



REPORT

For

Dali Wireless, Inc.

535 Middlefield Road, Suite 280,
Menlo Park, California
94025, U.S.A.

Date: December 21, 2016
Report No.: 13774-2E
Revision No.: 02
Project No.: 13774
Equipment: Quad Band High Power Remote Unit
Model No.: HD43-4-NA-CEHI-O4HF
FCC ID: HCOHD434NACEHIO4A



ONE STOP GLOBAL CERTIFICATION SOLUTIONS



3128-20800 Westminster Hwy, Richmond, BC
V6V 2W3, Canada
Phone: 604-247-0444
Fax: 604-247-0442
www.labtestcert.com

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FCC Part 22/24/27	
Report reference No.	13774-2E
Report Revision History:	<ul style="list-style-type: none"> ✓ Rev. 0(Draft): October 27, 2016 ✓ Rev. 01: Corrected Model number and FCC ID – Released December 08, 2016 ✓ Rev. 02: Corrected List of test items and add some photos – Released December 21, 2016
Tested by (printed name and signature)	David Johanson 
Approved by (printed name and signature)	Jeremy Lee. 
Date of issue	December 21, 2016
<p>Note: By signing this report, both the Testing Technician and the Reviewer hereby declare to abide by the applicable LabTest policies: 1.) Statement of Independence # 3014 (LabTest Employees), 2.) Independence, Impartiality, and Integrity #1039, clause 11 (Engineering Service Subcontractors), or 3.) Independence, Impartiality, and Integrity #1019, clause 3.5 (Testing Subcontractors).</p>	
FCC Site Registration No.:	552549
IC Site Registration No.:	5970A
Testing Laboratory Name	LabTest Certification Inc.
Address	3128 – 20800 Westminster Hwy, Richmond, B.C. V6V-2W3
OATS Test Location Name	LabTest Certification Inc.
Address	5340 – 164 Street, Surrey, BC, Canada
Applicant's Name	Dali Wireless, Inc.
Address	535 Middlefield Road, Suite 280, Menlo Park, CA, U.S.A. 94025
Manufacturer's Name	Same as Applicant
Address	Same as Applicant
Test specification	Field Strength of Radiated Emissions - Only
Standards	FCC Parts 22/24/27
Date Test sample received	Sept 21, 2016
Date of Testing	Sept. 21 to Oct. 10, 2016
Test item description	Quad Band High Power Remote Unit
Manufacturer	Same as Applicant
Model and/or type reference	HD43-4-NA-CEHI-O4HF
Serial numbers	N/A
Transmitter Board ID	Multiple
Frequency Range:	Multiple Bands 698-2155MHz
Type of modulation:	Multiple Modulations

Power (W):	+20 Watt (MAX)
Rating(s)	-48Vdc 16Amps
Equipment mobility	Fixed
Operating condition	-40 to +55°C
Nominal Voltages for:	<input checked="" type="checkbox"/> stand-alone equipment <input type="checkbox"/> combined (or host) equipment <input type="checkbox"/> test jig
Supply Voltage:	_____ AC _____ Amps _____ 48V _____ DC _____ 16 _____ Amps

Device Under Test Description

Test Modulation Used:	Multiple
General Product Information:	<p>hd43™ is a high-power modular radio unit. The hd43 can process 4 RF frequency bands simultaneously and transport data over a single optical fiber at a data rate of 10 Gb/s. It has an optical link budget of 15 dBo to 30 dBo and can accommodate 1 Gb/s or higher Ethernet backhaul via 4 ethernet interfaces with PoE.hd43web</p> <p>On the DL path, hd43 receives the digital data stream from the UBiT and converts it back into RF for transmission over the antenna.</p> <p>On the UL path, hd43 converts the RF signals into digital data streams and transports the signal over a single optical fiber back to the UBiT. hd43 can process aggregated RF bandwidth of up to 320 MHz on uplink and up to 320 MHz on downlink path.</p>

List of ancillary and/or support equipment provided by the applicant

Model:	Description:
UBiT Host	Modular Integrated Headend
Dynet	Ethernet Switch
Lenovo E520	Thinkpad PC with custom Dali Wireless Software
E-Camera	3 x Ethernet Cameras attached to Ethernet Ports
R&S	Vector Signal Generator

Description of Interface Cables for Testing

Connected port	Cable Type	Cable length	Shield	Ferrite
Ethernet	Cat-5e	15meter	No	No
DC Power	1Pair	15meter	No	No
4 x RF Ports	Coax	1meter	Yes	No
Grnd	10AWG Stranded Cond	1Meter	No	No

Test Summary

Test	FCC CFR 47	Frequency Range (MHz)	Result
Field Strength of Spurious Emissions Radiated	27.5 (c), 27.50(c), 27.53(c,g) GSM Mode	728-757	PASS
	27.5 (c), 27.50(c), 27.53(c,g) LTE Mode	728-757	PASS
	22.905, 22.913, 22.917 GSM Mode	869-894	PASS
	22.905, 22.913, 22.917 LTE Mode	869-894	PASS
	24.229, 24.232, 24.238 GSM Mode	1930-1995	PASS
	24.229, 24.232, 24.238 LTE Mode	1930-1995	PASS
	27.5 (h), 27.50(d), 27.53(h) GSM Mode	2110-2155	PASS
	27.5 (h), 27.50(d), 27.53(h) LTE Mode	2110-2155	PASS

- Each Unit has up to 4 transmitter modules, dedicated to a specific frequency band.
- Each transmitter module was connected to a meter RF cable terminated with a 50Ohm load.
- Each band was investigated for Radiated Spurious Emissions up to the 10th Harmonic using the appropriate modulation and test method as outlined in ANSI TIA-603-C.

Radiated Spurious Emissions

PART 22—PUBLIC MOBILE SERVICES Subpart H—Cellular Radiotelephone Service

22.905 Channels for cellular service.

Frequency bands: 824-835MHz, 835-845MHz, 845-846.5MHz and 846.4-849MHz

22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

PART 24—PERSONAL COMMUNICATIONS SERVICES Subpart E—Broadband PCS

24.238 Emission limitations for Broadband PCS equipment.

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

PART 27—MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

27.53 Emission limits.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10} (P)$ dB.

$$\begin{aligned} \text{Peak Transmitter Power} &= 43\text{dBm} = 20\text{Watts} \\ \text{Limit} &= [43\text{dBm} - (43+10\text{Log}20)] = [43\text{dBm} - (43 + 13)] = [43\text{dBm} - (56)] = -10\text{dBm} \end{aligned}$$

Test setup

Testing was performed in accordance with ANSI TIA-603-E (2.2.12)

The EUT was placed on a 1 meter by 1.5 meters wide and 0.8-meter high nonconductive table that was placed directly onto a flush mounted turntable. The EUT was connected to its support equipment located outside of the testing area. The 4 RF ports were connected to 1 Meter cables and terminated to 50Ohm loads.

Prescan tests were performed to determine the “worst-case” orientation of the EUT (By Manipulating the EUT's position through all three orthogonal axes). With the EUT positioned in the “worst case” orientation, emissions from the unit were maximized by manipulating the cables, and by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable.

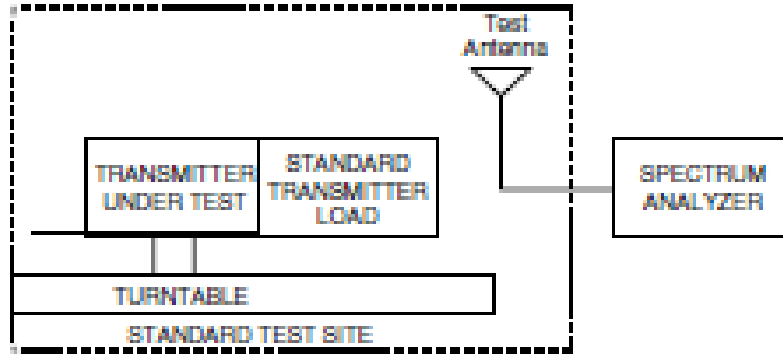
All spurious and expected harmonic frequency radiated emissions were investigated and the peak measurement was performed. If the expected harmonic emission is below the noise floor, the noise floor level was measured for the next three harmonics and the level was recorded.

The final measurement was done using the procedures in ANSI TIA-603-E using the substitution method.

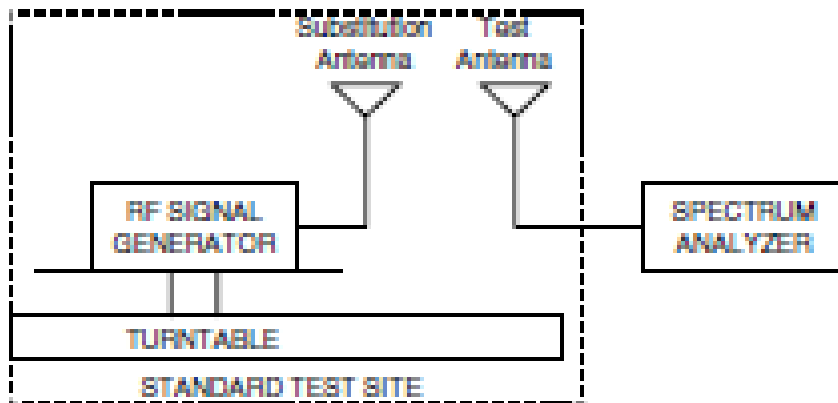
Radiated Emissions Test Characteristics

Frequency range	30 MHz – 20GHz
Test distance	3 m
Test instrumentation resolution bandwidth	100kHz(below 1GHz) / 1MHz(above 1GHz)
Detecting Method	- Quasi-Peak(below 1GHz) - Average(above 1GHz)
Receive antenna scan height	1 m – 4 m
Receive antenna polarization	Vertical/Horizontal

Setup for measuring emissions from the Cabinet with 50Ohm Loads



Setup for final measurement using substitution method



Test Results:

All radiated spurious signals were under limits as outline in FCC Parts 22, 24 and 27. All spurious emissions were close to or in the noise floor of the measurement system.

The highest spurious emission was 32dB below the limit line.

All measured data are calculated as below formula.

$$P_d(\text{dBm}) = P_g(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dB)}$$

where:

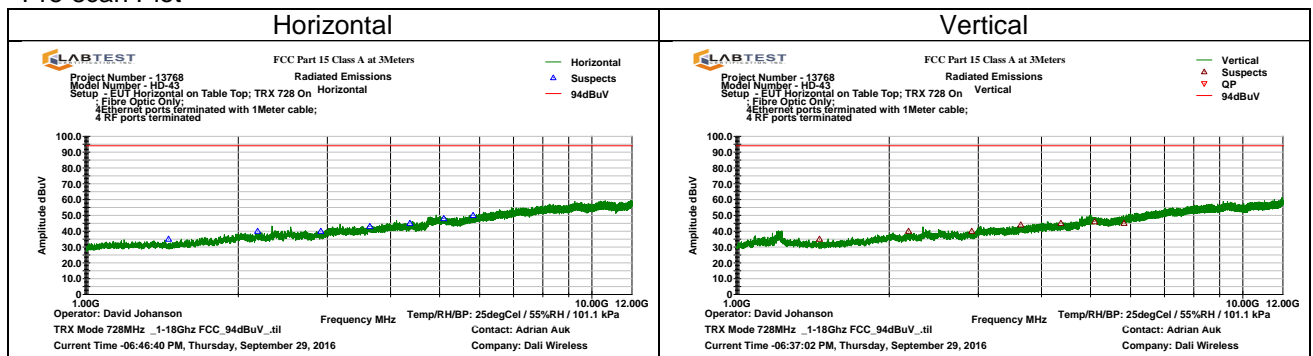
P_d is the dipole equivalent power and

P_g is the generator output power into the substitution antenna.

Frequency Band 728-757MHz
 Low Channel – 728MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(GHz)	(dBμV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
1.4560	24.14	-85.0	9.6	-75.4	-10.0	65.4	H	212	198
1.4560	24.16	-85.0	9.0	-76.0	-10.0	66.0	V	181	123
2.1840	23.68	-85.0	9.1	-75.9	-10.0	65.9	H	257	136
2.1840	23.64	-85.0	8.6	-76.4	-10.0	66.4	V	286	190
2.9120	21.83	-85.0	10.0	-75.0	-10.0	65.0	H	267	230
2.9120	22.01	-85.0	10.1	-74.9	-10.0	64.9	V	233	230

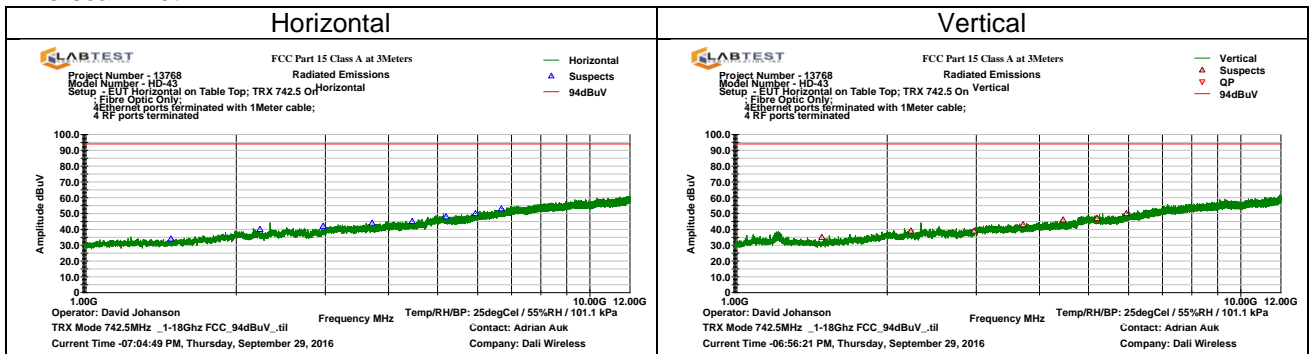
Pre-scan Plot



Middle Channel – 742.5MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(GHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
1.4850	24.17	-85.0	9.6	-75.4	-10.0	65.4	H	2	165
1.4850	24.07	-85.0	9.0	-76.0	-10.0	66.0	V	30	220
2.2275	23.18	-85.0	9.2	-75.8	-10.0	65.8	H	260	104
2.2275	23.07	-85.0	8.6	-76.4	-10.0	66.4	V	322	148
2.9700	21.83	-85.0	10.0	-75.0	-10.0	65.0	H	251	101
2.9700	21.65	-85.0	10.1	-74.9	-10.0	64.9	V	191	167

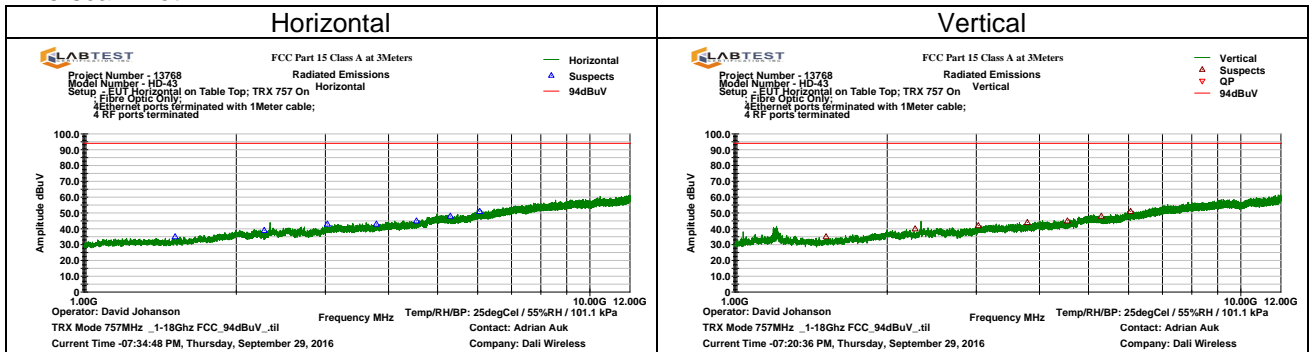
Pre-scan Plot



High Channel – 757MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(GHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
1.5140	24.17	-85.0	9.6	-75.4	-10.0	65.4	H	171	242
1.5140	24.60	-85.0	9.0	-76.0	-10.0	66.0	V	119	239
2.2710	23.18	-85.0	9.4	-75.6	-10.0	65.6	H	193	253
2.2710	22.02	-85.0	8.9	-76.1	-10.0	66.1	V	67	151
3.0280	21.65	-85.0	10.0	-75.0	-10.0	65.0	H	176	222
3.0280	22.96	-85.0	10.1	-74.9	-10.0	64.9	V	248	152

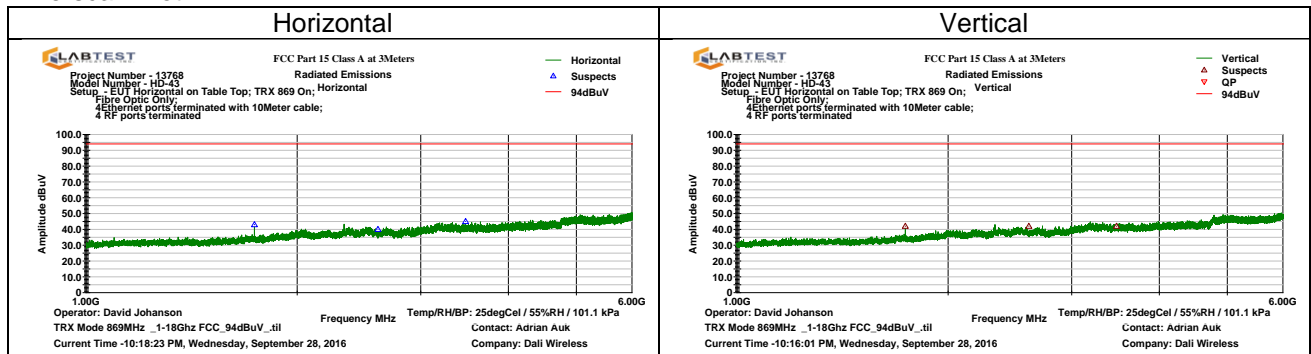
Pre-scan Plot



Frequency Band 869-894MHz
 Low Channel – 869MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(GHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
1.7380	43.03	-58.4	9.8	-48.6	-10.0	38.6	H	132	292
1.7380	38.70	-62.3	9.1	-53.2	-10.0	43.2	V	101	53
2.6070	21.80	-85.0	10.2	-74.8	-10.0	64.8	H	102	225
2.6070	21.60	-85.0	9.9	-75.1	-10.0	65.1	V	183	47
3.4760	23.70	-85.0	10.8	-74.2	-10.0	64.2	H	105	208
3.4760	23.50	-85.0	10.8	-74.2	-10.0	64.2	V	101	180

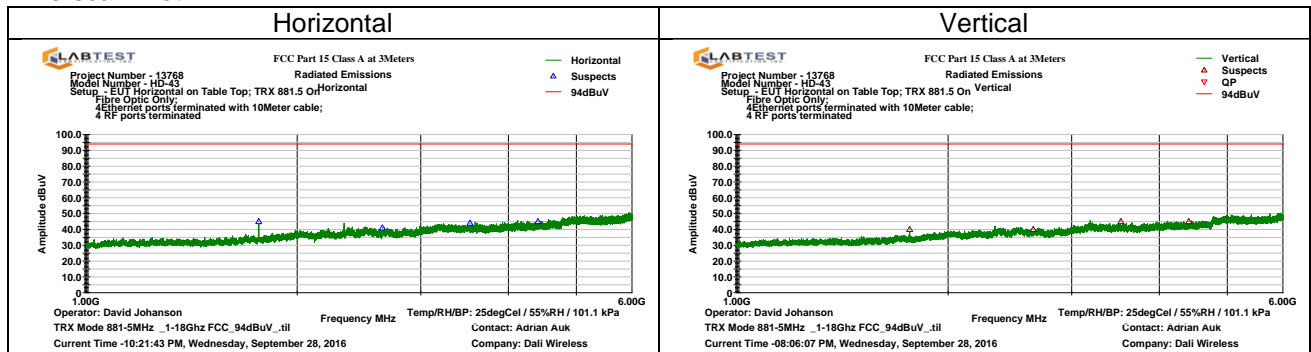
Pre-scan Plot



Middle Channel – 881.5MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(MHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
1.7630	48.07	-54.7	9.8	-44.9	-10.0	34.9	H	294	133
1.7630	40.72	-61.7	9.1	-52.6	-10.0	42.6	V	165	120
2.6445	22.40	-85.0	10.2	-74.8	-10.0	64.8	H	109	114
2.6445	22.39	-85.0	9.9	-75.1	-10.0	65.1	V	257	243
3.5260	22.47	-85.0	10.8	-74.2	-10.0	64.2	H	109	114
3.5260	22.47	-85.0	10.8	-74.2	-10.0	64.2	V	257	101

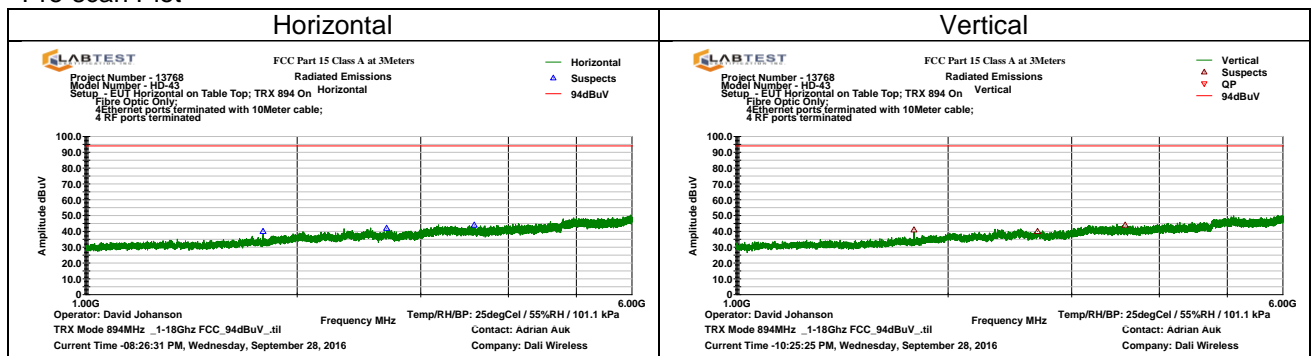
Pre-scan Plot



High Channel – 894MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(MHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
1.7880	48.61	-52.7	9.8	-42.9	-10.0	32.9	H	283	128
1.7880	40.88	-56.5	9.1	-47.4	-10.0	37.4	V	283	130
2.6820	29.66	-65.2	10.1	-55.1	-10.0	45.1	H	150	102
2.6820	27.83	-66.5	9.8	-56.7	-10.0	46.7	V	178	230
3.5760	22.00	-85.0	10.8	-74.2	-10.0	64.2	H	150	102
3.5760	21.94	-85.0	10.8	-74.2	-10.0	64.2	V	180	100

Pre-scan Plot

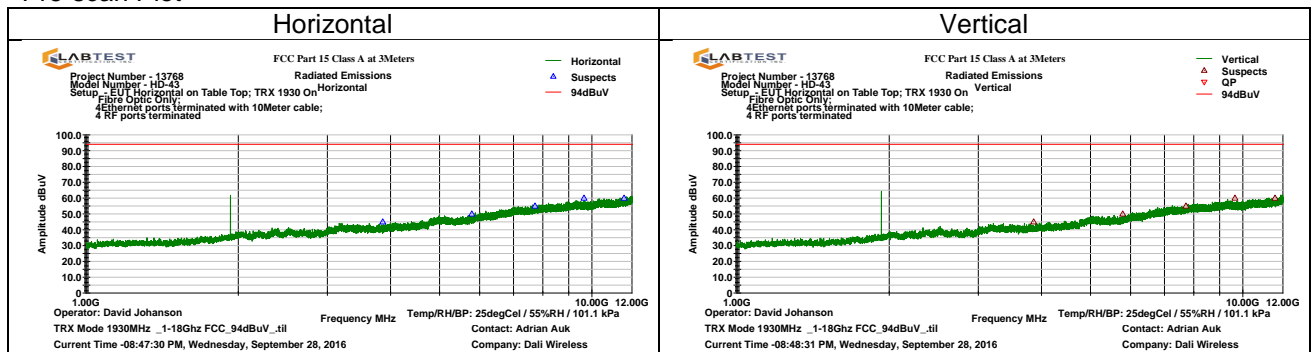


Frequency Band 1930-1995MHz

Low Channel – 1930MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(GHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
3.8600	21.39	-85.0	10.5	-74.5	-10.0	64.5	H	59	182
3.8600	21.47	-85.0	10.0	-75.0	-10.0	64.0	V	152	165
5.7900	19.01	-85.0	11.6	-73.4	-10.0	63.4	H	176	124
5.7900	19.14	-85.0	11.2	-73.8	-10.0	63.8	V	359	154
7.7200	21.55	-85.0	11.5	-73.5	-10.0	63.5	H	175	235
7.7200	21.58	-85.0	11.9	-73.1	-10.0	63.1	V	239	154

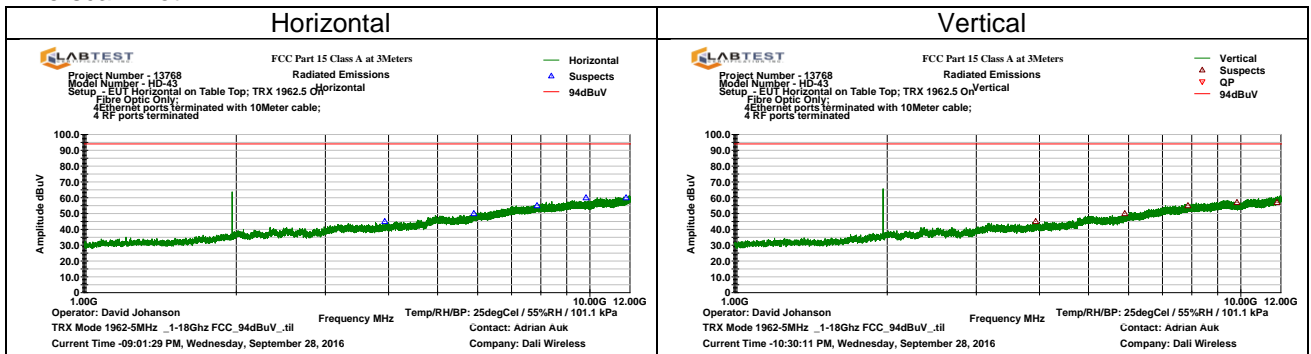
Pre-scan Plot



Middle Channel – 1962.5MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(MHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
3.9250	21.48	-85.0	10.3	-74.7	-10.0	64.7	H	318	184
3.9250	21.36	-85.0	9.7	-75.3	-10.0	65.3	V	165	120
5.8875	19.00	-85.0	11.6	-73.4	-10.0	63.4	H	253	103
5.8875	19.00	-85.0	11.2	-73.8	-10.0	63.8	V	257	243
7.8500	21.71	-85.0	11.5	-73.5	-10.0	63.5	H	358	108
7.8850	21.58	-85.0	11.9	-73.1	-10.0	63.1	V	257	101

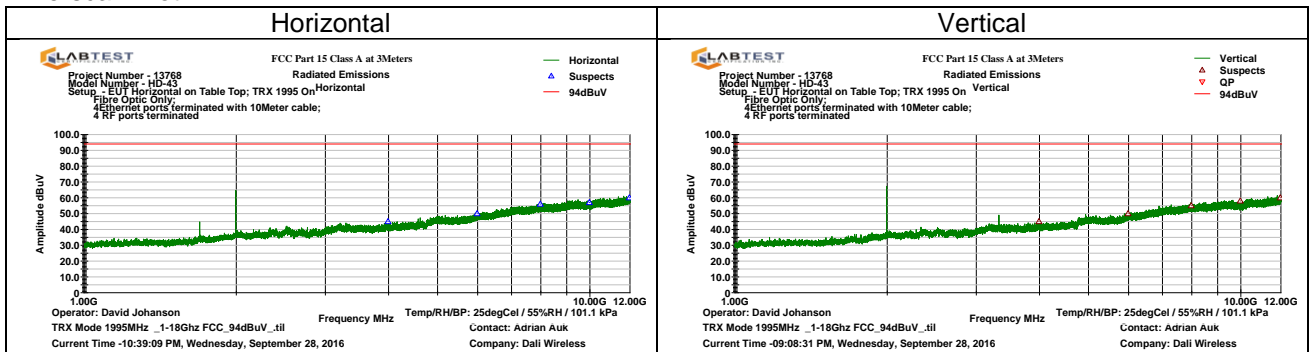
Pre-scan Plot



High Channel – 1995MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(MHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
3.9900	21.34	-85.0	10.3	-74.7	-10.0	64.7	H	359	111
3.9900	21.38	-85.0	9.7	-75.3	-10.0	65.3	V	283	130
5.9850	18.57	-85.0	11.7	-73.3	-10.0	63.3	H	87	249
5.9850	18.62	-85.0	11.1	-73.9	-10.0	63.9	V	178	230
7.9800	21.02	-85.0	11.4	-73.6	-10.0	63.6	H	142	211
7.9800	20.97	-85.0	11.9	-73.1	-10.0	63.1	V	180	100

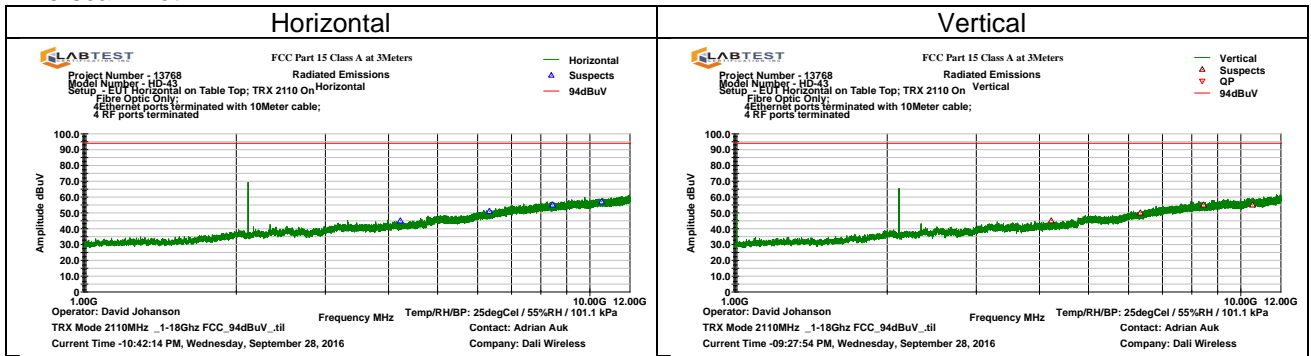
Pre-scan Plot



Frequency Band 2110-2155MHz
 Low Channel – 2110MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(GHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
4.2200	21.04	-85.0	10.5	-74.5	-10.0	64.5	H	53	102
4.2200	21.17	-85.0	10.1	-74.9	-10.0	64.9	V	190	173
6.3300	21.31	-85.0	11.5	-73.5	-10.0	63.5	H	114	227
6.3300	21.30	-85.0	11.1	-73.9	-10.0	63.9	V	171	101
8.4400	20.36	-85.0	11.5	-73.5	-10.0	63.5	H	153	168
8.4400	20.31	-85.0	12.0	-73.0	-10.0	63.0	V	220	100

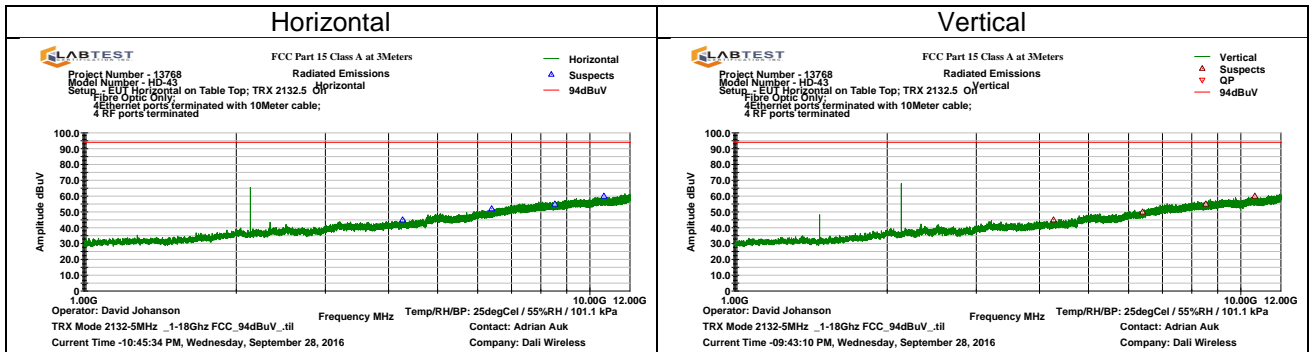
Pre-scan Plot



Middle Channel – 2132.5MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(MHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
4.2650	21.76	-85.0	10.5	-74.5	-10.0	64.5	H	175	135
4.2650	20.87	-85.0	10.2	-74.8	-10.0	64.8	V	8	109
6.3975	21.82	-85.0	11.3	-73.7	-10.0	63.7	H	184	159
6.3975	21.97	-85.0	11.1	-73.9	-10.0	63.9	V	154	239
8.5300	20.31	-85.0	11.5	-73.5	-10.0	63.5	H	85	103
8.5300	20.22	-85.0	12.0	-73.0	-10.0	63.0	V	112	207

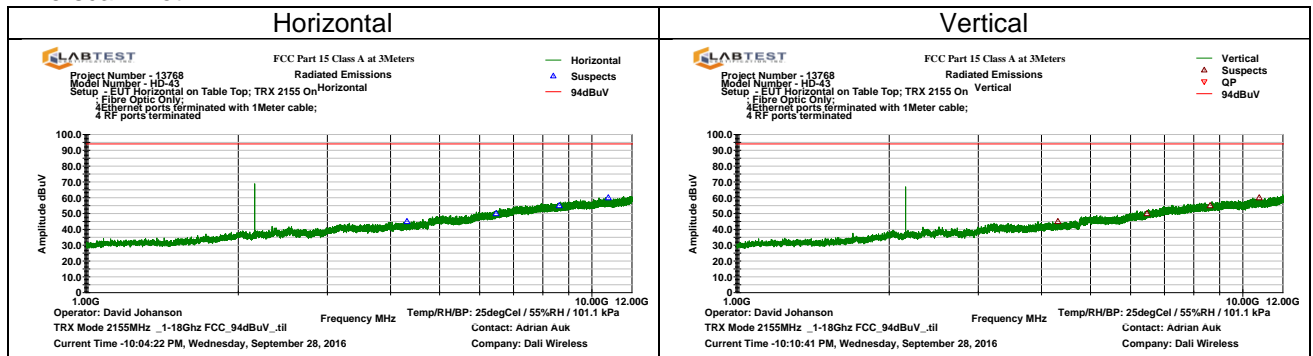
Pre-scan Plot



High Channel – 2155MHz

Frequency	Average	Generator with Cable Power	Antenna Gain	Final Power	Limit	Margin	Polarity	Turntable Position	Antenna Height
(MHz)	(dBµV/m)	(dB)	(dBi)	(dBm)	(dBm)	(dB)		(deg)	(cm)
4.3100	21.08	-85.0	10.6	-74.4	-10.0	64.4	H	214	146
4.3100	20.23	-85.0	10.3	-74.7	-10.0	64.7	V	252	189
6.4650	20.78	-85.0	11.7	-73.3	-10.0	63.3	H	212	253
6.4650	20.73	-85.0	11.1	-73.9	-10.0	63.9	V	118	220
8.6200	20.58	-85.0	11.5	-73.5	-10.0	63.5	H	334	164
8.6200	20.56	-85.0	12.0	-73.0	-10.0	63.0	V	62	224

Pre-scan Plot



APPENDIX A: Test equipment used for tests

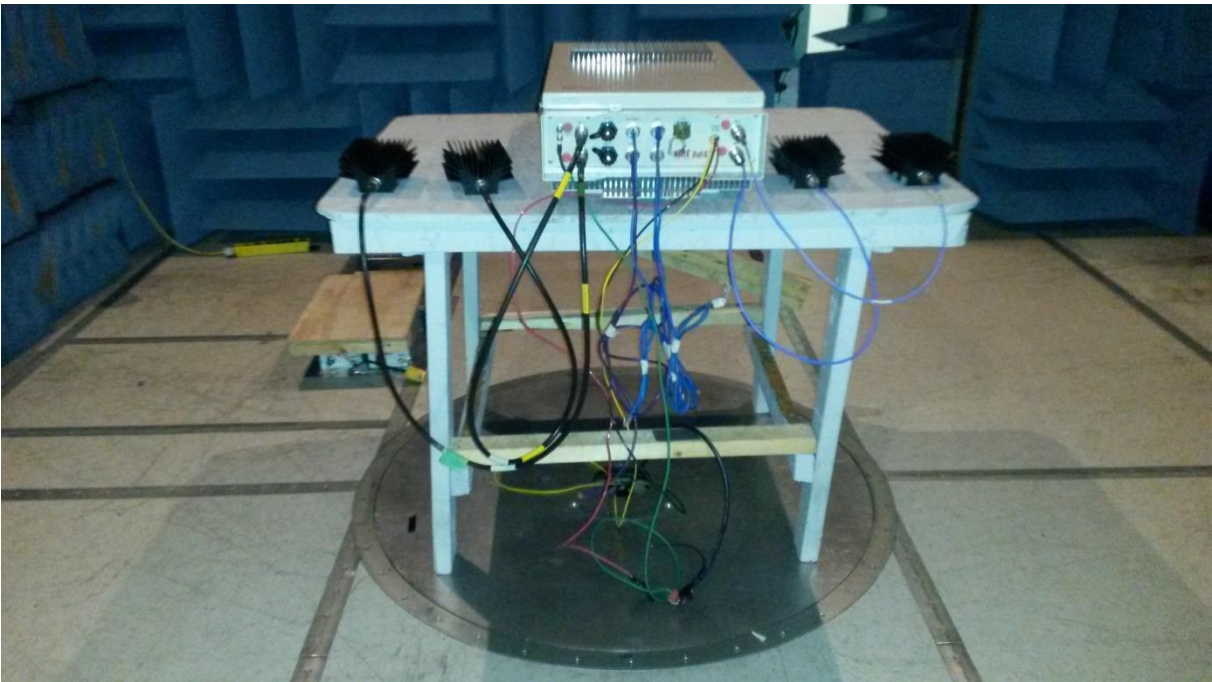
ID No.	Description	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due Date	Calibration Certificate No:	Calibration Laboratory
227C	Horn Antenna	A.H. Systems	SAS-571	936	22-Sep-2016	22-Sep-2018	1609-7066	A.H.Systems
266	Humidity/ Temperature Logger	Onset HOBO	U14-001	2436907	06-Jan-2016	06-Jan-2018	393966	Wescan
272	EMC Analyzer	Agilent	E7405A	US41110263	16-Jun-2016	16-Jun-2017	1-7914055940-1	Keysight
273	RF Preamplifier	Agilent	8449B	3008A02264	N/A	N/A	N/A	N/A
371	EMC Broadband Antenna	Sunol	JB1	A022012	29-Mar-2016	29-Mar-2018	1603-6070	A.H.Systems
374	EMC Shielded Enclosure	USC	USC-26	111811	N/A	N/A	N/A	N/A
702	EMI Receiver	Keysight	N9038A	MY53220126	17-Mar-2016	17-Mar-2017	4181876-5014495-1	Keysight
707	Vector Signal Generator	Anritsu	MG3710A	6201305991	07-Jun-2016	07-Jun-2017	201618805	BRL Test
N1	Horn Antenna	A.H. Systems	SAS-571	10845	05-Oct-2016	05-Oct-2018	161005007-01	Axiom Labs

APPENDIX B: Photos

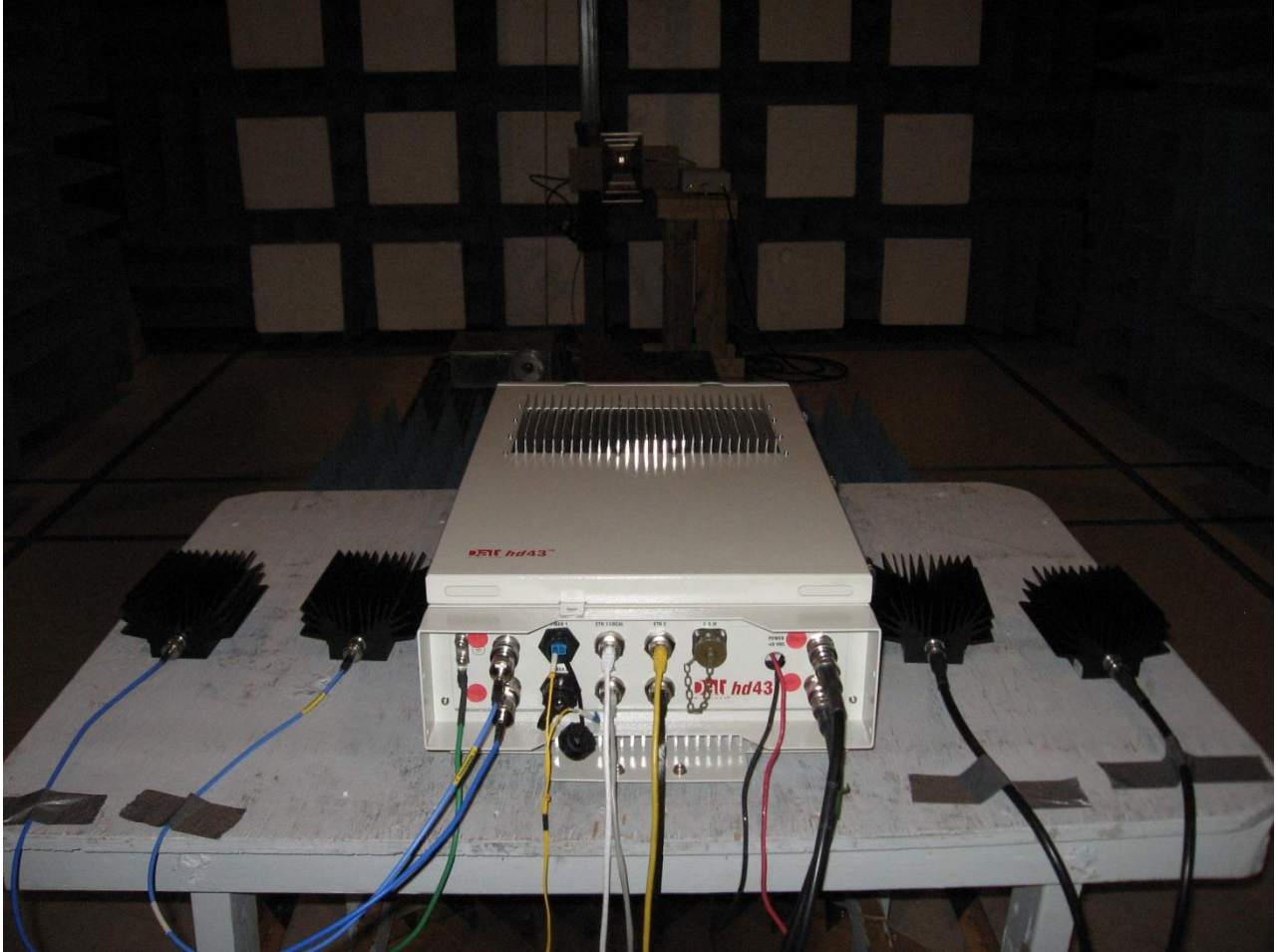
- Test Setup under 1GHz with JB1 Antenna.



- Test Setup under 1GHz, front view.



- Test Setup over 1GHz with SAS-571 Antenna.



END OF REPORT