FCC TYPE ACCEPTANCE REPORT

FOR THE

BMTMBSR100MW, 100 mW MBS BAND BOOSTER SYSTEM

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1.0 INTRODUCTION

This report contains the required information for type acceptance of the EMCEE Model MBSR100MW low-power repeater system. The data presented was taken from laboratory tests performed on a production repeater system designed to receive and amplify up to seven digital or analog channels in the MBS band (2572-2614 MHz). This device is intended to provide retransmission gap filling into service areas which are shadowed from reception from the main MBS base station. The repeater system design and test data reflect the rules as prescribed in Part 27 of the Commission's Rules.

2.0 CERTIFICATION OF DATA

FCC §2.909

I certify that the testing procedures and the accumulated test data contained in this report have been personally supervised by me, and that the test results are true and correct to the best of my knowledge and belief.

James A. Yard, CEO
EMCEE Communications

3.0 TEST EQUIPMENT

The following is a list of major test equipment which was used in testing the PA-2507MBS and RA-2507MBS low power repeater system.

Manufacturer	Model #	Serial Number	Description
HP/Agilent	89431A	US39312280	VSA RF Section
HP/Agilent	89441A	US39313875	Vector Signal Analyzer
HP/Agilent	8753ES	US39171643	Vector Network Analyzer
HP/Agilent	E4433B	US38080113	Signal Generator (2)
HP/Agilent	E4402B	US39010125	Spectrum Analyzer
HP/Agilent	E3611	KR83015731	DC Power Supply
HP/Agilent	E7405A	US39440172	EMC/Spectrum Analyzer
Conifer	MC-7EBS	Multi-channel Analog/Digital Signal Source	

4.0 OPERATIONAL DESCRIPTION

The MBSR100MW is a solid state low-power MBS Band retransmission repeater (amplifier) system, and is formed from a combination of a pre-selected frequency input pre-amplifier module (P/N 701007) and an AGC controlled 100mW post amplifier module (P/N 50800002A), each of which is in a separate chassis/housing and connected via an interconnecting coaxial cable with Type 'N' connectors. The system is capable of retransmitting from one to seven MBS channels with either analog NTSC or digital modulation. The system provides an end-to-end gain of about 70dB. The system has no frequency generating circuits, and as such, the output carrier frequencies and modulations are dependent on the inputs. The pre-amplifier contains a dual section inter-digital filter system which provides high Q MBS pass-band circuitry at the input stage. This is to prevent pre-amplifier input overloads due to out of band interference from close stations utilizing the LBS and UBS bands. The input pre-selection also prevents the retransmission of out of band signals. The output (post) amplifier has an output AGC range of 20dB, with a 20dBm average power output power threshold. The AGC circuitry is necessary to provide a constant low distortion output with varying input signal power levels.

Field deployment and configuration of the system includes fitting the system with the appropriate receive and re-transmit antennas. Typically, narrow beam parabolic reflectors are used to provide the necessary input/output link budget and output coverage area. The system, fully into the AGC range, has a maximum input level of -35 dBm and is labeled "DO NOT EXCEED -35 dBm Input" accordingly. A typical installation would have input link characteristics as follows:

Base Station EIRP (maximum)	63.0 dBm
10 Mile Path Loss	-124.9 dB
Receive Antenna Gain (typical)	24.0 dB
System Input Level	- 37.9 dBm

The spectral performance of the system complies with FCC §27.53. All construction and manufacturing techniques are in accordance with accepted principles of good engineering and manufacturing practice. The system is powered with a low voltage (16-24VDC) supply and requires low current (<1 Ampere), and as such, no hazard to operating personnel exists. The pre-amp and post amplifier modules are sealed, therefore there are no user serviceable parts or adjustments inside.

4.1 System Specifications

4.1.1 The system is compatible with the following emission types:

1) Analog Visual-5M75C3F
2) Analog Aural-250KF3E
3) Digital 64/256 QAM-6M00D7W

4.1.2 System Frequency Range: 2572-2614 MHz (MBS Channels A4 through E4)

4.1.3 Operating Power Range: 20dBm (-10dBW) Average

4.1.4 Power Rating: 1 Channel @ 20dBm ±1dB
2 Channels @ 17dBm ±1dB
4 Channels @ 14dBm ±1dB
7 Channels @ 11dBm ±1dB

4.1.5 E & I on Finals (Q1 & Q2): Drain Voltage 10V
Drain Current 180mA

5.0 EXTERNAL PHOTOS

Application for FCC Certification
BMTMBSR100MW

5.1 Identification Label

Application for FCC Certification
BMTMBSR100MW

6.0 INTERNAL PHOTOS

Application for FCC Certification
BMTMBSR100MW

7.0 PARTS LISTS AND TUNE-UP PROCEEDURE

There is no user tuning or adjustment of the system, and all manufacturing adjustments are component value changes which are completed at the factory prior to final assembly and shipment. Component values which are factory selected during the manufacturing test process are designated SAT (Select at Test).

Parts List P/N 701007 Pre-Amplifier Module

Designator	Part Number	Description/Value	Qty. per Assembly	Vendor
R2,4,9	281000	0 Ohm 0805	2	Various
R7,17	281103	10K Ohm 0805 1%	2	Various
R10,16	281110	11 Ohm 0805 1%	2	Various
R19,99	281152	1.5K 0805 1%	2	Various
R8,12,14,18	281182	1.82K 0805 1%	4	Various
R11,15	281332	3.3K 0805 1%	2	Various
R6,13	281510	51 Ohm 0805 1%	2	Various
R20, R21	281112	270 Ohm 0805 1%		
C6,7,8,10,14	313104	.1uF X7R 1210	5	Various
C11	342225	22uF 35V Alum Electrolytic	1	Various
C9,13,24	343106	10uF 16V Tant	3	Various
C42	343207	1.5 pf 1210	1	Various
TP1	365024	RF Test Jack	1	Various
C3,31	382100	10PF NPO 0805	2	Various
C1,2,4,5,17,19,10,22,23,25,26,27,29,30,36,43	383102	1000PF NPO 0805	16	Various
L1, L2, L3	414271	270nH 1210	3	Various
CR1	510006	Transorb - Lightning Protection	1	Various
U2	530003	12V Regulator 78M12ACD	1	Various
U3	530004	5 V Regulator 78M05ACD	1	Various
U1	530007	LM317CDT	1	Various
Q1,4	550001	ATF55143	2	Various
U4	550002	SGA6589	1	Various
C39,40	3830R5	0.5PF NPO 0805 Capacitor	2	Various
C15	3831R0	1PF NPO 0805	1	Various
C21,32	3831R5	1.5PF NPO 0805	2	Various
C18	3834R7	4.7PF NPO 0805	1	Various
Q2,3	MMBT3906LT1	MMBT3906	2	Various
D1,2,3	SS24	SS24/2 Diode	3	Various
R5		1 Ohm 1/2 Watt Resistor	1	Various
IDF1,2	6PEBSIDF	6 Pole EBS band IDF Filter	2	Various
C16,33,34,35,38		Not Installed - SAT	0	Various
L2,3,4		Not Installed - SAT	0	Various
R1,3		Not Installed - SAT	0	Various

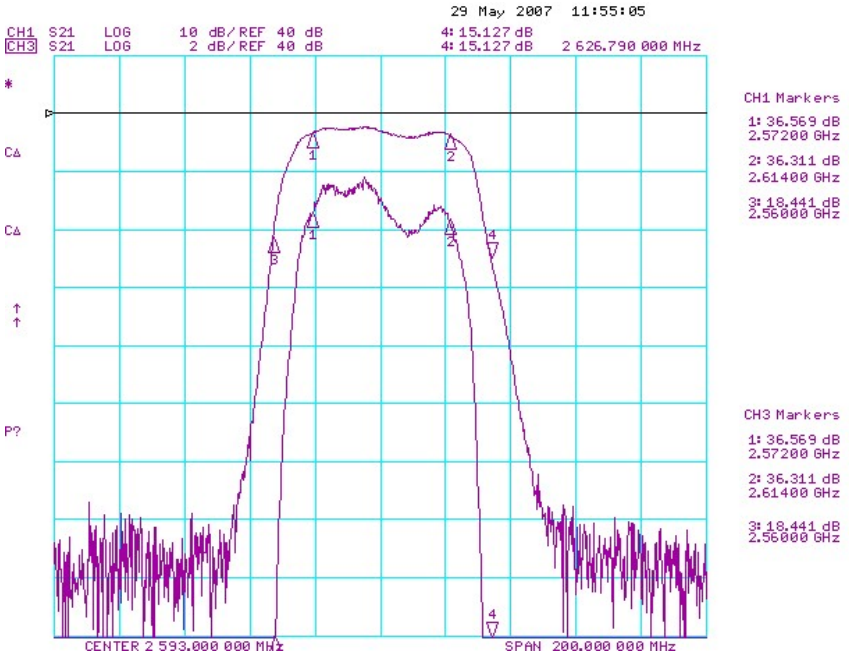
Parts List P/N 50800002A 100 milli-Watt Post Amplifier Module

Designator	Part Number	Value	Qty. per Assembly	Vendor
C1,C3,C4,C6,C8, C10,C12,C13,C15,C16, C17,C18,C19,C21,C22, C23,C24,C26,C27,C28, C29,C31,C33,C35,C36, C37,C39,C40,C42,C43, C51,C53,C58,C59,C60	WA 383100	10pF (0805)	35	Various
C2,C5,C7,C9,C11,C14, C20,C25,C30,C32,C34, C38,C41,C45,C52,C54	WA 383103	.01uF (0805)	16	Various
C44	GRM42-6C0G104M50V	.1uF (1206)	1	Various
C46	GRM42-6Y5v154K50V	.15uF (1206)	1	Various
C48,C55,C56	293D107X9020E	100uF 20V	3	Various
C49,C50,C57	12065C105MAT_T	1uF (1206)	3	AVX
CP1,CP2	1X603	3dB Coupler	2	ANAREN
CR1,CR2,CR3	HSMP4810		3	AVAGO
CR4,CR5	HSMS2810		2	AVAGO
CR6,CR7,CR8	15MQ040NPBF		3	Int. Rectifier
FB1,FB2	WA		2	Various
L1,L2,L3,L4,L5, L6,L7	0805CS-180XJLB	18nH (0805)	7	Coilcraft
L8	1008CS-150XJLB	15nH (1008)	1	Coilcraft
Q1,Q2	FLU10ZM		2	Eudyna
Q3	MMBT3904		1	Various
R1	RM73B2ET120J	12 Ohm (1210)	1	Various
R2,R3	RM73B2ET241J	240 Ohm (1210)	2	Various
R4,R6	WA 222181	180 Ohm (1206)	2	Various
R5	RM73B2ET271J	270 Ohm (1210)	1	Various
R7,R8	RM73B2ET240J	24 Ohm (1210)	2	Various
R9,R14,R15	WA 282510	51 Ohm (0805)	3	Various
R10,R11	WA 282100	10 Ohm (0805)	2	Various
R12,R13	RM73B2ET8R2J	8.2 Ohm (1210)	2	Various
R16	WA 282680	68 Ohm (0805)	1	Various
R17	WA 282472	4.7K (0805)	1	Various
R18	WA 222273	27K (1206)	1	Various
R19	WA 282103	10K (0805)	1	Various
R20	WA 282273	27K (0805)	1	Various
R21	WA 282474	470K (0805)	1	Various
R22,R25	WA 282102	1K (0805)	2	Various
R23,R26,R27	3214W-1-102	1K Pot	3	Bourns
R24,R28	RK73B2ATTD303J	30K (0805)	2	Various
U1	AM1	MMIC AMP	1	Watkins Johnson
U2	AH102	MMIC AMP	1	Watkins Johnson
U3	MAX1719EUT	Voltage Converter	1	Maxim
U4	MC78L05	5V Regulator	1	Various
U5	AD823AR	OP-AMP	1	Analog Devices
U6	PT6101C	Voltage Regulator	1	Texas Instruments
U7	LM317AEMP	Voltage Regulator	1	Various

8.0 TEST RESULTS

8.1 SYSTEM GAIN MEASUREMENT

This test is made using the HP 8753 Network Analyzer. A 50Ω, 35dB pad with substantially zero reactance is utilized ahead of the analyzer to provide the proper input level to the device and which yields full dynamic range of the instrument. The system is then swept by the Network Analyzer. The analyzer at marker 1 shows the total system gain to be 36.56 + 35dB (pad) = 71.56dB. At marker 2, the gain is 36.31 + 35dB = 71.31 dB. The overall gain flatness is shown to be better than ±1dB across the band of interest, 2572-2614 MHz.



8.2 OCCUPIED BANDWIDTH

Using the test setup in Figure 1, and with the transmitter operating at maximum power carrying a seven (7*6MHz=42MHz) channel load, the following transmitter occupied bandwidth plots were taken.

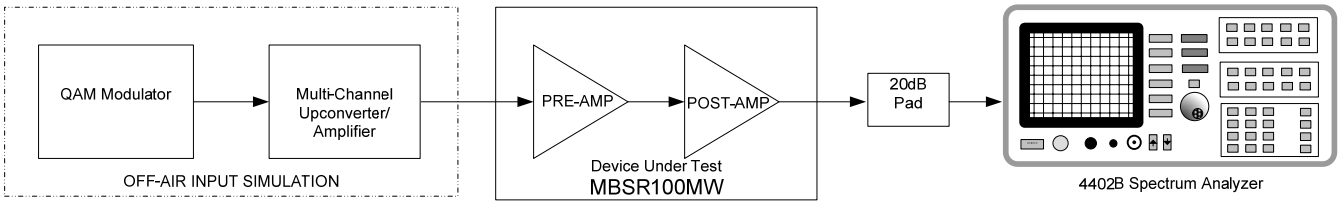
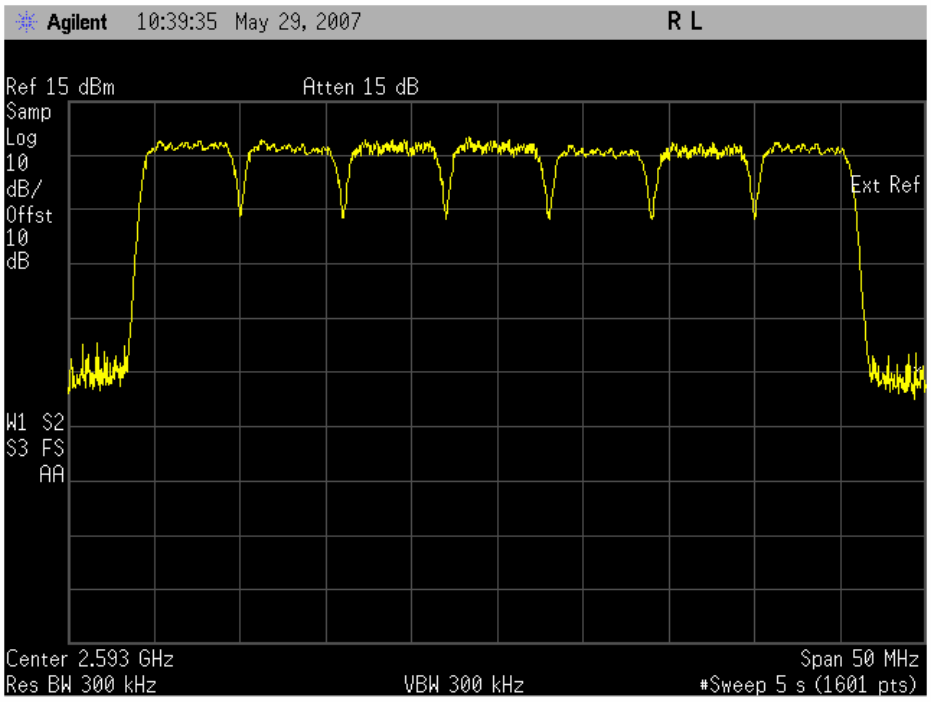
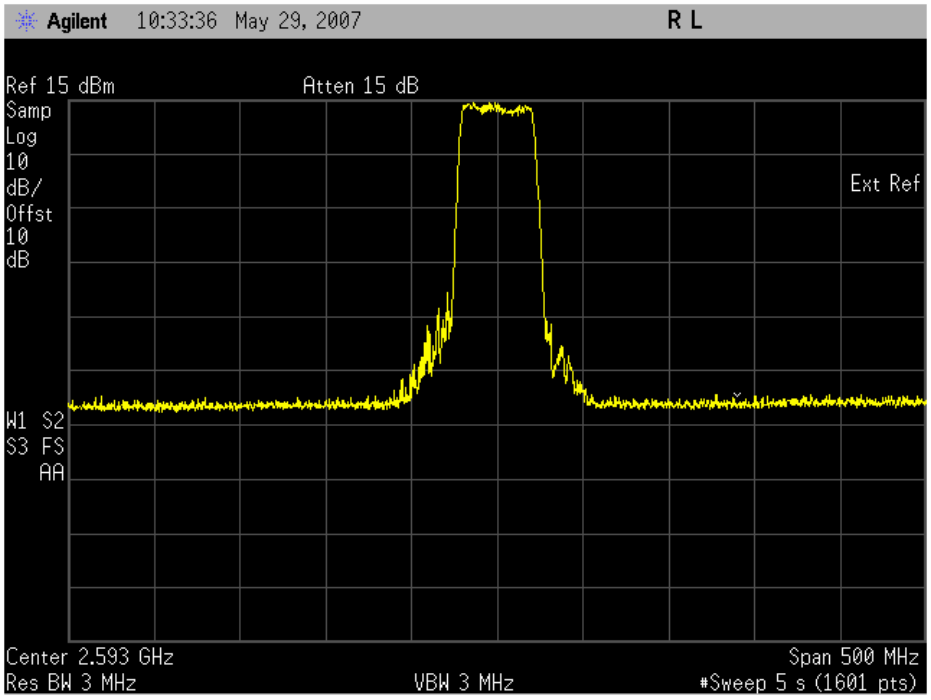


Figure 1. Test Equipment Setup

8.2.1 Occupied Bandwidth-50 MHz Analyzer Span



8.2.2 Occupied Bandwidth-500 MHz Analyzer Span



8.3 POWER OUTPUT MEASUREMENTS

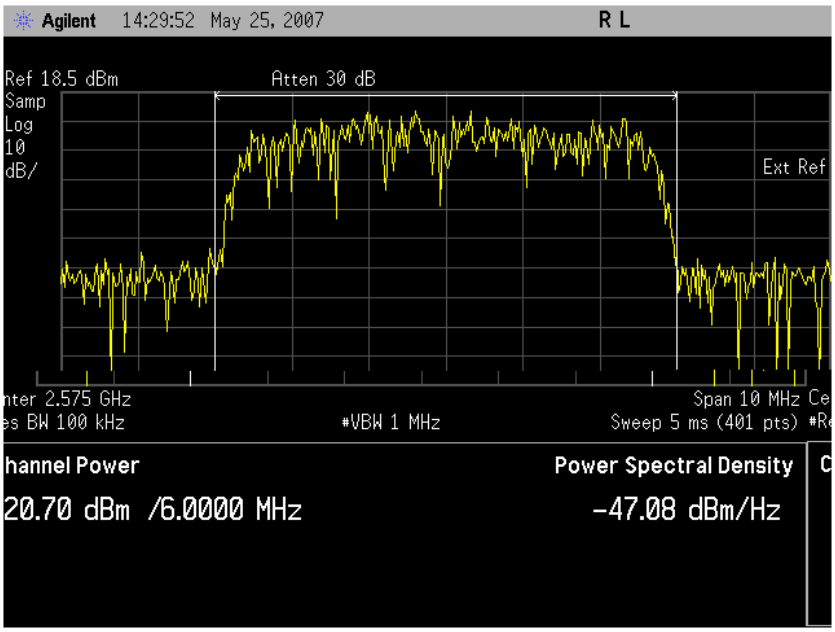
The Conifer MC-7EBS Multi-channel Analog/Digital Signal Source was utilized to simulate off-air inputs of various channel loads to the system. Testing with both digital and analog carriers was accomplished, which provide power output measurements with both input signal types.

The test equipment setup is shown in Figure 1. The HP/Agilent E4402B input was fitted with a 50 Ω, 20dB pad with substantially zero reactance so as to provide the proper input level and yield maximum dynamic range of the instrument. The channel power function of the analyzer was used to measure the power integrated into a 6 MHz bandwidth. The system's AGC control error was found to be <3% of 20dBm average power throughout its range. Channel power measurements were taken using one, two, four, and seven channels loaded on the system and the levels were recorded as follows:

Number of Channels	Power Output/Channel	Type of Modulation
1	20.70dBm (-9.30dBW)	Digital
1	22.02dBm (-7.85dBW)	Analog
2	16.89dBm (-13.11dBW)	Digital
2	18.19dBm (-11.81dBW)	Analog
4	13.51dBm (-16.49dBW)	Digital
4	15.16dBm (-14.84dBW)	Analog
7	11.34dBm (-18.66dBW)	Digital
7	12.34dBm (-17.66dBW)	Analog

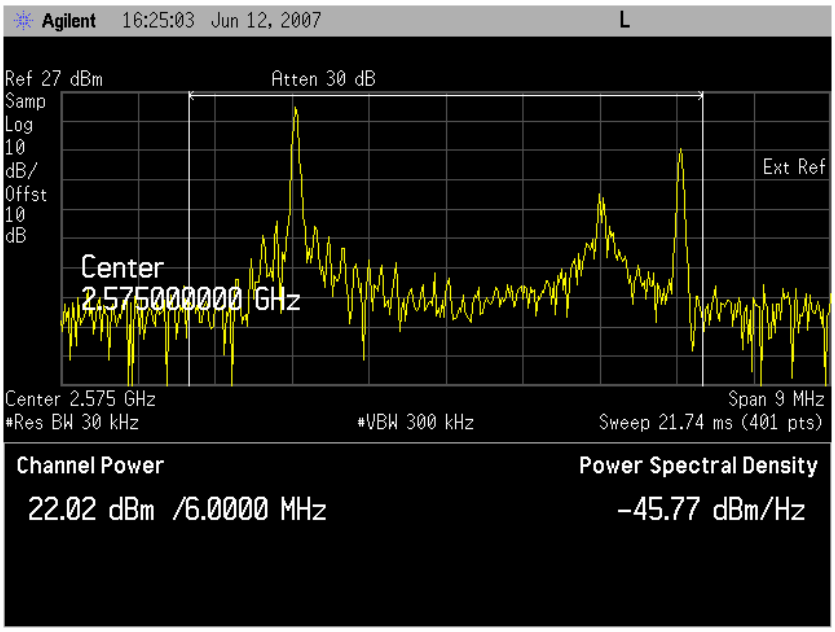
8.3.1 Power Output, Single Channel Digital, Power Measurement

This test, made using the Agilent HP E4402B Spectrum Analyzer, shows the single channel, digital channel power output at 20.70dBm. The test channel was modulated with a 64 QAM, 5.07ms carrier. The system input drive was swept across a 20 dB range with no change in the system output. Channel power is measured at 20.70dBm.



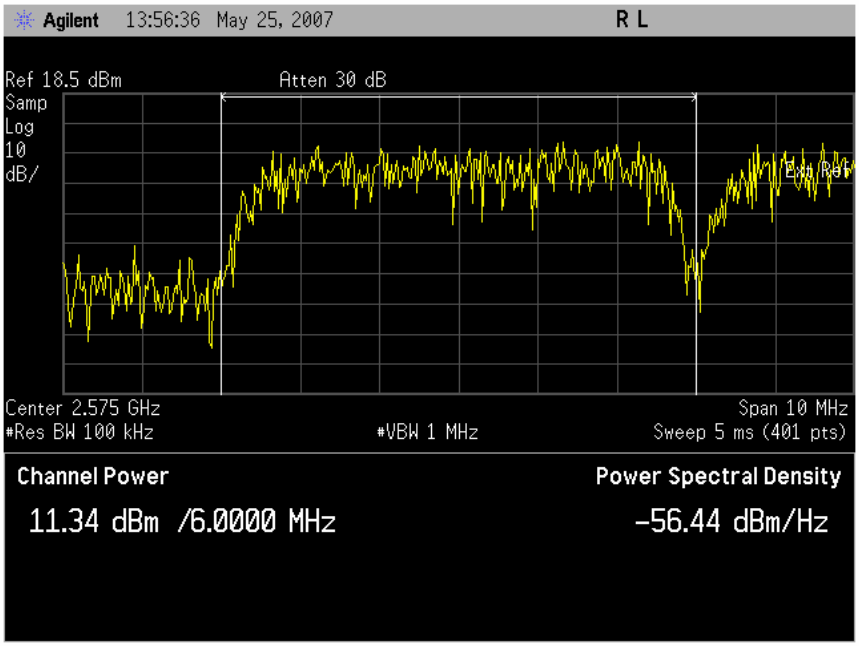
8.3.2 Power Output, Single Channel Analog, Power Measurement

The test channel was then modulated with a single NTSC composite color television carrier. The system input drive was swept across a 20 dB range with no change in the system output. Channel power is measured at 22.02dBm.



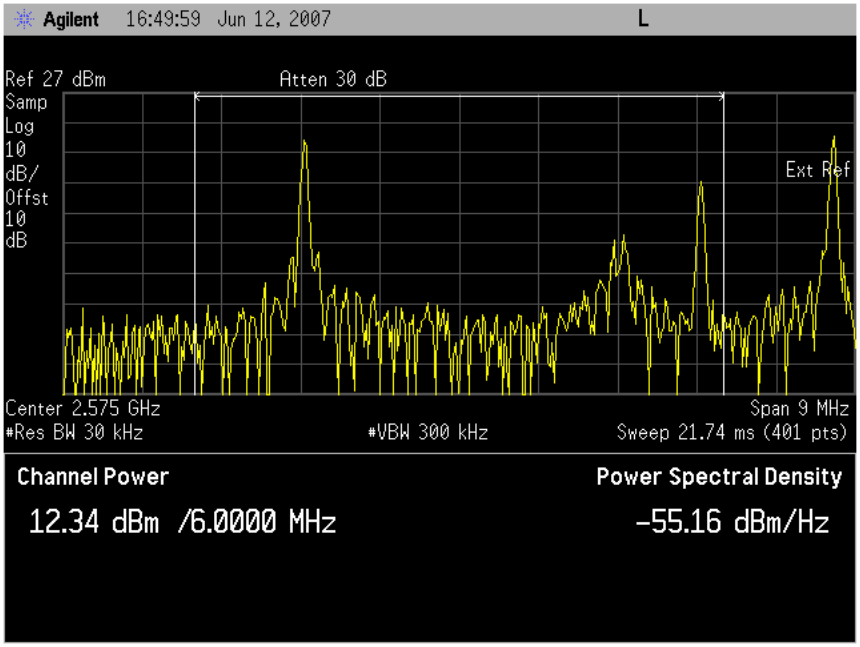
8.3.3 Power Output, 7 Channel Digital, Power Measurement

Power Output, Measured with seven like digital carriers. Power output per carrier is reduced to 11dBm (11.34dB)/carrier with the additional channel load. Total composite output remains at 20dBm.



8.3.3 Power Output, 7 Channel Analog, Power Measurement

Power Output, Measured with seven like analog carriers. Power output per carrier is reduced to 12dBm (12.34dB)/carrier with the additional channel load. Total composite output remains at 20dBm.



8.4 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Part 27.53 of the Rules states:

27.53 (l) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.

27.53 (l)(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB.

27.53 (l)(6) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of

which all emissions are attenuated at least 26 dB below the transmitter power. With respect to television operations, measurements must be made of the separate visual and aural operating powers at sufficiently frequent intervals to ensure compliance with the rules.
Applying the formula above, the required attenuation of out-of-band (OOB) power in a 1MHz bandwidth relative to the transmitter power can be calculated:

100mW Transmitter:
43 + 10*log(.1)=33dB

With regard to §27.53 (l)(6), the 1% emission bandwidth option has been chosen so as to provide for the most accurate measurement of the out of band (OOB) emissions. The amount of out-of-band power in 1% (60KHz) of the emission bandwidth (6MHz) relative to the transmitter power can be automatically measured by the channel power function of the 4402B Spectrum Analyzer. With 64 QAM digital modulation, the out of band emissions we sampled at various points outside the band with different channel loading, and no emissions above -60dB relative to the carrier power were observed. The test setup in Figure 1 was used to obtain the following measurements.

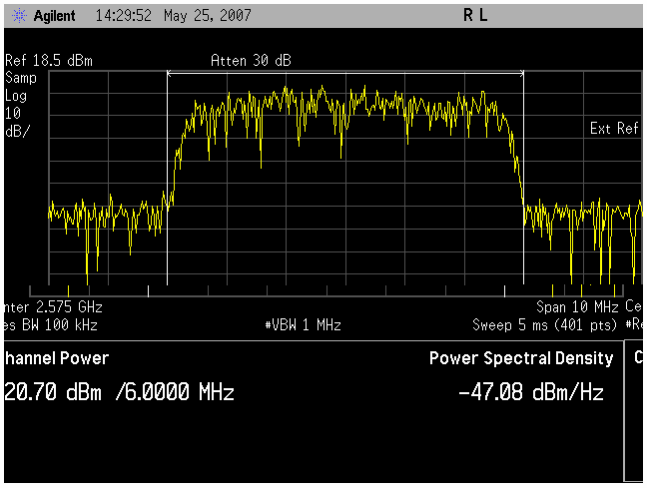
8.4.1 Spurious Emissions-Test #1

System Loading, One Digital Channel, A4 @ 2575 MHz (lowest MBS channel)

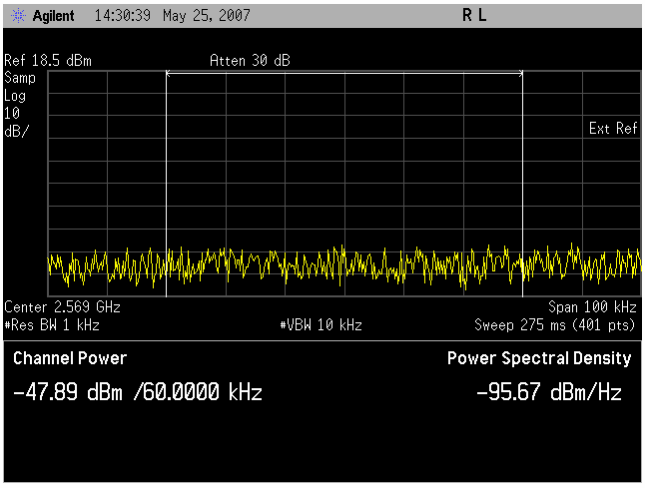
Plot #1, Channel Power of +20.70 dBm w/6 MHz Integrated Bandwidth

Plot #2, Channel Power at -6 MHz, -47.89 dBm w/60 KHz Integrated Bandwidth

Measurement Results: +20.70 dBm - (-47.89 dBm) = 68.59 dB of OOB Rejection @ -3MHz



Plot 1



Plot 2

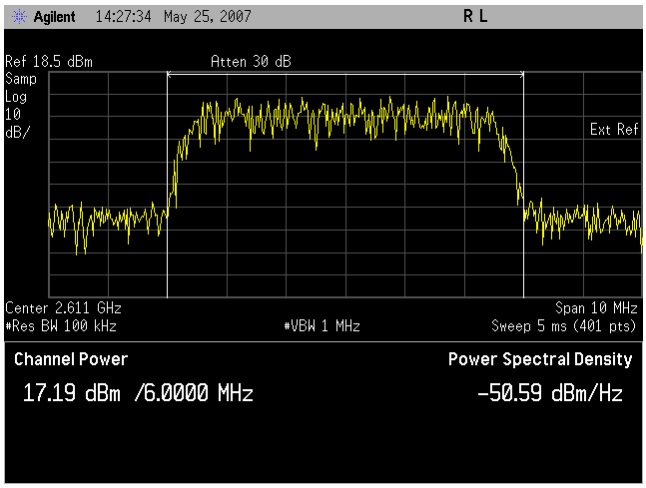
8.4.2 Spurious Emissions-Test #2

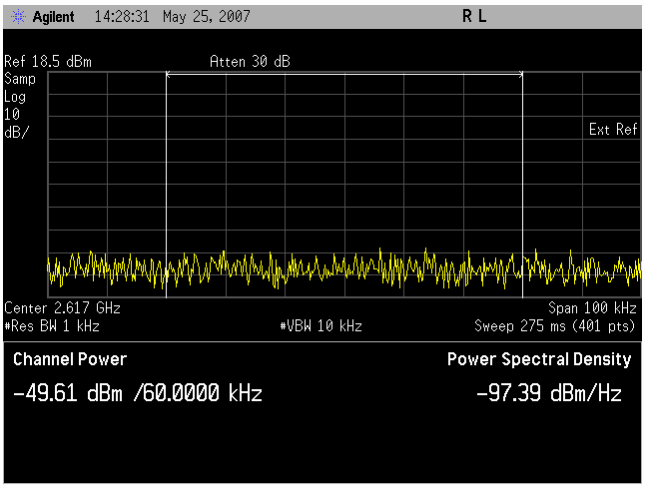
System Loading, Two Digital Channels, F4 and E4 at Upper Band Limit

Plot #1, Channel Power of E4, +16.89 dBm w/6 MHz Integrated Bandwidth

Plot #2, Channel Power at +6 MHz, -49.93 dBm w/60 KHz Integrated Bandwidth

Measurement Results: +17.19 dBm - (-49.61 dBm) = 66.80 dB of OOB Rejection @ +3MHz





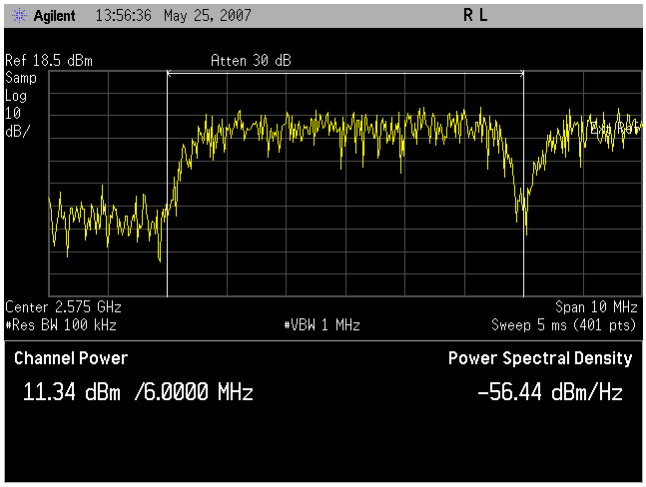
8.4.3 Spurious Emissions Test #3

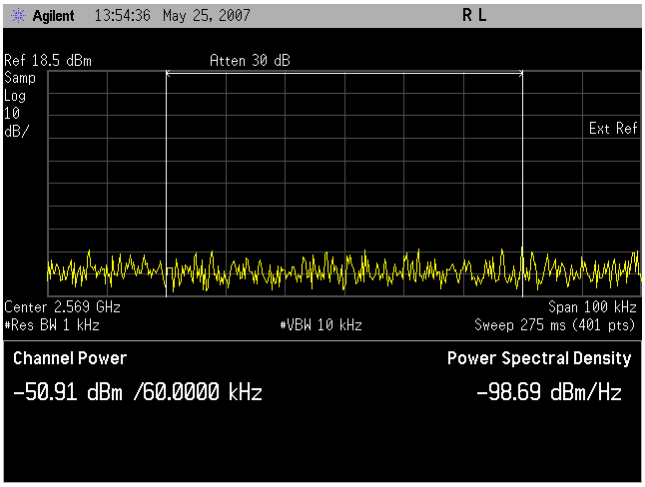
System Loading, Seven Digital Channels, at Lower Band Limit

Plot #1, Channel Power of A4, +11.34 dBm w/6 MHz Integrated Bandwidth

Plot #2, Channel Power at -6 MHz, -50.91 dBm w/60 KHz Integrated Bandwidth

Measurement Results: +11.34 dBm - (-50.91 dBm) = 62.25 dB of OOB Rejection @ -3MHz





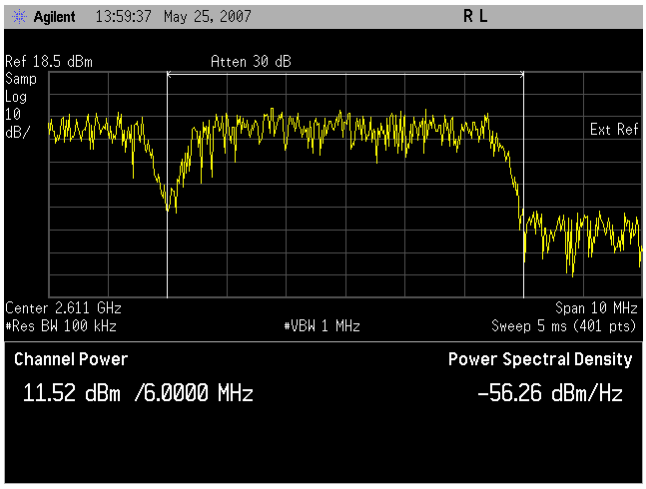
8.4.4 Spurious Emissions Test #4

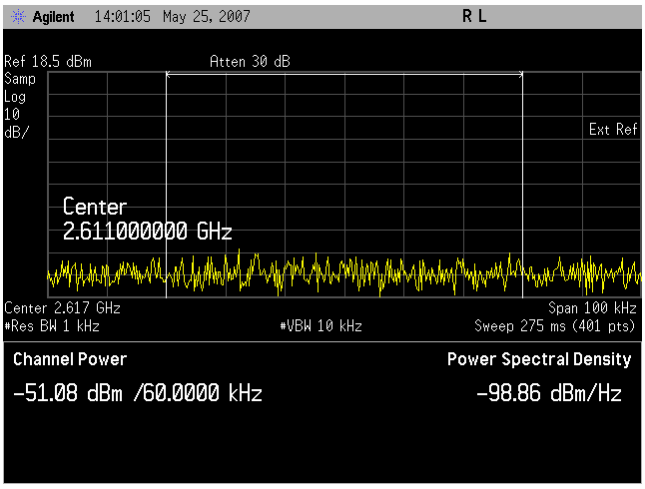
System Loading, Seven Digital Channels, at Upper Band Limit

Plot #1, Channel Power of E4, +11.52 dBm w/6 MHz Integrated Bandwidth

Plot #2, Channel Power at +6 MHz, -50.08 dBm w/60 KHz Integrated Bandwidth

Measurement Results: +11.52 dBm - (-51.08 dBm) = 62.60 dB of OOB Rejection @ +3MHz





Part 27.53 of the Rules also states:

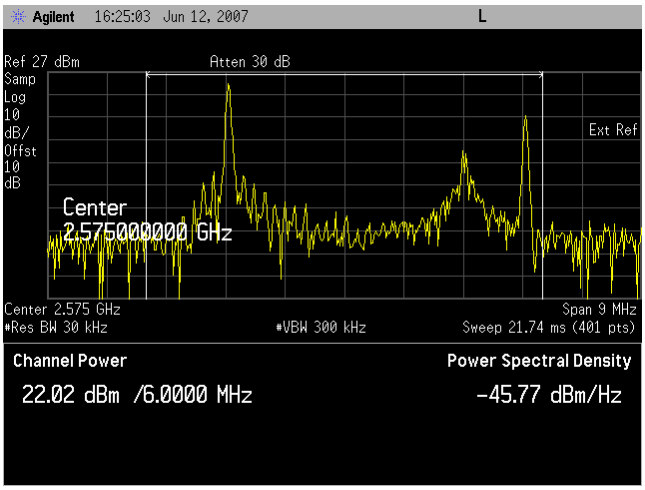
27.53 (l)(1) Prior to the transition, and thereafter, solely within the MBS, for analog operations with an EIRP in excess of -9 dBW, the signal shall be attenuated at the channel edges by at least 38 dB relative to the peak visual carrier, then linearly sloping from that level to at least 60 dB of attenuation at 1 MHz below the lower band edge and 0.5 MHz above the upper band edge, and attenuated at least 60 dB at all other frequencies.

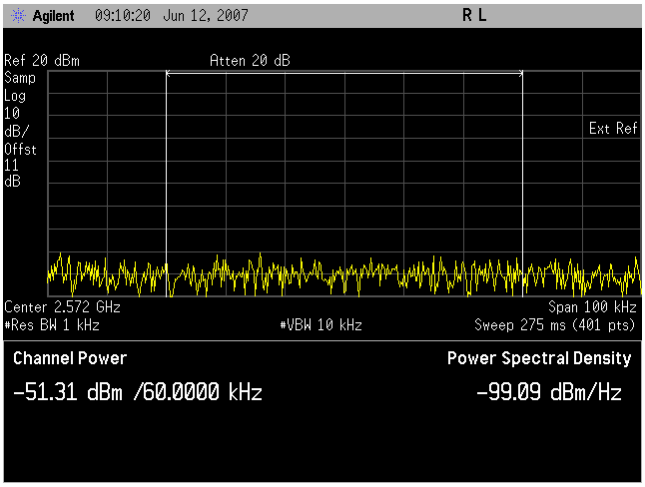
Out of band emission tests were also conducted using NTSC composite modulation on channel loads of one through seven channels. The device was driven into its maximum power range and the following tests were performed.

8.4.5 Spurious Emissions Test # 5

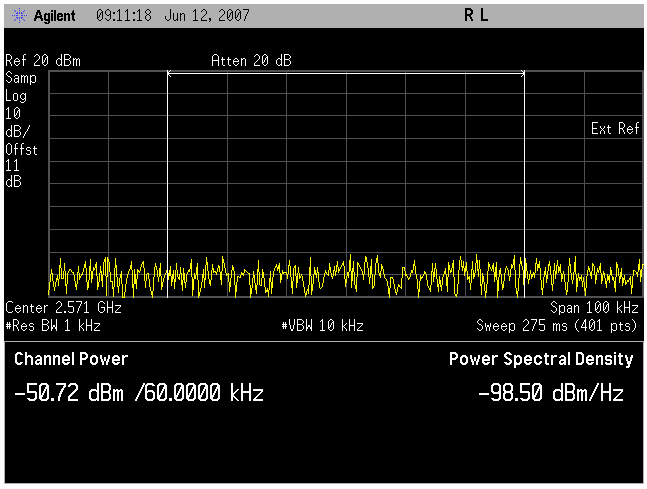
System Loading, One Analog Channel at Lower Band Limit (Maximum Power)

Out Of Band Measurement shows -73.3dB attenuation at Band Edge. (22.0 + -51.3)





Attenuation at 1 MHz below band edge

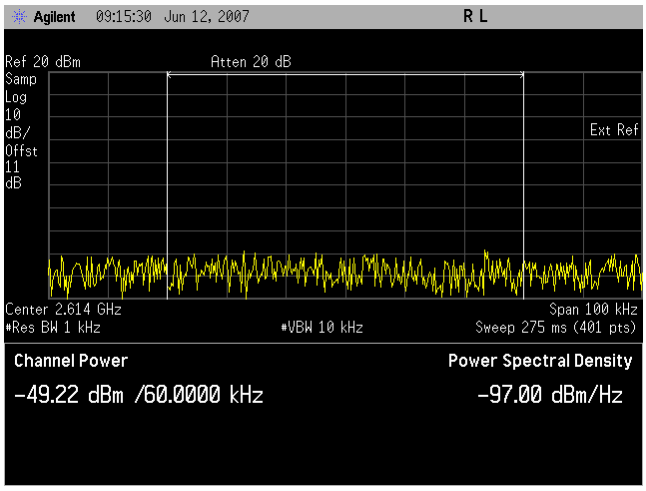


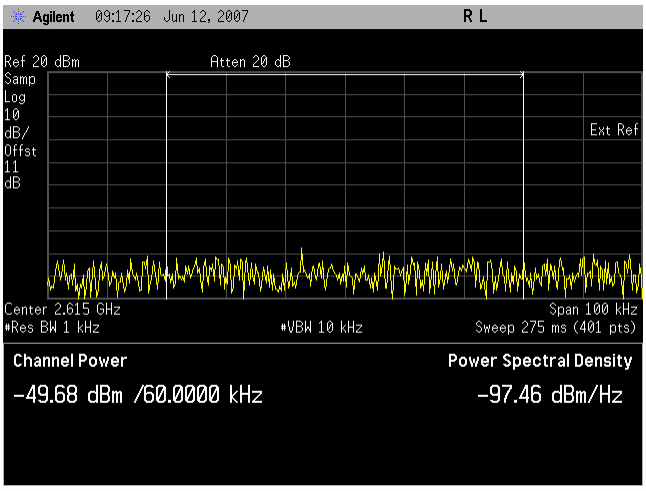
8.4.6 Spurious Emissions Test # 6

A similar test was run with a seven channel load at maximum power. Out of band measurements at the upper edge of the band and out of band measurements were taken at the band edge and 500KHz above. The reference channel power was measured at 12.34dB.

System Loading, Seven analog channels at upper band limit (Maximum Power) test shows 61.5dB (12.3dB + -49.2dB).

Out of band measurement shows -62.0dB attenuation at 500KHz above the band edge. (12.3dB + -49.7dB).



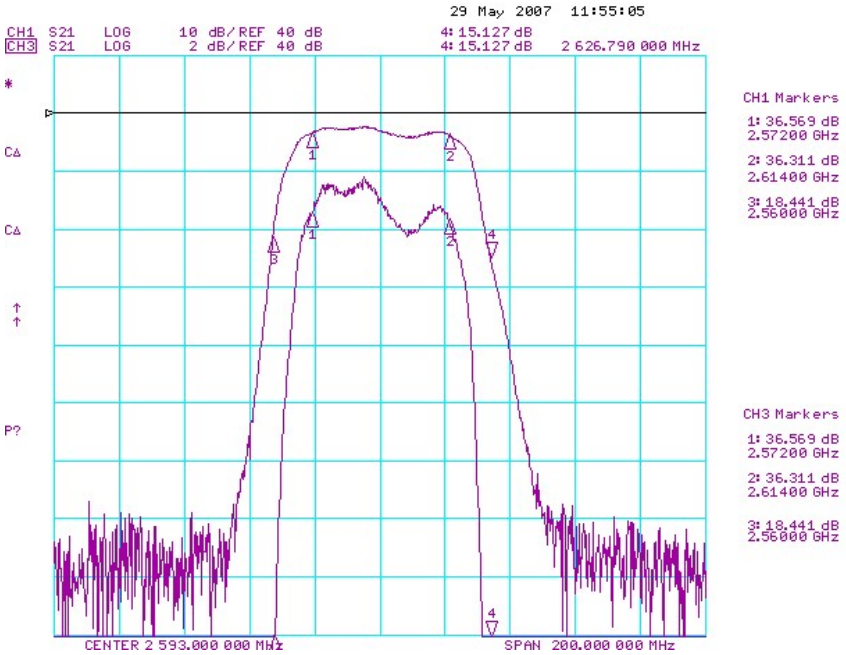


8.5 ATTENUATION CHARACTERISTICS & FREQUENCY RESPONSE

The MBSR100MW is designed for retransmission of up to seven analog or digital modulated carriers with little or no distortion. This repeater system does not include frequency translating circuitry, so the only distortion that is generated is from the frequency response and linearity of the amplifier networks.

8.5.1 Frequency Response

This frequency response test is made using the HP 8753 Network Analyzer. A 50Ω, 40dB pad with substantially zero reactance is utilized ahead of the analyzer to provide the proper input level to the device and which yields full dynamic range of the instrument. The system is then swept by the Network Analyzer. The overall frequency response is shown to be better than ±1dB across the 42 MHz band of interest, 2572-2614 MHz.

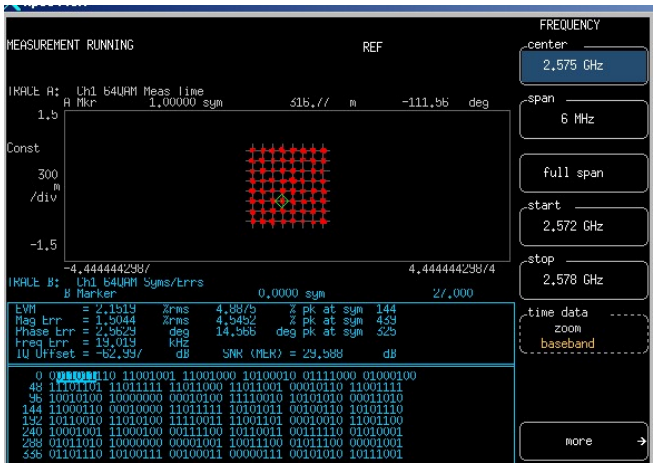


8.5.2 Linear Distortion

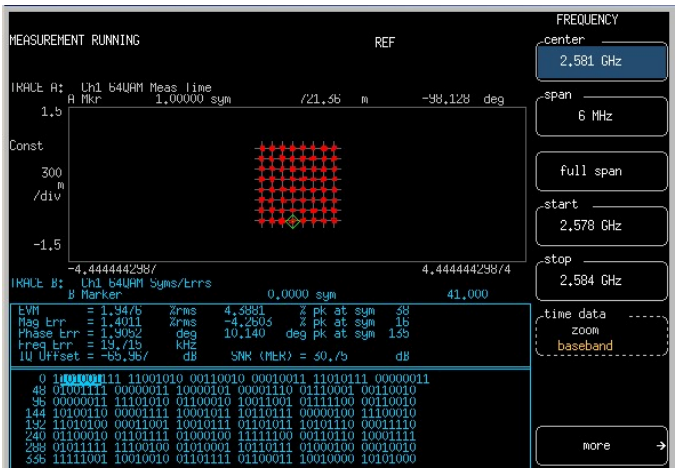
Linear distortion arises primarily from the frequency response of the repeater system. The frequency response of the MBSR100MW is very flat and provides for near perfect retransmission of the incoming carriers without linear distortion.

The linear distortion test employs the use of the HP89441 Vector Signal Analyzer. The system is loaded with seven modulated digital carriers at the full output of 20dBm composite power. The SNR/EVM is measured on each of the seven channels and the results plotted below. The worst case SNR/MER is measured on channel A4 @ 29.588 dB.

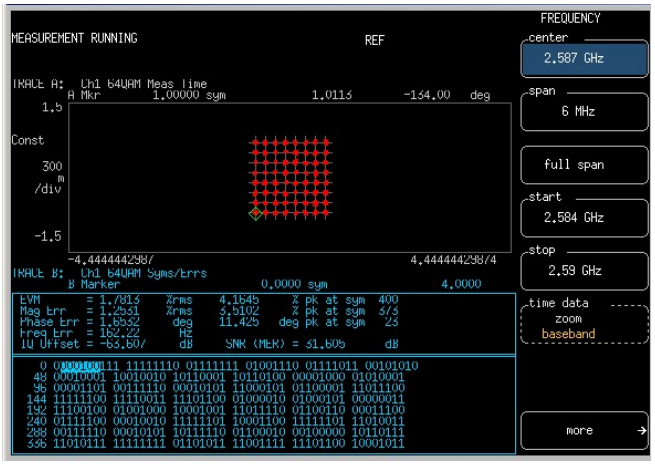
Channel A4 (2575 MHz)



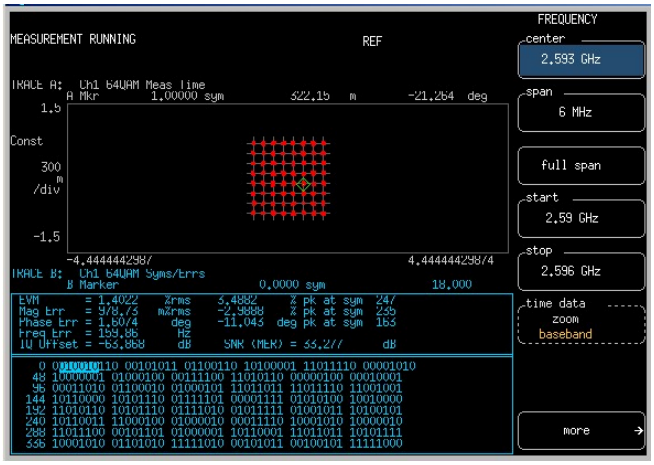
Channel B4 (2581 MHz)



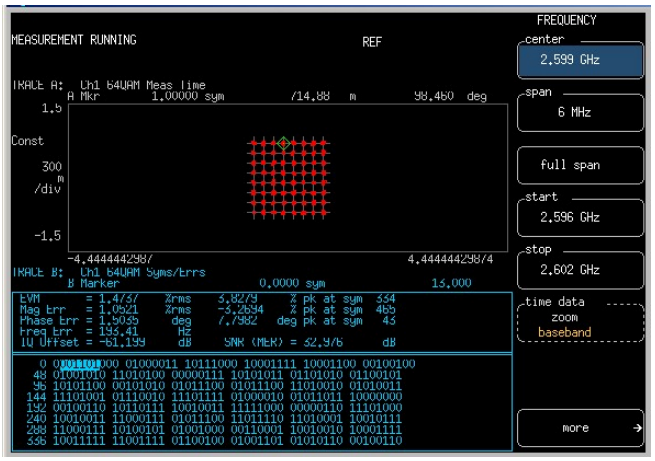
Channel C4 (2587 MHz)



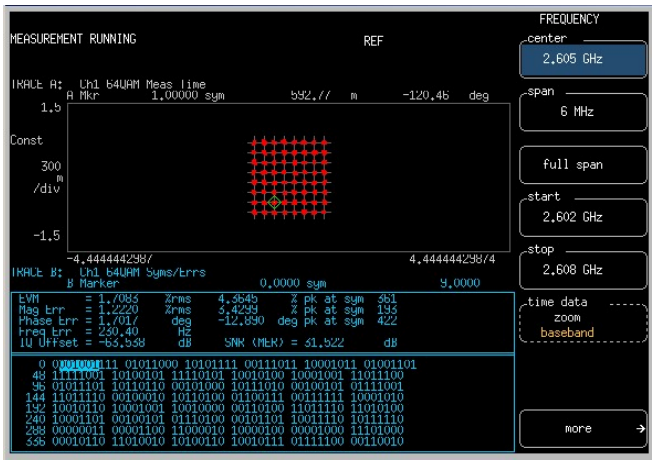
Channel D4 (2593 MHz)



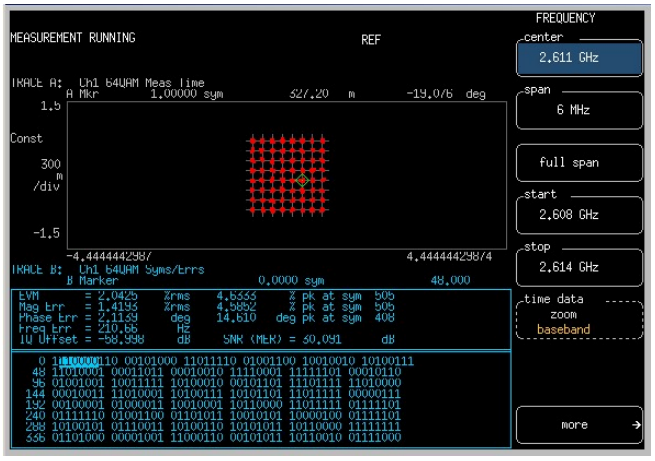
Channel G4 (2599 MHz)



Channel F4 (2605 MHz)



Channel E4 (2611 MHz)



8.6 MODULATION CHARACTERISTICS

FCC § 2.1047

Modulation characteristics do not apply. The system is a repeater and as such the input modulation is replicated at the output.

8.7 FREQUENCY STABILITY

FCC § 2.1055

Frequency Stability does not apply as there is no Local Oscillator or frequency translation in the system.

8.8 FIELD STRENGTH OF SPURIOUS EMISSIONS

FCC § 2.1053

Visual Carrier Output Power: 1 Channel @ 22.0dBm
7 Channels @ 12.3dBm/Channel

Modulation: NTSC Composite Television Signals or QAM Modulated Carriers

Spectrum Analyzer Settings:

Frequency Span:	1 MHz/Division
Center Frequency:	Adjusted Continuously from 10 MHz to 27 GHz
Resolution Bandwidth:	100 KHz
Video Bandwidth:	100 KHz
Analyzer Noise Floor	<-89dBm

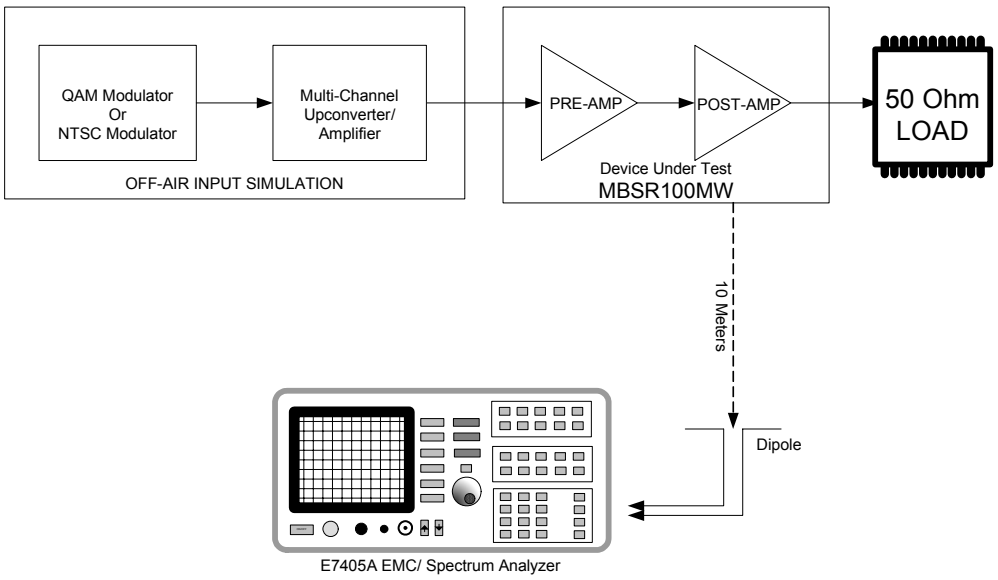


Figure 2. Test Setup for Measuring Radiated Emissions

Method of Measurement:

Using the test setup in Figure 2, the repeater was driven to full power (20dBm) with one analog channel. The test was repeated using QAM modulation on the channel, and no difference was noted. Using MBS channel D4 (2593 MHz) as a reference, the spectrum analyzer was moved 10 meters from the unit under test. A dipole antenna cut to the reference frequency was connected to the spectrum and oriented to achieve maximum receive level and the data was recorded. The antenna was then cut to the second to the tenth harmonic frequencies and the resultant levels were recorded.

FREQUENCY (MHz)	SOURCE	PEAK LEVEL (dB)
2593	Reference Channel	None Observed
5186	2nd Harmonic	None Observed
7779	3rd Harmonic	None Observed
10372	4th Harmonic	None Observed
12965	5th Harmonic	None Observed
15558	6th Harmonic	None Observed
18151	7th Harmonic	None Observed
20744	8th Harmonic	None Observed
23337	9th Harmonic	None Observed
25930	10th Harmonic	None Observed

Spurious Radiation:

The system is encapsulated in an enclosed and sealed casing due to the design needed for the high gain and mitigation of feedback. No radiated signals were detected to the threshold of the Spectrum Analyzer of -89dB.

9.0 SUMMARY

This report demonstrates that the MBSR100MW repeater system meets or exceeds the FCC Type Acceptance Criteria for devices utilized under FCC §27.5. Peak and average power outputs were verified with direct power measurements at microwave. Measurements of spurious emissions at the RF output indicated no emissions above that specified in FCC §27.53. Field strength measurements of spurious emissions revealed no detectable emissions down to the measurement equipment threshold of <-89 dBm.