
Project 17598-15

**Hetronic International
CS458TRT-1
Transceiver Module
458.500 to 459.200 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

9 Feb 2016

Reviewed by



Larry Finn
Chief Technical Officer

Written by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial draft for review.	8 Feb 2016
03	Final; corrected model info, removed name from lab certificate.	9 Feb 2016

Corrections:

None.

Table of Contents

Revision History..... 2

Certificate of Compliance 4

1.0 Introduction..... 5

 1.1 Scope..... 5

 1.2 EUT Description 5

 1.3 EUT Operation..... 5

 1.4 Modifications to Equipment..... 6

 1.5 Test Site 6

2.0 Applicable Documents and Clauses..... 7

3.0 Conducted Output Power..... 8

 3.1 Procedure 8

 3.2 Criteria 8

 3.3 Results..... 8

4.0 Emission Mask..... 9

 4.1 Procedure 9

 4.2 Criteria 9

 4.3 Results..... 9

5.0 Spurious Emissions at Antenna Terminals 10

 5.1 Procedure 10

 5.2 Criteria 10

 5.3 Results..... 10

6.0 Field Strength of Radiated Spurious Emissions..... 13

 6.1 Procedure 13

 6.2 Criteria 13

 6.3 Results..... 13

 6.3.1 Transmit Mode 14

 6.3.2 Receive Mode..... 18

7.0 Frequency Stability 22

 7.1 Procedure 22

 7.2 Criteria 22

 7.3 Results..... 22

 7.3.1 Temperature..... 23

 7.3.2 Operating Voltage 23

8.0 Transmit Transient..... 24

 8.1 Procedure - Exempt..... 24

9.0 Emission Bandwidth 25

 9.1 Procedure 25

 9.2 Criteria 25

 9.3 Results..... 25

10.0 Equipment Lists 26

 10.1 Conducted Power, Conducted Spurious, and Bandwidth 26

 10.2 Frequency Stability 26

 10.3 Radiated Spurious Transmit Mode and Receive Mode..... 27

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty 28

End of Report 29

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- (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 3905 NW 36th St. Oklahoma City, OK 73112 USA Certificate Date: 9 Feb 2016	FCC ID:	LW9-CS458TRT1
	IC ID:	2119-CS458TRT1
	Model(s):	CS458TRT-1
	Laboratory Project ID:	17598-15

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 ≤ 120 mW	90.217(b)	RSS-119 5.10
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 North America.

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 the manufacturer's systems that transmit control codes to other associated wireless devices in industrial environments; inclusive of locomotive control systems. It receives power, control, and data signals from the host system. The EUT supports external antennas, or a cable thereto, attached to the modules SMB-F connector.


Table 1.2.1 Equipment Under Test			
Manufacturer & Description	Model	Serial #	Photo
Hetronic International Transceiver module for 458.5 to 459.2 MHz.	CS458TRT-1	none	 <p>Module appearance with whip antenna attached.</p>

Table 1.2.2 Options		
Manufacturer & Description	Gain	Notes
Hetronic; ¼ wave SMB whip antenna	0 dBi	For use directly on module inside host.
Hetronic; cable extension to TNC-F	NA	Extends module to external antenna.
Hetronic; ¼ wave TNC-M antenna	0 dBi	External antenna.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. It was tested alone in its permanent module shield with no additional shielding or filtering. It was powered by a bench-grade linear DC power supply.

The module is used as a transmitter in portable battery or vehicular powered applications. The module is used as a receiver in vehicular or mains powered applications. The mains powered hosts are tested for emission compliance separately.

Table 1.3.1 Operating Frequency/Range			
Lowest Frequency	Center Frequency	Highest Frequency	Total Frequency Range
458.500 MHz	458.850 MHz	459.200 MHz	0.700 MHz
The center channel was tested per customary practice for a frequency range of under +/- 0.5 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
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-F 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

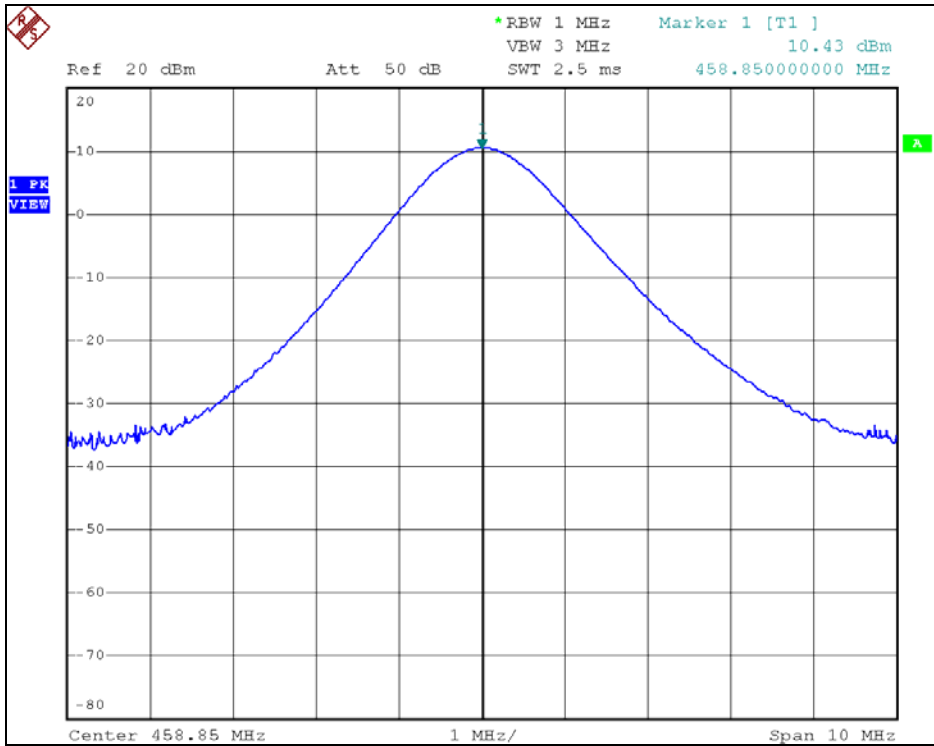
Parameter	Section Reference	Date
Conducted Output Power	90.210, 2.1046 RSS-119 Issue 12, 5.4	15 Jan 2016

3.3 Results

An SMB-SMA adapter set was used to connect to the EUT antenna port directly to the spectrum analyzer 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)
458.850	10.43	11.04



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

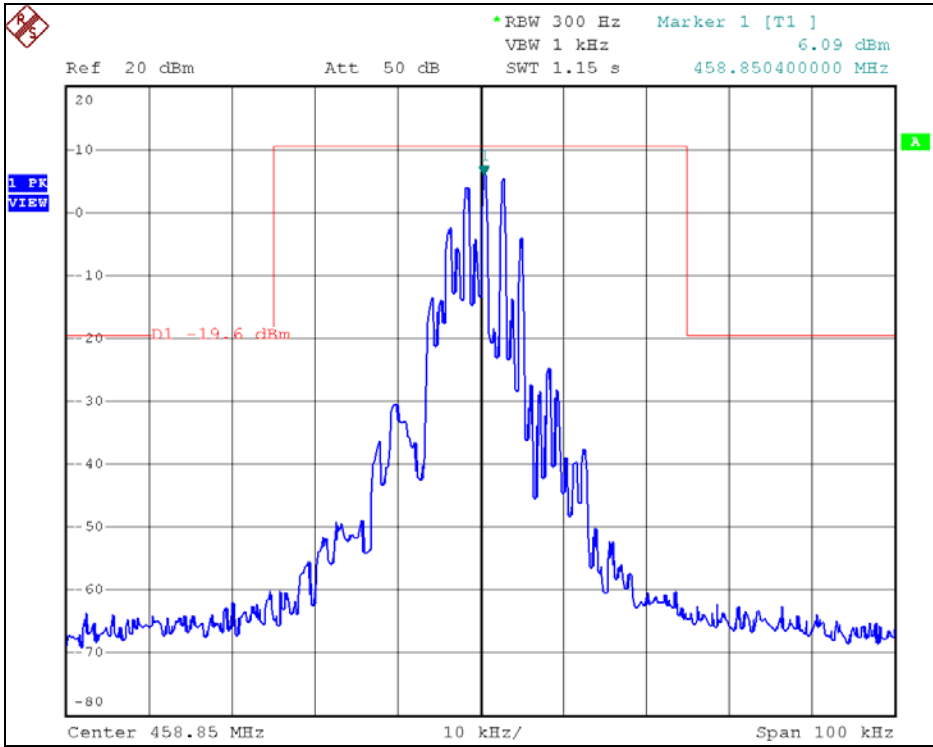
Parameter	Section Number	Date
Emissions at Antenna Terminals	90.210(c), 90.217(b), 2.1047 RSS-119 Issue 12, 5.8.3	15 Jan 2016

4.3 Results

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

$$Limit_{dBm} = Fundamental_Power_{dBm} - Attenuation_{dB} = 10.43\text{ dBm} - 30\text{ dB} = -19.57\text{ dBm}$$

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)

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	15 Jan 2016

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) $Attenuation_{dB} = 30 \text{ dB}$

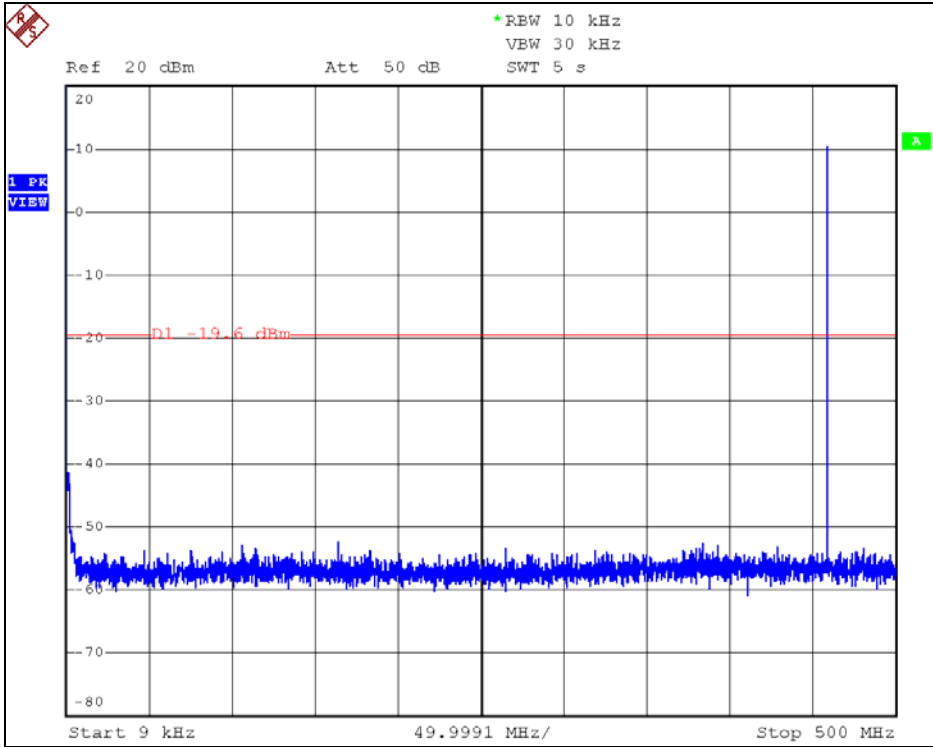
$Limit_{dBm} = Fundamental_Power_{dBm} - Attenuation_{dB} = 10.43 \text{ dBm} - 30 \text{ dB} = -19.57 \text{ dBm}$

5.3 Results

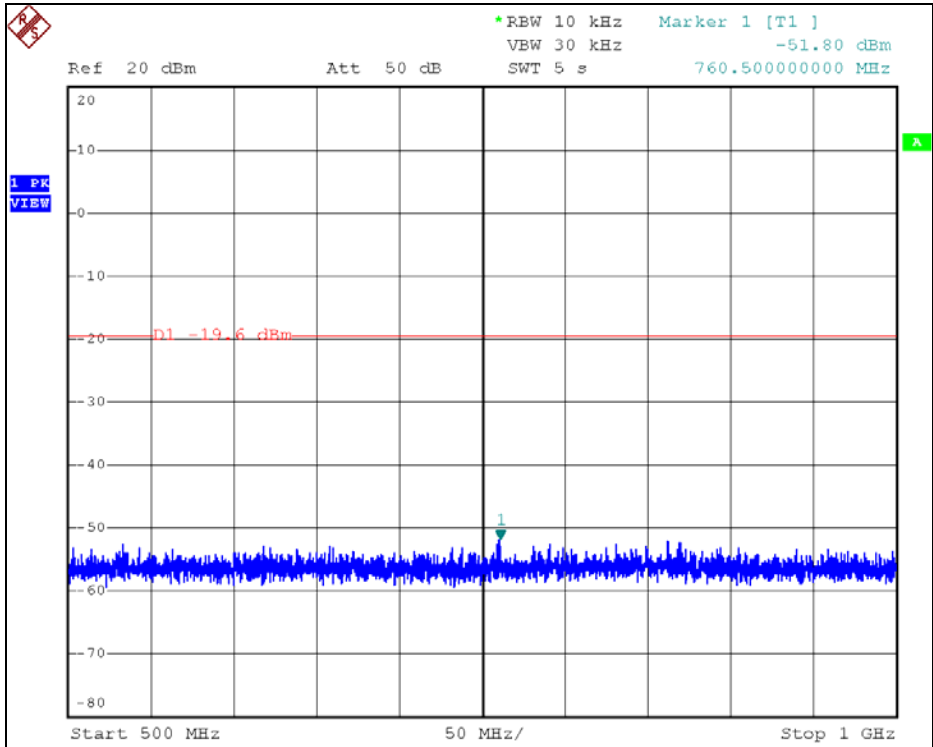
Measurements were performed with a direct connection to the spectrum analyzer such that no external losses or gains would apply.

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

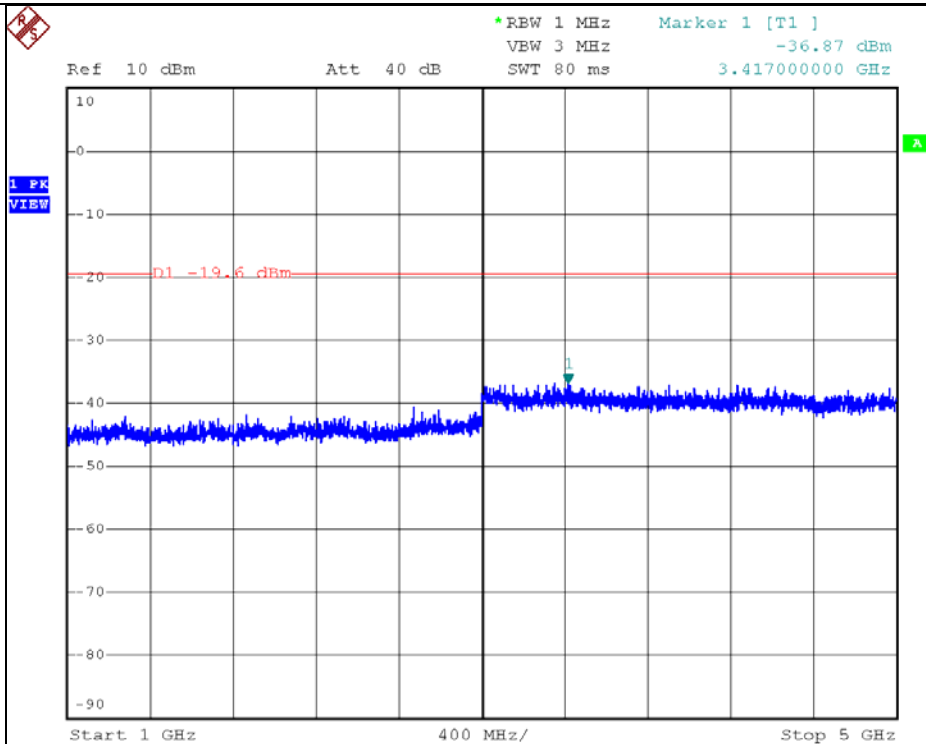
In the plots the emission limit is shown as a red line at -19.6 dBm.



Range 1: 9 kHz to 500 MHz including Fundamental



Range 2: 500 MHz to 1 GHz

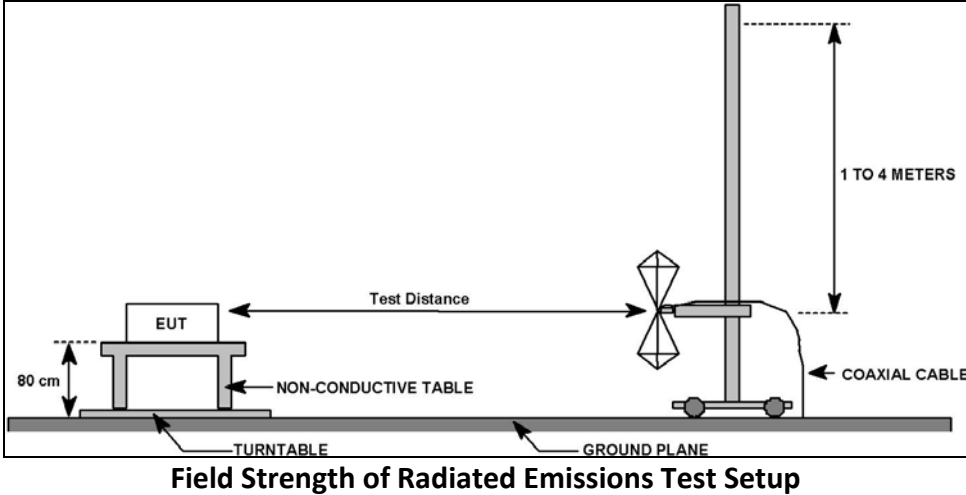


Range 3: 1 GHz to 5 GHz

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	4 Jan 2016

6.3 Results

The emission limits for the module were determined as follows:

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

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

$Limit_{dBm} = Fundamental_Power_{dBm} - Attenuation_{dB} = 10.43 \text{ dBm} - 30 \text{ dB} = -19.57 \text{ dBm}$

The conducted limit restates as field strengths for 10 meters (65.2 dBμV/m) and 3 meters (75.66 dBμV/m) distances. However, the EUT transmit mode satisfied the more rigorous general emission limits of Part 15 so those limits were presented.

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.

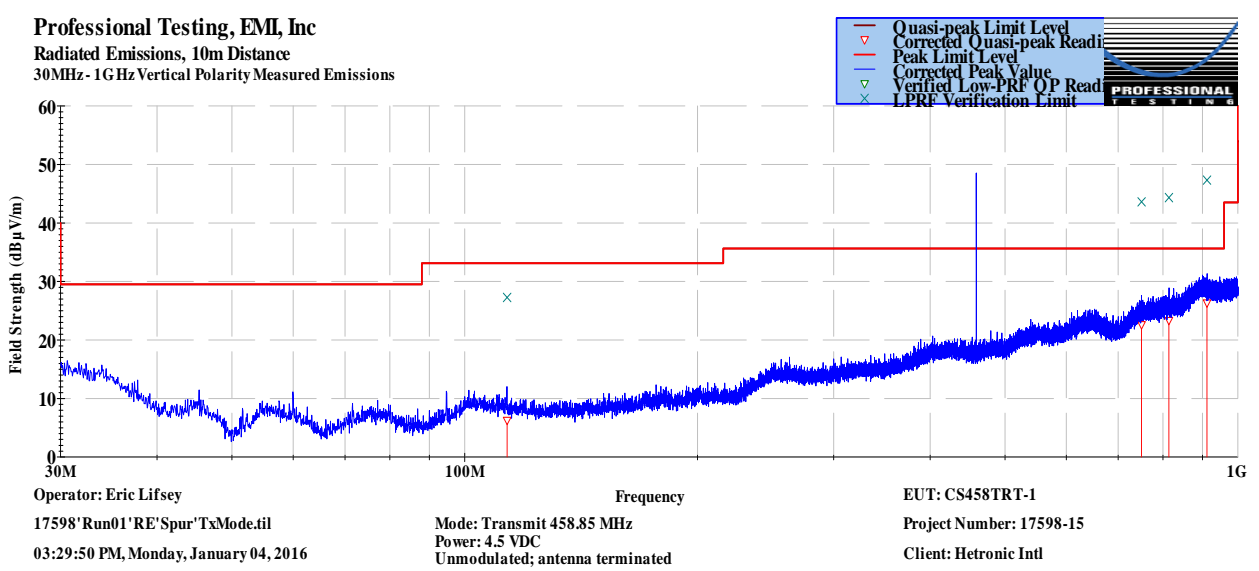
6.3.1 Transmit Mode

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 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	1/4/2016	EUT Serial #:	None
Customer:	Hetronic Intl	EUT Part #:	None
Project Number:	17598-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	CS458TRT-1	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.5	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz					
EUT Mode of Operation:			Transmit unmodulated continuous 458.85 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
113.431	10	94	3.96	Quasi-peak	23.1	6.252	33.1	-26.8	Pass
750.678	10	18	1.38	Quasi-peak	21.7	22.582	35.6	-13.0	Pass
814.497	10	47	3.46	Quasi-peak	21.5	23.302	35.6	-12.3	Pass
912.375	10	217	2.99	Quasi-peak	21.2	26.306	35.6	-9.3	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

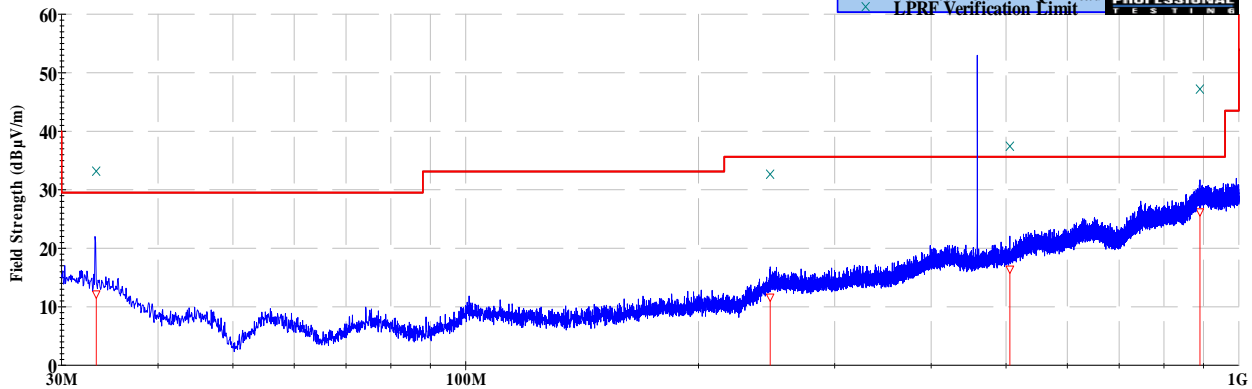
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	1/4/2016	EUT Serial #:	None
Customer:	Hetronic Intl	EUT Part #:	None
Project Number:	17598-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	CS458TRT-1	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.5	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal		Frequency Range:	30MHz to 1GHz					
EUT Mode of Operation:			Transmit unmodulated continuous 458.85 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
33.2745	10	334	2.39	Quasi-peak	23.7	12.163	29.5	-17.3	Pass
247.607	10	352	1.42	Quasi-peak	22.2	11.631	35.6	-24.0	Pass
505.712	10	285	2.88	Quasi-peak	22.2	16.416	35.6	-19.2	Pass
890.398	10	12	3.04	Quasi-peak	21.4	26.194	35.6	-9.4	Pass

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



Operator: Eric Lifsey

17598' Run01'RE'Spur'TxMode.til

03:29:50 PM, Monday, January 04, 2016

Mode: Transmit 458.85 MHz

Power: 4.5 VDC

Unmodulated; antenna terminated

EUT: CS458TRT-1

Project Number: 17598-15

Client: Hetronic Intl

≤ 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 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	1/4/2016	EUT Serial #:	None
Customer:	Hetronic Intl	EUT Part #:	None
Project Number:	17598-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	CS458TRT-1	Witness' Name:	None

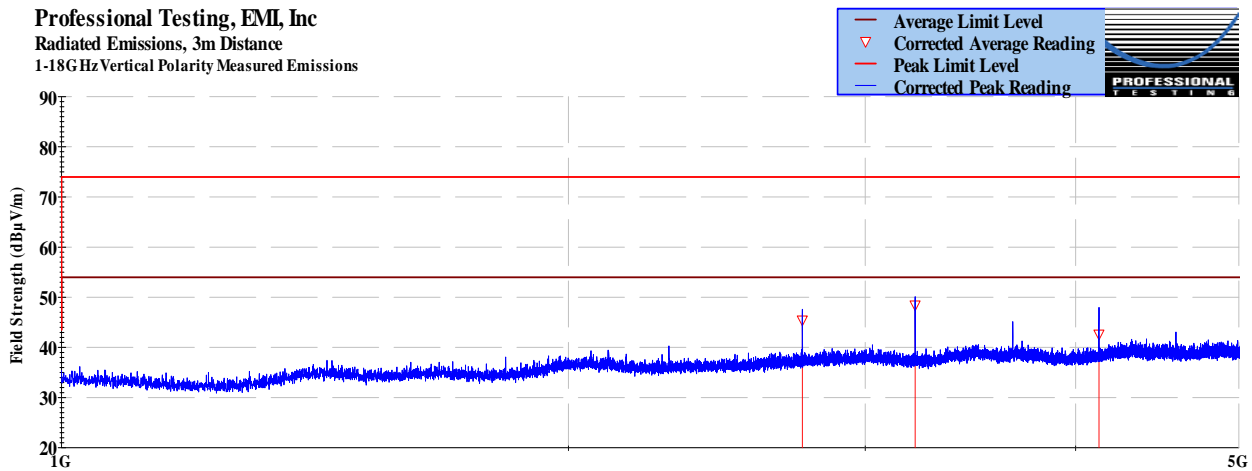
Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.5	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz	
EUT Mode of Operation:			Transmit unmodulated continuous 458.85 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
2753.08	3	313	1	Peak	55.4	47.518	74.0	-26.4	Pass
3211.98	3	62	1	Peak	56.6	49.672	74.0	-24.3	Pass
4129.59	3	295	1	Peak	51.2	46.071	74.0	-27.9	Pass

Professional Testing, EMI, Inc
 Radiated Emissions, 3m Distance
 1-18GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey
 17598' Run01'RE'Spur'TxMode.til
 03:49:24 PM, Monday, January 04, 2016

Mode: Transmit 458.85 MHz
 Power: 4.5 VDC
 Unmodulated; antenna terminated

EUT: CS458TRT-1
 Project Number: 17598-15
 Client: Hetronic Intl

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

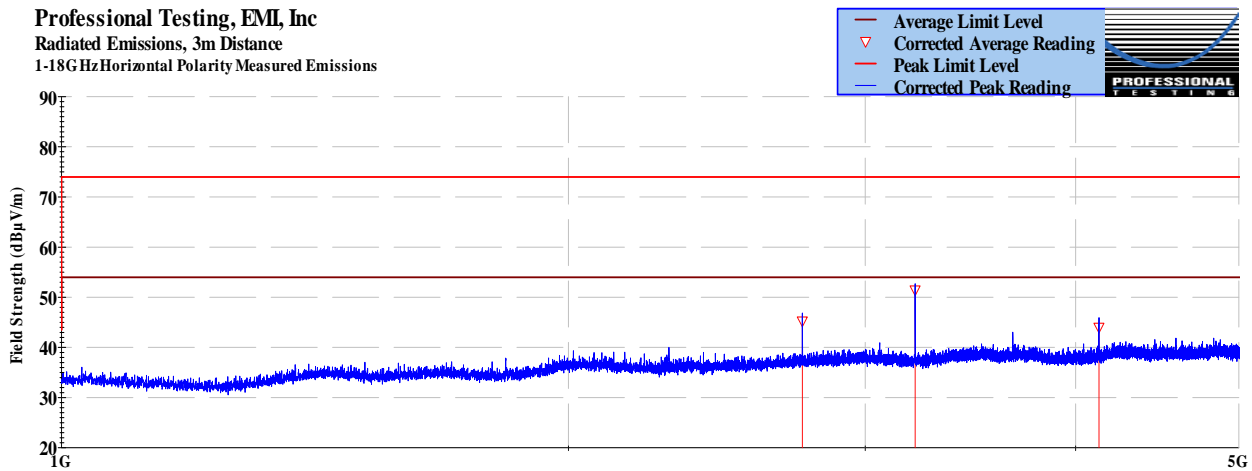
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	1/4/2016	EUT Serial #:	None
Customer:	Hetronic Intl	EUT Part #:	None
Project Number:	17598-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	CS458TRT-1	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.5	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal		Frequency Range:	Above 1GHz					
EUT Mode of Operation:			Transmit unmodulated continuous 458.85 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
2753.15	3	93	1	Peak	55.1	47.252	74.0	-26.7	Pass
3212.01	3	94	1	Peak	59.5	52.53	74.0	-21.4	Pass
4129.59	3	14	1	Peak	52.3	47.161	74.0	-26.8	Pass

Professional Testing, EMI, Inc
 Radiated Emissions, 3m Distance
 1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Frequency

EUT: CS458TRT-1

17598' Run01'RE'Spur'TxMode.til

Mode: Transmit 458.85 MHz

Project Number: 17598-15

03:49:24 PM, Monday, January 04, 2016

Power: 4.5 VDC
 Unmodulated; antenna terminated

Client: Hetronic Intl

> 1GHz Horizontal Antenna Polarity Measured Emissions

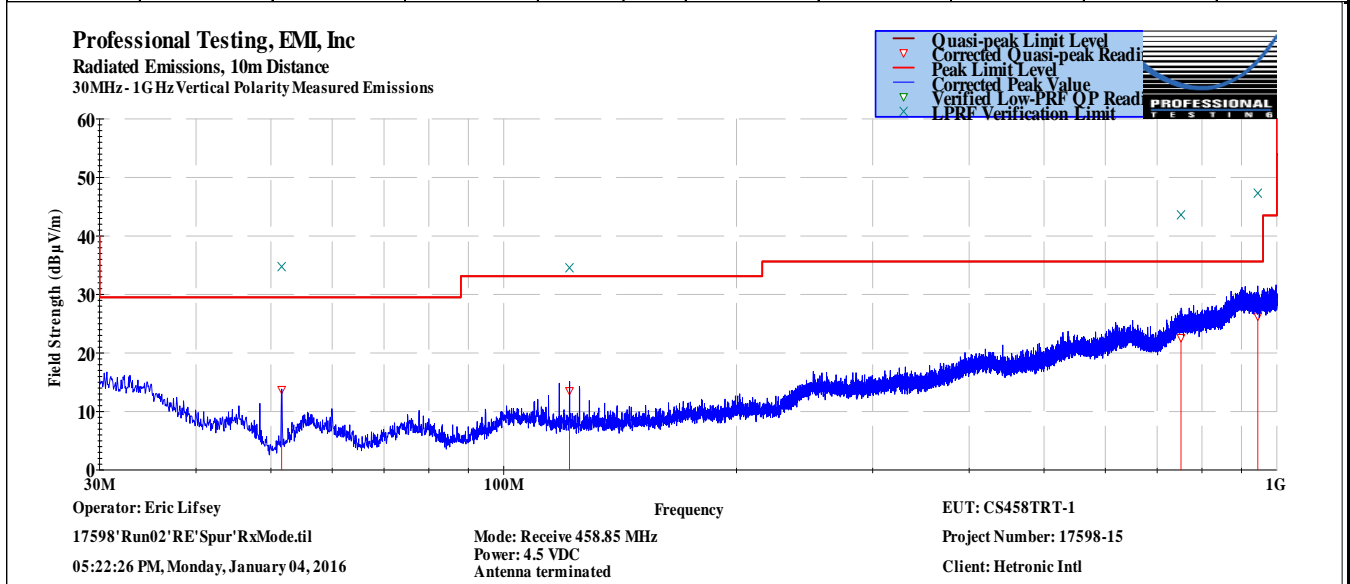
6.3.2 Receive Mode

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):	1/4/2016	EUT Serial #:	None
Customer:	Hetronic Intl	EUT Part #:	None
Project Number:	17598-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	CS458TRT-1	Witness' Name:	None

Radiated Emissions Test Results Data Sheet Page: 1 of 1

EUT Line Voltage:	4.5	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz	

EUT Mode of Operation:				Receive					
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
51.5996	10	102	1.4	Quasi-peak	34.3	13.729	29.5	-15.8	Pass
121.631	10	34	2.4	Quasi-peak	30.8	13.555	33.1	-19.5	Pass
751.562	10	159	3.25	Quasi-peak	21.7	22.605	35.6	-13.0	Pass
944.861	10	213	4.15	Quasi-peak	21.1	26.284	35.6	-9.3	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

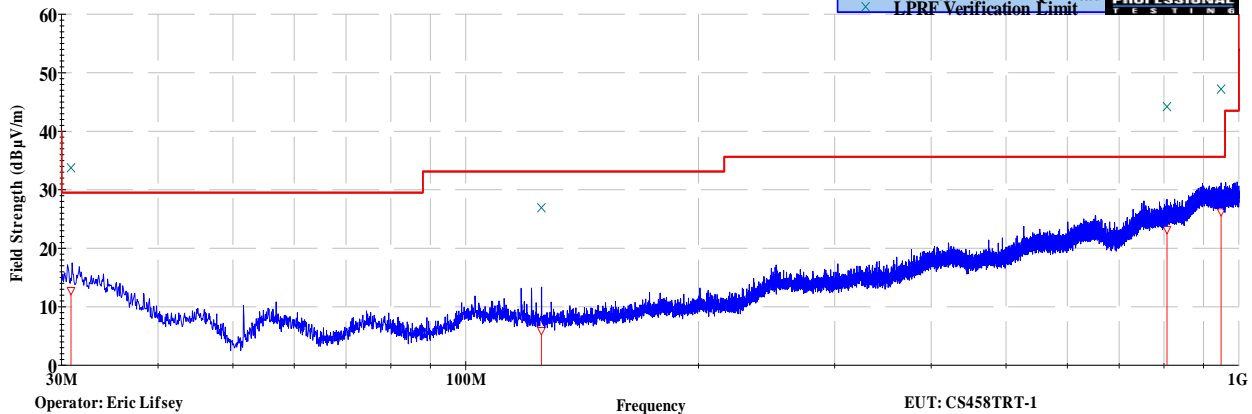
Test Method:	ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	1/4/2016	EUT Serial #:	None
Customer:	Hetronic Intl	EUT Part #:	None
Project Number:	17598-15	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	CS458TRT-1	Witness' Name:	None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	4.5	VDC	EUT Power Frequency:	0	N/A				
Antenna Orientation:	Horizontal		Frequency Range:	30MHz to 1GHz					
EUT Mode of Operation:			Receive						
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
30.8621	10	41	3.66	Quasi-peak	24.2	12.752	29.5	-16.7	Pass
125.278	10	315	1.03	Quasi-peak	23.2	5.905	33.1	-27.2	Pass
807.327	10	41	2.76	Quasi-peak	21.4	23.19	35.6	-12.4	Pass
948.562	10	80	1.47	Quasi-peak	21	26.192	35.6	-9.4	Pass

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



Operator: Eric Lifsey
 17598' Run02'RE'Spur'RxMode.til
 05:22:26 PM, Monday, January 04, 2016

Mode: Receive 458.85 MHz
 Power: 4.5 VDC
 Antenna terminated

EUT: CS458TRT-1
 Project Number: 17598-15
 Client: Hetronic Intl

≤ 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): 1/4/2016 **EUT Serial #:** None

Customer: Hetronic Intl **EUT Part #:** None

Project Number: 17598-15 **Test Technician:** Eric Lifsey

Purchase Order #: NA **Supervisor:** Lisa Arndt

Equip. Under Test: CS458TRT-1 **Witness' Name:** None

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

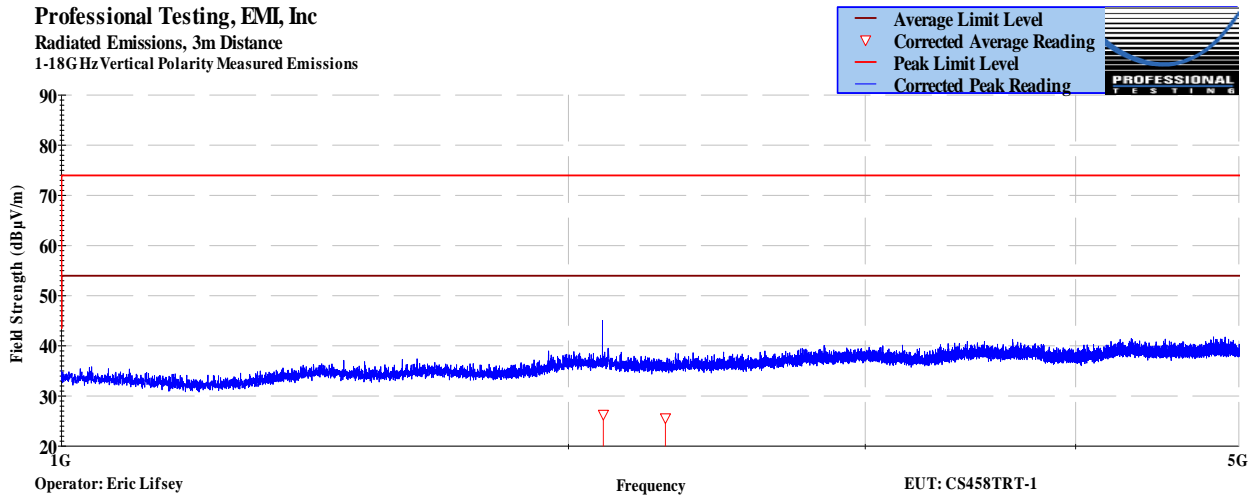
EUT Line Voltage: 4.5 VDC **EUT Power Frequency:** 0 N/A

Antenna Orientation: Vertical **Frequency Range:** Above 1GHz

EUT Mode of Operation: Receive

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
2097.62	3	19	1	Peak	44.6	35.747	74.0	-38.2	Pass
2283.28	3	357	1	Peak	44.2	35.126	74.0	-38.8	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-18GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey
17598' Run02' RE'Spur' RxMode.tif
05:03:00 PM, Monday, January 04, 2016

Mode: Receive 458.85 MHz
Power: 4.5 VDC
Antenna terminated

EUT: CS458TRT-1
Project Number: 17598-15
Client: Hetronic Intl

> 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): 1/4/2016 **EUT Serial #:** None

Customer: Hetronic Intl **EUT Part #:** None

Project Number: 17598-15 **Test Technician:** Eric Lifsey

Purchase Order #: NA **Supervisor:** Lisa Arndt

Equip. Under Test: CS458TRT-1 **Witness' Name:** None

Radiated Emissions Test Results Data Sheet Page: 1 of 1

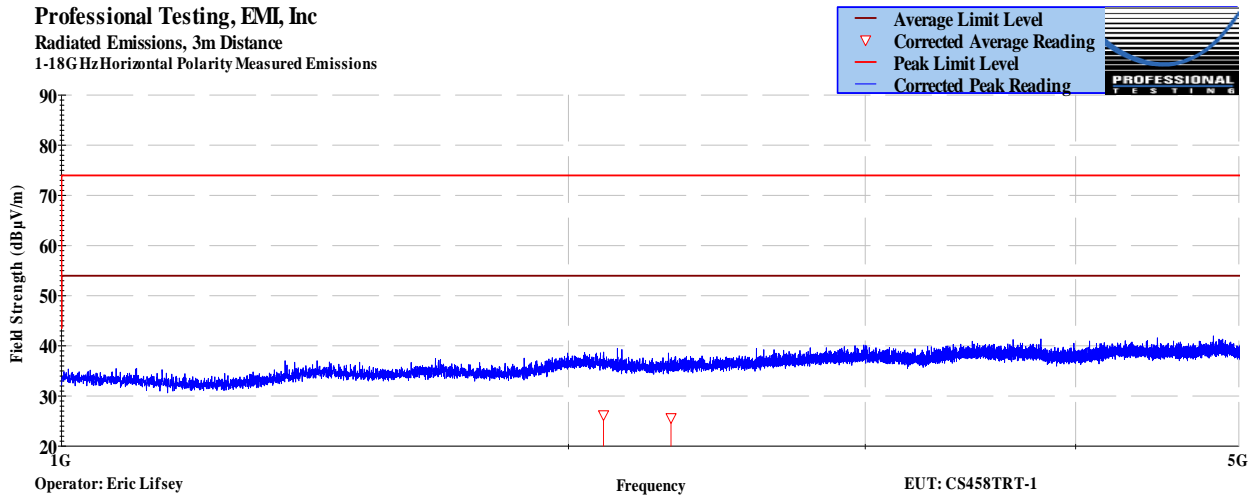
EUT Line Voltage: 4.5 VDC **EUT Power Frequency:** 0 N/A

Antenna Orientation: Horizontal **Frequency Range:** Above 1GHz

EUT Mode of Operation: Receive

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
2097.99	3	225	1	Peak	43.2	34.31	74.0	-39.6	Pass
2300.62	3	169	1	Peak	43.4	34.373	74.0	-39.6	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

17598'Run02'RE'Spur'RxMode.tif

05:03:00 PM, Monday, January 04, 2016

Frequency

Mode: Receive 458.85 MHz

Power: 4.5 VDC

Antenna terminated

EUT: CS458TRT-1

Project Number: 17598-15

Client: Hetronic Intl

> 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 4.5 VDC from a DC source of any type.

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.

The frequency counter function of the spectrum analyzer was set to resolution of 1 kHz.

7.3.1 Temperature

Frequency Stability				19-Jan-2016
Condition	Frequency		Deviation	
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)	
-30	458.850000	458.847	-3000	
-20	458.850000	458.847	-3000	
-10	458.850000	458.848	-2000	
0	458.850000	458.848	-2000	
10	458.850000	458.848	-2000	
20	458.850000	458.848	-2000	
30	458.850000	458.848	-2000	
40	458.850000	458.848	-2000	
50	458.850000	458.847	-3000	
Max Deviation (Hz)			-2000	
Min Deviation (Hz)			-3000	

7.3.2 Operating Voltage

Frequency Stability				19-Jan-2016
Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-15%	3.83	458.850000	458.848000	-2000
Nominal	4.50	458.850000	458.848000	-2000
+15%	5.18	458.850000	458.848000	-2000

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.

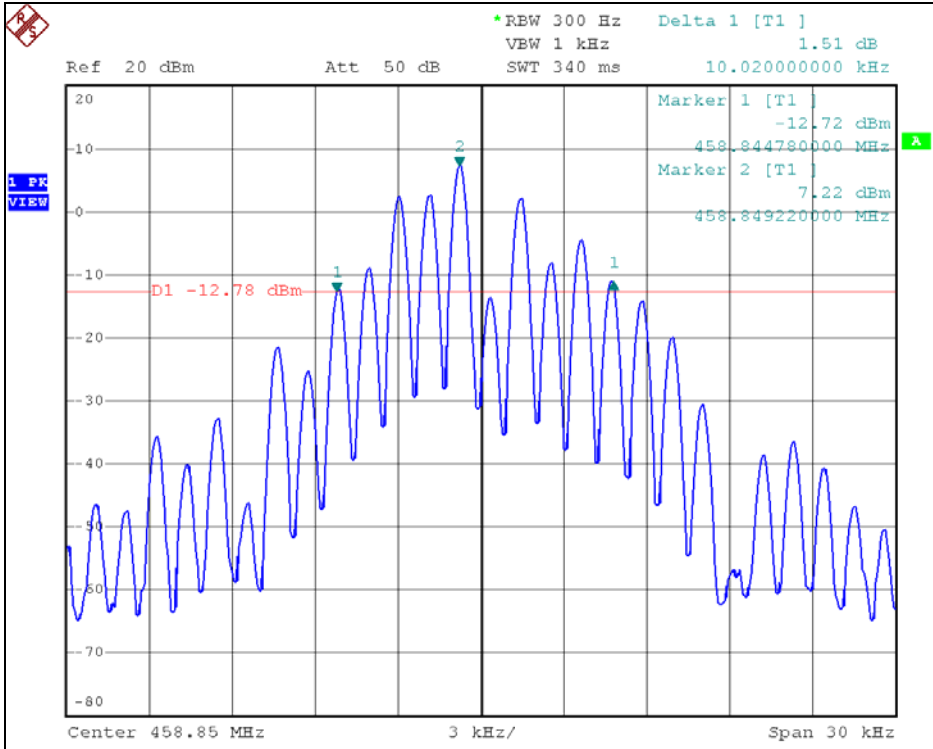
9.2 Criteria

Parameter	Section Number	Date
90.210(c) Bandwidth < 12.5 kHz	90.209, 2.1049 RSS-119 Issue 12, 5.5	15 Dec 2016

9.3 Results

Table 9.3.1 Bandwidth, 20 dB
Maximum Measured Bandwidth
10.02 kHz

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



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	16 Dec 2016
0472	Tektronix	THS730A	Scope/DMM	7 Dec 2016
None	B&K	1710	Adjustable DC Power Supply	CIU

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	16 Dec 2016
2134	Tenny	TPS	Temperature Chamber	13 Oct 2016
C247	Pasternack	RG type	Coaxial Cable, double shielded	CNR
0472	Tektronix	THS730A	Scope/DMM	7 Dec 2016
None	B&K	1710	Adjustable DC Power Supply	CIU

10.3 Radiated Spurious Transmit Mode and 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, FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators,			
In accordance with:		Radiated Emissions Limits			
Section:		15.209			
Test Date(s):	1/4/2016	EUT Serial #:	None		
Customer:	Hetronic Intl	EUT Part #:	None		
Project Number:	17598-15	Test Technician:	Eric Lifsey		
Purchase Order #:	NA	Supervisor:	Lisa Arndt		
Equip. Under Test:	CS458TRT-1	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, Opt. AYZ	MY44303298	12/15/2016
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027D	none	RG214	Cable Coax, N-N, 25m	none	10/1/2016
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	1/29/2016
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2016
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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