Willow Run (WR) Test Labs, Inc.
7117 Fieldcrest Dr.
Brighton, Michigan 48116 USA
Tel: (734) 252-9785
Fax: (734) 926-9785
e-mail: info@wrtest.com

Testing of

# Electromagnetic Emissions

per

| | | |
|---|---|---|
| **USA:** | **CFR Title 47, Part 15.519** | (Emissions) |
| **USA:** | **CFR Title 47, Part 2.1091;2.1093** | (Exposure) |
| **Canada:** | **ISED RSS-220** | (Emissions) |
| **Canada:** | **ISED RSS-102** | (Exposure) |

are herein reported for

# Lear Corporation
# KOBJXF18A

Test Report No.: 20170616-RPTWAC0100054Br0



Applicant/Provider:
Lear Corporation
21557 Telegraph Road Building 100, Southfield Michigan 48033 USA
Phone: +1 (248) 447-1357, Fax: +1 (248) 447-1683
Contact Person: Jason Summerford; jsummerford@lear.com

Data Recorded by: Dr. Joseph Brunett, EMC-002790-NE
Reviewed by: Dr. Joseph Brunett, EMC-002790-NE
Prepared by: Dr. Joseph Brunett, EMC-002790-NE
Date of Issue: June 16, 2017

**Results of testing completed on (or before) April 10, 2017 are as follows.**

**Emissions:** The transmitter intentional emissions **COMPLY** with the regulatory limit(s) by no less than 1.5 dB. Transmit chain spurious or harmonic emissions **COMPLY** by no less than 4.7 dB. Unintentional spurious emissions from digital circuitry **COMPLY** with radiated emission limit(s) by at least 20 dB.

## Revision History

| Rev. No. | Date | Details | Revised By |
|---|---|---|---|
| r0 | June 16, 2017 | Split from A report + updates. | J. Brunett |

## Contents

## List of Tables



## List of Figures

# 1 Test Report Scope and Limitations

## 1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: 688478) and with ISED Canada, Ottawa, ON (File Ref. No: IC8719A-1 and IC22227-1).

## 1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until June 2027.

## 1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

## 1.4 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

## 1.5 Copyright

This report shall not be reproduced, except in full, without the written approval of Willow Run (WR) Test Labs, Inc..

## 1.6 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

### 1.7 Test Location

The EUT was fully tested by **Willow Run (WR) Test Labs, Inc.**, 7117 Fieldcrest Dr., Brighton, Michigan 48116 USA. Table 1 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report.

Table 1: Test Site List.

| Description | Location | Quality Num. |
|---|---|---|
| OATS (3 meter) | 8501 Beck Rd. Bldg 2227, Belleville MI 48111 | OATSA |

### 1.8 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Willow Run (WR) Test Labs, Inc. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

| Description | Manufacturer/Model | SN | Quality Num. | Last Cal By / Date Due |
|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz / FSV30 | 101660 | RSFSV30001 | RS / May-2018 |
| Spectrum Analyzer | Rohde & Schwarz / FSV4 | 101222 | RSFSV4001 | RS / Mar-2018 |
| Biconical | EMCO / 93110B | 9802-3039 | BICEMCO01 | Lib. Labs / Aug-2017 |
| Log Periodic Antenna | EMCO / 3146 | 9305-3614 | LOGEMCO01 | Lib. Labs / Aug-2017 |
| Quad Ridge Horn | ETS Lind. / 3164-04 | 00066988 | HRNQR316401 | Lib. Labs / Aug-2017 |
| Quad Ridge Horn | Singer / A6100 | C35200 | HQR2TO18S01 | Lib. Labs / Aug-2017 |
| K-Band Horn | JEF / NRL Std. | 001 | HRNK01 | WRTL / Jul-2017 |
| Ka-Band Horn | JEF / NRL Std. | 001 | HRNKA001 | WRTL / Jul-2017 |

# 2 Test Specifications and Procedures

## 2.1 Test Specification and General Procedures

The ultimate goal of Lear Corporation is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Lear Corporation KOB-JXF18A for compliance to:

| Country/Region | Rules or Directive | Referenced Section(s) |
|---|---|---|
| United States | Code of Federal Regulations | CFR Title 47, Part 15.519 |
| Canada | ISED Canada | ISED RSS-220 |

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

| | |
|---|---|
| ANSI C63.4:2014 | "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" |
| ANSI C63.10:2013 (USA) | "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices" |
| CFR 47 2.1091/1093 | "447498 D01 General RF Exposure Guidance v06: RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices" |
| ISED Canada | "The Measurement of Occupied Bandwidth" |
| ICES-003; Issue 6 (2016) | "Information Technology Equipment (ITE) Limits and methods of measurement" |
| ISED Canada RSS-102 | "Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)" |
| ISED Canada SPR-002 | "Supplementary Procedure for Assessing Compliance with RSS-102 Nerve Stimulation Exposure Limits." |

# 3 Configuration and Identification of the Equipment Under Test

## 3.1 Description and Declarations

The equipment under test is an automotive UWB Transceiver. The EUT is approximately 5 x 3 x 1 cm in dimension, and is depicted in Figure 1. It is powered by 3 VDC Lithium coin-cell battery. In use, this device is hand held. Table 3 outlines provider declared EUT specifications.


Figure 1: Photos of EUT.

Table 3: EUT Declarations.

| | | | |
|---|---|---|---|
| **General Declarations** | | | |
| **Equipment Type:** | UWB Transceiver | **Country of Origin:** | Spain |
| **Nominal Supply:** | 3 VDC | **Oper. Temp Range:** | $-40^oC$ to $+85^oC$ |
| **Frequency Range:** | 3615 – 4337 MHz | **Antenna Dimension:** | 3 cm |
| **Antenna Type:** | Integral | **Antenna Gain:** | Chip (UWB) |
| **Number of Channels:** | 1(UWB) | **Channel Spacing:** | None |
| **Alignment Range:** | Not Declared | **Type of Modulation:** | PPM(UWB) |
| **United States** | | | |
| **FCC ID Number:** | KOBJXF18A | **Classification:** | DSC, UWB |
| **Canada** | | | |
| **IC Number:** | 3521A-JXF18A | **Classification:** | Remote Control Device, UWB Device |

### 3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

### 3.1.2 Modes of Operation

There are two principle modes of operation for this device. The first mode (UHF-MODE) is addressed in WRTL report 20170411-RPTWAC0100054Ar4.

The second principle mode addressed herein is that of a UWB transceiver (UWB-MODE) which is automatically activated upon detection of an encoded 125 kHz LF signal from a paired RFA module within the vehicle. The UWB-MODE then sends inquiry frames to paired in-vehicle UWB transceivers (SATs) which triangulate the position of the keyfob for passive entry and passive start operations. In normal operation the EUT sends a single PPM UWB frame as an inquiry to and then as a response to a paired SAT. If no SAT is present, the EUT will continue to inquire for no more than 1 second.

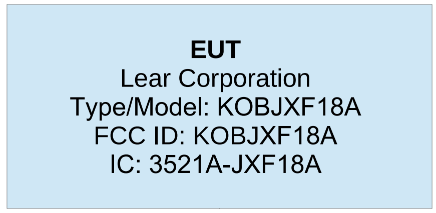



Figure 2: EUT Test Configuration Diagram.

#### 3.1.3 Variants

There is only a single variant of the EUT, as tested.

#### 3.1.4 Test Samples

Four samples of the EUT were provided for testing. One normal operating sample paired with a corresponding SAT UWB transceiver and RFA UHF receiver for encoding and timing tests, one software modified sample capable of transmitting UWB frames repeatedly at a higher than normal rate (once every 10 ms), a third sample with custom UHF CW and continuously modulated UHF transmitter modes (see WRTL report 20170411-RPTWAC0100054Ar4 for details), and a fourth sample apart for photographs.

#### 3.1.5 Functional Exerciser

EUT functionality was verified by observation of transmitted signal.

#### 3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

#### 3.1.7 Production Intent

The EUT appears to be a production ready sample.

#### 3.1.8 Declared Exemptions and Additional Product Notes

None.

# 4 Emissions

## 4.1 General Test Procedures

### 4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our shielded anechoic chamber or GTEM test cell. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.7 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded.

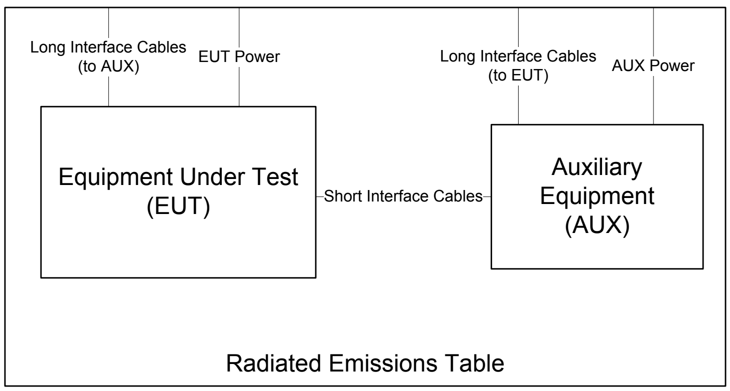



Figure 3: Radiated Emissions Diagram of the EUT.

If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied. For devices with intentional emissions below 30 MHz, a shielded loop antenna is used. It is placed at a 1 meter receive height. Emissions between 30 MHz and 1 GHz are measured using tuned dipoles and/or calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through $360^o$ in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain horn or broadband ridge-horn antennas on our OATS with a $4 \times 5$ m rectangle of H-4 absorber placed over the ground screen covering the OATS ground screen. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dB$\mu$V/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where $P_R$ is the power recorded on spectrum analyzer, in dBm, $K_A$ is the test antenna factor in dB/m, $K_G$ is the combined pre-amplifier gain and cable loss in dB, $K_E$ is duty correction factor (when applicable) in dB, and $C_F$ is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

When microwave measurements are made at a range different than the regulatory distance or made at close-range to improve receiver sensitivity, the reading is corrected back to the regulatory distance. This is done using a 20 dB/decade field behavior as dictated by the test procedures. When measurements are made in the near-field, the near-field/far-field boundary (N/F) is reported. It is computed as

$$N/F = 2D^2/\lambda$$

where $D$ is the maximum dimension of the transmitter or receive antenna, and $\lambda$ is the wavelength at the measurement frequency. Typically for high frequency measurements the receive antenna is connected to test receiver / analyzer through an external mixer. In this case, cable loss, IF amplifier gain, and mixer conversion losses are corrected for in the data table, or directly in the spectrum analyzer.

Figure 4: Radiated Emissions Test Setup Photograph(s).

### 4.1.2 Conducted Emissions Test Setup and Procedures

**Battery Power Conducted Spurious** The EUT is not subject to measurement of power line conducted emissions as it is powered solely by its internal battery.

### 4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a battery power source, the extreme test voltages are evaluated over the range specified in the test standard; no less than $\pm 10\%$ of the nominal battery voltage declared by the manufacturer. For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

### 4.1.4 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report. The provider has declared that the EUT is designed for operation over the temperature range $-40^{o}$C to $+85^{o}$C. Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber, temperature and humidity are recorded, and thermal balance is verified via a thermocouple–based probe.

## 4.2 Intentional Emissions

### 4.2.1 Fundamental Emission Pulsed Operation

**Test Setup & Procedure** The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Duty cycle is measured using the maximum possible receiver IFBW for the purpose of computing RF exposure compliance and documenting the encoding employed by the EUT. The test equipment employed includes RSFSV30001, HRNQR316401.

**Measurement Results** The details and results of testing the EUT are summarized in Table 4. Plots showing the measurements made to obtain these values are provided in Figure 5.

Table 4: Fundamental Emission Pulsed Operation.

| Frequency Range | Det | IFBW | VBW |
|---|---|---|---|
| f > 1 000 MHz | Pk | 28 MHz | 28 MHz |

| | |
|---|---|
| **Test Date:** | 23-Mar-17 |
| **Test Engineer:** | Joseph Brunett |
| **EUT** | Normal Operating |
| **Meas. Distance:** | 60 cm |

| Pulsed Operation / Duty Cycle | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Transmit Mode | Voltage (V) | Oper. Freq (MHz) | Min. Cycle Time (ms) | Total Off-Time/s* (ms) | EN 302-065-3 Total Off-Time/s Limit (ms) | Mean Off-Time Limit (ms) | On-Time** (ms) | EN 302-065-3 On-Time LDC Limit (ms) | Exposure Duty Correction*** (dB) |
| UWB PPM (Paired) subfigure (c) | 3.0 | 3993.6 | 21.10 | 998.77 | 950.00 | 38.00 | 1.23 | 5.00 | 12.3 |
| UWB PPM (Unpaired) subfigure (d) | 3.0 | 3993.6 | 10.40 | 999.69 | 950.00 | 38.00 | 0.31 | 5.00 | 15.3 |

* Total Off-time/sec is equal to 1000ms – duration of the four frames observed due to a single manual activation per second (maximum possible repetition rate of system unlock response time observed by test laboratory > 1 sec).

** Maximum two-frame on-time measured.

*** Worst-case Exposure duty cycle correction (due to burst-modulated carrier) computed as 10*Log(On-Time/ Min Cycle-Time). Overestimate due to finite transmission length of only four frames in the actual paired use system.

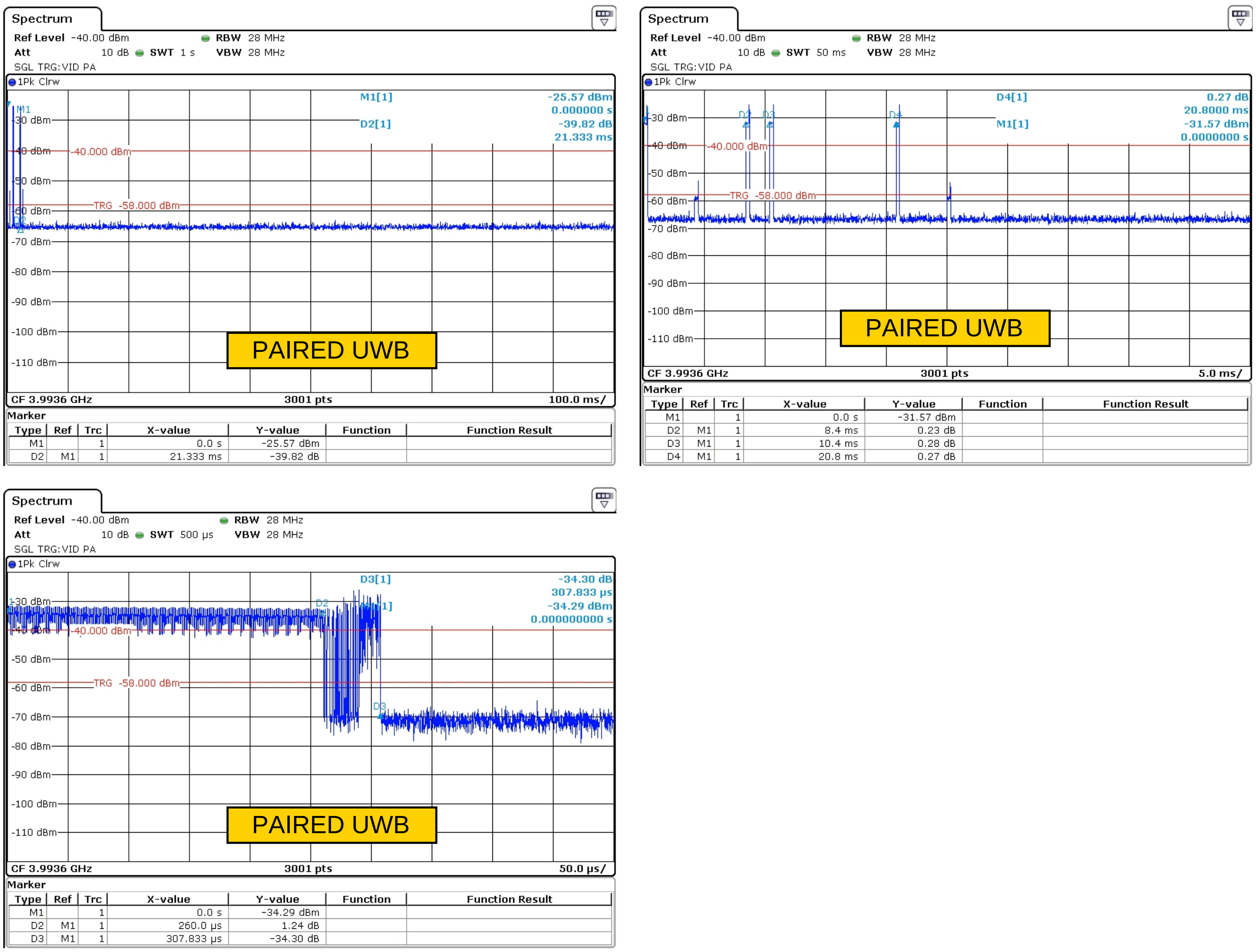



Figure 5(a): Fundamental Emission Pulsed Operation.

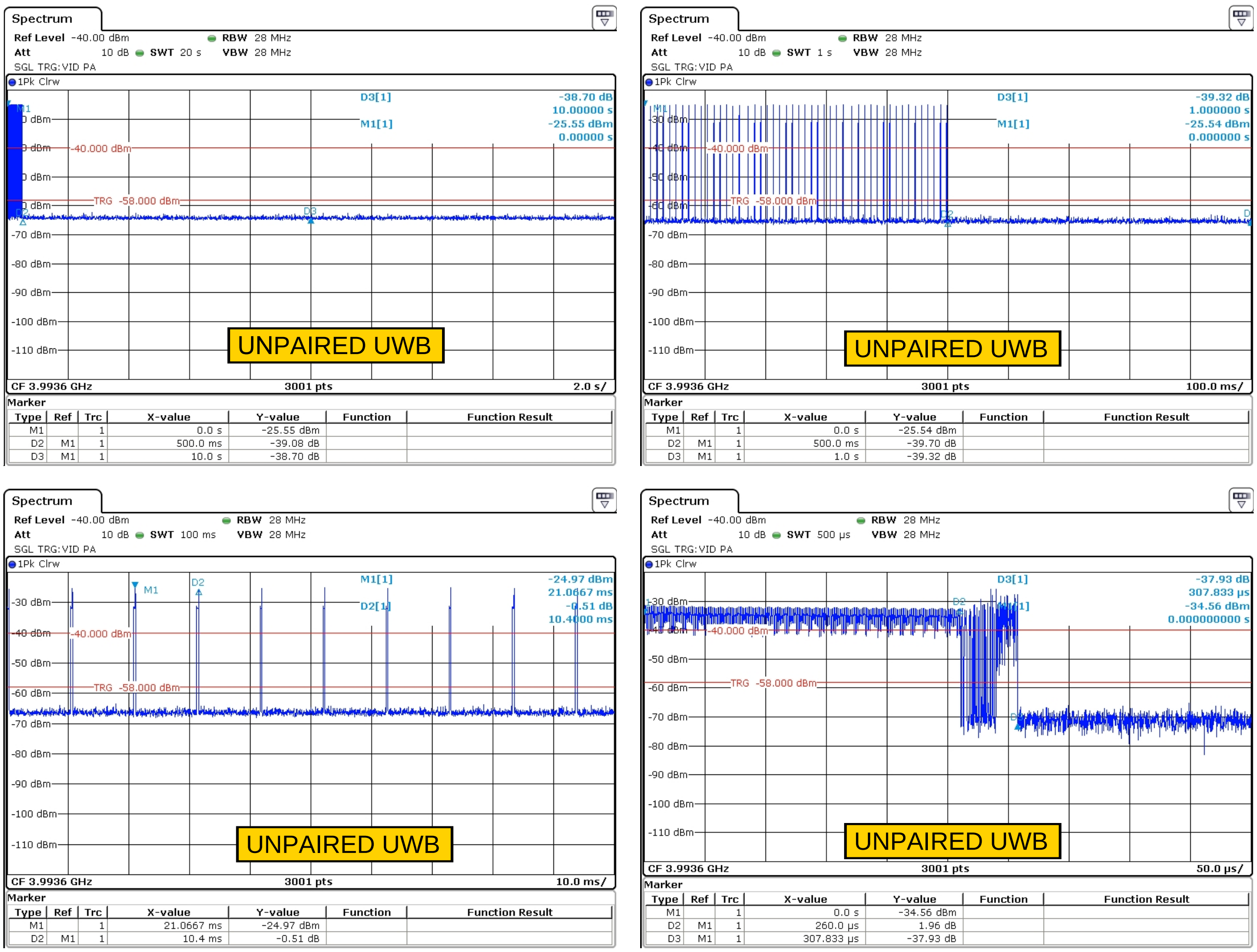



Figure 5(b): Fundamental Emission Pulsed Operation.

### 4.2.2 Fundamental Emission Bandwidth

**Test Setup & Procedure** The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Emission bandwidth (EBW) of the EUT is measured following the UWB measurement procedures in ANSI C63.10:2013/RSS-220. The test equipment employed includes RSFSV30001, HRNQR316401.

**Measurement Results** The details and results of testing the EUT are summarized in Table 5. Plots showing the measurements made to obtain these values are provided in Figure 6.

Table 5: Fundamental Emission Bandwidth.

| Frequency Range | Det | IFBW | VBW | Span | | |
|---|---|---|---|---|---|---|
| f < 1 000 MHz | Pk | 30 kHz | 100 kHz | 3 MHz | **Test Date:** | 23-Mar-17 |
| f > 1 000 MHz | Pk | 1 MHz | 3 MHz | 1 GHz | **Test Engineer:** | Joseph Brunett |
| | | | | | **EUT** | Lear PEPS UWB Fob |
| | | | | | **Meas. Distance:** | 60 cm |

| UWB Occupied Bandwidth | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmit Mode | Symbol Rate (Msym/s) | Data Rate (Mbps) | Voltage (V) | Oper. Freq (MHz) | 99% OBW (MHz) | 10 dB EBW (MHz) | 10 dB EBW Limit (MHz) | fL (MHz) | fL Limit (MHz) | fH (MHz) | fH Limit (MHz) | fmax (MHz) | Pass/Fail |
| UWB PPM | - | - | 3.0 | 3993.6 | 748.4 | 784.4 | 500.0 | 3574.4 | 3100.0 | 4358.8 | 10600.0 | 3838.3 | Pass |

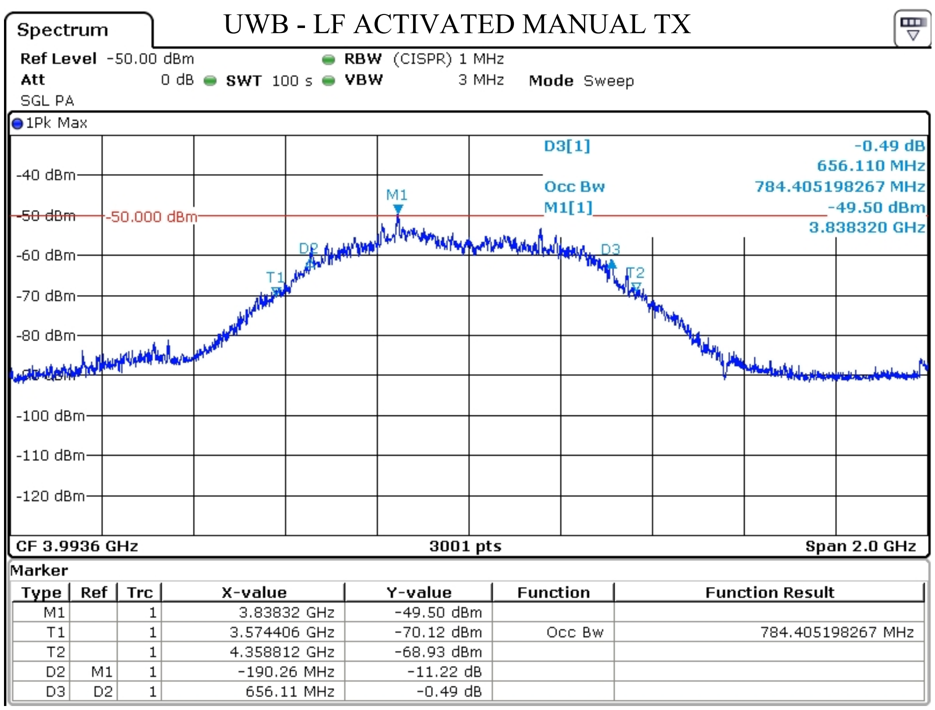



Figure 6: Fundamental Emission Bandwidth.

### 4.2.3 Fundamental Emission Field Strength

**Test Setup & Procedure** The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. The fundamental emission is measured at the regulatory distance on our OATS following the UWB measurement procedures in ANSI C63.10:2013/RSS-220. The test equipment employed includes RSFSV30001, HRNQR316401.

**Measurement Results** The details and results of testing the EUT are summarized in Table 6.

Table 6: Fundamental Emission Field Strength.

**EUT Modes:**
- a1 UHF CW mode on Center Channel
- a2 UHF Normal Operating Mode – Manual Activation by button press.
- a3 UWB continuously modulated at higher than normal periodic rate, max frame width.
- a4 UWB Normal Operating Mode – Actuated by detection of LF interrogation.

**Test Date:** 03/22/17
**Test Engineer:** Joseph Brunett

| | Frequency | | | Site | | | | EUT | | | Test Antenna | | | Cable | Receiver | | | | Field Strength @ DR | | | | | | EUT EIRP | | | | | | Details |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Start | Stop | Temp. | MR | DR | N/F | CF | | | | Pol. | Dim. | Ka | Kg | Rx Power | | Bandwidth | | Pk | | | RMS | | | Pk | | | RMS | | | |
| R0 | | | | | | | | Mode | Volt. | Dim | | | | | Pk | RMS | RBW | VBW | Meas. | Limit | | Meas. | Limit | | Meas. | Limit | | Meas. | Limit | | Pass |
| | | | | | | | | see | | | | | | | | | | | | USA | CAN | | USA | CAN | | USA | CAN | | USA | CAN | Fail |
| | MHz | MHz | ( C ) | m | | | dB | table | (V) | cm | H/V | cm | dB/m | dB | dBuV/m | | MHz | | dBuV/m | | | | | | dBm | | | | | | dB |
| R1 | SETUP | | OATSA | | | | | LEAR PEPS | | | HRNQR316401 | | | | RSFSV30001 | | | | NOTES: NOTES: Max all orientations of EUT and both Test Antenna Polarizations | | | | | | | | | | | | |
| R2 | 3837.0 | 3837.0 | -2.0 | 3.0 | 3.0 | 1.2 | 0.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 34.2 | -0.4 | | | 28.00 | 28.00 | 88.9 | | | | | | | | | | | | |
| R3 | 3837.0 | 3837.0 | -2.0 | 3.0 | 3.0 | 1.2 | 0.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 34.2 | -0.4 | | | 50.00 | 50.00 | 93.9 | | | | | | -1.3 | .0 | .0 | | | | 1.3 |
| R4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R5 | 3837.0 | 3837.0 | -2.0 | 3.0 | 3.0 | 1.2 | 0.0 | a3 | 2.7 | 4.0 | H/V | 22.0 | 34.2 | -0.4 | | | 1.00 | 3.00 | | | | 52.4 | | | | | | -42.8 | -41.3 | -41.3 | 1.5 |
| R6 | 3837.0 | 3837.0 | -2.0 | 3.0 | 3.0 | 1.2 | 0.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 34.2 | -0.4 | | | 1.00 | 3.00 | | | | 52.5 | | | | | | -42.7 | -41.3 | -41.3 | 1.4 |
| R7 | 3837.0 | 3837.0 | -2.0 | 3.0 | 3.0 | 1.2 | 0.0 | a3 | 3.3 | 4.0 | H/V | 22.0 | 34.2 | -0.4 | | | 1.00 | 3.00 | | | | 52.4 | | | | | | -42.8 | -41.3 | -41.3 | **1.5** |
| R8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| # | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C20 | C21 | C22 | C23 | C24 | C25 | C26 | C27 | C28 | C29 | C30 | C31 |

| (ROW) | (COLUMN) | NOTE: |
|---|---|---|
| R0 | C4 | MR is Measurement Range, which is reduced from DR to achieve necessary SNR. |
| R0 | C5 | DR is the regulatory Desired Range measurement distance. |
| R0 | C6 | N/F is Near-Field / Far-Field distance computed for max of EUT Antenna Dimension (C10) and Test Antenna dimension (C12), where applicable. |
| R0 | C7 | CF is computed using a 20 dB/decade Decay Rate. |
| R0 | C15 | When E-field or EIRP is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings and Pr is not reported. |
| R2-R7 | C19,C22 | PEAK and RMS Power measured with 1 GHz Span, 1001 Freq Samples, 1 sec sweep, Max-Held. |
| R3 | C19 | Peak in 50 MHz BW computed from (R2;C19) using 20*log10(50MHz / 28MHz) |
| R5-7 | C30 | ISED Correspondence regarding this particular product permitted use at proposed power rating under RSS-220 Hand-Held Regulations. See correspondence included in this application. |

### 4.2.4 Exposure and Potential Health Hazard

To demonstrate compliance with with regulations that place limitations on human electromagnetic field exposure for both the general public and for workers, we compute EIRP from measured emission data. These levels are compared with limits placed by the directives and recommendations detailed in Section 2.1. Table 7 details the results of these computations.

Table 7: Electromagnetic Field Exposure.

**USA REF:** 1.1310, 2.1091/1093, 447498 D01 General RF Exposure Guidance v06
**IC REF:** RSS-102 Issue 5, Safety Code 6
**Min. Sep. Distance:** <5 mm (Portable)

**Test Date:** 22-Mar-17
**Test Engineer:** Joseph Brunett
**EUT:** LEAR SAT 4
**EUT Mode:** Worst Case
**Meas. Distance:** See Fund. Power Table

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Frequency Band | | E-Field | EIRP | H-Field | Canada ISED RSS-102 MPE | | | USA FCC 1.1310 MPE | | |
| Mode | Start MHz | Stop MHz | @ 3m (Avg) dBuV/m | (Avg) mW | @ MSP (Avg) dBuA/m | SC6 Limit @ MSP dBuV/m | SC6 Limit @ MSP dBuA/m | MPE Ratio | SAR Threshold | SAR Threshold Limit | Worst Case MPE Ratio |
| Other | | | | | | | | | | | |
| | Frequency Band | | Pk EIRP + Duty | E-Field | Pwr Density | EIRP + Duty | Minimum | | | Minimum | |
| Mode | Start MHz | Stop MHz | (Avg/RMS) dBm | @20cm (RMS) dBuV/m | @20cm (RMS)* mW/cm2 | (RMS) mW | 1g / 10g SAR Threshold Limit | MPE Ratio | SAR Threshold | 1g / 10g SAR Threshold Limit | MPE Ratio |
| UHF | 314.7 | 315.3 | -26.7 | 92.0 | 0.00000 | 0.00212 | 69.1 | 0.00003 | 0.00008 | 3 | |
| UWB | 3574.40 | 4358.80 | -20.2 | 98.6 | 0.00000 | 0.00966 | 1.5 | 0.00644 | 0.00039 | 3 | 0.00013 |
| IF SUM OF ALL MPE RATIOS IS > 1, THEN THE EUT MUST UNDERGO SAR TESTING PER FCC AND ISED (IC) REGULATIONS. | | | | | | | MPE RATIO Total (<1): | **.006** | | MPE RATIO Total (<1): | **.000** |
| | | | | | | | REQUIRES SAR TESTING | No | | REQUIRES SAR TESTING | No |

* EIRP (mW) = S (mW/cm^2) x 4 x PI x 20cm^2

## 4.3 Unintentional Emissions

### 4.3.1 Transmit Chain Spurious Emissions

**Test Setup & Procedure** The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Spurious radiated emissions measurements are made following the UWB measurement procedures in ANSI C63.10:2013/RSS-220 up to 40 GHz. The test equipment employed includes RSFSV30001, BICEMCO01, LOGEMCO01, HRNQR316401, HQR2TO18S01, HRNK01, HRNKA01.

**Measurement Results** The details and results of testing the EUT are summarized in Table 8.

Table 8(a): Transmit Chain Spurious Emissions.

**EUT Modes:**
- a1 UHF CW mode on Center Channel
- a2 UHF Normal Operating Mode – Manual Activation by button press.
- a3 UWB continuously modulated at higher than normal periodic rate, max frame width.
- a4 UWB Normal Operating Mode – Actuated by detection of LF interrogation.

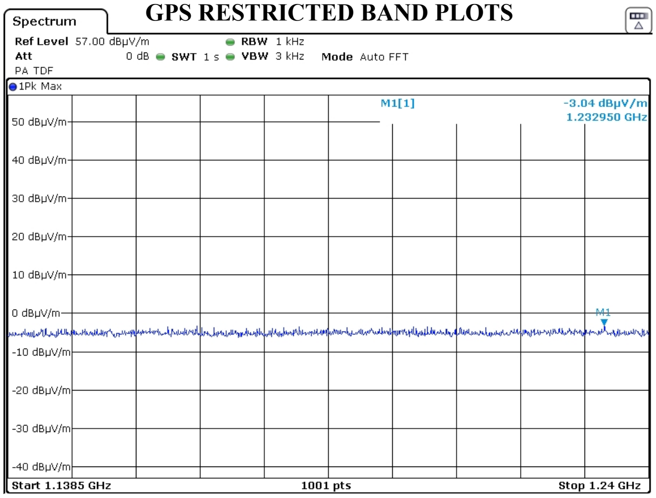
**Test Date:** 03/29/17
**Test Engineer:** Joseph Brunett

| R0 | Frequency | | Site | | | | | EUT | | | Test Antenna | | | Cable | Receiver | | | | Field Strength @ DR | | | | | | EUT EIRP | | | | | | Details |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Start | Stop | Temp. | MR | DR | N/F | CF | Mode | Volt. | Dim | Pol. | Dim. | Ka | Kg | Rx Power | | Bandwidth | | Pk | | | RMS | | | Pk | | | RMS | | | |
| | | | | | | | | | | | | | | | Pk | RMS | RBW | VBW | Meas. | Limit | | Meas. | Limit | | Meas. | Limit | | Meas. | Limit | | Pass |
| | | | | | | | | see | | | | | | | | | | | | USA | CAN | | USA | CAN | | USA | CAN | | USA | CAN | Fail |
| | MHz | MHz | ( C ) | | m | | dB | table | (V) | cm | H/V | cm | dB/m | dB | dBm | | MHz | | dBuV/m | | | | | | dBm | | | | | | dB |
| R1 | SETUP: | | | | OATSA | | | | LEAR PEPS | | | BICEMCO01 | | | | | RSFSV4001 | | NOTES: All background noise | | | | | | | | | | | | |
| R2 | 30.0 | 88.0 | 20 | 3.0 | 3.0 | 1.3 | 0.0 | a3 | 3.0 | 4.0 | H/V | 150.0 | 16.9 | 35.0 | | | 0.1 | 0.3 | 32.1 | | | | | | | | | | 40.0 | 40.0 | 7.9 |
| R3 | 88.0 | 216.0 | 20 | 3.0 | 3.0 | 3.2 | 0.0 | a3 | 3.0 | 4.0 | H/V | 150.0 | 16.9 | 35.0 | | | 0.1 | 0.3 | 33.1 | | | | | | | | | | 43.5 | 43.5 | 10.4 |
| R4 | SETUP: | | | | OATSA | | | | LEAR PEPS | | | LOGEMCO01 | | | | | RSFSV4001 | | NOTES: Max all orientations of EUT, noise floor data | | | | | | | | | | | | |
| R5 | 216.0 | 960.0 | 20 | 3.0 | 3.0 | 6.4 | 0.0 | a3 | 3.0 | 4.0 | H/V | 100.0 | 20.1 | 29.9 | | | 0.1 | 0.3 | 38.0 | | | | | | | | | | 46.0 | 46.0 | 8.0 |
| R6 | SETUP: | | | | OATSA | | | | LEAR PEPS | | | HRNQR316401 | | | | | RSFSV30001 | | NOTES: Max all orient. of EUT, noise floor data in R7-R11, measured signal R12, R13. | | | | | | | | | | | | |
| R7 | 1164.0 | 1240.0 | 20 | 0.6 | 3.0 | 0.4 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 25.2 | -0.4 | | | 0.001 | 0.001 | -3.0 | | | | | | -98.2 | | | | -85.3 | -85.3 | 12.9 |
| R8 | 1559.0 | 1610.0 | 20 | 0.6 | 3.0 | 0.5 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 21.9 | -0.4 | | | 0.001 | 0.001 | -0.1 | | | | | | -95.3 | | | | -85.3 | -85.3 | 10.0 |
| R9 | 960.0 | 1610.0 | 20 | 0.6 | 3.0 | 0.5 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 27.6 | 19.3 | | | 1 | 3 | 22.0 | | | 12.0 | | | -73.2 | -34.0 | -34.0 | -83.2 | -75.3 | -75.3 | 7.9 |
| R10 | 1610.0 | 1990.0 | 20 | 0.6 | 3.0 | 0.6 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 21.7 | 19.1 | | | 1 | 3 | 26.1 | | | 15.9 | | | -69.1 | -34.0 | -34.0 | -79.3 | -63.3 | -70.0 | 9.3 |
| R11 | 1990.0 | 3100.0 | 20 | 0.6 | 3.0 | 1.0 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 20.6 | 18.2 | | | 1 | 3 | 32.1 | | | 19.8 | | | -63.1 | -34.0 | -34.0 | -75.4 | -61.3 | -70.0 | 5.4 |
| R12 | 3100.0 | 3615.0 | 20 | 0.6 | 3.0 | 1.2 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 27.4 | 18.0 | | | 1 | 3 | 53.9 | | | 41.1 | | | -41.3 | -34.0 | -34.0 | -54.1 | -41.3 | -41.3 | 7.3 |
| R13 | 4337.0 | 4750.0 | 20 | 0.6 | 3.0 | 1.5 | 14.0 | a3 | 3.0 | 4.0 | H/V | 22.0 | 52.5 | 17.3 | | | 1 | 3 | 54.9 | | | 41.0 | | | -40.3 | -34.0 | -34.0 | -54.2 | -41.3 | -41.3 | 6.3 |
| R14 | SETUP: | | | | OATSA | | | | LEAR PEPS | | | HQR2TO18S01 | | | | | RSFSV30001 | | NOTES: Max all orientations of EUT, noise floor data | | | | | | | | | | | | |
| R15 | 4750.0 | 10600.0 | 20 | 0.6 | 3.0 | 1.6 | 14.0 | a3 | 3.0 | 4.0 | H/V | 15.0 | 35.3 | 29.1 | | | 1 | 3 | 25.2 | | | 15.1 | | | -70.0 | -34.0 | -34.0 | -80.1 | -41.3 | -41.3 | 36.0 |
| R16 | 10600.0 | 18000.0 | 20 | 0.6 | 3.0 | 2.7 | 14.0 | a3 | 3.0 | 4.0 | H/V | 15.0 | 34.3 | 23.5 | | | 1 | 3 | 26.9 | | | 16.1 | | | -68.3 | -34.0 | -34.0 | -79.1 | -61.3 | -61.3 | 17.8 |
| R17 | SETUP: | | | | OATSA | | | | LEAR PEPS | | | HRNK001 | | | | | RSFSV30001 | | NOTES: Max all orientations of EUT, noise floor data | | | | | | | | | | | | |
| R18 | 18000.0 | 26500.0 | 20 | 0.3 | 3.0 | 1.8 | 20.0 | a3 | 3.0 | 4.0 | H/V | 10.2 | 33.7 | 36.5 | | | 1 | 3 | 33.1 | | | 23.8 | | | -62.1 | -34.0 | -34.0 | -71.4 | -61.3 | -61.3 | 10.1 |
| R19 | SETUP: | | | | OATSA | | | | LEAR PEPS | | | HRNKA001 | | | | | RSFSV30001 | | NOTES: Max all orientations of EUT, noise floor data | | | | | | | | | | | | |
| R20 | 26500.0 | 40000.0 | 20 | 0.2 | 3.0 | 2.3 | 23.5 | a3 | 3.0 | 4.0 | H/V | 9.2 | 37.2 | 12.5 | 39 | 28 | 1 | 3 | 42.5 | | | 29.2 | | | -52.7 | -34.0 | -34.0 | -66.0 | -61.3 | -61.3 | **4.7** |
| # | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C20 | C21 | C22 | C23 | C24 | C25 | C26 | C27 | C28 | C29 | C30 | C31 |

| (ROW) | (COLUMN) | NOTE: |
|---|---|---|
| R0 | C4 | MR is Measurement Range, which is reduced from DR to achieve necessary SNR. |
| R0 | C5 | DR is the regulatory Desired Range measurement distance. |
| R0 | C6 | N/F is Near-Field / Far-Field distance computed for max of EUT Antenna Dimension (C10) and Test Antenna dimension (C12), where applicable. |
| R0 | C7 | CF is computed using a 20 dB/decade Decay Rate. |
| R0 | C15 | When E-field or EIRP is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings and Pr (C15/16) is not reported. |
| R19 | C19,C22 | PEAK and RMS Power measured with 1 GHz Span, 1001 Freq Samples, 1 sec sweep, Max-Held. |
| R20 | C19 | Peak in 50 MHz BW computed from (R19;C19) using 20*log10(50MHz / 28MHz) |
| R12-13 | C30 | ISED Correspondence regarding this particular product permitted use at proposed power rating under RSS-220 Hand-Held Regulations. See correspondence included in this application. |

Table 8(b): Transmit Chain Spurious Emissions.

**GPS RESTRICTED BAND PLOTS**



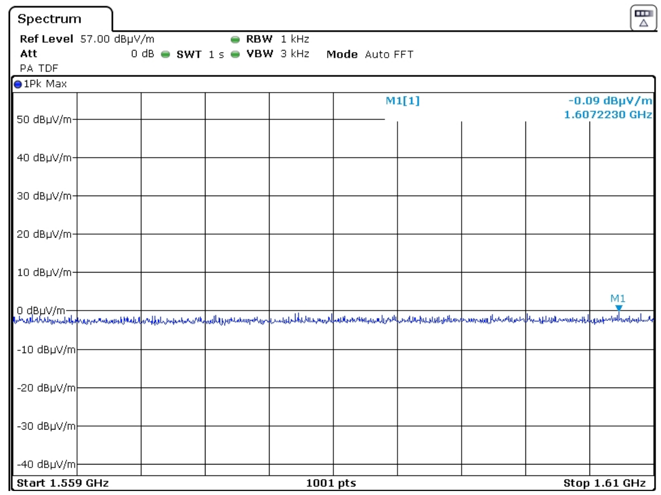
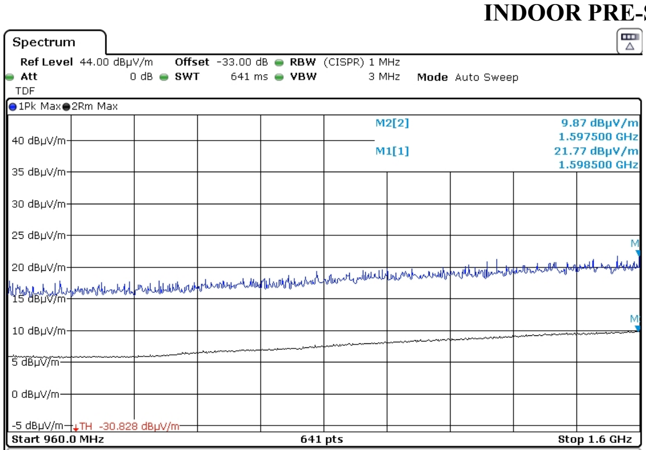
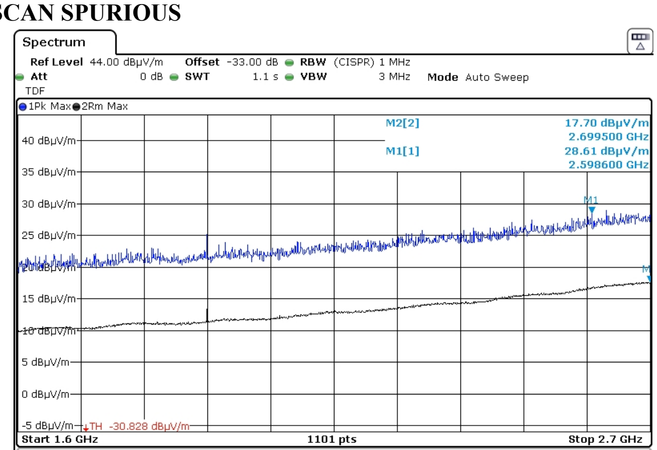




Table 8(c): Transmit Chain Spurious Emissions.

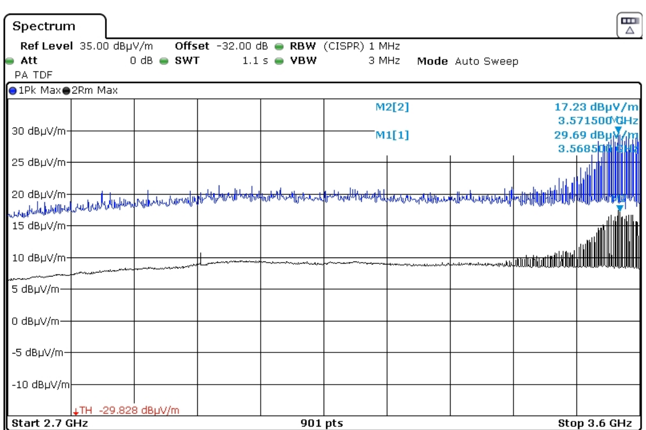
**INDOOR PRE-SCAN SPURIOUS**



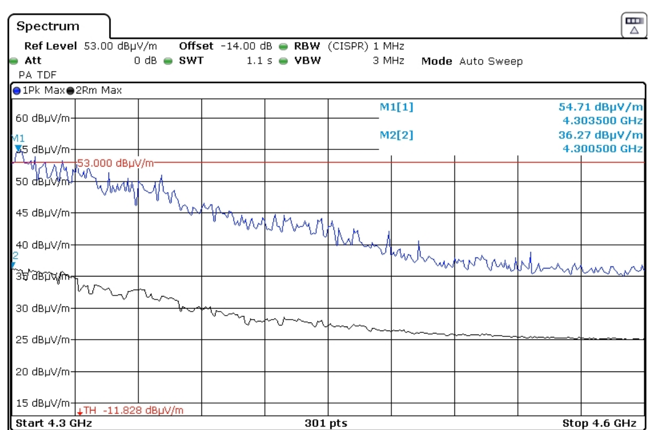

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 1.5985 GHz | 21.77 dBµV/m | | |
| M2 | | 2 | 1.5975 GHz | 9.87 dBµV/m | | |




| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.5986 GHz | 28.61 dBµV/m | | |
| M2 | | 2 | 2.6995 GHz | 17.70 dBµV/m | | |



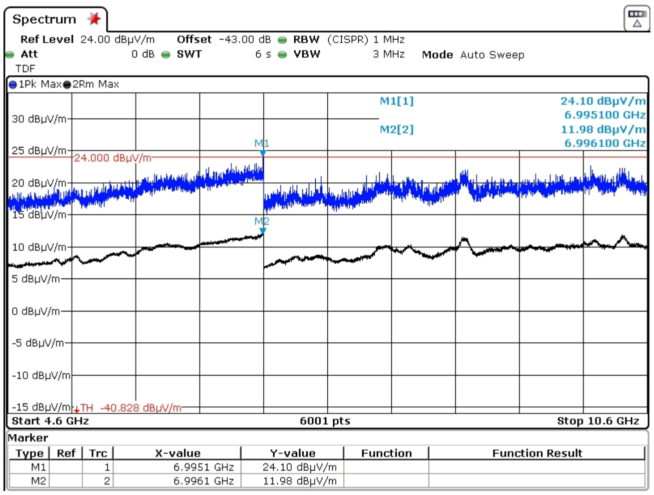

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 3.5685 GHz | 29.69 dBµV/m | | |
| M2 | | 2 | 3.5715 GHz | 17.23 dBµV/m | | |

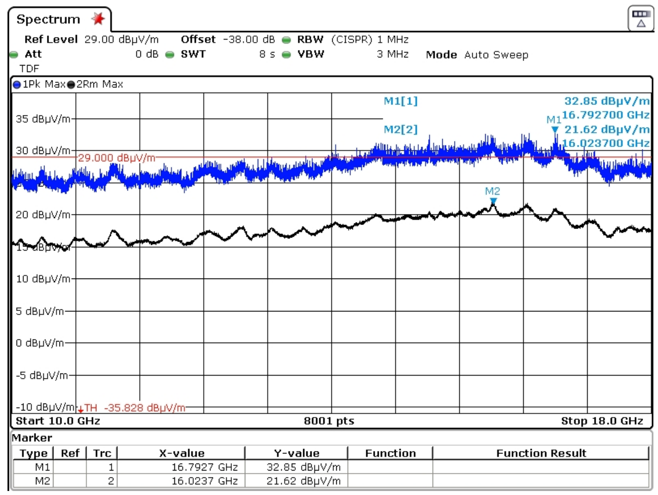



| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 4.3035 GHz | 54.71 dBµV/m | | |
| M2 | | 2 | 4.3005 GHz | 36.27 dBµV/m | | |

Table 8(d): Transmit Chain Spurious Emissions.

**INDOOR PRE-SCAN SPURIOUS**



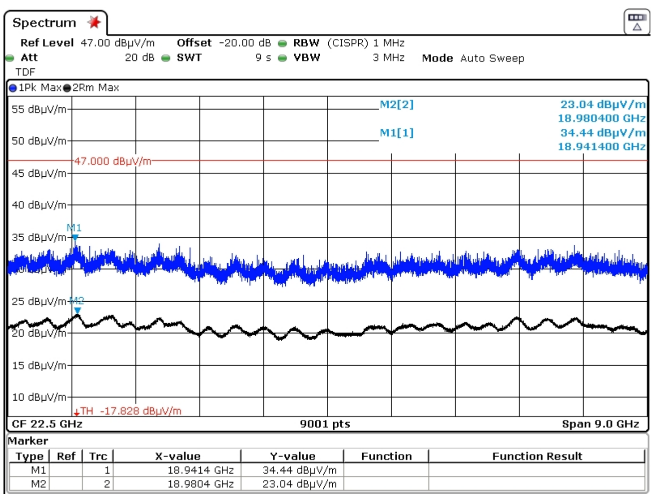
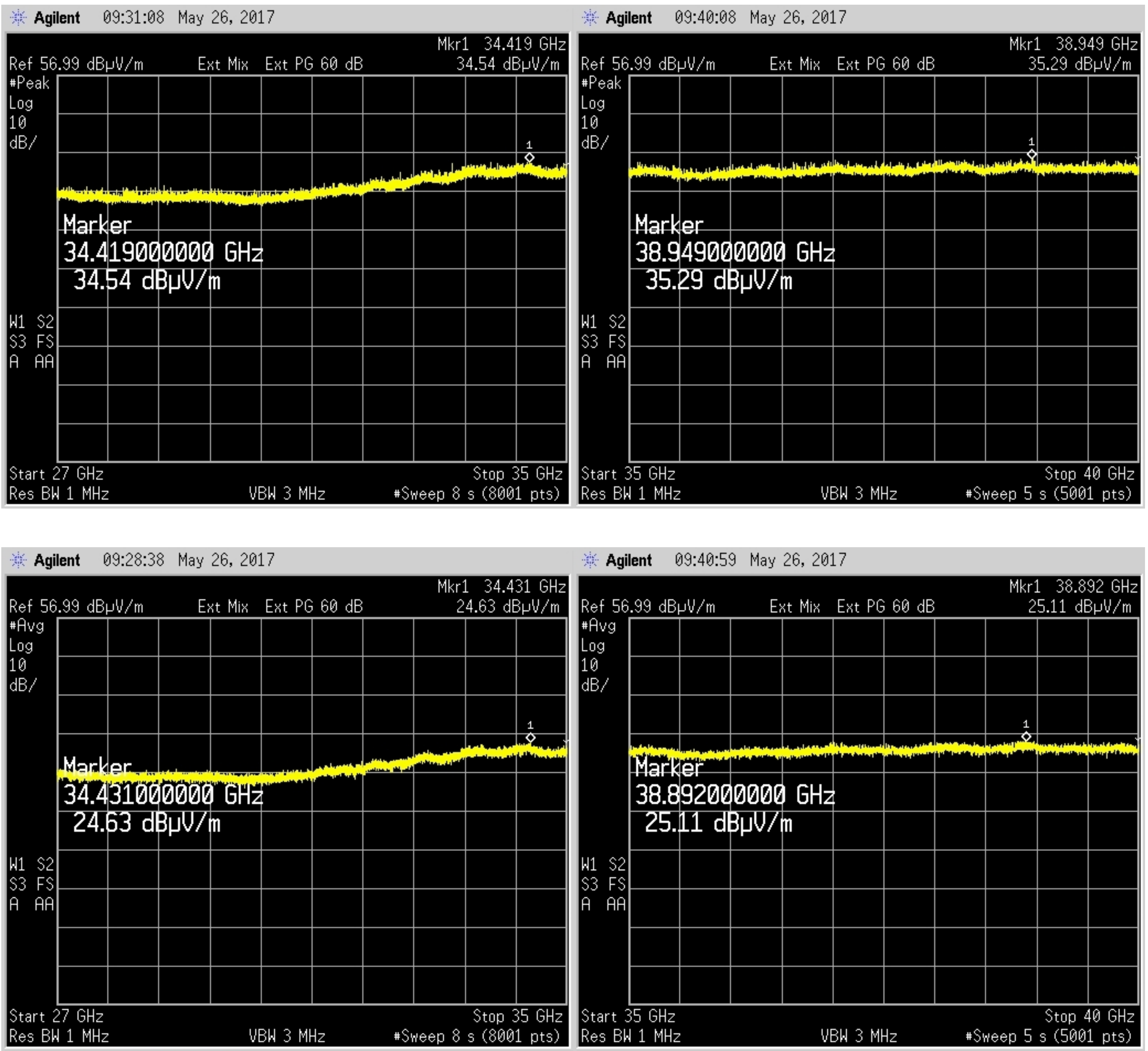



Table 8(e): Transmit Chain Spurious Emissions.

**INDOOR PRE-SCAN SPURIOUS (TOP PEAK, BOTTOM RMS)**



### 4.3.2 Radiated Digital Spurious

The results for the measurement of digital spurious emissions are not reported herein as all digital emissions were greater than 20 dB below the regulatory limit. Radiation from digital components was measured to 4 GHz, or to five times the maximum digital component operating frequency, whichever is greater.

# 5 Measurement Uncertainty

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 9: Measurement Uncertainty.

| **Measured Parameter** | **Measurement Uncertainty**† |
|---:|:---:|
| Radio Frequency | $\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS-1))/2 + 1\,\mathrm{Hz})$ |
| Conducted Emm. Amplitude | $\pm 1.8\,\mathrm{dB}$ |
| Radiated Emm. Amplitude $(30 - 200\,\mathrm{MHz})$ | $\pm 2.7\,\mathrm{dB}$ |
| Radiated Emm. Amplitude $(200 - 1000\,\mathrm{MHz})$ | $\pm 2.5\,\mathrm{dB}$ |
| Radiated Emm. Amplitude $(f > 1000\,\mathrm{MHz})$ | $\pm 3.7\,\mathrm{dB}$ |
| DC and Low Frequency Voltages | ±2% |
| Temperature | ±0.5°C |
| Humidity | ±5% |

†Ref: CISPR 16-4-2:2011+A1:2014