ITS Intertek Testing Services
ETL SEMKO

FCC Part 95(G) Test Report

for

Phonic Ear Inc.

on the

Low Power Radio Service Station

Model: BTE-FM 216

FCC ID: BRG300T216A

Job No: J20042625
Date of Test: March 28, 2001

Report No.: 20426251a
Date of Report: March 30, 2001

Tested by:	Suresh Kondapalli Test Engineer
Reviewer:	Ollie Moyrong, EMC Manager

TABLE OF CONTENTS

1.0 Job Description

1.1 Client Information

The EUT has been tested at the request of

Company: Phonic Ear Inc.
3880 Cypress Drive
Petaluma CA 94954, USA

Name of contact: Barbara Brown
Telephone: (707) 769-1110
Fax: (707) 769-9624

1.2 Equipment under test (EUT)

Equipment type: Low Power Radio Service

Model number(s): Sprite BTE-FM 216MHz
Transmitter PE 300TS
Receiver PE 800R

Part or serial number: FCC ID: BRG300T216

Manufacturer: SAME as above.

Use of Product : Voice communications

Production is planned: [X] Yes, [ ] No

Technical Specifications:

Type of Emission	26K8F3E
Range of RF Output	0.006 W (ERP)
Means for variation of operating power	None
Frequency Range	216.025 - 216.975 MHz
Max. number of Channels	19
Channel Bandwidth (authorized)	50 kHz
Antenna	Mic & ear phone cable - used as antenna.
Detachable antenna?	Yes,
External input	Audio
DC voltage and current into final RF Stage	2.1V , 20mA

EUT receive date: 3/20/01

EUT received condition: Good condition prototype

Test start date: 3/26/01

Test end date: 3/30/01

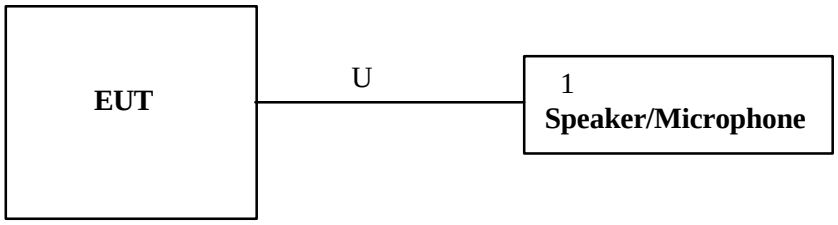
1.3 Test plan reference

FCC Part 2.1033, FCC Part 95 (G)

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details the placement of the equipment under test on the turntable. Please note that the equipment on the rear of the table was centered along the back edge. Equipment on the front of the turntable was centered along the front edge. All peripherals were separated by 10 cm.



S:	Shielded	**U:**	Unshield	**F:**	With Ferrite Core

Support equipment					
Equp. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
1	Speaker/Microphone	Emkay	AT667	Not labeled	N/A

1.4.2 Justification

The system was configured for testing in a typical manner in accordance with ANSI C63.4 standard. During testing, the peripheral locations were varied with respect to the EUT.

1.4.3 Mode(s) of operation

The EUT was powered and fully operational with option speaker/microphone connected. The unit was powered from 2 fully charged AA batteries.

1.4.4 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

2.0 Test Summary

FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
Transmitter Section			
2.1046 95.639(d)	Effective Radiated Power	7.6 dBm	7
2.1047 95.631(d) 95.637	Modulation Characteristics, F3E type. Peak frequency deviation	 6.0 kHz	9
2.1049 95.633(c)	Occupied Bandwidth	26.8 kHz	13
2.1053 95.635(c)	Field Strength of Spurious Radiation	Attenuation more than 40 dB	22
15.107	Line Conducted Emissions	Margin more than 15 dB	28
2.1055	Frequency Stability Vs. Temperature Vs. Voltage	 10.52 ppm 18.70 ppm	31
Receiver Section			
15.109(a)	Radiated Emissions	Worst case Freq.: 148 MHz Margin: 18.9 dB	25

3.0 Effective Radiated Power

3.1 Test Description

Parameter:	FCC § 2.1046
Requirement:	FCC § 95.639
Effective Radiated Power (ERP):	< 0.1 watts

3.2 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 bandwidth of the spectrum analyzer were set to 100 kHz. To maximize emissions, the system was rotated through 360°, the antenna height was varied from 1m to 4m, and the antenna polarization was changed.

The ERP was measured using the substitution method.:

Th EUT was substituted by half-wave dipole connected to the signal generator.

3.3 Test Results

Field Strength at Fundamental

Frequency MHz	Reading dB(μV)	Antenna Factor dB(1/m)	Preamp Gain dB	Cable Loss dB	Field Strength dB(μV/m)
216.525	91.0	11.0	0	3.4	105.4

Note: Field Strength = Reading + Antenna Factor – preamp + Cable loss

Radiated Power (Substitution Method)

Frequency MHz	Field Strength (EUT) dBuV/m	Field Strength (Signal Generator+ Tuned Dipole) dB(μV/m)	Signal Generator Output dBm	ERP (EUT) dBm
216.525	105.4	107.8	10.0	7.6

3.4 Modifications made during testing

None.

3.5 Test Instrumentation

[x] Hewlett Packard HP8566B Spectrum Analyzer (S.A.)
[x] EMCO Bi-Log Antenna
[x] CDI Roberts Antenna

4.0 Modulation Characteristics

4.1 Test Description

Parameter:	FCC § 2.1047

4.2 Test Procedure

4.2.1 Audio Frequency Response

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 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 connectors.

The audio signal input level was adjusted to obtain 20% of the maximum rated system deviation at 1 kHz, and recorded as DEV_{REF}. With the audio, signal generator level unchanged, set the generator frequency between 300 Hz to 5000 Hz. The transmitter deviations (DEV_{FREQ}) were measured and the audio frequency response at test frequency was calculated as

LEV_{FREQ} - LEV_{REF}

$$20\log_{10}\left[\frac{DEV_{FREQ}}{DEV_{REF}}\right]$$

4.2.2 Modulation Limiting

With the same setup as section 4.2.1 above, at three different modulating frequencies, the output level of the audio generator was varied and the FM deviation level was recorded.

4.3 Test Results

X	The test data is presented tables 5.1 and 5.2

Test Condition	
Frequency (MHz)	216.525MHz
Vinp	30 mV

Table 5.1
Audio Filter Characteristics

Modulation Frequency kHz	Deviation kHz	Attenuation dB
0.3	4.75	+0.53
0.4	4.78	+0.47
0.5	4.82	+0.40
0.6	4.85	+0.35
0.7	4.82	+0.40
0.8	4.85	+0.35
0.9	4.92	+0.22
1.0	5.05	0
1.2	5.36	-0.51
1.4	5.30	-0.41
1.6	5.30	-0.41
1.8	5.58	-0.86
2.0	5.50	-0.74
2.2	5.28	-0.38
2.5	4.75	+0.53
3.0	4.72	+0.58
3.5	4.64	+0.73
4.0	4.36	+1.27
4.5	3.98	+2.06
5.0	3.56	+3.03
5.5	3.11	+4.21
6.0	2.25	+7.02
6.5	1.76	+9.15
7.0	0.76	+16.44
8.0	0.03	+44.52

Test Condition	
Frequency (MHz)	216.525MHz

Table 5.2 Modulation Deviation Limiting

Ouput Level (mV)	FM Deviation in kHz at Indicated Modulating Frequency		
	3000 Hz	1000 Hz	300 Hz
1.0	2.86	2.23	1.99
5.0	4.50	3.05	3.96
10.0	4.62	4.62	4.34
15.0	4.61	4.83	4.56
20.0	4.58	4.95	4.65
30.0	4.60	5.07	4.72
40.0	4.58	5.07	4.75
50.0	4.60	5.13	4.81
60.0	4.63	5.01	4.75
70.0	4.64	4.88	4.72
80.0	4.66	4.81	4.70
90.0	4.63	4.84	4.72
100.0	4.58	4.86	4.70
110.0	4.49	4.89	4.66
150.0	4.30	4.92	4.61
160.0	4.28	5.08	4.60
170.0	4.27	5.17	4.68
200	4.31	5.34	4.85
250	4.31	5.35	5.19
300	4.41	5.42	5.62
400	4.43	5.54	5.96
450	4.28	5.30	5.97
500	4.28	5.28	5.99

4.4 Modifications made during testing

None.

4.5 Test Instrumentation

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

5.0 Occupied Bandwidth

5.1 Test Description

Parameter:	FCC §2.1049
Requirement:	FCC § 95.633(c)
Emission Bandwidth:	26.8 kHz

5.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

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

The resolution bandwidth of the spectrum analyzer was set up at least 10 times higher then the authorized bandwidth of the transmitter. With the transmitter keyed, the level of the unmodulated carrier was set to the full-scale reference line of the spectrum analyzer. This is used as a 0dB reference for emission mask measurements.

The transmitter was then modulated with a 2500 Hz tone at an input level 16 dB greater than the necessary to produce 50% of rated system deviation. The resolution bandwidth of the spectrum analyzer was set up to 100 Hz and the spectrum of the transmitting signal was recorded. This spectrum was compared to the required emission mask.

The emission designator was defined as 26K8F3E where 26.8 kHz is the 99% measured power bandwidth. See plot 11-2.f for details.

5.3 Modifications made during testing

None.

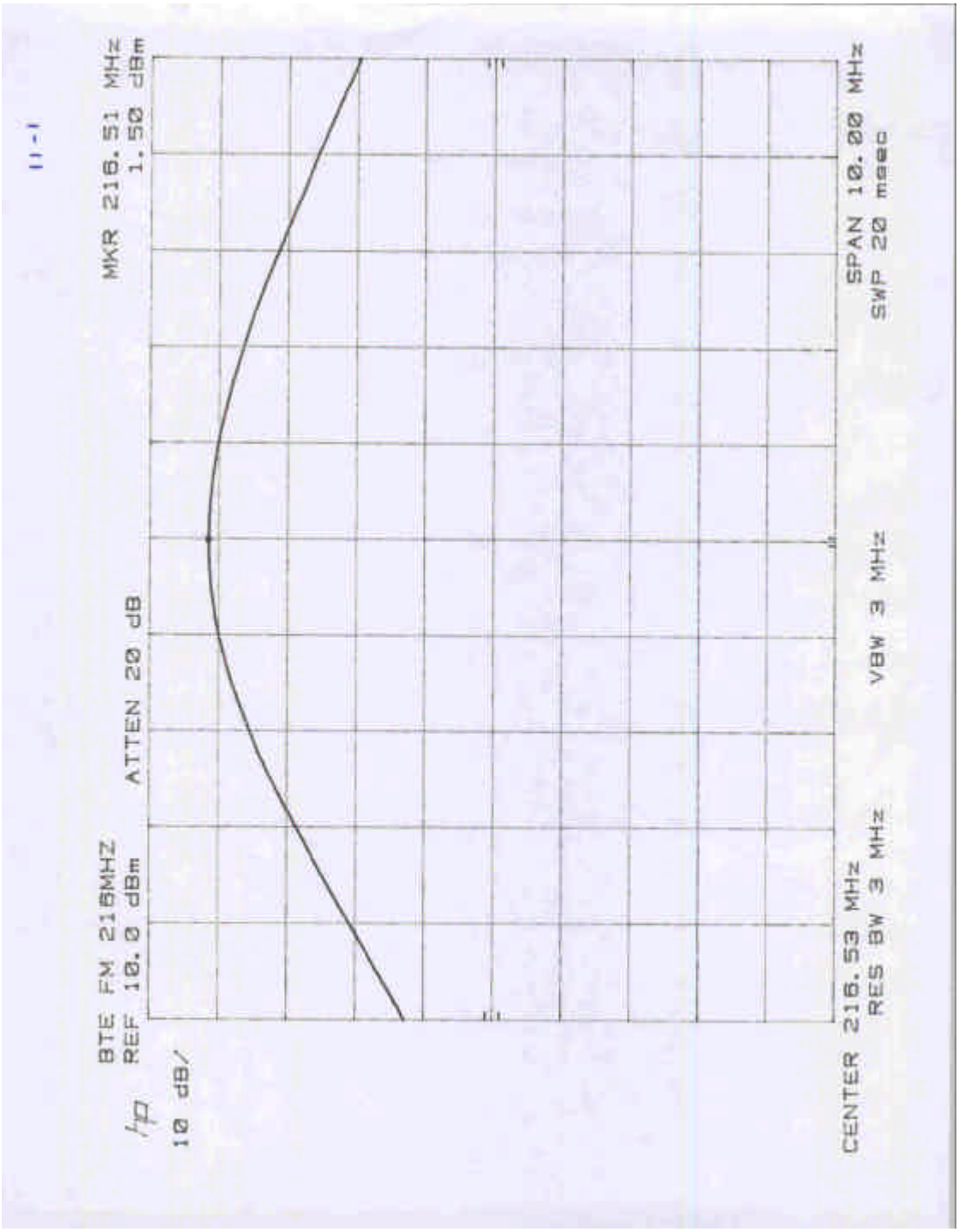
5.4 Test instrumentation

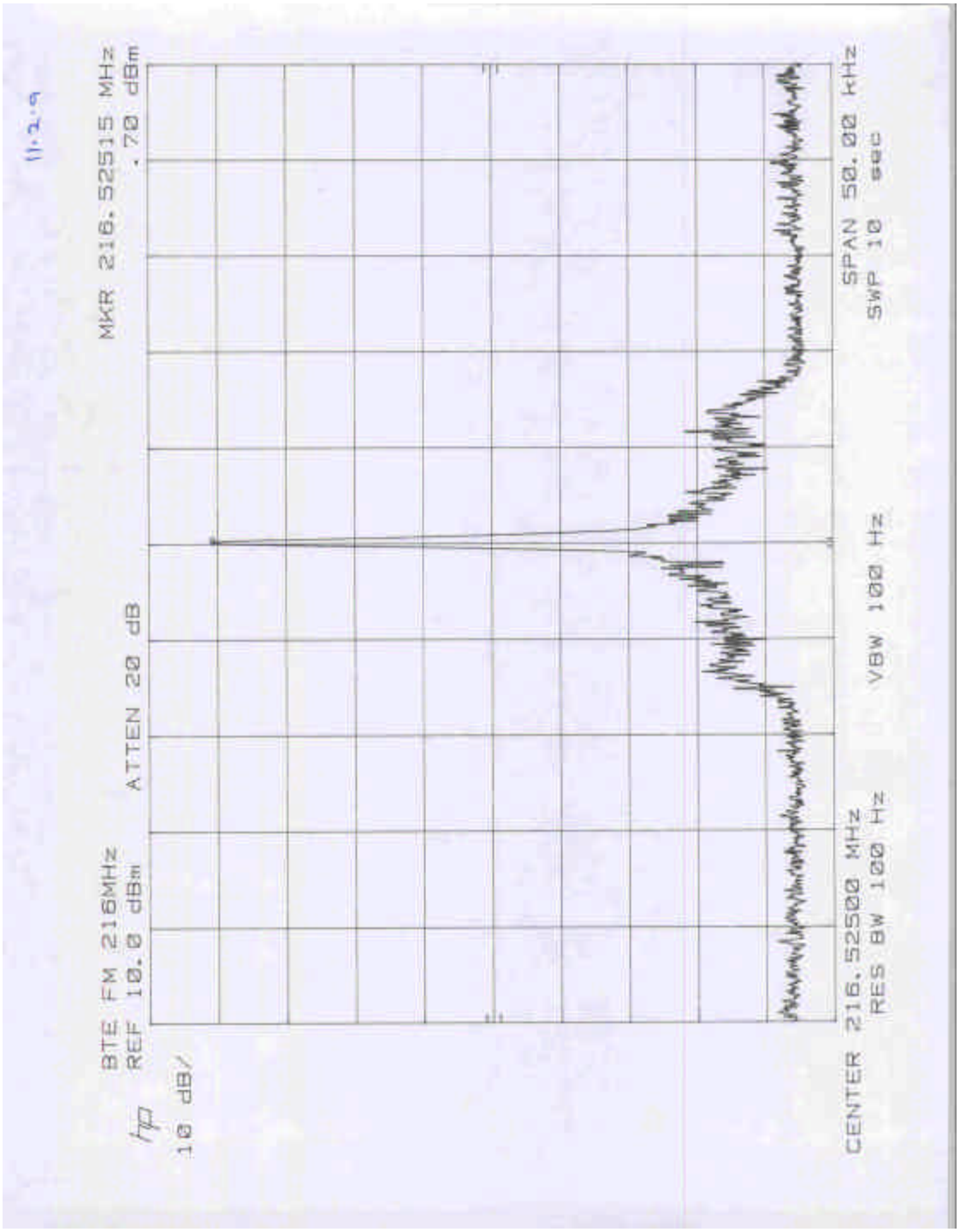
[X] Leader LFG-1300S Function Generator
[X] HP 8566B Spectrum Analyzer
[X] HP 7470A Plotter

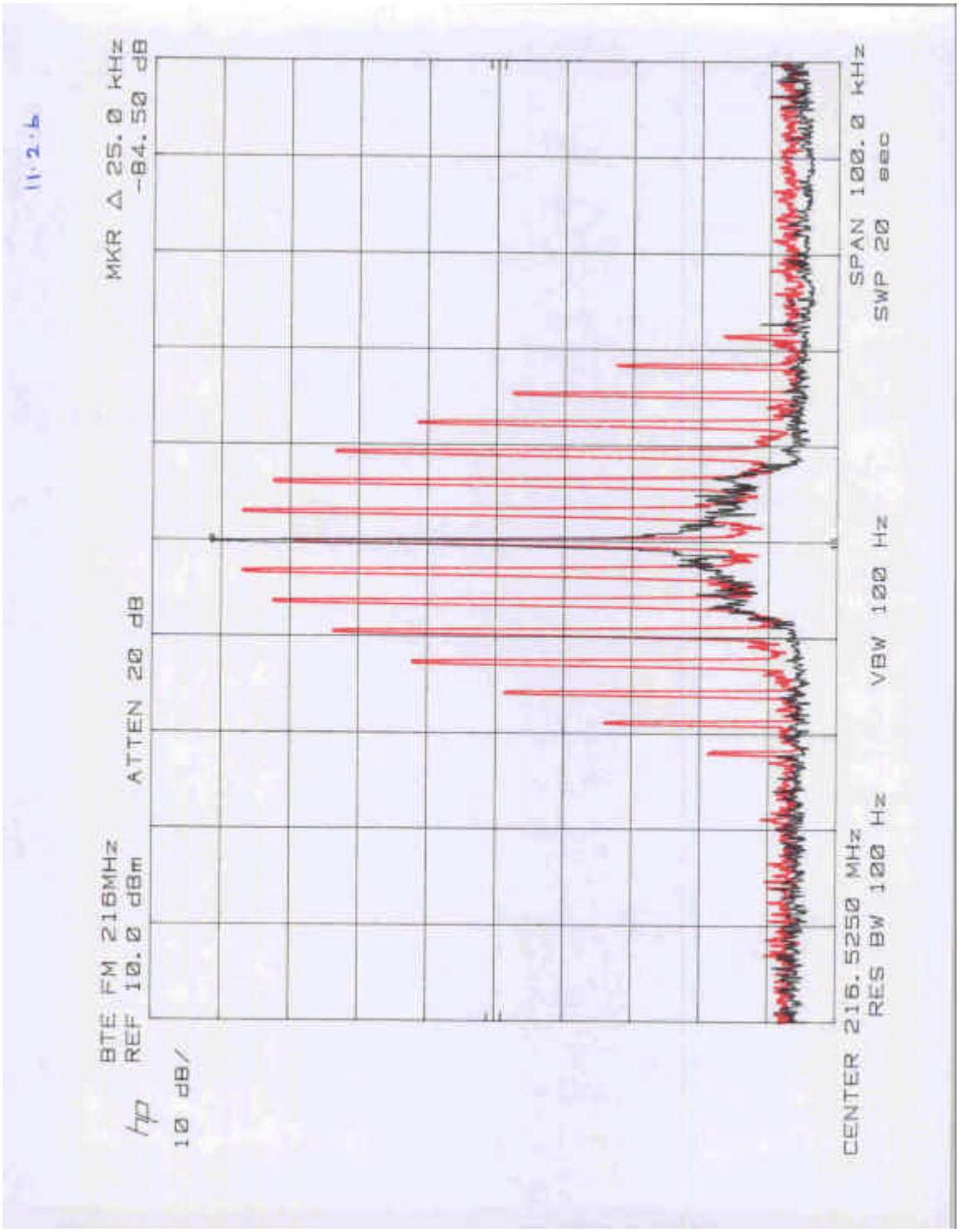
5.5 Test Results (Plots)

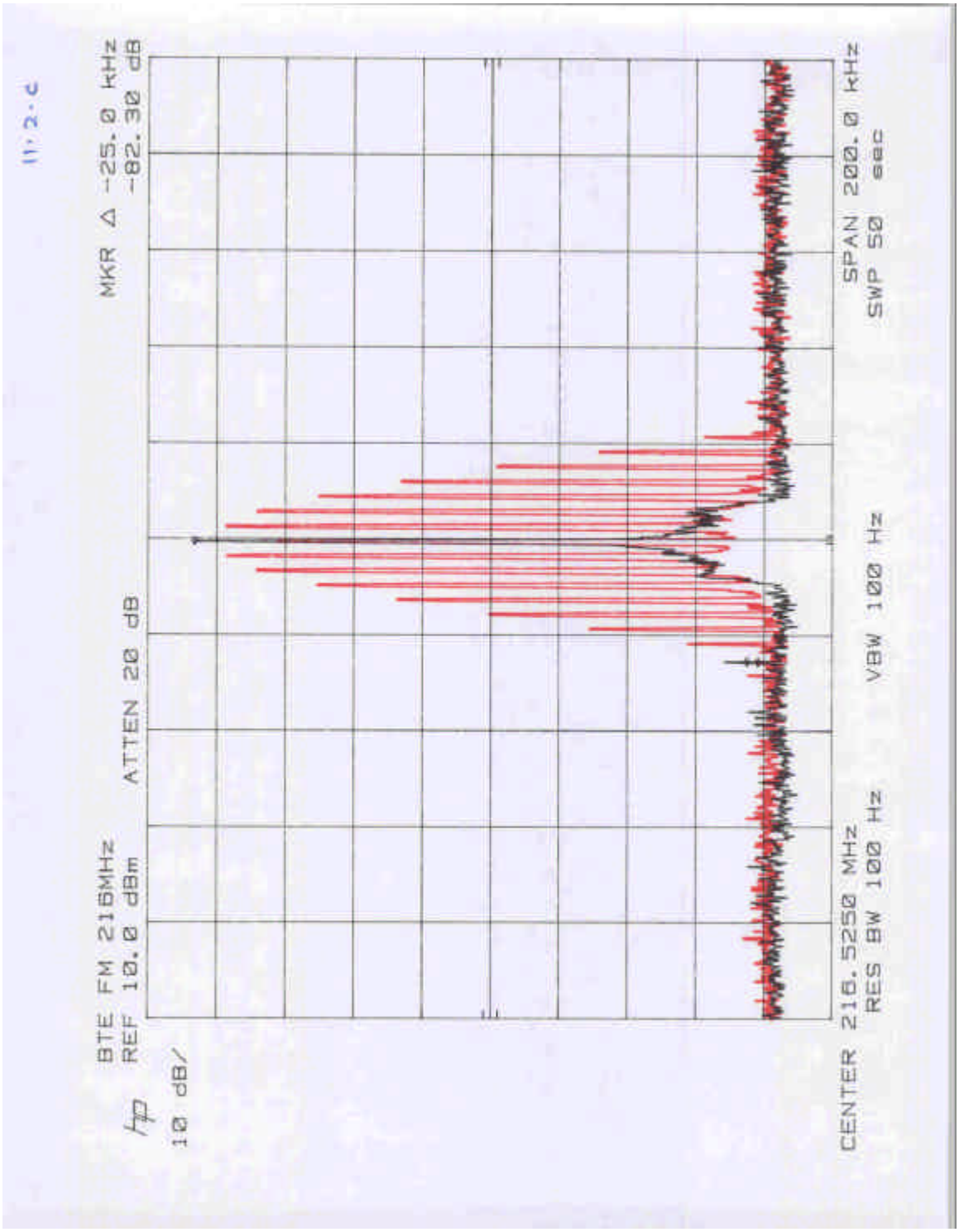
Please see next page for the occupied bandwidth plots:

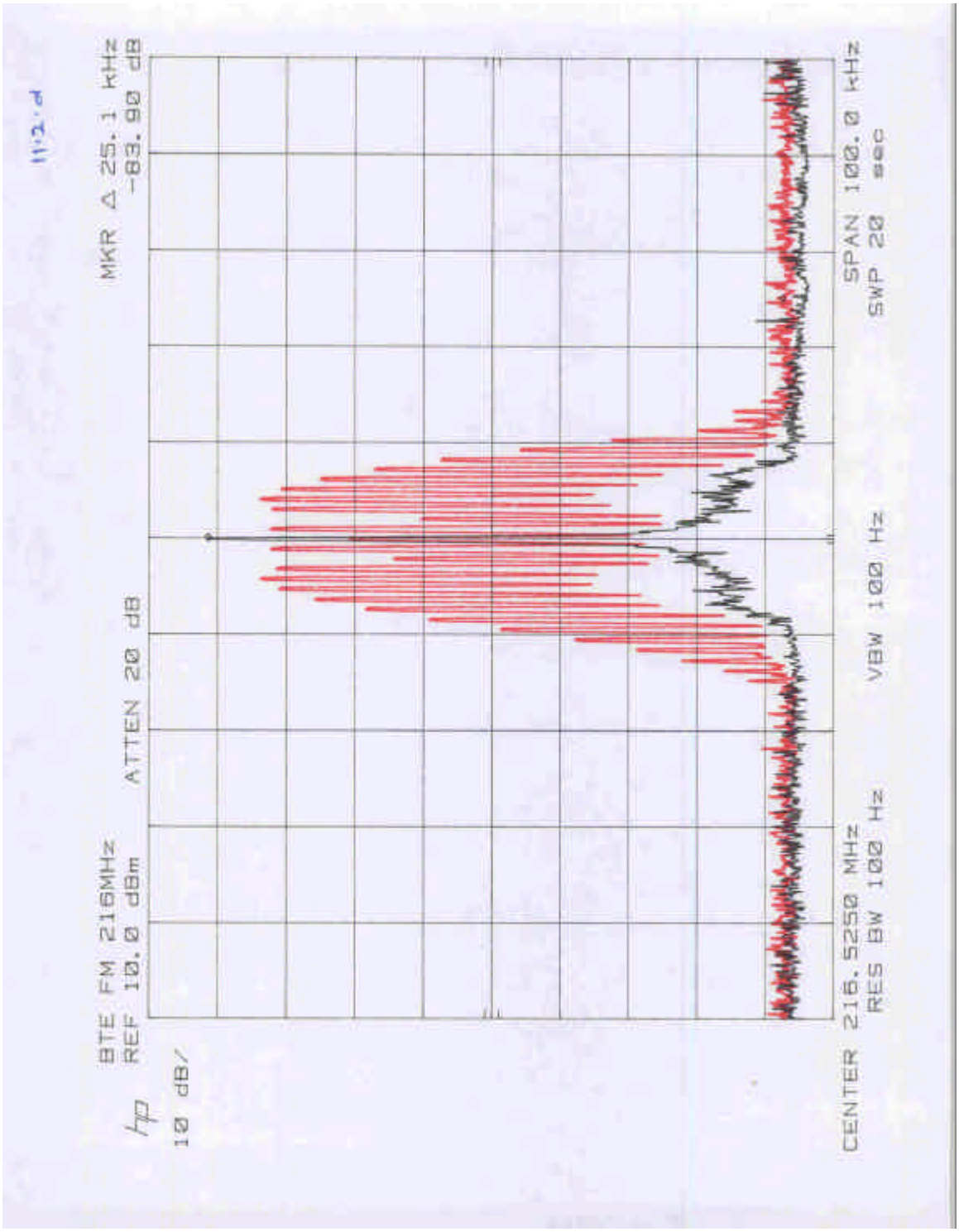
Plot Number	Description
11-1	Full Power, reference level
11-2.a	Occupied bandwidth, Carrier only, 50 kHz span
11-2.b	Occupied bandwidth, Modulated, 0.3 kHz, 100 KHz span
11-2.c	Occupied bandwidth, Modulated, 0.3 kHz, 200 KHz span
11-2.d	Occupied bandwidth, Modulated, 1 kHz, 100 KHz span
11-2.e	Occupied bandwidth, Modulated, 3 kHz, 100 KHz span
11-2.f	Occupied bandwidth, 99% PWR BW

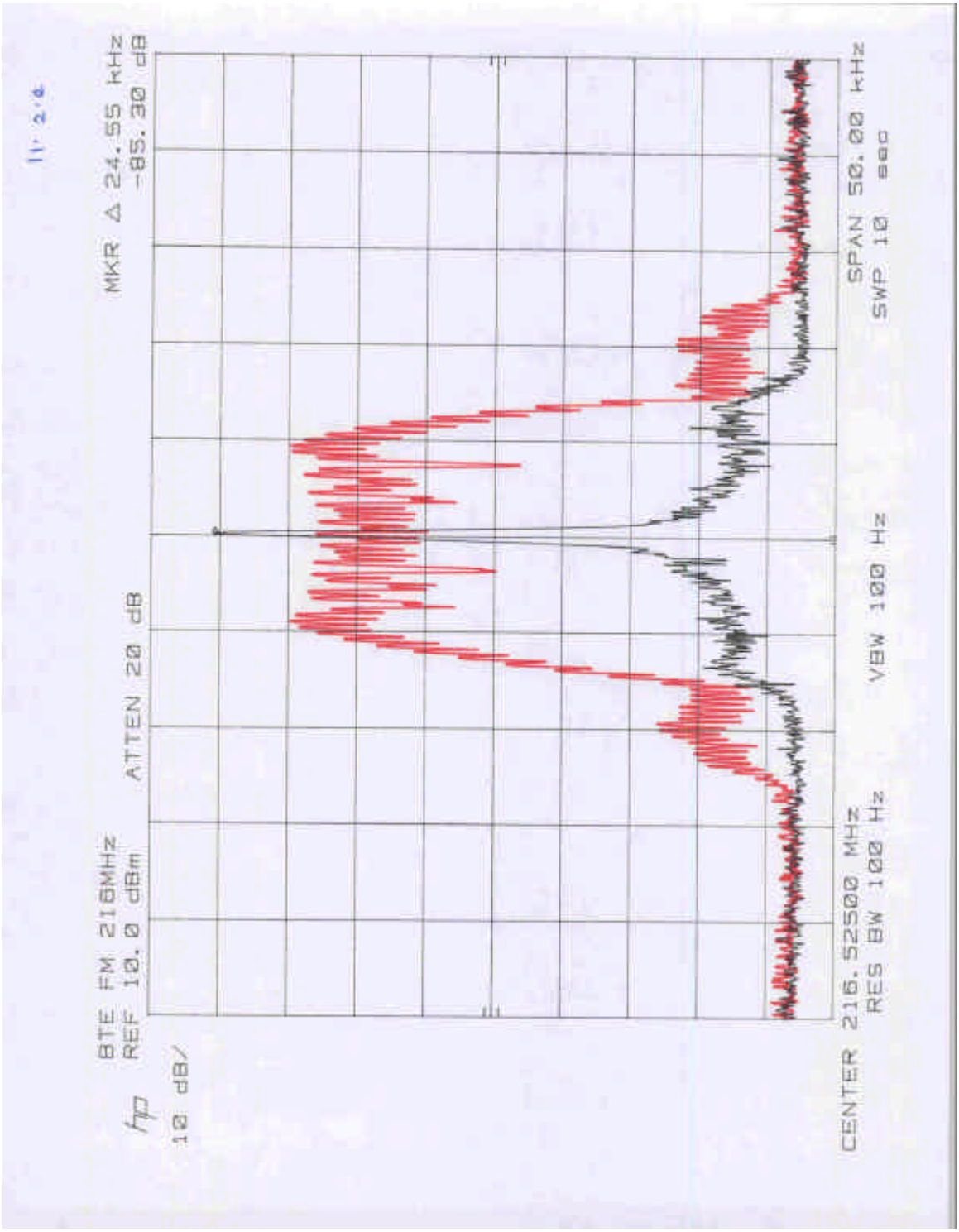

MKR 216.51 MHz
1.50 dBm
SPAN 10.00 MHz
SWP 20 msec
BTE FM 216MHZ
REF 10.0 dBm
ATTEN 20 dB
VBW 3 MHz
10 dB/
CENTER 216.53 MHz
RES BW 3 MHz


11.2.9
MKR 216.52515 MHz
.70 dBm
SPAN 50.00 kHz
SWP 10 sec
BTE FM 216MHz
REF 10.0 dBm
ATTEN 20 dB
VBW 100 Hz
10 dB/
CENTER 216.52500 MHz
RES BW 100 Hz

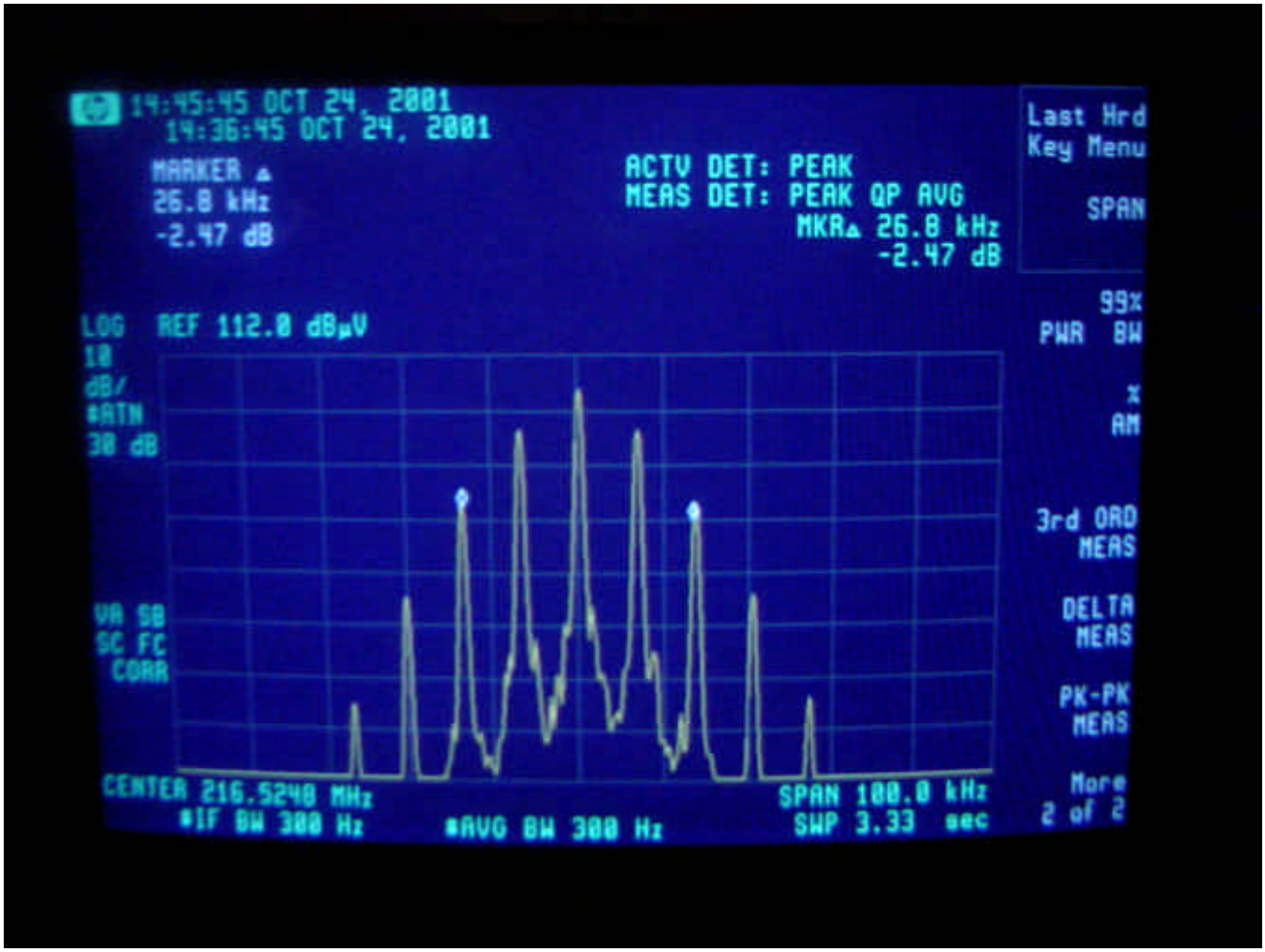

11·2·b
MKR Δ 25.0 kHz
-84.50 dB
SPAN 100.0 kHz
SWP 20 sec
BTE FM 216MHz
REF 10.0 dBm
ATTEN 20 dB
VBW 100 Hz
10 dB/
CENTER 216.5250 MHz
RES BW 100 Hz


11:2:c
MKR Δ -25.0 kHz
-82.30 dB
SPAN 200.0 kHz
SWP 50 sec
BTE FM 216MHz
REF 10.0 dBm
ATTEN 20 dB
VBW 100 Hz
10 dB/
CENTER 216.5250 MHz
RES BW 100 Hz


11'2.d
MKR Δ 25.1 kHz
-83.90 dB
BTE FM 216MHz
REF 10.0 dBm
ATTEN 20 dB
10 dB/
SPAN 100.0 kHz
SWP 20 sec
VBW 100 Hz
CENTER 216.5250 MHz
RES BW 100 Hz


MKR Δ 24.55 kHz
-85.30 dB
BTE FM 216MHz
REF 10.0 dBm
ATTEN 20 dB
10 dB/
SPAN 50.00 kHz
SWP 10 sec
VBW 100 Hz
CENTER 216.52500 MHz
RES BW 100 Hz

Plot 11-2.f


14:45:45 OCT 24, 2001
14:36:45 OCT 24, 2001
MARKER Δ
26.8 kHz
-2.47 dB
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKRΔ 26.8 kHz
-2.47 dB
Last Hrd Key Menu
SPAN
99% PWR BW
AM
3rd ORD MEAS
DELTA MEAS
PK-PK MEAS
More 2 of 2
LOG 10 dB/
#ATN 30 dB
REF 112.0 dBμV
VA SB
SC FC
CORR
CENTER 216.5248 MHz
#IF BW 300 Hz
#AVG BW 300 Hz
SPAN 100.0 kHz
SWP 3.33 sec

6.0 Field Strength of Spurious Radiation

6.1 Test description

Parameter:	FCC §2.1053
Requirement:	FCC § 95.635(c), § 15.109

6.2 Test Procedure

The transmitter was placed on a wooden turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

The spurious emissions attenuation is measured by the substitution method unless the Field Strength of spurious emissions is more than 20 dB below the equivalent radiated power of -13 dBm. In this case the spurious emissions attenuation was calculated as the difference between E in dB(uV/m) at the fundamental frequency and at the spurious emission frequency.

Spurious emissions attenuation limit in dB equals $43 + 10\text{Log}_{10}$(Power in Watts)

Note: Field strength of spurious emissions measured was found less than 64.6 dBµv/u (which is corresponds to –33 dBm ERP). Therefore, the substitution method was not used.

In addition, radiated emissions (near field radiation) were measured in a strip-line; scan from 30 MHz to 2.4 GHz was performed

Field strength of emissions from digital part was measured in the frequency range from 30 MHz to 1 GHz according the ANSI C63.4 procedure.

6.3 Test Instrumentation

[X] CDI B100/200/300 Biconical Antennas
[X] EMCO Bi-logcon Antenna
[X] EMCO 3115 Horn Antenna
[X] HP 8566B Spectrum Analyzer
[X] Preamplifiers

6.4 Test Results

Please see the following pages for:

[X] Spurious harmonic attenuation
[X] FCC Part 15.109 Radiated Emission
[X] Radiated Spurious Emissions 30 MHz to 1.0 GHz
[X] Radiated Spurious Emissions 1.0 GHz to 2.4 GHz

Modifications made during testing:

None.

Radiated Emissions Test Data

Company:	Phonic Ear Inc	**Model #:**	BTE -FM 216MHz		Req.	FCC 2.1053	
EUT:	LPRS device	**FCC #:**	BRG300T216A		Test Dist.	3	meters
Project #:	J20042625	**Test Date:**	March 30, 2001		TP	0.01	Watt
Test Mode:	TX@216.525MHz	**Engineer:**	Suresh K		Min. Attn.	23.00	dBc

	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used
Number:	1	8	0	5	8	0	6	21	0	0
Model:	EMCO 3143	EMCO 3115	None	CDI_P950	CDI_P1000	None	NPS 785	Grn_M+L	None	None

Frequency	Reading	Detector	Ant.	Amp.	Ant. Pol.	Ant. Factor	Pre-Amp	Insert. Loss	Net	ERP	Attn.	Margin
MHz	dB(µV)	P/A/Q	#	#	H/V	dB(1/m)	dB	dB	dB(µV/m)	mW	dBc	dB
216.52	91.0	Peak	1	0	V	11.0	0.0	3.4	105.4	6.34E+00	-	-
433.06	42.1	Peak	1	5	V	16.4	17.7	3.6	44.4	5.04E-06	61.0	-38.0
649.57	47.5	Peak	1	5	V	19.2	15.0	5.3	57.0	9.17E-05	48.4	-25.4
866.10	41.4	Peak	1	5	V	22.0	12.7	6.1	56.8	8.76E-05	48.6	-25.6
1082.00	54.8	Peak	8	8	V	25.0	30.3	6.5	56.0	7.28E-05	49.4	-26.4
1299.00	45.1	Peak	8	8	V	25.0	30.0	7.2	47.3	9.82E-06	58.1	-35.1
1515.60	45.1	Peak	8	8	V	26.7	29.6	2.7	44.9	5.65E-06	60.5	-37.5
1732.19	42.5	Peak	8	8	V	26.7	29.4	3.0	42.8	3.49E-06	62.6	-39.6
1939.10	40.3	Peak	8	8	V	26.7	29.2	2.2	40.0	1.83E-06	65.4	-42.4
2165.25	41.0	Peak	8	8	V	29.1	29.1	2.3	43.3	3.91E-06	62.1	-39.1

Notes:

a) O.C.F. Other Correction Factor

b) Insert. Loss = Cable A + Cable B + Cable C + Transducer.

c) Net = Reading + Antenna Factor - Pre-Amp + Insert. Loss.

d) Attn. = Field Strength (Fundamental) - Field Strength (Harmonics).

e) Negative signs (-) in Margin column signify levels below the limits.

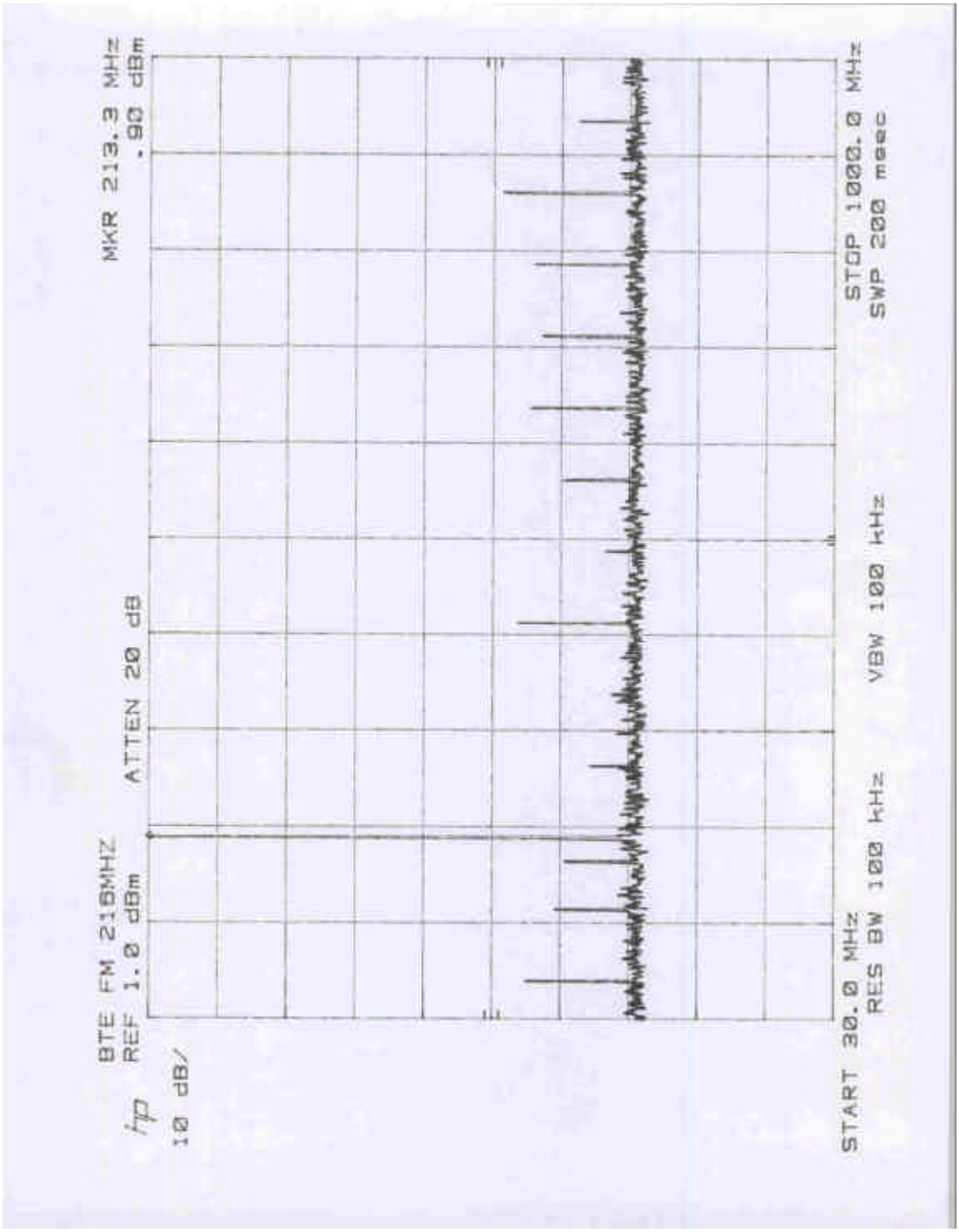
Radiated Emissions Test Data

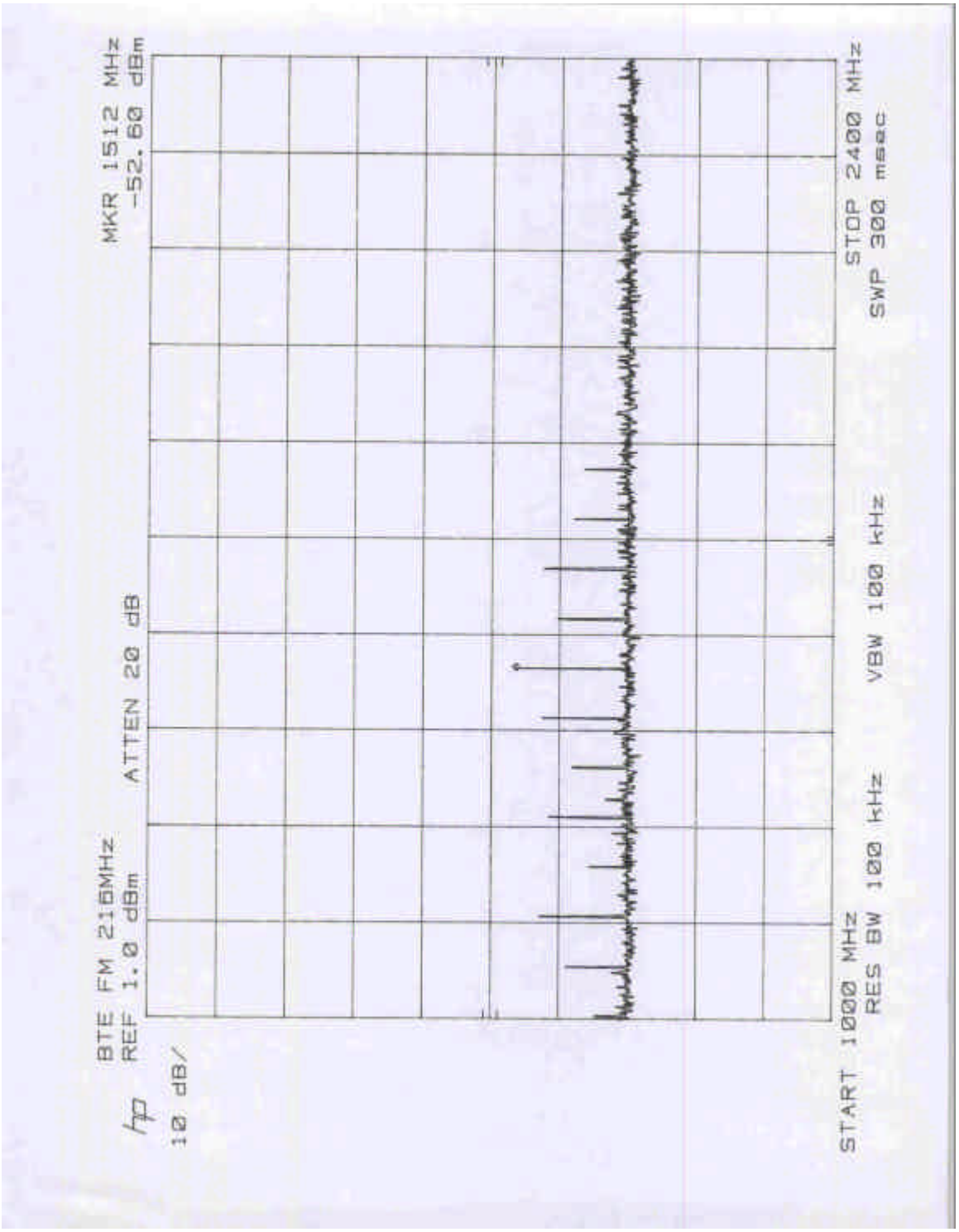
Company:	Phonic Ear Inc	**Model #:**	BTE-FM 216	**Standard**	**FCC § 15B**	
EUT:	LPRS device	**S/N #:**		**Limits**	2	
Project #:	J20042625	**Test Date:**	March 28, 2001	**Test Distance**	3	meters
Test Mode:	Normal Operation	**Engineer:**	Suresh K.	**Duty Relaxation**	0	dB

	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used
Number:	1	5	0	5	0	0	6	0	0	0
Model:	EMCO 3143	CDI B300	None	CDI_P950	None	None	NPS 785	None	None	None

Frequency	Reading	Detector	Ant	Amp.	Ant. Pol.	Ant. Factor	Pre-Amp	Insert. Loss	D. C. F.	Net	Limit @3m	Margin
MHz	dB(µV)	P/A/Q	#	#	H/V	dB(1/m)	dB	dB	dB	dB(µV/m)	dB(µV/m)	dB
74.03	19.2	Peak	1	5	H	7.4	18.7	1.6	0.0	9.5	40.0	-30.5
148.00	30.6	Peak	1	5	H	11.0	19.1	2.1	0.0	24.6	43.5	-18.9
144.00	27.8	Peak	1	5	H	9.5	19.1	2.1	0.0	20.3	43.5	-23.2
74.03	19.2	Peak	1	5	V	6.6	18.7	1.6	0.0	8.7	40.0	-31.3
176.40	16.7	Peak	1	5	V	9.1	18.3	2.3	0.0	9.8	43.5	-33.7
438.59	16.9	Peak	1	5	V	16.0	17.7	3.2	0.0	18.4	46.0	-27.6
601.20	18.2	Peak	1	5	V	18.3	15.0	3.6	0.0	25.1	46.0	-21.0

Notes:	
	a) D.C.F.: Distance Correction Factor
	b) Insert. Loss (dB) = Cable A + Cable B + Cable C .
	c) Net (dB) = Reading + Antenna Factor - Pre-amp + Insert. Loss. - Transducer Loss - Duty Relaxation (transmitter only).
	d) Negative signs (-) in Margin column signify levels below the limits.
	e) All other emissions not reported are below the equipment noise floor which is at least 20 dB below the limits.


MKR 213.3 MHz
-.90 dBm
STOP 1000.0 MHz
SWP 200 msec
BTE FM 216MHZ
REF 1.0 dBm
ATTEN 20 dB
VBW 100 kHz
10 dB/
START 30.0 MHz
RES BW 100 kHz


MKR 1512 MHz
-52.60 dBm
BTE FM 216MHz
REF 1.0 dBm
ATTEN 20 dB
10 dB/
START 1000 MHz
RES BW 100 kHz
VBW 100 kHz
STOP 2400 MHz
SWP 300 msec

7.0 AC Line Conducted Emissions

7.1 Test Description

Parameter:	ANSI C63.4
Requirement:	FCC § 15.107

7.2 Test Procedure

The EUT was connected to the DC power supply that was connected to the AC line through the LISNs.

Both HOT and NEUTRAL leads were tested according the ANSI C63.4 procedure.

7.3 Modifications made during testing

None.

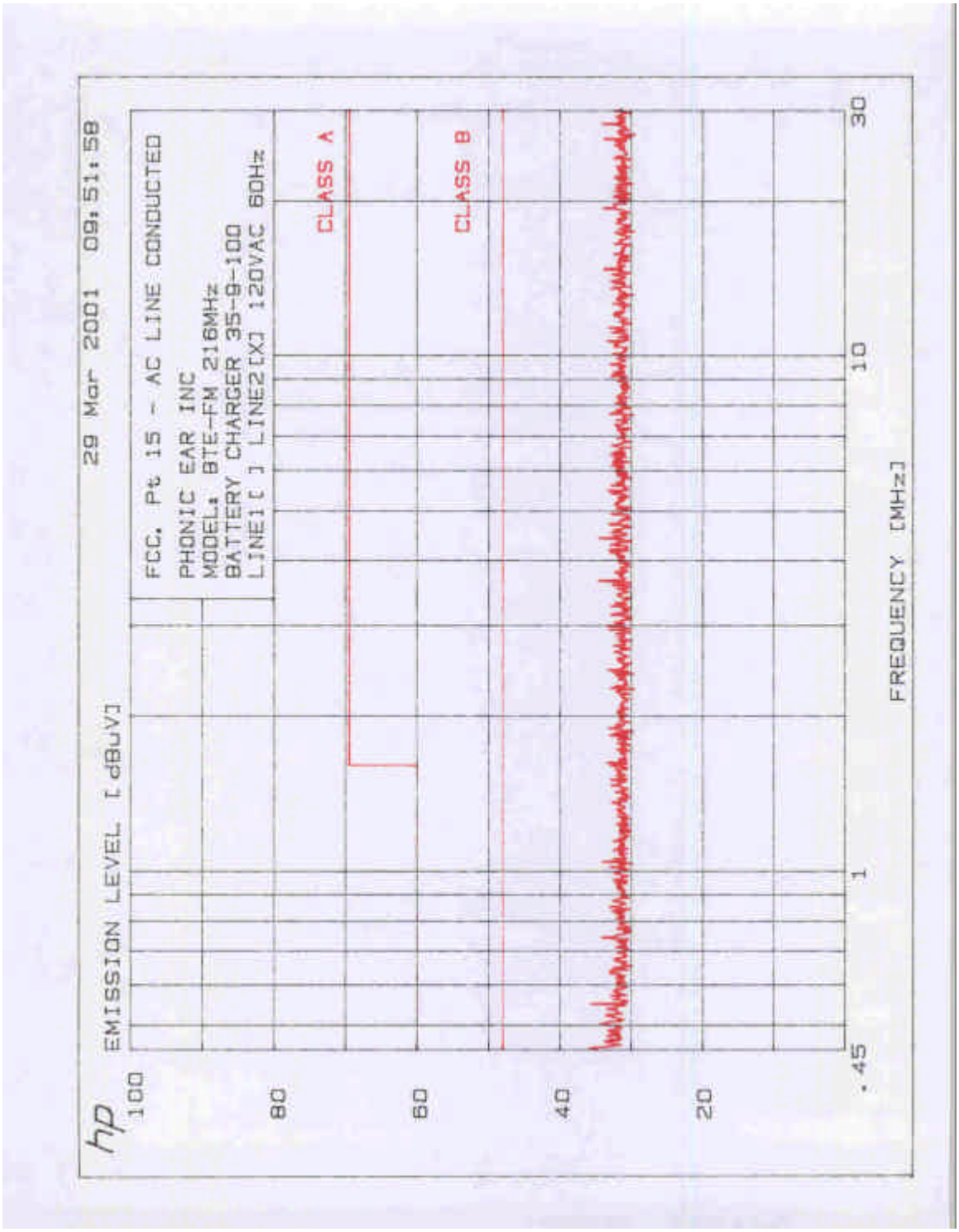
7.4 Test instrumentation

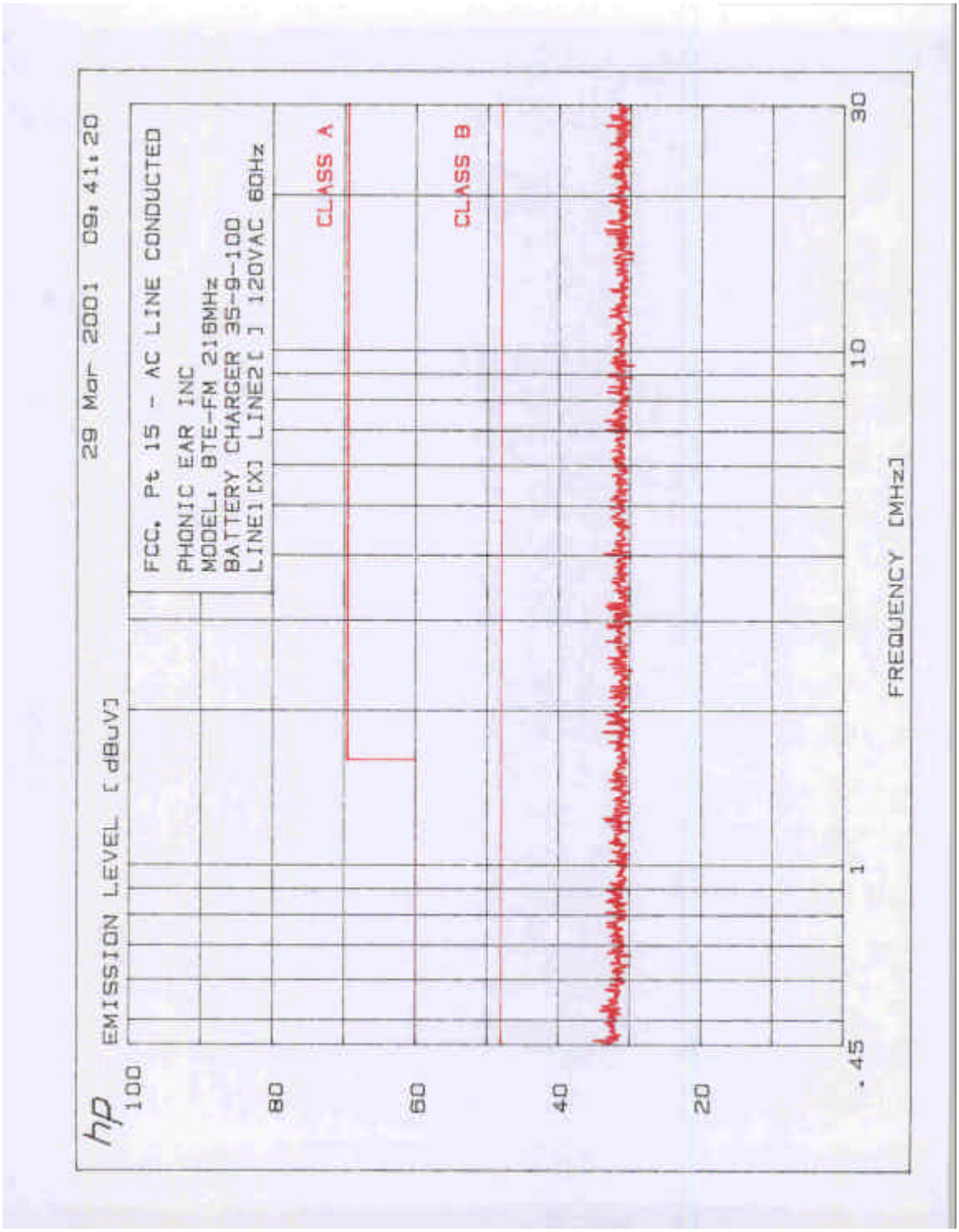
[x] HP 8566B Spectrum Analyzer
[x] LISN

7.5 Test Results

Please see the following pages for:

[X] FCC Part 15.107 AC Line Conducted Emission


29 Mar 2001 09:51:58
FCC, Pt 15 - AC LINE CONDUCTED
PHONIC EAR INC
MODEL: BTE-FM 216MHz
BATTERY CHARGER 35-9-100
LINE1[ ] LINE2[X] 120VAC 60Hz
CLASS A
CLASS B
EMISSION LEVEL [dBuV]
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]


29 Mar 2001 09:41:20
FCC, Pt 15 - AC LINE CONDUCTED
PHONIC EAR INC
MODEL: BTE-FM 216MHz
BATTERY CHARGER 35-9-100
LINE1[X] LINE2[ ] 120VAC 60Hz
CLASS A
CLASS B
EMISSION LEVEL [dBuV]
FREQUENCY [MHz]
100
80
60
40
20
.45
1
10
30

8.0 Frequency Stability

8.1 Test description

Parameter:	FCC §2.1055
Requirement:	FCC § 95.627
Frequency Tolerance:	Within 0.00050% (50ppm)

8.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm\,error = \left(\frac{MCF}{ACF} - 1\right) \cdot 10^6$$

Where MCF is the Measured Carrier Frequency in MHz
ACF is the Assigned Carrier Frequency in MHz

8.2.1 Frequency Stability vs. Temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

8.2.2 Frequency Stability vs. Voltage

At room temperature (25 ±5 ^{o}C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

8.3 Test Results

Frequency Stability vs Temperature		
ACF (MHz): 216.52508		Limit: 50.0ppm
Temperature, C	MCF (MHz)	PPM Error
50	216.5228	-10.52995801
40	216.5235	-7.297076163
30	216.52515	0.323288184
20	216.52513	0.230920132
10	216.5261	4.710770688
0	216.52655	6.789051873
-10	216.52665	7.250892137
-20	216.5267	7.481812269
-30	See Note 1	See Note 1

Note 1: At –30 Degrees C the EUT discontinues operation

Frequency Stability vs Voltage			
ACF (MHz): 216.525			**Limit: 50.0 ppm**
%	***Voltage***	***MCF (MHz)***	***PPM Error***
115	4.50	216.5244	-3.14
100	3.00	216.52515	0.32
85	2.55	216.52418	-4.16
Battery Endpoint	2.12	216.52103	-18.70

8.4 Modifications made during testing

None.

8.5 Test instrumentation

[X] Temperature Chamber, -50C to +100C
[X] Hewlett Packard 5383A Frequency Counter
[X] Tektronix 2784 Spectrum Analyzer
[X] Goldstar DC Power Supply, GR303