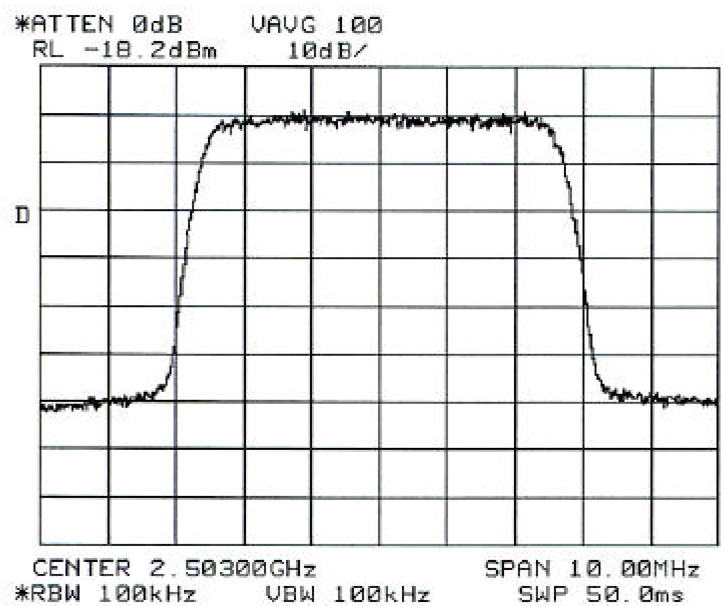
3.0 ENGINEERING DATA

3.2 Occupied Bandwidth

Using the test set-up shown in Section 3.1, with the booster operating at the rated output power of 5.0 W with four 64 QAM input signals (A1, A3, G2 and G4) present, the analyzer was set to a span of 10 MHz centered on channel A1 (see Figure 3.2.1 below) to illustrate the spectrum of a single channel.

The occupied channel bandwidth is a function of the symbol rate, Rs, and the root-raised cosine filter used in the generation of the 64 QAM signal. The 3 dB bandwidth is equal to Rs = 5.0565 MHz and the bandwidth near the noise floor is Rs*(1 + alpha) = 5.0565 * (1+0.18) = 5.96667 MHz. It is routinely considered to be 6 MHz.

Figure 3.2.1
Spectrum of a Single Channel (A1) Having a Bandwidth of 6 MHz

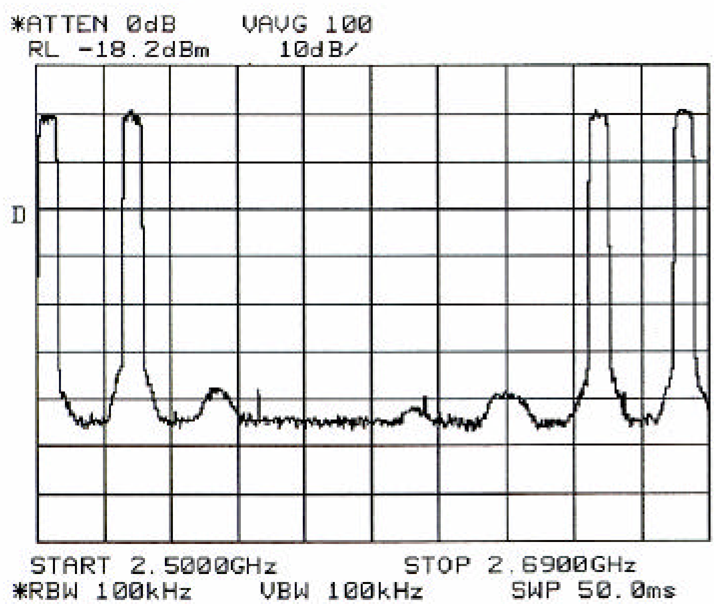


3.0 ENGINEERING DATA

3.2 Occupied Bandwidth

The analyzer was then adjusted to a span of 190 MHz and the occupied bandwidth (2500 MHz – 2690 MHz) was observed and recorded in Figure 3.2.2. This plot shows the entire MMDS band using the same four channels as before (A1, A3, G2 and G4) with a total average power of 5.0 W.

Figure 3.2.2
Occupied Bandwidth Plot of Channels (A1, A3, G2 and G4) at 5.0 Watts Total Average Power



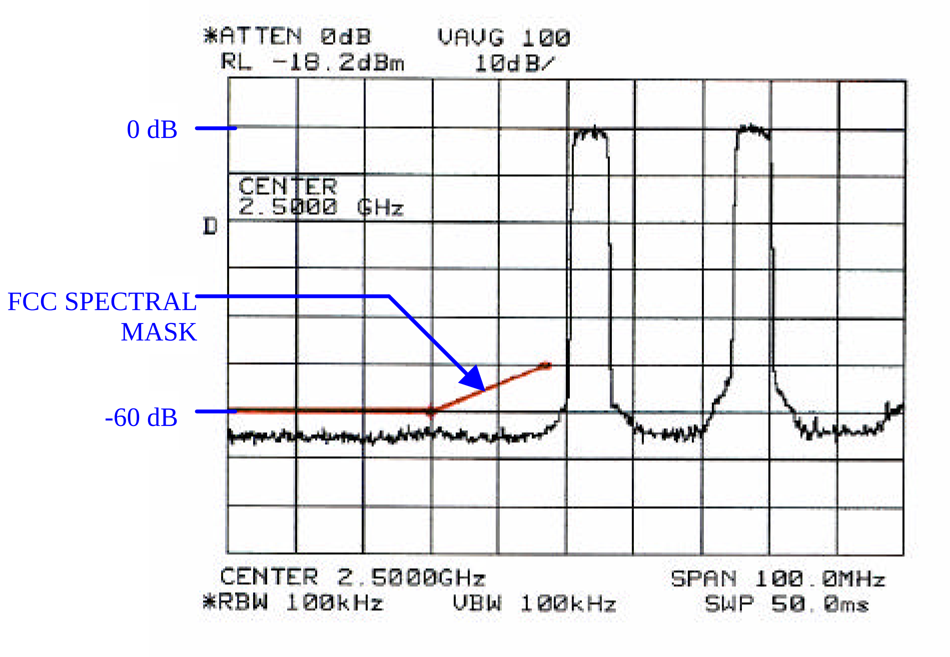
3.0 ENGINEERING DATA

3.3 Out-of-Band Power

Using the test set-up shown in Section 3.1 with the output power adjusted to 5.0 watts total average power, the spectrum for various channel combinations was captured and attenuation measurements of out-of-band power were performed following the guidelines in Section 21.908 (e) part (2) and compared to the FCC spectral mask described in Section 21.908 (b) part (2) for multi-channel broadband boosters in the frequency range of 2.500 to 2.690 GHz. Markers on the spectrum analyzer were used to record the amplitude separation (in dB) between the flat top of a nearby channel and the spectral points of concern. The formula for relative power measurements then applies where Attenuation in dB (below flat top) = A + 10*log (RBW1/RBW2). Since the same RBW of 100 KHz was used for both points (RBW1=RBW2=100 KHz), the log term disappears leaving the measured delta. The maximum measurable attenuation was 65 dB between the flat top of a channel and the noise floor of the spectrum analyzer. The attenuation data is recorded in tables following the corresponding spectral plots of different channel arrangements.

Spurious emissions were observed on the analyzer using several different channel arrangements selected to represent worse case operating conditions in terms of measuring out-of-band emissions. The first measurement was performed with two channels placed at the lower band edge (A1 and A3), 24 MHz separation, and two channels placed at the upper band edge (G2 and G4) with 24 MHz separation. The second measurement was performed with four non-adjacent channels placed at the lower band edge (A1, A2, A3, and A4). The third and final measurement was performed with four non-adjacent channels placed at the upper band edge (G1, G2, G3, and G4).

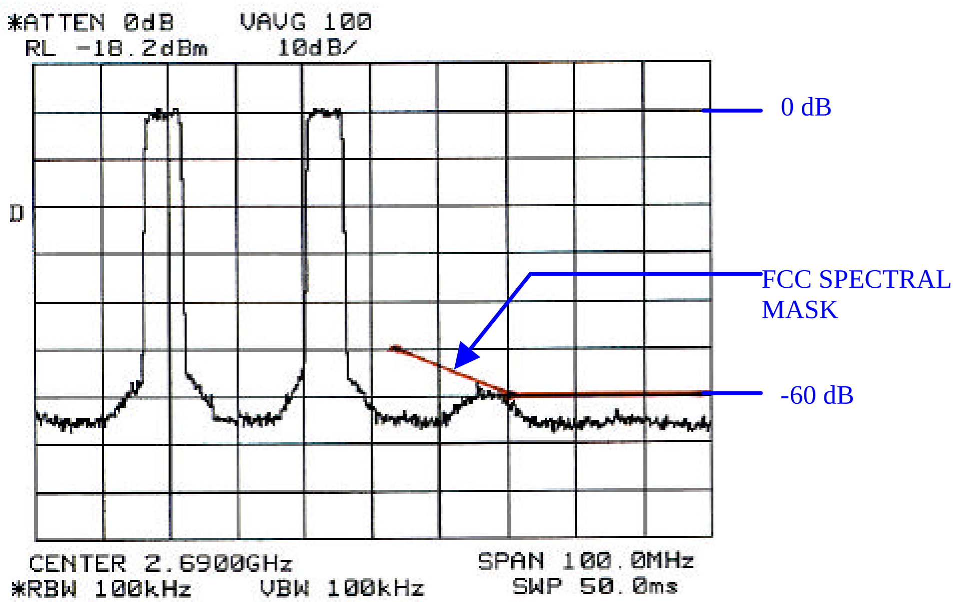
Figure 3.3.1
Spectrum Analyzer Plot (Showing Lower Band Edge) With Four Channels Present (A1, A3, G2 and G4)



3.0 ENGINEERING DATA

3.3 Out-of-Band Power - continued

Figure 3.3.2
Spectrum Analyzer Plot (Showing Upper Band Edge) With Four Channels Present (A1, A3, G2 and G4)

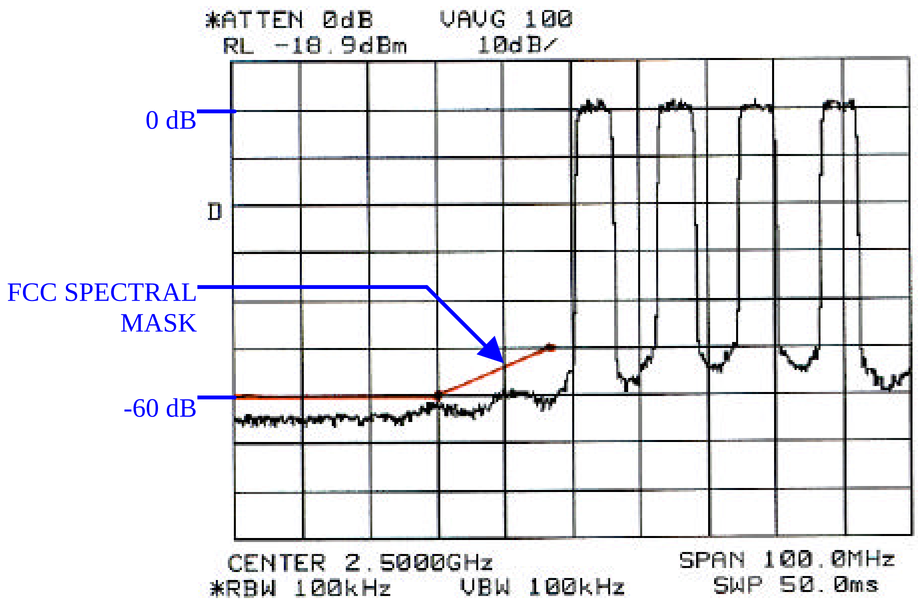


Frequency	Source	Attenuation Observed
2503.00 MHz	center of channel (A1)	0 dB (Reference)
44.00 MHz	IF	>65.0 dB
2500.00 MHz	lower band edge	56.3 dB
2499.75 MHz	250.0 KHz below band edge	56.5 dB
2497.00 MHz	3.0 MHz below band edge	61.5 dB
2480.00 MHz	20.0 MHz below band edge	62.3 dB
2690.00 MHz	upper band edge	62.5 dB
2690.25 MHz	250.0 KHz above band edge	62.6 dB
2693.00 MHz	3.0 MHz above band edge	63.5 dB
2710.00 MHz	20.0 MHz above band edge	61.3 dB
5000 - 5380 MHz	2nd Harmonic frequencies	>65.0 dB
7500 - -8070 MHz	3rd Harmonic frequencies	>65.0 dB
10000 – 10760 MHz	4th Harmonic frequencies	>65.0 dB
12500 – 13450 MHz	5th Harmonic frequencies	>65.0 dB
15000 – 16140 MHz	6th Harmonic frequencies	>65.0 dB
17500 – 18830 MHz	7th Harmonic frequencies	>65.0 dB
20000 – 21520 MHz	8th Harmonic frequencies	>65.0 dB
22500 – 24210 MHz	9th Harmonic frequencies	>65.0 dB
25000 – 26900 MHz	10th Harmonic frequencies	>65.0 dB

3.0 ENGINEERING DATA

3.3 Out-of-Band Power - continued

Figure 3.3.3
Spectrum Analyzer Plot (Showing Lower Band Edge) With Four Channels Present (A1, A2, A3 and A4)

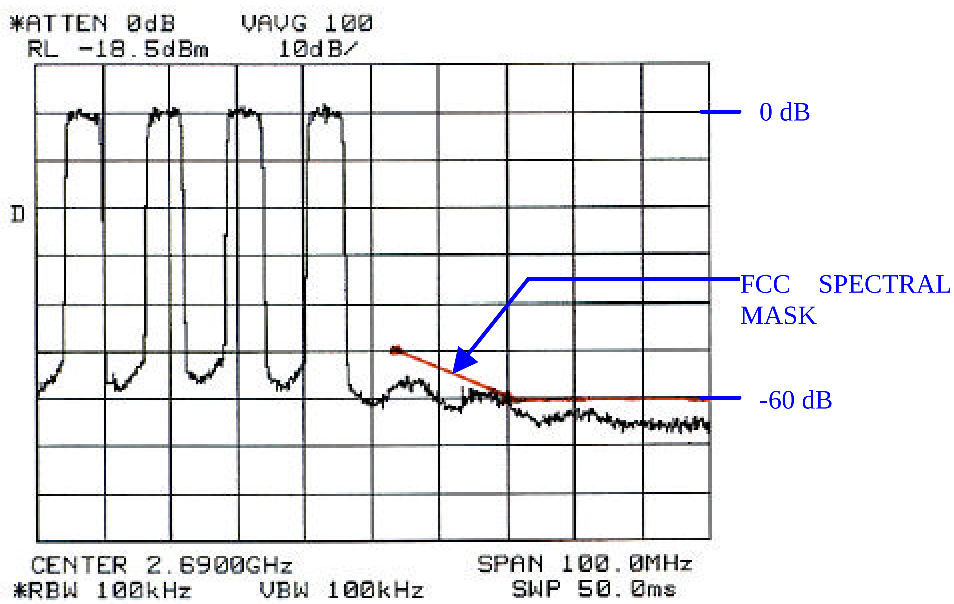


Frequency	Source	Attenuation Observed
2503.00 MHz	center of channel (A1)	0 dB (Reference)
44.00 MHz	IF	>65.0 dB
2500.00 MHz	lower band edge	56.5 dB
2499.75 MHz	250.0 KHz below band edge	56.5 dB
2497.00 MHz	3.0 MHz below band edge	62.3 dB
2480.00 MHz	20.0 MHz below band edge	62.6 dB
2690.00 MHz	upper band edge	>65.0 dB
2690.25 MHz	250.0 KHz above band edge	>65.0 dB
2693.00 MHz	3.0 MHz above band edge	>65.0 dB
2710.00 MHz	20.0 MHz above band edge	>65.0 dB
5000 - 5380 MHz	2nd Harmonic frequencies	>65.0 dB
7500 - -8070 MHz	3rd Harmonic frequencies	>65.0 dB
10000 – 10760 MHz	4th Harmonic frequencies	>65.0 dB
12500 – 13450 MHz	5th Harmonic frequencies	>65.0 dB
15000 – 16140 MHz	6th Harmonic frequencies	>65.0 dB
17500 – 18830 MHz	7th Harmonic frequencies	>65.0 dB
20000 – 21520 MHz	8th Harmonic frequencies	>65.0 dB
22500 – 24210 MHz	9th Harmonic frequencies	>65.0 dB
25000 – 26900 MHz	10th Harmonic frequencies	>65.0 dB

3.0 ENGINEERING DATA

3.3 Out-of-Band Power - continued

Figure 3.3.4
Spectrum Analyzer Plot (Showing Upper Band Edge) With Four Channels Present (G1, G2, G3 and G4)



Frequency	Source	Attenuation Observed
2683.00 MHz	center of channel (G4)	0 dB (Reference)
44.00 MHz	IF	>65.0 dB
2500.00 MHz	lower band edge	>65.0 dB
2499.75 MHz	250.0 KHz below band edge	>65.0 dB
2497.00 MHz	3.0 MHz below band edge	>65.0 dB
2480.00 MHz	20.0 MHz below band edge	>65.0 dB
2690.00 MHz	upper band edge	61.3 dB
2690.25 MHz	250.0 KHz above band edge	61.0 dB
2693.00 MHz	3.0 MHz above band edge	59.5 dB
2710.00 MHz	20.0 MHz above band edge	62.1 dB
5000 - 5380 MHz	2nd Harmonic frequencies	>65.0 dB
7500 - -8070 MHz	3rd Harmonic frequencies	>65.0 dB
10000 – 10760 MHz	4th Harmonic frequencies	>65.0 dB
12500 – 13450 MHz	5th Harmonic frequencies	>65.0 dB
15000 – 16140 MHz	6th Harmonic frequencies	>65.0 dB
17500 – 18830 MHz	7th Harmonic frequencies	>65.0 dB
20000 – 21520 MHz	8th Harmonic frequencies	>65.0 dB
22500 – 24210 MHz	9th Harmonic frequencies	>65.0 dB
25000 – 26900 MHz	10th Harmonic frequencies	>65.0 dB

3.0 ENGINEERING DATA

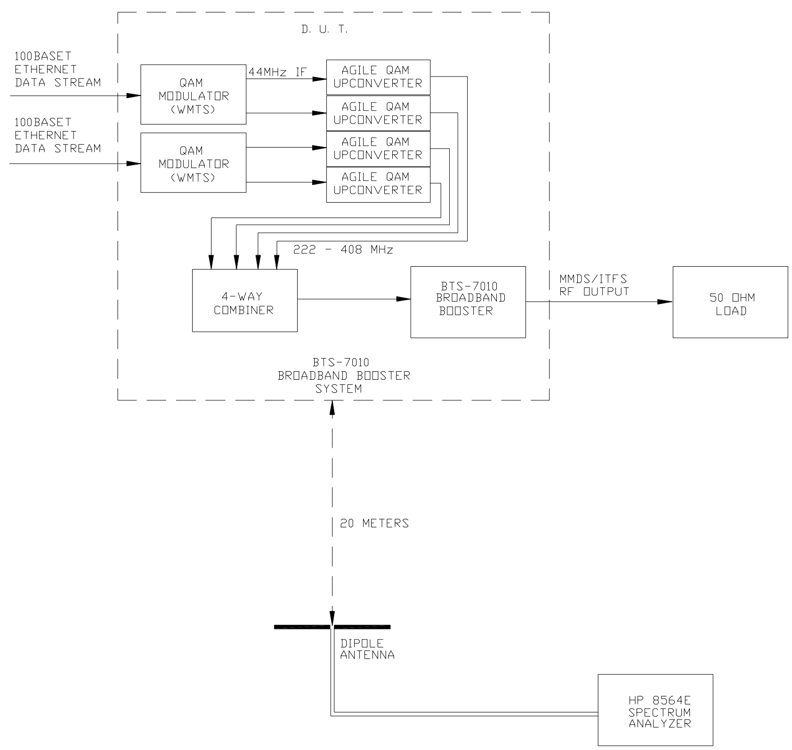
3.4 Radiated Emissions

Using the test set-up shown below in Fig 3.4.1, with four input signals present (A1, A3, G2, and G4) and operating at 5.0 watts (total average), the spectrum analyzer was moved 20 meters from the transmitter and connected to a dipole antenna cut to the carrier frequency of A1 (2503 MHz). This antenna was oriented to maximize the received level, and the data was recorded. The antenna was then cut to the remaining channel frequencies and the receive level was observed on the spectrum analyzer. The antenna was then cut to the IF frequency, and the second through the tenth harmonic frequencies and all signals received were maximized by antenna orientation, and their absolute levels were recorded.

With these various antennas the data was taken and recorded in the table on the following page. Then the measured level of radiated emission was converted to dBc through calculation.

Note: The spectrum analyzer had a maximum sensitivity of -100 dBm (or –74.3 dBc) during this test.

Figure 3.4.1
Radiated Emissions Test Set-up



3.0 ENGINEERING DATA

3.4 Radiated Emissions - continued

MEASURED LEVELS

Frequency	Source	Level Observed
44.00 MHz	IF	None Observed
2500 – 2690 MHz	operating band	-75 dBm
5000 – 5380 MHz	2^{nd} harmonic frequencies	None Observed
7500 – 8070 MHz	3^{rd} harmonic frequencies	None Observed
10000 – 10760 MHz	4^{th} harmonic frequencies	None Observed
12500 - 13450 MHz	5^{th} harmonic frequencies	None Observed
15000 – 16140 MHz	6^{th} harmonic frequencies	None Observed
17500 - 18830 MHz	7^{th} harmonic frequencies	None Observed
20000 - 21520 MHz	8^{th} harmonic frequencies	None Observed
22500 - 24210 MHz	9^{th} harmonic frequencies	None Observed
25000 - 26900 MHz	10^{th} harmonic frequencies	None Observed

CONVERSION OF MEASURED LEVEL TO dBc

The measured levels were then compared to the following reference level:

If all of the transmitter's power (5.0 Watts) was radiated by an isotropic radiator, the power density at 20 meters would be:

$Pd = Pt/4\pi\ R^2 = 5.0/4\pi\ (20)^2 \cong 0.9947x10^{-3}$ w/m^2

Using a dipole transmitting antenna increases this by 1.64 to:

$1.64 * 0.99474x10^{-3} = 1.6313\ x10^{-3}$ w/m^2

If a dipole receive antenna of area $1.64 * \lambda^2/4\pi$ is used to receive the signal, the received level would be:

$1.6313\ x10^{-3} * 1.64 * \lambda^2/4\pi = 2.689\ x10^{-6}$w = - 55.7 dBw = -25.7 dBm

The received levels were therefore at the following relative levels:

Frequency	Received Level	Relative Measured Level (Ref = -25.7 dBm)
2509.00 MHz	-75 dBm	-49.3 dBc