

FCC Radio Test Report

FCC ID: TE7M4RV2

This report concerns: Original Grant

Project No.	: 1907C001
Equipment	: AC1200 Whole Home Mesh Wi-Fi System
Brand Name	: tp-link
Test Model	Deco M4R
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	: Jul. 01, 2019
Date of Test	: Jul. 01, 2019 ~ Sep. 26, 2019
Issued Date	: Sep. 27, 2019
Report Version	: R01
Test Sample	: Engineering Sample No.: DG19070151 for conducted, DG19070152 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.

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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.	Sep. 19, 2019
R01	Updated the data of Spectrum Bandwidth.	Sep. 27, 2019

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC Part15, Subpart E(15.407)						
Standard(s) Section	Test Item	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.
- (3) For UNII-1 this device was functioned as a
 - \boxtimes Access point device \square Client device
- (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
	CISPR	30MHz ~ 200MHz	V	4.88
		30MHz ~ 200MHz	Н	4.14
DG-CB03		200MHz ~ 1,000MHz	V	4.62
DG-CB03		200MHz ~ 1,000MHz	Н	4.80
		1GHz ~ 6GHz	-	4.58
		6GHz ~ 18GHz	-	5.18
		18GHz ~ 26.5 GHz	-	3.80
		26.5GHz ~ 40 GHz	-	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	ROBIN Zhuang
Radiated Emissions-9K-30MHz	25°C	60%	AC 120V/60Hz	ROBIN Zhuang
Radiated Emissions-30 MHz to 1GHz	25°C	60%	AC 120V/60Hz	Sheldon Ou
Radiated Emissions-Above 1000 MHz	25°C	60%	AC 120V/60Hz	Sheldon Ou
Spectrum Bandwidth	24°C	62%	AC 120V/60Hz	Jonas Chen
Maximum Output Power	24°C	62%	AC 120V/60Hz	Jonas Chen
Power Spectral Density	24°C	62%	AC 120V/60Hz	Jonas Chen
Frequency Stability	24°C	62%	AC 120V/60Hz	Jonas Chen



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	AC1200 Whole Home Mesh Wi-Fi System
Brand Name	tp-link
Test Model	Deco M4R
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	UNII-1: 5150 MHz~5250 MHz UNII-3: 5725 MHz~5850 MHz
Modulation Type	OFDM
Bit Rate of Transmitter	Up to 866.7 Mbps
Maximum Output Power for UNII-1 Non Beamforming	IEEE 802.11a: 26.82 dBm (0.4808 W) IEEE 802.11n (HT20): 26.59 dBm (0.4560 W) IEEE 802.11n (HT40): 27.47 dBm (0.5585 W) IEEE 802.11ac (VHT20): 26.63 dBm (0.4603 W) IEEE 802.11ac (VHT40): 27.51 dBm (0.5636 W) IEEE 802.11ac (VHT80): 18.99 dBm (0.0793 W)
Maximum Output Power for UNII-3 Non Beamforming	IEEE 802.11a: 28.22 dBm (0.6637 W) IEEE 802.11n (HT20): 28.11 dBm (0.6471 W) IEEE 802.11n (HT40): 27.86 dBm (0.6109 W) IEEE 802.11ac (VHT20): 28.08 dBm (0.6427 W) IEEE 802.11ac (VHT40): 27.84 dBm (0.6081 W) IEEE 802.11ac (VHT80): 24.81 dBm (0.3027 W)
Maximum Output Power for UNII-1 With Beamforming	IEEE 802.11n (HT20): 26.59 dBm (0.4560 W) IEEE 802.11n (HT40): 27.47 dBm (0.5585 W) IEEE 802.11ac (VHT20): 26.63 dBm (0.4603 W) IEEE 802.11ac (VHT40): 27.51 dBm (0.5636 W) IEEE 802.11ac (VHT80): 20.63 dBm (0.1156 W)
Maximum Output Power for UNII-3 With Beamforming	IEEE 802.11n (HT20): 28.06 dBm (0.6397 W) IEEE 802.11n (HT40): 27.81 dBm (0.6039 W) IEEE 802.11ac (VHT20): 28.10 dBm (0.6457 W) IEEE 802.11ac (VHT40): 27.84 dBm (0.6081 W) IEEE 802.11ac (VHT80): 26.96 dBm (0.4966 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 802.11a IEEE 802.11n (HT20) IEEE 802.11ac (VHT20)		IEEE 802. ⁻ IEEE 802.11	11n (HT40) Iac (VHT40)	IEEE 802.11	ac (VHT80)
UNI	I-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 802.11a IEEE 802.11n (HT20) IEEE 802.11ac (VHT20)		IEEE 802.11n (HT40) IEEE 802.11ac (VHT40)		IEEE 802.11	ac (VHT80)
UNI	I-3	UNII-3		UN	II-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	Model Name	Antenna Type	Connector	Gain (dBi)	Note
1	TP-LINK °	N/A	Monopole	N/A	0.92	UNII-1
2	TP-LINK °	N/A	Monopole	N/A	0.85	UNII-1
1	TP-LINK	N/A	Monopole	N/A	0.96	UNII-3
2	TP-LINK °	N/A	Monopole	N/A	0.96	UNII-3

Note:

This EUT supports CDD, and antenna gains are not equal for UNII-1, all antennas have the same gain for UNII-3, so

(1) For Non Beamforming Function:

For UNII-1:

Directional gain =10log[$(10^{G1/20}+10^{G2/20}+...10^{GN/20})^2/N$]dBi, that is Directional gain= 10log[$(10^{0.92/20}+10^{0.85/20})^2/2$]dBi =3.90.

For UNII-3:

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

So Directional gain = G_{ANT} + Array Gain =10 log (N_{ANT} / N_{SS}) dB =0.96+10log(2/1)dBi=3.97. b) Power measurements, Array Gain = 0 dB ($N_{ANT} \le 4$), so the Directional gain=0.96.

(2) For With Beamforming Function:

Beamforming Gain: 3 dB. So UNII-1Directional gain = 0.92+3=3.92, UNII-3 Directional gain = 0.96+3=3.96.



4. Table for Antenna Configuration:

For Non Beamforming:	
Operating Mode	2TX
TX Mode	21A
IEEE 802.11a	V (Ant. 1 + Ant. 2)
IEEE 802.11n (HT20)	V (Ant. 1 + Ant. 2)
IEEE 802.11n (HT40)	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)

For With Beamforming:

Operating Mode TX Mode	2TX
IEEE 802.11n (HT20)	V (Ant. 1 + Ant. 2)
IEEE 802.11n (HT40)	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)



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 N (HT20) Mode / CH36, CH40, CH48 (UNII-1)
Mode 3	TX N (HT40) Mode / CH38, CH46 (UNII-1)
Mode 4	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)
Mode 5	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)
Mode 7	TX A Mode / CH149,CH157,CH165 (UNII-3)
Mode 8	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)
Mode 9	TX N (HT40) Mode / CH151,CH159 (UNII-3)
Mode 10	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)
Mode 11	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)
Mode 13	TX A Mode / CH157 (UNII-3)

Following mode(s) as (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 13	TX A Mode / CH157 (UNII-3)	

	Radiated emissions test - Below 1G
Final Test Mode	Description
Mode 13	TX A Mode / CH157 (UNII-3)

Radiated emissions test - Above 1G for Non Beamforming		
Final Test Mode	Description	
Mode 1	TX A Mode / CH36, CH40, CH48 (UNII-1)	
Mode 2	TX N (HT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 3	TX N (HT40) Mode / CH38, CH46 (UNII-1)	
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)	
Mode 7	TX A Mode / CH149,CH157,CH165 (UNII-3)	
Mode 8	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 9	TX N (HT40) Mode / CH151,CH159 (UNII-3)	
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)	



Radiated emissions test - Above 1G for With Beamforming		
Final Test Mode	Description	
Mode 4	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 5	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)	
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)	
Mode 10	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 11	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)	
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)	

Output Power test for Non Beamforming		
Final Test Mode	Description	
Mode 1	TX A Mode / CH36, CH40, CH48 (UNII-1)	
Mode 2	TX N (HT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 3	TX N (HT40) Mode / CH38, CH46 (UNII-1)	
Mode 4	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 5	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)	
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)	
Mode 7	TX A Mode / CH149,CH157,CH165 (UNII-3)	
Mode 8	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 9	TX N (HT40) Mode / CH151,CH159 (UNII-3)	
Mode 10	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 11	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)	
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)	

Output Power test for With Beamforming		
Final Test Mode	Description	
Mode 2	TX N (HT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 3	TX N (HT40) Mode / CH38, CH46 (UNII-1)	
Mode 4	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 5	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)	
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)	
Mode 8	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 9	TX N (HT40) Mode / CH151,CH159 (UNII-3)	
Mode 10	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 11	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)	
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)	



Others Conducted test for Non Beamforming		
Final Test Mode	Description	
Mode 1	TX A Mode / CH36, CH40, CH48 (UNII-1)	
Mode 2	TX N (HT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 3	TX N (HT40) Mode / CH38, CH46 (UNII-1)	
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)	
Mode 7	TX A Mode / CH149,CH157,CH165 (UNII-3)	
Mode 8	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 9	TX N (HT40) Mode / CH151,CH159 (UNII-3)	
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)	

Others Conducted test for With Beamforming		
Final Test Mode	Description	
Mode 4	TX AC (VHT20) Mode / CH36, CH40, CH48 (UNII-1)	
Mode 5	TX AC (VHT40) Mode / CH38, CH46 (UNII-1)	
Mode 6	TX AC (VHT80) Mode / CH42 (UNII-1)	
Mode 10	TX AC (VHT20) Mode / CH149,CH157,CH165 (UNII-3)	
Mode 11	TX AC (VHT40) Mode / CH151,CH159 (UNII-3)	
Mode 12	TX AC (VHT80) Mode / CH155 (UNII-3)	

Note:

(1) For radiated emission below 1 GHz test, the IEEE 802.11a channel 157 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) For Non Beamforming Function, the measurements for Power were tested, the worst case were IEEE 802.11a mode, IEEE 802.11n (HT20) mode, IEEE 802.11n (HT40) mode and IEEE 802.11ac(VHT80) mode, only worst case were documented for other test items. For With Beamforming Function, the measurements for Power were tested, the worst case were IEEE 802.11ac (VHT20) mode, IEEE 802.11ac (VHT40) mode and IEEE 802.11ac (VHT20) mode, IEEE 802.11ac (VHT40) mode and IEEE 802.11ac (VHT80) mode, only worst case were documented for other test items.

2.3 PARAMETERS OF TEST SOFTWARE

Non Beamforming			
	UNII-1		
Test Software		QRCT v3.0.187.0	
Test Frequency (MHz)	5180	5200	5240
IEEE 802.11a	22.5	24	24
IEEE 802.11n (HT20)	24	24	24
IEEE 802.11ac (VHT20)	24	24	24
Test Frequency (MHz)	5190	5230	
IEEE 802.11n (HT40)	19.5	24	
IEEE 802.11ac (VHT40)	19.5	24	
Test Frequency (MHz)	5210		
IEEE 802.11ac (VHT80)	16		
	UNII-	3	
Test Software		QRCT v3.0.187.0	
Test Frequency (MHz)	5745	5785	5825
IEEE 802.11a	25.5	25.5	25.5
IEEE 802.11n (HT20)	25.5	25.5	25.5
IEEE 802.11ac (VHT20)	25.5	25.5	25.5
Test Frequency (MHz)	5755	5795	
IEEE 802.11n (HT40)	24.5	24.5	
IEEE 802.11ac (VHT40)	24.5	24.5	
Test Frequency (MHz)	5775		
IEEE 802.11ac (VHT80)	22		



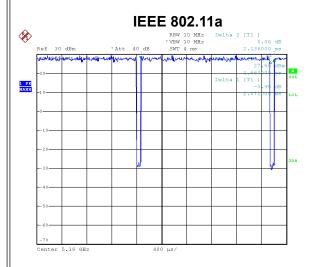
With Beamforming			
UNII-1			
Test Software		QRCT v3.0.187.0	
Test Frequency (MHz)	5180	5200	5240
IEEE 802.11n (HT20)	24	24	24
IEEE 802.11ac (VHT20)	24	24	24
Test Frequency (MHz)	5190	5230	
IEEE 802.11n (HT40)	17.5	24	
IEEE 802.11ac (VHT40)	17.5	24	
Test Frequency (MHz)	5210		
IEEE 802.11ac (VHT80)	17.5		

UNII-3			
Test Software		QRCT v3.0.187.0	
Test Frequency (MHz)	5745	5785	5825
IEEE 802.11n (HT20)	25.5	25.5	25.5
IEEE 802.11ac (VHT20)	25.5	25.5	25.5
Test Frequency (MHz)	5755	5795	
IEEE 802.11n (HT40)	24.5	24.5	
IEEE 802.11ac (VHT40)	24.5	24.5	
Test Frequency (MHz)	5775		
IEEE 802.11ac (VHT80)	25		



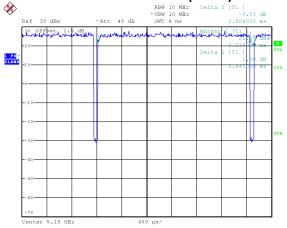
2.4 DUTY CYCLE

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.



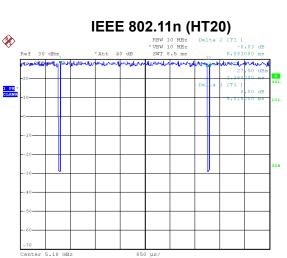
Date: 2.JUL.2019 18:39:55

Duty cycle = 2.072 ms / 2.136 ms = 97.00% Duty Factor = 10 * log(1 / Duty cycle) = 0.13 IEEE 802.11n (HT40)

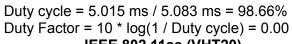


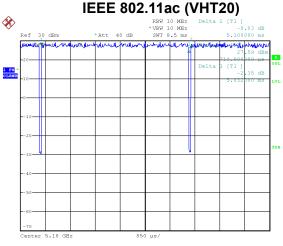
Date: 2.JUL.2019 18:42:31

Duty cycle = 2.440 ms / 2.504 ms = 97.44% Duty Factor = 10 * log(1 / Duty cycle) = 0.11



Date: 2.JUL.2019 18:40:31

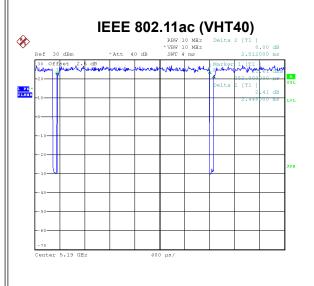


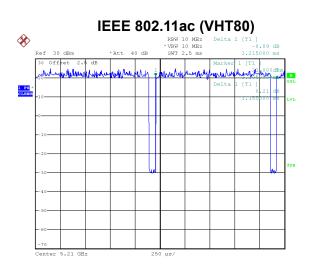


Date: 2.JUL.2019 18:41:39

Duty cycle = 5.032 ms / 5.100 ms = 98.67% Duty Factor = 10 * log(1 / Duty cycle) = 0.00

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Date: 2.JUL.2019 18:42:48

Duty cycle = 2.448 ms / 2.512 ms = 97.45% Duty Factor = 10 * log(1 / Duty cycle) = 0.11 Date: 2.JUL.2019 18:43:04

Duty cycle = 1.155 ms / 1.215 ms = 95.06% Duty Factor = 10 * log(1 / Duty cycle) = 0.22

NOTE:

For IEEE 802.11a, IEEE 802.11n (HT20) and IEEE 802.11ac (VHT20):

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 802.11n (HT40) and IEEE 802.11ac (VHT40):

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):

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%).



2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

2.6 SUPPORT UNITS

Item	Equipment	Brand	Model No.	Series No.
А	Notebook	Lenovo	G410	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

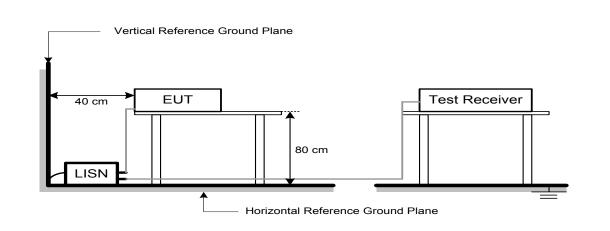
- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- 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	
5725-5850	-27 NOTE 0	68.3	
	10 NOTE 0	105.3	
	15.6 NOTE 0	110.9	
	27 NOTE 0	122.3	

NOTE:

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

 μ V/m, where P is the eirp (Watts)

(2)According to FCC 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 27 dBm/MHz at the band edge.



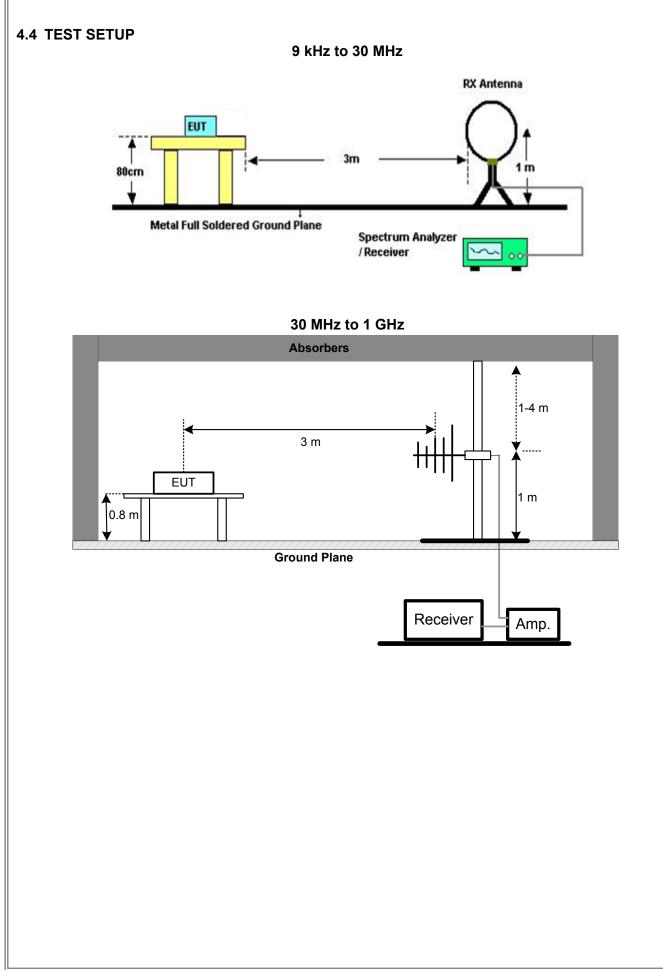
4.2 TEST PROCEDURE

- 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)
- h. 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.

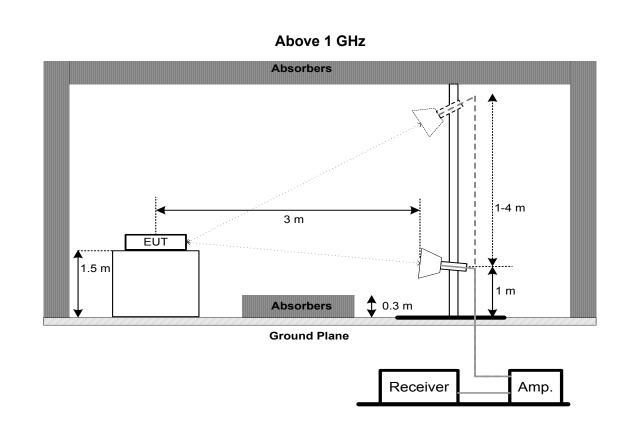
4.3 DEVIATION FROM TEST STANDARD

No deviation

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4.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.5 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. pectrum Setting:
 - For UNII-1:

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> 26 dB Bandwidth
RBW	300 kHz (Bandwidth 20 MHz)
	1 MHz (Bandwidth 40 MHz and 80 MHz)
VBW	1 MHz (Bandwidth 20 MHz)
	3 MHz (Bandwidth 40 MHz and 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 below carrier

5.3 TEST PROCEDURE

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 EUT TEST CONDITIONS

Temperature: 24°C Relative Humidity: 62% Test Voltage: AC 120V/60Hz

6.7 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 Range (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) 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



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 Test Item Limit Frequency (MH						
15.407(g)	Eroquopov Stability	Specified in the user'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
Span Frequency	bandwidth
RBW	10 kHz
VBW	10 kHz
Sweep Time	Auto

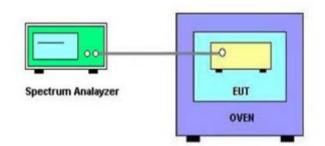
- c. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value.
- d. User manual temperature is 0°C~40°C.

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	Mar. 10, 2020		
2	LISN	EMCO	3816/2	52765	Mar. 10, 2020		
3	50ohm Teminator	SHX	TF5-3	15041305	Mar. 10, 2020		
4	Artificial-Mains Network	SCHWARZBEC K	NSLK 8127	8127685	Mar. 10, 2020		
5	TRANSIENT LIMITER	EM	EM-7600	772	Mar. 10, 2020		
6	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A		
7	Cable	N/A	RG223	12m	Mar. 12, 2020		
			issions - 9 kHz to	30 MHz			
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Loop Antenna	EM	EM-6876-1	230	Jan. 15, 2020		
2	Cable	N/A	RG 213/U	C-102	May 31, 2020		
3	EMI Test Receiver	R&S	ESCI	100895	Mar. 10, 2020		
4	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A		
			ssions - 30 MHz to		-		
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Antenna	Schwarzbeck	VULB9160	9160-3232	Mar. 09, 2020		
2	Amplifier	HP	8447D	2944A09673	Aug. 11, 2019		
3	Receiver	Agilent	N9038A	MY52130039	Aug. 11, 2019		
4	Cable	emci	LMR-400(30MHz- 1GHz)(8m+5m)	N/A	May 24, 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		
			<u> </u>				
			missions - Above '				
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until		
1	Double Ridged Guide Antenna	ETS	3115	75789	Mar. 09, 2020		
2	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Jun. 23, 2020		
3	Amplifier	Agilent	8449B	3008A02333	Mar. 10, 2020		
4	Microwave Preamplifier With Adaptor	EMC INSTRUMENT	EMC2654045	980039 & HA01	Mar. 10, 2020		
5	Receiver	Agilent	N9038A	MY52130039	Aug. 11, 2019		
6	Controller	CT	SC100	N/A	N/A		
7	Controller	MF	MF-7802	MF780208416	N/A		
8	Cable	mitron	B10-01-01-12M	18072744	Jun. 29, 2020		
	Measurement	Farad	EZ-EMC	N/A	N/A		



Bandwidth					
Ite	m Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	I Spectrum Analyzer	R&S	FSP40	100185	Aug. 11, 2019

Maximum Output Power						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until	
1	Peak Power Analyzer	Keysight	8990B	MY51000506	Nov. 26, 2019	
2	Wideband power	Keysight	N1923A	MY58310004	Nov. 26, 2019	

Power Spectral Density					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 11, 2019

	Frequency Stability					
Ite	em	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
	1	Spectrum Analyzer	R&S	FSP40	100185	Aug. 11, 2019
	2	Precision Oven Tester	Bell	BTH-50C	20170306001	Mar. 10, 2020

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

All calibration period of equipment list is one year.



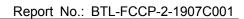


10. EUT TEST PHOTOS

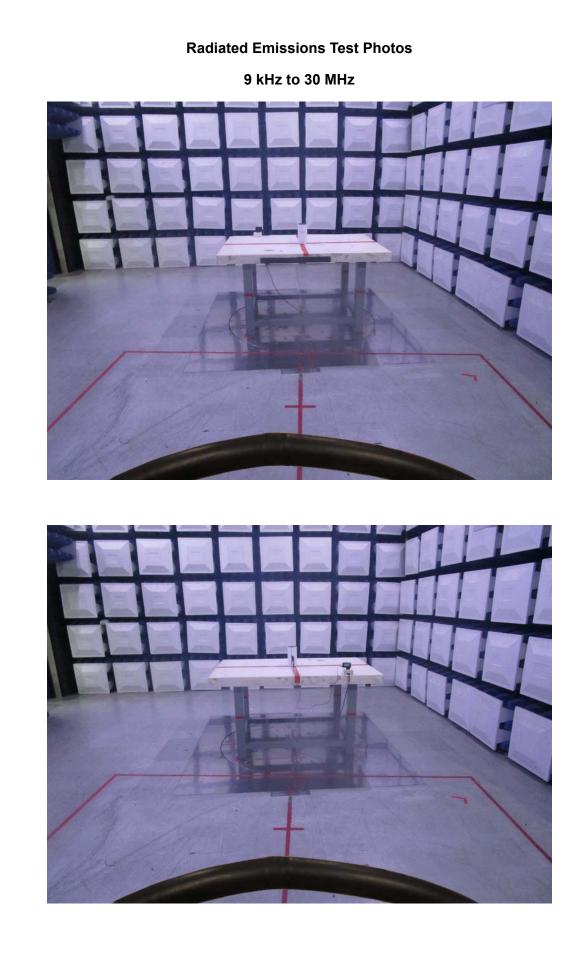












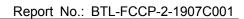




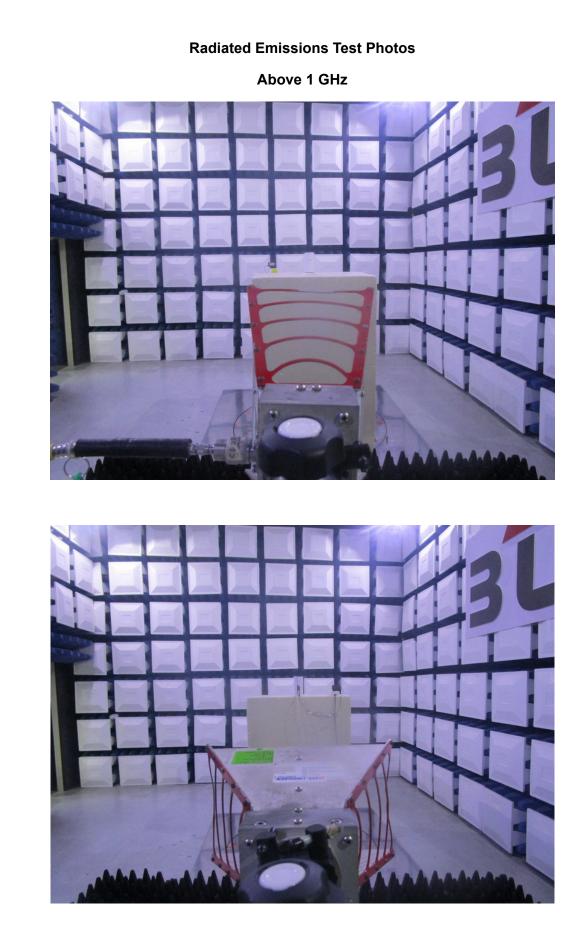
30 MHz to 1 GHz







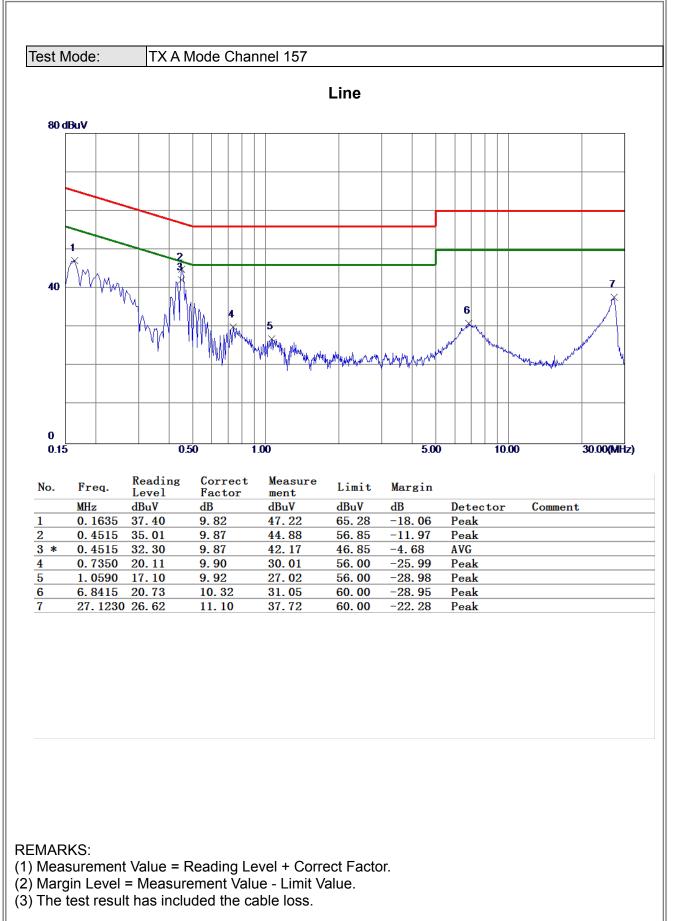




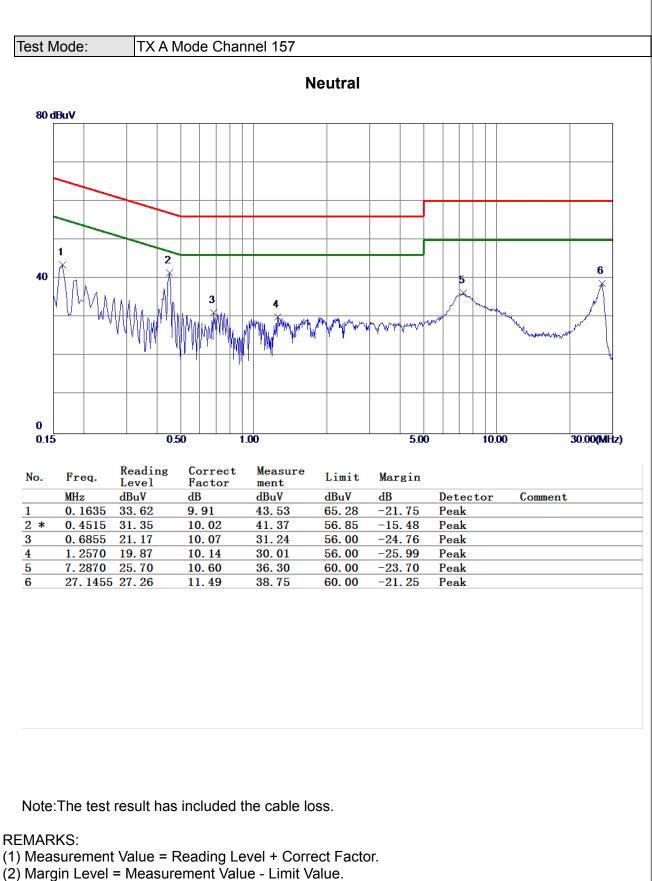


APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

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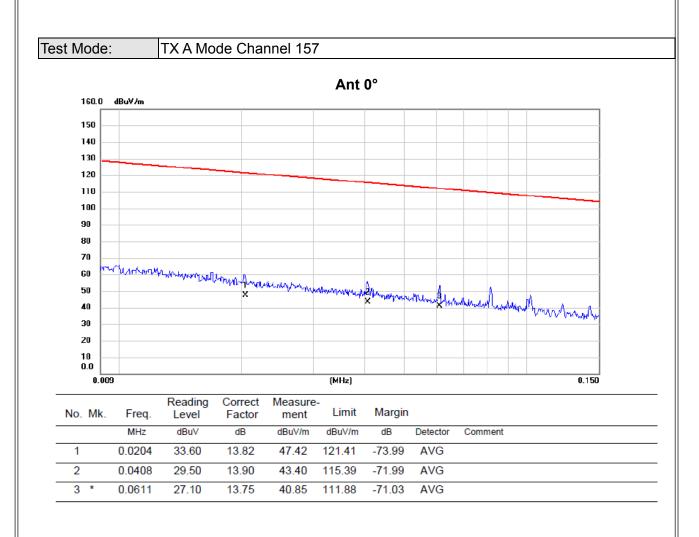
(3) The test result has included the cable loss.





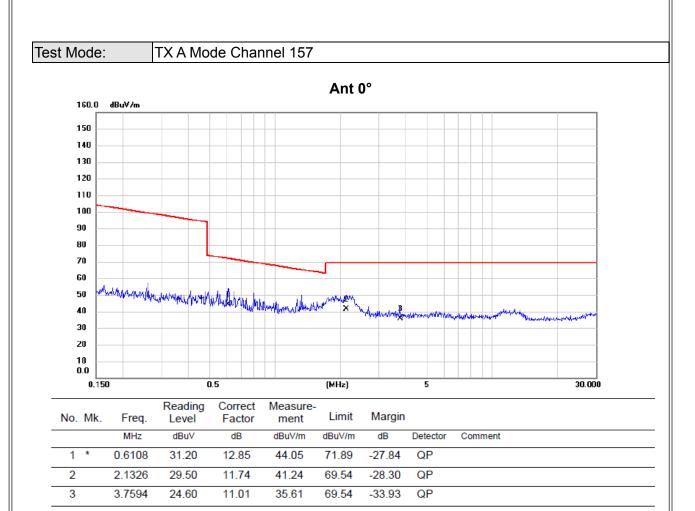
APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ





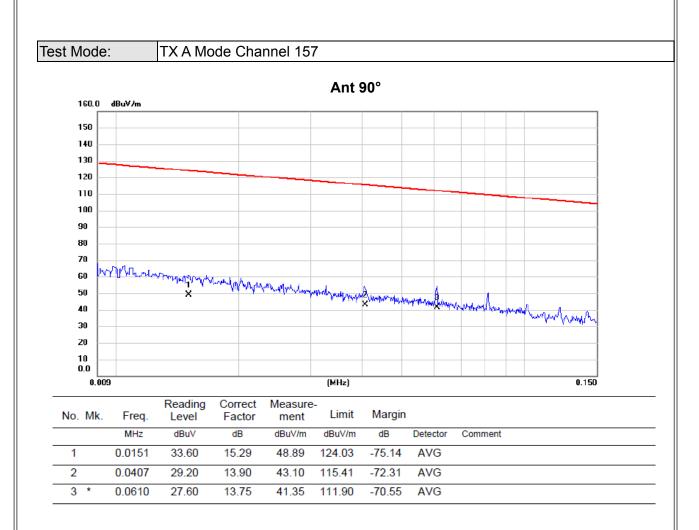
- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.





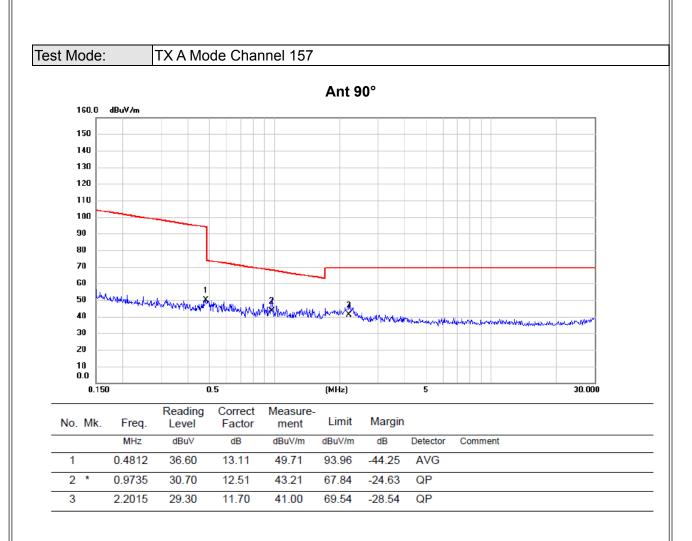
- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.





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





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

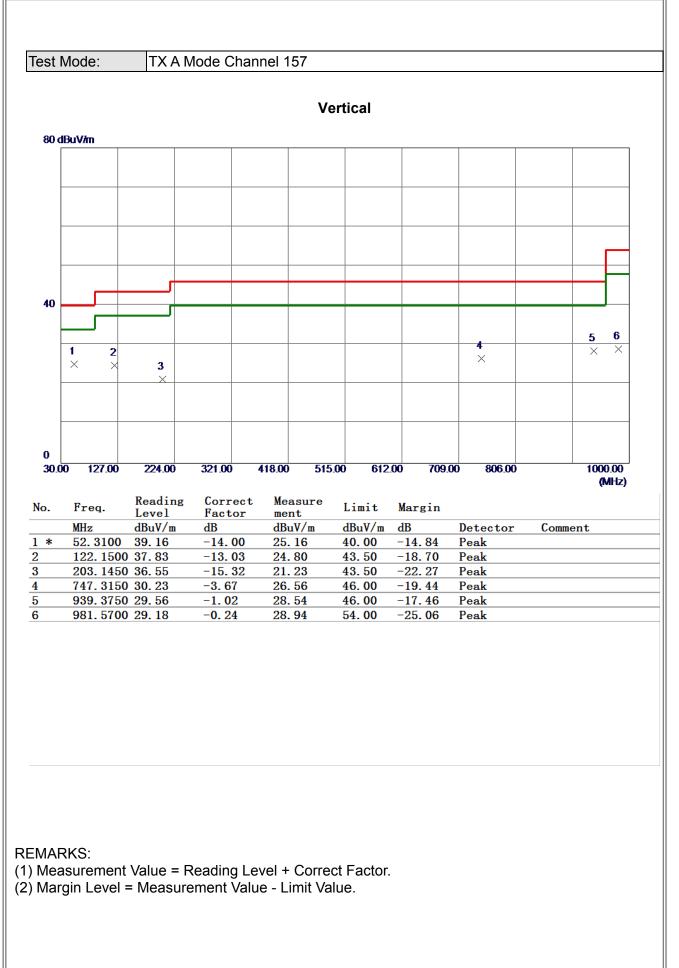
(2) Margin Level = Measurement Value - Limit Value.



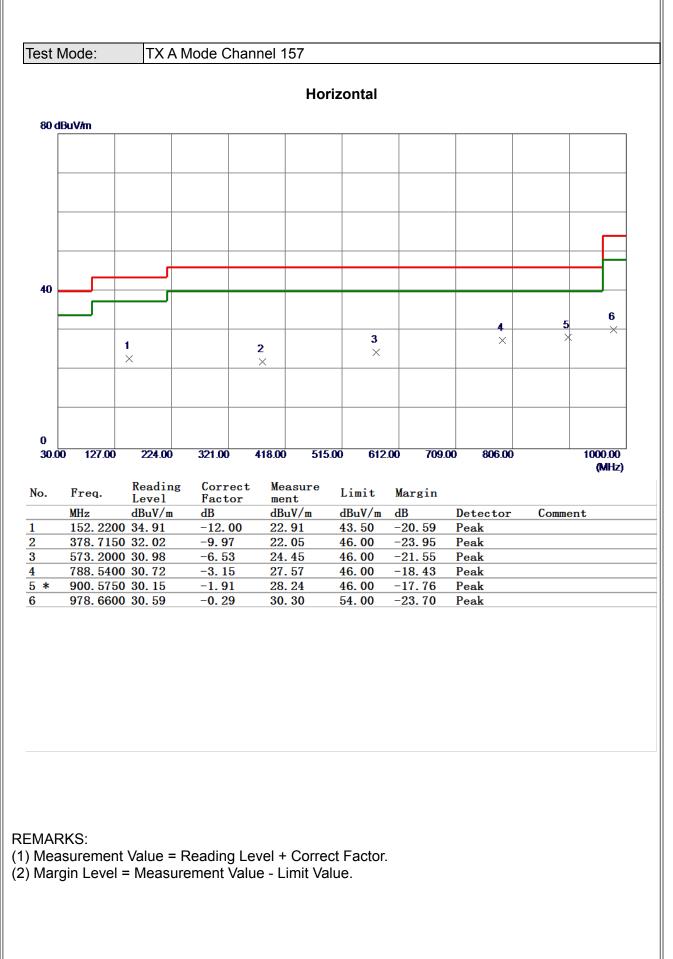


APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1 GHZ









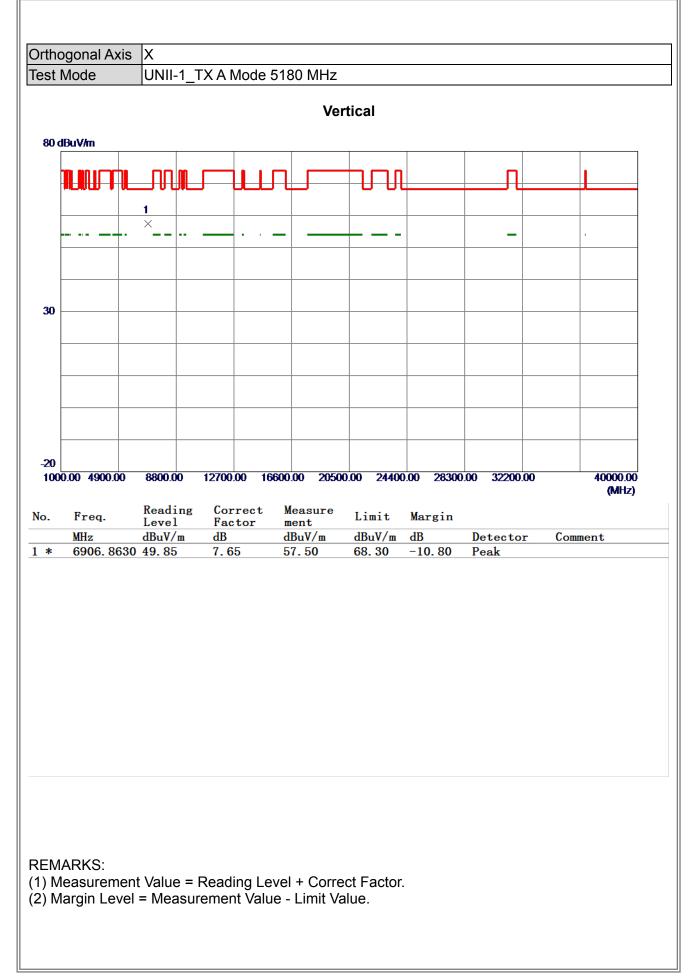


APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

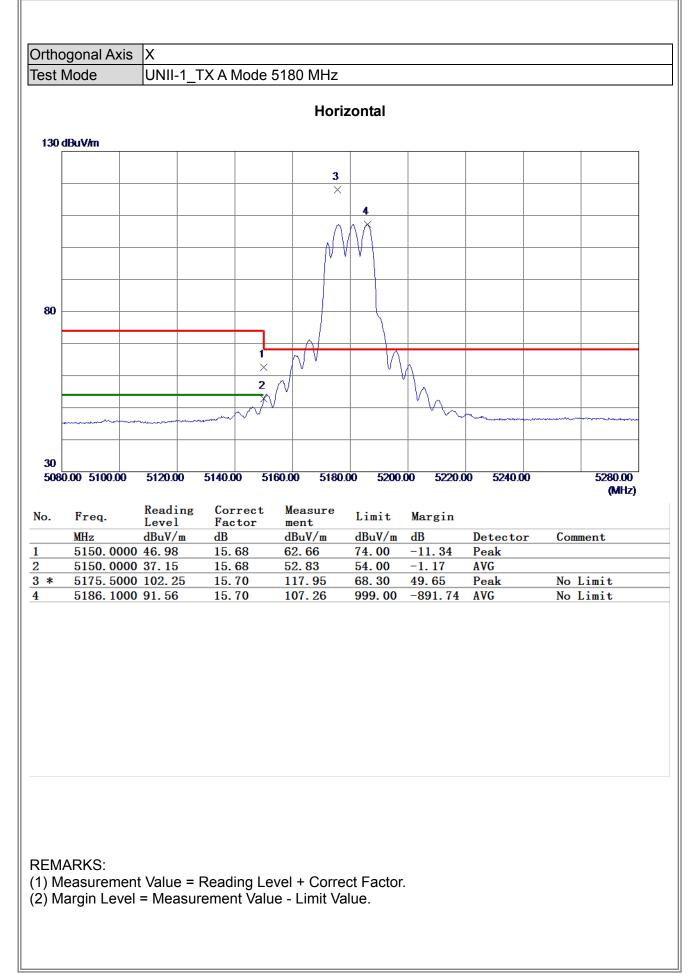


t Mode	Axis X UNII-	1_TX A Mode	e 5180 MHz				
			Vei	rtical			
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080.00 5100	0.00 5120.00	0 5140.00	5160.00 5180.	.00 5200.	.00 5220.0	0 5240.00	5280.00 (MHz)
Freq.	Readi Level	ng Correct Factor	Measure ment	Limit	Margin		
	dBuV/r	n dB	dBuV/m	dBuV/m	dB	Detector	Comment
MHz		15.68	64.65	74.00	-9.35	Peak	
<b>5150</b> .	0000 48.97		53.82		-0.18	AVG	
5150. 5150. 5175.	0000 48.97 0000 38.14 6000 90.06	15.68 15.70	53.82 105.76	54.00 999.00	-0.18 -893.24	AVG AVG	No Limit
5150. 5150. 5175.	0000 48.97 0000 38.14	15.68 15.70		<b>54.00</b>			No Limit No Limit
5150. 5150. 5175.	0000 48.97 0000 38.14 6000 90.06	15.68 15.70	105.76	54.00 999.00	-893.24	AVG	
5150. 5150. 5175.	0000 48.97 0000 38.14 6000 90.06	15.68 15.70	105.76	54.00 999.00	-893.24	AVG	
5150. 5150. 5175.	0000 48.97 0000 38.14 6000 90.06	15.68 15.70	105.76	54.00 999.00	-893.24	AVG	
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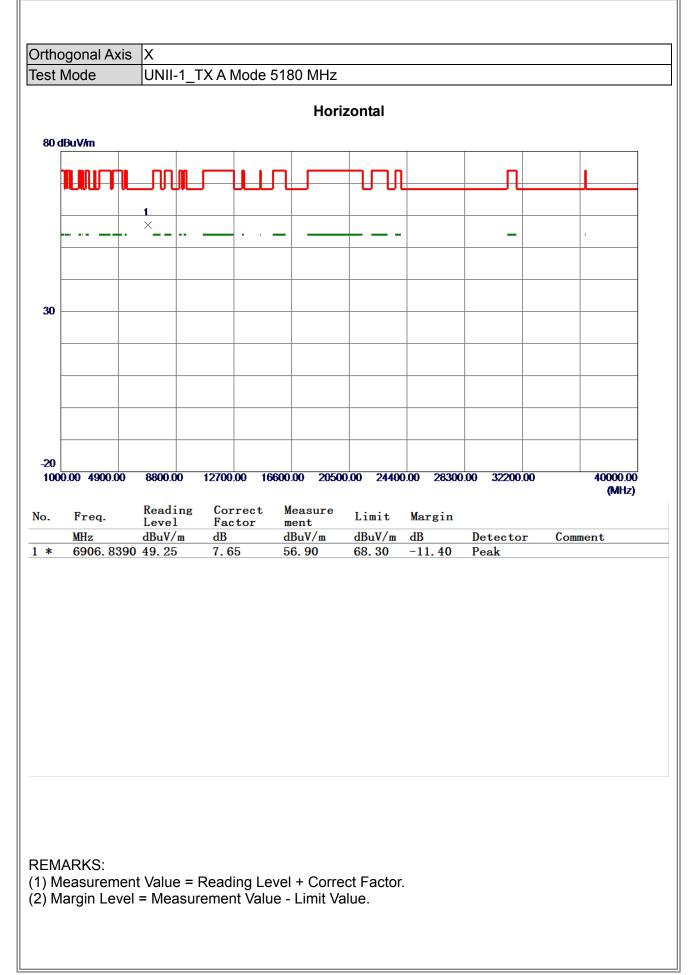




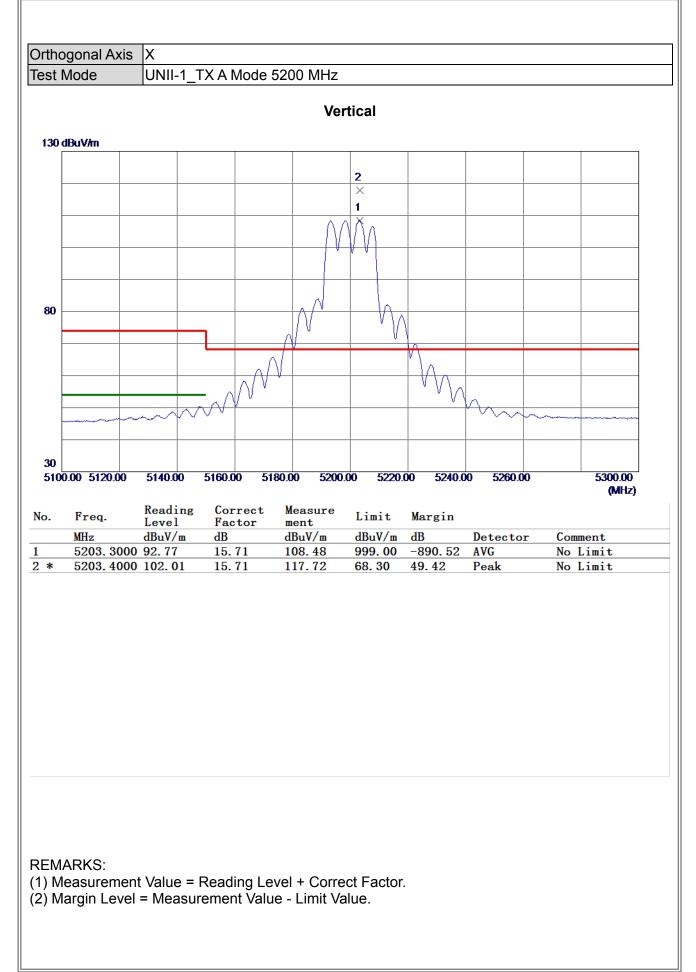




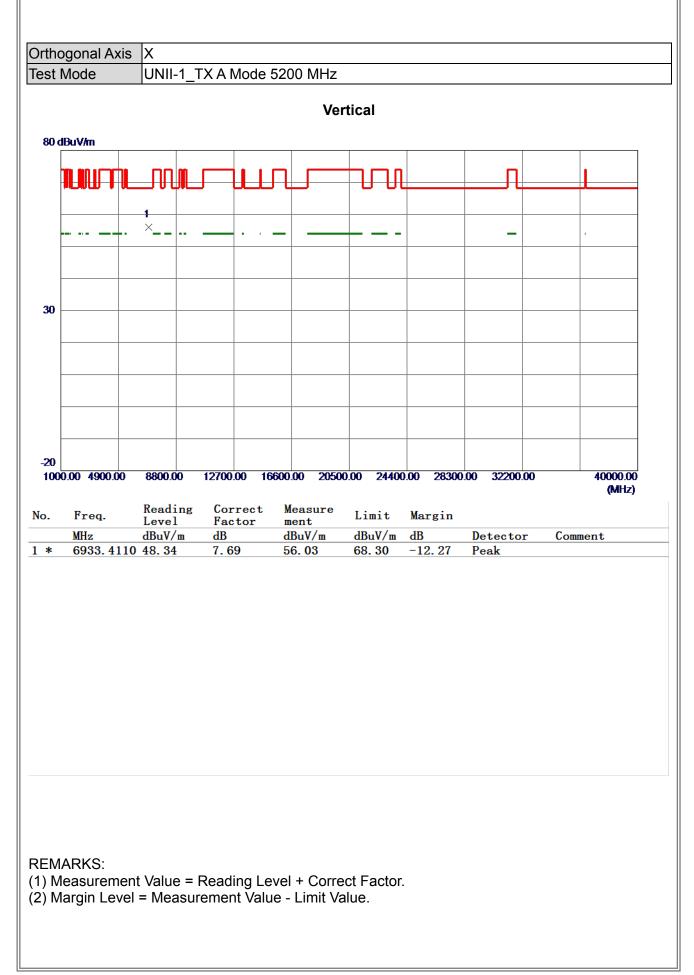




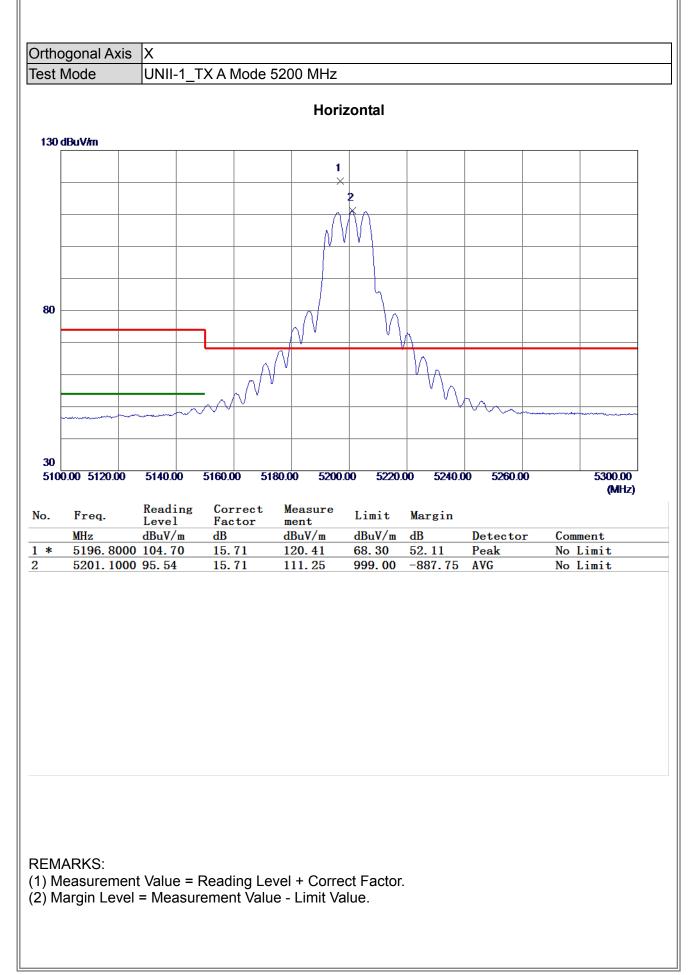




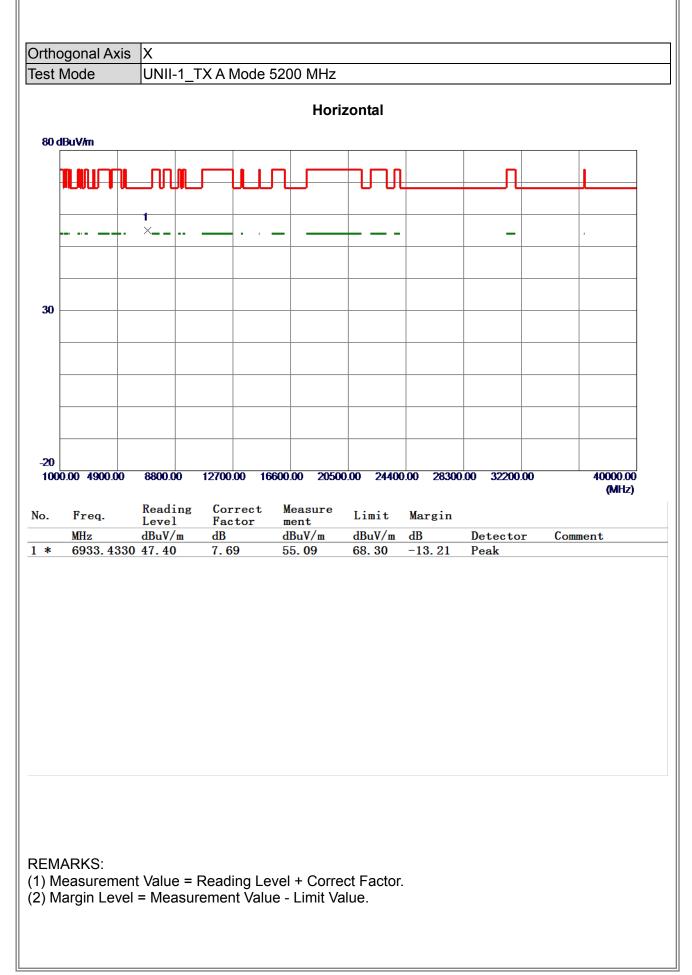




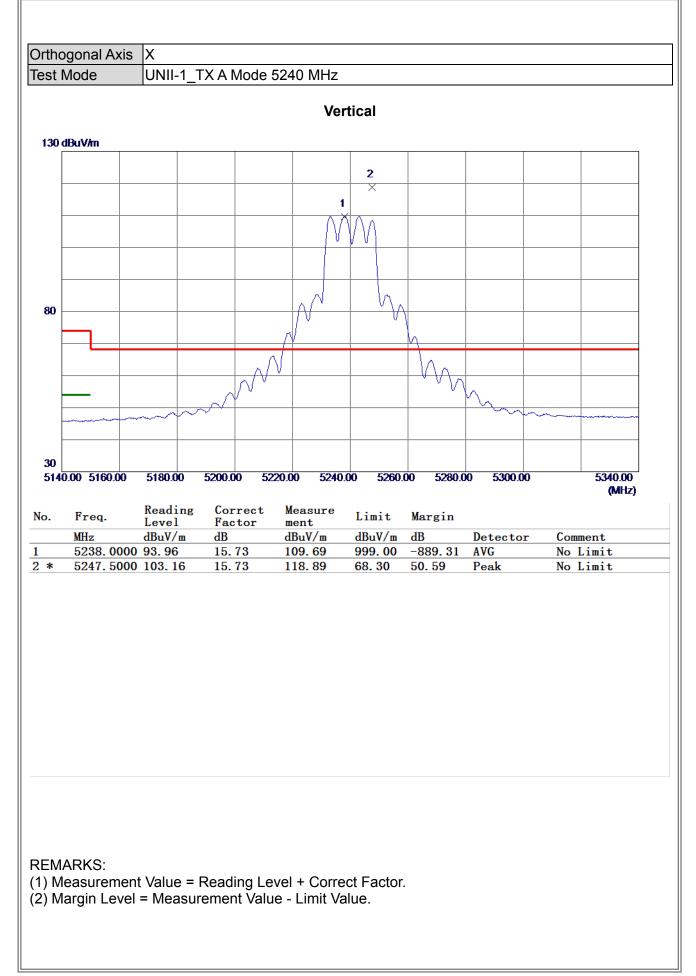




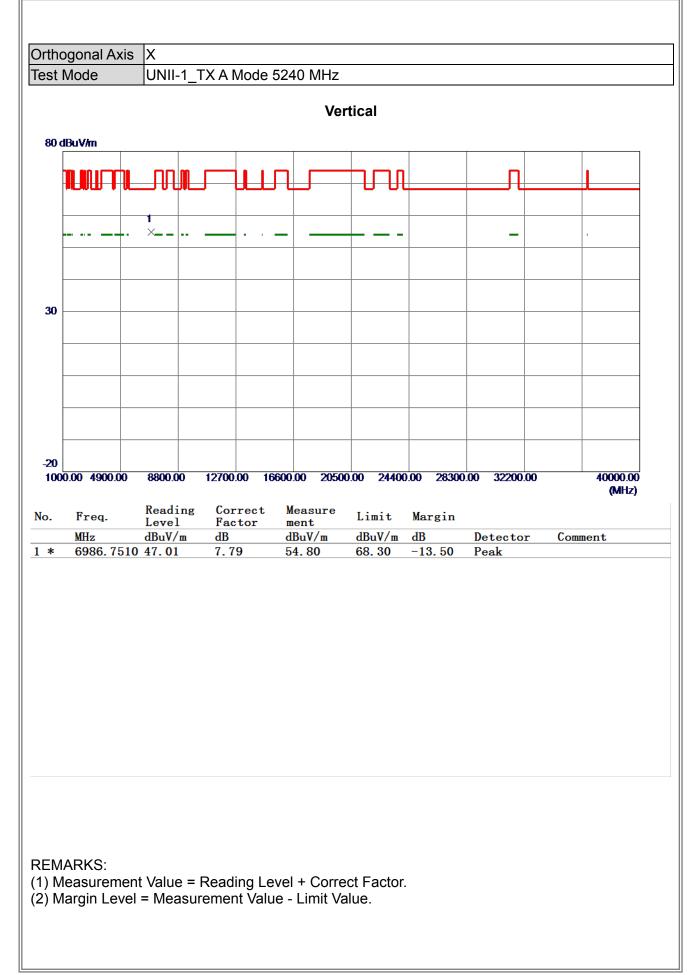




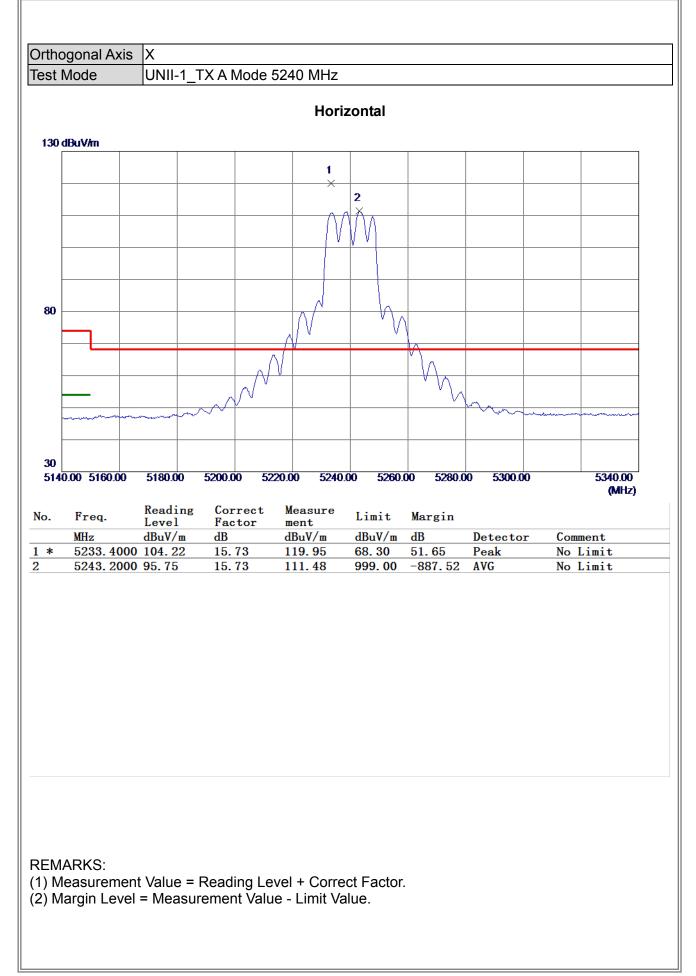




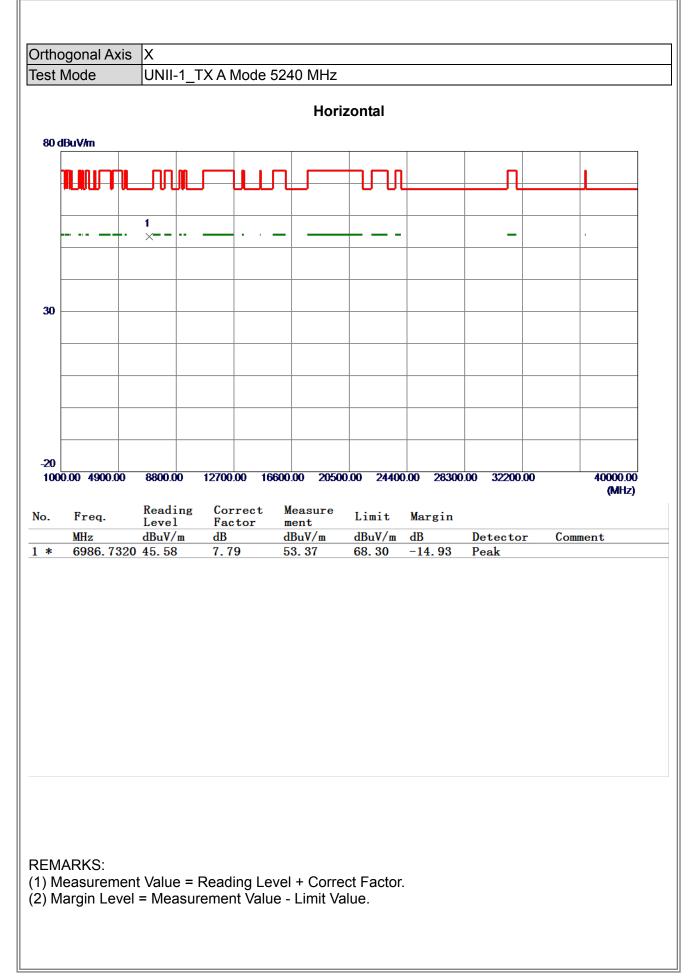




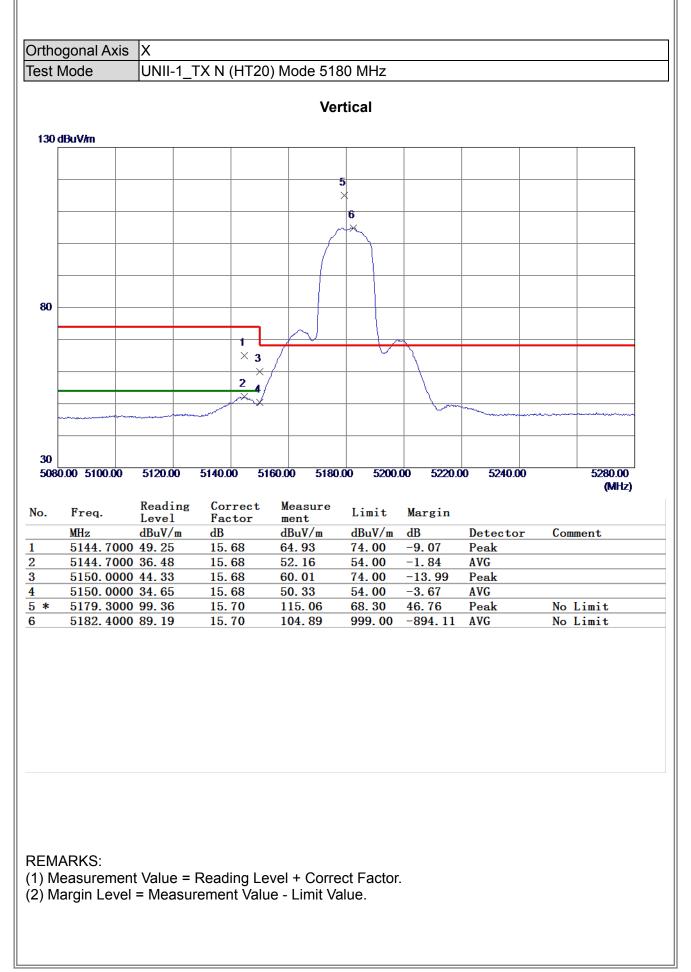




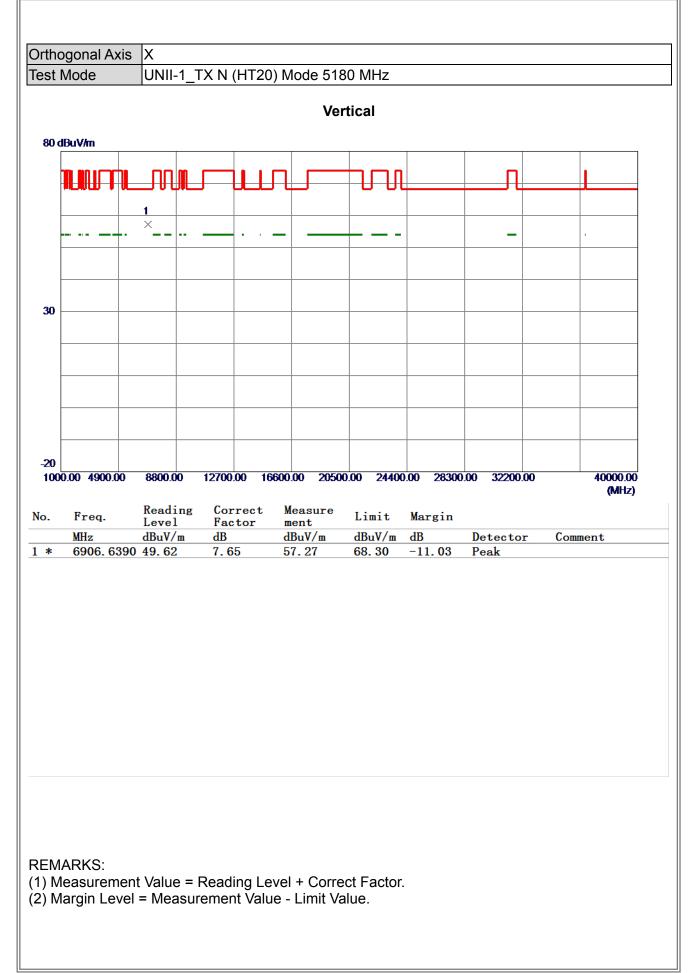




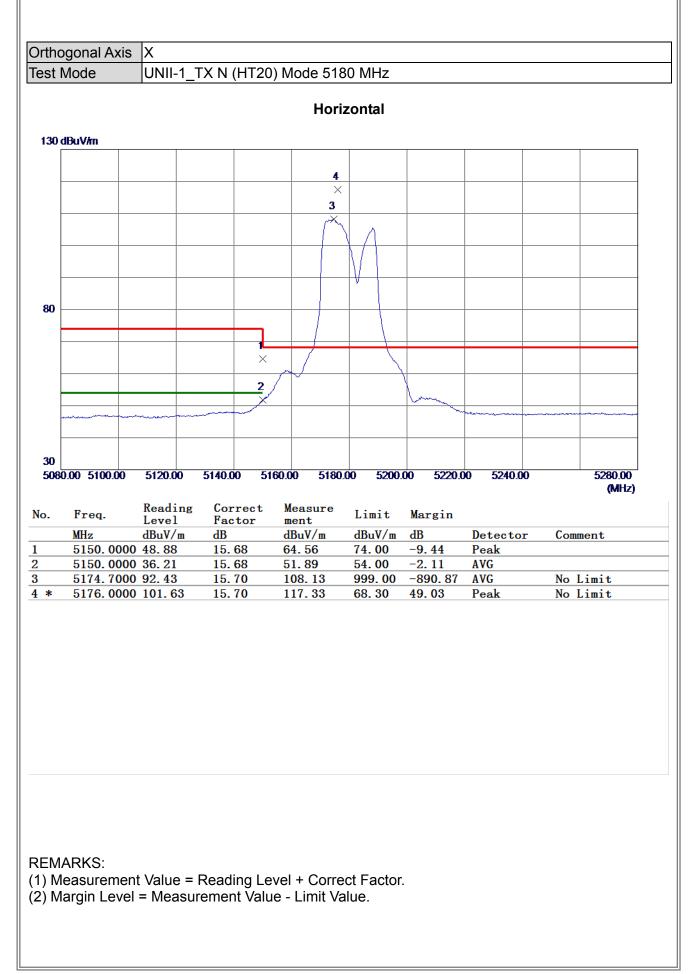




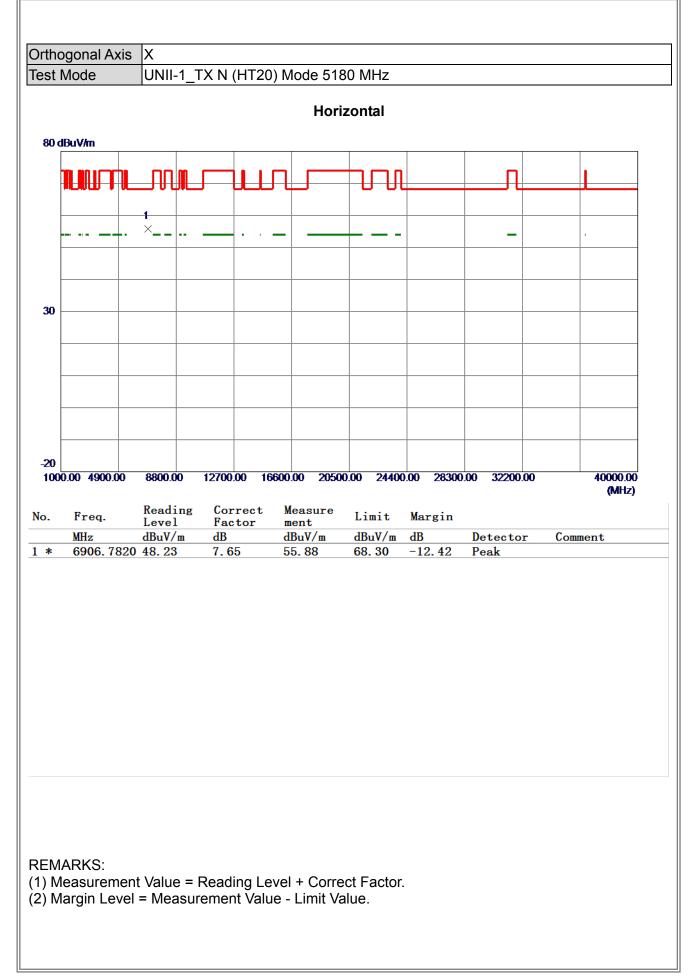




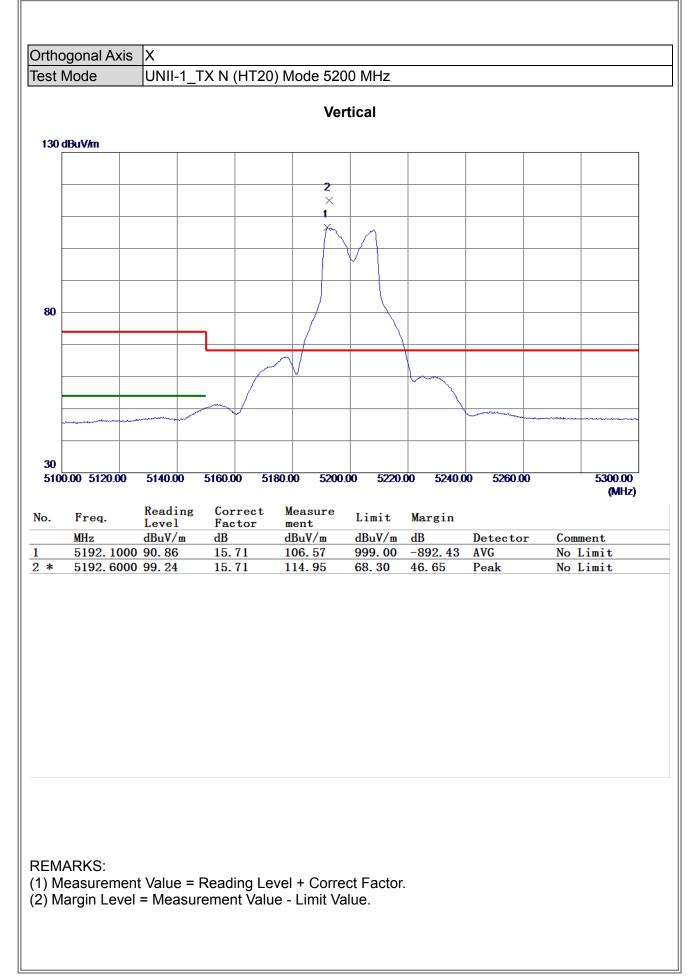




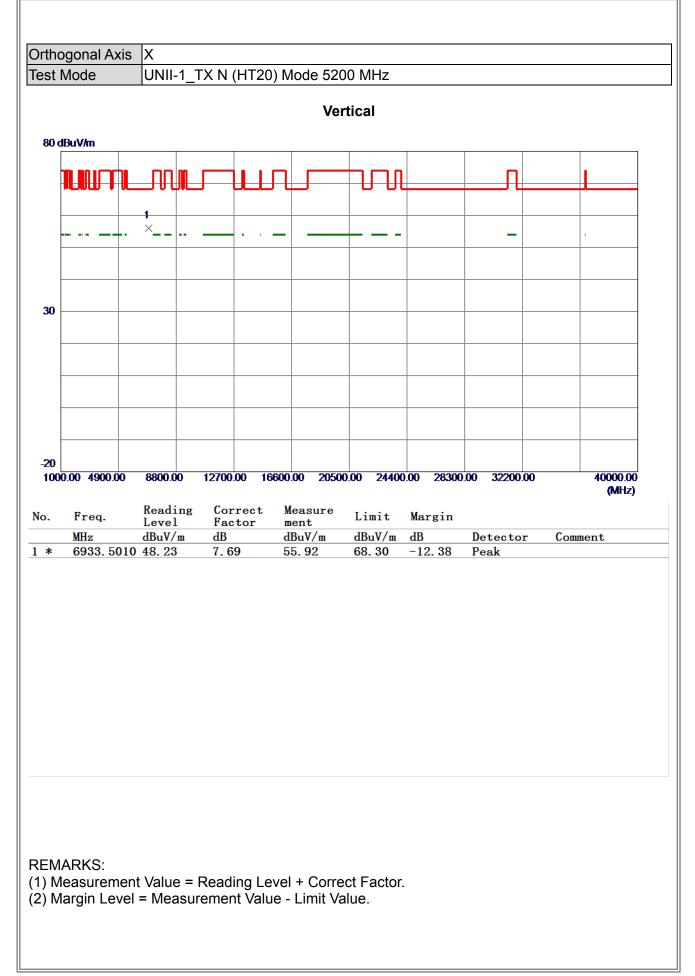




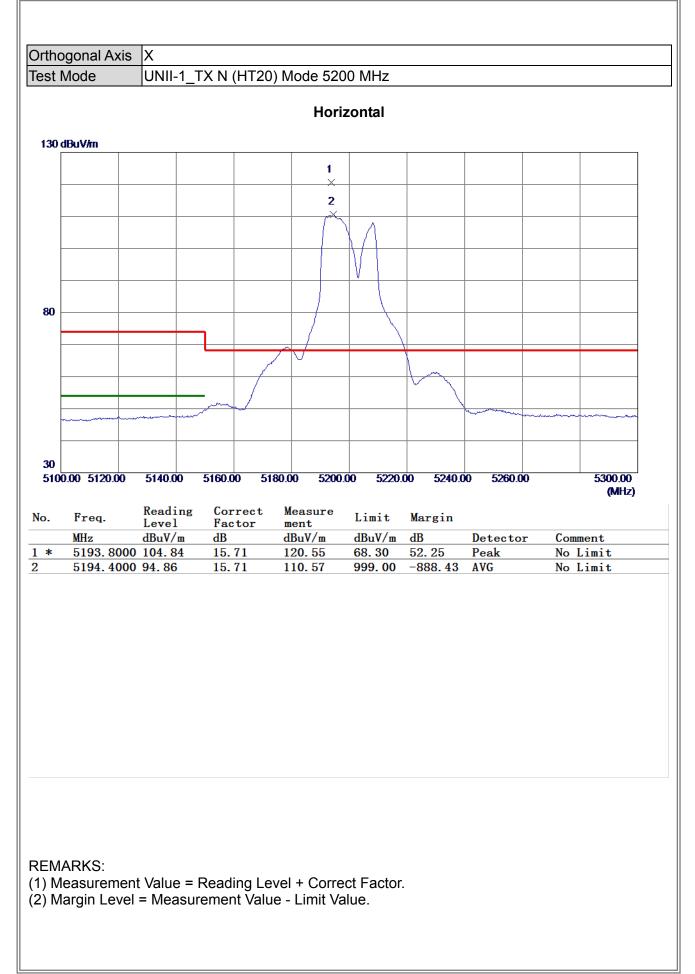




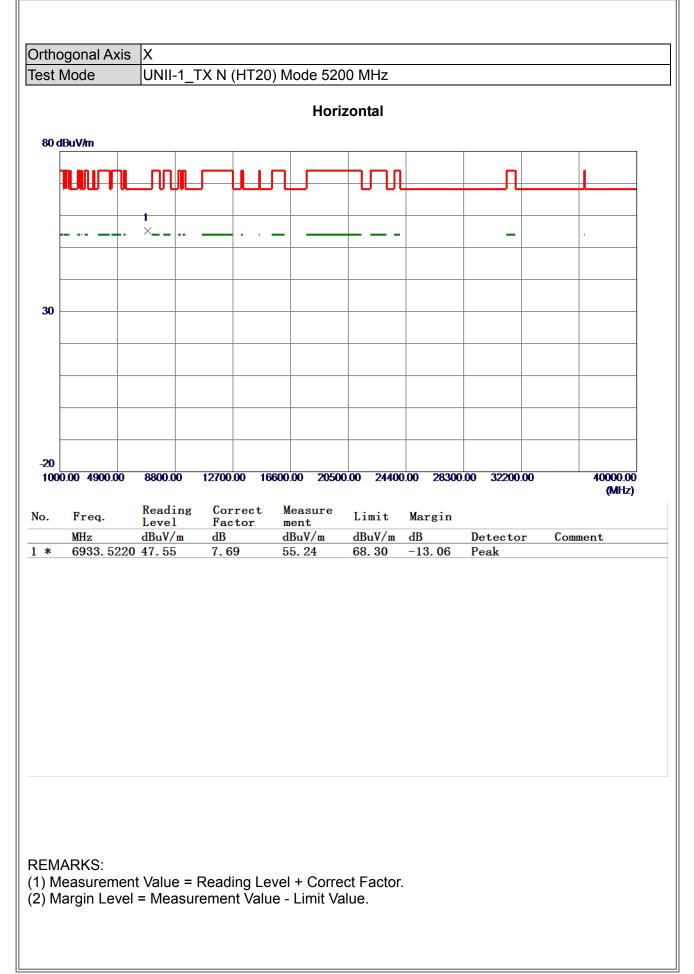




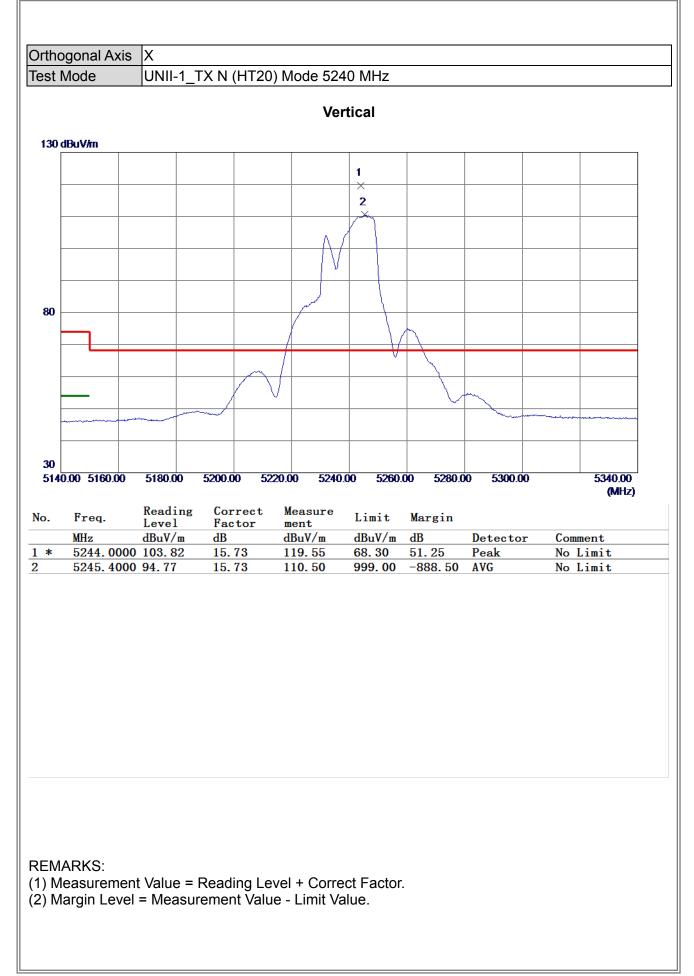




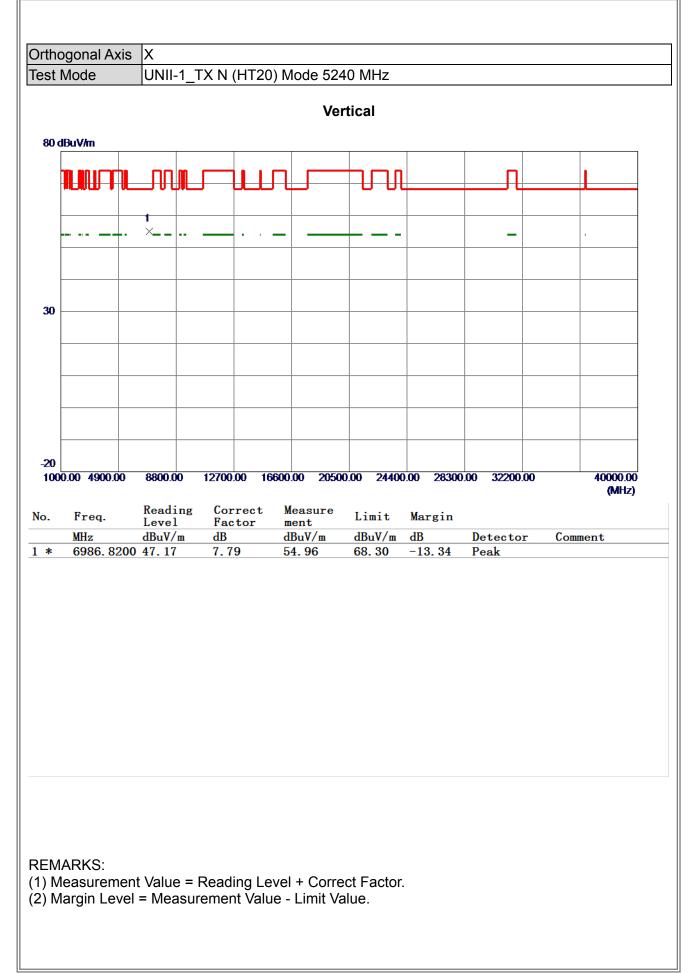




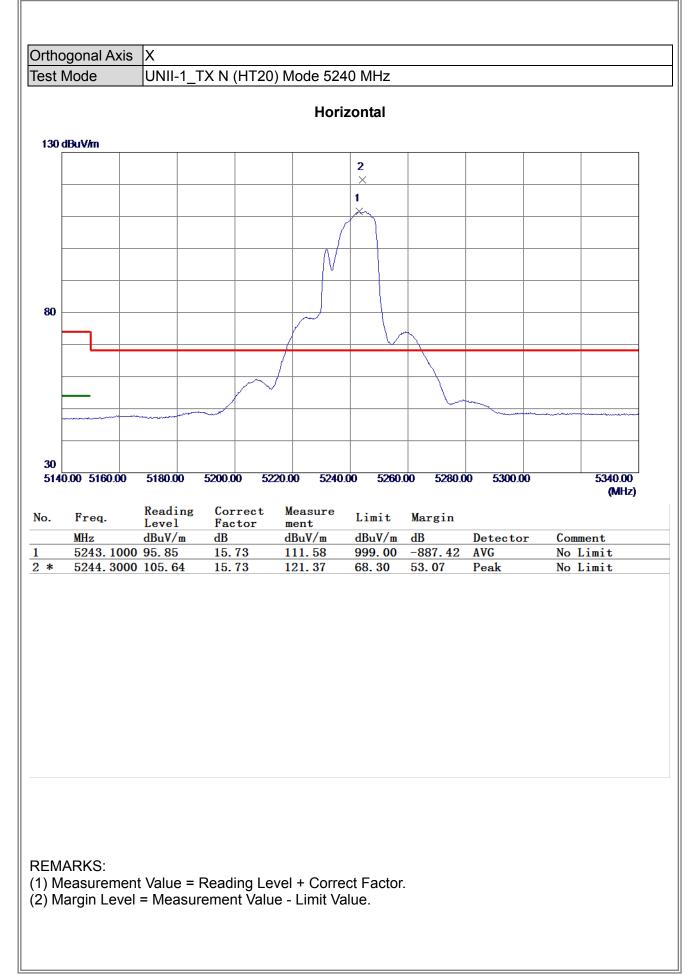








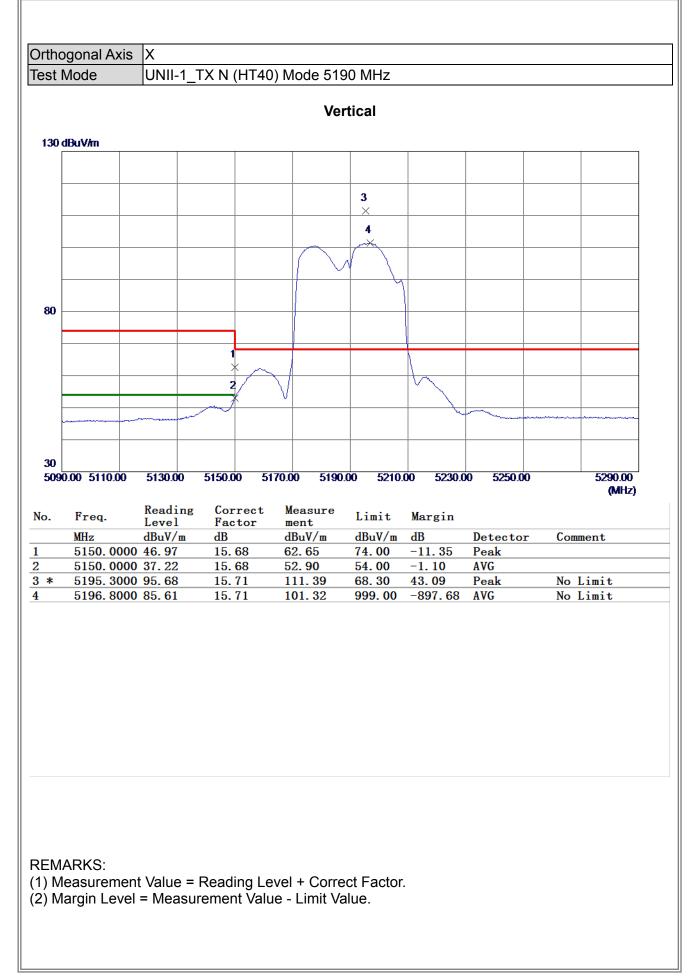




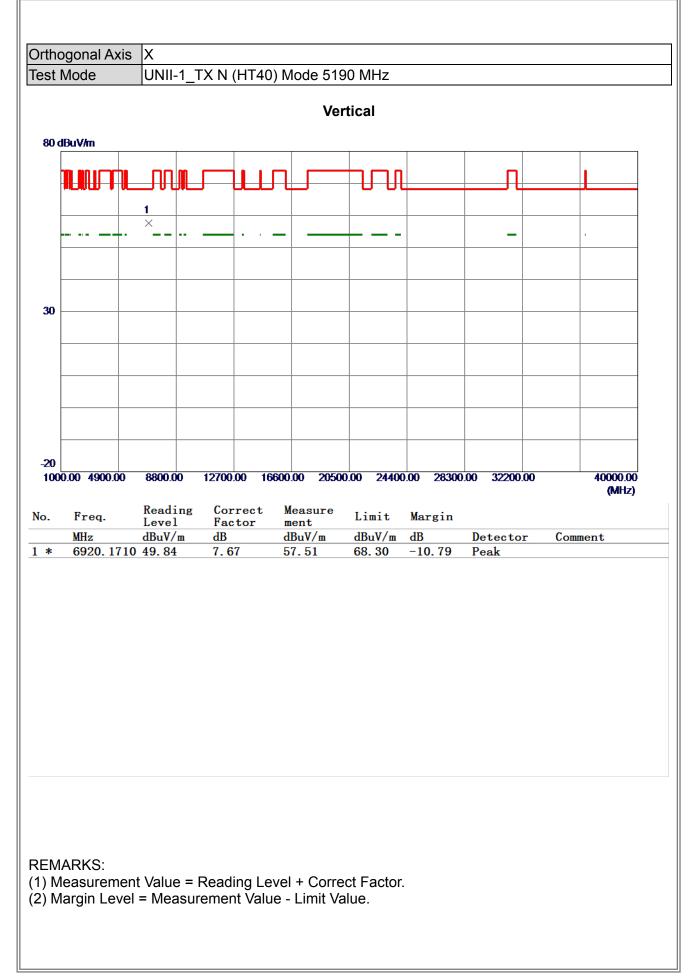




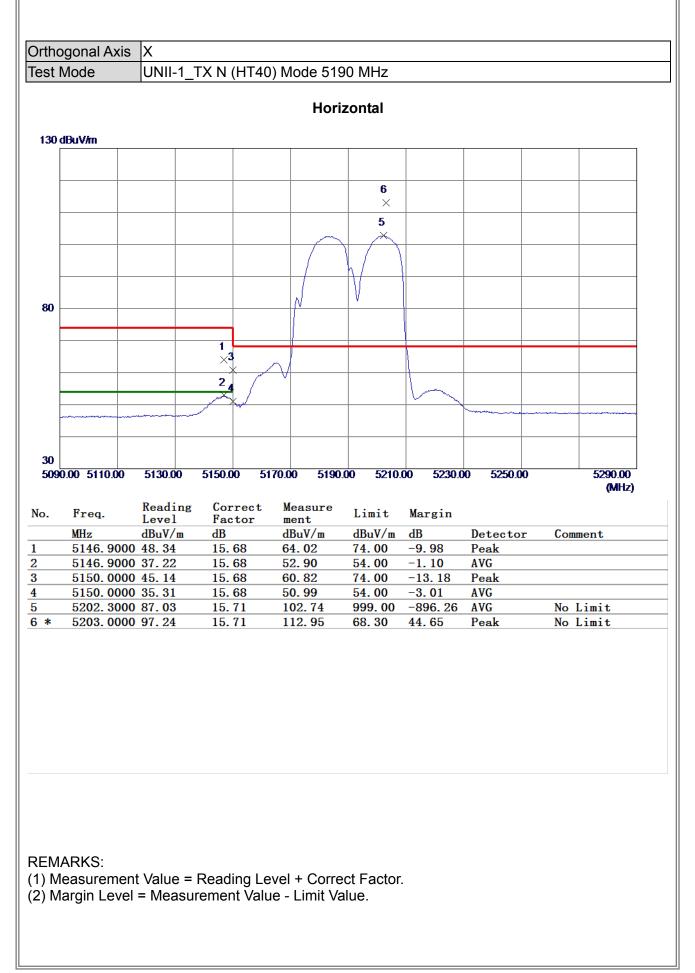




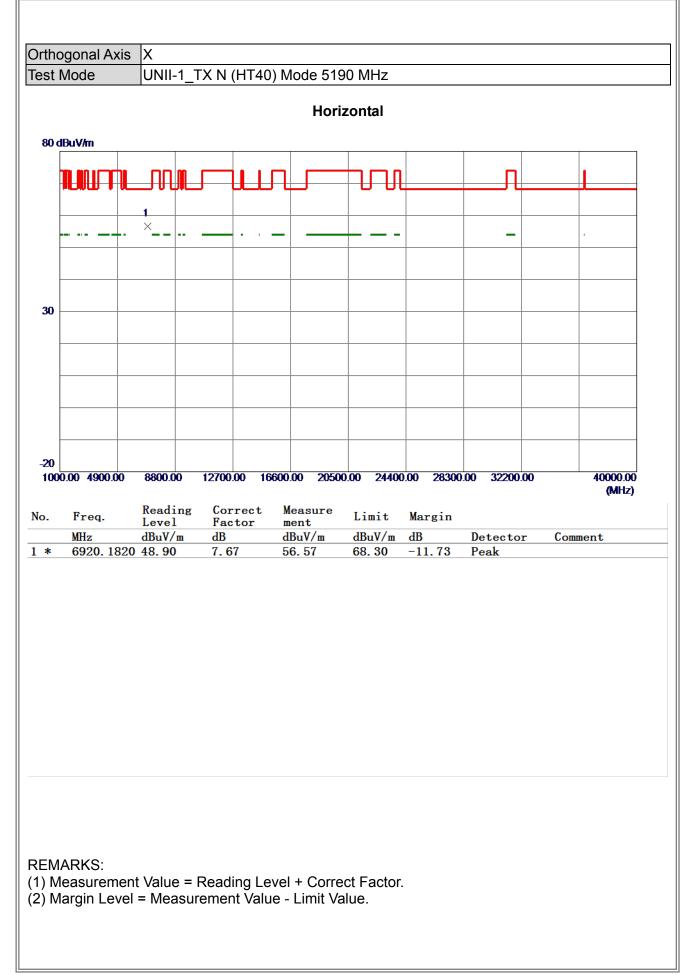




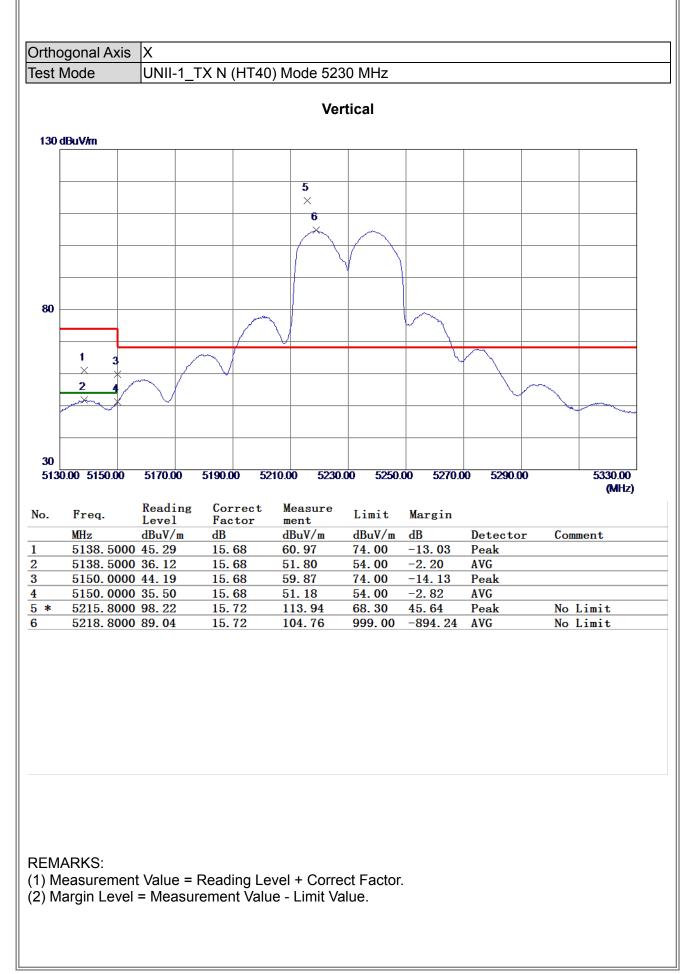




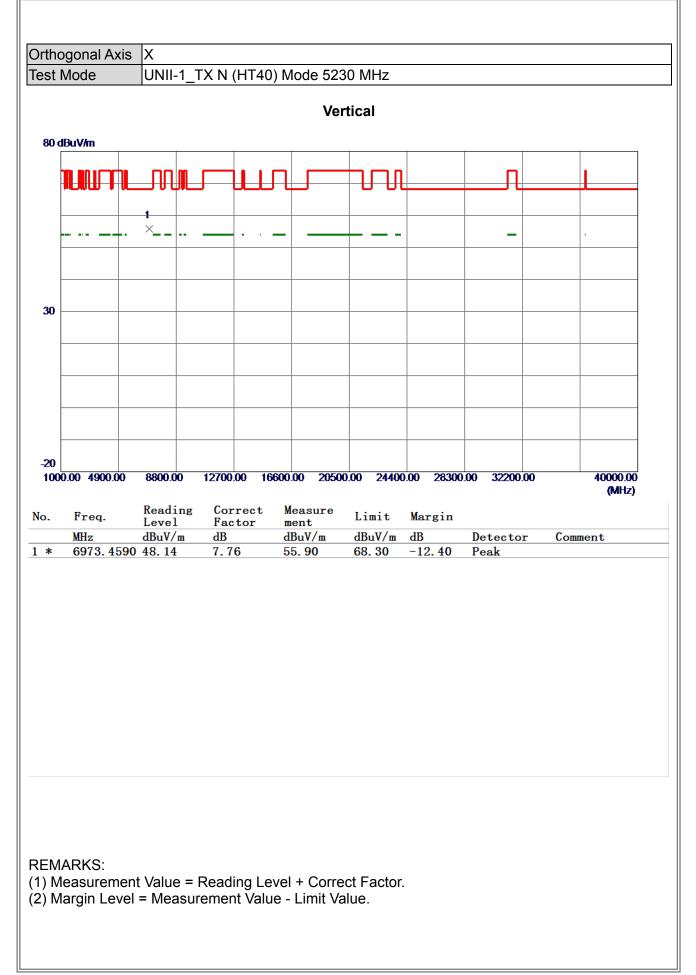




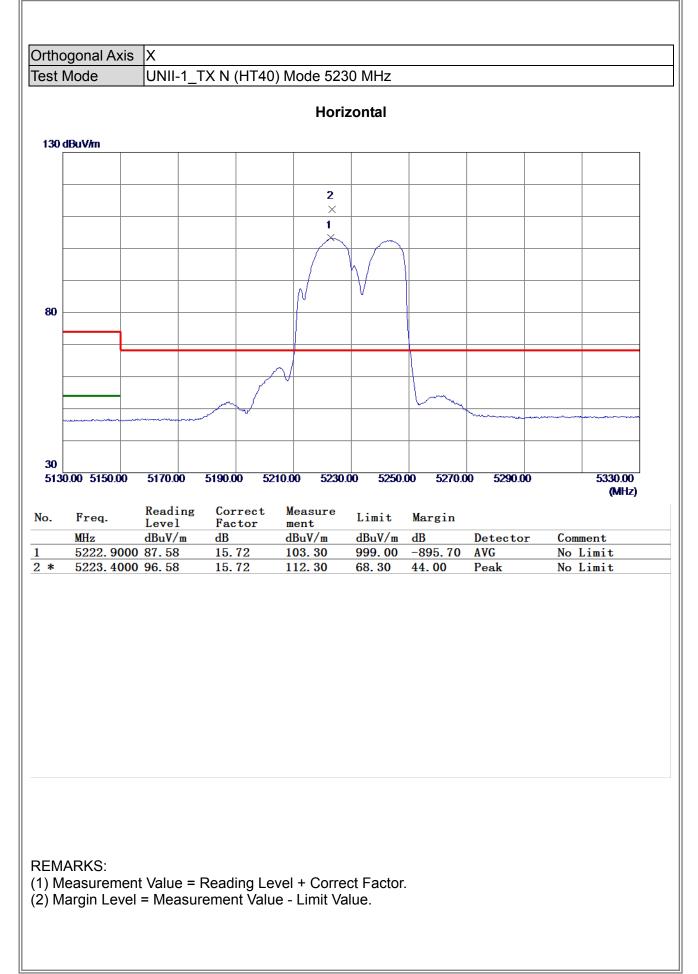




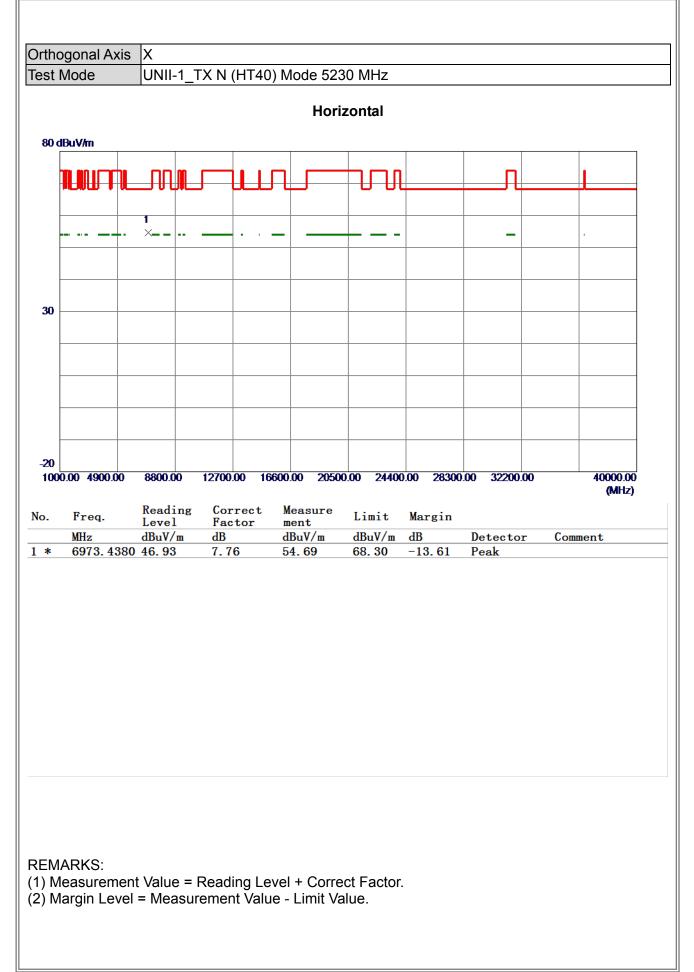




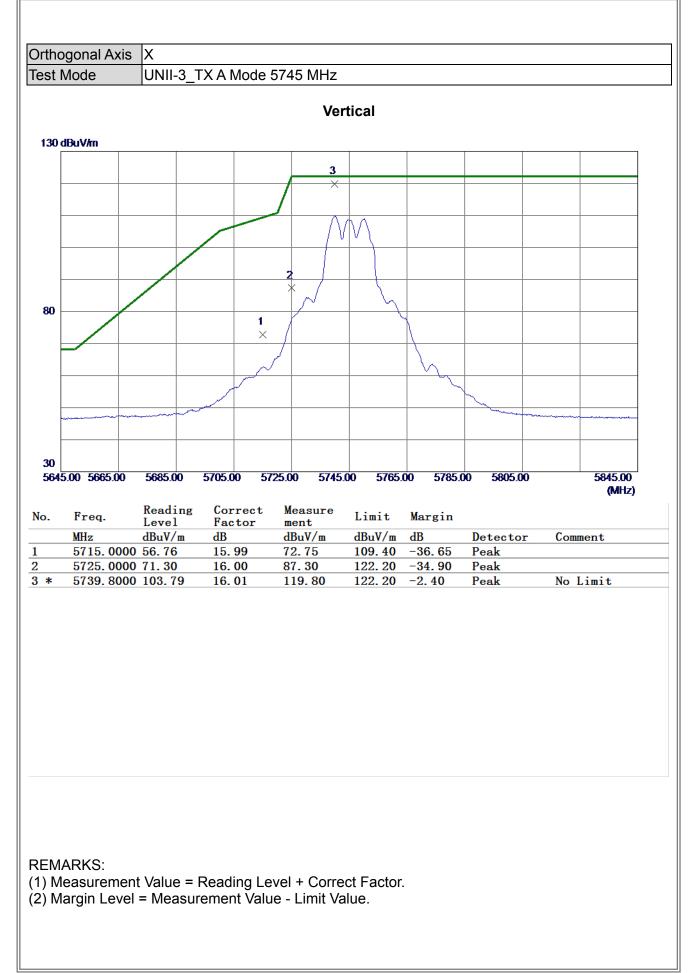




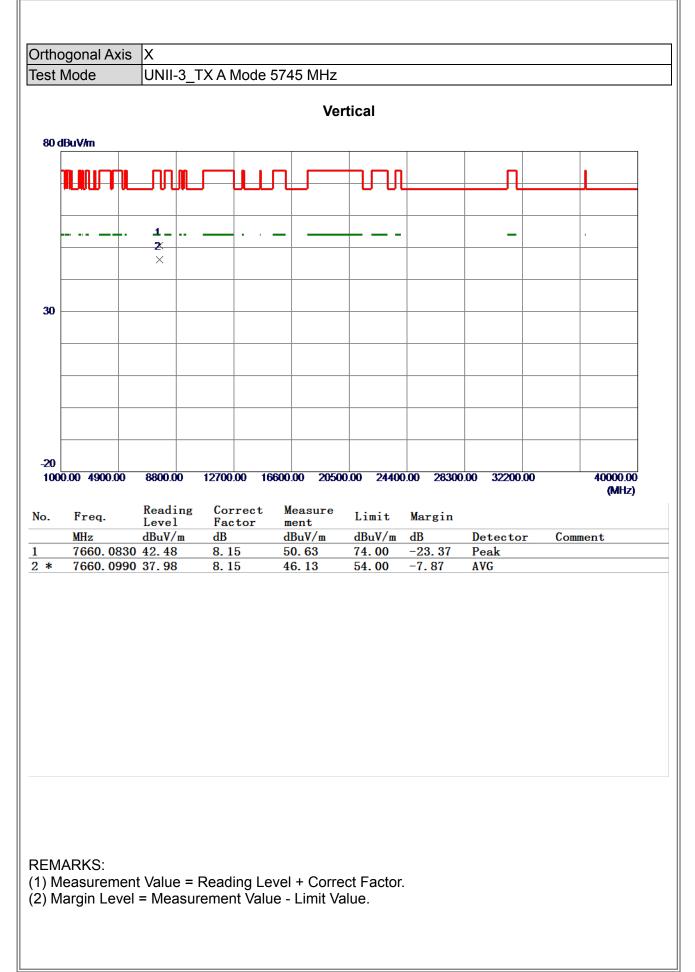




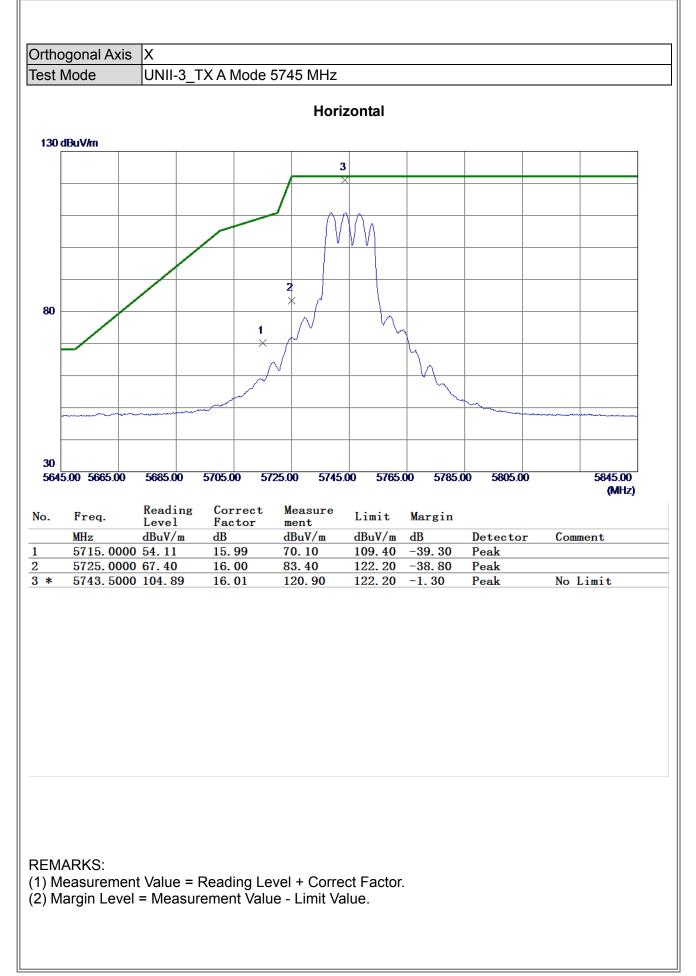




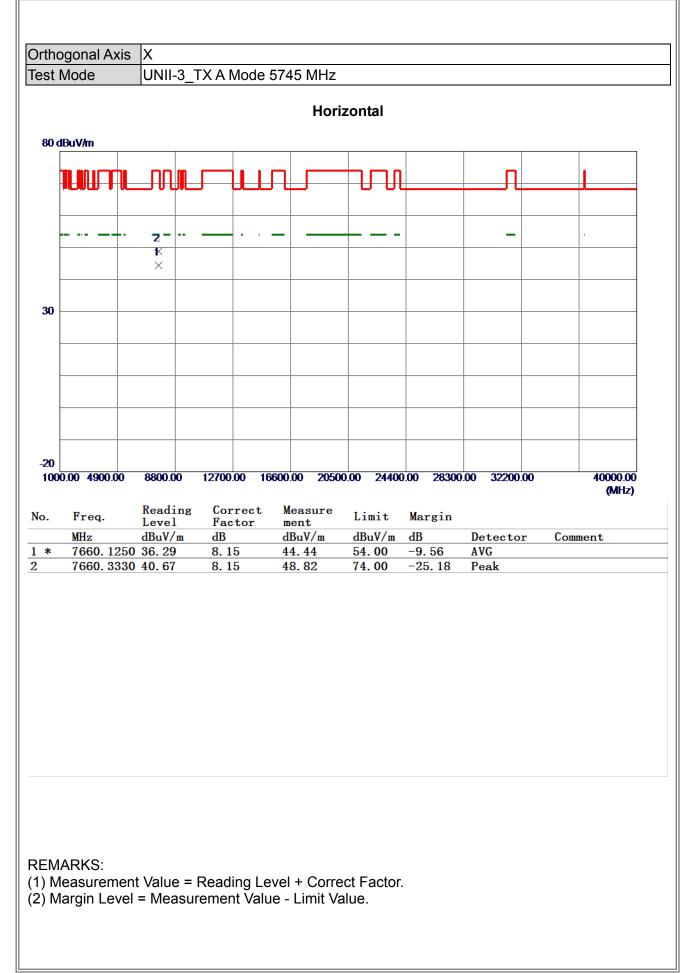




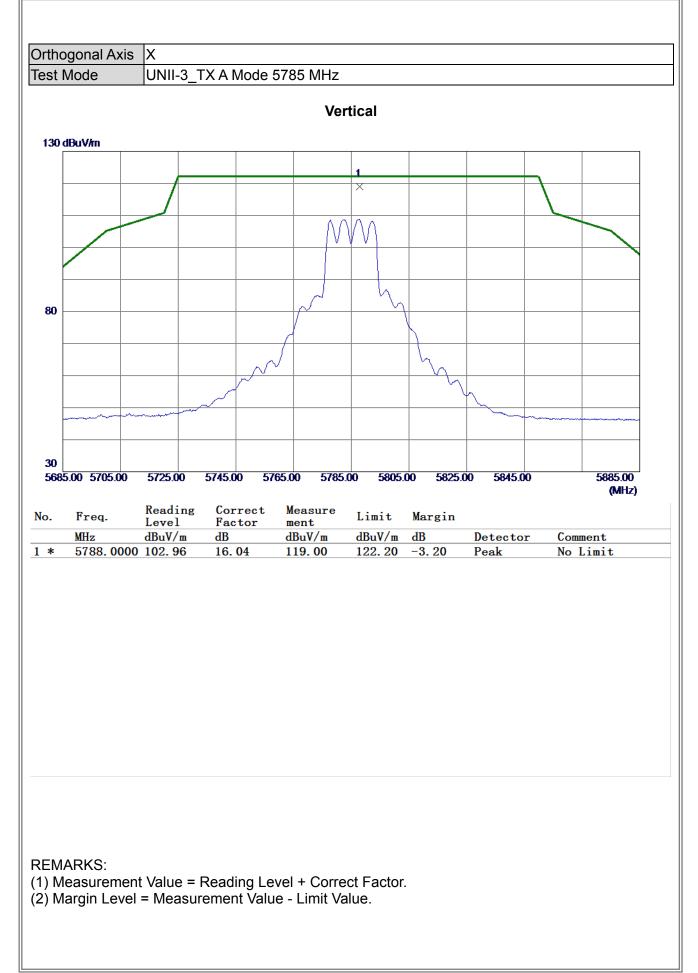




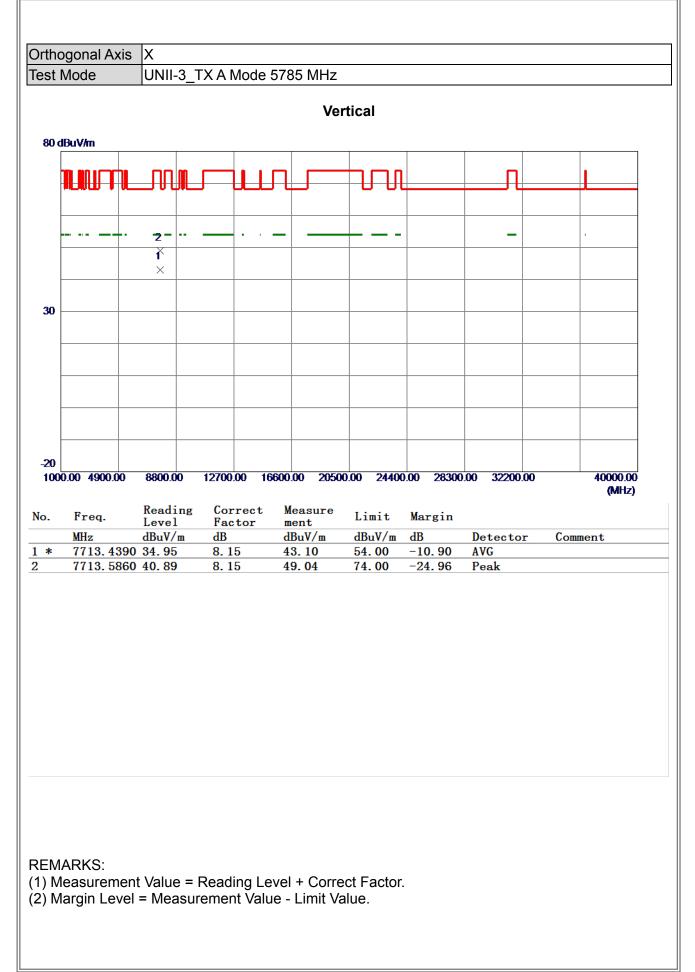




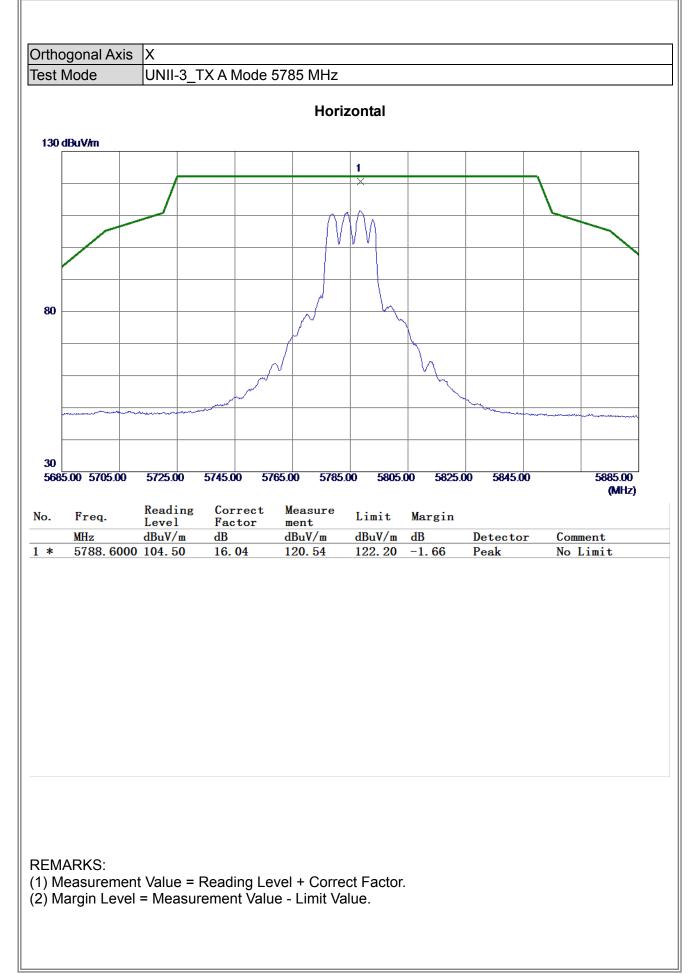




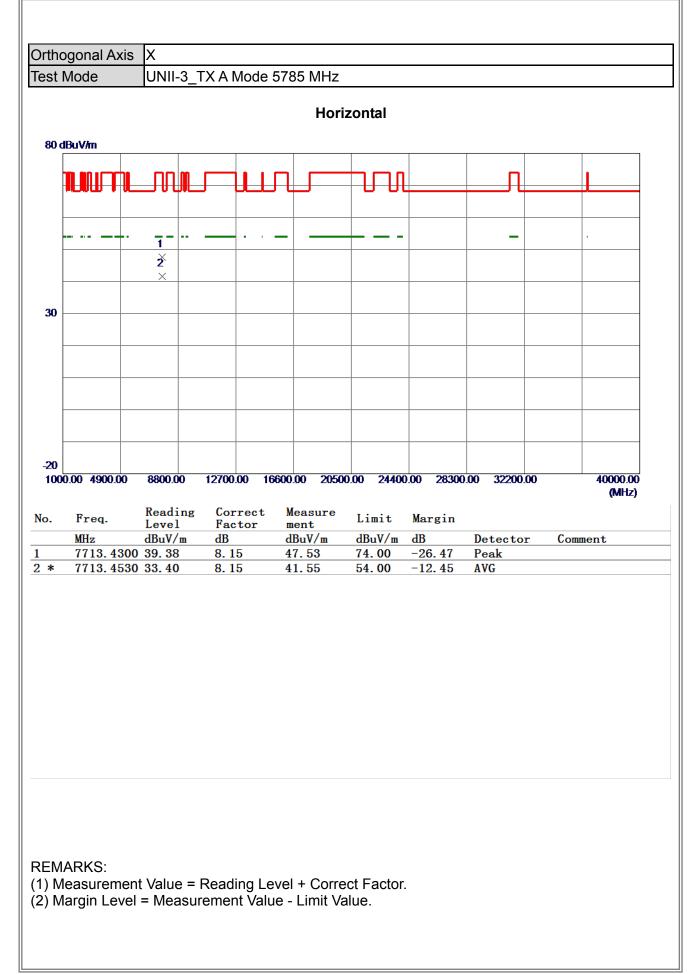




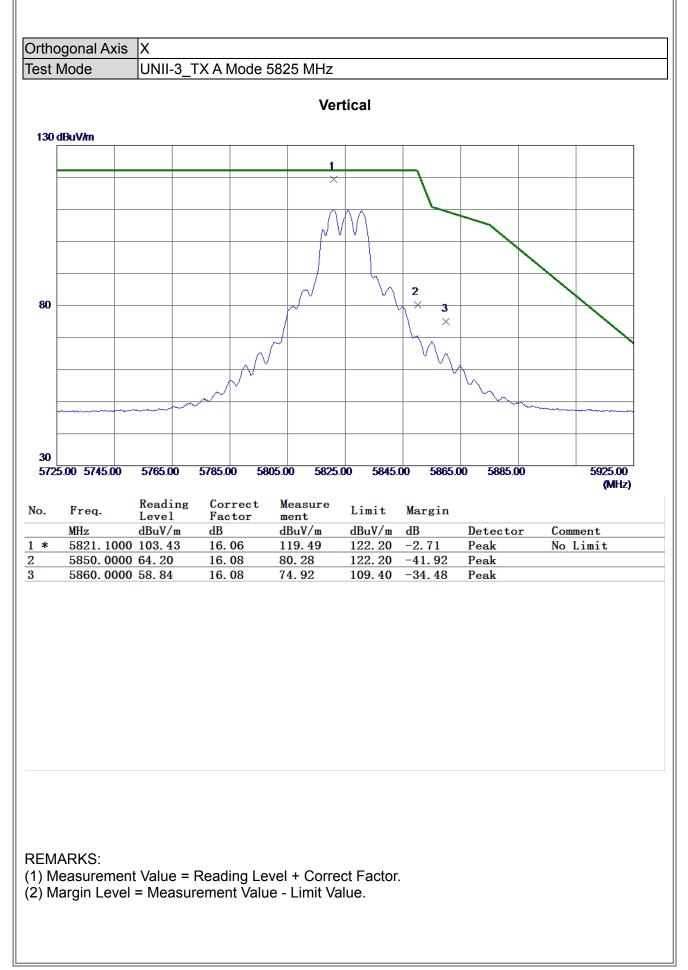




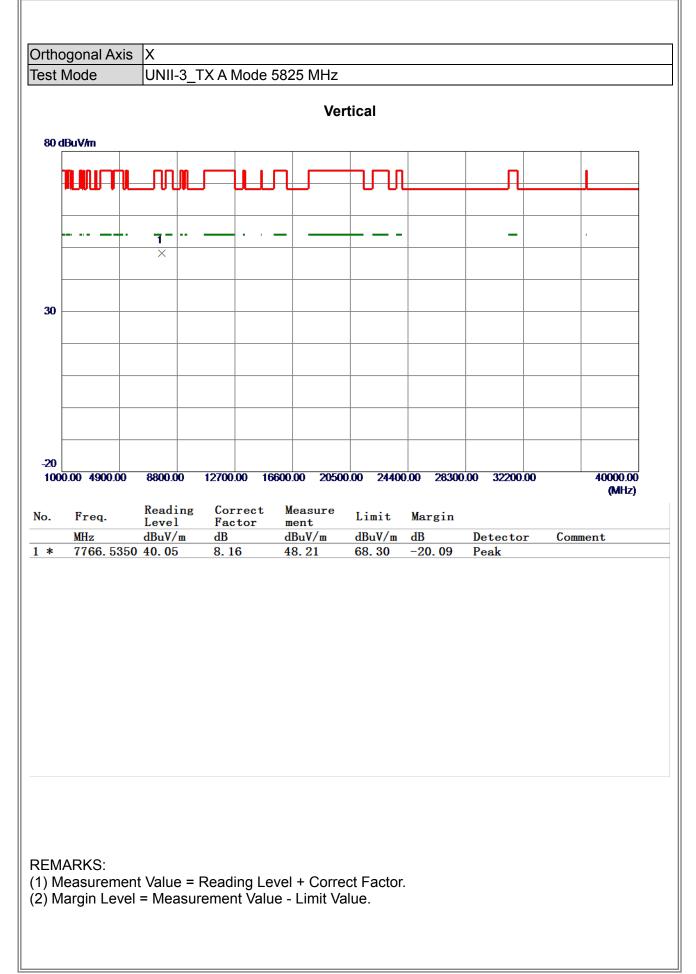




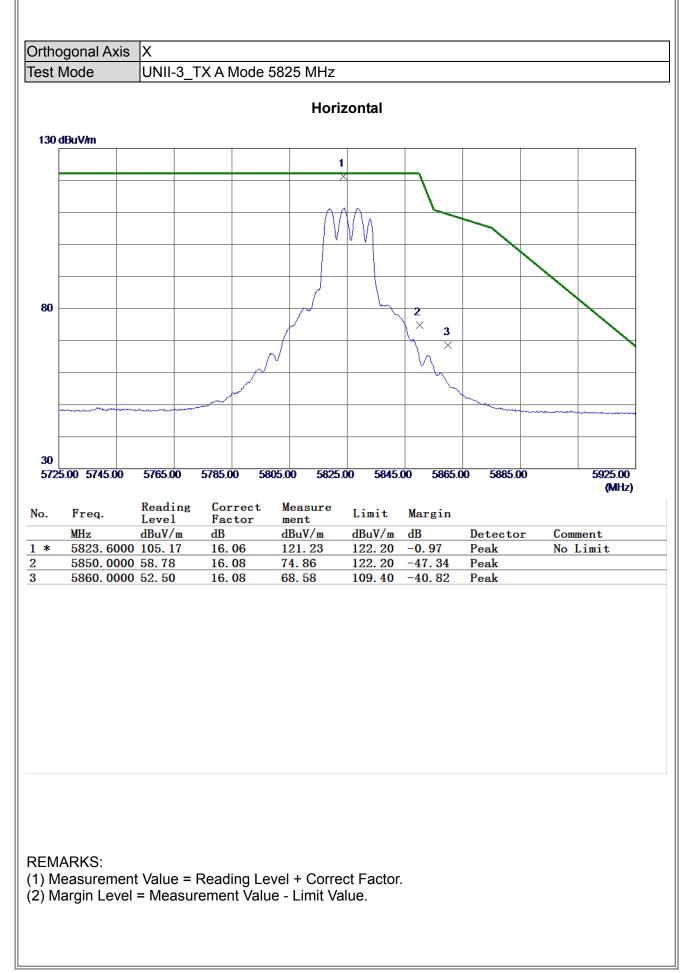




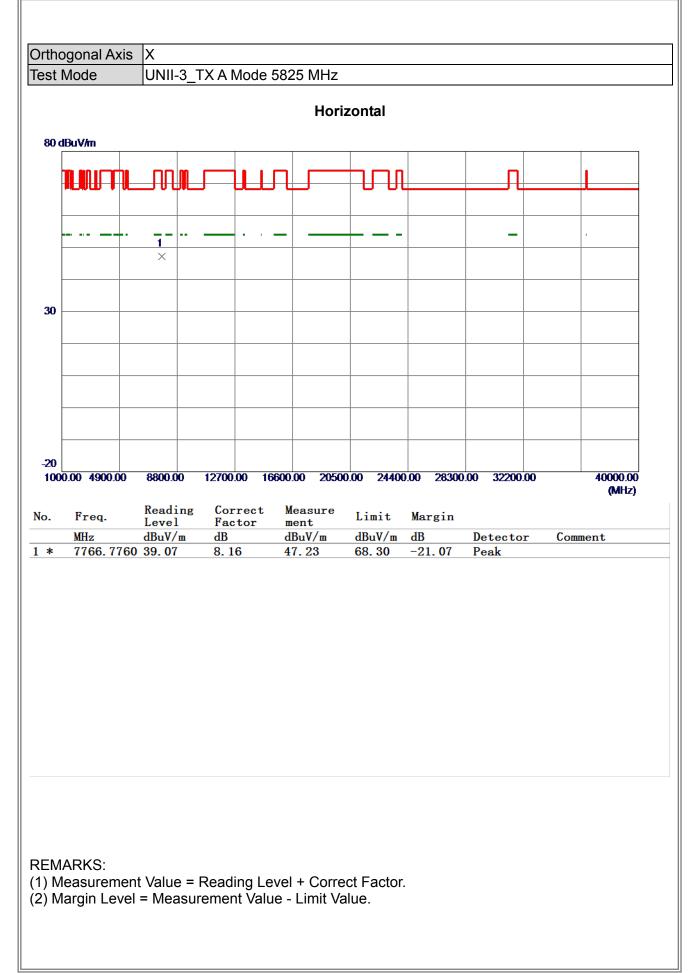




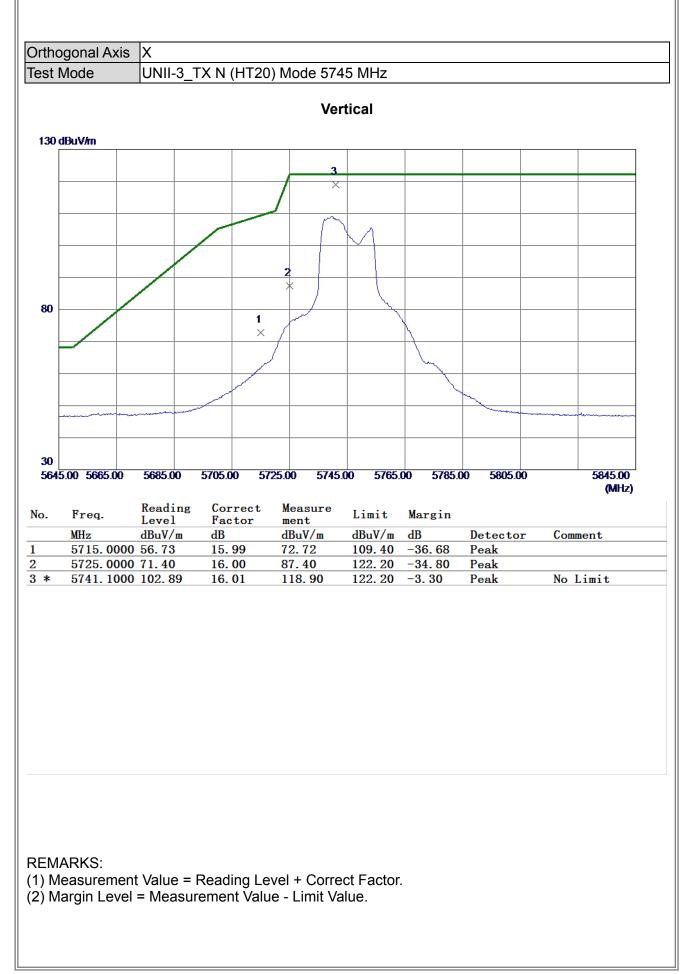




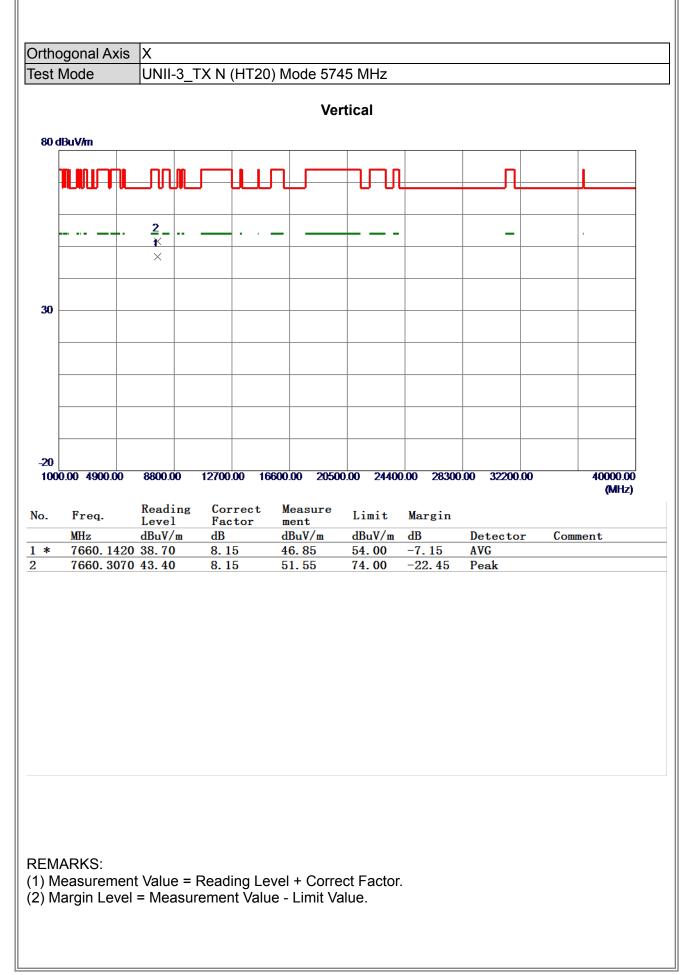




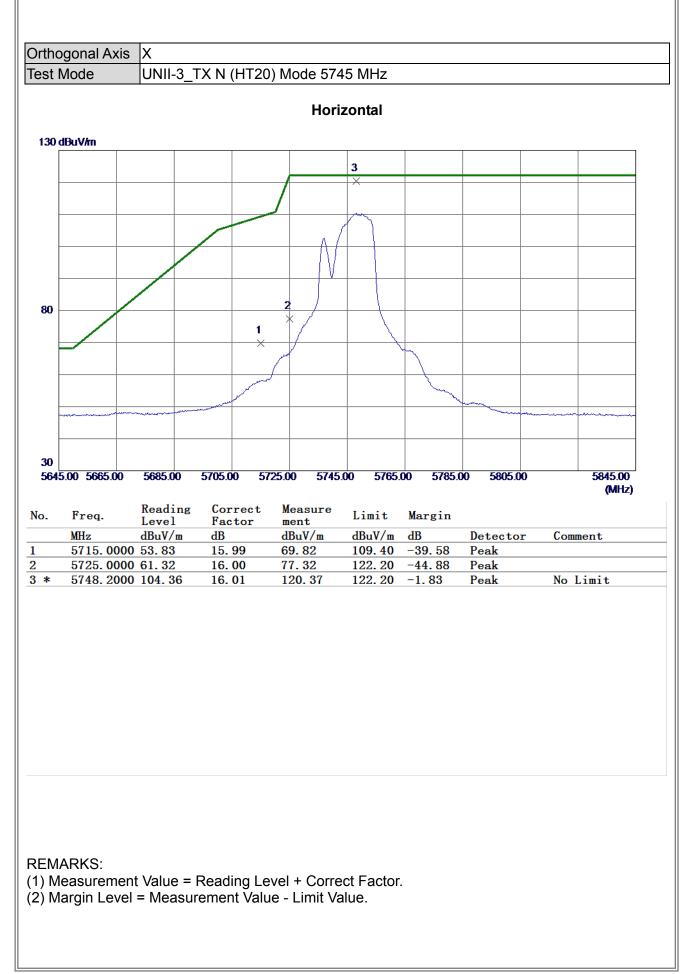




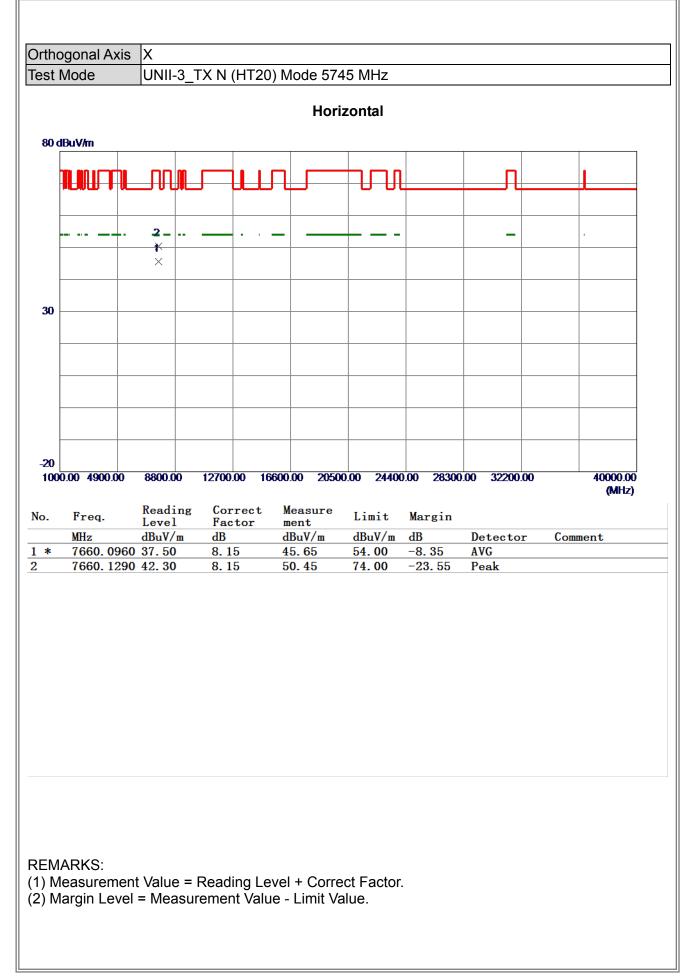




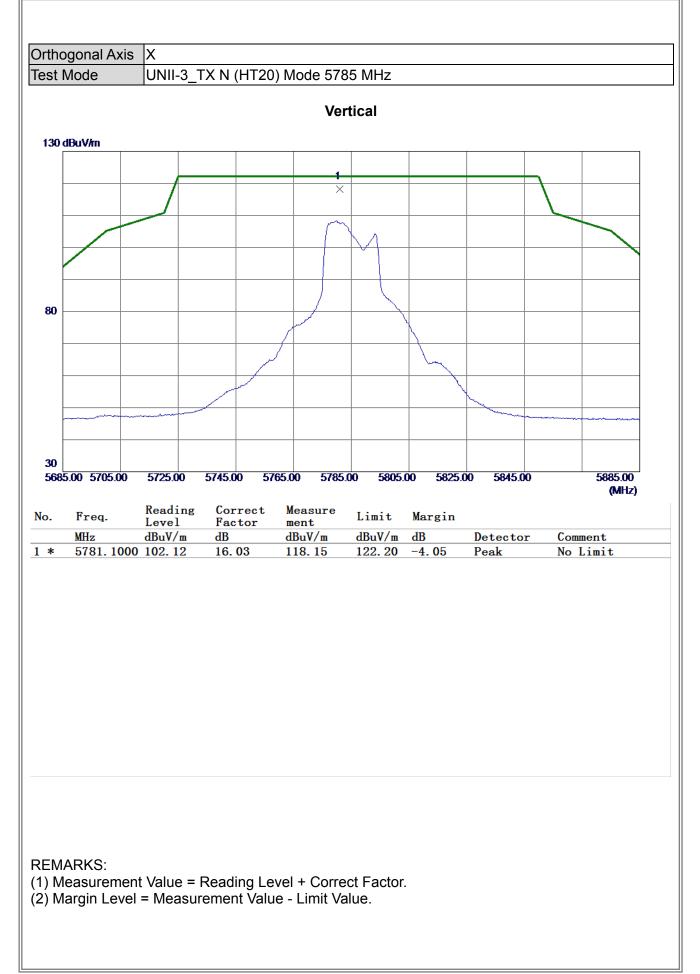




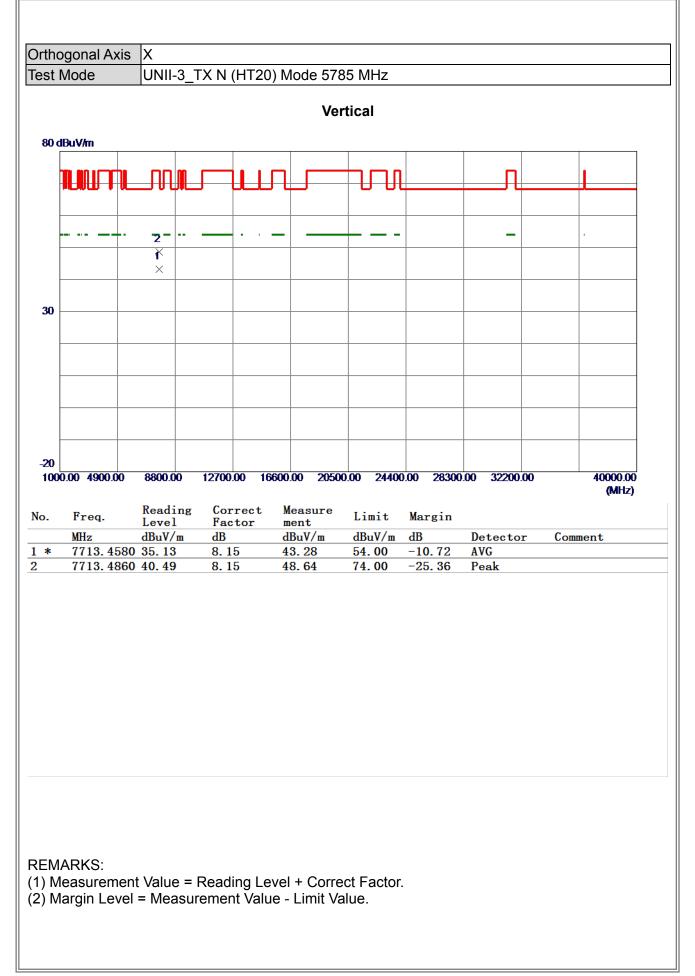




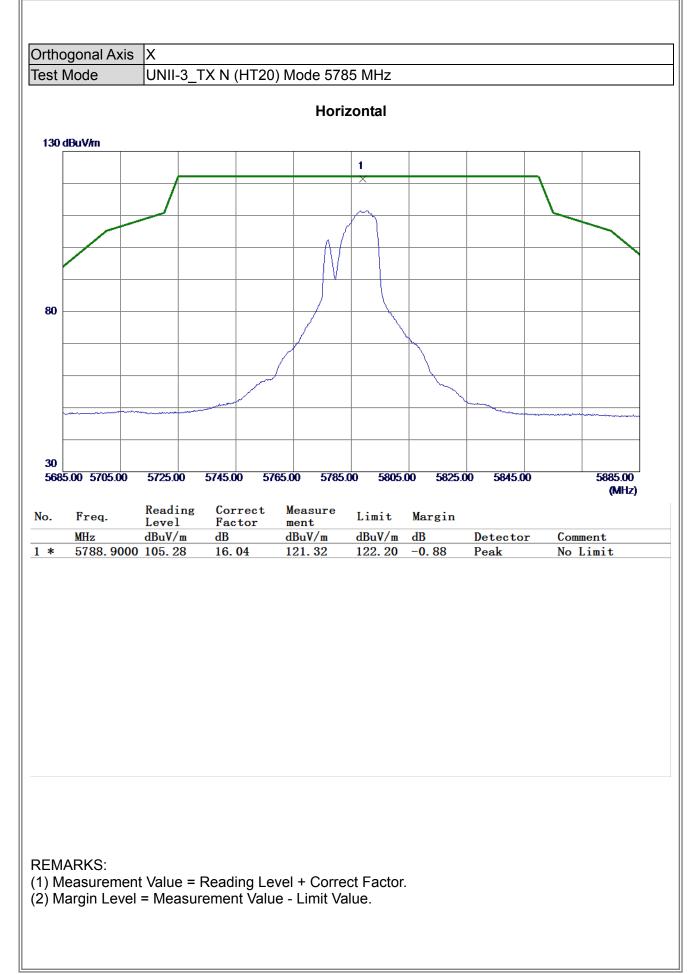




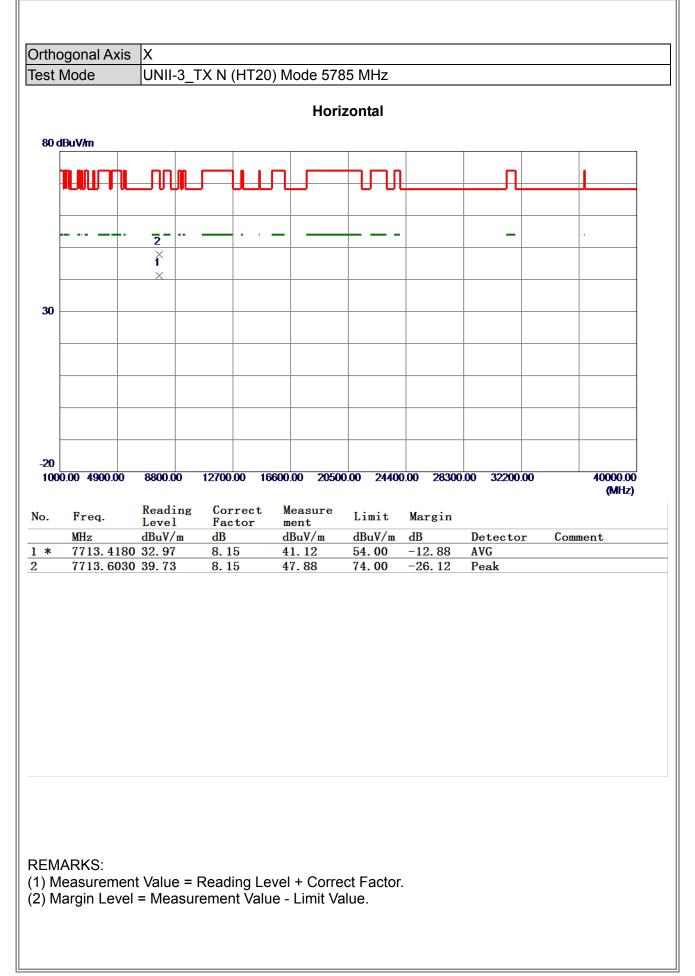




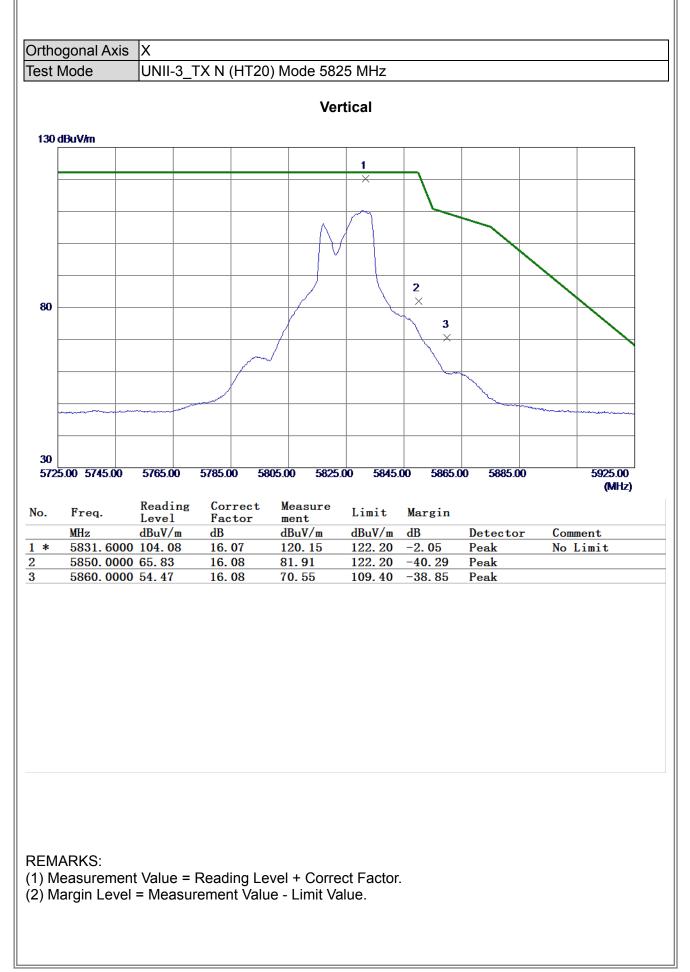




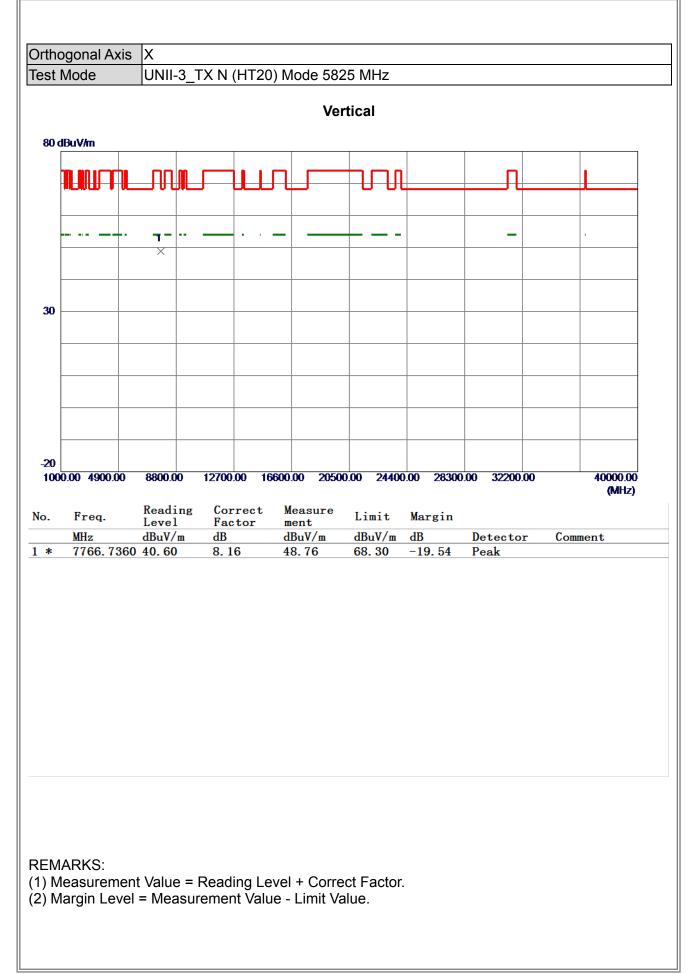




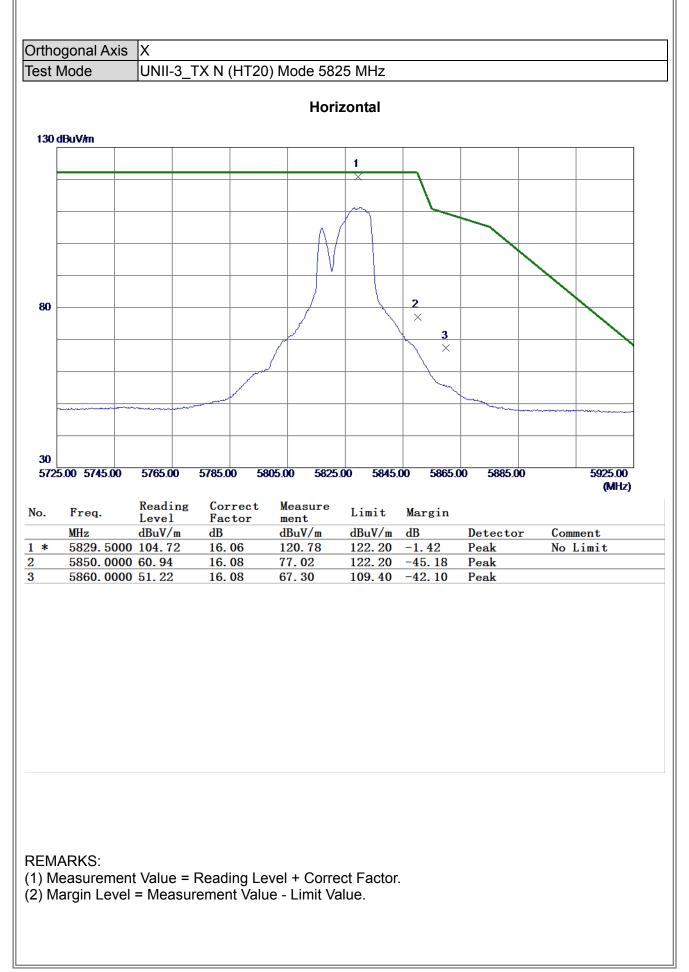




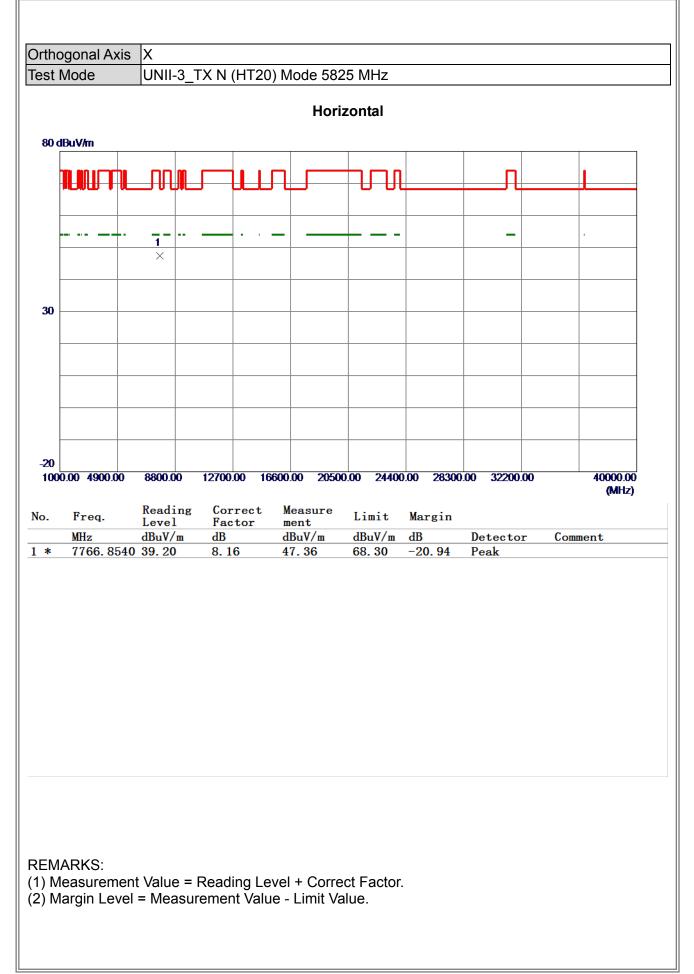




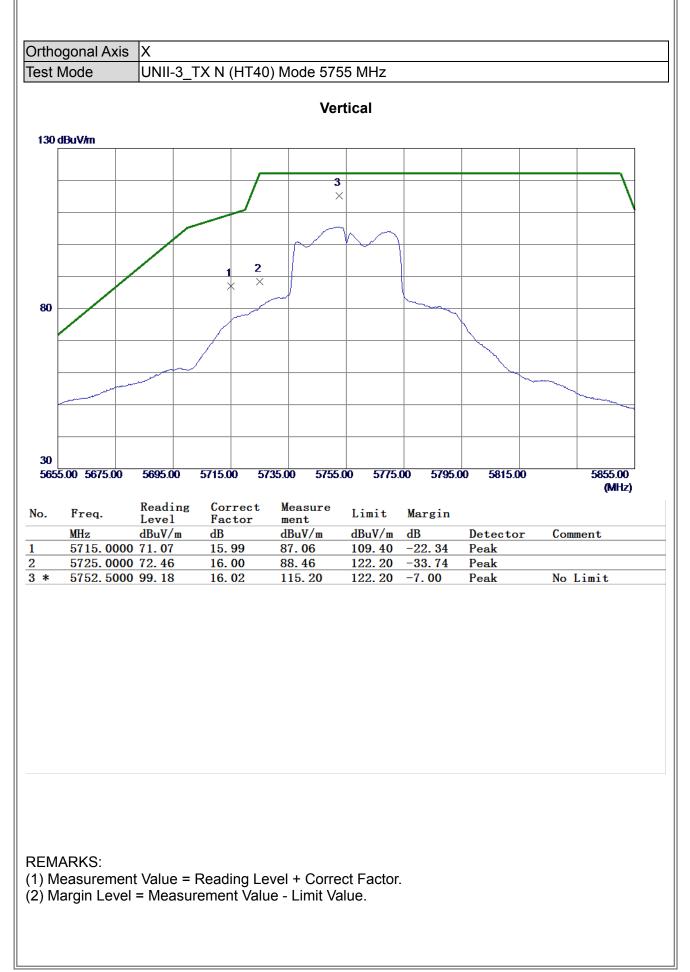




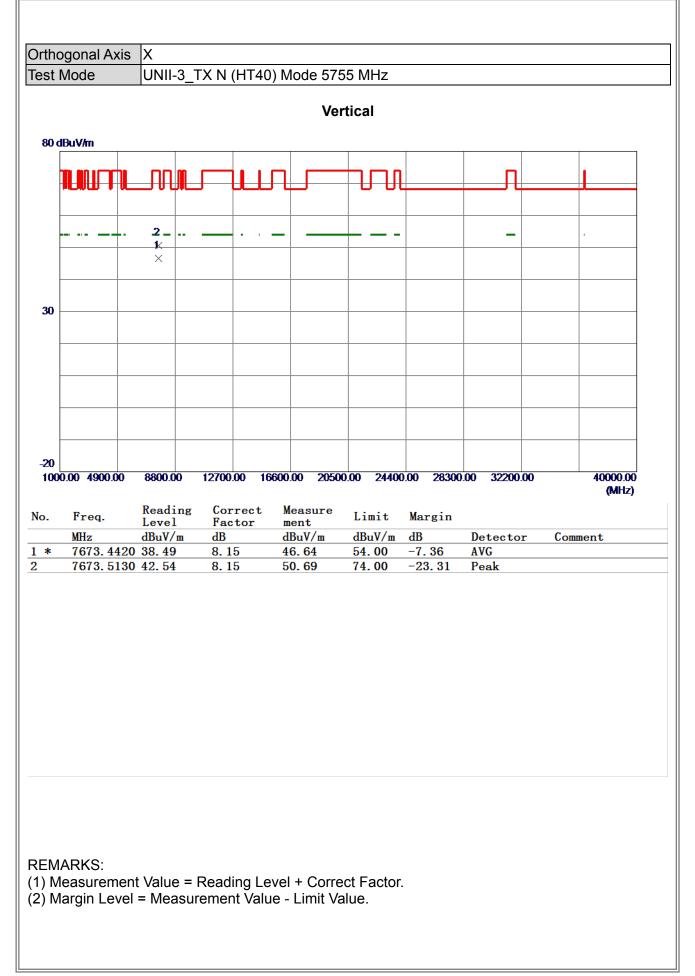




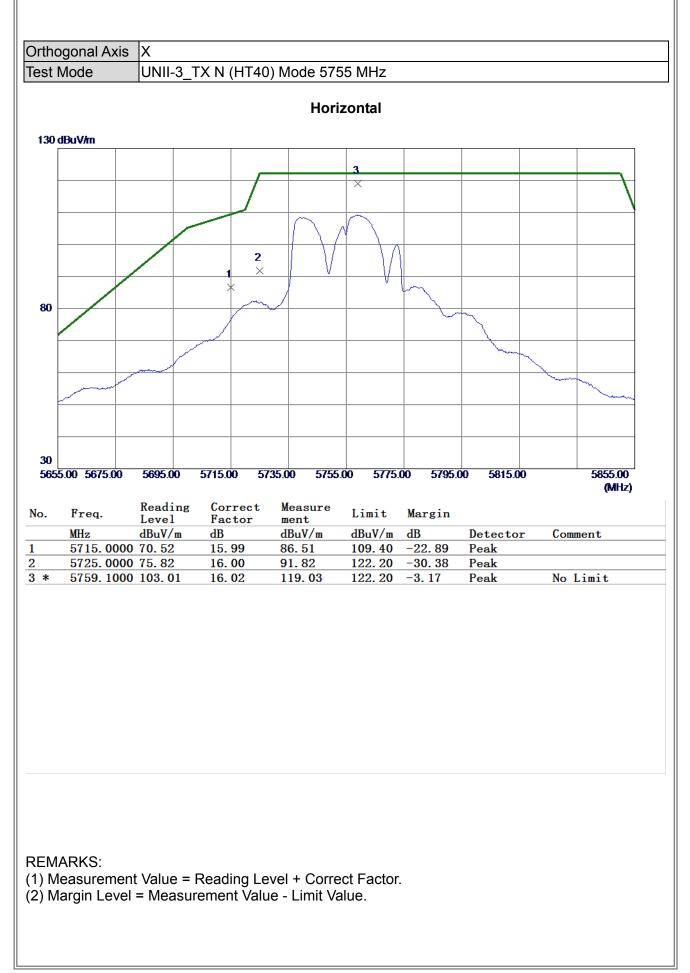




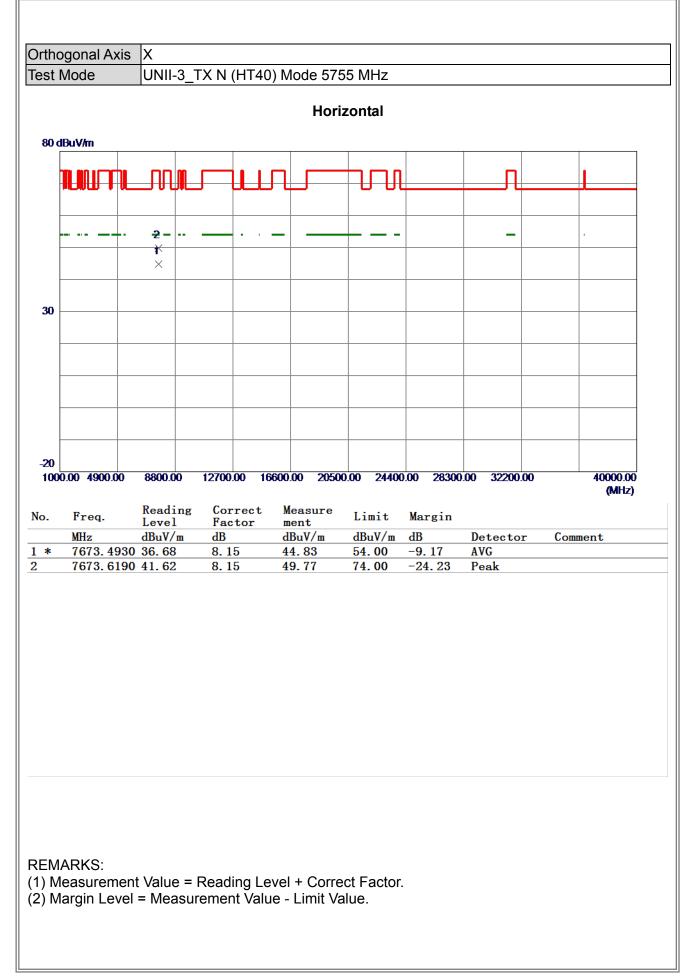




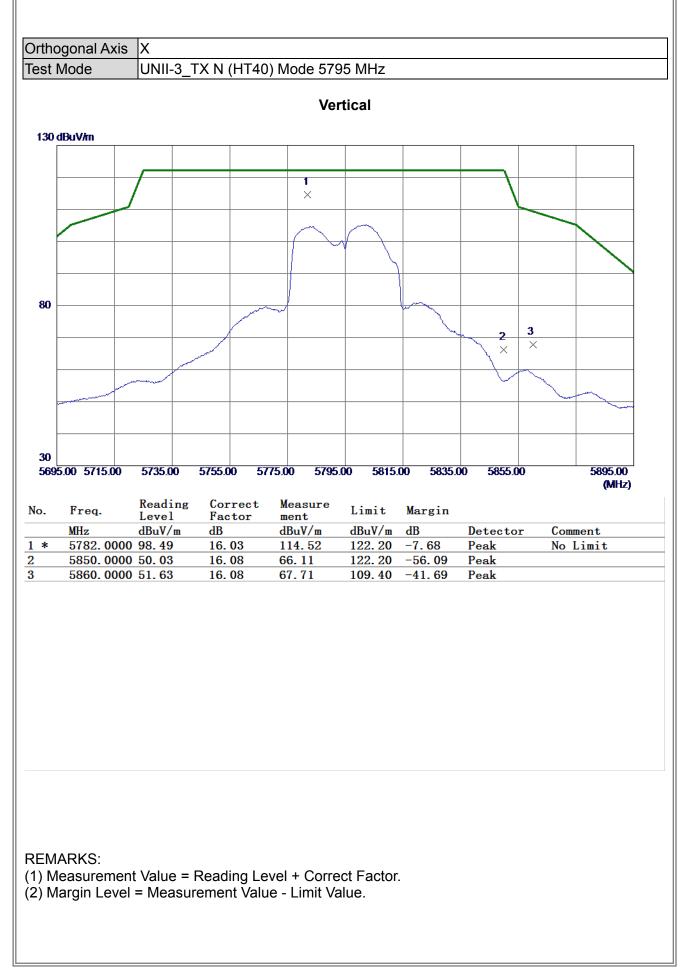




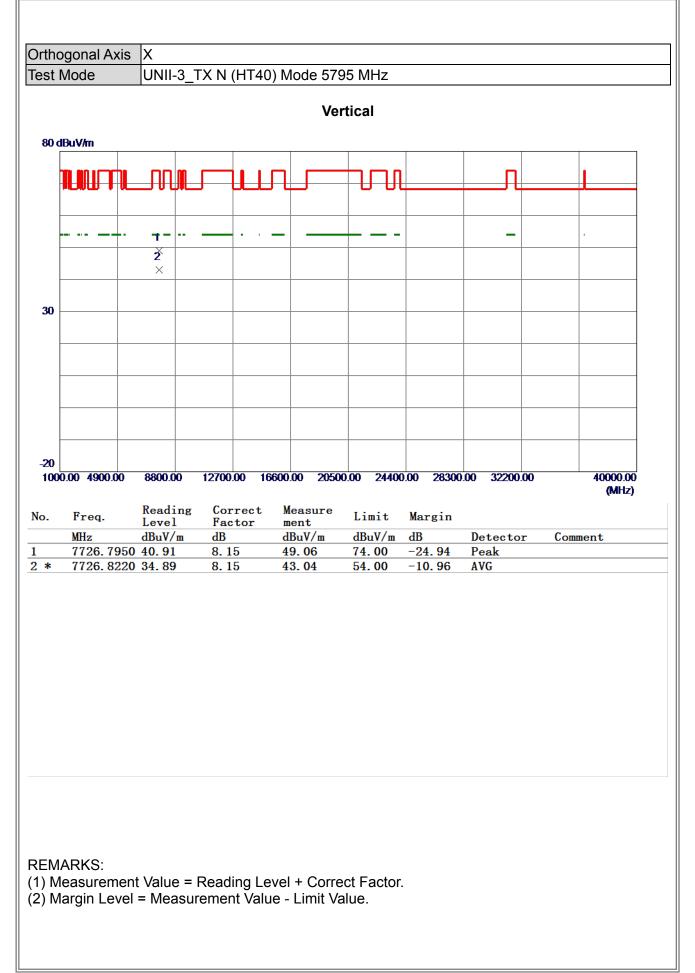




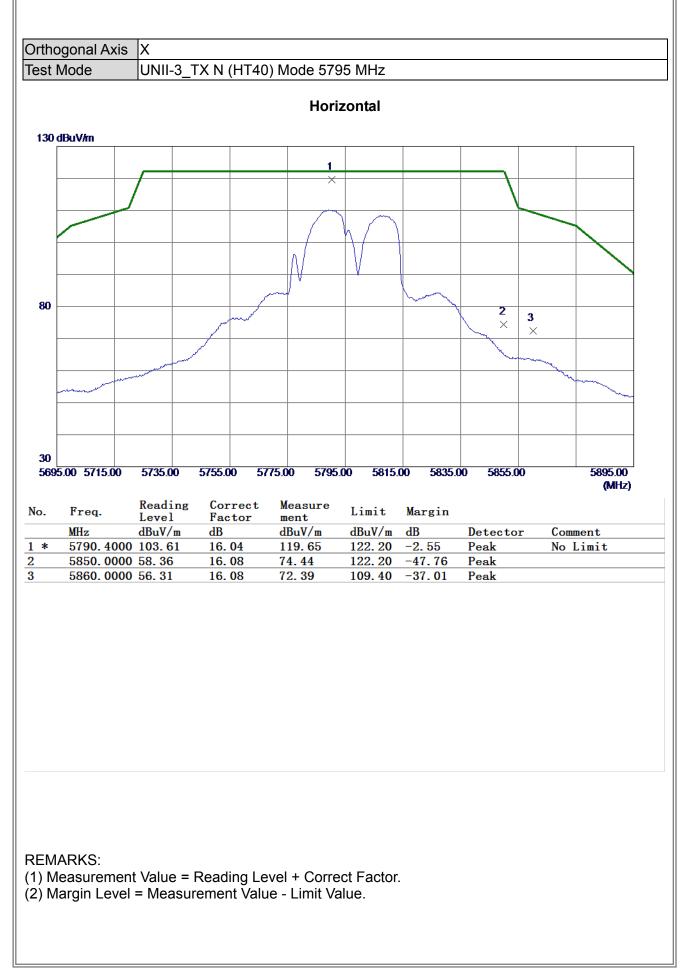




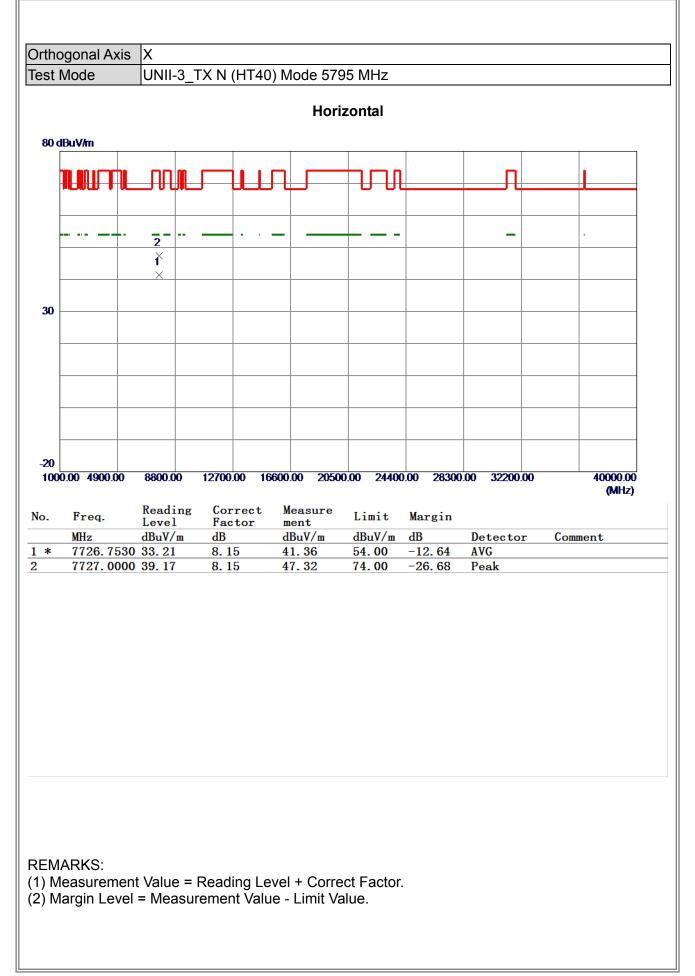




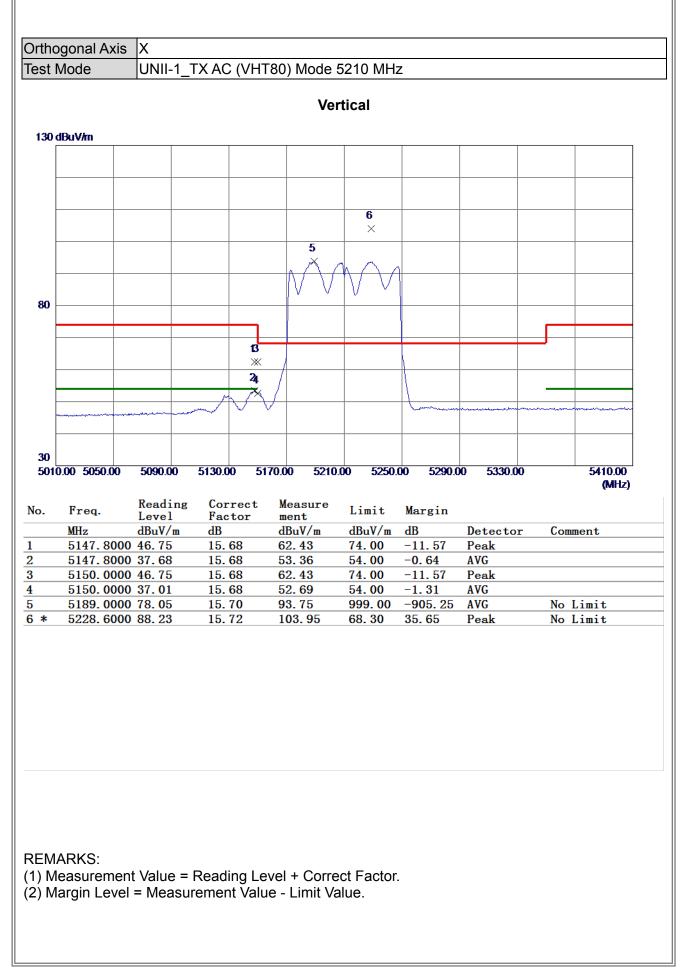




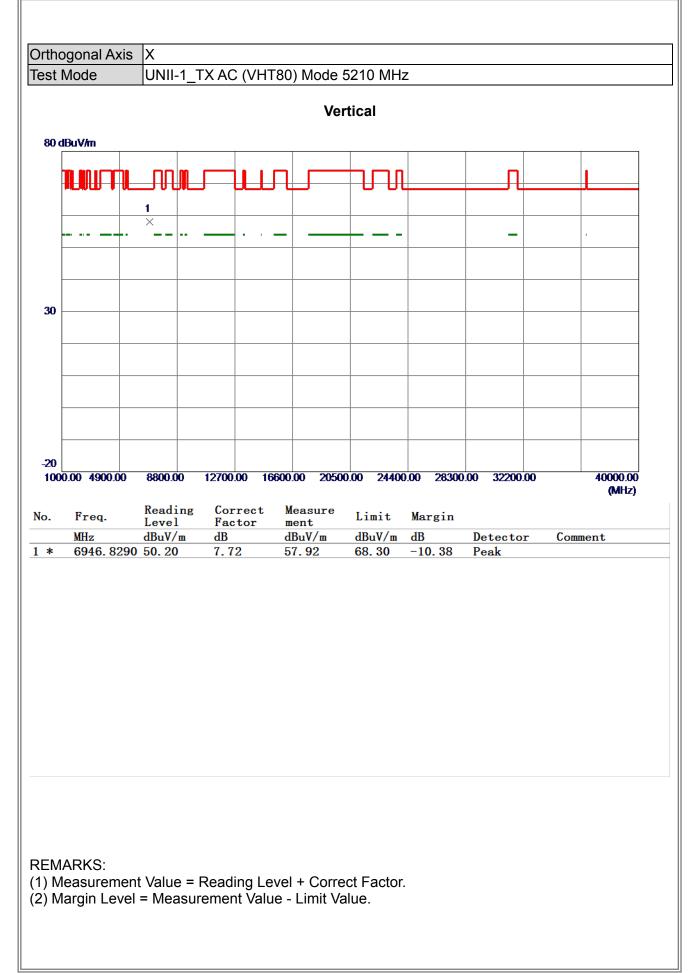




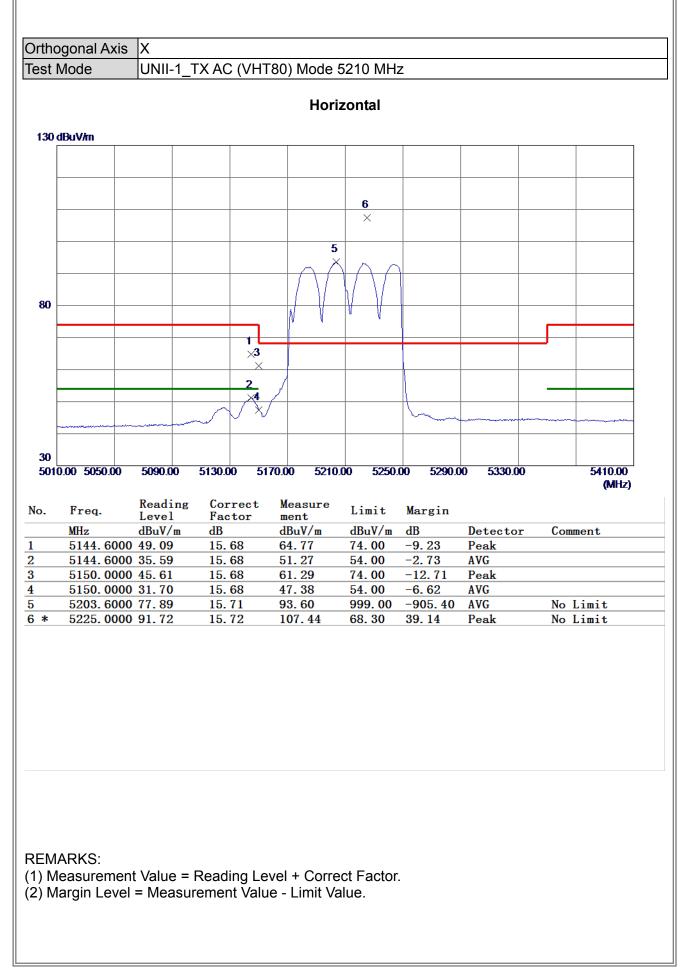




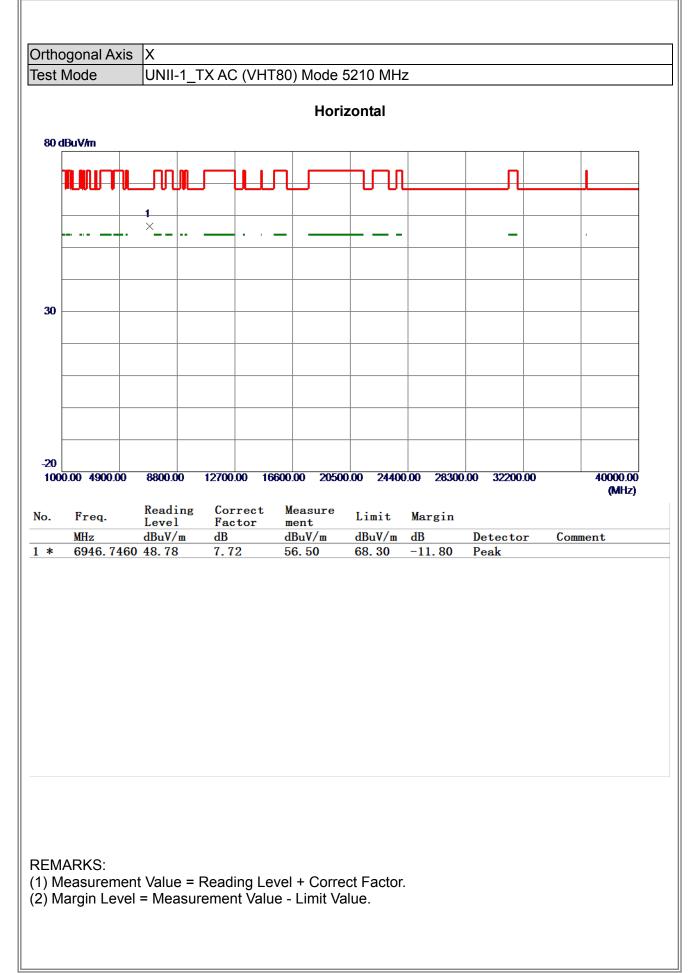




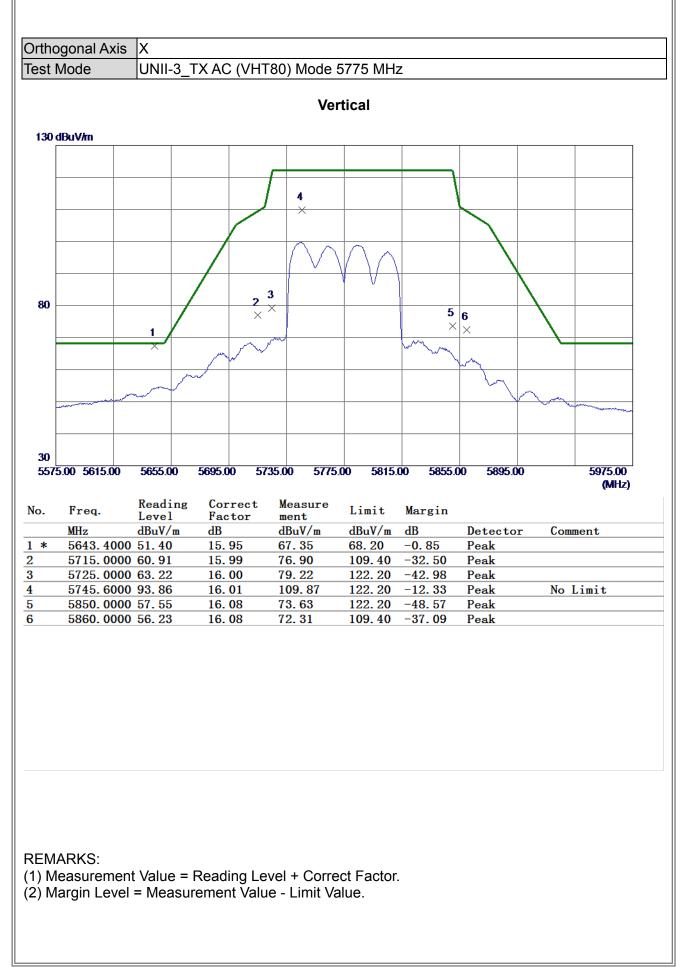




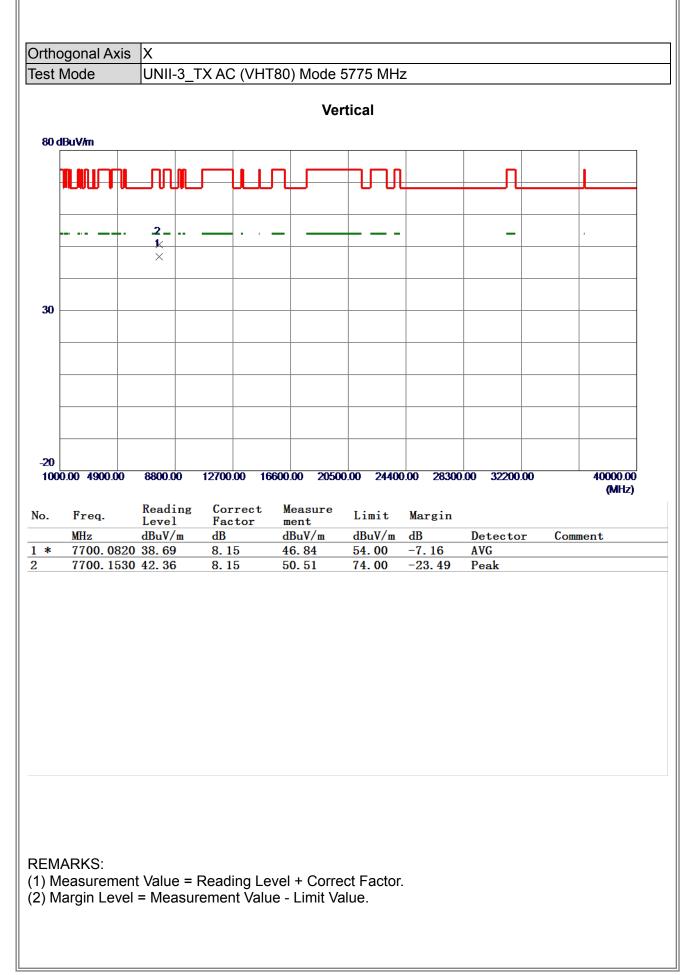




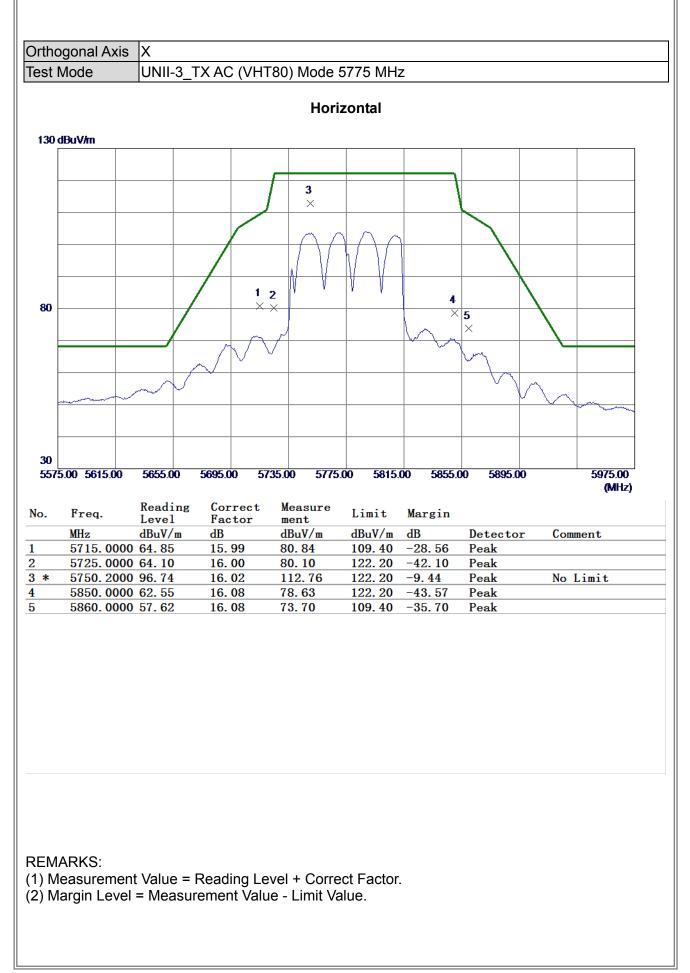




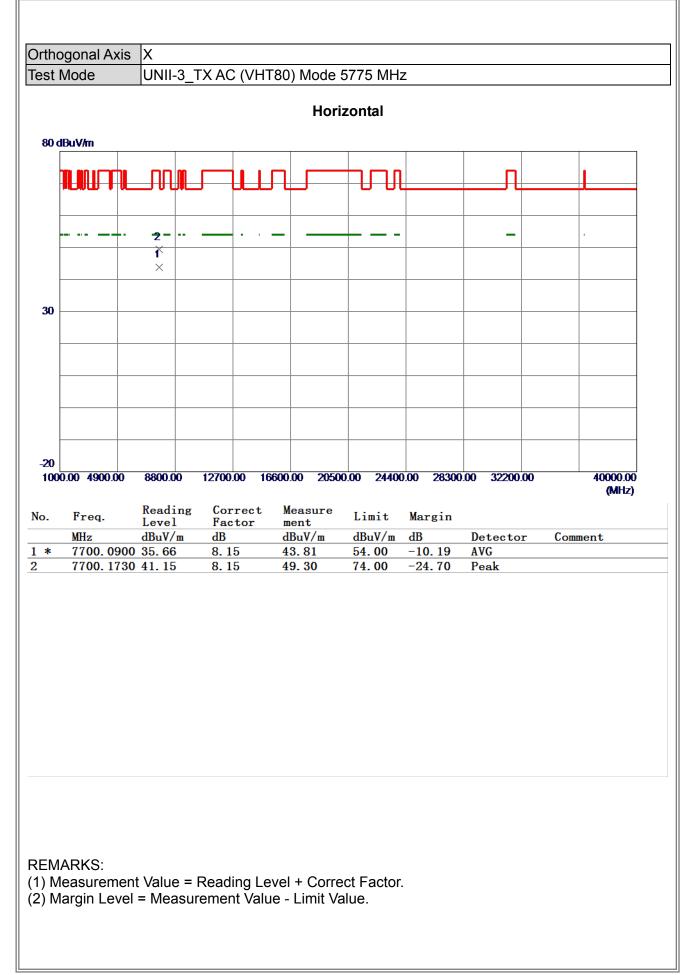




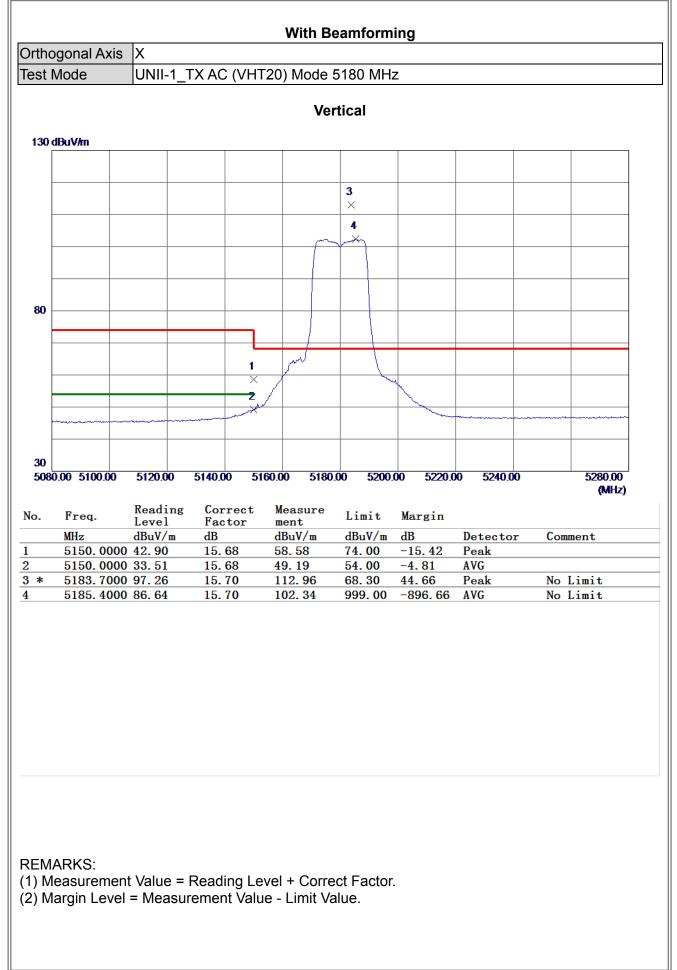




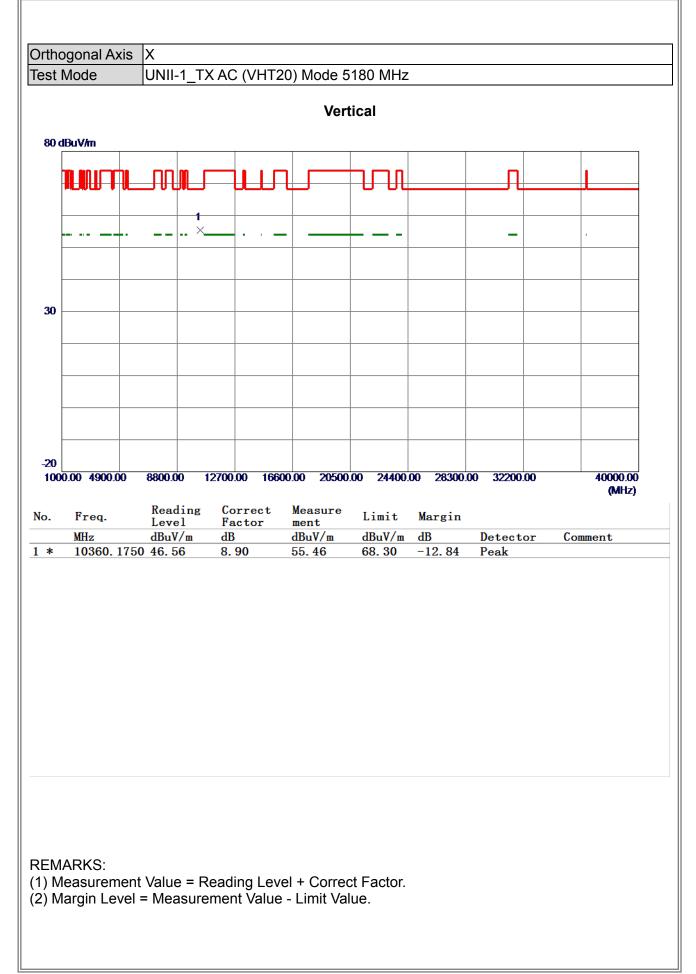




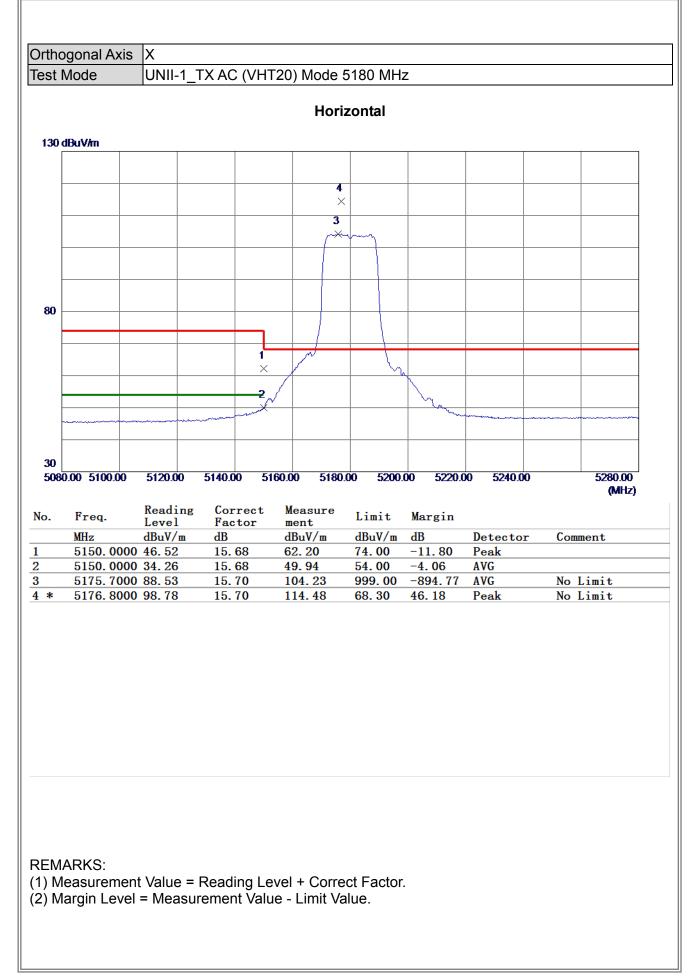




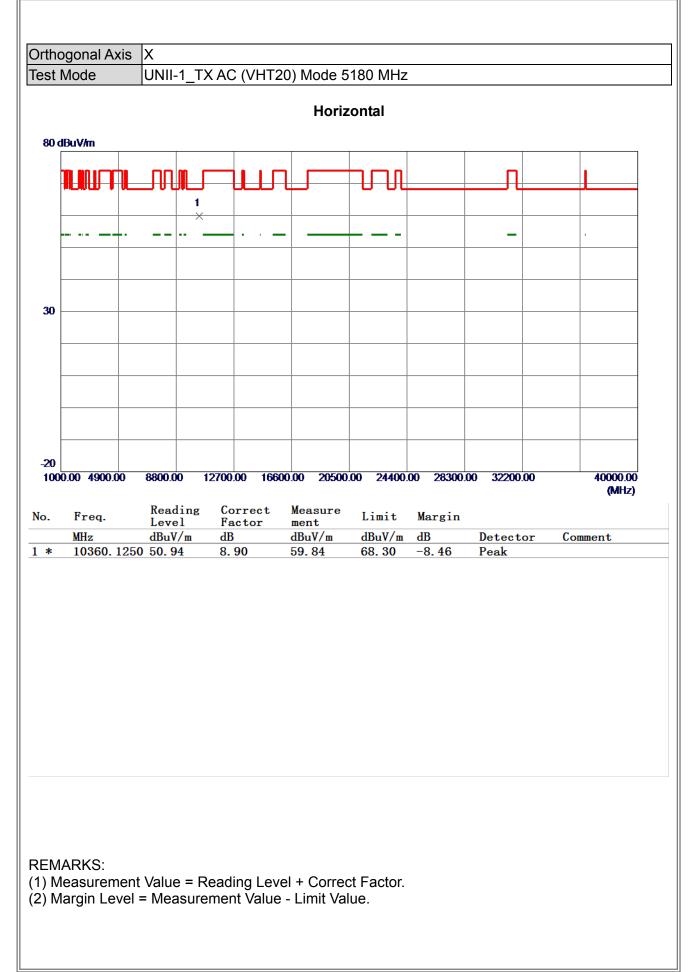




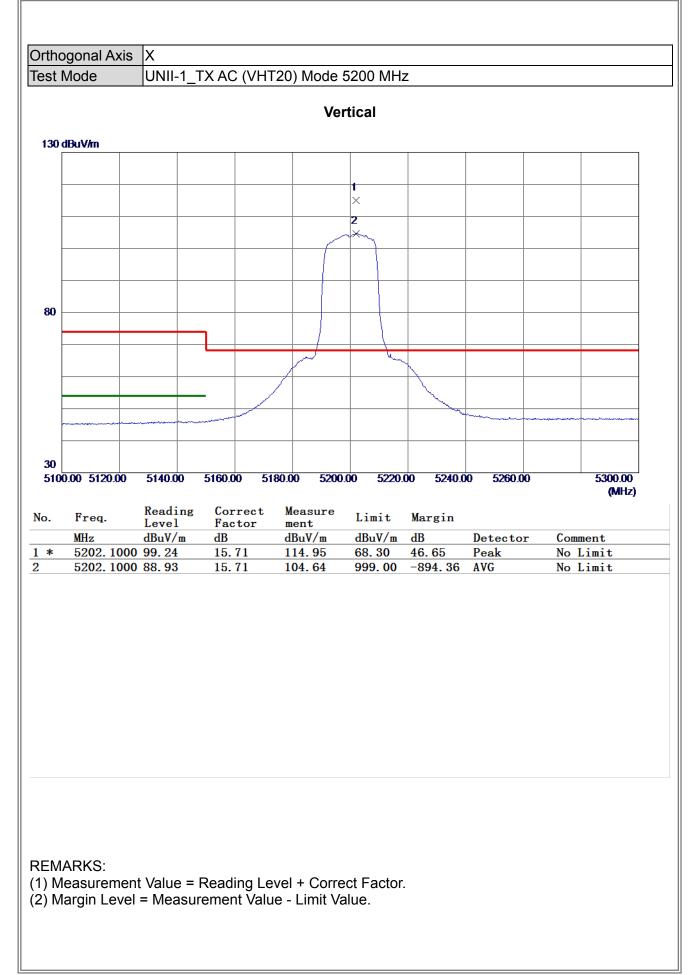




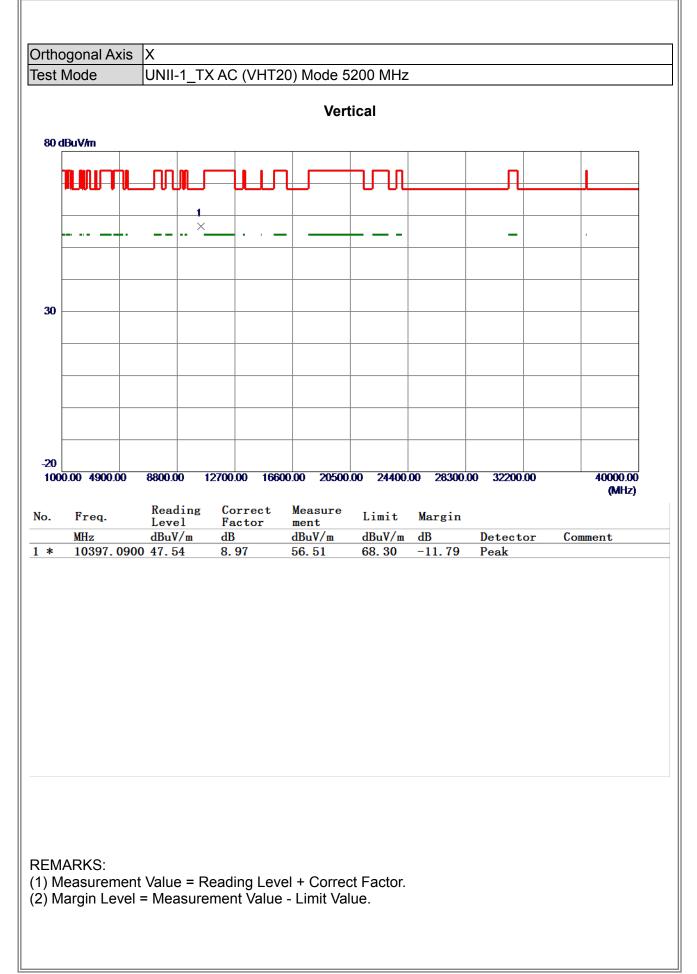




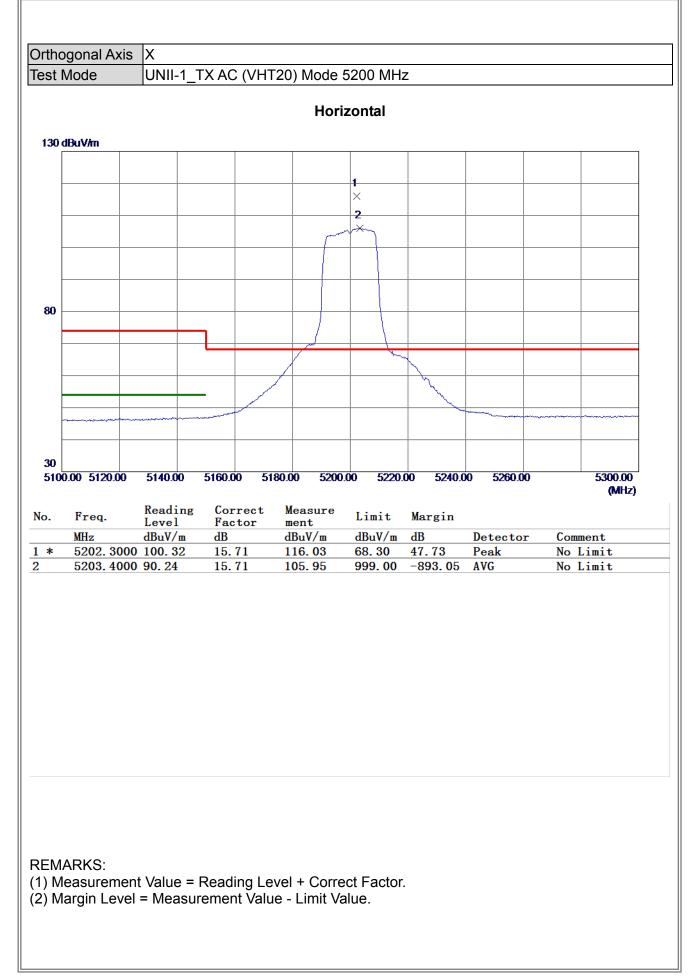




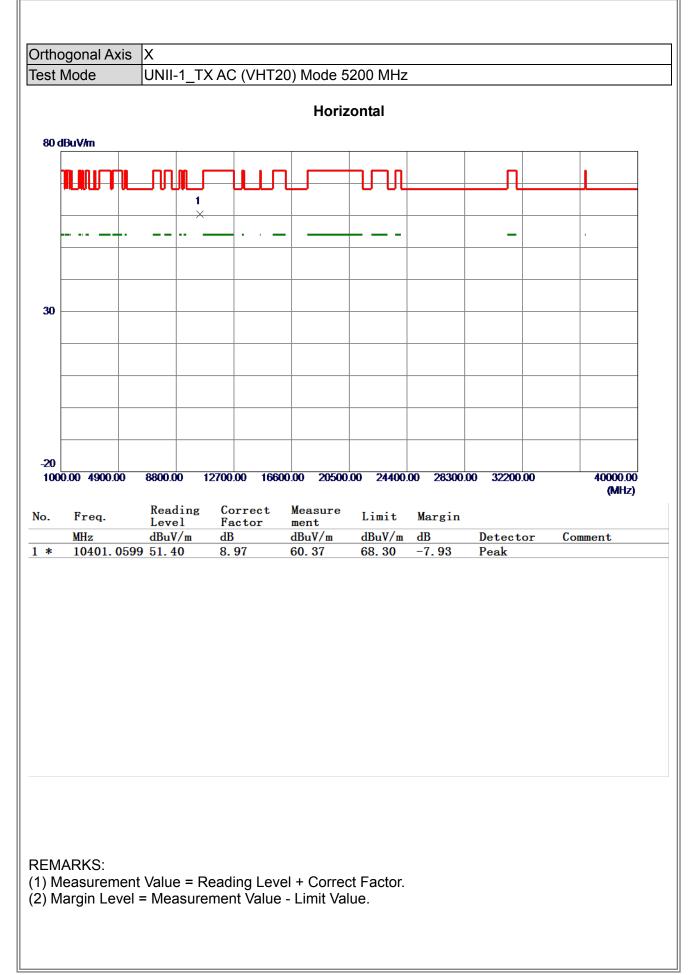




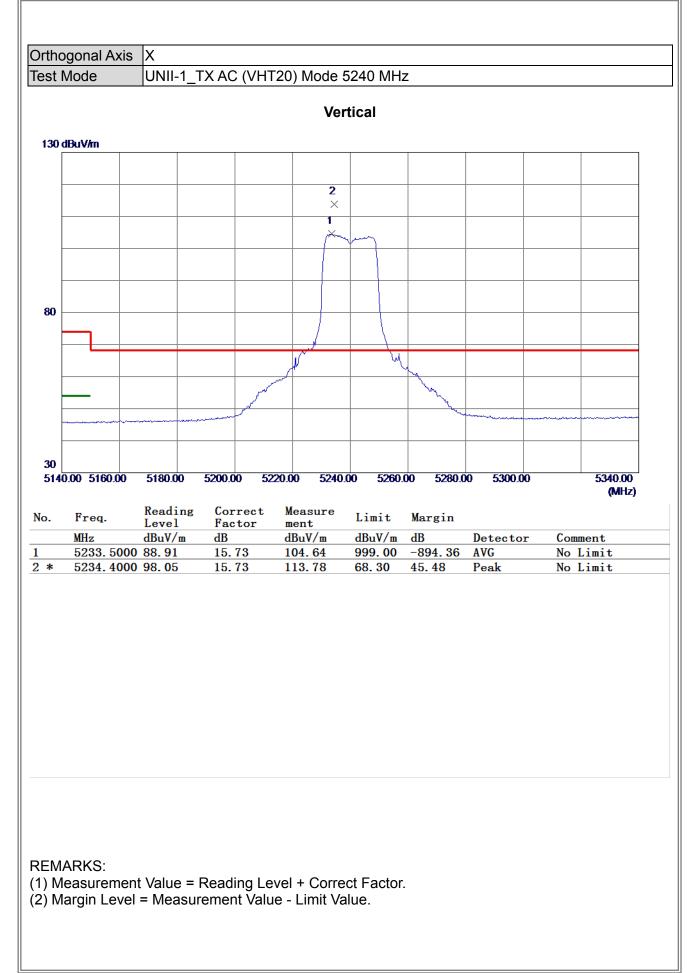




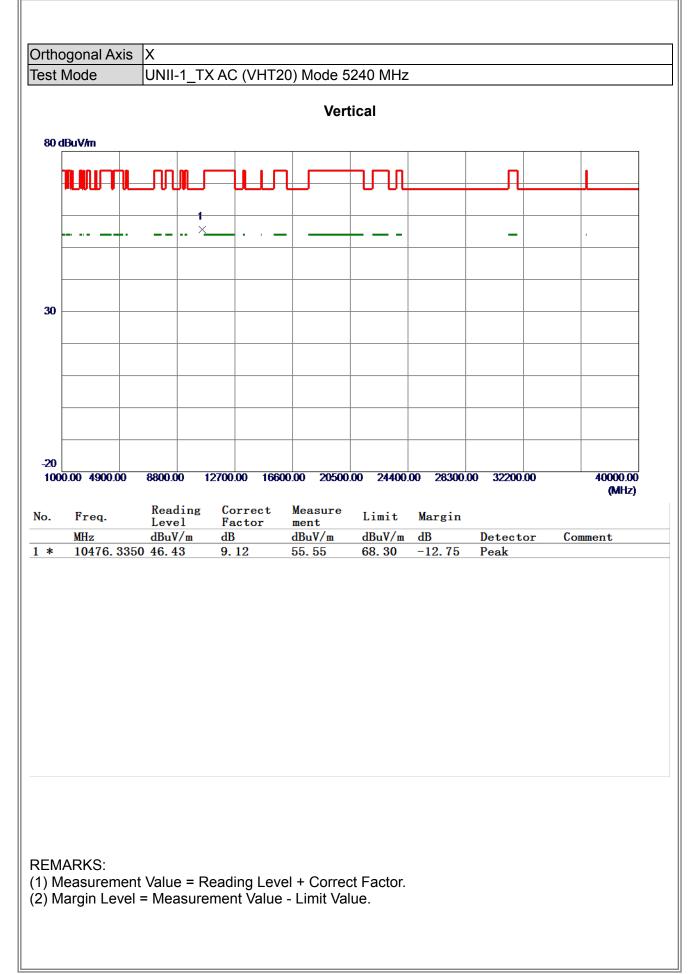




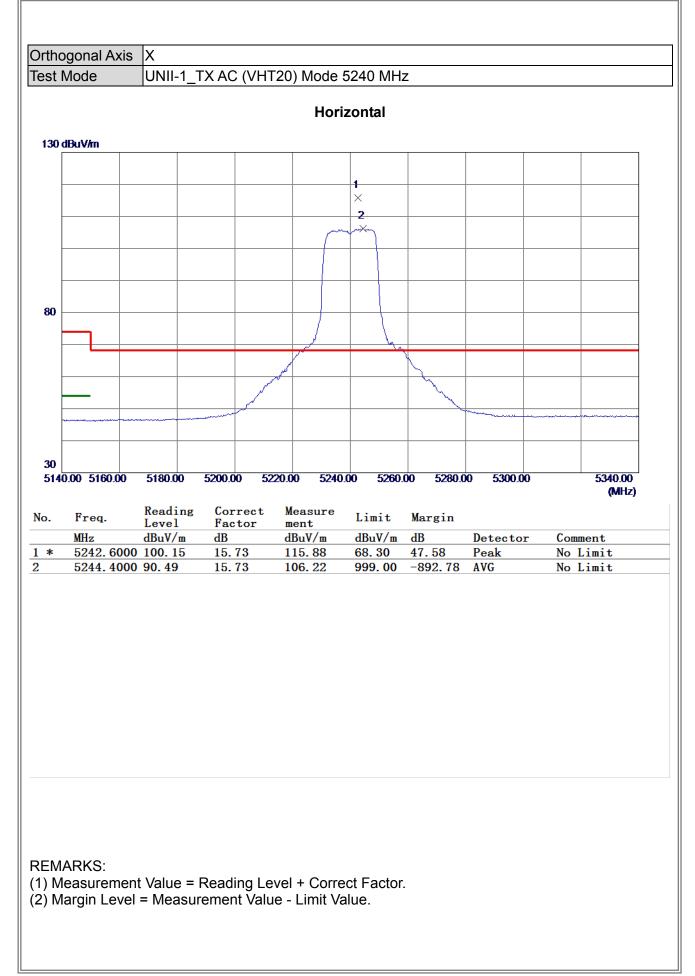




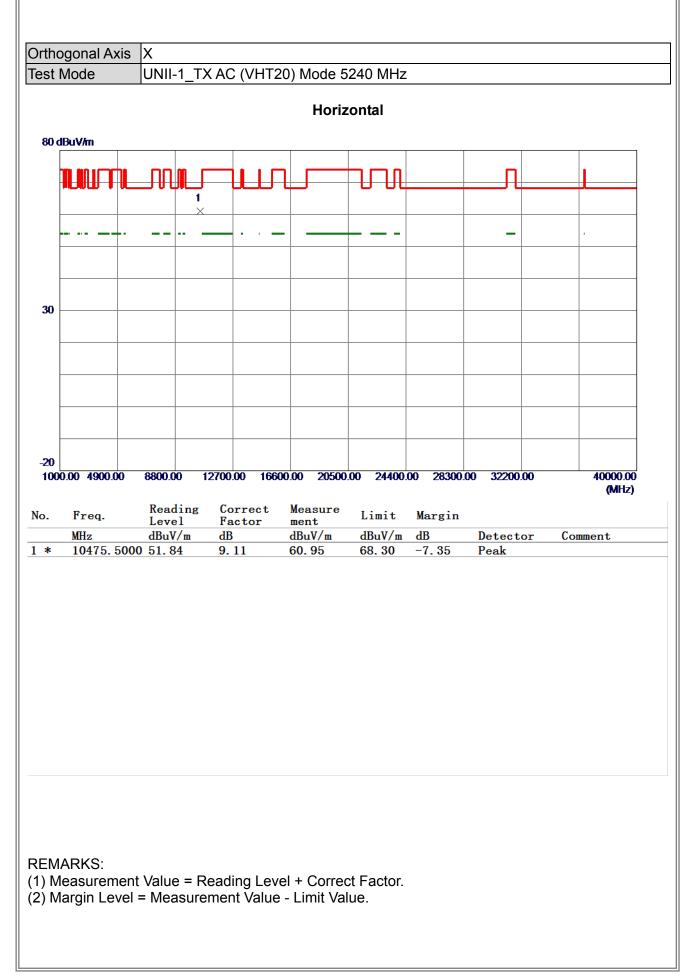




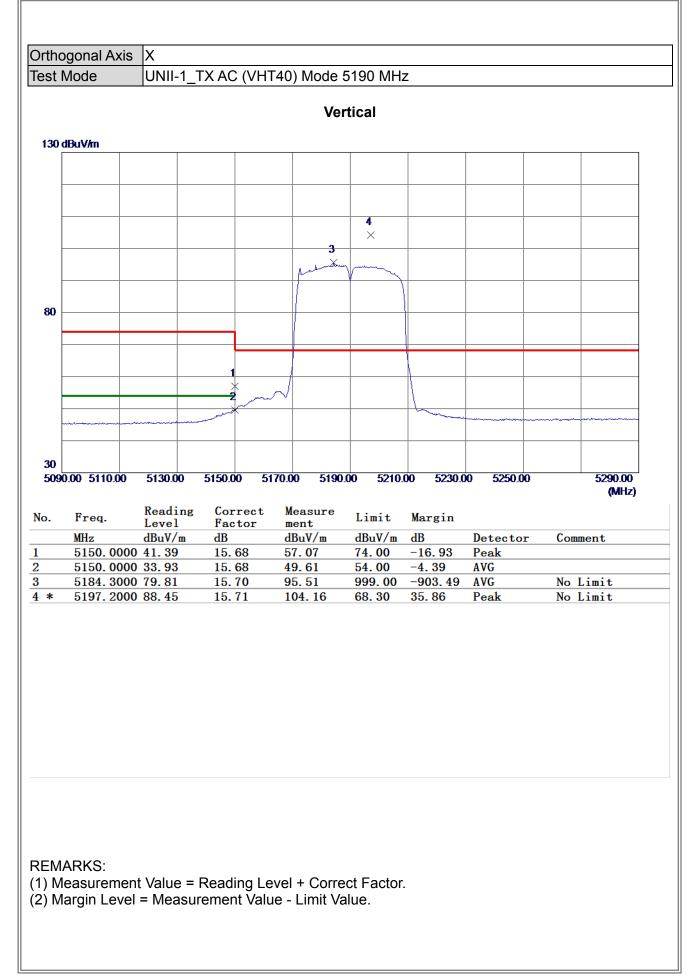




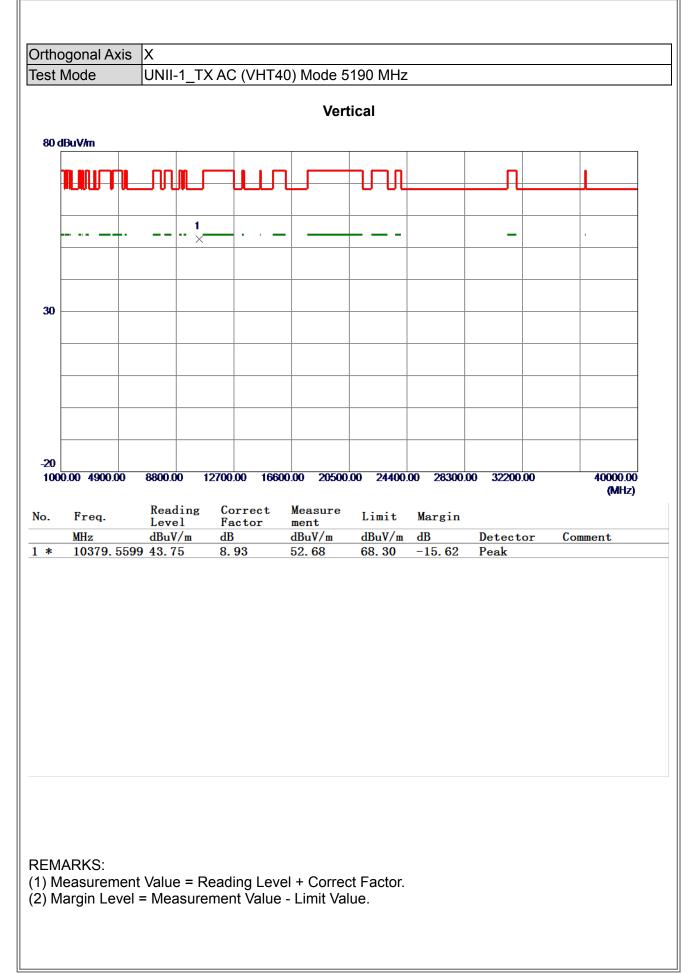




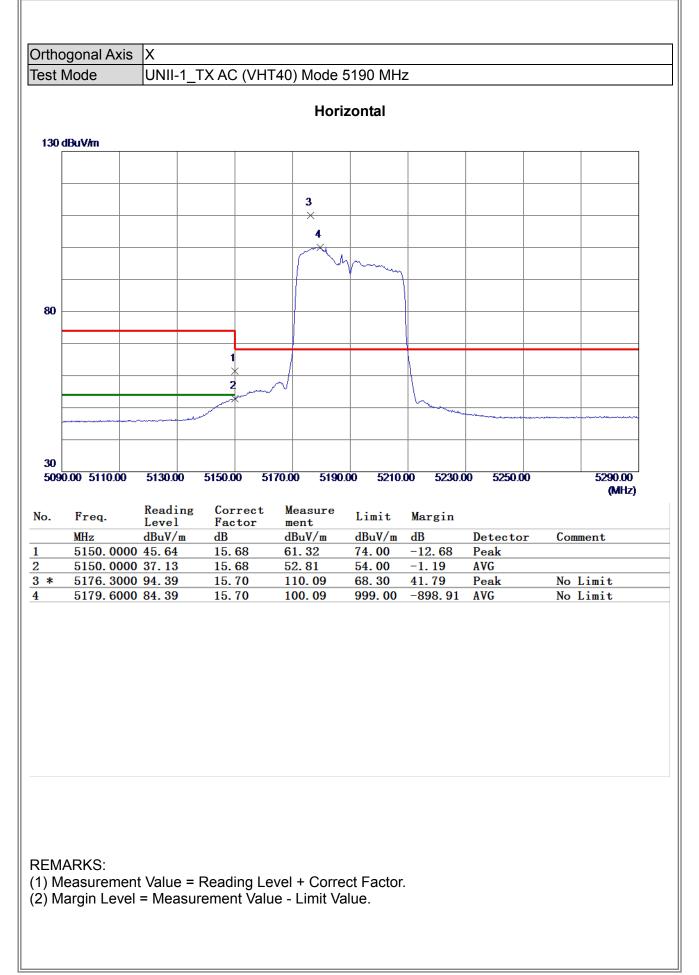




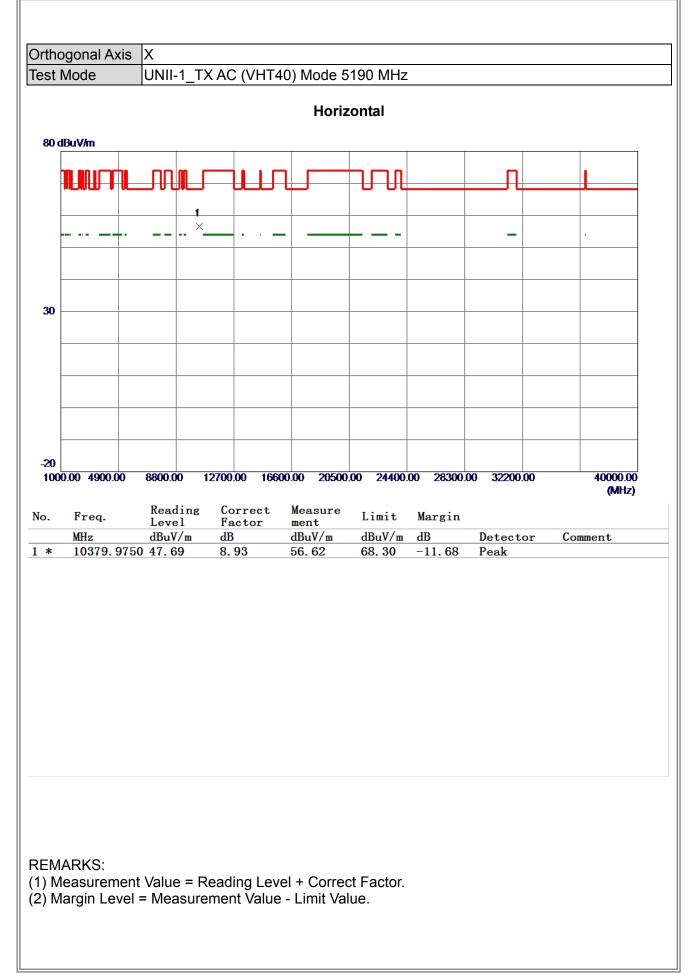




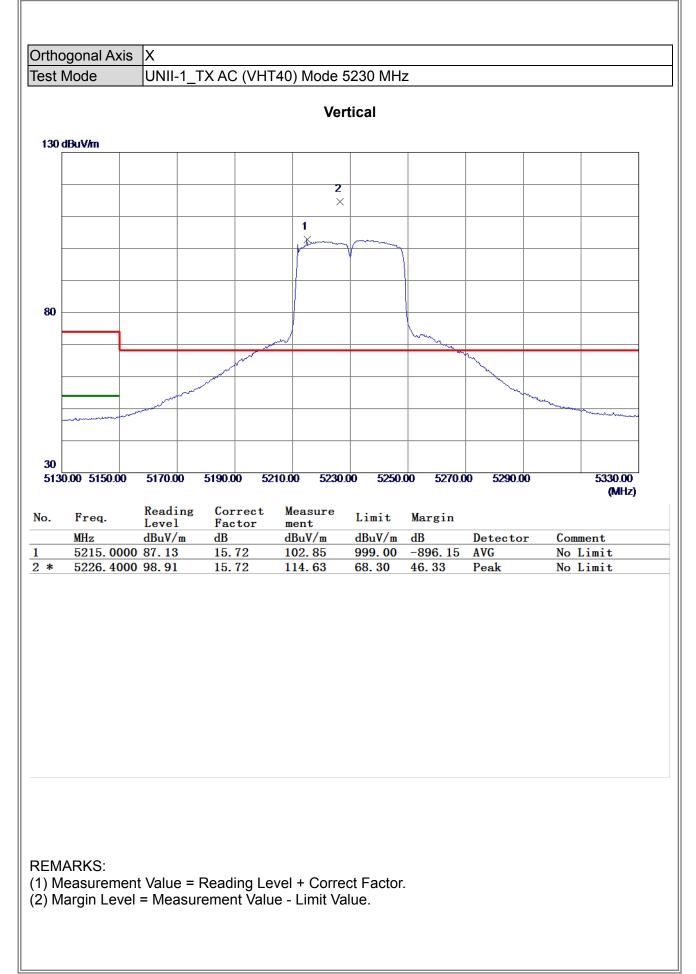




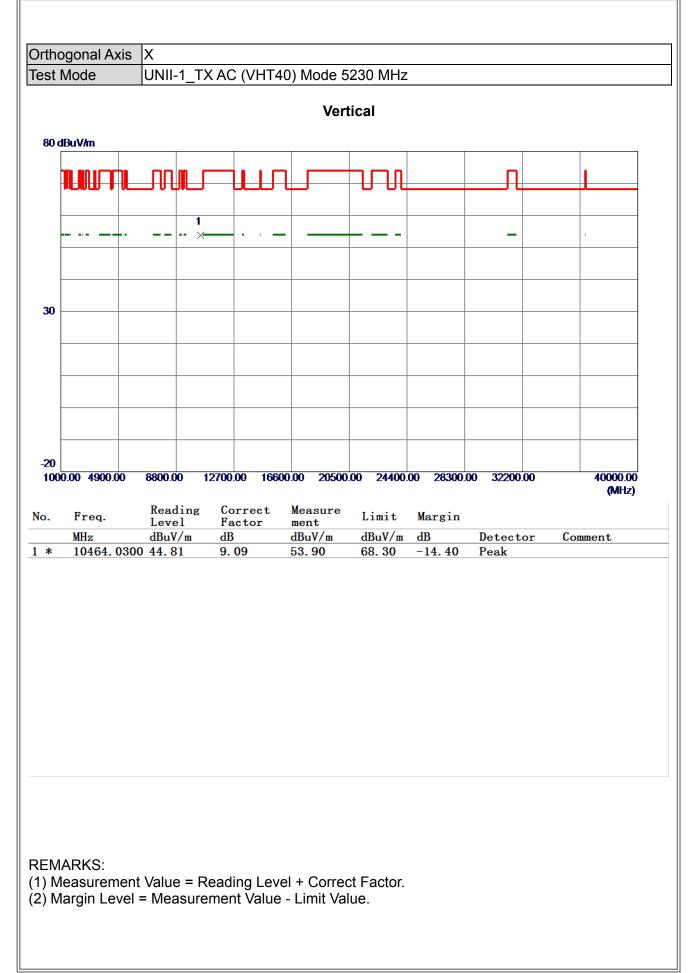




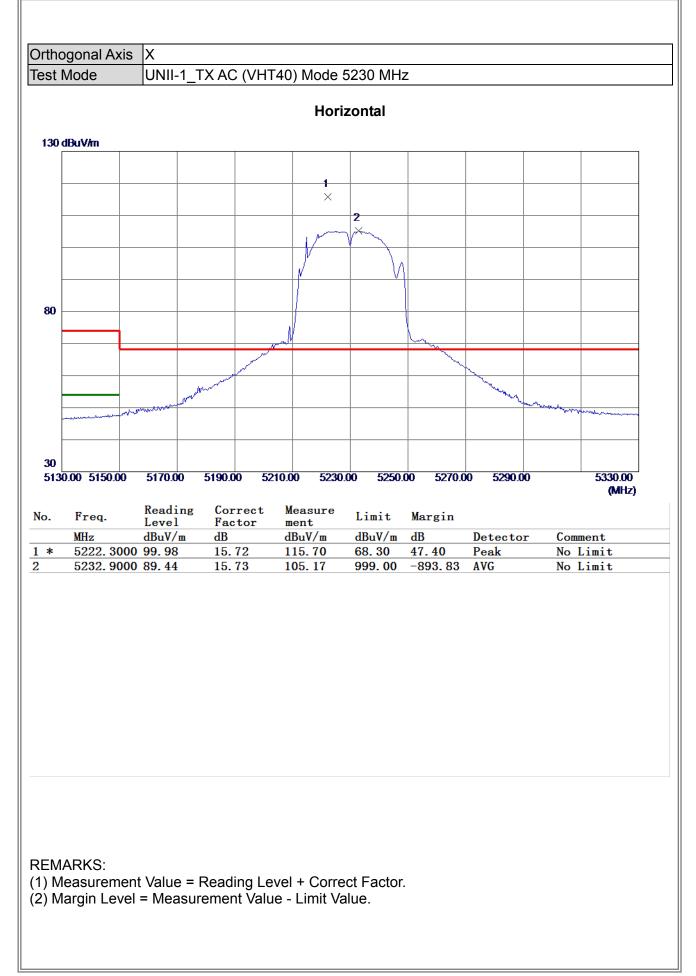




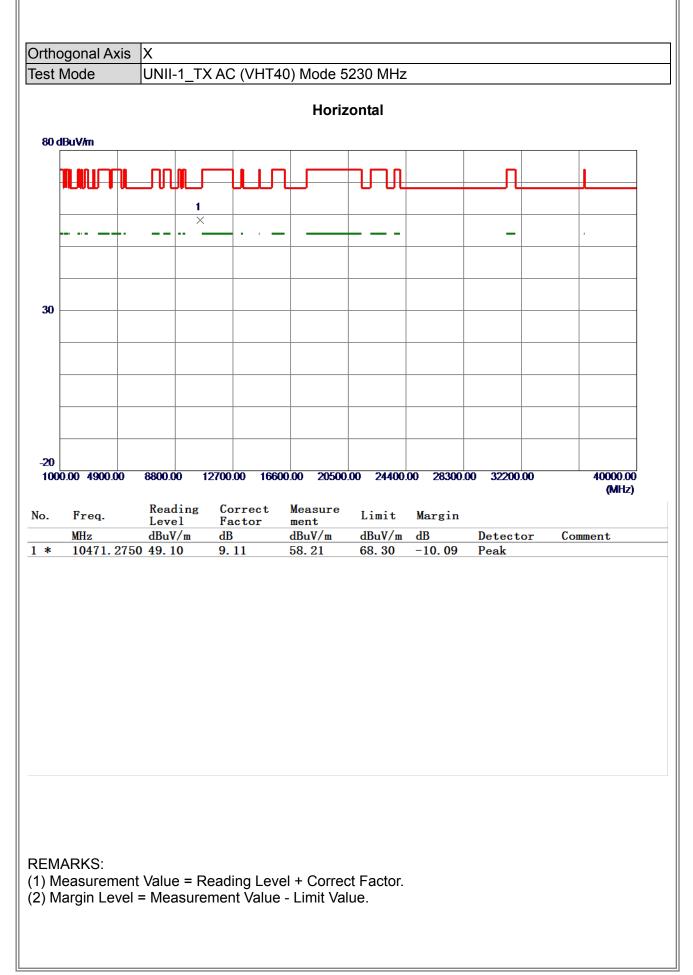




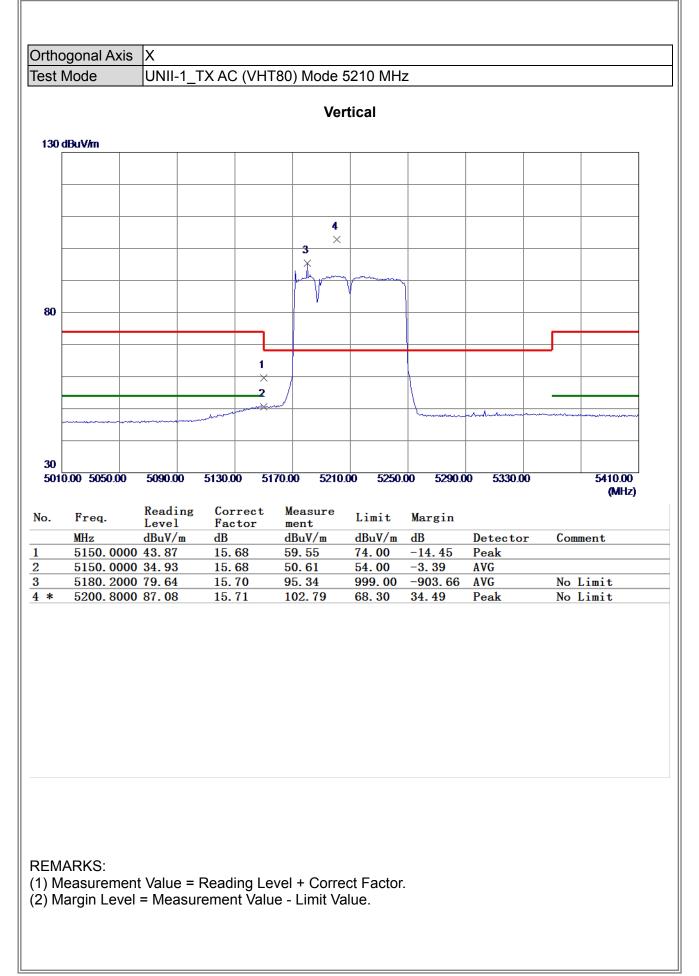




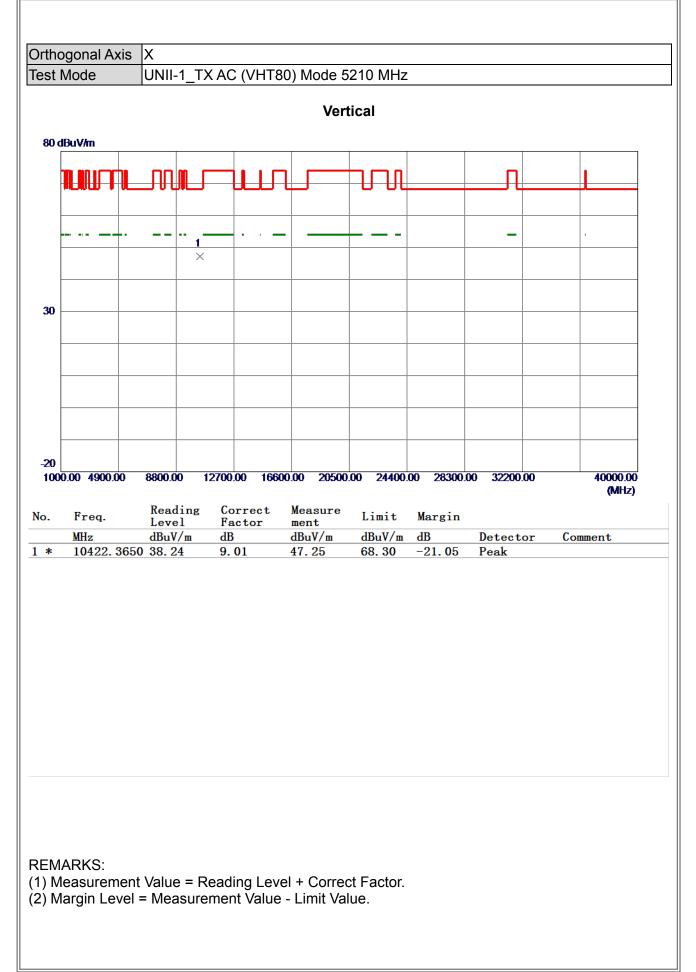




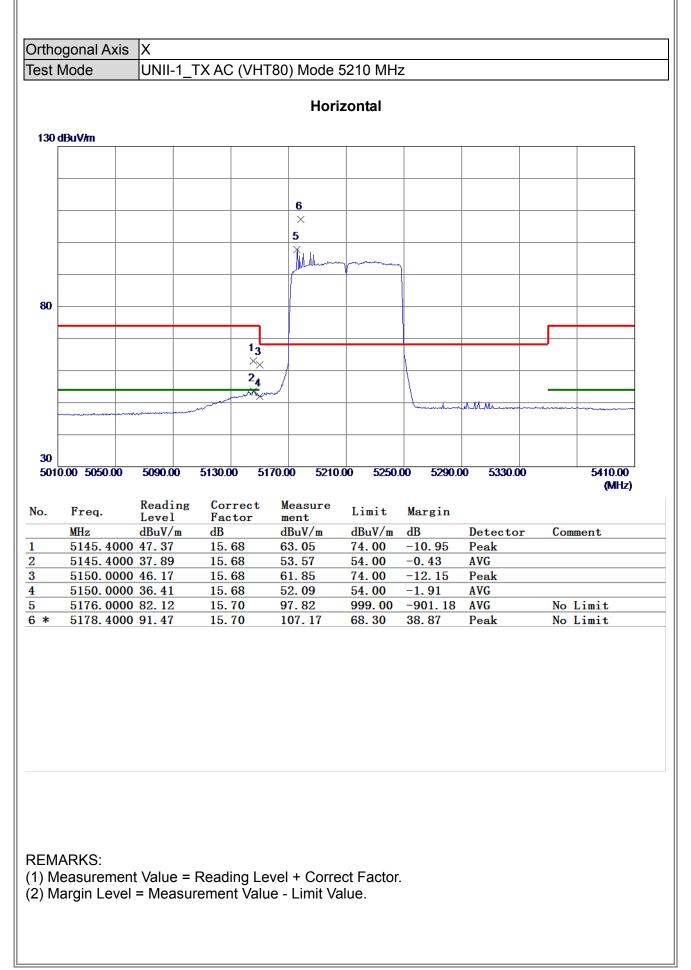




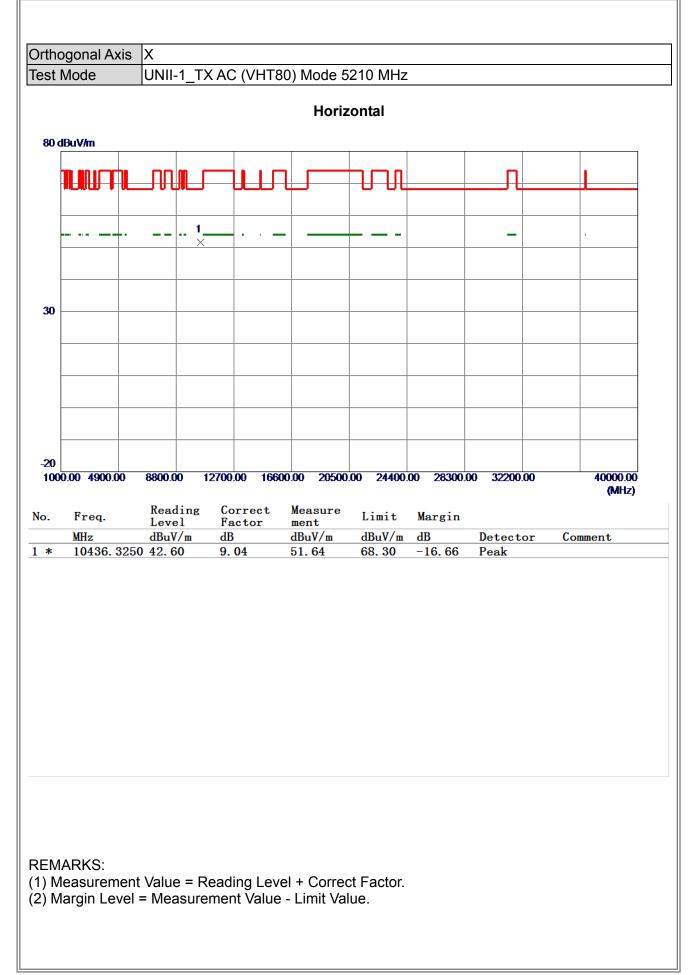




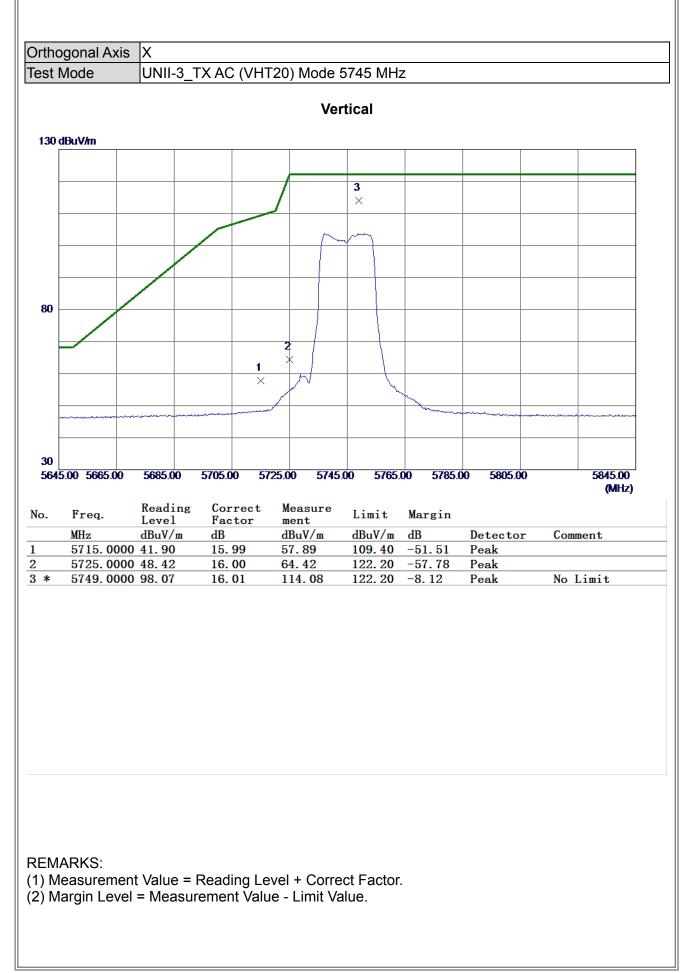




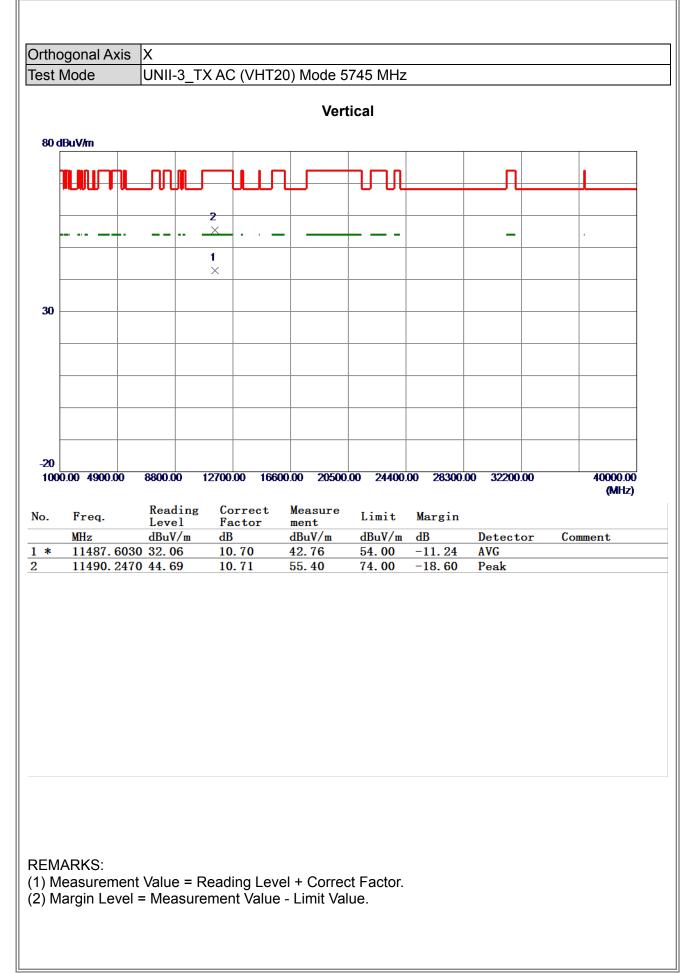




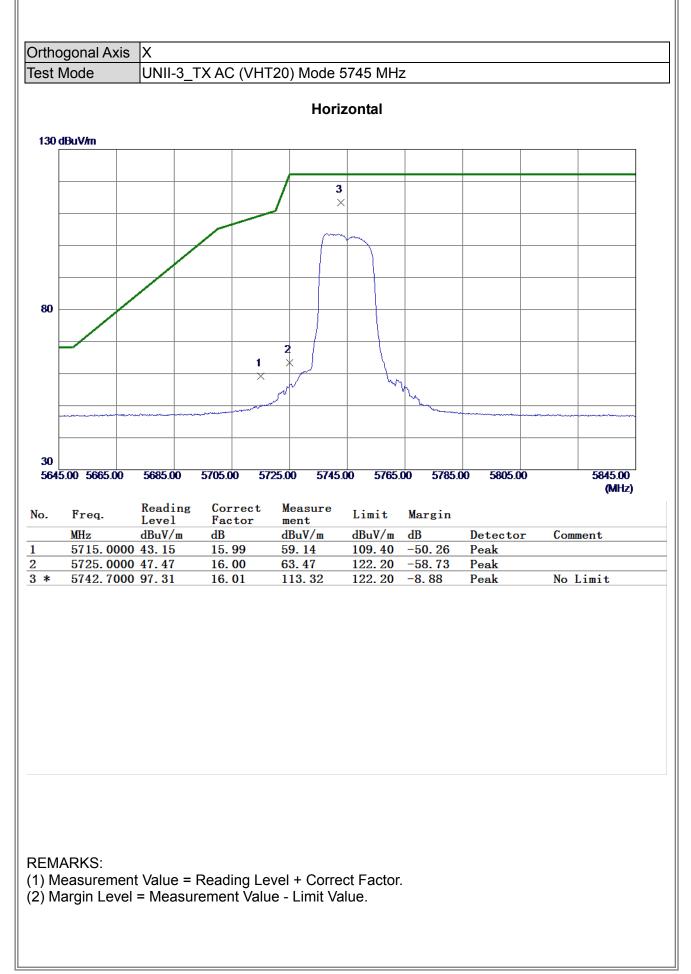




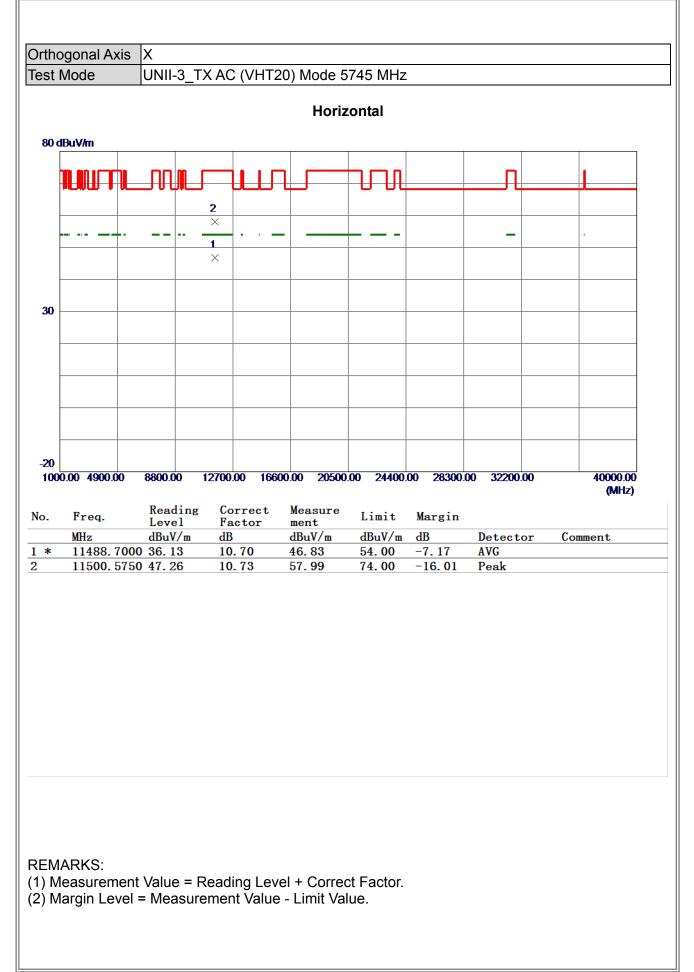




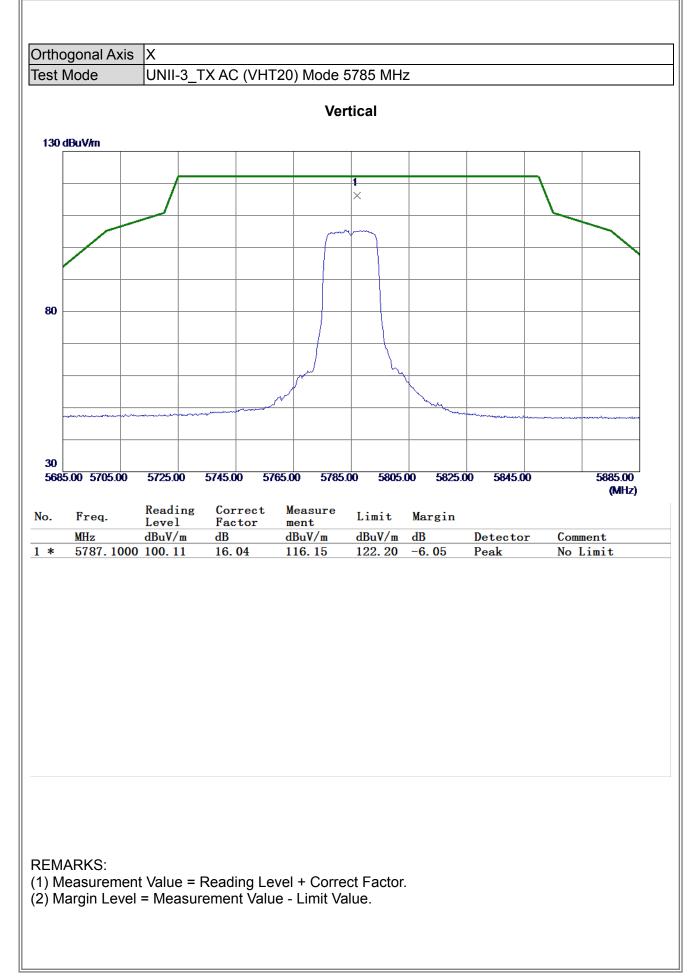




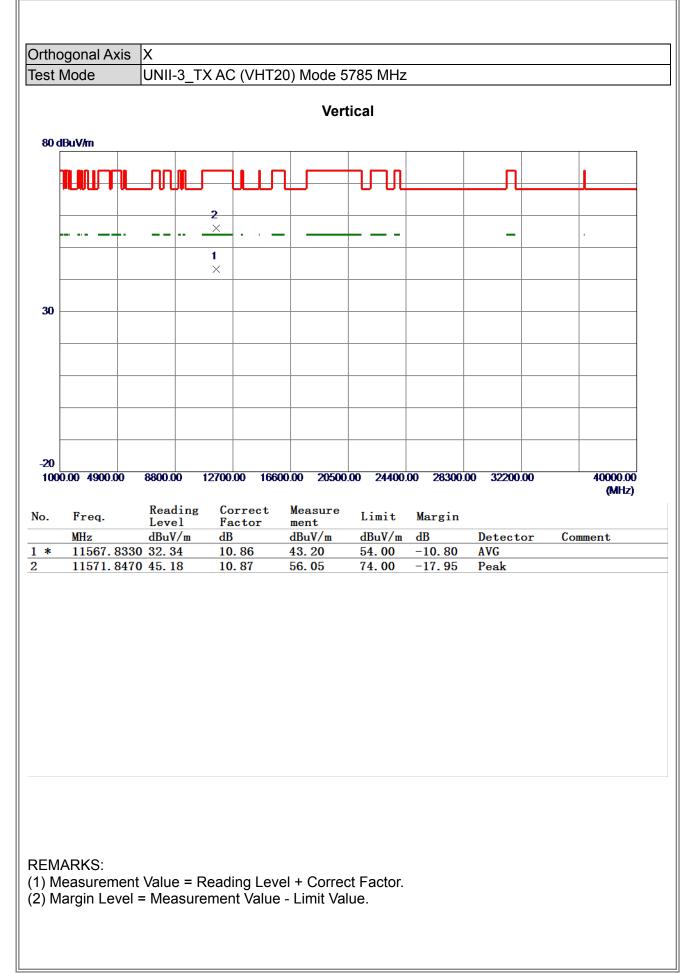




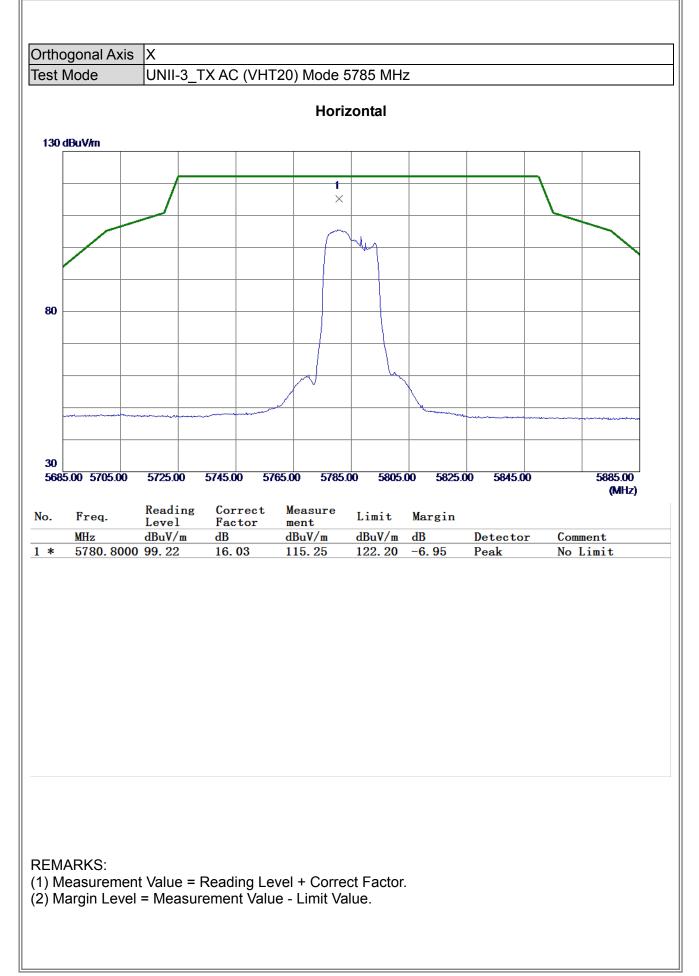




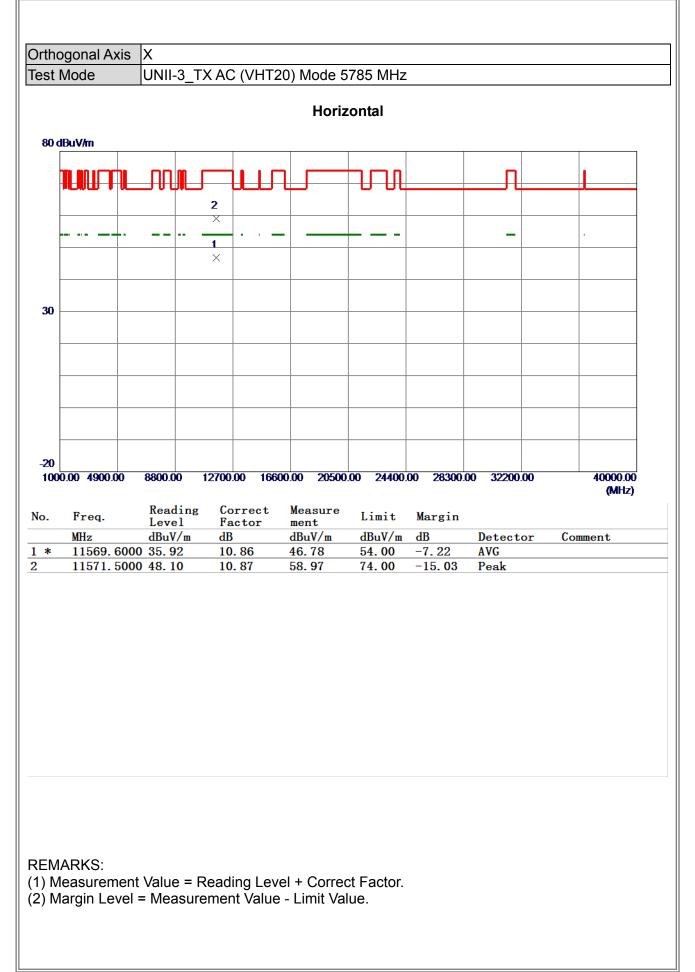




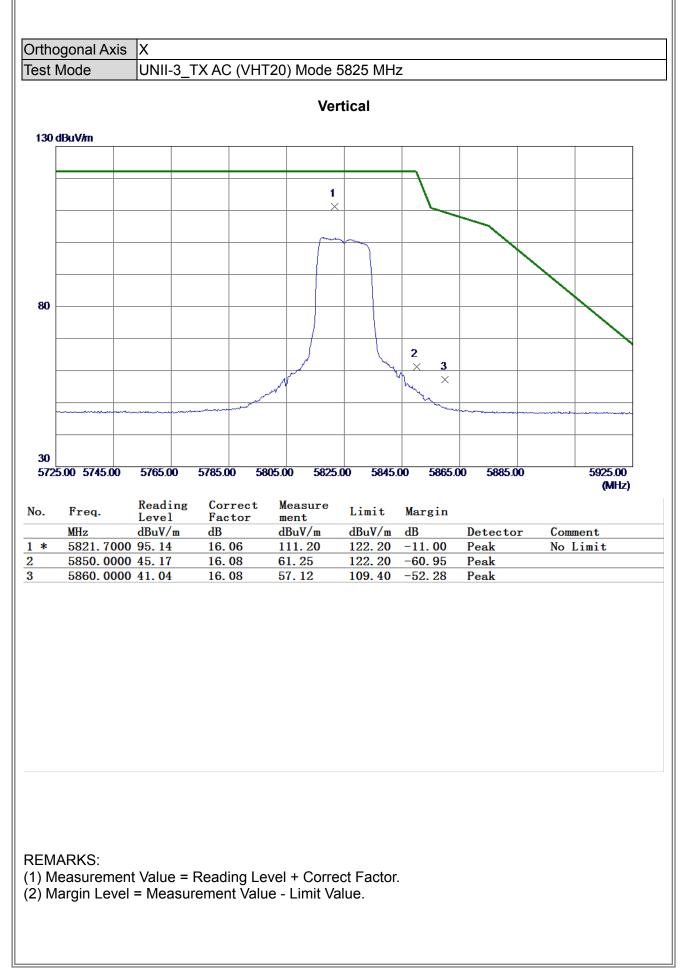




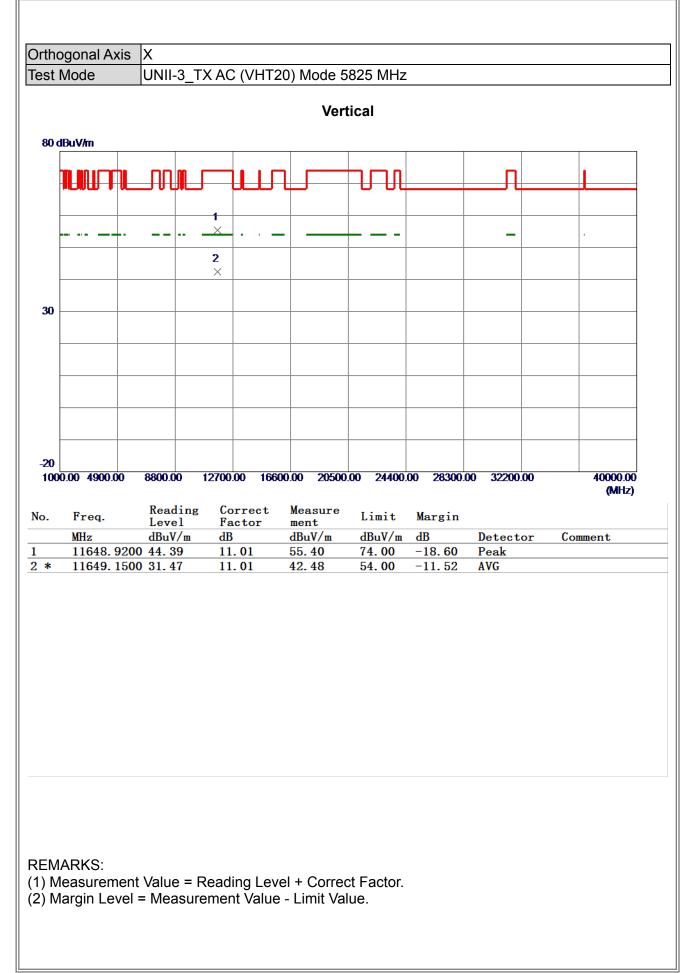




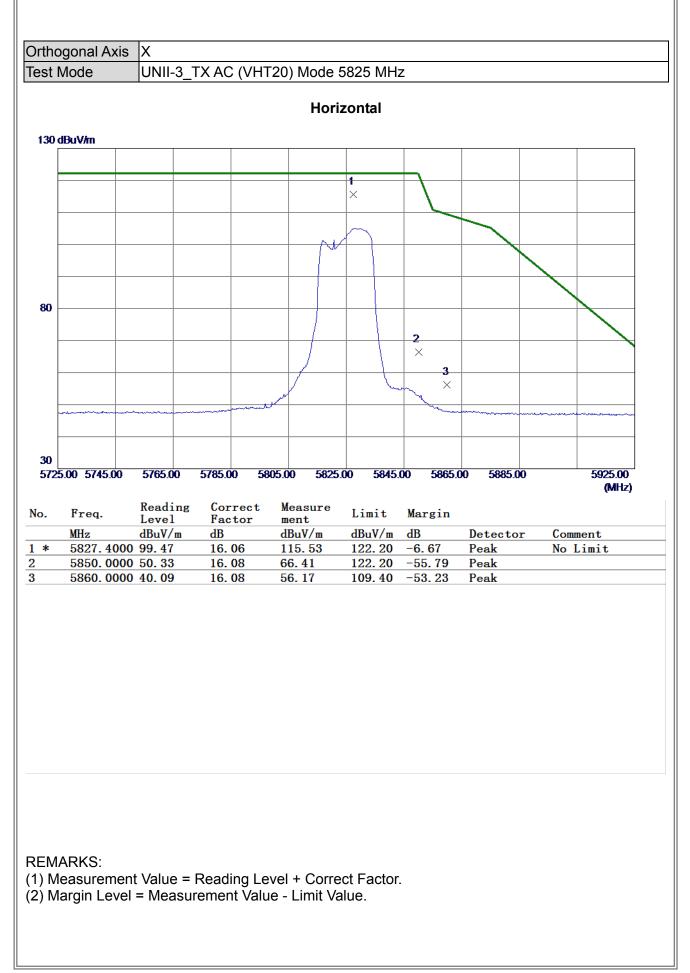




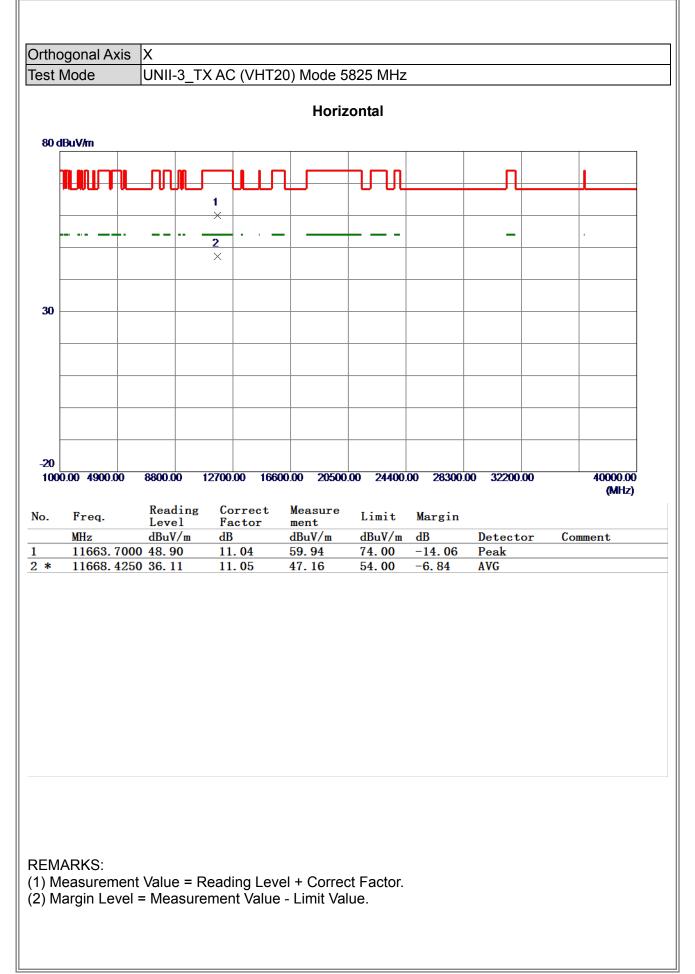




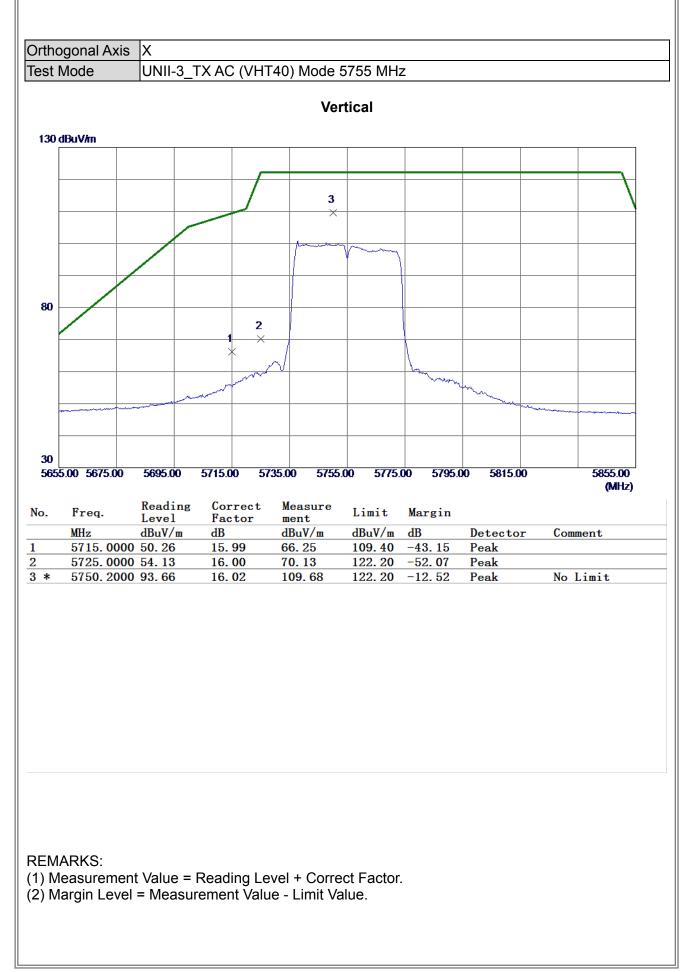




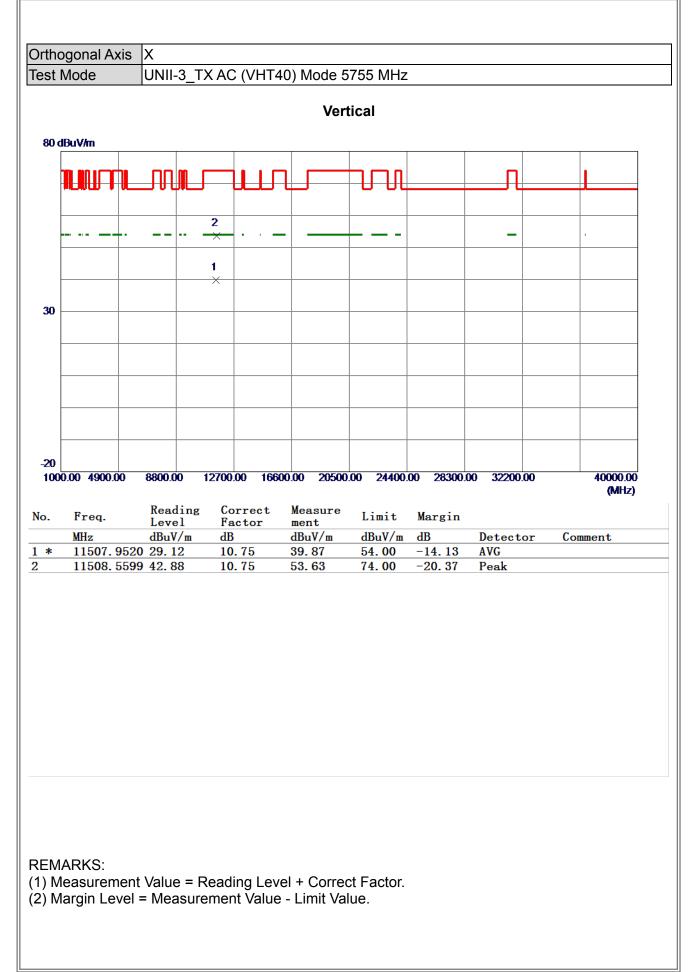




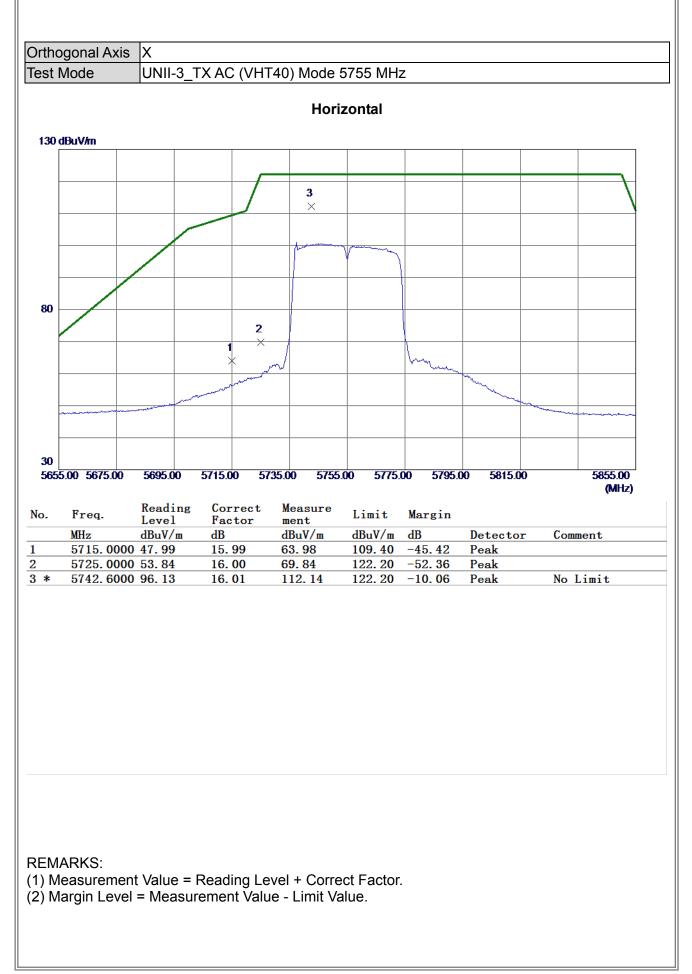




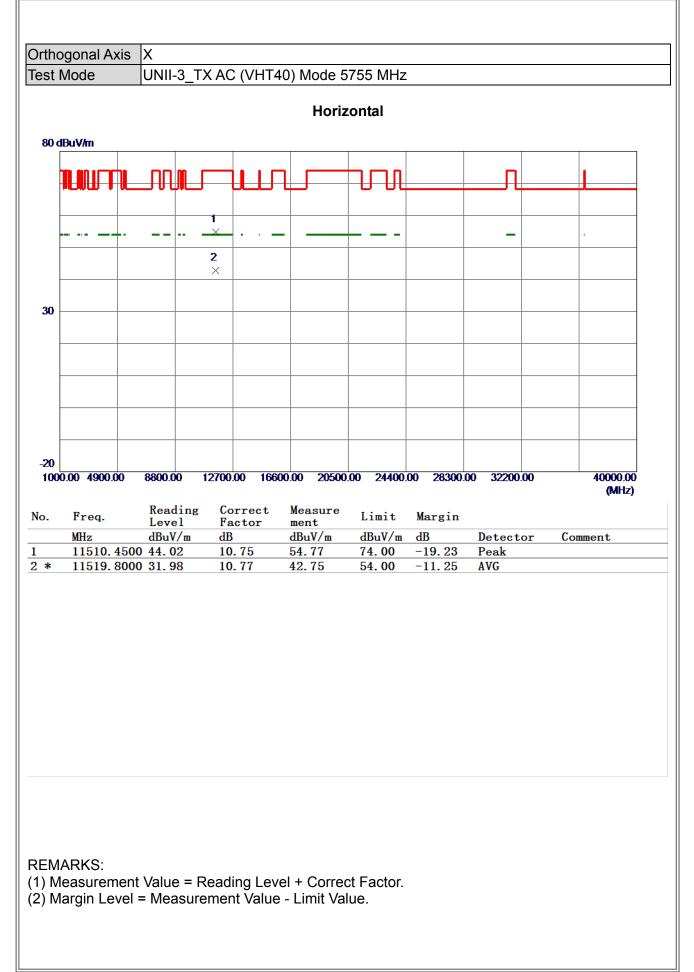




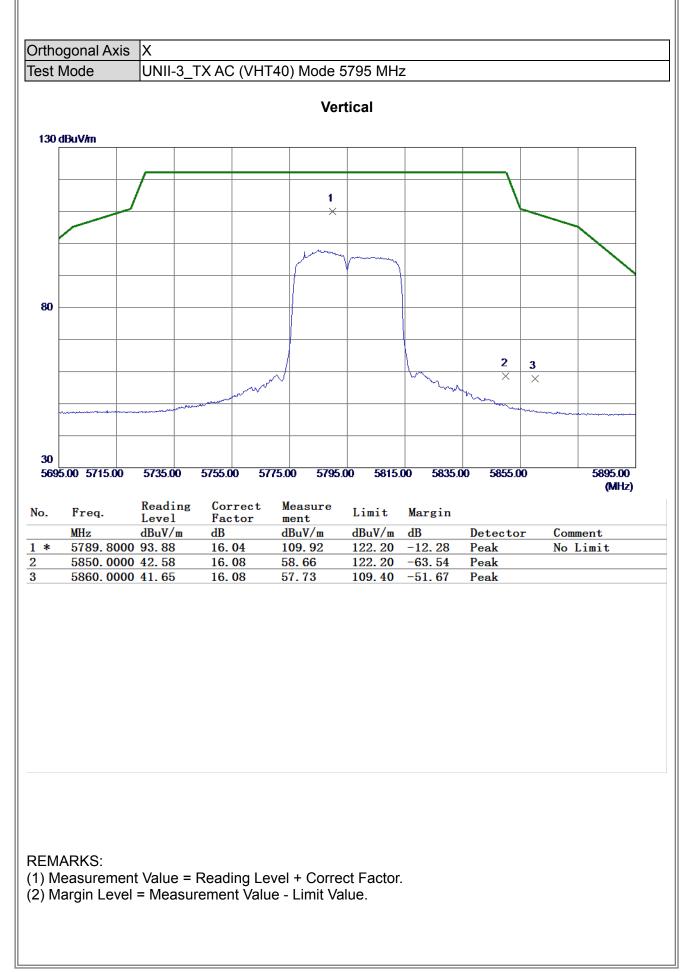




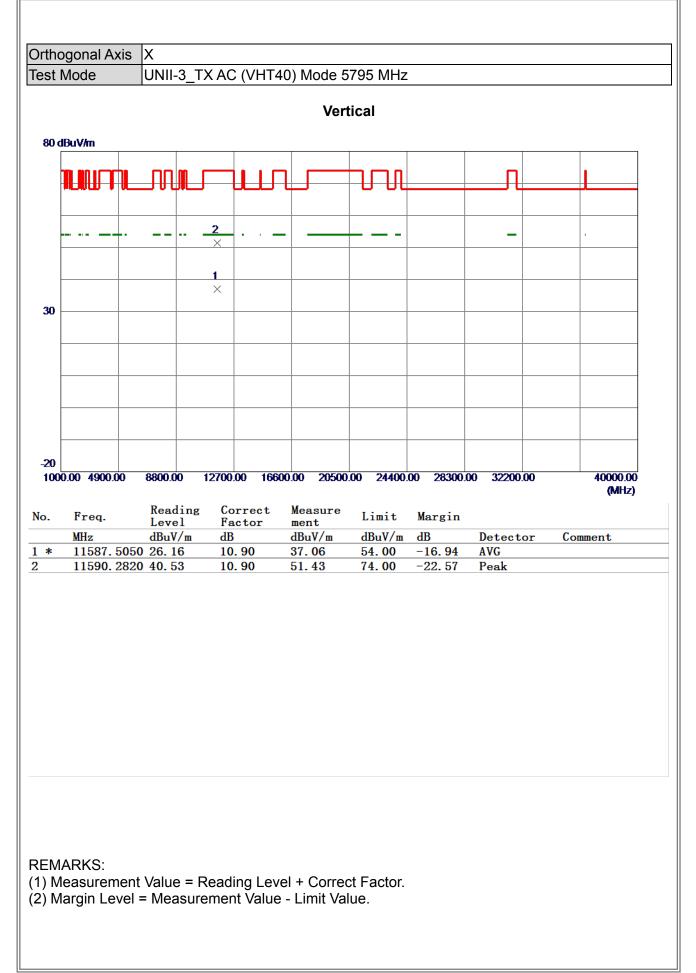




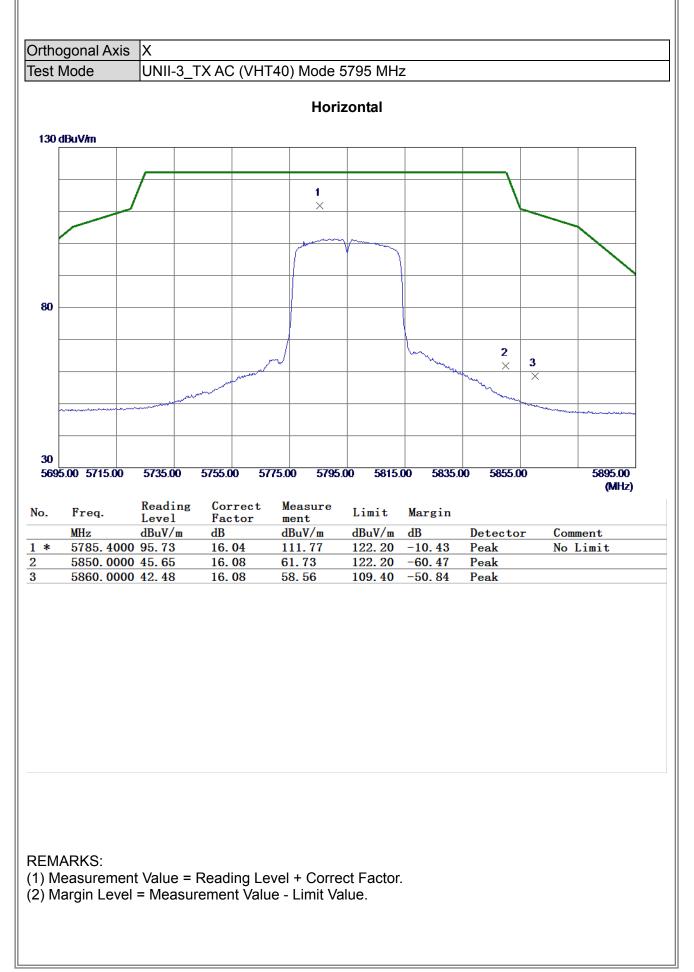




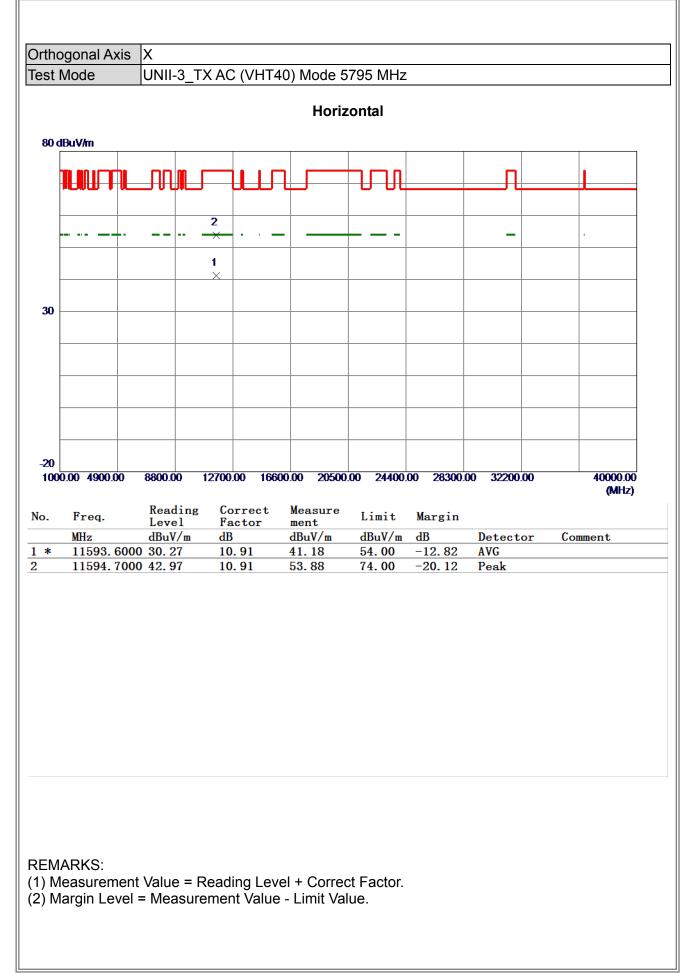




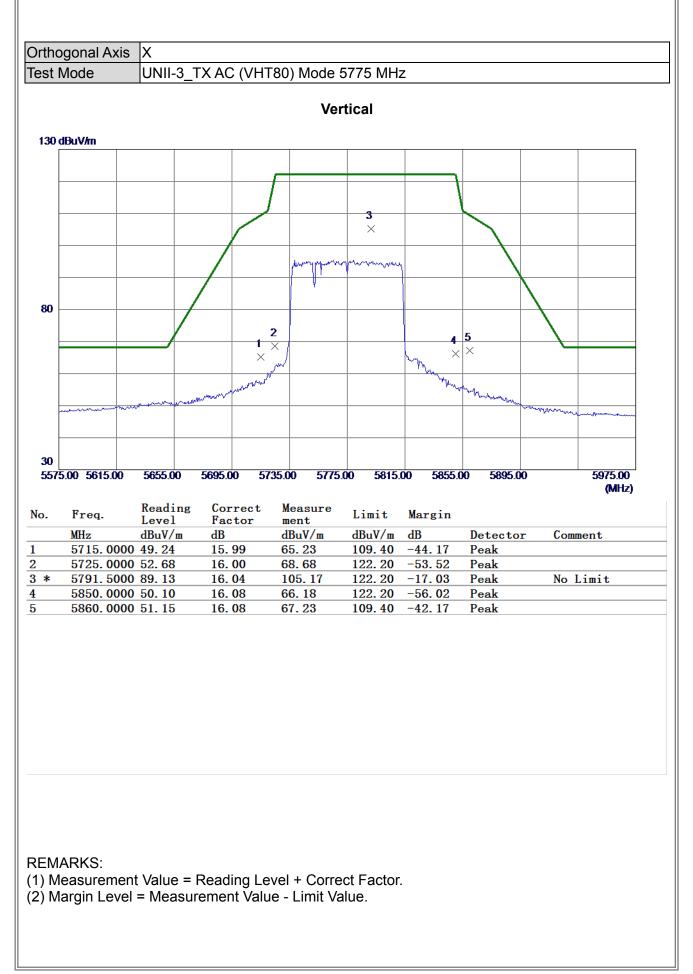




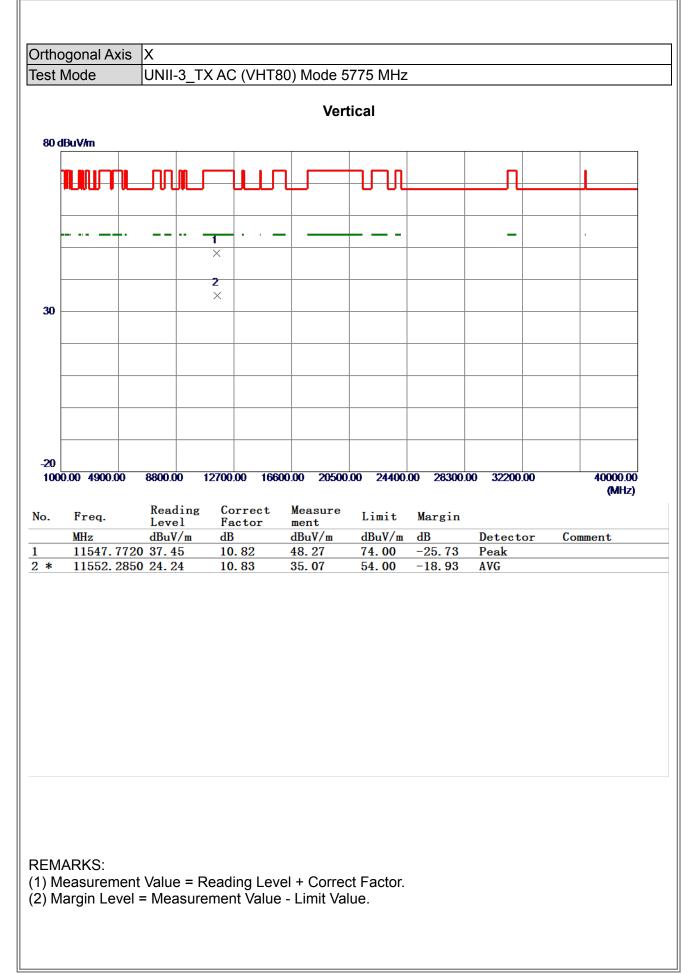




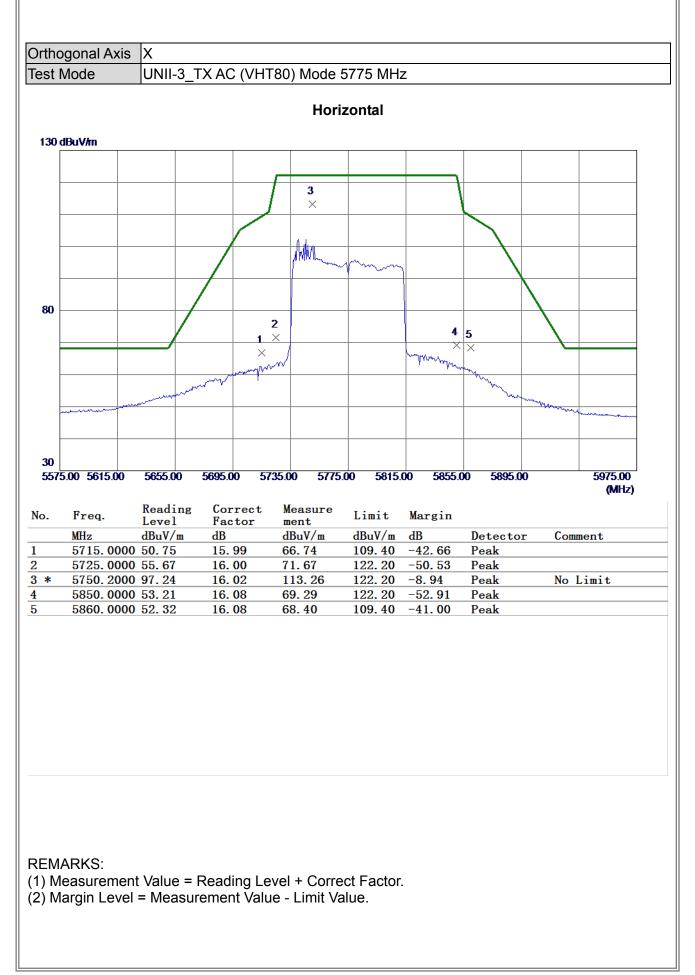




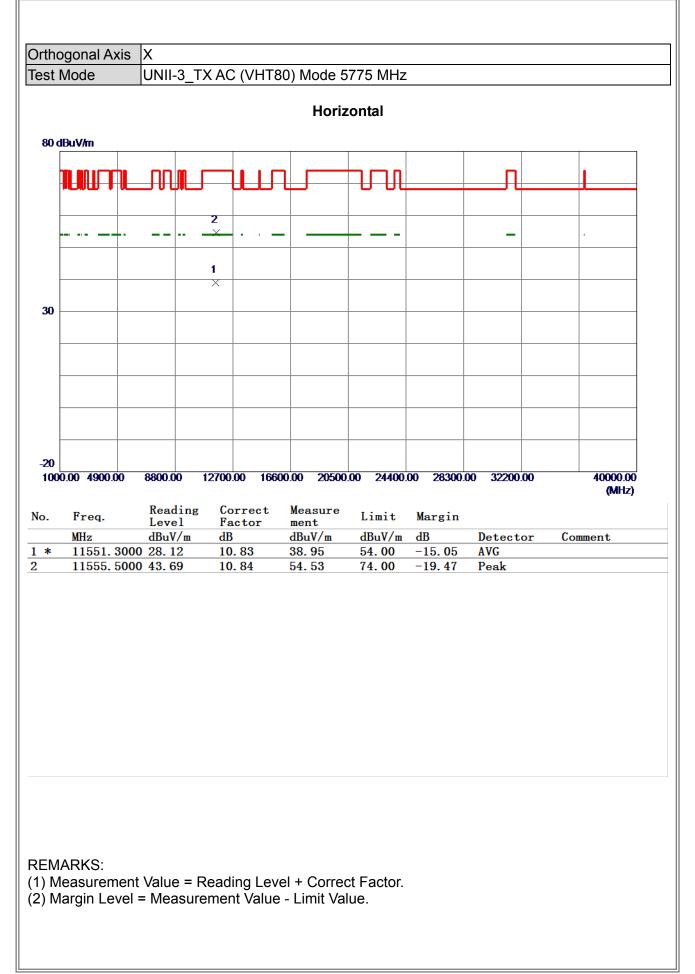
















## **APPENDIX E - BANDWIDTH**