L. S. Compliance, Inc.
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L. S. Compliance, Inc.

Compliance Testing of:

Teklogix Inc

900 MHZ MICRO RADIO

Prepared for:

Mr. Sada Dharwarkar

Test Report Number: 90030

Date(s) of Testing:

September 8,9,29, 1999

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

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FCC ID: GM3TRX7450

Section 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 47CFR Section 2.948."

Section 1.2

SIGNATURE PAGE

Tested By:



30 Sept. 1999

Thomas T Lee, EMC Engineer — Date

Prepared By:



30 Sept. 1999

Kenneth L. Boston, EMC Lab Manager — Date

Approved By:



30 Sept. 1999

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

1.3 SUMMARY OF TEST REPORT

MANUFACTURER:	Teklogix Incorporated
MODEL:	900 MHz Micro Radio
SERIAL:	pre-production
DESCRIPTION:	900 MHz FSK transceiver
FREQUENCY RANGE:	902.652-904.150 MHz; 925.764-927.262 MHz

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

1.4 INTRODUCTION

On September 8, 9 and 29 of 1999, a series of Radiated Emissions tests were performed on two sample models of the Teklogix Micro Radio, a small wireless 900 MHz transceiver combined with a handheld data terminal used to interface with a data terminal. 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 15.249 for a low power transmitter. These tests were performed by Thomas T Lee of L. S. Compliance, Inc.

1.5 PURPOSE

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

15.109 15.209
15.205 15.249

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. Each test sample was powered via a short cable to the handheld scanner containing an internal battery. The test samples were configured to run in a continuous transmit mode (either cw carrier or a repetitive data string) during the radiated emission measurements. Both test samples were set to operate on standard channels and were tested as intentional radiators, in order to determine compliance within a frequency range of-902-928 MHz, as determined by FCC part 15.31m

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 15.249 limits for low power devices. For the calculations used to determine the limits applicable for each of the two test samples (at their respective operating frequencies) 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. These frequencies, and their associated limits, are referenced in Appendix A. The samples were 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, 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.

Significant emissions, which were investigated, include the transmitter fundamental, clock harmonics associated with the data terminal, and some harmonics. For the frequency range 30-10000 the samples were tested for transmitter emissions to CFR 47; 15.249. The unit was scanned for emissions in both transmit and receive modes, over the range 30 to 5000 MHz to establish compliance with Part 15.109 for both the transmitter and the receiver (which is subject to verification under Part 15.101b)., The same procedures as detailed for the transmitter tests described above were used to perform these measurements.

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. 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 Average 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, or the battery located in the handheld scanner, as opposed to using a power cord, it was not necessary to perform a test for Conducted Emissions.

FCC ID: GM3TRX7450

Manufacturer: Teklogix
Model: Micro Radio
Serial Number(s): preproduction

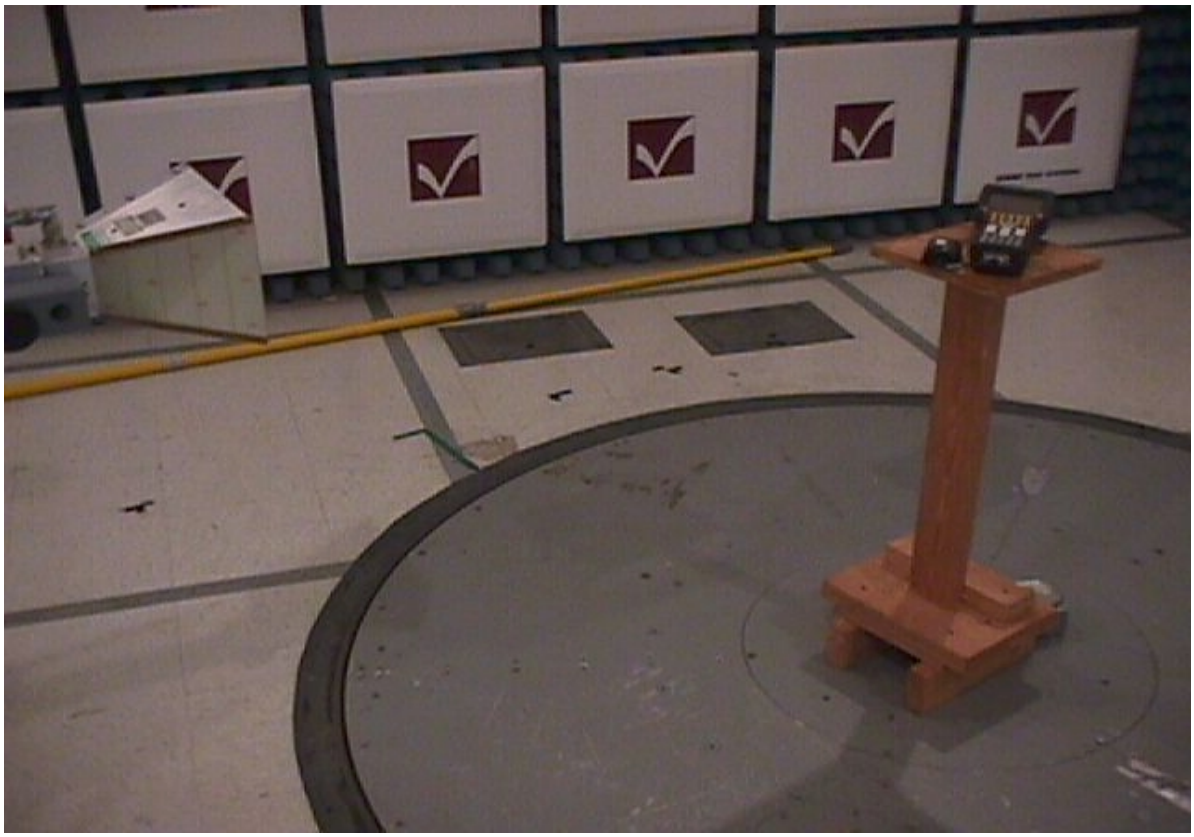
1.10 - Restricted Bands affecting this product

Frequency (MHz)	Limit (µV)	Limit (dB/µV/m)
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
4500-5150	500	54.0
5350-5460	500	54.0
7250-7750	500	54.0
8025-8500	500	54.0
9000-9200	500	54.0

1.11 – Photos taken during testing



View of the Scanner and transceiver during the Radiated Emissions tests. This view shows the orientation of the product where the maximum signal levels were present (horizontal polarity).



View of the Scanner during the Radiated Emissions tests. This view shows the sample during the 1 meter measurements above 5 GHz.

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 Micro Radio does **"meet"** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator. The level of the fundamental carrier is found to be only **1.5 dB** below the limit at channel 0, and **1.9 dB** below at channel 8. As these levels are 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: GM3TRX7450

1.13 - Test Equipment

Asset #	Manufacturer	Model #	Serial#	Description	Due Date
AA960003	EMCO	3146	9512-4276	Log Periodic Antenna	3aug2000
AA960003	EMCO	3110B	9601/2280	Biconical Antenna	3aug2000
AA960003	EMCO	3115	99111-4198	Double Ridge Horn Antenna	1aug2000
AA960003	EMCO	2090	9607-1164	Mast/Ttable controller	I.O.
AA960003	HP	85460	3617A00320	EMI receiver Display section	23aug2000
AA960003	HP	85462	3205A00103	EMI receiver Preselector section	23aug2000
AA960003	HP	E4407b	Us39160256	26.5 GHz Spectrum Analyzer	16june2000

APPENDIX A:

SAMPLE CALCULATIONS

FCC ID: GM3TRX7450

Manufacturer: Teklogix
Model: Micro Radio
Serial Number(s): Preproduction

Calculation of Radiated Emissions limits for FCC Part 15.249 (902-928 MHz)

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:

Limit of 50,000 uV / m; in dB; 20 log(50,000) = 94 dBuV / m

FIELD STRENGTH OF HARMONIC FREQUENCIES:

Limit of 500 uV / m; in dB; 20 log(500) = 54 dBuV / m

FIELD STRENGTH OF SPURIOUS/ FREQUENCIES:BY 15.249 (C)

Limit of -50 dBc of the fundamental limit; 94 - 50 + 44 dBuV /
Except where the 15.209 limits will allow a higher limit to be used.

Frequency (MHz)	limit (µV/m)	limit (dB µV/m)
902-928	50,000	94
f2,f3,f4....	500	54
Spurs; 30-88	159	44
Spurs; 88-216	159	44
Spurs; 216-960	500	46
Spurs; 960-9280	500	54

APPENDIX B:

DATA CHARTS

FCC ID: GM3TRX7450

Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 30 to 9280 MHz

Date of Test:	September 8,9,29, 1999	Manufacturer:	Teklogix
Location:	L.S. Compliance, Inc. W66 N220 Commerce Court Cedarburg, WI 53012	Model No.:	Micro radio
Specifications:	Title 47CFR, FCC Part 15.231b	Serial No.:	Pre-production
Distance:	3 meters, 1 meter	Configuration:	Continuous transmit
Equipment:	HP 8546A EMI Receiver EMCO 3115 Double Ridged Waveguide EMCO 3146A Log Periodic	Detector(s) Used:	Quasi-peak, Average

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°)	Channel	EMI Meter Reading (dB µV / m)	15.249 Limit (dB µV / m)	Margin (dB)
902.63	V	1.0	216	0	92.5	94.0	1.5
903.92	V	1.0	83	6	89.0	94.0	5.0
925.76	V	1.0	85	8	92.1	94.0	1.9
927.26	V	1.0	85	15	90.8	94.0	3.2
1855	V	1.0	255	15	37.5	54.0	16.5
1855	H	1.0	23	15	39.8	54.0	14.2
1805	H	1.0	60	0	42.0	54.0	12.0

FCC ID: GM3TRX7450

Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 30 to 9280 MHz

Date of Test:	September8,9 and 29,1999	Manufacturer:	Teklogix
Location:	L.S. Compliance, Inc. W66 N220 Commerce Court Cedarburg, WI 53012	Model No.:	Micro Radio
Specifications:	Title 47CFR, FCC Part 15.231b	Serial No.:	Pre-production
Distance:	3 meters	Configuration:	Continuous xmit , chs. 0 & 15
Equipment:	HP 8546A EMI Receiver EMCO 3115 Double Ridged Waveguide EMCO 3146A Log Periodic	Detector(s) Used:	Quasi-peak

The following table depicts the level of significant spurious emissions found:

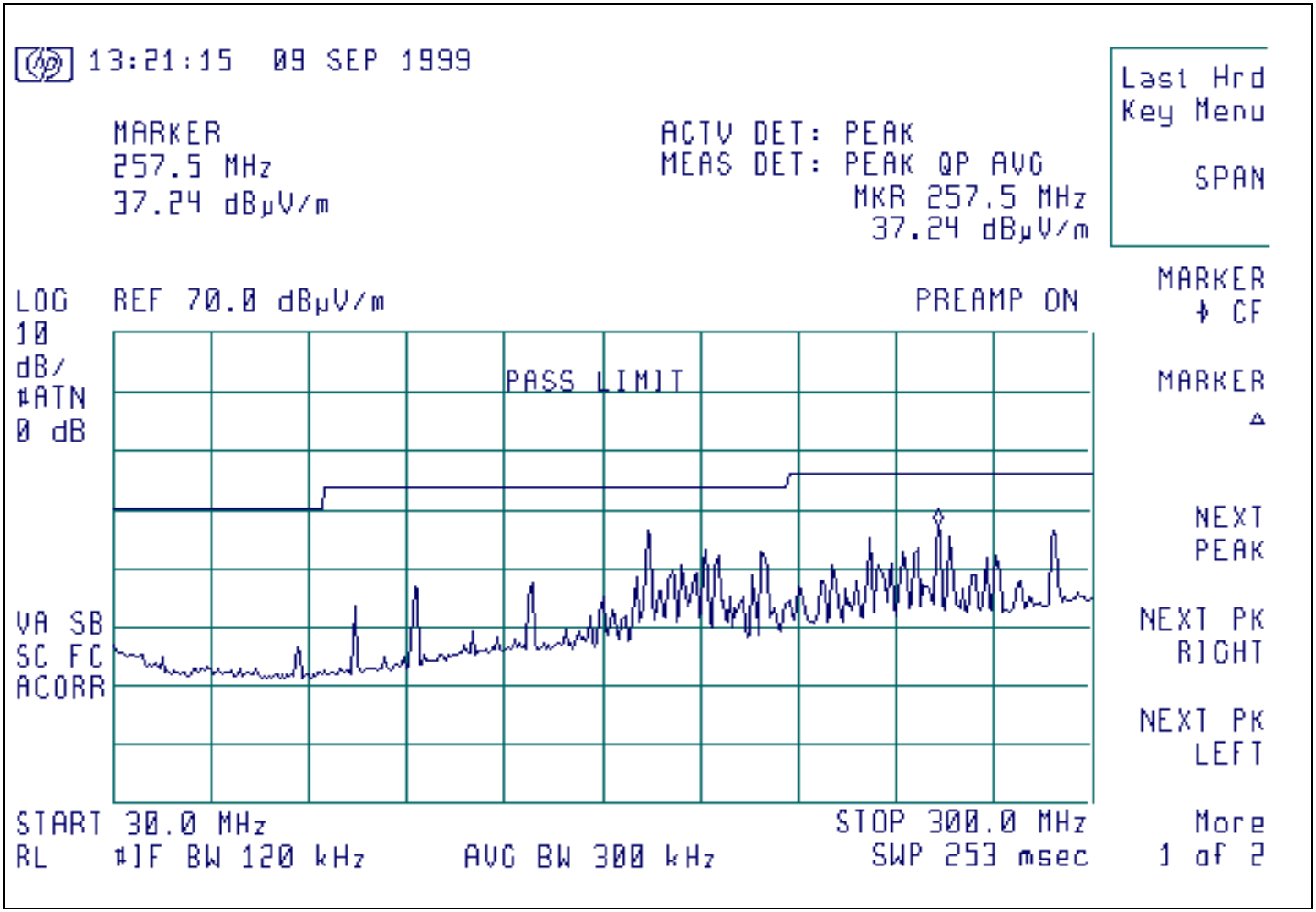
Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dB µV / m)	15.249 Limit (dB µV / m)	Margin (dB)
176.0	H	1.3	0	34.4	44.0	9.6
208.0	H	1.3	17	30.1	44.0	13.9
256.0	H	1.0	169	32.7	46.0	13.3
288.0	H	1.0	169	34.3	46.0	11.7
288.0	V	1.0	62	28.8	46.0	17.2
320.0	H	1.4	306	37.3	46.0	8.7
432.0	H	1.0	130	40.3	46.0	5.7
928.0	H	1.2	200	39.3	46.0	6.7
2056.0	V	1.0	178	40.2	54.0	13.8
2552.0	V	1.0	193	38.8	54.0	15.2
2565.0	H	1.0	104	37.1	54.0	16.9

APPENDIX C:

GRAPHS

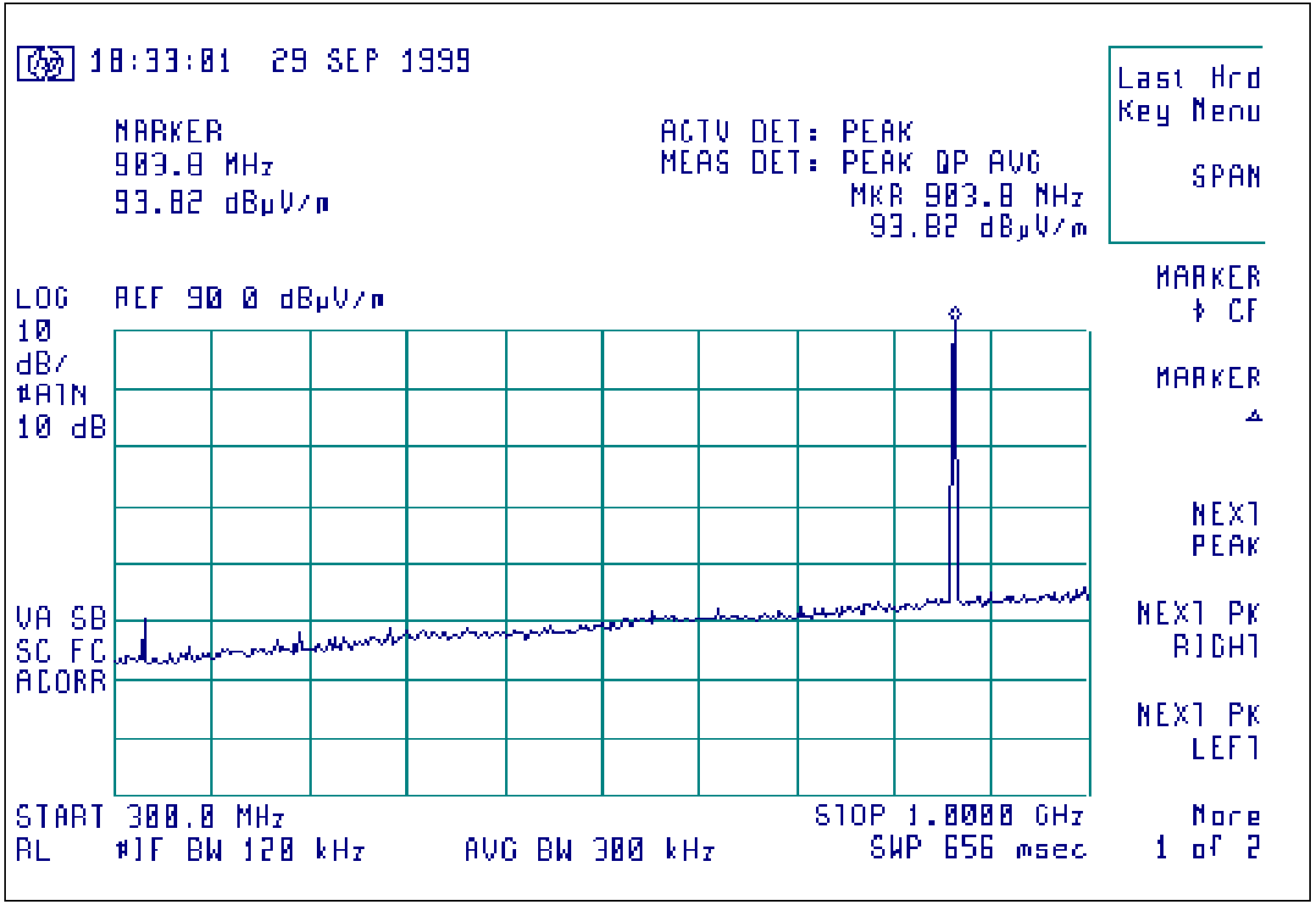
FCC ID: GM3TRX7450

Transmitter, emissions below 1 GHz, horizontal polarity, Channel 0



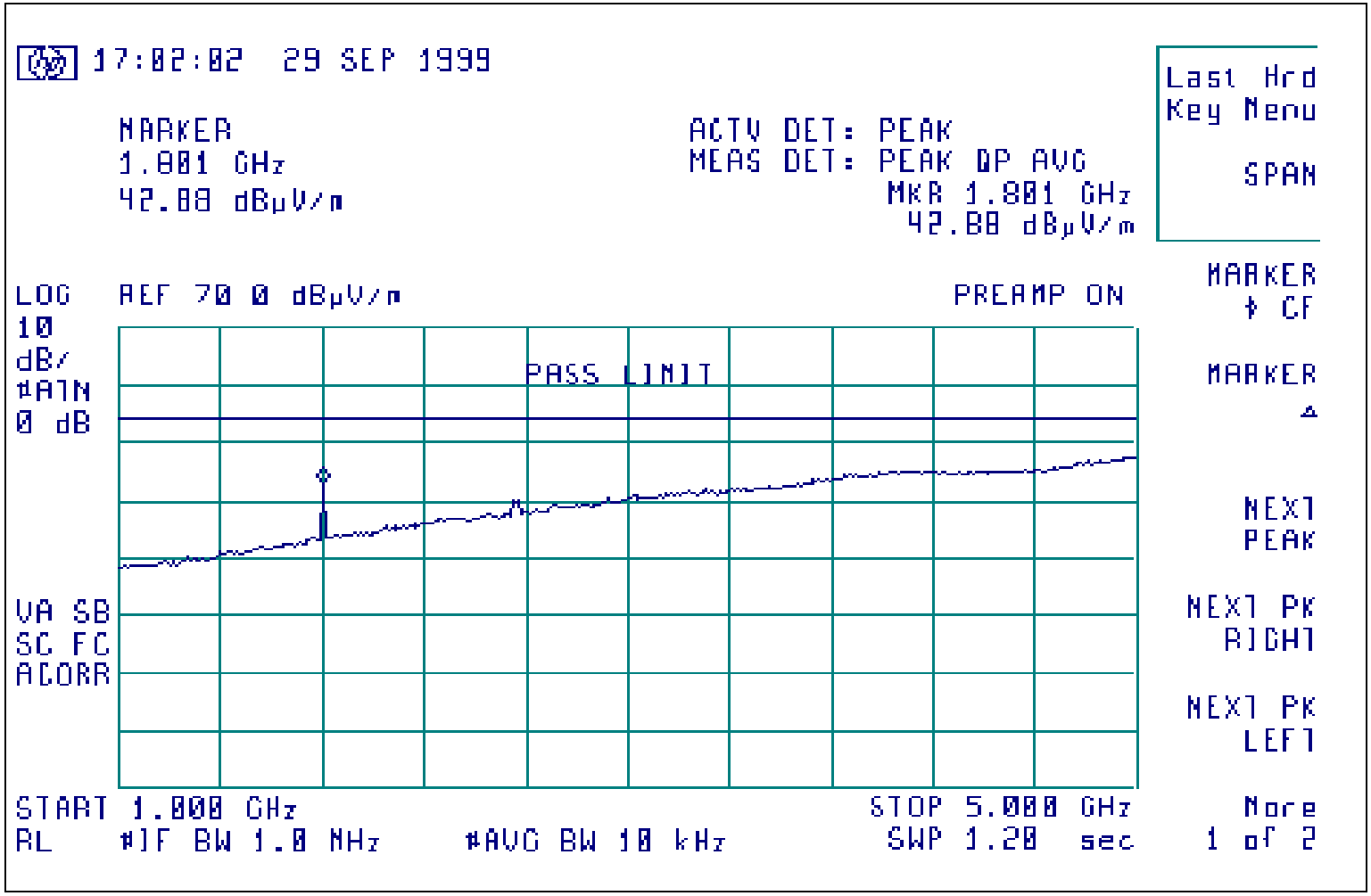
FCC ID: GM3TRX7450

Transmitter, emissions below 1 GHz, horizontal polarity, channel 0



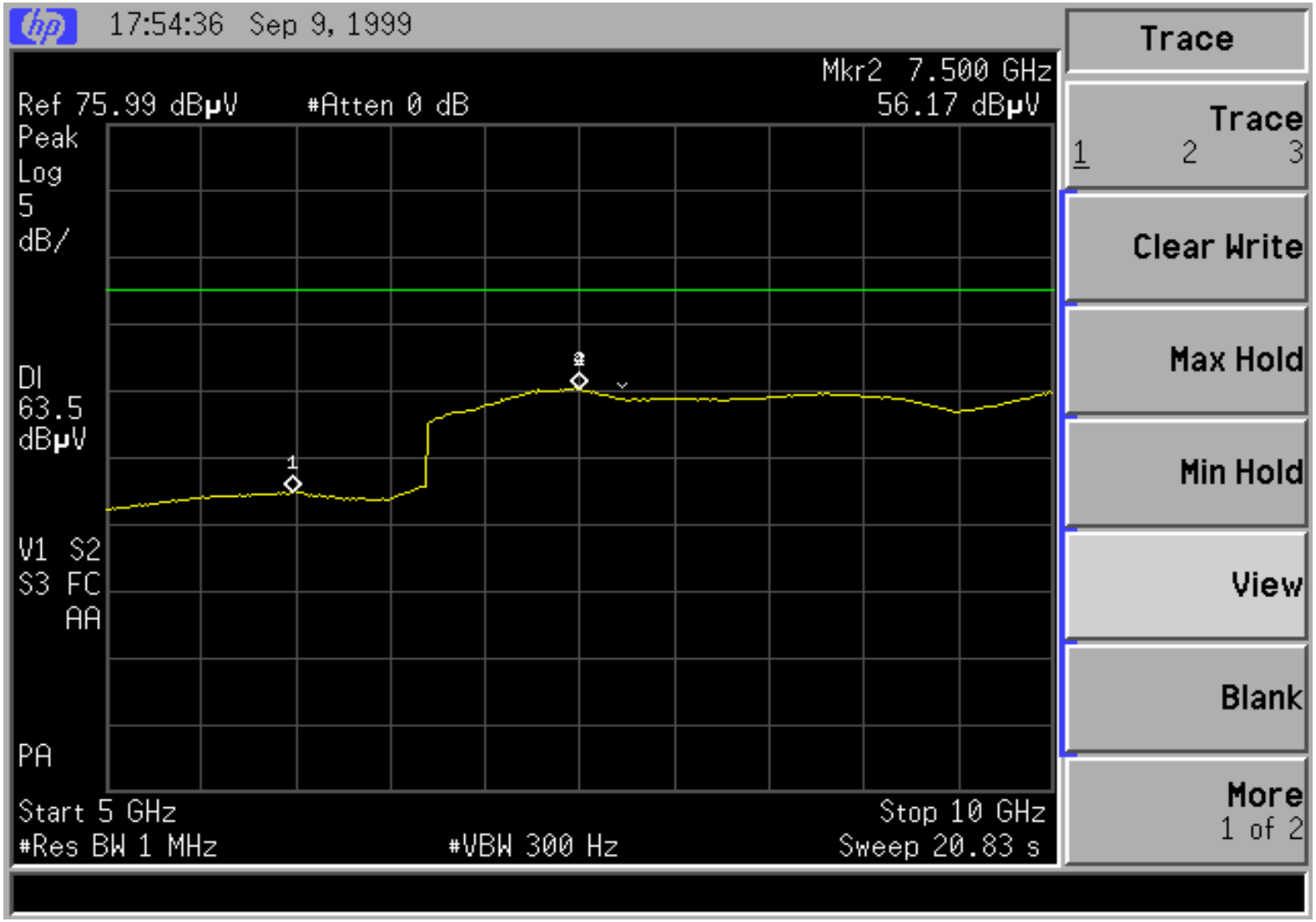
FCC ID: GM3TRX7450

Transmitter, emissions above 1 GHz, horizontal polarity, channel 0



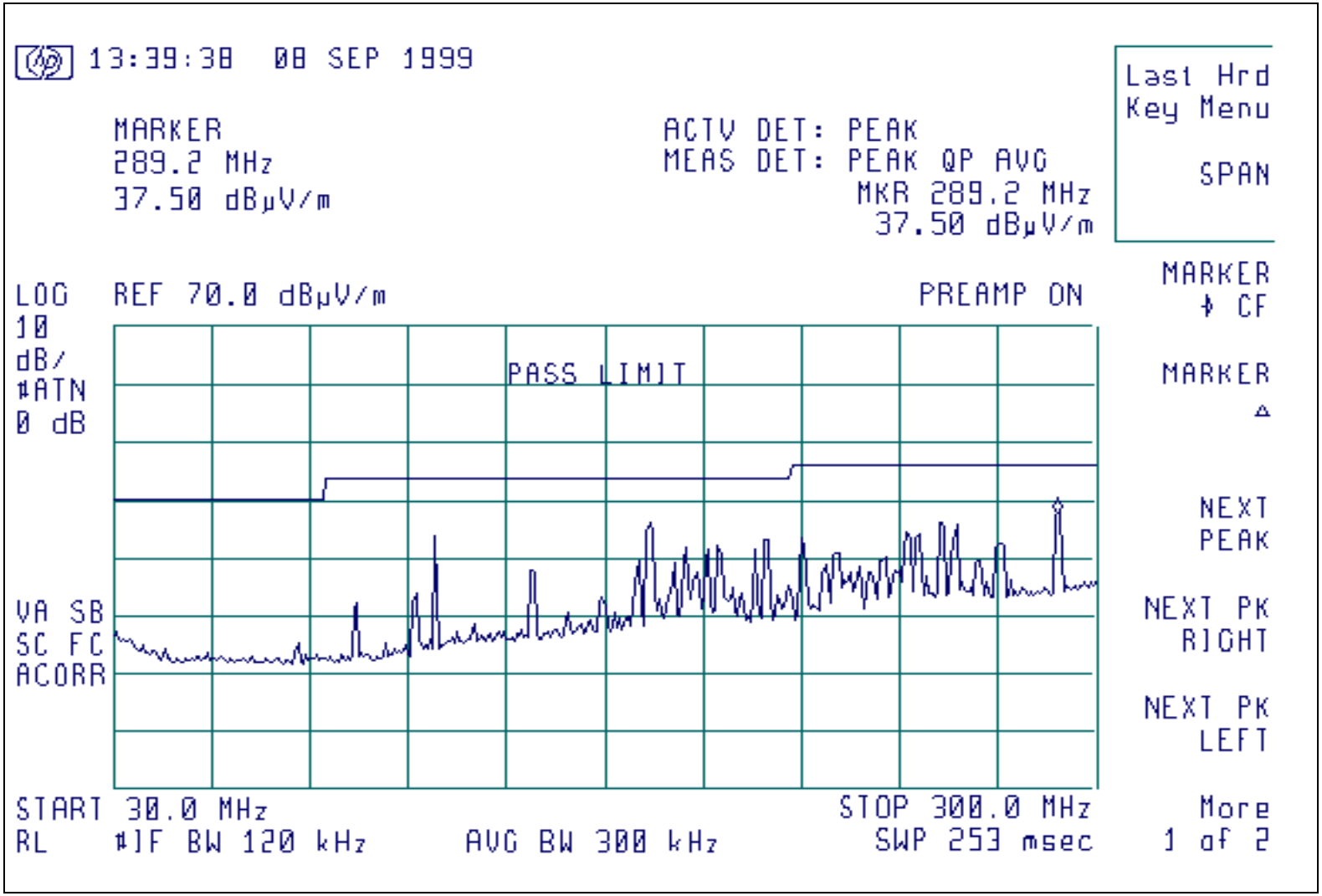
FCC ID: GM3TRX7450

Transmitter, emissions above 1 gig, channel 0 & 15 (at 1 meter)



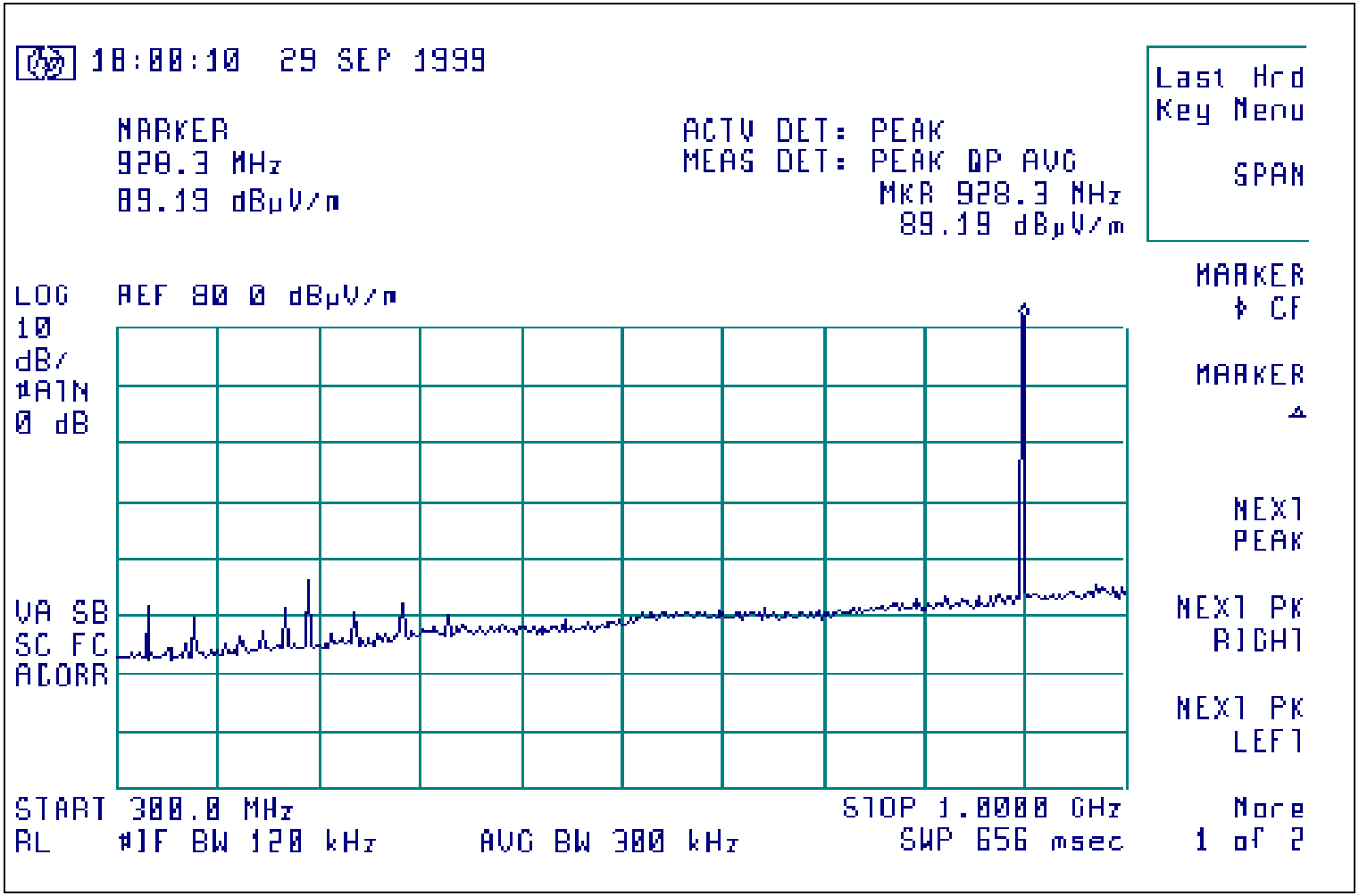
FCC ID: GM3TRX7450

Transmitter, emissions below 1 GHZ, horizontal polarity, ch15



FCC ID: GM3TRX7450

Transmitter, emissions below 1 GHz, vertical polarity ch15



FCC ID: GM3TRX7450

Transmitter, vertical above 1 gigahertz, channel 15

