FCC Part 15 Subpart C

EMI TEST REPORT

of

E.U.T. : FM STEREO TRANSMITTER

FCC ID. : BYG006

MODEL : FT-007

Working Frequency : 88.3MHz-107.7MHz

for

APPLICANT : SANGEAN ELECTRONICS INC.
ADDRESS : NO. 18, LANE 7, LI-DE STREET, CHUNG HO CITY, TAIPEI HSIEN, TAIWAN, R.O.C.

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO. 8 LANE 29, WENMIMG ROAD,
LOSHAN TSUN, KWEISHAN HSIANG,
TAOYUAN, TAIWAN, R.O.C.

Tel:(02)26023052, 26023054
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Report Number : ET90R-11-024

TEST REPORT CERTIFICATION

Applicant : SANGEAN ELECTRONICS INC.
NO. 18, LANE 7, LI-DE STREET, CHUNG HO CITY, TAIPEI HSIEN, TAIWAN, R.O.C.

Manufacturer : SANGEAN ELECTRONICS INC.
NO. 18, LANE 7, LI-DE STREET, CHUNG HO CITY, TAIPEI HSIEN, TAIWAN, R.O.C.

Description of EUT :

a) Type of EUT	: FM STEREO TRANSMITTER
b) Trade Name	: SANGEAN
c) Model No.	: FT-007
d) FCC ID	: BYG006
e) Working Frequency	: 88.3MHz-107.7MHz
f) Adaptor	: I/P: 120VAC, 60Hz; O/P: 5VDC, 100mA

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C (1999)

I HEREBY CERTIFY THAT; The data shown in this report were made in accordance with the procedures given in ANSI C63.4 and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Issued Date : Nov. 13, 2001

Test Engineer : S S Liou
(S. S. Liou)

Approve & Authorized Signer : Will Yauo
Will Yauo, Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

Table of Contents Page

1. GENERAL INFORMATION

1.1 Product Description

a) Type of EUT	: FM STEREO TRANSMITTER
b) Trade Name	: SANGEAN
c) Model No.	: FT-007
d) FCC ID	: BYG006
e) Working Frequency	: 88.3MHz-107.7MHz
f) Adaptor	: I/P: 120VAC, 60Hz; O/P: 5VDC, 100mA

1.2 Characteristics of Device:

1. Apply Audio Signal 400mVrms into the FM Stereo transmitter.
2. Select the frequency to transmit. Tested Frequencies: 88.3MHz, 98.0MHz, 107.7MHz.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in chapter 13 of ANSI C63.4.

The FM STEREO TRANSMITTER under test was operated in its normal operating mode for the purpose of the measurements.

The receiving antenna polarized horizontally was varied from 1 to 4 meters and the wooden turntable was rotated through 360 degrees to obtain the highest reading on the field strength meter or on the display of the spectrum analyzer. And also, each emission was to be maximized by changing the orientation of the FM STEREO TRANSMITTER under test.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No. 34, Lin 5, Ding Fu Tsun, Linkou Hsiang, Tapei Hsien, Taiwan 244, R.O.C.

This site has been fully described in a report submitted to your office, and accepted in a letter dated Feb. 10, 2000.

2. DEFINITION AND LIMITS

2.1 Definition

Intentional radiator:
A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.25
0.495 - 0.505 **	16.69475 - 16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425 - 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3360-4400	Above 38.6
13.36-13.41			

Remark "**" : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.3 Limitation

(1) Conducted Emission Limits :

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the conducted limit is the following:

Frequency (MHz)	Emission (μV)	Emission (dBμV)
0.45 - 30.0	250	48.0

(2) Radiated Emission Limits :

According to 15.239 the field strength of emissions fom intentional radiators operated under these frequency bands shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental	
	μV/meter	dBμV/meter
88-108	250	48

Field strength limits are at the distance of 3 meters, emissions radiated outside of the specified bands, shall be according to the general radiated limits in 15.209,as following table:

Other Frequencies (MHz)	Field Strength of Fundamental	
	μV/meter	dBμV/meter
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

(3) Antenna Requirement :

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

(4) Emissions Band Limits :

According to 15.239(a), emissions from the intentional radiator shall be confined within a band 200kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of 88-108 MHz.

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3. RADIATED EMISSION MEASUREMENT

3.1 Applicable Standard

1. The field strength of any emission within this band shall not exceed 250 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in Section 15.35 for limiting peak emissions apply.

2. The field strength of any emissions which appear outside of this band shall not exceed the general radiated emission limits in Section 15.209.

3.2 Measurement Procedure

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.

2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.

3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.

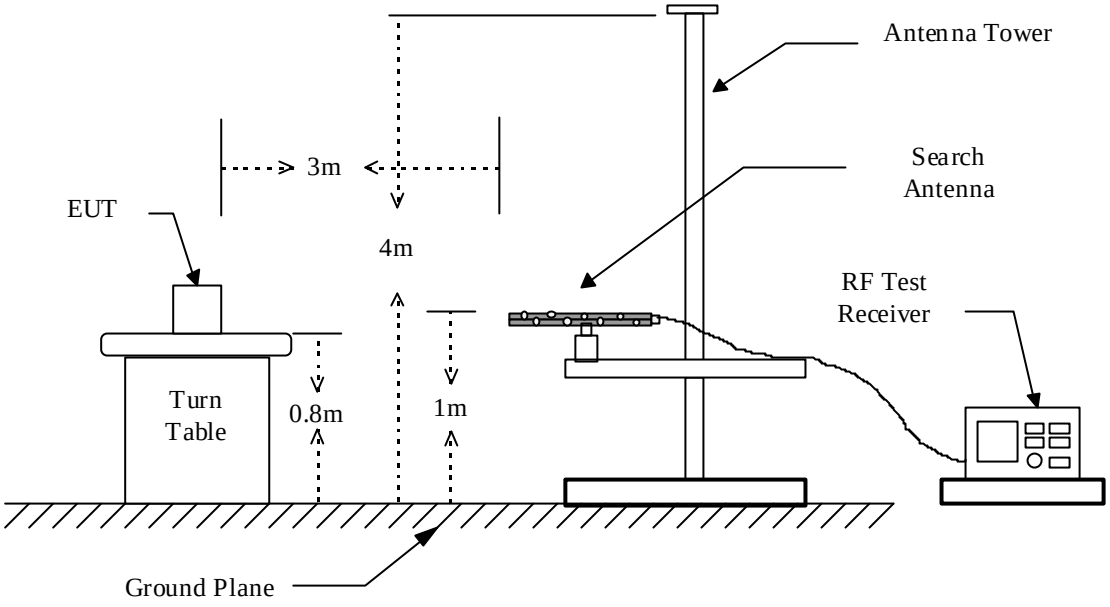
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0° to 360° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

5. Repeat step 4 until all frequencies need to be measured were complete.

6. Repeat step 5 with search antenna in vertical polarized orientations.

7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration



3.3 Radiated Test Equipment

Equipment	Manufacturer	Model No.	Next Cal. Date
Spectrum Analyzer	Hewlett-Packard	8568B	12/21/2001
Pre-selector	Hewlett-Packard	85685A	01/01/2002
Quasi Peak Detector	Hewlett-Packard	85650A	01/01/2002
RF Test Receiver	Rohde & Schwarz	ESVS 30	08/06/2001
Log periodic Antenna	EMCO	3146	11/02/2001
Biconical Antenna	EMCO	3110B	11/02/2001
Preamplifier	Hewlett-Packard	8447D	12/29/2001
Spectrum Analyzer	Hewlett-Packard	8564E	04/22/2002

3.4 Measuring Instrument Setup

Explanation of measuring instrument setup in frequency band measured is as following :

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz

3.5 Test Data

A. 88.3 MHz

Operation Mode : Transmitting

Test Date : Nov. 02, 2001 Temperature : 26 ℃ Humidity: 70 %

Frequency (MHz)	Meter Reading (dBuV)		Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
88.289	57.4	60.2	-14.2	46.0	48.0	-2.0	121	2.20
176.578	34.4	33.2	-9.1	25.3	43.5	-18.2	50	1.30
264.867	34.3	32.9	-3.8	30.5	46.0	-15.5	48	1.10
353.156	43.3	48.9	-9.9	39.0	46.0	-7.0	140	2.00
441.445	44.7	46.1	-5.6	40.5	46.0	-5.5	95	1.90
529.734	38.0	37.1	-5.0	33.0	46.0	-13.0	331	1.20
618.023	40.4	39.3	-3.6	36.8	46.0	-9.2	65	1.20
706.312	38.5	38.0	-0.9	37.6	46.0	-8.4	267	1.00
794.601	39.6	36.3	0.5	40.1	46.0	-5.9	168	1.00
882.890	---	---	2.3	---	46.0	---	---	---

B. 98.0 MHz

Operation Mode : Transmitting

Test Date : Nov. 02, 2001 Temperature : 26 ℃ Humidity: 70 %

Frequency (MHz)	Meter Reading (dBuV)		Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
97.989	57.0	59.5	-13.9	45.6	48.0	-2.4	124	2.30
195.978	32.7	31.6	-7.6	25.1	43.5	-18.4	49	1.30
293.967	32.2	30.8	-1.5	30.7	46.0	-15.3	48	1.10
391.956	39.8	44.9	-6.2	38.7	46.0	-7.3	140	1.30
489.945	43.9	44.6	-4.4	40.2	46.0	-5.8	95	1.80
587.934	38.0	37.4	-4.9	33.1	46.0	-12.9	270	1.20
685.923	37.7	37.0	-1.0	36.7	46.0	-9.3	69	1.20
783.912	37.7	37.1	0.1	37.8	46.0	-8.2	262	1.00
881.901	37.7	34.9	2.3	40.0	46.0	-6.0	160	1.00
979.890	---	---	3.4	---	54.0	---	---	---

Note :

1. Remark "---" means that the emissions from EUT are too weak to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

C. 107.7 MHz

Operation Mode : Transmitting

Test Date : Nov. 02, 2001 Temperature : 26 ℃ Humidity: 70 %

Frequency (MHz)	Meter Reading (dBuV)		Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
107.693	55.2	58.0	-12.2	45.8	48.0	-2.2	120	2.30
215.386	31.2	30.3	-6.1	25.1	43.5	-18.4	49	1.30
323.079	36.9	35.5	-6.7	30.2	46.0	-15.8	48	1.00
430.772	39.1	44.3	-5.5	38.8	46.0	-7.2	140	1.30
538.465	44.1	45.5	-5.1	40.4	46.0	-5.6	98	1.80
646.158	36.2	35.4	-3.0	33.2	46.0	-12.8	270	1.70
753.851	37.5	35.9	-0.3	37.2	46.0	-8.8	65	1.20
861.544	35.1	34.7	2.3	37.4	46.0	-8.6	268	1.00
969.237	37.5	33.7	3.3	40.8	54.0	-13.2	167	1.00
1076.930	---	---	-9.4	---	54.0	---	---	---

Note :

1. Remark "---" means that the emissions from EUT are too weak to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

3.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

Peak = Reading + Corrected Factor

where

Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

3.7 Radiated Measurement Photos

Please See Setup Photos In Exhibit F.

4 CONDUCTED EMISSION MEASUREMENT

4.1 Standard Applicable

For unintentional digital devices, Line Conducted Emission Limits are in accordance to § 15.107(a) . And according to § 15.107(e), an alternative to the conducted limits is CISPR 22.

4.2 Measurement Procedure

1. Setup the configuration per figure 2.

2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.

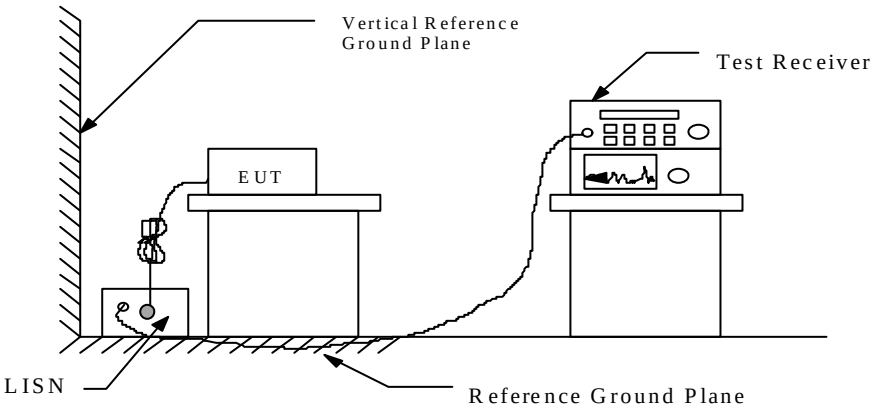
3. Record the 6 or 8 highest emissions relative to the limit.

4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.

5. Confirm the highest three emissions with variation of the EUT cable configuration and record the final data.

6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 2 : Conducted emissions measurement configuration



4.3 Conducted Emission Data

A. 88.3 MHz

Operation Mode : Transmitting

Test Date : Nov. 02, 2001 Temperature : 21 ℃ Humidity : 60 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	Va	Vb		Va	Vb		
0.6506	18.3	18.1	0.2	18.5	18.3	48.0	-29.5
1.8852	17.8	18.6	0.3	18.1	18.9	48.0	-29.1
4.5328	18.6	17.9	0.3	18.9	18.2	48.0	-29.1
8.2754	18.2	18.1	0.4	18.6	18.5	48.0	-29.4
13.1961	18.5	17.5	0.7	19.2	18.2	48.0	-28.8
25.2429	22.7	19.2	1.0	23.7	20.2	48.0	-24.3

B. 98.0 MHz

Operation Mode : Transmitting

Test Date : Nov. 02, 2001 Temperature : 21 ℃ Humidity : 60 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	Va	Vb		Va	Vb		
0.6506	18.6	18.4	0.2	18.8	18.6	48.0	-29.2
1.8852	17.8	18.9	0.3	18.1	19.2	48.0	-28.8
4.5328	18.8	17.8	0.3	19.1	18.1	48.0	-28.9
8.2754	18.6	18.6	0.4	19.0	19.0	48.0	-29.0
13.1961	18.4	17.6	0.7	19.1	18.3	48.0	-28.9
25.2429	22.8	19.5	1.0	23.8	20.5	48.0	-24.2

C. 107.7 MHz

Operation Mode : Transmitting

Test Date : Nov. 02, 2001 Temperature : 21 ℃ Humidity : 60 %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)	Margin (dB)
	Va	Vb		Va	Vb		
0.6506	18.6	18.2	0.2	18.8	18.4	48.0	-29.2
1.8852	17.8	18.6	0.3	18.1	18.9	48.0	-29.1
4.5328	18.8	17.8	0.3	19.1	18.1	48.0	-28.9
8.2754	18.4	18.0	0.4	18.8	18.4	48.0	-29.2
13.1961	18.6	17.6	0.7	19.3	18.3	48.0	-28.7
25.2429	22.8	19.0	1.0	23.8	20.0	48.0	-24.2

Note :

1. ***The expanded uncertainty of the conducted emission tests is 2.45 dB***
2. ***Please see appendix 1 for Plotted Data***

4.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

RESULT = READING + LISN FACTOR

Assume a receiver reading of 22.5 dBμV is obtained, and LISN Factor is 0.1 dB, then the total of field strength is 22.6 dBμV.

RESULT = 22.5 + 0.1 = 22.6 dBμV
Level in μV = Common Antilogarithm[(22.6 dBμV)/20]
= 13.48 μV

4.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test .

Equipment	Manufacturer	Model No.	Serial No.	Nest Cal. Date
RF Test Receiver	Rohde and Schwarz	ESH3	894718/018	12/29/2001
Spectrum Monitor	Rohde and Schwarz	EZM	861960/024	N/A
Line Impedance Stabilization network	Rohde and Schwarz	ESH2-Z5	881362/009	08/06/2002
Line Impedance Stabilization network	Kyoritsu	KNW-407	8-823-6	11/24/2001
Plotter	Hewlett-Packard	7440A	----	N/A
Shielded Room	Riken	----	----	N/A

Note: The standards used to perform this calibration are traceable to NML/ROC and NIST/USA.

4.6 Photos of Conduction Measuring Setup

Please See Setup Photos In Exhibit F.

5 ANTENNA REQUIREMENT

5.1 Standard Applicable

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

5.2 Antenna Construction

The antenna is permanently mounted on PCB, no consideration of replacement.

6 EMISSION BAND MEASUREMENT

6.1 Standard Applicable

According to 15.239(a), emissions from the intentional radiator shall be confined within a band 200kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of 88-108 MHz.

6.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 1 and measurement the turn on the EUT. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 30 kHz and 100kHz respectively with a convenient frequency span including 200kHz bandwidth of the emission.
4. Mark the bandwidth of 200kHz points and plot the graph on spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

6.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESBI	05/15/2002
Plotter	Hewlett-Packard	7440A	N/A

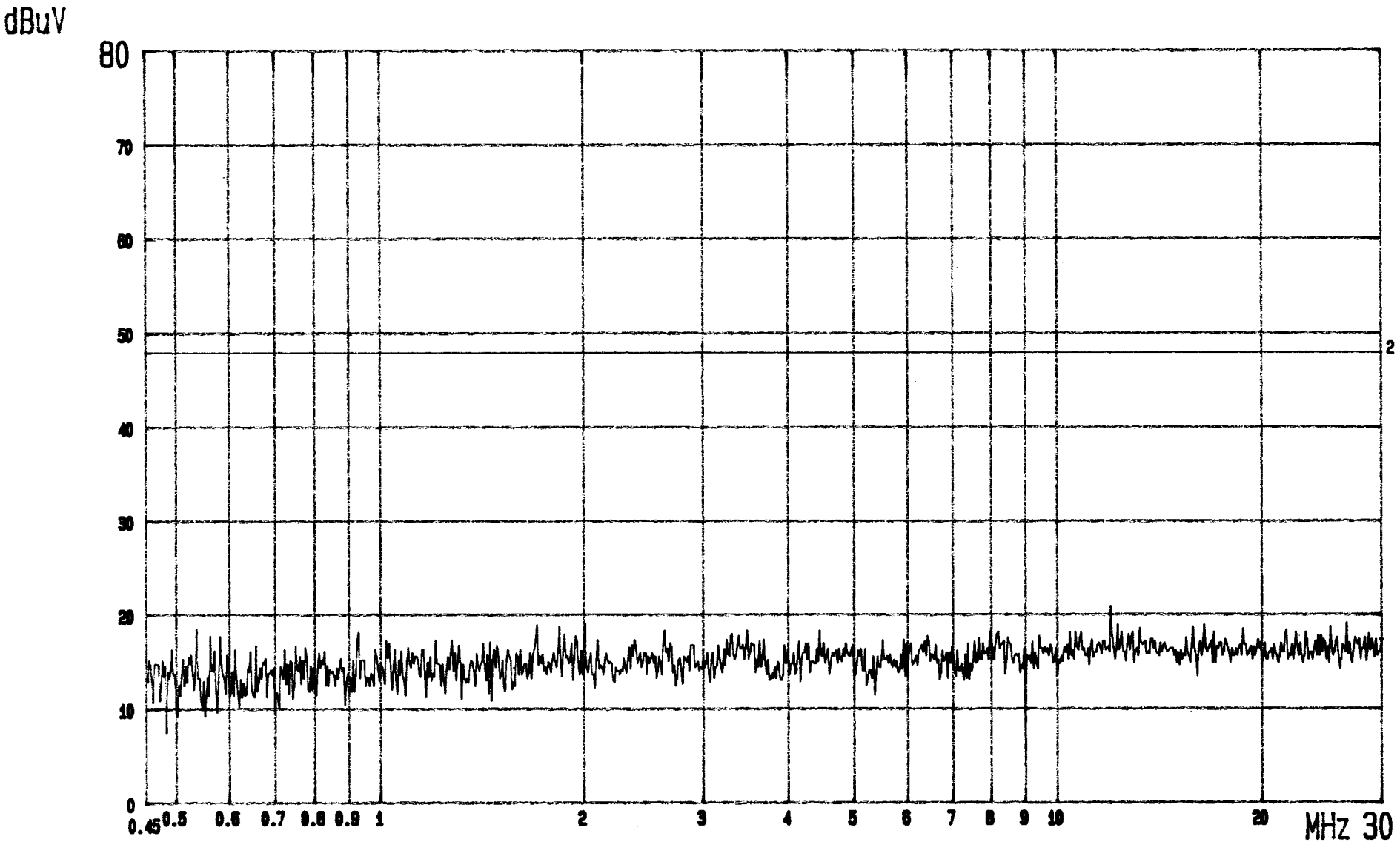
6.4 Measurement Data

Test Date : Nov. 11, 2001 Temperature : 21 ℃ Humidity: 60%

The 26dB Bandwidth for 88.3MHz is 151.1KHz.
The 26dB Bandwidth for 98.0MHz is 167.7KHz.
The 26dB Bandwidth for 107.7MHz is 157.2KHz.

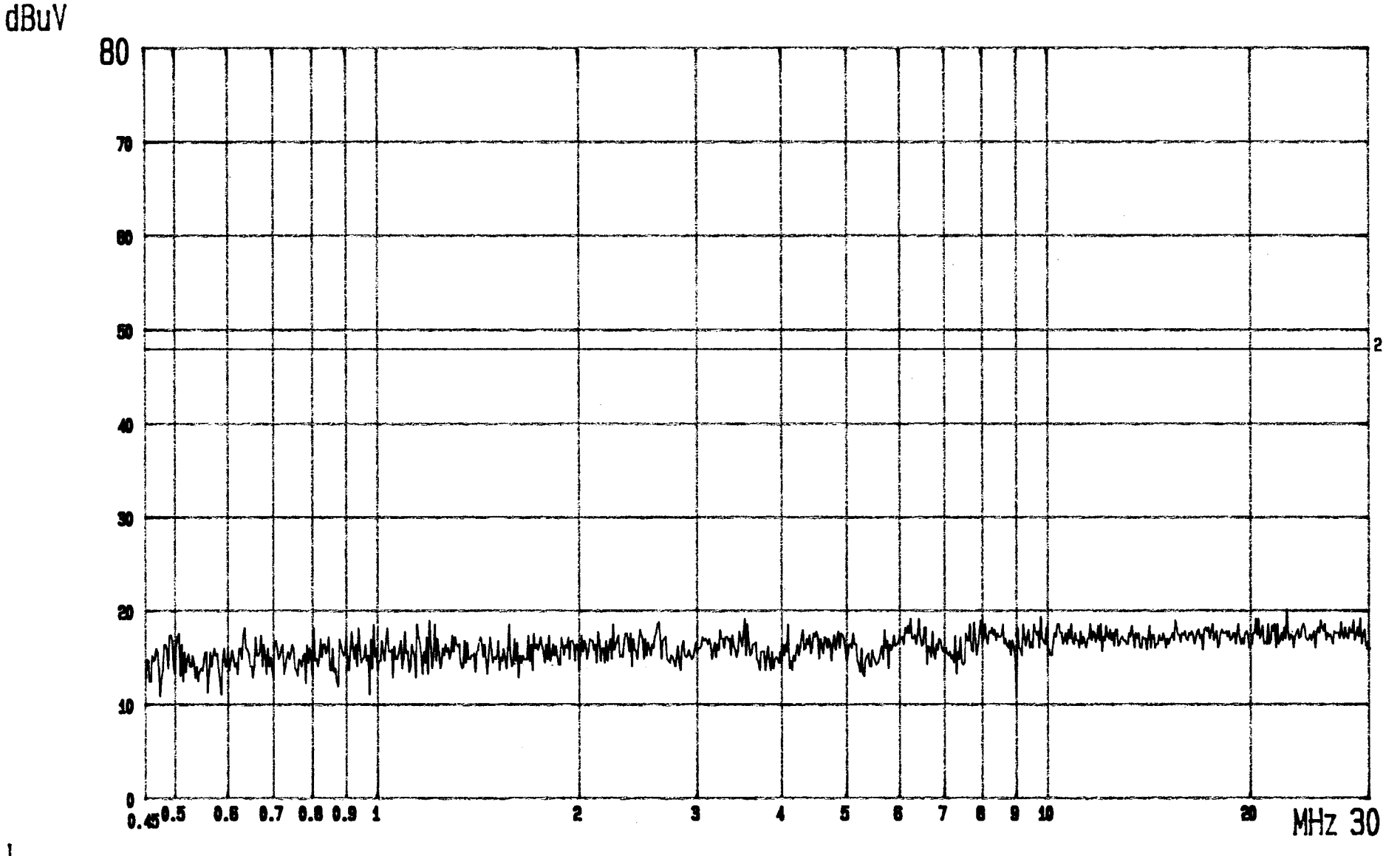
Note : Please see appendix 2 for Plotted Data

APPENDIX 1 : PLOTTED DATA FOR CONDUCTED EMISSION



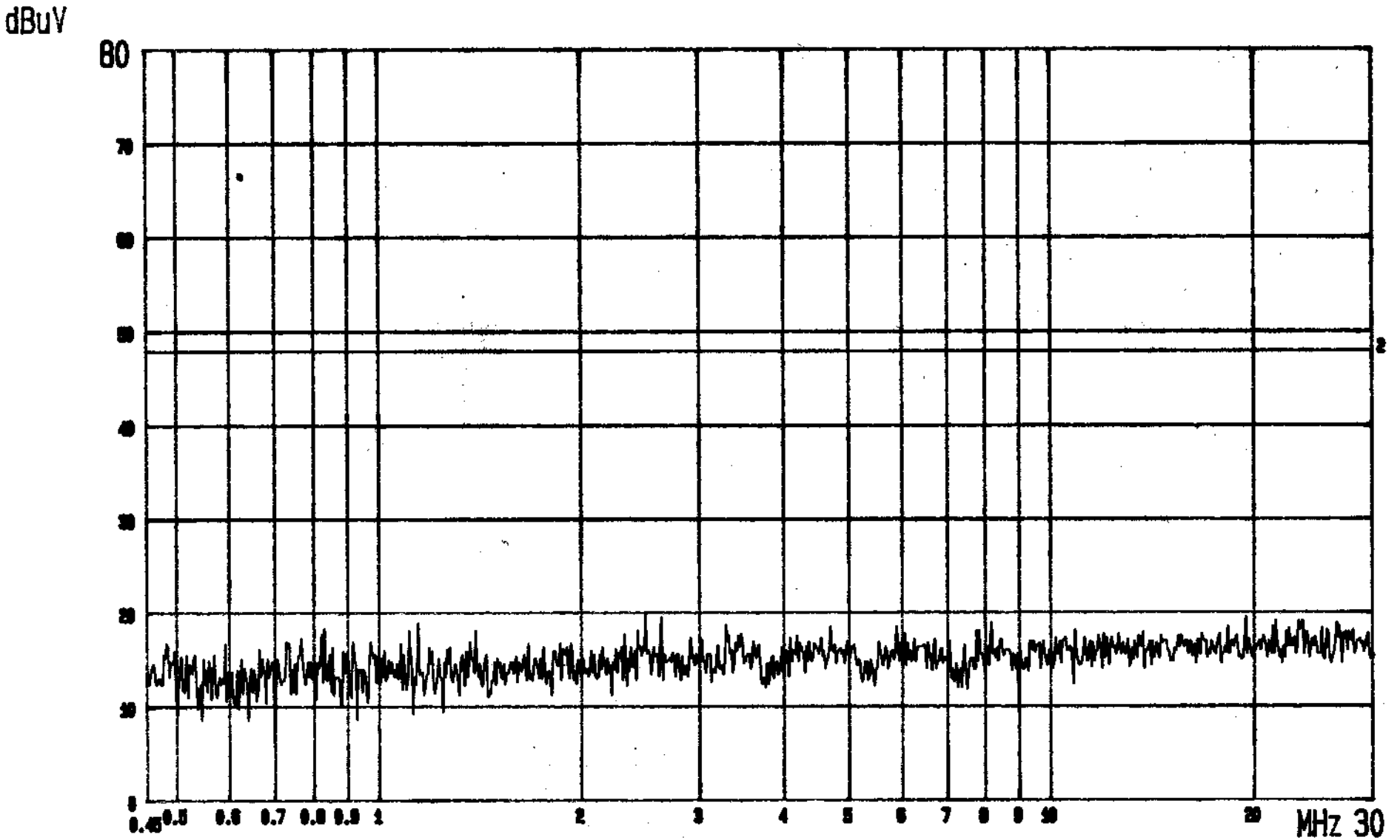
FCC CONDUTED TEST EUT: FM STEREO TRANSMITTER 2: QP. CLASS B LIMIT

MODEL: FT-007 MODE: 88.3MHz POWER: 120V/60Hz LISN: Va ETC EMI LAB.

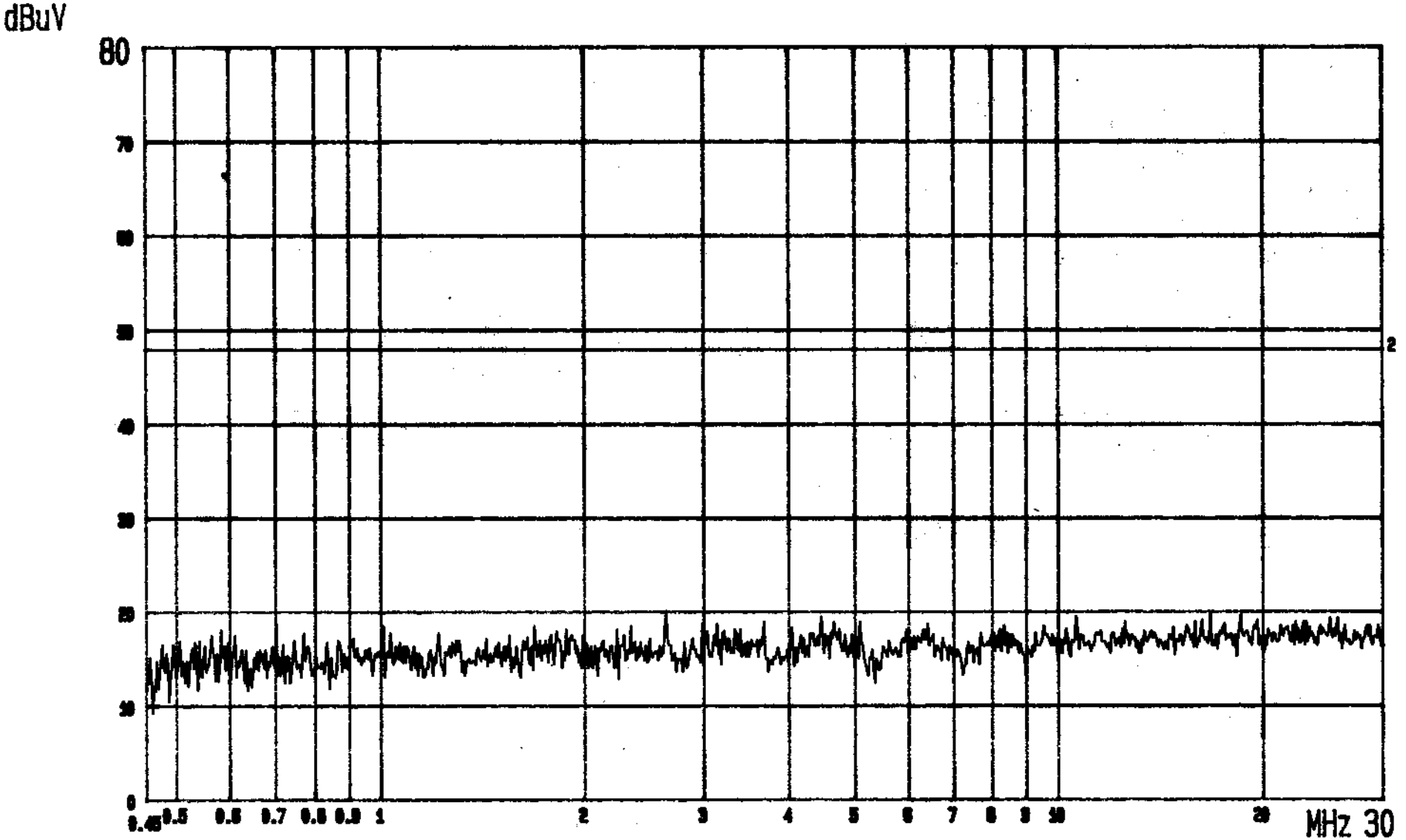


FCC CONDUTED TEST EUT: FM STEREO TRANSMITTER 2: QP. CLASS B LIMIT

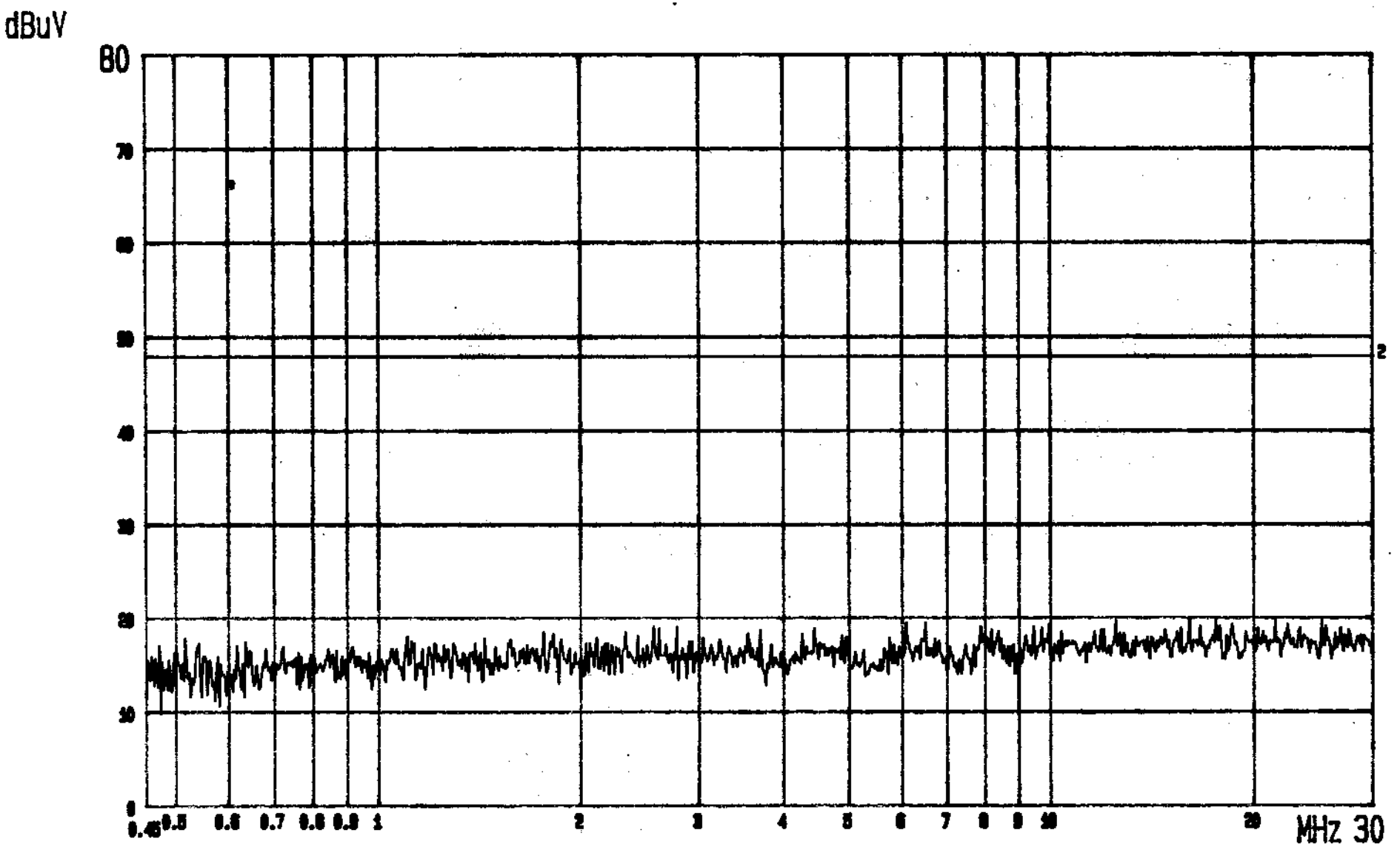
MODEL: FT-007 MODE: 88.3MHz POWER: 120V/60Hz LISN: Vb ETC EMI LAB.



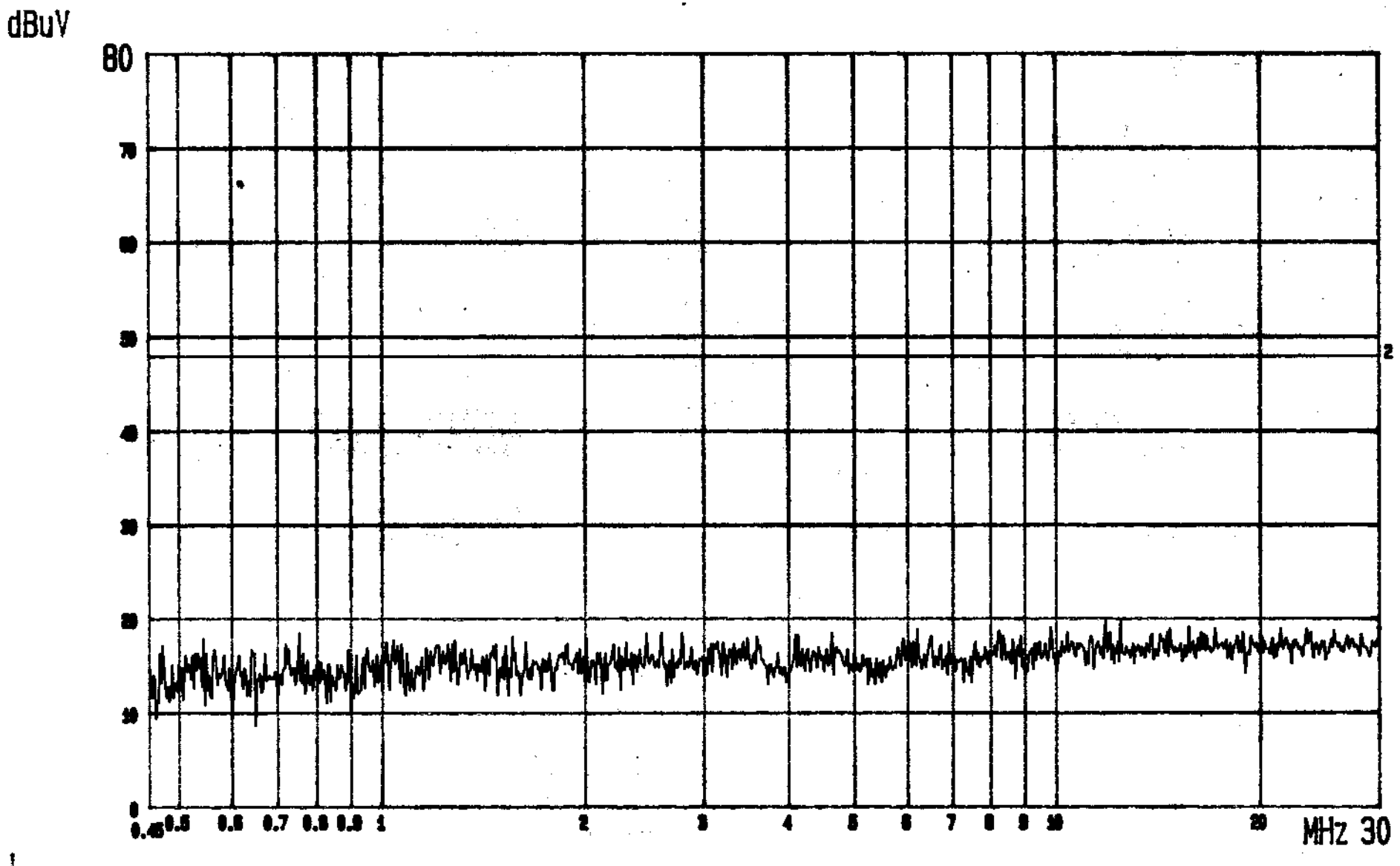
FCC CONDUTED TEST EUT: FM STEREO TRANSMITTER 2: QP. CLASS B LIMIT
MODEL: FT-007 MODE: 98.0MHz POWER: 120V/60Hz LISN: Va ETC EMI LAB.



FCC CONDUTED TEST EUT: FM STEREO TRANSMITTER 2: QP. CLASS B LIMIT
MODEL: FT-007 MODE: 98.0MHz POWER: 120V/60Hz LISN: Vb ETC EMI LAB.

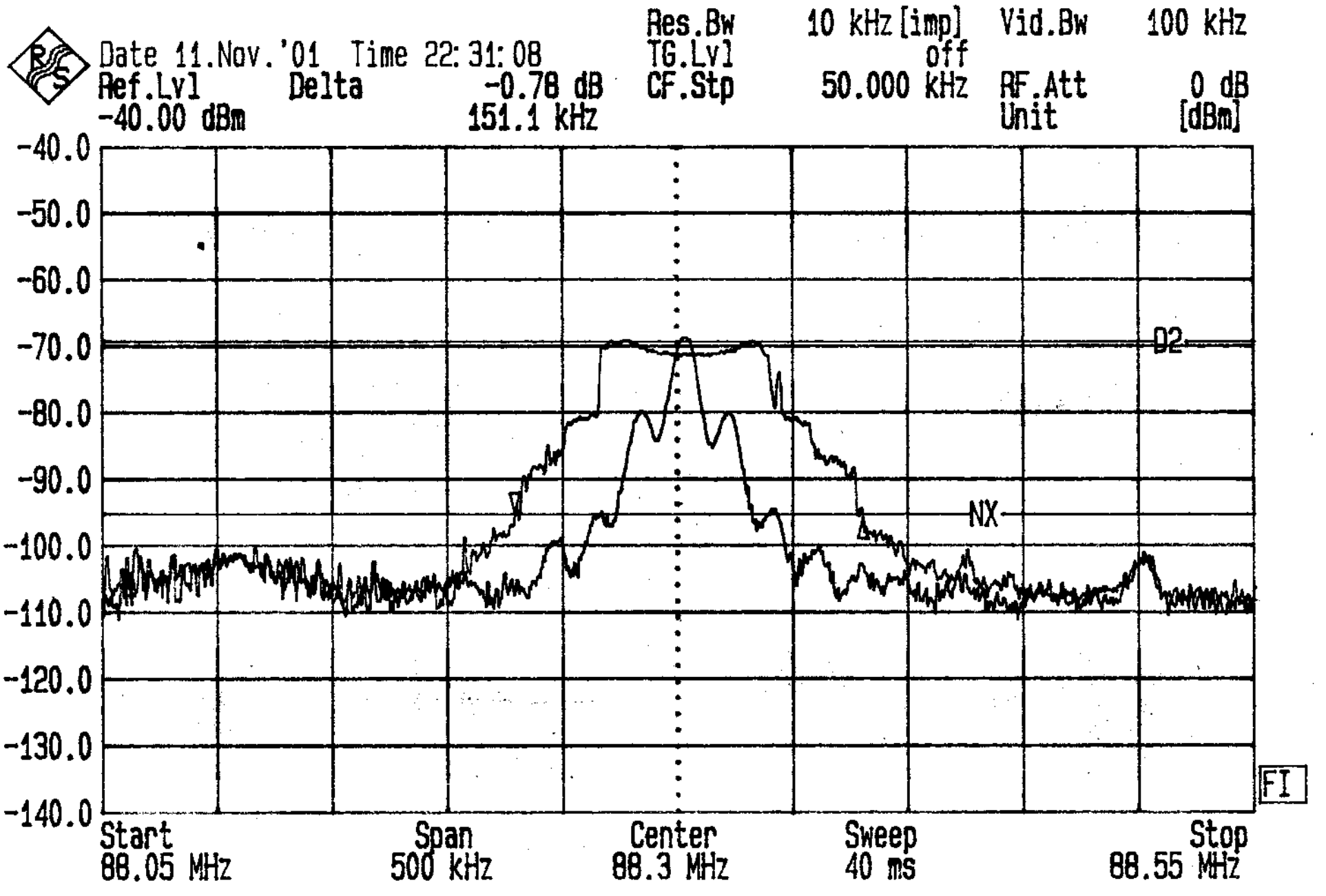


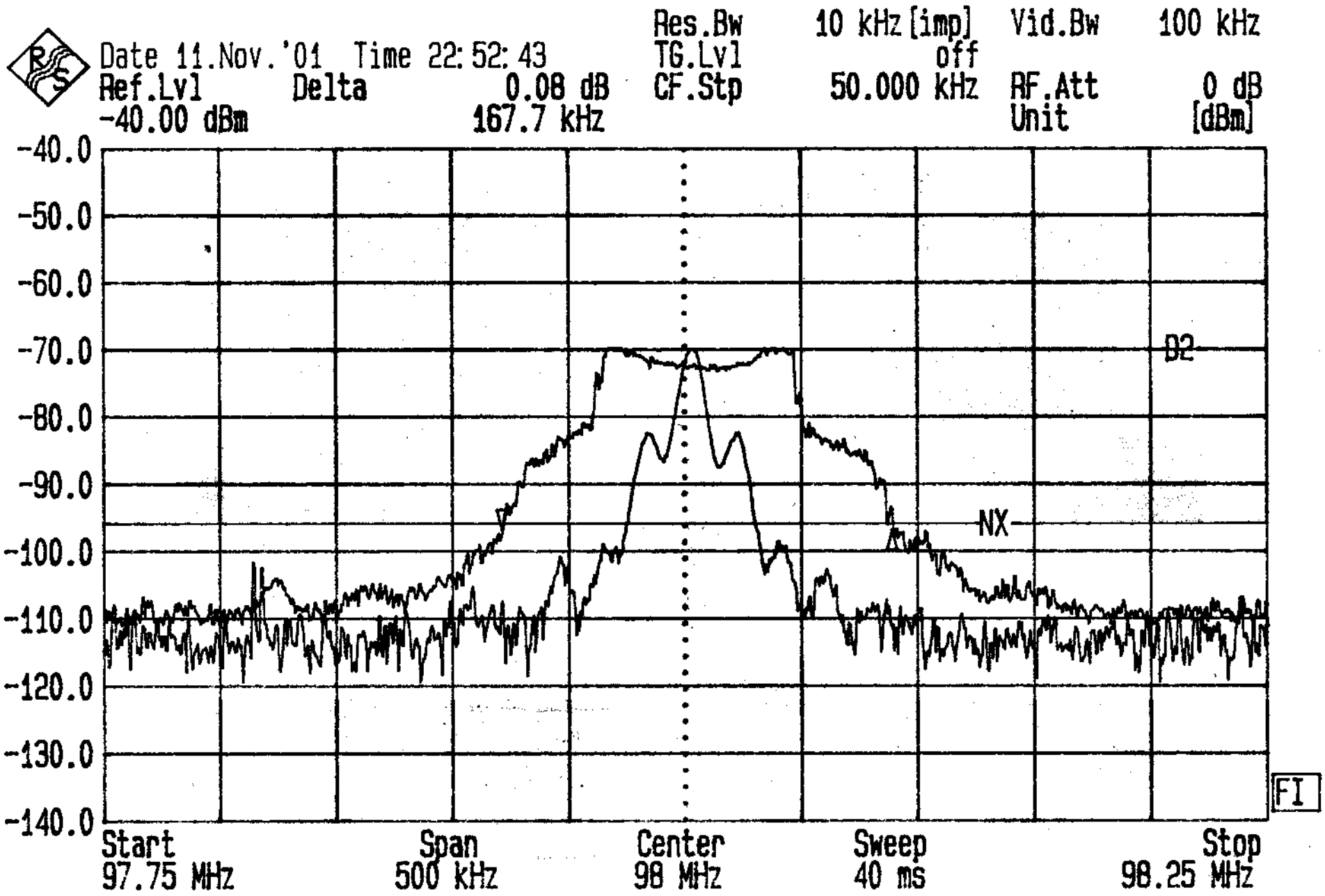
FCC CONDUTED TEST EUT: FM STEREO TRANSMITTER 2: QP. CLASS B LIMIT
MODEL: FT-007 MODE: 107.7MHz POWER: 120V/60Hz LISN: Va ETC EMI LAB.

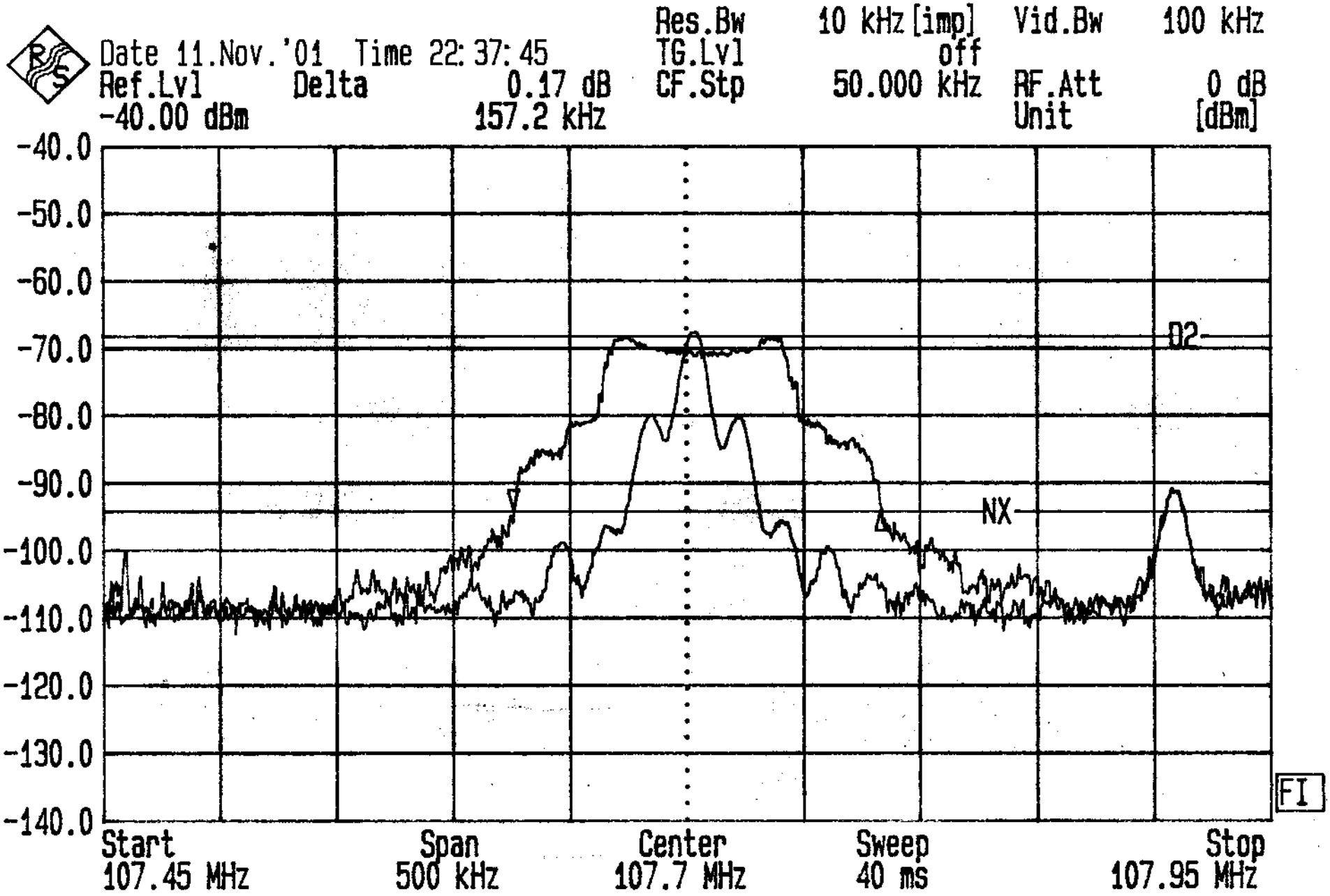


FCC CONDUTED TEST EUT: FM STEREO TRANSMITTER 2: QP. CLASS B LIMIT
MODEL: FT-007 MODE: 107.7MHz POWER: 120V/60Hz LISN: Vb ETC EMI LAB.

APPENDIX 2 : PLOTTED DATA FOR EMISSION BAND MEASUREMENT


Date 11.Nov.'01 Time 22:31:08
Res.Bw 10 kHz [imp]
Vid.Bw 100 kHz
TG.Lvl off
Ref.Lvl Delta -0.78 dB
CF.Stp 50.000 kHz
RF.Att 0 dB
-40.00 dBm 151.1 kHz
Unit [dBm]
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100.0
-110.0
-120.0
-130.0
-140.0
D2
NX
FI
Start 88.05 MHz
Span 500 kHz
Center 88.3 MHz
Sweep 40 ms
Stop 88.55 MHz


Date 11.Nov.'01 Time 22:52:43
Res.Bw 10 kHz [imp]
Vid.Bw 100 kHz
TG.Lvl off
Ref.Lvl -40.00 dBm
Delta 0.08 dB 167.7 kHz
CF.Stp 50.000 kHz
RF.Att 0 dB
Unit [dBm]
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100.0
-110.0
-120.0
-130.0
-140.0
D2
NX
FI
Start 97.75 MHz
Span 500 kHz
Center 98 MHz
Sweep 40 ms
Stop 98.25 MHz


Date 11.Nov.'01 Time 22:37:45
Res.Bw 10 kHz [imp]
Vid.Bw 100 kHz
TG.Lvl off
Ref.Lvl Delta 0.17 dB
CF.Stp 50.000 kHz
RF.Att 0 dB
-40.00 dBm 157.2 kHz
Unit [dBm]
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100.0
-110.0
-120.0
-130.0
-140.0
D2
NX
FI
Start 107.45 MHz
Span 500 kHz
Center 107.7 MHz
Sweep 40 ms
Stop 107.95 MHz