

FCC Test Report

FCC ID : TVE-120506

Equipment : 2T2R PCIeModule selectable 5GHz+2.4G

Model No. : WMDQ-177ACN

Brand Name : Fortinet, Inc.

Applicant : Fortinet, Inc.

Address : 899 Kifer Road Sunnyvale, CA 94086, USA

Standard : 47 CFR FCC Part 15.407

Received Date : Jul. 16, 2015

Tested Date : Jul. 30 ~ Aug. 13, 2015

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Approved & Reviewed by:

Gary Chang / Manager

ilac MRA



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Release Record

Report No.	Version	Description	Issued Date
FR571605AN	Rev. 01	Initial issue	Sep. 07, 2015

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Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.181MHz 40.39 (Margin -14.07dB) - AV	Pass
15.407(b) 15.209	Radiated Emissions	[dBuV/m at 3m]: 5350.00MHz 53.34 (Margin -0.66dB) - AV [dBuV/m at 3m]: 5150.00MHz 53.34 (Margin -0.66dB) - AV	Pass
15.407(a)	Emission Bandwidth	Meet the requirement of limit	Pass
15.407(e)	6dB bandwidth	Meet the requirement of limit	Pass
15.407(a)	RF Output Power	Max Power [dBm]: 5150-5250MHz: 19.70 5725-5850MHz: 18.14	Pass
15.407(a)	Peak Power Spectral Density	Meet the requirement of limit	Pass
15.407(g)	Frequency Stability	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

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1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information						
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N _{TX})	Data Rate / MCS	
5150-5250	а	5180-5240	36-48 [4]	2	6-54 Mbps	
5150-5250	n (HT20)	5180-5240	36-48 [4]	2	MCS 0-15	
5150-5250	n (HT40)	5190-5230	38-46 [2]	2	MCS 0-15	
5150-5250	ac (VHT20)	5180-5240	36-48 [4]	2	MCS 0-9	
5150-5250	ac (VHT40)	5190-5230	38-46 [2]	2	MCS 0-9	
5150-5250	ac (VHT80)	5210	42 [1]	2	MCS 0-9	

Note 1: RF output power specifies that Maximum Conducted Output Power.

Note 2: 802.11a/n/ac uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM modulation.

Note 3: 802.11a is transmitting signal through chain 0 only.

RF General Information						
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N _{TX})	Data Rate / MCS	
5725-5850	а	5745-5825	149-165 [5]	2	6-54 Mbps	
5725-5850	n (HT20)	5745-5825	149-165 [5]	2	MCS 0-15	
5725-5850	n (HT40)	5755-5795	151-159 [2]	2	MCS 0-15	
5725-5850	ac (VHT20)	5745-5825	149-165 [5]	2	MCS 0-9	
5725-5850	ac (VHT40)	5755-5795	151-159 [2]	2	MCS 0-9	
5725-5850	ac (VHT80)	5775	155 [1]	2	MCS 0-9	

Note 1: RF output power specifies that Maximum Conducted Output Power.

Note 2: 802.11a/n/ac uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM modulation.

Note 3: 802.11a is transmitting signal through chain 0 only.

1.1.2 Antenna Details

Ant. No.	Model	Type	Connector -	Operating Fr	equency (MHz) / Gain (dBi)
Ant. No.	Wodel	i ype		2400~2483.5	5150~5250	5725~5850
1	C210-510579-A	Dipole	R-SMA	2.8	3	2.2

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.3Vdc from host

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1.1.4 Accessories

N/A

1.1.5 Channel List

For Frequency band 5150-5250 MHz					
802.11 a / H	T20 / VHT20	HT40 /	VHT40		
Channel	Frequency(MHz)	Channel	Frequency(MHz)		
36	5180	38	5190		
40	5200	46	5230		
44	5220	VH	Γ 80		
48	5240	42	5210		

For Frequency band 5725~5850 MHz					
802.11 a / H	802.11 a / HT20 / VHT20		VHT40		
Channel	Frequency(MHz)	Channel	Frequency(MHz)		
149	5745	151	5755		
153	5765	159	5795		
157	5785	VH.	T80		
161	5805	155	5775		
165	5825				

1.1.6 Test Tool and Duty Cycle

Test Tool	ART2-GUI, version: 2.3			
	Mode	Duty cycle (%)	Duty factor (dB)	
	11a	98.06%	0.09	
Duty Cycle and Duty Factor	VHT20	98.21%	0.08	
	VHT40	93.56%	0.29	
	VHT80	88.64%	0.52	

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1.1.7 Power Setting

	For Frequency band 5150-5250 MHz					
Modulation Mode	Test Frequency (MHz)	Power Set				
11a	5180	9.5				
11a	5200	9.5				
11a	5240	13				
HT20	5180	9.5				
HT20	5200	9.5				
HT20	5240	13				
HT40	5190	13				
HT40	5230	16.5				
VHT20	5180	9.5				
VHT20	5200	9.5				
VHT20	5240	13				
VHT40	5190	13				
VHT40	5230	16.5				
VHT80	5210	10.5				

F	For Frequency band 5725~5850 MHz					
Modulation Mode	Test Frequency (MHz)	Power Set				
11a	5745	14				
11a	5785	15				
11a	5825	15				
HT20	5745	14				
HT20	5785	15				
HT20	5825	15				
HT40	5755	13.5				
HT40	5795	15.5				
VHT20	5745	14				
VHT20	5785	15				
VHT20	5825	15				
VHT40	5755	13.5				
VHT40	5795	15.5				
VHT80	5775	10.5				

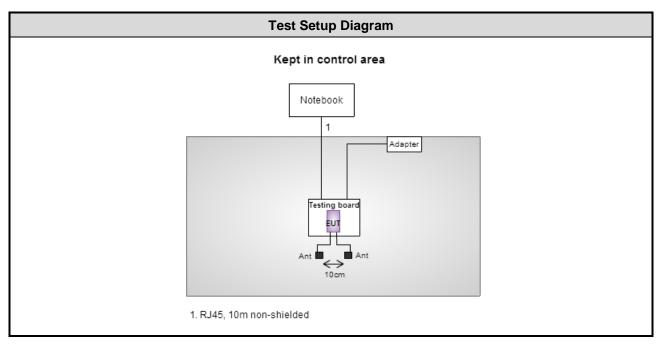
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1.2 Local Support Equipment List

Support Equipment List								
No.	Equipment Brand		Model FCC ID		Signal cable / Length (m)			
1	Notebook	DELL	Latitude E6440	DoC	RJ45, 10m non-shielded.			

1.3 Test Setup Chart



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1.4 The Equipment List

Test Item	Conducted Emission								
Test Site	Conduction room 1 / (Conduction room 1 / (CO01-WS)							
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until				
EMC Receiver	R&S	ESCS 30	100169	Oct. 17, 2014	Oct. 16, 2015				
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 17, 2014	Nov. 16, 2015				
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Dec. 31, 2014	Dec. 30, 2015				
Measurement Software	AUDIX	e3	6.120210k	NA	NA				
Note: Calibration Interval of instruments listed above is one year.									

Test Item	Radiated Emission								
Test Site	966 chamber1 / (03CH01-WS)								
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until				
Spectrum Analyzer	R&S	FSV40	101498	Dec. 09, 2014	Dec. 08, 2015				
Receiver	R&S	ESR3	101658	Nov. 10, 2014	Nov. 09, 2015				
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Sep. 05, 2014	Sep. 04, 2015				
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 11, 2014	Dec. 10, 2015				
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 10, 2014	Nov. 09, 2015				
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 10, 2014	Nov. 09, 2015				
Preamplifier	Burgeon	BPA-530	SN:100219	Sep. 09, 2014	Sep. 08, 2015				
Preamplifier	Agilent	83017A	MY39501308	Oct. 09, 2014	Oct. 08, 2015				
Preamplifier	EMC	EMC184045B	980192	Aug. 26, 2014	Aug. 25, 2015				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 15, 2014	Dec. 14, 2015				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 15, 2014	Dec. 14, 2015				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 15, 2014	Dec. 14, 2015				
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 15, 2014	Dec. 14, 2015				
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 15, 2014	Dec. 14, 2015				
Measurement Software	AUDIX	e3	6.120210g	NA	NA				
Note: Calibration Inter	rval of instruments listed	d above is one year.							

Test Item	RF Conducted	RF Conducted								
Test Site	(TH01-WS)									
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until					
Spectrum Analyzer	R&S	FSV40	101063	Feb. 03, 2015	Feb. 02, 2016					
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Dec. 03, 2014	Dec. 02, 2015					
Power Meter	Anritsu	ML2495A	1241002	Sep. 29, 2014	Sep. 28, 2015					
Power Sensor	Anritsu	MA2411B	1207366	Sep. 29, 2014	Sep. 28, 2015					
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA					
Note: Calibration Interval of instruments listed above is one year.										

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1.5 Testing Applied Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.407

ANSI C63.10-2013

FCC KDB 789033 D02 General UNII Test Procedures New Rules v01

FCC KDB 644545 D03 Guidance for IEEE 802 11ac New Rules v01

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

FCC KDB 412172 D01 Determining ERP and EIRP v01r01

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty							
Parameters	Uncertainty						
Bandwidth	±34.134 Hz						
Conducted power	±0.808 dB						
Frequency error	±34.134 Hz						
Power density	±0.463 dB						
Conducted emission	±2.670 dB						
AC conducted emission	±2.92 dB						
Radiated emission ≤ 1GHz	±3.72 dB						
Radiated emission > 1GHz	±5.65 dB						
Time	±0.1%						
Temperature	±0.6 °C						

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2 Test Configuration

2.1 Testing Condition

Test Item	Test Item Test Site		Tested By
AC Conduction	CO01-WS	22°C / 58%	Kevin Ma
Radiated Emissions	diated Emissions 03CH01-WS		Aska Huang Morgan Chen
RF Conducted	TH01-WS	22°C / 63%	Felix Sung

FCC site registration No.: 657002IC site registration No.: 10807A-1

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2.2 The Worst Test Modes and Channel Details

	For Frequency band 5150-5250 MHz									
Test item	Modulation Mode	Test Frequency (MHz)	Data Rate (Mbps) / MCS	Test Configuration						
Conducted Emissions	VHT40	5230	MCS 0							
Radiated Emissions ≤1GHz	VHT40	5230	MCS 0							
	11a	5180 / 5200 / 5240	6 Mbps							
	HT20	5180 / 5200 / 5240	MCS 0							
RF Output Power	HT40	5190 / 5230	MCS 0							
IN Output I owel	VHT20	5180 / 5200 / 5240	MCS 0							
	VHT40	5190 / 5230	MCS 0							
	VHT80	5210	MCS 0							
	11a	5180 / 5200 / 5240	6 Mbps							
Radiated Emissions >1GHz	VHT20	5180 / 5200 / 5240	MCS 0							
Emission Bandwidth Peak Power Spectral Density	VHT40	5190 / 5230	MCS 0							
Trock Fower opeoural bensity	VHT80	5210	MCS 0							
Frequency Stability	Un-modulation	5200								

NOTE:

^{1.} The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.

For Frequency band 5725-5850 MHz									
Test item	Modulation Mode	Test Frequency (MHz)	Data Rate (Mbps) / MCS	Test Configuration					
Conducted Emissions	11a	5785	6 Mbps						
Radiated Emissions ≤1GHz	11a	5785	6 Mbps						
	11a	5745 / 5785 / 5825	6 Mbps						
	HT20	5745 / 5785 / 5825	MCS 0						
RF Output Power	HT40	5755 / 5795	MCS 0						
IN Output I owel	VHT20	5745 / 5785 / 5825	MCS 0						
	VHT40	5755 / 5795	MCS 0						
	VHT80	5775	MCS 0						
Radiated Emissions >1GHz	11a	5745 / 5785 / 5825	6 Mbps						
Emission Bandwidth	VHT20	5745 / 5785 / 5825	MCS 0						
6dB bandwidth	VHT40	5755 / 5795	MCS 0						
Peak Power Spectral Density	VHT80	5775	MCS 0						
Frequency Stability	Un-modulation	5785							

NOTE:

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^{2.} The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.



3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit							
Frequency Emission (MHz) Quasi-Peak Average							
0.15-0.5	66 - 56 *	56 - 46 *					
0.5-5	56	46					
5-30	60	50					
Note 1: * Decreases with the logarithm of the frequency.							

3.1.2 Test Procedures

- 1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
- 2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
- 3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
- 4. This measurement was performed with AC 120V / 60Hz.

3.1.3 Test Setup



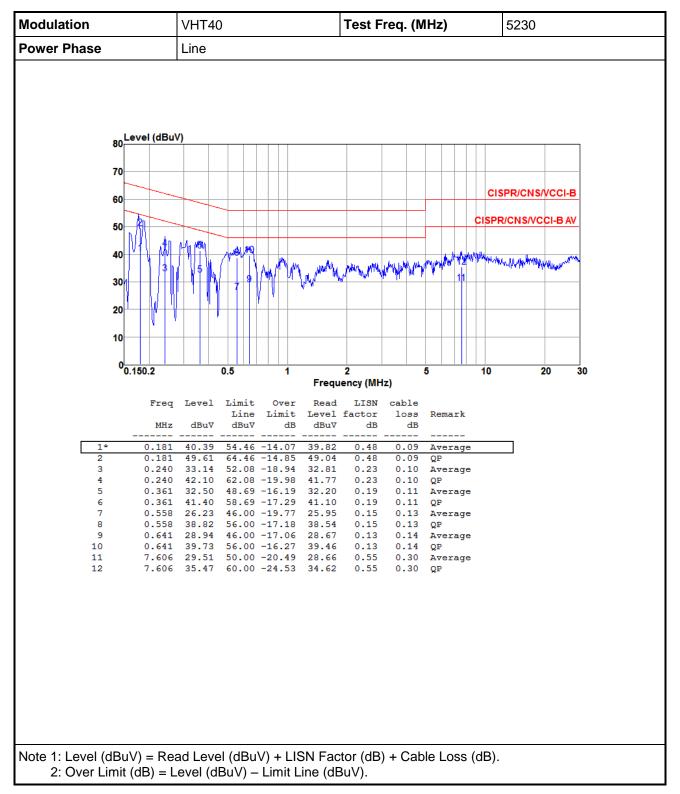
Note: 1. Support units were connected to second LISN.

Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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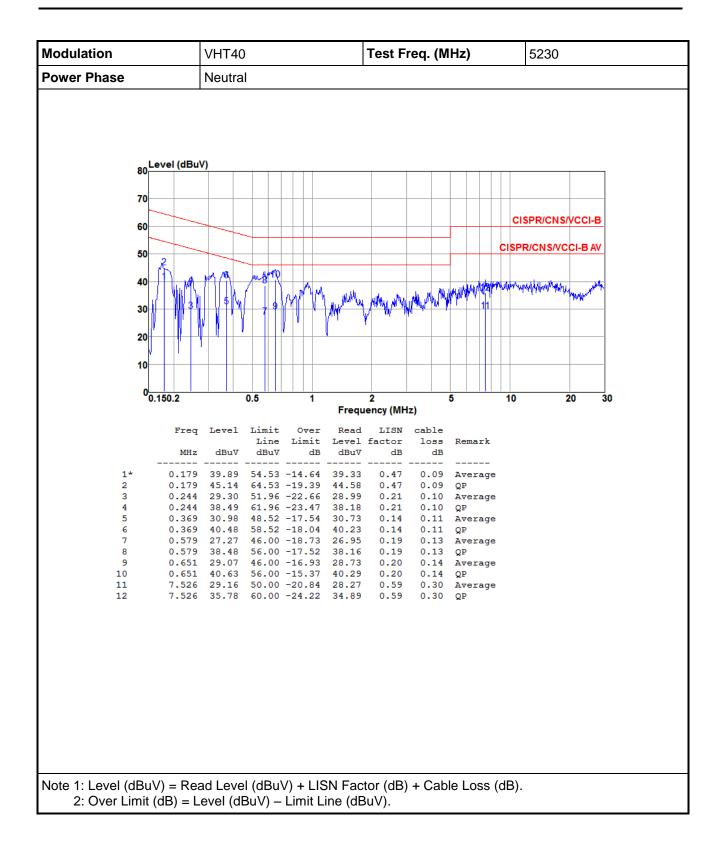


3.1.4 Test Result of Conducted Emissions



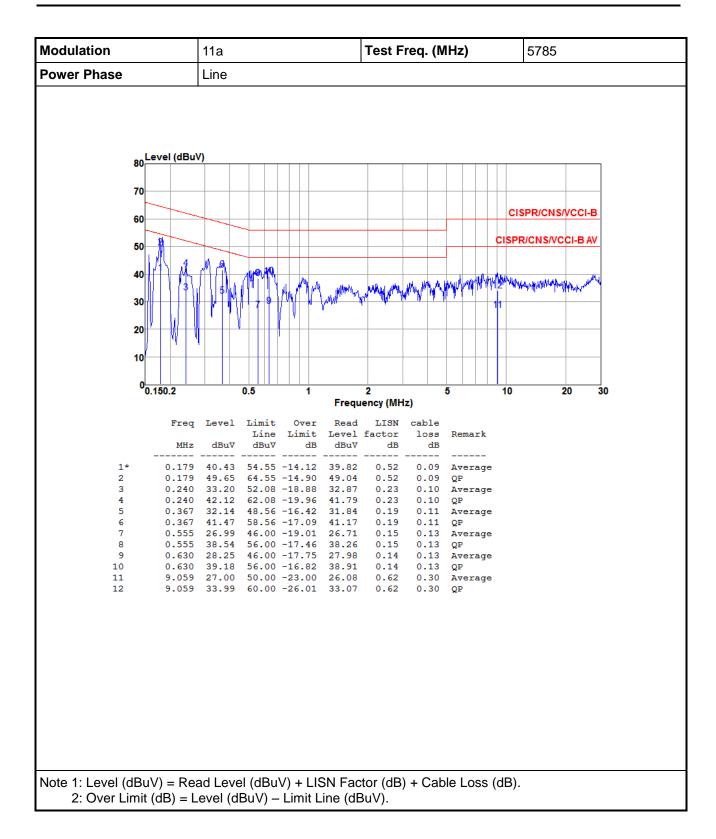
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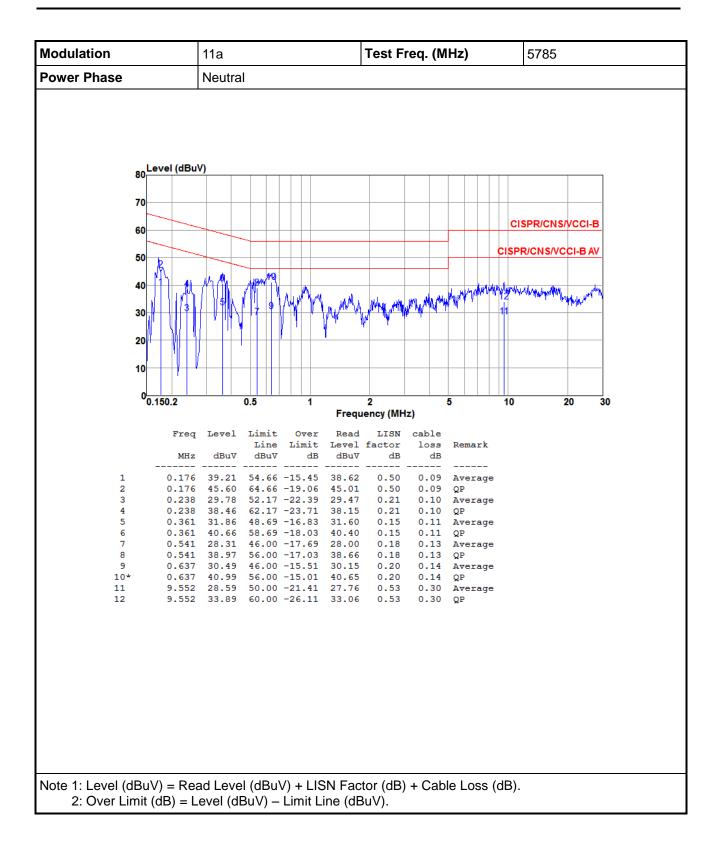
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3.2 Emission Bandwidth

3.2.1 Limit of Emission bandwidth

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

3.2.2 Test Procedures

26dB Bandwidth

- 1. Set RBW = approximately 1% of the emission bandwidth.
- 2. Set the VBW > RBW, Detector = Peak.
- Trace mode = max hold.
- 4. Measure the maximum width of the emission that is 26 dB down from the peak of the emission.

Occupied Bandwidth

- 1. Set RBW = 1 % to 5 % of the OBW
- 2. Set VBW ≥ 3 RBW
- 3. Sample detection and single sweep mode shall be used
- 4. Use the 99 % power bandwidth function of the instrument

6dB Bandwidth

- 1. Set RBW = 100kHz, VBW = 300kHz
- 2. Detector = Peak, Trace mode = max hold.
- 3. Allow the trace to stabilize.
- 4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

3.2.3 Test Setup

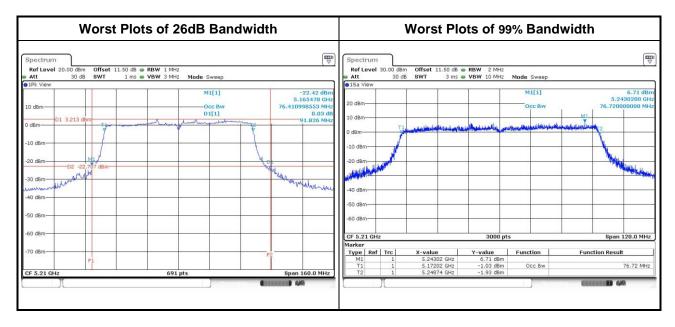


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3.2.4 Test Result of Emission Bandwidth

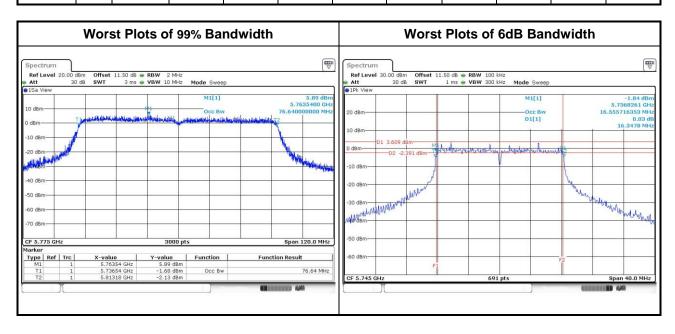
	For Frequency band 5150-5250 MHz									
	Emission Bandwidth									
Mode	l N	Freq.	2	26dB Band	width (MHz)		99% Bandv	vidth (MHz)	1
wode	N _{TX}	(MHz)	Chain 0	Chain 1	Chain 2	Chain 3	Chain 0	Chain 1	Chain 2	Chain 3
11a	2	5180	22.43	23.48			16.77	16.72		
11a	2	5200	22.67	22.96			16.74	16.72		
11a	2	5240	23.19	23.01			16.79	16.72		
VHT20	2	5180	23.48	23.77			17.94	17.92		
VHT20	2	5200	23.48	24.81			17.90	17.88		
VHT20	2	5240	23.77	24.64			17.88	17.90		
VHT40	2	5190	47.65	47.42			36.82	36.92		
VHT40	2	5230	51.25	47.07			37.10	37.10		
VHT80	2	5210	91.83	89.04			76.72	76.64		



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	For Frequency band 5725-5850 MHz										
	Emission Bandwidth										
			o	BW Band	width (MH	z)		6dB B	andwidth	(MHz)	
Mode	N _{TX}	Freq. (MHz)	Chain 0	Chain 1	Chain 2	Chain 3	Chain 0	Chain 1	Chain 2	Chain 3	6dB BW Limit (MHz)
11a	2	5745	16.88	16.84			16.35	16.35			0.5
11a	2	5785	16.98	16.95			16.35	16.35			0.5
11a	2	5825	16.93	16.87			16.35	16.35			0.5
VHT20	2	5745	17.92	17.90			17.57	17.62			0.5
VHT20	2	5785	18.05	18.05			16.35	16.35			0.5
VHT20	2	5825	18.03	18.01			16.35	16.35			0.5
VHT40	2	5755	36.88	36.86			36.41	36.41			0.5
VHT40	2	5795	36.98	36.88			36.29	36.29			0.5
VHT80	2	5775	76.64	76.60			76.29	76.06			0.5



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3.3 RF Output Power

3.3.1 Limit of RF Output Power

	Frequency band 5150-5250 MHz							
Оре	erating Mode	Limit						
	Outdoor access point	Conducted Power: 1 W The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm)						
	Indoor access point	Conducted Power: 1 W						
	Fixed point-to-point access points	Conducted Power: 1 W						
	Mobile and portable client devices	Conducted Power: 250 mW						

Fred	quency Band (MHz)	Limit
	5250 ~ 5350	250mW or 11dBm+10 log B
	5470 ~ 5725	250mW or 11dBm+10 log B
	5725 ~ 5850	1 W
Note	e: "B" is the 26dB emission bandwidth i	n MHz.

3.3.2 Test Procedures

Method PM-G (Measurement using a gated RF average power meter)

Measurements may is performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

3.3.3 Test Setup



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3.3.4 Test Result of Maximum Conducted Output Power

			For Freq	uency band	d 5150-5250) MHz			
			С	onducted l	Power (dBn	n)	Total	Total	Limit
Mode	N _{TX}	Freq. (MHz)	Chain 0	Chain 1	Chain 2	Chain 3	Power (mW)	Power (dBm)	(dBm)
11a	2	5180	9.49	9.59			17.991	12.55	30.00
11a	2	5200	10.12	10.16			20.655	13.15	30.00
11a	2	5240	13.61	13.65			46.135	16.64	30.00
HT20	2	5180	9.52	9.49			17.846	12.52	30.00
HT20	2	5200	10.02	10.06			20.185	13.05	30.00
HT20	2	5240	13.51	13.54			45.033	16.54	30.00
HT40	2	5190	12.91	12.72			38.250	15.83	30.00
HT40	2	5230	16.45	16.71			91.038	19.59	30.00
VHT20	2	5180	9.65	9.62			18.388	12.65	30.00
VHT20	2	5200	10.13	10.18			20.727	13.17	30.00
VHT20	2	5240	13.62	13.68			46.349	16.66	30.00
VHT40	2	5190	13.02	12.82			39.187	15.93	30.00
VHT40	2	5230	16.55	16.82			93.270	19.70	30.00
VHT80	2	5210	10.58	10.39			22.368	13.50	30.00

			For Freq	uency band	d 5725-5850	MHz			
		F (MIL)	C	onducted I	Power (dBn	n)	Total	Total	Limit
Mode	N _{TX}	Freq. (MHz)	Chain 0	Chain 1	Chain 2	Chain 3	Power (mW)	Power (dBm)	(dBm)
11a	2	5745	13.92	13.85			48.926	16.90	30.00
11a	2	5785	15.2	15.06			65.176	18.14	30.00
11a	2	5825	14.76	14.65			59.097	17.72	30.00
HT20	2	5745	14.13	14.21			52.245	17.18	30.00
HT20	2	5785	15.11	14.95			63.695	18.04	30.00
HT20	2	5825	14.69	14.51			57.693	17.61	30.00
HT40	2	5755	12.82	12.74			37.936	15.79	30.00
HT40	2	5795	14.35	14.21			53.590	17.29	30.00
VHT20	2	5745	14.26	14.34			53.833	17.31	30.00
VHT20	2	5785	15.22	15.03			65.108	18.14	30.00
VHT20	2	5825	14.81	14.62			59.243	17.73	30.00
VHT40	2	5755	12.93	12.85			38.909	15.90	30.00
VHT40	2	5795	14.48	14.32			55.094	17.41	30.00
VHT80	2	5775	9.76	9.56			18.499	12.67	30.00

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3.4 Peak Power Spectral Density

3.4.1 Limit of Peak Power Spectral Density

	Frequ	uency band 5150-5250 MHz
Ope	rating Mode	Limit
	Outdoor access point	17 dBm / MHz
\boxtimes	Indoor access point	17 dBm / MHz
	Fixed point-to-point access points	17 dBm / MHz
	Mobile and portable client devices	11 dBm / MHz

Free	quency Band (MHz)	Limit
	5250 ~ 5350	11 dBm / MHz
	5470 ~ 5725	11 dBm / MHz
	5725 ~ 5850	30 dBm / 500 kHz

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3.4.2 Test Procedures

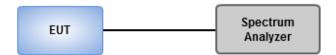
For 5150 ~ 5250 MHz

- Method SA-1 (for 11a/VHT20)
 - 1. Set RBW = 1 MHz, VBW = 3 MHz, Sweep time = auto, Detector = RMS.
 - 2. Trace average 100 traces.
 - 3. Use the peak marker function to determine the maximum amplitude level.
- Method SA-2 Alternative (for VHT40/VHT80)
 - Set RBW = 1 MHz, VBW = 3 MHz, Detector = RMS.
 - 2. Set sweep time ≥ 10 * (number of points in sweep) * (total on/off period of the transmitted signal).
 - 3. Perform a single sweep.
 - 4. Use the peak marker function to determine the maximum amplitude level.
 - 5. Add 10 log(1/x), where x is the duty cycle.

For 5725 ~ 5850 MHz

- Method SA-1 (for 11a/VHT20)
 - 1. Set RBW = 500 kHz, VBW = 2 MHz, Sweep time = auto, Detector = RMS.
 - 2. Trace average 100 traces.
 - 3. Use the peak marker function to determine the maximum amplitude level.
- Method SA-2 Alternative (for VHT40/VHT80)
 - 1. Set RBW = 500 kHz, VBW = 2 MHz, Detector = RMS.
 - 2. Set sweep time ≥ 10 * (number of points in sweep) * (total on/off period of the transmitted signal).
 - 3. Perform a single sweep.
 - 4. Use the peak marker function to determine the maximum amplitude level.
 - 5. Add $10 \log(1/x)$, where x is the duty cycle.

3.4.3 Test Setup



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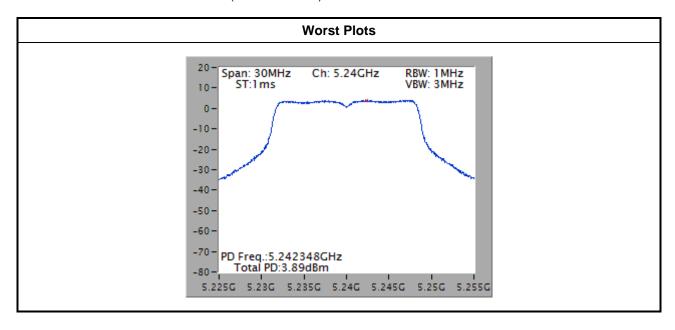


Test Result of Peak Power Spectral Density 3.4.4

			For Frequency	band 5150-5250 MF	łz	
Co	ndition			Peak Power Spectra	al Density (dBm/MH	z)
Modulation Mode	N _{TX}	Freq. (MHz)	PPSD w/o D.F (dBm/MHz)	Duty Factor (dB)	PPSD with D.F (dBm/MHz)	PPSD Limit (dBm/MHz)
11a	2	5180	0.05	0.00	0.05	16.99
11a	2	5200	0.96	0.00	0.96	16.99
11a	2	5240	3.89	0.00	3.89	16.99
VHT20	2	5180	-0.15	0.00	-0.15	16.99
VHT20	2	5200	0.59	0.00	0.59	16.99
VHT20	2	5240	3.40	0.00	3.40	16.99
VHT40	2	5190	-0.25	0.29	0.04	16.99
VHT40	2	5230	3.58	0.29	3.87	16.99
VHT80	2	5210	-5.62	0.52	-5.10	16.99

Note:

- 1. D.F is duty factor.
- Test result is bin-by-bin summing measured value of each TX port. Directional gain = $3+10*\log(2/1) = 6.01$ dBi > 6 dBi. Limit shall be reduced to 17 dBm - (6.01 dBi - 6 dBi) = 16.99 dBm.



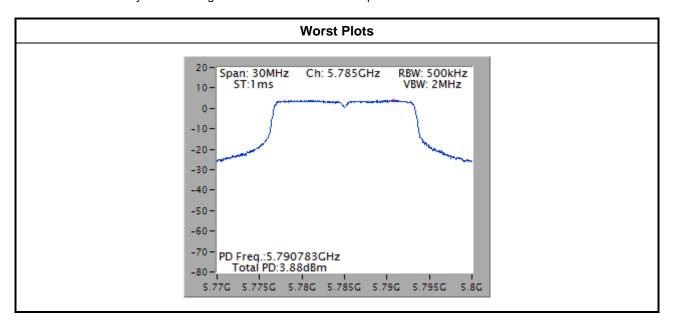
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			For Frequency	band 5725-5850 MH	lz	
Co	ndition	1	F	Peak Power Spectral	Density (dBm/500kl	Hz)
Modulation Mode	N _{TX}	Freq. (MHz)	PPSD w/o D.F (dBm/500kHz)	Duty Factor (dB)	PPSD with D.F (dBm/500kHz)	PPSD Limit (dBm/500kHz)
11a	2	5745	3.26	0.00	3.26	30.00
11a	2	5785	3.88	0.00	3.88	30.00
11a	2	5825	3.59	0.00	3.59	30.00
VHT20	2	5745	2.11	0.00	2.11	30.00
VHT20	2	5785	3.62	0.00	3.62	30.00
VHT20	2	5825	2.94	0.00	2.94	30.00
VHT40	2	5755	-1.77	0.29	-1.48	30.00
VHT40	2	5795	-0.46	0.29	-0.17	30.00
VHT80	2	5775	-8.02	0.52	-7.50	30.00

Note:

- 1. D.F is duty factor.
- 2. Test result is bin-by-bin summing measured value of each TX port.



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3.5 Transmitter Radiated and Band Edge Emissions

3.5.1 Limit of Transmitter Radiated and Band Edge Emissions

	Restricted Band	Emissions Limit	
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

	Un-restricted band emissions above 1GHz Limit
Operating Band	Limit
5.15 - 5.25 GHz	e.i.r.p27 dBm [68.2 dBuV/m@3m]
5.25 - 5.35 GHz	e.i.r.p27 dBm [68.2 dBuV/m@3m]
5.47 - 5.725 GHz	e.i.r.p27 dBm [68.2 dBuV/m@3m]
5.725 - 5.850 GHz	5.715 5.725 GHz: e.i.r.p17 dBm [78.2 dBuV/m@3m] 5.85 5.86 GHz: e.i.r.p17 dBm [78.2 dBuV/m@3m] Other un-restricted band: e.i.r.p27 dBm [68.2 dBuV/m@3m]

Note 1: Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

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3.5.2 Test Procedures

- Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
- 2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
- 3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

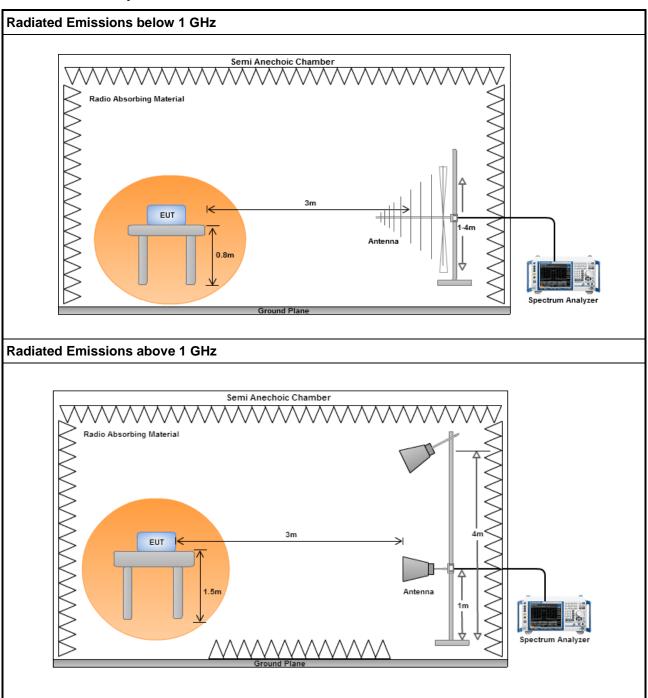
Note:

- 1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
- 2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
- RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

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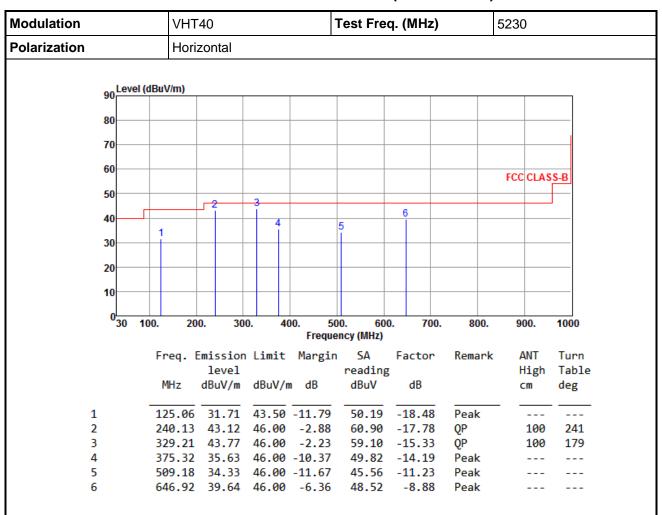
3.5.3 Test Setup



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3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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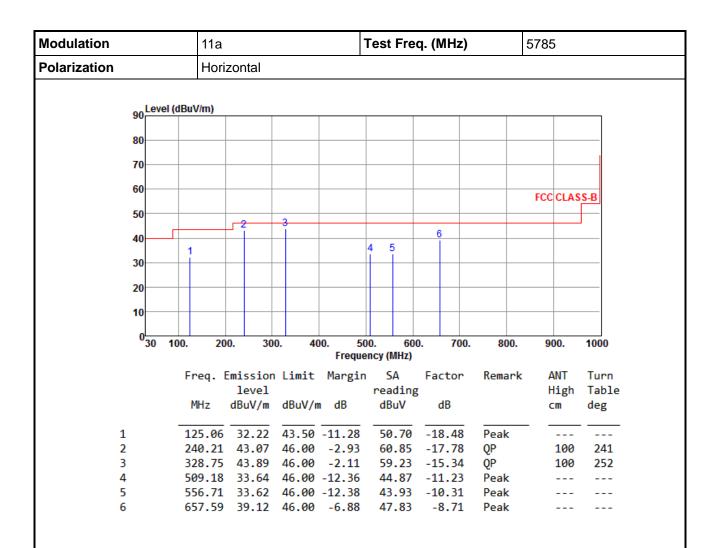
Modulation		VHT40			-	Test Freq. (MHz)			5230		
Polarization			Vertical								
	90Le	vel (dBu	IBuV/m)								
	80										
	70										
	60									FCC CLAS	SS-B
	50										
				<u>, 3</u>	4						_
	40 1	2	2					6			
	30										
	20										
	10										
	030	100.	20	0. 30	0. 40		00. 600	0. 700.	800.	900.	1000
		_	_				ency (MHz)	_			_
		۲	req. E	missior level	Limit	Margin		Factor	Remark	ANT	Turn
			MHz		dBuV/m	dB	reading dBuV	dB		High cm	Table deg
		'	11112	ubuv/III	ubuv/ii	ub	ubuv	ub		CIII	ueg
	1	_	46.49	35.05	40.00	-4.95	51.33	-16.28	Peak		
	2		25.06	36.20	43.50	-7.30	54.68	-18.48	Peak		
	3	2	39.52	42.74	46.00	-3.26	60.53		Peak		
	4		29.73		46.00	-4.27	57.05		Peak		
	5				46.00	-9.44	47.96		Peak		
	6	6	50.80	36.02	46.00	-9.98	44.85	-8.83	Peak		

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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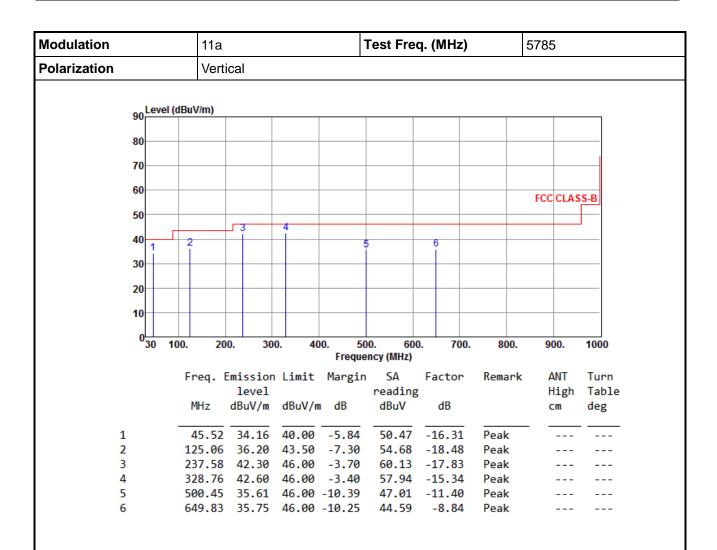
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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*Factor includes antenna factor, cable loss and amplifier gain

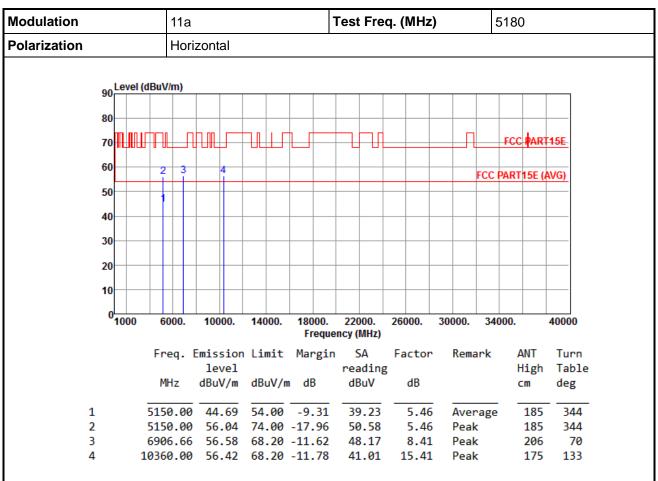
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 11a



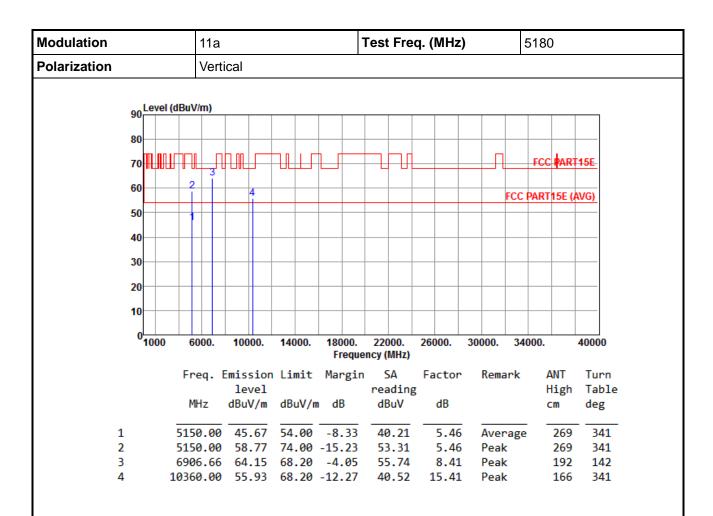
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

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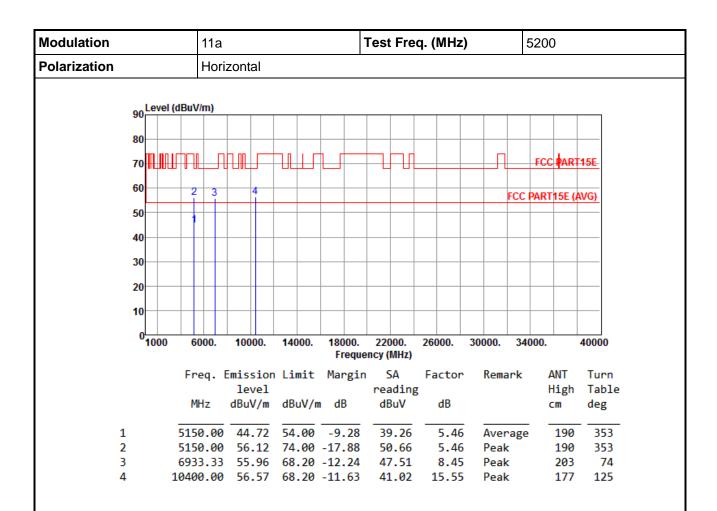


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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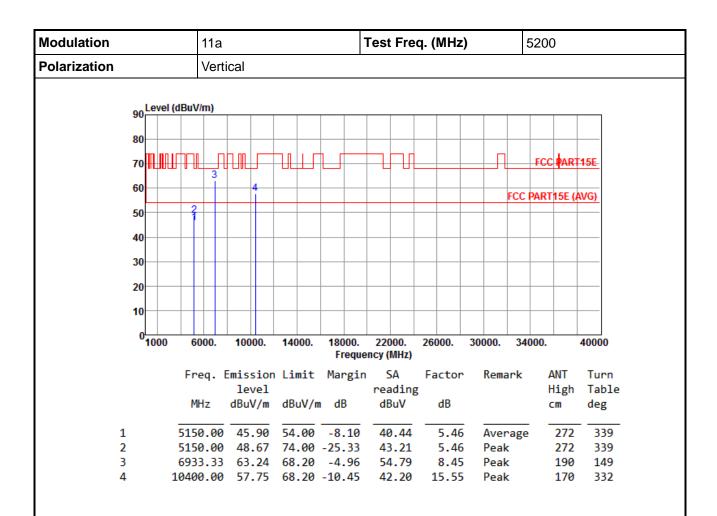


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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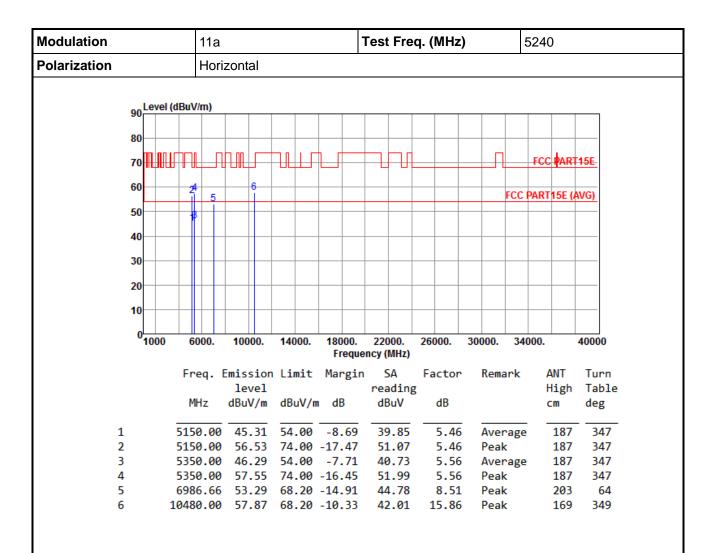


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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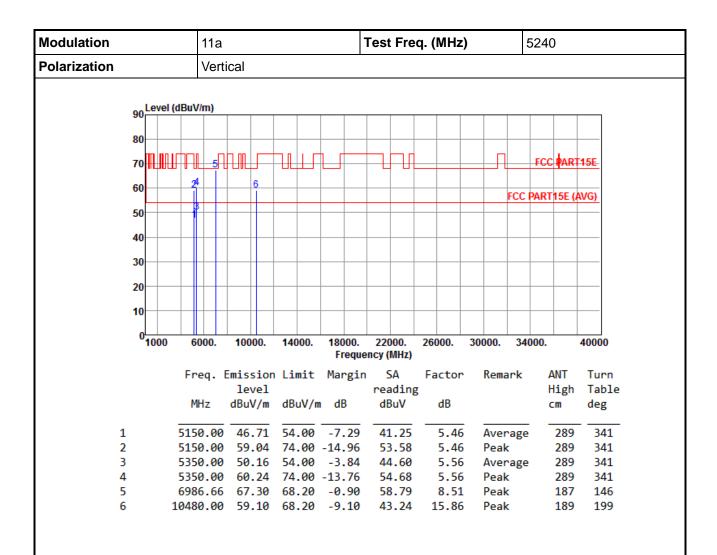


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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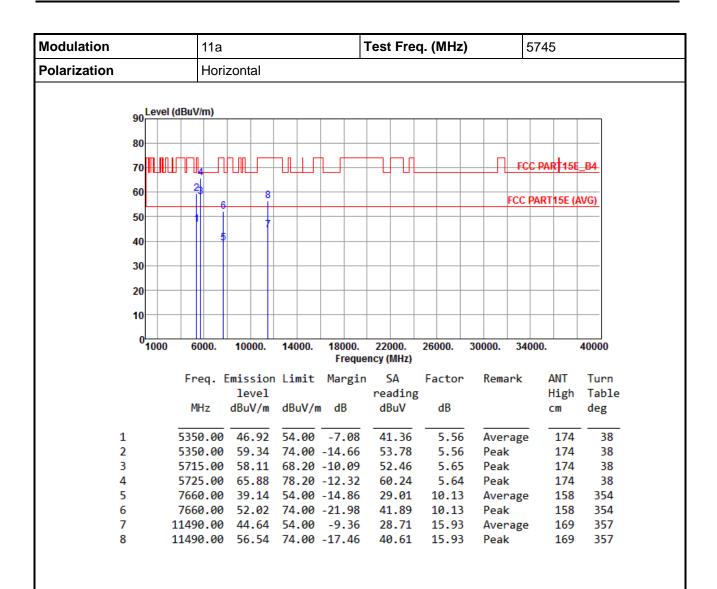


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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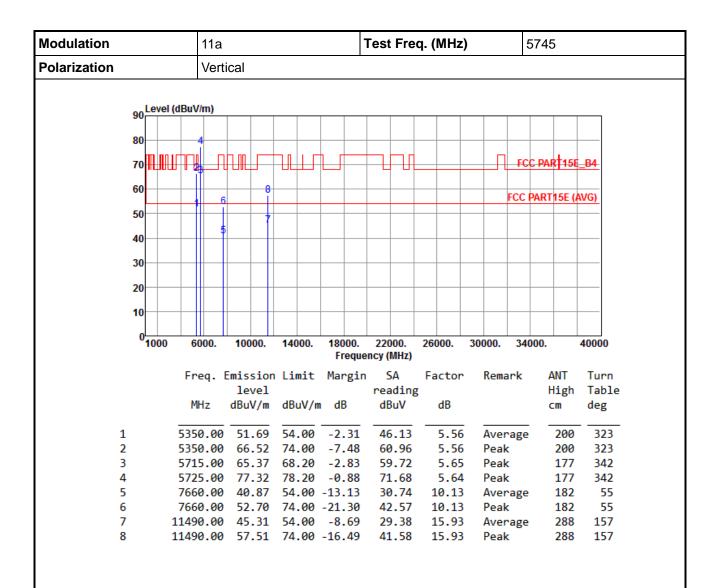


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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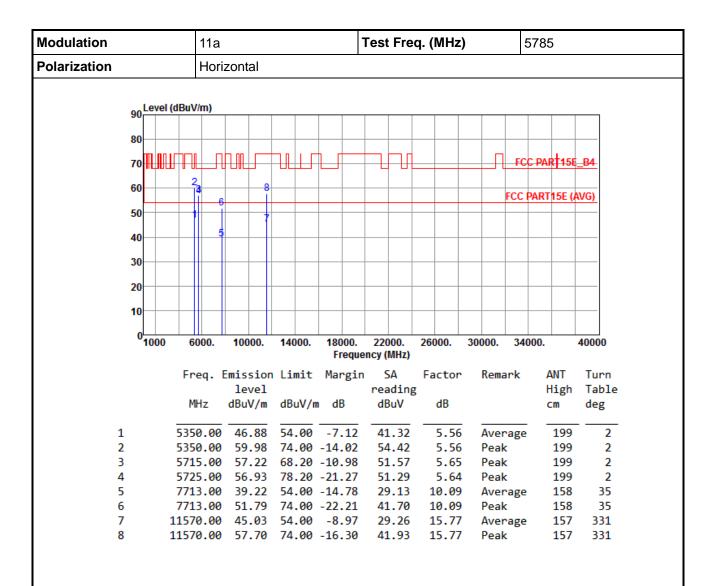


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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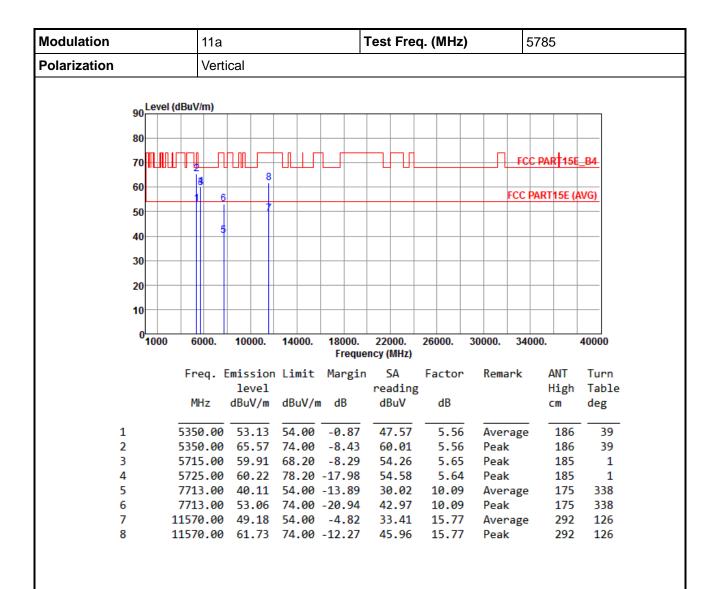


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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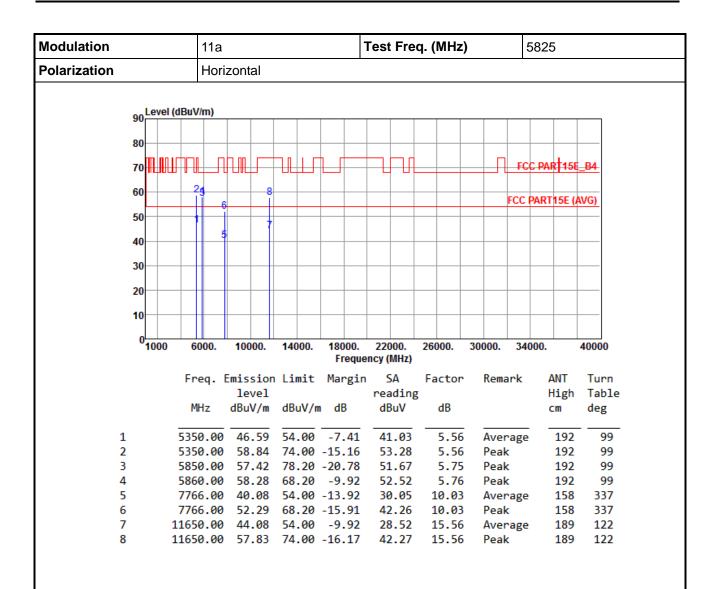


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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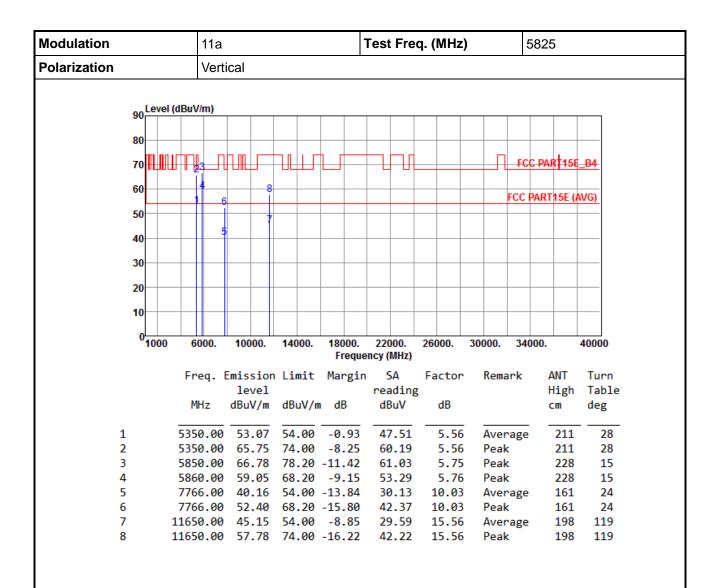


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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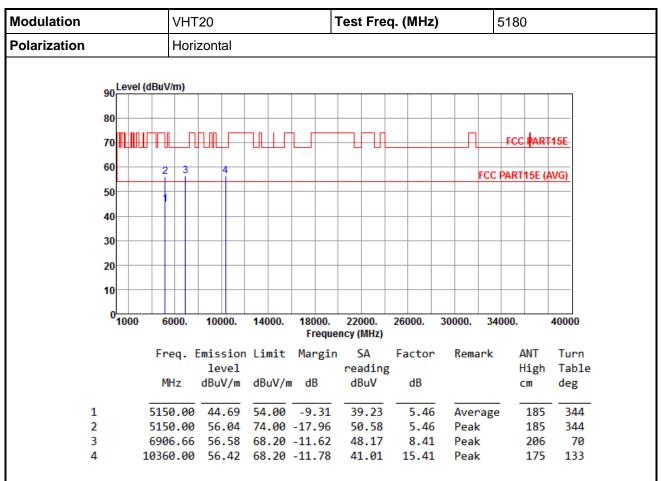
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.5.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for VHT20



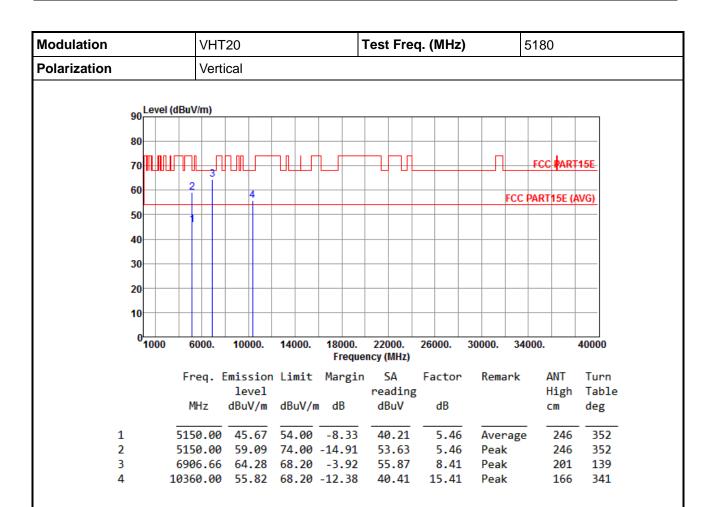
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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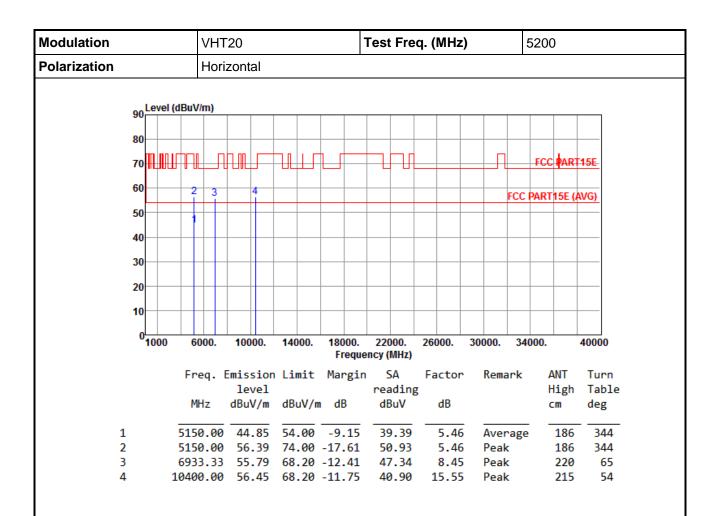


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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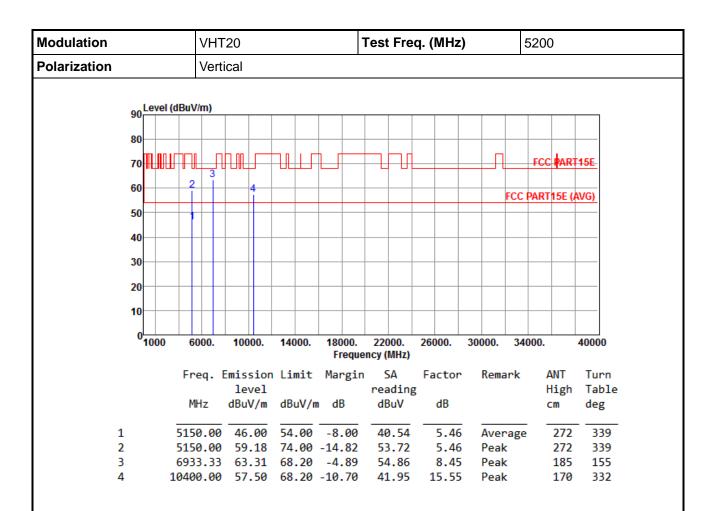


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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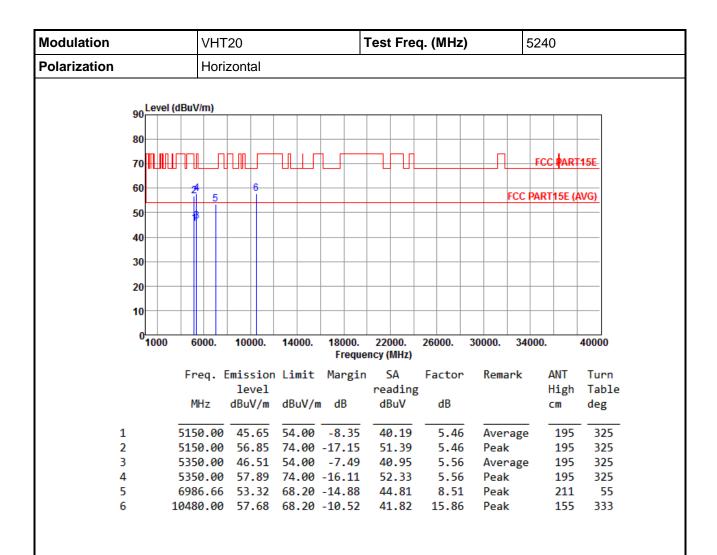


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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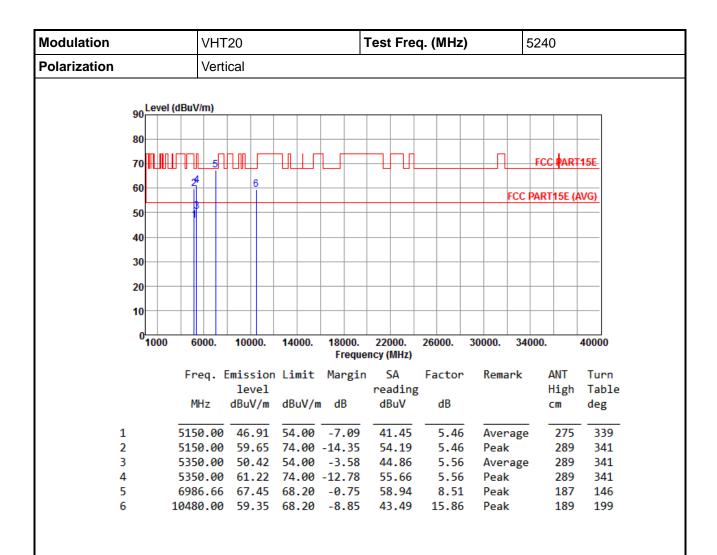


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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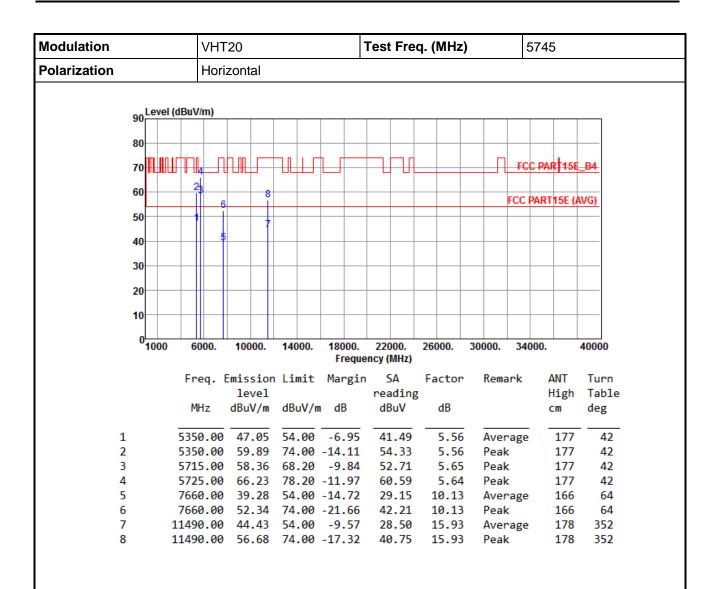


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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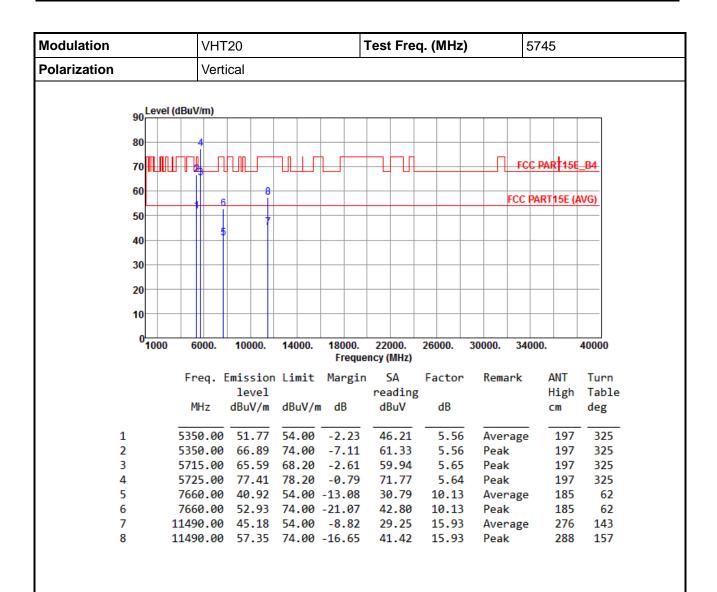


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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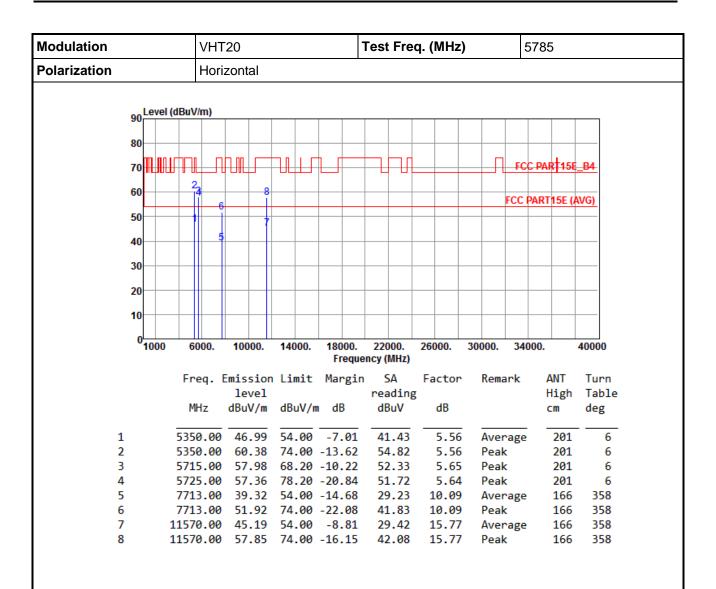


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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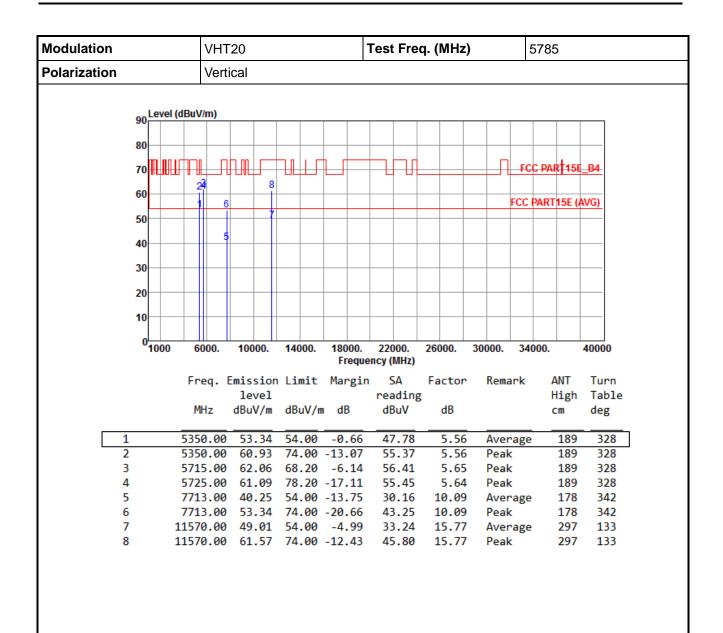


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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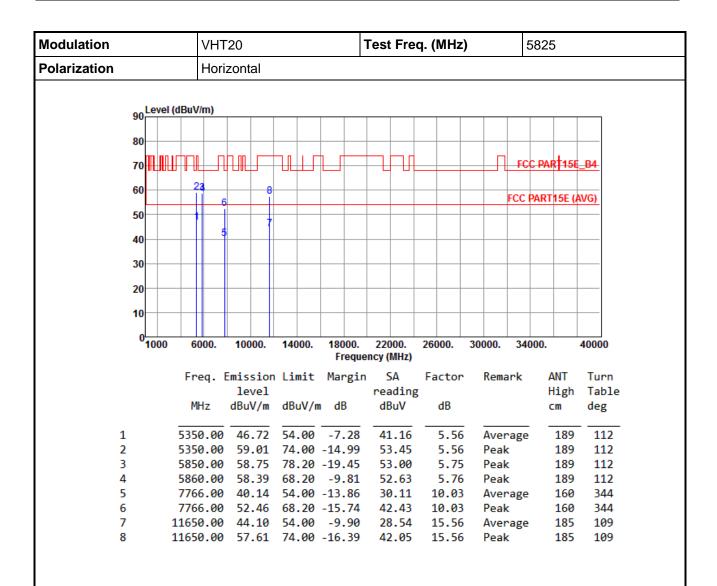


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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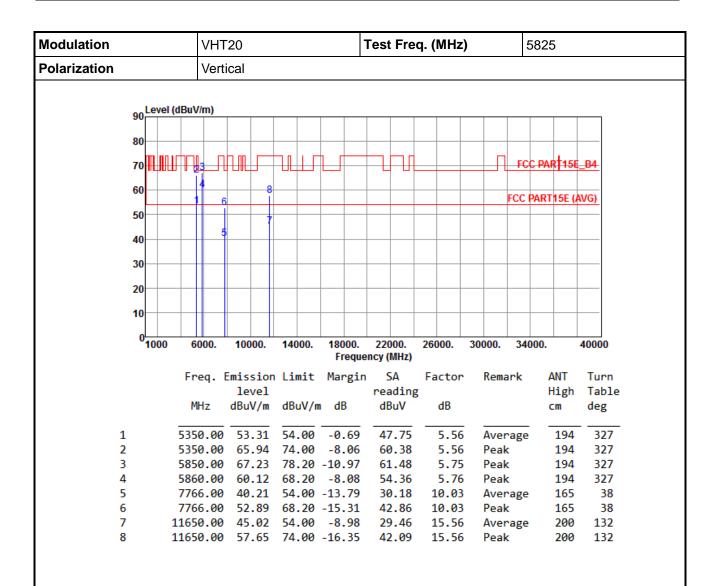


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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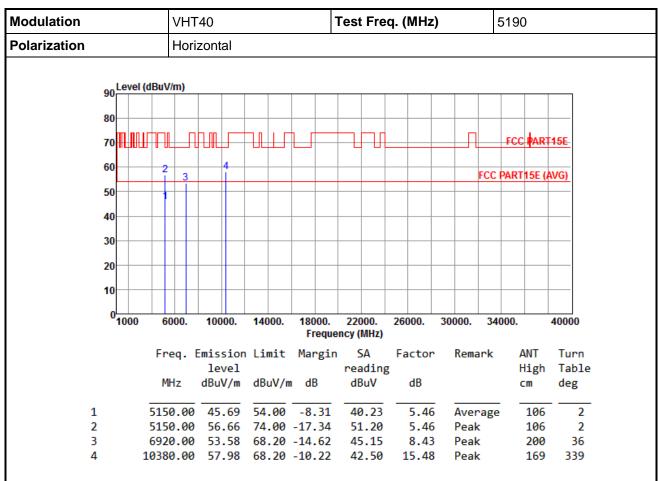
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.5.7 Transmitter Radiated Unwanted Emissions (Above 1GHz) for VHT40



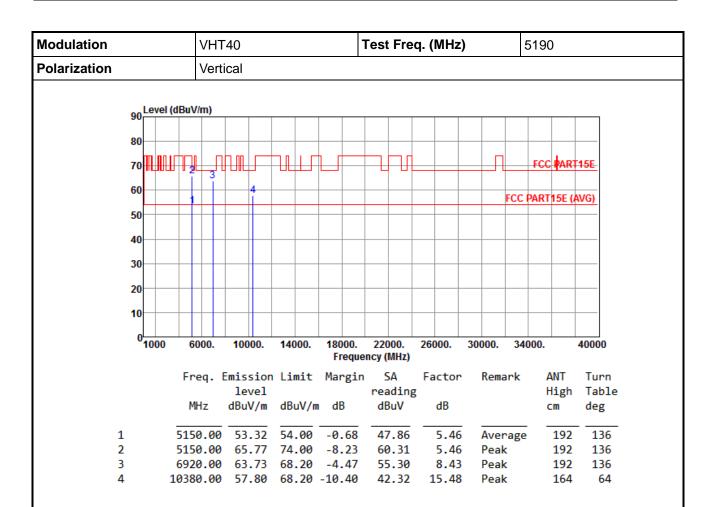
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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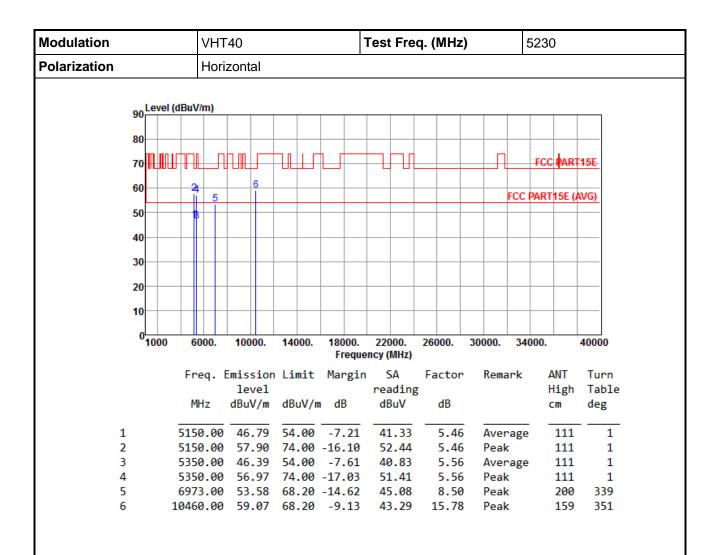


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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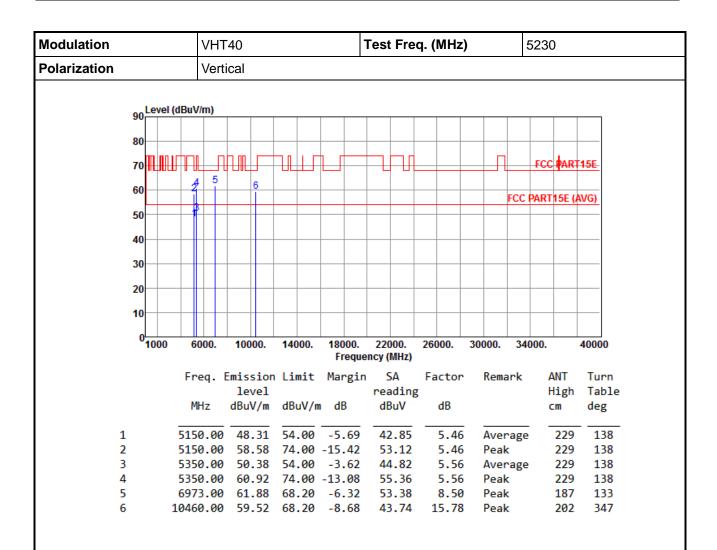


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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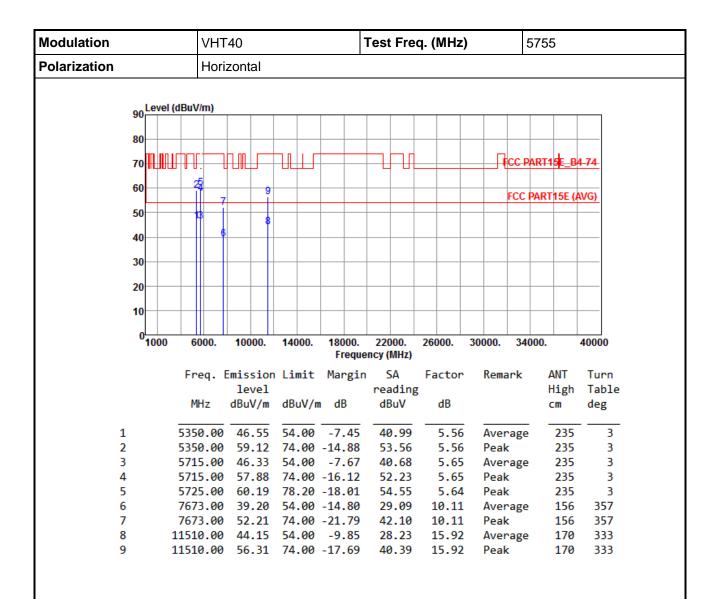


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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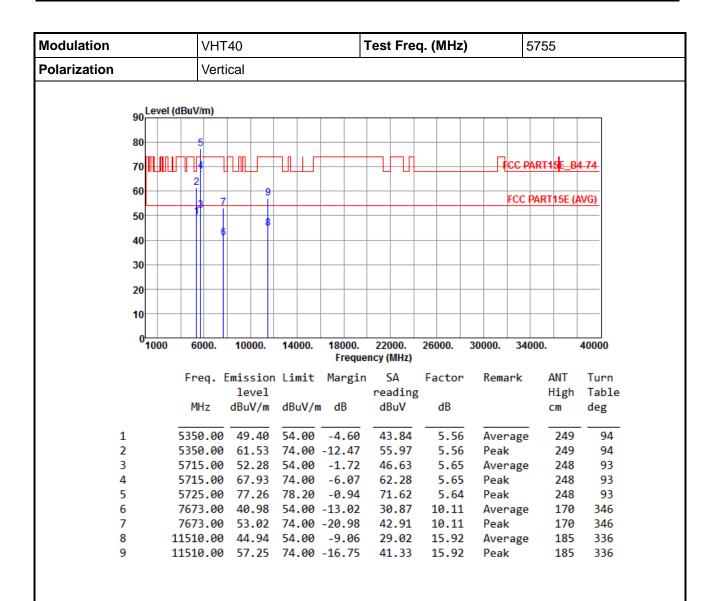


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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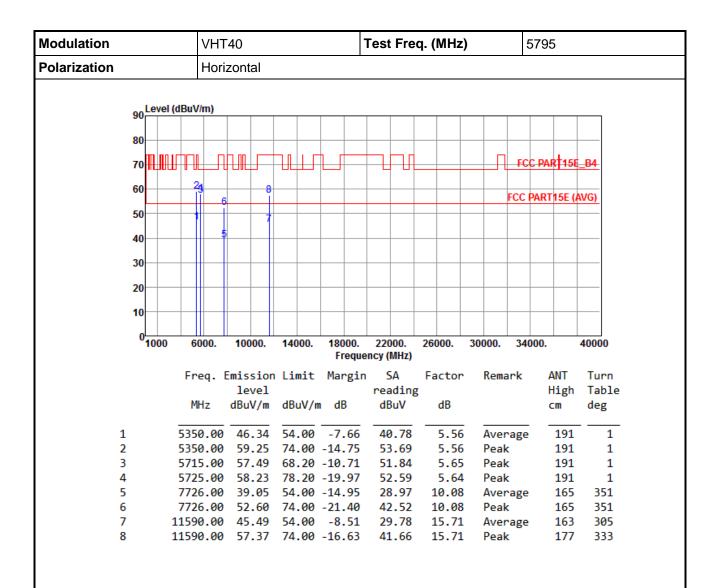


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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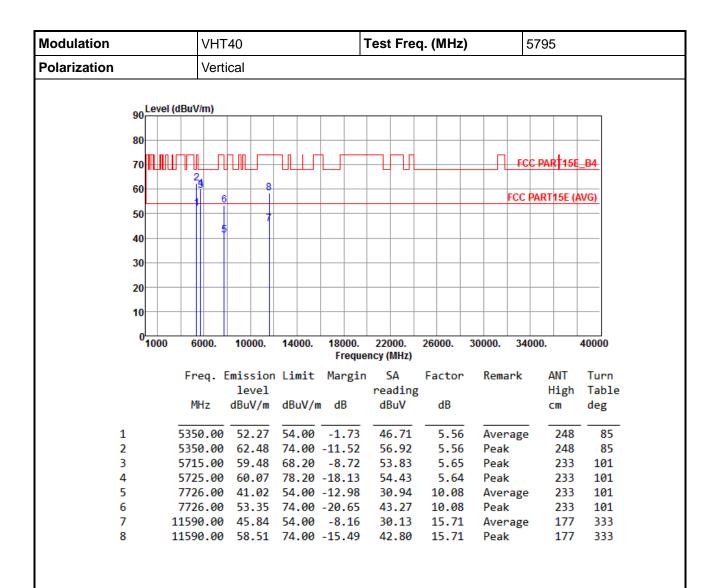


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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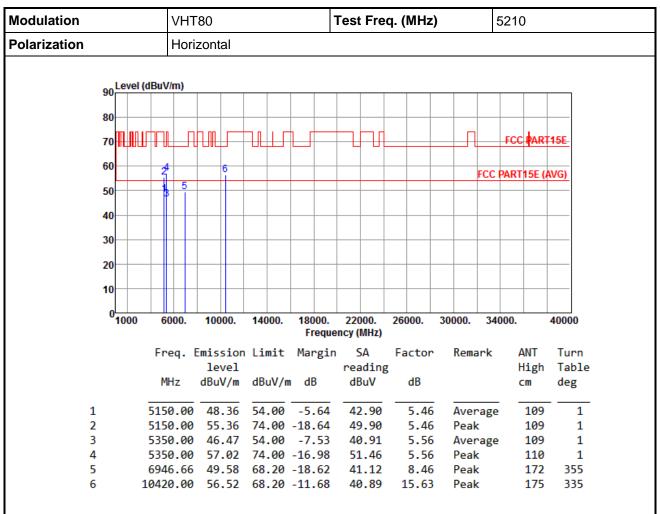
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.5.8 Transmitter Radiated Unwanted Emissions (Above 1GHz) for VHT80



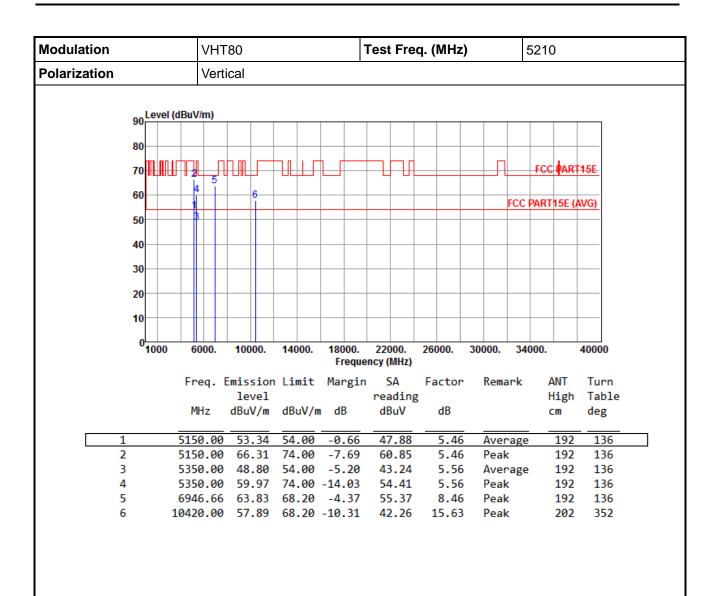
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

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^{*}Factor includes antenna factor, cable loss and amplifier gain



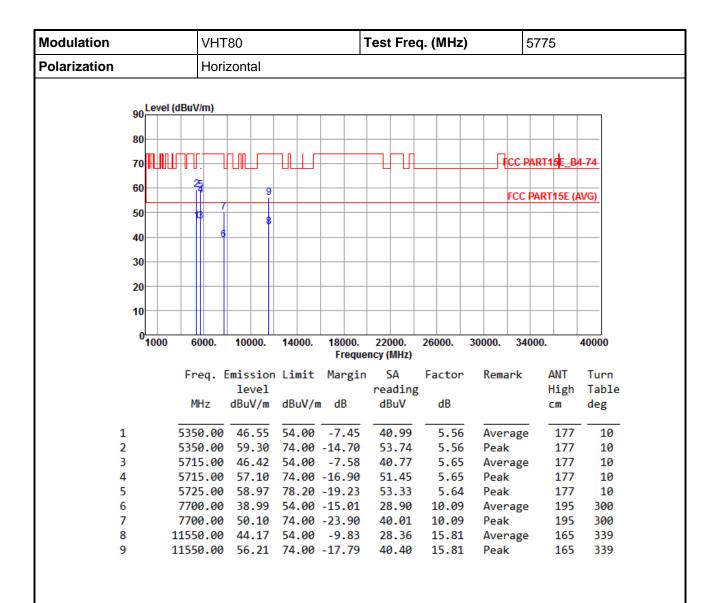


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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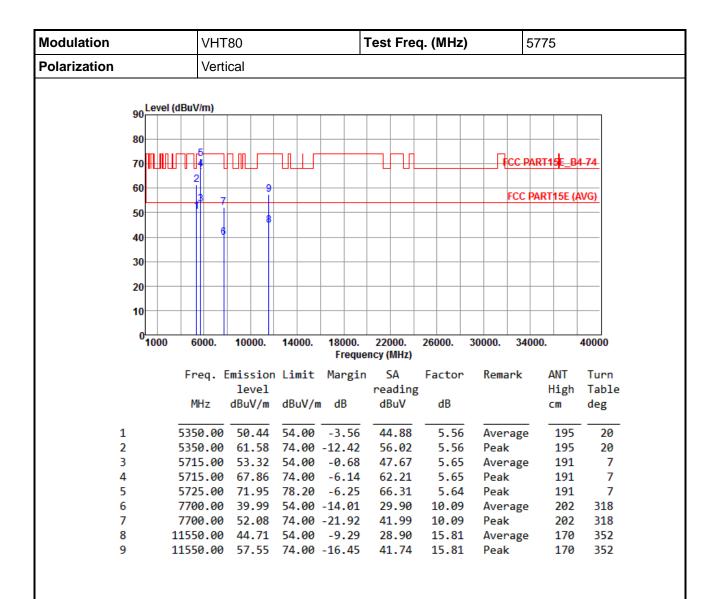


*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.6 Frequency Stability

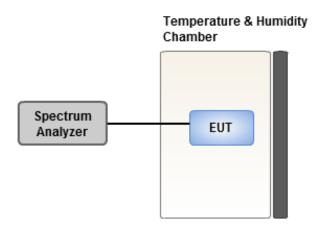
3.6.1 Limit of Frequency Stability

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

3.6.2 Test Procedures

- 1. The EUT is installed in an environment test chamber with external power source.
- Set the chamber to operate at 50 centigrade and external power source to output at nominal voltage of EUT.
- 3. A sufficient stabilization period at each temperature is used prior to each frequency measurement.
- 4. When temperature is stabled, measure the frequency stability.
- 5. The test shall be performed under -30 to 50 centigrade and 85 to 115 percent of the nominal voltage. Change setting of chamber and external power source to complete all conditions.

3.6.3 Test Setup



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3.6.4 Test Result of Frequency Stability

Frequency: 5200 MHz	Frequency Drift (ppm)				
Temperature (°C)	0 minute	2 minutes	5 minutes	10 minutes	
T20°CVmax	5.70	5.29	5.86	5.96	
T20°CVmin	4.49	5.02	4.09	5.16	
T55°CVnom	4.10	3.59	4.30	4.24	
T50°CVnom	3.22	3.21	3.61	3.47	
T40°CVnom	3.07	3.13	3.82	3.48	
T30°CVnom	3.29	3.64	3.08	3.53	
T20°CVnom	2.13	2.69	2.05	2.36	
T10°CVnom	2.17	1.83	2.17	2.58	
T0°CVnom	2.25	1.96	2.45	2.07	
T-10°CVnom	1.11	0.76	1.58	1.97	
T-20°CVnom	0.71	0.74	1.31	1.42	
T-30°CVnom	0.06	0.31	0.10	0.03	
Vnom [Vac]: 120		max [Vac]: 138	Vmin [Vac]: 1	Vmin [Vac]: 102	
Tnom [°C]: 20 T		max [°C]: 55	Tmin [°C]: -30	Tmin [°C]: -30	

Frequency: 5785 MHz	Frequency Drift (ppm)				
Temperature (°C)	0 minute	2 minutes	5 minutes	10 minutes	
T20°CVmax	4.64	4.99	4.35	4.96	
T20°CVmin	3.29	3.54	3.12	3.60	
T55°CVnom	3.28	2.81	3.08	3.45	
T50°CVnom	3.39	3.45	3.21	3.43	
T40°CVnom	2.91	2.92	3.49	3.16	
T30°CVnom	2.76	3.45	3.46	2.73	
T20°CVnom	1.67	2.46	2.17	1.75	
T10°CVnom	2.38	2.42	2.68	2.34	
T0°CVnom	1.95	2.24	2.38	2.46	
T-10°CVnom	1.32	1.32	1.70	1.38	
T-20°CVnom	1.10	0.78	1.50	1.65	
T-30°CVnom	0.12	0.31	0.79	0.02	
Vnom [Vac]: 120		max [Vac]: 138	Vmin [Vac]:	Vmin [Vac]: 102	
Tnom [°C]: 20		max [°C]: 55	Tmin [°C]: -3	Tmin [°C]: -30	

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4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp, it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan Hsiang. Location map can be found on our website http://www.icertifi.com.tw.

Linkou

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan,

R.O.C.

Kwei Shan

Tel: 886-3-271-8666 No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C. Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666 Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

==END==

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