

RADIO TEST REPORT

Test Report No. 14854382S-AG-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 (5 GHz band) part DFS test only (* Client without radar detection)

Representative Test EngineerKenichi 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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- This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
- The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
- The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
- The information provided by the customer for this report is identified in SECTION 1.
- The laboratory is not responsible for information provided by the customer which can impact the validity of the results.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 14854382S-AG

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

Revision	Test Report No.	Date	Page Revised Contents																																																																																				
- (Original)	14854382S-AG	August 27, 2024	-																																																																																				
1	14854382S-AG-R1	September 18, 2024	<p>Clause 2.2 Corrected transmission patterns from;</p> <table><tr><th>Port</th><th>Mode</th><th>Config.1</th><th>Config.2</th><th>Config.3</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 *1)</td><td>Transmit</td></tr><tr><td>5G_CH0</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit *1)</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>-</td></tr><tr><td>2G_CH1</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit *1)</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>-</td></tr></table> <p>to;</p> <table><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></tr><tr><td>2G_CH0</td><td>Bluetooth</td><td>-</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit *1)</td></tr><tr><td>5G_CH0</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit</td><td>Transmit *1)</td></tr><tr><td>5G_CH0</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit</td><td>-</td></tr><tr><td>2G_CH1</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit</td><td>Transmit *1)</td></tr><tr><td>5G_CH1</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit</td><td>-</td></tr></table> <p>Clause 4.1 FCC Part 15.31 (e) Deleted “regardless of input voltage”. FCC Part 15.203 Antenna requirement 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>	Port	Mode	Config.1	Config.2	Config.3	Config.5	Config.6	2G_CH0	Bluetooth	-	-	Transmit	Transmit *1)	Transmit	5G_CH0	2.4 GHz	-	Transmit	-	Transmit *1)	-	5G_CH0	5 GHz / 6 GHz	Transmit	-	Transmit	-	-	2G_CH1	2.4 GHz	-	Transmit	Transmit	Transmit *1)	-	5G_CH1	5 GHz / 6 GHz	Transmit	-	Transmit	-	-	Port	Mode	Config.1	Config.2	Config.3	Config.4	Config.5	2G_CH0	Bluetooth	-	-	Transmit	Transmit	Transmit *1)	5G_CH0	2.4 GHz	-	Transmit	-	Transmit	Transmit *1)	5G_CH0	5 GHz / 6 GHz	Transmit	-	-	Transmit	-	2G_CH1	2.4 GHz	-	Transmit	Transmit	Transmit	Transmit *1)	5G_CH1	5 GHz / 6 GHz	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	Comite International Special des Perturbations Radioelectriques	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 5: 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 5.2
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	June 17, 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 / $\pi/4$ -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	-	-	Transmit	Transmit	Transmit *1)
	2.4 GHz	-	Transmit	-	-	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: Scope of Report

This report only covers DFS requirement, as specified by the following referenced procedures.

SECTION 4: Test specification, Procedures & Results

4.1 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
Test Specification	KDB 905462 D02 UNII DFS Compliance Procedure New Rules v02
Title	COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350MHz AND 5470-5725MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION
Test Specification	KDB905462 D03 Client Without DFS New Rules v01r02
Title	U-NII CLIENT DEVICES WITHOUT RADAR DETECTION CAPABILITY
Test Specification	KDB905462 D04 Operational Modes for DFS Testing New Rules v01
Title	OPERATIONAL MODES SUGGESTED FOR DFS TESTING

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.

4.2 Procedures and Results

Table 1: Applicability of DFS Requirements

< Client mode>

Requirement	Operating Mode	Test Procedures & Limits	Deviation	Results
	Client without Radar Detection			
U-NII Detection Bandwidth	Not required	KDB905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A	N/A
Initial Channel Availability Check Time	Not required	FCC15.407 (h)	N/A	N/A
		KDB905462 D02 UNII DFS Compliance Procedures New Rules v02		
		RSS-247 6.3		
Radar Burst at the Beginning of the Channel Availability Check Time	Not required	FCC15.407 (h)	N/A	N/A
		KDB905462 D02 UNII DFS Compliance Procedures New Rules v02		
		RSS-247 6.3		
Radar Burst at the End of the Channel Availability Check Time	Not required	FCC15.407 (h)	N/A	N/A
		KDB905462 D02 UNII DFS Compliance Procedures New Rules v02		
		RSS-247 6.3		
In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time	Yes	FCC15.407 (h)	N/A	Complied
		KDB905462 D02 UNII DFS Compliance Procedures New Rules v02		
		RSS-247 6.3		
In-Service Monitoring for Non-Occupancy period	Yes *	FCC15.407 (h)	N/A	Complied
		KDB905462 D02 UNII DFS Compliance Procedures New Rules v02		
		RSS-247 6.3		
Statistical Performance Check	Not required	FCC15.407 (h)	N/A	N/A
		KDB905462 D02 UNII DFS Compliance Procedures New Rules v02		
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.				

*Although this test was not required in FCC, KDB 905462 D02, it was performed as additional test.

Table 2 DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Notes 1,2, and 3)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
< 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
<p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p>Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.</p> <p>Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p>	

Table 3 DFS Response Requirement Values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2
U-NII Detection Bandwidth	Minimum 100 % of the U-NII 99 % transmission power bandwidth See Note 3
<p>Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.</p> <p>Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signal will not count quiet periods in between transmissions.</p> <p>Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.</p>	

Table 4 Short Pulse Radar Test Waveform

Radar Type	Pulse Width (μs)	PRI (μs)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μs, with a minimum increment of 1 μs, excluding PRI values selected in Test A	Roundup{(1/3 60)* (19*10 ⁶ /PRI _{us})}	60 %	30
2	1-5	150-230	23-29	60 %	30
3	6-10	200-500	16-18	60 %	30
4	11-20	200-500	12-16	60 %	30
Aggregate (Rader Types 1-4)				80 %	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 5 Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μs)	Chip Width (MHz)	PRI (μs)	Number of Pulses per Burst	Number of Burst	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5 - 20	1000-2000	1-3	8-20	80 %	30

Table 6 Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μs)	PRI (μs)	Pulse per Hop (kHz)	Hopping Rate (kHz)	Hopping Sequence Length (ms)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70 %	30

4.3 Addition to Standard

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

4.4 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 $k=2$.

Time Measurement uncertainty for this test was: $(\pm) 0.27\%$

4.5 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	-

4.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 5: Operation of EUT during testing

5.1 Operating Mode(s)

The EUT, which is a Client Device without Radar detection capability, operates over the U-NII-2A and U-NII-2C Band.

The channel-loading of approximately 17 % or greater was used for testing, and its test data was transferred from the Master Device to the Client Device for all test configurations.

WLAN traffic is generated random data by iperf program from the Master to the Client.

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

The FCC ID for the Master Device used with EUT for DFS testing is MSQ-RTAXHP00.

The rated output power of the Master unit is >200 mW (23 dBm). Therefore the required interference threshold level is -64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is $-64 + 1 + 0 = -63.0$ dBm (threshold level + additional 1 dB + antenna gain).

It is impossible for users to change DFS control, because the DFS function is written on the firmware and users cannot access it.

The EUT was set by the software as follows:

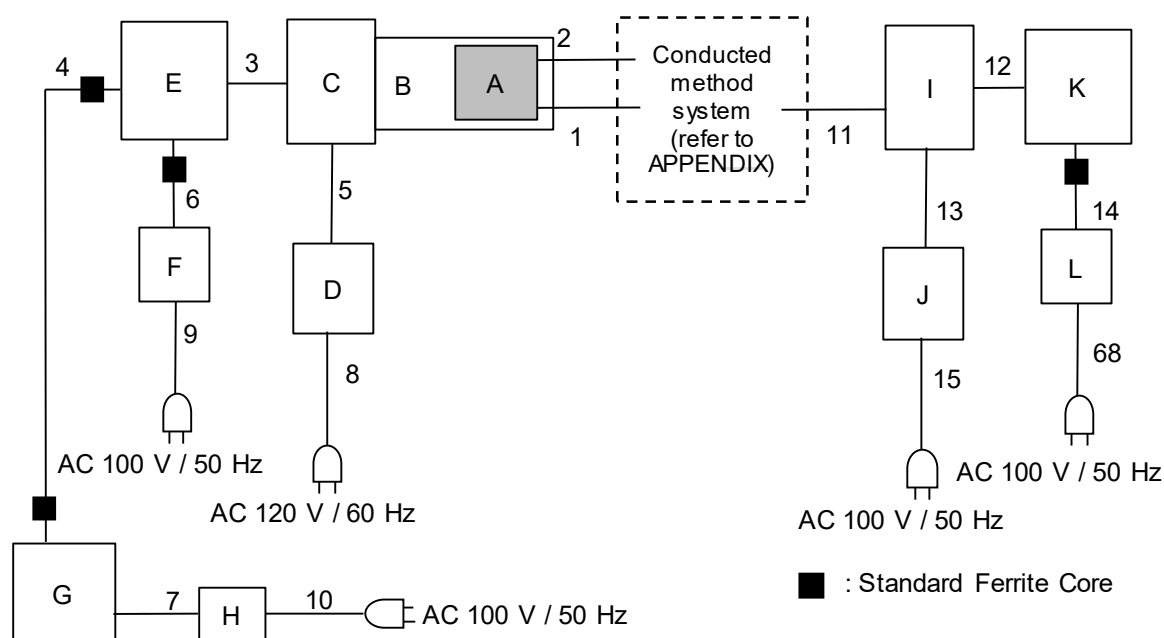
Software name & version:

connect_AP_Qcom.sh, Version 1.0

iperf.exe, version 2.0.9

(all program, Date: March 24, 2021, Storage location: Driven by connected PC(i.MX 8M Quad))

5.2 Configuration and peripherals



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

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)	RPE-4323	150D015G2	RS Pro	-
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	ThinkPad E14 Gen2	PF397TQG	LENOVO	-
H	AC Adapter	ADLX65YCC2D	8SSA10R16922C2TJ19M1368	LENOVO	-
I	Wireless-AX6000 Dual Band Gigabit Router	RT-AX88U	N3IG392024277EW	ASUSTek Computer Inc.	-
J	AC Adapter	ADH011	ADH01117AG212935824A	Acbel Polytech Inc.	-
K	Laptop PC	Type 20H1-CT01WW	PF-0UU34A	Lenovo	-
L	AC Adapter	ADLX45DLC2A	8SSA10E75792L1CZ75Z0W0R	Lenovo	-

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	0.5	Unshielded	Unshielded	-
11	Antenna	0.1	Shielded	Shielded	-
12	LAN	1.5	Unshielded	Unshielded	-
13	DC	1.5	Unshielded	Unshielded	-
14	DC	1.8	Unshielded	Unshielded	-
15	AC	0.9	Unshielded	Unshielded	-
16	AC	0.9	Unshielded	Unshielded	-

5.3 Test and Measurement System

SYSTEM OVERVIEW

The measurement system is based on a conducted test method.

The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution. The short pulse types 1, 2, 3, and 4, the long pulse type 5, and the frequency hopping type 6 parameters are randomized at run-time.

The signal monitoring equipment consists of a spectrum analyzer with the capacity to display 10001 bins on the horizontal axis. A time-domain resolution of 1.6 ms/bin is achievable with a 16 second sweep time, meeting the 10 seconds short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection.

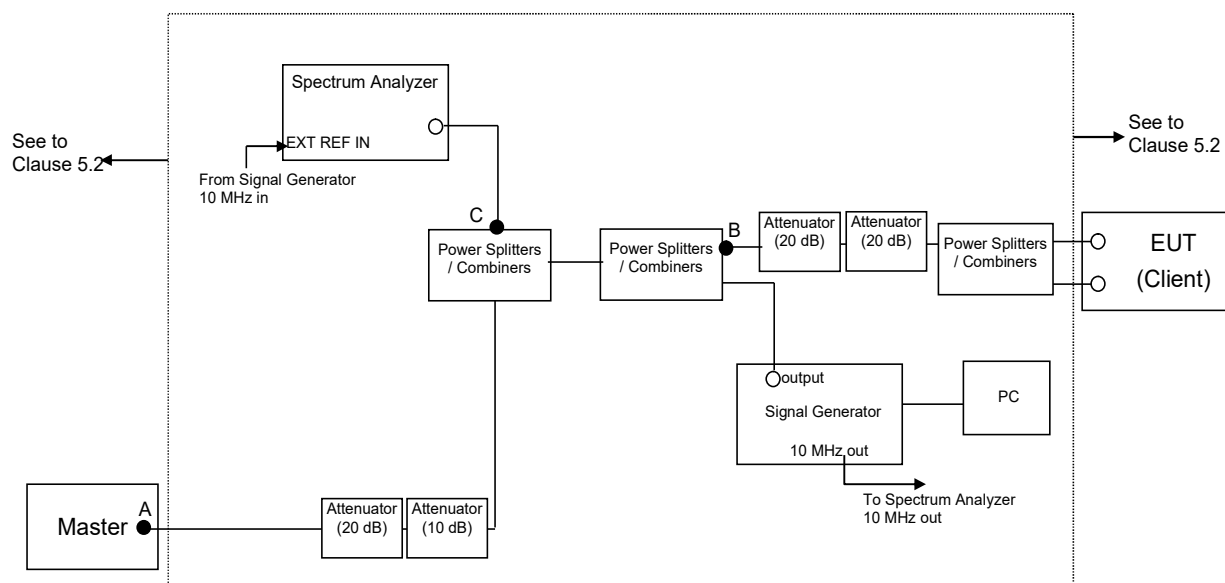
FREQUENCY HOPPING RADAR WAVEFORM GENERATING SUBSYSTEM

The first 100 frequencies are selected out of the hopping sequence of the randomized 475 hop frequencies.

Only a *Burst* that has the frequency falling within the receiver bandwidth of the tested U-NII device is selected among those frequencies. (Frequency-domain simulation). The radar waveform generated at the start time of the selected *Burst* (Time-domain simulation) is download to the Signal Generator. If all of the randomly selected 100 frequencies do not fall within the receiver bandwidth of the U-NII device, the radar waveform is not used for the test.

CONDUCTED METHODS SYSTEM BLOCK DIAGRM

<Client mode>



MEASUREMENT SYSTEM FREQUENCY REFERENCE

Lock the signal generator and the spectrum analyzer to the same reference sources as follows: Connect the 10 MHz OUT on the signal generator to the EXT REF IN on the spectrum analyzer and set the spectrum analyzer Ext to On.

SYSTEM CALIBRATION

Step 1: Set the system as shown in Figure 3 of KDB905462 D02, 7.2.2.

Step 2: Adjust each attenuator to fulfill the following three conditions:

- WLAN can be communicated, and
- Radar detection threshold level is bigger than Client Device traffic level on the spectrum analyzer, and
- Master Device traffic level is not displayed on the spectrum analyzer.

Step 3: Terminate 50 ohm at B and C points, and connect the spectrum analyzer to the point A. (See the figure on before page of Clause 5.3)

At the point A, adjust the signal generator and spectrum analyzer to the center frequency of the channel to be measured.

Download the applicable radar waveforms to the signal generator. Select the radar waveform, trigger a burst manually and measure the amplitude on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection threshold.

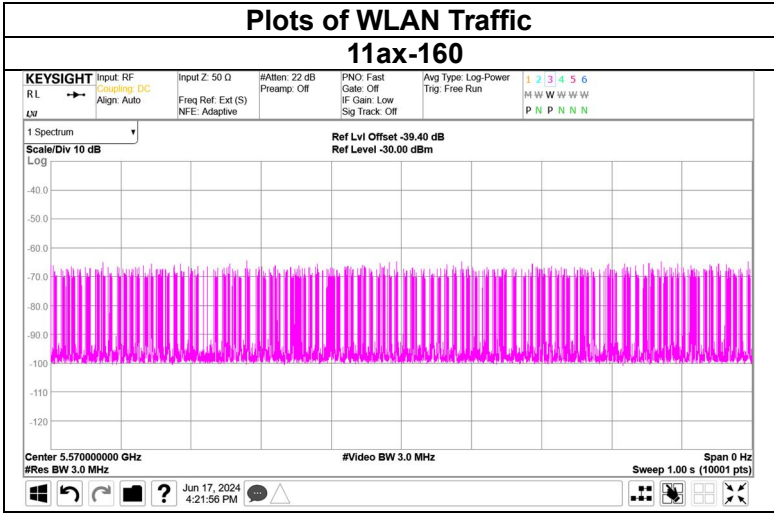
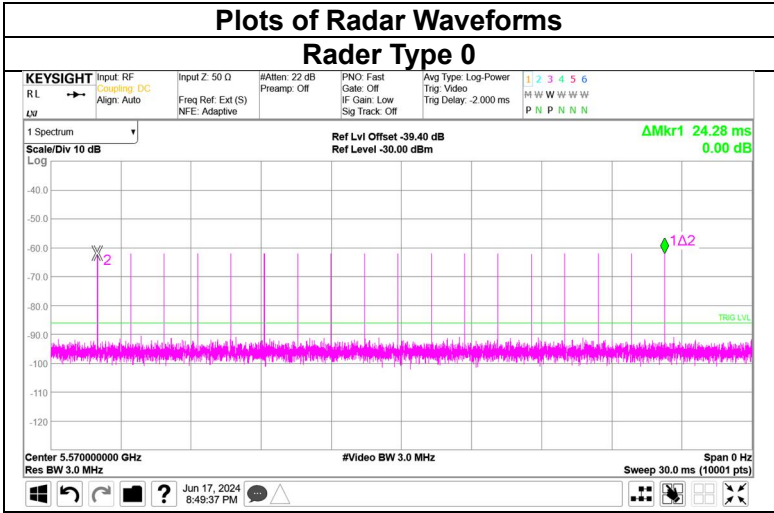
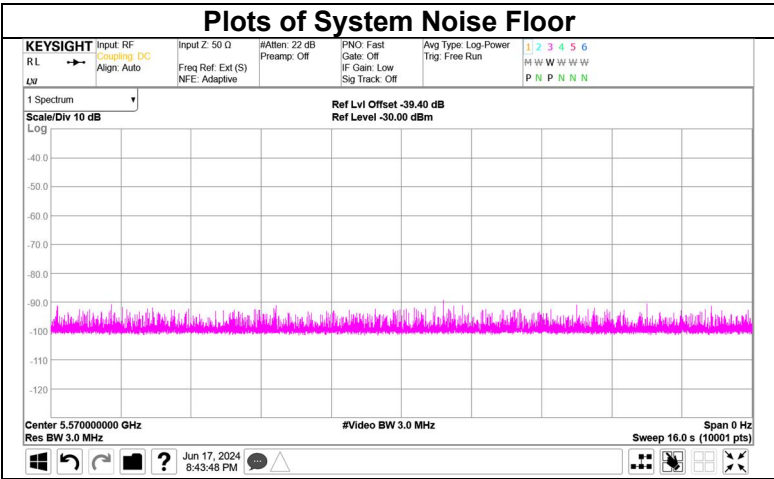
Separate signal generator amplitude settings are determined as required for each radar type.

Step 4: Without changing any of the instrument settings, restore the system setting to Step 2 and adjust the Reference Level Offset of the spectrum analyzer to the level at Step 3.

By taking the above steps 1 to 4, the spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device.

See Clause 5.4 for Plots of Noise, Radar Waveforms, and WLAN signals.

5.4 Plots of Noise, Rader Waveforms, and WLAN signals



SECTION 6: Channel Move Time, Channel Closing Transmission Time

6.1 Operating environment

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	June 17, 2024
Temperature/ Humidity	25 deg. C / 44 % RH
Engineer	Kenichi Adachi
Mode	11ax-160

6.2 Test Procedure

Transmit the data from the Master Device to the Client Device on the test Channel for the entire period of the test.

The Radar Waveform generator sends a Burst of pulses for one of the Radar Types 0 at levels defined on the Operating Channel. An additional 1 dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.

Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds.

6.3 Test data

11ax-160

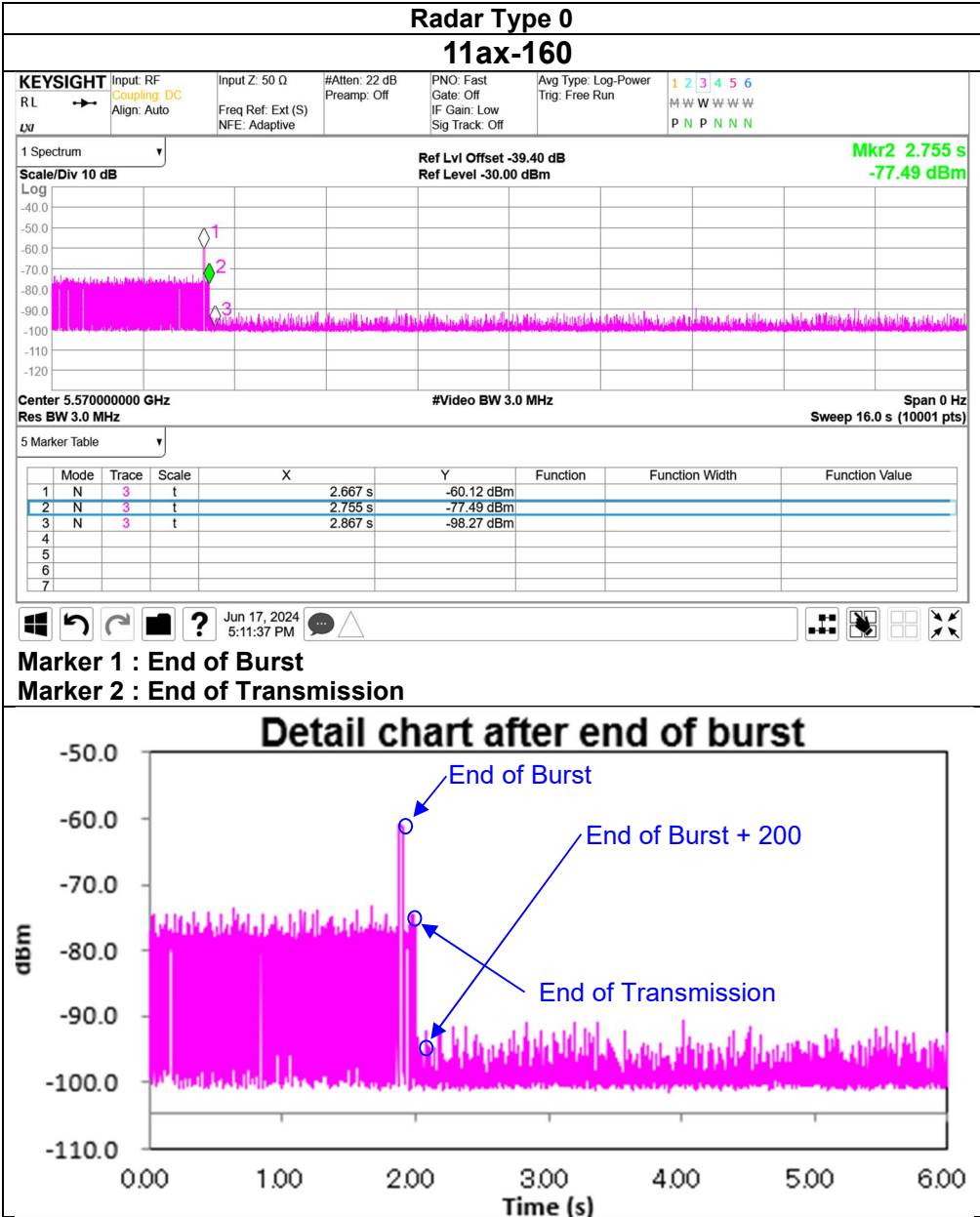
Test Item	Unit	Measurement Time	Limit	Results
Channel Move Time *1)	[s]	0.088	10.000	Pass
Channel Closing Transmission Time *2)	[ms]	0	60	Pass

*1) Channel Move Time is calculated as follows:

$$(\text{Channel Move Time}) = (\text{End of Transmission}) - (\text{End of Burst}) = 2.755 - 2.667$$

*2) Channel Closing Transmission Time is calculated from (End of Burst + 200 ms) to (End of Burst + 10 s)

$$(\text{Channel Closing Transmission Time}) = (\text{Number of analyzer bins showing transmission}) \times (\text{dwell time per bin}) \\ = 0 \times 1.6 \text{ [ms]}$$



6.4 Test result

Test result: Pass

SECTION 7: Non-Occupancy Period

7.1 Operating environment

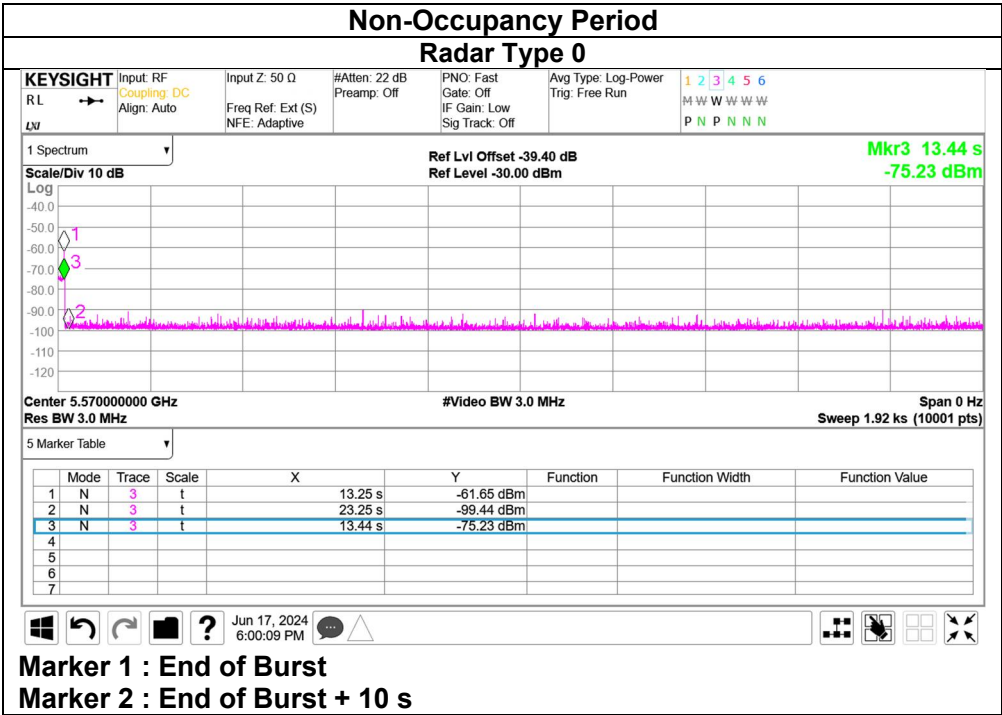
Test place Shonan EMC Lab. No.5 Shielded Room
Date June 17, 2024
Temperature/ Humidity 25 deg. C / 44 % RH
Engineer Kenichi Adachi
Mode 11ax-160

7.2 Test Procedure

The following two tests are performed:

- 1). Transmit the data from the Master Device to the Client Device on the test Channel for the entire period of the test.
- The Radar Waveform generator sends a Burst of pulses for one of the Radar Types 0 (Client Device) at levels defined on the Operating Channel. An additional 1 dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.
- Observe the transmissions of the EUT after the Channel Move Time on the Operating Channel for duration greater than 30 minutes.

7.3 Test data



7.4 Test result

Test result: Pass

APPENDIX 1: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
DFS	144864	Radar Generating Software for DFS	Keysight Technologies Inc	-	-	-	-
DFS	145144	Attenuator	Keysight Technologies Inc	8493C-020	74891	2024/03/05	12
DFS	145175	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	2023/12/08	12
DFS	145182	Coaxial Cable	Suhner	141PE	-	2024/07/02	12
DFS	145804	Signal Generator	Keysight Technologies Inc	E4438C	MY47271584	2024/04/27	12
DFS	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2023/09/25	12
DFS	146277	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G+	-	2023/11/22	12
DFS	151609	Attenuator	Weinschel Corp.	54A-10	81601	2024/03/12	12
DFS	157772	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G-S+	-	2023/08/10	12
DFS	157774	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G-S+	-	2023/08/10	12
DFS	191845	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/07	12
DFS	202923	Microwave cable	RS Pro	R-132G7210 100CO	-	2023/11/24	12
DFS	235697	Coaxial Cable	Hayashi-Repic co., Ltd.	KMS020B-GL140sE-KMS020B-2.0m	47456-01-01	2024/04/09	12
DFS	236375	Microwave cable	RS Pro	R-132G7210 100CO	-	2024/04/10	12
DFS	236410	Spectrum Analyzer	Keysight Technologies Inc	N9030B	MY63050151	2024/04/26	12
DFS	242070	Attenuator	Weinschel Corp.	54A-20	120415	2023/11/02	12
DFS	242072	Attenuator	Weinschel Corp.	54A-20	120518	2023/11/02	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:

DFS: Dynamic Frequency Selection