Project 18583-15

Hetronic
MFS ERGO120

Wireless Certification Report

Prepared for:

Hetronic
3905 NW 36th St.
Oklahoma City, OK 73112
USA

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

1 May 2017

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
DRAFT 2	Draft for review.	1 May 2017
01	Final	9 May 2017

Errata: none.

Table of Contents

Compliance Certificate

Applicant	Device & Test Identification	
Hetronic	FCC ID:	LW9-MFSERGO120
3905 NW 36th St.	Industry Canada ID:	2119B-MFSERGO120
Oklahoma City, OK 73112 USA	Model(s):	MFS ERGO120
Certificate Date: 1 May 2017	Laboratory Project ID:	18583-15

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Requirement	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant**.** The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

_____
Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	**Serial #**	**Description**
Hetronic Model: MFS ERGO120	none	2400-2483.5 MHz DTS transceiver; using Zigbee style protocol.

Table 1.2.2: Support Equipment		
Manufacturer / Model	**Serial #**	**Description**
None		

This device is a hand-held remote control for industrial systems such as cranes.

The device is powered by a lithium battery pack that is recharged in a separate charger.

The EUT is composed of a main board which contains the radio module being tested. Optional daughter boards can be populated for other radio bands and are tested separately. EUT is controlled by a variety of push buttons arranged on front and 3 sides. A USB connector is provided for factory programming of firmware.

The radio uses a monopole wire antenna bent to fit the space available.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Radiated Measurements

Table 1.6 1 Measurement Corrections	
Parameter	**From Sums Of**
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses

Additionally, measurement distance extrapolation factors (such as 1/d above 30 MHz) are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents	
Document	**Title**
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Table 1.7.2: Applicable Clauses		
Parameter	**FCC Part 15 Rule Paragraphs**	**IC RSS References**
Transmitter Characteristics	15.247	RSS-247 5.2 (DTS) & 5.4, RSS-Gen
Bandwidth	15.247(a)(1), 2.1049, KDB 558074 D01	RSS-Gen 4.6
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 4.9, 4.10
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 4.9
Antenna Requirement	15.247, 15.203	RSS-Gen 8.3

2.0 Fundamental Power

2.1 Test Procedure

Peak power is measured using conducted means and with modulation.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(3) // RSS-247 5.2	Fundamental Power Conducted Limits 1 W Limit Restated as Field: 125.23 dBµV/m @ 3 m	7 Mar 2017

2.3 Test Results, Peak Power

The EUT was measured for radiated power at 3 meters.

Table 2.3.1 Power, Peak, Radiated
Orientation Maximum: Flat
Polarity Maximum: Horizontal

Frequency MHz	Measured Peak Radiated Power in dBµV/m	Peak Power Restated in dBm	Peak Power Restated in mW
2405	101.1	5.9	3.9
2440	101.9	6.7	4.7
2480	103.4	8.2	6.6

Measured in 3 MHz RBW, 8 MHz VBW. Sweep triggered with max-hold.

Power setting 14 applied.

The EUT was satisfied the requirements.

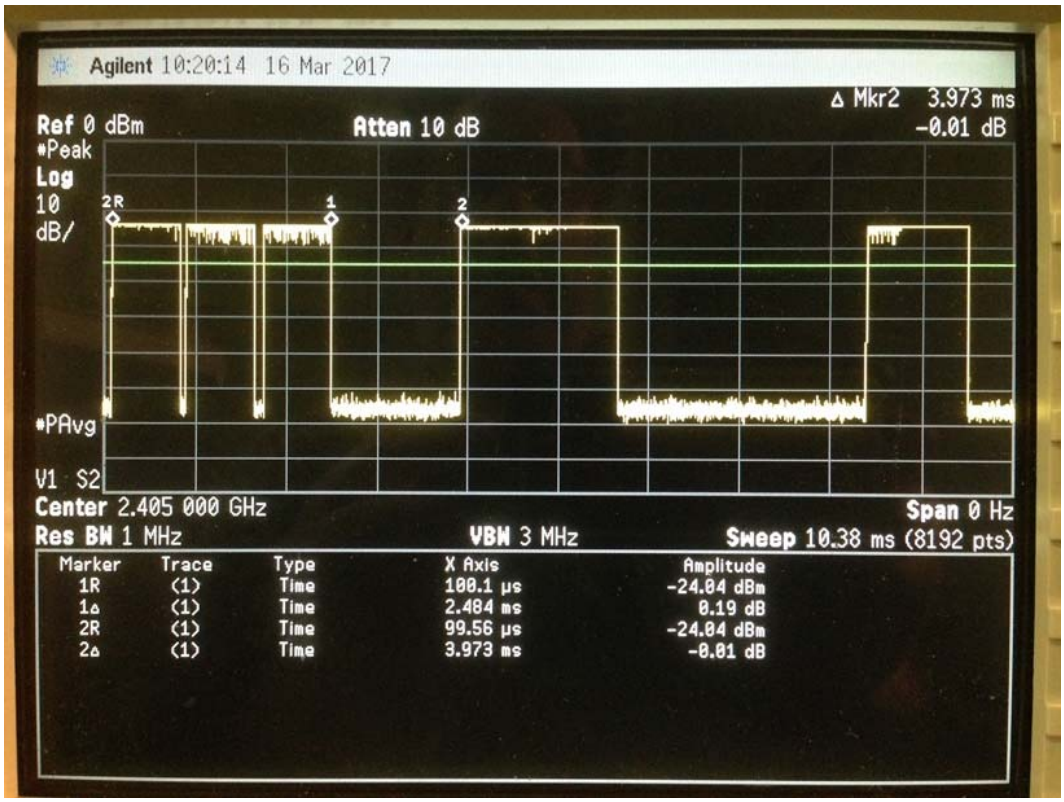
2.4 Test Results, Duty Cycle

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

Table 2.5.1 Duty Cycle Results and Average Duty Cycle Factor Result

Total Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
2.484	3.973	= 20 * Log_{10} (2.484 msec / 3.973 msec)	-4.1	-4.1

The allowed duty cycle factor is applied to peak measured harmonic signals to find average levels.



Transmit Event & Time Interval

3.0 Power Spectral Density

3.1 Test Procedure

A spectrum analyzer is either connected directly to the EUT or used by radiated means to measure the fundamental emission. It is adjusted to measure the power spectral density in the specified resolution bandwidth.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(e) // RSS-247, 5.2	Power Spectral Density, Conducted Limit: 8 dBm / 3 kHz Restated as field strength limit: 103.23 dBµV/m at 3 m	14 Mar 2017

3.3 Test Results

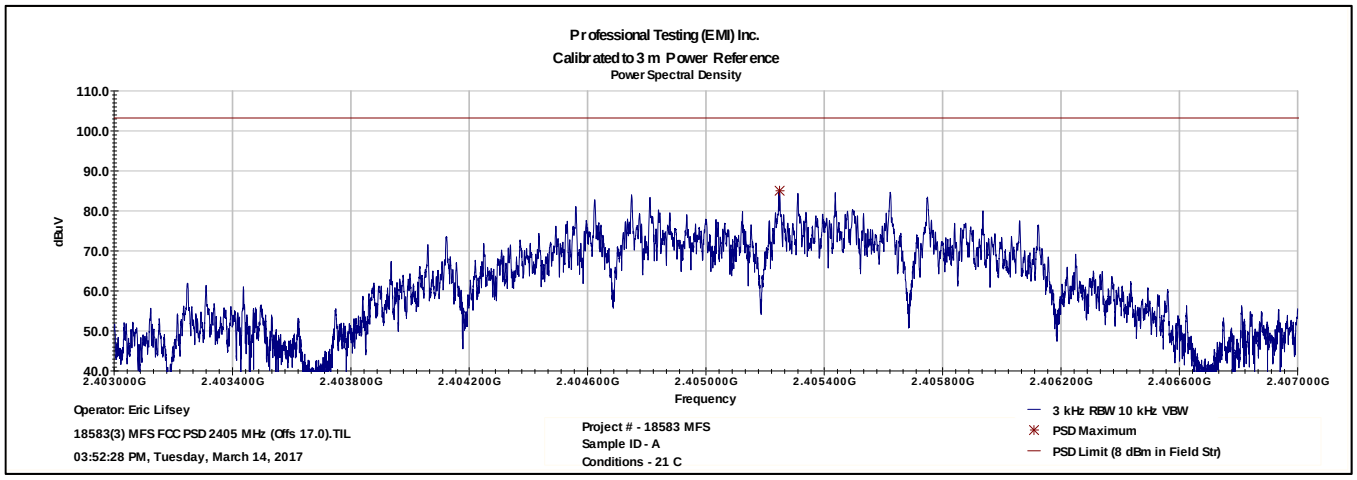
The highest channel when measured in full bandwidth exceeded 8 dBm. The measurement was taken calibrated relative to full power in a controlled environment.

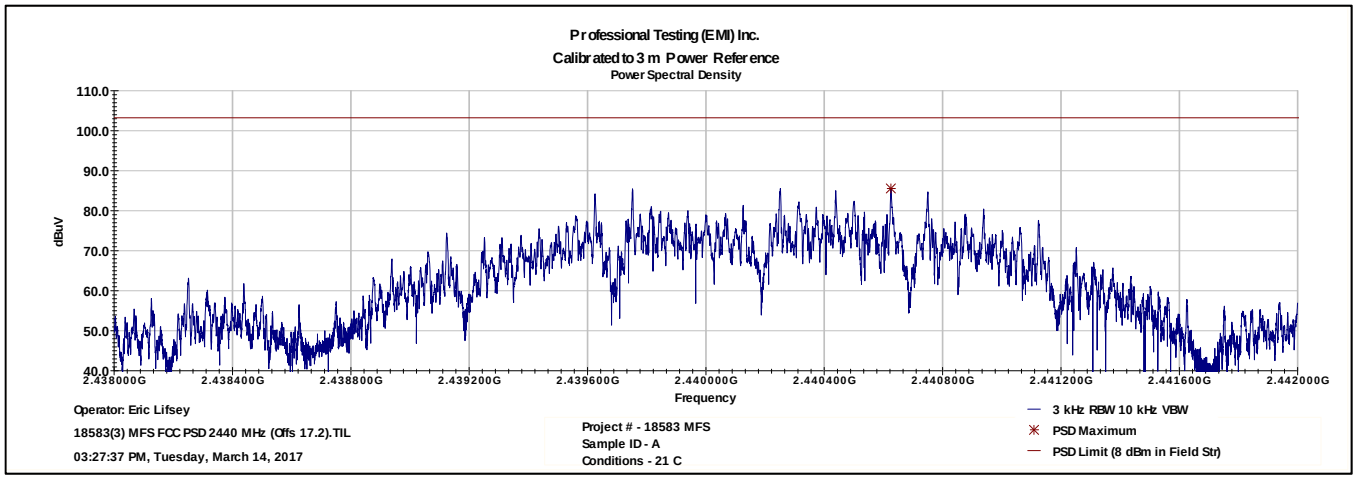
Table 3.3.1 Power Spectral Density

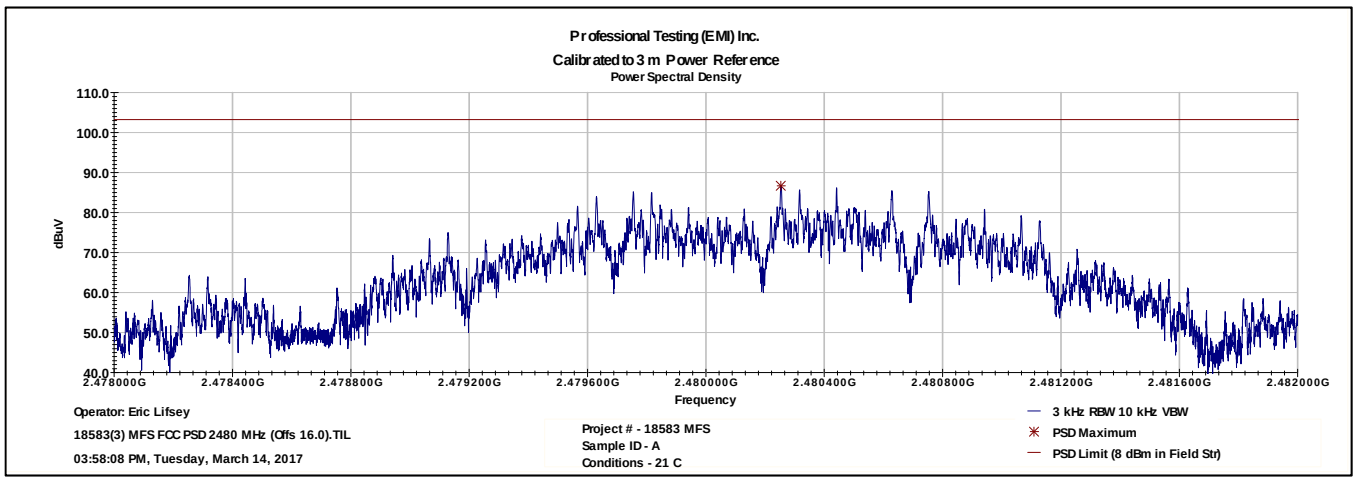
Frequency MHz	Measured Peak Radiated Power in dBµV/m	Peak Power Restated in dBm
2405	85.0	-10.2
2440	85.6	-9.6
2480	86.7	-8.5

Measured in 3 kHz RBW, 10 kHz VBW.

3.4 Plotted PSD







4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured by radiated means. A recording of the results is included.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
14.247(a)(2), 2.1049, KDB 558074 D01 // RSS-Gen 4.6	Bandwidth, 6 dB, 20 dB	14 Mar 2017

4.3 Test Results

The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

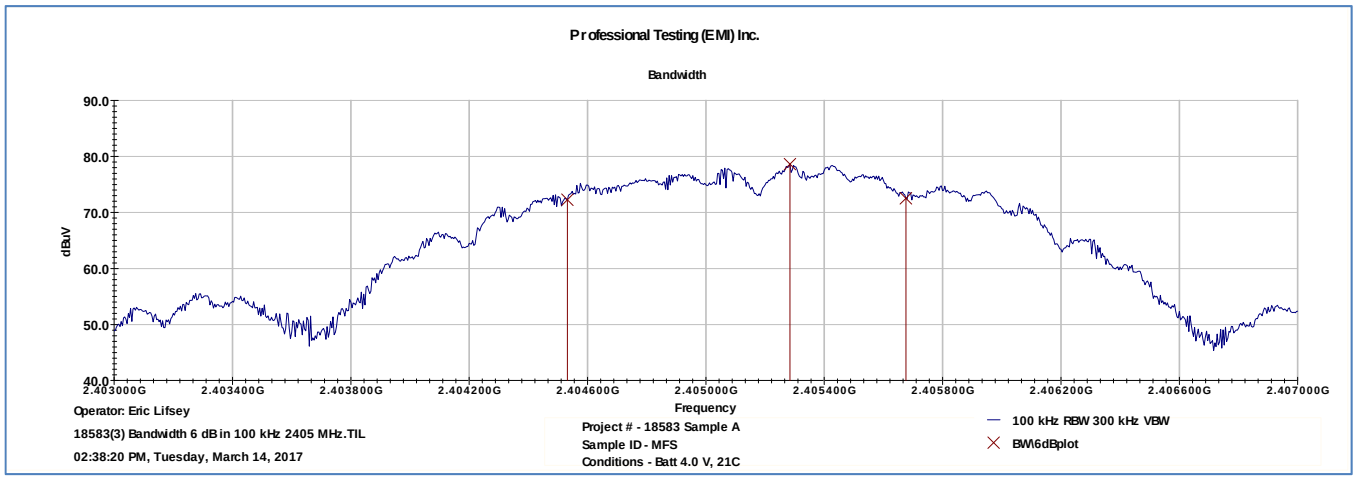
The EUT was found to be in compliance with applicable requirements.

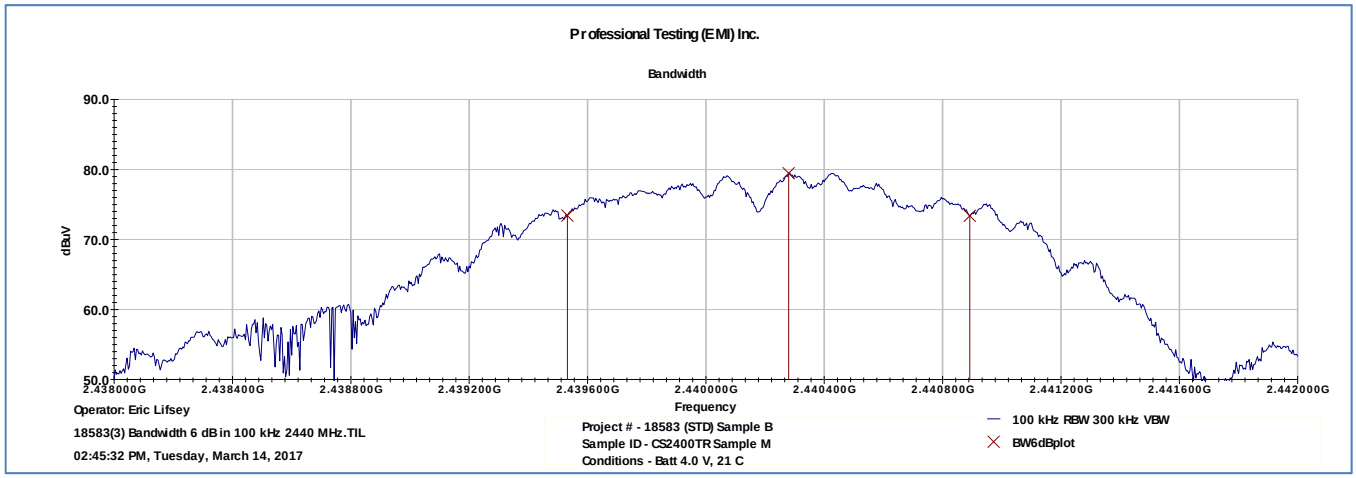
Table 4.3.1			
Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Minimum BW (kHz)**
1144	1360	1148	**1144**
Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
2225	2272	2280	**2280**

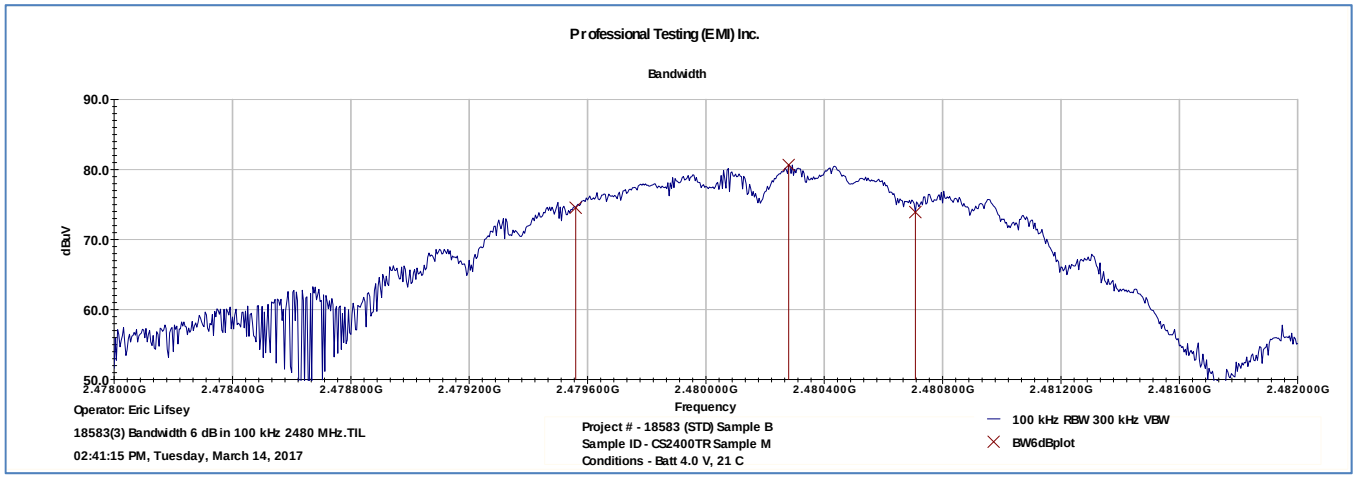
Plotted measurements appear on the following pages.

In cases where the software function failed to find/mark the correct edge of the modulated envelope, a manual measurement (marker-delta over display line) was taken with the same spectrum analyzer settings.

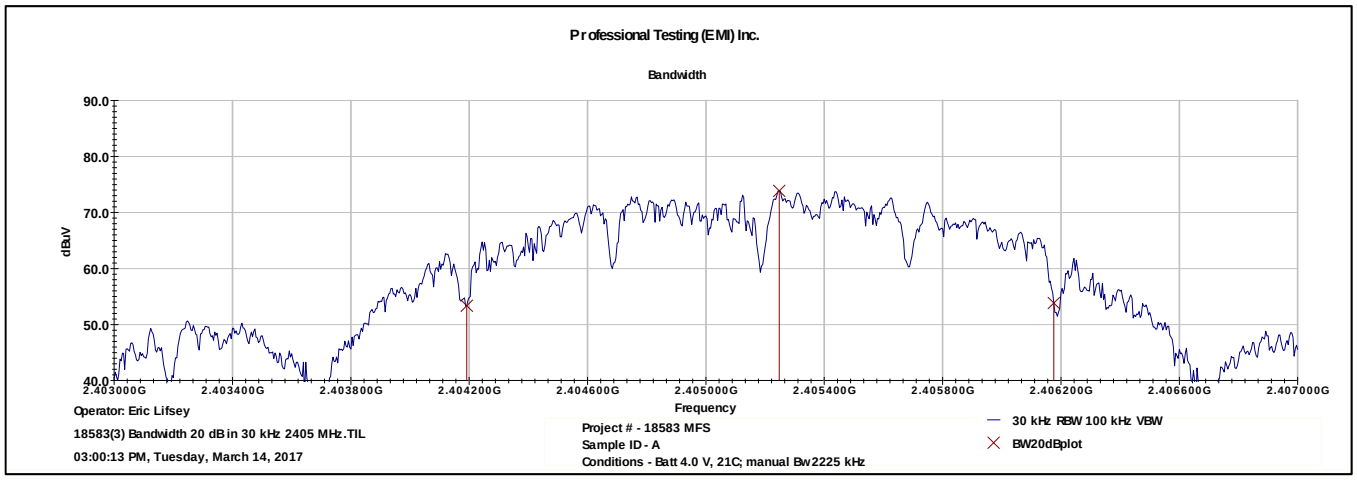
4.3.1 Bandwidth Plots, 6 dB

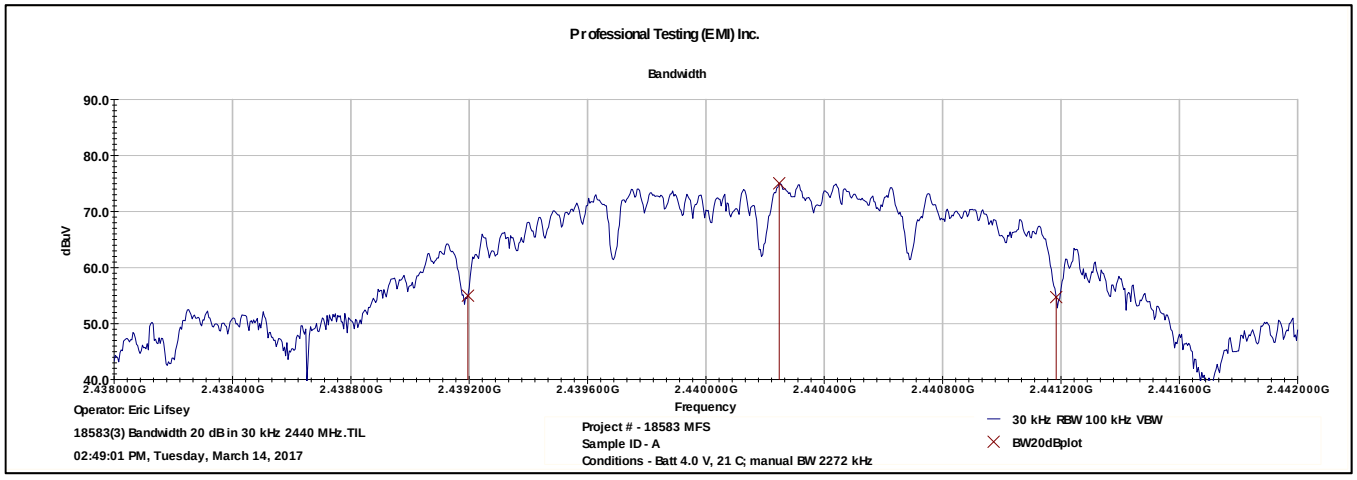


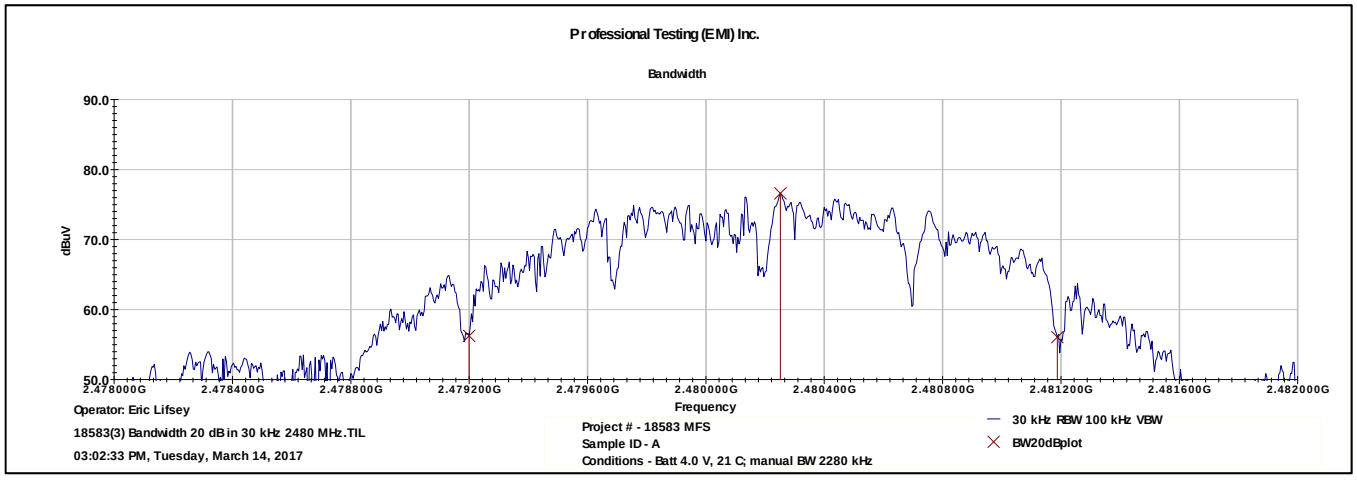




4.3.2 Bandwidth Plots, 20 dB







5.0 Band Edge

5.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is approximately centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method is utilized.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.205 // RSS-247 5.5, RSS-Gen 4.9	Unwanted Emissions Adjacent to Authorized Band	14 Mar 2017 25 Apr 2017

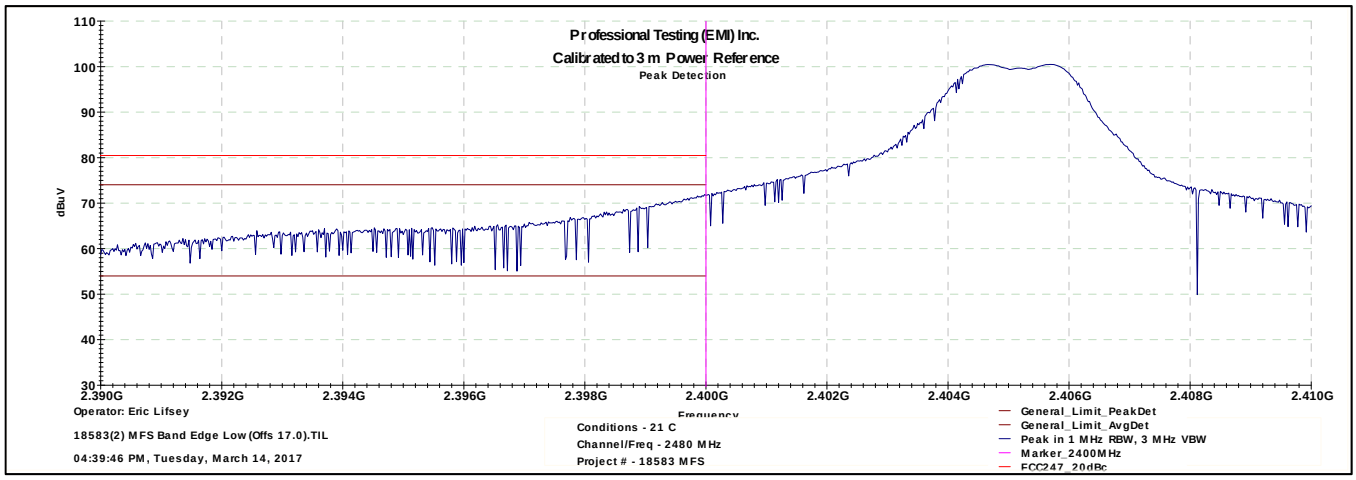
5.3 Test Results

Measurements included fundamental and more than 2 standard bandwidths (standard bandwidth 1 MHz) beyond the band edges to provide a clear view of the fundamental and the declining emission levels.

Average levels were measured outside the band using 1 Hz video bandwidth.

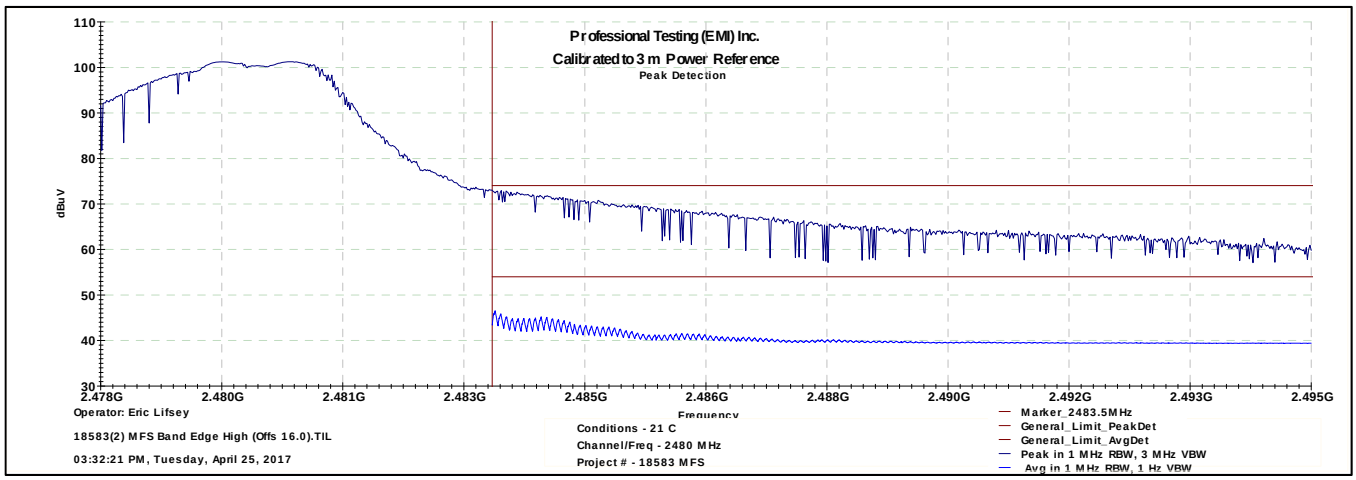
The EUT satisfied the criteria. Plotted results appear on the following pages.

5.3.1 Low Channel Band Edge



The 15.247 (-20 dBc) and general emission limits are shown.

5.3.2 High Channel Band Edge



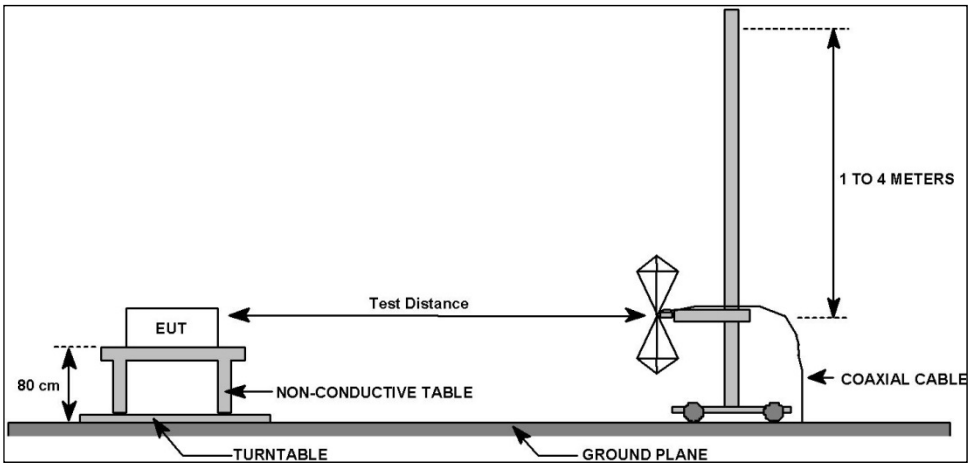
The general emission limit is shown.

6.0 Radiated Spurious Emissions, Transmit Mode

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate using 1 MHz resolution bandwidth. A diagram showing the test setup appears below.



6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	14 Mar 2017, 20 Mar 2017

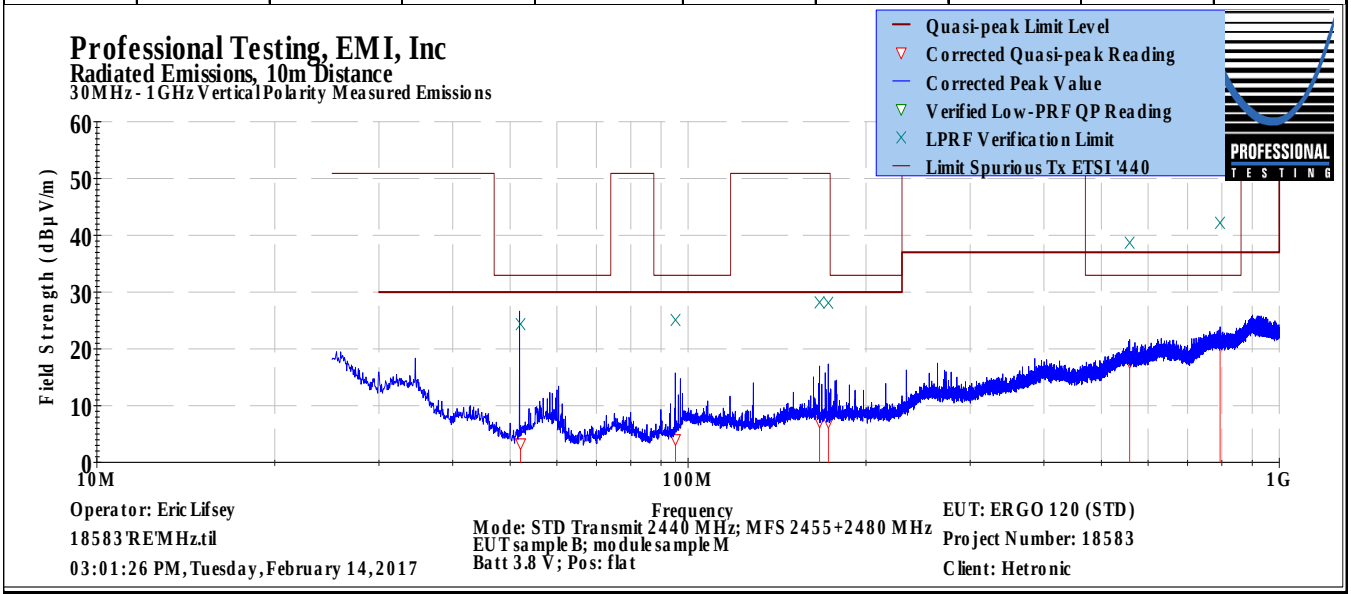
6.3 Test Results

6.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	EUT Serial #:	Item/Sample B
Customer:	Hetronic	EUT Part #:	None
Project Number:	18583	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	MFS ERGO120	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1		
EUT Line Voltage:	3.8	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz	
EUT Mode of Operation:			Transmit 2440 MHz		

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
52.0849	10	59	1.78	Quasi-peak	23.5	3.345	29.5	-26.2	Pass
95.2181	10	33	1.38	Quasi-peak	22.9	4.068	33.1	-29.0	Pass
166.909	10	63	2.17	Quasi-peak	22.6	7.173	33.1	-25.9	Pass
172.714	10	255	2.28	Quasi-peak	22.6	7.107	33.1	-26.0	Pass
558.287	10	357	4.07	Quasi-peak	22	17.687	35.6	-17.9	Pass
794.276	10	21	2.54	Quasi-peak	21.4	21.187	35.6	-14.4	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

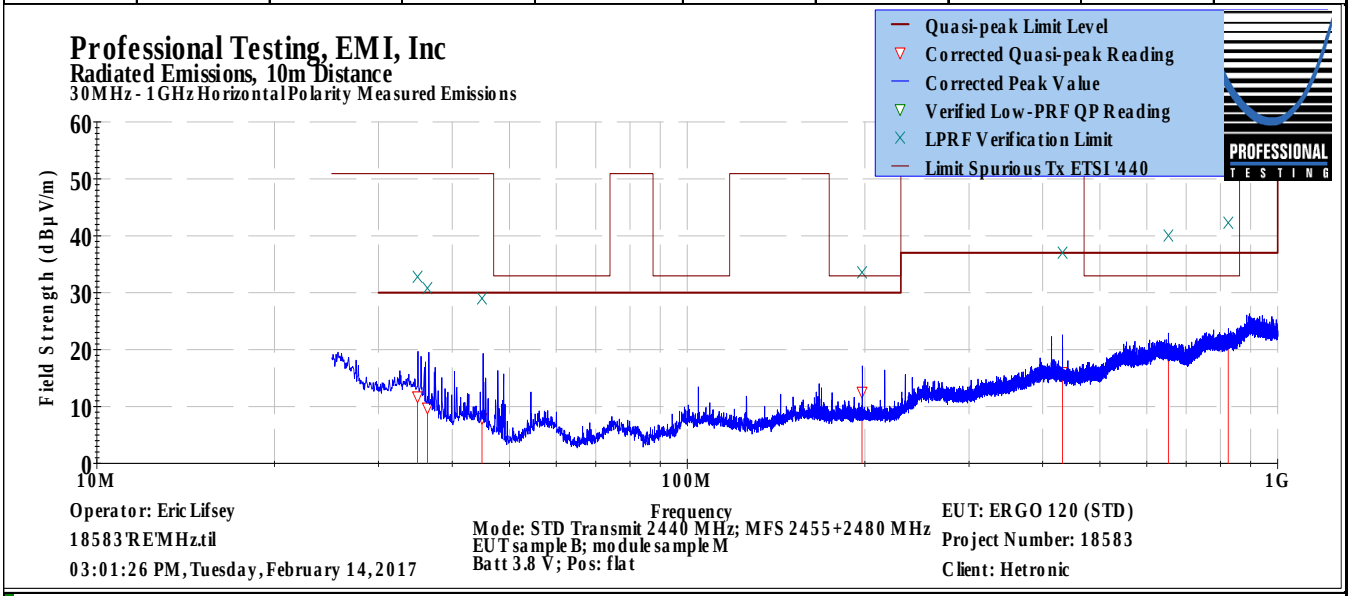
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit 2440 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
34.9402	10	138	3.44	Quasi-peak	23.4	11.77	29.5	-17.7	Pass
36.3154	10	238	3.16	Quasi-peak	23	9.786	29.5	-19.7	Pass
44.9096	10	64	2.49	Quasi-peak	24.3	7.97	29.5	-21.5	Pass
197.763	10	251	3.92	Quasi-peak	27.5	12.575	33.1	-20.5	Pass
432.085	10	296	3.9	Quasi-peak	23.6	16.022	35.6	-19.6	Pass
653.181	10	134	2.11	Quasi-peak	21.9	19.041	35.6	-16.6	Pass
824.791	10	205	2.55	Quasi-peak	21.4	21.285	35.6	-14.3	Pass



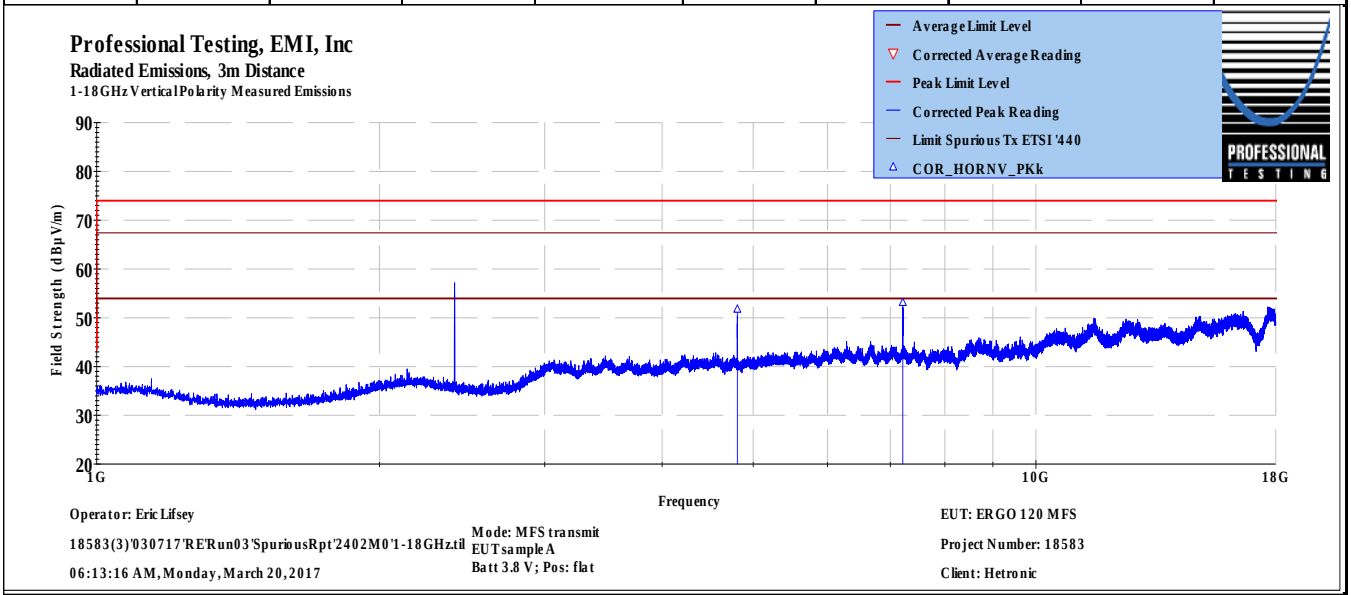
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Up to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	EUT Serial #:	Item/Sample B
Customer:	Hetronic	EUT Part #:	None
Project Number:	18583	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	MFS ERGO120	Witness' Name:	None

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3.8 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2405 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4811.39	3	54	3.06	Peak	55.5	51.758	74.0	-22.2	Pass
7216.96	3	72	1.57	Peak	50.2	53.084	74.0	-20.9	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

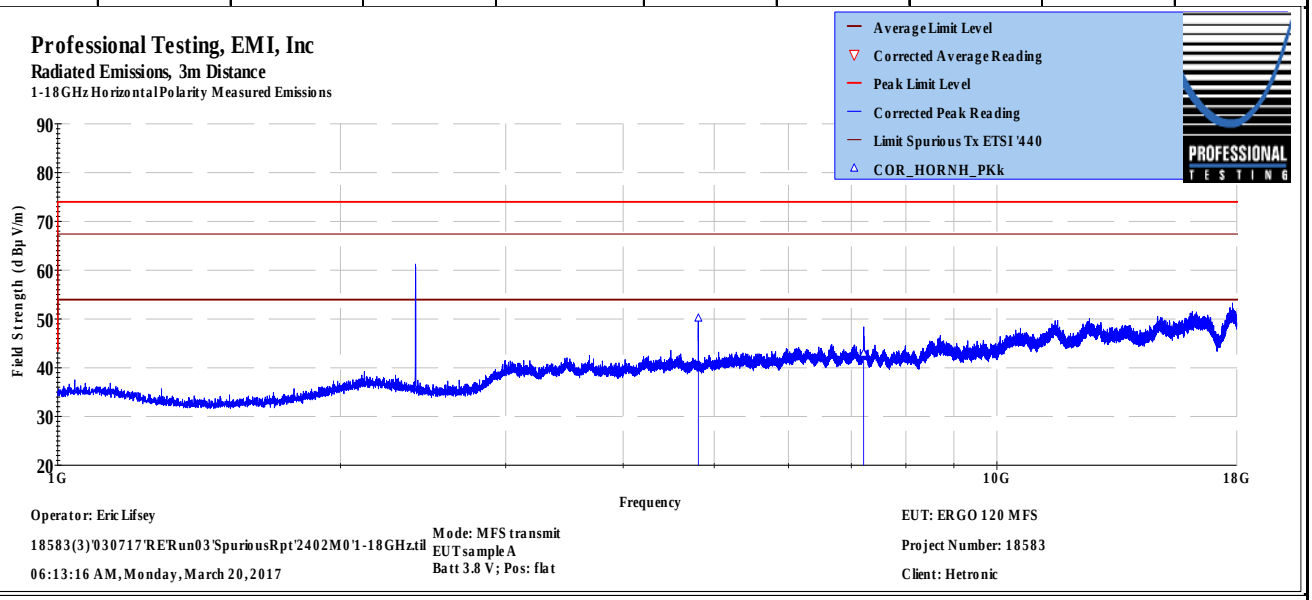
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2405 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4809.46	3	51	1.93	Peak	53.9	50.151	74.0	-23.8	Pass
7212.42	3	35	3.82	Peak	40	42.946	74.0	-31.0	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

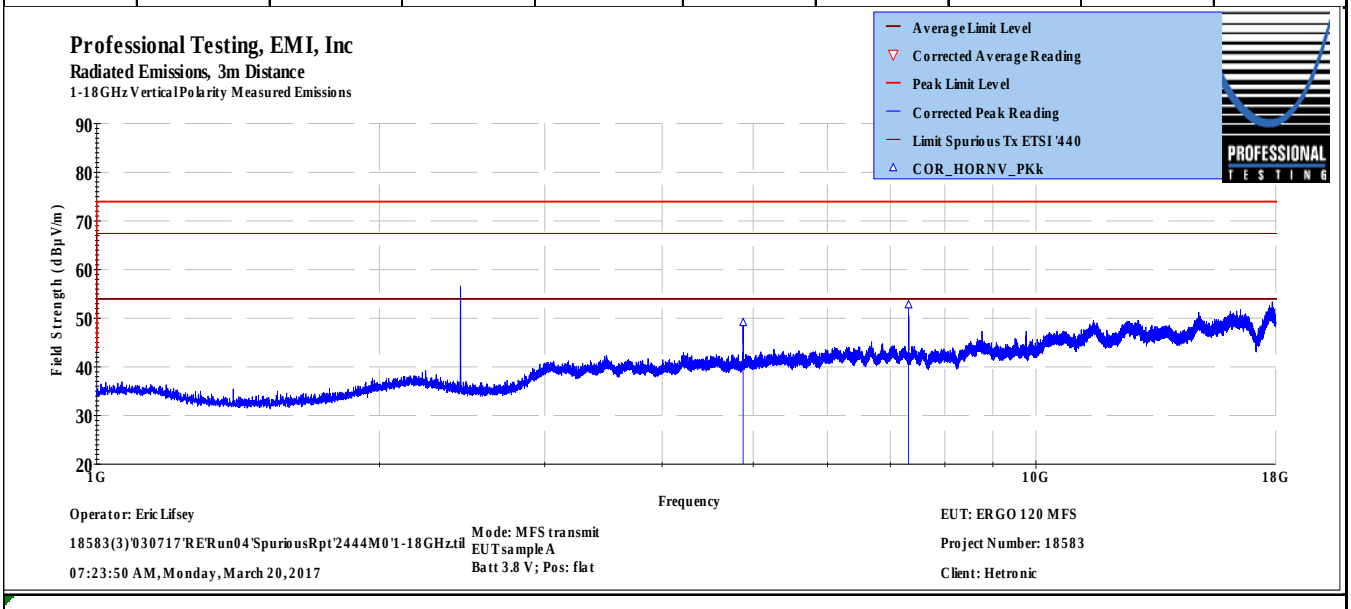
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2440 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4879.46	3	220	1.46	Peak	52.6	49.074	74.0	-24.9	Pass
7319.14	3	59	1.47	Peak	49.5	52.726	74.0	-21.2	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

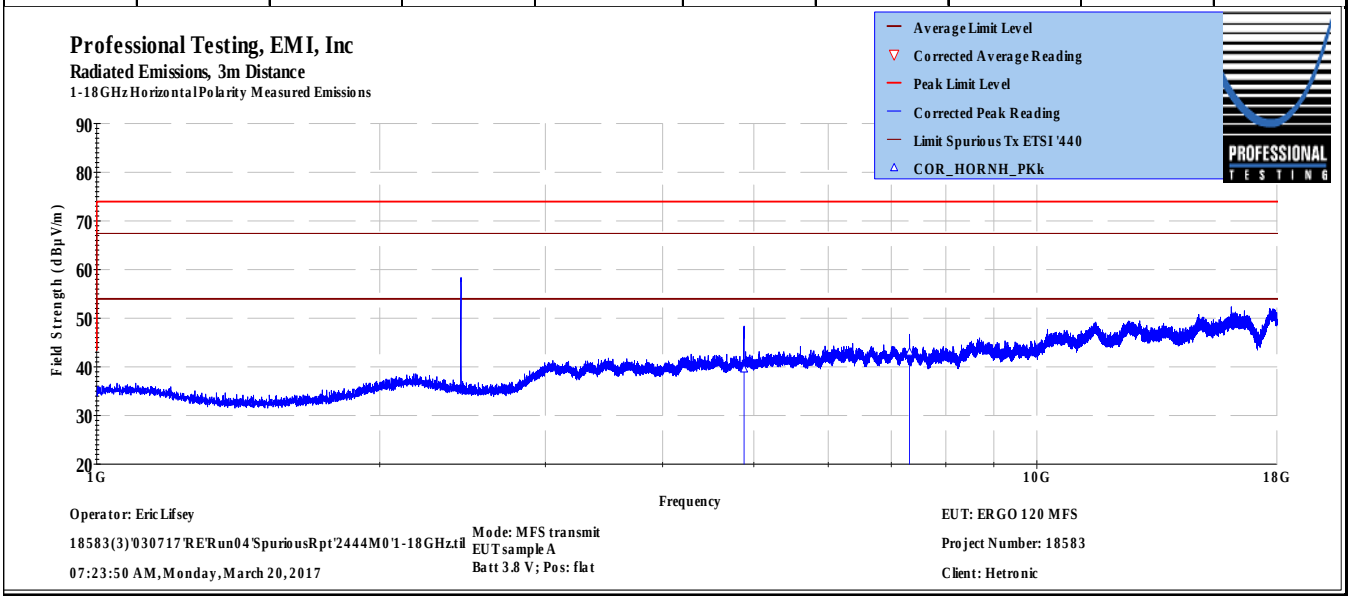
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2440 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4881.45	3	297	1.66	Peak	43	39.527	74.0	-34.4	Pass
7318.9	3	51	2.29	Peak	39.8	43.012	74.0	-30.9	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

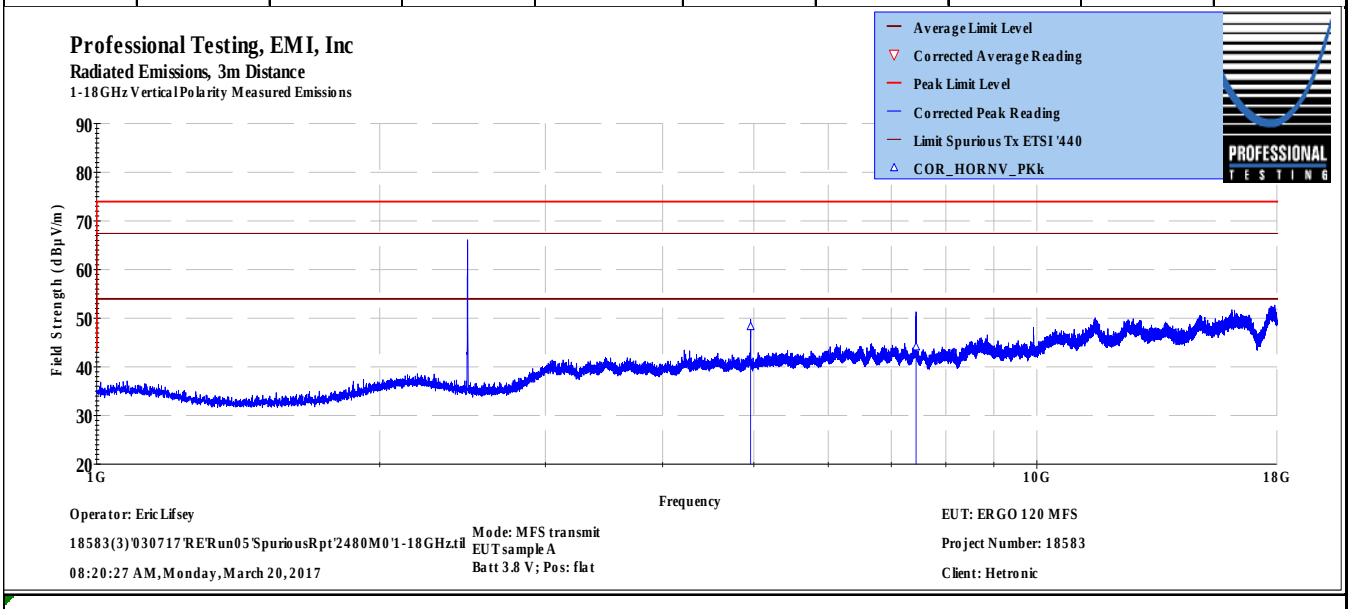
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2480 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4959.75	3	218	1.83	Peak	51.5	48.266	74.0	-25.7	Pass
7439.24	3	195	1.53	Peak	40.3	44.084	74.0	-29.9	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

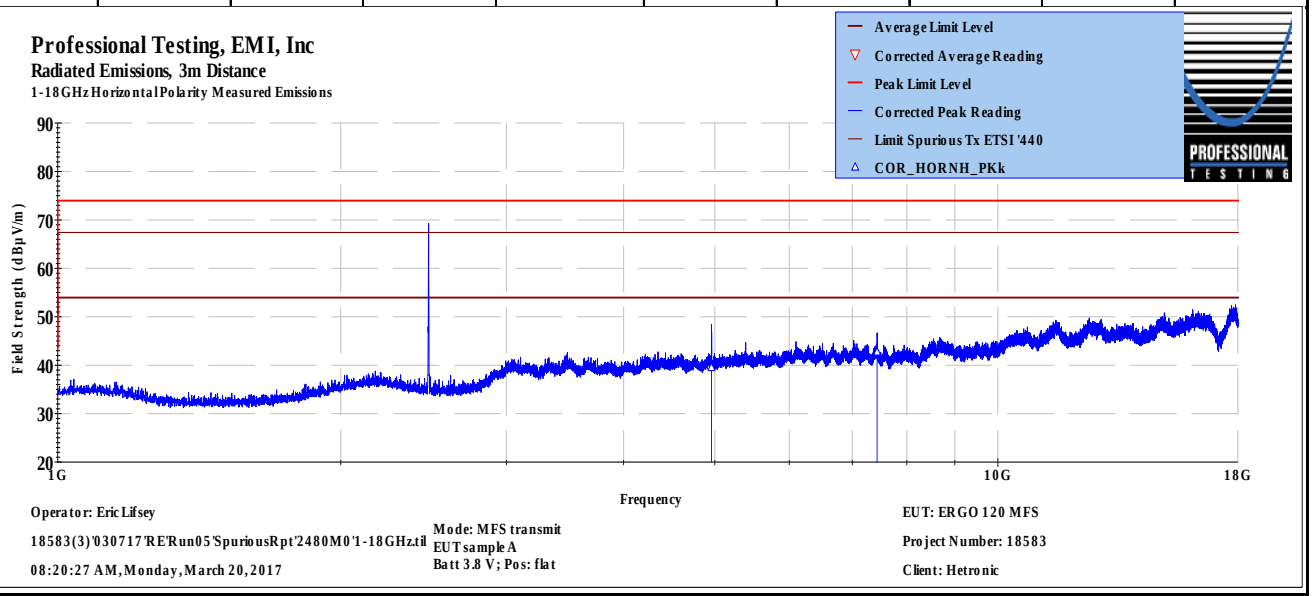
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2480 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4959.42	3	286	1.51	Peak	42.7	39.516	74.0	-34.4	Pass
7438.89	3	342	2.25	Peak	38.9	42.684	74.0	-31.3	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

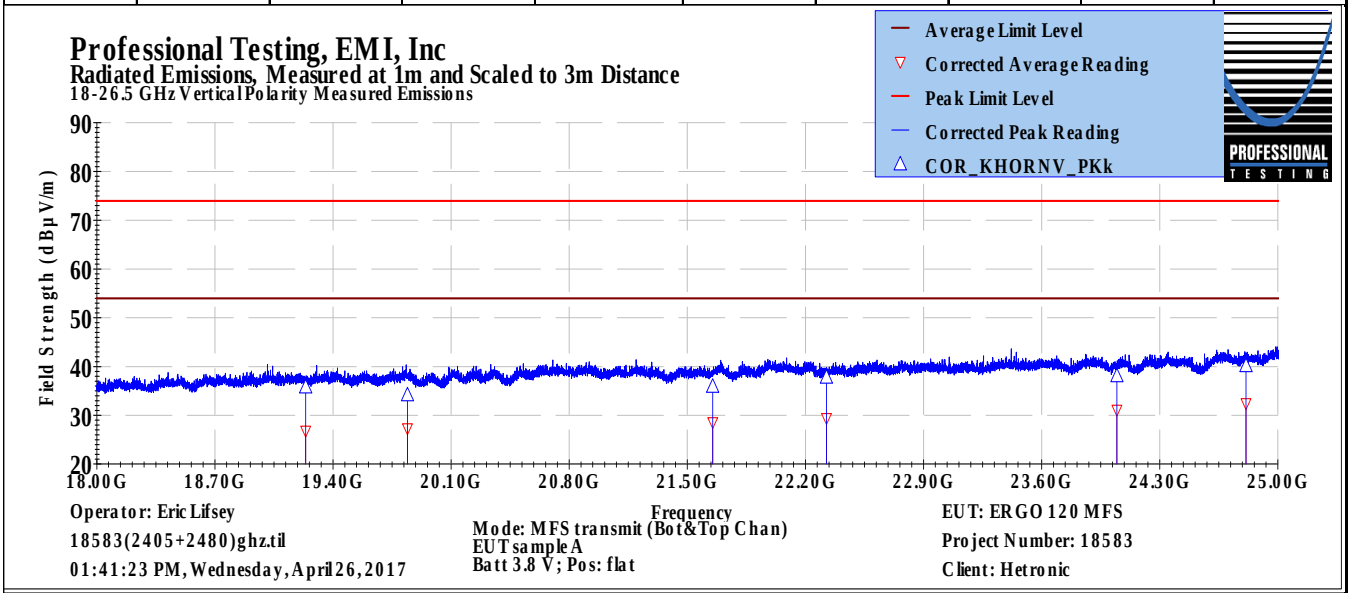
6.3.3 Up to 25 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	EUT Serial #:	Item/Sample B
Customer:	Hetronic	EUT Part #:	None
Project Number:	18583	Test Technician:	Eric Lifsey
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	MFS ERGO120	Witness' Name:	None

Radiated Emissions Test Results Data Sheet Page: 1 of 1

EUT Line Voltage:	3.8 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2405 MHz & 2480 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4806.19	3	131	3.88	Peak	42.2	38.52	74.0	-35.4	Pass
4960.16	3	92	3.30	Peak	44.6	41.37	74.0	-32.6	Pass
7206.38	3	55	2.38	Peak	38.4	41.33	74.0	-32.6	Pass
7439.71	3	9	1.42	Peak	39.4	43.11	74.0	-30.9	Pass
9605.33	3	279	2.25	Peak	36.8	44.86	74.0	-29.1	Pass
9918.14	3	72	2.16	Peak	35.6	43.49	74.0	-30.5	Pass
12008.3	3	68	3.44	Peak	36.0	46.35	74.0	-27.6	Pass
12402.3	3	162	2.47	Peak	37.4	48.18	74.0	-25.8	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

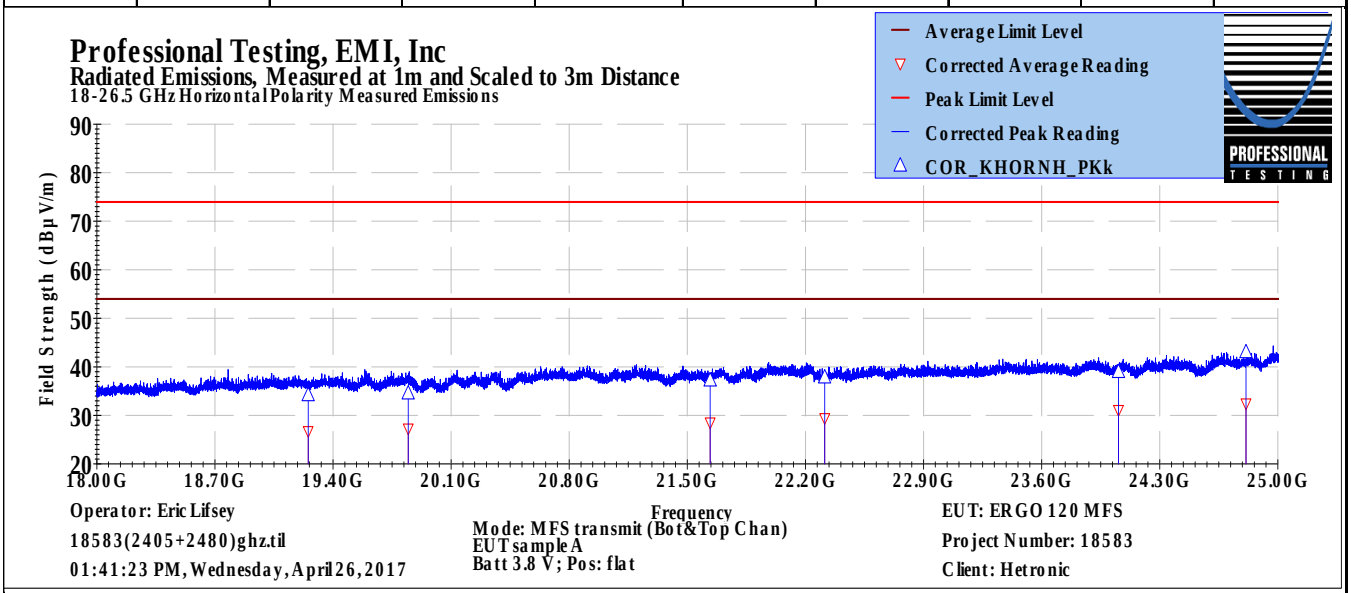
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2405 MHz & 2480 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4800.38	3	134	3.72	Peak	41.2	37.426	74.0	-36.5	Pass
4959.86	3	315	1.18	Peak	41.8	38.588	74.0	-35.4	Pass
7205.19	3	316	1.91	Peak	38.8	41.67	74.0	-32.3	Pass
7434.46	3	258	3.62	Peak	38.3	42.003	74.0	-32.0	Pass
9612.81	3	345	1.02	Peak	35.1	43.145	74.0	-30.8	Pass
9918.42	3	319	3.13	Peak	36.5	44.365	74.0	-29.6	Pass
12013.4	3	108	1.37	Peak	36.6	46.977	74.0	-27.0	Pass
12402.5	3	44	2.76	Peak	36	46.707	74.0	-27.3	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

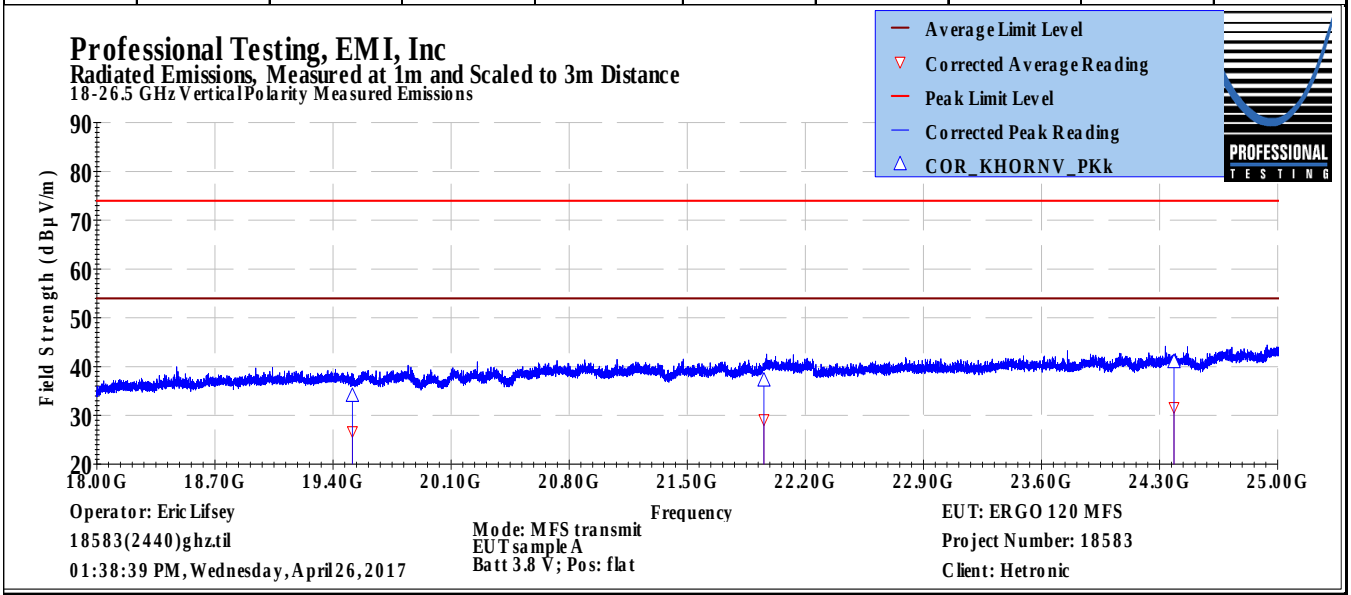
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Vertical	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2440 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19515.6	3	378	1	Peak	39.9	34.002	74.0	-40.0	Pass
21954.6	3	66	1	Peak	42.7	37.156	74.0	-36.8	Pass
24385.4	3	321	1	Peak	44.9	40.938	74.0	-33.0	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

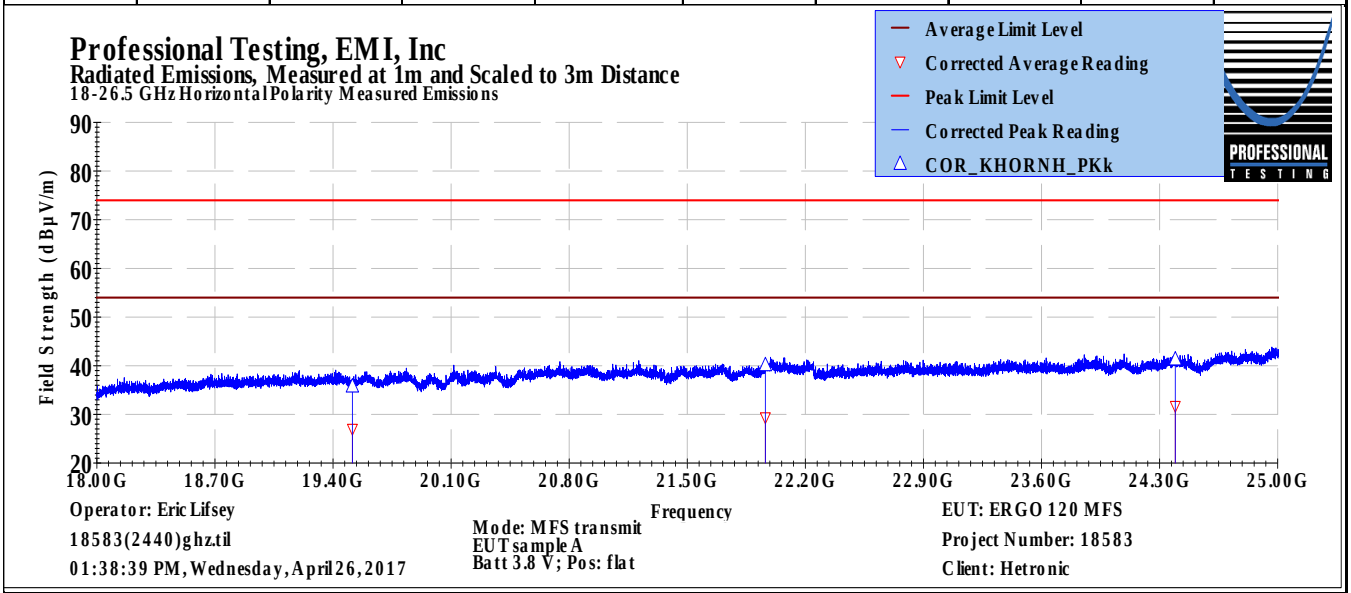
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2017	**EUT Serial #:**	Item/Sample B
Customer:	Hetronic	**EUT Part #:**	None
Project Number:	18583	**Test Technician:**	Eric Lifsey
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MFS ERGO120	**Witness' Name:**	None

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3.8 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit Mode 2440 MHz	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4883.36	3	26	2.63	Peak	42.4	38.933	74.0	-35.0	Pass
7315.35	3	123	1.63	Peak	38.6	41.784	74.0	-32.2	Pass
9762.07	3	318	2.63	Peak	37	44.784	74.0	-29.2	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Antenna Construction Requirements

7.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users.

7.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203, 15.247 // RSS-Gen 8.3	Antenna Construction	25 Apr 2017

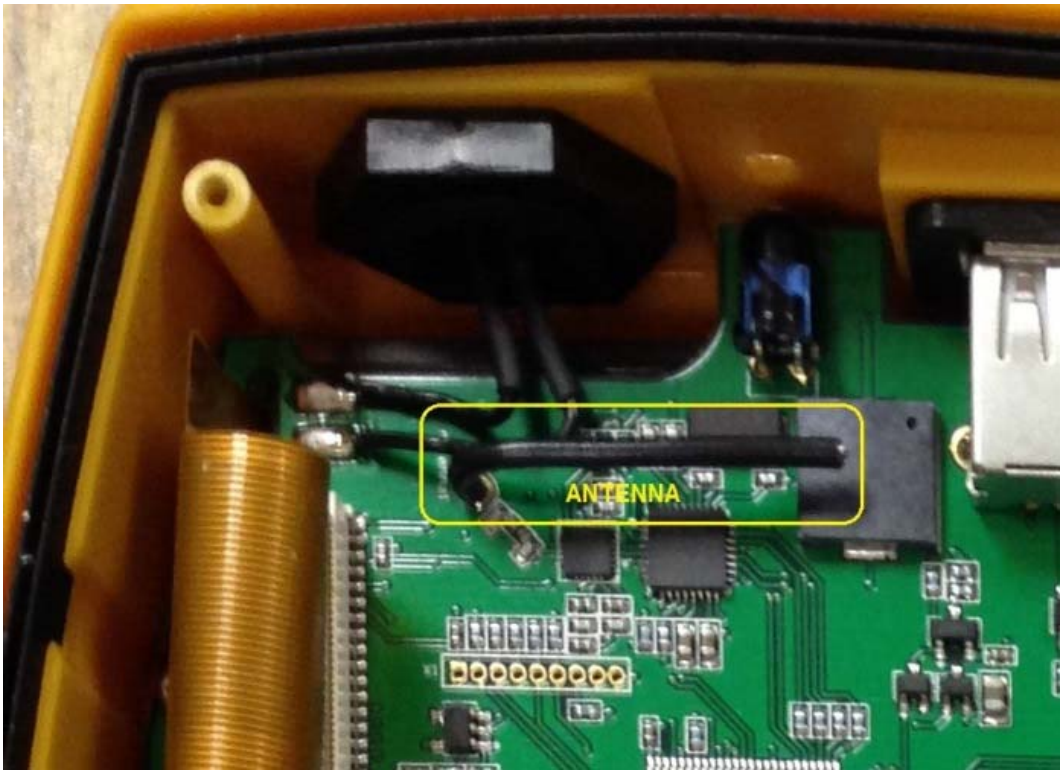
7.3 Results

Table 8.3.1 Antenna Construction Details

On-Board Wire Antenna

Manufacturer: Hetronic
Model/PN:

Type: monopole, bent wire
Gain 0.0 dBi
Soldered to circuit board, internal to system, and not subject to user modification.



Antenna Location / Construction Detail

The antenna system design above satisfies the requirements of the rules.

8.0 Equipment

8.1 Radiated Emissions 30 MHz to 25 GHz

Tile! Software Version:	4.2.A, May 23, 2010, 08:38:52 AM
Test Profile:	2016 RE_ClassA - Boresite+Mast_LowPRF_072616.til or 2016 RE_ClassB - Boresite+Mast_LowPRF_072616.til

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2017
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/15/2017
2172	ETS-Lindgren	3142C	Antenna, Biconilog, 26 MHz-3GHz	49383	11/27/2018
C027D	PTI	None	Relay	none	N/A
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	6/19/2017
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2017
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/15/2019
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	11/20/2018
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	11/17/2018

8.2 Bandwidth, Duty Cycle, Band Edge

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017
1831	HP	6622A	Power Supply	CIU
0472	Tektronix	THS730A	DMM/Scope	15 Nov 2017
C241	Pasternack	PE300-120	RG type cable	21 Jan 2018
None	ETS	5211	Shielded Enclosure	CIU
None	PTI	None	2 GHz Sleeve Sense Antenna	CIU

9.0 Measurement Bandwidths

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	1000	2	Multiple Sweeps
18000	26500	1000	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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