Project 06303-10

Hetronic International
MFSHL915 Pocket

Certification
Electromagnetic Compatibility Test Report

Prepared for:

Hetronic International

401 East Memorial Road
Suite 300
Oklahoma City, OK 73114

By

Professional Testing (EMI), Inc.
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MARCH 3, 2006

Reviewed by	Written by	Tests Performed by
Michael Royer	Annette Rice	Eric Lifsey
EMC Department Manager	Technical Writer	Test Engineer

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Certificate Of Compliance

Applicant: Hetronic International

Applicant's Address: 401 East Memorial Road, Suite 300
Oklahoma City, OK 73114

Project Number: 06303-10

Test Dates: February 15th & 24th, 2006

I, Michael A. Royer, for Professional Testing (EMI), Inc., being familiar with the FCC and Industry Canada rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

The **Hetronic International, MFSHL915 Pocket** was tested to and found to be in compliance with FCC Part 15 Subpart C for an Intentional Radiator.

The highest emissions generated by the above equipment are listed below:

	Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Fundamental	915	92.7	94	-1.3
Harmonics	2745	80.8	83.5	-2.7
Spurious	77.2	33.6	40	-6.4

Occupied Bandwidth 34.3 (kHz)

Michael A. Royer, BSEE, NCE
EMC Department Manager

This report has been reviewed and accepted by Hetronic International. The undersigned is responsible for ensuring that **Hetronic International, MFSHL915 Pocket** will continue to comply with the FCC rules.

1.0 EUT Description

The Hetronic International 915MHz Transmitter is a controller for heavy equipment. The Pocket transmitter has a coder board with 24 digital channel inputs. Four of the inputs can be used for a gray code trigger. It includes a Low Voltage Indicator (LVI) warning, 1% duty cycle, and 2 seconds turn off time. It also includes switch detection on power up to ensure that no switch is active when the battery is inserted. The RF section uses FM-RF with 915MHz frequency and 76800 baud rate.

The system tested consisted of the following:

Manufacturer	Description	FCC ID	IC Company Number
Hetronic International	915MHz Pocket	LW9-Pocket-MFSHL	2119B - MFSHLPKT

1.1 Modifications to Equipment

No modifications were made to the EUT.

1.2 Applicable Documents

The following guidelines apply to the operation of the EUT:

Guidelines	FCC Rule Parts Part 15	IC Rule Parts
Transmitter Characteristics	15.249	RSS-210 Issue 6 A2.9
Spurious Radiated Power	15.249	RSS-210 Issue 6 A2.6
Occupied Bandwidth	15.249	RSS-210 Issue 6 A2.9
Antenna Requirements	15.203	RSS-Gen 5.5
Averaging Calculations	15.35b	RSS-Gen 4.3

1.3 EUT Operation

To measure fundamental, harmonics, and spurious radiation, the EUT was operated in continuous transmit mode at maximum power in a continuous wave. For Occupied Bandwidth and Duty Cycle the EUT was operated at maximum power and modulated with a 101010 bit pattern.

2.0 Electromagnetic Emissions Testing

Professional Testing (EMI), Inc. (PTI), follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing.

2.1 Radiated Emissions Measurements

Radiated emission measurements were made of the Fundamental and Spurious Emission levels for the EUT. Measurements of the occupied bandwidth were also made for the EUT.

Measurements of the maximum emission levels for the fundamental and spurious/harmonic emissions of the EUT were made at the Professional Testing "Open Field" Site 3, located in Round Rock, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

Tests of the fundamental for the device were performed to determine the worst case polarization of the devices. The fundamental emissions of the device were measured with the antenna of the device in three orthogonal axes.

2.1.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable which allows 360 degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. The radiated emissions were maximized by rotating the EUT.

A Spectrum Analyzer with peak detection was used to find the maximums of the radiated emissions during the variability testing. A drawing showing the test setup is given as Figure 2.

2.1.2 Test Criteria

The table below shows FCC radiated limits for an intentional radiator operating under the provisions of part 15.249. The measurement of the harmonics was performed to 10 GHz. The reference distance for each limit is also shown in this table.

2.1.3 The FCC 15.249 radiated limits

Frequency (MHz)	Test Distance (Meters)	Field Strength (dBμV/m)
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
960 and above	3	54.0

Note: The lower limit shall apply at the transition frequency. The spurious limits are expressed in Quasi-Peak.

Frequency MHz	Test Distance (Meters)	Field Strength (uV/m)@3m Distance	(dBuV/m)@Test
Fundamental	3	50000	94.0
Harmonics	1	500	63.5

Note: Fundamental is expressed in Peak field strength and Harmonic Limits are expressed in Average field strengths.

2.1.4 Test Results

The radiated test data for the fundamental is included in Appendix A. Peak detection was used during the test for the fundamental and harmonics. To determine Harmonic field strength an average calculation was applied. Quasi-Peak detection was used for spurious emissions below 1 GHz. The radiated emission test data is included in Appendix A. The radiated emissions generated by the MFSHL915 Pocket are below the FCC Part 15.249 limits.

2.1.5 Radiated Emissions Test Equipment

Asset #	Manufacturer	Model #	Description	Calibration Due
C005	None	None	Underground Coaxial Cable	December 8, 2006
0754	Compliance Design	B100	Biconical Antenna	June 3, 2006
0238	HP	85685A	RF Preselector	March 24, 2006
0950	HP	8566B	Spectrum Analyzer	March 24, 2006
0949	HP	8566B	Spectrum Analyzer Display	March 24, 2006
0275	HP	85650A	Quasi-peak Adapter	March 24, 2006
0483	HP	8447D	RF Preamplifier	January 12, 2007
0755	EMCO	3146	Log Periodic Dipole Array Antenna	June 8, 2006

2.1.6 Microwave Radiated Emissions Test Equipment

Asset #	Manufacturer	Model #	Description	Calibration Due
C031	None	None	1.5 meter Coaxial RF Cable	November 23, 2006
0267	EMCO	3115	Ridge Guide Antenna	July 16, 2006
0950	HP	8566B	Spectrum Analyzer	March 24, 2006
0949	HP	8566B	Spectrum Analyzer Display	March 24, 2006
0897	Miteq	None	Microwave Preamplifier (preamp 2)	May 16, 2006

3.0 Occupied Bandwidth Measurements

Measurements of the occupied bandwidth for the fundamental signals were made at Professional Testing Round Rock, Texas site. All measurements were made in a controlled indoor environment in a configuration which did not present measurement distortion or ambient interference.

3.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor. The table was rotated to an angle which presented the highest signal level. The occupied bandwidth was based on a 20 dB criteria (20 dB down either side of the emission from the peak emission). A drawing showing the test setup is given as Figure 1.

3.2 Test Criteria

According to FCC Part 15.249, the emission must remain in the defined band.

3.3 Test Results

The occupied bandwidth test data is included in Appendix A. The maximum occupied bandwidth for the fundamental frequency 916.5 MHz is 34.3 kHz. This occupied bandwidth complies with the FCC requirement.

4.0 Pulse Width, Pulse Repetition Rate, and Burst Width

Measurements of the occupied bandwidth for the fundamental signals were made at Professional Testing Round Rock, Texas site. All measurements were made in a controlled indoor environment in a configuration which did not present measurement distortion or ambient interference.

4.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor. The transmitter pulse burst was measured in a 100 ms period.

4.2 Test Criteria

According to FCC Part 15.35, the maximum correction factor that can be used is 20dB.

4.3 Test Results

The pulse test data is included in Appendix A. Calculated a Peak-to-Average correction based on the duty cycle and the result was -35.9dB. Based on the criteria the maximum useable correction factor is 20dB.

5.0 Antenna Requirement

An analysis of the MFSHL915 Pocket was performed to determine compliance with FCC Section 15.203. This section requires specific handling and control of antennas used for devices subject to regulations.

5.1 Evaluation Procedure

The structure and application of the MFSHL915 Pocket was analyzed with respect to the rules. The antenna is an internal antenna, and is not accessible to the user. An auxiliary antenna port is not present.

5.2 Evaluation Criteria

Section 15.203 of the rules states that the subject device must meet at least one of the following criteria:

(a) Antenna must be permanently attached to the unit.

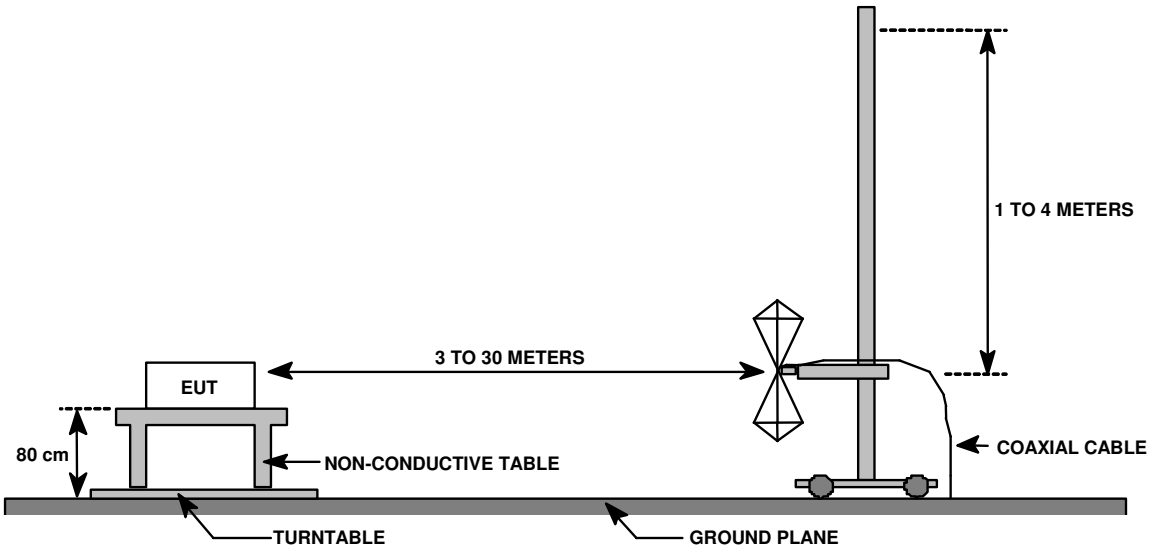
(b) Antenna must use a unique type of connector to attach to the EUT.

(c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

5.3 Evaluation Results

The MFSHL915 Pocket meets the criteria of this rule by virtue of having an internal antenna inaccessible to the user. The EUT is therefore compliant.

FIGURE 1: Radiated Emissions Test Setup



APPENDIX A TEST DATA SHEETS

Radiated Emissions Data Sheet
Hetronic International
MFSHL915 Pocket

MEASUREMENT DISTANCE (m): 3 FEBRUARY 15, 2006
ANTENNA POLARIZATION: Horizontal PROJECT #: 06303-10
DETECTOR FUNCTION: Quasi-Peak

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elev. (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
77.2	0	2.5	51.1	26.7	6.9	2.3	33.6	40	-6.4
144	noise	floor	36.2	26.7	11.2	3.2	23.9	44	-20.1
165.9	noise	floor	37.1	26.8	14.2	3.5	28.1	44	-15.9
175	noise	floor	37	26.7	15.7	3.7	29.7	44	-14.3
184	noise	floor	37.3	26.9	16.7	3.7	30.8	44	-13.2
192	noise	floor	36.9	26.8	16.8	3.9	30.8	44	-13.2

MEASUREMENT DISTANCE (m): 3 FEBRUARY 15, 2006
ANTENNA POLARIZATION: Vertical PROJECT #: 06303-10
DETECTOR FUNCTION: Quasi-Peak

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elev. (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
70	noise	floor	37.7	26.7	6.7	3.5	21.2	40	-18.8
144	noise	floor	36.2	26.7	11.2	3.2	23.9	44	-20.1
165.9	noise	floor	37.1	26.8	14.2	3.5	28.1	44	-15.9
175	noise	floor	37	26.7	15.7	3.7	29.7	44	-14.3
184	noise	floor	37.3	26.9	16.7	3.7	30.8	44	-13.2
192	noise	floor	36.9	26.8	16.8	3.9	30.8	44	-13.2

Test Engineer: Eric Lifsey

Microwave Radiated Emissions Data Sheet
Hetronic International
MFSHL915 Pocket
Harmonics

MEASUREMENT DISTANCE (m): 1 DATE: February 20, 2006
ANTENNA POLARIZATION: Horizontal PROJECT #: 06303-10
DETECTOR FUNCTION: Peak/Average

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elev. (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1626	180	1	38.4	32.5	25.8	0.5	32.3	63.5	-31.2*
1788	165	1	34.9	33.1	26.6	0.6	52.7	63.5	-10.8*
1830	165	1	58.3	33.3	26.8	0.6	52.4	63.5	-11.1*
2745	270	1	65.1	34.9	29.5	0.6	60.4	63.5	-3.1*
3660	215	1	48.6	34.0	32.1	0.8	47.5	63.5	-16.0*
4575	330	1	36.8	31.8	33.5	0.8	39.3	63.5	-24.2*
1626	180	1	58.4	32.5	25.8	0.5	52.3	83.5	-31.2
1788	165	1	54.9	33.1	26.6	0.6	52.7	83.5	-30.8
1830	165	1	78.3	33.3	26.8	0.6	72.4	83.5	-11.1
2745	270	1	85.1	34.9	29.5	0.6	80.4	83.5	-3.1
3660	215	1	68.6	34.0	32.1	0.8	67.5	83.5	-16.0
4575	330	1	56.8	31.8	33.5	0.8	59.3	83.5	-24.2

Note: * Average calculation

Test Engineer: Eric Lifsey

Microwave Radiated Emissions Data Sheet
Hetronic International
MFSHL915 Pocket
Harmonics

MEASUREMENT DISTANCE (m): 1 DATE: February 20, 2006
ANTENNA POLARIZATION: Vertical PROJECT #: 06303-10
DETECTOR FUNCTION: Peak/Average

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elev. (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1830	90	1	61.1	33.3	26.8	0.6	55.2	63.5	-8.3*
1626	90	1	38.5	32.5	25.8	0.5	32.4	63.5	-31.1*
2745	270	1	65.5	34.9	29.5	0.6	60.8	63.5	-2.7*
3660	270	1	48.3	34.0	32.1	0.8	47.2	63.5	-16.3*
4575	90	1	32.9	31.8	33.5	0.8	35.4	63.5	-28.1*
1788	270	1	37.5	33.1	26.6	0.6	31.5	63.5	-32.0*
1830	90	1	81.1	33.3	26.8	0.6	75.2	83.5	-8.3
1626	90	1	58.5	32.5	25.8	0.5	52.4	83.5	-31.1
2745	270	1	85.5	34.9	29.5	0.6	80.8	83.5	-2.7
3660	270	1	68.3	34.0	32.1	0.8	67.2	83.5	-16.3
4575	90	1	52.9	31.8	33.5	0.8	55.4	83.5	-28.1
1788	270	1	57.5	33.1	26.6	0.6	51.5	83.5	-32.0

Note: * Average calculation

Test Engineer: Eric Lifsey

Radiated Emissions Data Sheet
Hetronic International
MFSHL915 Pocket
Transmitter

MEASUREMENT DISTANCE (m): 3 DATE: Test Date: March 3, 2006
ANTENNA POLARIZATION: Horizontal PROJECT #: 06303-10
DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elev. (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
915	45	2	87	26.3	22.7	9.3	92.7	94	-1.3
915	105	1	84.1	26.3	22.7	9.3	89.8	94	-4.2
915	180	1	85.9	26.3	22.7	9.3	91.6	94	-2.4

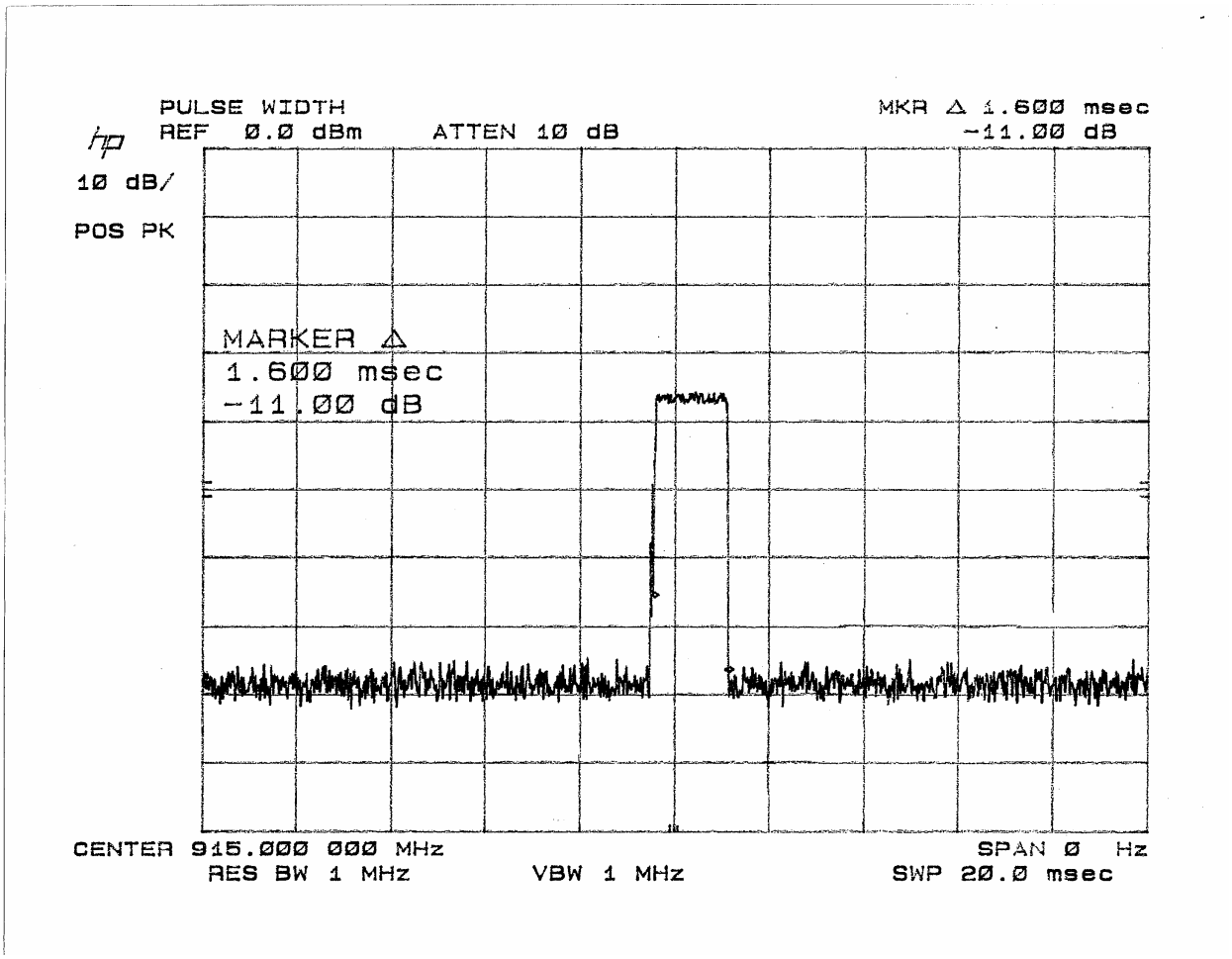
MEASUREMENT DISTANCE (m): 3 DATE: March 3, 2006
ANTENNA POLARIZATION: Vertical PROJECT #: 06303-10
DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elev. (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
915	45	1.5	75.3	26.3	22.7	9.3	81.0	94	-13.0
915	0	1.5	83.8	26.3	22.7	9.3	89.5	94	-4.5
915	90	1.5	79.9	26.3	22.7	9.3	85.6	94	-8.4

Test Engineer: Eric Lifsey

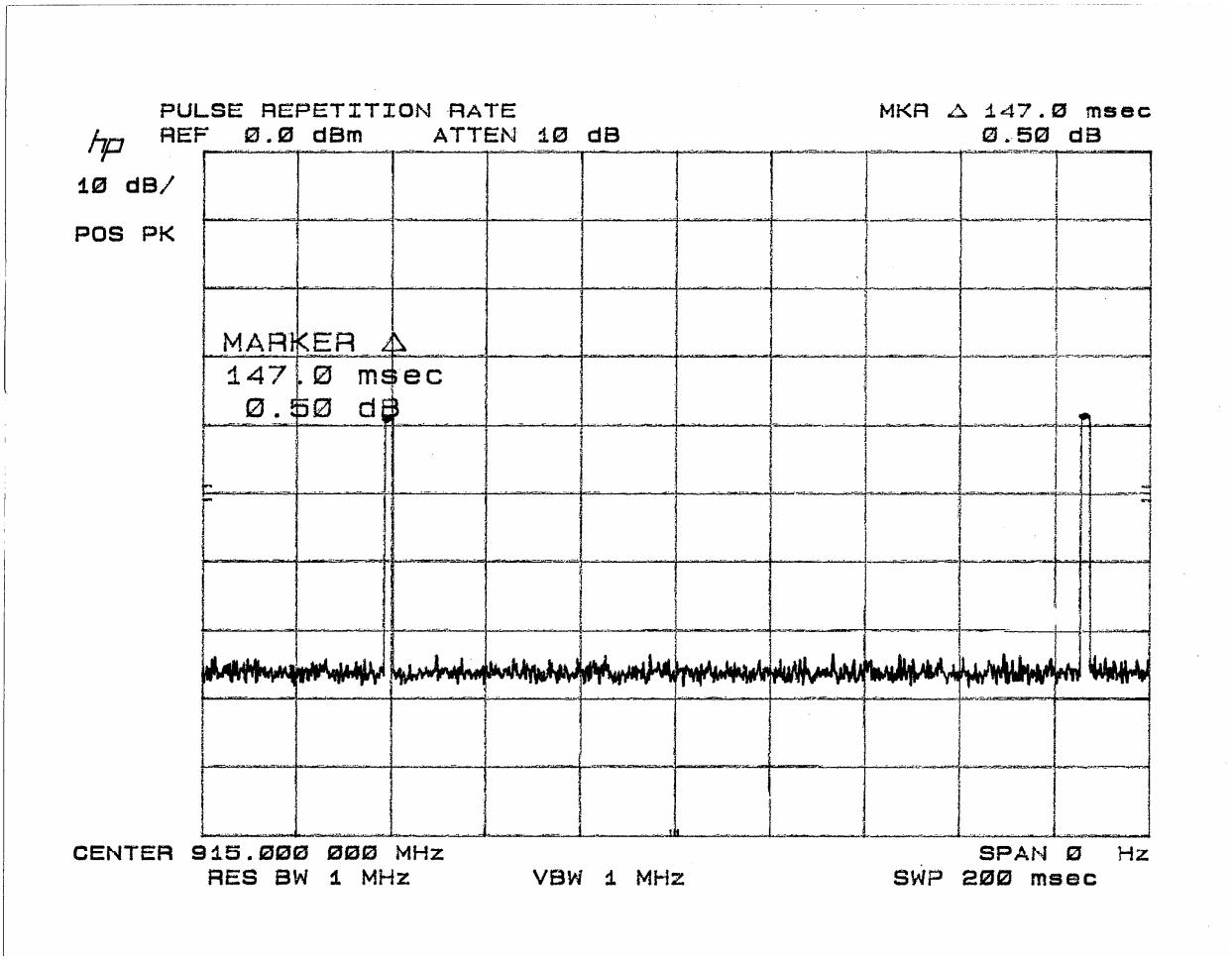
Pulse Width Datasheet
Hetronic International
MFSHL915 Pocket

Test Date: February 20, 2006
Measurement Distance (Meters): 3



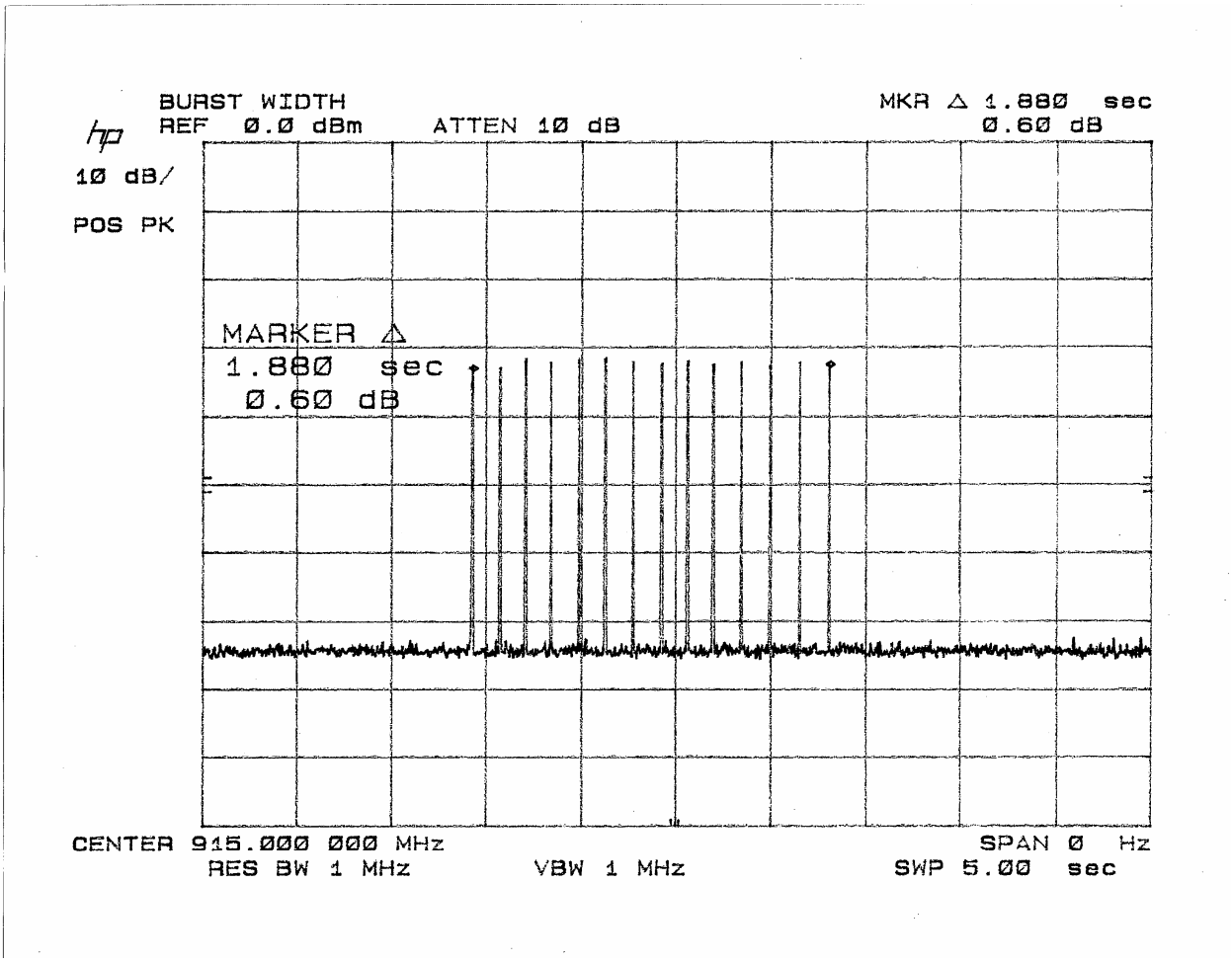
Pulse Repetition Datasheet
Hetronic International
MFSHL915 Pocket

Test Date: February 20, 2006
Measurement Distance (Meters): 3



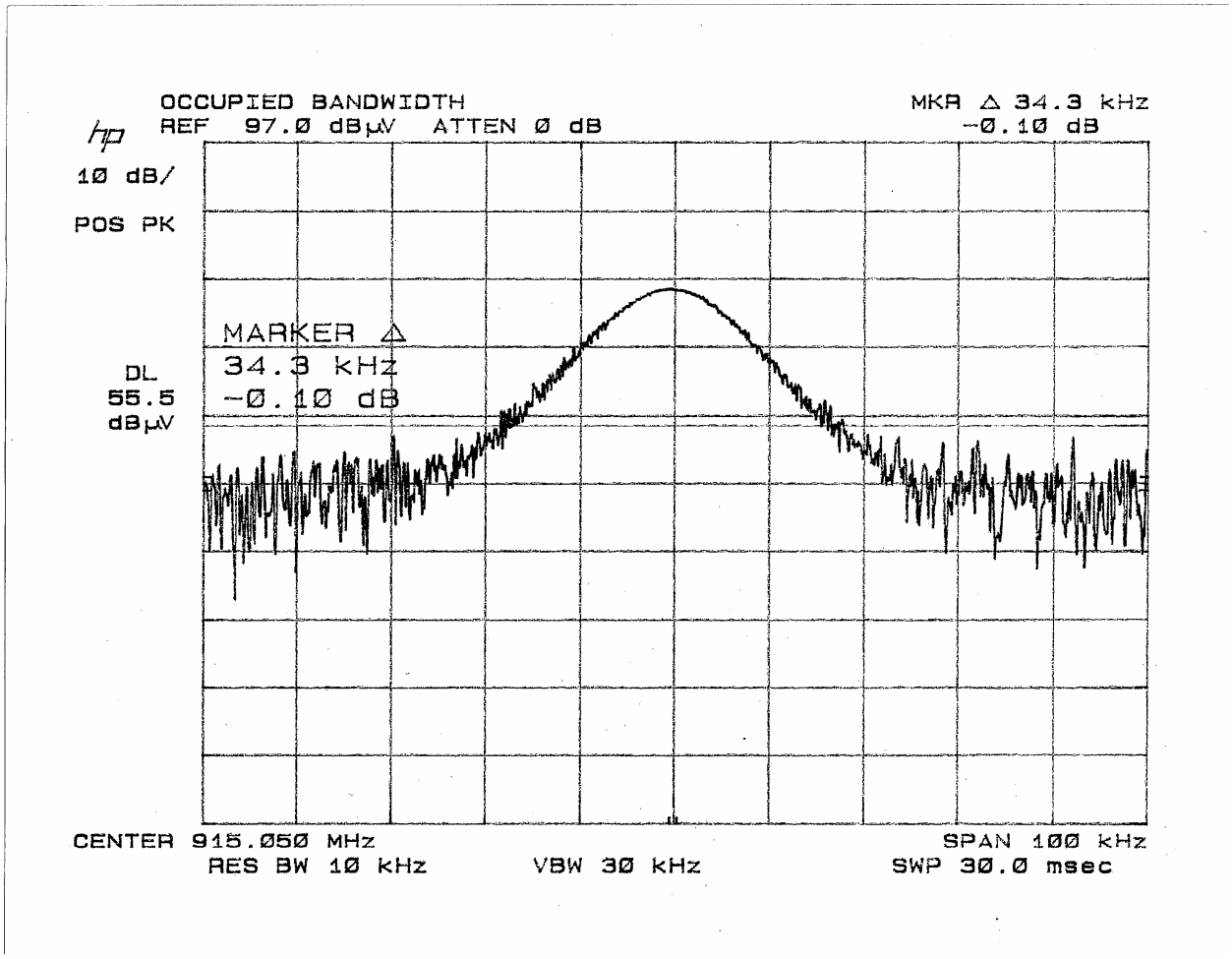
Burst Width Datasheet
Hetronic International
MFSHL915 Pocket

Test Date: February 20, 2006
Measurement Distance (Meters): 3



Occupied Bandwidth Datasheet
Hetronic International
MFSHL915 Pocket

Test Date: February 20, 2006
Measurement Distance (Meters): 3



Timing Assessment
Calculations

Test Date: February 20, 2006

Duty Cycle

$$DutyCycle = \frac{PulseDuration}{TotalTime}$$

$$DutyCycle = \frac{1.6mS}{100mS} = 1.6\%$$

Peak to Average Correction

$$CorrFact = 20 * \log(DutyCycle)$$

$$CorrFact = 20 * \log(.016) = -35.9dB$$