FCC ID: HBW1A5247

COMPLIANCE TESTING

OF

CHAMBERLAIN 3 BUTTON

REMOTE CONTROL TRANSMITTER

- TEST REPORT -

NOVEMBER 11, 1998

Prepared for:

The Chamberlain Group

Elmhurst, Illinois 60126

FCC ID: HBW1A5247

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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 47CFR Section 2.948."

FCC ID: HBW1A5247

SIGNATURE PAGE

Prepared By:

Approved By: Kenneth L. Boston — 11 Nov1998

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

Date

FCC ID: HBW1A5247

FCC ID: HBW1A5247

1.3 SUMMARY OF TEST REPORT

MANUFACTURER:	The Chamberlain Group
MODEL:	Craftsman 3 Channel Transmitter; 1A5247
SERIAL:	LS08
DESCRIPTION:	Low power Remote Transmitter
FREQUENCY RANGE:	390 MHz

The Craftsman 3 button Remote control was found to **"meet"** the radiated emission specification of Title 47 CFR FCC, Part 15, subpart C. for an intentional radiator

This Remote Control device is meant to control the operation of a Garage Door lifting mechanism, from a distance of up to 150 feet or more. The associated control receiver is part of this system, and has been certified at an earlier date.

FCC ID: HBW1A5247

1.4 INTRODUCTION

On November 2 and 11 of 1998, a series of Radiated Emissions tests were performed on a sample model of the Craftsman 3 button Remote, a Remote control which operates a garage door by means of a short burst of data transmission containing an I.D. code. These tests were performed using the test procedures 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, of L. S. Compliance, Inc.

1.5 PURPOSE

The above mentioned tests were performed in order to determine the compliance of Craftsman 3 button Remote product with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.205	15.231b
15.209	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 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 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 configured to run in a continuous transmit mode during the 15.231c and 15.231b measurements. This was accomplished by the use of a small Plexiglas stand, which had a plastic plunger simulating a finger, which held down on of the activating buttons. The three buttons were all activated to transmit, and the large button gave the highest emission signature, and was used for all the testing. One test sample, set to operate on the standard channel, was tested as an intentional radiator, in order to determine compliance at a frequency of 390 MHz,

Please refer to Section 1.11 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 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 sample was 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 7.10. The sample was placed on a nonconductive (wooden) 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 or tuned dipole was used to measure emissions from 30 to 200 MHz, a log periodic or tuned dipole 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 object was programmed to operate in continuous transmit, with a shortened repeat time, 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 object 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 4000 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 20 dB 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 pedestal within the 3 meter chamber. The transmitted signal was received on a tuned dipole 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 indeed **"meet"** the bandwidth requirement established by FCC Part 15.231(c).

1.8 TEST EQUIPMENT UTILIZED FOR RADIATED EMISSIONS TEST

A list of the test equipment and antennas used for the tests can be found in Section 1.13, 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. 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. Both the peak and Quasi-peak detector functions were used.

1.9 CONDUCTED EMISSION TEST

Due to the fact that this product operated on its own internal battery power, as opposed to using a power cord, it was not necessary to perform a test for Conducted Emissions.

FCC ID: HBW1A5247

Manufacturer: Chamberlain
Model: 1A5247
Serial Number(s): LS08

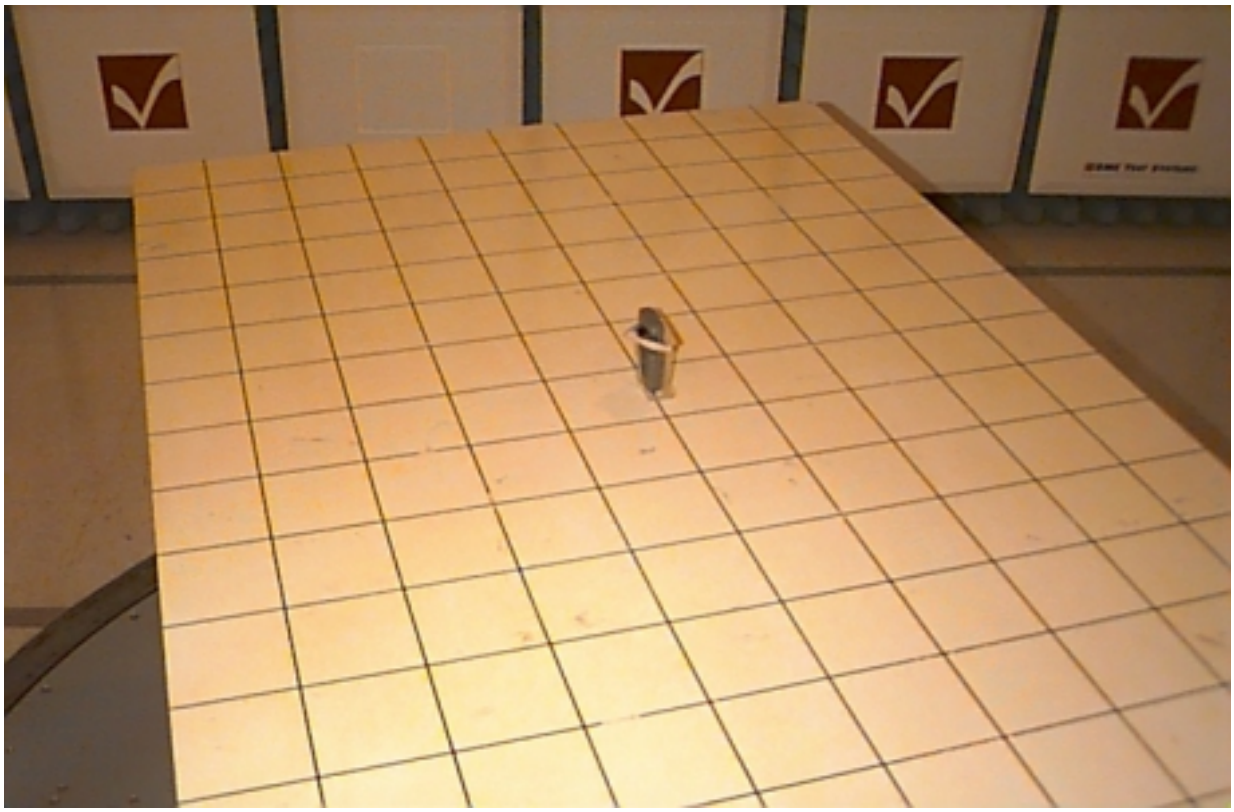
1.10 - Restricted Bands affecting this product

Frequency (MHz)	Limit (µV)	Limit (dB/µV/m)
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
3260-3267	500	54.0
3332-3339	500	54.0
3345.8-3358	500	54.0
3600-4400	500	54.0

FCC ID: HBW1A5247

1.11 – Photos taken during testing

FCC ID: HBW1A5247



View of the Remote Control transmitter during the Radiated Emissions tests. This view shows the orientation of the product where the maximum signal levels were present (vertical polarity). In order to cause the remote transmitter to run continuously, a small plexiglass fixture can be seen which pushes a plunger down on the appropriate button to activate transmission.

1.12 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 Craftsman 3 button Remote Transmitter does **"meet"** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator. The level of the 3rd harmonic emission of the sample was found to be only 0.23 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 this unit, or a similar unit 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.

FCC ID: HBW1A5247

1.13 - Test Equipment

Asset #	Manufacturer	Model #	Serial #	Description	Due Date
AA960003	EMCO	3121C	786	Dipole Set Antenna	7/14/99
AA960004	EMCO	3146	9512-4276	Log Periodic Antenna	9/12/99
AA960005	EMCO	3110B	9601/2280	Biconical Antenna	9/12/99
AA960007	EMCO	3115	99111-4198	Double Ridged Guide/Horn Antenna	7/20/99
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

FCC ID: HBW1A5247

APPENDIX A:

SAMPLE CALCULATIONS

FCC ID: HBW1A5247

Manufacturer: The Chamberlain Group
Model: 1A5247
Serial Number(s): LS08

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

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 = 390 MHz
  Fundamental: 3750+41.667(390-260) = 9166.7 μV/m
  Harmonic: 375+4.1667(390-260) = 916.67 μV/m

Frequency (MHz)	Fundamental limit (μV/m)	Fundamental limit (dB μV/m)	Harmonic limit (μV/m)	Harmonic limit (dB μV/m)
390	9166.67	79.24	916.67	59.24

FCC ID: HBW1A5247

Model: 1A5247
Serial Number(s): LS08

Duty Cycle Correction Factor Calculation

For a graphical presentation of the data bursts being transmitted from the Remote Control Transmitter, refer to Appendix C. This plot was taken of a unit, which has been programmed to send its activation code repeatedly, by holding down one of the buttons, to permit radiated emissions tests to be readily performed. When the unit is activated by a user pressing one of the keys, the transmitter sends out an alternating code frame, where the first frame is 80 milliseconds long; consisting of 41 ms of code and a 39 ms. Blanking interval.. This is followed by a second frame consisting of 43 ms of code and 37 ms. of blanking interval. These frames alternate continuously as long as the button is held down, out to a maximum of 3 minutes, where it will shut down. The auto shutdown saves batteries in case of a key being accidentally depressed while in a persons pocket, by pressure from keys or coins.

The coded bits are trinary, with a ¾ on time per bit corresponding to a logic one. The highest duty cycle occurs when a second frame is followed by a first frame, and all the bits are logic one. When the total On-time is computed over a100 millisecond window, according to FCC Part 15.35(c), where the pulse train exceeds 100 milliseconds, a total of 48.25 milliseconds is obtained. This results in a relaxation factor of 6.33 dB, which is under the allowable cap of 20 dB, as stated in FCC Part 15.35(b)

Relaxation Factor = 20 log (48.25/100)
= 6.33 dB

FCC ID: HBW1A5247

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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 390 MHz, the 20 dB bandwidth is 0.0025 X 390 = 0.975 MHz

Refer to Appendix C for the set of graphs that show the actual occupied bandwidth of the test sample, which for this sample is 0.473 MHz, well within the limits.

FCC ID: HBW1A5247

APPENDIX B:

DATA CHARTS

FCC ID: HBW1A5247

Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 30 to 3500 MHz

Date of Test:	November 2, 1998	Manufacturer:	The Chamberlain Group
Location:	L. S. Compliance, Inc.	Model No.:	1A5247
	W66 N220 Commerce Court	Operating Freq.	390 MHz
	Cedarburg, WI 53012		
Specifications:	47CFR FCC Part 15.231b,15.205	Serial No.:	
Distance:	3 meters	Configuration:	Active, continuous burst
Equipment:	HP 8546A EMI Receiver	Detector(s) Used:	Peak
	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:

Higher order harmonics were found to be below the noise floor of the receiving system:

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)
390.55	H	1.0	90	82.5	6.33	76.17	79.24	3.07
390.55	V	1.4	90	82.3	6.33	75.97	79.24	3.27
781.33	H	1.1	200	50.4	6.33	44.07	59.24	15.17
781.33	V	1.3	95	45.0	6.33	38.67	59.24	20.57
1171.9	H	1.35	280	60.1	6.33	53.77	54.0	0.23
1171.9	V	1.0	95	59.3	6.33	52.97	54.0	1.03
1562.6	H	1.0	65	57.8	6.33	51.47	54.0	2.53
1562.6	V	1.05	90	55.8	6.33	49.47	54.0	4.53
1953.3	H	1.1	75	54.9	6.33	48.57	59.24	10.67
1953.3	V	1.2	110	53.5	6.33	47.17	59.24	12.07
2343.9	H	1.2	215	52.0	6.33	45.67	54.0	8.33
2343.9	V	1.0	70	50.6	6.33	44.27	54.0	9.73

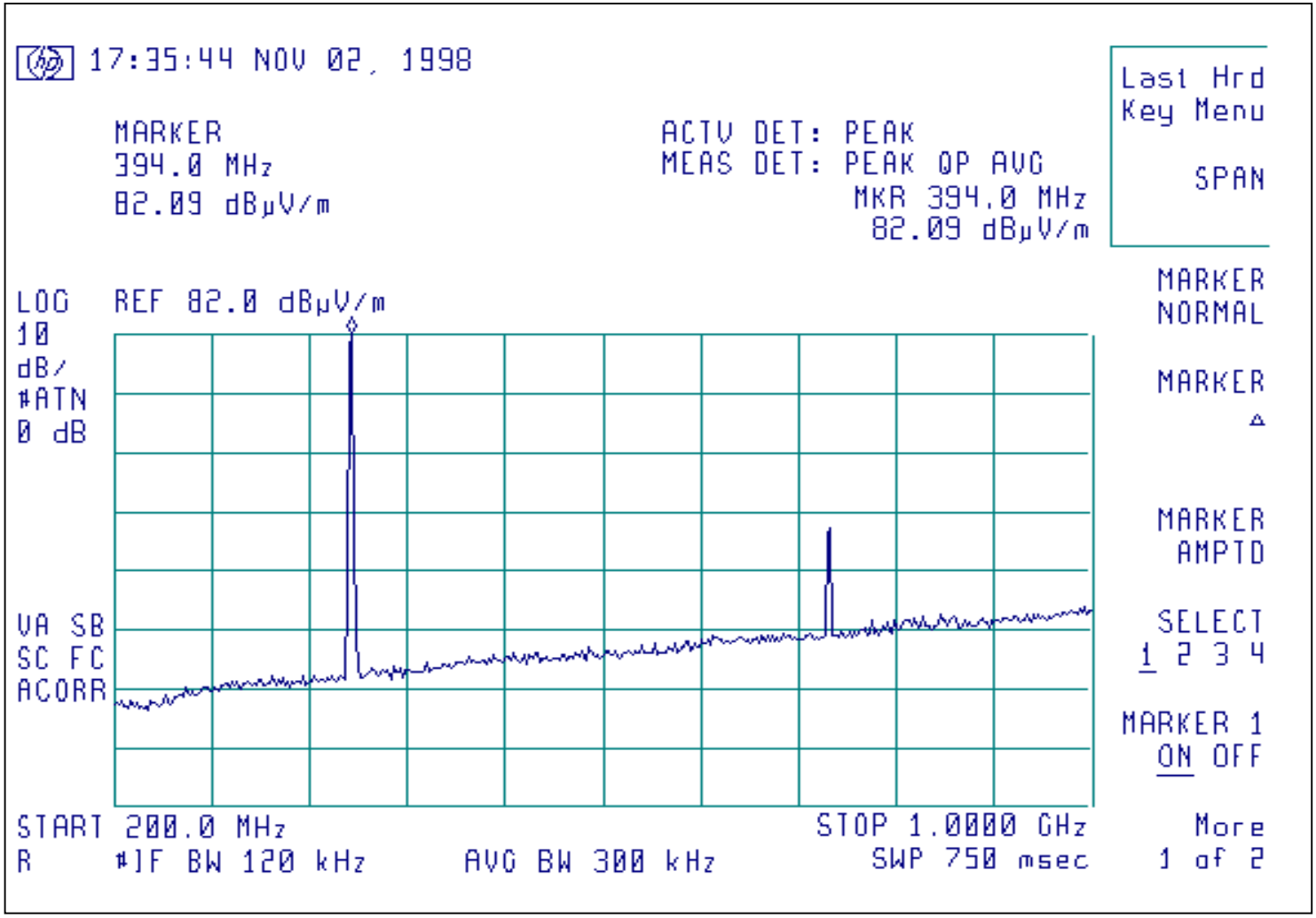
FCC ID: HBW1A5247

APPENDIX C:

GRAPHS

FCC ID: HBW1A5247

390 MHz Remote Control, emissions below 1 GHz, horizontal polarity



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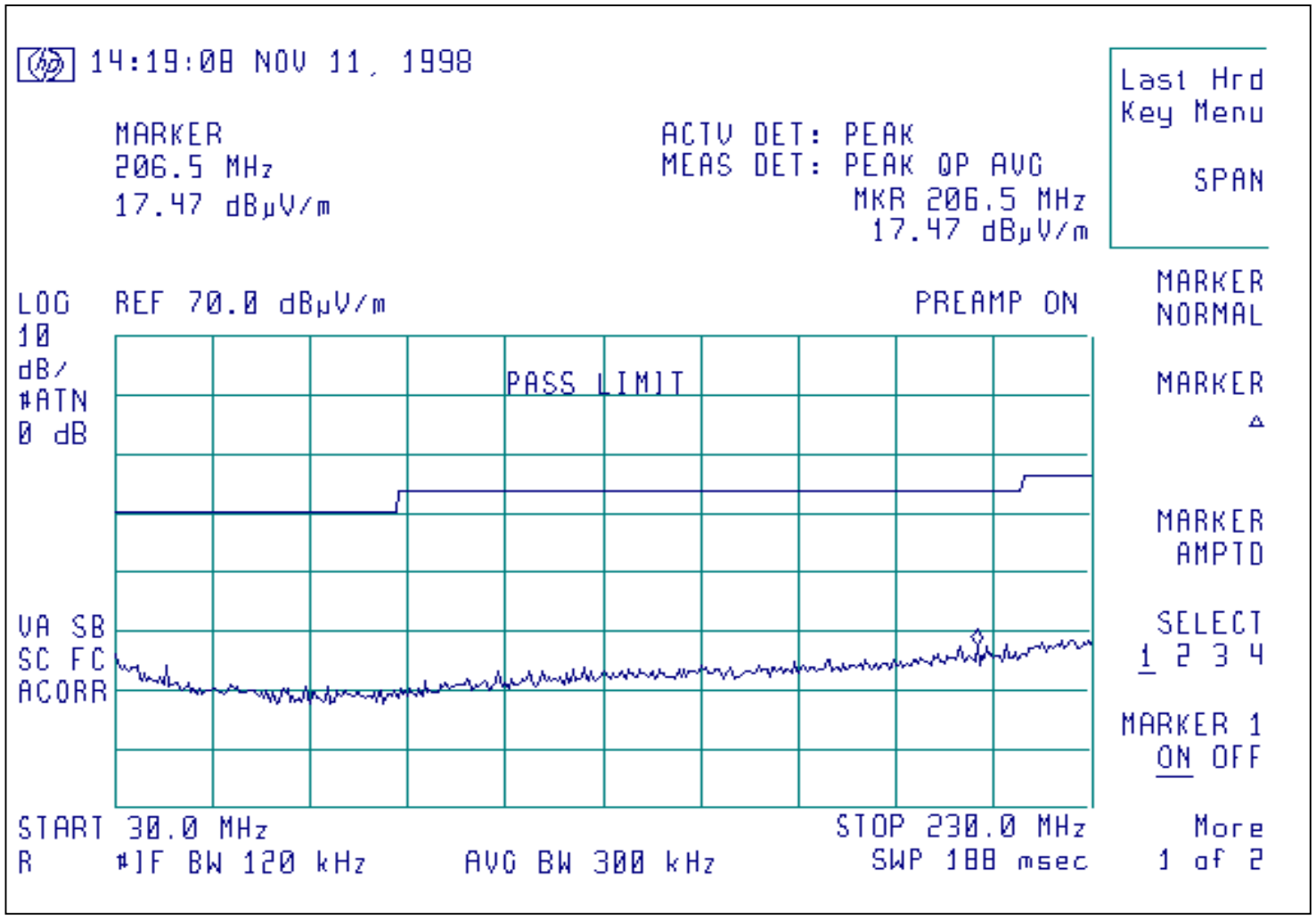
390 MHz Remote Control, emissions below 1 GHz, vertical/horiz polarity



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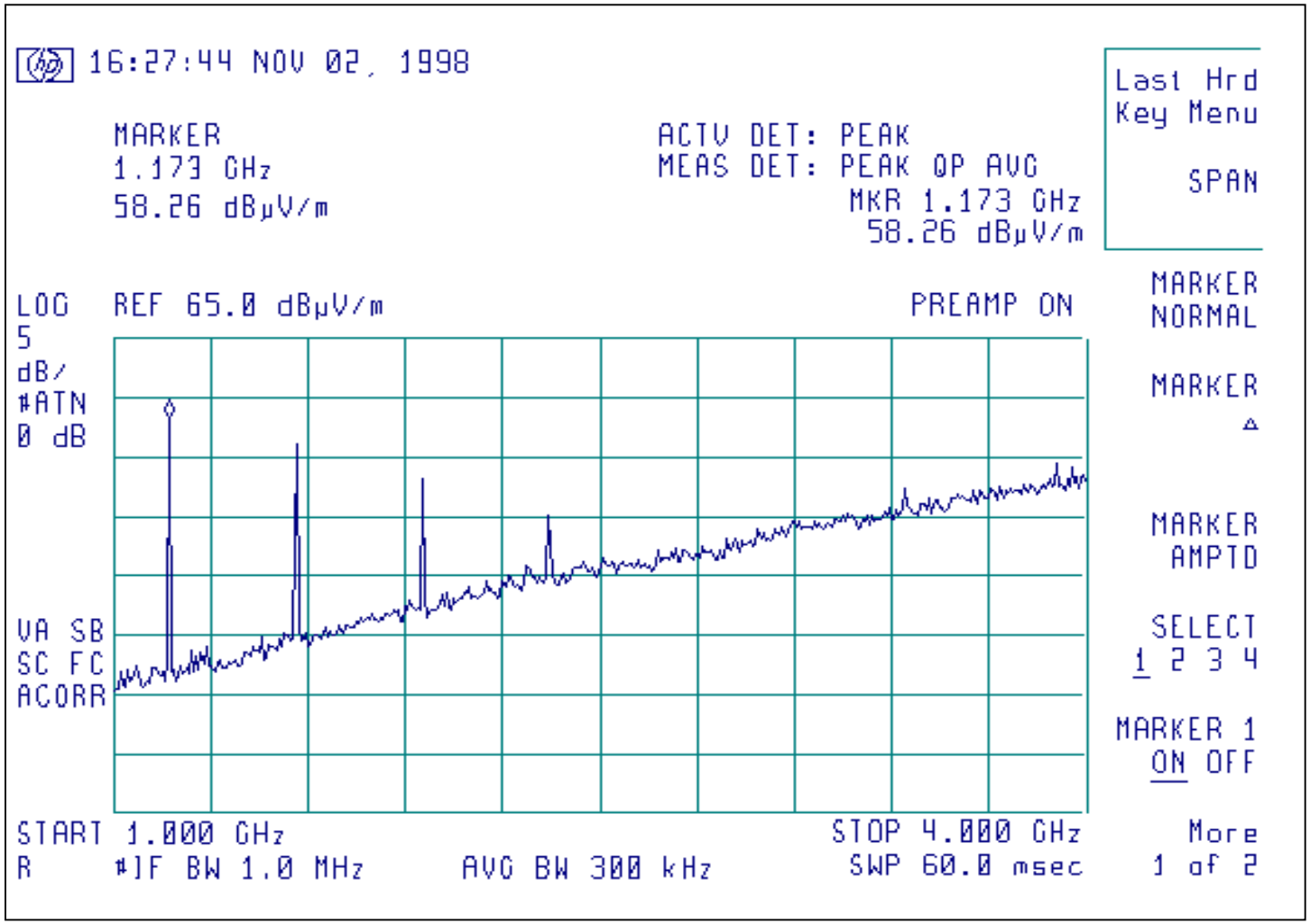
390 MHz Remote Control, emissions above 1 GHz, horizontal polarity



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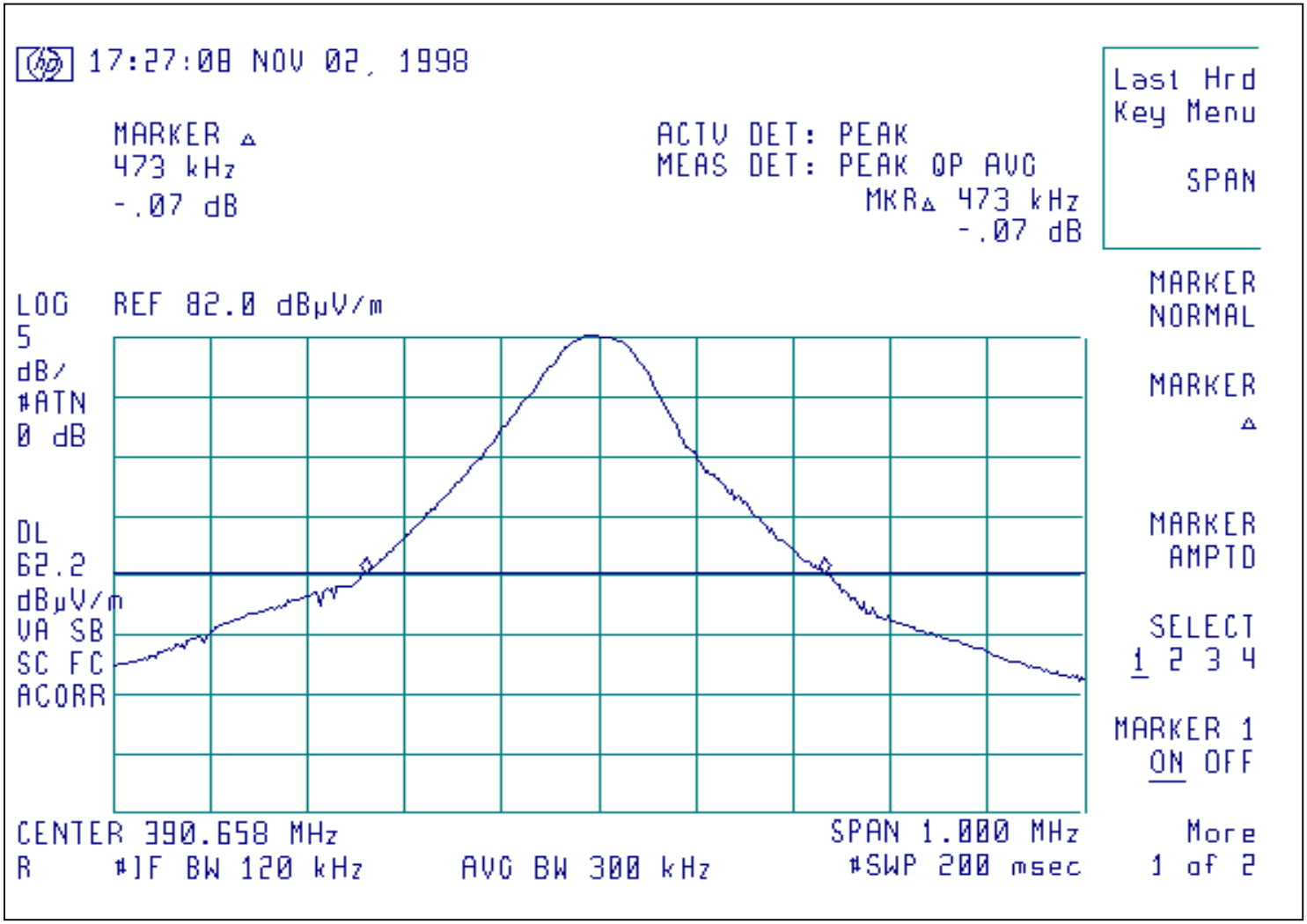
390 MHz Remote Control, occupied bandwidth



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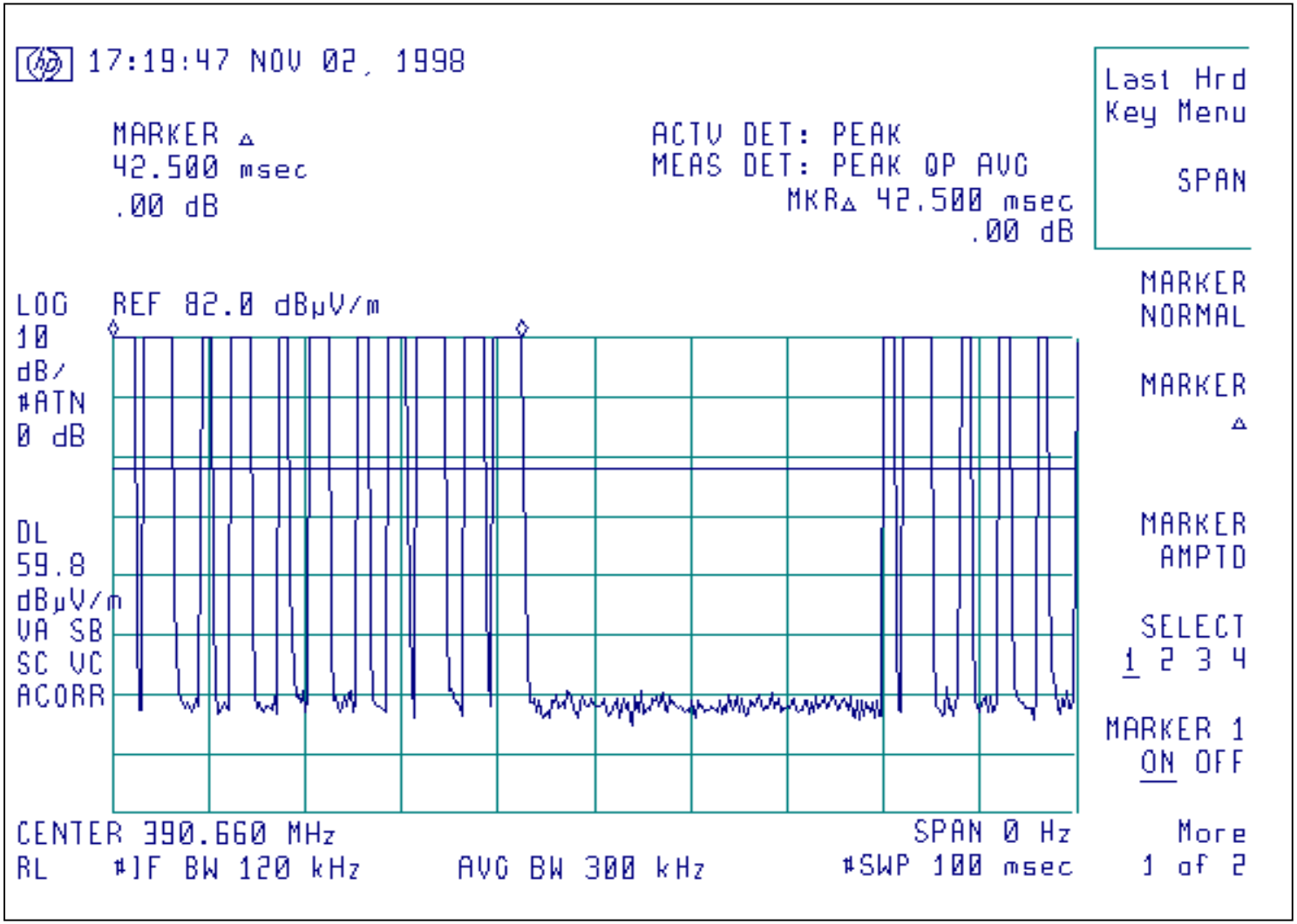
390 MHz Remote Control, duty cycle, burst period



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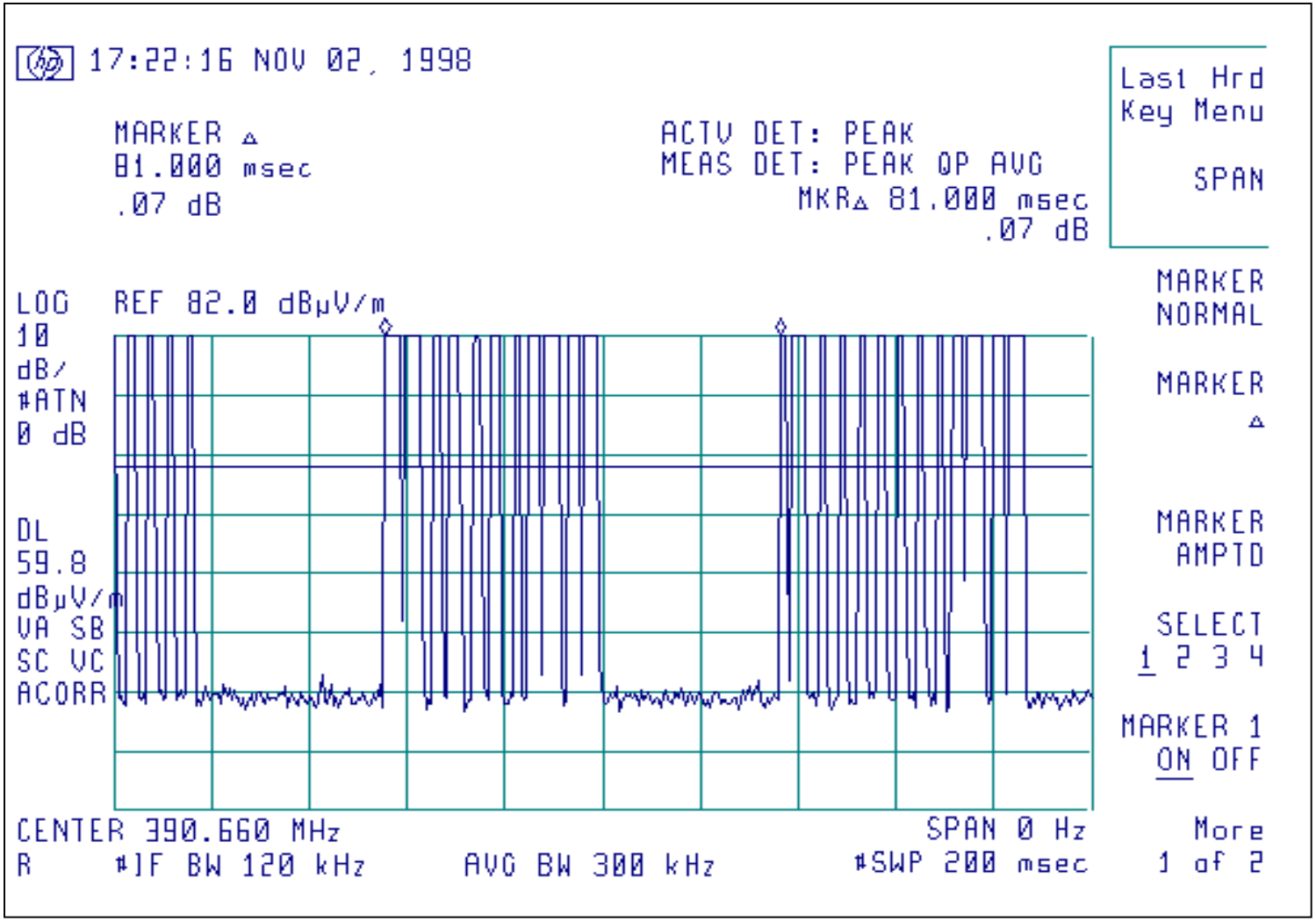
390 MHz Remote Control, duty cycle, burst duty cycle



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