MEASUREMENT/TECHNICAL REPORT

Company - Model: PinPoint
0300-11882-001
FCC ID: OGK30011882001
February 14, 2001

Description: This is a report to support a request for an original grant of equipment authorization.

Equipment Type: Low Power Communications Device Transmitter (DXX)

Report prepared for:

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Introduction

This report is an application for Certification of a Transmitter operating pursuant to Part 15.249 of the FCC Rules, Code of Federal Regulations 47. The model number covered by this report is 0300-11882-001. This report is designed to demonstrate the compliance of this device with the requirements outlined in Part 15 of CFR 47 using the methods outlined in Part 2 of CFR 47. The current revision date, October 1,1999, of each Part has been used for technical requirements.

The confidential information and descriptions included in this application are detailed descriptions of the products, block diagrams, component specifications, and schematic diagrams. We hereby respectfully request under the provision of section 0.457d of the code that the documents listed below be held confidential.

Technical Descriptions and Block Diagrams

Schematics

Bill of Materials

PinPoint is requesting that the Technical Descriptions, Block Diagrams, Schematics and Bill of Materials be kept confidential in the FCC application because of the proprietary design developed by PinPoint that is unique to the industry.

Statement of Conformity

The PinPoint Mobile Resource Management System (MRM) Tag Model T40 0300-11882-001 has been found to conform with the following parts of the 47 CFR as detailed below:

Part 2	Part 15	Comments
	15.15(b)	The product contains no user accessible controls that increase transmission power above allowable levels.
2.925	15.19	The label is shown in the label exhibit.
	15.21	Information to the user is shown in the instruction manual exhibit.
	15.27	No special accessories are required for compliance.
	15.203	The antenna is built into the board and there is no external antenna connection.
	15.205 15.209	The fundamental is not in a Restricted band and the spurious and harmonic emissions in the Restricted bands comply with the general emission limits of 15.209.
	15.207	The unit is battery powered without the capability of being recharged or operated from the AC mains.
	15.249(a)	The unit complies with the field strength limits of the 15.249(a) table including the 20dB peak restriction of 15.35(b) and 15.249(d).
	15.249(c)	The unit complies with the field strength limits of the 15.209(a) table.

General Description

Product Description

The tag is a low cost RF device, which transponds radio signals from the cell controller transmit antenna to the cell controller receive antenna. Additionally, it modulates tag information such as the tag ID onto the signal sent to the cell controller receive antenna. The tag has three important design parameters: cost, battery life and size. Low tag cost is achieved by making the tag RF and digital design as simple as possible while using off the shelf components. In addition, an Application Specific Integrated Circuit (ASIC) further reduces cost.

Battery life is achieved with low-current RF and digital designs and by utilizing a small duty cycle. Size is achieved by a combination of surface-mount technology and three-dimensional CAD tools.

Units Tested
Model Number: 0300-11882-001
Serial Number: FCC 2

Related Submittal(s) Grants

There are no other approvals required for this device.

Test Methodology

Radiated emission testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters below 1 GHz, and at a distance of 3 or 1 meter(s) above 1 GHz. The actual test distance used is noted in the test data sheets. The device's performance was investigated to 40GHz. The EUT was powered by a 6 VDC battery for all tests. The device is voltage regulated, however, a fresh battery was used every few hours to ensure that the maximum emissions were recorded. Since the tag can be operated in any orientation, the tag emissions were maximized in each of the three orthogonal axes and the maximum reading was recorded. The integrated antenna cannot be maximized separately. The tag was set to operate continuous on and a duty cycle calculation was used (see Timing Diagram calculation).

All other performance tests were made in accordance with the procedures outlined in Part 15 of CFR 47 with the expansion noted below. The applicable sections provided under Part 15 are provided in the measurement section of this report.

Discussion of CFR47 Part 15.249 Testing Procedure

The PinPoint T40 Tag is a low-power transponder. It accepts incoming signals in the 2400-2483.5 MHz band and shifts these signals to the 5725-5875 MHz band. The PinPoint cell controller emits a spread-spectrum signal in the 2400-2483.5 MHz band which is "reflected" by the tag, with some modifications (principally modulation of the tag ID) into the 5725-5875 MHz band. The cell controller then correlates the received signal to determine the tag location. For all legal Part 15.247 input signals, the tag conforms to the requirements of Part 15.249.

There is a possibility that signals present at 2367 MHz and below, and at 2517 MHz and above will be seen and shifted in frequency by the tag. These frequencies translate to the band edges at 5725 MHz and 5875 MHz at the tag output. For these frequencies, there is not such a clear-cut definition of emitter power as for 2400-2483.5 MHz. To show conformance to the requirements of Part 15.249, we looked at the Part 2 allocations around these frequencies and found that the primary likely emitters are amateur radio below 2400 MHz and passive, non-transmitting astronomical use above 2483.5 MHz.

Power components at 2.4 GHz are expensive, so for amateur operation, an effective isotropic radiated power of 10 W is a top-end estimate of likely emission. PinPoint Mobile Resource Management system installations will be within areas owned by private companies, which have typical separations to residences (likely amateur radio operators) of at least 100 feet. Following this reasoning, the search for tag outputs corresponding to input signals outside the ISM band proceeds with looking at the tag output with inputs corresponding to the likely worst-case emission from amateur radio operation at a distance of 100 feet.

It is difficult to provide the radiated signals necessary to excite the T40 Tag while still measuring the tag output on an open-air test site. To facilitate the testing process, a T40 Tag had the input antenna removed and an SMA connector installed at the input to the receive bandpass filter. This allowed the introduction of wired signals, both spread signals from PinPoint cell controllers and CW signals representing potential in-band and out-of-band emitters to the tag so the tag output could be examined for compliance to 15.249.

The determination of the input signal for the in-band signals was done as follows. The input signals were brought up in power from very low levels up to +10 dBm. The radiated measurement was made on a spectrum

analyzer to read emissions in max hold thereby capturing the peak emission over the entire input power range of the tag, including with no input present.

For signals present outside the frequencies of 2400-2483.5 MHz, the input bandpass filter reduces the amplitude of the input sufficiently that the AGC is not operating (the tag sets the RF gain to the maximum value). This also represents the worst case for the out-of-band signals because any additional AGC gain reduction also reduces the tag output signal. The test for compliance to 15.249 at the 5725-5875 MHz band edges then merely needs an examination of the tag output for an input at 2367 MHz and below as well as 2517 MHz and above at a level into the tag corresponding to the scenario outlined above.

So, the input signal level at 2367 MHz will be the effective power 30 m from a 10 W isotropic radiator. This power level is:

$P_{rx} = P_{tx} – P_{path}$

P_{rx} = +40 dBm – (32.44 dB + 20 * log(f) + 20 * log(D)),

where f is expressed in GHz and D is expressed in meters.

Thus,

P_{rx} = +40 - (32.44 + 7.48 + 29.54) = -29.6 dBm

represents the isotropic power level impinging on the tag receive antenna. This signal experiences a gain of 4.6 dB from the tag Rx antenna, so the signal into the tag itself should be -25 dBm.

The test is performed as follows. A tag is supplied with the antenna removed and a connector installed at the input bandpass filter. A cable is then attached to this connector and to a signal generator set to a frequency of 2367 MHz and a level of –25 dBm. The output signal radiated from the tag is examined to determine if the radiated field strength at 3 m complies with the requirements of 15.249. This signal is then swept down in frequency to ensure that the tag signal rolls off. This procedure is then repeated with the signal generator set to 2517 MHz and –25.5 dBm (the frequency term in the path loss equation increases by 0.5 dB from 2367 MHz to 2517 MHz) and swept up.

It was determined that the highest in-band input level that the PinPoint T40 Tag Model 0300-11882-001 would see would be the output of the Cell Controller. The PinPoint T40 Tag Model 0300-11882-001 in-band input level was found to be +10dbm when placed against the antenna of the cell controller.

Test Facility

Curtis-Straus LLC
All testing for the range 30–40,000MHz was performed at Curtis-Straus (NVLAP Lab Code: 200057-0). The open area test site used to collect the radiated data is located at 527 Great Road, Littleton, MA 01460. Site "T" was used. This test facility has been fully described in a report submitted to your office, and a letter from your office dated February 28, 1997 verified receipt of the report and confirmed compliance of the site. Please reference your file # 31040/SIT 1300F2 should you have any questions regarding the test site construction.

Test Equipment Used

Curtis- Straus

SPECTRUM ANALYZERS					
X	**Analyzer**	**Model No.**	**Company**	**Serial No.**	**Calibration Due**
X	**ORANGE** 9kHz-26.5GHz	E4407B	HP	US39440975	05-MAY-2001

OPEN AREA TEST SITES (OATS)					
X	**Site**	**FCC Code**	**IC Code**	**VCCI Code**	**Calibration Due**
X	**"T"** Texas	93448	IC 2762-T	R-905/ C-480	09-AUG-2001

ANTENNAS					
X	**Antenna**	**Model No.**	**Company**	**Serial No.**	**Calibration Due**
X	**RED** Bilog: 30MHz-1GHz	3143	EMCO	1270	23- JUN-2001
X	**YELLOW** Horn: 1-18GHz	3115	EMCO	9608-4898	14-APR-2001
X	**WHITE** Std Gain Horn: 18-26.5GHz	3160-09	EMCO	9610-1068	10-MAY-2001

HARMONIC MIXER					
x	**Mixer**	**Model No.**	**Company**	**Serial No.**	**Calibration Due**
X	**HARMONIC MIXER** 26.5-40 GHz	11970A	HP	2332A00900	24-MAY-2001

PREAMPLIFIERS					
X	**Preamplifier**	**Model No.**	**Company**	**Serial No.**	**Calibration Due**
X	**BLUE** 0.01-2000MHz	ZFL-1000-LN	MiniCircuits/ C-S	n/a	13-DEC-2001
X	**WHITE** 1-20GHz	SMC-12A	MITEQ	426643	09-OCT-2001

METEOROLOGICAL METERS					
X	**Meter**	**Model No.**	**Company**	**Serial No.**	**Calibration Due**
X	**TEMPERATURE /HUMIDITY GAUGE**	TH300	Dickson	9044101	27-MAR-2001
X	**ATMOSPHERIC PRESSURE GAUGE**	BA928	Oregon Scientific	C3166-1	21-AUG-2001

Unless otherwise noted the calibration interval is one year. All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Measurement Results

Operating Frequency

This device operates at 5800.0 MHz.

Electric Field Strength Radiation Measurements

For information on how the duty cycle (averaging) factor was calculated, please reference the separate Timing Diagram calculation. Unless otherwise noted, all readings are peak readings.

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 11-Jan-01 **Company:** PinPoint **Table** 1
Engineer: Evan Gould **EUT Desc:** T40 Tag **Work Order:** A1462
Frequency Range: 1-18GHz **Measurement Distance:** 3 m
Notes: Tag Fundamental and Band Edge Readings **EUT Max Freq:** 5.8GHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Duty Cycle (dB)	Adjusted Reading (dBµV/m)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
Tag TX Band Edge Readings at Fundamental - Continuous Wave -25dBm (to simulate ambient signals)										
V	*5725.0*	*44.2*	*19.8*	*36.7*	*3.8*	*20.0*	*44.9*	*54.0*	*-9.1*	*Pass*
V	*5875.0*	*51.2*	*19.8*	*36.8*	*3.9*	*20.0*	*52.1*	*54.0*	*-1.9*	*Pass*
Tag TX Fundamental and Band Edge Readings - Spread Source set at +10dBm										
V	*5800.0*	*83.6*	*19.8*	*36.8*	*3.9*	*20.0*	*84.5*	*94.0*	*-9.5*	*Pass*
V	*5725.0*	*42.5*	*19.8*	*36.7*	*3.8*	*20.0*	*43.2*	*54.0*	*-10.8*	*Pass*
V	*5875.0*	*42.7*	*19.8*	*36.8*	*3.9*	*20.0*	*43.6*	*54.0*	*-10.4*	*Pass*

Table Result: Pass by -1.9 dB ***Worst Freq:*** 5875.0 MHz

Test Site: "T" **Pre-Amp:** White **Cable:** 3m Microflex **Antenna:** Yellow Horn

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 11-Jan-01 **Company:** PinPoint **Table** 2
Engineer: Evan Gould **EUT Desc:** T40 Tag **Work Order:** A1462
Frequency Range: 1-18GHz **Measurement Distance:** 1 m
Notes: Tag TX Harmonics **EUT Max Freq:** 5.8GHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Duty Cycle (dB)	Adjusted Reading (dBµV/m)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
V	*11600.0*	*52.7*	*15.6*	*40.8*	*5.2*	*20.0*	*63.1*	*63.5*	*-0.4*	*Pass*
V	*17400.0*	*36.2*	*17.6*	*44.1*	*6.4*	*20.0*	*49.1*	*63.5*	*-14.4*	*Pass*

Table Result: Pass by -0.4 dB ***Worst Freq:*** 11600.0 MHz

Test Site: "T" **Pre-Amp:** White **Cable:** 3m Microflex **Antenna:** Yellow Horn

Radiated Emissions Table

Curtis-Straus LLC

Date: 11-Jan-01 **Company:** PinPoint **Table** 3
Engineer: Evan Gould **EUT Desc:** T40 Tag **Work Order:** A1462

Frequency Range: 18-26.5GHz **Measurement Distance:** 0.1m
Notes: Tag TX Harmonics **EUT Max Freq:** 5.8GHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Duty Cycle (dB)	Adjusted Reading (dBµV/m)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
	23200.0	***35.9***	***21.8***	***40.4***	***8.0***	***20.0***	***42.5***	***83.5***	***-41.0***	***Pass***

Table Result: Pass by -41.0 dB ***Worst Freq:*** 23200.0 MHz

Test Site: "T" **Pre-Amp:** HF **Cable:** 3m Microflex **Antenna:** High F Horn

Radiated Emissions Table

Curtis-Straus LLC

Date: 11-Jan-01 **Company:** PinPoint **Table** 4
Engineer: Evan Gould **EUT Desc:** T40 Tag **Work Order:** A1462

Frequency Range: 26.5-40GHz **Measurement Distance:** 0.1m
Notes: Tag TX Harmonics **EUT Max Freq:** 5.8GHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Duty Cycle (dB)	Adjusted Reading (dBµV/m)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
	29000.0	***36.9***	***0.0***	***41.2***	***---***	***20.0***	***58.1***	***83.5***	***-25.4***	***Pass***
	34800.0	***27.9***	***0.0***	***43.1***	***---***	***20.0***	***51.0***	***83.5***	***-32.5***	***Pass***

Table Result: Pass by -25.4 dB ***Worst Freq:*** 29000.0 MHz

Test Site: "T" **Pre-Amp:** none **Cable:** 40GHz Mixer **Antenna:** 40GHz Mixer

Radiated Emissions Table

Curtis-Straus LLC

Date: 11-Jan-01 **Company:** PinPoint **Table** 5
Engineer: Evan Gould **EUT Desc:** T40 Tag **Work Order:** A1462

Frequency Range: 30MHz-40GHz **Measurement Distance:** 3 m
Notes: spurious emissions **EUT Max Freq:** 5.8GHz

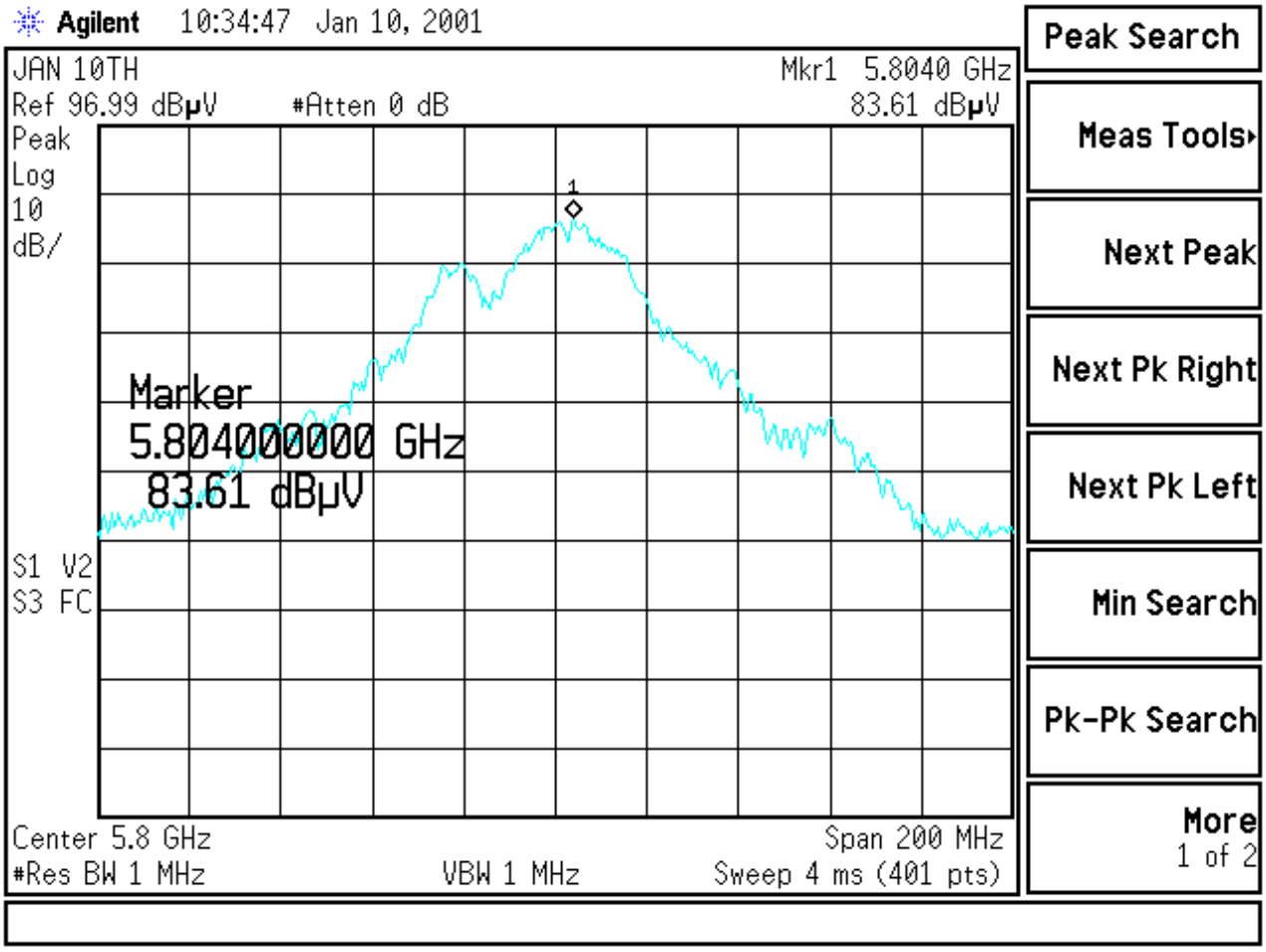
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Duty Cycle (dB)	Adjusted Reading (dBµV/m)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
noise floor	30.2	22.3	22.1	13.7	0.4	-	14.3	40.0	-25.7	Pass
noise floor	109.8	20.4	22.1	6.8	1.0	-	6.1	43.5	-37.4	Pass
noise floor	209.2	18.3	22.5	10.7	1.6	-	8.1	43.5	-35.4	Pass
noise floor	320.1	19.3	22.4	14.4	2.1	-	13.4	46.0	-32.6	Pass
noise floor	439.2	19.0	22.3	16.7	2.5	-	15.9	46.0	-30.1	Pass
noise floor	483.2	18.9	22.2	17.3	2.7	-	16.7	46.0	-29.3	Pass
V	5190.0	52.3	19.7	36.0	3.7	20.0	52.3	54.0	-1.7	Pass
V	5651.0	51.7	19.8	36.7	3.8	20.0	52.4	54.0	-1.6	Pass

Table Result: Pass by -1.6 dB ***Worst Freq:*** 5651.0 MHz

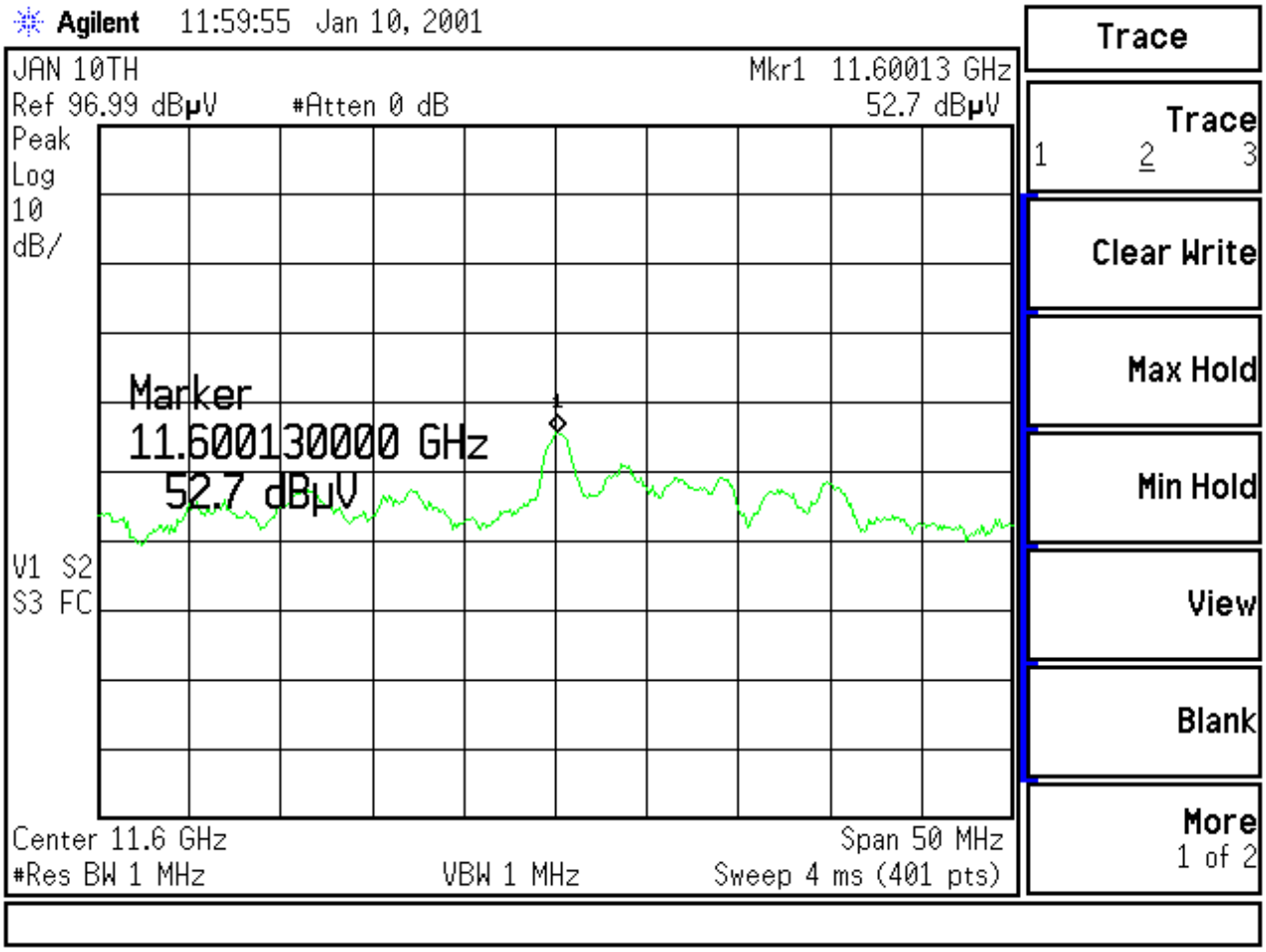
Test Site: "T" **Pre-Amp:** Blue, White **Cable:** 65 ft RG8A/U **Antenna:** Red, Yellow Horn

Emissions Plots

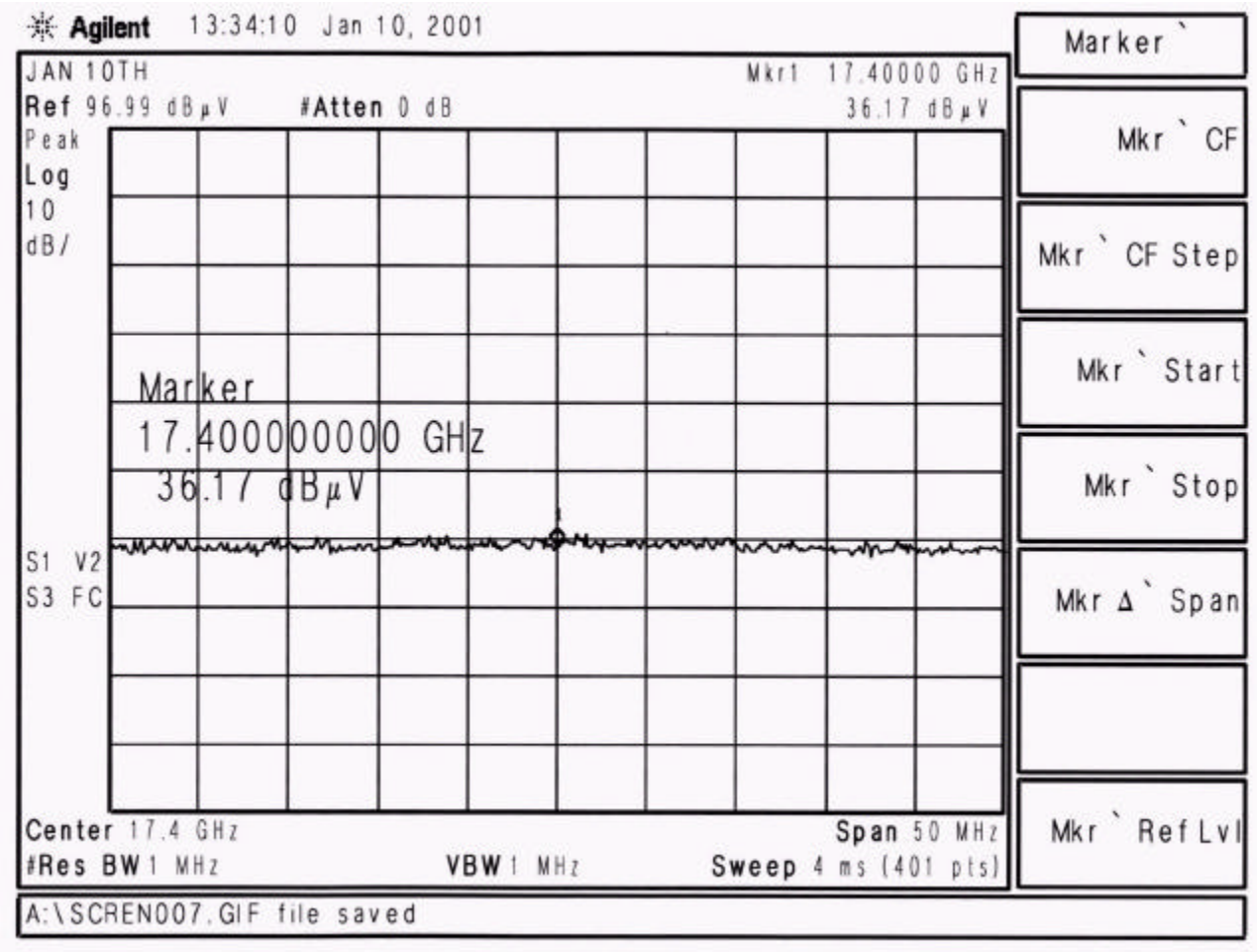
Fundamental



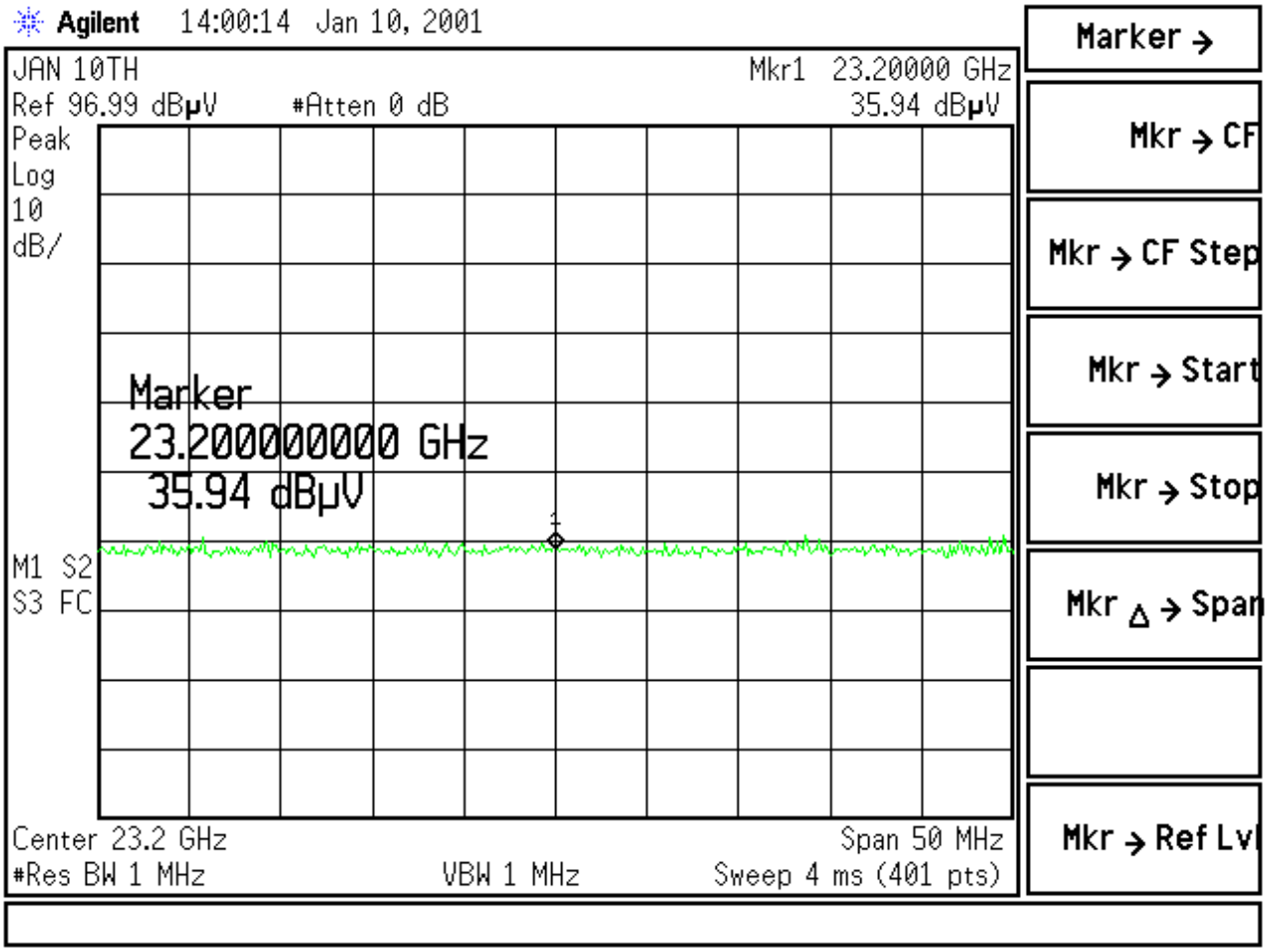
2nd Harmonic



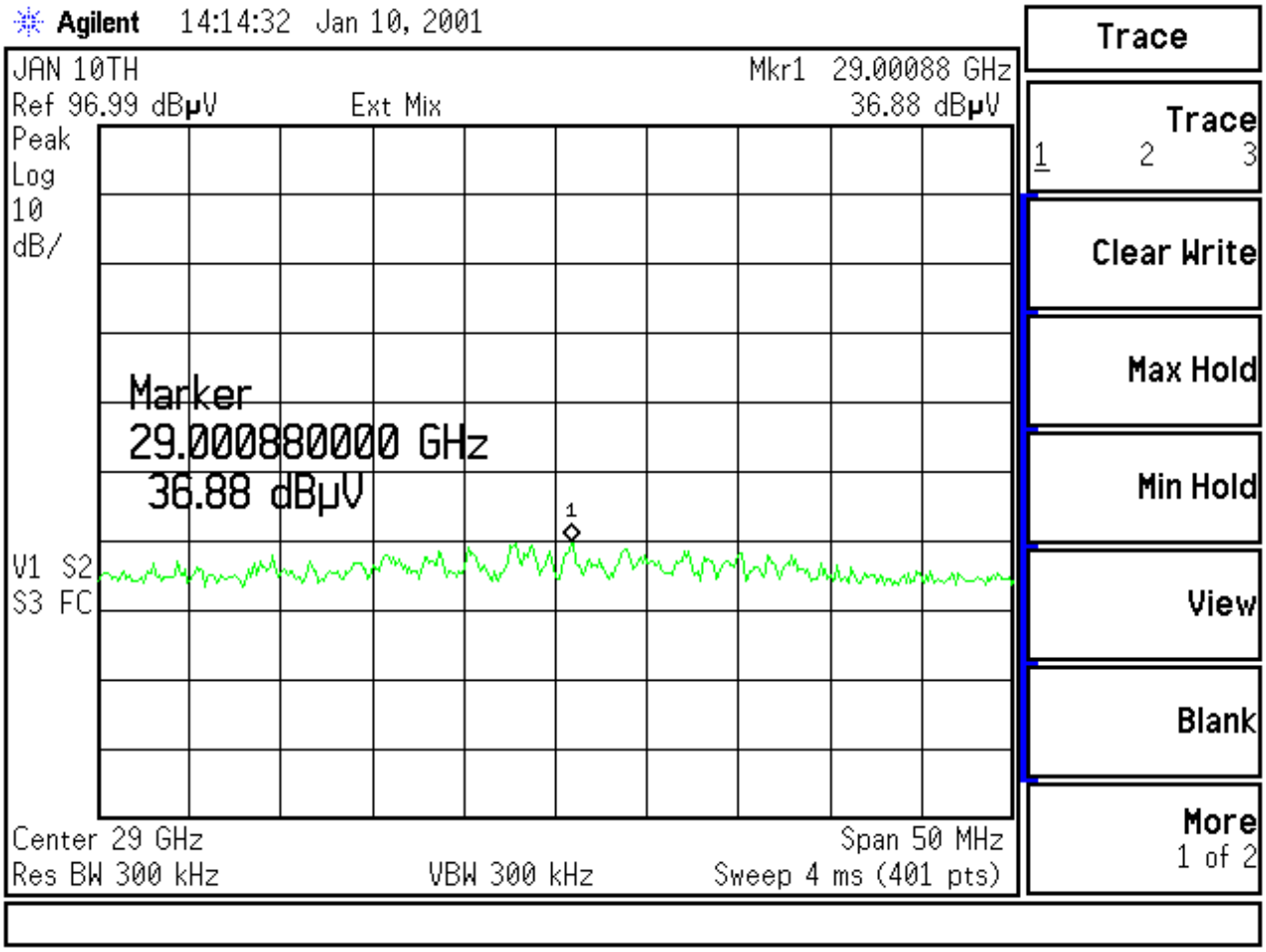
3rd Harmonic



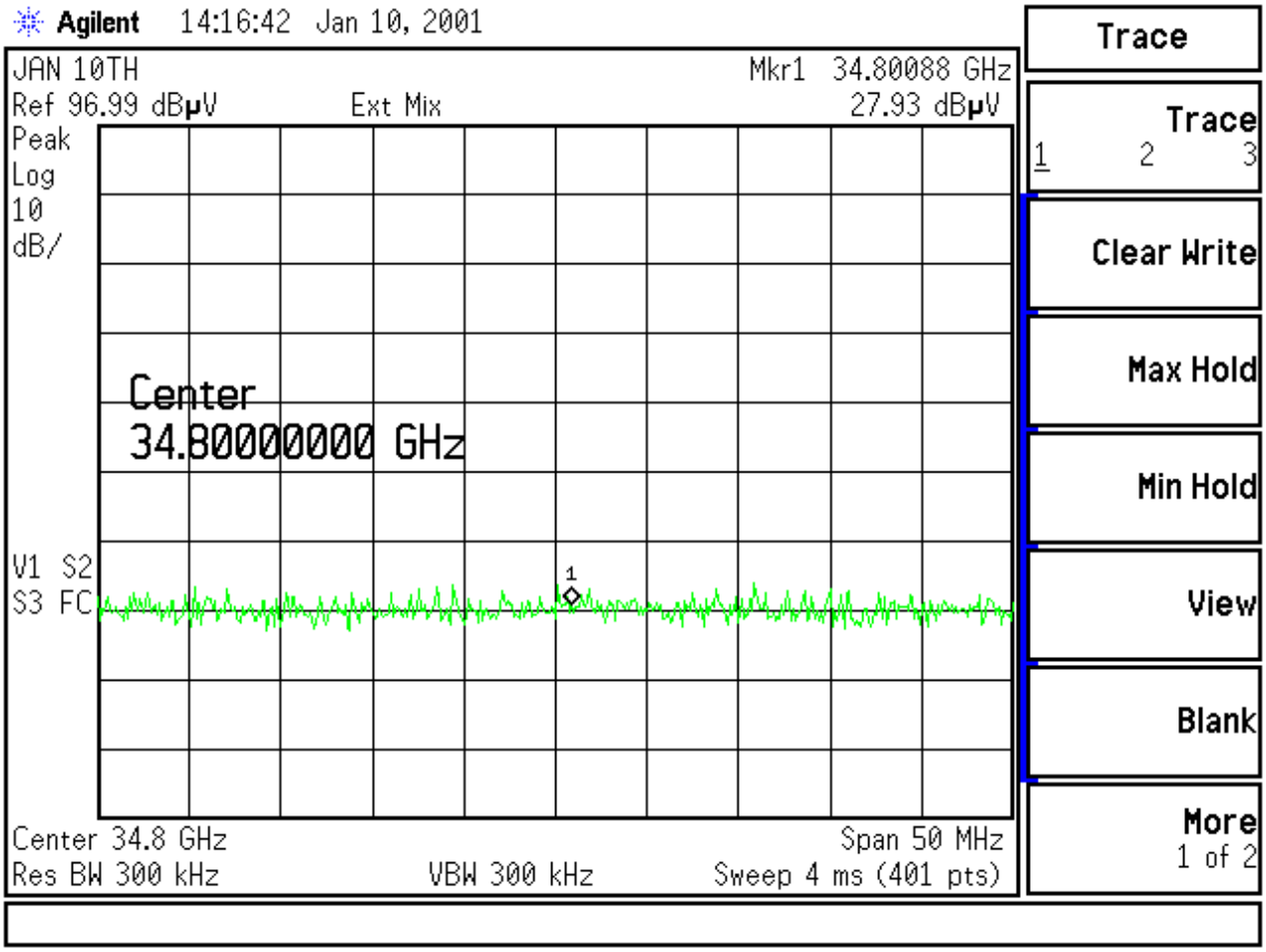
4th Harmonic



5th Harmonic



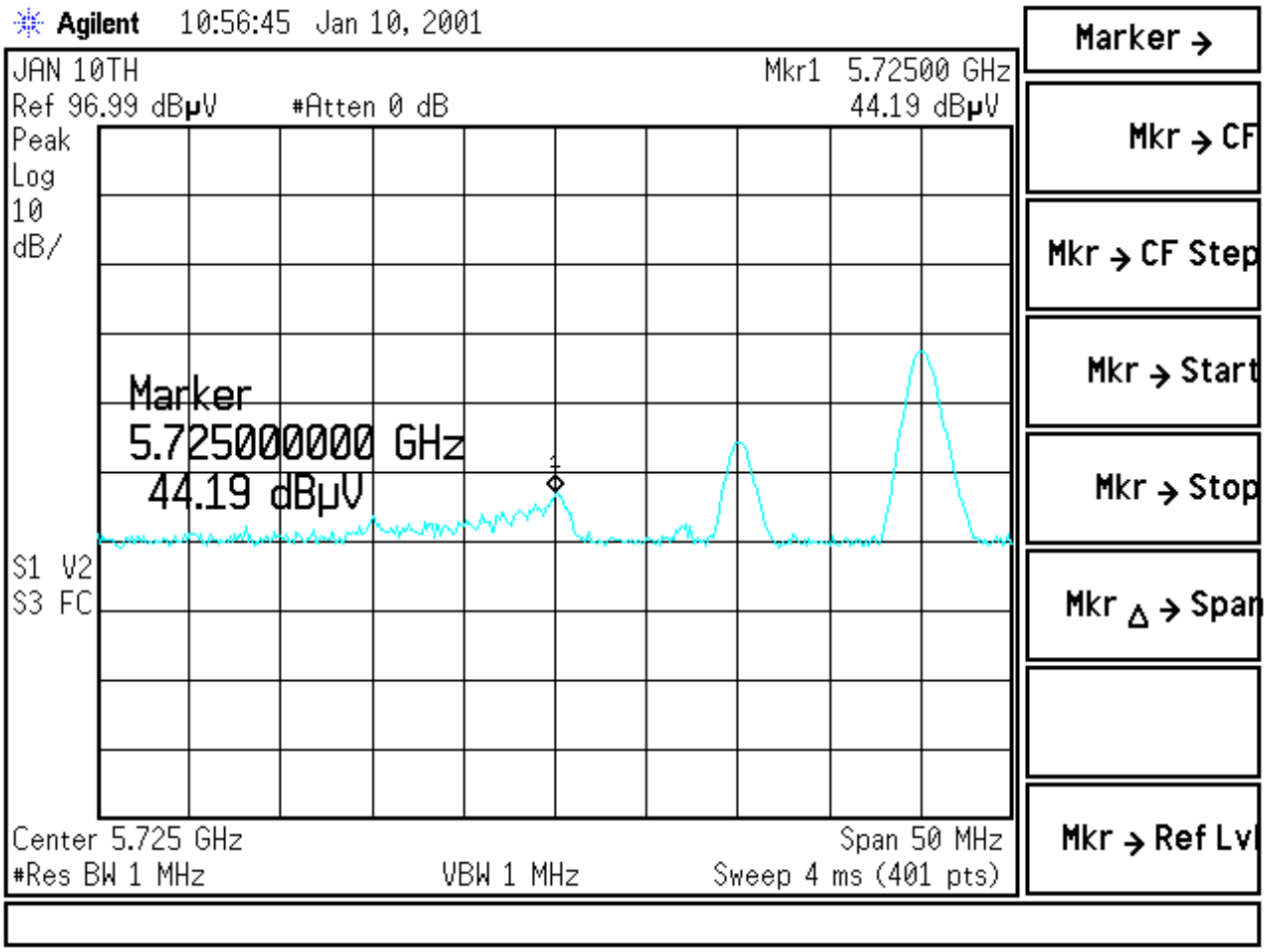
6th Harmonic



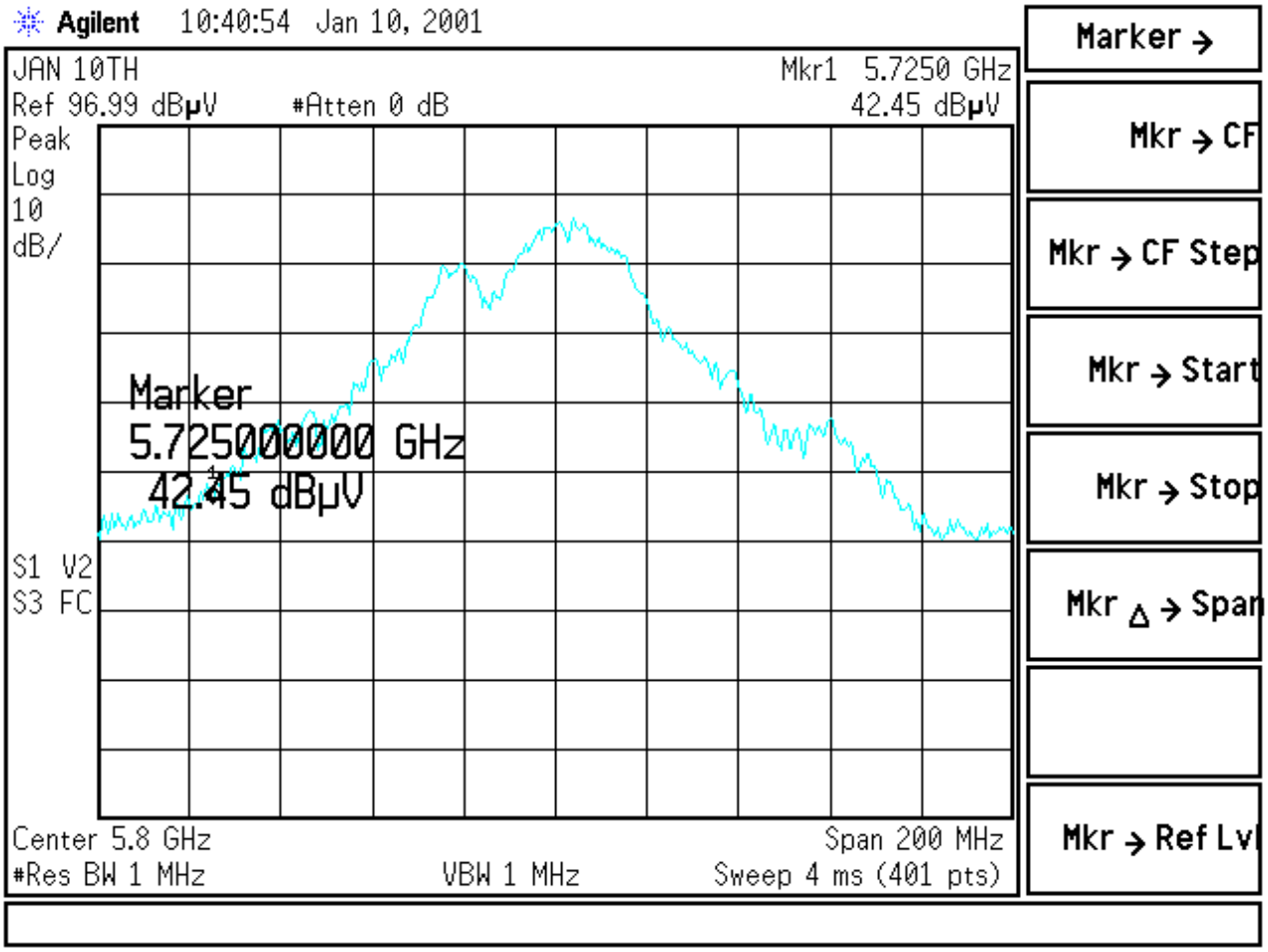
Bandedge Measurements

The two bandedge frequencies were measured while the unit was operating with a continuous wave (CW) source, and the measurements were also taken while using a spread spectrum source. As shown in the plots below and the table on page 10, the T40 Tag meets the FCC Class B limits for unintentional radiated emissions.

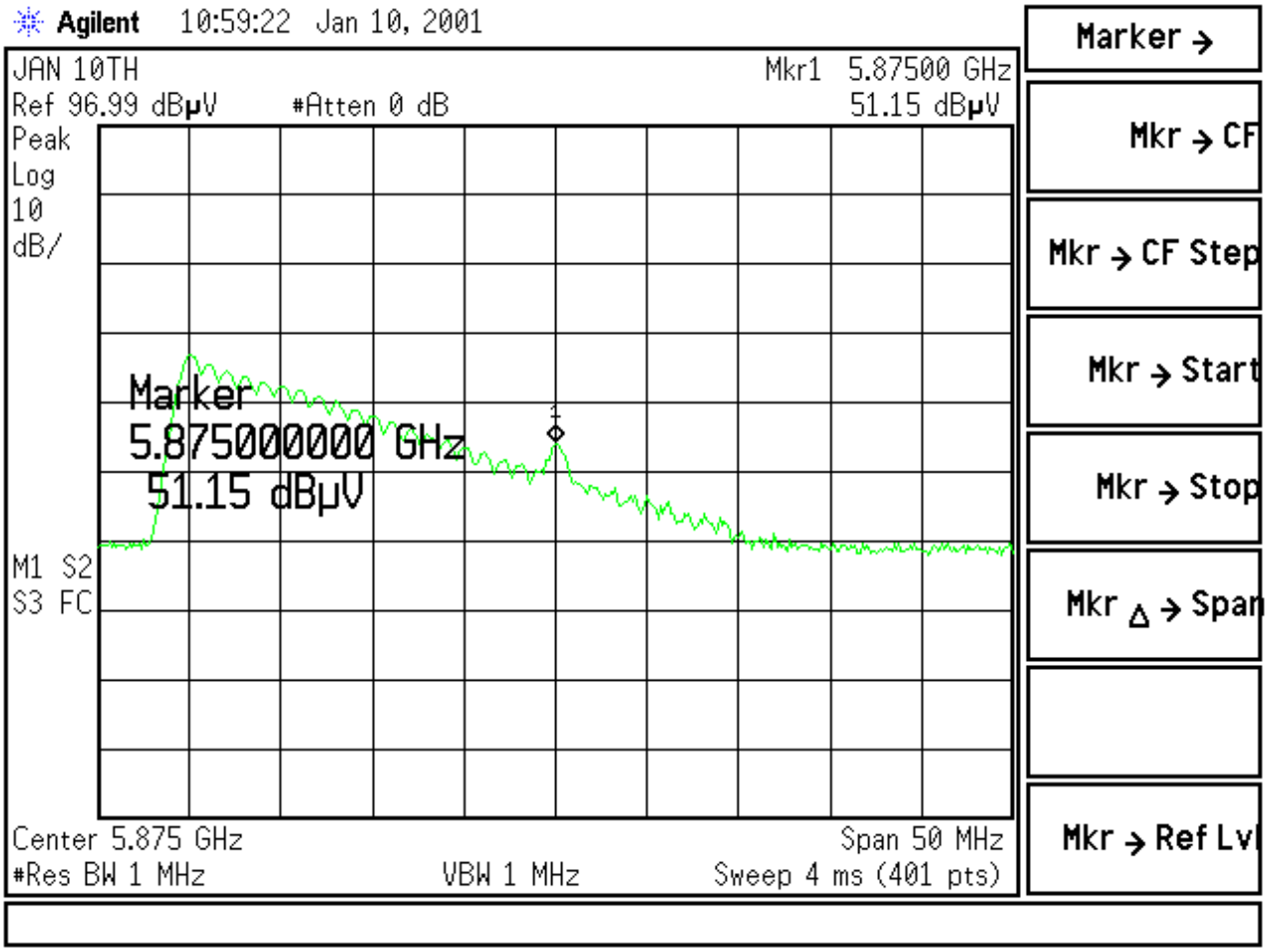
Lower Bandedge – CW Source



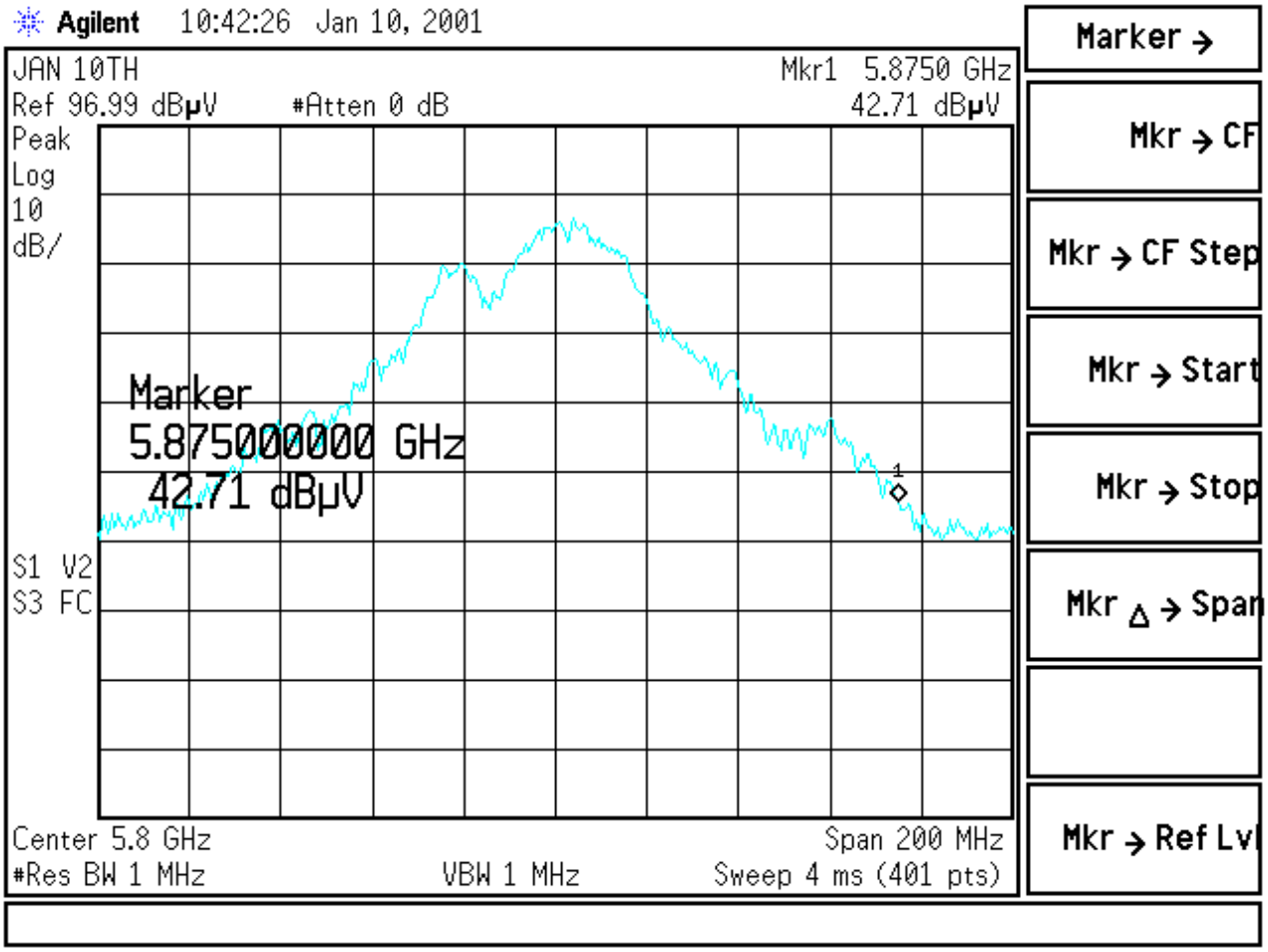
Lower Bandedge – Spread Spectrum Source



Upper Bandedge – CW Source



Upper Bandedge – Spread Spectrum Source



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