**FCC ID: NTL-PCB4950**

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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."*

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# COMPLIANCE TESTING

# OF

# BRUNO INDEPENDENT LIVING AIDS

# REMOTE CONTROL TRANSMITTER

- TEST REPORT -

JULY 14, 17, AND AUGUST 4, 1998

Prepared for:

Bill Belson

Bruno Independent Living Aids

**FCC ID: NTL-PCB4950**

1780 Executive Drive

Oconomowoc, WI 53066

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# *SIGNATURE PAGE*

Prepared By:

Approved By: Kenneth L. Boston — 12 aug 1998

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: | BRUNO INDEPENDENT LIVING AIDS |
| MODEL: | Call / Send Remote Control |
| SERIAL: | 621 |
| DESCRIPTION: | Low power Periodic Transmitter |
| FREQUENCY RANGE: | TRANSMITTER; 318 MHz |

The Bruno Call / Send 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 chair Lift which is mounted on a stairway, in order to allow an elderly or disabled person to move the lift up and down the staircase. The associated control receiver is part of this system, and subject to Notification. The receiver is the subject of a concurrent filing.

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## 1.4 INTRODUCTION

On July 14, 17 and August 4 of 1998, a series of Radiated Emissions tests were performed on a sample model of the Bruno Call/Send Remote control product; a Remote control which operates a stairlift 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. and witnessed by Kelly Smith of Bruno Independent Living Aids.

## 1.5 PURPOSE

The above mentioned tests were performed in order to determine the compliance of the Call/Send Remote control 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. 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 318 MHz,

Please refer to Section 1.11 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 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 3500 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 at the band edges, 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 were 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.

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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 7.13, 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.

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Manufacturer: Bruno Independent Living Aids
Model: Call / Send
Serial Number(s): 621

## 1.10 - 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 |

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# 1.11 – Photos taken during testing

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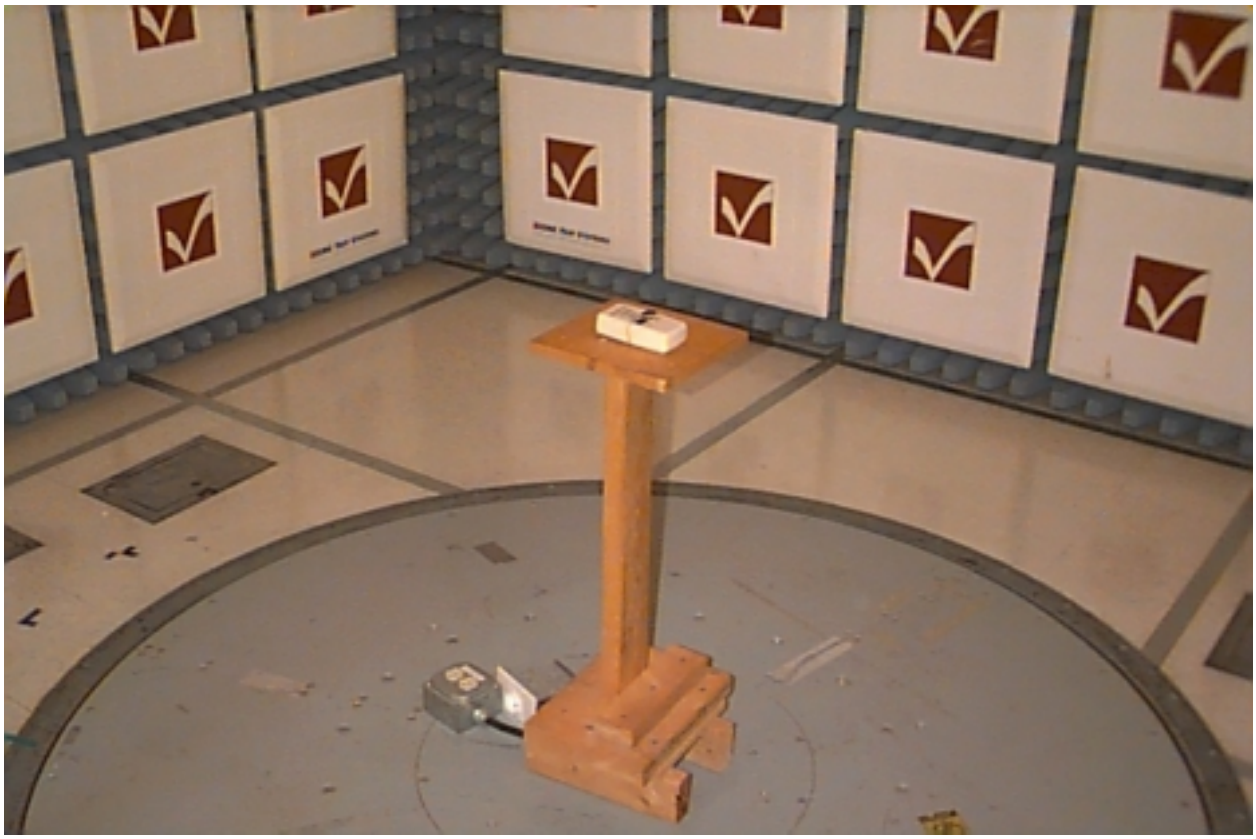

view of the Remote Control transmitter during the Radiated Emissions tests. This view shows the orientation of the product where the maximum signal levels were present (horizontal polarity).

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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 Bruno Call/Send Remote Control Transmitter does **"meet"** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator. The level of the fundamental emission of the sample was found to be only 1.5 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.

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## 1.13 - Test Equipment

| Asset # | Manufacturer | Model # | Serial # | Description | Due Date |
|---|---|---|---|---|---|
| AA960003 | EMCO | 3121C | 786 | Dipole Set Antenna | 7/14/98 |
| AA960004 | EMCO | 3146 | 9512-4276 | Log Periodic Antenna | 9/9/98 |
| AA960005 | EMCO | 3110B | 9601/2280 | Biconical Antenna | 9/9/98 |
| AA960007 | EMCO | 3115 | 99111-4198 | Double Ridged Guide/Horn Antenna | 9/9/98 |
| EE960004 | EMCO | 2090 | 9607-1164 | Mast/Ttable Controller | I.O |
| EE960013 | HP | 8546A | 3617A00320 | Receiver RF Section W/Display and RF filter section | 7/30/98 |
| EE960014 | HP | 85460A | 3448A00296 | Receiver RF Section Preselector | 7/30/98 |

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# APPENDIX A:

SAMPLE CALCULATIONS

**FCC ID: NTL-PCB4950**

Manufacturer: Bruno Independent Living Aids
Model: Call / Send
Serial Number(s): 621

# 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 $f_0$ = 318 MHz
  Fundamental: 3750+41.667(318-260) = 6166.7 µV / m
  Harmonic: 375+4.1667(318-260) = 616.67 µV / m

| Frequency (MHz) | Fundamental limit (µV/m) | Fundamental limit (dB µV/m) | Harmonic limit (µV/m) | Harmonic limit (dB µV/m) |
|---|---|---|---|---|
| 318 | 6166.7 | 75.80 | 616.67 | 55.80 |

**FCC ID: NTL-PCB4950**

Model: Call / Send
Serial Number(s): 621

# 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, with a repeating burst, 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 a pre-set identifier code of 29.24 milliseconds duration, followed by a blanking interval of 70.76 milliseconds. During the transmission of the identifier code packet, a fixed length preamble of duty cycle of 50% is sent, followed by a short blanking interval, and then a sequential serial number beginning at zero and increasing to about 20000.

Using the identifier code for the serial numbers intended to be used over the life of the product, the serial number, in base 2, with the largest number of 1's (resulting in an on time of 2 / 3 per digit) is selected. During the transmission of the identifier packet, this results in an on-time of 14.44 milliseconds and an off-time of 14.8 milliseconds. 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 14.44 milliseconds is obtained. This results in a relaxation factor of 16.8 dB, which is under the allowable cap of 20 dB, as stated in FCC Part 15.35(b)

Relaxation Factor = 20 log (14.44 / 100)
= 16.80 dB

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Serial Number: 621

# 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 318 MHz, the 20 dB bandwidth is $0.0025 \times 318 = 795 \ \ kHz$

Refer to Appendix C for the set of graphs that show the actual occupied bandwidth of the test sample.

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# APPENDIX B:

DATA CHARTS

**FCC ID: NTL-PCB4950**

Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 30 to 3500 MHz

| | | | |
|---|---|---|---|
| Date of Test: | August 4, 1998 | Manufacturer: | Bruno Independent Living Aids |
| Location: | L. S. Compliance, Inc. | Model No.: | Call/Send |
| | W66 N220 Commerce Court | Operating Freq. | 318 MHz |
| | Cedarburg, WI 53012 | | |
| Specifications: | 47CFR FCC Part 15.231b,15.205 | Serial No.: | 621 |
| 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) |
|---|---|---|---|---|---|---|---|---|
| 318.0 | H | 1.05 | 260 | 91.08 | 16.8 | 74.28 | 75.80 | 1.52 |
| 636.1 | H | 1.3 | 330 | 41.54 | 16.8 | 24.74 | 55.80 | 31.06 |
| 954.18 | H | 1.45 | 105 | 36.01 | 16.8 | 19.21 | 55.80 | 36.59 |
| 1272.27 | H | 1.13 | 290 | 40.03 | 16.8 | 23.23 | 55.80 | 32.57 |
| 1272.27 | V | 1.3 | 0 | 41.30 | 16.8 | 24.50 | 55.80 | 31.30 |
| 1590.36 | H | 1.0 | 195 | 42.64 | 16.8 | 25.84 | 54.00 | 28.16 |
| 1908.39 | H | 1.1 | 155 | 44.89 | 16.8 | 28.09 | 55.80 | 27.71 |
| 2226.47 | H | 1.2 | 155 | 48.30 | 16.8 | 31.50 | 54.00 | 22.50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2544.56 | H | 1.06 | 120 | 47.95 | 16.8 | 31.15 | 54.00 | 22.85 |

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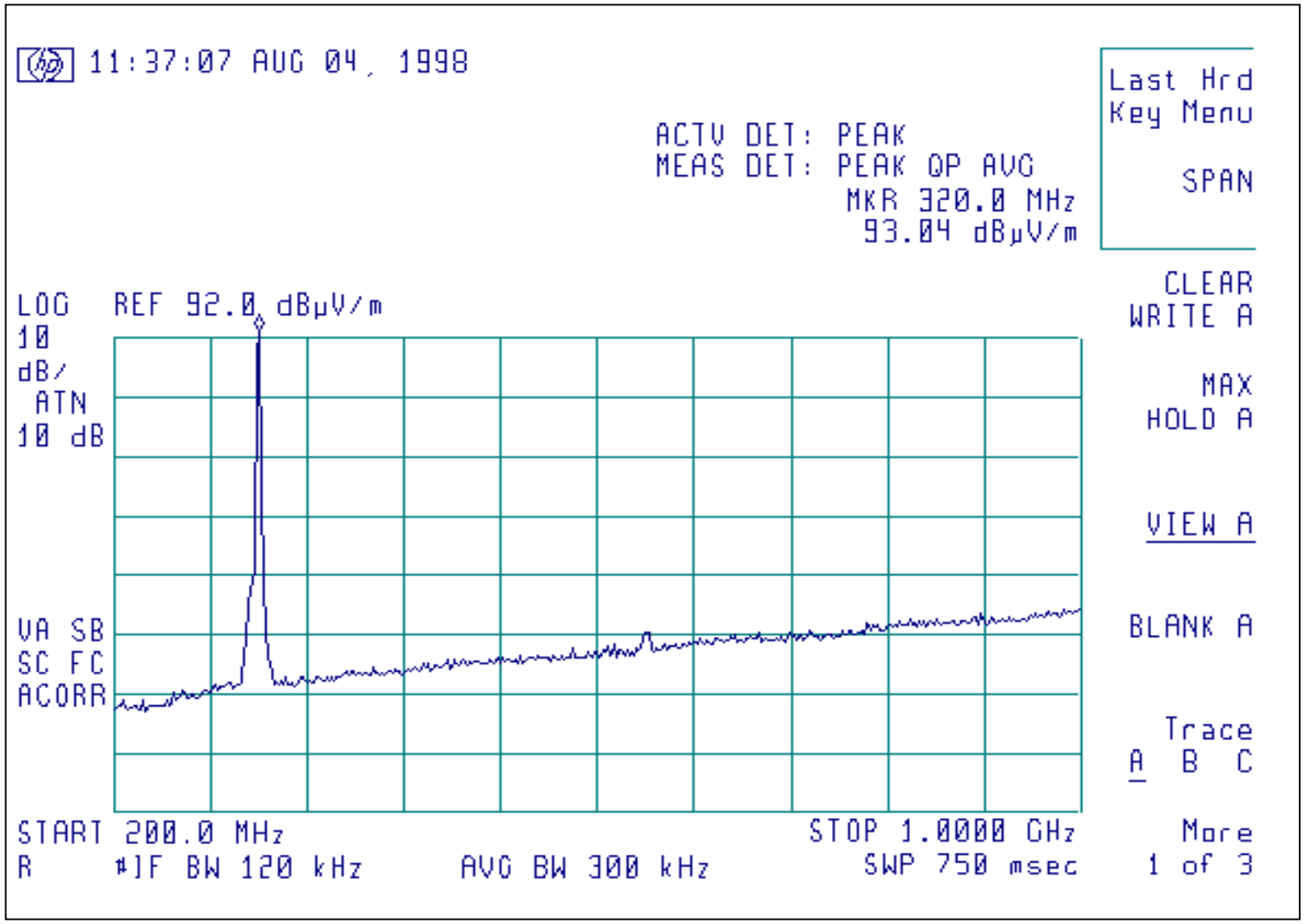
# APPENDIX C:

GRAPHS

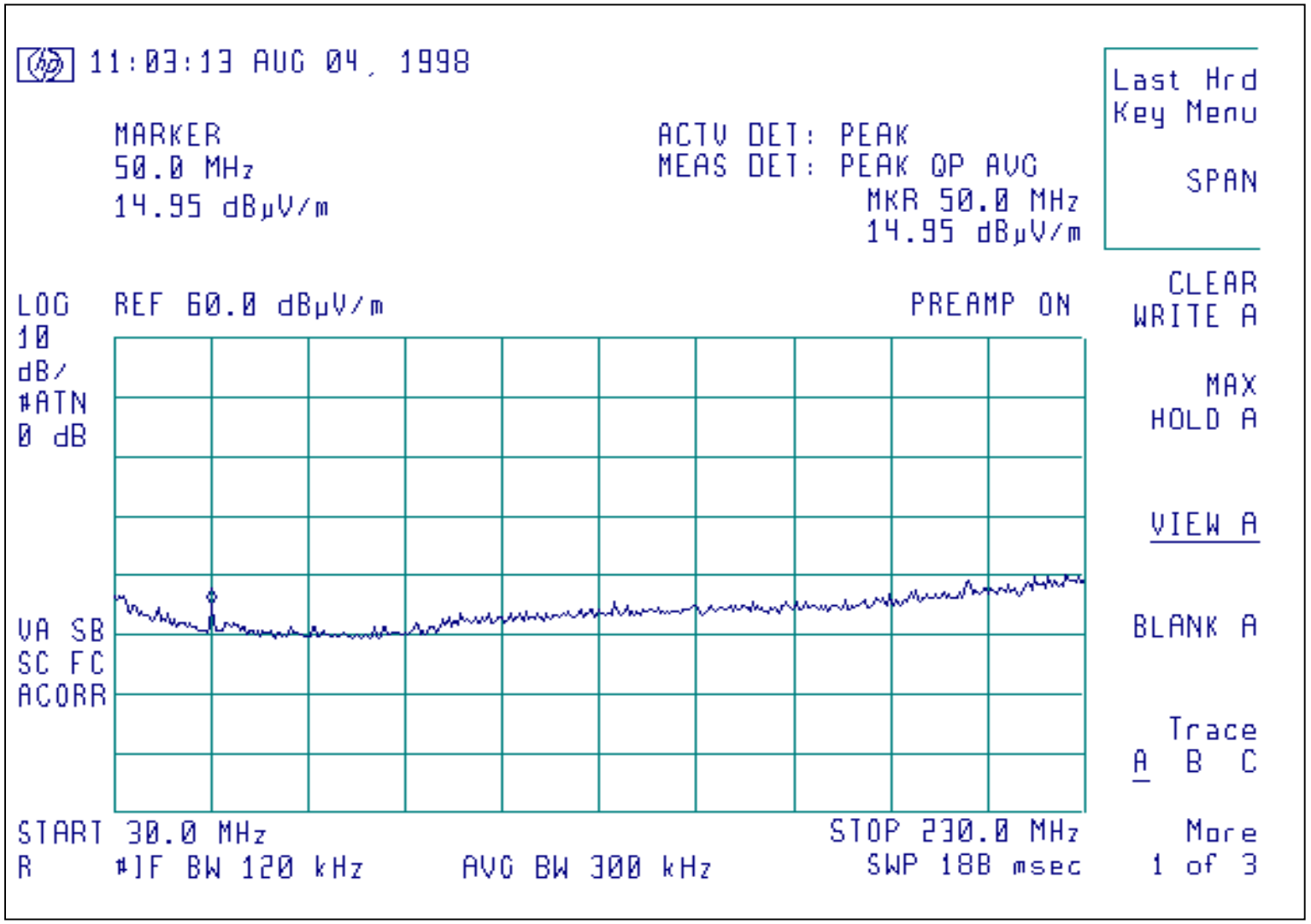
**FCC ID: NTL-PCB4950**

**318 MHz Remote Control, emissions below 1 GHz, horizontal polarity**



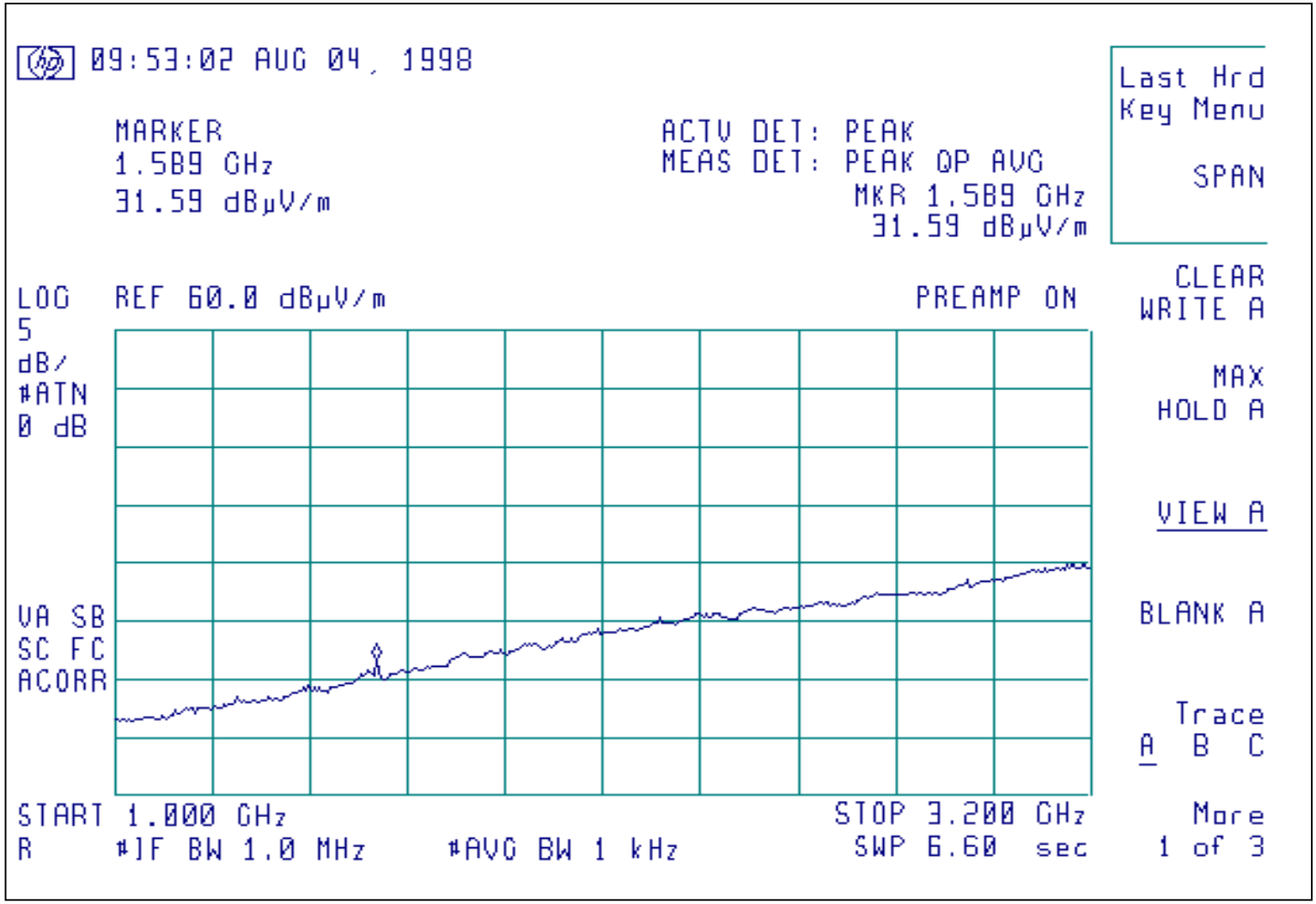
**FCC ID: NTL-PCB4950**

**318 MHz Remote Control, emissions below 1 GHz, horizontal polarity**



**FCC ID: NTL-PCB4950**

**318 MHz Transponder, emissions above 1 GHz, horizontal polarity**



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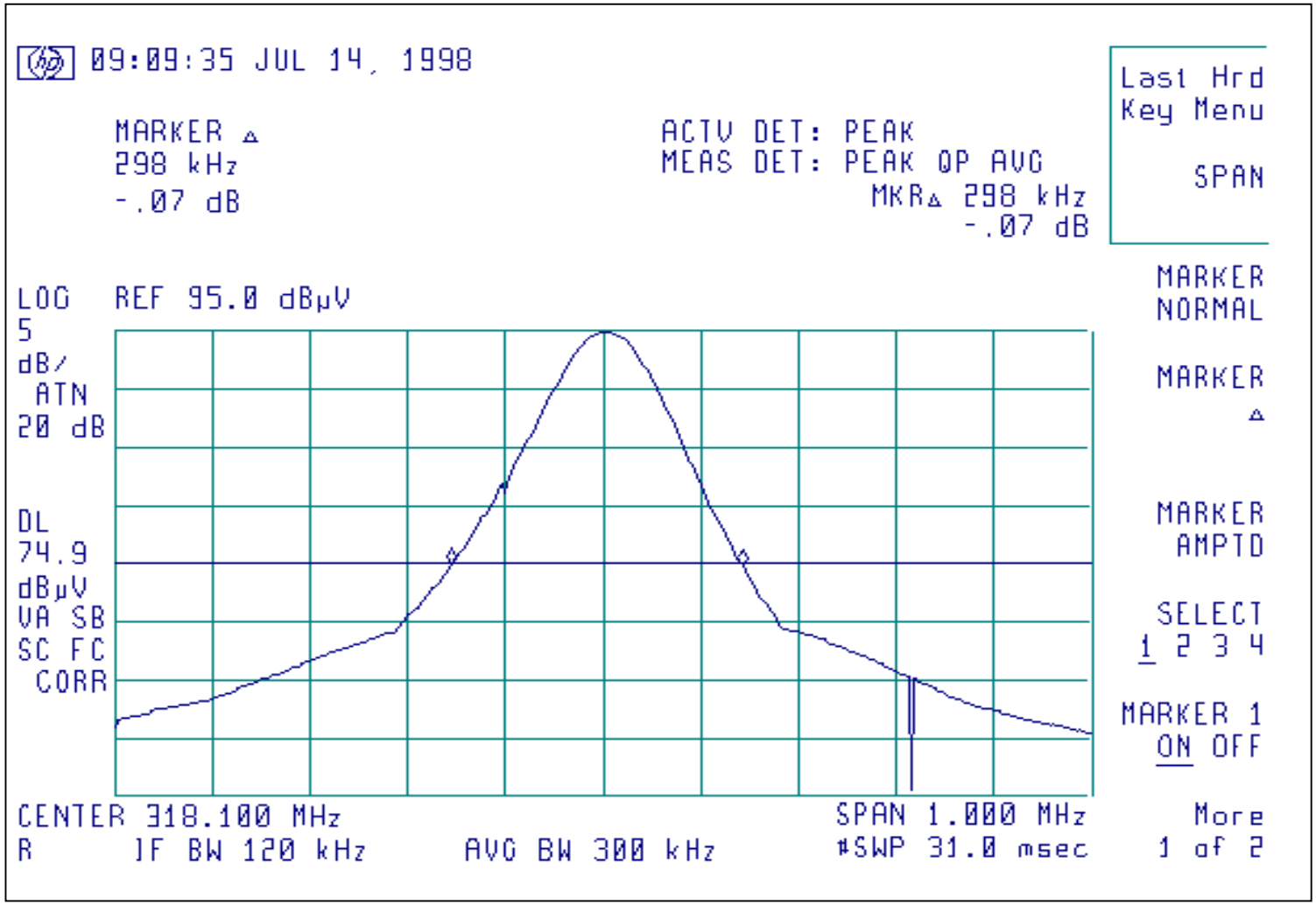
**318 MHz Remote Control, occupied bandwidth**



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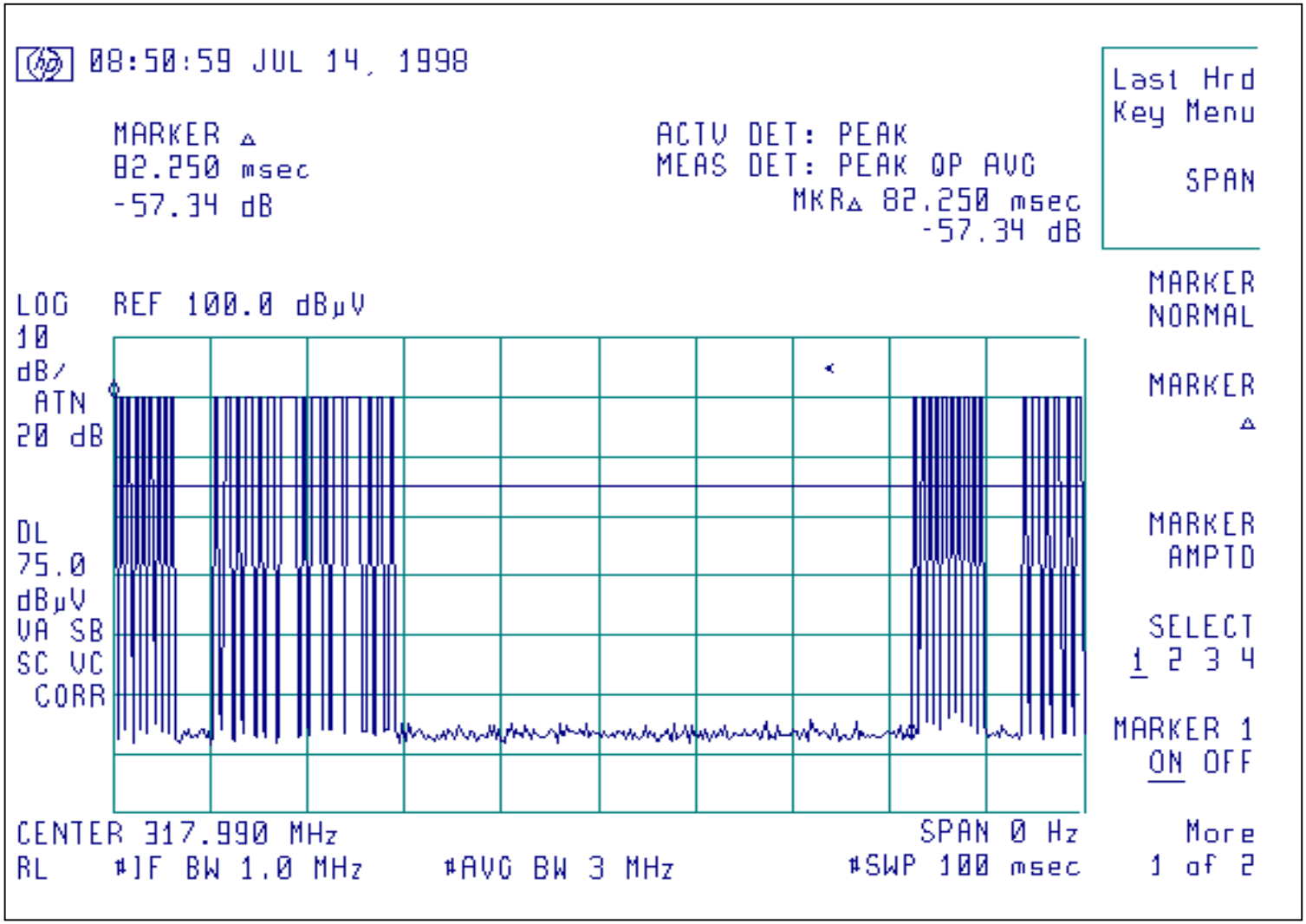
**318 MHz Remote Control, duty cycle, burst period**



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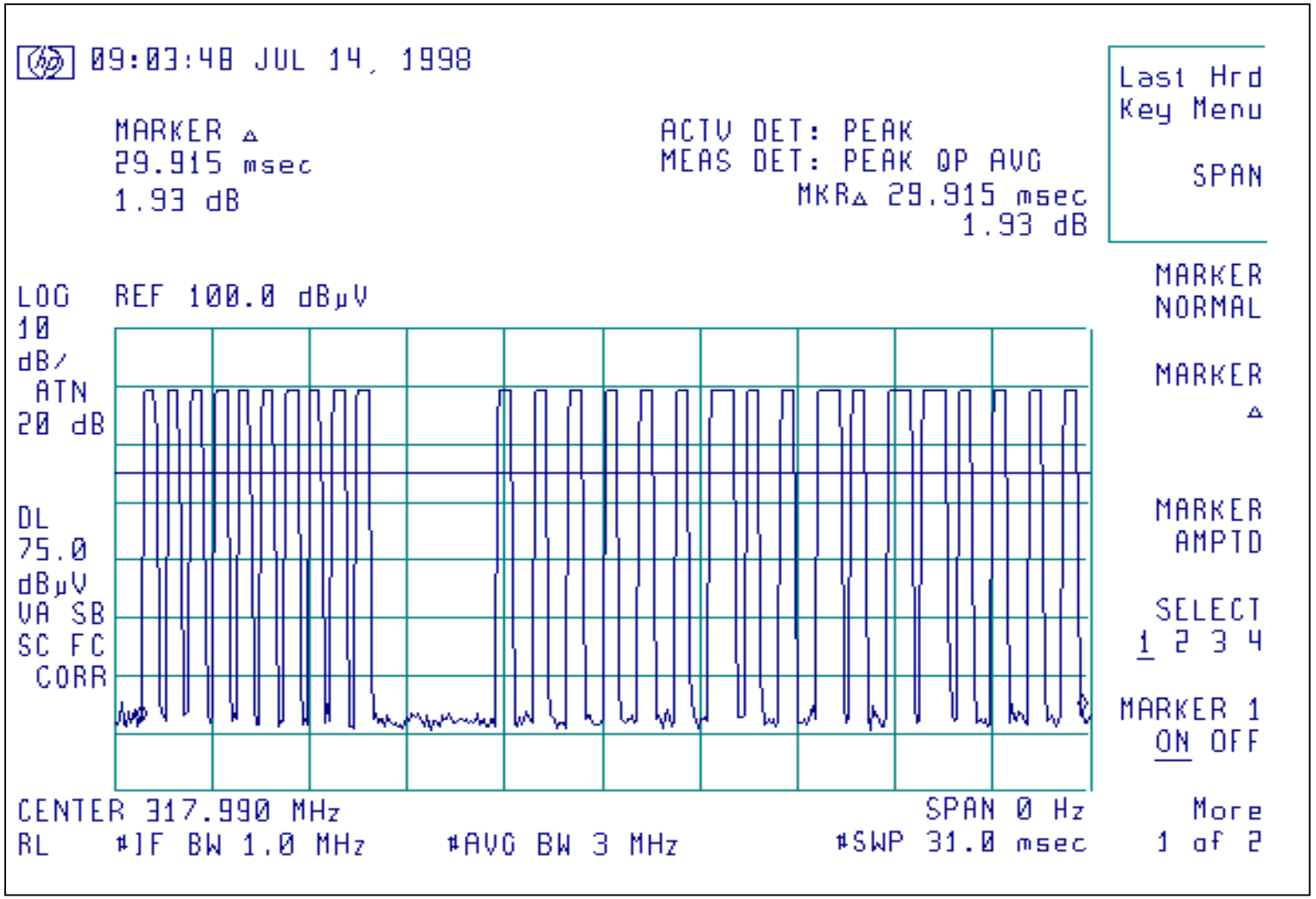
**FCC ID: NTL-PCB4950**

**318 MHz Remote Control, duty cycle, burst duty cycle**



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