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EMC testing of the HiTech Safety Displays Ltd. Arc Generating Hot Stick RF device in accordance with:

FCC Part 15.231, ANSI C63.4-2014, ANSI C63.10-2013

FCC ID: 2AHDNAGHS2

Test Personnel: Imran Akram, D. Raynes

Prepared for: HiTech Safety Displays Ltd

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REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2016-02-17	D. Raynes	Initial draft submitted for review.
Release 1	2016-02-22	M. Rousseau	Sign off

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1.0 INTRODUCTION

1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.231, ANSI C63.4-2014 and ANSI C63.10-2013. All test procedures, limits, criteria, and results described in this report apply only to the HiTech Safety Displays Ltd. Arc Generating Hot Stick test sample, referred to herein as the EUT (Equipment Under Test).

This report does not imply product endorsement by the Electronics Test Centre, SCC, NAVLP, A2LA, nor any Canadian Government agency.

1.2 Applicant

This test report has been prepared for HiTech Safety Displays Ltd, located in Sherwood Park, Alberta, Canada.

1.3 Test Sample Description

As provided to ETC (Airdrie) by HiTech Safety Displays Ltd:

Product Name:	Arc Generating Hot Stick
Model #	AGHS2
Serial #	ETC-001
Power:	Internal Battery

The device is a wireless device. It incorporates an internal antenna.

1.4 General Test Conditions and Assumptions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

1.5 Scope of Testing

Tests were performed in accordance with FCC Part 15.231, ANSI C63.4-2014 and ANSI C63.10-2013.

The EUT was also tested as an unintentional radiator, as reported separately.

1.5.1 Test Methodology

Test methods are documented in the part of Section 2 of this report associated with each particular Test Case.

1.5.2 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

1.5.3 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

2.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

Test Case	Test Type	Specification	Test Sample	Mods	Config.	Result
2.1	AC Conducted Emissions	FCC Part 15.207(a)	Arc Generating Arc Generating Hot Stick	none	see § 2.1	**N/A**
2.2	Antenna Requirement	FCC Part 15.203	Arc Generating Arc Generating Hot Stick	none	see § 2.2	**Compliant**
2.3	Periodic Operation	FCC Part 15.231(a)	Arc Generating Arc Generating Hot Stick	none	see § 2.4	**Compliant**
2.4	Duty Cycle	ANSI C63.10 FCC part15.35(c)	Arc Generating Arc Generating Hot Stick	none	see § 2.5	**Compliant**
2.5	Occupied Bandwidth	ANSI C63.10 FCC part 15.231(c)	Arc Generating Arc Generating Hot Stick	none	see § 2.3	**Compliant**
2.6	EUT Position	ANSI C63.4	Arc Generating Arc Generating Hot Stick	none	see § 2.6	**Compliant**
2.7	Tx Radiated Emissions	FCC Part 15.231(b)	Arc Generating Hot Stick	none	see § 2.7	**Compliant**
2.8	RF Exposure	FCC Part 1.1307(b)(1)	Arc Generating Hot Stick	none	N/A	**Compliant**

Refer to the test data for applicable test conditions.

2.1 AC Power Line Conducted Emissions: Transmit Mode

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel:	**Standard: FCC Part 15.207**
Test Method: TM-EMC 11	**Basic Standard: ANSI C63.4-2014**
Date:	

EUT status: N/A

Comments: The device is only powered by an internal battery.
There is no connection to the AC mains.

2.2 Antenna Requirements

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel: Imran Akram	**Standard: FCC PART 15.203**
Date: 2016-02-02	

EUT status: Compliant

Specification: FCC Part 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

2.2.1 Test Methodology

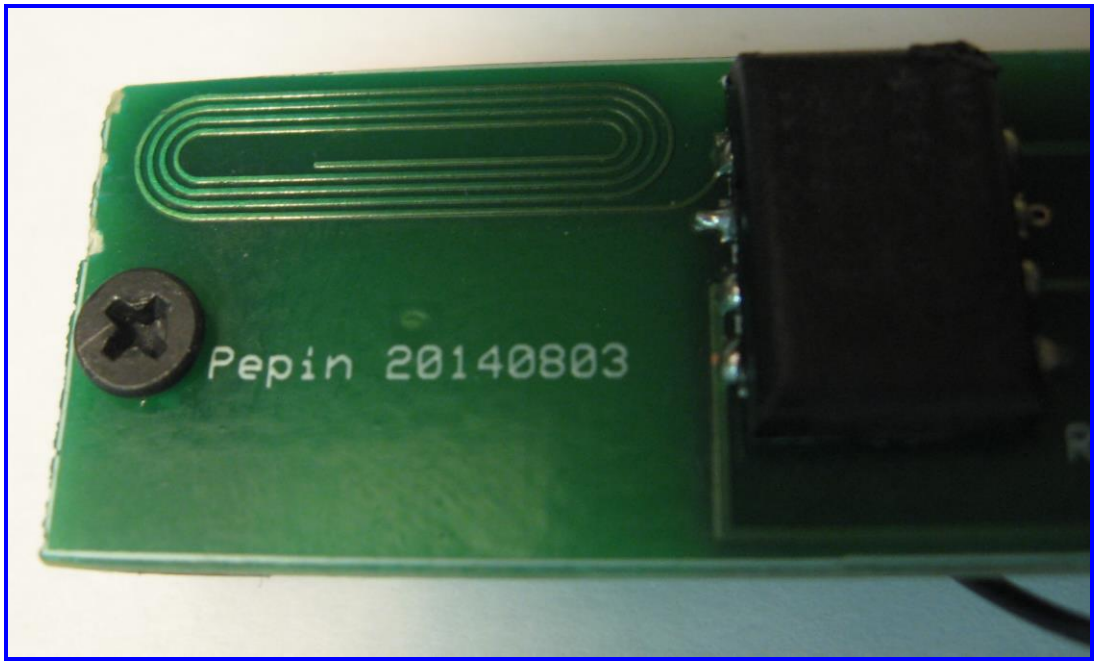
The EUT is visually inspected to assess compliance.

2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.2.3 Assessment

The antenna is integral to the printed circuit board of the device, preventing any replacement or substitution by the end user.



2.3 Periodic Operation Characteristics

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel: Imran Akram	**Standard: FCC PART 15.231**
Test Method: TM-EMC 13	**Basic Standard: ANSI C63.10: 2013**
Date: 2015-02-04 (18.3° C,15.6 % RH)	

EUT status: Compliant

Specification: FCC Part 15.231(a)

The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after 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 two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(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

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

2.3.1 Test Methodology:

This measurement is performed with modulation.

If the EUT antenna is integral to the device, the radiated output is measured with an antenna placed to capture the emissions.

The spectrum analyzer is set for a 0 Hz frequency span (time domain) centered on the carrier. The RBW is set to 100 kHz and VBW is set to 300 kHz. The Peak detector is used, with the trace set to Video or level Trigger and Single Sweep. The Marker Delta function measures the transmit duration of resulting trace.

2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.3.3 Test Equipment

Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due Date
EMI receiver	Agilent	N9038A	6130	2015-06-17	2016-06-17

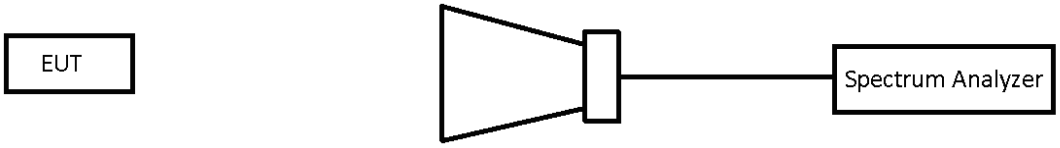
2.3.4 Test Sample Verification, Configuration & Modifications

The EUT does not support continuous transmission, voice, video or the remote control of toys. The EUT sends a control signal to trigger a display function in response to a button being pressed by the operator. There is no provision for automatic initiation of wireless transmission. There are no periodic supervisory signals transmitted by this device.

The EUT transmission was manually initiated.

The EUT met the requirements without modification.

EUT configuration for Periodic Operation testing:



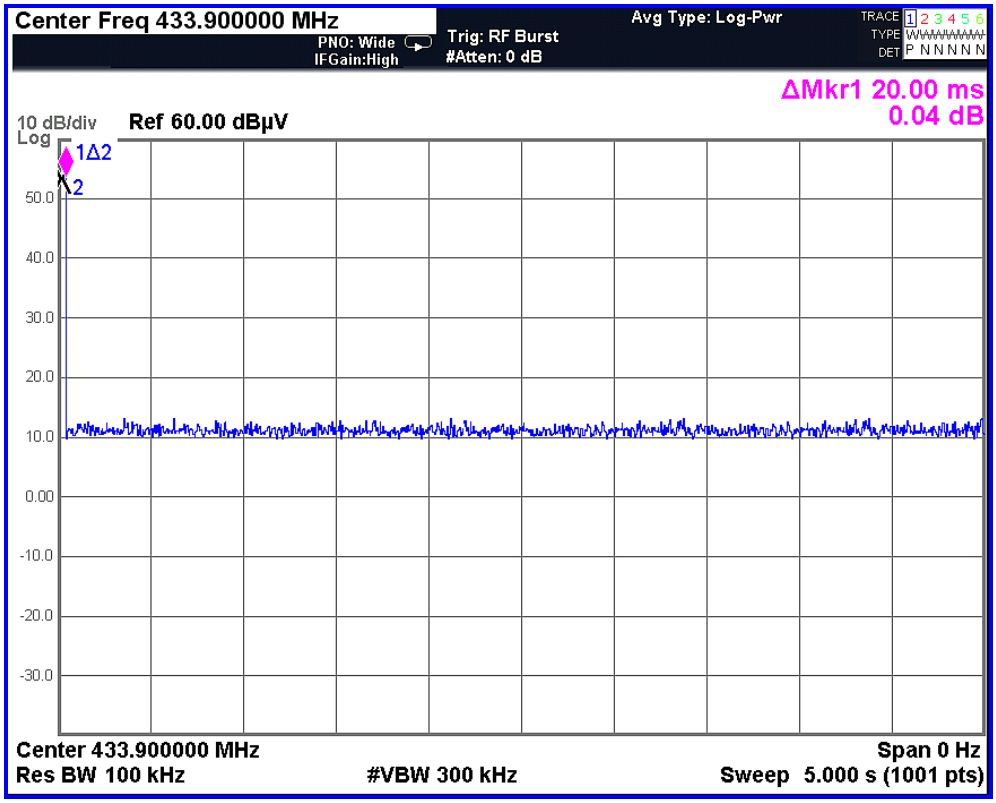
Result:

EUT ceases transmission immediately after the button is released.

2.3.5 Transmission Duration Data

Duration of transmission: 20 ms

Screen Captures from the spectrum analyzer:



2.4 Duty Cycle Correction Factor

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel: David Raynes	**Standard: FCC Part 15.231**
Test Method: TM-EMC 14	**Basic Standard: ANSI C63.10-2013**
Date: 2016-02-11 (18.3° C, 15.6% RH)	

EUT status: Compliant

Specification: ANSI C63.10-2013, Clause 11.6(b)

Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the ON and OFF times of the transmitted signal

§15.35(c), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds

2.4.1 Test Methodology: ANSI C63.10-2013 Clause 11.6(b)

This measurement is performed with modulation.

Set the spectrum analyzer to Zero-Span (time domain), centered on the channel frequency. Adjust the sweep time to clearly capture the transmitted signal. Set the RBW to ≥100 kHz. Set the VBW to 3* RBW. Use the Peak detector. Use the Marker functions to measure the 'on time' of the transmitter. This may require adding up the pulses within the Tx burst. Capture a 100 ms time span to determine the Duty Cycle.

2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.4.3 Test Equipment

Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due Date
EMI receiver	Agilent	N9038A	6130	2015-06-17	2016-06-17

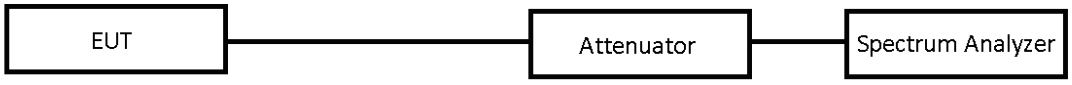
2.4.4 Test Sample Verification, Configuration & Modifications

The EUT does not support continuous transmission, voice, video or the remote control of toys. The EUT sends a control signal to trigger a display function in response to a button being pressed by the operator. There is no provision for automatic initiation of wireless transmission. There are no periodic supervisory signals transmitted by this device.

The EUT transmission was manually initiated.

The EUT met the requirements without modification.

EUT configuration for Periodic Operation testing:



2.4.5 Duty Cycle Calculation

The Duty Cycle is defined as the ratio of the 'On' time during a 100 ms interval.

Duty Cycle = (Pulse Length in ms) / 100

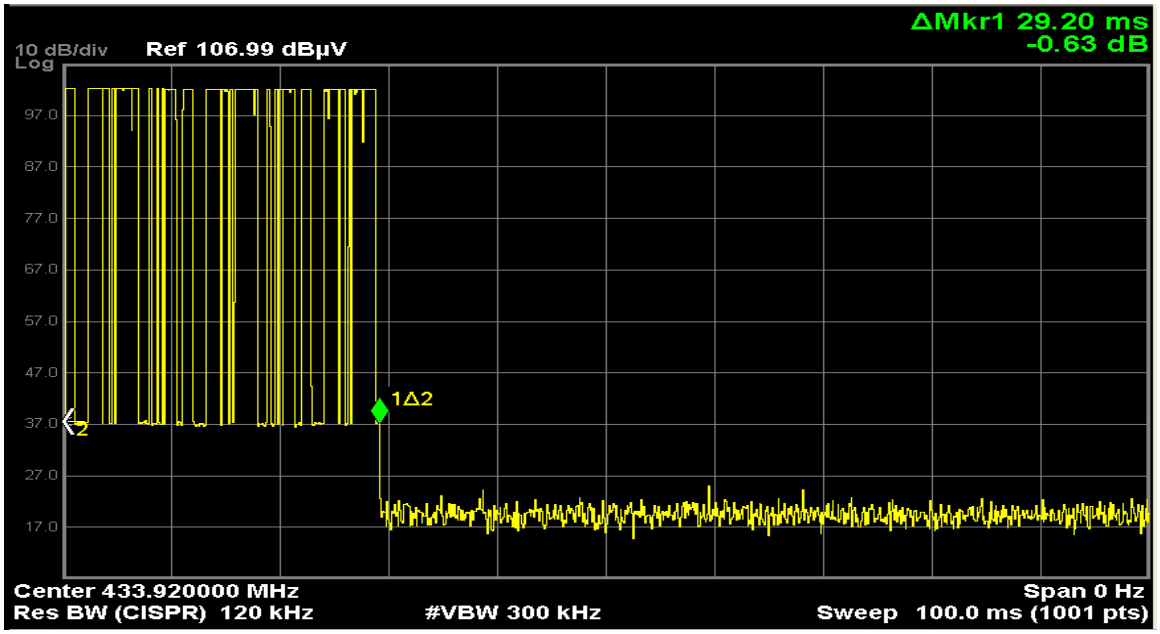
The Duty Cycle Correction Factor is determined according to the following equation:

Duty Cycle Correction Factor (dB) = 20 * $\log_{10}$(Duty Cycle)

Total ON time = 23.0 ms

Duty Cycle = 23.0 / 100 = 0.23

DCCF = 20 * $\log_{10}$(0.23) = **-12.76 dB**



2.5 Channel Occupied Bandwidth

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel: Imran Akram	**Standard: FCC PART 15.231**
Test Method: TM-EMC 13	**Basic Standard: ANSI C63.10: 2009**
Date: 2016-02-04 (18.3° C,15.6% RH)	

EUT status: Compliant

Specification: FCC Part 15.231(c)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

2.5.1 Test Methodology: ANSI C63.10-2009, Clause 6.9.1

This measurement is performed with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. If the EUT antenna is integral to the device, an antenna is placed to capture the transmitted signals.

The spectrum analyzer is set for a frequency span selected to clearly display the channel. The RBW is set ≥ 1% of the 20 dB BW. The Peak detector is used, with the trace set to Max Hold.

The automated 99% BW function of the spectrum analyzer is engaged, and the 20 dB OBW is measured with the x dB function.

2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.5.3 Test Equipment

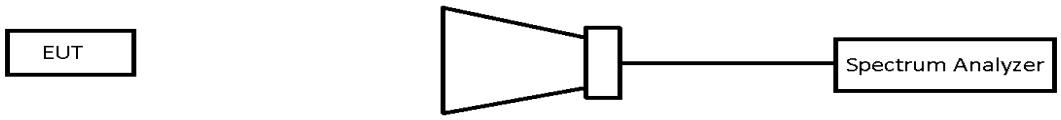
Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration	Due Date
EMI receiver	Agilent	N9038A	6130	2015-06-17	2016-06-17

2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously by pressing ON/OFF button. The output was modulated as in normal operation. The EUT met the requirements without modification.

EUT configuration for Occupied Bandwidth testing:

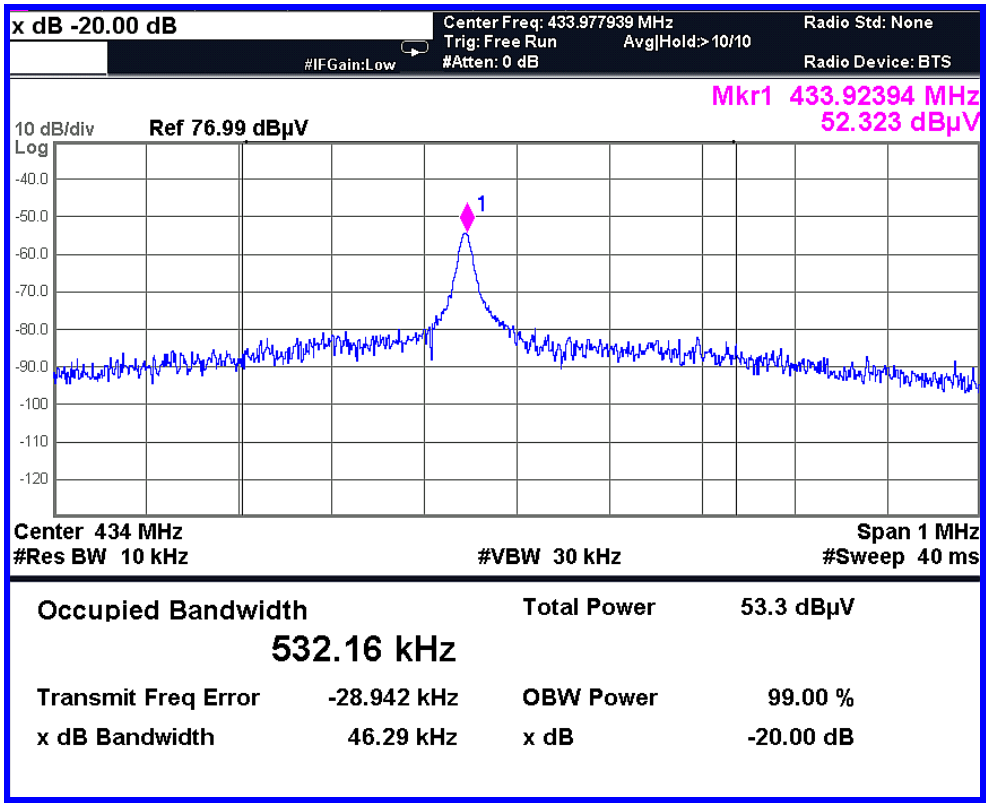


2.5.5 Channel Occupied Bandwidth Data:

Carrier Frequency [MHz]	Maximum 20 dB OBW [MHz]	Measured 20 dB OBW [MHz]	Margin [MHz]
433.92	1.08	0.0463	1.03

Screen Capture from the spectrum analyzer:

20 dB OBW, 433.92 MHz:



2.6 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel: Imran Akram	**Standard: FCC Part 15.231**
Test Method: TM-EMC 14	**Basic Standard: ANSI C63.4-2014**
Date: 2016-02-03(19.8° C, 25.6% RH)	

EUT status: Flat position selected

Specification: ANSI C63.4-2014, Clause 6.3.2.1

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a nonconducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

2.6.1 Test Methodology: ANSI C63.4-2014, Clause 6.3.2.1

The EUT is set to a selected channel with test-specific software. The output is modulated as in normal operation.

Assessment measurements are performed with an antenna appropriate to the carrier frequency. The EUT is placed 80 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The EUT is rotated in azimuth over 360 degrees to find the direction of maximum emission. Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the Peak detector and recorded.

This process is repeated for all three orthogonal axes of the EUT, in both polarizations.

2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.6.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document "Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002." as based on the "ISO Guide to the Expression of Uncertainty in Measurement, 1995."

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	30 MHz – 1 GHz	±4.6 dB

2.6.4 Test Equipment

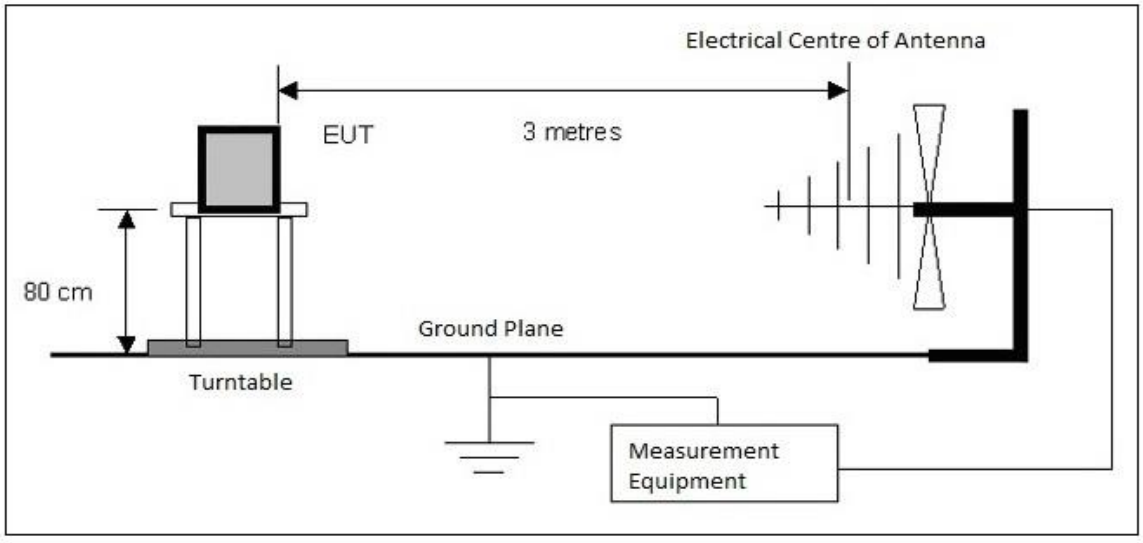
Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due-Date
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A	N/A
EMI receiver	Agilent	N9038A	6130	2015-06-17	2016-06-17
Biconilog Antenna	ARA	LPB-2520/A	4318	2015-02-20	2017-02-20

2.6.5 Test Sample Verification, Configuration & Modifications

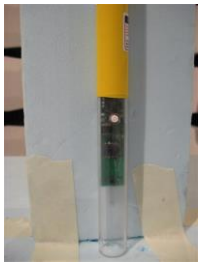
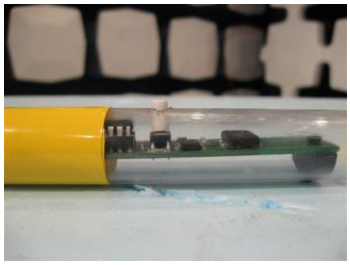
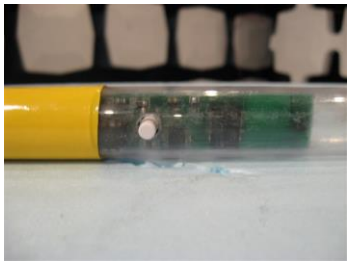
The EUT was made to transmit continuously by using tape to hold down the trigger button. The output was modulated as in normal operation. The EUT was not modified.

EUT configuration for EUT Positioning:



2.6.6 Peak Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, and the uncorrected spectrum analyzer reading.

EUT Position		F [MHz]	SA Reading [dBuV]	Azimuth [deg]	Antenna Height [cm]	Polarization
Upright		433.9	31.25	0 -360	100	Horizontal
			52.31	0 -360	100	Vertical
Flat		433.9	54.07	0 -360	100	Horizontal
			46.18	0 -360	100	Vertical
On Edge		433.9	53.77	0 -360	100	Horizontal
			46.85	0 -360	100	Vertical

2.7 Radiated Spurious Emissions

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick**
Test Personnel: I. Akram	**Standard: FCC Part 15.231**
Test Method: TM-EMC 13	**Basic Standard: ANSI C63.10-2013**
Date: 2016-02-(3,4) (19.8° C, 25.6% RH)	

EUT status: Compliant

Specification: FCC Part 15.231(b)

In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental		Field strength of spurious emissions	
	(µv/m)	(dBµv/m)	(µv/m)	(dBµv/m)
40.66-40.70	2,250	67	225	47
70-130	1,250	61.9	125	41.9
130-174	1,250 to 3,750*	61.9 to 71.5*	125 to 375*	41.9 to 51.5*
174-260	3,750	71.5	375	51.5
260-470	3,750 to 12,500*	71.5 to 81.9*	375 to 1,250*	51.5 to 61.9*
Above 470	12,500	81.9	1,250	61.9

*Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

§15.209 Radiated emission limits; general requirements.

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

Frequency (MHz)	Field strength		Measurement distance (meters)	
	(µv/m)	(dBµv/m)		
0.009-0.490	2400/F(kHz)	128.5- 93.8	300	3
0.490-1.705	24000/F(kHz)	73.8 – 62.97	30	3
1.705-30.0	30	69.54	30	3
30-88	100**	40	3	3
88-216	150**	43.52	3	3
216-960	200**	46.02	3	3
Above 960	500	53.98	3	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §15.231 and §15.241.

Specification: ANSI C63.10-2013, Clause 5.9

An unlicensed wireless device shall be tested to demonstrate that any emissions within restricted frequency bands specified by the regulatory authority are spurious emissions only. Unless otherwise specifically authorized, the spurious emission shall meet prescribed limits and the fundamental transmit signal shall not fall within these frequency bands. Test reports shall provide measured data to demonstrate compliance with these regulatory requirements.

Restricted Bands of Operation:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000 *	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000 *	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000 *	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000 *	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000 **	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000 **	960.00000 – 1240.0000 ***	3260..0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000 *	1300.0000 – 1427.0000 ***	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475- 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000 ****		

* US only ** Canada 108 – 138 MHz *** Canada 960 – 1427 MHz **** Canada only

2.7.1 Test Methodology: ANSI C63.10-2013, Clause 6.6.4

From 9kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 Mhz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna.

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 6 dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

Note: The EUT was assessed for worst-case orientation. All radiated testing was performed with this orientation, as shown in the test setup photos.

2.7.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.7.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

Test Method	Frequency	Uncertainty
Radiated Emissions Level	30 MHz – 1 GHz	±4.6 dB
Radiated Emissions Level	1 GHz – 26.5 GHz	±5.31 dB

2.7.4 Test Equipment

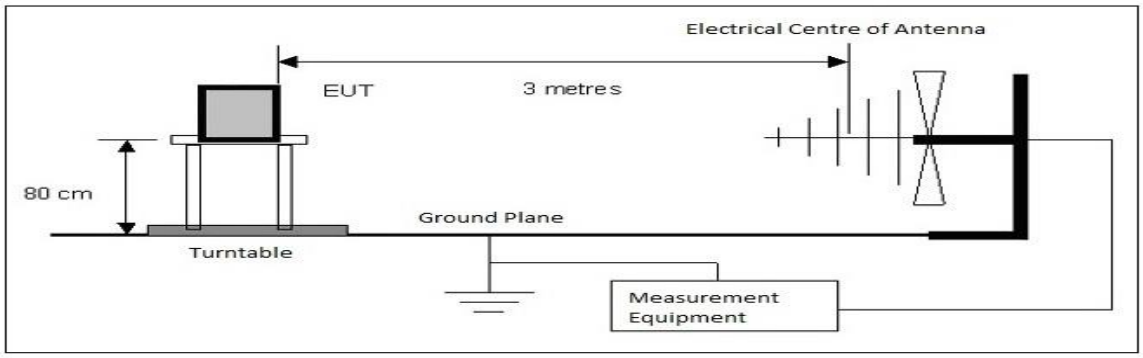
Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due-Date
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A	N/A
EMI receiver	Agilent	N9038A	6130	2015-06-17	2016-06-17
Loop antenna	EMCO	6502	10868	2015-04-10	2017-04-10
Biconilog Antenna	ARA	LPB-2520/A	4318	2015-02-20	2017-02-20
DRG Horn	EMCO	3115	19357	2014-09-17	2016-09-17
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	Monitored	Monitored

2.7.5 Test Sample Verification, Configuration & Modifications

The EUT was made to transmit continuously by using tape to hold down the trigger button. The output was modulated as in normal operation. The EUT was not modified.

EUT configuration for Radiated Spurious Emissions testing:



2.7.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbμV/m.

Delta = Field Strength - Limit

Notes:

- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- Preliminary scans were performed in Transmit mode.

- The EUT was assessed up to 5 GHz.
- Lowest EUT frequency is 8 MHz (MCU clock). No emission higher than 6dB below the limits were reported during the measurement made from 8 MHz to 30 MHz.

Negative values for Delta indicate compliance.

Unintentional radiated emission Test Result Data

Freq. Marker	Freq. [MHz]	Raw reading [dBµv]	Det	Antenna Factor [dB/m]	Cable Loss [dB]	Corrected Reading [dBµv/m]	FCC 15.209 Limit [dBµv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	177.8552	14.39	QP	9.3	3.1	26.79	43.52	-16.73	180	175	Horizontal
2	186.0322	18.44	QP	9.4	3.1	30.94	43.52	-12.58	347	179	Horizontal
3	191.8226	16.86	QP	9.6	3.1	29.56	43.52	-13.96	15	200	Horizontal
4	212.3986	11.67	QP	11.1	3.3	26.07	43.52	-17.45	358	158	Horizontal
5	232.3222	9.86	QP	11.9	3.4	25.16	46.02	-20.86	3	143	Horizontal
6	261.1762	11.99	QP	12.5	3.6	28.09	46.02	-17.93	186	151	Horizontal
7	278.4459	14.91	QP	13.0	3.7	31.61	46.02	-14.41	6	114	Horizontal
8	288.9787	16.85	QP	12.7	3.8	33.35	46.02	-12.67	185	121	Horizontal
9	305.3498	17.13	QP	13.3	3.9	34.33	46.02	-11.69	4	100	Horizontal
10	338.9348	19.89	QP	14.2	4.1	38.19	46.02	-7.83	176	113	Horizontal
11	359.0447	21.52	QP	15.4	4.2	41.12	46.02	-4.90	173	100	Horizontal
12	368.4715	17.79	QP	15.5	4.2	37.49	46.02	-8.53	163	108	Horizontal
13	380.2000	12.12	QP	15.0	4.3	31.42	46.02	-14.60	169	104	Horizontal
14	531.6212	10.74	QP	18.0	4.9	33.64	46.02	-12.38	341	188	Horizontal
15	703.8164	6.05	QP	19.7	5.6	31.35	46.02	-14.67	221	125	Horizontal
16	723.3767	6.30	QP	19.8	5.7	31.80	46.02	-14.22	149	120	Horizontal
17	748.6239	5.90	QP	21.0	5.8	32.70	46.02	-13.32	26	116	Horizontal
18	926.4919	3.41	QP	22.5	6.4	32.31	46.02	-13.71	312	184	Horizontal
19	950.8231	3.29	QP	22.6	6.5	32.39	46.02	-13.63	356	272	Horizontal
20	185.7773	6.97	QP	9.4	3.1	19.47	43.52	-24.05	104	276	Vertical
21	195.0924	6.44	QP	9.7	3.2	19.34	43.52	-24.18	279	229	Vertical
22	200.6894	3.89	QP	9.7	3.2	16.79	43.52	-26.73	282	248	Vertical
23	350.1326	7.00	QP	14.9	4.1	26.00	46.02	-20.02	101	348	Vertical
24	366.1779	5.79	QP	15.5	4.2	25.49	46.02	-20.53	106	321	Vertical
25	370.7478	5.95	QP	15.5	4.2	25.65	46.02	-20.37	81	311	Vertical

QP - Quasi-Peak detector

*** Restricted Band**

Freq. Marker	Freq. [GHz]	Raw reading [dBµv]	Det	Antenna Factor [dB/m]	Cable Loss [dB]	Corrected Reading [dBµv/m]	FCC 15.209 Limit [dBµv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	1.251	46.16	Av	26.3	-52.5	19.96	53.98	-34.02	118	338	Horizontal
2	1.639	45.3	Av	27.5	-51.2	21.60	53.98	-32.38	240	110	Horizontal
3	1.948	44.53	Av	28.7	-50.0	23.23	53.98	-30.75	0	119	Horizontal
4	1.250	46.18	Av	26.3	-52.5	19.98	53.98	-34.00	267	100	Vertical
5	1.272	46.34	Av	26.3	-52.3	20.34	53.98	-33.64	73	102	Vertical
6	1.950	44.46	Av	28.7	-50.0	23.16	53.98	-30.82	356	102	Vertical
7	1.979	44.5	Av	28.8	-49.9	23.40	53.98	-30.58	248	118	Vertical

Av - average detection

Transmitter Radiated Emission Test Result Data

Field Strength of Fundamental test result

Marker	Freq. (MHz)	Raw reading (dBµV)	Detector	Antenna Factor (dB/m)	Cable Loss (dB)	Duty Cycle Correction Factor (dB)	Corrected Peak Reading (dBµV/m)	FCC 15.231(b) Limit (dBµV/m)	Field Strength Margin [dB]	Azimuth (Deg)	Height (cm)	Polarization
1	433.9196	55.28	PK	16.2	4.5	N/A	75.98	100.83	-24.85	208	230	Horizontal
1	433.9196	55.28	PK	16.2	4.5	-12.76	63.22	80.83	-17.61	208	230	Horizontal
2	433.9196	50.98	PK	16.2	4.5	N/A	71.68	100.83	-29.15	266	227	Vertical
2	433.9196	50.98	PK	16.2	4.5	-12.76	58.92	80.83	-21.91	266	227	Vertical

Field Strength of Spurious Peak Emission test result

Freq. Marker	Freq. [GHz]	Raw reading [dBµv]	Detector	Antenna Factor [dB/m]	AMP Gain [dB]	Corrected Reading [dBµv/m]	FCC 15.231(b) Peak-Limit [dBµv/m	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
3	1.736	69.91	PK	28	-50.6	47.31	80.83	-33.52	249	165	Horizontal
4	2.169	66.51	PK	29.2	-49.8	45.91	80.83	-34.92	213	164	Horizontal
1	3.905	58.1	PK	33.9	-47.5	44.50	80.83	-36.33	180	100	Horizontal
5	1.736	62.19	PK	28	-50.6	39.59	80.83	-41.24	93	173	Vertical
6	2.169	63.15	PK	29.2	-49.8	42.55	80.83	-38.28	69	243	Vertical
7	2.604	61.65	PK	29.8	-48.6	42.85	80.83	-37.98	100	170	Vertical
2	4.494	59.42	PK	33.6	-45.8	47.22	80.83	-33.61	360	100	Vertical

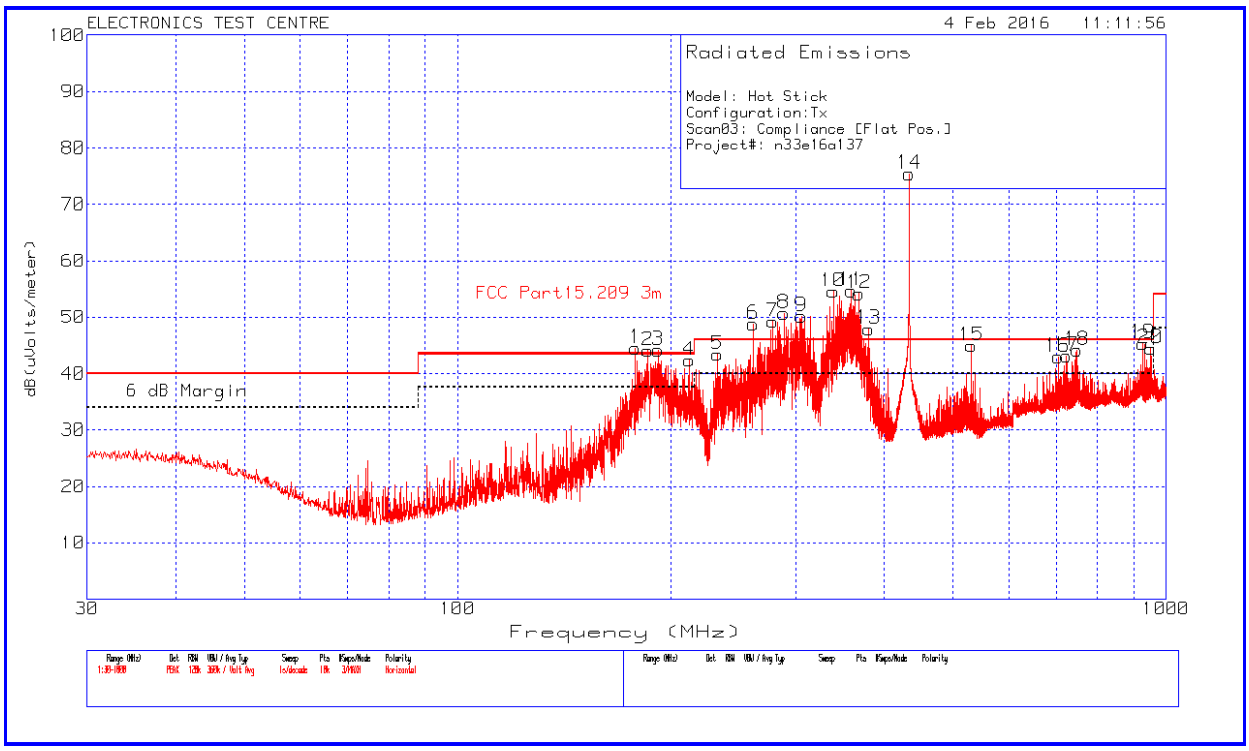
Field Strength of Spurious Average Emission test result

Freq. Marker	Freq. [GHz]	Corrected Reading [dBµv/m]	Detector	Duty Cycle Correction Factor [dB]	Corrected Average Reading [dBµv/m]	FCC 15.231(b) Avg-Limit [dBµv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
3	1.736	47.31	PK	-12.76	34.55	60.83	-26.28	249	165	Horizontal
4	2.169	45.91	PK	-12.76	33.15	60.83	-27.68	213	164	Horizontal
1	3.905	44.50	PK	-12.76	31.74	60.83	-29.09	180	100	Horizontal
5	1.736	39.59	PK	-12.76	26.83	60.83	-34.00	93	173	Vertical
6	2.169	42.55	PK	-12.76	29.79	60.83	-31.01	69	243	Vertical
7	2.604	42.85	PK	-12.76	30.09	60.83	-30.74	100	170	Vertical
2	4.494	47.22	PK	-12.76	34.46	60.83	-26.37	360	100	Vertical

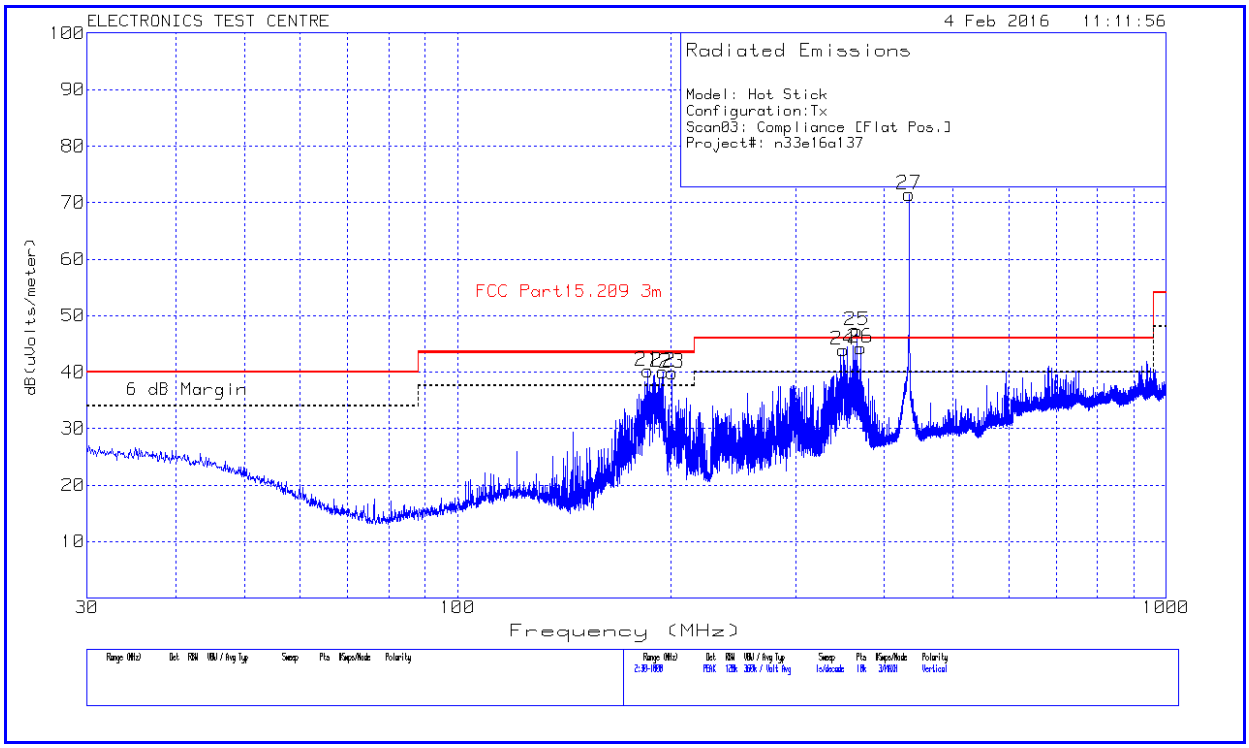
Note: Spectrum analyzer setting for measurement:

- 30 – 1000 MHz: Peak Detector, RBW: 120KHz, VBW: 360KHz
- Above 1 GHz: Peak Detector, RBW: 1MHz, VBW: 3MHz
- Duty Cycle Correction Factor as calculated from §15.35(c)
- Average field Strength (dBuv/m) = Peak field strength(dBuv/m) + Duty Cycle correction Factor (dB)

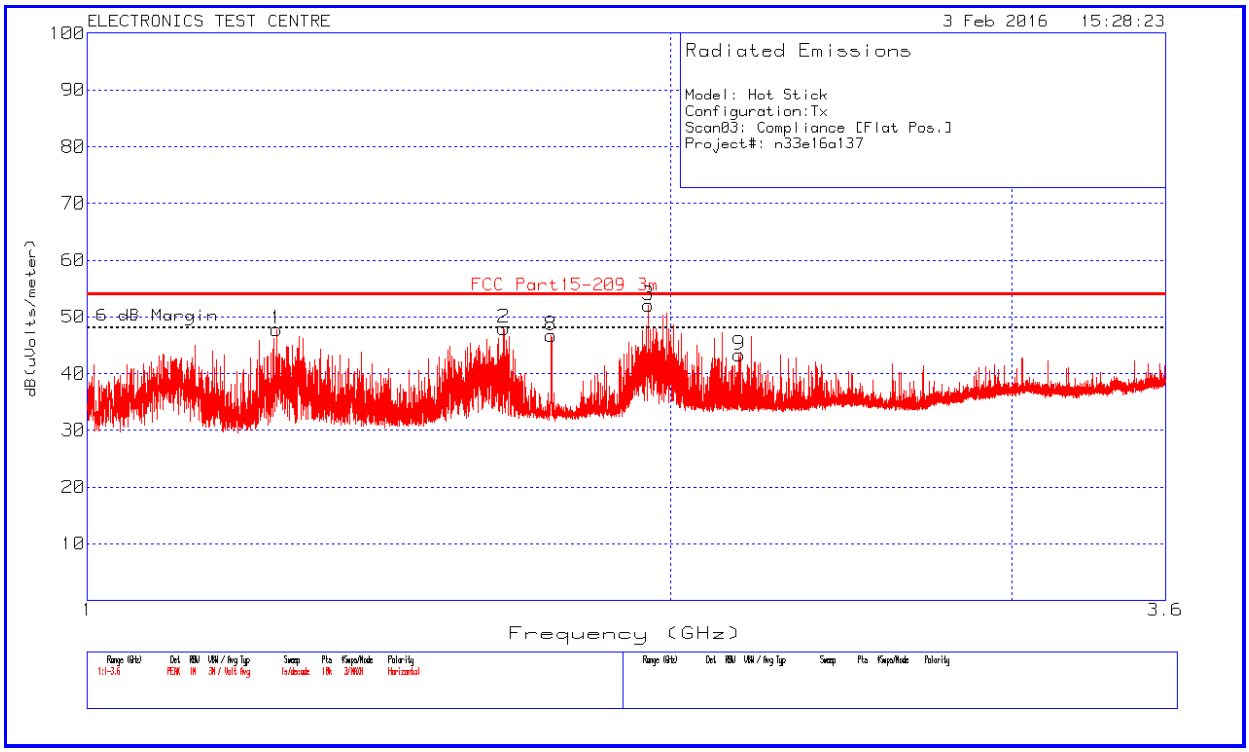
Plot of Radiated Emissions: Horizontal polarization



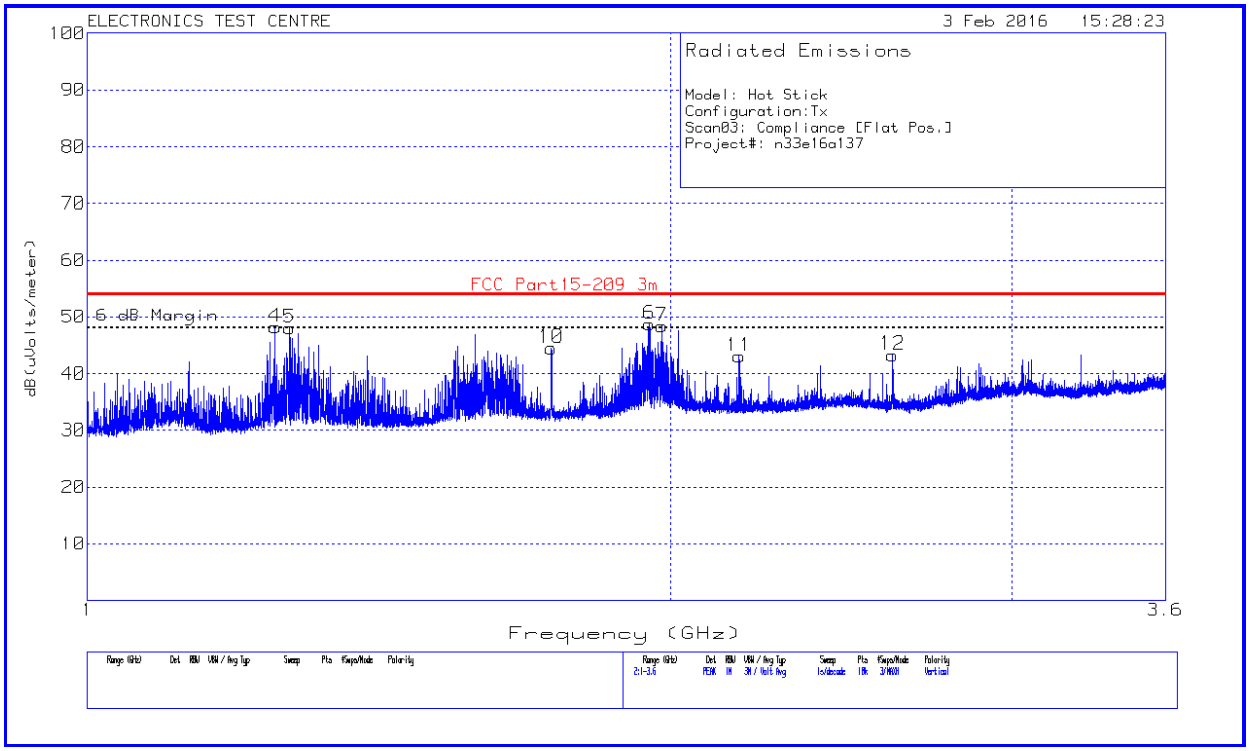
Plot of Radiated Emissions: Vertical polarization



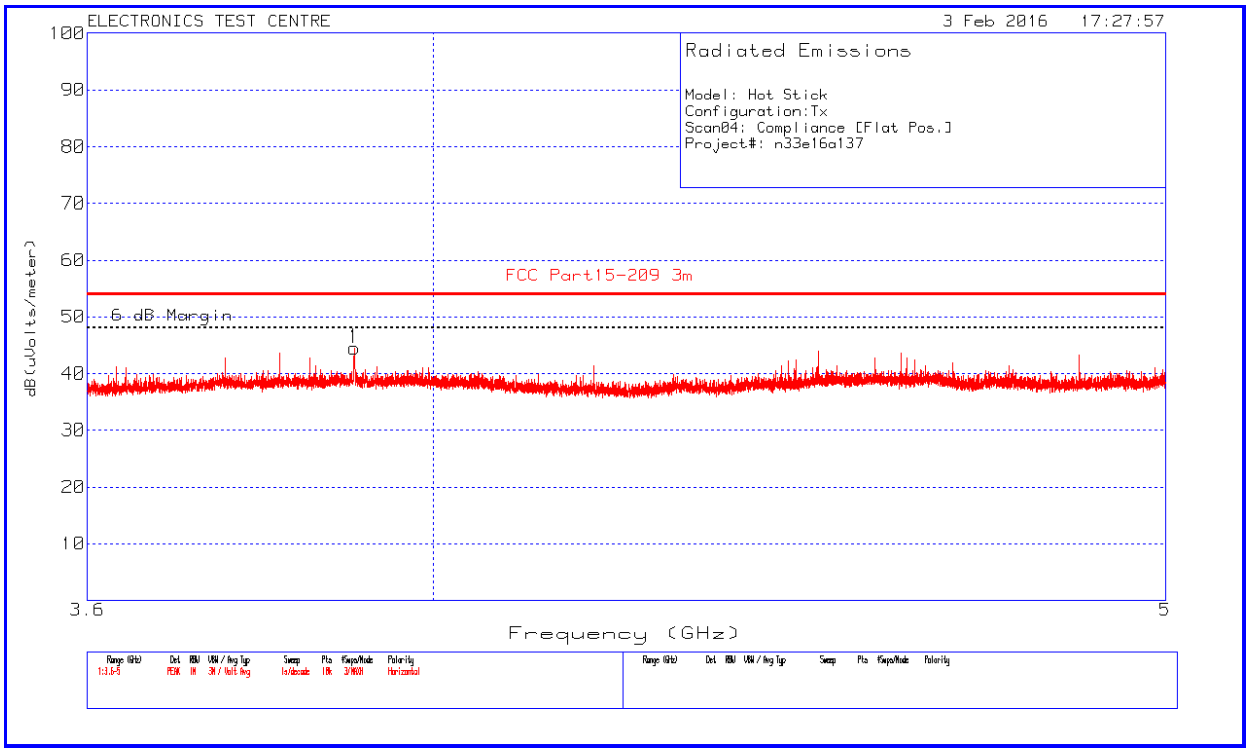
Plot of Radiated Emissions: Horizontal polarization



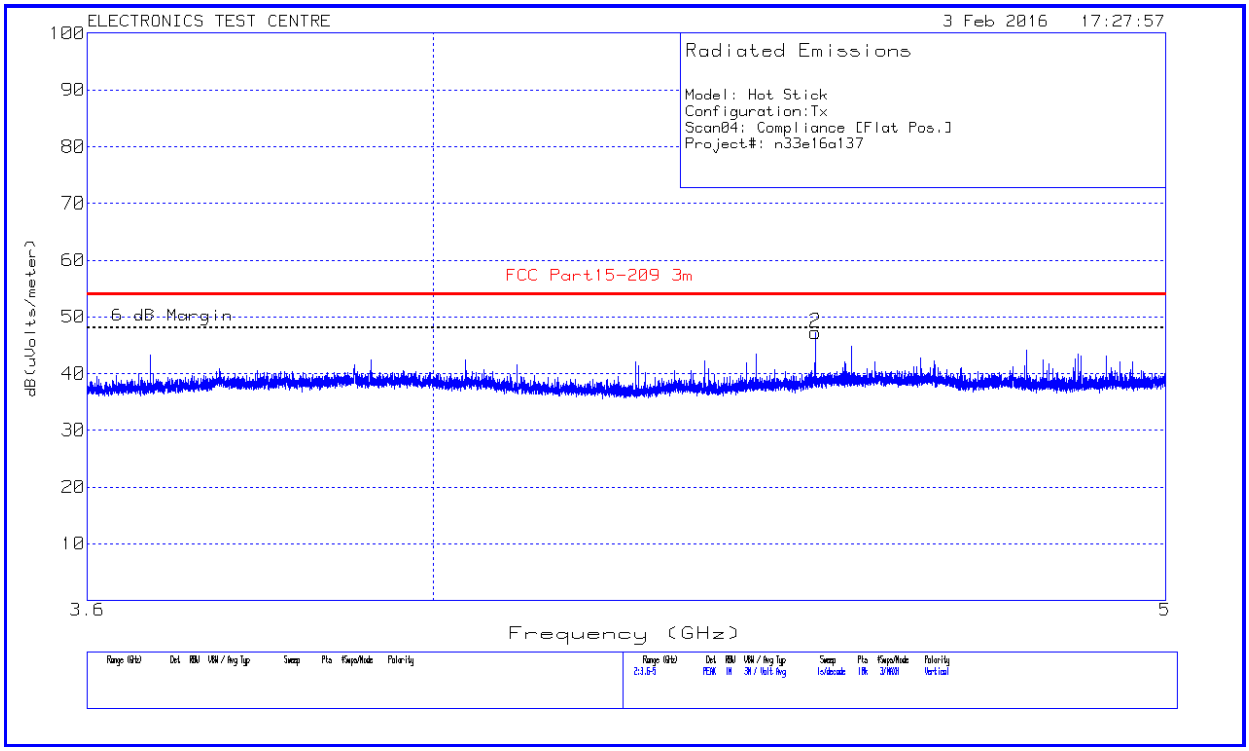
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.8 RF Exposure

Test Lab: Electronics Test Centre, Airdrie	**EUT: Arc Generating Hot Stick** **Standard: FCC PART 1.1307(b)(1)**
EUT status: Compliant	

Compliant: See the Environmental Assessment provided in a separate Exhibit.

3.0 TEST FACILITY

3.1 Location

The Arc Generating Hot Stick was tested for emissions at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Designation Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

3.2 Grounding Plan

The Arc Generating Hot Stick was placed at the centre of the test chamber turntable on top of a polystyrene foam table. The EUT was not grounded, in accordance with HiTech Safety Displays Ltd specifications.

3.3 Power Supply

All EUT power was supplied by internal batteries. New batteries were used for testing.

3.4 Emissions Profile

Ambient emission profiles were generated throughout the tests and are included in the test data.

End of Document