

FCC Parts 22 Test Report  
for  
Wireless Link  
on the  
Fixed Wireless Cellular Desktop Phone  
Model: FWT-8100  
FCC ID: NJIFW8100

Report #: 20451372  
Date of Report: April 28, 2001

Job #: J20045137  
Date of Test: April 18 to April 23, 2001

Total No of Pages Contained in this Report: 91 + Data Sheets



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|            |                                   |                       |
|------------|-----------------------------------|-----------------------|
| Tested by: | Engineer<br>Suresh Kondapalli     | Review Date: 04/30/01 |
| Reviewer:  | EMC Manager<br>David Chernomordik | Review Date: 4/30/01  |

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## 1.0 Introduction

### 1.1 Test Summary

| FCC RULE                       | DESCRIPTION OF TEST                                                                    | RESULT | PAGE                   |
|--------------------------------|----------------------------------------------------------------------------------------|--------|------------------------|
| 2.1046                         | RF Power Output                                                                        | Passed | 6                      |
| 22.913                         | ERP                                                                                    | Passed | 7                      |
| 2.1047                         | Modulation Requirements                                                                | Passed | 9                      |
| 22.915(d)(1)                   | Audio Filter Characteristics                                                           | Passed | 12                     |
| 2.1049<br>22.917(b)(d)         | Emission Limitation, Occupied Bandwidth                                                | Passed | 15                     |
| 2.1051, 22.917(e)<br>22.917(f) | Out of Band Emissions at Antenna Terminals<br>Mobile Emissions In Base Frequency Range | Passed | 17                     |
| 2.1053                         | Field Strength of Spurious Radiation                                                   | Passed | 19                     |
| 15.107                         | Line Conducted Emissions                                                               | Passed | 20                     |
| 2.1055                         | Frequency Stability vs. Temperature                                                    | Passed | 21                     |
| 2.1055                         | Frequency Stability vs. Voltage                                                        | Passed | 22                     |
| 2.1093                         | Specific Absorption Rate                                                               | Passed | See separate<br>report |

Tested By:

  
Suresh Kondapalli

4/30/01  
Date

Approved By:

  
David Chernomordik, Ph.D.,  
EMC Site Manager

4/30/01  
Review Date:

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**1.0 Introduction**

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| 2.1093                         | Specific Absorption Rate                                                               | Passed | See separate<br>report |

Tested By: \_\_\_\_\_  
Suresh Kondapalli\_\_\_\_\_  
DateApproved By: \_\_\_\_\_  
David Chernomordik, Ph.D.,  
EMC Site Manager\_\_\_\_\_  
Review Date:

## 1.2 Product Description

The Wireless Link FWP-8100 is a Fixed Wireless Cellular Desktop Phone is a stand-alone telephone with digital TDMA and analog AMPS cellular transceiver radio system built-in. It provides extended telephone service bringing subscriber wireless access to a cellular network.

For more information, please refer to the attached product description.

|                                             |                                                                                      |
|---------------------------------------------|--------------------------------------------------------------------------------------|
| Use of Product                              | Cellular Desktop Phone                                                               |
| Whether quantity (>1) production is planned | <input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No                 |
| Cellular Phone standards                    | <input checked="" type="checkbox"/> AMPS<br><input checked="" type="checkbox"/> TDMA |
| Type(s) of Emission                         | 40K0F8W, 40K0F1D, 30K0G7D                                                            |
| Allowed Deviation                           | 12± 10% (AMPS mode)                                                                  |
| Range of RF Output                          | 27.2dBm AMPS Mode, 35.4dBm TDMA Mode                                                 |
| Frequency Range                             | 824 - 849 MHz (AMPS & TDMA)                                                          |
| Antenna(e) & Gain                           | 0 dBi                                                                                |
| Detachable antenna ?                        | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                  |
| Receiver L.O. frequency                     | 988.38, 1001.19, 1013.61 MHz                                                         |
| External input                              | <input checked="" type="checkbox"/> Audio <input type="checkbox"/> Digital Data      |

## 1.3 Related Submittal(s) Grants

☒ None

☐ DOC for computer section, a separate DOC is prepared.

**2.0 RF Power Output**

FCC 2.1046

**2.1 Test Procedure**

The transmitter output was connected to a calibrated coaxial attenuator, the other end of which was connected to a spectrum analyzer. Transmitter output was read off the spectrum analyzer in dBm. The power output at the transmitter antenna port was determined by adding the value of the attenuator to the spectrum analyzer reading. A HP power meter was also used to measure the RF power.

Tests were performed at three frequencies (low, middle, and high channels) and on all power levels which can be setup on the transmitters.

**2.2 Test Equipment**

Hewlett Packard 8481A Power Sensor, 435B Power Meter  
Hewlett Packard HP8566B Spectrum Analyzer, 100 Hz - 22 GHz  
Tektronix 2784 Spectrum Analyzer, 100 Hz – 40 GHz

**2.3 Test Results****AMPS Mode**

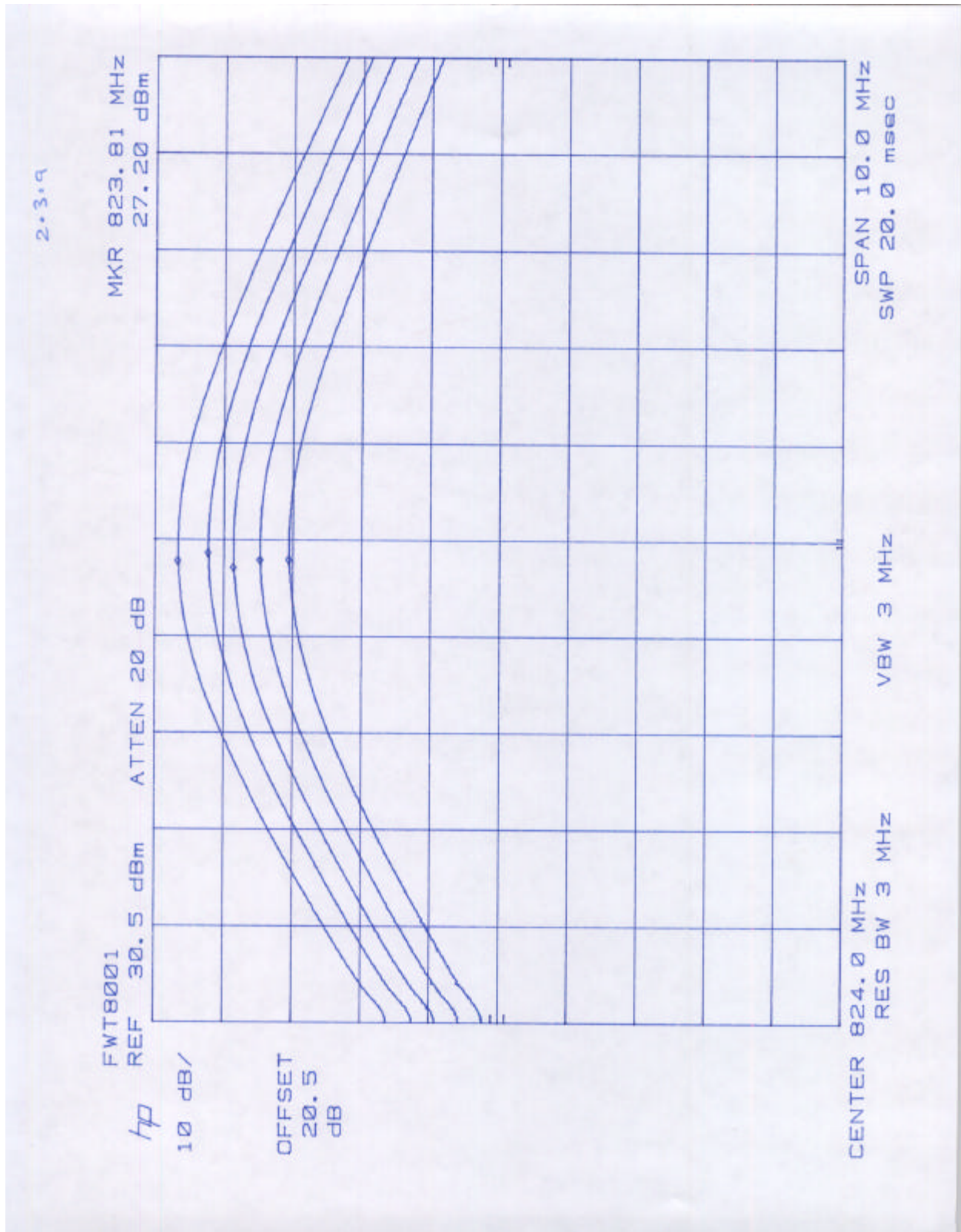
| <b>Frequency (MHz)</b> | <b>Measured Power (dBm)</b> |
|------------------------|-----------------------------|
| 824                    | 27.2                        |
| 836.5                  | 26.5                        |
| 849                    | 24.4                        |

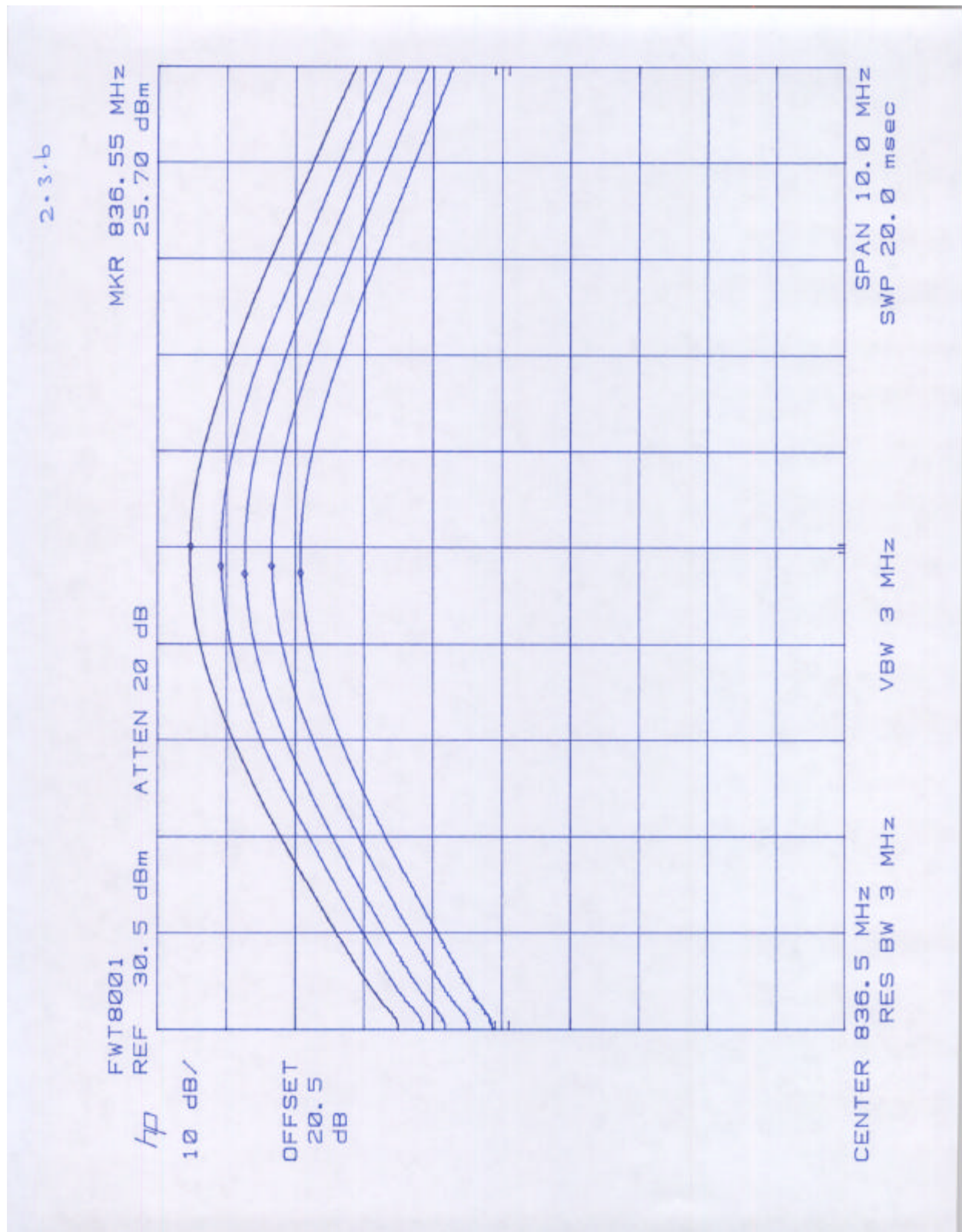
**TDMA Mode**

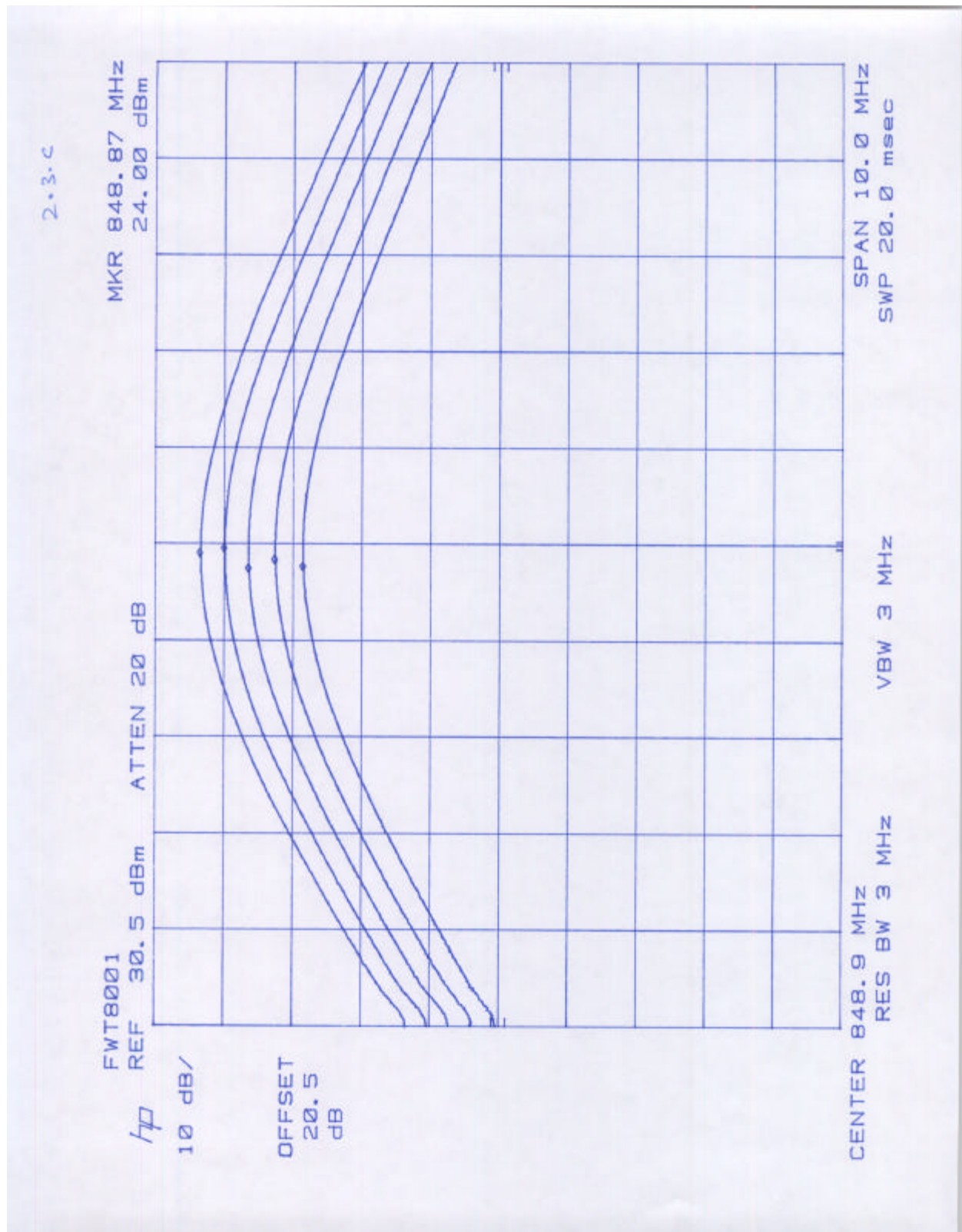
| <b>Frequency (MHz)</b> | <b>Measured Power (dBm)</b> |
|------------------------|-----------------------------|
| 824                    | 35.4                        |
| 836.5                  | 34.7                        |
| 849                    | 34.1                        |

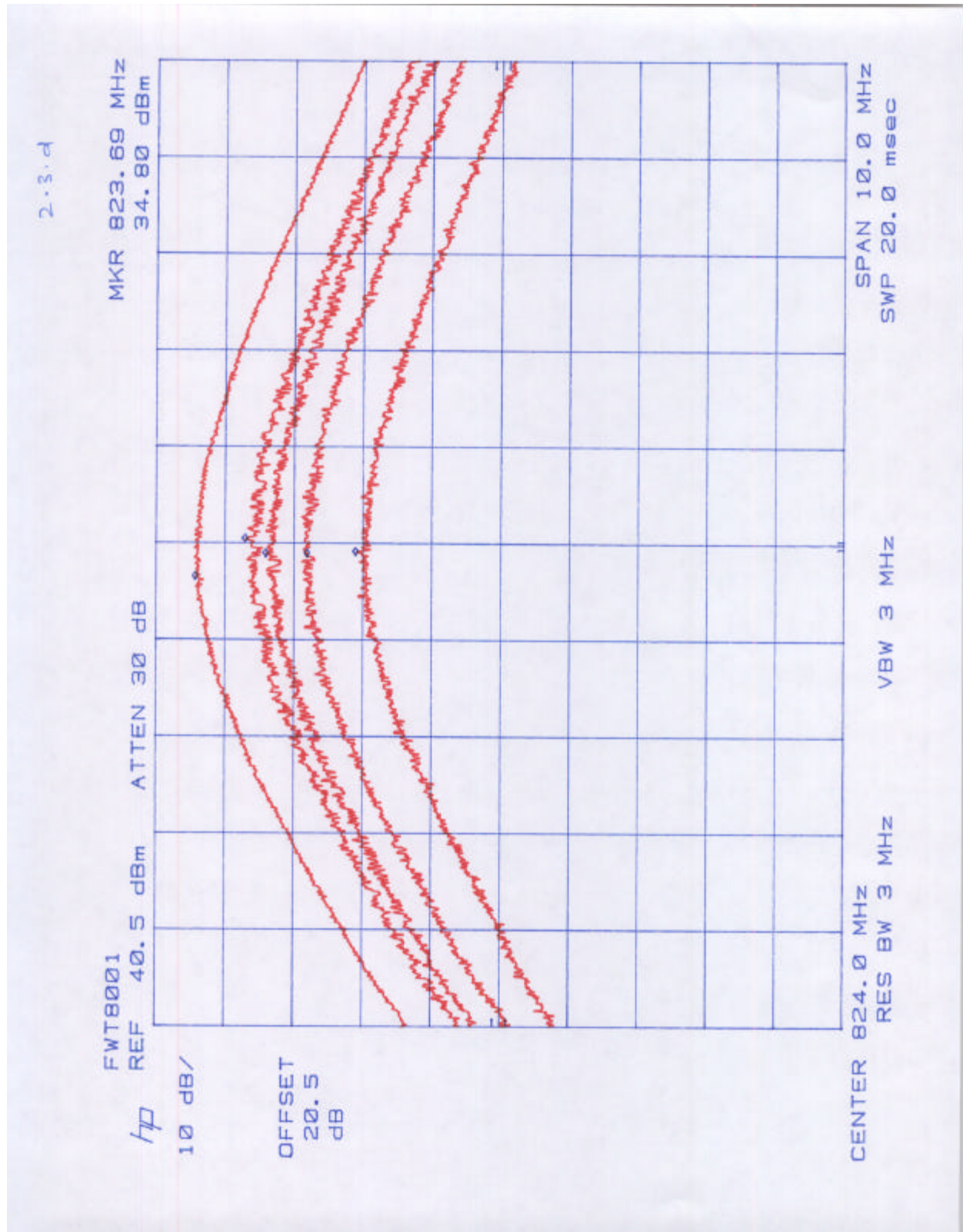
For more details, refer to the attached plots:

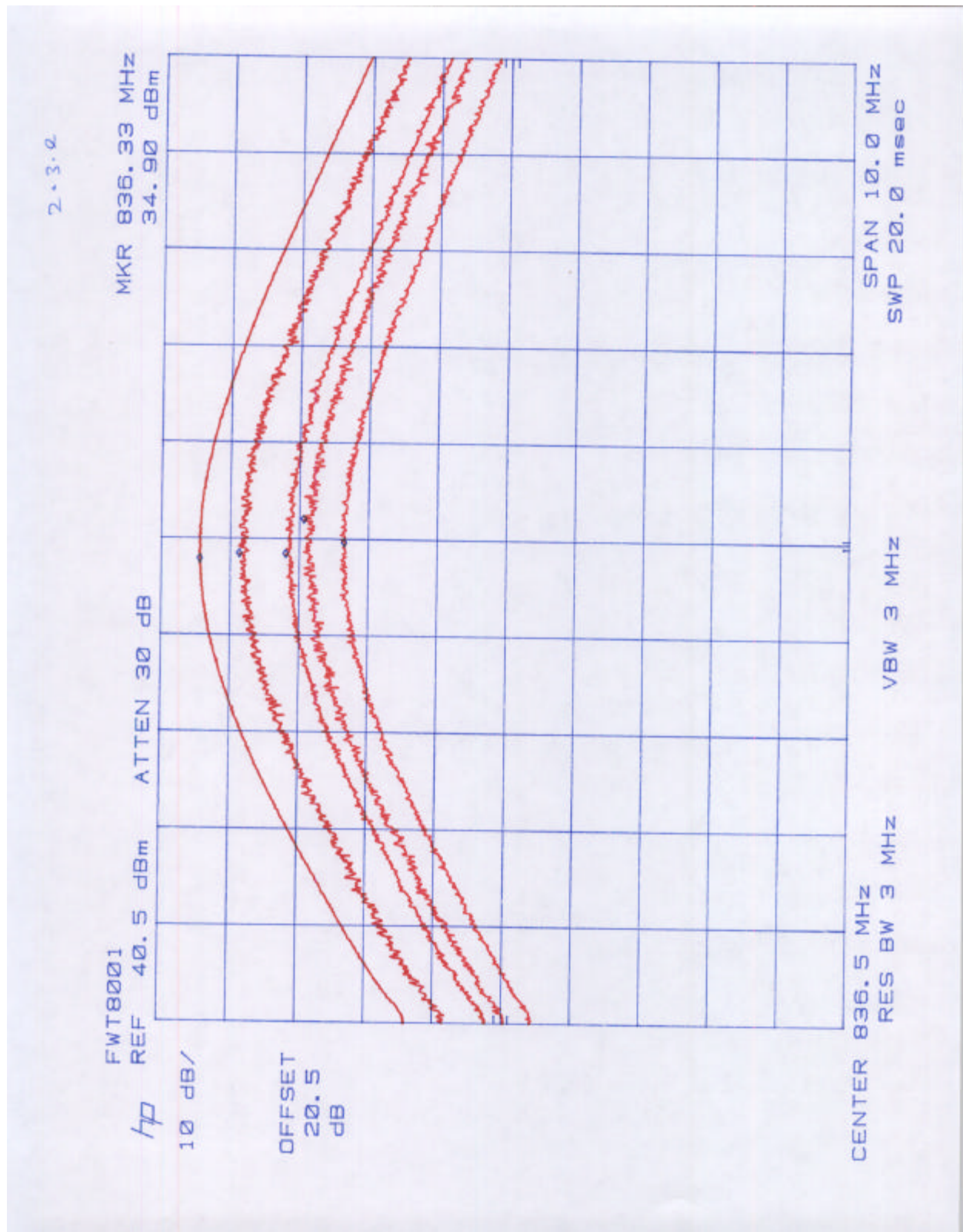
| <b>AMPS Mode</b>   |                    |
|--------------------|--------------------|
| <b>Plot Number</b> | <b>Description</b> |
| 2.3.a              | Low Channel        |
| 2.3.b              | Middle Channel     |
| 2.3.c              | High Channel       |
| <b>TDMA Mode</b>   |                    |
| <b>Plot Number</b> | <b>Description</b> |
| 2.3.d              | Low Channel        |
| 2.3.e              | Middle Channel     |
| 2.3.f              | High Channel       |

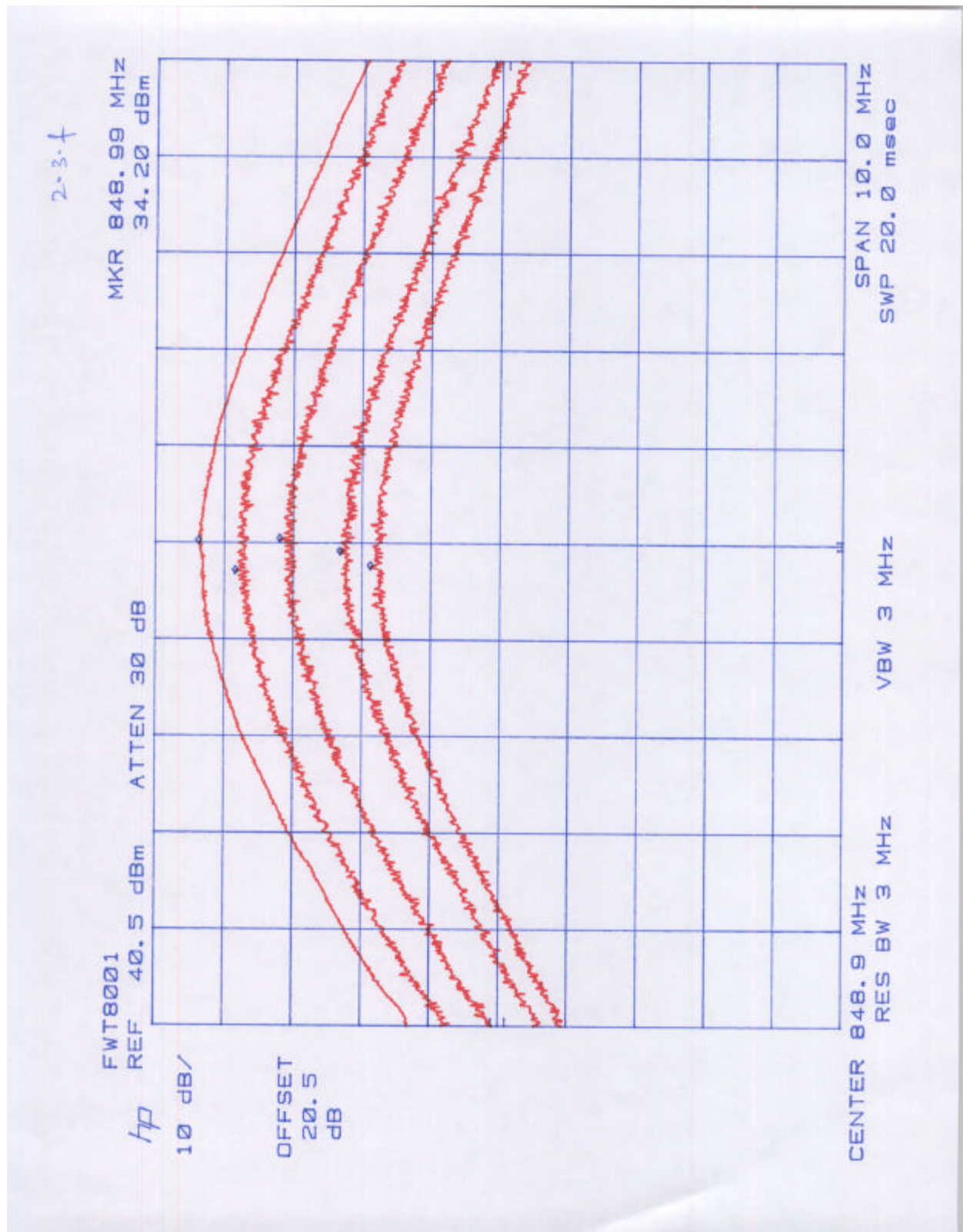












**3.0 Radiated Power**

## FCC 22.913

The Effective Radiated Power (ERP) of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

**3.1 Test Procedure**

The EUT was positioned on a non-conductive turntable, 0.8m above the ground plane on an open test site. The radiated emission at the fundamental frequency was measured at 3m distance with a test antenna and spectrum analyzer. During the measurement, the resolution and video bandwidths of the spectrum analyzer were set to 100 kHz (for frequencies below 1 GHz) and 1 MHz (for frequencies above 1 GHz).

Worst case emission was recorded with the rotation of the turntable and the raising and lowering of the test antenna. The spectrum analyzer reading was recorded and the field strength ( $E_1$  in dBuV/m) was calculated.

ERP was measured using a substitution method. The EUT was replaced by half-wave dipole connected to a signal generator. The spectrum analyzer reading was recorded and the field strength ( $E_2$  in dBuV/m) was calculated.

ERP was calculated as follows:

$$ERP = E_1 - E_2 + P_g$$

where  $E_1$  &  $E_2$  are field strength in dBuV/m when measured from EUT & generator accordingly;  $P_g$  is the generator output in dBm

**3.2 Test Equipment**

Hewlett Packard HP8566B Spectrum Analyzer

EMCO 3148 Log Periodic Antenna

CDI Robert's Antenna

Rohde & Schwarz SMH 44 signal generator

**3.3 Test Results**

|               |                                    |
|---------------|------------------------------------|
| <b>Passes</b> | Refer to the attached data sheets. |
|---------------|------------------------------------|

Field Strength of Fundamental

| Frequency<br>MHz | Antenna<br>Polarity | Detector | SA Reading<br>dB( $\mu$ V) | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Field<br>Strength<br>dB( $\mu$ V/m) |
|------------------|---------------------|----------|----------------------------|------------------------------|---------------------|-------------------------------------|
| <b>AMPS Mode</b> |                     |          |                            |                              |                     |                                     |
| 824.04           | V                   | Peak     | 98.8                       | 23.0                         | 6.0                 | 127.8                               |
| 836.55           | V                   | Peak     | 96.5                       | 23.3                         | 6.0                 | 125.8                               |
| 848.97           | V                   | Peak     | 96.7                       | 23.3                         | 6.0                 | 126.0                               |
| <b>TDMA Mode</b> |                     |          |                            |                              |                     |                                     |
| 824.04           | V                   | Peak     | 107.6                      | 23.0                         | 6.0                 | 136.6                               |
| 836.55           | V                   | Peak     | 106.6                      | 23.3                         | 6.0                 | 135.9                               |
| 848.97           | V                   | Peak     | 105.5                      | 23.3                         | 6.0                 | 135.0                               |

Radiated Power (Substitution Method)

| Frequency<br>MHz | Antenna<br>Polariz. | Field Strength<br>(EUT)<br>dB $\mu$ V/m | Field Strength<br>(Sig. Gen. +Tuned Dipole)<br>dB $\mu$ V/m | Signal Generator<br>Output<br>dBm | ERP<br>dBm |
|------------------|---------------------|-----------------------------------------|-------------------------------------------------------------|-----------------------------------|------------|
| <b>AMPS Mode</b> |                     |                                         |                                                             |                                   |            |
| 824.04           | V                   | 127.8                                   | 111.4                                                       | 10.0                              | 26.4       |
| 836.55           | V                   | 125.8                                   | 111.3                                                       | 10.0                              | 24.5       |
| 848.97           | V                   | 126.0                                   | 111.2                                                       | 10.0                              | 24.8       |
| <b>TDMA Mode</b> |                     |                                         |                                                             |                                   |            |
| 824.04           | V                   | 136.6                                   | 111.4                                                       | 10.0                              | 35.2       |
| 836.55           | V                   | 135.9                                   | 111.3                                                       | 10.0                              | 34.6       |
| 848.97           | V                   | 135.0                                   | 111.2                                                       | 10.0                              | 33.8       |

#### **4.0 Modulation Deviation Limiting**

FCC 2.1047, 22.915(b)(c)

##### **4.1 Test Procedure**

The RF output of the transceiver was connected to the input of a FM deviation meter through sufficient attenuation so as not to overload the meter or distort the readings. An audio signal generator with a variable attenuator on the output was coupled into the external microphone jack of the transceiver, or alternatively, the microphone element was removed and the generator output was connected to the microphone wires by clip leads.

At three different modulating frequencies, the output level of the audio generator was varied and the FM deviation level was recorded (Table 4.1a).

In addition, the audio signal was adjusted to obtain 8 kHz deviation at 1 kHz modulation frequency. Then the input signal was increased in 1 step by 20 dB and the peak deviation and steady state deviation were recorded. This test was performed at modulation frequencies from 300 Hz to 3 kHz.

##### **4.2 Test Equipment**

Marconi 2955A Radio Communication Test Set  
Leader LFG-1300S Function Generator  
LMV-182 AC Millivoltmeter

##### **4.3 Test Results**

The deviation is not to exceed 12 kHz. The EUT passed the test. See test data in table 4.1a.

Table 4.1a

| Output Level<br>(mV) | Modulation Deviation Limiting                         |         |        |
|----------------------|-------------------------------------------------------|---------|--------|
|                      | FM Deviation in kHz at Indicated Modulating Frequency |         |        |
|                      | 3000 Hz                                               | 1000 Hz | 300 Hz |
| 10.0                 | 3.18                                                  | 3.9     | 0.79   |
| 15.0                 | 4.5                                                   | 5.68    | 1.02   |
| 20.0                 | 5.8                                                   | 7.3     | 1.22   |
| 30.0                 | 7.0                                                   | 9.5     | 1.70   |
| 40.0                 | 7.4                                                   | 10.4    | 2.6    |
| 60.0                 | 7.6                                                   | 11.1    | 3.7    |
| 70.0                 | 7.7                                                   | 00.3    | 4.3    |
| 80.0                 | 7.8                                                   | 11.4    | 4.8    |
| 90.0                 | 7.9                                                   | 11.4    | 5.4    |
| 100.0                | 7.9                                                   | 11.5    | 5.8    |
| 110.0                | 7.3                                                   | 11.5    | 6.2    |
| 150.0                | 7.3                                                   | 11.5    | 7.2    |
| 160.0                | 7.3                                                   | 11.5    | 7.3    |
| 170.0                | 7.3                                                   | 11.5    | 7.5    |
| 180.0                | 7.3                                                   | 11.5    | 7.6    |
| 190.0                | 7.3                                                   | 11.5    | 7.7    |
| 200                  | 7.3                                                   | 11.4    | 7.8    |
| 250                  | 7.3                                                   | 10.8    | 7.8    |
| 300                  | 7.4                                                   | 10.2    | 10.9   |
| 400                  | 8.19                                                  | 9.5     | 9.8    |
| 450                  | 7.7                                                   | 9.5     | 10.8   |
| 500                  | 7.8                                                   | 9.5     | 10.6   |
| 600                  | 7.6                                                   | 9.4     | 10.6   |

Middle Channel: 836.52 MHz

Table 4.1b

| Frequency Deviation |                      |                   |                           |
|---------------------|----------------------|-------------------|---------------------------|
| Frequency<br>kHz    | Initial<br>Deviation | Peak<br>Deviation | Steady State<br>Deviation |
| 0.3                 | 1.3                  | 10.5              | 10.2                      |
| 0.5                 | 2.1                  | 11.1              | 10.1                      |
| 0.7                 | 4.2                  | 9.3               | 9.1                       |
| 0.9                 | 7.4                  | 10.9              | 10.6                      |
| 1.0                 | 8.0                  | 11.3              | 8.0                       |
| 1.2                 | 9.5                  | 13.0              | 12.7                      |
| 1.4                 | 9.7                  | 12.3              | 12.1                      |
| 1.6                 | 9.3                  | 11.7              | 11.0                      |
| 1.8                 | 8.8                  | 10.9              | 10.7                      |
| 2.0                 | 8.4                  | 10.4              | 10.1                      |
| 2.4                 | 6.3                  | 8.0               | 7.9                       |
| 2.8                 | 6.2                  | 7.8               | 7.7                       |
| 3.0                 | 6.0                  | 7.3               | 7.2                       |

Test Conditions:

$V_{\text{inp}} = 9.6 \text{ mV}$

Deviation = 8 kHz at 1 kHz modulation frequency

Middle Channel = 836.52 MHz

**5.0 Audio Filter Characteristics**

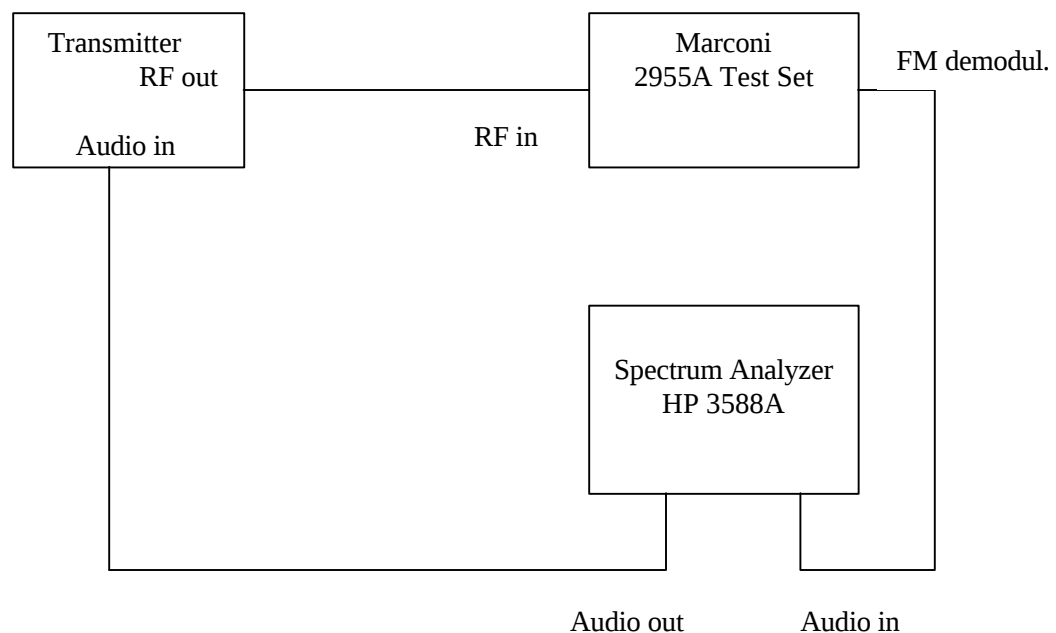
FCC 22.915(d)

For mobile stations, these signals must be attenuated, relative to the level at 1 kHz, as follows:

- (i) In the frequency ranges of 3.0 to 5.9 kHz and 6.1 to 15.0 kHz, signals must be attenuated by at least 40 log (f/3) dB, where f is the frequency of the signal in kHz.
- (ii) In the frequency range of 5.9 to 6.1 kHz, signals must be attenuated at least 35 dB.
- (iii) In the frequency range above 15 kHz, signals must be attenuated at least 28 dB.

**5.1 Test Procedure**

The test was performed according to the block diagram shown below.



On that block diagram, the HP 3885A spectrum analyzer having the tracing generator, and the Marconi 2955A Radio Communication Test Set having an output of a FM demodulator, are used. After the calibration was made (the -20 dBm reading of the spectrum analyzer corresponds to the 9 kHz deviation) the spectrum analyzer was set to scan the frequency from 300 Hz to 30 kHz, with the same audio input level as described above, and with compressor OFF and expander OFF.

The audio filter response was plotted directly from the spectrum analyzer (Refer to Plots # 5.1.a, 5.1.b).

Using the level measured at 1 kHz as a reference (0 dB), the audio filter response was calculated (See Table 5.1).

Table 5.1

| Audio Filter Characteristics |                       |             |
|------------------------------|-----------------------|-------------|
| Modulation Frequency<br>kHz  | Relative Level<br>dBm | Attenuation |
| 0.3                          | -38.95                | 17.8        |
| 0.4                          | -36.12                | 14.9        |
| 0.5                          | -32.47                | 11.2        |
| 0.6                          | -30.27                | 6.2         |
| 0.7                          | -27.4                 | 5.2         |
| 0.8                          | -24.94                | 3.7         |
| 0.9                          | -23.53                | 2.3         |
| 1.0                          | -21.21                | 0           |
| 1.2                          | -19.59                | -1.7        |
| 1.4                          | -19.26                | -2.0        |
| 1.6                          | -19.45                | -1.8        |
| 1.8                          | -20.08                | -1.2        |
| 2.0                          | -20.68                | -0.6        |
| 2.2                          | -21.15                | -0.1        |
| 2.5                          | -21.89                | 0.6         |
| 3.0                          | -23.34                | 1.1         |
| 3.5                          | -28.51                | 7.3         |
| 4.0                          | -59.23                | 38.5        |
| 4.5                          | -59.98                | 38.7        |
| 5.0                          | -60.31                | 39.4        |
| 5.5                          | -60.77                | 39.5        |
| 5.9                          | -61.60                | 40.4        |
| 6.0                          | -61.20                | 40.2        |
| 6.1                          | -60.79                | 40.5        |
| 8.0                          | -63.50                | 42.3        |
| 10.0                         | -64.22                | 43.0        |
| 15.0                         | -69.98                | 48.7        |
| 20.0                         | -85.38                | 63.1        |
| 30.0                         | -94.98                | 72.7        |

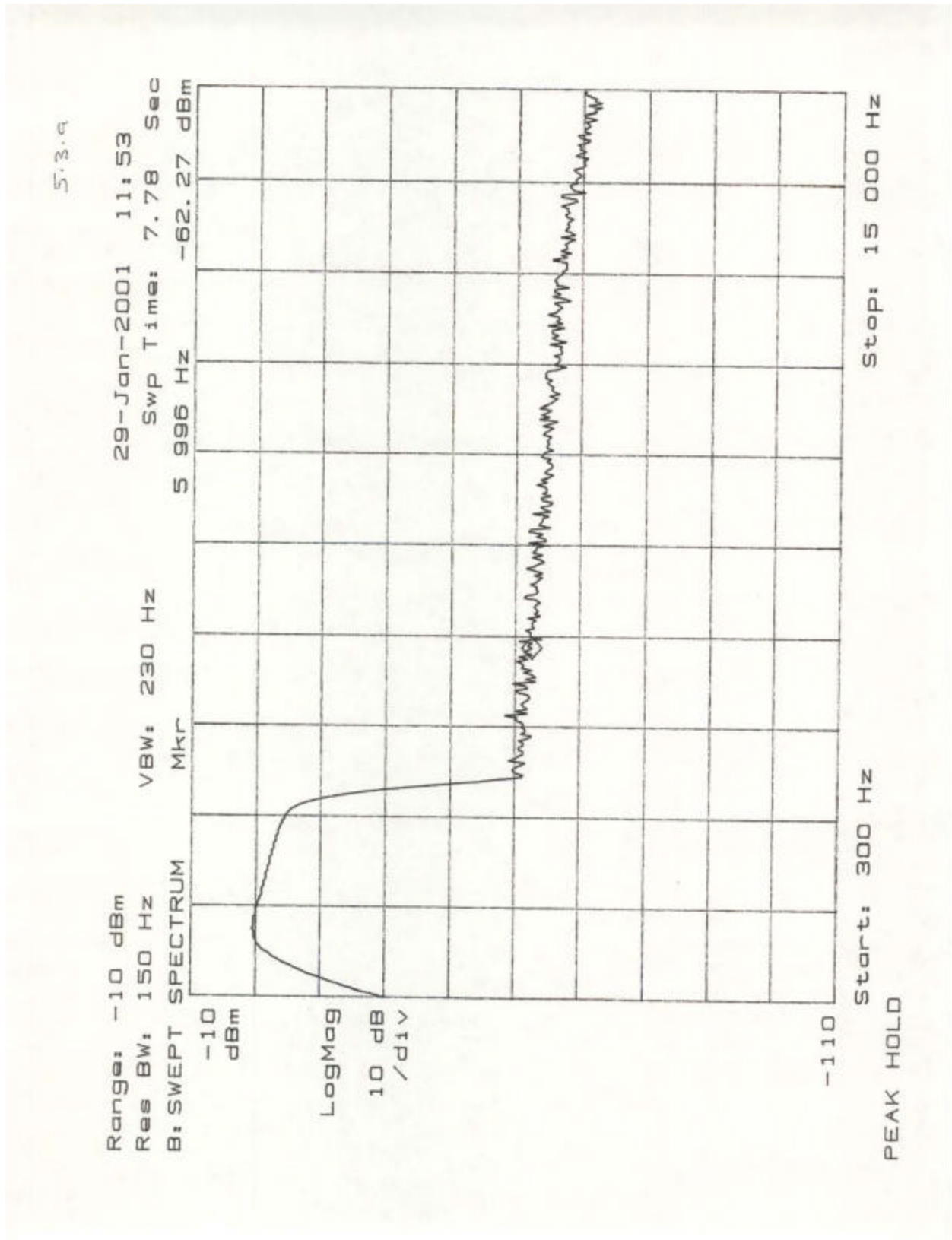
## 5.2 Test Equipment

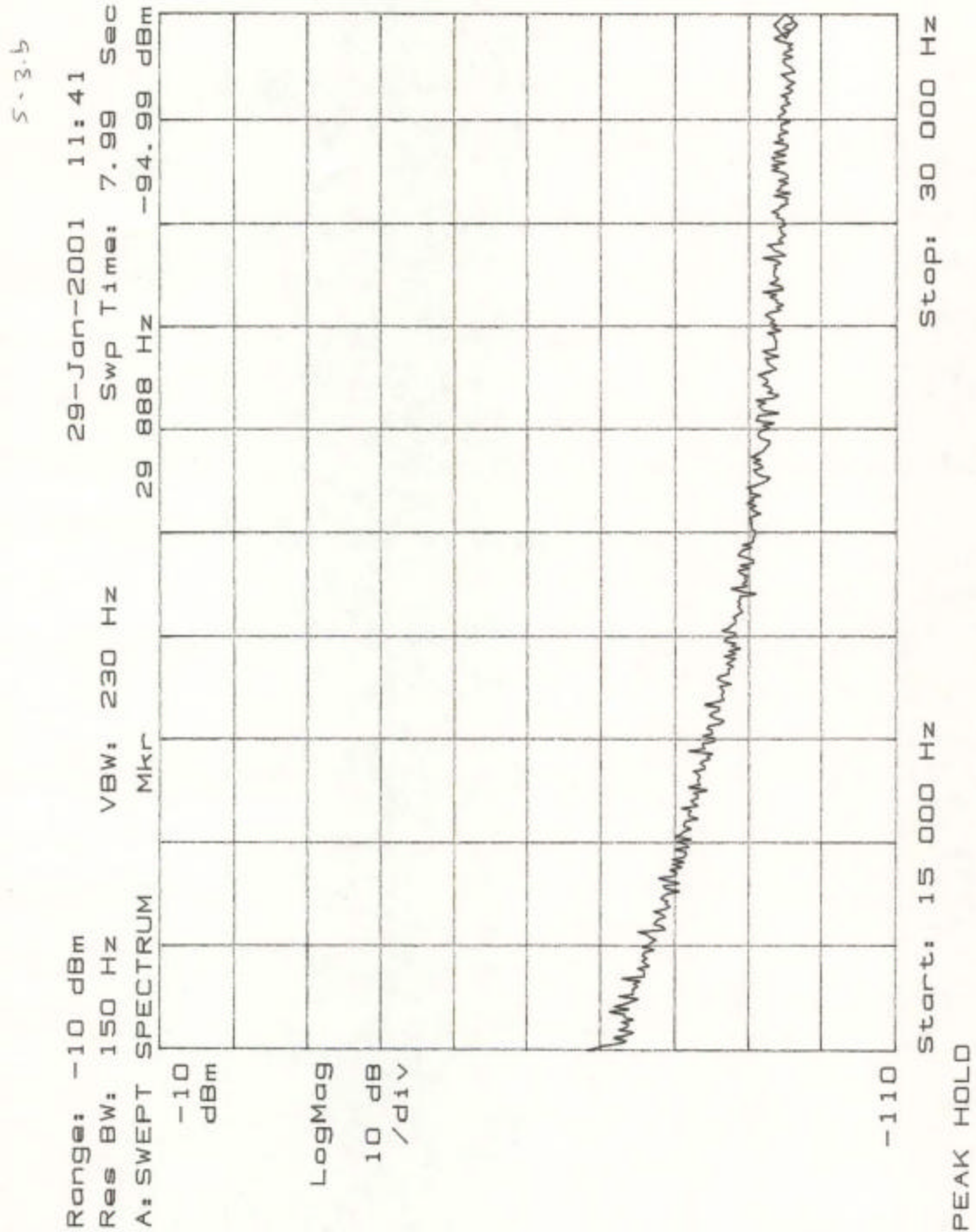
Marconi Instruments 2955A Radio Communications Test Set  
HP 3588A Spectrum Analyzer  
HP 7470A Plotter

5.3 Test Results

Passed, refer to the attached plots.

| Audio Filter Characteristics |                |
|------------------------------|----------------|
| Plot Number                  | Description    |
| 5.3.a                        | 300Hz to 15KHz |
| 5.3.b                        | 15KHz to 30KHz |





**6.0 Emission Limitations, Occupied Bandwidth**

FCC 2.1049, 22.917(b)(d)

For F3E/F3D emission mask uses with audio filter, the mean power of emissions must be attenuated below the mean power of the unmodulated carrier wave (P) as follows:

- (1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz: at least 26 dB;
- (2) On any frequency removed from the carrier frequency by more than 45 kHz, up to the first multiple of the carrier frequency: at least 60 dB or  $(43 + 10 \log P)$  dB, whichever is the lesser attenuation.

For F1D emission mask, the mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) as follows:

- (1) On any frequency removed from the carrier frequency by more than 20 kHz but no more than 45 kHz: at least 26 dB;
- (2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz: at least 45 dB;
- (2) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency: at least 60 dB or  $(43 + 10 \log P)$  dB, whichever is the lesser attenuation.

**6.1 Test Procedure**

The RF output of the transceiver was connected to the input of the spectrum analyzer through sufficient attenuation. The audio generator was connected to the audio input of the transceiver.

The spectrum with no modulation was recorded. The audio input signal was adjusted to obtain the frequency deviation equal 6 kHz at the audio frequency of maximum response which was determined measuring deviation versus frequency from 300 Hz to 3.5 kHz and was found 2.8 kHz. The audio input level was increased by 16 dB. The audio frequency was set to the frequency 2.5 kHz.

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band  $\pm 50$  kHz and  $\pm 100$  kHz from the carrier frequency. The same plots has been done for wideband emissions, SAT, ST, DTMF9, Voice, some of the combinations of these modulating signals and in TDMA mode.

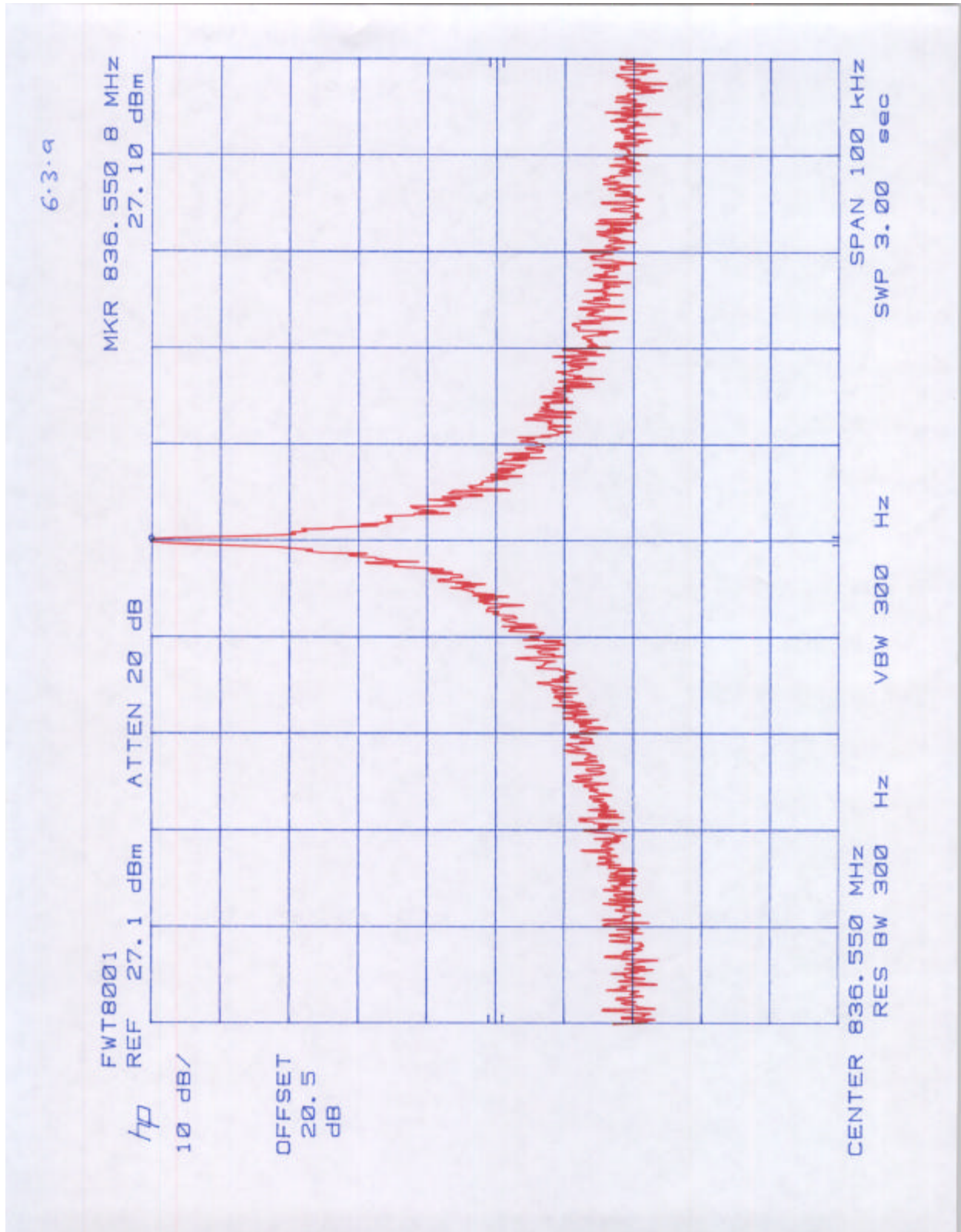
## 6.2 Test Equipment

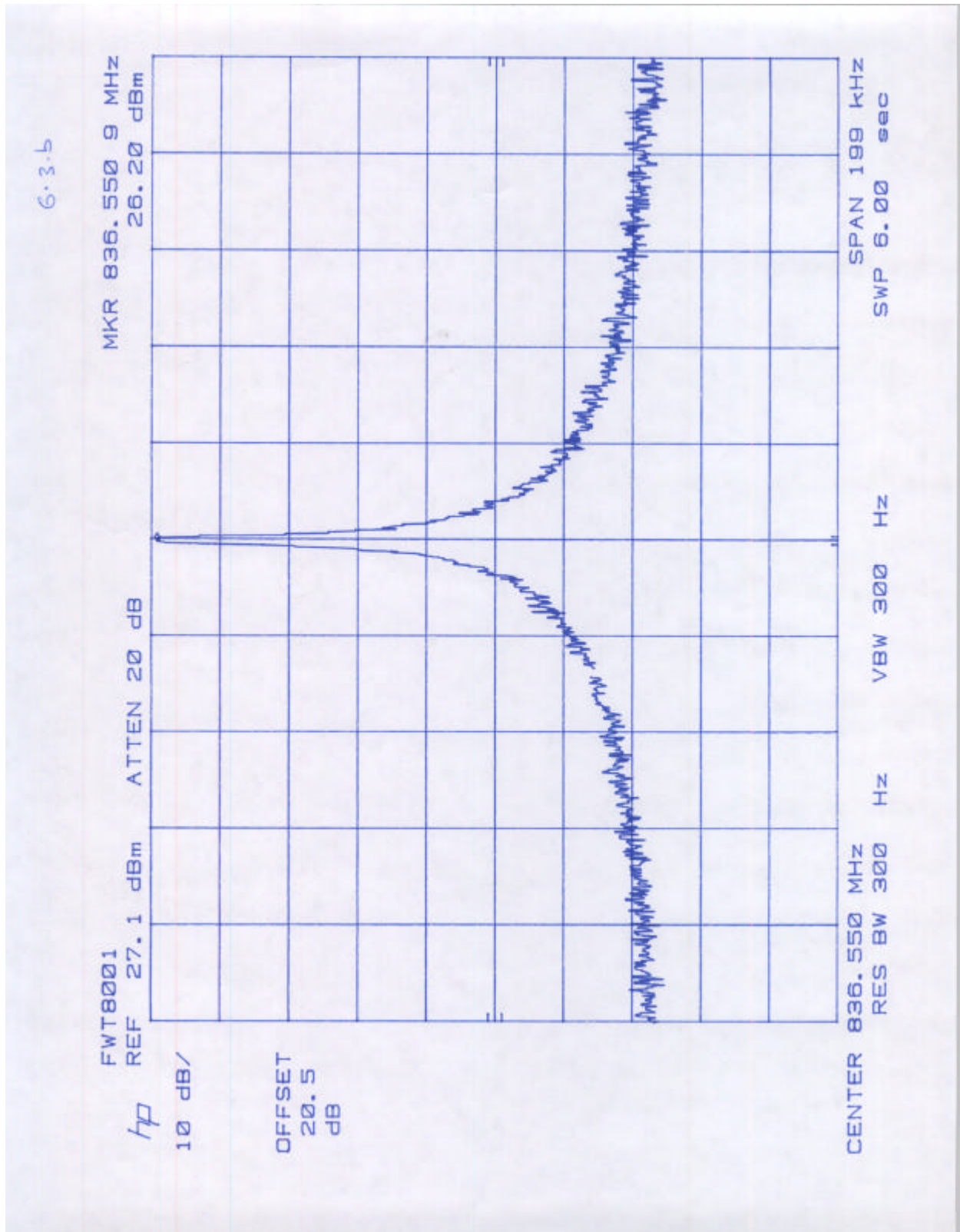
HP 8566B Spectrum Analyzer  
Leader LFG-1300S Function Generator  
Leader LMV-182 AC Millivoltmeter  
Marconi 2955A Radio Communication Test Set  
HP 7470A Plotter

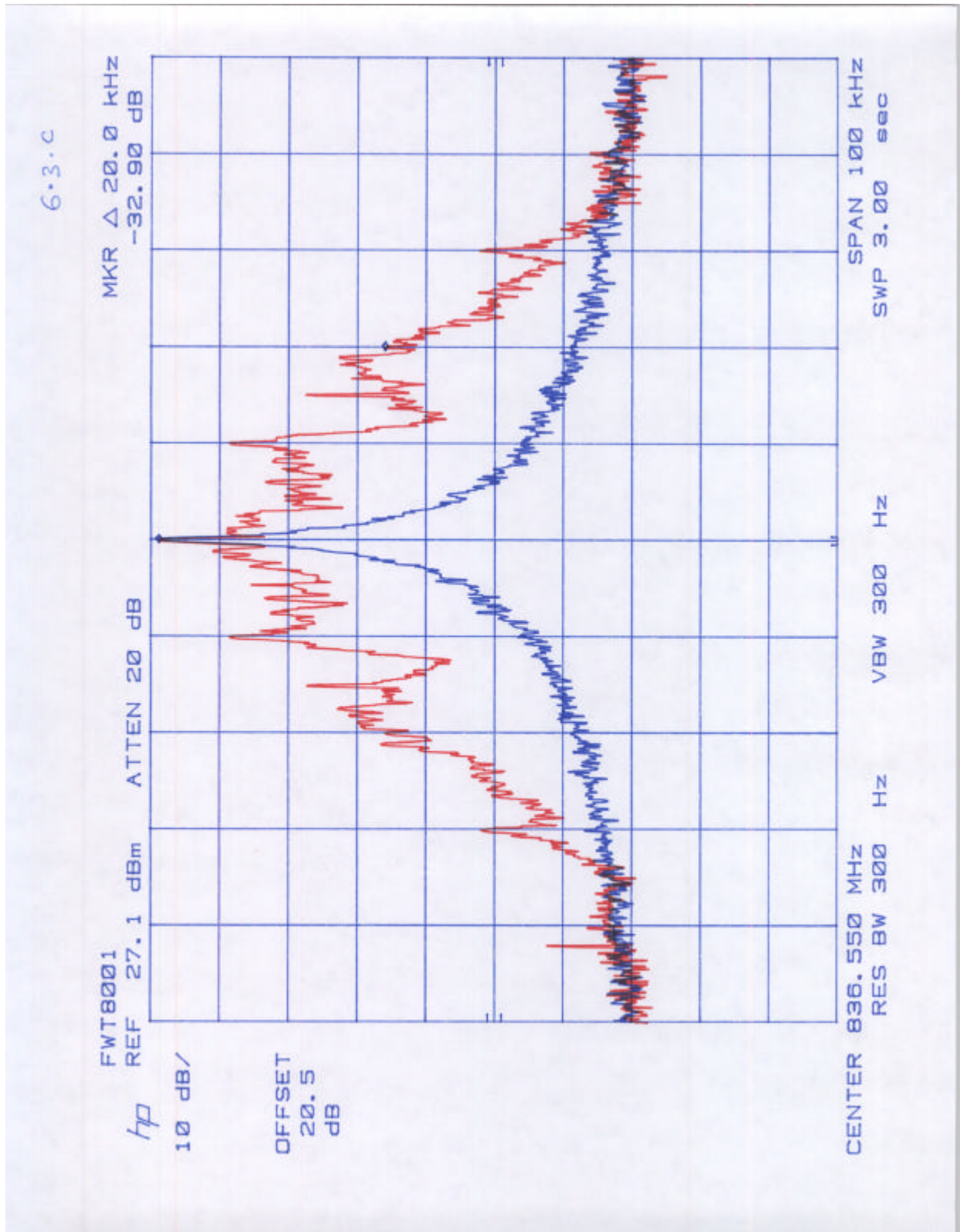
## 6.3 Test Results

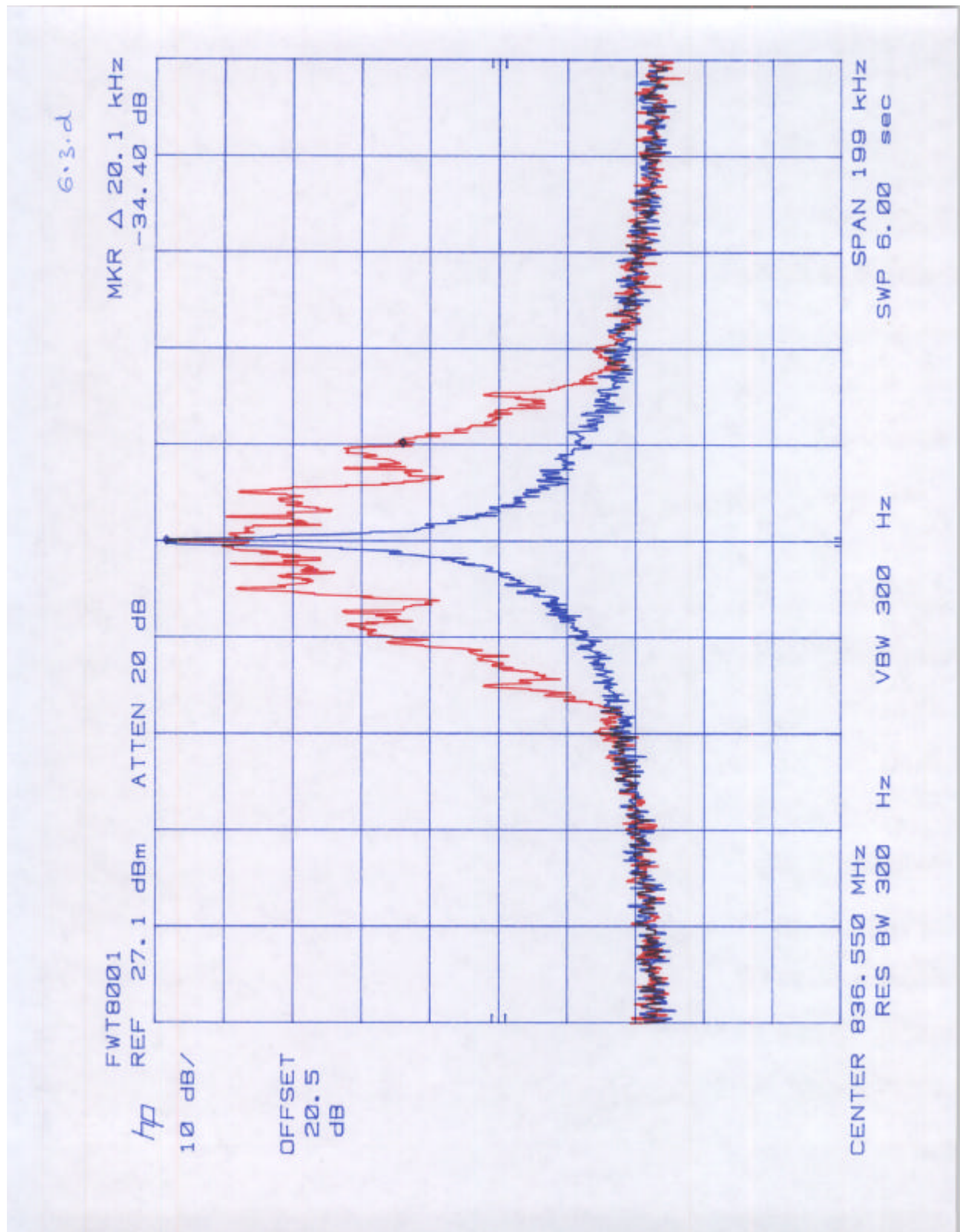
|               |                              |
|---------------|------------------------------|
| <b>Passes</b> | Refer to the attached plots. |
|---------------|------------------------------|

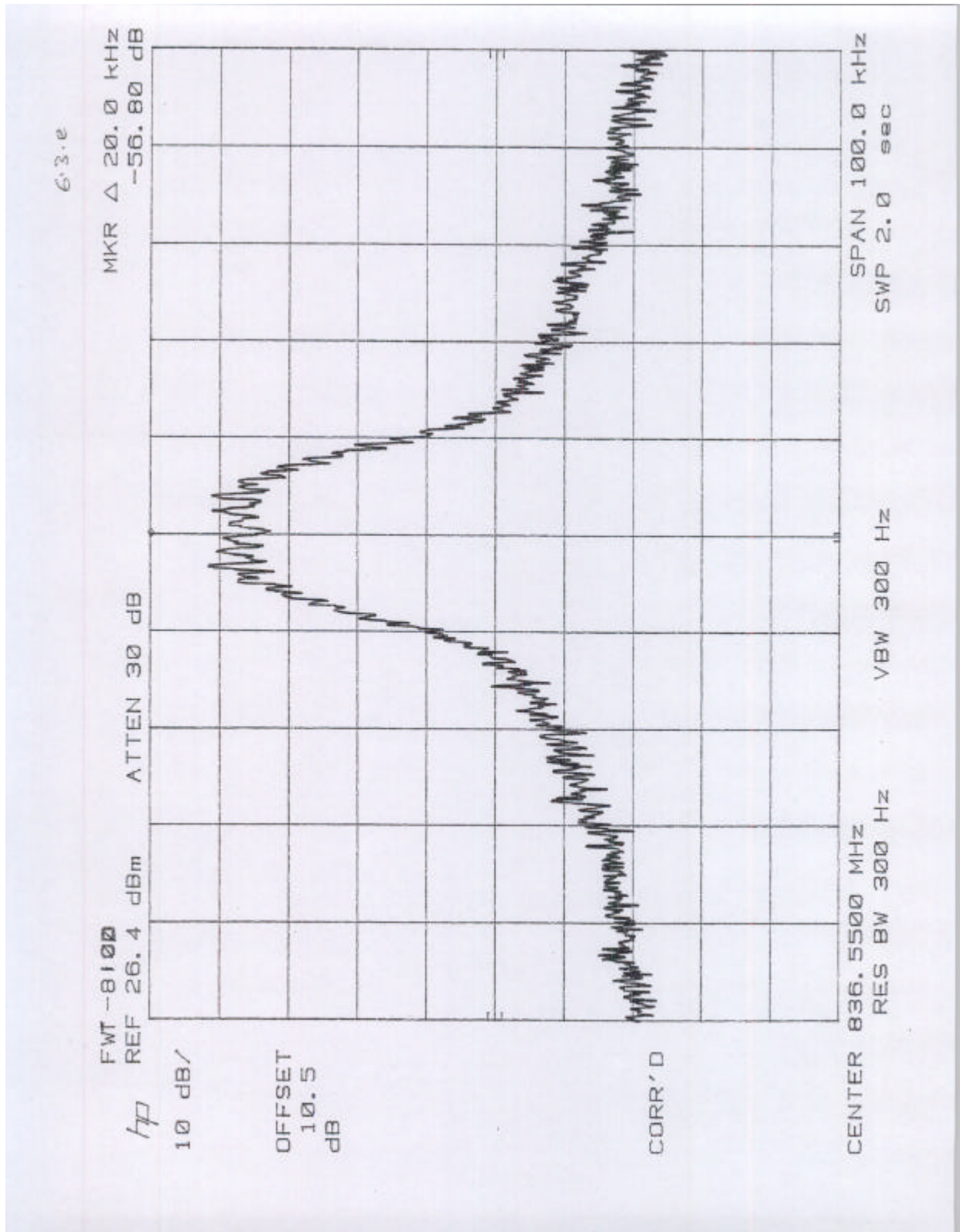
| Plot Number | Description                                    |
|-------------|------------------------------------------------|
| 6.3.a       | Carrier frequency, no modulation, scan 100 kHz |
| 6.3.b       | Carrier frequency, no modulation, scan 200 kHz |
| 6.3.c       | Wideband emissions (0, 1, 0, 1), scan 100 kHz  |
| 6.3.d       | Wideband emissions (0, 1, 0, 1), scan 200 kHz  |
| 6.3.e       | DTMF "9"                                       |
| 6.3.f       | SAT (6 kHz, 2 kHz deviation)                   |
| 6.3.g       | ST (10 kHz, 8 kHz deviation), scan 50 kHz      |
| 6.3.h       | ST (10 kHz, 8 kHz deviation ), scan 100 kHz    |
| 6.3.i       | ST & SAT (6 kHz & 10 kHz), scan 100 kHz        |
| 6.3.j       | DTMF & SAT, scan 100 kHz                       |
| 6.3.k       | Voice (2.5 kHz), scan 100 kHz                  |
| 6.3.l       | Voice (2.5 kHz) & SAT (6 kHz), scan 100 kHz    |
| 6.3.m       | Voice (2.5 kHz) & SAT (6 kHz), low power       |
| 6.3.n       | TDMA mode, scan 100 kHz                        |

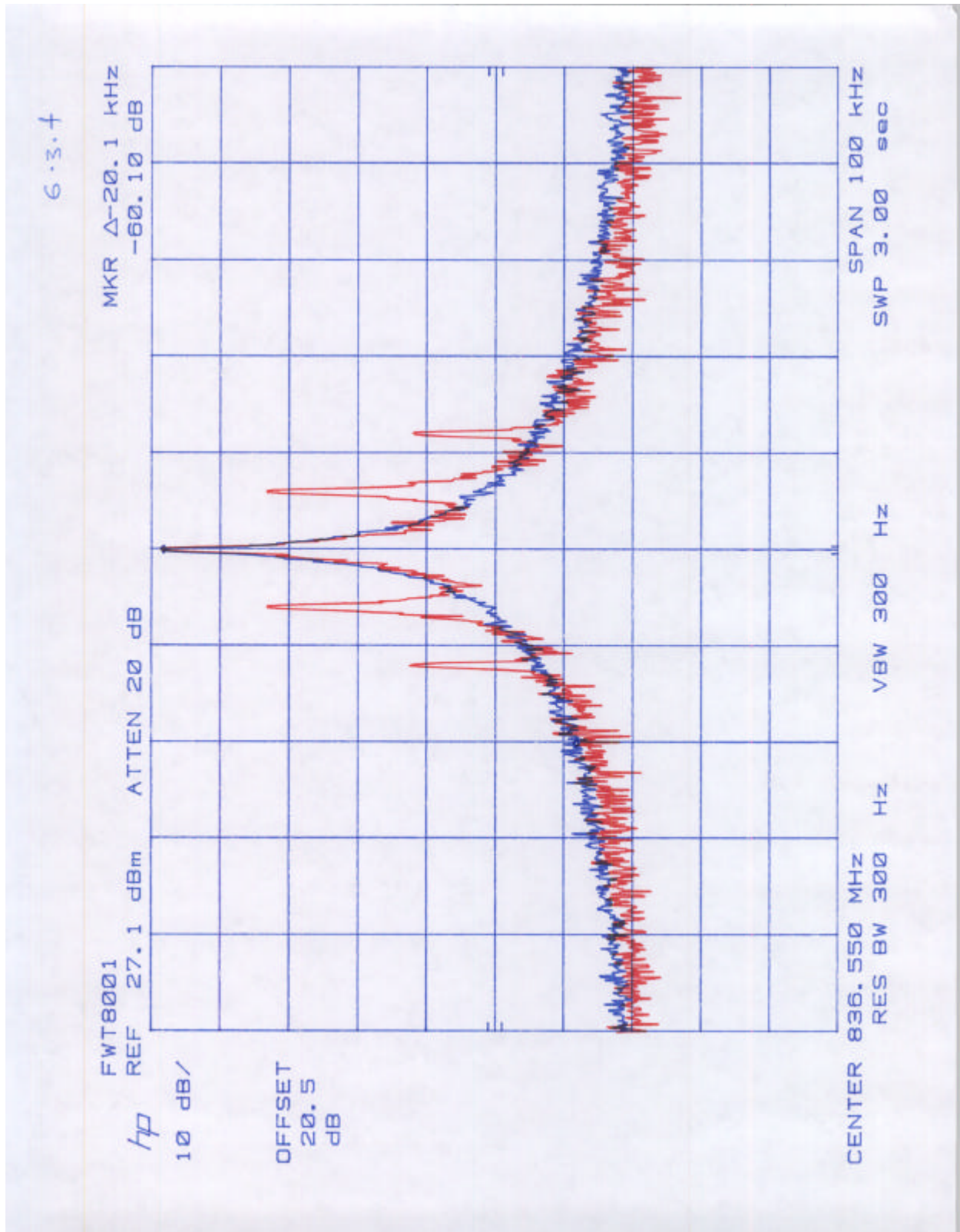


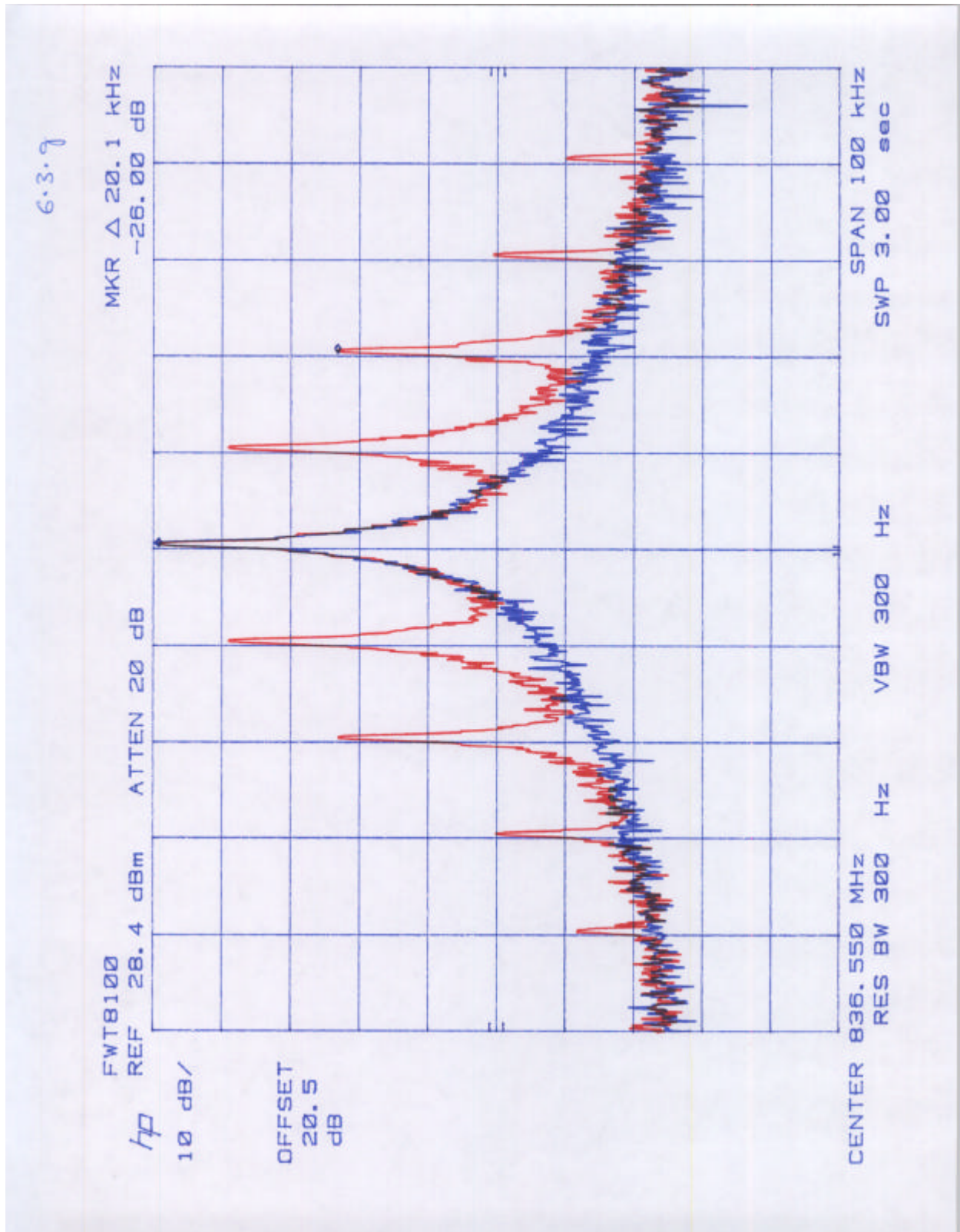


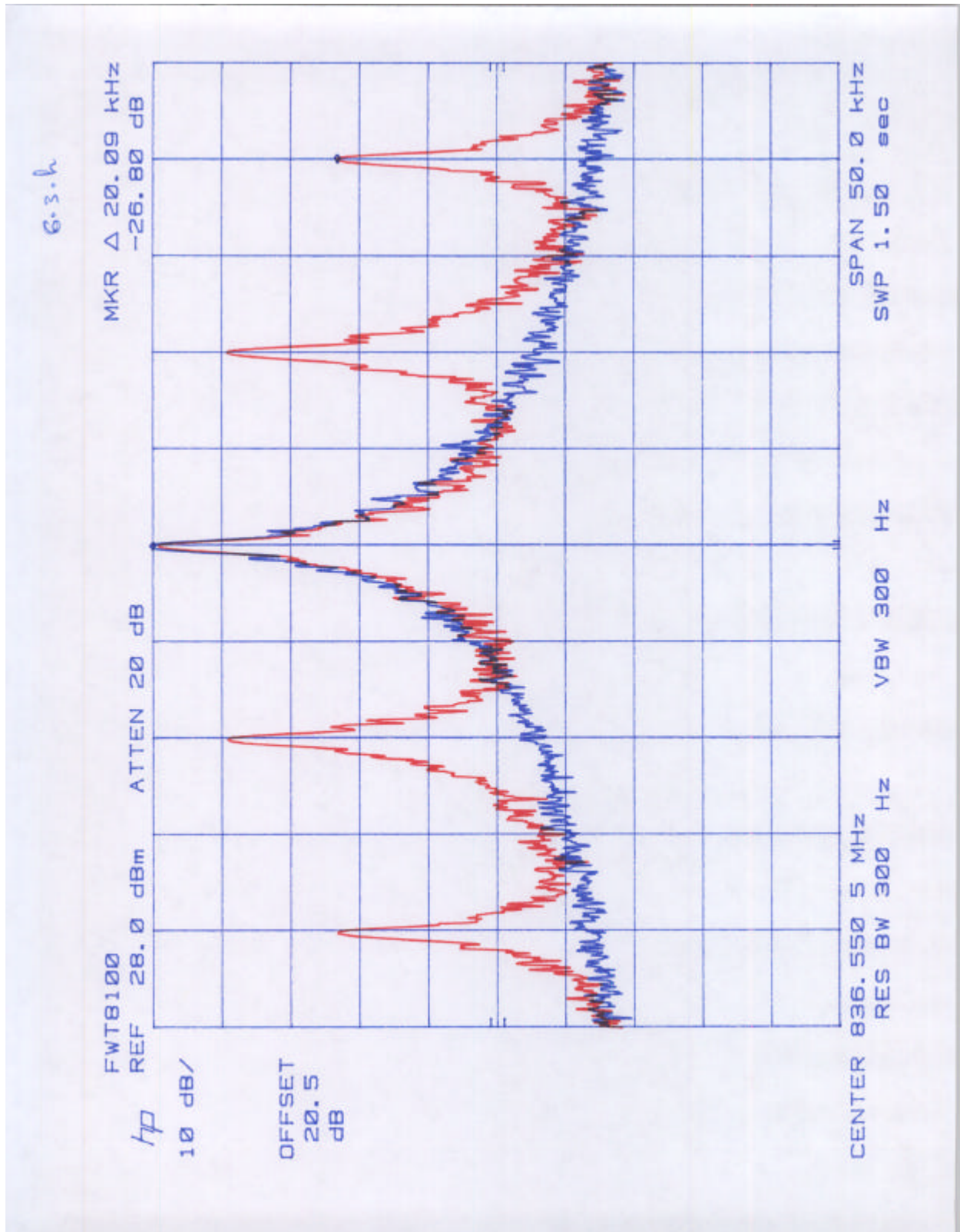


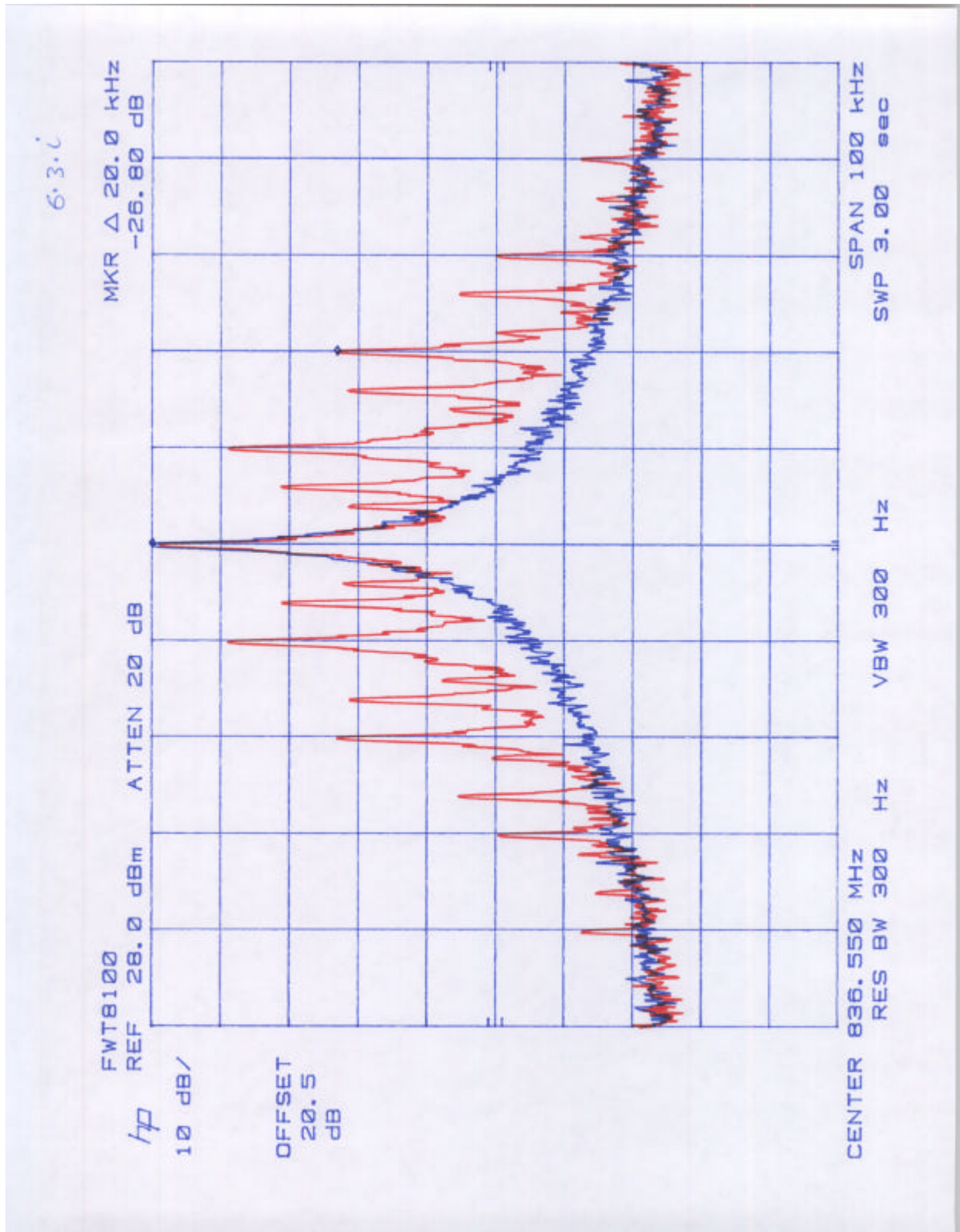


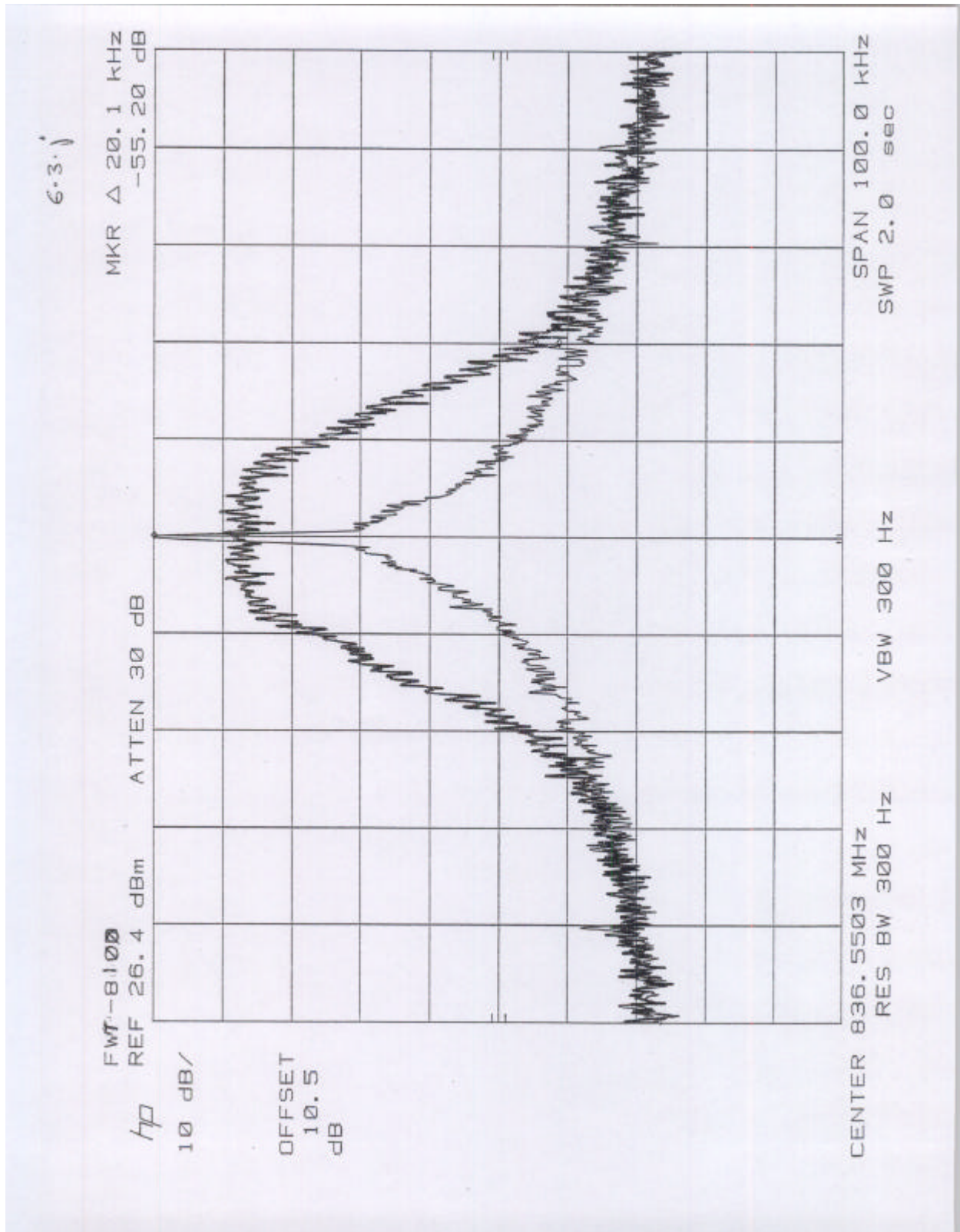


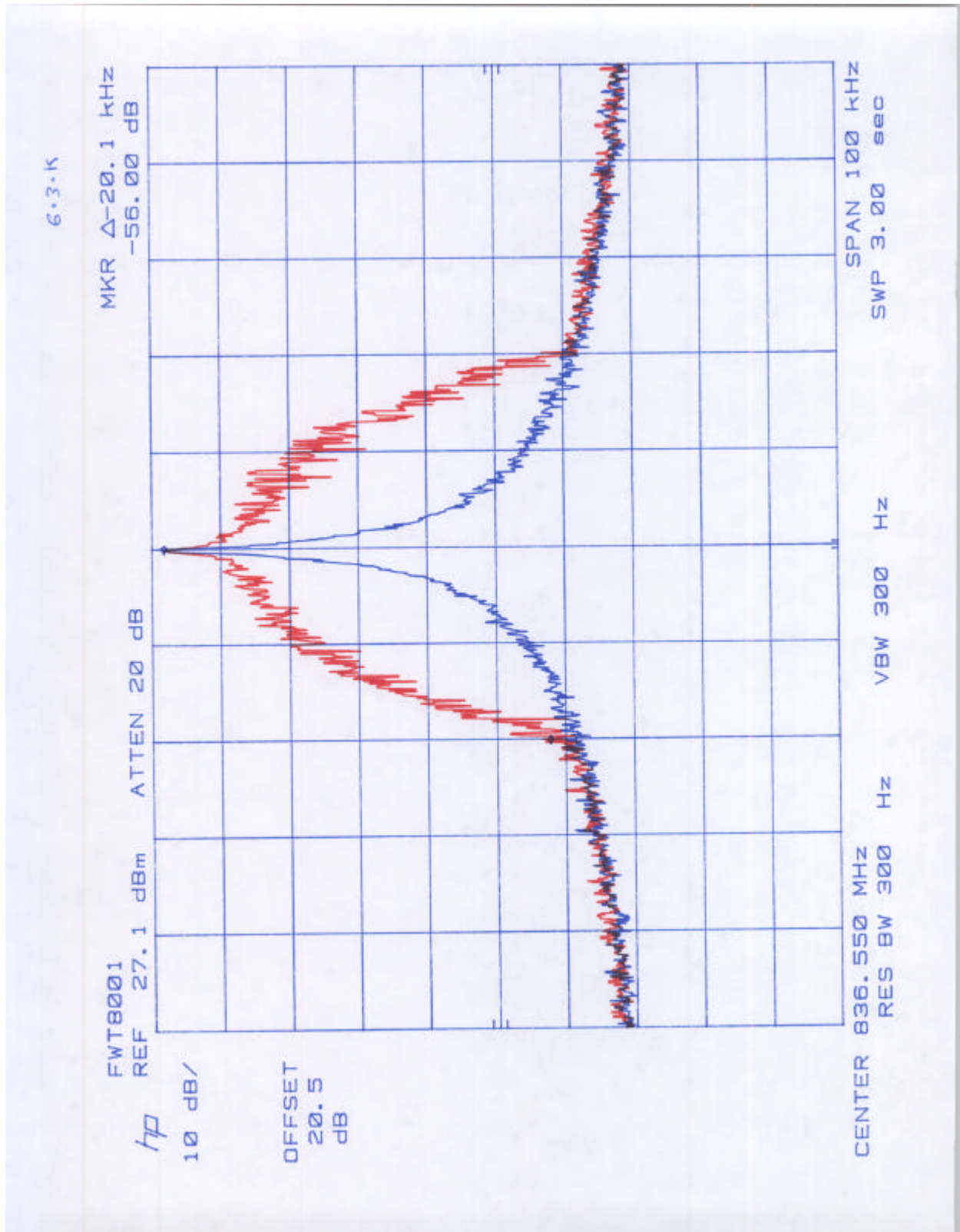


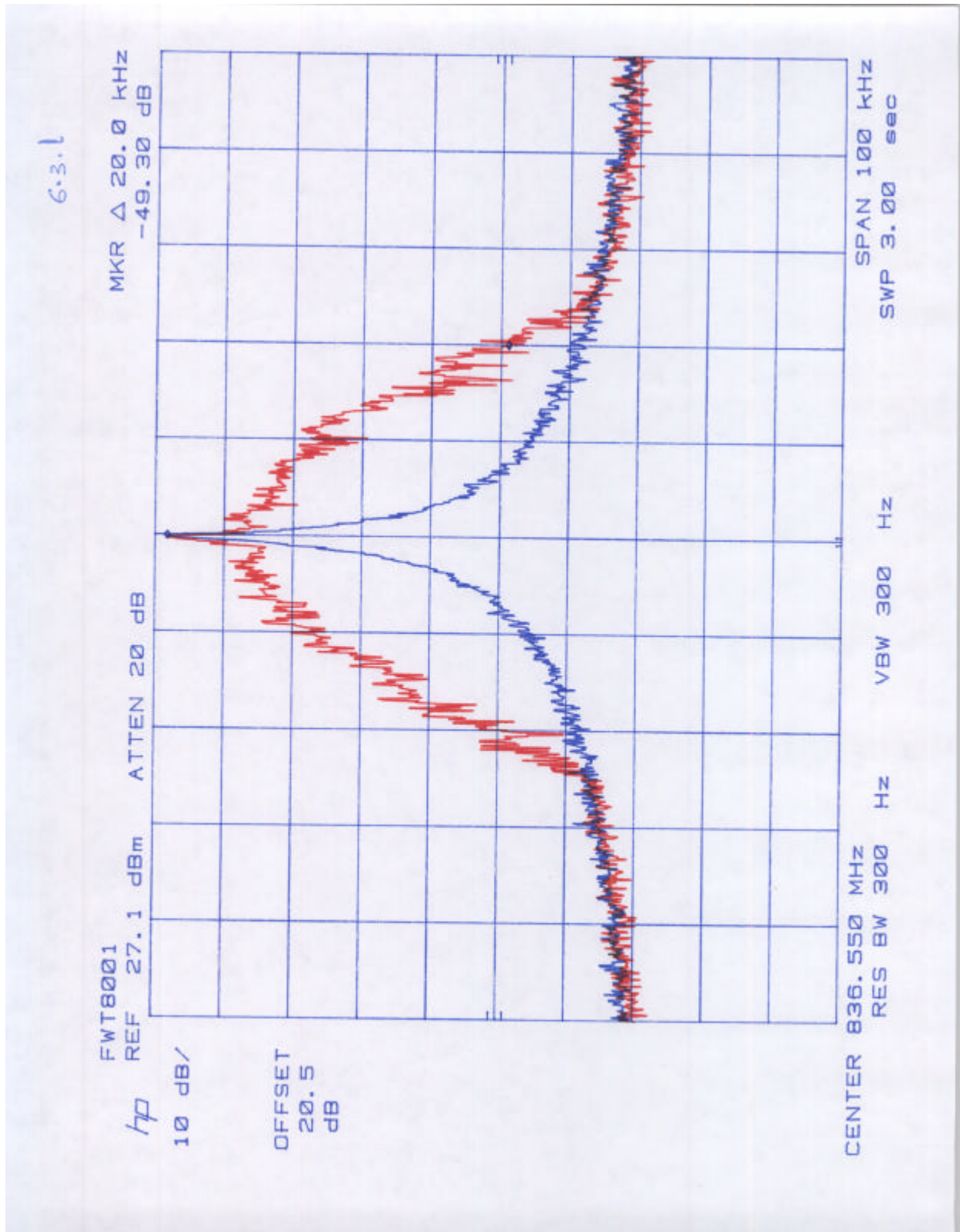


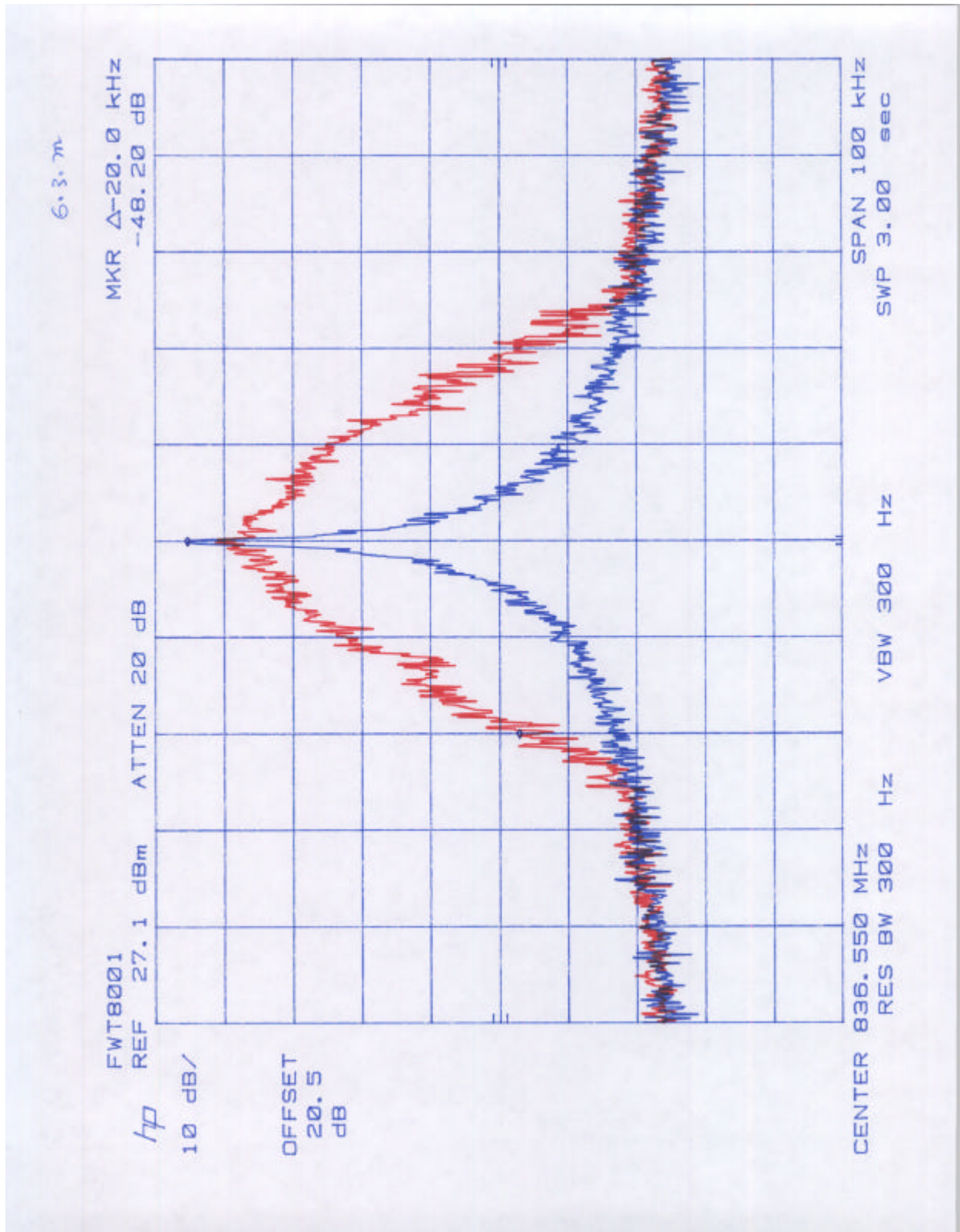


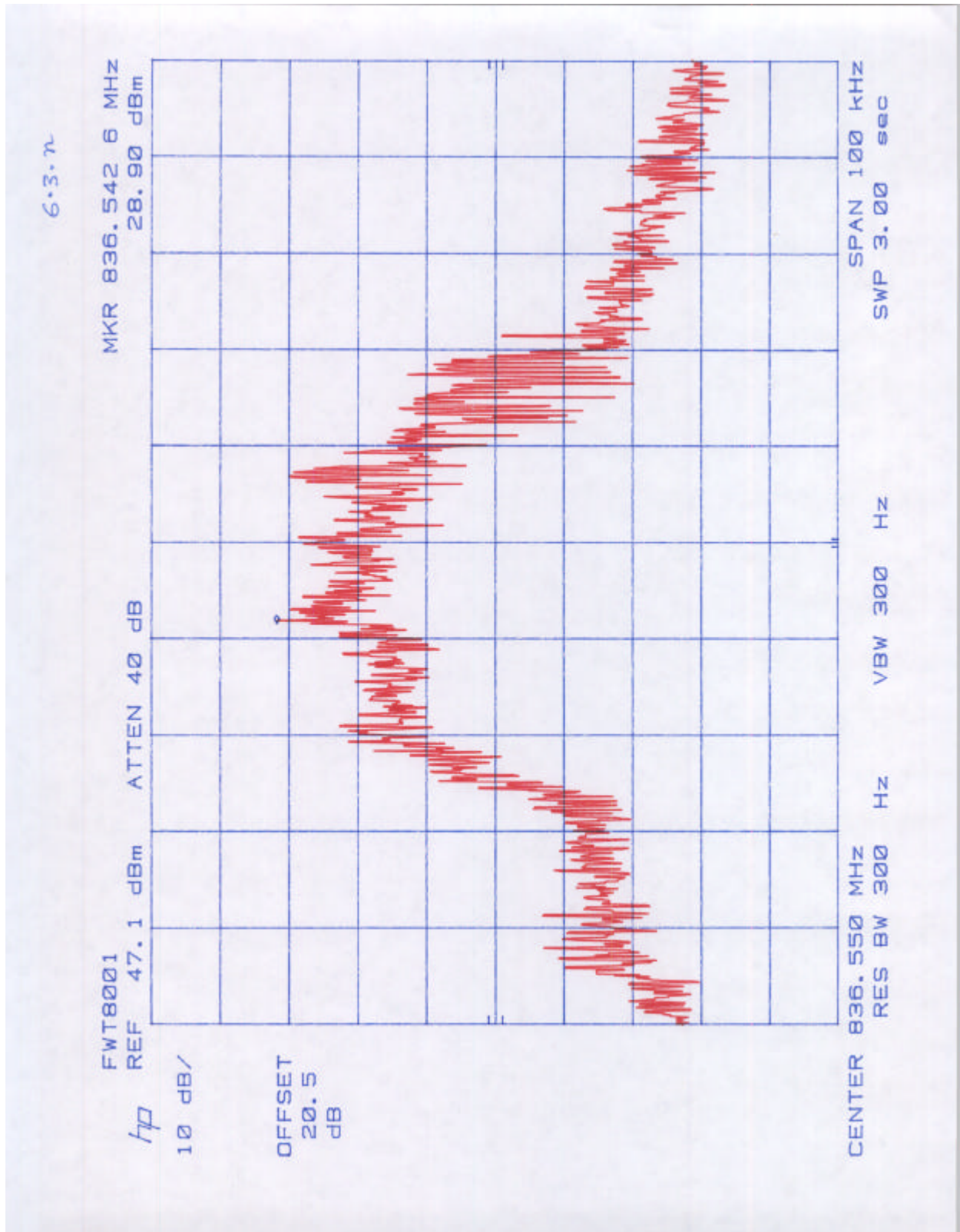












## **7.0 Out of Band Emissions at Antenna Terminals**

FCC 22.917(e), 22.917(f), 24.238(a), 24.238(a)

### Out of Band Emissions:

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency twice or more than twice the fundamental frequency by at least  $43 + 10 \log (P)$  in dB.

### Mobile Emissions in Base Frequency Range:

The mean power of any emissions appearing in the base station frequency range from cellular mobile transmitters operated must be attenuated to a level not to exceed -80 dBm at the transmit antenna connector.

## **7.1 Test Procedure**

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 30 kHz. The audio modulating signal was adjusted like it is described in Section 6.1 of this report. Sufficient scans were taken to show the out-of-band emissions if any up to 10th harmonic.

## **7.2 Test Equipment**

HP 8566B Spectrum Analyzer  
Leader LFG-1300S Function Generator  
Leader LMV-182 AC Millivoltmeter

### 7.3 Test Results

|               |                              |
|---------------|------------------------------|
| <b>Passed</b> | Refer to the attached plots. |
|---------------|------------------------------|

| AMPS Mode         |                                                     |
|-------------------|-----------------------------------------------------|
| Plot Number       | Description                                         |
| 7.3.1.a - 7.3.1.c | Low Channel AMPS                                    |
| 7.3.2.a - 7.3.2.c | Middle Channel AMPS                                 |
| 7.3.3.a - 7.3.3.c | High Channel AMPS                                   |
| 7.3.7             | Emissions in the receiver band, Low Channel AMPS    |
| 7.3.8             | Emissions in the receiver band, Middle Channel AMPS |
| 7.3.9             | Emissions in the receiver band , High Channel AMPS  |
| 7.3.4.a - 7.3.4.c | Low Channel TDMA                                    |
| 7.3.5.a - 7.3.5.c | Middle Channel TDMA                                 |
| 7.3.6.a - 7.3.6.c | High Channel TDMA                                   |
| 7.3.10            | Emissions in the receiver band, Low Channel TDMA    |
| 7.3.11            | Emissions in the receiver band, Middle Channel TDMA |
| 7.3.12            | Emissions in the receiver band , High Channel TDMA  |

