FCC Parts 22 and 24 Test Report

Performed on the

TDMA/AMPS Cellular and PCS Telephone
Model: TDM - 3100
For
Telian Corporation
FCC ID: NPQTDM-3100
Date of Test: November 6-7 & 28-30, 2000 & December 6, 2000

Report #: J20028710

Total Nos. of Pages Contained in this Report: 20 + data pages

FCC Parts 22, 24 Certification, Ver 7/98

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* Not Applicable as EUT is battery Operated

Tested By: _____ _____
Suresh Kondapalli Date

Approved By: _____ _____
David Chernomordik Date

1.2 Product Description

The Wireless Link Corporation Model TDM - 3100 is a dual mode, dual band TDMA and AMPS cellular radio telephone.

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

Use of Product	Portable Cellular and PCS Phone
Whether quantity (> 1) production is planned	[X] Yes, [ ] No
Cellular Phone standards	[X] AMPS [X] TDMA
Type(s) of Emission	40K0F8W, 40K0F1D, 30K0G7D
Allowed Deviation	12± 10% (AMPS mode)
RF Output Power	824-849 MHz: 25.2 dBm - AMPS 27.6 dBm - TDMA 1850-1910 MHz: 27.9 dBm - TDMA
Frequency Range	824 - 849 (AMPS & TDMA), 1850 - 1910 (TDMA)
Antenna(e) & Gain	0 dBi
Detachable antenna ? Receiver L.O. frequency External input	[ ]Yes [X] No [X] Audio [ ] Digital Data

1.3 Related Submittal(s) Grants

[X] 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. An 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

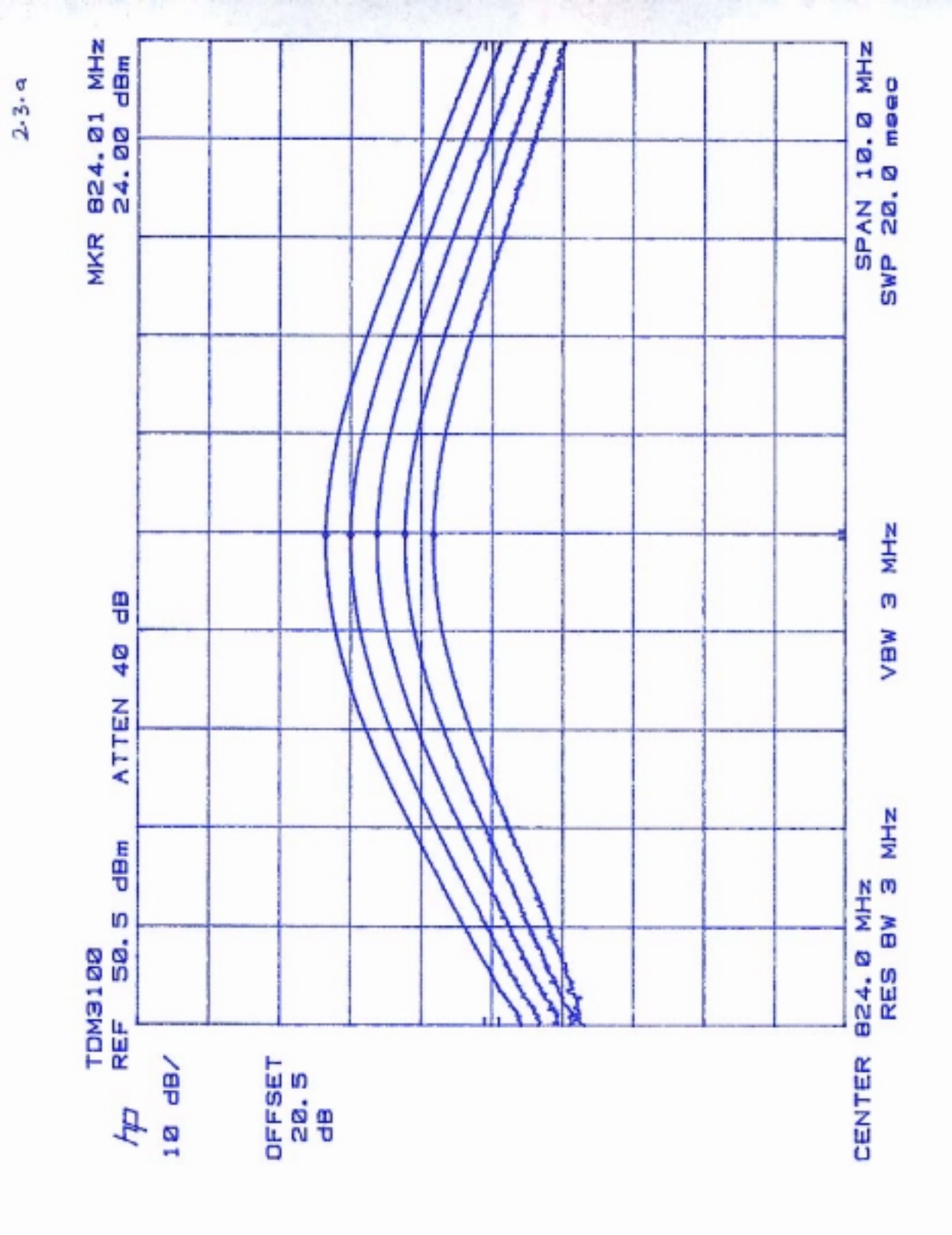
Hewlett Packard 8481A Power Sensor, 435B Power Meter
Hewlett Packard HP8566B Spectrum Analyzer, 100 Hz - 22 GHz
Tektronix 2784 Spectrum Analyzer, 100 Hz – 40 GHz

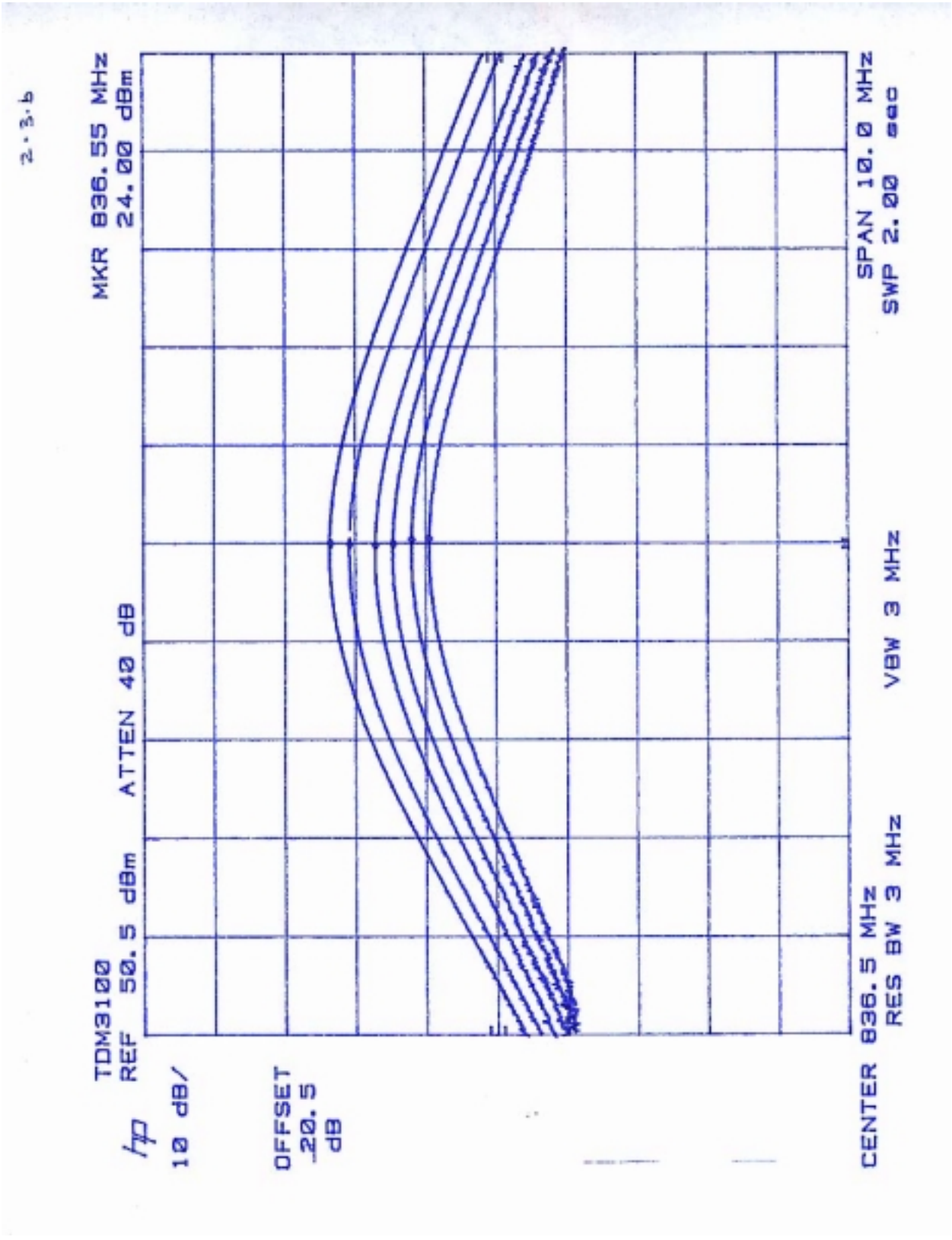
2.3 Test Results

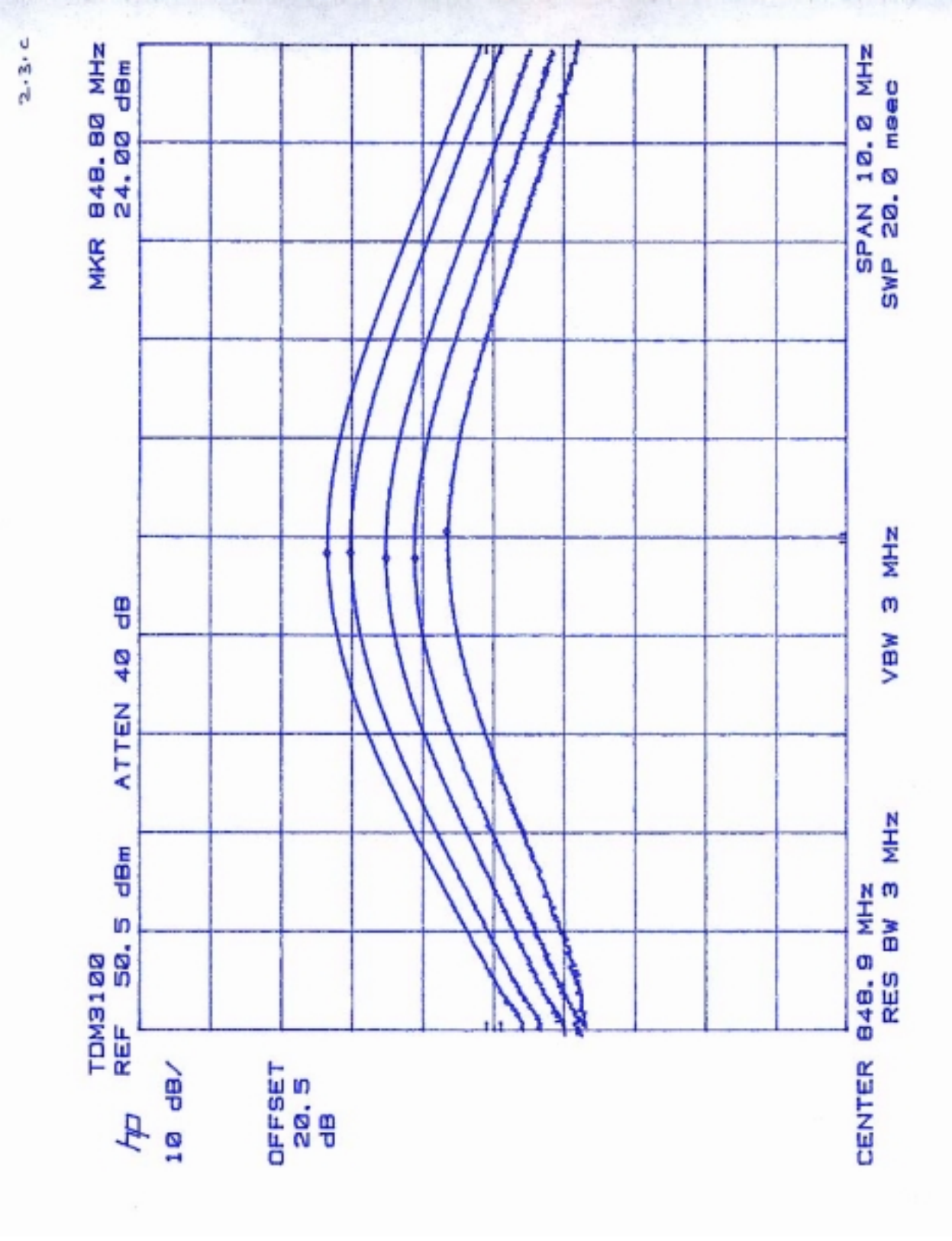
Frequency (MHz)	**Measured Power (dBm)**
824.04	23.9
836.55	23.8
848.97	23.8
1850.0	27.8
1880.0	27.8
1909.9	27.9

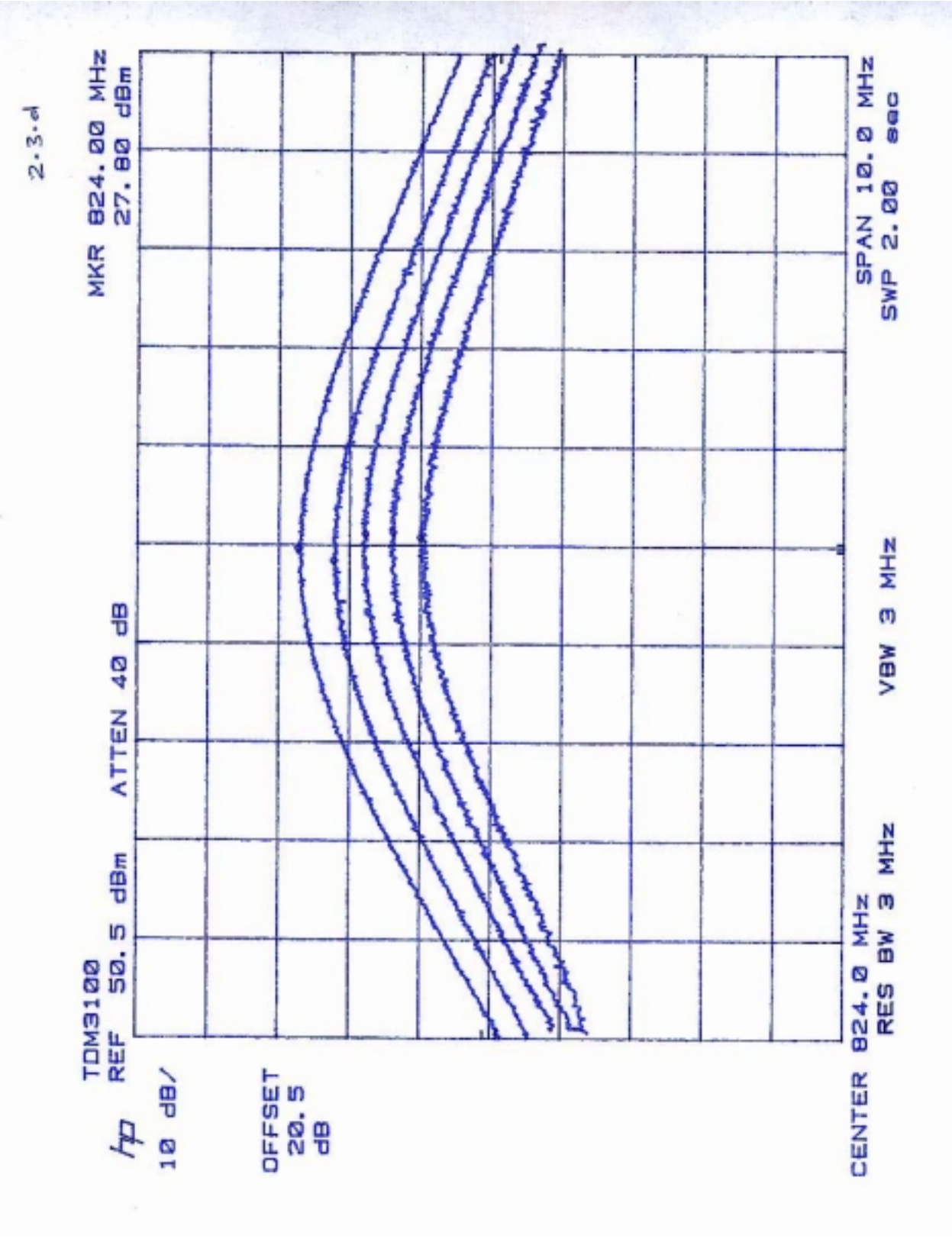
For more details refer to the attached plots:

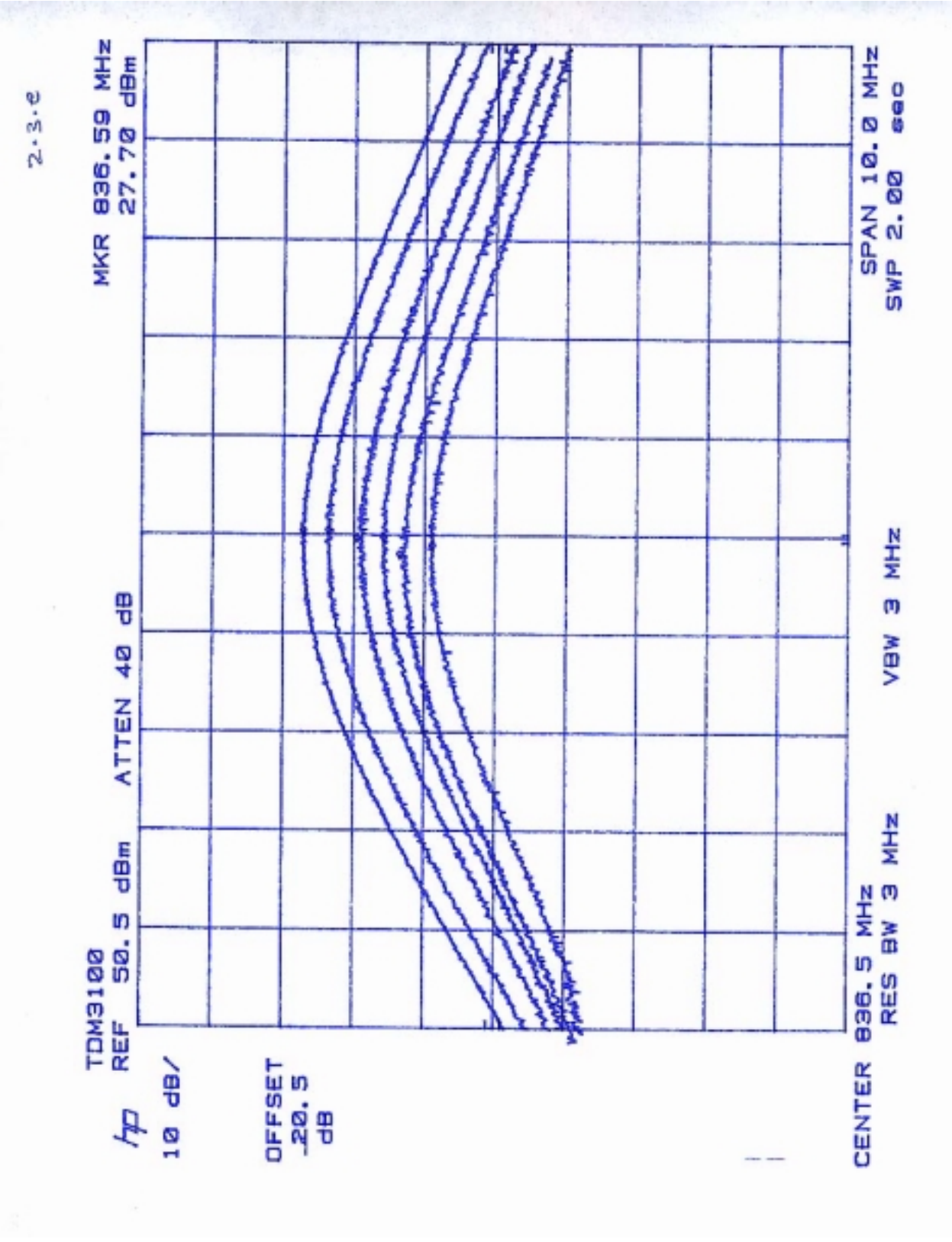
AMPS Mode	
Plot Number	Description
2.3.a	Low Channel
2.3.b	Middle Channel
2.3.c	High Channel
TDMA Mode	
Plot Number	Description
2.3.d	Low Channel
2.3.e	Middle Channel
2.3.f	High Channel
PCS Band (TDMA Mode)	
Plot Number	Description
2.3.g	Low Channel
2.3.h	Middle Channel
2.3.j	High Channel

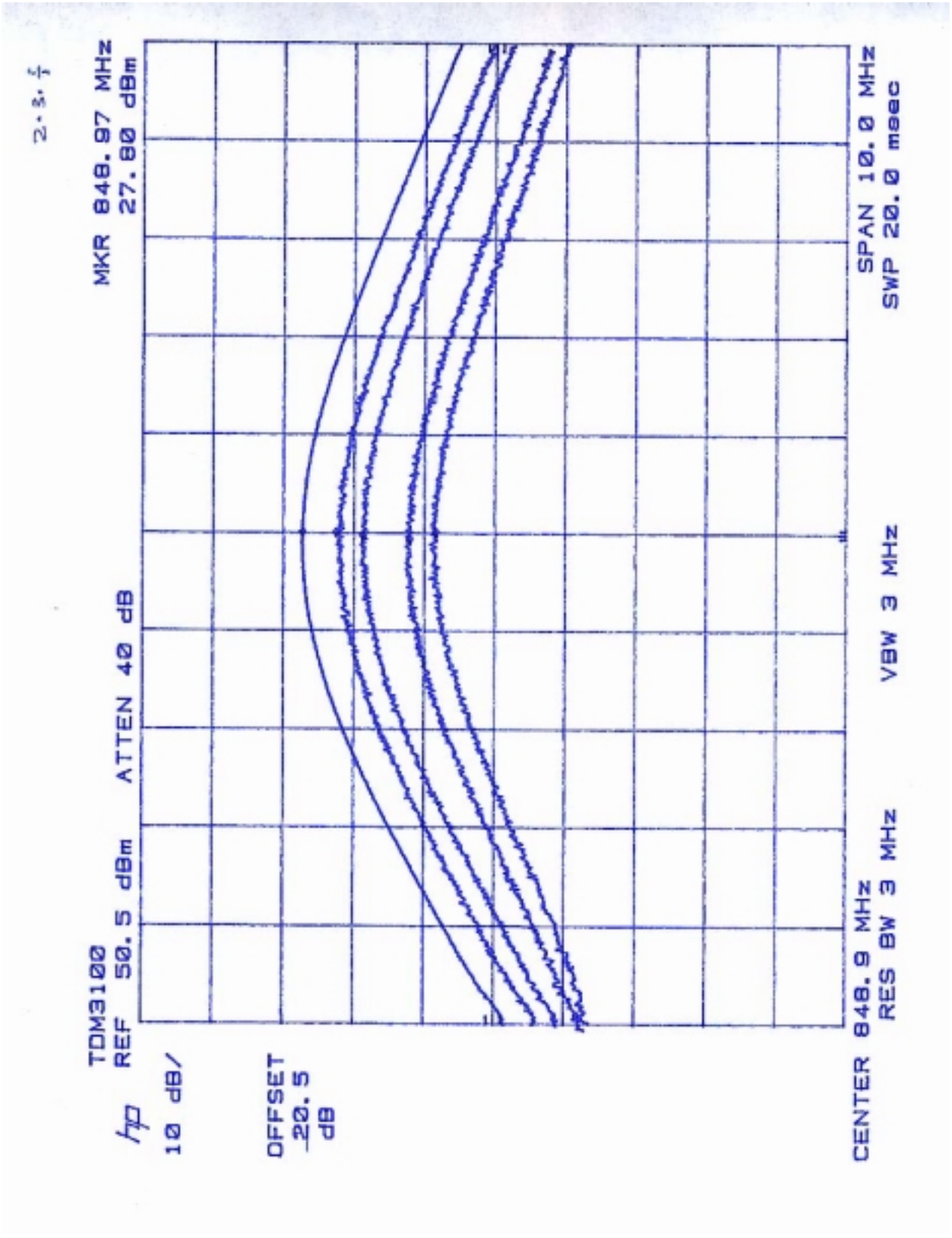

2-3-a
MKR 824.01 MHz
24.00 dBm
SPAN 10.0 MHz
SWP 20.0 msec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 824.0 MHz
RES BW 3 MHz

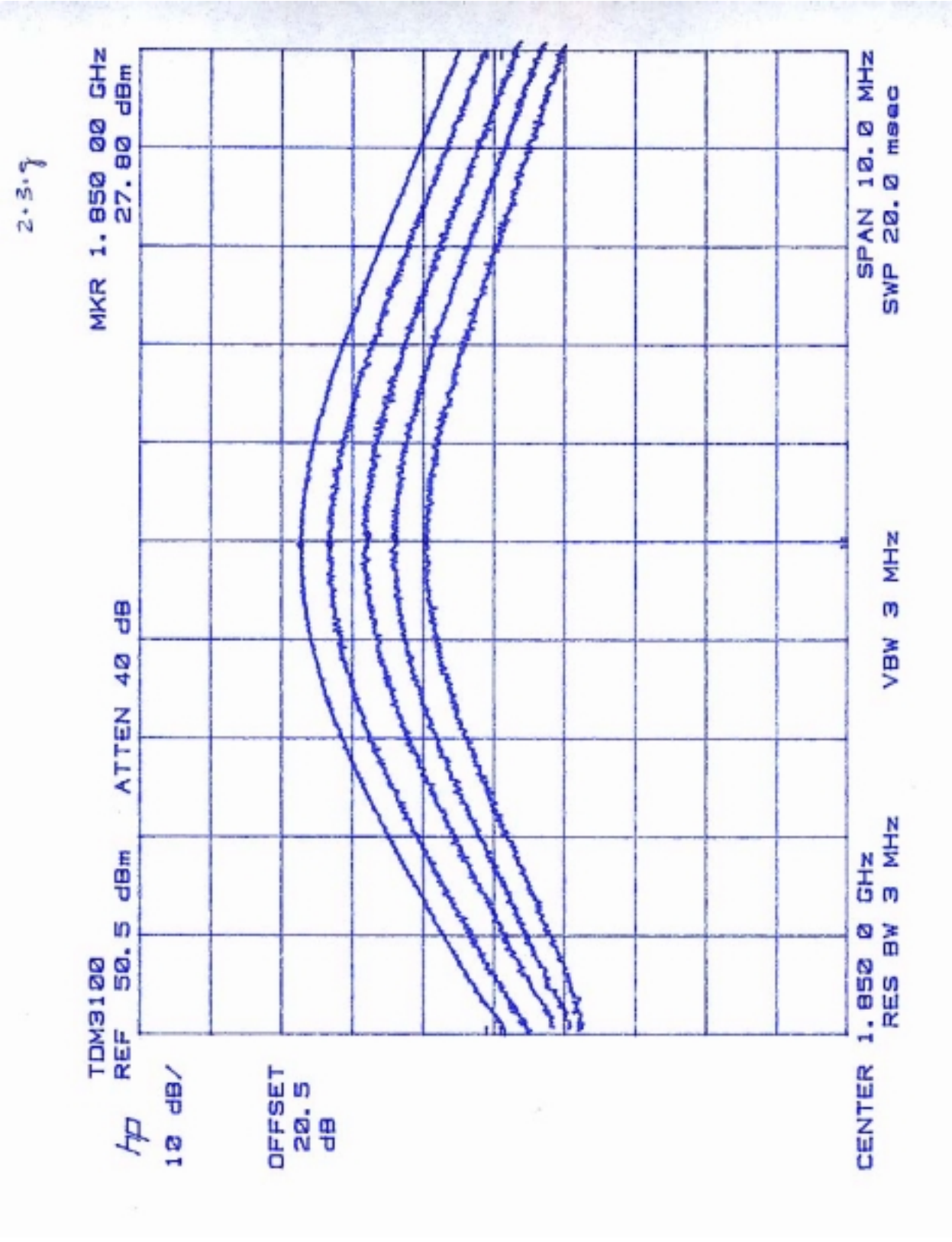

2.3.6
MKR 836.55 MHz
24.00 dBm
SPAN 10.0 MHz
SWP 2.00 sec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 836.5 MHz
RES BW 3 MHz

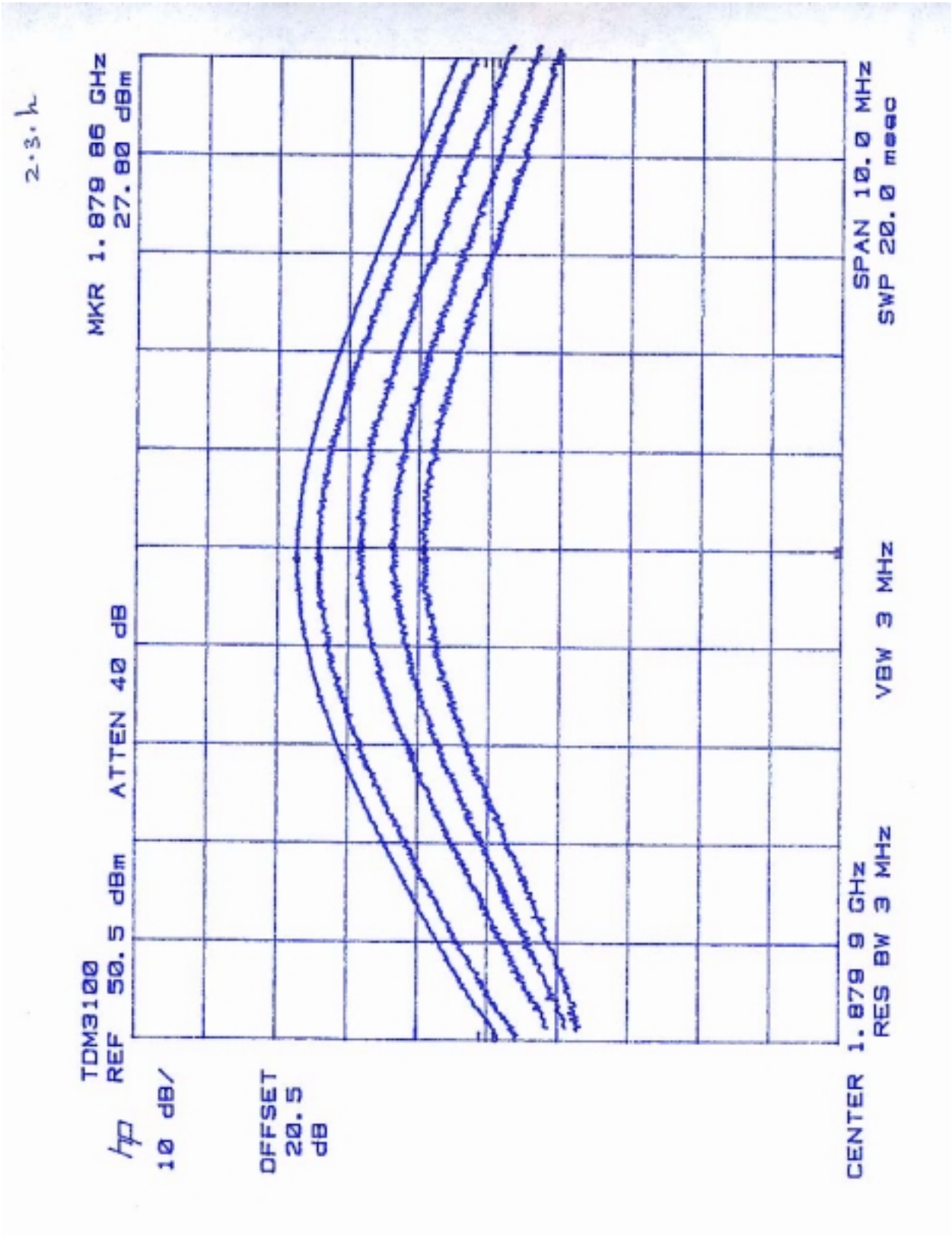

2.3.c
MKR 848.80 MHz
24.00 dBm
SPAN 10.0 MHz
SWP 20.0 msec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 848.9 MHz
RES BW 3 MHz

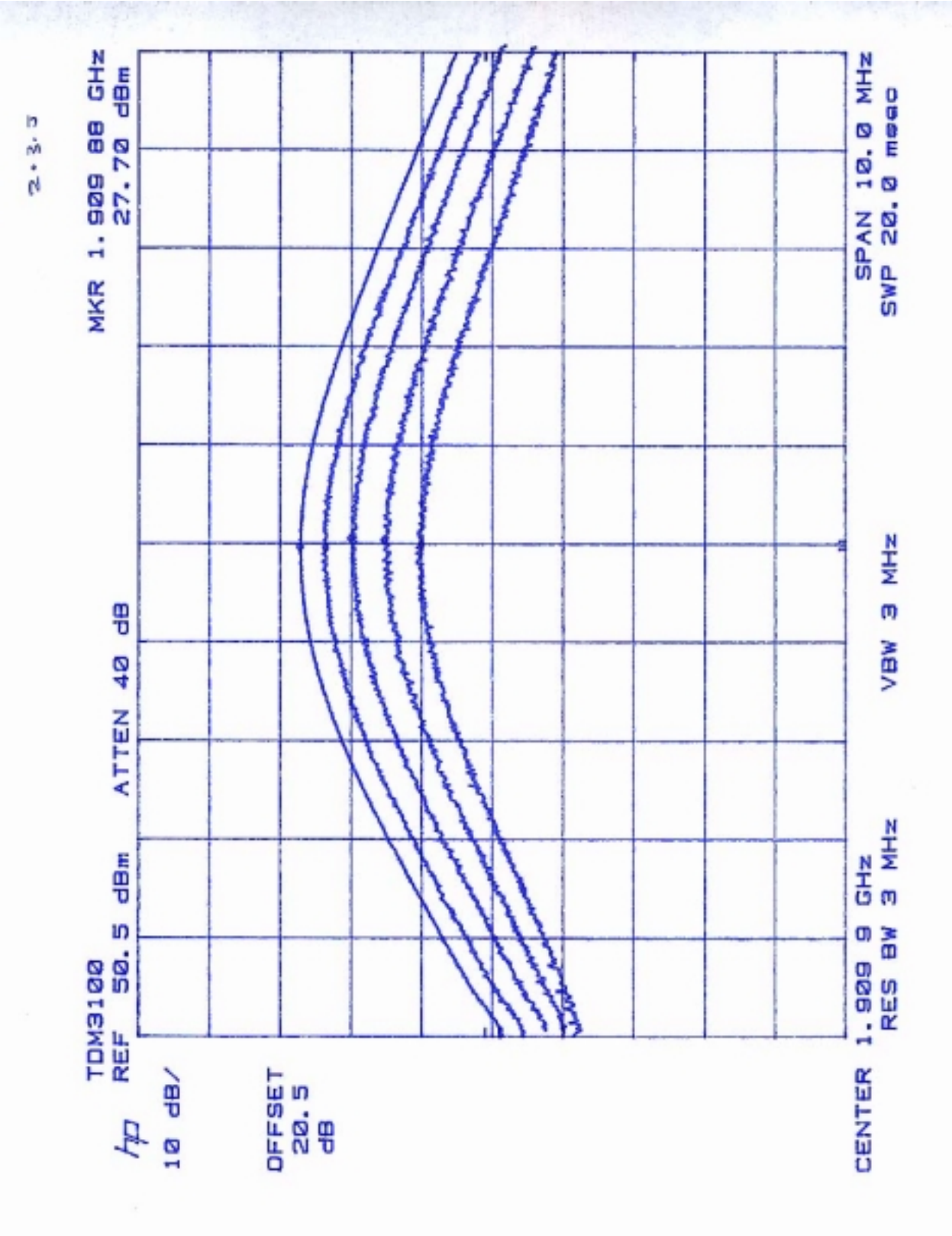

2.3.d
MKR 824.00 MHz
27.80 dBm
SPAN 10.0 MHz
SWP 2.00 sec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 824.0 MHz
RES BW 3 MHz


2.3.e
MKR 836.59 MHz
27.70 dBm
SPAN 10.0 MHz
SWP 2.00 sec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 836.5 MHz
RES BW 3 MHz


2.3.5
MKR 848.97 MHz
27.80 dBm
SPAN 10.0 MHz
SWP 20.0 msec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 848.9 MHz
RES BW 3 MHz


2.3.7
MKR 1.850 00 GHz
27.80 dBm
SPAN 10.0 MHz
SWP 20.0 msec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 1.850 0 GHz
RES BW 3 MHz


2-3-h
MKR 1.879 86 GHz
27.80 dBm
SPAN 10.0 MHz
SWP 20.0 msec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 1.879 9 GHz
RES BW 3 MHz


MKR 1.909 88 GHz
27.70 dBm
SPAN 10.0 MHz
SWP 20.0 msec
TDM3100
REF 50.5 dBm
ATTEN 40 dB
VBW 3 MHz
10 dB/
OFFSET
20.5
dB
CENTER 1.909 9 GHz
RES BW 3 MHz

3.0 **Radiated Power**

FCC 22.913

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

FCC 24.232

The equivalent Isotropic Radiated Power (EIRP) must not exceed 2 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 in dBuV/m) was calculated.

ERP in frequency band 824-849 MHz, and EIRP in frequency band 1850-1910 MHz were measured using a substitution method. The EUT was replaced by half-wave dipole (824-849 MHz) or horn antenna (1850-1910 MHz) connected to a signal generator. The spectrum analyzer reading was recorded and ERP/EIRP was calculated as follows:

$$ERP = E_1 - E_2 + V_g, \; ; \; EIRP = E_1 - E_2 + V_g + G$$

where E_1 & E_2 are spectrum analyzer readings in dBuV/m when measured field strength from EUT & generator accordingly; V_g is the generator output in dBm; G is the transmitting antenna gain.

3.2 Test Equipment

Hewlett Packard HP8566B Spectrum Analyzer
EMCO 3148 Log Periodic Antenna
EMCO 3115 Horn Antenna
CDI Robert's Antenna
Rohde & Schwarz SMH 44 signal generator

3.3 Test Results

Passes	Refer to the attached data sheets.

Field Strength of fundamental

Frequency MHz	**Antenna Polarity**	**Detector**	**SA Reading dB(µV)**	**Antenna Factor dB(1/m)**	**Cable Loss dB**	**Field Strength dB(µV/m)**
AMPS Mode						
824.04	V	Peak	103.2	23.0	2.0	128.2
836.55	V	Peak	103.3	23.3	2.0	128.6
848.97	V	Peak	103.0	23.3	2.0	128.3
TDMA Mode						
824.04	V	Peak	106.1	23.0	2.0	131.1
836.55	V	Peak	104.4	23.3	2.0	129.7
848.97	V	Peak	103.7	23.3	2.0	129.0
TDMA Mode						
1850.0	V	Peak	94.8	30.1	2.2	127.1
1879.9	V	Peak	90.9	30.1	2.2	123.2
1909.9	V	Peak	89.4	30.1	2.2	121.7

Radiated Power (Substitution Method)

Frequency MHz	Antenna Polariz.	Field Strength (EUT) dBµV/m	Field Strength (Sig. Gen. + Tuned Dipole) dBµV/m	Signal Generator Output dBm	ERP dBm
AMPS Mode					
824.04	V	128.2	113.5	10.0	24.7
836.55	V	128.6	113.4	10.0	25.2
848.97	V	128.3	113.3	10.0	25.0
TDMA Mode					
824.04	V	131.1	113.5	10.0	27.6
836.55	V	129.7	113.4	10.0	26.3
848.97	V	129.0	113.3	10.0	25.7

Radiated Power (Substitution Method)

Frequency MHz	Antenna Polariz.	Field Strength (EUT) dBµV/m	Field Strength (Sig. Gen. + horn ant.) dBµV/m	Signal Generator output + ant. gain* dBm	EIRP dBm
TDMA Mode					
1850.0	V	127.1	116.2	17.0	27.9
1879.9	V	123.2	115.0	17.0	25.2
1909.9	V	121.7	115.2	17.0	23.5

*Antenna gain equals 7.0 dBi

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 an 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 Modulation Deviation Limiting			
Ouput Level (mV)	FM Deviation in kHz at Indicated Modulating Frequency		
	3000 Hz	1000 Hz	300 Hz
10.0	3.9	2.2	1.5
15.0	4.6	2.6	1.5
20.0	5.4	2.9	1.5
30.0	6.3	3.3	1.6
40.0	7.2	3.7	1.7
50.0	7.8	3.7	1.7
60.0	8.2	4.0	1.7
70.0	8.8	4.3	1.7
80.0	9.2	4.3	1.8
90.0	9.5	4.6	1.8
100.0	10.2	4.6	1.8
110.0	10.3	4.7	1.9
150.0	10.9	4.9	1.9
160.0	11.1	5.8	2.0
170.0	11.1	5.9	2.0
180.0	11.1	6.0	2.1
190.0	11.1	6.1	2.2
200	11.1	6.4	2.2
250	11.2	6.5	2.2
300	11.3	6.6	2.3
400	11.4	6.6	2.4
450	11.4	6.6	2.4
500	11.4	6.6	2.6
600	11.5	6.6	2.9
650	11.5	6.6	3.1
700	11.5	6.5	3.8
800	11.4	6.5	4.4
900	11.4	5.9	4.0
1000	11.4	4.8	3.8

Middle Channel: 836.52 MHz

Table 4.1b Frequency Deviation			
Frequency kHz	Initial Deviation	Peak Deviation	Steady State Deviation
0.3	1.8	2.07	1.97
0.5	2.1	3.42	2.61
0.7	2.7	3.42	3.18
0.9	2.9	3.52	3.51
1.0	2.9	3.72	3.60
1.2	3.3	4.78	4.60
1.4	3.7	4.82	4.73
1.6	3.7	5.01	4.90
1.8	3.9	10.08	5.57
2.0	8.1	9.50	9.39
2.4	7.8	10.10	9.85
2.8	8.1	10.10	9.73
3.0	7.0	9.25	9.10

Test Conditions:

V_{inp} = 38.5 mV
Deviation = 8 kHz at 2 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.

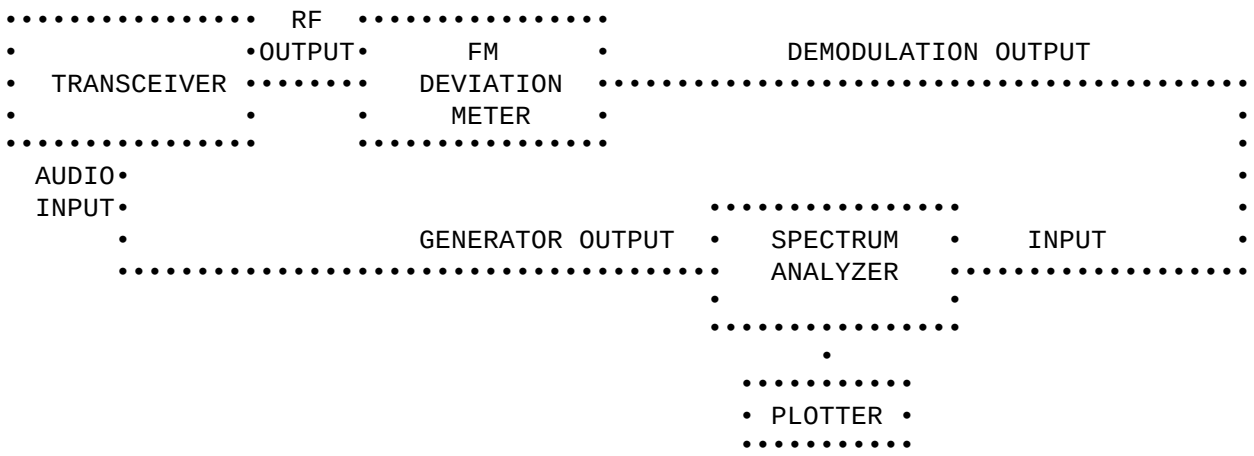
(ii) In the frequency range of 5.9 to 6.1 kHz, signals must be attenuated at least 35 dB.

(iii) In the frequency range above 15 kHz, signals must be attenuated at least 28 dB.

5.1 Test Procedure

The RF output of the transceiver was connected to the input of an 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 coupledl 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.

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 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).

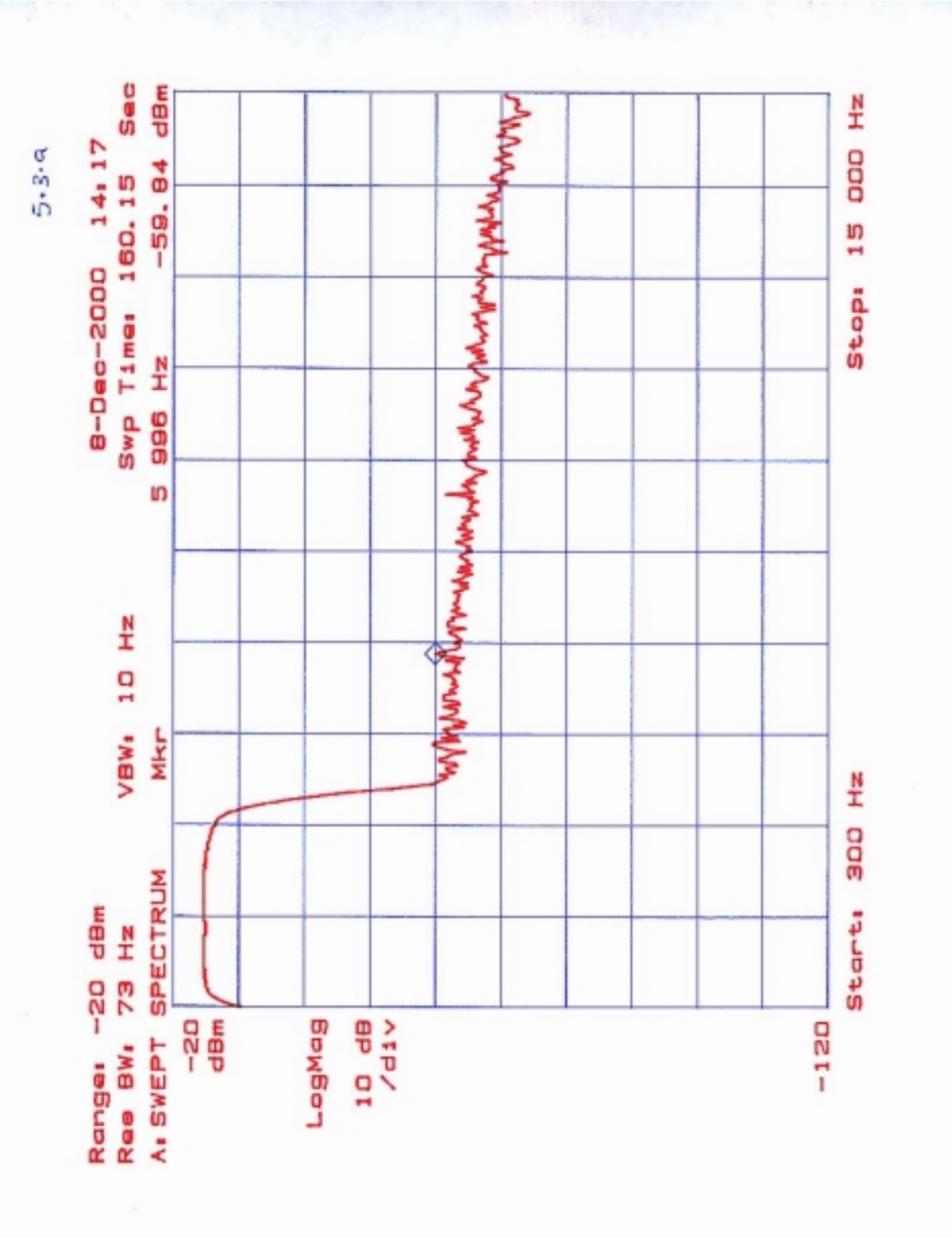
5.2 Test Equipment

Marconi Instruments 2955A Radio Communications Test Set
HP 3588A Spectrum Analyzer
HP 7470A Plotter
Leader LFG-1300S Function Generator
LMV-182 AC Millivoltmeter

5.3 Test Results

Passed, refer to the attached plots and data table.

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


5.3.9
8-Dec-2000 14:17
Swp Time: 160.15 Sec
5 996 Hz
-59.84 dBm
Stop: 15 000 Hz
VBW: 10 Hz
Mkr
Range: -20 dBm
Res BW: 73 Hz
A: SWEPT SPECTRUM
-20 dBm
LogMag
10 dB /div
-120
Start: 300 Hz

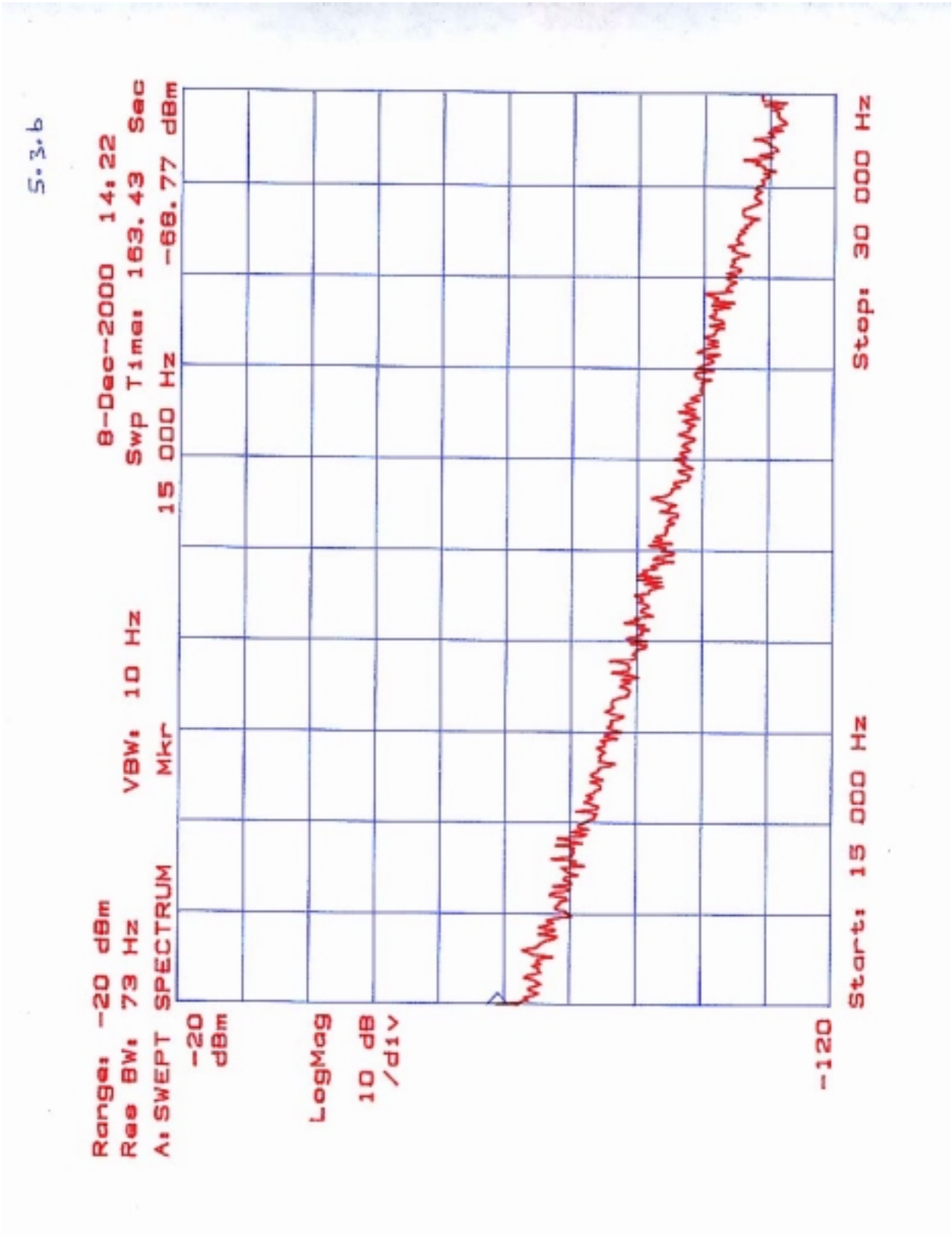

5.3.6
8-Dec-2000 14:22
Swp Time: 163.43 Sec
15 000 Hz
-68.77 dBm
Step: 30 000 Hz
VBW: 10 Hz
Mkr
Range: -20 dBm
Res BW: 73 Hz
A: SWEPT SPECTRUM
-20 dBm
LogMag
10 dB /div
-120
Start: 15 000 Hz

Table 5.1 Audio Filter Characteristics		
Modulation Frequency kHz	Relative Level dBm	Attenuation
0.3	-29.96	5.43
0.4	-27.02	2.49
0.5	-25.40	0.90
0.6	-24.72	0.20
0.7	-24.77	0.03
0.8	-24.91	0.03
0.9	-24.58	0.04
1.0	-24.58	0.04
1.2	-24.57	0.01
1.4	-24.53	0.00
1.6	-24.46	-0.07
1.8	-24.56	0.03
2.0	-24.58	0.05
2.2	-24.48	-0.05
2.5	-24.46	-0.07
3.0	-24.56	0.03
3.5	-24.61	0.07
4.0	-33.61	9.08
4.5	-60.84	36.31
5.0	-61.99	37.46
5.5	-62.89	38.36
5.9	-61.50	36.97
6.0	-62.09	37.56
6.1	-62.87	38.34
8.0	-64.94	40.41
10.0	-65.19	40.66
15.0	-71.29	46.76
20.0	-84.47	59.94
30.0	-97.20	72.67

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 unmodualted 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 ofthe 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 frequencies 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.

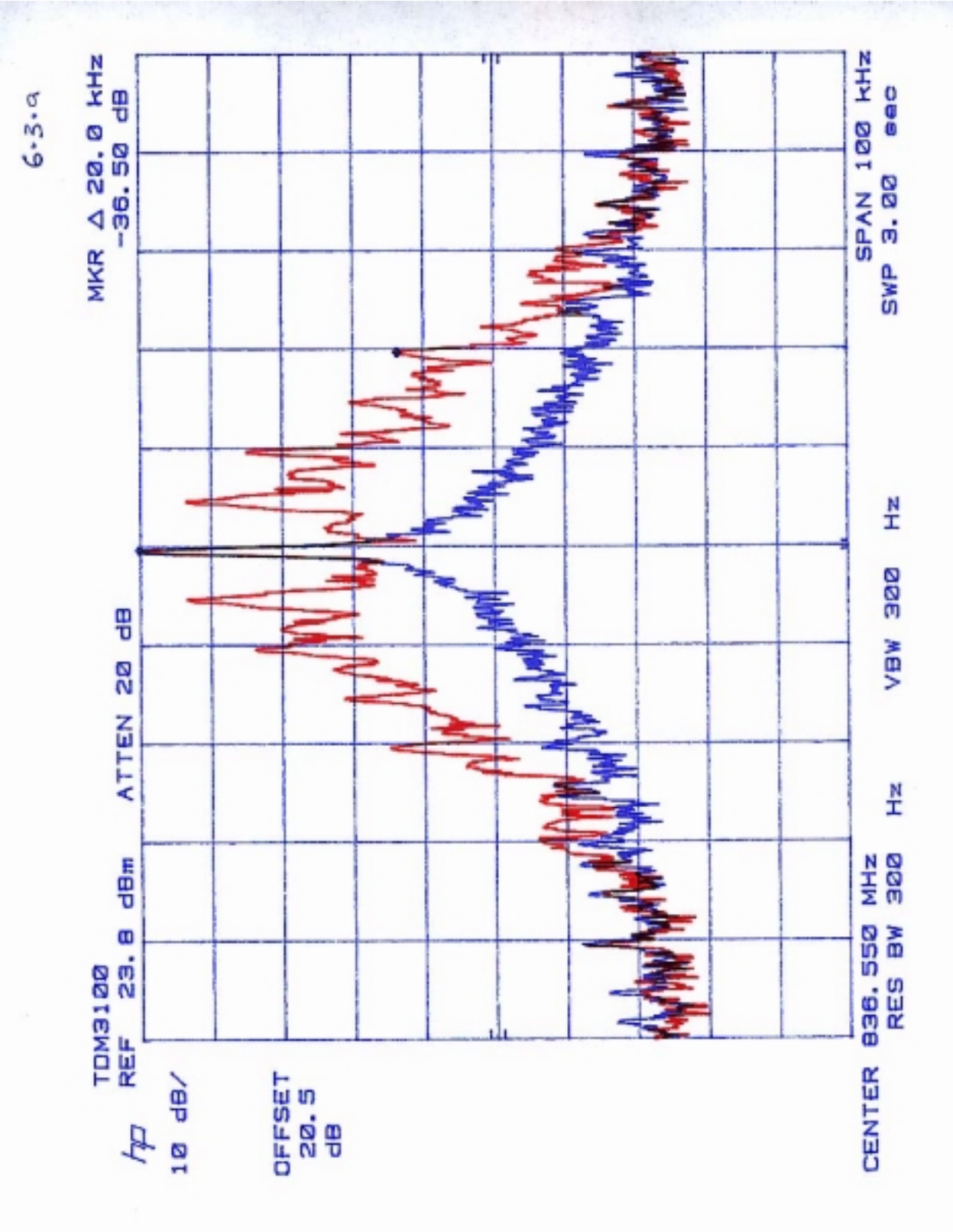
6.2 Test Equipment

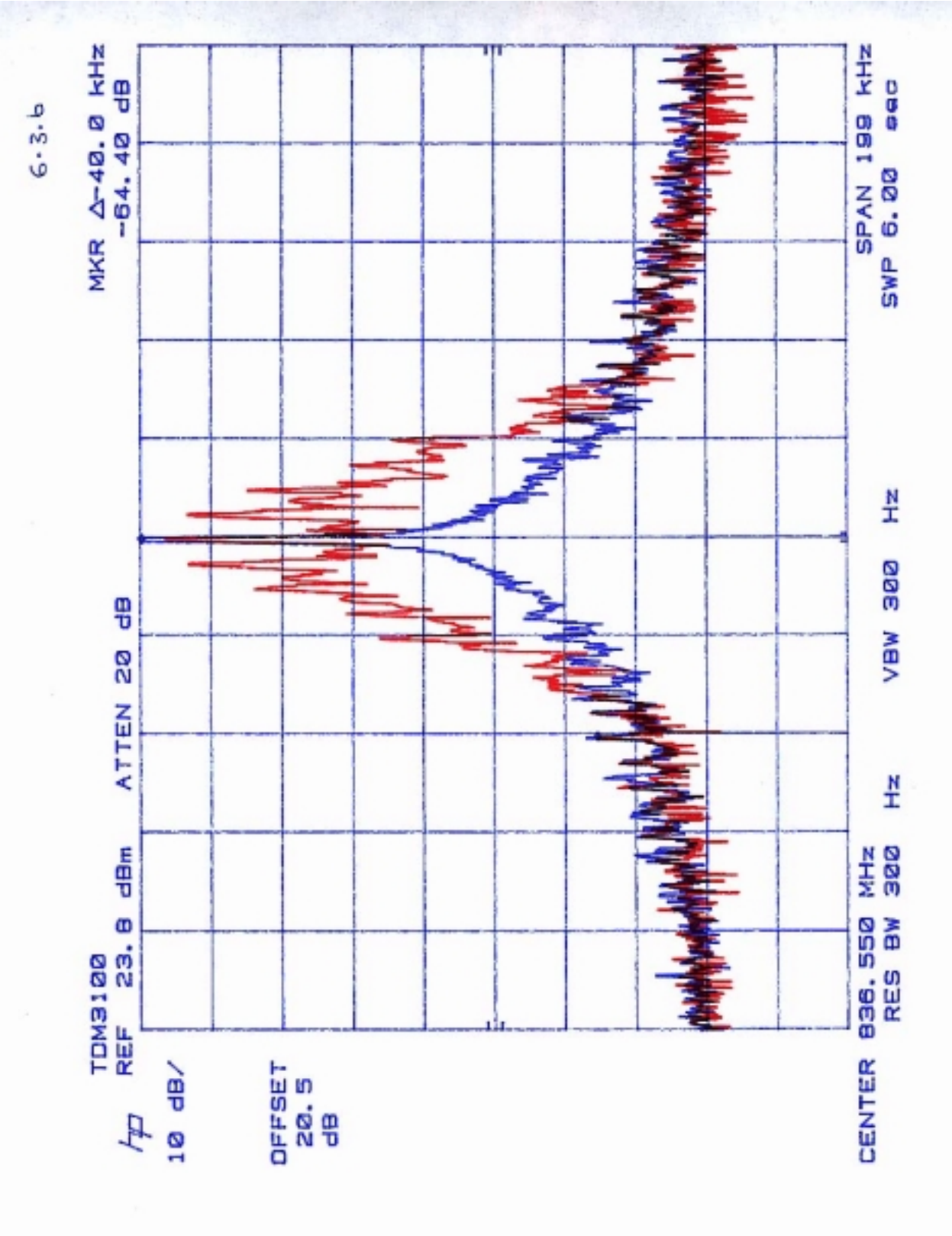
HP 8566B Spectrum Analyzer
Leader LFG-1300S Function Generator
Leader LMV-182 AC Millivoltmeter
Marconi 2955A Radio Communication Test Set
HP 7470A Plotter

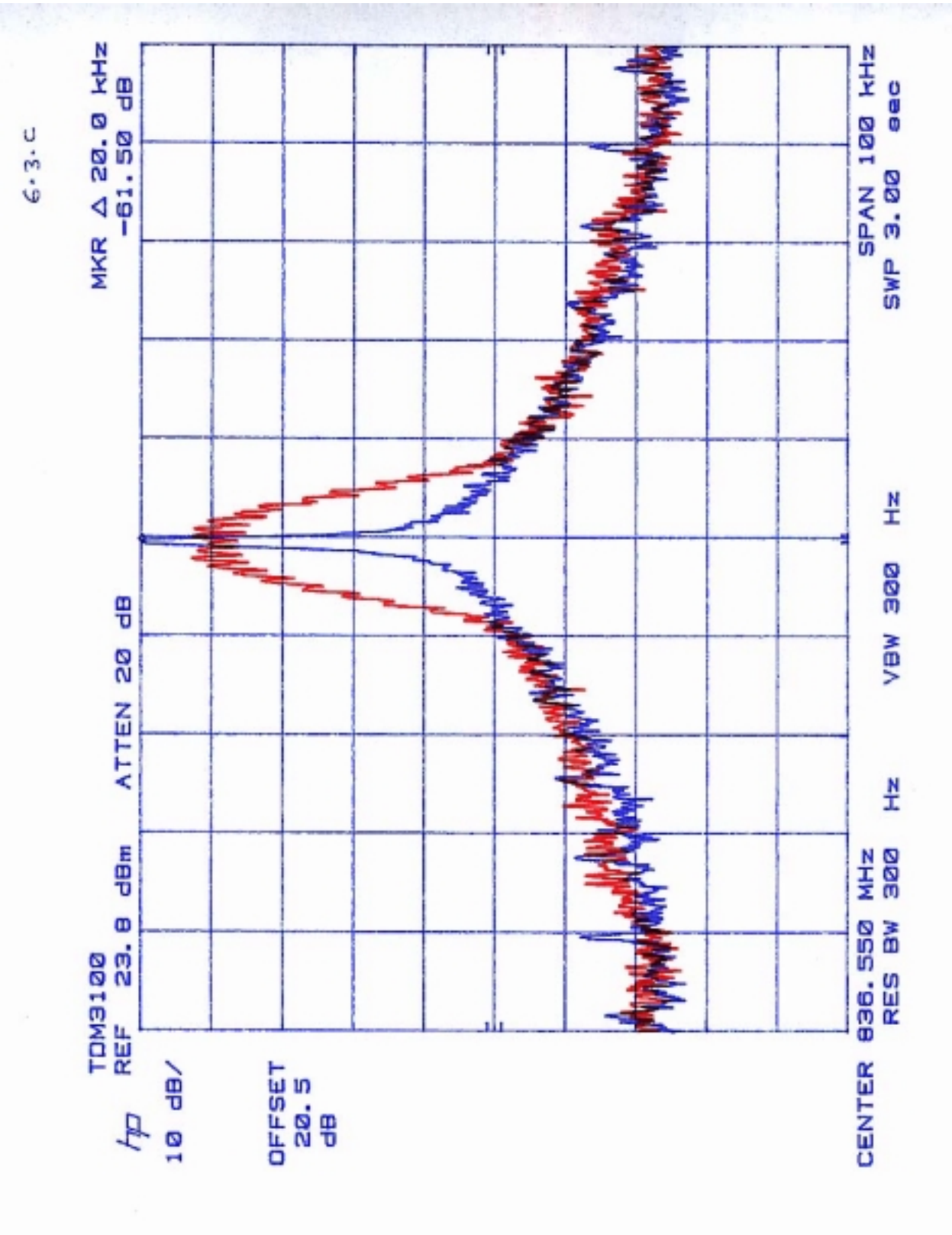
6.3 Test Results

Passes	Refer to the attached plots.

Plot Number	Description
6.3.a	Wideband emissions (0, 1, 0, 1), scan 100 kHz
6.3.b	Wideband emissions (0, 1, 0, 1), scan 200 kHz
6.3.c	DTMF "9"
6.3.d	SAT (6 kHz, 2 kHz deviation)
6.3.e	ST (10 kHz, 8 kHz deviation), scan 100 kHz
6.3.f	ST & SAT (6 kHz & 10 kHz), scan 100 kHz
6.3.g	DTMF & SAT, scan 100 kHz
6.3.h	Voice (2.5 kHz), scan 100 kHz
6.3.i	Voice (2.5 kHz) & SAT (6 kHz), scan 100 kHz
6.3.j	Voice (2.5 kHz) & SAT (6 kHz), low power
6.3.k	TDMA mode, scan 100 kHz
6.3.l	TDMA mode, scan 200 kHz


6-3-a
MKR Δ 20.0 kHz
-36.50 dB
SPAN 100 kHz
SWP 3.00 sec
TDM3100
REF 23.8 dBm
ATTEN 20 dB
VBW 300 Hz
10 dB/
OFFSET
20.5
dB
CENTER 836.550 MHz
RES BW 300 Hz


6.3.6
MKR Δ-40.0 kHz
-64.40 dB
SPAN 199 kHz
SWP 6.00 sec
TDM3100
REF 23.8 dBm
ATTEN 20 dB
VBW 300 Hz
10 dB/
OFFSET
20.5
dB
CENTER 836.550 MHz
RES BW 300 Hz


6.3.c
MKR Δ 20.0 kHz
-61.50 dB
SPAN 100 kHz
SWP 3.00 sec
TDM3100
REF 23.0 dBm
ATTEN 20 dB
VBW 300 Hz
10 dB/
OFFSET
20.5
dB
CENTER 836.550 MHz
RES BW 300 Hz