L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, Wisconsin 53012

Phone: 262 - 375 - 4400 Fax: 262 - 375 - 4248

L. S. Compliance, Inc.

Compliance Testing of:

DOOR TRANSMITTER
FCC ID NUMBER: O82-226038

Prepared for:

Nabco Entrances, Inc.
S82 W18717 Gemini Drive
Muskego, WI 53150

Test Report Number:

300225

Date of Testing:

September 7, 2000
October 17, 2000
(Updated per Curtis-Straus)

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1.0 Description of Measurement Facilities

Site on File with the Federal Communications Commission – United States
ID Number: 31040/SIT, 1300F2
For 3 Meter Semi-Anechoic Chamber and OATS

Site Listed with Industry Canada of Ottawa, Canada
ID Numbers: IC 3088, IC 3088-A
For 3 Meter Semi-Anechoic Chamber and OATS

"The site referenced above has been found to comply with the test criteria found in ANSI C63.4-1992 and 47CFR Section 2.948"

1.1 A2LA Certificate of Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

L.S. COMPLIANCE, INC.
Cedarburg, WI

for technical competence in the field of

Electrical (EMC) Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC Guide 25-1990 "General Requirements for the Competence of Calibration and Testing Laboratories" (equivalent to relevant requirements of the ISO 9000 series of standards) and any additional program requirements in the identified field of testing.

Presented this 30th day of December, 1998.

SEAL

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2001

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) Scope of Accreditation

1.2 Signature Page

Prepared By: Betty Ventura 10/3/00
Betty Ventura, Documents Coordinator Date

Tested By: 10/3/00
Thomas T. Lee, EMC Engineer Date

Tested and
Approved By: 10/3/00
Kenneth L. Boston, EMC Lab Manager Date
PE #31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

1.3 Summary Of Test Report

Manufacturer: NABCO Entrances, Inc.

Model: Door Transmitter

Serial: Not Applicable

Description: Transmitter

Frequency Range: 300 MHZ

The NABCO model Door Transmitter was tested and found to **MEET** the radiated emission specification of Title 47 CFR FCC, part 15, subpart C for an intentional radiator.

Product Description:

The Transmitter Board, which is purchased from LINEAR CORPORATION generates a 300 MHz signal. There are 10 rocker or slide switches on a dip socket which selects the pattern of transmission.

The Board that NABCO attaches to the transmitter is called the pulse extender board. Its purpose is to extend the pulse train of the transmitter board. A wall switch is used to activate the pulse extender.

When an activation device is initiated, 9 VDC is momentarily placed across the 220 uf capacitor. This will cause the transistor to turn on, which will start the transmitter board to begin sending its 300 MHz signal toward its receiver. The transistor will stay in the on state for approximately two seconds. At this point, the capacitor will have discharged to the point where the emitter-base voltage falls below the voltage needed to keep the transistor conducting (turned on). This turns off the 300 MHz transmitter.

1.4 Introduction

On September 7, 2000, a series of Radiated Emissions tests were performed on one test sample model of the door transmitter. This product operates by a means of a short burst of data transmission containing an I. D. code.

These tests were performed using the test procedure outlined in ANSI C63.4, 1992 for intentional radiators, and in accordance with the limits set forth in FCC Part 15. 231a,b**,** for a periodic transmitter. These tests were performed by Kenneth L. Boston, PE, EMC Engineer and Thomas T. Lee, EMC Engineer of L.S. Compliance, Inc. and witnessed by Tom Holdorf of NABCO Entrances, Inc.

1.5 Purpose

The above mentioned tests were performed in order to determine the compliance of the Test Sample with limits contained in various provisions of Title 47 CFR, FCC Part 15, including: 15.109, 15.205, 15.209, 15.231b and 15.231c.

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 procedures 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 Chamber, (FCC listed and on file with Industry Canada),located at L.S. Compliance in Cedarburg, Wisconsin. The test sample was placed on an 80cm high wooden pedestal, which was centered on the flush mounted 2m diameter metal turntable. The test sample was operated on its own (new) internal battery

The test sample was operated in a normal manner, with all functions being exercised. The test sample was configured to run in a continuous transmit mode during the15.231c and 15.231b measurements. This was accomplished by using a plastic sheet, and fastening down the key on the transmitter. The test sample, set to operate on the standard channel, was tested as an intentional radiator, in order to determine compliance at a frequency of 300 MHz.

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1.7 Radiated Emission Test Procedure

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to Title 47 CFR, FCC Part 15.231b limits for periodic devices. 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 test sample was tested from the lowest frequency generated by the transmitter (without going below 9 kHz) to the 10^{th} 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 7.10 (I.C. RSS 210 Section 6.2.2. M)

The sample was placed on an nonconductive (wooden) 80 cm tall pedestal in the 3 Meter Chamber and the antenna mast was placed such that the antenna was 3m from the test object. A biconical antenna was used to measure emissions from 30 to 200 MHz, a log periodic was used to measure emissions from 200 to 1000 MHz, and a double ridged waveguide horn was used to measure emissions above 1 GHz.

The test sample was programmed to operate in continuous transmit, and the resultant signals were maximized by rotating the turntable 360 degrees, and by raising and lowering the antenna between 1 and 4 meters. The test sample was also given several different orientations to determine the maximum signal levels, using both horizontal and vertical antenna polarities.

No significant emissions were found aside from the transmitter fundamental and several harmonics. The unit was scanned for emissions, over the range 30 to 3000 MHz to establish compliance with Part 15.231b and 15.205 while in continuous transmit. At frequencies below the fundamental, no spurious signals, other than the noise floor of the system could be found within 20dB of the limits.

In addition to measuring the levels of radiated emissions, the occupied bandwidth of the transmitter was measured. In accordance with FCC Part 15.231c, the 20dB bandwidth of the transmitted signal should be within a window of 0.25% of the center carrier frequency. The calculation for this bandwidth can be found in Appendix A. The resolution bandwidth was set to the closest available filter setting on the HP8546A EMI system that corresponded to 5% of the allowable bandwidth determined in the calculation mentioned above, without going below the resolution bandwidth of 10kHz, as dictated in ANSI C63.4-1992 section 13.1.7.

The sample was activated to transmit in a continuous mode and was placed on the aforementioned test configuration within the 3-meter chamber. The transmitted signal was received on a log periodic antenna and fed to the HP8546A EMI System, where the fundamental frequency was displayed, and a plot of the occupied bandwidth was produced. These plots are included in Appendix C. From the data supplied, it can be seen that the test samples do **MEET** the bandwidth requirement established by FCC Part 15.231c .

1.8 Radiated Emission Test Equipment Utilized

A list of the test equipment and antennas used for the tests can be found in Section 1.11, 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 change 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. When a reading is taken using the peak detector, a duty cycle correction factor can be applied for conversion to an average reading. This operation can be used when measuring periodic data transmission, under FCC Part 15.231b and Part 15.35c. The calculation for deriving this duty factor can be found in Appendix A.

The resulting average reading was then compared to the appropriate limit in order to determine compliance. The HP 8546A EMI receiver was operated with a bandwidth of 120 kHz when receiving signals below 1 GHz, and with a bandwidth of 1 MHz when receiving signals above 1 GHz, in accordance with CISPR 16.

1.9 Conducted Emission Measurements

Due to the fact that the product operated from its own internal batteries, as opposed to using a power cord, it was not necessary to perform a test for conducted emissions.

1.10 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 test sample does **MEET** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator.

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 the report.

1.11 Test Equipment

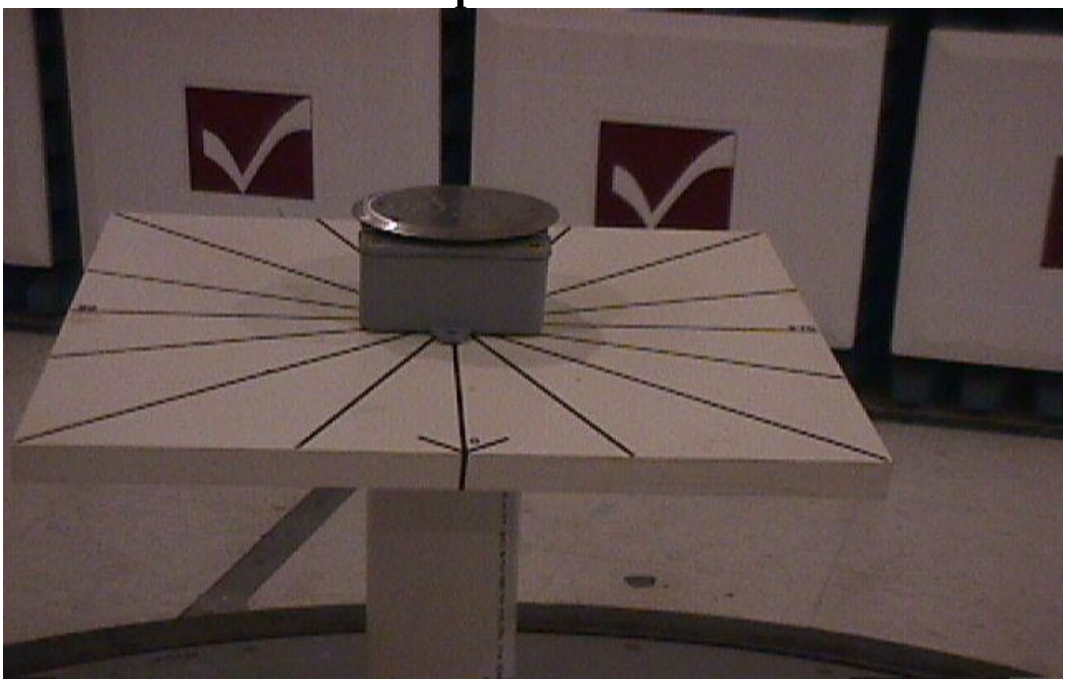
Asset #	Manufacturer	Model #	Serial#	Description	Due Date Date of Cal
AA960004	EMCO	3146	9512-4276	Log Periodic Antenna	September 13, 2000
AA960005	EMCO	3110B	9601/2280	Biconical Antenna	September 13, 2000
AA960007	EMCO	3115	99111-4198	Double Ridge Horn Antenna	Aug 1, 2001
EE960004	EMCO	2090	9607-1164	Mast/Table controller	PM
EE960014	HP	85460	3617A00320	EMI receiver Display section	Aug 23, 2001
EE960013	HP	85462	3205A00103	EMI receiver Preselector section	Aug 23, 2001
CC000221	HP	E4407b	US39160256	26.5 GHz Spectrum Analyzer	Jun 16, 2001
N/A	LSC	Cable	0011	3 meter 1/2 " Heliax Cable	January 18, 2001
N/A	LSC	Cable	0038	1 meter RG214 Cable	January 18, 2001
N/A	LSC	cable	0050	10 meter RG214 Cable	January 1, 2001
N/A	LSC	Attenuator		10 dB Attenuator	PM

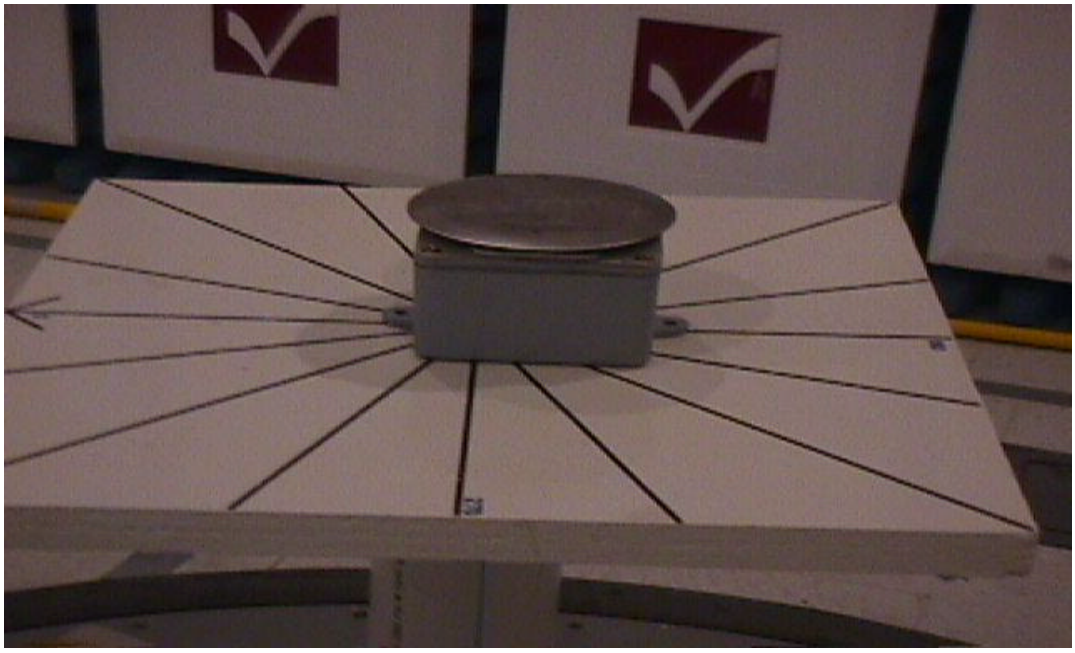
1.12 Measurement of Electromagnetic Radiated Emissions within the FCC Listed 3 meter Chamber
Frequency Range Inspected: 30 to 3200 MHz

FCC Part 15.205 Restricted Bands affecting this Product

Frequency (MHz)	Limit (µV)	Limit (dB/µV/m)
322-335.4	200	46.0
399.9-410	200	46.0
608-614	200	46.0
960-1240	500	54.0
1300-1427	500	54.0
1435-1626.5	500	54.0
1645.5-1646.5	500	54.0
1660-1710	500	54.0
1718.8-1722.2	500	54.0
2200-2300	500	54.0
2310-2390	500	54.0
2483.5-2500	500	54.0
2655-2900	500	54.0

1.13 Photo of Test Set Up





Manufacturer: NABCO Entrances, Inc.

Model Number: Door Transmitter

Serial Number (s): Not Applicable

Appendix A

Sample Calculations

Manufacturer: NABCO Entrances, Inc.
Model: Door Transmitter
Serial Number(s): Not Applicable

Calculation of Radiated Emissions limits for: FCC Part 15.231b (260-470 MHz)

FIELD STRENGTH OF FUNDAMENTAL/HARMONIC FREQUENCIES:

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:

The calculation involves a linear interpolation of 3750 to 12500 µV/m over 260-470 MHz, where field strength of the fundamental frequency (f_0) when, $260 \leq f_0 \leq 470$ MHz, can be found by: $3750.0+41.667(f_0-260)$, where f_0 is in MHz.

FIELD STRENGTH OF SPURIOUS/HARMONIC FREQUENCIES:

The calculation involves a linear interpolation of 375 to 1250 µV/m over 260 to 470 MHz, where field strength of the harmonic frequencies ($2f_0$, $3f_0$..), when $260 \leq f_0 \leq 470$ MHz, can be found by: $375.0+4.1667(f_0-260)$, where f_0 is in MHz.

- Where f_0 = 300 MHz
  Fundamental: 3750+41.667(300-260) = 5417 µV/m
  Harmonic: 375+4.1667(300-260) = 541.7 µV/m

Frequency (MHz)	Fundamental limit (µV/m)	Fundamental limit (dB µV/m)	Harmonic limit (µV/m)	Harmonic limit (dB µV/m)
300	5417	74.68	541.7	54.68

Duty Cycle Correction Factor Calculation

Manufacturer: NABCO Entrances, Inc.
Model: Door Transmitter
Serial Number(s): Not Applicable

Duty Cycle Correction Factor Calculation

For a graphical presentation of the data bursts being transmitted from the transmitter, refer to Appendix D for the amount of time that the transmitter is active. Figures are provided that show the On-time of the transmitter that occurs when a key is held down continuously, and also over a 100 milliseconds (worst case) period. In the 100 millisecond window, with 20ms packet length, and 20 ms between packets with each packet consisting of 10 bits we will obtain a total of 3 packets transmitted during the 100 ms interval. If all bits are high and each bit is 1.5 ms long with 0.5ms between, the On-time for a burst is; 1.5ms x 10 bits = 15ms. The worst case On-time during a 100 ms period , is equal to 3 x 15ms = 45ms. When the total On-time is computed over a100 millisecond window, according to FCC Part 15.35(c), where the pulse duration exceeds 100 milliseconds, a total of 45 milliseconds is obtained as shown above. This results in a relaxation factor of 6.94 dB, which is under the allowable cap of 20 dB, as stated in FCC Part 15.35(b).

45 milliseconds out of 100 milliseconds for a duty cycle of 45%

Relaxation Factor= 20*log(45/100)

= -6.94dB

Occupied Bandwidth Calculations

FCC Part 15.231(c) states that the bandwidth of the periodic device shall be no wider than 0.25% of the center frequency for devices operating between 70 and 900 MHz.

Said bandwidth is determined at the **-20 dB** reference to peak carrier points.

For 300 MHz, the 20 dB allowable bandwidth is 0.0025 X 300 = 800 kHz

Refer to Appendix C for the set of graphs that show the actual occupied bandwidth of the test sample, which for this sample is 458 kHz, well within the limits

Appendix B

Data Charts

1.12 Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 30 to 3200 MHz

Date of Test:	September 7, 2000	**Manufacturer:**	NABCO Entrances, Inc.
Location:	L. S. Compliance, Inc.	**Model No.:**	Door Transmitter
	W66 N220 Commerce Court	**Operating Freq.**	300 MHz
	Cedarburg, WI 53012		
Specifications:	47CFR FCC Part 15.231b,15.205	**Serial No.:**	N/A
Distance:	3 meters	Configuration:	Active, continuous burst
Equipment:	HP 8546A EMI Receiver	Detector(s) Used:	Peak (Corrected to Average)
	EMCO 3115 Double Ridged Waveguide		
	EMCO 3146A Log Periodic		
	EMCO 3121C Tuned Dipole		
	EMCO 3110B Biconical		

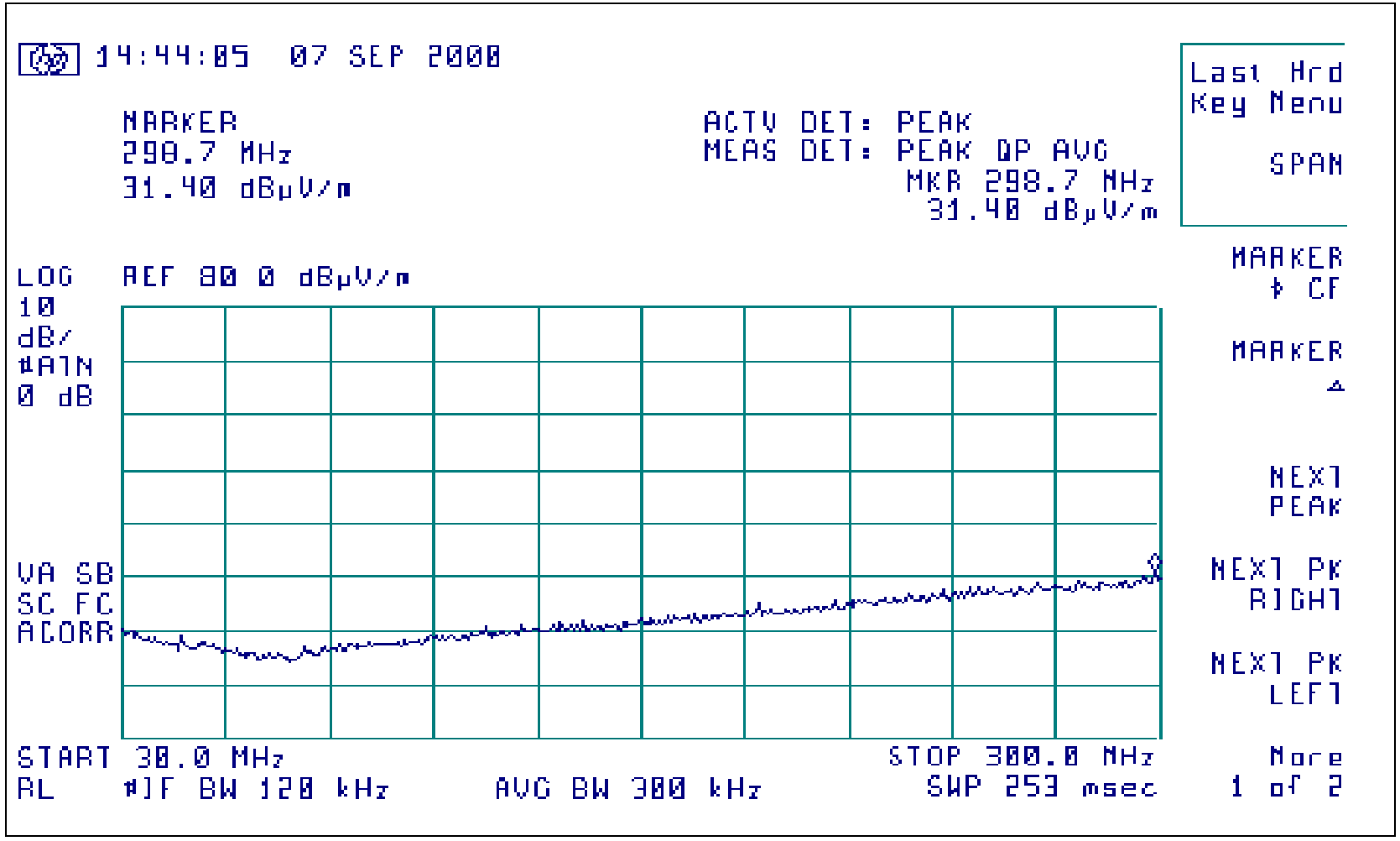
The following table depicts the level of significant fundamental and harmonic emissions found:

Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dB µV/m)	Duty Cycle Correction (dB)	Corrected Reading (dB µV/m)	15.231b Limit (dB µV/m)	Margin (dB)
300	V	1.6	74	70.2	6.9	63.3	74.7	11.4
600	V	1.0	252	53.0	6.9	46.1	54.7	8.6
900	V	1.15	217	40.5	6.9	33.6	54.7	21.1
300	H	1.0	0	75.6	6.9	68.7	74.7	6.0
600	H	1.3	0	41.8	6.9	34.9	54.7	19.8
901	H	1.8	0	50.4	6.9	43.5	54.7	11.2
1200	V	1.1	295	49.4	6.9	42.5	54.0	11.5
1500	V	1.15	198	53.1	6.9	46.2	54.0	7.8
1800	H	1.16	107	46.4	6.9	39.5	54.7	15.2

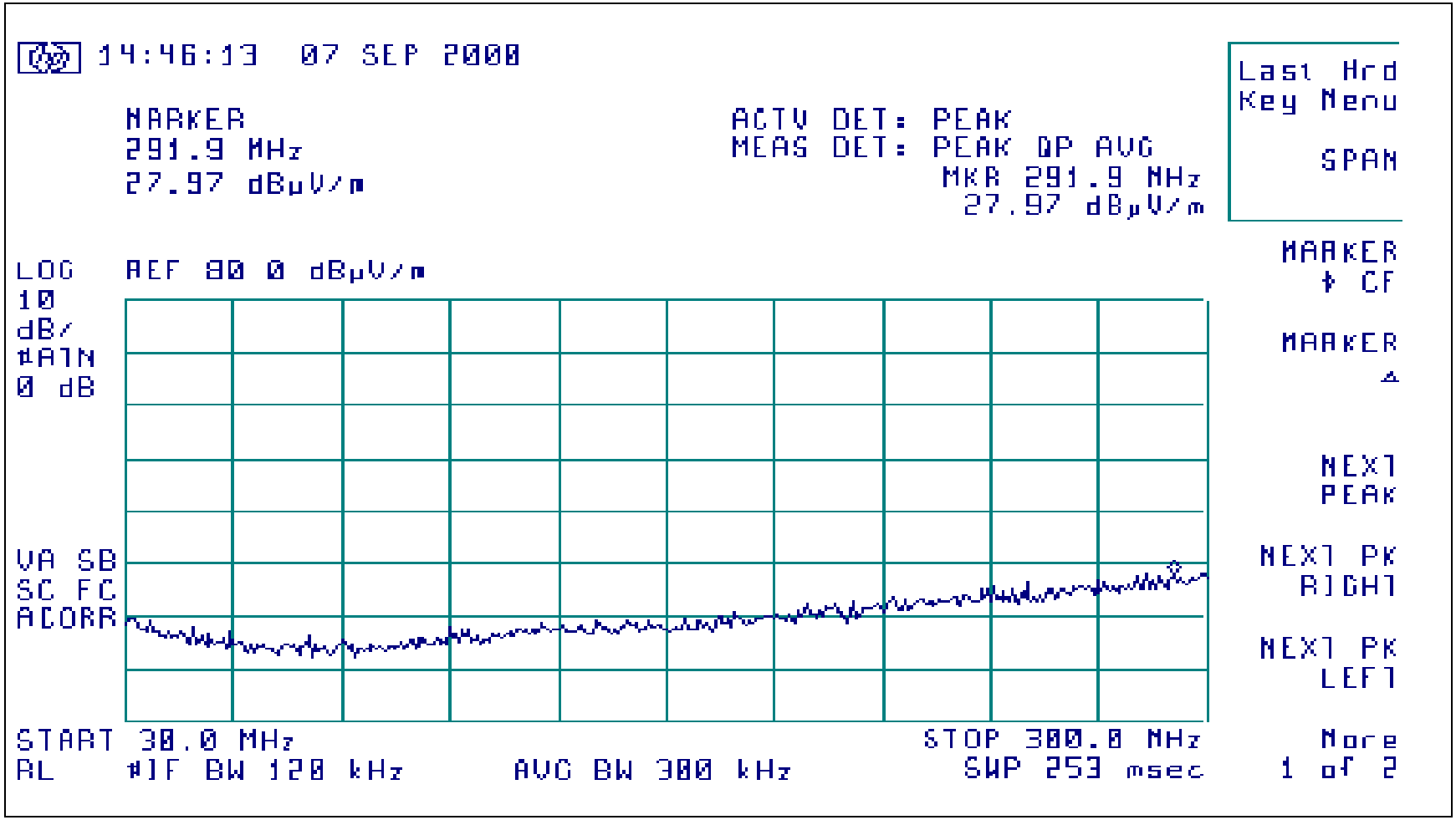
Appendix C

Graph

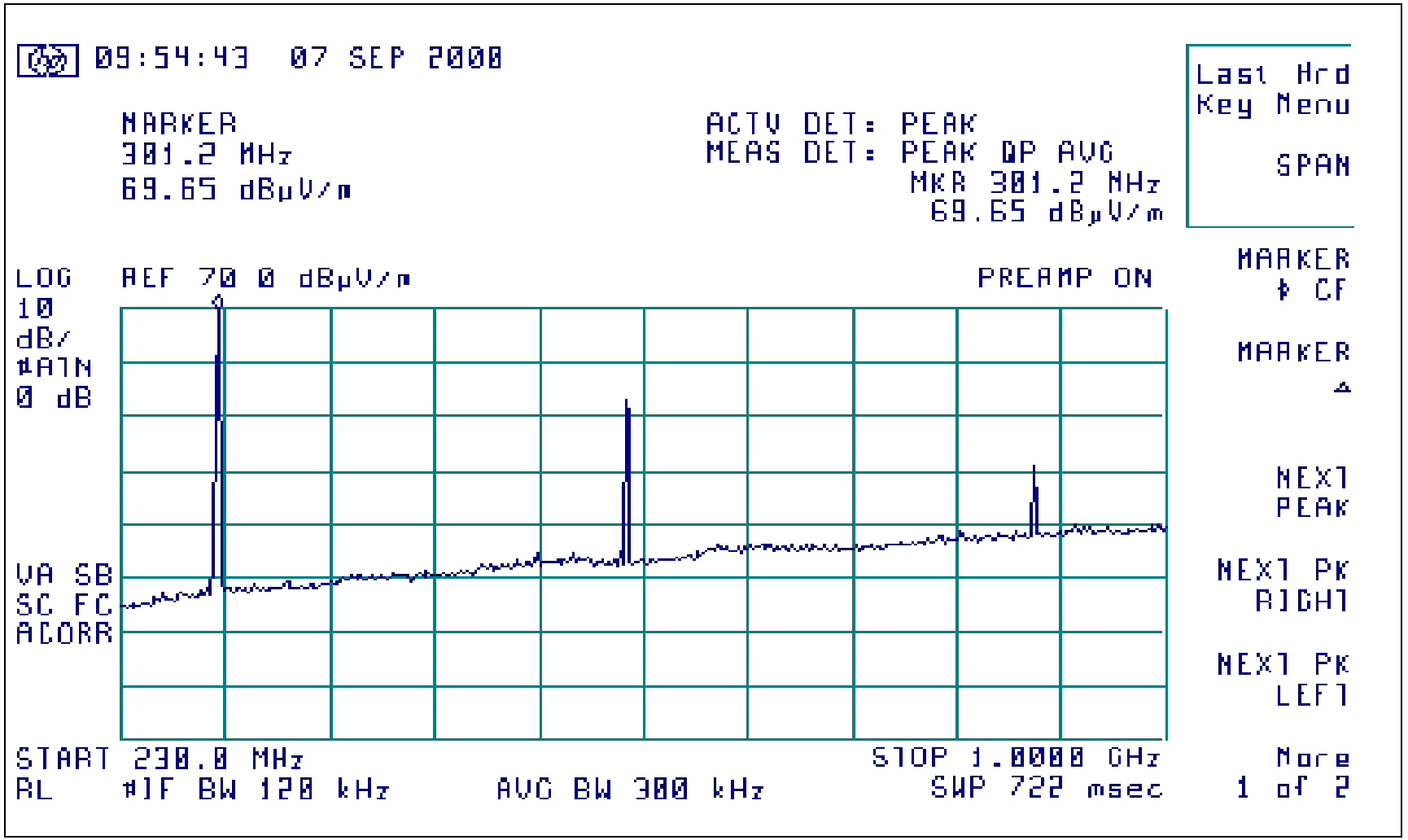
Door Transmitter, Emissions 30-300 MHz, Vertical Polarity



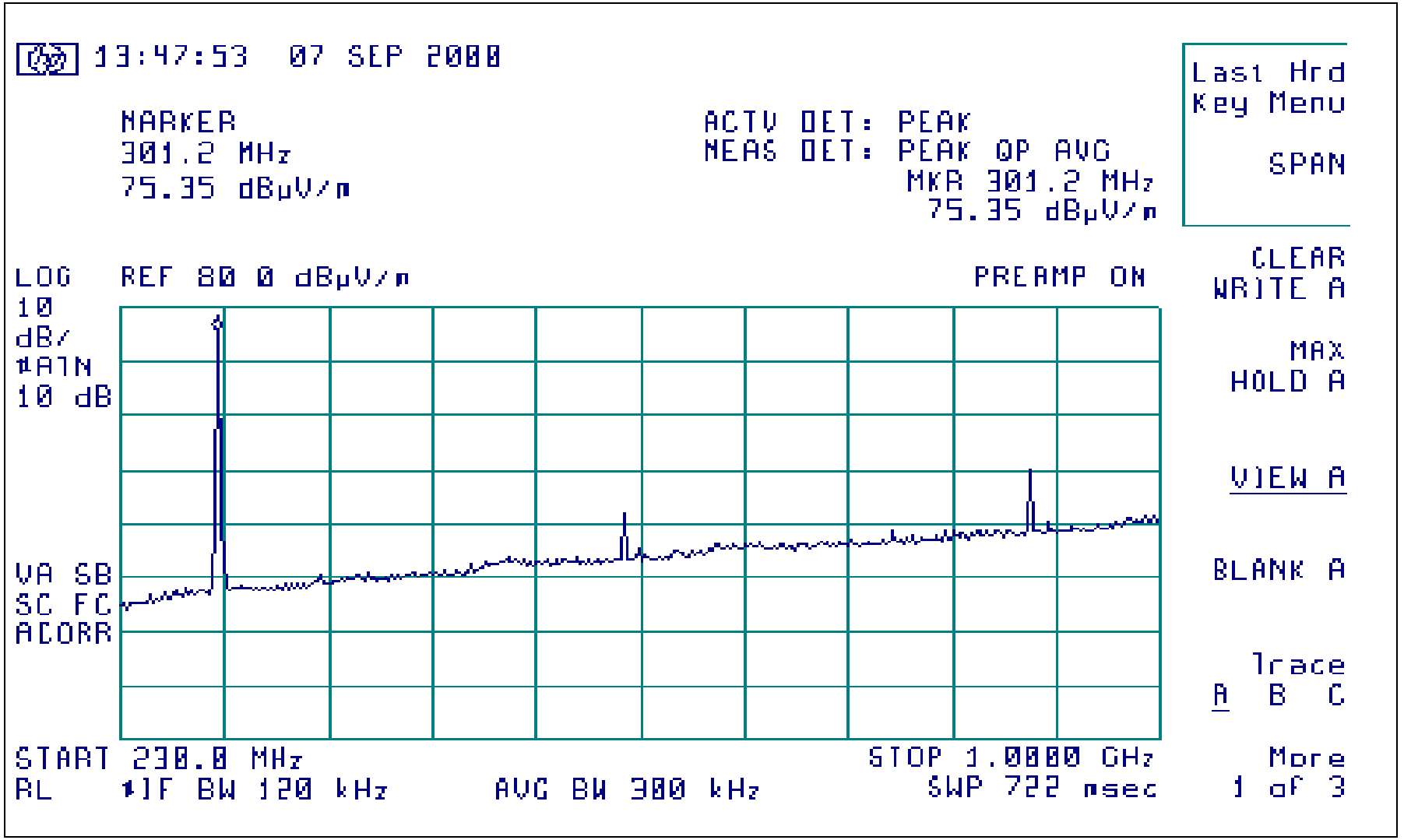
Door Transmitter, Emissions 30-300 MHz, Horizontal Polarity



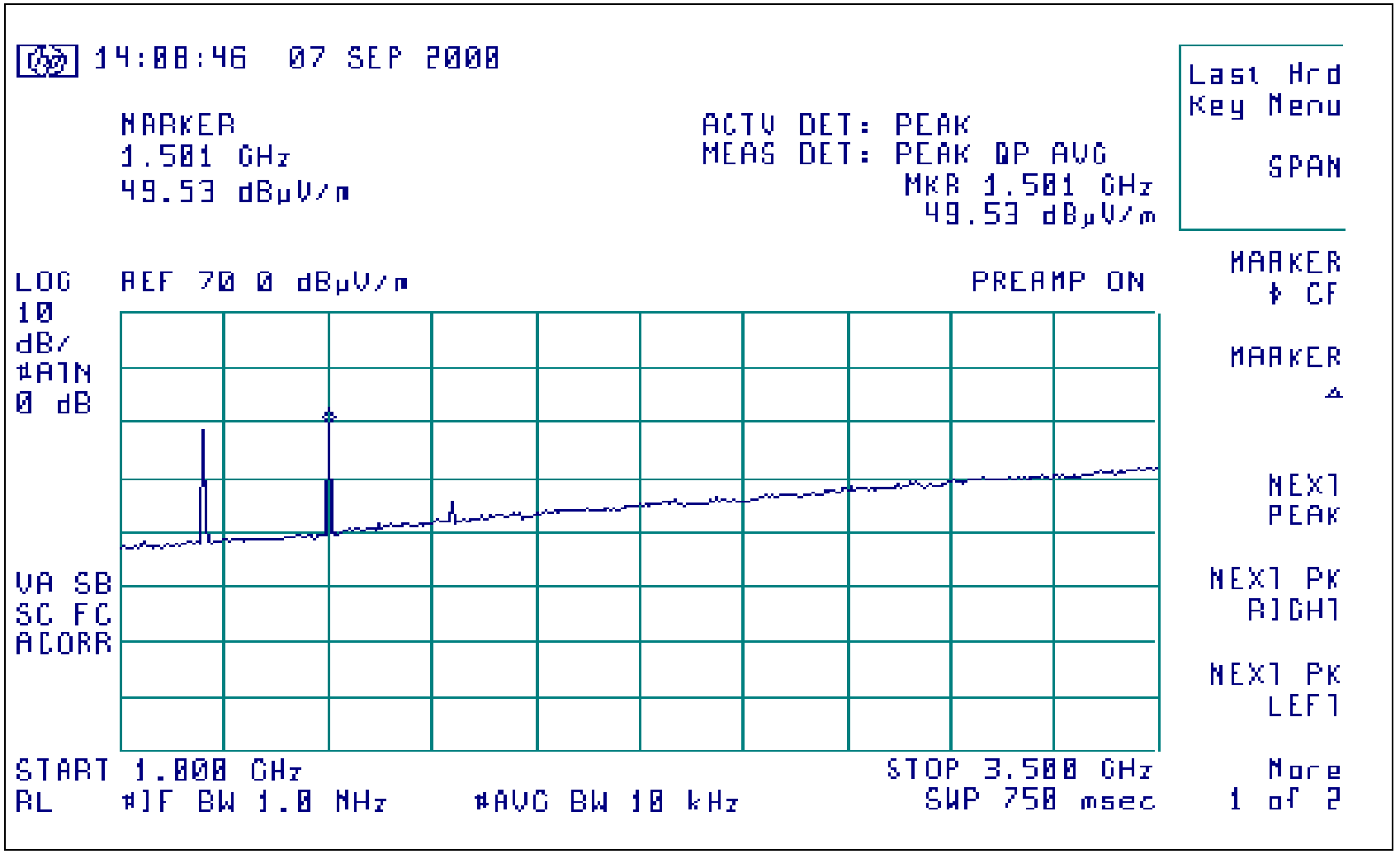
Door Transmitter, Emissions 230 MHz – 1.000 GHz Vertical Polarity



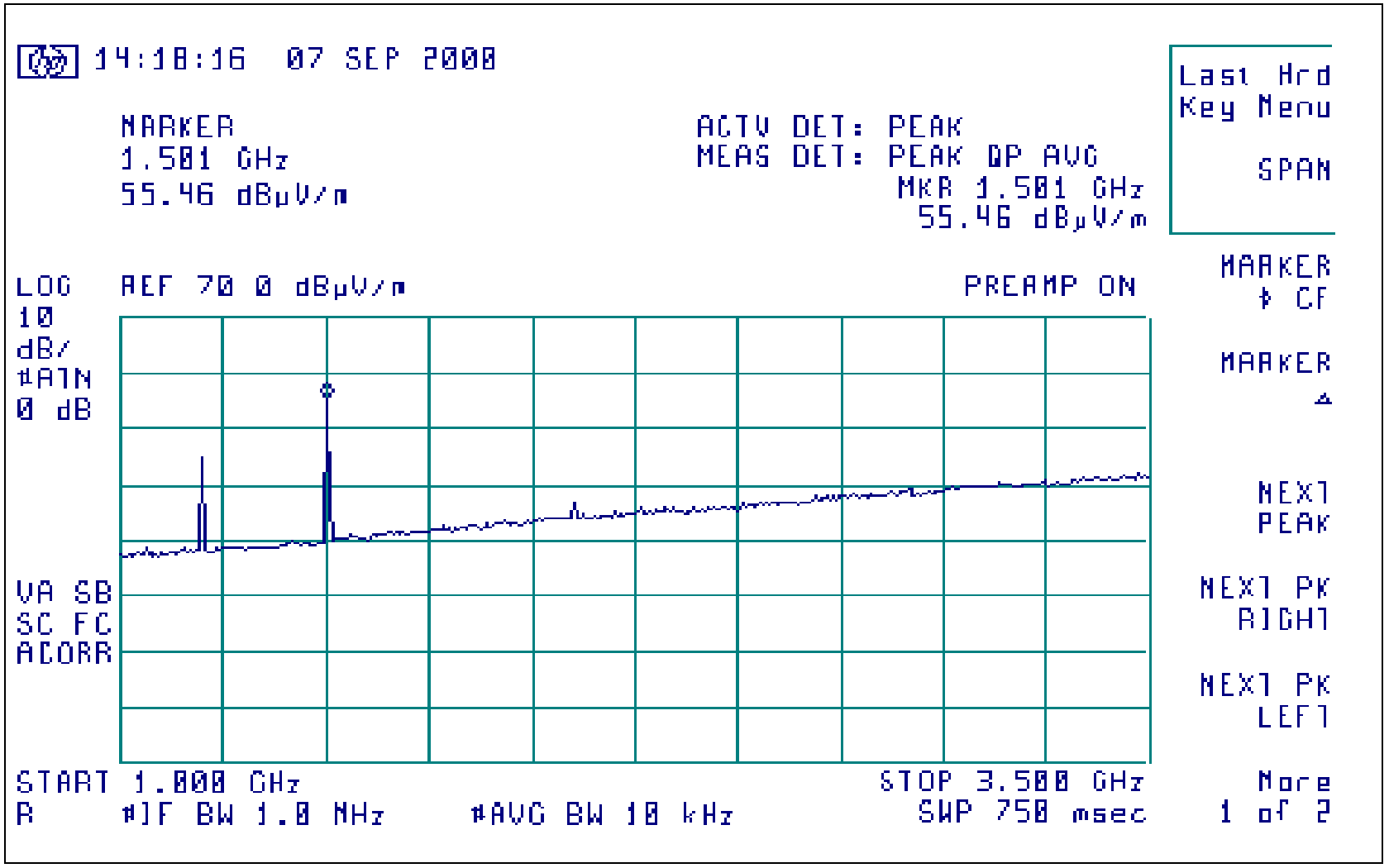
Door Transmitter, Emissions 230 MHz – 1.000 GHz Horizontal Polarity



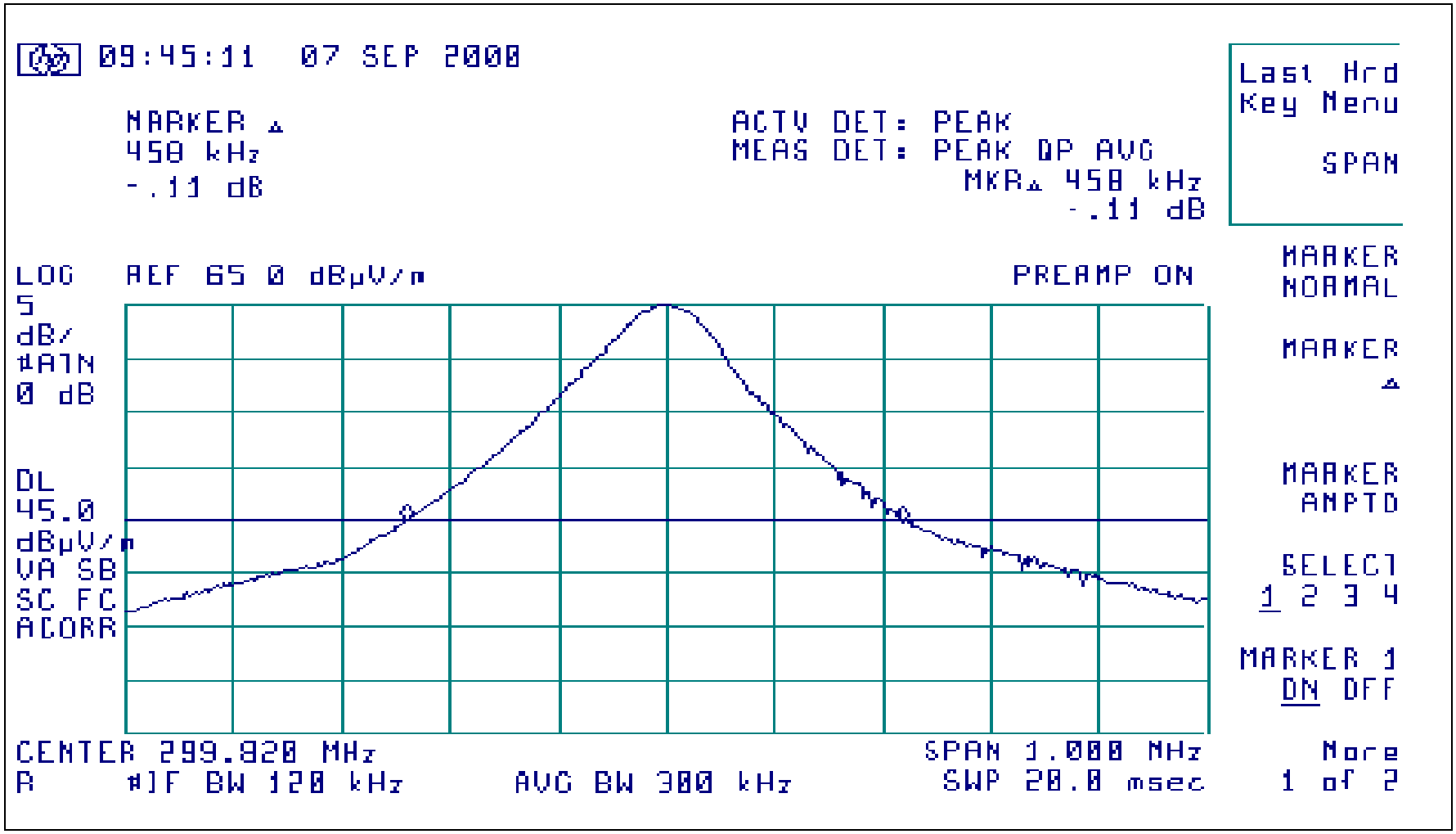
Door Transmitter, Emissions 1.000 GHz – 3.500 GHz , Vertical Polarity



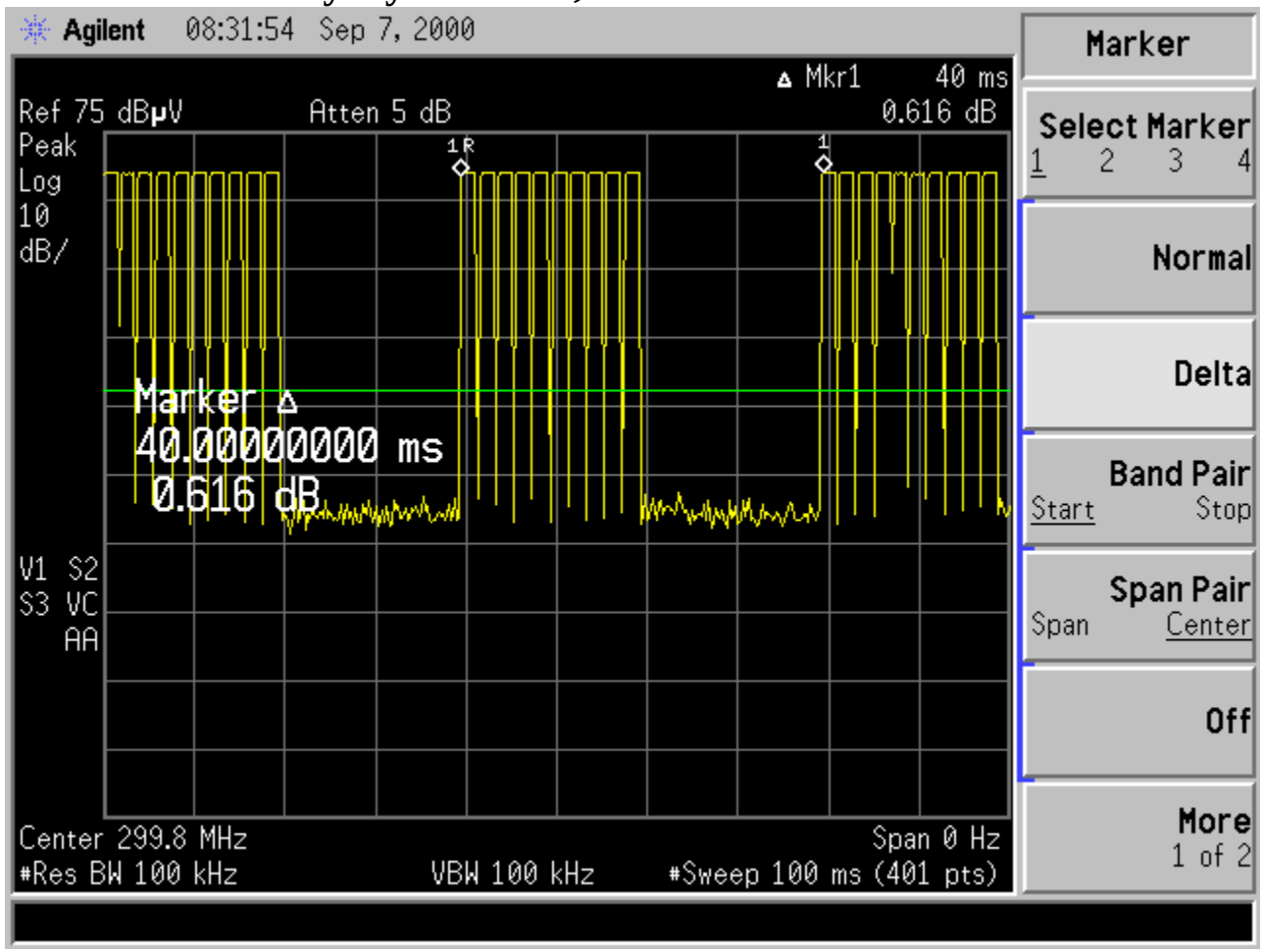
Door Transmitter, Emissions 1.000 GHz – 3.500 GHz , Horizontal Polarity



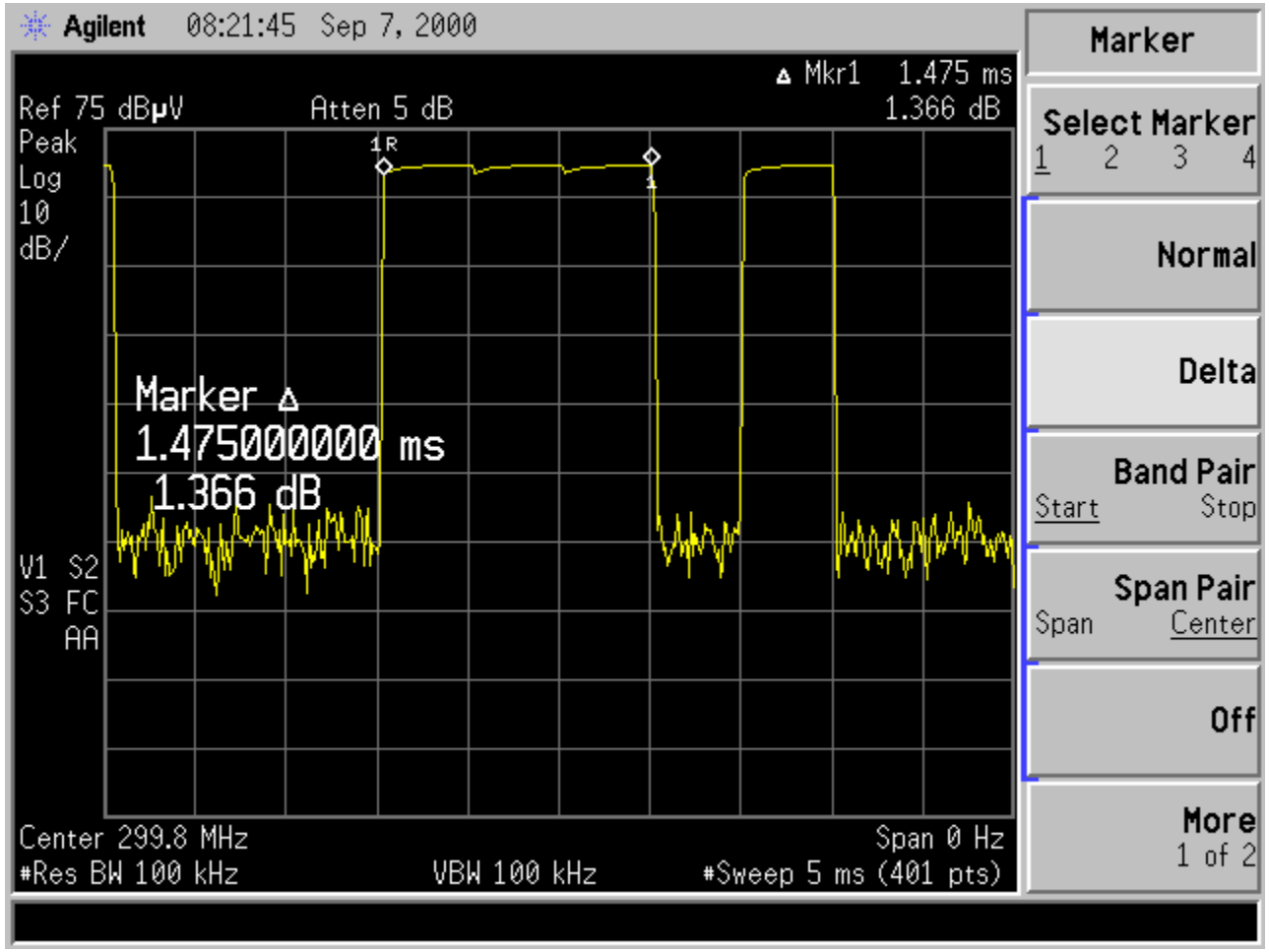
Door Transmitter , Emissions Occupied Bandwidth



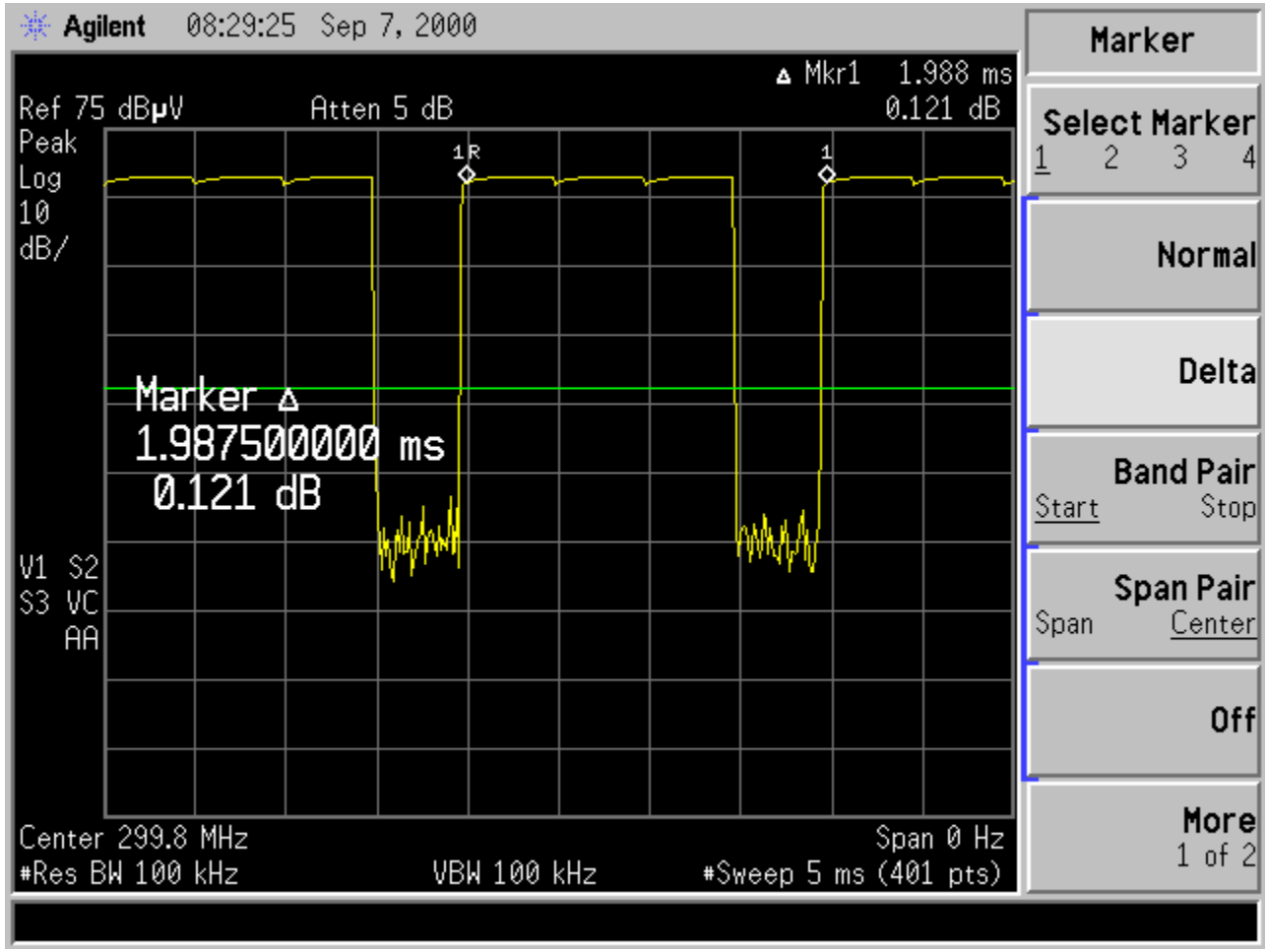
Duty Cycle Detail, Over a 100 ms Interval



Duty Cycle Detail, Over a 5.0 ms Interval



Duty Cycle Detail, Over a 5.0 ms Interval



Transmitter Turn-Off Release Time, Upon Momentary Activation of Push Switch
(Showing release time less than 2 seconds)