EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 102327065BOX-001a
Project Number: G102327065

Report Issue Date: 11/19/2015

Model(s) Tested: ZEVO Hybrid
Model(s) Partially Tested: None
Model(s) Not Tested but declared equivalent by the client: ZEVO Pulse

Standards: FCC 47CFR Part 15 Subpart C 15.247 (10/2015),
FCC 47CFR Part 15 Subpart B (10/2015)
RSS247 Issue 1 May 2015,
ICES-003 Issue 5 August 2012,
RSS-Gen Issue 3 December 2010,
RSS-102 Issue 4 March 2010 updated December 2010

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Osram Sylvania
71 Cherry Hill Drive
Beverly, MA 01915
USA

Report prepared by

Kouma Sinn / Staff Engineer, EMC

Report reviewed by

Vathana F. Ven / Staff Engineer, EMC

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test	--
5	System Setup and Method	--
6	Maximum Peak Output Power, Human RF Exposure, & Duty Cycle CFR47 FCC Part 15:2015 Subpart C, Section 15.247 (b)(3) RSS247 Issue 1 May 2015, Section 5.4 (2) IC RSS-102 Issue 4 March 2010 updated December 2010	Pass
7	Transmitter Radiated Spurious Emissions CFR47 FCC Part 15:2015 Subpart C Section 15.247 (d) CFR47 FCC Part 15:2015 Subpart C Section 15.209 RSS247 Issue 1 May 2015, Section 5.5	Pass
8	6 dB Bandwidth & 99% Power Bandwidth CFR47 FCC Part 15:2015 Subpart C Section 15.247 (a)(2) RSS247 Issue 1 May 2015, Section 5.2 (1)	Pass
9	Power Spectral Density CFR47 FCC Part 15:2015 Subpart C Section 15.247 (e) RSS247 Issue 1 May 2015, Section 5.2 (2)	Pass
10	Band-edge Compliance CFR47 FCC Part 15:2015 Subpart C Section 15.247 (d) RSS247 Issue 1 May 2015, Section 5.5	Pass
11	Digital Devices Radiated Spurious Emissions CFR47 FCC Part 15:2015 Subpart B Section 15.109 IC ICES-003 Issue 5 August 2012	Pass
--	Receiver Radiated Spurious Emissions IC RSS-Gen 3 December 2010, Section 6	Exempt, above 960 MHz
--	AC Mains Conducted Emissions CFR47 FCC Part 15:2013 Subpart B Section 15.207 IC RSS-Gen Issue 3 December 2010, 7.2.2 (Table 2)	N/A
12	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Osram Sylvania
71 Cherry Hill Drive
Beverly, MA 01915
USA

Contact: Cindy Mulqueeney
Telephone: +1 (978) 750-1577
Fax: None
Email: cindy.mulqueeney@sylvania.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Osram Sylvania
71 Cherry Hill Drive
Beverly, MA 01915
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Automotive LED lighting with Bluetooth	Osram Sylvania	ZEVO Hybrid	QC 009-10 (CCC)

Receive Date:	10/21/2015
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
Automotive LED lighting with Bluetooth

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
3.3 V battery	N/A	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmit Mode: Low, Mid, and High channels
2	Idle/Receive Mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	None

Radio/Receiver Characteristics	
Frequency Band(s)	2402-2480 MHz
Modulation Type(s)	Packet length 37, payload type 0
Maximum Output Power	4.67 dBm (EIRP)
Test Channels	2402, 2440, and 2480 MHz (BLE)
Occupied Bandwidth	1.077 MHz

Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	N/A
Equipment Type	Standalone
ETSI LBT/Adaptivity	Non-Adaptive
ETSI Adaptivity Type	Non-LBT
ETSI Temperature Category (I, II, III)	I
ETSI Receiver Category (1, 2, 3)	3
Antenna Type and Gain	Integrated

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

ZEVO Pulse

5 System Setup and Method

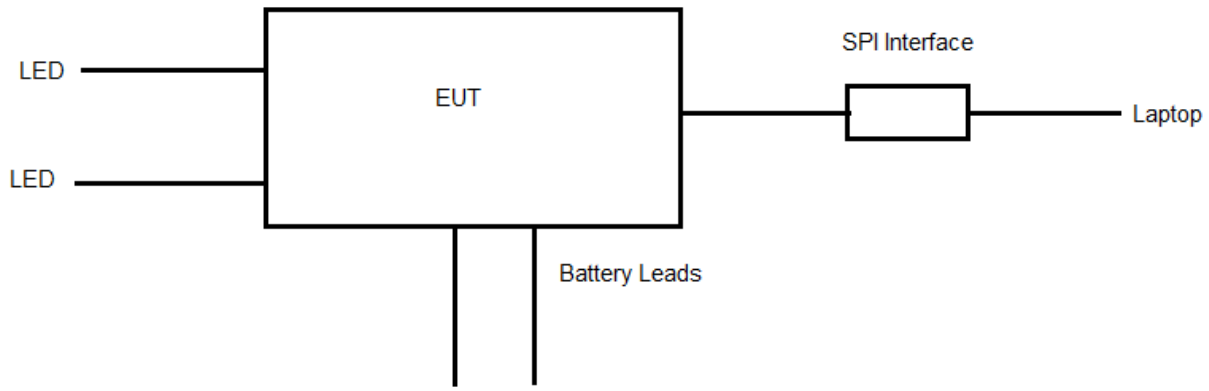
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	LED (2)	2	None	None	LED
--	Battery Leads	1	None	None	None
--	USB	10	USB Shield	Yes	Laptop

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	HPZB15	CND4132NH5
SPI Interface	CSR	CSRSPI interface	None

5.1 Method:

Configuration as required by FCC 47CFR Part 15.247:2015, ANSI C63.4-2014, ANSI C63.10-2013, KDB558074 v03r03 DTS 06-09-2015, and RSS-102 Issue 4 March 2010 updated December 2010.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power, Human RF Exposure, & Duty Cycle

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15:2015 Subpart C, Section 15.247 (b)(3), RSS247 Issue 1 May 2015, Section 5.4 (2) and RSS-102 Issue 4 March 2010 updated December 2010.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	01/14/2015	01/14/2016
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/08/2015	10/08/2016

Software Utilized:

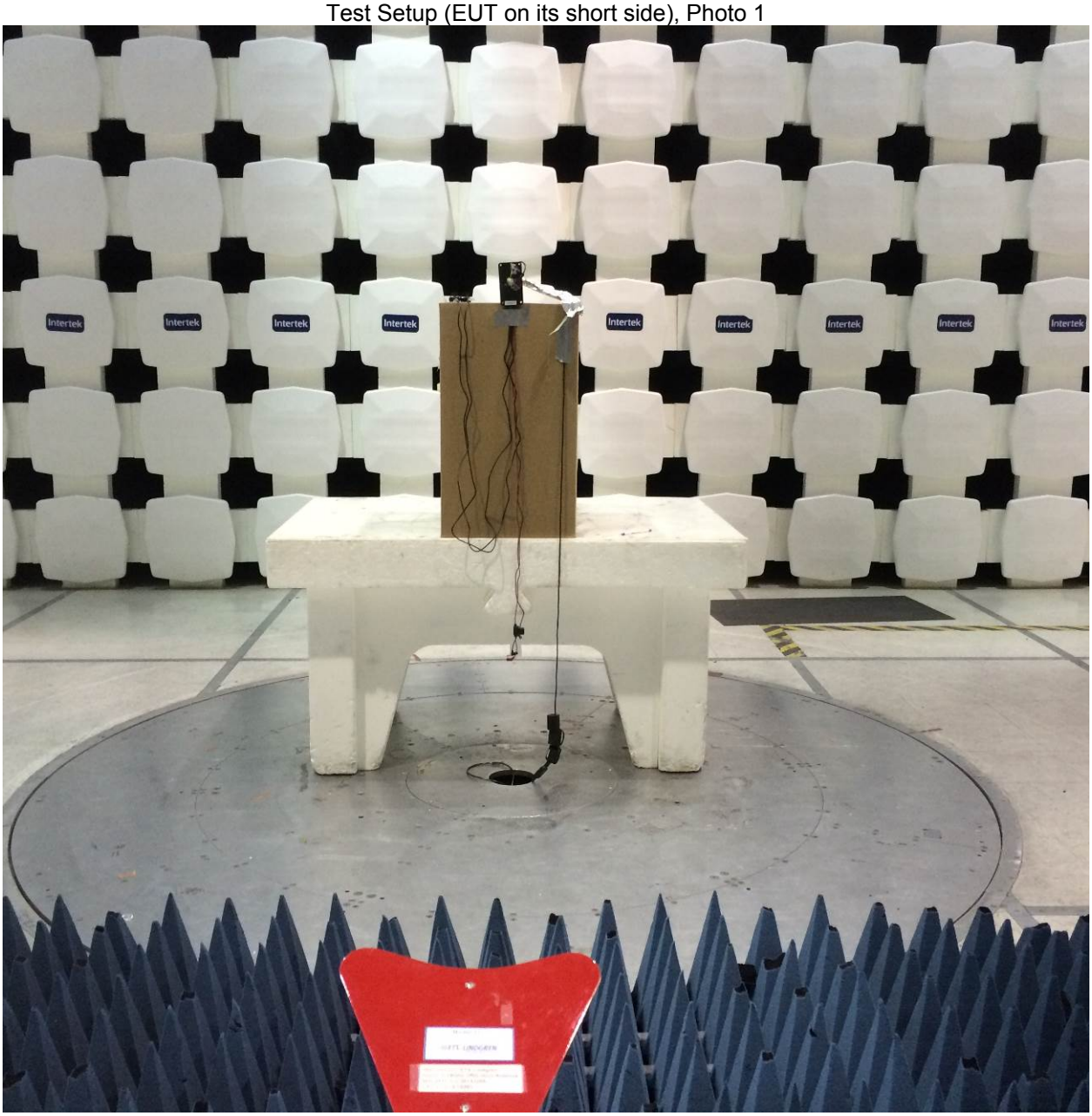
Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

6.3 Results:

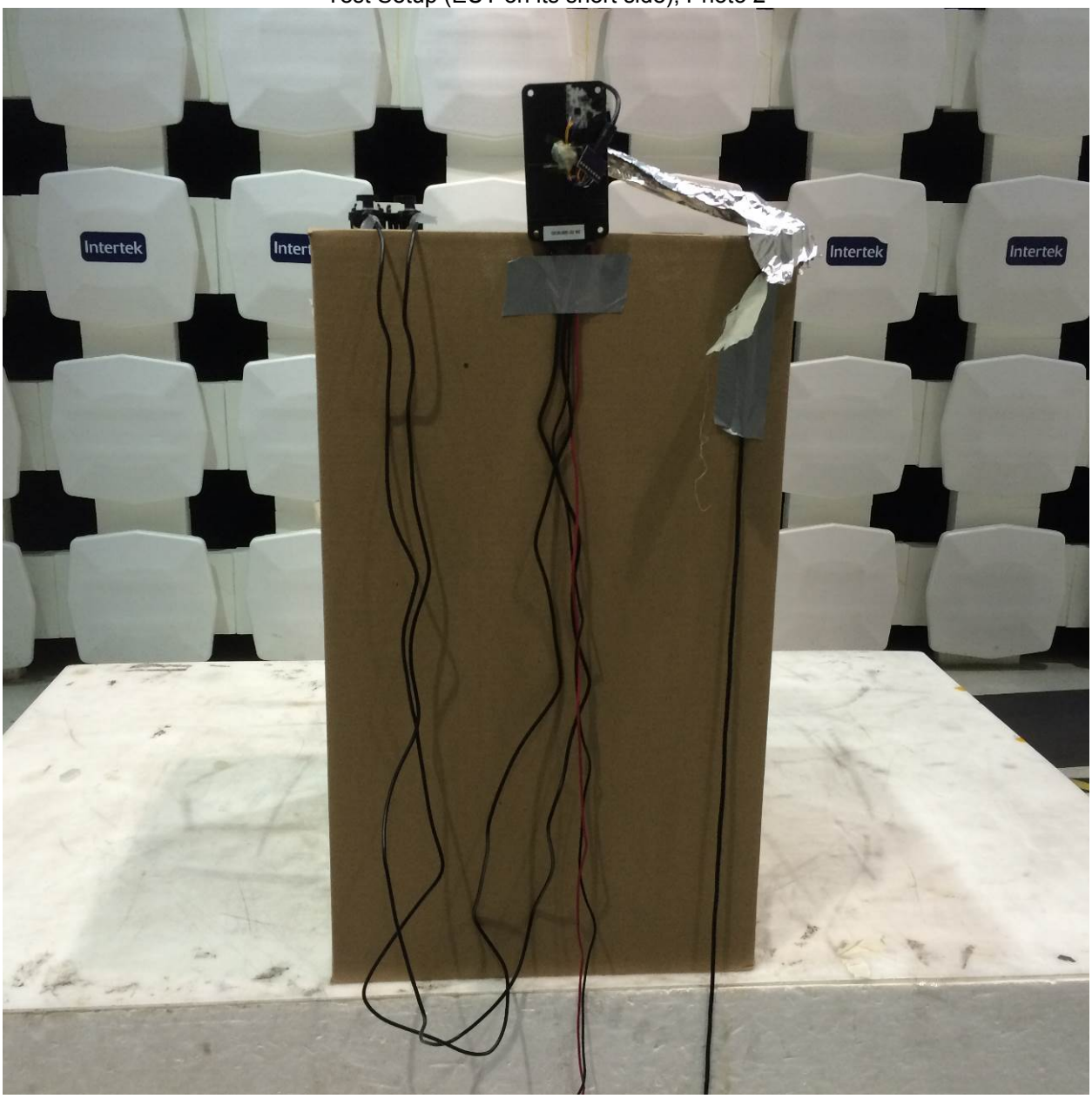
The sample tested was found to comply. The EIRP must not exceed 20.97 dBm. The RSS-102 Issue 5 Human Exposure Limit at 2.44 GHz = 5.41 W/m^2 and FCC at 1 mW/cm^2.

6.4 Setup Photographs:

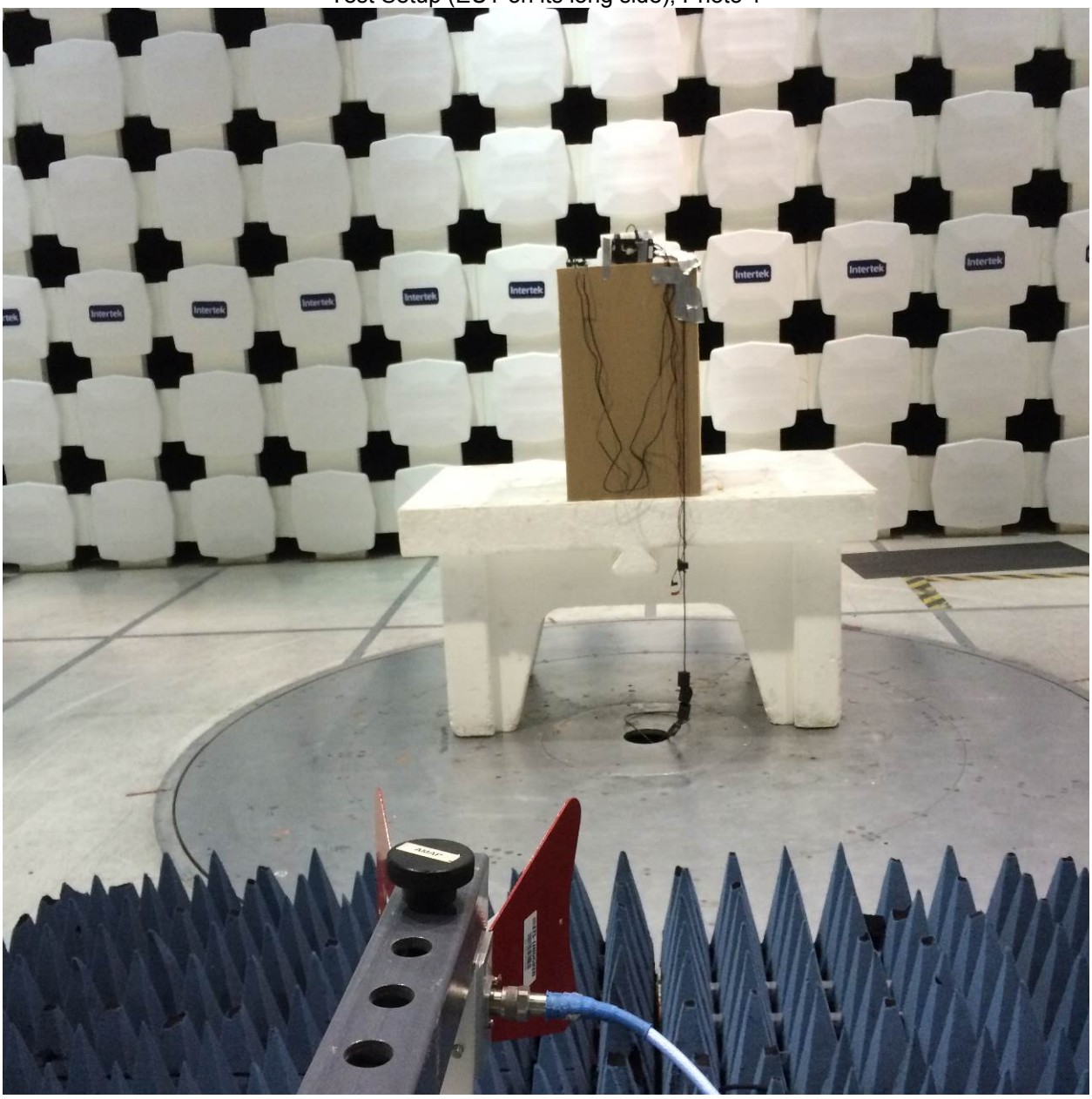
Test Setup (EUT on its short side), Photo 1



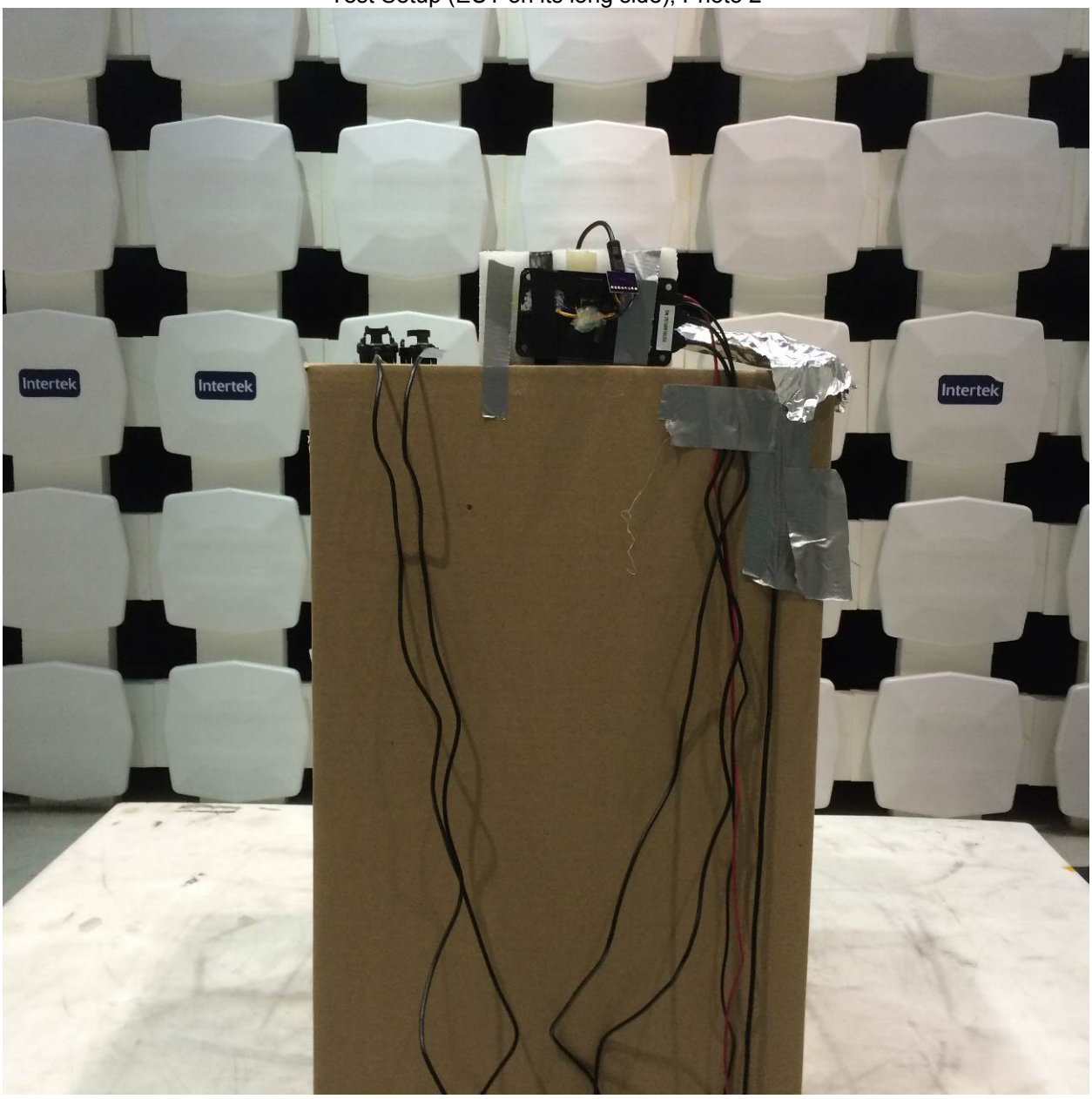
Test Setup (EUT on its short side), Photo 2



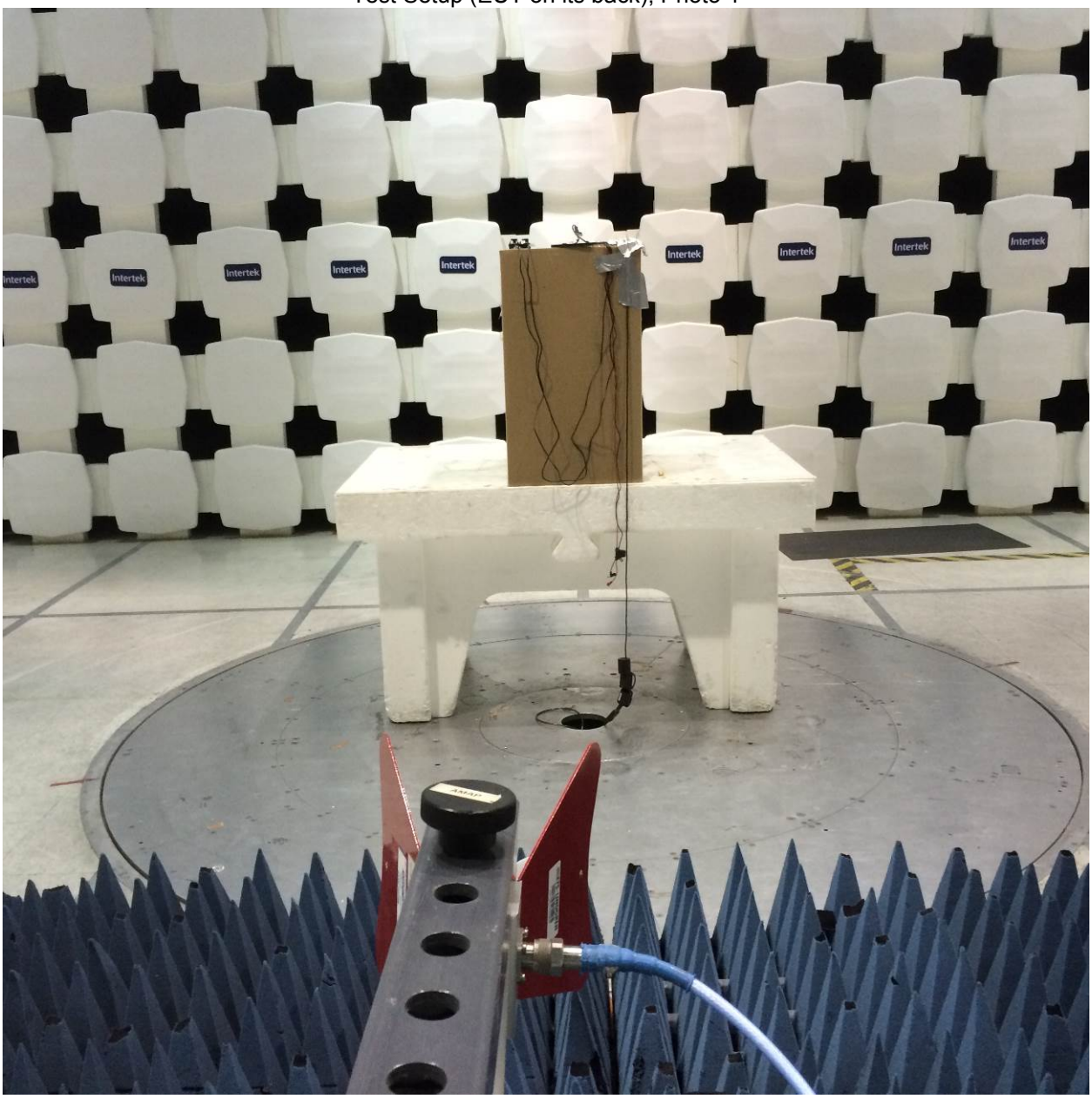
Test Setup (EUT on its long side), Photo 1



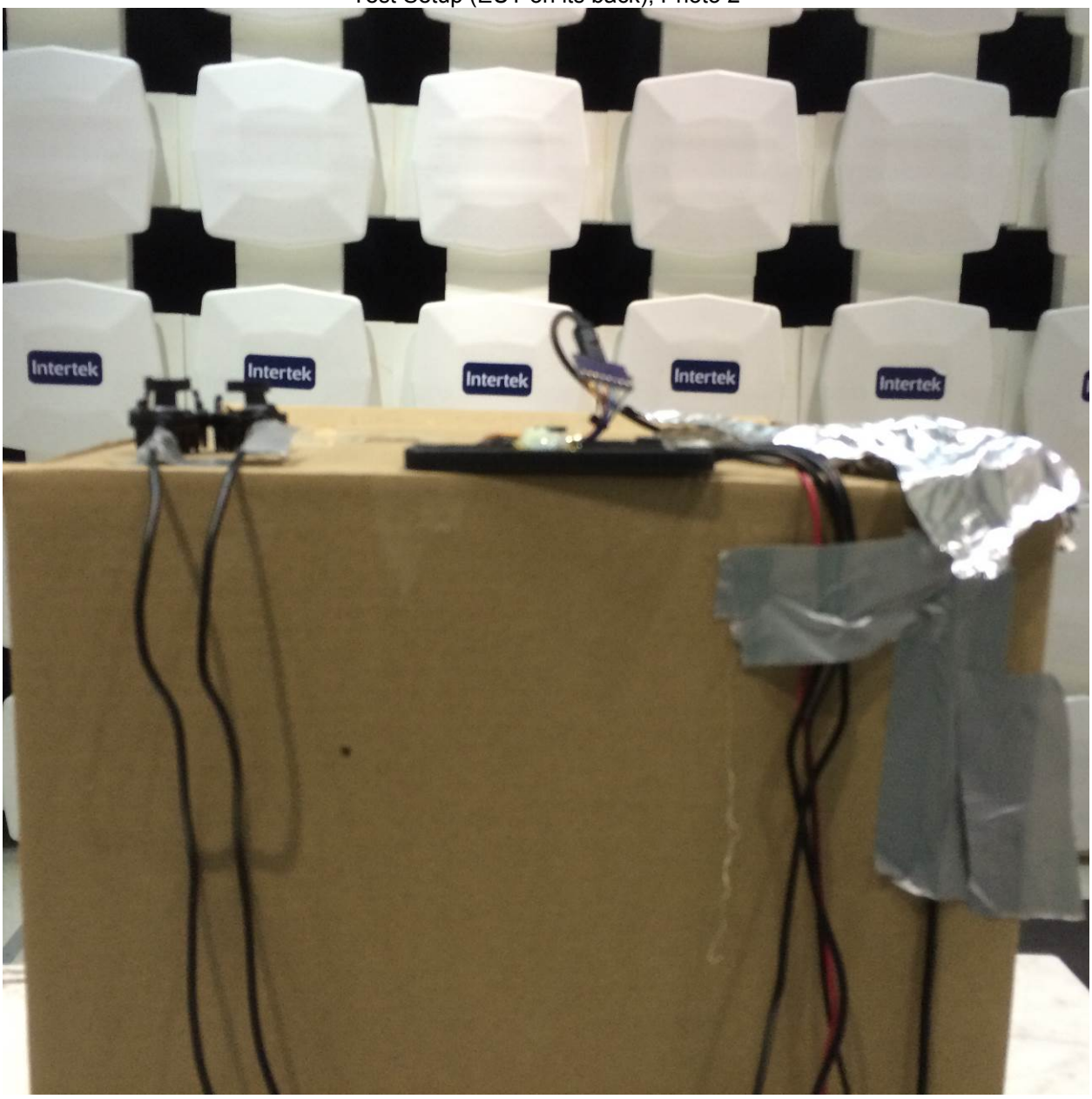
Test Setup (EUT on its long side), Photo 2



Test Setup (EUT on its back), Photo 1



Test Setup (EUT on its back), Photo 2



6.5 Test Data:

Low Channel: 2402 MHz Radiated Emissions

Company: Osram | Antenna & Cables: LF | Bands: N, LF, HF, SHF
Model #: ZEVO Hybrid | Antenna: ETS001 01-14-16.txt | ETS001 01-14-16.txt
Serial #: QC 009-10 (CCC) | Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt | NONE.
Engineers: Kouma Sinn | Location: 10m Chamber | Barometer: DAVO04 | Filter: NONE
Project #: Qu-00647661 | Date(s): 11/11/15
Standard: FCC Part 15 Subpart C 15.247 | Temp/Humidity/Pressure: 20C 41% 1001mbar
Receiver: 145-128 | Limit Distance (m): 3
PreAmp: NONE. | Test Distance (m): 3
PreAmp Used? (Y or N): N | Voltage/Frequency: Internal Battery | Frequency Range: 2402 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dBm	Limit dBm	Margin dB	Bandwidth
x-axis (Back side) 2402 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2402.000	59.95	31.96	5.87	0.00	0.00	2.56	20.97	-18.41	5/10MHz
PK	H	2402.000	59.56	31.96	5.87	0.00	0.00	2.17	20.97	-18.80	1/3MHz
PK	H	2402.000	59.00	31.96	5.87	0.00	0.00	96.83	--	--	100kHz
y-axis (long side) 2402 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2402.000	53.98	31.96	5.87	0.00	0.00	-3.41	20.97	-24.38	5/10MHz
PK	H	2402.000	53.55	31.96	5.87	0.00	0.00	-3.84	20.97	-24.81	1/3MHz
PK	H	2402.000	52.89	31.96	5.87	0.00	0.00	90.72	--	--	100kHz
z-axis (short side) 2402 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2402.000	60.59	31.96	5.87	0.00	0.00	3.20	20.97	-17.77	5/10MHz
PK	H	2402.000	60.52	31.96	5.87	0.00	0.00	3.13	20.97	-17.84	1/3MHz
PK	H	2402.000	59.82	31.96	5.87	0.00	0.00	97.65	--	--	100kHz

Mid Channel: 2440 MHz Radiated Emissions

Company: Osram
Model #: ZEVO Hybrid
Serial #: QC 009-10 (CCC)
Engineers: Kouma Sinn
Project #: Qu-00647661
Standard: FCC Part 15 Subpart C 15.247
Receiver: 145-128
PreAmp: NONE.
Antenna & Cables: LF Bands: N, LF, HF, SHF
Antenna: ETS001 01-14-16.txt ETS001 01-14-16.txt
Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt NONE.
Location: 10m Chamber Barometer: DAVO04 Filter: NONE
Date(s): 11/11/15
Temp/Humidity/Pressure: 20C 41% 1001mbar
Limit Distance (m): 3
Test Distance (m): 3
PreAmp Used? (Y or N): N Voltage/Frequency: Internal Battery Frequency Range: 2402 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dBm	Limit dBm	Margin dB	Bandwidth
x-axis (Back side) 2440 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2440.000	61.86	32.11	5.92	0.00	0.00	4.67	20.97	-16.30	5/10MHz
PK	H	2440.000	61.77	32.11	5.92	0.00	0.00	4.58	20.97	-16.39	1/3MHz
PK	H	2440.000	60.97	32.11	5.92	0.00	0.00	99.00	--	--	100kHz
y-axis (long side) 2440 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2440.000	54.50	32.11	5.92	0.00	0.00	-2.69	20.97	-23.66	5/10MHz
PK	H	2440.000	53.98	32.11	5.92	0.00	0.00	-3.21	20.97	-24.18	1/3MHz
PK	H	2440.000	53.35	32.11	5.92	0.00	0.00	91.38	--	--	100kHz
z-axis (short side) 2440 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2440.000	59.95	32.11	5.92	0.00	0.00	2.76	20.97	-18.21	5/10MHz
PK	H	2440.000	59.51	32.11	5.92	0.00	0.00	2.32	20.97	-18.65	1/3MHz
PK	H	2440.000	58.95	32.11	5.92	0.00	0.00	96.98	--	--	100kHz

Top Channel: 2480 MHz Radiated Emissions

Company: Osram
Model #: ZEVO Hybrid
Serial #: QC 009-10 (CCC)
Engineers: Kouma Sinn
Project #: Qu-00647661
Standard: FCC Part 15 Subpart C 15.247
Receiver: 145-128
PreAmp: NONE.
PreAmp Used? (Y or N): N
Antenna & Cables: LF Bands: N, LF, HF, SHF
Antenna: ETS001 01-14-16.txt ETS001 01-14-16.txt
Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt NONE.
Location: 10m Chamber Barometer: DAVO04 Filter: NONE
Date(s): 11/11/15
Temp/Humidity/Pressure: 20C 41% 1001mbar
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: Internal Battery Frequency Range: 2402 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dBm	Limit dBm	Margin dB	Bandwidth
x-axis (Back side) 2480 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2480.000	56.43	32.26	5.98	0.00	0.00	-0.55	20.97	-21.52	5/10MHz
PK	H	2480.000	56.29	32.26	5.98	0.00	0.00	-0.69	20.97	-21.66	1/3MHz
PK	H	2480.000	55.64	32.26	5.98	0.00	0.00	93.88	--	--	100kHz
y-axis (long side) 2480 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2480.000	51.84	32.26	5.98	0.00	0.00	-5.14	20.97	-26.11	5/10MHz
PK	H	2480.000	51.17	32.26	5.98	0.00	0.00	-5.81	20.97	-26.78	1/3MHz
PK	H	2480.000	50.35	32.26	5.98	0.00	0.00	88.59	--	--	100kHz
z-axis (short side) 2480 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2480.000	57.66	32.26	5.98	0.00	0.00	0.68	20.97	-20.29	5/10MHz
PK	H	2480.000	57.43	32.26	5.98	0.00	0.00	0.45	20.97	-20.52	1/3MHz
PK	H	2480.000	56.84	32.26	5.98	0.00	0.00	95.08	--	--	100kHz

Test Personnel: Kouma Sinn KPS
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC 15.247, RSS247
Input Voltage: Battery powered
Pretest Verification w/ Ambient Signals or BB Source: **BB Source**

Test Date: 11/11/2015
Limit Applied: Section 5.4 (2)
Ambient Temperature: 20 ºC
Relative Humidity: 41 %
Atmospheric Pressure: 1001 mbars

Deviations, Additions, or Exclusions: None

RSS-102 Issue 5 Exposure Limits:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.1 Test Procedure

The EUT was measured in a radiated fashion. The RF output power was measured using a resolution bandwidth which encompassed the entire emission bandwidth. The data obtained was adjusted for equipment losses and converted from a field strength reading to a power reading using the provisions of RSS-Gen 4.6. .

1.2 Results:

RSS-102 Issue 5 Exposure Limit at 2.44 GHz = 5.41 W/m^2

Maximum EIRP measured at 244 MHz 4.67 dBm or 2.93 mW

Power Density = EIRP/(4*pi*20^2)

Power Density = 0.000583 mW/cm^2

Power Density = 0.00583 W/m^2

The calculated maximum power density at 20 cm distance is less than the limit for general population / uncontrolled exposure.

FCC Exposure Limits:

1.1 Test Procedure

The EUT was measured in a radiated fashion. The RF output power was measured using a resolution bandwidth which encompassed the entire emission bandwidth. The data obtained was adjusted for equipment losses and converted from a field strength reading to a power reading using the provisions of FCC KDB 558074 and RSS-Gen 4.6.

1.2 Results:

The human RF exposure limit is 1 mW/cm^2. The power density S generated by some value of EIRP at a given distance d is related by the equation:

$$S=EIRP / (4\pi d^2)$$

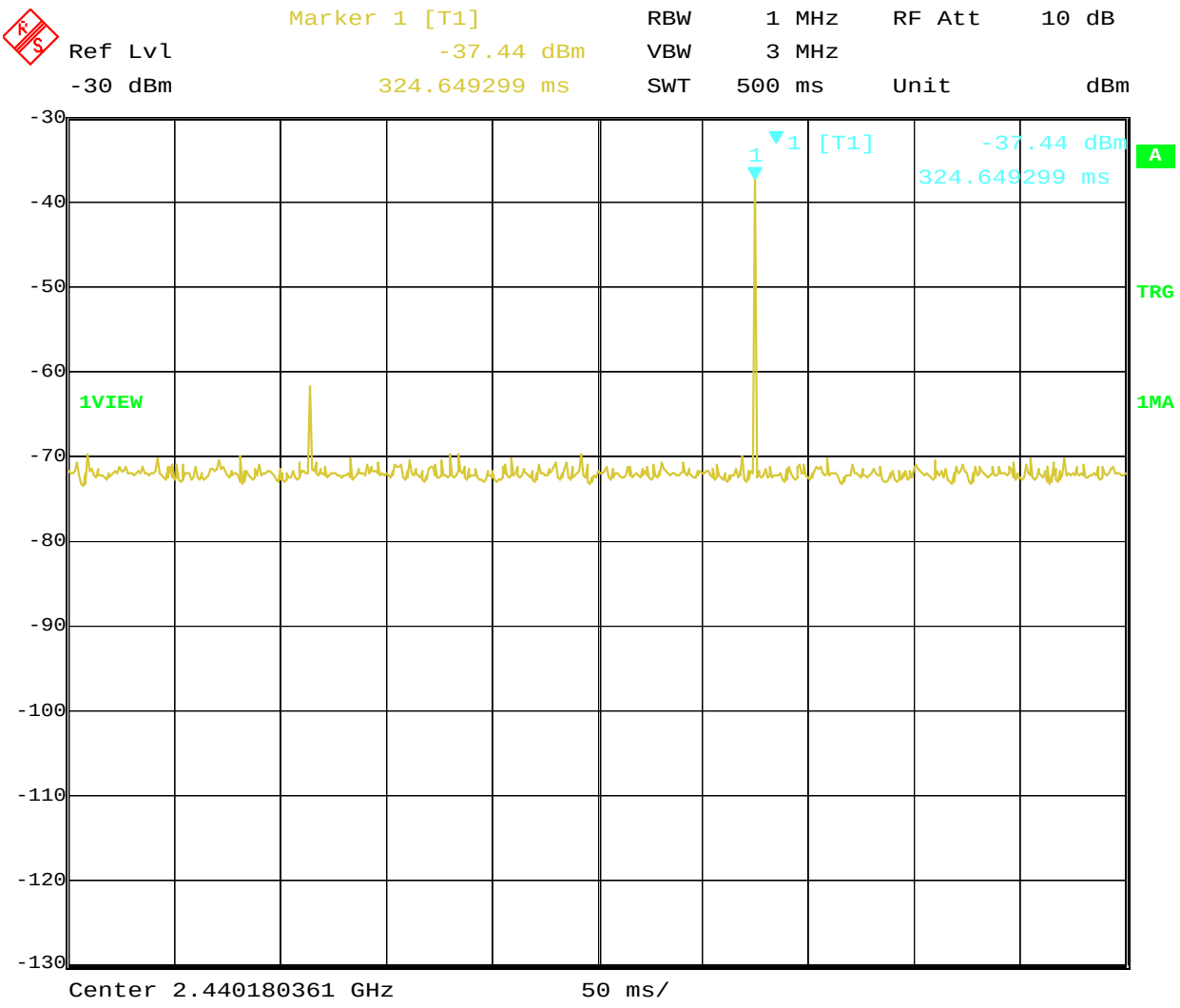
The distance, given a maximum EIRP of 4.67 dBm (2.93 mW), at which the radiated power density of the EUT is equal to the human RF exposure limit is 0.483 cm from the antenna. This result does not take averaging into account. The EUT is exempt from FCC SAR RF Exposure evaluation because the output power is below the KDB 447498 exemption threshold:

*[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] * [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR.*

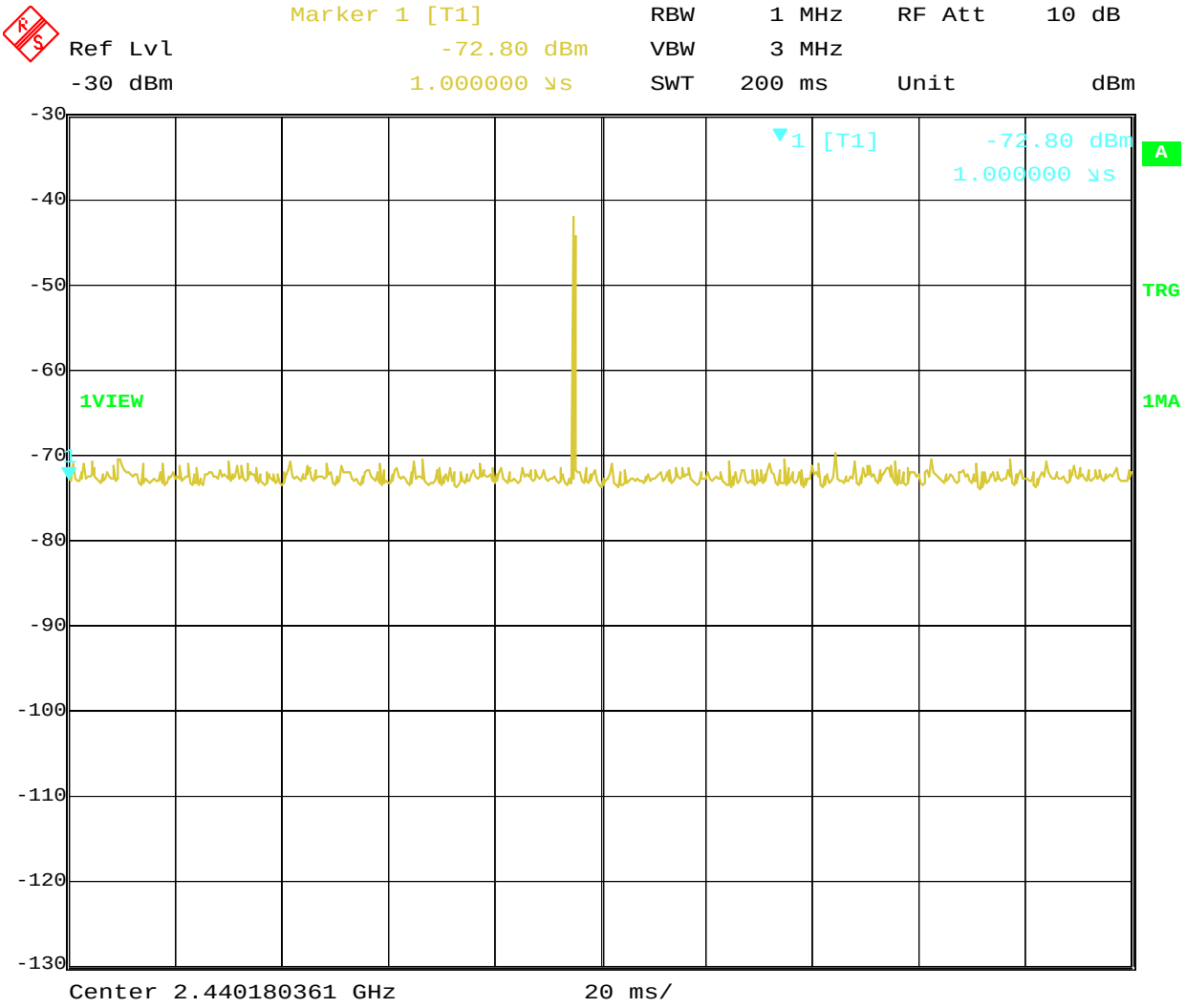
[2.93 mW / 5 mm] * [√f(2.440 GHz)] = **0.915 <3.0 and 7.5**

Duty Cycle:

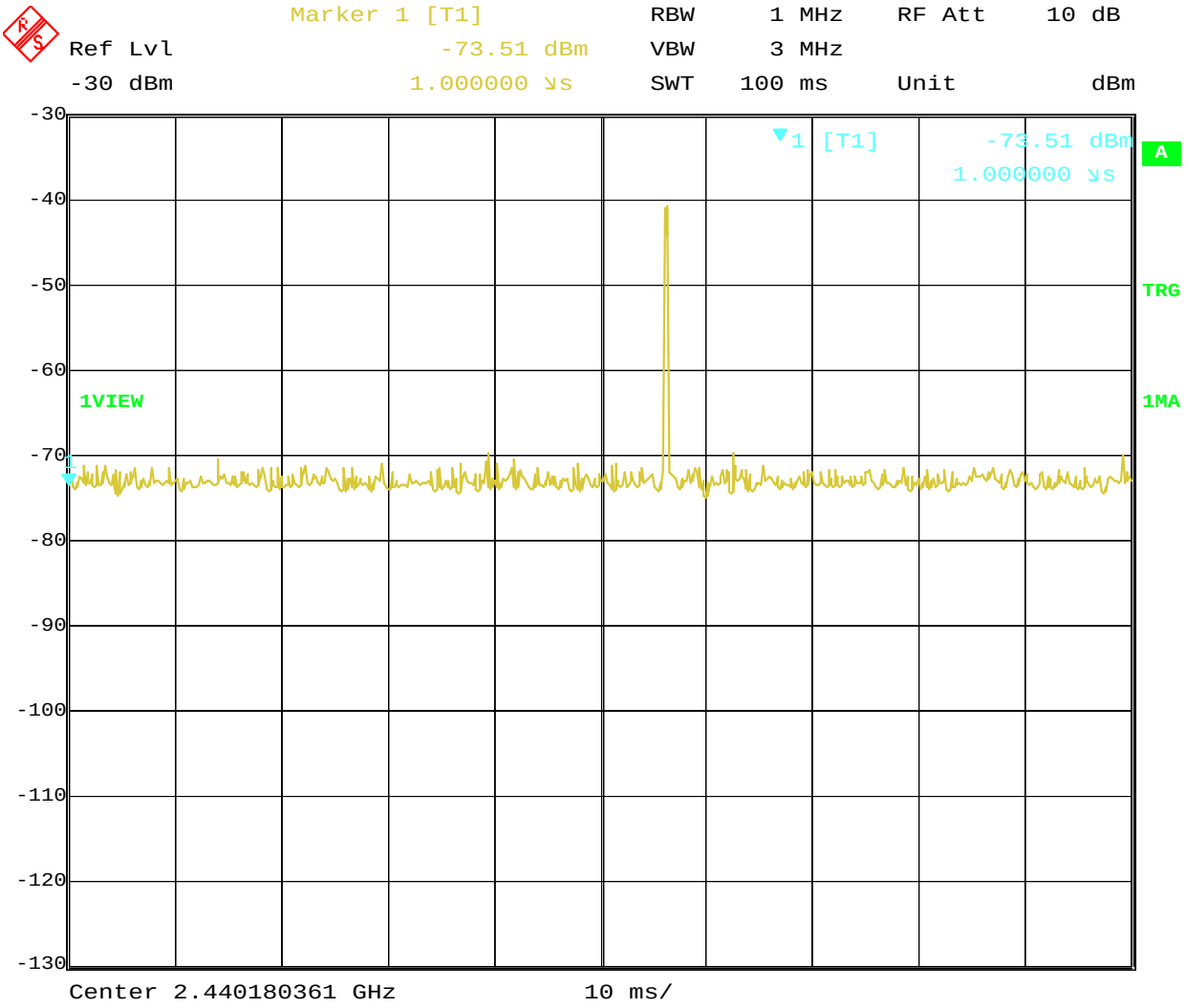
Pulse number within 500 ms



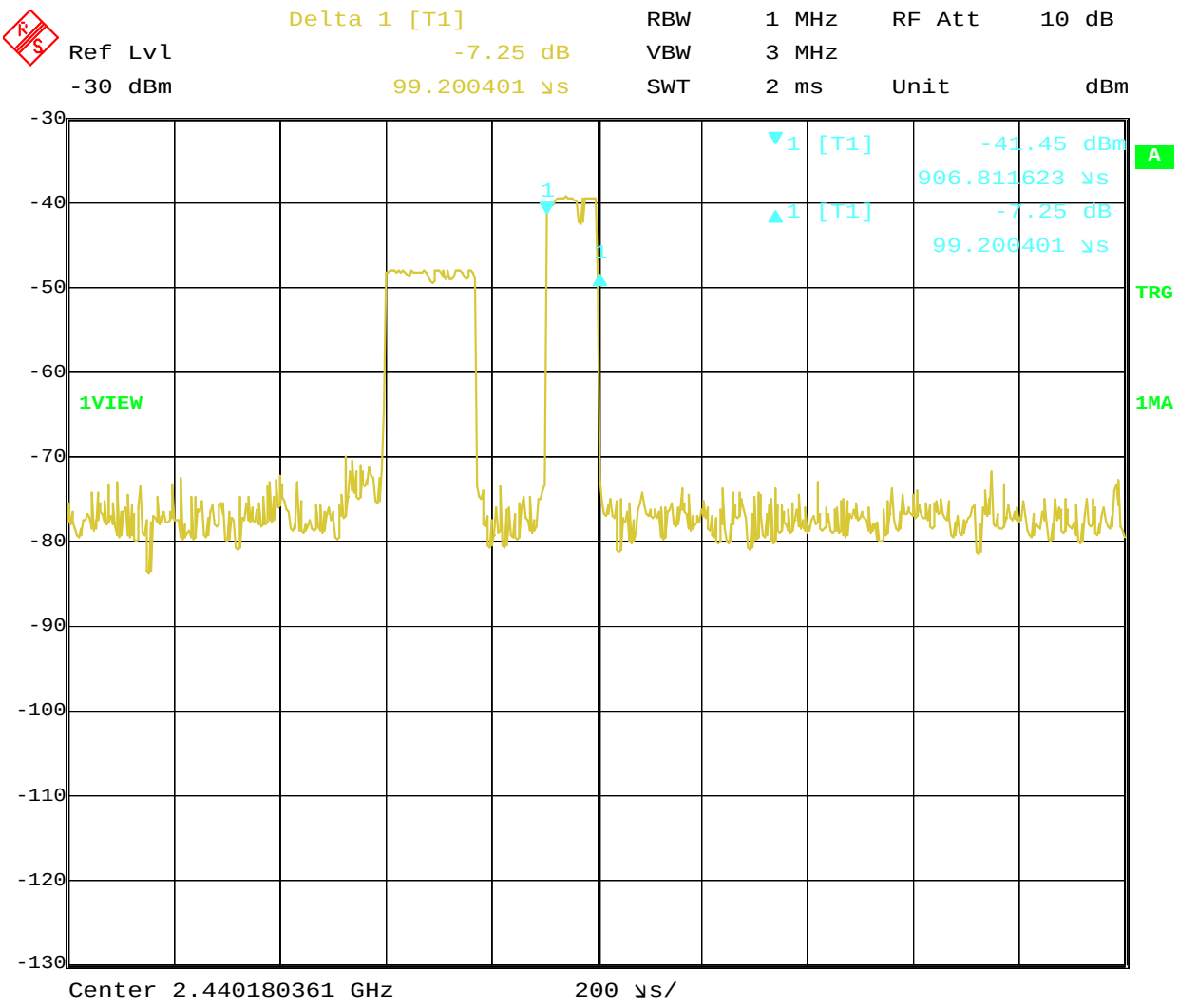
Pulse number within 200 ms



Pulse number within 100 ms



Pulse on time (t_1)



Duty Cycle Calculation:

On time (t_1) =0.0992 ms

Duty Cycle = 0.0992/100

Average Factor = 20*log (Duty Cycle) dB or 60 dB

Test Personnel:	Kouma Sinn KPS	Test Date:	11/11/2015
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247, RSS247	Limit Applied:	RSS-102
Input Voltage:	Battery Powered	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**Ambient Signals**	Relative Humidity:	37 %
		Atmospheric Pressure:	1000 mbars

Deviations, Additions, or Exclusions: None

7 Transmitter Radiated Spurious Emissions

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15:2015 Subpart C Section 15.247 (d) and CFR47 FCC Part 15:2015 Subpart C Section 15.209 and RSS247 Issue 1 May 2015, Section 5.5.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	09/28/2015	09/28/2016
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	01/14/2015	01/14/2016
145013'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2944A07027	10/12/2015	10/12/2016
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	09/01/2015	09/01/2016
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	01/14/2015	01/14/2016
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	05/13/2015	05/13/2016
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/08/2015	10/08/2016
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	04/15/2015	04/15/2016
CBLHF201 2-5M-1'	5m 9kHz-40GHz Coaxial Cable - SET 1	Huber & Suhner	SF102	252676001	02/05/2015	02/05/2016
REA006'	18GHz High Pass Filter	Reactel, Inc	7HS-18G/40G K11	(06)1	08/28/2014	08/28/2016
PRE8'	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	08-28-2015	08-28-2016
REA002'	2.5GHz High Pass Filter	Reactel, Inc	7HS-2.5G/18G-S11	06-1	12/30/2013	12/30/2015
REA006'	18GHz High Pass Filter	Reactel, Inc	7HS-18G/40G K11	(06)1	08/28/2014	08/28/2016
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	06/04/2015	06/04/2016
CBLHF201 2-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/05/2015	02/05/2016

Software Utilized:

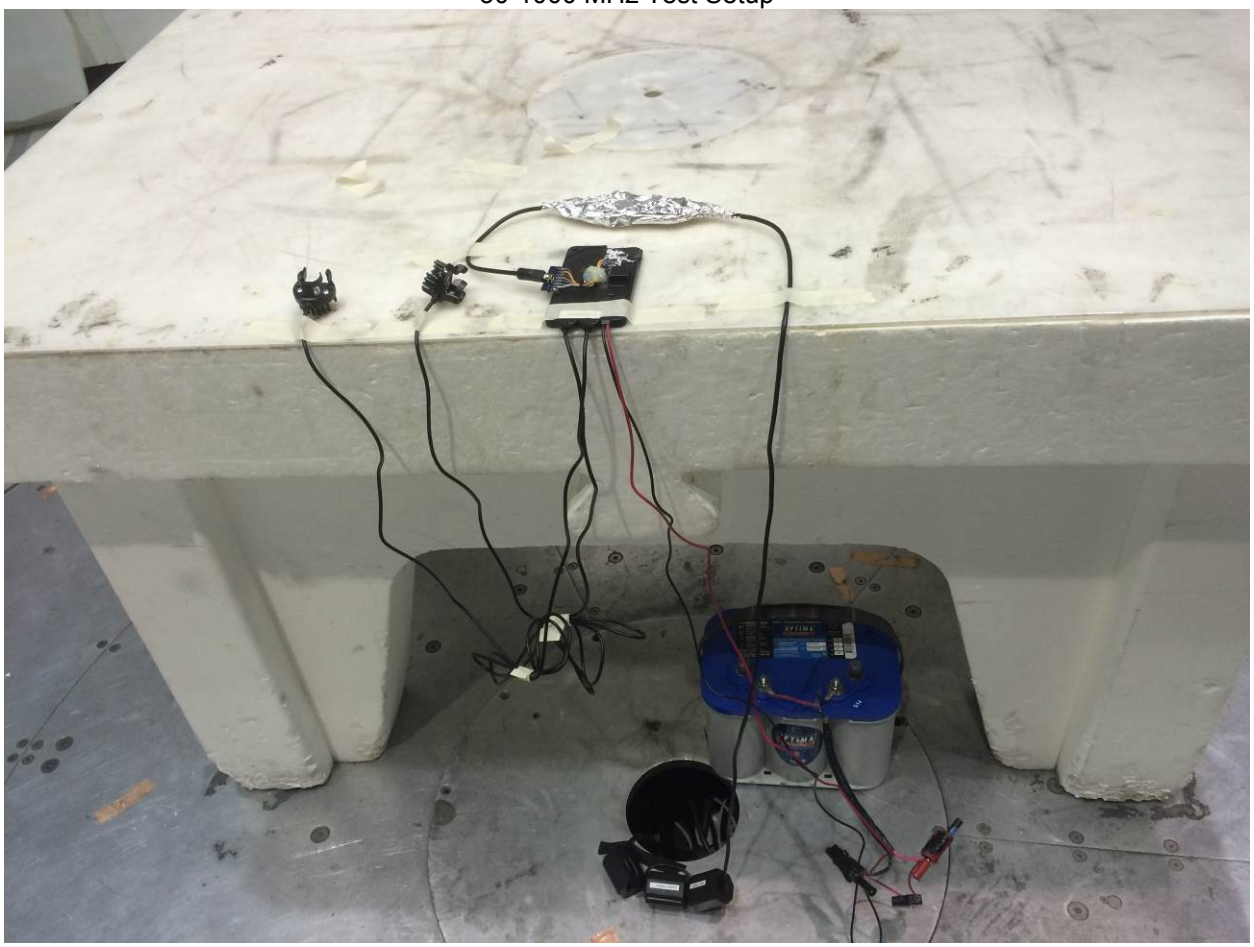
Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010
C5	Teseq	5.02.00 Build 5.26.46.46.

7.3 Results:

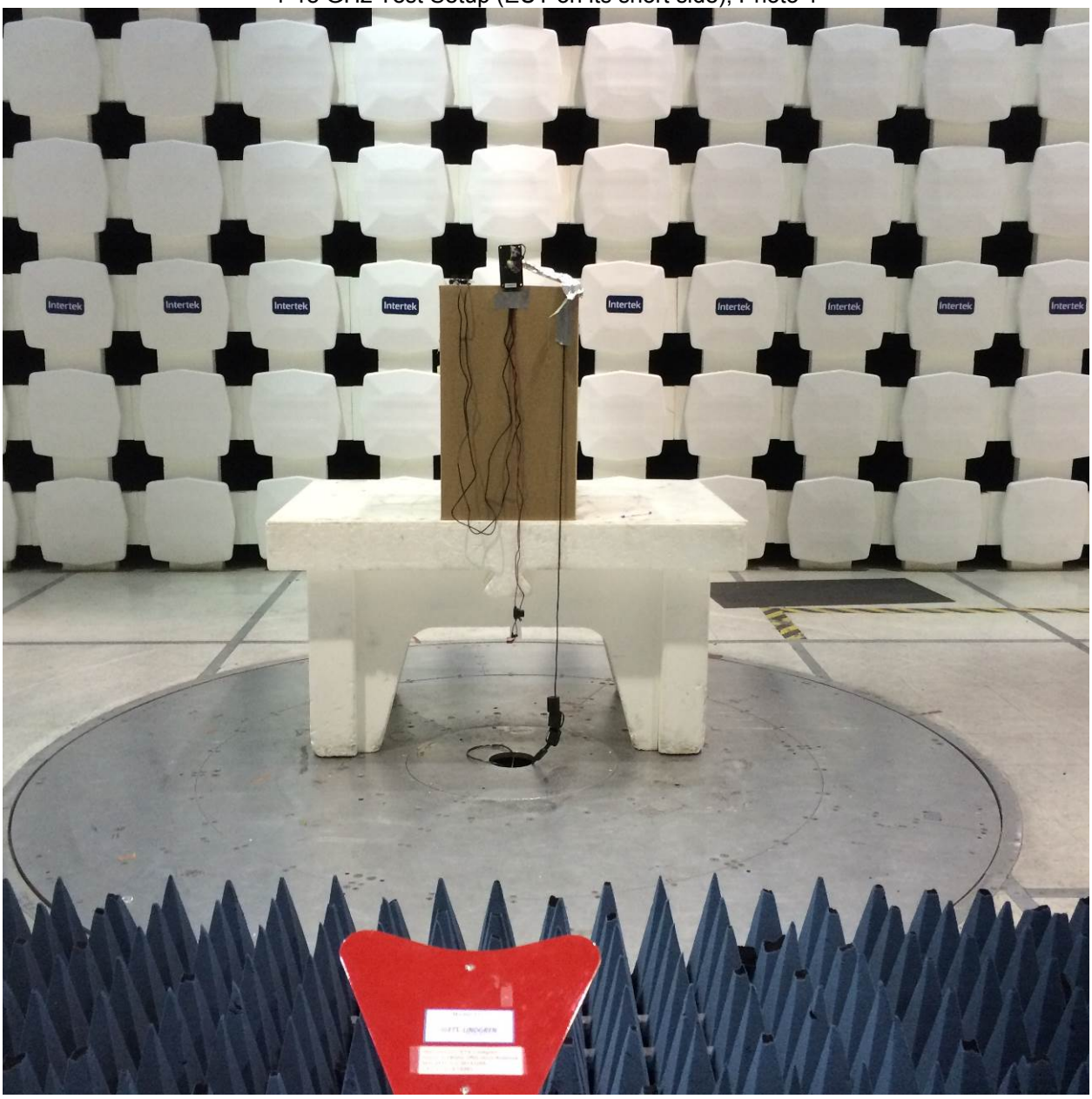
The sample tested was found to Comply.

7.4 Setup Photographs:

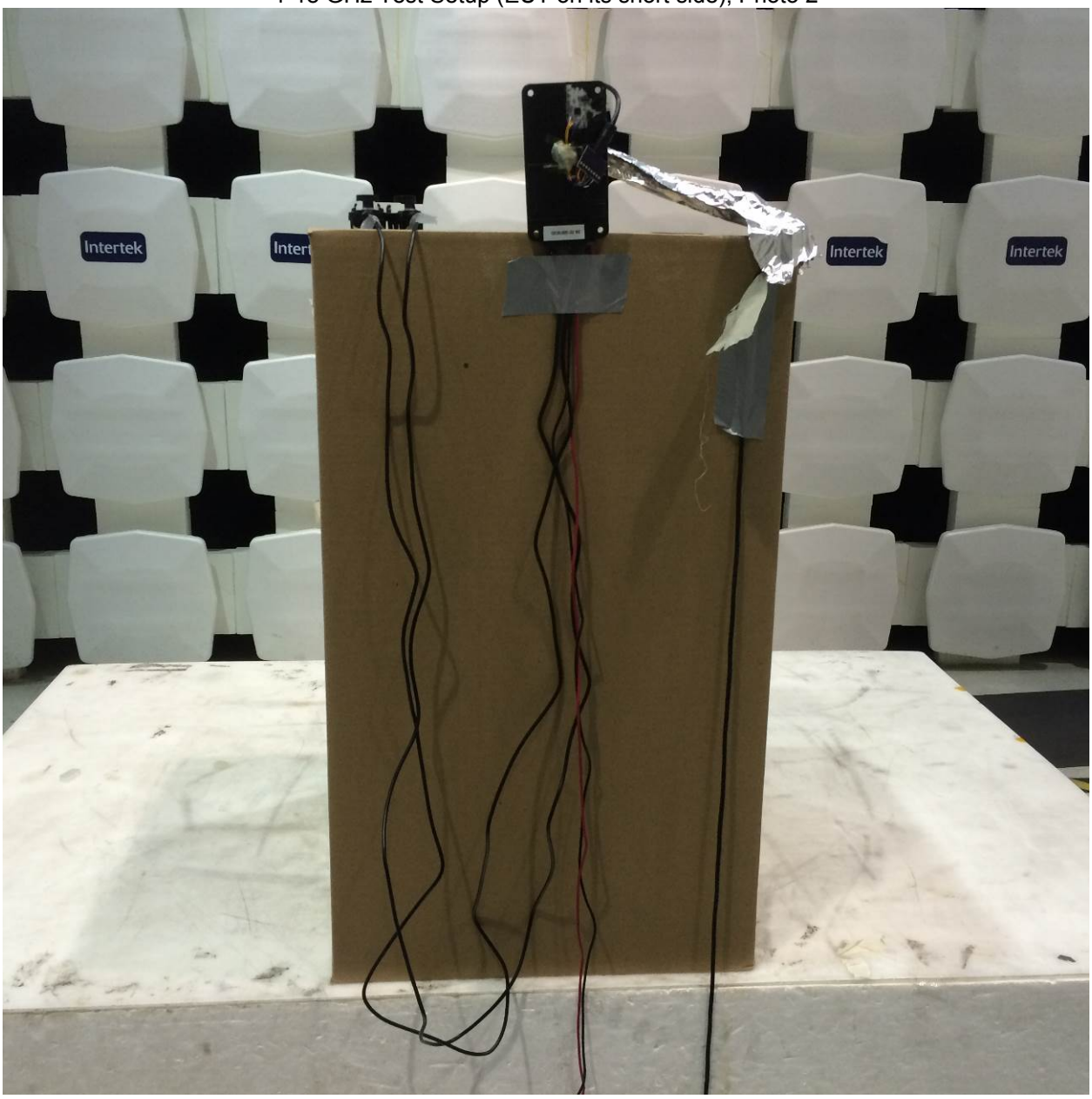
30-1000 MHz Test Setup



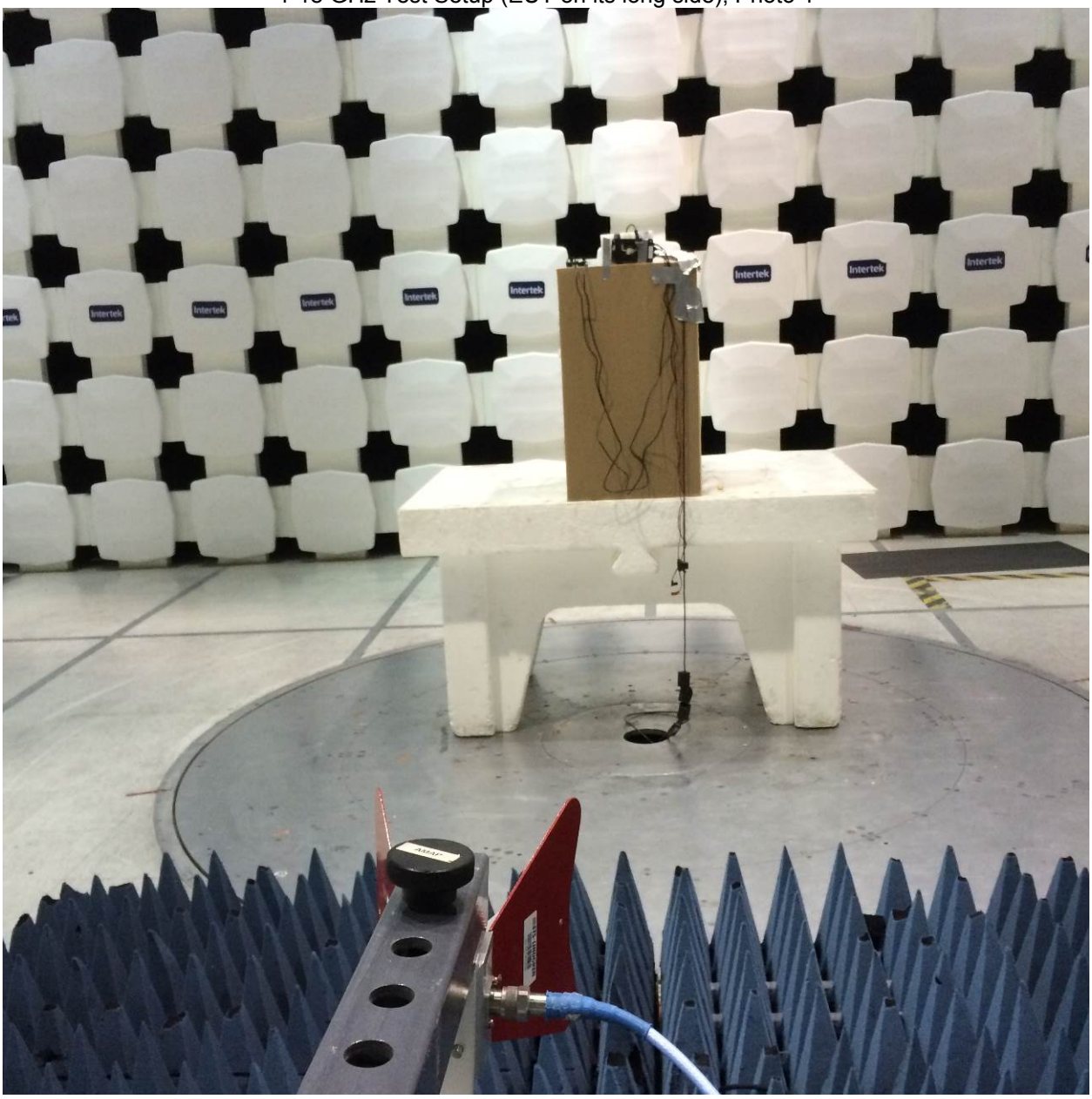
1-18 GHz Test Setup (EUT on its short side), Photo 1



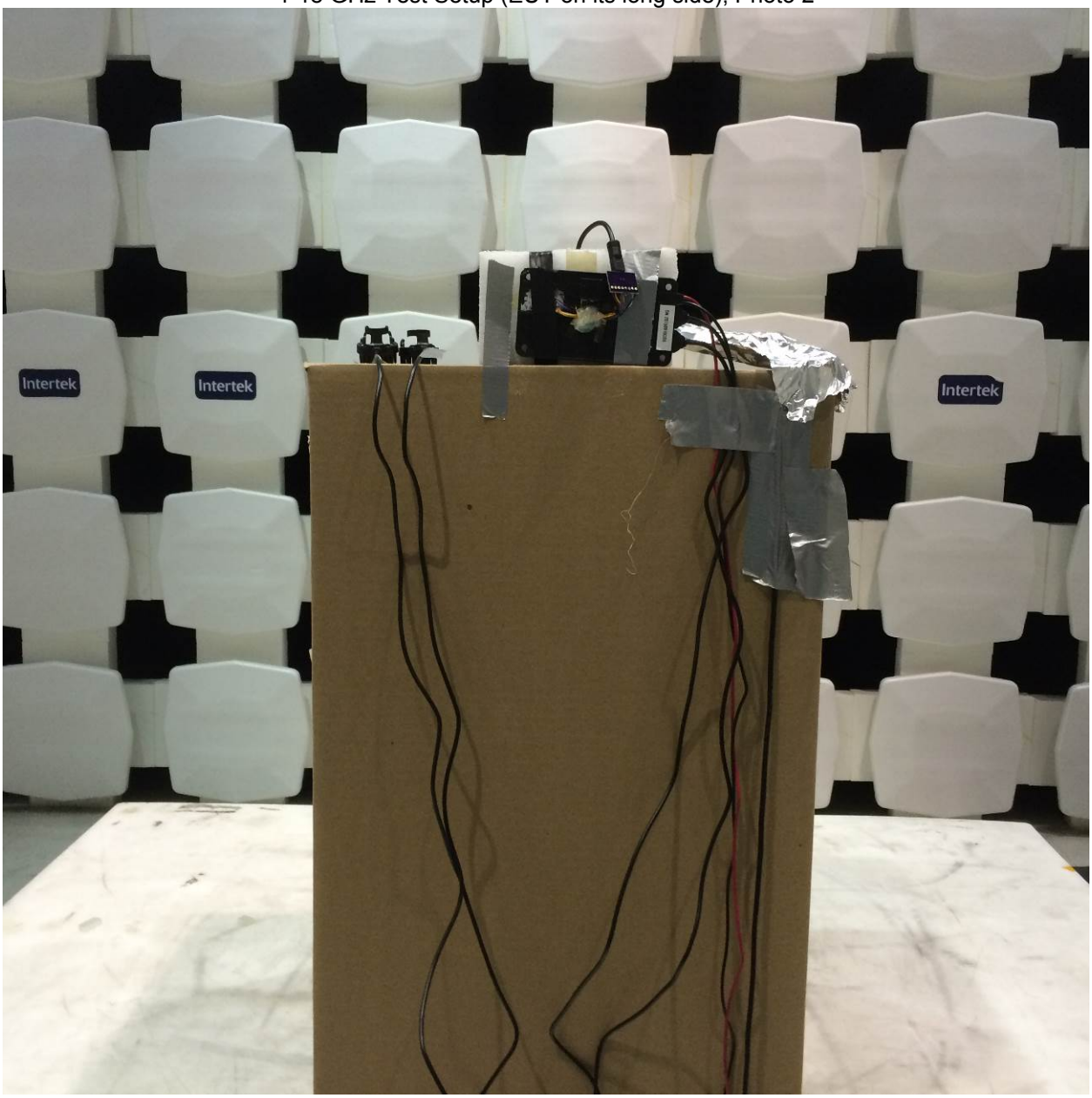
1-18 GHz Test Setup (EUT on its short side), Photo 2



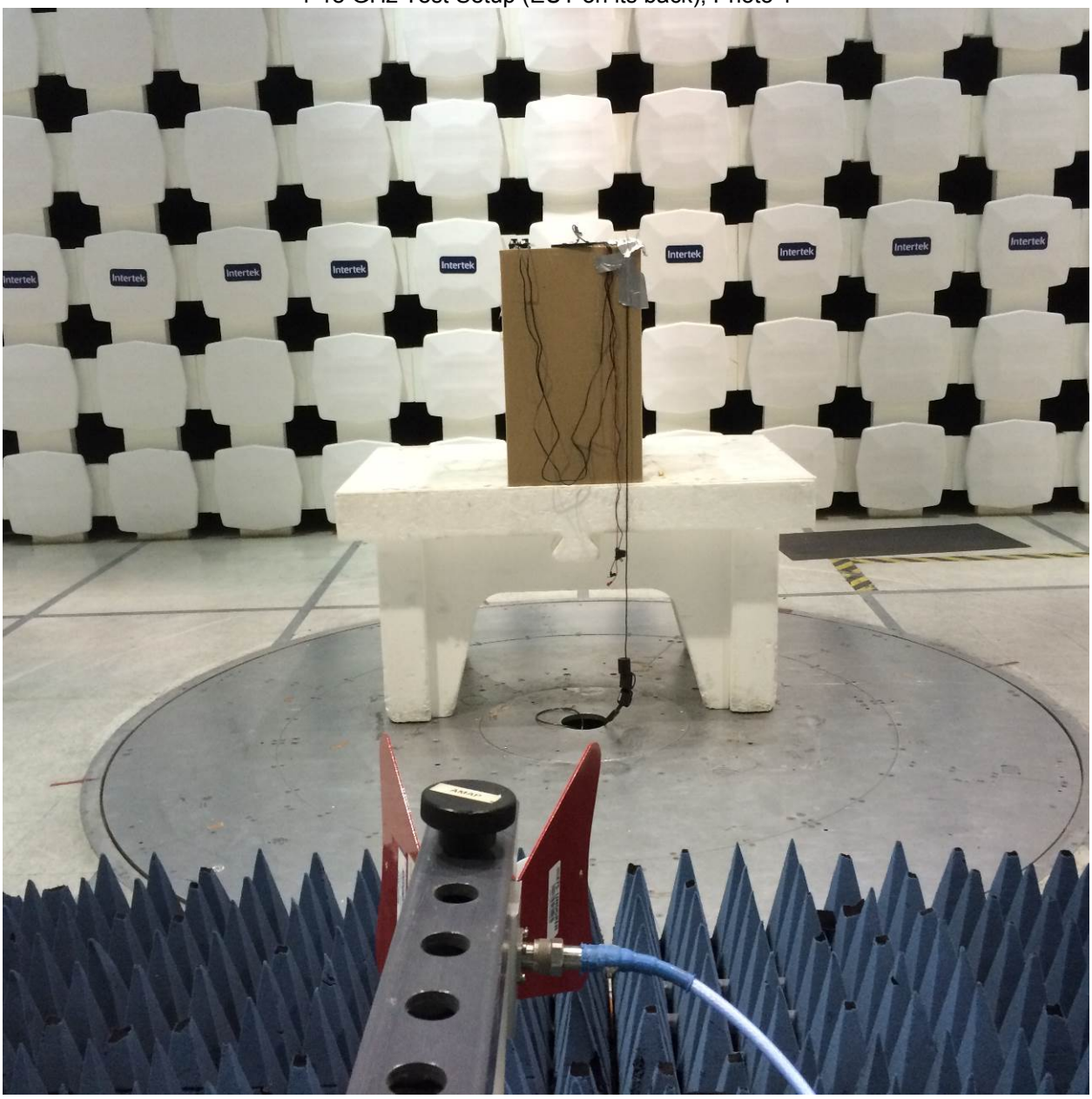
1-18 GHz Test Setup (EUT on its long side), Photo 1



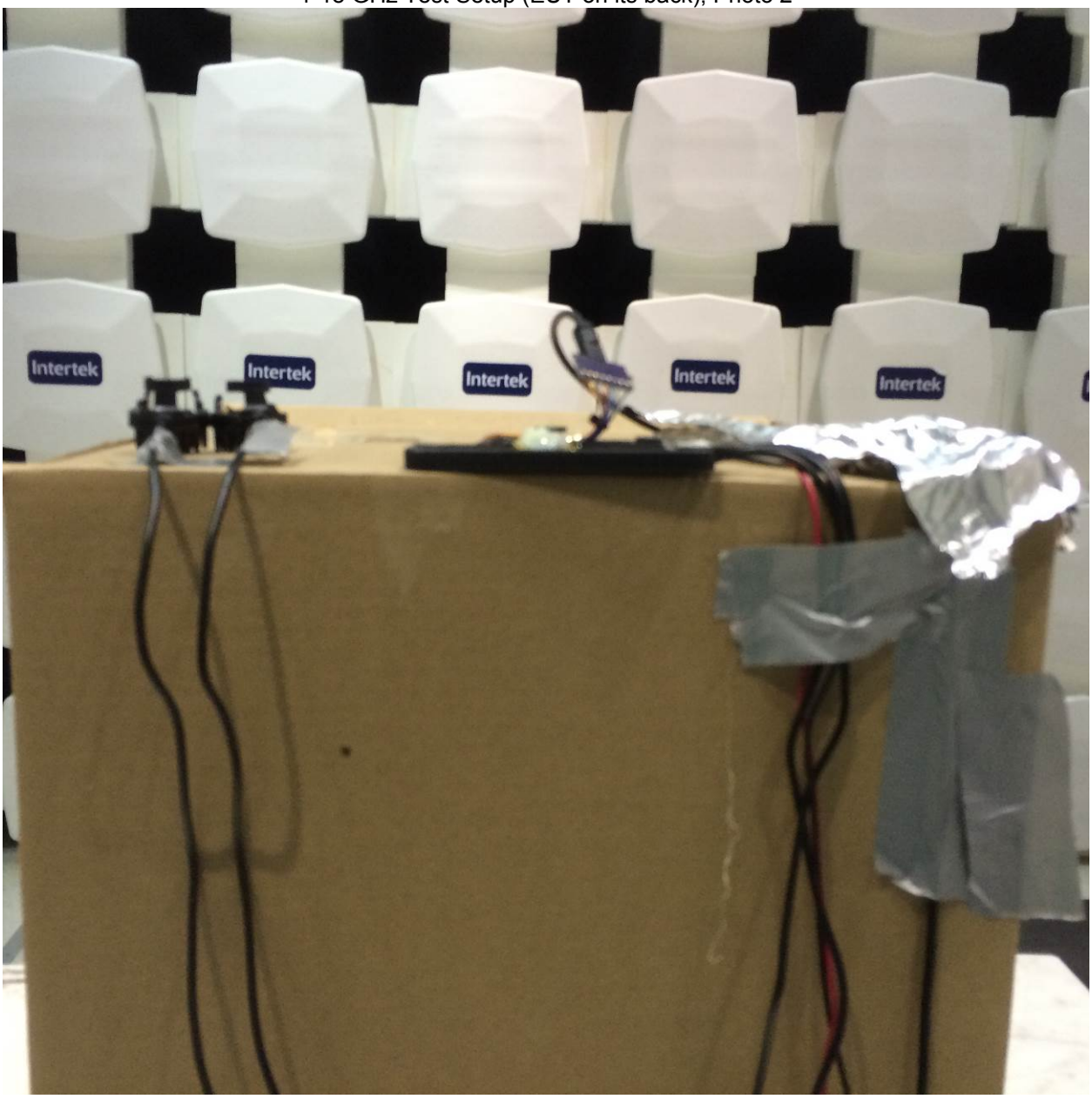
1-18 GHz Test Setup (EUT on its long side), Photo 2



1-18 GHz Test Setup (EUT on its back), Photo 1



1-18 GHz Test Setup (EUT on its back), Photo 2



18-25 GHz Test Setup (Hand scan), Photo 1

18-25 GHz Test Setup (Hand scan), Photo 2

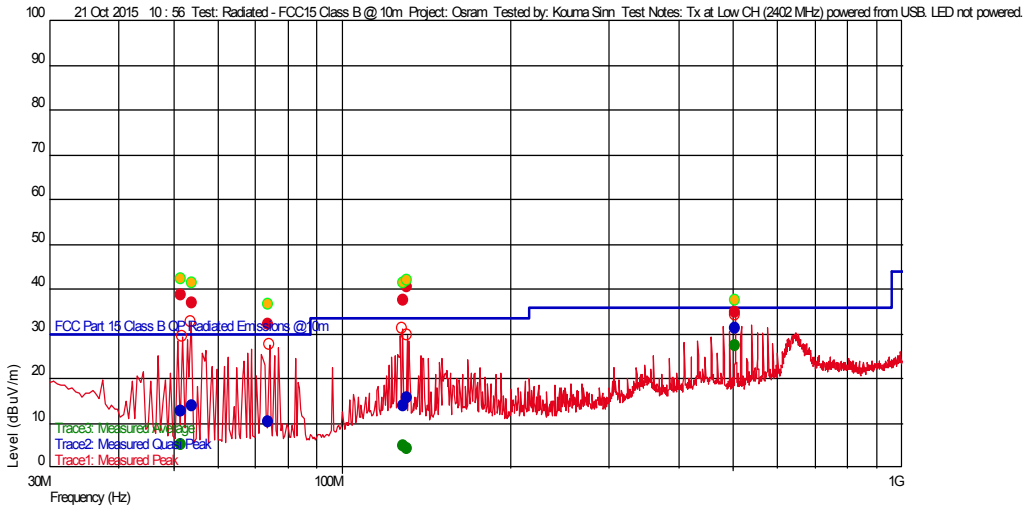
7.5 Plots/Data:

Transmit at Low CH, 2402 MHz, 30-1000 MHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Osram	
Test Notes:	Tx at Low CH (2402 MHz) powered from USB. LED not powered.	
Tested by:	Kouma Sinn	
Test Started:	21 Oct 2015 10 : 56	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

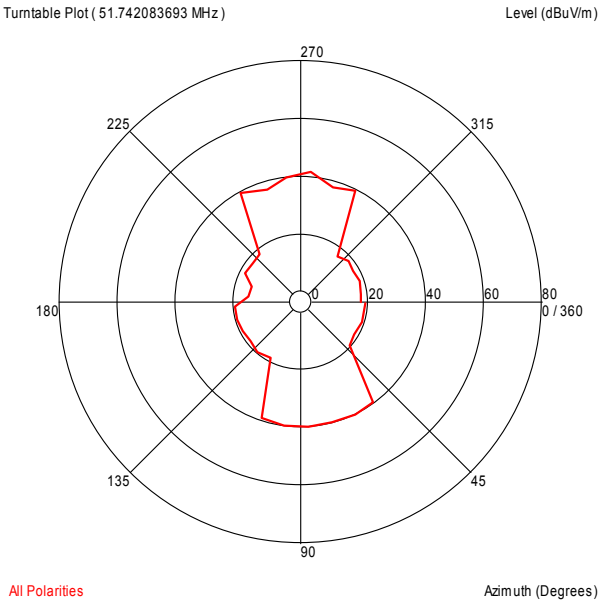
Trace1: Measured Peak

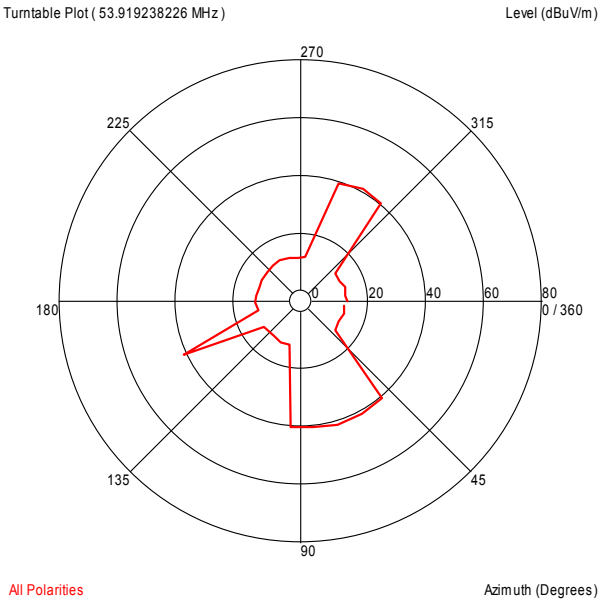
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
504.040079926 M	34.88	17.742	-24.273	--	--	--	183	1.66	120 k	
74.012625357 M	32.00	8.099	-27.050	--	--	|	325	1.25	120 k	
128.572745826 M	37.43	13.685	-26.200	--	--	|	265	2.41	120 k	
130.670741098 M	40.37	13.533	-26.185	--	--	|	255	1.05	120 k	
53.919238226 M	36.88	7.108	-27.552	--	--	|	288	1.67	120 k	
51.742083693 M	38.66	7.452	-27.606	--	--	|	263	1.55	120 k	

Trace2: Measured Quasi Peak

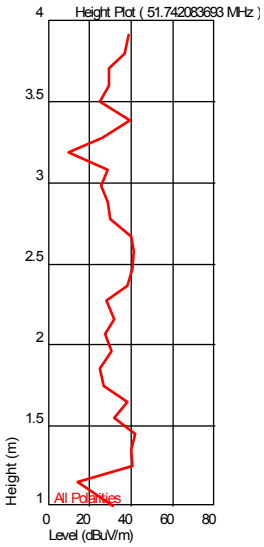
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
74.012625357 M	10.24	8.099	-27.050	30.000	-19.76	|	325	1.25	120 k	
128.572745826 M	13.86	13.685	-26.200	33.520	-19.66	|	265	2.41	120 k	
130.670741098 M	15.64	13.533	-26.185	33.520	-17.88	|	255	1.05	120 k	
51.742083693 M	12.78	7.452	-27.606	30.000	-17.22	|	263	1.55	120 k	
53.919238226 M	13.87	7.108	-27.552	30.000	-16.13	|	288	1.67	120 k	
504.040079926 M	31.27	17.742	-24.273	36.020	-4.75	--	183	1.66	120 k	

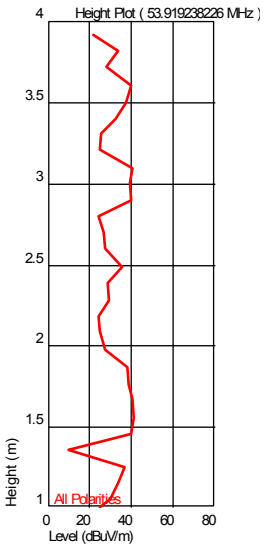
Azimuth Plots

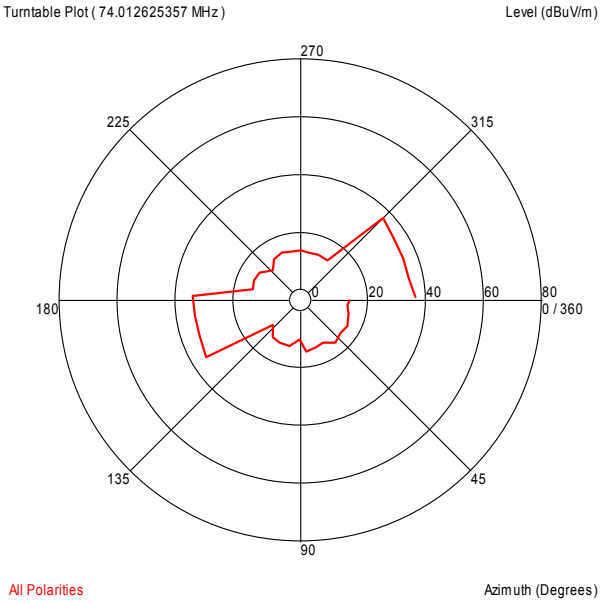


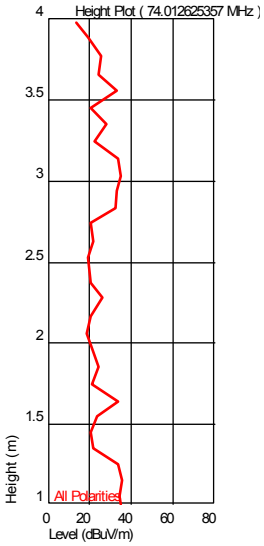


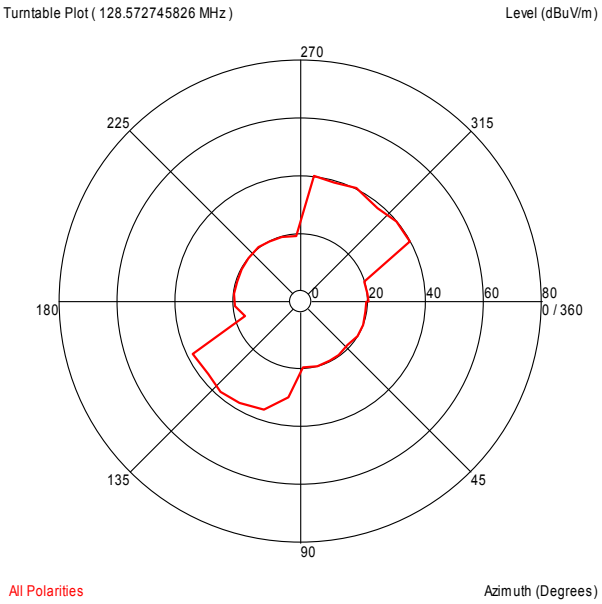
Turntable Plots

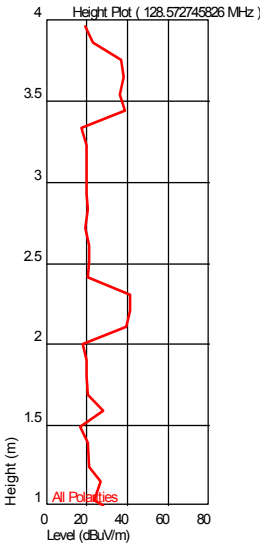


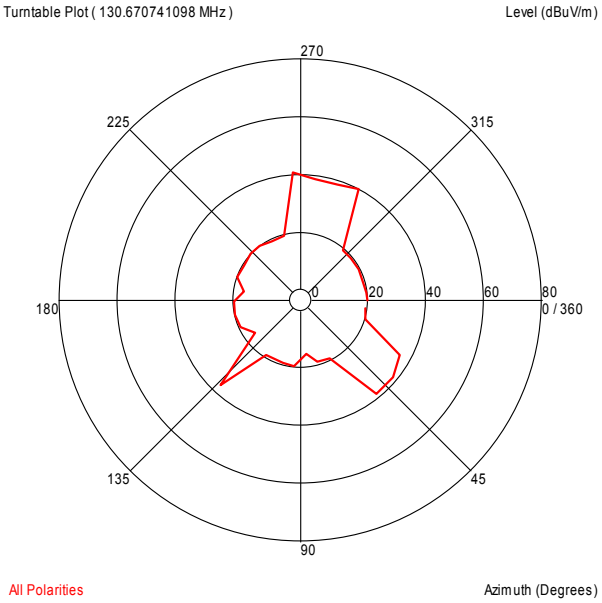


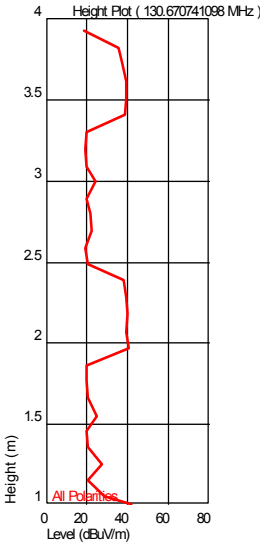

Turntable Plot (74.012625357 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

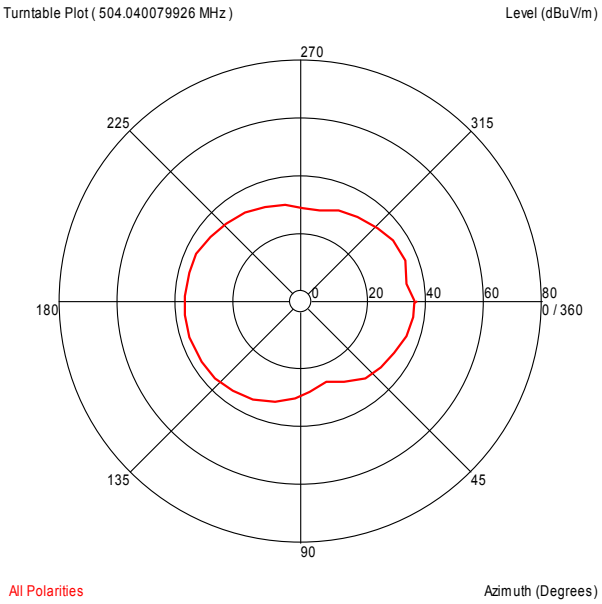

Height Plot (74.012625357 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

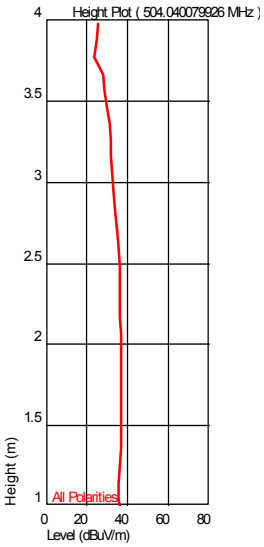

Turntable Plot (128.572745826 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (128.572745826 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (130.670741098 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (130.670741098 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (504.040079926 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

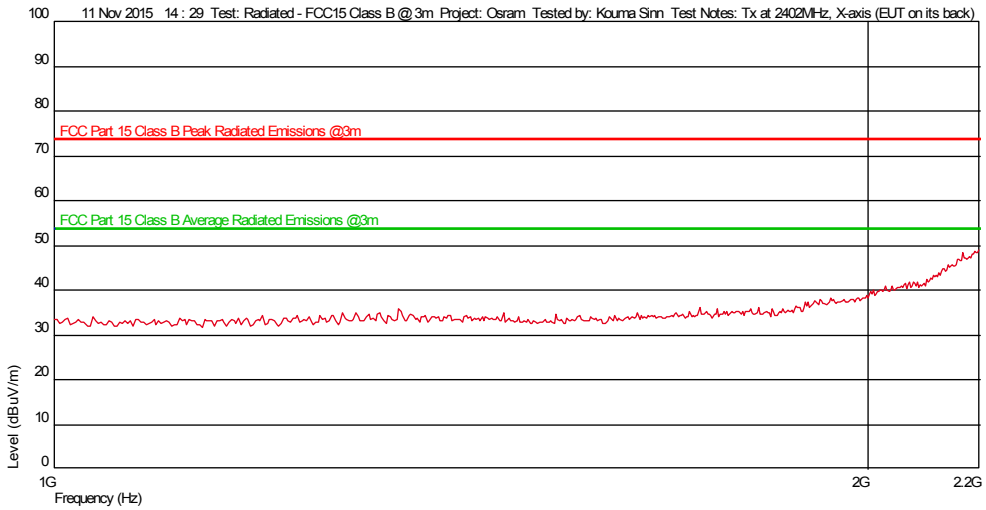

Height Plot (504.040079926 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Transmit at Low CH, 2402 MHz, x-axis (EUT on its back, worst-case), 1-2.2 GHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Osram	
Test Notes:	Tx at 2402MHz, X-axis (EUT on its back)	
Temperature:	20C	
Humidity:	40%, 999mbar	
Tested by:	Kouma Sinn	
Test Started:	11 Nov 2015 14 : 29	

Prescan Emission Graph



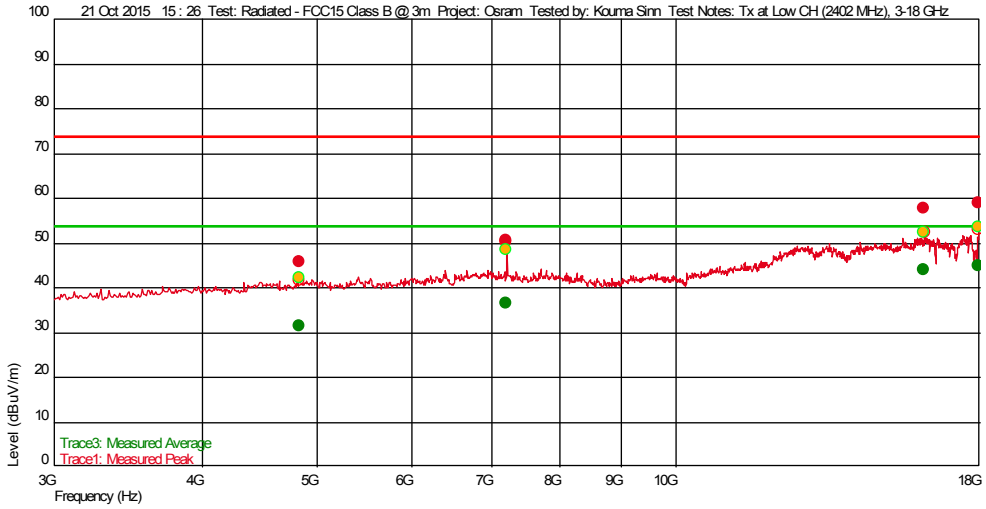
Notes: No emissions were detected.

Transmit at Low CH, 2402 MHz, x-axis (EUT on its back, worst-case), 3-18 GHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Osram	
Test Notes:	Tx at Low CH (2402 MHz), 3-18 GHz	
Temperature:	22C	
Humidity:	35%, 1016mbar	
Tested by:	Kouma Sinn	
Test Started:	21 Oct 2015 15 : 26	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable
Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace1: Measured Peak

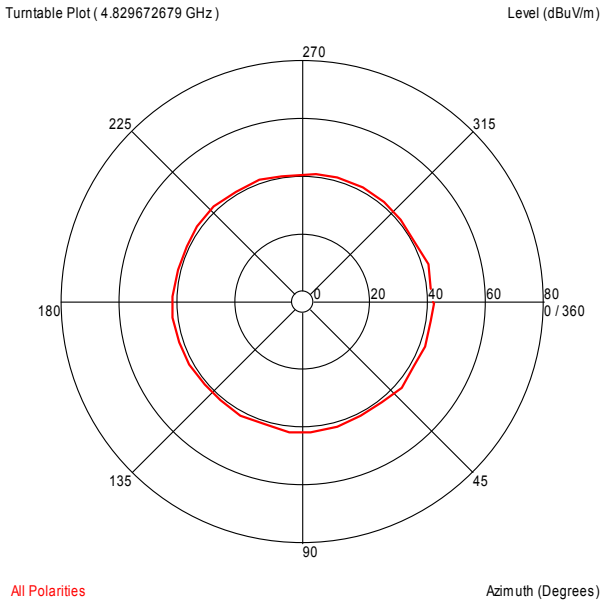
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
4.829672679 G	45.67	34.001	-29.884	74.000	-28.33	--	9	2.98	1 M	
7.207254509 G	50.68	35.620	-29.559	74.000	-23.32	|	122	3.42	1 M	
16.190688043 G	57.65	41.005	-25.319	74.000	-16.35	|	8	2.07	1 M	
17.984021376 G	58.81	41.360	-23.591	74.000	-15.19	|	151	1.62	1 M	

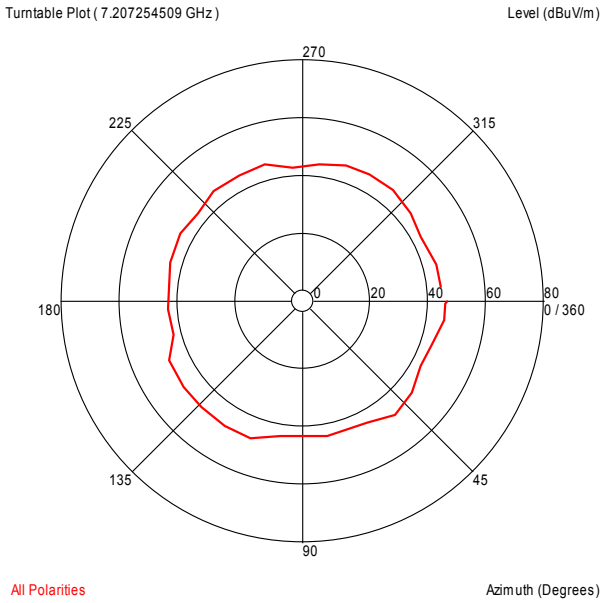
Trace3: Measured Average

Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
4.829672679 G	31.62	34.001	-29.884	54.000	-22.38	--	9	2.98	1 M	
7.207254509 G	36.62	35.620	-29.559	54.000	-17.38	|	122	3.42	1 M	
16.190688043 G	44.10	41.005	-25.319	54.000	-9.90	|	8	2.07	1 M	
17.984021376 G	45.07	41.360	-23.591	54.000	-8.93	|	151	1.62	1 M	

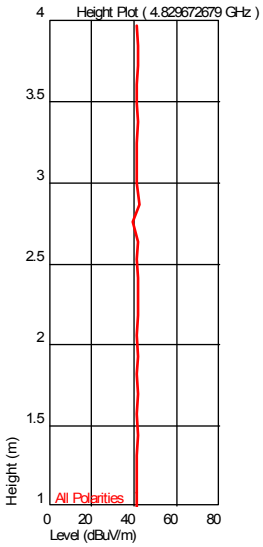
Notes: The device meets the General Limits of FCC Part 15 Subpart C Section 15.209. Scan at 100 kHz Resolution Bandwidth was not performed since it meets the general requirements at 1 MHz Resolution bandwidth. Hand scan was performed from 18-25 GHz with no emissions detected.

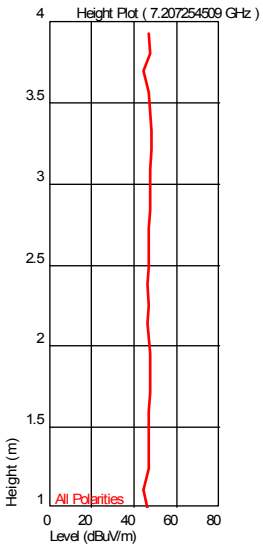
Azimuth Plots

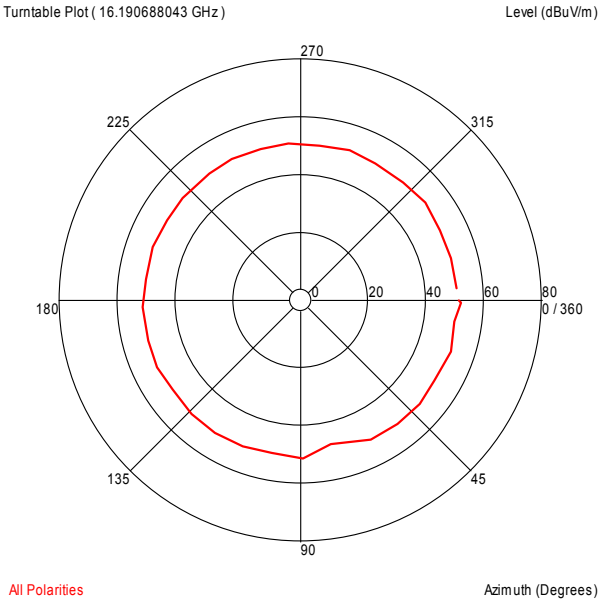


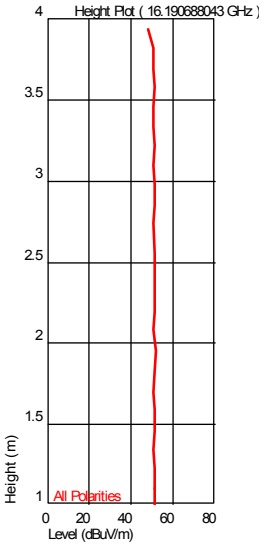


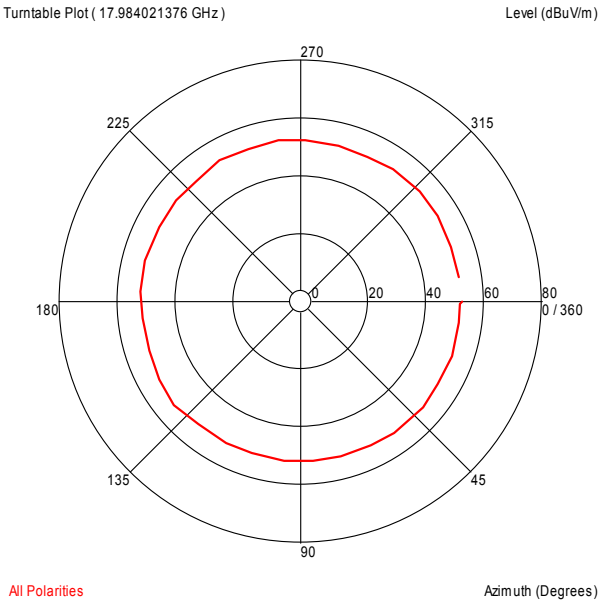
Turntable Plots

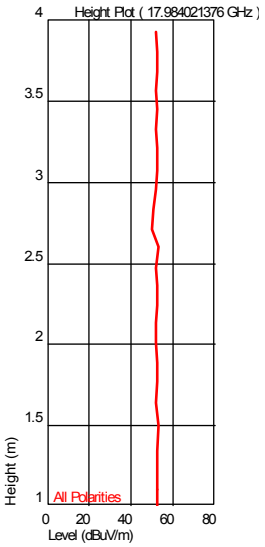





Turntable Plot (16.190688043 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (16.190688043 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (17.984021376 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

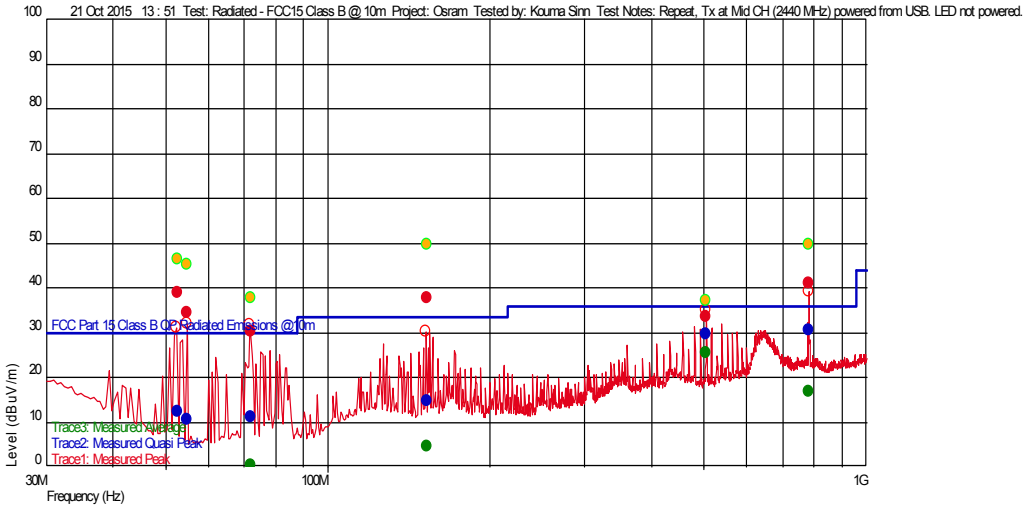

Height Plot (17.984021376 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Transmit at Mid CH, 2440 MHz, 30-1000 MHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Osram	
Test Notes:	Repeat, Tx at Mid CH (2440 MHz) powered from USB. LED not power	
Temperature:	22C	
Humidity:	35%, 1016mbar	
Tested by:	Kouma Sinn	
Test Started:	21 Oct 2015 13 : 51	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

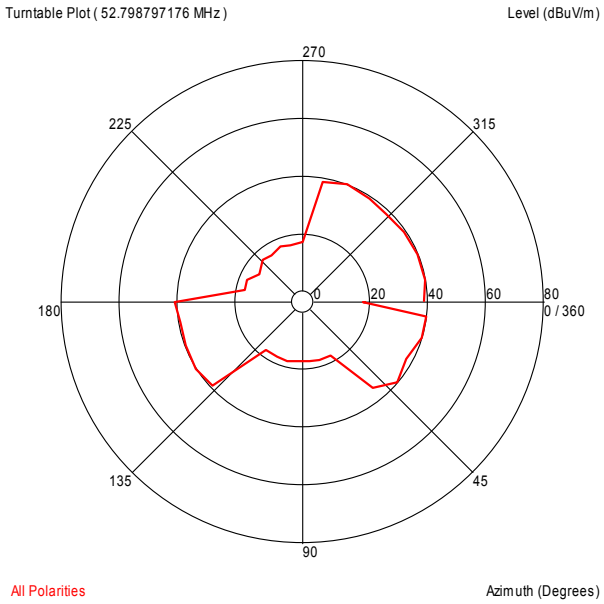
Trace1: Measured Peak

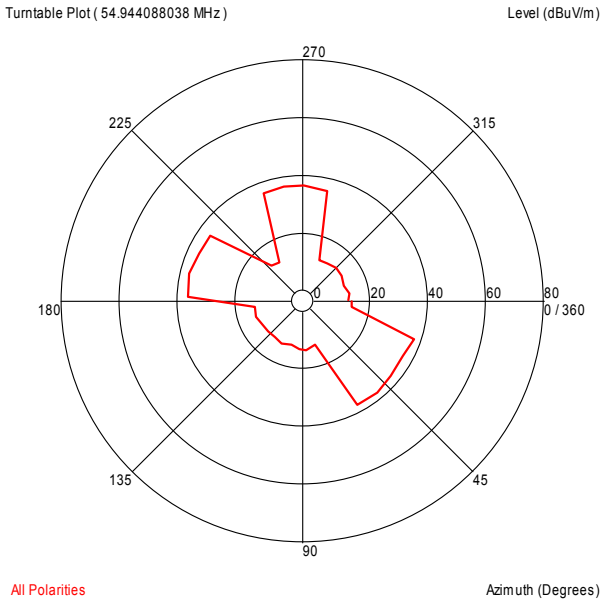
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
504.045691148 M	33.64	17.743	-24.273	--	--	--	179	1.87	120 k	
71.955510848 M	30.43	8.196	-27.101	--	--	|	31	3.50	120 k	
153.049298737 M	37.83	12.100	-26.029	--	--	|	255	1.05	120 k	
54.944088038 M	34.54	7.006	-27.526	--	--	|	62	1.04	120 k	
782.338075958 M	40.97	20.753	-23.735	--	--	|	254	1.35	120 k	
52.798797176 M	38.94	7.240	-27.580	--	--	|	360	1.04	120 k	

Trace2: Measured Quasi Peak

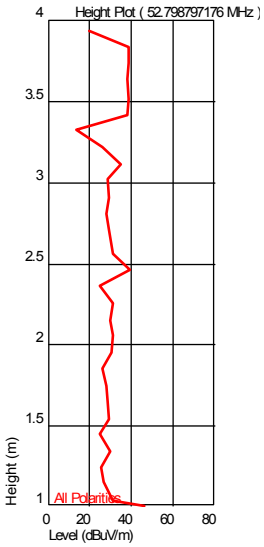
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
54.944088038 M	10.56	7.006	-27.526	30.000	-19.44	|	62	1.04	120 k	
71.955510848 M	11.20	8.196	-27.101	30.000	-18.80	|	31	3.50	120 k	
153.049298737 M	14.75	12.100	-26.029	33.520	-18.77	|	255	1.05	120 k	
52.798797176 M	12.49	7.240	-27.580	30.000	-17.51	|	360	1.04	120 k	
504.045691148 M	29.66	17.743	-24.273	36.020	-6.36	--	179	1.87	120 k	
782.338075958 M	30.61	20.753	-23.735	36.020	-5.41	|	254	1.35	120 k	

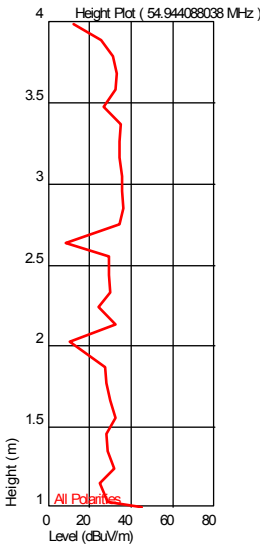
Azimuth Plots

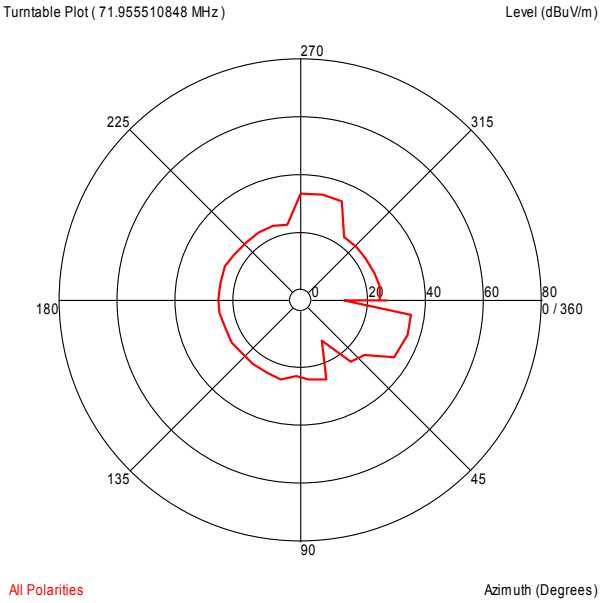


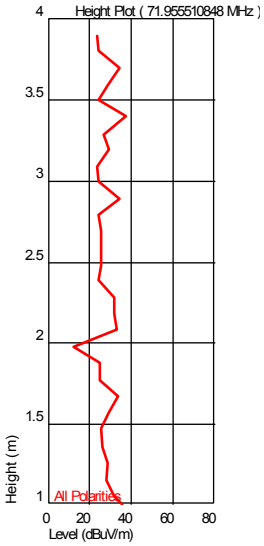


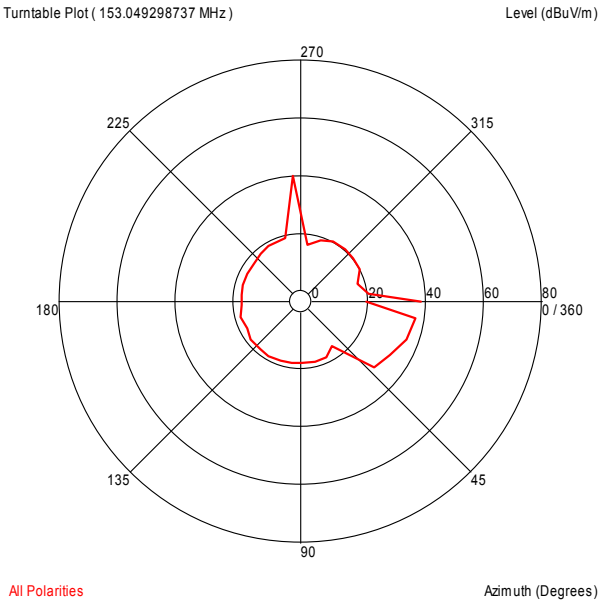
Turntable Plots

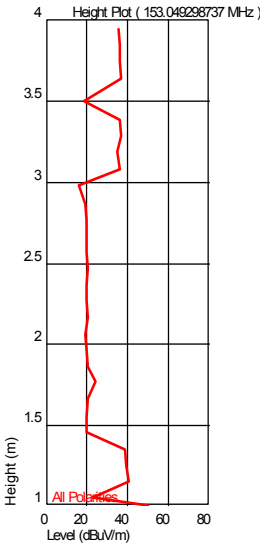


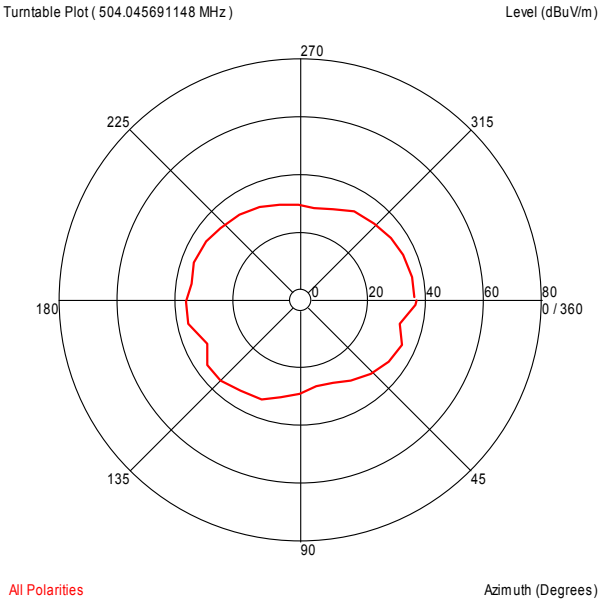


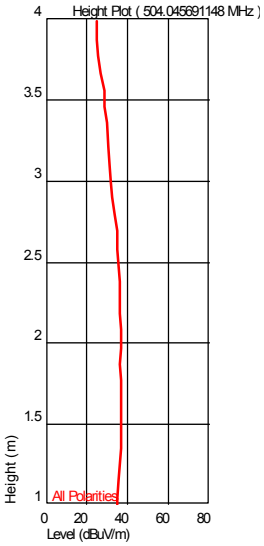

Turntable Plot (71.955510848 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

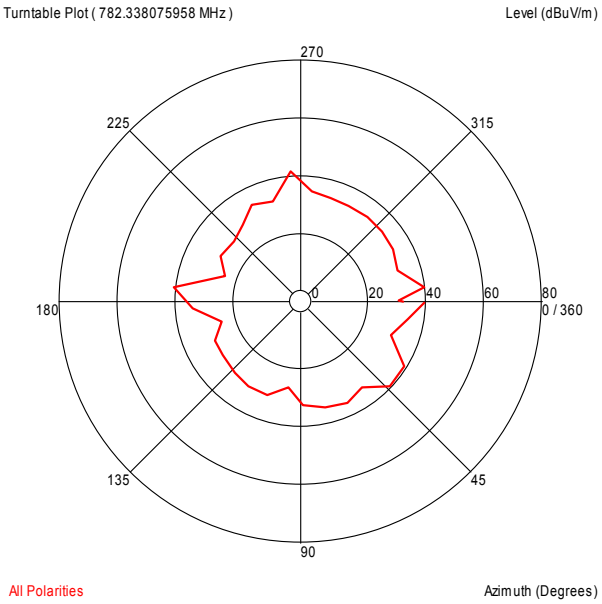

Height Plot (71.955510848 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

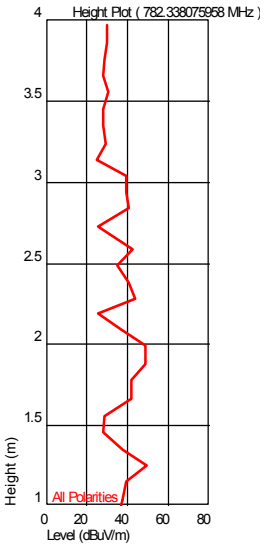

Turntable Plot (153.049298737 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (153.049298737 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (504.045691148 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (504.045691148 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (782.338075958 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

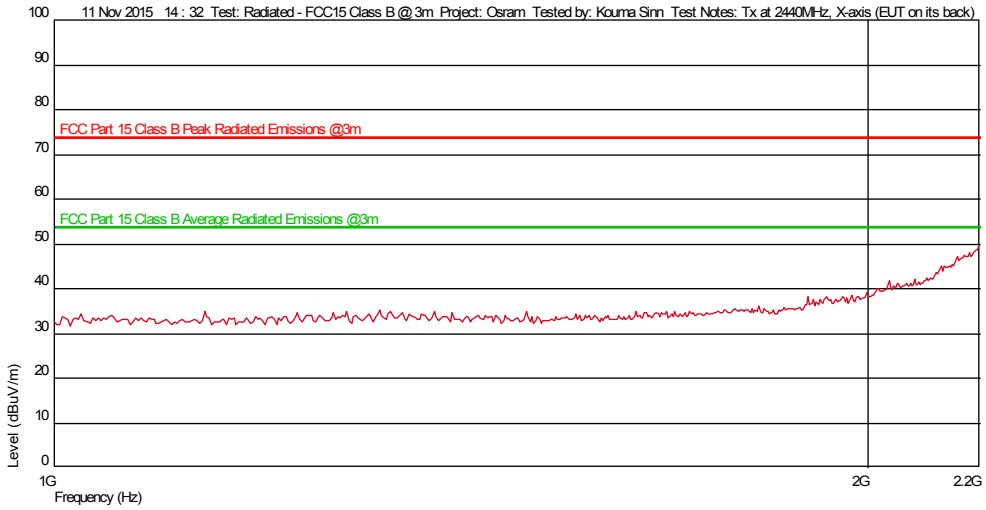

Height Plot (782.338075958 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Transmit at Mid CH, 2440 MHz, x-axis (EUT on its back, worst-case), 1-2.2 GHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Osram	
Test Notes:	Tx at 2440MHz, X-axis (EUT on its back)	
Temperature:	20C	
Humidity:	40%, 999mbar	
Tested by:	Kouma Sinn	
Test Started:	11 Nov 2015 14 : 32	

Prescan Emission Graph



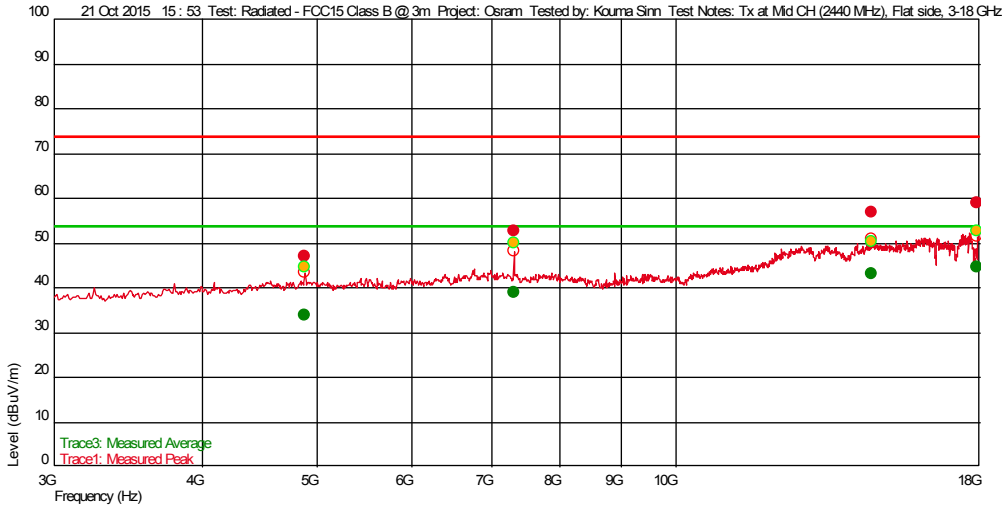
Notes: No emissions were detected.

Transmit at Mid CH, 2440 MHz, x-axis (EUT on its back, worst-case), 3-18 GHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Osram	
Test Notes:	Tx at Mid CH (2440 MHz), Flat side, 3-18 GHz	
Temperature:	22C	
Humidity:	35%, 1016mbar	
Tested by:	Kouma Sinn	
Test Started:	21 Oct 2015 15 : 53	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable
Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace1: Measured Peak

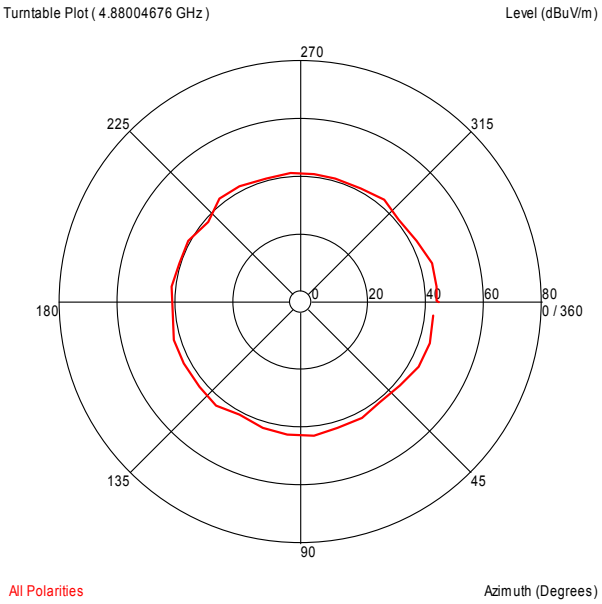
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
4.88004676 G	47.08	33.997	-29.812	74.000	-26.92	|	359	1.07	1 M	
7.320774884 G	52.74	35.591	-29.668	74.000	-21.26	|	143	2.06	1 M	
14.621523046 G	56.74	39.239	-24.609	74.000	-17.26	|	40	2.25	1 M	
17.949619239 G	58.81	41.328	-23.679	74.000	-15.19	|	294	3.84	1 M	

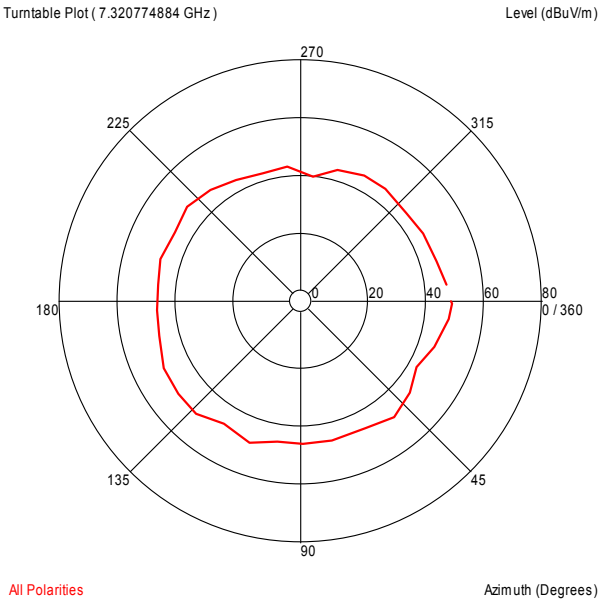
Trace3: Measured Average

Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
4.88004676 G	33.74	33.997	-29.812	54.000	-20.26	|	359	1.07	1 M	
7.320774884 G	38.84	35.591	-29.668	54.000	-15.16	|	143	2.06	1 M	
14.621523046 G	43.22	39.239	-24.609	54.000	-10.78	|	40	2.25	1 M	
17.949619239 G	44.75	41.328	-23.679	54.000	-9.25	|	294	3.84	1 M	

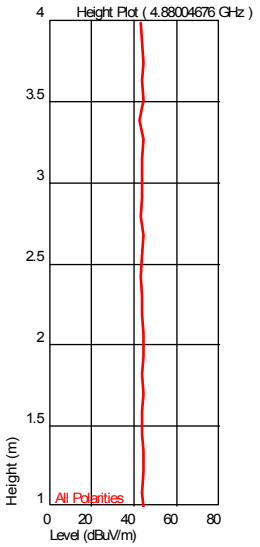
Notes: The device meets the General Limits of FCC Part 15 Subpart C Section 15.209. Scan at 100 kHz Resolution Bandwidth was not performed since it meets the general requirements at 1 MHz Resolution bandwidth. Hand scan was performed from 18-25 GHz with no emissions detected.

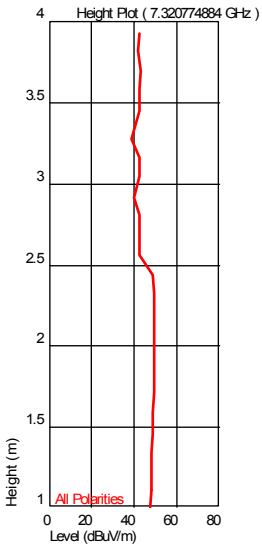
Azimuth Plots

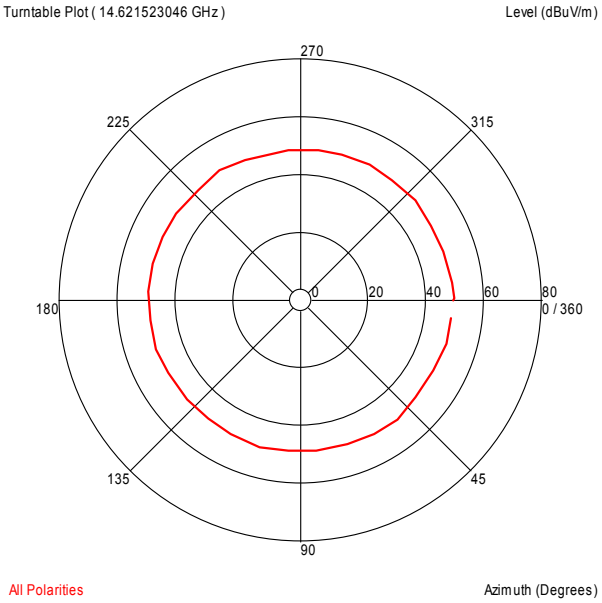


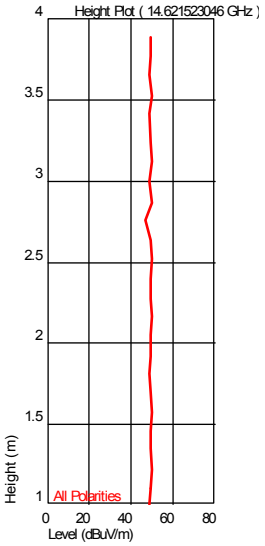


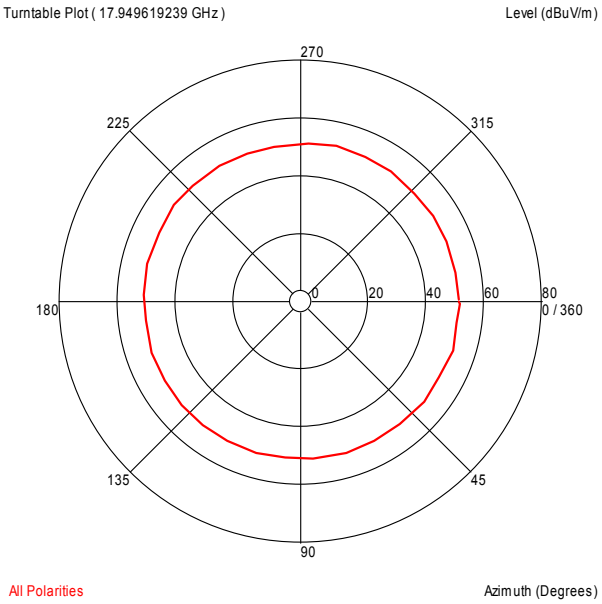
Turntable Plots

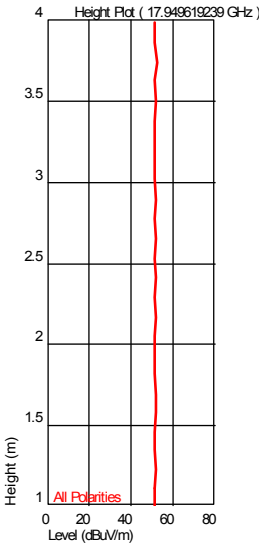





Turntable Plot (14.621523046 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (14.621523046 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (17.949619239 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

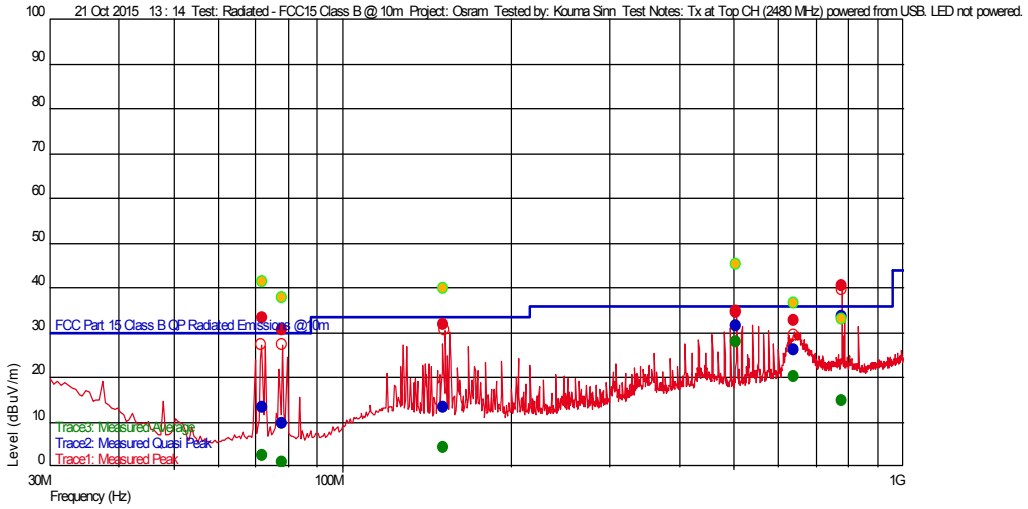

Height Plot (17.949619239 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Transmit at High CH, 2480 MHz, 30-1000 MHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Osram	
Test Notes:	Tx at Top CH (2480 MHz) powered from USB. LED not powered.	
Temperature:	22C	
Humidity:	35%, 1016mbar	
Tested by:	Kouma Sinn	
Test Started:	21 Oct 2015 13 : 14	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

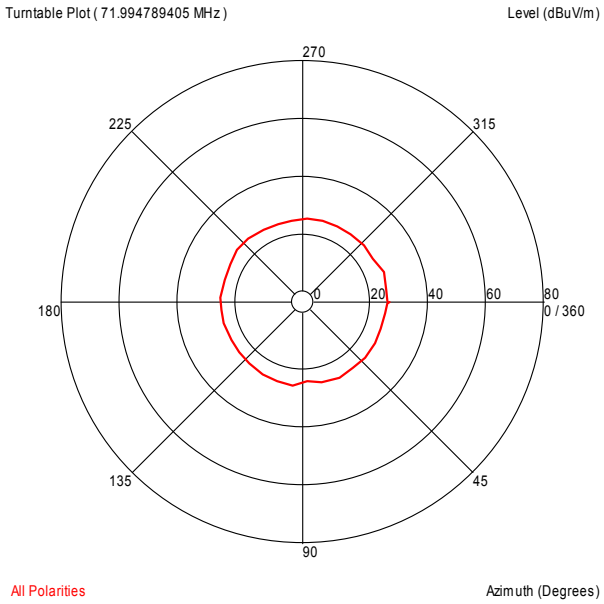
Trace1: Measured Peak

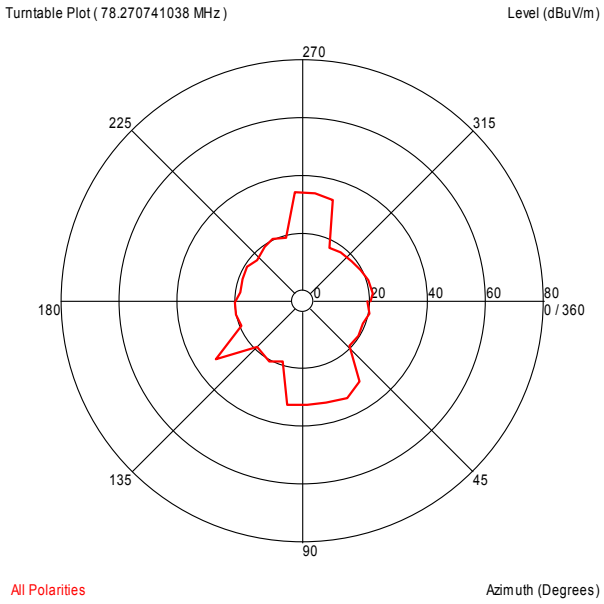
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
639.751102569 M	32.82	19.295	-23.919	--	--	--	297	1.76	120 k	
151.845290721 M	31.88	12.085	-26.037	--	--	|	276	3.99	120 k	
504.012023814 M	34.58	17.741	-24.273	--	--	--	173	1.05	120 k	
78.270741038 M	30.65	7.773	-26.943	--	--	|	255	3.04	120 k	
71.994789405 M	33.29	8.199	-27.100	--	--	|	351	1.05	120 k	
777.585170641 M	40.37	20.752	-23.742	--	--	|	318	4.00	120 k	

Trace2: Measured Quasi Peak

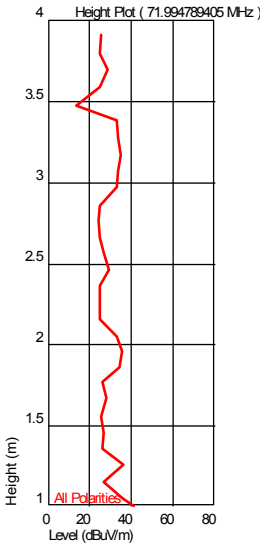
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
78.270741038 M	9.61	7.773	-26.943	30.000	-20.39	|	255	3.04	120 k	
151.845290721 M	13.40	12.085	-26.037	33.520	-20.12	|	276	3.99	120 k	
71.994789405 M	13.35	8.199	-27.100	30.000	-16.65	|	351	1.05	120 k	
639.751102569 M	26.17	19.295	-23.919	36.020	-9.85	--	297	1.76	120 k	
504.012023814 M	31.44	17.741	-24.273	36.020	-4.58	--	173	1.05	120 k	
777.585170641 M	33.53	20.752	-23.742	36.020	-2.49	|	318	4.00	120 k	

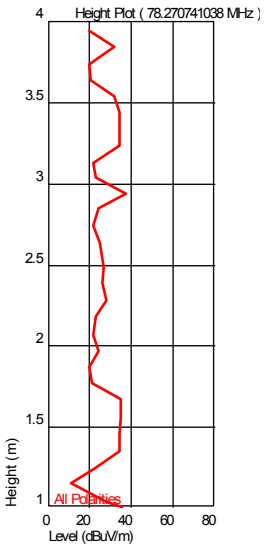
Azimuth Plots

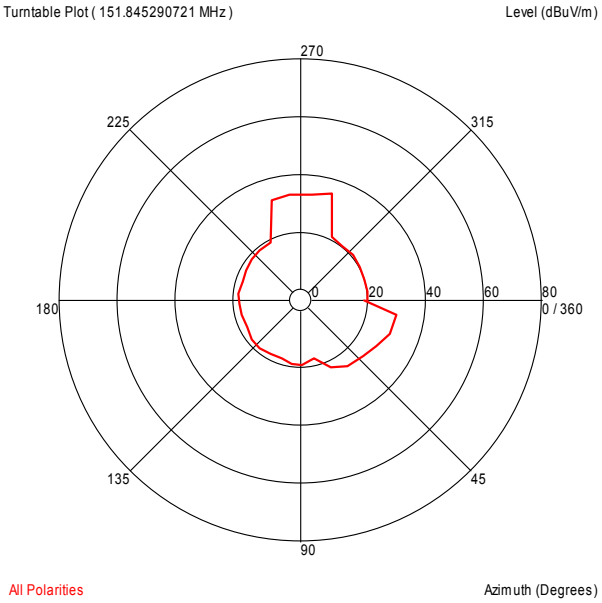


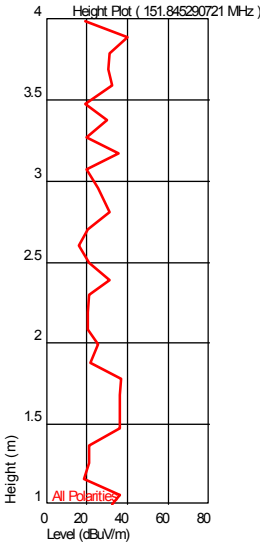


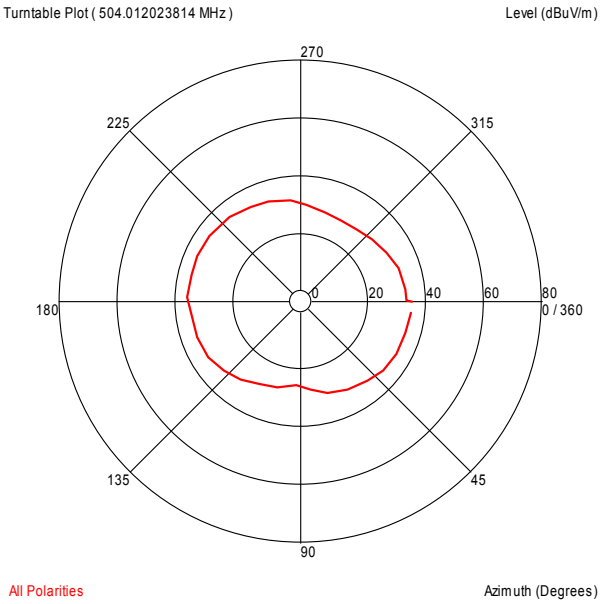
Turntable Plots

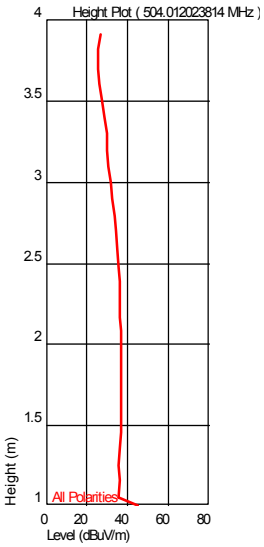


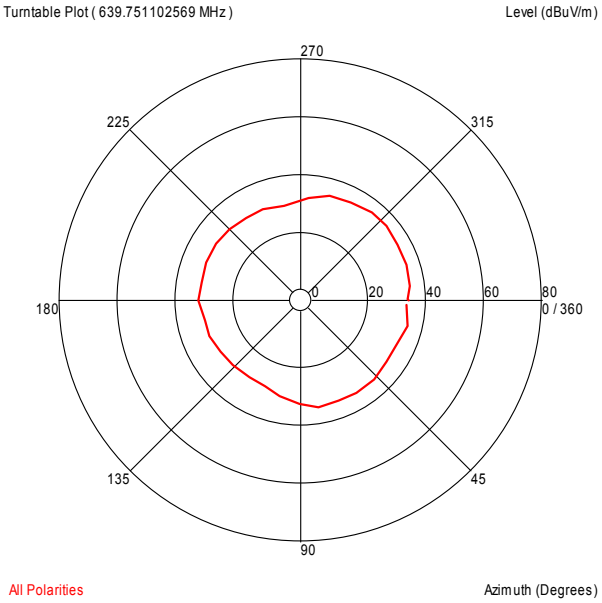


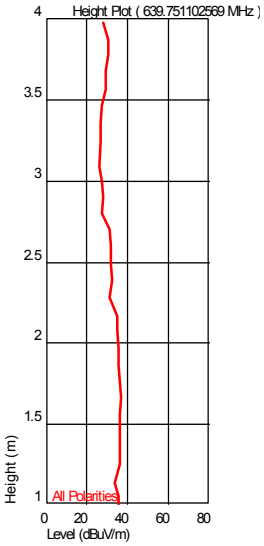

Turntable Plot (151.845290721 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

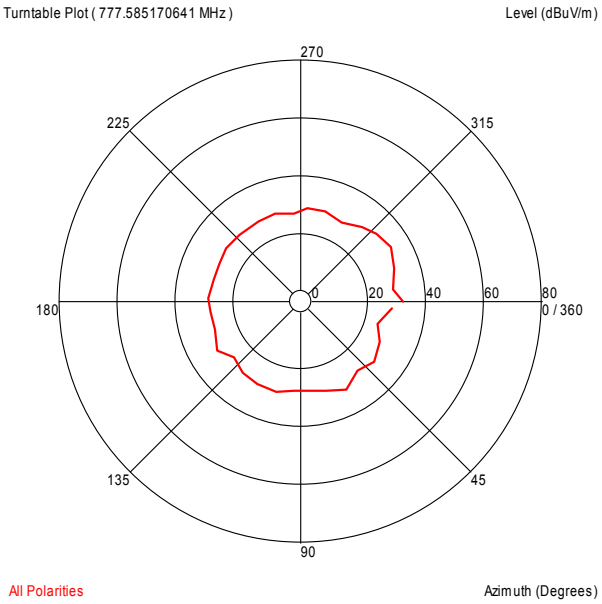

Height Plot (151.845290721 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

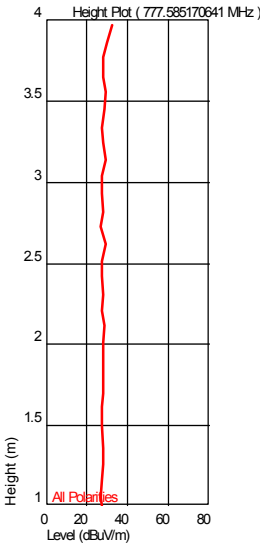

Turntable Plot (504.012023814 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (504.012023814 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (639.751102569 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (639.751102569 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (777.585170641 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

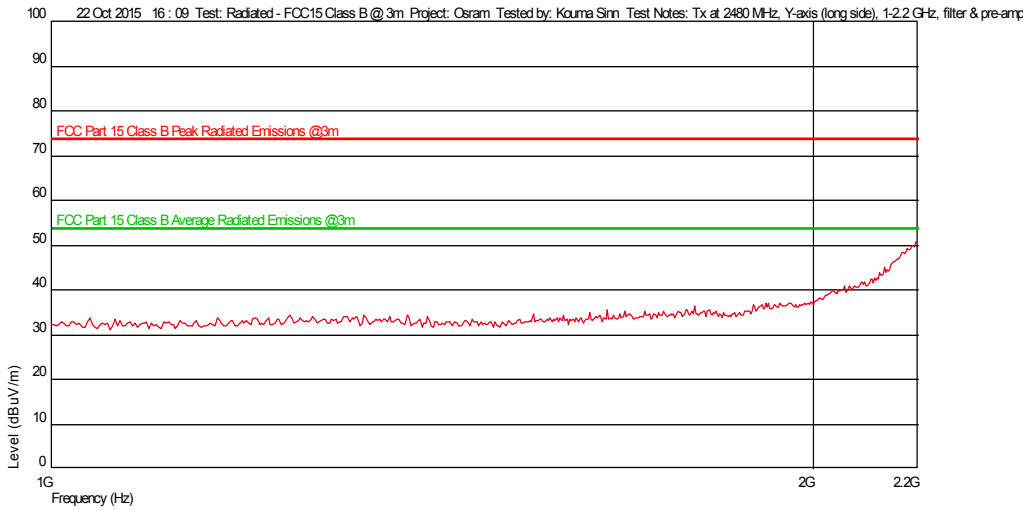

Height Plot (777.585170641 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Transmit at High CH, 2480 MHz, y-axis (EUT on its long side, worst-case), 1-2.2 GHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Osram	
Test Notes:	Tx at 2480 MHz, Y-axis (long side), 1-2.2 GHz, filter & pre-amp	
Tested by:	Kouma Sinn	
Test Started:	22 Oct 2015 16 : 09	

Prescan Emission Graph



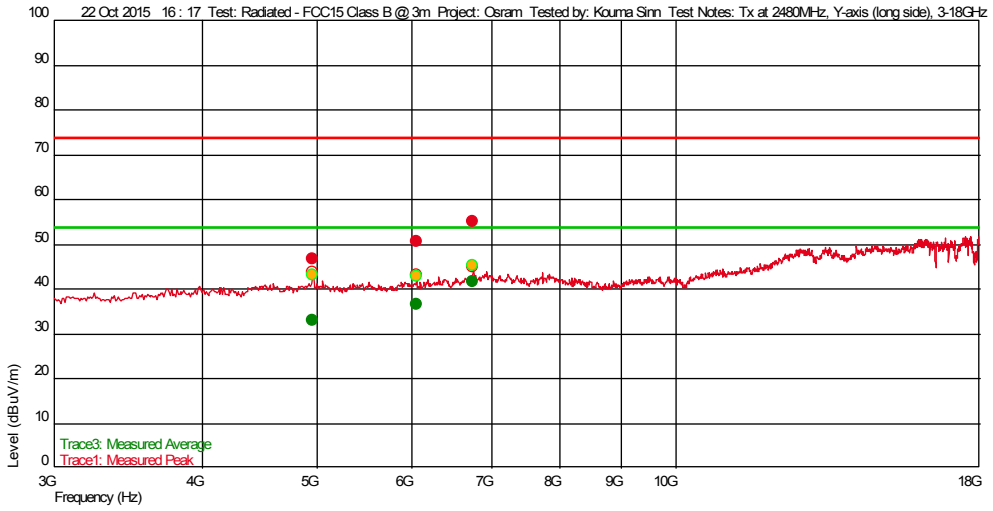
Notes: No emissions were detected.

Transmit at High CH, 2480 MHz, y-axis (EUT on its long side, worst-case), 3-18 GHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Osram	
Test Notes:	Tx at 2480MHz, Y-axis (long side), 3-18GHz	
Tested by:	Kouma Sinn	
Test Started:	22 Oct 2015 16 : 17	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace1: Measured Peak

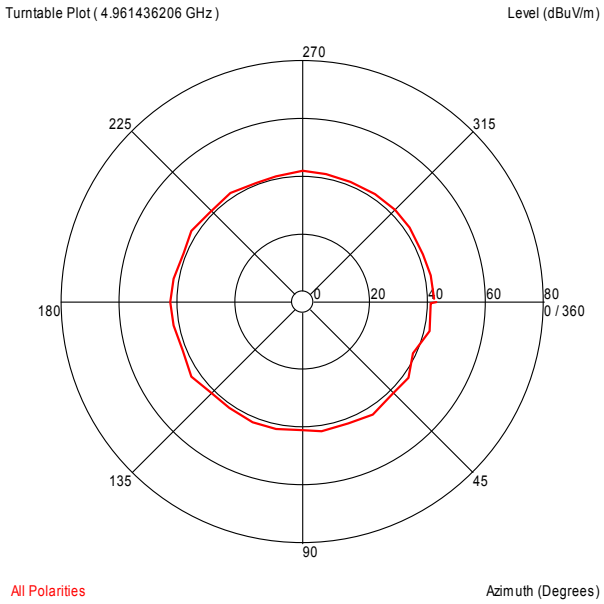
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
4.961436206 G	46.59	34.031	-29.695	74.000	-27.41	--	158	2.42	1 M	
6.059679358 G	50.66	35.316	-30.545	74.000	-23.34	--	141	2.36	1 M	
6.758744155 G	55.09	35.750	-29.664	74.000	-18.91	|	332	2.16	1 M	

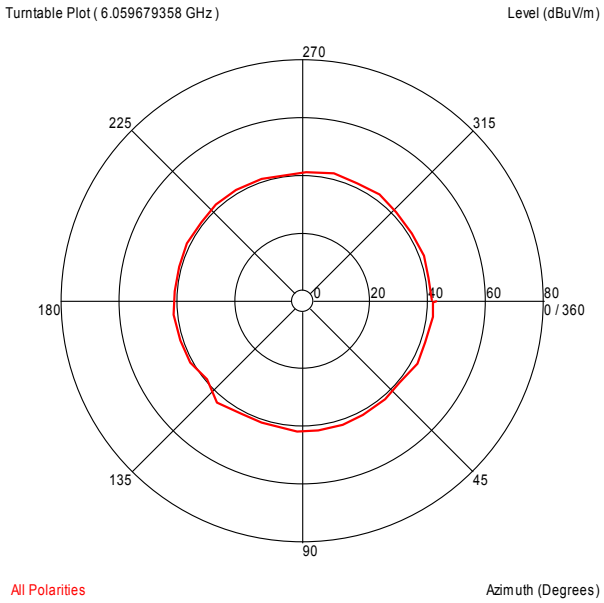
Trace3: Measured Average

Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
4.961436206 G	32.92	34.031	-29.695	54.000	-21.08	--	158	2.42	1 M	
6.059679358 G	36.71	35.316	-30.545	54.000	-17.29	--	141	2.36	1 M	
6.758744155 G	41.58	35.750	-29.664	54.000	-12.42	|	332	2.16	1 M	

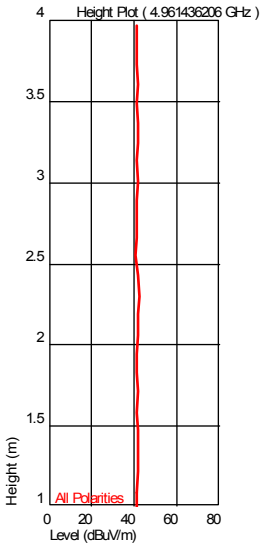
Notes: The device meets the General Limits of FCC Part 15 Subpart C Section 15.209. Scan at 100 kHz Resolution Bandwidth was not performed since it meets the general requirements at 1 MHz Resolution bandwidth. Hand scan was performed from 18-25 GHz with no emissions detected.

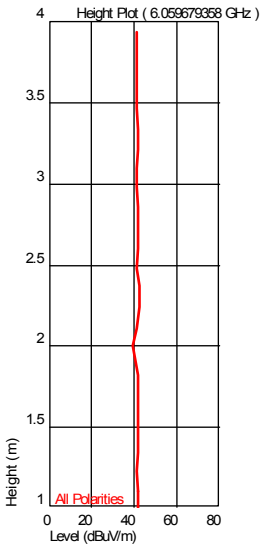
Azimuth Plots

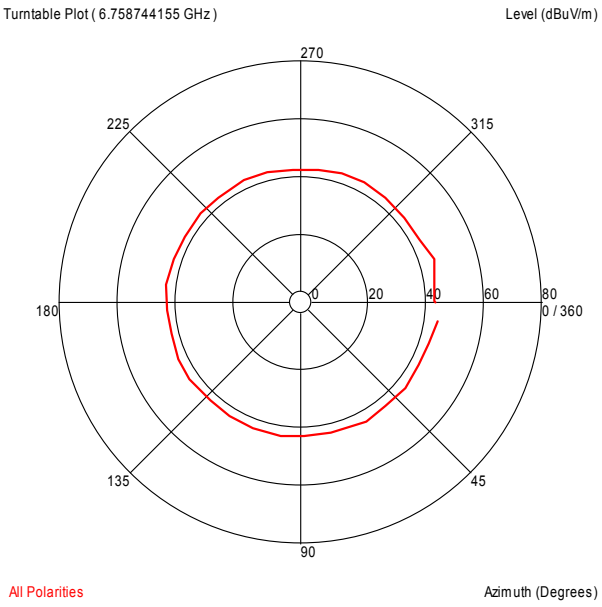


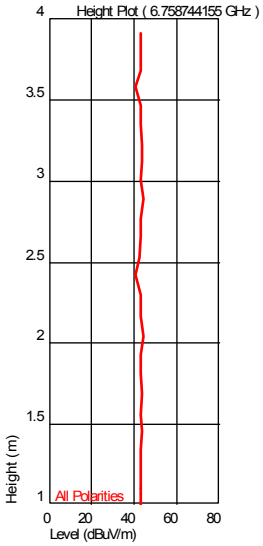


Turntable Plots









Test Personnel:	Kouma Sinn KPS	Test Date:	10/21/2015, 10/22/2015, 11/11/2015
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247, RSS247	Limit Applied:	Section 5.5
Input Voltage:	Battery Powered	Ambient Temperature:	22, 20, 20 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**BB Source**	Relative Humidity:	35, 30, 40 %
		Atmospheric Pressure:	1016, 1000, 999 mbars

Deviations, Additions, or Exclusions: None

8 6 dB Bandwidth & 99% Power Bandwidth

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15:2015 Subpart C Section 15.247 (a)(2) and RSS247 Issue 1 May 2015, Section 5.2 (1).

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	09/28/2015	09/28/2016
MEG002'	Cable,SMA-SMA,9KHz-40GHz, (Cable Kit 6)	Megaphase	TM40-K1K1-197	59006401001	09/03/2015	09/03/2016
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	04/10/2015	04/10/2016
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	06/04/2015	06/04/2016

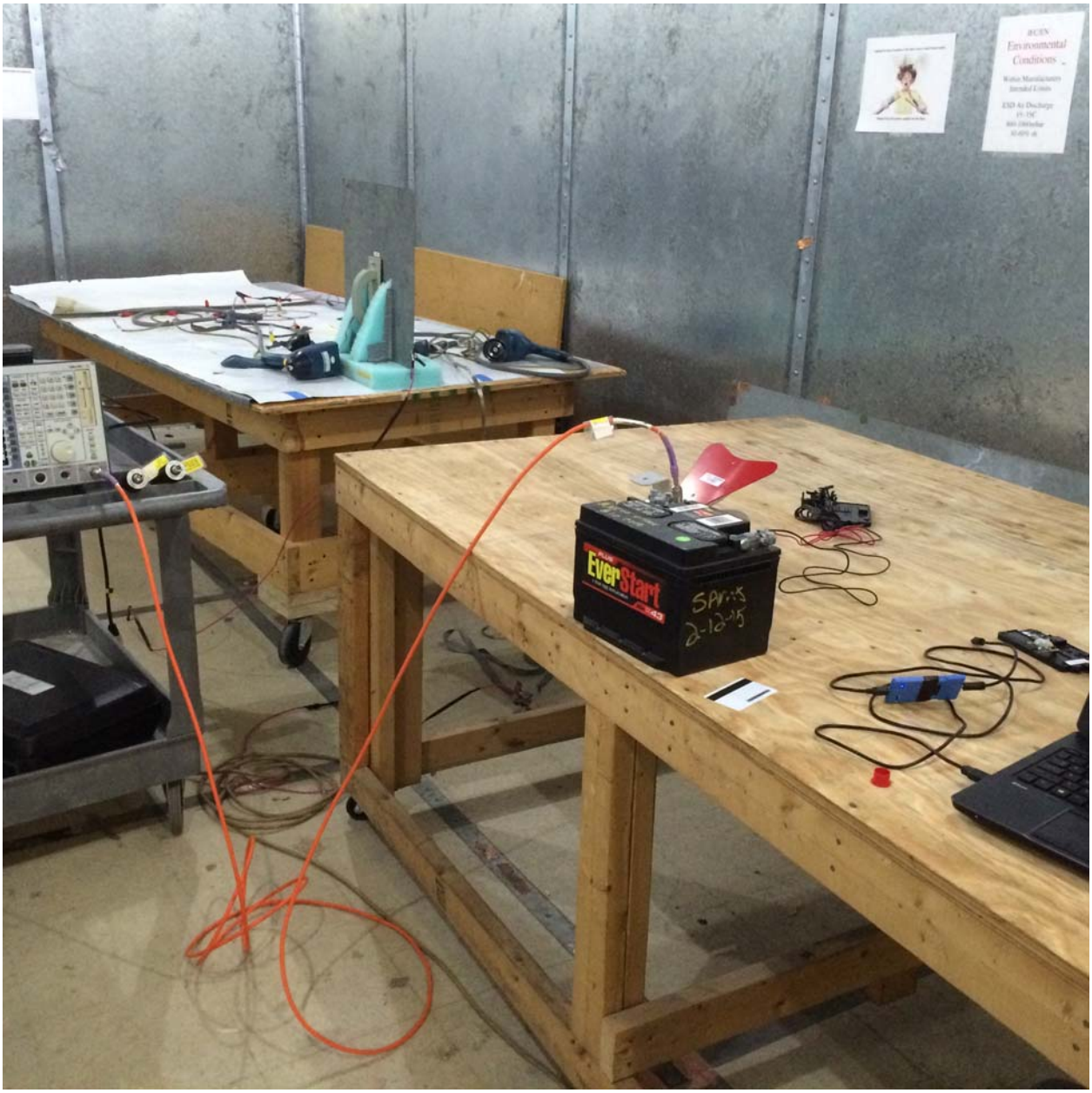
Software Utilized:

Name	Manufacturer	Version
None		

8.3 Results:

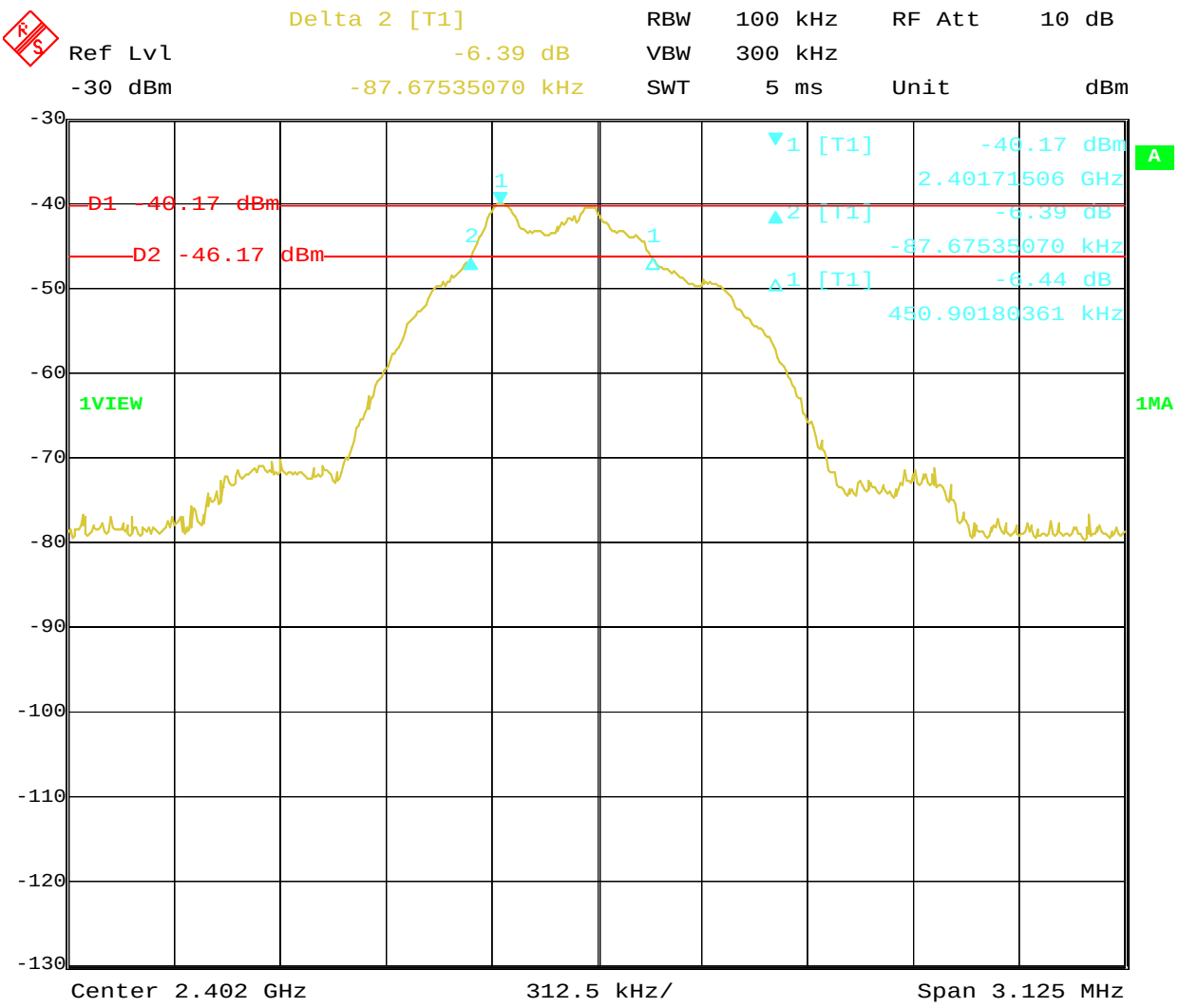
The sample tested was found to Comply. The 99% power bandwidth, or 6 dB bandwidth, must not be less than 500 kHz.

8.4 Setup Photograph:

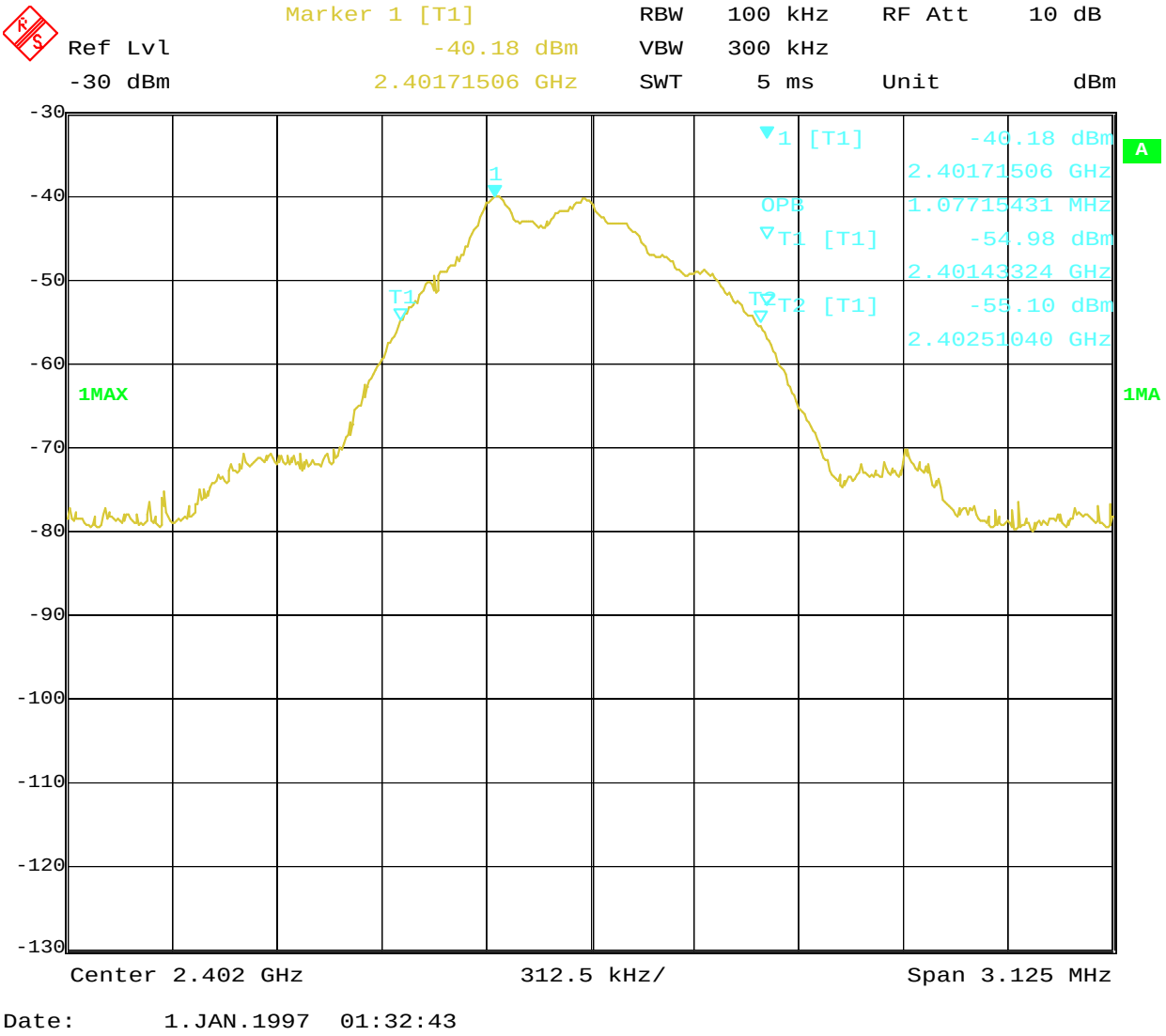


8.5 Plots/Data:

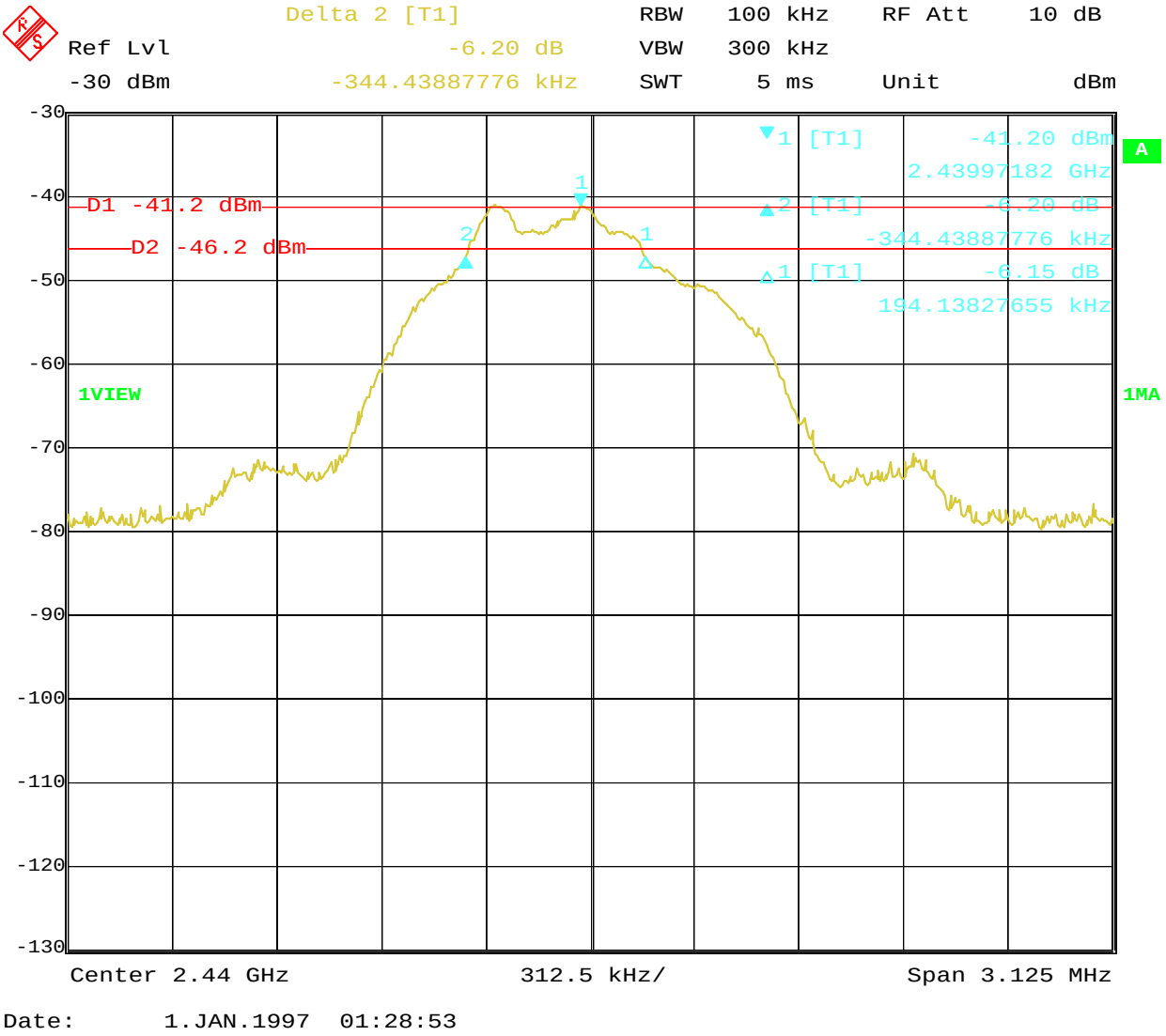
Low Channel: 2402 MHz, 6 dB Bandwidth – 538.576 kHz



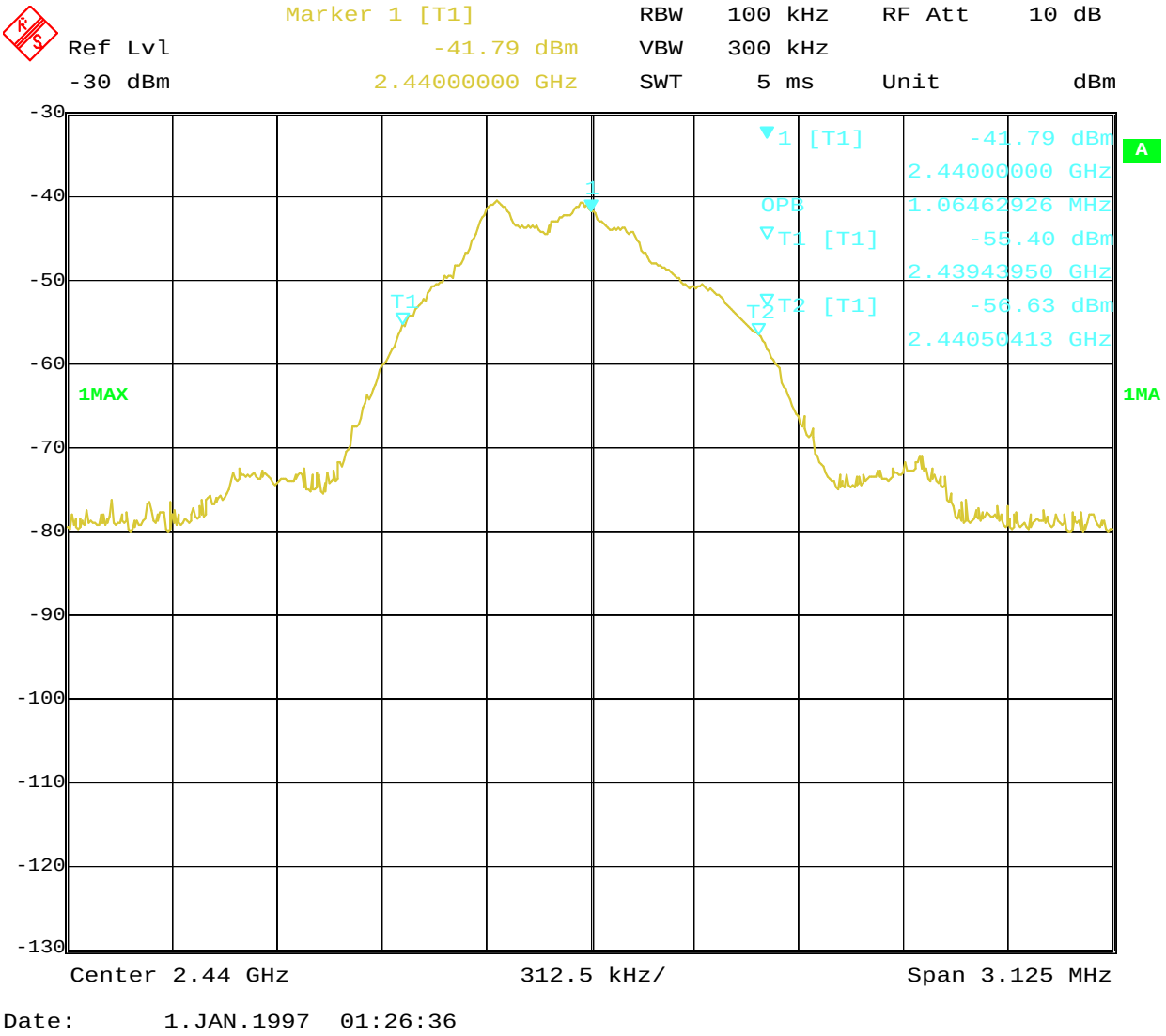
Low Channel: 2402 MHz, 99% Bandwidth – 1.077 MHz



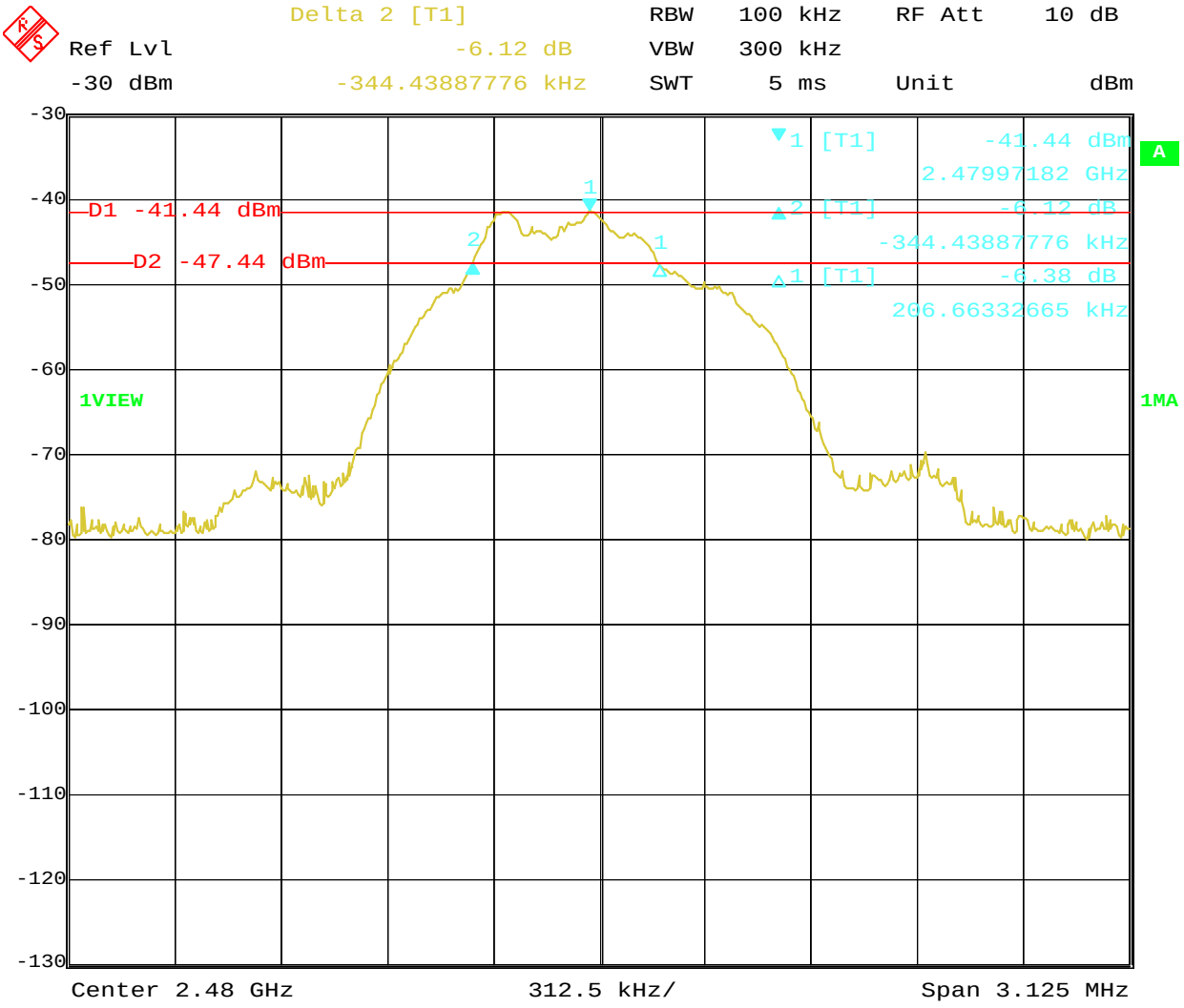
Mid Channel: 2440 MHz, 6 dB Bandwidth – 538.577 kHz



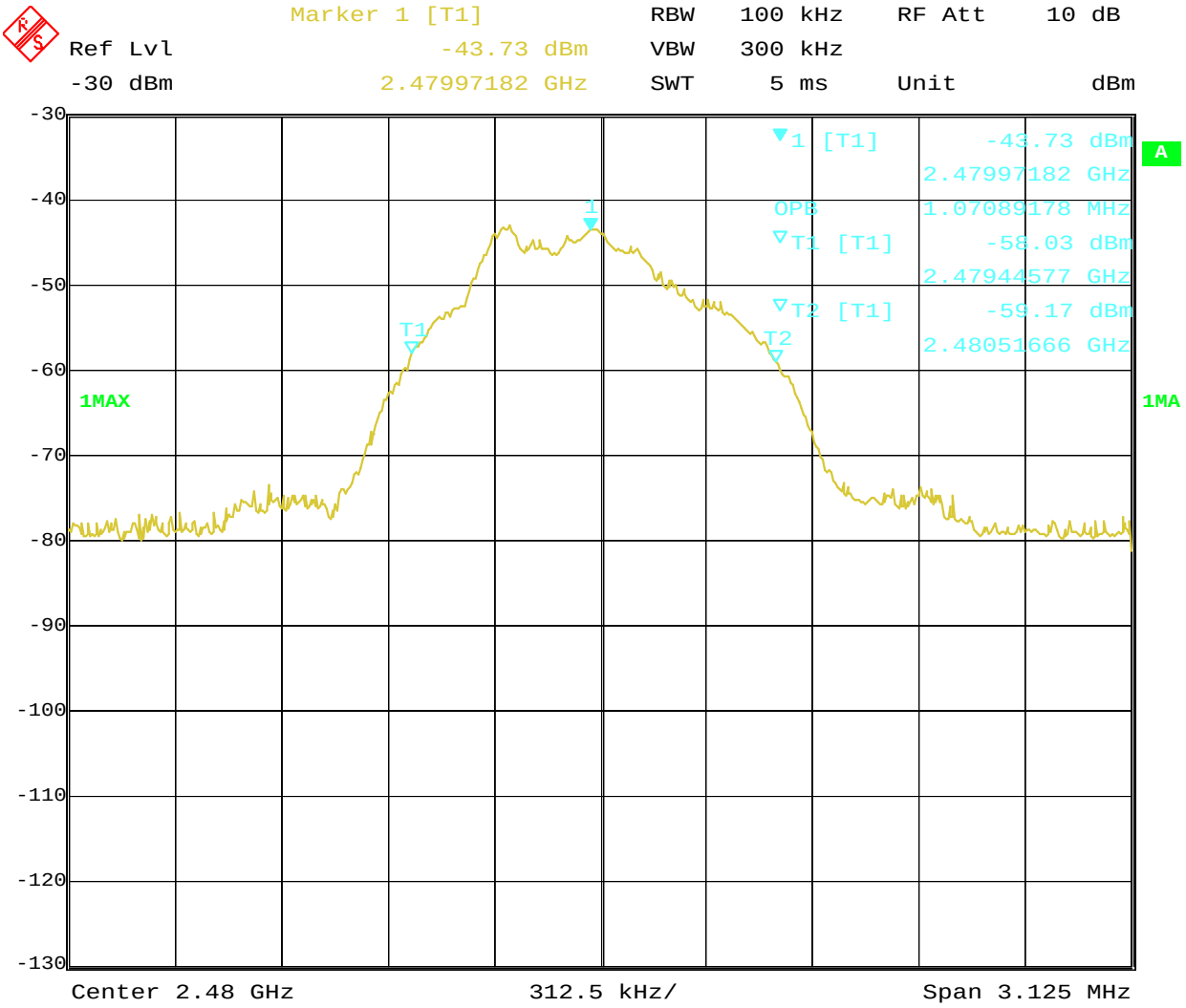
Mid Channel: 2440 MHz, 99% Bandwidth – 1.065 MHz



High Channel: 2480 MHz, 6 dB Bandwidth – 551.102 kHz



High Channel: 2480 MHz, 99% Bandwidth – 1.071 MHz



Test Personnel:	Kouma Sinn KPS	Test Date:	11/11/2015
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247, RSS247	Limit Applied:	Section 5.2 (1)
Input Voltage:	Battery Powered	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Relative Humidity:	37 %
		Atmospheric Pressure:	1000 mbars

Deviations, Additions, or Exclusions: None

9 Power Spectral Density

9.1 Method

Tests are performed in accordance with CFR47 FCC Part 15:2015 Subpart C Section 15.247(e) and RSS247 Issue 1 May 2015, Section 5.2 (2).

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	01/14/2015	01/14/2016
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2014	10/04/2015

Software Utilized:

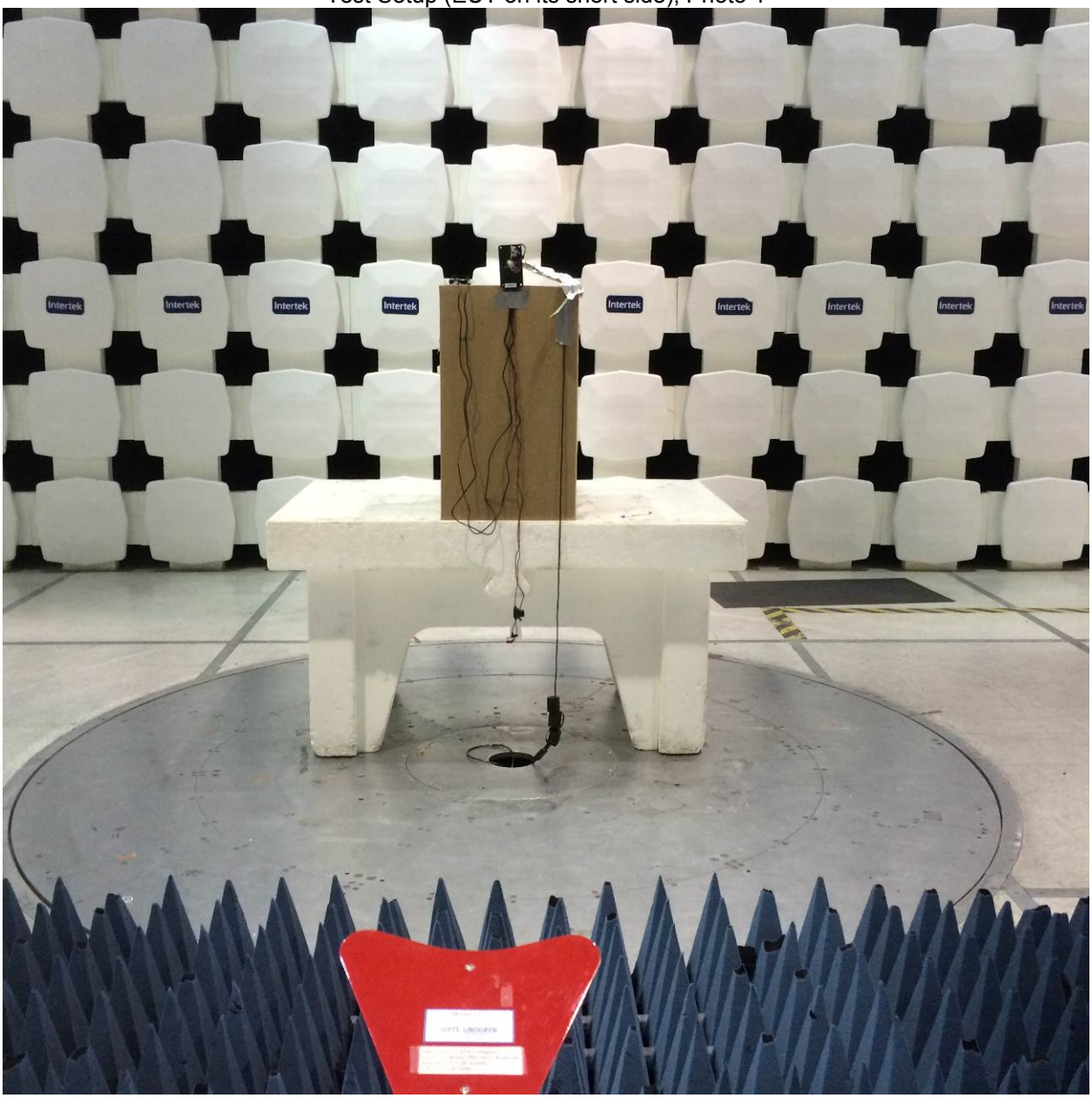
Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

9.3 Results:

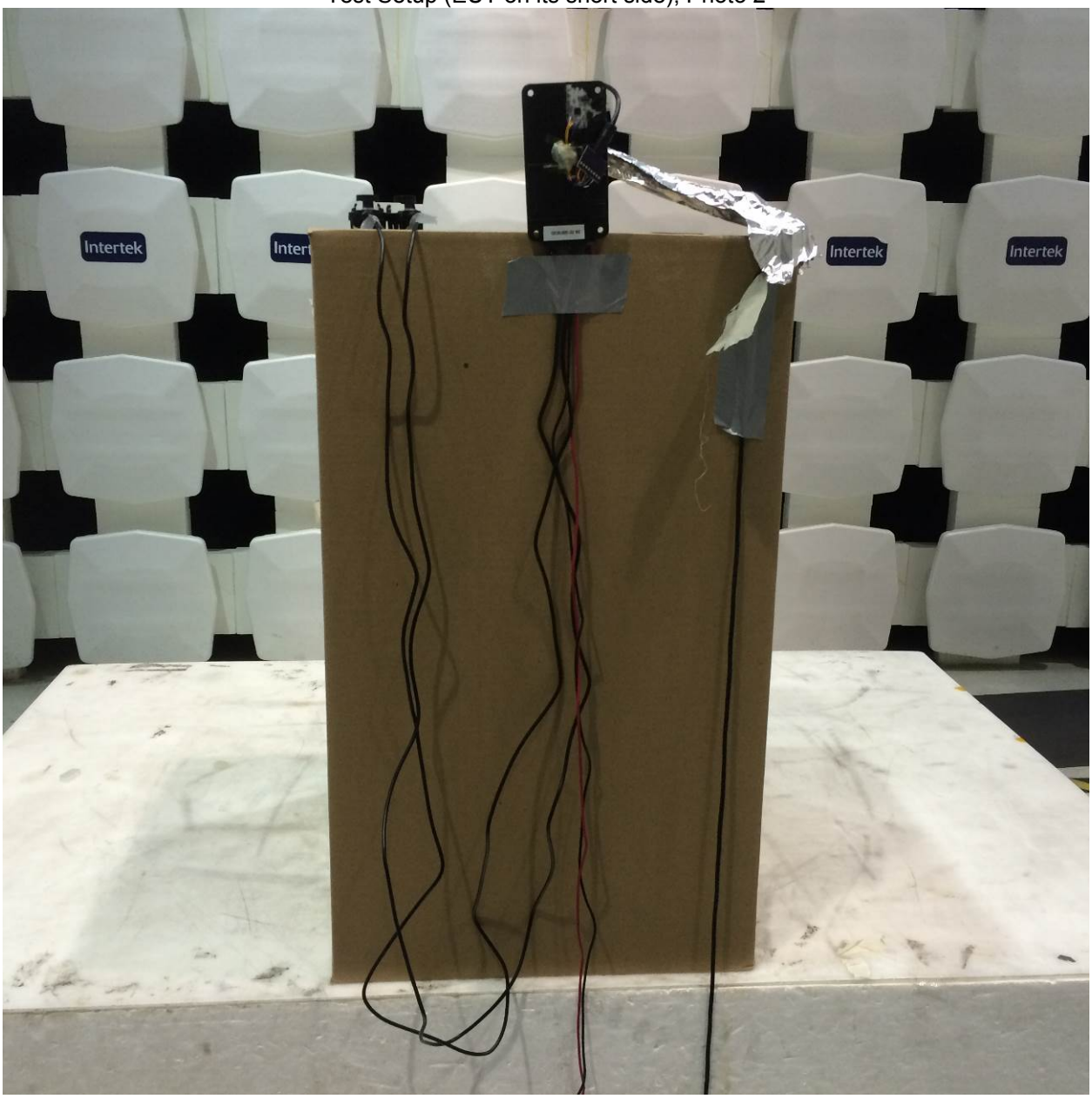
The sample tested was found to Comply. The peak power spectral density must not exceed 8 dBm in any 3 kHz bandwidth.

9.4 Setup Photographs:

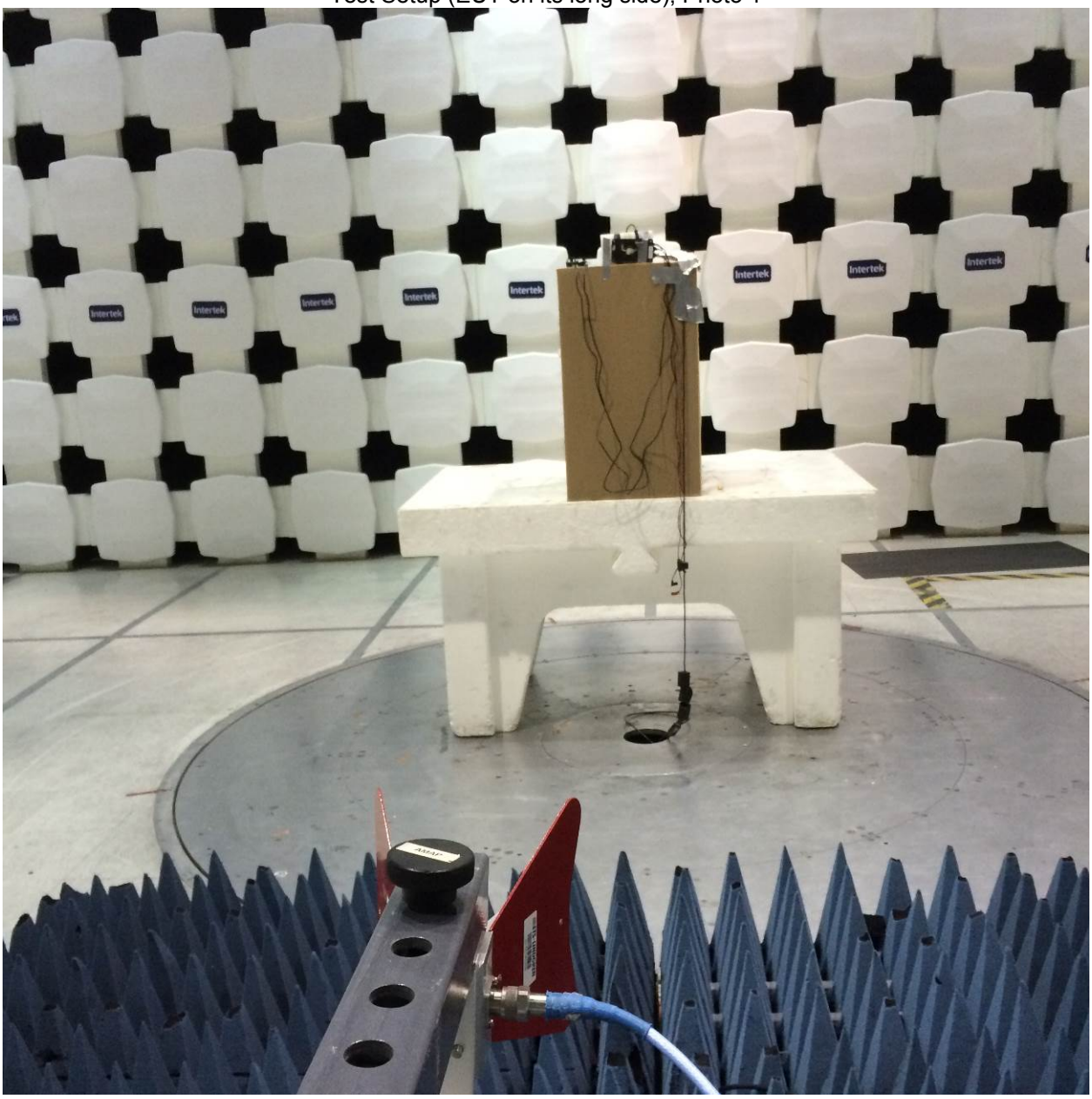
Test Setup (EUT on its short side), Photo 1



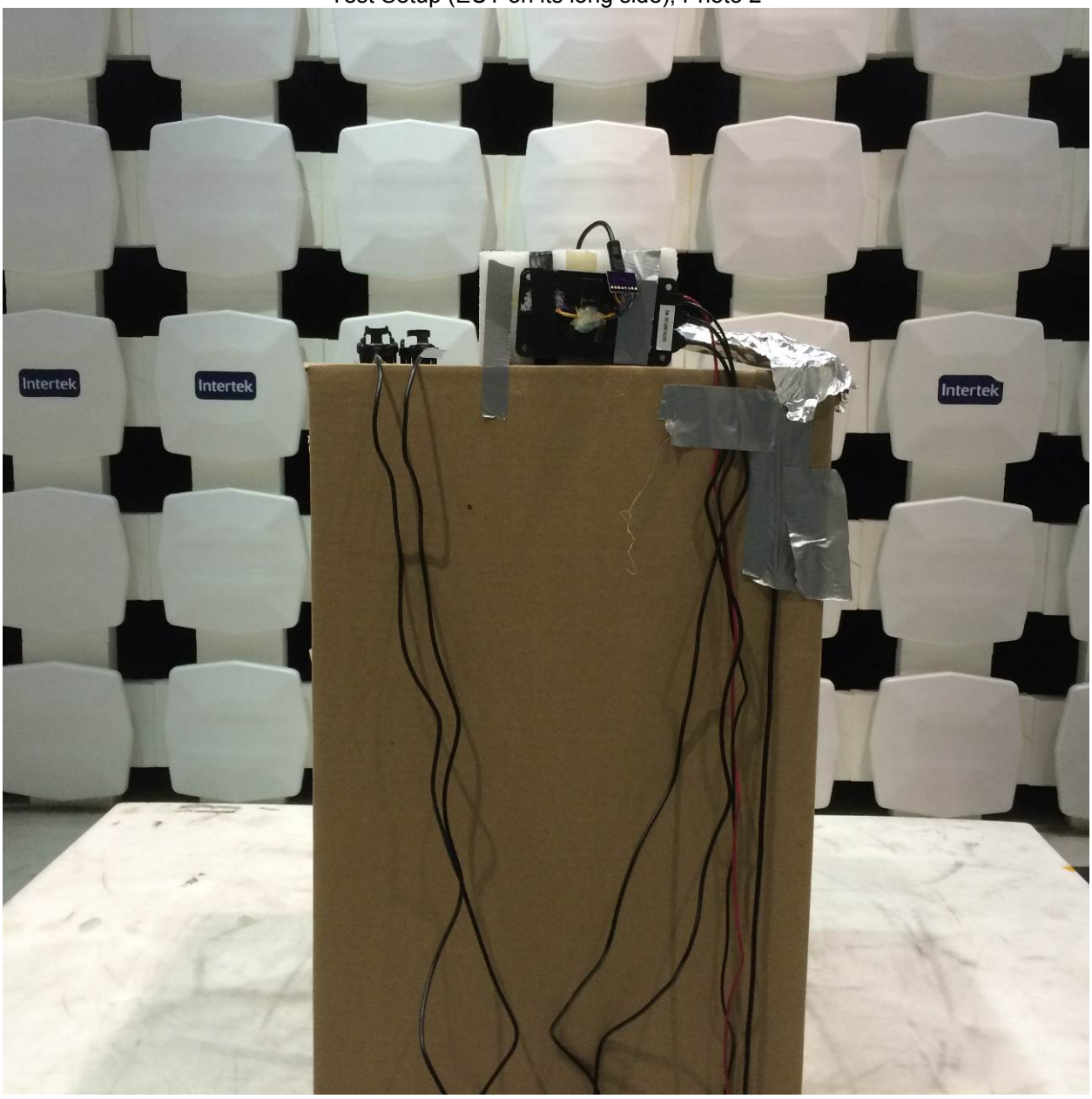
Test Setup (EUT on its short side), Photo 2



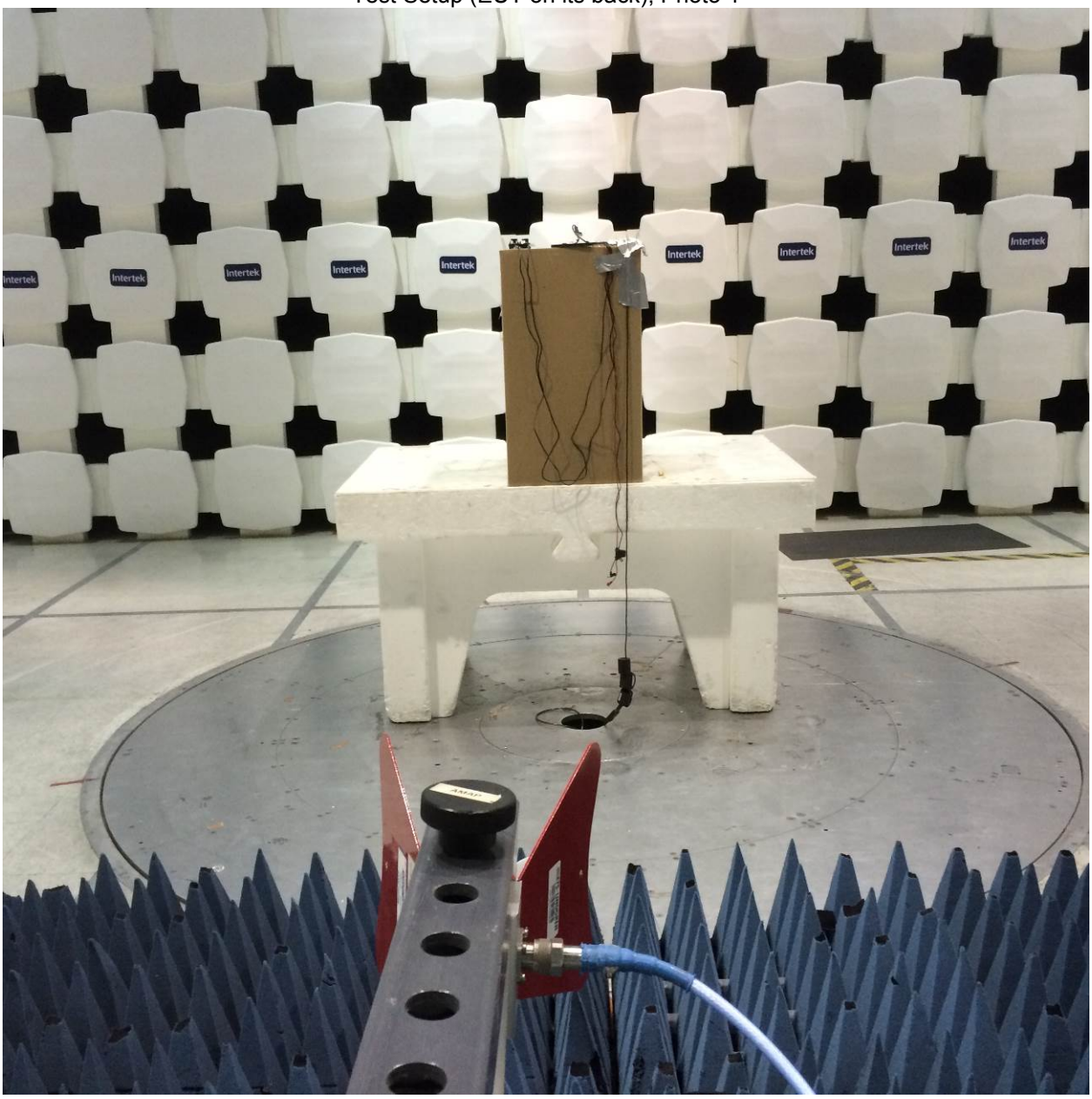
Test Setup (EUT on its long side), Photo 1



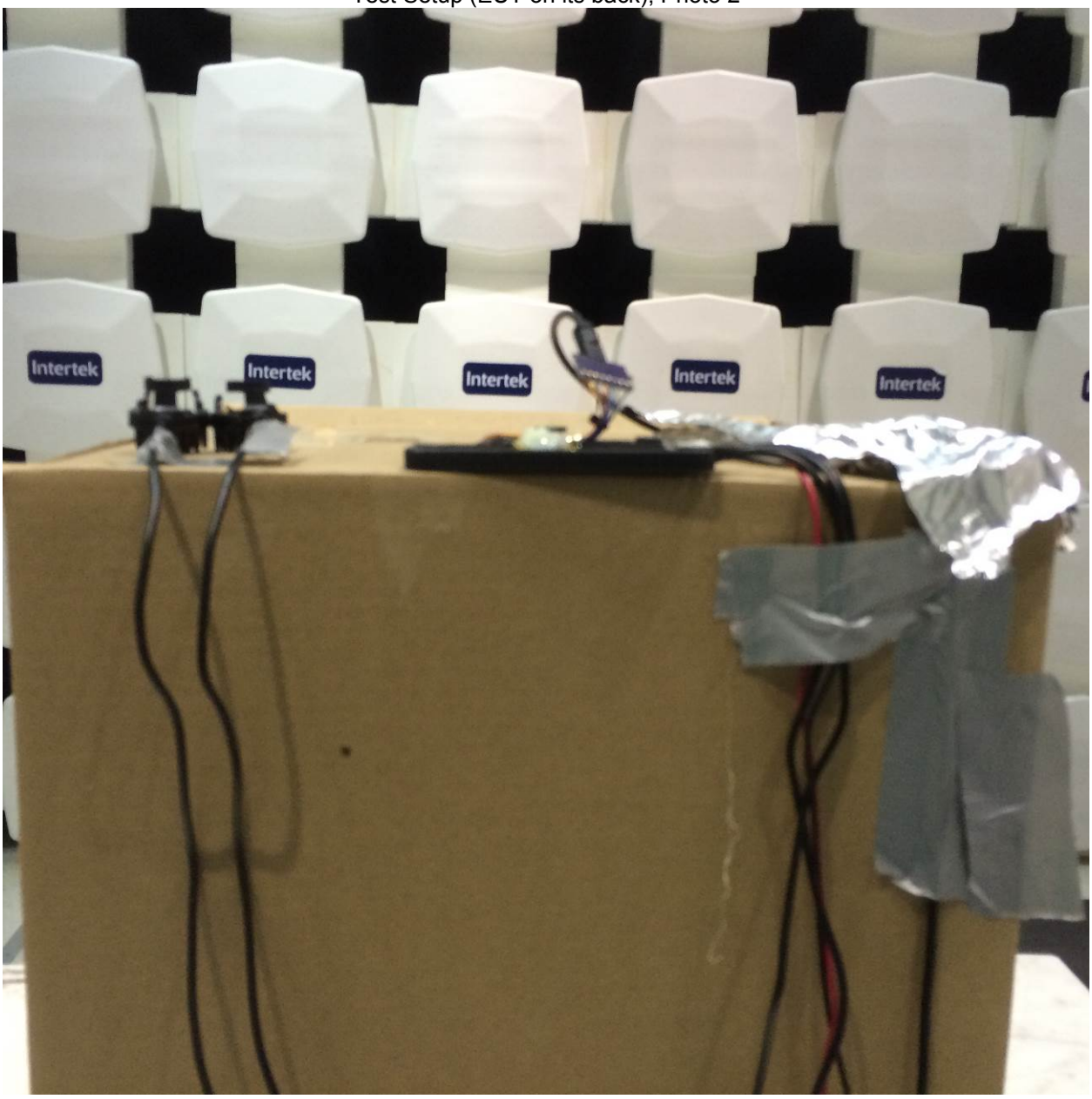
Test Setup (EUT on its long side), Photo 2



Test Setup (EUT on its back), Photo 1



Test Setup (EUT on its back), Photo 2



9.5 Test Data:

Low Channel: 2402 MHz Radiated Emissions

Company: Osram — Antenna & Cables: LF — Bands: N, LF, HF, SHF
Model #: ZEVO Hybrid — Antenna: ETS001 01-14-16.txt — ETS001 01-14-16.txt
Serial #: QC 009-10 (CCC) — Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt — NONE.
Engineers: Kouma Sinn — Location: 10m Chamber — Barometer: DAVO04 — Filter: NONE
Project #: Qu-00647661 — Date(s): 11/11/15
Standard: FCC Part 15 Subpart C 15.247 — Temp/Humidity/Pressure: 20C — 41% — 1001mbar
Receiver: 145-128 — Limit Distance (m): 3
PreAmp: NONE. — Test Distance (m): 3
PreAmp Used? (Y or N): N — Voltage/Frequency: Internal Battery — Frequency Range: 2402 MHz
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dBm	Limit dBm	Margin dB	Bandwidth
X-axis (back side) 2402 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2402.000	43.46	31.96	5.87	0.00	0.00	-13.93	8.00	-21.93	3/10kHz
y-axis (long side) 2402 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2402.000	37.36	31.96	5.87	0.00	0.00	-20.03	8.00	-28.03	3/10kHz
z-axis (short side) 2402 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2402.000	44.44	31.96	5.87	0.00	0.00	-12.95	8.00	-20.95	3/10kHz

Mid Channel: 2440 MHz Radiated Emissions

Company: Osram — Antenna & Cables: LF — Bands: N, LF, HF, SHF
Model #: ZEVO Hybrid — Antenna: ETS001 01-14-16.txt — ETS001 01-14-16.txt
Serial #: QC 009-10 (CCC) — Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt — NONE.
Engineers: Kouma Sinn — Location: 10m Chamber — Barometer: DAVO04 — Filter: NONE
Project #: Qu-00647661 — Date(s): 11/11/15
Standard: FCC Part 15 Subpart C 15.247 — Temp/Humidity/Pressure: 20C — 41% — 1001mbar
Receiver: 145-128 — Limit Distance (m): 3
PreAmp: NONE. — Test Distance (m): 3
PreAmp Used? (Y or N): N — Voltage/Frequency: Internal Battery — Frequency Range: 2402 MHz
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dBm	Limit dBm	Margin dB	Bandwidth
x-axis (back side) 2440 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2440.000	45.68	32.11	5.92	0.00	0.00	-11.51	8.00	-19.51	3/10kHz
y-axis (long side) 2440 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2440.000	37.72	32.11	5.92	0.00	0.00	-19.47	8.00	-27.47	3/10kHz
z-axis (short side) 2440 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2440.000	43.61	32.11	5.92	0.00	0.00	-13.58	8.00	-21.58	3/10kHz

Top Channel: 2480 MHz Radiated Emissions

Company: Osram
Model #: ZEVO Hybrid
Serial #: QC 009-10 (CCC)
Engineers: Kouma Sinn
Project #: Qu-00647661
Standard: FCC Part 15 Subpart C 15.247
Receiver: 145-128
PreAmp: NONE.
PreAmp Used? (Y or N): N
Location: 10m Chamber
Date(s): 11/11/15
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: Internal Battery
Antenna & Cables: LF
Antenna: ETS001 01-14-16.txt
Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt
Barometer: DAVO04
Temp/Humidity/Pressure: 20C 41% 1001mbar
Bands: N, LF, HF, SHF
ETS001 01-14-16.txt
NONE.
Filter: NONE
Frequency Range: 2402 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dBm	Limit dBm	Margin dB	Bandwidth
x-axis (Back side) 2480 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2480.000	40.39	32.26	5.98	0.00	0.00	-16.59	8.00	-24.59	3/10kHz
y-axis (long side) 2480 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2480.000	35.49	32.26	5.98	0.00	0.00	-21.49	8.00	-29.49	3/10kHz
z-axis (short side) 2480 MHz at 3 meters, no pre-amp 11/11/2015											
EIRP Obtained by applying the path loss correction for a 3m test distance, E(dBuV/m)@3m - 95.22 = dBm EIRP											
PK	H	2480.000	41.80	32.26	5.98	0.00	0.00	-15.18	8.00	-23.18	3/10kHz

Test Personnel: Kouma Sinn KPS
Test Date: 11/11/2015
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC 15.247, RSS-247
Limit Applied: 8 dBm
Input Voltage: Battery Powered
Ambient Temperature: 22 ºC
Pretest Verification w/ Ambient Signals or BB Source: **Ambient Signals**
Relative Humidity: 37 %
Atmospheric Pressure: 1000 mbars

Deviations, Additions, or Exclusions: None

10 Band-edge Compliance

10.1 Test Method

Tests are performed in accordance with CFR47 FCC Part 15:2015 Subpart C Section 15.247 (d) and RSS247 Issue 1 May 2015, Section 5.5.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	09/28/2015	09/28/2016
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	01/14/2015	01/14/2016
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/08/2015	10/08/2016

Software Utilized:

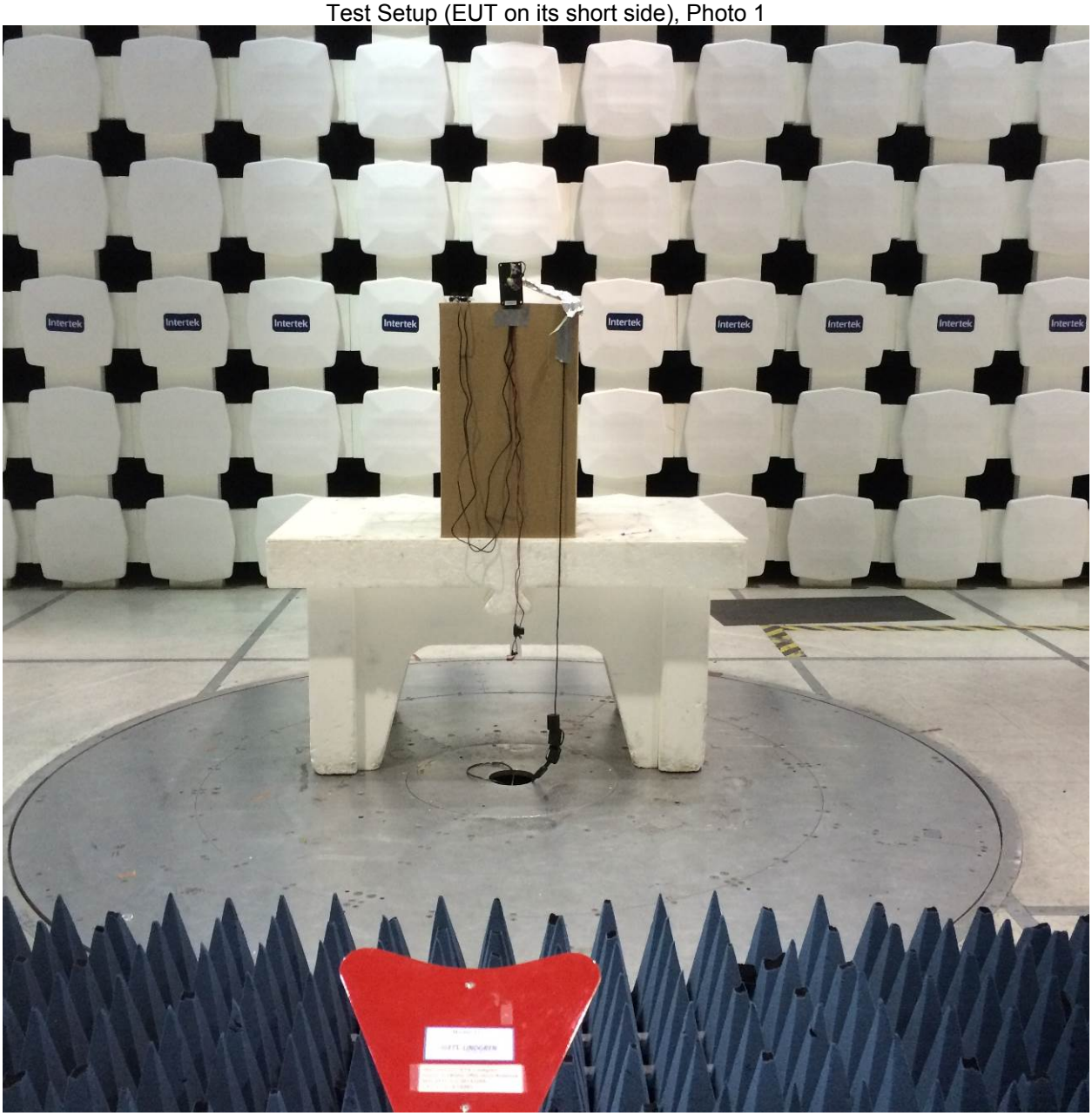
Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

10.3 Results:

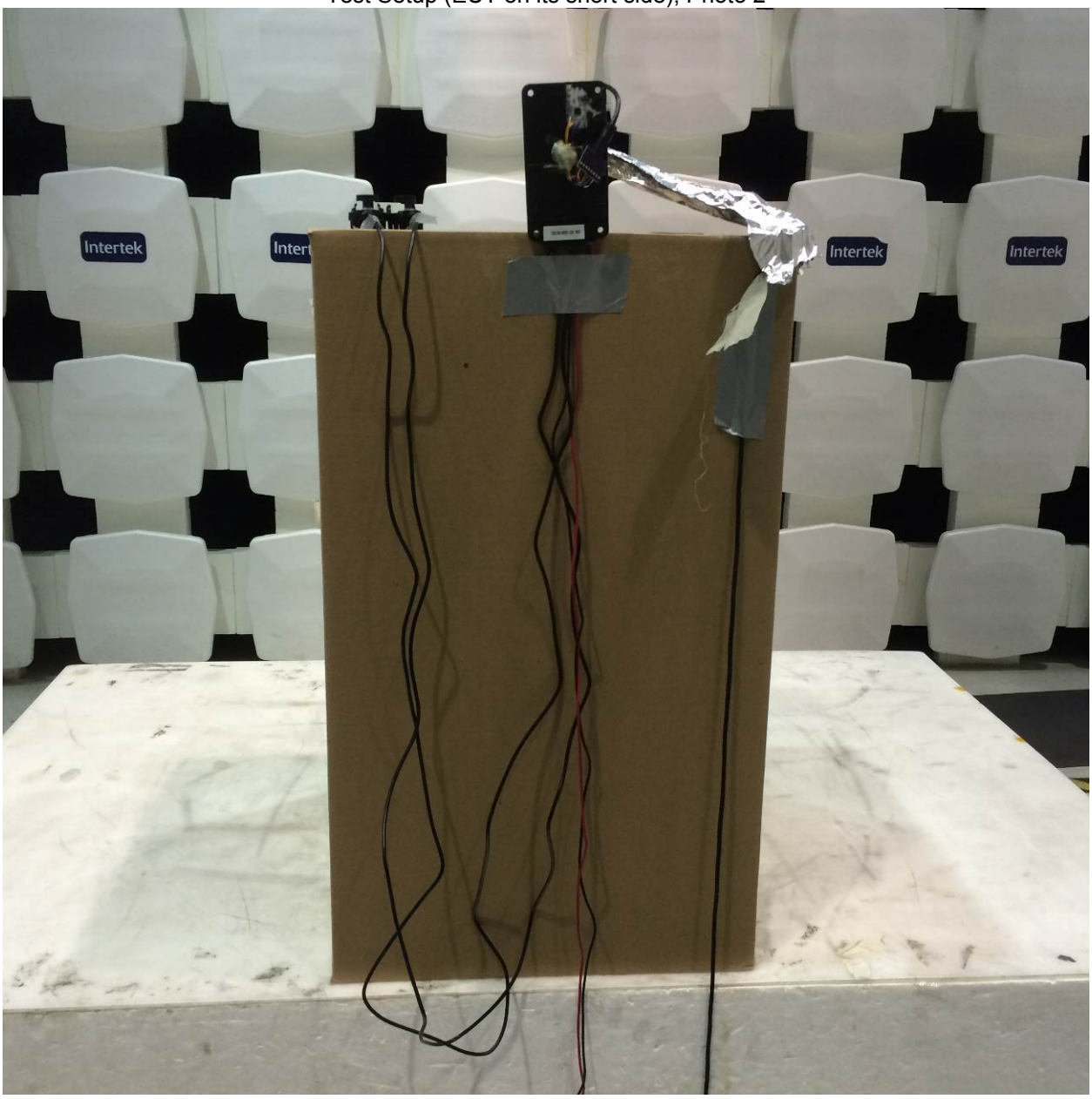
The sample tested was found to Comply.

10.4 Setup Photographs:

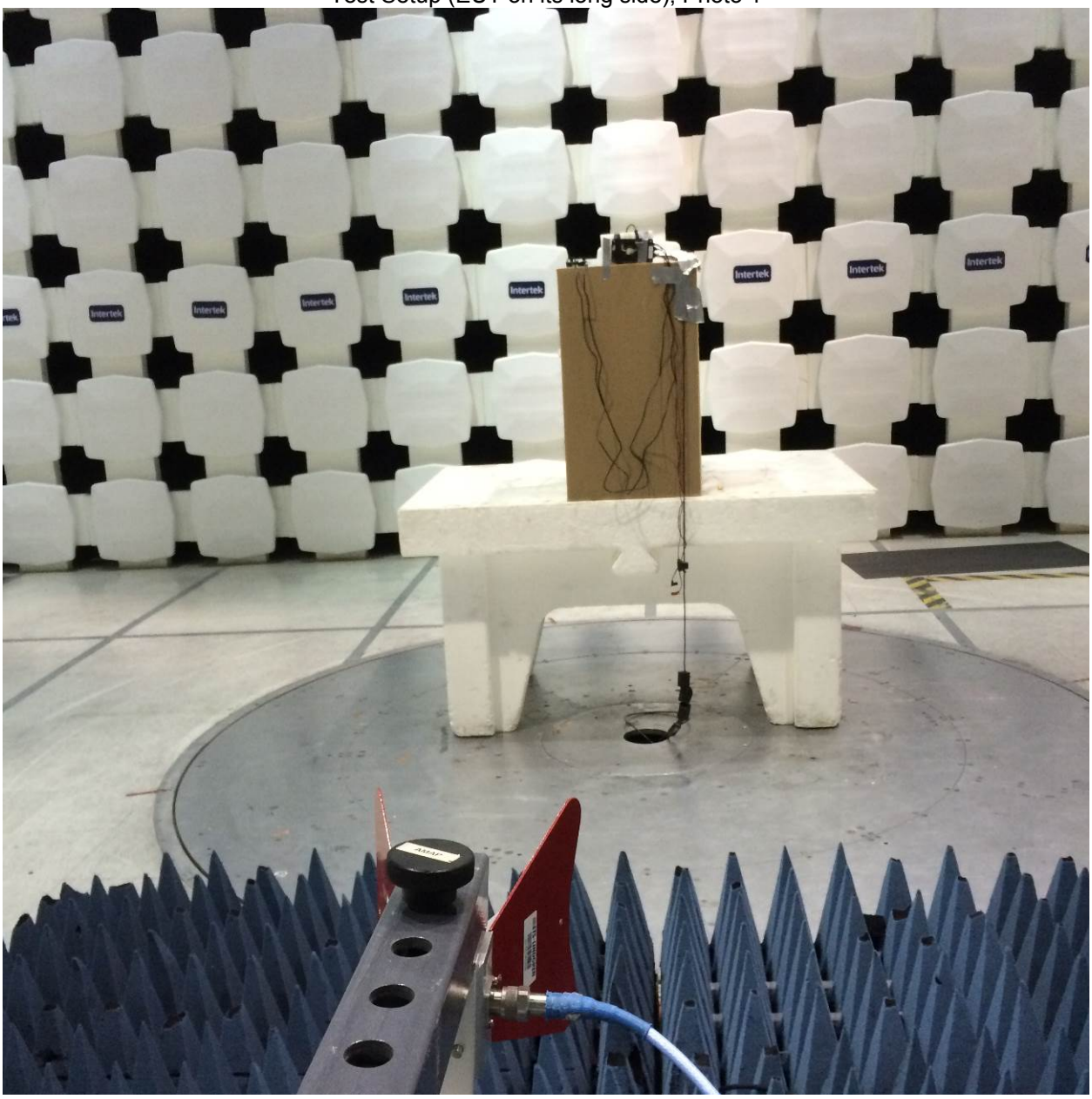
Test Setup (EUT on its short side), Photo 1



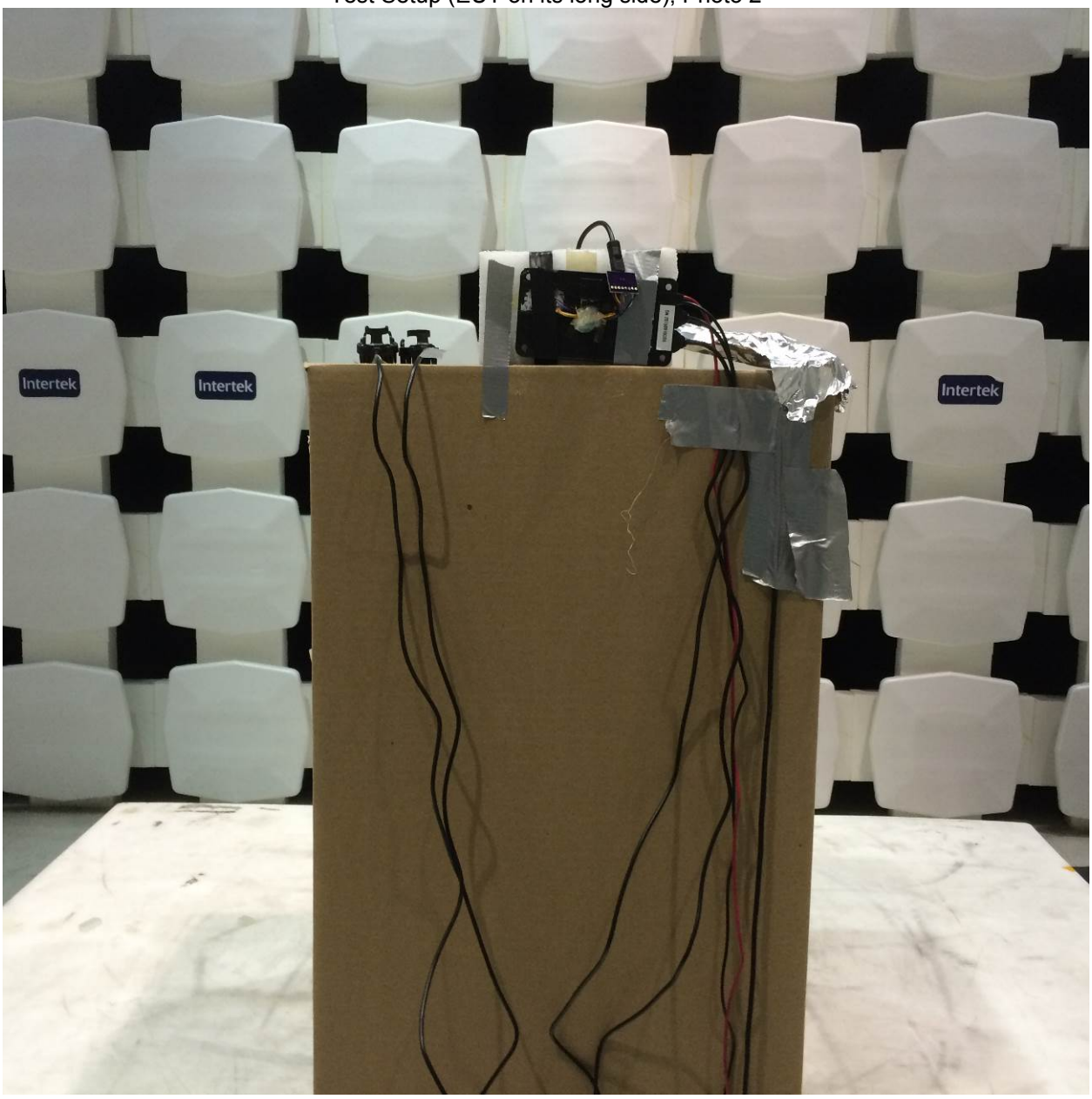
Test Setup (EUT on its short side), Photo 2



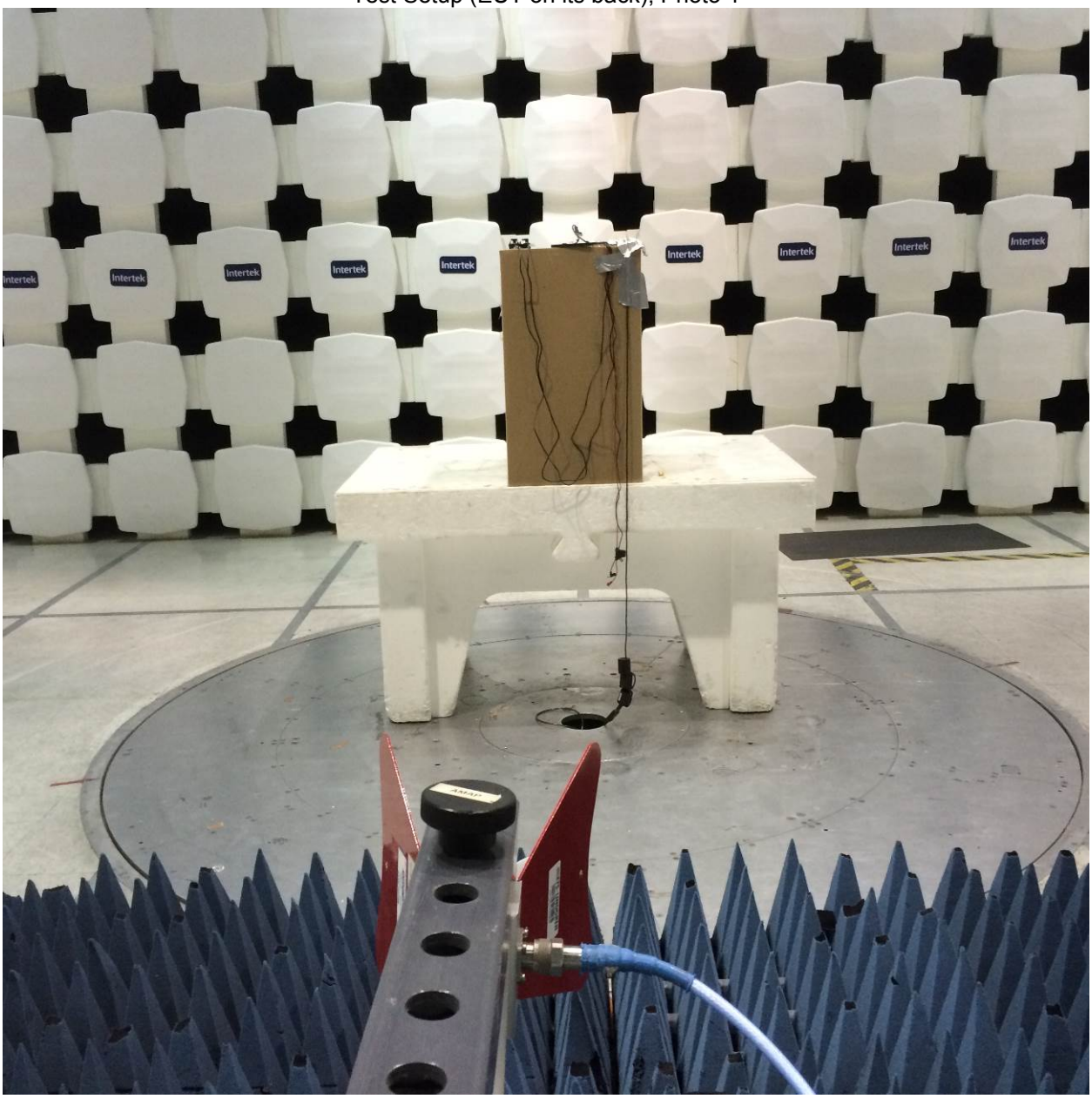
Test Setup (EUT on its long side), Photo 1



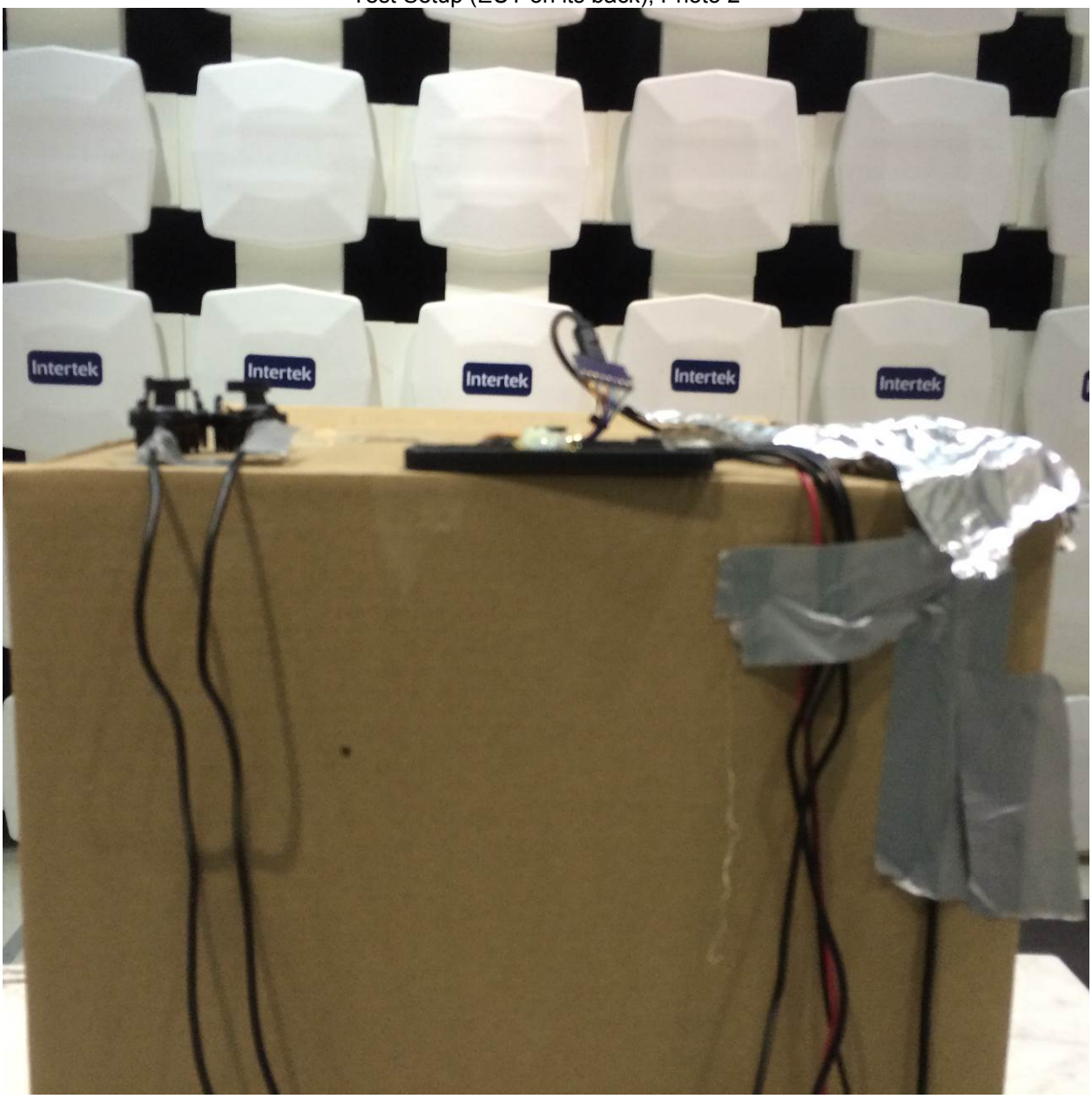
Test Setup (EUT on its long side), Photo 2



Test Setup (EUT on its back), Photo 1

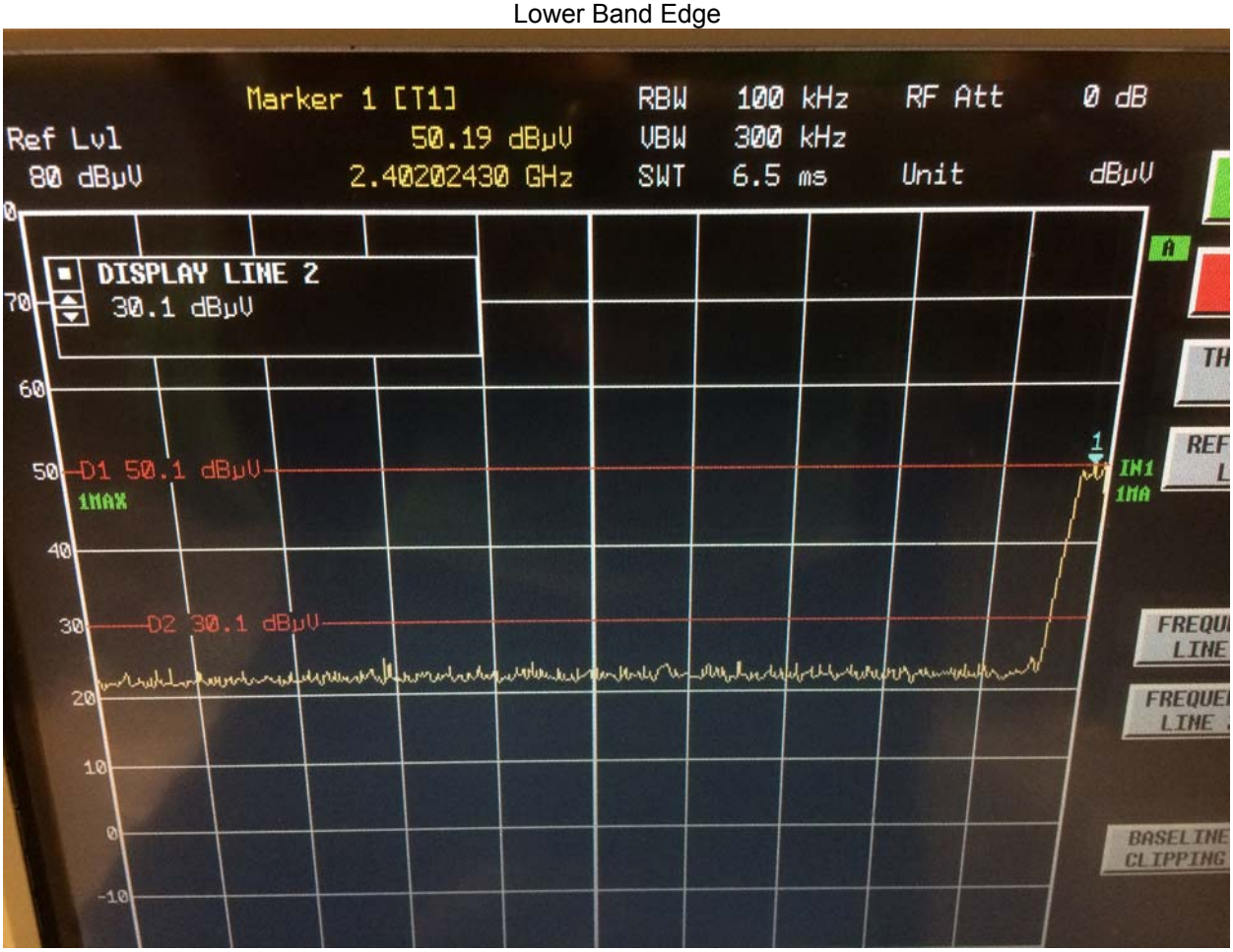


Test Setup (EUT on its back), Photo 2

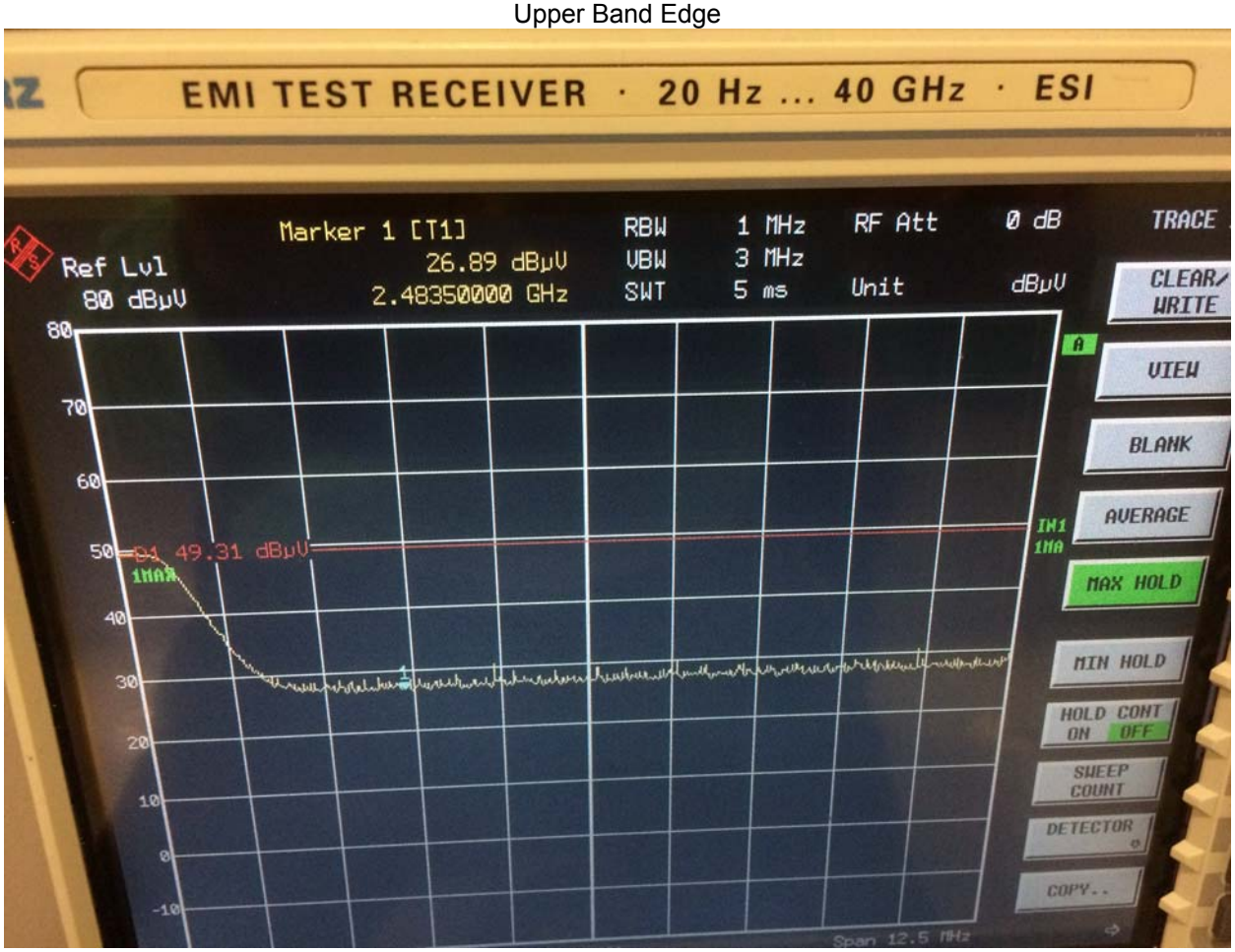


10.5 Plots/Data:

Lower Band Edge



Upper Band Edge



Notes: There's no emission detected in the restricted band frequencies

Test Personnel:	Kouma Sinn KPS	Test Date:	11/11/2015
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247, RSS-247	Limit Applied:	Section 5.5
Input Voltage:	Battery Powered	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**Ambient Signals**	Relative Humidity:	37 %
		Atmospheric Pressure:	1000 mbars

Deviations, Additions, or Exclusions: None

11 Digital Devices Radiated Spurious Emissions

11.1 Test Method

Tests are performed in accordance with CFR47 FCC Part 15:2015 Subpart C Section 15.247 (d) and CFR47 FCC Part 15:2015 Subpart C Section 15.209, and IC ICES-003 Issue 5 August 2012.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	09/28/2015	09/28/2016
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	01/14/2015	01/14/2016
145013'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2944A07027	10/12/2015	10/12/2016
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/14/2015	03/14/2016
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	09/01/2015	09/01/2016

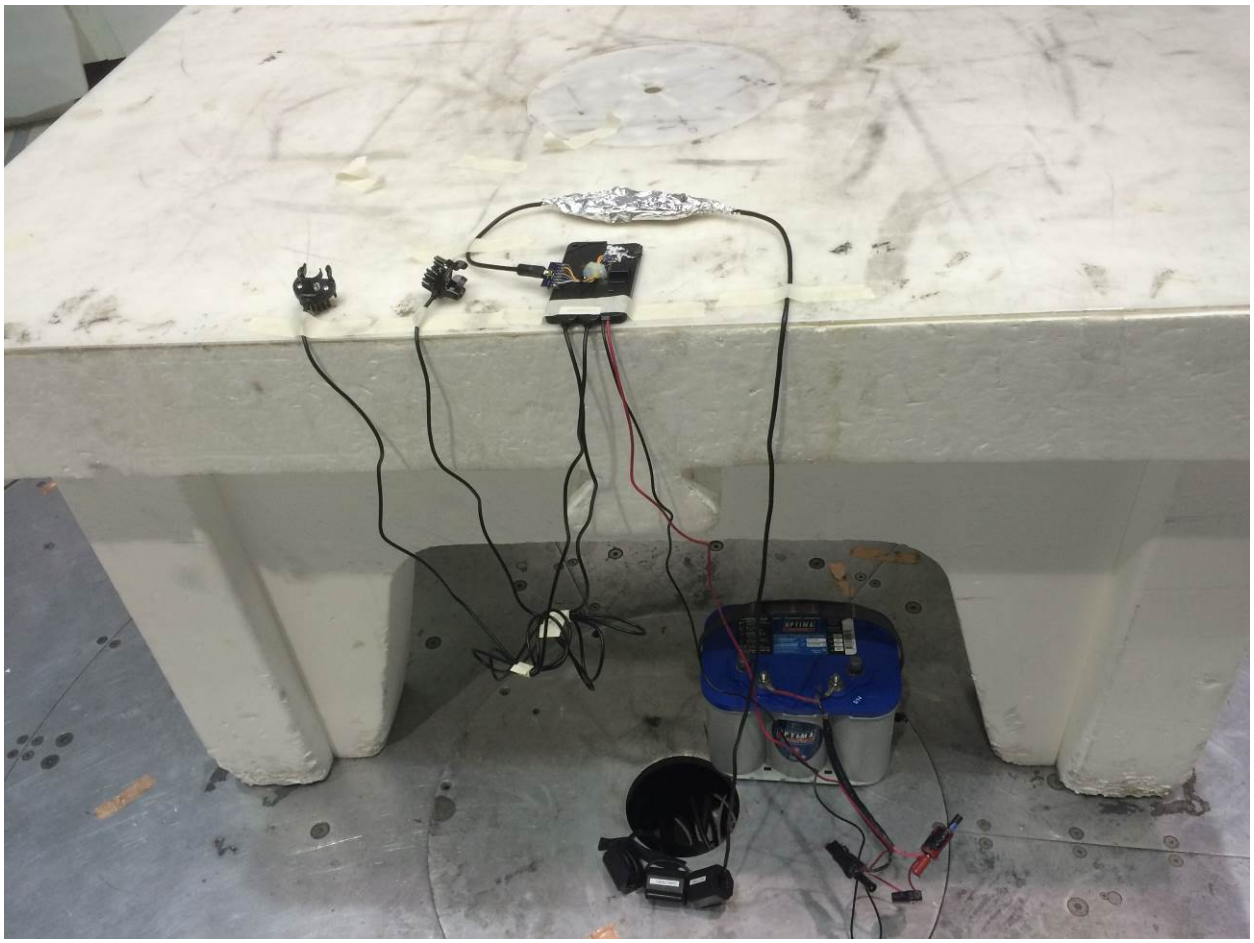
Software Utilized:

Name	Manufacturer	Version
C5	Teseq	5.02.00 Build 5.26.46.46.

11.3 Results:

The sample tested was found to Comply.

11.4 Setup Photograph:



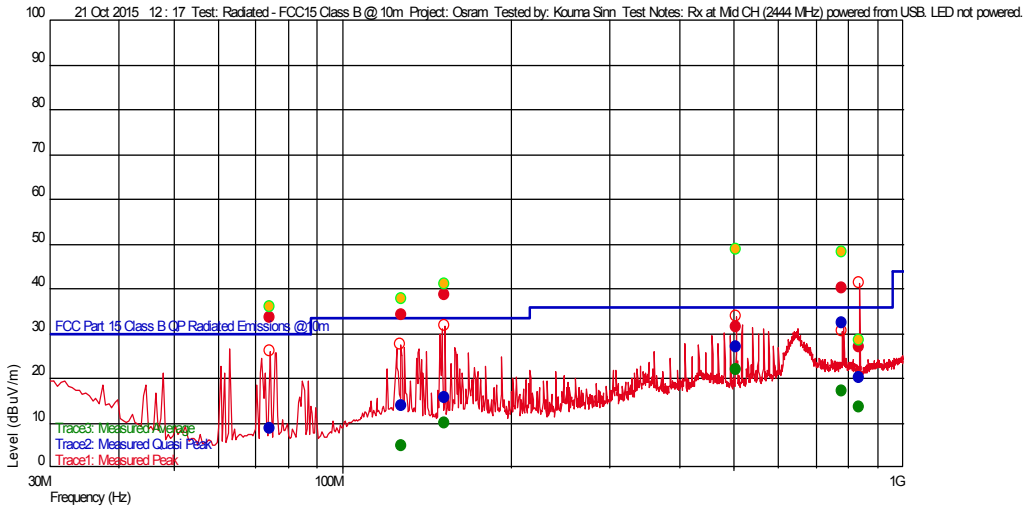
11.5 Plots/Data:

Receive at Mid CH (2440 MHz)

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Osram	
Test Notes:	Rx at Mid CH (2444 MHz) powered from USB. LED not powered.	
Tested by:	Kouma Sinn	
Test Started:	21 Oct 2015 12 : 17	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable
- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

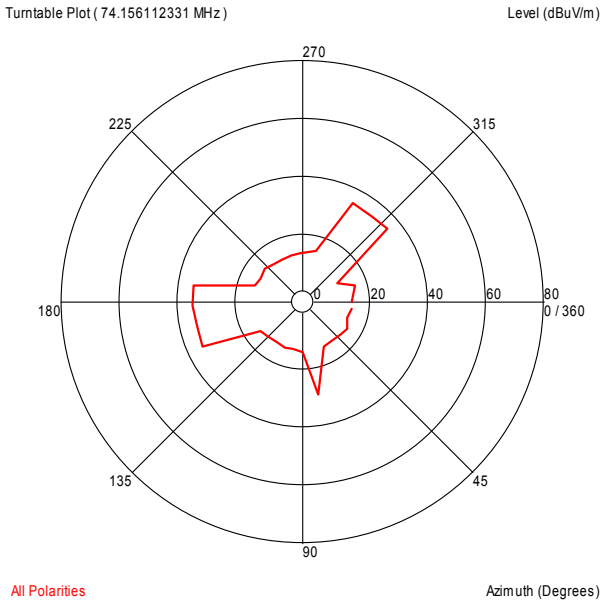
Trace1: Measured Peak

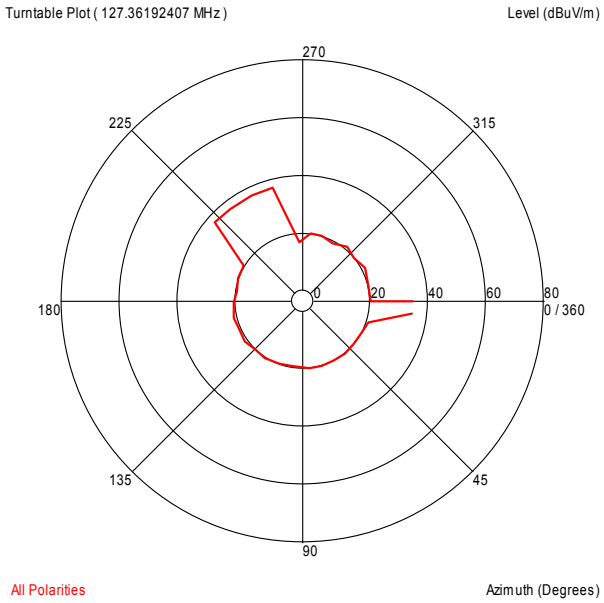
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
835.988777701 M	27.04	21.141	-23.446	--	--	|	63	1.35	120 k	
504.060921609 M	31.57	17.744	-24.273	--	--	--	185	1.05	120 k	
127.36192407 M	34.26	13.800	-26.208	--	--	|	211	1.98	120 k	
74.156112331 M	33.59	8.084	-27.046	--	--	|	309	1.45	120 k	
779.374348222 M	40.27	20.787	-23.739	--	--	|	117	1.04	120 k	
151.985571283 M	38.64	12.099	-26.036	--	--	|	331	1.05	120 k	

Trace2: Measured Quasi Peak

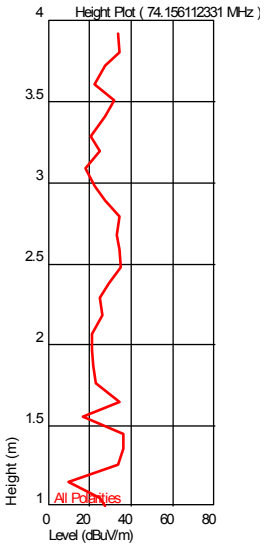
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
74.156112331 M	8.76	8.084	-27.046	30.000	-21.24	|	309	1.45	120 k	
127.36192407 M	13.82	13.800	-26.208	33.520	-19.70	|	211	1.98	120 k	
151.985571283 M	15.79	12.099	-26.036	33.520	-17.73	|	331	1.05	120 k	
835.988777701 M	20.08	21.141	-23.446	36.020	-15.94	|	63	1.35	120 k	
504.060921609 M	26.91	17.744	-24.273	36.020	-9.11	--	185	1.05	120 k	
779.374348222 M	32.26	20.787	-23.739	36.020	-3.76	|	117	1.04	120 k	

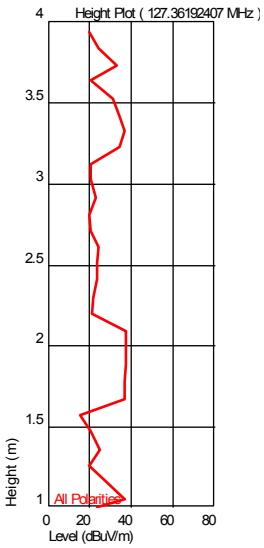
Azimuth Plots

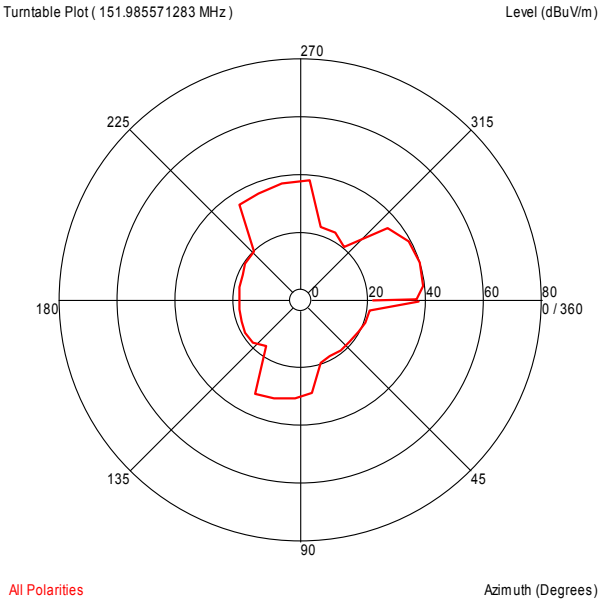


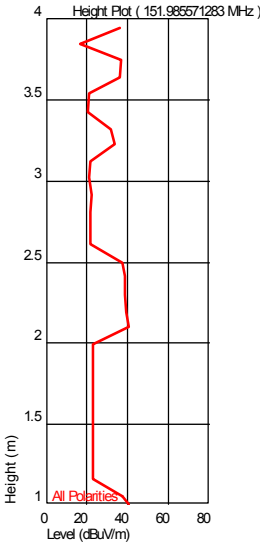


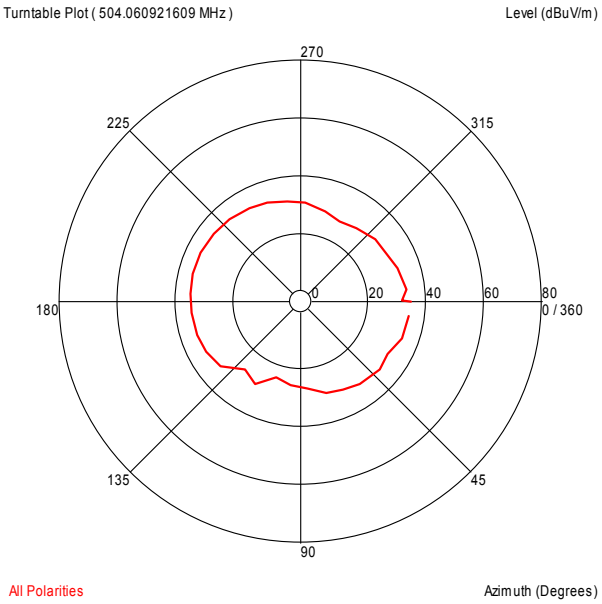
Turntable Plots

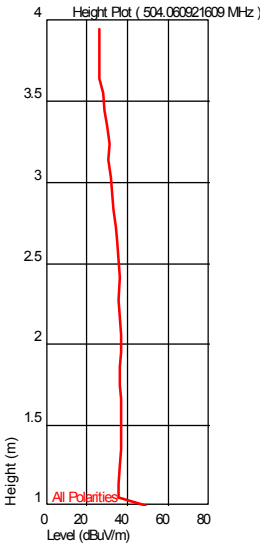


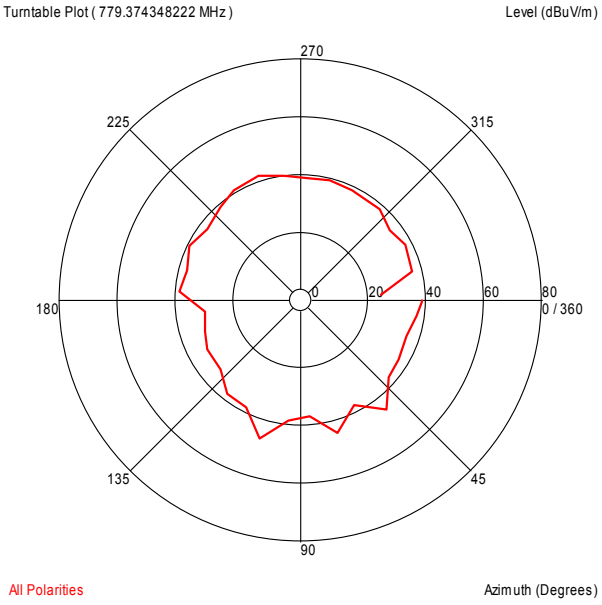


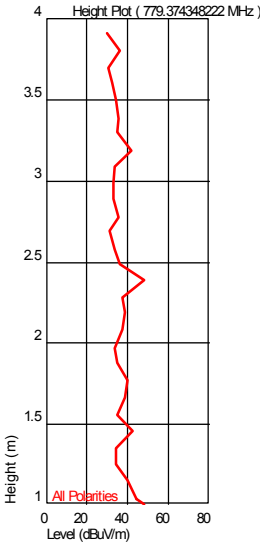

Turntable Plot (151.985571283 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

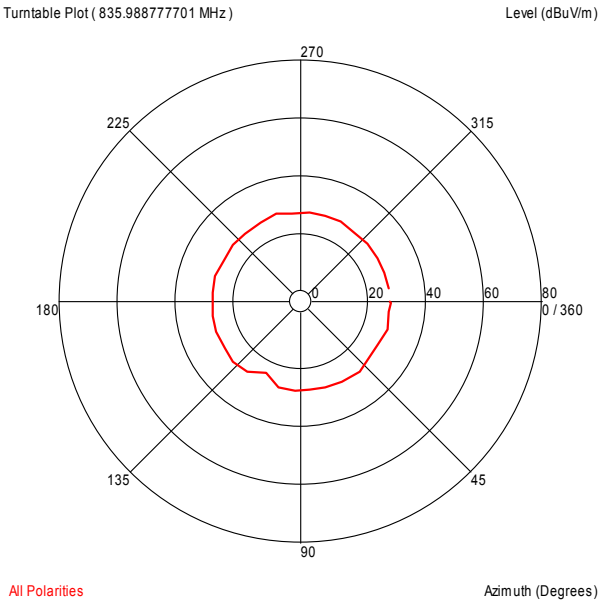

Height Plot (151.985571283 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

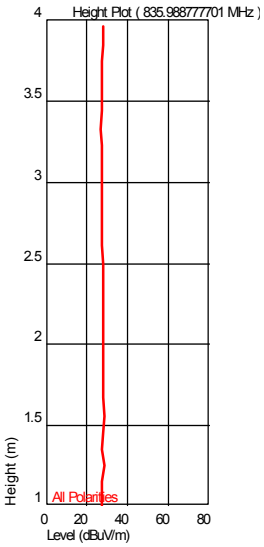

Turntable Plot (504.060921609 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (504.060921609 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)









Test Personnel:	Kouma Sinn KPS	Test Date:	10/21/2015
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.247, RSS247	Limit Applied:	ICES-003
Input Voltage:	Battery Powered	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**BB Source**	Relative Humidity:	35 %
		Atmospheric Pressure:	1016 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	11/19/2015	102327065BOX-001a	KPS KPS	VFV VFV	Original Issue