

VERIFICATION OF COMPLIANCE

Reunion 28-07M BTR

On the basis of measurements here reported on June 9, 2000, the above referenced equipment is verified as meeting the requirements of FCC Part 101 (Fixed Microwave Services), and FCC Part 2 requirements. The Test data included in this report applies to the product titled above manufactured by Nortel Networks.

Tested by:

Denis Lalonde
Nortel Networks
21 Richardson Side rd
Kanata, Ontario
Canada
K2K 2C1

1. Results Summary

The system described in Section 3.0 meets the requirements FCC Part 101 and Part 2, Fixed Microwave Services (10-1-97 edition).

A summary of the test cases can be found in the following table.

Table 1-1: Test Case Summary

Parameter	C	NC	NT	NA	Reference to remark
Transmitter characteristics					
Maximum output power (FCC Part 2.1046)	X				
Occupied Bandwidth (FCC Part 2.1049)	X				
RF spectrum mask (FCC Part 101.111)	X				
Tx Conducted Spurious emissions (FCC Part 101.111)	X				
Radiated Spurious emissions (FCC Part 101.111)	X				
Tx Frequency Stability (FCC Part 101.107)	X				
Note: C: The parameter is compliant with the requirements NC: The parameter is not compliant with the requirements NT: The parameter is not tested NA: The test of this parameter is not applicable					

2. Introduction

2.1. Scope

This report contains the measured results as required by FCC Part 101, and Part 2 requirements. The measurement procedure used is described in this document.

3. Production Description

3.1. Product and Functional Description

The unit tested in this report consisted of a DC powered system. The product trade name is Reunion 28-07M BTR. This is a Reunion family product.

The FCC ID of this product is AB6BTR2807M.

The model of this product is NTVG14CA.

The emission designators for this product are 7M0D7W (1 carrier), 14M0D7W (2 carriers) , and 28M0D7W (4 carriers).

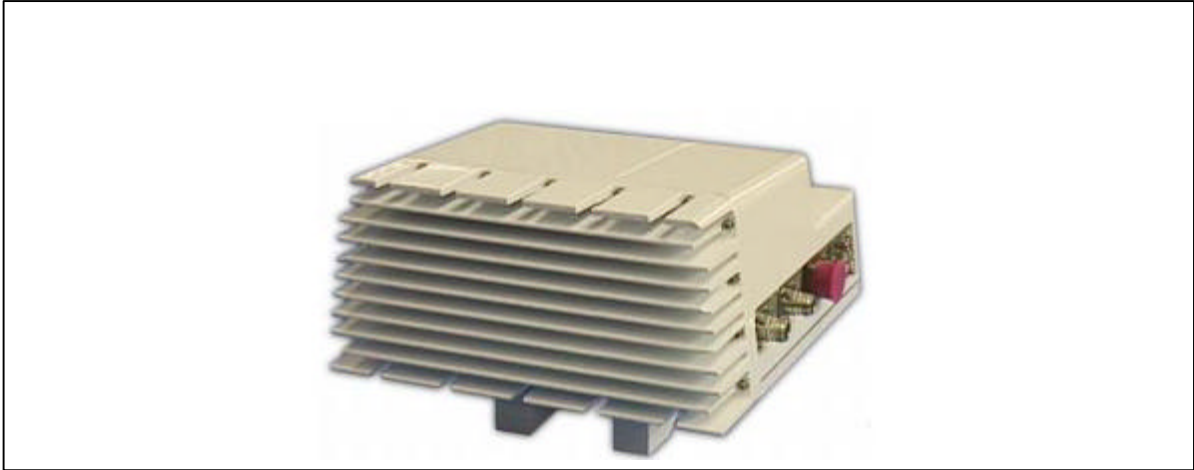
This system was configured with a NNE (Network Node Equipment), a BTR, an RPE and the cables necessary to activate the hardware under investigation. Table 3-1 below provides a description of each component and the respective serial and model numbers.

Table 3-1: Hardware descriptions

	Product and Firmware description	Model No.	Serial No.
EUT	BTR	NTVG14CA	NNTR2807MB01
Support Equipmen t	BRM x 4	NTVH28AA NTVH28BA NTVH28AA NTVH28AA	NNTM532LLXU3 NNTM532LLXNX NNTM532LM2P4 NNTM532LM2K0
	CIM	NTVH25AA	NNTM532G83MJ
	AWM	NTVH04AA	NNTM532Q1X92
	Ethernet hub	Baystack 107	00227746
	RSM 9016	NTVH13BA	NNTM532G9M7P
	RSM 9116	NTVH20BA	NNTM532GC0WU
	UGB	NTVH29AB	NNTM532GC356
	RPE	NTVH24AA	NNTM532G94KQ

A picture of the equipment under test is shown in Figure 1.

Figure 1: Equipment Under Test



3.2. Manufacturer

Nortel Networks Canada Limited
Calgary, Alberta
Canada

3.3. Software

The software used during testing was representative of system performance under actual network usage conditions. Additional features required to activity and/or control specific radio functions (i.e. channel allocation, BER performance, power control) may be required as long as they are consistent with radio performance under actual network usage conditions.

3.4. Transmitter Technical Characteristics

The following table lists the technical characteristics of the transmitters.

Table 3-2: Transmitter Technical Characteristics

Tx Parameter	Description
Frequency Range	29.1 GHz to 29.25 GHz (BTR)
Channel Spacing	7 MHz
IF	500 MHz to 650 MHz (BTR)
Tx Power (nom)	21.0 dBm per carrier (1 carriers configuration) 16.0 dBm per carrier (2 carriers configuration) 11.5 dBm per carrier (4 carriers configuration)
Modulation Characteristics	16-QAM
Antenna gain	15.5 dBi (90 deg. sector) 18.2 dBi (45 deg. sector) 20.0 dBi (30 deg. sector) 23.0 dBi (15 deg. sector)

3.5.Receiver Technical Characteristics

The following table lists the technical characteristics of the receiver.

Table 3-3: Receiver Technical Characteristics

Rx Parameter	Description
Frequency Range	28.2 GHz to 28.35 GHz (BTR)
Channel Spacing	7 MHz
IF	250 MHz to 400 MHz
Modulation Characteristics	QPSK

3.6.Antenna Port(s) and System Cables

The following tables show the EUT antenna interface port(s) used for RF measurements and description of any system cables (IF IDU to ODU for example).

Table 3-4: Antenna Port Description

Identification	Description	Connector
Tx Antenna Port	Waveguide Connection for Transmission to Antenna	WR-28
Rx Antenna Port	Waveguide Connection for Receiver to Antenna	WR-28

Table 3-5: Cable Description

Qty	Purpose	Description	Connector
1	NNE to RPE telemetry cable	10m	MIL type
1	RPE to BTR telemetry cable	2 feet	MIL type
1	1 to 4 Telemetry cable splitter		MIL type
2	IF cables	10m	N type
2	AC Power cables	10m	250V, 20A

3.7.System Modification

No modifications were necessary in order to comply with requirements as detailed FCC Part 101 requirements.

4. General test conditions

4.1. Test Facility

Emission testing was performed in the Nortel Networks Product Integrity Radio Compatibility laboratory, located at 21 Richardson Side rd, Kanata, Ontario, Canada.

4.2. Climatic Conditions

Climatic conditions are controlled within the following specifications:

- Ambient temperature: 15 °C to 25 °C
- Relative humidity: 20% to 50%

4.3. Measurement Instrumentation

Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy as per ISO 25 requirements.

5. Test Results

5.1. Name of Test: Maximum Transmit Power

5.1.1. Test Procedure

As per FCC Part 2.1046

The maximum transmit power was measured using the average power detector on a power meter.

5.1.2. Test Results

Ambient Temperature: 15 to 25 deg. C
Relative Humidity: 20 to 50 %
Test Conditions: Nominal temperature, Nominal Power Supply Voltage

Number of Carriers	Transmitter Power Level (dBm)		
	Channel B 29.1035 GHz	Channel M 29.1665 GHz	Channel T 29.2435 GHz
1	21.6	21.4	21.2
2	18.9	19.4	19.4
4	17.5	17.6	17.6

The equipment complies with the limits.

5.1.3. Limits

Authorized Power (dBm) as quoted on Form 731	21.0 dBm (1 carrier) 19.0 dBm (2 carriers) 17.5 dBm (4 carriers)
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Test Equipment Used	1, 2, 3, 4
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5.2. Name of Test: Occupied Bandwidth

5.2.1. Test Procedure

As per FCC Part 2.1049

5.2.2. Test Results

Ambient Temperature: 15 to 25 deg. C
 Relative Humidity: 20 to 50 %
 Test Conditions: Nominal temperature, Nominal Power Supply Voltage

Number of Carriers	Occupied Bandwidth (MHz)		
	Channel B 29.1035 GHz	Channel M 29.1665 GHz	Channel T 29.2435 GHz
1	6.2	6.0 Plot: 2807M 01 0001	6.2
2	13.2	13.1 Plot: 2807M 01 0002	13.2
4	27.0	27.0 Plot: 2807M 01 0003	27.0

5.2.3. Limits

Number of carriers	Channel Spacing (MHz)
1	7
2	14
4	28

Test Equipment Used	4, 5
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5.3. Name of Test: RF Spectrum Mask

5.3.1. Test Procedure

As per FCC Part 101.111 a)

This measurement was performed using a spectrum analyzer with 1 MHz resolution bandwidth.

5.3.2. Test Results

Ambient Temperature: 15 to 25 deg. C

Relative Humidity: 20 to 50 %

RF Spectrum Mask Results – 1 TDMA carrier

Number of Carriers	Occupied Bandwidth (MHz)		
	Channel B 29.1035 GHz	Channel M 29.1665 GHz	Channel T 29.2435 GHz
1	Plot: 2807M 01 0004	Plot: 2807M 01 0005	Plot: 2807M 01 0006
2	Plot: 2807M 01 0007	Plot: 2807M 01 0008	Plot: 2807M 01 0009
4	Plot: 2807M 01 0010	Plot: 2807M 01 0011	Plot: 2807M 01 0012

The equipment complies with the limit.

5.3.3. Limits

Allowed Power Range (dBm)	Attenuation = 11 + 0.4(P - 50) + 10 Log ₁₀ B. (Attenuation greater than 56 decibels is not required.)
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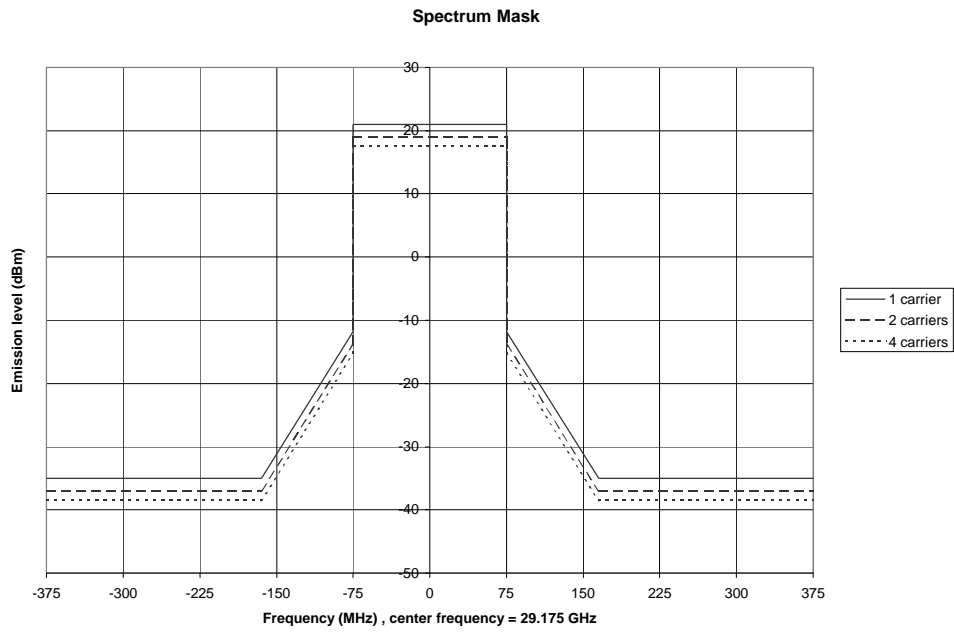


Figure 2 Spectrum mask limit

Test Equipment Used	1, 2, 3, 4, 5
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5.4. Name of Test: Transmitter Conducted Spurious Emissions

5.4.1. Test Procedure

As per FCC Part 101.111 a)

This measurement was performed using a spectrum analyzer with 1 MHz resolution bandwidth. Down-converting mixers are used for frequencies higher than 40 GHz.

5.4.2. Test Results

Ambient Temperature: 15 to 25 deg. C
 Relative Humidity: 20 to 50%

Plot Range	1 carrier Channel M 29.1665 GHz	4 carriers Channel M 29.1665 GHz
30 MHz to 10 GHz	Plot: 2807M 01 0013	Plot: 2807M 01 0019
10 to 28.8 GHz	Plot: 2807M 01 0014	Plot: 2807M 01 0020
29.55 to 40 GHz	Plot: 2807M 01 0015	Plot: 2807M 01 0021
40 to 60 GHz	Plot: 2807M 01 0016	Plot: 2807M 01 0022
60 to 90 GHz	Plot: 2807M 01 0017	Plot: 2807M 01 0023
90 to 140 GHz	Plot: 2807M 01 0018	Plot: 2807M 01 0024

The equipment complies with the limit.

5.4.3. Limits

Spurious Emissions Limit (dBm)	-13 dBm
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Test Equipment Used	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14
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5.5. Name of Test: Radiated Spurious Emissions

5.5.1. Test Procedure

As per FCC Part 101.111 a)

The measurement between 30 MHz and 18 GHz was performed at the Nortel Networks Ambient Free Chamber located at 21 Richardson Side road in Kanata Ontario. The higher frequency measurements were performed in another anechoic chamber in the Nortel Networks laboratory.

Frequency	Measurement Distance	Field Strength Limit
30 MHz to 1 GHz	3m	84 dBuV/m
1 GHz to 10 GHz	3m	84 dBuV/m
10 GHz to 18 GHz	3m	84 dBuV/m
18 GHz to 26.5 GHz	3m	84 dBuV/m
26.5 GHz to 40 GHz	3m	84 dBuV/m
40 GHz to 60 GHz	0.5m	99.9 dBuV/m
60 GHz to 90 GHz	0.125m	111.9 dBuV/m
90 GHz to 100 GHz	0.125m	111.9 dBuV/m

The -13 dBm requirement was changed into a field strength limit using the $E = 1/R \sqrt{30 \cdot \text{EIRP}}$ equation. All the measurements were done using the peak hold feature of the spectrum analyzer while the equipment was rotated 360 degrees in both vertical and horizontal polarization. The dBuV levels on the recorded plots are corrected with the antenna factors and cables losses of the measuring equipment, therefore, they are equivalent to dBuV/m.

5.5.2. Test Results

Ambient Temperature: 15 to 25 deg. C
 Relative Humidity: 20 to 50%

Plot Range	1 carrier Channel M 29.1665 GHz	4 carriers Channel M 29.1665 GHz
30 MHz to 1 GHz	Plot: 2807M 010025	Plot: 2807M 010033
1 to 10 GHz	Plot: 2807M 010026	Plot: 2807M 010034
10 to 18 GHz	Plot: 2807M 010027	Plot: 2807M 010035
18 to 26.5 GHz	Plot: 2807M 010028	Plot: 2807M 010036
26.5 to 40 GHz	Plot: 2807M 010029	Plot: 2807M 010037
40 to 60 GHz	Plot: 2807M 010030	Plot: 2807M 010038
60 to 90 GHz	Plot: 2807M 010031	Plot: 2807M 010039
90 to 100 GHz	Plot: 2807M 010032	Plot: 2807M 010040

Note 1: The spurious emissions on plot 2807M 01 0029 and 2807M 01 0037 are the wanted transmitted signal.

The equipment complies with the limit.

5.5.3. Limits

Spurious Emissions Limit (dBm)	-13 dBm
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Test Equipment Used	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19
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5.6. Name of Test: Radio Frequency Tolerance

5.6.1. Test Procedure

As per FCC Part 101.107

The measurement was performed while transmitting an un-modulated signal.

5.6.2. Test Results

Ambient Temperature: 15 to 25 deg. C
Relative Humidity: 20 to 50 %
Configuration: 1 carrier

Test Conditions		Measured Frequency Channel M 29.1665 GHz	Frequency offset (%)
T _{nom} = 20 deg. C	V _{nom} = 48.0 VDC	29.166505447	0.000019
	V _{min} = 40.8 VDC	29.166505301	0.000018
	V _{max} = 55.2 VDC	29.166504945	0.000017
T = -30 deg. C	V _{nom}	29.166505334	0.000018
T = -20 deg. C	V _{nom}	29.166512427	0.000043
T = -10 deg. C	V _{nom}	29.166514693	0.000050
T = 0 deg. C	V _{nom}	29.166513986	0.000048
T = 10 deg. C	V _{nom}	29.166510931	0.000037
T = 20 deg. C	V _{nom}	29.166506006	0.000021
T = 30 deg. C	V _{nom}	29.166503597	0.000012
T = 40 deg. C	V _{nom}	29.166493785	-0.000021
T = 50 deg. C	V _{nom}	29.166481323	-0.000064

The equipment complies with the limit.

5.6.3. Limits

Frequency Tolerance Limit (%)	+/- 0.001%
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Test Equipment Used	4, 5, 6, 17
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6. Test equipment

The following is a list of test equipment used to perform all tests described in this report:
All measurement equipment/antennas were within their respective calibration periods

Table 6-1 Test equipment used

Item	Description	Make	Model #	Asset # Or Serial #	Cal. due date
1	Power Meter	Anritsu	ML2438A	Z0079967	10/00
2	Power Sensor	Anritsu	MA2424A	971397	09/00
3	RF Signal Generator	Wiltron	68369B	L0099251	06/00
4	Wave-guide attenuator	Lectronic Research Labs	521A-20/599 & 521A-30/599		NA NA
5	Spectrum Analyzer	HP	8564E	Z0082288	11/00
6	Environmental Chamber	EMS	QRS-400T	L0541937	05/00
7	Down converting mixer (40 to 60 GHz)	Oleson Microw.	M19HWA HP	U90611-1	NA
8	Down converting mixer (60 to 90 GHz)	Oleson Microw.	M12HWA HP	E90611-1	NA
9	Down converting mixer (90 to 140 GHz)	Oleson Microw.	M08HWA HP	F90611-1	NA
10	Down converting mixer (140 to 220 GHz)	Oleson Microw.	M05HWA HP	G90611-1	NA
11	Wave-guide transition (40 to 60 GHz)	Penn Eng.	4430-11B 4428-11B	S0634 S0549	NA NA
12	Wave-guide transition (60 to 90 GHz)	Penn Eng.	4426-11B 4424-11B	Z5001 S0930	NA NA
13	Wave-guide transition (90 to 140 GHz)	Penn Eng.	4422-11B 4420-11B	S0911 S0763	NA NA
14	Wave-guide transition (140 to 220 GHz)	Penn Eng.	4418-11B 4416-11B	S0840 S0010	NA NA
15	Horn antenna (18 to 26.5 GHz)	EMCO	3160-10	9305-1031	02/01
	Horn antenna (26.5 to 40 GHz)	EMCO	3160-10	9305-1010	02/01
16	Horn antenna (1 to 18 GHz)	EMCO	3115	2703	01/01
17	Rubidium Frequency Reference	UCT	2008	L0539049	07/00
18	AFC antenna	Chase	CBL6111	1011	02/01
19	AFC Spectrum Analyzer	HP	8566	3014A0872 56	04/01

7. References

1. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations amended per FCC 89-103 (GEN. Docket No. 87-389). Part 2 and 101, U.S. Federal Communications Commission 1995.
2. ANSI C63.4-1992, Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, May 1992.

Annex A (Test Configuration)

The following figures describe the test configuration for the transmitter and receiver radio test cases.

Figure 3: Test Configuration for Tx Output Power, Tx Nominal Output Power

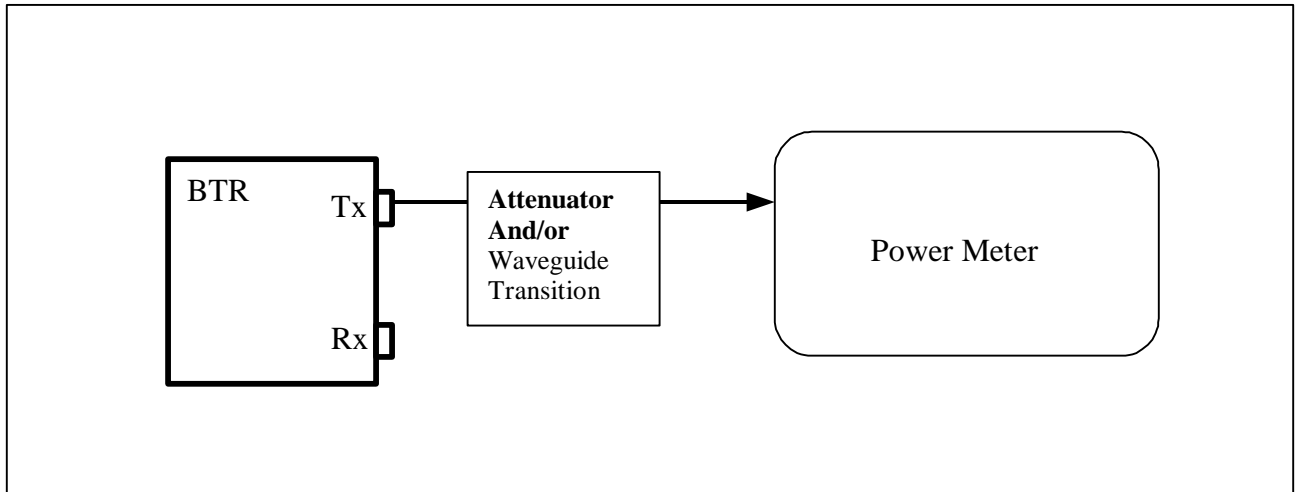


Figure 4: Test Configuration for Radio Frequency Tolerance Test Case

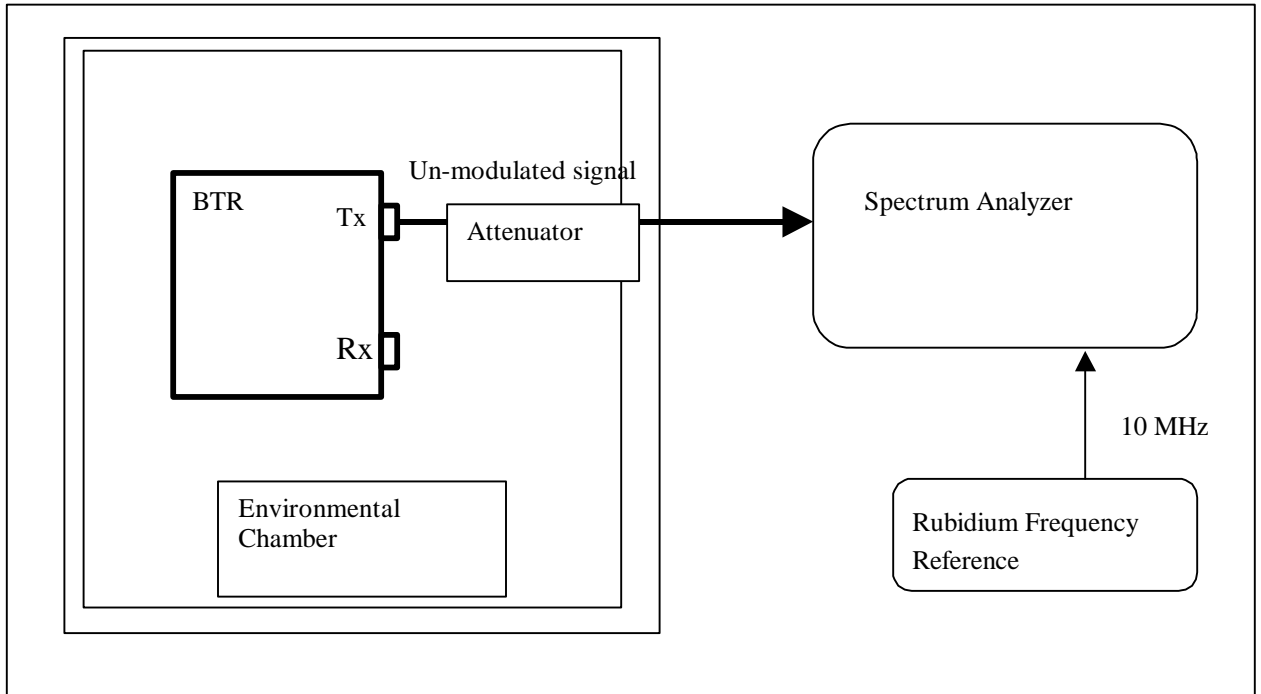
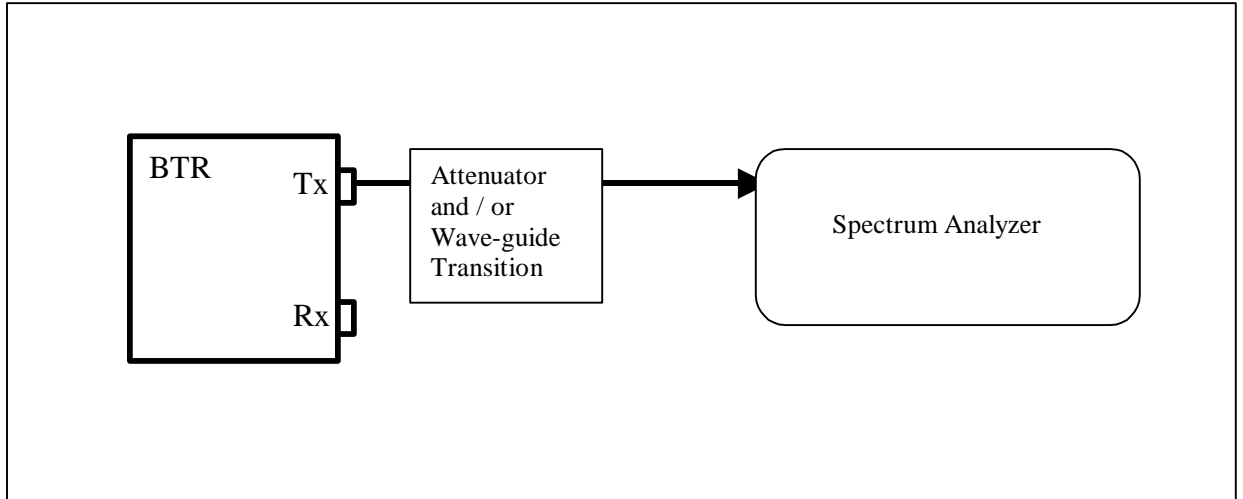


Figure 5: Test Configuration for Spectrum Mask, Occupied Bandwidth, and Spurious Emissions Test Cases



Annex B (Plots)

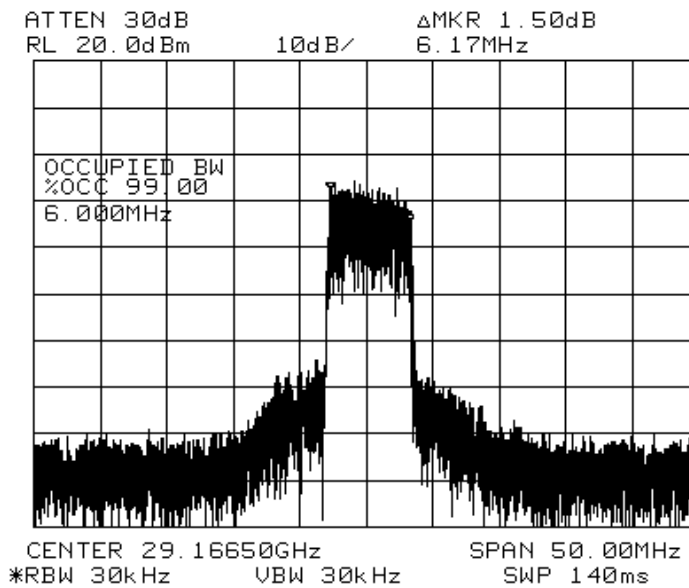


Figure 6 (2807M 01 0001)

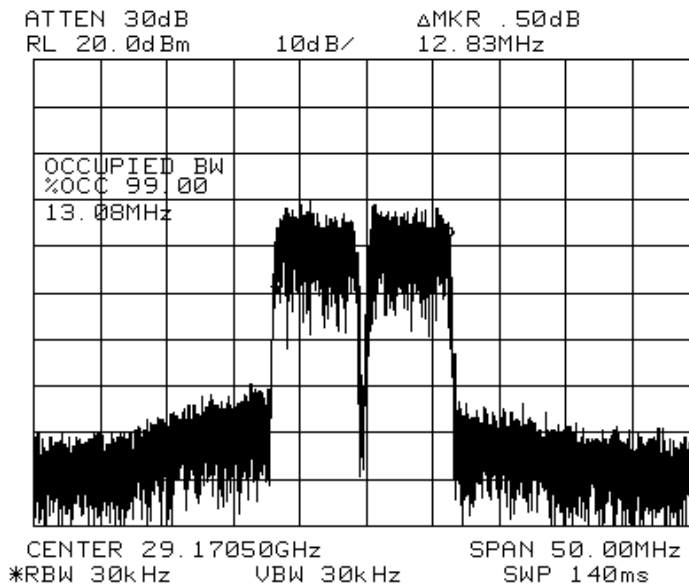


Figure 7 (2807M01 0002)

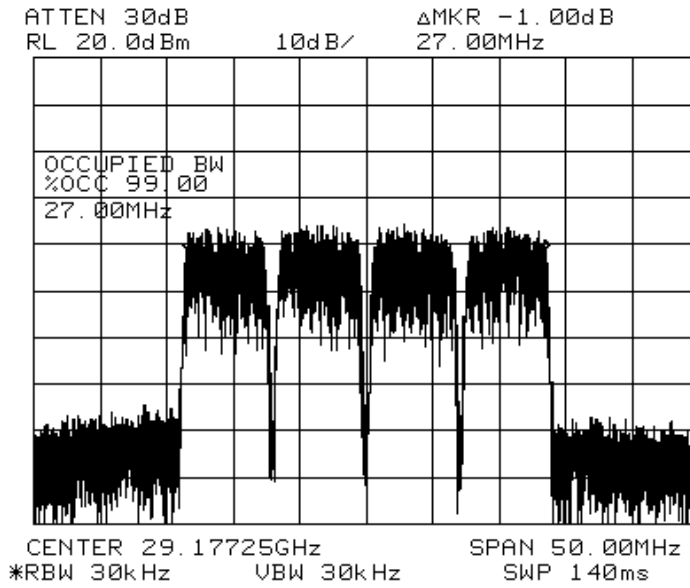


Figure 8 (2807M 01 0003)

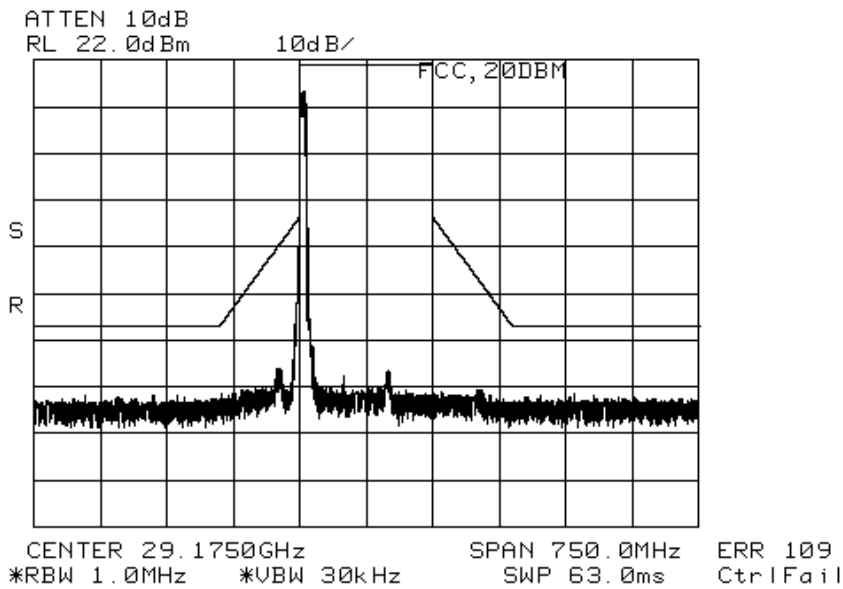


Figure 9 (2807M 01 0004)

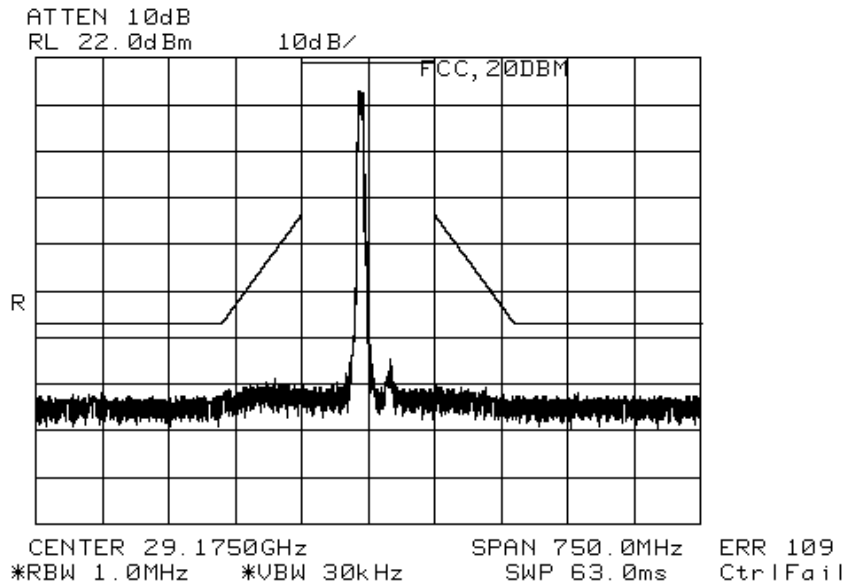


Figure 10 (2807M 01 0005)

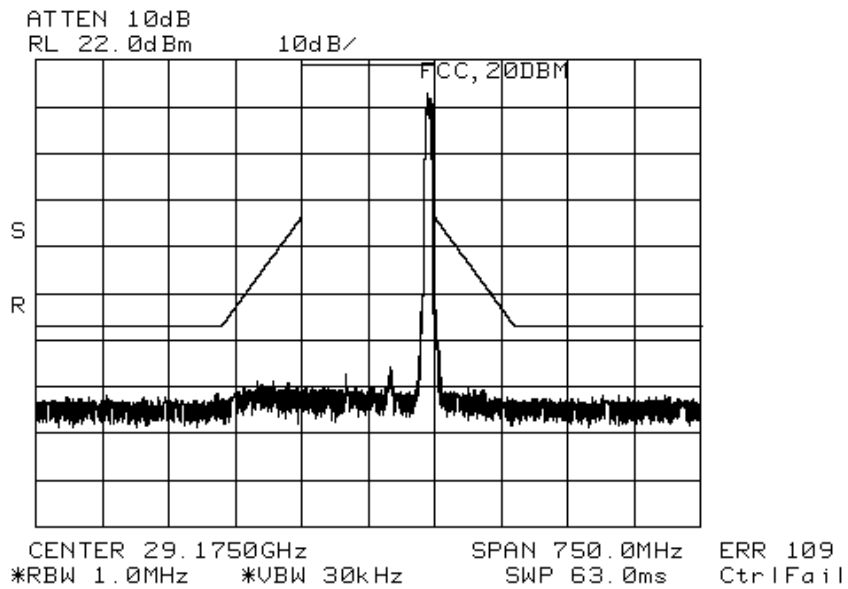


Figure 11 (2807M 01 0006)

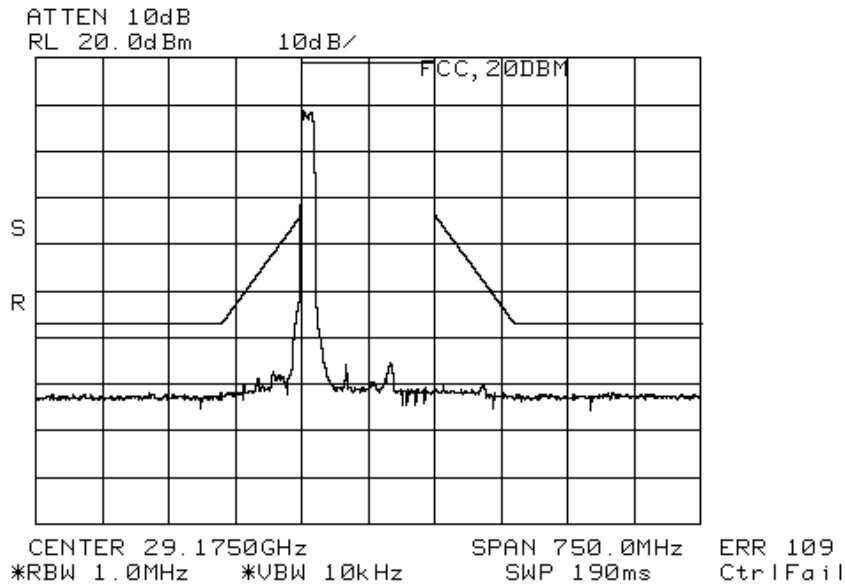


Figure 12 (2807M 01 0007)

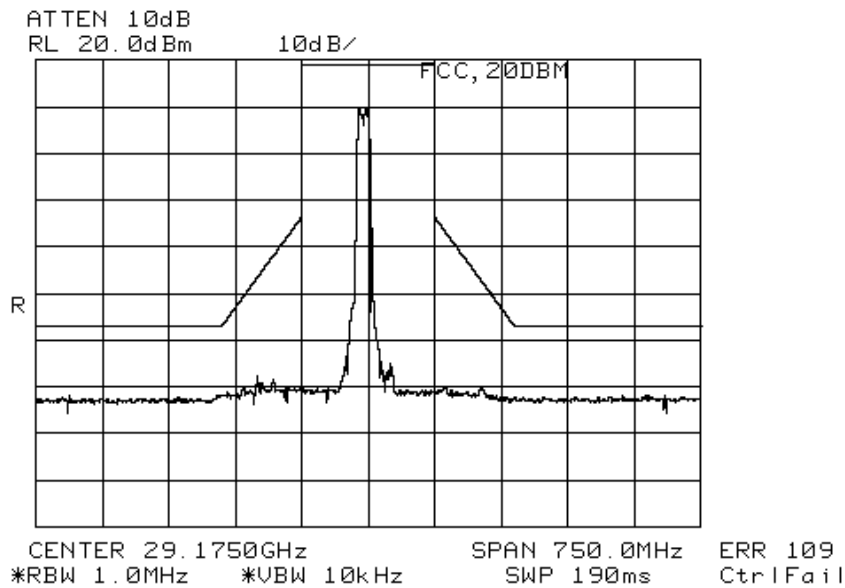


Figure 13 (2807M 01 0008)

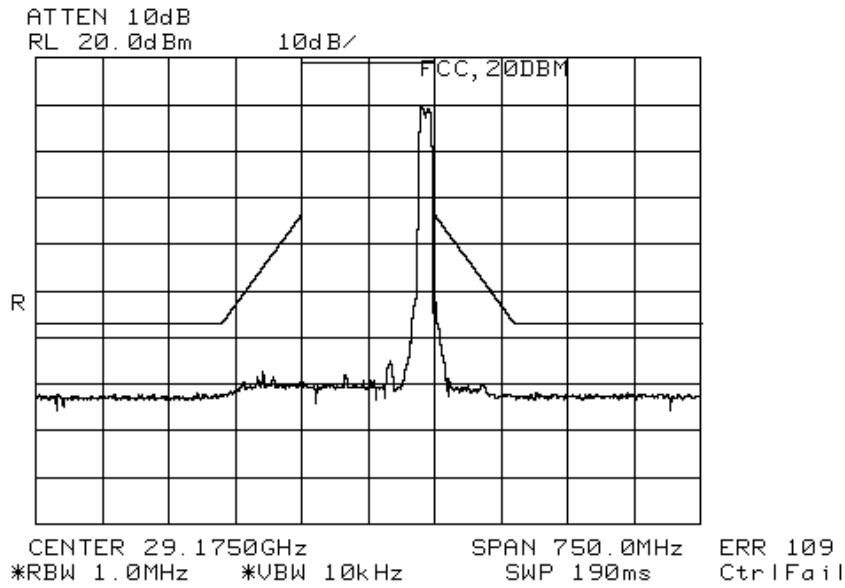


Figure 14 (2807M 01 0009)

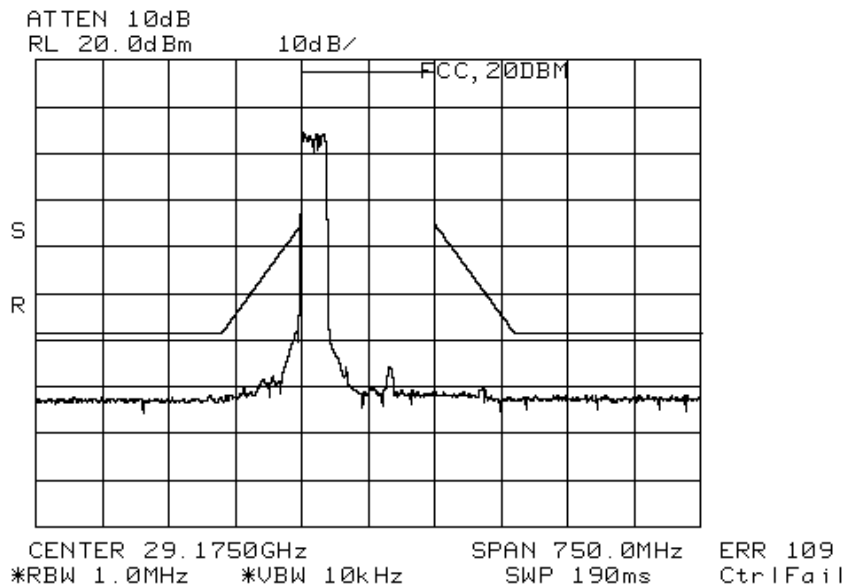


Figure 15 (2807M 01 0010)

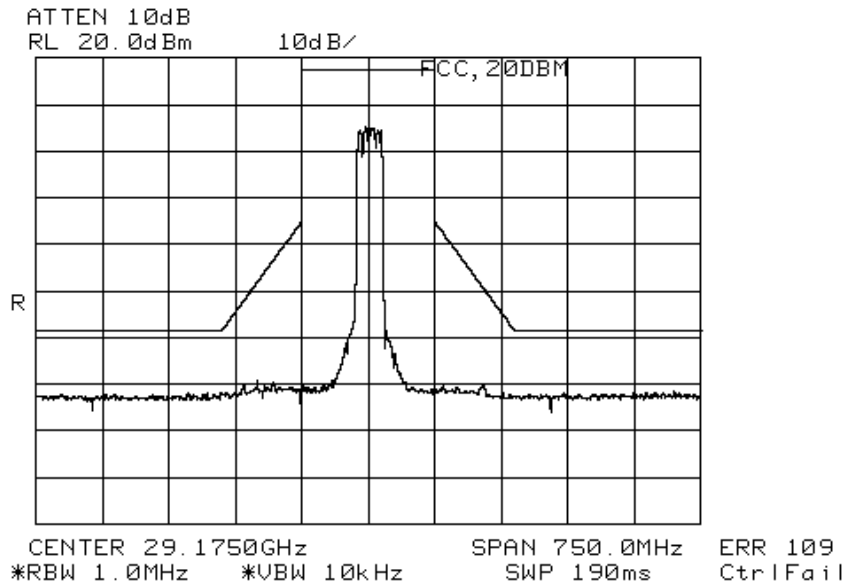


Figure 16 (2807M 01 0011)

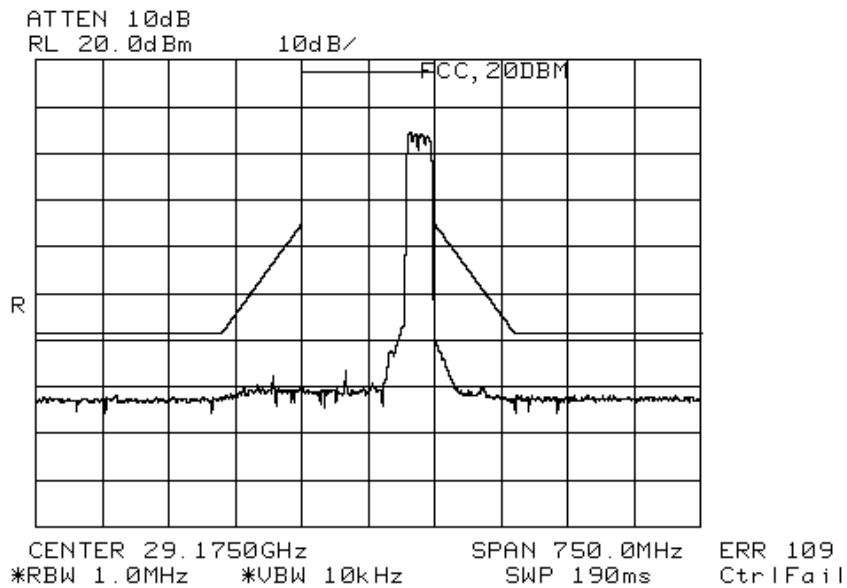


Figure 17 (2807M 01 0012)

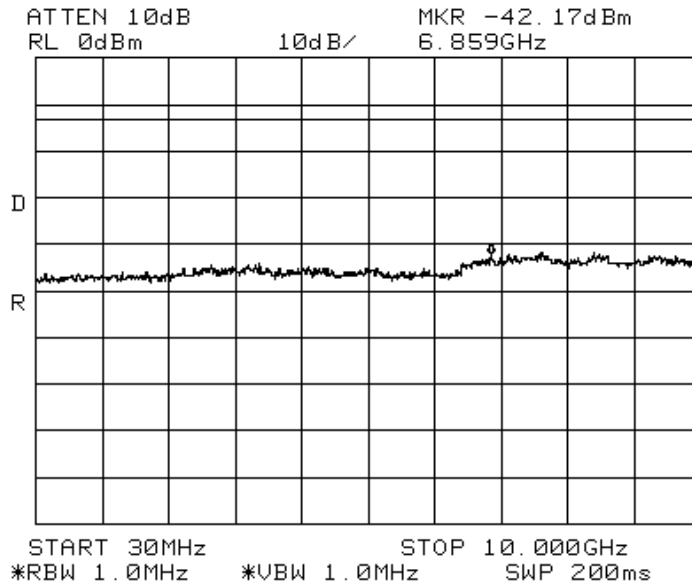


Figure 18 (2807M 01 0013)

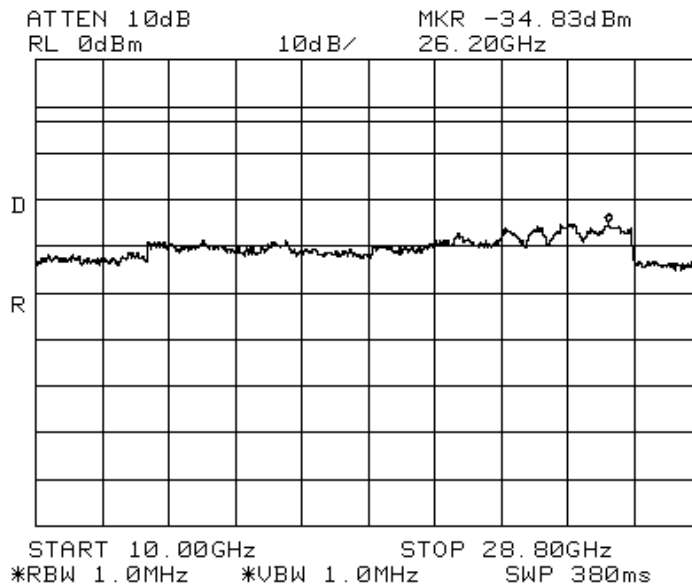


Figure 19 (2807M 01 0014)

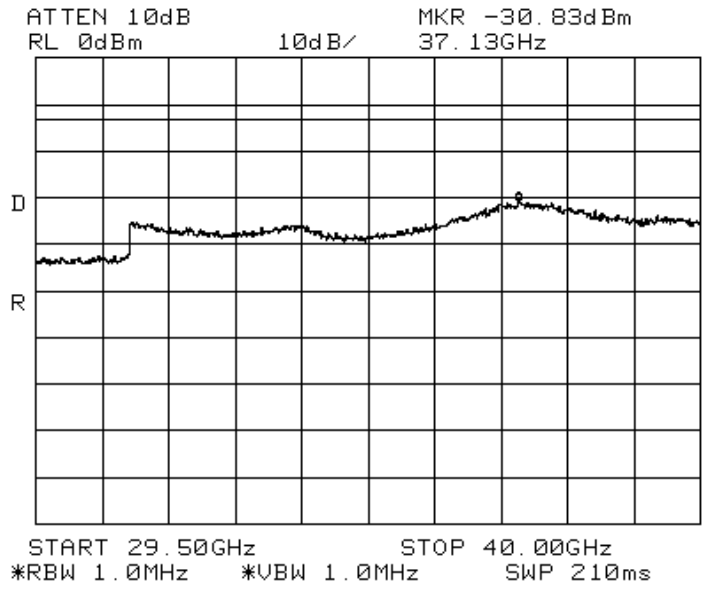


Figure 20 (2807M 01 0015)

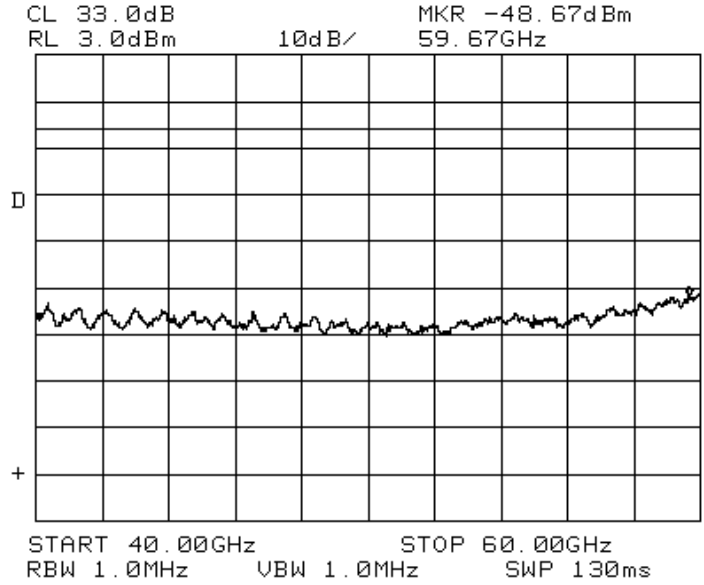


Figure 21 (2807M 01 0016)

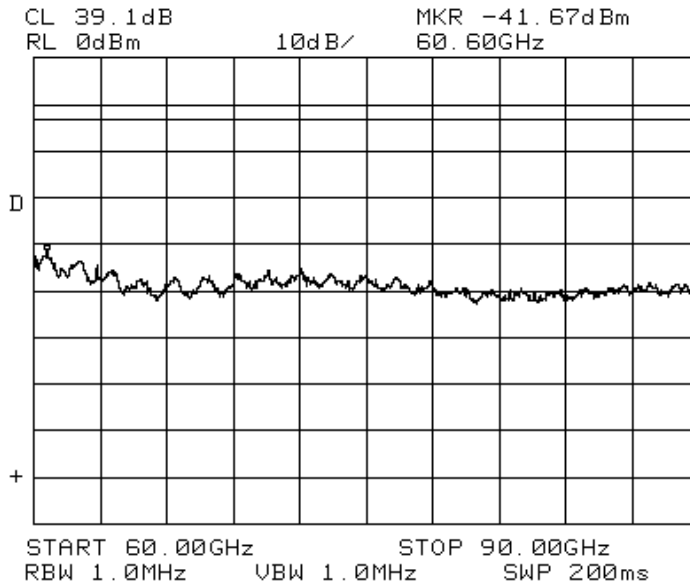


Figure 22 (2807M 01 0017)

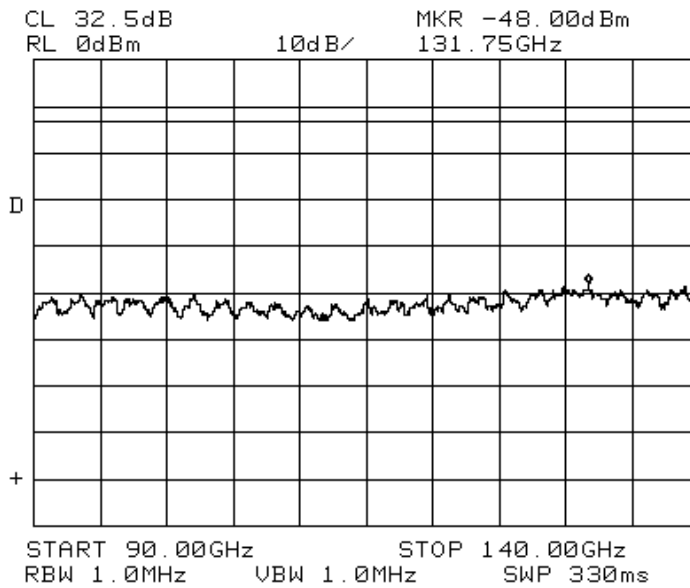


Figure 23 (2807M 01 0018)

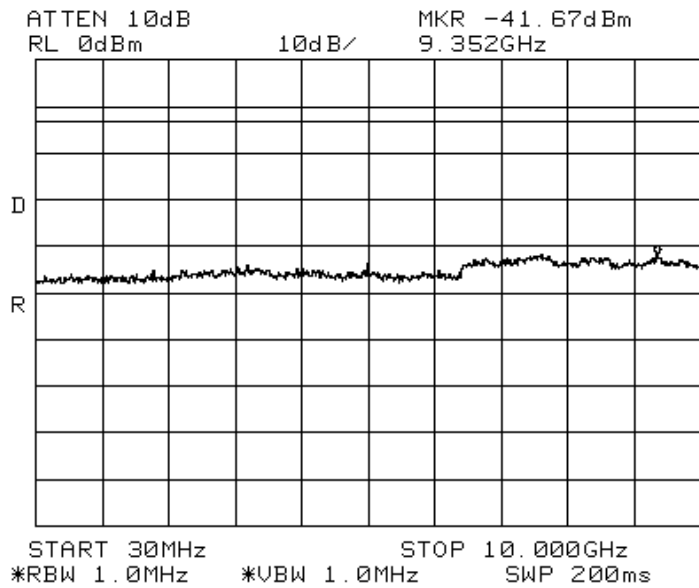


Figure 24 (2807M 01 0019)

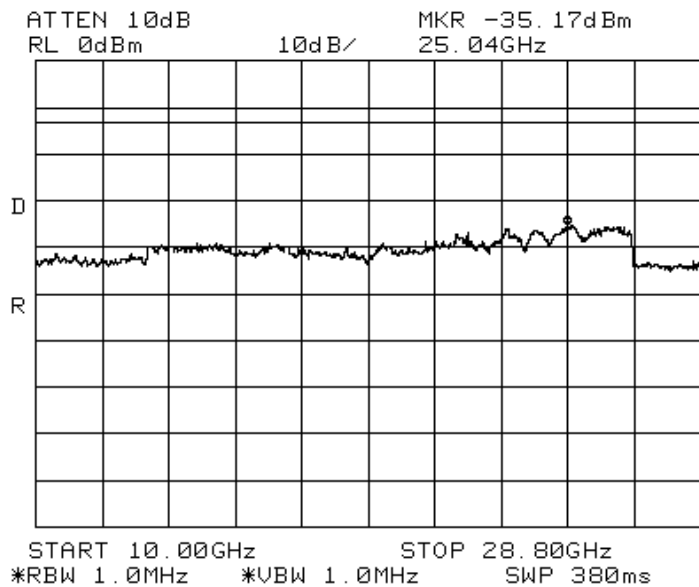


Figure 25 (2807M 01 0020)

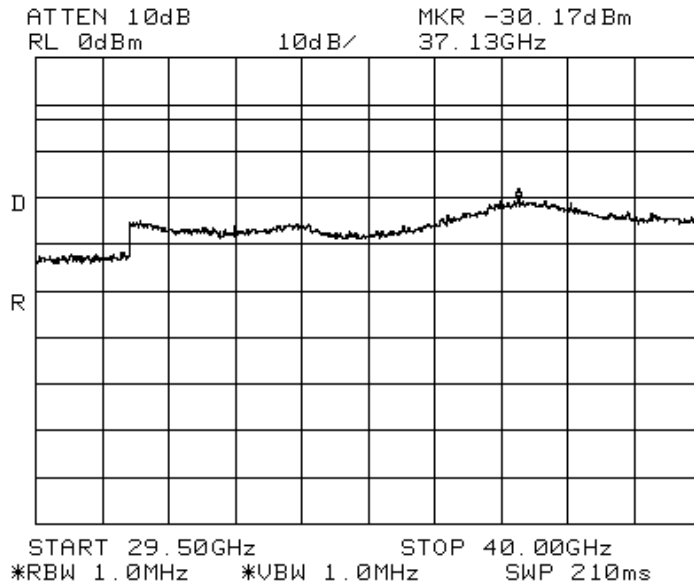


Figure 26 (2807M 01 0021)

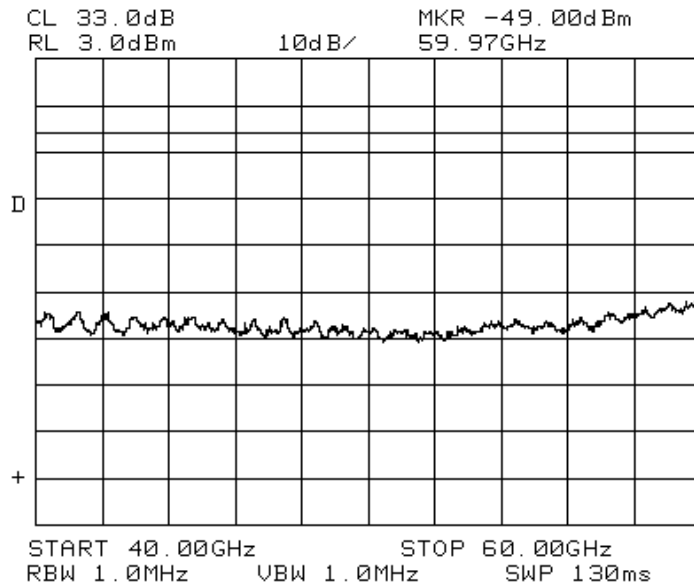


Figure 27 (2807M 01 0022)

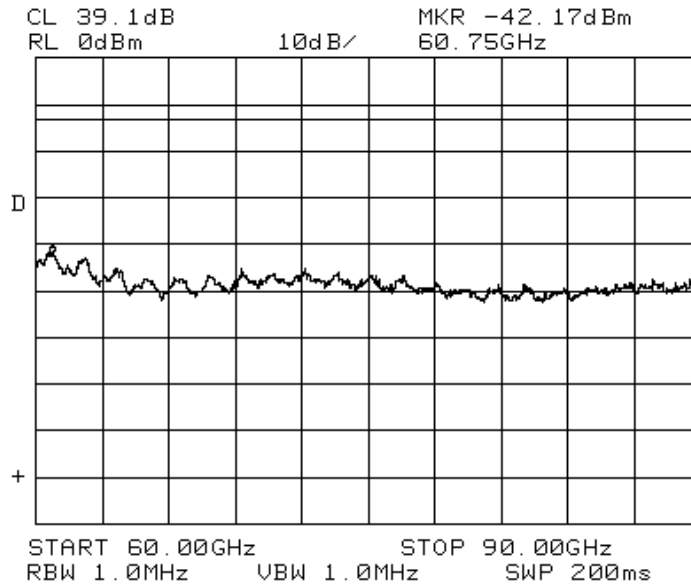


Figure 28 (2807M 01 0023)

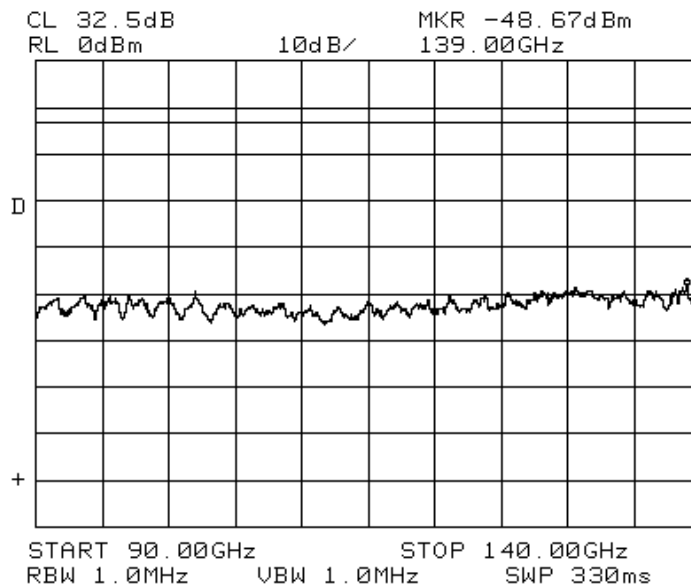


Figure 29 (2807M 01 0024)

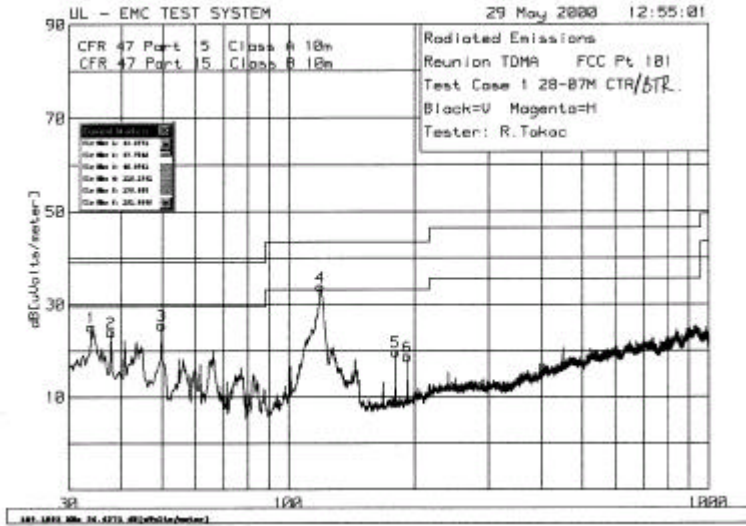


Figure 30 (2807M 01 0025)

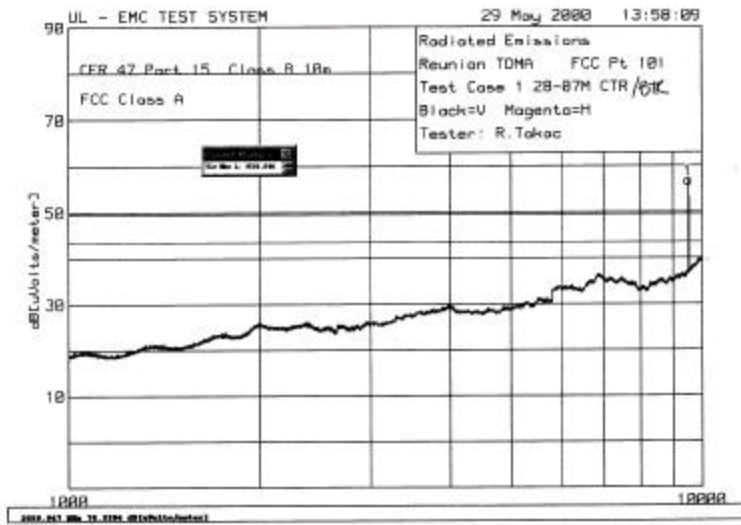


Figure 31 (2807M 01 0026)

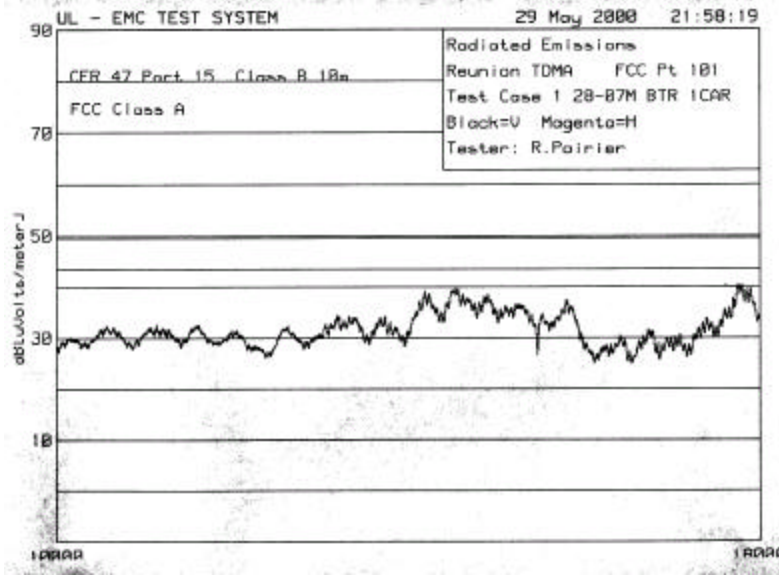


Figure 32 (2807M 01 0027)

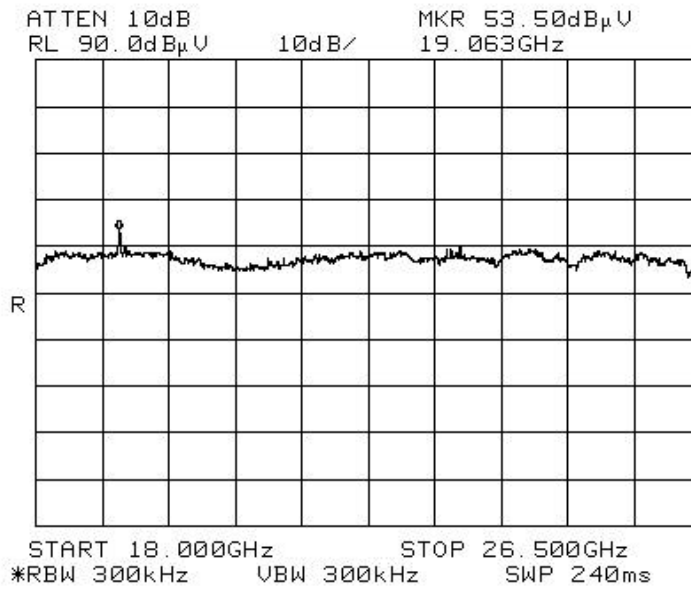


Figure 33 (2807M 01 0028)

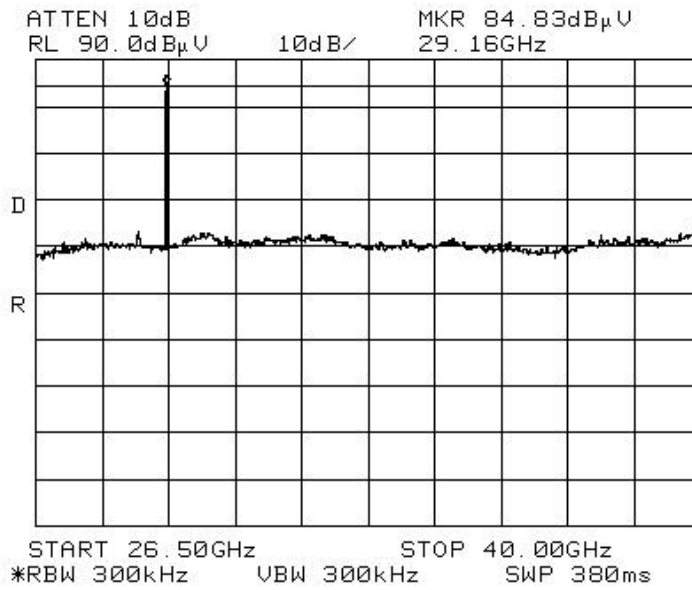


Figure 34 (2807M 01 0029)

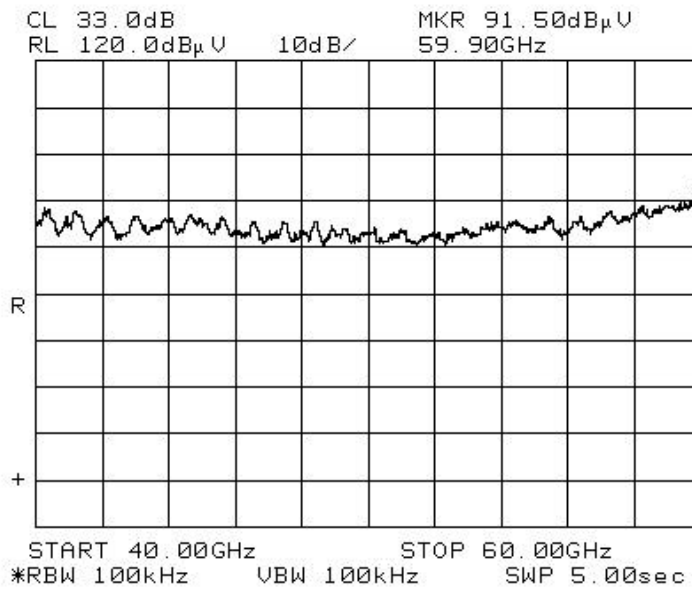


Figure 35 (2807M 01 0030)

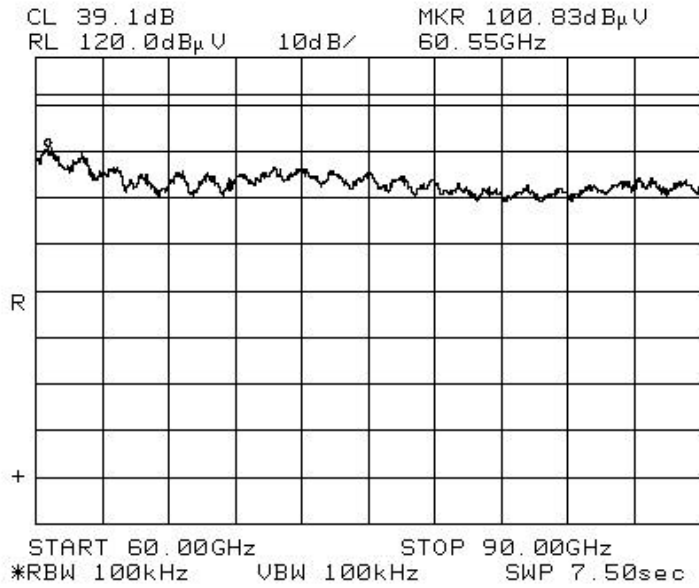


Figure 36 (2807M 01 0031)

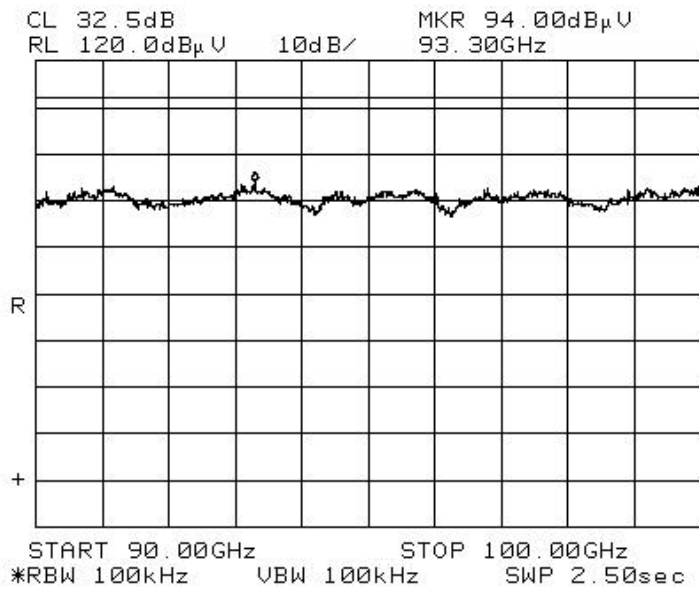


Figure 37 (2807M 01 0032)

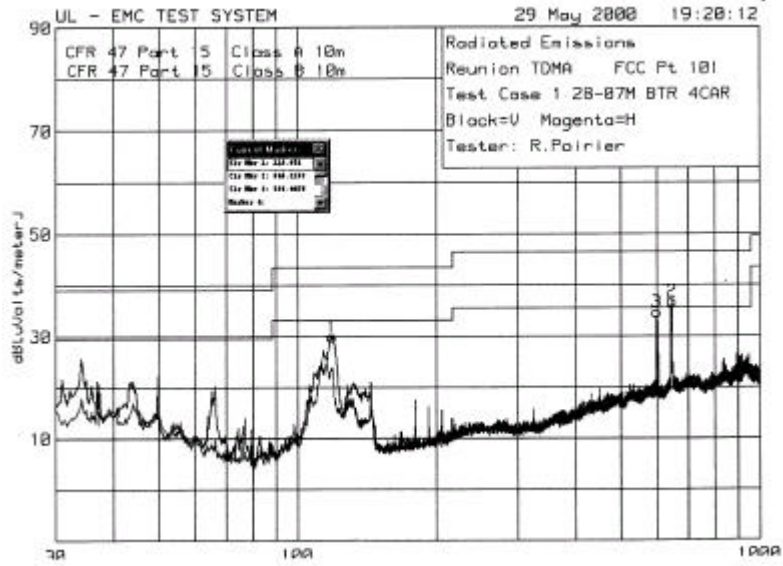


Figure 38 (2807M 01 0033)

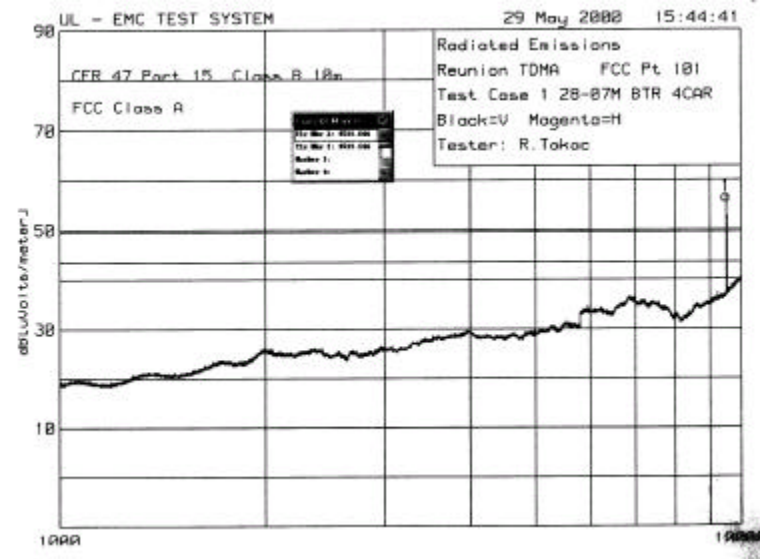


Figure 39 (2807M 01 0034)

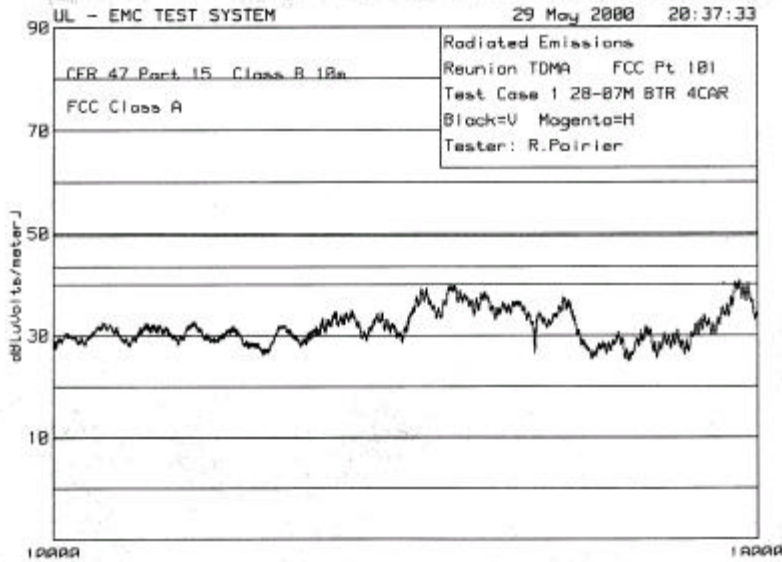


Figure 40 (2807M 01 0035)

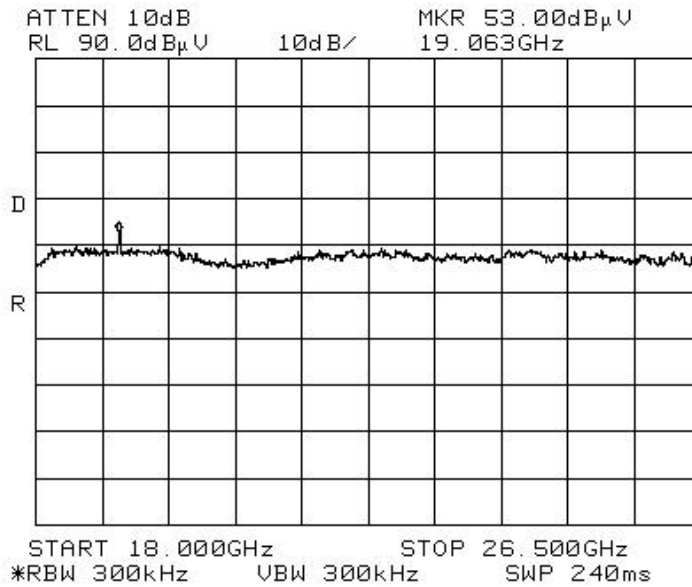


Figure 41 (2807M 01 0036)

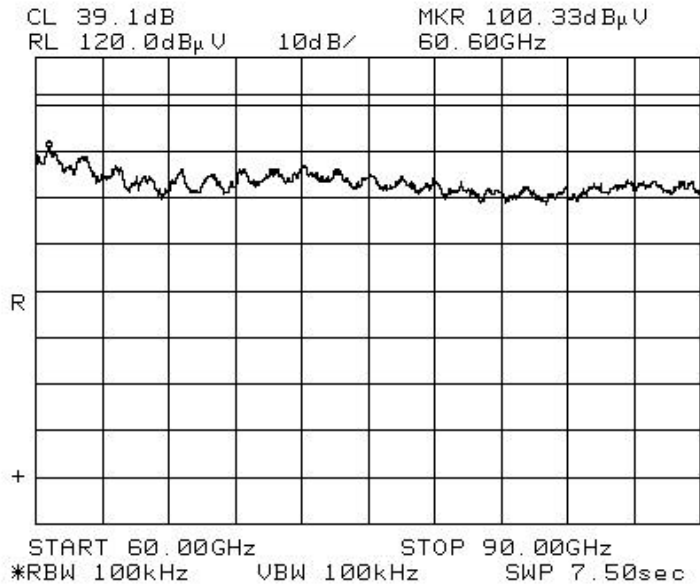


Figure 44 (2807M 01 0039)

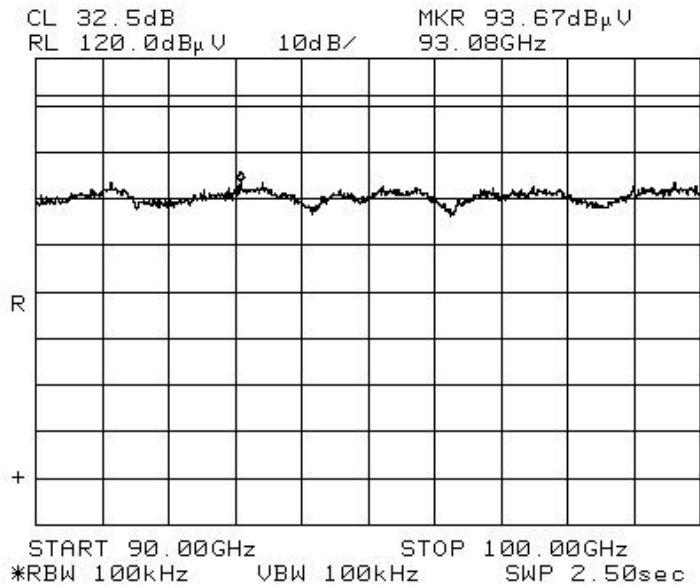


Figure 45 (2807M 01 0040)

Radio Compatibility Test Plan

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