



**FCC 47 CFR PART 15 SUBPART E
C2PC CERTIFICATION TEST REPORT**

FOR

802.11 a/b/g/n WLAN, BT 2.1 and RF4CE SATELLITE SE

MODEL NUMBER: ID:075

FCC ID: DKNCB1138

REPORT NUMBER: 16U23276-E2V2

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Prepared for
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Echostar Technologies LLC
94 Inverness Terrace East
Englewood, CO 80112

EUT DESCRIPTION: WLAN 802.11 a/b/g/n, BT 2.1 and RF4CE Satellite Set Top Box

MODEL: ID:075

SERIAL NUMBER: 200101R01292Y00110H (Conducted)
200101R01282Y00107H (Radiated)

DATE TESTED: FEBRUARY 26 – MAY 5, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, and ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
<input checked="" type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input checked="" type="checkbox"/> Chamber B	<input type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F
	<input type="checkbox"/> Chamber G
	<input type="checkbox"/> Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 9KHz to 30 MHz	2.14 dB
Radiated Disturbance, 30 to 1000 MHz	4.98 dB
Radiated Disturbance,1000 to 6000 MHz	3.86 dB
Radiated Disturbance,6000 to 18000 MHz	4.23 dB
Radiated Disturbance,18000 to 26000 MHz	5.30 dB
Radiated Disturbance,26000 to 40000 MHz	5.23 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11a/b/g/n/ WLAN, BT 2.1 and RF4CE SATTELITE SE.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Power, Chain 0 (dBm)	Power, Chain 1 (dBm)	Output Power (dBm)	Output Power (mW)
5.8 GHz band, 1TX					
5745-5825	802.11a	17.39	N/A	17.39	54.83
5745-5825	802.11n HT20	17.42	N/A	17.42	55.21
5755-5795	802.11n HT40	17.09	N/A	17.09	51.17
5.8 GHz band, 2TX					
5745-5825	802.11a CDD	17.03	16.88	19.97	99.22
5745-5825	802.11n HT20 CDD	17.23	16.93	20.09	102.16
5755-5795	802.11n HT40 CDD	17.00	17.00	20.01	100.24

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency (MHz)	Antenna Gain (J0) dBi	Antenna Gain (J1) dBi
5745-5825	3.2	1.8

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Broadcom, rev. 5.102 RC98.37

The EUT driver software installed during testing was Broadcom, rev. 5.102.98.37 (WLTEST)

The test utility software used during testing was Broadcom MTool, rev 2.0.1.1

5.5. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Please refer to Echostar Technologies L.L.C Class II Change Description Letter for details.

5.6. WORST-CASE CONFIGURATION AND MODE

The EUT can only be setup in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

Radiated emission below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

For SISO mode, the conducted & radiated testing was only performed with the highest antenna gain chain, J0.

Worst-case data rates as provided by the client were:

802.11a mode: 6 Mbps

802.11n HT20mode: MCS0

802.11n HT40mode: MCS0

Radiated emissions for EUT with antenna was performed and passed; therefore, antenna port spurious was not performed.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	EliteBook 8470	CNU342CP2Y	N/A
Laptop AC adapter	HP	PPP009L-E	WCNXA0C3U5IA7F	N/A
Router	Netgear	WNR1000	28C2035S0B654	N/A
Router AC adapter	Netgear	T012LF1209	N/A	N/A

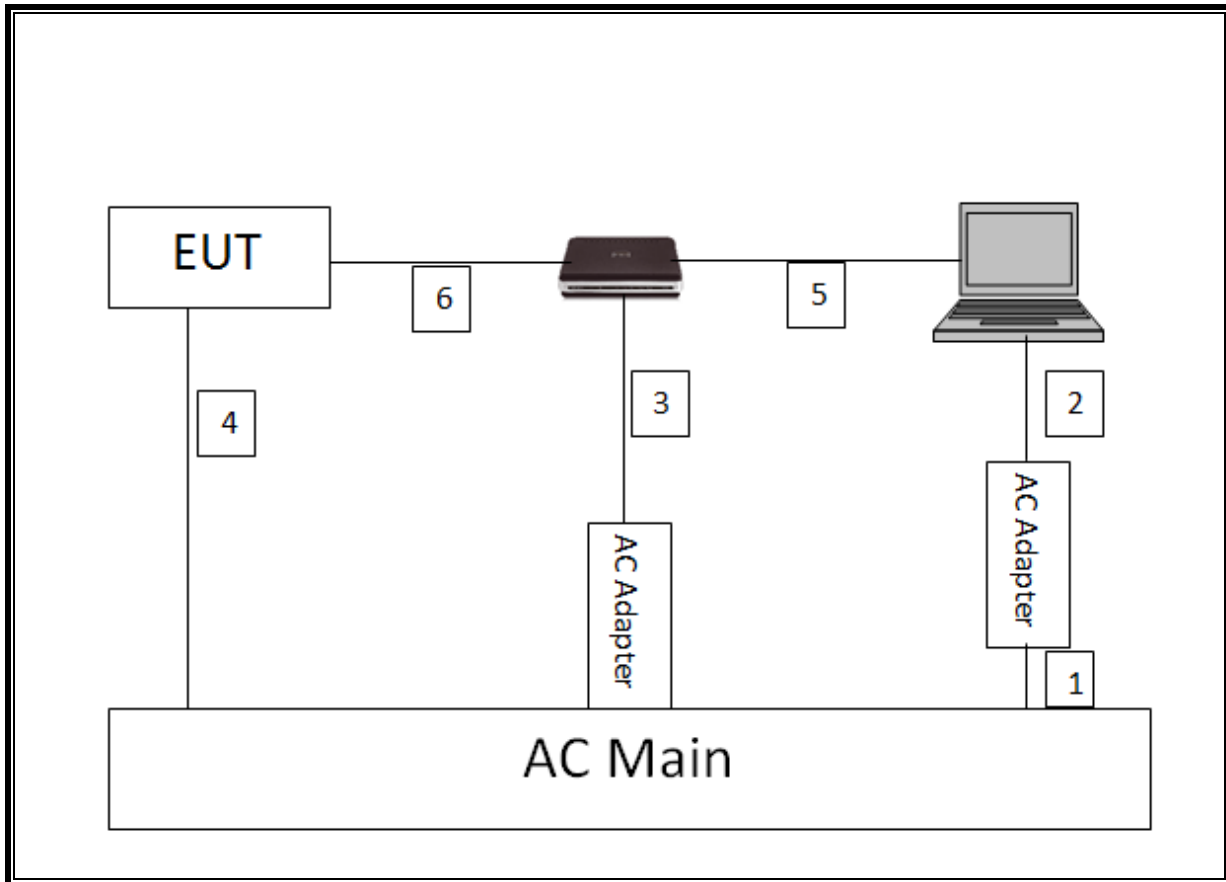
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US115V	Un-shielded	1.8	N/A
2	DC	1	19.5VDC	Un-shielded	1.8	N/A
3	DC	1	12VDC	Un-shielded	1.8	N/A
4	AC	1	US115V	Un-shielded	1.8	N/A
5	LAN	1	RJ45	Un-shielded	2	N/A
6	LAN	1	RJ45	Un-shielded	2	N/A

TEST SETUP

The EUT was tested stand alone and the communication was established via RJ45 cable between EUT and support laptop. Test software exercised the radio.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	Manufacturer	Model	T No.	Cal Date	Cal Due
Bilog Antenna 30-1000MHz	Sunol	JB1	130	09/01/15	09/01/16
Horn Antenna 1-18GHz	ETS	3117	344	02/22/16	02/22/17
Horn Antenna 1-18GHz	ETS	3117	345	03/27/16	03/27/17
Horn Antenna 18-26.5GHz	ARA	MWH-1826	447	05/12/15	05/12/16
Horn Antenna 26.5- 40GHz	ARA	MWH-2640/B	90	07/28/15	07/28/16
Preamp 10kHz-1000MHz	Sonoma	310	300	11/05/15	11/05/16
Preamp 1-8GHz	Miteq	AMF-4D-01000800-30-29P	782	12/17/15	12/17/16
Preamp 1-18GHz	Miteq	AFS42-00101800-25-2-42	493	07/23/15	07/23/16
Preamp 1-26.5GHz	Agilent	8449B	404	06/28/15	06/28/16
Amplifier, 26-40GHz	Miteq	NSP4000-SP2	88	04/07/16	04/07/17
Spectrum Analyzer 3kHz - 44GHz	Keysight	E4440A	119	07/22/15	07/22/16
Spectrum Analyzer 3kHz - 44GHz	Keysight	N9030A	908	05/26/15	05/26/16
Spectrum Analyzer 3kHz - 44GHz	Keysight	N9030A	907	01/06/16	01/06/17
Spectrum Analyzer 9kHz - 40GHz	HP	8564E	106	08/14/15	08/14/16
3GHz HPF	Micro-Tronics	HPM17543	487	01/26/16	01/27/17
EMI Test Receiver	Rohde & Schwarz	ESR	1436	12/19/15	12/19/16
Power Meter	Keysight	N1911A	1264	07/01/15	07/01/16
Power Sensor	Keysight	N1921A	750	09/17/15	09/17/16
LISN for Conducted Emission CISPR-11	Fischer	FCC-LISN-50/250-25-2-01-C	1310	09/16/15	09/16/16

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Version 9.5, 06/24/15
Conducted Software	UL	UL EMC	Version 9.5, 05/26/15
Antenna Port Software	UL	UL RF	Version 4.7, 04/28/16

7. SUMMARY TABLE

FCC Part Section	RSS Section	Test Description	Test Limit	Test Condition	Test Result
§15.407 (a)	RSS-247	Occupied Band width (26dB)	N/A	Conducted	N/A
§15.407	RSS-247 6.2.4	6dB Band width (5.8Ghz)	>500KHz		Pass
§15.407 (a)(1)	RSS-247 6.2	TX Cond. Power5.15-5.25	<24dBm (FCC) / <23 dBm or <10+10Log(99% BW) (IC)		N/A
§15.407 (a)(2)	RSS-247 6.2	TX Cond. Power 5.25-5.35 & 5.47-5.725	<24dBm or <11+10log (OBW) (FCC) / <24 dBm or <11+10Log(99% BW) (IC)		N/A
§15.407 (a)(3)	RSS-247 6.2.4	TX Cond. Power 5.725- 5.850	<30dBm		Pass
§15.407 (a)(1)	RSS-247 6.2	PSD (5.15-5.25)	<11dBm/MHz (FCC) <10dBm/MHz EIRP (IC)		N/A
§15.407 (a)(2)	RSS-247 6.2	PSD (5.3,5.5GHz)	<11dBm/MHz		N/A
§15.407 (a)(3)	RSS-247 6.2.4	PSD (5.8GHz)	<30dBm per 500kHz		Pass
§15.207 (a)	RSS-GEN 8.8	AC Power Line conducted emissions	Section 10		Pass
§15.407 (b) & 15.209	RSS-GEN 8.9/7	Radiated Spurious Emission	<54dBuV/m	Radiated	Pass

8. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 789033 D02 v01r01, Section B.

6 dB Emission BW: KDB 789033 D02 v01r01, Section C, and KDB 662911 D01 v02r01.

26 dB Emission BW: KDB 789033 D02 v01r01, Section C, and KDB 662911 D01 v02r01.

99% Occupied BW: KDB 789033 D02 v01r01, Section D, and KDB 662911 D01 v02r01.

Conducted Output Power: KDB 789033 D02 v01r01, Section E.3.b (Method PM-G), and KDB 662911 D01 v02r01.

Power Spectral Density: KDB 789033 D02 v01r01, Section F, and KDB 662911 D01 v02r01.

Unwanted emissions in restricted bands: KDB 789033 D02 v01r01, Sections G.3, G.4, G.5, and G.6, and KDB 662911 D01 v02r01.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01r01, Sections G.3, G.4, and G.5, and KDB 662911 D01 v02r01.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a	2.064	2.172	0.950	95.03%	0.22	0.484
802.11n HT20	1.908	2.007	0.951	95.07%	0.22	0.524
802.11n HT40	0.932	1.030	0.905	90.49%	0.43	1.073

DUTY CYCLE PLOTS

