

**Occupied Bandwidth Measurements
(FCC Rule 73.317)**

Common Antenna and Combiner System

KOPB-FM 91.5 MHz, Portland, Oregon

KKRZ 100.3 MHz, Portland, Oregon

KINK 101.9 MHz, Portland, Oregon

KKCW 103.3 MHz, Beaverton, Oregon

KSTE 105.9 MHz, Vancouver, Washington

September 28, 2001

On September 28th, 2001, Boyd Broadcast Technical Services was contracted to make measurements of KOPB-FM (90.5 MHz), KKRZ (100.3 MHz), KINK (101.9 MHz), all Portland, Oregon and KKCW (103.3 MHz), Beaverton, Oregon and KSTE (105.9 MHz), Vancouver, Washington, to show compliance with FCC Rule 73.317. These measurements were made after these five stations began using a common antenna and combining system at the "Skyline Tower" a joint venture of KGW-TV and Oregon Public Broadcasting.

All measurements were made at the forward port of a Shively directional coupler which had previously been installed in-line following the multi-station combining system and prior to the two-branch power divider feeding the facility's common antenna system. At this point attenuators were inserted ahead of the Tektronix 2712 spectrum analyzer (Serial Number B033975, last calibration 05/06/00) which was used for the measurements. A total of 50 dB of external attenuation was used to make reference measurements of the five stations. The amplitude calibration of the instrument was electronically adjusted to account for this attenuation.

30 dB of external attenuation was used for all other measurements. And again, the amplitude calibration of the instrument was electronically adjusted to account for this attenuation. This smaller amount of attenuation provides the necessary dynamic range for the spectrum analyzer to observe any spurious signals. Also double cavity notch filters, one for each of the five stations, were inserted in cascade following the attenuators and ahead of the spectrum analyzer to prevent signal overload and subsequent erroneous intermodulation products. The amplitude versus frequency response of each of these filters is shown on pages 3, 4 and 5 of this report.

The filters, Model 6367-2, are manufactured by Microwave Filter Company, Inc. Attenuators are precision 100-watt devices manufactured by Coaxial Dynamics. All cables are constructed of high quality RG-214 with premium type N connectors. Adapter connectors used are also premium quality. A block diagram of the measurement setup is shown on page 22 and a photograph of the complete test setup is shown on page 23.

Signals measured by the Tektronix 2712 spectrum analyzer are digitized in the analyzer. This data was collected for a short period using the instrument's peak-hold feature. The data for the reference plots was collected over an approximate 10 minute period. Other measurements were collected for approximately one minute each. This is done to observe possible short duration peaks.

A laptop computer using software to display, tabulate and save for analysis (and to provide the plots shown in this report) was connected to the Tektronix analyzer via GPIB. The peak-hold plots gathered were then downloaded into this computer. The Tektronix analyzer collects 512 points over the instrument's selected frequency span. These 512 individual data points, when downloaded into the computer, provide the capability via software to quantify specific points of interest.

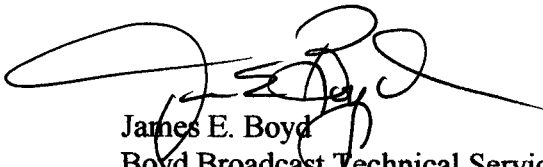
The reference plots for each of the stations connected to the combiner, are shown on pages 6, 7 and 8 of this report. These measurements show compliance with paragraph (b) and (c) of section 73.317 of the Commission's rules.

A computer program was used prior to making the measurements to determine possible intermodulation products. Particular attention was paid to products that could occur in the FM broadcast band (88 to 108 MHz), below the FM band into television channels 2, 3, 4, 5 and 6 and immediately above the FM broadcast band. Several signals were discovered, but nearly all were identified (mostly television broadcast signals) and those not identified were below the FCC limit of -80 dB referenced to the peak carrier level of the five stations being studied. It is believed that most of these signals were coming back down the transmission line from the common antenna and some were perhaps the result of instrument and/or cabling pickup in the room. Other FM broadcast stations from nearby sites were also seen at this directional coupler port. Spectral plots of signals found through 1.06 GHz, are shown on pages 9 through 21. No harmonic emissions or other spurious emissions from any of the five stations being studied were observed.

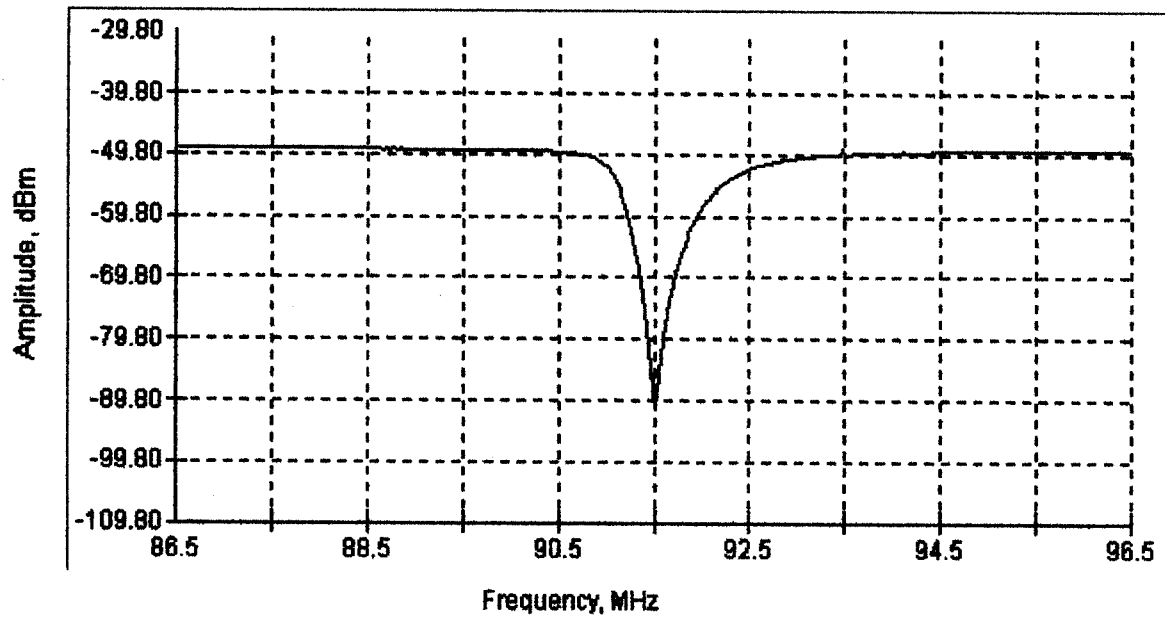
It is believed that all of the stations are in full compliance with section 73.317 of the commission's rules. A copy of the pertinent sections of this rule can be found on page 24.

All information contained in this report was gathered by James E. Boyd, who has experience making these kinds of measurements and whose qualifications are a matter of record with the Federal Communications Commission.

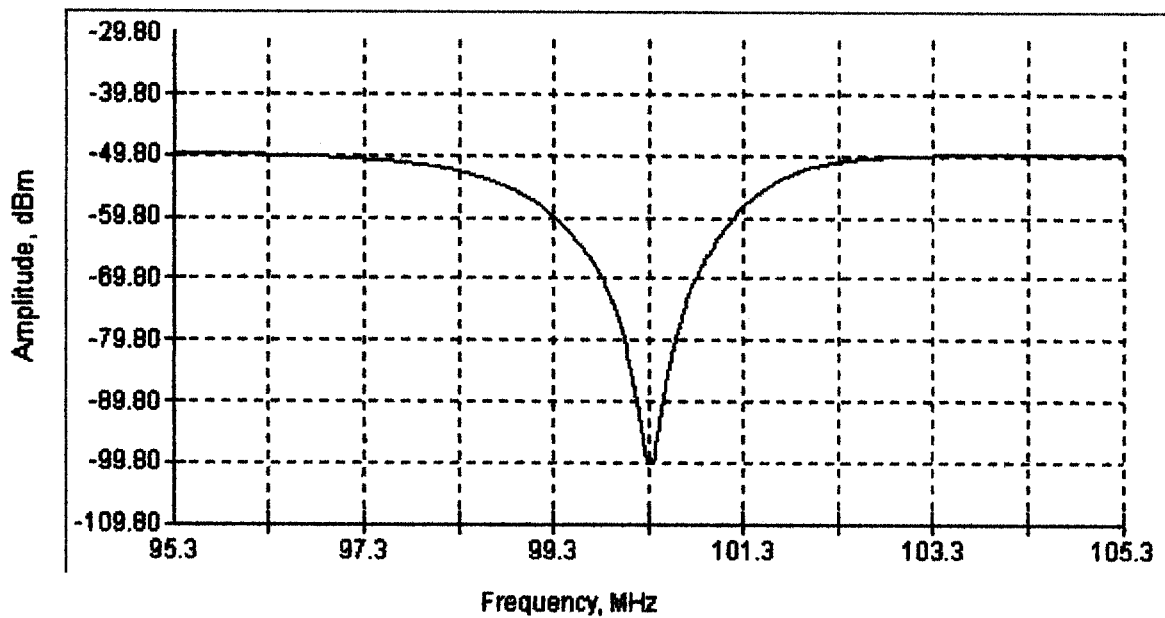
Respectfully Submitted,



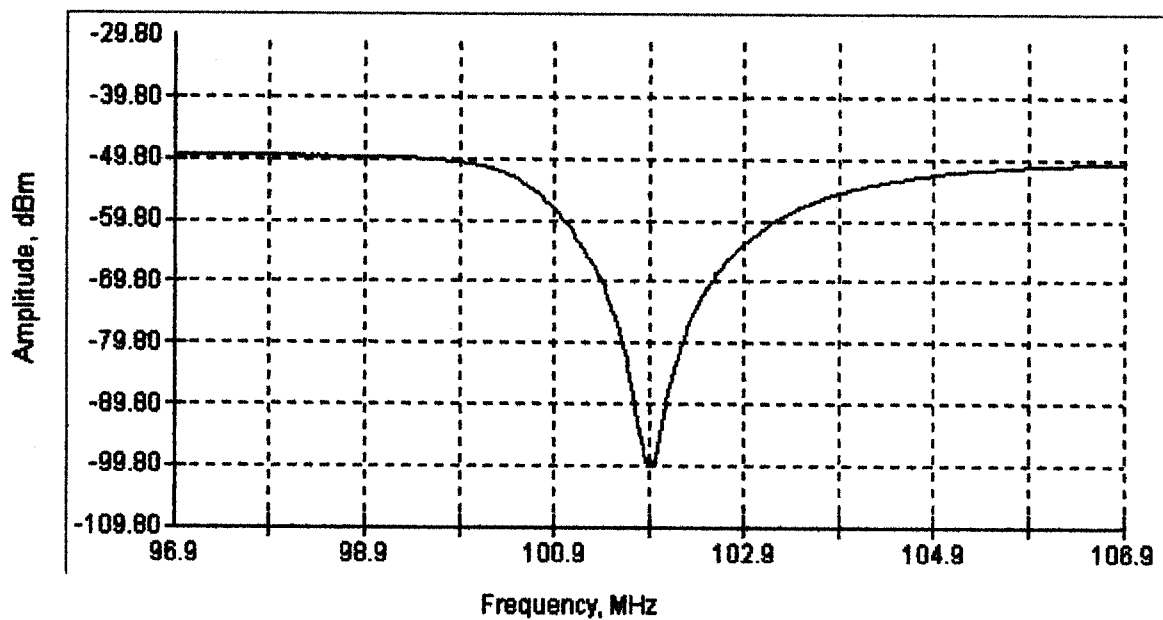
James E. Boyd
Boyd Broadcast Technical Services
21818 SW Columbia Circle
Tualatin, OR 97062
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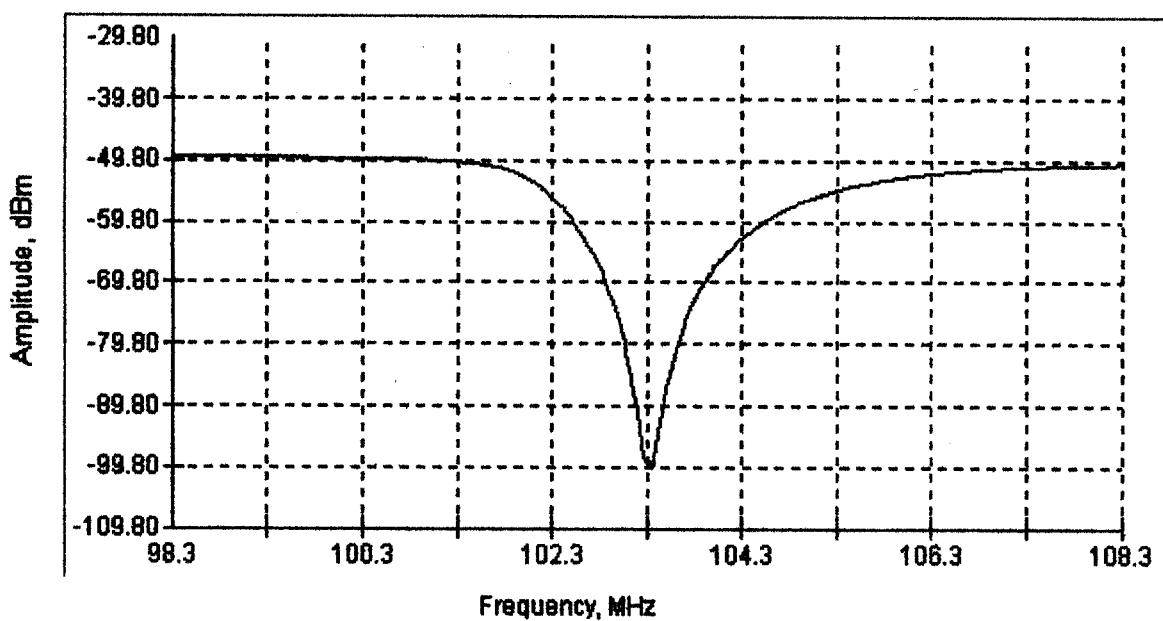
91.5 MHz Cavity Notch Filter
Insertion Loss is 0.33 dB



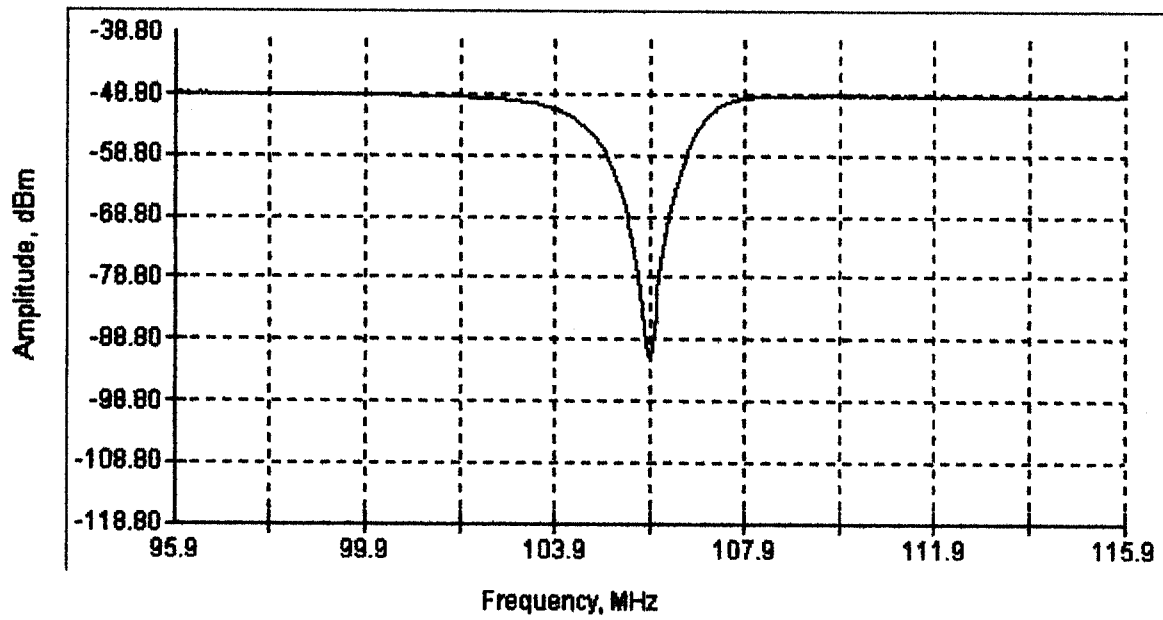
100.3 MHz Cavity Notch Filter
Insertion Loss is 0.34 dB



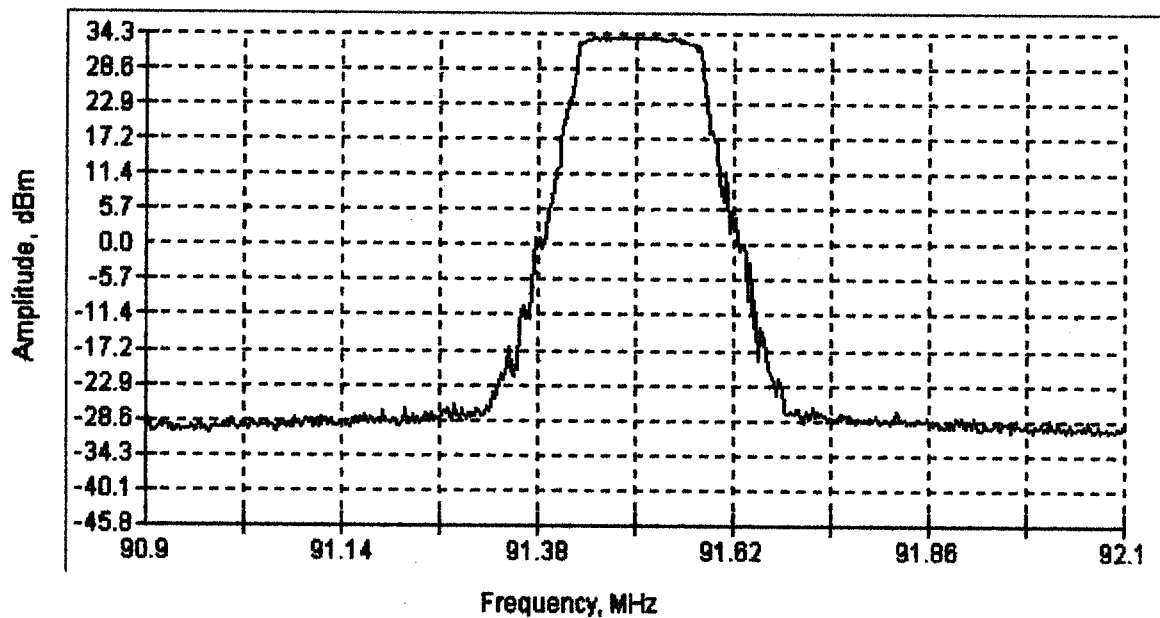
101.9 MHz Cavity Notch Filter
Insertion Loss 0.34 dB



103.3 MHz Cavity Notch Filter
Insertion Loss 0.34 dB

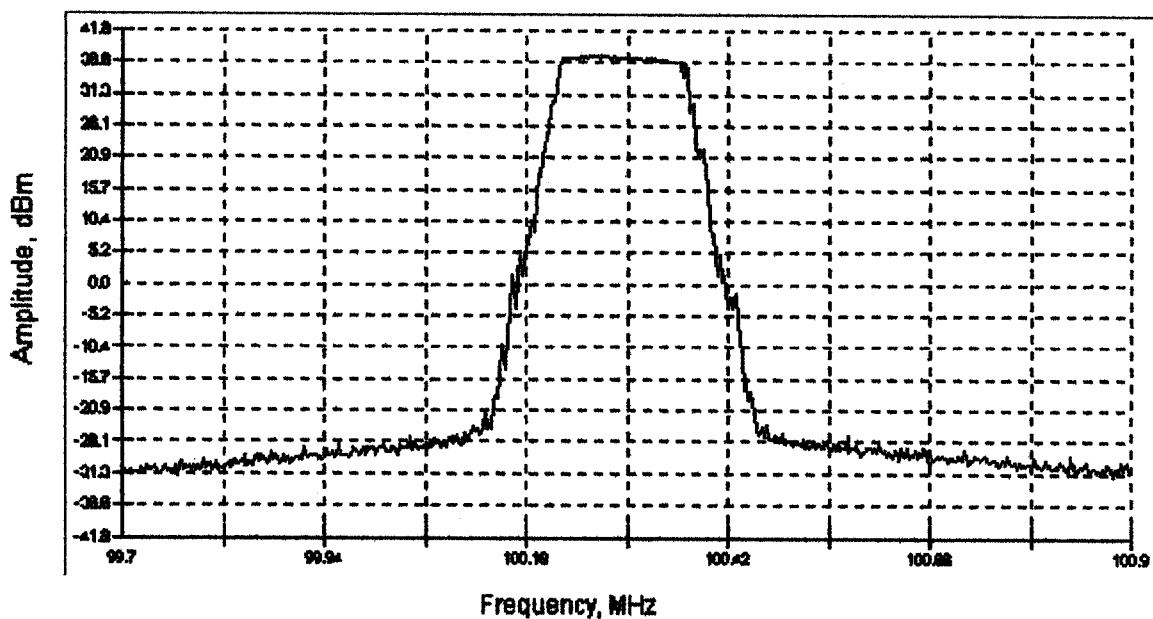


105.9 MHz Cavity Notch Filter
Insertion Loss is 0.43 dB



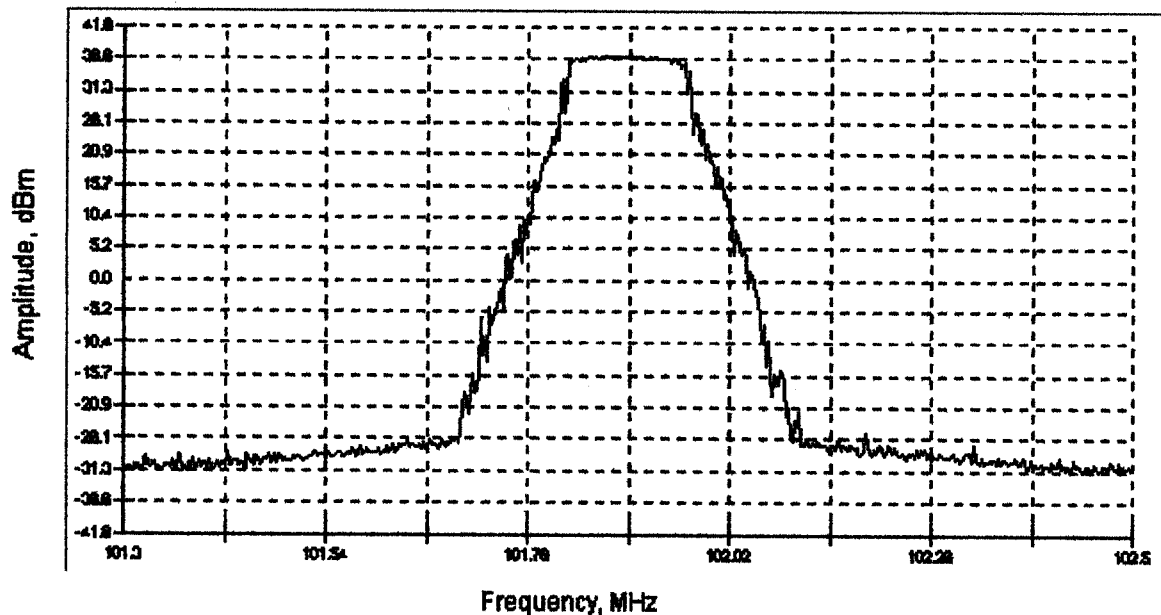
Center Frequency 91.5 MHz
 Span: 120 kHz per division
 Resolution Bandwidth 30 kHz

Carrier Peak Level (absolute): 33.87 dBm
 120 kHz below carrier: 0.2 dBm (33.67 dB below carrier)
 120 kHz above carrier: 2.87 dBm (31 dB below carrier)



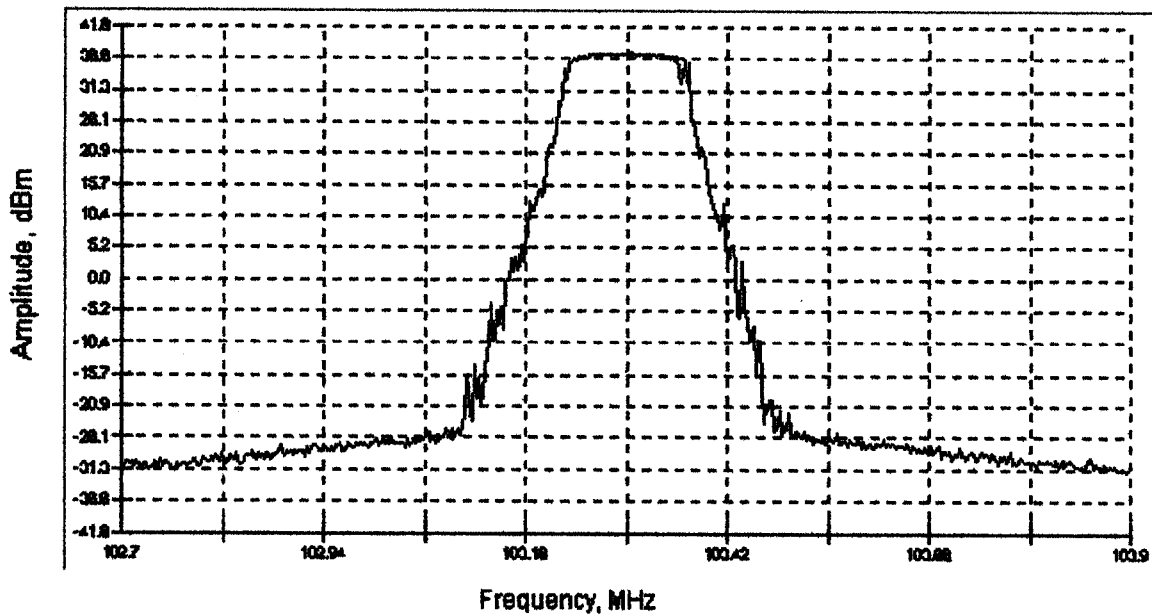
Center Frequency 100.3 MHz
 Span: 120 kHz per division
 Resolution Bandwidth 30 kHz

Carrier Peak Level (absolute): 37.53 dBm
 120 kHz below carrier: 6.2 dBm (31.33 dB below carrier)
 120 kHz above carrier: -3.47 dBm (41 dB below carrier)



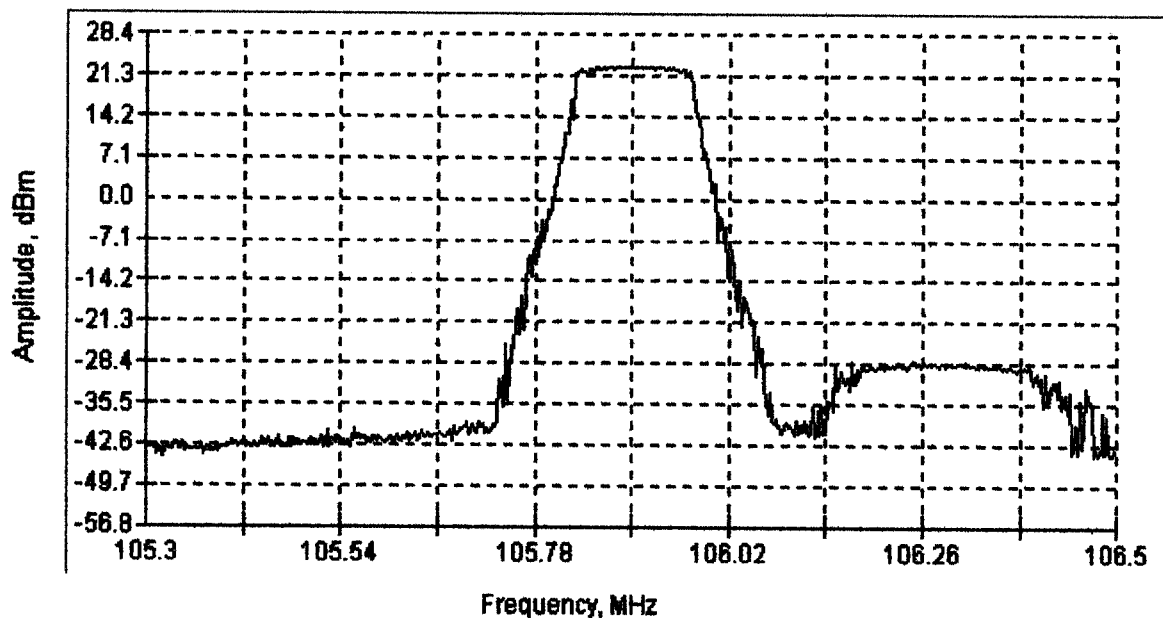
Center Frequency 101.9 MHz
 Span : 120 kHz per division
 Resolution Bandwidth 30 kHz

Carrier Peak Level (absolute): 36.87 dBm
 120 kHz below carrier: 10.53 dBm (26.34 dB below carrier)
 120 kHz above carrier: 8.87 dBm (28 dB below carrier)



Center Frequency 103.3 MHz
 Span: 120 kHz per division
 Resolution Bandwidth 30 kHz

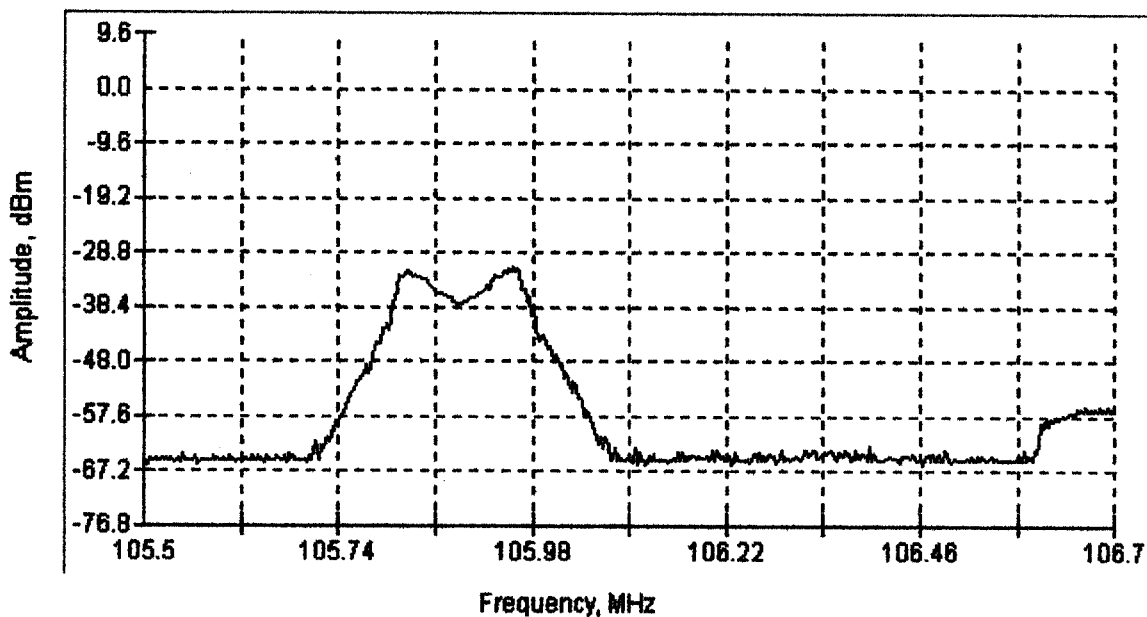
Carrier Peak Level (absolute): 37.53 dBm
 120 kHz below carrier: 8.87 dBm (28.66 dB below carrier)
 120 kHz above carrier: 1.53 dBm (36 dB below carrier)



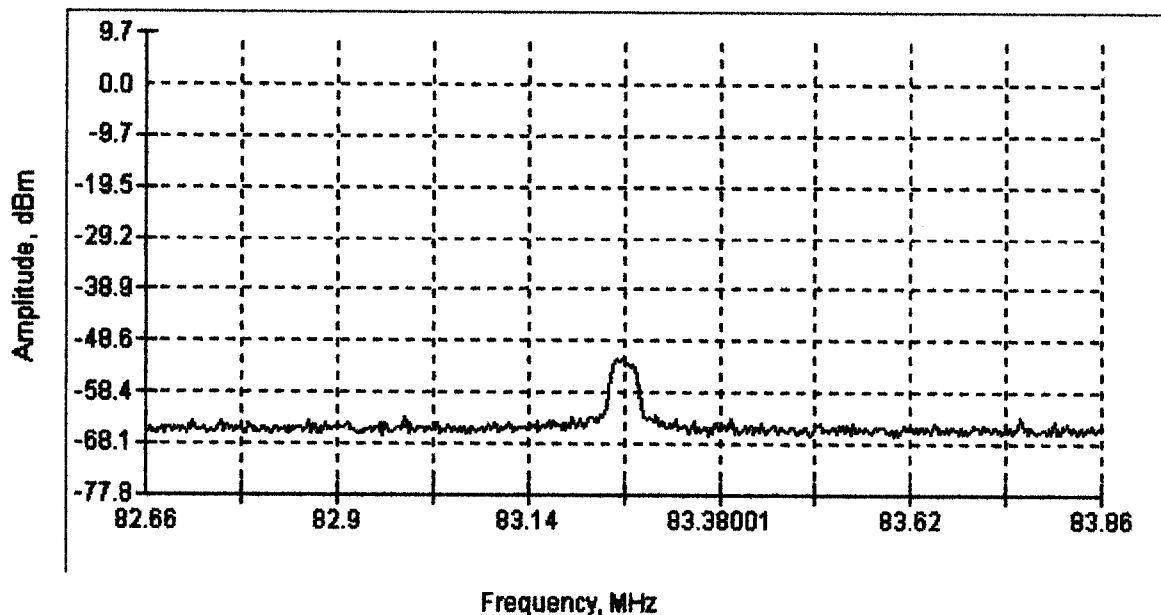
Center Frequency 105.9 MHz
 Span: 120 kHz per division
 Resolution Bandwidth 30 kHz

Carrier Peak Level (absolute): 22.87 dBm
 120 kHz below carrier: -8.8 dBm (31.67 dB below carrier)
 120 kHz above carrier: -13.13 dBm (36 dB below carrier)

Note: the signal at 106.3 is spurious and is developed in the spectrum analyzer because of signal overload. This signal drops to more than 80 dB below the reference level of any of the five stations on this system when a cavity notch filter for 105.9 MHz is inserted. See next graph:



The signal at 106.7 is coming from the antenna from another area transmitter site located about 1.5 kiloMeters away.
 30 dB external attenuation / 6 dB internal attenuation / 30 kHz resolution bandwidth



Center Frequency Approximately 83.25 MHz

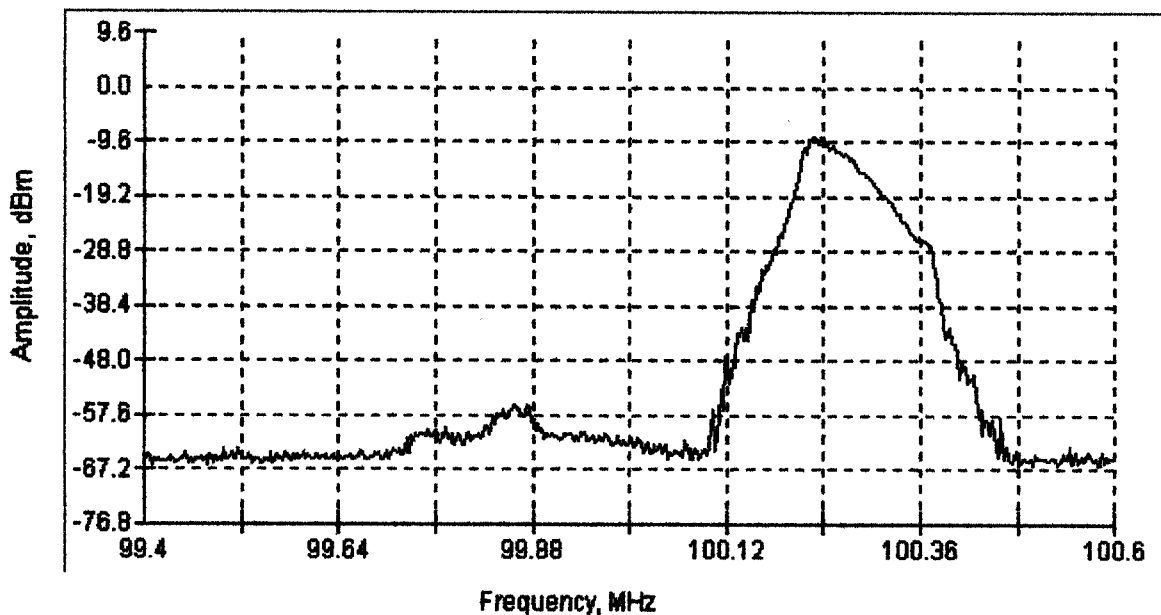
Resolution Bandwidth 30 kHz

6 dB Internal Attenuation

Absolute level of signal: -52.13 dBm

Span: 120 kHz per division

Note: This signal corresponds to the frequency of the visual carrier of Channel 6 (KOIN) which is located about 1.5 km away from this transmitter site.



Center Frequency 100 MHz

Resolution Bandwidth: 30 kHz

6 dB Internal Attenuation

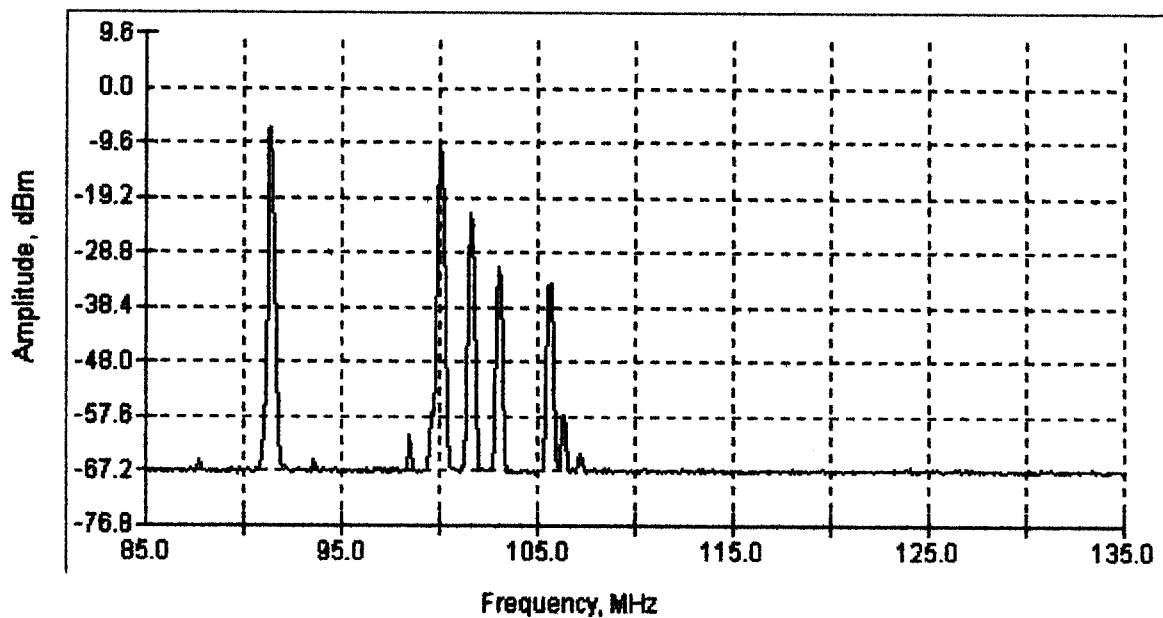
Span: 120 kHz per division

The signal at 100.3 MHz is KKRZ with 100.3 MHz notch filter in line

Absolute Level of product at 99.772 MHz : -59.8 dBm

Absolute Level of product at 99.872 MHz: -55.8 dBm

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)



Center Frequency 110 MHz
Span: 5 MHz per division

100 kHz Resolution Bandwidth

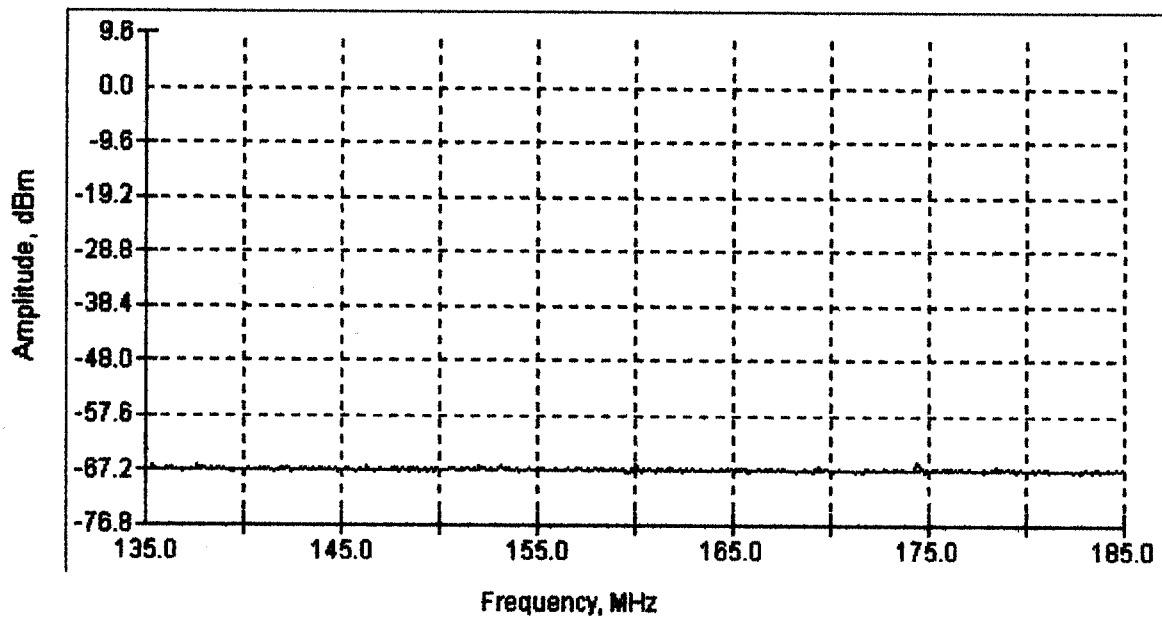
6 dB Internal Atten.

30 dB External Attenuation (Amplitude Calibration is corrected for this attenuation)

Signals identified are near 87 MHz (apparently part of Channel 6 located about 1.5 km away)

91.5 MHz KOPB (part of combined facility under test)
93.7 MHz KPDQ-FM (located about 5.5 km away)
98.7 MHz KUPL-FM (located about 1.5 km away)
100.3 MHz KKRZ (part of combined facility under test)
101.9 MHz KINK (part of combined facility under test)
103.3 MHz KKCW (part of combined facility under test)
105.9 MHz KSTE (part of combined facility under test)
106.7 MHz KKJZ (located about 1.5 km away)
107.5 MHz KVMX (located about 1.5 km away)

Notch Filters are in line for 91.5 MHz, 100.3 MHz, 101.9 MHz, 103.3 MHz and 105.9 MHz

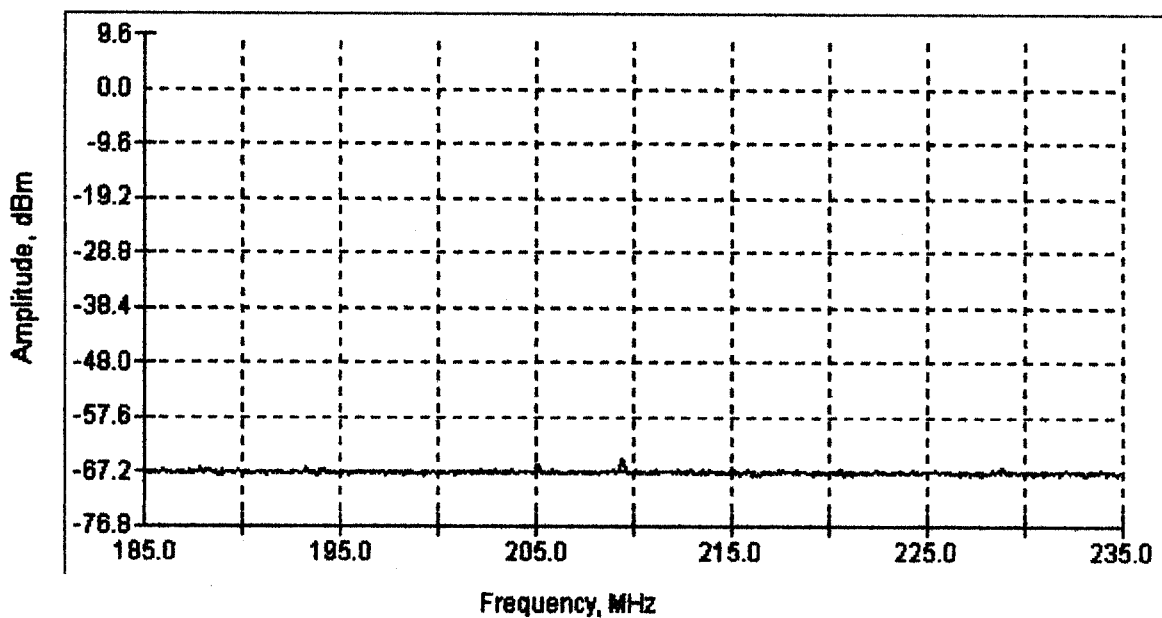


Center Frequency 160 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

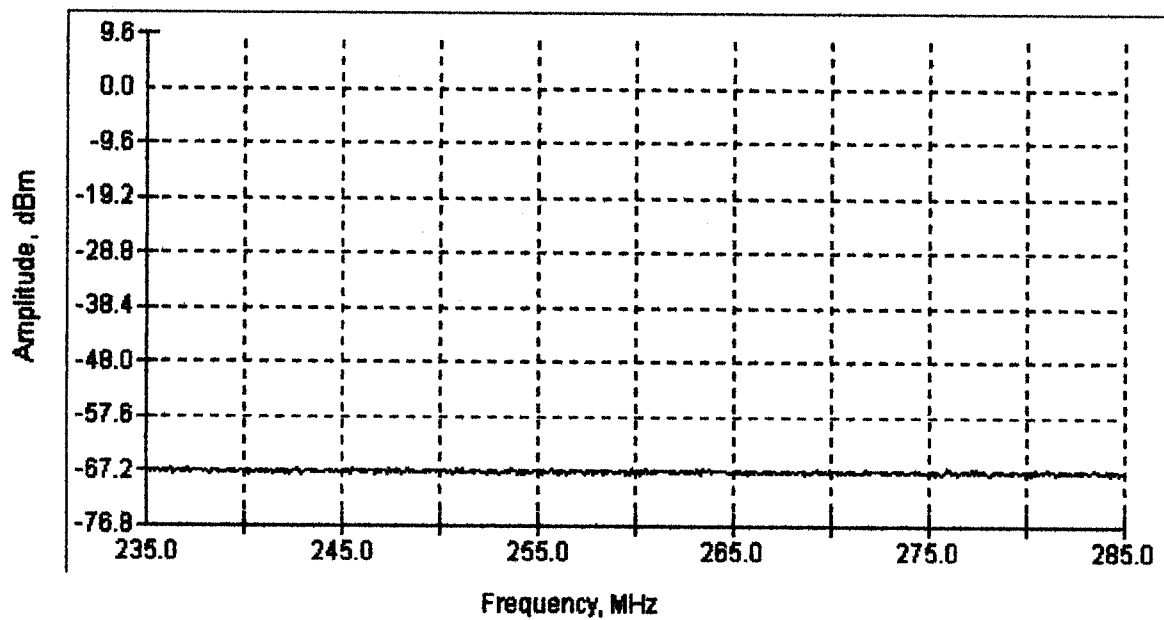


Center Frequency 210 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

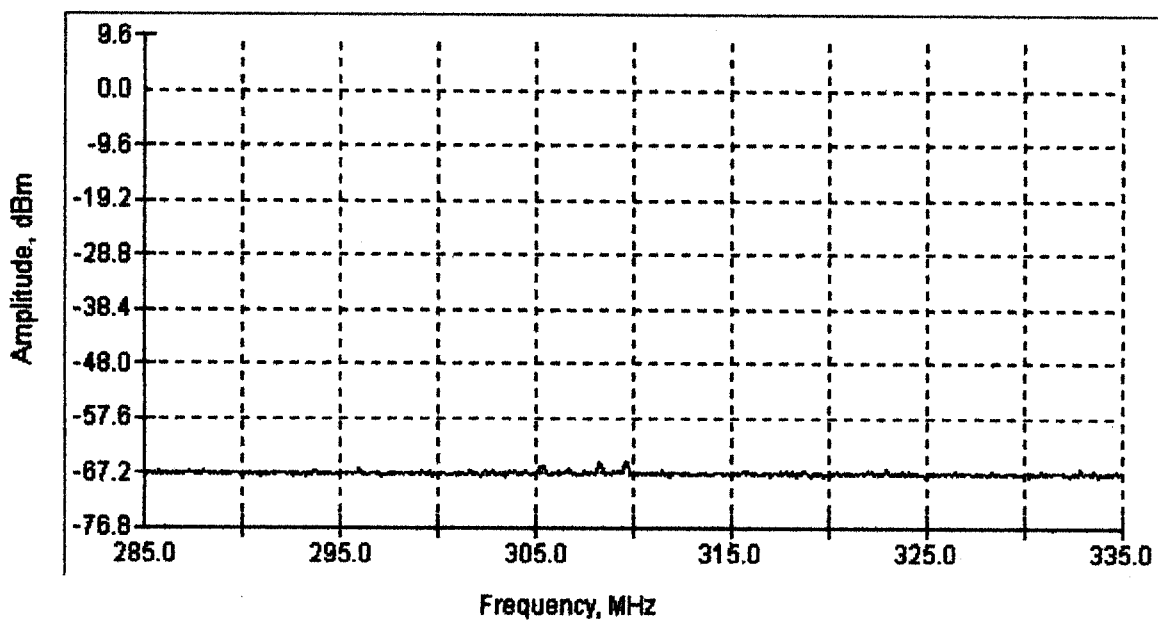


Center Frequency 260 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

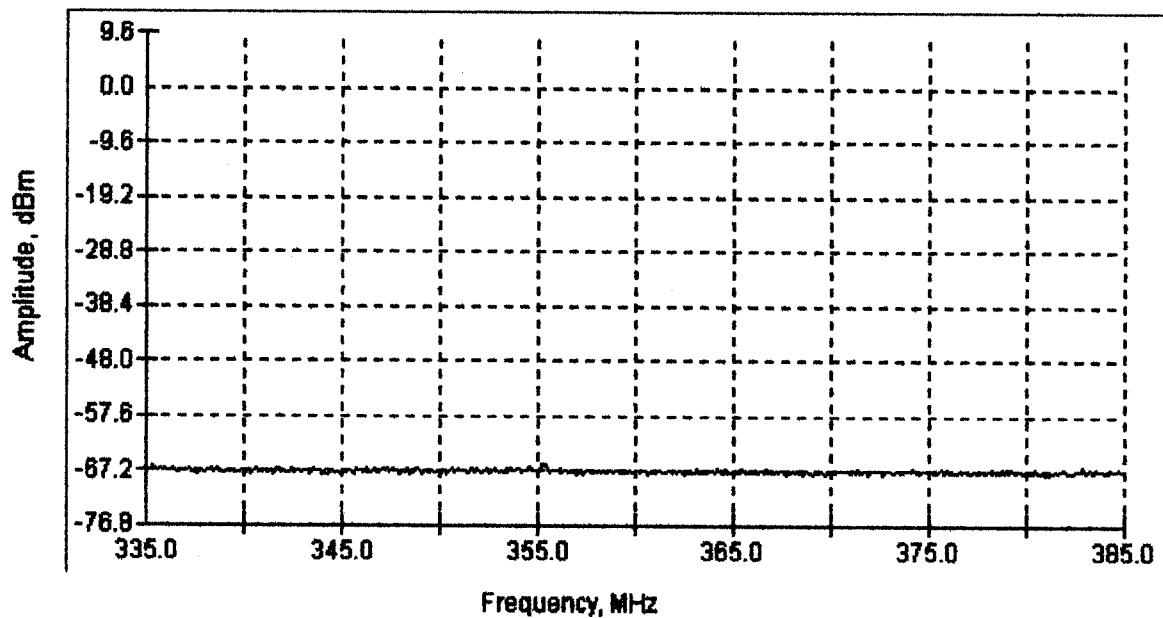


Center Frequency 310 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

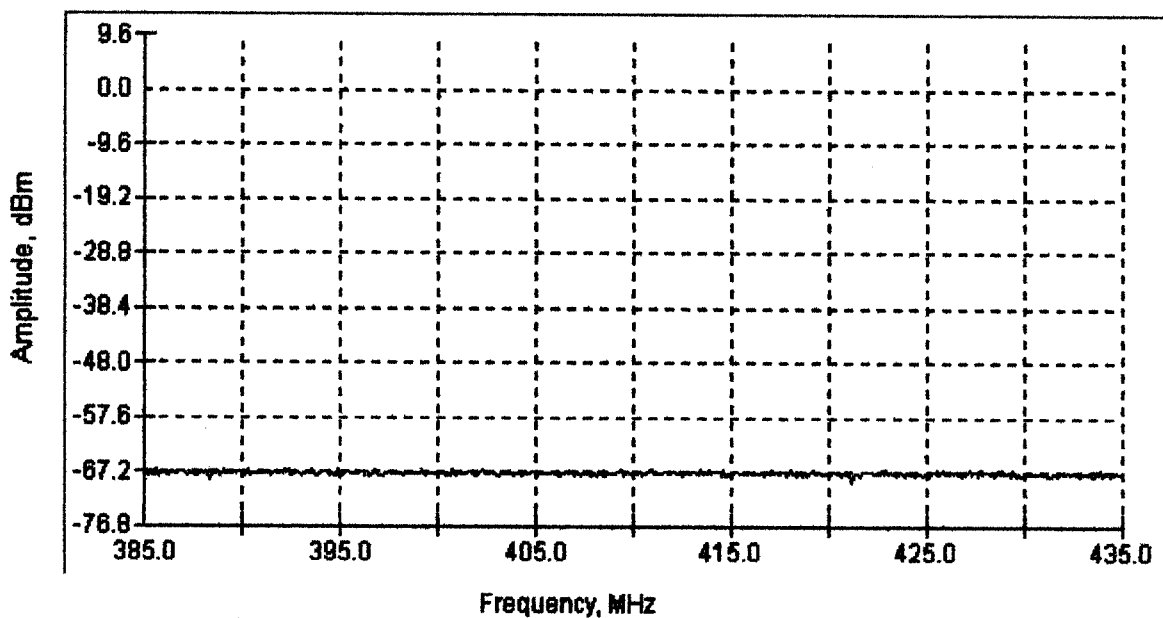


Center Frequency 360 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

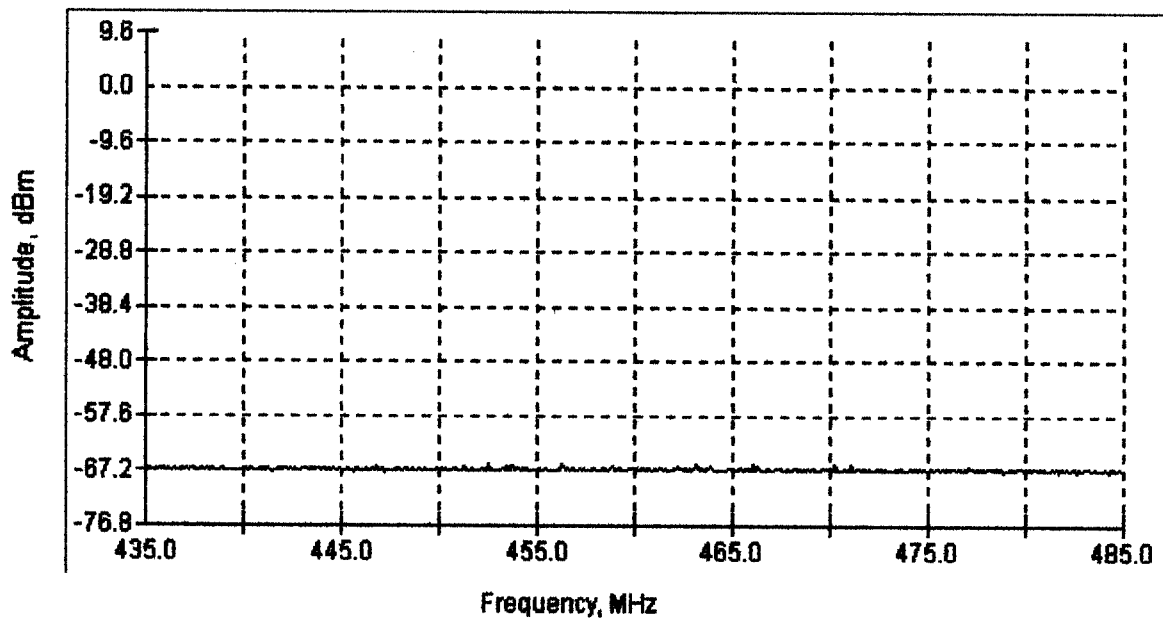


Center Frequency 410 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

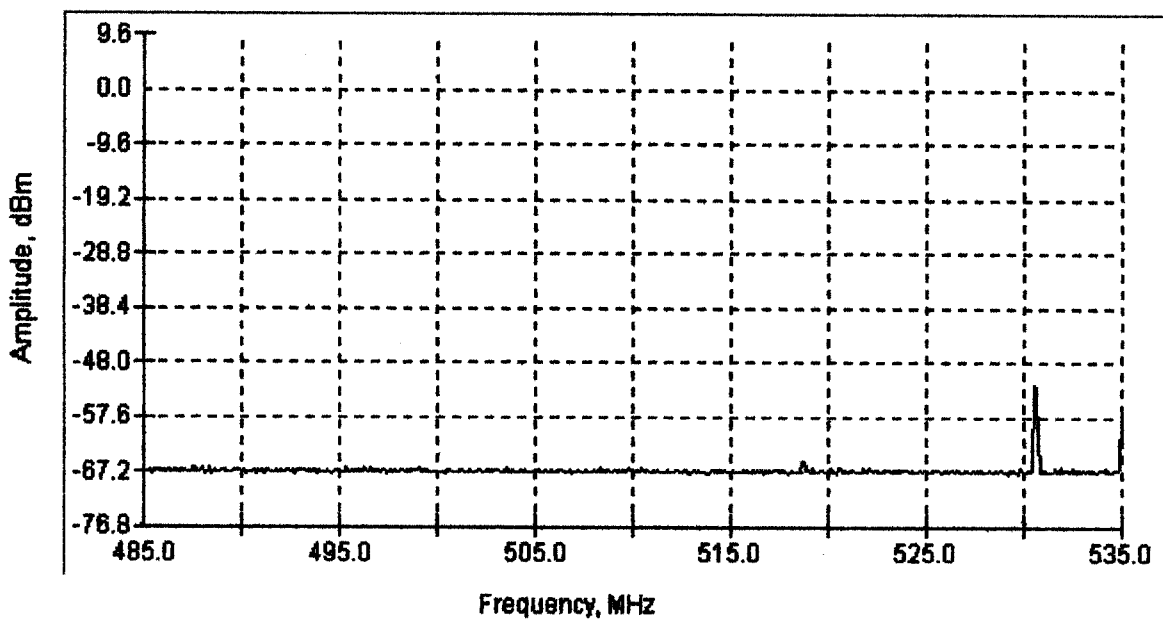


Center Frequency 460 MHz
Span: 5 MHz per division

Resolution Bandwidth 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)



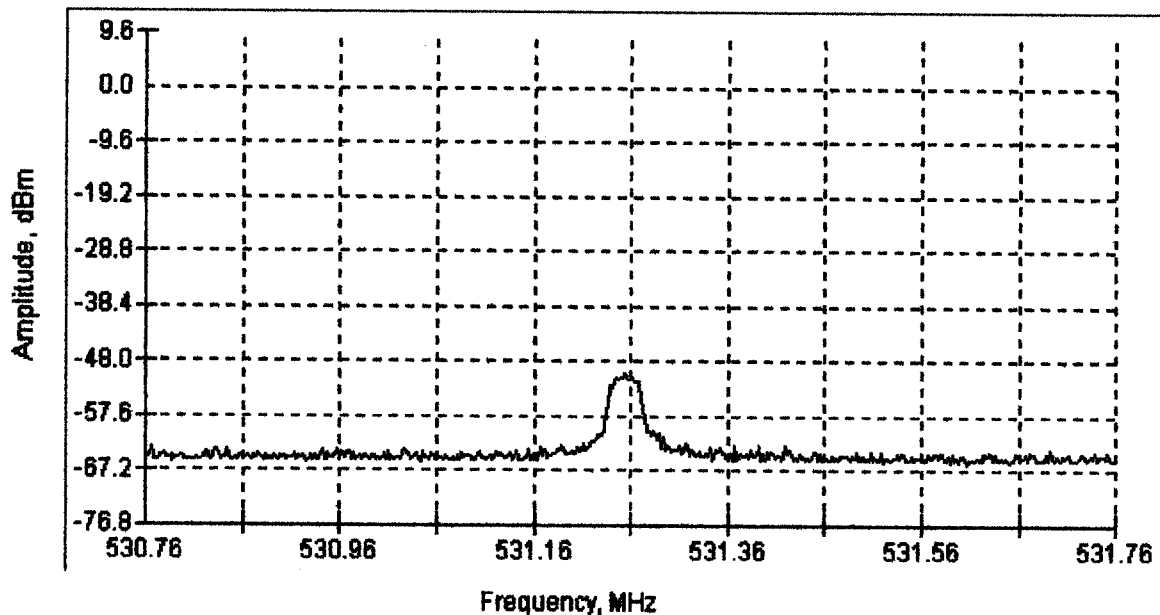
Center Frequency 510 MHz
Span: 5 MHz per division

Resolution Bandwidth 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is correct for this attenuation)

The following page has more detail about the signal which can be seen near 530 MHz.



Center Frequency Approximately 531.25 MHz

Resolution Bandwidth 100 kHz

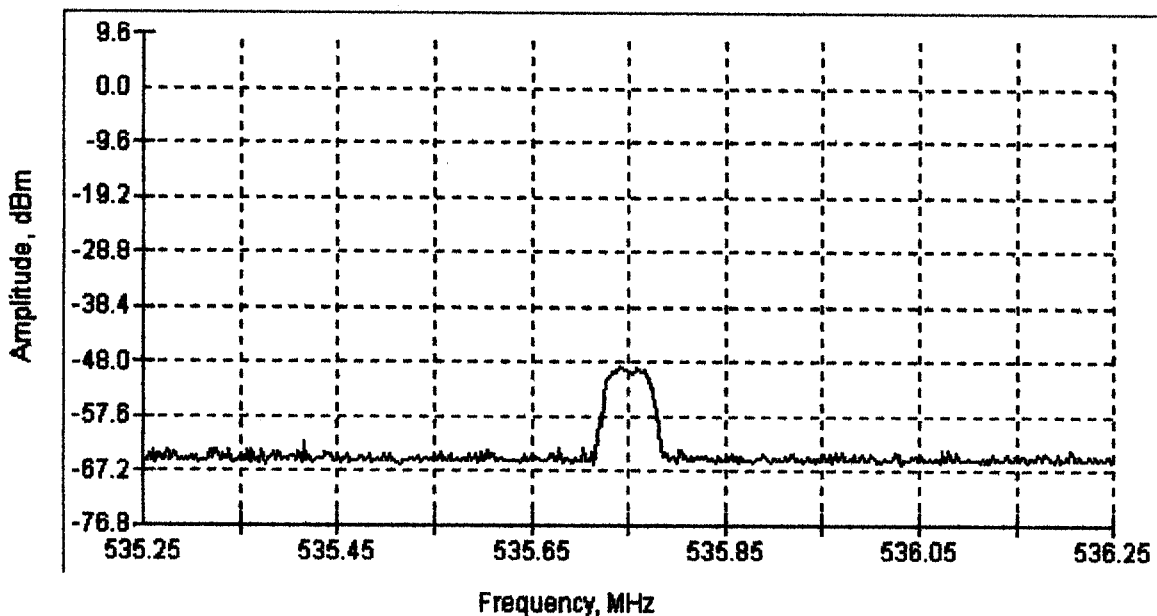
6 dB Internal Attenuation

Absolute level of signal: -50.47 dBm

Span: 5 MHz per division

30 dB External Attenuation

Note: This signal corresponds to the visual carrier frequency of Channel 24 (KNMT) which is located about 1.5 km away from this site.



Center Frequency Approximately 535.75 MHz

Resolution Bandwidth 100 kHz

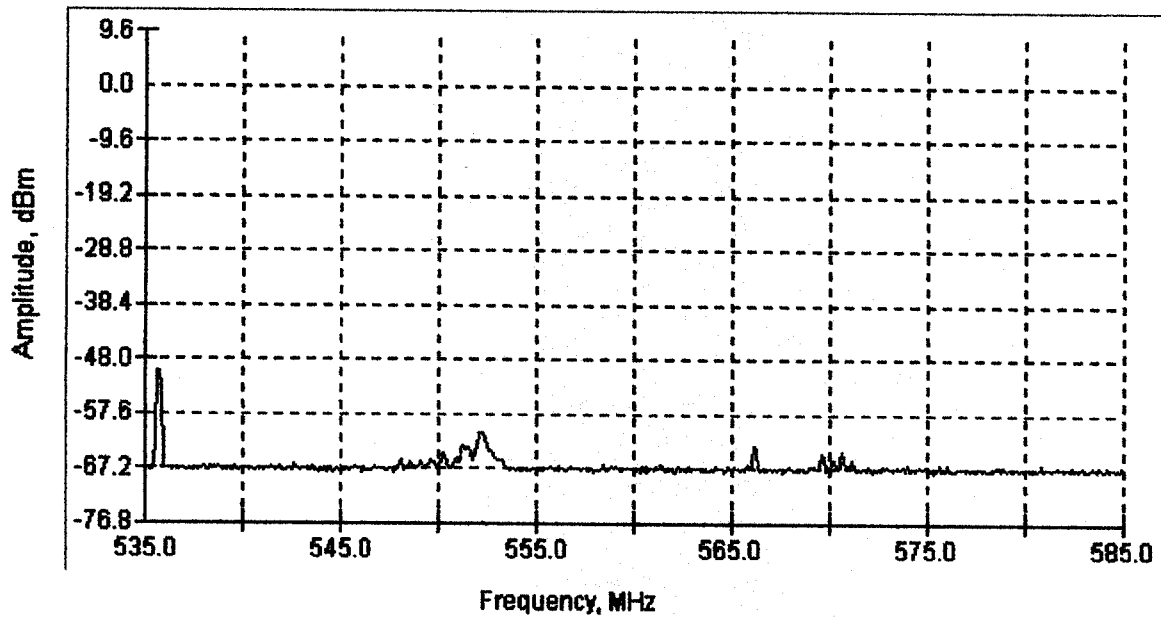
6 dB Internal Attenuation

Absolute level of signal: -49.13 dBm

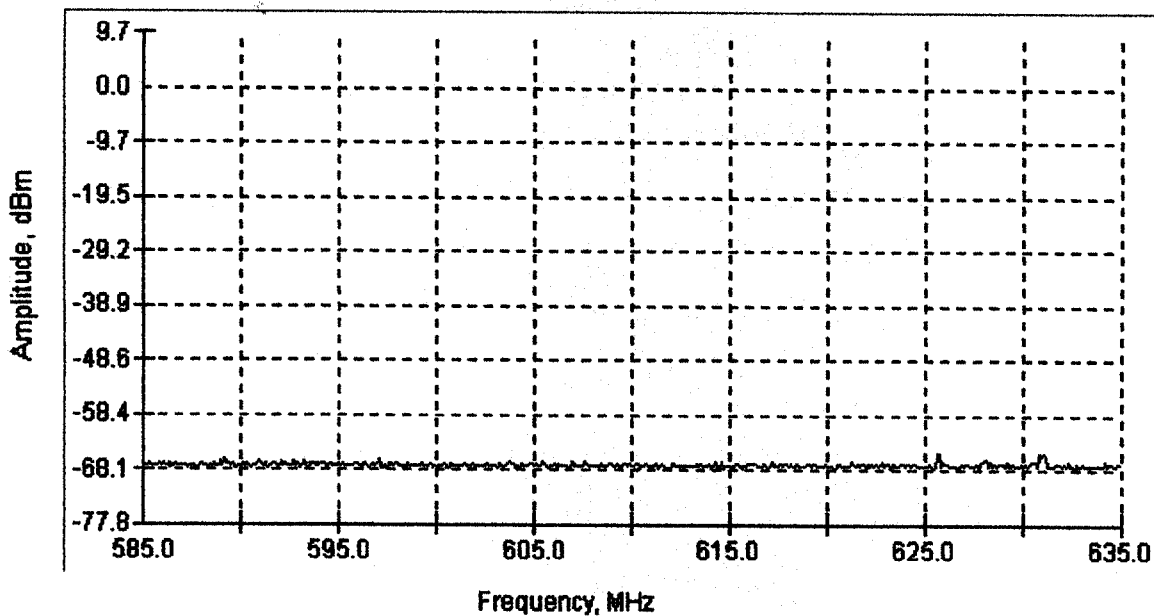
Span: 5 MHz per division

30 dB External Attenuation

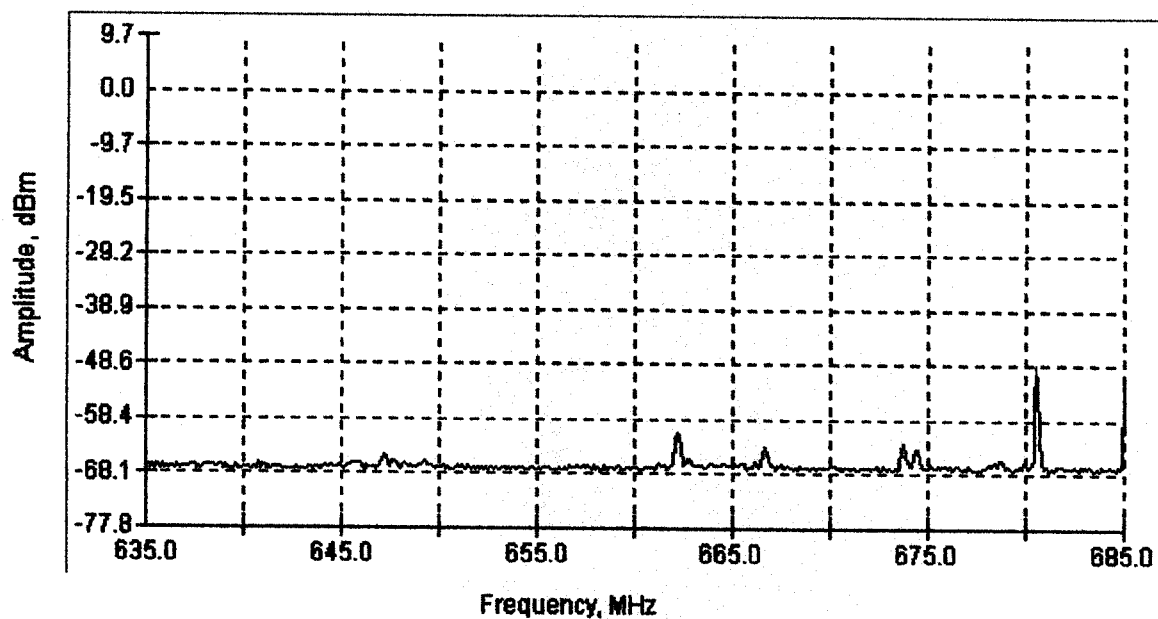
Note: This signal corresponds to the aural carrier frequency of Channel 24 (KNMT) which is located about 1.5 km away from this site.



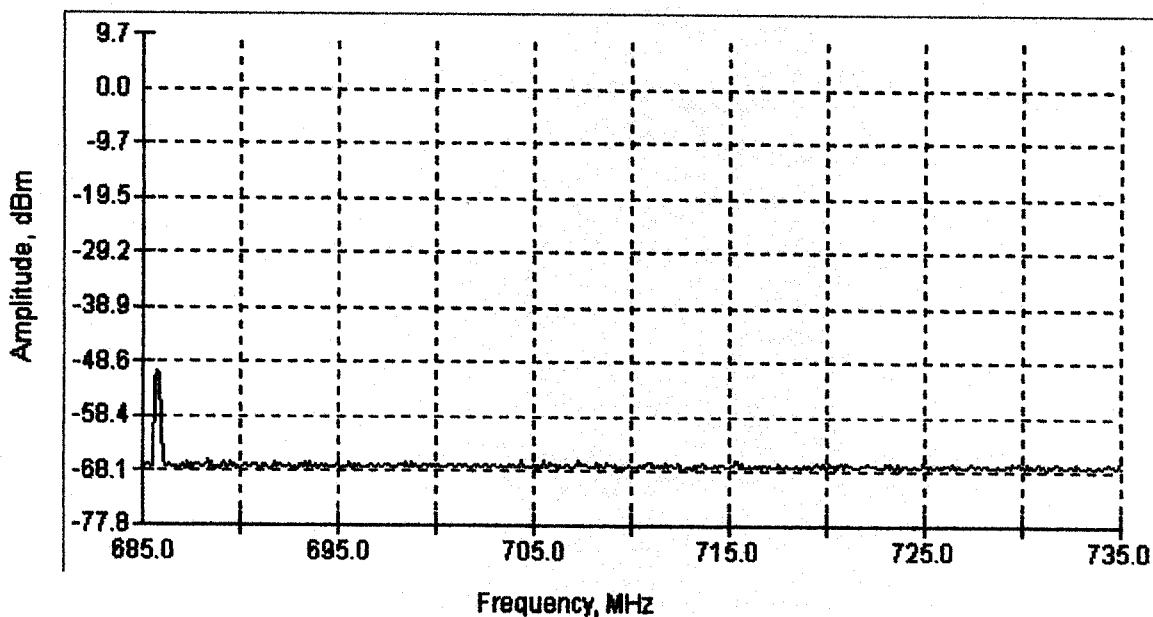
Center Frequency 560 MHz Resolution Bandwidth: 100 kHz 6 dB Internal Attenuation
 Span: 5 MHz per division 30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)
 Signal at 535.75 MHz corresponds to the aural carrier of Channel 24 (KNMT), located about 1.5 km away from this site. Value: -50.13 dBm
 Signal at about 552 MHz corresponds to Channel 27 (KOPB-DT) colocated on this tower. Value: -60.8 dBm
 Signal from 566 thru 572 MHz corresponds to Channel 30 (KPTV-DT) located about 0.2 km away. Value: -63.13 dBm



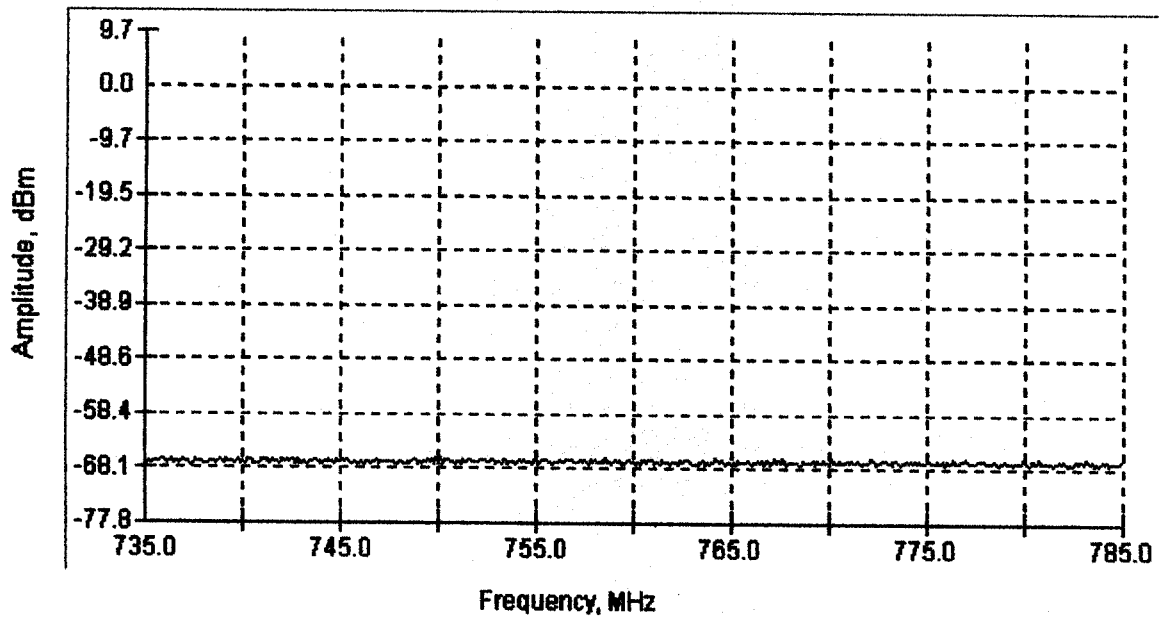
Center Frequency 610 MHz Resolution Bandwidth: 100 kHz 6 dB Internal Attenuation
 Span: 5 MHz per division 30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)



Center Frequency 660 MHz
 Span: 5 MHz per division
 Resolution Bandwidth: 100 kHz
 6 dB Internal Attenuation
 30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)
 Signal at 662-668 MHz corresponds to Channel 46 (KGW-DT) colocated at this site.
 Signal at 674-680 MHz corresponds to Channel 48 (KPDX-DT) located about 0.5 km away from this site.
 Signal at 681.25 MHz corresponds to the visual carrier of Channel 49 (KPDX) located about 0.5 km away from this site.
 Signal beginning at 685 MHz corresponds to the aural carrier of Channel 49 (KPDX) located about 0.5 km away from this site.



Center Frequency 710 MHz
 Span: 5 MHz per division
 Resolution Bandwidth 100 kHz
 6 dB Internal Attenuation
 30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)
 Signal at 685.75 MHz corresponds to the aural carrier of Channel 49 (KPDX) located about 0.5 km away from this site.

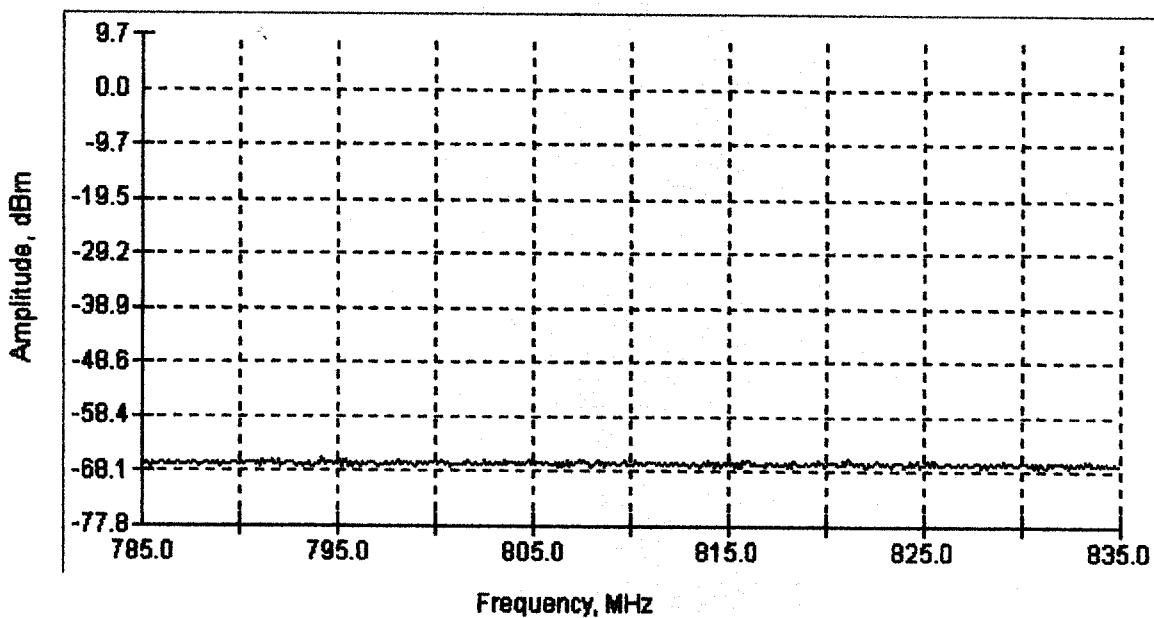


Center Frequency 760 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

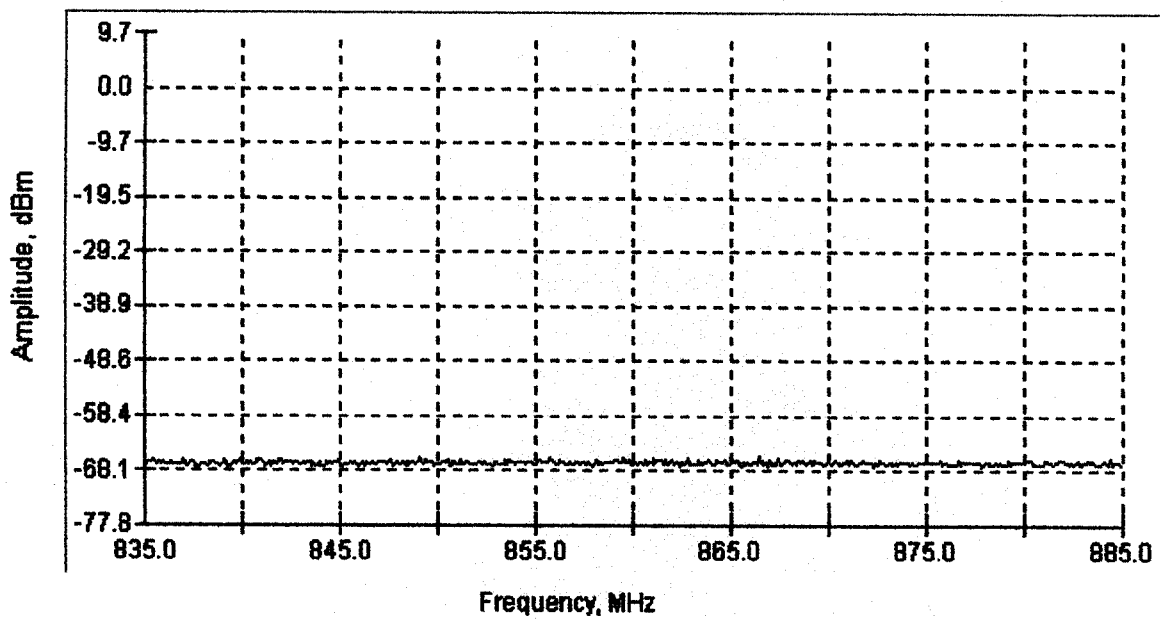


Center Frequency 810 MHz
Span 5 MHz per division

Resolution Bandwidth 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

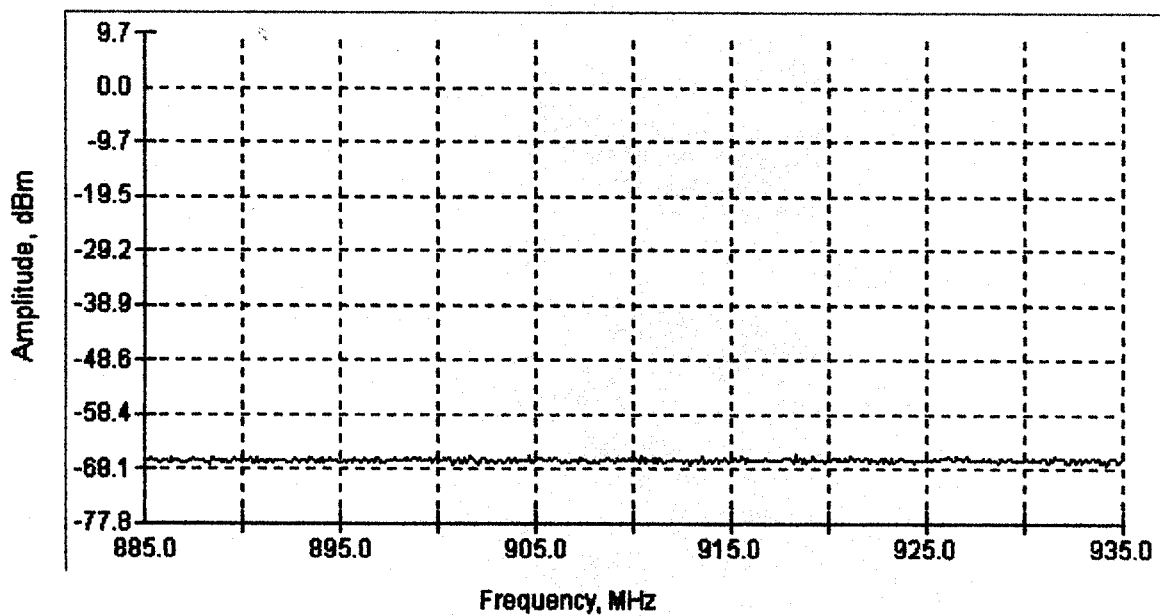


Center Frequency 860 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

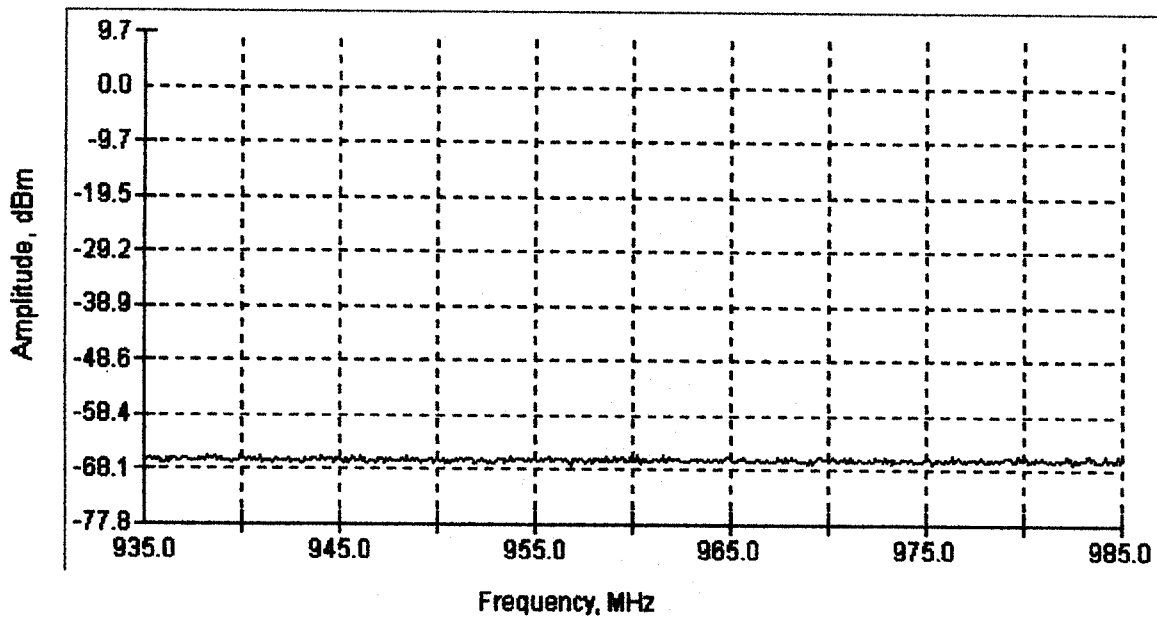


Center Frequency 910 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

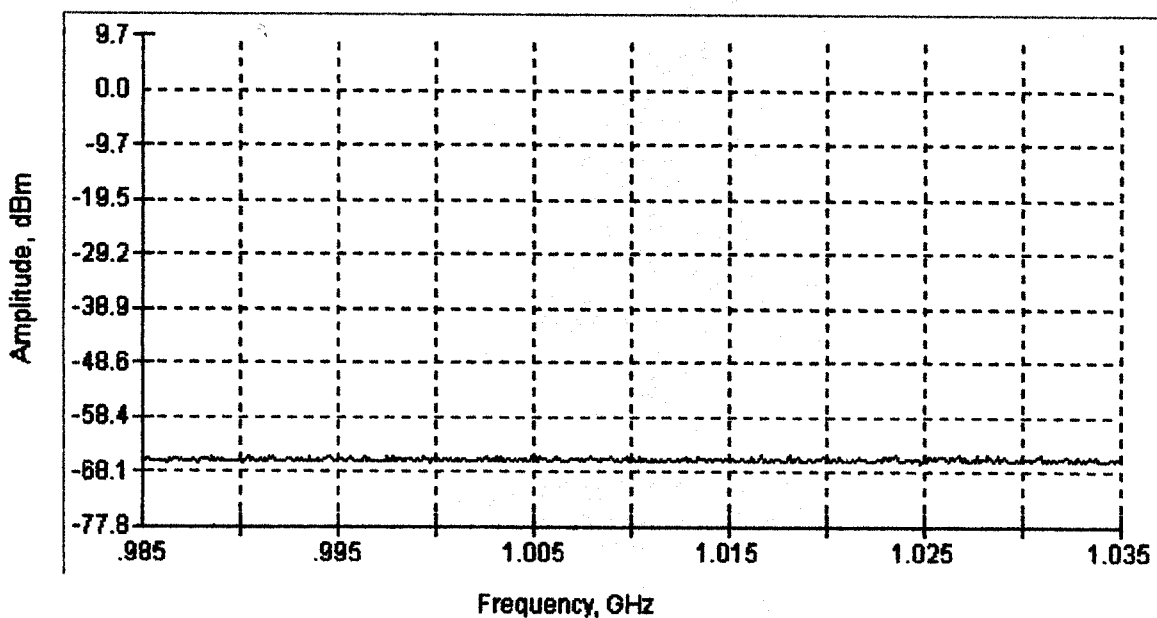


Center Frequency 960 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

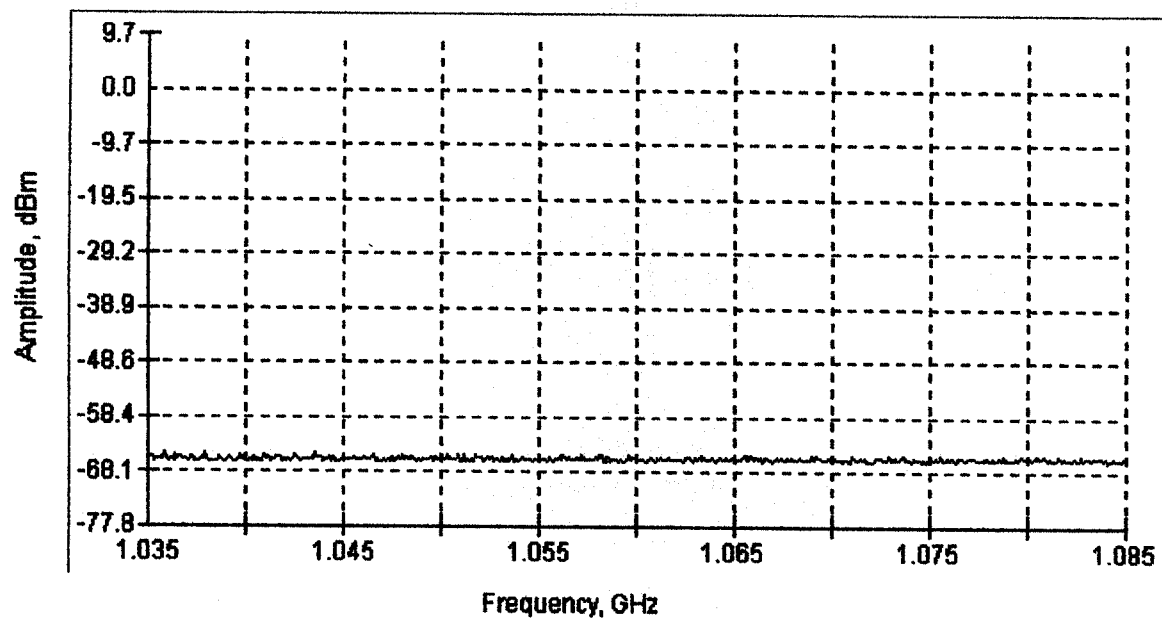


Center Frequency 1010 MHz
Span: 5 MHz per division

Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)



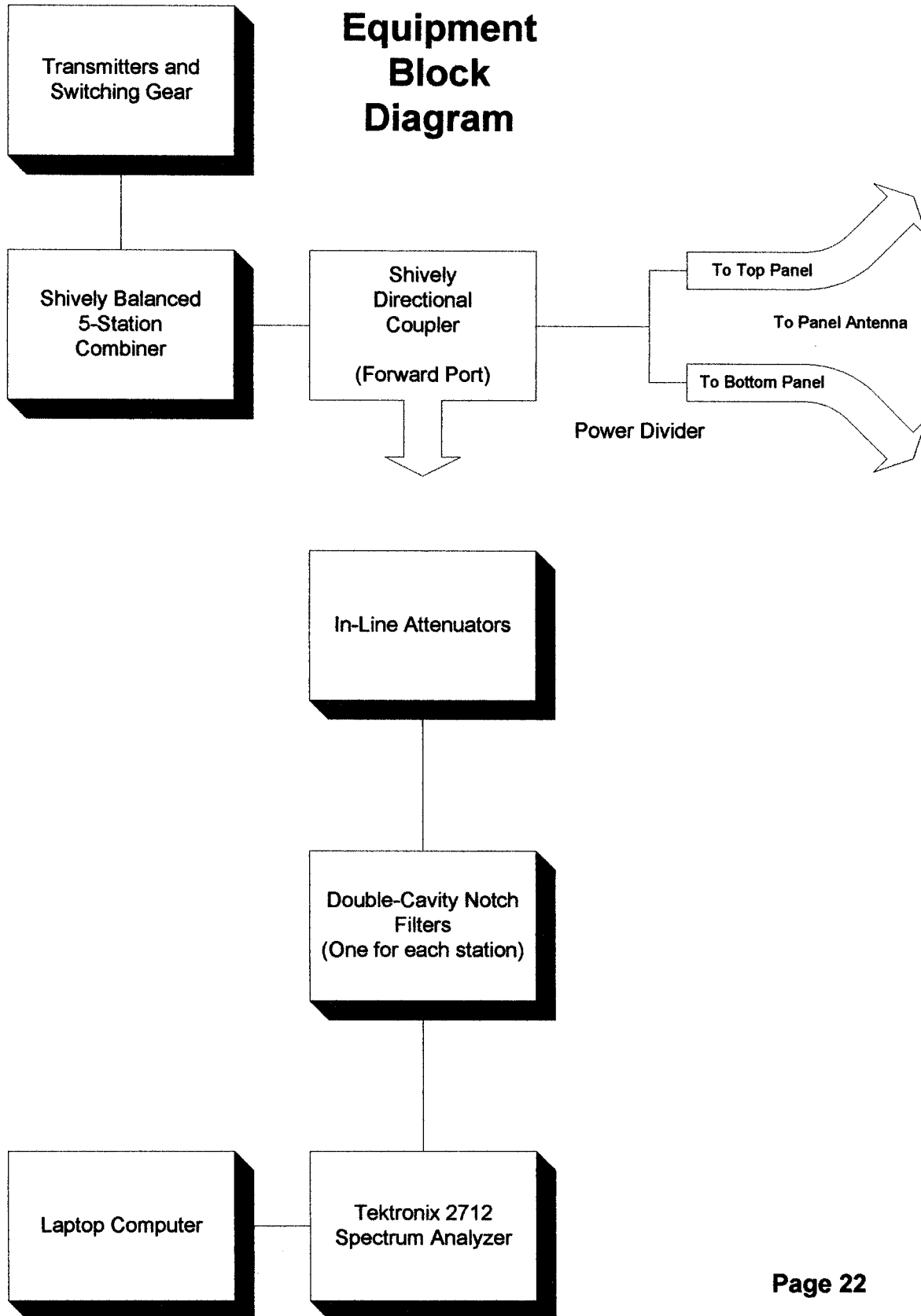
Center Frequency 1.060 GHz
Span: 5 MHz per division

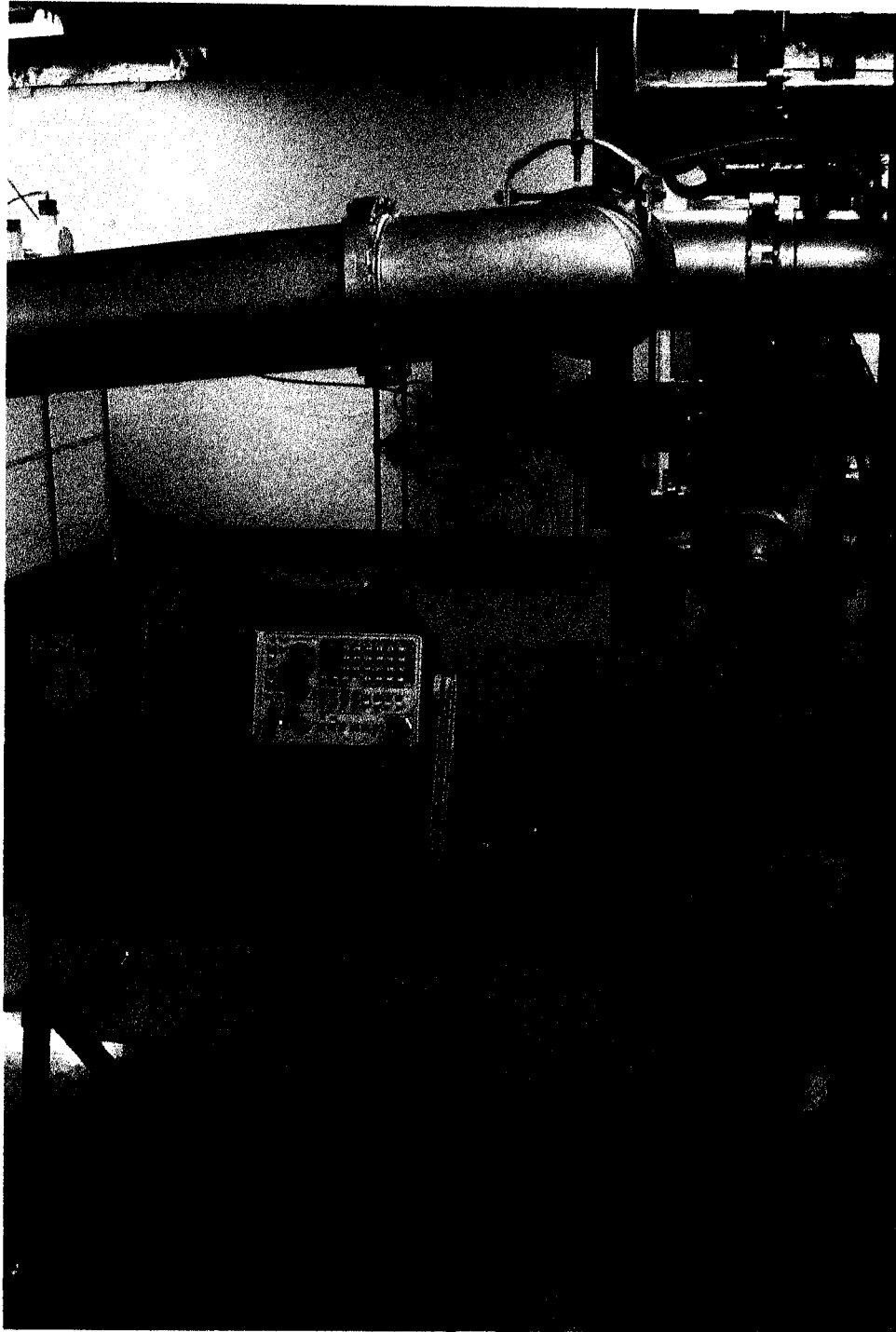
Resolution Bandwidth: 100 kHz

6 dB Internal Attenuation

30 dB External Attenuation (Amplitude calibration is corrected for this attenuation)

Equipment Block Diagram





Measurement equipment setup

73.317 FM TRANSMISSION SYSTEM REQUIREMENTS

- (a) FM broadcast stations employing transmitters authorized after January 1, 1960, must maintain the bandwidth occupied by their emissions in accordance with the specification detailed below. FM broadcast stations employing transmitters installed or type accepted before January 1, 1960, must achieve the highest degree of compliance with these specifications practicable with their existing equipment. In either case, should harmful interference to other authorized stations occur, the licensee shall correct the problem promptly or cease operation.
- (b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.
- (c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.
- (d) Any emission appearing on a frequency removed the carrier by more than 600 kHz must be attenuated at $43 + 10\log(\text{Power in watts})$ dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.