

FCC ID: HJR-X12-600~15

COMPLIANCE TESTING
OF THE
X12~600
Medical Telemetry Transmitter

~ TEST REPORT ~

Project Number: 301314

Prepared for:

Brian Sueppel

Mortara Instrument, Inc.

7865 North 86th Street

MILWAUKEE, WI 53224

Date(s) tests were performed: August 9th, 2001

All results of this report relate only to the items that were tested.

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1.1 DESCRIPTION OF MEASUREMENT FACILITIES

Site on File with the FCC

ID Number:

31040/SIT

1300F2

“The site referenced above has been found to comply with the test site criteria found in ANSI C63.4-1992 and Title 47CFR, FCC Part 15 Section 2.948.”

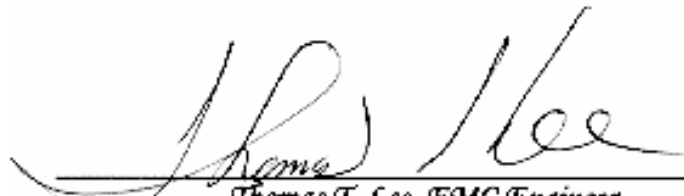


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1.2 SIGNATURE PAGE

SIGNATURE PAGE

Prepared By:

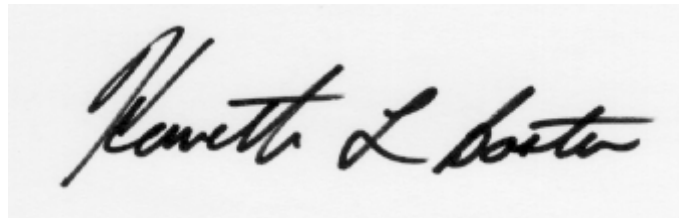


Thomas T. Lee, EMC Engineer

August 9th
2001

Date

Approved By:



August
9th,
2001

Date

Kenneth L. Boston, EMC Lab Manager

PE #31926

Registered Professional Engineer

(State of Wisconsin)



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1.3 SUMMARY OF TEST REPORT

MANUFACTURER:	Mortara Instrument, Inc.
MODEL:	X12-600
SERIAL:	30012-006-1000A
DESCRIPTION:	X12-600 Medical Telemetry Transmitter

The X12-600 medical telemetry transmitter was found to **MEET** the radiated emission specification of Title 47 CFR, FCC Part 15, subpart C, for an intentional radiator. No conducted emissions tests were performed, due to the product not being powered off of the public AC power mains.

The X12-600 medical telemetry transmitter was also found to **MEET** the radiated emission specification of Title 47 CFR FCC Part 15, subpart B for emissions with regards to the class B digital sections of the product.

This product is a composite device, with the digital section subject to verification. Therefore this technical report will primary contain data that is pertinent to the certification of the transmitter section of the product.



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1.4 INTRODUCTION

On August 9th, 2001, a series of Radiated Emissions tests were performed on a sample model of the Medical Telemetry Transmitter. The X12-600 is an ECG amplifier with digital conversion and integrated RF transmitter. The ECG amplifier is a 12 lead device with diagnostic quality digital conversion. The RF transmitter operates in the TV channels 37 through 41 (608 to 632 MHz) meeting FCC Part 15.242. The X12 has a detachable light weight 12 lead patient cable. The X12-600 operates from two AA Alkaline batteries for over 30 hours. When the battery compartment is removed, a power switch and RF channel select switches are exposed. The front panel has a two button keypad and a 51x27mm segment LCD. The overall dimensions are 140x67x25 mm. These tests were performed using the test procedures outlined in ANSI C63.4-1992 for intentional radiators, and in accordance with the general limits set forth in FCC Part 15.242 and 15.209 for a low power transmitter. Tests were also performed as outlined in ANSI C63.4-1992 for non-intentional radiators, in order to allow verification of emissions from the digital section of the product. These tests were performed by Thomas T. Lee, of L. S. Compliance, Inc. and witnessed by Brian Sueppel of Mortara Instruments, Inc.

1.5 PURPOSE

The above mentioned tests were performed in order to determine the compliance of the product with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.209

15.242

All radiated emissions tests were performed to measure the emissions in the frequency bands described by the above sections, and to determine whether said emissions are below the limits established by the above sections. These tests were performed in accordance with the procedure described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-1992). Another document used as reference for the EMI receiver specification was the International Special Committee on Radio Interference (CISPR) number 16-1 (1993).

1.6 RADIATED EMISSIONS TEST SETUP

The test sample was operated within the 3 meter Semi-Anechoic, FCC listed chamber located at L.S. Compliance in Cedarburg, WI. The test sample was operated using two AA alkaline batteries. The battery voltage is stepped up to 5 volts by switching regulators U2. This step up supply can operate with the two AA batteries down to ½ volt each. This effectively uses all the energy stored in the batteries. The test sample was positioned upon an 80cm high wooden table, which was positioned upon the 2meter turntable within the chamber. The measurement antenna, mounted upon a motorized mast was then placed 3 meters from the product perimeter. This allowed the test sample to be scanned in both azimuth and elevation. Measurements were performed for the transmitter fundamental, and harmonics up through the 10th harmonic, although harmonics above the 4th harmonic could not be seen in the noise floor. The test sample was set to operate on one of three channels available within the sample tuning range. Channel 00 at 608.48MHz, the low channel, channel 80 at 620.48MHz is the mid-channel and channel FF at 632.52MHz is the high channel.

Please refer to Section 1.10 for pictures of the test setup.



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1.7 RADIATED EMISSION TEST PROCEDURE

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to the general limits given in Title 47 CFR, FCC Part 15.242 and 15.209. For the calculations used to determine the limits applicable for the test sample, refer to Appendix A. These limits are expressed in decibels (dB) above 1 microvolt per meter ($\mu\text{V}/\text{m}$). The samples were tested from the lowest frequency generated by the transmitter (without going below 9 kHz) to the 10th harmonic of the highest fundamental frequency generated by the device. These frequencies, and their associated limits, are referenced in Section 1.9. The test sample was setup in the 3 Meter FCC listed Semi-Anechoic chamber located at L. S. Compliance, upon the 2 meter turntable in the chamber, and an antenna mast was placed 3 meters from the test object perimeter. A biconical antenna was used to measure emissions from 30 to 300 MHz, a log periodic was used to measure emissions from 300 to 1000 MHz. The test object was also given several different orientations (X- axis, Y axis, Z axis) to determine the maximum signal levels, using both horizontal and vertical antenna polarities. The test object was placed in continuous transmit, and the spurious signals were maximized by rotating the turntable 360 degrees, and by raising and lowering the antenna between 1 and 4 meters, and was tested using both horizontal and vertical antenna polarities.

The unit was scanned for emissions in both transmit and standby modes, over the range 30MHz to 6500MHz to establish compliance with FCC Part 15.209 and Part 15.242 for the transmitter. Also, the scans were performed to evaluate the digital controller section of the product, which is subject to verification as a Class B digital device. Any significant spurious signals, other than the noise floor of the system, are tabulated in the data section found in Appendix B. Signature scans (taken at 3 meters) can be found in Appendix C, and include close in spans of the three target channels to illustrate occupied bandwidth, and band edge compliance.



1.8 TEST EQUIPMENT UTILIZED FOR THE RADIATED EMISSIONS TEST

A list of the test equipment and antennas used for the tests can be found in Section 1.12, which includes the calibration information as well as the equipment description. All equipment is calibrated and used according to the user manuals supplied by the manufacturer. All antenna calibrations were performed at a N.I.S.T traceable site, and the resultant correction factors were entered into the Hewlett Packard 8546A EMI receiver software database. The connecting cables used were also measured for loss using a calibrated signal generator and the HP 8546A EMI receiver. The resulting loss factors were entered into the HP 8546A database. This allowed for automatic changes in the antenna correction factor, as well as cable loss or other corrections, to be added to the EMI receiver display while taking measurements. Thus, the resulting data taken from the HP 8546A is an actual reading and can be entered into the database as a corrected meter reading. The HP 8546A EMI receiver was operated with a bandwidth of 9 kHz when receiving signals below 30 MHz, a bandwidth of 120 kHz when receiving signals at 30 MHz-1 GHz and a bandwidth of 1 MHz when receiving signals above 1 GHz, in accordance with CISPR 16. The Peak, Quasi-peak, and Average detector functions were used.



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Manufacturer: Motara Instrument, Inc.

Model: X12-600

Serial Number(s): 30012-006-1000A

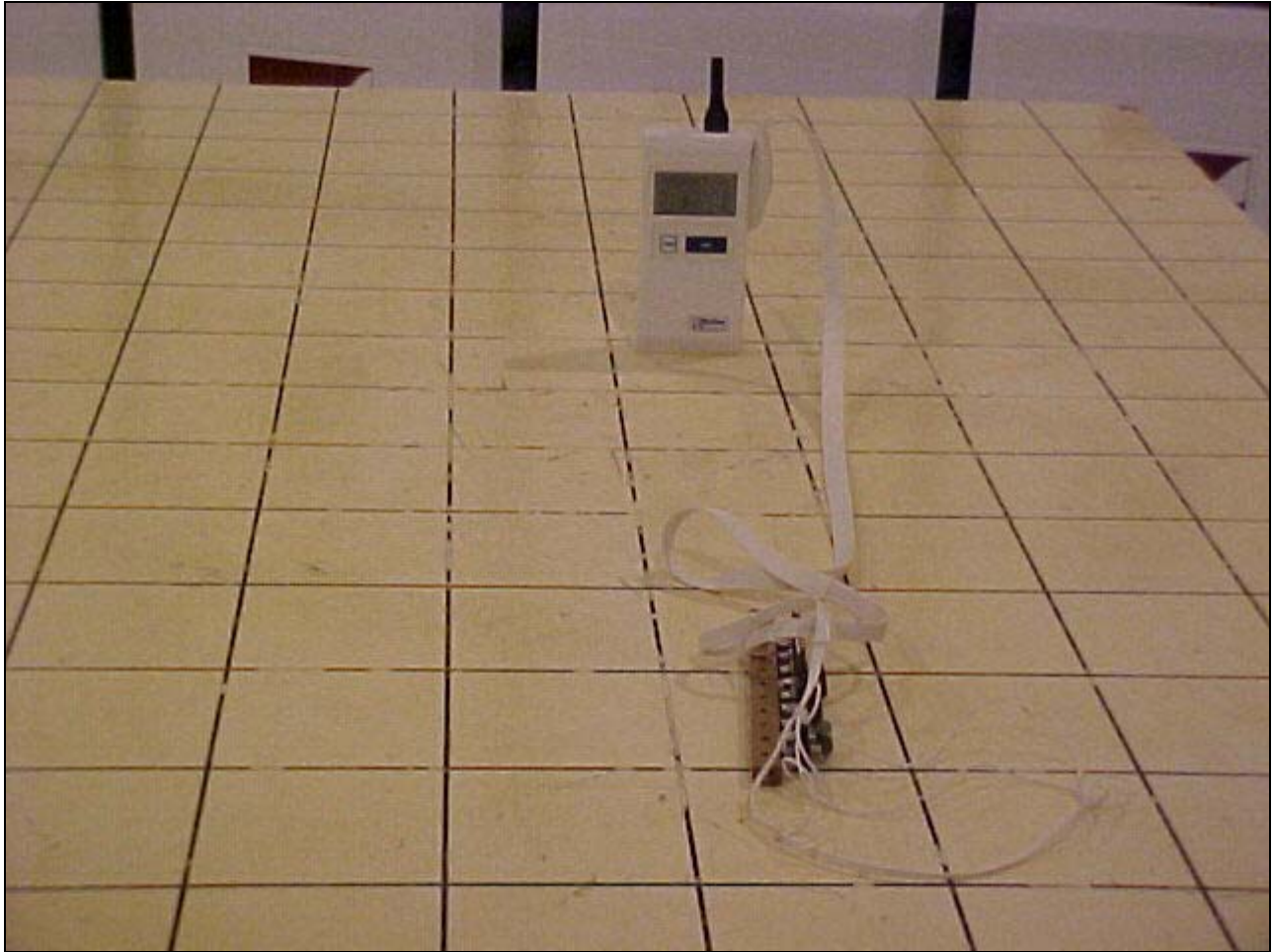
1.9 ~ Restricted Bands affecting this product (transmitter)

Frequency (MHz)
*608-614
960-1240
1300-1427
1645.5-1646.5
1660-1710
1718.8-1722.2
2200-2300
2310-2390
2483.5-2500
2655-2900
3260-3267
3332-3339
3345.8-3358
3600-4400
4500-5150
5350-5460

Note: *This is not a restricted frequency for a FCC Part15.242 device.

1.10 – Photos taken during testing

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Close up front view of the X12-600 during the Radiated Emissions tests on the 3-Meter FCC listed Semi-anechoic chamber

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Side view of the X12-600 during the Radiated Emissions tests on the 3-Meter Semi-anechoic Chamber



1.11 SUMMARY OF RESULTS AND CONCLUSIONS

Based on the procedures outlined in this report, and the test results included in Appendices B and C, it can be determined that the X12-600 does **MEET** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator. The X12-600 was also found to **MEET** the emission requirements of Part 15.242 and 15.209, subpart B for unintentional radiators with regards to the digital section of the test sample.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed on the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.



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1.12 ~ Test Equipment

Asset #	Manufacturer	Model #	Serial #	Description	Due Date
AA960004	EMCO	3146	9512-4276	Log Periodic Antenna	8/21/01
AA960005	EMCO	3110B	9601/2280	Biconical Antenna	9/28/01
EE960004	EMCO	2090	9607-1164	Mast/Ttable Controller	I.O
EE960013	HP	8546A	3617A00320	Receiver RF Section W/Display and RF filter section	11/1/01
EE960014	HP	85460A	3448A00296	Receiver RF Section Preselector	11/1/01
AA960007	EMCO	93115	99111-4198	Double Ridge Horn Antenna	9/18/01
~~	LSC	Cable	11	3 meter Helix	12/7/01
~~	LSC	Cable	38	1 meter RG 214	12/7/01
~~	LSC	Cable	50	10 meter RG 214	12/7/01



APPENDIX A:

SAMPLE CALCULATIONS



FCC ID: HJR-X12-600-15

Manufacturer: Mortara Instrument, Inc.

Model: X12-600

Serial Number(s): 30012-006-1000A

I. Calculation of Radiated Emissions limits for FCC Part 15.242C

**Field strength of transmitter fundamental Frequencies: (within the given 6MHz
Television channel that the device operates)**

For the frequency range of 608 to 632 MHz the limit (at 3 meters) is found by:

LIMIT(uv/m)=200,000 uV/m at 3 meters

LIMIT (dBuV/m) = $20\log(200000)=106.02$ dBuV/m

FIELD STRENGTH OF TRANSMITTER HARMONIC AND SPURIOUS FREQUENCIES:

For the frequency range of 30 MHz to 88 MHz the limit (at 3 meters) is found by:

LIMIT (dBuV/m) = $20\log(100)$

For the frequency range of 88 MHz to 216 MHz the limit (at 3 meters) is found by:

LIMIT (dBuV/m) = $20\log(150)$

For the frequency range of 216 MHz to 960 MHz the limit (at 3 meters) is found by:

LIMIT (dBuV/m) = $20\log(200)$

For the frequency range of 960 MHz to 40 GHz the limit (at 3 meters) is found by:

LIMIT (dBuV/m) = $20\log(500)$

Class B limits are in uV/m in FCC Part 15.209 and can be converted into dBuV/m using the formulas given above.

Frequency (MHz)	FCC limit (uV/m)	FCC limit (dBuV/m)
30-88	100	40
88-216	150	43.52
216-960	200	46.02
960-40000	500	53.98



APPENDIX B:

DATA CHARTS



FCC ID: HJR-X12-600-15

Measurement of Radiated Emissions in the 3 Meter FCC Listed Semi-Anechoic Chamber

Frequency Range inspected: 30 to 1000 MHz

Date of Test:	August 9 th , 2001	Manufacturer:	Mortara Instruement, Inc.
Location:	L.S. Compliance, Inc.	Model No.:	X12-600
	W66 N220 Commerce Court		
	Cedarburg, WI 53012		
Specifications:	Title 47CFR, FCC Part 15.209, 15.242	Serial No.:	30012-006-1000A
Distance:	3 meters	Configuration:	Active, transmitting
Equipment:	HP 8546A EMI Receiver	Detector(s) Used:	Quasi-Peak (below 1GHz)
	EMCO 3115 Double Ridged Waveguide		Average (above 1GHz)
	EMCO 3146A Log Periodic		
	EMCO 3110B Biconical		

The following table depicts the level of significant Class B spurious emissions

Frequency (MHz)	Channel	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	Q-Peak Reading (dBuV/m)	15.109a Limit(dBuV/m)	Margin (dB)
130.57	0.0	H	1.7	0	32.1	43.5	11.5
248.32	0.0	H	1.4	45	40.7	46	5.3
248.34	0.0	V	1	94	31.7	46	14.3
258.55	0.0	H	1.3	39.9	42.2	46	3.8
258.56	0.0	V	1	108	34.0	46	12.0
309.76	0.0	H	1	56.8	38.2	46	7.8
309.76	0.0	H	1	50	38.6	46	7.4
320.01	0.0	H	1	59.6	38.8	46	7.2
330.25	0.0	H	1	50	37.7	46	8.4
608.80	0.0	H	1	177.3	82.3	106	23.7
608.80	0.0	V	1	115	83.0	106	23.0
620.80	80.0	H	1	0	72.6	106	33.4
620.80	80.0	V	1	115.9	83.8	106	22.2
631.52	FF	H	1.4	0	72.3	106	33.7
631.54	FF	V	1	108.5	83.4	106	22.6
1216.93	0.0	V	1.7	275	43.6	54	10.4
1240.95	80.0	V	1	274	40.7	54	13.3
1825.51	0.0	V	1.1	86	44.4	54	9.6



APPENDIX C:

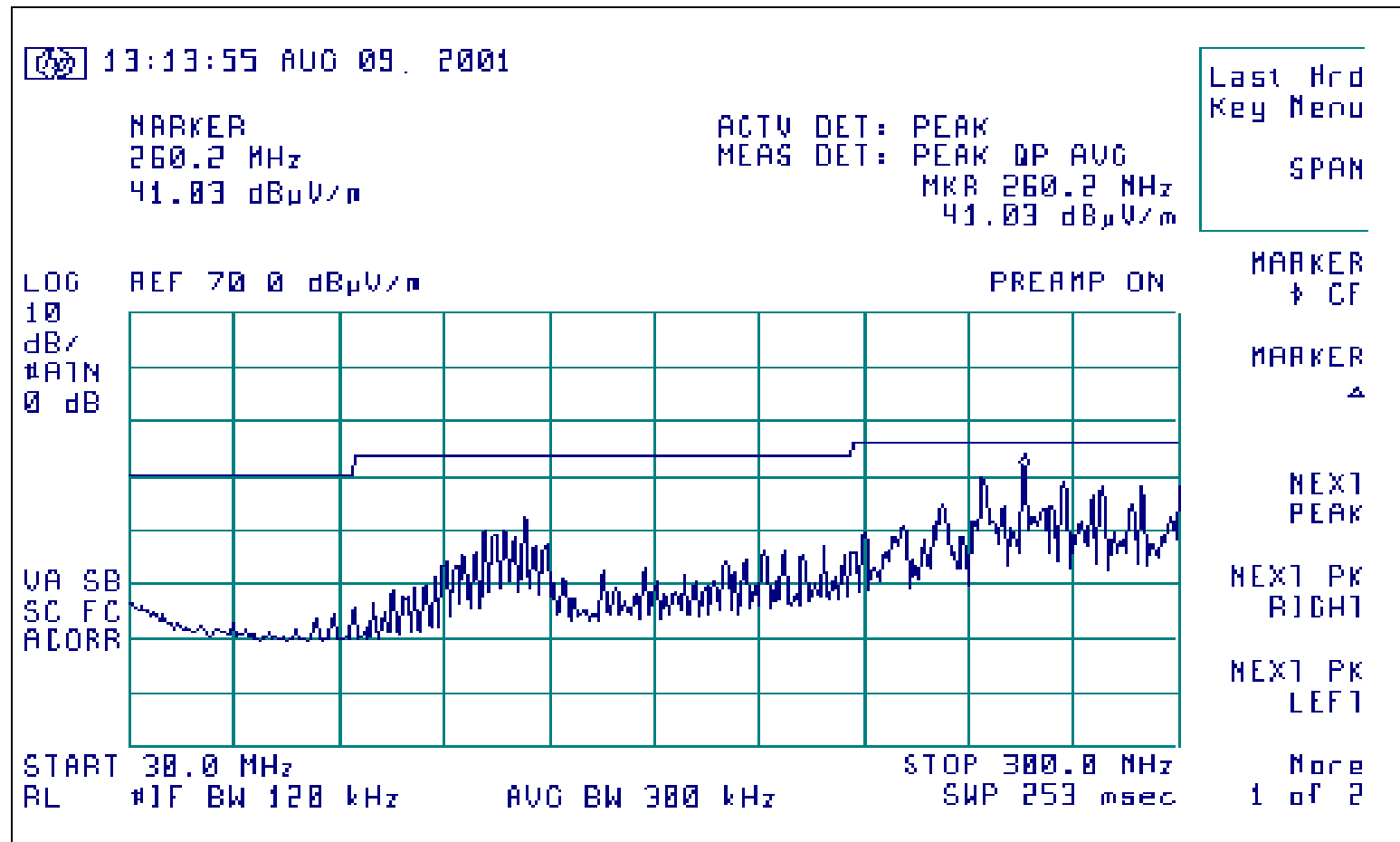
GRAPHS



FCC ID: HJR-X12-600-15

Channel 00

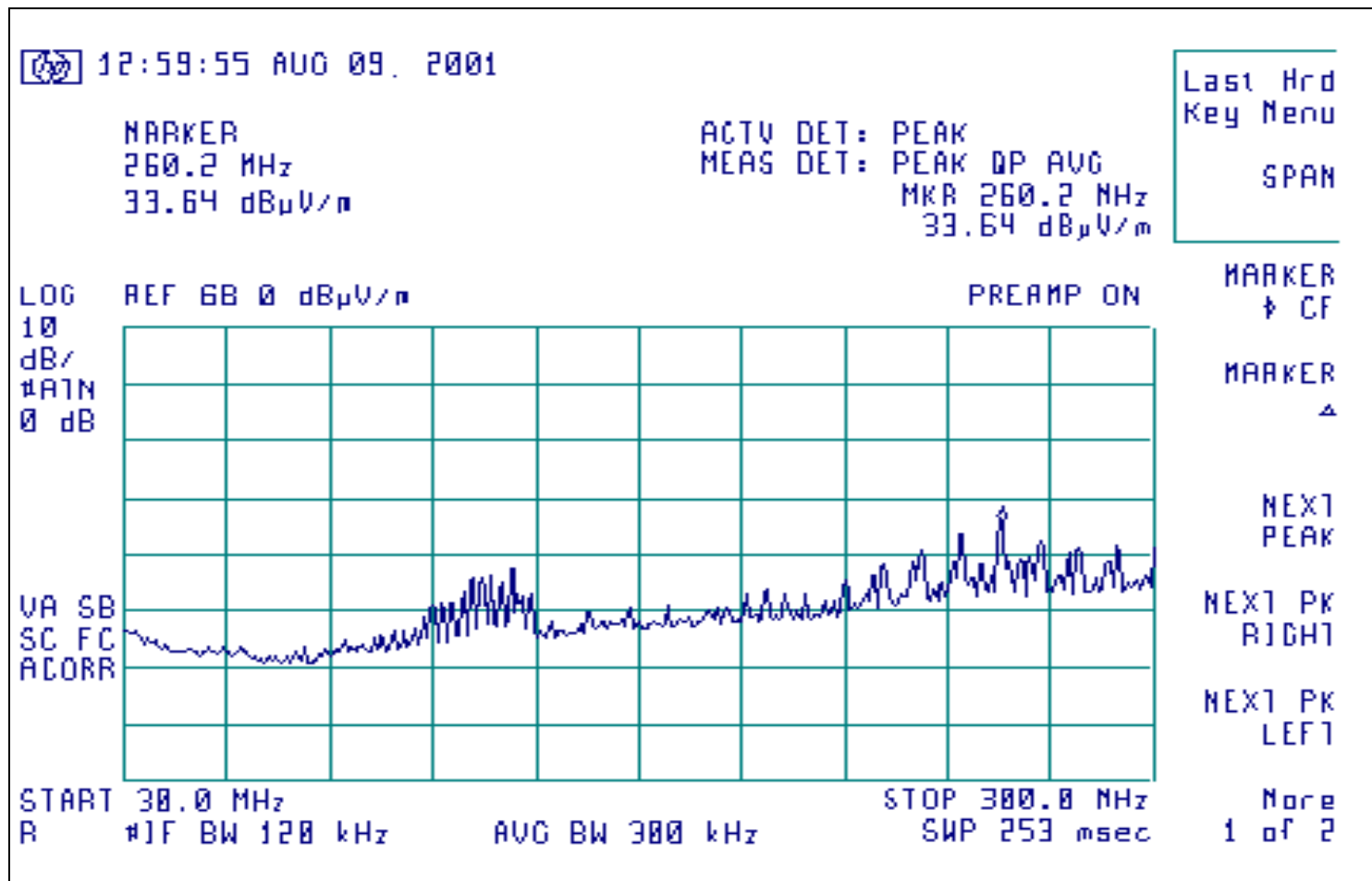
Signature Scan of the Radiated Emissions of the X12-600, horizontal polarity, 30-300 MHz
Inside 3 meter Semi-anechoic chamber, Peak hold scan



FCC ID: HJR-X12-600-15
Channel 00

Signature Scan of the Radiated Emissions of the X12-600, vertical polarity, 30~300 MHz

Inside 3 meter Chamber, Peak hold scan

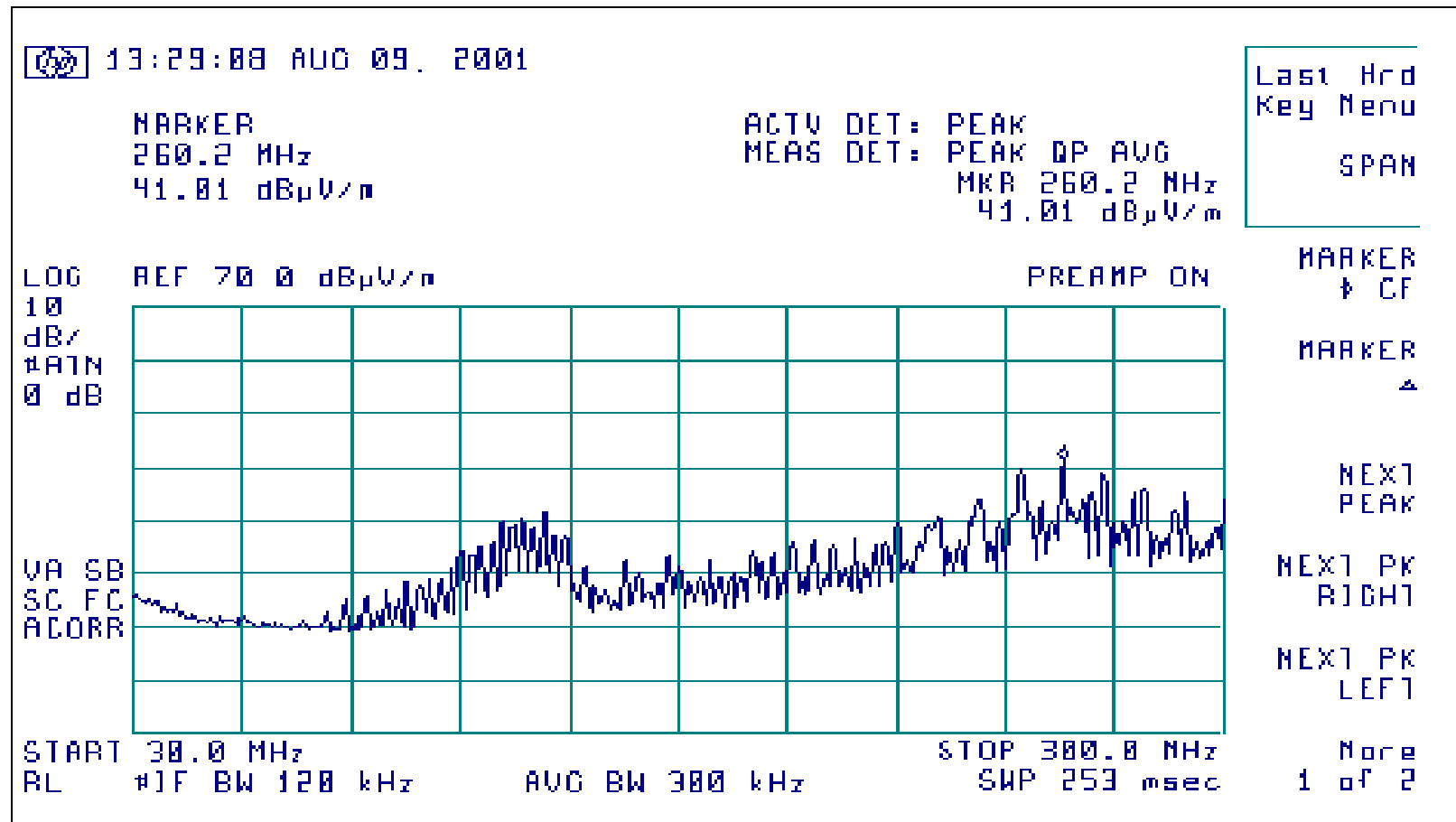




FCC ID: HJR-X12-600-15

Channel 80

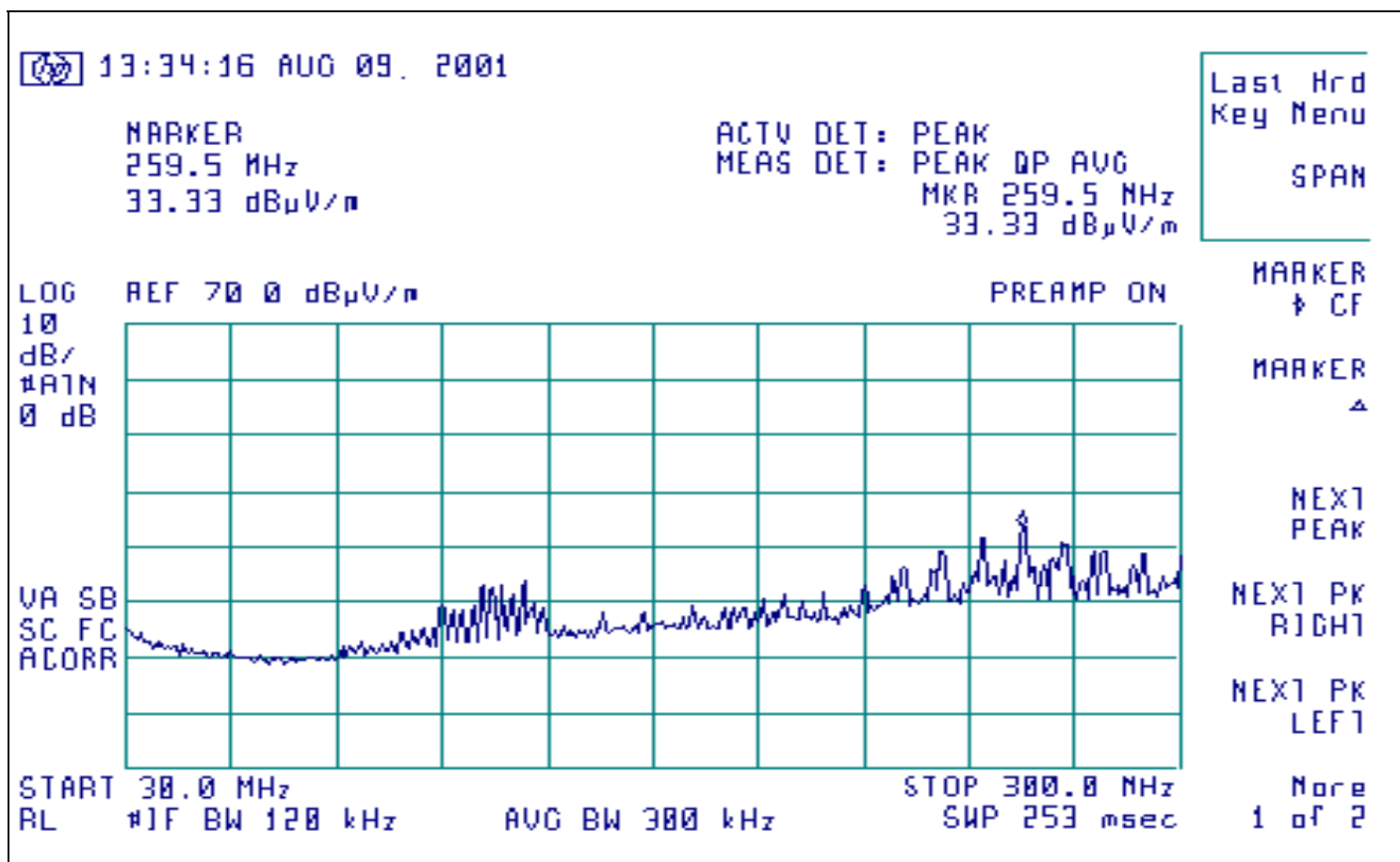
Signature Scan of the Radiated Emissions of the X12-600, horizontal polarity, 30-300 MHz
Inside 3 meter Semi-anechoic chamber, Peak hold scan



FCC ID: HJR-X12-600-15

Channel 80

Signature Scan of the Radiated Emissions of the X12-600, horizontal polarity, 30-300 MHz
Inside 3 meter Semi-anechoic chamber, Peak hold scan

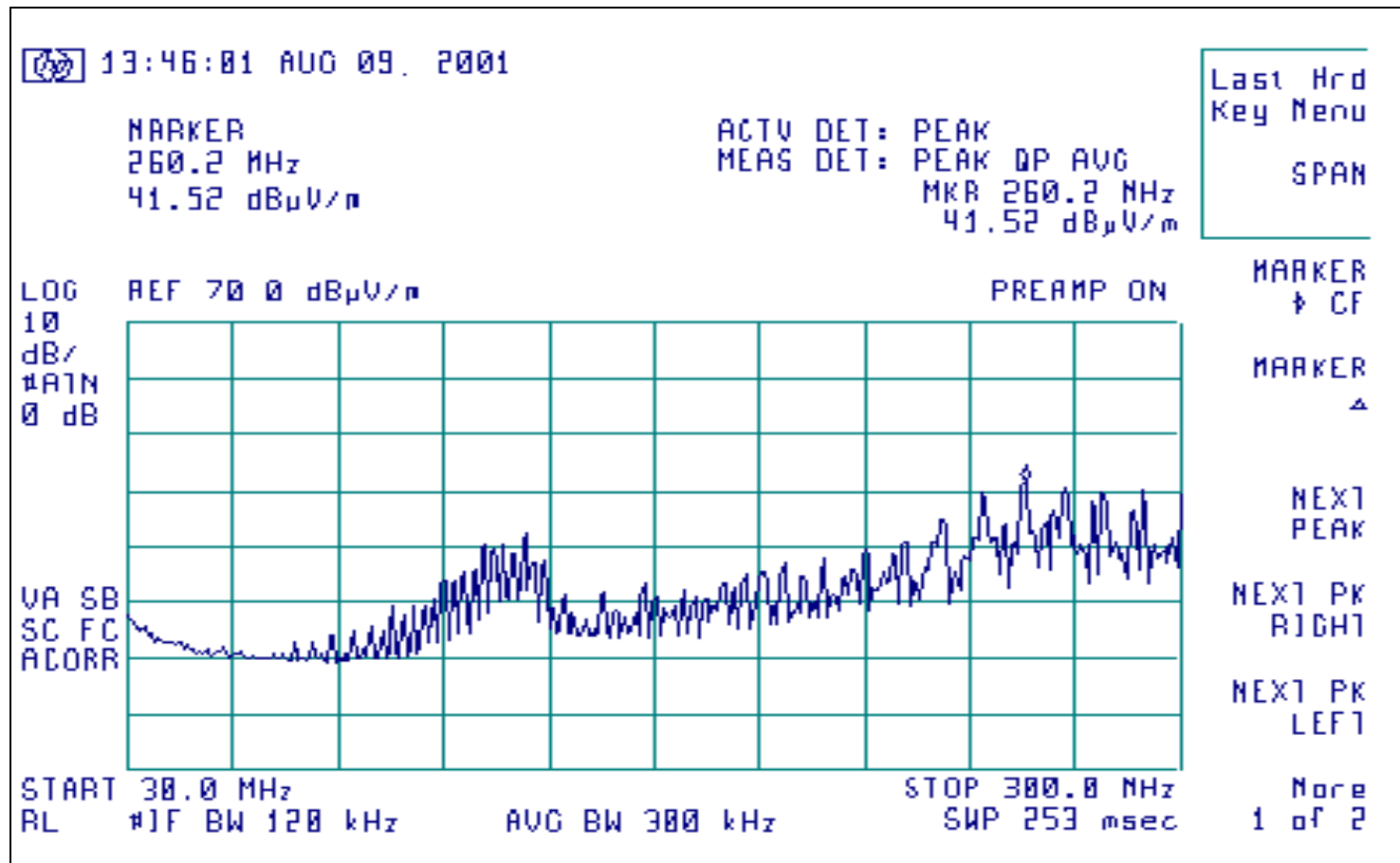




FCC ID: HJR-X12-600-15

Channel FF

Signature Scan of the Radiated Emissions of the X12-600, horizontal polarity, 30-300 MHz
Inside 3 meter Semi-anechoic chamber, Peak hold scan



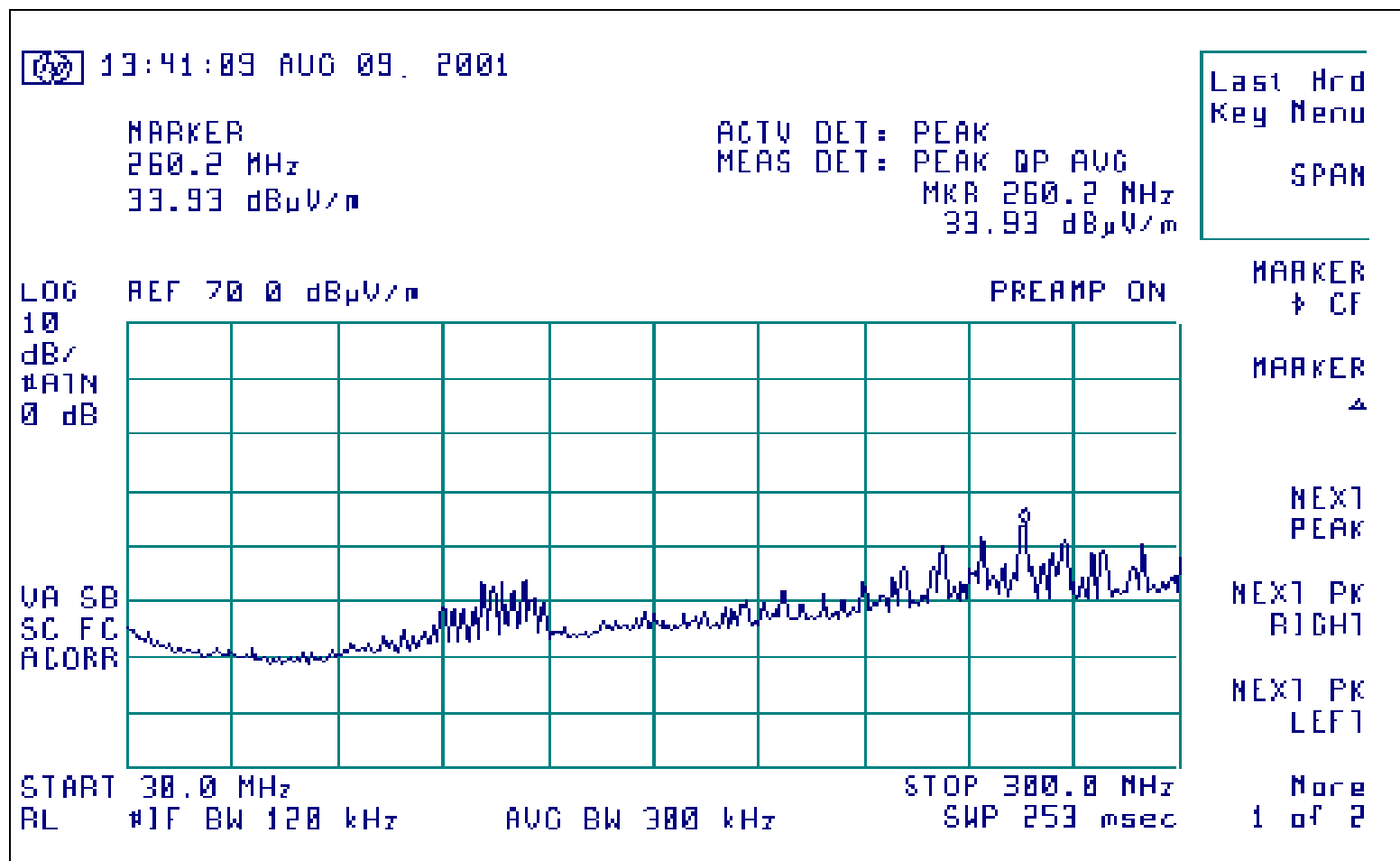


FCC ID: HJR-X12-600-15

Channel FF

Signature Scan of the Radiated Emissions of the X12-600, Vertical Polarity, 30-300 MHz

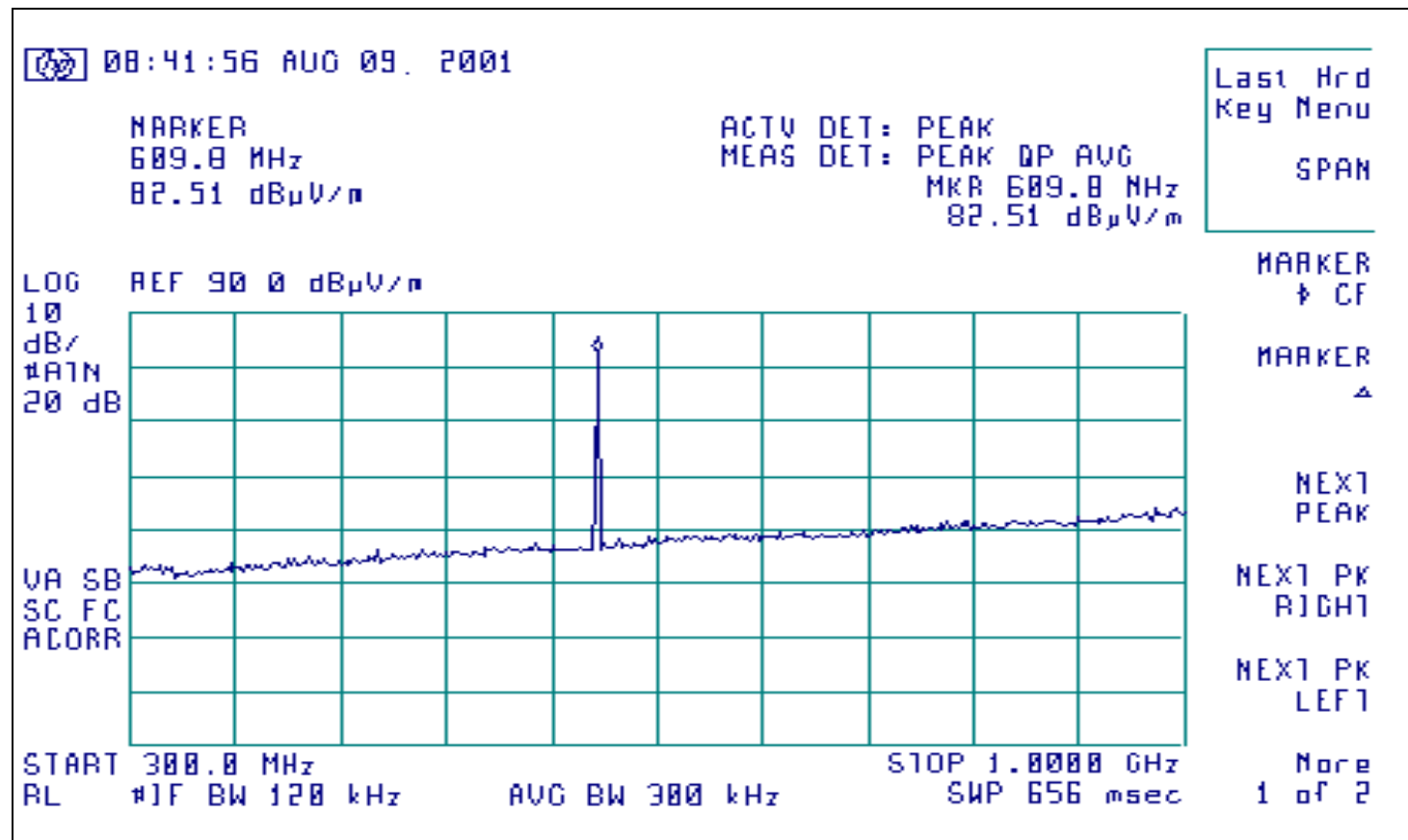
Inside 3 meter Semi-anechoic chamber, Peak hold scan



FCC ID: HJR-X12-600-15

Channel 00

Signature Scan of the Emissions of the X12-600, Vertical polarity, from 300 MHz to 1000 MHz
Inside 3 meter Chamber, Peak hold scan

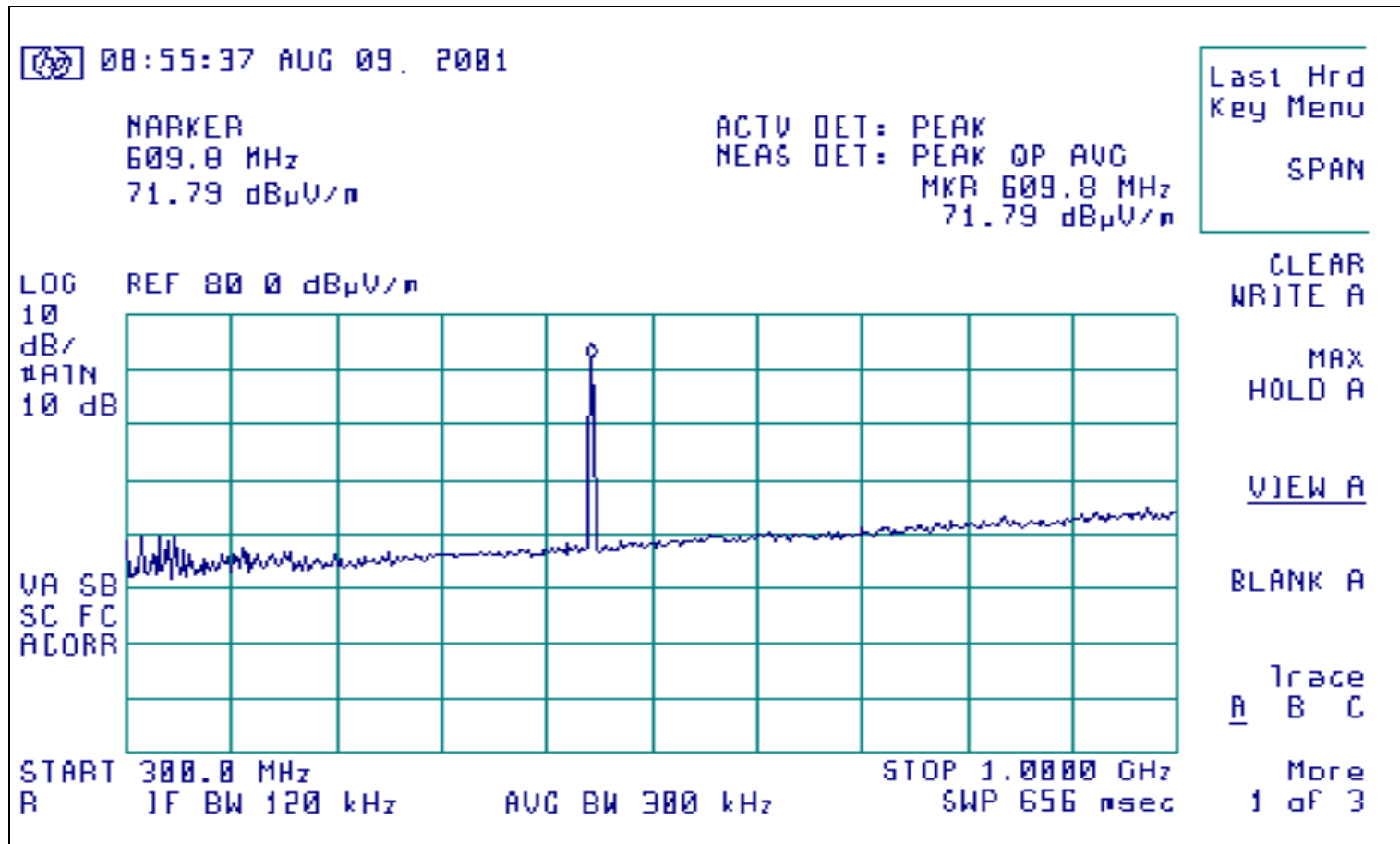




FCC ID: HJR-X12-600-15

Channel 00

Signature Scan of the Emissions of the X12-600, Horizontal polarity, from 300 MHz to 1000 MHz
Inside 3 meter Chamber, Peak hold scan

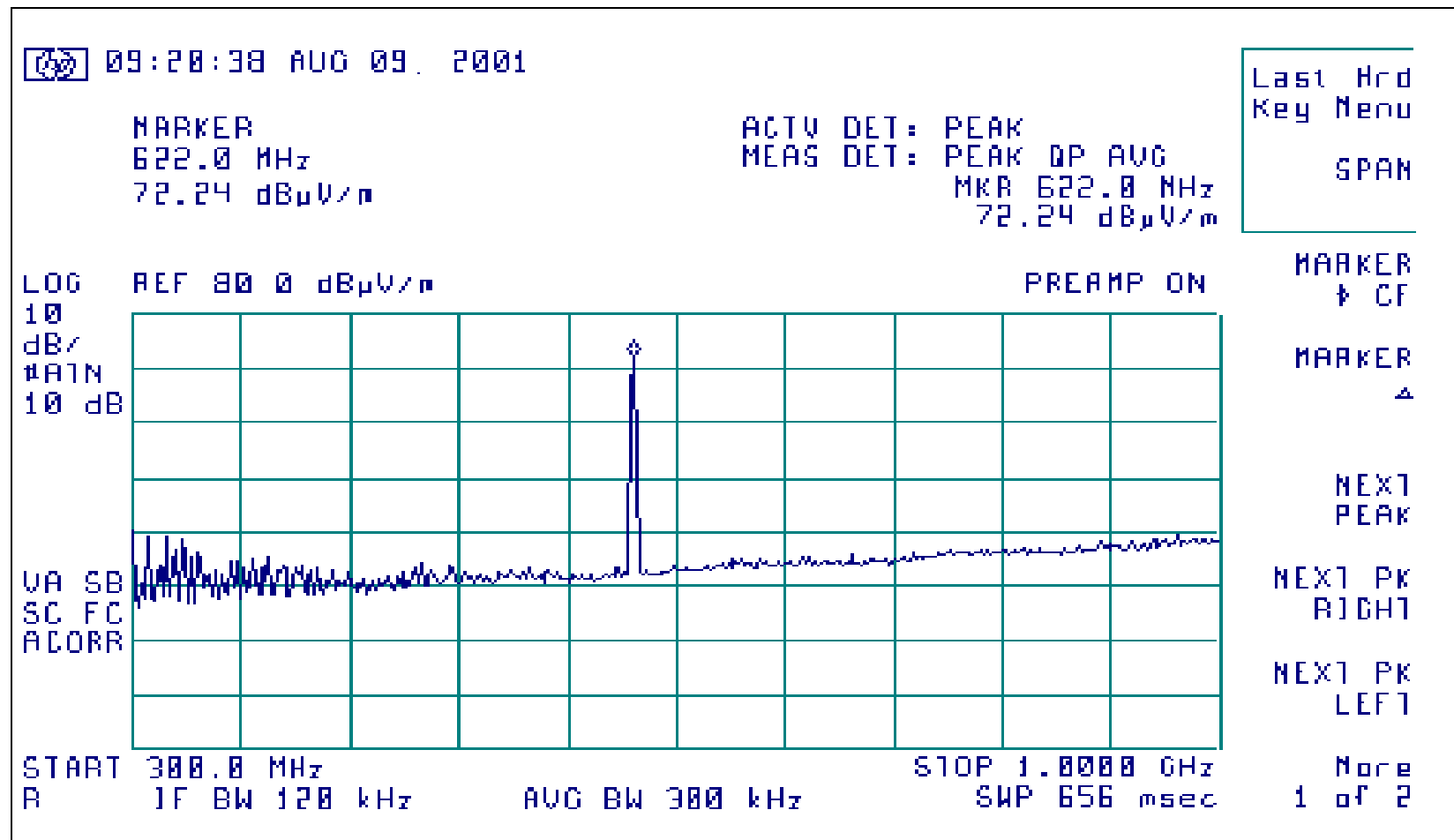




FCC ID: HJR-X12-600-15

Channel 80

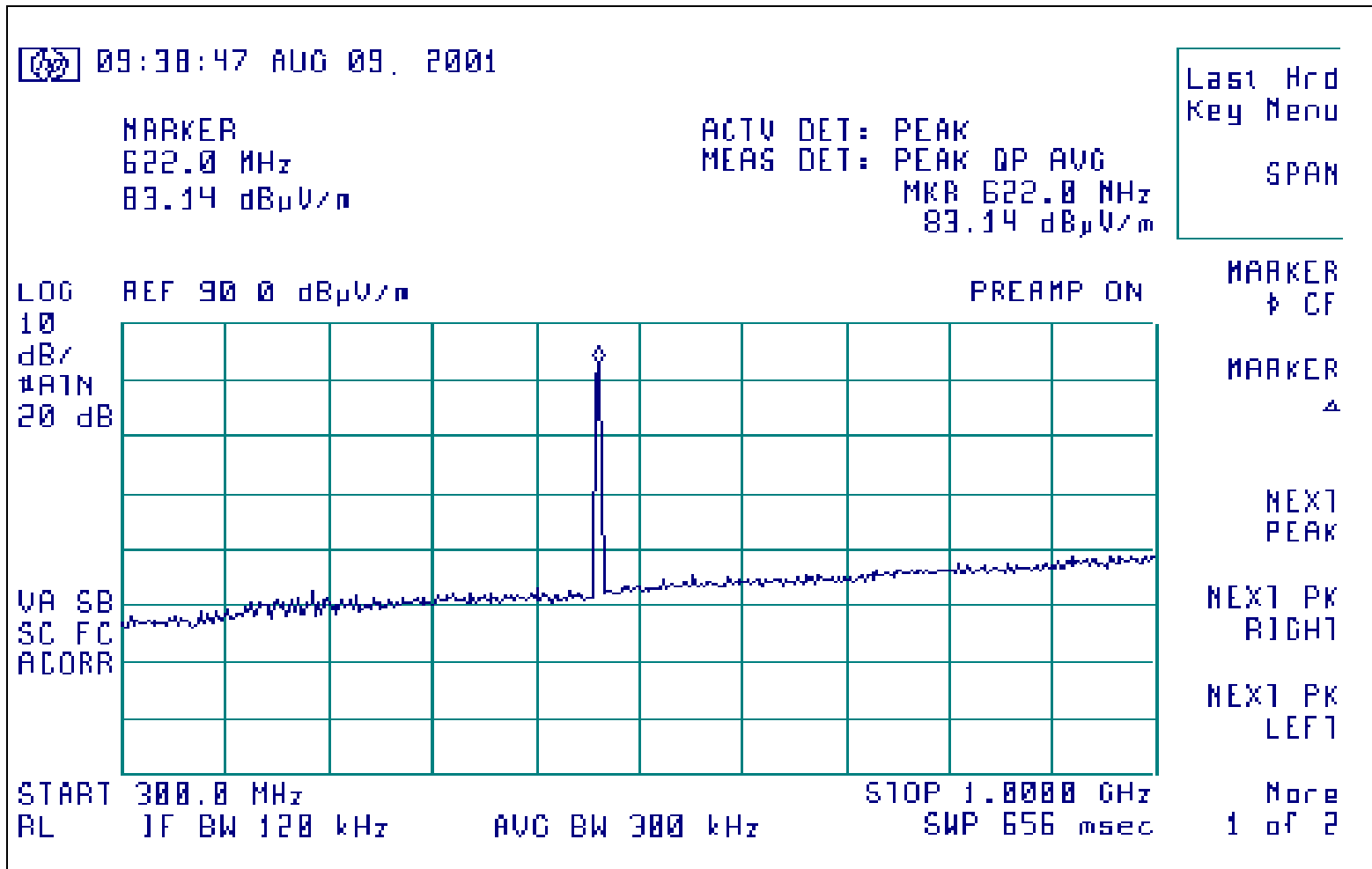
Signature Scan of the Emissions of the X12-600, Horizontal polarity, from 300 MHz to 1000 MHz
Inside 3 meter Chamber, Peak hold scan



FCC ID: HJR-X12-600-15

Channel 80

Signature Scan of the Emissions of the X12-600, Vertical polarity, from 300 MHz to 1GHz
Inside 3 meter Chamber, Peak hold scan

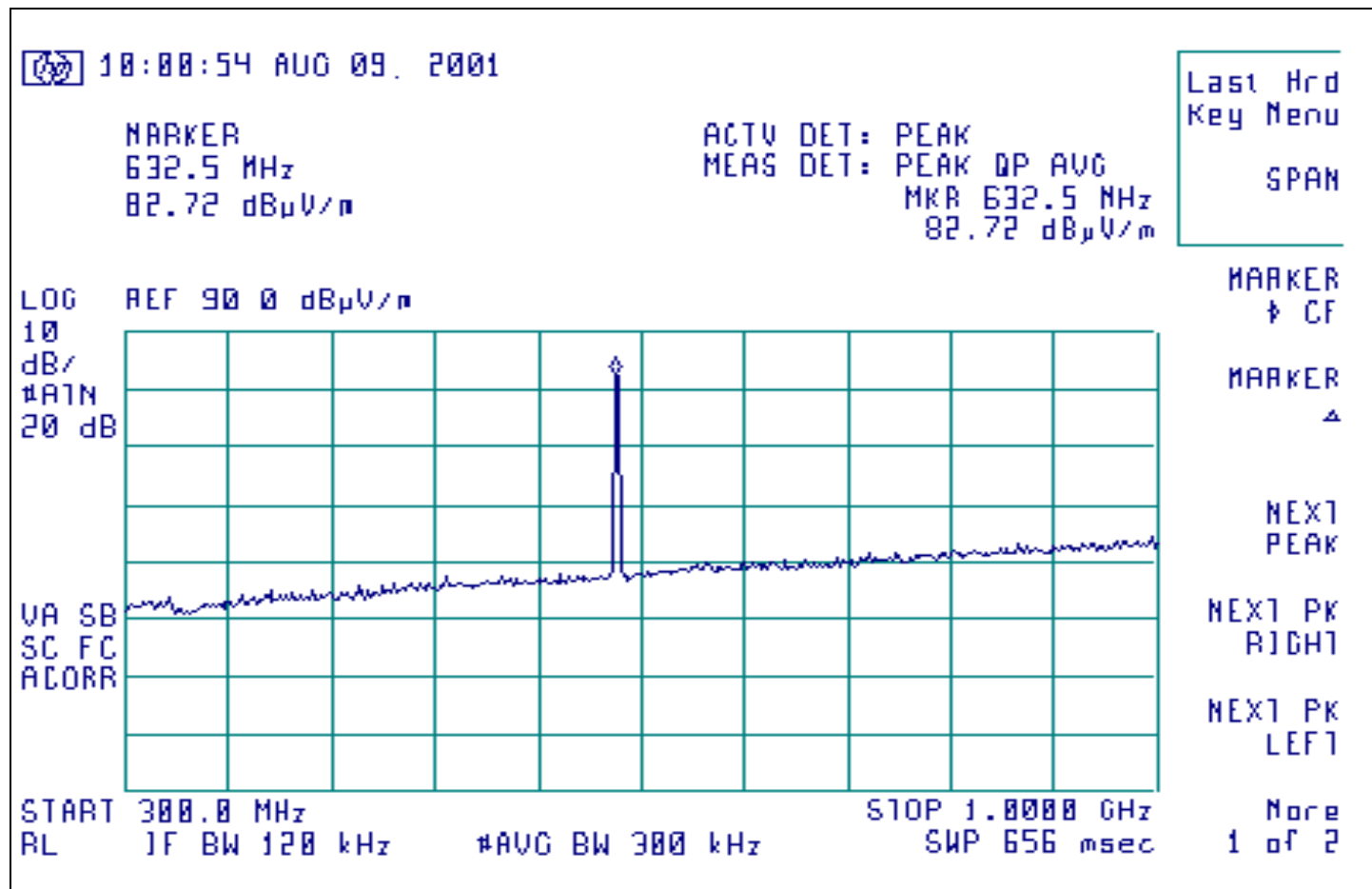




FCC ID: HJR-X12-600-15

Channel FF

Signature Scan of the Emissions of the X12-600, Vertical polarity, from 300MHz to 1GHz
Inside 3 meter Chamber, Peak hold scan

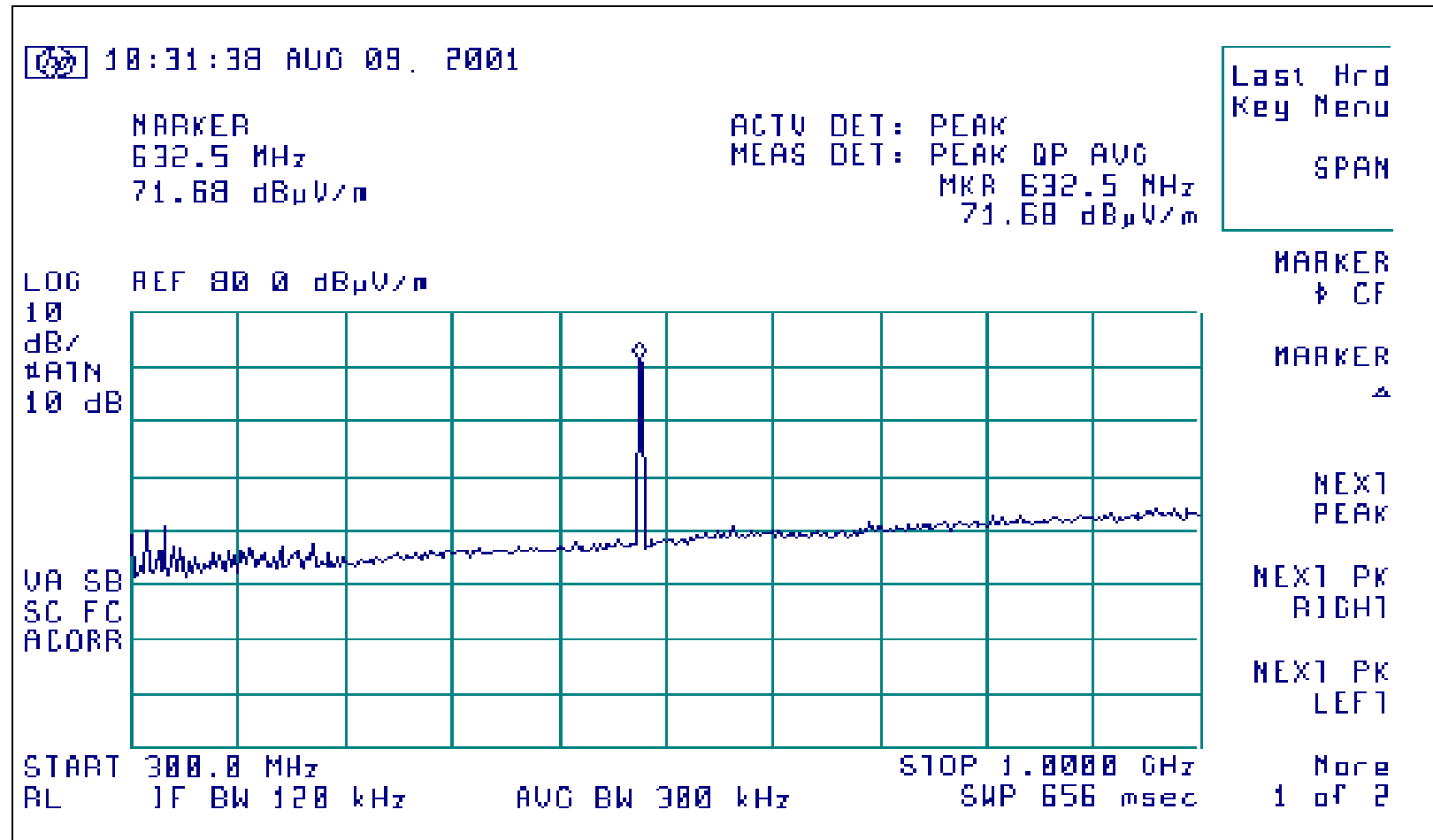




FCC ID: HJR-X12-600-15

Channel FF

Signature Scan of the Emissions of the X12-600, Horizontal polarity, from 300MHz to 1GHz
Inside 3 meter Chamber, Peak hold scan

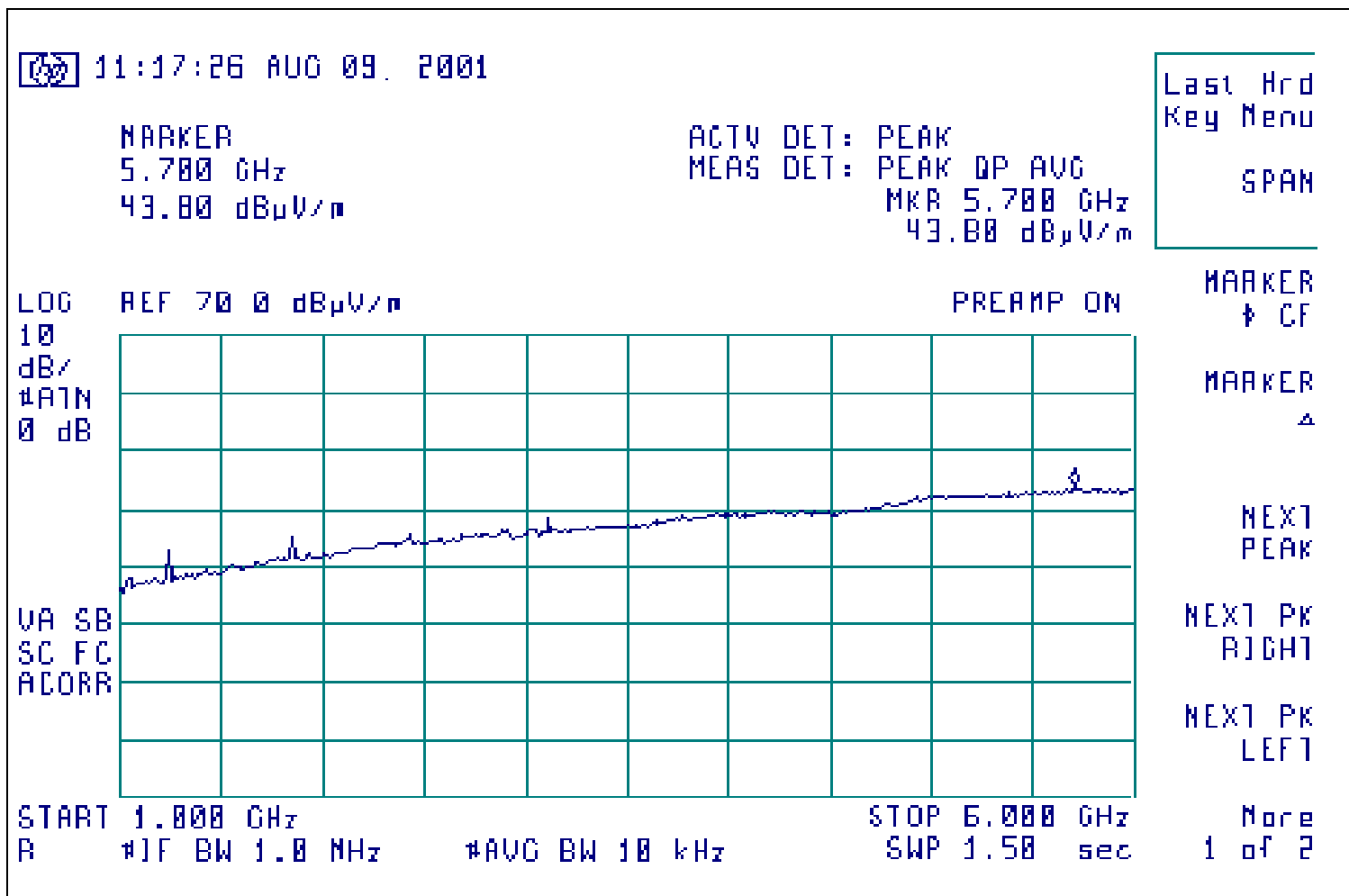




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Channel 80

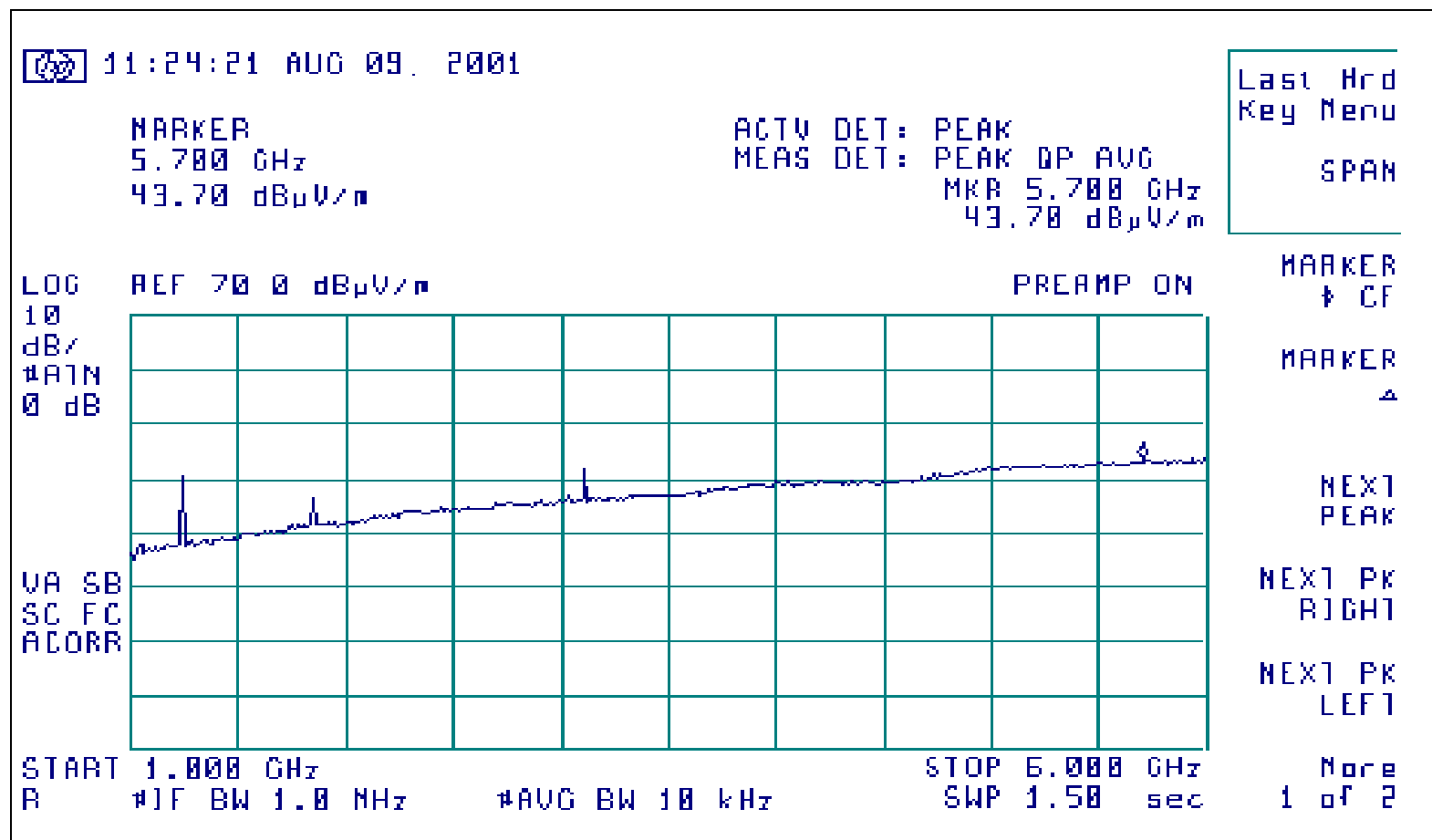
Signature Scan of the Emissions of the X12-600, Horizontal polarity, from 1GHz to 6GHz
Inside 3 meter Chamber, Peak hold scan



FCC ID: HJR-X12-600-15

Channel 80

Signature Scan of the Emissions of the X12-600, Vertical polarity, from 1GHz-6GHz
Inside 3 meter Chamber, Peak hold scan

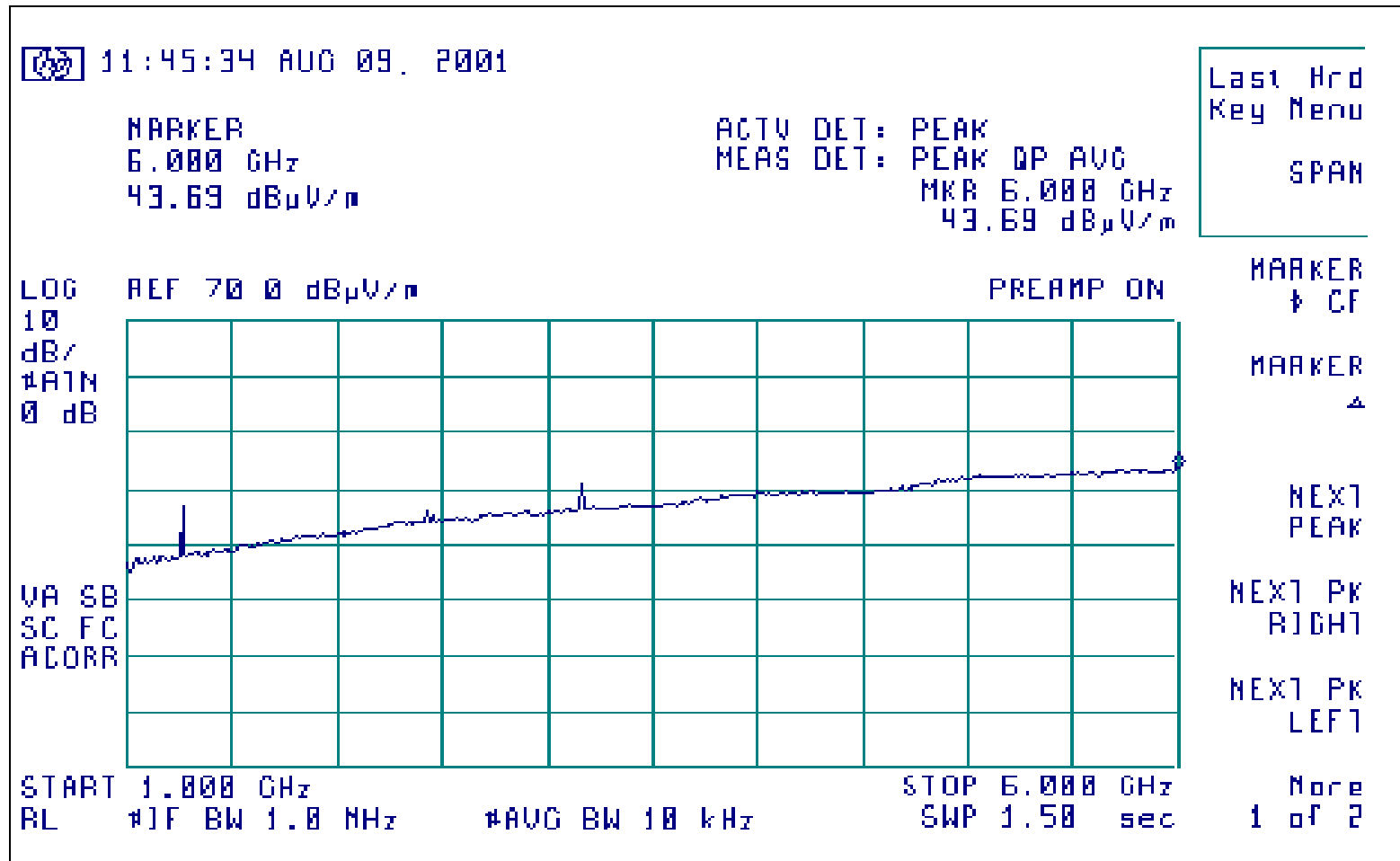




FCC ID: HJR-X12-600-15

Channel FF

Signature Scan of the Emissions of the X12-600, Vertical polarity, from 1GHz to 6GHz
Inside 3 meter Chamber, Peak hold scan



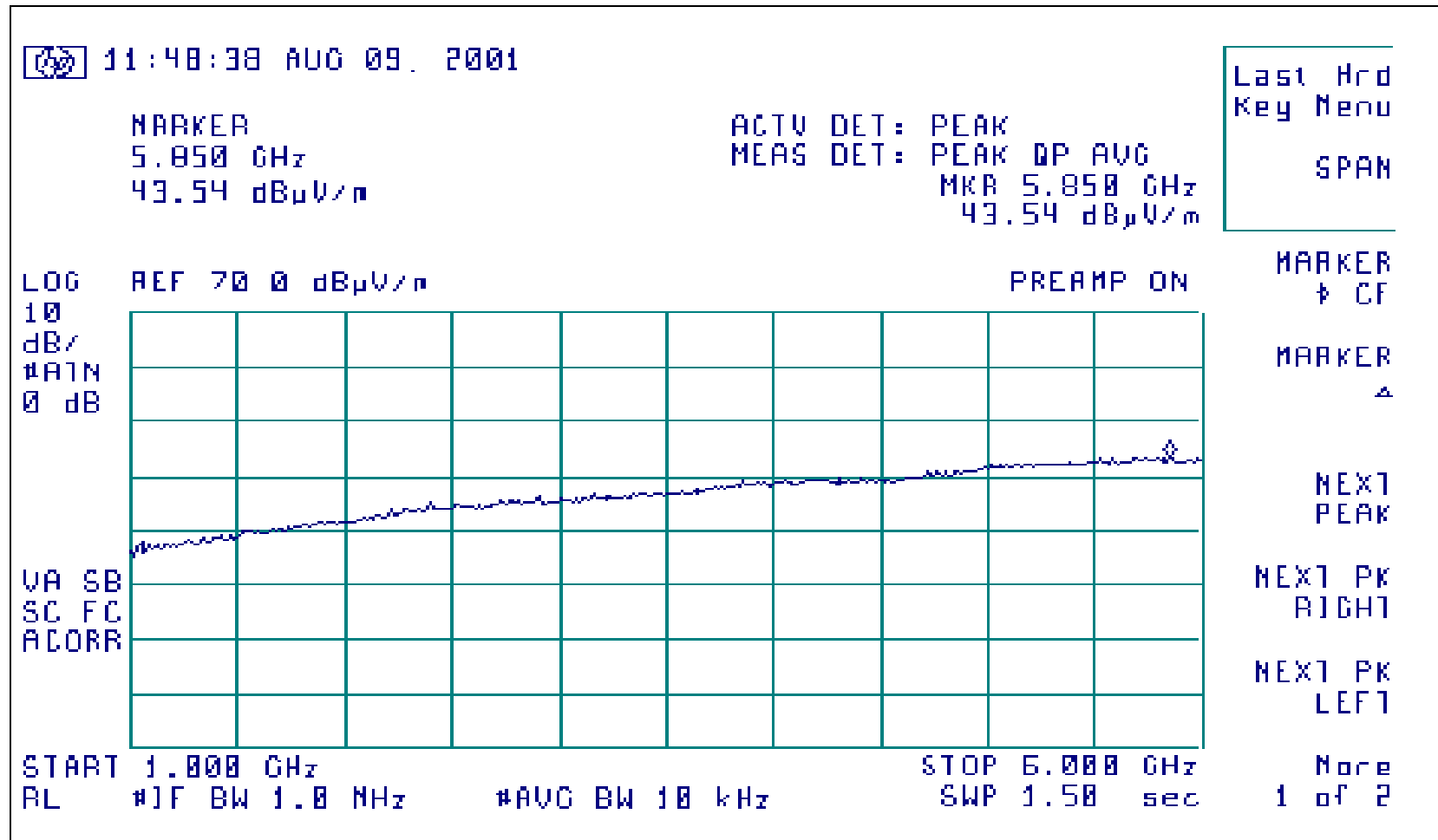


FCC ID: HJR-X12-600-15

Channel FF

Signature Scan of the Emissions of the X12-600, Horizontal polarity, from 1GHz to 6GHz

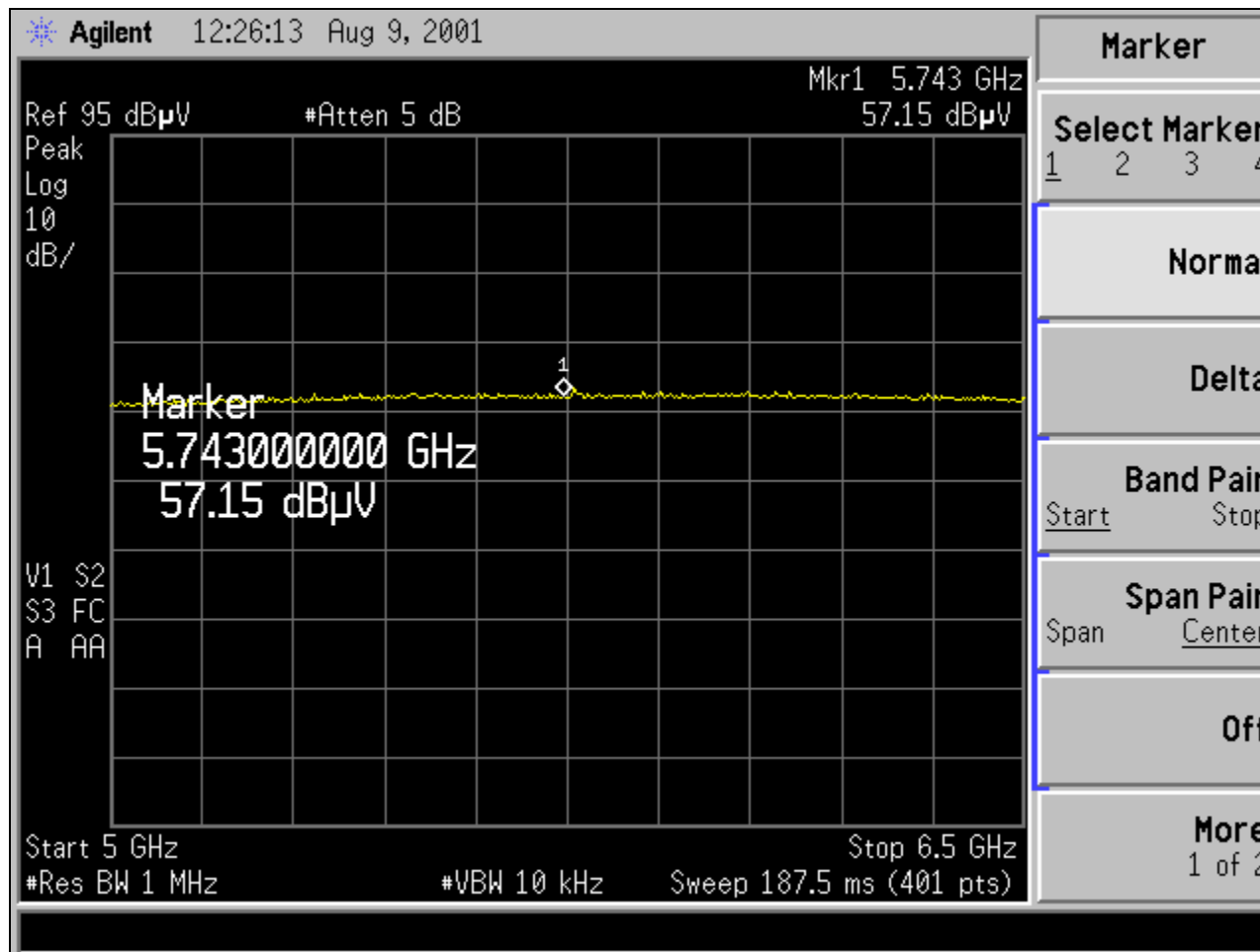
Inside 3 meter Chamber, Peak hold scan



FCC ID: HJR-X12-600-15

Channel 00

Signature Scan of the Radiated Emissions of the X12-600, Vertical polarity, 5-6.5 GHz
Inside 3 meter Semi-anechoic chamber, Peak hold scan, 1meter measurement

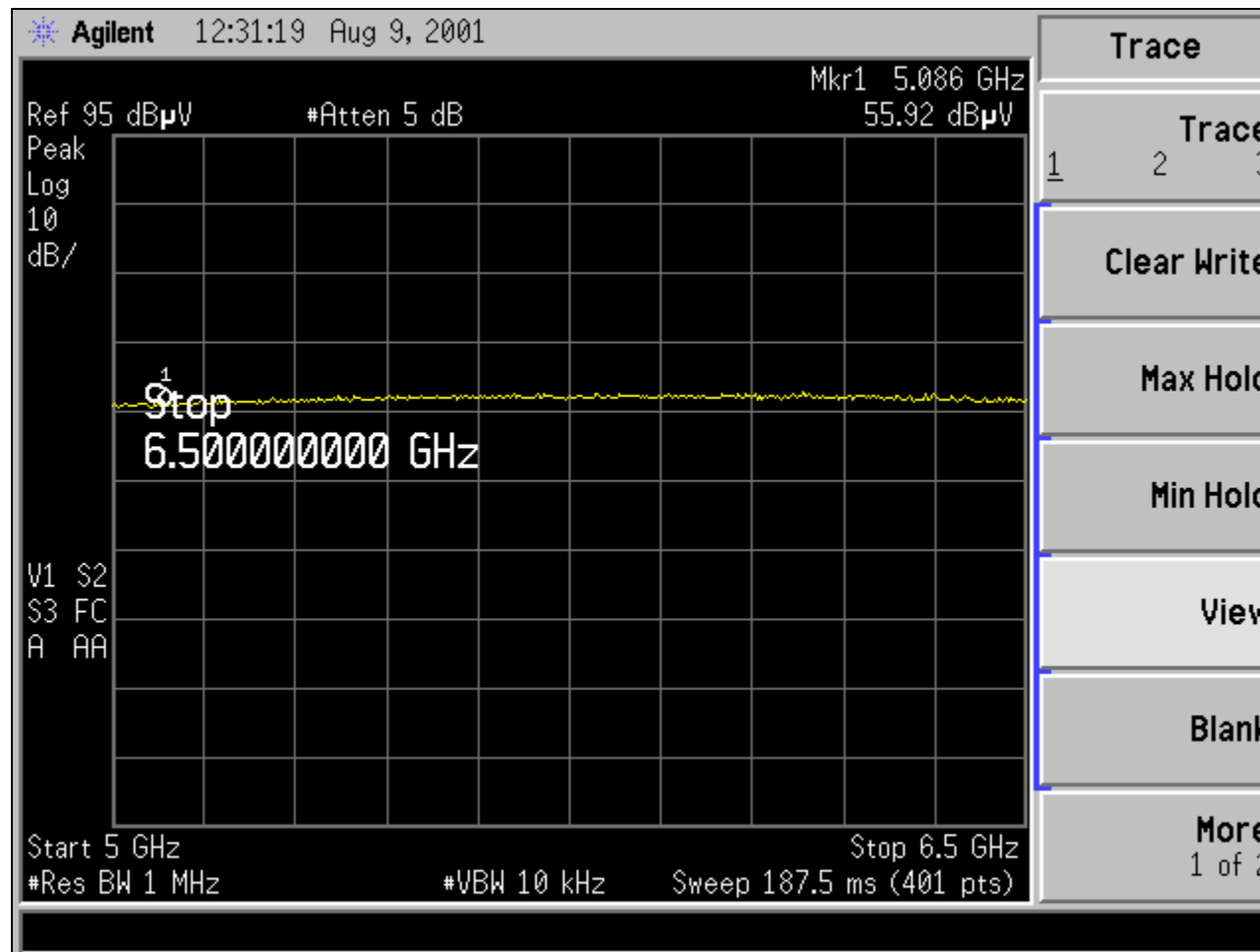




FCC ID: HJR-X12-600-15

Channel 00

Signature Scan of the Radiated Emissions of the X12-600, horizontal polarity, 5-6.5 GHz
Inside 3 meter Semi-anechoic chamber, Peak hold scan, 1meter measurement

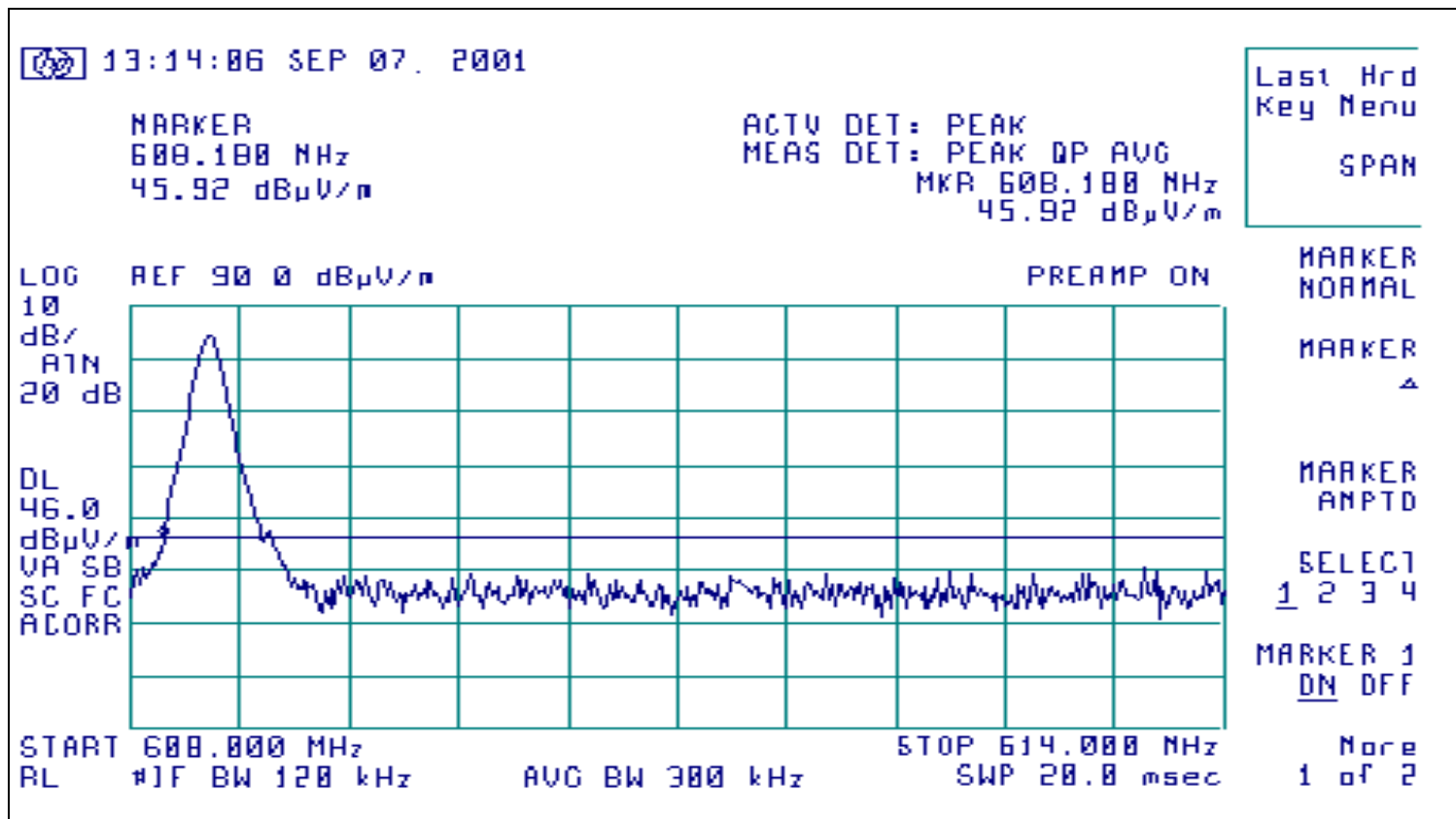


FCC ID: HJR-X12-600-15

Channel 00

Radiated Emissions detail of the X12-600 to show band-edge compliance

Inside 3 meter Semi-anechoic chamber, Peak hold scan

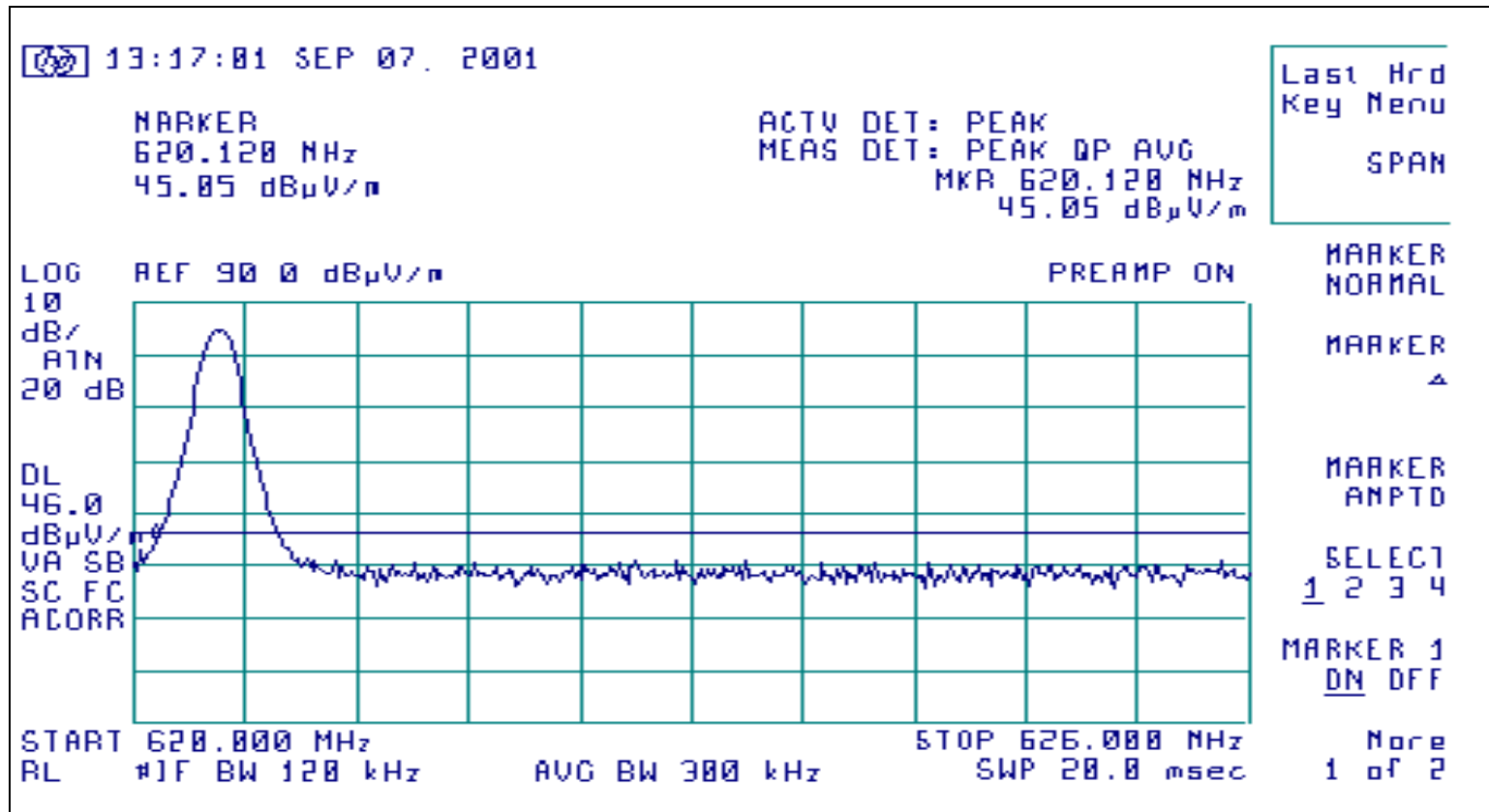


FCC ID: HJR-X12-600-15

Channel 80

Radiated Emissions detail of the X12-600 to show band-edge compliance

Inside 3 meter Semi-anechoic chamber, Peak hold scan



FCC ID: HJR-X12-600-15

Channel FF

Radiated Emissions detail of the X12-600 to show band-edge compliance
Inside 3 meter Semi-anechoic chamber, Peak hold scan

