

TEST REPORT

MEDEX XL20-10MED RETROFIT DTV TRANSMITTER

TECHNICAL REPORT

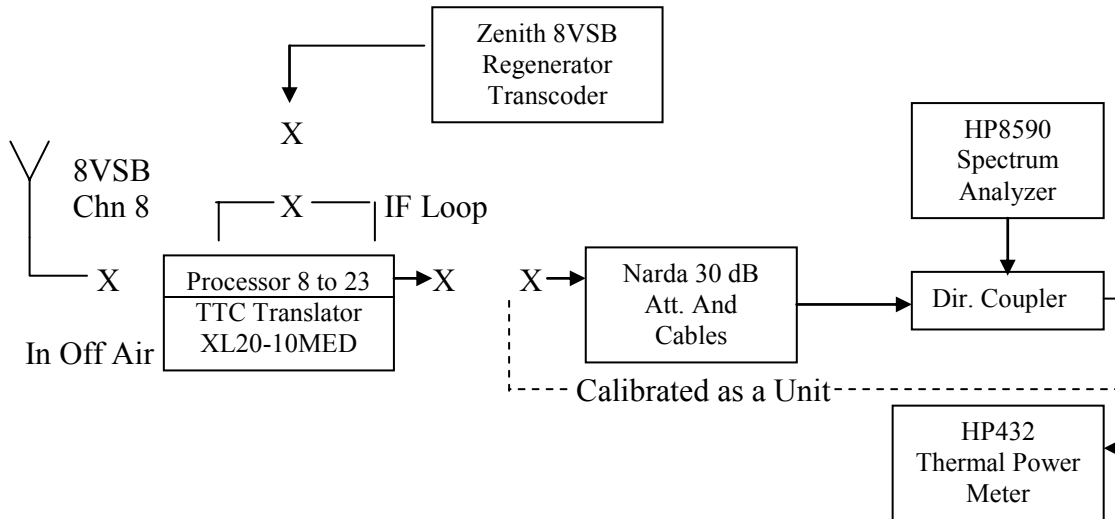
INTRODUCTION

The following information is provided to support the technical performance of the MEDEX XL20-10MED Retrofit Kit. The information is supplied for DTV broadcast service according to applicable portions of FCC rules contained in Part 2, Part 73, and Part 74.

1. Power Output Measurements as indicated by FCC Rule 74.795.
2. Frequency Measurements as identified by FCC Rule 74.795.
3. Output Power Variation with input level changes as identified by FCC rule 74.795 (c) (2).
4. Emission mask compliance as defined in FCC Rule 74.794.
5. Attenuation to harmonics produced in the RNSS bands as defined in FCC Rule 74.794
6. Demonstration of transmission and reception of 8-VSB ATSC signal.
7. Measurements of voltage and current to final amp stage as outlined in FCC Rule 74.795.

Measurements were conducted at transmitter power output levels of 5 watts average and 1.0 watts average and constitute the range of power for which type certification is sought. Measurements were taken on a unit with operating on UHF TV channel 23.

All test equipment was calibrated prior to the use of the equipment. The list of test equipment is provided on the page with the test setup.

TEST SET UP

To Set Power to 5Watts +37 dBm

TEST EQUIPMENT LIST

- MEDEX P617 Processor
- TTC XL20 SN 6907-5908-006
- HP Spectrum Analyzer #8590 SN 2713A01471
- HP Power meter #432A SN 1848A26841
- NARDA 30 dB #766-30 and Mini Circuits 10 dB #UNAT-10, Mini Circuits High Pass Filter # NHP700
- HP Tracking Generator 8444A-059, SN 2325A05483
- HP8640B SN: 6678A03049 Signal Generator
- Wandel & Golteman SMP17 Frequency Counter SN: K0065
- Holand GHS2 75 OHM Splitters
- FLUKE 85 Voltmeter
- Zenith 8VSB Transcoder DTVTRANS-A SN: 00003013

POWER OUTPUT TESTS

The internal power meter was calibrated using the test set up (Exhibit 2A). When the HP Power Meter was measuring +37 DBM, (5 watts) the internal meter was set and calibrated for a reading of 10 on the top scale. This is illustrated in the photograph below.



The following photograph shows the MEDEX XL20-10MED operating at 1.0 watt average power.



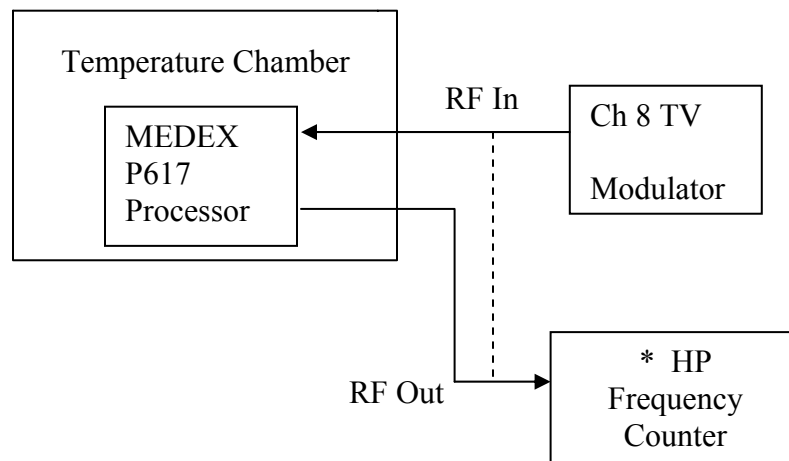
The power meter on the Unit Under Test reads 2 on the top scale corresponding to the level of 1 watt output power.

FREQUENCY STABILITY VERSUS TEMPERATURE

The MEDEX Processor was inserted into a temperature chamber and the RF input was connected to a channel 8 TV modulator of high stability with Visual input frequency measured at each point that the output frequency is measured. In this manner, the true frequency shift of the MEDEX processor can be measured. The power amplifiers were not part of this measurement since they do not contribute to the frequency stability performance. The temperature was initialized at 40 degrees C and then allowed to stabilize at each of the measurement points identified in the following table. A nominal channel 8 modulator was used in this case because the frequency counter can lock on to the carrier frequency whereas it cannot when an 8 VSB waveform is used.

Temp °C	Time	Visual Input Frequency MHz	Visual Output Frequency MHz	Change from Input in Hz
40	3:10 PM	181.251152	621.249342	-1810
30	3:20 PM	181.251296	621.250586	-710
20	3:30 PM	181.251331	621.251467	+136
10	3:45 PM	181.251383	621.252614	+1231
0	4:00 PM	181.251392	621.252615	+1223

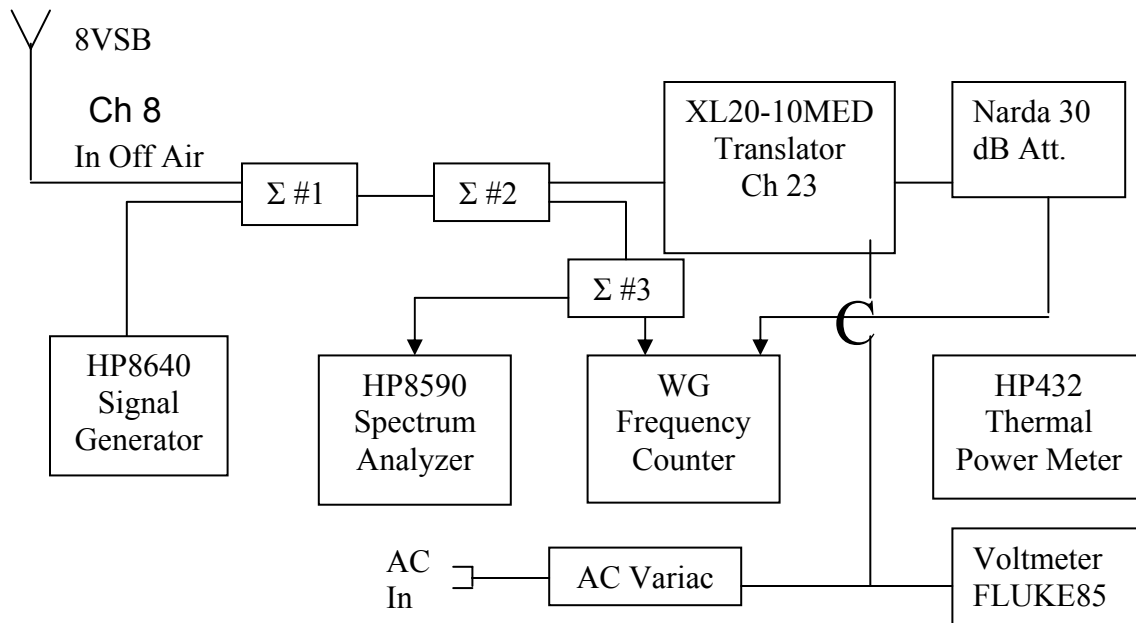
The frequency change from 20 degrees Celsius to 0 Degree Celsius was +1223 Hz, the frequency change from 20 degrees Celsius to 40 Degree Celsius was -1823 Hz, for a total frequency change of 3,046 Hz. This frequency shift over the temperature is well below the 10 kHz specification in the FCC rules.



- HP 53131A Frequency Counter SN: KR01204459

FREQUENCY DRIFT VERSUS CHANGE IN LINE VOLTAGE

The SSBXL20-10MED Translator's output was set to +37dBm (5 Watt) on Channel 23.



Test Method:

The following method of measuring the pilot carrier of the 8VSB signal was used, as the frequency counter is unable to read the pilot carrier due to the noise like 8VSB signal.

The channel 8 digital pilot carrier was combined with the HP signal generator (splitter #1).

Splitter #2 feeds the XL20-10MED translator, the other output fed splitter #3.

Splitter #3 feeds the HP8590 spectrum analyzer and the frequency counter. The output of the translator and NARDA 30dB attenuator also went to the frequency counter.

The HP8640 was adjusted to a zero beat on the pilot carrier, as measured on the spectrum analyzer using a 1 KHz RBW. After the zero beat was obtained the output of the signal generator was raised 20dB and measured on the frequency counter. Then the frequency counter was connected to the translator output and the frequency was measured as recorded.

This method was repeated for each of the following voltages:

Voltage	Input Frequency Reading	Output Frequency Reading
95V	180.310360MHz Net change 770Hz	524.309590MHz
118V	180.310360MHz Net change 770Hz	524.309590MHz
136V	180.310360MHz Net Change 770Hz	524.309590MHz

Changing the voltage from 95V to 136V did not change the translator output frequency of the pilot carrier. The frequency of the SSBXL20-10MED will be checked and adjusted on each unit before it is shipped.

The following results on the power meter were recorded:

Voltage		Power Output
95V	=	+37dBm
118V	=	+37dBm
135 V	=	+37dBm

Changing the voltage did not change the translator output power.

AGC PERFORMANCE VERSUS SIGNAL INPUT LEVEL

POWER OUTPUT VERSUS INPUT LEVEL TEST

Section 74.795(c) (2) identifies that the change in output power shall be less than 1 dB for 30 dB input level change for digital heterodyne translators.

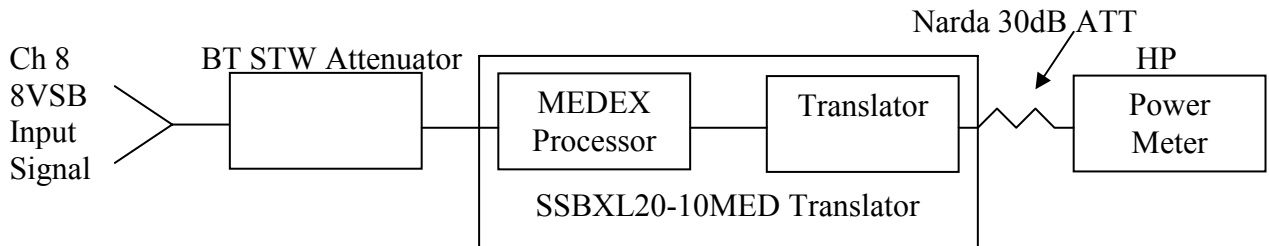
The input to the SSBXL20-10MED was changed in 10dB steps with the initial output power set at +37dBm (5 Watts) and the following steps were noted:

Input Level Change			Power Output Change		
FROM	TO	dBmV	from +37dBm (5 Watts)		
-30 dBmV	→	0 dBmV	=	-.3 dB change	= 36.7dBm
-20 dBmV	→	+10 dBmV	=	-.2 dB change	= 36.8dBm
-10 dBmV	→	+20 dBmV	=	-.2 dB change	= 36.8dBm
-0 dBmV	→	+30 dBmV	=	+.1 dB change	= 37.1dBm

The net change in output power was .4dB

At -36 dBmV the processor's automatic shutoff circuits shutdown the translator.

TEST SETUP

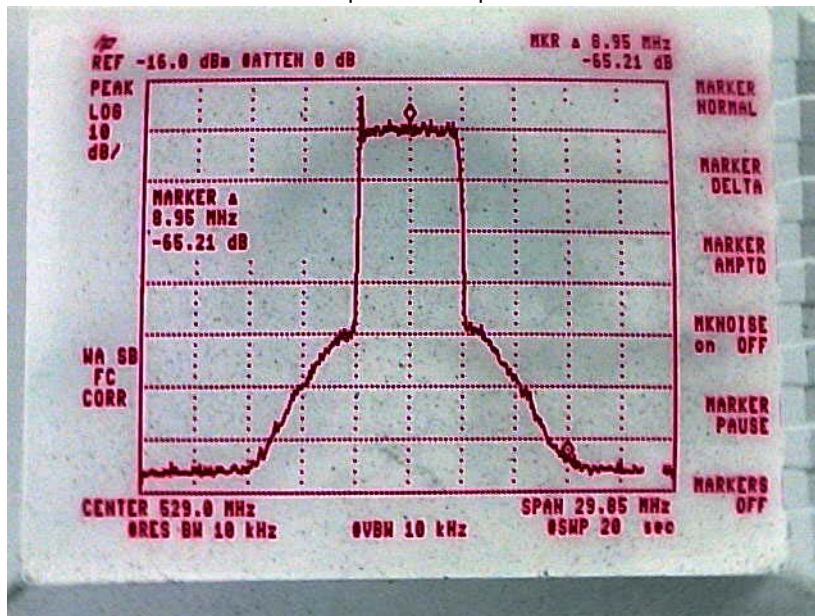


EMISSION MASK COMPLIANCE

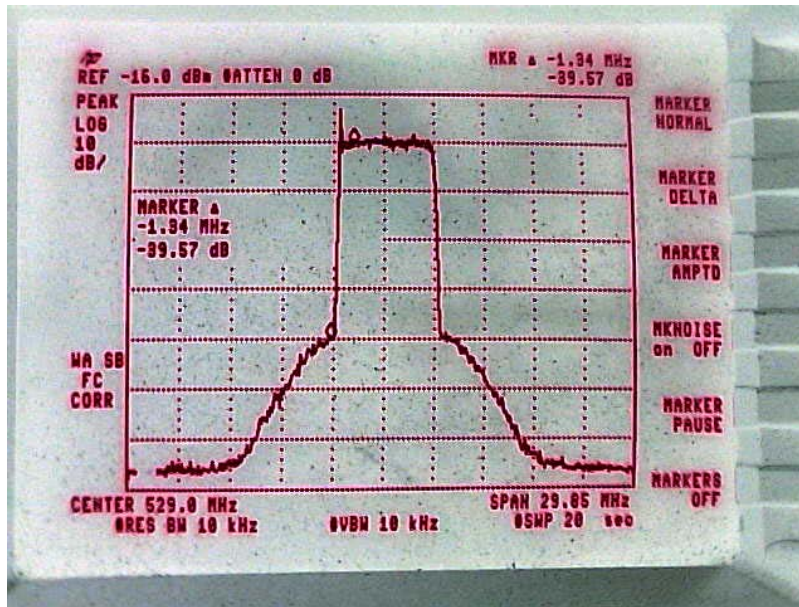
The transmitter was energized at 5 watts and tested for compliance with the “simple” emission mask. The output spectrum was measured using a spectrum analyzer and data was taken for each 500 kHz segment from both lower and upper bandedge. Measurement points were taken at the frequency in the middle of each 500 kHz segment. The process was repeated at 1.0 watt output power. Photographs were taken at each power level to illustrate that the emission mask requirements were met. Measurements were made in a 10 kHz measurement bandwidth and corrected for comparison against the total power in the channel.

Measurement Sub-Band (MHz)	Measured Level (dBm)	Corrected to compare to total power	Measurement Sub-Band (MHz)	Measured Level (dBm)	Corrected to compare to total power	Simple Mask Requirements
0.0 MHz (Shoulder)	38.03	48.63	0.0 MHz (Shoulder)	38.03	48.63	47.0
0-.5 @ -.250 MHz	42.62	53.22	0-.5 @ +.250 MHz	42.01	52.61	46.04
.5-1.0 @ -.750 MHz	42.65	53.25	.5-1.0 @ +.750 MHz	43.15	53.75	46.39
1.0-1.5 @ -1.250 MHz	45.09	55.69	1.0-1.5 @ +1.250 MHz	43.96	54.56	47.09
1.5-2.0 @ -1.750 MHz	46.83	57.43	1.5-2.0 @ +1.750 MHz	45.33	55.93	48.13
2.0-2.5 @ -2.25 MHz	49.72	60.32	2.0-2.5 @ +2.25 MHz	48.01	58.61	49.52
2.5-3.0 @ -2.75 MHz	52.21	63.31	2.5-3.0 @ +2.75 MHz	51.05	61.65	51.25
3.0-3.5 @ -3.25 MHz	55.22	65.82	3.0-3.5 @ +3.25 MHz	53.9	64.5	53.33
3.5-4.0 @ -3.75 MHz	56.91	67.51	3.5-4.0 @ +3.75 MHz	55.4	66	55.77
4.0-4.5 @ -4.25 MHz	58.78	69.38	4.0-4.5 @ +4.25 MHz	58.33	68.93	58.54
4.5-5.0 @ -4.75 MHz	60.15	70.75	4.5-5.0 @ +4.75 MHz	60.9	71.5	61.67
5.0-5.5 @ -5.25 MHz	62.27	72.87	5.0-5.5 @ +5.25 MHz	62.18	72.78	65.14
5.5-6.0 @ -5.75 MHz	63.36	73.96	5.5-6.0 @ +5.75 MHz	64.5	75.1	68.96
6.0	63.96	74.56	6.0	64.97	75.57	71.0

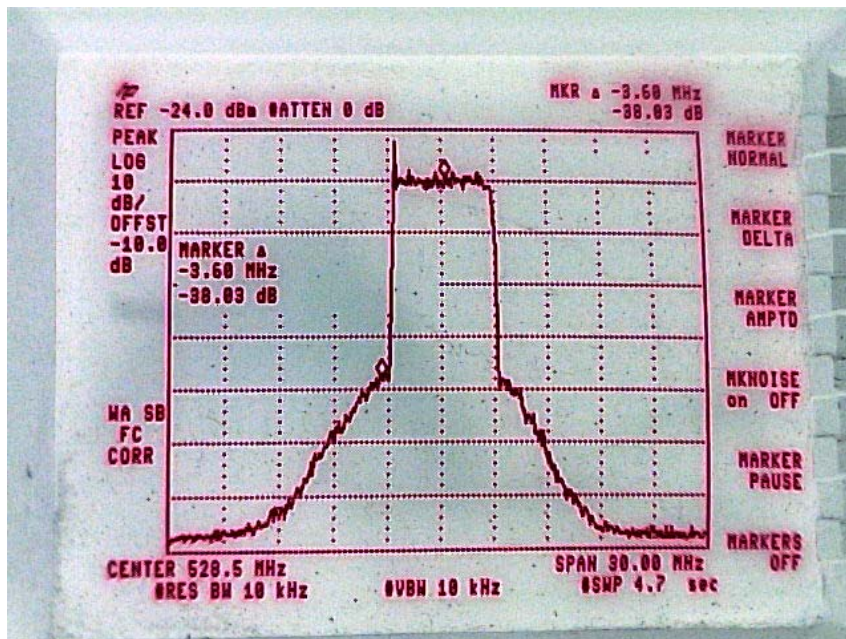
The above measurements meets the simple mask requirements.



Photograph showing attenuation in adjacent channels at 5.0 watts..

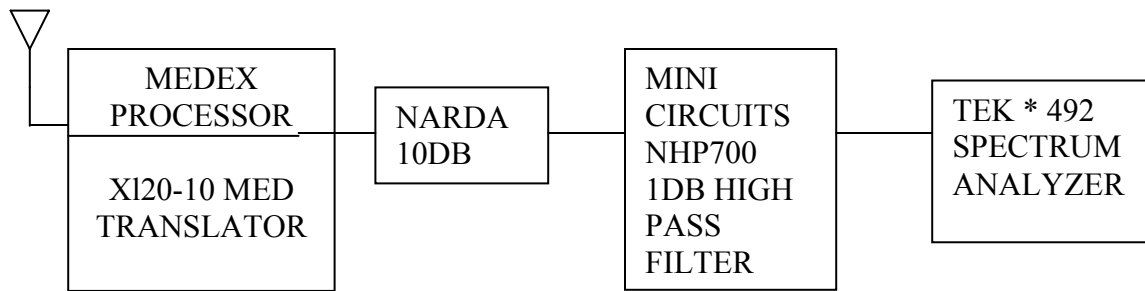


Photograph showing shoulder level at channel edge at 5.0 watts



Photograph showing shoulder level at channel edge at 1.0 watts

OUT OF BAND EMISSIONS



The power output of the XL20-10MED Translator was set to 5 Watts, +37dBm. The 10dB Attenuator, High Pass Filter, and TEK 492 are connected direct to the translator without any cables. The following results were noted:

+37dBm Translator output	
- 10dB NARDA Attenuator	
-1dB Mini Circuits High Pass Filter	
+26dBm input to TEK 492 Analyzer	
-80dBm Tek Noise Floor	
=106dB test equipment measurement capability (with high pass filter)	

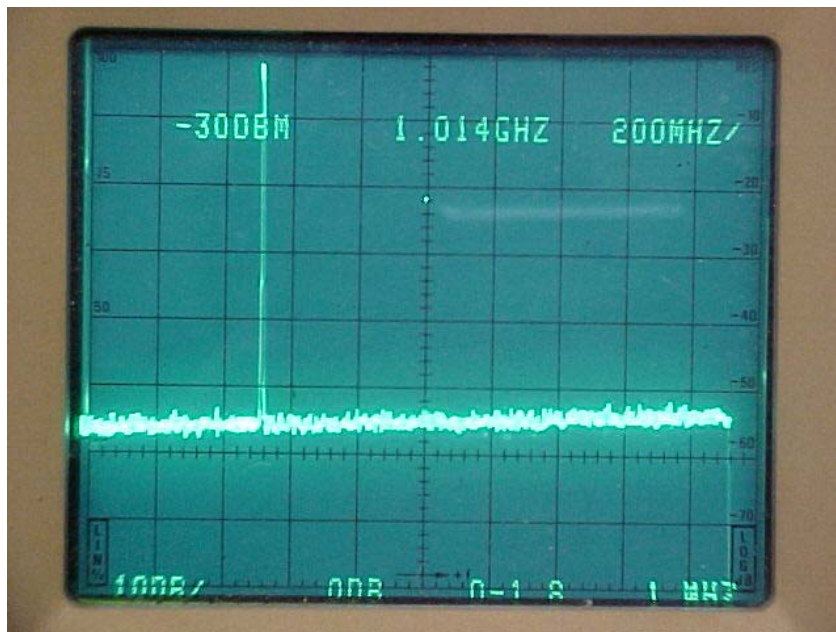
Out of band emissions were searched in 3 bands and the results are recorded below:

0 to 2 GHz	=	<-106dB
2 to 4 GHz	=	<-106dB
4 to 6 GHz	=	<-106dB

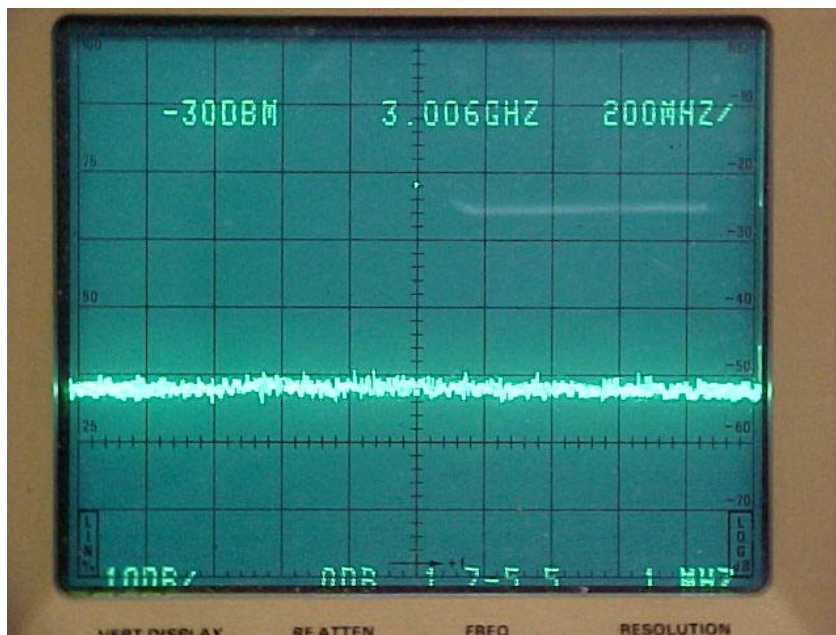
These results are represented in the next three photographs.

The 10th Harmonic of Channel 23, “524MHz”, is 5240MHz. Any out of band emissions were below the noise floor of the analyzer, or 106dB below the translator output level.

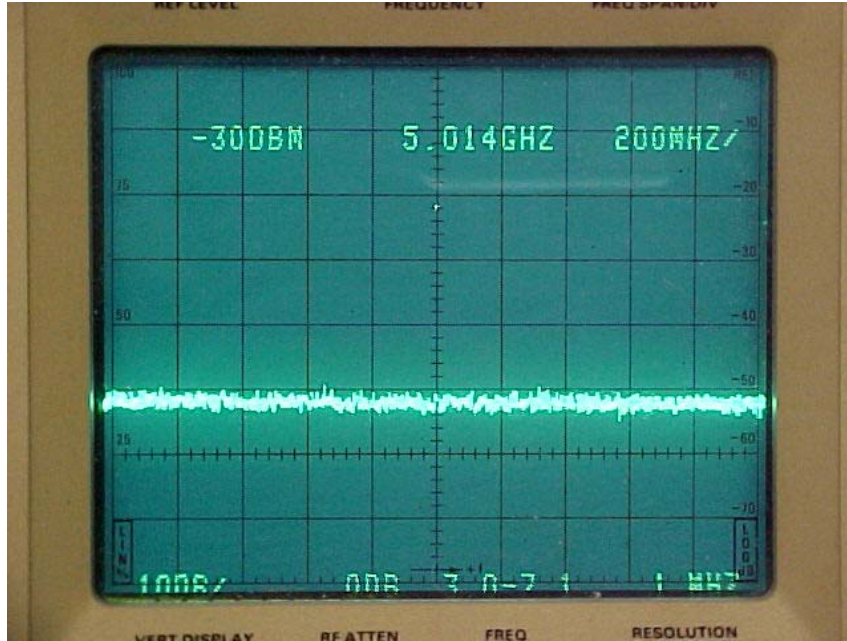
- TEKTRONICS 492 Serial Number B010160



Out of Band Emissions from DC to 2.0 GHz. The spectra is the fundamental frequency.

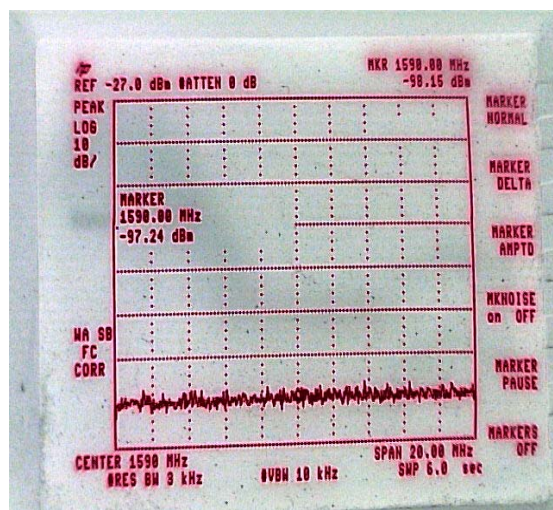
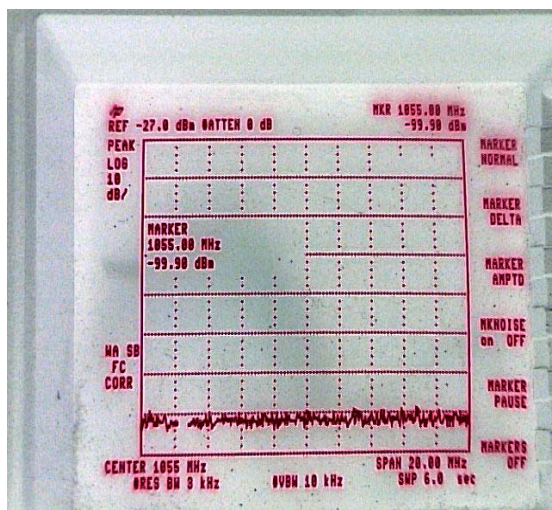


Out of Band Emissions from 2.0 to 4.0 GHz.



Out of Band Emissions from 4.0 to 6.0 GHz.

Additionally, the transmitter was energized at 1.0 watts and spectrum in the 2nd and 3rd harmonic areas were scrutinized using a lower resolution bandwidth to search for out-of-band emissions but none were found as evidenced by the photographs below.

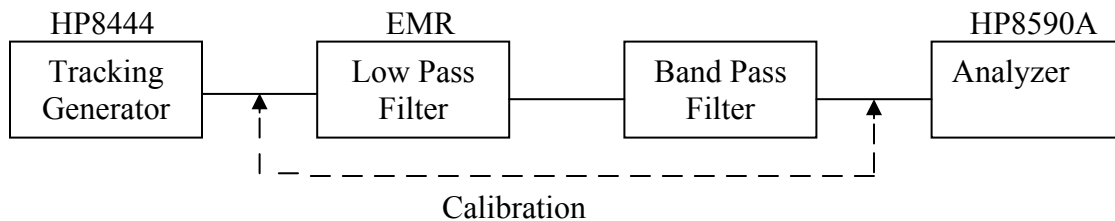


OUTPUT FILTER SYSTEM

The low pass filter and 3 pole bandpass filter combination was measured using the HP 8444 tracking generator and HP 8590A Spectrum Analyzer. Each GPS band was divided into 10 MHz sections. The test setup was calibrated for each 10 MHz section and the following results were obtained of the filters' attenuations:

Filter frequency and Input level	–	filter output level	=	Net attenuation
1190-1180 MHz @ -1.48 dBm	–	104.59 dBm	=	-103.42 dB
1180-1170 MHz @ -1.48 dBm	–	104.71 dBm	=	-103.23 dB
1170-1160 MHz @ -1.48 dBm	–	104.84 dBm	=	-103.36 dB
1240-1230 MHz @ -1.5 dBm	–	104.45 dBm	=	-102.95 dB
1230-1220 MHz @ -1.5 dBm	–	104.45 dBm	=	-102.95 dB
1220-1210 MHz @ -1.5 dBm	–	104.69 dBm	=	-103.19 dB
1610-1600 MHz @ -6 dBm	–	101.32 dBm	=	-95.32 dB
1600-1590 MHz @ -6 dBm	–	102.08 dBm	=	-96.08 dB
1590-1580 MHz @ -6 dBm	–	102.08 dBm	=	-96.08 dB
1580-1570 MHz @ -6 dBm	–	102.67 dBm	=	-96.67 dB
1570-1560 MHz @ -6 dBm	–	102.66 dBm	=	-96.66 dB
1560-1550 MHz @ -6 dBm	–	102.64 dBm	=	-96.64 dB

The measured results indicated the filter attenuation was greater than the analyzer could measure as it was below the analyzer noise floor.

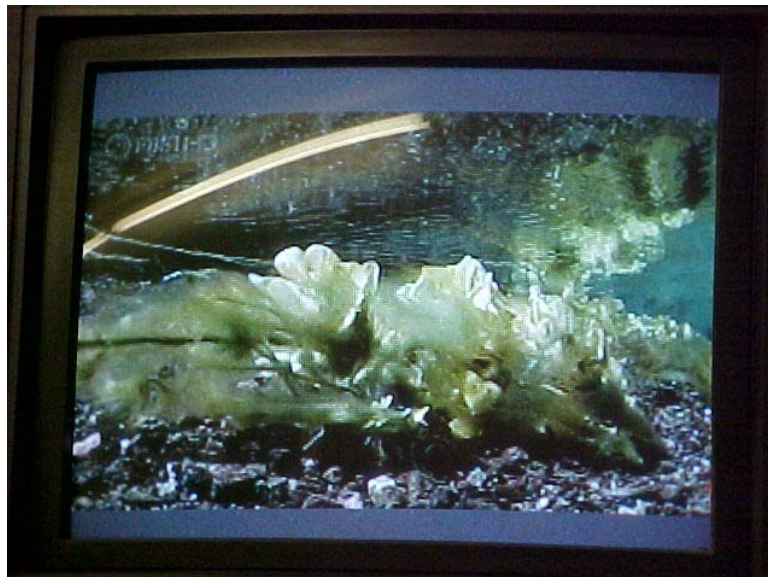


Shown on the next page is a picture of the EMR Low Pass Filter.



COMPATIBILITY WITH 8-VSB TRANSMISSION SYSTEM

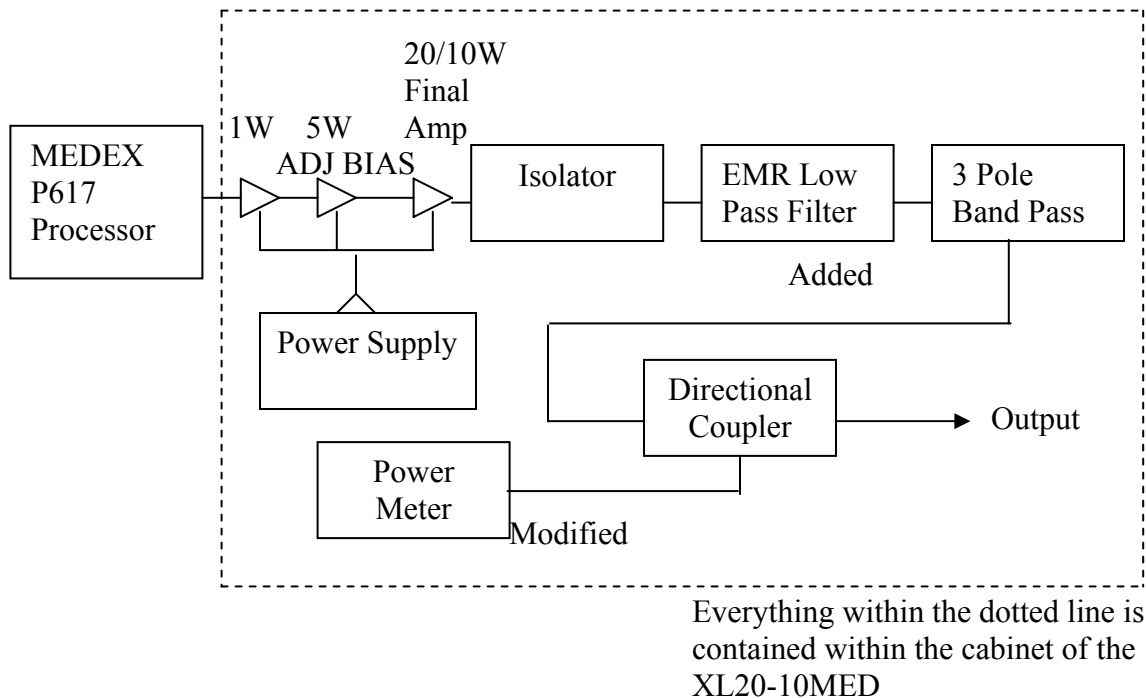
The translator was energized at 5 watts output to a dummy load on channel 23 and placed near a DTV receiver tuned to the same channel. The input of the translator was fed with a channel 8 DTV signal. The received picture is shown below demonstrating compatibility to reproduce the 8-VSB transmission system used in the US.



MODIFICATIONS TO XL-20 TRANSLATOR AND FINAL AMPLIFIER DC OPERATING PARAMETERS

The SSBXL20-10MED Main assemblies are shown below.

No parts were changed, only the bias was adjusted for the least distortion and best linearity, and the EMR low pass filter was added.



DC FINAL AMPLIFIER OPERATING PARAMETERS

With a digital average power of 5.0 Watts,

The final amplifier voltage = 24 volts.

The current of the final amp = 0.72 amps.

With a digital average power of 1.0 Watts,

The final amplifier voltage = 24 volts.

The current of the final amp = 0.3 amps.