

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



EUT Description: Communication Module
Applicant: Murata Manufacturing Co., Ltd.
1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Manufacturer: Murata Manufacturing Co., Ltd.
Brand Name: Murata Manufacturing Co., Ltd.
Model No./ISED HVIN: LBWA0ZZ2JM
ISED PMN: LBWA0ZZ2JM
Report Number: TERF2511003950ER
FCC ID VPYLBWA0ZZ2JM
IC: 772C-LBWA0ZZ2JM
Date of EUT Received: November 20, 2025
Date of Test: November 24, 2025 ~ December 18, 2025
Issue Date: January 21, 2026

Alex Hsieh

Approved By

Alex Hsieh

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 and the energy emitted by the sample EUT comply with FCC rule part §15.407, ISED RSS-247. The results of this report relate only to the sample identified in this report.

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2511003950ER	00	Original	January 21, 2026	Mini Yeh	

Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.

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1 GENERAL INFORMATION

1.1 Product Description

EUT Description	Communication Module
Brand Name	Murata Manufacturing Co., Ltd.
Model No. /ISED HVIN	LBWA0ZZ2JM
Hardware Version	1.0
Firmware Version	N/A
Power Supply	3.3 Vdc / 1.8 Vdc
Test Software (Name/Version)	Qualcomm Radio Control Toolkit v 4.0

1.2 RF Specification

Modulation type	802.11a	16QAM, QPSK, BPSK for OFDM
	802.11n	16QAM, QPSK, BPSK for OFDM
Transition Rate	802.11a	6 - 24 Mbps
	802.11n_HT20	6.5 - 28.9 Mbps

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1.3 Antenna Designation

Ant. Type	Brand	Part No.	Freq (MHz)	Peak Gain (dBi)
monopole	Molex	206994	5150~5250	3.6
			5250~5350	3.6
			5470~5725	3.6
			5725~5850	3.6
monopole	Unictron	FP-W18-01	5150~5250	3.3
			5250~5350	3.3
			5470~5725	3.4
			5725~5850	3.42
monopole	Taoglas	FXP840	5150~5250	3.37
			5250~5350	3.37
			5470~5725	3.37
			5725~5850	3.37

Note:

- 1 Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
- 2 The antenna information is provided by the applicant. The laboratory does not verify the accuracy of this information, and all test results related to antenna characteristics are based solely on the data supplied. Responsibility for the authenticity and accuracy of these specifications rests entirely with the party who provided the information.
- 3 The antenna complies with part 15.203 requirement and no consideration of replacement. Please see EUT photo for details.

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1.4 FCC Rated Power

Wi-Fi	Frequency Range	Channels	EIRP/Avg	Rated Power(EIRP/Avg) (dBm) (Worst Case)
802.11a 802.11n_HT20	5180~5240	4	Avg	9.99 dBm
	5260~5320	4	Avg	9.73 dBm
	5500~5720	12	Avg	9.95 dBm
	5745~5825	5	Avg	9.79 dBm

1.5 ISED Rated Power

Wi-Fi	Frequency Range	Channels	EIRP/Avg	Rated Power(EIRP/Avg) (dBm) (Worst Case)
802.11a 802.11n_HT20	5180~5240	4	EIRP	13.59 dBm
	5260~5320	4	Avg	9.73 dBm
	5500~5720	12	Avg	9.95 dBm
	5745~5825	5	Avg	9.79 dBm

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1.6 Operating Frequencies

Bandwidth: 20MHz							
CH	Freq.	CH	Freq.	CH	Freq.	CH	Freq.
36	5180 MHz	40	5200 MHz	44	5220 MHz	48	5240 MHz
52	5260 MHz	56	5280 MHz	60	5300 MHz	64	5320 MHz
100	5500 MHz	104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz	128	5640 MHz
132	5660 MHz	136	5680 MHz	140	5700 MHz	144	5720 MHz
149	5745 MHz	153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	-	-	-	-	-	-

Note: TDWR frequencies are not available in Canada.

1.7 EUT Availability and The Worst Test Modes

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case. The given UE is pre-scanned among below modes.

Modulation		Transmission Chain								Single Transmission Spatial		Multiple Transmission Spatial	
V	802.11 a	V	Ch0		Ch1		Ch2		Ch3	V	1TX		1TX
V	802.11 n	V	Ch0		Ch1		Ch2		Ch3	V	1TX		1TX

4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

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CONDUCTED TEST						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11a	5180~5240	36 to 48	36,44,48	OFDM	6	Ch0
	5260~5320	52 to 64	52,60,64			
	5500~5720	100 to 144	100,120,140,144			
	5745~5825	149 to 165	149,157,165			
802.11n_HT20	5180~5240	36 to 48	36,44,48	OFDM	MCS0	Ch0
	5260~5320	52 to 64	52,60,64			
	5500~5720	100 to 144	100,120,140,144			
	5745~5825	149 to 165	149,157,165			

TRANSMIT RADIATED EMISSION TEST (BELOW 1 GHz)						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11a	5180~5240	36 to 48	44	OFDM	6	Ch0
	5260~5320	52 to 64	60	OFDM		
	5500~5720	100 to 144	120	OFDM		
	5745~5825	149 to 165	157	OFDM		

TRANSMIT RADIATED EMISSION TEST (ABOVE 1 GHz)						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11a	5180~5240	36 to 48	36,44,48	OFDM	6	Ch0
	5260~5320	52 to 64	52,60,64	OFDM		
	5500~5700	100 to 140	100,120,140,144	OFDM		
	5745~5825	149 to 165	149,157,165	OFDM		
802.11n20	5180~5240	36 to 48	36,44,48	OFDM	MCS0	Ch0
	5260~5320	52 to 64	52,60,64	OFDM		
	5500~5700	100 to 140	100,120,140,144	OFDM		
	5745~5825	149 to 165	149,157,165	OFDM		

Note:

The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

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2 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.407(e)	RSS-Gen §6.7 RSS-247 §7.3.4.2	Emission Bandwidth	Compliant
§15.407(a)	RSS-247 §7.3.1.2 RSS-247 §7.3.2.2 RSS-247 §7.3.3.2 RSS-247 §7.3.4.3	Maximum Conducted Output Power	Compliant
§15.407(a)	RSS-247 §7.3.1.2 (UNII-1) RSS-247 §7.3.2.2 (UNII-2A) RSS-247 §7.3.3.2 (UNII-2C) RSS-247 §7.3.4.3 (UNII-3)	Power Spectral Density	Compliant
§15.205 §15.209 §15.407(b)	RSS-Gen 8.10 RSS-247 §7.3.1.3 RSS-247 §7.3.2.3&7.3.2.4 RSS-247 §7.3.3.3 RSS-247 §7.3.4.4	Undesirable Radiated Emissions	Compliant
§15.407(c)	RSS-247 §7.3.7 a	Transmission in case of Absence of Information	Compliant
§15.203	N/A	Antenna Requirement	Compliant

2.1 Test Methodology of Applied Standards

1. FCC Part 15, Subpart E §15.407
2. FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01
3. ISED RSS-Gen, Issue 5 April 2018, Amendment 2 (February 2021)
4. ISED RSS-247 issue 4 July 2025
5. ANSI C63.10:2020
6. ANSI C63.10-2020+Cor. 1-2023+C63.10a-2024 + Errata to C63.10a-2024

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2.2 Measurement Uncertainty

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 1.54 dB
Emission Bandwidth	+/- 1.38 Hz
Output Power measurement	+/- 0.97 dB
Peak Power Spectral Density Measurement	+/- 0.61 dB
Frequency Stability	+/- 1.48 Hz
Temperature	+/- 0.60 °C
Humidity	+/- 3.00 %
DC / AC Power Source	+/- 1.00 %

Radiated Spurious Emission Measurement Uncertainty		
Polarization: Vertical	+/- 1.89 dB	9kHz - 30MHz
	+/- 4.10 dB	30MHz - 1000MHz
	+/- 3.37 dB	1GHz - 18GHz
	+/- 3.83 dB	18GHz - 40GHz
Polarization: Horizontal	+/- 1.89 dB	9kHz - 30MHz
	+/- 4.10 dB	30MHz - 1000MHz
	+/- 3.37 dB	1GHz - 18GHz
	+/- 3.83 dB	18GHz - 40GHz
Radiated Spurious Emission	+/- 2.00 dB	33GHz - 50GHz
	+/- 1.59 dB	50GHz - 60GHz
	+/- 1.71 dB	60GHz - 90GHz
	+/- 1.64 dB	90GHz - 140GHz
	+/- 3.84 dB	140GHz - 220GHz

Note

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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2.3 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number / Registration Number	IC CAB identifier / Company Number
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803	SAC 1 / SAC 2 / SAC 3 Conduction 1 / Conducted 1 Conducted 2 / Conducted 3 Conducted 4 / Conducted 5 Conducted 6	TW0027 / 891563	TW3702 / 4620A
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.2, Keji 1st Rd, Guishan District, Taoyuan City, Taiwan 333	SAC C / SAC D / SAC G Conduction C/ Conducted A Conducted B / Conducted C Conducted D / Conducted E Conducted F / Conducted G	TW0028 / 200037	TW3702 / 4620E

Measurement	Test Site Name	Test Engineer	EUT S/N	Test Environment	Test Date
Conducted	Conducted 1	Teddy Lu	1025082901000041	22-26°C / 55-60%	2025/12/01 ~ 2025/12/11
Radiated	SAC 1	WJ Lin	1025082901000041	20~30°C / 60~75%	2025/12/05 ~ 2025/12/18
Conduction	Conduction 1	Dante Ding	1025082901000041	20~25°C / 55~60%	2025/12/08 ~ 2025/12/08

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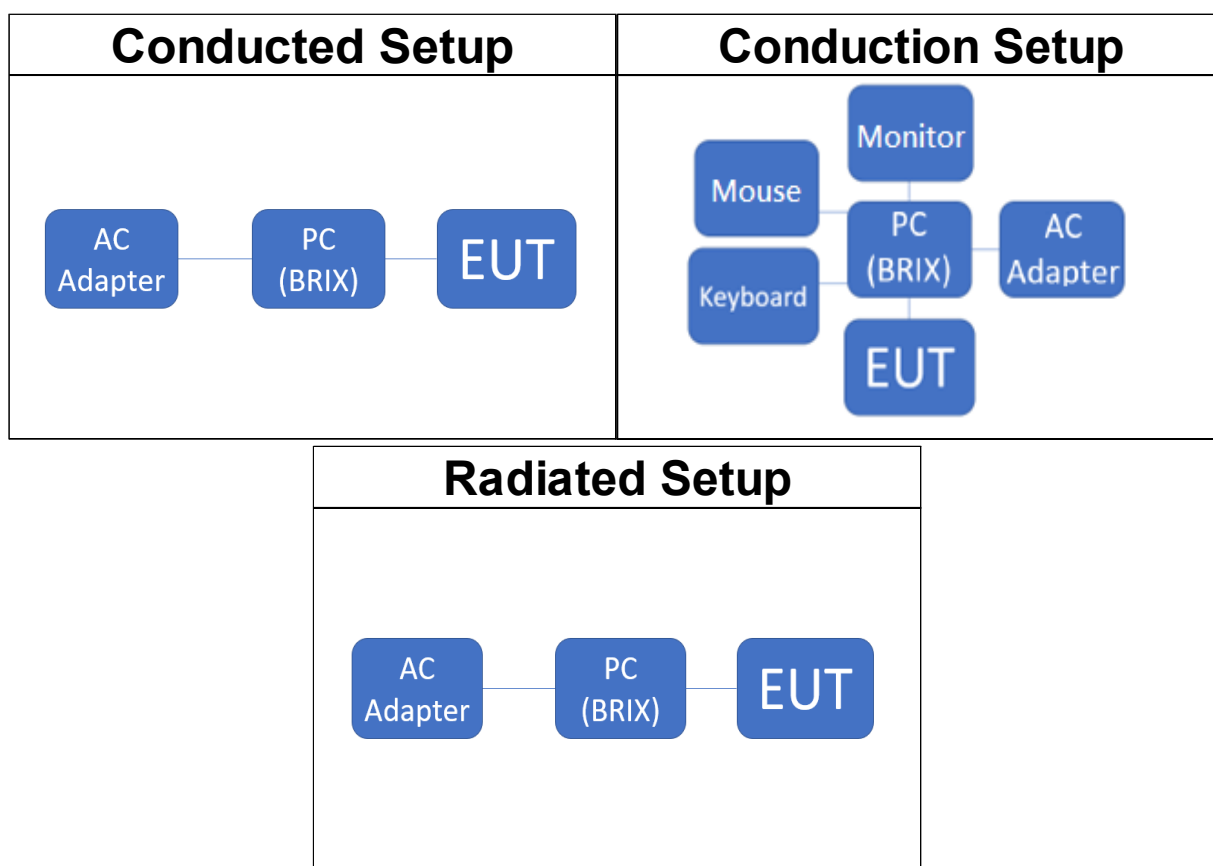
3 CONTROL UNIT(S) AND PERIPHERAL(S)

3.1 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

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

3.2 Diagrams



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3.3 List

3.3.1 Conduction Setup

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
AC Adapter	FPS GROUP INC.	FSP065-REB	H4191001974	N/A	N/A
USB Cable	Cvilux	DH-20M50052	PF-1QCNW8 19/06	N/A	N/A
PC(BRIX)	Gigabyte	GB-BX13-4010	N/A	N/A	N/A
HDMI Cable	Hotron	E246588	N/A	N/A	N/A
Keyboard	Lenovo	KU-0225	40669	N/A	N/A
Monitor	Dell	U2413f	CN-06VNX5-72872-34D-A6YL	N/A	N/A
Mouse	DELL	M0U5U0	N/A	N/A	N/A

3.3.2 Conducted Setup

Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
AC Adapter	FPS GROUP INC.	FSP065-REB	H4191001974	N/A	N/A
USB Cable	Cvilux	DH-20M50052	PF-1QCNW8 19/06	N/A	N/A
PC(BRIX)	Gigabyte	GB-BX13-4010	N/A	N/A	N/A

3.3.3 Radiated Setup

Radiated Emission Test Site: SAC 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
AC Adapter	FPS GROUP INC.	FSP065-REB	H4191001974	N/A	N/A
USB Cable	Cvilux	DH-20M50052	PF-1QCNW8 19/06	N/A	N/A
PC(BRIX)	Gigabyte	GB-BX13-4010	N/A	N/A	N/A

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4 TEST INSTRUMENT

4.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Coaxial Cables	EMC Instruments Corp.	EMCCFD300-BM-BM-3000	161207	06/22/2025	06/21/2026
EMI Test Receiver	R&S	ESCI 7	100759	09/02/2025	09/01/2026
LISN	SCHWARZBECK	NSLK 8127	1040	09/13/2025	09/12/2026
Pulse Limiter	SCHWARZBECK	VTSD 9561F-N	793	06/22/2025	06/21/2026
Test Software	Audix	e3	Ver. 9.210616	N.C.R	N.C.R

4.2 Conducted Measurement

Conducted Emission Test Site: Conducted 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Attenuator	Mini-Circuits	BW-S10W2+	1	12/11/2024	12/10/2025
Attenuator	Mini-Circuits	BW-S10W2+	1	12/07/2025	12/06/2026
DC Block	Mini-Circuits	BLK-18-S+	2	12/11/2024	12/10/2025
DC Block	Mini-Circuits	BLK-18-S+	2	12/07/2025	12/06/2026
MXA Spectrum Analyzer	KEYSIGHT	N9021B	MY62242004	06/11/2025	06/10/2026
Power Meter	Anritsu	ML2496A	1242004	10/23/2025	10/22/2026
Power Sensor	Anritsu	MA2411B	1207365	11/06/2025	11/05/2026
Power Sensor	Anritsu	MA2411B	1207368	10/23/2025	10/22/2026
Test Software	SGS	Radio Test Software	Ver. 21	N.C.R	N.C.R

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4.3 Radiated Measurement

Radiated Emission Test Site: SAC 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
7G High Pass Filter	WI	WHKX7.0	45	12/07/2025	12/06/2026
7G High Pass Filter	WI	WHKX7.0	45	12/11/2024	12/10/2025
Band Reject Filter 5150-5350	Titan	T04N5150535050S 01	211112-2-1	12/07/2025	12/06/2026
Band Reject Filter 5150-5350	Titan	T04N5150535050S 01	211112-2-1	12/11/2024	12/10/2025
Band Reject Filter 5150-5350	Titan	T04N5150535050S 01	211112-2-1	12/07/2025	12/06/2026
Band Reject Filter 5150-5350	Titan	T04N5150535050S 01	211112-2-1	12/11/2024	12/10/2025
Band Reject Filter 5725-5895	Titan	T04N5725589550S 01	23040703-20	12/07/2025	12/06/2026
Band Reject Filter 5725-5895	Titan	T04N5725589550S 01	23040703-20	12/11/2024	12/10/2025
Band Reject Filter 5895-5925	Titan	T04N5895592550S 01	211112-2-8	12/07/2025	12/06/2026
Band Reject Filter 5895-5925	Titan	T04N5895592550S 01	211112-2-8	12/11/2024	12/10/2025
Bi-log Antenna	SCHWARZBECK	VULB9168	443	07/22/2025	07/21/2026
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	12/09/2024	12/08/2025
Coaxial Cable	EMCI	EMC104-SM-SM- 8000+EMC106-SM- SM-7600	RX Cable 9K- 18G(160125+15081 7)	07/14/2025	07/13/2026
Coaxial Cables	Huber Suhner	SUCOFLEX 102	RX Cable 18G-40G MY2630/2+805062 /2	07/14/2025	07/13/2026
EMI Test Receiver	R&S	ESR 7	102525	02/08/2025	02/07/2026
EXA Spectrum Analyzer	KEYSIGHT	N9010B	MY60242081	10/29/2025	10/28/2026
Horn Antenna	RF SPIN	DRH0844	LE2D05A0844	08/07/2025	08/06/2026
Horn Antenna	SCHWARZBECK	BBHA9120D	D803	01/09/2025	01/08/2026
Loop Antenna	COM-POWER	AL-130R	10160104	12/19/2024	12/18/2025
Pre-Amplifier	EMCI	EMC118A45SEE	980933	07/14/2025	07/13/2026
Pre-Amplifier	HP	8447D	2944A09469	07/14/2025	07/13/2026
Pre-Amplifier	EMCI	EMC184045SEE	980939	07/14/2025	07/13/2026
Site Cal	SGS	SAC 1	N/A	07/14/2025	07/13/2026
Test Software	Audix	e3	Ver. 9.210616	N.C.R	N.C.R

NOTE: N.C.R refers to Not Calibrated Required.

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5 REGULATORY REQUIREMENTS

5.1 Emission Bandwidth

There is no limit bandwidth for U-NII-1, U-NII-2-A and U-NII-2-C.
The minimum of 6dB Bandwidth measurement is 0.5 MHz for U-NII-3 & UNII-4.

5.2 Maximum Output Power

5.2.1 Duty Cycle

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

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5.3 Maximum Power Spectral Density

e-CRF Title 47 §15.407					
Select	EUT CATEGORY	Conducted Output Power	EIRP	TPC	Antenna Directional Gain Requirements
U-NII-1 (5150~5250 MHz)					
	Fixed point-to-point	1 Watt(30dBm)	Not required	Not required	23dBi
	Outdoor AP	1 Watt(30dBm)	Elevation angle above 30 degrees 125mW (21dBm)	Not required	6dBi
	Indoor AP	1 Watt(30dBm)	Not required	Not required	6dBi
V	Other	250mW(23.98dBm)	Not required	Not required	6dBi
U-NII-2A (5250~5350 MHz)					
V	All	250mW(23.98dBm) or 11dBm+10 log B	Not required	When EIRP >500mW At least 6dB below EIRP 1W (30dBm)	6dBi
U-NII-2C (5470~5725 MHz)					
V	All	250mW(23.98dBm) or 11dBm+10 log B	Not required	When EIRP >500mW At least 6dB below EIRP 1W (30dBm)	6dBi
U-NII-3 (5725~5850 MHz)					
V	Other	1 Watt(30dBm)	Not required	Not required	6dBi
	Fixed point-to-point	1 Watt(30dBm)	Not required	Not required	Not required
1. If transmitting antennas of directional gain greater than the antenna requirements column, the Maximum transmit power shall be reduced by the amount in dB that the direction-al gain of the antenna. 2. For the 10 log B, B is the 26 dB emission bandwidth.					

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RSS-247				
Select	EUT CATEGORY	Conducted Output Power	EIRP	TPC
U-NII-1 (5150~5250 MHz)				
	OEM devices in- stalled in vehicles	N/A	30 mW or $1.76 + 10 \log_{10} B$	EIRP >15mW, at least 3dB below 30mW EIRP
V	Other device	N/A	200 mW or $10 + 10 \log_{10} B$ dBm	N/A
U-NII-2A (5250~5350 MHz)				
	OEM devices in- stalled in vehicles	N/A	30 mW or $1.76 + 10 \log_{10} B$	EIRP >15mW, at least 3dB below 30mW EIRP
	Outdoor Fixed with EIRP>200mW	N/A	-13 dBW/MHz for $0^\circ \leq \theta < 8^\circ$ -13 -0.716 (θ -8) dBW/MHz for $8^\circ \leq \theta < 40^\circ$ -35.9 -1.22 (θ -40) dBW/MHz for $40^\circ \leq \theta \leq 45^\circ$ -42 dBW/MHz for $\theta > 45^\circ$	EIRP >500mW, at least 6dB below 1W EIRP
V	Other device	250 mW or $11 + 10 \log_{10} B$	1.0 W or $17 + 10 \log_{10} B$ dBm	EIRP >500mW, at least 6dB below 1W EIRP
U-NII-2C (5470~5725 MHz)				
V	All	250 mW or $11 + 10 \log_{10} B$	1.0 W or $17 + 10 \log_{10} B$ dBm	EIRP >500mW, at least 6dB below 1W EIRP
U-NII-3 (5725~5850 MHz)				
V	All	1 W	N/A	N/A
1 For equipment operating in the band 5725-5850 MHz, If transmitting antennas of directional gain greater than 6 dBi are used, the Maximum transmit power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. 2. For the $10 \log B$, B is the 26 dB emission bandwidth.				

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5.4 Unwanted Emissions

5.4.1 5150~5850 MHz

Standards	Operation Freq. (MHz)	Freq.(MHz)	EIRP Limits (dBm/MHz)	Field Strength @ 3m(dBμV/m)
15.407(b)(1) RSS-247 §7.3.1.3	5150~5250	$f \leq 5150$ $f \geq 5350$	PK: -27	PK: 68.2
15.407(b)(2) RSS-247 §7.3.2.3 RSS-247 §7.3.2.4	5250~5350			
15.407(b)(3) RSS-247 §7.3.3.3	5475~5725	$f \leq 5470$ $f \geq 5725$	PK: -27	PK: 68.2
15.407(b)(4)(i) RSS-247 §7.3.4.4	5725~5850	at 75 MHz or more above or below the band edge	PK:-27	PK: 68.2
		increasing linearly from 75~25MHz above or below the band edge	PK:-27~10	PK: 68.2~105.2
		increasing linearly from 25~5MHz above or below the band edge	PK:10~15.6	PK: 105.2~110.8
		increasing linearly from 5~0 MHz above or below the band edge	PK: 15.6~27	PK:110.8~122.2

EIRP = $(E \cdot d)^2 / 30$, where E is the field strength in V/m, d is the measurement distance (3m), EIRP is the equivalent isotopically radiated power in Watts.

5.4.2 Spurious Emission

Unwanted spurious emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table:

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note: The lower limit shall apply at the transition frequencies.

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5.5 AC Power Line Conducted Emission

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dBuV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note		
1.The lower limit shall apply at the transition frequencies		
2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz		

5.6 Antenna Requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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6 TEST CONFIGURATION

6.1 Emission Bandwidth



1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules.
3. Remove antenna and connect EUT port to spectrum analyzer with low-loss RF cable.
4. 26dB Band width Measurement:
 Set the spectrum analyzer as 1% of emission BW
 RBW=1% of emission BW,
 VBW > RBW
 Sweep = Auto,
 Detector = Peak,
 Trace Mode = Max Hold,
 Manually adjust RBW until RBW/EBW ratio is 1% (per pre-sequence EBW result).
 Use the X dB bandwidth mode function of the spectrum analyzer and set to 26dB.
5. Minimum Emission Bandwidth for the band 5.725-5.850GHz
 Set the spectrum analyzer as
 RBW = 100 kHz,
 VBW ≥ 3*RBW,
 Detector = Peak,
 Span = large enough to capture all products of the modulation process,
 Sweep = Auto,
 Use the X dB bandwidth mode function of the spectrum analyzer and set to 6dB.
6. For 99% Bandwidth:
 Set the spectrum analyzer as
 RBW = 1% to 5% of the 99%,
 VBW ≥ 3*RBW,
 Span = 1.5 times to 5.0 times the OBW,
 Detector = Sample/Peak,
 Sweep = Auto,
 Turn on the 99% bandwidth function, max reading.
7. Repeat above procedures until all frequency of interest measured was complete.
8. For 26dB BW and OBW of straddle channels, the results were calculated as below.
 straddle channel emission BW in U-NII 2C = (emission BW/2) + (5725-straddle channel)
 straddle channel emission bandwidth in U-NII 3 = emission BW- emission BW_U-NII 2C

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6.2 Maximum Output Power

6.2.1 Duty Cycle



Set the spectrum analyzer as

Span = Zero,
RBW = 8 MHz,
VBW = 8 MHz,
Detector = Peak,

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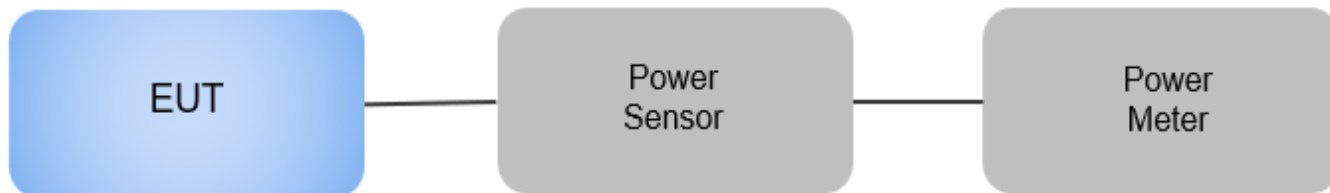
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6.2.2 Maximum Output Power



1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules.
3. Remove antenna and connect EUT port to power meter via low-loss RF cable.
4. Method PM (Measurement using an RF average power meter):
 - a. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the following conditions are satisfied:
 - b. The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
 - c. At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
 - d. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
 - e. If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal.
 - f. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
 - g. Adjust the measurement in dBm by adding $10 \log (1/x)$ where x is the duty cycle (e.g., $10 \log (1/0.25)$ if the duty cycle is 25%).

Note:

For U-NII1, 2A, 2C and 3 Bands, when the antenna gain is greater than 6 dBi, the power limit attenuated accordingly.

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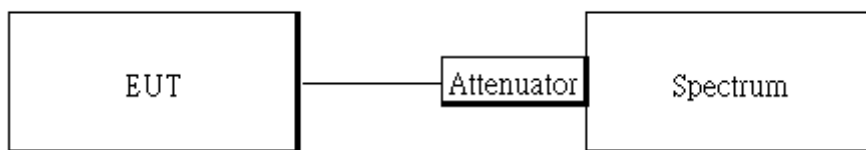
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6.3 Maximum Power Spectral Density



1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to Spectrum.
3. **For U-NII1, U-NII-2A, U-NII-2C, U-NII-4 Bands:**
Set RBW=1MHz, VBW=3MHz, where span is enough to capture the entire bandwidth, Sweep time = Auto (1001 pts), Detector = power averaging (rms), if available. Otherwise, use sample detector mode, traces 100 sweeps of video averaging. (SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
For U-NII-3 Band:
Set RBW=300kHz, VBW=1MHz, where span is enough to capture the entire bandwidth, Sweep time = Auto, detector = RMS or sample, traces 100 sweeps of video averaging. In addition, measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10 \log(500 \text{ kHz/RBW})$ to the measured result.
4. Use the cursor on spectrum to peak search the highest level of trace
5. (1) Duty cycle $\geq 98\%$: Record the max. reading.
(2) Duty cycle $< 98\%$: Record the max. reading and add $10 \log(1/\text{duty cycle})$.
6. Repeat above procedures until all default test channel (low, middle, and high) was complete.
7. For U-NII-1, 2A, 2C, and 3 bands, if the antenna gain exceeds 6 dBi, the power spectral density limit is correspondingly reduced.

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6.4 Unwanted Emissions

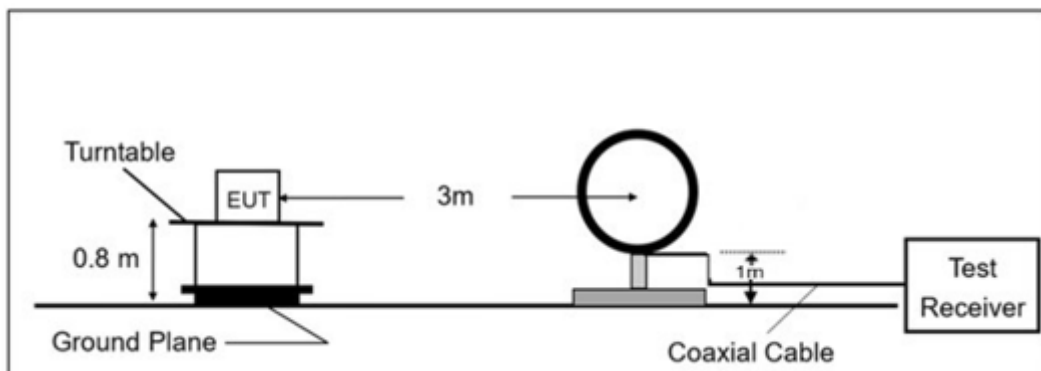
6.4.1 Radiated Emission Test Sites

For Measurements From 9 kHz To 30 MHz

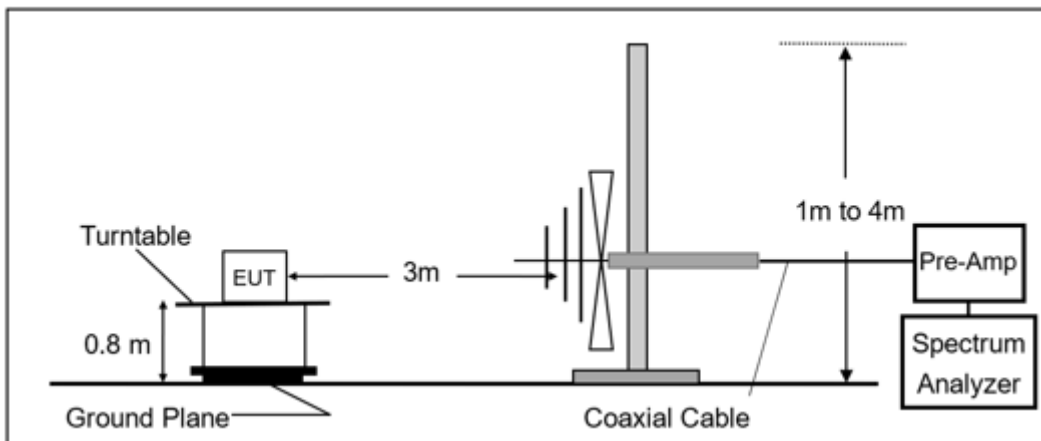
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

Radiated Emission Test Set-Up, Frequency Below 30MHz.



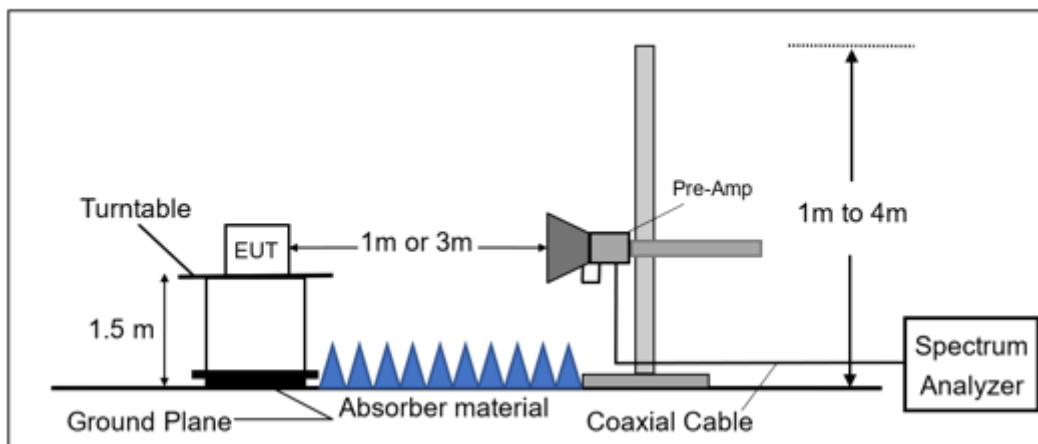
Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



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Radiated Emission Test Set-Up, Frequency Above 1GHz.



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6.4.2 Measurement Procedure

1. The testing follows FCC KDB 789033 D02.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. For measurements below 30MHz, set the spectrum analyzer as
 - ☒ For Peak measurement
 - RBW=10 kHz
 - VBW=30 kHz
 - Detector = peak
 - Trace mode = max-hold
 - ☒ For Quasi-peak measurement in receiver mode
 - RBW=10 kHz
 - Detector = Quasi-Peak
 - Peak detection is used unless otherwise noted as quasi-peak.
6. For measurements in 30MHz to 1GHz, set the spectrum analyzer as
 - ☒ For Peak measurement
 - RBW=100 kHz
 - VBW=300 kHz
 - Detector = peak
 - Trace mode = max-hold
 - ☒ For Quasi-peak measurement in receiver mode
 - RBW=120 kHz
 - Detector = Quasi-Peak
 - Peak detection is used unless otherwise noted as quasi-peak.
7. For measurements above 1GHz, set the spectrum analyzer as
 - ☒ For Peak measurement:
 - RBW=1 MHz
 - VBW=3 MHz
 - Detector = peak
 - Trace mode = max-hold
 - ☒ For Average measurement:
 - ☒ Duty cycle $\geq$ 98%:
 - RBW=1 MHz
 - VBW=3 MHz
 - Detector = Power averaging (rms)
 - trace average was performed over at least 100 traces
 - ☐ Duty cycle $\geq$ 98%:
 - RBW=1 MHz
 - VBW=10 Hz
 - Detector = peak

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Trace mode = max-hold

☒ Duty cycle < 98%

RBW=1 MHz

VBW $\geq$ 1/T

Detector = peak

Trace mode = max-hold

☐ Duty cycle < 98%

RBW=1 MHz

VBW $\geq$ 3 MHz

Detector = Power averaging (rms)

trace average was performed over at least 100 traces

add Duty cycle factor(dB).

8. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
11. Repeat above procedures until all frequency measured were complete.

Note: The emissions from 9 kHz to 30MHz was pre-scanned as 20dB lower than the limits, and hence not reported.

Pre-scan was conducted at 5.47 GHz and 5.85 GHz for band-edge measurements of straddle channels 138, 142, and 144. Since the results were 20 dB below the limit, they were not reported, in accordance with

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6.4.3 Field Strength Calculation

The field strength is calculated by adding the antenna factor and cable loss, then subtracting the amplifier gain and any applicable duty cycle correction factor from the measured reading. The basic equation and an example calculation are as follows:

$$FS = RA + AF + CL - AG$$

Where:

FS = Field Strength (dB μ V/m)
RA = Reading Amplitude (dB μ V)
AF = Antenna Factor (dB/m)
CL = Cable Loss (dB)
AG = Amplifier Gain (dB)

The emission limit is expressed in dB μ V/m, which corresponds to the logarithmic conversion of $20 \times \log_{10} (\mu\text{V/m})$.

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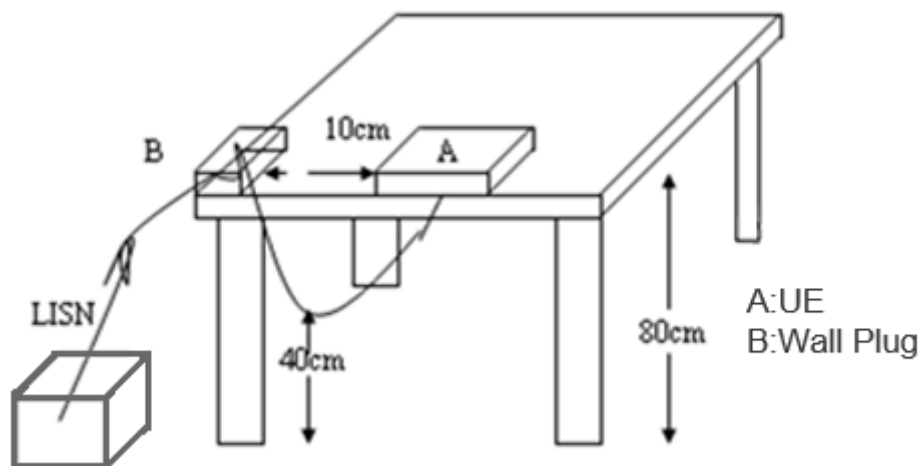
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6.5 AC Power Line Conducted Emission



1. The conducted emission tests were performed at the designated test site using a setup in accordance with ANSI_C63.10
2. The EUT was placed on a non-conductive table that is 0.8 meters above the ground plane. Conducted emissions were measured in the frequency range from 0.15 MHz to 30 MHz using CISPR Quasi-Peak and Average detector modes. The two LISNs provided 50 μ H / 50 ohm coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
3. The AC/DC power adaptor of the EUT was connected to the LISN. The EUT was positioned flush with the rear edge of the table, with a minimum 0.4-meter distance from the shielding wall.
4. The LISNs were connected to the power source and configured according to the test requirements.
5. The maximum emission levels were investigated for each mode of operation. The six highest emissions were further maximized to ensure compliance.
6. The above procedures were repeated for all power supply configurations of the EUT.

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7 TEST RESULTS

7.1 Emission Bandwidth

7.1.1 μ B Occupied Bandwidth

802.11a_Ch0

Freq. (MHz)	26dB BW (MHz)	10 Log (B) (dB)
5180	21.62	13.350
5220	21.86	13.400
5240	21.37	13.300
5260	22.27	13.480
5300	22.22	13.470
5320	22.40	13.500
5500	21.84	13.390
5600	21.81	13.390
5700	22.13	13.450
5720	16.16	12.080

802.11n_HT20_Ch0

Freq. (MHz)	26dB BW (MHz)	10 Log (B) (dB)
5180	21.62	13.350
5220	22.66	13.550
5240	22.54	13.530
5260	22.46	13.510
5300	22.20	13.460
5320	22.54	13.530
5500	22.89	13.600
5600	22.47	13.520
5700	22.01	13.430
5720	15.93	12.020

802.11a_Ch0

Freq. (MHz)	6dB BW (MHz)	10 Log (B) (dB)
5720	2.72	4.350
5745	15.63	11.940
5785	15.16	11.810
5825	15.11	11.790

802.11n_HT20_Ch0

Freq. (MHz)	6dB BW (MHz)	10 Log (B) (dB)
5720	2.53	4.030
5745	15.14	11.800
5785	15.68	11.950
5825	15.69	11.960

802.11a_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5240	5248.47	< 5250
5745	5736.77	> 5725

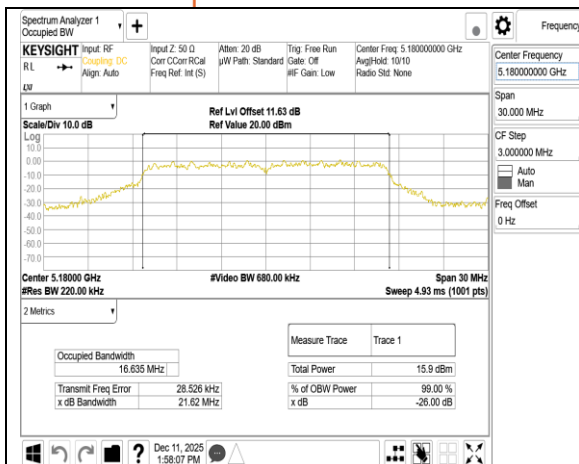
802.11n_HT20_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5240	5248.90	< 5250
5745	5736.21	> 5725

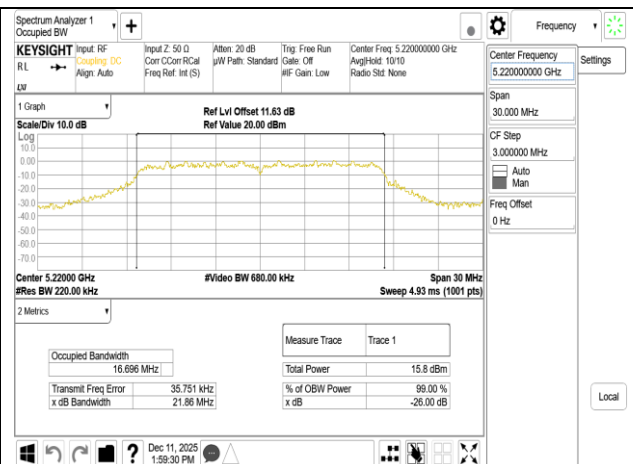
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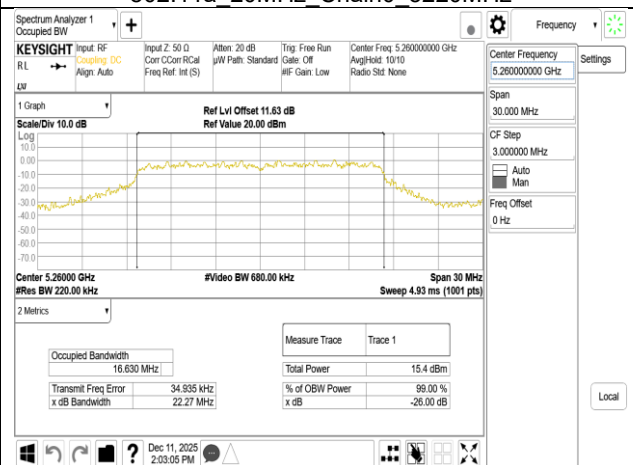
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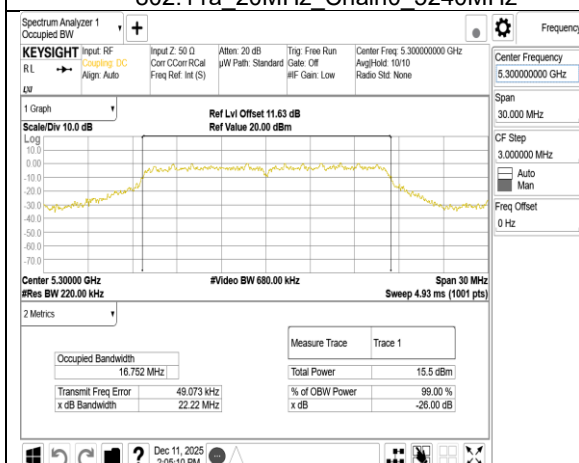
802.11a 20MHz Chain0_5220MHz



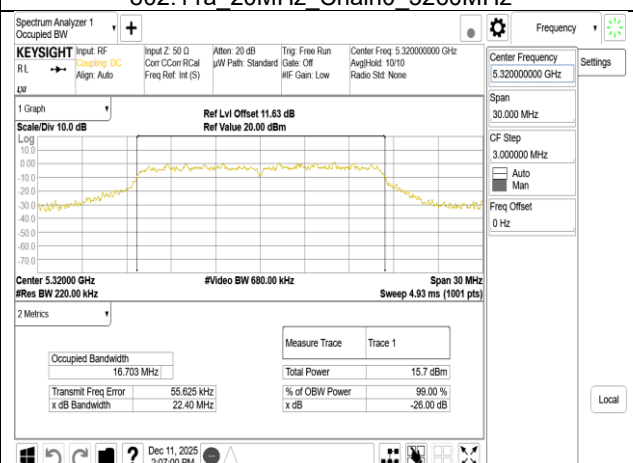
802.11a 20MHz Chain0_5240MHz



802.11a 20MHz Chain0_5260MHz



802.11a 20MHz Chain0_5300MHz

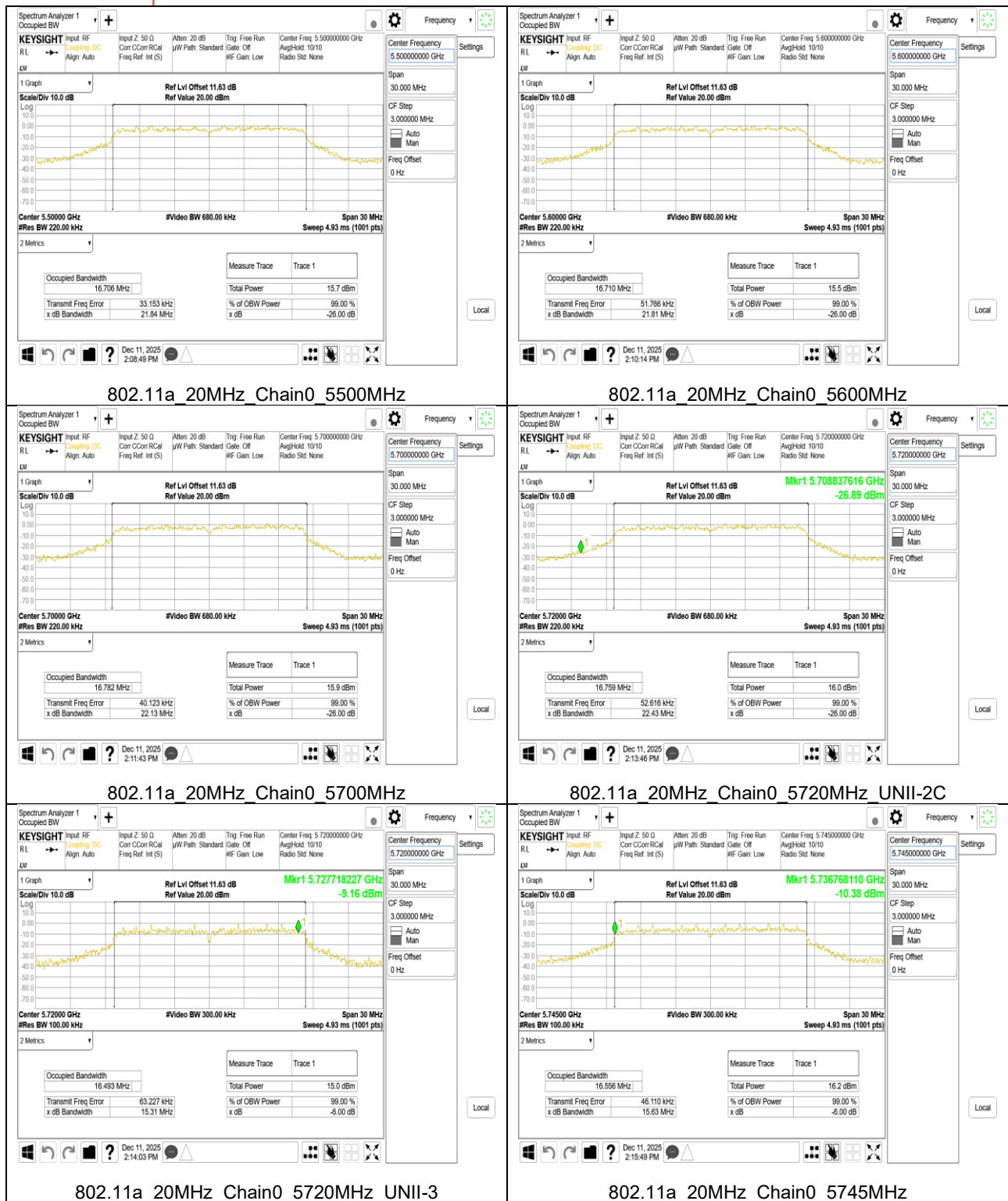


802.11a 20MHz Chain0_5320MHz

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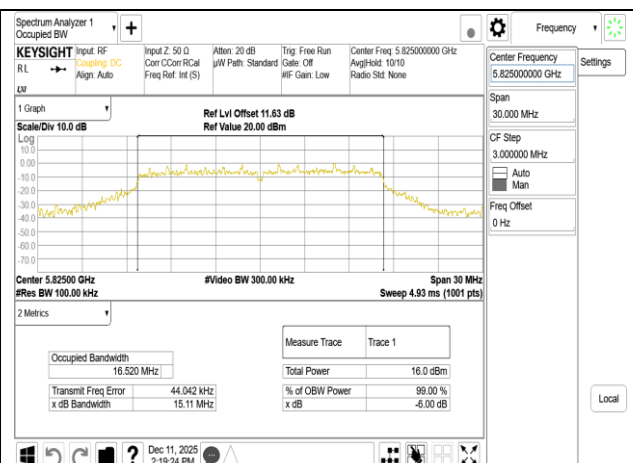
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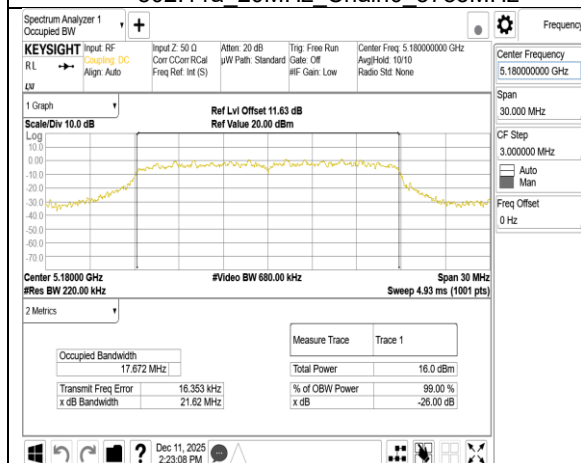
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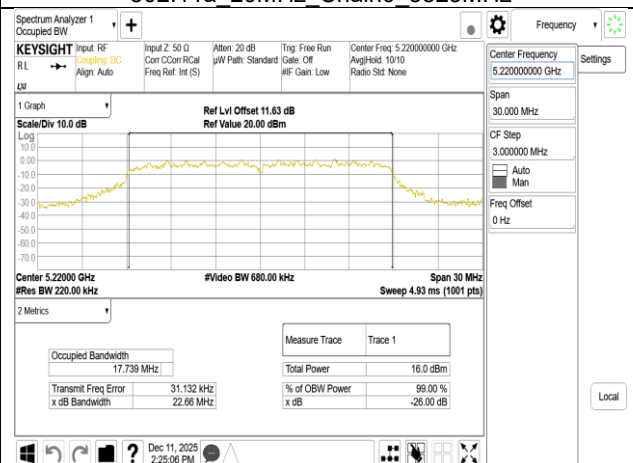
802.11a 20MHz Chain0_5785MHz



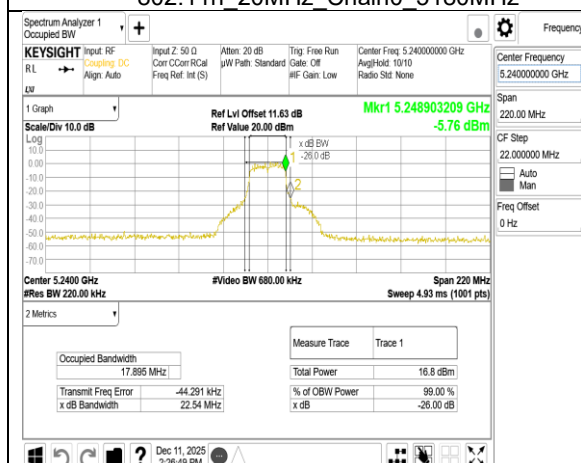
802.11a 20MHz Chain0_5825MHz



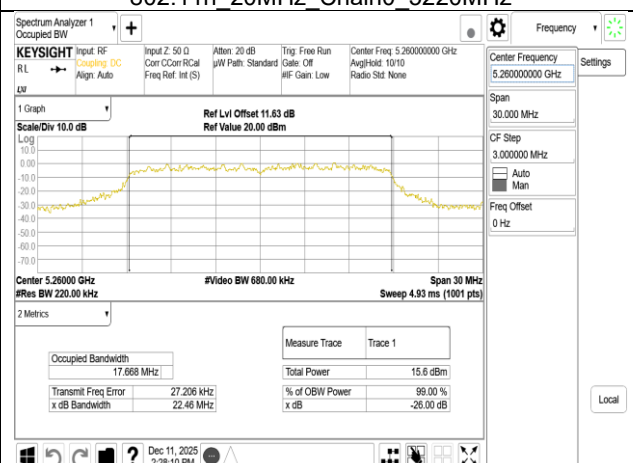
802.11n 20MHz Chain0_5180MHz



802.11n 20MHz Chain0_5220MHz



802.11n 20MHz Chain0_5240MHz



802.11n 20MHz Chain0_5260MHz

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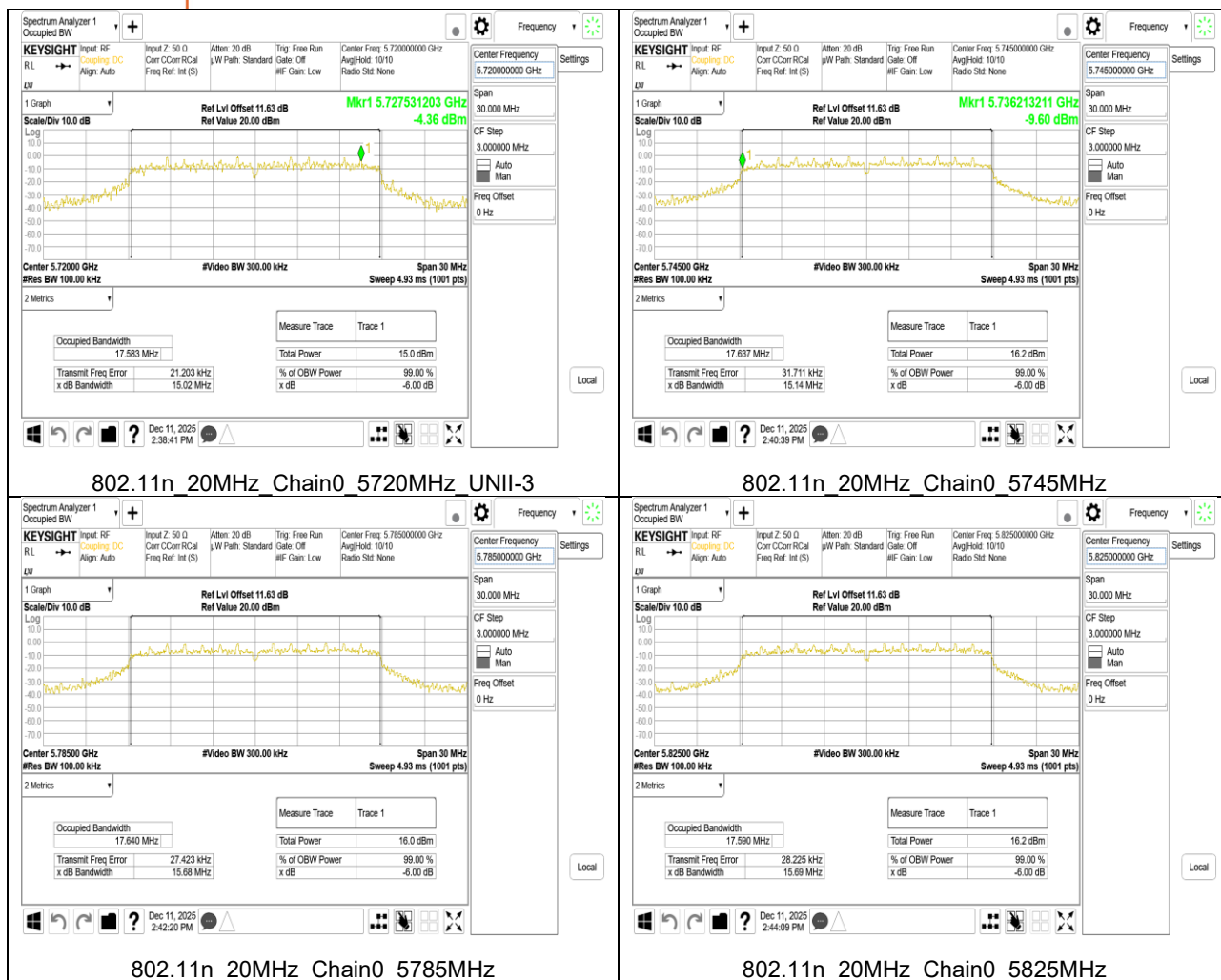
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7.1.2 99% Occupied Bandwidth

802.11a_Ch0

Frequency (MHz)	99% BW (MHz)	10 Log (B) (dB)
5180	16.662	12.220
5220	16.685	12.220
5240	16.676	12.220
5260	16.629	12.210
5300	16.674	12.220
5320	16.709	12.230
5500	16.701	12.230
5600	16.661	12.220
5700	16.721	12.230
5720(U-NII 2C)	13.360	11.260
5720(U-NII 3)	3.360	5.260

802.11n_HT20_Ch0

Frequency (MHz)	99% BW (MHz)	10 Log (B) (dB)
5180	17.670	12.470
5220	17.641	12.470
5240	17.667	12.470
5260	17.684	12.480
5300	17.681	12.480
5320	17.725	12.490
5500	17.711	12.480
5600	17.667	12.470
5700	17.698	12.480
5720(U-NII 2C)	13.840	11.410
5720(U-NII 3)	3.840	5.840

802.11a_Ch0

Frequency (MHz)	99% BW (MHz)	6dB BW (MHz)
5745	16.751	16.14
5785	16.697	16.13
5825	16.709	16.06

802.11n_HT20_Ch0

Frequency (MHz)	99% BW (MHz)	6dB BW (MHz)
5745	17.673	16.44
5785	17.695	17.00
5825	17.703	16.96

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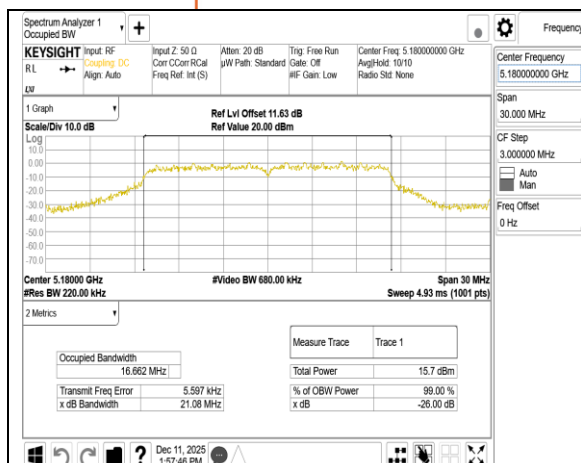
台灣檢驗科技股份有限公司

t (886-2) 2299-3279

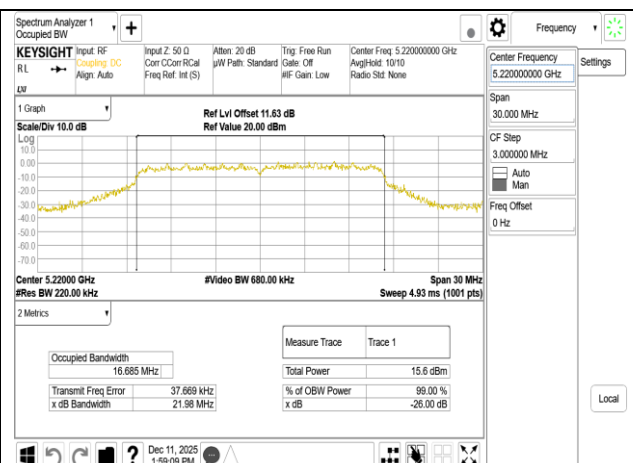
f (886-2) 2298-0488

www.sgs.com.tw

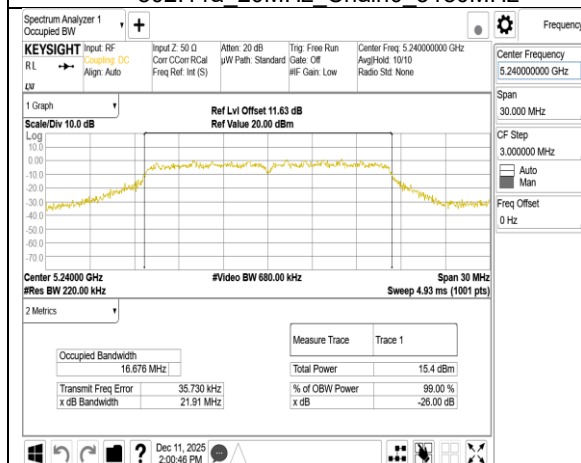
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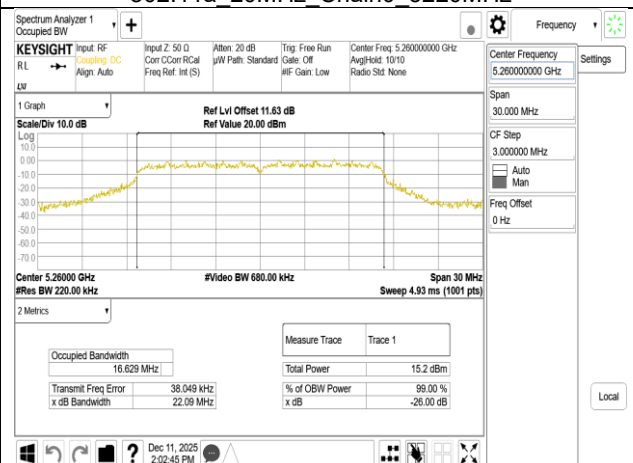
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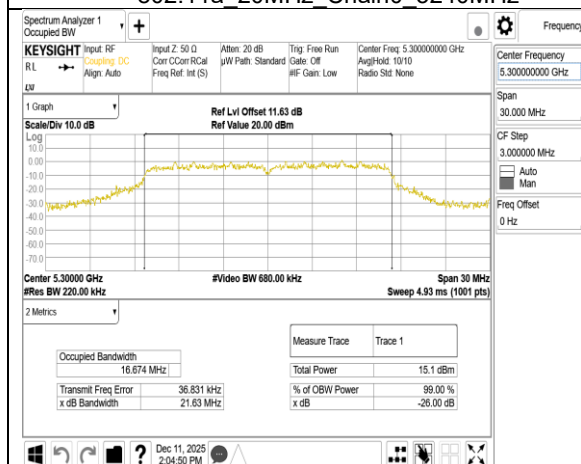
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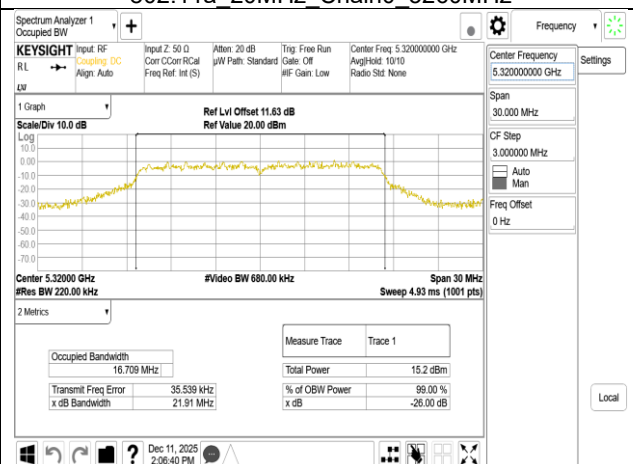
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802.11a 20MHz Chain0_5260MHz



802.11a 20MHz Chain0_5300MHz

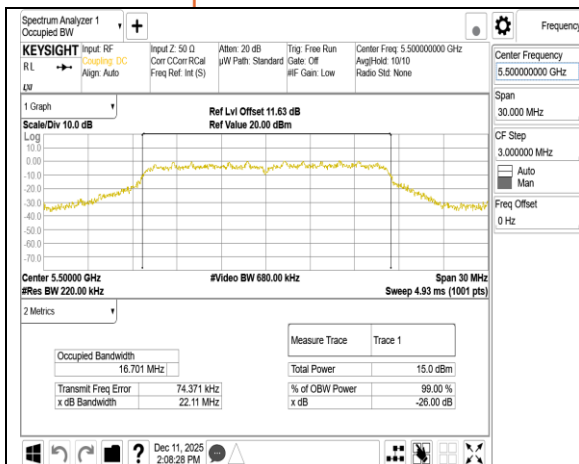


802.11a 20MHz Chain0_5320MHz

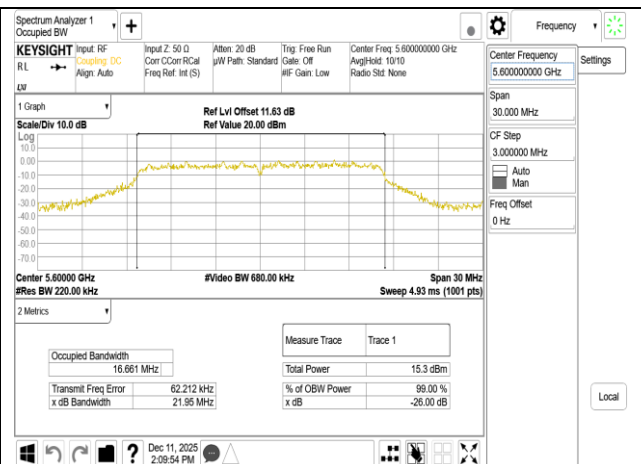
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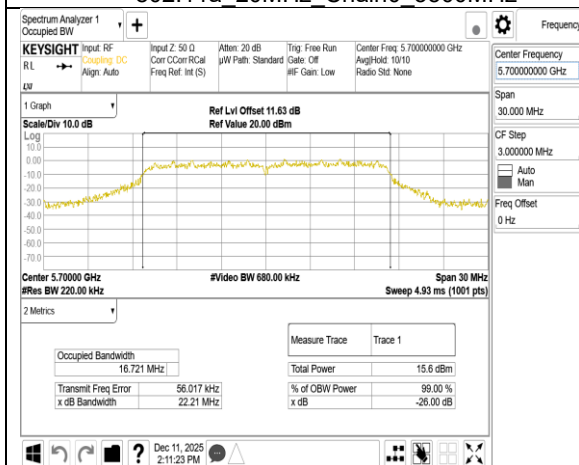
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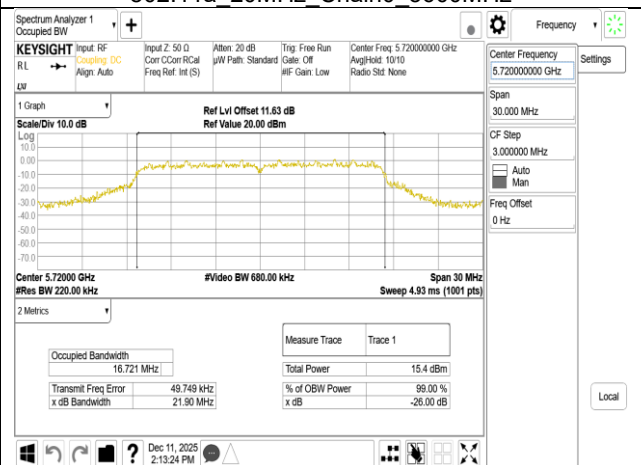
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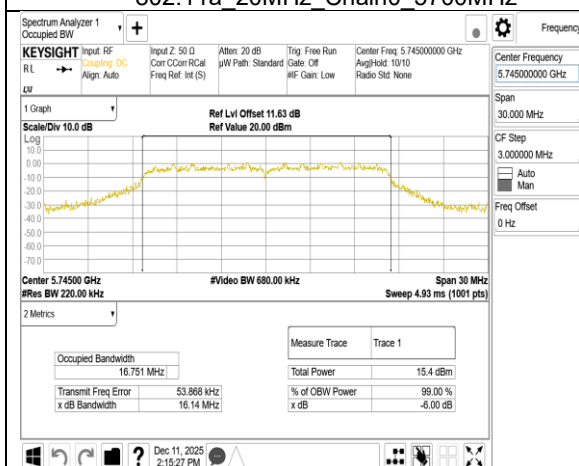
802.11a 20MHz Chain0 5600MHz



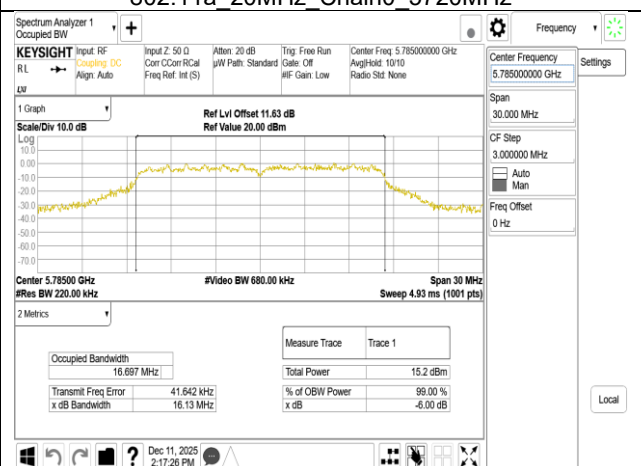
802.11a 20MHz Chain0 5700MHz



802.11a 20MHz Chain0 5720MHz



802.11a 20MHz Chain0 5745MHz

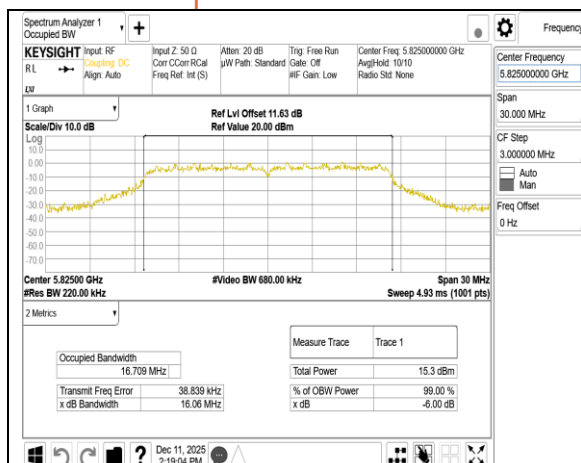


802.11a 20MHz Chain0 5785MHz

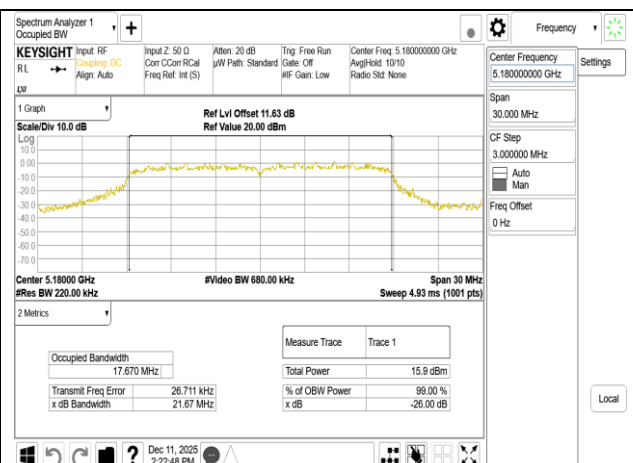
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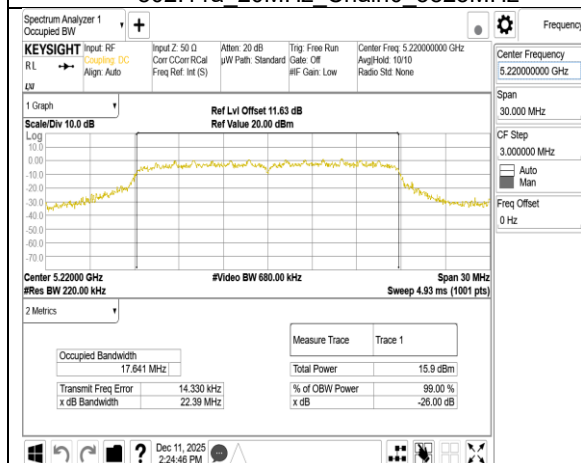
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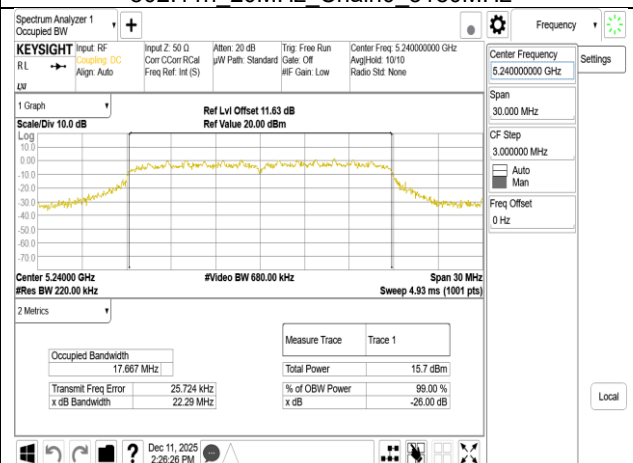
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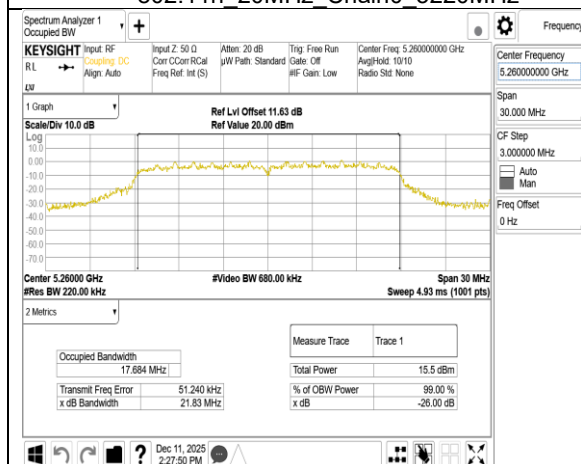
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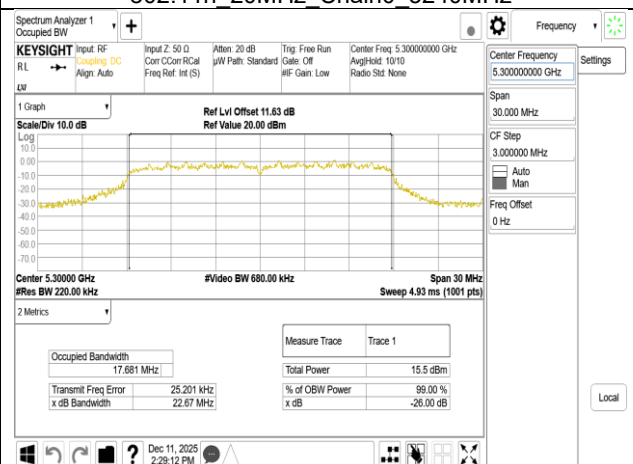
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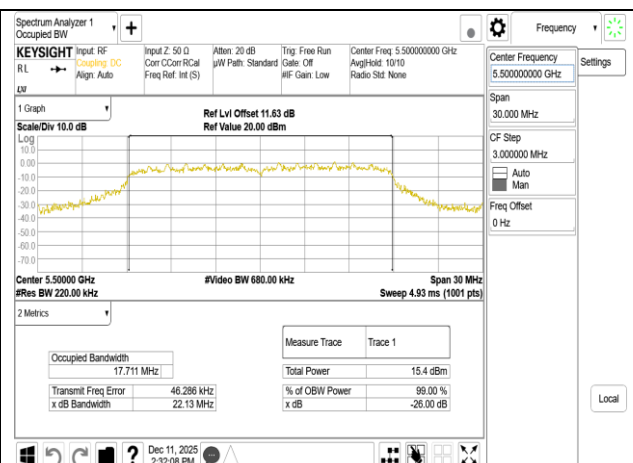
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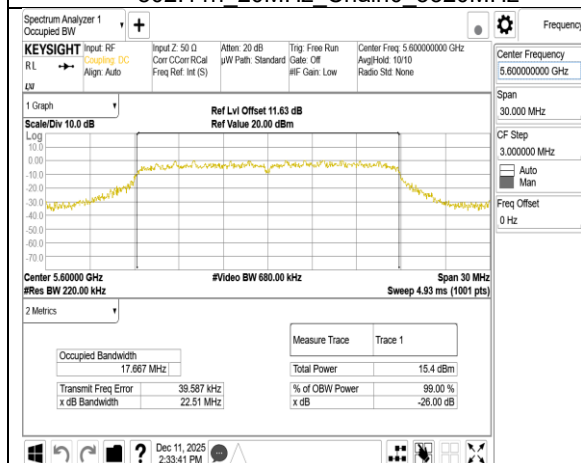
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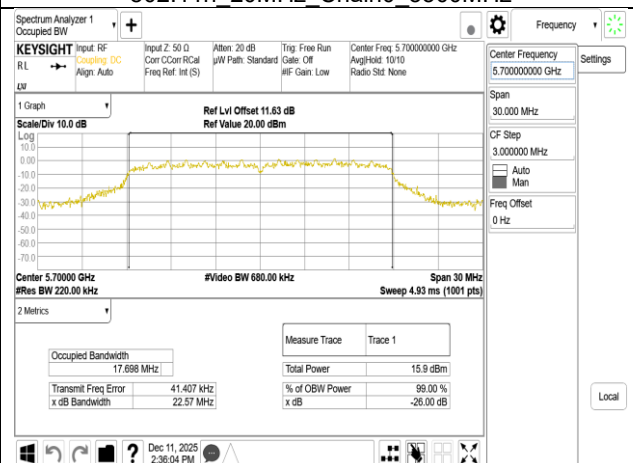
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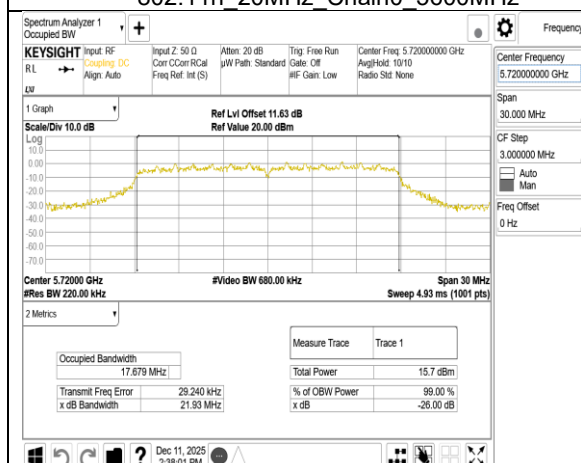
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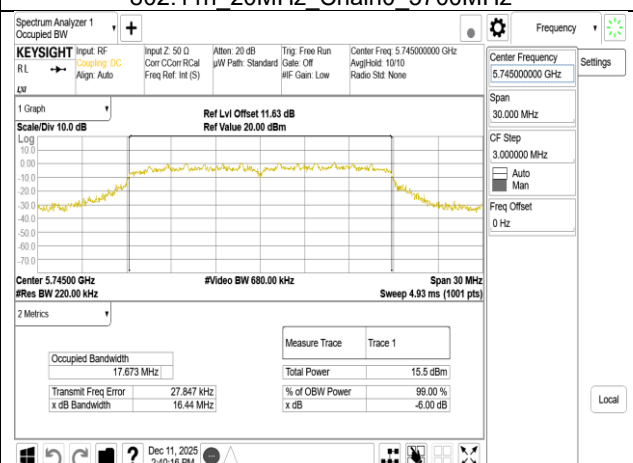
802.11n 20MHz Chain0_5600MHz



802.11n 20MHz Chain0_5700MHz



802.11n 20MHz Chain0_5720MHz



802.11n 20MHz Chain0_5745MHz

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