
Project 17389-15

**Hetronic International
CS46X Transceiver Module
462.000 to 469.000 MHz**

Wireless Certification Report

Prepared for:

Hetronic International
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

29 Sep 2015

Reviewed by



Larry Finn
Chief Technical Officer

Written by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial draft for review.	29 Sep 2015
00	Released/final no changes.	1 Oct 2015

Corrections

None.

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NOTICE:

(1) This Report must not be used to claim product endorsement, by NVLAP, NIST, the FCC or any other Agency. This report also does not warrant certification by NVLAP or NIST.

(2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc.

(3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



Certificate of Compliance

Applicant	Device & Test Identification
Hetronic International LLC (David Cameron) 3905 NW 36th St. Oklahoma City, OK 73112 USA Certificate Date: 29 Sep 2015	FCC ID: LW9-CS46X IC ID: 2119-CS46X Model(s): CS46X Laboratory Project ID: 17389-15

The device model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR (USA) FCC, RSS IC(Industry Canada)		
Parameter	FCC	IC
Conducted Output Power	90.210, 2.1046	RSS-119 Issue 12, 5.4
Emission Mask C	90.210(c), 2.1047	RSS-119 Issue 12, 5.8.3
Conducted Spurious/Harmonic Emissions at Antenna Terminals	90.210, 2.1051	RSS-119 Issue 12, 5.8; RSS-Gen Issue 4
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.210, 15.209, 2.1053	RSS-119 Issue 12, 5.8
Transient Frequency Behavior	90.214, TIA/EIA-603C	RSS-119 Issue 12, 5.9
Frequency Stability	90.213, 2.1055	RSS-119 Issue 12, 5.3
Occupied Bandwidth, 20 dB, < 11.5 kHz	90.209, 2.1049	RSS-119 Issue 12, 5.5
Radiated Emissions 30 MHz – 5 GHz	15.109	RSS-Gen Issue 4, ICES-003
Exemption For Power $\leq$ 120 mW	90.217(b)	RSS-119 5.10
Mains Conducted Emissions, Class B	15.107	RSS-Gen Issue 4, ICES-003
Maximum Permissible Exposure		

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above rules 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.

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. The procedures of ANSI C63.4: 2009 were used for making all radiated enclosure and mains emission measurements unless specified otherwise in TIA/EIA-603.

1.2 EUT Description

The EUT is a transceiver module used in systems that transmit alert codes to other associated wireless devices in industrial environments; inclusive of locomotive control systems. It receives power from the host system. The EUT supports external antennas, or cable thereto, attached to the host board by pin connectors then terminated to an SMB or SMA connector.

Table 1.2.1 Equipment Under Test			
Manufacturer & Description	Model	Serial #	Photo
Hetronic International Transceiver module for 462 to 469 MHz.	CS46X	none	 Module installed on C12H coder board.

Table 1.2.2 Options		
Manufacturer & Description	Gain	Approvals
ASA RF Amplifier Module	10 dB	FCC ID: LW9-ASA3460M

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. It was tested installed in a host system having an all plastic enclosure offering no additional shielding.

Table 1.3.1 Host System		
Manufacturer & Model	Serial Number	Description
Hetronic Controller, Nova H12-00429	30815306387	Control transmitter for industrial systems.

Table 1.3.2 Operating Frequency/Range
462.000 MHz to 469.000 MHz with center frequency 465.500 MHz.

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.

2.0 Applicable Documents and Clauses

Table 2.0.1: Applicable Documents		
Document #	Title/Description	Date
47 CFR	FCC Part 90	
IC RSS	RSS-119 Issue 12	2015
IC RSS	RSS-Gen Issue 4	2014
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment	2009
TIA/EIA-603D	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards	2009

Table 2.0.2: Applicable Clauses		
Parameter	FCC	IC
Conducted Output Power	90.210, 2.1046	RSS-119 Issue 12, 5.4
Emission Mask C ¹	90.210(c), 2.1047	RSS-119 Issue 12, 5.8.3
Conducted Spurious/Harmonic Emissions at Antenna Terminals	90.210, 2.1051	RSS-119 Issue 12, 5.8; RSS-Gen Issue 4
Field Strength of Radiated Spurious/Harmonic Emissions Fundamental to 5 GHz	90.210, 15.209, 2.1053	RSS-119 Issue 12, 5.8
Transient Frequency Behavior ²	90.214, TIA/EIA-603C	RSS-119 Issue 12, 5.9
Frequency Stability	90.213, 2.1055	RSS-119 Issue 12, 5.3
Occupied Bandwidth, 20 dB, < 11.5 kHz	90.209, 2.1049	RSS-119 Issue 12, 5.5
Radiated Emissions 30 MHz – 5 GHz	15.109	RSS-Gen Issue 4, ICES-003
Exemption For Power ≤ 120 mW ²	90.217(b)	RSS-119 5.10
Mains Conducted Emissions, Class B ³	15.107	RSS-Gen Issue 4, ICES-003
Maximum Permissible Exposure ³	³	³

¹Modified by 90.217(b) exemption.

²Transmit power is below 120 mW which meets the requirement for exemption for this test.

³Exposure is reported in a separate supplement to this report.

3.0 Conducted Output Power

3.1 Procedure

The EUT was provided with a SMB or SMA connector for attachment of cable or antenna. The EUT is placed into continuous transmit mode without modulation and peak power is measured.

3.2 Criteria

Parameter	Section Reference	Date
Conducted Output Power	90.210, 2.1046 RSS-119 Issue 12, 5.4	22 Sep 2015

3.3 Results

An SMB-SMA adapter set was used to connect to the EUT antenna port so power was read directly with no factors required.

The EUT satisfied the requirement. Tabular results are presented below.

Table 3.3.1 Power, Peak, Conducted		
Frequency (MHz)	Power (dBm)	Power (mW)
462.000	9.67	9.27
465.500	9.91	9.80
469.000	9.95	9.89

4.0 Emission Mask

4.1 Procedure

Emissions are measured with peak detector. The frequency span is the inner mask area and spectrum nearby.

4.2 Criteria

Parameter	Section Number	Date
Emissions at Antenna Terminals	90.210(c), 90.217(b), 2.1047 RSS-119 Issue 12, 5.8.3	23 Sep 2015

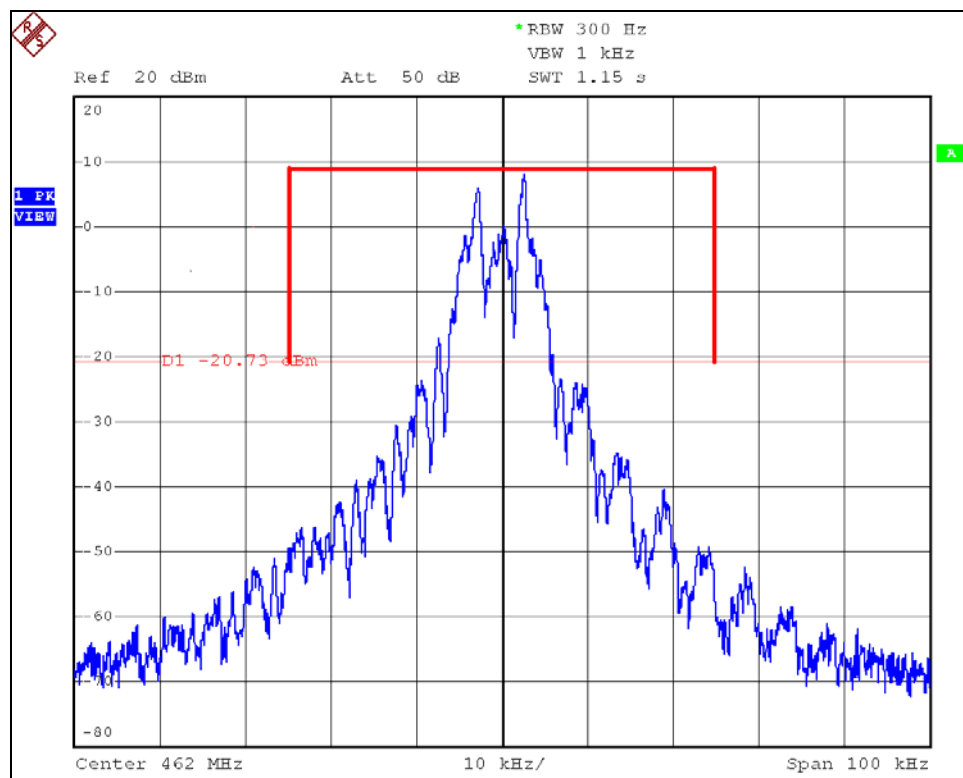
4.3 Results

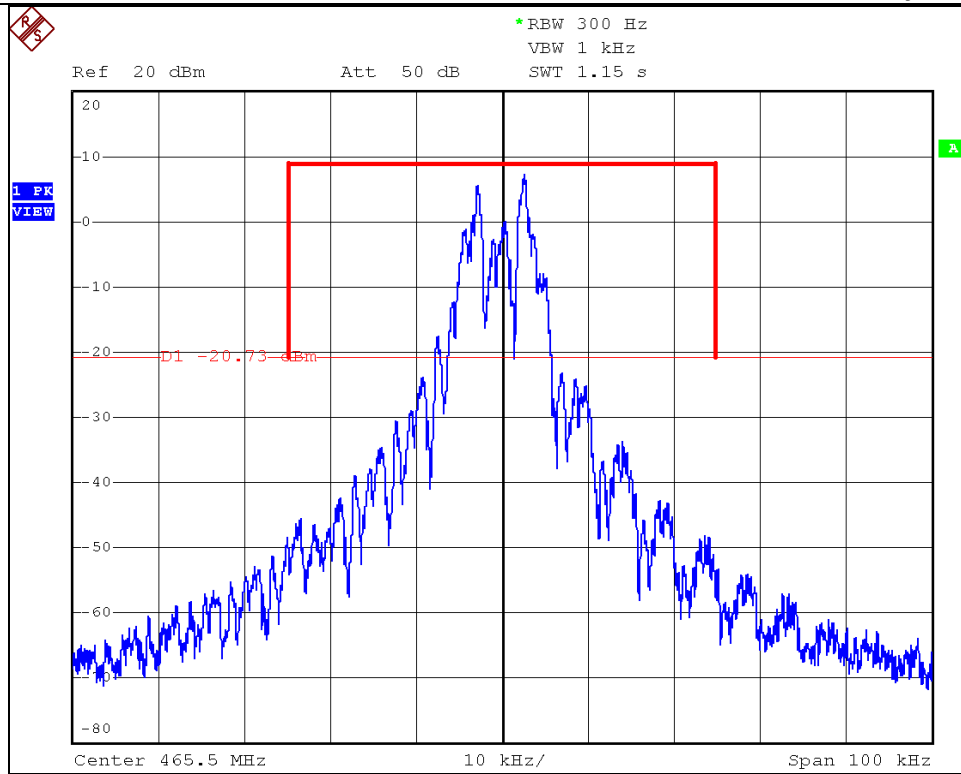
Per 90.217(b) $\text{Attenuation}_{\text{dB}} = 30 \text{ dBc}$

$\text{Limit}_{\text{dBm}} = \text{Fundamental_Power}_{\text{dBm}} - \text{Attenuation}_{\text{dB}}$

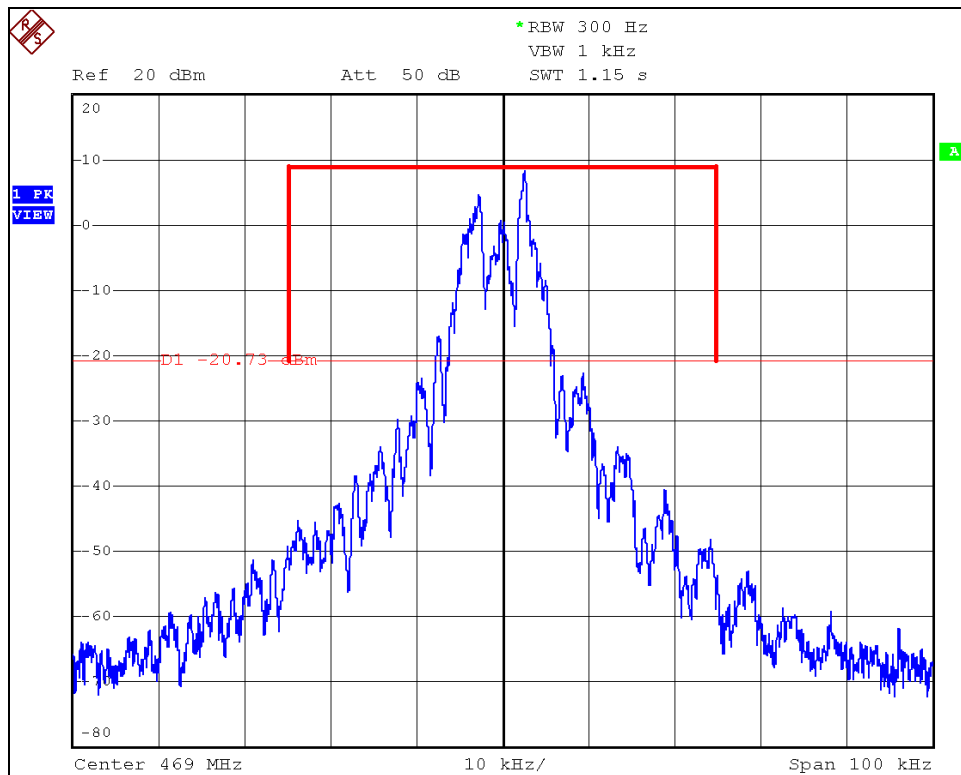
RF Module Limit = $9.27 \text{ dBm} - 30 \text{ dB} = -20.73 \text{ dBm}$

The emission measured within the mask as shown in the plot below. The EUT satisfied the requirement.





Modulated Emission with Superimposed Mask per 90.217(b), Middle Channel



Modulated Emission with Superimposed Mask per 90.217(b), High Channel

5.0 Spurious Emissions at Antenna Terminals

5.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode without modulation. The connection is direct and no cables are used. Spurious signals are then measured directly with no additional calculation required. Emissions are measured with a peak detector function from 9 kHz to 5 GHz to include the tenth harmonic 4.69 GHz.

5.2 Criteria

Parameter	Section Number	Date
Emissions at Antenna Terminals	90.210(b), 2.1047 RSS-119 Issue 12, 5.8	23 Sep 2015

Per procedures of TIA/EIA-603, below 1 GHz measurement resolution bandwidth is 10 KHz with video bandwidth set higher at 100 kHz. Above 1 GHz measurement resolution bandwidth is 1 MHz with video bandwidth higher at 10 MHz.

Limit is determined from 90.217(b) for emissions beyond 25 kHz from authorized bandwidth.

Per 90.217(b) $\text{Attenuation}_{\text{dB}} = 30 \text{ dB}$

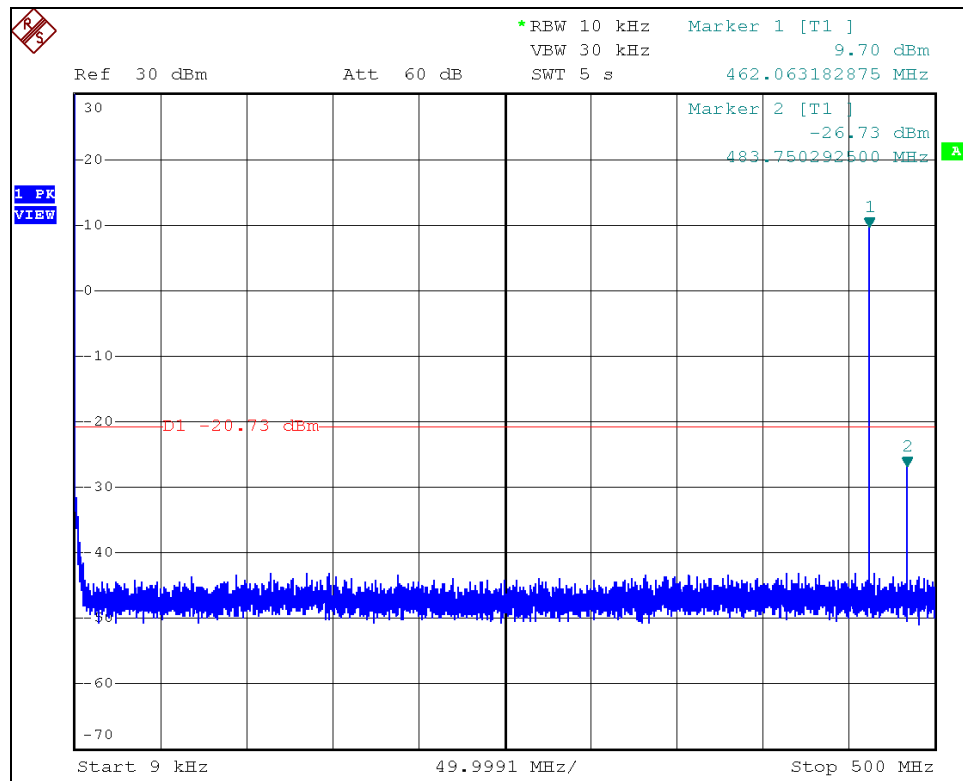
$\text{Limit}_{\text{dBm}} = \text{Fundamental_Power}_{\text{dBm}} - \text{Attenuation}_{\text{dB}} = 9.27 \text{ dBm} - 30 \text{ dB} = -20.73 \text{ dBm}$

5.3 Results

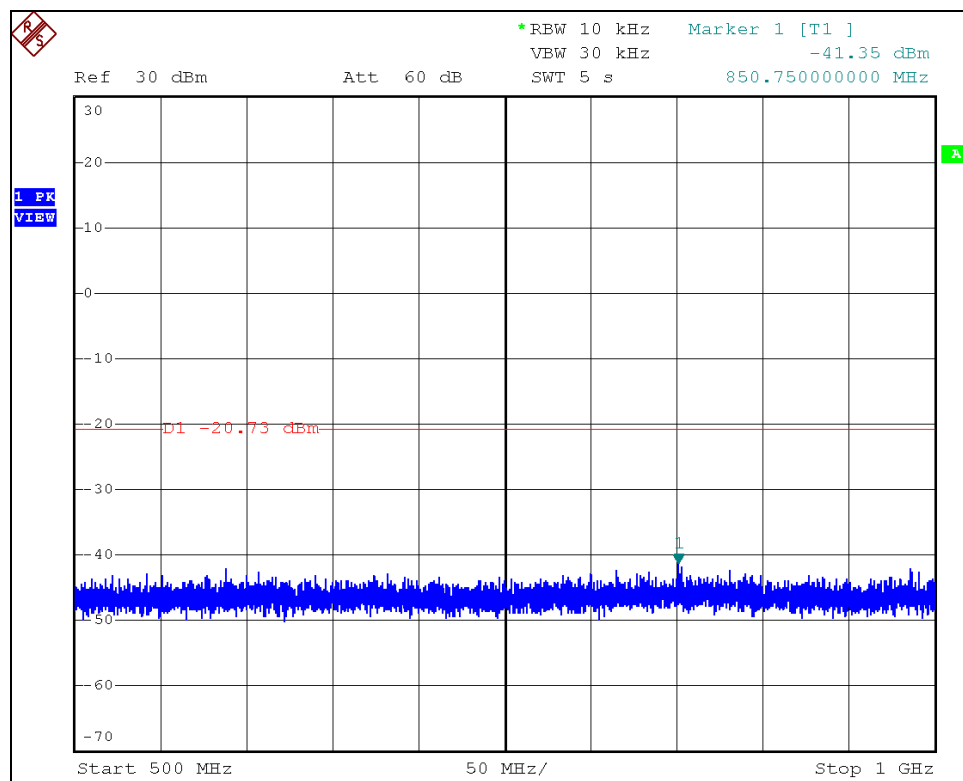
Measurements were performed with a direct connection to the spectrum analyzer such that no external losses or gains would apply.

The EUT was found to be in compliance with applicable requirements. Plotted results are presented below.

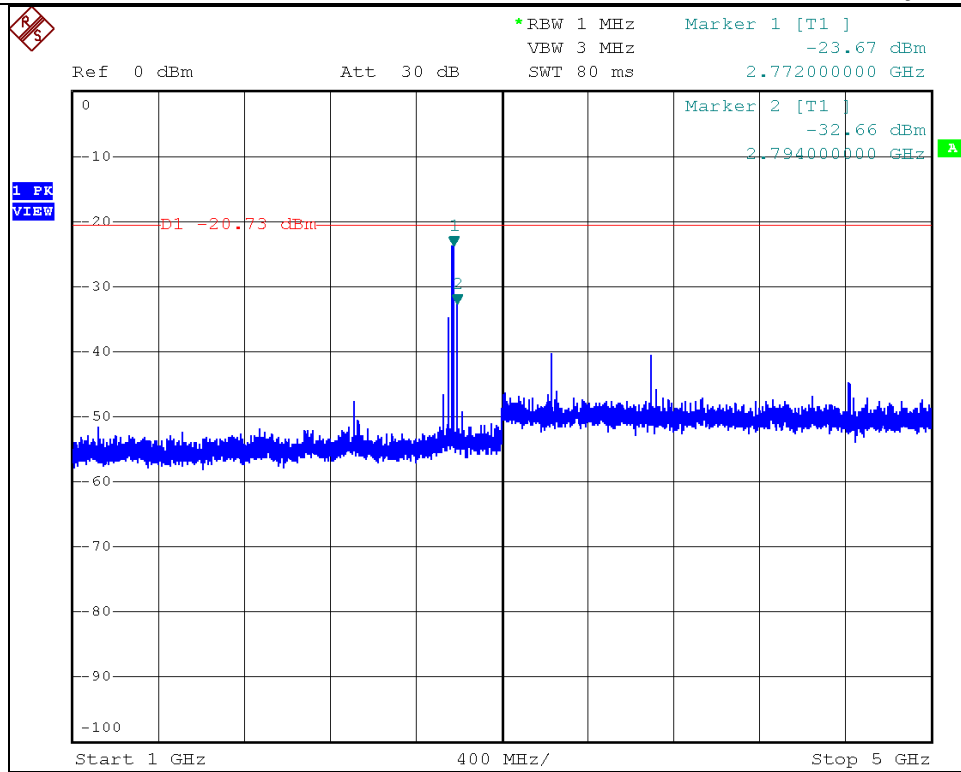
In the plots the emission limit is shown as a red line at -20.73 dBm.



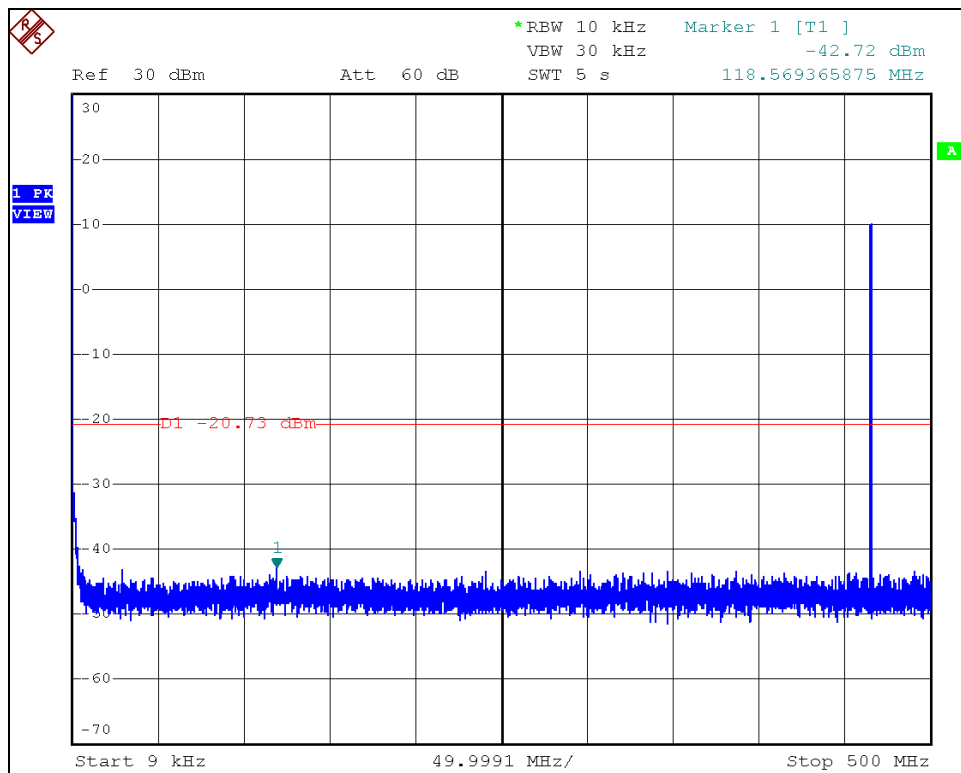
Low Channel, Range 1: 9 kHz to 500 MHz including Fundamental



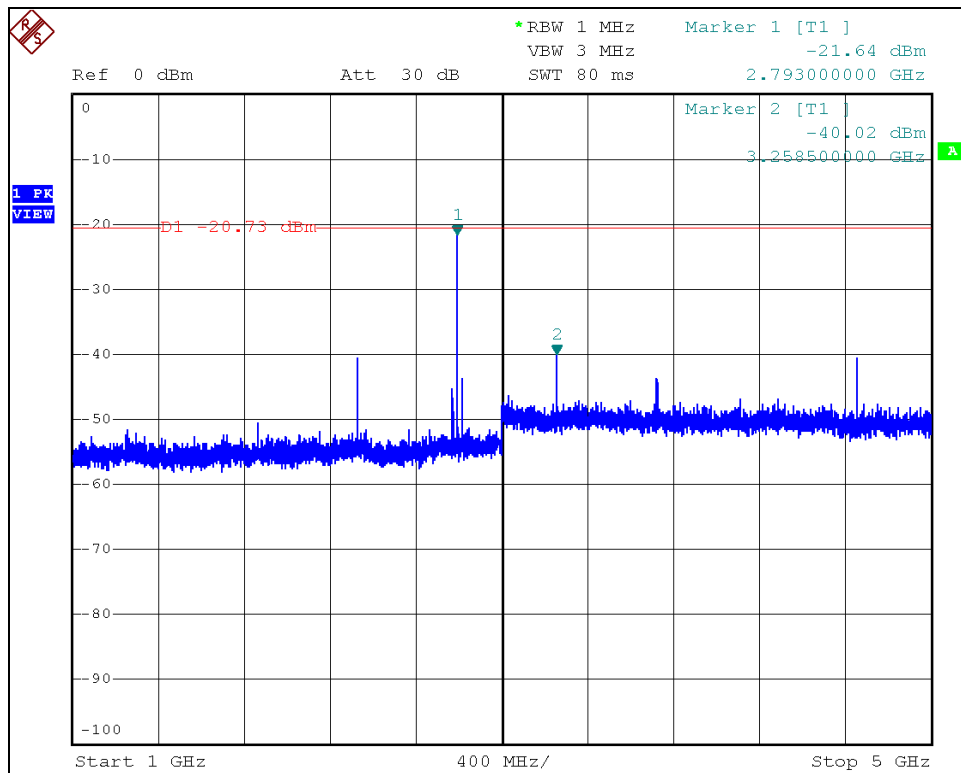
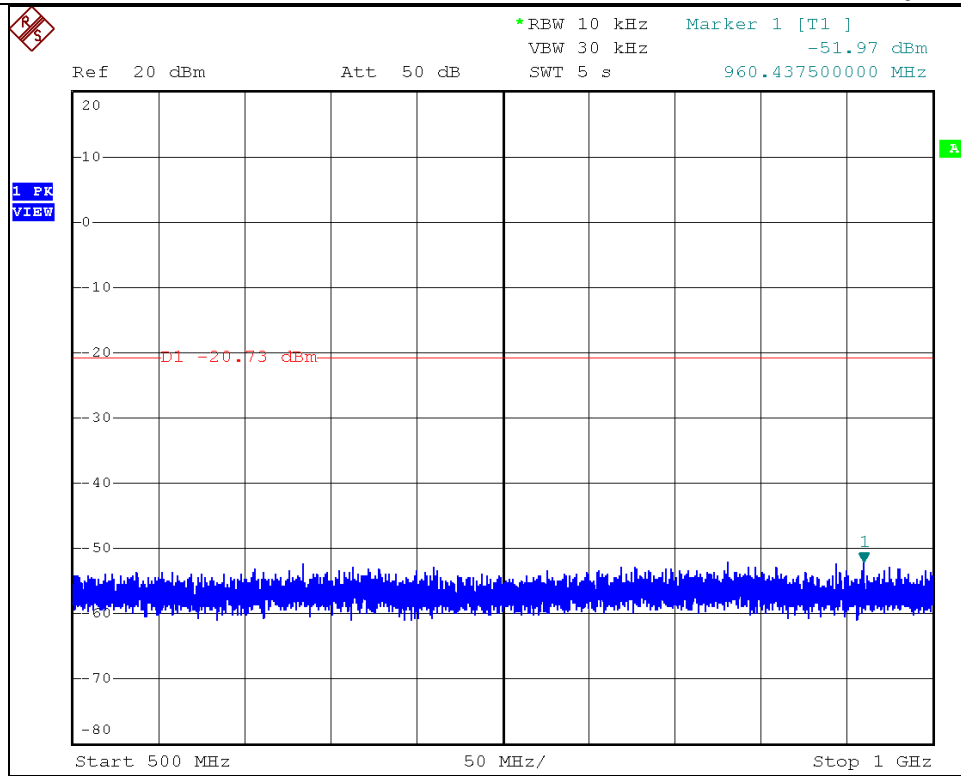
Low Channel, Range 2: 500 MHz to 1 GHz

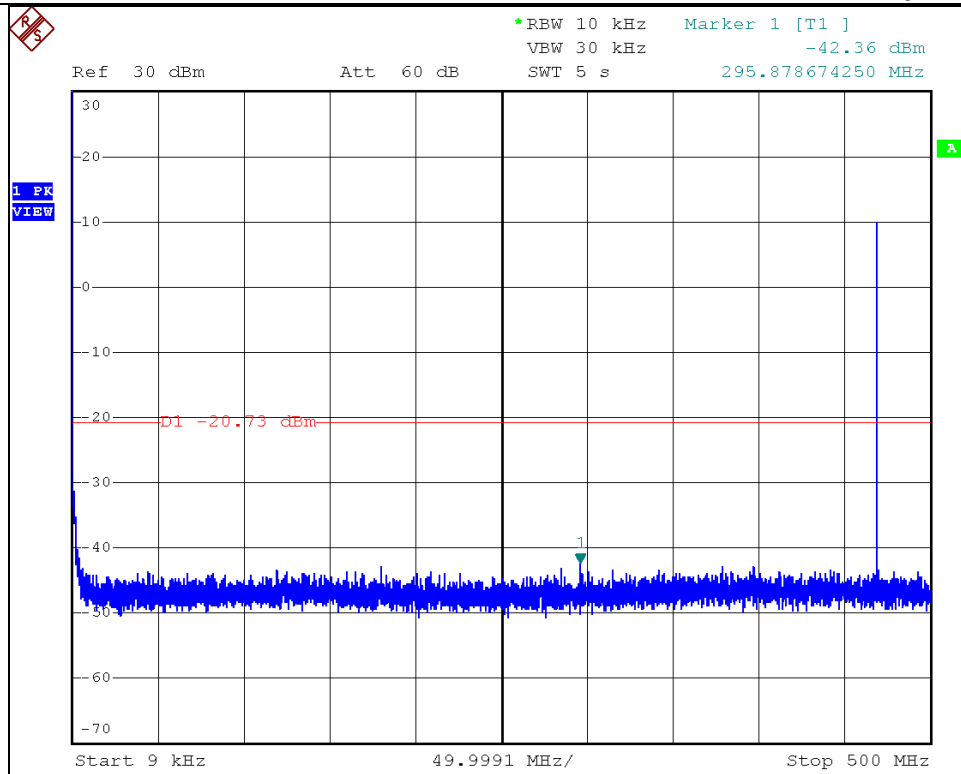


Low Channel, Range 3: 1 GHz to 5 GHz

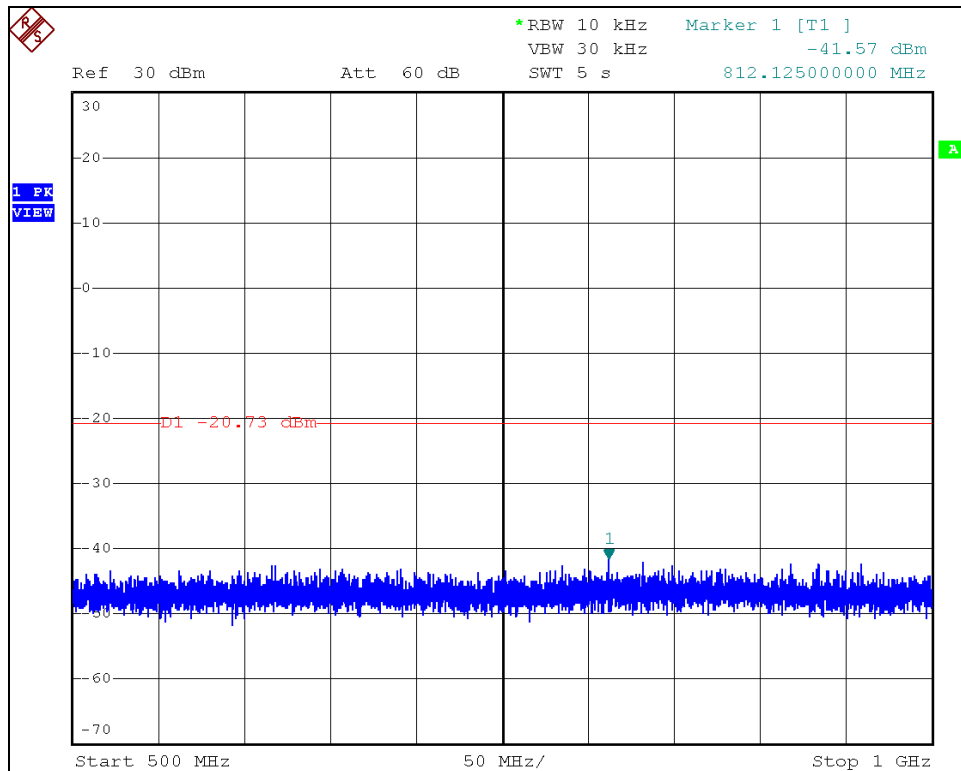


Middle Channel, Range 1: 9 kHz to 500 MHz including Fundamental

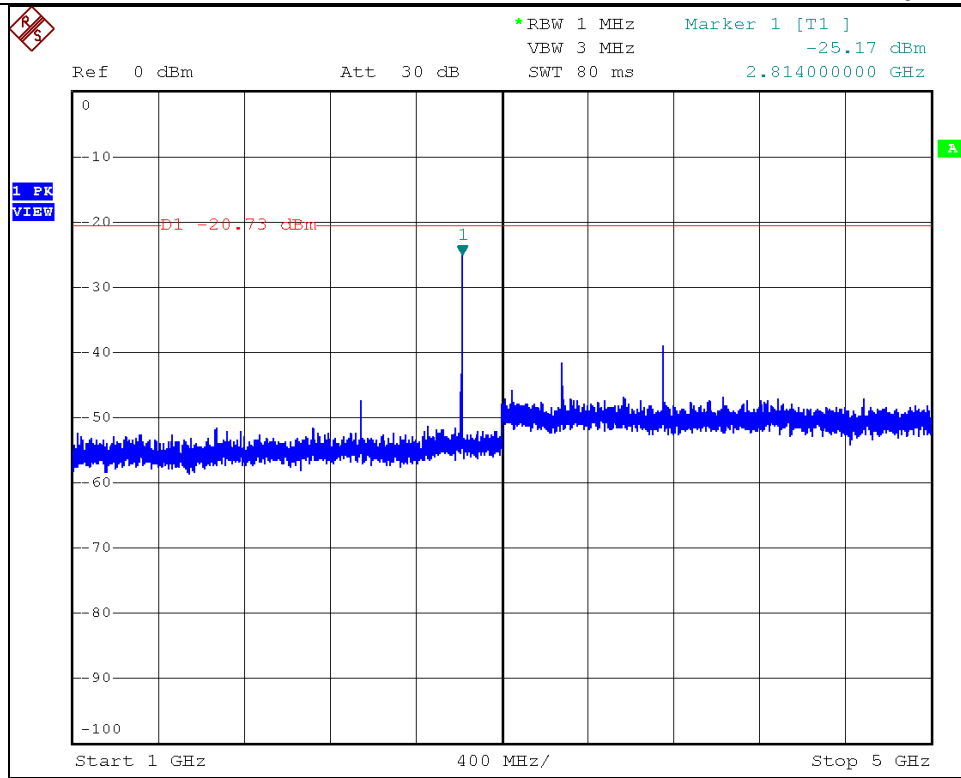




High Channel, Range 1: 9 kHz to 500 MHz including Fundamental



High Channel, Range 2: 500 MHz to 1 GHz

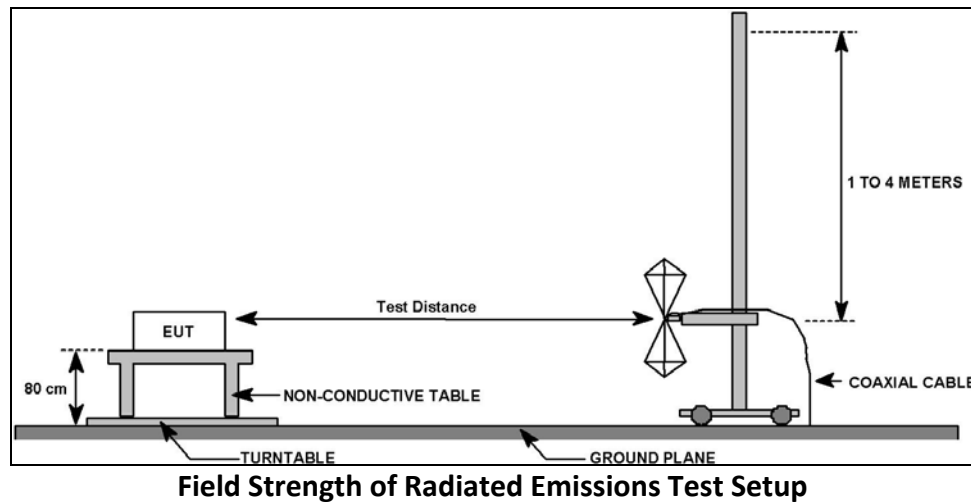


High Channel, Range 3: 1 GHz to 5 GHz

6.0 Field Strength of Radiated Spurious Emissions

6.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna. The EUT was placed into transmit mode with the antenna removed and a resistive terminator substituted.



6.2 Criteria

Parameter	Section Number	Date
Field Strength of Radiated Emissions 30 MHz to 5 GHz	90.210, 15.209, 2.1053 RSS-119 Issue 12, 5.8; RSS-Gen Issue 4	24 Sep 2015 28 Sep 2015

6.3 Results

The EUT is hand-held which called for 3 measurement orientations in transmit mode. The optional power amplifier was included for worst-case emissions. The lower emission limits for the module transmitter were applied and determined as follows:

Limit is determined from 90.217(b) for emissions beyond 25 kHz from authorized bandwidth.

Per 90.217(b) $\text{Attenuation}_{\text{dB}} = 30 \text{ dB}$

$\text{Limit}_{\text{dBm}} = \text{Fundamental_Power}_{\text{dBm}} - \text{Attenuation}_{\text{dB}} = 9.27 \text{ dBm} - 30 \text{ dB} = -20.73 \text{ dBm}$

The conducted limit was converted to the field strengths for 10 and 3 meter distances.

The worse-case orientation of the EUT was determined as flat.

For receive mode emissions, the general emission limits were applied.

The EUT satisfied the requirement.

6.3.1 Transmit Mode, Low Channel

Professional Testing, EMI, Inc.			
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).	
In accordance with:		FCC Part 90	
Section:		Exempted, -30 dBc Criteria	
Test Date(s):	9/24/2015	EUT Serial #:	30815306387
Customer:	Hetronic International	EUT Part #:	0
Project Number:	17389-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	H12-00429; Nova Controller	Witness' Name:	None
Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	3.6	VDC	
EUT Power Frequency:	0	N/A	
Antenna Orientation:	Vertical		Frequency Range: 30MHz to 1GHz
EUT Mode of Operation:		Transmit, Low Chan, Flat Pos	
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz- 1GHz Vertical Polarity Measured Emissions Corrected Peak Value Limit_30dBc_10m The graph shows Field Strength (dB μV/m) on the y-axis (0 to 70) versus Frequency (MHz) on the x-axis (30M to 1G). A blue line represents the 'Corrected Peak Value' and a red line represents the 'Limit_30dBc_10m'. The blue line shows several peaks, with the highest reaching approximately 60 dB μV/m at 100 MHz and another near 50 dB μV/m at 1 GHz. The red limit line is constant at approximately 65 dB μV/m. Operator: Eric Lifsey 17389\Run02\RE\SpuriousPosFlatChanLow.ttl 11:48:51 AM, Thursday, September 24, 2015 Mode: transmit, constant, unmodulated Pos: Flat, Chan: Low Limits: module -20.73 dBm EUT: Nova Controllerw/PA-1 Project Number: 17389-15 Client: Hetronic International			

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

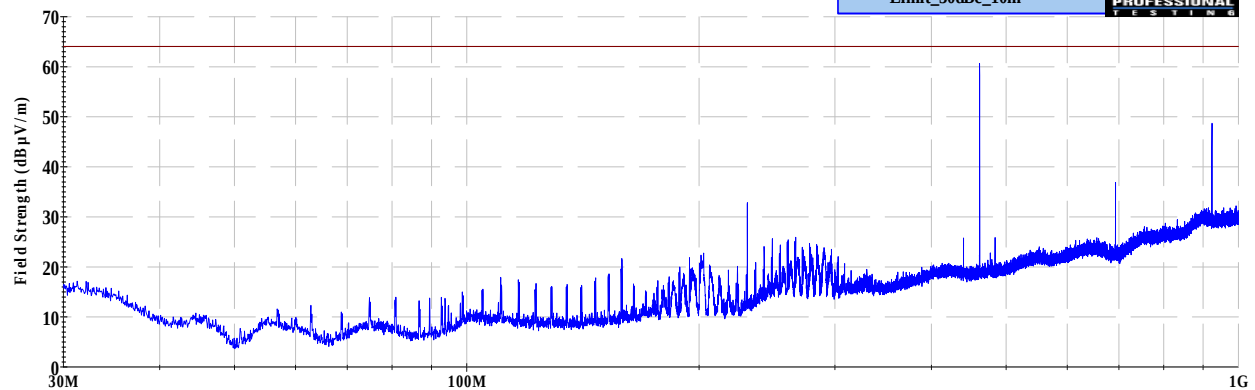
Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

Transmit, Low Chan, Flat Pos

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run02 RE Spurious Pos Flat Chan Low.til

Mode: transmit, constant, unmodulated

Project Number: 17389-15

11:48:50 AM, Thursday, September 24, 2015

Pos: Flat, Chan: Low
Limits: module -20.73 dBm

Client: Hetronic International

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

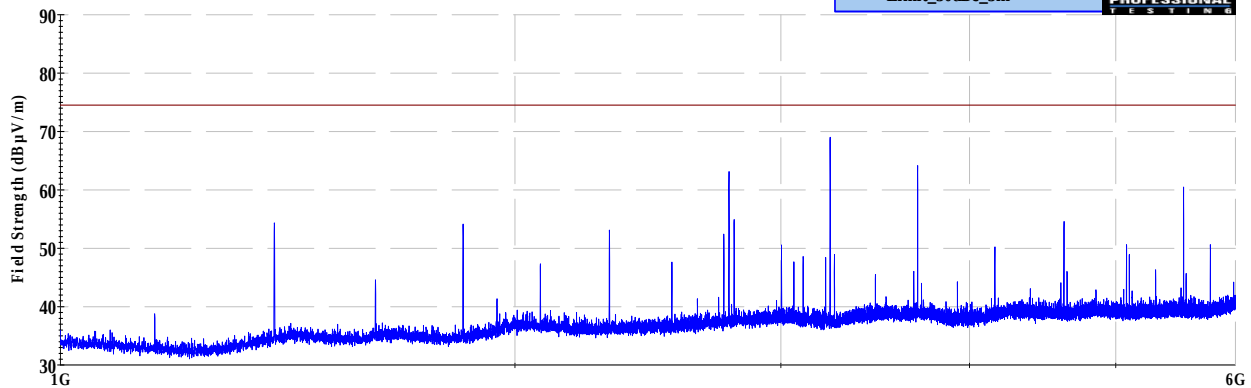
Antenna Orientation: Vertical

Frequency Range: Above 1GHz

EUT Mode of Operation:

Transmit, Low Chan, Flat Pos

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run02 RE Spurious Pos Flat Chan Low.til

Mode: transmit, constant, unmodulated

Project Number: 17389-15

11:57:01 AM, Thursday, September 24, 2015

Pos: Flat, Chan: Low
Limits: module -20.73 dBm

Client: Hetronic International

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

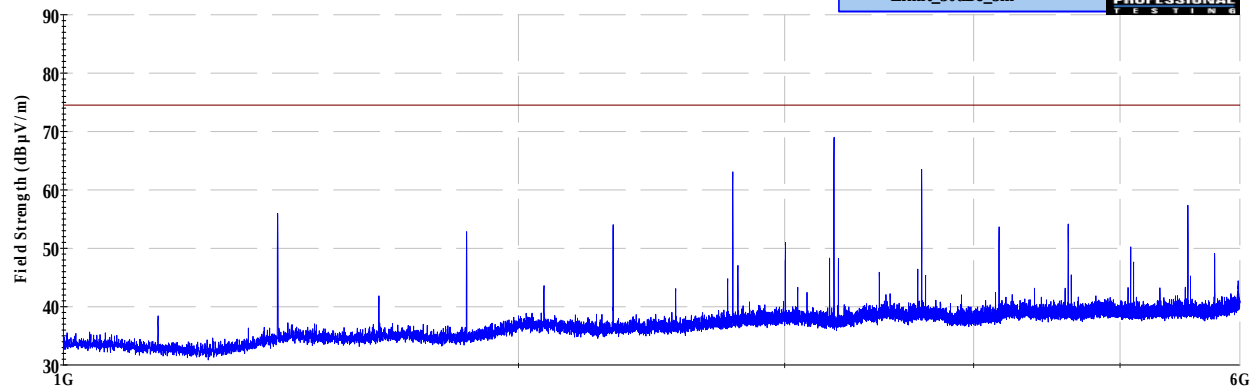
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:

Transmit, Low Chan, Flat Pos

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run02 RE'Spurious'PosFlat'ChanLow.ttl

Mode: transmit, constant, unmodulated

Project Number: 17389-15

11:56:59 AM, Thursday, September 24, 2015

Pos: Flat, Chan: Low
Limits: module -20.73 dBm

Client: Hetronic International

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Transmit Mode, Middle Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 90		
Section:	Exempted, -30 dBc Criteria		
Test Date(s):	9/24/2015	EUT Serial #:	30815306387
Customer:	Hetronic International	EUT Part #:	0
Project Number:	17389-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	H12-00429; Nova Controller	Witness' Name:	None
Radiated Emissions Test Results Data Sheet		Page:	1 of 1
EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Mid Channel, Flat Position	
Professional Testing, EMI, Inc. Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions Field Strength (dB µV/m) Frequency Operator: Eric Lifsey 17389 'Run04'RE'Spurious'PosFlat'ChanMid.tif 01:22:31 PM, Thursday, September 24, 2015 Mode: transmit, constant, unmodulated Pos: Flat, Chan: Mid Limits: module -20.73 dBm — Corrected Peak Value — Limit_30dBc_10m PROFESSIONAL TESTING EUT: Nova Controllerw/PA-1 Project Number: 17389-15 Client: Hetronic International			
≤ 1GHz Vertical Antenna Polarity Measured Emissions			

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

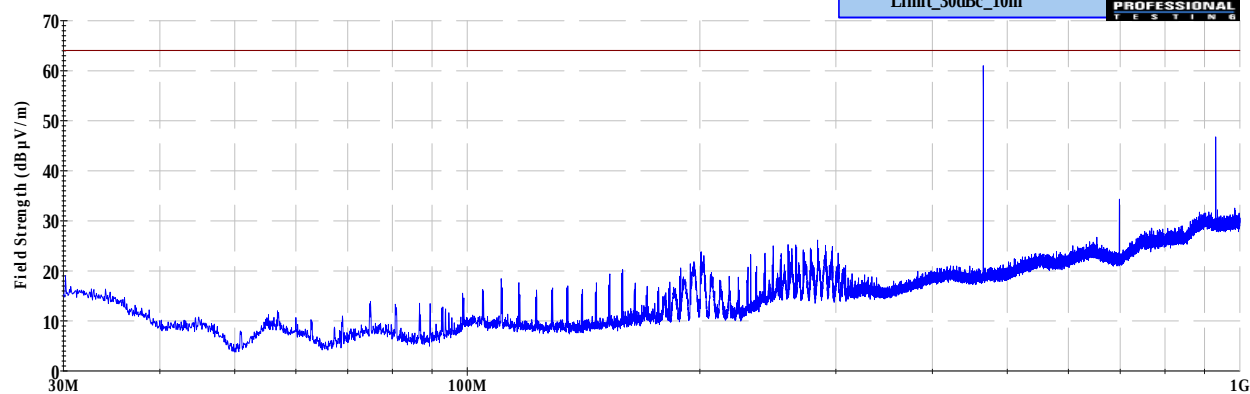
Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

Transmit, Mid Channel, Flat Position

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

17389 Run04 RE'Spurious'PosFlat'ChanMid.ttl

01:22:29 PM, Thursday, September 24, 2015

Mode: transmit, constant, unmodulated

Pos: Flat, Chan: Mid

Limits: module -20.73 dBm

EUT: Nova Controller w/PA-1

Project Number: 17389-15

Client: Hetronic International

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

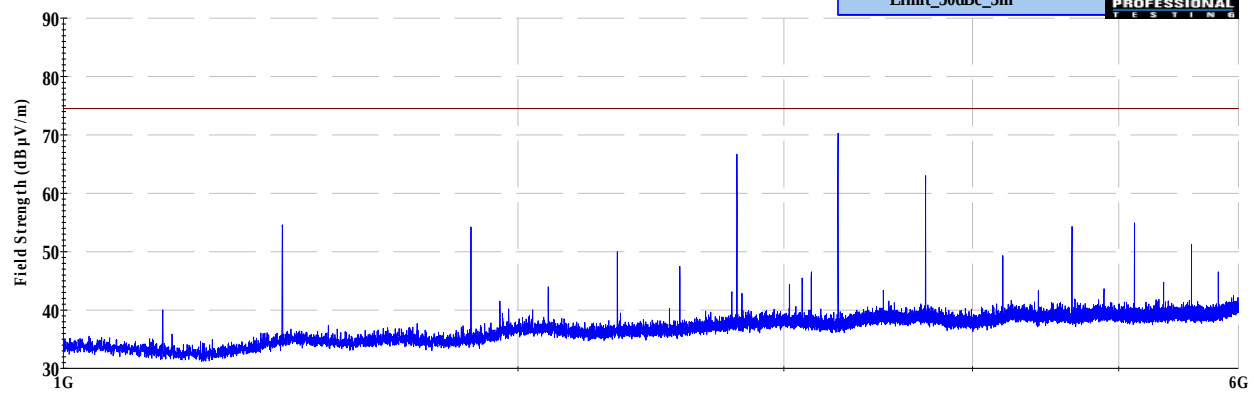
EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

Antenna Orientation: Vertical

Frequency Range: Above 1GHz

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run04 RE Spurious Pos Flat Chan Mid.ttl

Mode: transmit, constant, unmodulated

Project Number: 17389-15

01:31:08 PM, Thursday, September 24, 2015

Pos: Flat, Chan: Mid
Limits: module -20.73 dBm

Client: Hetronic International

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

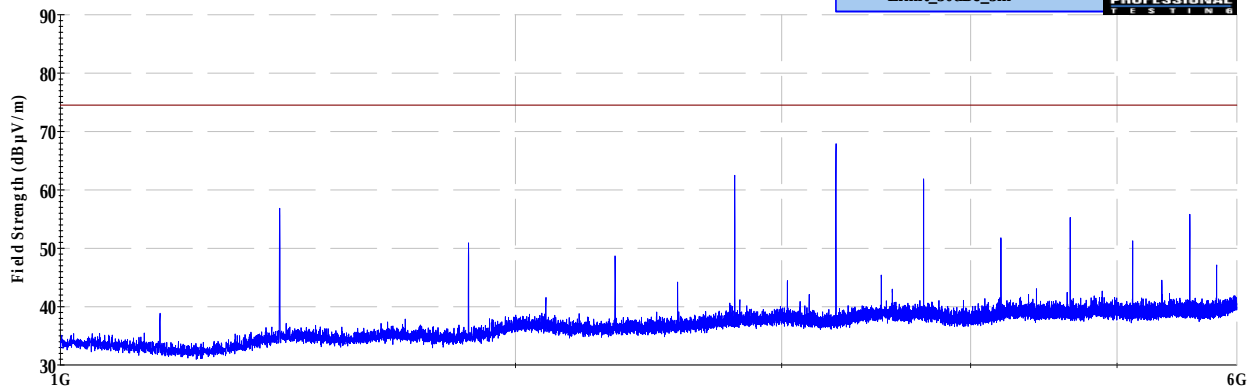
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:

Transmit, Mid Channel, Flat Position

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz HorizontalPolarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run04 RE'Spurious'PosFlat'ChanMid.ttl

Mode: transmit, constant, unmodulated

Project Number: 17389-15

01:31:06 PM, Thursday, September 24, 2015

Pos: Flat, Chan: Mid
Limits: module -20.73 dBm

Client: Hetronic International

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.3 Transmit Mode, High Channel

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 90		
Section:	Exempted, -30 dBc Criteria		
Test Date(s):	9/24/2015	EUT Serial #:	30815306387
Customer:	Hetronic International	EUT Part #:	0
Project Number:	17389-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	H12-00429; Nova Controller	Witness' Name:	None
Radiated Emissions Test Results Data Sheet		Page:	1 of 1
EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit, Top Channel, Flat Position	
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions Corrected Peak Value Limit_30dBc_10m Operator: Eric Lifsey 17389 Run05 RE'Spurious PosFlat'ChanHigh.til Mode: transmit, constant, unmodulated 02:03:06 PM, Thursday, September 24, 2015 Pos: Flat, Chan: High Limits: module-20.73 dBm EUT: Nova Controller w/PA-1 Project Number: 17389-15 Client: Hetronic International			
≤ 1GHz Vertical Antenna Polarity Measured Emissions			

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

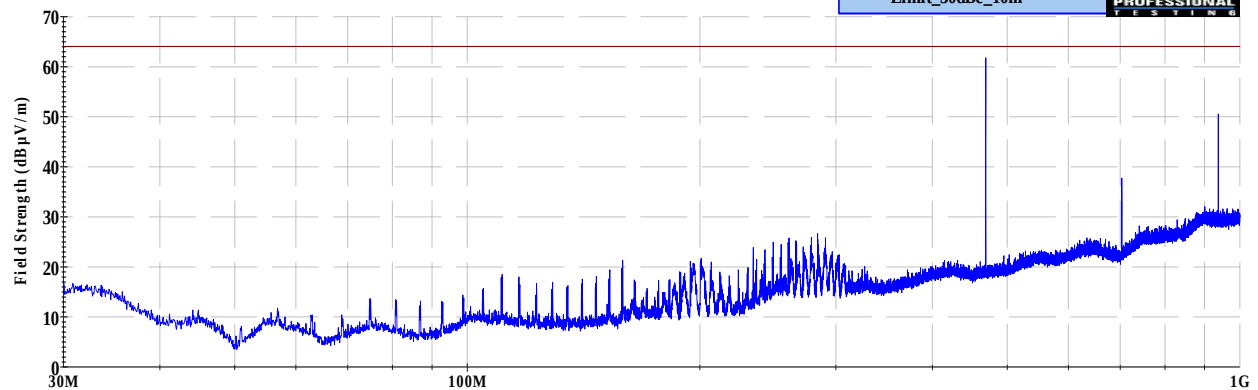
Antenna Orientation: Vertical

Frequency Range: Above 1GHz

EUT Mode of Operation:

Transmit, Top Channel, Flat Position

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

17389 Run05 RE'Spurious'PosFlat'ChanHigh.ttl

02:03:04 PM, Thursday, September 24, 2015

Mode: transmit, constant, unmodulated

Pos: Flat, Chan: High

Limits: module -20.73 dBm

EUT: Nova Controller w/PA-1

Project Number: 17389-15

Client: Hetronic International

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

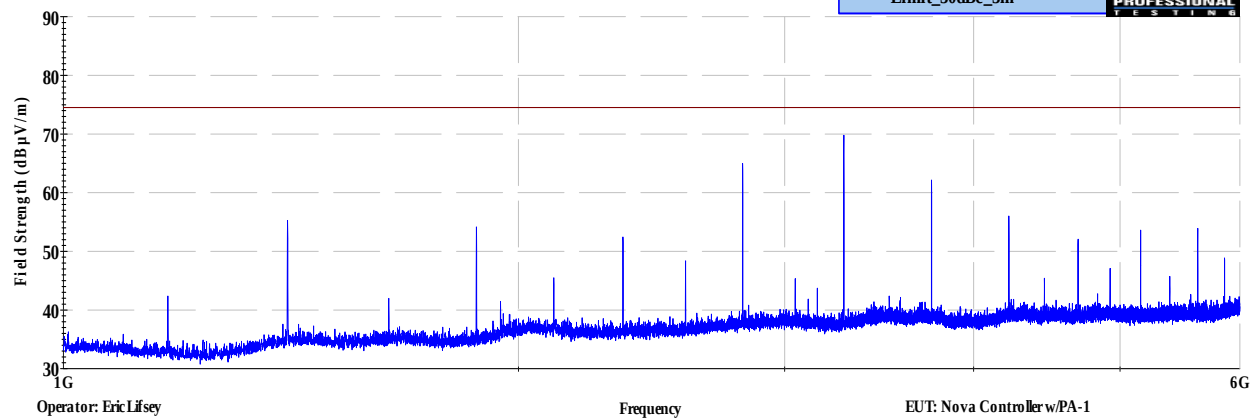
EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

Professional Testing, EMI, Inc.
Radiated Emissions, 3m Distance
1-6 GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run05 RE'SpuriousPosFlatChanHigh.tif

Mode: transmit, constant, unmodulated

Project Number: 17389-15

02:16:07 PM, Thursday, September 24, 2015

Pos: Flat, Chan: High
Limits: module -20.73 dBm

Client: Hetronic International

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 90

Section: Exempted, -30 dBc Criteria

Test Date(s): 9/24/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

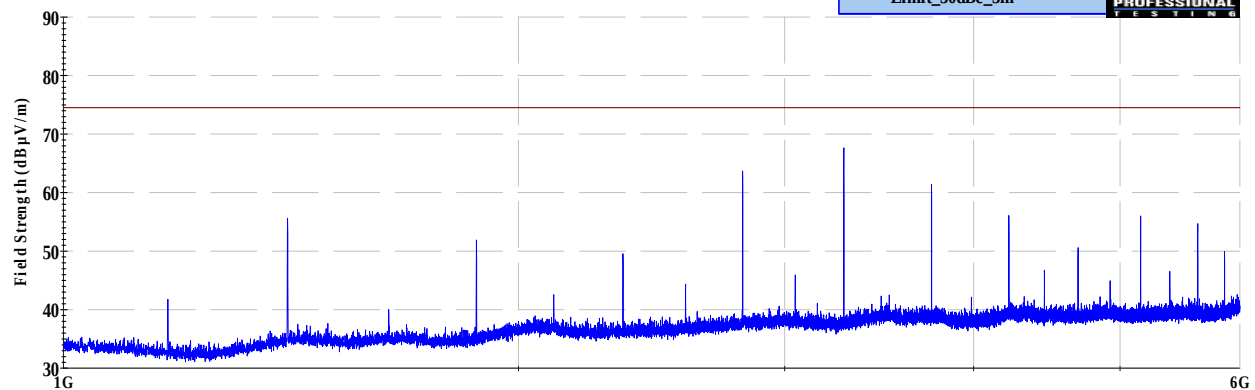
Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:

Transmit, Top Channel, Flat Position

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz HorizontalPolarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova Controller w/PA-1

17389 Run05 RE'SpuriousPosFlat'ChanHigh.ttl

Mode: transmit, constant, unmodulated

Project Number: 17389-15

02:16:06 PM, Thursday, September 24, 2015

Pos: Flat, Chan: High

Client: Hetronic International

Limits: module -20.73 dBm

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.4 Receive Mode

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits							
Section:		15.109							
Test Date(s):		9/28/2015		EUT Serial #:		30815306387			
Customer:		Hetronic International		EUT Part #:		0			
Project Number:		17389-15		Test Technician:		Eric Lifsey			
Purchase Order #:		NA		Supervisor:		Lisa Arndt			
Equip. Under Test:		H12-00429; Nova Controller		Witness' Name:		None			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3.6 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Vertical		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Receive Mode, Center Channel					
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
905.485	10	97	3.62	Quasi-peak	21.3	26.47	35.6	-9.1	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Vertical Polarity Measured Emissions

Field Strength (dBμV/m)

Frequency

Operator: Eric Lifsey
17389 RERun01 Spurious RX Mode til
07:40:27 AM, Monday, September 28, 2015

EUT Mode: Receive
EUT Power: 3.6 V Battery
Center Channel

EUT: Nova
Project Number: 17389-15
Client: Hetronic International

Legend:
— Quasi-peak Limit Level
△ Corrected Quasi-peak Reading
— Peak Limit Level
— Corrected Peak Value
△ Verified Low-PRF QP Reading
x LPRF Verification Limit

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).

In accordance with: FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits

Section: 15.109

Test Date(s): 9/28/2015

EUT Serial #: 30815306387

Customer: Hetronic International

EUT Part #: 0

Project Number: 17389-15

Test Technician: Eric Lifsey

Purchase Order #: NA

Supervisor: Lisa Arndt

Equip. Under Test: H12-00429; Nova Controller

Witness' Name: None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage: 3.6 VDC

EUT Power Frequency: 0 N/A

Antenna Orientation: Horizontal

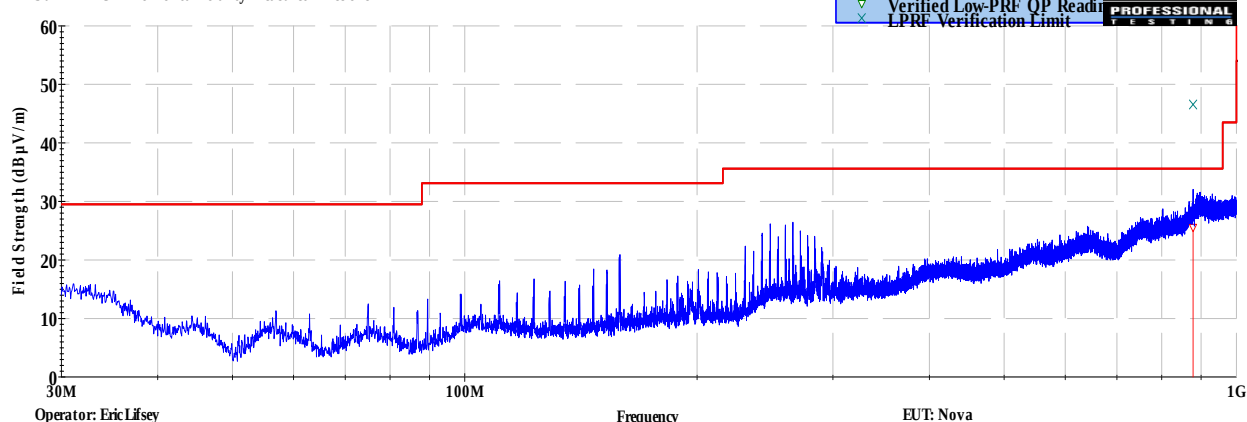
Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

Receive Mode, Center Channel

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
878.645	10	203	1.26	Quasi-peak	21.4	25.553	35.6	-10.0	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: Nova

17389\RERun01\Spurious\RX\Modet.f

EUT Mode: Receive
EUT Power: 3.6 V Battery
Center Channel

Project Number: 17389-15

07:40:27 AM, Monday, September 28, 2015

Client: Hetronic International

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

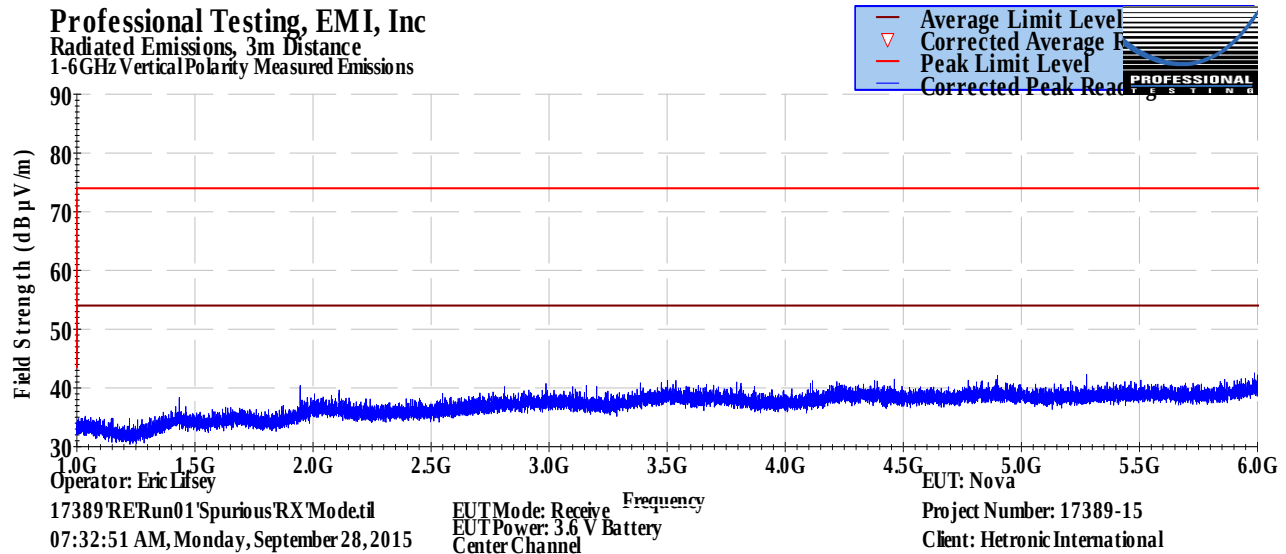
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	9/28/2015	EUT Serial #:	30815306387
Customer:	Hetronic International	EUT Part #:	0
Project Number:	17389-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	H12-00429; Nova Controller	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz	
EUT Mode of Operation:			Receive Mode, Center Channel		

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz Vertical Polarity Measured Emissions



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

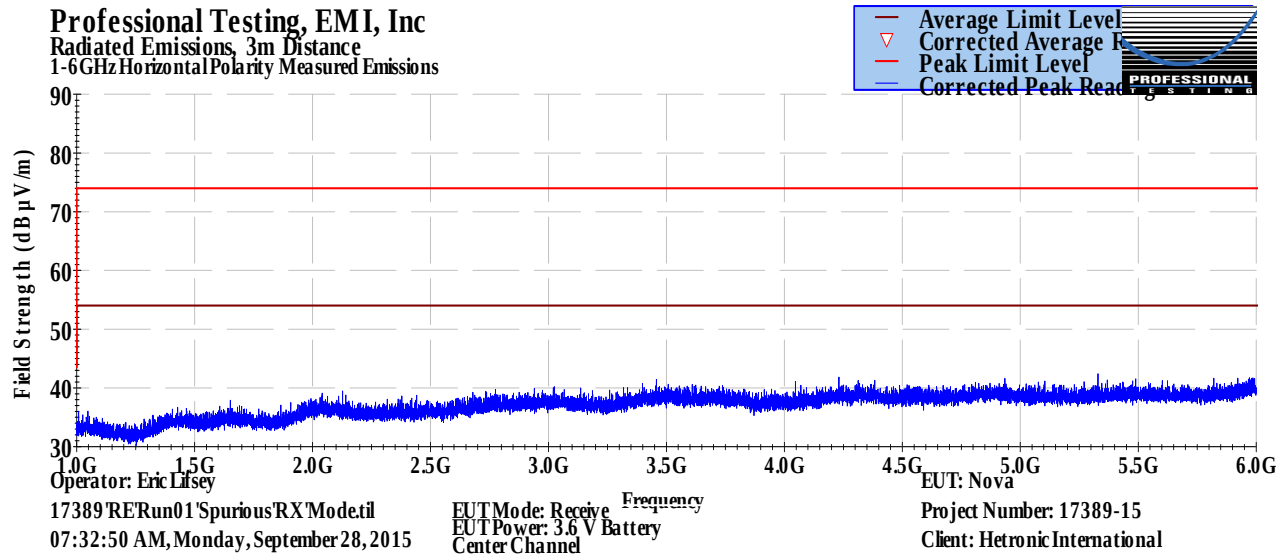
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	9/28/2015	EUT Serial #:	30815306387
Customer:	Hetronic International	EUT Part #:	0
Project Number:	17389-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	H12-00429; Nova Controller	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:	Receive Mode, Center Channel		

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz Horizontal Polarity Measured Emissions



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Frequency Stability

7.1 Procedure

The EUT is placed into a temperature chamber with a small dipole to pass the transmitted signal to a spectrum analyzer. On reaching each set point temperature, the EUT is allowed to soak at least 10 minutes without power applied. After soak time was satisfied, the EUT is powered on in transmit mode and the frequency is observed until it becomes stable; then the measurement of frequency is taken. The time required to become stable is also recorded.

Operating voltage stability was also measured for extremes of +/- 15% from nominal. In this case the power source is nominally 3.6 VDC from a Lithium-ion battery.

7.2 Criteria

Table 7.3.1 Frequency Stability Criteria, 90.217(b)
Parameter: Frequency Tolerance
+/- 25 kHz

The operating frequency shall remain within the required tolerance. The measurement is performed for lowest, middle, and highest operating frequency.

7.3 Results

The EUT satisfied the requirement.

7.3.1 Temperature

Low Channel	24-Sep-2015
--------------------	--------------------

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	462.000000	462.003820	3820
-20	462.000000	462.003450	3450
-10	462.000000	462.003420	3420
0	462.000000	462.003183	3183
10	462.000000	462.003040	3040
20	462.000000	462.002853	2853
30	462.000000	462.002578	2578
40	462.000000	462.002161	2161
50	462.000000	462.001757	1757

Middle Channel	24-Sep-2015
-----------------------	--------------------

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	465.500000	465.503822	3822
-20	465.500000	465.503529	3529
-10	465.500000	465.503426	3426
0	465.500000	465.503222	3222
10	465.500000	465.503056	3056
20	465.500000	465.502853	2853
30	465.500000	465.502577	2577
40	465.500000	465.502172	2172
50	465.500000	465.501727	1727

High Channel	24-Sep-2015
---------------------	--------------------

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	469.000000	469.003804	3804
-20	469.000000	469.003543	3543
-10	469.000000	469.003404	3404
0	469.000000	469.003224	3224
10	469.000000	469.003043	3043
20	469.000000	469.002840	2840
30	469.000000	469.002572	2572
40	469.000000	469.002197	2197
50	469.000000	469.001714	1714

7.3.2 Operating Voltage

Low Channel	23-Sep-2015
--------------------	--------------------

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-15%	3.40	462.000000	462.002855	2855
Nominal	4.00	462.000000	462.002853	2853
+15%	4.60	462.000000	462.002850	2850

Middle Channel	23-Sep-2015
-----------------------	--------------------

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-15%	3.40	465.500000	465.502854	2854
Nominal	4.00	465.500000	465.502853	2853
+15%	4.60	465.500000	465.502833	2833

High Channel	23-Sep-2015
---------------------	--------------------

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-15%	3.40	469.000000	469.002834	2834
Nominal	4.00	469.000000	469.002840	2840
+15%	4.60	469.000000	469.002846	2846

8.0 Transmit Transient

8.1 Procedure - Exempt

Transmit power under 120 mW exempts this test.

9.0 Emission Bandwidth

9.1 Procedure

The EUT antenna port is coupled through a power attenuator to a spectrum analyzer and then is placed into continuous transmit mode with modulation. The spectrum analyzer amplitude is offset to compensate for the attenuator calibrated power loss. The connection is direct and no cables are used. The modulated signal is then measured directly in a manner consistent with power measurement. Resolution bandwidth is typically ~1-3 percent of the bandwidth of ~12 kHz max where that range is 120 Hz to 360 Hz; 300 Hz RBW is selected for measurement.

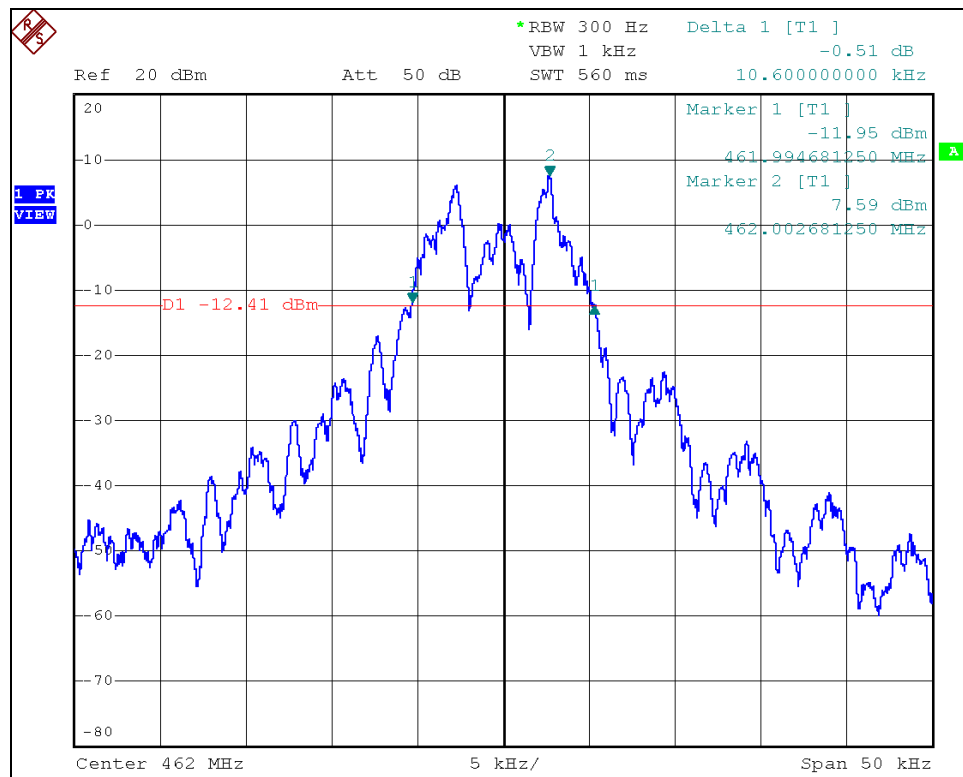
9.2 Criteria

Parameter	Section Number	Date
90.210(c) Bandwidth < 12.5 kHz	90.209, 2.1049 RSS-119 Issue 12, 5.5	22 Sep 2015

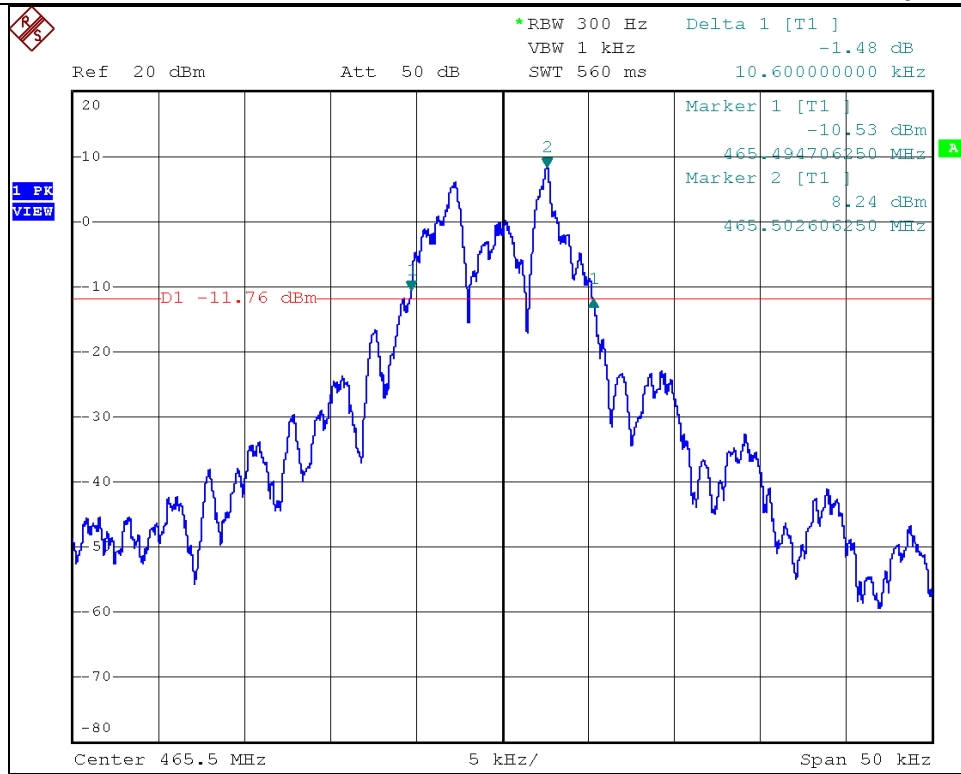
9.3 Results

Table 9.3.1 Bandwidth, 20 dB			
Low Channel	Middle Channel	High Channel	Maximum Measured Bandwidth
10.6 kHz	10.6 kHz	10.7 kHz	10.7 kHz

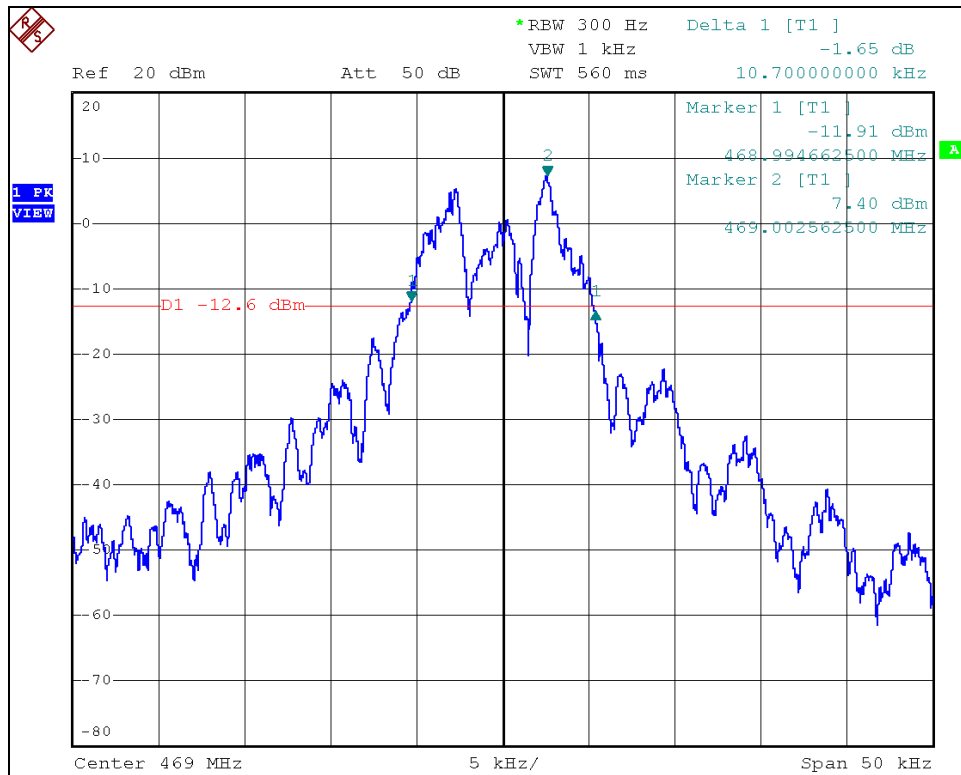
The emission satisfies the bandwidth criteria. Plotted results appear below.



Low Channel; Bandwidth, 20 dB



Middle Channel; Bandwidth, 20 dB



High Channel; Bandwidth, 20 dB

10.0 Equipment Lists

10.1 Conducted Power, Conducted Spurious, and Bandwidth

Table 10.1 Equipment List; Bandwidth				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer, 9 kHz to 30 GHz	29 Jan 2016

10.2 Frequency Stability

Table 10.2 Equipment List; Frequency Stability				
Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer, 9 kHz to 30 GHz	29 Jan 2016
2134	Tenny	TPS	Temperature Chamber	31 Oct 2015
C235	Unknown	RG type	Coaxial Cable, double shielded	CNR
1778	B&K	2408	DMM	20 Apr 2016
None	B&K	1710	Adjustable DC Power Supply	CIU
none	PTI	none	Sense Antenna, small sleeve dipole	CNR

10.3 Radiated Spurious Transmit Mode

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference,			
In accordance with:		FCC Part 90			
Section:		Exempted, -30 dBc Criteria			
Test Date(s):		9/24/2015	EUT Serial #:	30815306387	
Customer:		Hetronic International	EUT Part #:	0	
Project Number:		17389-15	Test Technician:	Eric Lifsey	
Purchase Order #:		NA	Supervisor:	Lisa Arndt	
Equip. Under Test:		H12-00429; Nova Controller	Witness' Name:	None	
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		2015 Rad Emissions_ClassA - LowPRF_072715.til or 2015 Rad Emissions_ClassB - LowPRF_072715.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	9/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027D	none	RG214	Cable Coax, N-N, 25m	none	10/22/2015
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	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	none	none	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017

10.4 Radiated Spurious Idle Mode

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators,			
In accordance with:		Radiated Emissions Limits			
Section:		15.109			
Test Date(s):		9/28/2015	EUT Serial #:		30815306387
Customer:		Hetronic International	EUT Part #:		0
Project Number:		17389-15	Test Technician:		Eric Lifsey
Purchase Order #:		NA	Supervisor:		Lisa Arndt
Equip. Under Test:		H12-00429; Nova Controller	Witness' Name:		None
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		2015 Rad Emissions_ClassA - LowPRF_072715.til or 2015 Rad Emissions_ClassB - LowPRF_072715.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	9/29/2015
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027D	none	RG214	Cable Coax, N-N, 25m	none	10/22/2015
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	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	none	none	Cable Coax, N-N, 30m	none	10/10/2015
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017

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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