

FCC Parts 22 and 24 Test Report

For
Sharp Labs of America

Performed on the

CDMA/AMPS Cellular and PCS (CDMA) Telephone
Model: TQ-CX1
FCC ID: APYHRO00022

Date of Test: April 25-26 & Jun 10-15, 2001

Report #: 20466372

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FCC Parts 22, 24 Certification, Ver 7/98

Tested by:	Suresh Kondapalli	Review Date: 6/29/01
Reviewed by:	David Chernomordik, Ph.D. EMC Site Manager	Review Date: 6/30/01



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Sharp Labs, CDMA/AMPS Cellular Phone
FCC ID: AHYRO00022

Date of Test: April 25-28 & Jun10-15, 2001

1.0 Introduction

1.1 Test Summary

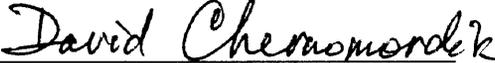
FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
2.1046	RF Power Output	Passed	5
22.913, 24.232	ERP, EIRP	Passed	16
2.1047	Modulation Requirements	Passed	18
22.915(d)(1)	Audio Filter Characteristics	Passed	21
2.1049 22.917(b)(d)	Emission Limitation, Occupied Bandwidth	Passed	27
2.1051, 22.917(e) 22.917(f), 24.238(a)	Out of Band Emissions at Antenna Terminals Mobile Emissions In Base Frequency Range	Passed	43
2.1053	Field Strength of Spurious Radiation	Passed	94
15.107	Line Conducted Emissions	Not* Applicable	115
2.1055	Frequency Stability vs. Temperature	Passed	116
2.1055	Frequency Stability vs. Voltage	Passed	118
2.1091, 2.1093	Specific Absorption Rate	Passed	**

* Not Applicable as EUT is battery Operated,

** Separate Report

Tested By: 
Suresh Kondapalli

06/29/01
Date

Approved By: 
David Chernomordik

6/30/01
Date

Sharp Labs, CDMA/AMPS Cellular Phone
FCC ID: AHYRO00022

Date of Test: April 25-28 & Jun10-15,2001

1.2 Product Description

The Wireless Link Corporation Model TDM - 3100 is a dual mode, dual band CDMA 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	<input checked="" type="checkbox"/> Yes, <input type="checkbox"/> No
Cellular Phone standards	<input type="checkbox"/> AMPS <input checked="" type="checkbox"/> CDMA
Type(s) of Emission	40K0F8W, 40K0F1D, 30K0G7D
Allowed Deviation	12± 10% (AMPS mode)
RF Output Power	824-849 MHz: 24.4 dBm - AMPS 824-849 MHz: 27.0 dBm - CDMA 1850-1910 MHz: 24.4 dBm - CDMA
Frequency Range	824 - 849 (AMPS & CDMA), 1850 - 1910 (CDMA)
Antenna(e) & Gain	0 dBi
Detachable antenna ?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Receiver L.O. frequency	
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.

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

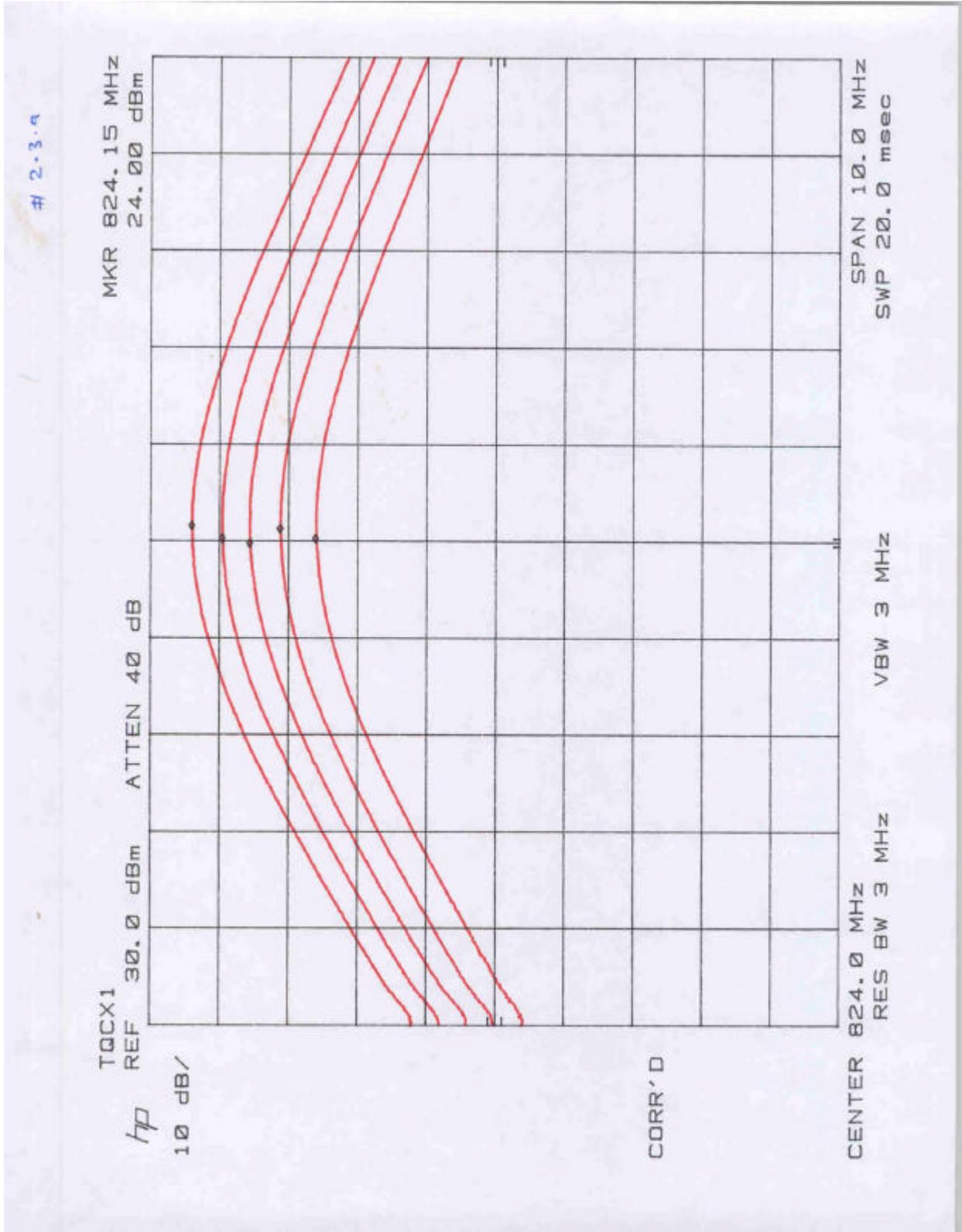
Tektronix 2784 Spectrum Analyzer, 100 Hz – 40 GHz

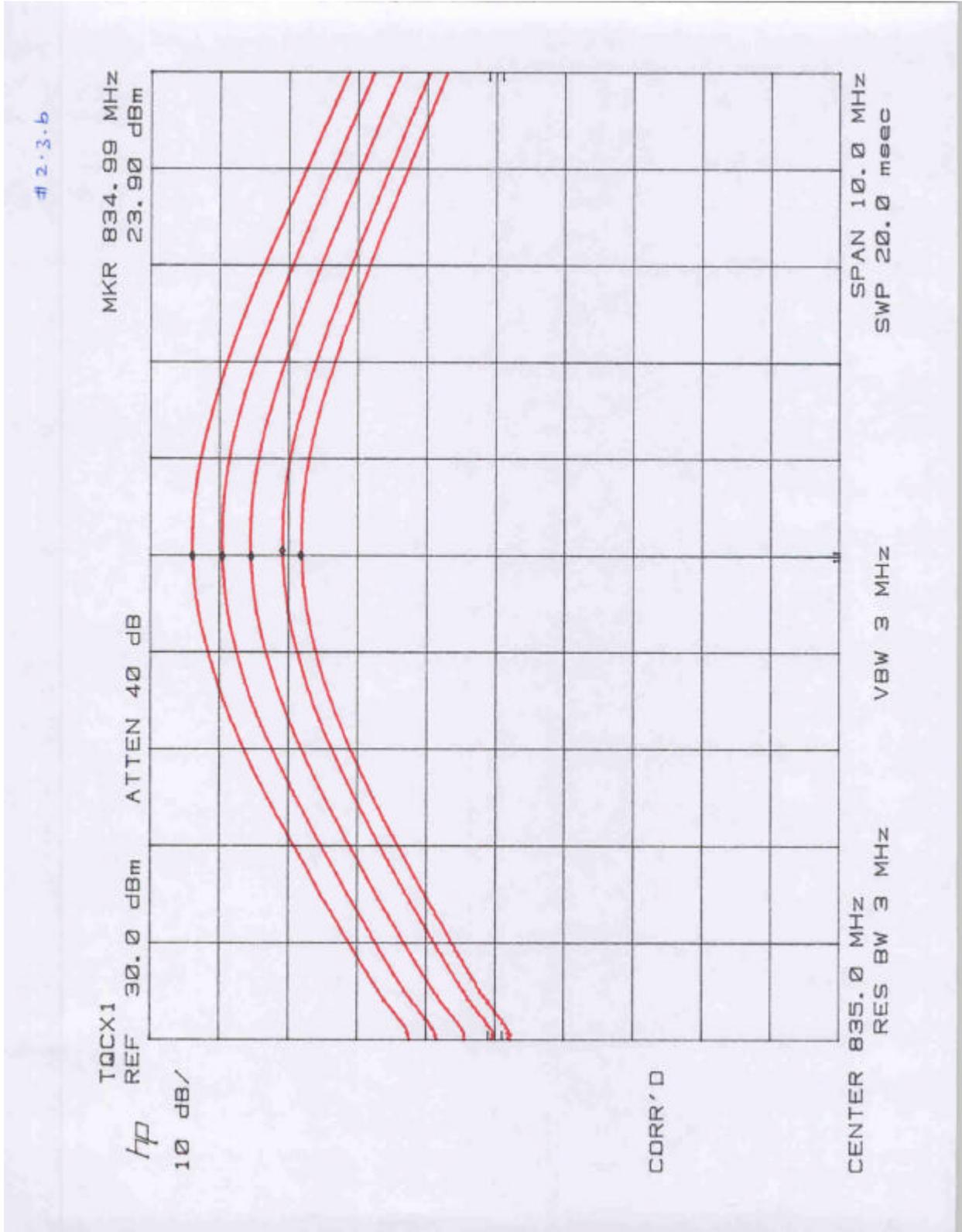
2.3 Test Results

Frequency (MHz)	Measured Power (dBm)
824.04 (AMPS)	24.4
835.02 (AMPS)	24.2
848.97 (AMPS)	24.3
824.04 (CDMA)	26.9
835.02 (CDMA)	27.0
848.97 (CDMA)	26.9
1851.2 (CDMA)	23.9
1880.0 (CDMA)	24.4
1909.9 (CDMA)	24.3

For more details refer to the attached plots:

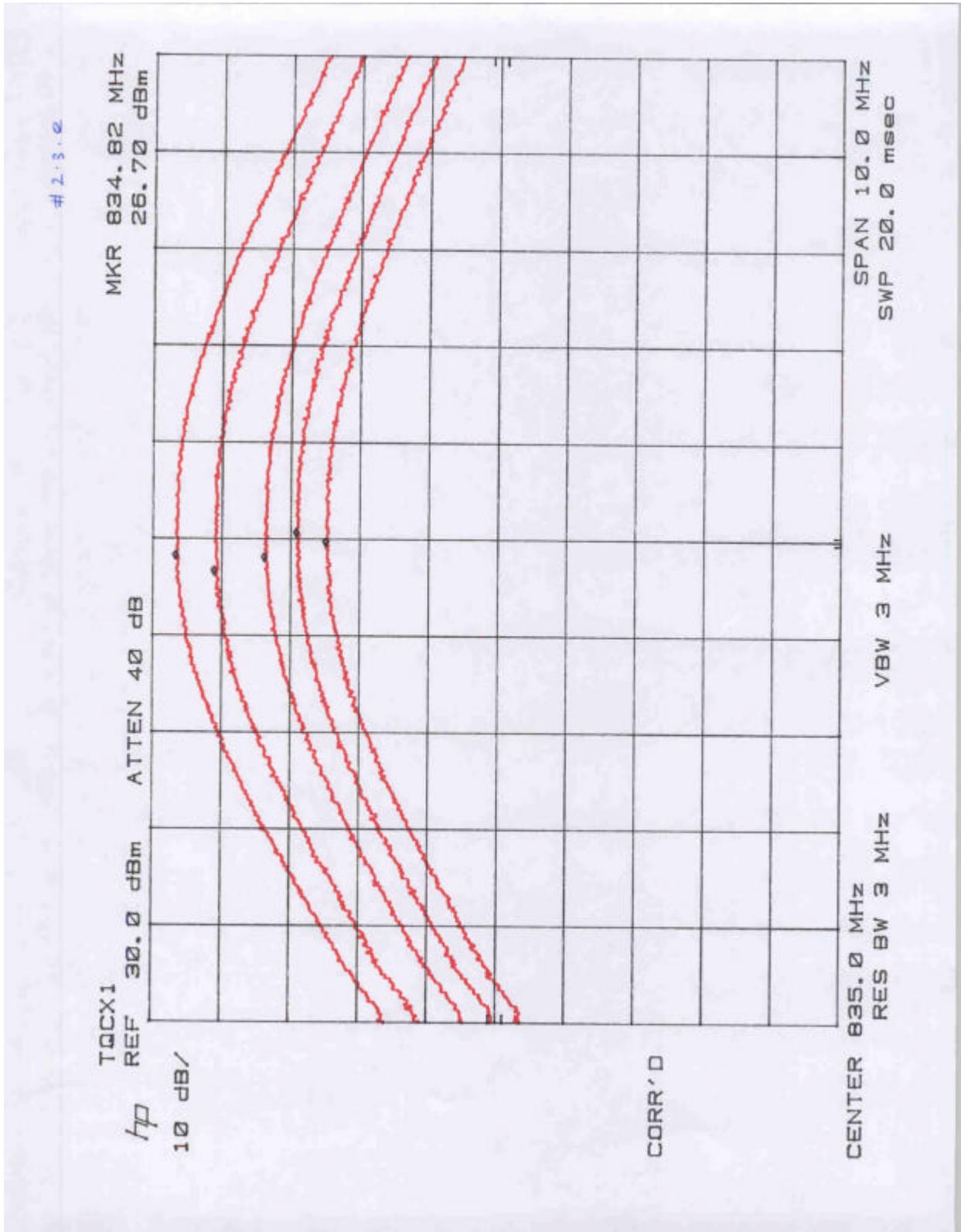
AMPS Mode	
Plot Number	Description
2.3.a	Low Channel
2.3.b	Middle Channel
2.3.c	High Channel
CDMA Mode	
Plot Number	Description
2.3.d	Low Channel
2.3.e	Middle Channel
2.3.f	High Channel
PCS Band (CDMA Mode)	
Plot Number	Description
2.3.g	Low Channel
2.3.h	Middle Channel
2.3.j	High Channel



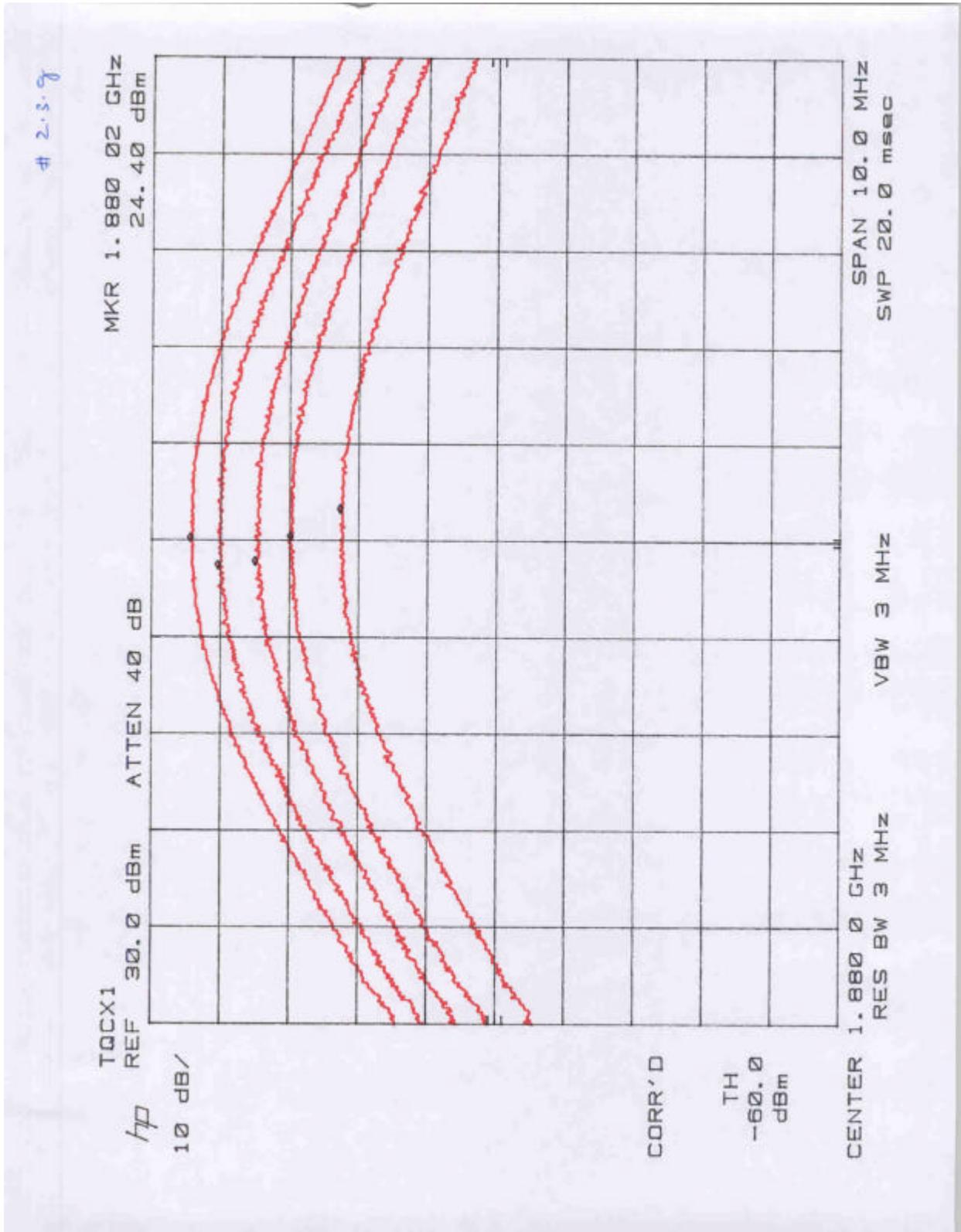


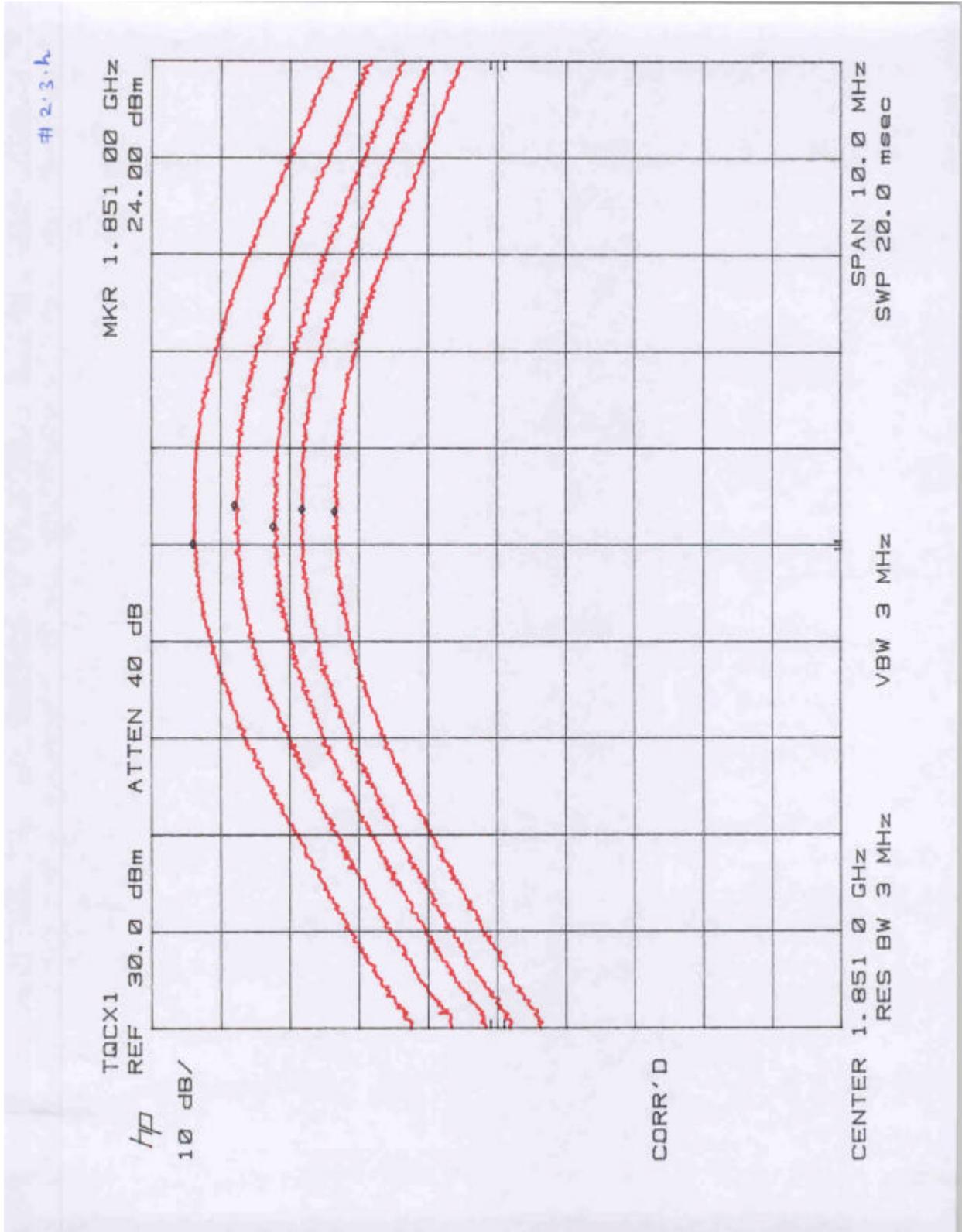














3.0 Radiated Power

FCC 22.913

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

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 1851.25-1910 MHz were measured using a substitution method. The EUT was replaced by half-wave dipole (824-849 MHz) or horn antenna (1851.25-1910 MHz) connected to a signal generator. The spectrum analyzer reading was recorded and ERP/EIRP was calculated as follows:

$$\text{ERP} = E_1 - E_2 + V_g; \quad \text{EIRP} = E_1 - E_2 + V_g + G$$

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

Passed	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	102.4	23.0	2.0	127.4
835.02	V	Peak	100.8	23.3	2.0	126.1
848.97	V	Peak	100.6	23.3	2.0	125.9
CDMA Mode						
824.04	V	Peak	103.3	23.0	2.0	128.3
835.02	V	Peak	102.9	23.3	2.0	128.2
848.97	V	Peak	100.9	23.3	2.0	126.2
CDMA Mode						
1851.2	V	Peak	97.1	30.1	2.7	129.9
1879.9	V	Peak	96.5	30.1	2.7	129.3
1909.9	V	Peak	94.0	30.1	2.8	126.9

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	127.4	111.4	10.0	26.0
835.02	V	126.1	111.3	10.0	24.8
848.97	V	125.9	111.2	10.0	24.7
CDMA Mode					
824.04	V	128.3	111.4	10.0	26.9
835.02	V	128.2	111.3	10.0	26.9
848.97	V	126.2	111.2	10.0	25.0

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
CDMA Mode					
1851.2	V	129.9	118.7	17.0	28.2
1879.9	V	129.3	118.7	17.0	27.6
1909.9	V	126.9	118.8	17.0	25.1

*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
1.0	1.4	0.7	0.1
2.0	2.7	1.3	0.2
3.0	4.0	1.9	0.3
5.0	6.4	3.1	0.4
10.0	8.1	6.1	0.8
15.0	8.6	9.1	1.1
20.0	8.8	10.6	1.5
30.0	8.9	11.9	2.1
40.0	9.0	11.8	2.2
50.0	8.9	9.7	2.9
60.0	8.7	9.7	3.5
70.0	8.7	10.0	4.2
80.0	8.7	11.5	5.9
90.0	8.7	12.4	6.6
100.0	8.7	13.0	6.7
110.0	8.7	13.1	6.8
150.0	8.7	13.1	6.9
160.0	8.7	13.1	7.9
170.0	8.7	13.2	8.0
180.0	8.7	13.2	8.2
190.0	8.7	13.2	8.4
200	8.7	13.2	10.2
250	8.7	13.2	11.4
300	8.7	13.2	11.7
400	8.7	13.2	11.7
450	8.7	13.2	11.7
500	8.7	13.2	11.7
600	8.7	13.2	11.5
650	8.7	13.2	11.4
700	8.7	13.2	11.3
800	8.7	13.2	11.0
900	8.7	13.2	10.8
1000	8.7	13.2	10.6

Middle Channel: 835.02 MHz

Table 4.1b			
Frequency Deviation			
Frequency kHz	Initial Deviation	Peak Deviation	Steady State Deviation
0.3	1.0	7.6	7.3
0.5	3.1	11.0	10.9
0.7	5.3	10.4	10.3
0.9	7.1	11.5	11.4
1.0	8.0	13.1	13.0
1.2	9.4	13.1	12.8
1.4	9.8	13.1	12.1
1.6	9.9	11.2	11.0
1.8	9.9	13.2	11.3
2.0	9.9	13.2	10.1
2.4	10.1	12.0	12.0
2.8	9.8	10.2	10.0
3.0	8.7	9.0	8.8

Test Conditions:

$V_{inp} = 13.2$ mV
Deviation = 8 kHz at 1 kHz modulation frequency
Middle Channel = 835.02 MHz

5.0 Audio Filter Characteristics, FCC 22.915(d)

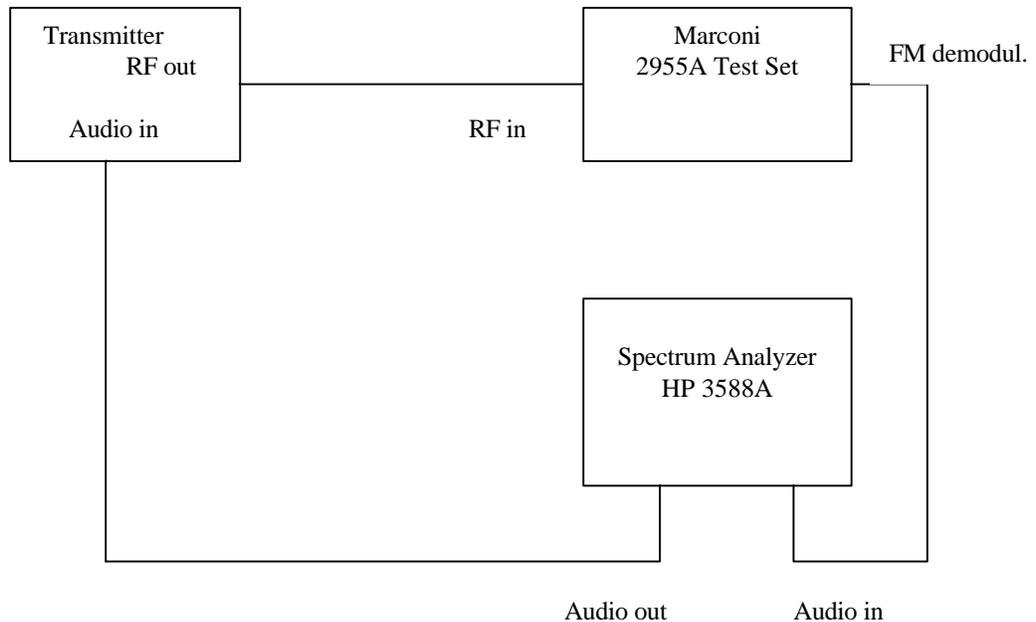
For mobile stations, these signals must be attenuated, relative to the level at 1 kHz, as follows:

- (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 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.

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).

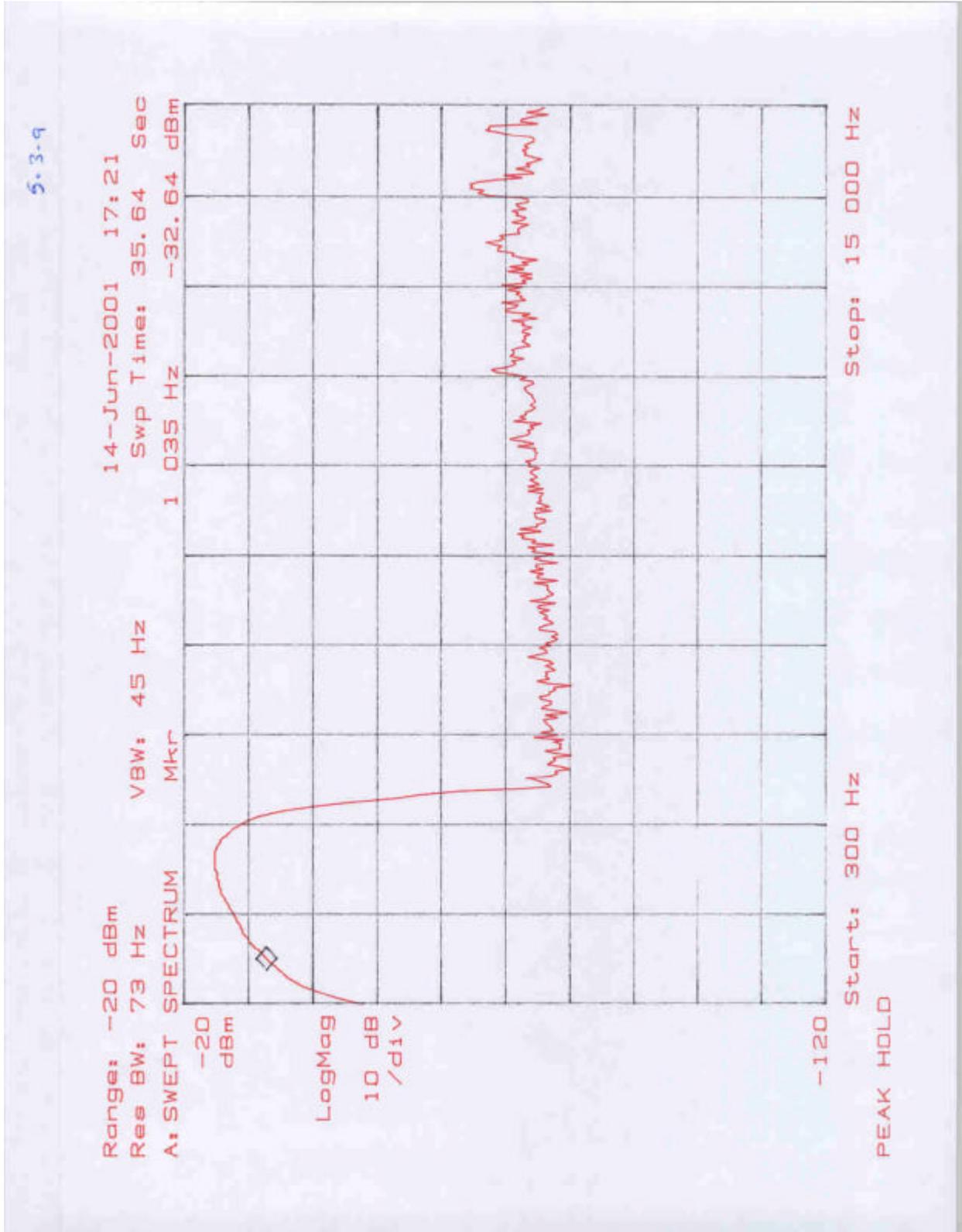
5.2 Test Equipment

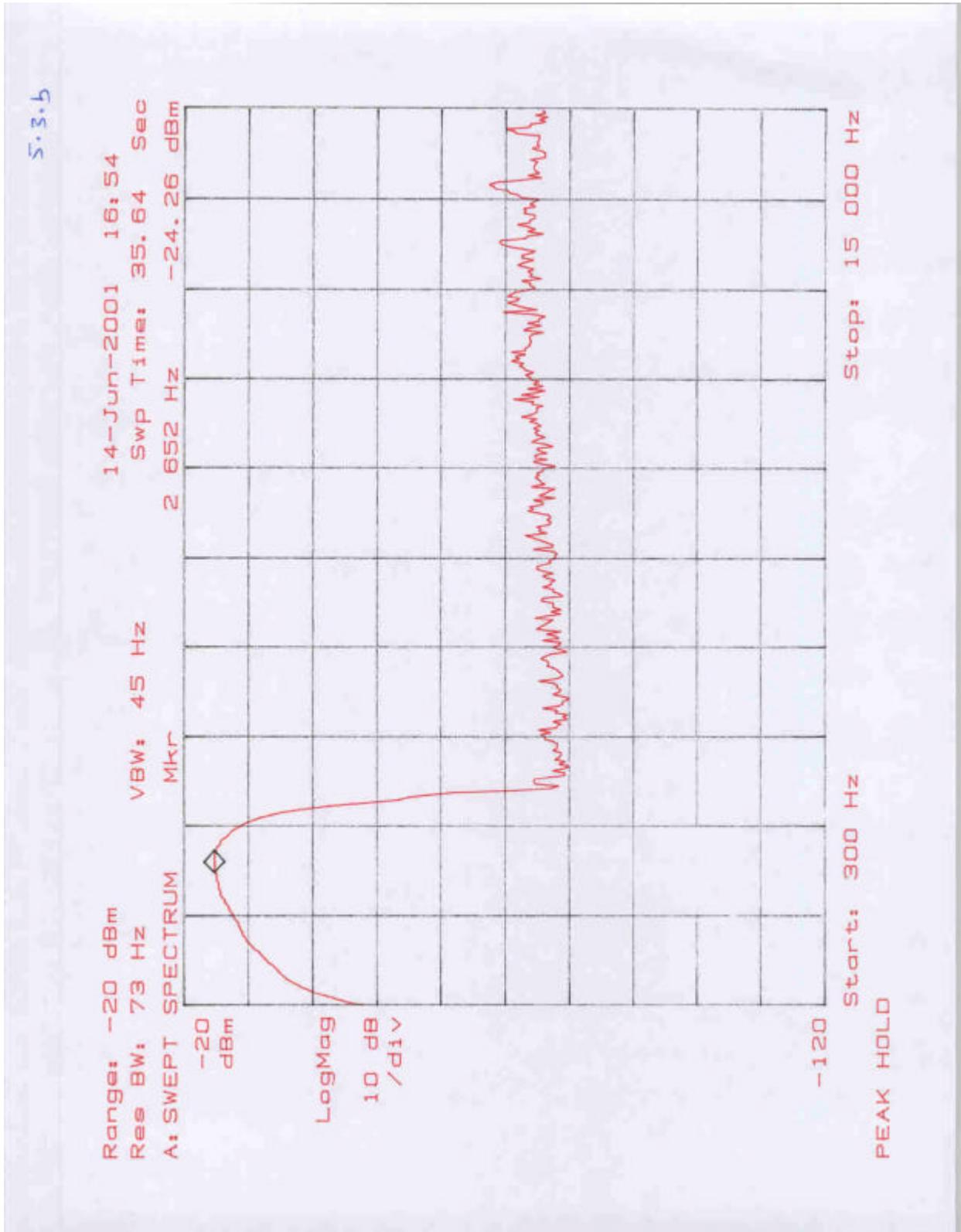
Marconi Instruments 2955A Radio Communications Test Set
HP 3588A Spectrum Analyzer
HP 7470A Plotter
Leader LFG-1300S Function Generator
LMV-182 AC Millivoltmeter

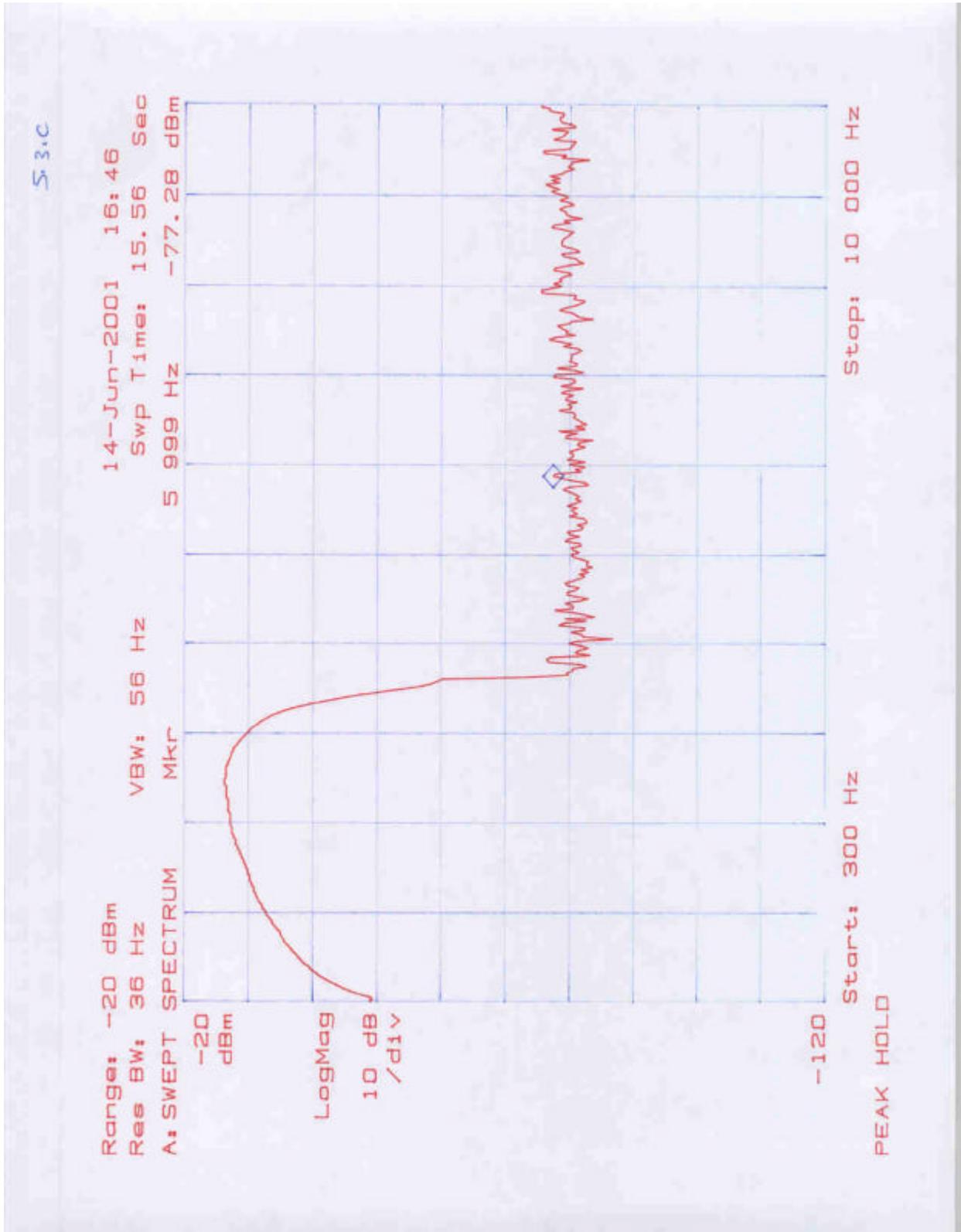
5.3 Test Results

Audio Filter Characteristics	
Plot Number	Description
5.3.a	300Hz to 15KHz, Marker at 1KHz
5.3.b	300Hz to 15KHz, Marker at Peak Deviation
5.3.c	300Hz to 15KHz, Marker at 5.99KHz

Table 5.1 Audio Filter Characteristics		
Modulation Frequency kHz	Relative Level dBm	Attenuation
0.3	-45.6	12.6
0.4	-43.0	10.0
0.5	-39.9	6.9
0.6	-38.2	5.2
0.7	-36.3	3.3
0.8	-34.9	1.9
0.9	-33.9	0.9
1.0	-32.9	0
1.2	-30.8	-2.1
1.4	-29.3	-3.6
1.6	-27.8	-5.1
1.8	-26.7	-6.2
2.0	-25.7	-7.2
2.2	-25.0	-7.9
2.5	-24.4	-8.5
3.0	-25.7	-7.2
3.5	-34.7	1.7
4.0	-78.6	45.6
4.5	-77.2	44.2
5.0	-76.2	43.3
5.5	-77.1	44.1
5.9	-75.0	42.0
6.0	-75.3	42.3
6.1	-78.1	45.1
8.0	-71.8	38.8
10.0	-73.7	40.7
15.0	-73.6	40.6







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 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 CDMA 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 100kHz
6.3.b	Carrier Frequency, no modulation, scan 200kHz
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 100 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	ST & SAT (6 kHz & 10 kHz), scan 200 kHz
6.3.k	DTMF & SAT, scan 100 kHz
6.3.l	Voice (2.5 kHz), scan 100 kHz
6.3.m	Voice (2.5 kHz) & SAT (6 kHz), scan 100 kHz
6.3.n	Voice (2.5 kHz) & SAT (6 kHz), low power

