



# **Compliance Testing, LLC**

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

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## **Test Report**

**Prepared for: Garmin International, Inc.**

**Model: A03070/A03071**

**Description: Short Range Transceiver**

**Serial Number: N/A**

**FCC ID: IPH-03070 & FCC ID: IPH-03071**

**IC: 1792A-03070 & IC: 1792A-03071**

**To**

**FCC Part 15.247**

**IC RSS-247**

**Date of Issue: December 12, 2017**

**On the behalf of the applicant:**

**Garmin International, Inc.**

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**Attention of:**

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**Project No: p1780018**

**Alex Macon**

**Project Test Engineer**

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All results contained herein relate only to the sample tested.



## Test Report Revision History

| Revision | Date               | Revised By | Reason for Revision                                                                                                                                                                                             |
|----------|--------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0      | September 29, 2017 | Alex Macon | Original Document                                                                                                                                                                                               |
| 2.0      | December 11, 2017  | Alex Macon | Included 10dB attenuator into setup diagram on page 9 and 11<br>Updated additional information section with antenna gain statement.<br>Updated 99% BW table.<br>Updated AC power line section with tabular data |
|          |                    |            |                                                                                                                                                                                                                 |
|          |                    |            |                                                                                                                                                                                                                 |



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**ILAC / A2LA**

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



**FCC Site Reg. #349717**

**IC Site Reg. #2044A-2**

**Non-accredited tests contained in this report:**

**N/A**

**The applicant has been cautioned as to the following**

**15.21 - Information to User**

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**15.27(a) - Special Accessories**

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.



## Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

| Environmental Conditions |                 |                    |
|--------------------------|-----------------|--------------------|
| Temperature<br>(°C)      | Humidity<br>(%) | Pressure<br>(mbar) |
| 23.4 – 24.5              | 32.1 – 35.8     | 966 - 968          |

### EUT Description

**Model:** A03070/A03071

**Description:** Short Range Transceiver

**Firmware:** N/A

**Software:** N/A

**Serial Number:** N/A

#### Additional Information:

The system consists of a base unit intended to be operated by the end user and a roaming device which is intended to be moving at various locations near the base unit. These devices are described as Base Unit (A03070) and Roaming Device (A03071). The devices utilize Zigbee, ANT, and BLE protocols for communication. The ANT and BLE emissions are identical so only one emission is included within the report. The Base Unit incorporates a MIMO configuration for the Zigbee communication. Both ports have been measured and the data is included below.

An antenna gain of 2dBi is used throughout the testing of each modulation.

### EUT Operation during Tests

The devices were placed into test modes using manufacturer supplied software. Continuous output in both CW and modulated tones were possible for high mid and low channels.

**Accessories:** None

**Cables:** None

**Modifications:** None

### 15.203: Antenna Requirement:

- ☒ The antenna is permanently attached to the EUT
- ☐ The antenna uses a unique coupling
- ☐ The EUT must be professionally installed
- ☐ The antenna requirement does not apply





## Test Results Summary

| FCC 15.247 Specification     | Test Name                          | Pass, Fail, N/A | Comments |
|------------------------------|------------------------------------|-----------------|----------|
| 15.247(b)                    | Peak Output Power                  | Pass            |          |
| 15.247(b)                    | Conducted Spurious Emissions       | Pass            |          |
| 15.247(d), 15.209(a), 15.205 | Radiated Spurious Emissions        | Pass            |          |
| 15.247(d), 15.209(a), 15.205 | Emissions At Band Edges            | Pass            |          |
| 15.247(a)(2)                 | Occupied Bandwidth                 | Pass            |          |
| 15.247(e)                    | Transmitter Power Spectral Density | Pass            |          |
| 15.207                       | A/C Powerline Conducted Emissions  | Pass            |          |

| References                | Description                                                                                                                       |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| CFR47, Part 15, Subpart B | Unintentional Radiators                                                                                                           |
| CFR47, Part 15, Subpart C | Intentional Radiators                                                                                                             |
| ANSI C63.10-2013          | American National standard for testing Unlicensed Wireless Devices                                                                |
| ANSI C63.4-2014           | Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz. |
| ISO/IEC 17025:2005        | General requirements for the Competence of Testing and Calibrations Laboratories                                                  |
| KDB 558074 D01 v04        | Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247                     |



## Conducted Output Power

Engineer: Alex Macon

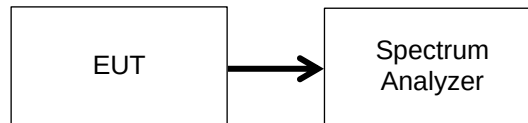
Test Date: 9/13/17

### Test Procedure

The EUT was connected directly to a spectrum analyzer. For BLE and ANT emissions, section 9.1.1 of KDB 558074 was followed. For the Zigbee emission, section 9.2.2.1 a) of KDB 558074 was followed.

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level.

### Test Setup



### Transmitter Output Power

#### Base Unit

| Tuned Frequency (MHz) | Modulation | Measured Value (dBm) | Specification Limit | Result |
|-----------------------|------------|----------------------|---------------------|--------|
| 2402                  | BLE        | 4.22                 | 1 W (30 dBm)        | Pass   |
| 2441                  | BLE        | 4.3                  | 1 W (30 dBm)        | Pass   |
| 2480                  | BLE        | 4.2                  | 1 W (30 dBm)        | Pass   |

| Tuned Frequency (MHz) | Modulation | Port 0 (dBm) | Port 1 (dBm) | Total Summer Power (dBm) | Specification Limit | Result |
|-----------------------|------------|--------------|--------------|--------------------------|---------------------|--------|
| 2405                  | Zigbee     | 19.8         | 19.6         | 22.7                     | 1 W (30 dBm)        | Pass   |
| 2445                  | Zigbee     | 19.0         | 18.8         | 21.9                     | 1 W (30 dBm)        | Pass   |
| 2470                  | Zigbee     | 18.4         | 17.9         | 21.2                     | 1 W (30 dBm)        | Pass   |

#### Roaming Device

| Tuned Frequency (MHz) | Modulation | Measured Value (dBm) | Specification Limit | Result |
|-----------------------|------------|----------------------|---------------------|--------|
| 2405                  | Zigbee     | 2.47                 | 1 W (30 dBm)        | Pass   |
| 2445                  | Zigbee     | 2.13                 | 1 W (30 dBm)        | Pass   |
| 2470                  | Zigbee     | 1.46                 | 1 W (30 dBm)        | Pass   |
| 2402                  | BLE        | 1.24                 | 1 W (30 dBm)        | Pass   |
| 2441                  | BLE        | 2.05                 | 1 W (30 dBm)        | Pass   |
| 2480                  | BLE        | -1.7                 | 1 W (30 dBm)        | Pass   |



## Conducted RF Measurements (15.209)

**Engineer:** Alex Macon

**Test Date:** 9/18/17

### Test Procedure

Antenna-port conducted measurements were performed as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands for 15.209.

The following offsets were added to the measurements:

The maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level

A maximum ground reflection factor to the EIRP level, 6 dB for frequencies  $\leq 30$  MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies  $> 1000$  MHz.

The following equations were used to determine the field strength from the conducted values.

$E[\text{dB}\mu\text{V/m}] = \text{EIRP}[\text{dBm}] - 20 \log(d[\text{meters}]) + 104.77$ , where  $E$  = field strength and  $d = 3\text{m}$

$E[\text{dB}\mu\text{V/m}] = \text{EIRP}[\text{dBm}] + 95.2$ , for  $d = 3$  meters.

The Spectrum Analyzer was set to the following:

#### The Spectrum Analyzer was set to the following for emissions $> 1000$ MHz:

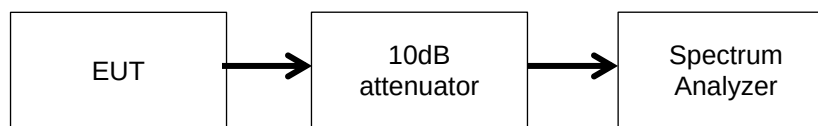
- a. RBW = 1 MHz
- b. VBW  $\geq 3$  MHz
- c. Detector = Peak.
- d. Sweep time = auto
- e. Trace mode = max hold
  - 1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
- f. RBW = 1 MHz
- g. VBW  $\leq \text{RBW}/100$  (i.e., 10 kHz) but not less than 10 Hz

#### For emissions below 1000 MHz the Spectrum Analyzer settings were as follows:

- a. RBW = 100 kHz
- b. VBW  $\geq 300$  kHz
- c. Detector = Peak
- d. Sweep time = auto
- e. Trace mode = max hold

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The frequency range from 30 MHz to the 10<sup>th</sup> harmonic of the fundamental transmitter was investigated. Only noise floor was observed past 18 GHz

### Test Setup



See Annex A1 and A2 for test data



## Radiated Spurious Emissions

**Engineer:** Alex Macon

**Test Date:** 8/30/17

### Test Procedure Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 1 GHz were examined.

Measured Level includes antenna and receiver cable correction factors.

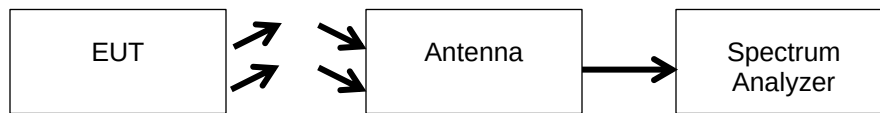
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz

VBW = 300 KHz

Detector – Quasi Peak

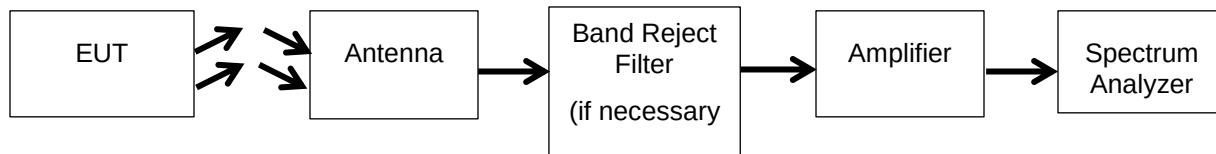
#### Test Setup



### Test Procedure for Radiated Spurious Emissions above 1 GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized. Only noise floor was observed past 18GHz

#### Test Setup



See Annex B1 and B2 for Test Data



## 15.247 Spurious Emissions

**Engineer:** Alex Macon

**Test Date:** 8/28/17

### Test Procedure

For the Base Unit, The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz

VBW  $\geq 3 \times$  RBW

Peak Detector

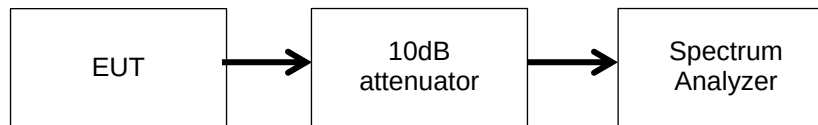
Trace mode = max hold

Sweep = auto couple

Frequency Range = 30MHz – 10<sup>th</sup> Harmonic of the fundamental

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The trace was allowed to stabilize. All emissions were investigated to insure they were attenuated from the peak fundamental by at least 20dB. If the average power levels were measured then the out-of-band emissions needed to be attenuated by 30dB. In addition emissions were investigated at the band edges to insure all out-of-band emissions were attenuated 20 or 30dB as necessary.

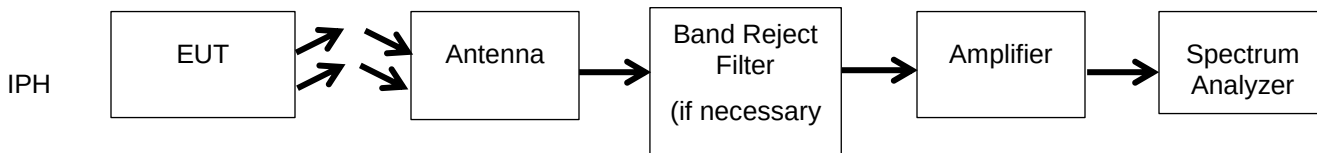
### Test Setup



### Test Procedure for the Roaming Device

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized. Only noise floor was observed past 18GHz

### Test Setup



See Annex A2 and B1 for test data



## DTS Bandwidth

Engineer: Alex Macon

Test Date: 9/11/17

### Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz

VBW  $\geq 3 \times$  RBW

Peak Detector

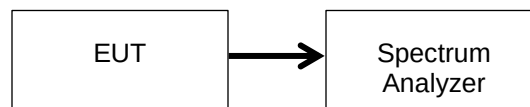
Trace mode = max hold

Sweep = auto couple

Span =  $1.5 \times$  EBW

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. The maximum width of the emission that was determined by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that were attenuated by 6db and this value was used to determine the width of the carrier. Alternatively the spectrum analyzer's automatic bandwidth capability was used.

### Test Setup



## Roaming Device

### 6 dB Occupied Bandwidth Summary

| Frequency (MHz) | Modulation | Measured Bandwidth (MHz) | Specification Limit (kHz) | Result |
|-----------------|------------|--------------------------|---------------------------|--------|
| 2405            | Zigbee     | 1.48                     | $\geq 500$                | Pass   |
| 2445            | Zigbee     | 1.49                     | $\geq 500$                | Pass   |
| 2470            | Zigbee     | 1.47                     | $\geq 500$                | Pass   |
| 2402            | BLE/ANT    | 0.5                      | $\geq 500$                | Pass   |
| 2441            | BLE/ANT    | 0.5                      | $\geq 500$                | Pass   |
| 2480            | BLE/ANT    | 0.5                      | $\geq 500$                | Pass   |

### 99% Bandwidth Summary

| Frequency (MHz) | Modulation | Measured Bandwidth (MHz) |
|-----------------|------------|--------------------------|
| 2405            | Zigbee     | 2.35                     |
| 2445            | Zigbee     | 2.42                     |
| 2470            | Zigbee     | 2.40                     |
| 2402            | BLE/ANT    | 0.999                    |
| 2441            | BLE/ANT    | 0.995                    |
| 2480            | BLE/ANT    | 0.995                    |

See Annex C1 and C2 for Test Data



## Base Unit

### 6 dB Occupied Bandwidth Summary

| Frequency (MHz) | Modulation | Measured Bandwidth (MHz) | Specification Limit (kHz) | Result |
|-----------------|------------|--------------------------|---------------------------|--------|
| 2405            | Zigbee     | 1.56                     | ≥ 500                     | Pass   |
| 2445            | Zigbee     | 1.58                     | ≥ 500                     | Pass   |
| 2470            | Zigbee     | 1.55                     | ≥ 500                     | Pass   |
| 2402            | BLE/ANT    | 0.516                    | ≥ 500                     | Pass   |
| 2441            | BLE/ANT    | 0.513                    | ≥ 500                     | Pass   |
| 2480            | BLE/ANT    | 0.515                    | ≥ 500                     | Pass   |

### 99% Bandwidth Summary

| Frequency (MHz) | Modulation | Measured Bandwidth (MHz) |
|-----------------|------------|--------------------------|
| 2405            | Zigbee     | 2.34                     |
| 2445            | Zigbee     | 2.38                     |
| 2470            | Zigbee     | 2.39                     |
| 2402            | BLE/ANT    | 0.990                    |
| 2441            | BLE/ANT    | 0.991                    |
| 2480            | BLE/ANT    | 0.992                    |

See Annex C1 and C2 for Test Data



## Transmitter Power Spectral Density (PSD)

Engineer: Alex Macon

Test Date: 9/13/17

### Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

DTS channel center frequency

Span 1.5 x DTS bandwidth

RBW = 3 kHz

VBW  $\geq 3 \times$  RBW

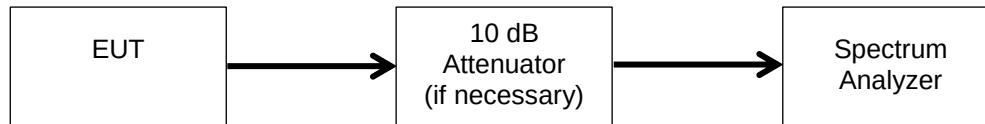
Peak Detector

Sweep time = auto couple

Trace mode = max hold

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. Once the trace has stabilize the peak marker was used to determine the peak power spectral density.

### Test Setup



### Base Unit

| Tuned Frequency (MHz) | Modulation | Measured Value (dBm) | Specification Limit | Result |
|-----------------------|------------|----------------------|---------------------|--------|
| 2402                  | BLE        | -5.56                | 8 dBm               | Pass   |
| 2441                  | BLE        | -5.99                | 8 dBm               | Pass   |
| 2480                  | BLE        | -5.56                | 8 dBm               | Pass   |

| Tuned Frequency (MHz) | Modulation | Port 0 (dBm) | Port 1 (dBm) | Total Summer Power (dBm) | Specification Limit | Result |
|-----------------------|------------|--------------|--------------|--------------------------|---------------------|--------|
| 2405                  | Zigbee     | 3.5          | 4.2          | 6.9                      | 8 dBm               | Pass   |
| 2445                  | Zigbee     | 2.0          | 1.1          | 4.6                      | 8 dBm               | Pass   |
| 2470                  | Zigbee     | 1.3          | 1.3          | 4.3                      | 8 dBm               | Pass   |

### Roaming Device

| Tuned Frequency (MHz) | Modulation | Measured Value (dBm) | Specification Limit | Result |
|-----------------------|------------|----------------------|---------------------|--------|
| 2405                  | Zigbee     | -14.1                | 8 dBm               | Pass   |
| 2445                  | Zigbee     | -14.29               | 8 dBm               | Pass   |
| 2470                  | Zigbee     | -15.75               | 8 dBm               | Pass   |
| 2402                  | BLE        | -8.54                | 8 dBm               | Pass   |
| 2441                  | BLE        | -7.74                | 8 dBm               | Pass   |
| 2480                  | BLE        | -11.87               | 8 dBm               | Pass   |



## A/C Powerline Conducted Emission

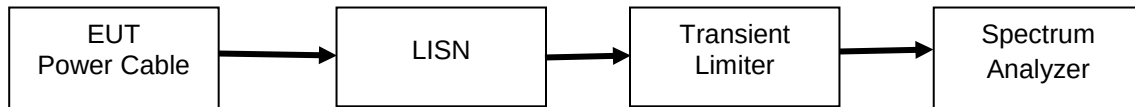
Engineer: Alex Macon

Test Date: 9/20/17

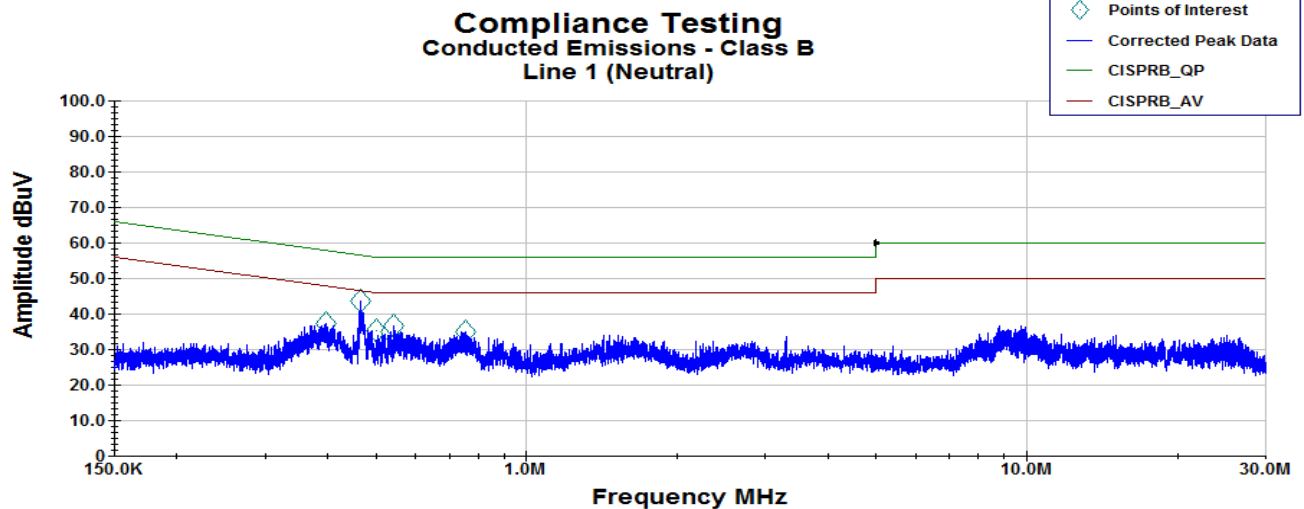
### Test Procedure

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

### Test Setup



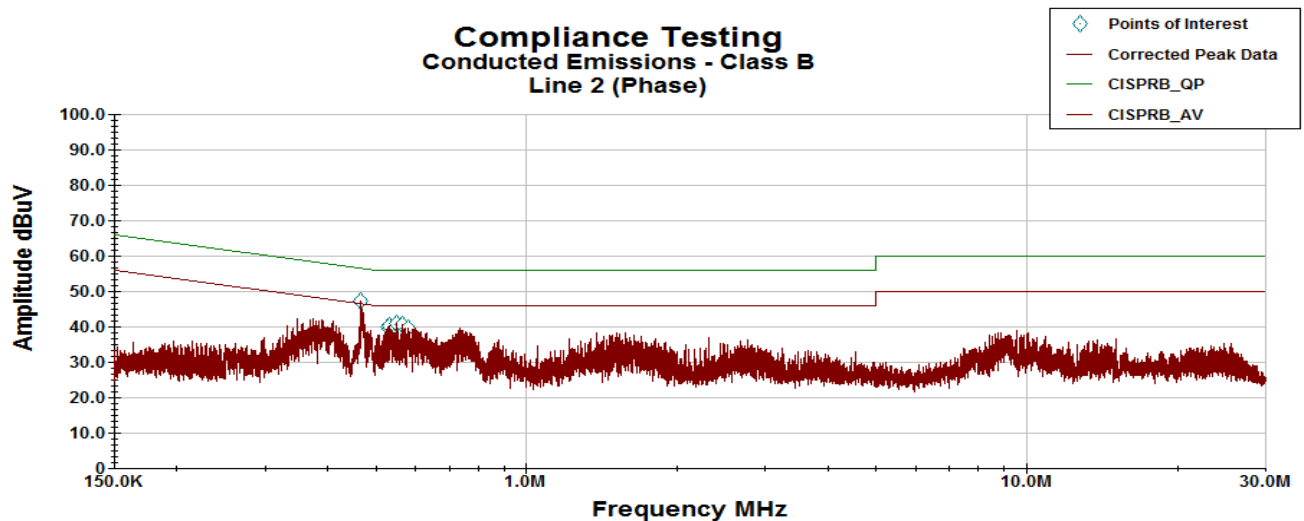
### Line 1



Operator: AM  
EN55032 Class B\_p1780018.til

Job #: p1780018

### Line 2



Operator: AM  
EN55032 Class B\_p1780018.til

Job #: p1780018



**Line 1 Neutral Avg Detector**

| Frequency  | Measured Value (dBuV) | LISN Correction Factor (dB) | Cable Loss (dB) | Transient Limiter (dB) | Final Data (dBuV) | Limit (dBuV) | Avg Margin (dB) |
|------------|-----------------------|-----------------------------|-----------------|------------------------|-------------------|--------------|-----------------|
| 392.11 KHz | 18.74                 | 0.10                        | 0.030           | 10.100                 | 28.977            | 49.083       | -20.106         |
| 469.64 KHz | 23.00                 | 0.10                        | 0.030           | 10.100                 | 33.227            | 46.867       | -13.641         |
| 513.0 KHz  | 9.28                  | 0.10                        | 0.030           | 10.100                 | 19.510            | 46.000       | -26.490         |
| 526.81 KHz | 11.10                 | 0.10                        | 0.030           | 10.100                 | 21.330            | 46.000       | -24.670         |
| 528.42 KHz | 11.77                 | 0.10                        | 0.030           | 10.100                 | 22.000            | 46.000       | -24.000         |
| 752.13 KHz | 14.34                 | 0.02                        | 0.038           | 10.100                 | 24.502            | 46.000       | -21.498         |

**Line 2 Phase Avg Detector**

| Frequency  | Measured Value (dBuV) | LISN Correction Factor (dB) | Cable Loss (dB) | Transient Limiter (dB) | Final Data (dBuV) | Limit (dBuV) | Avg Margin (dB) |
|------------|-----------------------|-----------------------------|-----------------|------------------------|-------------------|--------------|-----------------|
| 461.67 KHz | 15.00                 | 0.10                        | 0.030           | 10.100                 | 25.227            | 47.095       | -21.868         |
| 536.92 KHz | 14.23                 | 0.10                        | 0.030           | 10.100                 | 24.457            | 46.000       | -21.543         |
| 542.04 KHz | 13.38                 | 0.10                        | 0.030           | 10.100                 | 23.610            | 46.000       | -22.390         |
| 551.98 KHz | 15.30                 | 0.10                        | 0.030           | 10.100                 | 25.533            | 46.000       | -20.467         |
| 554.65 KHz | 12.49                 | 0.10                        | 0.030           | 10.100                 | 22.720            | 46.000       | -23.280         |
| 581.34 KHz | 16.46                 | 0.10                        | 0.030           | 10.100                 | 26.693            | 46.000       | -19.307         |

**Line 1 Neutral QP Detector**

| Frequency  | Measured Value (dBuV) | LISN Correction Factor (dB) | Cable Loss (dB) | Transient Limiter (dB) | Final Data (dBuV) | Limit (dBuV) | QP Margin (dB) |
|------------|-----------------------|-----------------------------|-----------------|------------------------|-------------------|--------------|----------------|
| 392.11 KHz | 23.870                | 0.104                       | 0.030           | 10.100                 | 34.104            | 59.083       | -24.979        |
| 469.64 KHz | 27.610                | 0.100                       | 0.030           | 10.100                 | 37.840            | 56.867       | -19.027        |
| 513.0 KHz  | 18.030                | 0.100                       | 0.030           | 10.100                 | 28.260            | 56.000       | -27.740        |
| 526.81 KHz | 18.930                | 0.100                       | 0.030           | 10.100                 | 29.160            | 56.000       | -26.840        |
| 528.42 KHz | 18.260                | 0.100                       | 0.030           | 10.100                 | 28.490            | 56.000       | -27.510        |
| 752.13 KHz | 20.170                | 0.024                       | 0.038           | 10.100                 | 30.332            | 56.000       | -25.668        |

**Line 2 Phase QP Detector**

| Frequency  | Measured Value (dBuV) | LISN Correction Factor (dB) | Cable Loss (dB) | Transient Limiter (dB) | Final Data (dBuV) | Limit (dBuV) | QP Margin (dB) |
|------------|-----------------------|-----------------------------|-----------------|------------------------|-------------------|--------------|----------------|
| 461.67 KHz | 29.30                 | 0.10                        | 0.030           | 10.100                 | 39.530            | 57.095       | -17.565        |
| 536.92 KHz | 25.25                 | 0.10                        | 0.030           | 10.100                 | 35.480            | 56.000       | -20.520        |
| 542.04 KHz | 24.30                 | 0.10                        | 0.030           | 10.100                 | 34.530            | 56.000       | -21.470        |
| 551.98 KHz | 25.34                 | 0.10                        | 0.030           | 10.100                 | 35.570            | 56.000       | -20.430        |
| 554.65 KHz | 24.44                 | 0.10                        | 0.030           | 10.100                 | 34.670            | 56.000       | -21.330        |
| 581.34 KHz | 26.31                 | 0.10                        | 0.030           | 10.100                 | 36.540            | 56.000       | -19.460        |



## Test Equipment Utilized

| Description                   | Manufacturer    | Model #                       | CT Asset # | Last Cal Date       | Cal Due Date |
|-------------------------------|-----------------|-------------------------------|------------|---------------------|--------------|
| EMI Receiver                  | HP              | 8546A                         | i00033     | 3/28/17             | 3/28/18      |
| Preamplifier                  | HP              | 8447D                         | i00055     | Verified on:9/20/17 |              |
| Horn Antenna                  | ARA             | DRG-118/A                     | i00271     | 6/16/16             | 6/16/18      |
| Horn Antenna, Amplified       | ARA             | MWH-1826/B                    | i00273     | 4/22/15             | 4/22/18      |
| Humidity / Temp Meter         | Newport         | IBTHX-W-5                     | i00282     | 6/9/17              | 6/9/18       |
| Spectrum Analyzer             | Agilent         | E4407B                        | i00331     | 10/19/16            | 10/19/17     |
| Data Logger                   | Fluke           | Hydra Data Bucket             | i00343     | 5/25/17             | 5/25/18      |
| Vector Signal Generator       | Agilent         | E4438C                        | i00348     | 5/5/17              | 5/5/18       |
| Bi-Log Antenna                | Schaffner       | CBL 6111D                     | i00349     | 8/3/16              | 8/3/18       |
| AC Power Source               | Behlman         | BL 6000                       | i00362     | Verified on:9/20/17 |              |
| EMI Analyzer                  | Agilent         | E7405A                        | i00379     | 2/22/17             | 2/22/18      |
| 3 Meter Semi-Anechoic Chamber | Panashield      | 3 Meter Semi-Anechoic Chamber | i00428     | 8/15/16             | 8/15/19      |
| PSA Spectrum Analyzer         | Agilent         | E4445A                        | i00471     | 9/6/17              | 9/6/19       |
| Voltmeter                     | Fluke           | 179                           | i00488     | 3/1/17              | 3/1/18       |
| Signal Generator              | Agilent         | E4437B                        | i00489     | 5/5/17              | 5/5/18       |
| Spectrum Analyzer             | Rohde & Schwarz | FSU26                         | i00501     | 3/27/17             | 3/27/18      |
| Network Analyzer              | HP              | 8753D                         | i00505     | 6/8/17              | 6/8/18       |
| Audio Analyzing DMM           | Keithley        | 2015-P                        | i00506     | 5/26/17             | 5/26/18      |
| Preamplifier                  | Miteq           | AFS44 00101 400 23-10P-44     | i00509     | N/A                 | N/A          |

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT