Supplemental Information

T R A N S M I T T A L

FAX

To: Frank Coperich

Fax: (301) 344-2050

From: M. Brett Wilson

Date: September 27, 1994

Pages: Lead + 11

Subject: Pending Application for Type Acceptance, FCC ID AJKPN822-0329 - dB down conversions

Frank:

I have enclosed the latest fix to our field strength demonstration problems. Each of the attached graphs from the original Exhibit I now note dB down. Please let me know if this is what you wanted. My phone number is (703) 412-6635.

Thank you,

Brett Wilson

M. Brett Wilson
Rockwell International
Suite 1200
'45 Jefferson Davis Highway
Arlington, VA 22202

Telephone: 703/412-6635
Fax: 703/412-6868
Comnet: 747-6635/6868

3.5 Field Strength of Spurious Radiation (2.993)

The DME and test equipment were connected as shown in the Figure 3-39.

Data was taken with the DME tracking channels 1X and 126X. The unit was scanned using a linearly polarized antenna in the horizontally polarized position. Broad band emissions were recorded from 150 KHZ to 1215 MHz and are included in Figures 3-40 through 3-42. Figures 3-43 and 3-44 are broad band plots centered on the DME's transmit frequency at channels 1X and 126X. Narrow band emissions were recorded from 150 KHZ to 12 GHz and are included in Figures 3-45 through 3-50. Figures 3-51 and 3-52 are narrow band plots centered on the DME's transmit frequency at channels 1X and 126X

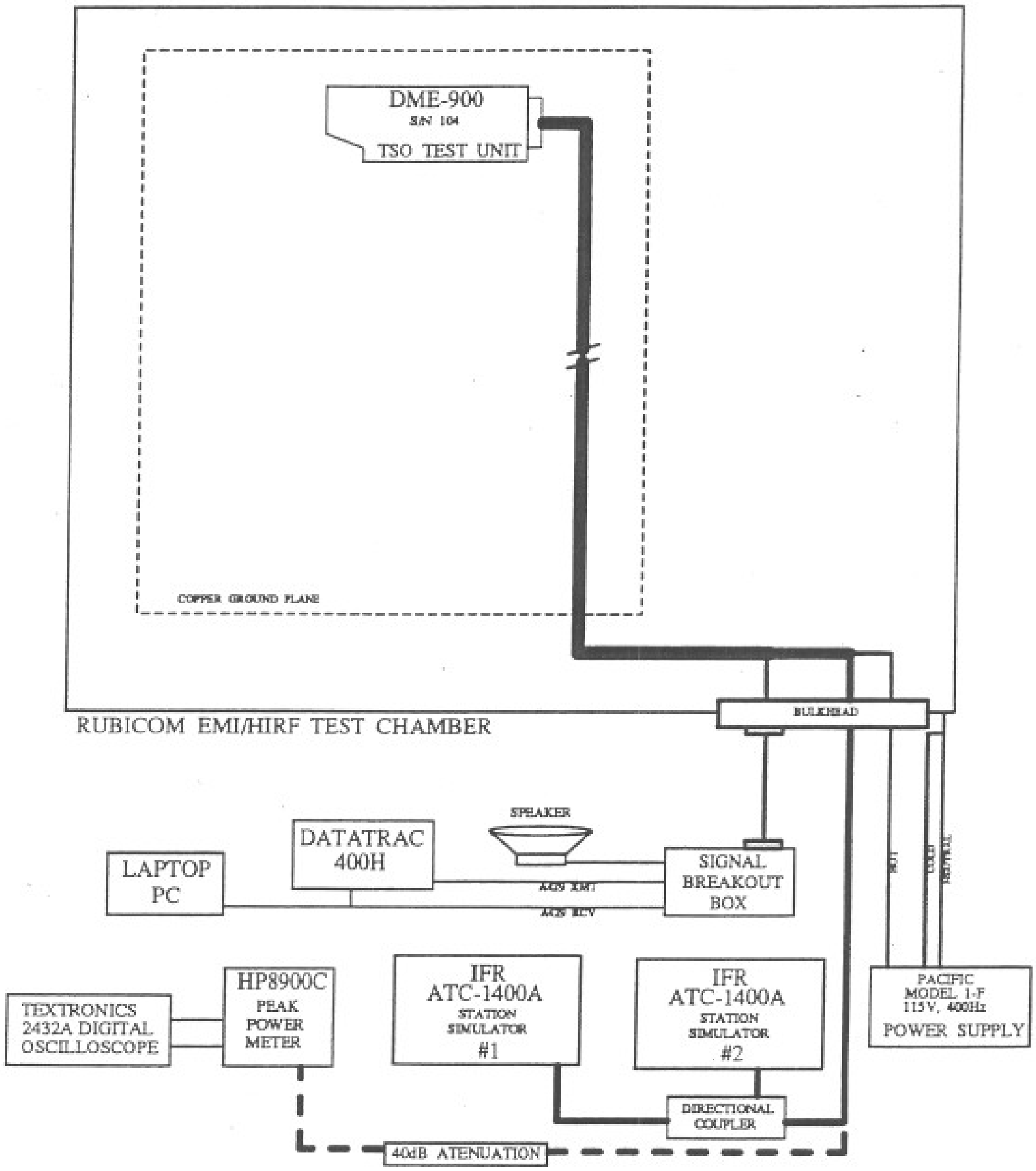

Figure 3-39 Radiated Emissions Equipment Set-up

To calculate the radiated power of the transmitter the Friis Transmission Formula (from Kraus Antennas Equ. 3-39) is used to calculate the power density P:

$$P = \frac{W_t}{4\pi r^2}$$

Where:

r = 1 Meter

W_t = 28.4 dBW (from Exhibit E, page 21 section 3.1.1)

W_t in Watts is calculated:

$$W_t = 10^{\left(\frac{28.4}{10}\right)} = 691.8 \text{ Watts}$$

$$P = \frac{691.8}{4\pi} = 55 \text{ W/Meter}^2$$

Factoring in the antenna gain for a 1/2 wave dipole:

$$P_t = D_t P$$

Where the directivity D_t is given by Kraus Table 3-1 as 1.64:

$$P_t = 1.64*55 = 90.3 \text{ W/Meter}^2$$

Converting Watts/Meter^2 to Volts/Meter using 120π ohms as the impedance of free space:

$$P_t = 20 \log(120\pi*90.28)^{1/2} = 45.3 \text{ dBV/Meter}$$

In dBμ V/Meter:

$$P_t = (20 \log 10^6) + 45.3 = 165 \text{ dB}\mu \text{ V/Meter}$$

In Figures 3-40 through 3-56 following, the reference line at the top of the graph is shown with respect to the transmitter as radiated with a 1/2 wave dipole and is the number given in dB within parenthesis. The maximum emission is also shown relative to the transmitter and is given in dB of to the right of the chart.

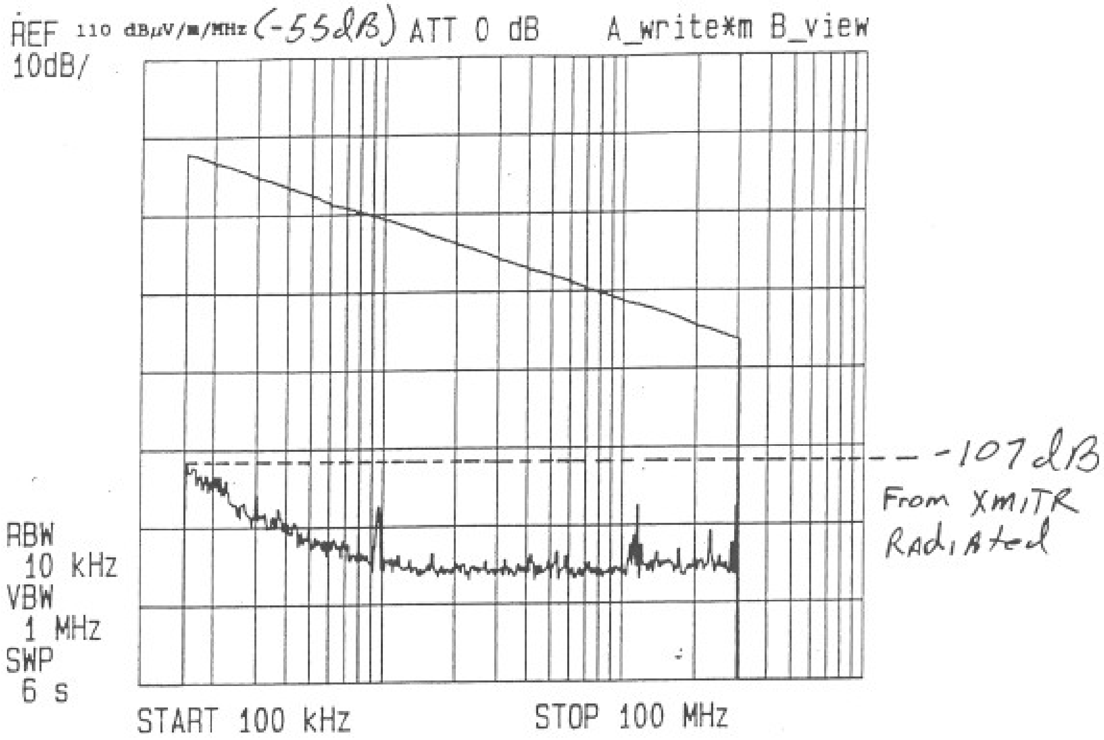

Figure 3-40 Radiated Emissions, Broad Band 150 KHz to 30 MHz

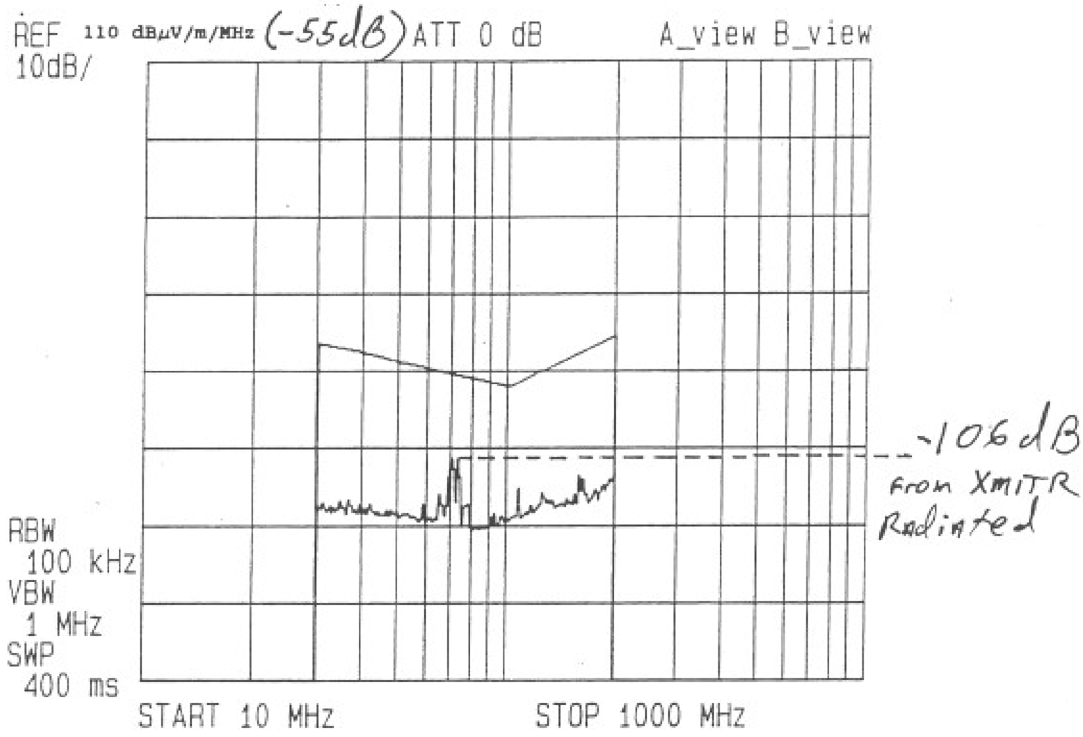

Figure 3-41 Radiated Emissions, Broad Band 30 to 200 MHz

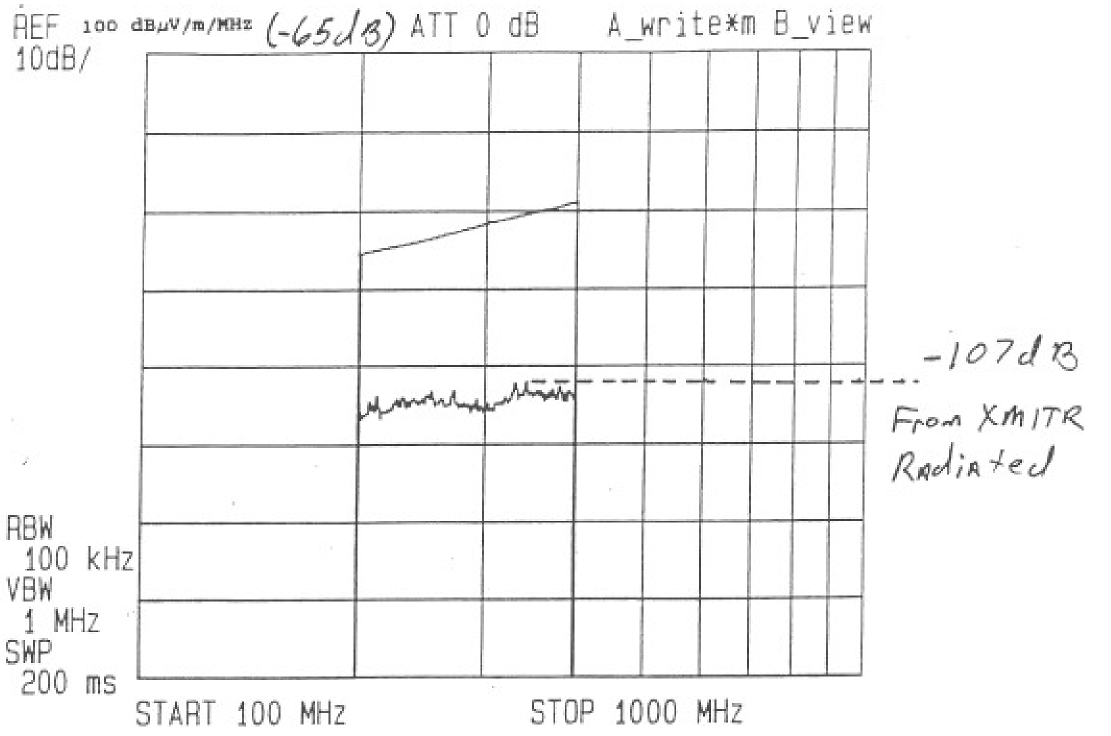

Figure 3-42 Radiated Emissions, Broad Band 200 to 400 MHz

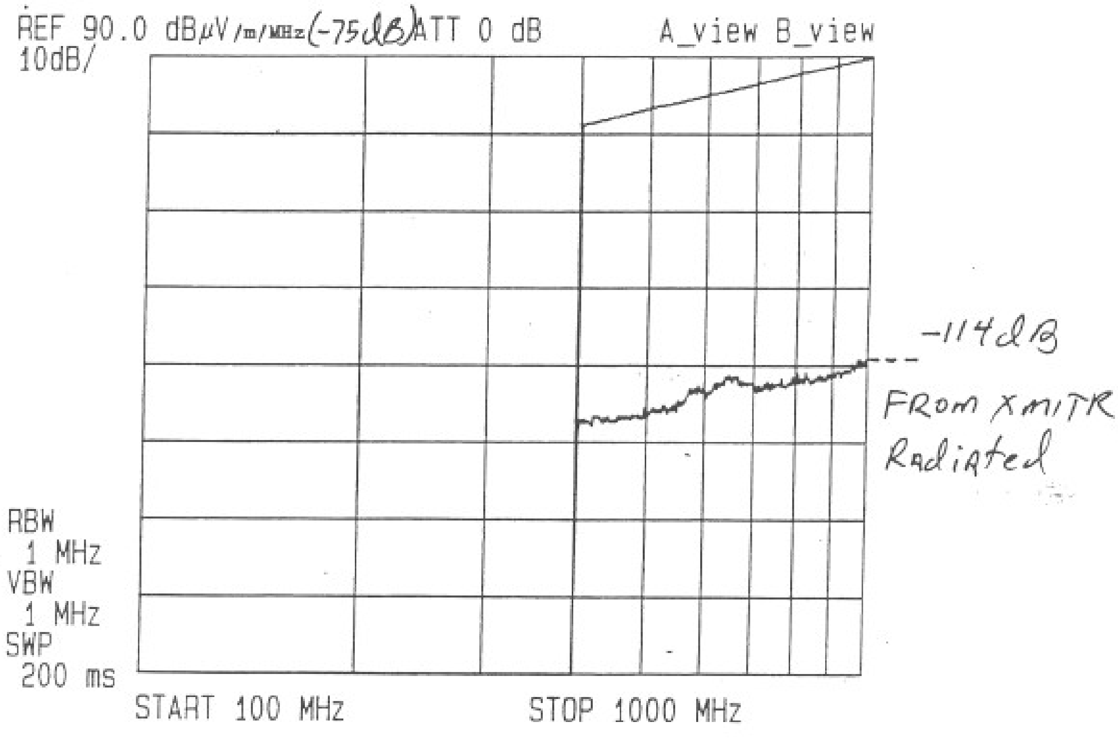

Figure 3-43 Radiated Emissions, Broad Band 400 to 1,000 MHz

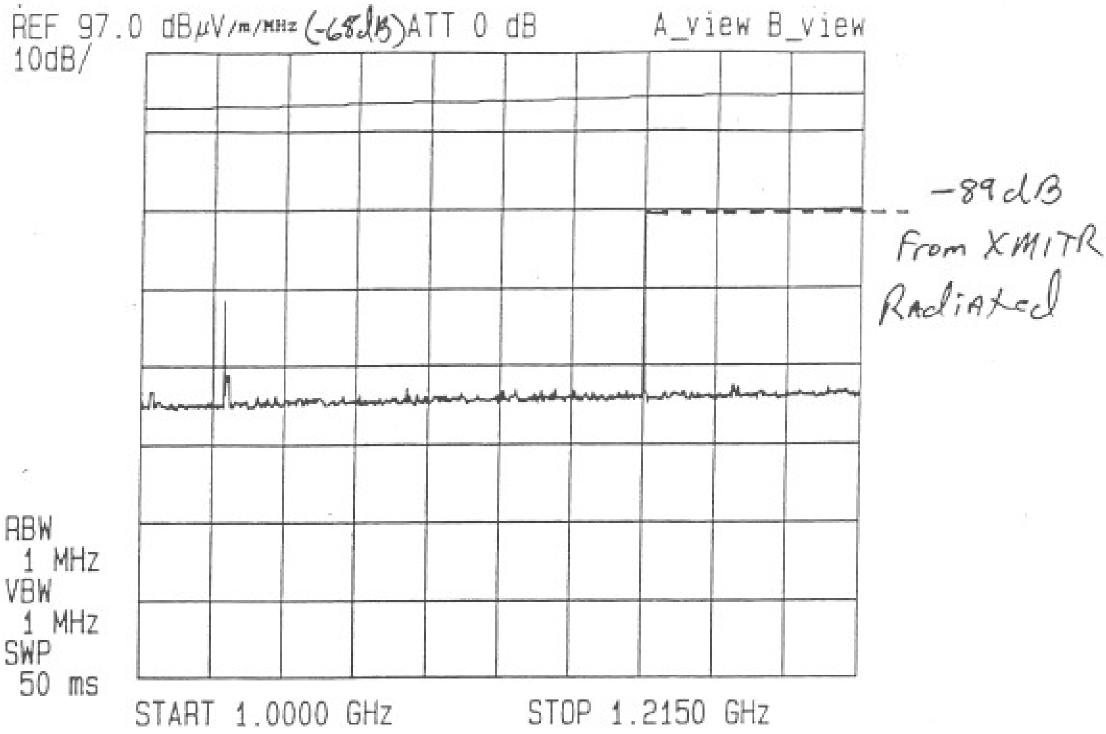

Figure 3-44 Radiated Emissions, Broad Band 1,000 to 1,215 MHz

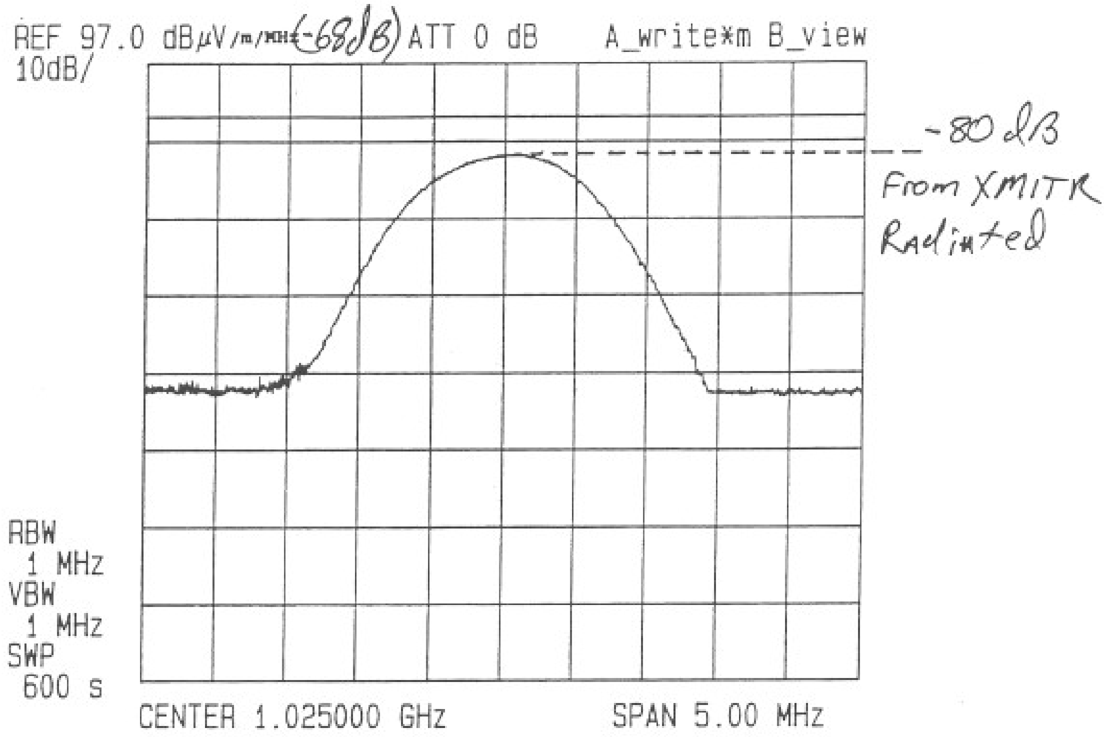

Figure 3-45 Radiated Emissions, Broad Band Centered on Channel 1X

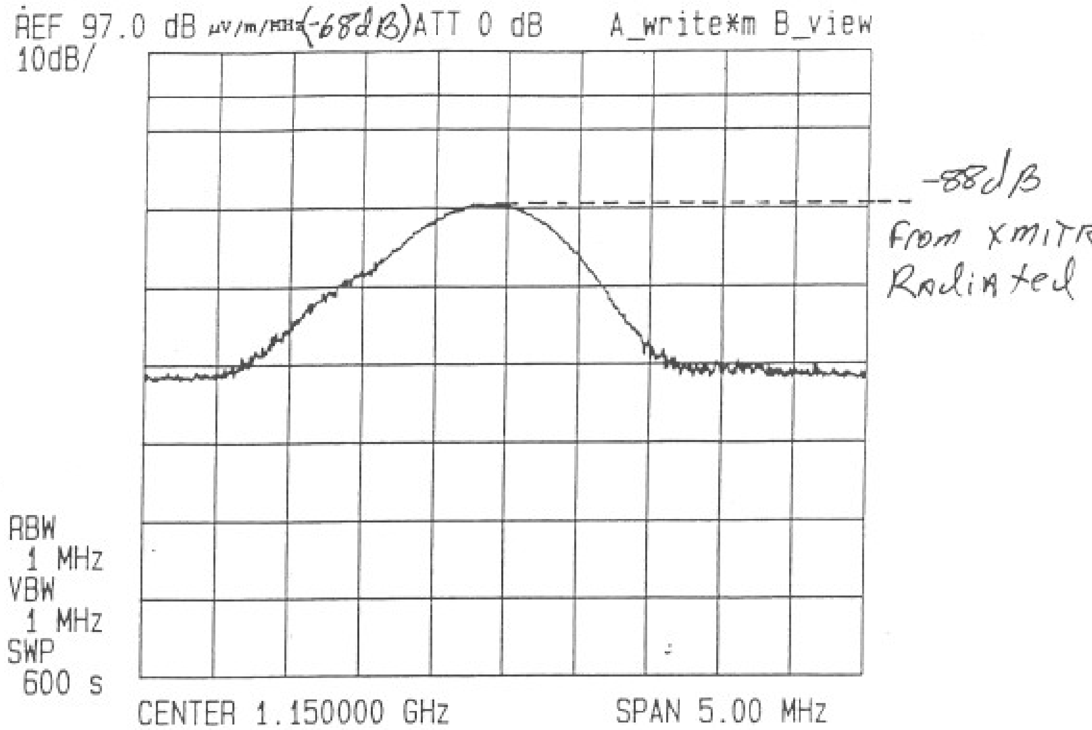

Figure 3-46 Radiated Emissions, Broad Band Centered on Channel 126X MHz

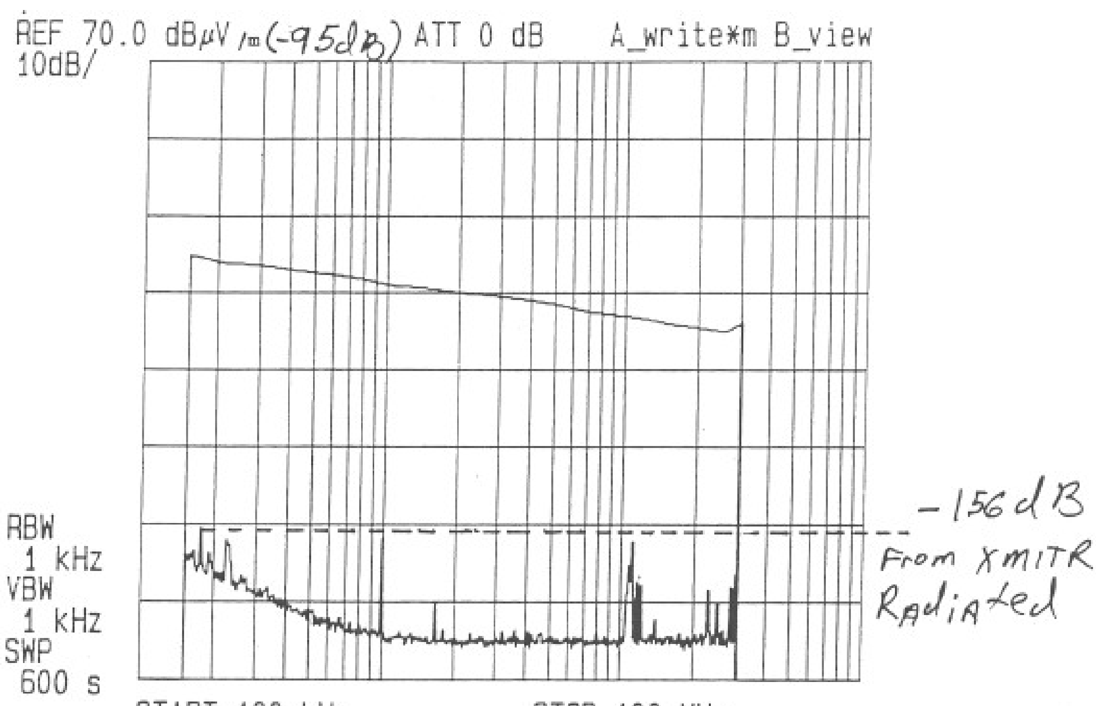

Figure 3-47 Radiated Emissions, Narrow Band 150 KHz to 30 MHz

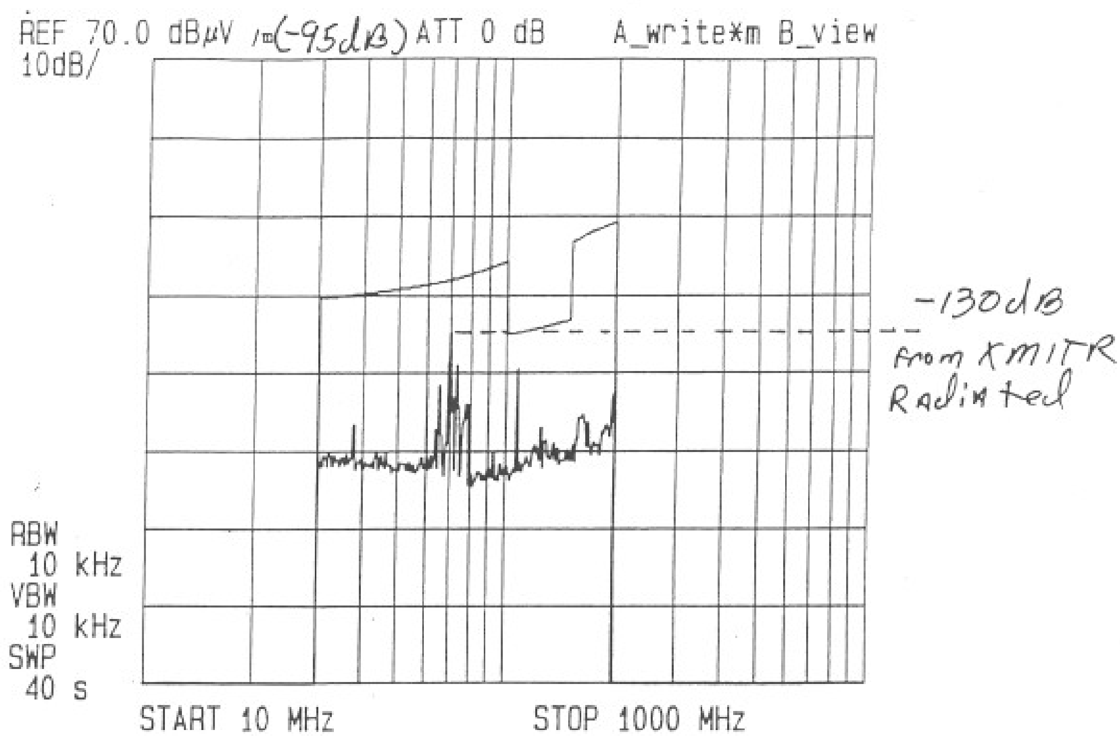

Figure 3-48 Radiated Emissions, Narrow Band 30 to 200 MHz

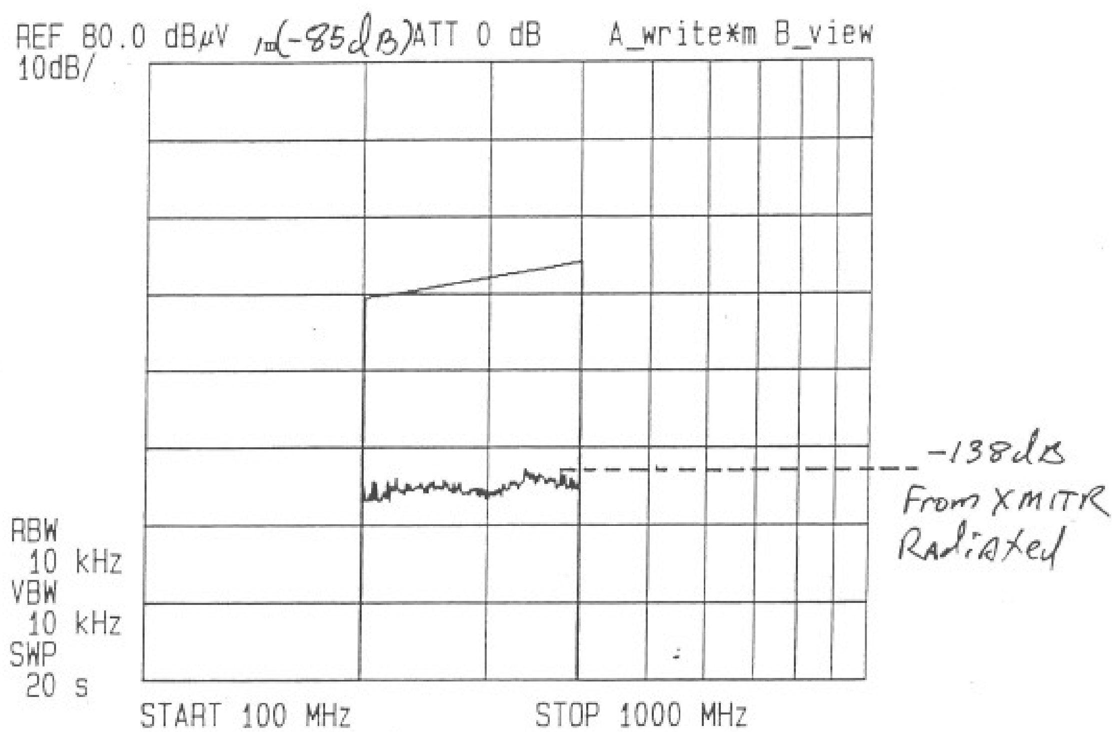

Figure 3-49 Radiated Emissions, Narrow Band 200 to 400 MHz

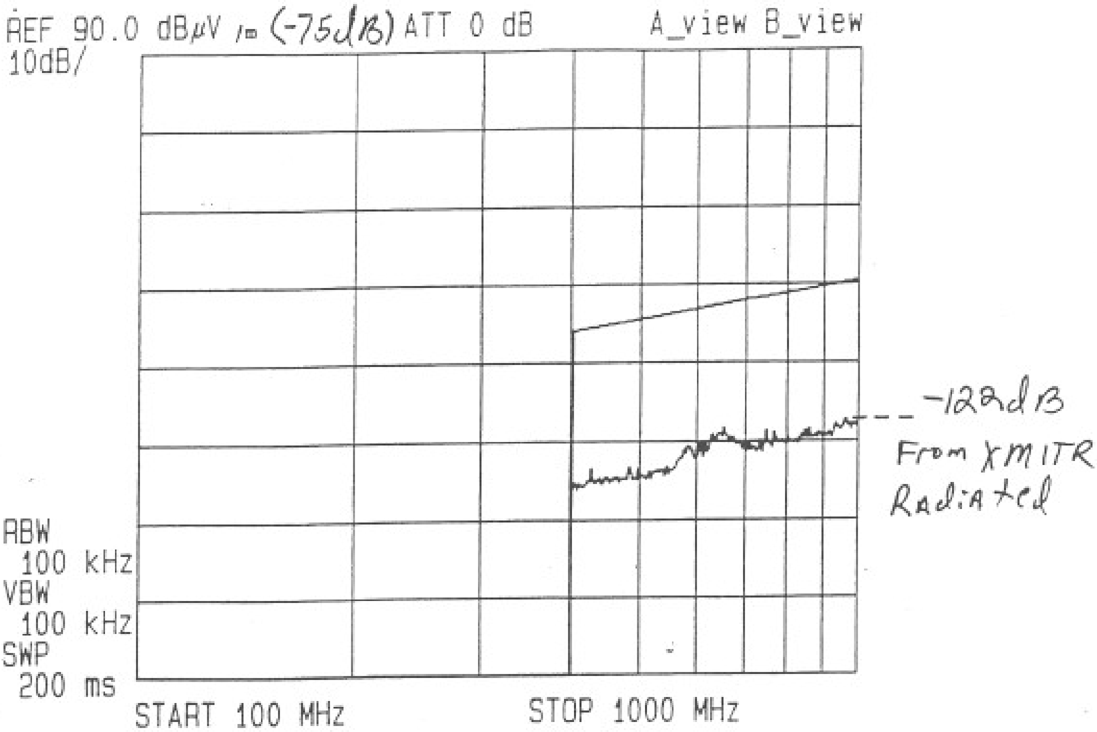

Figure 3-50 Radiated Emissions, Narrow Band 400 to 1,000 MHz

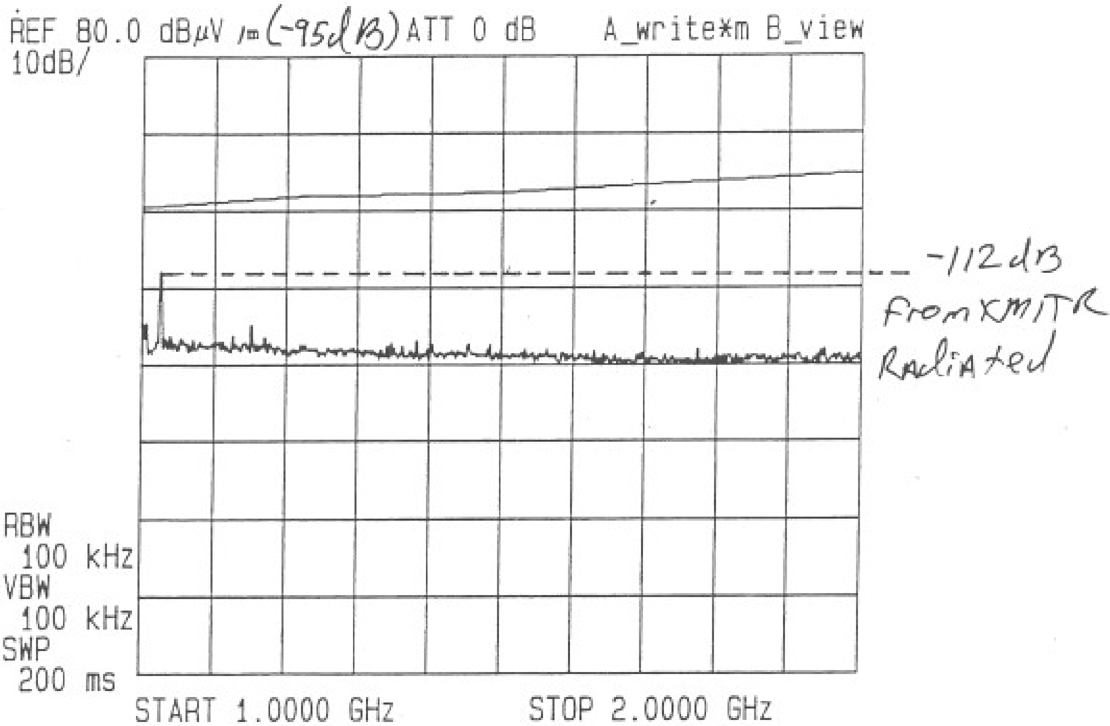

Figure 3-51 Radiated Emissions, Narrow Band 1.0 to 2.0 GHz

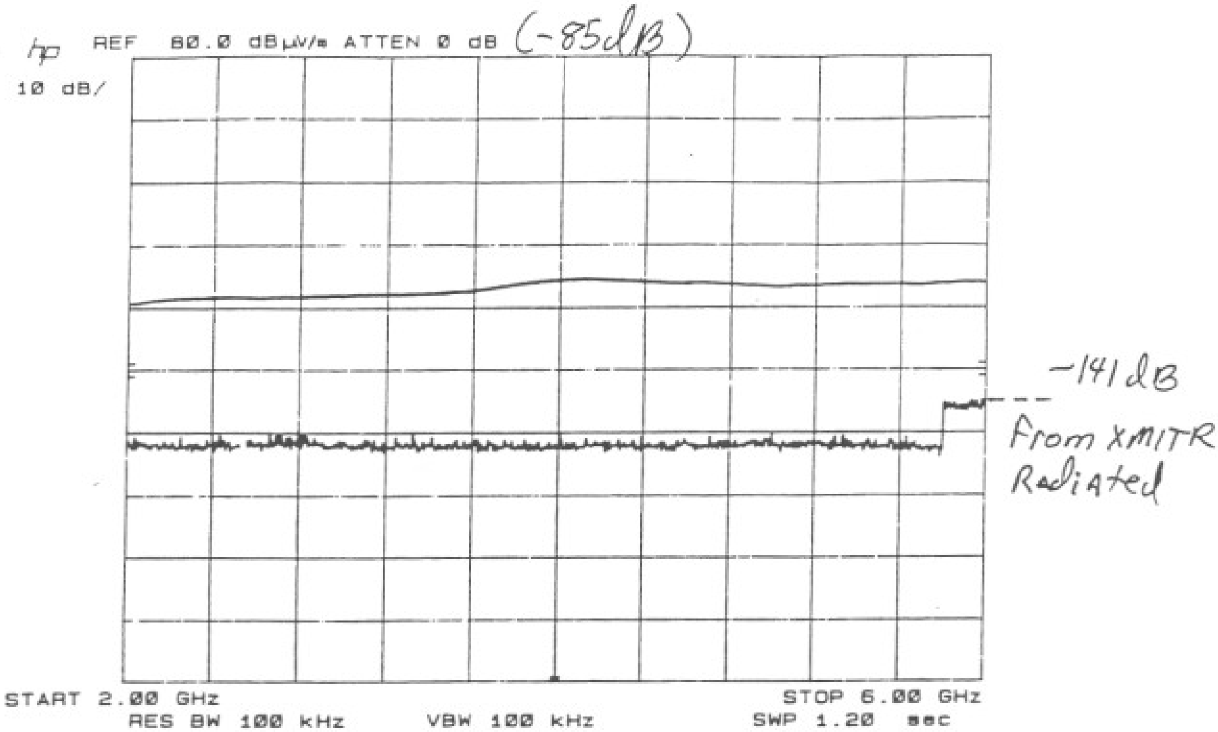

Figure 3-52 Radiated Emissions, Narrow Band 2.0 to 6.0 GHz

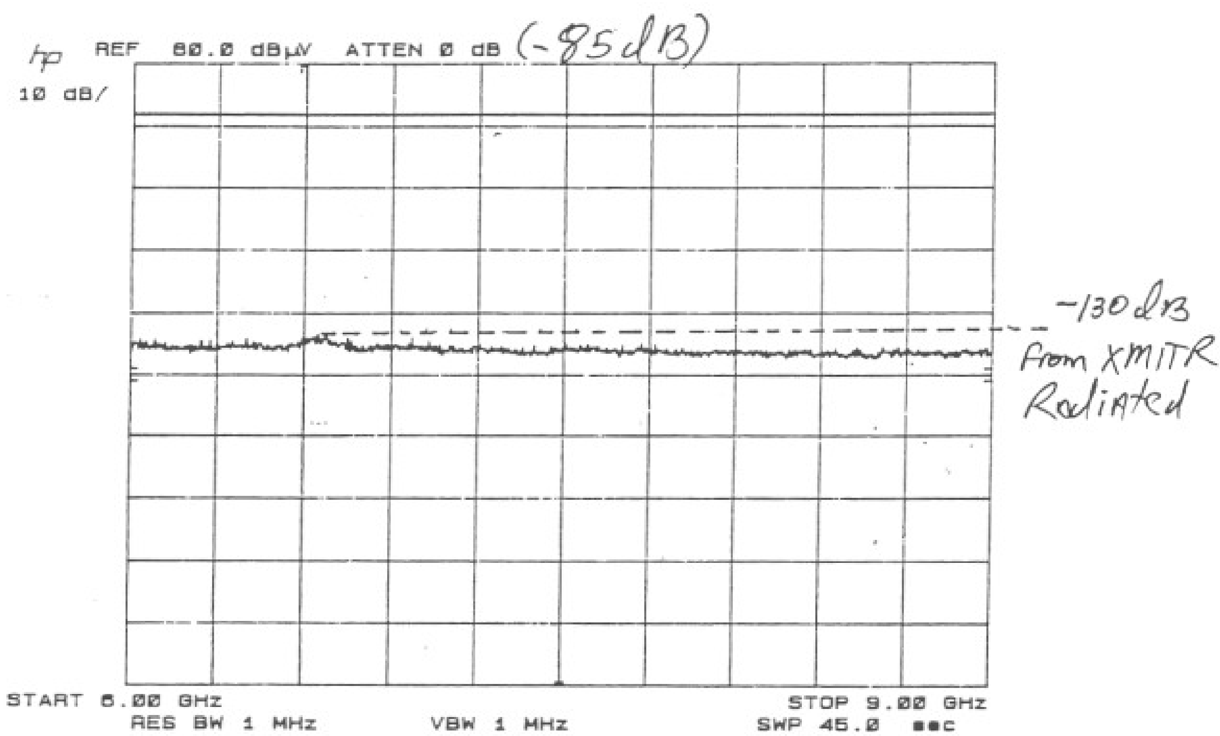

Figure 3-53 Radiated Emissions, Narrow Band 6.0 GHz to 9.0 GHz

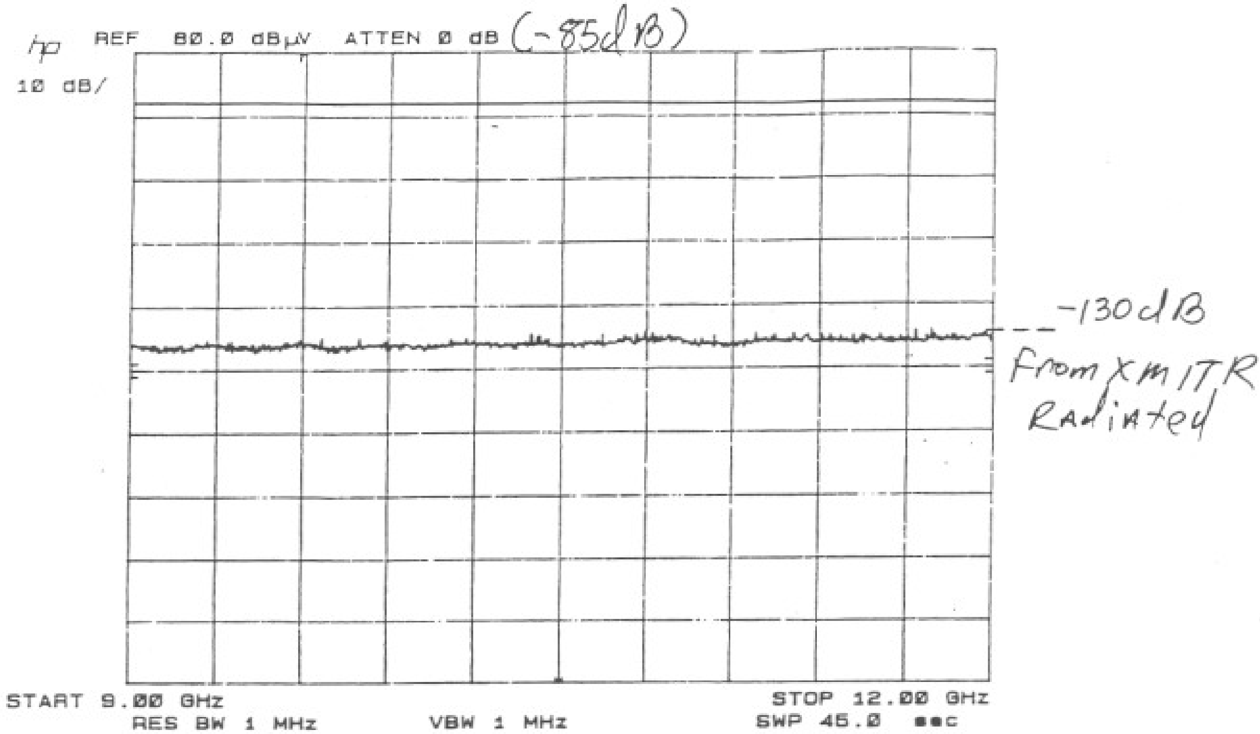

Figure 3-54 Radiated Emissions, Narrow Band 9.0 to 12.0 GHz

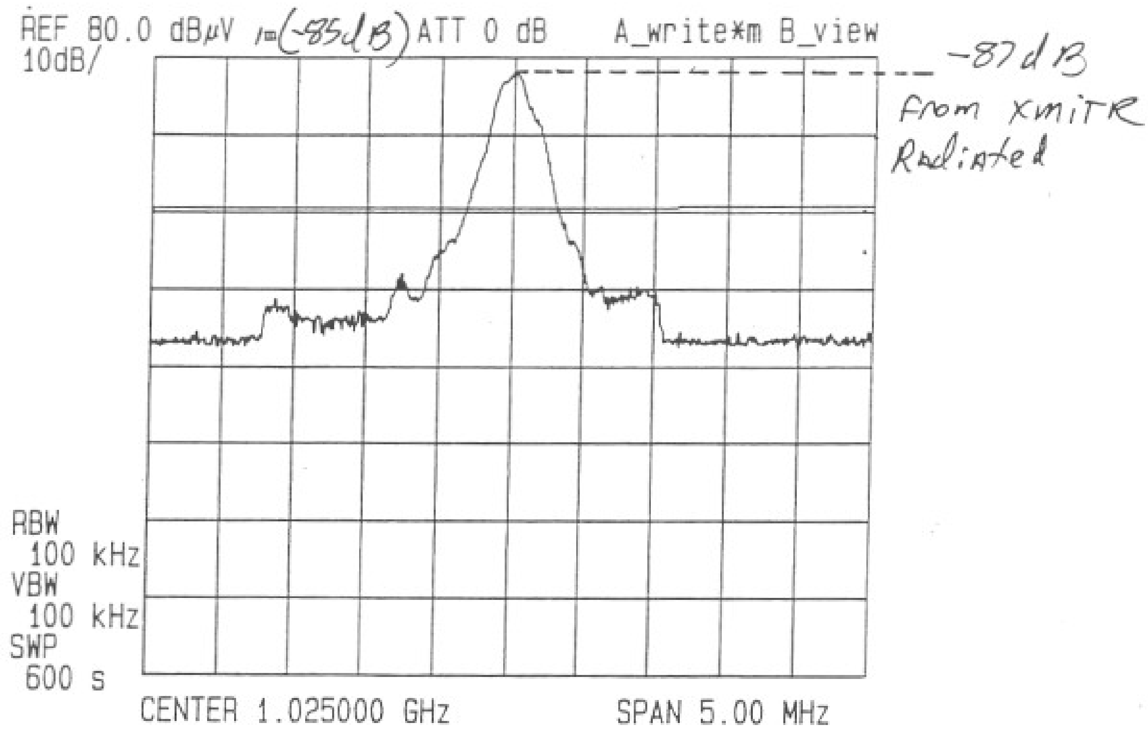

Figure 3-55 Radiated Emissions, Narrow Band Centered on Channel 1X

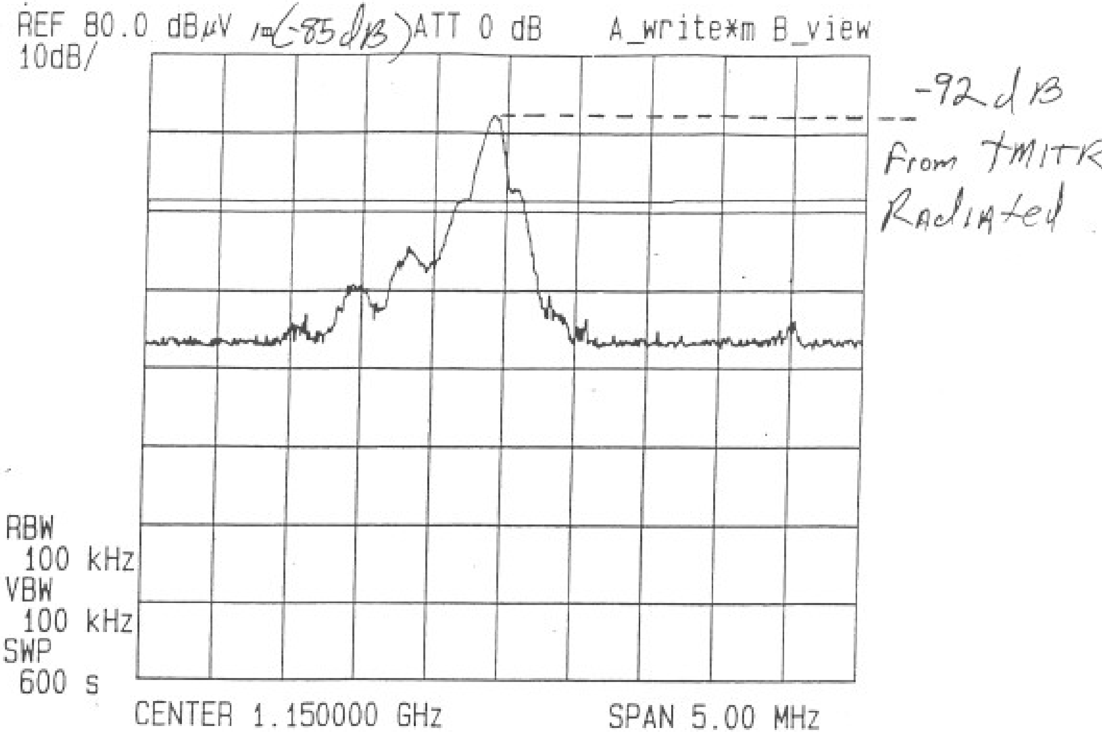

Figure 3-56 Radiated Emissions, Narrow Band Centered on Channel 126X

T R A N S M I T T A L

FAX

To: Frank Coperich

Fax: (301) 344-2050

From: M. Brett Wilson

Date: September 19, 1994

Pages: Lead + 5

Subject: Pending Application for Type Acceptance, FCC ID AJKPN822-0329 - Your fax to Rubicom Systems on 9/14/94.

Frank:

Attached is an answer to your inquiry about the above application and replacement pages for page 29, Exhibit G.

We realize that our fax number was not included on the Form 731s of more than one of our recent applications. Please fax any additional request for information on Rockwell Equipment Authorization Applications to Linda Sadler at (703) 412-6811 or to me at (703) 412-6868.

Thank You,

Brett Wilson

M. Brett Wilson
Rockwell International
Suite 1200
745 Jefferson Davis Highway
Arlington, VA 22202

Telephone: 703/412-6635
Fax: 703/412-6868
Comnet: 747-6635/6868

INQUIRY:

"Please convert the field strength readings for radiated spurious emissions to show dB below the desired signal so that the attenuation requirements of Section 87.139 may be demonstrated."

ANSWER:

For a field strength of 1 uV/meter, the associated power density radiated from the DME-900 is calculated as follows.

> $10*\mathrm{LOG}(E^2/Z_o)$ in dBW /sq. meter

E = energy (volts)
Z_o = impedance of free space ($120*\pi$ ohms)

> Substituting into the equation...

$$10*\mathrm{LOG}\left(\frac{[1*(10)^{-6}\ \mathrm{Volts/meter}]^2}{120*\pi}\right) = -145.76 \text{ dBW per sq. meter}$$

> Thus 80 dB at field strength of 1uV per meter converts to a power density of **–65.76 dBW per sq. meter.**

Rockwell International, Avionics Division
Melbourne, Florida

3.3.3 Emission Limitations (87.139 (3))

Replaced

Part 87, section 87.193 requires the transmitter power to be attenuated by 40 dB when the frequency is removed by 250% of the authorized bandwidth. The authorized bandwidth for the DME is calculated 800 KHz (1 MHz channel seperation - 2 X 100 KHz transmitter frequency stability). The limit is then calculated to be 2.0 Mhz. A plot of the spectrum taken with the HP 8591E is shown in Figures 3-13a for channel 64X indicating the transmitter output to be attenuated by 40 dB 780 KHz removed from the assigned frequency.

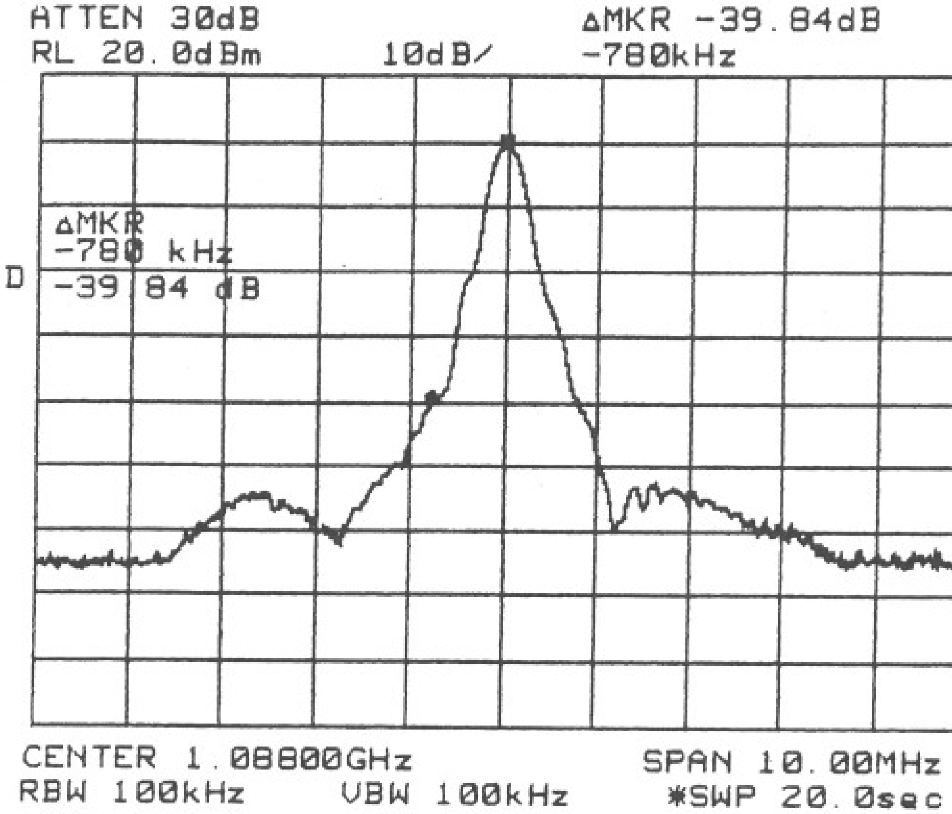

Figure 3-13a Pulse Spectrum of Channel 64X Showing Spectrum Width @ -40 dB

FAX Cover Sheet

Federal Communications Commission

Authorization & Evaluation Division
7435 Oakland Mills Road
Columbia, MD 21046
Telephone No.: (301) 725-1585
FAX No.: (301) 344-2050

Date: Sept. 14, '94 Time: 3:30 AM (PM)

From:

Name: Frank Coperich Ext: 211

To.

Name: ENGINEER in CHARGE

Organization. Rubicon Syst.

Phone Number: ( ) --

FAX Number: (✓) --

This Cover Sheet Is Page 1 of 2 Pages Please direct inquiries, if any, to the sender at the above extension.

Comments: Reference pending type acceptance filing for Rockwell FCC ID: AJK9URPN822-0329. Please see attached Page.

Please convert the field strength readings for radiated spurious emissions to show dB below the desired signal so that the attenuation requirements in Section 87.139 may be demonstrated.

BRETT WILSON

INQUIRY:

"Please convert the field strength readings for radiated spurious emissions to show dB below the desired signal so that the attenuation requirements of Section 87.139 may be demonstrated."

ANSWER:

For a field strength of 1 uV/meter, the associated power density radiated from the DME-900 is calculated as follows.

> $10 * LOG(E^2/Z_o)$ in dBW /sq. meter

E = energy (volts)
Z_o = impedance of free space (120*π ohms)

> Substituting into the equation...

$$10 * LOG\left(\frac{[1*(10)^{-6}\ \text{Volts/meter}]^2}{120*\pi}\right) = -145.76\ \text{dBW per sq. meter}$$

> Thus 80 dB at field strength of 1uV per meter converts to a power density of **-65.76 dBW per sq. meter**.

Rockwell International, Avionics Division
Melbourne, Florida

3.3.3 Emission Limitations (87.139 (a))

Part 87, section 87.139 (a)(1) requires the transmitter power to be attenuated by at least 25 dB when the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth. The authorized bandwidth for the DME is calculated to be 1 MHz as described in Exhibit D section 2.4.1. Plots of the spectrum taken with the HP 8591E are shown in Figures 3-13a for channel 64X indicating the transmitter output to be attenuated by 26.89 dB 500 KHz below the assigned frequency, and in Figures 3-13b for channel 64X indicating the transmitter output to be attenuated by 27.45 dB 500 KHz above the assigned frequency.

Part 87, section 87.139 (a)(2) requires the transmitter power to be attenuated by at least 35 dB when the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth. Plots of the spectrum taken with the HP 8591E are shown in Figures 3-13c for channel 64X indicating the transmitter output to be attenuated by 46.94 dB 1 MHz below the assigned frequency, and in Figures 3-13d for channel 64X indicating the transmitter output to be attenuated by 49.53 dB 1 MHz above the assigned frequency.

Part 87, section 87.139 (a)(3) requires the transmitter power to be attenuated by at least 40 dB when the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth. Plots of the spectrum taken with the HP 8591E are shown in Figures 3-13e for channel 64X indicating the transmitter output to be attenuated by 55.76 dB 2.5 MHz below the assigned frequency, and in Figures 3-13f for channel 64X indicating the transmitter output to be attenuated by 58.50 dB 2.5 MHz above the assigned frequency.

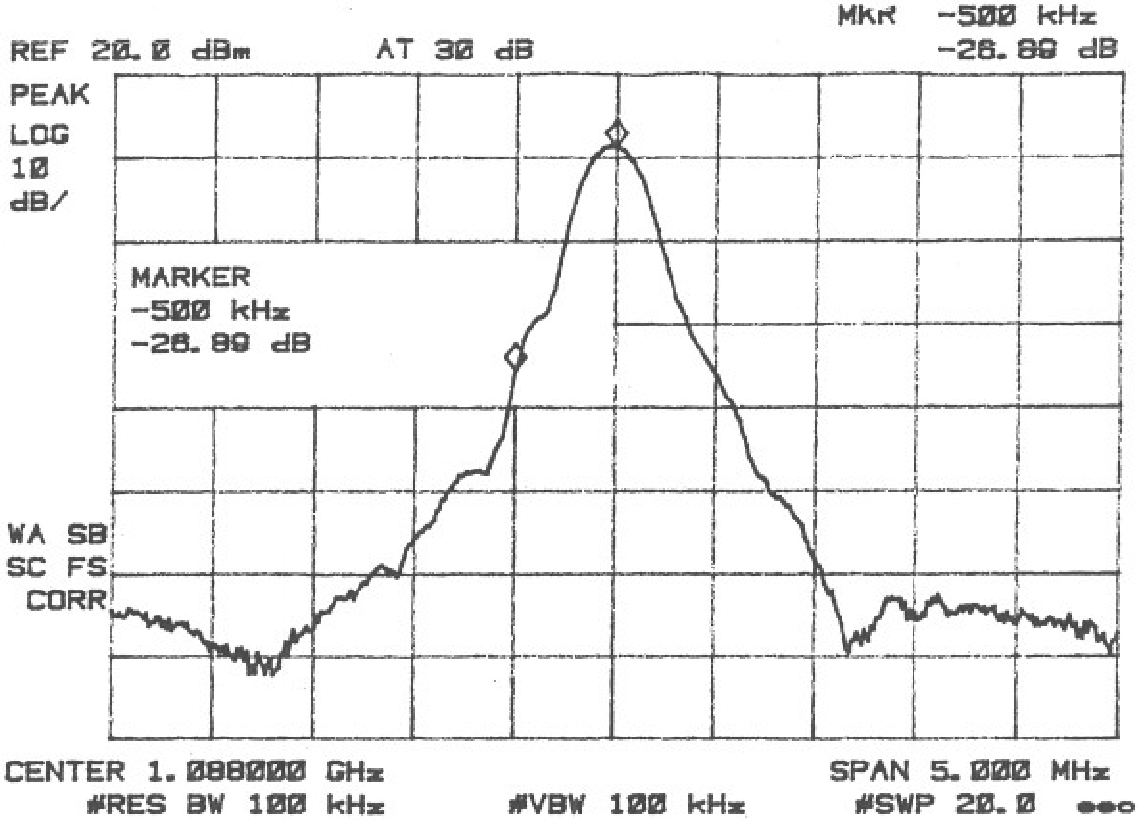

Figure 3-13a Pulse Spectrum of Channel 64X Showing Attenuation @ -50% Authorized Bandwidth

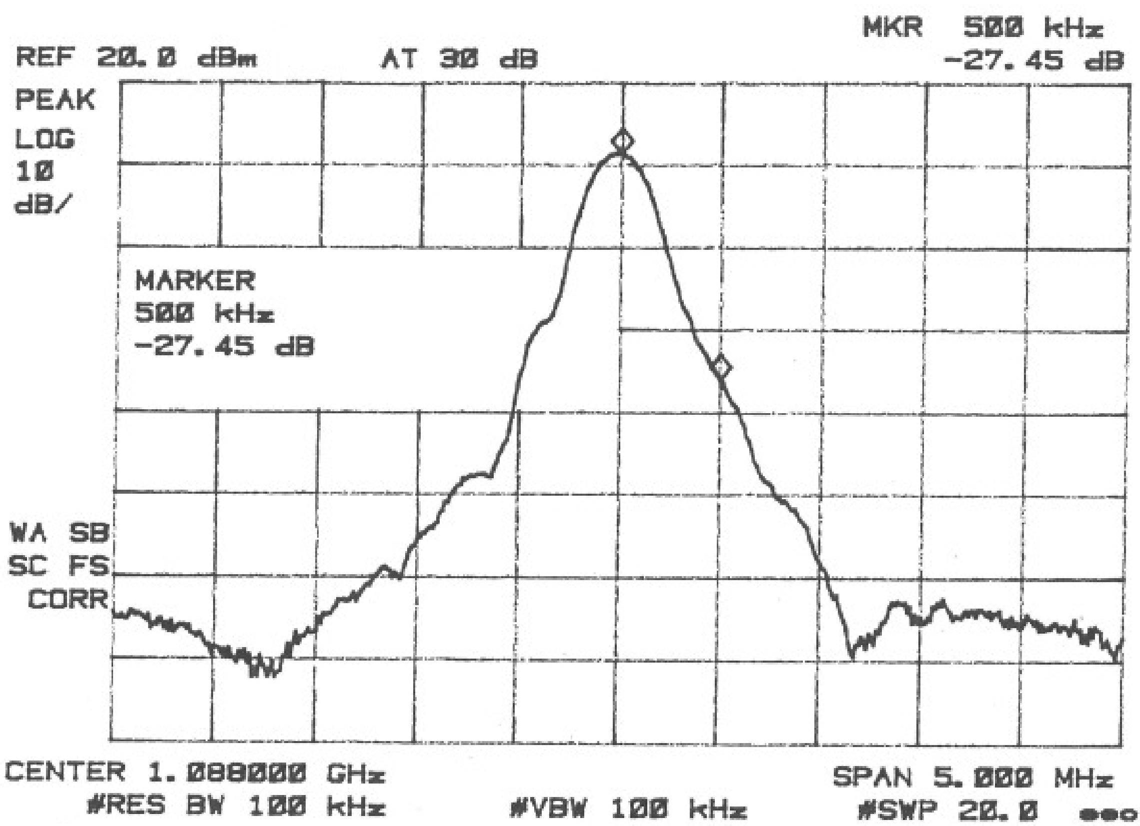

Figure 3-13b Pulse Spectrum of Channel 64X Showing Attenuation @ -50% Authorized Bandwidth

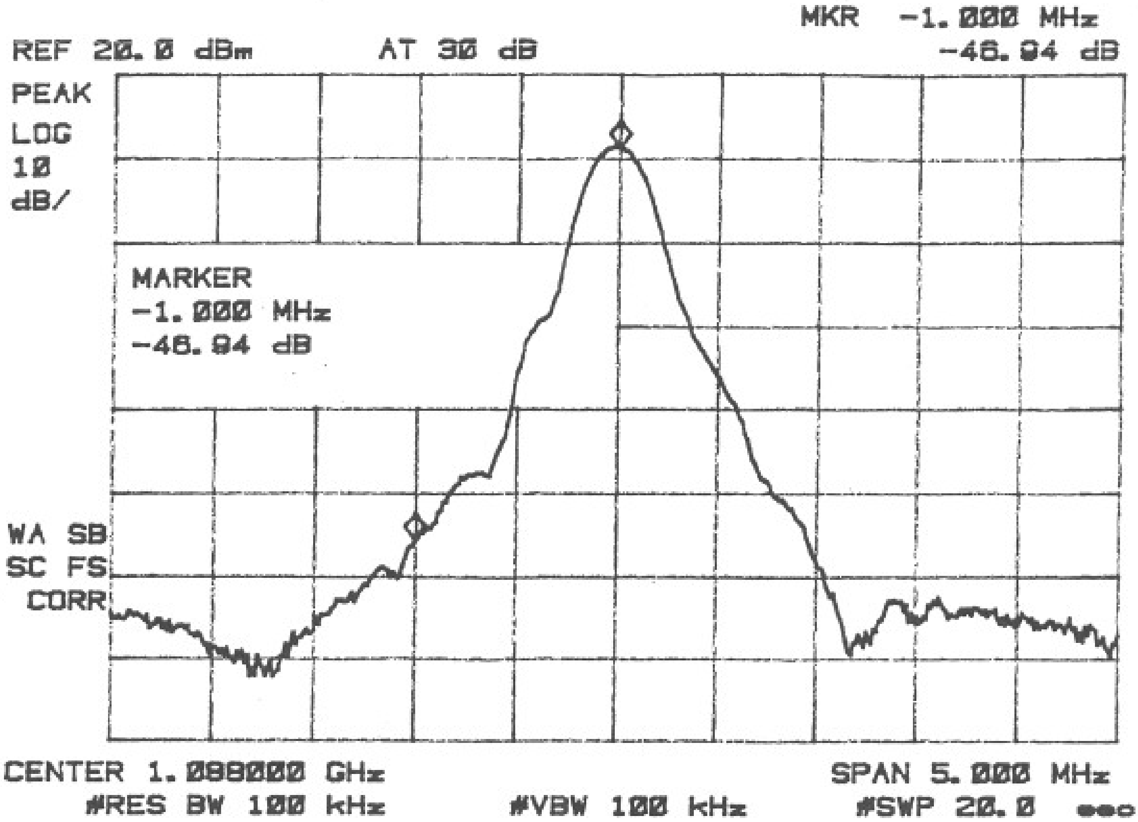

Figure 3-13c Pulse Spectrum of Channel 64X Showing Attenuation @ -100% Authorized Bandwidth

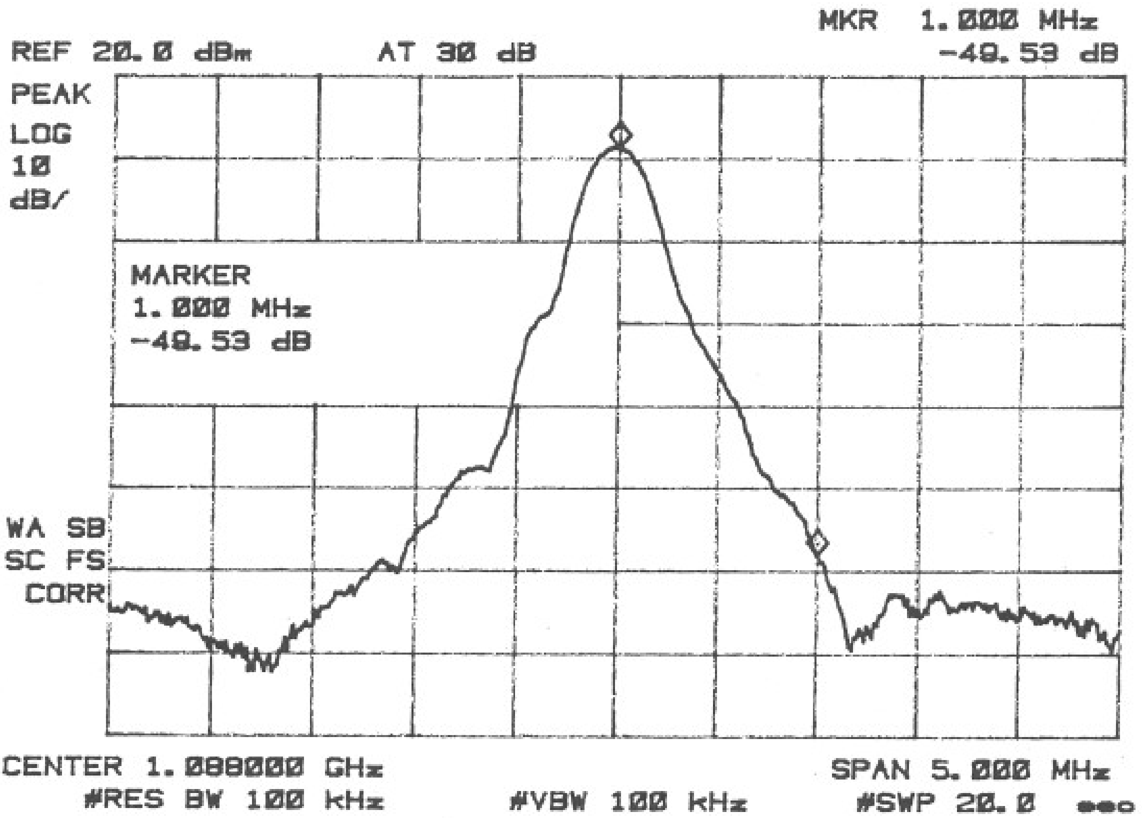

Figure 3-13d Pulse Spectrum of Channel 64X Showing Attenuation @ +100% Authorized Bandwidth

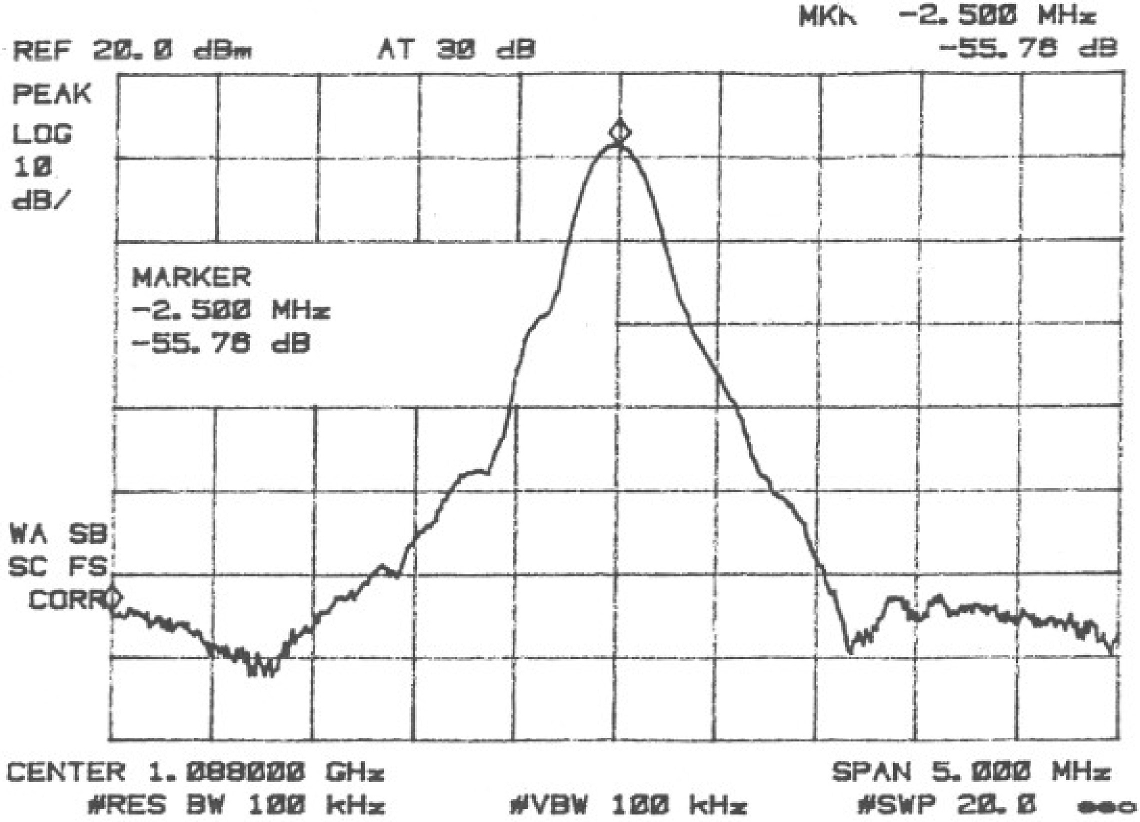

Figure 3-13e Pulse Spectrum of Channel 64X Showing Attenuation @ -250% Authorized Bandwidth

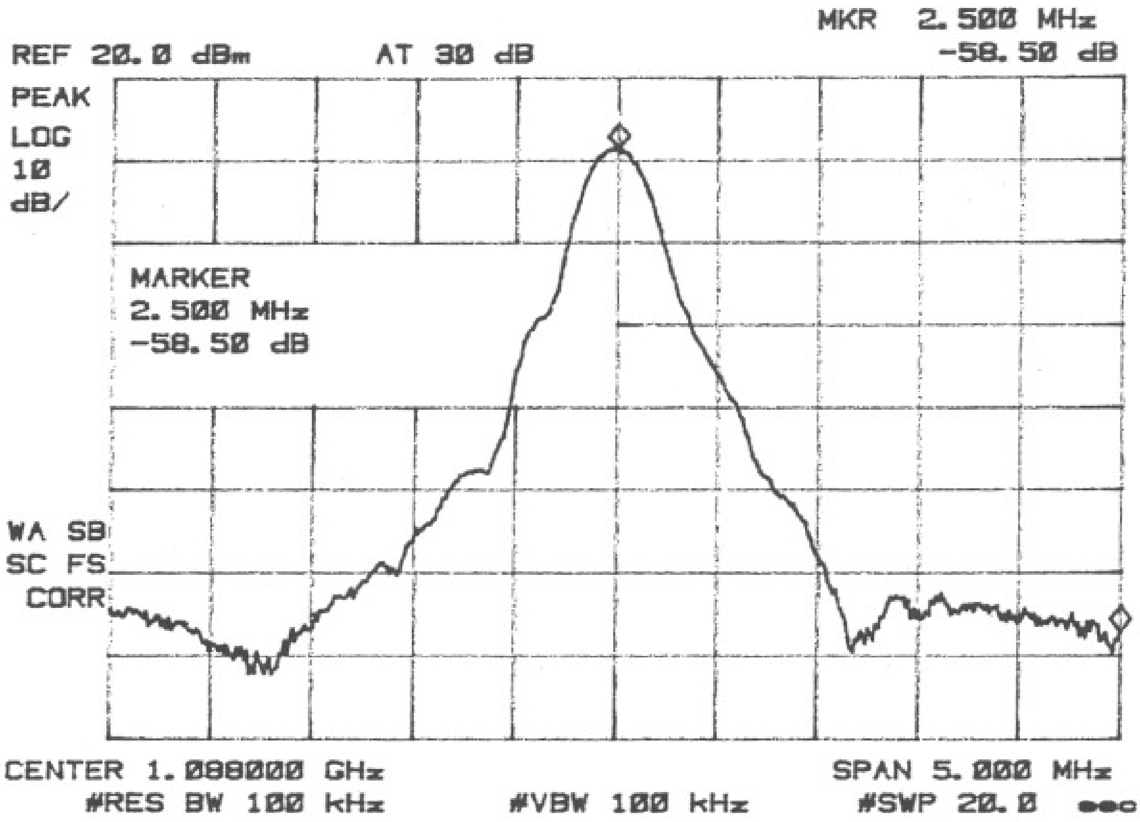

Figure 3-13f Pulse Spectrum of Channel 64X Showing Attenuation @ +250% Authorized Bandwidth