

FCC REPORT

Applicant: Alligator Communications Inc

Address of Applicant: 317 Brokaw Road, Santa Clara, CA 95050 USA

Equipment Under Test (EUT)

Product Name: 220 MHz Licensed MAS Radio

Model No.: 2288

FCC ID: JIL2288

Applicable standards: FCC CFR Title 47 Part 2
FCC CFR Title 47 Part 90 Subpart K

Date of sample receipt: 21 Jun., 2018

Date of Test: 21 Jun., to 27 Jul., 2018

Date of report issued: 27 Jul., 2018

Test Result: PASS*

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Bruce Zhang
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the CCIS product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

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2. Version

Version No.	Date	Description
00	27 Jul., 2018	Original

Tested by:

Mike.ou

Date:

27 Jul., 2018

Test Engineer

Reviewed by:

Wimer Zhang

Date:

27 Jul., 2018

Project Engineer

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4. Test Summary

Test Item	Section in CFR 47	Result
RF Output Power	Part 2.1046 Part 90.259 (a)(4)	Pass
Types of emissions	Part 2.1047 Part 90.207	Pass
Occupied Bandwidth	Part 2.1049 Part 90.209	Pass
Emission masks	Part 90.210	Pass
Spurious Emissions at Antenna Terminal	Part 2.1051	Pass
Field Strength of Spurious Radiation	Part 2.1053	Pass
Frequency stability	Part 2.1055 Part 90.213	Pass
<i>Pass: The EUT complies with the essential requirements in the standard.</i>		

5. General Information

5.1 Client Information

Applicant:	Alligator Communications Inc
Address:	317 Brokaw Road, Santa Clara, CA 95050 USA
Manufacturer/ Factory:	Alligator Communications Inc
Address:	317 Brokaw Road, Santa Clara, CA 95050 USA

5.2 General Description of E.U.T.

Product Name:	220 MHz Licensed MAS Radio
Model No.:	2288
Operation Frequency range:	217 MHz-220 MHz
Modulation type:	4GFSK
Antenna type:	External antenna ("N" type)
Antenna gain:	9 dBi
Power supply:	DC 12V

Operation Frequency of Test Channel	
Test Channel	Frequency
Lowest channel	217.575MHz
Middle channel	218.575MHz
Highest channel	219.575MHz

5.3 Test modes

Operating Environment:	
Temperature:	Normal: 15°C ~ 35°C, Extreme: -30°C ~ +50°C
Humidity:	20 % ~ 75 % RH
Atmospheric Pressure:	1008 mbar
Voltage:	Nominal: 12Vdc, Extreme: Low 10.2 Vdc, High 13.8 Vdc
Test mode:	
Transmitting mode	Keep the EUT in continuously transmitting mode with modulation.

5.4 Description of Support Units

Manufacturer	Description	Model	S/N	FCC ID/DoC
Lenovo	PC	ThinkPad-E450	2014AP5917	/
GS Japan	Lead-acid battery	55D26R-MFZ	8362810610	N/A

5.5 Measurement Uncertainty

Parameters	Expanded Uncertainty
Radiated Emission (9kHz ~ 30MHz)	±2.76 dB (k=2)
Radiated Emission (30MHz ~ 1000MHz)	±4.28 dB (k=2)
Radiated Emission (1GHz ~ 18GHz)	±5.72 dB (k=2)
Radiated Emission (18GHz ~ 40GHz)	±2.88 dB (k=2)

5.6 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC - Registration No.: 727551**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been accredited as a testing laboratory by FCC (Federal Communications Commission). The Registration No. is 727551.

- **IC - Registration No.: 10106A-1**

The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

- **CNAS - Registration No.: CNAS L6048**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6048.

- **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: <https://portal.a2la.org/scopepdf/4346-01.pdf>

5.7 Laboratory Location

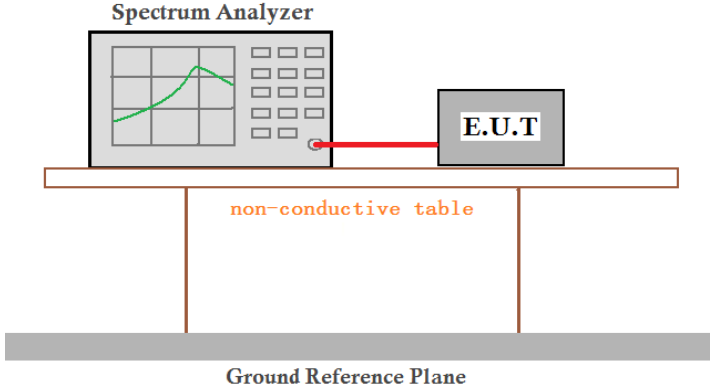
Shenzhen Zhongjian Nanfang Testing Co., Ltd.
 Address: No. B-C, 1/F., Building 2, Laodong No.2 Industrial Park, Xixiang Road,
 Bao'an District, Shenzhen, Guangdong, China
 Tel: +86-755-23118282, Fax: +86-755-23116366
 Email: info@ccis-cb.com, Website: http://www.ccis-cb.com

5.8 Test Instruments list

Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
3m SAC	SAEMC	9m*6m*6m	966	07-22-2017	07-21-2020
BiConiLog Antenna	SCHWARZBECK	VULB9163	497	03-16-2018	03-15-2019
Biconical Antenna	SCHWARZBECK	VUBA9117	359	06-22-2017	06-21-2020
Horn Antenna	SCHWARZBECK	BBHA9120D	916	03-16-2018	03-15-2019
Horn Antenna	SCHWARZBECK	BBHA9120D	1805	06-22-2017	06-21-2020
EMI Test Software	AUDIX	E3	6.110919b	N/A	N/A
Pre-amplifier	HP	8447D	2944A09358	03-07-2018	03-06-2019
Pre-amplifier	CD	PAP-1G18	11804	03-07-2018	03-06-2019
Spectrum analyzer	Rohde & Schwarz	FSP30	101454	03-07-2018	03-06-2019
EMI Test Receiver	Rohde & Schwarz	ESRP7	101070	03-07-2018	03-06-2019
Spectrum Analyzer	Agilent	N9020A	MY50510123	11-10-2017	11-09- 2018
Signal Generator	Rohde & Schwarz	SMX	835454/016	03-07-2018	03-06-2019
Signal Generator	R&S	SMR20	1008100050	03-07-2018	03-06-2019
RF Switch Unit	MWRFTST	MW200	N/A	N/A	N/A
Cable	ZDECL	Z108-NJ-NJ-81	1608458	03-07-2018	03-06-2019
Cable	MICRO-COAX	MFR64639	K10742-5	03-07-2018	03-06-2019
Cable	SUHNER	SUCOFLEX100	58193/4PE	03-07-2018	03-06-2019
DC Power Supply	XinNuoEr	WYK-10020K	1409050110020	10-31-2017	10-30-2018
Temperature Humidity Chamber	HengPu	HPGDS-500	20140828008	09-24-2017	09-23-2018

6. Test results

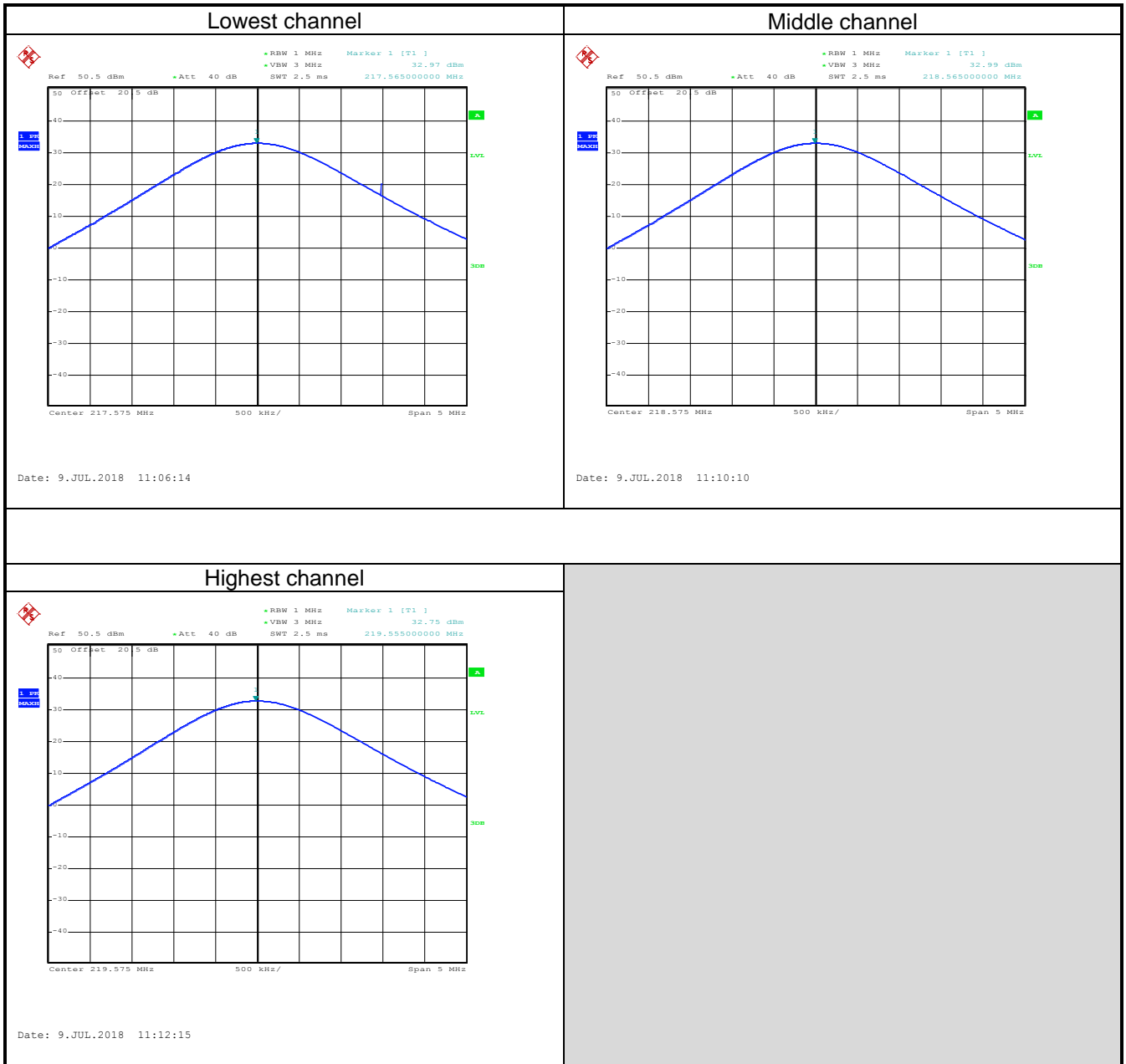
6.1 RF Output Power

Test Requirement:	FCC part 90.259(a)(4)
Test Method:	ANSI/TIA-603-D 2010
Limit:	2W (33dBm)
Test setup:	 <p>The diagram shows a Spectrum Analyzer on the left and an E.U.T. on the right, connected by a red cable. They are positioned on a table labeled 'non-conductive table'. Below the table is a shaded area labeled 'Ground Reference Plane'.</p>
	<ol style="list-style-type: none"> 1. The EUT output RF connector was connected with a short cable to the spectrum analyzer. 2. Spectrum analyzer was set: RBW= 1MHz, VBW= 3 times RBW. 3. Use peak marker function to determine the peak amplitude level.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

Test Channel	Output Power (dBm)	Limit(dBm)
Lowest channel	32.97	33.00
Middle channel	32.99	
Highest channel	32.75	

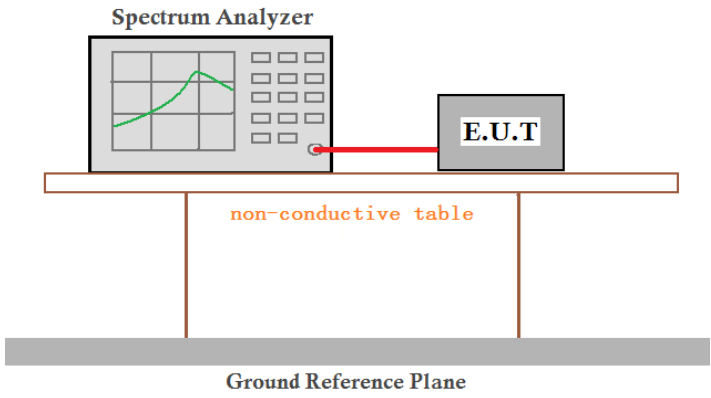
Test plot as follows:



6.2 Types of emissions

CHANNEL SPACING	SYMBOL RATE	TX FREQ DEVIATION	EMISSION DESIGNATOR
5k	sr = 1920	td = 960	/
6.25k	sr = 2400	td = 1200	/
12.5 kHz	sr = 4800	td = 2400	11k0F1D
25 kHz	sr = 9600	td = 4800	19K2F1D
50 kHz	sr = 19200	td = 9600	39 K0F1D

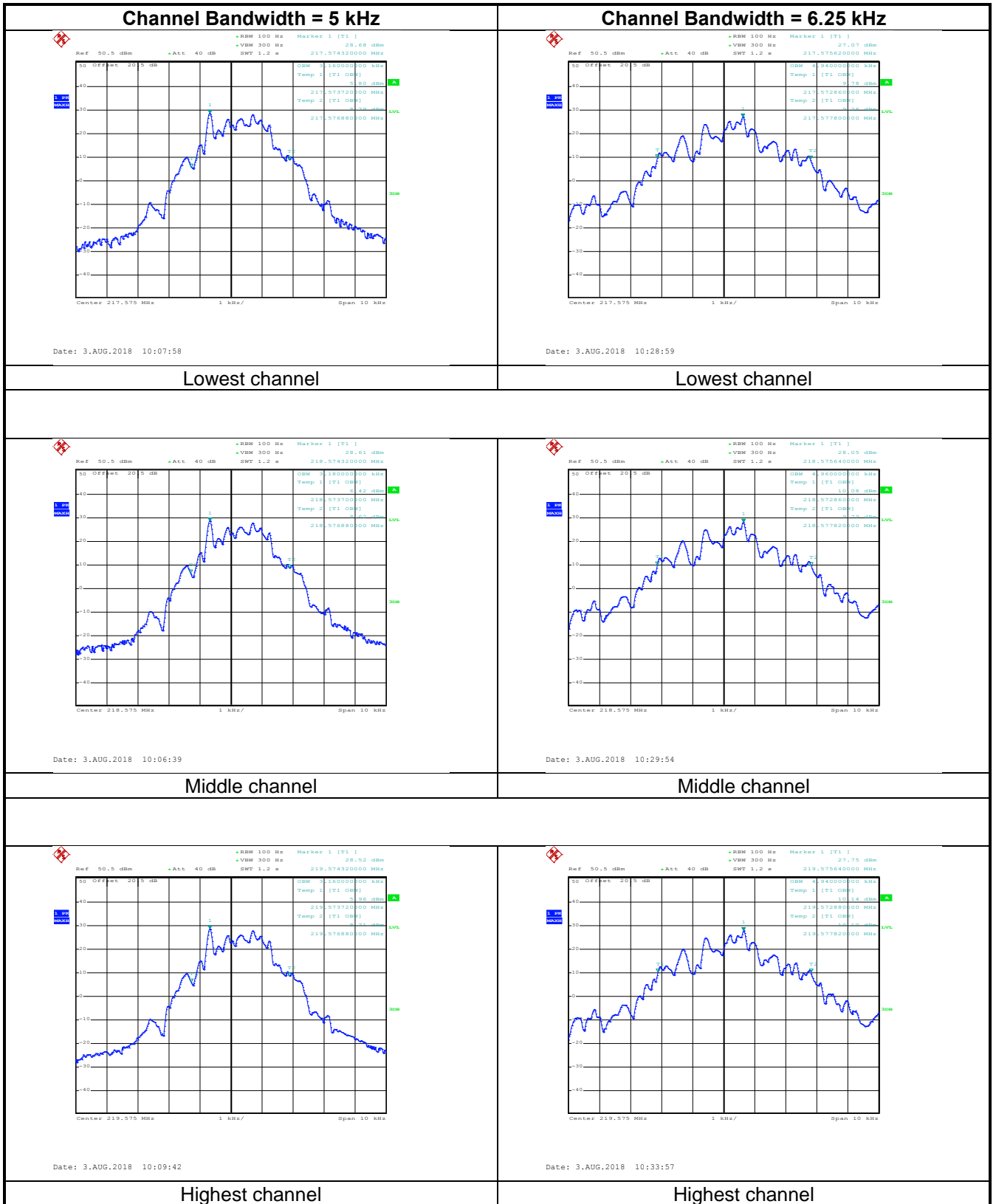
6.3 Occupied Bandwidth

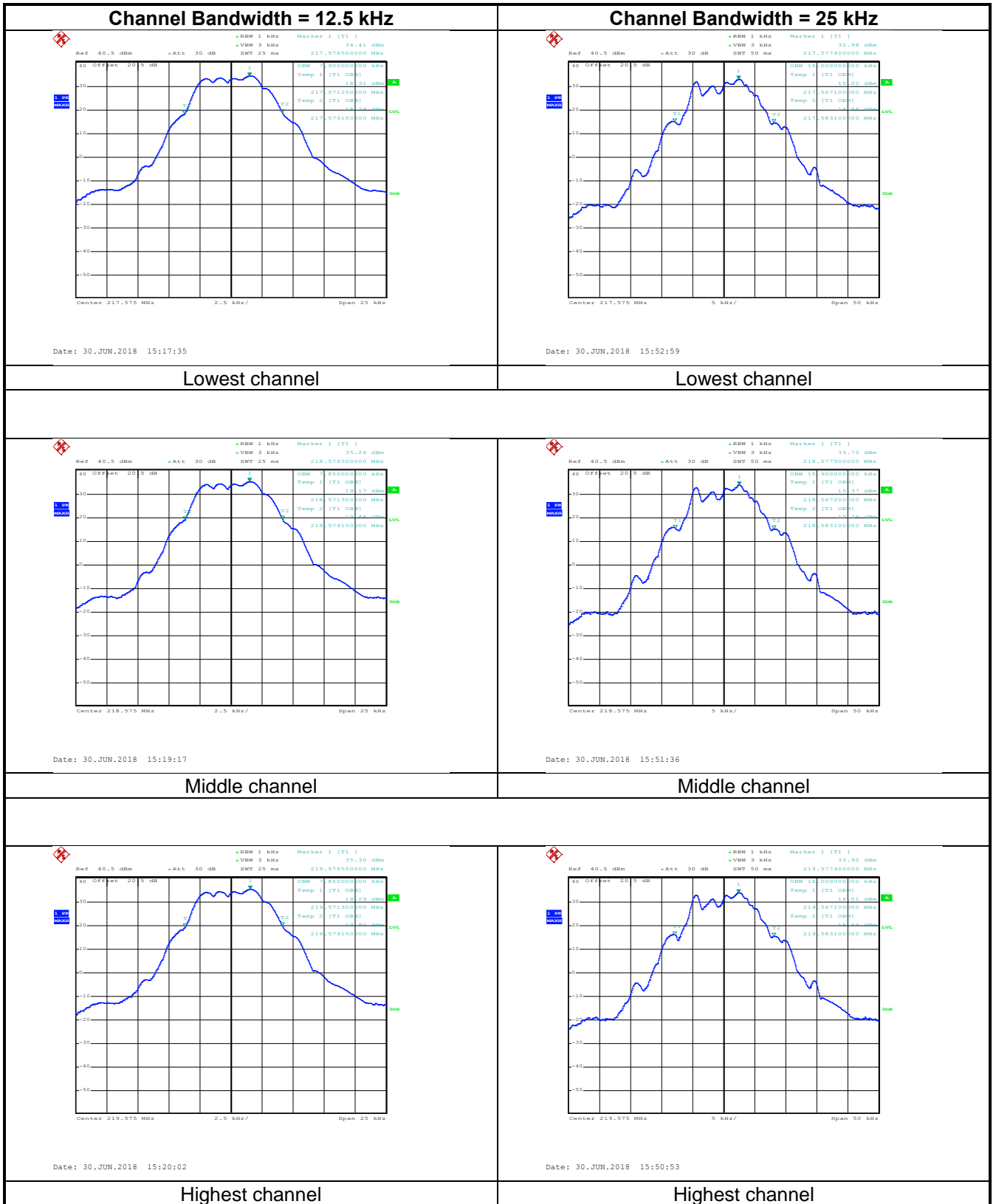
Test Requirement:	FCC part 90.209
Test Method:	ANSI/TIA-603-D 2010
Test setup:	 <p>The diagram shows a Spectrum Analyzer on the left and an E.U.T. on the right, connected by a red cable. They are both on a table labeled 'non-conductive table'. Below the table is a 'Ground Reference Plane'.</p>
Test Procedure:	<ol style="list-style-type: none"> 1. The EUT output RF connector was connected with a short cable to the spectrum analyzer 2. RBW was set to about 1% of emission BW, VBW= 3 times RBW. 3. 99% bandwidth display line was placed on the screen, the occupied bandwidth is the delta frequency between the two points where the display line intersects the signal trace.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

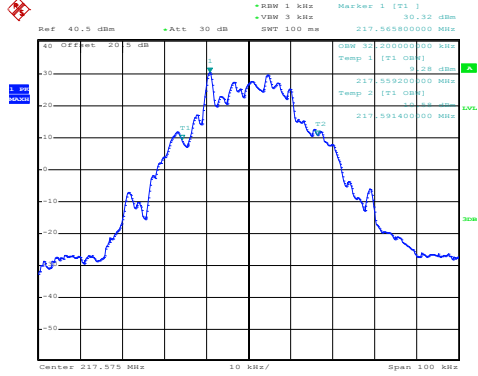
Channel Bandwidth (kHz)	Test Channel	Occupied Bandwidth (kHz)	Limit (kHz)
5	Lowest channel	3.16	/
	Middle channel	3.18	
	Highest channel	3.16	
6.25	Lowest channel	4.94	6
	Middle channel	4.96	
	Highest channel	4.94	
12.5	Lowest channel	7.90	11.25
	Middle channel	7.85	
	Highest channel	7.85	
25	Lowest channel	16.00	20.00
	Middle channel	15.90	
	Highest channel	16.00	
50	Lowest channel	32.20	/
	Middle channel	32.20	
	Highest channel	32.20	

Test plot as follows:



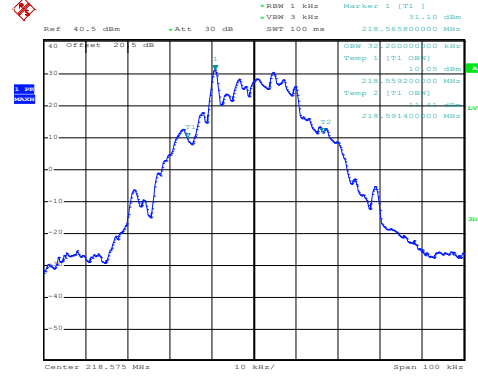


Channel Bandwidth = 50 kHz



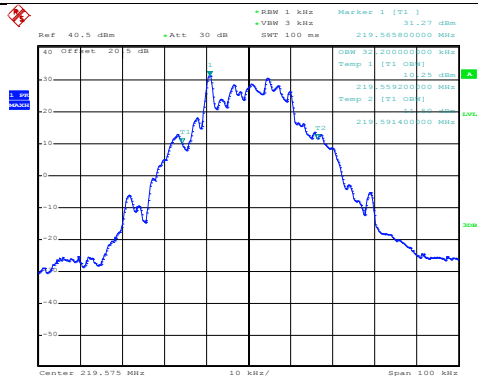
Date: 30 JUN.2018 15:54:07

Lowest channel



Date: 30 JUN.2018 15:56:11

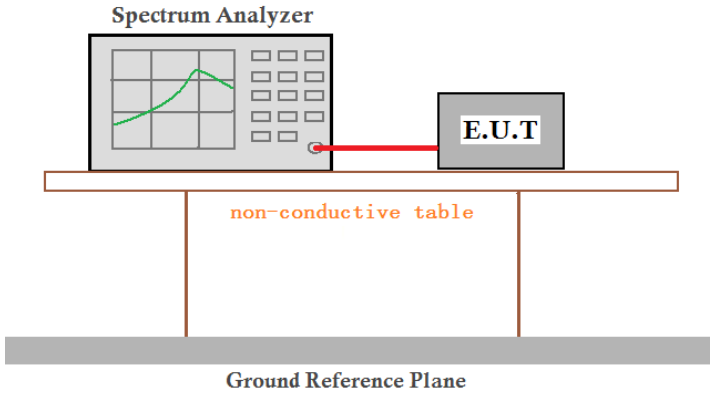
Middle channel



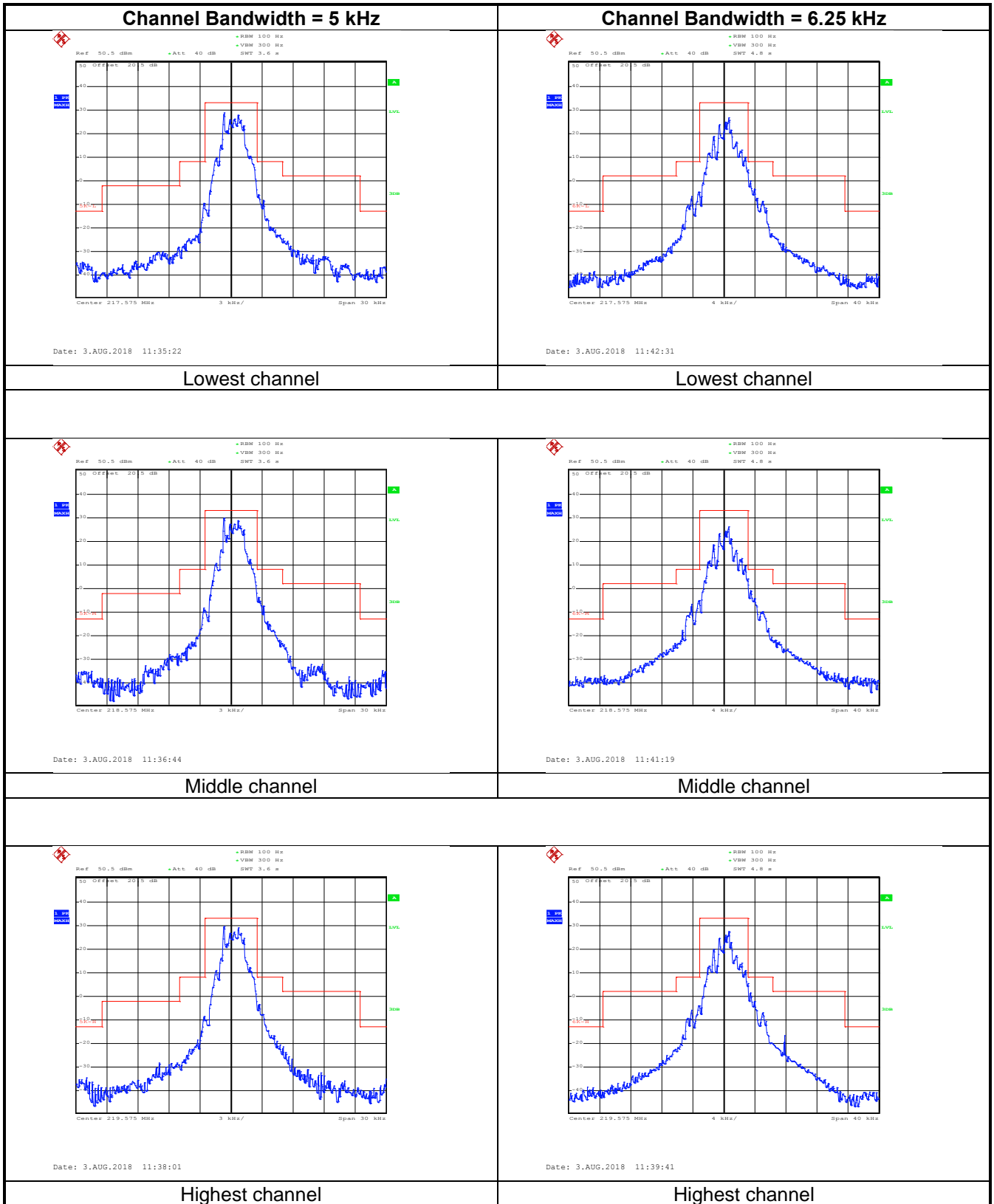
Date: 30 JUN.2018 15:57:03

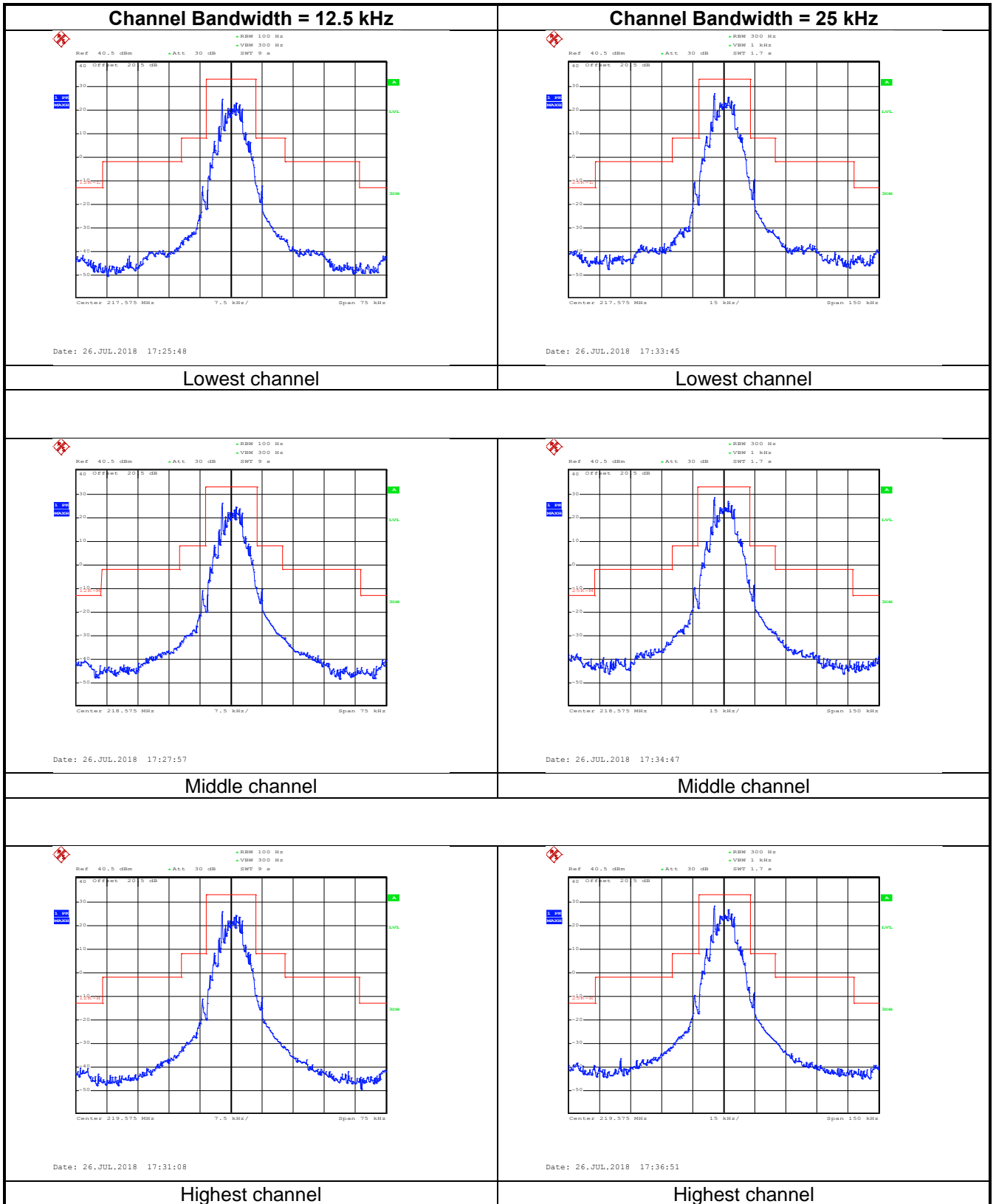
Highest channel

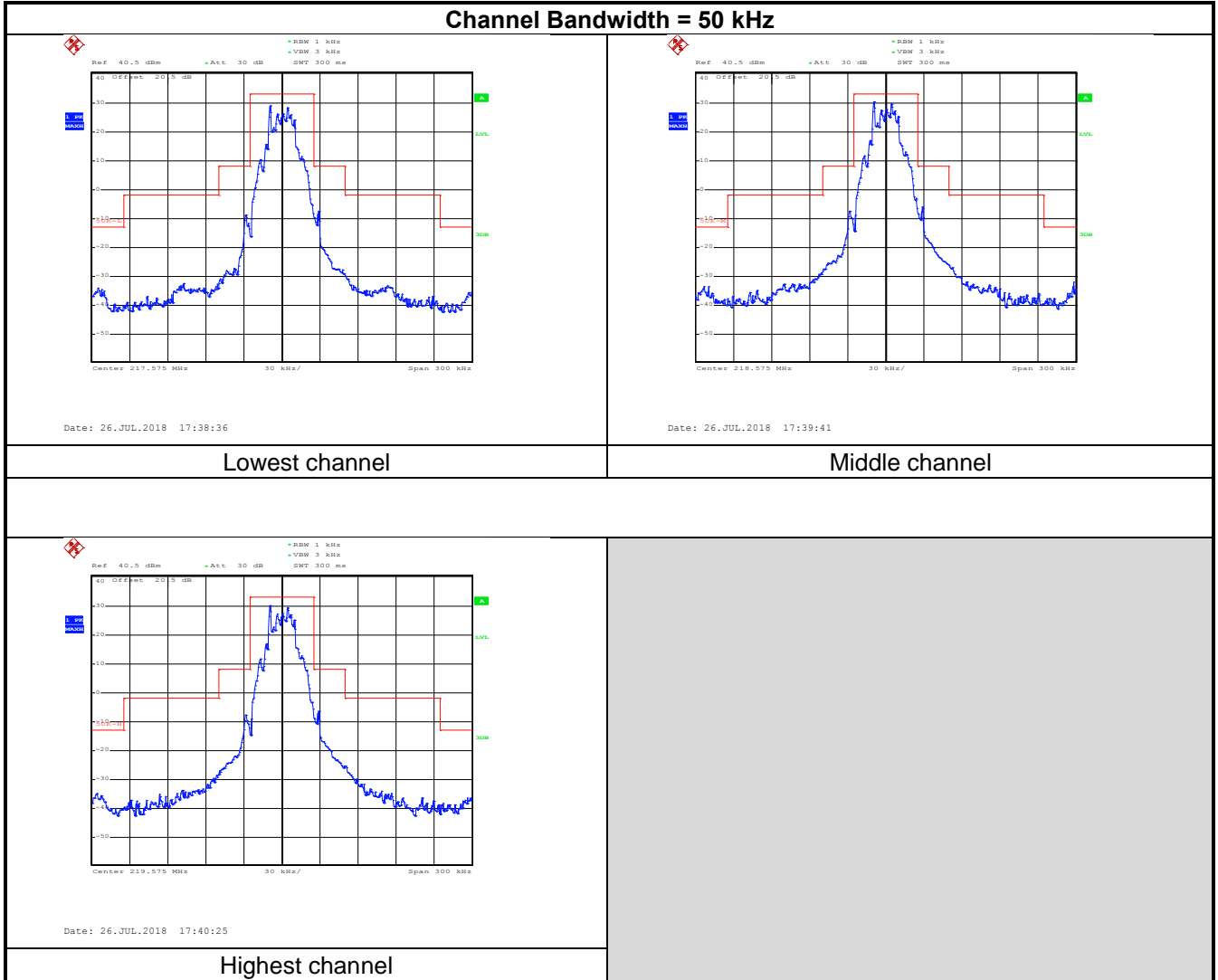
6.4 Emission Masks

Test Requirement:	FCC part 90.210
Test Method:	ANSI/TIA-603-D 2010
Limit:	<p>Emission Mask B. For transmitters that are equipped with an audio lowpass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:</p> <p>(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.</p> <p>(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.</p> <p>(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.</p>
Test setup:	 <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a non-conductive table. Below the table is a Ground Reference Plane.</p>
Test Procedure:	<ol style="list-style-type: none"> 1. The EUT output RF connector was connected with a short cable to the spectrum analyzer 2. RBW was set to about 1% of emission BW, VBW= RBW. 3. Trace mode = max hold.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

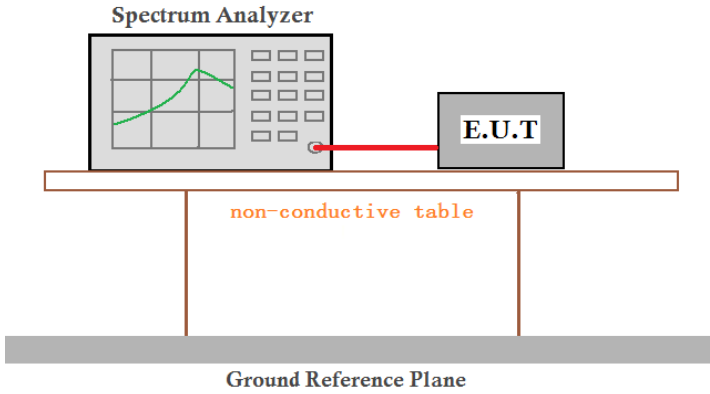
Test plot as follows:



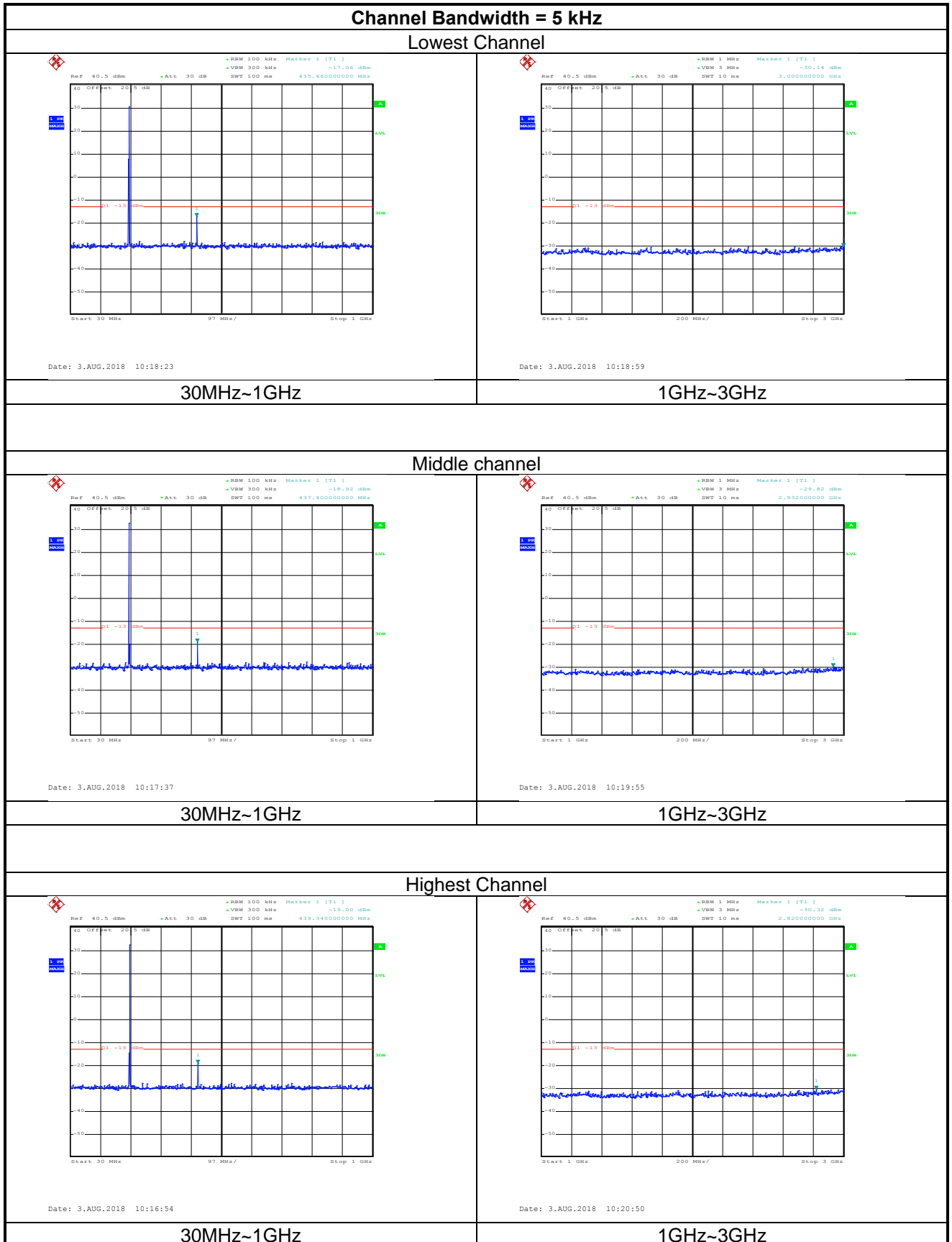


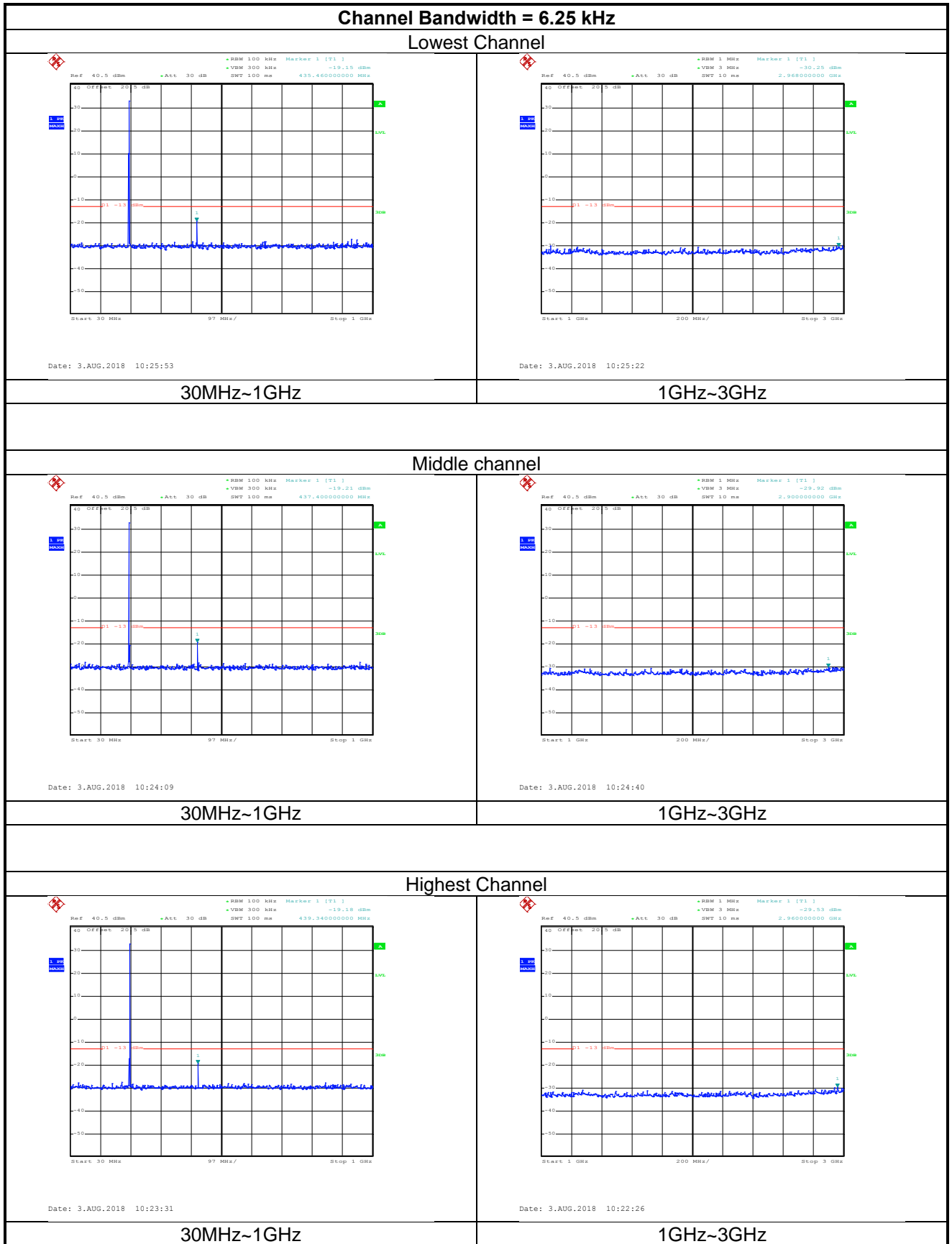


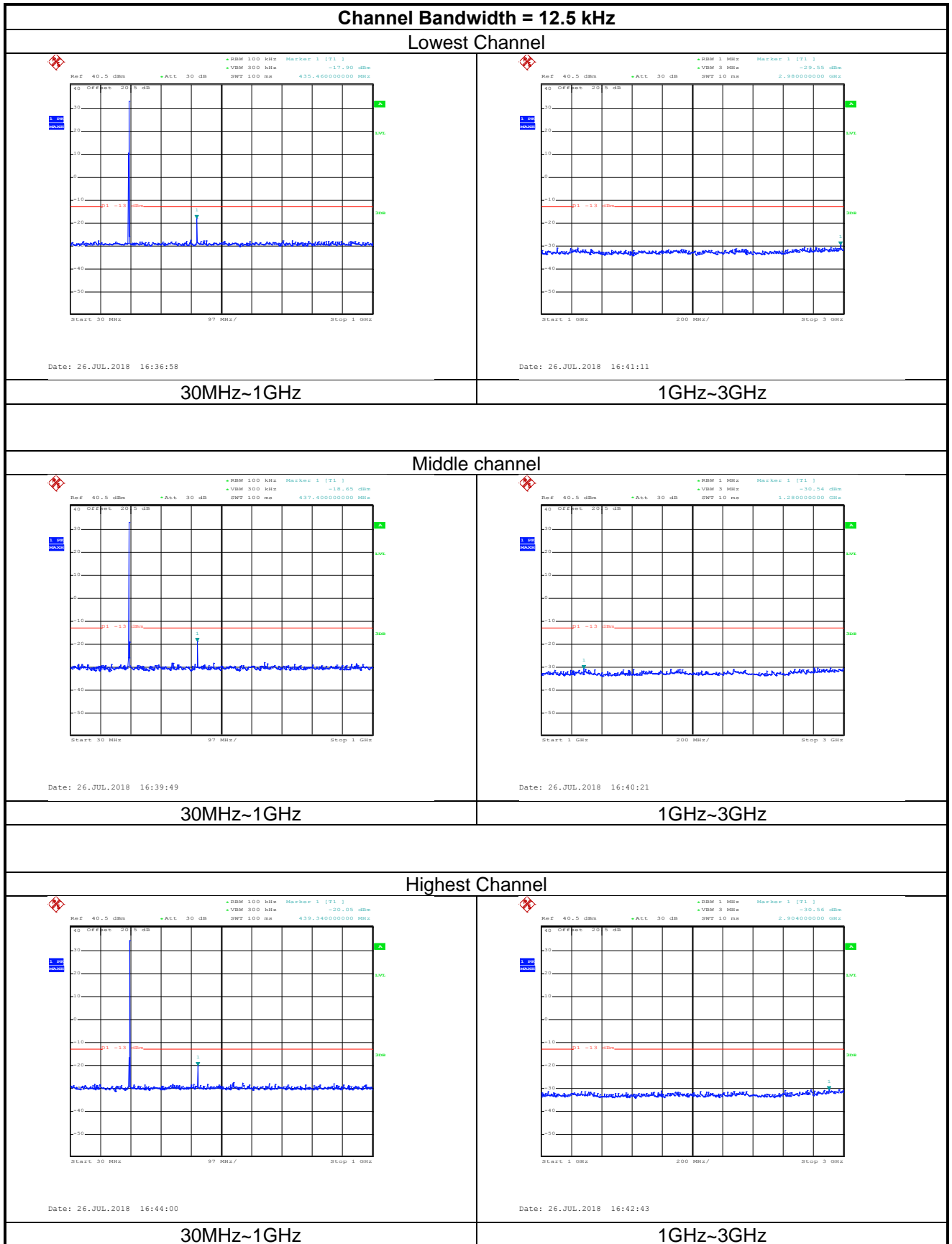
6.5 Out of band emission at antenna terminals

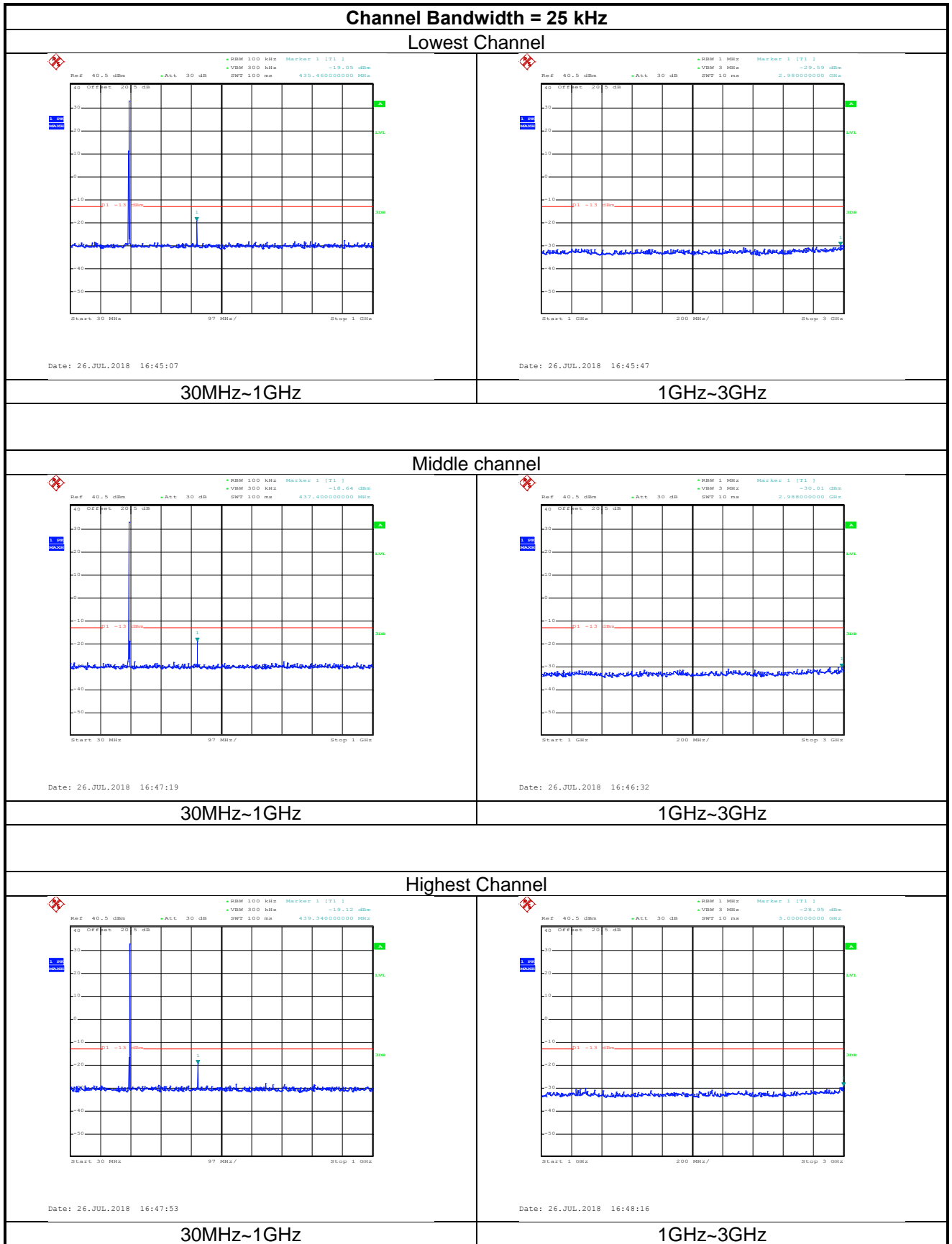
Test Requirement:	FCC part 2.1051
Test Method:	ANSI/TIA-603-D 2010
Limit:	-13dBm
Test setup:	 <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a non-conductive table. Below the table is a Ground Reference Plane.</p>
Test Procedure:	<ol style="list-style-type: none"> 1 The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. 2 The resolution bandwidth of the spectrum analyzer was set at 100 kHz when below 1GHz, 1MHz when above 1 GHz; sufficient scans were taken to show the out of band Emissions if any up to 10th harmonic.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

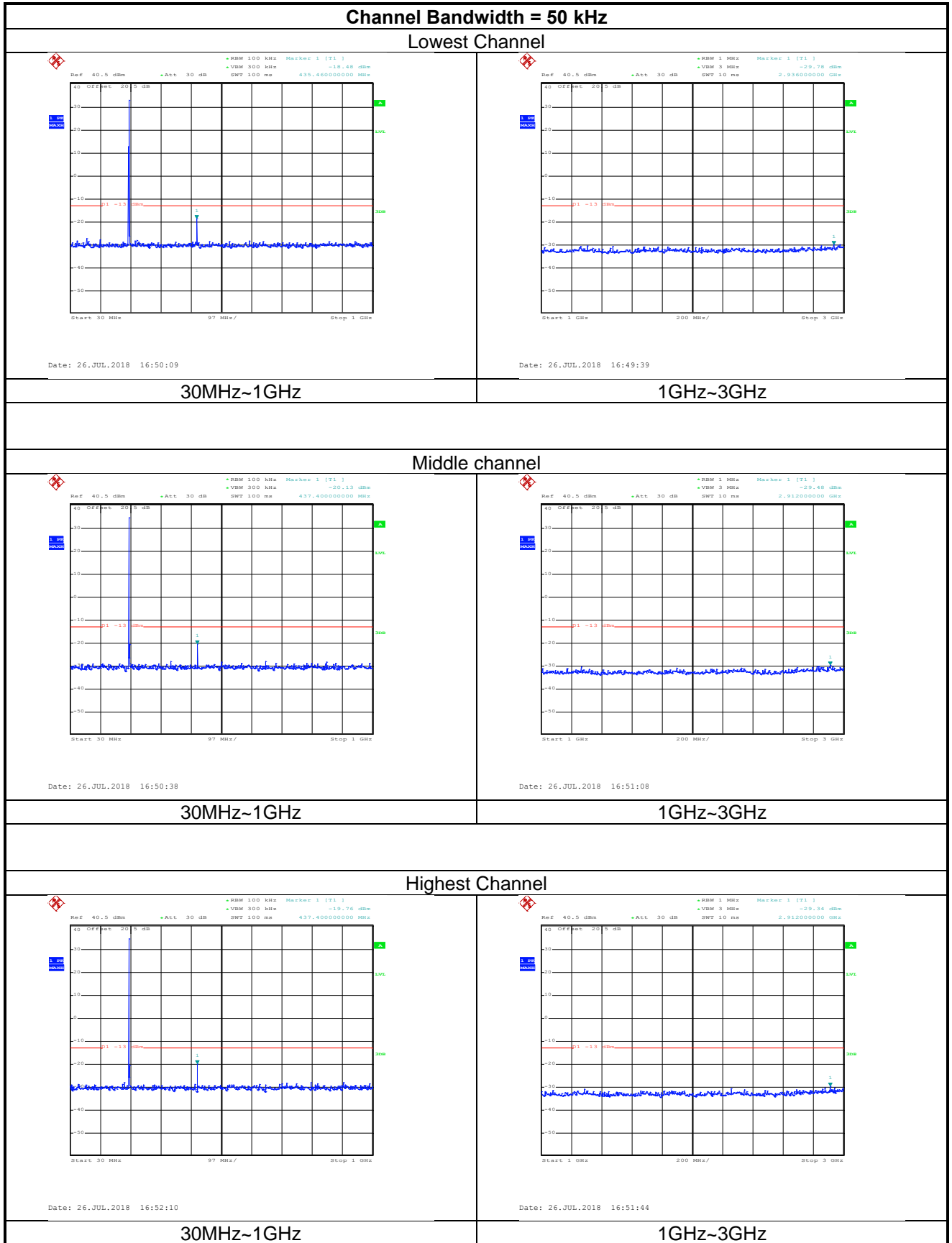
Test plots as follows:



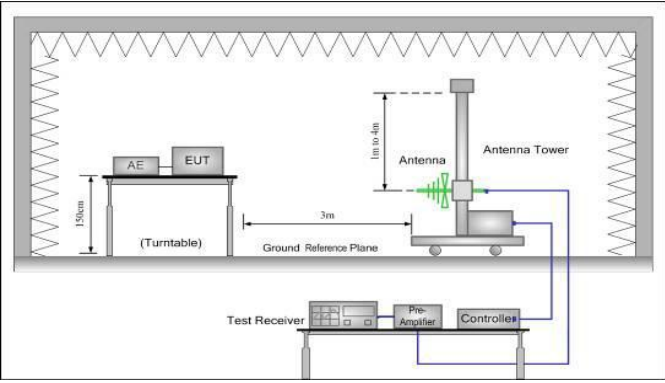
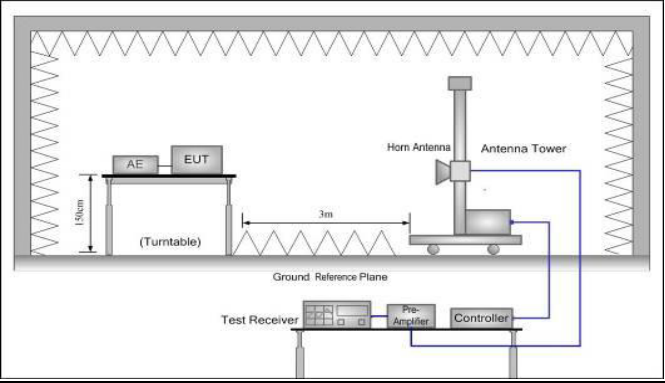








6.6 Field strength of spurious radiation measurement

Test Requirement:	FCC part 2.1053
Test Method:	ANSI/TIA-603-D 2010
Limit:	-13dBm
Test setup:	<p>Below 1GHz</p>  <p>Above 1GHz</p> 
Test Procedure:	<ol style="list-style-type: none"> 1. The EUT was placed on an non-conductive turntable using a non-conductive support. The radiated emission at the fundamental frequency was measured at 3 m with a test antenna and EMI spectrum analyzer. 2. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations. 3. The frequency range up to tenth harmonic was investigated for each of three fundamental frequency (low, middle and high channels). Once spurious emission was identified, the power of the emission was determined using the substitution method. 4. The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and the spurious emissions frequency. $\text{ERP / EIRP} = \text{S.G. output (dBm)} + \text{Antenna Gain(dB/dBi)} - \text{Cable Loss (dB)}$
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details.
Test results:	Passed

Measurement Data (worst case):

Channel Bandwidth = 5 kHz				
Lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
436.15	Vertical	-49.20	-13.00	Pass
452.73	V	-40.20		
870.30	V	-30.02		
436.15	Horizontal	-46.95	-13.00	Pass
452.73	H	-39.27		
870.30	H	-33.09		
Middle channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
437.15	Vertical	-33.76	-13.00	Pass
655.73	V	-33.37		
874.30	V	-32.41		
437.15	Horizontal	-33.52	-13.00	Pass
655.73	H	-33.54		
874.30	H	-30.83		
Highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
439.15	Vertical	-34.82	-13.00	Pass
658.73	V	-37.64		
878.30	V	-29.82		
439.15	Horizontal	-29.54	-13.00	Pass
658.73	H	-29.76		
878.30	H	-36.23		
<i>Remark:</i>				
1. The emission levels of above 1 GHz are very lower than the limit and not show in test report.				

Channel Bandwidth = 6.25 kHz				
Lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
436.15	Vertical	-49.28	-13.00	Pass
452.73	V	-40.24		
870.30	V	-30.02		
436.15	Horizontal	-46.92	-13.00	Pass
452.73	H	-39.21		
870.30	H	-33.23		
Middle channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
437.15	Vertical	-33.65	-13.00	Pass
655.73	V	-33.66		
874.30	V	-32.43		
437.15	Horizontal	-33.52	-13.00	Pass
655.73	H	-33.66		
874.30	H	-30.82		
Highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
439.15	Vertical	-34.82	-13.00	Pass
658.73	V	-37.63		
878.30	V	-29.54		
439.15	Horizontal	-29.53	-13.00	Pass
658.73	H	-29.77		
878.30	H	-36.03		
Remark: 1. The emission levels of above 1 GHz are very lower than the limit and not show in test report.				

Channel Bandwidth = 12.5 kHz				
Lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
436.15	Vertical	-49.20	-13.00	Pass
452.73	V	-40.20		
870.30	V	-30.02		
436.15	Horizontal	-46.95	-13.00	Pass
452.73	H	-39.27		
870.30	H	-33.09		
Middle channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
437.15	Vertical	-33.71	-13.00	Pass
655.73	V	-33.46		
874.30	V	-32.42		
437.15	Horizontal	-33.58	-13.00	Pass
655.73	H	-33.76		
874.30	H	-30.86		
Highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
439.15	Vertical	-34.80	-13.00	Pass
658.73	V	-37.73		
878.30	V	-29.84		
439.15	Horizontal	-29.66	-13.00	Pass
658.73	H	-29.87		
878.30	H	-36.12		
<i>Remark:</i>				
2. The emission levels of above 1 GHz are very lower than the limit and not show in test report.				

Channel Bandwidth = 25 kHz				
Lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
436.15	Vertical	-49.22	-13.00	Pass
452.73	V	-40.26		
870.30	V	-30.12		
436.15	Horizontal	-46.65	-13.00	Pass
452.73	H	-39.45		
870.30	H	-33.39		
Middle channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
437.15	Vertical	-33.81	-13.00	Pass
655.73	V	-33.66		
874.30	V	-32.52		
437.15	Horizontal	-33.78	-13.00	Pass
655.73	H	-33.86		
874.30	H	-30.76		
Highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
439.15	Vertical	-34.82	-13.00	Pass
658.73	V	-37.83		
878.30	V	-29.64		
439.15	Horizontal	-29.76	-13.00	Pass
658.73	H	-29.97		
878.30	H	-36.62		
<p>Remark:</p> <p>2. The emission levels of above 1 GHz are very lower than the limit and not show in test report.</p>				

Channel Bandwidth = 50 kHz				
Lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
436.15	Vertical	-49.26	-13.00	Pass
452.73	V	-40.20		
870.30	V	-30.78		
436.15	Horizontal	-46.99	-13.00	Pass
452.73	H	-39.34		
870.30	H	-33.84		
Middle channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
437.15	Vertical	-33.85	-13.00	Pass
655.73	V	-33.49		
874.30	V	-32.48		
437.15	Horizontal	-33.67	-13.00	Pass
655.73	H	-33.79		
874.30	H	-30.96		
Highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Result
	Polarization	Level (dBm)		
439.15	Vertical	-34.83	-13.00	Pass
658.73	V	-37.54		
878.30	V	-29.92		
439.15	Horizontal	-29.87	-13.00	Pass
658.73	H	-29.98		
878.30	H	-36.26		
<i>Remark:</i>				
1. The emission levels of above 1 GHz are very lower than the limit and not show in test report.				

6.7 Frequency stability

Test Requirement:	FCC Part 90.213, FCC Part 2.1055
Test Method:	ANSI/TIA-6-3-D 2010
Limit:	±1 ppm
Test setup:	
Test procedure:	<p>For V.S. temperature measurement:</p> <ol style="list-style-type: none"> 1. The equipment under test was connected to an external power supply and input rated voltage. 2. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. 3. The EUT was placed inside the temperature chamber. 4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency. 5. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. 6. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached. <p>For V.S. voltage measurement:</p> <ol style="list-style-type: none"> 1. Set chamber temperature to 25°C. Use a variable DC power source to power the EUT and set the voltage to rated voltage. 2. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency. 3. Reduce the input voltage to specify extreme voltage variation (+/- 15%) and endpoint, record the maximum frequency change.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

a) For V.S. temperature measurement Data (the worst channel):

Reference Frequency =Middle channel					
Power supplied (Vdc)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
12	-30	174	0.207985	±1	Pass
	-20	155	0.185274		
	-10	136	0.162563		
	0	125	0.149414		
	10	114	0.136266		
	20	142	0.169735		
	30	139	0.166149		
	40	128	0.153000		
	50	117	0.139852		

b) For V.S. temperature measurement Data (the worst channel):

Reference Frequency =Middle channel					
Temperature (°C)	Power supplied (Vdc)	Frequency error		Limit (ppm)	Result
		Hz	ppm		
25	10.2	85	0.101602	±1	Pass
	12	78	0.093235		
	13.8	68	0.081281		