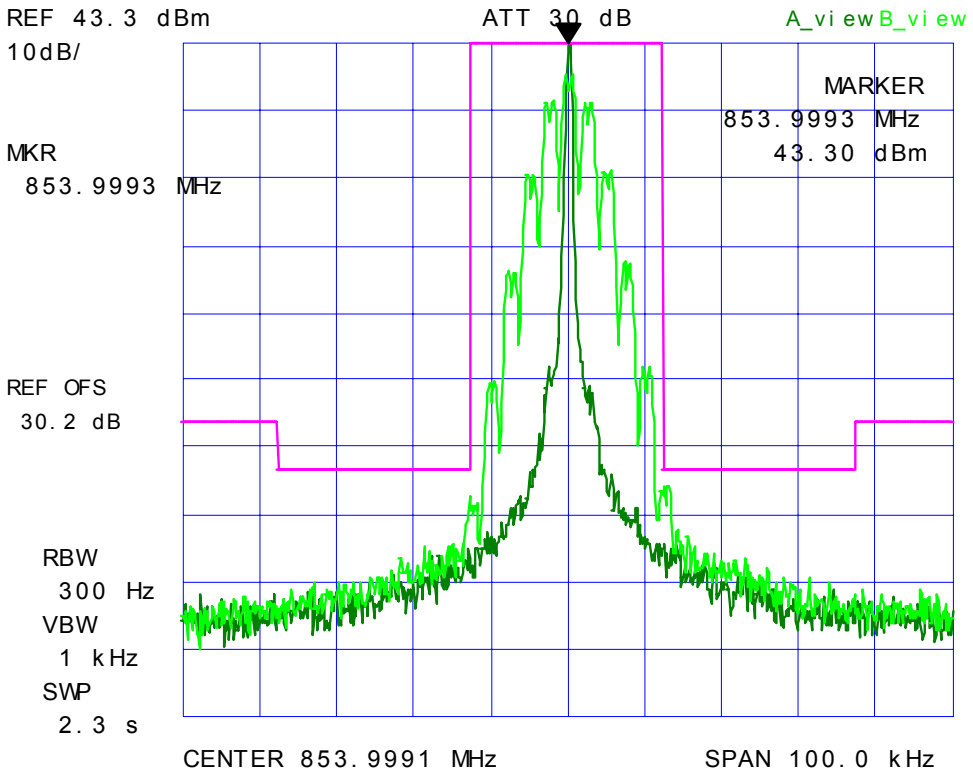
Plot 84: Emission Mask § 90.691
Test Frequency: 824 MHz, 25 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



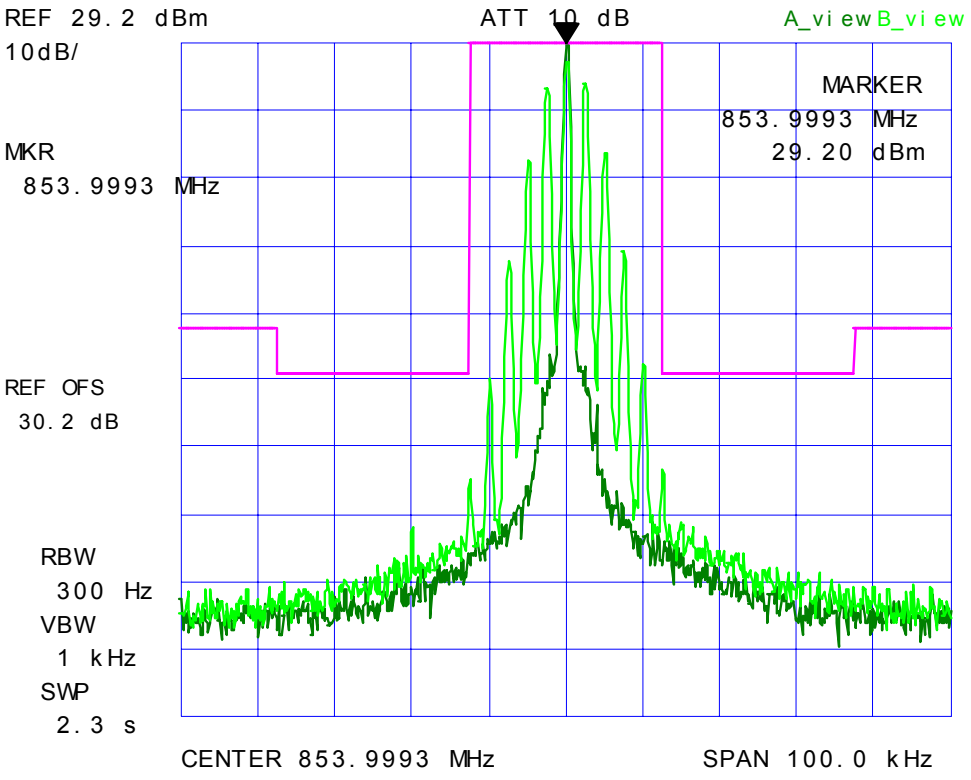
Plot 85: Emission Mask § 90.691
Test Frequency: 854 MHz, 25 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



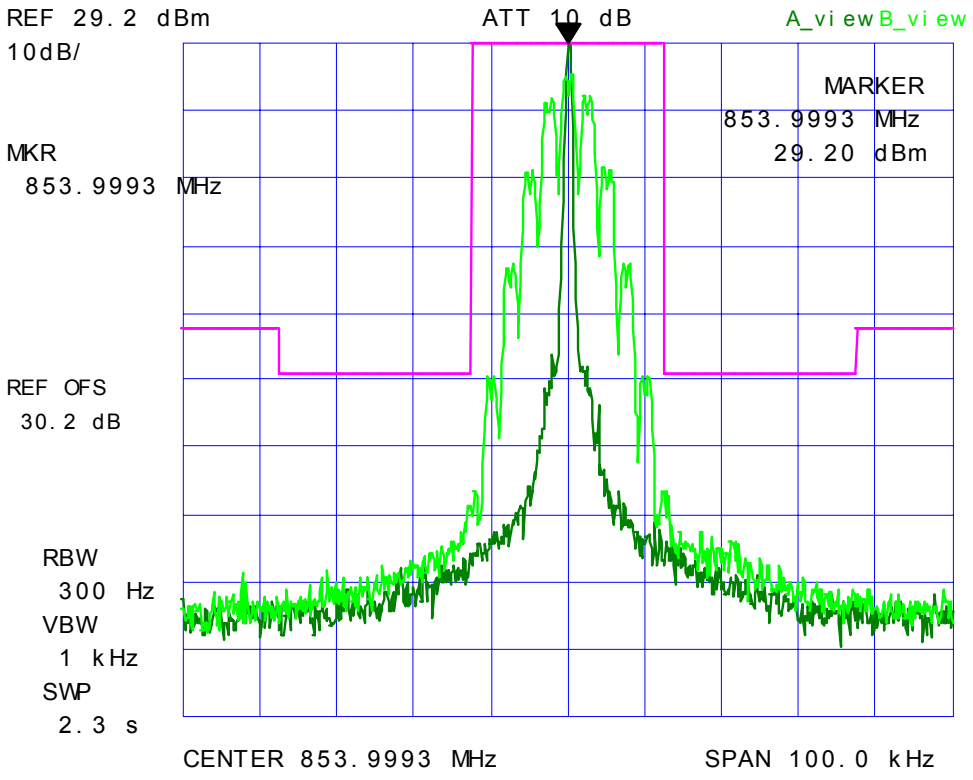
Plot 86: Emission Mask § 90.691
Test Frequency: 854 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



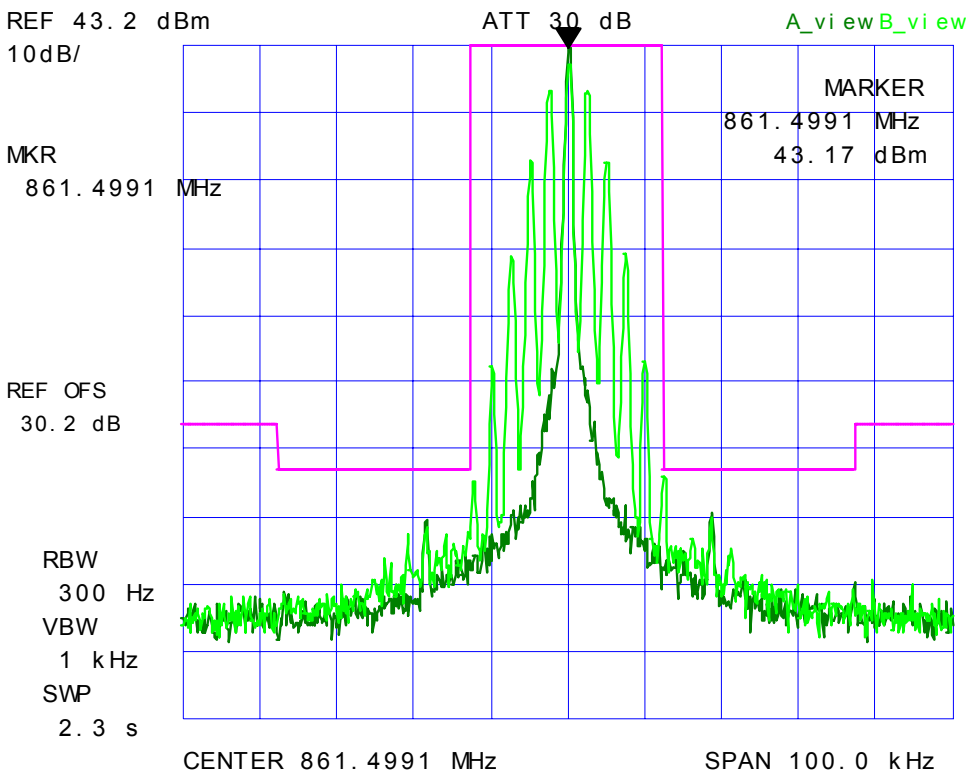
Plot 87: Emission Mask § 90.691
Test Frequency: 854 MHz, 25 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



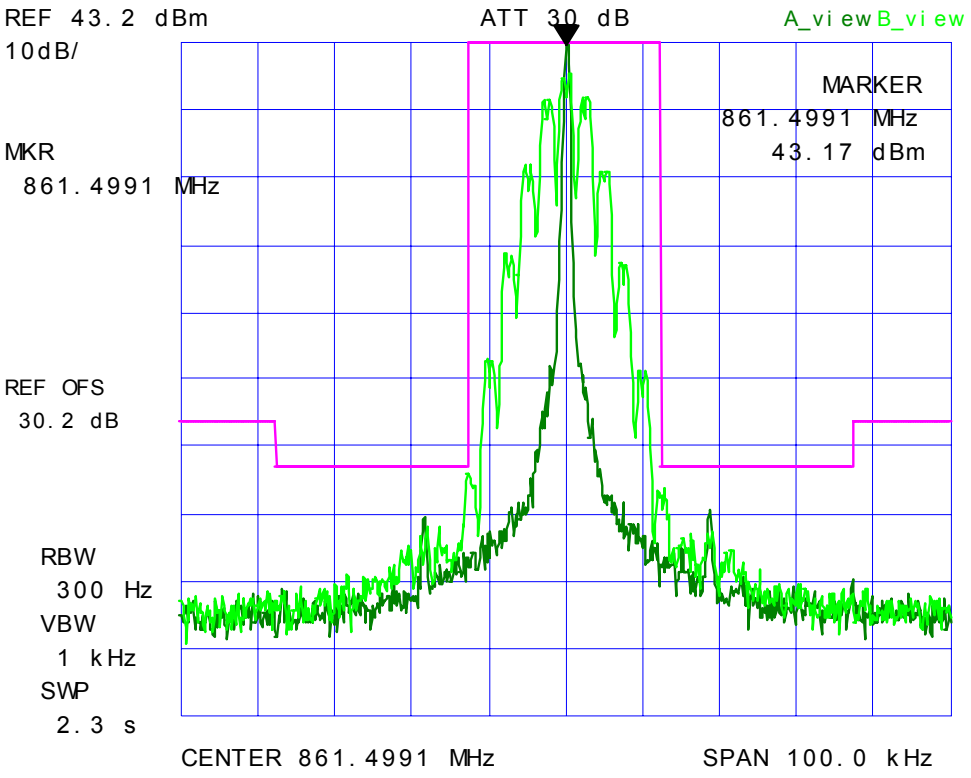
Plot 88: Emission Mask § 90.691
Test Frequency: 854 MHz, 25 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



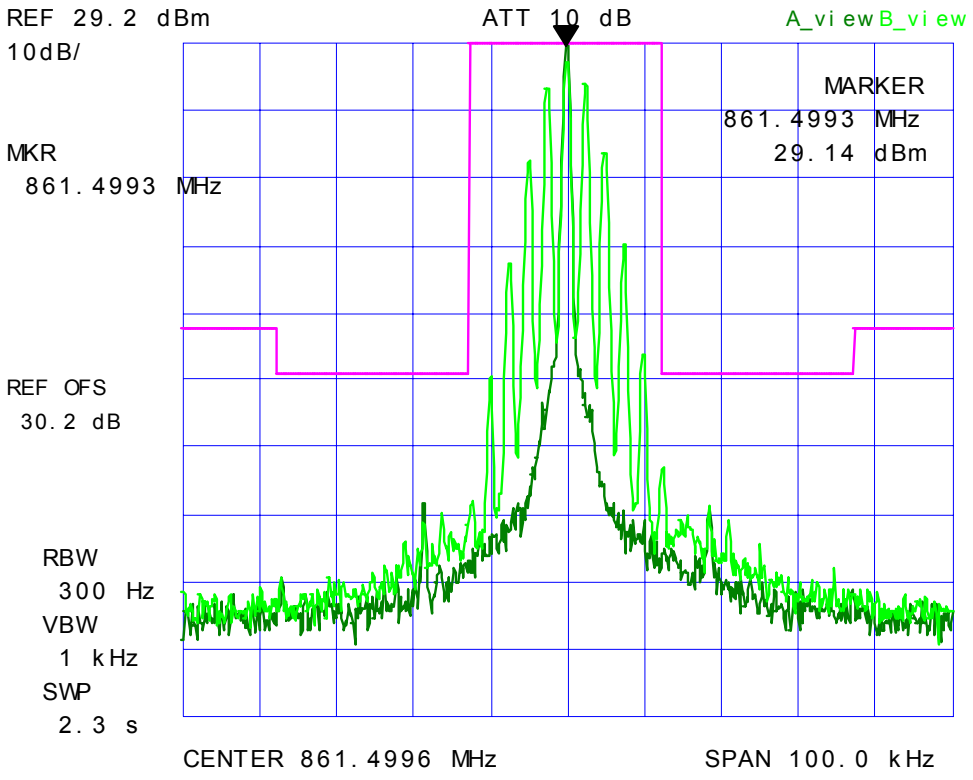
Plot 89: Emission Mask § 90.691
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



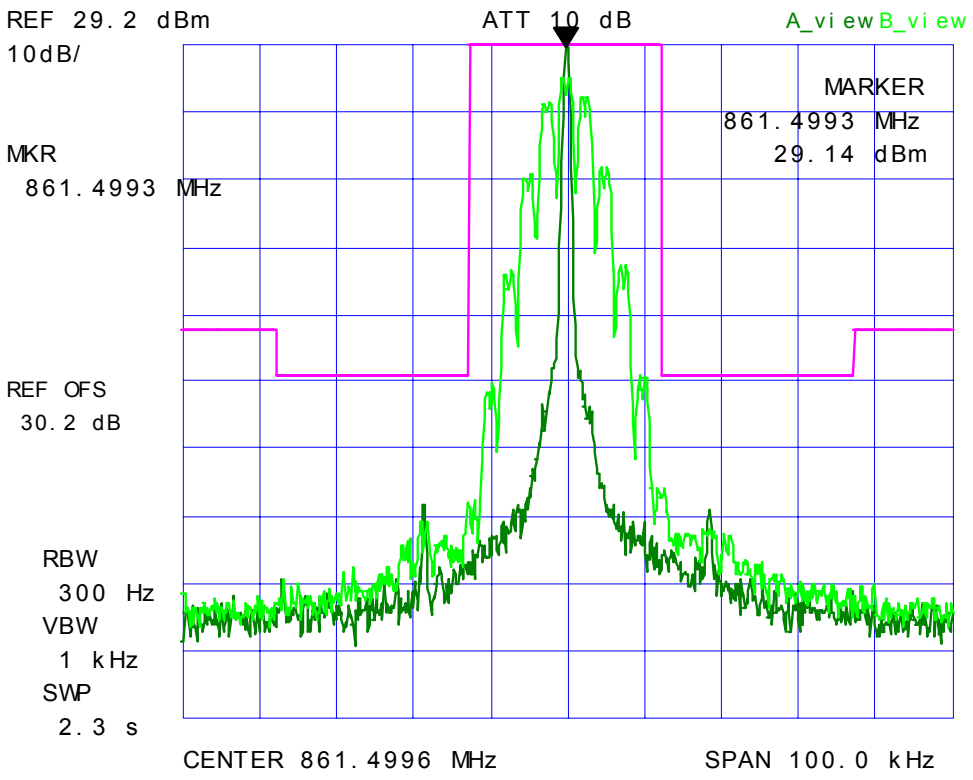
Plot 90: Emission Mask § 90.691
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



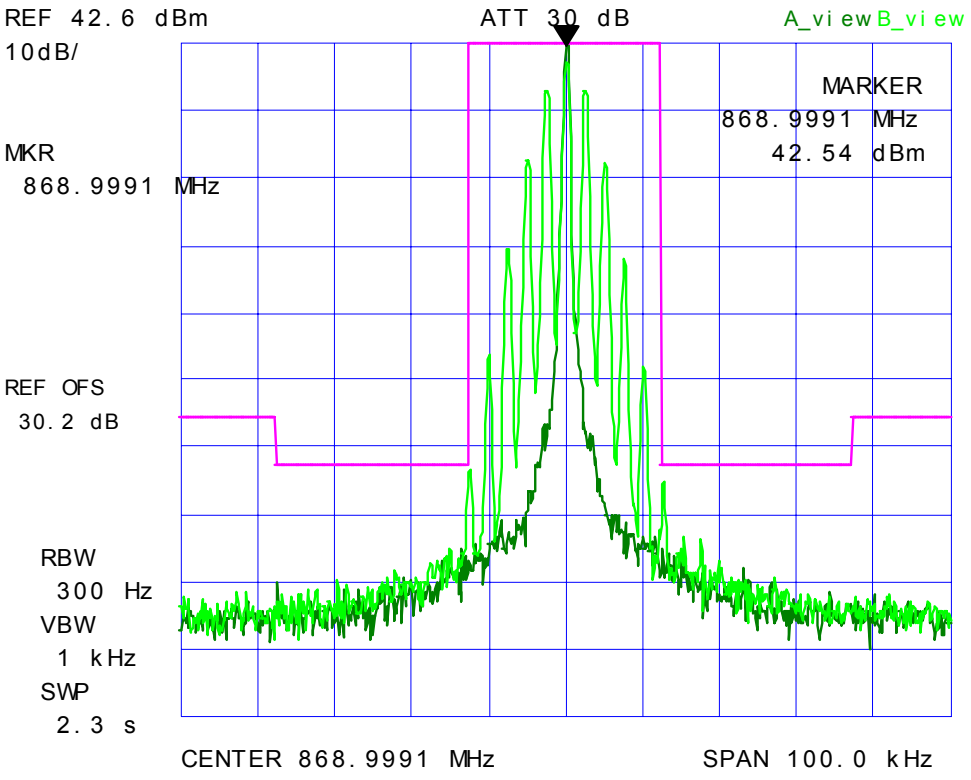
Plot 91: Emission Mask § 90.691
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



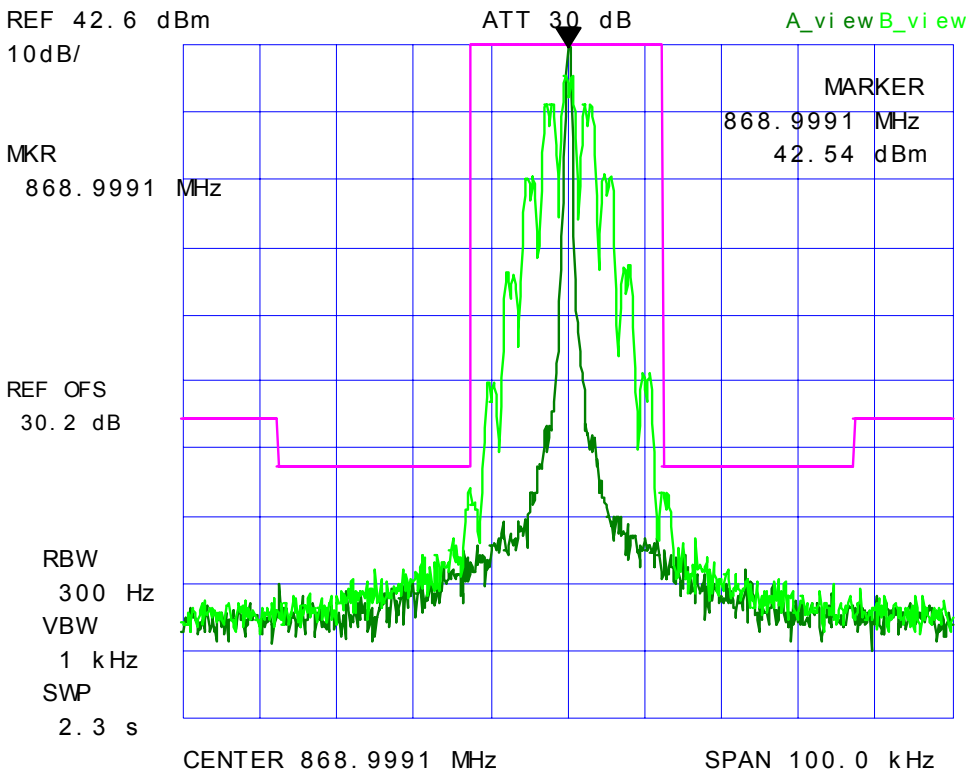
Plot 92: Emission Mask § 90.691
Test Frequency: 861.5 MHz, 25 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



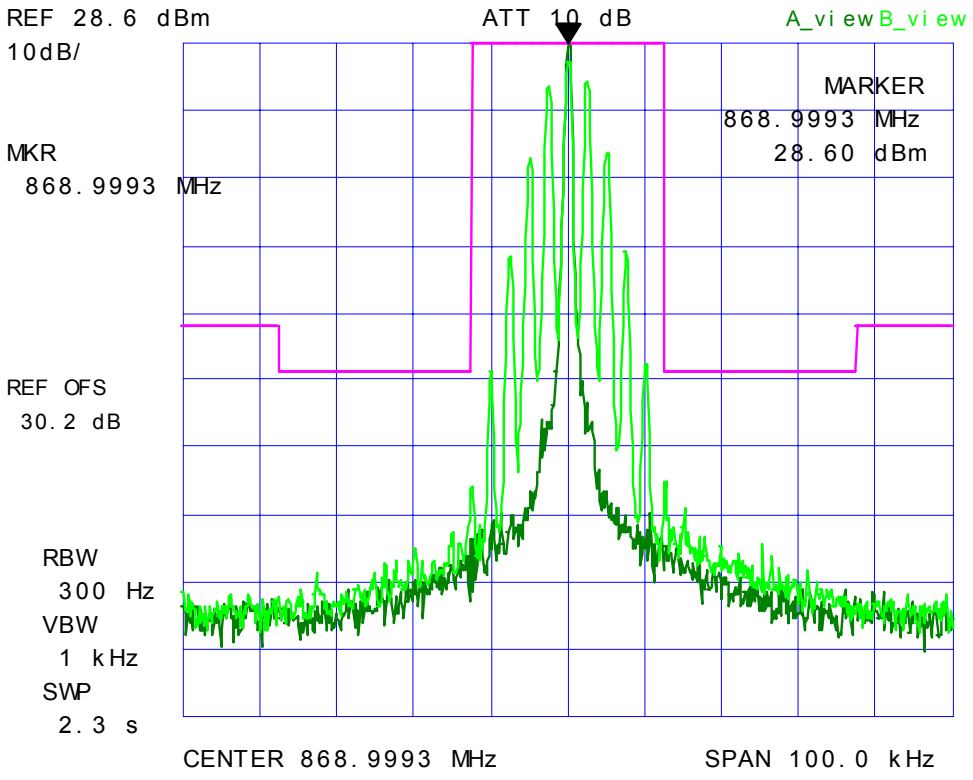
Plot 93: Emission Mask § 90.691
Test Frequency: 869 MHz, 25 kHz Channel Spacing, High power
Modulation: FM modulation with 2.5 kHz sine wave signal



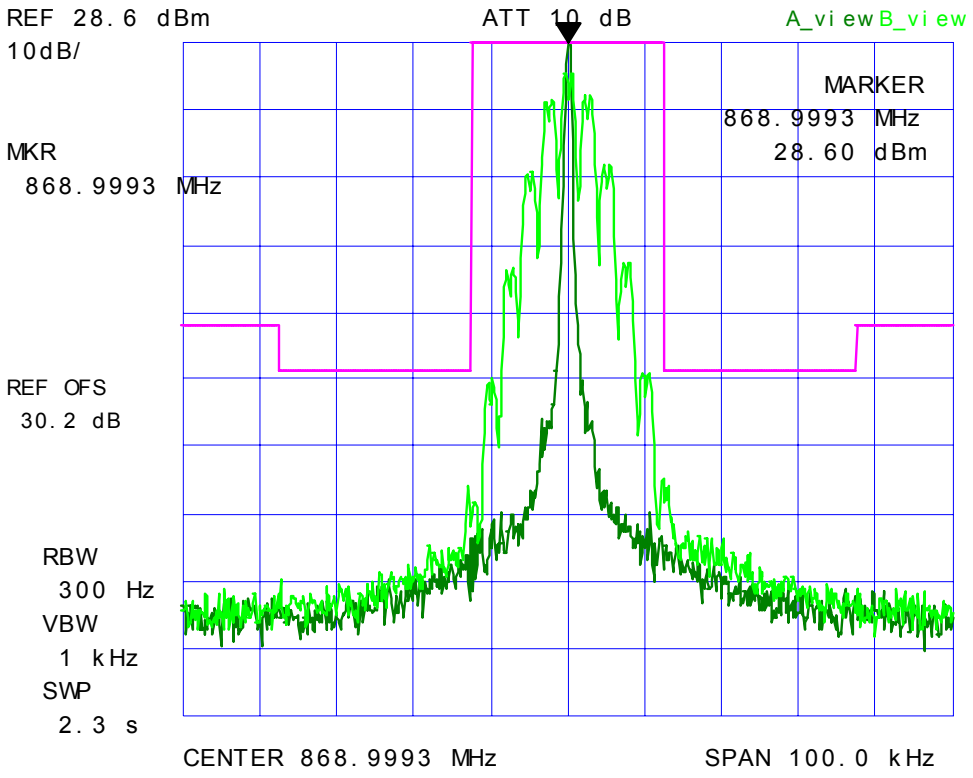
Plot 94: Emission Mask § 90.691
Test Frequency: 869 MHz, 25 kHz Channel Spacing, High power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



Plot 95: Emission Mask § 90.691
Test Frequency: 869 MHz, 25 kHz Channel Spacing, Low power
Modulation: FM modulation with 2.5 kHz sine wave signal



Plot 96: Emission Mask § 90.691
Test Frequency: 869 MHz, 25 kHz Channel Spacing, Low power with sub-carrier 250.3Hz
Modulation: FM modulation with 2.5 kHz sine wave signal



6.11. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§ 90.210(b & h) & 90.669]

6.11.1. Limits

Out-of-band emission limit. On any frequency outside of the frequency ranges, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB or 80 dB, whichever is the lesser attenuation.

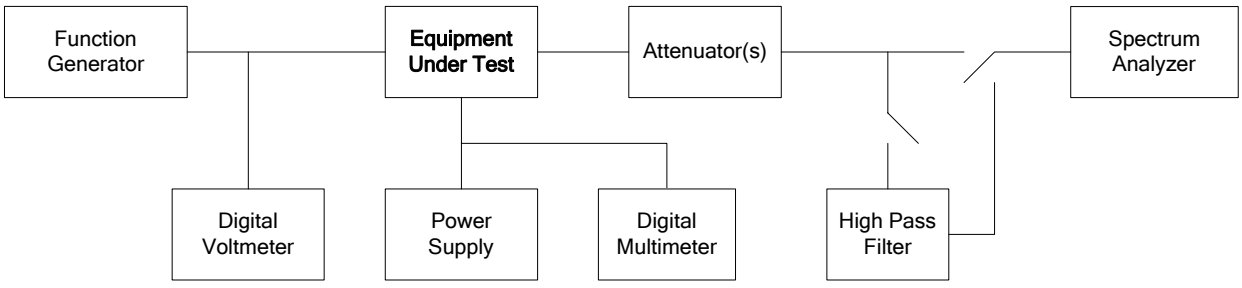
6.11.2. Method of Measurements

Refer to Exhibit 8 Section 8.4 of this report for measurement details

6.11.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Function Generator	Stanford Research Systems	DS345	34591	1 μHz – 30.2 MHz
Digital Voltmeter	Hewlett-Packard	3456A	2015A04523	DC-250 KHz
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9 kHz- 40 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Digital Multimeter	Tenma	72-6202	2080027	DC-100 kHz
Power Supply	Tenma	72-6153	--	DC 0-20 V, 0-10A.
High Pass Filter	Mini-Circuits	SHP-800	10425	Cut-off Frequency at 750 MHz

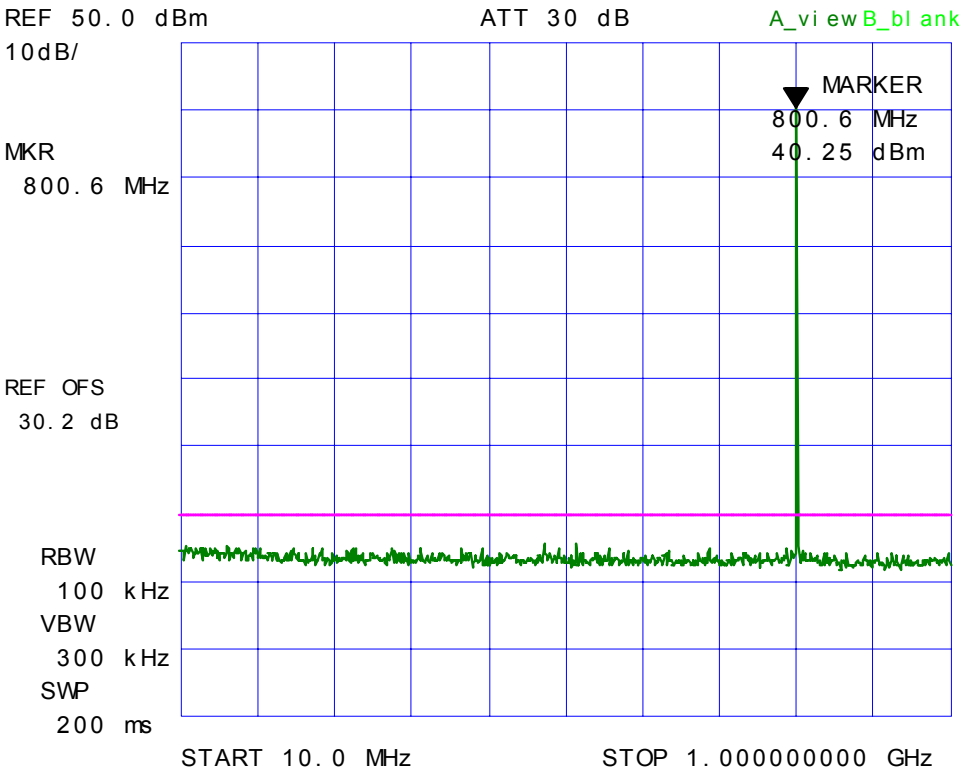
6.11.4. Test Arrangement



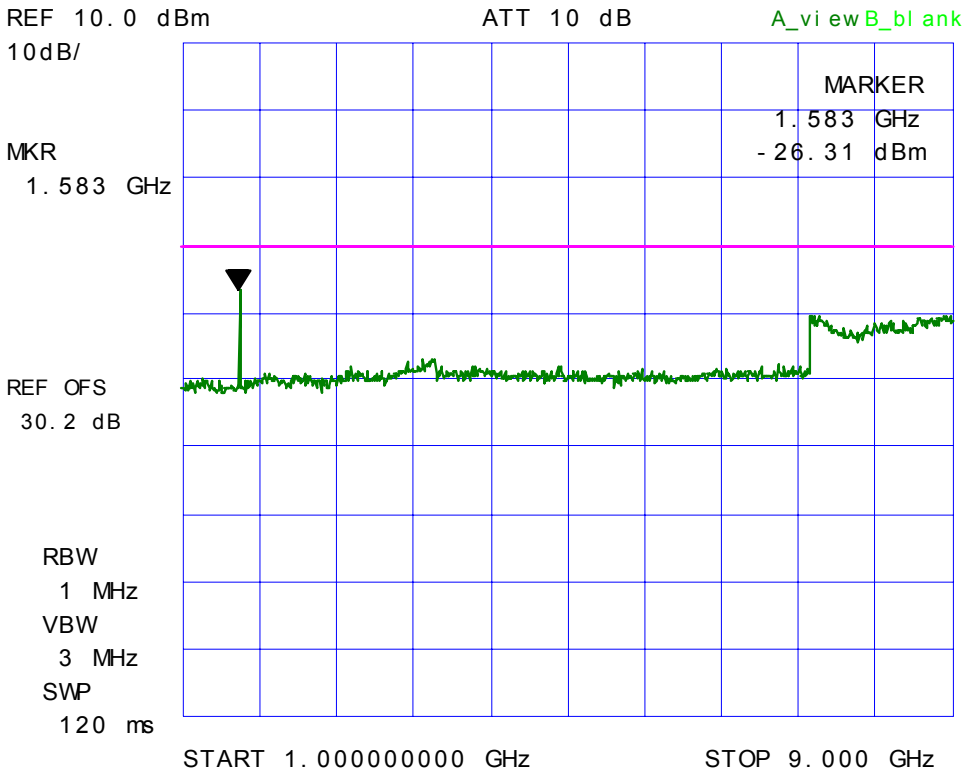
6.11.5. Test Data

6.11.5.1. 806 –824 MHz Band

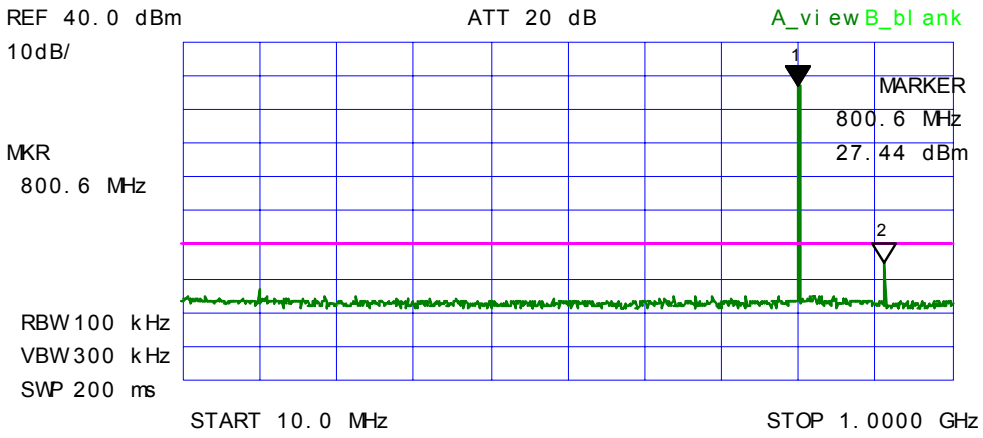
Plot 97: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 20 W



Plot 98: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 20 W



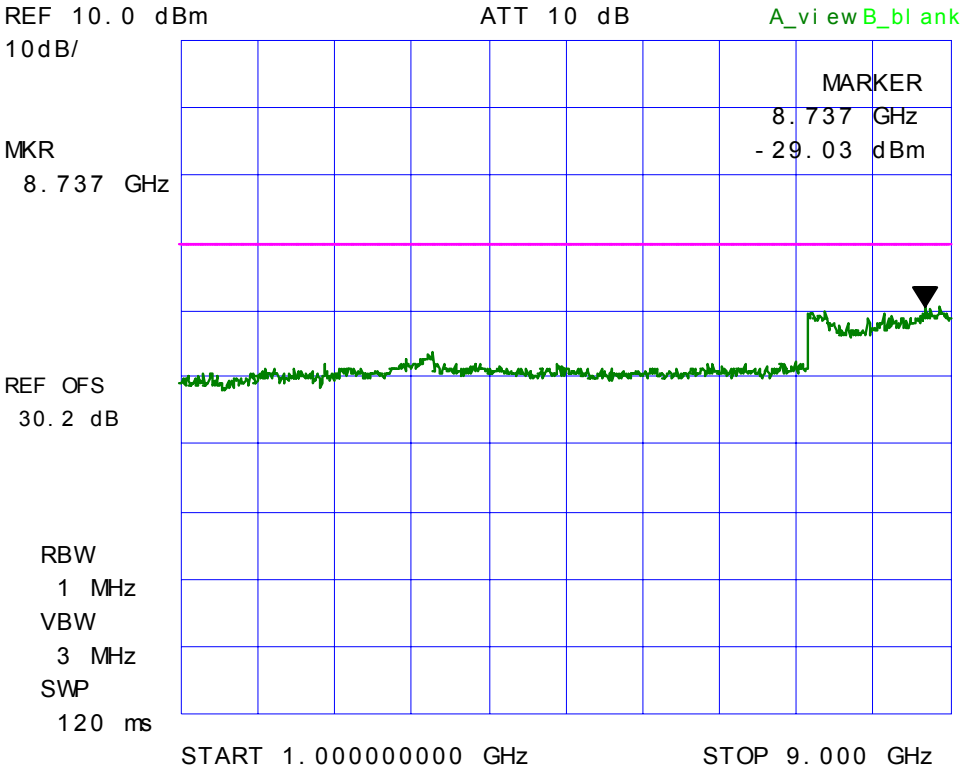
Plot 99: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 1 W



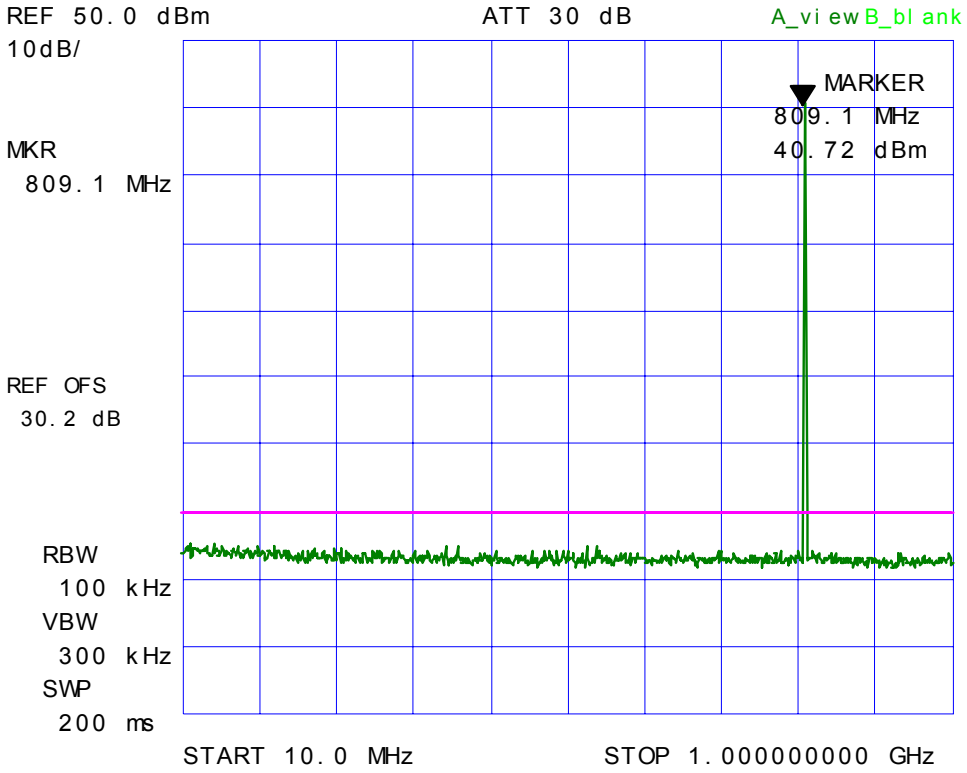
*** Multi Marker List ***

No. 1:	800.6 MHz	27.44 dBm	A
No. 2:	910.9 MHz	-24.88 dBm	A
No. 3:			
No. 4:			
No. 5:			
No. 6:			
No. 7:			
No. 8:			

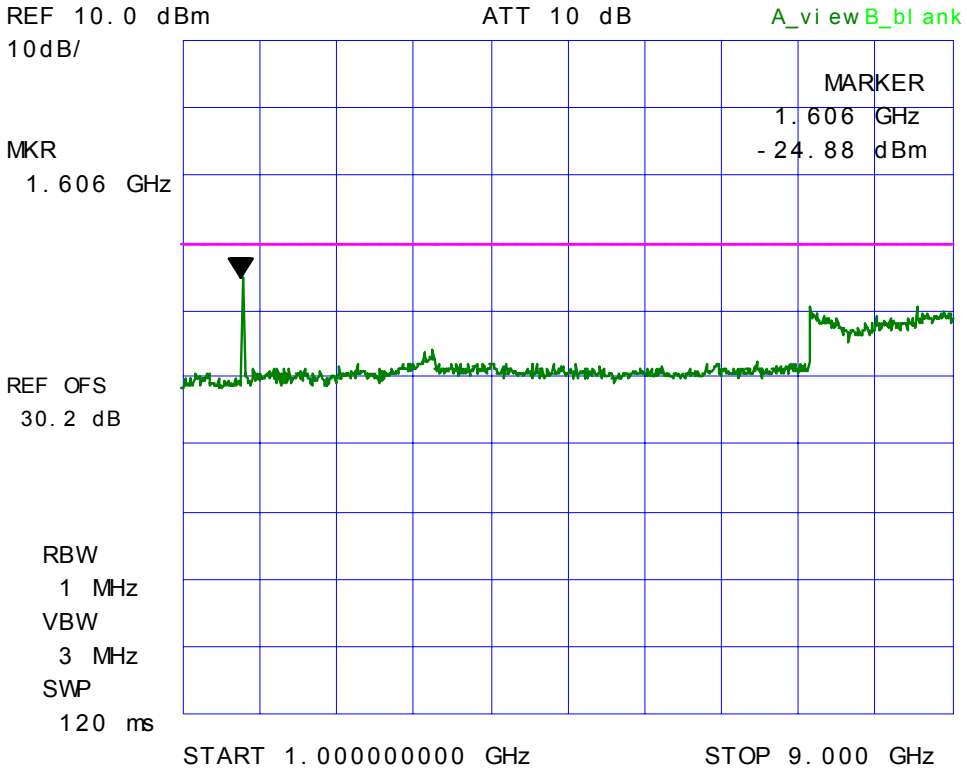
Plot 100: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 1 W



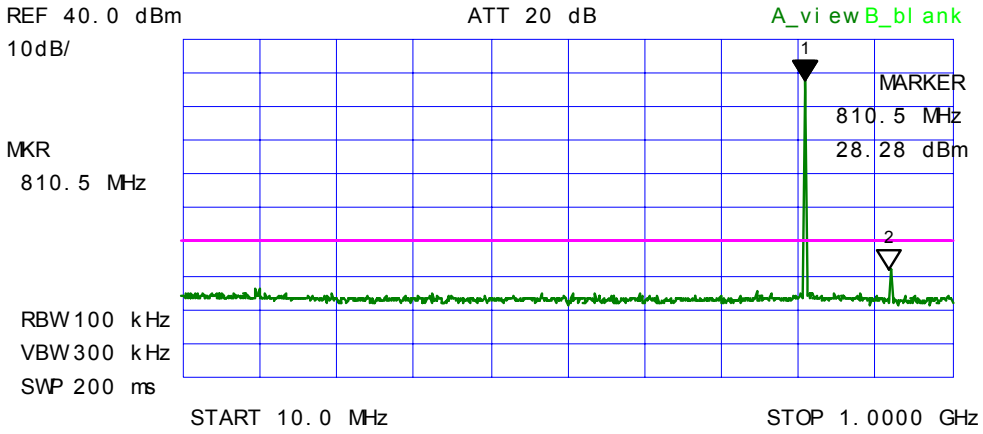
Plot 101: Spurious Emissions at Antenna Terminals
Fc: 816.5 MHz; Power: 20 W



Plot 102: Spurious Emissions at Antenna Terminals
Fc: 816.5 MHz; Power: 20 W



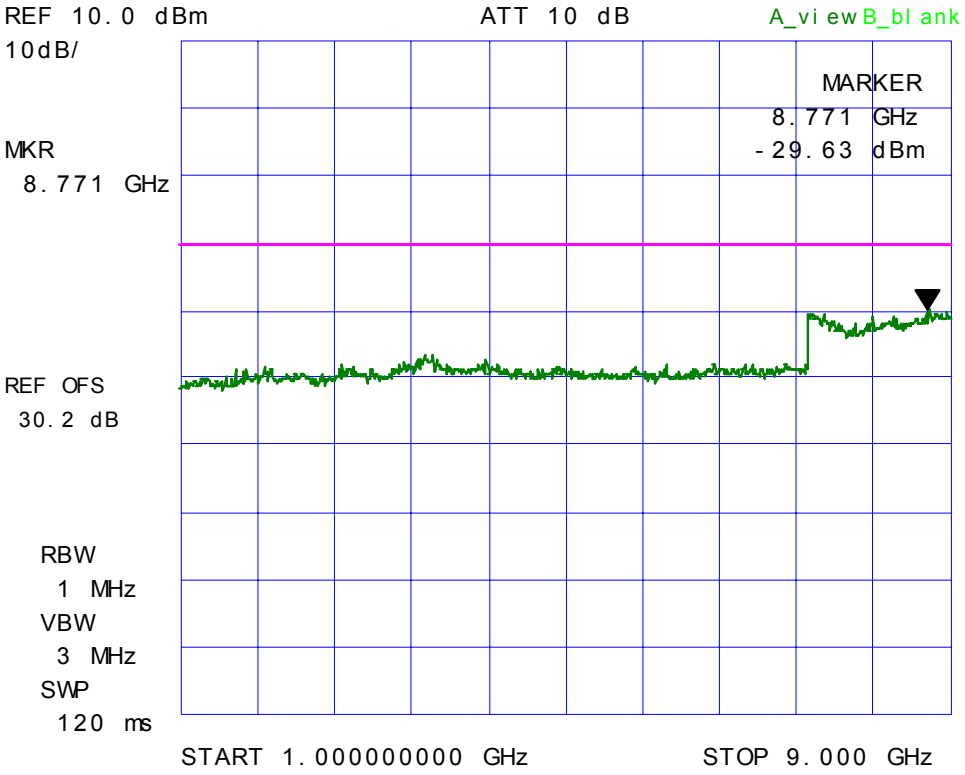
Plot 103: Spurious Emissions at Antenna Terminals
Fc: 816.5 MHz; Power: 1 W



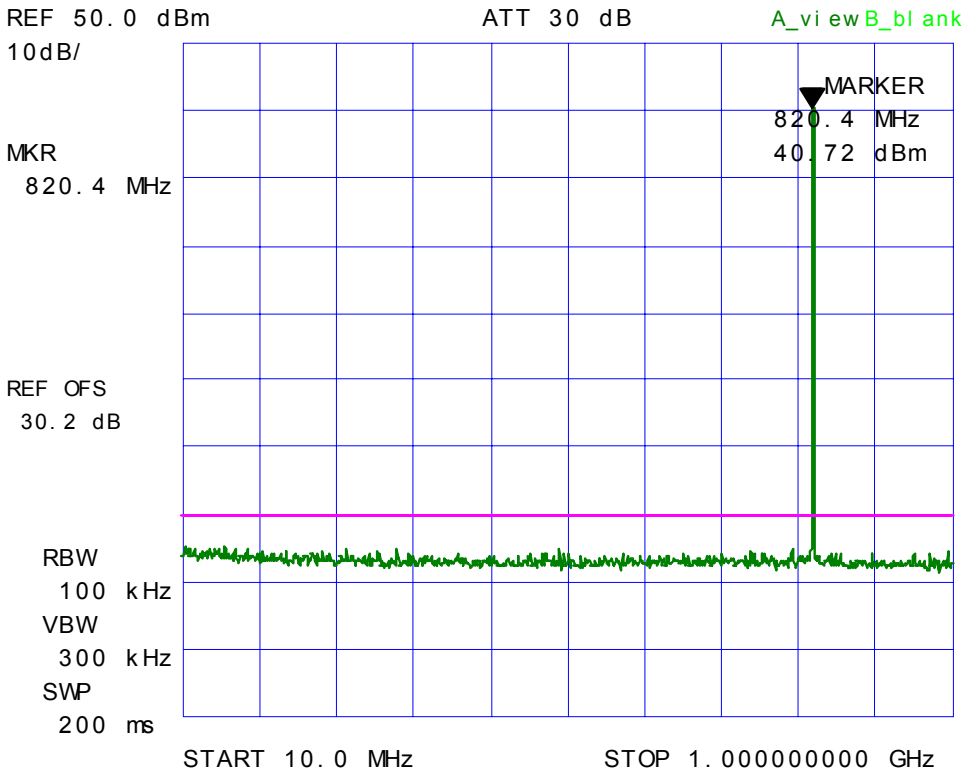
*** Multi Marker List ***

No. 1:	810.5 MHz	28.28 dBm	A
No. 2:	919.4 MHz	-27.56 dBm	A
No. 3:			
No. 4:			
No. 5:			
No. 6:			
No. 7:			
No. 8:			
1:			

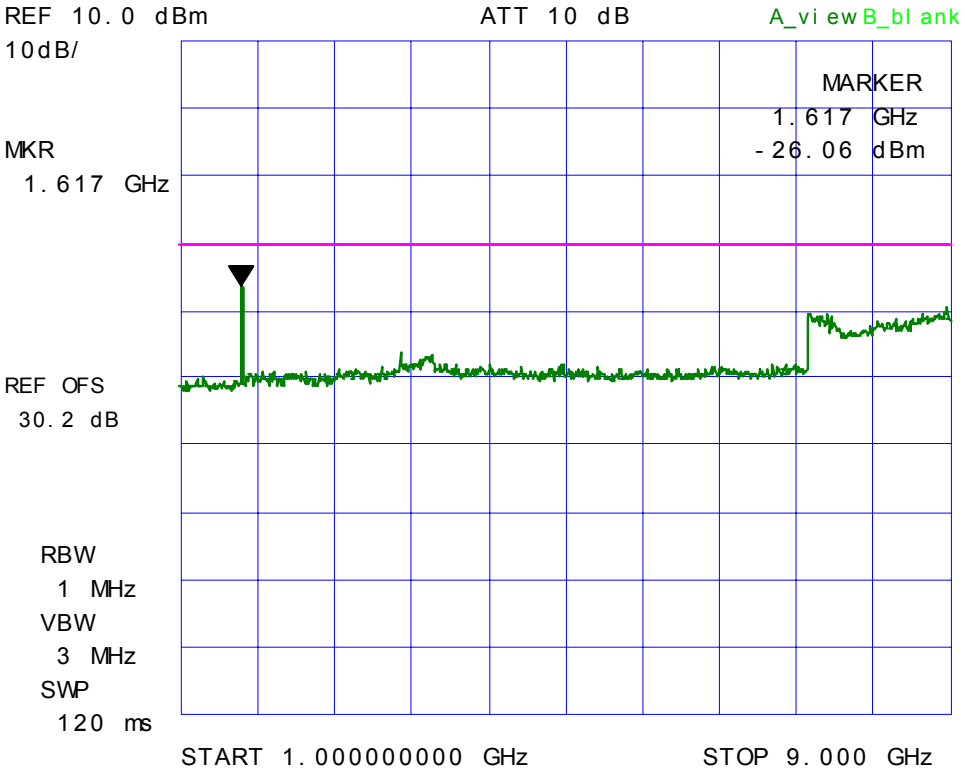
Plot 104: Spurious Emissions at Antenna Terminals
Fc: 816.5 MHz; Power: 1 W



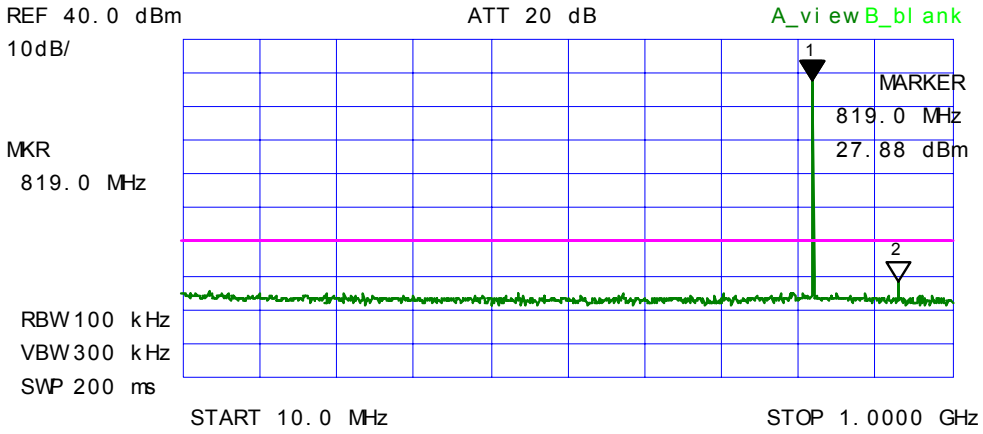
Plot 105: Spurious Emissions at Antenna Terminals
Fc: 824 MHz; Power: 20W



Plot 106: Spurious Emissions at Antenna Terminals
Fc: 824 MHz; Power: 20W



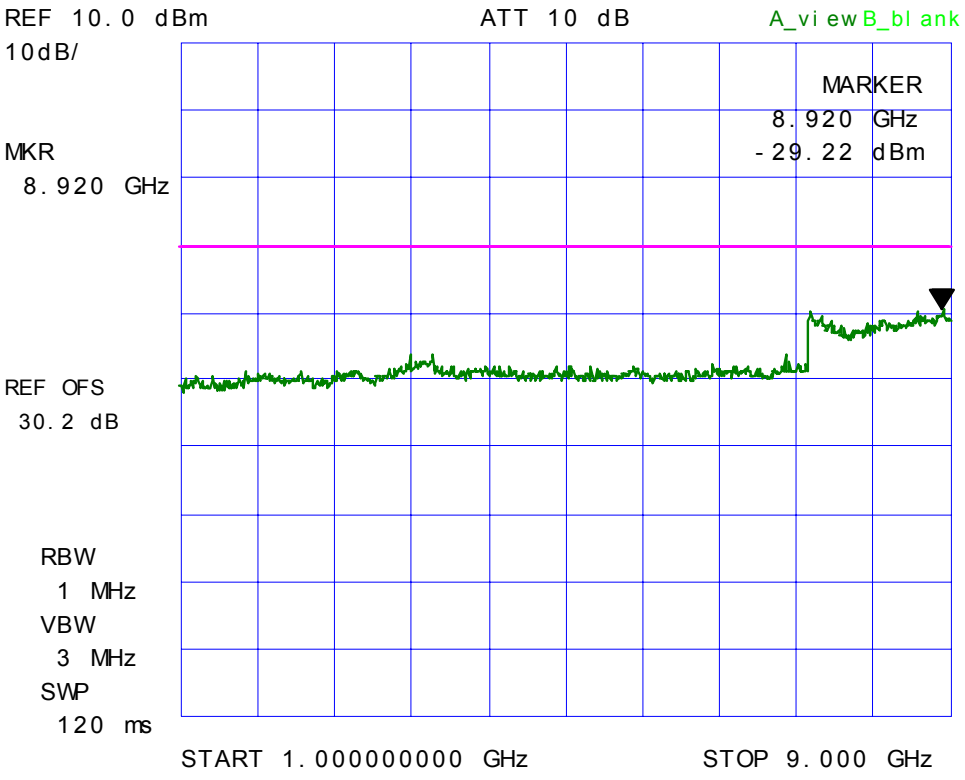
Plot 107: Spurious Emissions at Antenna Terminals
Fc: 824 MHz; Power: 1W



*** Multi Marker List ***

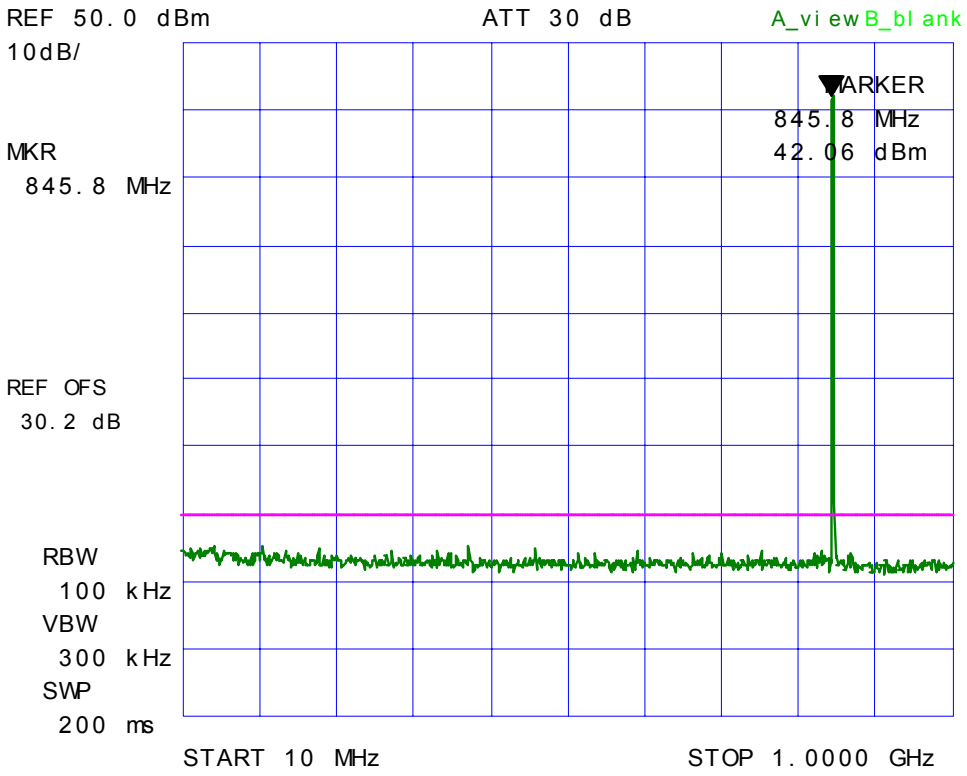
No. 1:	819.0 MHz	27.88 dBm	A
No. 2:	929.3 MHz	-31.16 dBm	A
No. 3:			
No. 4:			
No. 5:			
No. 6:			
No. 7:			
No. 8:			
:			

Plot 108: Spurious Emissions at Antenna Terminals
Fc: 824 MHz; Power: 1W

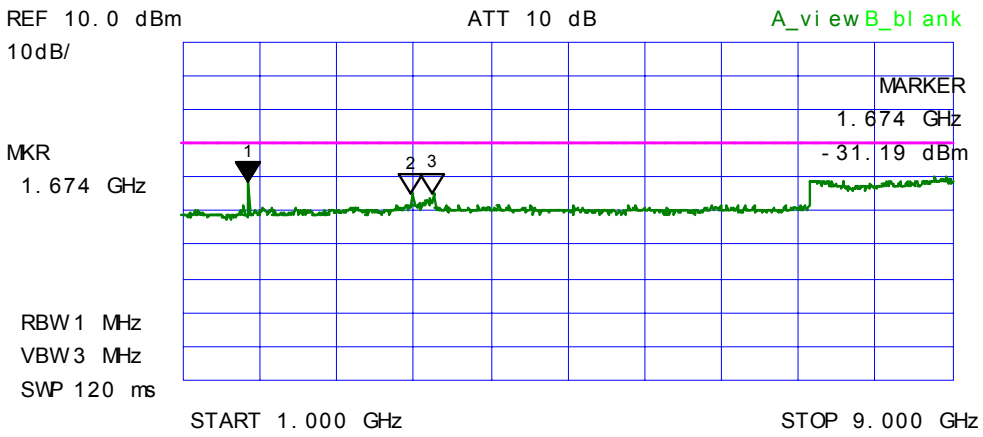


6.11.5.2. 851 –869 MHz Band

Plot 109: Spurious Emissions at Antenna Terminals
Fc: 851 MHz Power: 20 W



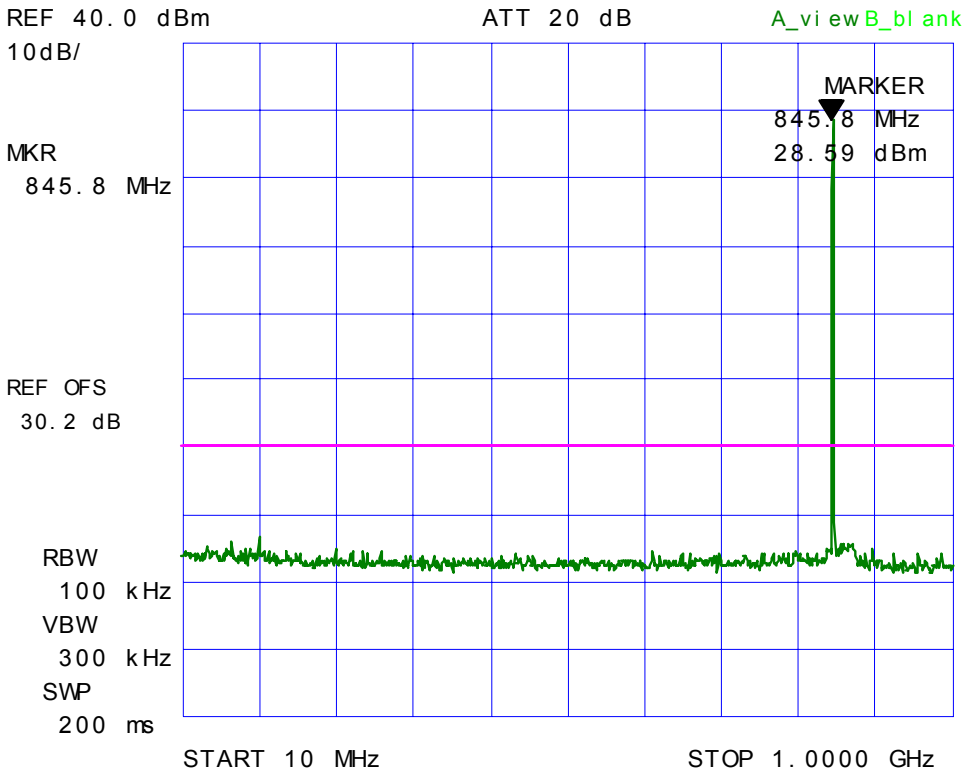
Plot 110: Spurious Emissions at Antenna Terminals
Fc: 851 MHz Power: 20 W



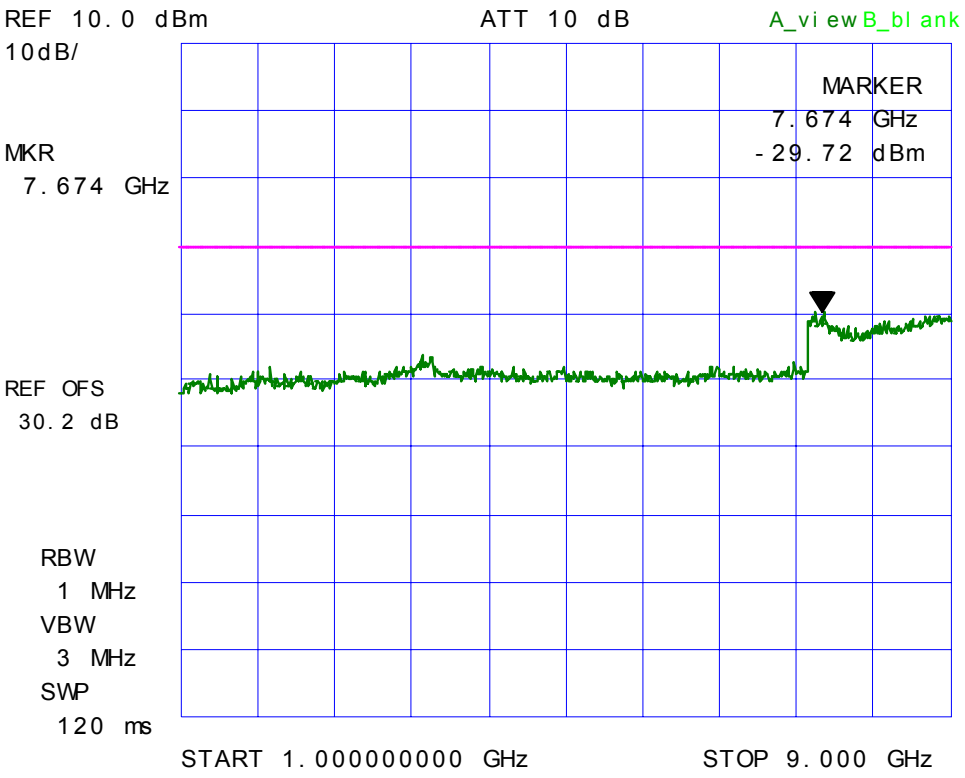
*** Multi Marker List ***

No. 1:	1.674 GHz	-31.19 dBm	A
No. 2:	3.377 GHz	-34.59 dBm	A
No. 3:	3.594 GHz	-34.19 dBm	A
No. 4:			
No. 5:			
No. 6:			
No. 7:			
No. 8:			
:			

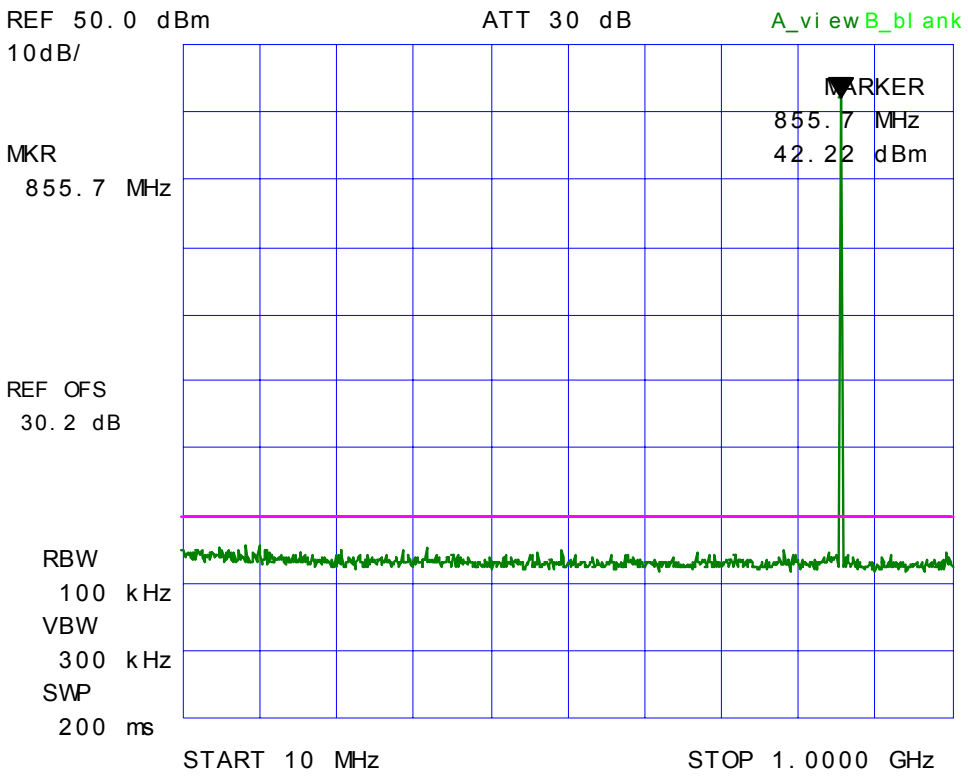
Plot 111: Spurious Emissions at Antenna Terminals
Fc: 851 MHz; Power: 1 W



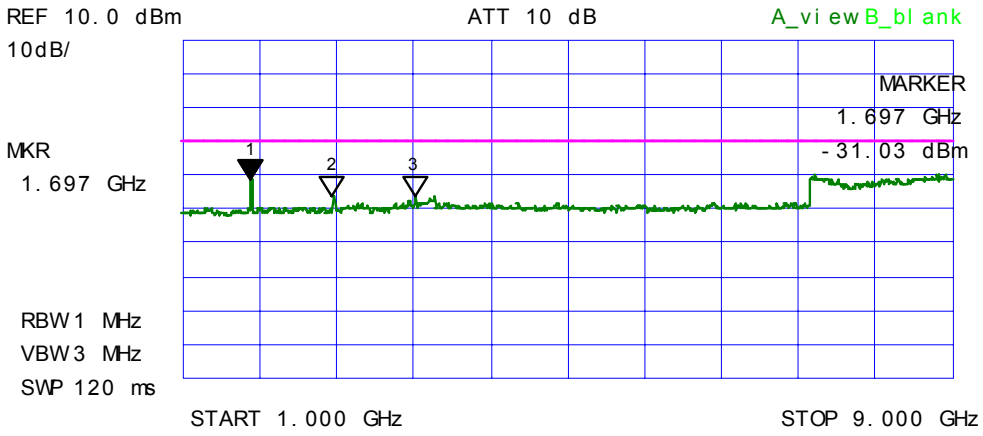
Plot 112: Spurious Emissions at Antenna Terminals
Fc: 851 MHz; Power: 1 W



Plot 113: Spurious Emissions at Antenna Terminals
Fc: 861.5 MHz; Power: 20 W



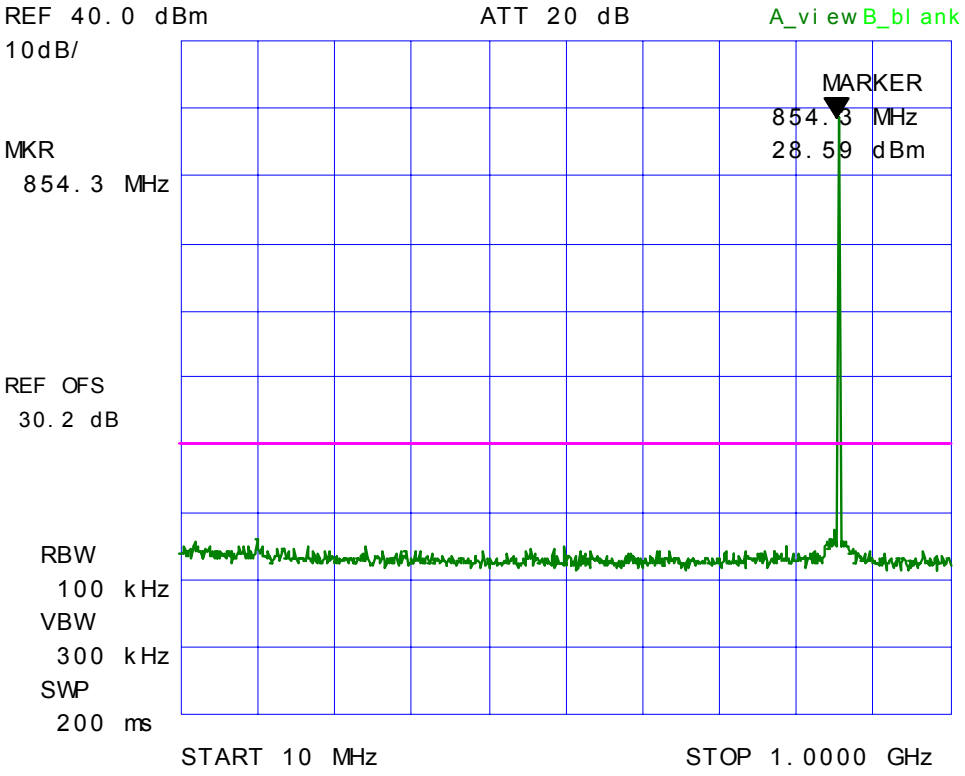
Plot 114: Spurious Emissions at Antenna Terminals
Fc: 861.5 MHz; Power: 20 W



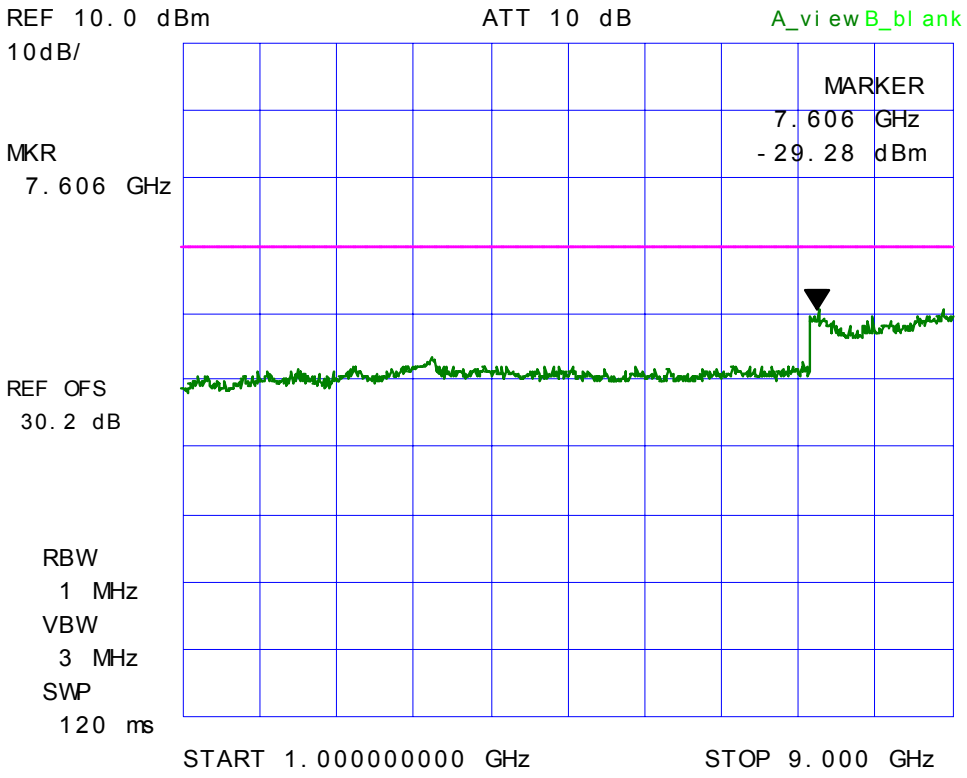
*** Multi Marker List ***

No. 1:	1.697 GHz	-31.03 dBm	A
No. 2:	2.554 GHz	-35.81 dBm	A
No. 3:	3.411 GHz	-35.91 dBm	A
No. 4:			
No. 5:			
No. 6:			
No. 7:			
No. 8:			
:			

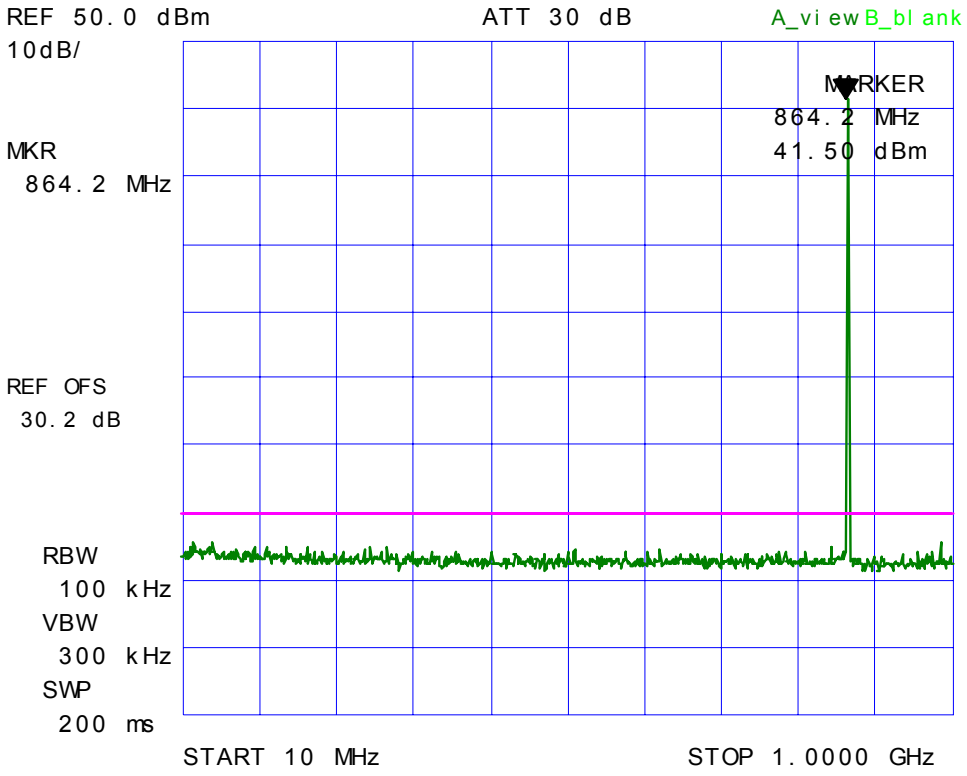
Plot 115: Spurious Emissions at Antenna Terminals
Fc: 861.5 MHz; Power: 1 W



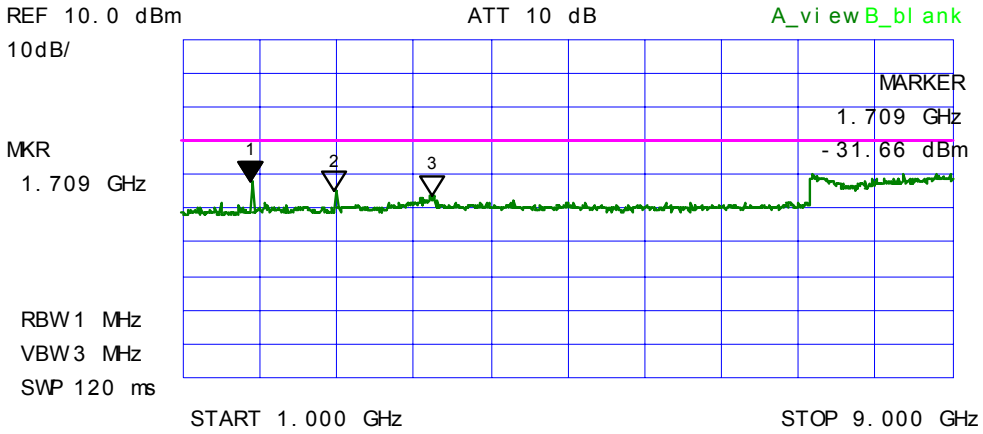
Plot 116: Spurious Emissions at Antenna Terminals
Fc: 861.5 MHz; Power: 1 W



Plot 117: Spurious Emissions at Antenna Terminals
Fc: 869 MHz; Power: 20 W



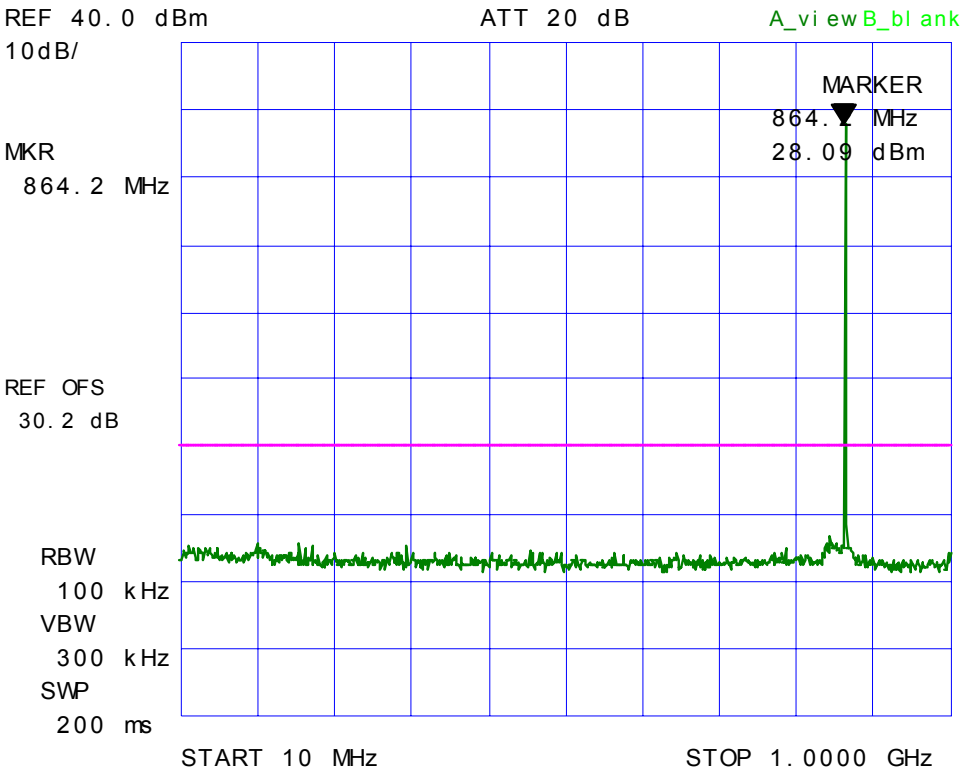
Plot 118: Spurious Emissions at Antenna Terminals
Fc: 869 MHz; Power: 20 W



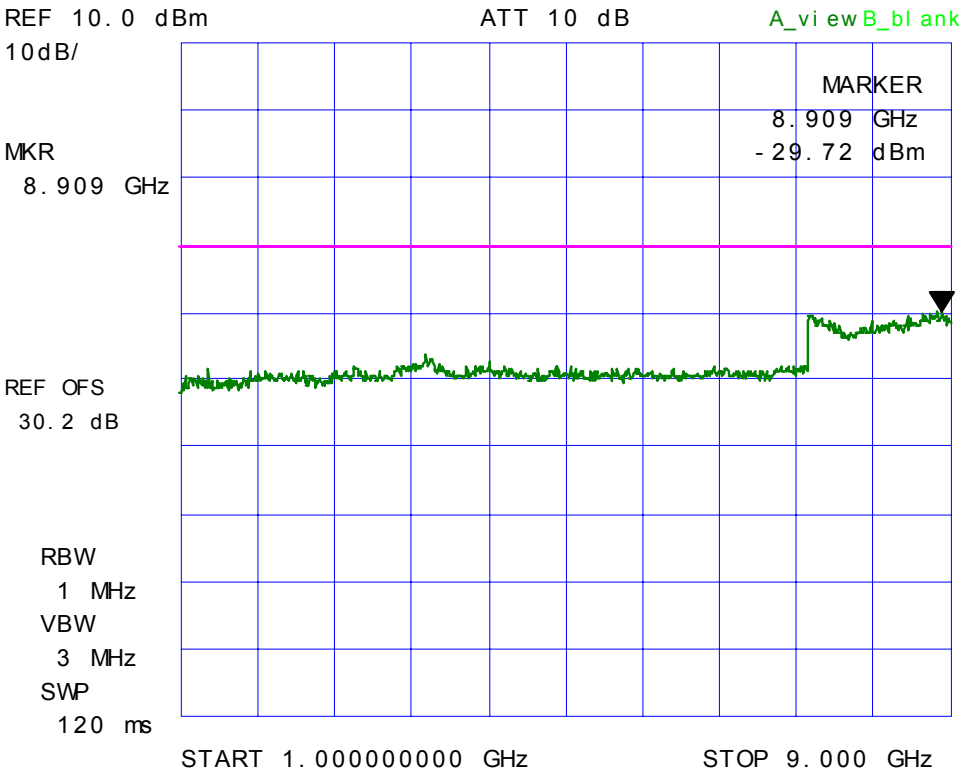
*** Multi Marker List ***

No. 1:	1.709 GHz	-31.66 dBm	A
No. 2:	2.577 GHz	-34.66 dBm	A
No. 3:	3.594 GHz	-35.66 dBm	A
No. 4:			
No. 5:			
No. 6:			
No. 7:			
No. 8:			
:			

Plot 119: Spurious Emissions at Antenna Terminals
Fc: 869 MHz; Power: 1 W



Plot 120: Spurious Emissions at Antenna Terminals
Fc: 869 MHz; Power: 1 W



6.12. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§ 90.210(b & h) & 90.669]

6.12.1. Limits

Out-of-band emission limit. On any frequency outside of the frequency ranges, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB or 80 dB, whichever is the lesser attenuation.

6.12.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, Section 8.2 of this report and its value in dBc is calculated as follows:

- If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
- If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
  Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = xxx dBm (conducted) + 0 dBi – 2.15 dB
- Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

  ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

6.12.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
RF Amplifier	Com-Power	PA-102		1 MHz to 1 GHz, 30 dB gain nomimal
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz, 30 dB nominal
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 GHz – 1 GHz
Dipole Antenna	EMCO	3121C	8907-440	30 GHz – 1 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

6.12.4. Test Data

Remarks:

The rf spurious/harmonic emission characteristics between 2 different channel spacing operations and different modulations (voice/digital) are identical. Therefore, the following radiated emissions were performed on the radio set with 12.5 kHz channel spacing operation.

The radiated emissions were performed at 3 meters distance. At its maximum power for worst case.

The emissions were scanned from 10 MHz to 10 GHz; all emissions that are within 25 dB below the limit are recorded.

6.12.4.1. 806-824 MHz Band

6.12.4.1.1. Lowest Frequency (806 MHz)

Carrier Frequency (MHz): 806
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
1612	65.93	Peak	V	-36.88	79.9	56.0	-23.9
1612	64.54	Peak	H	-37.98	81.0	56.0	-25.0

6.12.4.1.2. Middle Frequency (816.5 MHz)

Carrier Frequency (MHz): 816.5
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
1631	64.49	Peak	V	-38.47	81.5	56.0	-25.5
1631	62.21	Peak	H	-41.50	84.5	56.0	-28.5

6.12.4.1.3. Highest Frequency (824 MHz)

Carrier Frequency (MHz): 824
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
1650	64.47	Peak	V	-38.84	81.8	56.0	-25.8
1650	61.94	Peak	H	-42.31	85.3	56.0	-29.3

6.12.4.2. 851-869 MHz Band

6.12.4.2.1. Lowest Frequency (851 MHz)

Carrier Frequency (MHz): 851
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
1702	67.48	Peak	V	-35.15	78.2	56.0	-22.2
1702	64.75	Peak	H	-38.27	81.3	56.0	-25.3
2553	64.44	Peak	V	-36.40	79.4	56.0	-23.4
2553	63.01	Peak	H	-38.72	81.7	56.0	-25.7
3404	70.15	Peak	V	-34.00	77.0	56.0	-21.0
3404	66.79	Peak	H	-37.98	81.0	56.0	-25.0

6.12.4.2.2. Middle Frequency (861.5 MHz)

Carrier Frequency (MHz): 861.5
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
1721.0	68.43	Peak	V	-34.47	77.5	56.0	-21.5
1721.0	62.79	Peak	H	-40.65	83.7	56.0	-27.7
2581.5	69.23	Peak	V	-32.33	75.3	56.0	-19.3
2581.5	67.40	Peak	H	-35.75	78.8	56.0	-22.8

6.12.4.2.3. Highest Frequency (869 MHz)

Carrier Frequency (MHz): 869
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
1740	66.25	Peak	V	-35.33	78.3	56.0	-22.3
1740	65.23	Peak	H	-36.56	79.6	56.0	-23.6
2610	72.34	Peak	V	-29.65	72.7	56.0	-16.7
2610	68.93	Peak	H	-33.89	76.9	56.0	-20.9

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. Radiated Emission Measurement Uncertainty

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

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).

1. If the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
2. The following method of measurement shall apply to both conducted and radiated measurements.
3. The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
4. 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 = Tx on / (Tx on + 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.

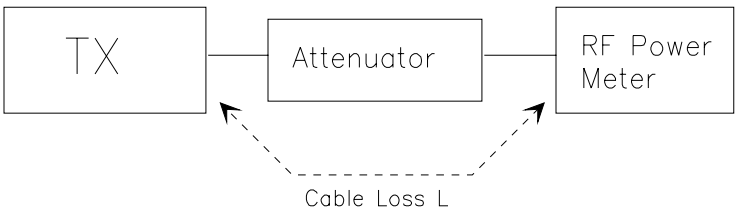
Step 2: Calculation of Average EIRP. See Figure 1

- 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:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(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)

The measurements were performed with full rf output power and modulation.
Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
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 (dBμV/m) = Reading (dBμV) + Total Correction Factor (dB/m)

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

The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
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.
Repeat for all different test signal frequencies.

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

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: 10 kHz
Video BW: same
Detector Mode: positive
Average: off
Span: 3 x the signal bandwidth

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 (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
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 }.
Mount the transmitting antenna at 1.5 meter high from the ground plane.
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 }.
If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
Adjust both transmitting and receiving antenna in a VERTICAL polarization.
Tune the EMI Receivers to the test frequency.
Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
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.
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
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
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

Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
Repeat step (d) to (o) for different test frequency
Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
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

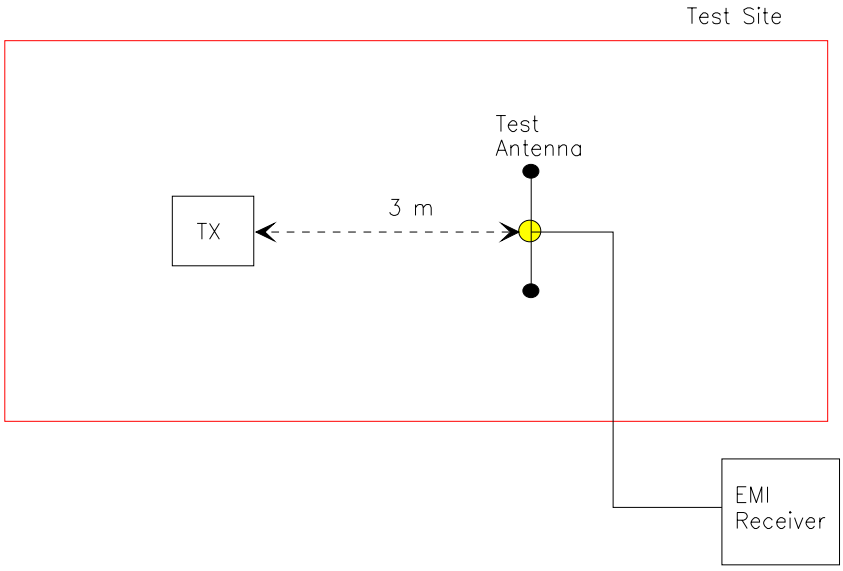
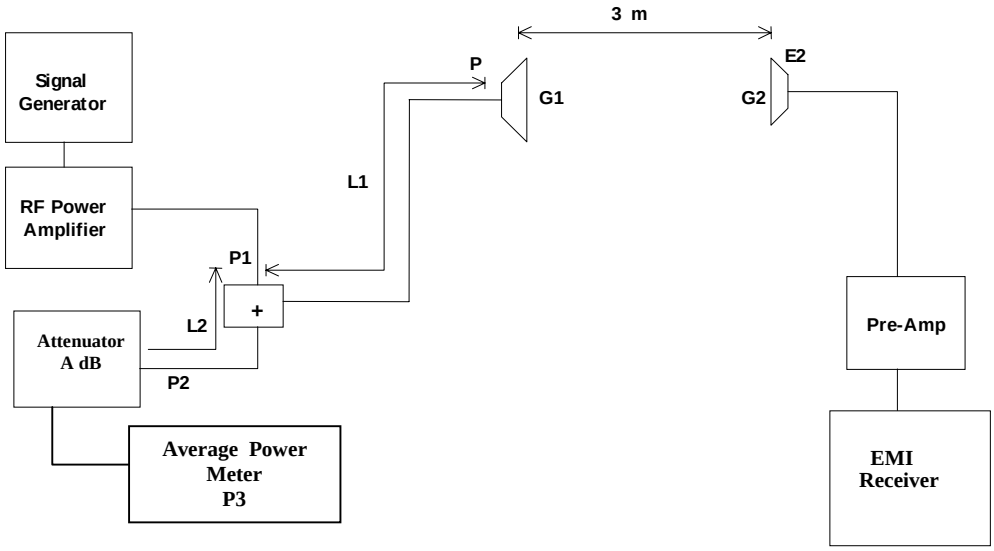


Figure 3



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. 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 CFR 47, Para. 2.1057 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} 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 CFR 47, Para. 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.