Radio Certification Test Report

As per

FCC Part 15, Subpart 15.231:2016
&
RSS-210, Issue 9

Momentarily Operated Devices,
License Exempt Radio Apparatus

on the

OpenBAS-HV-WLSTH
Wireless Thermostat

Issued by: **TÜV SÜD Canada Inc.**
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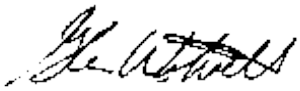
Testing produced for

Mircom™

Glen Westwell,
Project Engineer



Industry Canada
Registration #
6844A-3

Testing Laboratory
Certificate #2955.02

R-4023, G-506
C-4498, T-1246

Registration #
CA6844

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Report Scope

This report addresses the Radio / EMC certification testing and test results of the **OpenBAS-HV-WLSTH**, momentarily operated device, herein referred to as EUT (Equipment Under Test). Results in this report are applicable to all units, except where indicated as otherwise or individually. The EUT was tested for compliance against the following standards:

FCC Part 15 Subpart C:2016

FCC Part 15 Subpart B:2016

RSS-210, Issue 9

ICES-003, Issue 6

RSS-Gen, Issue 4

For a more detailed list of the standards and the revision used, see the "Applicable Standards, Specifications and Methods" section of this report.

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc. accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc., unless otherwise stated.

Radio Specifications

EUT Description	Wireless Thermostat – Momentarily Operated Device
Manufacturer	Mircom Group of Companies 25 Interchange Way, Vaughan, Ontario L4K 5W3 Ph: 905-660-4655
Model Name	OpenBAS-HV-WLSTH
Model Number	OpenBAS-HV-WLSTH
Serial Number	None
Rule Part	FCC Part 15.231 RSS-210, Appendix A
FCC ID:	2ABFD-9246AE80D86
IC ID:	1156A-DF9DBB57B1
Max. Field Strength	76.4 dBuV/m@3m
Frequency	433.92 MHz
Modulation	OOK
Antenna Type	Integral
99% OBW	2.22 kHz
Input voltage	2x AA 1.5V Battery, or 12V/24Vdc or 24Vac

Summary

The results contained in this report relate only to the item(s) tested.

Equipment Under Test (EUT)	OpenBAS-HV-WLSTH
EUT passed all tests performed	Yes
Testing conducted by	Glen Westwell

For testing dates, see 'Testing Environmental Conditions and Dates'.

Test Results Summary

Standard/ Method	Description	Class / Level	Result
FCC 15.231(a) RSS-210(A.1.1)	Periodic operation requirements	---	Compliant
FCC 15.231(b) RSS-210(A.1.2)	Intentional & Unintentional fields strength	---	Compliant
FCC 15.231(c) RSS-210(A.1.3)	Emission bandwidth	---	Compliant
FCC 15.231(d)	40-66-40.70 MHz Band	---	N/A
FCC 15.231(e) RSS-210(A.1.4)	Reduced field strength	---	N/A
FCC 15.207 ICES-003	Power Line Conducted Emissions	Class B	Compliant
FCC 15.209 ICES-003	Radiated Emissions	Class B	Compliant
Overall Result			**Compliant**

If the product as tested complies with the specification or requirement, the EUT is deemed to comply and is issued a 'Compliant' grade. If not, 'non-compliant' grade is issued.

Notes, Justifications, or Deviations

The following notes, justifications for tests not performed or deviations from the above listed specifications apply.

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used is listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)
Margin = 50.5dBµV/m – (50dBµV + 10dB + 2.5dB – 20dB)
Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

Margin = Limit – (Received Signal + Attenuation Factor + Cable Loss + LISN Factor)
Margin = 73.0dBµV – (50dBµV + 10dB + 2.5dB + 0.5dB)
Margin = 10.0 dB (pass)

Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard of Procedures for Compliance testing of Unlicensed Wireless Devices.
CFR47 FCC Part 15 Subpart B:2016	Code of Federal Regulations – Radio Frequency Devices
CFR47 FCC Part 15 Subpart C:2016	Code of Federal Regulations – Radio Frequency Devices
RSS-GEN Issue 4 2014	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 9:2016	Licence-Exempt Radio Apparatus: Category I Equipment
ICES-003, Issue 6 2016	Information Technology Equipment (ITE) – Limits and Methods of Measurement.
CISPR 32:2015	Electromagnetic Compatibility of Multimedia Equipment – Emission Requirements.
ISO 17025:2005	General requirements for the competence of testing and calibration laboratories

Document Revision Status

Revision 0 June 8, 2017
Initial Release

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has a calibrated 3m semi-anechoic chamber which allows measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Industry Canada (IC, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-4023, G-506, C-4498, and T-1246). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
May 4, 2017	Radiated Emissions	GW	20 – 24	40 – 51	98.0 – 102.0
May 5, 2017	Power Line Conducted Emissions	GW	20 – 24	40 – 51	98.0 – 102.0

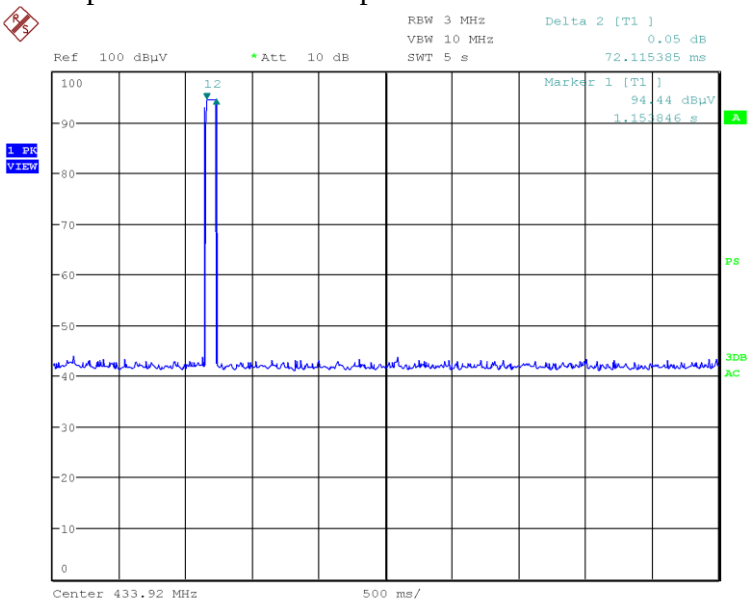
Detailed Test Result Section

1. Periodic Operational Requirements

	FCC 15.231(a) **RSS-210 (A.1.1)**
1.	A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds after being released. • N/A – this is an automatic transmitter
2.	A transmitter activated automatically shall cease transmissions within 5 seconds after activation. • This automatic transmitter deactivates transmission within 72ms of activation.
3.	Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than 2 seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed 2 seconds per hour. • N/A – This device does not transmit periodically at predetermined intervals, and does not transmit polling or supervision transmissions. • This device only transmits pseudo-random transmit cycles.
4.	Intentional radiators which are employed for radio control purposes during emergencies involving fire, security and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition. • N/A – this device is not for this use.
5.	Transmissions of set up information for security systems may exceed the transmission duration limits in paragraphs (1) and (2) above, provided such transmissions are under the control of a professional installer and do not exceed 10 seconds after a manually operated switch is released or a transmitter is activated automatically. Such set up information mat include data. • N/A – This device has a maximum 1 second transmission in set up mode.

Automatic transmitter activation / de-activation performance plots.

72mS pulse width / 5s sweep.



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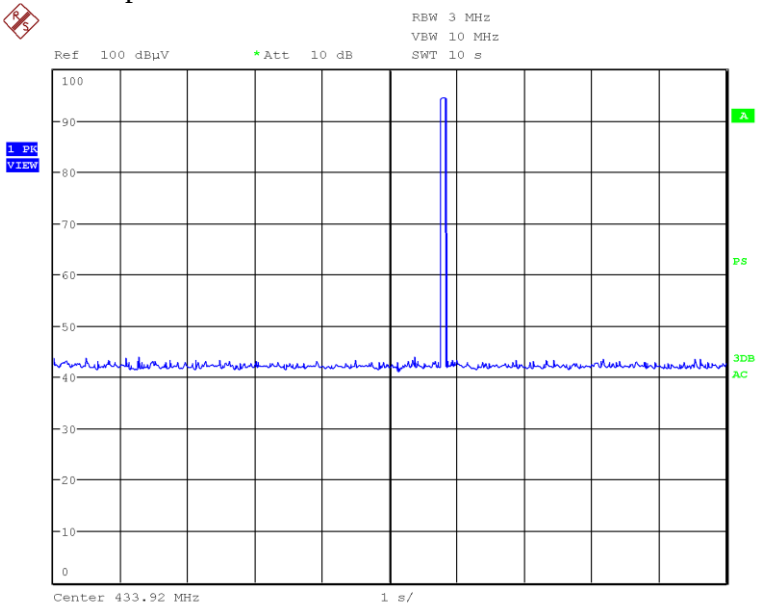
10S sweep



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2. Field Strength of Emissions

FCC 15.231(b) / RSS-210 (A.1.2)

All provisions of FCC part 15.231 & RSS-210 issue 9 apply to the measurements in this report.

The field strength of emissions from momentarily operated intentional radiators shall not exceed the limits outlined on the table below based on the average value measured:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

Observations:

1. Fundamental Frequency – 433.92MHz
2. The transmitter was configured for continuous transmit, maximum duty cycle.
3. The EUT was characterized on three orthogonal axis, all power variants and extremes and all antenna polarizations – worst case configuration data is presented.
4. The EUT was exercised for all tests via wireless data link configured by the client for typical operation simulation.
5. All data is reported using a peak detector and compared to the average limits (worst case).
6. No duty cycle correction is required to comply, and therefore not considered.
7. Emissions were search from 150kHz to 6Ghz. Worst case data presented.
8. All detected emissions are reported.
9. FCC part 15.205 was considered, no emissions were detected in the restricted bands.

Measurement Uncertainty:

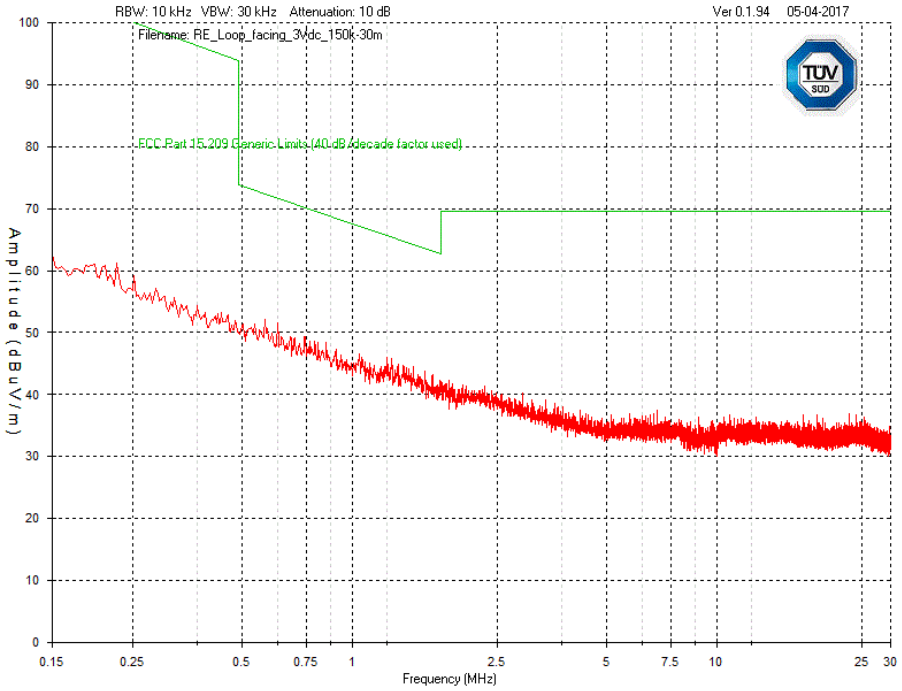
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±4.25dB for 30MHz – 1GHz and ±4.93dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Test Results

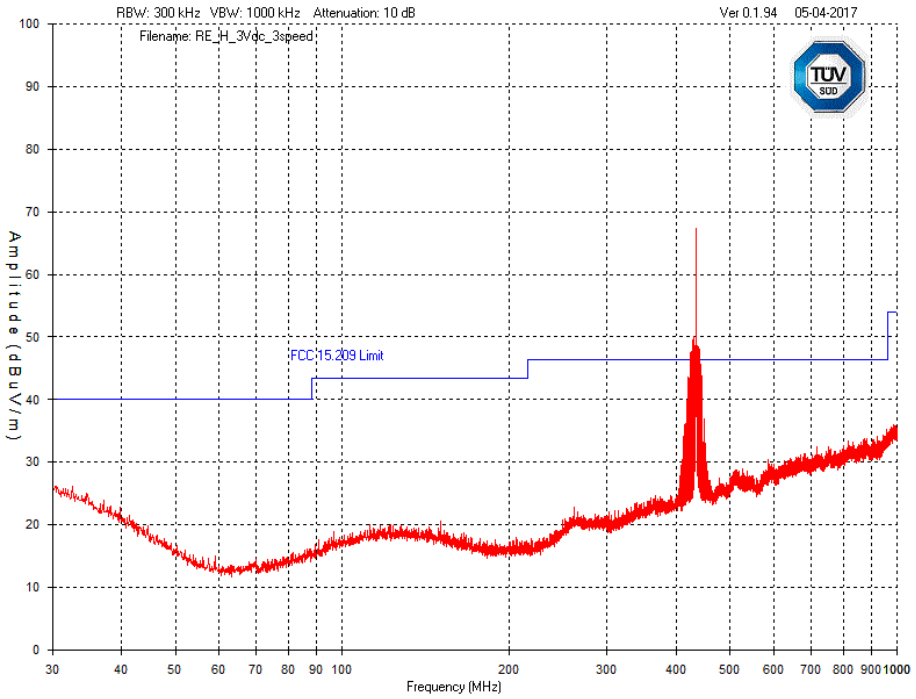
Fundamental & Spurious Emissions								
Freq. (MHz)	**Ant. Pol.**	**Level (dBuV)**	**Ant. Factor (dB)**	**Cable Loss & Attn.**	**Amp Gain (dB)**	**Field Strength (dBuV/m@3m)**	**Limit (dBuV)**	**Margin (dB)**
433.92	H	76.6	16.8	4.7	28.7	69.4	80.8	-11.4
433.92	V	83.6	16.8	4.7	28.7	76.4	80.8	-4.4
867.84	H	N.D.	22.7	5.5	28.32	---	60.8	N.D.
867.84	V	28.85	22.7	5.5	28.32	28.73	60.8	-32.07
1735.7	H	N.D.	26.2	5.8	36.3	---	60.8	N.D.
1735.7	V	48.0	26.2	5.8	36.3	43.7	60.8	-17.1
2169.6	H	47.19	28.2	3.3	36.1	42.79	60.8	-18.01
2169.6	V	48.52	28.2	3.3	36.1	43.92	60.8	-16.88
N.D. = Not Detected Peak detector levels compared to average limits (worst case).								

Spurious emission plots.

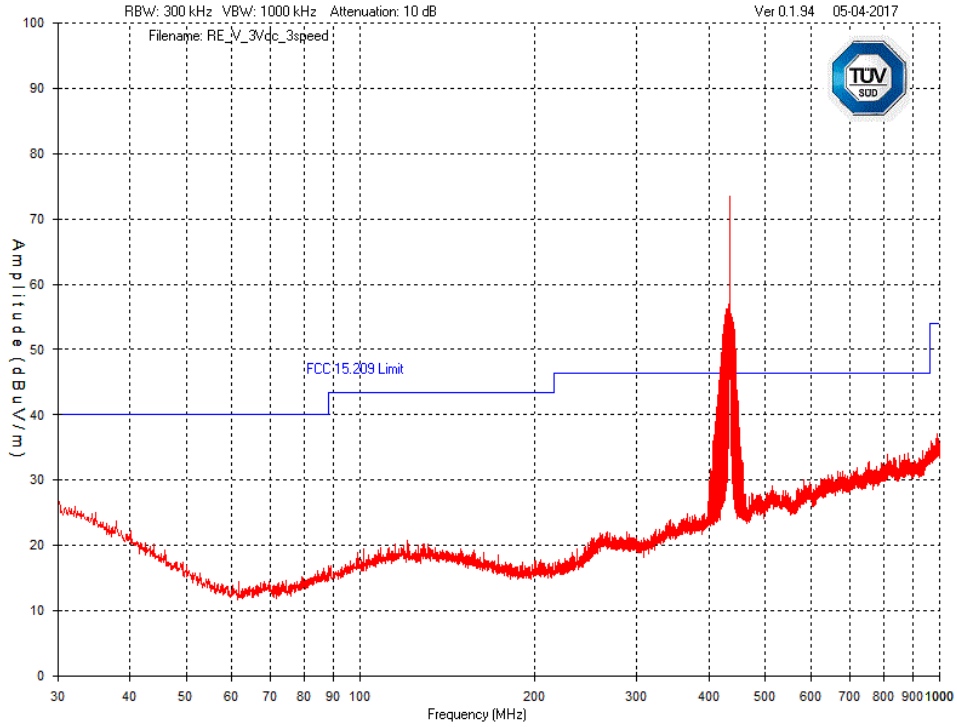
150kHz -30MHz



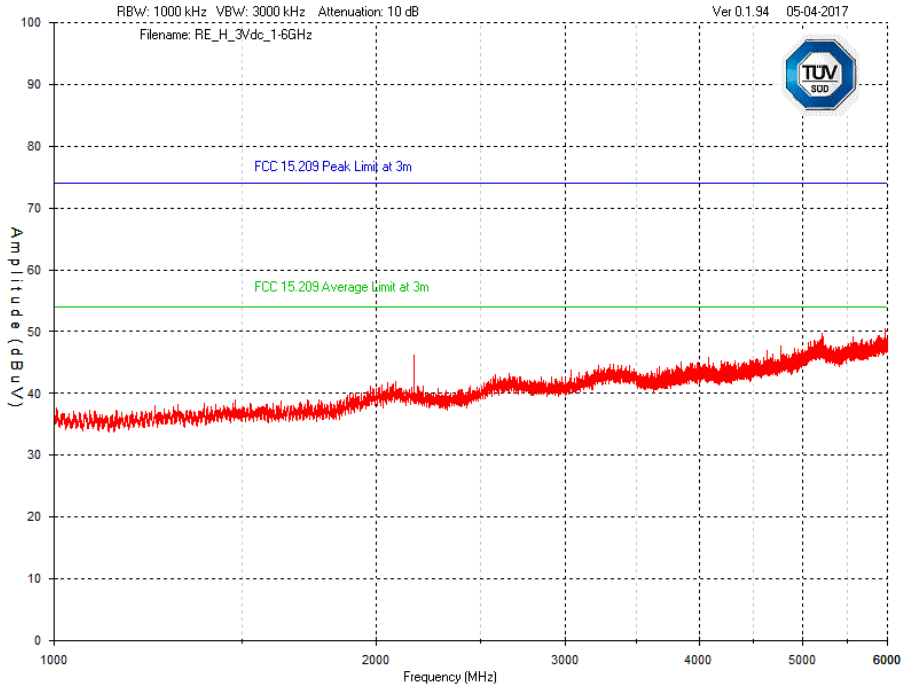
30MHz-1GHz - Horizontal



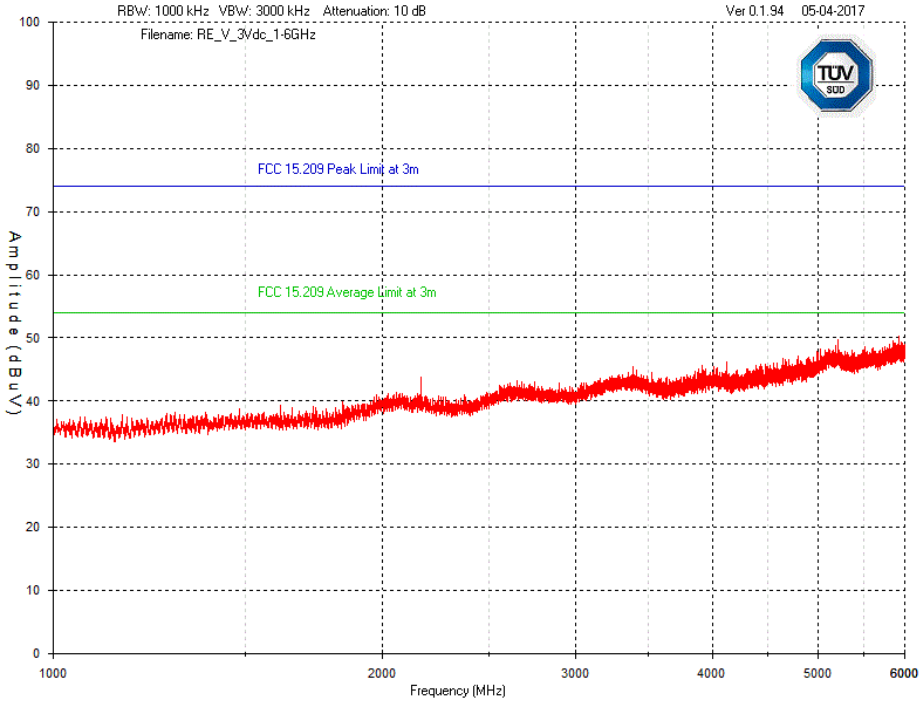
30MHz-1GHz - Vertical



1-6GHz - Horizontal



1-6GHz – Vertical

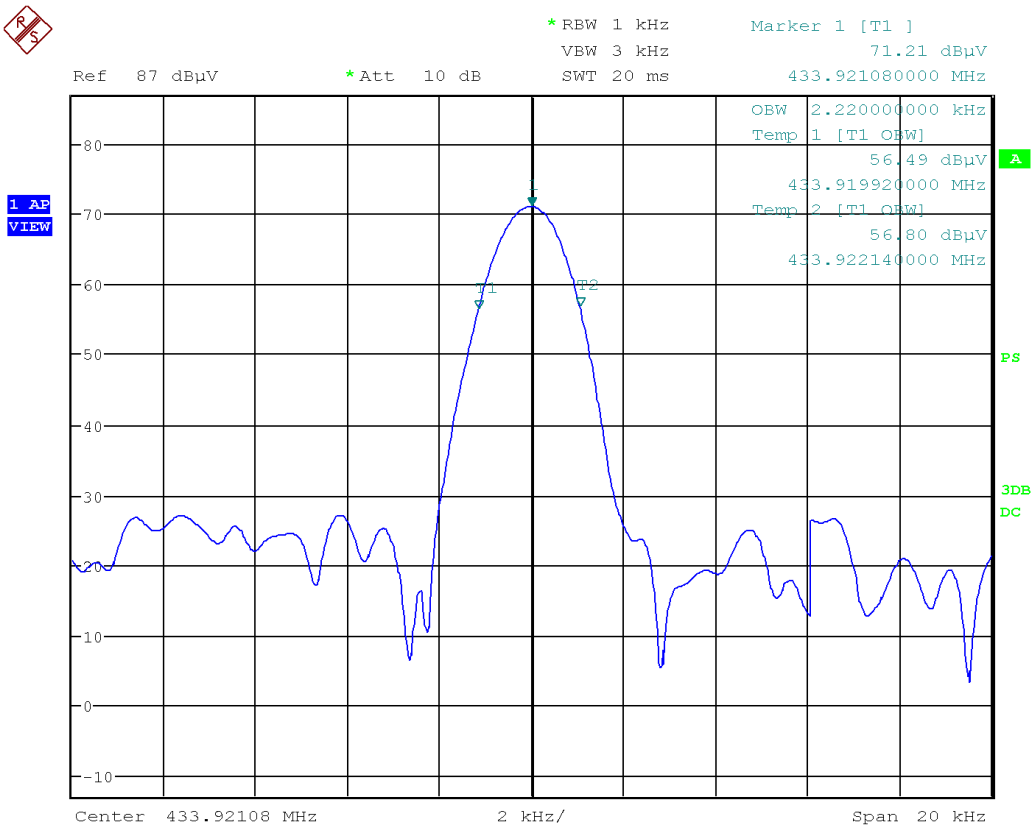


3. Emission Bandwidth

FCC 15.231(c) / RSS-210(A.1.3)

Transmitter Frequency	Modulation	Requirement: <0.25% of Center Freq.	Measurement: 99% OBW
433.92MHz	OOK	<1.0825MHz	2.22 kHz

Test Result Plot.



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4. Powerline Conducted Emissions

FCC 15.207 / ICES-003

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard and measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The method is as defined in ANSI C63.4. The limits are as defined in FCC Part 15 Section 15.207 and ICES-003 Issue 6 Section 6.1:

CLASS B

Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	56 to 46* dBµV	150 kHz – 500 kHz	66 to 56* dBµV
500 kHz – 5 MHz	46 dBµV	500 kHz – 5 MHz	56 dBµV
5 MHz – 30 MHz	50 dBµV	5 MHz – 30 MHz	60 dBµV

* Decreases linearly with the logarithm of the frequency

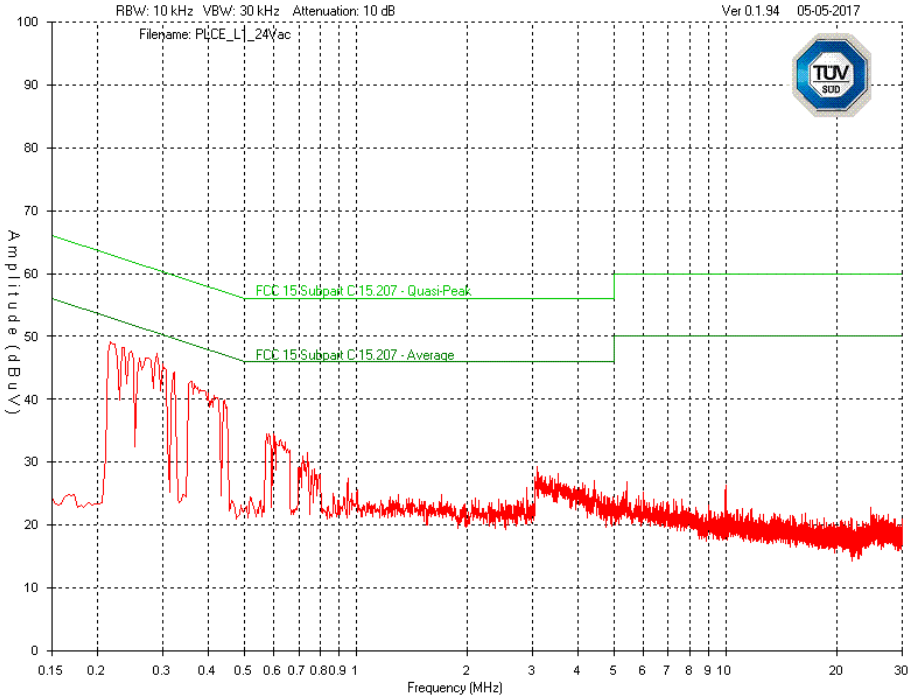
Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

Based on ANSI C63.4 Section 4.2, if the Peak or Quasi-Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

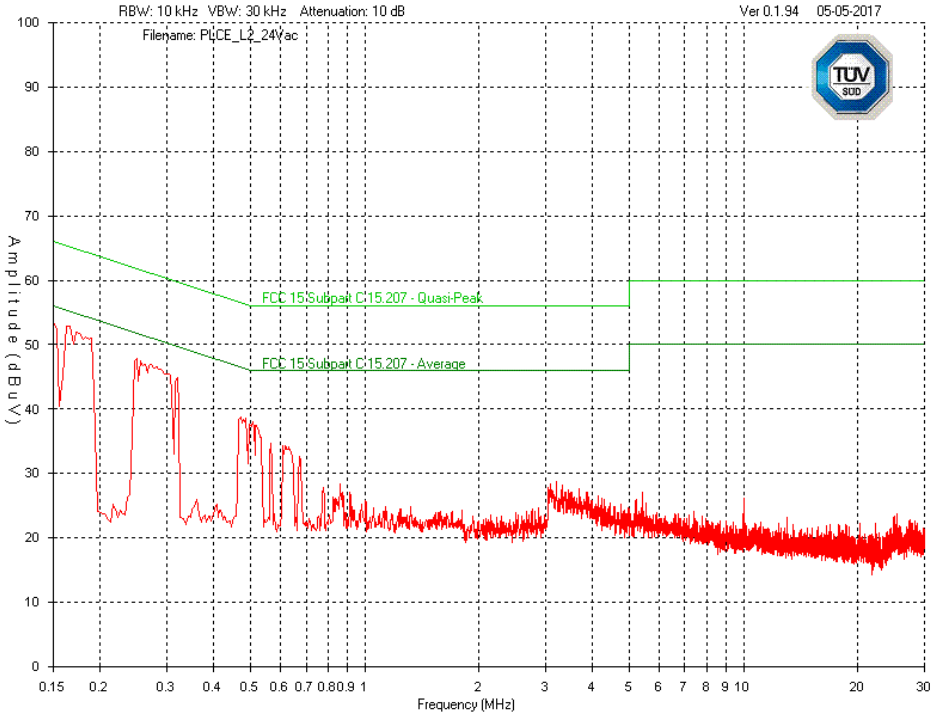
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±2.91dB with a 'k=2' coverage factor and a 95% confidence level.

Line (L1) – 24Vac 60Hz



Neutral (L2) – 24Vac 60Hz



Final Measurements

Average and Quasi-Peak Emissions Table

Product Category			Class B								
EUT			OpenBAS-HV-WLSTH - Wireless Momentarily Operated Transmitter								
Supply			24Vac 60Hz								
Frequency (MHz)	Detector Peak/ AVG/QP	Received Signal (dBµV)	Atten Factor (dB)	Cable Factor (dB)	LISN Factor (dB)	Level (dBµV)	QP Limit (dBµV)	AVG Limit (dBµV)	QP Margin (dB)	AVG Margin (dB)	Pass/ Fail
Line 1											
0.290	AVG	4.7	10	0.1	0.0	14.8	--	50.5	--	35.7	Pass
0.217	AVG	5.6	10	0.0	0.0	15.6	--	53.0	--	37.4	Pass
0.236	AVG	5.5	10	0.0	0.0	15.5	--	52.2	--	36.7	Pass
0.323	AVG	4.4	10	0.1	0.0	14.5	--	49.6	--	35.1	Pass
0.359	AVG	4.2	10	0.1	0.0	14.3	--	48.7	--	34.4	Pass
0.443	AVG	3.6	10	0.1	0.0	13.7	--	47.0	--	33.3	Pass
0.290	PEAK	37.2	10	0.1	0.0	47.3	61	--	13.2	--	Pass
0.217	PEAK	39.2	10	0.0	0.0	49.2	63	--	13.8	--	Pass
0.236	PEAK	38.2	10	0.0	0.0	48.2	62	--	14.0	--	Pass
0.323	PEAK	34.2	10	0.1	0.0	44.3	60	--	15.3	--	Pass
0.359	PEAK	32.8	10	0.1	0.0	42.9	59	--	15.8	--	Pass
0.443	PEAK	29.9	10	0.1	0.0	40.0	57	--	17.0	--	Pass
Line 2											
0.163	AVG	18.0	10	0.0	0.0	28.0	--	55.3	--	27.3	Pass
0.153	AVG	18.1	10	0.0	0.1	28.2	--	55.8	--	27.6	Pass
0.250	AVG	17.6	10	0.0	0.0	27.6	--	51.8	--	24.2	Pass
0.320	AVG	17.4	10	0.1	0.0	27.5	--	49.7	--	22.2	Pass
0.163	PEAK	42.9	10	0.0	0.0	52.9	65	--	12.4	--	Pass
0.153	PEAK	42.5	10	0.0	0.1	52.6	66	--	13.2	--	Pass
0.250	PEAK	37.9	10	0.0	0.0	47.9	62	--	13.9	--	Pass
0.320	PEAK	34.9	10	0.1	0.0	45.0	60	--	14.7	--	Pass

Note:

Peak = Peak measurement
AVG = Average measurement
QP = Quasi-Peak measurement

Appendix A – Test Equipment Table

Test Equipment List – Powerline Conducted Emissions

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Nov. 25, 2015	Nov. 25, 2017	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 1, 2017	Feb. 1, 2019	GEMC 65
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	Feb 20, 2017	Feb 20, 2018	GEMC 276
Attenuator 10 dB	612-10-1	Meca Electronics, Inc	Feb. 20, 2017	Feb. 20, 2018	GEMC 223
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58

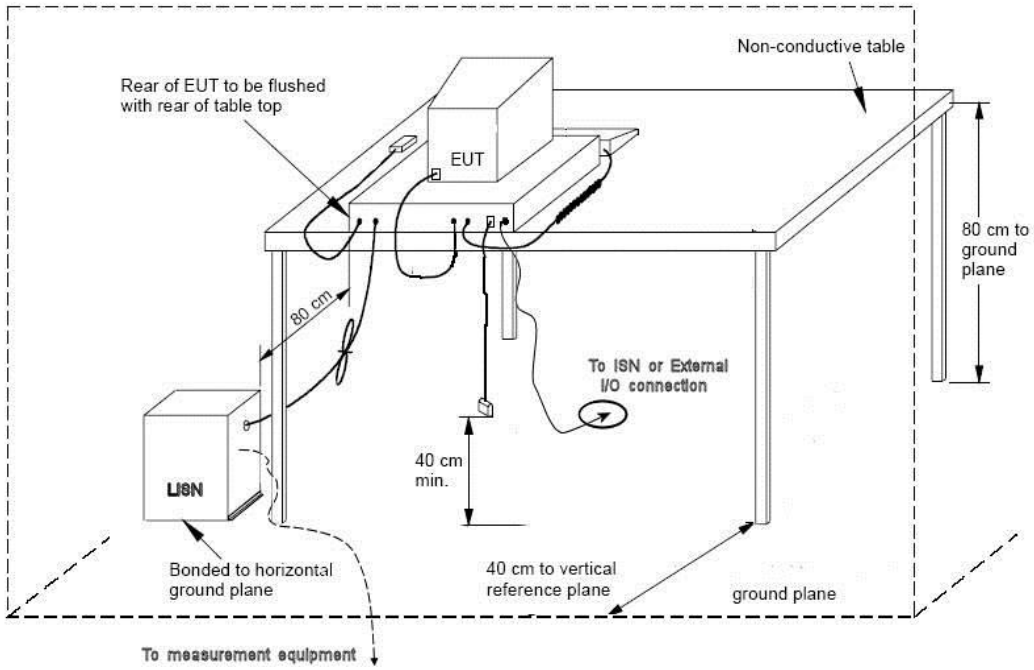
FCC_ICES003_RE-CLASS-B_Rev1

Test Equipment List – Radiated Emissions

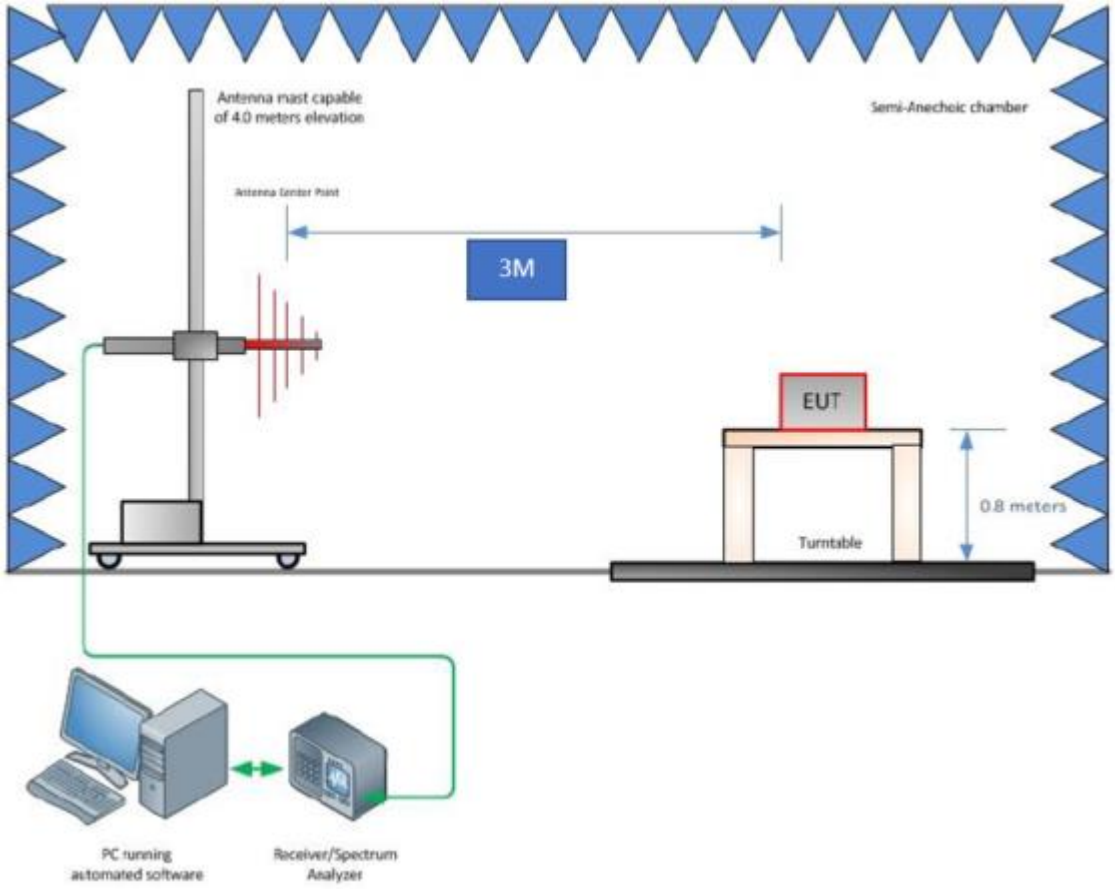
Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 6, 2016	Jan. 6, 2018	GEMC 233
BiLog Antenna	CBL6111	Chase	Dec. 17, 2015	Dec 17, 2017	GEMC 201
Loop Antenna	EM-6871	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb. 13, 2017	Feb. 13, 2019	GEMC 71
Attenuator 3 dB	612-03-1	Meca Electronics, Inc	Feb. 20, 2017	Feb. 20, 2018	GEMC 222
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 2, 2017	Feb. 2, 2019	GEMC 168
Horn Antenna 1 – 18 GHz	AH-118	Com-Power Corporation	July 1, 2015	July 1, 2017	GEMC 214
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Nov. 27, 2015	Nov. 27, 2017	GEMC 189
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	Feb. 20, 2017	Feb. 20, 2018	GEMC 274
RF Cable 2m	Sucoflex 104A	Huber+Suhner	Feb. 20, 2017	Feb. 20, 2018	GEMC 272
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58

Appendix B – Test Set Up Diagrams

Power Line Conducted Emissions

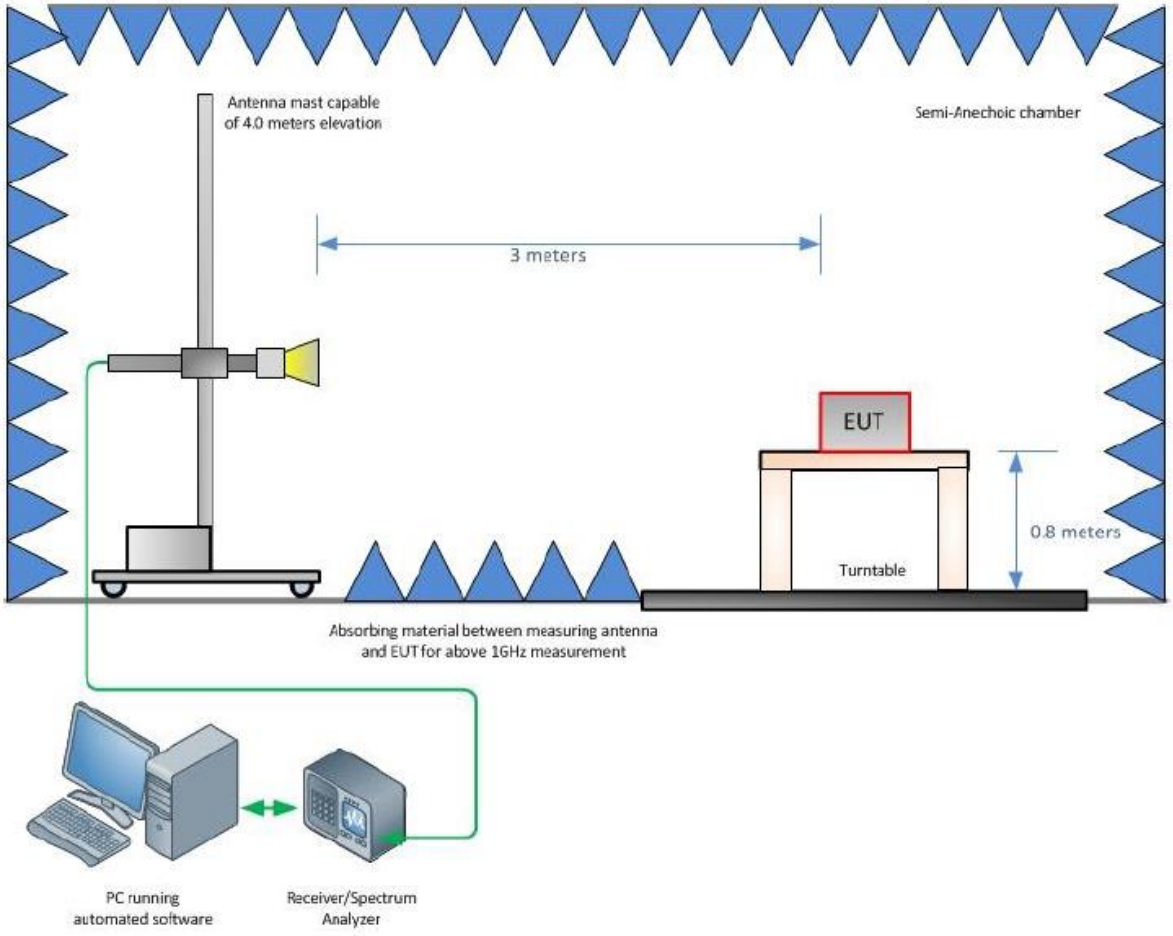


Radiated Emissions 150kHz-1GHz



Note: Emission measurements from 150kHz to 30MHz uses a loop antenna as seen in Annex C – Test Set Up Photos.

Radiated Emissions 1-6GHz



Appendix C – Test Set Up Photos

Refer to the files separate from this test report.