



**ENGINEERING REPORT OF
TELEVISION TRANSMITTER PERFORMANCE
CHARACTERISTICS**

For

KCWY-DT

By

Mark Hills

Measurements taken

September 7th 2008

Signature *M. Hills*

KCWY-DT Proof Of Performance

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FACILITIES AUTHORIZED IN CONSTRUCTION PERMIT:

Name of applicant: Bozeman Trail Communications Company
Call letters: KCWY- DT
Channel number: 12
File number of license or CP: BPCDT-20080619ABO
Channel allocation: 204MHz to 210MHz
Pilot Frequency:204,309,440.6Hz

TRANSMITTER LOCATION:

State: WY
County: Natrona
City: Casper
Street: Tower Hill Rd

TRANSMITTER MANUFACTURER: Electrosys

Type: T 352 SVZ
Serial Number: 08260766

POWER SUMMARY:

	AVERAGE DIGITAL POWER	
	dBk	KW
Transmitter rated power	-5.23	0.3
Transmitter power output	-6.93	.203
RF Filter loss		Included
Transmission line loss		1.416
Antenna input power	-8.35	146
Antenna power gain (Max)		13.4dB
ERP (Avg.)	5.05	3.2

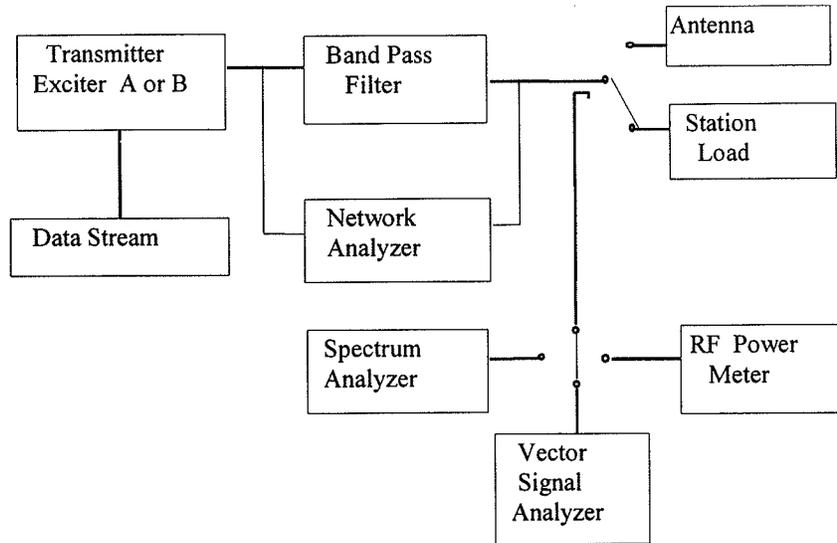
FILTER MANUFACTURER: COM-TECH

Type: C26X60B S/N 035442

ANTENNA MANUFACTURER: SCA

Type: DRV-4/1HW

SIGNAL BLOCK DIAGRAM



Test Equipment List:

Test equipment	Make	Model	S/N
Spectrum Analyzer	AGILENT	E4402B	US40241233
8VSB Analyzer	TEKTRONIX	RFA300A	B010119
Network Analyzer	AGILENT	8753ES	US40241233
Power meter	AGILENT	E4416A	GB41293790
Power Sensor	AGILENT	E9300B	US40010137

METHOD OF DETERMINING POWER OUTPUT**DIGITAL TRANSMITTER** [Section 73.663(b)]

This describes the method of power output determination as described in the FCC rules and Regulations.

With the transmitter adjusted to produce 100% RMS. Power, the following data was recorded.

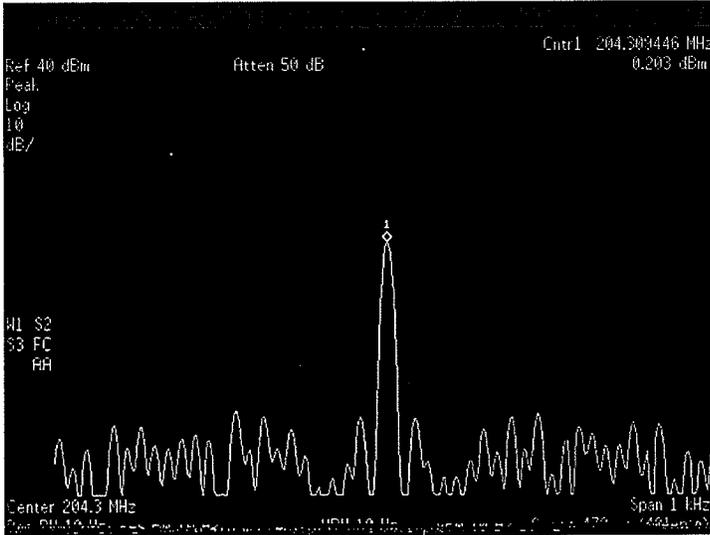
The test equipment was set up as shown on the block diagram.

A calibrated HP RF Power meter was used to measure the RF Power from a precision directional coupler at the output of the DTV mask filter.

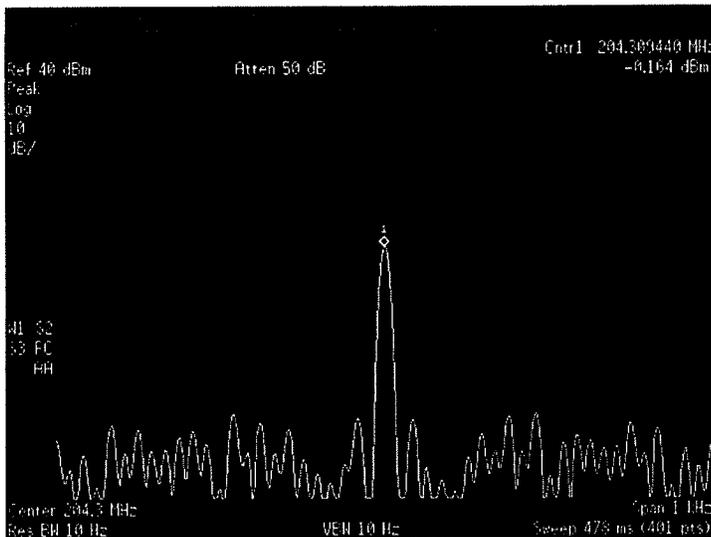
The precision coupler in the RF system was factory calibrated at -41.8dB . The RF power meter was operated with a -41.8dB offset. Average digital power was then displayed at 203W

FREQUENCY MEASUREMENTS OF THE DIGITAL CARRIER
[Section 73.1545(c)(1) and (2)]

Frequency measurements of the pilot carrier frequency were made using the E4402B Spectrum analyzer fitted with a precision frequency reference.



EXCITER A
204,309,446Hz



EXCITER B
204,309,440Hz

- FCC limit: +/-3Hz from assigned carrier frequency. (N+1)
- FCC limit +/- 10Hz from assigned carrier frequency (DTV to DTV)
- FCC limit +/- 1000Hz from assigned carrier frequency. (N -1)

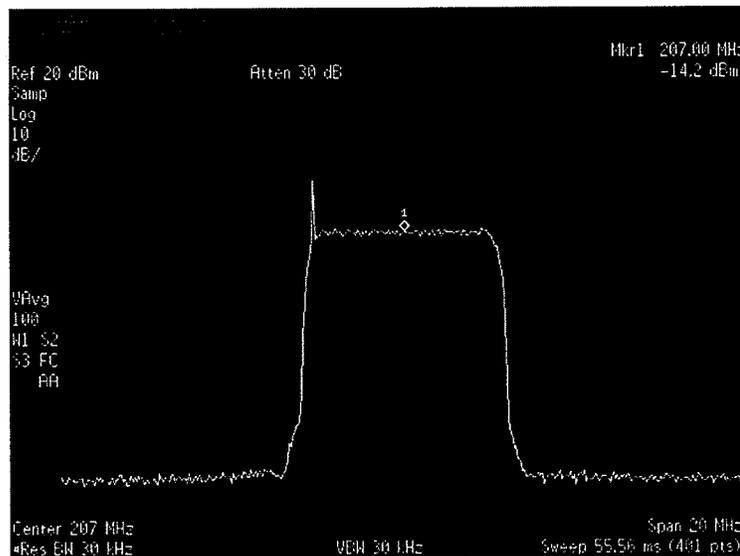
HARMONIC MEASUREMENTS

EXCITER A

[Section 73.687 (e)(1)]

The capacitive sample at the output of the mask filter was connected to the spectrum analyzer to obtain a reference for this measurement. Three notch filters tuned to reduce the fundamental signal were inserted, preventing overloading. The input sensitivity and the span of the instrument were then increased to make the harmonic and spurious measurements.

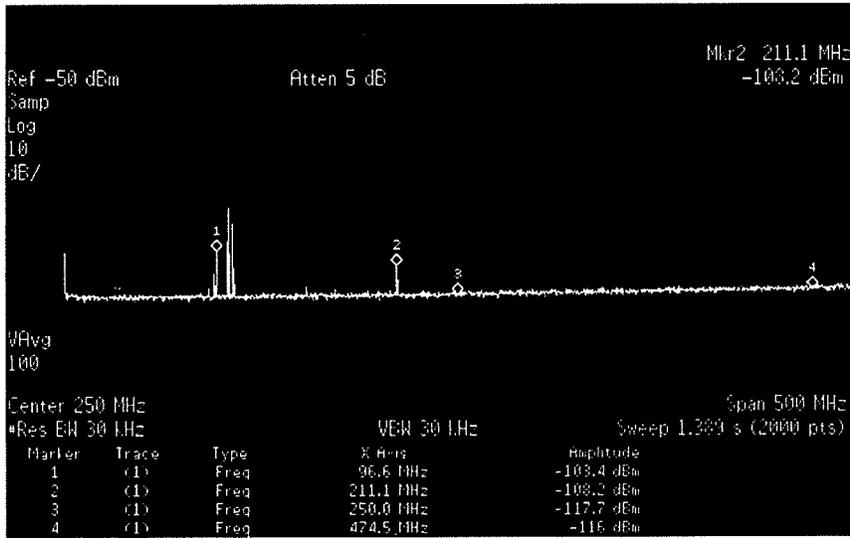
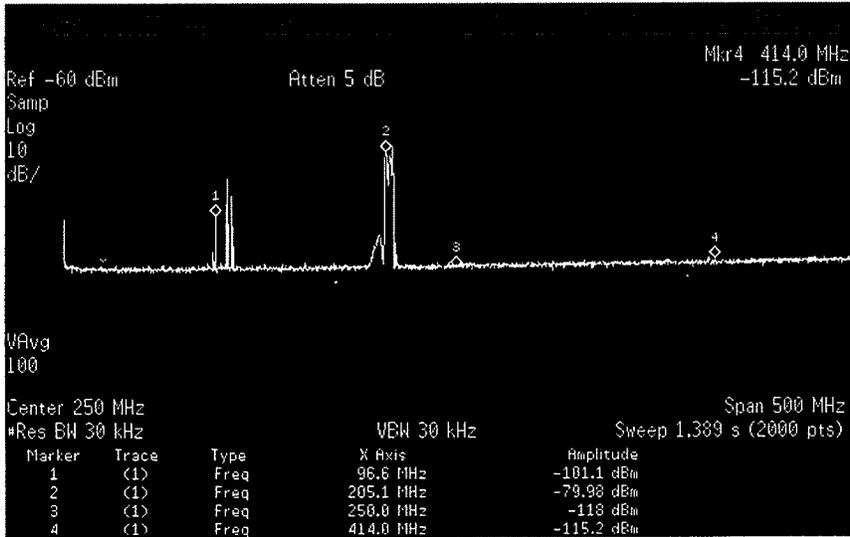
Measurements to be taken with Spectrum Analyzer set for 30 kHz resolution bandwidth, and 30 kHz video bandwidth.



Reference level = -14.2dBm = 0dB

HARMONIC MEASUREMENTS

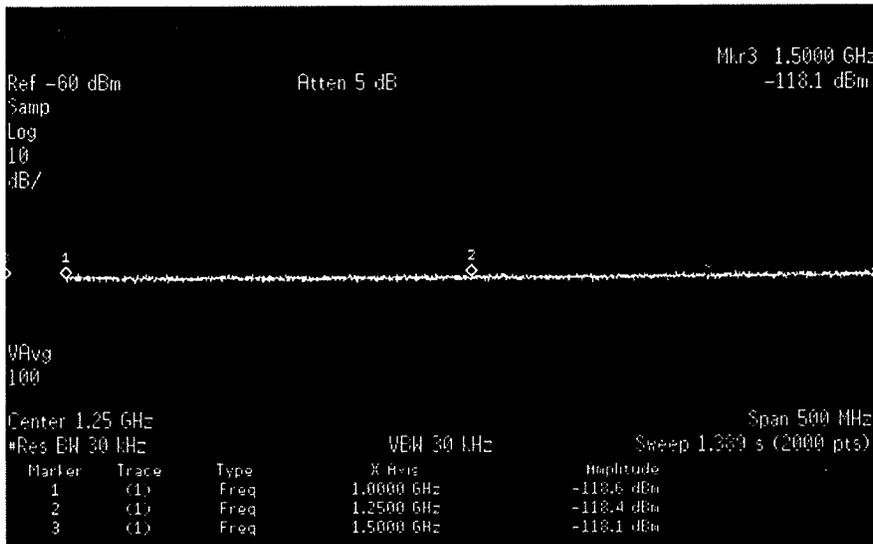
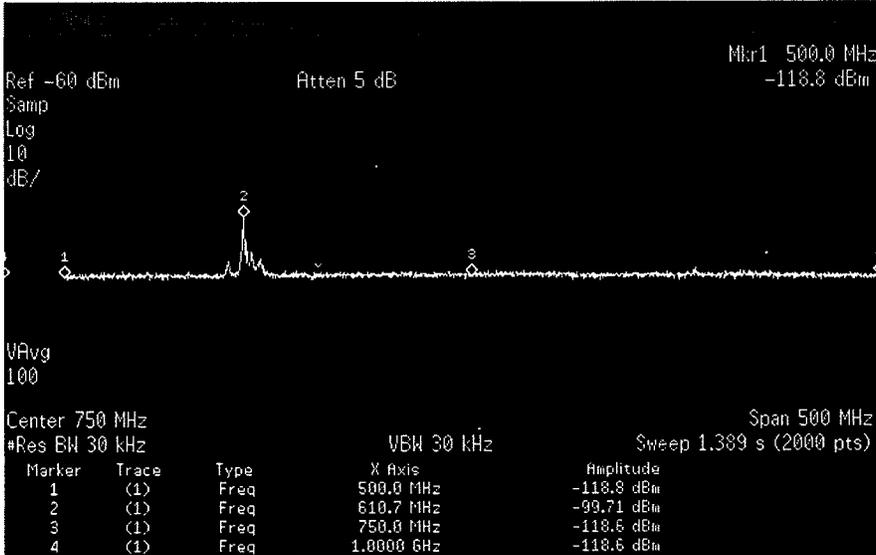
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The above plot was taken with the transmitter off

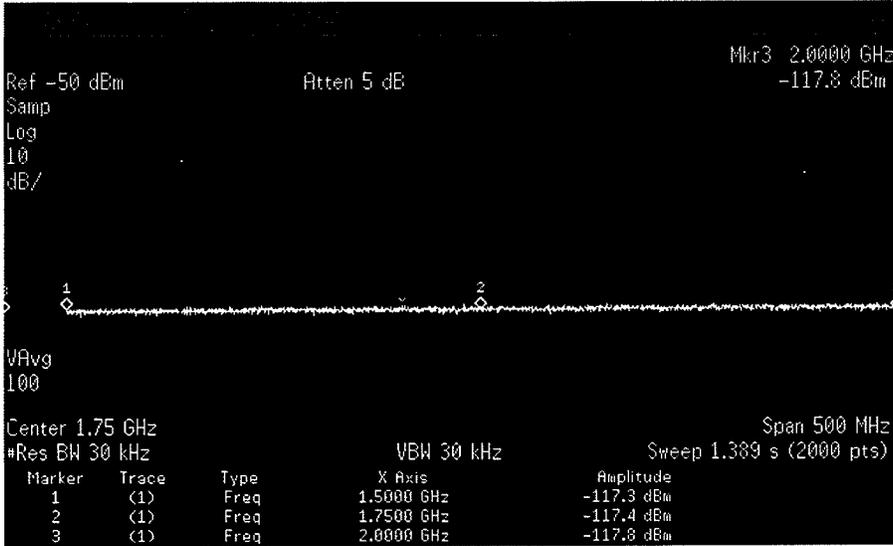
HARMONIC MEASUREMENTS

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HARMONIC MEASUREMENTS

Continued



Reference Level -14.2dBm	Harmonic	Cable loss wrt Fundamental	Coupler correction	Analyzer reading	Correction Factor *	Result
0dB	2nd	0.5dB	+6dB	-115.2dBm	+10.6dB	-117.1dBr
0dB	3rd	0.9dB	+9.54dB	-99.71dBm	+10.6dB	-104.75dBr

**The -110dBc FCC requirement applied to the area of electromagnetic spectrum >6MHz below the lower channel edge and >6MHz above the higher channel edge assume the reference power used is the total output power from the channel, in a 6MHz bandwidth. The measurement outside the channel is specified with a measurement resolution of 500kHz. When a 30kHz resolution bandwidth is used to make the in-channel power and out-of-channel measurements a correction factor of 10.6dB must be applied.*

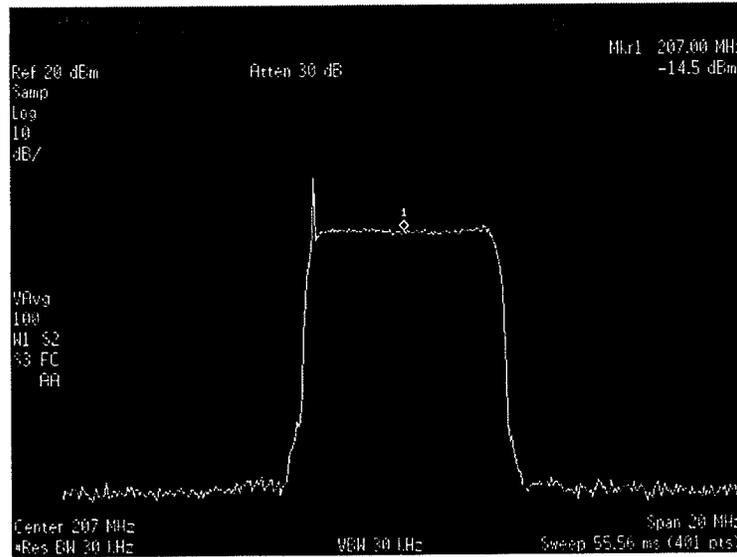
HARMONIC MEASUREMENTS

EXCITER B

[Section 73.687 (e)(1)]

The capacitive sample at the output of the mask filter was connected to the spectrum analyzer to obtain a reference for this measurement. Three notch filters tuned to reduce the fundamental signal were inserted, preventing overloading. The input sensitivity and the span of the instrument were then increased to make the harmonic and spurious measurements.

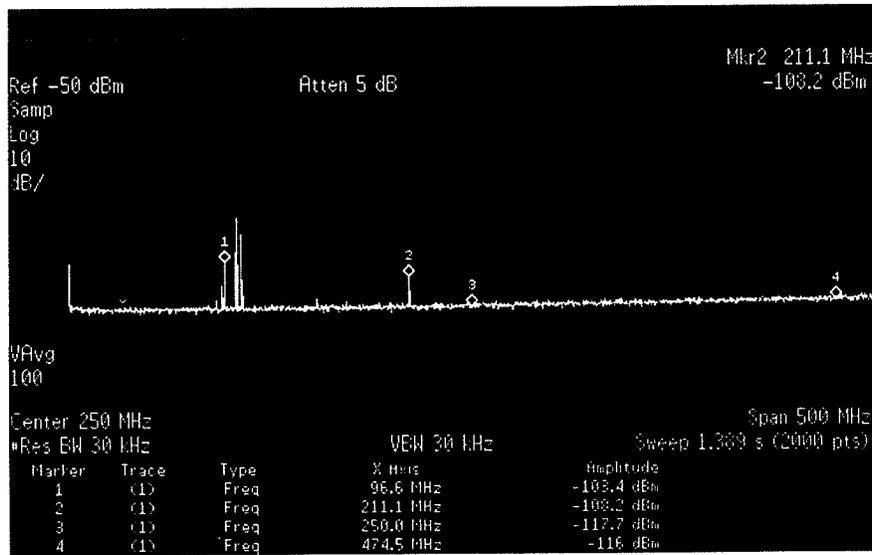
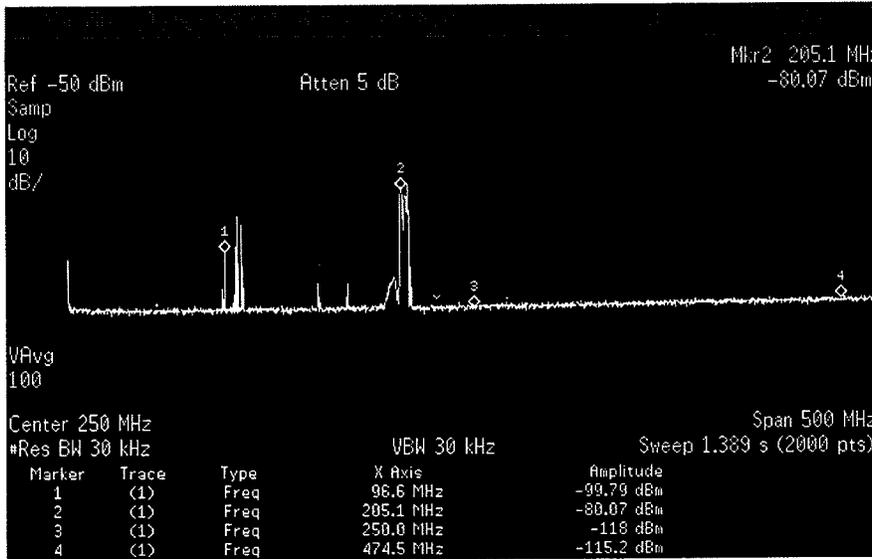
Measurements to be taken with Spectrum Analyzer set for 30 kHz resolution bandwidth, and 30 kHz video bandwidth.



Reference level = -14.5dBm = 0dBr

HARMONIC MEASUREMENTS

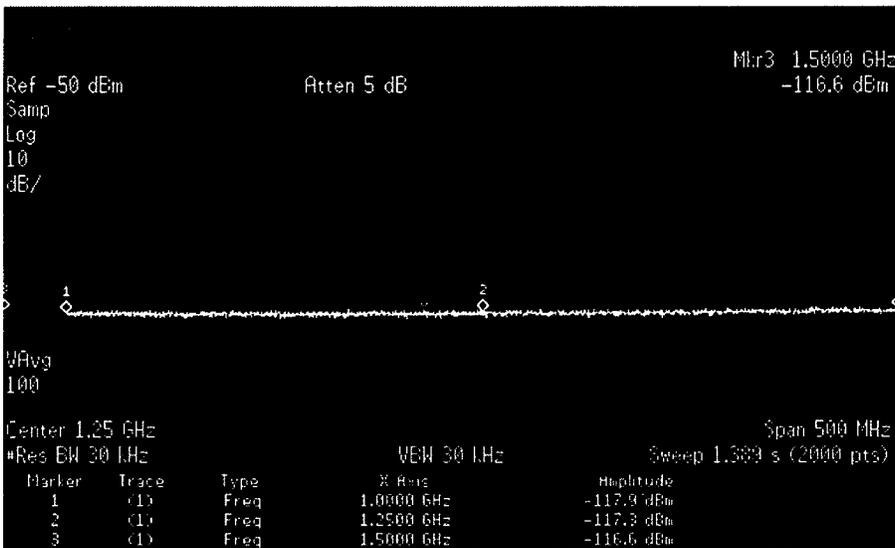
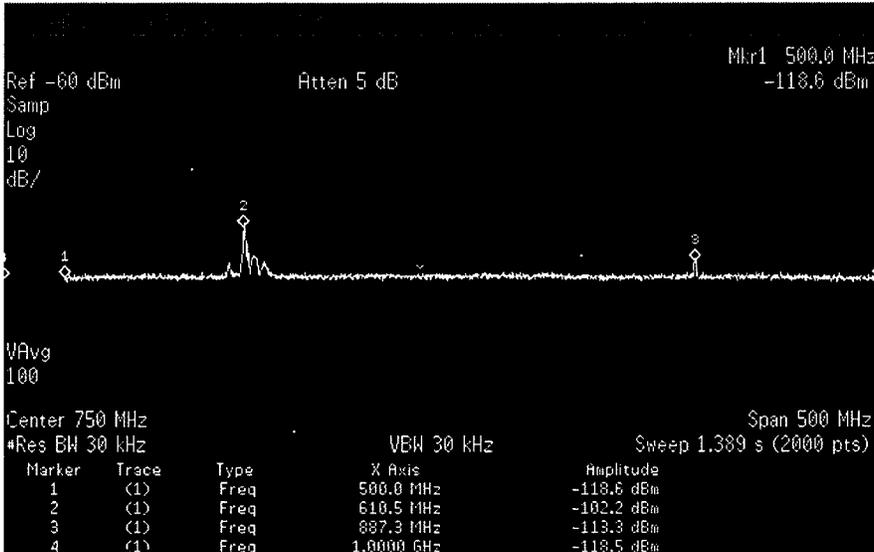
Continued



The above plot was taken with the transmitter off

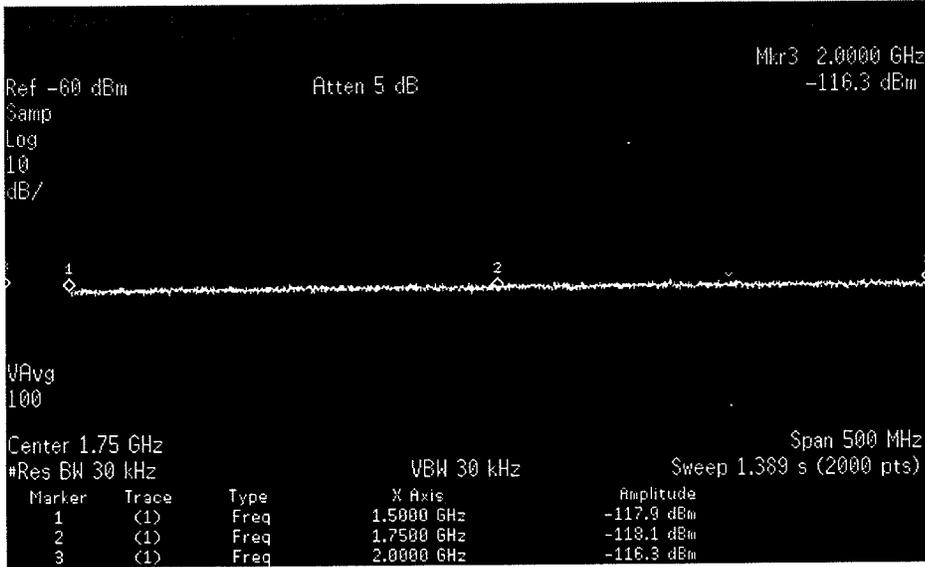
HARMONIC MEASUREMENTS

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HARMONIC MEASUREMENTS

Continued



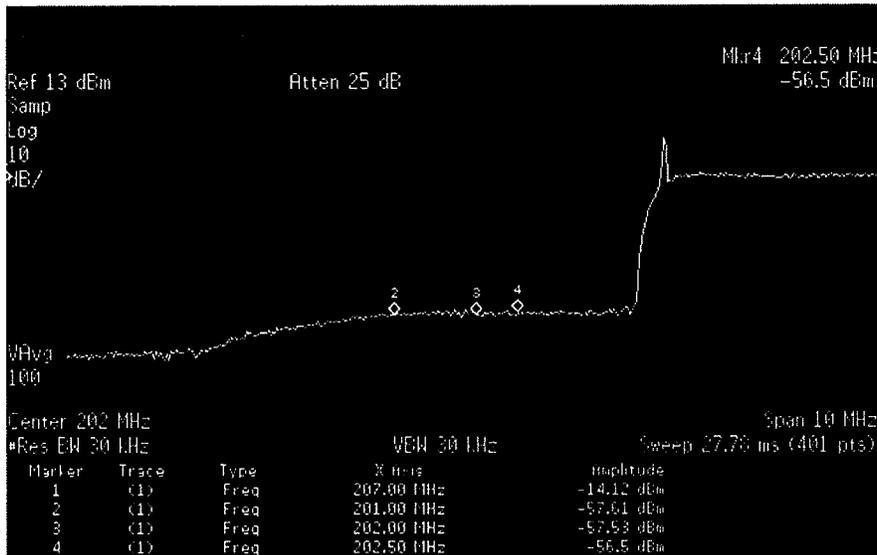
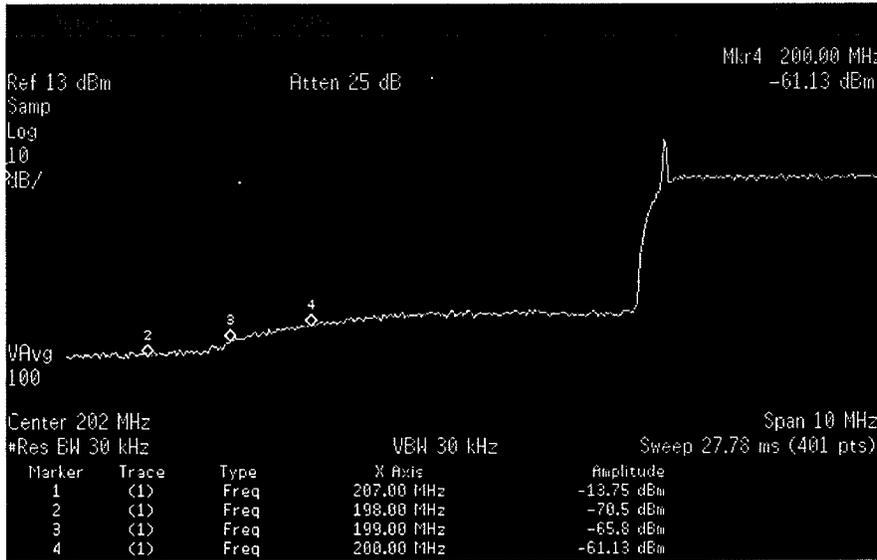
Reference Level -14.5dBm	Harmonic	Cable loss wrt Fundamental	Coupler correction	Analyzer reading	Correction Factor *	Result
0dB	2nd	0.5dB	+6dB	-115.2dBm	+10.6dB	-116.8dBr
0dB	3rd	0.9dB	+9.54dB	-102.2dBm	+10.6dB	-106.94dBr

**The -110dBc FCC requirement applied to the area of electromagnetic spectrum >6MHz below the lower channel edge and >6MHz above the higher channel edge assume the reference power used is the total output power from the channel, in a 6MHz bandwidth. The measurement outside the channel is specified with a measurement resolution of 500kHz. When a 30kHz resolution bandwidth is used to make the in-channel power and out-of-channel measurements a correction factor of 10.6dB must be applied.*

DIGITAL TRANSMITTER AMPLITUDE RESPONSE

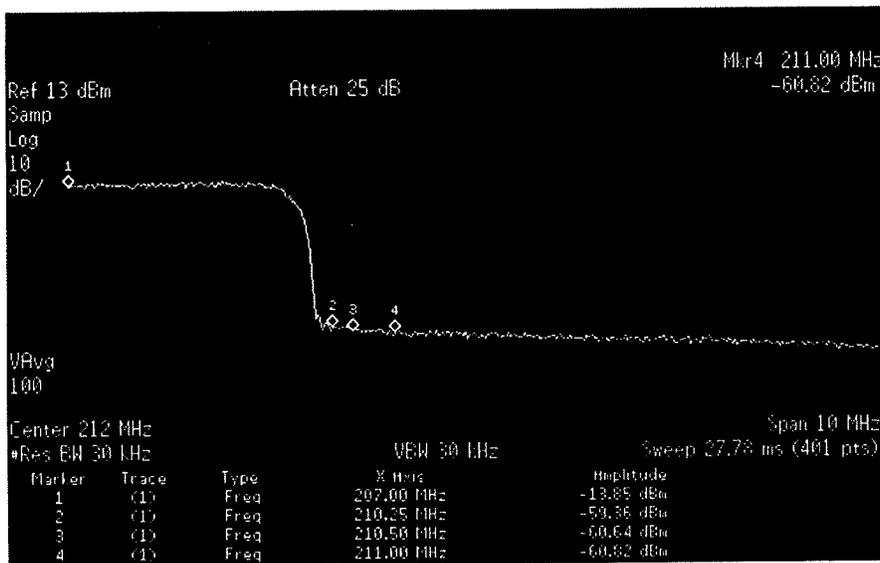
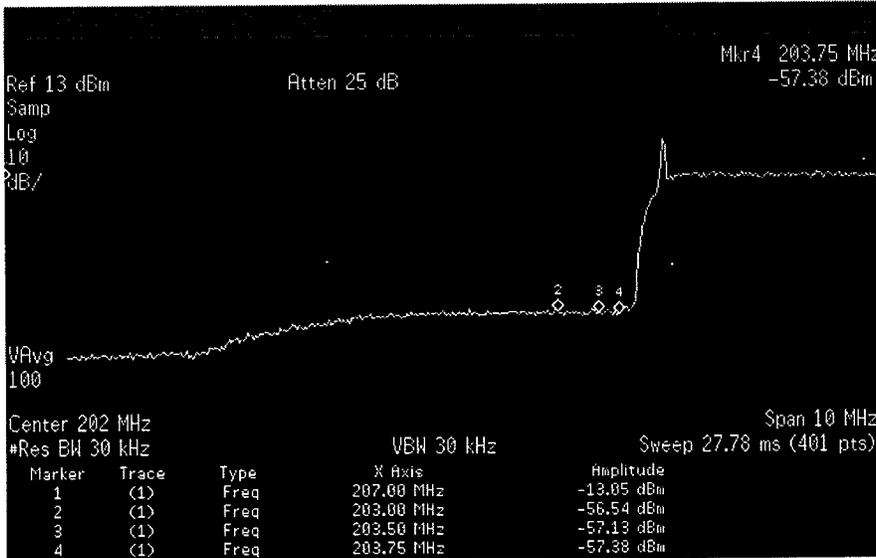
EXCITER A

The test equipment was connected as shown in the Block Diagram. The response was measured before the bandpass filter. The results are recorded below.



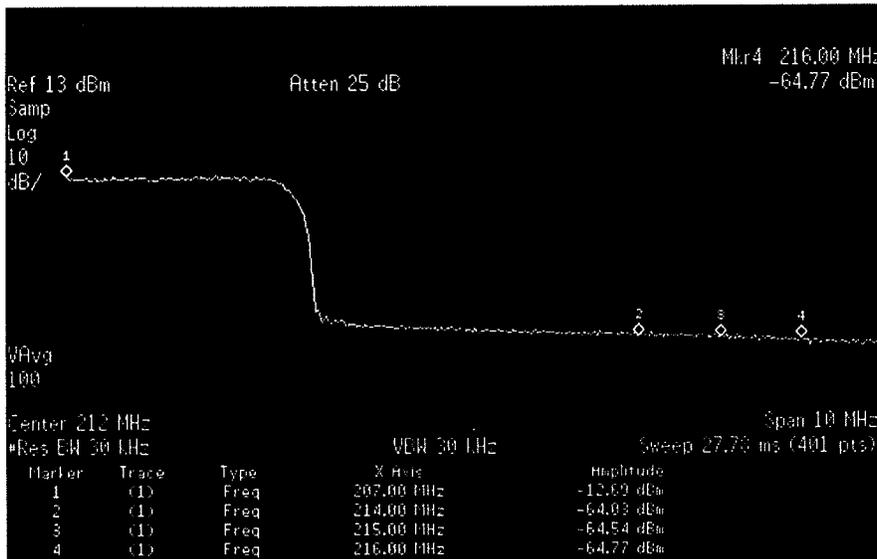
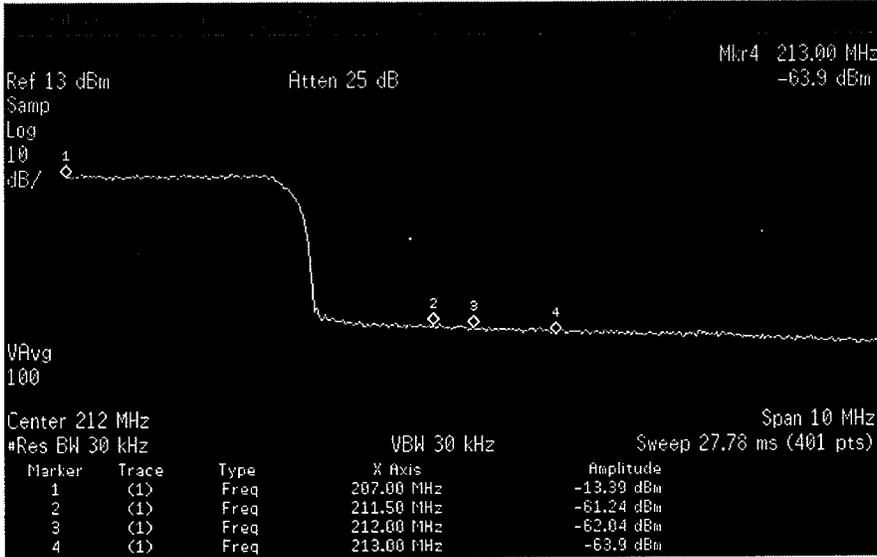
DIGITAL TRANSMITTER AMPLITUDE RESPONSE

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DIGITAL TRANSMITTER AMPLITUDE RESPONSE

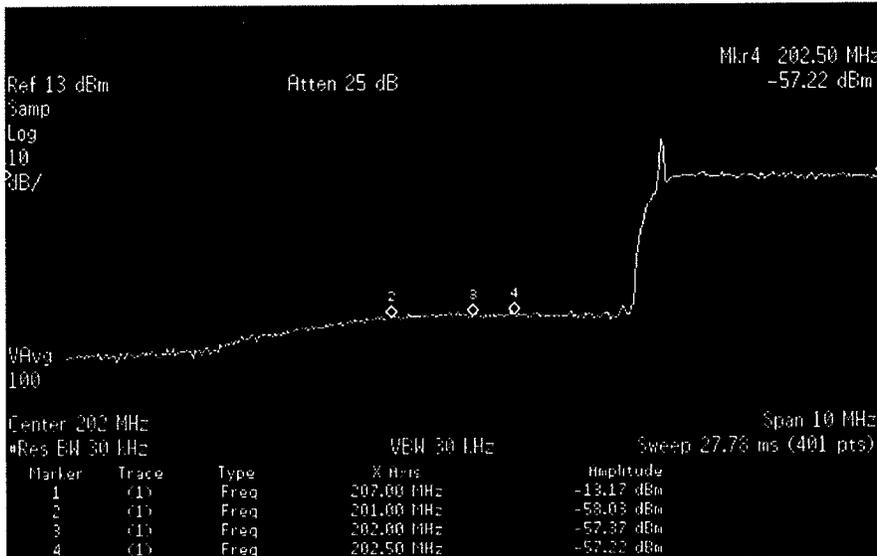
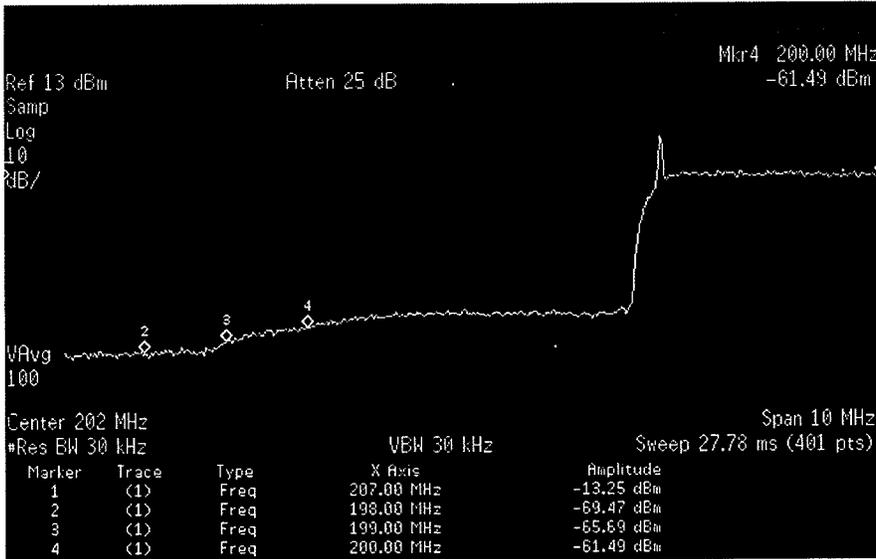
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DIGITAL TRANSMITTER AMPLITUDE RESPONSE

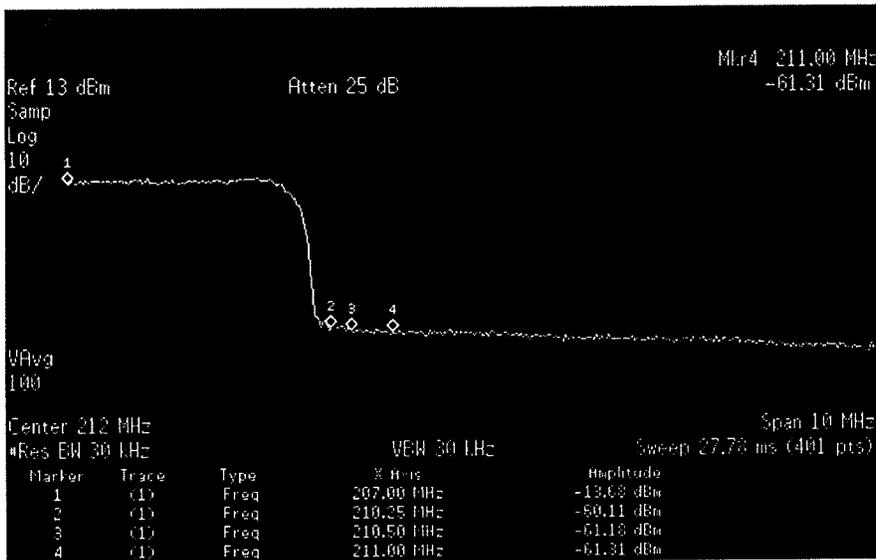
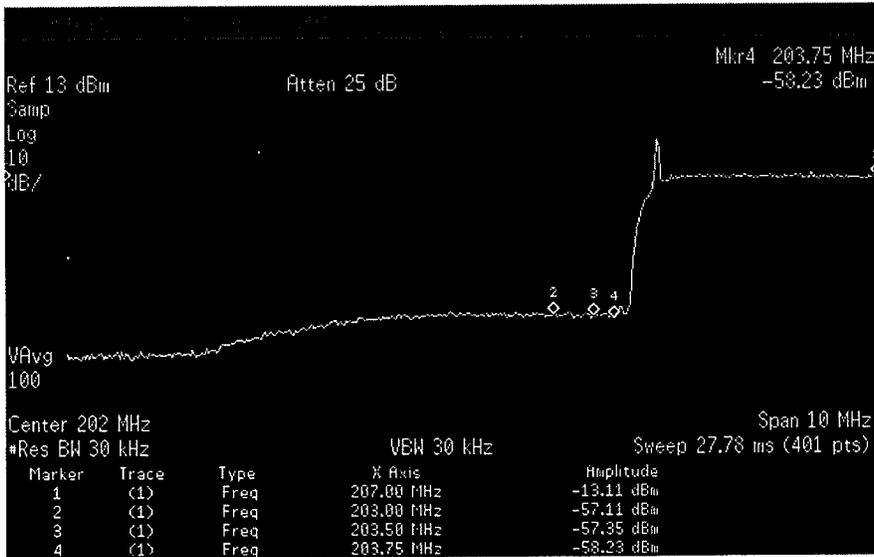
EXCITER B

The test equipment was connected as shown in the Block Diagram. The response was measured before the bandpass filter. The results are recorded below.



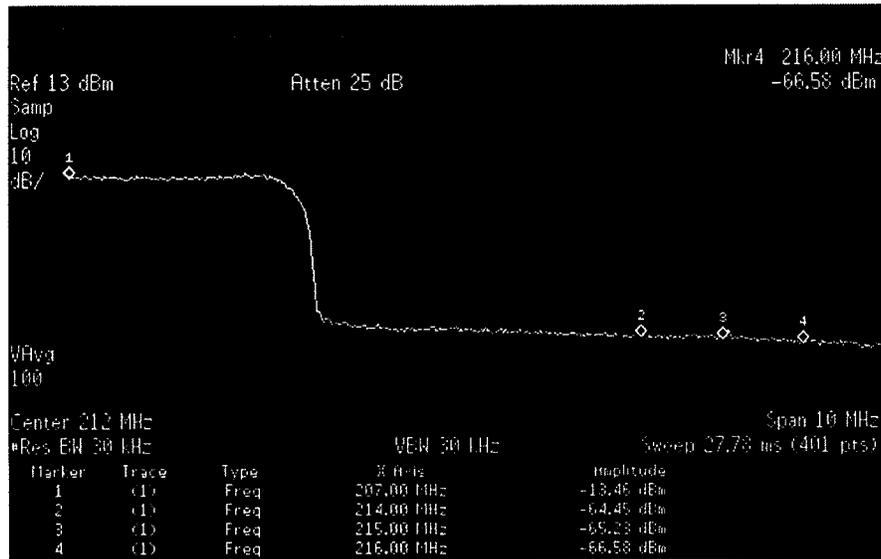
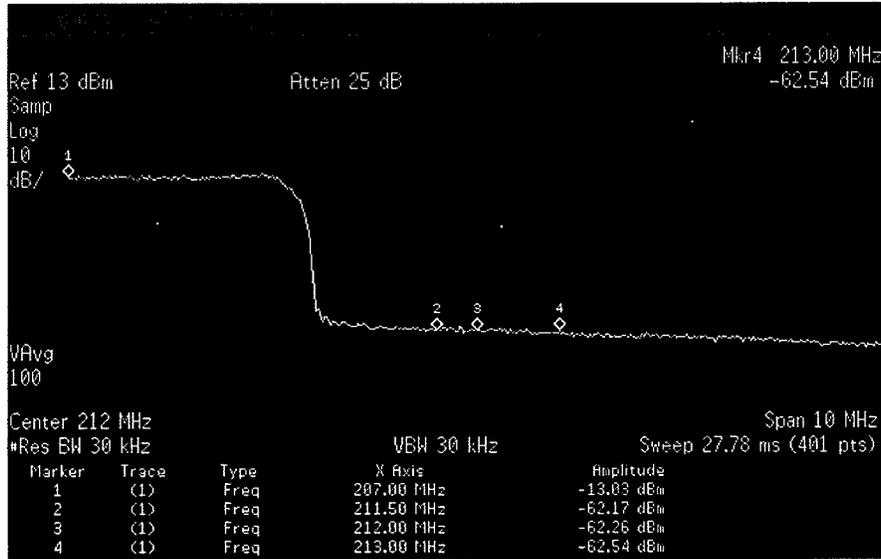
DIGITAL TRANSMITTER AMPLITUDE RESPONSE

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DIGITAL TRANSMITTER AMPLITUDE RESPONSE

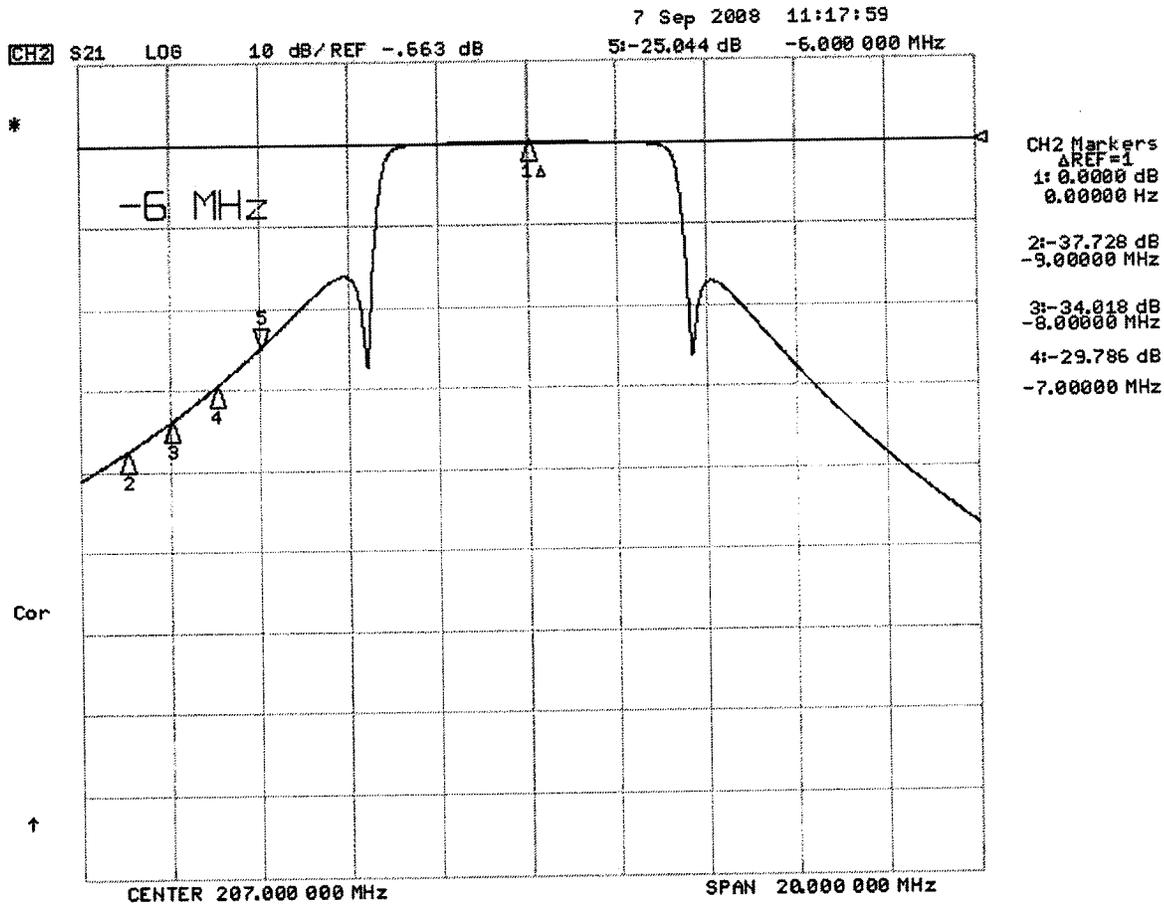
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BANDPASS FILTER RESPONSE

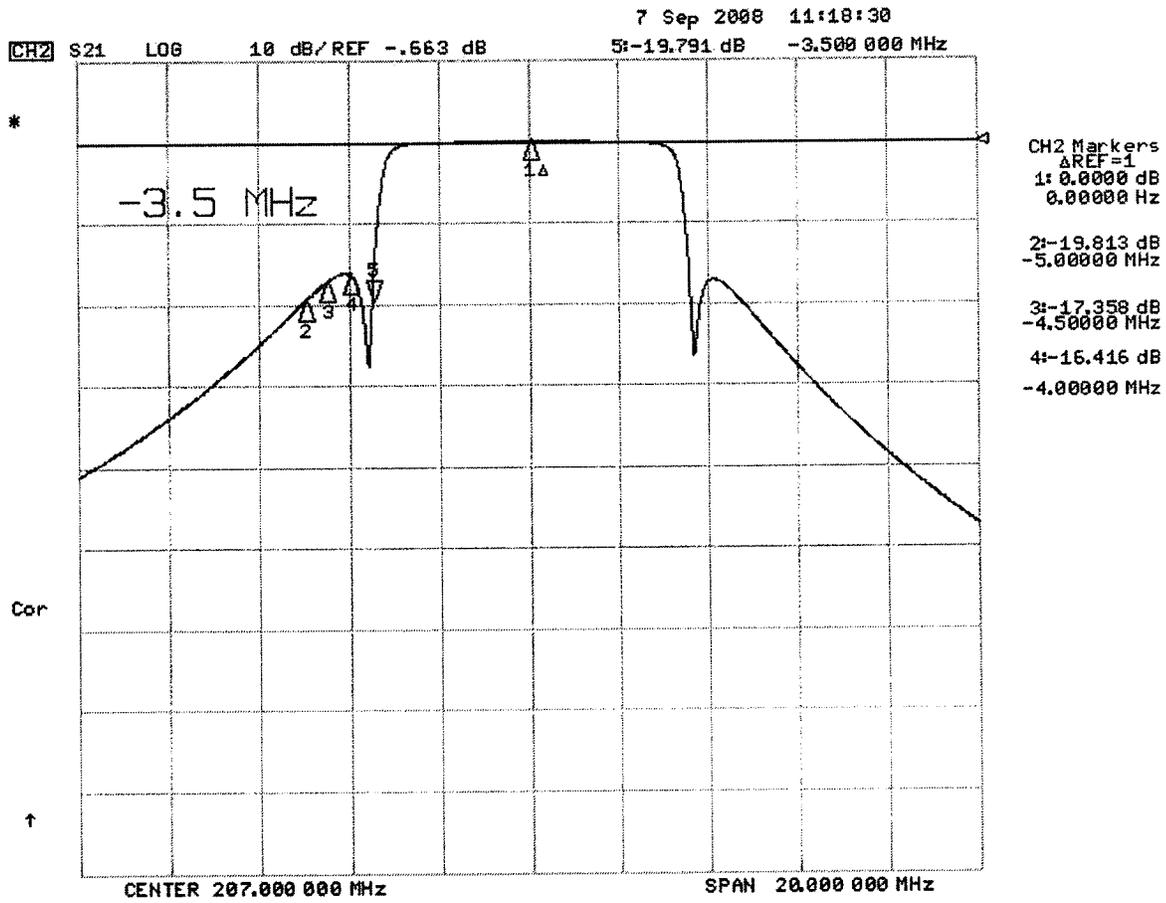
The response of the Bandpass Filter was measured using the 8753ES Network Analyzer; Serial number; US 39173024.

The results are recorded below.



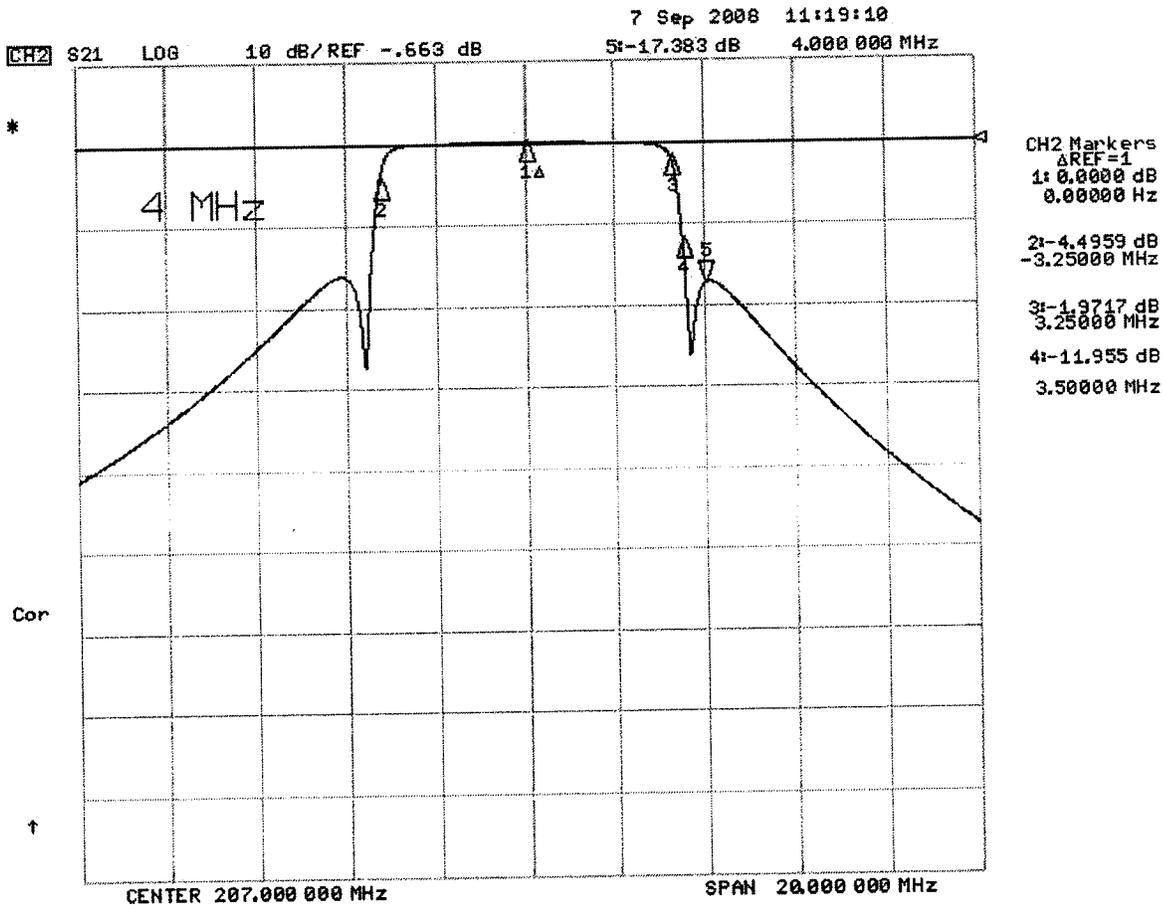
BANDPASS FILTER RESPONSE

Continued



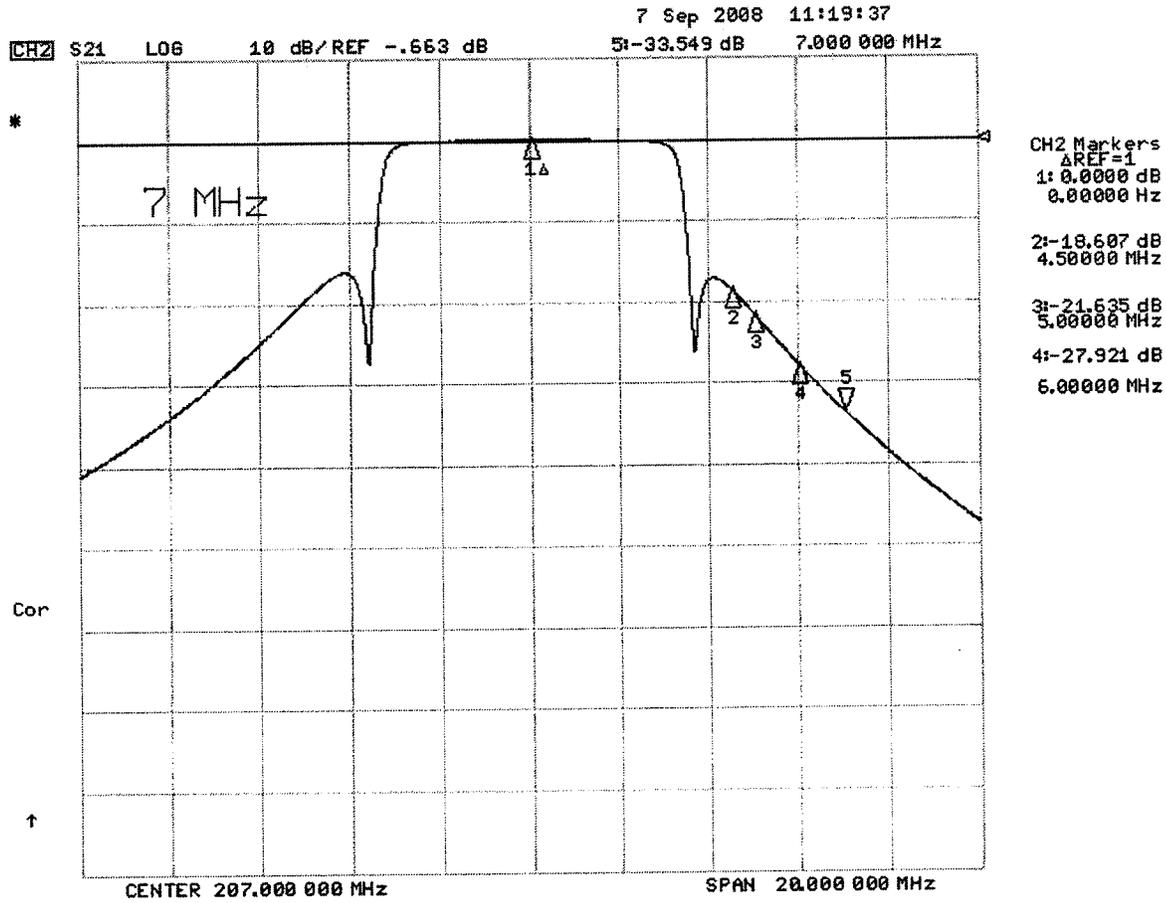
BANDPASS FILTER RESPONSE

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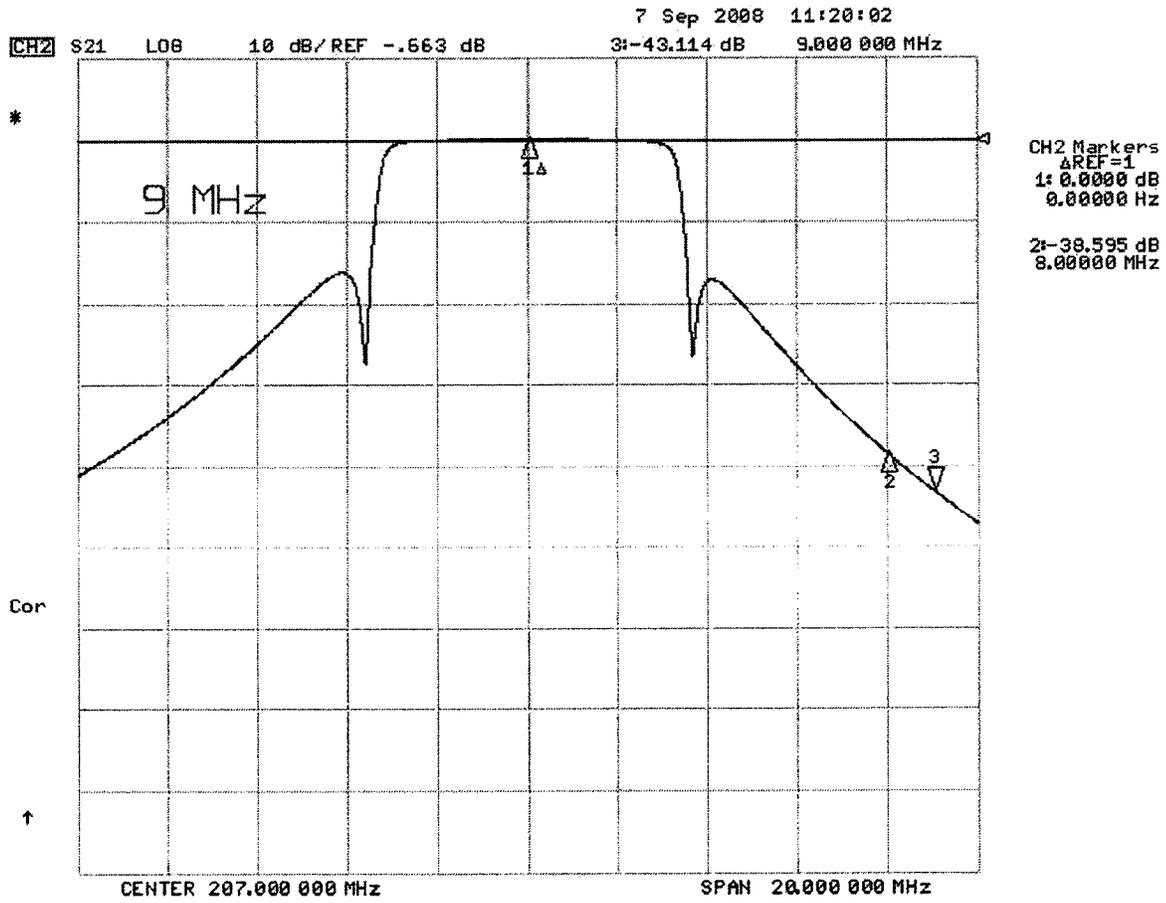
BANDPASS FILTER RESPONSE

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BANDPASS FILTER RESPONSE

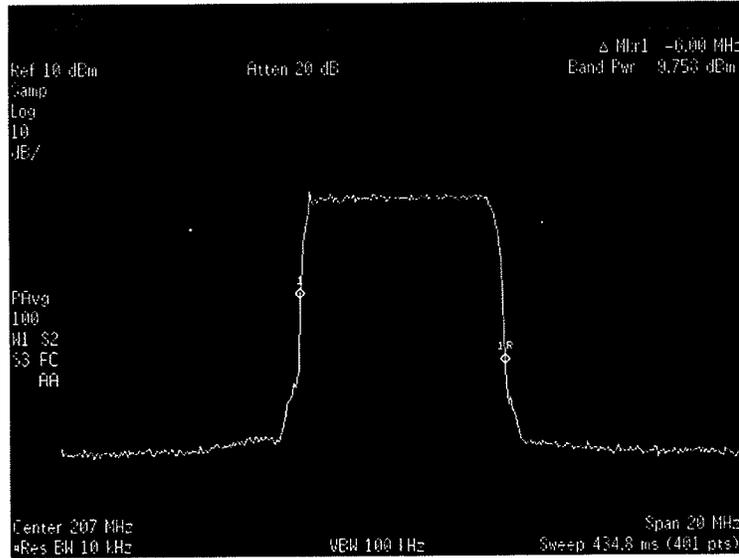
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SYSTEM SIDEBEAND ENERGY AT +/- 3.25MHz FROM CENTER

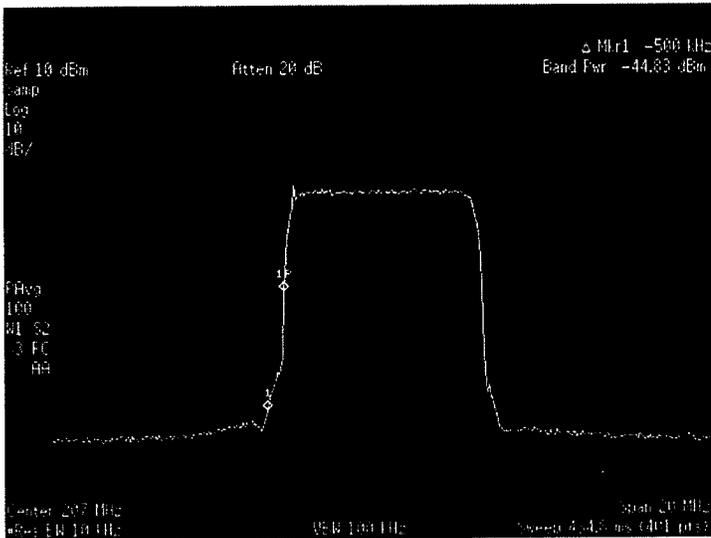
EXCITER A

Data recorded at operational power. Spectrum analyzer to be set up to measure 6MHz band power. FCC specification -47dB.

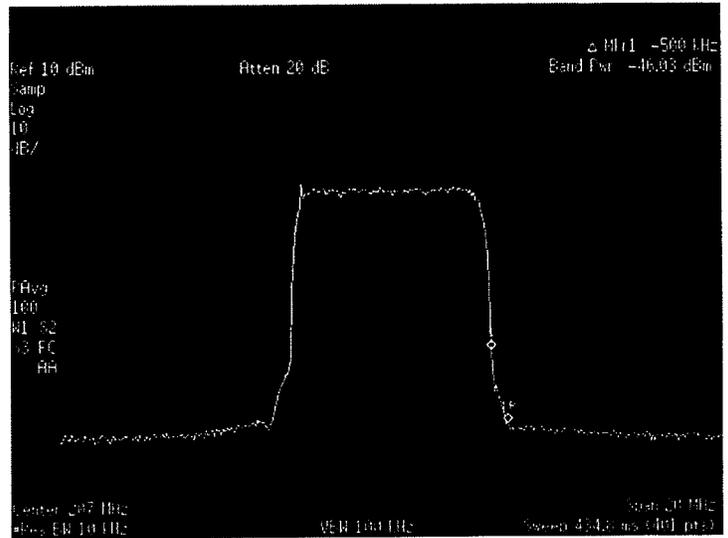


6MHz Power 9.8dBm = 0dBr

Measurement bandwidth set to 500kHz, centered at ± 3.25MHz



Lower Sideband = --54.6dBr

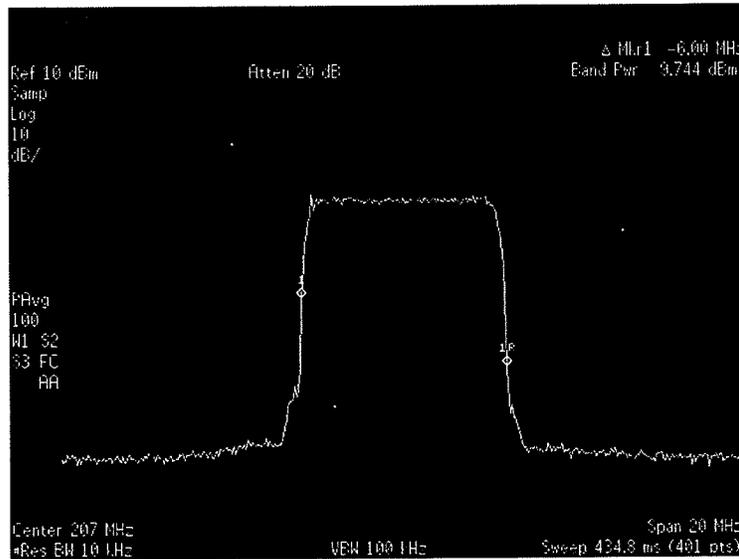


Upper Sideband = -55.8dBr

SYSTEM SIDEBAND ENERGY AT +/- 3.25MHz FROM CENTER

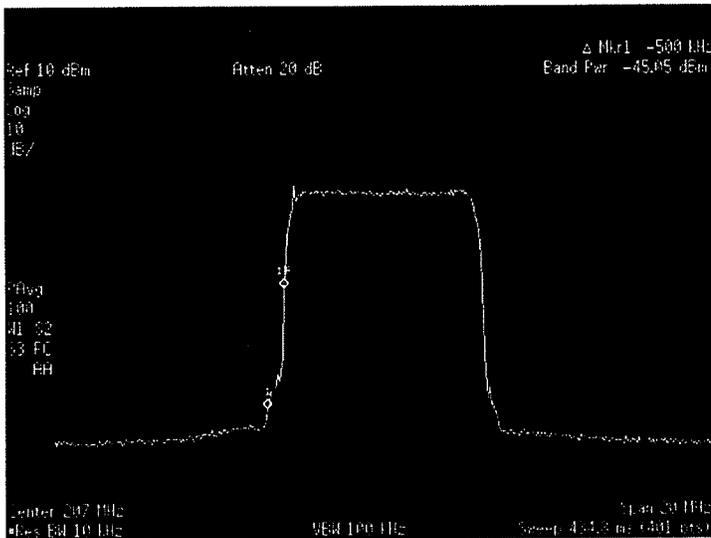
EXCITER B

Data recorded at operational power. Spectrum analyzer to be set up to measure 6MHz band power. FCC specification -47dB.

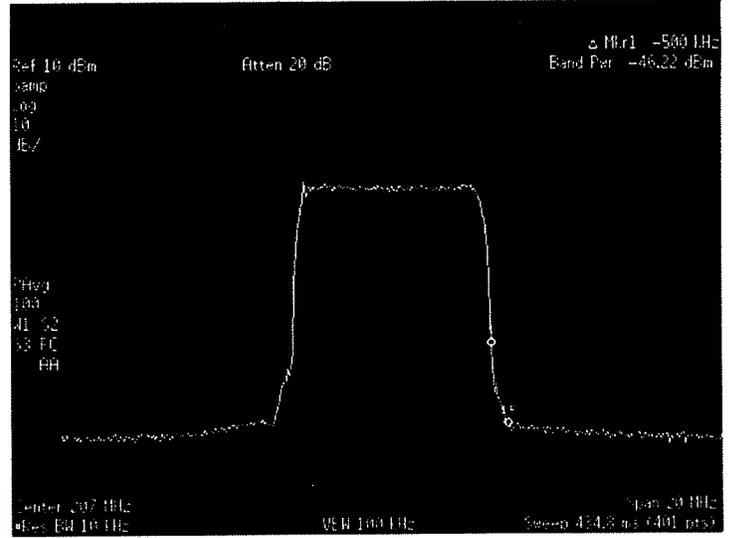


6MHz Power 9.7dBm = 0dBr

Measurement bandwidth set to 500kHz, centered at ± 3.25MHz



Lower Sideband = -54.8dBr



Upper Sideband = -55.9dBr

S 2 O N E

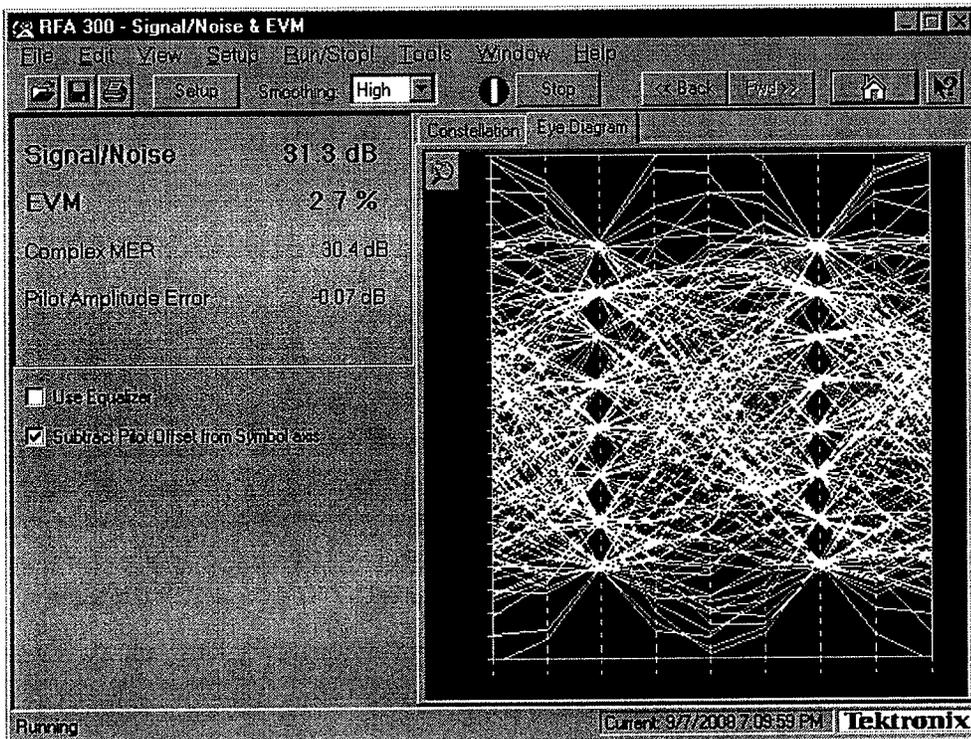
PROOF: KCWY-DT

ERROR VECTOR MAGNITUDE

EXCITER A

The Error Vector Magnitude was measured using the Tektronix RF300A; serial number; B010109.

The results are recorded below.



ATSC SPECIFICATION: SNR \geq 27dB

S 2 O N E

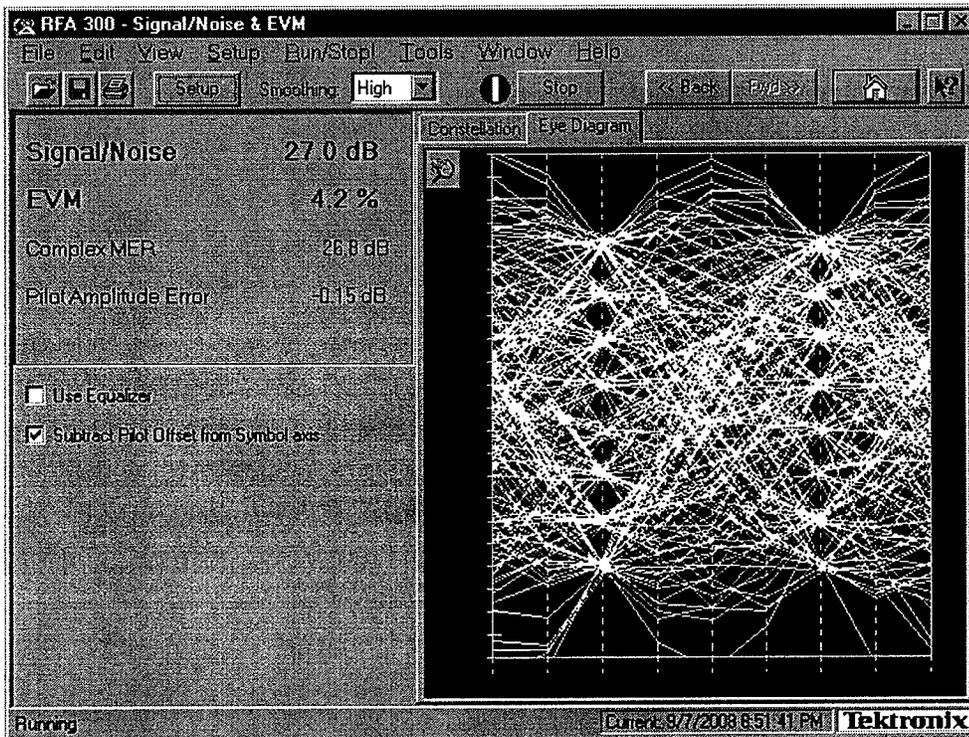
PROOF: KCWY-DT

ERROR VECTOR MAGNITUDE

EXCITER B

The Error Vector Magnitude was measured using the Tektronix RF300A; serial number; B010109.

The results are recorded below.



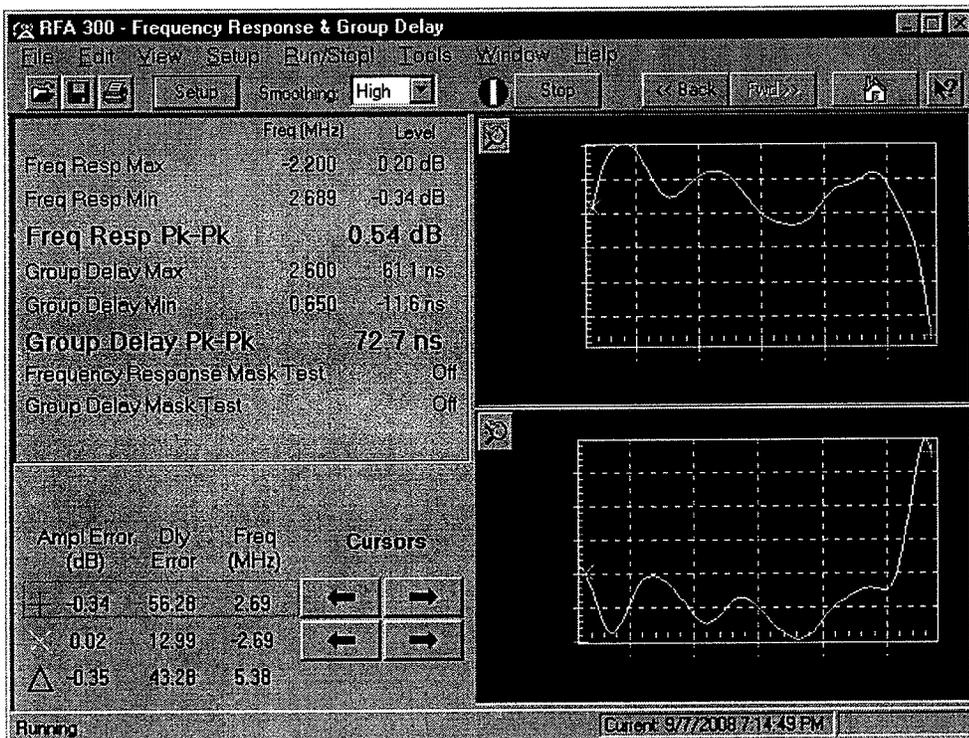
ATSC SPECIFICATION: SNR \geq 27dB

RESPONSE AND GROUP DELAY

EXCITER A

The System Amplitude Response and Group Delay were measured using the Tektronix RF300A; Serial number; B010119.

The results are recorded below



ATSC SPECIFICATION: Not specified.

S Z O N E

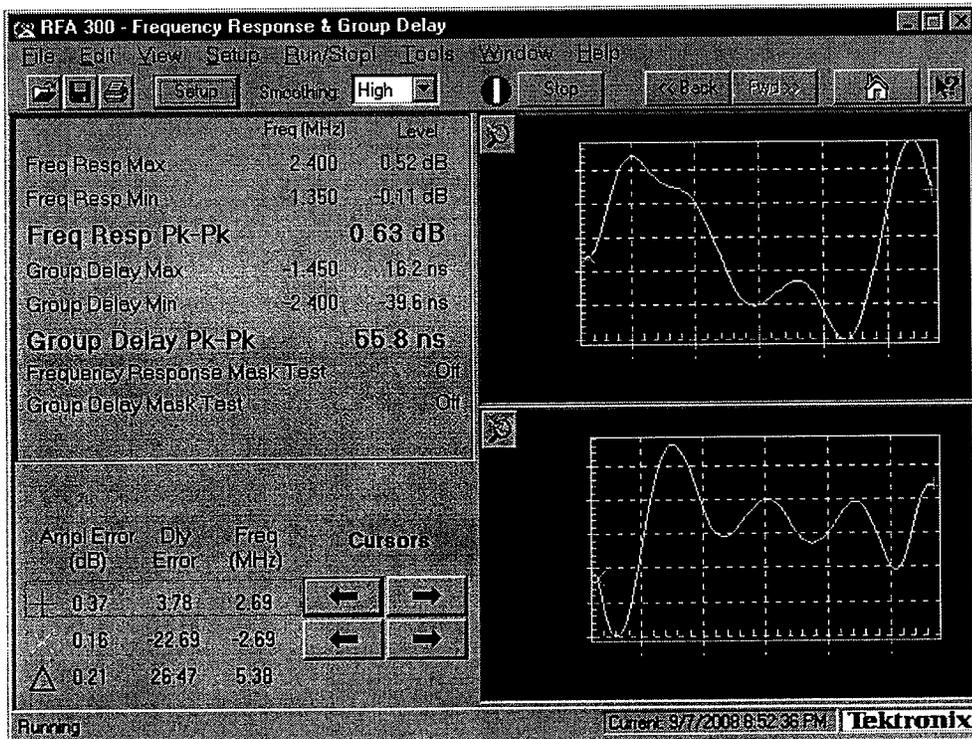
PROOF: KCWY-DT

RESPONSE AND GROUP DELAY

EXCITER B

The System Amplitude Response and Group Delay were measured using the Tektronix RF300A; Serial number; B010119.

The results are recorded below



ATSC SPECIFICATION: Not specified.

OVERALL SYSTEM RESPONSE

EXCITER A

The following chart shows the addition of the Bandpass Filter and the Transmitter response to obtain a Net Response, which is then compared to the FCC Mask. A negative number in the last column would indicate that the response does not meet FCC specifications. Reference for these measurements are from the ATSC Standard Document A64 Revision A.

Frequency	Filter Response			Transmitter Response before filter			Net Response	FCC Mask Response	Negative # is out of FCC Specifications
	Analyzer Reading	Center Freq. Reference	Filter Response	Analyzer Reading	Center Freq. Reference	Transmitter Response			
198.00	-37.73	0.00	-37.73	-70.50	-13.75	-56.75	-94.48	-99.40	-4.92
199.00	-34.02	0.00	-34.02	-65.80	-13.75	-52.05	-86.07	-88.60	-2.53
200.00	-29.79	0.00	-29.79	-61.13	-13.75	-47.38	-77.17	-77.10	0.07
201.00	-25.04	0.00	-25.04	-57.61	-14.12	-43.49	-68.53	-65.60	2.93
202.00	-19.81	0.00	-19.81	-57.53	-14.12	-43.41	-63.22	-54.10	9.12
202.50	-17.36	0.00	-17.36	-56.50	-14.12	-42.38	-59.74	-48.40	11.34
203.00	-16.42	0.00	-16.42	-56.54	-13.05	-43.49	-59.91	-42.60	17.31
203.50	-19.71	0.00	-19.71	-57.13	-13.05	-44.08	-63.79	-36.40	27.39
203.75	-4.50	0.00	-4.50	-57.38	-13.05	-44.33	-48.83	-36.40	12.43
210.25	-1.97	0.00	-1.97	-59.36	-13.85	-45.51	-47.48	-36.40	11.08
210.50	-11.96	0.00	-11.96	-60.64	-13.85	-46.79	-58.75	-36.40	22.35
211.00	-17.38	0.00	-17.38	-60.82	-13.85	-46.97	-64.35	-42.60	21.75
211.50	-18.61	0.00	-18.61	-61.24	-13.39	-47.85	-66.46	-48.40	18.06
212.00	-21.64	0.00	-21.64	-62.04	-13.39	-48.65	-70.29	-54.10	16.19
213.00	-27.92	0.00	-27.92	-63.90	-13.39	-50.51	-78.43	-65.60	12.83
214.00	-33.55	0.00	-33.55	-64.03	-12.69	-51.34	-84.89	-77.10	7.79
215.00	-38.60	0.00	-38.60	-64.54	-12.69	-51.85	-90.45	-88.60	1.85
216.00	-43.11	0.00	-43.11	-64.77	-12.69	-52.08	-95.19	-99.40	-4.21

OVERALL SYSTEM RESPONSE

EXCITER B

The following chart shows the addition of the Bandpass Filter and the Transmitter response to obtain a Net Response, which is then compared to the FCC Mask. A negative number in the last column would indicate that the response does not meet FCC specifications. Reference for these measurements are from the ATSC Standard Document A64 Revision A.

Frequency	Filter Response			Transmitter Response before filter			Net Response	FCC Mask Response	Negative # is out of FCC Specifications
	Analyzer Reading	Center Freq. Reference	Filter Response	Analyzer Reading	Center Freq. Reference	Transmitter Response			
198.00	-37.73	0.00	-37.73	-69.47	-13.25	-56.22	-93.95	-99.40	-5.45
199.00	-34.02	0.00	-34.02	-65.69	-13.25	-52.44	-86.46	-88.60	-2.14
200.00	-29.79	0.00	-29.79	-61.49	-13.25	-48.24	-78.03	-77.10	0.93
201.00	-25.04	0.00	-25.04	-58.03	-13.17	-44.86	-69.90	-65.60	4.30
202.00	-19.81	0.00	-19.81	-57.37	-13.17	-44.20	-64.01	-54.10	9.91
202.50	-17.36	0.00	-17.36	-57.22	-13.17	-44.05	-61.41	-48.40	13.01
203.00	-16.42	0.00	-16.42	-57.11	-13.11	-44.00	-60.42	-42.60	17.82
203.50	-19.71	0.00	-19.71	-57.35	-13.11	-44.24	-63.95	-36.40	27.55
203.75	-4.50	0.00	-4.50	-58.23	-13.11	-45.12	-49.62	-36.40	13.22
210.25	-1.97	0.00	-1.97	-60.11	-13.68	-46.43	-48.40	-36.40	12.00
210.50	-11.96	0.00	-11.96	-61.18	-13.68	-47.50	-59.46	-36.40	23.06
211.00	-17.38	0.00	-17.38	-61.31	-13.68	-47.63	-65.01	-42.60	22.41
211.50	-18.61	0.00	-18.61	-62.17	-13.03	-49.14	-67.75	-48.40	19.35
212.00	-21.64	0.00	-21.64	-62.26	-13.03	-49.23	-70.87	-54.10	16.77
213.00	-27.92	0.00	-27.92	-62.54	-13.03	-49.51	-77.43	-65.60	11.83
214.00	-33.55	0.00	-33.55	-64.45	-13.46	-50.99	-84.54	-77.10	7.44
215.00	-38.60	0.00	-38.60	-65.23	-13.46	-51.77	-90.37	-88.60	1.77
216.00	-43.11	0.00	-43.11	-66.58	-13.46	-53.12	-96.23	-99.40	-3.17

S 2 O N E

PROOF: KCWY-DT

TRANSMITTER METER READINGS

Power Out203W
Reflected.....0W

Exciter A -5.3dBm Pre-Corrector Table 2
Exciter B -5.4dBm Pre-Corrector Table 5 (Constructed on site)

HPA.....51.8A 227W

Mains.....117.8V@22A