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FCC RADIO TEST REPORT

Applicant's company	D-Link Corporation
Applicant Address	No.289, Sinhu 3rd Rd., Neihu District, Taipei City 114, Taiwan, R.O.C.
FCC ID	KA2IR885LA1

Product Name	AC3150 Ultra Wi-Fi Router			
Brand Name	D-Link			
Model No.	DIR-885L			
Test Rule Part(s)	47 CFR FCC Part 15 Subpart E § 15.407			
Test Freq. Range	5150 ~ 5250 MHz / 5725 ~ 5850 MHz			
Received Date	May 11, 2015			
Final Test Date	Jul. 05, 2016			
Submission Type	Class II Change			

Statement

Test result included is for the IEEE 802.11n and IEEE 802.11a/ac of the product.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in ANSI C63.10-2013, 47 CFR FCC Part 15 Subpart E, KDB789033 D02 v01r03, KDB662911 D01 v02r01, KDB644545 D03 v01, ET Docket No. 13–49; FCC 16–24. The test equipment used to perform the test is calibrated and traceable to NML/ROC.







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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR551807-06AB	Rev. 01	Initial issue of report	Nov. 21, 2016

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Project No: CB10507150

1. VERIFICATION OF COMPLIANCE

Product Name :

AC3150 Ultra Wi-Fi Router

Brand Name :

D-Link

Model No. :

DIR-885L

Applicant:

D-Link Corporation

Test Rule Part(s) :

47 CFR FCC Part 15 Subpart E § 15.407

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on May 11, 2015 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

Sam Chen

SPORTON INTERNATIONAL INC.

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2. SUMMARY OF THE TEST RESULT

	Applied Standard: 47 CFR FCC Part 15 Subpart E						
Part Rule Section Description of Test Result							
4.1	15.407(b)	Radiated Emissions	Complies				
4.2	15.407(b)	Band Edge Emissions	Complies				
4.3	15.203	Antenna Requirements	Complies				



3. GENERAL INFORMATION

3.1. Product Details

Items	Description			
Product Type	WLAN (4TX, 4RX)			
Radio Type	Intentional Transceiver			
Power Type	From power adapter			
Modulation	IEEE 802.11a: OFDM			
	IEEE 802.11n/ac: see the below table			
Data Modulation	IEEE 802.11a/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)			
	IEEE 802.11ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM,			
	1024QAM)			
Data Rate (Mbps)	IEEE 802.11a: OFDM (6/9/12/18/24/36/48/54)			
	IEEE 802.11n/ac: see the below table			
Frequency Range	5150 ~ 5250 MHz / 5725 ~ 5850 MHz			
Channel Number	9 for 20MHz bandwidth ; 4 for 40MHz bandwidth			
	2 for 80MHz bandwidth			
Carrier Frequencies	Please refer to section 3.4			
Antenna	Please refer to section 3.3			

Items	Description				
Communication Mode	\boxtimes	IP Based (Load Based)		Frame Based	
Beamforming Function	\boxtimes	With beamforming		Without beamforming	
Operate Condition	\boxtimes	Indoor		Outdoor	

Note: The product has beamforming function for 801.11ac in 2.4GHz and 5GHz.

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Antenna and Band width

Antenna	Four (TX)						
Band width Mode	20 MHz	80 MHz					
IEEE 802.11a	V	X	Х				
IEEE 802.11n	V	V	Х				
IEEE 802.11ac	V	V	V				

IEEE 11n/ac Spec.

Protocol	Number of Transmit Chains (NTX)	Data Rate / MCS
802.11n (HT20)	4	MCS 0-31
802.11n (HT40)	4	MCS 0-31
802.11ac (VHT20)	4	MCS0-11/Nss1-4
802.11ac (VHT40)	4	MCS0-11/Nss1-4
802.11ac (VHT80)	4	MCS0-11/Nss1-4

Note 1: IEEE Std. 802.11n modulation consists of HT20 and HT40 (HT: High Throughput). Then EUT supports HT20 and HT40.

Note 2: IEEE Std. 802.11ac modulation consists of VHT20, VHT40, VHT80 and VHT160 (VHT: Very High Throughput). Then EUT supports VHT20, VHT40 and VHT80.

Note 3: Modulation modes consist of below configuration: HT20/HT40: IEEE 802.11n, VHT20/VHT40/VHT80: IEEE 802.11ac

3.2. Accessories

Power	Brand	Model	Rating
Adapter	APD	WA-36A12R	Input:100-240V~50/60Hz 0.9A Max.
Addptet	ArD		Output:12V-3A

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3.3. Table for Filed Antenna

Ant.	Brand Holder	P/N	Antenna Connector		Antenr (di		Cable (d	e Loss Bi)	True (d		
			Туре		2.4G	5G	2.4G	5G	2.4G	5G	
1	HL TECHNOLOGY	290-20187	Dipole	SMA Plug	1.8	2.8	0.5	1	1.3	1.8	
ļ	GROUP LIMITED	270-20107	Antenna	Reverse	1.0	2.0	0.5	-	1.0	1.0	
2	HL TECHNOLOGY	290-20187	Dipole Antenna	SMA Plug	1.0	0.0	0.5	1	1.3	1.8	
2	GROUP LIMITED			Reverse	1.8	2.8	0.5	ı	1.3	1.0	
3	HL TECHNOLOGY	290-20188	200 20100	Dipole	SMA Plug	1.0	0.0	0.5	1	1.3	1.8
3	GROUP LIMITED		Antenna	Reverse	1.8	2.8	0.5	ı	1.3	1.0	
4	HL TECHNOLOGY	200 201 88	Dipole	SMA Plug	1.0	0.0	0.5	1	1.0	1.8	
4	GROUP LIMITED	290-20188	Antenna	Reverse	1.8	2.8	0.5	1	1.3	1.0	
5	HL TECHNOLOGY	290-20213	РСВ	I DEV	1.2				1.3		
5	GROUP LIMITED	290-20213	Antenna	I-PEX	1.3	-	-	•	1.3	-	

Note: The EUT has five antennas.

<For 2.4GHz Band>

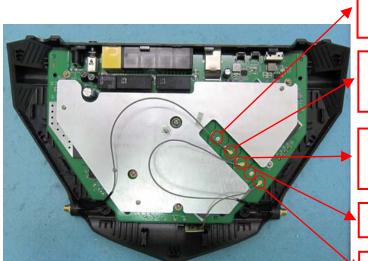
For IEEE 802.11b/g/n/ac mode (4TX/4RX)

Chain 1, Chain 2, Chain 3 and Chain 4 could transmit/receive simultaneously.

<For 5GHz Band >

For IEEE 802.11a/n/ac mode (4TX/4RX):

Chain 1, Chain 2, Chain 3 and Chain 4 could transmit/receive simultaneously.



2.4GHz: Chain 1 / Connect to Ant 1 5GHz: Chain 4 / Connect to Ant 1

2.4GHz: Chain 2 / Connect to Ant 35GHz: Chain 3 / Connect to Ant 3

2.4GHz: Chain 3 / Connect to Ant 45GHz: Chain 2 / Connect to Ant 4

5GHz: Chain 1 / Connect to Ant 2

2.4GHz: Chain 4 / Connect to Ant 5

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3.4. Table for Carrier Frequencies

There are three bandwidth systems.

For 20MHz bandwidth systems, use Channel 36, 40, 44, 48, 149, 153, 157, 161, 165.

For 40MHz bandwidth systems, use Channel 38, 46, 151, 159.

For 80MHz bandwidth systems, use Channel 42, 155.

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
	36	5180 MHz	44	5220 MHz
5150~5250 MHz	38	5190 MHz	46	5230 MHz
Band 1	40	5200 MHz	48	5240 MHz
	42	5210 MHz	-	-
	149	5745 MHz	157	5785 MHz
5725~5850 MHz	151	5755 MHz	159	5795 MHz
Band 4	153	5765 MHz	161	5805 MHz
	155	5775 MHz	165	5825 MHz

3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mod	de	Data Rate	Channel	Chain		
Radiated Emission Above 1GHz	For Non-Bean	nforming mod	de				
	11a/BPSK Band 1 6		6Mbps	36	1+2+3+4		
	11ac VHT20	Band 4	MCS0/Nss1	165	1+2+3+4		
Band Edge Emission	For Non-Beamforming mode						
	11a/BPSK	Band 1	6Mbps	36	1+2+3+4		
	11ac VHT20 Band 4		MCS0/Nss1	165	1+2+3+4		

Note 1: VHT20 covers HT20, due to same modulation.

Note 2: All the specification of test configurations and test modes were based on customer's request

The following test modes were performed for all tests:

For Radiated Emission test:

The EUT can be placed in Y-axis and Z-axis. According to the original report, the worst case was found at Z-axis. So The measurement followed the same test mode.

Mode 1. CTX - Place EUT in Z-axis

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3.6. Table for Testing Locations

Test Site Location										
Address:	No.	No.8, Lane 724, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.								
TEL:	886	886-3-656-9065								
FAX:	886	886-3-656-9085								
Test Site No.		Site Category	Location	FCC Designation No.	IC File No.	VCCI Reg. No				
03CH01-CB SAC		SAC	Hsin Chu	TW0006	IC 4086D	-				

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

3.7. Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR551807AB and FR551807-05.

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking				
	After evaluating, the worst case is found at 802.11a				
	CH36 and 802.11ac MCS0/Nss1 VHT20 CH165 (For				
	Non-Beamforming Mode) and retest these channels				
Undating the chin version from PCM4244P1 to	only.				
Updating the chip version from BCM4366B1 to	The test item as below.				
BCM4366C0.	Radiated Emissions (Above 1GHz)				
	2. Emissions Measurement				
	Note: The above test items will be based on original				
	output power to re-test.				

3.8. Table for Supporting Units

For Test Site No: 03CH01-CB

Support Unit	Brand	Model	FCC ID		
Notebook	DELL	E4300	DoC		

3.9. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

3.10. Duty Cycle

Mode	On Time On+Off Time (ms) (ms)		Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)	
802.11a	2.058	2.090	98.50	0.07	0.01	
802.11ac MCS0/Nss1 VHT20	1.839	1.948	94.40	0.25	0.54	

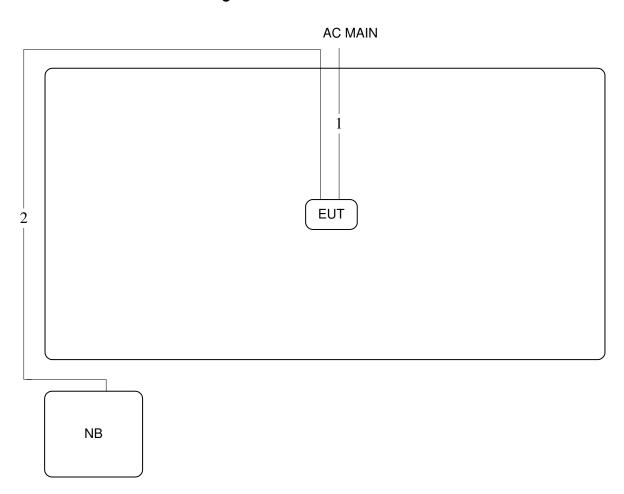
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3.11. Test Configurations

3.11.1. Radiation Emissions Test Configuration



Item	Connection	Shielded	Length		
1	Power cable	No	1.2m		
2	RJ-45 cable	No	10m		

4. TEST RESULT

4.1. Radiated Emissions Measurement

4.1.1. Limit

For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: Follow 15.407(b)(4)(ii), the emission limits in § 15.247(d), 30dBc in any 100 kHz bandwidth outside the operating frequency band.

In addition, In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies	Field Strength	Measurement Distance		
(MHz)	(micorvolts/meter)	(meters)		
0.009~0.490	2400/F(kHz)	300		
0.490~1.705	24000/F(kHz)	30		
1.705~30.0	30	30		
30~88	100	3		
88~216	150	3		
216~960	200	3		
Above 960	500	3		

4.1.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	40 GHz
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak,
	1MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	1MHz / 3MHz for peak

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

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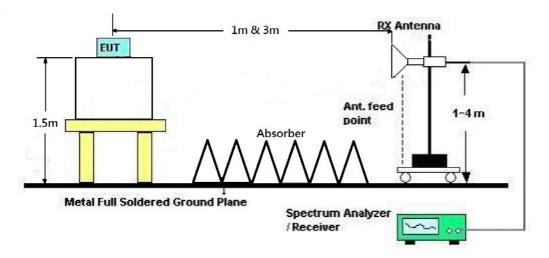
4.1.3. Test Procedures

Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5
meter above ground. The phase center of the receiving antenna mounted on the top of a
height-variable antenna tower was placed 1m & 3m far away from the turntable.

- 2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
- 3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
- 4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
- 5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
- 6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
- 7. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
- 8. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- 9. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High Low scan is not required in this case.

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4.1.4. Test Setup Layout



4.1.5. Test Deviation

There is no deviation with the original standard.

4.1.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

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4.1.7. Results for Radiated Emissions (1GHz~40GHz)

Temperature	25°C	Humidity	60%
Test Engineer	Test Engineer Aking Chiu Configurations	IEEE 802.11a CH 36 /	
Test Engineer	Akina Chiu	Configurations	Chain 1 + Chain 2 + Chain 3 + Chain 4
Test Date	Jul. 05, 2016		

Horizontal

	Freq	Level						Preamp Factor		T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	15531.08	46.93	54.00	-7.07	29.60	12.95	38.25	33.87	151	260	Average	HORIZONTAL
2	15536.76	60.46	74.00	-13.54	43.13	12.95	38.25	33.87	151	260	Peak	HORIZONTAL

Vertical

	Freq	Level		Over Limit					A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		7
1	15532.40	60.98	74.00	-13.02	43.65	12.95	38.25	33.87	166	303	Peak	VERTICAL
2	15536.08	46.99	54.00	-7.01	29.66	12.95	38.25	33.87	166	304	Average	VERTICAL

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Temperature	25°C	Humidity	60%
Test Engineer	Akina Chiu	Configurations	IEEE 802.11ac MCS0/Nss1 VHT20 CH 165 /
Test Engineer	Akina Chiu	Configurations	Chain 1 + Chain 2 + Chain 3 + Chain 4
Test Date	Jul. 05, 2016		

Horizontal

	Freq	Level		Over Limit				Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		-13 18
1	11649.80	63.98	74.00	-10.02	46.85	11.24	39.73	33.84	100	183	Peak	HORIZONTAL
2	11650.24	49.16	54.00	-4.84	32.03	11.24	39.73	33.84	100	183	Average	HORIZONTAL

Vertical

	Freq	Level	Limit					Preamp	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11650.32	53.94	54.00	-0.06	36.81	11.24	39.73	33.84	100	63	Average	VERTICAL
2	11650.40	70.17	74.00	-3.83	53.04	11.24	39.73	33.84	100	63	Peak	VERTICAL

Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = $20 \log Emission$ level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

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4.2. Band Edge Emissions Measurement

4.2.1. Limit

For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: Follow 15.407(b)(4)(ii), the emission limits in § 15.247(d), 30dBc in any 100 kHz bandwidth outside the operating frequency band.

In addition, In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies	Field Strength	Measurement Distance
(MHz)	(micorvolts/meter)	(meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

4.2.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RBW / VBW (Emission in restricted band)	1 MHz / 3MHz for Peak,
	1MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	1 MHz / 3MHz for Peak
RBW / VBW (30dBc in any 100 kHz bandwidth emission)	100 kHz / 300 kHz for Peak

4.2.3. Test Procedures

For Radiated band edges Measurement:

The test procedure is the same as section 4.1.3.

For Radiated Emissions in non-restricted frequency bands Measurement:

Test was performed in accordance with Clause 11.11 of ANSI C63.10-2013 and/or in Section 11.0 of KDB Publication 558074.

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4.2.4. Test Setup Layout

For Radiated band edges Measurement:

This test setup layout is the same as that shown in section 4.1.4.

For Radiated Emissions in non-restricted frequency bands Measurement:

This test setup layout is the same as that shown in section 4.1.4.

4.2.5. Test Deviation

There is no deviation with the original standard.

4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

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4.2.7. Test Result of Band Edge and Fundamental Emissions

Temperature	25°C	Humidity	60%
			IEEE 802.11a CH 36, 40, 48 /
Test Engineer	Akina Chiu	Configurations	Chain 1 + Chain 2 + Chain 3 +
			Chain 4
Test Date	Jul. 05, 2016		

Channel 36

	Fred	Freq	Level	Limit Line		Read Level			The second secon	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg			
1	5146.40	53.98	54.00	-0.02	46.76	7.34	31.52	31.64	209	263	Average	VERTICAL	
2	5147.60	72.65	74.00	-1.35	65.43	7.34	31.52	31.64	209	263	Peak	VERTICAL	
3 0	5186.00	106.53			99.25	7.37	31.55	31.64	209	263	Average	VERTICAL	
4 0	5186.40	120.09			112.81	7.37	31.55	31.64	209	263	Peak	VERTICAL	

Item 3, 4 are the fundamental frequency at 5180 MHz.

Note:

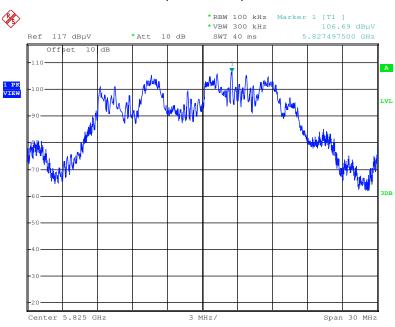
Emission level (dBuV/m) = $20 \log Emission$ level (uV/m)

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

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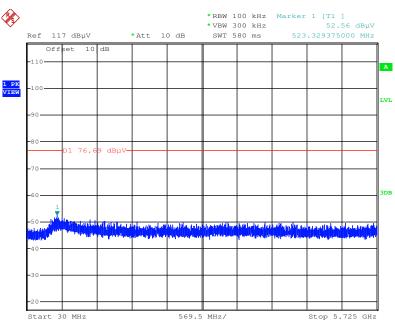
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For Radiated Emissions in non-restricted frequency bands Measurement Plot on Configuration IEEE 802.11ac MCS0/Nss1 VHT20 / Reference Level



Date: 5.JUL.2016 23:27:08

Plot on Configuration IEEE 802.11ac MCS0/Nss1 VHT20 / CH 165 / 30MHz~5725MHz (down 30dBc)



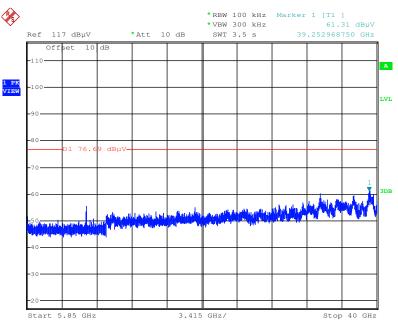
Date: 5.JUL.2016 23:28:27

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Plot on Configuration IEEE 802.11ac MCS0/Nss1 VHT20 / CH 165 / 5850MHz~40000MHz (down 30dBc)



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4.3. Antenna Requirements

4.3.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

4.3.2. Antenna Connector Construction

Please refer to section 3.3 in this test report; antenna connector complied with the requirements.

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5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Oct. 22, 2015	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 21, 2015	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 18, 2016	Radiation (03CH01-CB)
Pre-Amplifier	WM	TF-130N-R1	923365	26GHz ~ 40GHz	Nov. 13, 2015	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Oct. 27, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-17	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-1	N/A	18GHz ~ 40 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-2	N/A	18GHz ~ 40 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
Test Software	Audix	E3	6.2009-10-7	N/A	N/A	Radiation (03CH01-CB)

Note: Calibration Interval of instruments listed above is one year.

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6. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	Remark
Radiated Emission (1GHz \sim 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz \sim 40GHz)	3.5 dB	Confidence levels of 95%

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