

RADIO TEST REPORT

Test Report No. 14854382S-AK-R1

Customer	Murata Manufacturing Co., Ltd.
Description of EUT	Communication Module
Model Number of EUT	2CX
FCC ID	VPYLBEE5QG2CX
Test Regulation	FCC Part 15 Subpart E
Test Result	Complied
Issue Date	September 18, 2024
Remarks	WLAN (6 GHz band) part Low-power indoor client Contention Based Protocol test only

Representative Test Engineer

Kenichi Adachi
Engineer

Approved By

Kazutaka Takeyama
Leader

CERTIFICATE 1266.03

The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
 There is no testing item of "Non-accreditation".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 23.0

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- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 14854382S-AK

This report is a revised version of 14854382S-AK. 14854382S-AK is replaced with this report.

Revision	Test Report No.	Date	Revised Contents																																																																																
- (Original)	14854382S-AK	August 27, 2024	-																																																																																
1	14854382S-AK-R1	September 18, 2024	<p><u>Cover sheet, Section 1</u> Deleted extra period at the end of company name.</p> <p><u>Clause 2.2</u> Corrected transmission patterns from; <table border="1"><tr><th>Port</th><th>Mode</th><th>Config 1</th><th>Config 2</th><th>Config 3</th><th>Config 4</th><th>Config 5</th><th>Config 6</th></tr><tr><td>2G_CH0</td><td>Bluetooth</td><td>-</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit (*)</td><td>-</td></tr><tr><td>5G_CH0</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit (*)</td><td>-</td></tr><tr><td>2G_CH1</td><td>2.4 GHz</td><td>-</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit (*)</td><td>-</td></tr><tr><td>5G_CH1</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit (*)</td><td>-</td></tr></table> to; <table border="1"><tr><th>Port</th><th>Mode</th><th>Config 1</th><th>Config 2</th><th>Config 3</th><th>Config 4</th><th>Config 5</th><th>Config 6</th></tr><tr><td>2G_CH0</td><td>Bluetooth</td><td>-</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit (*)</td><td>Transmit (*)</td></tr><tr><td>5G_CH0</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit (*)</td></tr><tr><td>2G_CH1</td><td>2.4 GHz</td><td>-</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit</td><td>Transmit (*)</td></tr><tr><td>5G_CH1</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit</td></tr></table> <p><u>Clause 3.2</u> FCC Part 15.31 (e) Deleted "regardless of input voltage".</p><p><u>FCC Part 15.203 Antenna requirement</u> Corrected from; "The EUT has a unique coupling/antenna connector (U.FL)." to; "The EUT has an external antenna connector, but it is installed inside the end product by the professionals."</p></p>	Port	Mode	Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	2G_CH0	Bluetooth	-	-	Transmit	-	Transmit (*)	-	5G_CH0	5 GHz / 6 GHz	Transmit	-	Transmit	-	Transmit (*)	-	2G_CH1	2.4 GHz	-	-	Transmit	-	Transmit (*)	-	5G_CH1	5 GHz / 6 GHz	Transmit	-	Transmit	-	Transmit (*)	-	Port	Mode	Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	2G_CH0	Bluetooth	-	-	Transmit	Transmit	Transmit (*)	Transmit (*)	5G_CH0	5 GHz / 6 GHz	Transmit	-	-	Transmit	Transmit	Transmit (*)	2G_CH1	2.4 GHz	-	-	Transmit	-	Transmit	Transmit (*)	5G_CH1	5 GHz / 6 GHz	Transmit	-	-	Transmit	Transmit	Transmit
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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	IEC	International Electrotechnical Commission
AC	Alternating Current	IEEE	Institute of Electrical and Electronics Engineers
AFH	Adaptive Frequency Hopping	IF	Intermediate Frequency
AM	Amplitude Modulation	ILAC	International Laboratory Accreditation Conference
Amp, AMP	Amplifier	ISED	Innovation, Science and Economic Development Canada
ANSI	American National Standards Institute	ISO	International Organization for Standardization
Ant, ANT	Antenna	JAB	Japan Accreditation Board
AP	Access Point	LAN	Local Area Network
APD	Absorbed Power Density	LIMS	Laboratory Information Management System
ASK	Amplitude Shift Keying	MCS	Modulation and Coding Scheme
Atten., ATT	Attenuator	MRA	Mutual Recognition Arrangement
AV	Average	N/A	Not Applicable
BPSK	Binary Phase-Shift Keying	NIST	National Institute of Standards and Technology
BR	Bluetooth Basic Rate	NS	No signal detect.
BT	Bluetooth	NSA	Normalized Site Attenuation
BT LE	Bluetooth Low Energy	NVLAP	National Voluntary Laboratory Accreditation Program
BW	BandWidth	OBW	Occupied Band Width
Cal Int	Calibration Interval	OFDM	Orthogonal Frequency Division Multiplexing
CCK	Complementary Code Keying	OFDMA	Orthogonal Frequency Division Multiple Access
Ch., CH	Channel	P/M	Power meter
CISPR	Comité International Special des Perturbations Radioélectriques	PCB	Printed Circuit Board
CW	Continuous Wave	PER	Packet Error Rate
DBPSK	Differential BPSK	PHY	Physical Layer
DC	Direct Current	PK	Peak
D-factor	Distance factor	PN	Pseudo random Noise
DFS	Dynamic Frequency Selection	PP	Preamble Puncturing
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SAR	Specific Absorption Rate
Freq.	Frequency	SG	Signal Generator
FSK	Frequency Shift Keying	SVSWR	Site-Voltage Standing Wave Ratio
GFSK	Gaussian Frequency-Shift Keying	TR	Test Receiver
GNSS	Global Navigation Satellite System	Tx	Transmitting
GPS	Global Positioning System	VBW	Video BandWidth
Hori.	Horizontal	Vert.	Vertical
HPF	High-Pass Filter	WLAN	Wireless LAN
ICES	Interference-Causing Equipment Standard	WPT	Wireless Power Transmit

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SECTION 1: Customer Information

Company Name	Murata Manufacturing Co., Ltd.
Address	1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Telephone Number	+81-50-1737-2801
Contact Person	Kenji Hayashikoshi

The information provided from the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Communication Module
Model Number	2CX
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	June 16, 2023
Test Date	April 25 and 26, 2024

2.2 Product Description

General Specification

Rating	VPH_PA_2G_CH0 : 3.85 V (typical) (3.00 V to 4.60 V) VPH_PA_2G_CH1 : 3.85 V (typical) (3.00 V to 4.60 V) VPH_PA_5G_CH0 : 3.85 V (typical) (3.00 V to 4.60 V) VPH_PA_5G_CH1 : 3.85 V (typical) (3.00 V to 4.60 V) VDD18_DIG_IO : 1.80 V (typical) (1.71 V to 2.10 V) AON_RFACMN_LDO_IN : 0.95 V (typical) (0.90 V to 2.10 V) WLCX_BT_LDO_IN / WLMX_LDO_IN : 0.95 V (typical) (0.90 V to 2.10 V) RFA0P8_LDO_IN : 0.95 V (typical) (0.90 V to 2.10 V) RFA12_LDO_IN : 1.35 V (typical) (1.30 V to 2.10 V) RFA17_LDO_IN : 1.90 V (typical) (1.85 V to 2.10 V) PCIE0P92_LDO_IN : 1.35 V (typical) (1.28 V to 2.10 V) PCIE18_LDO_IN : 1.90 V (typical) (1.85 V to 2.10 V)
Operating temperature	-30 deg. C to +85 deg. C

Radio Specification

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer. The data provided by the customer is marked "a)" in the table below.

Bluetooth (BR/EDR/BTLE)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS, GFSK / π/4-DQPSK, 8DPSK / GFSK
Antenna Type	Monopole Antenna
Antenna Gain a)	2G_CH0: -0.23 dBi

WLAN (IEEE802.11b/11g/11n-20/11ax-20)

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	CCK, DSSS, OFDM OFDMA: (20 MHz band): 26/52/106/242-tone RU
Antenna Type	Monopole Antenna, Slot antenna
Antenna Gain a)	2G_CH0: -0.23 dBi (monopole antenna) 2G_CH1: +1.60 dBi (monopole antenna) +1.65 dBi (slot antenna)

WLAN (IEEE802.11a/11n-20/11ac-20/11ax-20/11n-40/11ac-40/11ax-40/11ac-80/11ax-80/11ax-160)

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band:	5180 MHz to 5240 MHz 5260 MHz to 5320 MHz 5500 MHz to 5720 MHz 5745 MHz to 5825 MHz 5955 MHz to 6415 MHz 6435 MHz to 6515 MHz 6535 MHz to 6875 MHz (*6875 MHz:straddle ch) 6895 MHz to 7095 MHz
	40 MHz Band	5190 MHz to 5230 MHz 5270 MHz to 5310 MHz 5510 MHz to 5710 MHz 5755 MHz to 5795 MHz 5965 MHz to 6405 MHz 6445 MHz to 6525 MHz (*6525 MHz:straddle ch) 6565 MHz to 6885 MHz (*6885 MHz:straddle ch) 6925 MHz to 7085 MHz
	80 MHz band	5210 MHz 5290 MHz 5530 MHz to 5690 MHz 5775 MHz 5985 MHz to 6385 MHz 6465 MHz to 6545 MHz (*6545 MHz:straddle ch) 6625 MHz to 6865 MHz (*6865 MHz:straddle ch) 6945 MHz to 7025 MHz
	160 MHz band	5250 MHz 5570 MHz 6025 MHz to 6345 MHz 6505 MHz (*6505 MHz:straddle ch) 6665 MHz to 6825 MHz (*6825 MHz:straddle ch) 6985 MHz
Type of Modulation	OFDM	
	OFDMA (IEEE802.11ax only)	(20 MHz band): 26/52/106/242-tone RU (40 MHz band): 26/52/106/242/484-tone RU (80 MHz band): 26/52/106/242/484/996-tone RU (160 MHz band): 26/52/106/242/484/996/2x996-tone RU
Antenna Type	Monopole Antenna, Slot antenna	
Antenna Gain a)	U-NII-1, -2A, -2C, -3, 5180 MHz to 5825 MHz	5G_CH0: +0.51 dBi (monopole antenna) 5G_CH1: +0.57 dBi (monopole antenna) +1.13 dBi (slot antenna)
	U-NII-5, -6, -7, -8, 5955 MHz to 7095 MHz	5G_CH0: -1.36 dBi (monopole antenna) 5G_CH1: -1.25 dBi (monopole antenna) -1.14 dBi (slot antenna)
6 GHz Contention Based Protocol incumbent avoidance	Channel puncturing: Not supported Bandwidth reduction: Supported	

Transmission patterns

Port	Mode	Config.1	Config.2	Config.3	Config.4	Config.5
2G_CH0	Bluetooth 2.4 GHz	-	-	Transmit	Transmit	Transmit *1) Transmit *1)
5G_CH0	5 GHz / 6 GHz	Transmit	-	-	Transmit	-
2G_CH1	2.4 GHz	-	Transmit	-	-	Transmit *1)
5G_CH1	5 GHz / 6 GHz	Transmit	-	-	Transmit	-

*1) WLAN and Bluetooth do not transmit simultaneously.

SECTION 3: Test specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart E The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart E Unlicensed National Information Infrastructure Devices Section 15.407 General technical requirements

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Contention Based Protocol	FCC: KDB Publication Number 987594 ISED: -	FCC: 15.407 (d) (6) ISED: RSS-248 4.7	N/A	Complied	Conducted
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.					

FCC Part 15.31 (e)

The module is constantly provided with the stable voltage from the host device. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The EUT has an external antenna connector, but it is installed inside the end product by the professionals. Therefore the equipment complies with the requirement of 15.203.

3.3 Addition to Standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.

Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)	1.3 dB
Power Measurement above 1 GHz (Peak Detector)	1.8 dB
Spurious Emission (Conducted) below 1 GHz	0.91 dB
Conducted Emissions Power Density Measurement 1 GHz to 3 GHz	1.3 dB
Conducted Emissions Power Density Measurement 3 GHz to 18 GHz	2.5 dB
Spurious Emission (Conducted) 18 GHz to 26.5 GHz	2.8 dB
Spurious Emission (Conducted) 26.5 GHz to 40 GHz	2.6 dB
Bandwidth Measurement	0.012 %
Duty Cycle and Time Measurement	0.27 %
Temperature	2.2 deg.C.
Humidity	4.0 %
Voltage	0.74 %
Contention based protocol	2.5 dB

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan
Telephone: +81-463-50-6400
A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test room	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber (SAC1)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber (SAC2)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber (SAC3)	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber (SAC4)	8.1 x 5.1 x 3.55	8.1 x 5.1	-
Wireless anechoic chamber 1 (WAC1)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
Wireless anechoic chamber 2 (WAC2)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 Shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	-	-
No.2 Measurement room	4.5 x 3.5 x 2.5	-	-
Wireless shielded room 1	3.0 x 4.5 x 2.7	3.0 x 4.5	-
Wireless shielded room 2	3.0 x 4.5 x 2.7	3.0 x 4.5	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Remarks*
IEEE 802.11ax MIMO 20 MHz BW (11ax-20)	MCS 0 (1SS), PN9
IEEE 802.11ax MIMO 160 MHz BW (11ax-160)	MCS 0 (1SS), PN9

*The worst condition was determined based on the test result of Maximum Peak Output Power.
(* SS: Spatial Stream)

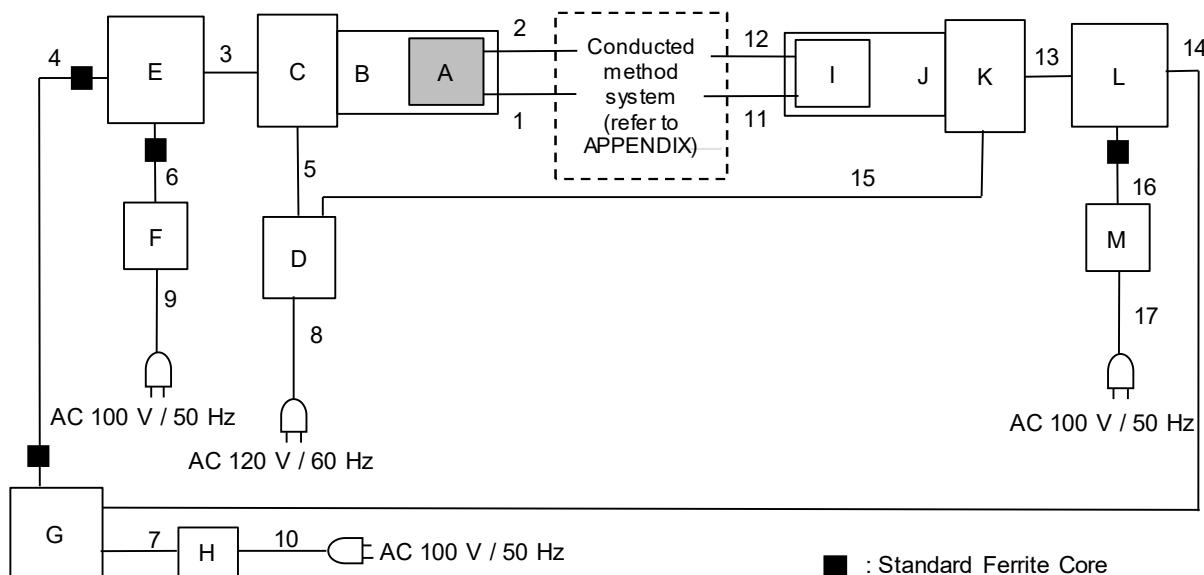
*Power of the EUT was set by the software as follows;
Power Setting: Fixed
Software: start_hostapd_11AX_6G_HE20.sh, version 1.0
start_hostapd_11AX_6G_HE160.sh, version 1.0
connect_to_6g.sh, version 1.0
iperf.exe, version 2.0.9
(all program, Date: 2021.03.21, Storage location: Driven by connected PC (i.MX 8M Quad))

*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

*The Details of Operation Mode(s)

Test Item	Operating Mode	Tested Antenna	Tested Frequency			
			U-NII-5	U-NII-6	U-NII-7	U-NII-8
Contention Based Protocol	Communication 11ax-20	5G_CH0 & 5G_CH1	6175 MHz 6185 MHz	6475 MHz 6505 MHz	6695 MHz 6665 MHz	6995 MHz 6985 MHz
	Communication 11ax-160					

4.2 Configuration and Peripherals



■ : Standard Ferrite Core

Description of EUT and Support Equipment

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Communication Module	2CX	A-13	Murata Manufacturing Co., Ltd.	EUT
B	Jig Board	P2ML10932	A-13	Murata Manufacturing Co., Ltd.	-
C	LDO Board	P2ML8516	A-13	Murata Manufacturing Co., Ltd.	-
D	Power Supply(DC)	PWR800M	QJ003485	Kikusui Electronics Corp.	-
E	Platform	i.MX 8M Quad	CERT-PL024	NXP Semiconductors N.V.	-
F	AC Adapter	EA10682N-120	CERT-PL017	Edac Power Electronics Co., Ltd.	-
G	Laptop Computer	dynabook Satellite B453 M	ZE127581H	TOSHIBA	-
H	AC Adapter	PA3917U-1ACA	G71C000DP410	TOSHIBA	-
I	Communication module	2CX	A-6	Murata Manufacturing Co., Ltd.	AE
J	Jig Board	P2ML10932	A-6	Murata Manufacturing Co., Ltd.	-
K	LDO Board	P2ML8516	A-14	Murata Manufacturing Co., Ltd.	-
L	Platform	i.MX 8M Quad	CERT-PL017	NXP Semiconductors N.V.	-
M	AC Adapter	EA10682N-120	CERT-PL024	Edac Power Electronics Co., Ltd.	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna	0.13	Shielded	Shielded	-
2	Antenna	0.13	Shielded	Shielded	-
3	Signal	0.15	Unshielded	Unshielded	-
4	USB	1.0	Shielded	Shielded	-
5	DC	0.5	Unshielded	Unshielded	-
6	DC	1.0	Unshielded	Unshielded	-
7	DC	1.7	Unshielded	Unshielded	-
8	AC	1.8	Unshielded	Unshielded	-
9	AC	1.6	Unshielded	Unshielded	-
10	AC	0.8	Unshielded	Unshielded	-
11	Antenna	0.1	Shielded	Shielded	-
12	Antenna	0.1	Shielded	Shielded	-
13	Signal	0.2	Unshielded	Unshielded	-
14	USB	1.0	Shielded	Shielded	-
15	DC	2.0	Unshielded	Unshielded	-
16	DC	1.0	Unshielded	Unshielded	-
17	AC	1.6	Unshielded	Unshielded	-

SECTION 5: Contention Based Protocol

Operating Modes

The EUT operates in the following band / bands: U-NII-5 (5925 MHz to 6425 MHz), U-NII-6 (6425 MHz to 6525 MHz), U-NII-7 (6525 MHz to 6875 MHz) and U-NII-8 (6875 MHz to 7125 MHz).

The EUT is classified as a 6 GHz Low power Indoor Client.

The lowest gain antenna assembly utilized with the EUT has a gain of -1.36 dBi in the U-NII 5/6/7/8 band.

Two sets of two antennas, one set per chain, are utilized to meet the diversity and MIMO operational requirements.

The EUT uses two transmitter/receiver chains, each connected to a 50-ohm coaxial antenna port. All antenna ports are connected to the test system via a power divider to perform conducted tests.

The maximum allowable AWGN Incumbent Detection Threshold level is -62 dBm/MHz.

WLAN traffic was generated by transferring a data stream from the EUT to the Companion Device using iperf version 2.0.9 software package.

(Date: February 26, 2024 / Storage location: Driven by connected PC (i.MX 8M Quad Evaluation kit))

The EUT utilizes the 802.11ax architecture, with a 20 MHz, 40 MHz, 80 MHz and 160 MHz channel bandwidth.

System Overview

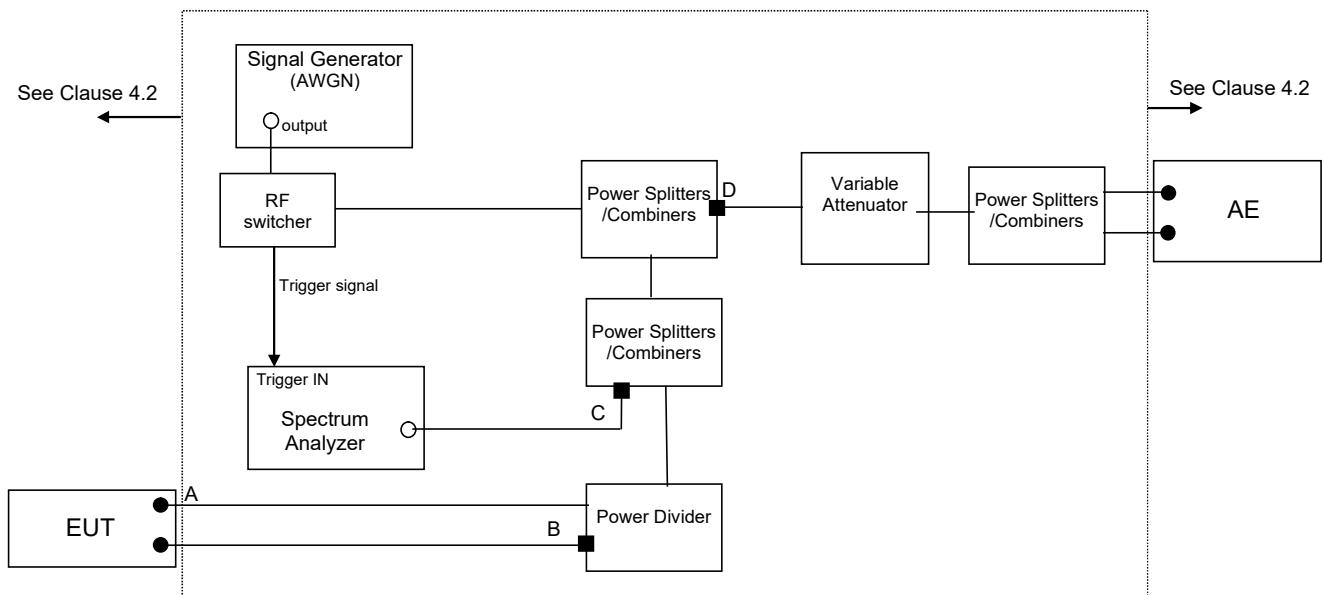
Should multiple RF ports be utilized for the EUT and/or Companion devices (for example, for diversity or MIMO implementations), combiner/dividers are inserted between the EUT MIMO Combiner/Divider and the attenuator connected to the EUT (and/or between the Companion MIMO Combiner/Divider and the attenuator connected to the Companion Device). Additional attenuators may be utilized such that there is one attenuator at each RF port on each device.

The Test setup is different from 987594 D02 U-NII 6 GHz EMC Measurement v02r01, but it is equivalent.

SYSTEM CALIBRATION

The monitoring cable is disconnected from the spectrum analyzer and a 50-ohm load is connected to the end of the monitoring cable in place of the spectrum analyzer. The cable connected to the EUT is then attached to the spectrum analyzer in place of the monitoring cable. A signal generator is then set to produce a modulated AWGN Incumbent Signal that has a 99% occupied power bandwidth of 10 MHz. The output amplitude of the signal generator is adjusted to yield the allowable maximum AWGN Incumbent Signal level as measured on the spectrum analyzer. The EUT and monitoring cables are then returned to their original configurations to perform the test.

Conducted Methods System Block Diagram



*Signal Generator and Spectrum Analyzer were started at the same time by RF Switcher.

Test Data
Test Result

: APPENDIX
: Pass

APPENDIX 1: Test Data

Contention Based Protocol

Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	April 25, 2024	April 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH	23 deg. C / 42 % RH
Engineer	Kenichi Adachi	Kenichi Adachi
Mode	Communication 11ax-20 / Communication 11ax-160	

Incumbent signal plots

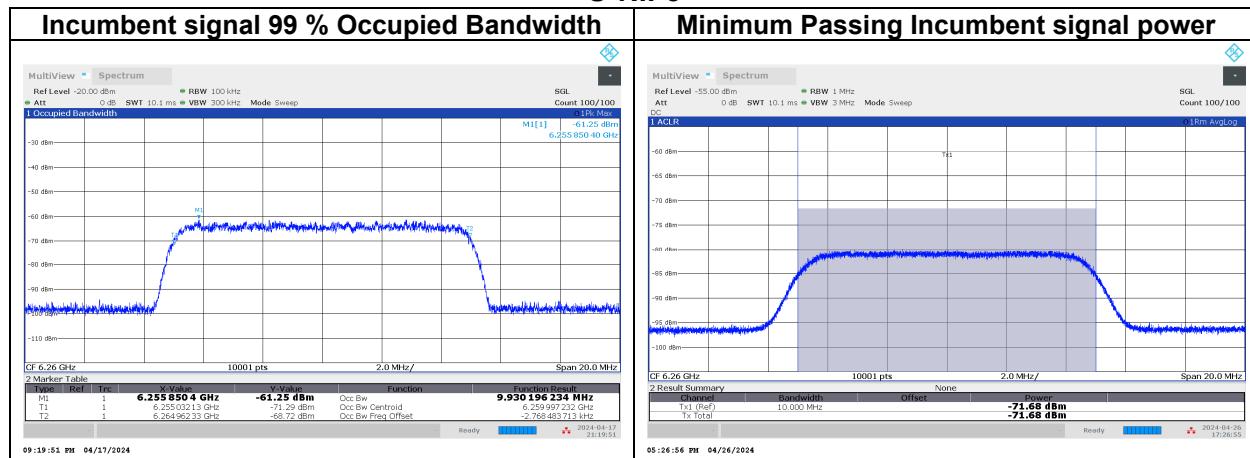
[20 MHz BW mode]

All tests were conducted with the Incumbent Signal frequency set to the middle of EUT channel and a nominal 99 % occupied power bandwidth of 10 MHz.

[160 MHz BW mode]

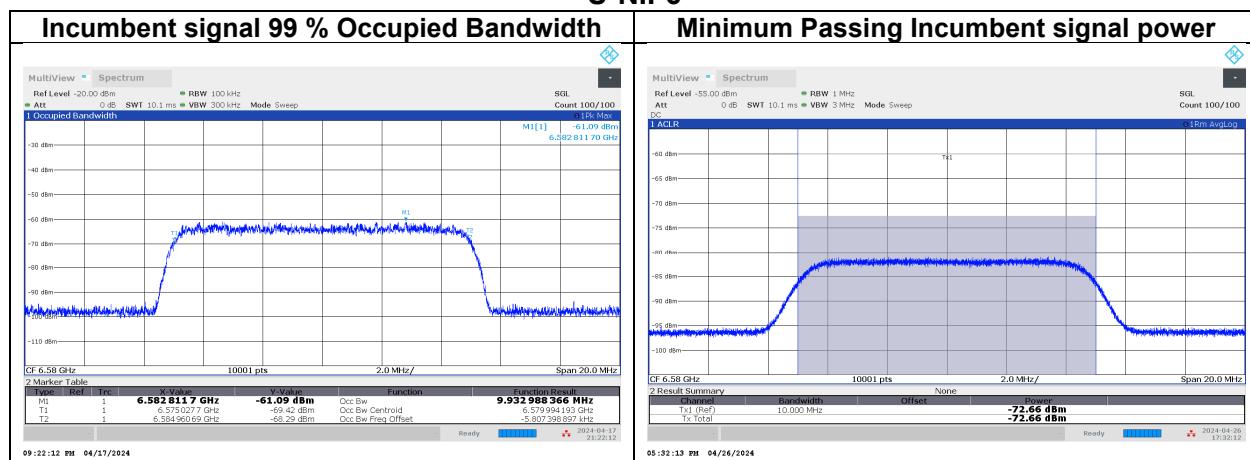
All tests were conducted with the Incumbent Signal frequency set to as closely as possible to the lower edge of the EUT channel, in the middle of EUT channel, and as closely as possible to the upper edge of the EUT channel and a 99 % occupied bandwidth of 10 MHz.

Reference plot U-NII-5



Incumbent signal power takes into account customer supplied cable losses.

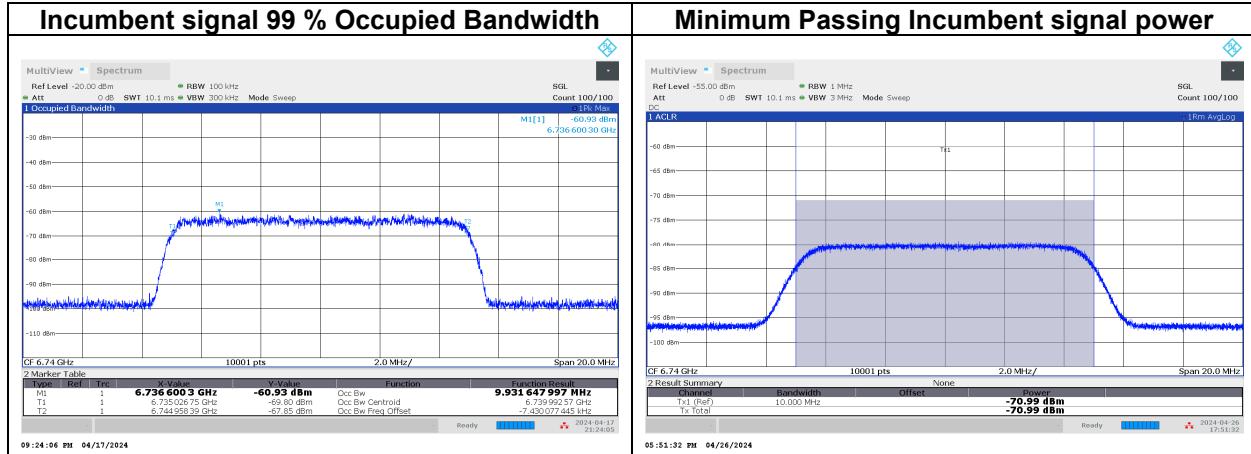
Reference plot U-NII-6



Incumbent signal power takes into account customer supplied cable losses.

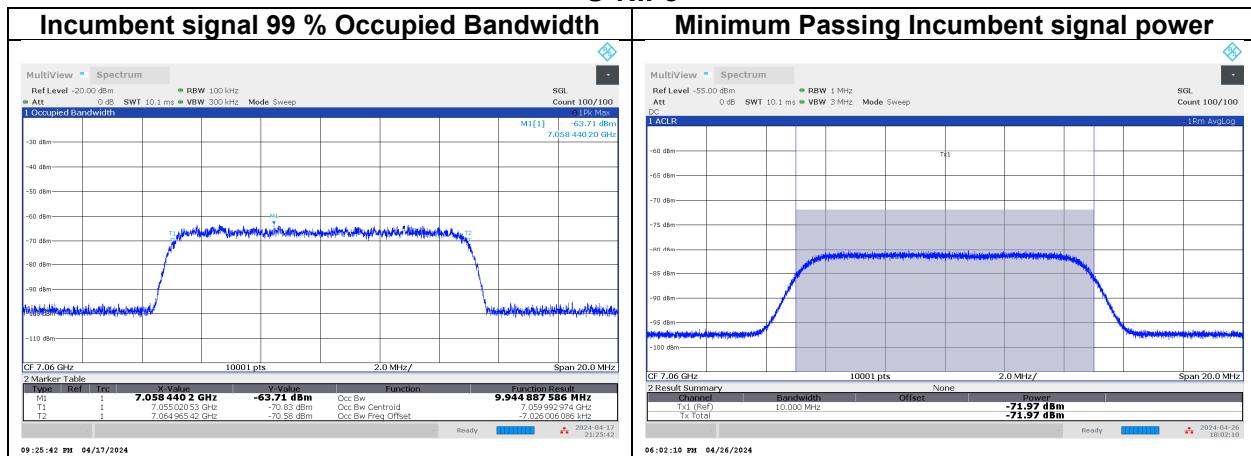
Contention Based Protocol

Reference plot U-NII-7



Incumbent signal power takes into account customer supplied cable losses.

Reference plot U-NII-8



Incumbent signal power takes into account customer supplied cable losses.

Contention Based Protocol

EUT response to the applied incumbent signal

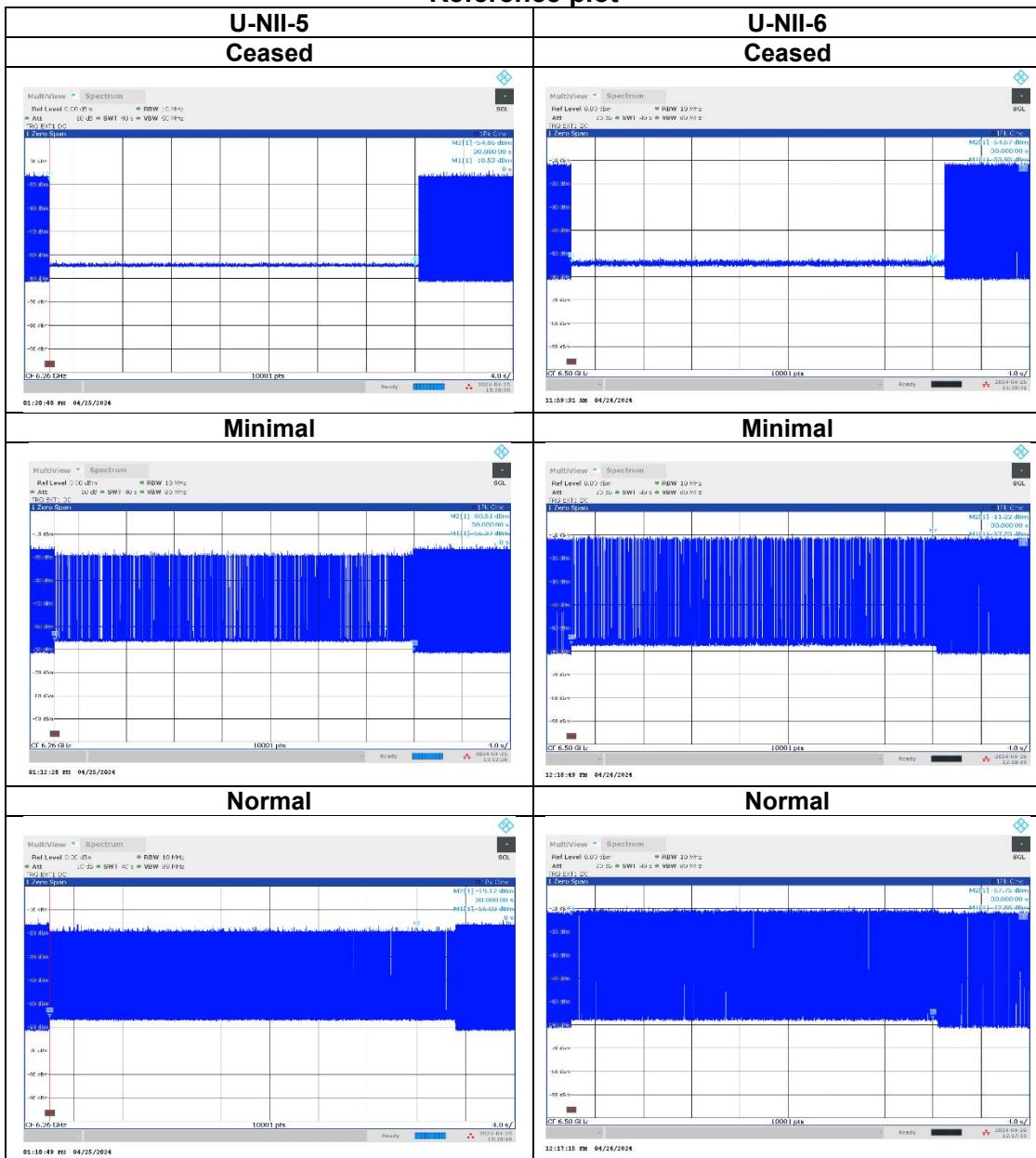
A link between the EUT and the Companion Device was established on the test channel.

Traffic flowing from the EUT to Companion Device was then initiated.

A sweep was started, and the incumbent signal was continuously applied at approximately 5 seconds after the start of the sweep for a duration of 30 seconds and removed after the end of the observation period.

Transmissions cease while the incumbent AWGN Signal is present and resume after it is removed. Span was set to zero to ensure detection of transmissions from EUT.

Reference plot



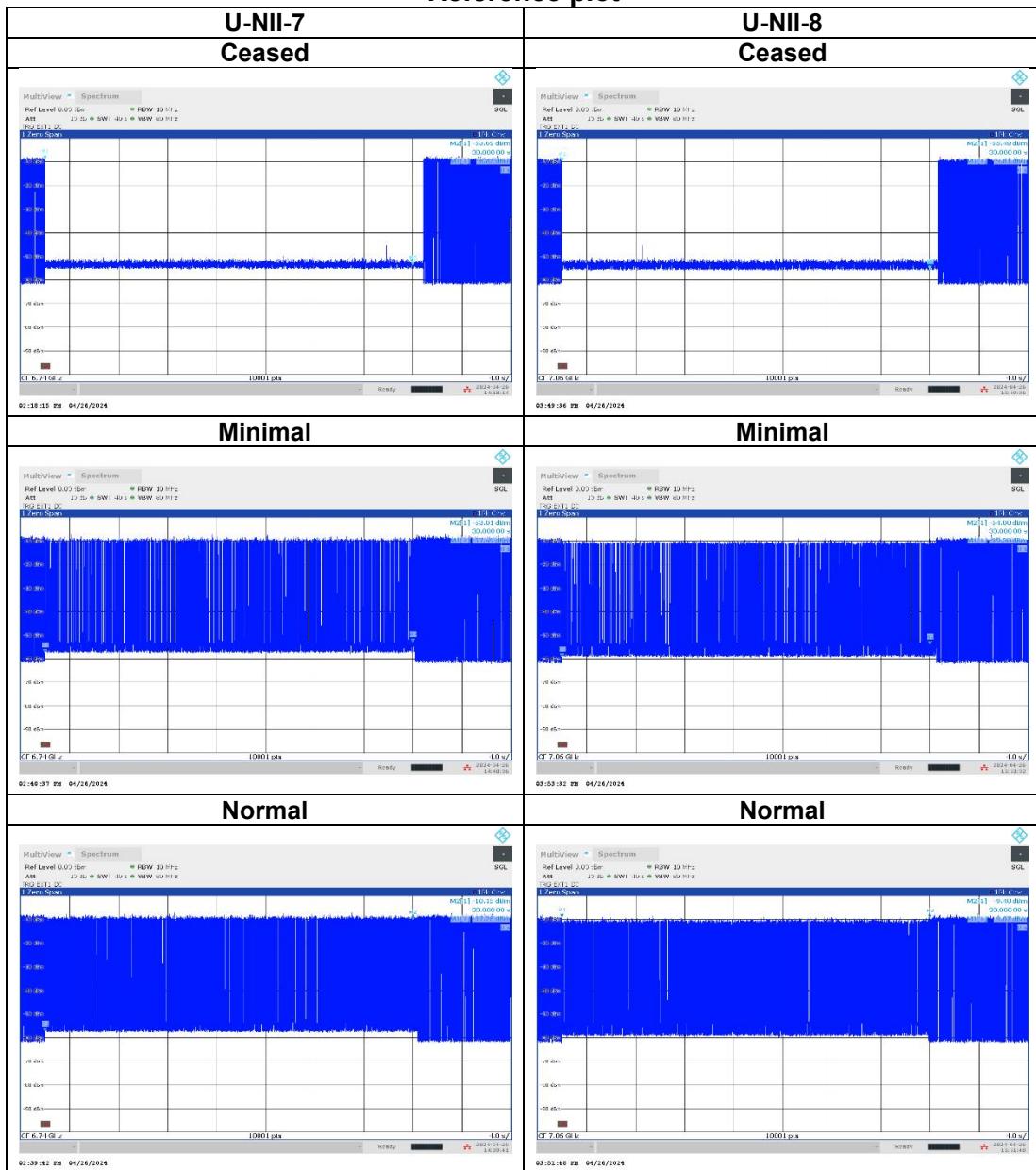
Ceased: The level at which no transmission is detected, consistently for a minimum period of 10 seconds.

Minimal: The AWGN level at which the system begins to trigger the transmission switch off, albeit not being kept off consistently.

Normal: The level at which there no apparent detection and the operation of the EUT is still considered optimal.

Contention Based Protocol

Reference plot



Ceased: The level at which no transmission is detected, consistently for a minimum period of 10 seconds.

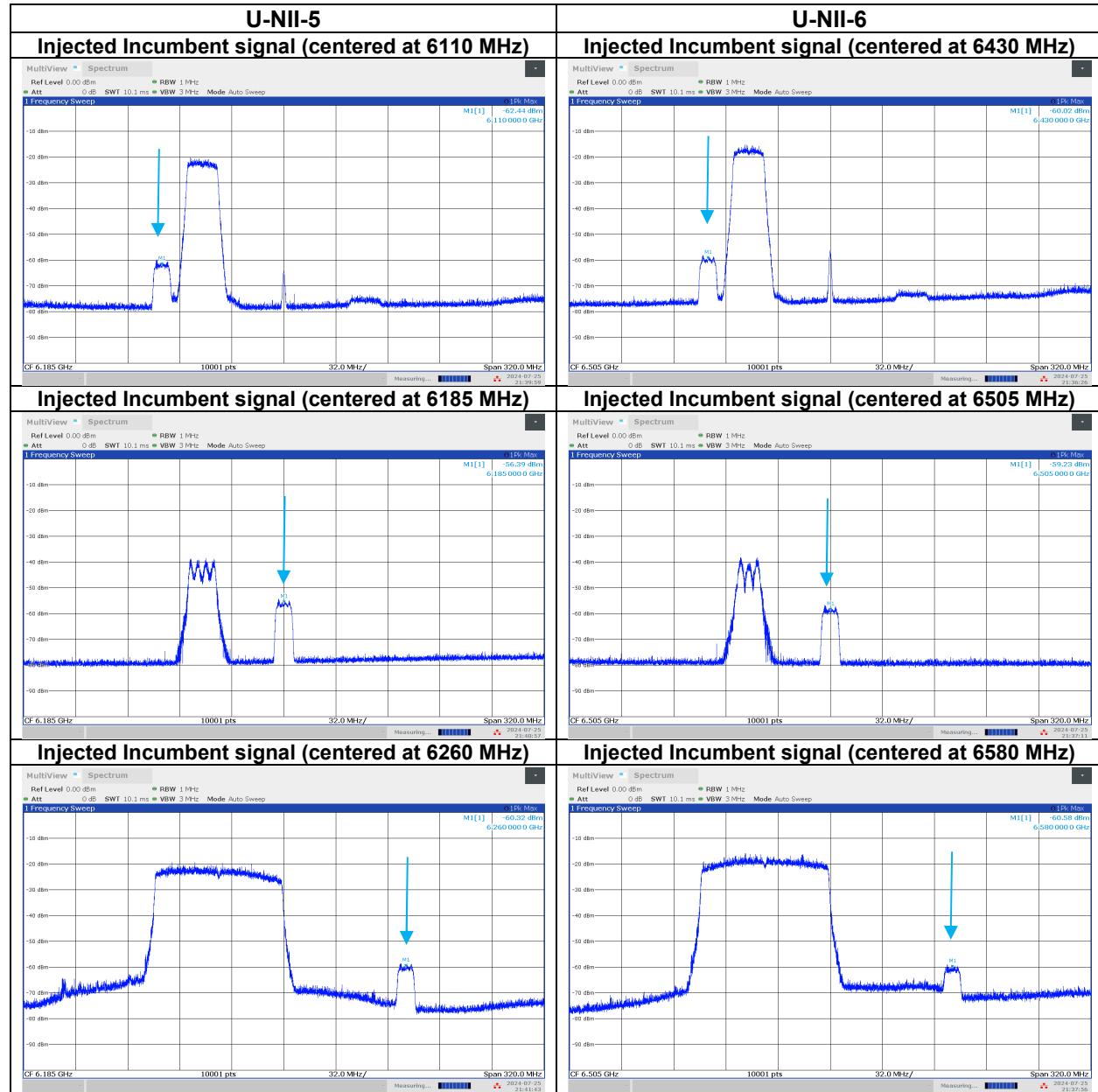
Minimal: The AWGN level at which the system begins to trigger the transmission switch off, albeit not being kept off consistently.

Normal: The level at which there no apparent detection and the operation of the EUT is still considered optimal.

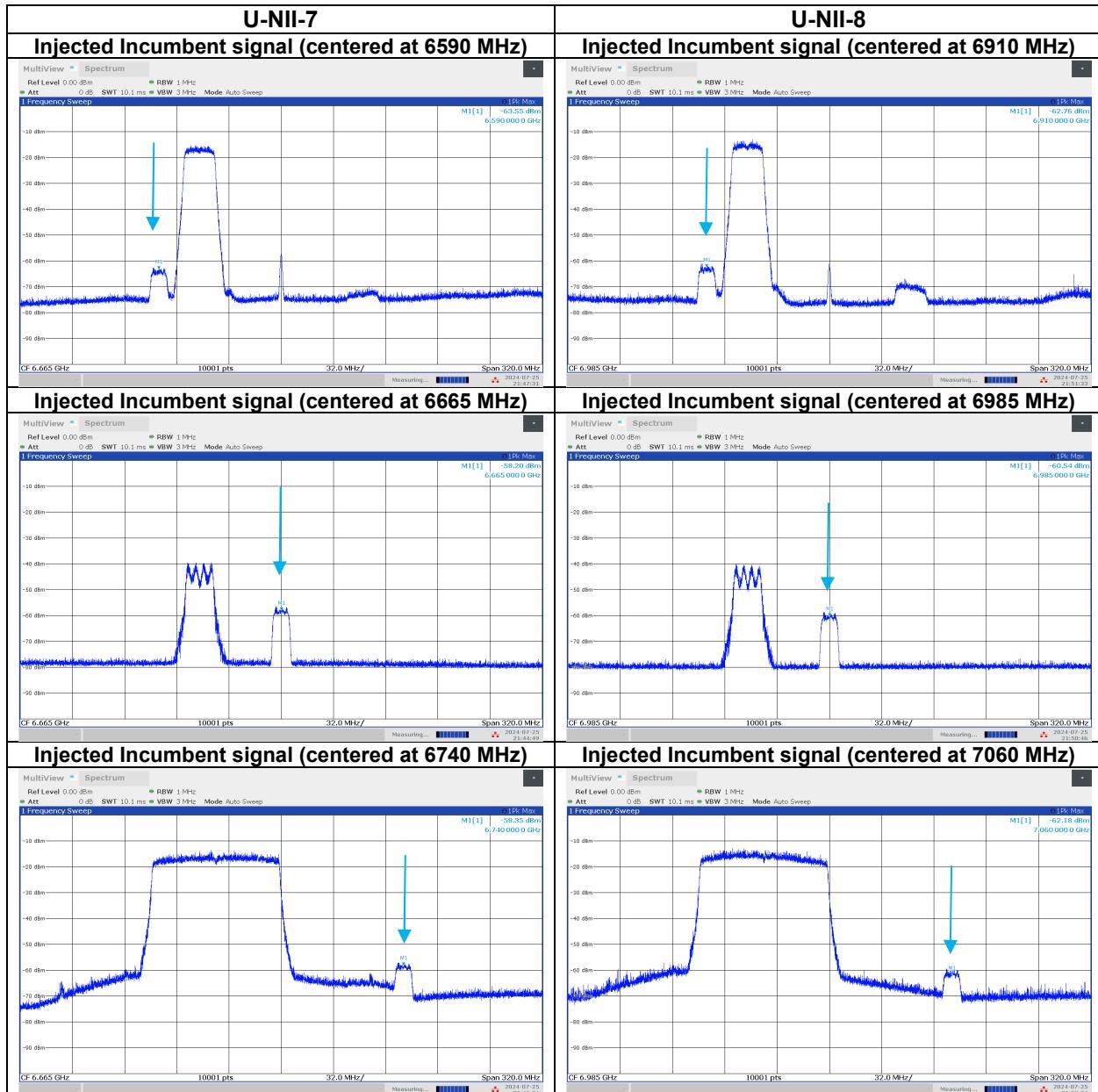
Contention Based Protocol

CBP Bandwidth Reduction Description

It was confirmed how the channel is reduced when AWGN is injected at the lower edge of the EUT channel, in the middle of EUT channel, and as closely as possible to the upper edge of the EUT channel.



Contention Based Protocol



→ : Incumbent signal

Contention Based Protocol

Incumbent signal detection results

UNII Band	Center Frequency [MHz]	BW [MHz]	Incumbent Frequency [MHz]	Incumbent Power [dBm]	customer's cable Loss [dB]	Antenna gain * [dBi]	Adjusted Incumbent Power [dBm]	Detection Limit [dBm]	EUT Tx Status
5	6175	20	6175	-75.12	0.57	-1.36	-74.33	-62.00	Ceased
				-77.92	0.57	-1.36	-77.13	-62.00	Minimal
				-78.12	0.57	-1.36	-77.33	-62.00	Normal
	6185	160	6110	-72.92	0.56	-1.36	-72.12	-62.00	Ceased
				-75.52	0.56	-1.36	-74.72	-62.00	Minimal
				-75.92	0.56	-1.36	-75.12	-62.00	Normal
			6185	-67.75	0.57	-1.36	-66.96	-62.00	Ceased
				-69.75	0.57	-1.36	-68.96	-62.00	Minimal
				-69.95	0.57	-1.36	-69.16	-62.00	Normal
			6260	-71.68	0.56	-1.36	-70.88	-62.00	Ceased
				-73.88	0.56	-1.36	-73.08	-62.00	Minimal
				-74.08	0.56	-1.36	-73.28	-62.00	Normal
6	6475	20	6475	-74.78	0.59	-1.36	-74.01	-62.00	Ceased
				-80.78	0.59	-1.36	-80.01	-62.00	Minimal
				-80.98	0.59	-1.36	-80.21	-62.00	Normal
	6505	160	6430	-71.84	0.56	-1.36	-71.04	-62.00	Ceased
				-76.24	0.56	-1.36	-75.44	-62.00	Minimal
				-76.44	0.56	-1.36	-75.64	-62.00	Normal
			6505	-70.17	0.59	-1.36	-69.40	-62.00	Ceased
				-72.57	0.59	-1.36	-71.80	-62.00	Minimal
				-72.77	0.59	-1.36	-72.00	-62.00	Normal
			6580	-72.66	0.59	-1.36	-71.89	-62.00	Ceased
				-76.86	0.59	-1.36	-76.09	-62.00	Minimal
				-77.06	0.59	-1.36	-76.29	-62.00	Normal

Adjusted Incumbent Power = Incumbent Power - Cable Loss - Antenna gain.

* The antenna gain value was applied as conservative condition (minimum antenna gain).

* Adjusted Incumbent power is injected level at EUT antenna that is adjusted by tested cable loss and antenna gain value.

The testing was performed with the AWGN signal set to Normal level (more than 20 dB below the -62 dBm threshold) and increased until the EUT detected and stopped transmitting (Ceased level).

EUT Tx Status means below

Ceased: The level at which no transmission is detected, consistently for a minimum period of 10 seconds.

Minimal: The AWGN level at which the system begins to trigger the transmission switch off, albeit not being kept off consistently.

Normal: The level at which there no apparent detection and the operation of the EUT is still considered optimal.

Contention Based Protocol

Incumbent signal detection results

UNII Band	Center Frequency [MHz]	BW [MHz]	Incumbent Frequency [MHz]	Incumbent Power [dBm]	customer's cable Loss [dB]	Antenna gain * [dBi]	Adjusted Incumbent Power [dBm]	Detection Limit [dBm]	EUT Tx Status
7	6695	20	6695	-76.50	0.59	-1.36	-75.73	-62.00	Ceased
				-78.50	0.59	-1.36	-77.73	-62.00	Minimal
				-78.70	0.59	-1.36	-77.93	-62.00	Normal
	6665	160	6590	-76.12	0.59	-1.36	-75.35	-62.00	Ceased
				-81.52	0.59	-1.36	-80.75	-62.00	Minimal
				-81.72	0.59	-1.36	-80.95	-62.00	Normal
			6665	-70.26	0.59	-1.36	-69.49	-62.00	Ceased
				-74.26	0.59	-1.36	-73.49	-62.00	Minimal
				-74.46	0.59	-1.36	-73.69	-62.00	Normal
			6740	-70.99	0.59	-1.36	-70.22	-62.00	Ceased
				-74.99	0.59	-1.36	-74.22	-62.00	Minimal
				-75.19	0.59	-1.36	-74.42	-62.00	Normal
8	6995	20	6995	-75.28	0.58	-1.36	-74.50	-62.00	Ceased
				-78.08	0.58	-1.36	-77.30	-62.00	Minimal
				-78.28	0.58	-1.36	-77.50	-62.00	Normal
	6985	160	6910	-73.44	0.58	-1.36	-72.66	-62.00	Ceased
				-76.64	0.58	-1.36	-75.86	-62.00	Minimal
				-76.84	0.58	-1.36	-76.06	-62.00	Normal
			6985	-70.62	0.58	-1.36	-69.84	-62.00	Ceased
				-73.22	0.58	-1.36	-72.44	-62.00	Minimal
				-73.42	0.58	-1.36	-72.64	-62.00	Normal
			7060	-71.97	0.57	-1.36	-71.18	-62.00	Ceased
				-76.57	0.57	-1.36	-75.78	-62.00	Minimal
				-76.77	0.57	-1.36	-75.98	-62.00	Normal

Adjusted Incumbent Power = Incumbent Power - Cable Loss - Antenna gain.

* The antenna gain value was applied as conservative condition (minimum antenna gain).

* Adjusted Incumbent power is injected level at EUT antenna that is adjusted by tested cable loss and antenna gain value.

The testing was performed with the AWGN signal set to Normal level (more than 20 dB below the -62 dBm threshold) and increased until the EUT detected and stopped transmitting (Ceased level).

EUT Tx Status means below

Ceased: The level at which no transmission is detected, consistently for a minimum period of 10 seconds.

Minimal: The AWGN level at which the system begins to trigger the transmission switch off, albeit not being kept off consistently.

Normal: The level at which there is no apparent detection and the operation of the EUT is still considered optimal.

Contention Based Protocol

Incumbent signal detection certainty results

UNII Band	Center Frequency [MHz]	BW [MHz]	Incumbent * Frequency [MHz]	Trial No.										Detection Rate [%]	Detection Rate Limit [%]
				1	2	3	4	5	6	7	8	9	10		
5	6175	20	6175	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6110	○	○	○	○	○	○	○	○	○	○	100.0	90.0
	6185	160	6185	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6260	○	○	○	○	○	○	○	○	○	○	100.0	90.0
6	6475	20	6475	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6430	○	○	○	○	○	○	○	○	○	○	100.0	90.0
	6505	160	6505	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6580	○	○	○	○	○	○	○	○	○	○	100.0	90.0
7	6695	20	6695	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6590	○	○	○	○	○	○	○	○	○	○	100.0	90.0
	6665	160	6665	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6740	○	○	○	○	○	○	○	○	○	○	100.0	90.0
8	6995	20	6995	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			6910	○	○	○	○	○	○	○	○	○	○	100.0	90.0
	6985	160	6985	○	○	○	○	○	○	○	○	○	○	100.0	90.0
			7060	○	○	○	○	○	○	○	○	○	○	100.0	90.0

"○" means EUT ceased.

Blank means EUT did not ceased.

* Test was performed at the level which the EUT Tx status was ceased.

APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CBP	145110	Digital Tester	SANWA	PC500	7019240	2024/05/29	12
CBP	145181	Coaxial Cable	Suhner	141PE	-	2024/07/02	12
CBP	145182	Coaxial Cable	Suhner	141PE	-	2024/07/02	12
CBP	146020	RF switch circuit	UL Japan	-	1	-	-
CBP	146261	Power Divider	Keysight Technologies Inc	11636B	56998	2024/04/04	12
CBP	146276	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G+	-	2023/11/22	12
CBP	146277	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G+	-	2023/11/22	12
CBP	146293	Thermo-Hygrometer	A&D Company	AD-5681	4062518	2023/08/03	12
CBP	157772	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G-S+	-	2023/08/10	12
CBP	167151	Step Attenuator	Keysight Technologies Inc	8494B	MY42157639	2024/02/14	12
CBP	167152	Step Attenuator	Keysight Technologies Inc	8496B	MY42151198	2024/02/14	12
CBP	196947	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803478/2	2024/03/07	12
CBP	196949	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803480/2	2024/03/07	12
CBP	197395	Microwave cable	RS Pro	R-132G7210 100CO	-	2024/04/10	12
CBP	202923	Microwave cable	RS Pro	R-132G7210 100CO	-	2023/11/24	12
CBP	226868	Signal Generator	Rohde & Schwarz	SMW200A	108835	2024/04/09	12
CBP	235269	Spectrum Analyzer	Rohde & Schwarz	FSW43	102488	2023/12/18	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

CBP: Contention Based Protocol