FCC ID: OHTVACS599072

COMPLIANCE TESTING

OF THE

VEHICLE ACCESS CONTROL SYSTEM

- TEST REPORT -

Project Number: 90054

Prepared for:

Michael Feucht

Strattec Security Systems

3333 W. Good Hope Rd.

Glendale, WI 53209-2043

Date(s) tests were performed: March 22nd, 1999

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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

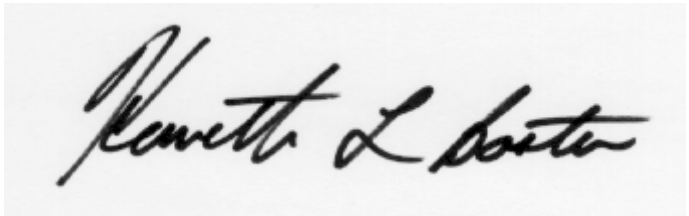
SIGNATURE PAGE

Prepared By:

27 April 1999

Date

Approved By:



27 April 1999

Kenneth L. Boston, EMC Lab Manager
PE #31926
Registered Professional Engineer
(State of Wisconsin)

Date

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1.3 SUMMARY OF TEST REPORT

MANUFACTURER:	Strattec Security Systems
MODEL:	Vehicle Access Control System
SERIAL:	preproduction
DESCRIPTION:	Access Control System

The Access Control System 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 Access Control System 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 March 22nd of 1999, a series of Radiated Emissions tests were performed on a sample model of the Vehicle Access Control System.(VACS) This is a transceiver, which is designed to read transponder codes and unlock / unlatch the vehicle door when the appropriate codes are read. To enter a secured door, the driver places his wristband transponder approximately 10cm from the exterior mounted access reader. The VACS loop antenna will charge the transponder, then upon the VACS ceasing to transmit, the transponder transmits a 128 bit key code back to the access control module though the same antenna. If the transponder code matches one of the ten key codes stored in the VACS memory, the access control module energizes an electro-mechanical latch, which unlocks and unlatches the vehicle door for five seconds. 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 15.209 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 Jerome Alberte of Strattec Security Systems.

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:

15.109 15.209
15.205

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. and also on the 10 meter Open Air Test Site located outside the L.S. Compliance facility. The test sample was operated with power supplied by an external DC rechargeable battery. The test sample was positioned upon an 80 cm high wooden table, which was positioned upon the 2 meter turntable within the chamber. The measurement antenna, mounted upon a motorized mast was then placed 3 meters from the product perimeter. This allowed the reader to be scanned in both azimuth and elevation. For low frequency measurements, the product was operated while positioned upon the same table, positioned upon

the 2-meter turntable located on the 10 meter OATS facility. The measurement antenna, an active loop antenna, was positioned 10 meters away, and oriented to give maximum signal levels. Readings were also taken at a 30 meter separation distance upon the site to establish the range factor needed to correct the limits for the 10 meter distance. These 10 meter OATS 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.

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

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 15.209. 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 (μV / m). The samples were tested from the lowest frequency generated by the transmitter (without going below 9 kHz) to the 10th harmonic of the fundamental frequency generated by the device. The appropriate limits were also observed when the fundamental or spurious signals were located within any of the restricted bands as described in Part 15.205a. These frequencies, and their associated limits, are referenced in Section 1.9. The test sample was activated, by means of placing a passive tag near the front panel of the product, and while positioned on an 80 cm high non-conductive table. 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 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. Brief scans below 30 MHz were also performed in the chamber, using an active loop antenna as the sensing antenna. Information from this 3 meter test was used to identify frequencies for further investigation, during the emissions tests on the 10 meter OATS. For measurement of the transmitter fundamental, harmonics, and low frequency spurious signals, a magnetic loop antenna was used, which was placed at a separation distance of 10 meters upon an FCC listed OATS located at the L. S. Compliance facility in Cedarburg, WI. The fixture was set up on top of the 2 meter flush mounted turntable installed at the 10 meter OATS. The orientation of the loop and fixture were then varied to obtain the maximum signal levels and then readings were taken.

The unit was scanned for emissions in both transmit and standby modes, over the range 134.2 kHz to 1000 MHz to establish compliance with Part 15.109 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.

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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: Strattec Security Systems
Model: Access Control System
Serial Number(s): pre-production

1.9 - Restricted Bands affecting this product (transmitter)

0.090 kHz- 0.110 kHz

0.495 kHz- 0.505 kHz

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1.10 – Photos taken during testing

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Close up view of the Access Control System during the Radiated Emissions tests on the 10-Meter FCC listed OATS

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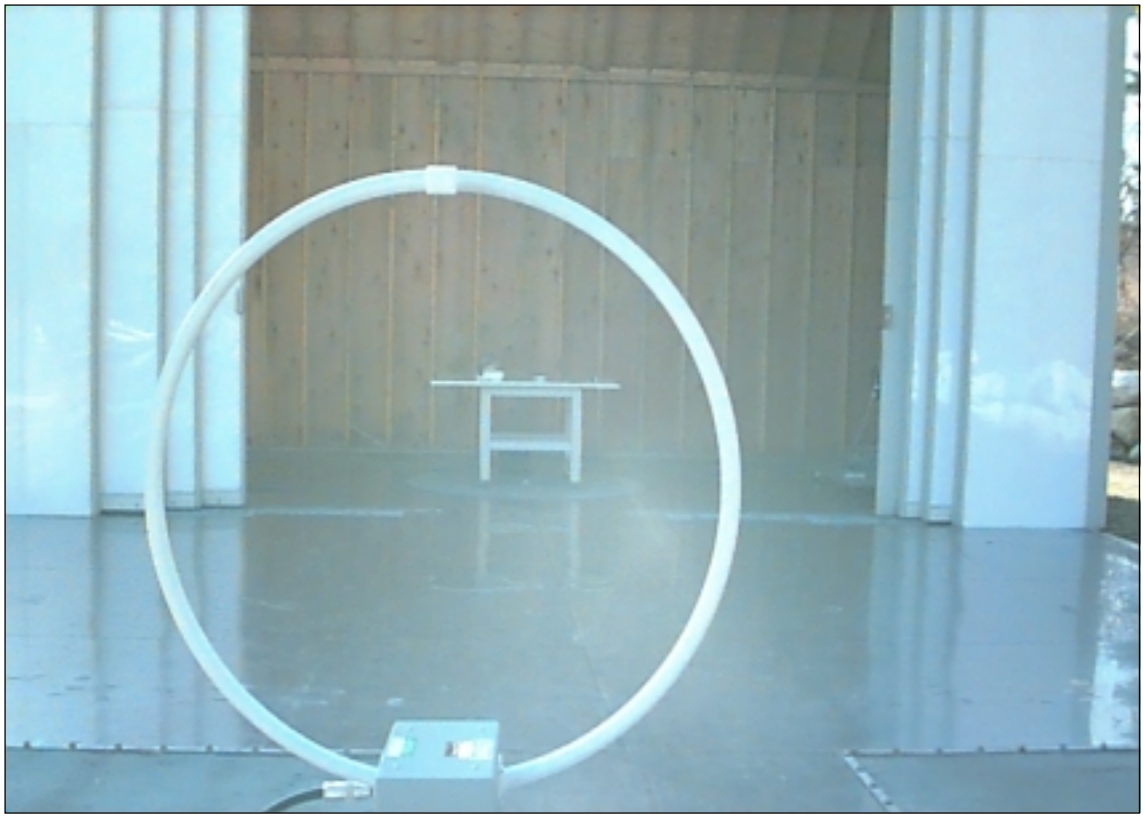
Front view of the Access Control System during the Radiated Emissions tests on the 10-Meter FCC listed

OATS



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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 Access Control System does **"meet"** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator. The Access Control Systems was also found to "meet" the emission requirements of Part 15, subpart B for unintentional radiators with regards to the Digital section of the Control unit. The levels of some spurious emissions, at 44.9 and 45.2 MHz (horizontal polarity) were found to be only 1.45 dB and 2.6 dB below the limit in the worst case configuration. As this level is within the tolerances of the test equipment and site employed, there is a possibility that these units, or similar units selected out of production may not meet the required limit specification if tested by another agency.

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	9/12/99
AA960005	EMCO	3110B	9601/2280	Biconical Antenna	9/12/99
AA96006	EMCO	6502	2753	Active loop antenna	6/7/99
EE960004	EMCO	2090	9607-1164	Mast/Ttable Controller	I.O
EE960013	HP	8546A	3617A00320	Receiver RF Section W/Display and RF filter section	8/12/99
EE960014	HP	85460A	3448A00296	Receiver RF Section Preselector	8/12/99

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APPENDIX A:

SAMPLE CALCULATIONS

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Manufacturer: Strattec Security Systems
Model: Vehicle Access Control System
Serial Number(s): "pre-production"

I. Calculation of Radiated Emissions limits for FCC Part 15.209; general limits for intentional radiators.

FIELD STRENGTH OF TRANSMITTER FUNDAMENTAL AND HARMONIC FREQUENCIES:

For the frequency range of 9 kHz to 490 kHz the limit (at 10 meters) is found by:
LIMIT (dBuV / m)= 20log(2400 / F in kHz) + 88.62

For the frequency range of 490 kHz to 1705 kHz the limit (at 10 meters) is found by:
LIMIT (bBuV / m)= 20log(24000 / F in kHz) + 28.62

For the frequency range of 1705 kHz to 30 MHz the limit (at 10 meters) is found by:
LIMIT (bDuV / m)= 20log(30) + 28.62

For the frequency range of 30 MHz to 88 MHz the limit (at 3 meters) is found by:
LIMIT (dBuV / m) = 20log(100)

For the frequency range of 88 MHz to 216 MHz the limit (at 3 meters) is found by:
LIMIT (dBuV / m) = 20log(150)

For the frequency range of 216 MHz to 960 MHz the limit (at 3 meters) is found by:
LIMIT (dBuV / m) = 20log(200)

For the frequency range of 960 MHz to 40 GHz the limit (at 3 meters) is found by:
LIMIT (dBuV / m) = 20log(500)

Where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance of 10 meters. In accordance with part 15.31(f)(2), the scaling factor was determined by taking measurements at three distances on the radial comprising the maximum signal level, and using the results to derive a scaling factor. The measurement values are shown in Appendix B, for readings taken at 10, 20 and 30 meters; this resulted in a scaling factor determined to be the cube of an inverse linear distance extrapolation factor. (1 / D^3), which derives the scaling factors shown below, which were used in performing the conversions shown above.

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From 300 meters down to 10 meters: FACTOR(dB) = 60log(300 / 10) = 88.62dB

From 30 meters down to 10 meters: FACTOR(dB) = 60log(30 / 10) = 28.62 dB

From 300 meters down to 30 meters: FACTOR(dB) = 60log(300 / 30) = 60 dB

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Manufacturer: Strattec Security Systems
Model: Access Control System
Serial Number(s): "pre-production"

II. LIMITS FOR READINGS TAKEN AT 10 METERS

Frequency (MHz)	FCC limit (uV/m)	FCC limit (dBuV/m)	Scaling factor	Adjusted limit (dBuV/m)
0.1342	17.88 @300m	25.0	88.62	113.62
0.2684	8.942 @300m	19.03	88.62	107.65
0.4026	5.96 @300m	15.5	88.62	104.17
0.5368	44.7 @ 30m	33.0	28.62	61.62
0.6710	35.77 @30m	31.07	28.62	59.69
0.8052	29.80 @30m	29.5	28.62	58.12
0.9394	25.55 @30m	28.15	28.62	56.77
1.0736	22.35 @30m	26.99	28.62	55.61
1.2078	19.87 @30m	25.96	28.62	54.58
1.3420	17.88 @30m	25.05	28.62	53.67
1.705-30.0	30.00 @30m	29.54	28.62	58.16

For a frequency of 0.1342 MHz, the 30 meter limit is: 25.0dBuV/m+ 60.0 dB = 85 dBuV

For a frequency of 0.1342 MHz, the 20 meter limit is: 25.0dBuV/m+ 70.56 dB = 95.56 dBuV

Class B limits are given in uV/m in 15.109a, and can be converted into dBuV/m using the formulas given on the preceding page.

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

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APPENDIX B:

DATA CHARTS

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

Frequency Range inspected: 30 to 1000 MHz

Date of Test:	March 22nd, 1999	Manufacturer:	Strattec Security Corp.
Location:	L.S. Compliance, Inc. W66 N220 Commerce Court Cedarburg, WI 53012	Model No.:	Vehicle Access Control System
Specifications:	Title 47CFR, FCC Part 15.109a	Serial No.:	Pre-production
Distance:	3 meters	Configuration:	Active, transmitting
Equipment:	HP 8546A EMI Receiver EMCO 3115 Double Ridged Waveguide EMCO 3146A Log Periodic EMCO 3110B Biconical	Detector(s) Used:	Quasi-Peak

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

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Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	Q-Peak Reading (dBuV/m)	15.109a Limit(dBuV/m)	Margin (dB)
33.534	V	1	0	30.87	40	9.13
42.027	V	1	0	34.75	40	5.25
41.997	V	1	220	35.55	40	4.45
42.930	V	1	14	29.27	40	10.73
171.739	V	1	244	36.81	43.52	6.71
206.132	V	1	31	30.58	43.52	12.94
257.664	V	1	264	31.1	46.02	14.92
292.019	V	1	101	29.39	46.02	16.63
44.976	H	3.3	0	38.55	40	1.45
45.247	H	3.3	220	37.4	40	2.6
112.732	H	3	220	24.26	43.52	19.26
154.604	H	3	273	34.75	43.52	8.77
171.755	H	2	244	36.81	43.52	6.71
206.135	H	1	30.6	30.58	43.52	12.94
276.800	H	1	101.3	30.74	46.02	15.28
446.626	V	1	0	31.1	46.02	14.92
480.993	V	1	0	38.55	46.02	7.47
309.161	V	3	54	36.64	46.02	9.38
395.086	V	3	289	37.4	46.02	8.62
431.171	V	1	0	24.26	46.02	21.76
446.702	V	1	0	30.24	46.02	15.78

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Measurement of Radiated Emission upon the 10 Meter FCC Listed OATS

Frequency range inspected: 0.009 MHz to 30 MHz

Date of Test:	March 22nd,1999	Manufacturer:	Strattec Security System
Location:	L.S. Compliance, Inc.	Model No.:	Access Control System
	W66 N220 Commerce Court		
	Cedarburg, WI 53012		
Specifications:	Title 47CFR, FCC Part 15.209	Serial No.:	Pre-production
Distance:	10 meters, 20 and 30 meters	Configuration:	Active, transmitting
Equipment:	HP 8546A EMI Receiver	Detector(s) Used:	Quasi-peak, average
	EMCO 6502 Active Loop		

Readings taken at 10 meters for Fundamental and Harmonic emissions:

Frequency (MHz)	Reading (dBuV/m)	Detectors	15.209 Limit(dBuV/m)	Margin (dB)
0.1342	59.3	Avg Amp	113.62	54.32
0.2684	40.9	Avg Amp	107.65	66.75
0.402	37.6	Avg Amp	104.17	66.57
0.536	55.9	QP **	61.62	5.72

Use of the characters ** in the detector column indicates noise and ambient signals (AM Broadcast) seen during the measurement procedure. Higher order harmonics were found to be below the noise floor on the outdoor site.

Readings taken at 20 and 30 meters :

Distance	Frequency	Reading (dBuv/m)	Detector	Limit (dBuv/m)	Margin (dB)
10 meters	0.1342	59.3	average	113.62	54.32
20 meters	0.1342	31.6	average	95.56	63.96

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30 meters	0.1342	28.0	average	85	57

The readings taken above are used to confirm the 1/dist^3 scaling factor.

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APPENDIX C:

GRAPHS

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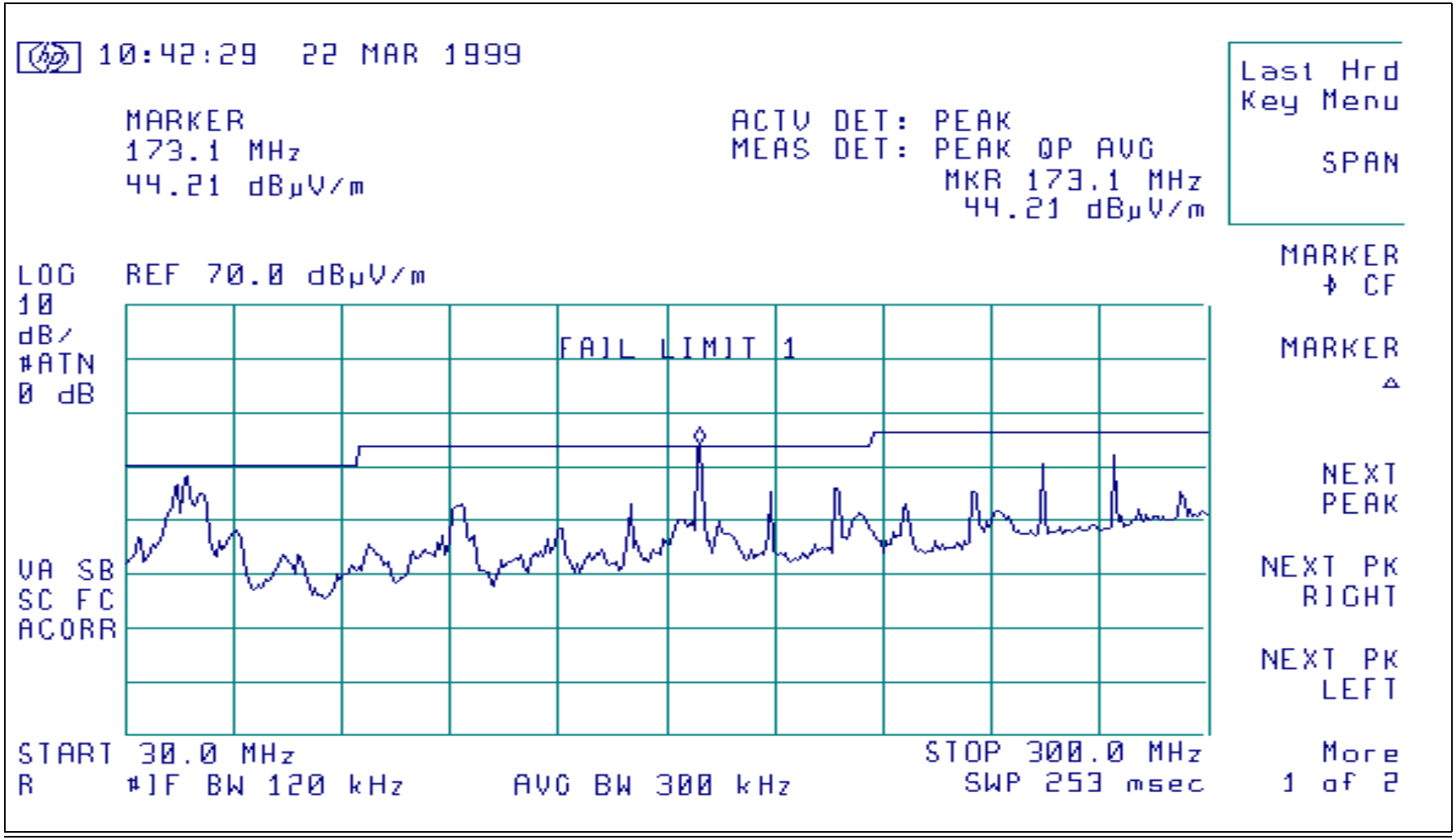
Signature Scan of the Radiated Emissions of the Strattec Access Control System, horizontal polarity, 30-300 MHz

Inside 3 meter Chamber, Peak hold scan, FCC class B limit displayed



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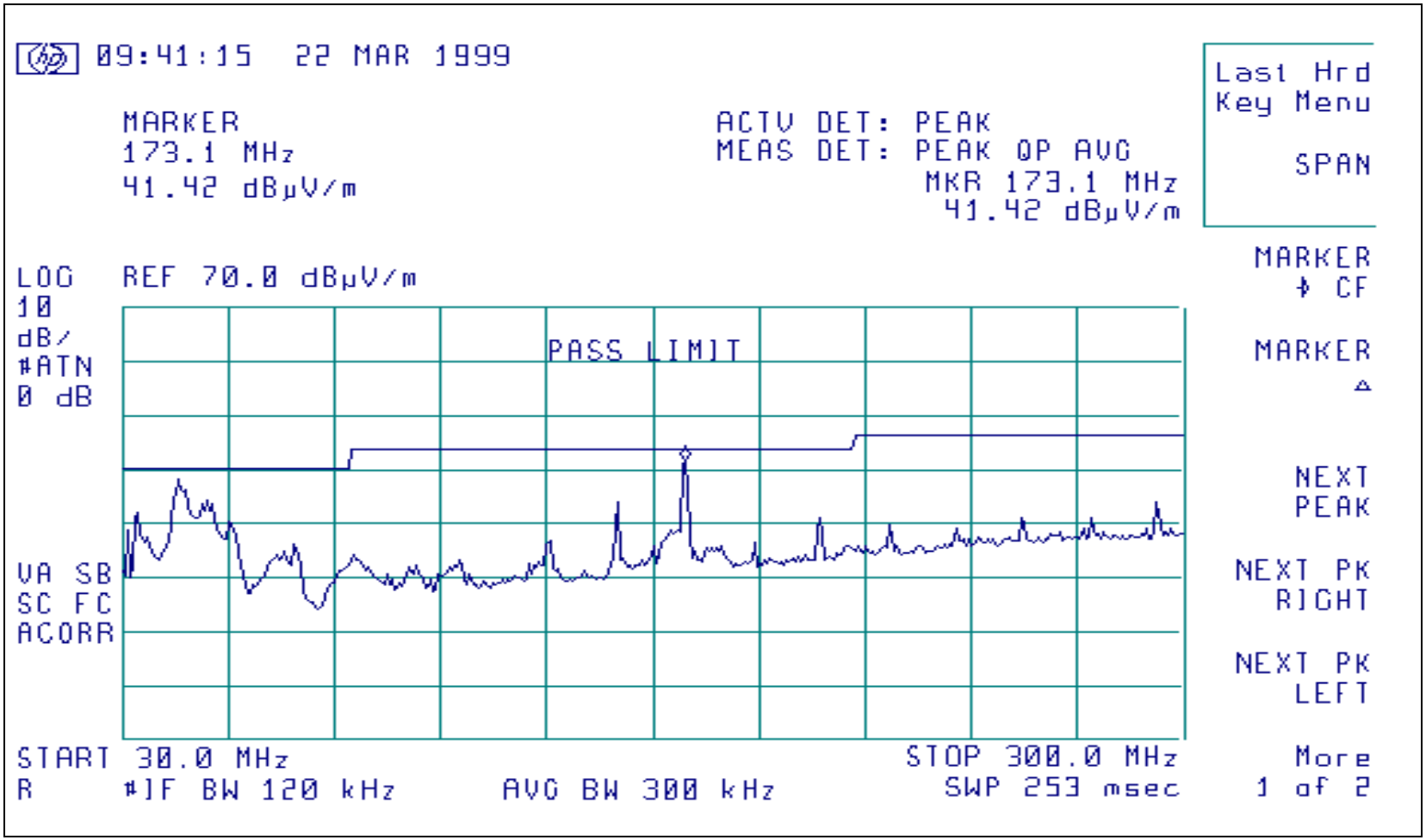
Signature Scan of the Radiated Emissions of the Strattec Access Control System, vertical polarity, 30-300 MHz

Inside 3 meter Chamber, Peak hold scan, FCC class B limit displayed



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Signature Scan of the Emissions of the Strattec Access Control System Vertical polarity, from 300 MHz to 1000 MHz

Inside 3 meter Chamber, Peak hold scan, FCC class B limit displayed

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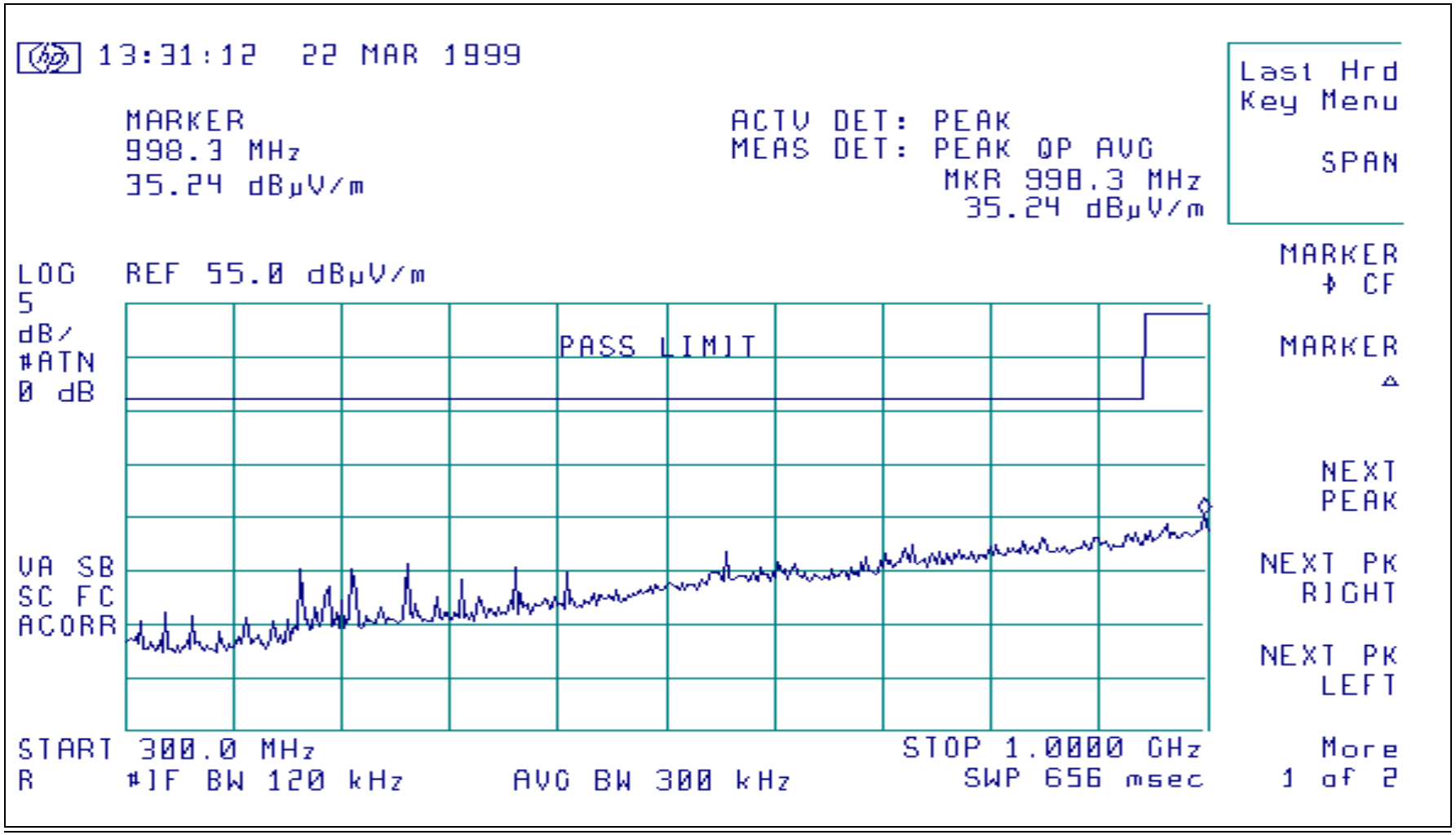

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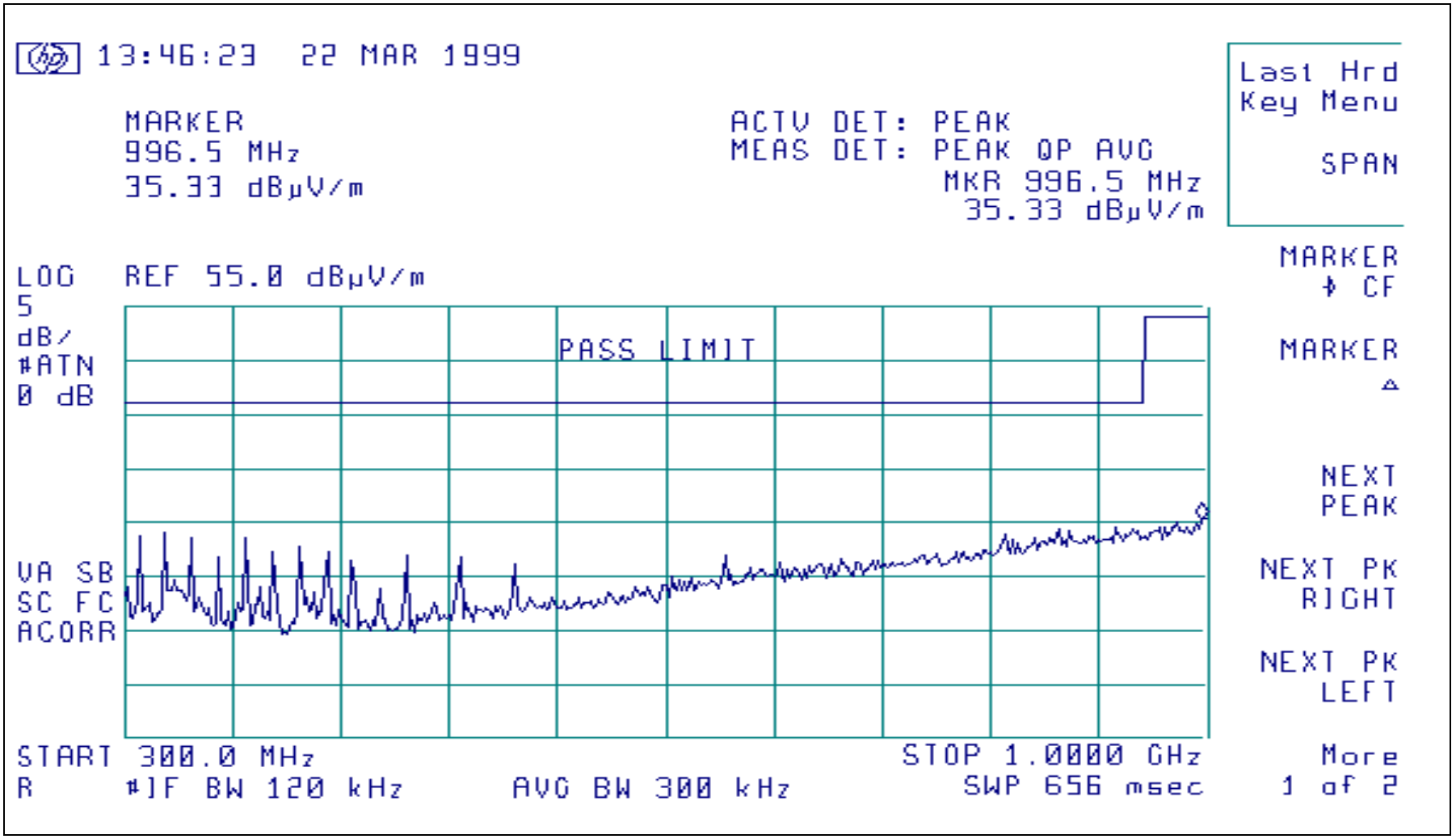
Signature Scan of the Emissions of the Strattec Access Control System, Horizontal polarity, from 300 MHz to 1000 MHz

Inside 3 meter Chamber, Peak hold scan,FCC class B limit displayed

FCC ID: OHTVACS599072



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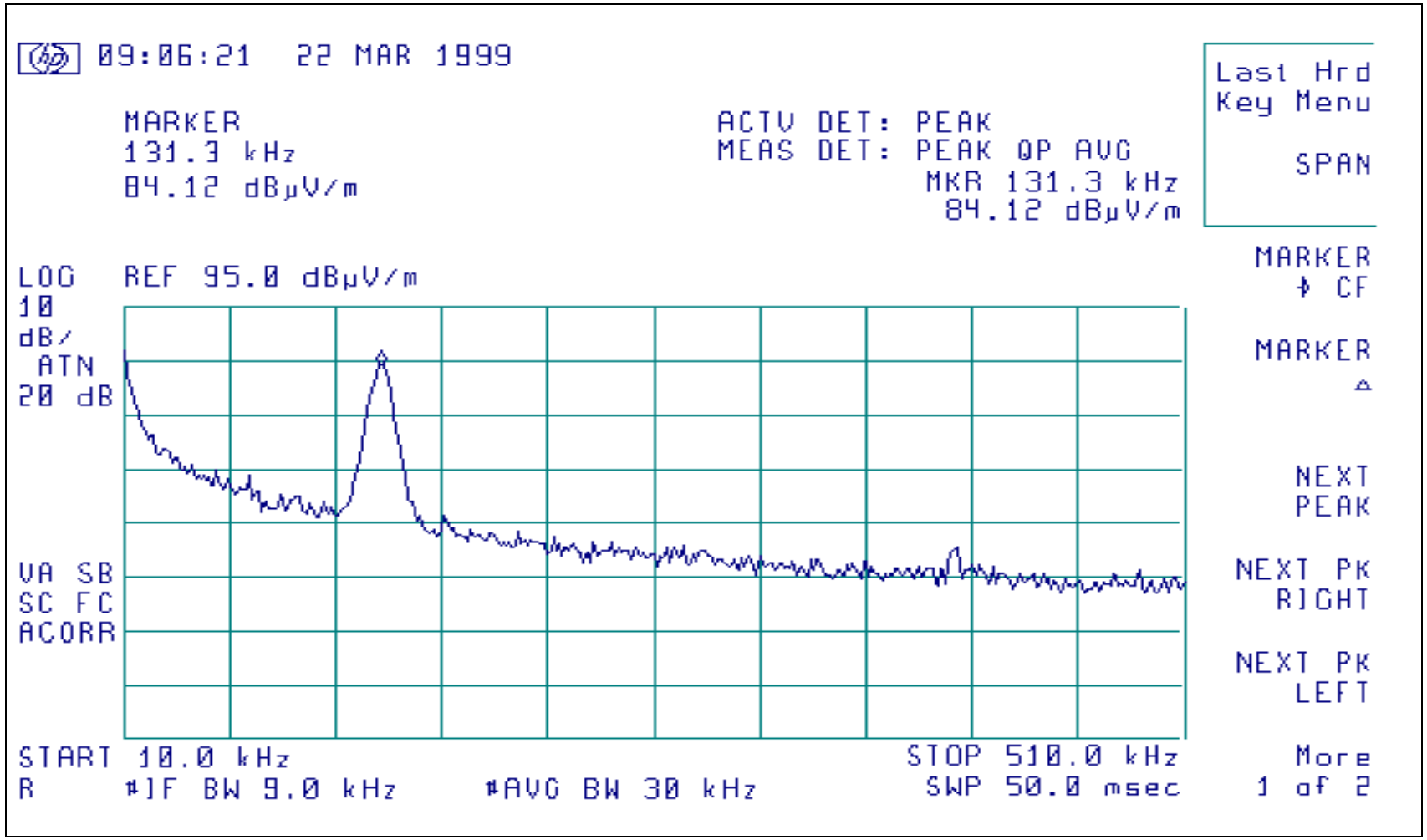
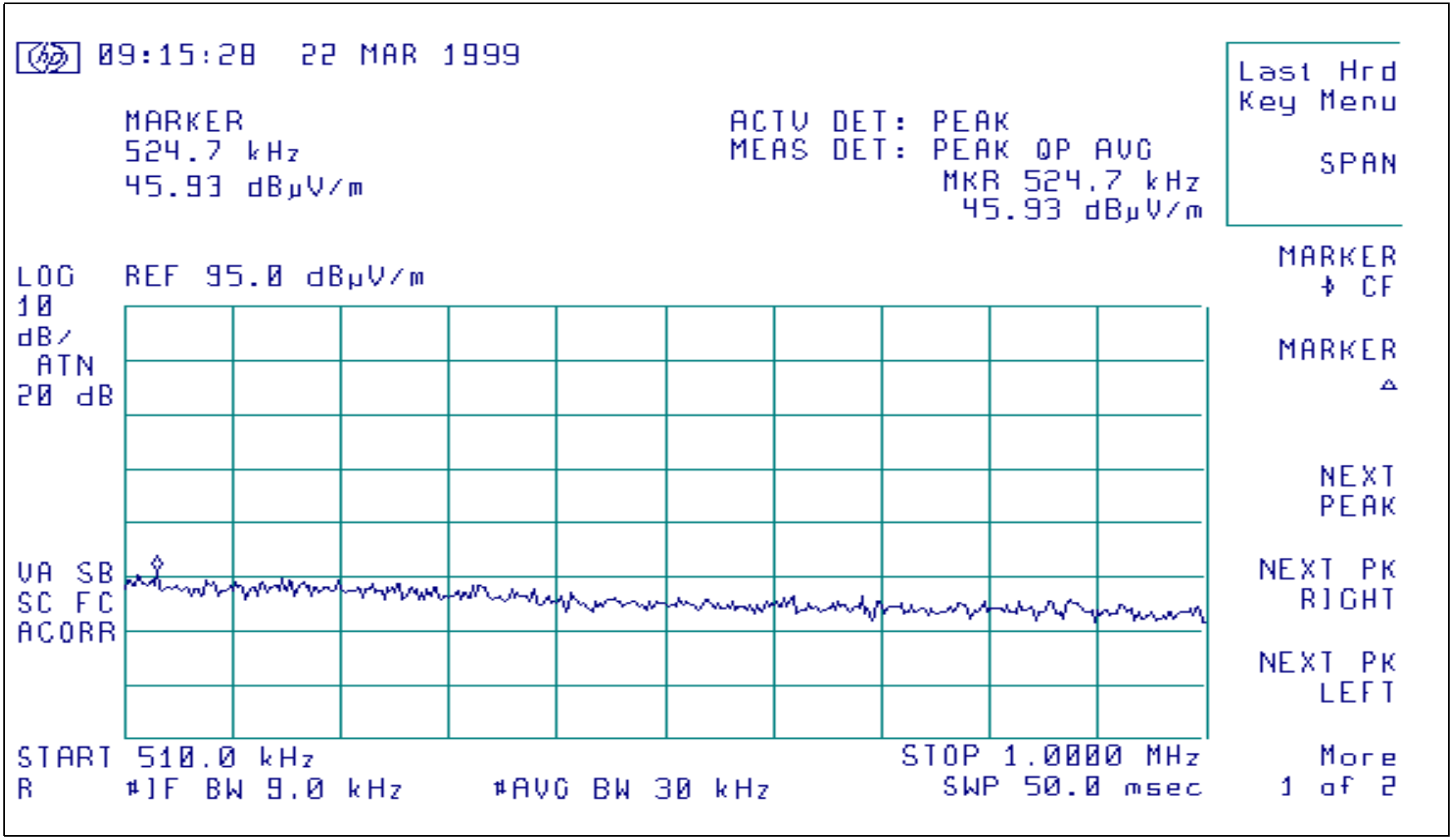
Signature scan of emissions from 10kHz to 510 KHz, performed at 3 meter distance, in 3 meter chamber



FCC ID: OHTVACS599072

Signature scan of emissions from 510 kHz to 1000 MHz, performed at 3 meter distance, in 3 meter chamber



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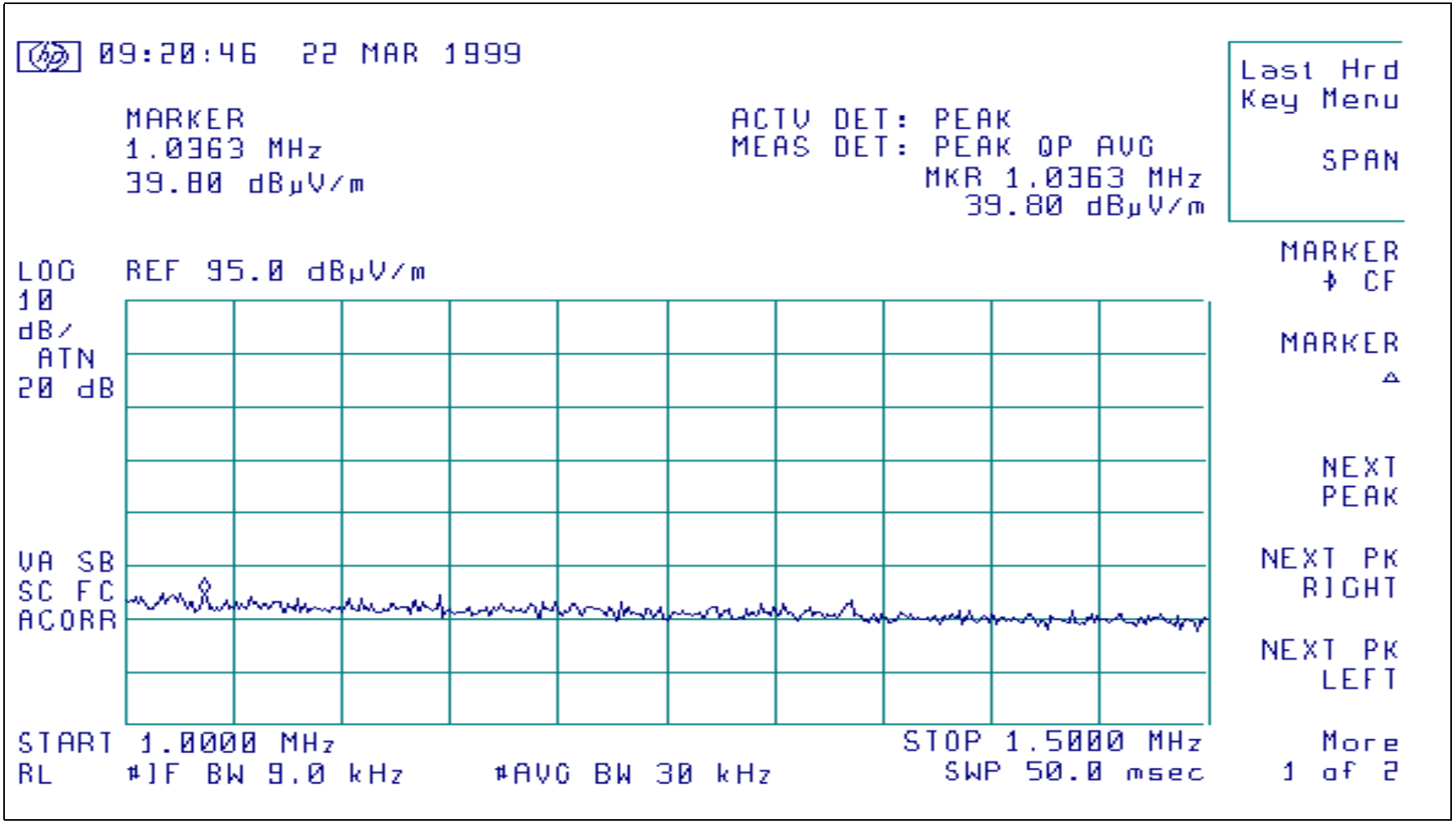
Signature scan of emissions from 1 MHz to 1.5 MHz, performed at 3 meter distance, in 3 meter chamber



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