

### FCC Radio Test Report

### FCC ID: XMR202005SC200RNA

#### This report concerns: Original Grant

Project No.	:	2005H018
Equipment	:	Multi-mode Smart LTE Module
Brand Name	:	Quectel
Test Model	:	SC200R-NA
Series Model	:	N/A
Applicant	:	Quectel Wireless Solutions Co., Ltd
Address	:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin
		Road, Minhang District, Shanghai, China 200233
Manufacturer	:	Quectel Wireless Solutions Co., Ltd
Address	:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin
		Road, Minhang District, Shanghai, China 200233
Date of Receipt	:	May 08, 2020
Date of Test	:	May 08, 2020 ~ Jun. 05, 2020
Issued Date	:	Aug. 10, 2020
<b>Report Version</b>	:	R00
Test Sample	:	Engineering Sample No.: SH2020050840, SH2020050840-1
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.

Kram. Wu

Prepared by : Krain Wu

Ryan. Wang

Approved by : Ryan Wang



Certificate # 5123.03

Add: No. 29, Jintang Road, Tangzhen Industry Park, Pudong New Area, Shanghai 201210, China TEL: +86-021-61765666 Web: www.newbtl.com



#### Declaration

**BTL** represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

**BTL**'s reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

The report must not be used by the client to claim product certification, approval, or endorsement by NIST, A2LA, or any agency of the U.S. Government.

This report is the confidential property of the client. As a mutual protection to the clients, the public and ourselves, the test report shall not be reproduced, except in full, without our written approval.

**BTL**'s laboratory quality assurance procedures are in compliance with the **ISO/IEC 17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

**BTL** is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

#### 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.



REPORT ISSUED HISTORY	5
1 . SUMMARY OF TEST RESULTS	6
1.1 TEST FACILITY	7
1.2 MEASUREMENT UNCERTAINTY	7
1.3 TEST ENVIRONMENT CONDITIONS	7
2 . GENERAL INFORMATION	8
2.1 GENERAL DESCRIPTION OF EUT	8
2.2 TEST MODES	10
2.3 PARAMETERS OF TEST SOFTWARE	12
2.4 DUTY CYCLE	13
2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	14
2.6 SUPPORT UNITS	14
3 . AC POWER LINE CONDUCTED EMISSIONS TEST	15
3.1 LIMIT	15
3.2 TEST PROCEDURE	15
3.3 DEVIATION FROM TEST STANDARD	15
3.4 TEST SETUP	16
3.5 EUT OPERATION CONDITIONS	16
3.6 TEST RESULTS	16
4 . RADIATED EMISSIONS TEST	17
4.1 LIMIT	17
4.2 TEST PROCEDURE	18
4.3 DEVIATION FROM TEST STANDARD	18
4.4 TEST SETUP	19
4.5 EUT OPERATION CONDITIONS	21
4.6 TEST RESULTS - 9 KHZ to 30 MHZ	21
4.7 TEST RESULTS - 30 MHz TO 1000 MHz	21
4.8 TEST RESULTS - ABOVE 1000 MHz	21
5 . BANDWIDTH TEST	22
5.1 LIMIT	22
5.2 TEST PROCEDURE	22
5.3 TEST PROCEDURE	22
5.4 TEST SETUP	22





Table of Contents	Page
5.5 EUT OPERATION CONDITIONS	22
5.6 TEST RESULTS	22
6 . MAXIMUM OUTPUT POWER TEST	23
6.1 LIMIT	23
6.2 TEST PROCEDURE	23
6.3 DEVIATION FROM STANDARD	23
6.4 TEST SETUP	23
6.5 EUT OPERATION CONDITIONS	23
6.6 TEST RESULTS	23
7 . POWER SPECTRAL DENSITY TEST	24
7.1 LIMIT	24
7.2 TEST PROCEDURE	24
7.3 DEVIATION FROM STANDARD	24
7.4 TEST SETUP	25
7.5 EUT OPERATION CONDITIONS	25
7.6 TEST RESULTS	25
8 . MEASUREMENT INSTRUMENTS LIST	26
9.EUT TEST PHOTOS	28
APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS	31
APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ	34
APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1 GHZ	35
APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ	38
APPENDIX E - BANDWIDTH	171
APPENDIX F - CONDUCTED OUTPUT POWER	180
APPENDIX G - POWER SPECTRAL DENSITY	185



#### **REPORT ISSUED HISTORY**

Report Version	Description	Issued Date
R00	Original Issue.	Aug. 10, 2020



#### **1. SUMMARY OF TEST RESULTS**

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 (3)	
15.407(c)	Automatically Discontinue Transmission		PASS	NOTE (3)	

Test procedures according to the technical standard(s):

#### Note:

- (1) "N/A" denotes test is not applicable in this test report.
- (2) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.
- (3) 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) For UNII-1 this device was functioned as a
  □ Access point device imes Client device



#### **1.1 TEST FACILITY**

The test facilities used to collect the test data in this report is at the location of No. 29, Jintang Road, Tangzhen Industry Park, Pudong New Area, Shanghai 201210, China BTL's Test Firm Registration Number for FCC: 476765

BTL's Designation Number for FCC: CN1241

#### **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)
SH-C01	CISPR	9 kHz ~ 150 MHz	2.92

#### B. Radiated emissions test:

Test Site	Method	Measurement Frequency Range	Ant. H / V	U, (dB)
		9 KHz~30 MHz	V	3.79
		9 KHz~30 MHz	Н	3.57
	CISPR	30 MHz~200 MHz	V	4.04
		30 MHz~200 MHz	Н	3.76
SH-CB01		200 MHz~1,000 MHz	V	4.24
2H-CB01		200 MHz~1,000 MHz	Н	3.84
		1 GHz~18 GHz	V	4.46
		1 GHz~18 GHz	Н	4.40
		18 GHz~40 GHz	V	3.95
		18 GHz~40 GHz	Н	3.95

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	23°C	60%	DC 3.8V	Forest Li
Radiated Emissions-30 MHz to 1GHz	23°C	46%	DC 3.8V	Forest Li
Radiated Emissions-Above 1000 MHz	23°C	46%	DC 3.8V	Forest Li
Spectrum Bandwidth	23°C	46%	DC 3.8V	Forest Li
Maximum Output Power	23°C	60%	DC 3.8V	Forest Li
Power Spectral Density	23°C	60%	DC 3.8V	Forest Li
Frequency Stability	Normal & Extreme	60%	Normal & Extreme	Forest Li

#### 2. GENERAL INFORMATION

#### 2.1 GENERAL DESCRIPTION OF EUT

Equipment	Multi-mode Smart LTE Module
Brand Name	Quectel
Test Model	SC200R-NA
Series Model	N/A
Model Difference(s)	N/A
Software Version	SC200RNANAR04A01
Hardware Version	R1.0
Power Source	DC power supply.
Power Rating	DC 3.8V
Operation Frequency	UNII-1: 5150 MHz~5250 MHz UNII-2A: 5250 MHz~5350 MHz UNII-2C: 5470 MHz~5725 MHz UNII-3: 5725 MHz~5850 MHz
Modulation Type	OFDM
Bit Rate of Transmitter	Up to 150 Mbps
Maximum Conducted Output Power for UNII-1 (1TX) Non-Beamforming	IEEE 802.11a: 16.66 dBm (0.0463 W) IEEE 802.11n (HT20): 15.49 dBm (0.0354 W) IEEE 802.11n (HT40): 13.42 dBm (0.0220 W)
Maximum Conducted Output Power for UNII-2A (1TX) Non-Beamforming	IEEE 802.11a: 16.24 dBm (0.0421 W) IEEE 802.11n (HT20): 15.06 dBm (0.0321 W) IEEE 802.11n (HT40): 13.15 dBm (0.0207 W)
Maximum Conducted Output Power for UNII-2C (1TX) Non-Beamforming	IEEE 802.11a: 16.94 dBm (0.0494 W) IEEE 802.11n (HT20): 15.86 dBm (0.0385 W) IEEE 802.11n (HT40): 15.10 dBm (0.0324 W)
Maximum Conducted Output Power for UNII-3 (1TX) Non-Beamforming	IEEE 802.11a: 15.50 dBm (0.0355 W) IEEE 802.11n (HT20): 14.68 dBm (0.0294 W) IEEE 802.11n (HT40): 14.36 dBm (0.0273 W)

Note:

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

#### 2. Channel List:

**B**TL

IEEE 80 IEEE 802.1		IEEE 802.11n (HT40)	
UNI	I-1	UN	II-1
Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	38	5190
40	5200	46	5230
44	5220		
48	5240		

IEEE 80 IEEE 802.1		IEEE 802.11n (HT40)	
UNII	-2A	UNI	I-2A
Channel	Frequency (MHz)	Channel	Frequency (MHz)
52	5260	54	5270
56	5280	62	5310
60	5300		
64	5320		

IEEE 80 IEEE 802.1		IEEE 802.11n (HT40)	
UNII	-2C	UNI	I-2C
Channel	Frequency (MHz)	Channel	Frequency (MHz)
100	5500	102	5510
104	5520	110	5550
108	5540	118	5590
112	5560	126	5630
116	5580	134	5670
120	5600		
124	5620		
128	5640		
132	5660		
136	5680		
140	5700		

IEEE 802.11a IEEE 802.11n (HT20)		IEEE 802.11n (HT40)	
UNII-3		UN	III-3
Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	151	5755
153	5765	159	5795
157	5785		
161	5805		
165	5825		



#### 3. Antenna Specification:

Ant.	Manufacturer	Model Name	Antenna Type	Connector	Gain(dBi)
1	N/A	N/A	Dipole	N/A	1.28

#### 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 A Mode / CH52, CH60, CH64 (UNII-2A)
Mode 5	TX N (HT20) Mode / CH52, CH60, CH64 (UNII-2A)
Mode 6	TX N (HT40) Mode / CH54, CH62 (UNII-2A)
Mode 7	TX A Mode / CH100, CH116, CH140 (UNII-2C)
Mode 8	TX N (HT20) Mode / CH100, CH116, CH140 (UNII-2C)
Mode 9	TX N (HT40) Mode / CH102, CH110, CH134 (UNII-2C)
Mode 10	TX A Mode / CH149,CH157,CH165 (UNII-3)
Mode 11	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)
Mode 12	TX N (HT40) Mode / CH151,CH159 (UNII-3)
Mode 13	TX A Mode / CH116 (UNII-2C)

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	Mode 13 TX A Mode / CH116 (UNII-2C)		



Radiated emissions test			
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 A Mode / CH52, CH60, CH64 (UNII-2A)		
Mode 5	TX N (HT20) Mode / CH52, CH60, CH64 (UNII-2A)		
Mode 6	TX N (HT40) Mode / CH54, CH62 (UNII-2A)		
Mode 7	TX A Mode / CH100, CH116, CH140 (UNII-2C)		
Mode 8	TX N (HT20) Mode / CH100, CH116, CH140 (UNII-2C)		
Mode 9	TX N (HT40) Mode / CH102, CH110, CH134 (UNII-2C)		
Mode 10	TX A Mode / CH149,CH157,CH165 (UNII-3)		
Mode 11	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)		
Mode 12	TX N (HT40) Mode / CH151,CH159 (UNII-3)		

	Conducted test			
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 A Mode / CH52, CH60, CH64 (UNII-2A)			
Mode 5	TX N (HT20) Mode / CH52, CH60, CH64 (UNII-2A)			
Mode 6	TX N (HT40) Mode / CH54, CH62 (UNII-2A)			
Mode 7	TX A Mode / CH100, CH116, CH140 (UNII-2C)			
Mode 8	TX N (HT20) Mode / CH100, CH116, CH140 (UNII-2C)			
Mode 9	TX N (HT40) Mode / CH102, CH110, CH134 (UNII-2C)			
Mode 10	TX A Mode / CH149,CH157,CH165 (UNII-3)			
Mode 11	TX N (HT20) Mode / CH149,CH157,CH165 (UNII-3)			
Mode 12	TX N (HT40) Mode / CH151,CH159 (UNII-3)			

Note:

For radiated emission below 1 GHz test, the IEEE 802.11a is found to be the worst case and recorded.
 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.

#### 2.3 PARAMETERS OF TEST SOFTWARE

UNII-1 - 1TX				
Test Software	QRCT			
Test Frequency (MHz)	5180	5200	5240	
IEEE 802.11a	15	15	15	
Test Frequency (MHz)	5180	5200	5240	
IEEE 802.11n (HT20)	14	14	14	
Test Frequency (MHz)	5190	5230		
IEEE 802.11n (HT40)	14	14		

UNII-2A - 1TX				
Test Software	QRCT			
Test Frequency (MHz)	5260	5300	5320	
IEEE 802.11a	15	15	15	
Test Frequency (MHz)	5260	5300	5320	
IEEE 802.11n (HT20)	14	14	14	
Test Frequency (MHz)	5270	5310		
IEEE 802.11n (HT40)	14	14		

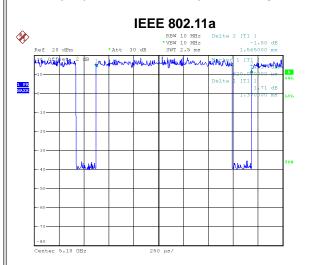
UNII-2C - 1TX				
Test Software		QRCT		
Test Frequency (MHz)	5500	5580	5700	
IEEE 802.11a	15	15	15	
Test Frequency (MHz)	5500	5580	5700	
IEEE 802.11n (HT20)	14	14	14	
Test Frequency (MHz)	5510	5550	5670	
IEEE 802.11n (HT40)	14	14	14	

UNII-3 - 1TX				
Test Software		QRCT		
Test Frequency (MHz)	5745	5785	5825	
IEEE 802.11a	15	15	15	
Test Frequency (MHz)	5745	5785	5825	
IEEE 802.11n (HT20)	14	14	14	
Test Frequency (MHz)	5755	5795		
IEEE 802.11n (HT40)	14	14		

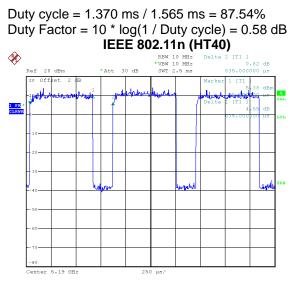


#### 2.4 DUTY CYCLE

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: 1.JUN.2020 21:05:02



Date: 1.JUN.2020 21:06:16

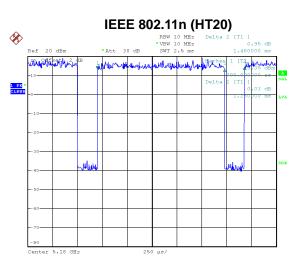
Duty cycle = 0.635 ms / 0.835 ms = 76.05% Duty Factor = 10 \* log(1 / Duty cycle) = 1.19 dB

#### NOTE:

For IEEE 802.11a, IEEE 802.11n (HT20):

For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 0.78 kHz (Duty cycle < 98%). For IEEE 802.11n (HT40):

For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1.57 kHz (Duty cycle < 98%).

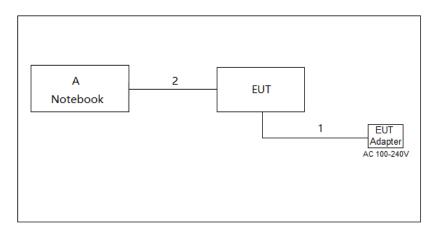


Date: 1.JUN.2020 21:05:35

Duty cycle = 1.280 ms / 1.480 ms = 86.49% Duty Factor = 10 \* log(1 / Duty cycle) = 0.63 dB



#### 2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



#### 2.6 SUPPORT UNITS

Item	Equipment	Brand	Model No.	Series No.
А	Notebook	Lenovo	#P152014	N/A

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



#### 3. AC POWER LINE CONDUCTED EMISSIONS TEST

#### 3.1 LIMIT

Frequency	Limit (dBµV)	
(MHz)	Quasi-peak	Average
0.15 - 0.5	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

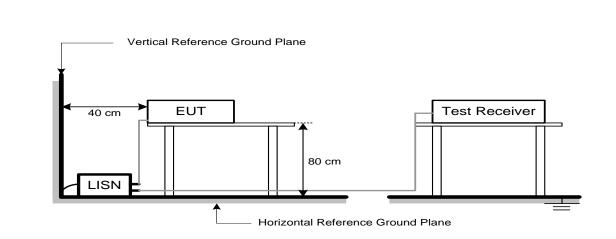
- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.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

# **B**TL

#### 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	Band edge	Harmonic
(MHz)	(dBm/MHz)	at 3m (dBµV/m)	at 1.5m (dBµV/m)
5150-5250	-27	68.3	74.3 (Note 3)
5250-5350	-27	68.3	74.3 (Note 3)
5470-5725	-27	68.3	74.3 (Note 3)
	-27 NOTE (2)	68.3	74.3 (Note 3)
5725-5850	10 NOTE (2)	105.3	111.3(Note 3)
5725-5650	15.6 NOTE (2)	110.9	116.9(Note 3)
	27 NOTE (2)	122.3	128.3(Note 3)

NOTE:

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

 $\mu$ V/m, where P is the eirp (Watts) З

(2) According to FCC 16-24, 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.

### **B**TL

#### 4.2 TEST PROCEDURE

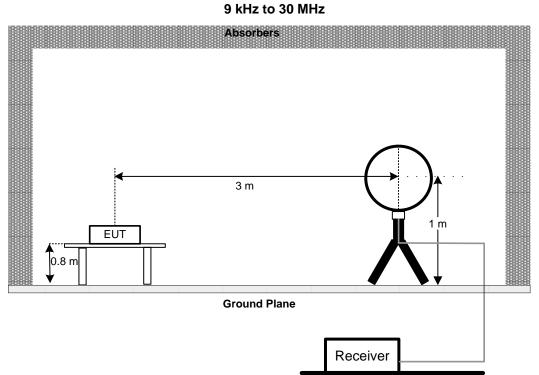
- a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
- b. The measuring distance of 3 m or 1.5m 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

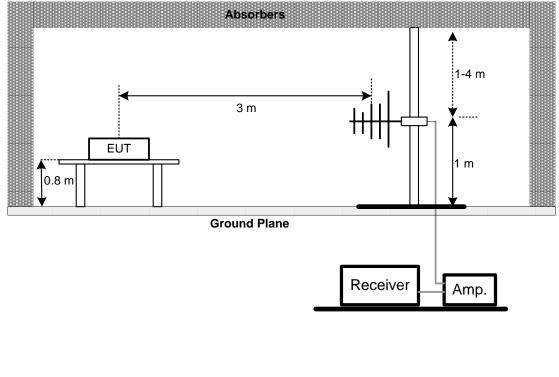
No deviation

## **B**TL

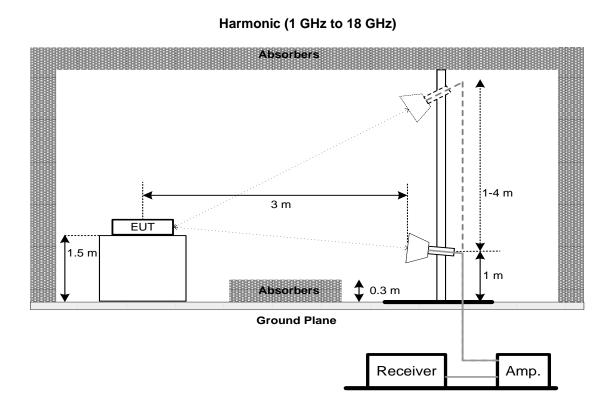
#### 4.4 TEST SETUP



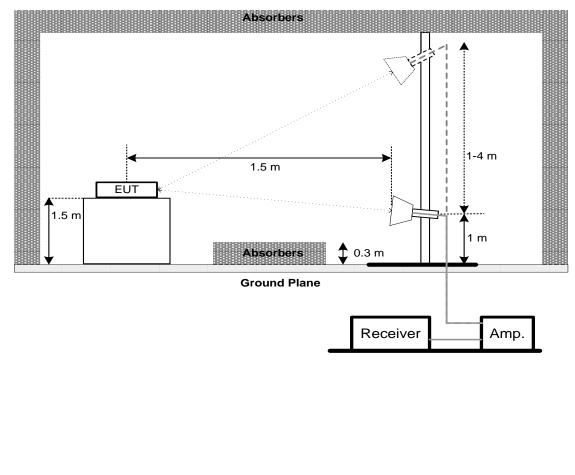
#### 30 MHz to 1 GHz



# **STL**



#### Harmonic (18 GHz to 26.5 GHz)





#### 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) The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.
- (2) Distance extrapolation factor = 40 log (specific distance / test distance) (dB).
- (3) 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)
	26 dB Bandwidth	-	5150-5250
15.407(a)	26 dB Bandwidth	-	5250-5350
15.407(e)	26 dB Bandwidth	-	5470-5725
	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. a. Spectrum Setting:
  - For UNII-1, UNII-2A, UNII-2C:

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)
VDVV	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)	
		AP device: 1 Watt (30 dBm) Client device: 250 mW (24 dBm)	5150-5250	
15.407(a) Conducted Output Po	Conducted Output Power	250 mW (24 dBm)	5250-5350	
		250 mW (24 dBm)	5470-5725	
		1 Watt (30dBm)	5725-5850	

#### Note:

- a. For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 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.
- b. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10log B, where B is the 26dB Bandwidth in megahertz.

#### 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



Power Meter

#### 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 Range (MHz)
		AP device: 17 dBm/MHz Client device: 11 dBm/MHz	5150-5250
15.407(a) Power Spectral Density	11 dBm/MHz	5250-5350	
		11 dBm/MHz	5470-5725
		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

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. MEASUREMENT INSTRUMENTS LIST

		AC Power I	Line Conducted Emiss	sions	
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Line Impedance Stabilisation Network	Schwarzbeck	NNLK 8121	8121-822	Mar. 21, 2021
2	TWO-LINE V-NETWORK	R&S	ENV216	101340	Sep. 01, 2020
3	Test Cable	emci	EMCRG400-BM-NM- 10000	170628	Jul. 16, 2020
4	EMI Test Receiver	R&S	ESCI	100082	Mar. 21, 2021
5	50Ω Terminator	SHX	TF2-1G-A	17051602	Mar. 21, 2021
6	$50\Omega$ coaxial switch	Anritsu	MP59B	6201750902	Mar. 21, 2021
7	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

		Radiated Er	nissions - 30 MHz to 1	GHz	
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	719	Apr. 02, 2021
2	Pre-Amplifier	emci	EMC9135	980400	Mar. 21, 2021
3	MXE EMI Receiver	Keysight	N9038A	MY56400088	Mar. 21, 2021
4	Test Cable	emci	EMC104-SM-SM-700 0	170330	Apr. 13, 2021
5	Test Cable	emci	EMC104-SM-SM-100 0	170331	Apr. 13, 2021
6	Test Cable	emci	EMC104-SM-NM-350 0	170621	Apr. 13, 2021
7	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
8	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	719	Apr. 02, 2021



		Radiated	Emissions - Above 1 C	GHz	
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Double-Ridged Waveguide Horn Antenna	ETS-Lindgren	9120D	00206960	Apr. 02, 2021
2	Pre-Amplifier	emci	EMC012645SE	980421	May. 11, 2021
3	EXA Spectrum Analyzer	Keysight	N9010A	MY56480545	Mar. 21, 2021
4	Test Cable	emci	EMC104-SM-SM-700 0	170330	Apr. 13, 2021
5	Test Cable	emci	EMC104-SM-SM-100 0	170331	Apr. 13, 2021
6	Test Cable	emci	EMC104-SM-NM-350 0	170621	Apr. 13, 2021
7	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
8	MXE EMI Receiver	Keysight	N9038A	MY57150106	May. 06, 2021
9	Antenna	Schwarzbeck	BBHA9170	9170-651	Apr. 02, 2021
10	Pre-Amplifier	EMC INSTRUMENT	EMC184045B	980265	Mar. 21, 2021
11	EXA Spectrum Analyzer	Keysight	N9010A	MY56480579	Mar. 21, 2021
12	Test Cable	emci	EMC102-SM-SM-800	170335	Apr. 13, 2021
13	Test Cable	emci	EMC102-KM-KM-250 0	170627	Apr. 13, 2021

		Ban	dwidth		
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100626	May. 06, 2021

			Conducted	Output Power		
lte	em	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
	1	Spectrum Analyzer	R&S	FSP40	100626	May. 06, 2021

		Power Spe	ctral Density		
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100626	May. 06, 2021

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

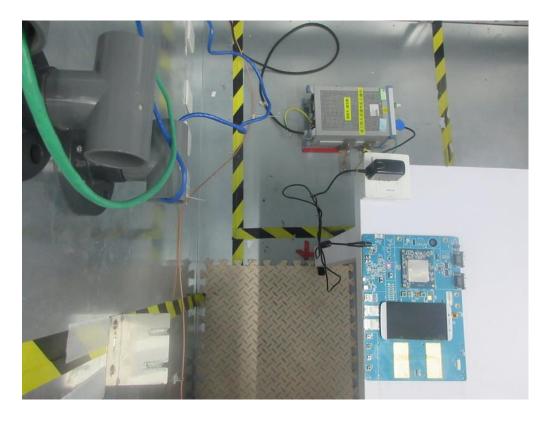
All calibration period of equipment list is one year.

#### 9. EUT TEST PHOTOS

3

#### Conducted Emissions Test Photos

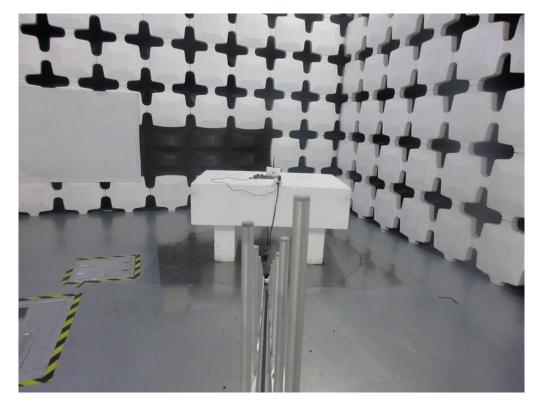


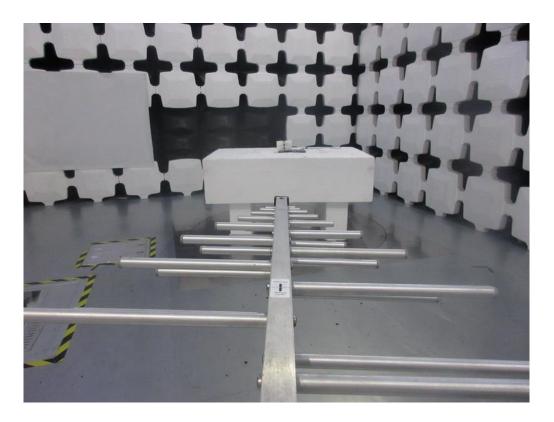


# **B**L



30 MHz to 1 GHz



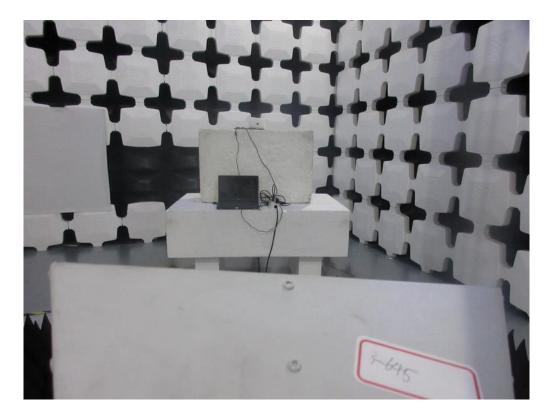


# **BIL**

#### **Radiated Emissions Test Photos**

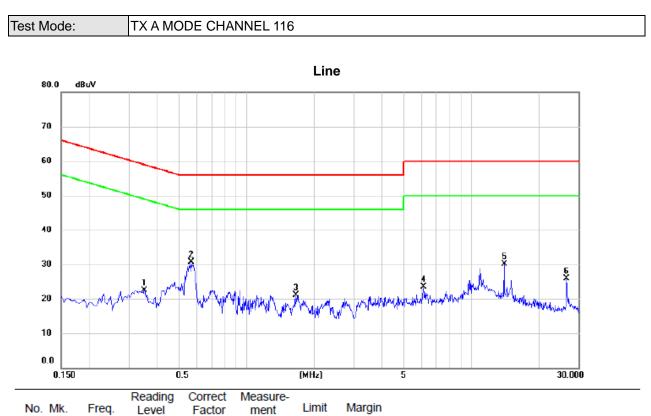
Above 1 GHz





### **APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS**



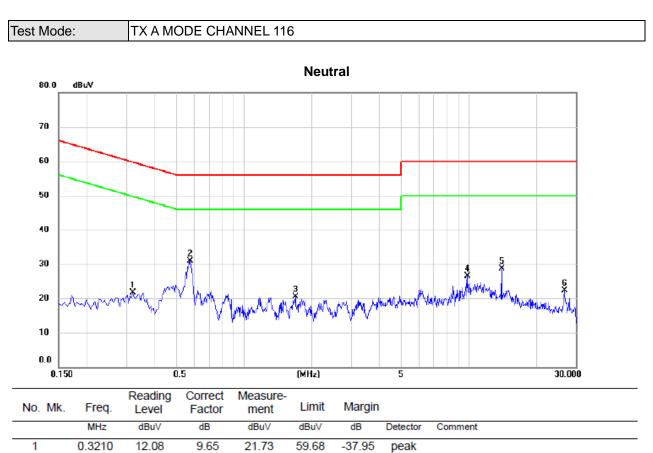


No.	Mk.	Freq.	Level	Factor	ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBu∨	dB	Detector	Comment
1		0.3525	12.75	9.85	22.60	58.90	-36.30	peak	
2	*	0.5685	20.79	9.89	30.68	56.00	-25.32	peak	
3		1.6665	11.33	9.78	21.11	56.00	-34.89	peak	
4		6.1350	13.43	10.02	23.45	60.00	-36.55	peak	
5		14.0010	19.88	10.19	30.07	60.00	-29.93	peak	
6		26.5470	15.21	10.70	25.91	60.00	-34.09	peak	

#### **REMARKS**:

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





1	0.3210	12.08	9.65	21.73	59.68	-37.95	peak
2 *	0.5775	21.16	9.70	30.86	56.00	-25.14	peak
3	1.6935	10.81	9.77	20.58	56.00	-35.42	peak
4	9.8745	16.38	10.16	26.54	60.00	-33.46	peak
5	14.0010	18.65	10.15	28.80	60.00	-31.20	peak
6	26.6235	11.75	10.56	22.31	60.00	-37.69	peak

**REMARKS**:

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

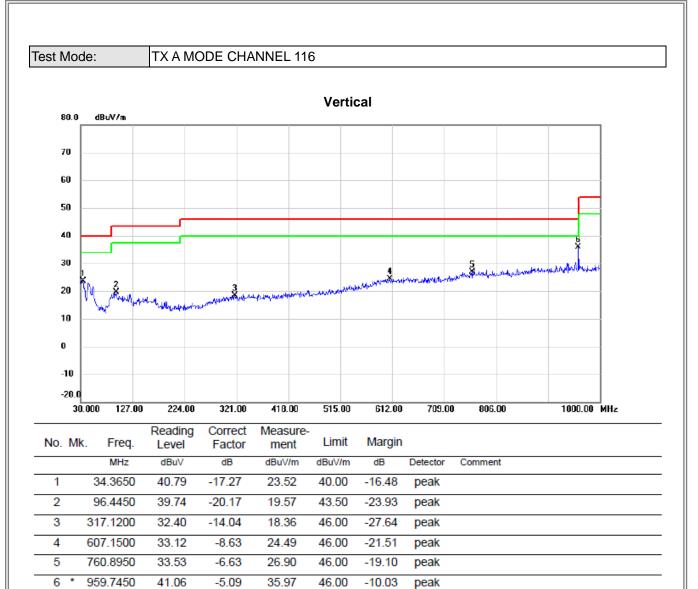
### **APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ**

Note: Below 30MHz, The measured value have enough margin over 20dB than the limit, therefore they are not reported



### **APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1 GHZ**



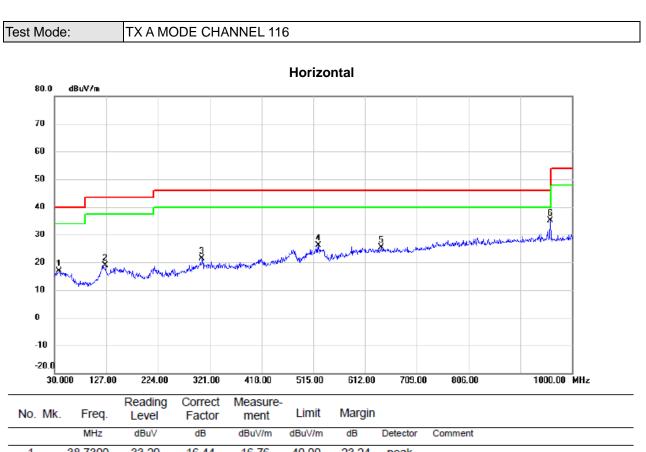


#### **REMARKS**:

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

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



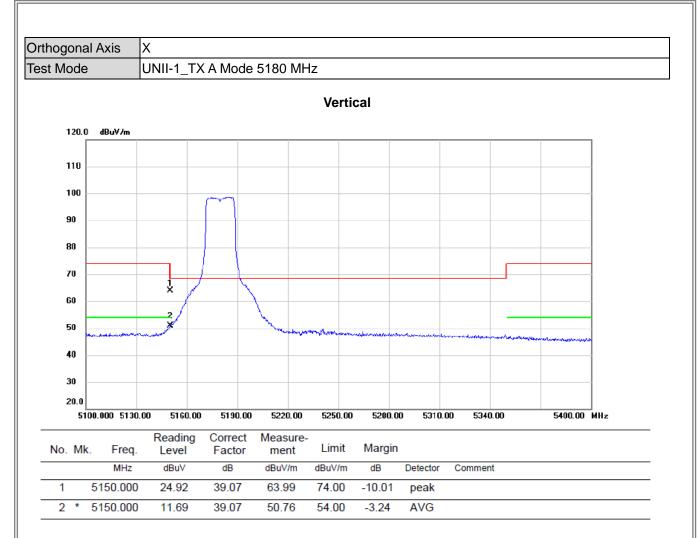


	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	38.7300	33.20	-16.44	16.76	40.00	-23.24	peak	
2	125.5450	35.72	-16.96	18.76	43.50	-24.74	peak	
3	306.4500	35.66	-14.21	21.45	46.00	-24.55	peak	
4	524.7000	38.17	-11.95	26.22	46.00	-19.78	peak	
5	642.0700	33.89	-8.53	25.36	46.00	-20.64	peak	
6 *	959.7450	40.14	-5.09	35.05	46.00	-10.95	peak	

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

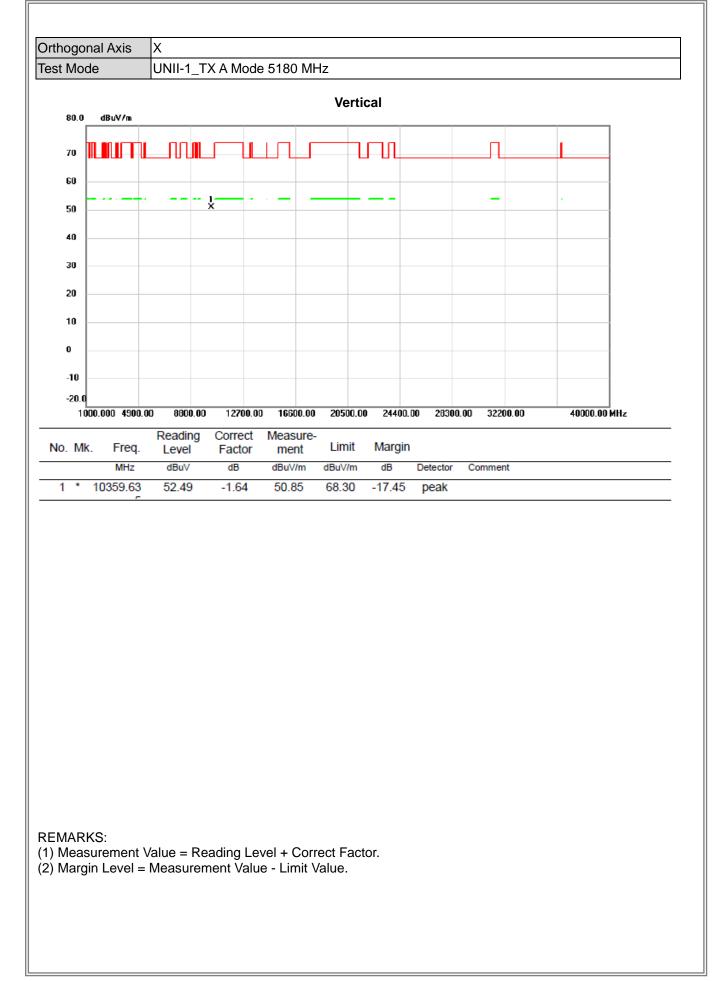
## **APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ**





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



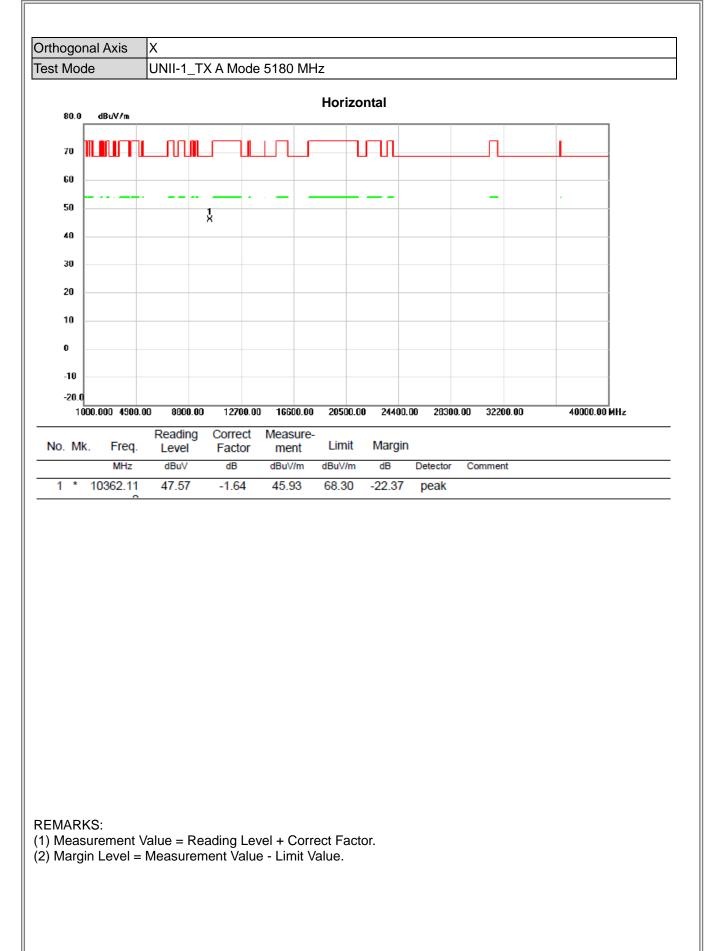




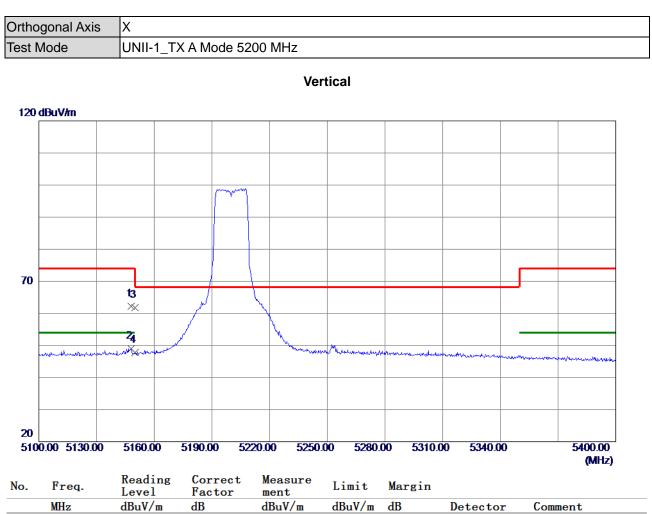


(1) Measurement Value = Reading Level + Correct Factor.





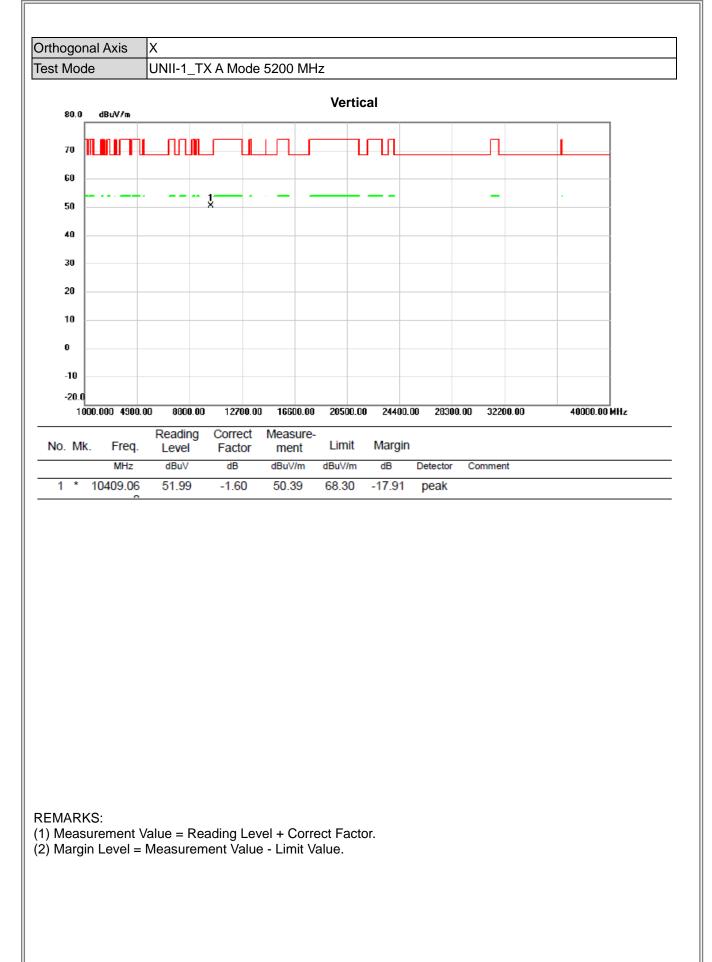




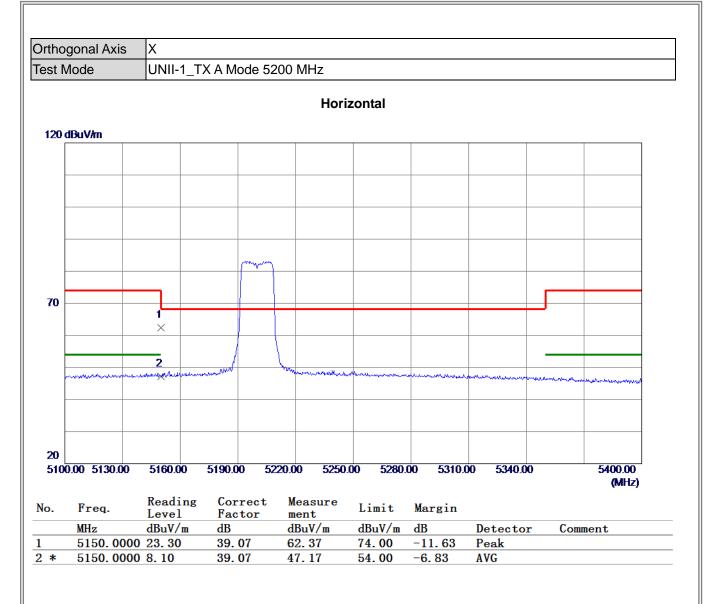
		dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	5147.8500	23. 21	39.07	62.28	74.00	-11.72	Peak	
2 *	5147.8500	9.97	39.07	49.04	<b>54.00</b>	-4.96	AVG	
3	5150.0000	22.66	39.07	61.73	74.00	-12.27	Peak	
4	5150. 0000	8.66	39.07	47.73	54.00	-6.27	AVG	

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



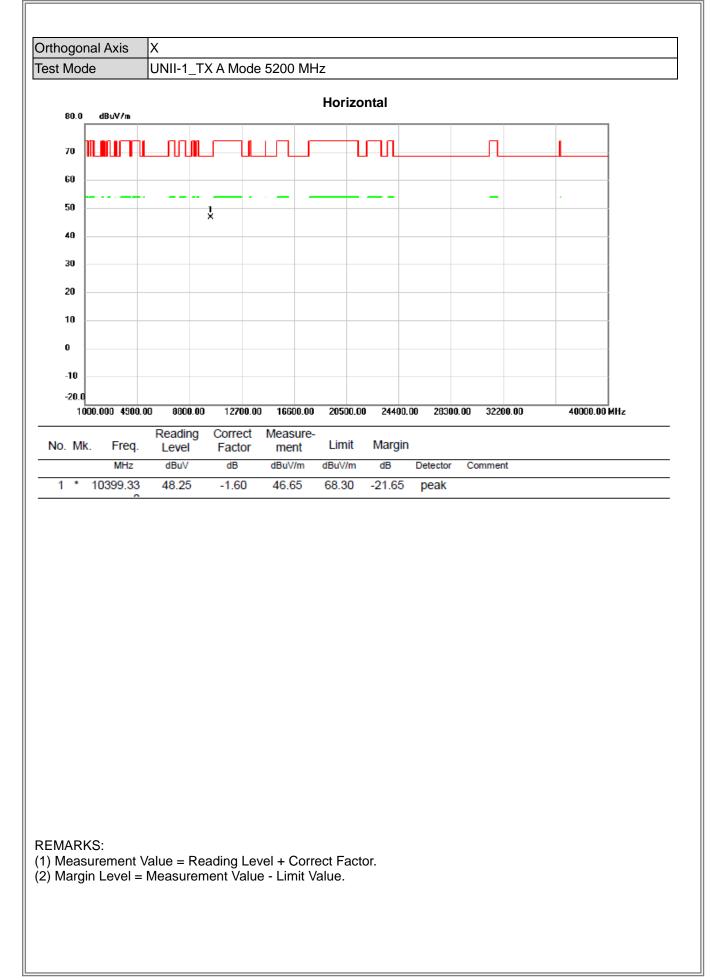




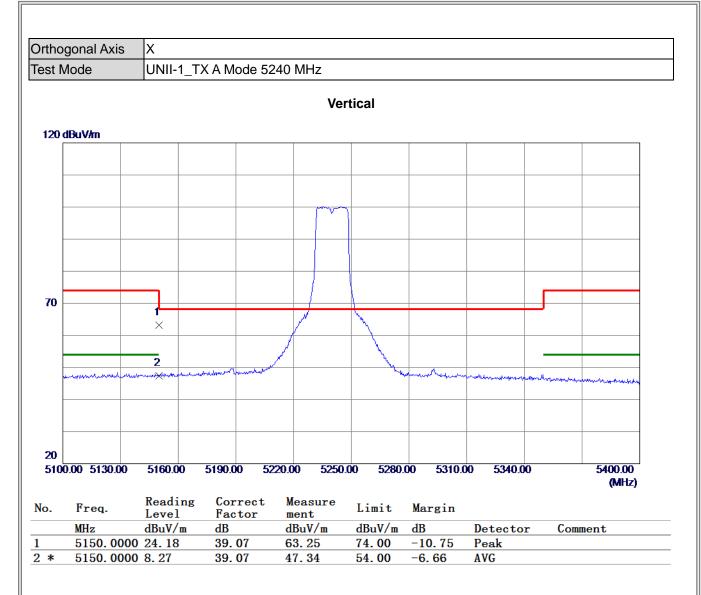


(1) Measurement Value = Reading Level + Correct Factor.



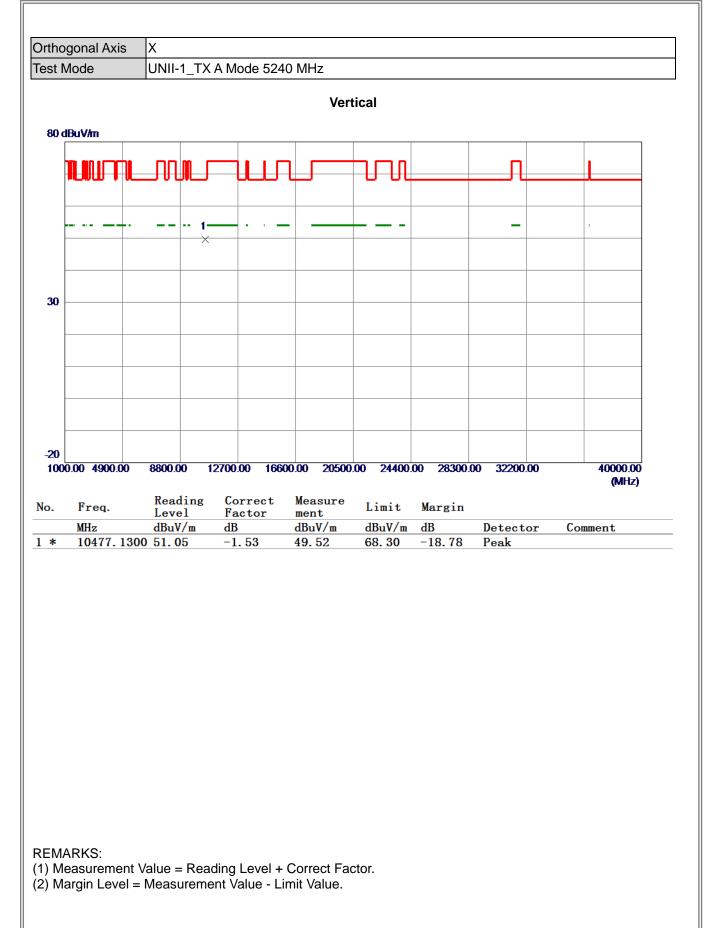




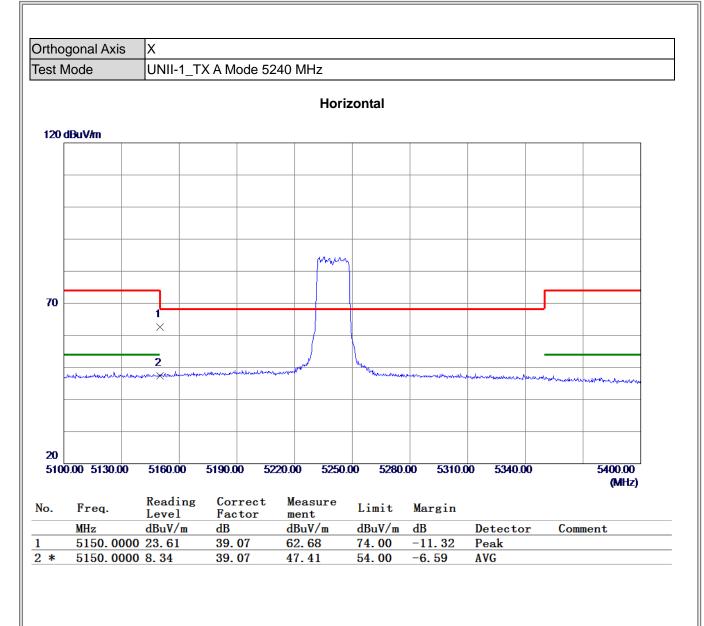


(1) Measurement Value = Reading Level + Correct Factor.



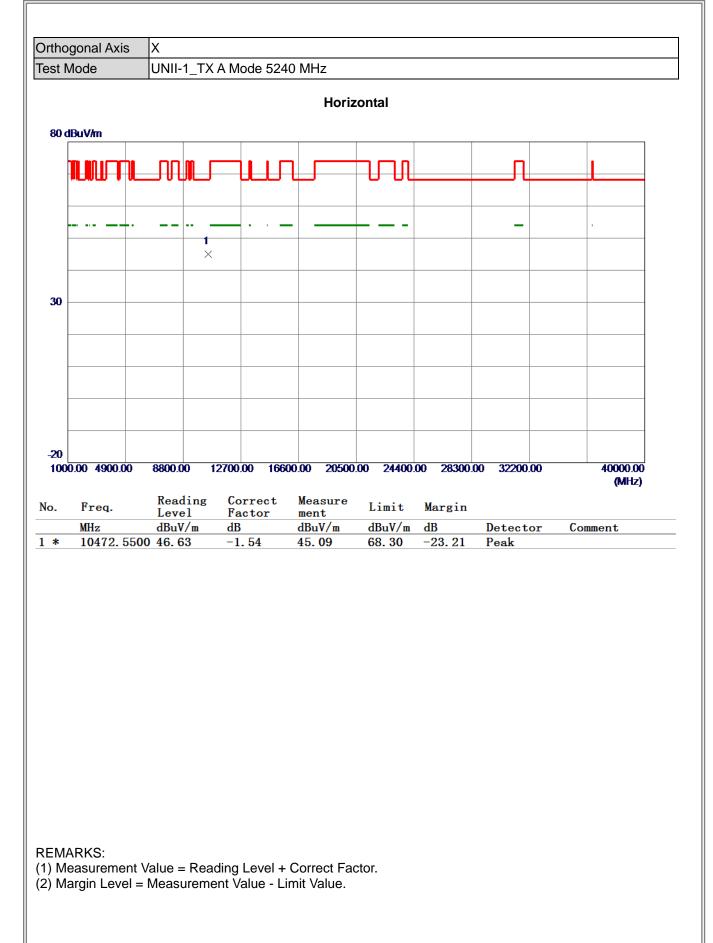




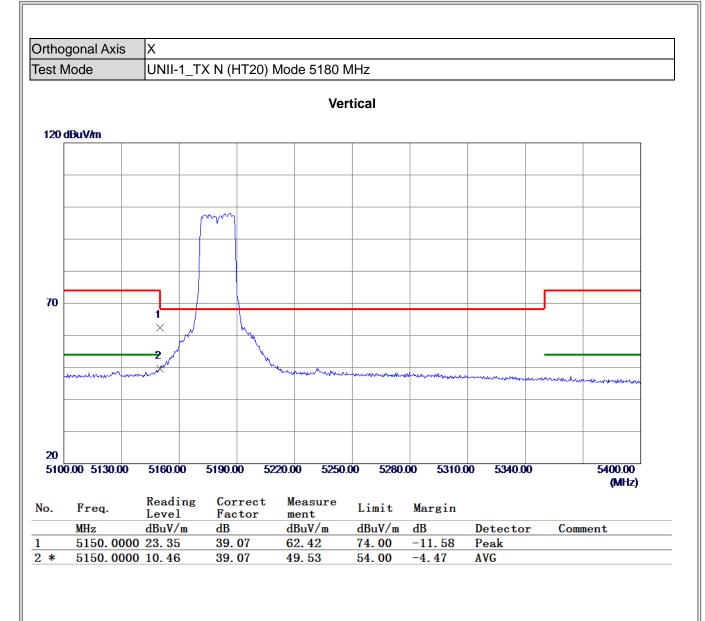


(1) Measurement Value = Reading Level + Correct Factor.



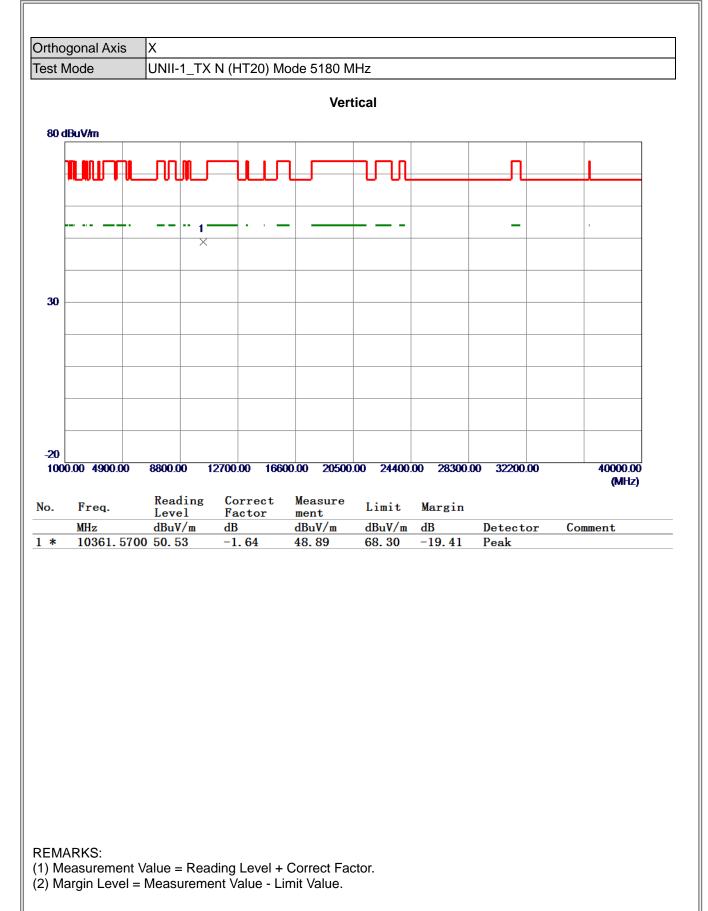




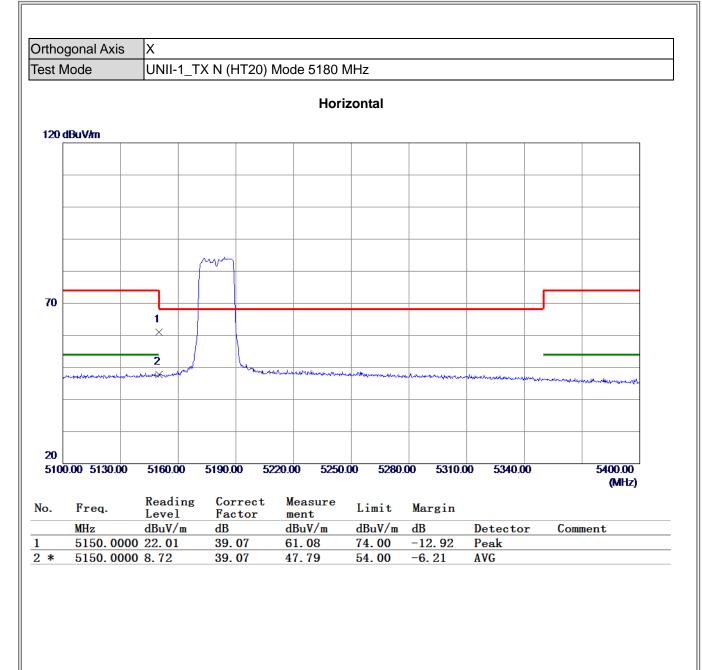


(1) Measurement Value = Reading Level + Correct Factor.



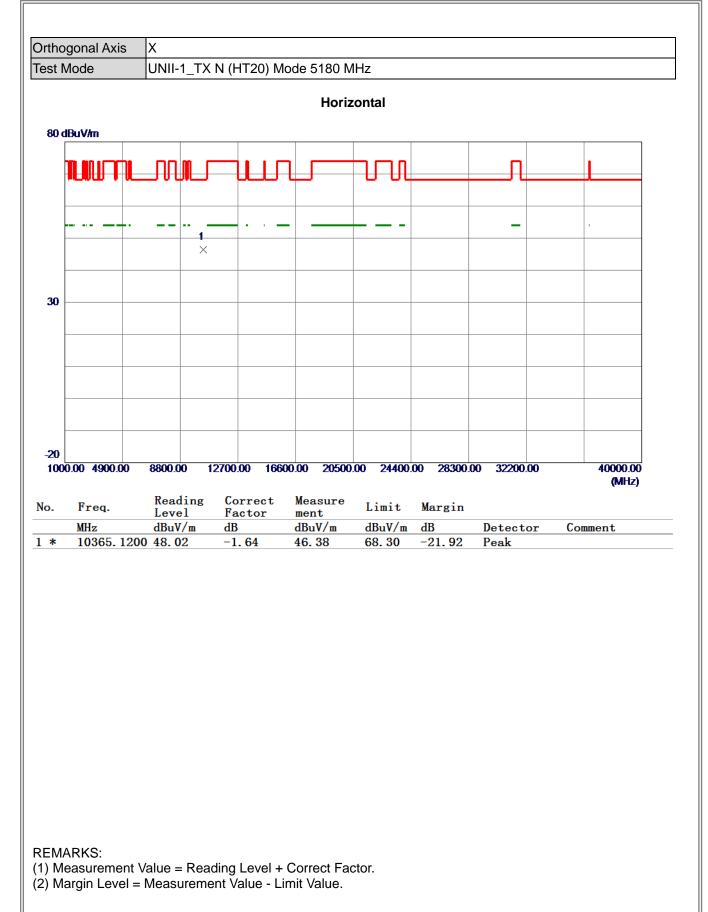




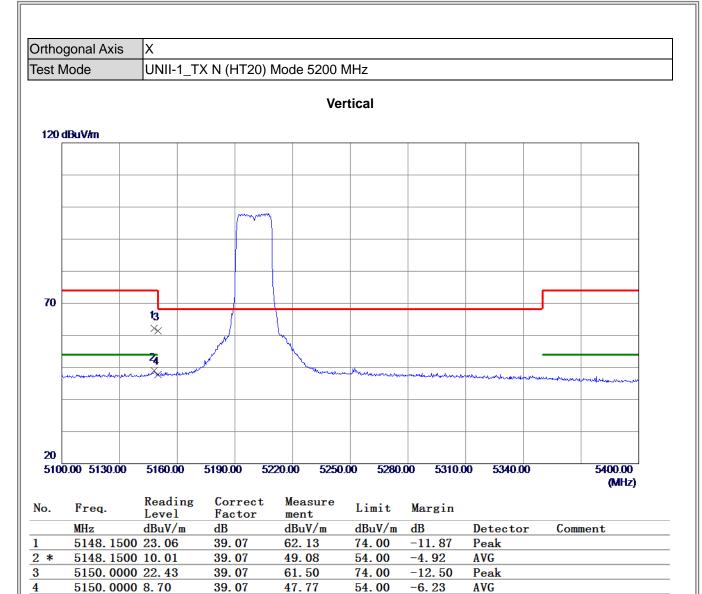


(1) Measurement Value = Reading Level + Correct Factor.



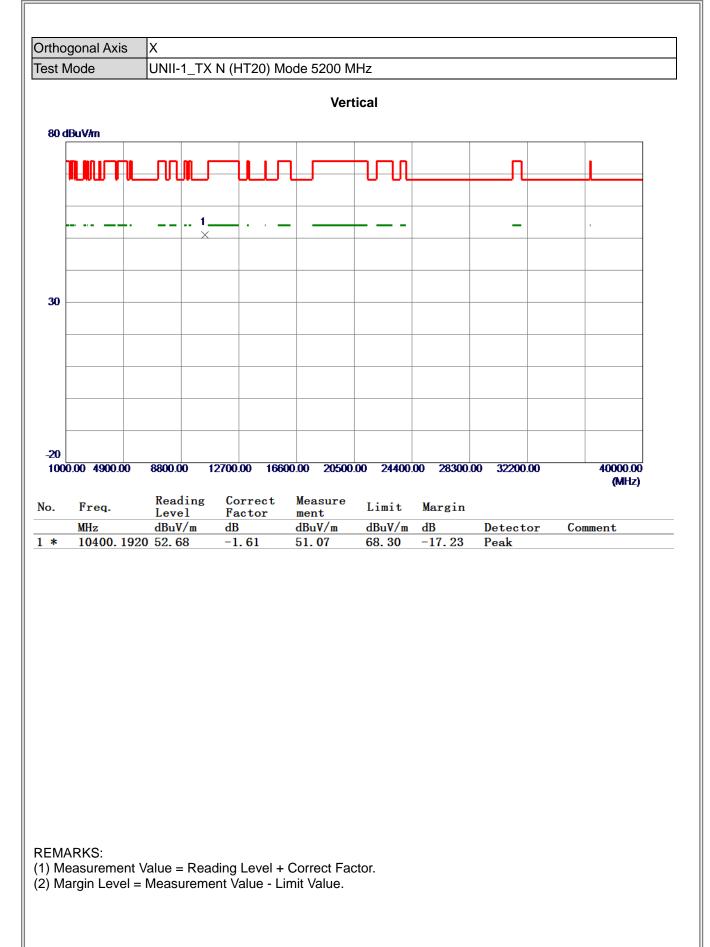




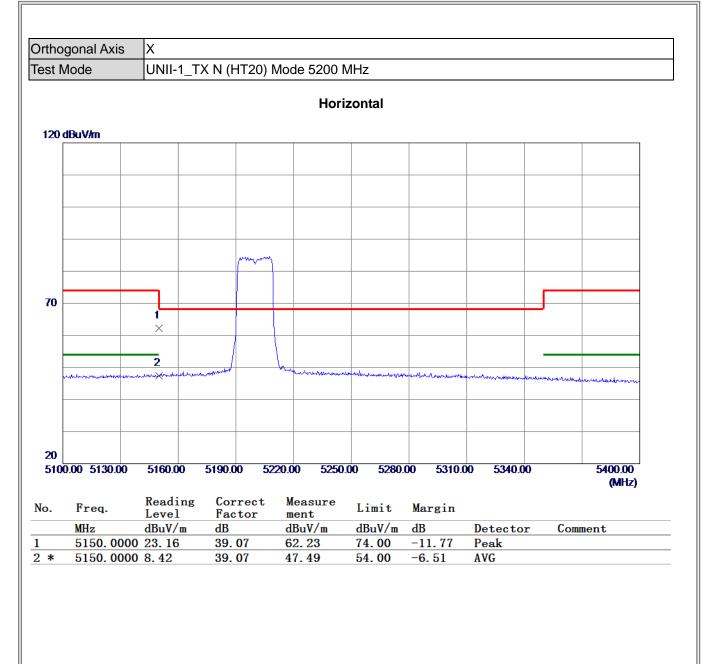


(1) Measurement Value = Reading Level + Correct Factor.



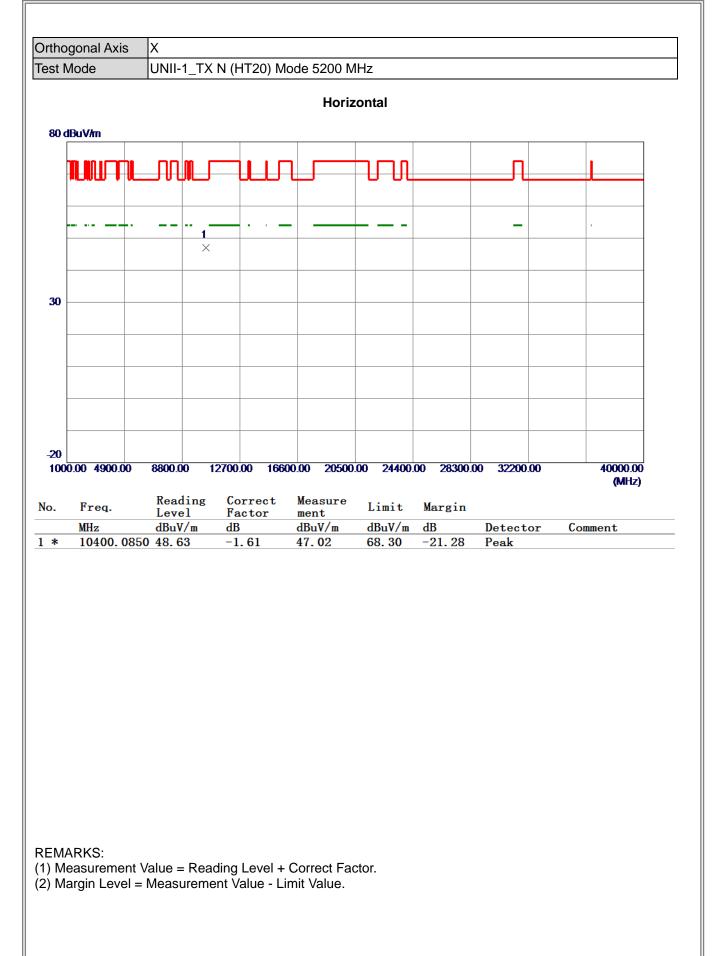




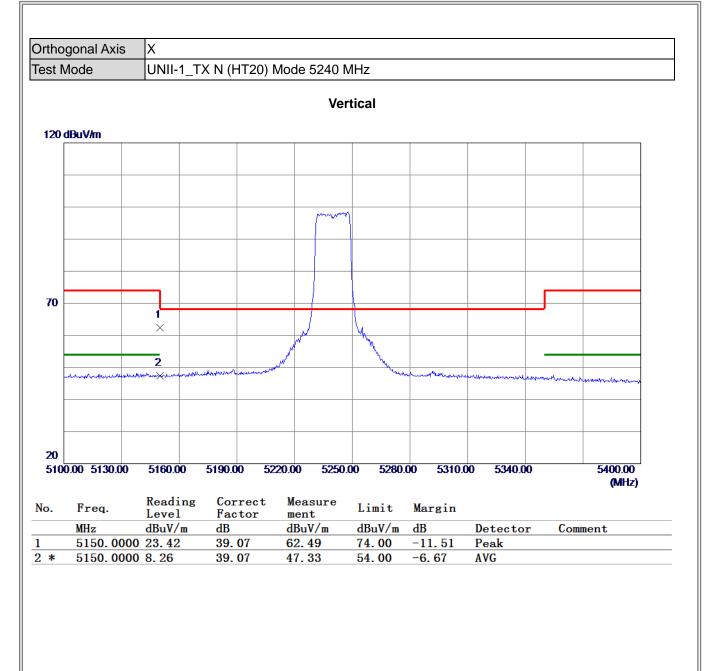


(1) Measurement Value = Reading Level + Correct Factor.



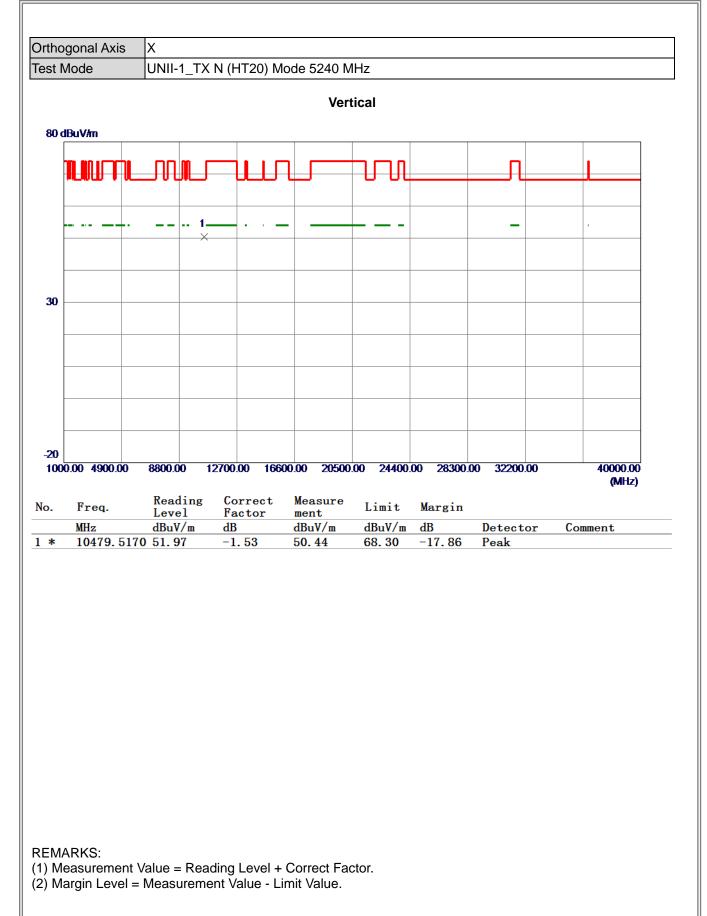




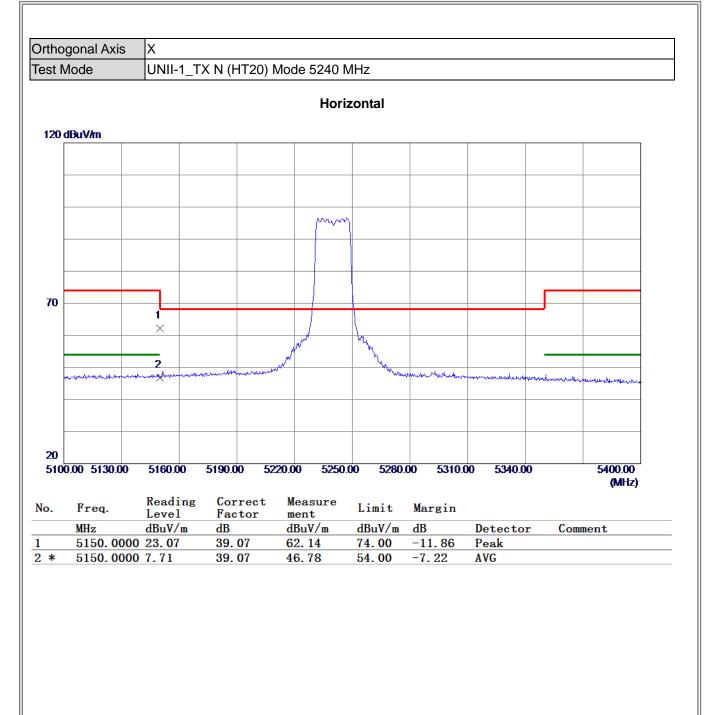


(1) Measurement Value = Reading Level + Correct Factor.



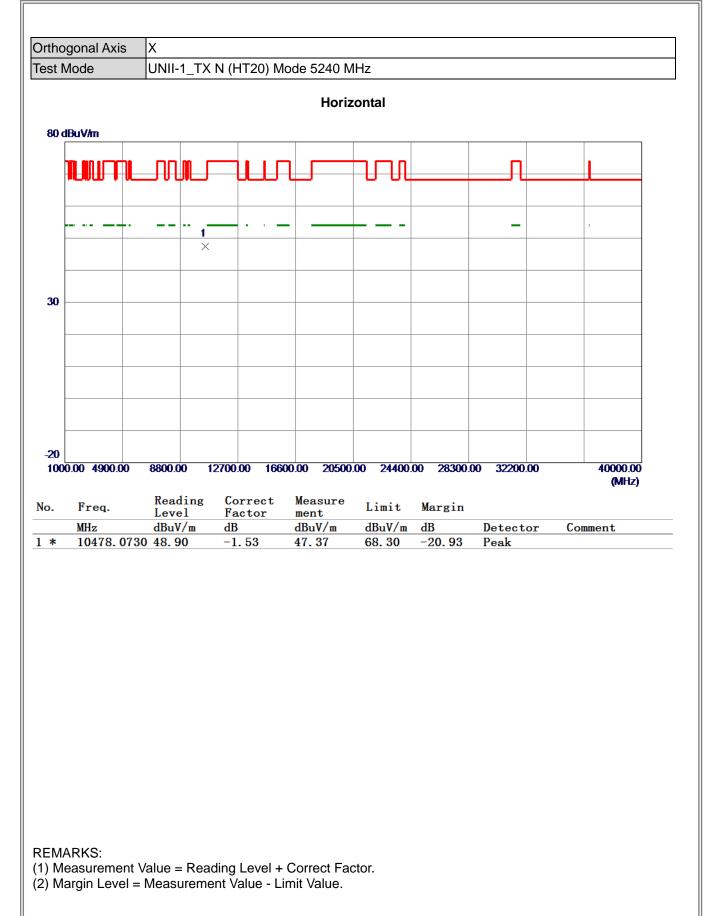




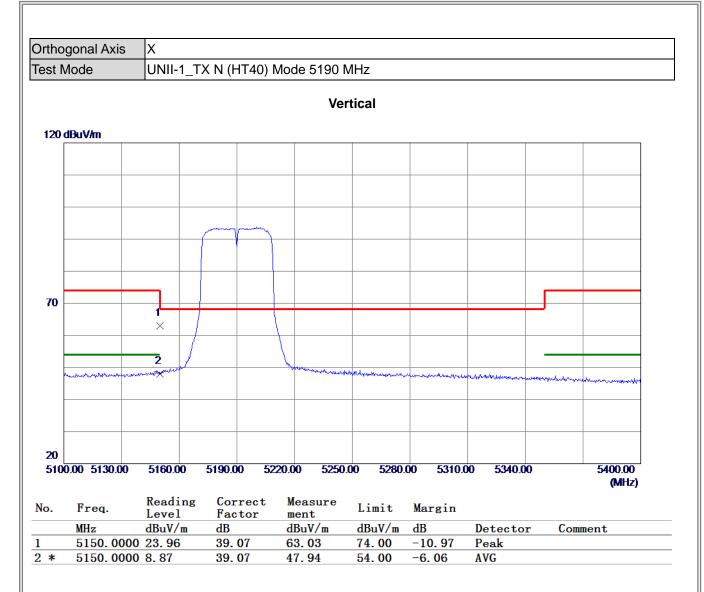


(1) Measurement Value = Reading Level + Correct Factor.



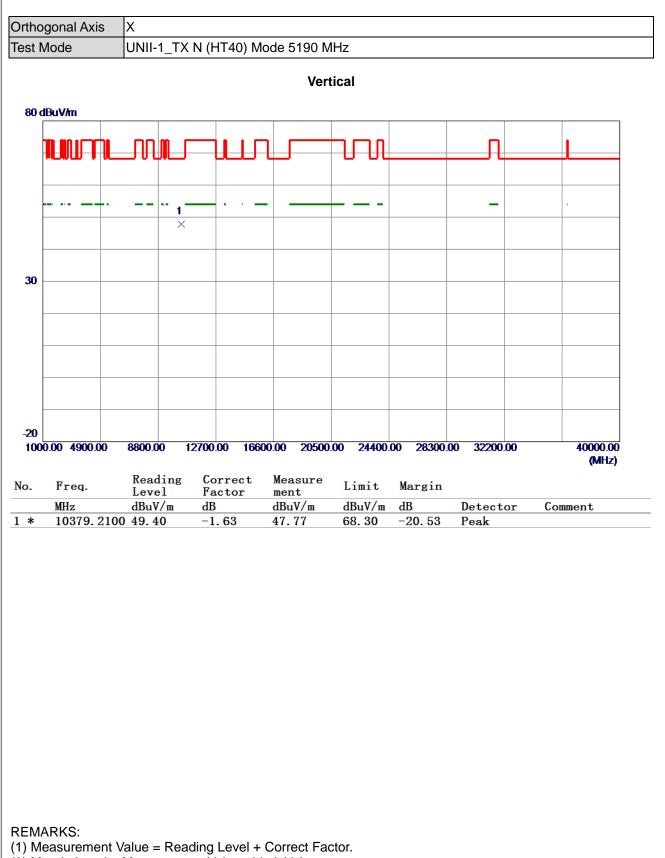




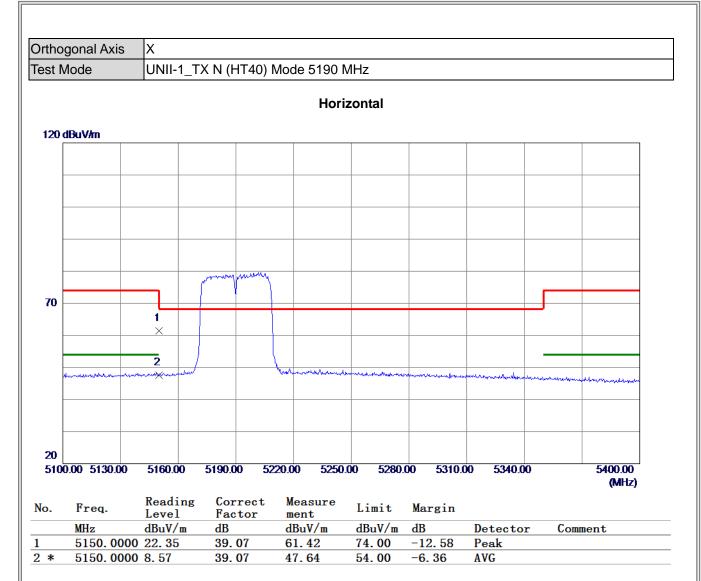


(1) Measurement Value = Reading Level + Correct Factor.



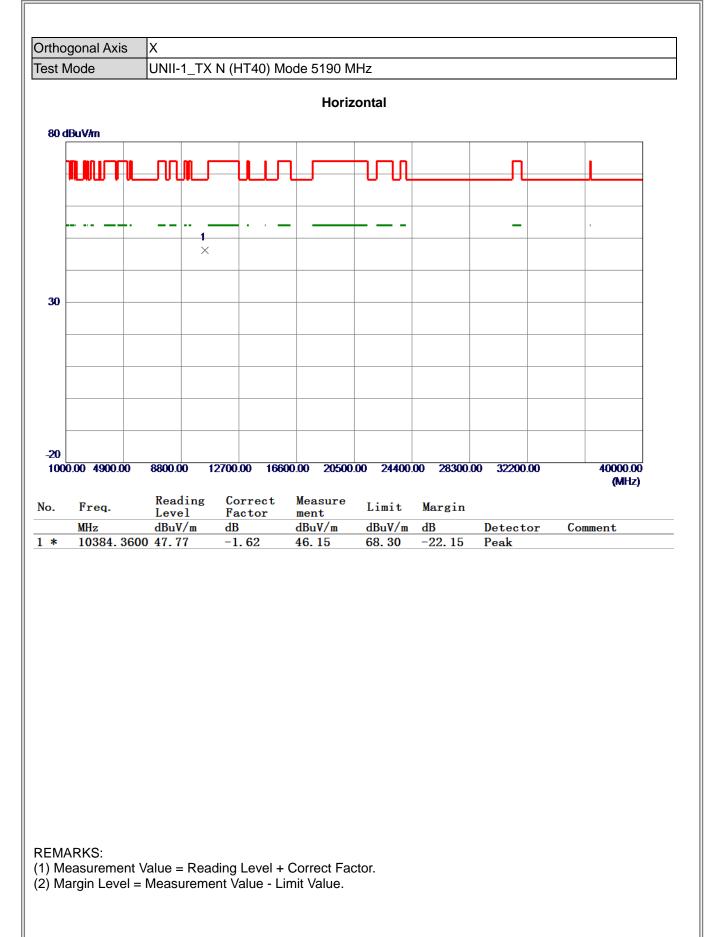




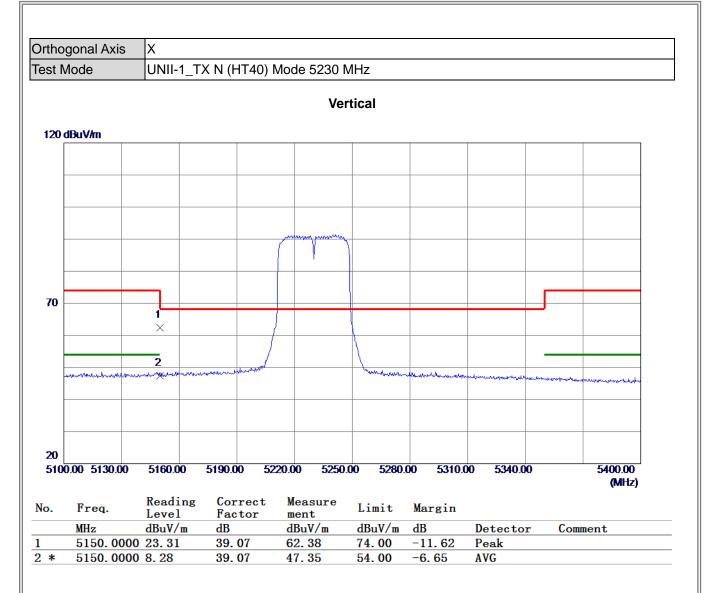


(1) Measurement Value = Reading Level + Correct Factor.



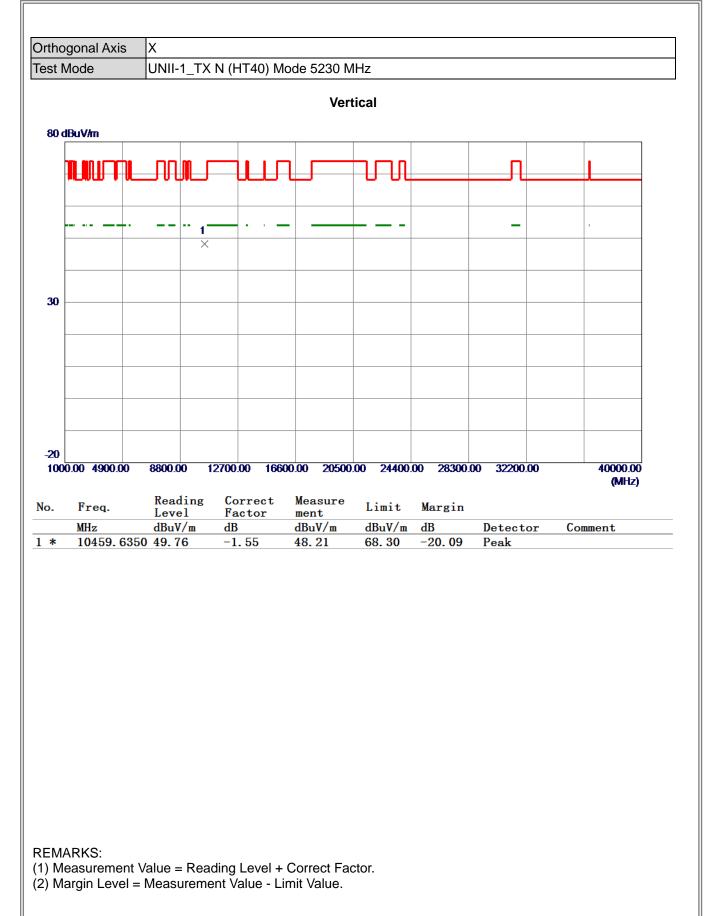






(1) Measurement Value = Reading Level + Correct Factor.



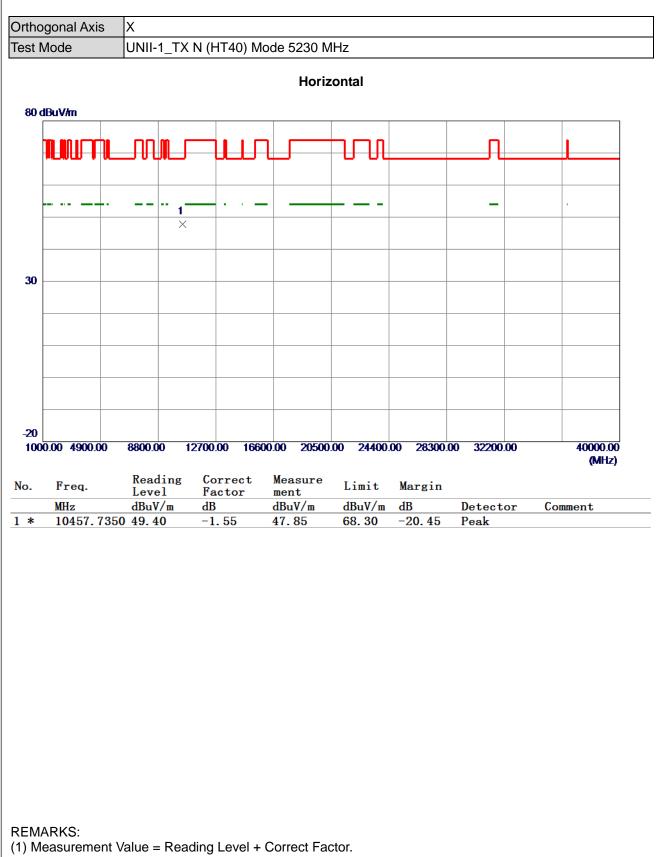




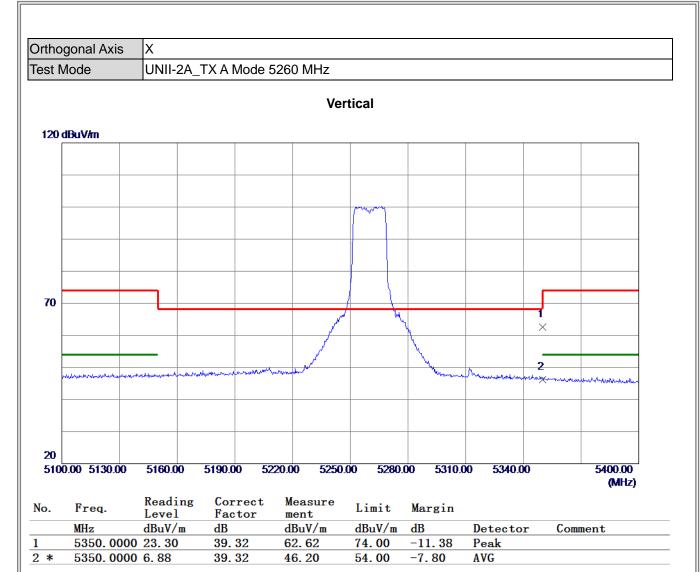


(1) Measurement Value = Reading Level + Correct Factor.



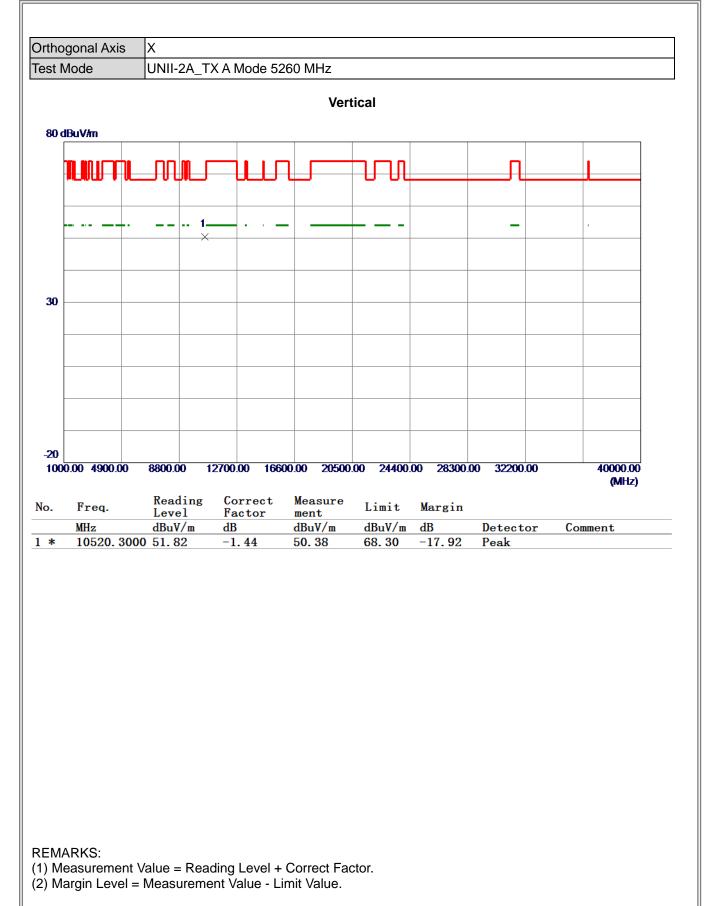




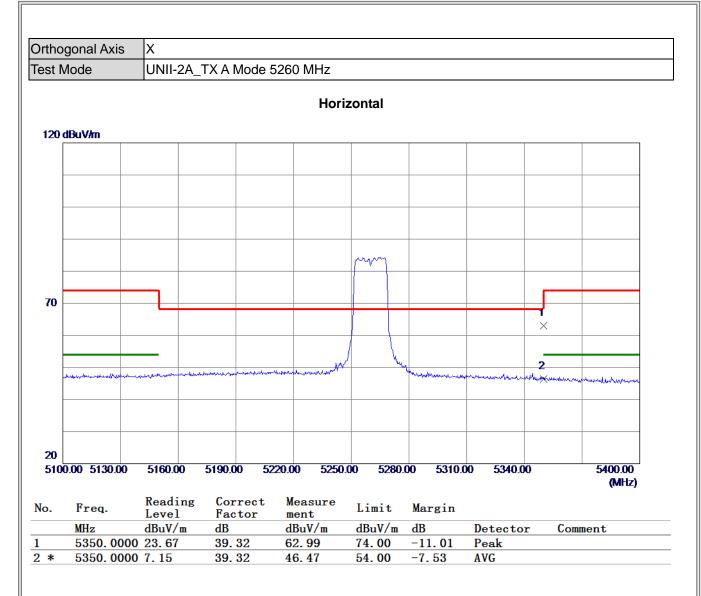


(1) Measurement Value = Reading Level + Correct Factor.



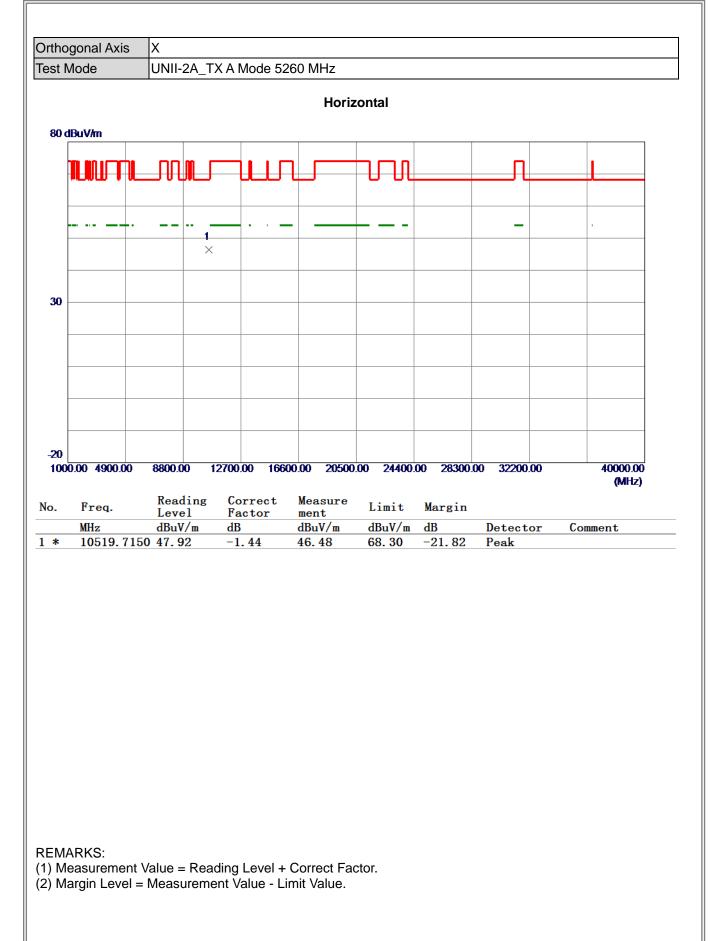




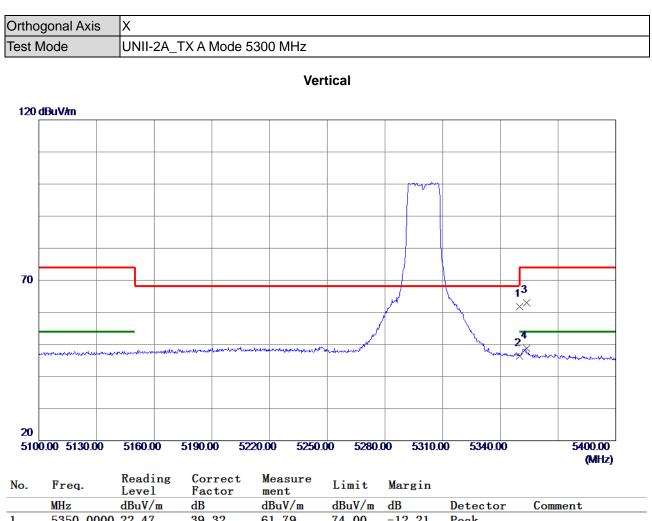


(1) Measurement Value = Reading Level + Correct Factor.





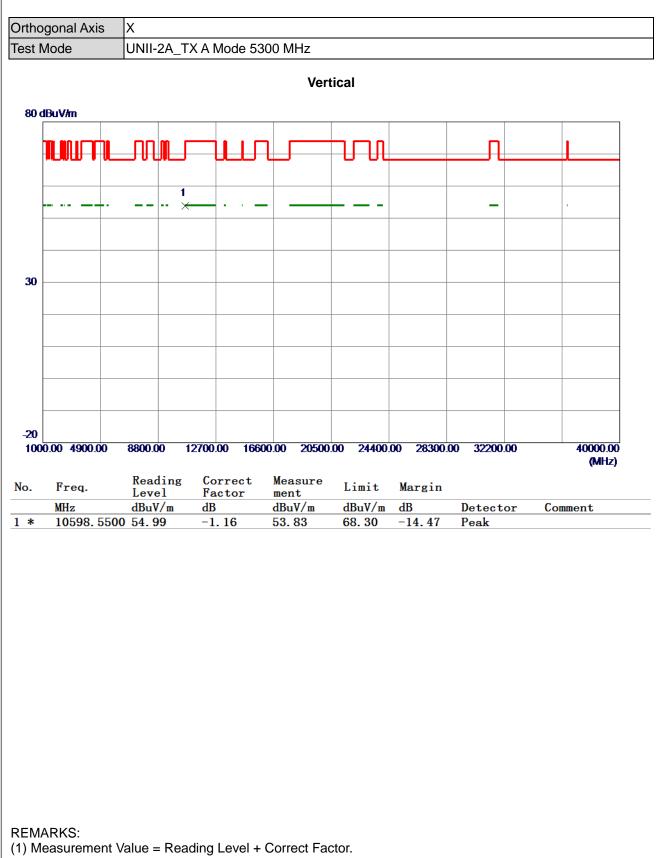




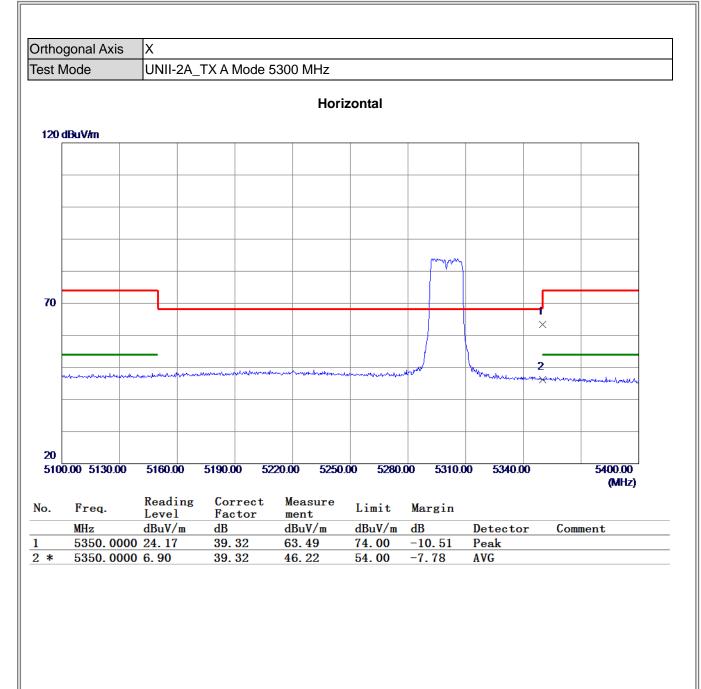
_		MHZ	dbuv/m	ab	dbuv/m	dbuv/m	ab	Detector	Comment
1	L	5350. 0000	22.47	39.32	61.79	74.00	-12.21	Peak	
2	2	5350.0000	7.10	39.32	46.42	<b>54.00</b>	-7.58	AVG	
3	3	5353. 5000	23.66	39.33	62.99	74.00	-11.01	Peak	
4	<b>! *</b>	5353. 5000	9.55	39. 33	48.88	<b>54.00</b>	-5.12	AVG	

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



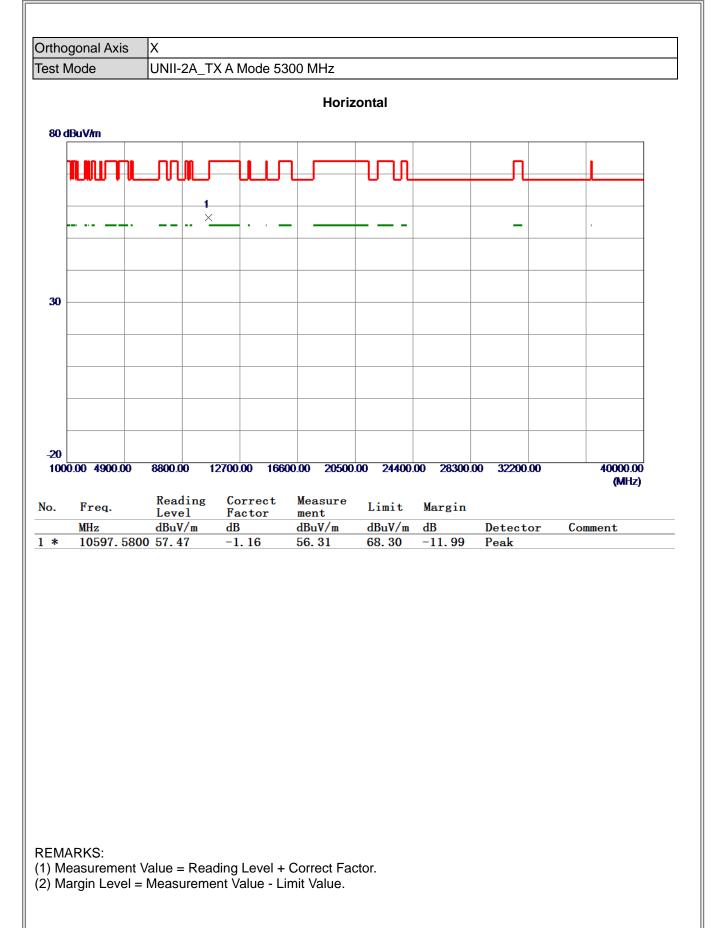




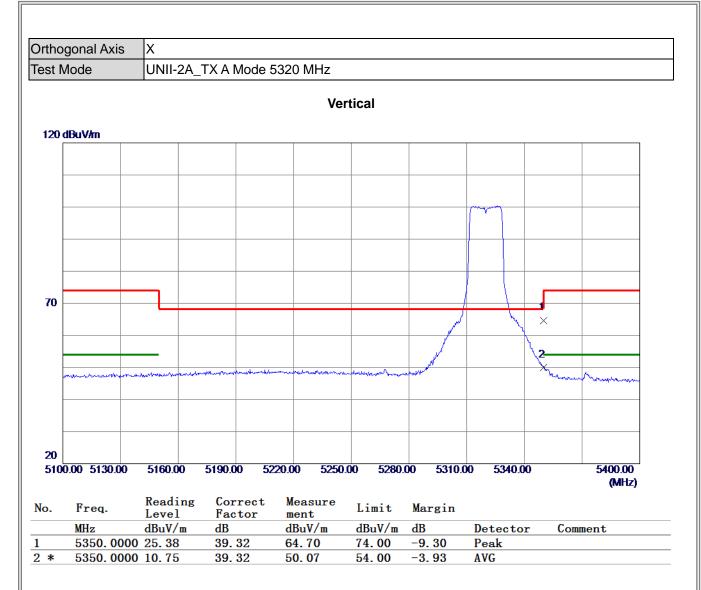


(1) Measurement Value = Reading Level + Correct Factor.



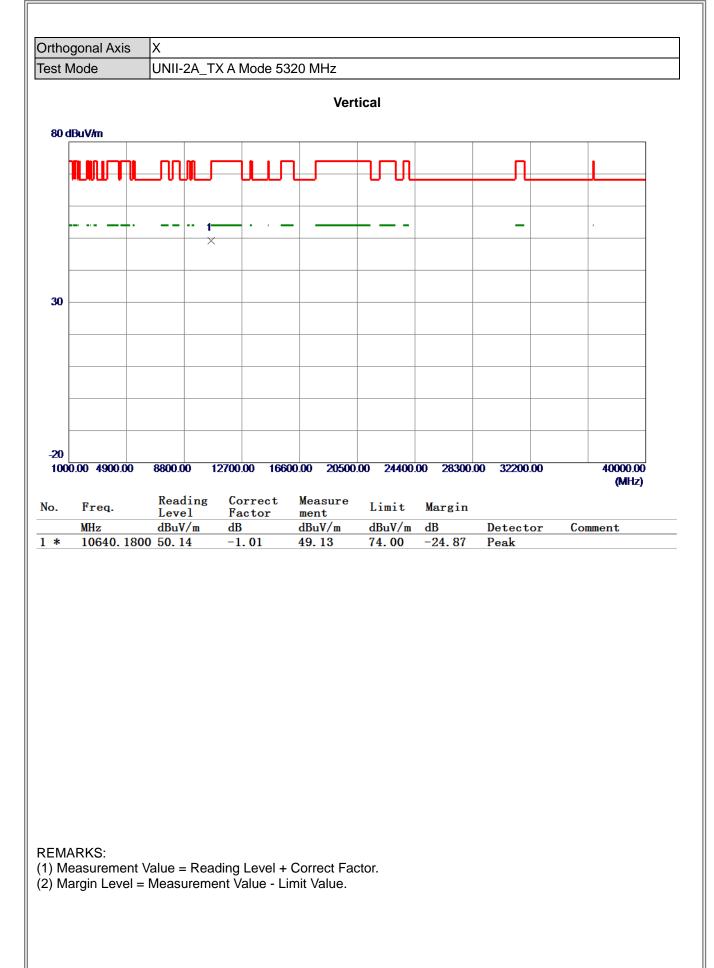




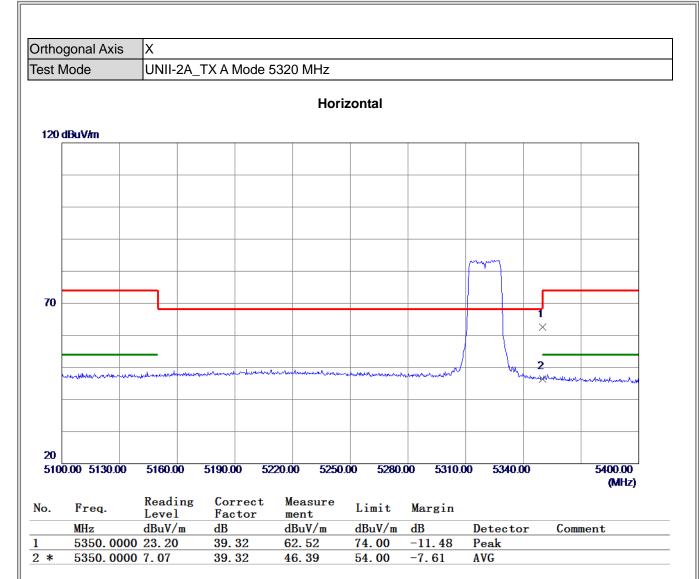


(1) Measurement Value = Reading Level + Correct Factor.



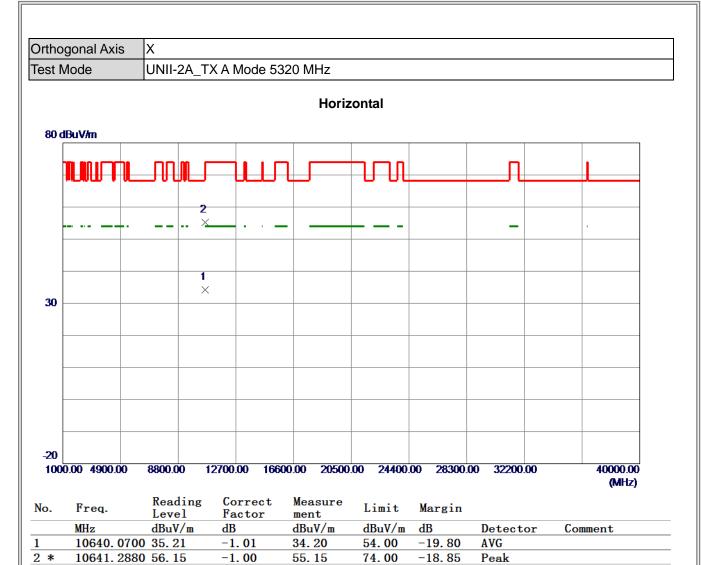






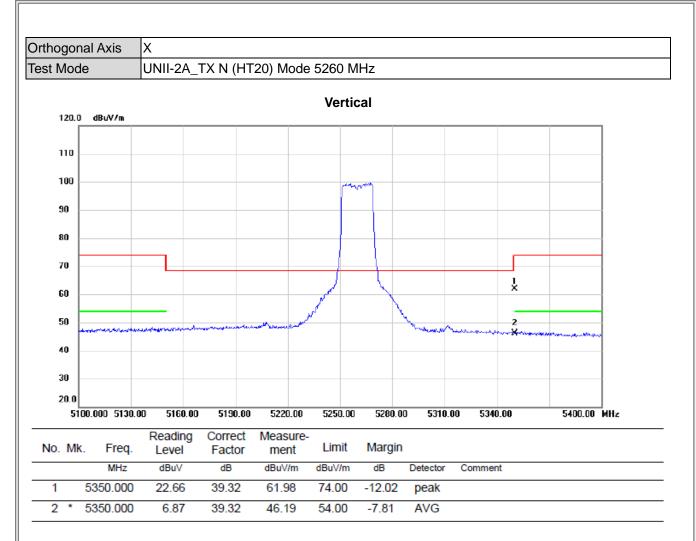
(1) Measurement Value = Reading Level + Correct Factor.





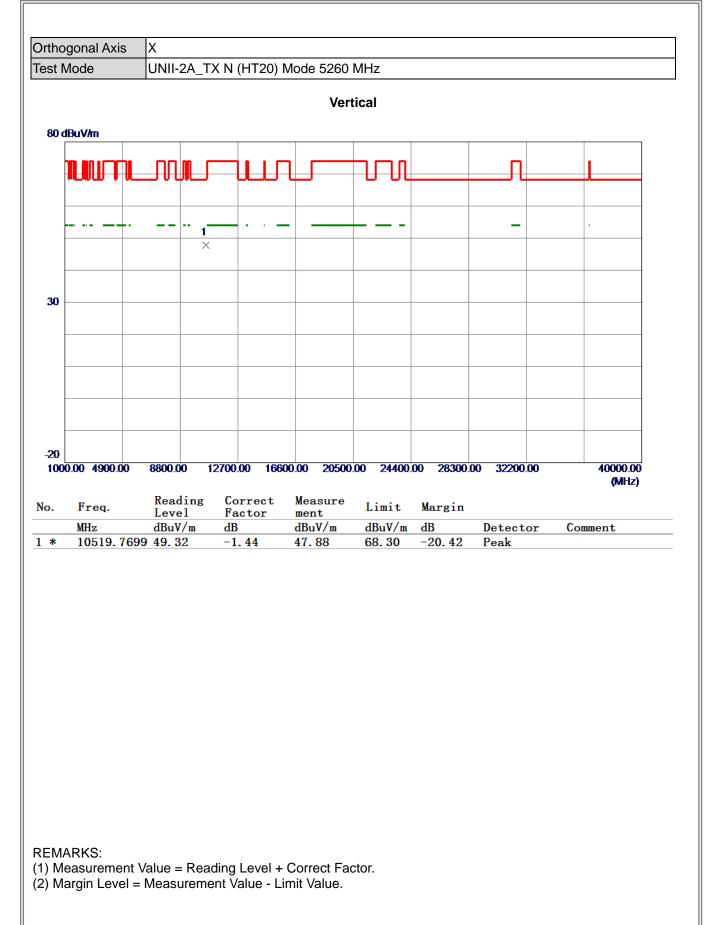
(1) Measurement Value = Reading Level + Correct Factor.





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

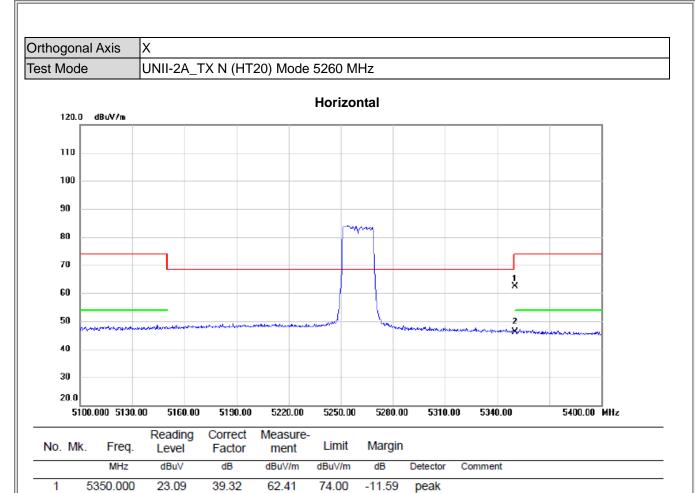






1

2 \* 5350.000



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

39.32

46.10

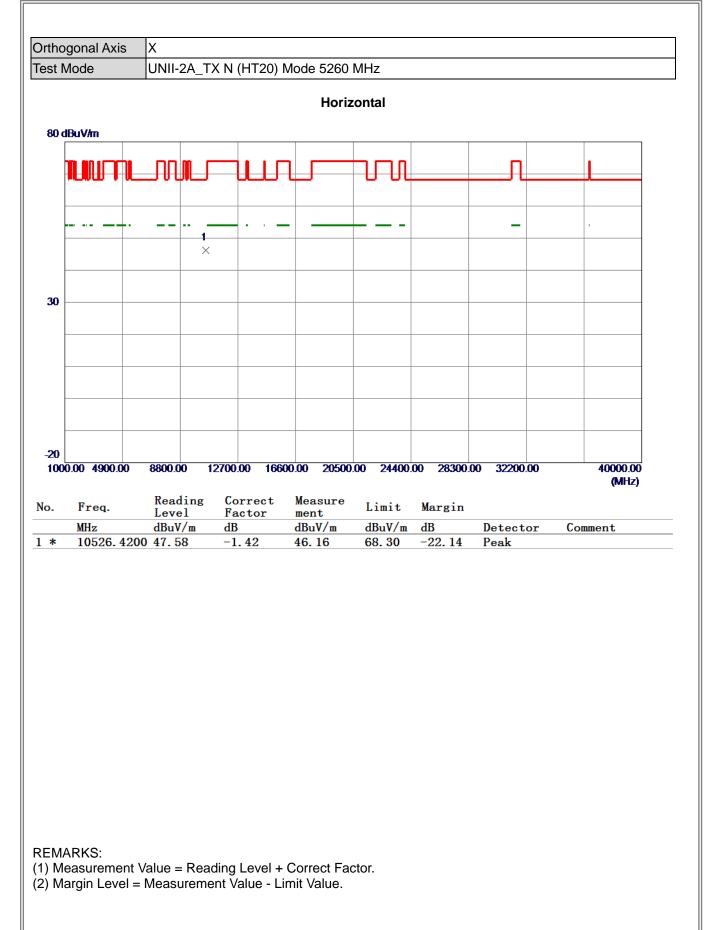
54.00

-7.90

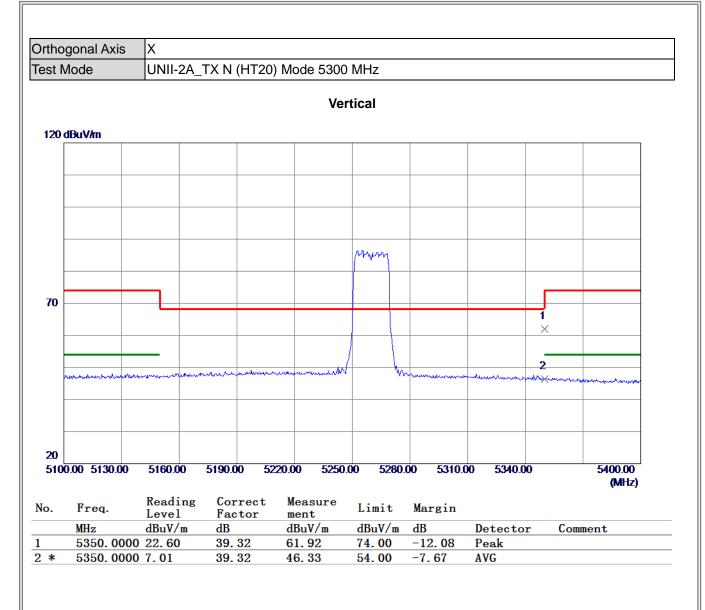
AVG

6.78



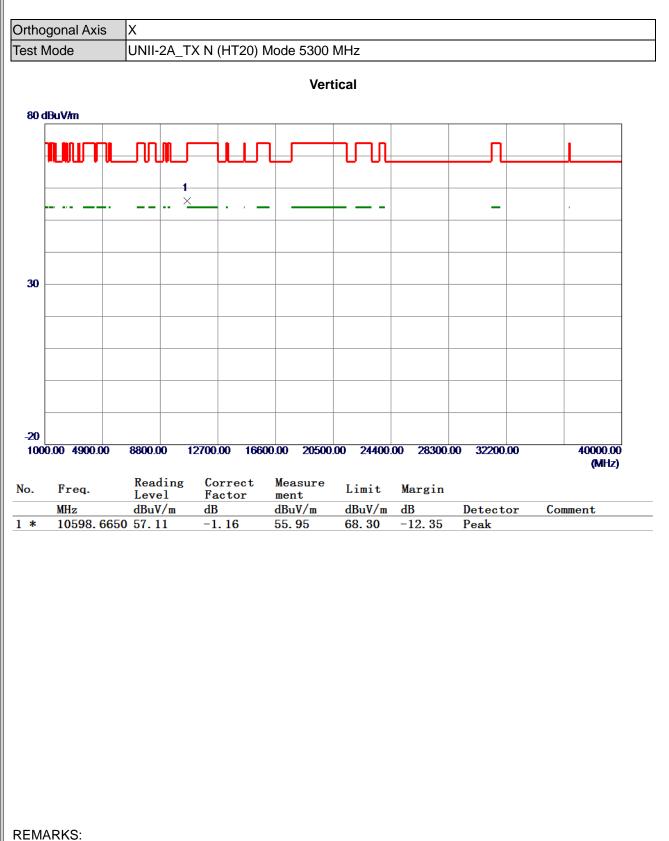






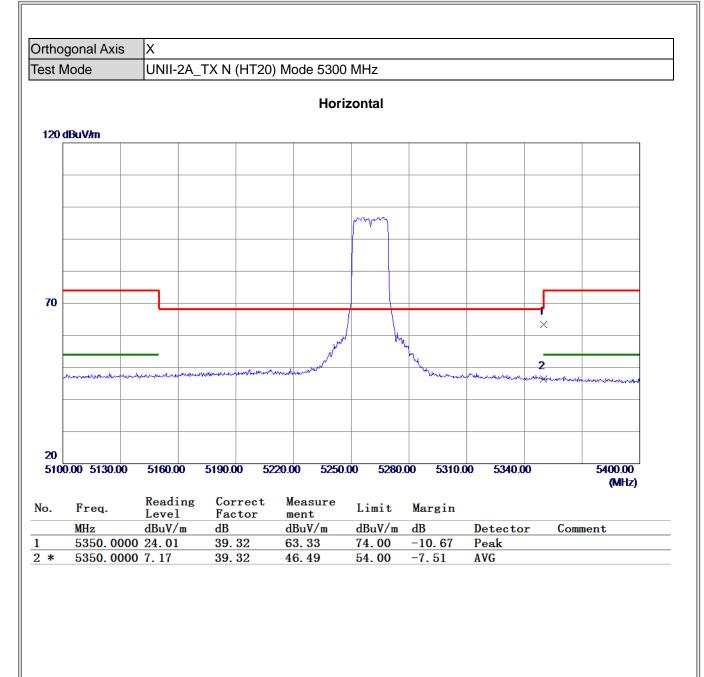
(1) Measurement Value = Reading Level + Correct Factor.





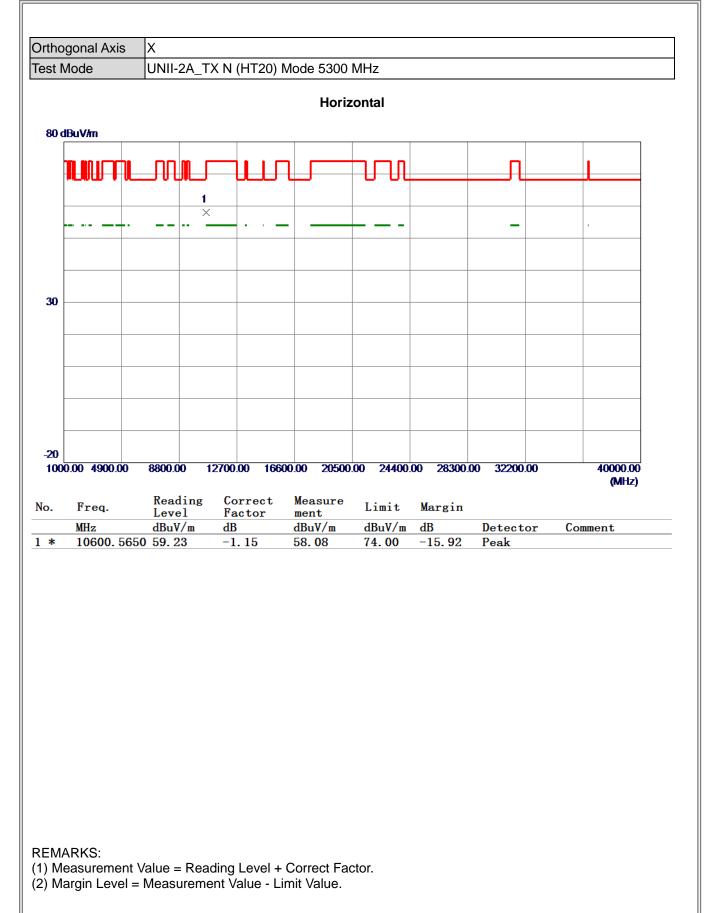
(1) Measurement Value = Reading Level + Correct Factor.



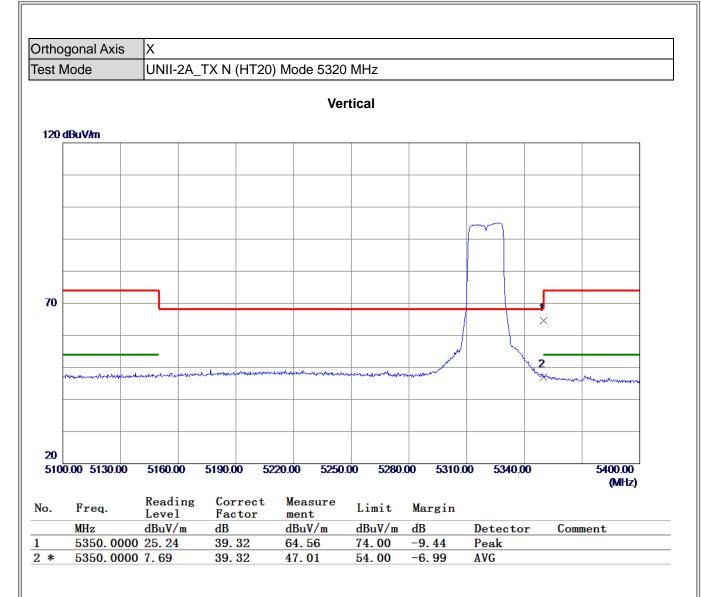


(1) Measurement Value = Reading Level + Correct Factor.



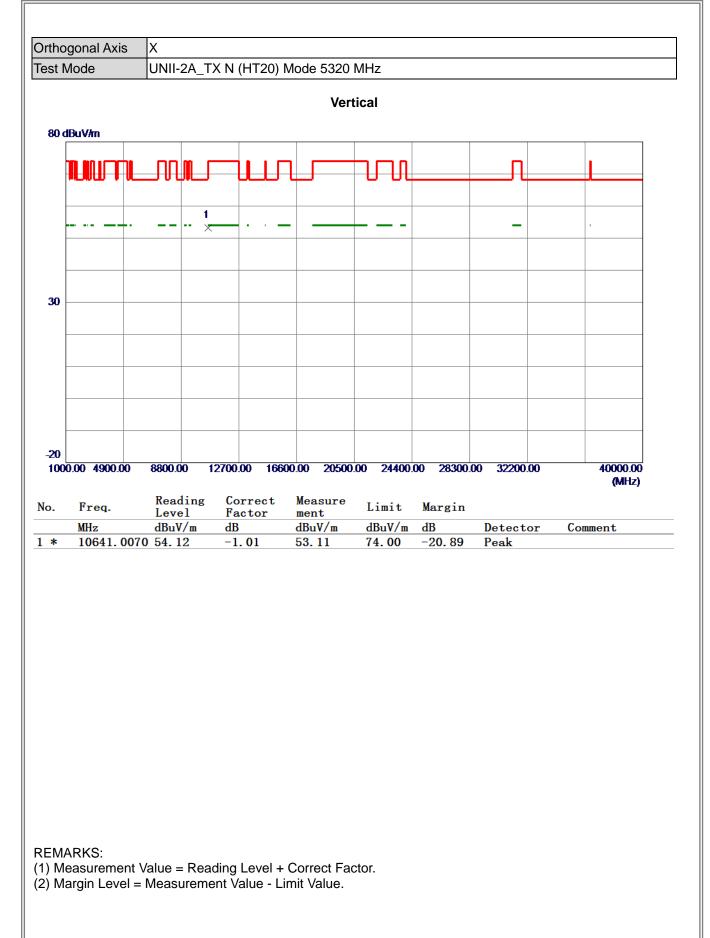




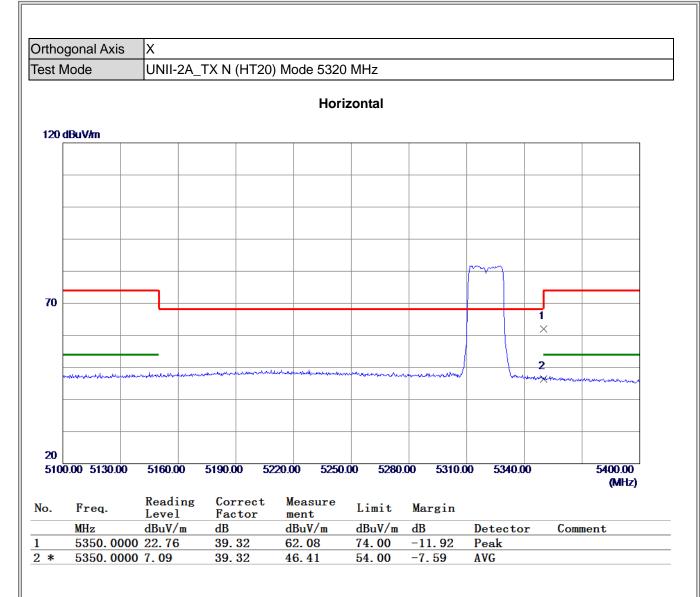


(1) Measurement Value = Reading Level + Correct Factor.



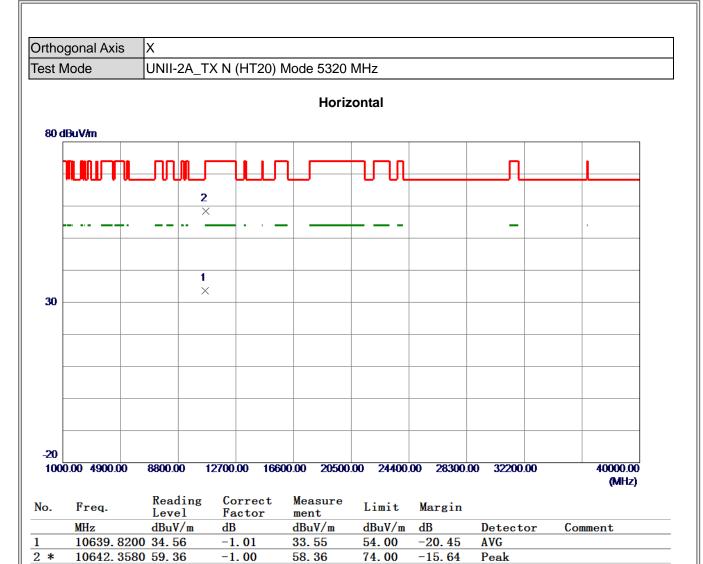






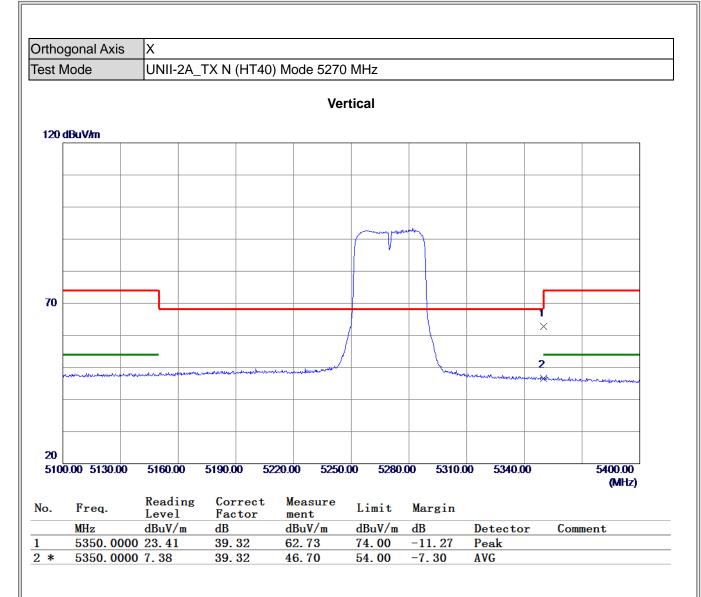
(1) Measurement Value = Reading Level + Correct Factor.





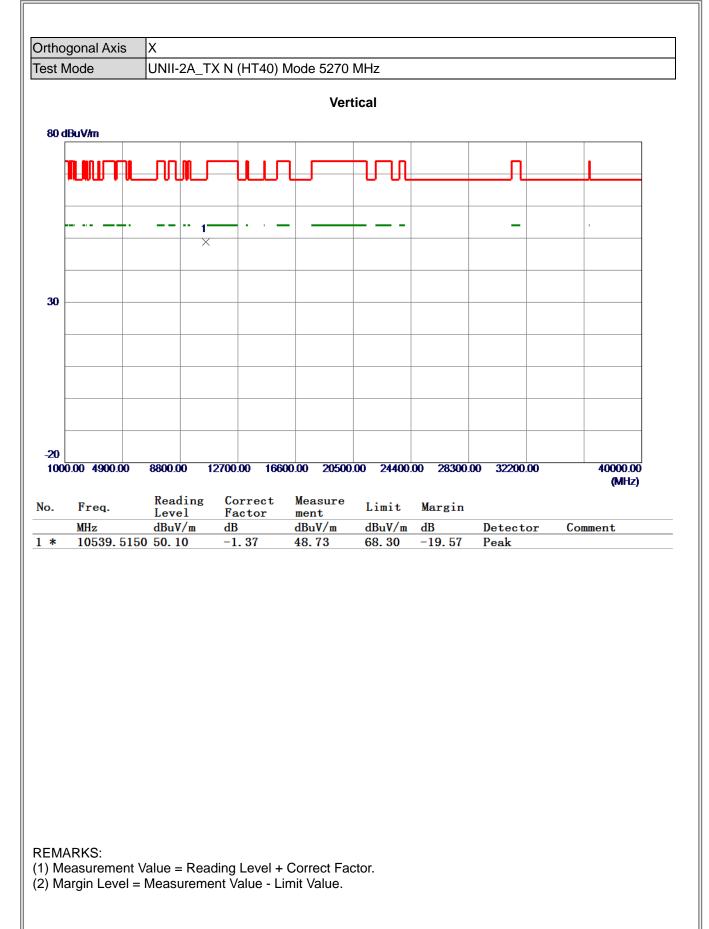
(1) Measurement Value = Reading Level + Correct Factor.



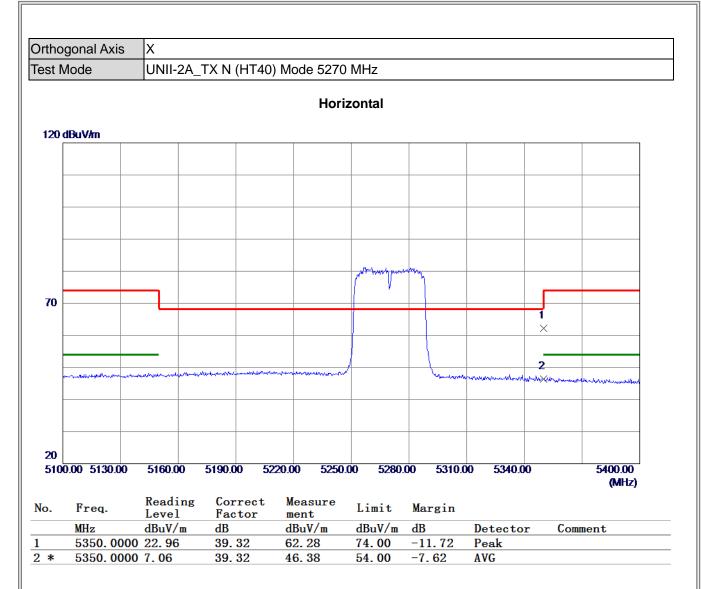


(1) Measurement Value = Reading Level + Correct Factor.



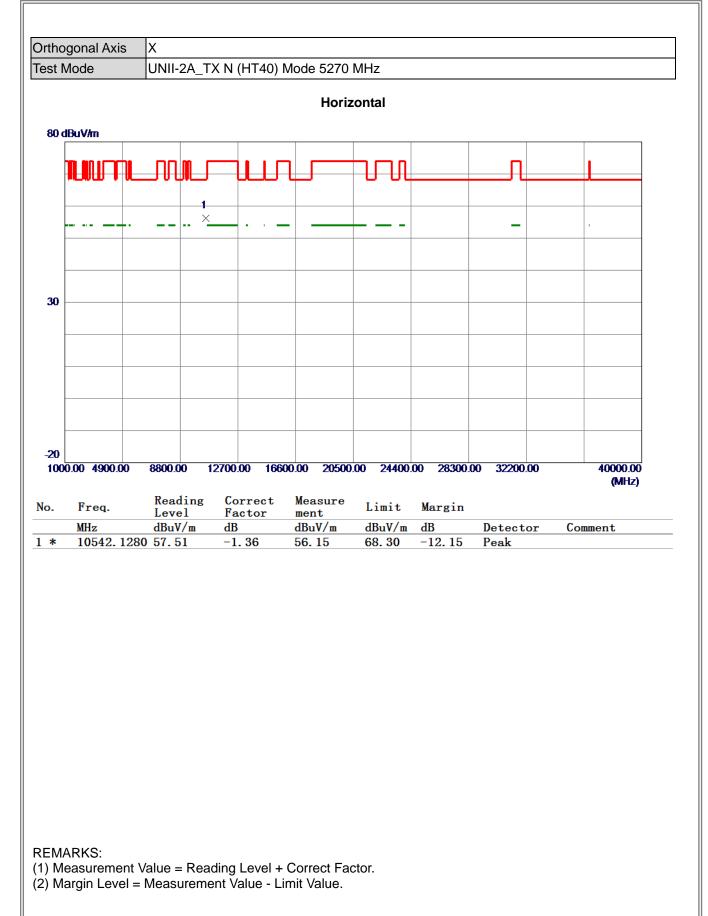




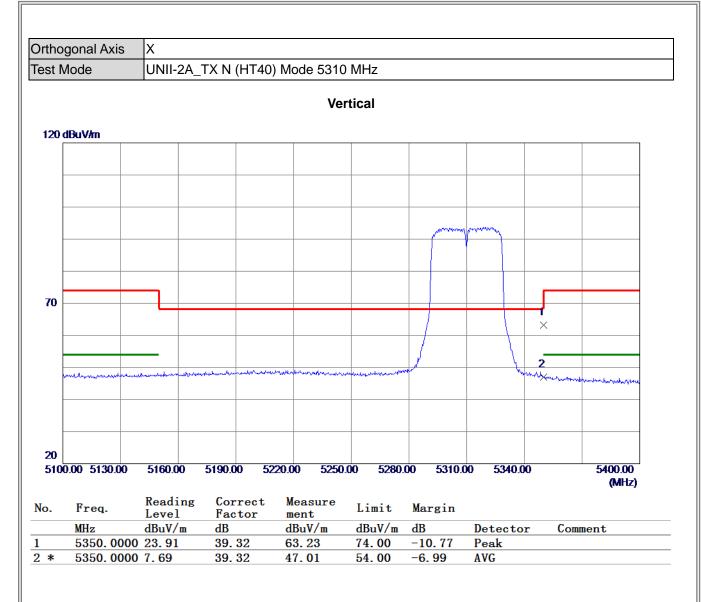


(1) Measurement Value = Reading Level + Correct Factor.



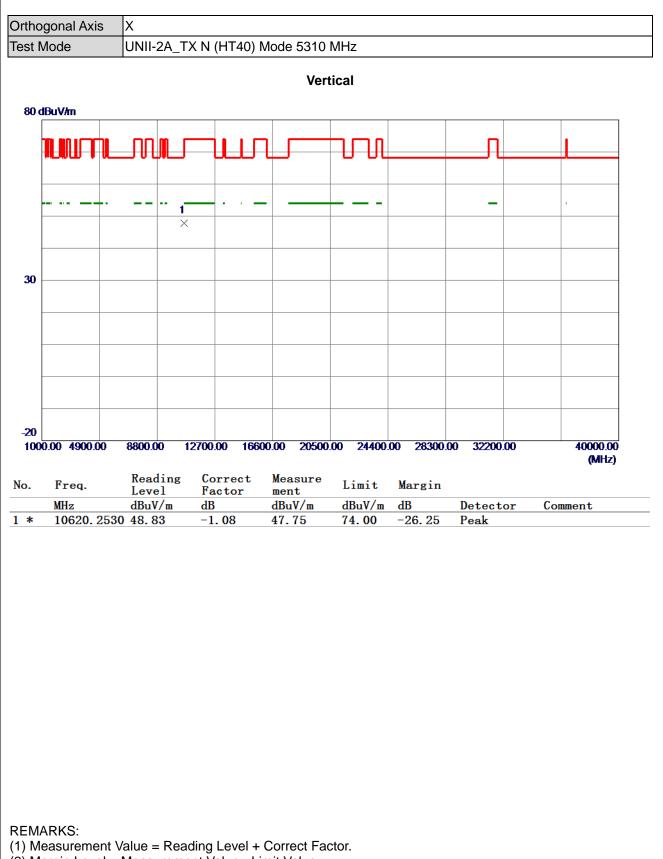




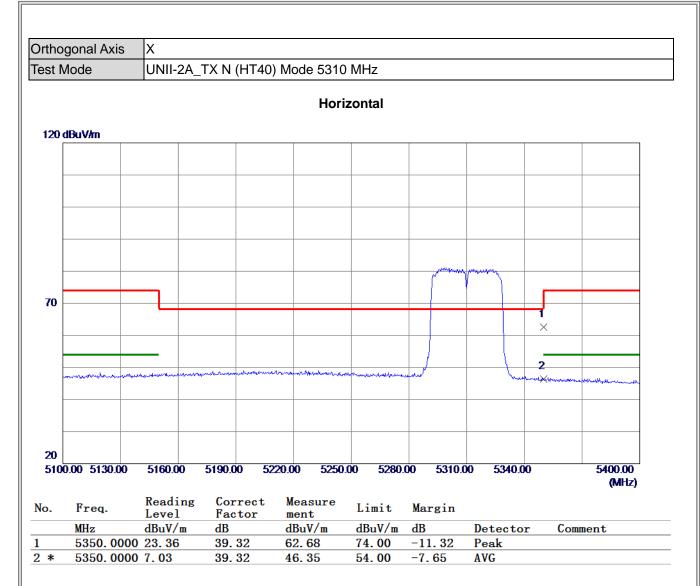


(1) Measurement Value = Reading Level + Correct Factor.



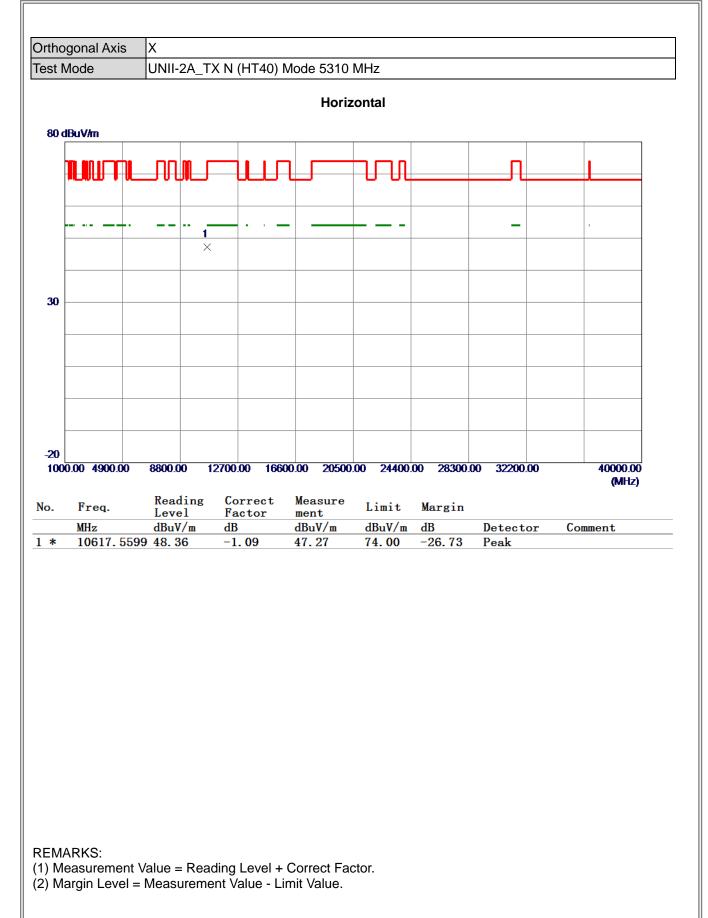




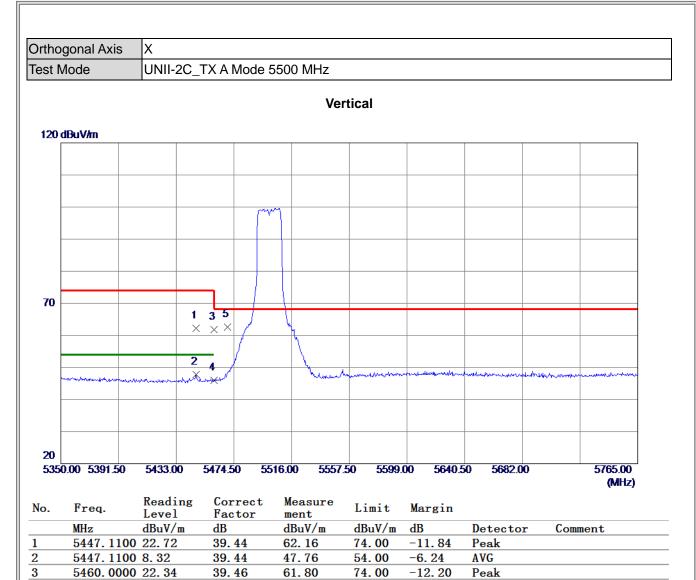


(1) Measurement Value = Reading Level + Correct Factor.









4 5 \*

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

39.46

39.47

**45.9**4

62.66

54.00

68.30

-8.06

-5.64

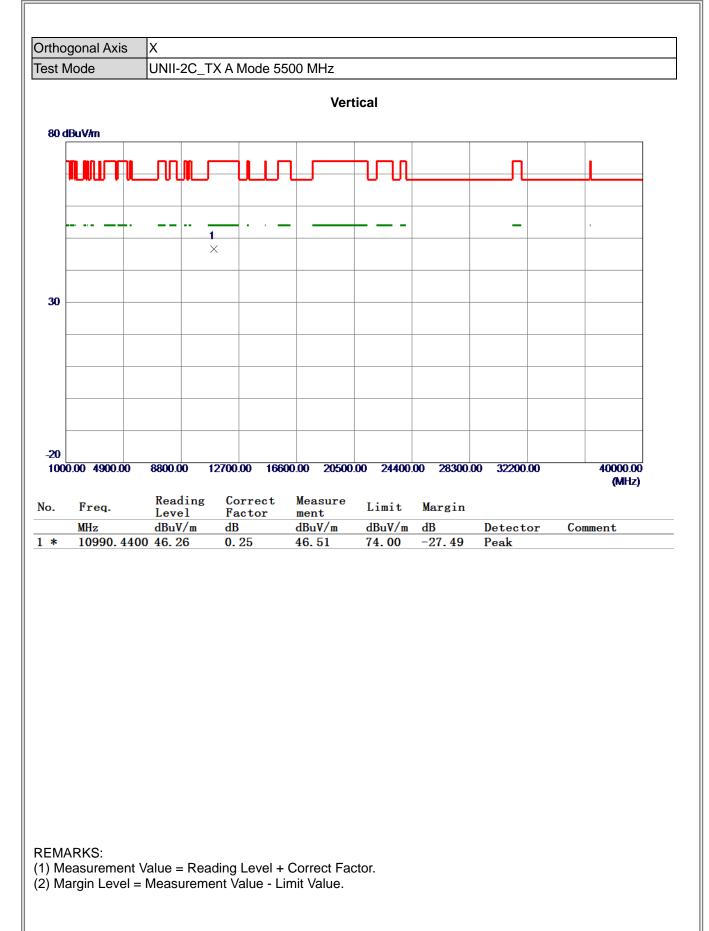
AVG

Peak

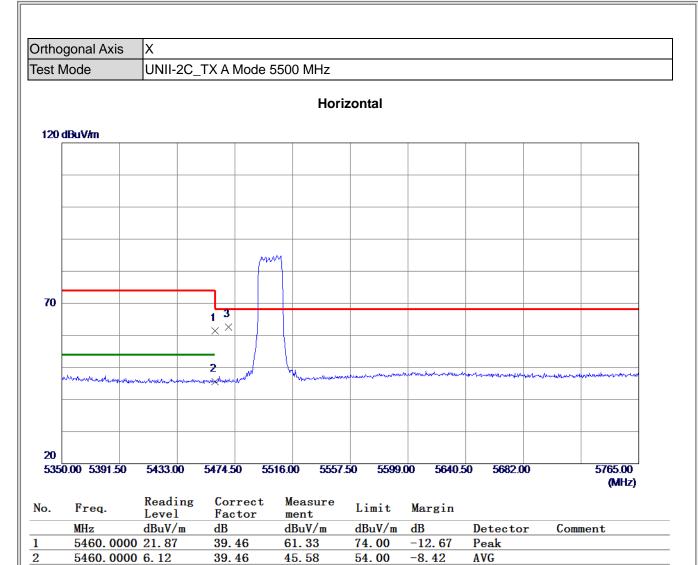
5460.0000 6.48

5470.0000 23.19









3 \*

5470.0000 23.17

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

39.47

62.64

68.30

-5. 66

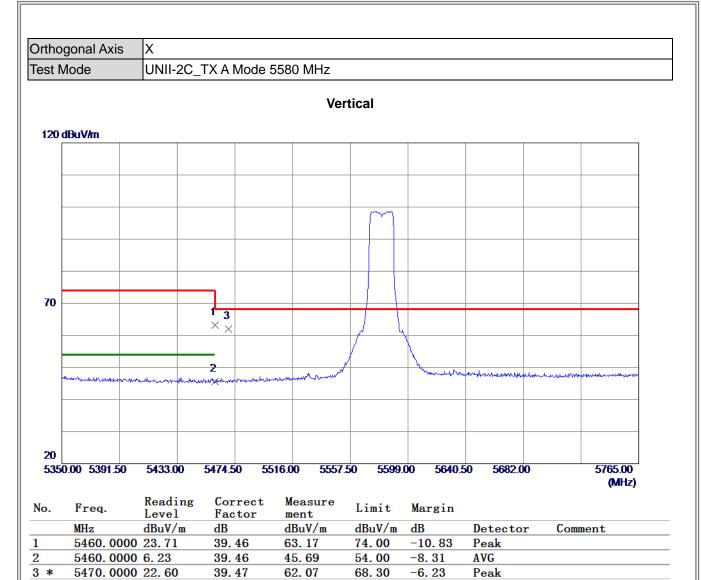
Peak





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



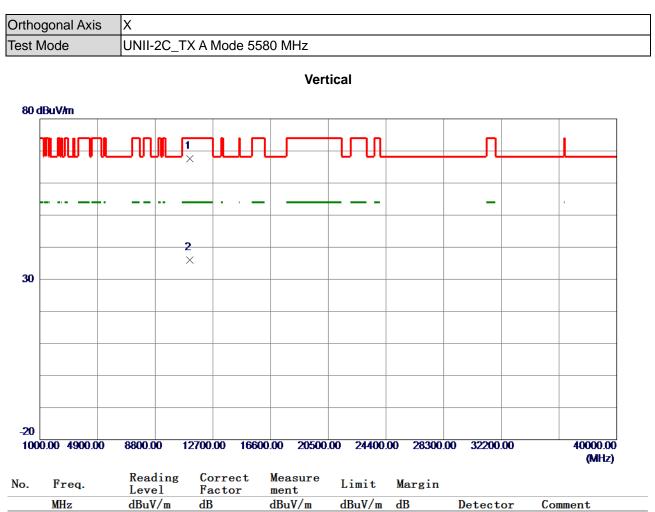


Peak

**REMARKS:** 

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

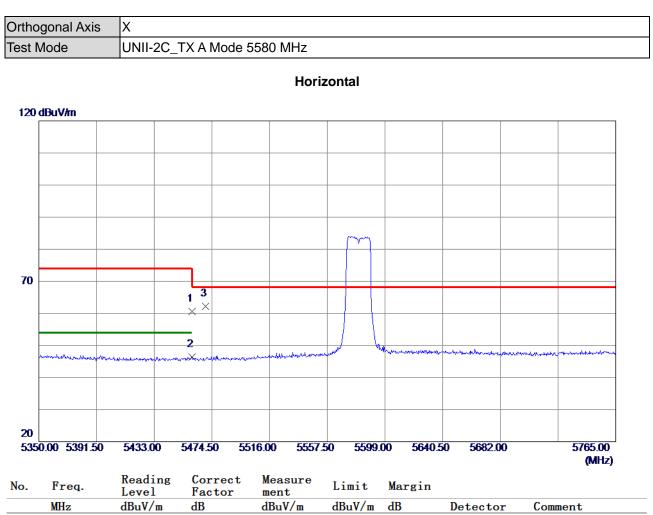




		LEVEL	I at tor	шенс				
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	11156. 5599	67.44	0.07	67.51	74.00	-6.49	Peak	
2	11160.0199	<b>35. 95</b>	0.07	<b>36. 0</b> 2	54.00	-17.98	AVG	

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

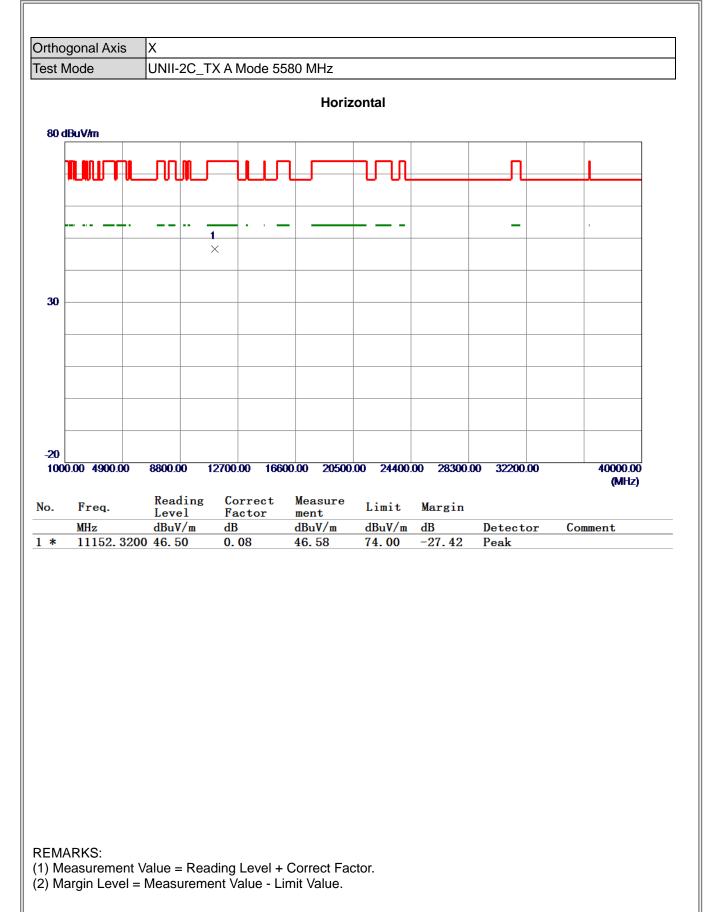




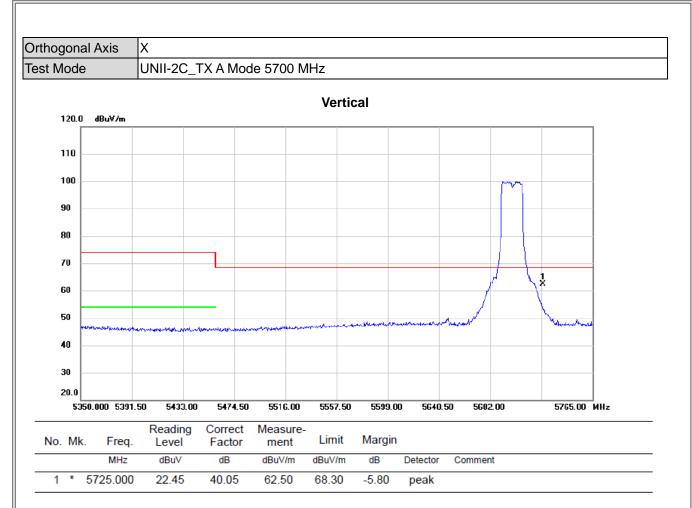
		LUVUI	1 40 001	mone				
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	5460.0000	21.13	39.46	60.59	74.00	-13.41	Peak	
2	5460.0000	7.00	39.46	46.46	54.00	-7.54	AVG	
3 *	5470.0000	22.73	39.47	62.20	68.30	-6.10	Peak	

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



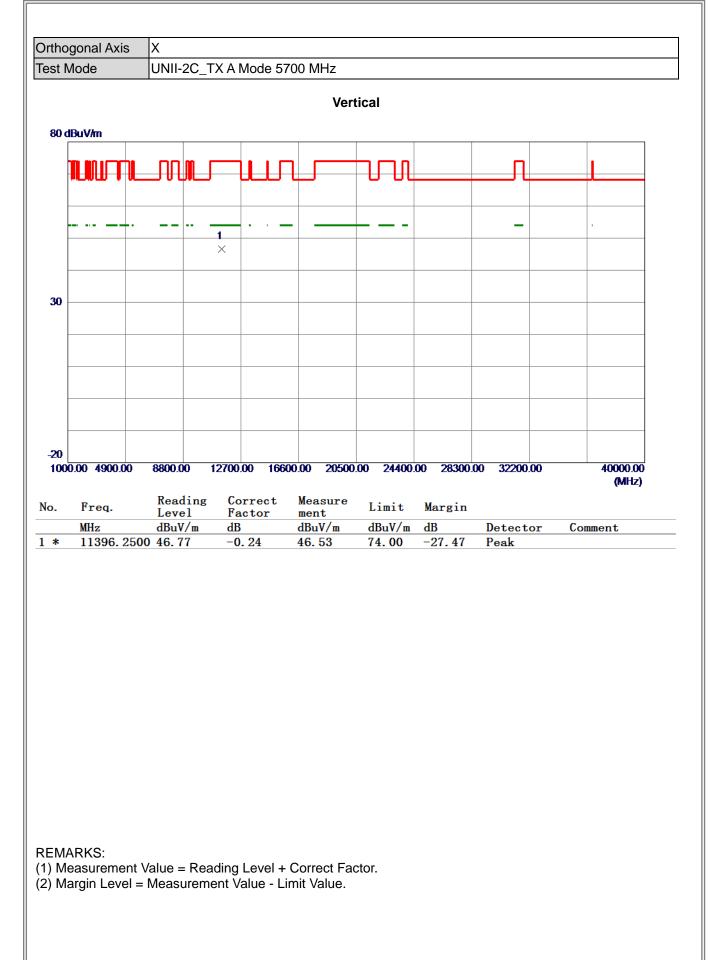




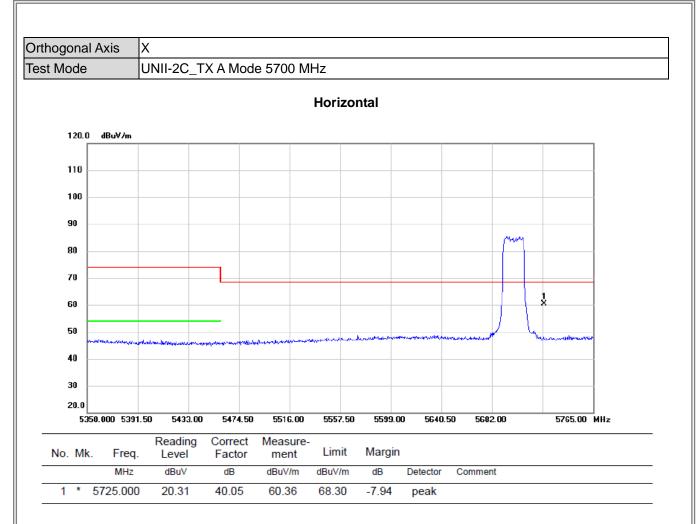


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.



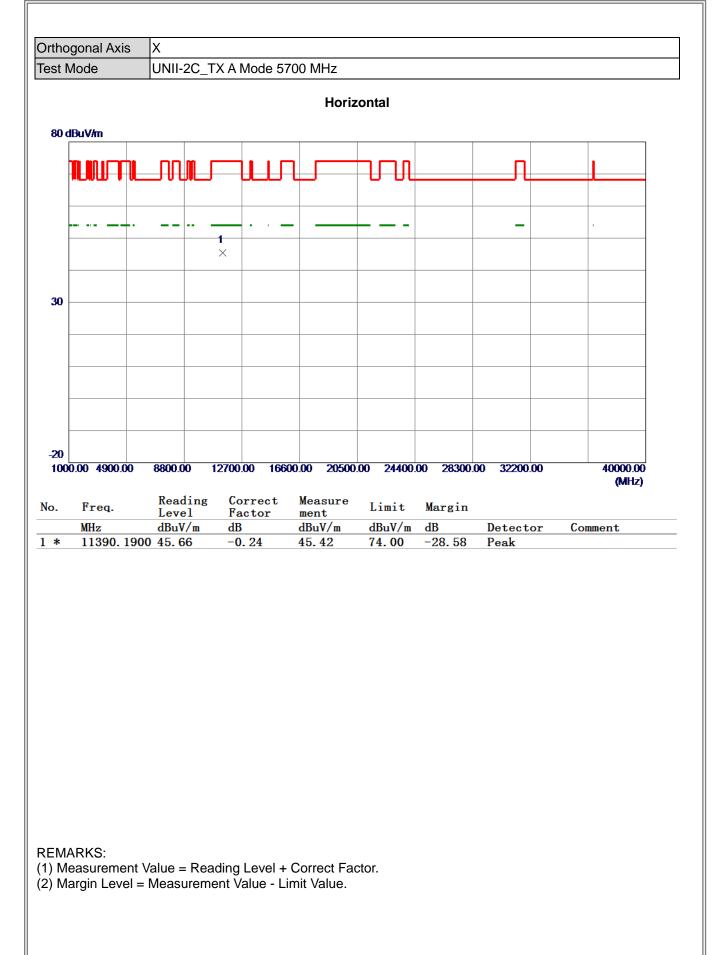




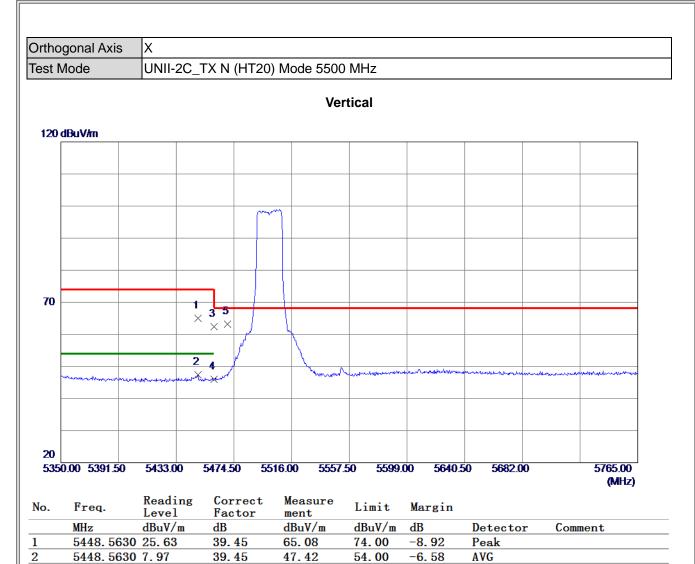


- (1) Measurement Value = Reading Level + Correct Factor.
- (2) Margin Level = Measurement Value Limit Value.









3

4 5 \* 5460.0000 22.89

5460.0000 6.50

5470.0000 23.67

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

39.46

39.46

39.47

62.35

45.96

63.14

74.00

54.00

68.30

-11.65

-8.04

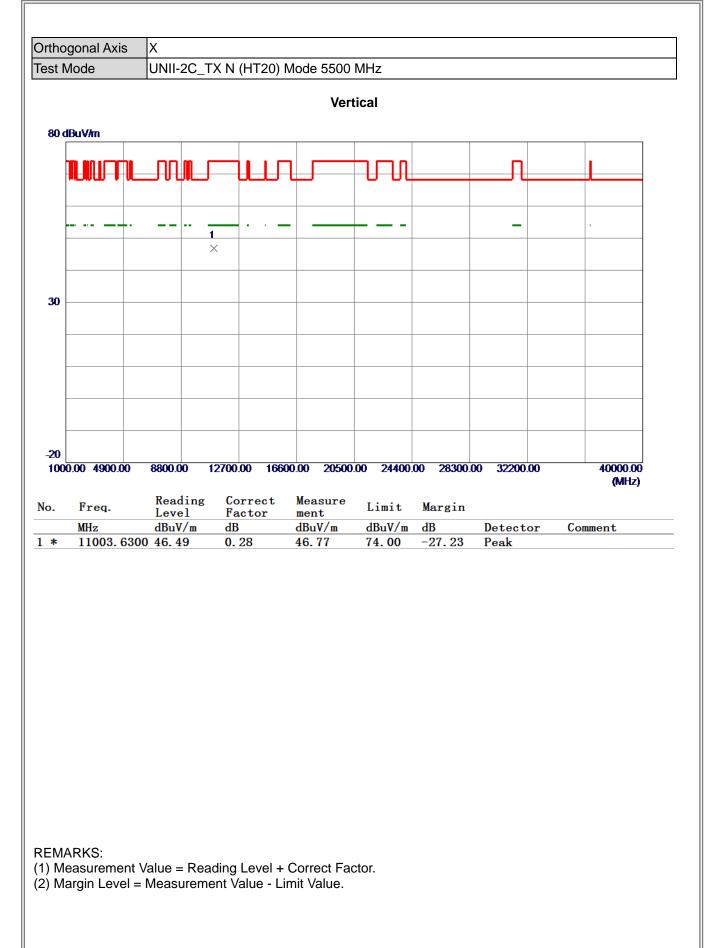
-5.16

Peak

Peak

AVG



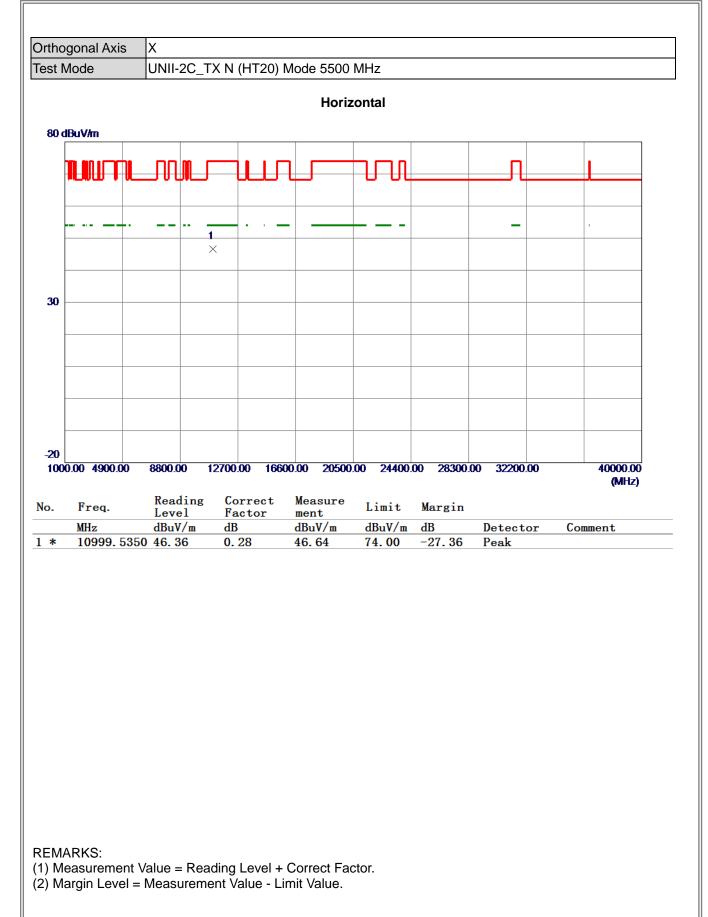




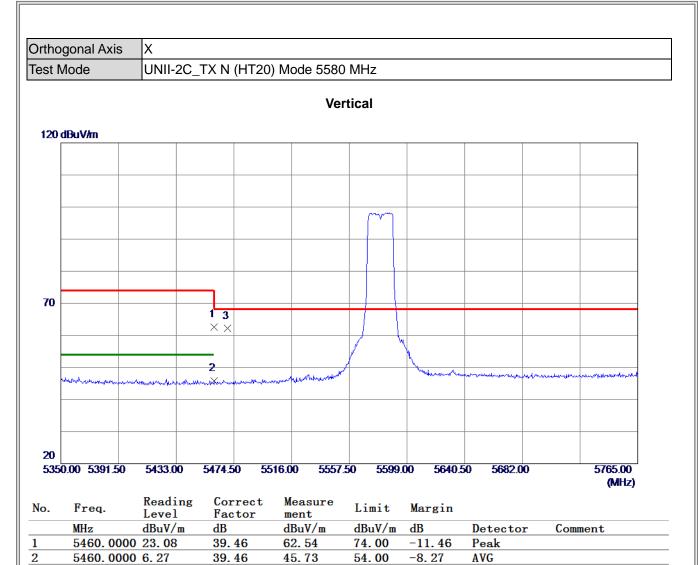


(1) Measurement Value = Reading Level + Correct Factor.









3 \*

5470.0000 22.63

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

39.47

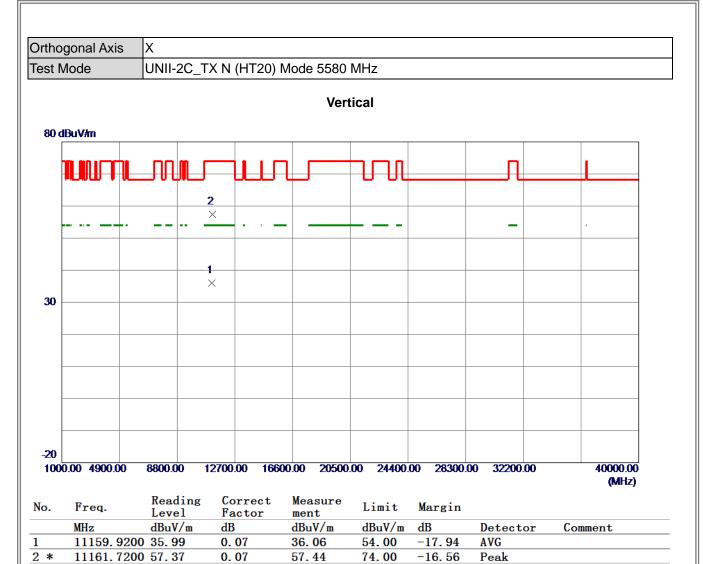
62.10

68.30

-6.20

Peak





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