



FCC RADIO TEST REPORT

FCC ID : UZ7EC500K
Equipment : Enterprise Computer
Brand Name : Zebra
Model Name : EC500K
Applicant : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Manufacturer : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Standard : FCC Part 15 Subpart C §15.247

The product was received on Jul. 09, 2020 and testing was started from Jul. 17, 2020 and completed on Aug. 20, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



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History of this test report

Report No.	Version	Description	Issued Date
FR070601C	01	Initial issue of report	Sep. 11, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)	Power Output Measurement	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges	Pass	-
		Conducted Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 1.12 dB at 2483.520 MHz
3.6	15.207	AC Conducted Emission	Pass	Under limit 7.79 dB at 0.157 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang

Report Producer: Celery Wei



1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Enterprise Computer
Brand Name	Zebra
Model Name	EC500K
FCC ID	UZ7EC500K
EUT supports Radios application	NFC WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
HW Version	EV2
SW Version	Android version 10
FW Version	10-12-29.00-QG-U00-PRD-HEL-04
MFD	17JUN20 13JUN20 20JUN20 15JUN20
EUT Stage	Engineering Sample

Remark: The above EUT's information was declared by manufacturer.

Specification of Accessories				
AC Adapter	Brand Name	Zebra	Part Number	PWR-WUA5V15W0US
USB TYPE-C to TYPE-C cable	Brand Name	Zebra	Part Number	CBL-EC5X-USBC3A-01
Battery 1	Brand Name	Zebra	Part Number	BT-000424-00
Battery 2	Brand Name	Zebra	Part Number	BT-000424-08
Earphone 1	Brand Name	Zebra	Part Number	HDST-35MM-PTVP-01
Earphone 2	Brand Name	Zebra	Part Number	HS2100-OTH
USB TYPE C to 3.5mm audio connector	Brand Name	Symbol	Part Number	ADP-USBC-35MM1-01
3.5mm Jack 43"(1.1m) Standard Cable	Brand Name	Zebra	Part Number	CBL-HS2100-3MS1-01
Trigger Handle	Brand Name	Zebra	Part Number	TRG-EC5X-SNP1-01
Soft Holster	Brand Name	Zebra	Part Number	SG-EC5X-HLSTR1-01
Protective Boot	Brand Name	Zebra	Part Number	SG-EC5X-BOOT1-01



Sample list				
	Sample 1	Sample 2	Sample 3	Sample 4
Operating System	ANDROID	ANDROID	ANDROID	ANDROID
RAM	3GB RAM	4GB	4GB	3GB
FLASH	32GB	64GB	64GB	32GB
Scanner	SE4100	SE4100	SE4100	NO
Front Camera	NO	5MP	5MP	5MP
Rear Camera	13MP	13MP	13MP	13MP
	MICRO SD	MICRO SD	MICRO SD	MICRO SD
	GMS	GMS	GMS	GMS
Back connector	2-PIN	2-PIN	8-PIN	NO I/O CONNECTOR
	ROW - Excludes China	ROW - Excludes China	ROW - Excludes China	ROW - Excludes China

1.2 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz
Maximum Peak Output Power to antenna	<Ant. 1>: 802.11b : 20.01 dBm (0.1002 W) 802.11g : 22.30 dBm (0.1698 W) 802.11n HT20 : 22.34 dBm (0.1714 W) 802.11n HT40 : 20.90 dBm (0.1230 W) <Ant. 2>: 802.11b : 20.30 dBm (0.1072 W) 802.11g : 22.21 dBm (0.1663 W) 802.11n HT20 : 22.18 dBm (0.1652 W) 802.11n HT40 : 22.12 dBm (0.1629 W) MIMO <Ant. 1 + 2>: 802.11b : 23.26 dBm (0.2118 W) 802.11g : 25.20 dBm (0.3311 W) 802.11n HT20 : 25.18 dBm (0.3296 W) 802.11n HT40 : 24.05 dBm (0.2541 W)
Maximum Average Output Power to antenna	<Ant. 1>: 802.11b : 17.80 dBm (0.0603 W) 802.11g : 17.90 dBm (0.0617 W) 802.11n HT20 : 17.80 dBm (0.0603 W) 802.11n HT40 : 15.10 dBm (0.0324 W) <Ant. 2>: 802.11b : 17.90 dBm (0.0617 W) 802.11g : 17.70 dBm (0.0589 W) 802.11n HT20 : 17.60 dBm (0.0575 W) 802.11n HT40 : 16.60 dBm (0.0457 W) MIMO <Ant. 1 + 2>: 802.11b : 20.86 dBm (0.1219 W) 802.11g : 20.91 dBm (0.1233 W) 802.11n HT20 : 20.81 dBm (0.1205 W) 802.11n HT40 : 18.16 dBm (0.0655 W)

Product Specification subjective to this standard			
99% Occupied Bandwidth	<Ant. 1>: 802.11b : 14.14 MHz 802.11g : 17.18 MHz 802.11n HT20 : 18.08 MHz 802.11n HT40 : 36.66 MHz <Ant. 2>: 802.11b : 13.84 MHz 802.11g : 16.93 MHz 802.11n HT20 : 18.03 MHz 802.11n HT40 : 36.56 MHz MIMO <Ant. 1>: 802.11b : 14.29 MHz 802.11g : 17.03 MHz 802.11n HT20 : 18.13 MHz 802.11n HT40 : 36.66 MHz MIMO <Ant. 2>: 802.11b : 14.04 MHz 802.11g : 17.33 MHz 802.11n HT20 : 18.38 MHz 802.11n HT40 : 36.56 MHz		
	Antenna Type / Gain <Ant. 1>: PIFA Antenna with gain 3.10 dBi <Ant. 2>: PIFA Antenna with gain 3.15 dBi		
Type of Modulation		802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)	
Antenna Function Description			
	802.11 b/g/n	Ant. 1	Ant. 2
	802.11 b/g/n MIMO	V	V

Note: MIMO Ant. 1+2 is a calculated result from sum of the power MIMO Ant. 1 and MIMO Ant. 2.

1.3 Modification of EUT

No modifications are made to the EUT during all test items.

1.4 Testing Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory	
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978	
Test Site No.	Sporton Site No.	
	TH05-HY	CO05-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory	
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No.	
	03CH16-HY	

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW0007

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane for Ant. 1, Y plane for Ant. 2 and Z plane for MIMO Ant. 1+2) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

Test Cases	
AC Conducted Emission	Mode 1 : WLAN (2.4GHz) Link + Bluetooth Link + NFC Active + Battery 1 + MPEG4 (Color Bar) + USB Cable (Charging from AC Adapter) for Sample 1
Remark: For Radiated Test Cases, the tests were performed with Battery 1, and Sample 1	

Ch. #	2400-2483.5 MHz			
	802.11b	802.11g	802.11n HT20	802.11n HT40
Low	01	01	01	03
Middle	06	06	06	06
High	11	11	11	09

Remark: For radiation spurious emission, the final modulation and the worst data rate was reference the max RF conducted power.



<Ant. 1>

802.11b RF Avg. Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	19.05	CH 11	19.97	19.96	19.97
CH 06	2437	20.00				
CH 11	2462	20.01				

802.11g RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						
		6M		9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
CH 01	2412	21.20	CH 06	22.10	22.10	22.20	22.20	22.10	22.00	22.00
CH 06	2437	22.30								
CH 11	2462	20.17								

802.11n HT20 RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
CH 01	2412	20.10	CH 06	22.24	22.24	22.20	22.15	22.20	22.20	22.20
CH 06	2437	22.34								
CH 11	2462	18.70								

802.11n HT40 RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
CH 03	2422	17.16	CH 06	20.80	20.80	20.80	20.80	20.80	20.80	20.80
CH 06	2437	20.90								
CH 09	2452	19.01								



<Ant. 2>

802.11b RF Avg. Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	19.10	CH 06	20.20	20.10	20.20
CH 06	2437	20.30				
CH 11	2462	20.09				

802.11g RF Avg. Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)					
		6M		9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps
CH 01	2412	20.27	CH 06	22.10	22.10	22.10	22.13	22.02	22.03
CH 06	2437	22.21							
CH 11	2462	20.98							

802.11n HT20 RF Avg. Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index					
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6
CH 01	2412	18.75	CH 06	22.08	22.08	21.97	21.97	22.00	22.00
CH 06	2437	22.18							
CH 11	2462	21.00							

802.11n HT40 RF Avg. Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index					
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6
CH 03	2422	17.50	CH 06	22.05	22.05	22.05	22.01	22.01	22.08
CH 06	2437	22.12							
CH 09	2452	21.15							



MIMO <Ant. 1+2>

802.11b RF Avg. Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	22.11	CH 11	23.22	23.24	23.24
CH 06	2437	23.09				
CH 11	2462	23.26				

802.11g RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						
		6M		9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
CH 01	2412	22.69	CH 06	25.06	25.05	25.00	25.00	25.06	25.10	25.10
CH 06	2437	25.20								
CH 11	2462	22.87								

802.11n HT20 RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	Data Rate (bps)						
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
CH 01	2412	21.77	CH 06	25.10	25.10	25.10	25.06	25.06	25.04	25.04
CH 06	2437	25.18								
CH 11	2462	21.78								

802.11n HT40 RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	Data Rate (bps)						
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
CH 01	2412	19.45	CH 06	23.95	23.95	23.95	23.95	23.95	23.95	23.95
CH 06	2437	24.05								
CH 11	2462	21.94								

<Ant. 1>

802.11b RF Avg. Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
Duty Cycle (%)		100.00		98.60	96.40	93.90
CH 01	2412	16.80		CH 11	17.70	17.60
CH 06	2437	17.70				
CH 11	2462	17.80				

802.11g RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						
		6M		9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
Duty Cycle (%)		98.08			97.40	96.60	95.10	93.60	91.10	89.20
CH 01	2412	17.00	CH 06	17.60	17.60	17.80	17.80	17.70	17.60	17.70
CH 06	2437	17.90								
CH 11	2462	15.70								

802.11n HT20 RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
Duty Cycle (%)		97.67		96.40	94.80	93.30	90.90	88.50	87.50	86.50
CH 01	2412	15.50		CH 06	17.70	17.60	17.50	17.60	17.60	17.60
CH 06	2437	17.80								
CH 11	2462	14.00								

802.11n HT40 RF Avg. Output Power (dBm)											
Power vs. Channel			Power vs Data Rate								
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index							
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	
Duty Cycle (%)		93.94									
CH 03	2422	11.50		CH 06	15.00	15.00	15.00	15.00	15.00	15.00	15.00
CH 06	2437	15.10									
CH 09	2452	12.70									

<Ant. 2>

802.11b RF Avg. Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
Duty Cycle (%)		100.00		98.60	96.40	93.90
CH 01	2412	16.80		CH 06	17.80	17.70
CH 06	2437	17.90				
CH 11	2462	17.80				

802.11g RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						
		6M		9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
Duty Cycle (%)		97.84		97.40	96.60	95.10	93.60	91.10	88.70	87.60
CH 01	2412	15.70		CH 06	17.60	17.60	17.60	17.60	17.50	17.50
CH 06	2437	17.70								
CH 11	2462	16.50								

802.11n HT20 RF Avg. Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
Duty Cycle (%)		97.67		96.30	94.70	93.80	90.20	88.10	87.40	86.10
CH 01	2412	13.80		CH 06	17.60	17.50	17.50	17.30	17.40	17.40
CH 06	2437	17.60								
CH 11	2462	16.30								

802.11n HT40 RF Avg. Output Power (dBm)											
Power vs. Channel			Power vs Data Rate								
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index							
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	
Duty Cycle (%)		93.91									
CH 03	2422	12.00		CH 06	16.50	16.50	16.50	16.40	16.40	16.50	16.50
CH 06	2437	16.60									
CH 09	2452	15.00									



MIMO <Ant. 1+2>

802.11b RF Avg. Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	19.81	CH 11	20.71	20.76	20.71
CH 06	2437	20.81				
CH 11	2462	20.86				

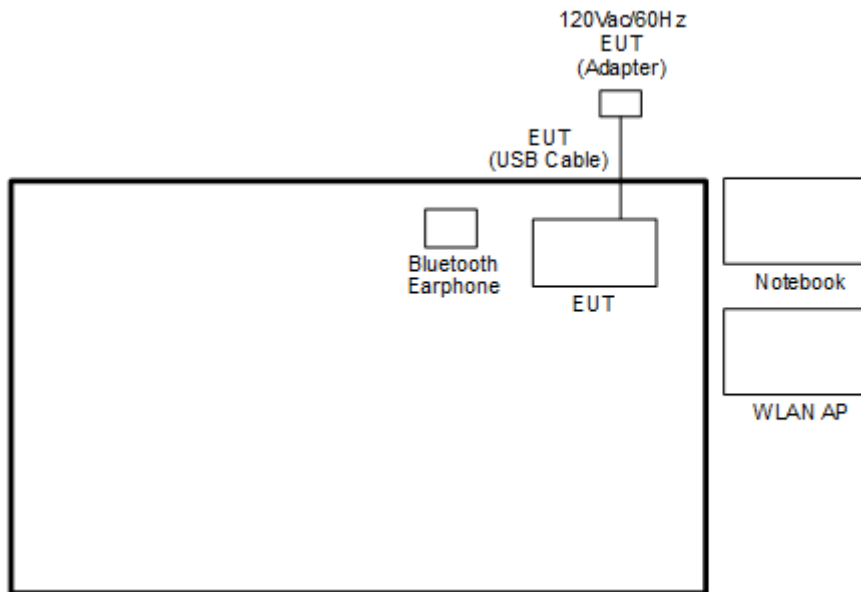
802.11g RF Avg. Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)					
		6M		9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps
CH 01	2412	18.16	CH 06	20.71	20.66	20.51	20.51	20.71	20.66
CH 06	2437	20.91							
CH 11	2462	18.21							

802.11n HT20 RF Avg. Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	MCS Index	Channel	Data Rate (bps)					
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6
CH 01	2412	16.96	CH 06	20.71	20.71	20.71	20.61	20.61	20.51
CH 06	2437	20.81							
CH 11	2462	17.06							

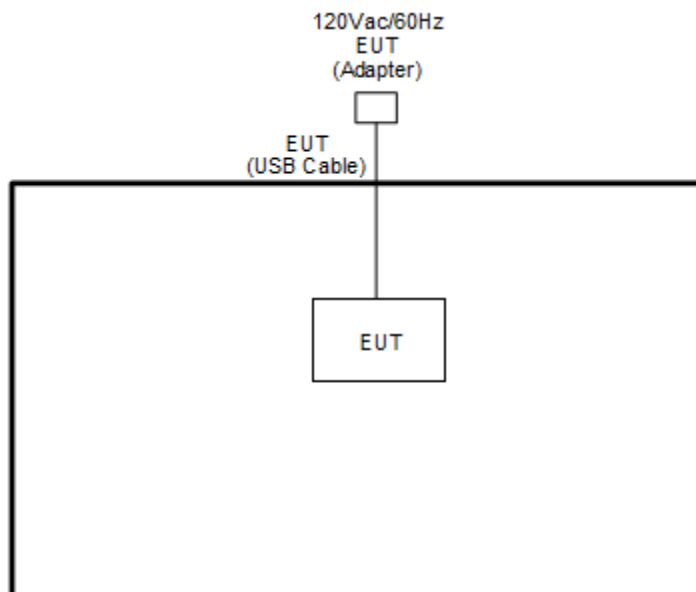
802.11n HT40 RF Avg. Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	MCS Index	Channel	Data Rate (bps)					
		MCS 0		MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6
CH 01	2412	13.37	CH 06	16.50	16.50	16.50	16.40	16.40	16.50
CH 06	2437	18.16							
CH 11	2462	15.66							

2.3 Connection Diagram of Test System

<AC Conducted Emission Mode>



<WLAN Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
2.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8 m
3.	Notebook	DELL	Latitude 3400	FCC DOC	N/A	AC I/P : Unshielded, 1.2m DC O/P : Shielded, 1.8m
4.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT 4” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\
 &= 4.2 + 10 = 14.2 \text{ (dB)}
 \end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

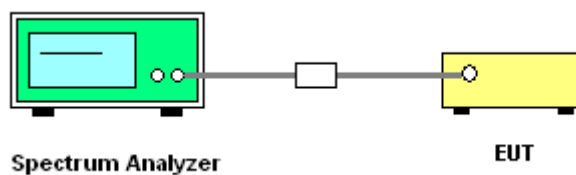
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) $\geq 3 * RBW$.
6. Measure and record the results in the test report.

3.1.4 Test Setup

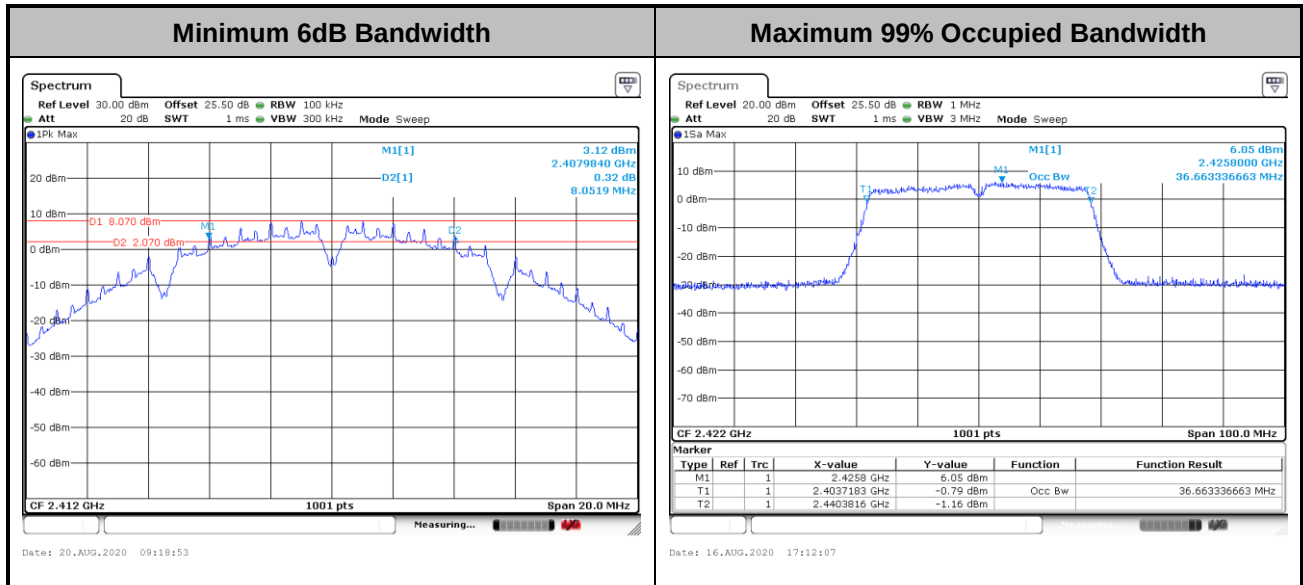




3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Test Engineer :	Hank Hsu, Shiming Liu and Mina Liu	Temperature :	23.5~24.3℃
		Relative Humidity :	49~55%

2.4GHz Band										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)		6dB BW (MHz)		6dB BW Limit (MHz)	Pass/Fail
					Ant. 1	Ant. 2	Ant. 1	Ant. 2		
11b	1Mbps	1	1	2412	14.04	13.79	8.05	8.55	0.50	Pass
11b	1Mbps	1	6	2437	13.89	13.79	8.55	8.53	0.50	Pass
11b	1Mbps	1	11	2462	14.14	13.84	9.01	8.53	0.50	Pass
11g	6Mbps	1	1	2412	17.18	16.93	16.28	15.70	0.50	Pass
11g	6Mbps	1	6	2437	16.83	16.88	15.32	15.70	0.50	Pass
11g	6Mbps	1	11	2462	16.98	16.88	15.50	15.70	0.50	Pass
HT20	MCS0	1	1	2412	18.08	18.03	16.64	16.32	0.50	Pass
HT20	MCS0	1	6	2437	17.93	18.03	15.70	16.08	0.50	Pass
HT20	MCS0	1	11	2462	18.08	17.98	15.90	15.94	0.50	Pass
HT40	MCS0	1	3	2422	36.66	36.36	35.44	35.08	0.50	Pass
HT40	MCS0	1	6	2437	36.26	36.36	35.12	35.12	0.50	Pass
HT40	MCS0	1	9	2452	36.66	36.56	35.72	35.72	0.50	Pass
11b	1Mbps	2	1	2412	14.19	13.79	9.03	8.55	0.50	Pass
11b	1Mbps	2	6	2437	13.94	13.74	8.55	8.53	0.50	Pass
11b	1Mbps	2	11	2462	14.29	14.04	9.01	8.55	0.50	Pass
11g	6Mbps	2	1	2412	17.03	16.88	16.28	15.72	0.50	Pass
11g	6Mbps	2	6	2437	16.98	17.33	15.32	16.30	0.50	Pass
11g	6Mbps	2	11	2462	17.03	16.78	15.30	15.70	0.50	Pass
HT20	MCS0	2	1	2412	18.13	18.03	16.88	16.32	0.50	Pass
HT20	MCS0	2	6	2437	18.08	18.38	15.68	16.88	0.50	Pass
HT20	MCS0	2	11	2462	18.13	17.93	15.70	16.32	0.50	Pass
HT40	MCS0	2	3	2422	36.56	36.36	35.32	35.12	0.50	Pass
HT40	MCS0	2	6	2437	36.26	36.36	35.08	35.08	0.50	Pass
HT40	MCS0	2	9	2452	36.66	36.56	35.72	35.72	0.50	Pass



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

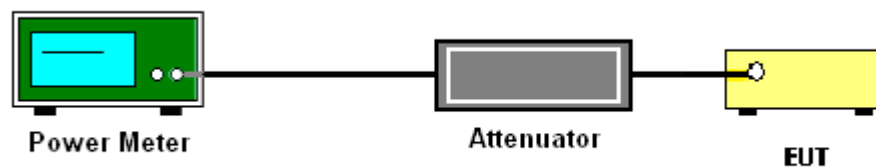
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. For Peak Power, the testing follows ANSI C63.10 Section 11.9.1.3 PKPM1
2. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
3. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Measure the conducted output power and record the results in the test report.
6. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.2.4 Test Setup





3.2.5 Test Result of Peak Output Power

Test Engineer :	Hank Hsu, Shiming Liu and Mina Liu	Temperature :	23.5~24.3℃
		Relative Humidity :	49~55%

2.4GHz Band																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
					Ant. 1	Ant. 2	SUM	Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11b	1Mbps	1	1	2412	19.05	19.10	-	30.00	30.00	3.10	3.15	22.15	22.25	36.00	36.00	Pass
11b	1Mbps	1	6	2437	20.00	20.30		30.00	30.00	3.10	3.15	23.10	23.45	36.00	36.00	Pass
11b	1Mbps	1	11	2462	20.01	20.09		30.00	30.00	3.10	3.15	23.11	23.24	36.00	36.00	Pass
11g	6Mbps	1	1	2412	21.20	20.27		30.00	30.00	3.10	3.15	24.30	23.42	36.00	36.00	Pass
11g	6Mbps	1	6	2437	22.30	22.21		30.00	30.00	3.10	3.15	25.40	25.36	36.00	36.00	Pass
11g	6Mbps	1	11	2462	20.17	20.98		30.00	30.00	3.10	3.15	23.27	24.13	36.00	36.00	Pass
HT20	MCS0	1	1	2412	20.10	18.75		30.00	30.00	3.10	3.15	23.20	21.90	36.00	36.00	Pass
HT20	MCS0	1	6	2437	22.34	22.18		30.00	30.00	3.10	3.15	25.44	25.33	36.00	36.00	Pass
HT20	MCS0	1	11	2462	18.70	21.00		30.00	30.00	3.10	3.15	21.80	24.15	36.00	36.00	Pass
HT40	MCS0	1	3	2422	17.16	17.50		30.00	30.00	3.10	3.15	20.26	20.65	36.00	36.00	Pass
HT40	MCS0	1	6	2437	20.90	22.12		30.00	30.00	3.10	3.15	24.00	25.27	36.00	36.00	Pass
HT40	MCS0	1	9	2452	19.01	21.15		30.00	30.00	3.10	3.15	22.11	24.30	36.00	36.00	Pass
11b	1Mbps	2	1	2412	19.40	18.78	22.11	30.00		3.15		25.26		36.00		Pass
11b	1Mbps	2	6	2437	19.95	20.21	23.09	30.00		3.15		26.24		36.00		Pass
11b	1Mbps	2	11	2462	20.06	20.43	23.26	30.00		3.15		26.41		36.00		Pass
11g	6Mbps	2	1	2412	19.70	19.66	22.69	30.00		3.15		25.84		36.00		Pass
11g	6Mbps	2	6	2437	22.08	22.30	25.20	30.00		3.15		28.35		36.00		Pass
11g	6Mbps	2	11	2462	19.65	20.06	22.87	30.00		3.15		26.02		36.00		Pass
HT20	MCS0	2	1	2412	18.67	18.85	21.77	30.00		3.15		24.92		36.00		Pass
HT20	MCS0	2	6	2437	22.13	22.21	25.18	30.00		3.15		28.33		36.00		Pass
HT20	MCS0	2	11	2462	18.70	18.83	21.78	30.00		3.15		24.93		36.00		Pass
HT40	MCS0	2	3	2422	16.27	16.60	19.45	30.00		3.15		22.60		36.00		Pass
HT40	MCS0	2	6	2437	20.98	21.10	24.05	30.00		3.15		27.20		36.00		Pass
HT40	MCS0	2	9	2452	18.98	18.87	21.94	30.00		3.15		25.09		36.00		Pass



3.2.6 Test Result of Average Output Power (Reporting Only)

Test Engineer :	Hank Hsu, Shiming Liu and Mina Liu	Temperature :	23.5~24.3℃
		Relative Humidity :	49~55%

2.4GHz Band																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
					Ant. 1	Ant. 2	SUM	Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11b	1Mbps	1	1	2412	16.80	16.80	-	30.00	30.00	3.10	3.15	19.90	19.95	36.00	36.00	Pass
11b	1Mbps	1	6	2437	17.70	17.90		30.00	30.00	3.10	3.15	20.80	21.05	36.00	36.00	Pass
11b	1Mbps	1	11	2462	17.80	17.80		30.00	30.00	3.10	3.15	20.90	20.95	36.00	36.00	Pass
11g	6Mbps	1	1	2412	17.00	15.70		30.00	30.00	3.10	3.15	20.10	18.85	36.00	36.00	Pass
11g	6Mbps	1	6	2437	17.90	17.70		30.00	30.00	3.10	3.15	21.00	20.85	36.00	36.00	Pass
11g	6Mbps	1	11	2462	15.70	16.50		30.00	30.00	3.10	3.15	18.80	19.65	36.00	36.00	Pass
HT20	MCS0	1	1	2412	15.50	13.80		30.00	30.00	3.10	3.15	18.60	16.95	36.00	36.00	Pass
HT20	MCS0	1	6	2437	17.80	17.60		30.00	30.00	3.10	3.15	20.90	20.75	36.00	36.00	Pass
HT20	MCS0	1	11	2462	14.00	16.30		30.00	30.00	3.10	3.15	17.10	19.45	36.00	36.00	Pass
HT40	MCS0	1	3	2422	11.50	12.00		30.00	30.00	3.10	3.15	14.60	15.15	36.00	36.00	Pass
HT40	MCS0	1	6	2437	15.10	16.60		30.00	30.00	3.10	3.15	18.20	19.75	36.00	36.00	Pass
HT40	MCS0	1	9	2452	12.70	15.00		30.00	30.00	3.10	3.15	15.80	18.15	36.00	36.00	Pass



2.4GHz Band																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
					Ant. 1	Ant. 2	SUM	Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11b	1Mbps	2	1	2412	16.90	16.70	19.81	30.00		3.15		22.96		36.00		Pass
11b	1Mbps	2	6	2437	17.70	17.90	20.81	30.00		3.15		23.96		36.00		Pass
11b	1Mbps	2	11	2462	17.80	17.90	20.86	30.00		3.15		24.01		36.00		Pass
11g	6Mbps	2	1	2412	15.20	15.10	18.16	30.00		3.15		21.31		36.00		Pass
11g	6Mbps	2	6	2437	17.90	17.90	20.91	30.00		3.15		24.06		36.00		Pass
11g	6Mbps	2	11	2462	15.10	15.30	18.21	30.00		3.15		21.36		36.00		Pass
HT20	MCS0	2	1	2412	14.10	13.80	16.96	30.00		3.15		20.11		36.00		Pass
HT20	MCS0	2	6	2437	17.70	17.90	20.81	30.00		3.15		23.96		36.00		Pass
HT20	MCS0	2	11	2462	14.00	14.10	17.06	30.00		3.15		20.21		36.00		Pass
HT40	MCS0	2	3	2422	10.10	10.60	13.37	30.00		3.15		16.52		36.00		Pass
HT40	MCS0	2	6	2437	15.20	15.10	18.16	30.00		3.15		21.31		36.00		Pass
HT40	MCS0	2	9	2452	12.70	12.60	15.66	30.00		3.15		18.81		36.00		Pass

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

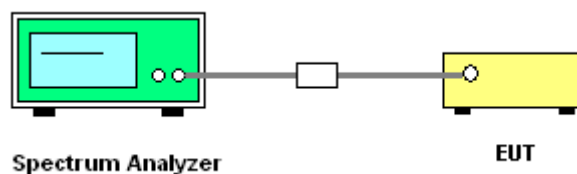
If measurements performed using method (2) plus $10 \log(N)$ exceeds the emission limit, the test should choose method (1) before declaring that the device fails the emission limit.

Method (1): Measure and sum the spectra across the outputs.

The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

Method (2): Measure and add $10 \log(N)$ dB, where N is the number of outputs. (N=2)

3.3.4 Test Setup





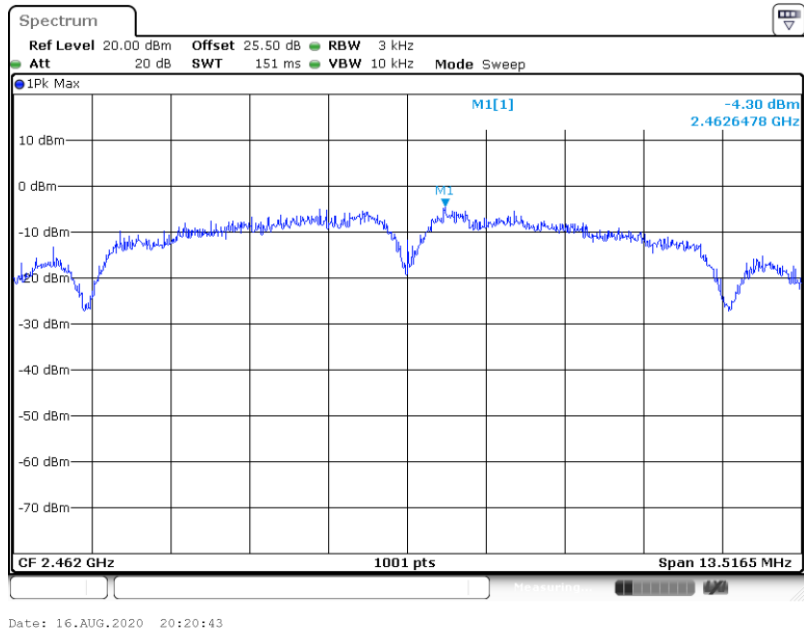
3.3.5 Test Result of Power Spectral Density

Test Engineer :	Hank Hsu, Shiming Liu and Mina Liu	Temperature :	23.5~24.3℃
		Relative Humidity :	49~55%

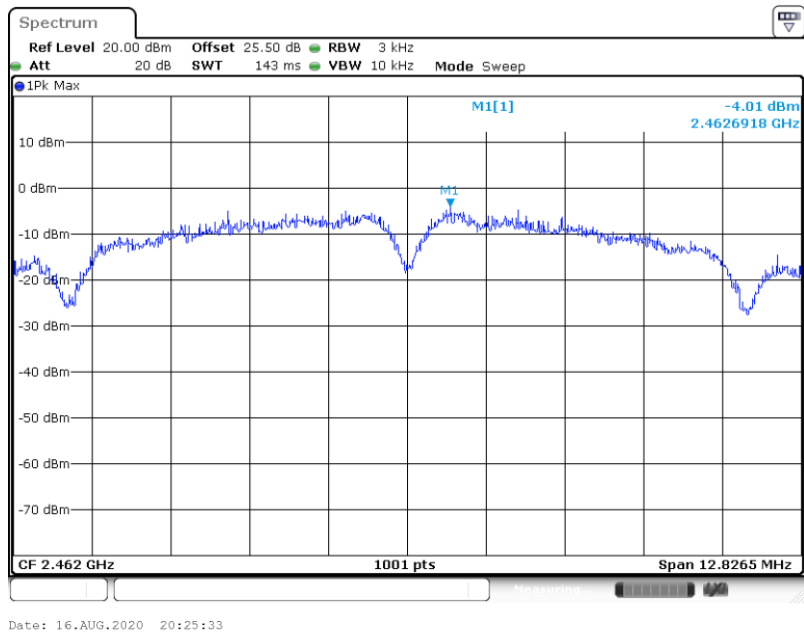
2.4GHz Band												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm/3kHz)			DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail
					Ant. 1	Ant. 2	Worse + 3.01	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11b	1Mbps	1	1	2412	-5.22	-5.64	-	3.10	3.15	8.00	8.00	Pass
11b	1Mbps	1	6	2437	-5.04	-4.81		3.10	3.15	8.00	8.00	Pass
11b	1Mbps	1	11	2462	-4.72	-4.85		3.10	3.15	8.00	8.00	Pass
11g	6Mbps	1	1	2412	-7.90	-8.88		3.10	3.15	8.00	8.00	Pass
11g	6Mbps	1	6	2437	-7.46	-7.67		3.10	3.15	8.00	8.00	Pass
11g	6Mbps	1	11	2462	-9.20	-8.08		3.10	3.15	8.00	8.00	Pass
HT20	MCS0	1	1	2412	-9.45	-11.27		3.10	3.15	8.00	8.00	Pass
HT20	MCS0	1	6	2437	-7.79	-8.05		3.10	3.15	8.00	8.00	Pass
HT20	MCS0	1	11	2462	-11.19	-8.87		3.10	3.15	8.00	8.00	Pass
HT40	MCS0	1	3	2422	-17.18	-16.14		3.10	3.15	8.00	8.00	Pass
HT40	MCS0	1	6	2437	-13.07	-11.36		3.10	3.15	8.00	8.00	Pass
HT40	MCS0	1	9	2452	-15.68	-12.68		3.10	3.15	8.00	8.00	Pass
11b	1Mbps	2	1	2412	-5.50	-5.92	-2.49	6.14		7.86		Pass
11b	1Mbps	2	6	2437	-4.09	-4.58	-1.08	6.14		7.86		Pass
11b	1Mbps	2	11	2462	-4.30	-4.01	-1.00	6.14		7.86		Pass
11g	6Mbps	2	1	2412	-9.89	-10.04	-6.88	6.14		7.86		Pass
11g	6Mbps	2	6	2437	-7.01	-6.99	-3.98	6.14		7.86		Pass
11g	6Mbps	2	11	2462	-9.77	-10.03	-6.76	6.14		7.86		Pass
HT20	MCS0	2	1	2412	-11.25	-11.50	-8.24	6.14		7.86		Pass
HT20	MCS0	2	6	2437	-7.37	-7.52	-4.36	6.14		7.86		Pass
HT20	MCS0	2	11	2462	-11.00	-11.55	-7.99	6.14		7.86		Pass
HT40	MCS0	2	3	2422	-17.67	-17.15	-14.14	6.14		7.86		Pass
HT40	MCS0	2	6	2437	-12.31	-12.25	-9.24	6.14		7.86		Pass
HT40	MCS0	2	9	2452	-15.18	-15.02	-12.01	6.14		7.86		Pass



Worst Case Power Density (dBm/3kHz) for MIMO Chain 0



Worst Case Power Density (dBm/3kHz) for MIMO Chain 1



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

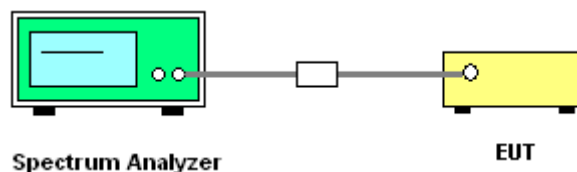
3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

3.4.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



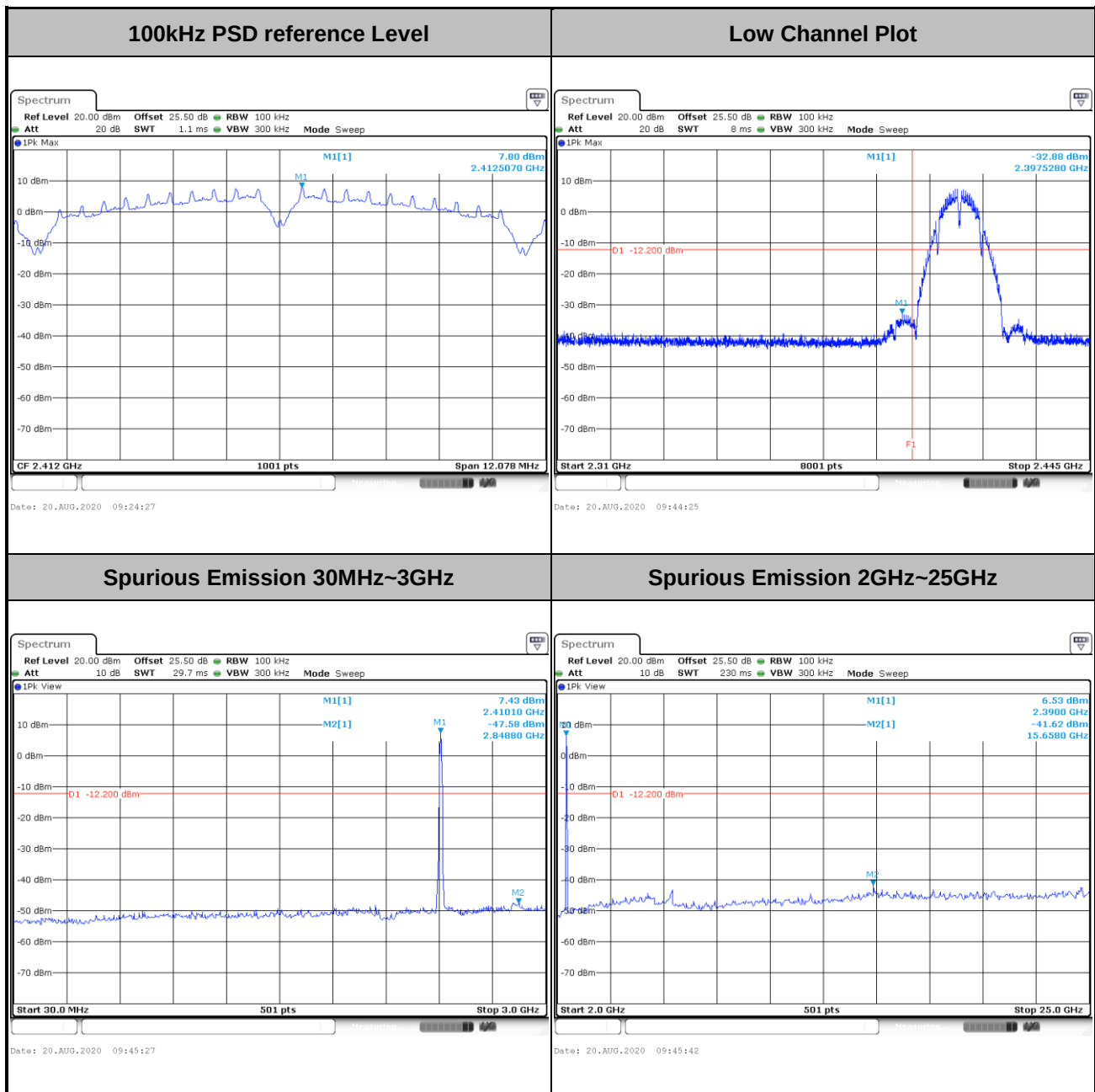


3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Test Engineer :	Hank Hsu, Shiming Liu and Mina Liu	Temperature :	23.5~24.3°C
		Relative Humidity :	49~55%

Number of TX = 1, Ant. 1 (Measured)

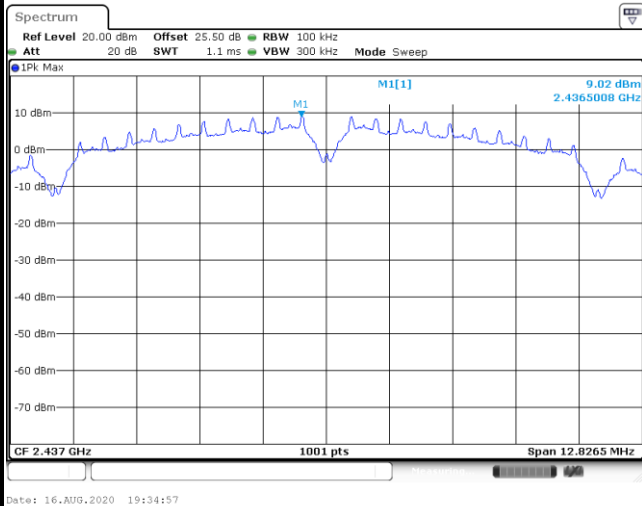
Test Mode :	802.11b	Test Channel :	01
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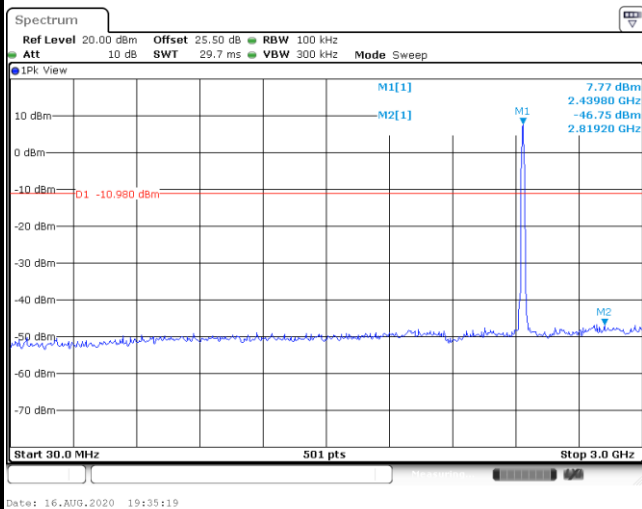
Test Mode :	802.11b	Test Channel :	06
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100kHz PSD reference Level

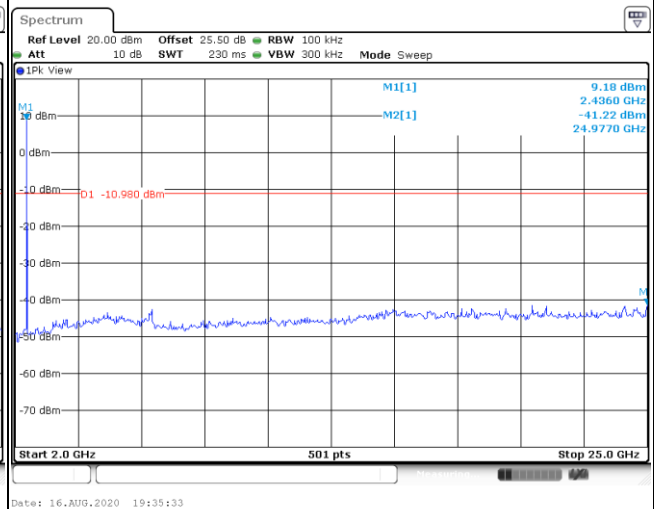


Mid Channel Plot

Spurious Emission 30MHz~3GHz

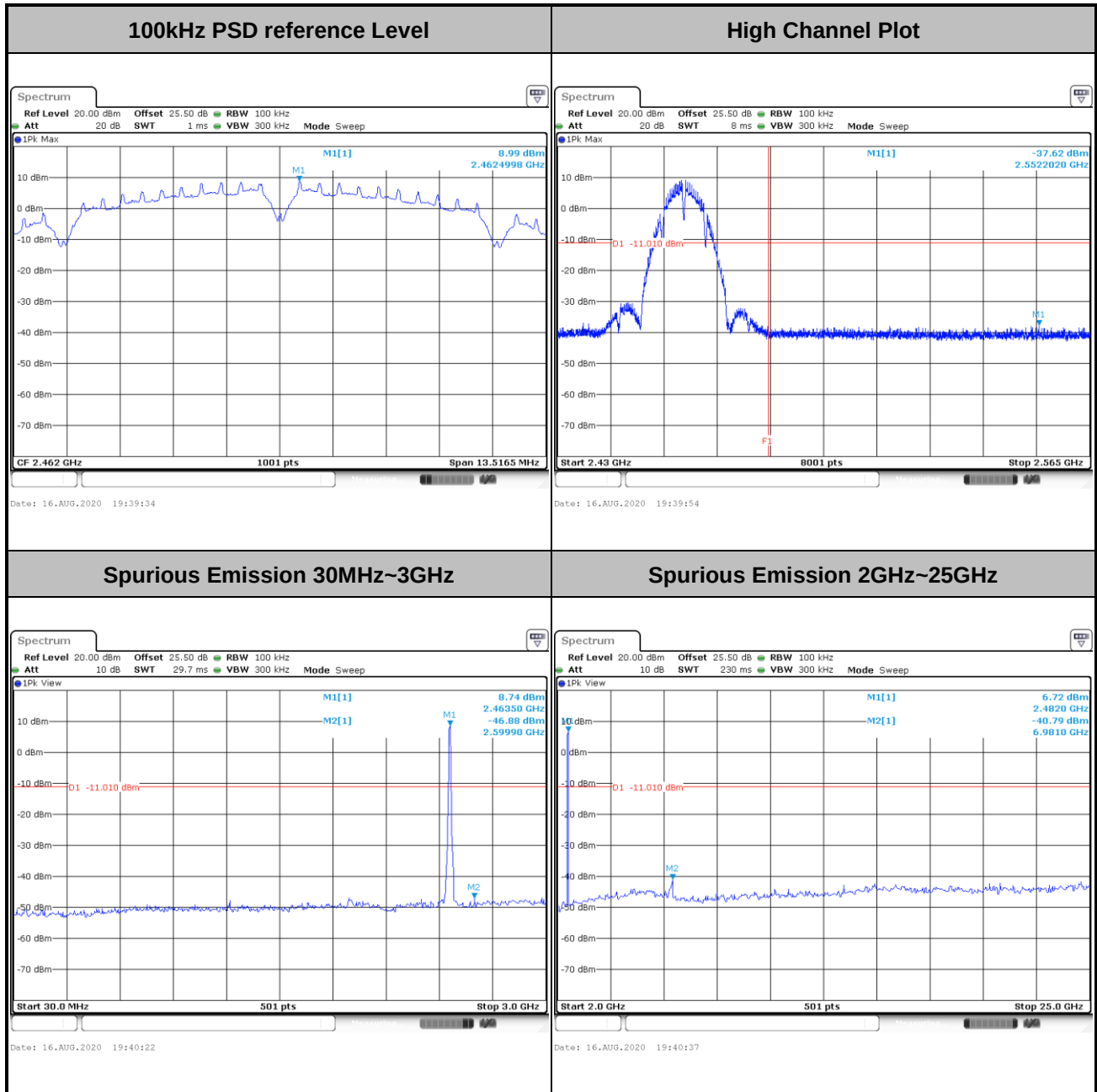


Spurious Emission 2GHz~25GHz



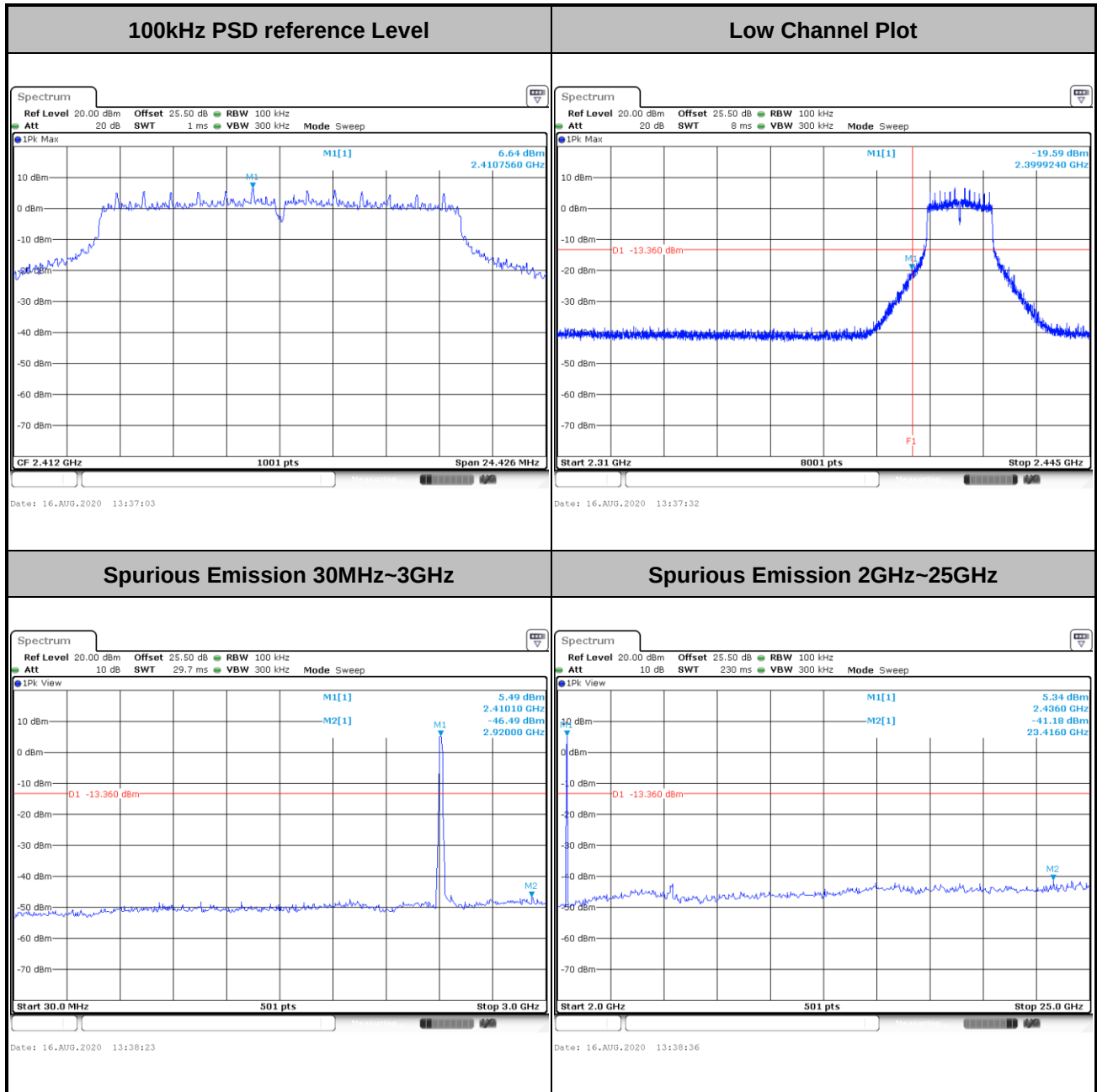


Test Mode :	802.11b	Test Channel :	11
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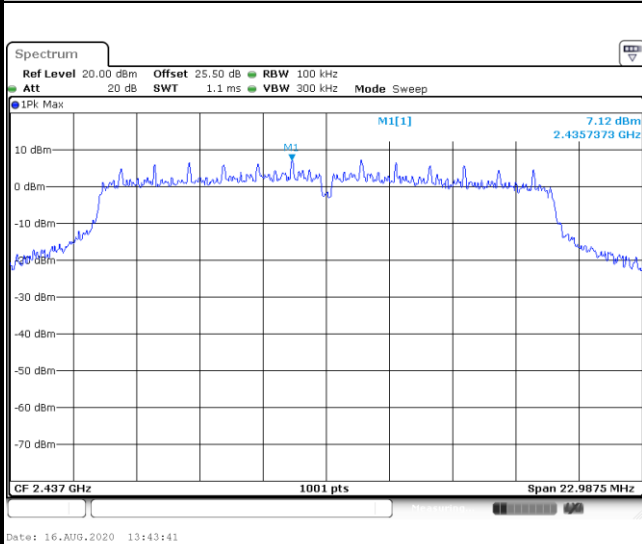
Test Mode :	802.11g	Test Channel :	01
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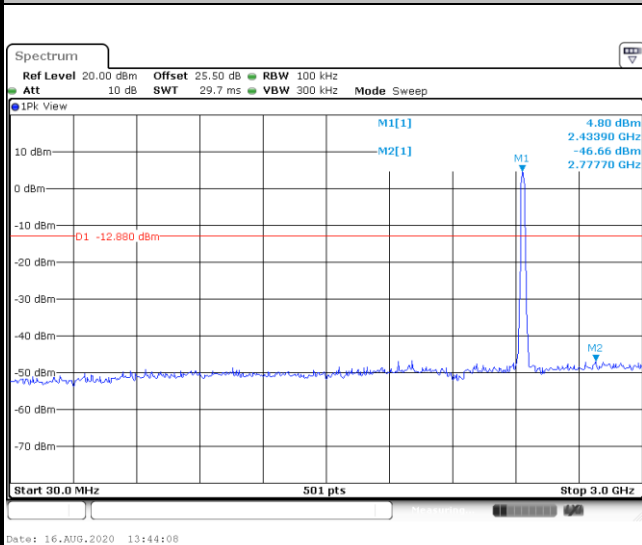
Test Mode :	802.11g	Test Channel :	06
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100kHz PSD reference Level

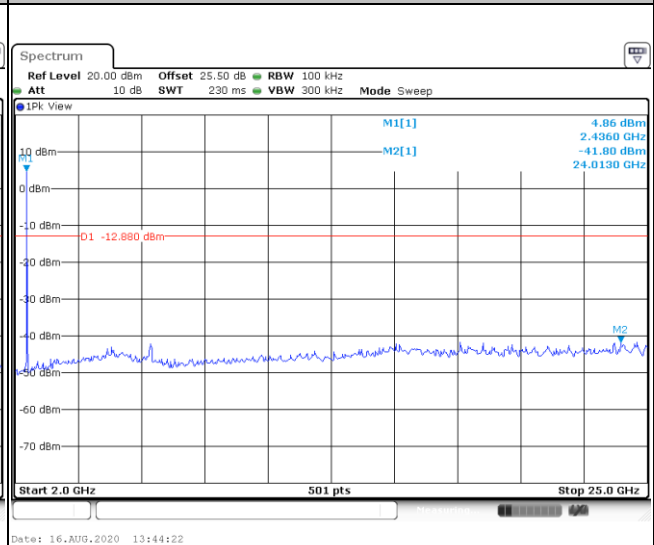


Mid Channel Plot

Spurious Emission 30MHz~3GHz

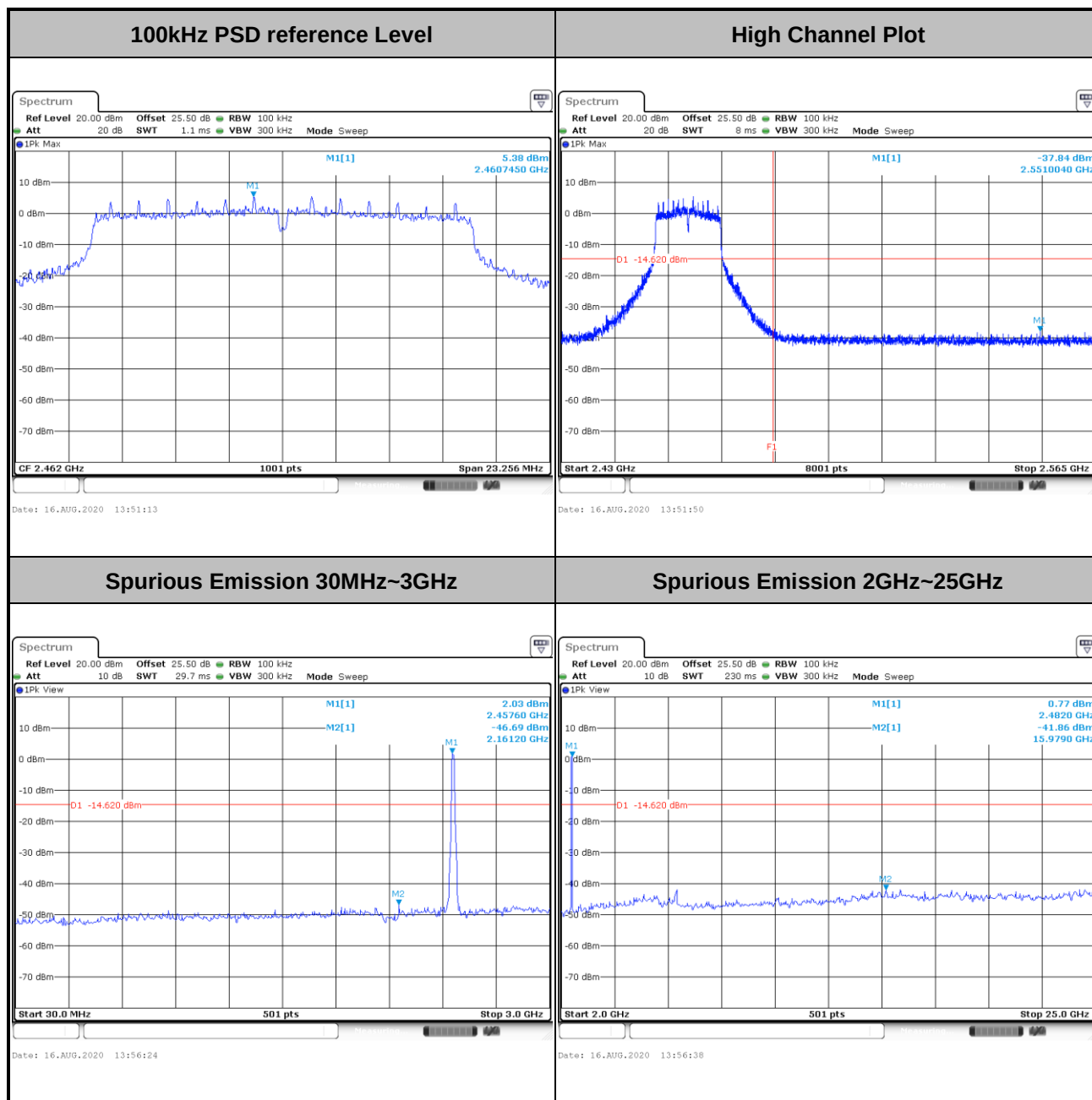


Spurious Emission 2GHz~25GHz



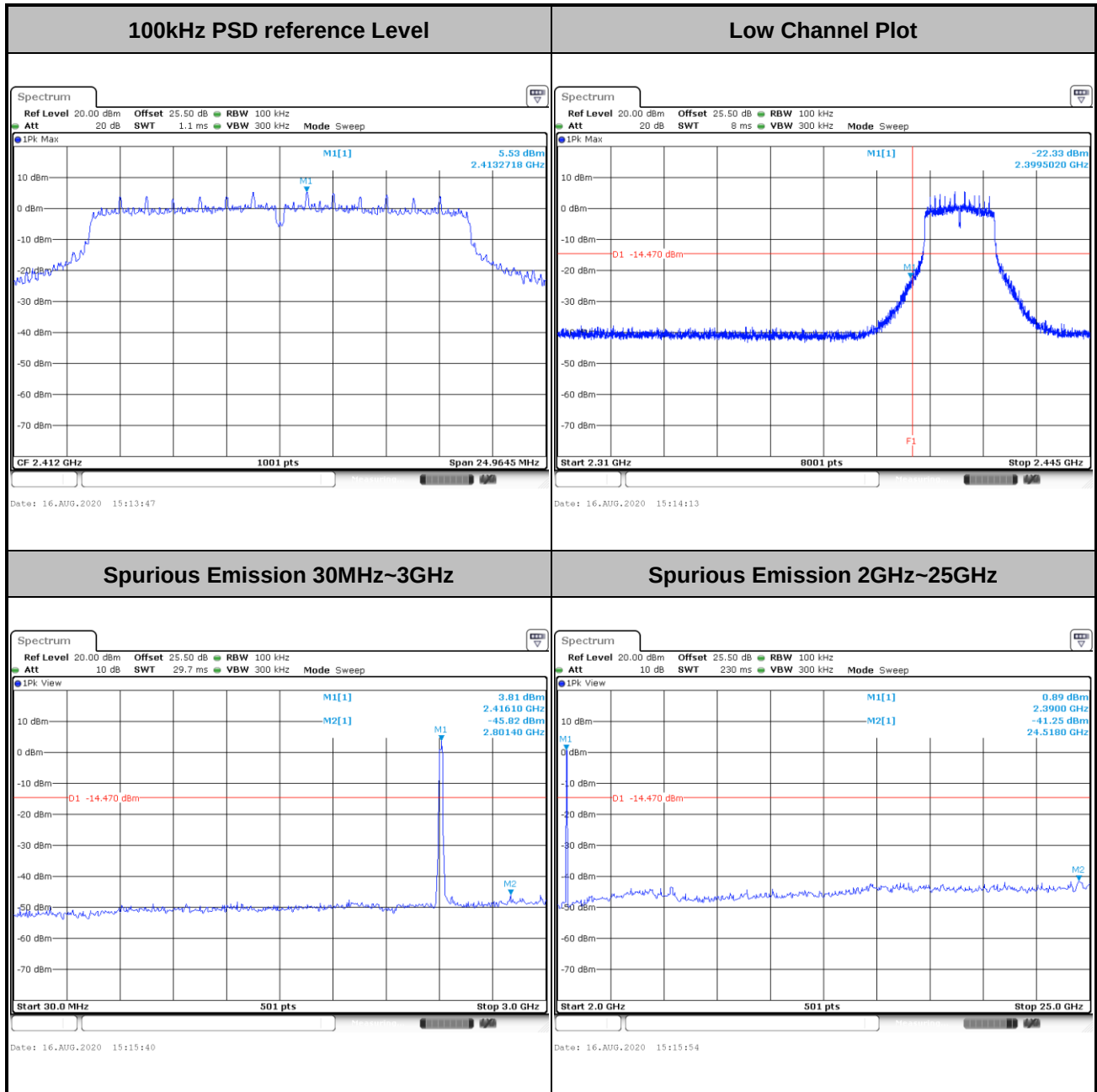


Test Mode :	802.11g	Test Channel :	11
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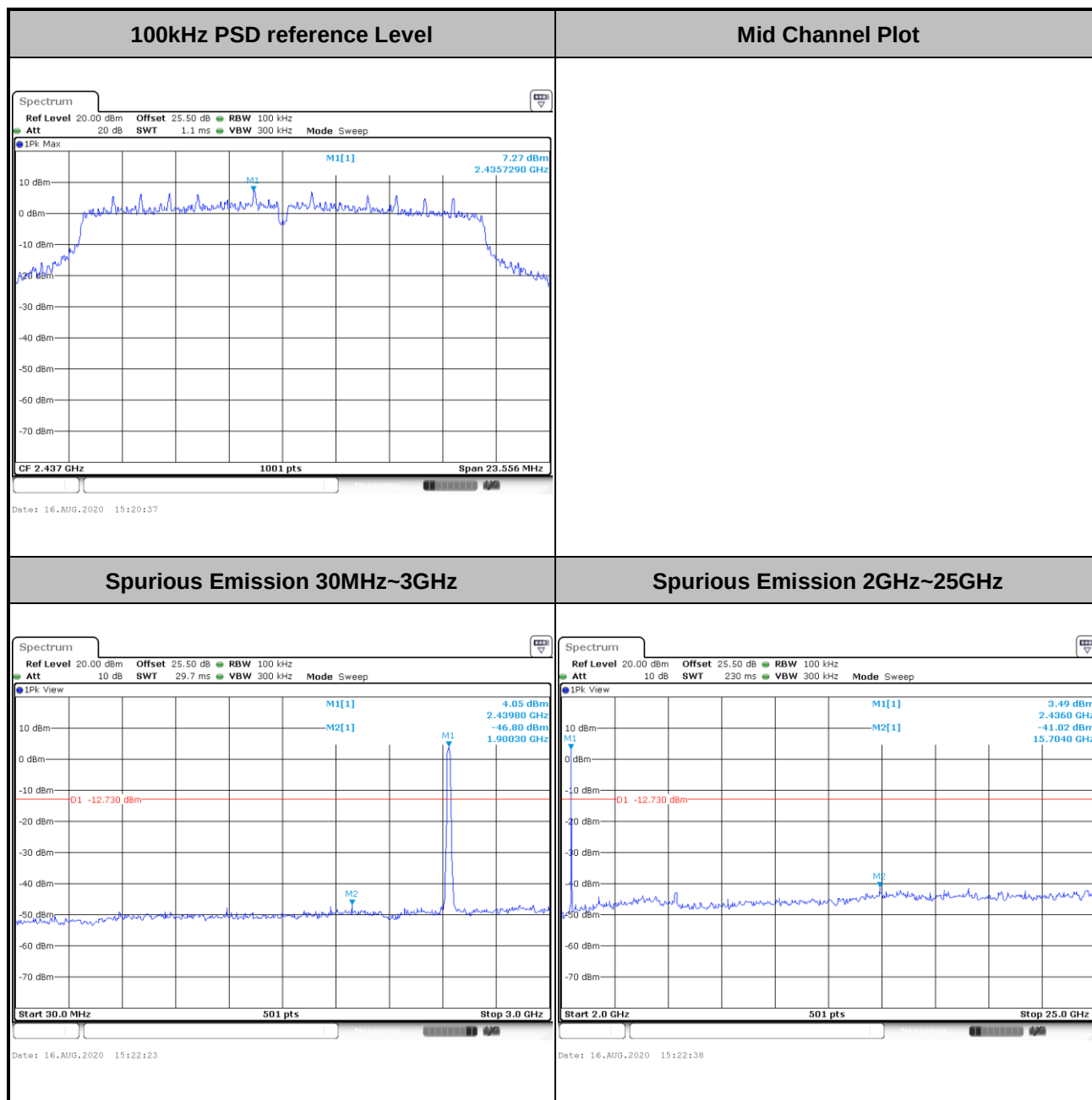


Test Mode :	802.11n HT20	Test Channel :	01
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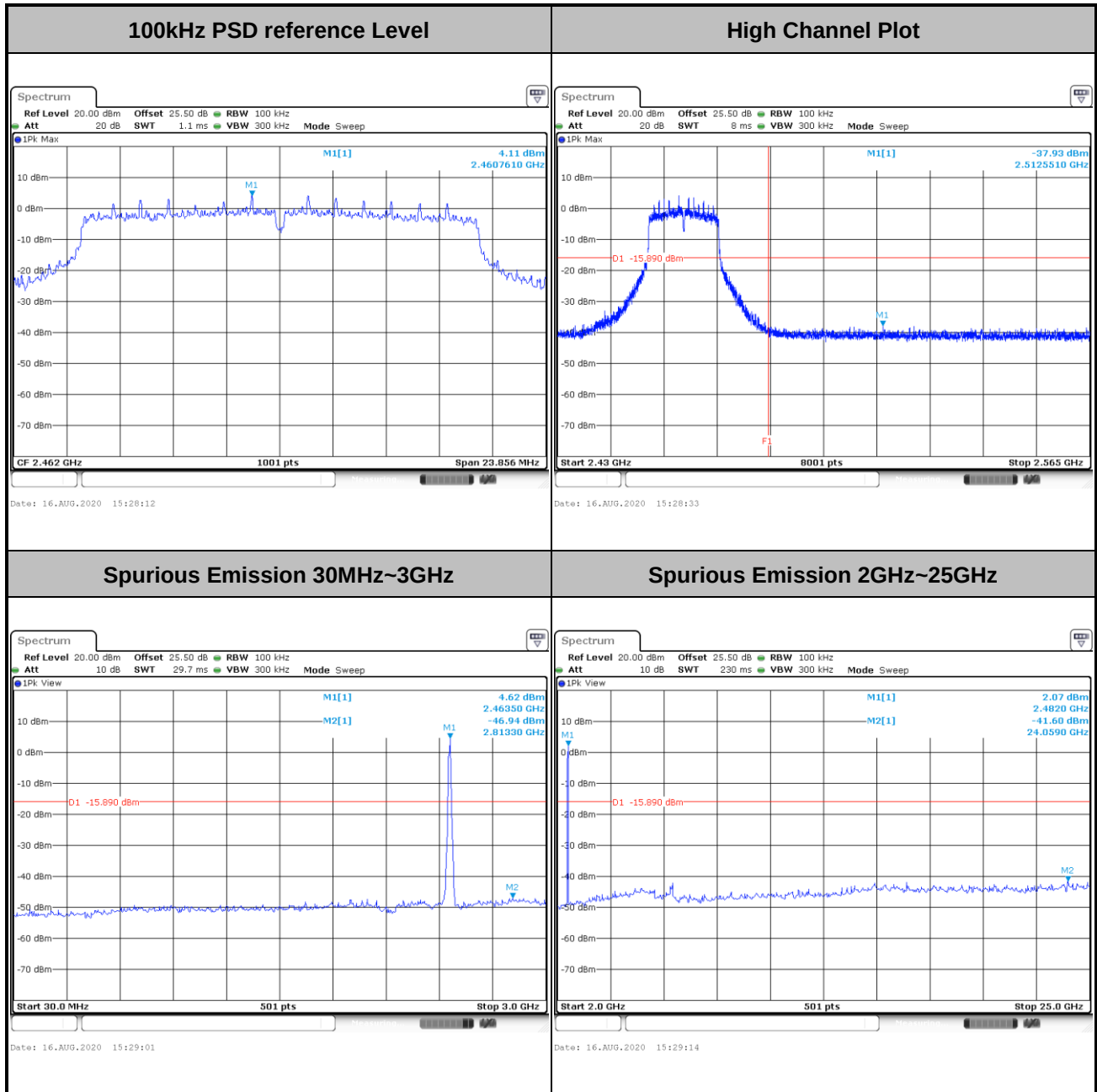


Test Mode :	802.11n HT20	Test Channel :	06
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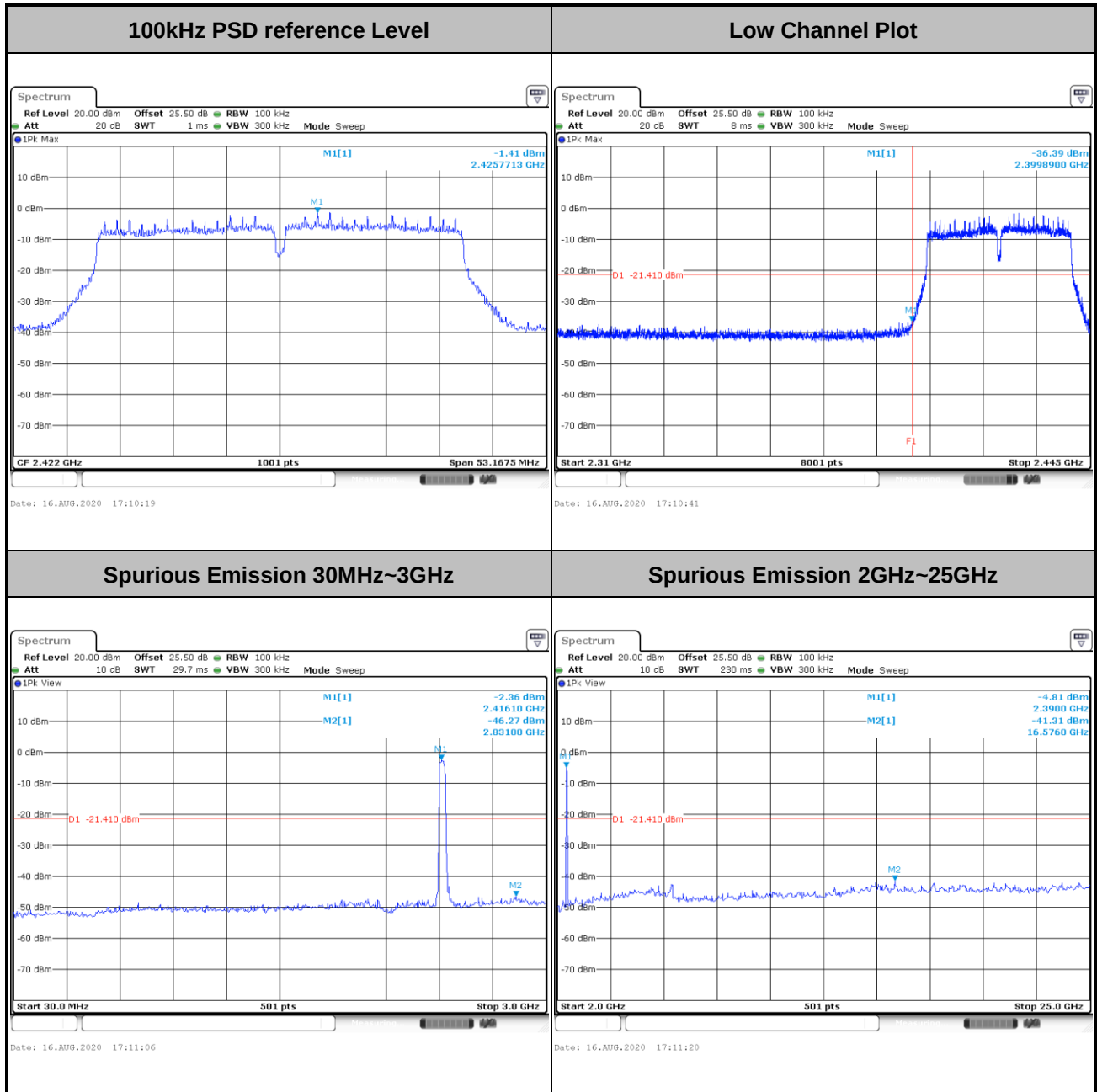


Test Mode :	802.11n HT20	Test Channel :	11
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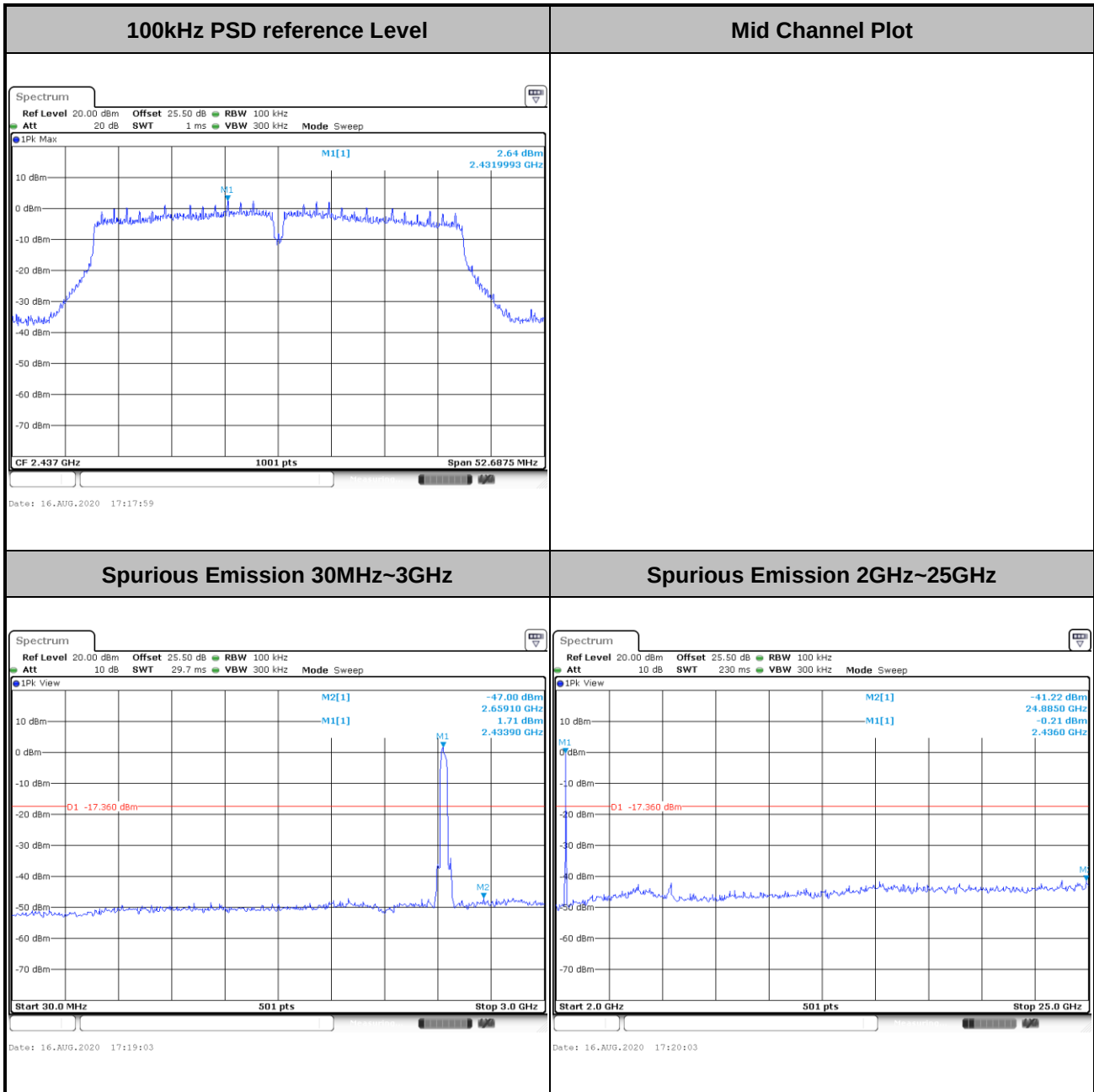


Test Mode :	802.11n HT40	Test Channel :	03
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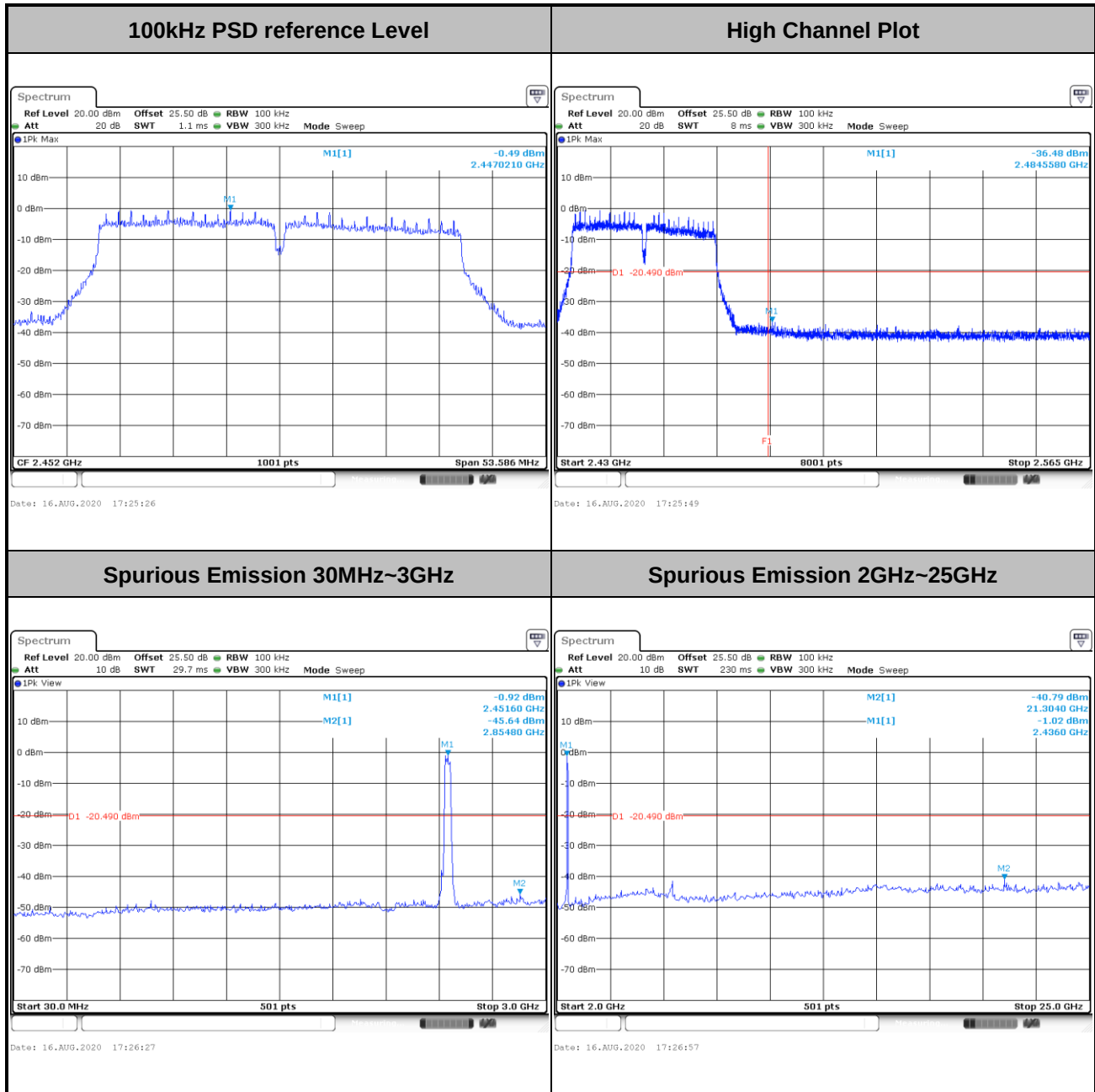


Test Mode :	802.11n HT40	Test Channel :	06
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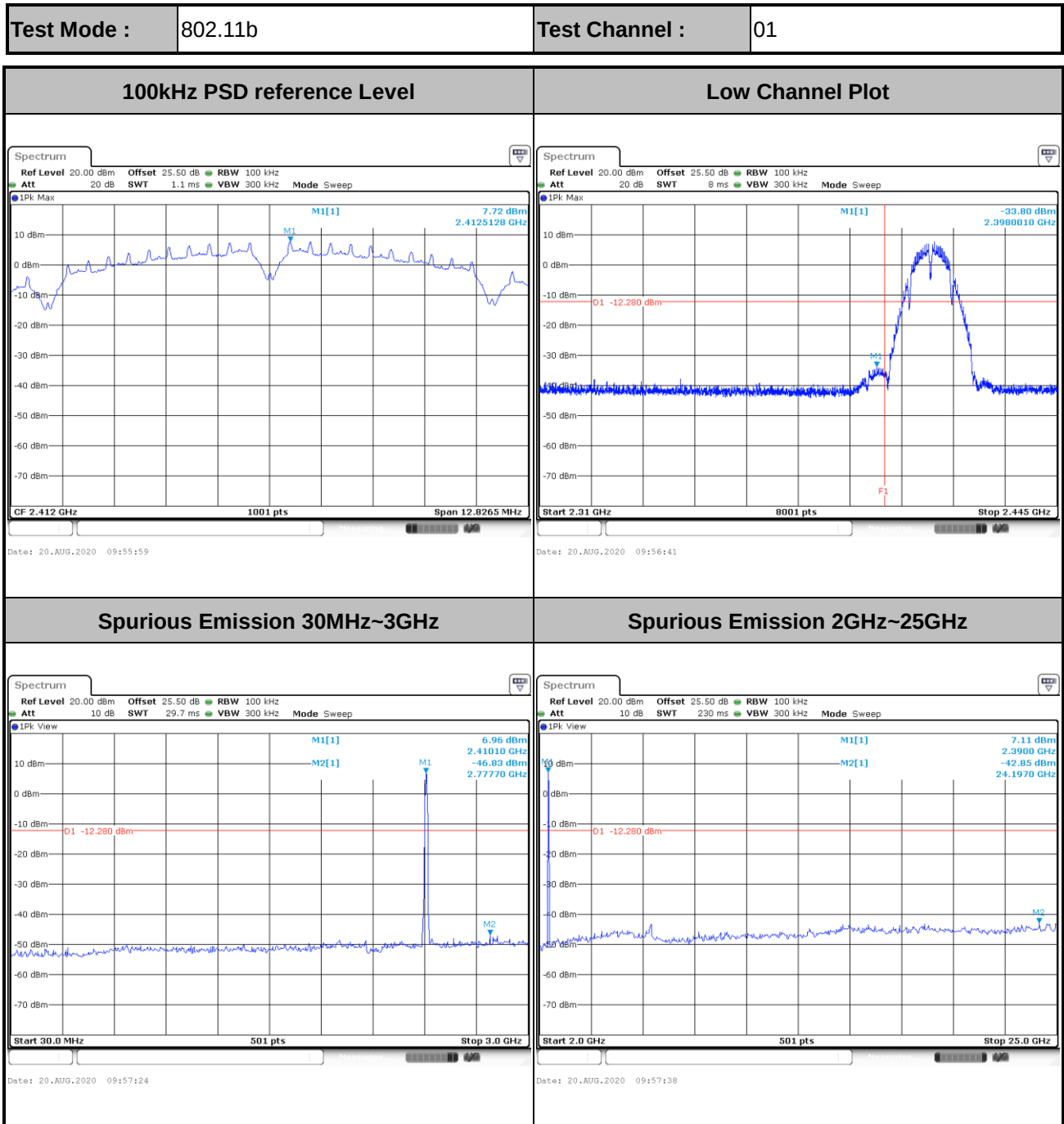


Test Mode :	802.11n HT40	Test Channel :	09
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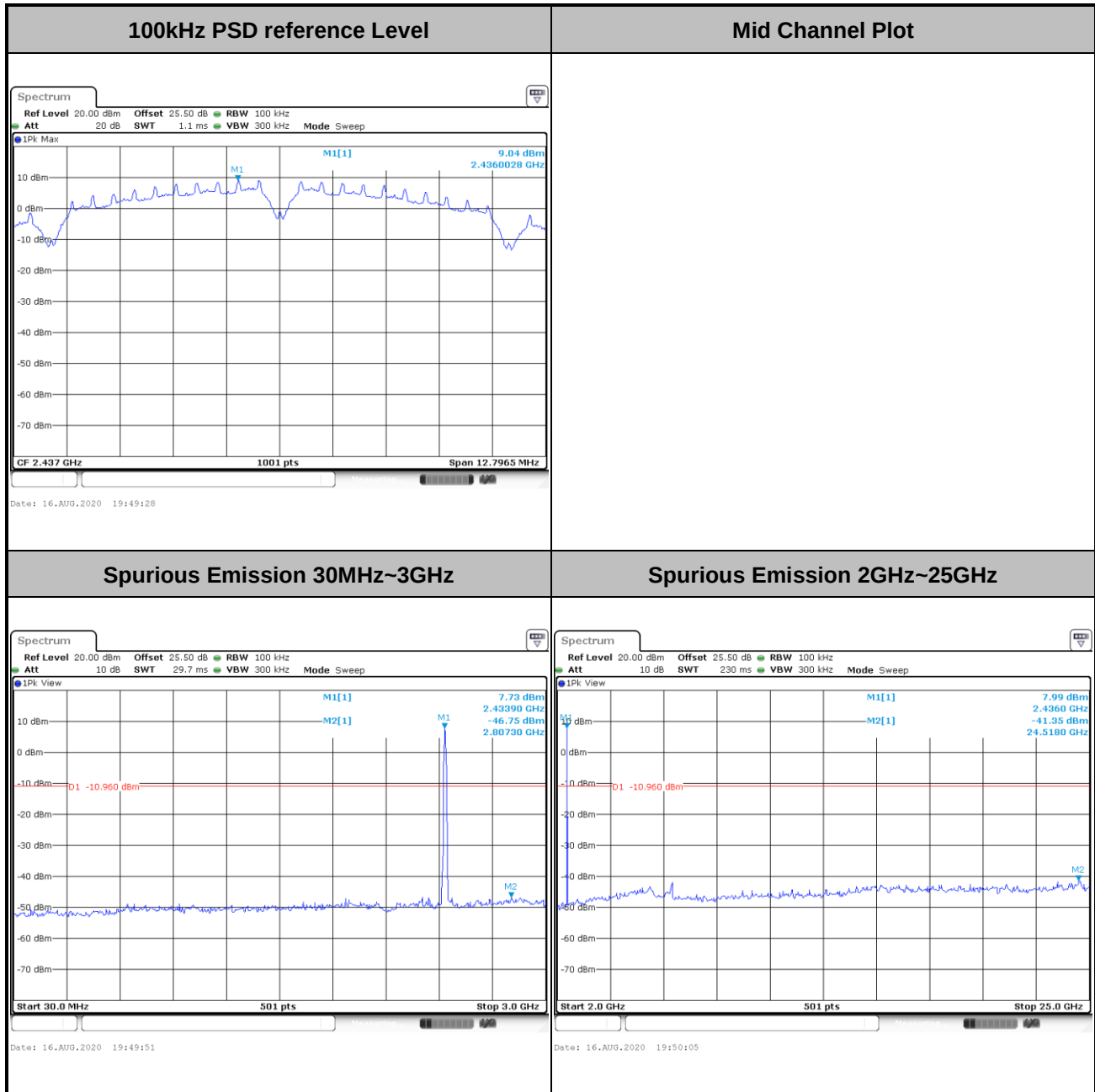


Number of TX = 1, Ant. 2 (Measured)



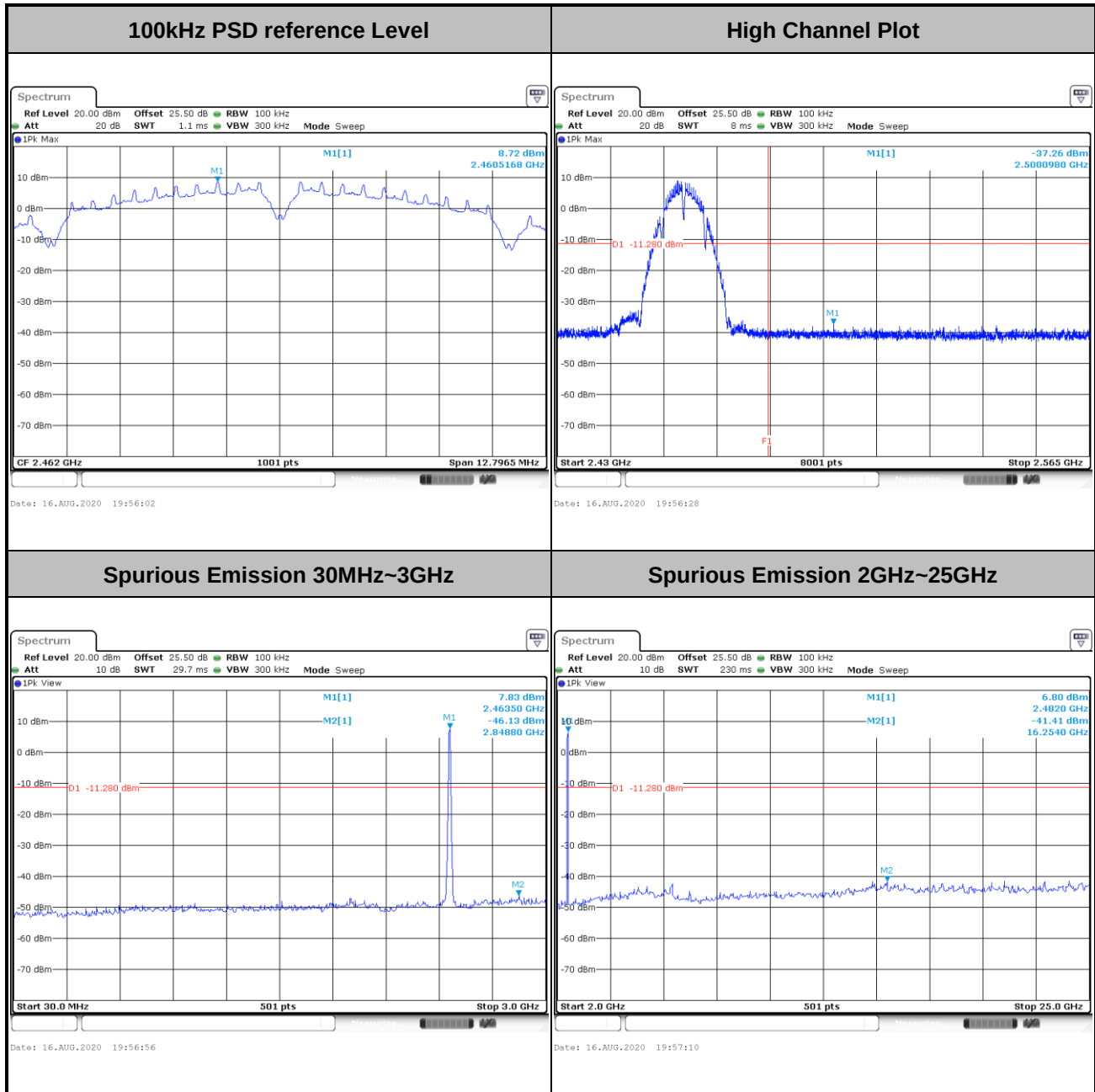


Test Mode :	802.11b	Test Channel :	06
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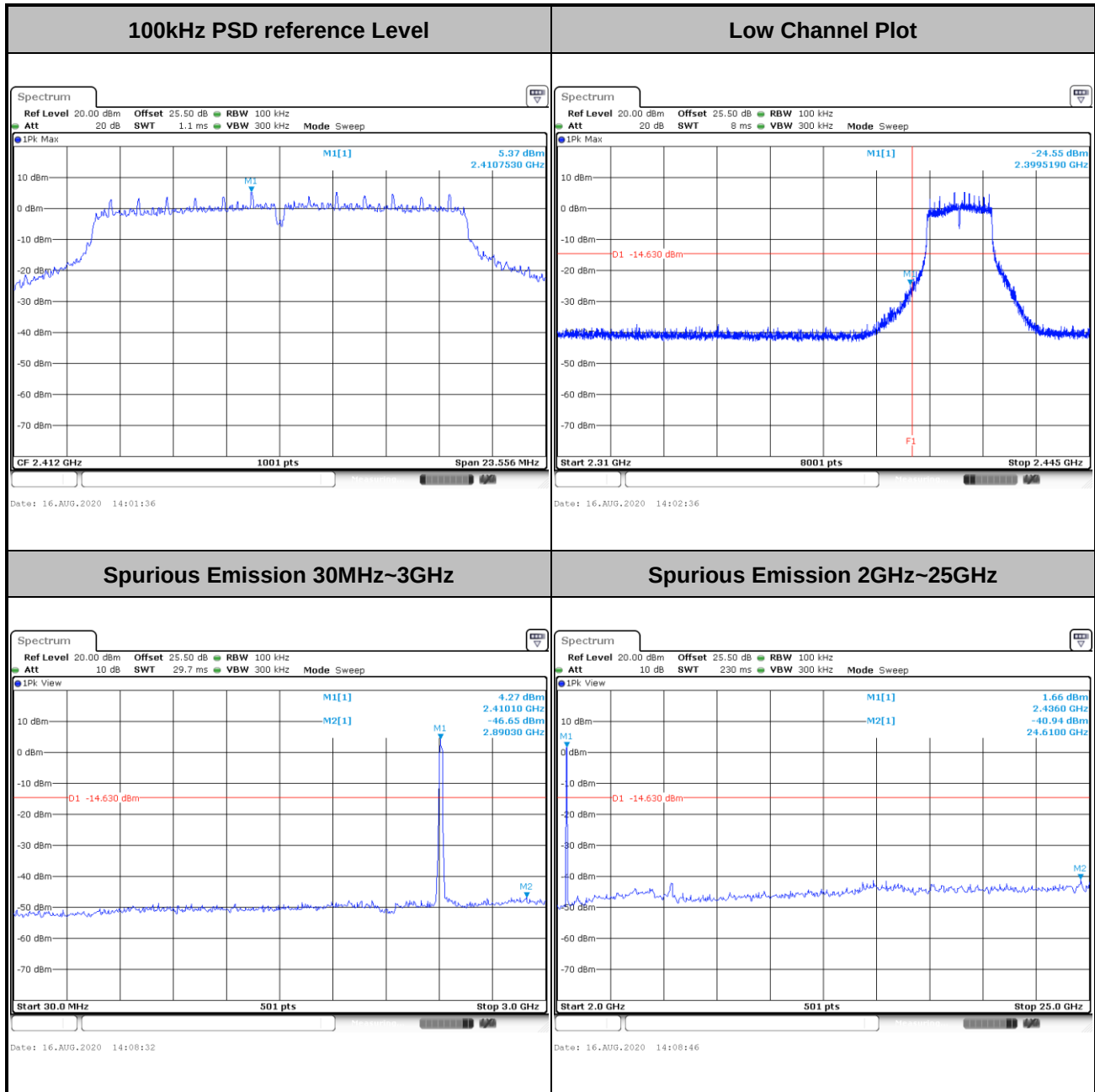


Test Mode :	802.11b	Test Channel :	11
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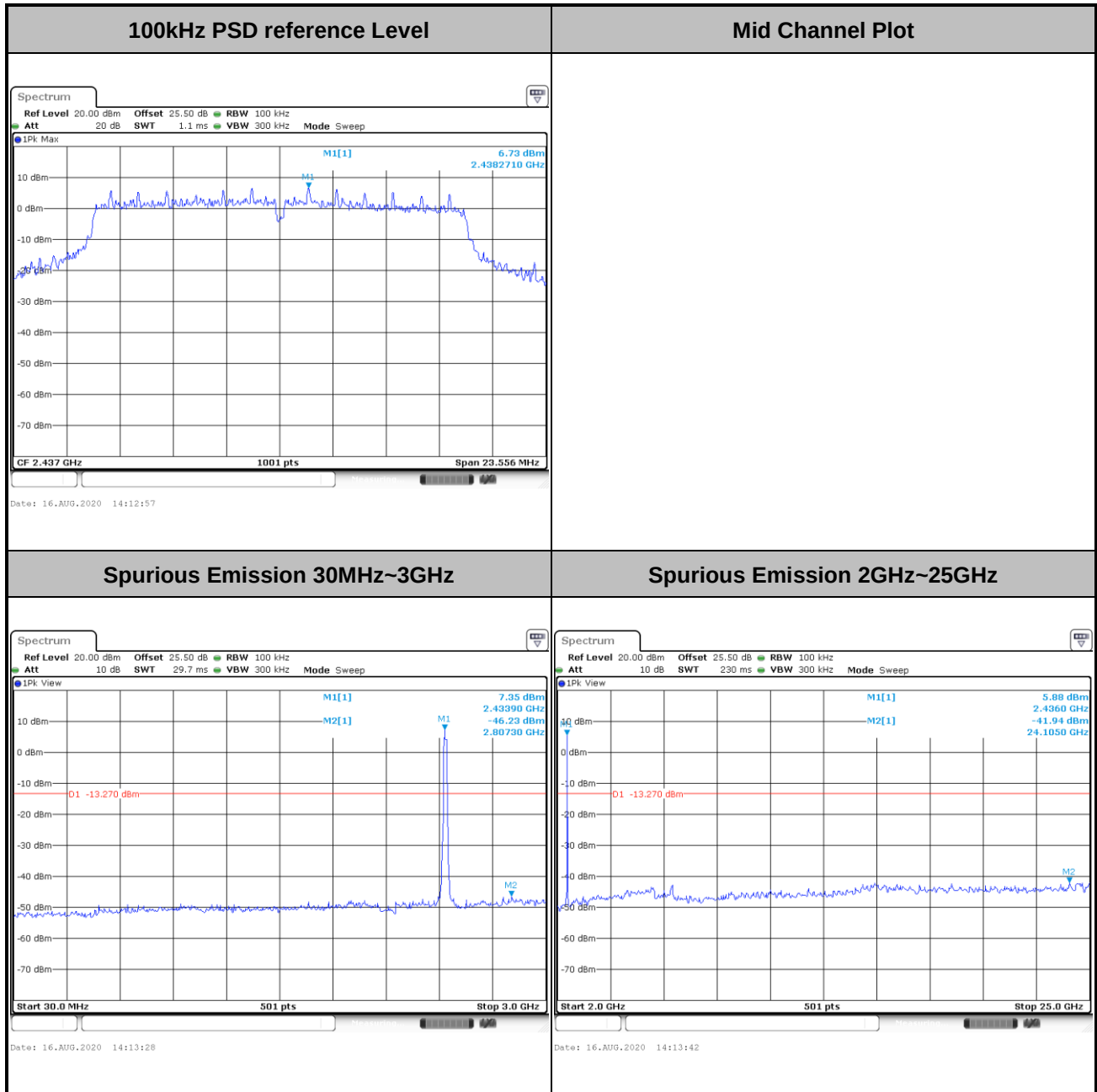


Test Mode :	802.11g	Test Channel :	01
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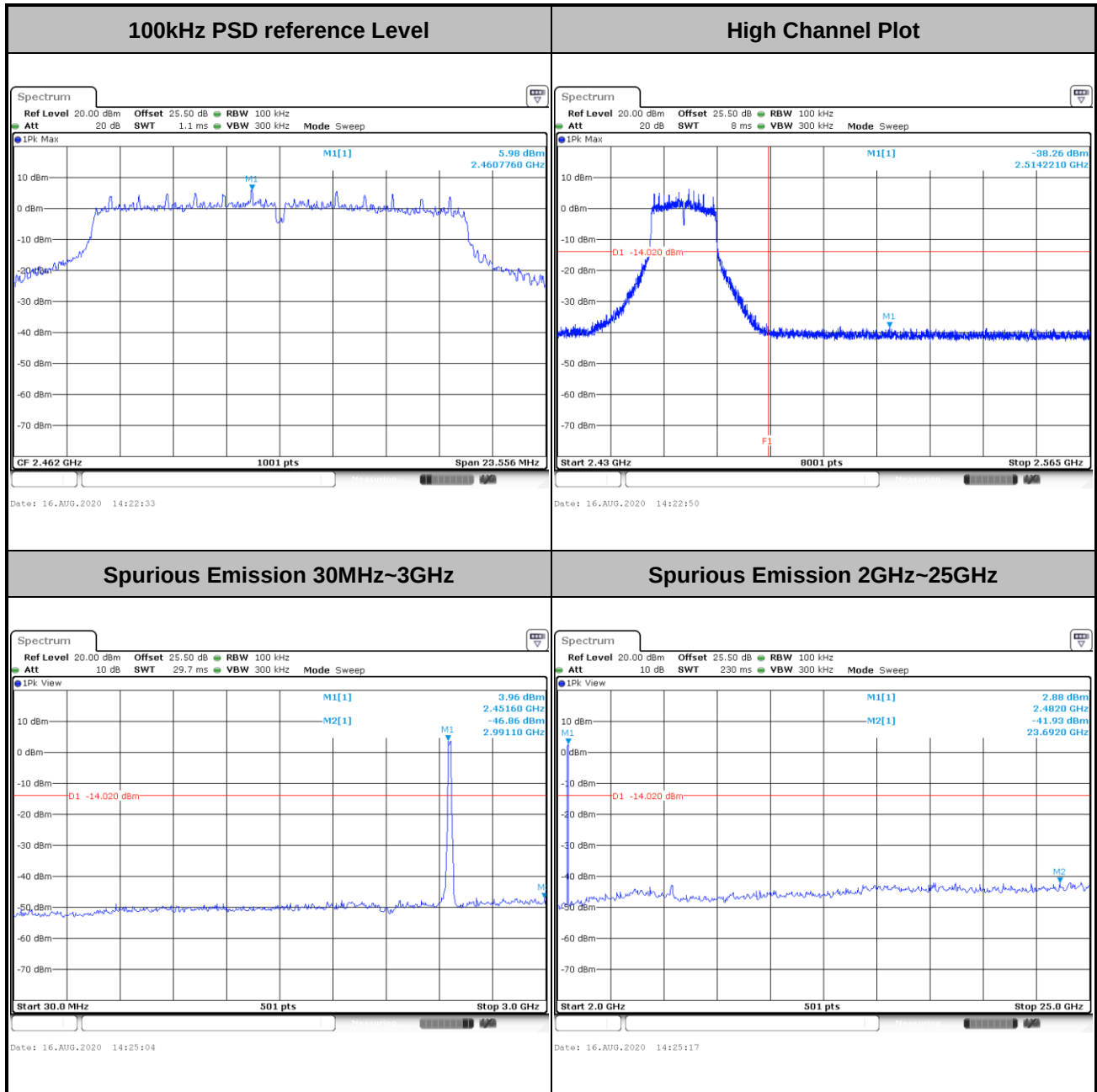


Test Mode :	802.11g	Test Channel :	06
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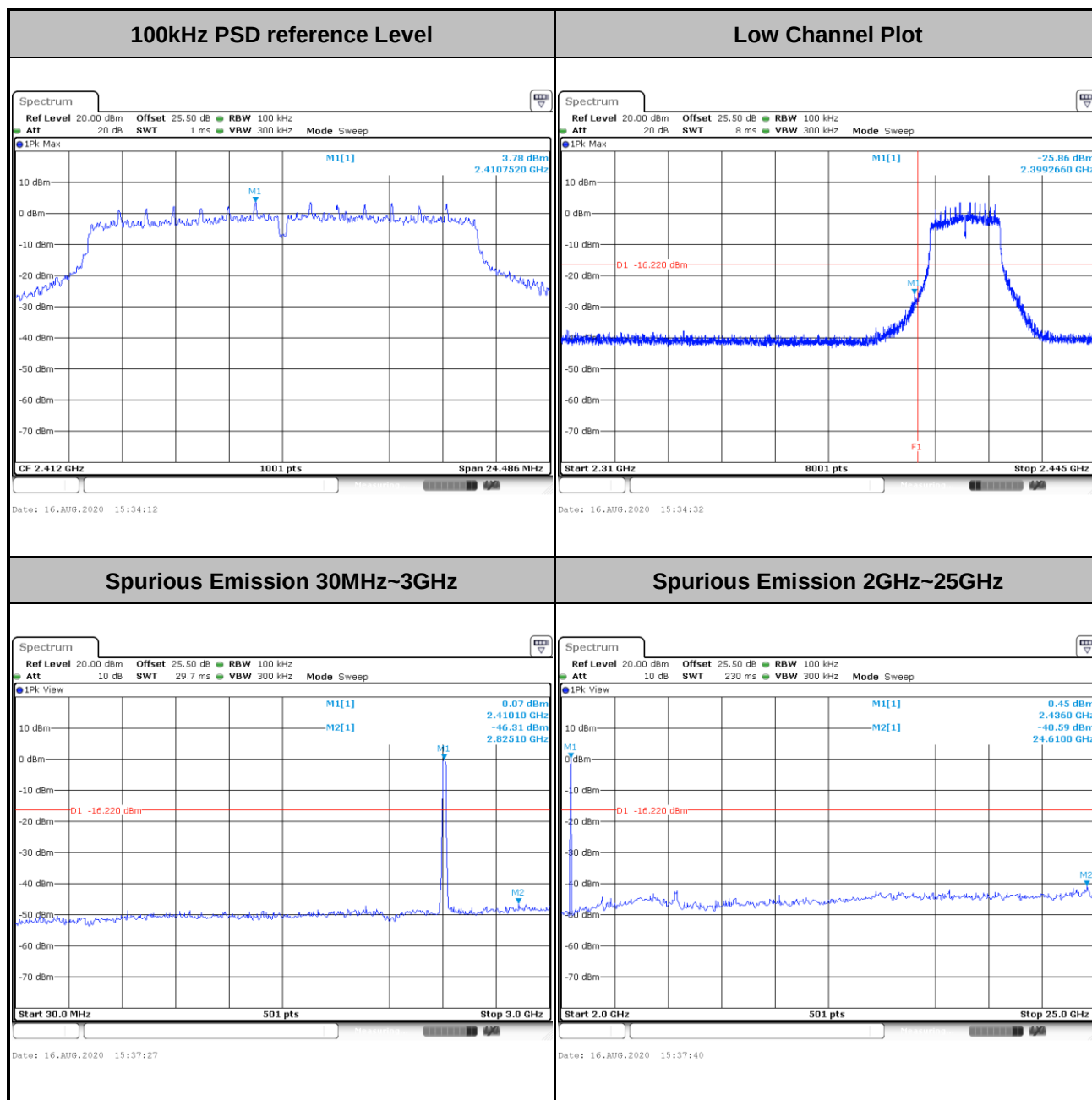


Test Mode :	802.11g	Test Channel :	11
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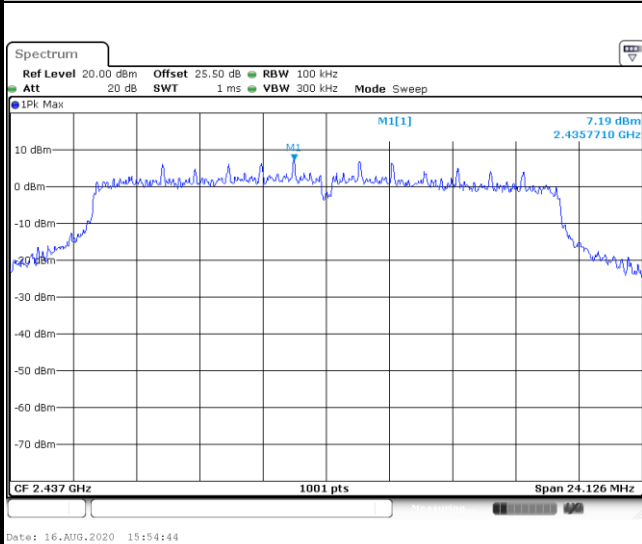
Test Mode :	802.11n HT20	Test Channel :	01
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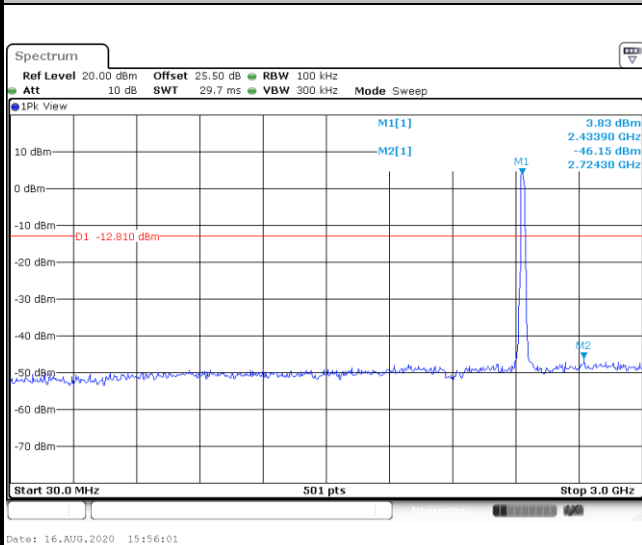
Test Mode :	802.11n HT20	Test Channel :	06
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100kHz PSD reference Level

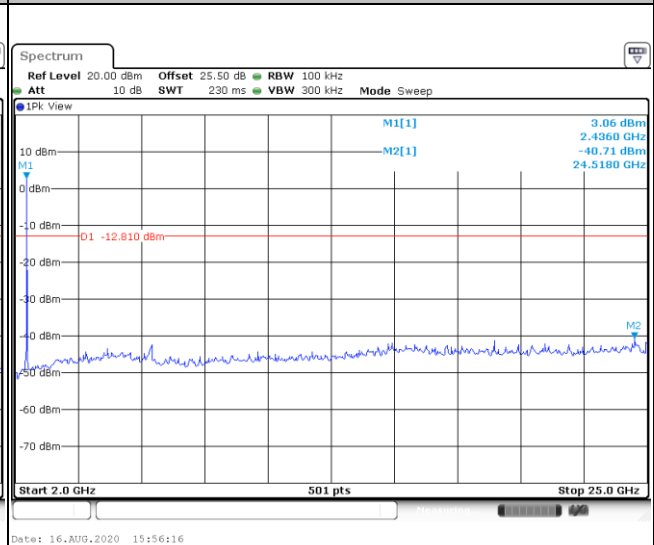


Mid Channel Plot

Spurious Emission 30MHz~3GHz

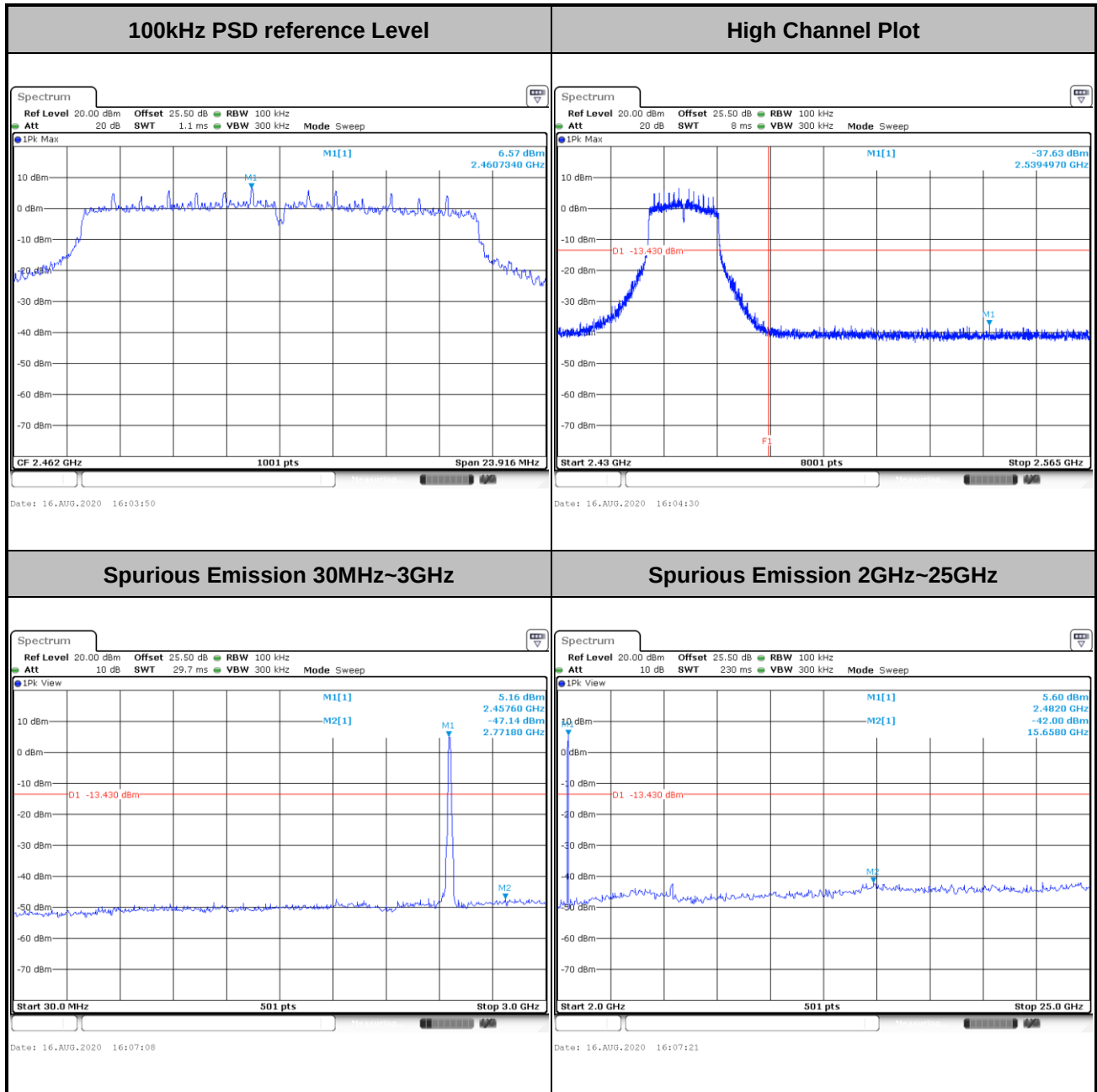


Spurious Emission 2GHz~25GHz



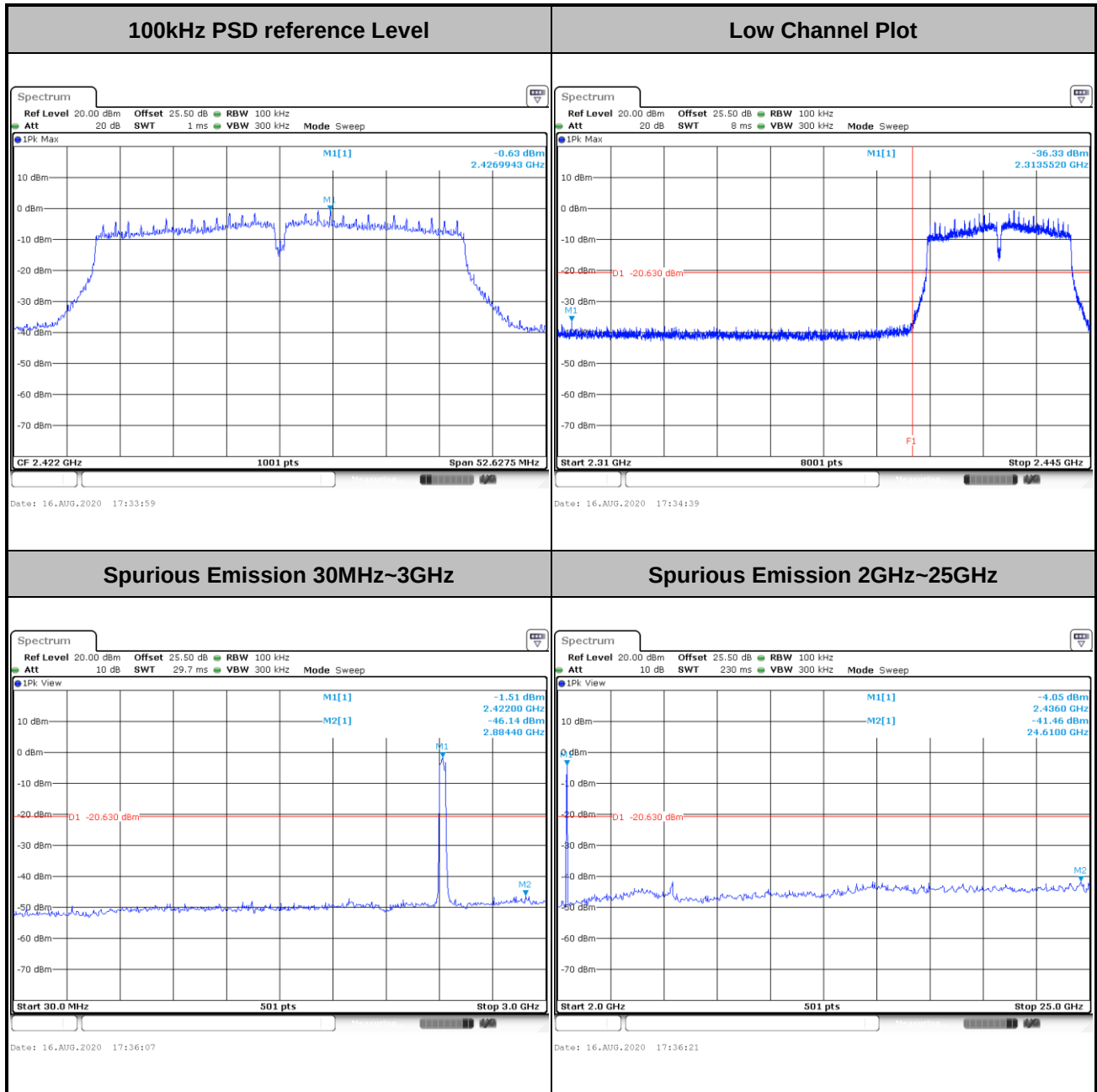


Test Mode :	802.11n HT20	Test Channel :	11
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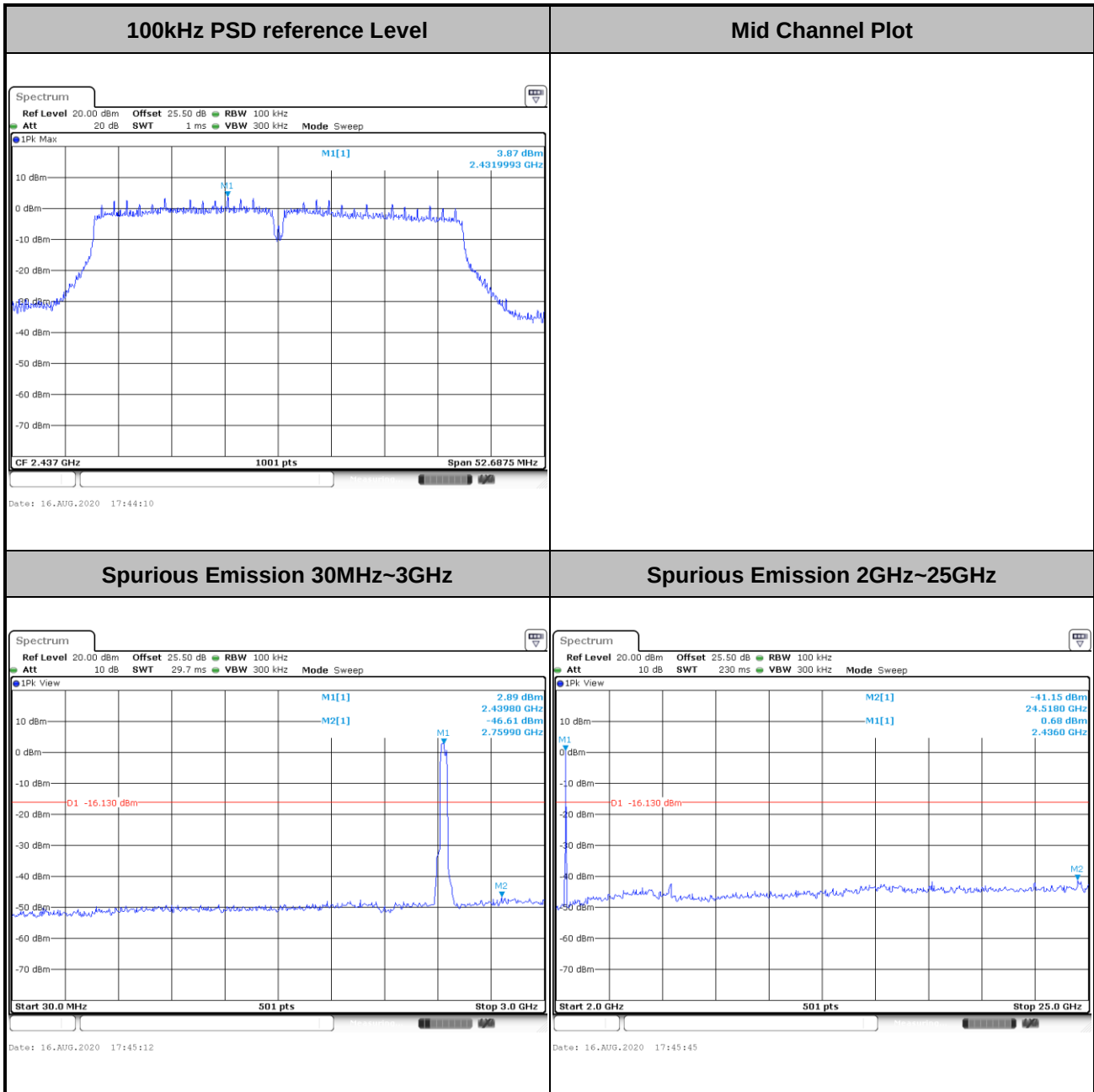




Test Mode :	802.11n HT40	Test Channel :	03
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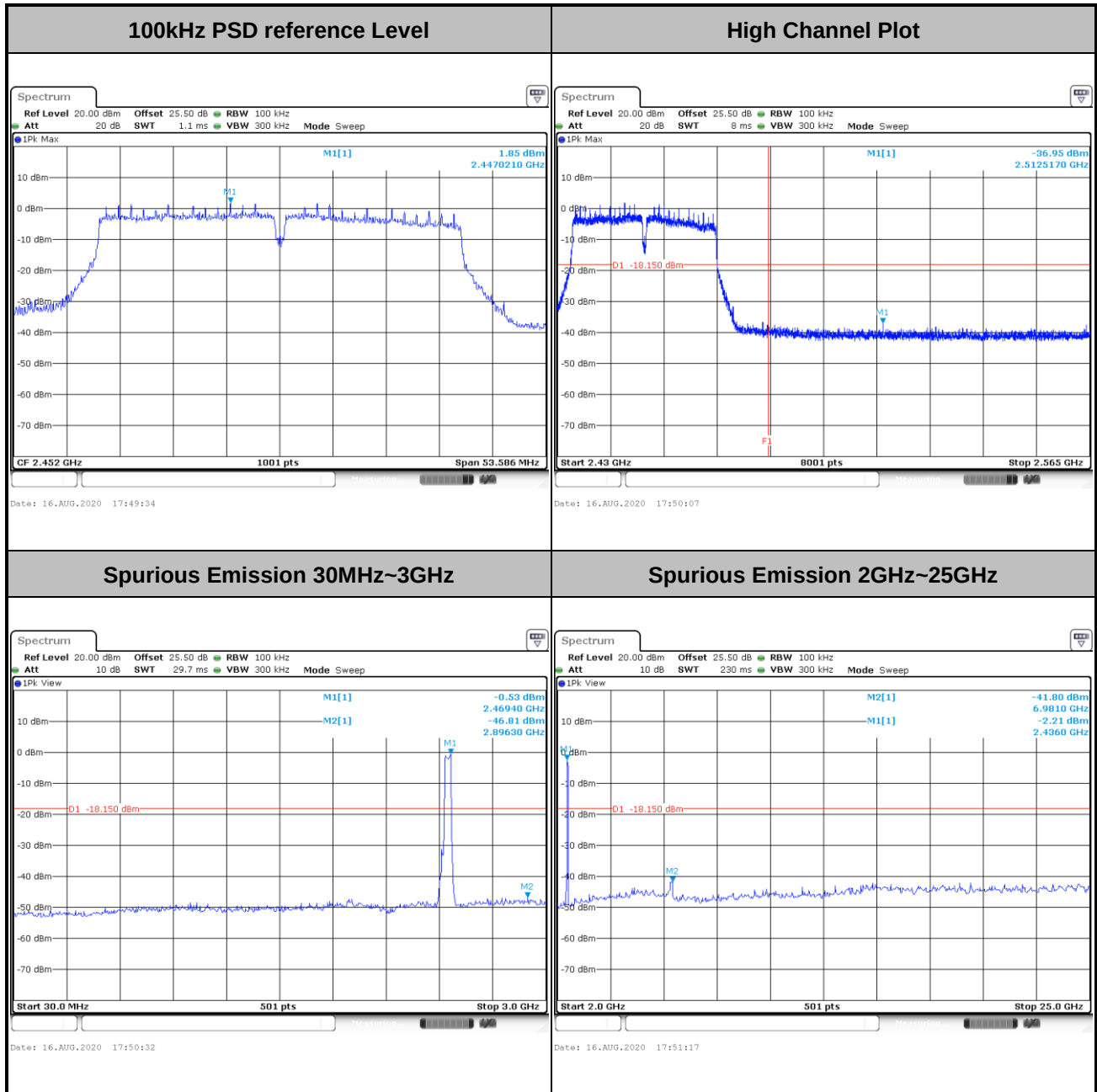


Test Mode :	802.11n HT40	Test Channel :	06
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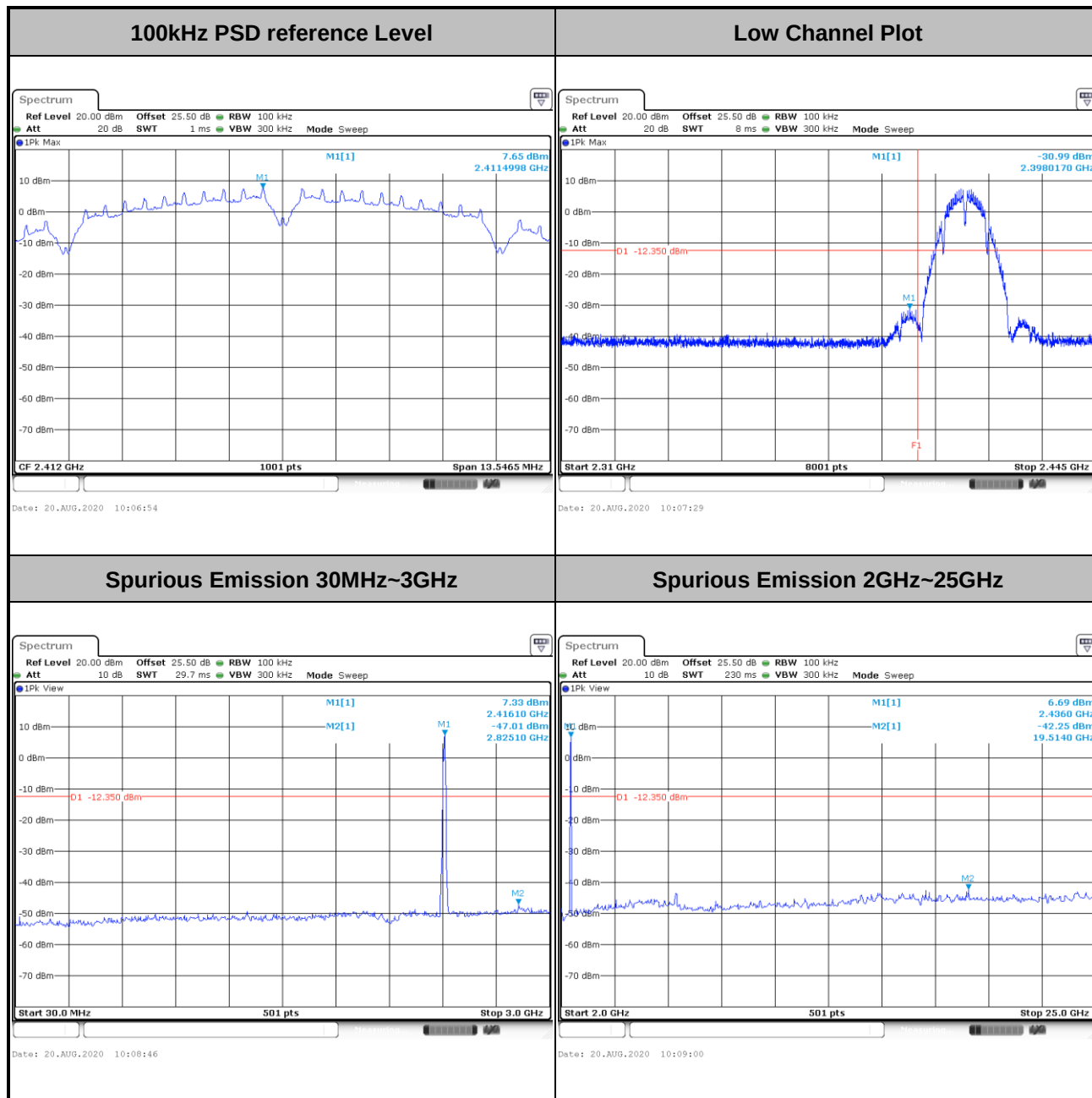
Test Mode :	802.11n HT40	Test Channel :	09
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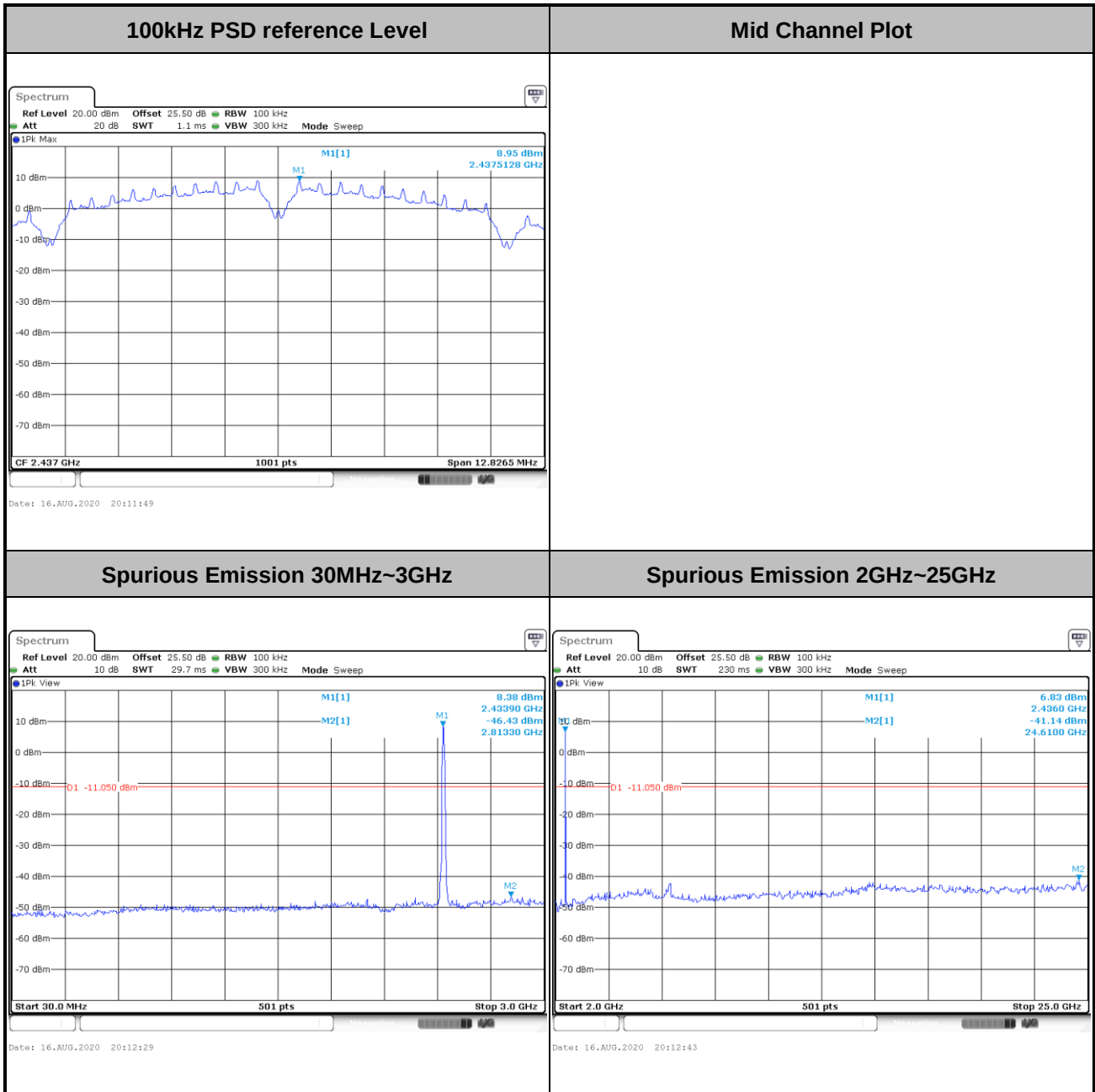
Number of TX = 2, Ant. 1 (Measured)

Test Mode :	802.11b	Test Channel :	01
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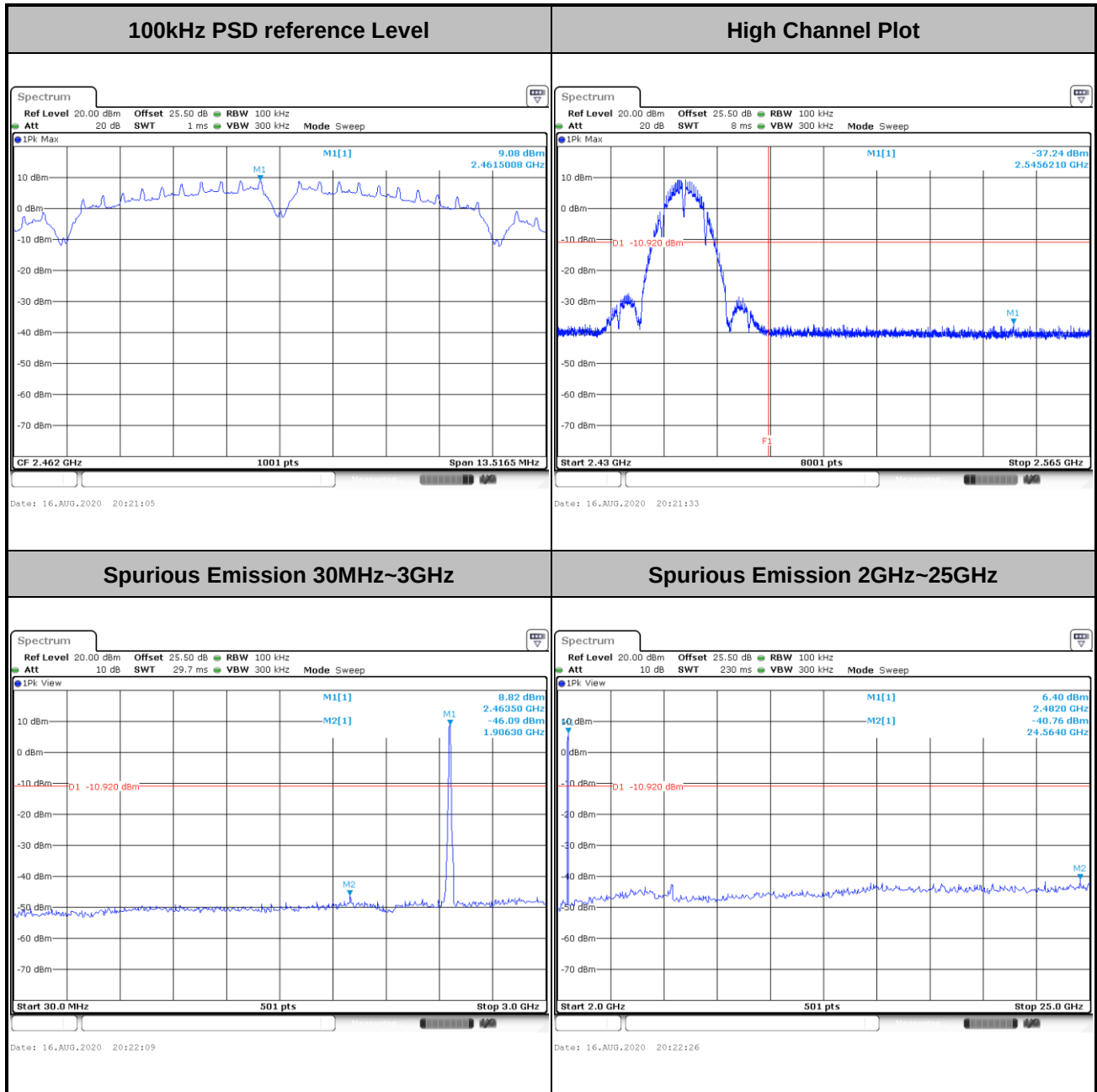


Test Mode :	802.11b	Test Channel :	06
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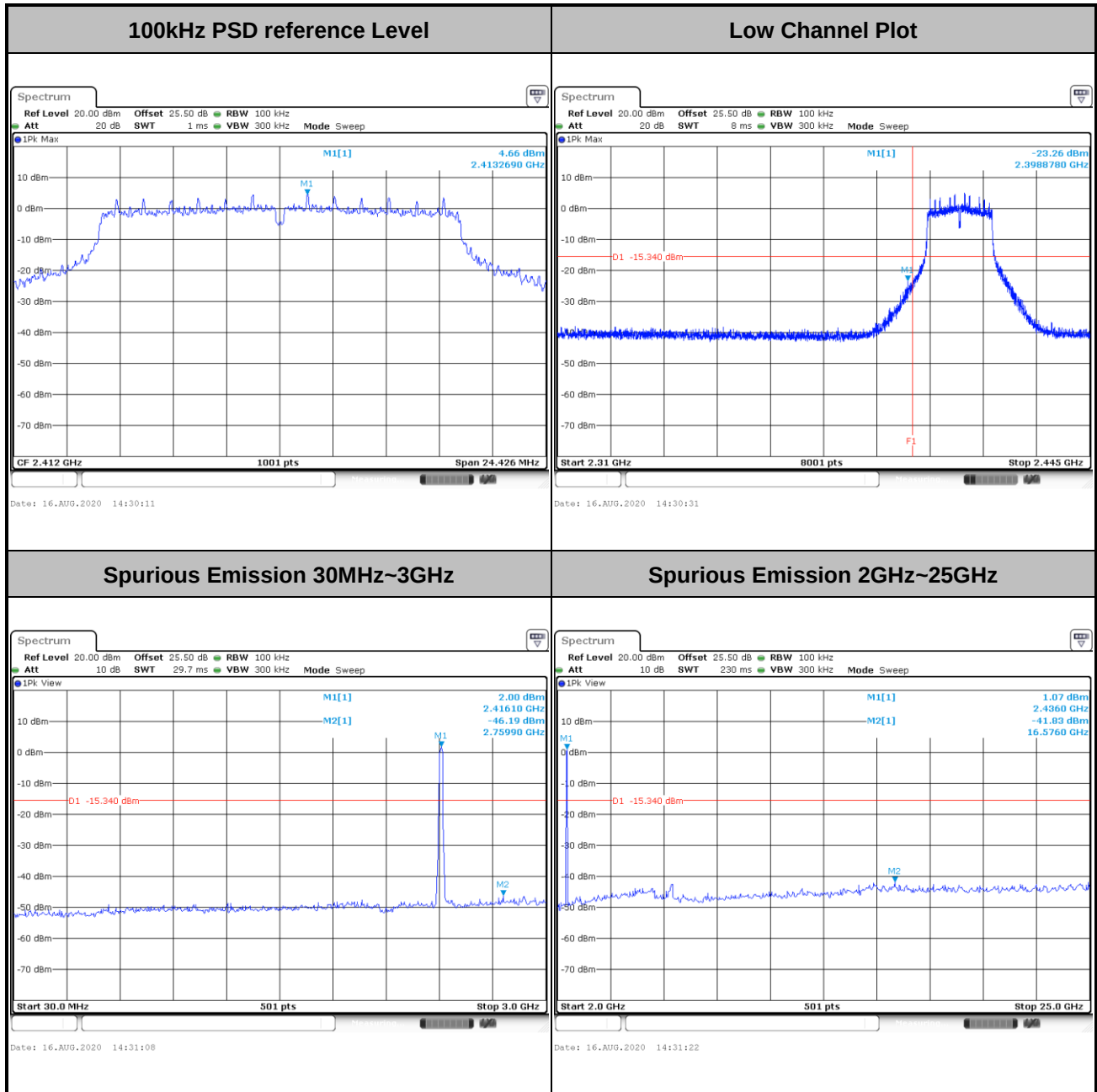


Test Mode :	802.11b	Test Channel :	11
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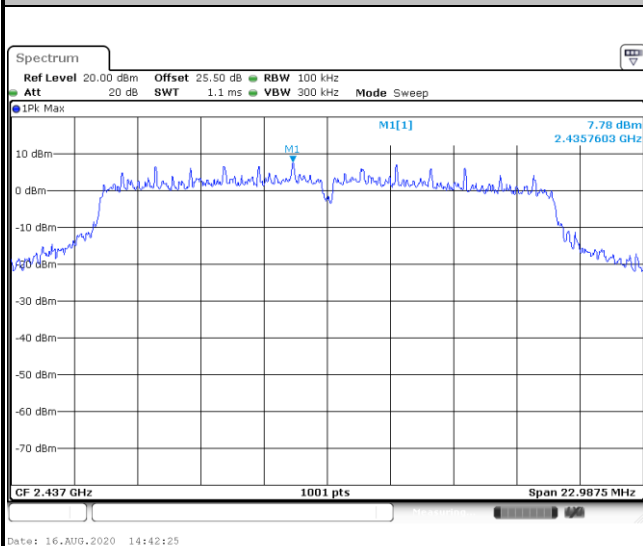
Test Mode :	802.11g	Test Channel :	01
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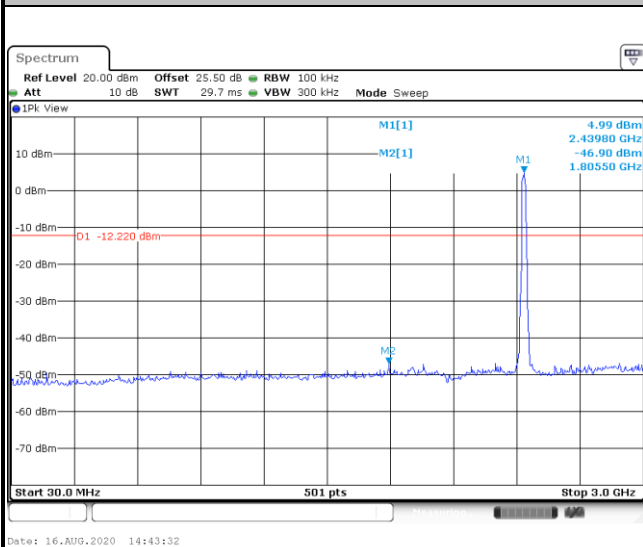
Test Mode :	802.11g	Test Channel :	06
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100kHz PSD reference Level

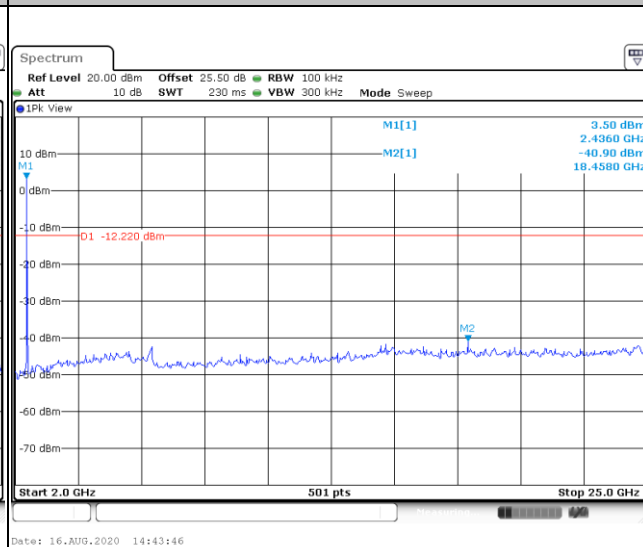


Mid Channel Plot

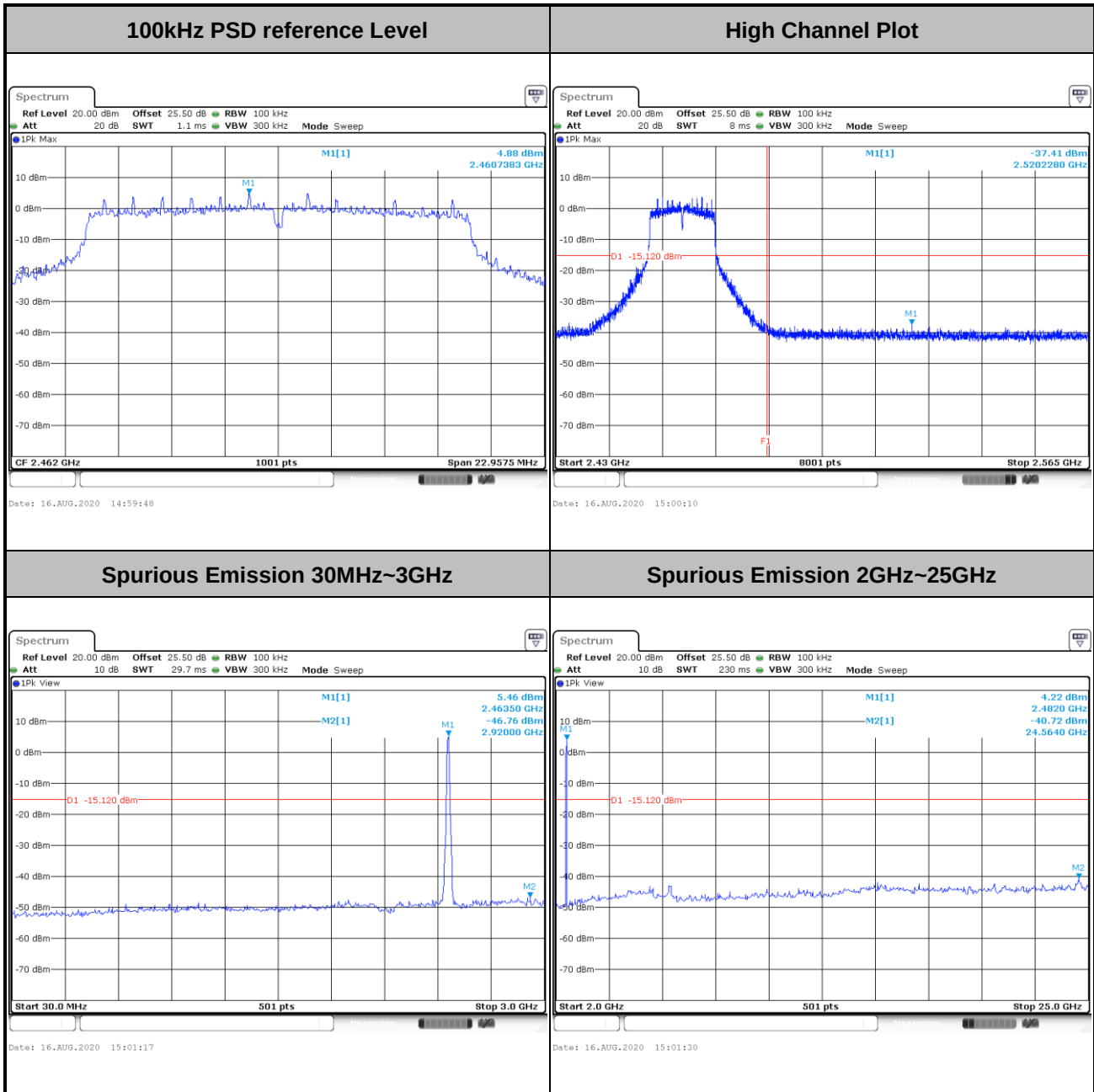
Spurious Emission 30MHz~3GHz



Spurious Emission 2GHz~25GHz



Test Mode :	802.11g	Test Channel :	11
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Test Mode :	802.11n HT20	Test Channel :	01
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