Test Report # 316317 (RFID Filing)

Equipment Under Test:	ELO
Test Date(s):	4/11/17, 4/13/17, 4/19/17, 6/8/17, & 8/9/17
Prepared for:	GE Healthcare Attn: Cibu Jose 9900 Innovation Drive. Wauwatosa, WI 53226

Report Issued by:

Signature: Coty Hammerer Date: 4/25/18

Report Reviewed by: Adam Alger, Quality Systems Engineer

Signature: Adam O Alger Date: 8/23/2017

Report Constructed by:

Signature: Coty Hammerer Date: 6/1/17

CONTENTS

Laird Technologies Test Services in Review

The Laird Technologies, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope
A2LA Certificate Number: 1255.01
Scope of accreditation includes all test methods listed herein, unless otherwise noted.

Federal Communications Commission (FCC) – USA

Accredited recognition of two 3 meter Semi-Anechoic Chambers

Accredited Test Firm Registration Number: 953492

Government of Canada

Innovation, Science and Economic Development Canada

ISED Site listing of two 3 meter Semi-Anechoic Chambers based on RSS-GEN – Issue 4
File Number: IC 3088A-2
File Number: IC 3088A-3

1 Test Report Summary

During 4/11/17, 4/13/17, 4/19/17, 6/8/17, and 8/9/17 the Equipment Under Test (EUT), ELO, as provided by GE Healthcare was tested to the following requirements:

Requirements	Description	Method	Compliant
FCC 15.209 FCC 15.225	RFID Radiated Emissions: 9 kHz – 1 GHz & OBW	ANSI C63.10	Yes
FCC 15.207	AC Mains Conducted Emissions: 0.150 – 30 MHz	FCC KDB 174176	Yes
RSS-GEN	RFID Radiated Emissions: 9 kHz – 1 GHz & OBW	ANSI C63.10	Yes

Notice:

The results relate only to the item tested and described in this report. Any modifications made to the equipment under test after the specified test date(s) may invalidate the data herein.

If the resulting measurement margin is seen to be within the uncertainty value, as listed in this report, the possibility exists that this unit may not meet the required limit specification if subsequently tested.

2 CLIENT INFORMATION

Company Name	GE Healthcare
Contact Person	Cibu Jose
Address	9900 Innovation Drive Wauwatosa, WI 53226

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	ELO
Model Number	ELO
Serial Number	MACVU360MV0917008

2.2 Product Description

The Elo ECG Analysis System is intended to acquire, analyze, display, and record electrocardiographic information from adult, pediatric or neonatal populations. Basic system delivers 3, 6, 12, or 15 lead ECG's, interpretive analysis and vector loops. Transmission and reception of ECG data and other clinical data to and from a central clinical information system is supported.

The Elo ECG Analysis System is intended to be used under the direct supervision of a licensed healthcare practitioner, by trained operators in a hospital or medical professional's facility.

RFID constantly Tx and Rx at 125 KHz and 13.56 MHz as soon as unit powered. No way to disable other than by disconnecting power pin for module. Only one radio will be active with one of its functionalities at a time along with the RFID continuously being on.

ELO Software Version: v1.0 R13 ELO MAC Address: 42:8f:34:2a:16:6b

The following Radios are contained within the ELO, the Wilink8 and WB45NBT modules are leveraging certification while the RFID reader is being tested for a Permissive Change Certification:

RFIDeas pcProx Plus RFID reader

Model #: OEM-805N2AKU

Wilink8 Module: FCC ID: Z64-WL18DBMOD, IC: 451I-WL18DBMOD

Model #: WL18MODGI / Serial #: 201-14447

WB45NBT Module: FCC ID: SQG-WB45NBT, IC: 3147A-WB45NBT

Model #: WB45NBT /Serial #: 001723E25EE8

2.3 Modifications Incorporated for Compliance

None noted at time of test.

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test.

2.5 Additional Information

Purpose of this Report: Permissive Change Certification

The ELO can be powered at 100VAC/60 Hz to 240VAC/50 Hz. The radiated emissions signatures at 120VAC and 230VAC are very similar. Therefore testing continued along with testing being done only at 120VAC/ 60 Hz after the 230VAC/ 50 Hz spot check. The EUT is capable of containing two back up batteries for instances of mains network power losses. To program the EUT an ethernet cable is run from the EUT to a laptop. The EUT acts as a client and PuTTy or Hyperterminal is used to connect to the EUT via a static IP address. Commands can then be entered in the laptop and sent to the EUT.

Example of a sample command using the Wilink8 module to transmit in the 2.4 GHz band at 2462 MHz with a power of 20 dBm with a 20 MHz BW and a data rate of 54 Mbps:
./wilink8_tx.py -channel 11 -band 0 -power 20 -channel_location 20 MHz -datarate 54

Antenna's used for the Wilink8 and FIPS modules: Laird CAF94505, Gain in the 2.4 GHz band: 2dBi, Gain in the 5 GHz bands: 3.9 – 4.0 dBi.

Note: EUT is considered a mobile device(s).

3 REFERENCES

Publication	Edition	Date
FCC. 15.209	1st	2017
FCC 15.225	1st	2017
RSS-GEN	4th	2014
RSS-210	9th	2016

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

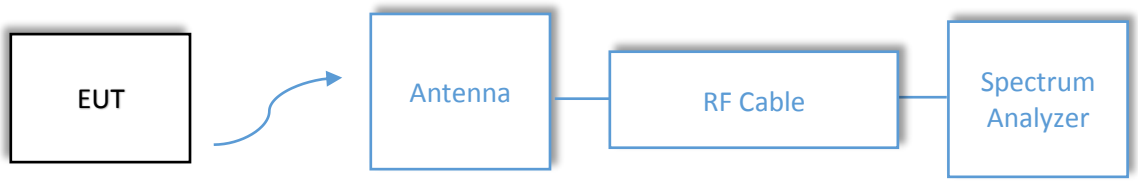
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 RFID

Description of Measurement	The frequency spectrum is investigated for unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBm) + Cable factor (dB) + Antenna Factor (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 RFID Radiated Emissions and OBW

Operator	Coty Hammerer
QA	Khairul Aidi Zainal
Test Date	4/11/17, 4/13/17, 4/19/17, and 6/8/17
Location	Chamber 5
Temp. / R.H.	71°F / 35 %
Requirement	FCC 15.209, 15.225 & RSS-210
Method	ANSI C63.10 Section 6.4

Limits:

§15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Per ANSI C63.10, the following steps are used to determine the field strength of a single point measurement at a 3m measurement distance:

D near field is calculated.

The λ/2π distance in m, $d_{\text{near field}}$, shall be determined using Equation (1):

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

where f_{MHz} is the frequency of the emission being measured in MHz.

Then, depending on whether the single point is closer than D near field and the limit distance is greater than D near field or if the single point and limit distance is less than or equal to D near field one of the following equations is used to find the Field Strength limit:

$$FS_{\text{limit}} = FS_{\text{max}} - 40\log\left(\frac{d_{\text{near field}}}{d_{\text{measure}}}\right) - 20\log\left(\frac{d_{\text{limit}}}{d_{\text{near field}}}\right) \quad (2)$$

$$FS_{\text{limit}} = FS_{\text{max}} - 40\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right) \quad (4)$$

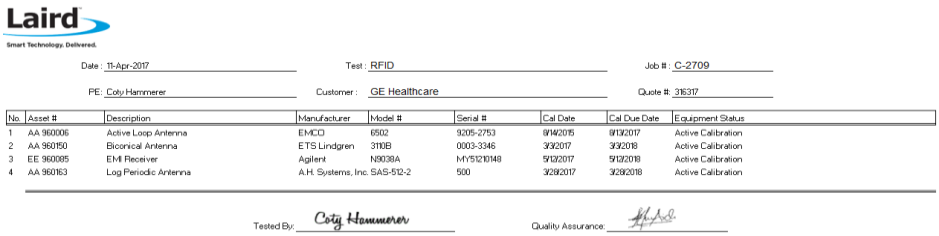
The above equations yield a conversion which is added to the measured field strength at a 3m distance which then yields the field strength limit at the limit distance. The limit from the table above is

converted to dB microvolts/meter by multiplying by 20log and then this limit is compare to the field strength limit at limit distance to provide a passing or failing margin.

Test Parameters

Frequency	9 kHz – 1 GHz
Settings	Plots all show Peak emissions RBW=200 Hz, VBW=2kHz for the range 9 kHz – 130 kHz, loop antenna RBW=9kHz, VBW=30kHz for the range130kHz – 30 MHz, loop antenna RBW=120kHz, VBW=1.2MHz for the range 30 MHz – 1 GHz, biconical antenna for 30 MHz – 200 MHz and log periodic antenna for 200MHz – 1 GHz
EUT	120VAC/ 60 Hz, RFID constantly transmitting at 125 kHz and 13.56 MHz
EUT	Main user display active
EUT	No other Radios active
Example Calculation	125 kHz Example: $d\ near\ field = {}^{47.77}/_{0.125} = 382.2$ Equation (4) would then be used: $-40 * LOG({}^{300}/_{3}) = -80$ The Spectrum analyzer would be used to record the peaked out field strength of the 125 kHz emission and in this case per FCC15.109 an Average detector would be used to record the emission field strength at 3 meters. 64.2 dBµV/m was recorded in this instance. This field strength is then added to the conversion from equation (4): $-80 + 64.2 = -15.8\ \mathrm{dB\mu V/m}$ This result stands for the field strength limit at limit distance. From the 15.209 Emission Limit Table: $20 * LOG({}^{2400}/_{125}) = 25.7\ dB\mu V/m$ The field strength limit at limit distance is then subtracted from the limit of 25.7 dBµV/m to yield the passing or failing margin of the emission measured. $Margin\ (dB) = 25.7 - (-15.8) = 41.4\ dB$ A positive margin is a passing result.
Notes	All emissions seen must be lower than the fundamental frequencies while the fundamental RFID frequencies must meet the limits set forth by the requirements. All emissions seen were higher with the loop antenna oriented parallel to the EUT.

Instrumentation



Date : 11-Apr-2017 Test : RFID Job # : C-2709

PE: Coty Hammerer Customer : GE Healthcare Quote #: 316317

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960006	Active Loop Antenna	EMCO	6502	9205-2753	9/14/2015	9/13/2017	Active Calibration
2	AA 960150	Biconical Antenna	ETS Lindgren	3110B	0003-3346	3/3/2017	3/3/2018	Active Calibration
3	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2017	5/12/2018	Active Calibration
4	AA 960163	Log Periodic Antenna	A.H. Systems, Inc.	SAS-512-2	500	3/28/2017	3/28/2018	Active Calibration

Tested By: Coty Hammerer Quality Assurance:

Table

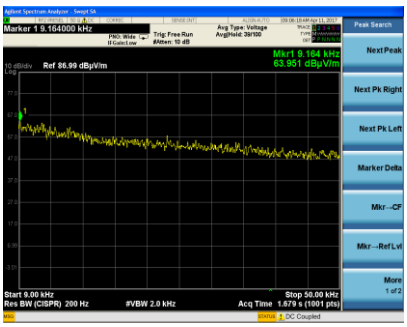
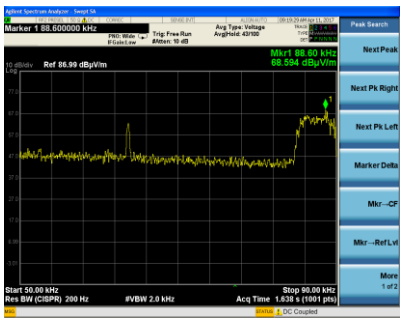
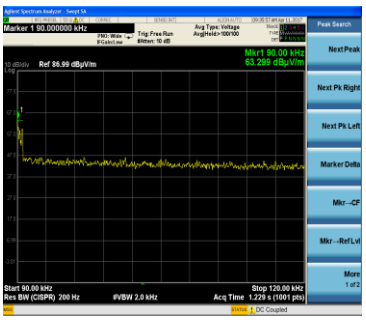
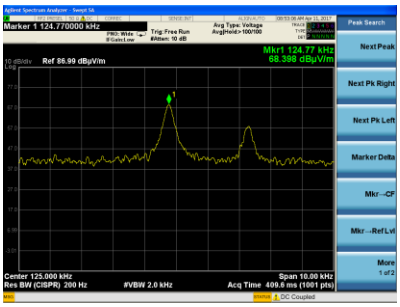
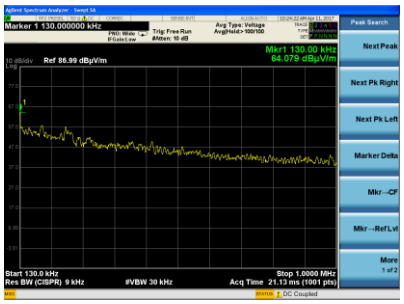
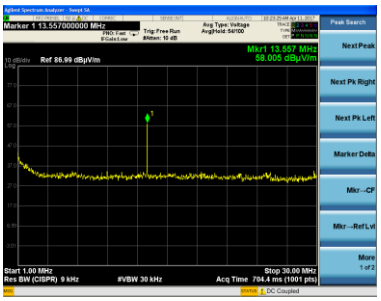
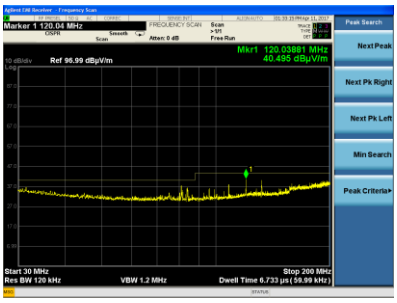
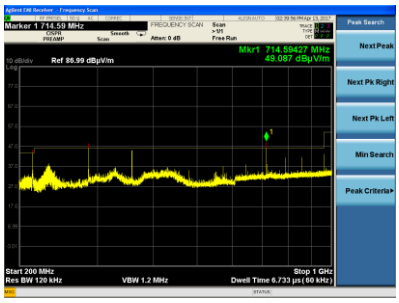
Frequency (kHz)	Frequency (MHz)	dnear field	Limit Distance	Conversion	Antenna Height (m)	Azimuth (degree)	Field Strength @ 3 m (dBµV/m)	FS Limit @ limit distance (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Notes
125.0	0.1250	382.2	300	-80	1.00	160.25	64.2	-15.8	25.7	41.4	Ant. Parallel to EUT
125.0	0.1250	382.2	300	-80	1.00	100.75	63.6	-16.4	25.7	42.1	Ant. Perpendicular to EUT
127.3	0.1273	375.1	300	-80	1.00	172	56.4	-23.6	25.5	49.1	Ant. Parallel to EUT
63.7	0.0637	749.7	300	-80	1.00	168	61.9	-18.1	31.5	49.6	Ant. Parallel to EUT
86.5	0.0865	552.1	300	-80	1.00	186.25	60.6	-19.4	28.9	48.3	Ant. Parallel to EUT
90.0	0.0900	530.8	300	-80	1.00	162	41.2	-38.8	28.5	67.3	Ant. Parallel to EUT
130.0	0.1300	367.5	300	-80	1.00	152	34.0	-46.0	25.3	71.3	Ant. Parallel to EUT
13560.0	13.5600	3.5	30	-21	1.00	140	51.8	30.4	84.0	53.6	Ant. Perpendicular to EUT
13560.0	13.5600	3.5	30	-21	1.00	156	55.2	33.8	84.0	50.2	Ant. Parallel to EUT

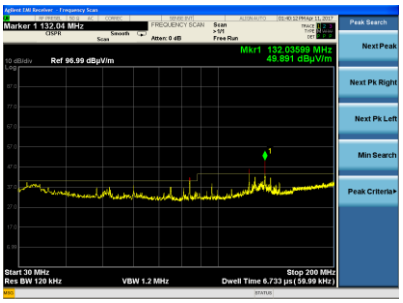
Note: The emissions shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz and 110-490 kHz. In these bands the emissions are based on measurements employing an average detector.

Note: Loop Antenna was rotated when parallel to EUT to determine position delivering highest emissions. All Loop Antenna orientations explored.

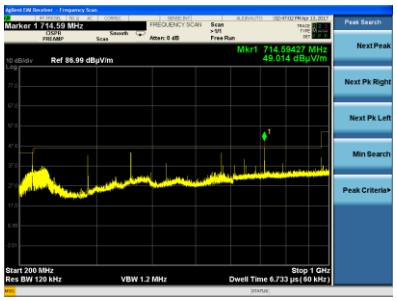
Plots

The below plots are all worst case which occurred when the loop antenna was directly facing the EUT (parallel to the EUT).

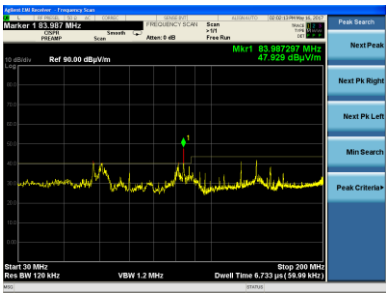
		
9 kHz – 50 kHz	50 kHz – 90 kHz	90 kHz – 120 kHz
		
120 kHz – 130 kHz	130 kHz – 1 MHz	1 MHz – 30 MHz
		
RFID On, Hor., 30-200 MHz	RFID On, Hor., 200-1000 MHz	RFID Off (Power to RFID module physically disconnected), Hor., 30-200 MHz



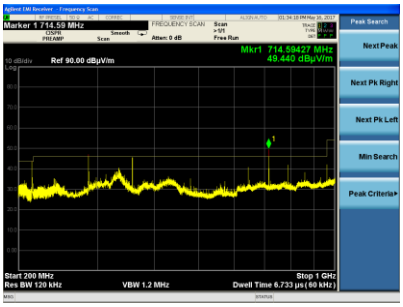
RFID On, Vert., 30-200 MHz



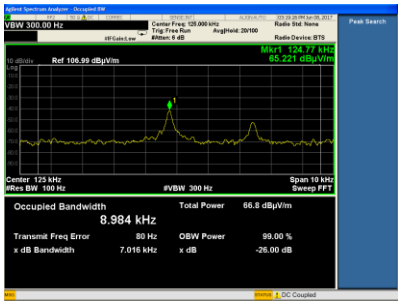
RFID On, Vert., 200-1000 MHz



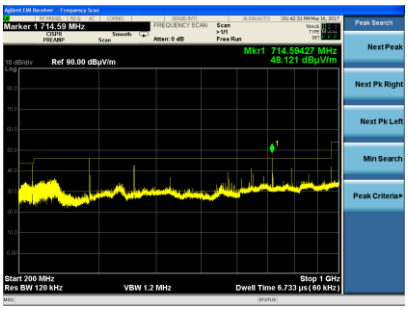
RFID Off (Power to RFID module physically disconnected), Vert., 30-200 MHz



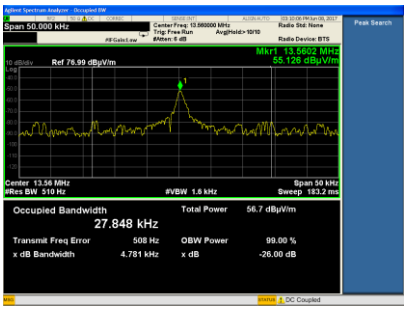
RFID Off (Power to RFID module physically disconnected), Hor., 200-1000 MHz



125 kHz OBW



RFID Off (Power to RFID module physically disconnected), Vert., 200-1000 MHz



13.56 MHz OBW

Note: All emissions seen from 30 MHz – 1 GHz are not a function of the RFID Radio. The radio was physically unplugged (not supplied power, +5V) and a baseline scan was done to verify the same emissions were present with the RFID radio not being supplied power.

5.1.2 AC Mains Conducted Emissions TX

Operator	Coty Hammerer
QA	Khairul Aidi Zainal
Test Date	8-9-17
Location	Ground Plane Area
Temp. / R.H.	70°F/ 58%
Requirement	FCC 15.207
Method	ANSI C63.10 and FCC KDB 174176

Limits:

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

Test Parameters

Frequency	0.15 – 30 MHz
Distance	80 cm EUT placement height, 40 cm from vertical ground plane
Settings	RBW=9kHz, VBW=90kHz for measurements from 150KHz – 30 MHz
Settings	RF Input 2, DC coupled, Transient Protected
EUT	120VAC/ 60 Hz, RFID module on at all times with one other radio in Tx mode
EUT	Dummy load in place of 13.56 RFID antenna, consisted of two 100Ω resistors in parallel.
EUT	RFID on with WB45NBT in Tx mode, RFID on with WIlink8 in Tx Mode (WLAN), then RFID on with WIlink8 in Tx Mode (Bluetooth)
Notes	Emissions not channel dependent or Voltage dependent, equivalent emissions at 120VAC and 230VAC

Instrumentation

Laird
Smart Technology. Delivered.

Date: 9-Aug-2017 Test: Conducted Emissions Job #: C-2709

PE: Coty Hammerer Customer: GE Healthcare Quote #: 316317

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960089	LISN	COM-POWER	LI-215A	191943	3/13/2017	3/13/2018	Active Calibration
2	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2017	5/12/2018	Active Calibration

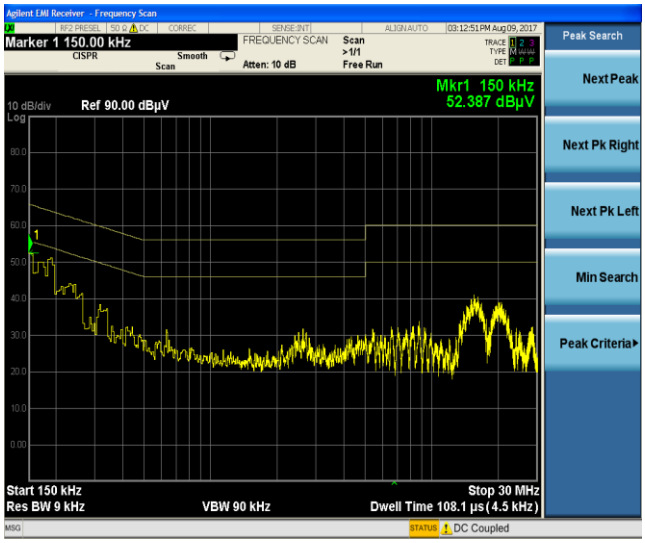
Tested By: Coty Hammerer Quality Assurance:

Table

Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Notes
0.186	1	47.8	64.2	16.4	33.4	54.2	20.8	120VAC/ 60 Hz
0.150	1	50.9	66.0	15.1	44.4	56.0	11.6	120VAC/ 60 Hz
15.560	1	37.0	60.0	23.0	30.5	50.0	19.5	120VAC/ 60 Hz
0.195	1	50.9	63.8	13.0	44.6	53.8	9.2	120VAC/ 60 Hz
0.155	2	46.4	65.7	19.3	25.7	55.7	30.0	120VAC/ 60 Hz
0.173	2	42.0	64.8	22.8	22.9	54.8	31.9	120VAC/ 60 Hz
0.195	2	50.6	63.8	13.2	44.3	53.8	9.5	120VAC/ 60 Hz

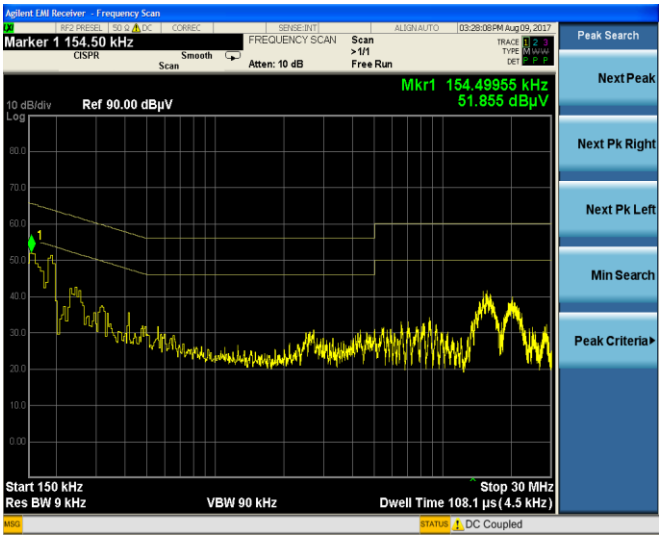
Note: The above data represents the worst case configuration. This was the RFID on with the Wilink 8 radio in Classic Bluetooth Tx mode with GFSK modulation at a frequency of 2402 MHz. The emissions were channel independent.

Plots



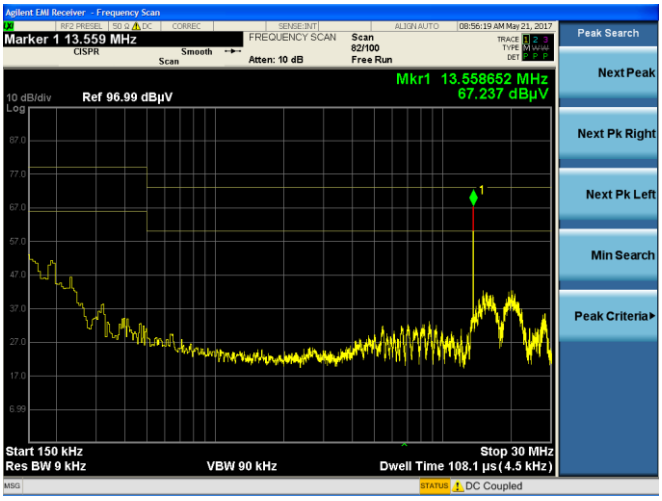
L1, 2402 MHz, Bluetooth (Wilink8), GFSK + RFID @ 125 kHz &13.56 MHz (Terminated)

120VAC/ 60 Hz



L2, 2402 MHz, Bluetooth (Wilink8), GFSK + RFID @ 125 kHz & 13.56 MHz (Terminated)

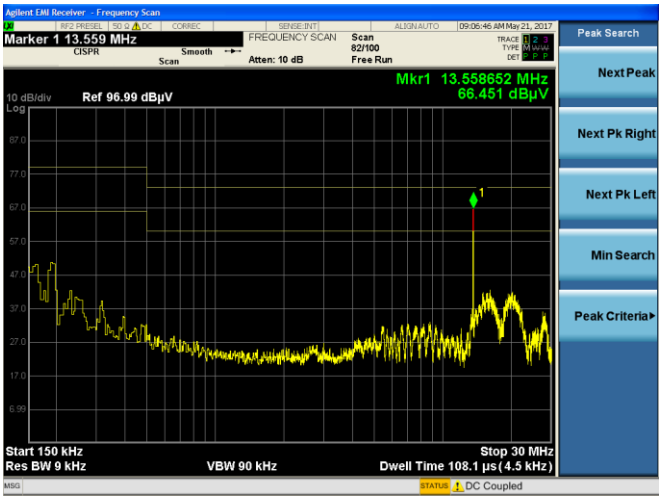
120VAC/ 60 Hz



L1, 2402 MHz, Bluetooth (Wilink8), GFSK + RFID @ 125 kHz &13.56 MHz (Not Terminated)

120VAC/ 60 Hz

Note: Limits displayed are not correct



L1, 2402 MHz, Bluetooth (Wilink8), GFSK + RFID @ 125 kHz &13.56 MHz (Not Terminated)

120VAC/ 60 Hz

Note: Limits displayed are not correct

Note: The above plots represent the worst case emissions.

6 REVISION HISTORY

Version	Date	Notes	Person
1	6-22-17		Coty Hammerer
2	8/16/17	Reference Added, Comments Addressed	Coty Hammerer
3	8/23/17	Reference Modified	Coty Hammerer

END OF REPORT