

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

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Reviewer:	EMC Manager David Chernomordik	Review Date:

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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 22.917(b)(d)	Emission Limitation, Occupied Bandwidth	Passed	15
2.1051, 22.917(e) 22.917(f)	Out of Band Emissions at Antenna Terminals 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 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 type="checkbox"/> AMPS <input checked="" type="checkbox"/> TDMA
Type(s) of Emission	40K0F8W, 40K0F1D, 30K0G7D
Allowed Deviation	12± 10% (AMPS mode)
Range of RF Output	27.8 dBm 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**

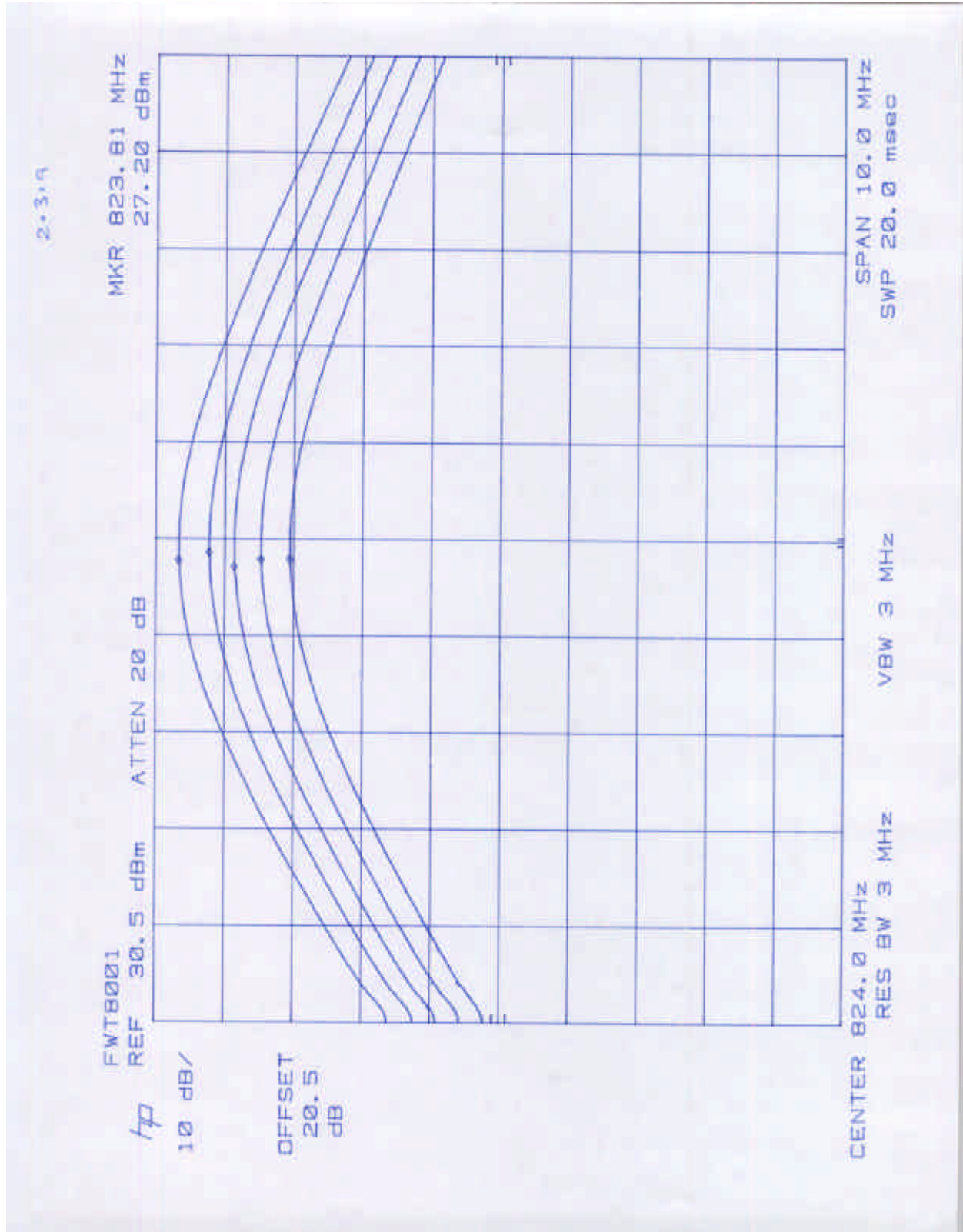
Frequency (MHz)	Measured Power (dBm)
824	26.9
836.5	26.5
849	24.4

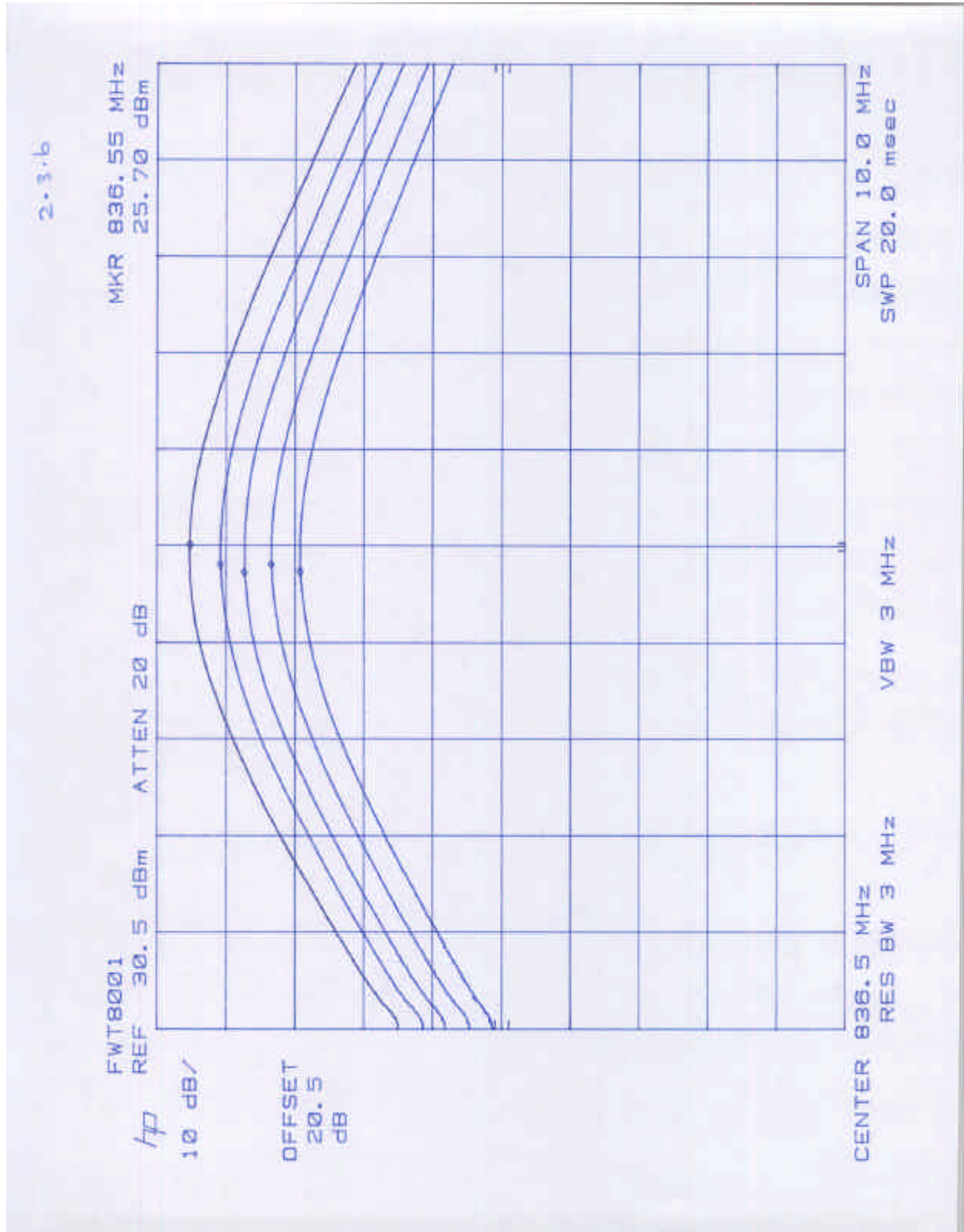
TDMA Mode

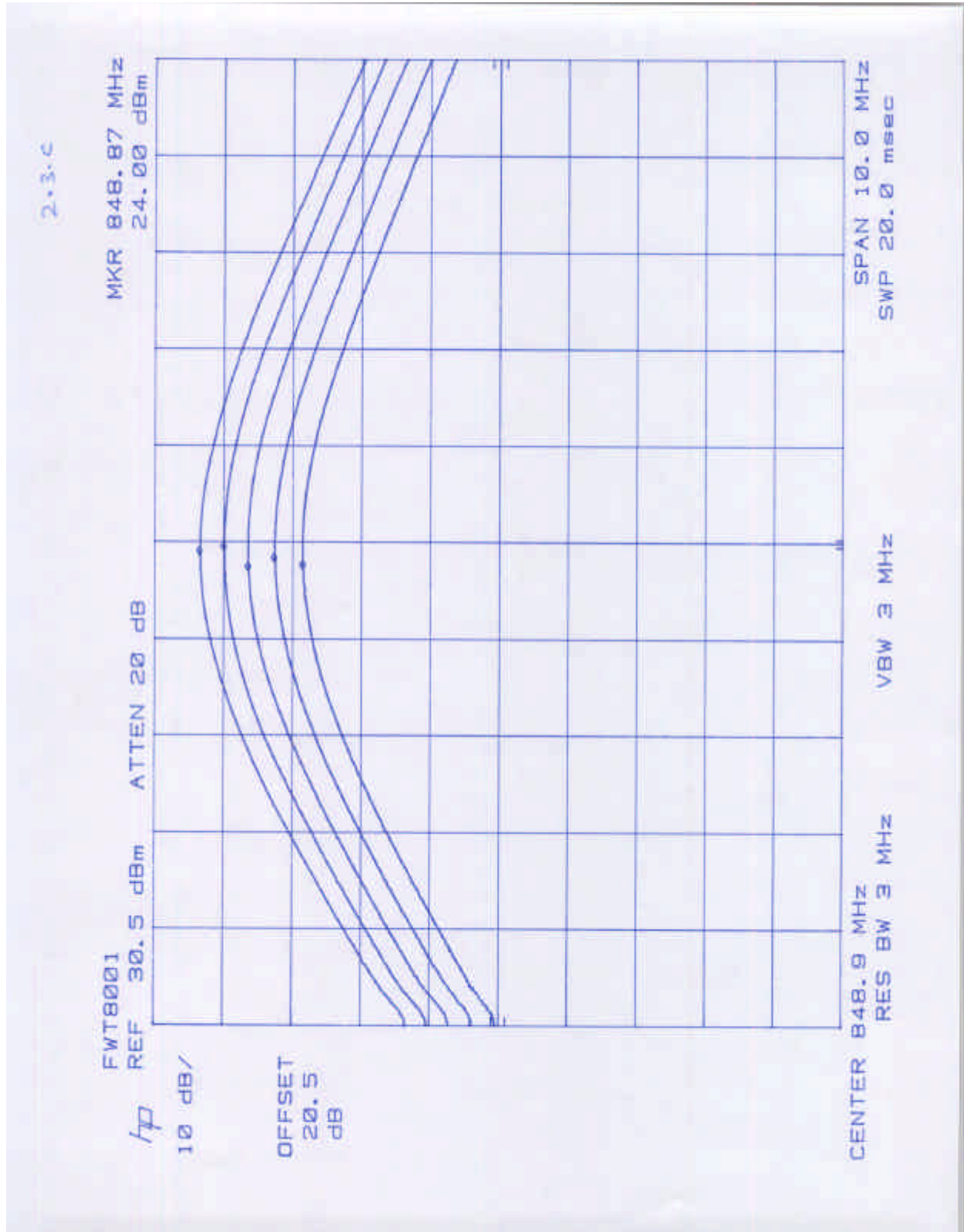
Frequency (MHz)	Measured Power (dBm)
824	35.4
836.5	34.7
849	34.1

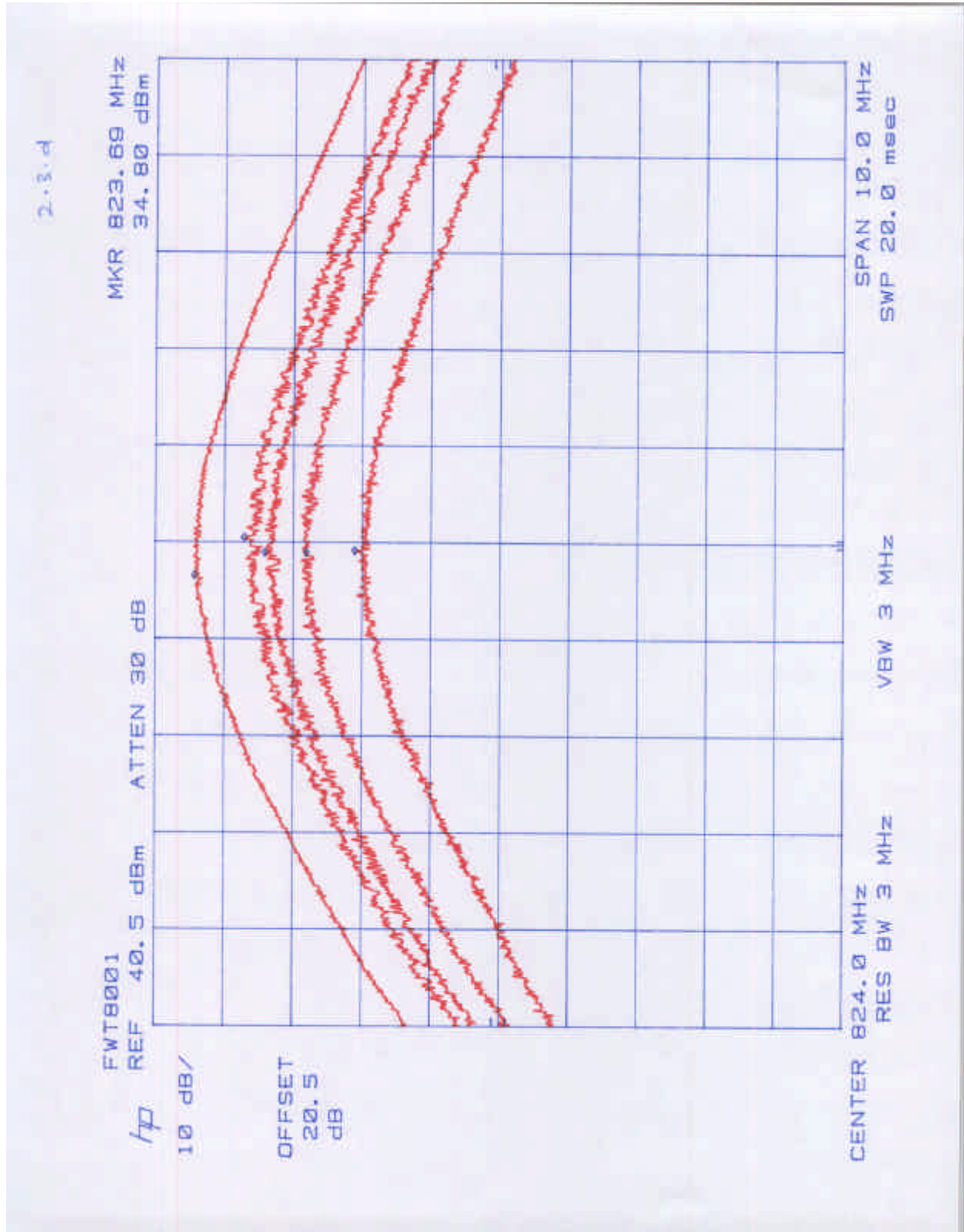
For more details, refer to the attached plots:

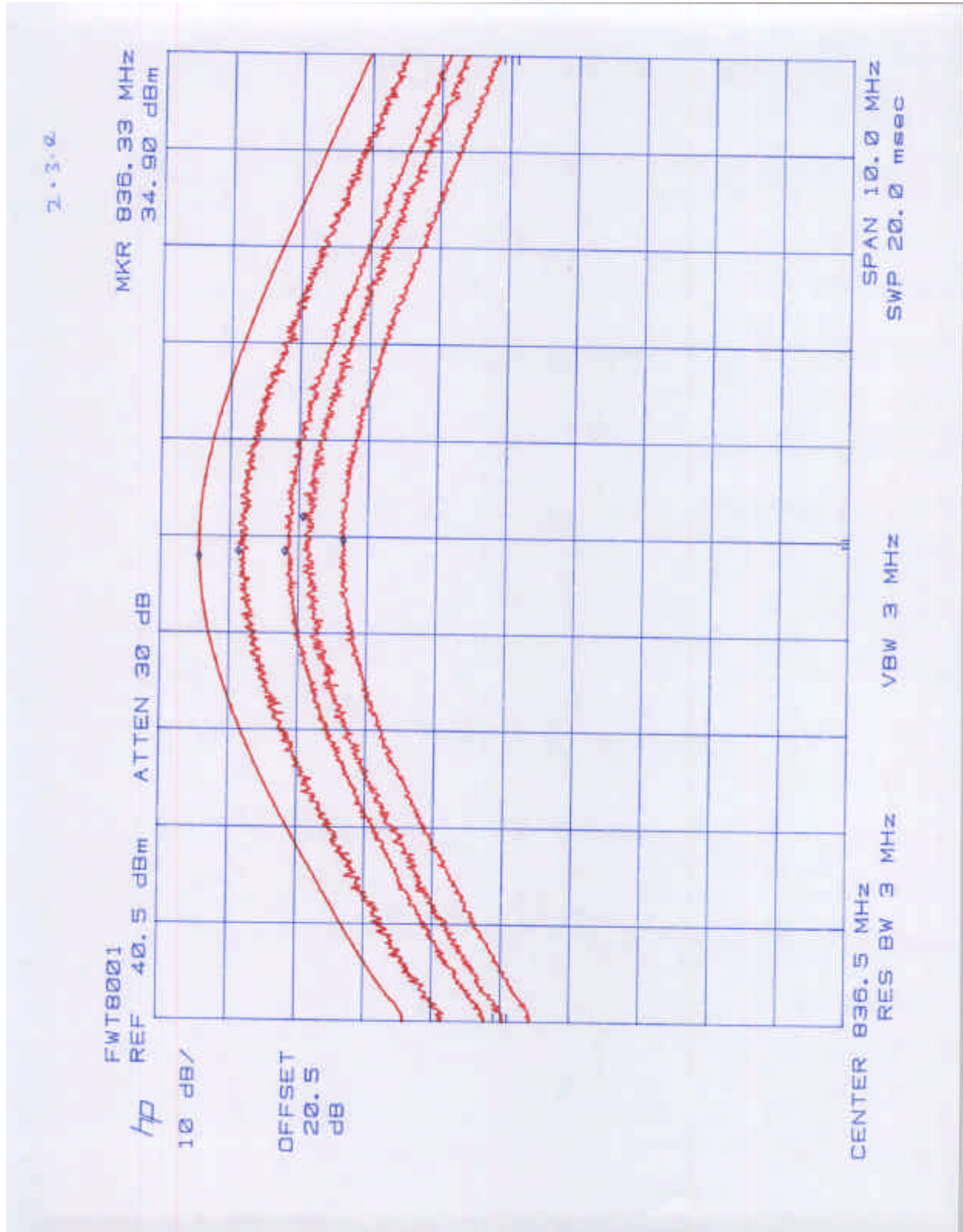
AMPS Mode	
Plot Number	Description
2.3.a	Low Channel
2.3.b	Middle Channel
2.3.c	High Channel
TDMA Mode	
Plot Number	Description
2.3.d	Low Channel
2.3.e	Middle Channel
2.3.f	High Channel

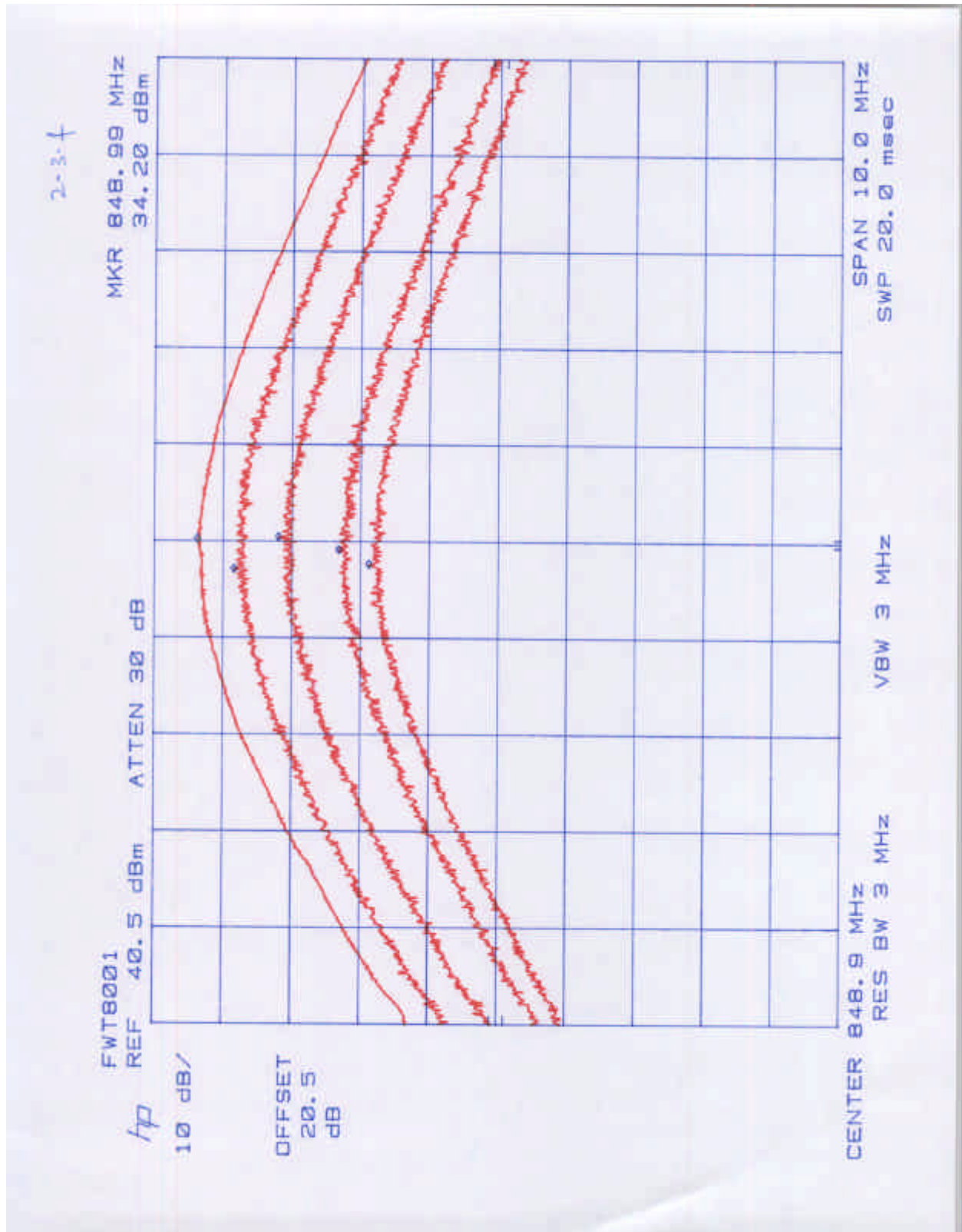












3.0 Radiated Power

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

Passes	Refer to the attached data sheets.
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Field Strength of Fundamental

Frequency MHz	Antenna Polarity	Detector	SA Reading dB(μ V)	Antenna Factor dB(1/m)	Cable Loss dB	Field Strength dB(μ V/m)
AMPS Mode						
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
TDMA Mode						
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 MHz	Antenna Polariz.	Field Strength (EUT) dB μ V/m	Field Strength (Sig. Gen. + Tuned Dipole) dB μ V/m	Signal Generator Output dBm	ERP dBm
AMPS Mode					
824.04	V	127.8	113.5	10.0	24.3
836.55	V	125.8	113.4	10.0	22.4
848.97	V	126.0	113.3	10.0	22.7
TDMA Mode					
824.04	V	136.6	113.5	10.0	33.0
836.55	V	135.9	113.4	10.0	32.5
848.97	V	135.0	113.3	10.0	31.7

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 (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	10.3	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 kHz	Initial Deviation	Peak Deviation	Steady State 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

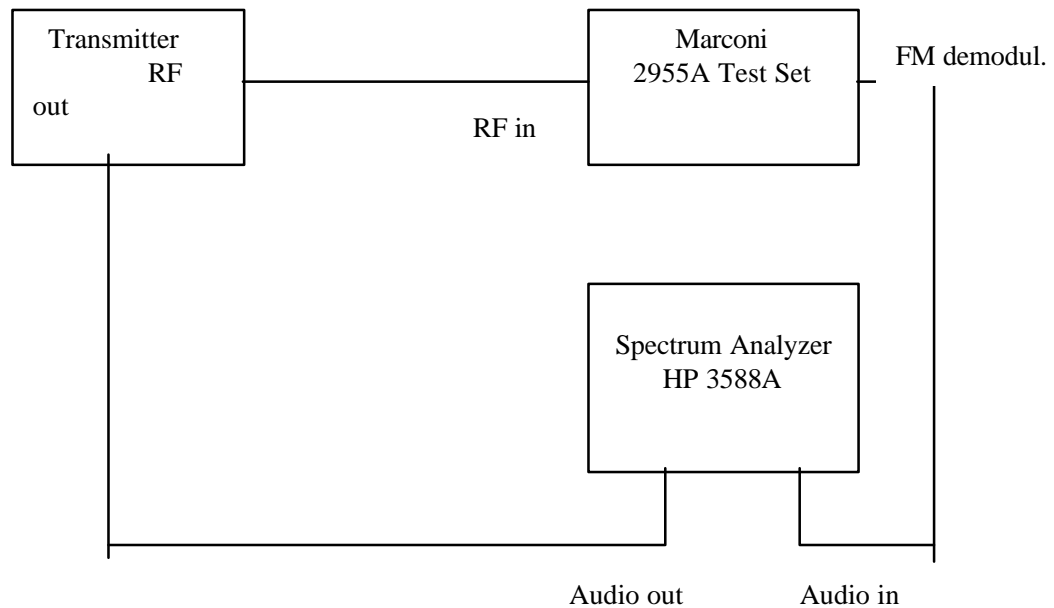
FCC 22.915(d)

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 kHz	Relative Level 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

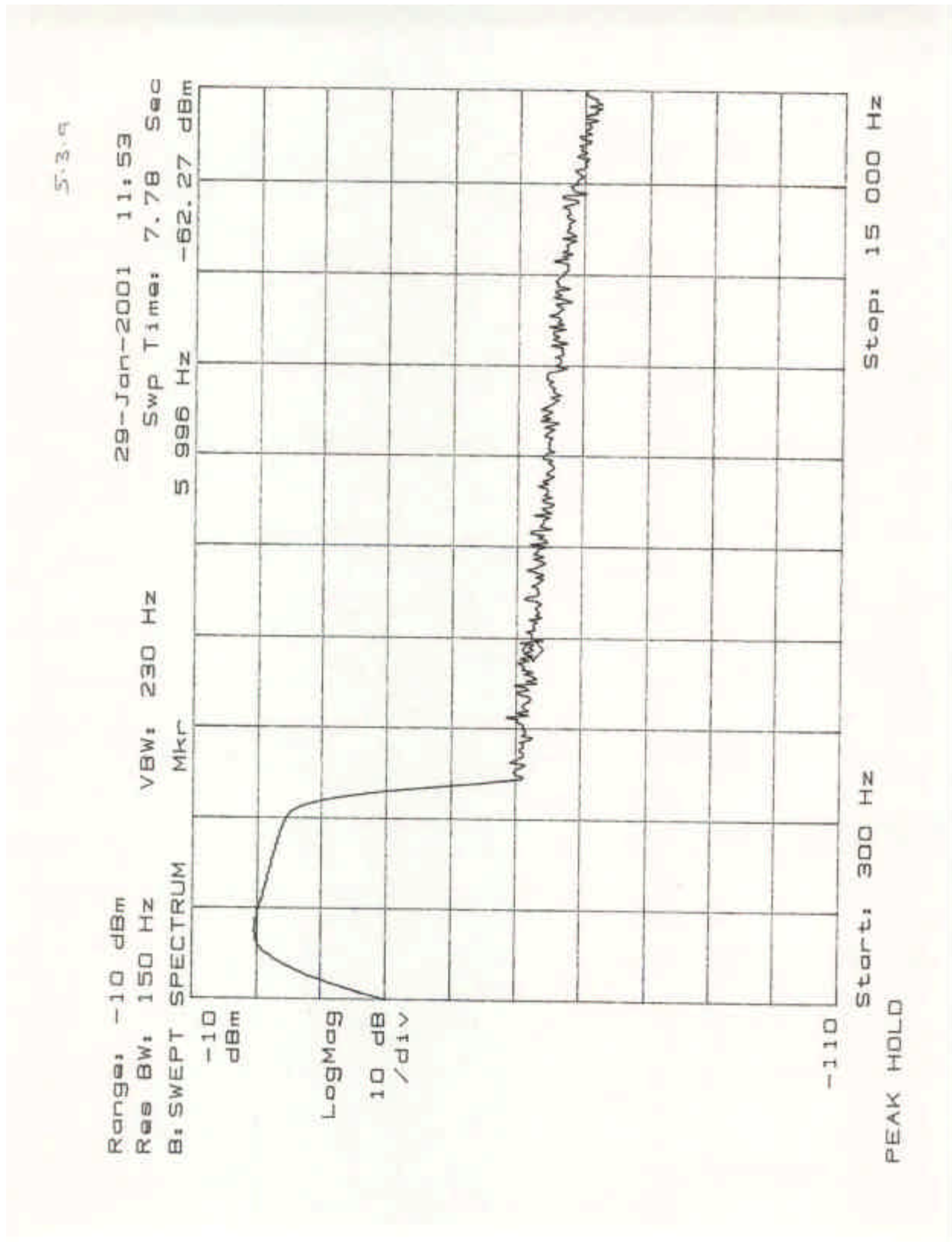
5.2 Test Equipment

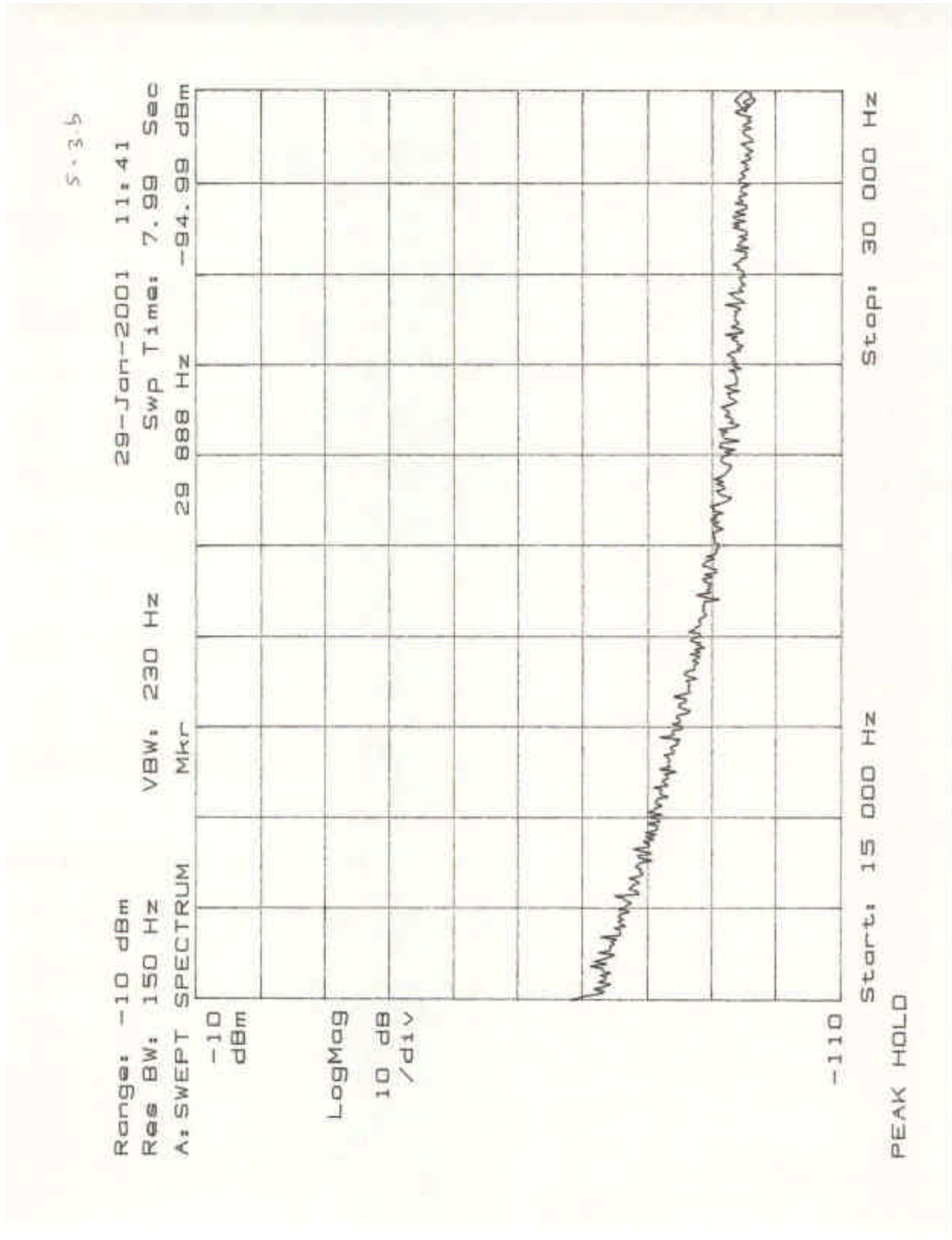
Marconi Instruments 2955A Radio Communications Test Set
HP 3588A Spectrum Analyzer
HP 7470A Plotter

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 ± 50 kHz and ± 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.

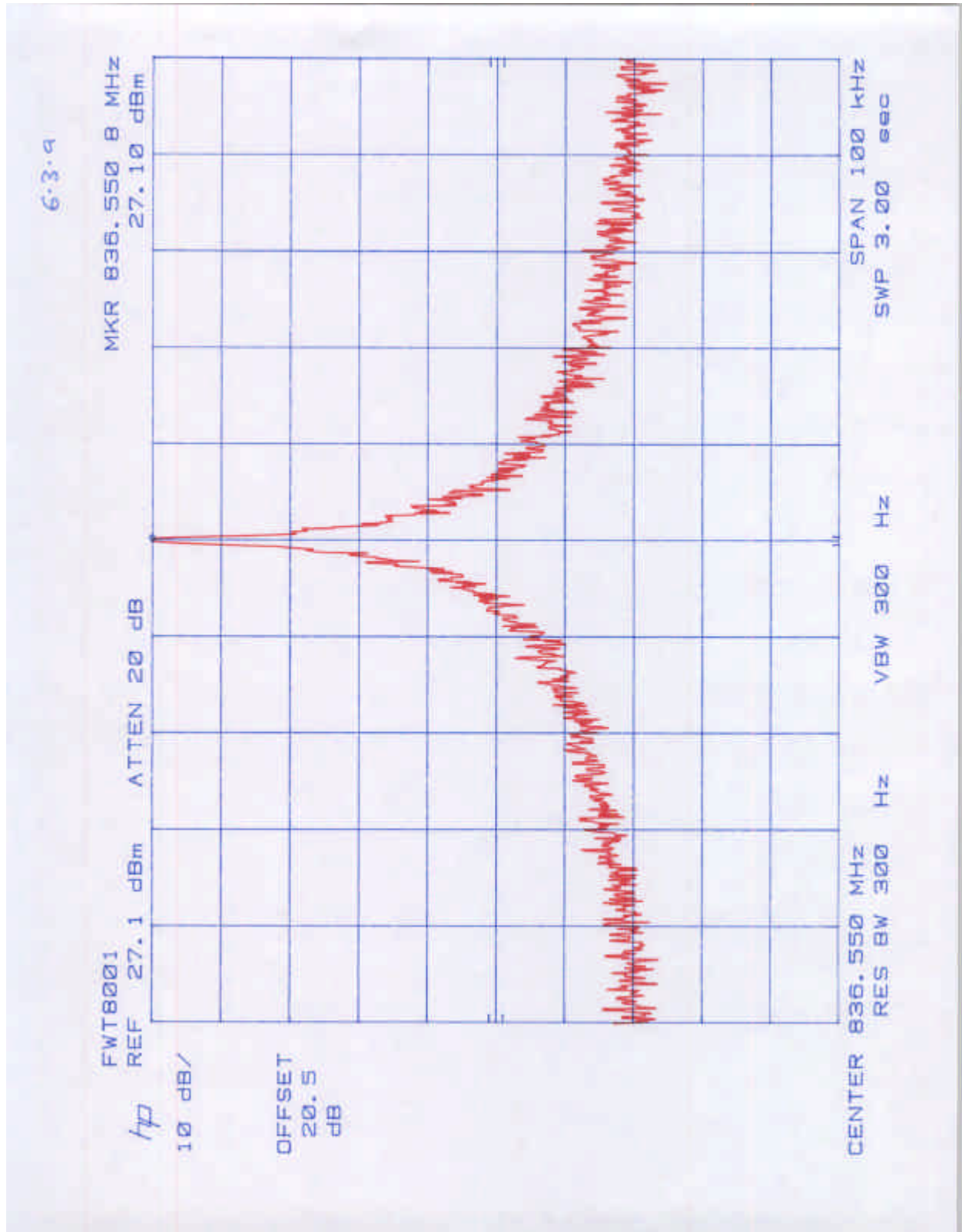
6.2 Test Equipment

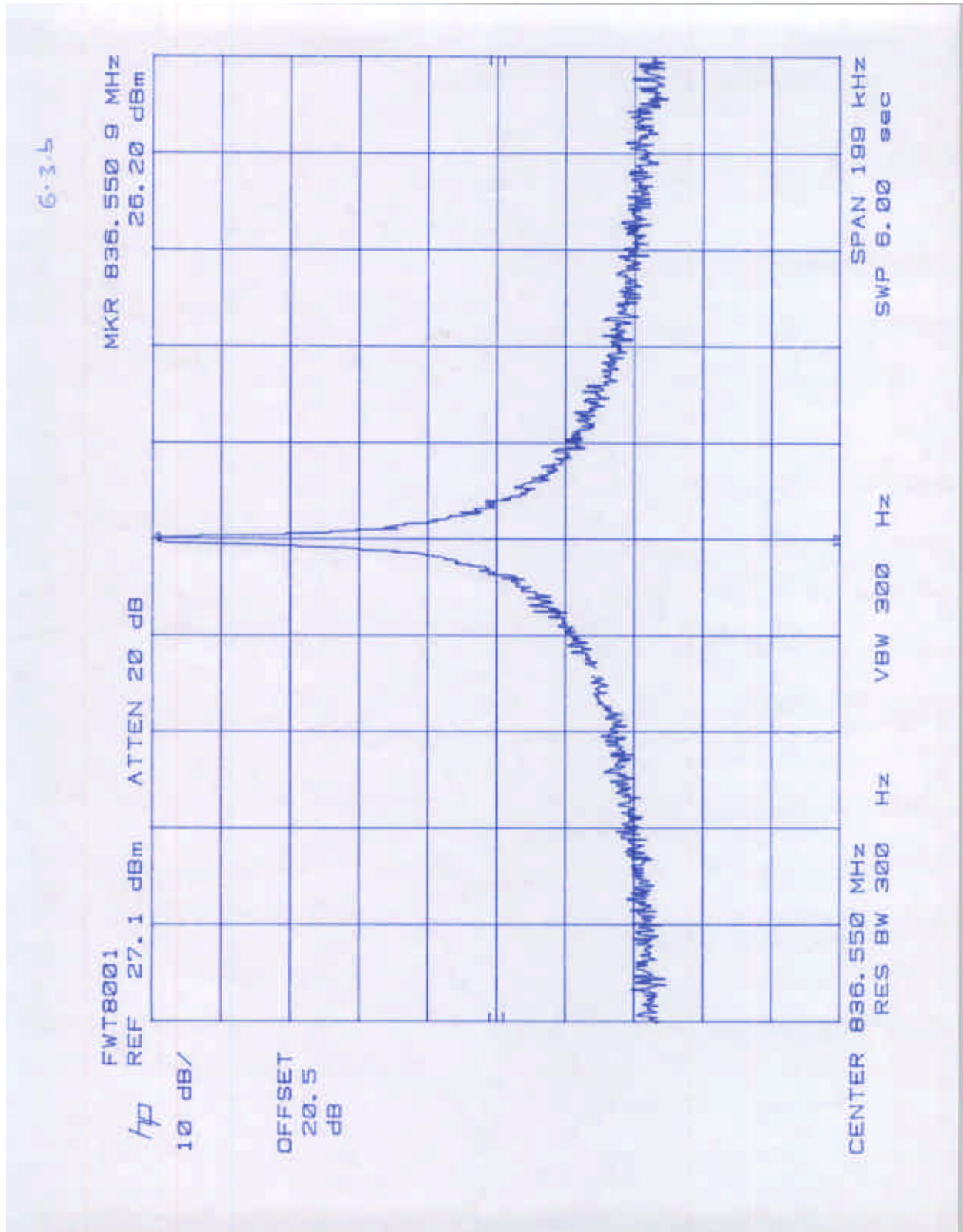
HP 8566B Spectrum Analyzer
Leader LFG-1300S Function Generator
Leader LMV-182 AC Millivoltmeter
Marconi 2955A Radio Communication Test Set
HP 7470A Plotter

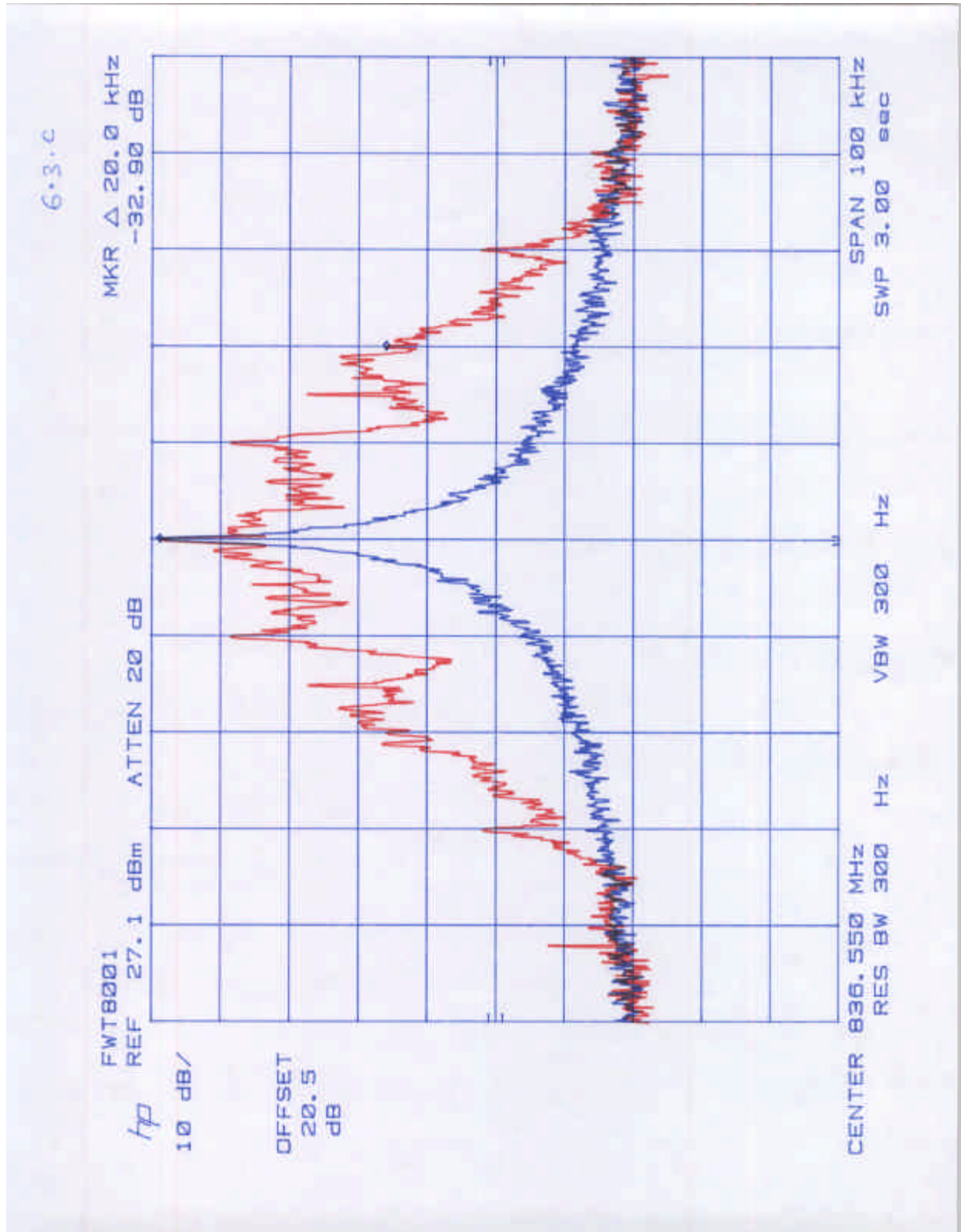
6.3 Test Results

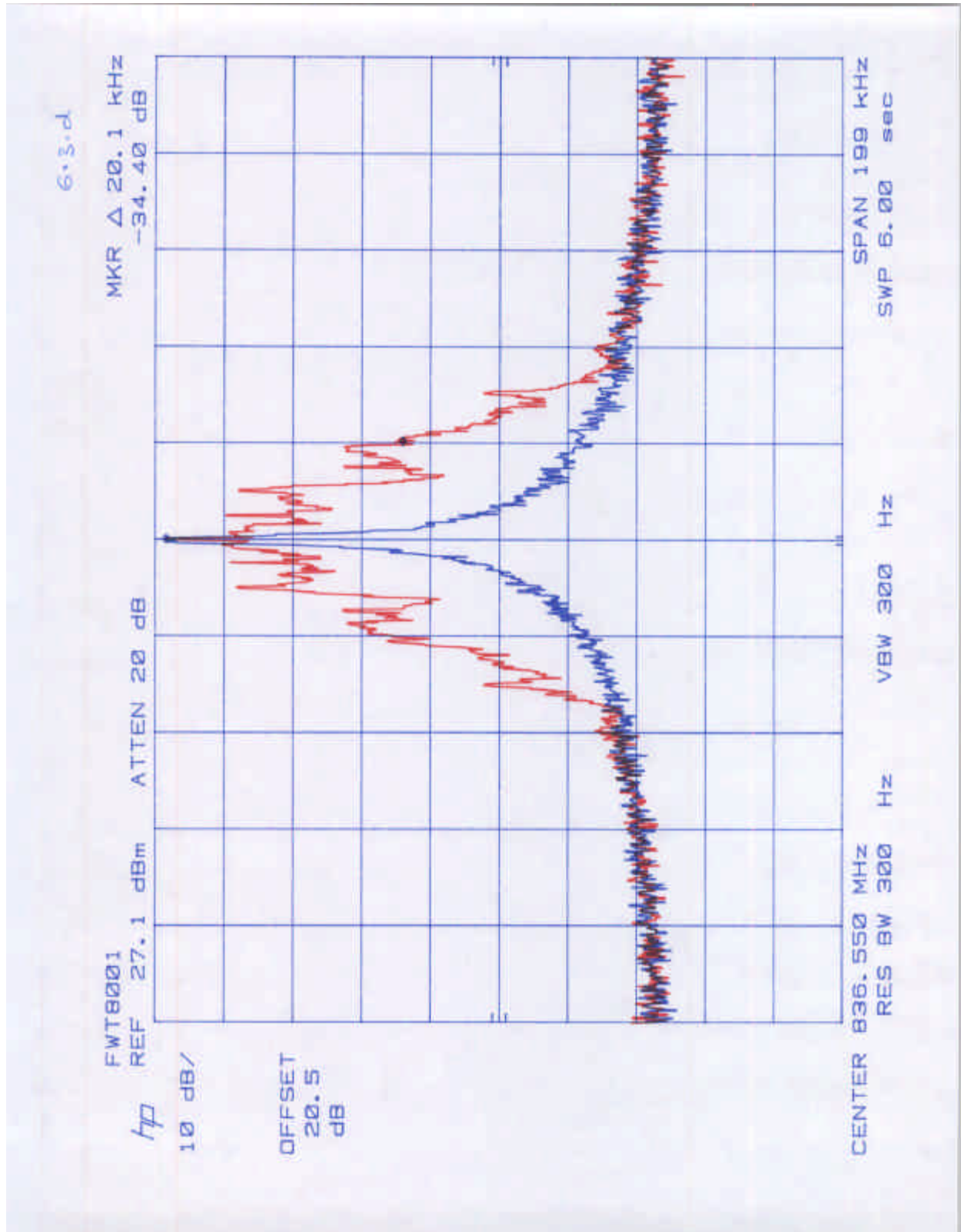
Passes	Refer to the attached plots.
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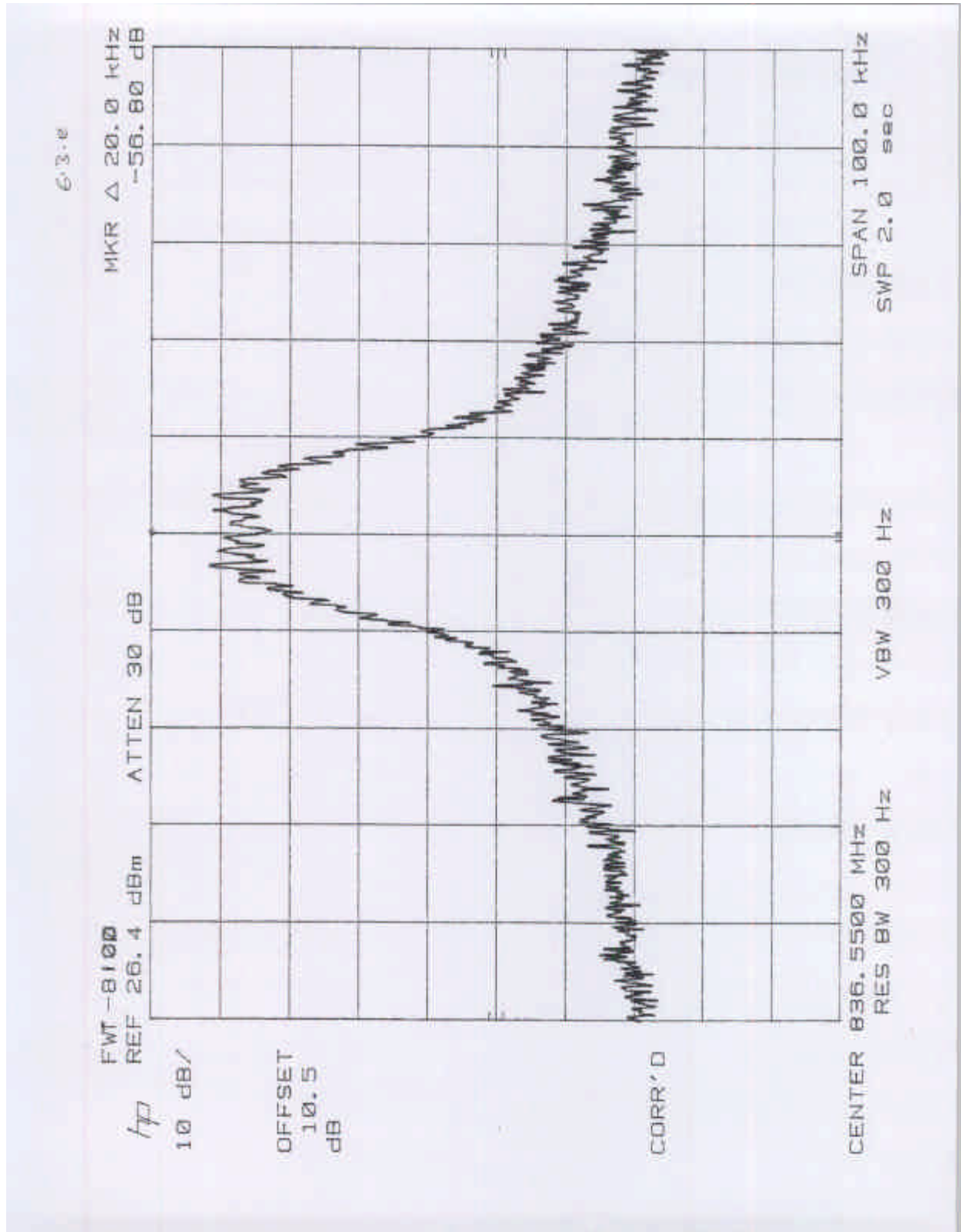
Plot Number	Description
6.3.a	Carrier frequency, no modulation, scan 100 kHz
6.3.b	Carrier frequency, no modulation, scan 200 kHz
6.3.c	Wideband emissions (0, 1, 0, 1), scan 100 kHz
6.3.d	Wideband emissions (0, 1, 0, 1), scan 200 kHz
6.3.e	DTMF "9"
6.3.f	SAT (6 kHz, 2 kHz deviation)
6.3.g	ST (10 kHz, 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

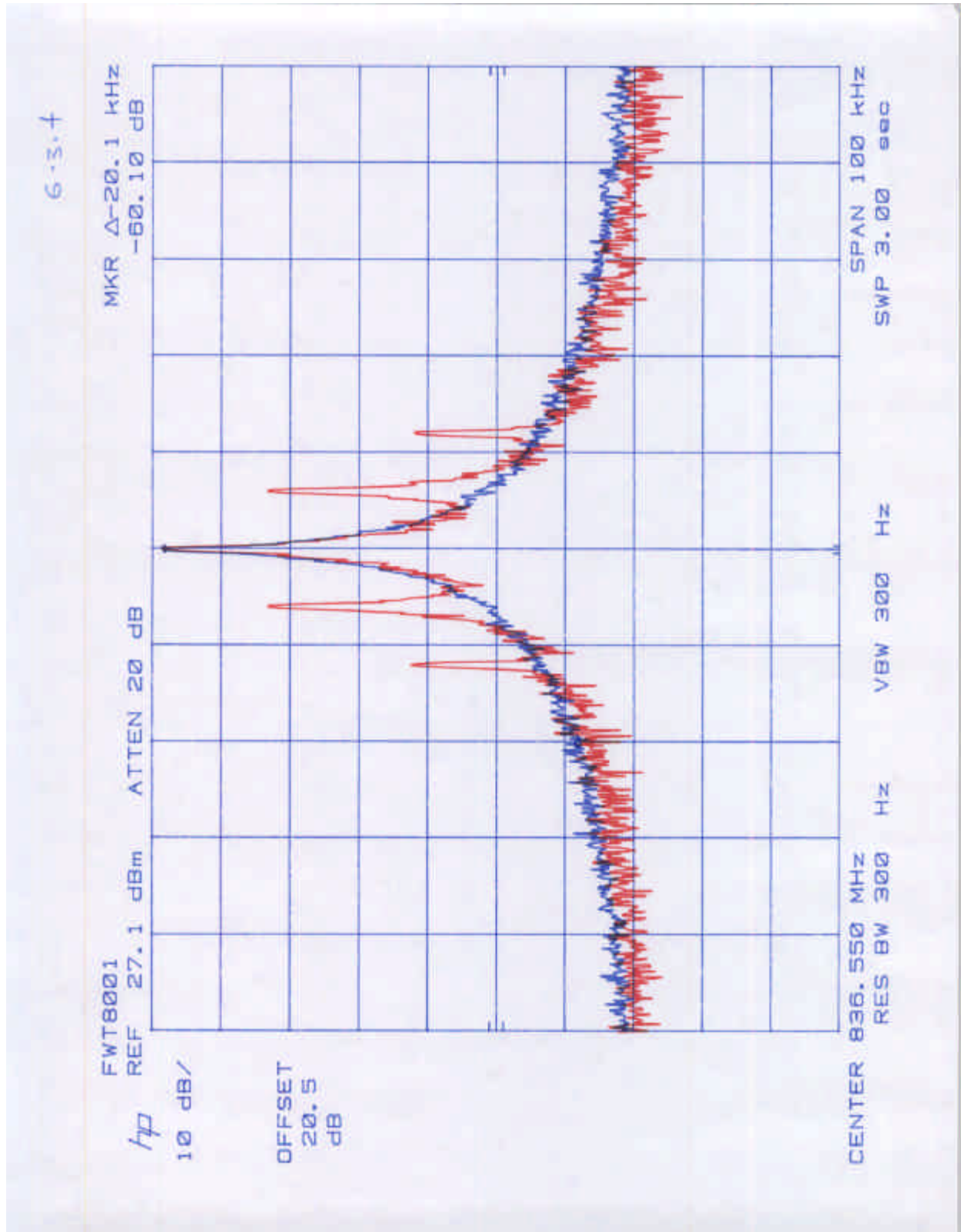


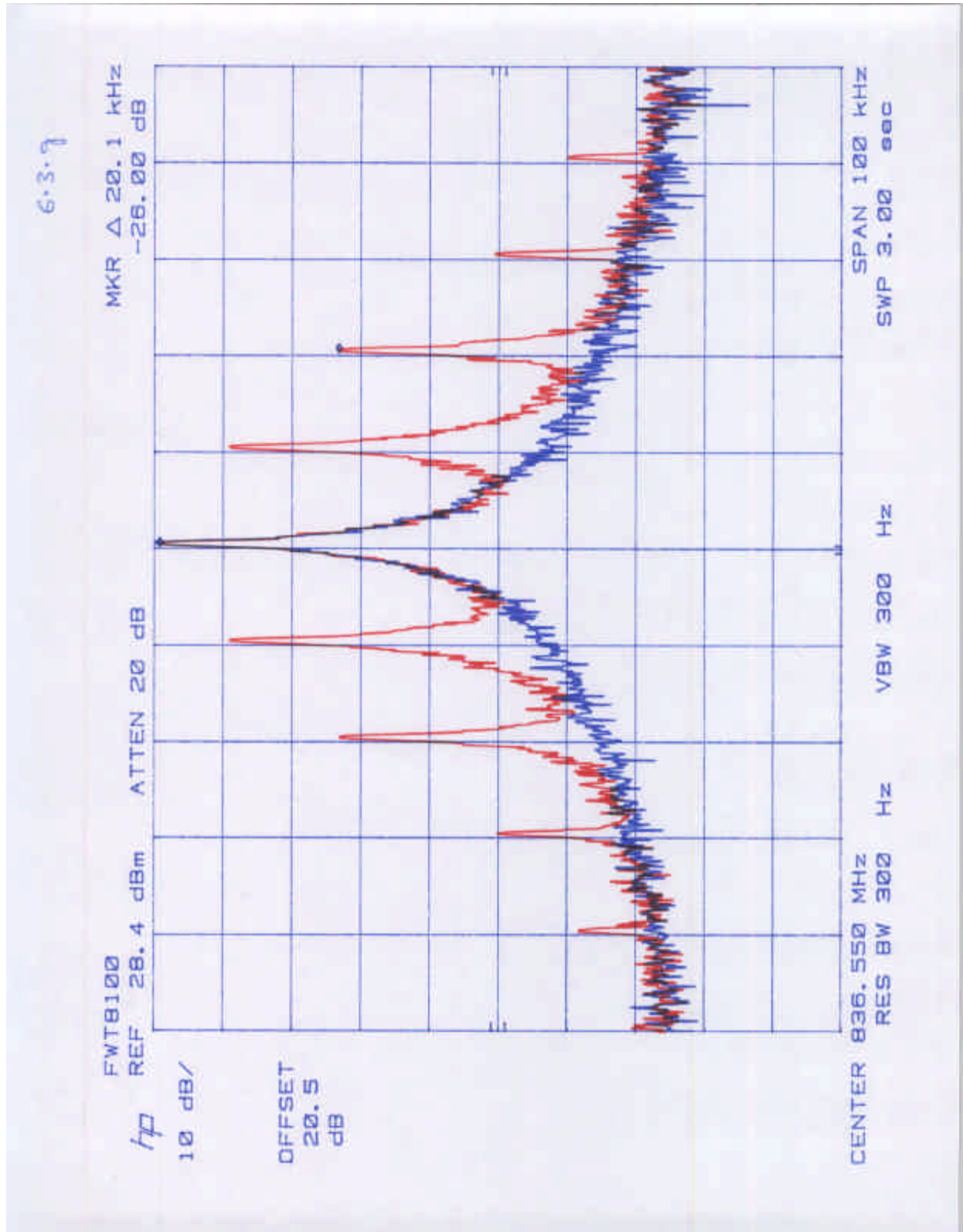


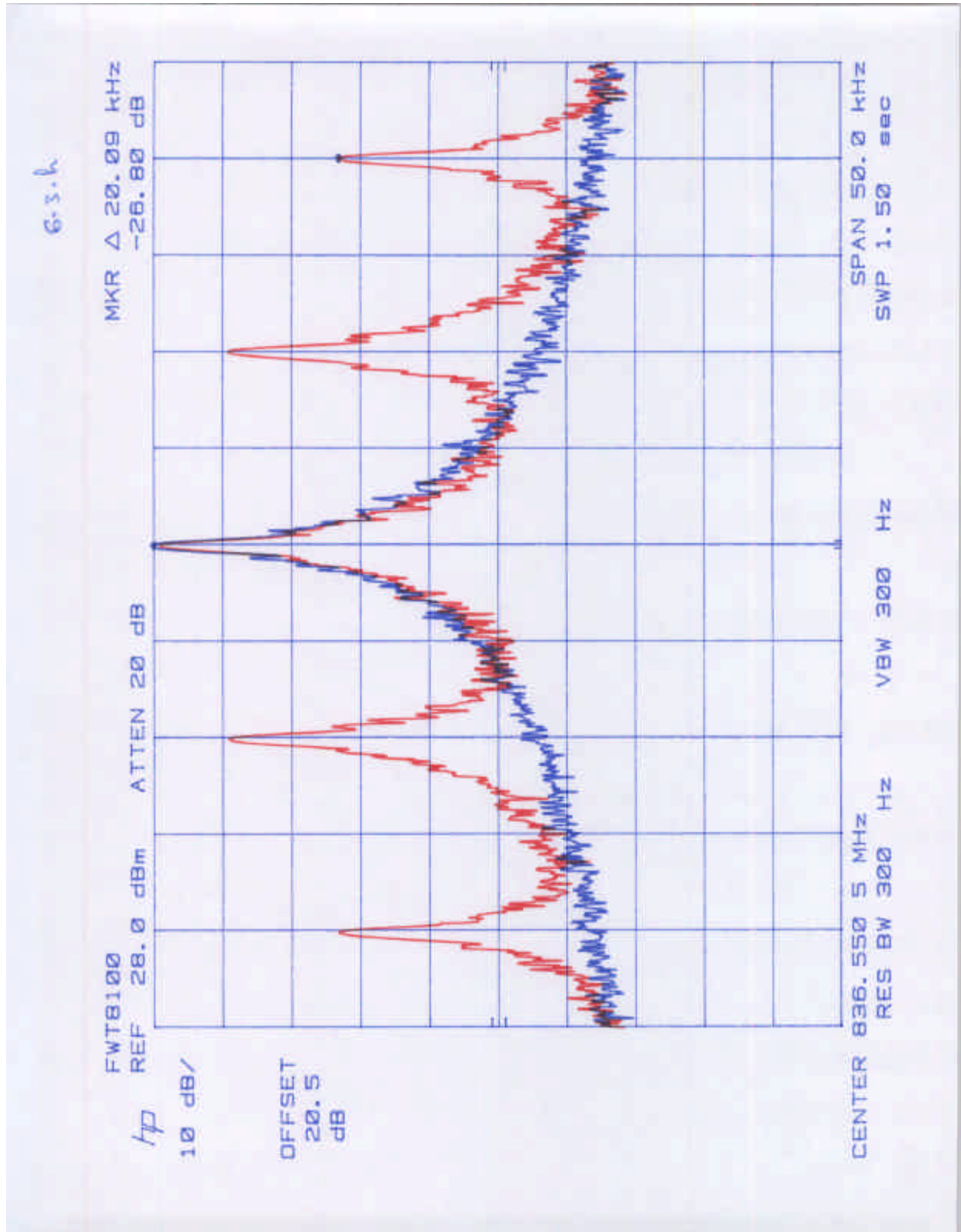


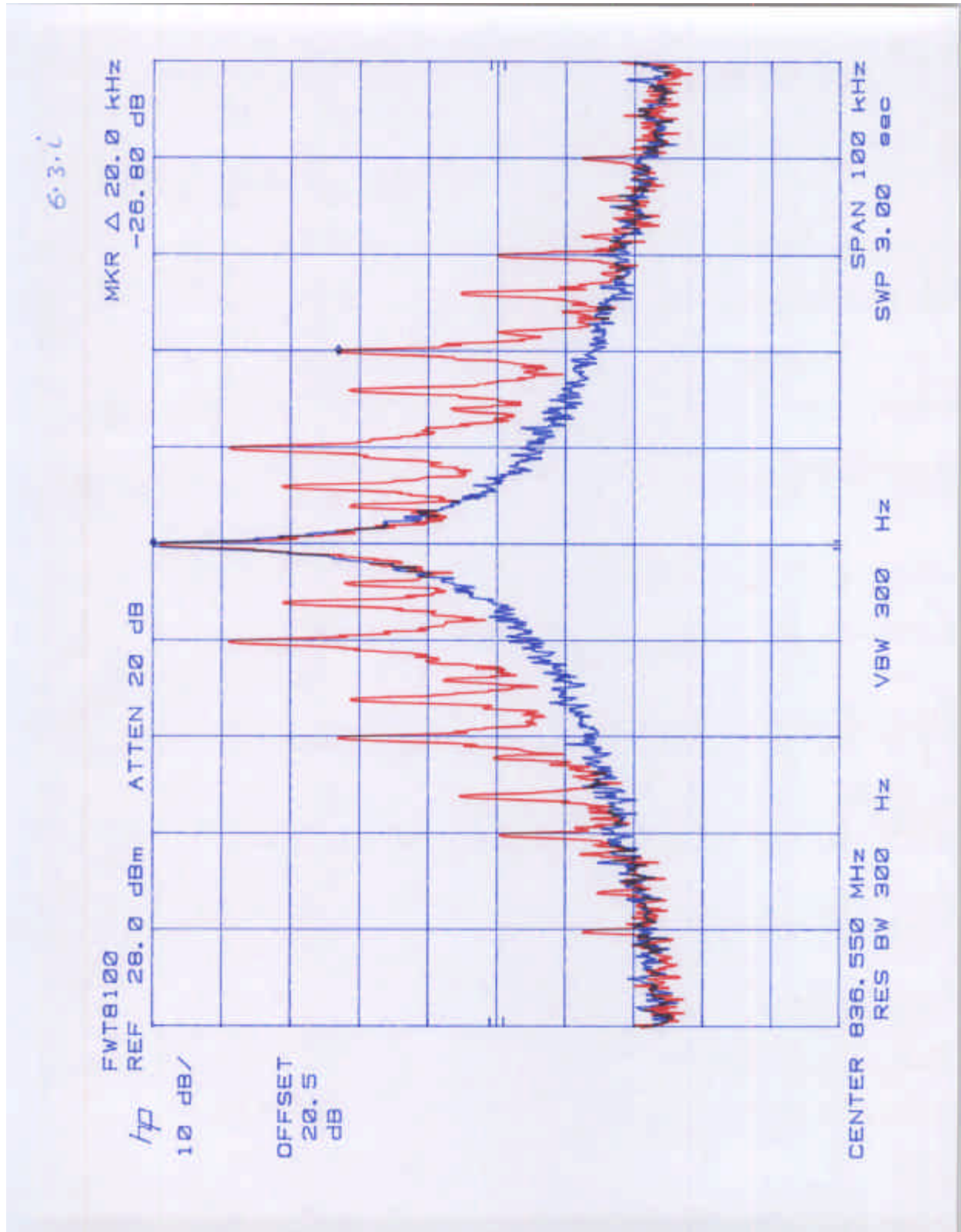


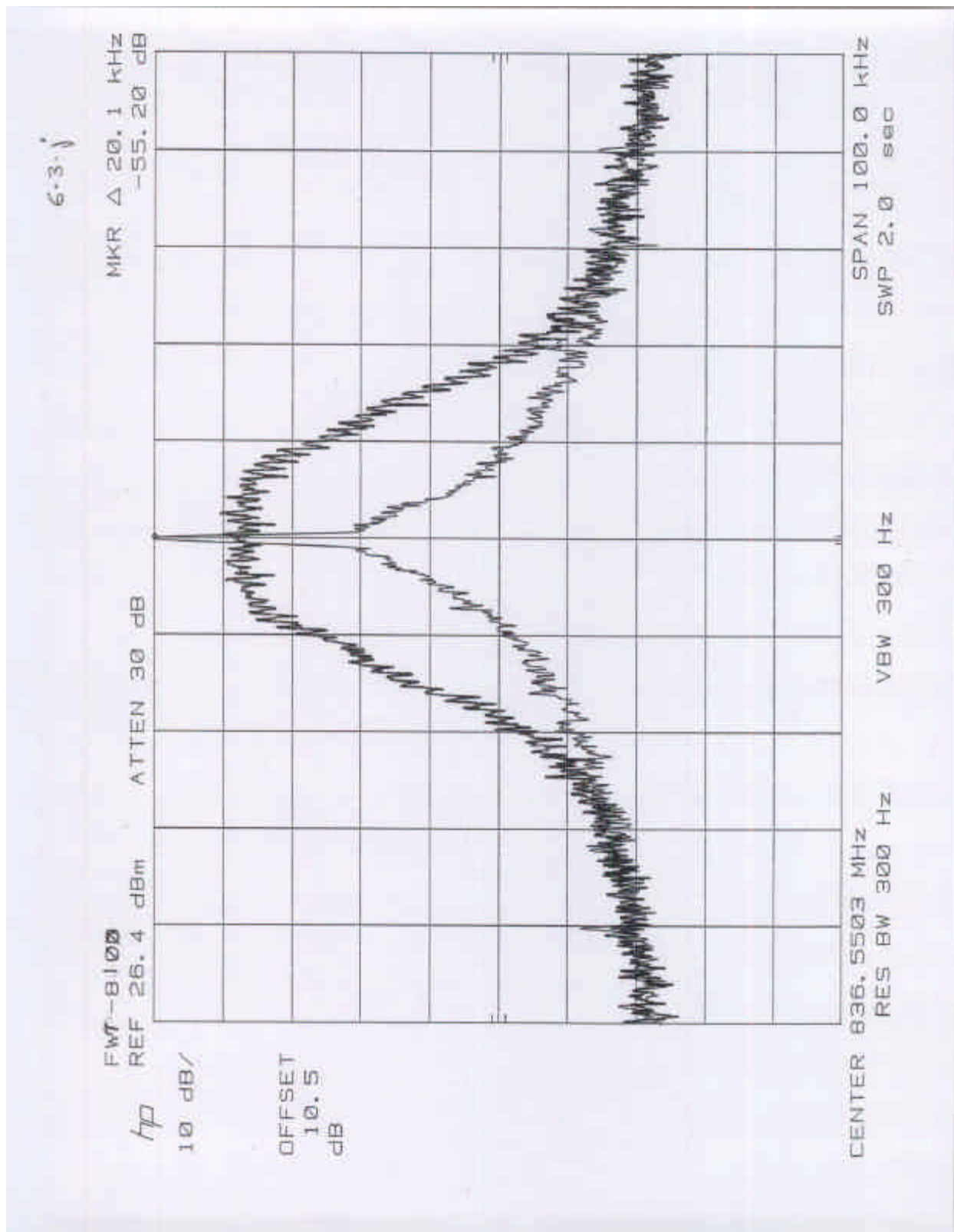


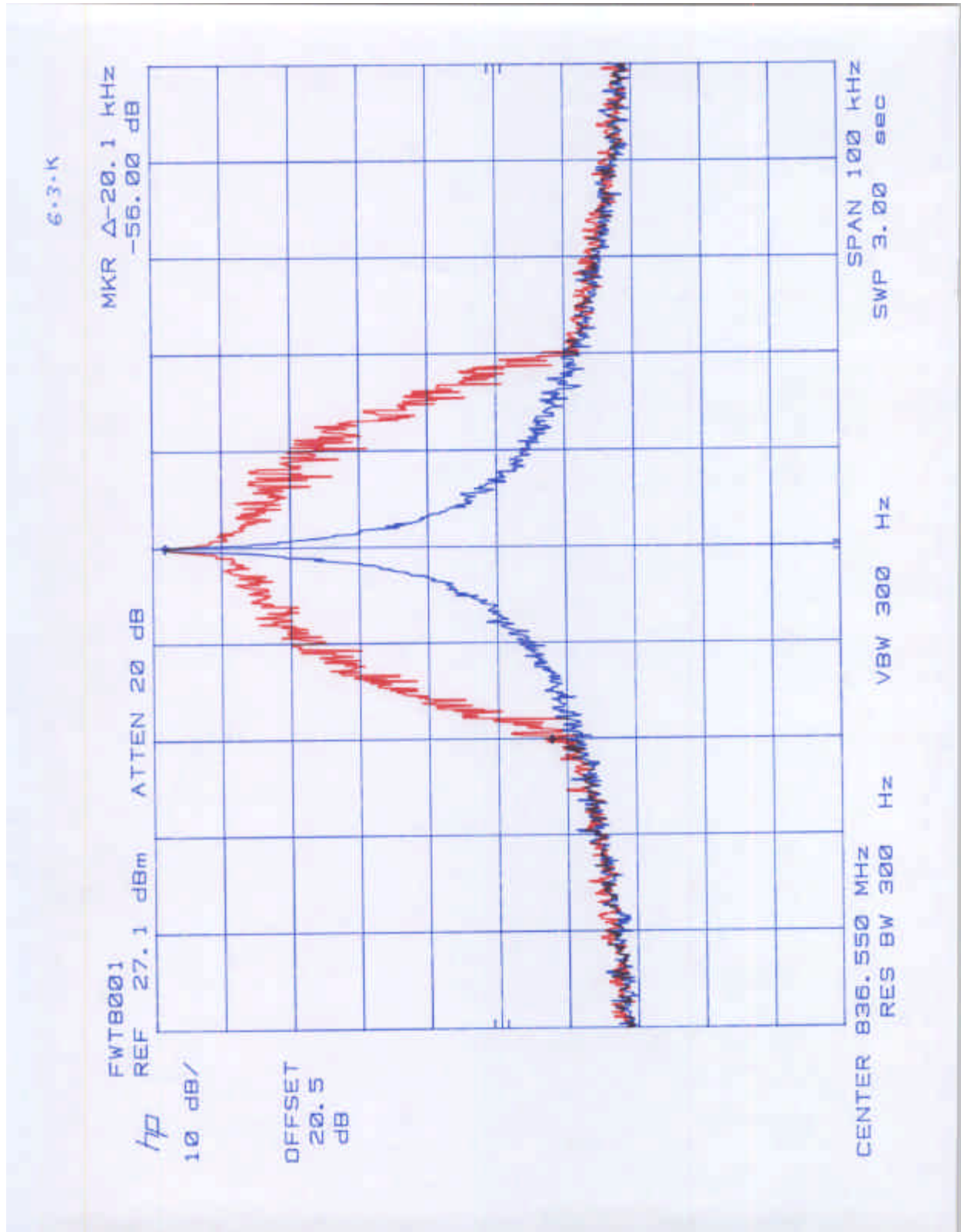


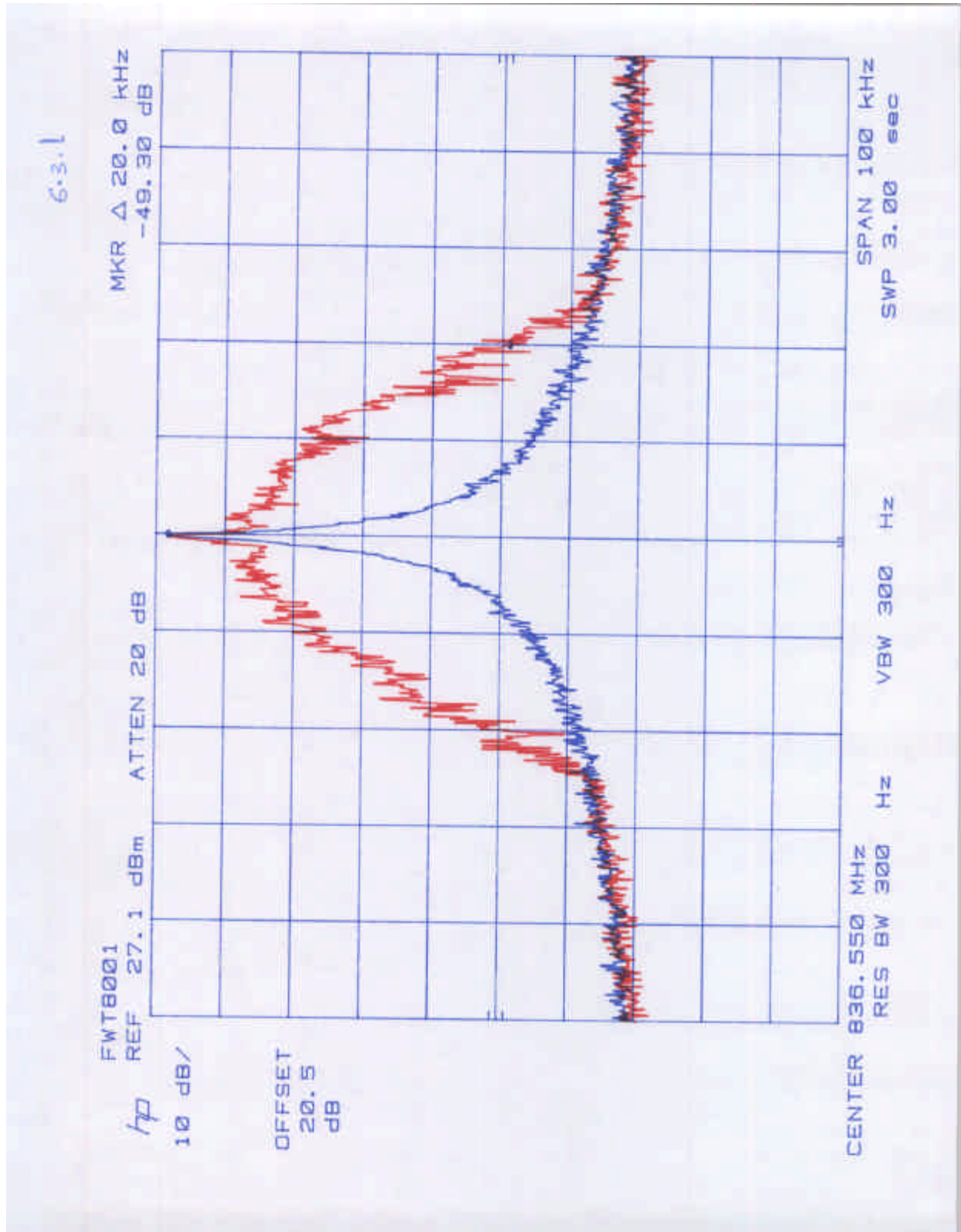


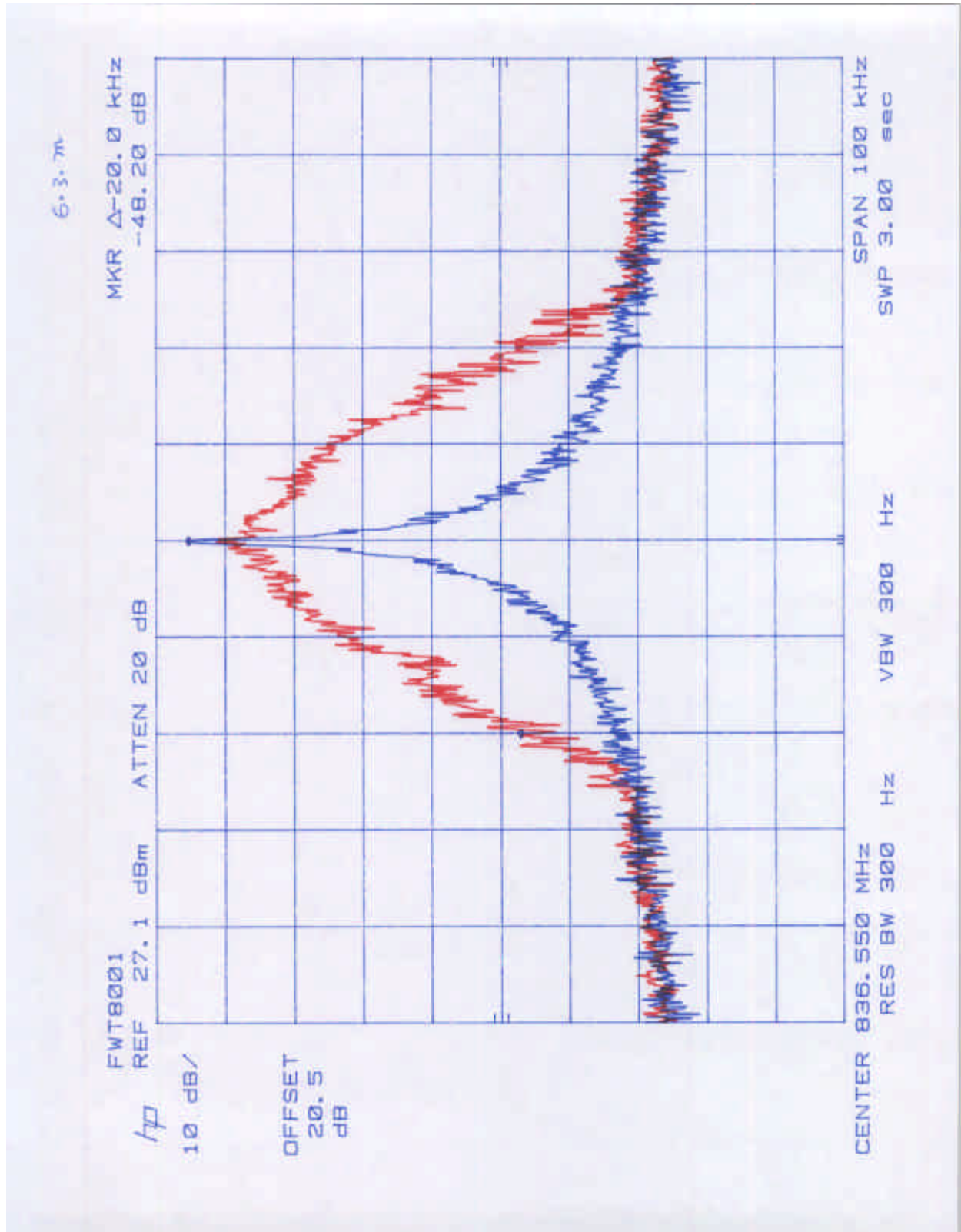


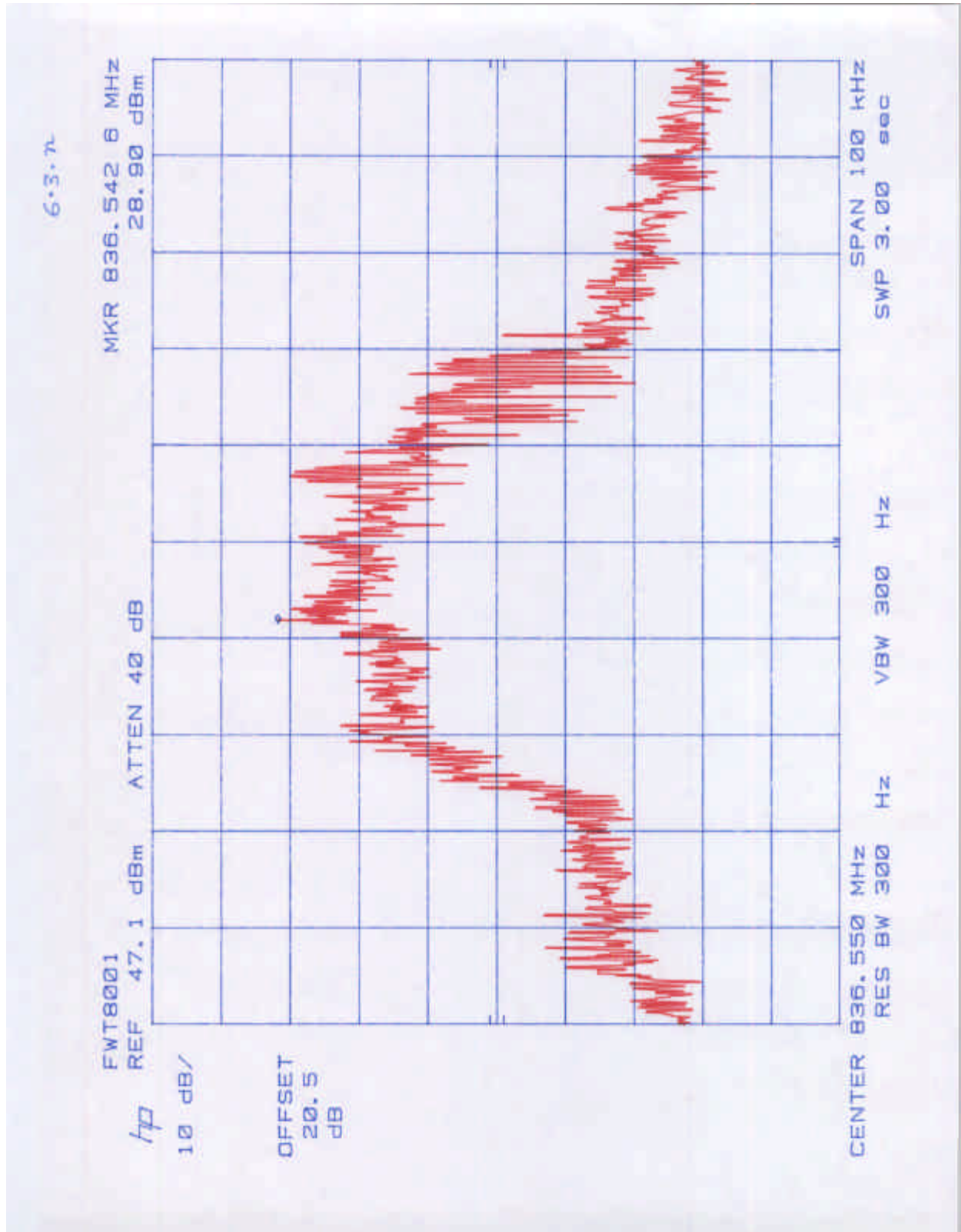












7.0 Out of Band Emissions at Antenna Terminals

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

Passed	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

