

FCC Radio Test Report

FCC ID: TE7AX20V1

This report concerns: Original Grant

Project No.	:	1907C233A
Equipment	:	AX1800 Wi-Fi 6 Router
Brand Name	:	tp-link
Test Model	:	Archer AX20
Series Model	:	N/A
Applicant	:	TP-Link Technologies Co., Ltd.
Address	:	Building 24(floors1,3,4,5) and 28(floors1-4) Central Science and Technology Park, Shennan Rd, Nanshan, Shenzhen, China
Manufacturer	:	TP-Link Technologies Co., Ltd.
Address	:	Building 24(floors1,3,4,5) and 28(floors1-4) Central Science and Technology Park, Shennan Rd, Nanshan, Shenzhen, China
Date of Receipt	:	Jan. 15, 2020
Date of Test	:	Jan. 15, 2020 ~ Mar. 13, 2020
Issued Date	:	Mar. 19, 2020
Report Version	:	R00
Test Sample	:	Engineering Sample No.: DG2020011473 for conducted, DG2020030638 for radiated.
Standard(s)	:	FCC Part15, Subpart E(15.407) ANSI C63.10-2013 FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 FCC KDB 662911 D01 Multiple Transmitter Output v02r01

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

Welly zhou

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Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective. Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.



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REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue.	Mar. 19, 2020
		1

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC Part15, Subpart E(15.407)						
Standard(s) Section	Test Item	Test Result	Judgement	Remark		
15.207 15.407(b)	AC Power Line Conducted Emissions	APPENDIX A	PASS			
15.407(b) 15.205(a) 15.209(a)	Radiated Emissions	APPENDIX B APPENDIX C APPENDIX D	PASS			
15.407(a) 15.407(e)	Spectrum Bandwidth	APPENDIX E	PASS			
15.407(a)	Maximum Output Power	APPENDIX F	PASS			
15.407(a)	Power Spectral Density	APPENDIX G	PASS			
15.407(g)	Frequency Stability	APPENDIX H	PASS			
15.203	Antenna Requirements		PASS	Note(4)		
15.407(c)	Automatically Discontinue Transmission		PASS	Note(2)		

Note:

- (1) "N/A" denotes test is not applicable in this test report.
- (2) During no any information transmission, the EUT can automatically discontinue transmission and become standby mode for power saving. the EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.
- (4) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.





1.1 TEST FACILITY

The test facilities used to collect the test data in this report is at the location of No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China. BTL's Test Firm Registration Number for FCC: 357015 BTL's Designation Number for FCC: CN1240

1.2 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)) The BTL measurement uncertainty as below table:

A. AC power line conducted emissions test:

Test Site	Method	Measurement Frequency Range	U, (dB)
DG-C02	CISPR	150 kHz ~ 30 MHz	2.32

B. Radiated emissions test:

Test Site	Method	Measurement Frequency Range	Ant. H / V	U, (dB)
		9kHz ~ 30MHz	V	3.79
		9kHz ~ 30MHz	Н	3.57
		30MHz ~ 200MHz	V	4.88
		30MHz ~ 200MHz		4.14
		200MHz ~ 1,000MHz	V	4.62
DG-CB03	CISPR	200MHz ~ 1,000MHz	Н	4.80
		1GHz ~ 6GHz	I	4.58
		6GHz ~ 18GHz	I	5.18
		18GHz ~ 26.5GHz	-	3.80
		26.5GHz ~ 40GHz	-	4.30

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

1.3 TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage	Tested By
AC Power Line Conducted Emissions	25°C	53%	AC 120V/60Hz	Kwok Guo
Radiated Emissions-9K-30MHz	25°C	60%	AC 120V/60Hz	Kwok Guo
Radiated Emissions-30 MHz to 1GHz	24°C	68%	AC 120V/60Hz	Kwok Guo
Radiated Emissions-Above 1000 MHz	25°C	60%	AC 120V/60Hz	Kwok Guo
Spectrum Bandwidth	25°C	66%	AC 120V/60Hz	Hayden Chen
Maximum Output Power	25°C	66%	AC 120V/60Hz	Laughing Zhang
Power Spectral Density	25°C	66%	AC 120V/60Hz	Hayden Chen
Frequency Stability	Normal & Extreme	66%	Normal & Extreme	Hayden Chen

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	AX1800 Wi-Fi 6 Router
Brand Name	tp-link
Test Model	Archer AX20
Series Model	N/A
Model Difference(s)	N/A
Power Source	DC voltage supplied from AC/DC adapter. Model: T120150-2B1
Power Rating	I/P: 100-240V~ 50/60Hz 0.6A O/P: 12V === 1.5A
Operation Frequency Bands	UNII-1: 5150 MHz~5250 MHz UNII-3: 5725 MHz~5850 MHz
Modulation Type	IEEE 802.11a: OFDM IEEE 802.11ac: OFDM IEEE 802.11ax: OFDMA
Bit Rate of Transmitter	Up to 1201 Mbps
Maximum Output Power for UNII-1 _Non Beamforming	IEEE 802.11a: 28.20 dBm (0.6607 W) IEEE 802.11ac (VHT20): 27.87 dBm (0.6124 W) IEEE 802.11ac (VHT40): 27.72 dBm (0.5916 W) IEEE 802.11ac (VHT80): 20.19 dBm (0.1045 W) IEEE 802.11ax (HEW20): 28.10 dBm (0.6457 W) IEEE 802.11ax (HEW40): 27.61 dBm (0.5768 W) IEEE 802.11ax (HEW80): 20.64 dBm (0.1159 W)
Maximum Output Power for UNII-3 _Non Beamforming	IEEE 802.11a: 29.25 dBm (0.8414 W) IEEE 802.11ac (VHT20): 29.06 dBm (0.8054 W) IEEE 802.11ac (VHT40): 29.75 dBm (0.9441 W) IEEE 802.11ac (VHT80): 24.76 dBm (0.2992 W) IEEE 802.11ax (HEW20): 29.82 dBm (0.9594 W) IEEE 802.11ax (HEW40): 29.79 dBm (0.9528 W) IEEE 802.11ax (HEW80): 24.76 dBm (0.2992 W)
Maximum Output Power for UNII-1_Beamforming	IEEE 802.11ac (VHT20): 28.25 dBm (0.6683 W) IEEE 802.11ac (VHT40): 28.07 dBm (0.6412 W) IEEE 802.11ac (VHT80): 17.01 dBm (0.0502 W) IEEE 802.11ax (HEW20): 28.02 dBm (0.6339 W) IEEE 802.11ax (HEW40): 26.53 dBm (0.4498 W) IEEE 802.11ax (HEW80): 19.24 dBm (0.0839 W)
Maximum Output Power for UNII-3_Beamforming	IEEE 802.11ac (VHT20): 27.01 dBm (0.5023 W) IEEE 802.11ac (VHT40): 27.09 dBm (0.5117 W) IEEE 802.11ac (VHT80): 24.17 dBm (0.2612 W) IEEE 802.11ax (HEW20): 27.14 dBm (0.5176 W) IEEE 802.11ax (HEW40): 27.08 dBm (0.5105 W) IEEE 802.11ax (HEW80): 24.36 dBm (0.2729 W)

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.



2. Channel List:

IEEE 80 IEEE 802.1 IEEE 802.11 IEEE 802.11	1n (HT20) ac (VHT20)	IEEE 802.1	11n (HT40) 1ac (VHT40) ax (HEW40)	IEEE 802.11 IEEE 802.11		
UNI	UNII-1		UNII-1		UNII-1	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	
36	5180	38	5190	42	5210	
40	5200	46	5230			
44	5220					
48	5240					

IEEE 80 IEEE 802.1 IEEE 802.11 IEEE 802.11	1n (HT20) ac (VHT20)	IEEE 802.11	11n (HT40) Iac (VHT40) ax (HEW40)	IEEE 802.11 IEEE 802.11	
UNI	I-3	UN	II-3	UNII-3	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	151	5755	155	5775
153	5765	159	5795		
157	5785				
161	5805				
165	5825				

3. Antenna Specification:

Ant.	Brand	P/N	Antenna Type	Connector	Gain (dBi)	Note
1	TP-LINK	3101502648	Dipole	I-PEX	4.37	UNII-1
2	TP-LINK	3101502649	Dipole	I-PEX	4.37	UNII-1
1	TP-LINK	3101502648	Dipole	I-PEX	5.80	UNII-3
2	TP-LINK	3101502649	Dipole	I-PEX	5.80	UNII-3

Note:

This EUT supports CDD, and all antennas have the same gain, Directional gain = G_{ANT} +Array Gain, where Array Gain is as follows:

(1) For Non Beamforming Function,

For power measurements, Array Gain = 0 dB ($N_{ANT} \le 4$), so the UNII-1 Directional gain=4.37, the UNII-3 Directional gain=5.80.

For power spectral density measurements, N_{ANT} = 2, N_{SS} = 1.

The UNII-1 Directional gain = G_{ANT} + Array Gain =10 log (N_{ANT}/N_{SS}) dB =4.37+10log(2/1)dBi=7.38, the UNII-3 Directional gain = G_{ANT} + Array Gain =10 log (N_{ANT}/N_{SS}) dB =5.80+10log(2/1)dBi=8.81. So the UNII-1 power spectral density limit is 17-(7.38-6)=15.62,

the UNII-3 power spectral density limit is 30-(8.81-6)=27.19.(2) For Beamforming Function, Beamforming Gain: 3.01 dB.

Then the UNII-1 Directional gain = 4.37+3.01=7.38, the UNII-3 Directional gain = 5.80+3.01=8.81. So the UNII-1 output power limit is 30-(7.38-6)=28.62,

the UNII-3 output power limit is 30-(8.81-6)=27.19.

the UNII-1 power spectral density limit is 17-(7.38-6)=15.62,

the UNII-3 power spectral density limit is 30-(8.81-6)=27.19.



4. Table for Antenna Configuration:

For Non Beamforming Function:

Operating Mode	2TX	
TX Mode	217	
IEEE 802.11a	V (Ant. 1 + Ant. 2)	
IEEE 802.11ac (VHT20)	V (Ant. 1 + Ant. 2)	
IEEE 802.11ac (VHT40)	V (Ant. 1 + Ant. 2)	
IEEE 802.11ac (VHT80)	V (Ant. 1 + Ant. 2)	
IEEE 802.11ax (HEW20)	V (Ant. 1 + Ant. 2)	
IEEE 802.11ax (HEW40)	V (Ant. 1 + Ant. 2)	
IEEE 802.11ax (HEW80)	V (Ant. 1 + Ant. 2)	

For Beamforming Function:

Operating Mode	2TX
TX Mode	21A
IEEE 802.11ac (VHT20)	V (Ant. 1 + Ant. 2)
IEEE 802.11ac (VHT40)	V (Ant. 1 + Ant. 2)
IEEE 802.11ac (VHT80)	V (Ant. 1 + Ant. 2)
IEEE 802.11ax (HEW20)	V (Ant. 1 + Ant. 2)
IEEE 802.11ax (HEW40)	V (Ant. 1 + Ant. 2)
IEEE 802.11ax (HEW80)	V (Ant. 1 + Ant. 2)



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2.2 TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.

Pretest Mode	Description
Mode 1	TX A Mode / CH36, CH40, CH48 (UNII-1)
Mode 2	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)
Mode 3	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)
Mode 4	TX AC (VHT80) Mode / CH42 (UNII-1)
Mode 5	TX AX (HEW20) Mode / CH36, CH40, CH48 (UNII-1)
Mode 6	TX AX (HEW40) Mode / CH38, CH46 (UNII-1)
Mode 7	TX AX (HEW80) Mode / CH42 (UNII-1)
Mode 8	TX A Mode / CH149,CH157,CH165 (UNII-3)
Mode 9	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)
Mode 10	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)
Mode 11	TX AC (VHT80) Mode / CH155 (UNII-3)
Mode 12	TX AX (HEW20) Mode / CH149,CH157,CH165 (UNII-3)
Mode 13	TX AX (HEW40) Mode / CH151,CH159 (UNII-3)
Mode 14	TX AX (HEW80) Mode / CH155 (UNII-3)
Mode 15	TX AX (HEW20) Mode / CH149 (UNII-3)

Following mode(s) was (were) found to be the worst case(s) and selected for the final test.

	AC power line conducted emissions test				
	Final Test Mode	Description			
Mode 15		TX AX (HEW20) Mode / CH149 (UNII-3)			

Radiated emissions test - Below 1GHz				
Final Test Mode Description				
Mode 15	TX AX (HEW20) Mode / CH149 (UNII-3)			



Radiated emissions test - Above 1GHz & Conducted tests for Non Beamforming				
Final Test Mode	Description			
Mode 1	TX A Mode / CH36, CH40, CH48 (UNII-1)			
Mode 2	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)			
Mode 3	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)			
Mode 4	TX AC (VHT80) Mode / CH42 (UNII-1)			
Mode 5	TX AX (HEW20) Mode / CH36, CH40, CH48 (UNII-1)			
Mode 6	TX AX (HEW40) Mode / CH38, CH46 (UNII-1)			
Mode 7	TX AX (HEW80) Mode / CH42 (UNII-1)			
Mode 8	TX A Mode / CH149,CH157,CH165 (UNII-3)			
Mode 9	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)			
Mode 10	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)			
Mode 11	TX AC (VHT80) Mode / CH155 (UNII-3)			
Mode 12	TX AX (HEW20) Mode / CH149,CH157,CH165 (UNII-3)			
Mode 13	TX AX (HEW40) Mode / CH151,CH159 (UNII-3)			
Mode 14	TX AX (HEW80) Mode / CH155 (UNII-3)			

Radiated emissions test - Above 1GHz & Conducted tests for Beamforming				
Final Test Mode	Description			
Mode 2	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)			
Mode 3	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)			
Mode 4	TX AC (VHT80) Mode / CH42 (UNII-1)			
Mode 5	TX AX (HEW20) Mode / CH36, CH40, CH48 (UNII-1)			
Mode 6	TX AX (HEW40) Mode / CH38, CH46 (UNII-1)			
Mode 7	TX AX (HEW80) Mode / CH42 (UNII-1)			
Mode 9	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)			
Mode 10	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)			
Mode 11	TX AC (VHT80) Mode / CH155 (UNII-3)			
Mode 12	TX AX (HEW20) Mode / CH149,CH157,CH165 (UNII-3)			
Mode 13	TX AX (HEW40) Mode / CH151,CH159 (UNII-3)			
Mode 14	TX AX (HEW80) Mode / CH155 (UNII-3)			

Note:

- For radiated emission below 1 GHz test, the IEEE 802.11ax20 channel 149 is found to be the worst case and recorded.
- (2) For radiated emission above 1 GHz test, 1GHz~26.5GHz and 26.5GHz~40GHz have been pre-tested and in this report only recorded the worst case. The remaining spurious points are all below the limit value of 20dB.
- (3) All the bit rate of transmitter have been tested and found the lowest rate is found to be the worst case and recorded.
- (4) VHT20/VHT40 covers HT20/HT40, due to same modulation. The power setting for 802.11n HT20 and HT40 are the same or lower than 802.11ac VHT20 and VHT40.

2.3 PARAMETERS OF TEST SOFTWARE

UNII-1					
Test Software	а	ccessMTool_REL_3_0_0_	5		
Test Frequency (MHz)	5180	5200	5240		
IEEE 802.11a	84	89	90		
IEEE 802.11ac (VHT20)	84	89	90		
IEEE 802.11ax (HEW20)	82	90	90		
Test Frequency (MHz)	5190	5230			
IEEE 802.11ac (VHT40)	67	93			
IEEE 802.11ax (HEW40)	67	92			
Test Frequency (MHz)	5210				
IEEE 802.11ac (VHT80)	65				
IEEE 802.11ax (HEW80)	66				

Non Beamforming

UNII-3				
Test Software	accessMTool_REL_3_0_0_5			
Test Frequency (MHz)	5745	5785	5825	
IEEE 802.11a	102	102	100	
IEEE 802.11ac (VHT20)	101	101	100	
IEEE 802.11ax (HEW20)	101	100	99	
Test Frequency (MHz)	5755	5795		
IEEE 802.11ac (VHT40)	97	102		
IEEE 802.11ax (HEW40)	94	101		
Test Frequency (MHz)	5775			
IEEE 802.11ac (VHT80)	83			
IEEE 802.11ax (HEW80)	82			



Beamforming

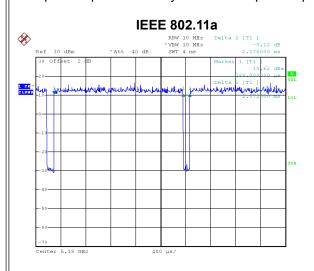
UNII-1				
Test Software	accessMTool_REL_3_0_0_5			
Test Frequency (MHz)	5180	5200	5240	
IEEE 802.11ac (VHT20)	88	94	96	
IEEE 802.11ax (HEW20)	76	90	90	
Test Frequency (MHz)	5190	5230		
IEEE 802.11ac (VHT40)	72	92		
IEEE 802.11ax (HEW40)	64	88		
Test Frequency (MHz)	5210			
IEEE 802.11ac (VHT80)	52			
IEEE 802.11ax (HEW80)	60			

UNII-3					
Test Software	accessMTool_REL_3_0_0_5				
Test Frequency (MHz)	5745	5785	5825		
IEEE 802.11ac (VHT20)	94	93	92		
IEEE 802.11ax (HEW20)	92	92	91		
Test Frequency (MHz)	5755	5795			
IEEE 802.11ac (VHT40)	92	92			
IEEE 802.11ax (HEW40)	80	91			
Test Frequency (MHz)	5775				
IEEE 802.11ac (VHT80)	80				
IEEE 802.11ax (HEW80)	80				



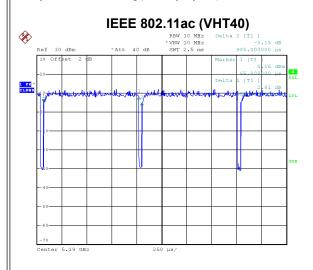
2.4 DUTY CYCLE

If duty cycle is \geq 98 %, duty factor is not required. If duty cycle is < 98 %, duty factor shall be considered. The output power = measured power + duty factor. The power spectral density = measured power spectral density + duty factor.



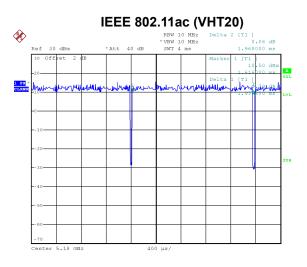
Date: 5.AUG.2019 14:31:07

Duty cycle = 2.072 ms / 2.184 ms = 94.87% Duty Factor = 10 log(1/Duty cycle) = 0.23



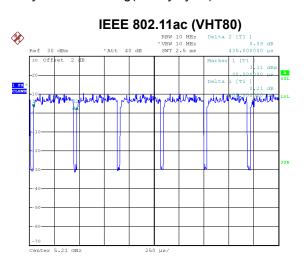
Date: 5.AUG.2019 14:33:41

Duty cycle = 0.960 ms / 0.990 ms = 96.97% Duty Factor = 10 log(1/Duty cycle) = 0.13



Date: 5.AUG.2019 14:32:05

Duty cycle = 1.936 ms / 1.960 ms = 98.78% Duty Factor = 10 log(1/Duty cycle) = 0.00

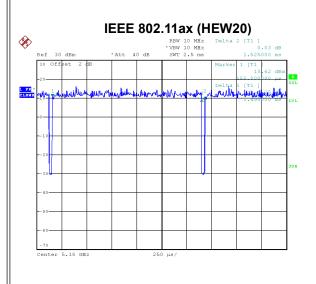


Date: 5.AUG.2019 14:34:04

Duty cycle = 0.460 ms / 0.490 ms = 93.88% Duty Factor = 10 log(1/Duty cycle) = 0.27

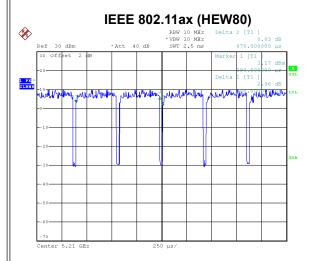


<u>3TL</u>



Date: 5.AUG.2019 14:36:29

Duty cycle = 1.495 ms / 1.530 ms = 97.71% Duty Factor = 10 log(1/Duty cycle) = 0.10



Date: 5.AUG.2019 14:37:05

Duty cycle = 0.400 ms / 0.435 ms = 91.95%Duty Factor = $10 \log(1/\text{Duty cycle}) = 0.36$

NOTE:

For IEEE 802.11a, IEEE 802.11ac (VHT20) and IEEE 802.11ax (HEW20):

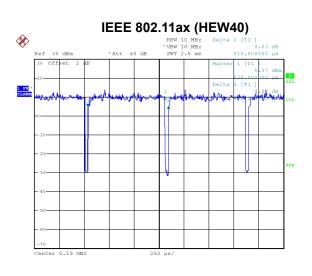
For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz (Duty cycle < 98%).

For IEEE 802.11ac (VHT40) and IEEE 802.11ax (HEW40):

For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 2 kHz (Duty cycle < 98%).

For IEEE 802.11ac (VHT80) and IEEE 802.11ax (HEW80):

For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 kHz (Duty cycle < 98%).



Date: 5.AUG.2019 14:36:48

Duty cycle = 0.775 ms / 0.805 ms = 96.27% Duty Factor = 10 log(1/Duty cycle) = 0.16



2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

2.6 SUPPORT UNITS

Item	Equipment	Brand	Model No.	Series No.
А	Notebook	Dell	Inspiron 15-7559	N/A

Item	Cable Type	Shielded Type	Ferrite Core	Length
1	DC Cable	NO	NO	1.5m
2	RJ45 Cable	NO	NO	10m



3. AC POWER LINE CONDUCTED EMISSIONS TEST

3.1 LIMIT

Frequency	Limit (dBµV)		
(MHz)	Quasi-peak	Average	
0.15 - 0.50	66 to 56*	56 to 46*	
0.50 - 5.0	56	46	
5.0 - 30.0	60	50	

NOTE:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameter	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 KHz

3.2 TEST PROCEDURE

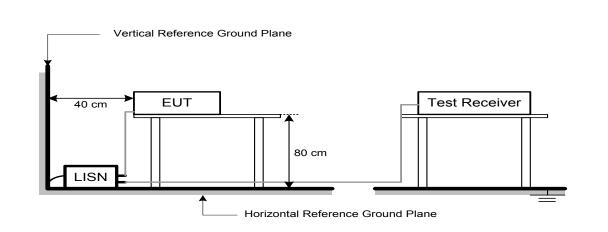
- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item -EUT Test Photos.

3.3 DEVIATION FROM TEST STANDARD

No deviation



3.4 TEST SETUP



3.5 EUT OPERATION CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

The EUT was programmed to be in continuously transmitting/TX mode.

3.6 TEST RESULTS

Please refer to the APPENDIX A.



4. RADIATED EMISSIONS TEST

4.1 LIMIT

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.

LIMITS OF RADIATED EMISSIONS MEASUREMENT (9 kHz to 1000 MHz)

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/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

LIMITS OF UNWANTED EMISSION OUT OF THE RESTRICTED BANDS

Frequency	EIRP Limit	Equivalent Field Strength at 3m			
(MHz)	(dBm/MHz)	(dBµV/m)			
5150-5250	-27	68.3			
	-27 NOTE (2)	68.3			
E72E E8E0	10 NOTE (2)	105.3			
5725-5850	15.6 NOTE (2)	110.9			
	27 NOTE (2)	122.3			

NOTE:

(1) The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength: $1000000\sqrt{30P}$

(2) According to 15.407(b)(4)(i), all emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge.





4.2 TEST PROCEDURE

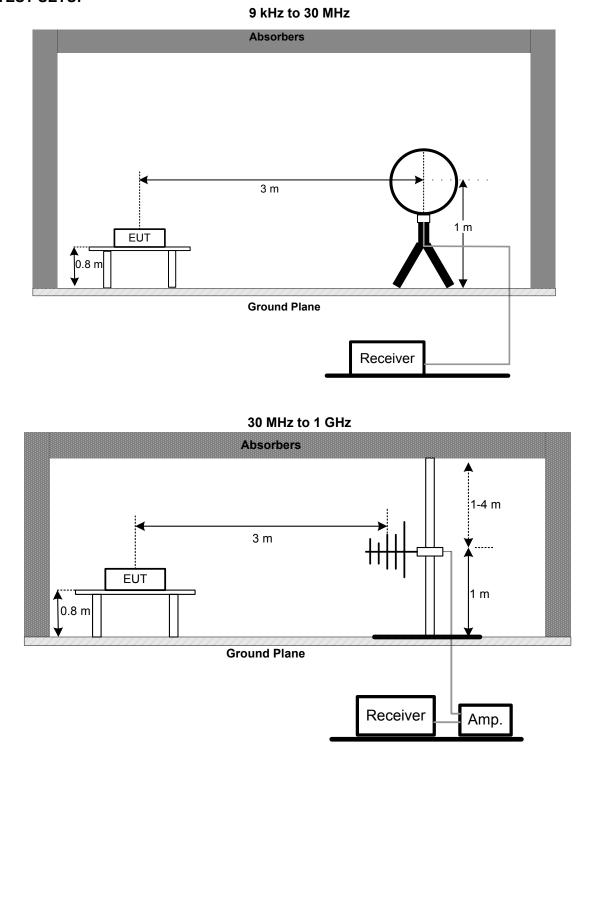
- a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
- b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1GHz)
- c. The height of the equipment or of the substitution antenna shall be 0.8m or 1.5m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights find the maximum reading (used Bore sight function).
- e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.
- f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform. (below 1 GHz)
- All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn't perform. (above 1 GHz)
- i. For the actual test configuration, please refer to the related Item -EUT Test Photos.

4.3 DEVIATION FROM TEST STANDARD

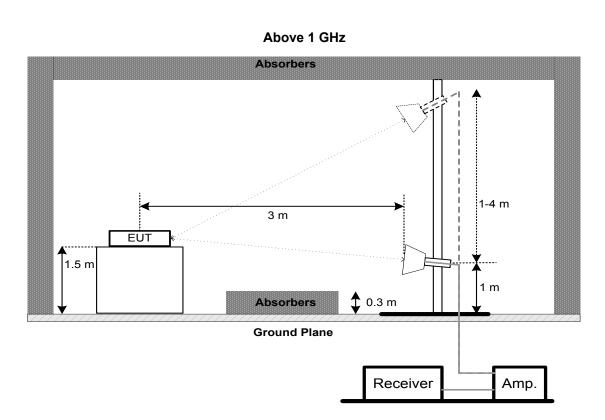
No deviation



4.4 TEST SETUP







4.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 3.5 unless otherwise a special operating condition is specified in the follows during the testing.

4.6 TEST RESULTS - 9 KHZ to 30 MHZ

Please refer to the APPENDIX B

Remark:

- (1) Distance extrapolation factor = 40 log (specific distance / test distance) (dB).
- (2) Limit line = specific limits (dBuV) + distance extrapolation factor.

4.7 TEST RESULTS - 30 MHz TO 1000 MHz

Please refer to the APPENDIX C.

4.8 TEST RESULTS - ABOVE 1000 MHz

Please refer to the APPENDIX D.

Remark:

(1) No limit: This is fundamental signal, the judgment is not applicable. For fundamental signal judgment was referred to Peak output test.



5. BANDWIDTH TEST

5.1 LIMIT

FCC Part15, Subpart E (15.407)					
Section	Test Item	Limit	Frequency Range (MHz)		
15.407(a)	26 dB Bandwidth	-	5150-5250		
15.407(e)	6 dB Bandwidth	Minimum 500 kHz	5725-5850		

5.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below

b. Spectrum Setting:

 				7
For	UNI	1-1	•	

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> 26 dB Bandwidth
RBW	300 kHz (Bandwidth 20 MHz and Bandwidth 40 MHz) 1 MHz (Bandwidth 80 MHz)
VBW	1 MHz (Bandwidth 20 MHz and Bandwidth 40 MHz) 3 MHz (Bandwidth 80 MHz)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

For UNII-3:

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	6 dB Bandwidth
RBW	100 kHz
VBW	300 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

c. Measured the spectrum width with power higher than 26 dB / 6 dB below carrier.

5.3 DEVIATION FROM STANDARD

No deviation.

5.4 TEST SETUP

EUT	SPECTRUM
	ANALYZER

5.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.6 TEST RESULTS

Please refer to the APPENDIX E.



6. MAXIMUM OUTPUT POWER TEST

6.1 LIMIT

FCC Part15, Subpart E (15.407)					
Section	Test Item	Limit	Frequency Range (MHz)		
15.407(a)	Maximum Output Power	AP device: 1 Watt (30 dBm) Client device: 250 mW (24 dBm)	5150-5250		
		1 Watt (30dBm)	5725-5850		

Note:

a. For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.2 TEST PROCEDURE

- a. The EUT was directly connected to the power meter and antenna output port as show in the block diagram below.
- b. Test test was performed in accordance with method of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP



6.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

6.6 TEST RESULTS

Please refer to the APPENDIX F.



7. POWER SPECTRAL DENSITY TEST

7.1 LIMIT

FCC Part15, Subpart E (15.407)					
Section Test Item Limit Frequency Rate (MHz)					
15.407(a)	Power Spectral Density	AP device: 17 dBm/MHz Client device: 11 dBm/MHz	5150-5250		
		30 dBm/500 kHz	5725-5850		

7.2 TEST PROCEDURE

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	Encompass the entire emissions bandwidth (EBW)
Span Frequency	of the signal
RBW	= 1 MHz.
VBW	≥ 3 MHz.
Detector	RMS
Trace average	100 trace
Sweep Time	Auto

Note:

- 1. For UNII-3, according to KDB publication 789033 D02 General UNII Test Procedures New Rules v02r01, section II.F.5., it is acceptable to set RBW at 1 MHz and VBW at 3 MHz if the spectrum analyzer does not have 500 kHz RBW.
- The value measured with RBW=1 MHz is to be added with 10log(500 kHz/1 MHz) which is -3 dB. For example, if the measured value is +10dBm using RBW=1 MHz (that is +10 dBm/MHz), then the converted value will be +7dBm/500kHz.

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP

EUT	SPECTRUM
	ANALYZER

7.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

7.6 TEST RESULTS

Please refer to the APPENDIX G.



8. FREQUENCY STABILITY MEASUREMENT

8.1 LIMIT

FCC Part15, Subpart E (15.407)						
Section	Frequency Range (MHz)					
15.407(a)	4E 407(a) Engruency Ctability Chaptified in the year's manual		5150-5250			
15.407(g)	Frequency Stability	Specified in the user's manual	5725-5850			

8.2 TEST PROCEDURE

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting:

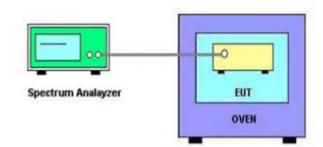
Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	Entire absence of modulation emissions bandwidth
RBW	10 kHz
VBW	10 kHz
Sweep Time	Auto

- c. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value.
- d. User manual temperature is 0°C~40°C.

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP



8.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

8.6 TEST RESULTS

Please refer to the APPENDIX H.



9. MEASUREMENT INSTRUMENTS LIST

	AC Power Line Conducted Emissions					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until	
1	EMI Test Receiver	R&S	ESCI	100382	Feb. 28, 2021	
2	LISN	EMCO	3816/2	52765	Mar. 01, 2021	
3	TWO-LINE V-NETWORK	R&S	ENV216	101447	May 19, 2020	
4	50Ω Terminator	SHX	TF5-3	15041305	Mar. 01, 2021	
5	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A	
6	Cable	N/A	RG223	12m	Mar. 10, 2021	

	Radiated Emissions - 9 kHz to 30 MHz						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	EMI Test Receiver	R&S	ESCI	100895	Feb. 28, 2021		
2*	Antenna	EM	EM-6876-1	230	Jan. 15, 2022		
3	Cable	N/A	RG 213/U(9kHz~1GHz)	N/A	May 31, 2020		
4	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A		

	Radiated Emissions - 30 MHz to 1 GHz						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Antenna	Schwarzbeck	VULB9160	9160-3232	Apr. 09, 2020		
2*	Amplifier	HP	8447D	2944A08742	Mar. 01, 2021		
3	Receiver	Agilent	N9038A	MY52130039	Aug. 03, 2020		
4	Cable	emci	LMR-400(30MHz-1 GHz)(8m+5m)	N/A	May 25, 2020		
5	Controller	СТ	SC100	N/A	N/A		
6	Controller	MF	MF-7802	MF780208416	N/A		
7	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A		

	Radiated Emissions - Above 1 GHz						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Double Ridged Guide Antenna	ETS	3115	75789	Apr. 09, 2020		
2	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Jun. 23, 2020		
3	Amplifier	Agilent	8449B	3008A02584	Aug. 03, 2020		
4	Microwave Preamplifier With Adaptor	EMC INSTRUMENT	EMC2654045	980039 & HA01	Mar. 07, 2021		
5	Receiver	Agilent	N9038A	MY52130039	Aug. 03, 2020		
6	Controller	СТ	SC100	N/A	N/A		
7	Controller	MF	MF-7802	MF780208416	N/A		
8	Cable	mitron	RWLP50-4.0A-KJ-S MSM-12M	N/A	Nov. 25, 2020		
9	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A		



	Bandwidth						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020		
		Powe	er Spectral Density				
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	EXA Spectrum Analyzer	Agilent	N9010A	MY50520044	Mar. 01, 2021		
		Maxir	num Output Power				
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Peak Power Analyzer	Keysight	8990B	MY51000506	Aug. 03, 2020		
2	Wideband power sensor	Keysight	N1923A	MY58310004	Aug. 03, 2020		
Frequency Stability							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 03, 2020		
2	Precision Oven Tester	CEPREI	CEEC-M64T-40	15-008	Feb. 28, 2021		

Remark: "N/A" denotes no model name, serial no. or calibration specified.

"*" calibration period of equipment list is three year.

Except * item, all calibration period of equipment list is one year.



10. EUT TEST PHOTOS

AC Power Line Conducted Emissions Test Photos



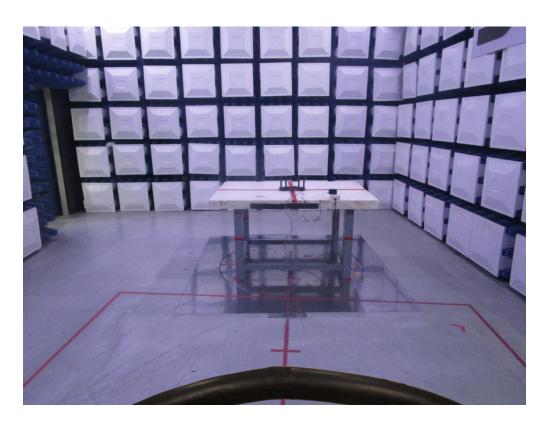






9 kHz to 30 MHz







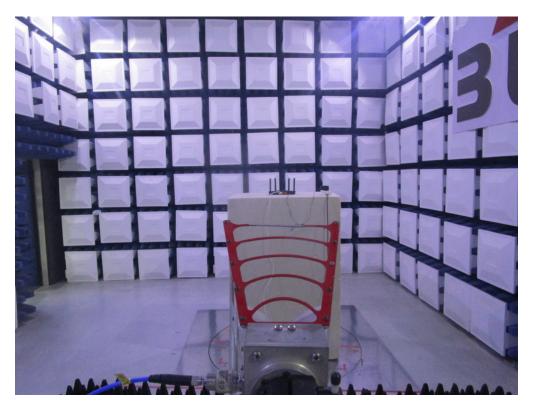




Radiated Emissions Test Photos

Above 1 GHz

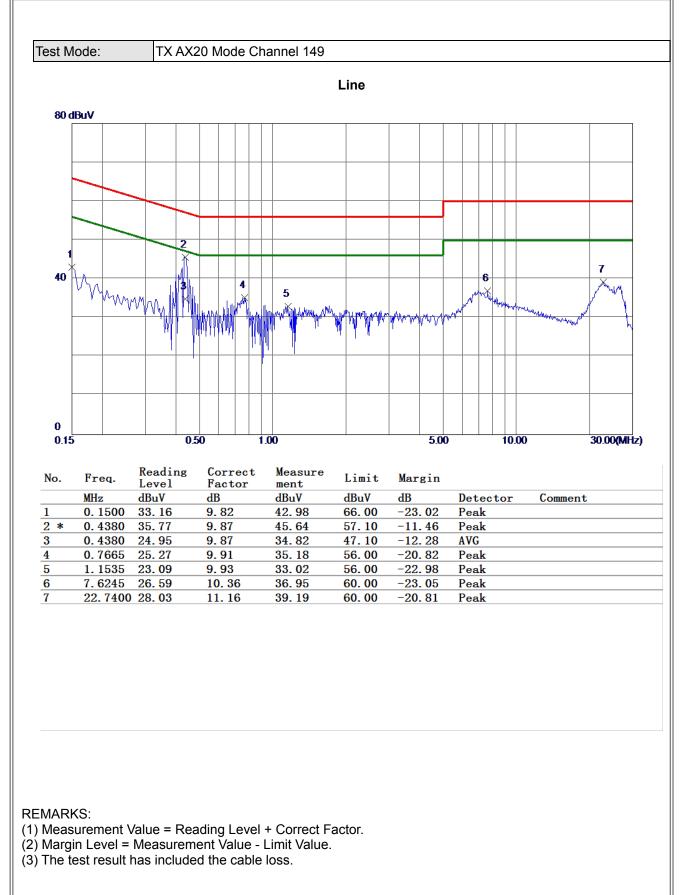




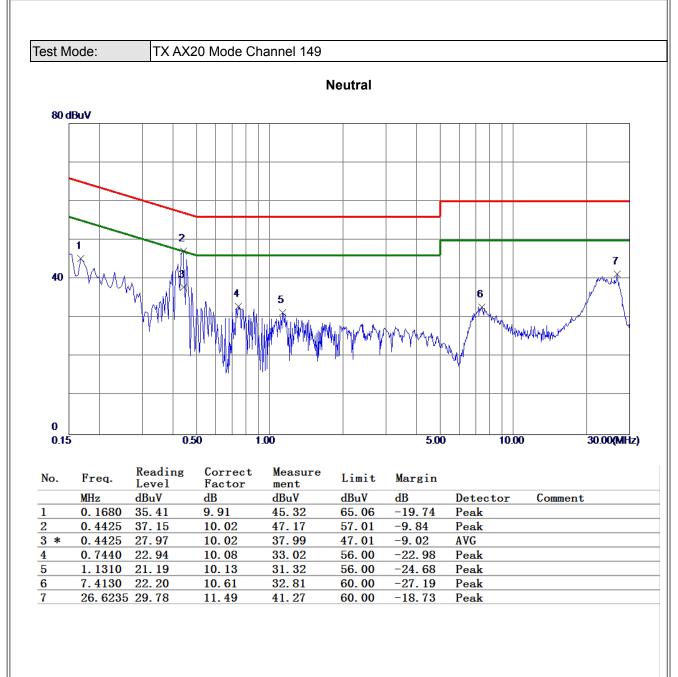


APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS







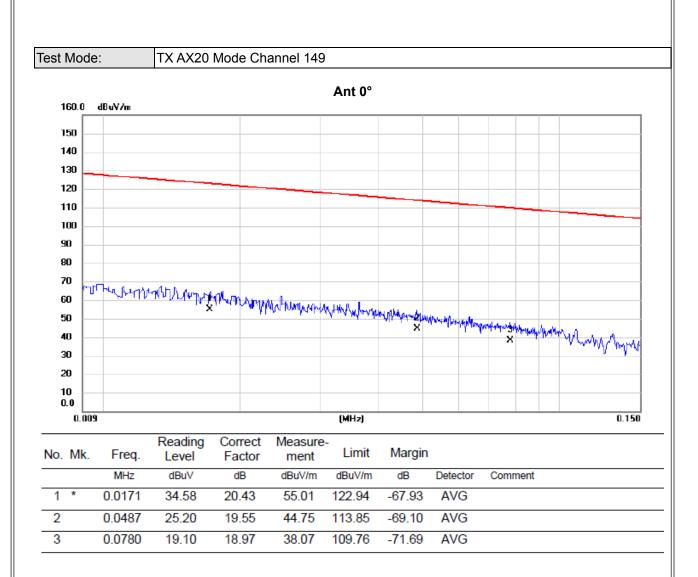


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.
- (3) The test result has included the cable loss.



APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ

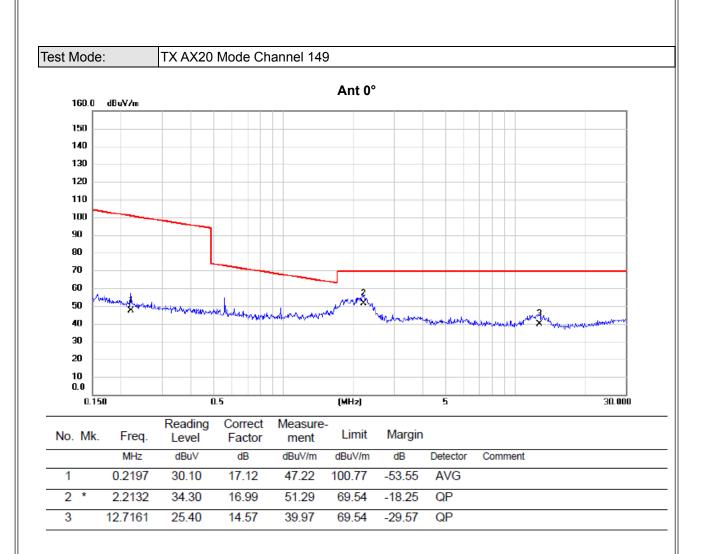




(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

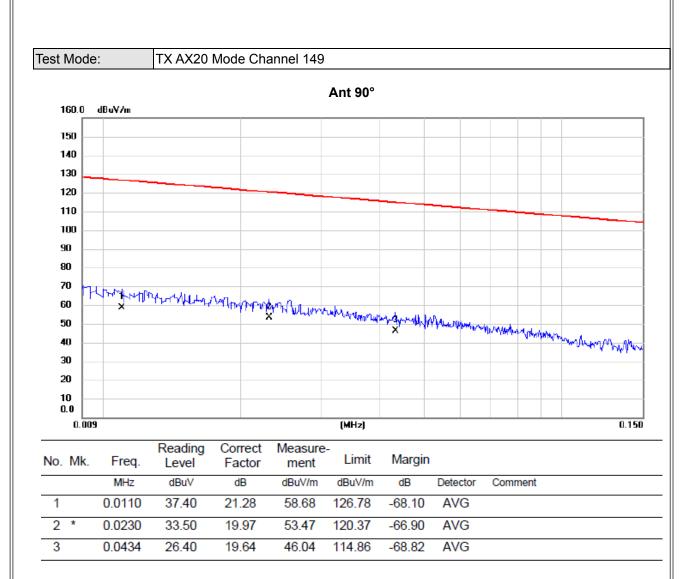




(1) Measurement Value = Reading Level + Correct Factor.

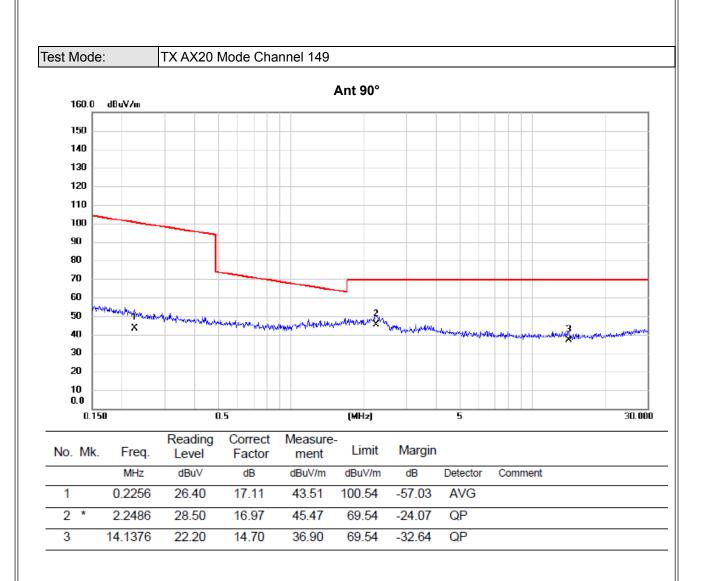
(2) Margin Level = Measurement Value - Limit Value.





- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



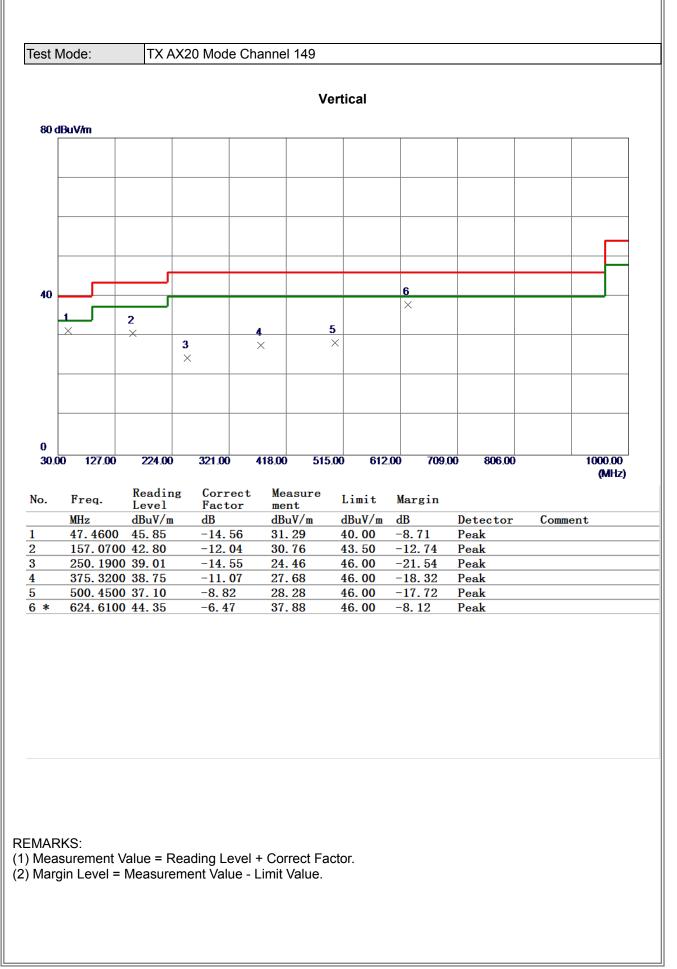


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1 GHZ

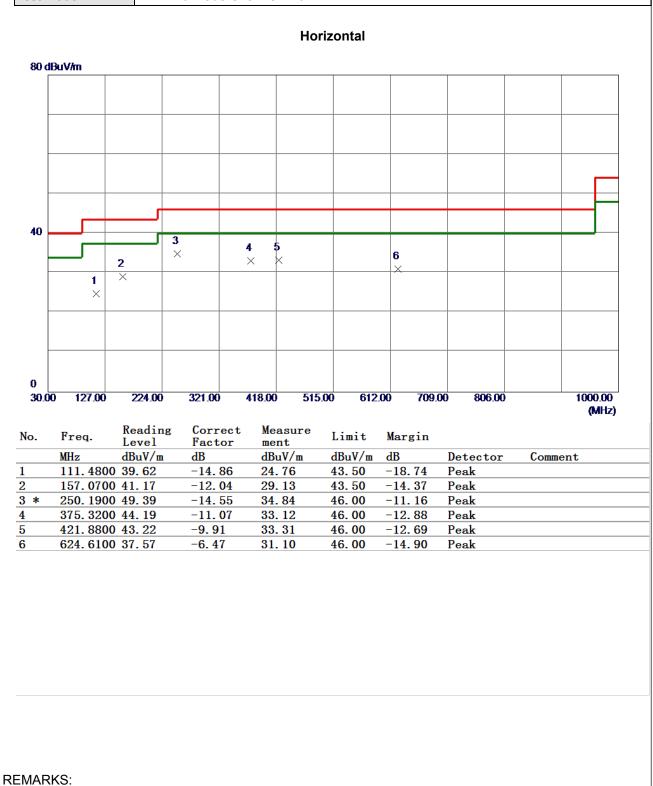






Test Mode:

TX AX20 Mode Channel 149



(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

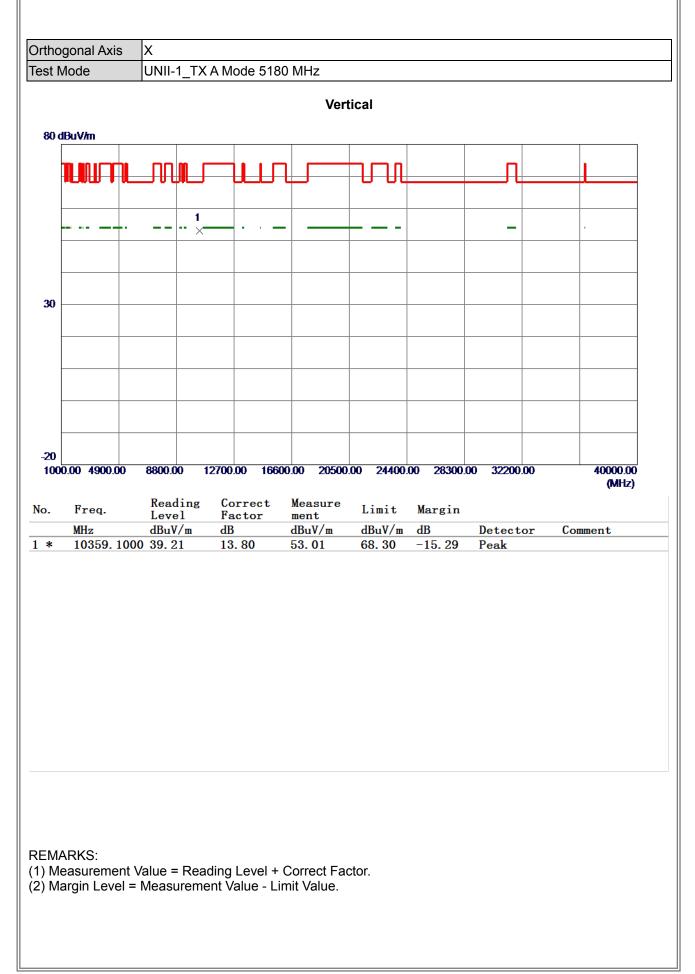


APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

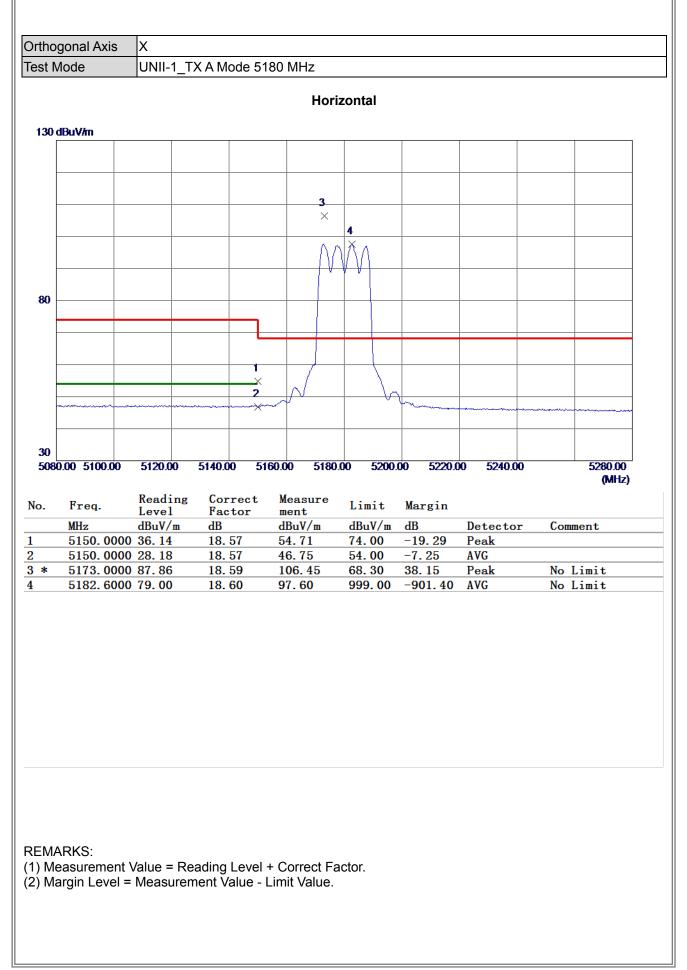


Drthogonal Axis X								
est M	lode	UNII-1_TX A Mode 5180 MHz						
				Vei	rtical			
130 d	lBuV/m							
					4 ×			
				3 ×	0.0			
					Λ			
				/*				
-								
80								
			1	N		h		
			2	~		how		
-								
\vdash								
30 5080	0.00 5100.00	5120.00	5140.00 51	60.00 5180.	.00 5200.	.00 5220.0	00 5240.00	5280.00
		Reading	Correct	Measure				(MHz)
0.	Freq. MHz	Level dBuV/m	Factor	dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
	5150.0000 5150.0000	0 41.87	18. 57 18. 57	60. 44 53. 57	74.00 54.00	-13.56 -0.43	Peak	COMMOND.
	5175. 7000	0 94.64	18.59	113.23	999.00	-885.77	AVG AVG	No Limit
*	5181.0000) 103.48	18.60	122.08	68.30	53.78	Peak	No Limit

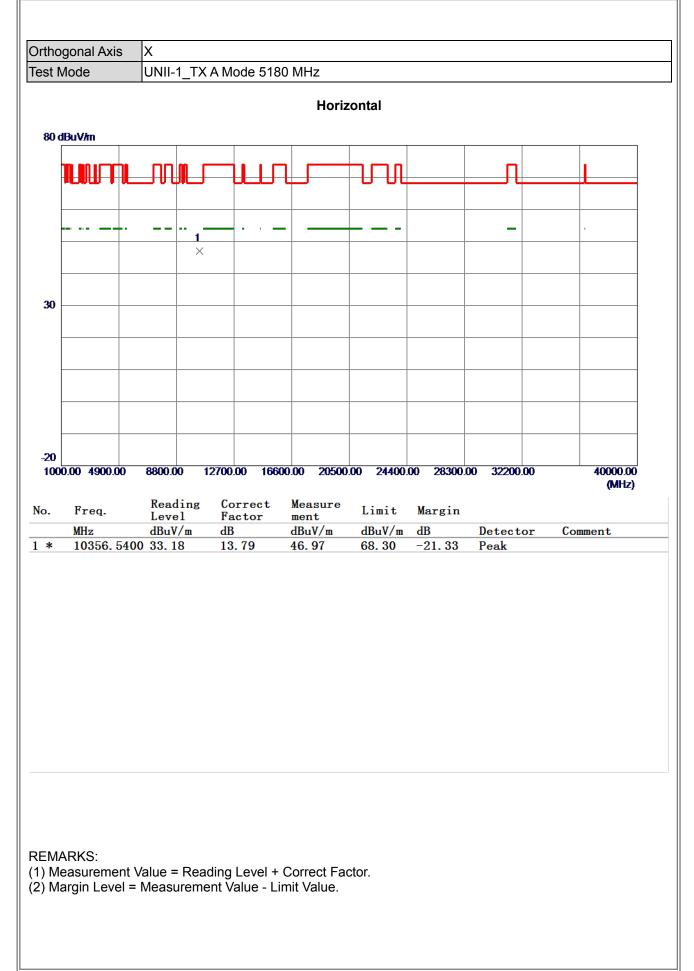




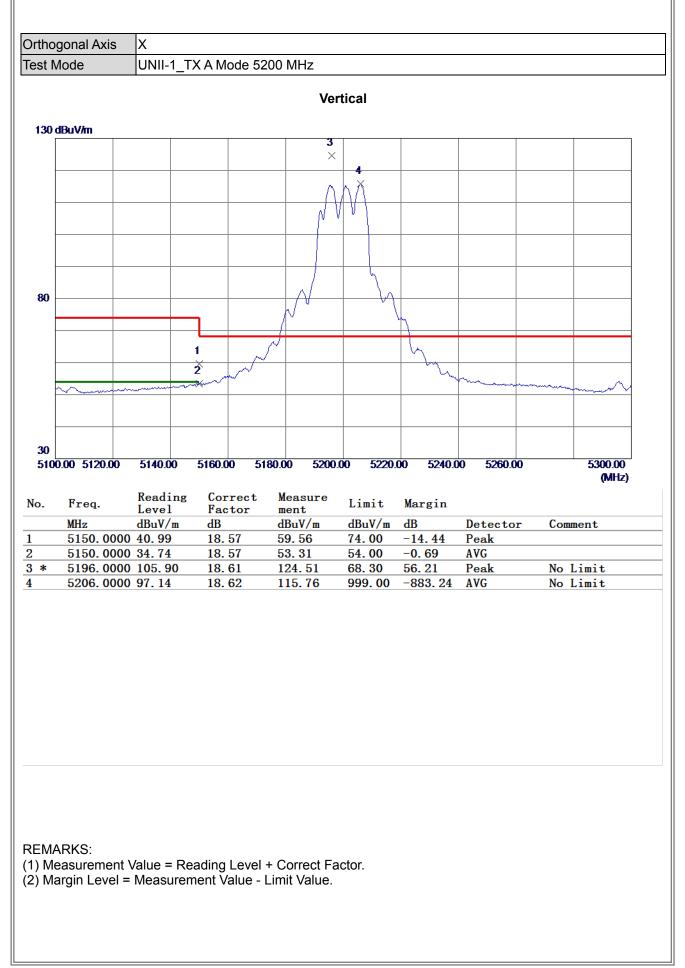




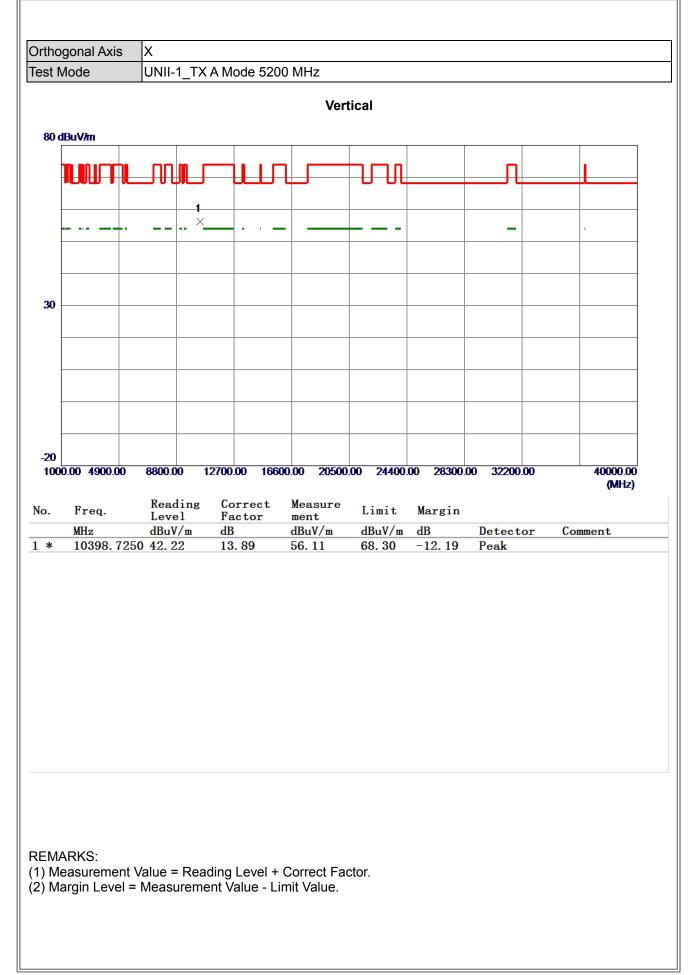




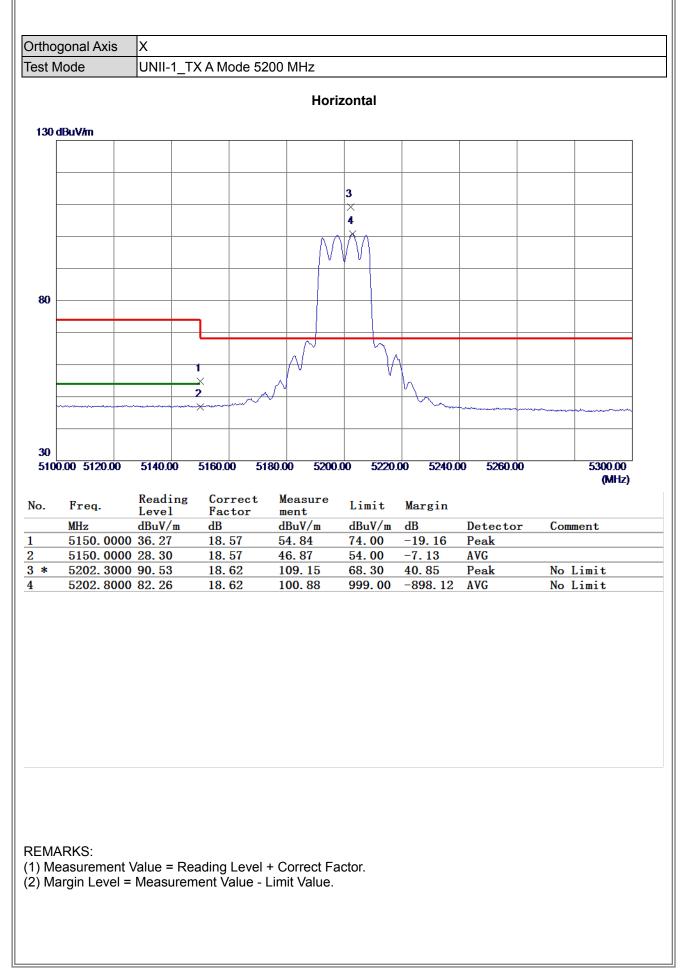




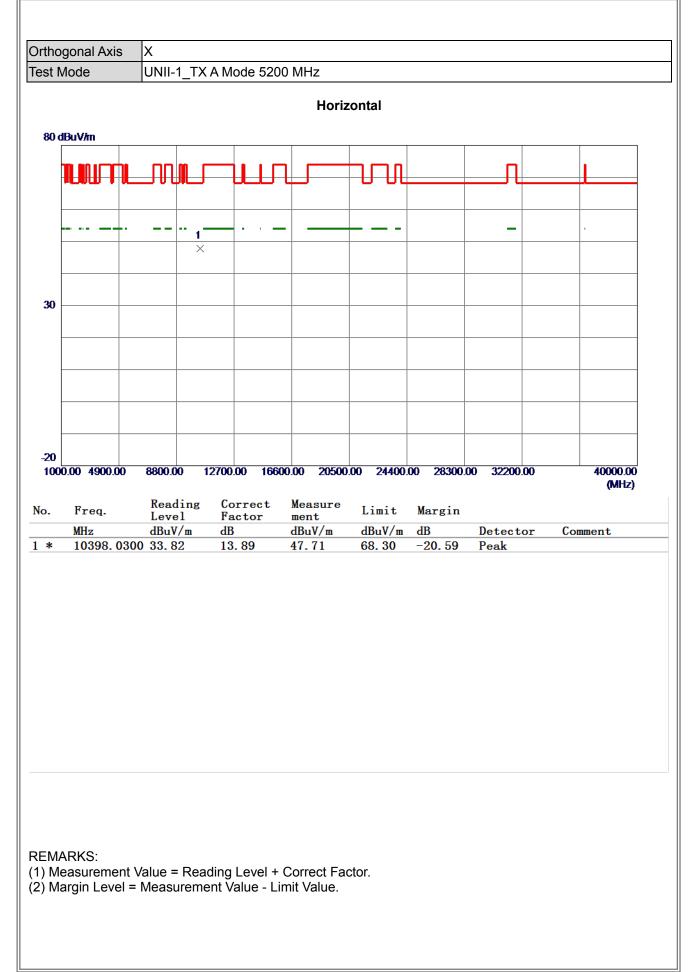




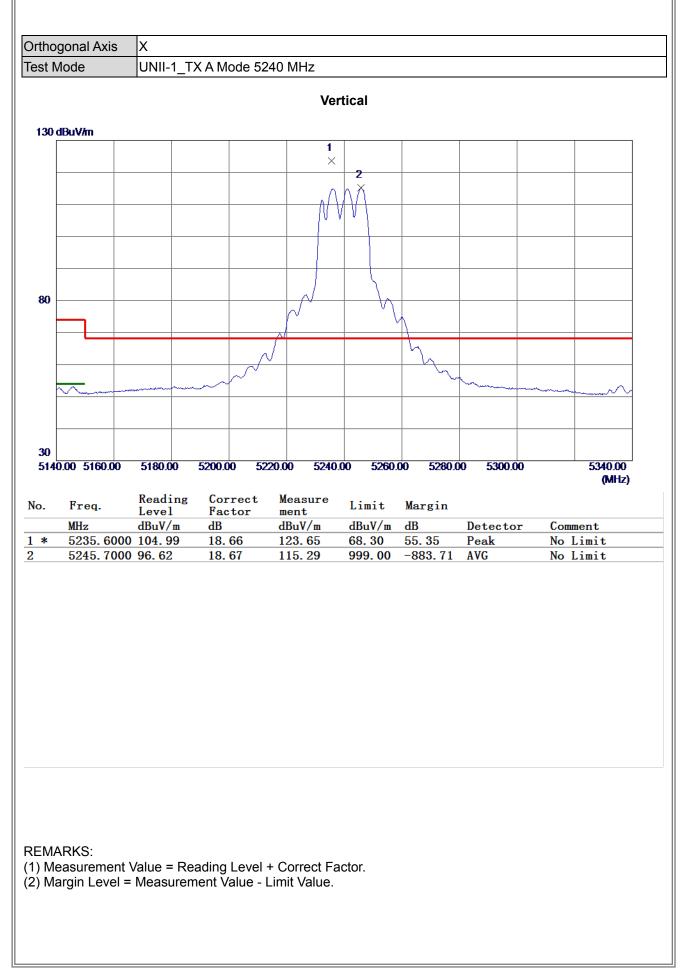




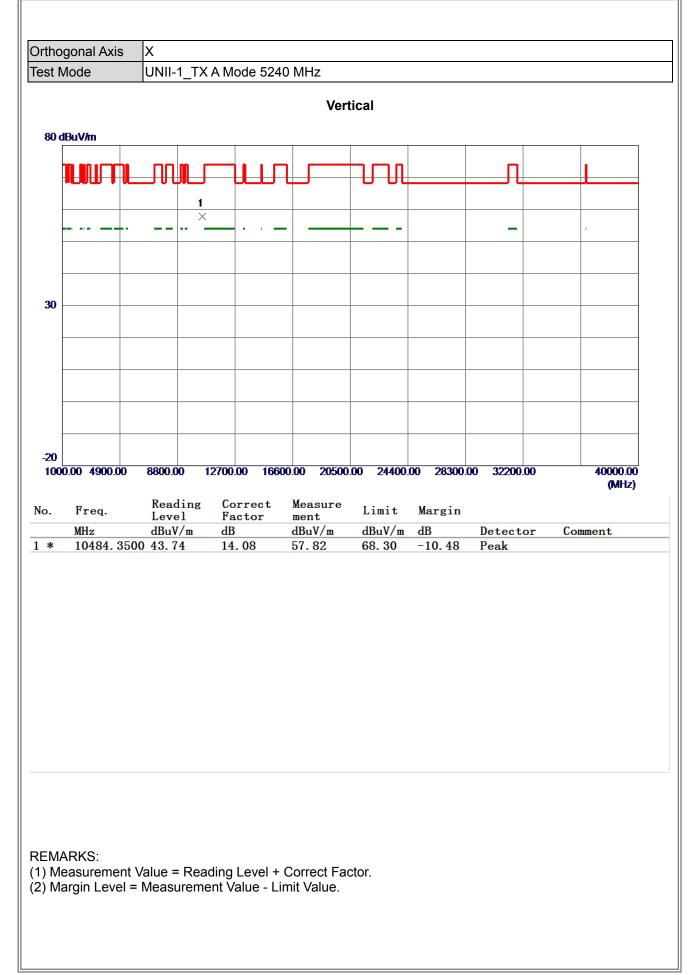




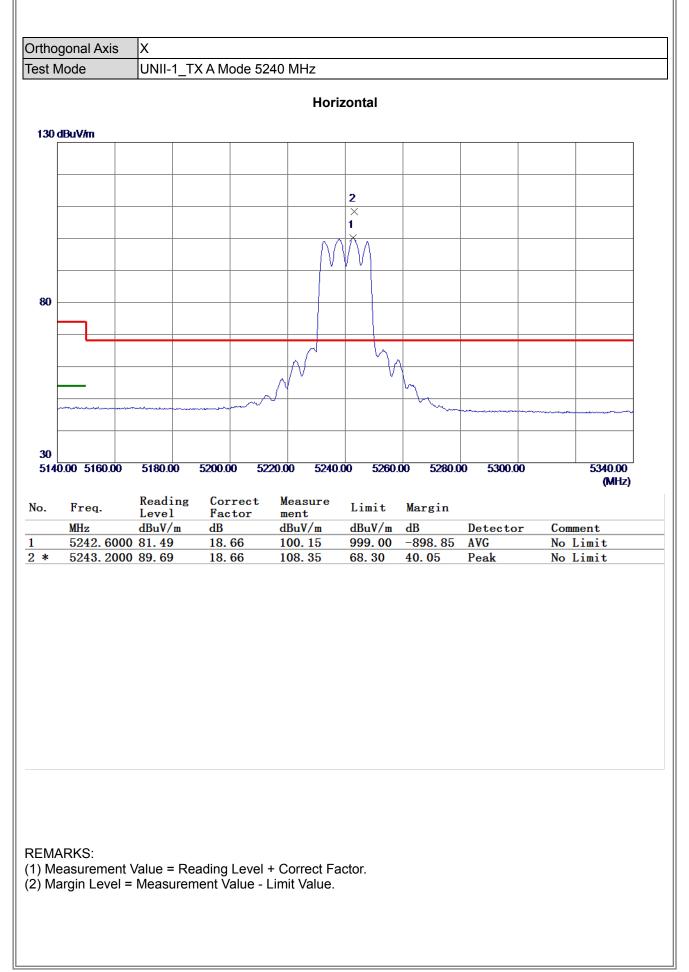




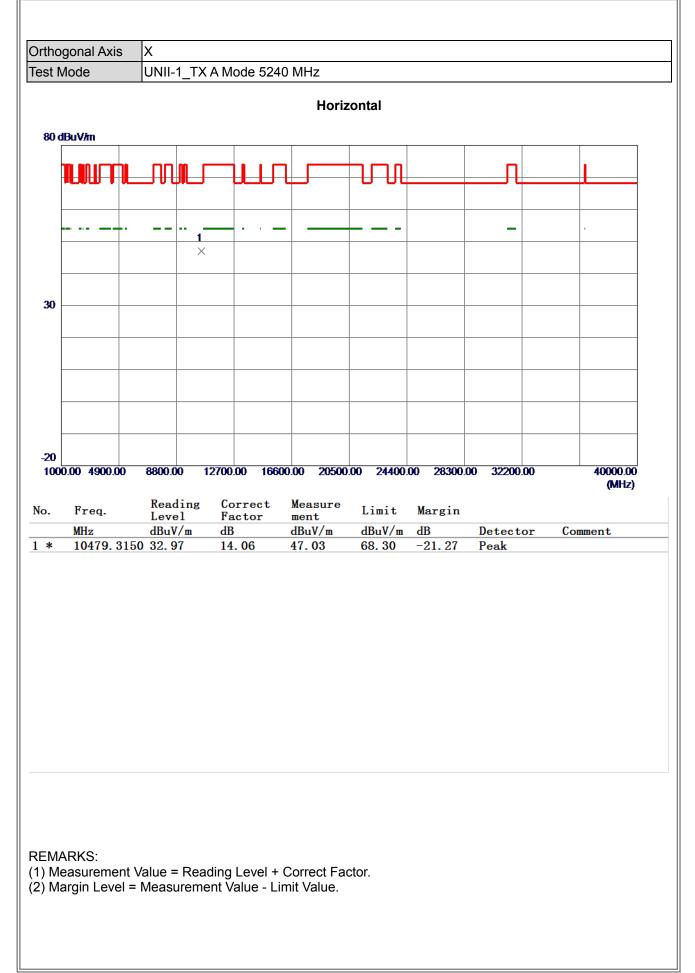




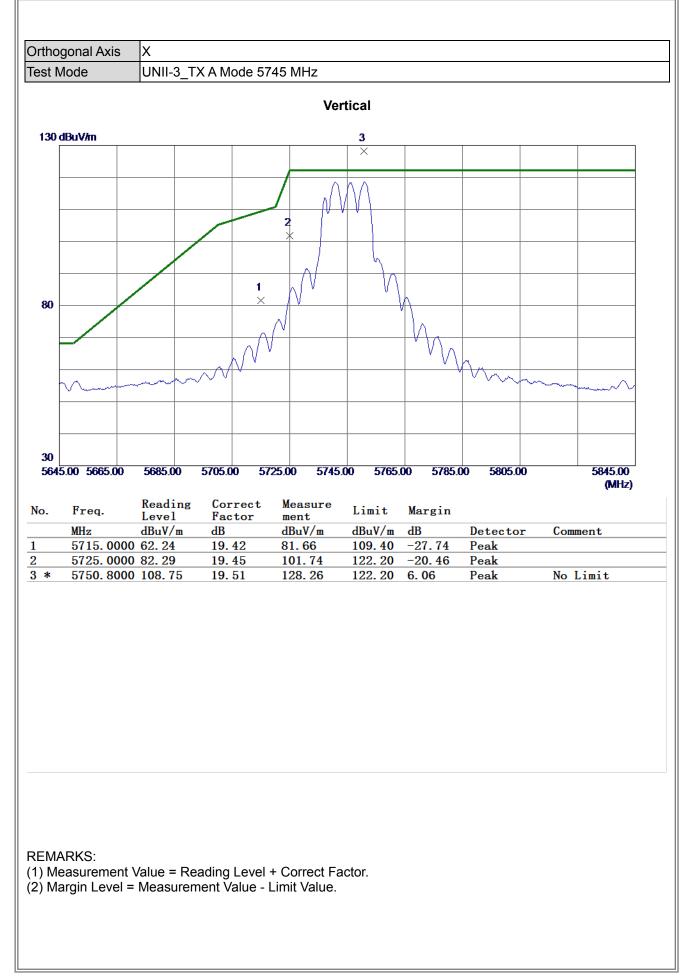




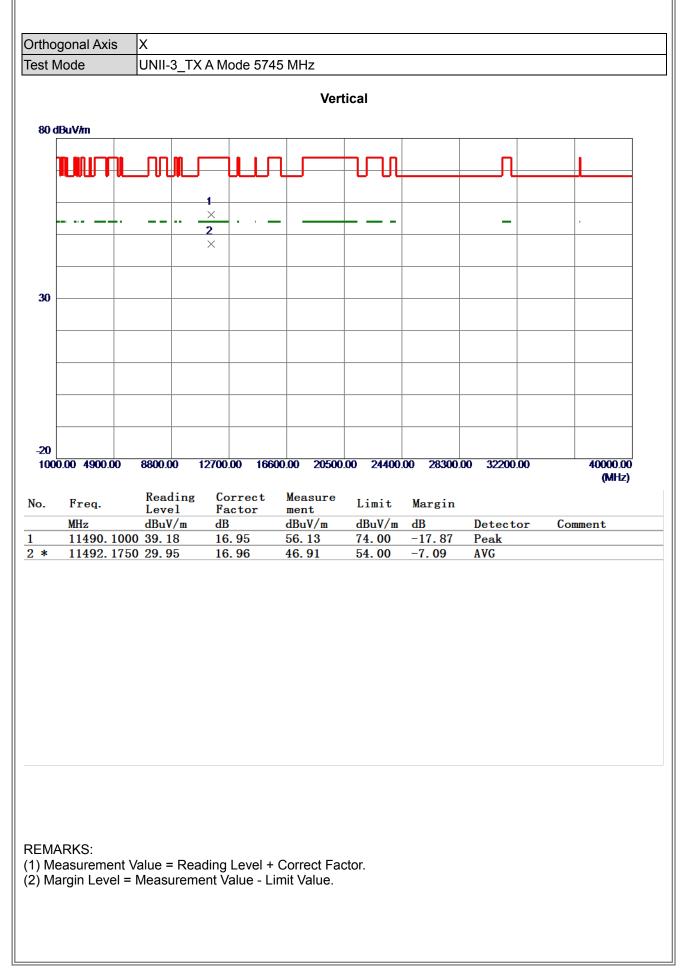




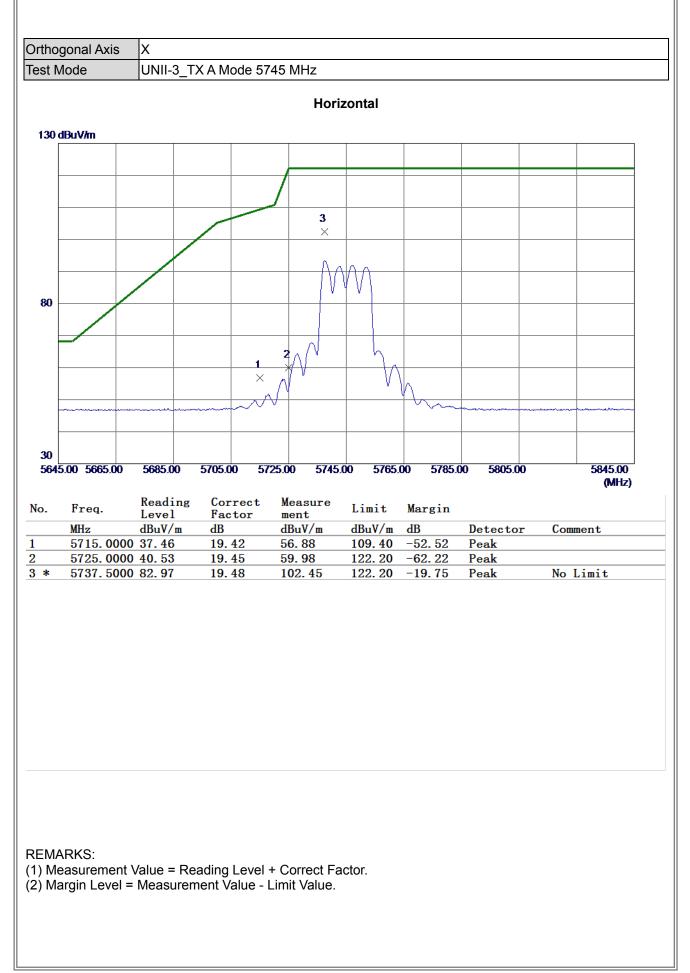




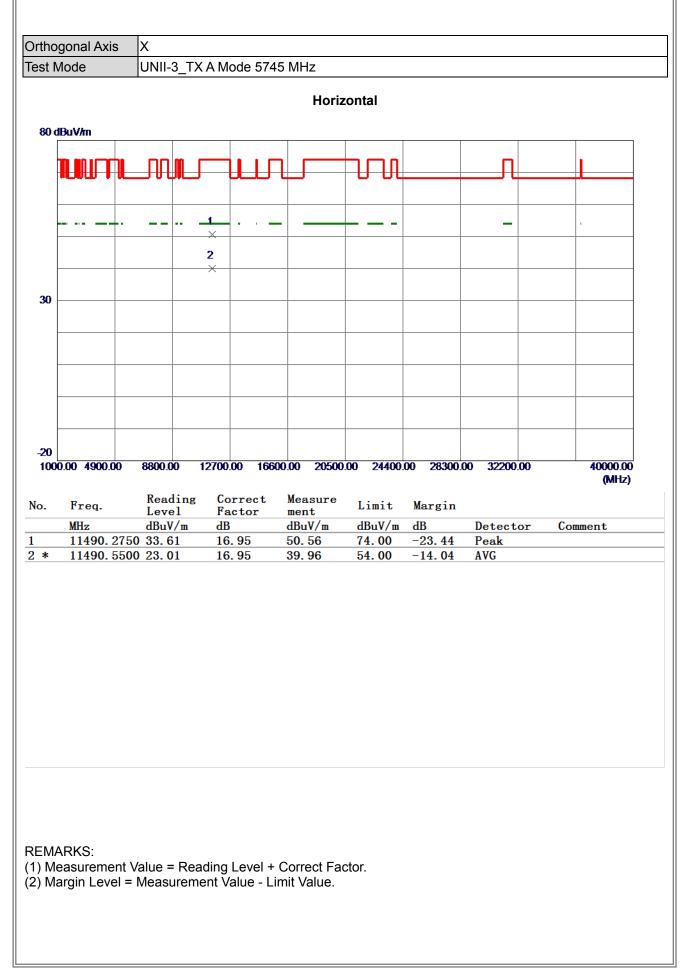




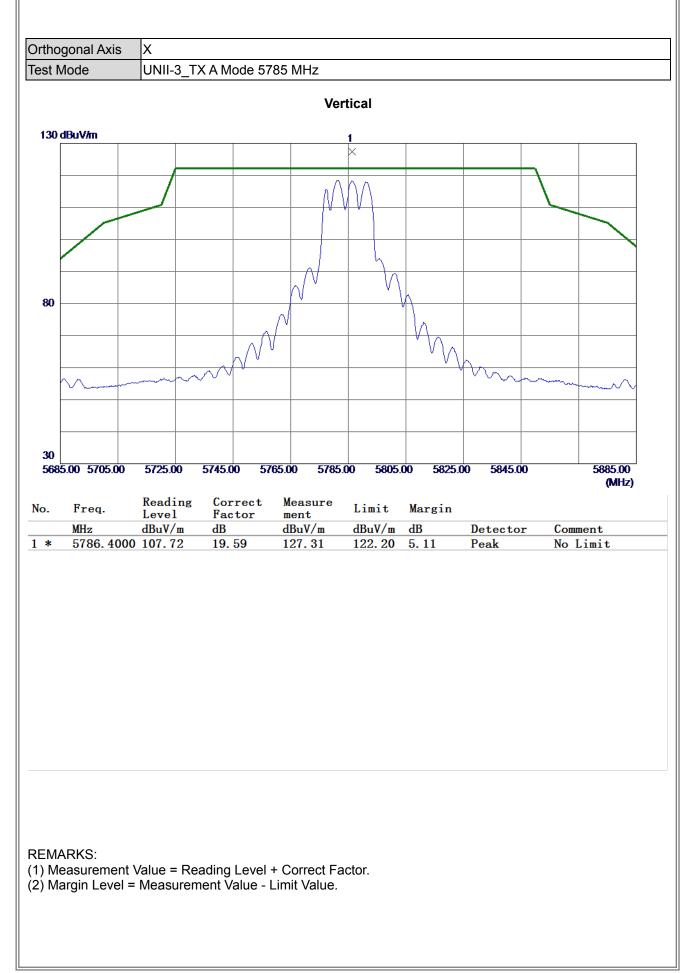




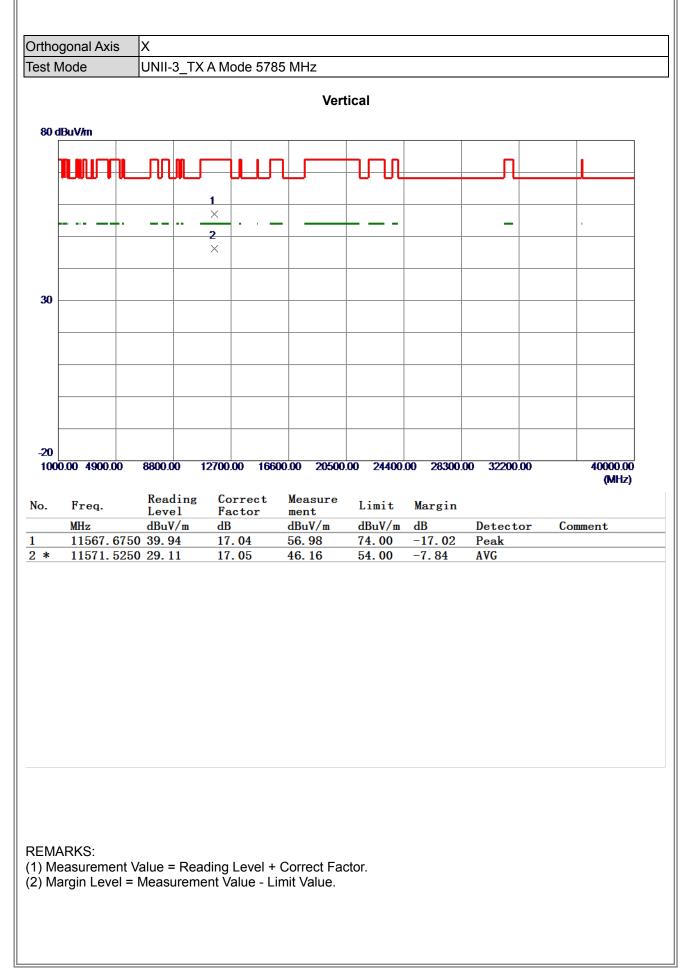




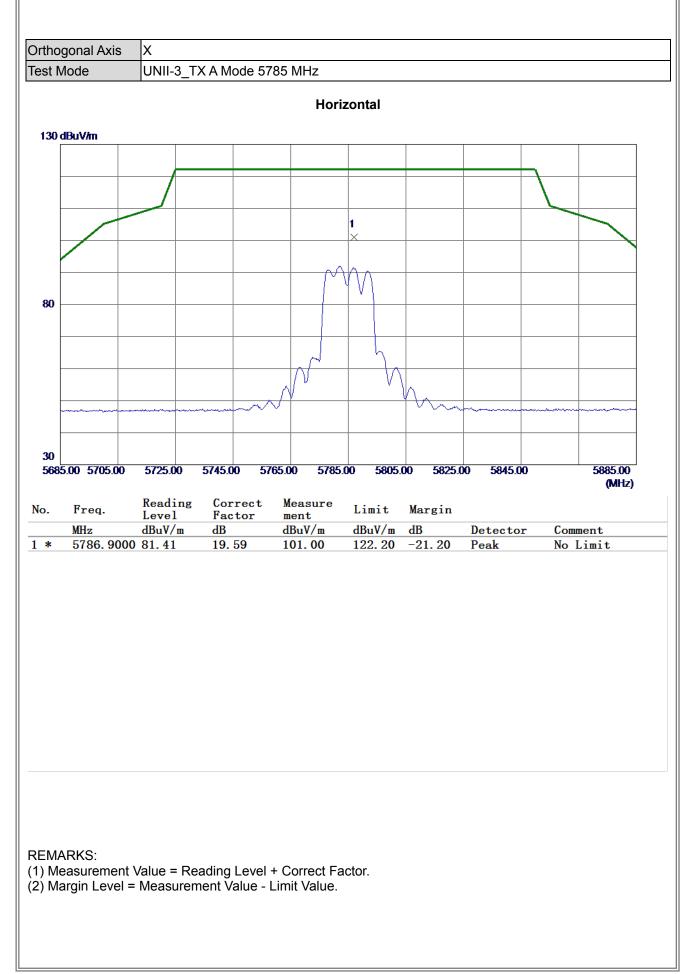




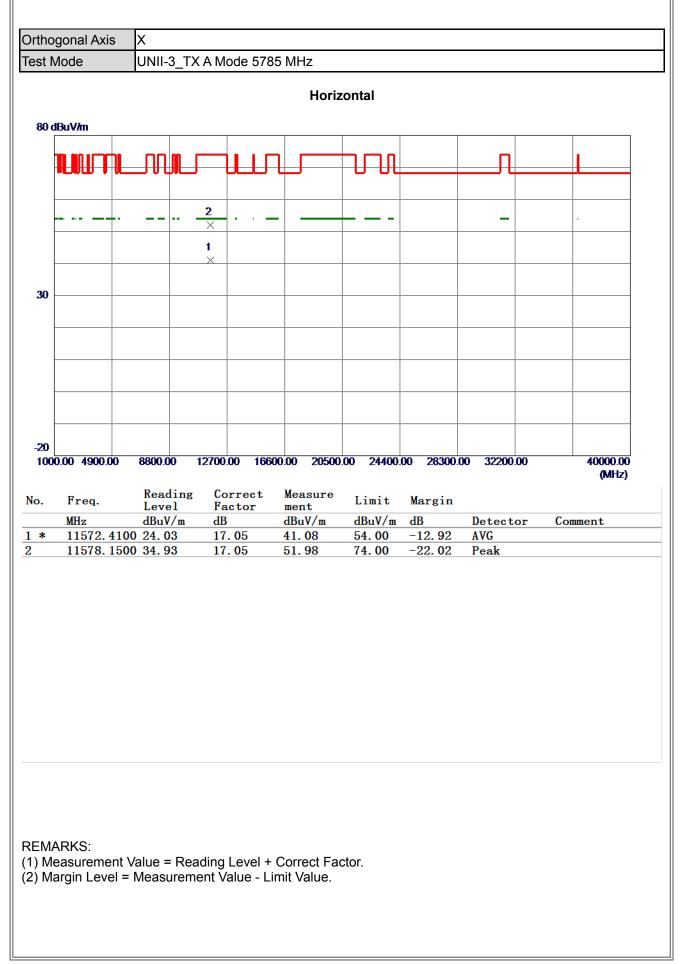




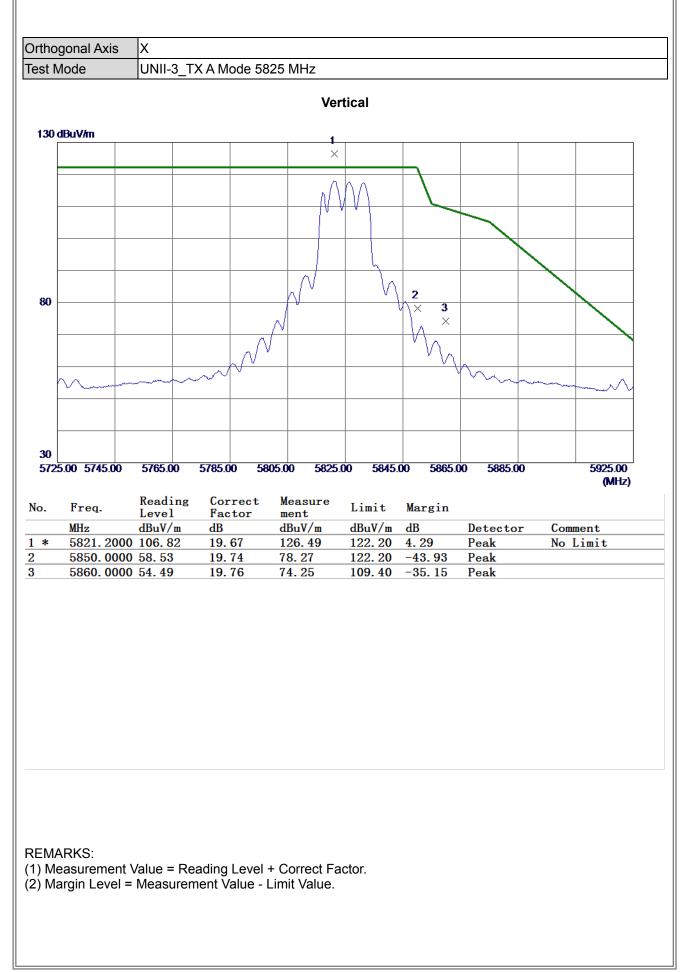




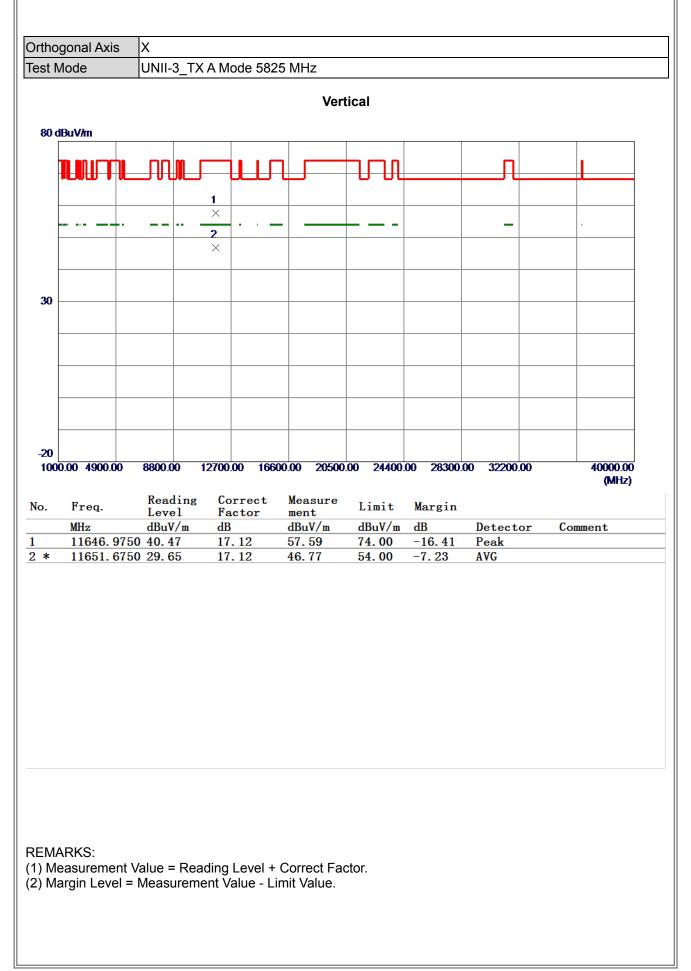




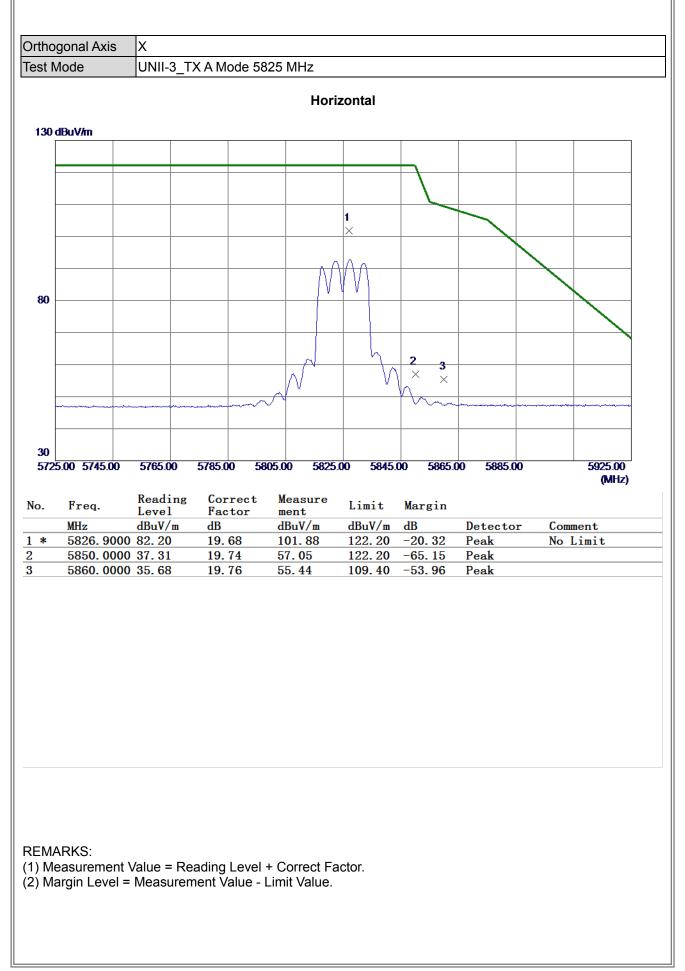




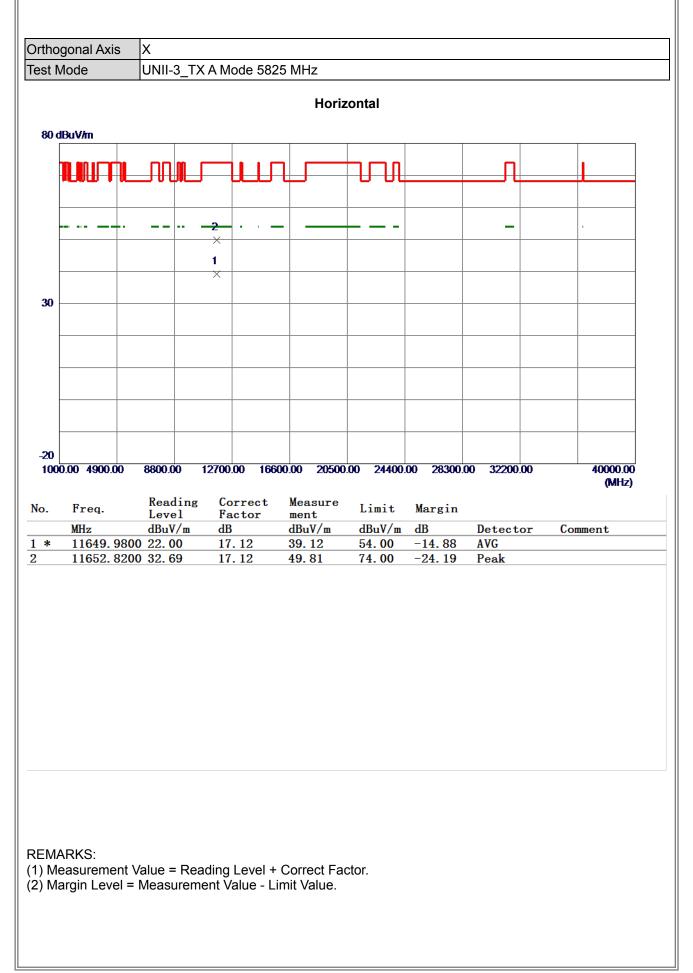




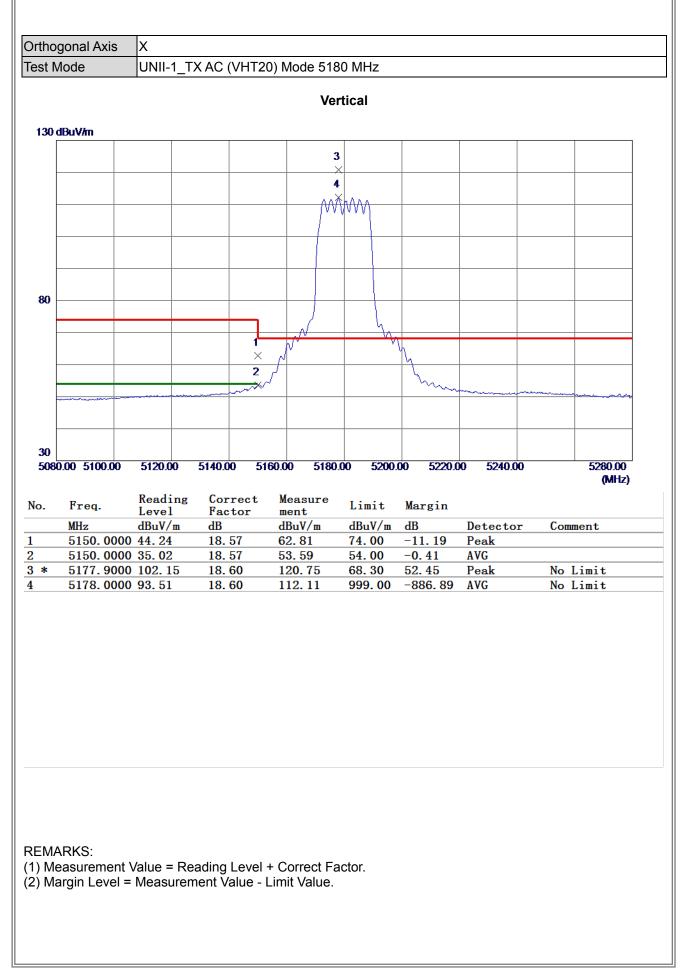




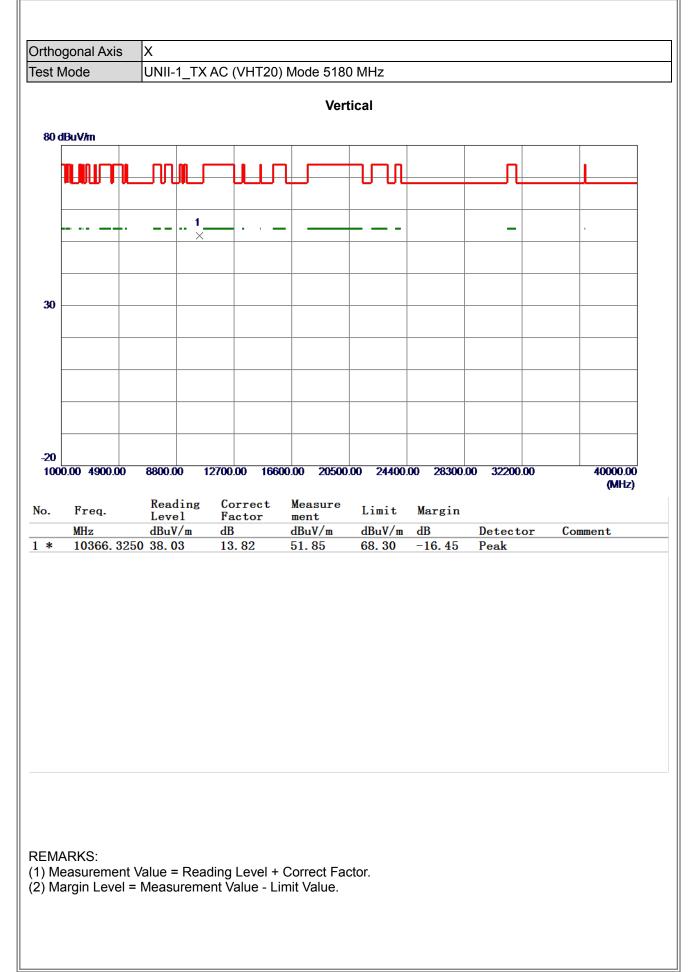




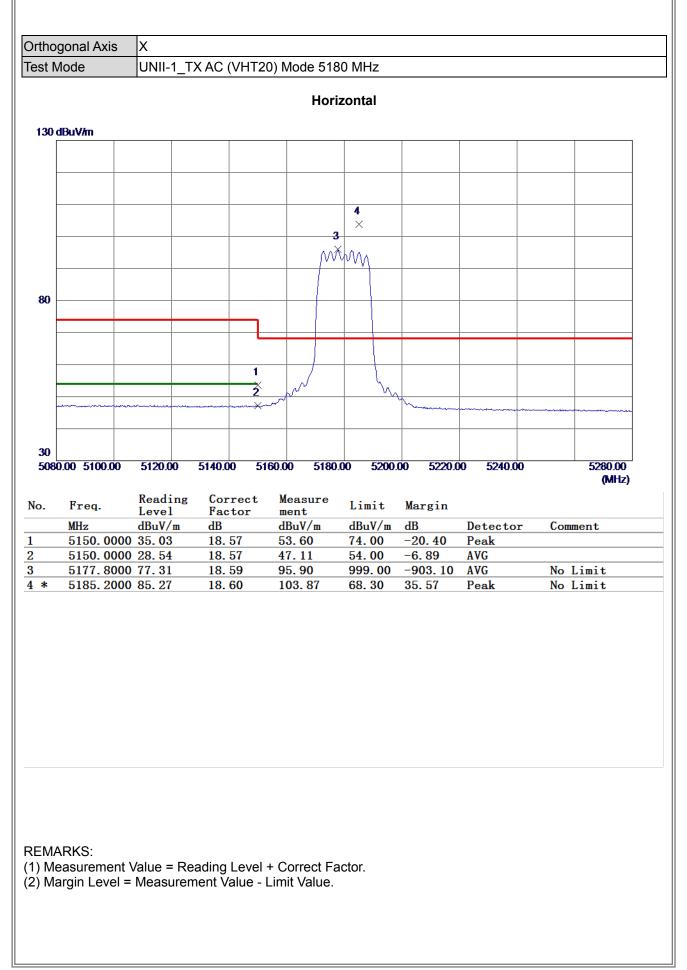




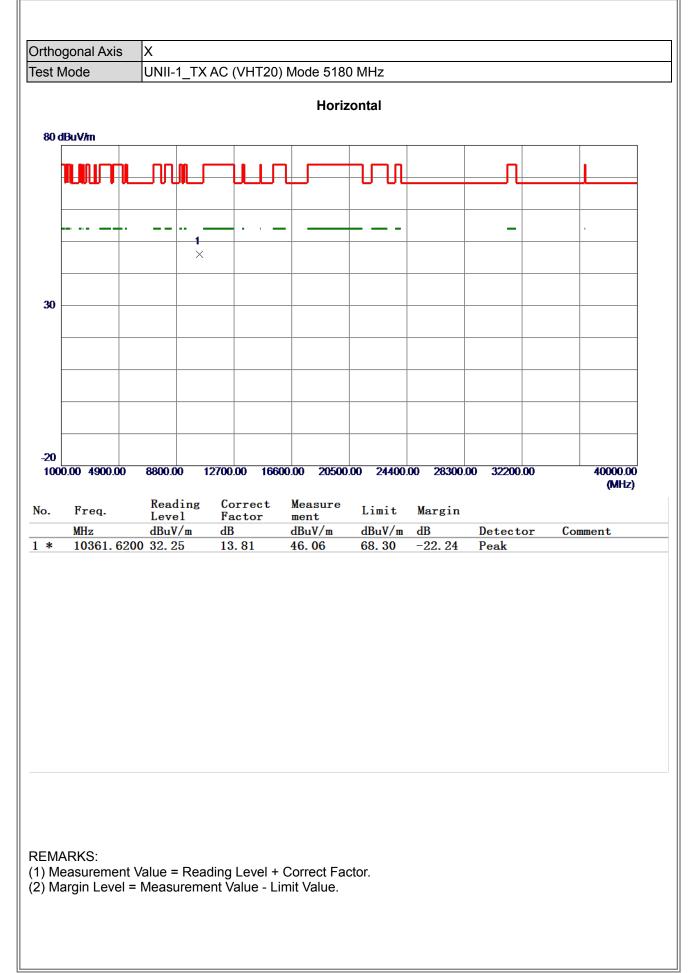




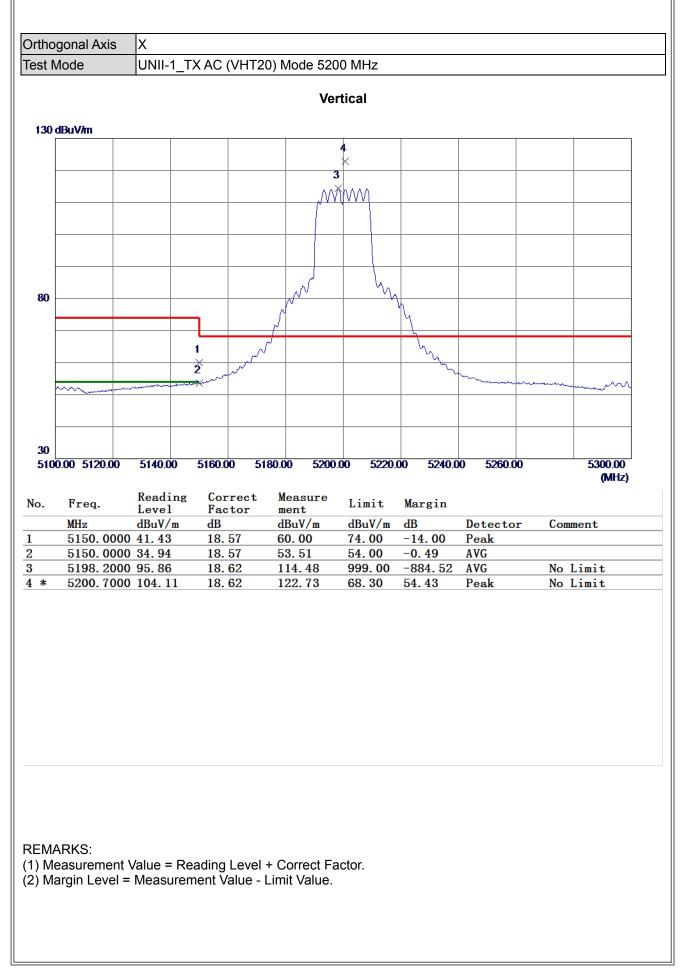




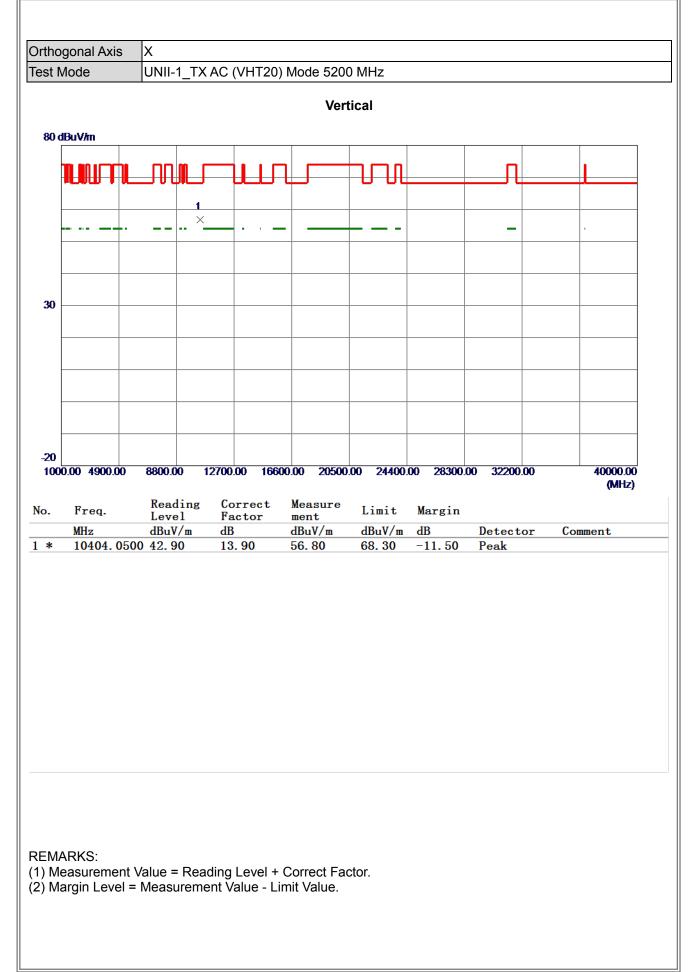




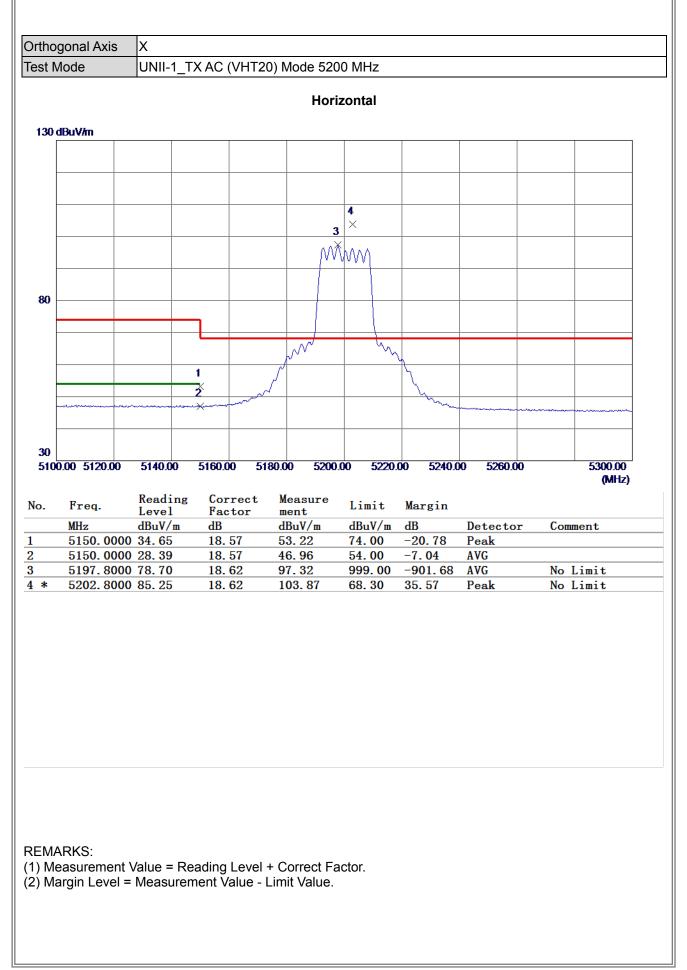




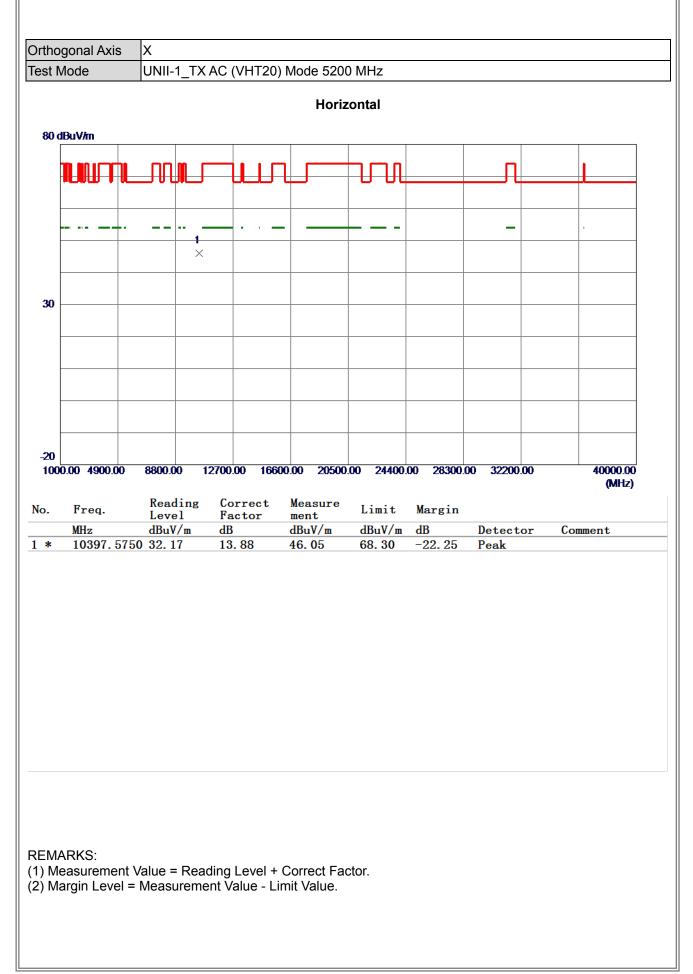




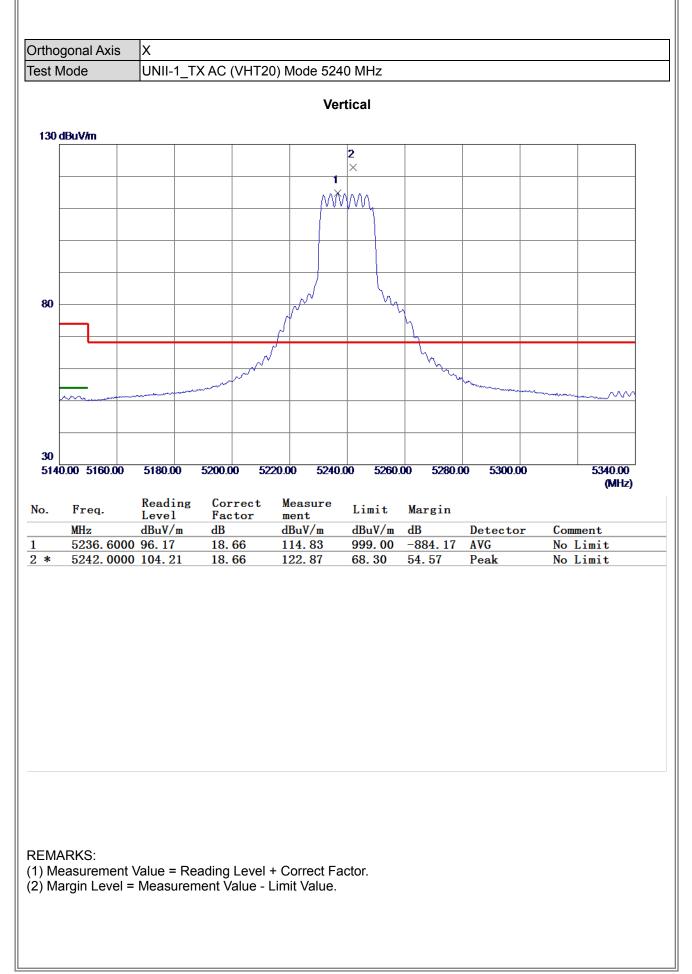




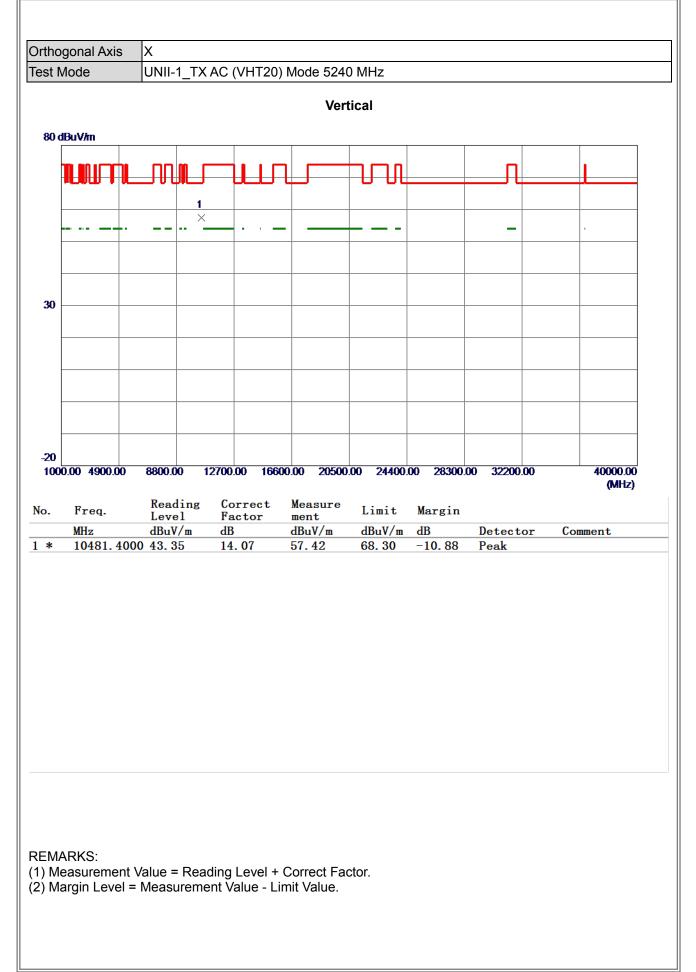




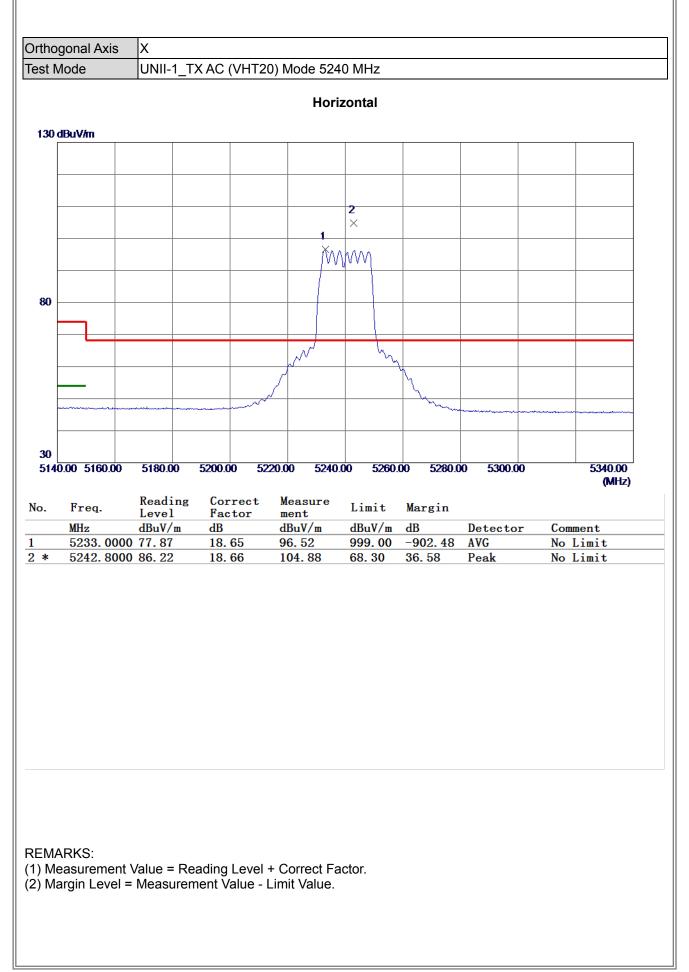




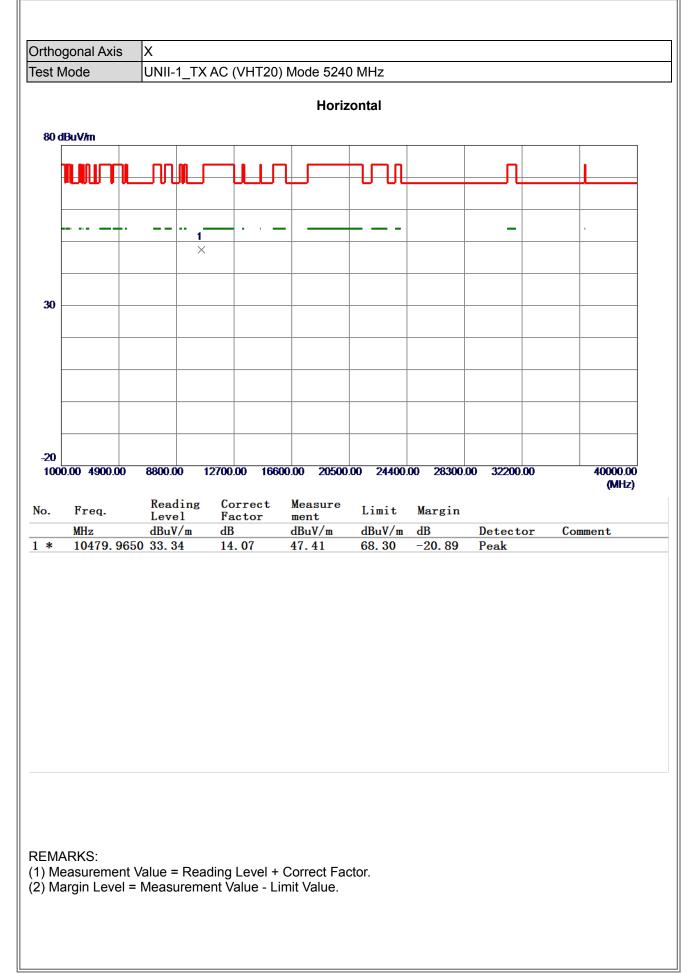




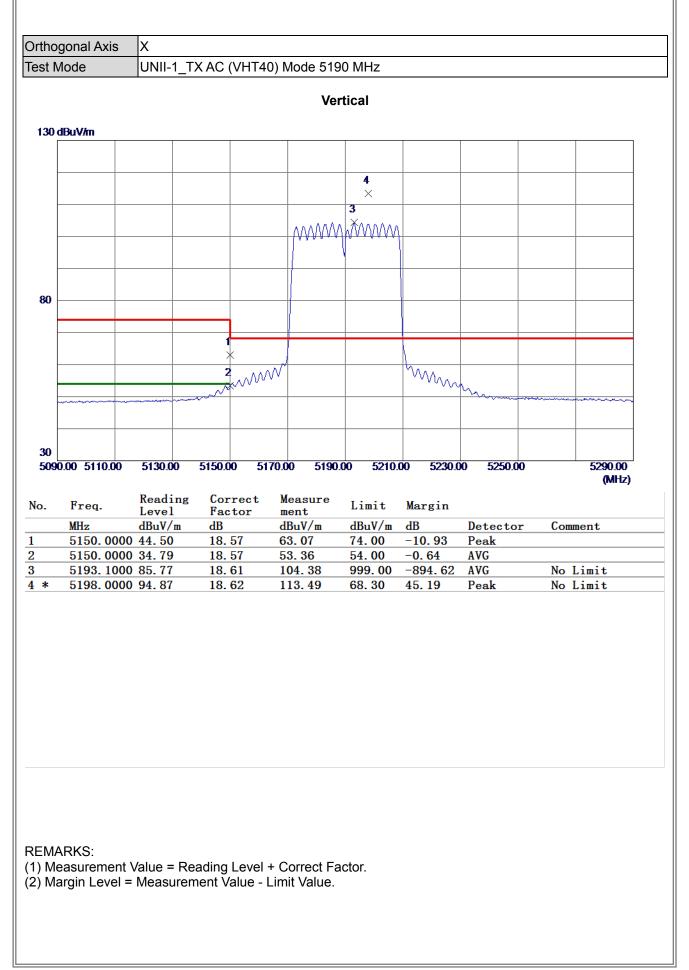




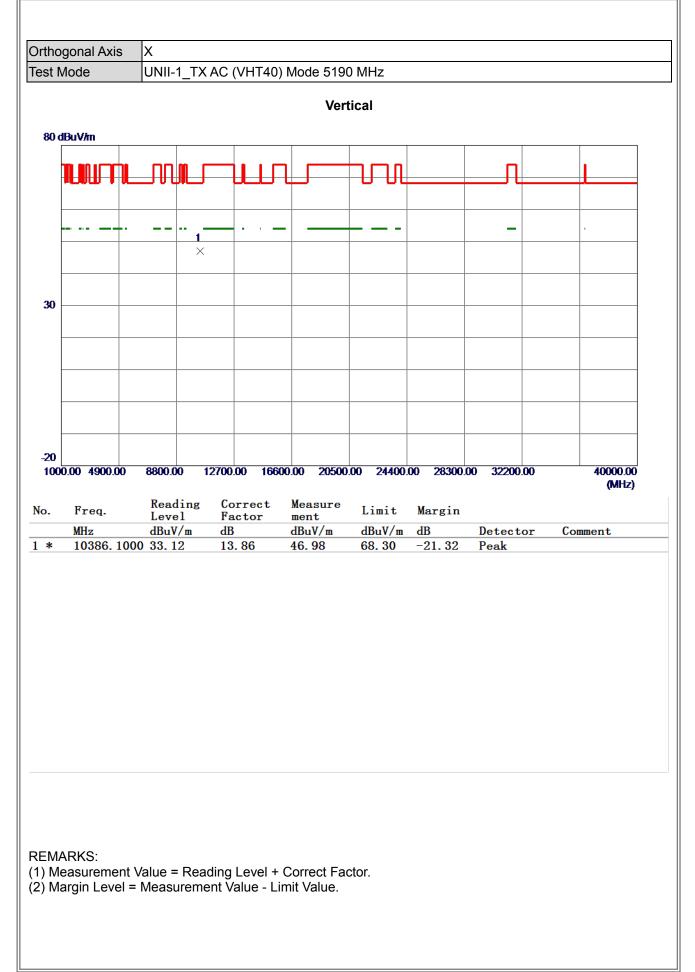




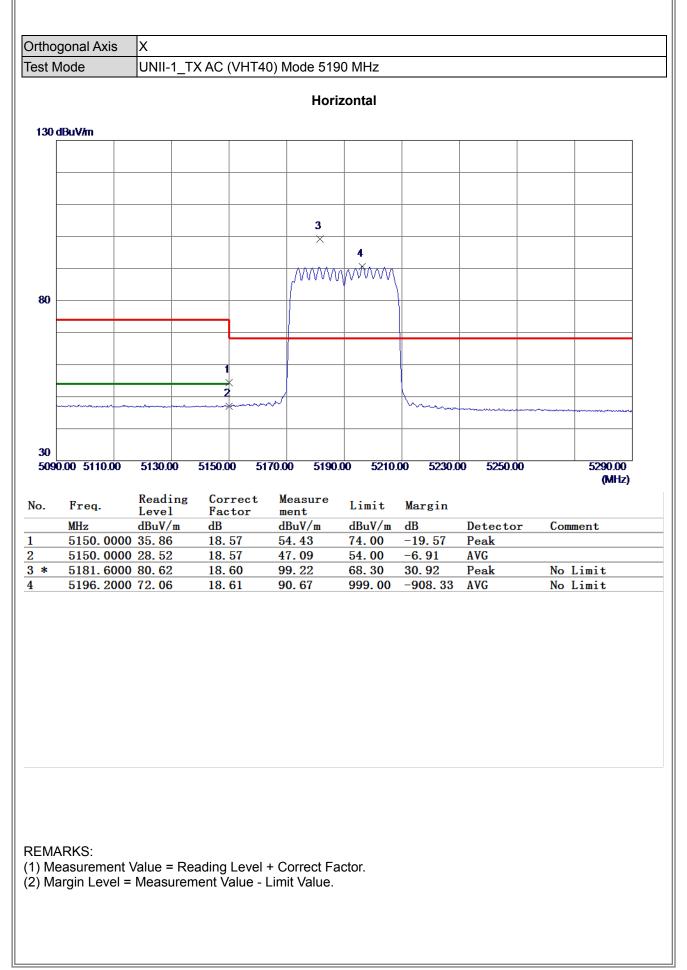




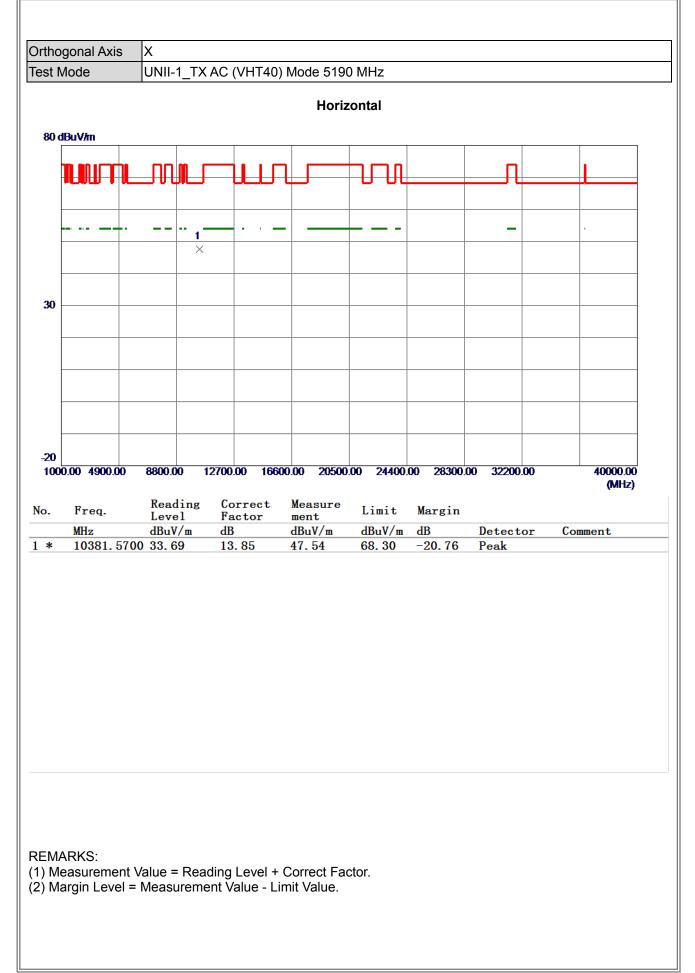




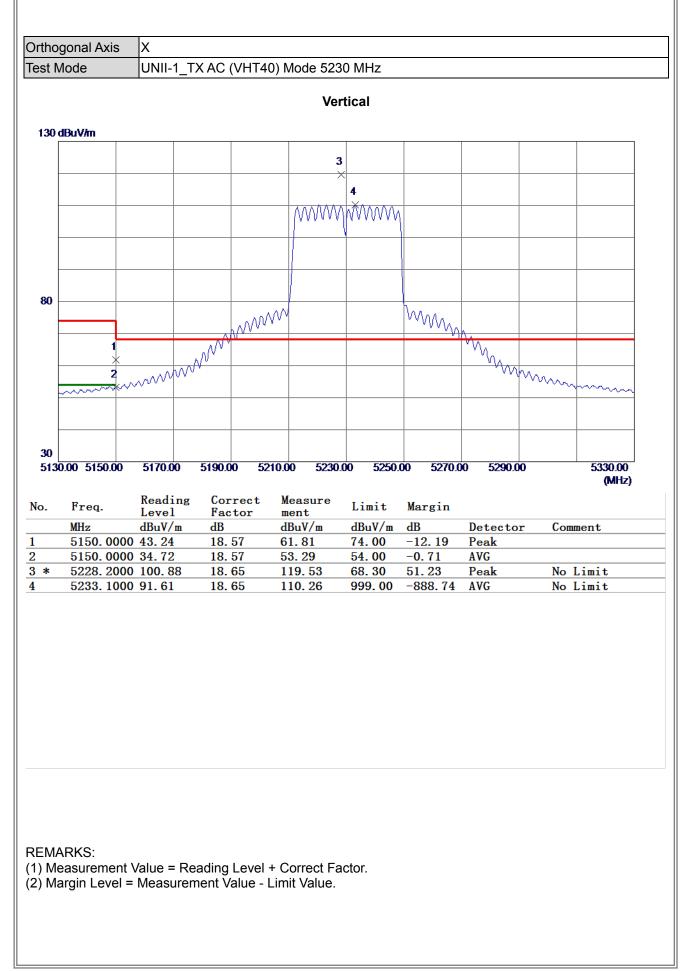




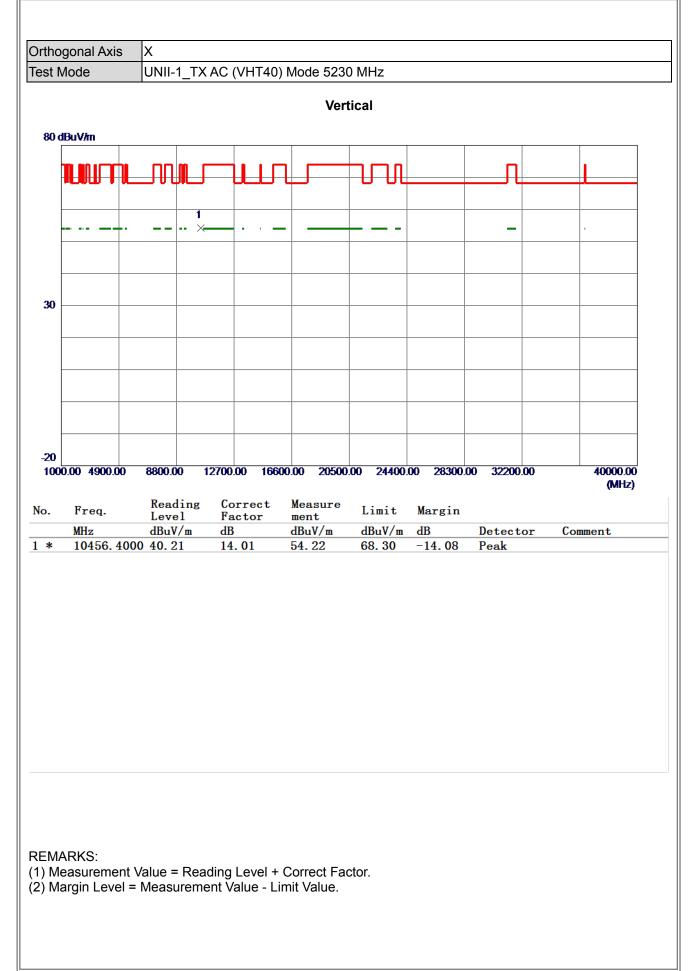




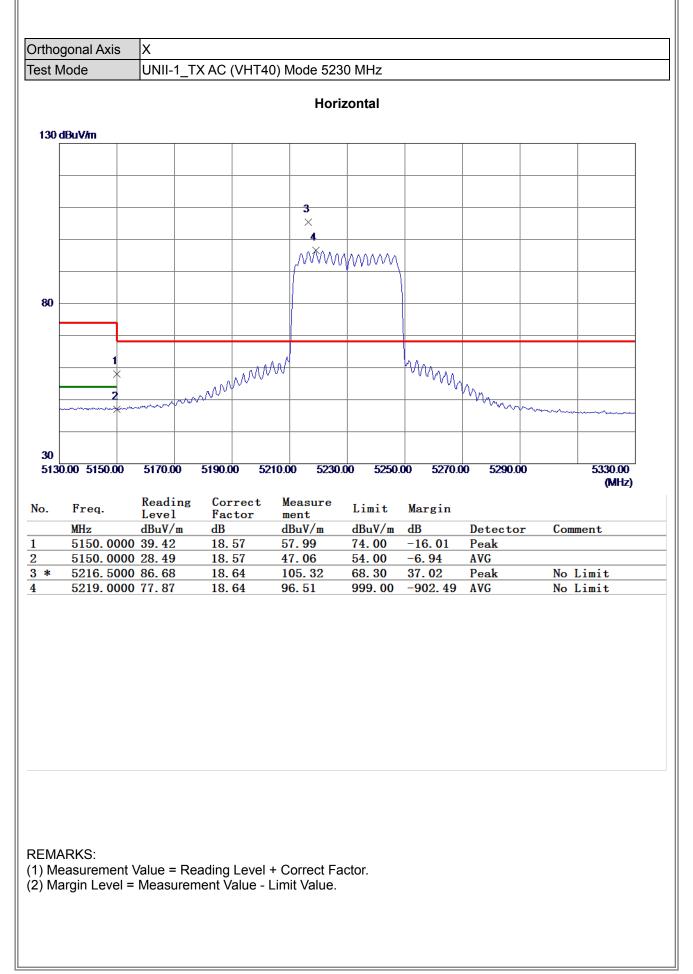




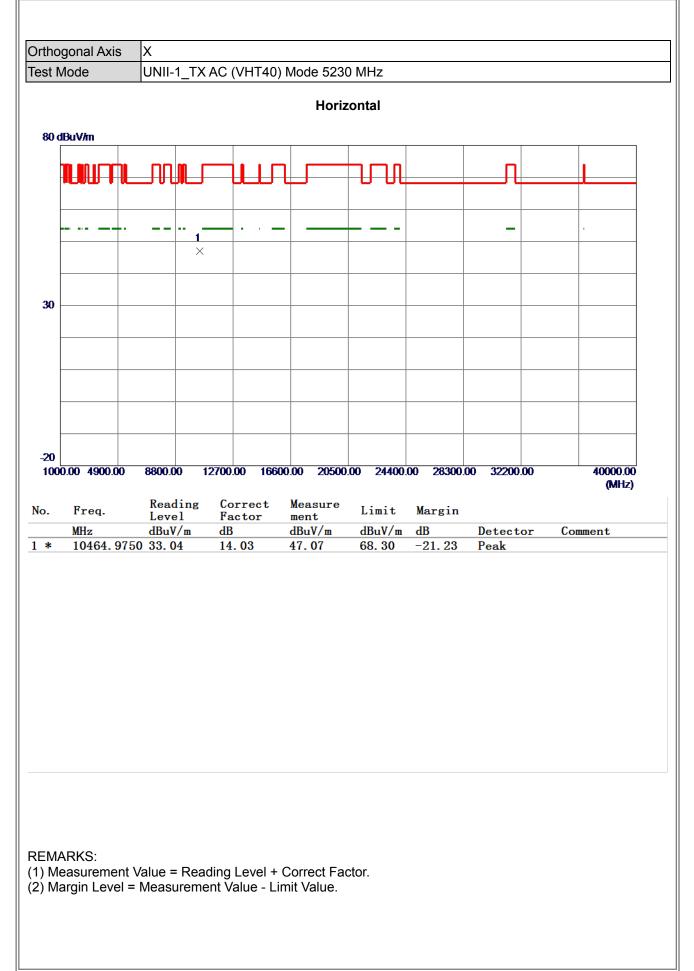




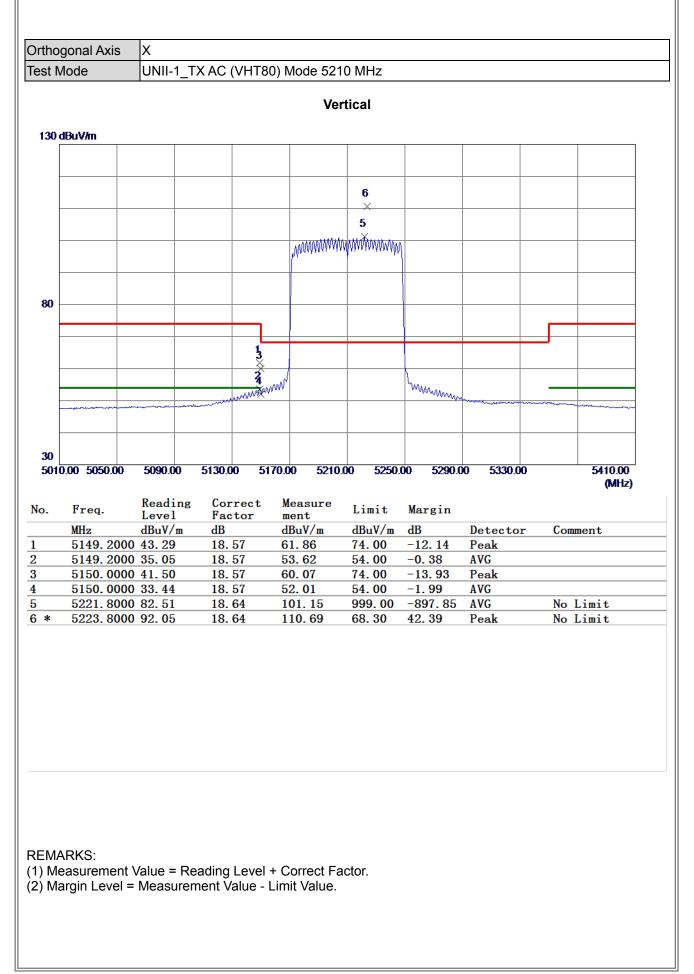




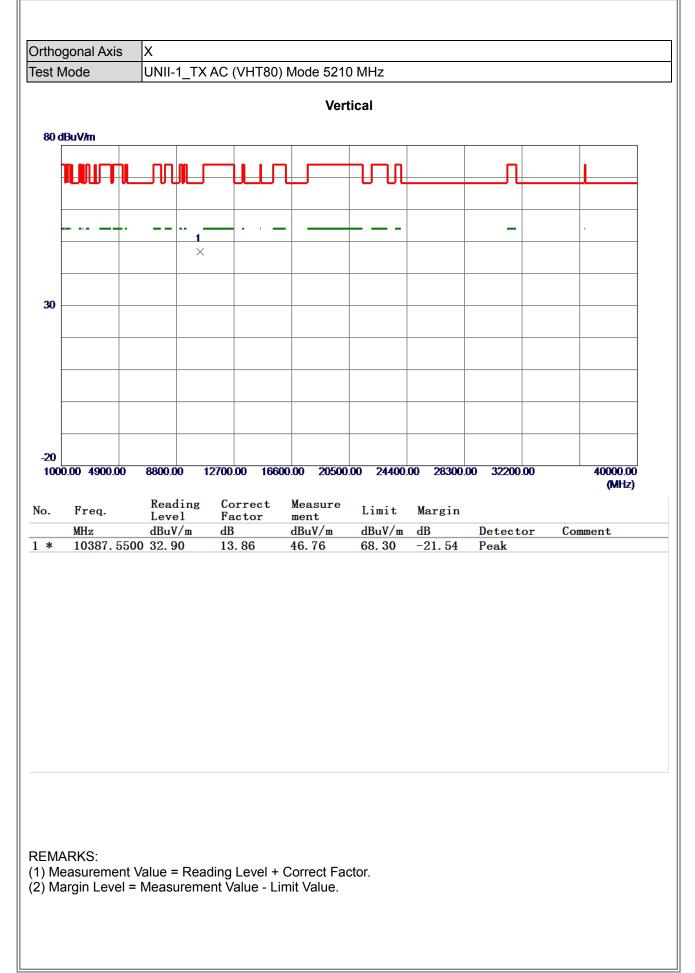




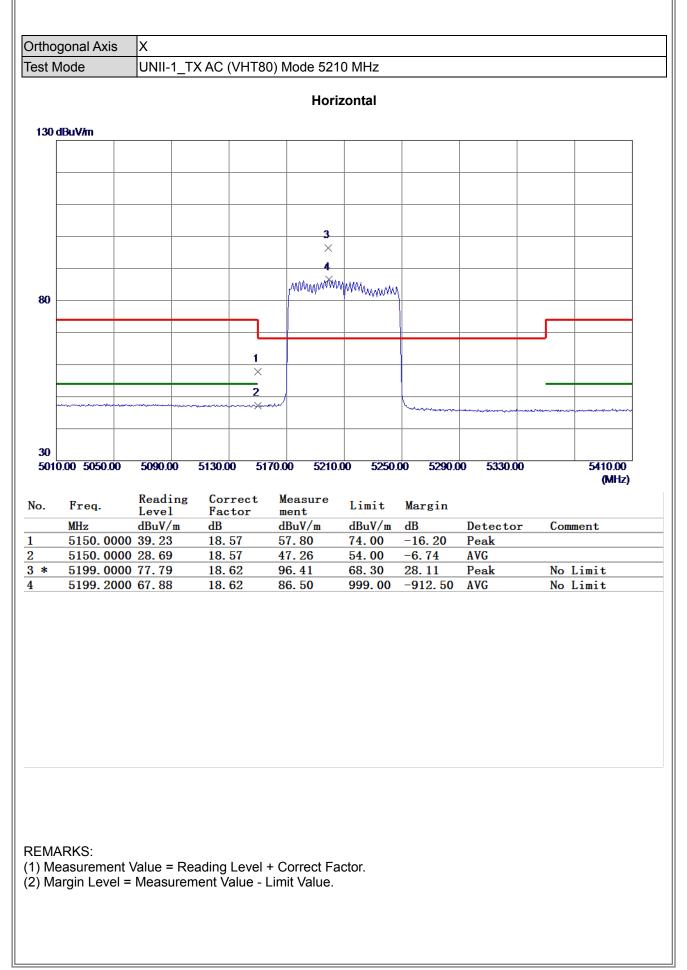




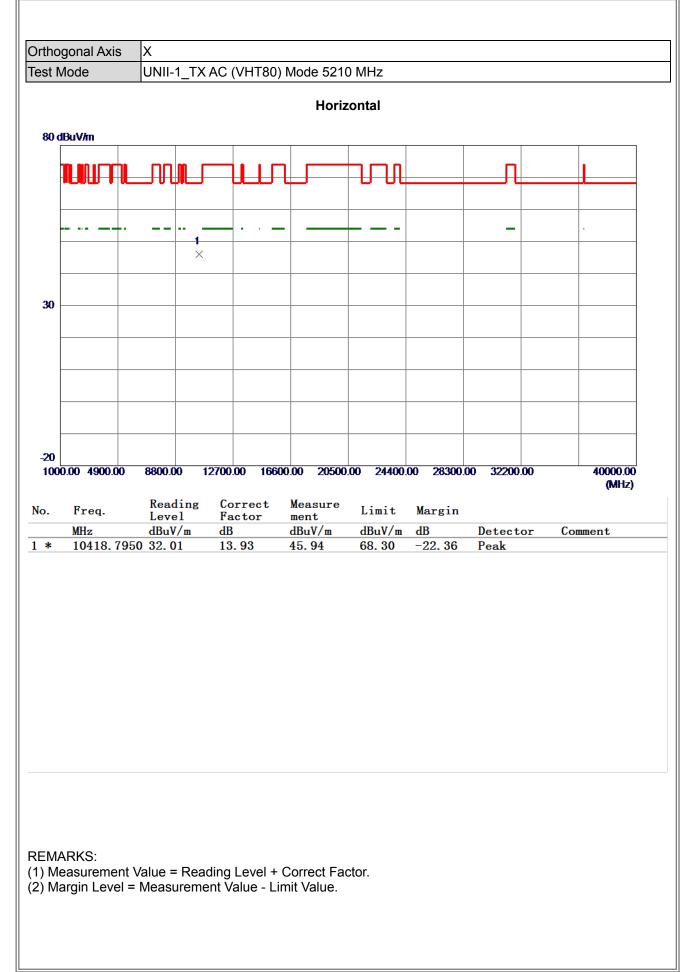




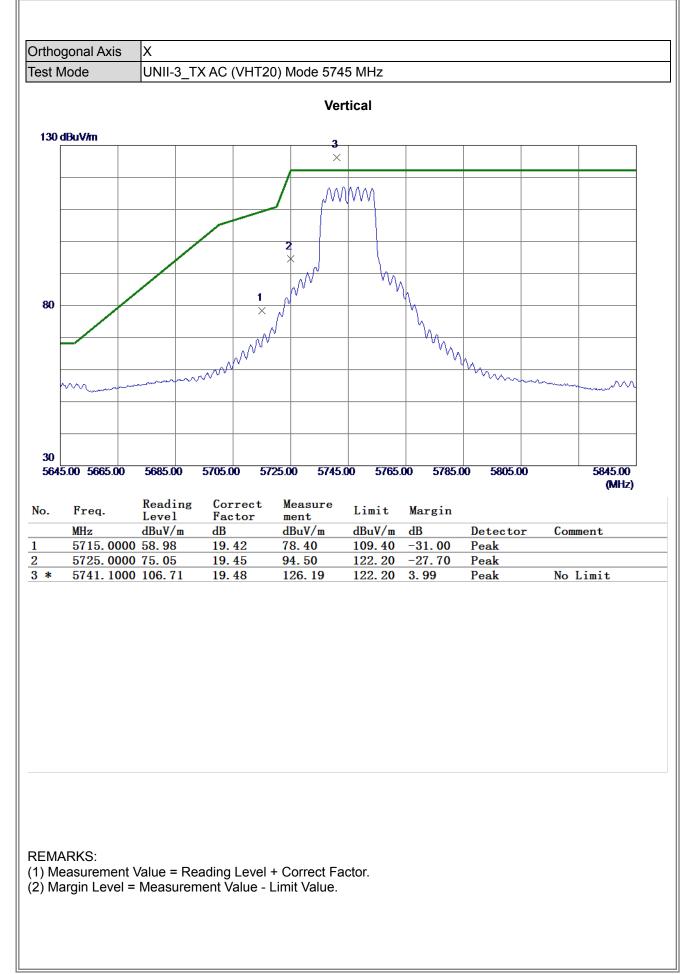




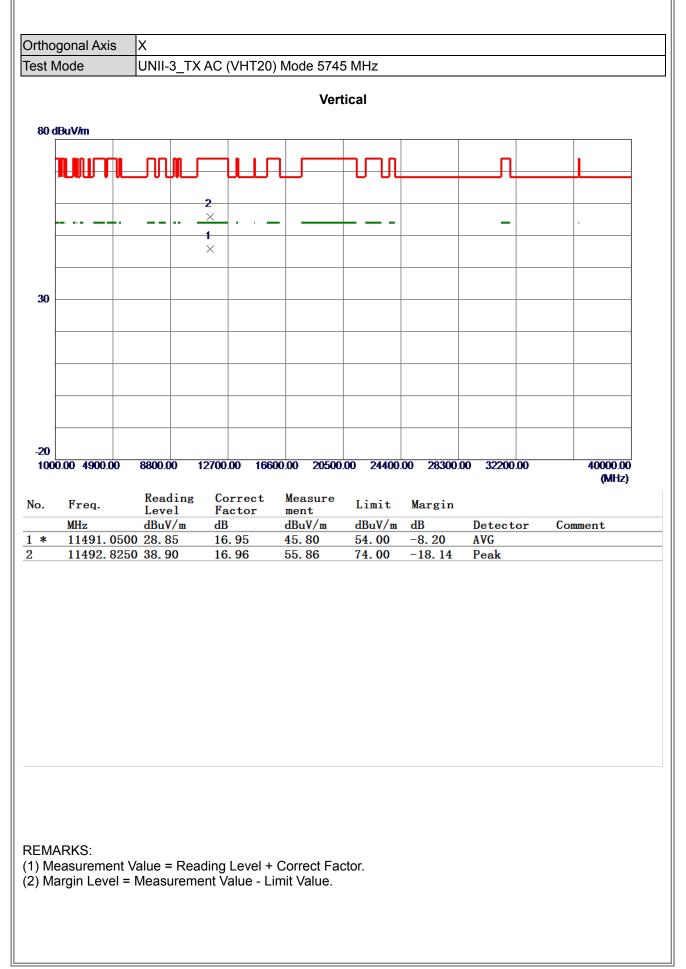




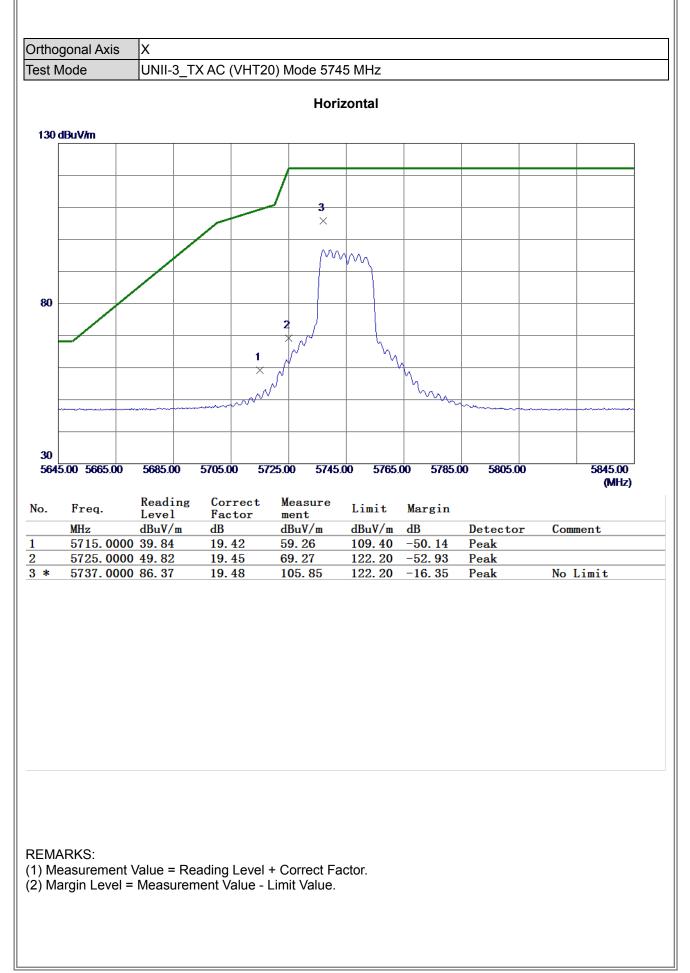




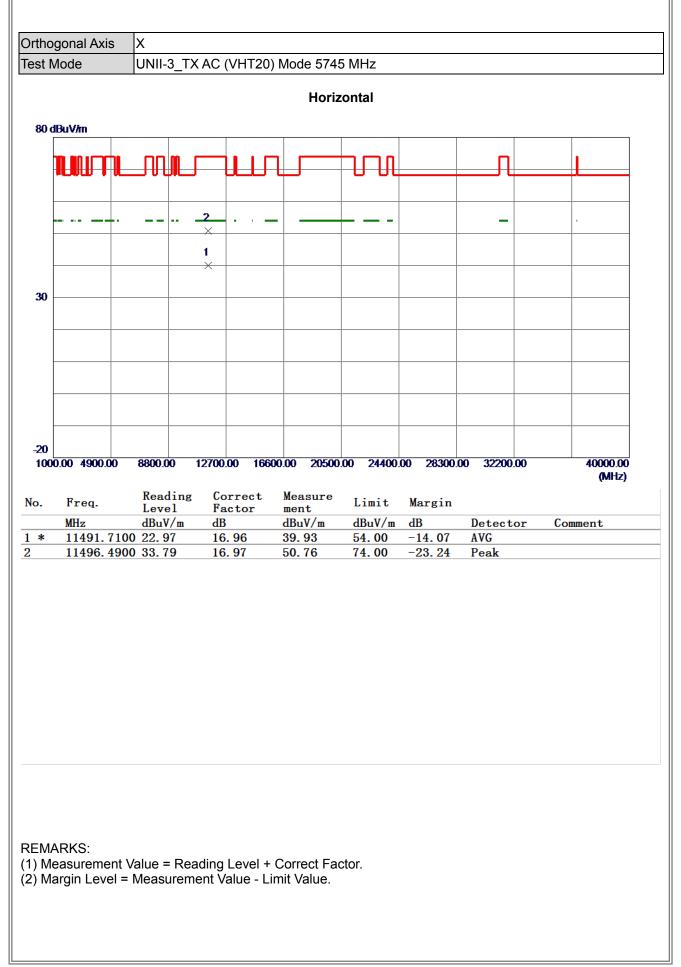




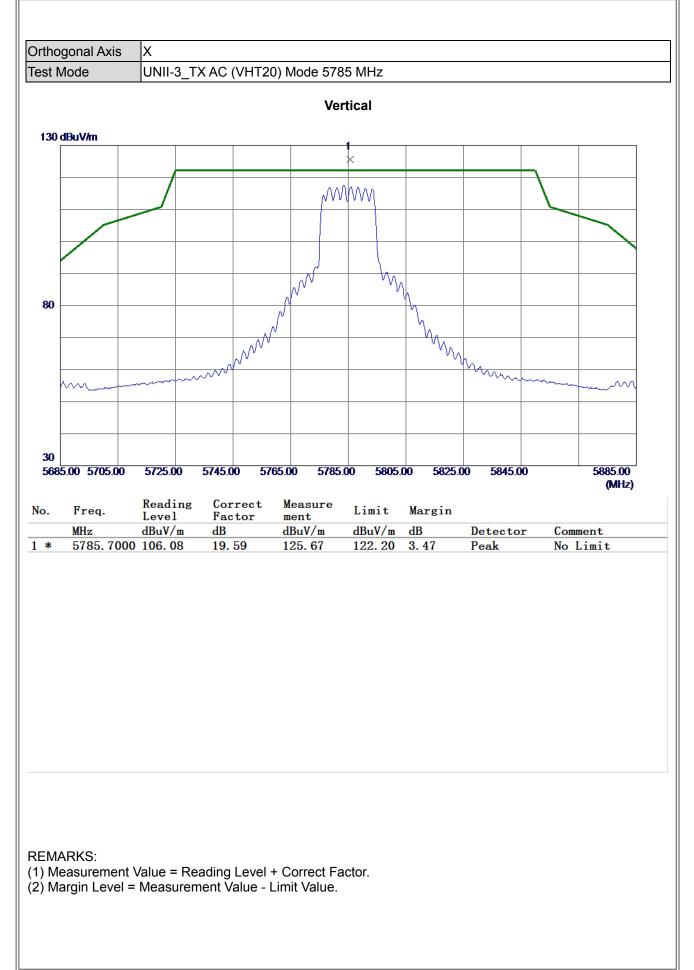




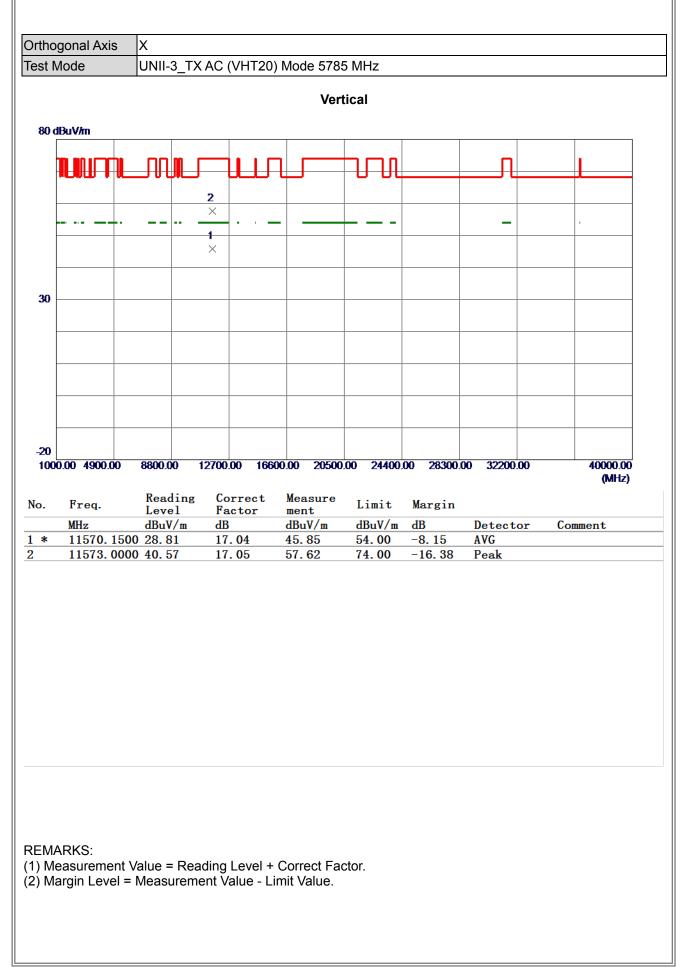




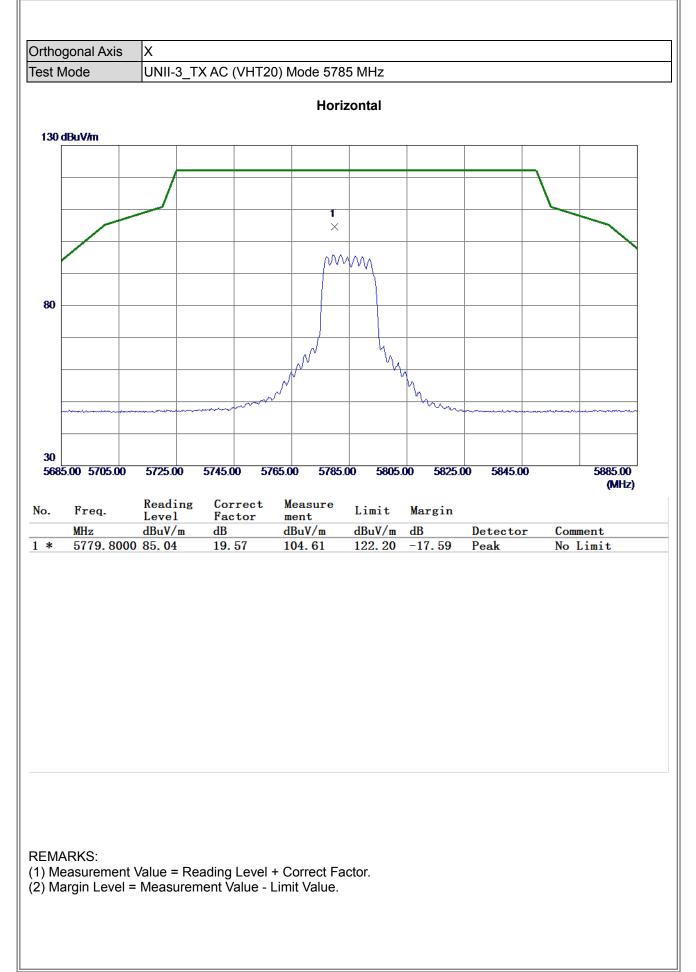




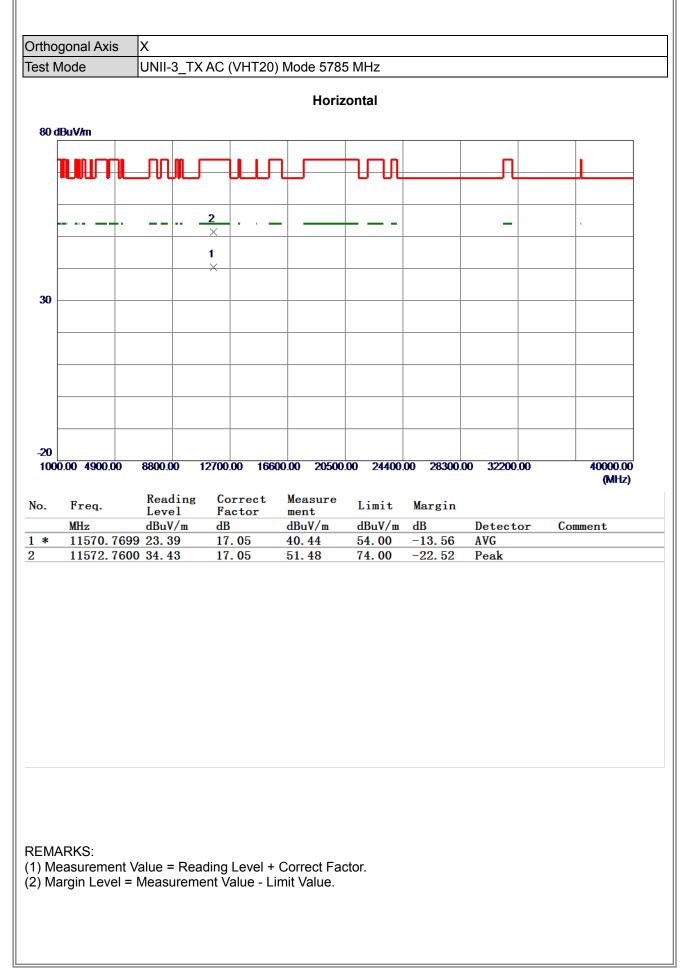




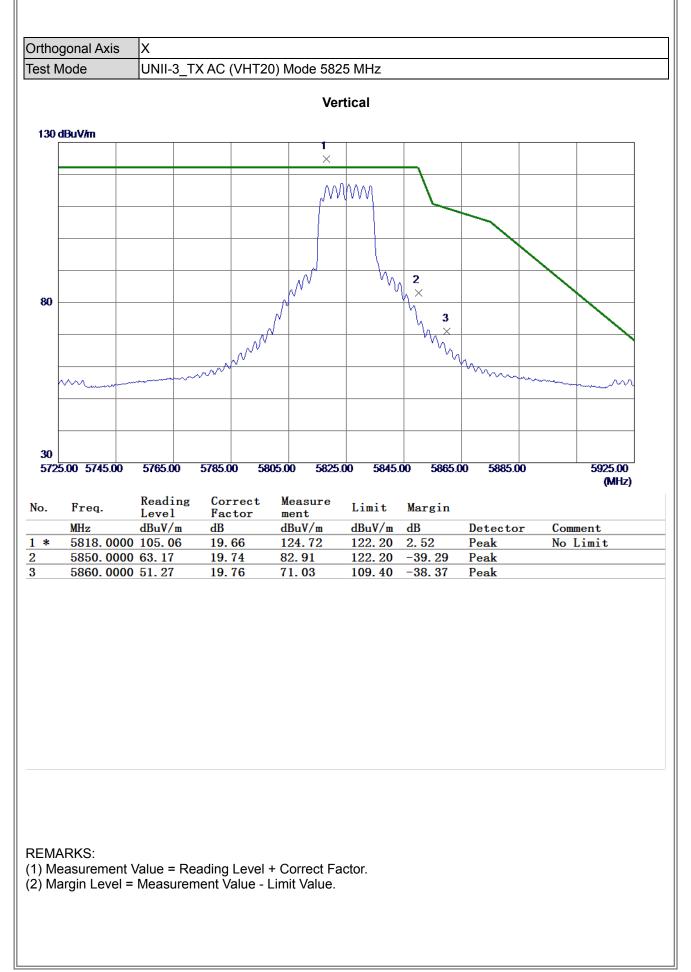




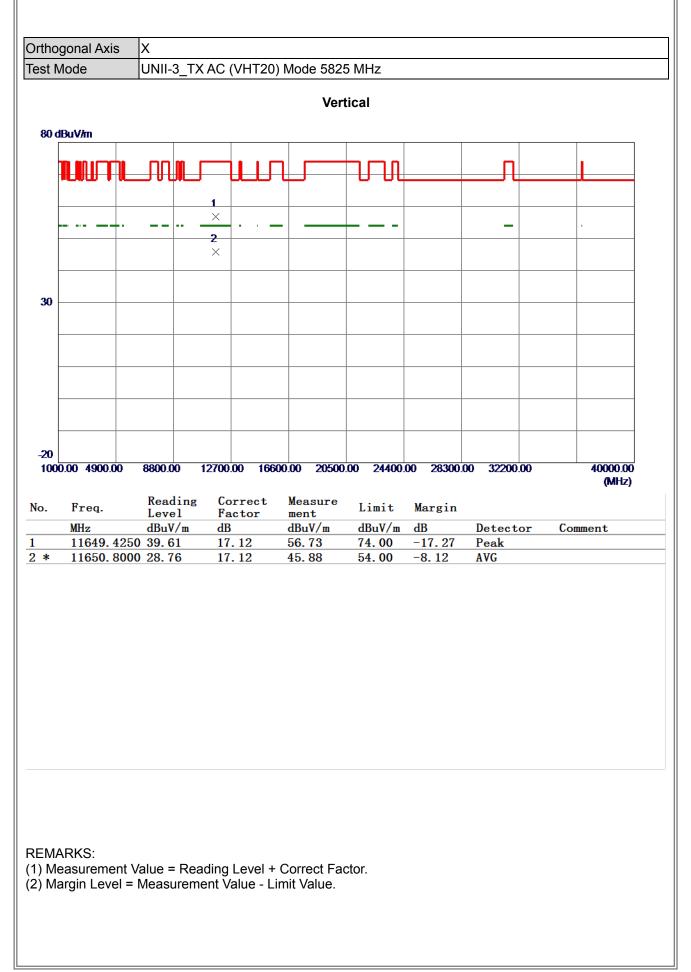




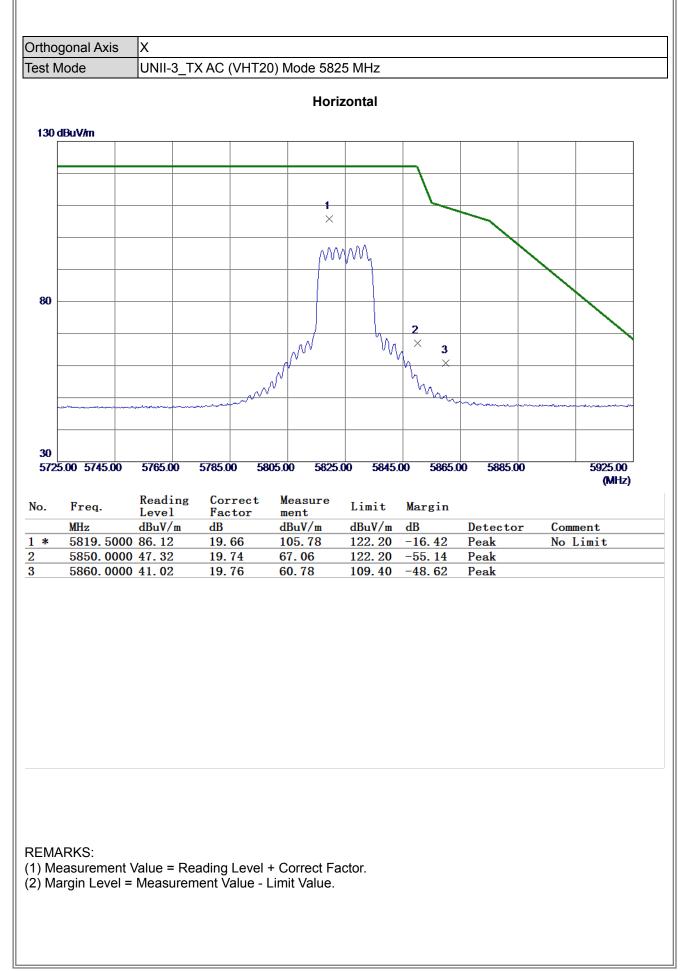




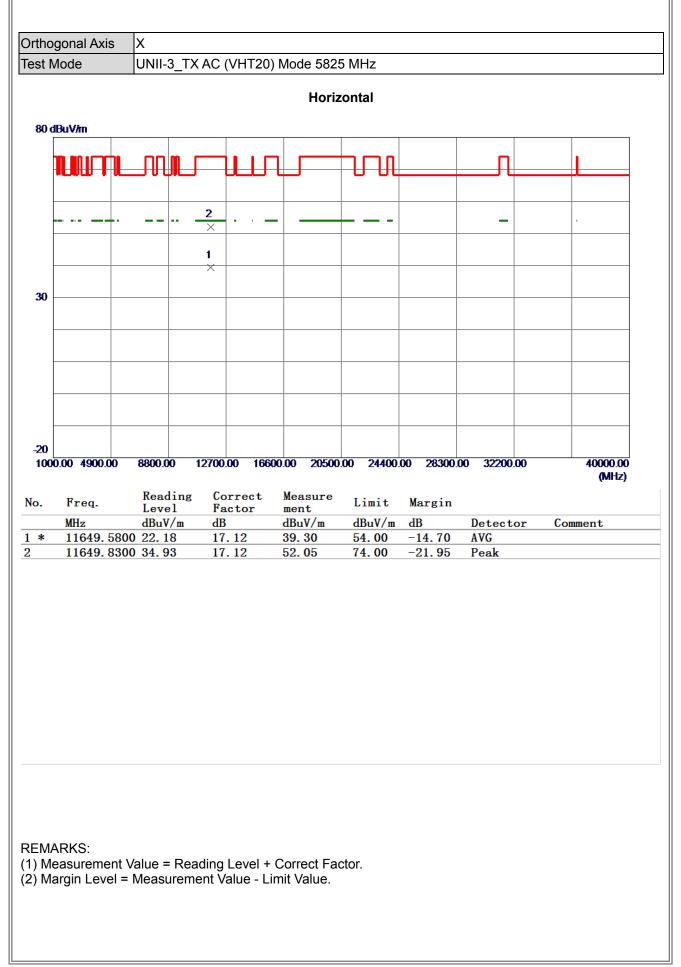




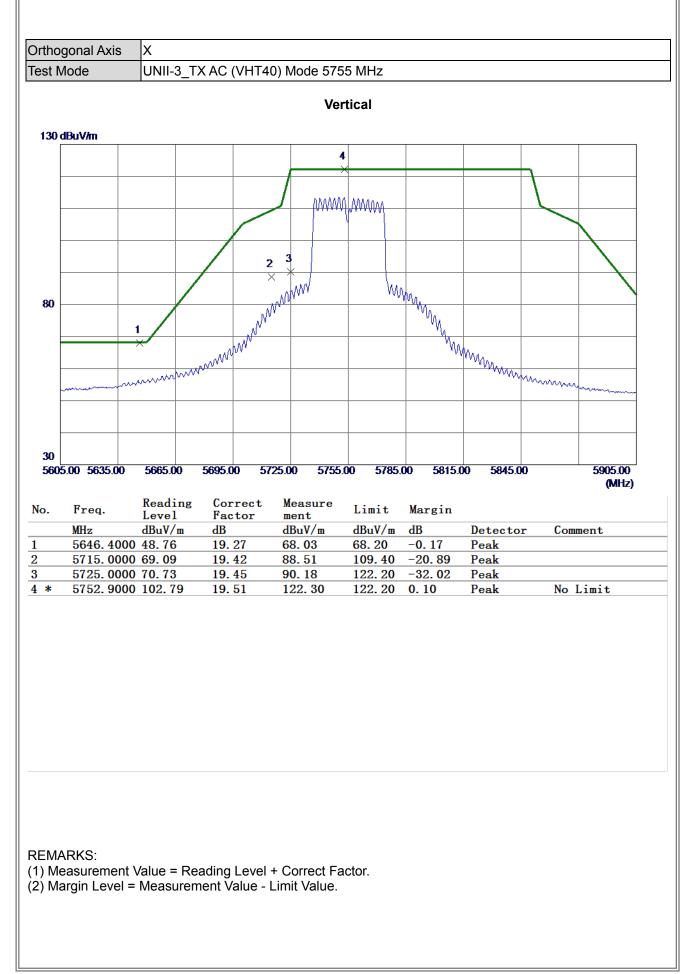




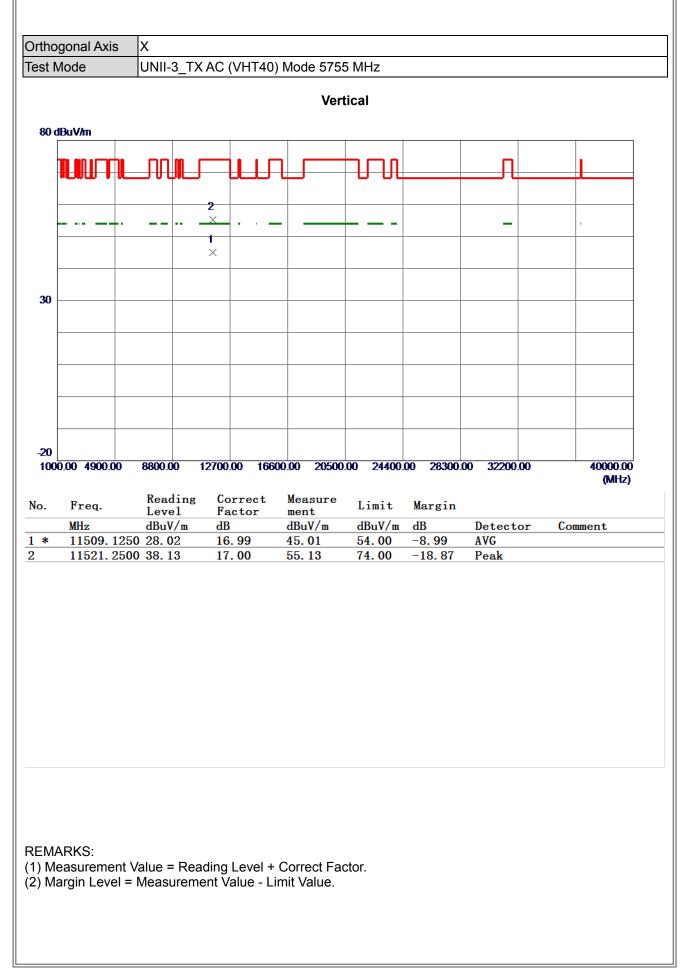




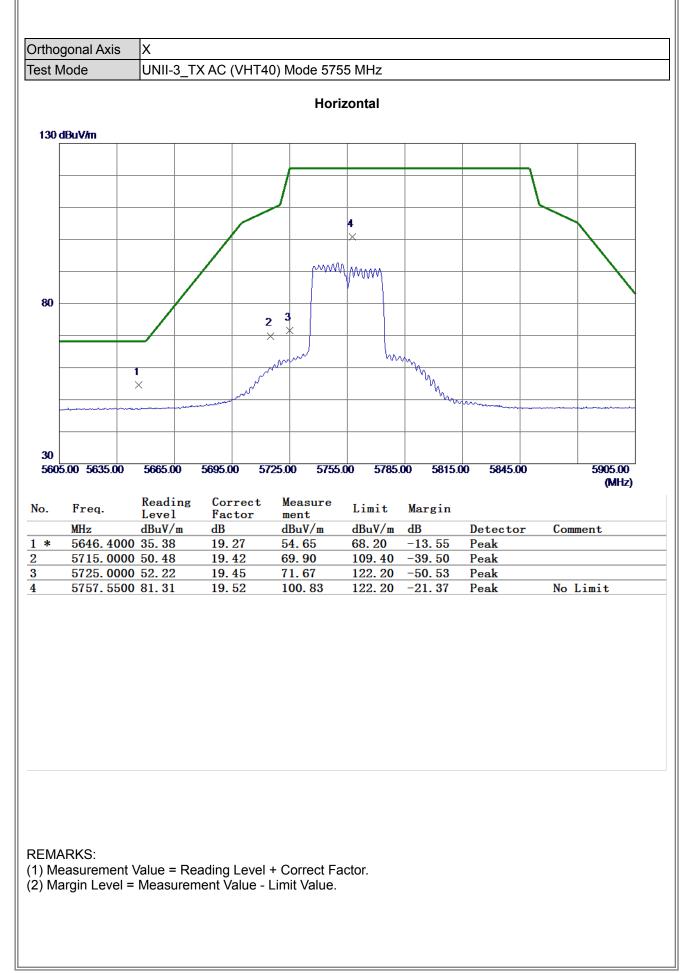




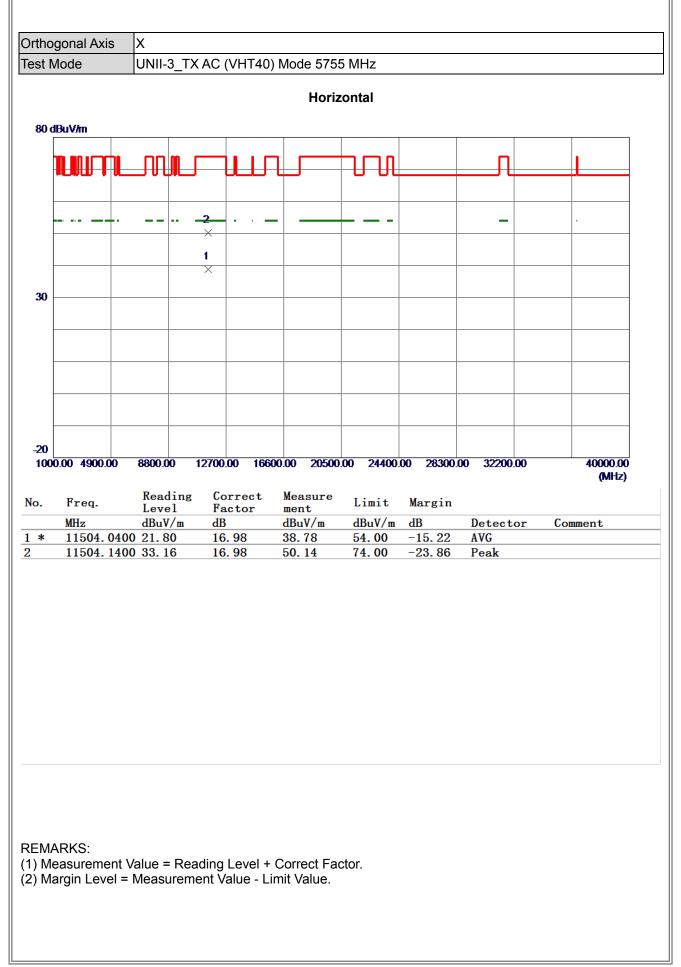




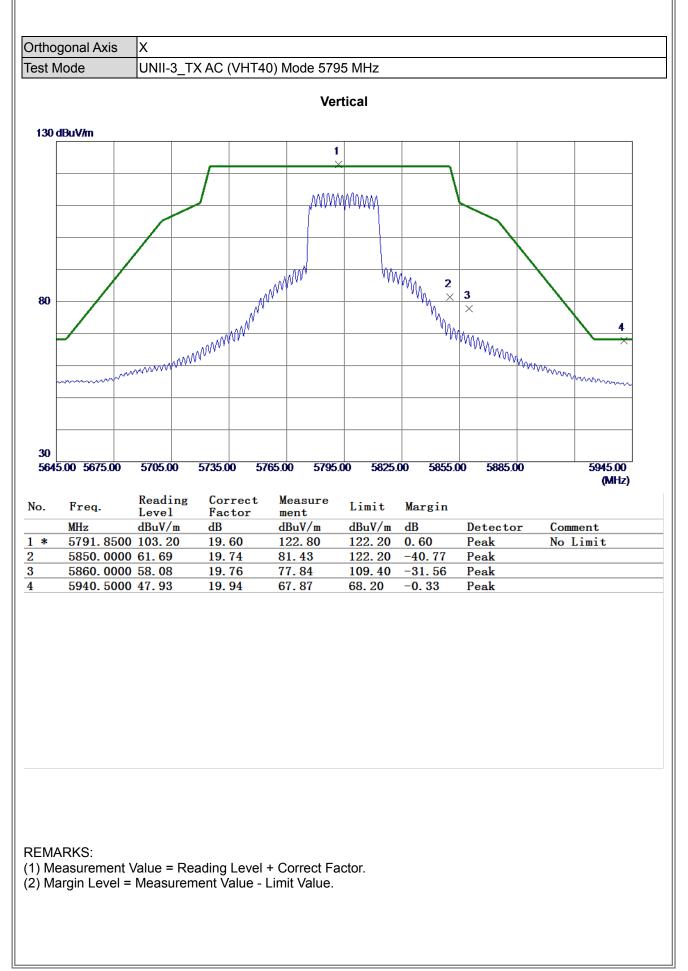




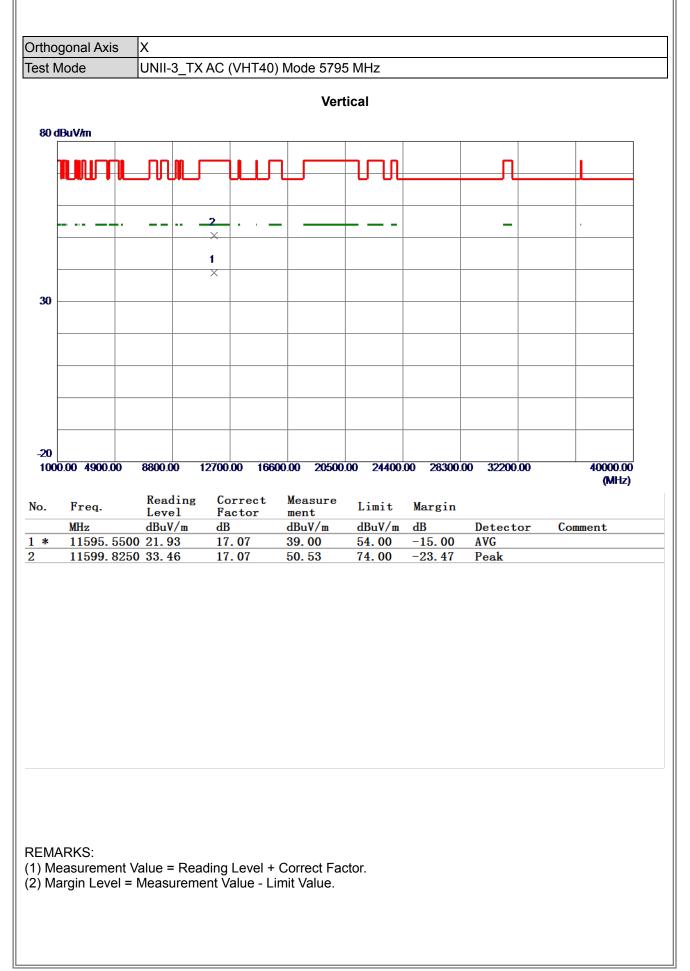




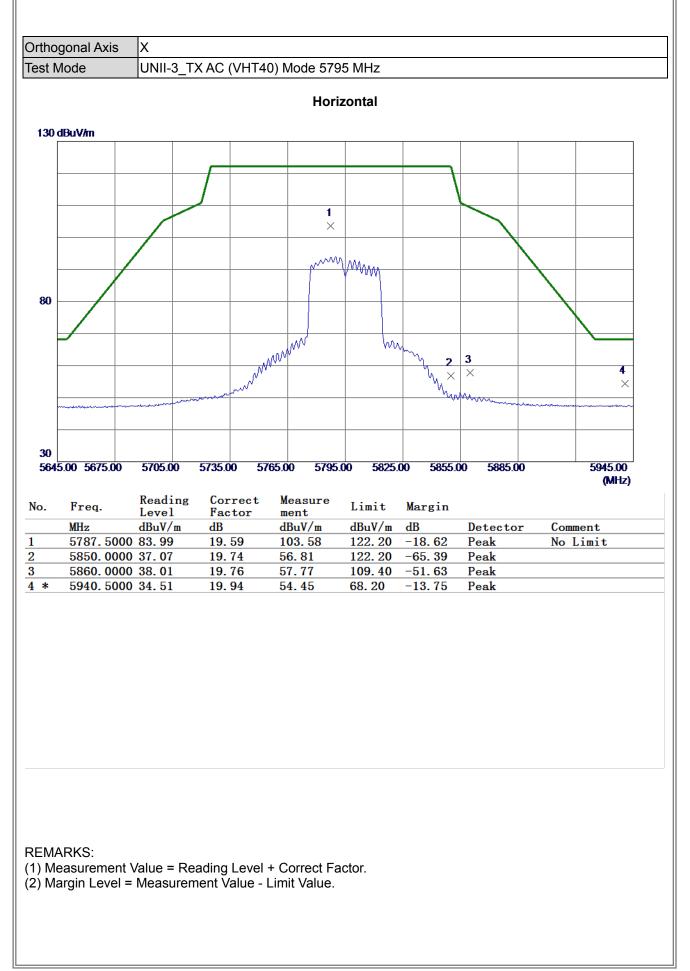




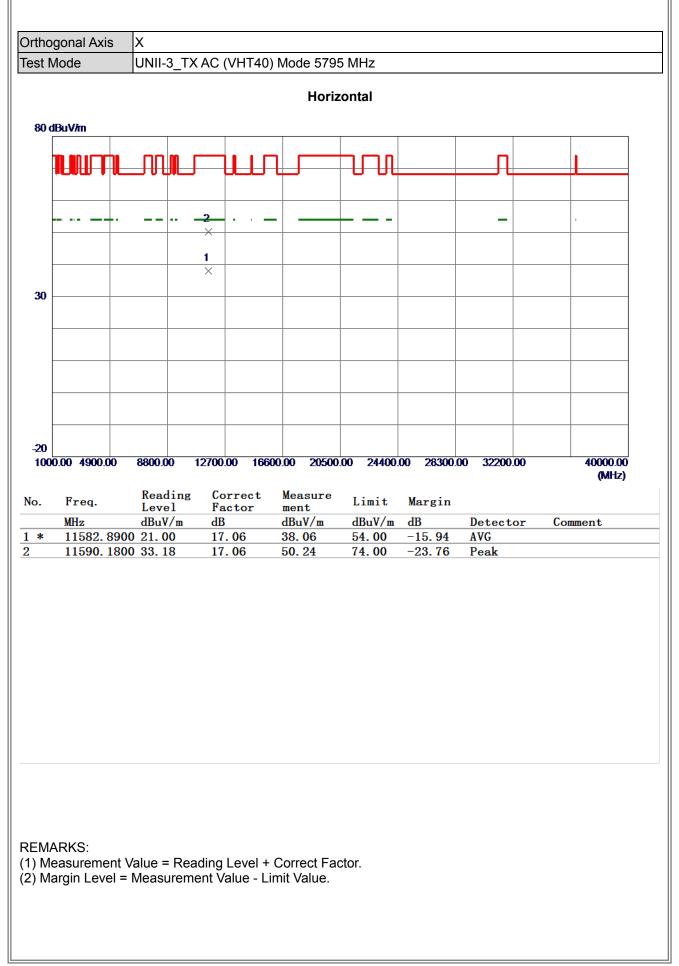




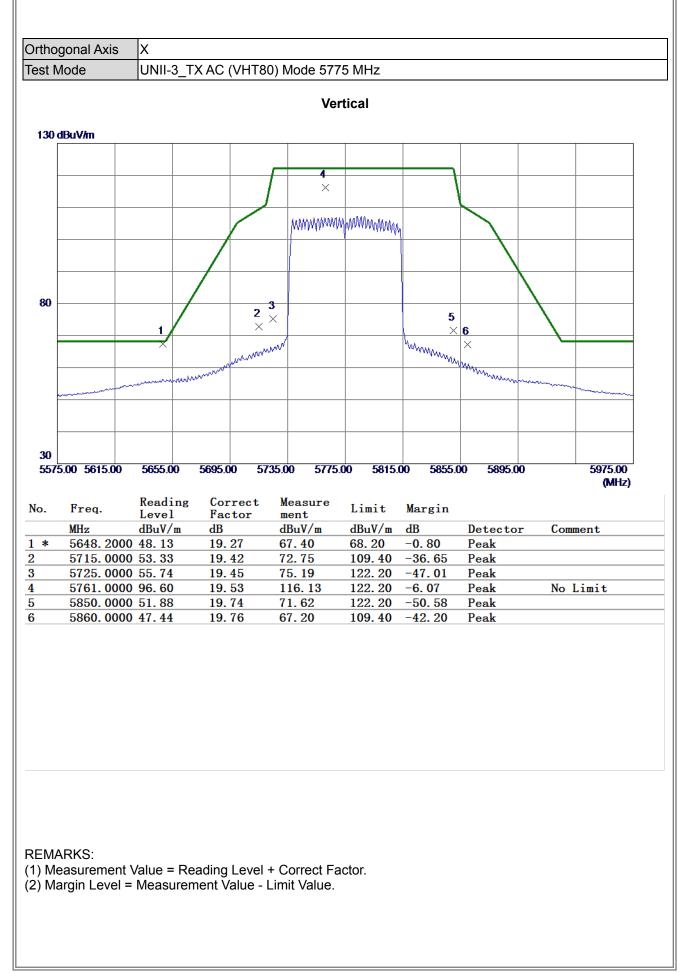




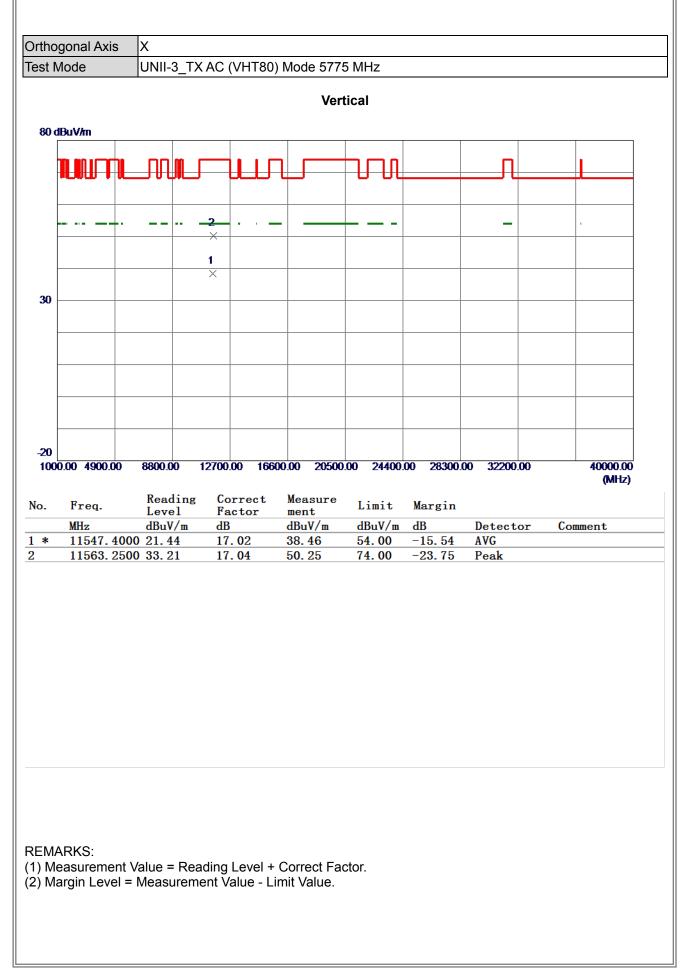




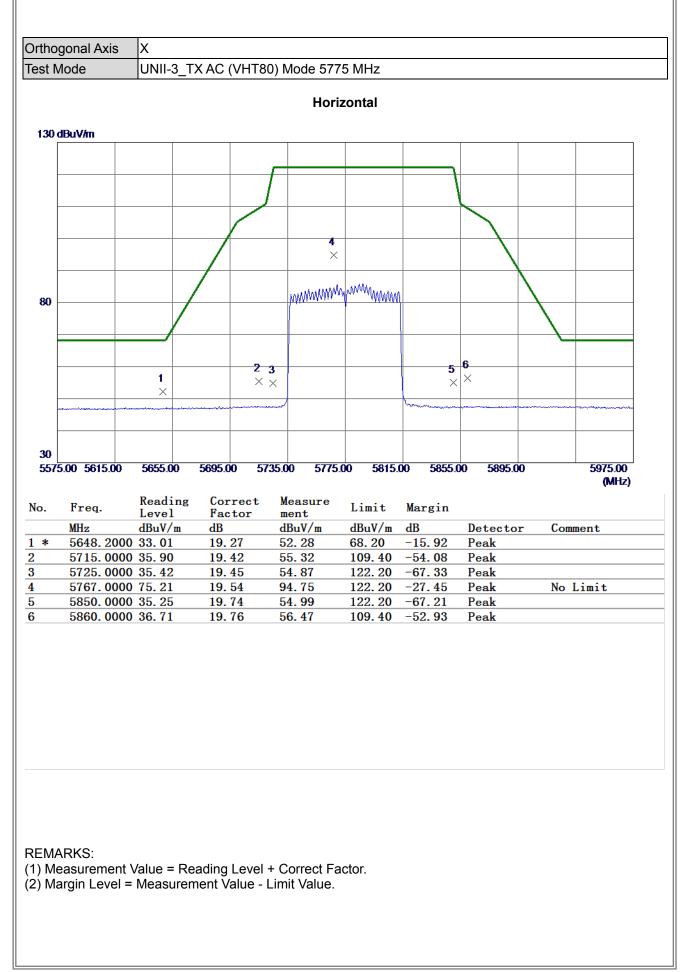




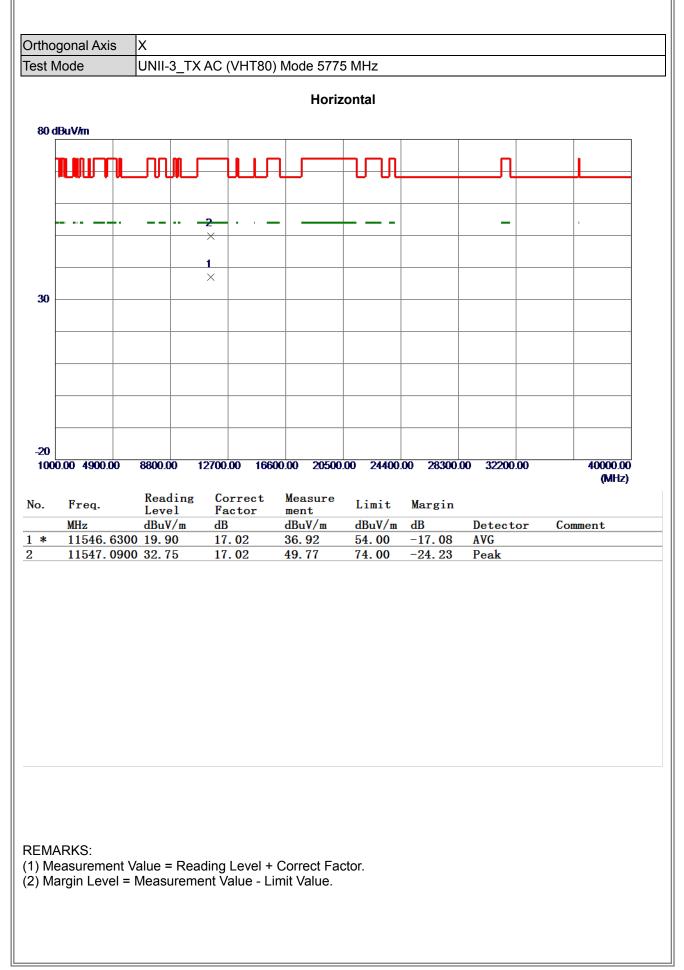




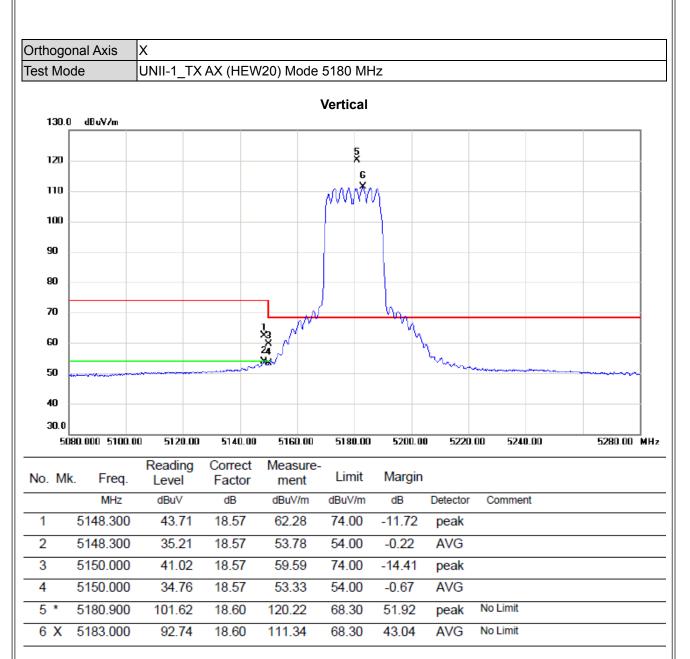






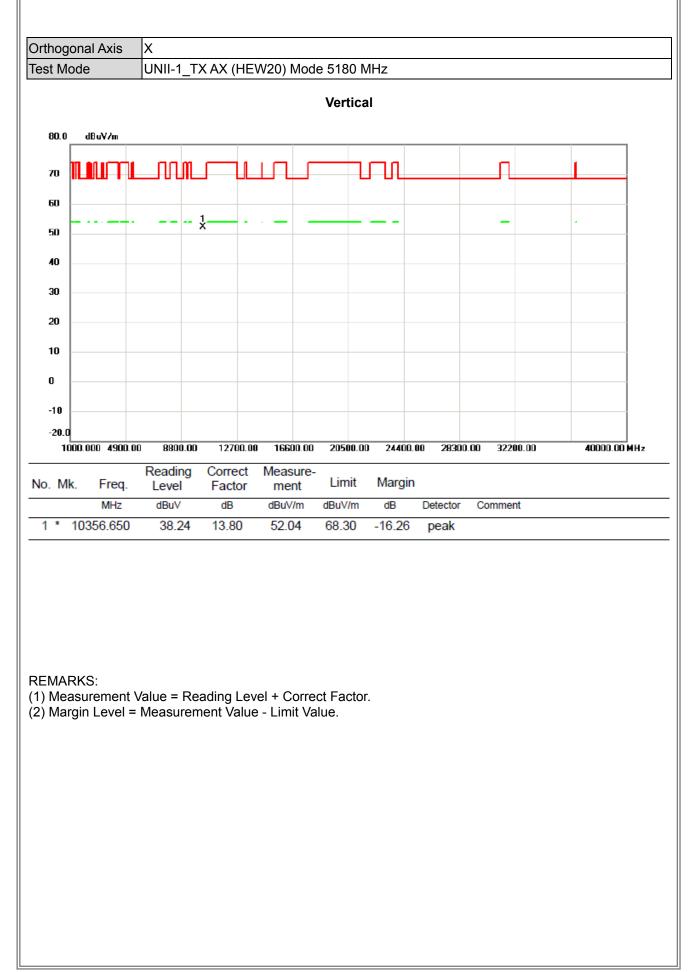




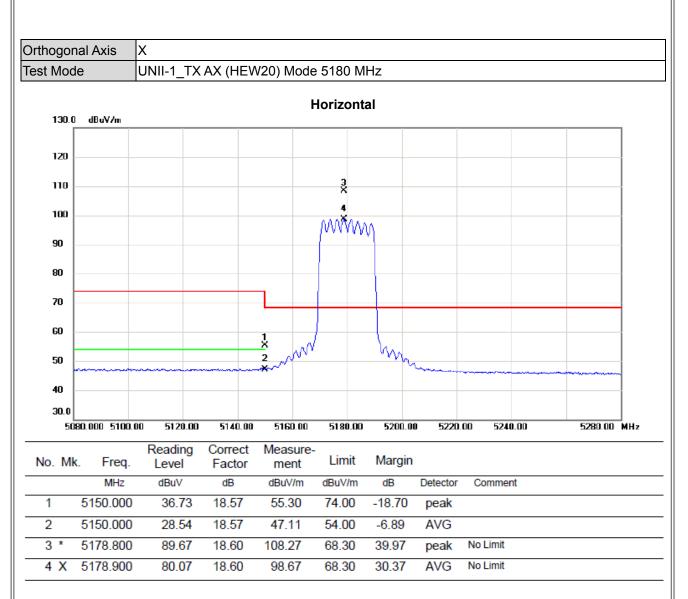


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



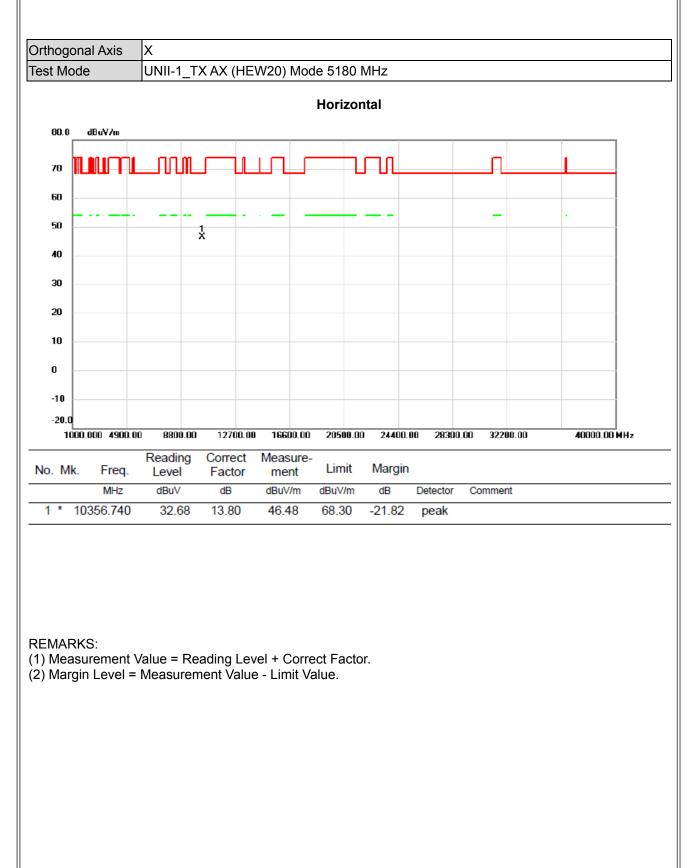




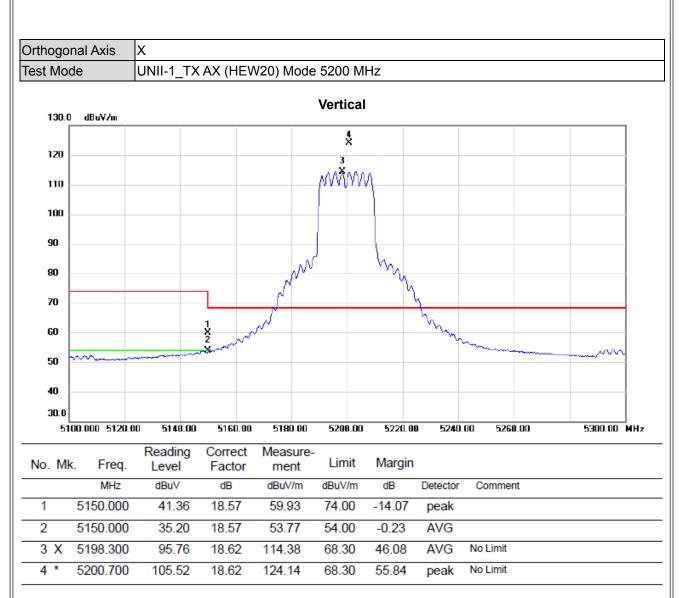


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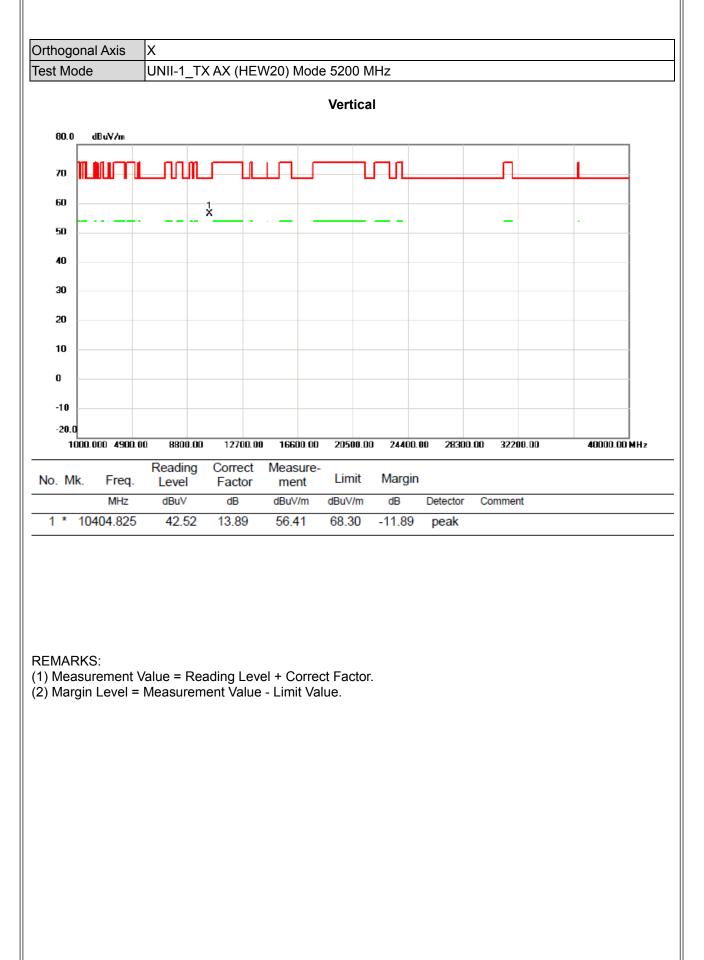




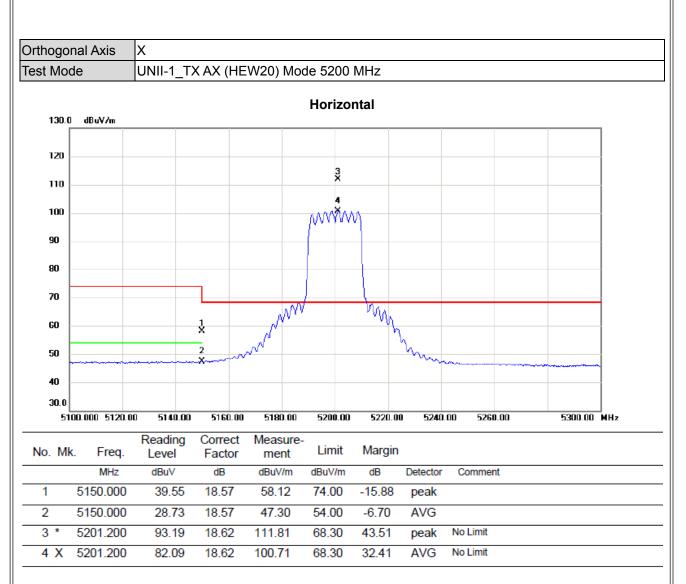


- (1) Measurement Value = Reading Level + Correct Factor.
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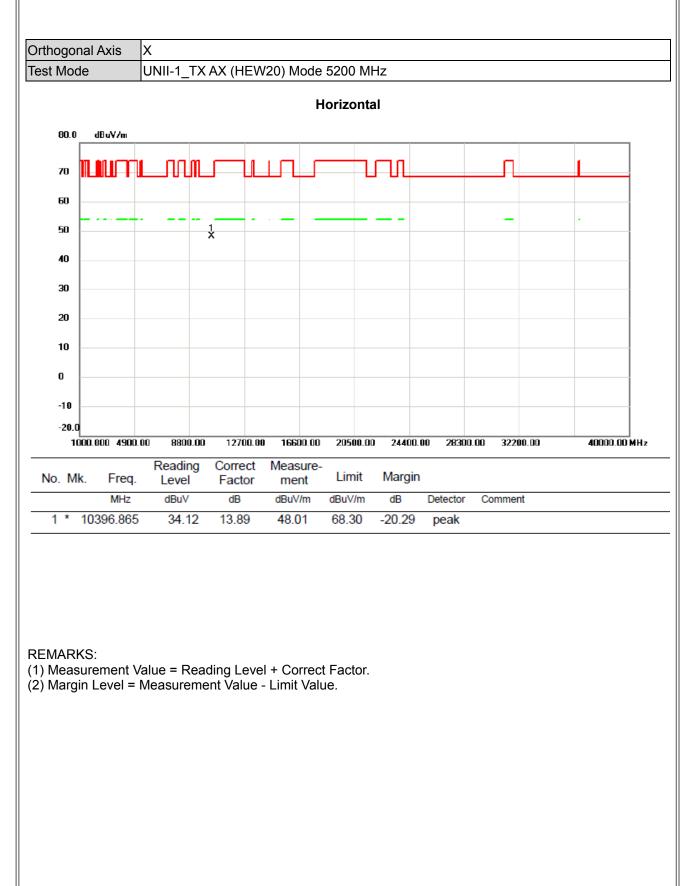




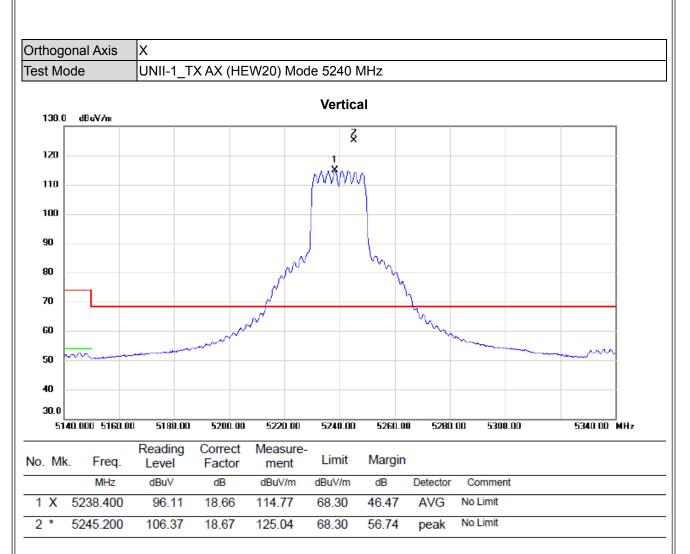


- (1) Measurement Value = Reading Level + Correct Factor.
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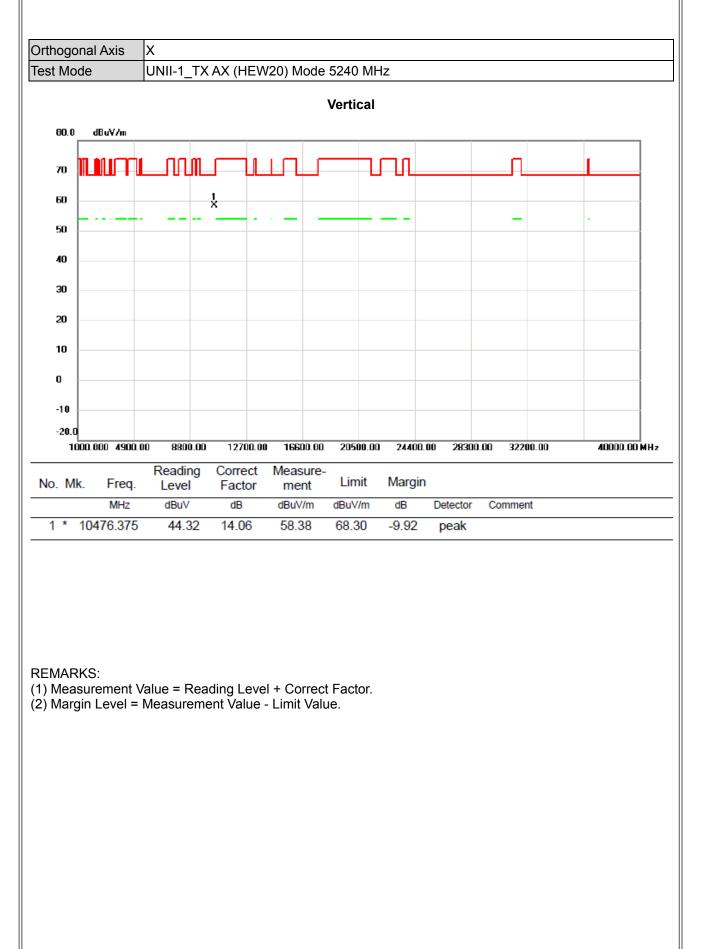




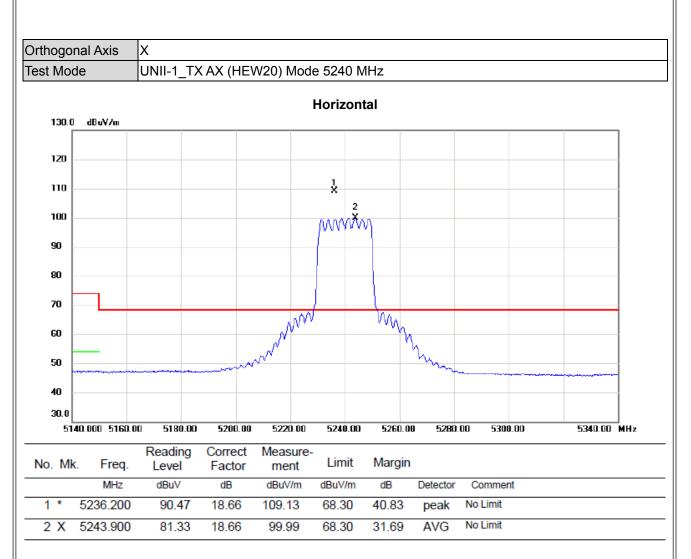
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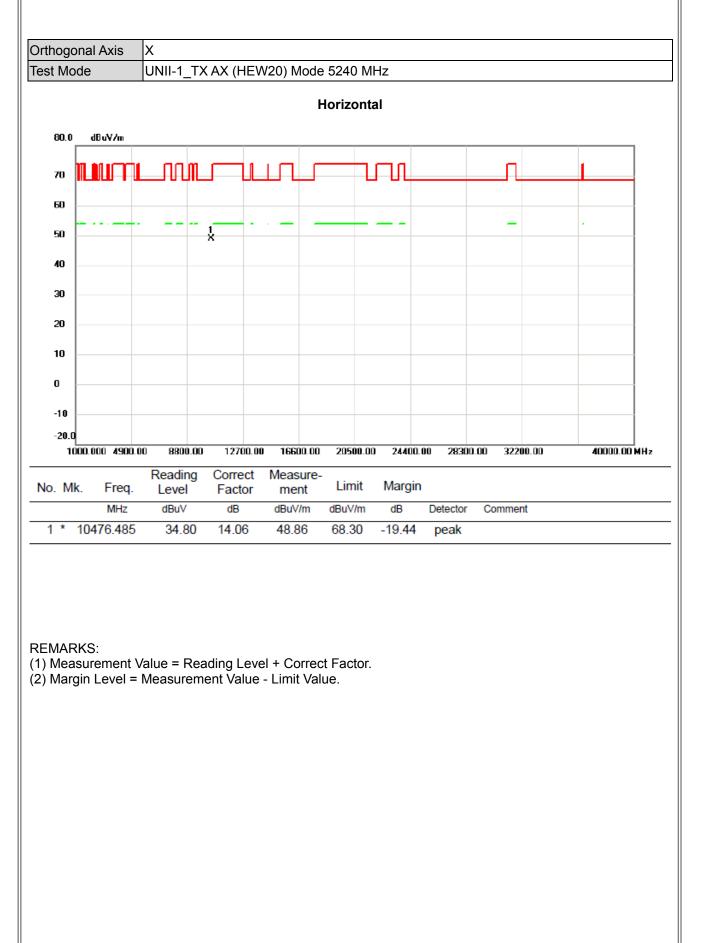




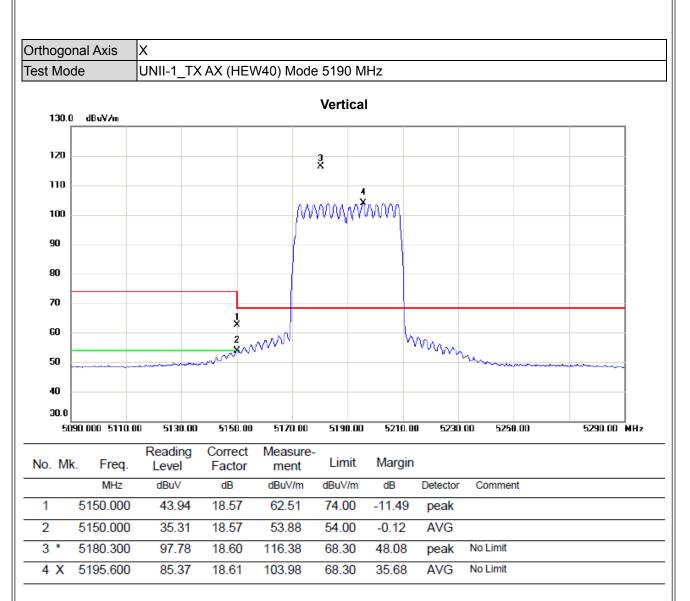


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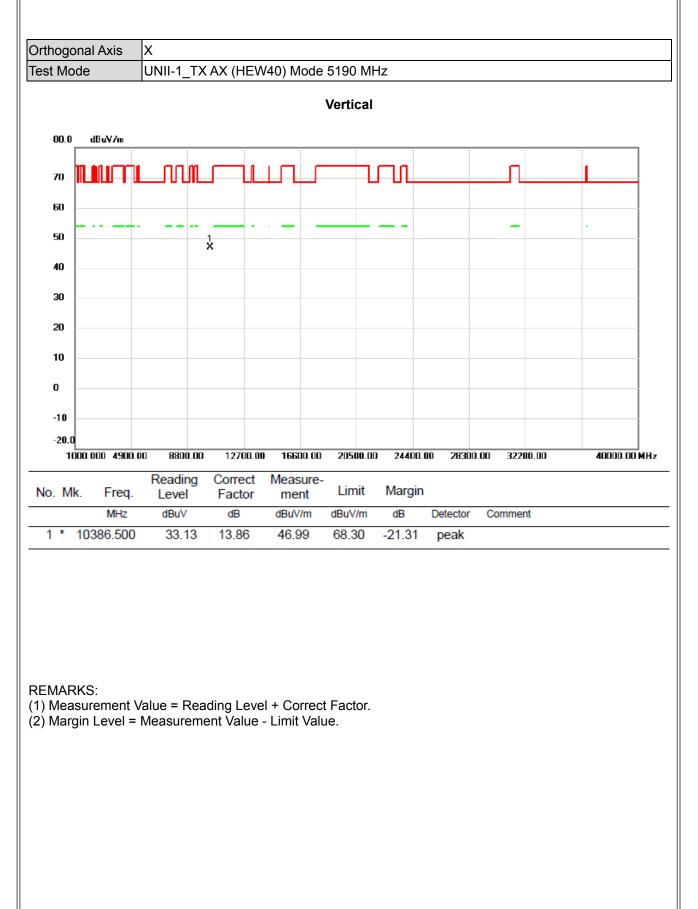




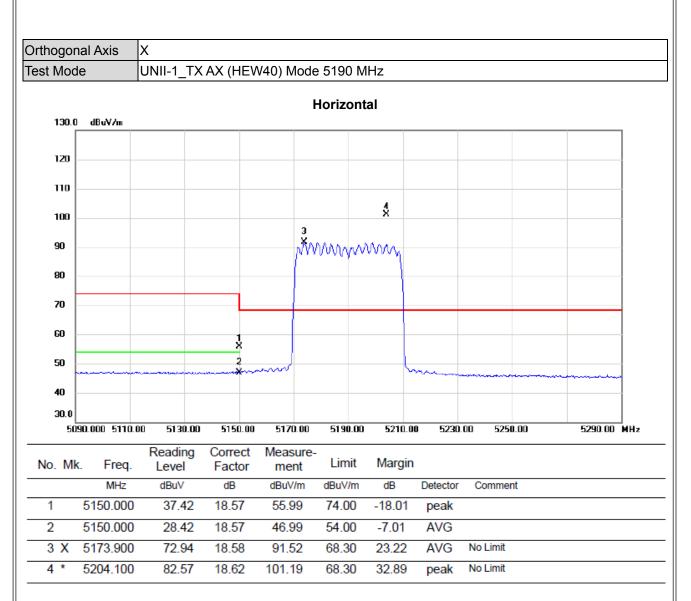


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



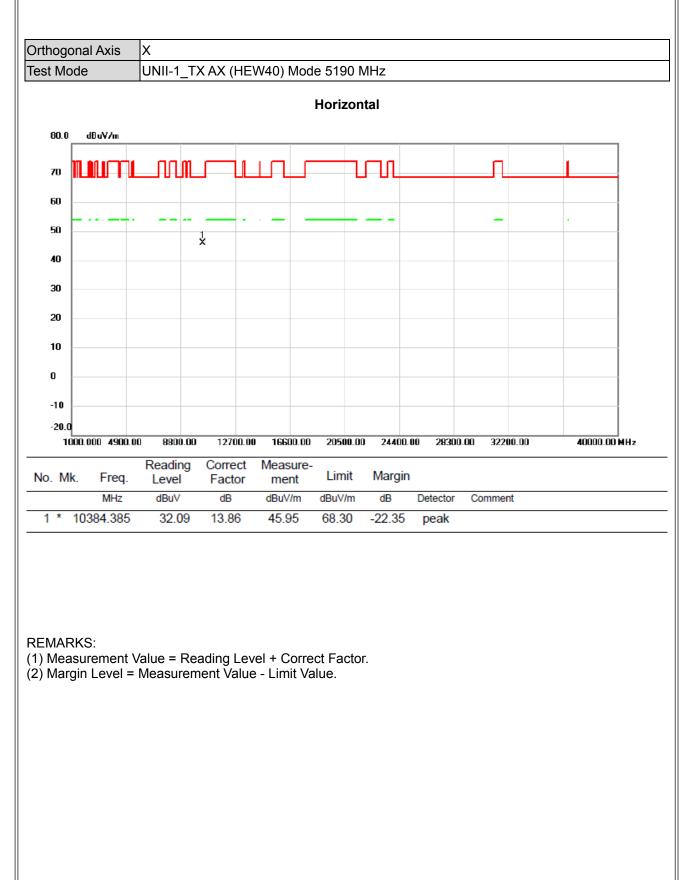




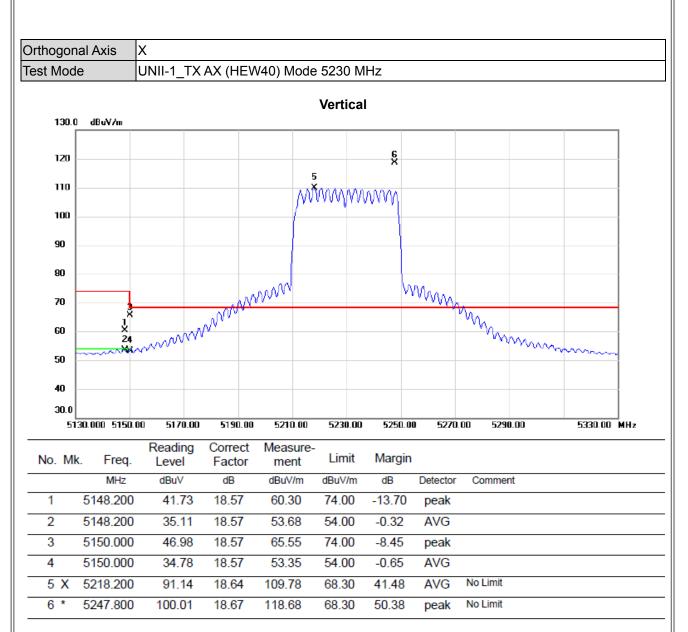


- (1) Measurement Value = Reading Level + Correct Factor.
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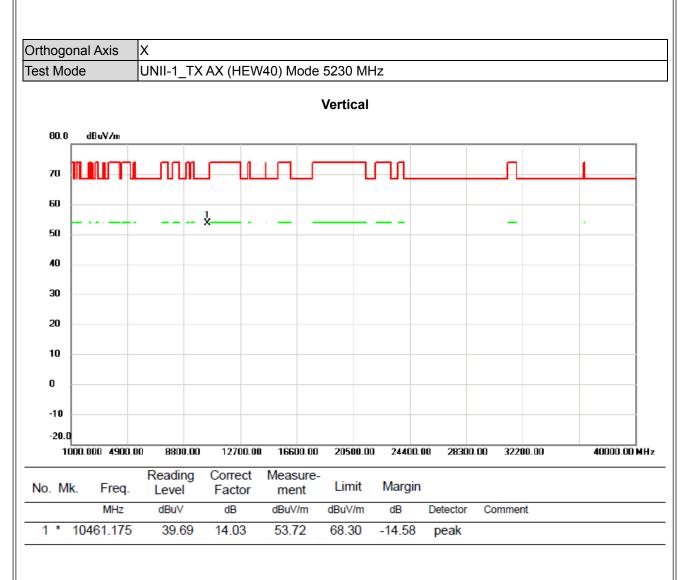






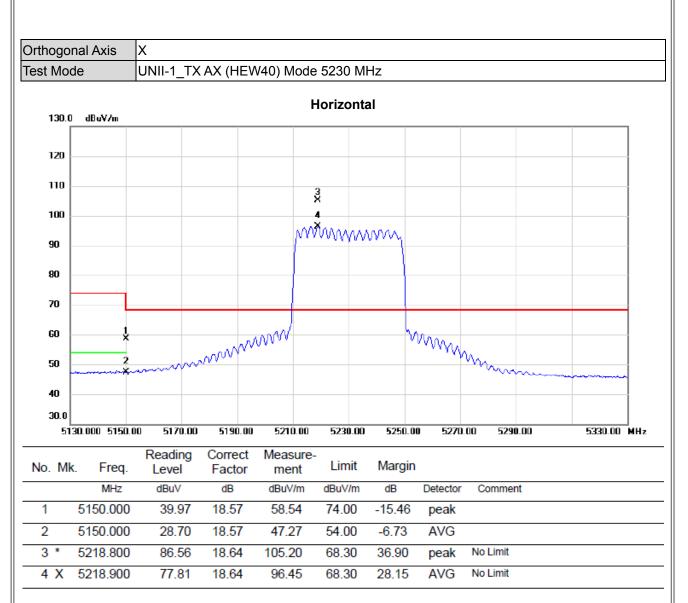
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- (2) Margin Level = Measurement Value Limit Value.





- (1) Measurement Value = Reading Level + Correct Factor.
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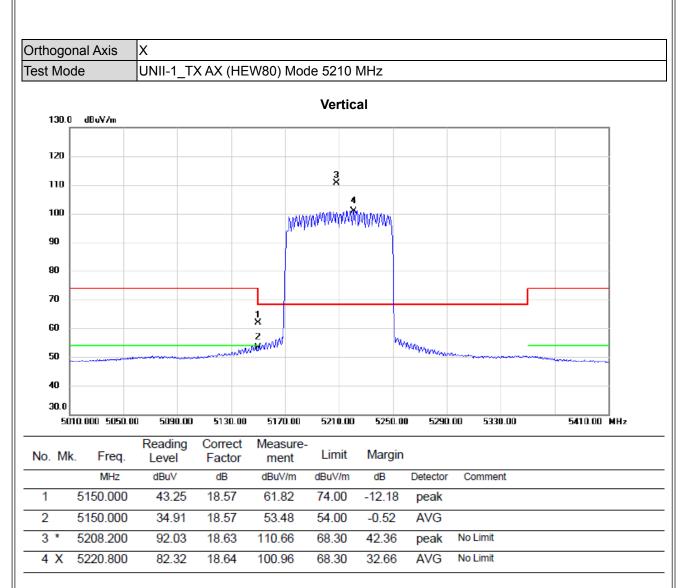


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.









- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.

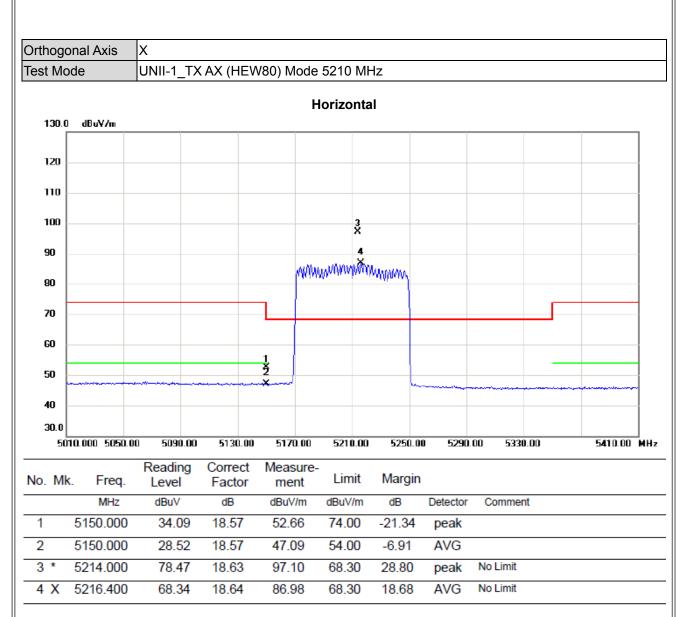




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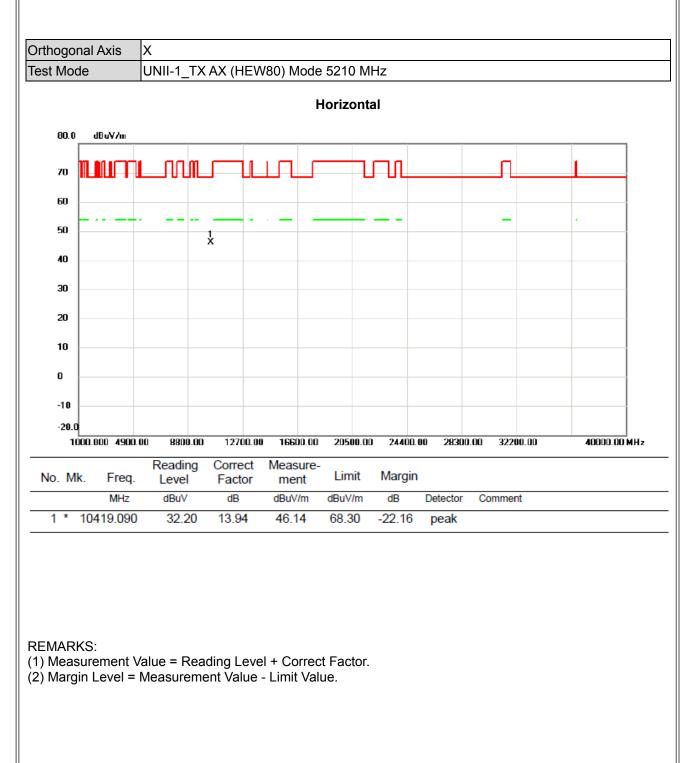
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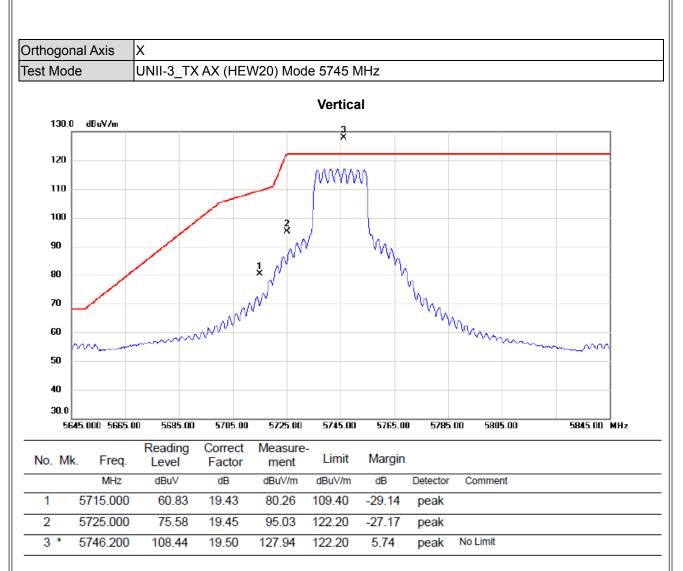


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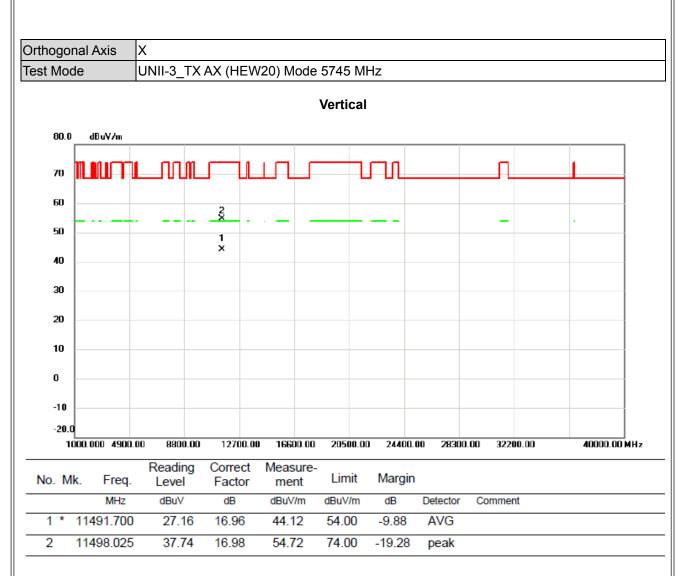






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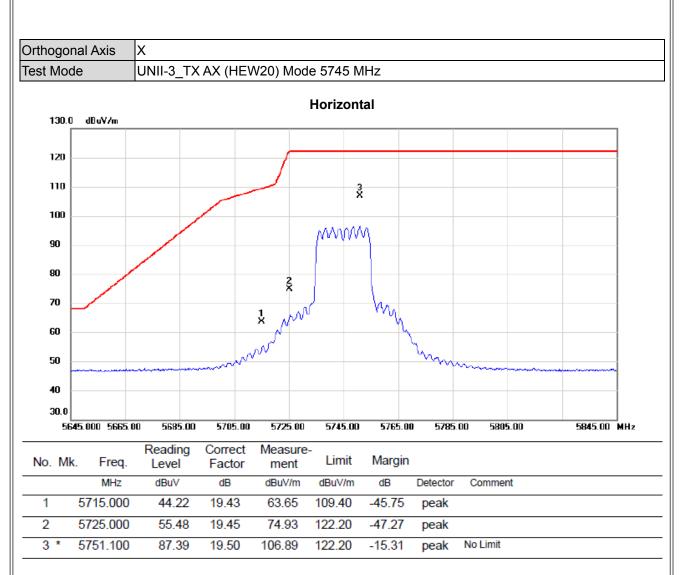




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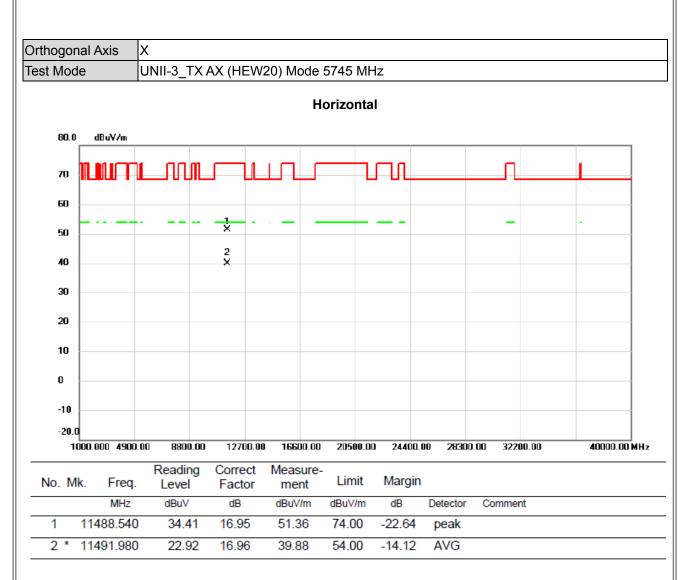
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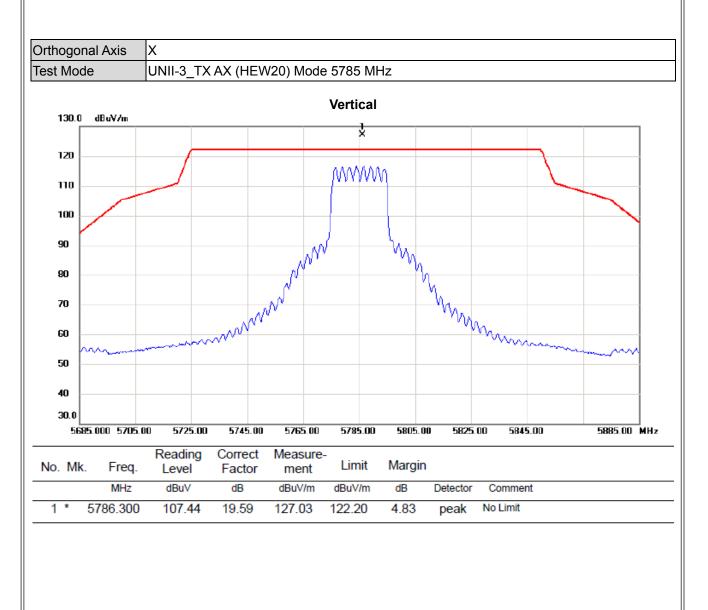
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(1) Measurement Value = Reading Level + Correct Factor.





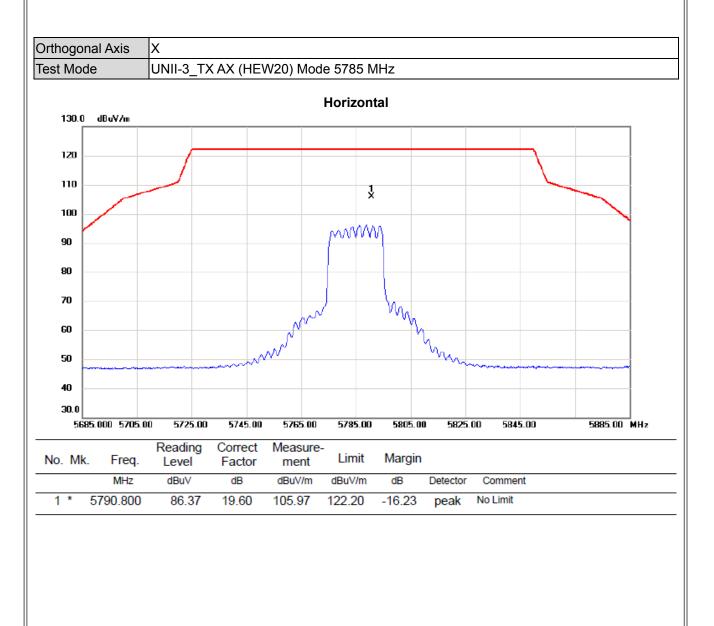
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- (1) Measurement Value = Reading Level + Correct Factor.
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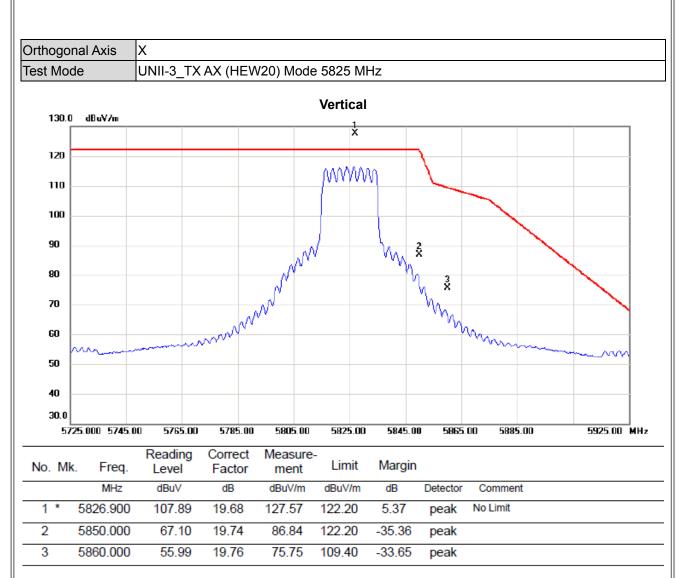
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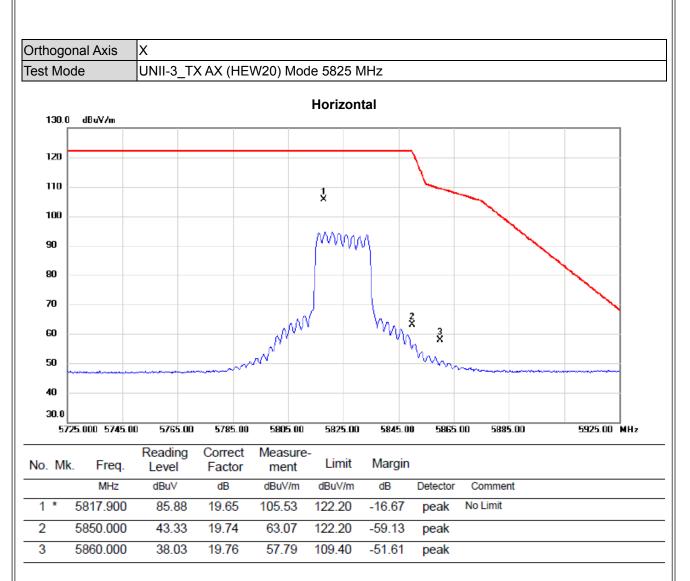
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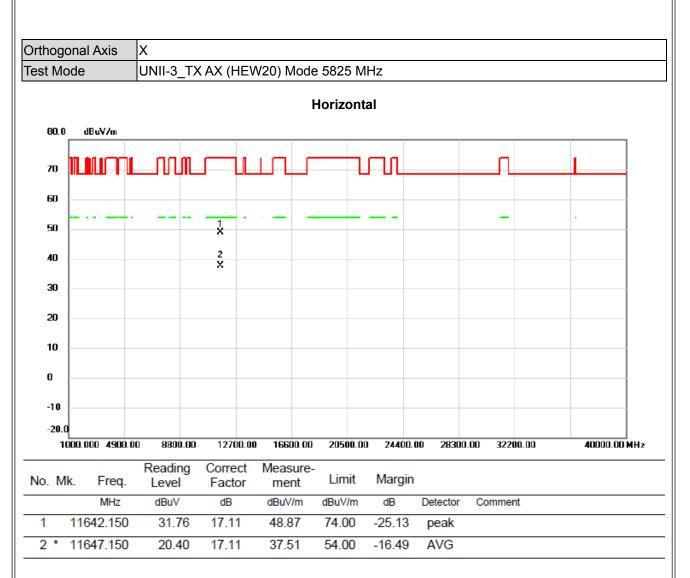
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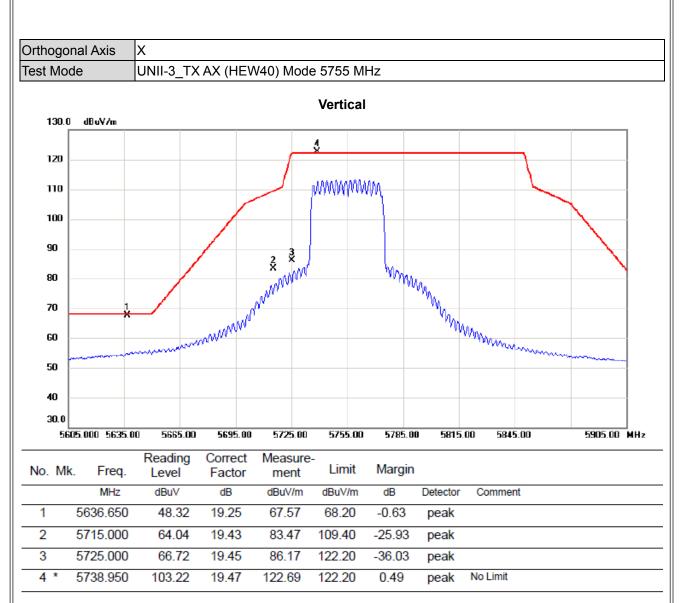
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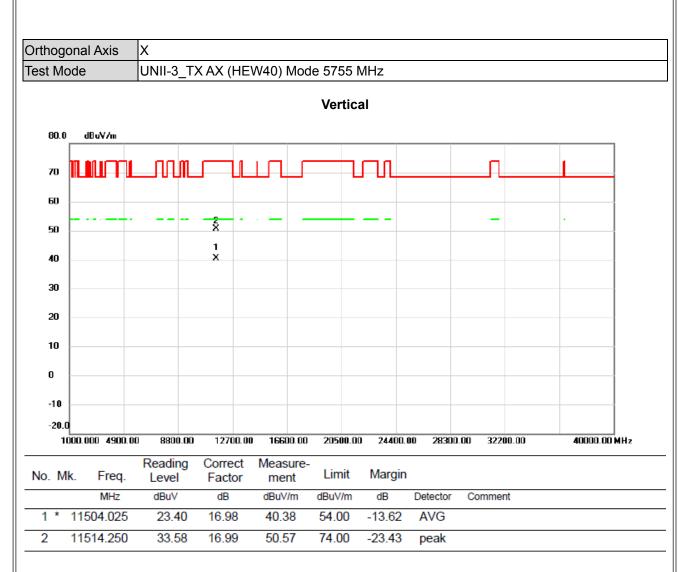
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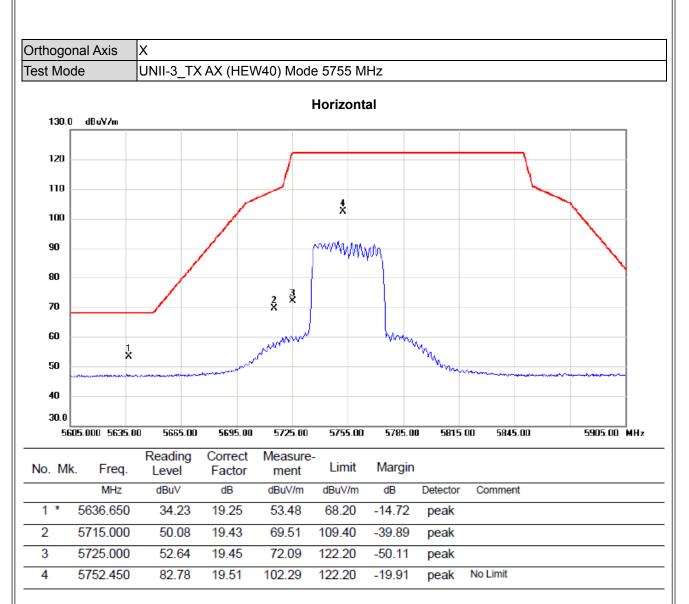
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- (1) Measurement Value = Reading Level + Correct Factor.
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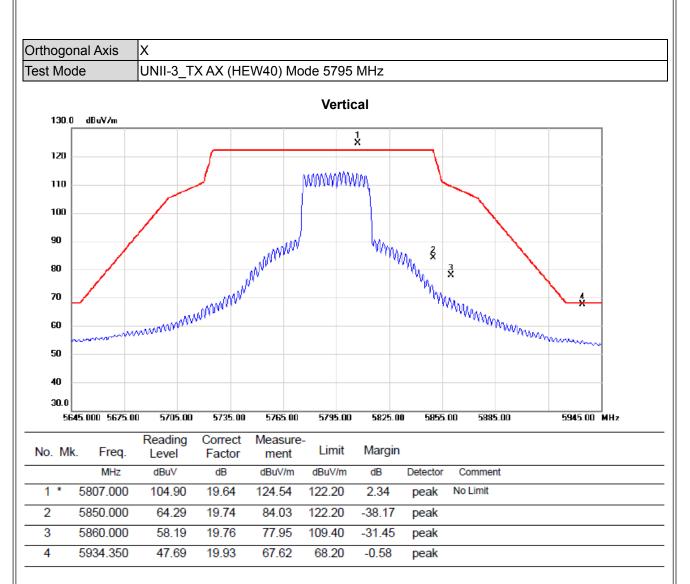
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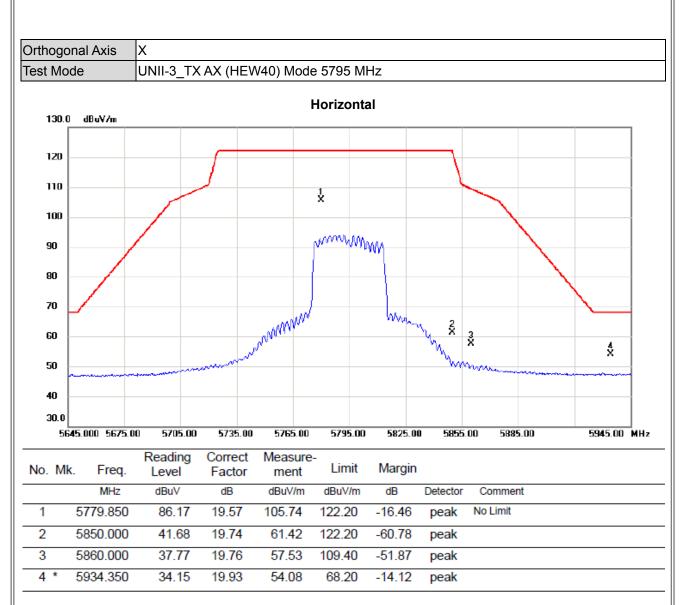
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- (1) Measurement Value = Reading Level + Correct Factor.
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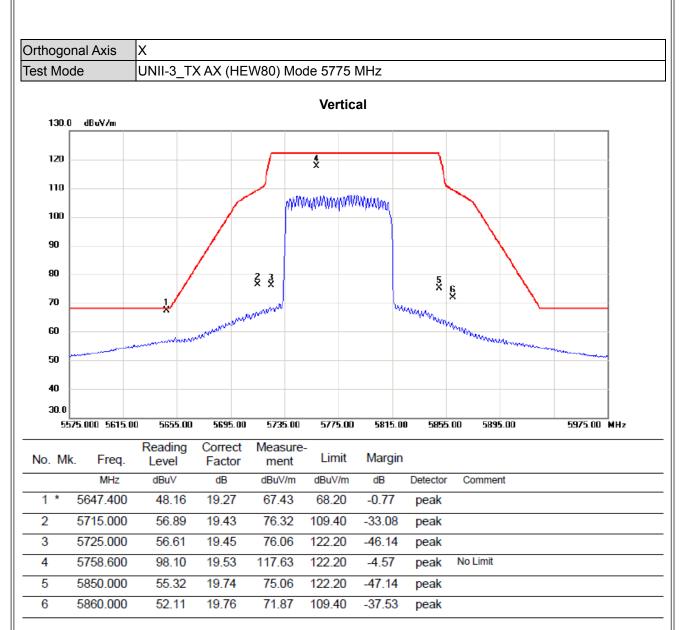
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(1) Measurement Value = Reading Level + Correct Factor.





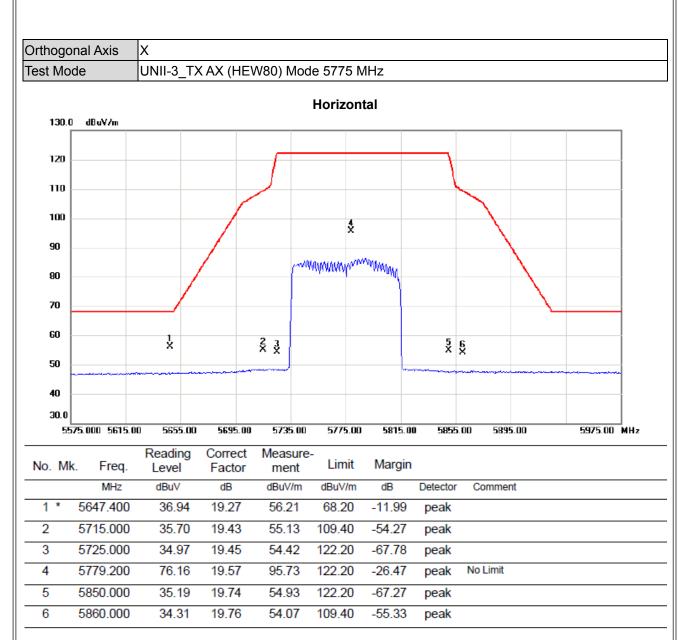
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(1) Measurement Value = Reading Level + Correct Factor.





- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.

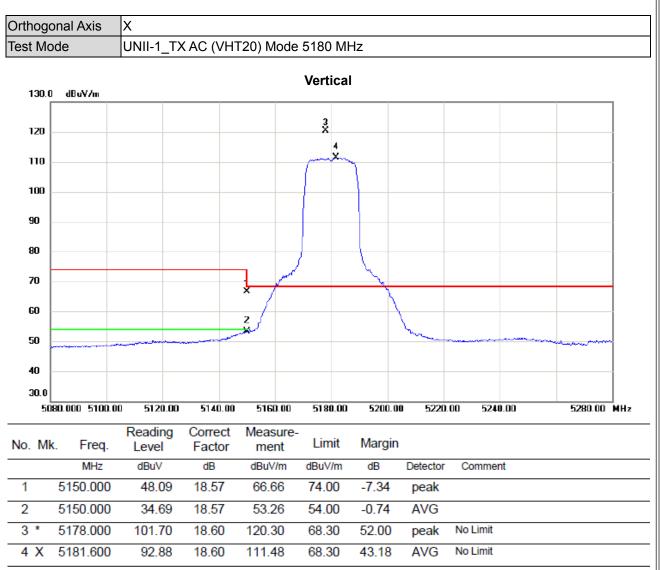




(1) Measurement Value = Reading Level + Correct Factor.



Beamforming



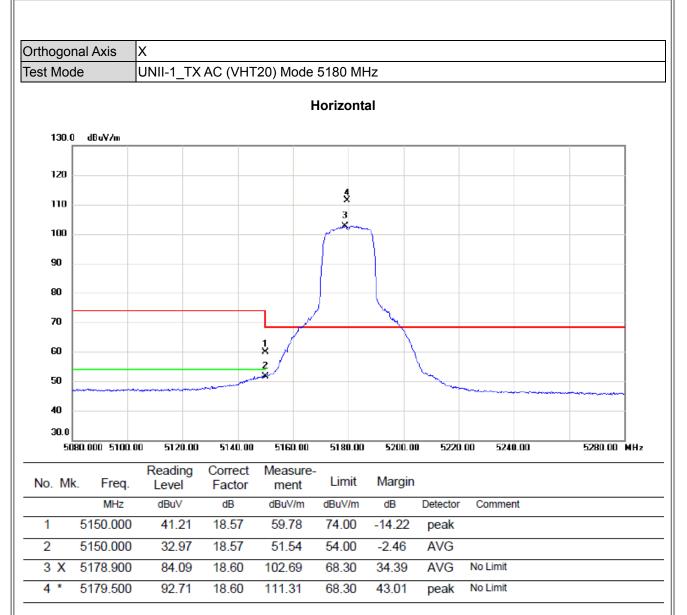
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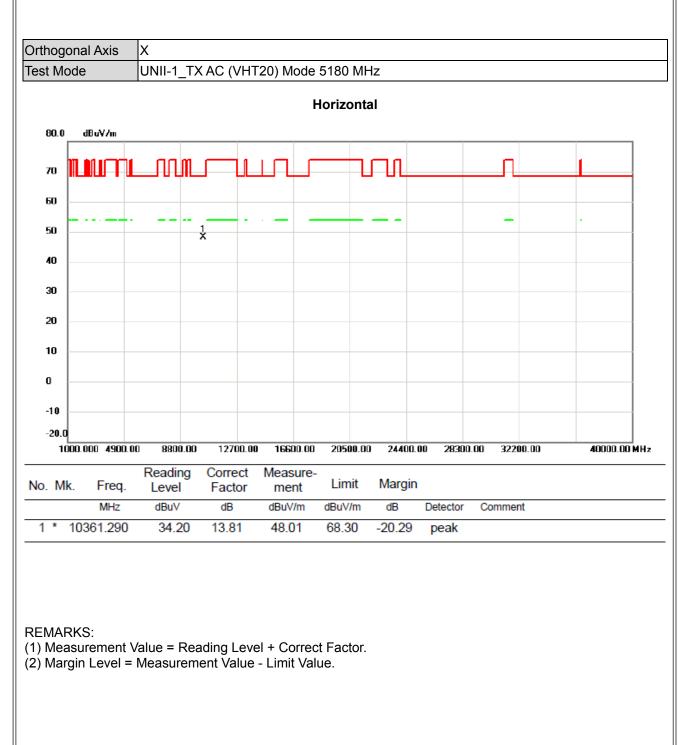
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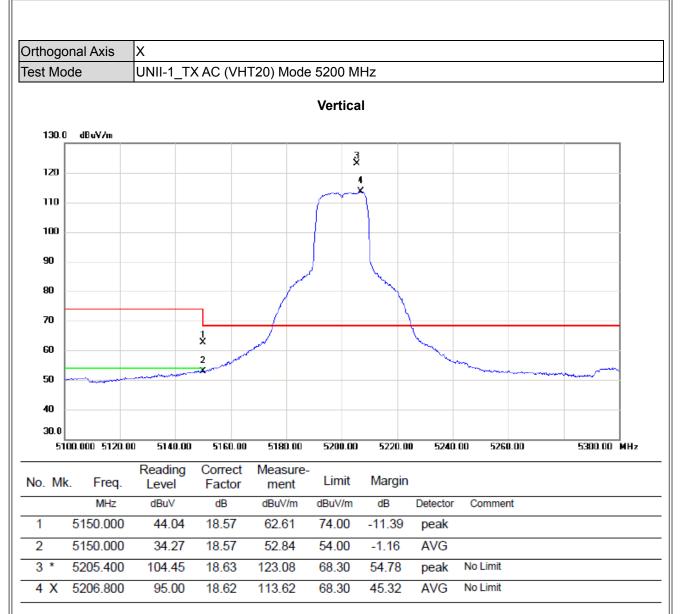


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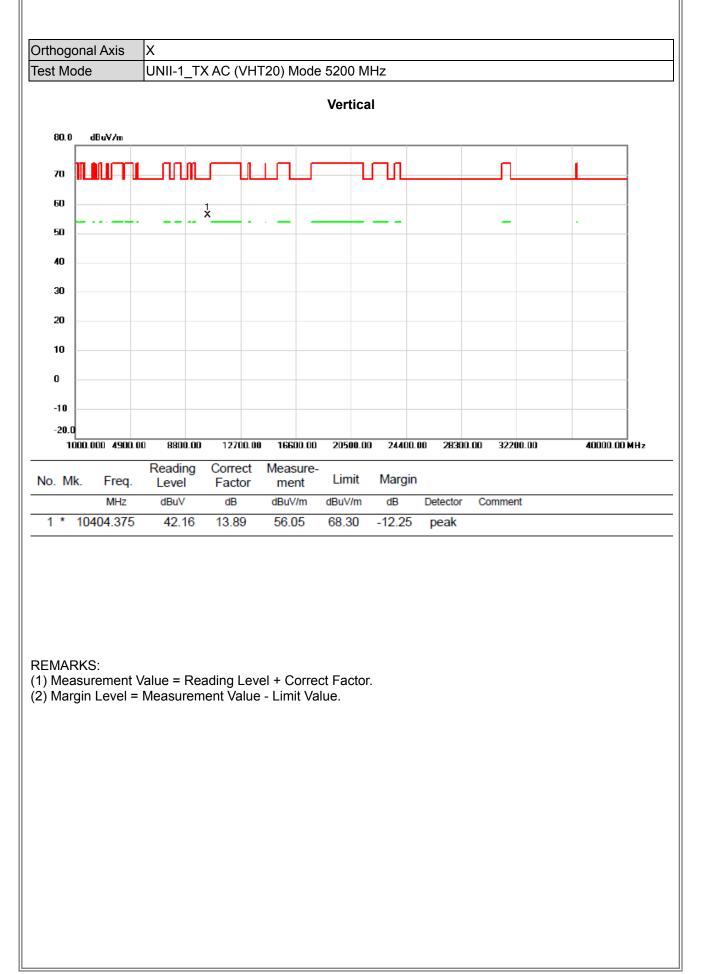




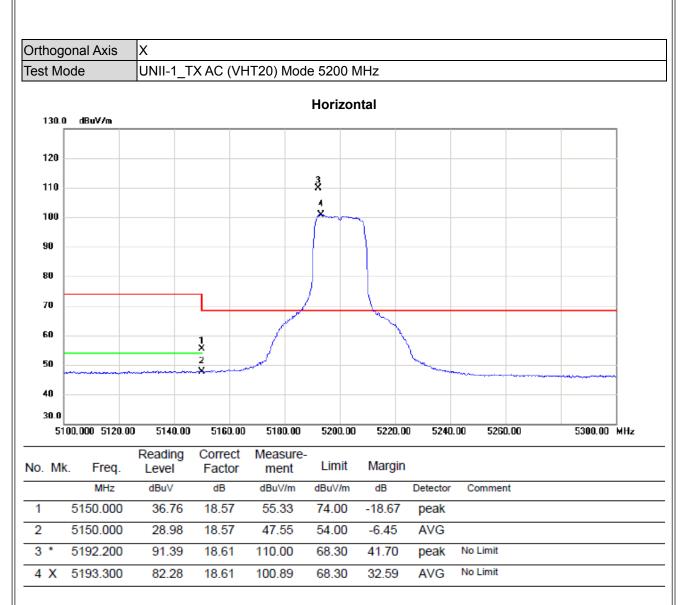


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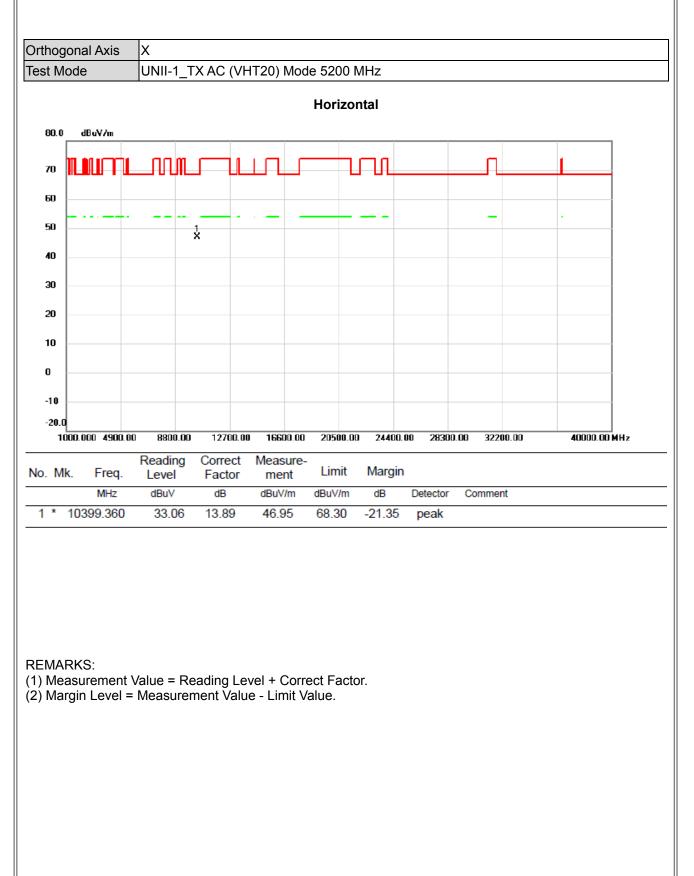




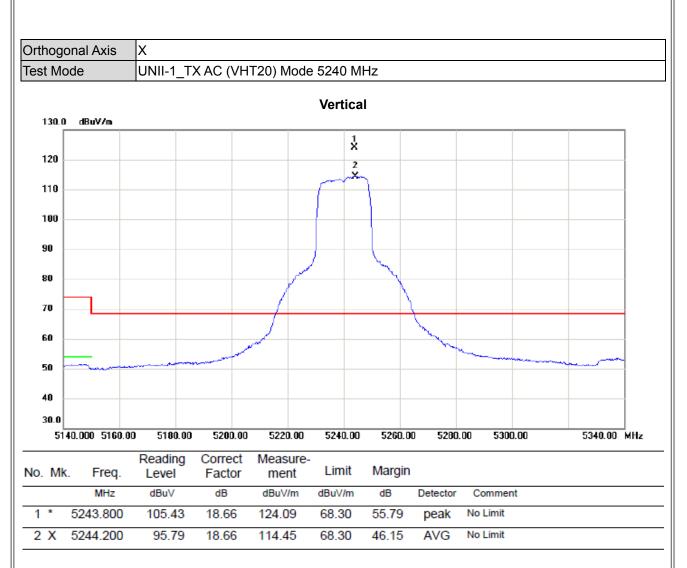


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- (2) Margin Level = Measurement Value Limit Value.



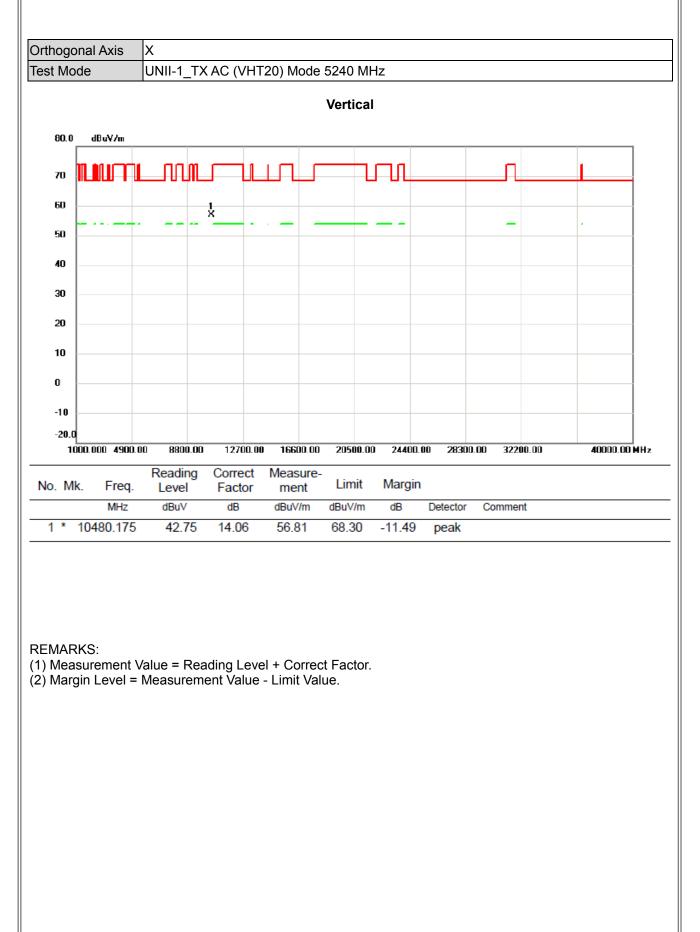




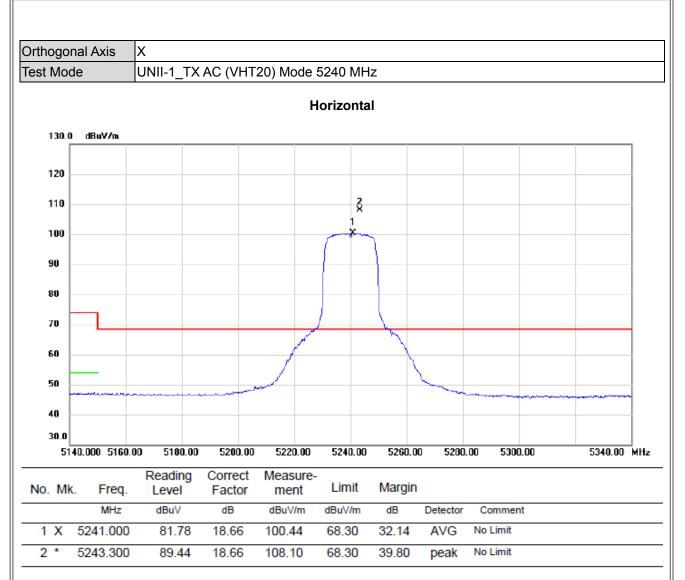


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



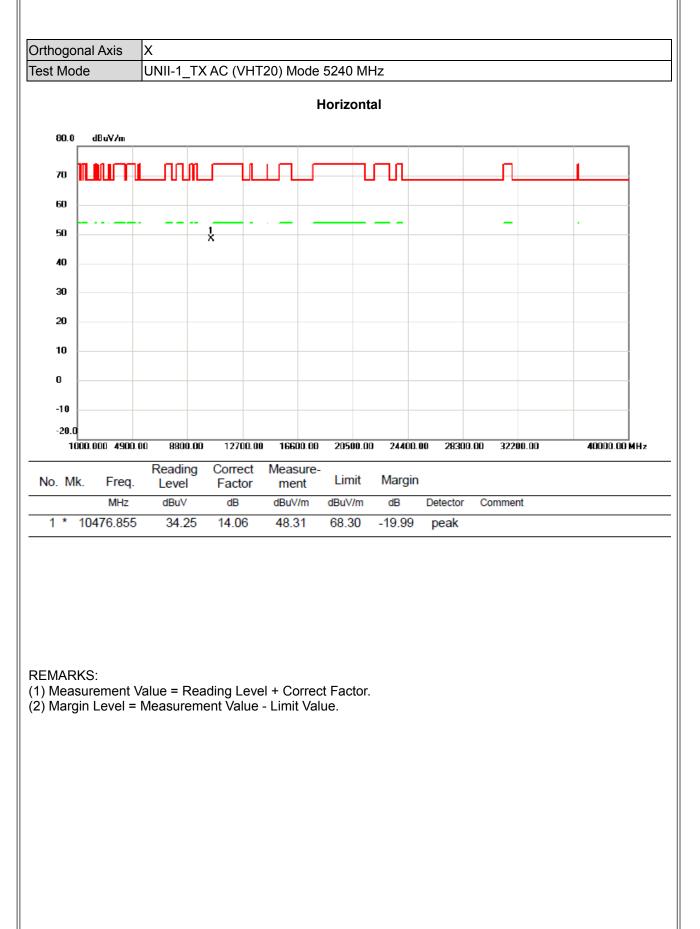




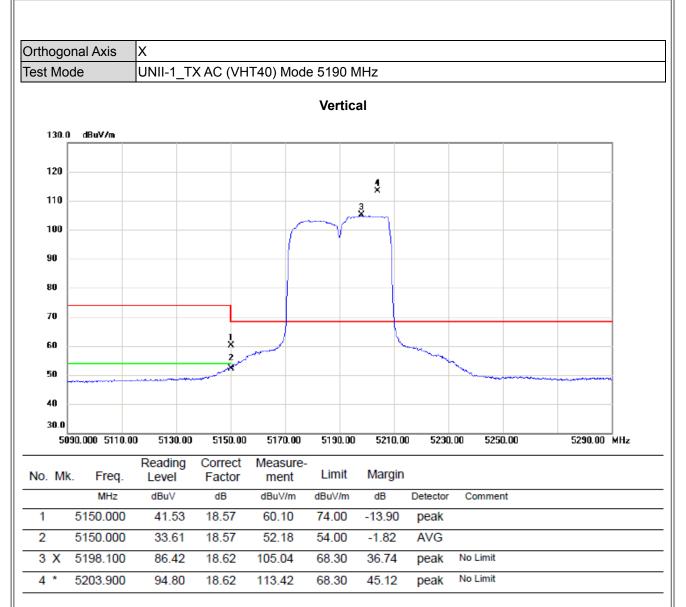


- (1) Measurement Value = Reading Level + Correct Factor.(2) Margin Level = Measurement Value Limit Value.









- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



