EMC Test Report
Application for Grant of Equipment Authorization
Class II Permissive Change/Reassessment
pursuant to
FCC PART 15 SUBPART C

Report#: S002E010-FCC Part 15 Subpart C

Manufacturer: Smart Technologies ULC
Model: KAPP 84
Serial# G010HW06Z0006
Test Start Date: Feb 17, 2015
Test Completion Date: Apr 06, 2015
Test Result: PASS
Report Issue Date: Apr 10, 2015
FCC ID: Z64-WL18SBMOD

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This report contains **47** pages

Document Release History

Approvals			
Organization	Name	Signature	Date
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Revision History			
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Information technology equipment (ITE) - CISPR22
Any equipment:

- which has a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer;
- with a rated supply voltage not exceeding 600 V.
- It includes, for example, data processing equipment, office machines, electronic business equipment and telecommunication equipment.

Any equipment (or part of the ITE equipment) which has a primary function of radio transmission and/or reception according to the ITU Radio Regulations are excluded from the scope of this publication.

NOTE: Any equipment which has a function of radio transmission and/or reception according to the definitions of the ITU Radio Regulations should fulfil the national radio regulations, whether or not this publication is also valid.

Equipment, for which all disturbance requirements in the frequency range are explicitly formulated in other IEC or CISPR publications, are excluded from the scope of this publication.

LABELING INFORMATION - FCC

Products subject to authorization under Verification procedures shall be labelled as follows: "This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation."

Where a device is constructed in two or more sections connected by wires and marketed together, the statement is required to be affixed only to the main control unit. When the device is so small or for such use that it is not practicable to place the statement on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

INFORMATION TO THE USER - FCC

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

For a Class A digital device or peripheral, the instructions furnished in the user manual shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For a Class B digital device or peripheral, the instructions furnished in the user manual shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE : This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio
- TV technician for help

LABELING INFORMATION - Industry Canada

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section for every ITE unit:

- Prior to marketing in Canada, for ITE manufactured in Canada, and
- Prior to importation into Canada, for imported ITE

The presence of the label on the ITE represents the manufacturer's or importer's Self-Declaration of Compliance (SDoC) to Industry Canada ICES-003. Each unit of an ITE model shall bear a label indicating the model's compliance with ICES-003. The label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. When the dimension of the device is too small or it is otherwise not practical to place the label on the ITE, the label shall be placed in a prominent location in the user manual supplied with the ITE.

The user manual may be in an electronic format and must be readily available.

Industry Canada ICES-003 Compliance Label:
CAN ICES-3 (*)/NMB-3(*) (Insert either "A" or "B" but not both to identify the applicable Class of ITE.)

INFORMATION TO THE USER - Industry Canada

For a Class A/B digital device, the instructions furnished in the user manual shall include the following or similar statement, placed in English and French, in a prominent location in the text of the manual:
This Class A/B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions:

- this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation.

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1.0 General

1.1 Scope

The purpose of this report is to document conformance with FCC 47 CFR PART 15 SUBPART C, intentional Radiators and to detail the results of testing performed on the sample Model: **kapp84** manufactured by **Smart Technologies ULC**. The test sample was received in good condition. Testing began on **Feb 17, 2015** and was completed on **Apr 01, 2015**.

An electromagnetic emissions test has been performed on the **Smart Technologies ULC**. Model **kapp84** pursuant to the following rule references [1, 2, and 3].

Conducted and radiated emission data has been collected, reduced and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards [4,5] as outlined in Applied Test Lab Inc Test procedures:

The system including the intentional radiator has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry standard's performance and procedural standards Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation power and I/O cabling, antenna search height and antenna polarization. Every practical effort was made to perform an impartial test using appropriate test equipment of defined calibration and specific standard related test setups and procedures. All pertinent factors have been applied to reach the assessment of compliance.

The test results reported in this report are based on a single type test of **Smart Technologies ULC**. Model **kapp84** and therefore apply only to the tested sample. The sample was selected and prepared by **Jeremy Hebert** of **Smart Technologies ULC**

1.2 Objective

The primary objective of the manufacturer is to be in compliance with the regulations outlined in the previous section for their electronic products with internally radiated devices.

Prior to placing the products on the markets in USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or manufacturer's declaration of conformity, with all other receive-only devices exempt from technical requirements. Prior to placing the products on the markets in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submittal documents including test data. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured following the equipment grant.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increase emission levels should be checked and verified to ensure continuous compliance has been maintained (i.e., printed circuit board layout changes, cable layout changes, changes to filter performance, power supply changes, I/O cable and interface changes, critical component changes, adding or modifying grounded or un-grounded conductive planes, enclosure changes etc.)

1.3 Relevant Standards and References

One or more of the following standards were used to evaluate the EUT:

1. Industry Canada RSS-Gen Issues 4
2. RSS 210 Issues 8 "Low power License-exempt Radio communication Devices (All Frequency Bands): Category I Equipment"
3. FCC Part 15 Subpart C
4. ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40GHz
5. DA-00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems , March 30, 2000

1.4 Summary of Compliance Performance

The tested sample of **Smart Technologies ULC**. Model **kapp84** complied with the requirement of the referenced regulations [1, 2, and 3]:

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increase emission levels should be checked and verified to ensure continuous compliance has been maintained (i.e., printed circuit board layout changes, cable layout changes, changes to filter performance, power supply changes, I/O cable and interface changes, critical component changes, adding or modifying grounded or un-grounded conductive planes, enclosure changes etc.)

1.5 Test Results Summary

Test Type	FCC Rule Part	Assessment	Limit/ Requirement	Result
Frequency Hopping or Digital Modulation	15.247(a)	System uses Frequency Hopping Techniques		PASS
Conducted Output Power	15.247(b) (3)	Full Power 12.373 dBm (17.27 mW) Normal Power -7.622 dBm (0.181 mW)	125mW	PASS
Antenna Conducted Band Edge Emissions	15.247(c)/15.209	2390 MHz Level: -62.747 dBc 2483.5 MHz Level:-61.592 dBc	< -20dBc	PASS
Transmitter Radiated Spurious Emissions	15.247(c)/15.209	Highest Fundamental: 2441 MHz, 104.9 dBuV/m Highest Spurious: 826MHz, -1.44dB	< -20dBc	PASS
Radiated Band Edge Emissions	15.247(c)/15.209	2390 MHz Level: -39.69 dBc 2483.5 MHz Level:-45.06 dBc	< -20dBc	PASS
RF Exposure Requirements	15.247(b) (5) 15.407(f)	0.0051 mW/cm²	1.000mW/ cm²	PASS
AC Conducted Emissions	15.207	Based on the changes proposed, the AC conducted emissions would not be affected	Refer to Standard	N/A
RF connector	FCC 15.203	External Antenna with non-standard connector	Integral Antenna or non-standard connector	PASS

1.6 Test Facility Information

Name	Applied Test Lab Inc.		
Address	Unit 4174-3961 52nd Avenue NE, Calgary, Alberta, T3J 0J8, Canada		
Telephone	403 590 8701	**Fax**	403 590 8570
Email	sale@appliedtestlab.com	**Website**	www.appliedtestlab.com
FCC Recognition	697081	**IC Recognition**	10988A

1.7 Measurement Uncertainties

ISO/IEC 17025 requires an estimate of the measurement uncertainties associated with the radiated and conducted emissions test results be included in the report. The measurement uncertainties given in the following table are estimated based on 95% confidence level and were calculated in accordance with UKAS document Lab 34.

Measurement	Frequency Range (MHz)	Calculated Uncertainity (dB)
Conducted Emission	0.15 to 30.0	+/- 2.71
Radiated Emission	0.009 to 30.0	+/- 3.0
Radiated Emission	30.0 to 1000.0	+/- 4.25
Radiated Emission	1000 to 26500.0	+/- 6.0

1.8 Client Information

Name	**Smart Technologies ULC**		
Address	3636 Research Road NW, Calgary, AB, Canada T2L 1Y1		
Telephone	1-403-407-4068	**Website**	www.smarttech.com
Contact Name	**Jeremy Hebert**	**Contact Email**	jeremyhebert@smarttech.com

1.9 Manufacturer

Same as client

2.0 Test Sample

2.1 Test Sample Information

The **kapp84** was only operated and exercised in the mode(s) and configuration(s) described in this report. All inputs and outputs to and from support equipment associated with the **kapp84** were provided or simulated under the direction and responsibility of **Smart Technologies ULC**. A description of system and their provisions are included in Appendix A.

2.2 Equipment Under Test (EUT)

Product Description	Dry erase whiteboard with digital imaging capacity and ability to share content in real time via paired Bluetooth mobile device.
Intended Application	Dry erase Whiteboard
Manufacturer	SMART Technologies ULC/ SMART Technologies Inc.
Address	3636 Research Road NW, Calgary, AB T2L 1Y1
Model/Trade Name	SMART kapp™ 84" capture board
Model Number	kapp84
Model Discrepancy/Variants	EVT2 unit
Serial Number	G010HW06Z0006
FCC ID	Z64-WL18SBMOD
Model discrepancy/Variations	N/A
Power Supply Requirements	5V DC
Power Supply Model, Serial, Manufacturer, Ratings, Regulatory Approvals	Power Supply 1 Manufacturer: DVE, Model# DSA-24CA-05 50300, 5V, 3A Power Supply 2 Manufacturer: TOP Microsystems, Model# ADS-25SGP-06 -05015G, 5V, 3A
Firmware Version	1.5.0.54 (MAN image for testing continuous transmit; used in spurious tests) 1.5.2.37 (APP image used for testing immunity)
Software Version	SMART kapp iOS application Version 1.3.x
Equipment Category	ITE, Bluetooth Low Power Device
Intended Operating Environment	Residential, Commercial and Light Industrial
Weight	57 lbs (25.9 kg)
Dimensions	72" x 52 5/8" (182.9cm x 133.8cm)
Supplied Accessories	5V, 3A power supply.
Operating Frequency(s)	2402-2480 MHz
Operating Modes	Tx and Rx
Transmitter power	0.0173Watts (12.38 dBm)
Modulation Technique	GFSK (Bluetooth BR & BLE). EDR modulations not used.
Emission Designator	1M19F1D(BR) , 1M01F1D (LE)
Transmit data Rate	32kbits per second
Number of Channels	79 (Bluetooth BR/EDR); 39 (Bluetooth Low Energy)
Number of Antennas	1
Antenna Specifications (Manufacturer, model, Gain, VSWR, Frequency range(s))	Molex 47950-4011, peak gain 1.88dBi, 2.4GHz-2.5GHz with 300mm cable (one end is soldered to Antenna and other end is connected with U.FL Plug connector to mate with U.FL Receptacle on the PCB)
Part number	1025956 (Revision 06 tested)

Typical Installations	Wall Mount
Duration of Self Test	20 seconds (performed at power up)
Cycle Time	1 minute (Initialization + pairing Bluetooth device + writing ink on board)
Reaction Time	Less than 1 second for most faults
Fault Recovery Time	Up to 25 seconds if unit resets
Highest Freq Generated	2480MHz
Other Information	N/A
Product Manufacturing Status	☒Production Unit ☐ Pre-Production Unit

2.3 Support Equipment and Details

☐ **Applicable**

Manufacturer	Description	Model No.	Serial Number	Other Info
Asus	Laptop	B43S	N/a	
RFID tag	RFID tag			Simulate read conditions

2.4 I/O Ports and Details

☐ **Applicable**

Port Type	Description	Filter Info	Shielding Info	Other Info
Mini USB	4 wired USB include power	No	Yes	

2.5 External I/O Cable Descriptions

☐ **Applicable**

Cable Description	Length (m)	Port From	Port To	Cable Type	Remarks
USB cable	1.8 M	USB Type B	USB Type A	shielded	
Power cable	1.8 M			Power cable	

2.6 Modifications

☐ **Applicable**

Modification Type	Component / Material Description	Placement	Test Used for
Change AC to DC adapter		From Asus to Gateway	Conducted Emission

		adapter	

Photo of Modifications ☐ **Applicable**

Notes:

3.0 Test Facilities

Laboratory Location

The radiated and conducted emissions test sites are located at the following address:

Applied Test Lab,
Unit 4174, 3961-52 Ave N.E., Calgary, AB T3J 0J8

Laboratory Accreditation/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC and Industry Canada for testing Interference by information technology equipment. In addition, ATL has implemented an interim in-house quality system which is based on the ISO 17025 standard and is actively pursuing to achieve its accreditation. The following certification numbers have been issued in recognition of the certifications:

FCC Registration Number: **697081**
Industry Canada Lab Code: **10988A**

Country	Agency	Accreditation/Certification	LOGO
USA	FCC	3m Semi-Anechoic Chamber to perform FCC Part 15/18 measurements	
Canada	Industry Canada	3m Semi-Anechoic Chamber to perform ICES-004 and RSS measurements	Industry Canada Industrie Canada

***Note:** Unless otherwise specified, ATL performs the tests using standard test methods to evaluate the EUT for compliance to the defined International standards. However, the report is not to be used to claim compliance, certification or endorsement by FCC or Industry Canada or any other government agency unless specifically submitted to such agency for such purpose.

3.1 Semi-Anechoic Chamber Test Site Description

The Semi-Anechoic Chamber Test Site consists of a 6.24 x 9.144 x 5.79 meter shielded enclosure. The chamber is lined with SAMWAH Ferrite Grid Absorber, model number SN-20. The ferrite tile grid is 100 x 100x 6.7mm thick and weighs approximately 200 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. Inner side Wall is lined by 600H Foam Absorber with White Cap. Chamber is illuminated by set of 12 Incandescent Bulbs.

The turntable is 198cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via Utility Ground installed at the side of the back East wall, it is bound to the Chamber ground Stud using 1/2″ copper braided cable.

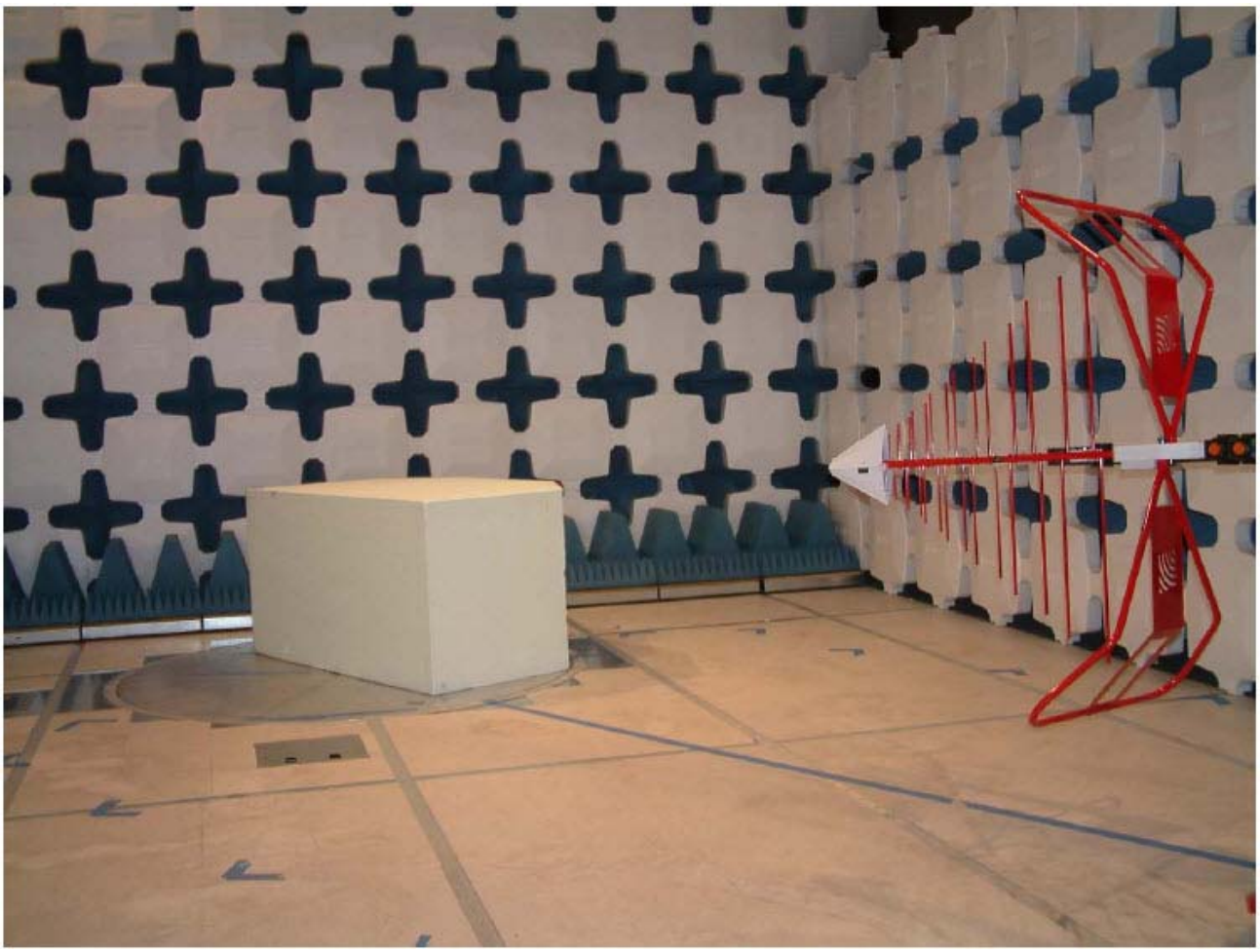


Figure 3.1 – Test Facility (setup for 30 MHz – 1GHz)

The turntable is all aluminum, flush mounted table installed in an all steel frame. The table is remotely operated from the control area located outside the Semi Anechoic Chamber. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Figure 3.2 – Test Facility (setup for 1 GHz – 18 GHz)

3.2 A Block Diagram of Semi-Anechoic Chamber Test Site

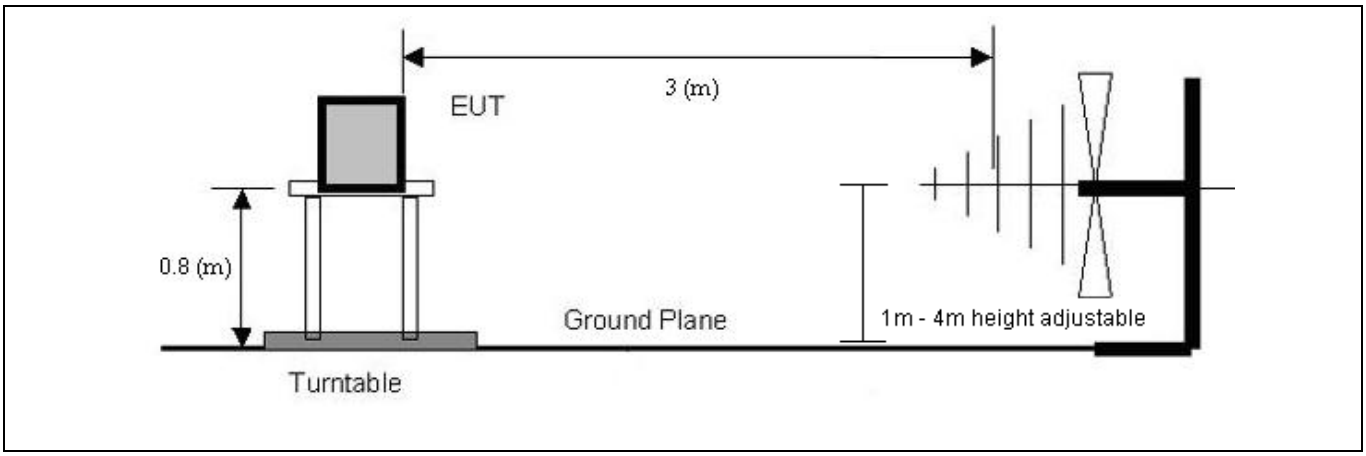


Figure 3.3 - Semi- Anechoic chamber diagram (30MHz - 1GHz)

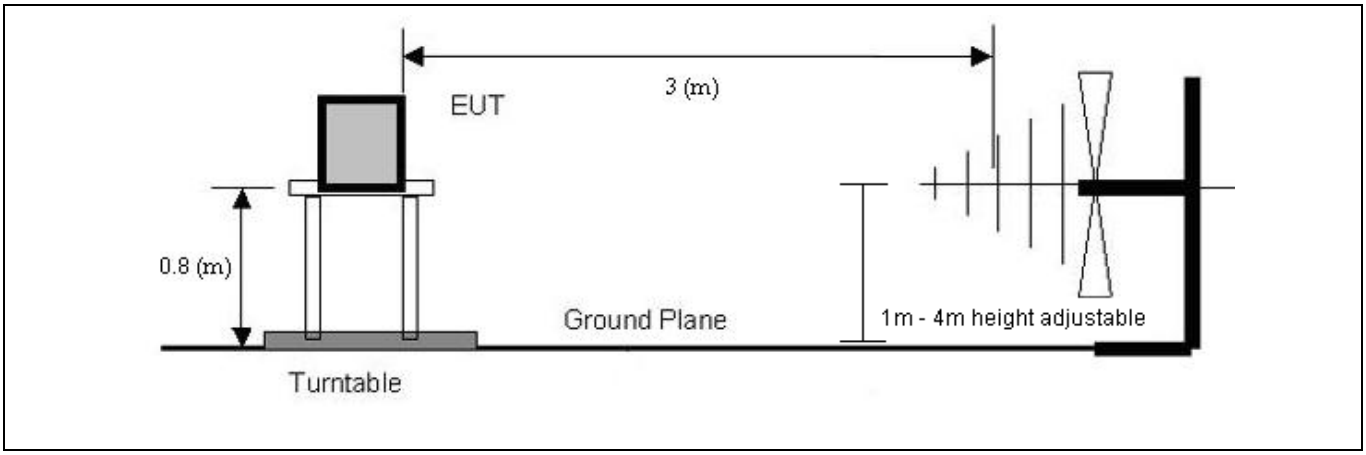


Figure 3.4 - Semi- Anechoic chamber diagram (1 GHz - 18GHz)

3.3 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main ATL EMC lab. It consists of a 2.04 x 2.04 Meter solid copper horizontal group reference plane (GRP) bonded to a 2.25 x 2.25 meter vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4. A diagram of the Conducted Emissions Test Site and block diagram is shown in Figure below.

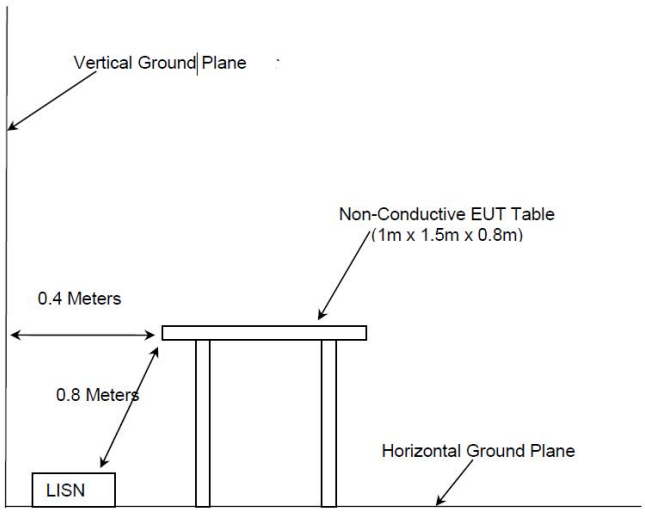


Figure 3.5 - Conducted Emissions test setup diagram

Figure 3.6- Conducted Emissions test setup

3.4 Test Equipment List

Table 3.4A-Test Equipments used for Radiated Emissions, Radiated Spurious and Band Edges

Description	Manufacturer	Model Number	Ser Number	Next Cal
Bi-Log antenna	ETS Lindgren	3142E	144760	09/25/2015
Double Ridged Horn	ETS Lindgren	3117	143095	08/29/2015
Loop Antenna	COM-POWER	AL-130	121035	08/24/2015
Standard Gain Antenna	ETS Lindgren	3160-09	00130132	PV
Spectrum Analyzer	Hewlett Packard	Hp8593EM	3639A00172	12/18/2015
EMI Receiver RF Filter Section	Hewlett Packard	8546A 85460A	3549A00306 3330A00109	07/07/2015
LNA	MITEQ	AMF-7D-01001800-22-10P	1782797	PV
Green Short Cable	Micro Coax UTIFLEX	UFB293C	303	PV
Green Long Cable	Micro Coax UTIFLEX	UFB311A	SFC220863	PV
Yellow short cable	IW microwave	N/A	389.11214.01.03.001	PV
DC Power Supply	Insteck	PC-3030	PC3030RP1	NCR
Turntable	ETS Lindgren	2187	NA	NCR
Antenna Bore-sight Mast	ETS Lindgren	2071B	136243	NCR
Multi Device Controller	ETS Lindgren	ETS 2090	148017	NCR
3 Meter chamber	ETS Lindgren	FACT 3-2.0	N/A	08/14/2015
Test SW	DVT Solutions Inc	REDvtAtlV3p29		

Note: The measurement uncertainty is less than +/- 4.25 dB which is evaluated as per the NAMAS NIS 81 and CISPR 16-4-x
NCR: No Calibration required.
PV: Periodic Verification
The calibration interval for all test equipment used for compliance measurements is two years

Table 3.4B-Test Equipment used for Power line Conducted Emissions

Description	Manufacturer	Model Number	Ser Number	Next Cal
LISN	Com-Power	LI-215A	191933	08/22/2015
EMI Receiver RF Filter Section	Hewlett Packard	8546A 85460A	3549A00267 3448A00245	03/11/2015
Cable	Huber & Suhner	M17/60-RG142	NA	PV
Transient Limiter	Com-Power	LIT-930	531577	PV
Test SW	DVT Solutions Inc	CETestExecV3p21D4.exe		

Note: The measurement uncertainty is less than +/- 2.71 dB which is evaluated as per the NAMAS NIS 81 and CISPR 16-4-x
NCR: No Calibration required.

PV: Periodic Verification
The calibration interval for all test equipment used for compliance measurements is two years

Table 3.4C-Test Equipments used for Transmitter Conducted Power, Spurious and Band Edges

Description	Manufacturer	Model Number	Ser Number	Next Cal
EXA Signal Analyzer	Agilent	N9010A-526 N9081A-2TP	MY51170076	Mar 17, 2016
P- Series Power Meter Wideband Power Sensor	Agilent	N1911A N1921A	MY53400015 SG50270012	Mar 17, 2016
Double shielded UMCC Plug to SMA Plug, 1.37mm OD, Type III	TE Connectivity	2032439-1	NA	PV
Test SW	DVT Solutions Inc	WirelessV1p0		

Note: The measurement uncertainty is less than +/- 2.71 which is evaluated as per the NAMAS NIS 81 and CISPR 16-4-x
NCR: No Calibration required.
PV: Periodic Verification
The calibration interval for all test equipment used for compliance measurements is two years

4.0 Test Setup Description

4.1 System Block Diagram

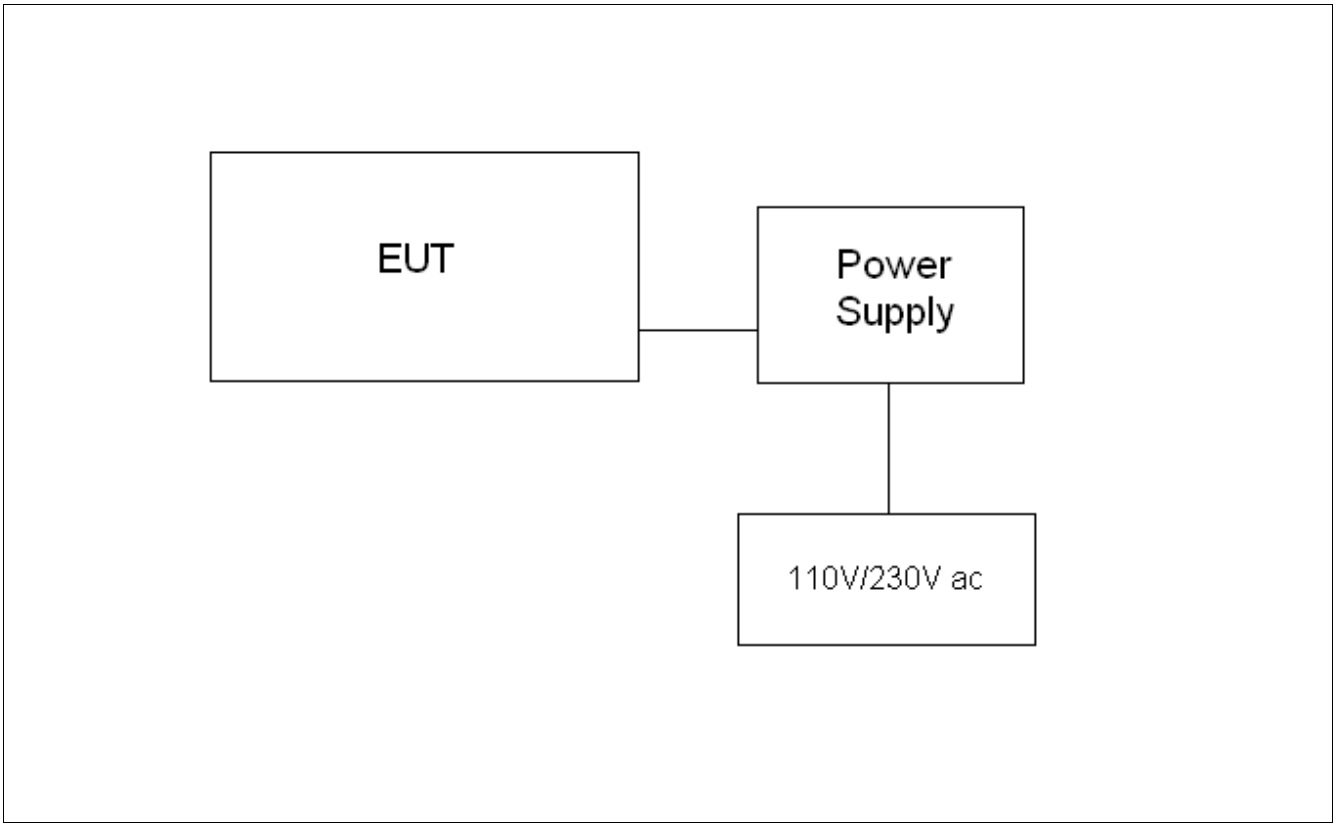


Figure 4.1 - System Block Diagram and Support Equipment

4.2 Support Equipment

☐ **Applicable**

Table 4.1 - Support Equipment Description

Item#	Type Device	Manufacture	Model#	Part#

4.3 Test Setup-Conducted Emissions

☐ **Applicable**

Figure 4.3A - Conducted Emissions Test Setup - Front View

Figure 4.3B - Conducted Emissions Test Setup - Side View

4.4 Test Setup-Radiated Emissions

☐ **Applicable**

Figure 4.4A – Radiated Emissions 30M-1000M Test Setup - Front View

Figure 4.4B – Radiated Emissions 30M-1000M Test Setup - Side View

Figure 4.4C – Radiated Emissions 1G -18G Test Setup - Front View

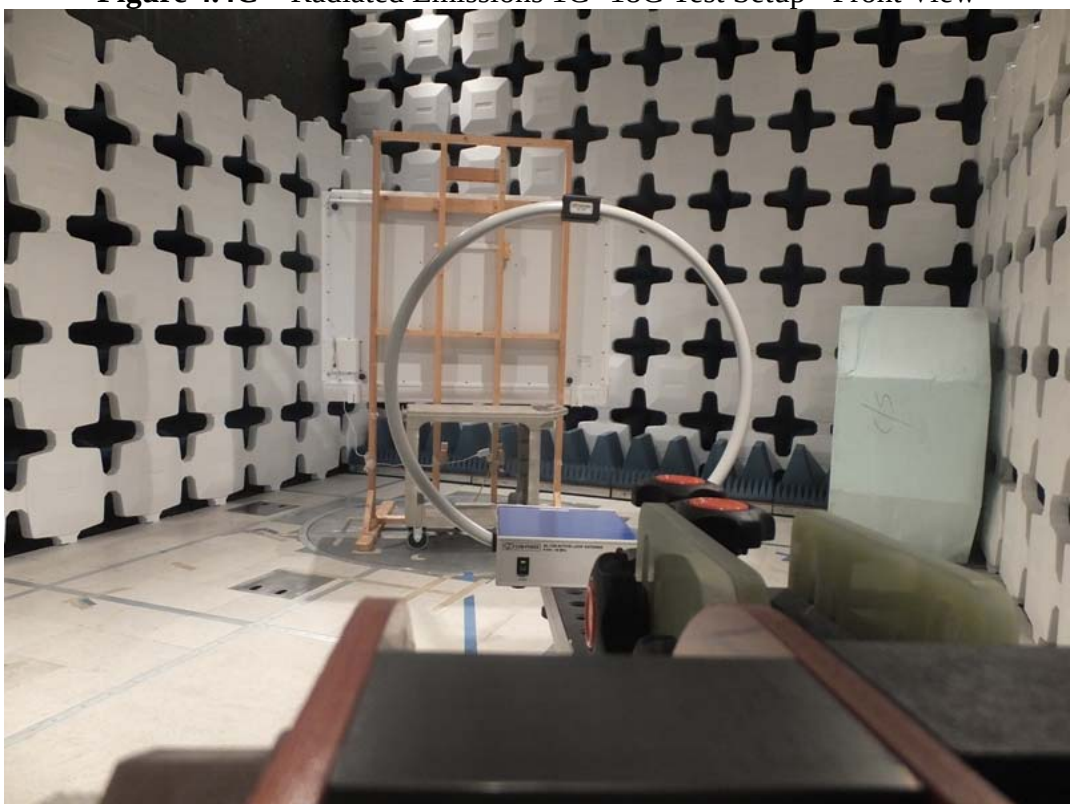


Figure 4.4D – Radiated Emissions 9K -30M Test Setup - Side View

4.5 Test Setup-Antenna Conducted

☐ **Applicable**

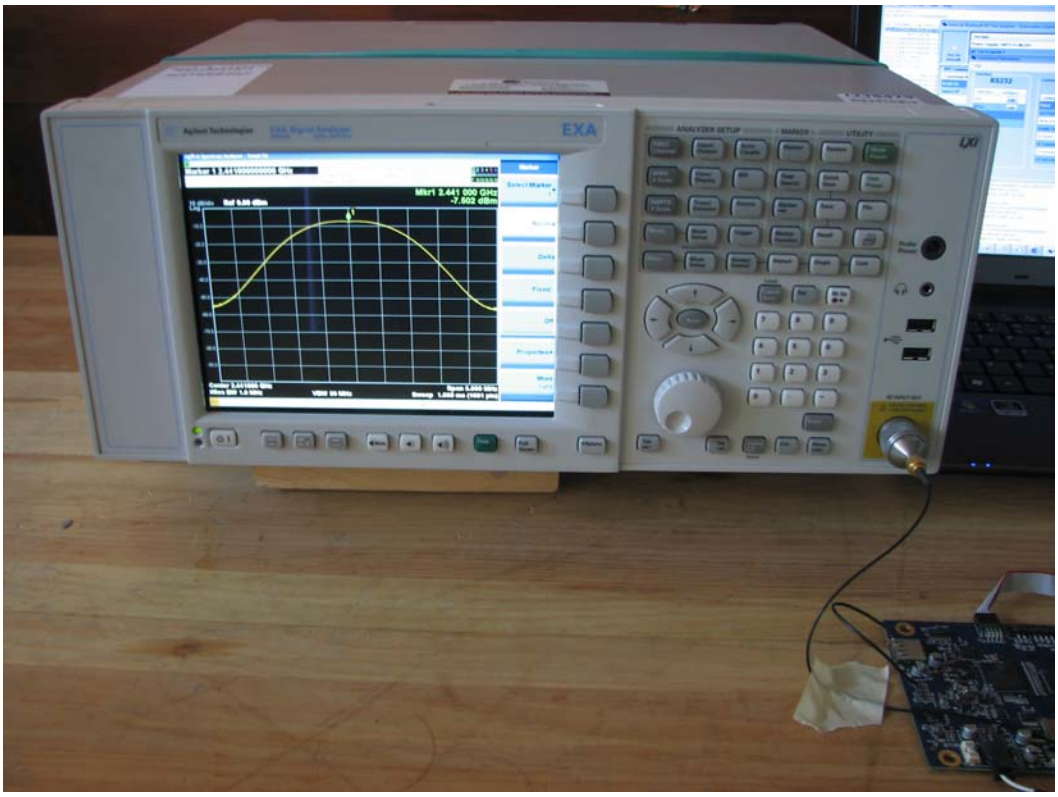


Figure 4.5A – Antenna Conducted Test Setup - Front View

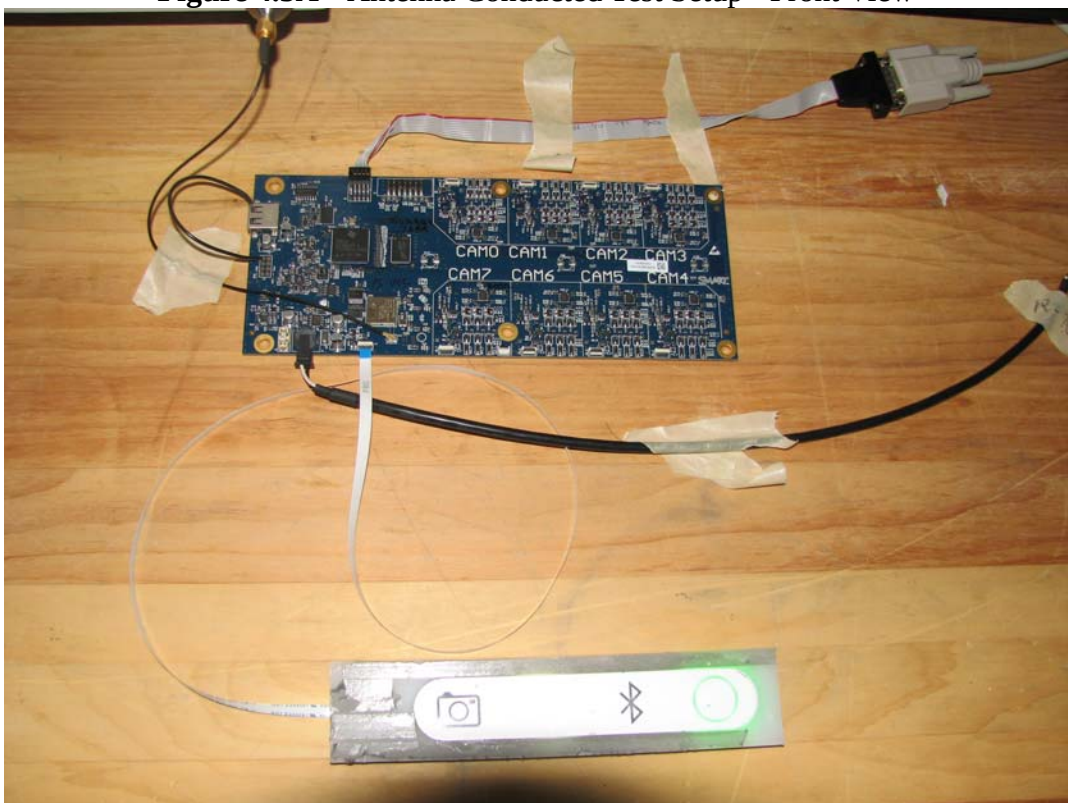


Figure 4.5B – Antenna Conducted Test Setup - Top View

5.0 Test Methodology

5.1 Method of Measurement of Conducted Emission

Conducted emissions measurements were made over the frequency range of 150 kHz to 30MHz. The software is programmed to perform a peak sweep of the frequency band using the max hold function. This sweep is performed for every power conductor of the power line. During the sweep measurement the spectrum analyzer/Receiver's resolution bandwidth set to 9.0 kHz and the video bandwidth set to 30.0 kHz. Although not a fully maximized scan, this type of scan provides emission data with a good indication of pass or fail.

Quasi- Peak measurements are taken with the Spectrum Analyzer/Receiver's resolution bandwidth set to 9.0 kHz and Video Bandwidth set to 30 kHz. Average measurements are taken with the resolution bandwidth set to 9.0 kHz and the video bandwidth set to 1.0 Hz: The calculation for the radiated emissions field strength is as follows:

Corrected Reading = Analyzer/Receiver Reading + Correction Factor (dB)
Correction Factor (dB) = LISN Insertion Loss + Cable Insertion Loss +Transient Limiter Insertion Loss
Margin = Corrected Reading – Applicable Limit

5.2 Method of Measurement of Radiated Emission

Measurement below 1 (GHz)

Measurements shall be made with a quasi-peak measuring receiver in the frequency range 30 (MHz) to 1000 (MHz). To reduce the testing time, a peak measuring receiver may be used instead of a quasi-peak measuring receiver. In case of dispute, measurement with a quasi-peak measuring receiver will take precedence.

The quasi-peak measuring receiver shall be in accordance with Clause 4 of CISPR 16-1-1. Receivers with peak detectors shall be in accordance with Clause 5 of CISPR 16-1-1 and shall have a 6 (dB) bandwidth in accordance with Clause 4 of CISPR 16-1-1. The antenna shall be a balanced dipole. For frequencies of 80 (MHz) or above, the antenna shall be resonant in length, and for frequencies below 80 (MHz) it shall have a length equal to the 80 (MHz) resonant length. Further detailed information is given in Clause 4 of CISPR 16-1-4.

Of those disturbances above (L – 20 dB), where L is the limit level in logarithmic units, record at least the disturbance levels and the frequencies of the six highest disturbances. Record the antenna polarization for each reported disturbance.

The software is programmed to perform a peak sweep of the frequency band using the max hold function. This sweep is performed every 22.5 (deg) in both horizontal and vertical polarities and at antenna heights of 100, 200 300 and 400 (cm). Although not a fully maximized scan, this type of scan provides emission data with a good indication of pass or fail.

Measurement above 1 (GHz)

The measurement instrumentation shall be as specified in CISPR 16-1-1.
The measuring antennas shall be as specified in 4.6 of CISPR 16-1-4.
The measuring site shall be as specified in 8 of CISPR 16-1-4.
The measurement method shall be as specified in 7.3 of CISPR 16-2-3.
The peak detector limits shall not be applied to disturbances produced by arcs or sparks that are high voltage breakdown events. Such disturbances arise when ITE devices contain or control mechanical switches that control current in inductors, or when ITE devices contain or control subsystems that create static electricity (such as

paper handling devices). The average limits apply to disturbances from arcs or sparks, and both peak and average limits will apply to other disturbances from such ITE devices.

Compliance Scans

Radiated emissions measurements were made over the frequency range of 30 (MHz) to 1000 (MHz). Quasi-peak measurements are taken with the Spectrum Analyzer/Receiver 's Resolution Bandwidth set to 120 (kHz) and Video Bandwidth set to 300 (kHz) for measurements below 1 (GHz). Average measurements are taken with the Resolution Bandwidth set to 120 (kHz) and the Video Bandwidth set to 120 (kHz) for measurements above 1000 (MHz). For unintentional radiators other than ITE, for each of the frequencies to which the device is tuned, the frequency and amplitude of the six highest radiated emissions relative to the limit and the operating frequency, or frequency to which the EUT is tuned (if appropriate), shall be reported unless such emissions are more than 20 (dB) below the limit. If less than the specified number (less than six) emissions are within 20 (dB) of the limit, the noise level of the measuring instrument at representative frequencies shall be reported.
The polarization of the measurement antenna (horizontal or vertical) shall be identified for each of the reported emissions. Radiated emissions measurements taken at alternative distances are to be converted to the limit distance using the inverse distance relationship, unless data can be presented to validate a different conversion. At a reported frequency, the polarization with the highest level shall be reported. The calculation for the radiated emissions field strength is as follows:

Corrected Reading (dB) = Analyzer/Receiver Reading + Correction Factor
Correction Factor (dB) = Cable Loss + Antenna Factor
Margin (dB) = Corrected Reading - Applicable Limit

5.3 Test Criteria

☐ Applicable

Table 5.1 - Class B Conducted Emissions Limits (FCC and ICES-003)

Emission Type	Frequency Range MHz	FCC Part 15 and ICES 003 Class B Voltage Limits (dBuV)	
		Quasi-Peak	Average
Conducted Emission	0.150 to 0.50	66.0 to 56.0	56.0 to 46.0
	0.50 to 5.0	56.0	46.0
	5.0 to 30.0	60.0	50.0

☐ Applicable

Table 5.2 - Class A Conducted Emissions Limits (FCC and ICES-003)

Emission Type	Frequency Range MHz	FCC Part 15 and ICES 003 Class A Voltage Limits (dBuV)	
		Quasi-Peak	Average
Conducted Emission	0.150 to 0.50	79	66
	0.50 to 5.0	79	66
	5.0 to 30.0	73	60

☒ Applicable

Table 5.3 –Radiated Emissions Limits of Licence Exempt Transmitters (FCC and Industry Canada)

Emission Type	Frequency Range MHz	FCC 15 Subpart C and Industry Canada RSS-Gen 8.9 E-Field Limits	
		Quasi-Peak (uV/m)	Peak (uV/m)
Radiated Emission	0.009-0.090		2400/F(kHz), 300m
	0.090-0.11	2400/F(kHz), 300m	
	0.11-0.49		2400/F(kHz), 300m
	0.490-1.705	24000/F(kHz), 30m	
	1.705-30.0	30, 30m	
	30.0 to 88.0	100, 3m	
	88.0 to 216.0	150, 3m	
	216.0 to 960.0	200, 3m	
	960.0 and	500, 3m	

Note:

1. Limits below 30 MHz are specified at a test distance of 30 meters, whilst below 0.49 MHz they are specified at a test distance of 300 meters. However, as specified by RSS-Gen Section 7.2.7 or FCC 15.31, 15.33, 15.35 (b) measurements may be performed at a closer distance and compliance limits corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40dB/decade).
2. Limits below 30 MHz are specified at a test distance of 30 meters, whilst below 0.49 MHz they are specified at a test distance of 300 meters. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the compliance limits level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40dB/decade).
3. Final measurement values include corrections for antenna factor and cable losses.
4. The emission shown at approximately 125 kHz is the fundamental.
5. All other emissions were found to be >20 dB below the applicable limit or below the measurement system noise floor.
6. The EUT was rotated around the X, Y and Z axis to maximize the emission. The measurement antenna was at a fixed distance of 3 m, fixed height of 80 cm and was positioned at 0 degrees, 45 degrees and 90 degrees to the EUT to maximize the emission.

Radiated emissions from an ITE shall be measured from the lowest frequency generated, or used, in the device or 30 (MHz), whichever is higher, up to the frequency determined in accordance with Table 5.5

Table 5.4 - Frequency Range of Measurement

Highest Frequency Generated or Used in Device	Upper Frequency of Radiated Measurement
Below 1.705 MHz	No radiated testing required
1.705 MHz - 108 MHz	1 (GHz)
108 MHz - 500 MHz	2 (GHz)
500 MHz - 1 GHz	5 (GHz)
Above 1 GHz	5th harmonic of the highest frequency or 40 (GHz), whichever is lower.

Class A: An ITE meeting the conditions for Class A operation defined in Section 1.3 shall comply with the Class A radiated limits set out in Table 5.5 determined at a distance of 3 (m).

☐ **Applicable**

Table 5.5 - Class A Radiated Emissions Limits (FCC and ICES-003)

Emission Type	Frequency Range (MHz)	FCC @ 3 m (dBuV/m)		ICES-003 @ 3m (dBuV/m)		
		Quasi-peak	Average	Quasi-peak	Lin Ave	Peak
Radiated Emissions	30 - 88	49.5		49.5		
	88 - 216	54.0		54.0		
	216 - 960	56.9		56.9		
	960 -1000		60.0	60.0		
	> 1000		60.0		60.0	80.0

Class B: An ITE meeting the conditions for Class B operation defined in Section 1.3 shall comply with the Class B radiated limits set out in Table 5.6 determined at a distance of 3 (m).

☐ **Applicable**

Table 5.6 - Class B Radiated Emissions (FCC and ICES-003)

Emission Type	Frequency Range (MHz)	FCC @ 3m (dBuV/m)		ICES-003 @ 3m (dBuV/m)		
		Quasi-peak	Average	Quasi-peak	Lin Ave	Peak
Radiated Emissions	30 - 88	40.0		40.0		-
	88 - 216	43.5		43.5		-
	216 - 960	46.0		46.0		-
	960 -1000		54.0	54.0		-
	>1000		54.0		54.0	74.0

5.4 EUT Operation during Emission Testing

EUT was tested while running software to exercise applications of the device. Custom verification software version 2, provide by client.

5.5 Test Justification

No test justification required.

6.0 Test Results

6.1 AC Conducted Emissions Test Data

Tested By: **Test Date** ☐ **Applicable**

Table 6.1 - Conducted Emissions information (CISPR 22, FCC and ICES-003)

Ambient Temperature	
Relative Humidity	
Test Standard/Reference	☐ **FCC Part 15** ☐ **ICES-003** ☐ **CISPR 22**
Frequency Range	150kHz – 30.0 MHz
Input Voltage	☐110 V AC ☐230 V AC
Line Frequency	☐60 Hz ☐50 Hz
Test Result	N/A
Limits	
Changes/Modifications	There were no modifications made to the EUT for this test case
Notes/Remarks	Not Applicable

Table 6.1A - Conducted Emissions Line 1

Freq (MHz)	Level (dBuV)	Correction Factor (dB)	QP Limit (dBuV)	Avg Limit (dBuV)	QP Margin (dB)	Avg Margin (dB)

Table 6.1B - Conducted Emissions Line 2

Frequency (MHz)	Level (dBuV)	Correction Factor (dB)	QP Limit (dBuV)	Avg Limit (dBuV)	QP Margin (dB)	Avg Margin (dB)

Figure 6.1A – Conducted Emissions Scan Line 1 (Line L)

Figure 6.1B – Conducted Emissions Scan Line 2 (Line N)

6.2 Radiated Spurious Emissions

Ambient Temperature	**21° C**
Relative Humidity	**23%**
Test Standard/Reference	☒ FCC Part 15 ☐ ICES-003 ☐ CISPR 22
Frequency Range	9kHz – 24800 MHz (10th Harmonic)
Input Voltage	110 V AC
Line Frequency	60 Hz (NA)
Measurement Parameters	• Test Distance: 3m • The EUT was placed on the turn table per EUT installation procedures • The turn table shall rotate 0 -360 degrees and the receiving antenna is varied from 1m to 4m to find out the highest emission at a given frequency. • Maximization procedure was performed on the six highest emissions to ensure EUT compliance • Each emission was to be maximized by changing the polarization of receiving antenna to both horizontal and vertical • Repeat the above procedure until all frequency measurements are completed • Radiated emission measurements in the frequency range from 30 MHz – 1000 MHz were made with an instrument using Peak and QP detector mode. RBW: 100kHz, VBW: 100kHz for Peak, RBW: 120kHz, VBW: 300kHz for QP • Radiated emission measurements in the frequency range above 1000 MHz were made with an instrument using Peak and Average detector mode. RBW: 1 MHz, VBW: 1MHz for Peak, RBW: 1 MHz, VBW: 10Hz for Average
Test Result	Highest Fundamental: **2441 MHz, 104.9 dBuV/m** Low Channel 2402 MHz, 98.54 dBuV/m Mid Channel 2441 MHz, 104.9 dBuV/m High Channel 2480 MHz, 98.31 dBuV/m Highest Spurious: **826 MHz, -1.44dB** Low Channel 4804 MHz, -13.36dB Mid Channel 144.3 MHz, -15.93 dB High Channel 826 MHz, -1.44dB
Limits	FCC 15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)
Changes/Modifications	There were no modifications made to the EUT for this test case
Notes/Remarks	There were no spurious emissions detected from 9 khz to 1000 MHz

Tested By: Jaeheon Yun **Test Date:** Feb 17- Feb 24, 2015 ☒ **Applicable**

Table 6.2A– Low Channel @ 2402 MHz Fundamental Signal Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
2402	118.58	61.6	100	-22.66	95.92	115.0	-19.08	
2402	121.2	11.0	100	-22.66	98.54	115.0	-16.46	

Table 6.2B– Low Channel @ 2402 MHz Fundamental Signal Field Strength (Average)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
2402	118.2	61.6	100	-22.66	95.54	115.0	-19.46	
2402	120.4	11.0	100	-22.66	97.74	115.0	-17.26	

Table 6.2C – Low Channel @ 2402 MHz Spurious Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
144.3	13.62	289.8	100	10.07	23.69	43.5	-19.81	V
144.3	4.02	0	100	10.07	14.09	43.5	-29.41	H
4804	71.48	141.2	100.0	-18.55	52.93	78.54	-25.61	V
4804	75.95	157.9	140.4	-18.55	57.40	78.54	-21.14	H
7206	60.2	302.4	100.0	-15.20	45.00	78.54	-33.54	V
7206	62.34	102.3	100.0	-15.20	47.14	78.54	-31.40	H
9608	59.98	124.6	100.0	-13.45	46.53	78.54	-32.01	V
9608	64.44	157.5	106.7	-13.45	50.99	78.54	-27.55	H
14412	64.22	170.0	100.0	-4.87	39.38	78.54	-39.16	V
14412	64.98	130.5	100.0	-4.87	39.38	78.54	-39.16	H

Table 6.2D– Low Channel @ 2402 MHz Spurious Field Strength (Average)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
4804	81.91	141.2	100.0	-18.55	64.34	78.54	-14.20	V
4804	82.75	157.9	140.4	-18.55	65.18	78.54	-13.36	H
7206	49.11	302.4	100.0	-15.20	34.32	78.54	-44.22	V
7206	55.35	102.3	100.0	-15.20	40.56	78.54	-37.98	H
9608	46.86	124.6	100.0	-13.45	34.27	78.54	-44.27	V
9608	52.14	157.5	106.7	-13.45	39.55	78.54	-38.99	H
14412	64.34	170.0	100.0	-4.87	61.20	78.54	-17.34	V
14412	66.62	130.5	100.0	-4.87	63.48	78.54	-15.06	H

Table 6.2E – Mid Channel @ 2441 MHz Fundamental Signal Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
2441	88.74	163.0	144.5	13.54	102.28	115.0	-12.72	V
2441	91.36	129.1	128.5	13.54	**104.9**	115.0	-10.10	H

Table 6.2F– Mid Channel @ 2441 MHz Fundamental Signal Field Strength (Average)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
2441	87.57	163.0	144.5	13.54	101.11	115.0	-14.89	V
2441	91.33	129.1	128.5	13.54	104.87	115.0	-10.13	H

Table 6.2G – Mid Channel @ 2441 MHz Spurious Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
144.3	17.0	281	100	10.07	27.07	43.5	-15.93	V
144.3	14.31	100	360	10.07	24.38	43.5	-19.12	H
4881	81.33	135.1	100	-18.31	63.02	84.9	-21.88	V
4881	83.22	139.6	100	-18.31	64.91	84.9	-19.99	H
7323	60.68	201.1	136	-15.12	45.56	84.9	-39.34	V
7323	64.32	186.7	100	-15.12	49.2	84.9	-35.7	H
12205	55.09	222.2	100	-9.18	45.91	84.9	-38.99	V
12205	57.37	138.1	100	-9.18	48.19	84.9	-36.71	H
14646	63.68	164.6	100	-3.48	60.20	84.9	-24.7	V
14646	65.36	126.9	100	-3.48	61.88	84.9	-23.02	H
17087	52.85	161.6	100	-4.2	48.65	84.9	-36.25	V
17087	55.34	171.7	100	-4.2	51.14	84.9	-33.76	H

Table 6.2H– Mid Channel @ 2441 MHz Spurious Field Strength (Average)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
4881	79.66	135.1	100	-18.31	61.35	84.9	-23.55	V
4881	81.87	139.6	100	-18.31	63.56	84.9	-21.34	H
7323	53.41	201.1	136	-15.12	38.29	84.9	-46.61	V
7323	58.93	186.7	100	-15.12	43.81	84.9	-41.09	H
12205	44.76	222.2	100	-9.18	35.58	84.9	-49.32	V
12205	47.52	138.1	100	-9.18	38.34	84.9	-46.56	H
14646	55.79	164.6	100	-3.48	52.31	84.9	-32.59	V
14646	57.93	126.9	100	-3.48	54.45	84.9	-30.45	H
17087	42.04	161.6	100	-4.2	37.84	84.9	-47.06	V
17087	44.54	171.7	100	-4.2	40.34	84.9	-44.56	H

Table 6.2I – High Channel @ 2480 MHz Fundamental Signal Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
2480	117.91	25.3	295	-22.65	95.26	115.0	-19.74	V
2480	120.96	106.7	100	-22.65	**98.31**	115.0	-16.69	H

Table 6.2J– High Channel @ 2480 MHz Fundamental Signal Field Strength (Average)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
2480	117.65	25.3	295	**-22.65**	95.00	115.0	-20.0	V
2480	120.66	106.7	100	**-22.65**	98.01	115.0	-16.99	H

Table 6.2K – High Channel @ 2480 MHz Spurious Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
144.3	12.94	281	100	10.07	23.01	43.5	-20.49	V
144.3	6.21	0	100	10.07	16.28	43.5	-27.22	H
826	17.39	162	130.8	24.67	42.06	43.5	-1.44	
826	14.44	147.7	179.4	24.67	39.11	43.5	-4.39	
4960	83.56	135.1	128.9	-17.57	65.99	78.31	-12.32	V
4960	84.38	136.2	100.0	-17.57	66.81	78.31	-11.50	H
7440	59.3	212.1	100.0	-14.79	44.51	78.31	-33.8	V
7440	63.17	114.0	140.9	-14.79	48.38	78.31	-29.93	H
9920	58.57	20.9	120.0	-12.59	45.98	78.31	-32.33	V
9920	61.66	155.7	126.8	-12.59	49.07	78.31	-29.24	H
14880	71.13	146.5	204.5	-3.14	67.99	78.31	-10.32	V
14880	73.03	125.9	100.0	-3.14	69.89	78.31	-8.42	H

Table 6.2L– High Channel @ 2480 MHz Spurious Field Strength (Average)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	15.209/ 15.247 Limit (dBuV/m)	Margin (dB)	Polarization
4960	81.91	135.1	128.9	-17.57	64.34	78.31	-13.97	V
4960	82.75	136.2	100.0	-17.57	65.18	78.31	-13.13	H
7440	49.11	212.1	100.0	-14.79	34.32	78.31	-43.99	V
7440	55.35	114	140.9	-14.79	40.56	78.31	-37.75	H
9920	46.86	20.9	120.0	-12.59	34.27	78.31	-44.04	V
9920	52.14	155.7	126.8	-12.59	39.55	78.31	-38.76	H
14880	64.34	146.5	204.5	-3.14	61.2	78.31	-17.11	V
14880	66.62	125.9	100.0	-3.14	63.48	78.31	-14.83	H

6.3 Conducted Spurious Emissions-Band Edges

Ambient Temperature	**20° C**
Relative Humidity	**21%**
Test Standard/Reference	☒ **FCC Part 15** ☐ **ICES-003** ☐ **CISPR 22**
Frequency Range	2390.0 MHz – 2483.5 MHz
Input Voltage	110 V AC
Line Frequency	60 Hz(NA)
Measurement Parameters	• Place the EUT on the Table and set it in Transmitting Mode • Remove the Antenna from the EUT and connect a low loss RF cable from the antenna port to spectrum analyzer or (RBW: 100kHz, VBW: 100kHz, Span 25MHz, Sweep = Auto) • Mark Peak, 2.390 GHz, 2.4835 GHz and record the max level • Repeat the above procedure for all frequencies.
Test Result	**Full Power** Restricted Band edge (2390 MHz) Level: **-69.322 dBc** Restricted Band edge (2483.5 MHz) Level:**-61.357 dBc** **Normal Power** Restricted Band edge (2390 MHz) Level: **-62.747 dBc** Restricted Band edge (2483.5 MHz) Level:**-61.592 dBc**
Limits	FCC 15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
Changes/Modifications	There were no modifications made to the EUT for this test case
Notes/Remarks	Not Applicable

Tested By: Hua Yan **Test Date:** Apr 6, 2015 ☒ **Applicable**

Table 6.3A–Band Edge Conducted Measurements (PEAK)-Full Power

Frequency (MHz)	Measured Reading (dBm)	Correction Factor (dB)	Corrected Reading (dBm)	Delta to Fundamental (dBc)	15.209/ 15.247 Limit
2402	11.498	0.2	11.698		15dBm
2390	-57.824	0.2	-57.624	-69.322	-20dBc
2480	11.375	0.2	11.575		15dBm
2483.5	-50.616	0.2	-50.416	-61.991	-20dBc
2484.0117	-49.982	0.2	-49.782	-61.357	-20dBc

Table 6.3B–Band Edge Conducted Measurements (PEAK)-Normal Power

Frequency (MHz)	Measured Reading (dBm)	Correction Factor (dB)	Corrected Reading (dBm)	Delta to Fundamental (dBc)	15.209/ 15.247 Limit (dBm)
2402.0000	-8.369	0.2	-8.169		15.0
2399.0358	-66.262	0.2	-66.062	-57.893	-20dBc
2395.9044	-69.077	0.2	-68.877	-60.708	-20dBc
2392.7500	-69.912	0.2	-69.712	-61.543	-20dBc
2390.0000	-76.072	0.2	-75.872	-67.703	-20dBc
2389.6600	-71.116	0.2	-70.916	-62.747	-20dBc
2480.0000	-8.404	0.2	-8.204		15.0
2483.5000	-70.423	0.2	-70.223	-62.019	-20dBc
2484.0327	-69.996	0.2	-69.796	-61.592	-20dBc
2486.6044	-63.677	0.2	-63.477	-55.273	-20dBc

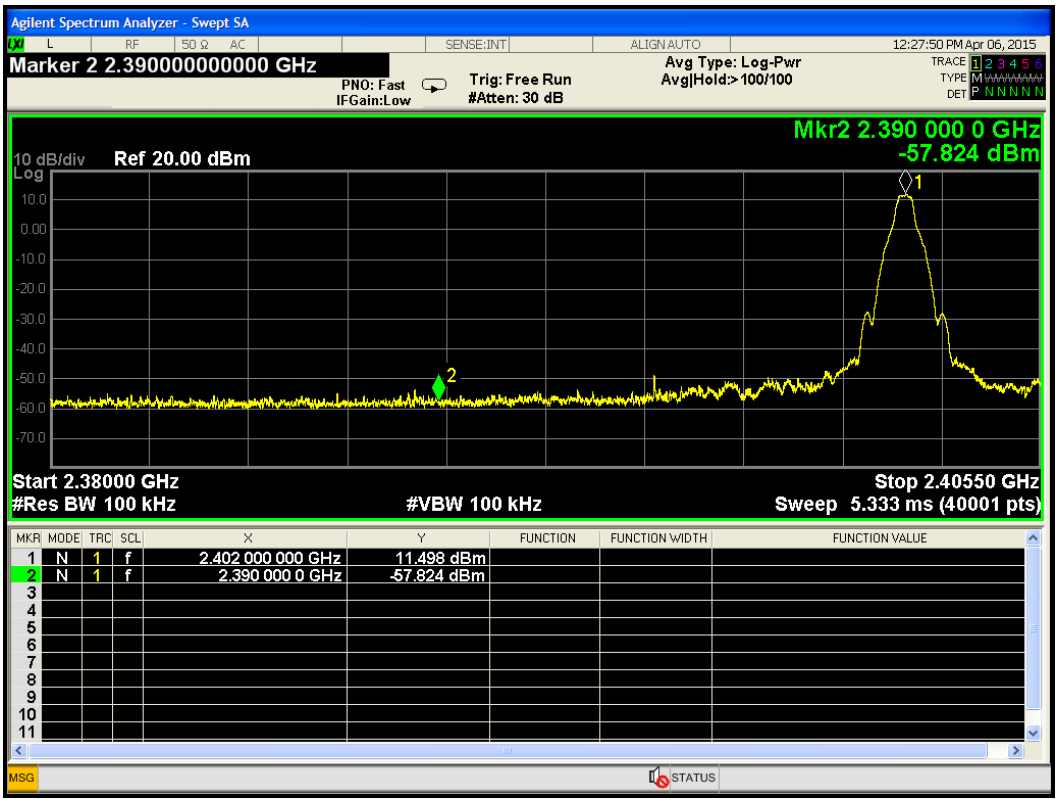


Figure 6.3A – Full Power Mode-Conducted Spurious Emissions –Band Edges-Low Channel

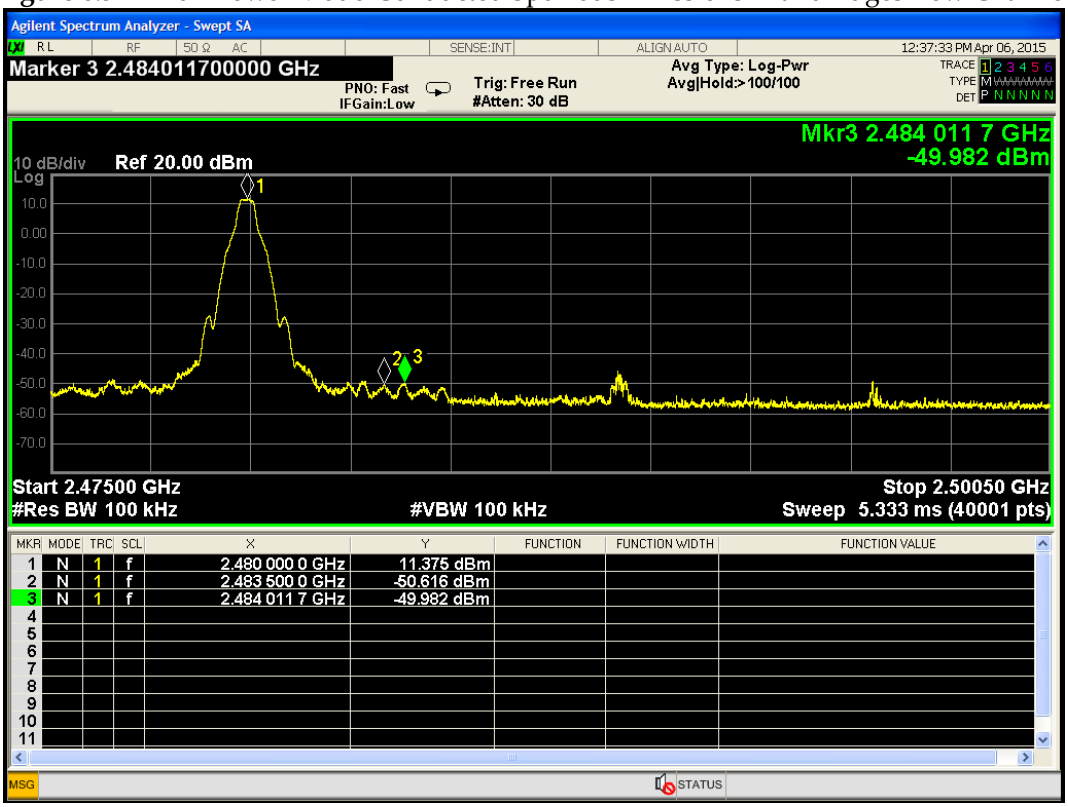


Figure 6.3B – – Full Power Mode-Conducted Spurious Emissions –Band Edges-High Channel

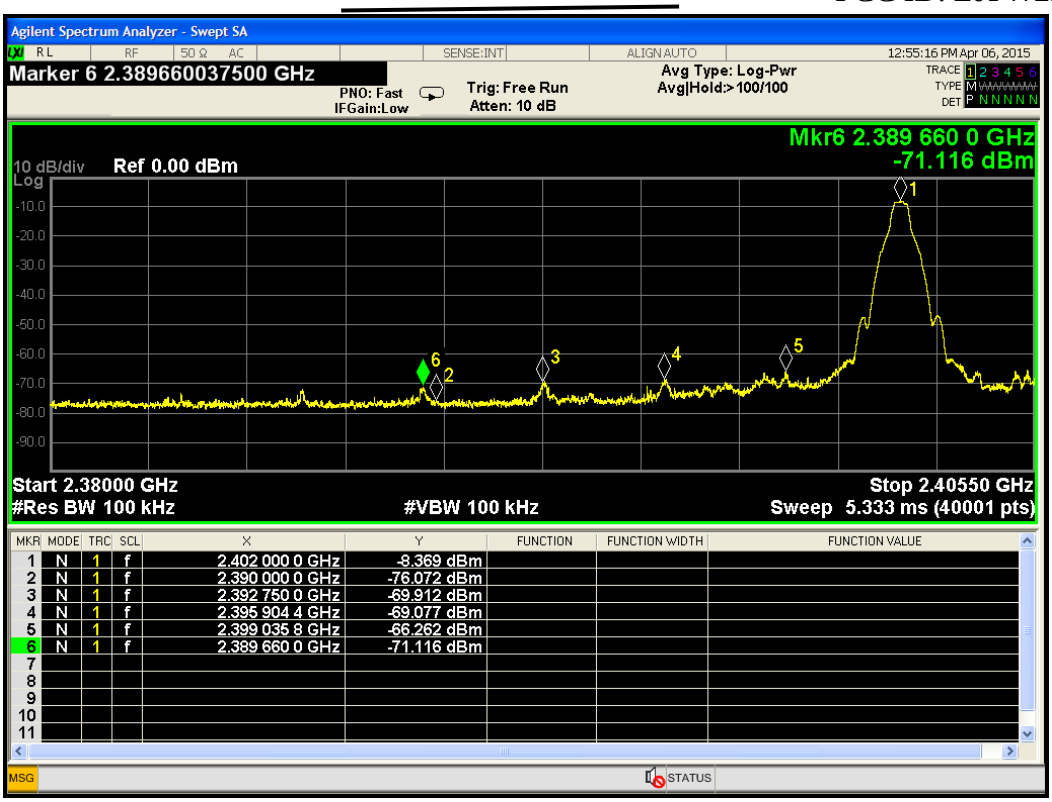


Figure 6.3C – Normal Power Mode-Conducted Spurious Emissions –Band Edges-Low Channel

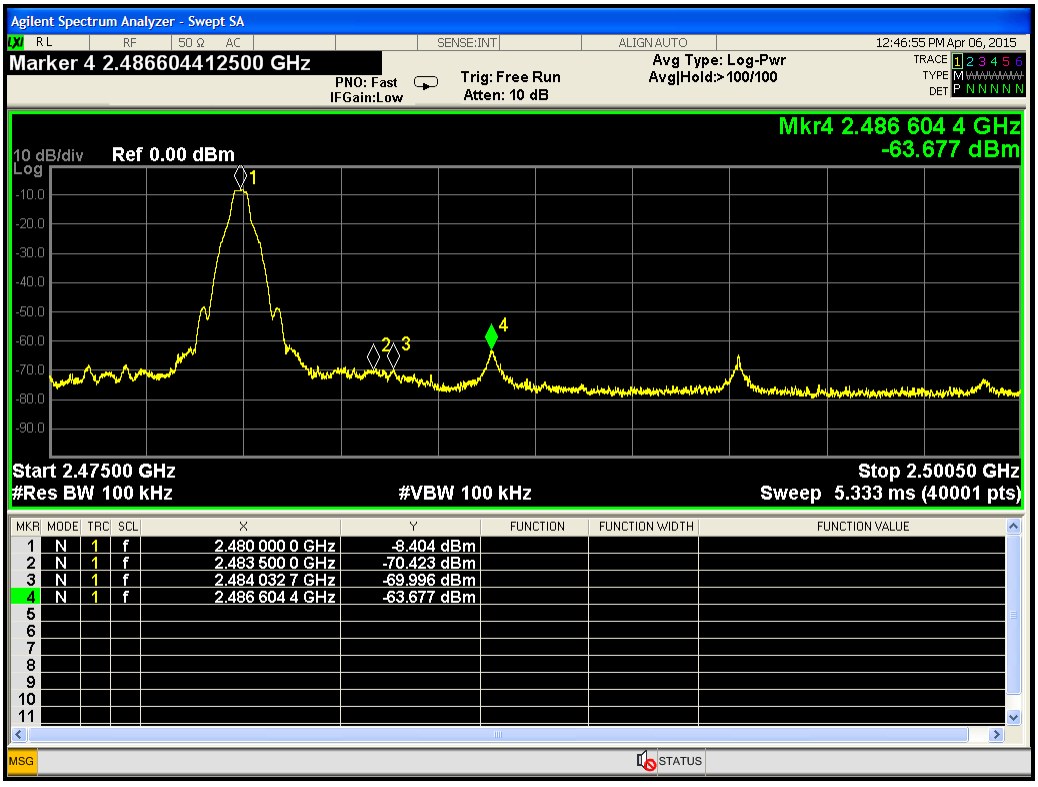


Figure 6.3D– – Normal Power Mode-Conducted Spurious Emissions –Band Edges-High Channel

6.4 Radiated Spurious Emissions-Band Edges

Ambient Temperature	**22° C**
Relative Humidity	**25%**
Test Standard/Reference	☒ **FCC Part 15** ☐ **ICES-003** ☐ **CISPR 22**
Frequency Range	2390 MHz – 2483.5 MHz
Input Voltage	110 V AC
Line Frequency	60 Hz(NA)
Measurement Parameters	Test distance is 3m • Test Distance: 3m • The EUT was placed on the turn table per EUT installation procedures • The turn table shall rotate 0 -360 degrees and the receiving antenna is varied from 1m to 4m to find out the highest emission at a given frequency. • Maximization procedure was performed on the six highest emissions to ensure EUT compliance • Each emission was to be maximized by changing the polarization of receiving antenna to both horizontal and vertical • Repeat the above procedure until all frequency measurements are completed • Radiated emission measurements in the frequency range from 30 MHz – 1000 MHz were made with an instrument using Peak and QP detector mode. RBW: 100kHz, VBW: 100kHz for Peak, RBW: 120kHz, VBW: 300kHz for QP • Radiated Band edge emission measurements in the frequency range above 1000 MHz were made with an instrument using Peak detector mode. . RBW: 100kHz, VBW: 100kHz
Test Result	**Normal Power** Restricted Band edge (2390 MHz) Level: **-39.69 dBc** Restricted Band edge (2483.5 MHz) Level:**-45.06 dBc**
Limits	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
Changes/Modifications	There were no modifications made to the EUT for this test case
Notes/Remarks	Not Applicable

Tested By: Jaeheon Yun **Test Date:** Mar 24, 2015 ☒ **Applicable**

Table 6.4A– Normal Power Low Channel @ 2402 MHz Band Edge Signal Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	Delta to Fundamental (dBc)	15.209/ 15.247	Polarization
2402	97.66	135	100	-22.613	75.047			V
2390	57.97	135	100	-22.613	35.357	-39.69	-20dBc	V
2402	103.91	39.4	128.6	-22.613	81.297			H
2390	61.03	39.4	128.6	-22.613	38.417	-42.88	-20dBc	H

Table 6.4B– Normal Power High Channel @ 2480 MHz Band Edge Signal Field Strength (PEAK)

Frequency (MHz)	Measured Reading (dBuV)	Azimuth Angle (deg)	Antenna Height (cm)	Correction Factor (dB)	Corrected Reading (dBuV/m)	Delta to Fundamental (dBc)	15.209/ 15.247	Polarization
2480	105.97	47.2	120.3	-22.643	83.327			V
2483.5	60.91	47.2	120.3	-22.643	38.267	-45.06	-20dBc	V
2480	112.31	105.6	100	-22.643	89.667			H
2483.5	63.42	105.6	100	-22.643	40.777	-48.89	-20dBc	H

6.5 Antenna Conducted Output Power

Ambient Temperature	**20° C**
Relative Humidity	**19%**
Test Standard/Reference	☒ **FCC Part 15** ☐ **ICES-003** ☐ **CISPR 22**
Frequency Range	150kHz – 30.0 MHz
Input Voltage	110 V AC
Line Frequency	60 Hz(NA)
Measurement Parameters	• Place the EUT on the Table and set it in Transmitting Mode • Remove the Antenna from the EUT and connect a low loss RF cable from the antenna port to spectrum analyzer or power meter (RBW: 1 MHz, VBW: 1MHz) • Record Max Reading • Repeat the above procedure for all frequencies.
Test Result	Peak Output Power:**12.373 dBm (172.7mW)**
Limit	For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.
Changes/Modifications	There were no modifications made to the EUT for this test case
Notes/Remarks	Not Applicable

Tested By: Hua Yan **Test Date:** Apr 06, 2015 ☒ **Applicable**

Table 6.5A– Antenna Conducted Output Power-BT Classic-Max Power

Frequency (MHz)	Measured Reading (dBm)	Cable Loss (dB)	Corrected Reading (dBm)	Corrected Reading (mW)	15.247 Limit (mW)
2402	12.173	0.2	12.373	17,27	125
2441	11.991	0.2	12.191	16.56	125
2480	12.031	0.2	12.231	16.72	125

Table 6.5B– Antenna Conducted Output Power-BT Classic-Normal Operation

Frequency (MHz)	Measured Reading (dBm)	Cable Loss (dB)	Corrected Reading (dBm)	Corrected Reading (mW)	15.247 Limit (mW)
2402	-7.790	0.2	-7.590	0.174	125
2441	-7.622	0.2	-7.422	0.181	125
2480	-7.899	0.2	-7.699	0.170	125

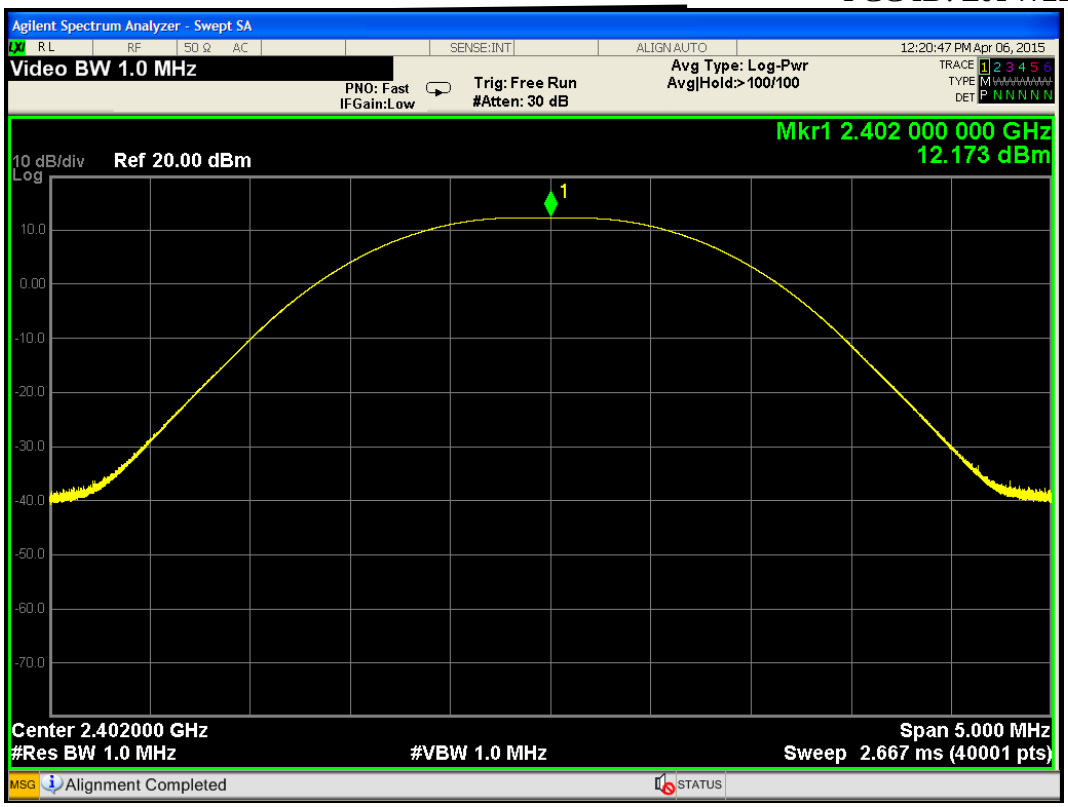


Figure 6.5A – High Power Mode-Conducted Output Power -Low Channel

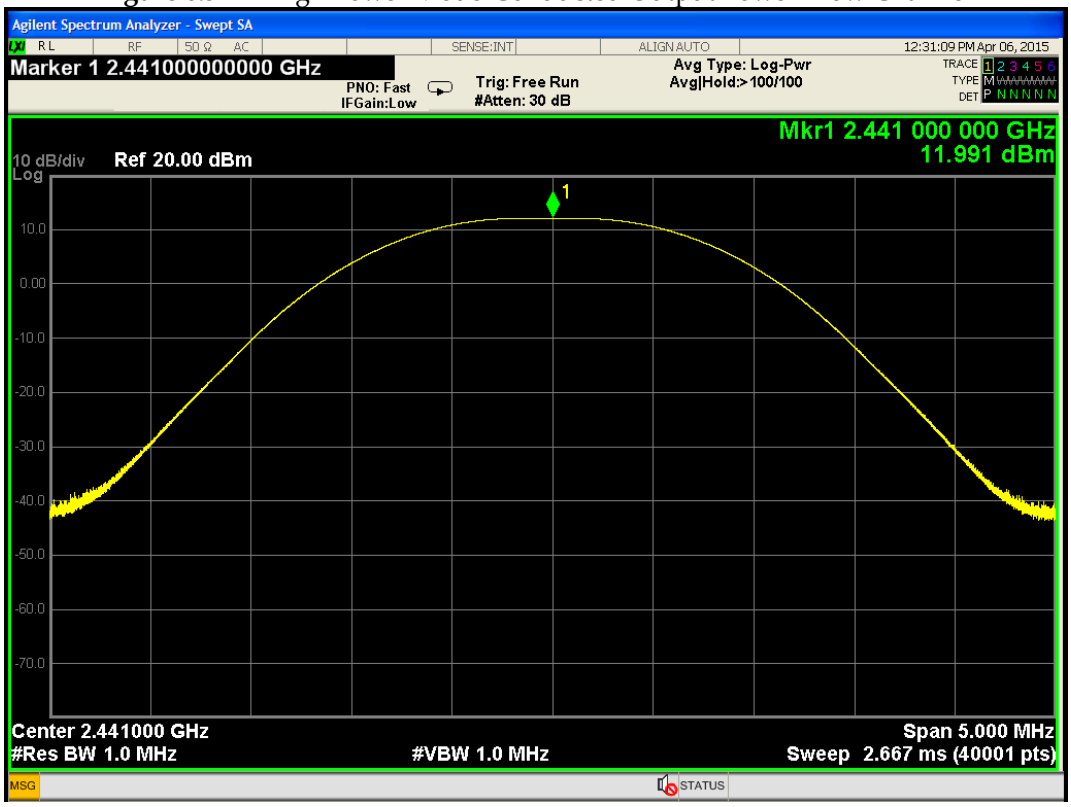


Figure 6.5B – High Power Mode-Conducted Output Power -Mid Channel

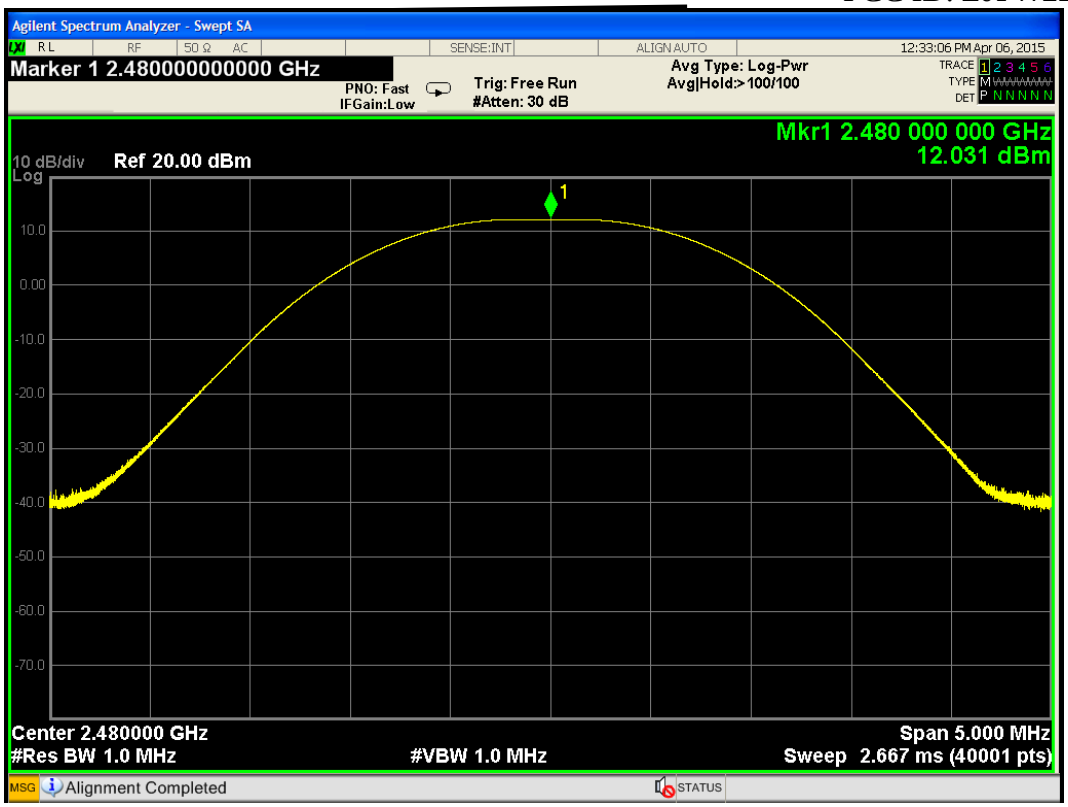


Figure 6.5C – High Power Mode-Conducted Output Power -High Channel

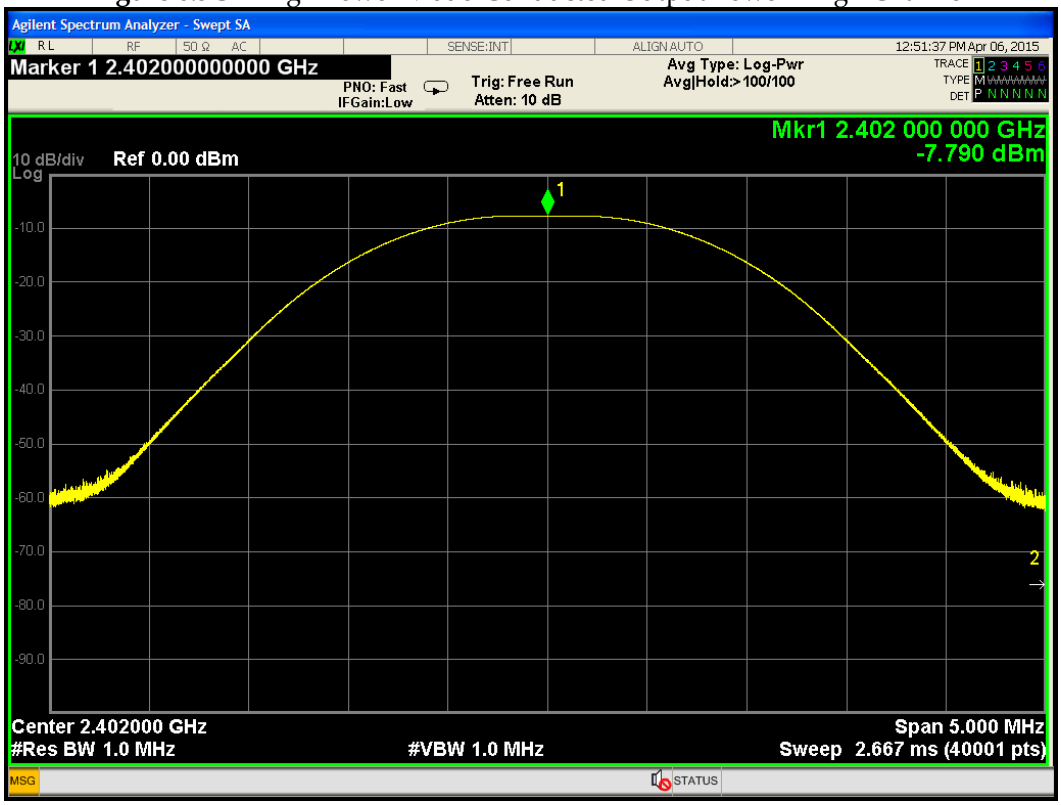


Figure 6.5D – Normal Power Mode-Conducted Output Power -Low Channel

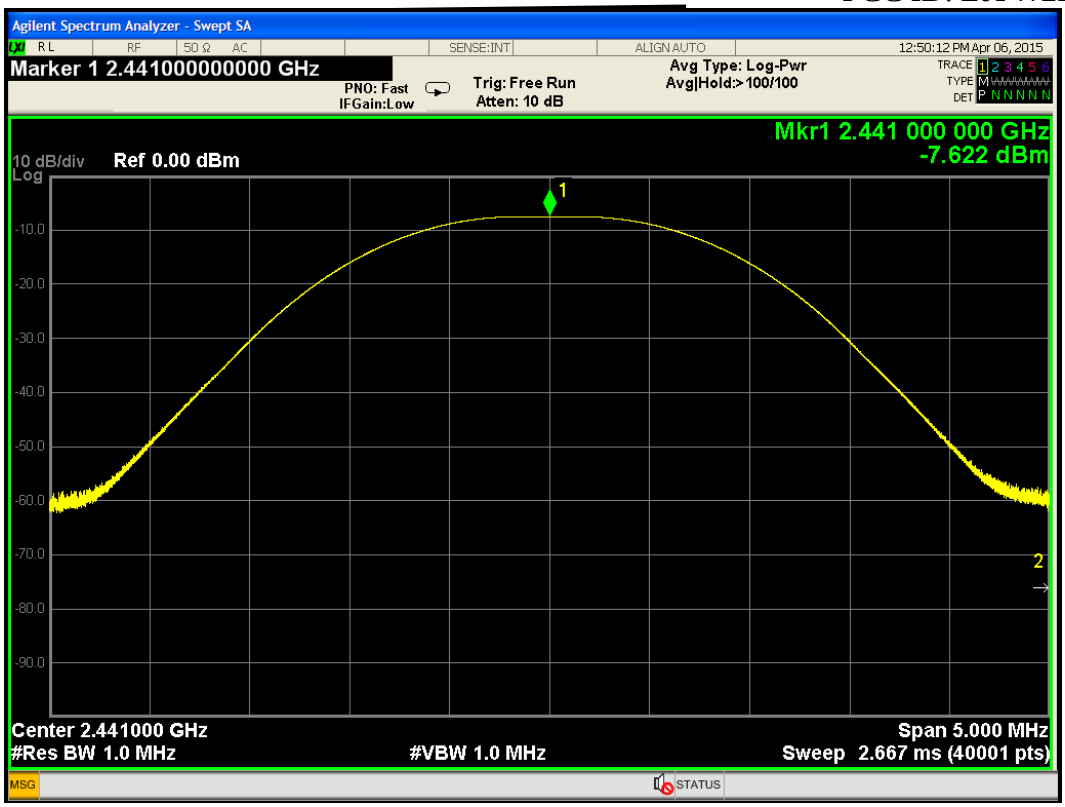


Figure 6.5E – Normal Power Mode-Conducted Output Power -Mid Channel

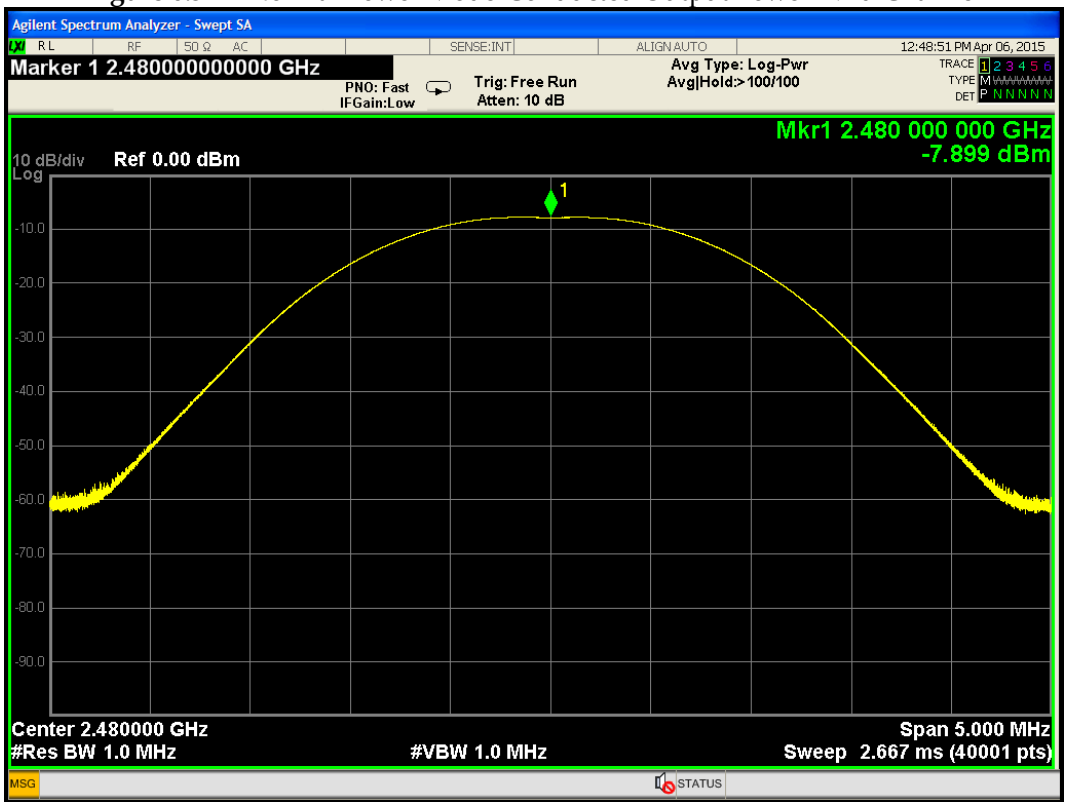
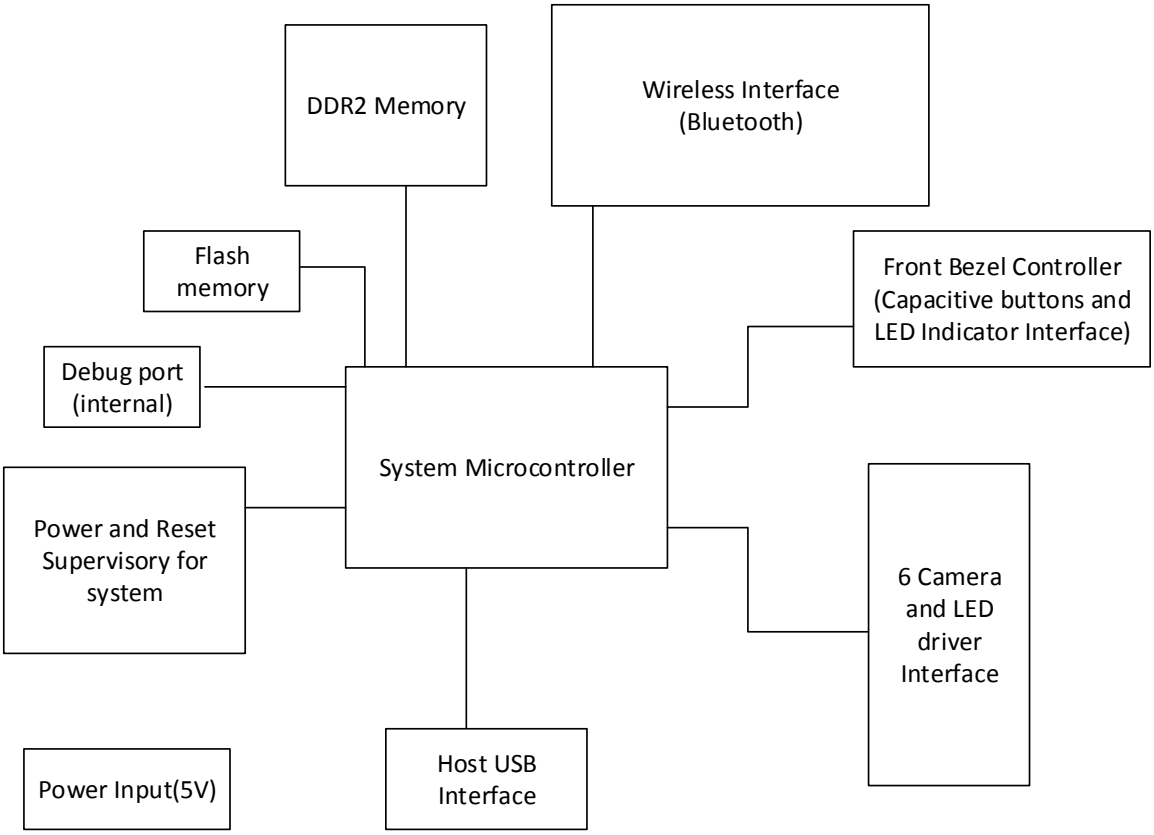


Figure 6.5F – Normal Power Mode-Conducted Output Power -High Channel

7.0 Appendix A – Test Sample Description

System Block Diagram



Support Equipment:

- Laptop was used communicating to EUT to change RF channels, modulations and power levels to place the device in specific test modes using proprietary test software
- Adapter used for communicating to EUT to change RF channels and modulations: USB to RS-232 DB9 serial Adapter (Prolific PL2303 chipset) with 12” cable. Similar to StarTech ICUSB232V2.
- 6ft USB A-A cable: StarTech USBFAA_6

8.0 Appendix B – List of Abbreviations and Acronyms

A/m	Amperes per meter	kPa	kilopascal
AC	Alternating Current	kV	kilovolt
ACF	Antenna Correction Factor	LISN	Line Impedance Stabilization Network
ANSI	American National Standards Institute	LNA	Low Noise Amplifier
CISPR	Comité International Spécial des Perturbations Radioélectriques	MHz	Megahertz
d	Measurement Distance in meters	uH	microhenry
dB	Decibels	uF	microfarad
dBuA	Decibels above one microamp	uS	microsecond
dBuV	Decibels above one microvolt	PRF	Pulse Repetition Frequency
dBuA/m	Decibels above one microamp per meter	RF	Radio Frequency
dBuV/m	Decibels above one microvolt per meter	RMS	Root Mean Square
DC	Direct Current	TWT	Travelling wave Tube
DUT	Device Under Test	V/m	Volts per meter
DSL	Digital Subscriber Line	VCP	Vertical Coupling Plane
E	Electric Field Intensity		
EN	European Standards (Norm)		
ESD	Electrostatic Discharge		
EUT	Equipment Under Test		
f	Frequency		
FCC	Federal Communication Commission		
GRP	Ground Reference Plane		
H	Magnetic Field Intensity		
HCP	Horizontal Coupling Plane		
Hz	Hertz		
IC	Industry Canada		
IEC	International Electrotechnical Commission		
kHz	Kilohertz		

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