RADIO TEST REPORT

Test Report No. 15058392M-B

Customer	**ALPS ALPINE CO., LTD.**
Description of EUT	**Head unit**
Model Number of EUT	**AH00ICB 4**
FCC ID	**A269ZUA171**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**June 25, 2024**
Remarks	**Bluetooth (BR / EDR) parts** **Radiated Spurious Emission only**

Representative Test Engineer	Approved By
Kazuhiro Ando Engineer	Kenichi Suda Manager

CERTIFICATE 1266.01

☐ 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

ANNOUNCEMENT

- This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
- The results in this report apply only to the sample tested. (Laboratory was not involved in sampling.)
- This sample tested is in compliance with the limits of the above regulation.
- The test results in this test report are traceable to the national or international standards.
- This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
- 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. Kashima 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.: 15058392M-B

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15058392M-B	June 25, 2024	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
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	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

CONTENTS PAGE

SECTION 1: Customer Information 5
SECTION 2: Equipment Under Test (EUT).....5
SECTION 3: Test Specification, Procedures & Results 7
SECTION 4: Operation of EUT during testing 9
SECTION 5: Radiated Spurious Emission.....12
APPENDIX 1: Test data 14
Radiated Spurious Emission.....15
APPENDIX 2: Test Instruments 36
APPENDIX 3: Photographs of test setup.....37
Radiated Spurious Emission.....37

SECTION 1: Customer Information

Company Name	ALPS ALPINE CO., LTD.
Address	20-1 Yoshima Industrial park, Iwaki, Fukushima, Japan 970-1192
Telephone Number	+81-246-36-4111
Contact Person	Kenji Nagase

The information provided by 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	Head unit
Model Number	AH00ICB 4
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	January 23, 2024
Test Date	March 11 to 13, 2024

2.2 Product Description

General Specification

Rating	DC 13.2 V
Operating temperature	-30 deg. C to +70 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 / Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	BT: FHSS (GFSK, π/4 DQPSK, 8 DPSK) BT LE: GFSK
Antenna Type	Planar Inverted-F Antenna
Antenna Gain[a)]	-0.2 dBi

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

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
Antenna Type	Planar Inverted-F Antenna
Antenna Gain[a)]	-0.78 dBi

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

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
	40 MHz Band	5190 MHz to 5230 MHz 5270 MHz to 5310 MHz 5510 MHz to 5710 MHz 5755 MHz to 5795 MHz
	80 MHz Band	5210 MHz 5290 MHz 5530 MHz to 5690 MHz 5775 MHz
Type of Modulation	OFDM	
Antenna Type	Planar Inverted-F Antenna	
Antenna Gain[a)]	+2.71 dBi (Chain 1) +2.29 dBi (Chain 2)	

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Spurious Emission & Band Edge Compliance	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	7.6 dB 36.250 MHz, QP, Vertical Mode: Tx, Hopping Off, 3DH5 2441 MHz with Tx 11a 5180 MHz	Complied	Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			
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. *1) Radiated test was selected over 30 MHz based on section 15.247(d).					

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the RF Part regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 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.

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.2 dB
	30 MHz to 200 MHz	6.2 dB
	200 MHz to 1000 MHz	6.3 dB
	1 GHz to 6 GHz	4.7 dB
	6 GHz to 18 GHz	5.1 dB
	18 GHz to 40 GHz	5.5 dB
1 m	1 GHz to 18 GHz	5.2 dB
	18 GHz to 40 GHz	5.6 dB
0.5 m	26.5 GHz to 40 GHz	5.8 dB

3.5 Test Location

UL Japan, Inc. Kashima EMC Lab.
1614 Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan
Telephone: +81-478-88-6500
A2LA Certificate Number: 1266.01 / FCC Test Firm Registration Number: 910230
ISED Lab Company Number: 4659A / CAB identifier: JP0006

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	6.0 x 5.5 x 2.5	20 x 40	10 m
No.5 Open site	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	5.4 x 4.5 x 2.3	-	-
No.5 Shielded Room	4.2 x 3.1 x 2.5	-	-
No.9 Shielded Room	6.1 x 3.6 x 2.8	-	-
No.6 Semi-anechoic Chamber	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	4.3 x 4.4 x 2.7	-	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

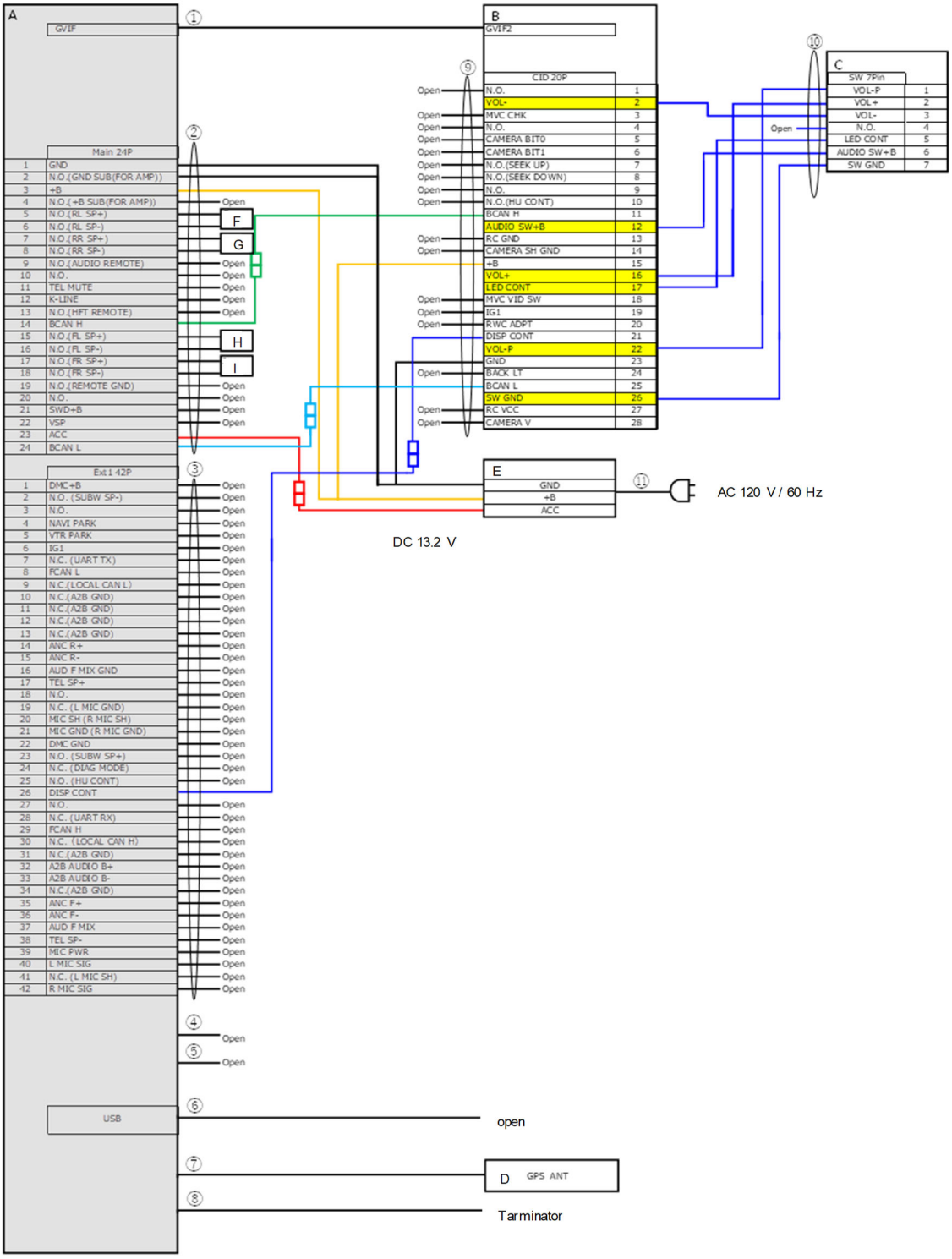
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth (BT)	BR / EDR, Payload: PRBS9
*EUT has the power settings by the software as follows; Power Setting: BR: 8 (Setting value) EDR: 9 (Setting value) Software: QRCT (Qualcomm Radio Control Toolkit) Version: 4.0.00195.0 (Date: 2021.10.19, Storage location: Driven by connected PC) *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.	

Details of Operating Mode(s)

Test Item	Mode	Tested Antenna	Tested Frequency
Radiated Spurious Emission (Below 1 GHz)	Tx (Hopping Off) 3DH5 Tx (Hopping Off) 3DH5 with Tx 11a 5180 MHz	Chain 2	2441 MHz *1)
Radiated Spurious Emission (Above 1 GHz)	Tx (Hopping Off) DH5 Tx (Hopping Off) 3DH5	Chain 2	2402 MHz 2441 MHz 2480 MHz
	Tx (Hopping Off) DH5 with Tx 11a 5180 MHz	Chain 2	2402 MHz *2) 2480 MHz *2)
	Tx (Hopping Off) 3DH5 with Tx 11a 5180 MHz	Chain 2	2402 MHz *2) 2441 MHz 2480 MHz *2)
*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test) *2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative. *It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all the test items based on Bluetooth Core specification.			
*1) Radiated spurious emissions for frequencies below 1 GHz were limited to the channel that had the highest power during the antenna terminal test, as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands. *2) Band-edge only			

4.2 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	Head unit	AH00ICB 4	13	ALPS ALPINE CO., LTD.	EUT
B	Display	QH00274A	9	ALPS ALPINE CO., LTD.	-
C	Switch Unit	-	-	ALPS ALPINE CO., LTD.	-
D	GPS Antenna	8B550-T20-A111-M1	17430300	YOKOWO	-
E	DC Power Supply	GSV3000	60646742	DIAMOND ANTENNA	-
F	Speaker	KFC-RS101	-	JVC KENWOOD	-
G	Speaker	KFC-RS101	-	JVC KENWOOD	-
H	Speaker	KFC-RS101	-	JVC KENWOOD	-
I	Speaker	KFC-RS101	-	JVC KENWOOD	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	GVIF Cable	2.4	Shielded	Shielded	-
2	Main Harness	2.2	Unshielded	Unshielded	-
3	EXT1 Harness	2.1	Unshielded	Unshielded	-
4	Ethernet Cable	2.2	Unshielded	Unshielded	-
5	EXT2 Cable	2.1	Unshielded	Unshielded	-
6	USB Cable	2.2	Shielded	Shielded	-
7	GPS Antenna Cable	2.2 + 0.5	Shielded	Shielded	-
8	Tuner Cable (Main/Sub)	2.2	Shielded	Shielded	-
9	Display Harness	1.5	Unshielded	Unshielded	-
10	Switch Unit Harness	0.5 + 0.5	Unshielded	Unshielded	-
11	AC Power Cable	2.0	Unshielded	Unshielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 1 GHz	Above 1 GHz
Antenna Type	Hybrid	Horn

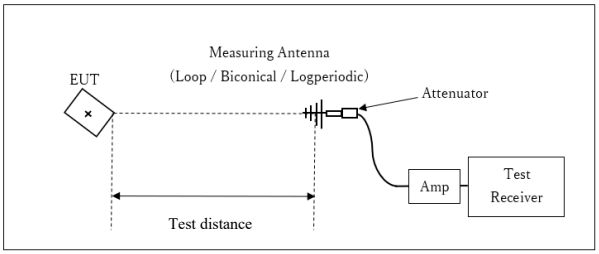
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 1/T (T: burst length, refer to Burst rate confirmation sheet) Detector: Peak	RBW: 100 kHz VBW: 300 kHz

Figure 2: Test Setup

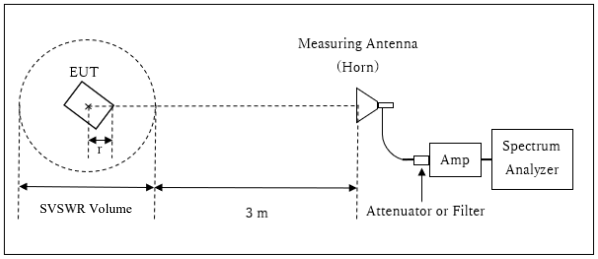
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

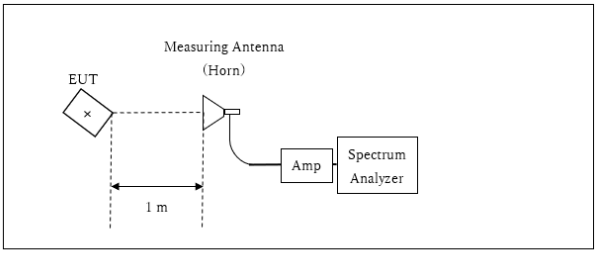


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.89 m / 3.0 m) = 2.26 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.89 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.11 m

10 GHz to 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.54 dB
*Test Distance: 1 m

The test was made on EUT at the normal use position.

Test results are rounded off and limit are rounded down, so some differences might be observed.

Measurement Range : 30 MHz to 26.5 GHz
Test Data : APPENDIX
Test Result : Pass

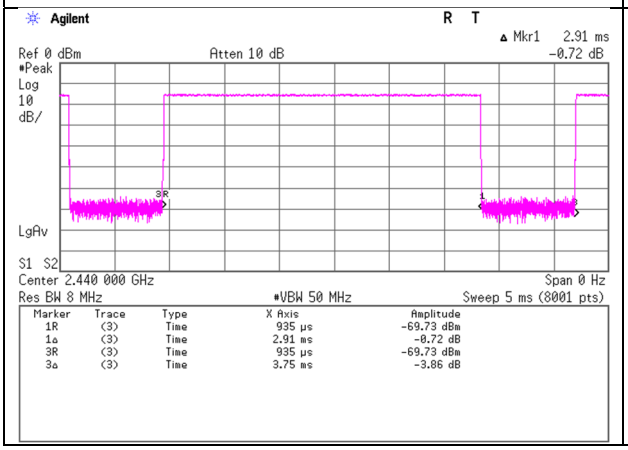
APPENDIX 1: Test data

Burst Rate Confirmation

Test place	Kashima EMC Lab. No.11 Semi-anechoic Chamber
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off

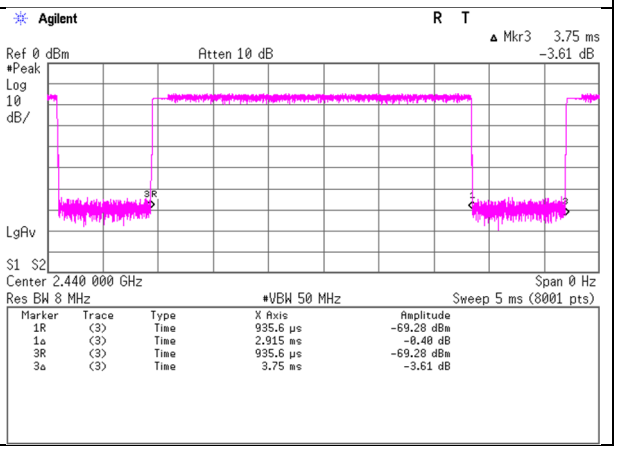
DH5

Tx on / (Tx on + Tx off) =	**0.776**
Tx on / (Tx on + Tx off) * 100 =	**77.6 %**
Duty factor = 10 * log (3.75 / 2.91) =	**1.10 dB**
VBW: 1 / on time = 343.6 Hz <	**360.00 Hz**



3DH5

Tx on / (Tx on + Tx off) =	**0.777**
Tx on / (Tx on + Tx off) * 100 =	**77.7 %**
Duty factor = 10 * log (3.75 / 2.915) =	**1.09 dB**
VBW: 1 / on time = 343.1 Hz <	**360.00 Hz**



Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	1481.760	PK	54.39	25.52	12.44	46.47	2.26	48.14	73.9	25.7	214	148	
Hori.	2390.000	PK	52.73	27.46	13.21	46.26	2.26	49.40	73.9	24.5	206	57	
Hori.	4804.000	PK	52.23	32.57	5.63	45.77	2.26	46.92	73.9	26.9	150	0	Floor noise
Hori.	7206.000	PK	49.02	37.05	6.97	44.83	2.26	50.47	73.9	23.4	150	0	Floor noise
Hori.	9608.000	PK	48.19	37.94	7.89	43.17	2.26	53.11	73.9	20.7	150	0	Floor noise
Hori.	1481.760	AV	43.84	25.52	12.44	46.47	2.26	37.59	53.9	16.3	214	148	VBW 10 Hz
Hori.	2390.000	AV	41.79	27.46	13.21	46.26	2.26	38.46	53.9	15.4	206	57	VBW 360 Hz
Hori.	4804.000	AV	41.39	32.57	5.63	45.77	2.26	36.08	53.9	17.8	150	0	Floor noise
Hori.	7206.000	AV	38.00	37.05	6.97	44.83	2.26	39.45	53.9	14.4	150	0	Floor noise
Hori.	9608.000	AV	36.58	37.94	7.89	43.17	2.26	41.50	53.9	**12.4**	150	0	Floor noise
Vert.	1481.760	PK	54.47	25.52	12.44	46.47	2.26	48.22	73.9	25.6	268	114	
Vert.	2390.000	PK	52.93	27.46	13.21	46.26	2.26	49.60	73.9	24.3	271	86	
Vert.	4804.000	PK	52.63	32.57	5.63	45.77	2.26	47.32	73.9	26.5	150	0	Floor noise
Vert.	7206.000	PK	49.64	37.05	6.97	44.83	2.26	51.09	73.9	22.8	150	0	Floor noise
Vert.	9608.000	PK	47.85	37.94	7.89	43.17	2.26	52.77	73.9	21.1	150	0	Floor noise
Vert.	1481.760	AV	43.82	25.52	12.44	46.47	2.26	37.57	53.9	16.3	268	114	VBW 10 Hz
Vert.	2390.000	AV	41.76	27.46	13.21	46.26	2.26	38.43	53.9	15.4	271	86	VBW 360 Hz
Vert.	4804.000	AV	41.57	32.57	5.63	45.77	2.26	36.26	53.9	17.6	150	0	Floor noise
Vert.	7206.000	AV	37.82	37.05	6.97	44.83	2.26	39.27	53.9	14.6	150	0	Floor noise
Vert.	9608.000	AV	36.48	37.94	7.89	43.17	2.26	41.40	53.9	12.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

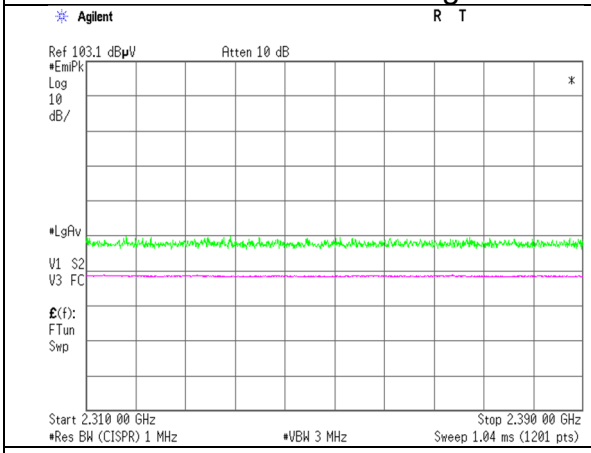
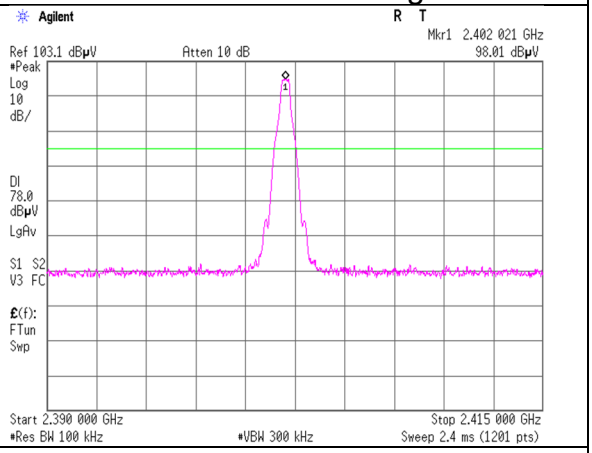
20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

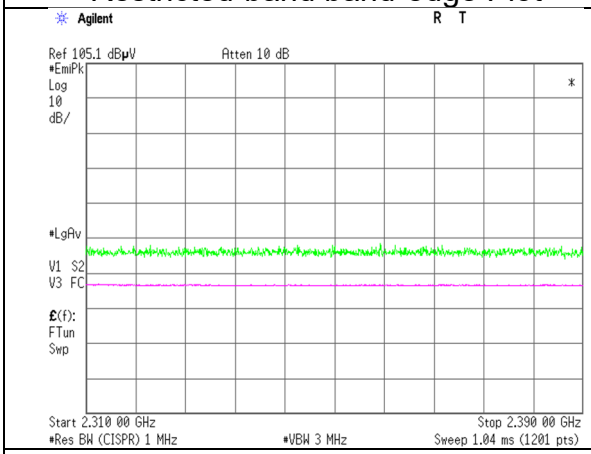
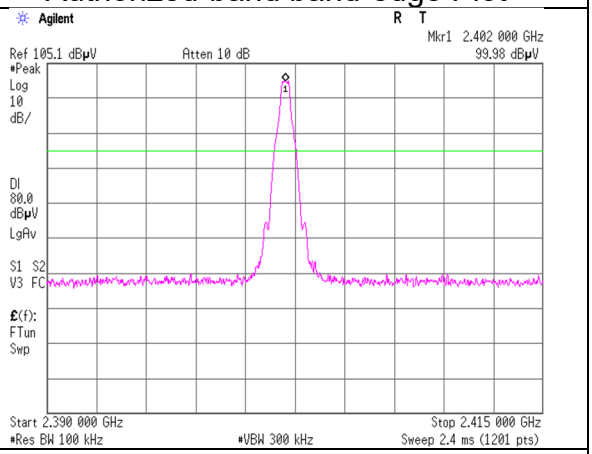
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	98.01	27.45	13.22	46.25	2.26	94.69	-	-	Carrier
Hori.	2400.000	PK	44.54	27.44	13.22	46.25	2.26	41.21	74.7	33.4	-
Vert.	2402.000	PK	99.98	27.45	13.22	46.25	2.26	96.66	-	-	Carrier
Vert.	2400.000	PK	44.65	27.44	13.22	46.25	2.26	41.32	76.7	35.3	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	1481.760	PK	54.51	25.52	12.44	46.47	2.26	48.26	73.9	25.6	190	145	
Hori.	4882.000	PK	51.27	32.59	5.68	45.76	2.26	46.04	73.9	27.8	150	0	Floor noise
Hori.	7323.000	PK	49.65	37.39	7.00	44.64	2.26	51.66	73.9	22.2	150	0	Floor noise
Hori.	9764.000	PK	47.18	37.92	7.96	43.12	2.26	52.20	73.9	21.7	150	0	Floor noise
Hori.	1481.760	AV	43.19	25.52	12.44	46.47	2.26	36.94	53.9	16.9	190	145	VBW 10 Hz
Hori.	4882.000	AV	40.00	32.59	5.68	45.76	2.26	34.77	53.9	19.1	150	0	Floor noise
Hori.	7323.000	AV	38.03	37.39	7.00	44.64	2.26	40.04	53.9	13.8	150	0	Floor noise
Hori.	9764.000	AV	36.34	37.92	7.96	43.12	2.26	41.36	53.9	12.5	150	0	Floor noise
Vert.	1481.760	PK	55.50	25.52	12.44	46.47	2.26	49.25	73.9	24.6	157	55	
Vert.	4882.000	PK	52.21	32.59	5.68	45.76	2.26	46.98	73.9	26.9	150	0	Floor noise
Vert.	7323.000	PK	49.00	37.39	7.00	44.64	2.26	51.01	73.9	22.8	150	0	Floor noise
Vert.	9764.000	PK	47.79	37.92	7.96	43.12	2.26	52.81	73.9	21.0	150	0	Floor noise
Vert.	1481.760	AV	43.06	25.52	12.44	46.47	2.26	36.81	53.9	17.0	157	55	VBW 10 Hz
Vert.	4882.000	AV	40.12	32.59	5.68	45.76	2.26	34.89	53.9	19.0	150	0	Floor noise
Vert.	7323.000	AV	37.67	37.39	7.00	44.64	2.26	39.68	53.9	14.2	150	0	Floor noise
Vert.	9764.000	AV	36.49	37.92	7.96	43.12	2.26	41.51	53.9	**12.3**	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	1481.760	PK	54.88	25.52	12.44	46.47	2.26	48.63	73.9	25.2	113	171	
Hori.	2483.500	PK	53.69	27.94	13.29	46.16	2.26	51.02	73.9	22.8	117	56	
Hori.	4960.000	PK	51.65	32.75	5.72	45.75	2.26	46.63	73.9	27.2	150	0	Floor noise
Hori.	7440.000	PK	50.21	37.35	7.06	44.58	2.26	52.30	73.9	21.6	150	0	Floor noise
Hori.	9920.000	PK	47.79	38.08	8.03	43.21	2.26	52.95	73.9	20.9	150	0	Floor noise
Hori.	1481.760	AV	45.63	25.52	12.44	46.47	2.26	39.38	53.9	14.5	113	171	VBW 10 Hz
Hori.	2483.500	AV	42.12	27.94	13.29	46.16	2.26	39.45	53.9	14.4	117	56	VBW 360 Hz
Hori.	4960.000	AV	40.14	32.75	5.72	45.75	2.26	35.12	53.9	18.7	150	0	Floor noise
Hori.	7440.000	AV	38.81	37.35	7.06	44.58	2.26	40.90	53.9	13.0	150	0	Floor noise
Hori.	9920.000	AV	35.91	38.08	8.03	43.21	2.26	41.07	53.9	12.8	150	0	Floor noise
Vert.	1481.760	PK	54.15	25.52	12.44	46.47	2.26	47.90	73.9	26.0	189	169	
Vert.	2483.500	PK	53.95	27.94	13.29	46.16	2.26	51.28	73.9	22.6	191	270	
Vert.	4960.000	PK	51.82	32.75	5.72	45.75	2.26	46.80	73.9	27.1	150	0	Floor noise
Vert.	7440.000	PK	50.26	37.35	7.06	44.58	2.26	52.35	73.9	21.5	150	0	Floor noise
Vert.	9920.000	PK	47.77	38.08	8.03	43.21	2.26	52.93	73.9	20.9	150	0	Floor noise
Vert.	1481.760	AV	42.98	25.52	12.44	46.47	2.26	36.73	53.9	17.1	189	169	VBW 10 Hz
Vert.	2483.500	AV	42.25	27.94	13.29	46.16	2.26	39.58	53.9	14.3	191	270	VBW 360 Hz
Vert.	4960.000	AV	40.16	32.75	5.72	45.75	2.26	35.14	53.9	18.7	150	0	Floor noise
Vert.	7440.000	AV	38.86	37.35	7.06	44.58	2.26	40.95	53.9	12.9	150	0	Floor noise
Vert.	9920.000	AV	35.98	38.08	8.03	43.21	2.26	41.14	53.9	**12.7**	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

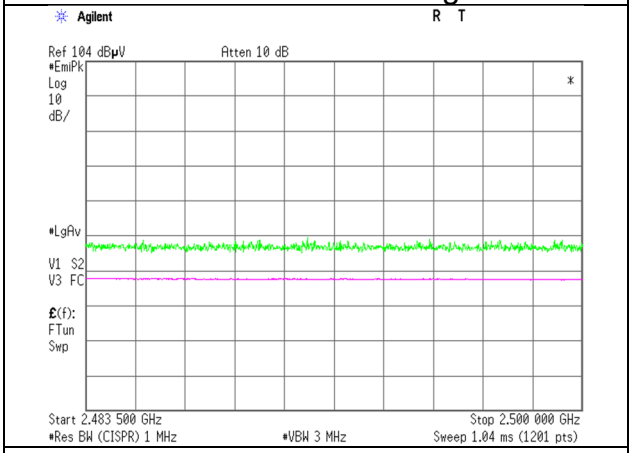
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for bandto edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz

Horizontal

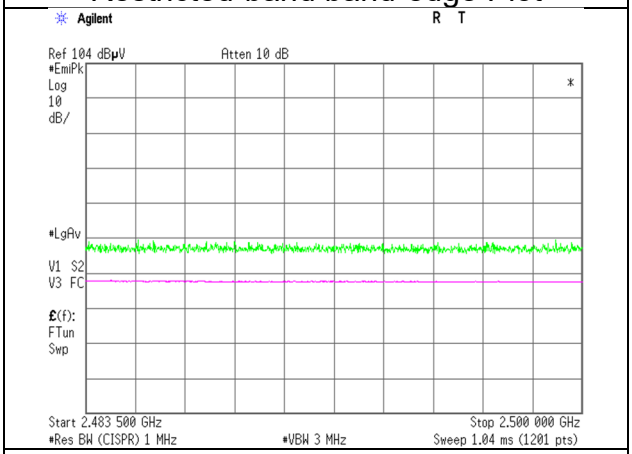
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	1481.760	PK	54.75	25.52	12.44	46.47	2.26	48.50	73.9	25.4	207	77	
Hori.	2390.000	PK	53.73	27.46	13.21	46.26	2.26	50.40	73.9	23.5	275	57	
Hori.	4804.000	PK	52.32	32.57	5.63	45.77	2.26	47.01	73.9	26.8	150	0	Floor noise
Hori.	7206.000	PK	49.27	37.05	6.97	44.83	2.26	50.72	73.9	23.1	150	0	Floor noise
Hori.	9608.000	PK	48.05	37.94	7.89	43.17	2.26	52.97	73.9	20.9	150	0	Floor noise
Hori.	1481.760	AV	42.62	25.52	12.44	46.47	2.26	36.37	53.9	17.5	207	77	VBW 10 Hz
Hori.	2390.000	AV	41.27	27.46	13.21	46.26	2.26	37.94	53.9	15.9	275	57	VBW 360 Hz
Hori.	4804.000	AV	41.59	32.57	5.63	45.77	2.26	36.28	53.9	17.6	150	0	Floor noise
Hori.	7206.000	AV	37.85	37.05	6.97	44.83	2.26	39.30	53.9	14.6	150	0	Floor noise
Hori.	9608.000	AV	37.84	37.94	7.89	43.17	2.26	42.76	53.9	**11.1**	150	0	Floor noise
Vert.	1481.760	PK	55.95	25.52	12.44	46.47	2.26	49.70	73.9	24.2	192	191	
Vert.	2390.000	PK	53.43	27.46	13.21	46.26	2.26	50.10	73.9	23.8	110	306	
Vert.	4804.000	PK	52.67	32.57	5.63	45.77	2.26	47.36	73.9	26.5	150	0	Floor noise
Vert.	7206.000	PK	49.74	37.05	6.97	44.83	2.26	51.19	73.9	22.7	150	0	Floor noise
Vert.	9608.000	PK	46.80	37.94	7.89	43.17	2.26	51.72	73.9	22.1	150	0	Floor noise
Vert.	1481.760	AV	44.61	25.52	12.44	46.47	2.26	38.36	53.9	15.5	192	191	VBW 10 Hz
Vert.	2390.000	AV	41.28	27.46	13.21	46.26	2.26	37.95	53.9	15.9	110	306	VBW 360 Hz
Vert.	4804.000	AV	41.32	32.57	5.63	45.77	2.26	36.01	53.9	17.8	150	0	Floor noise
Vert.	7206.000	AV	37.94	37.05	6.97	44.83	2.26	39.39	53.9	14.5	150	0	Floor noise
Vert.	9608.000	AV	36.44	37.94	7.89	43.17	2.26	41.36	53.9	12.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

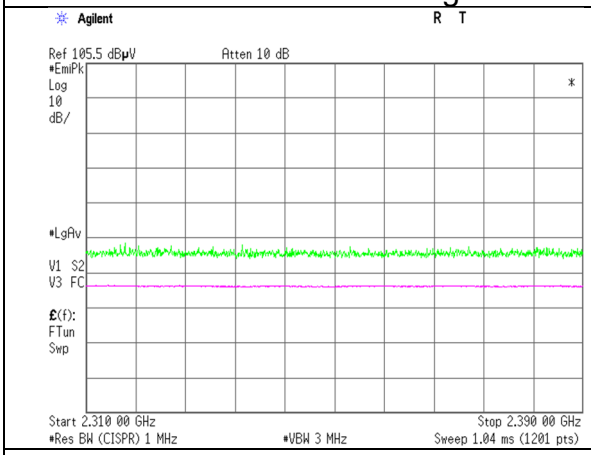
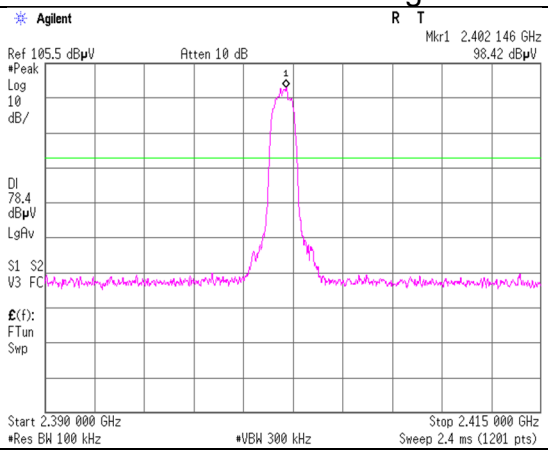
20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

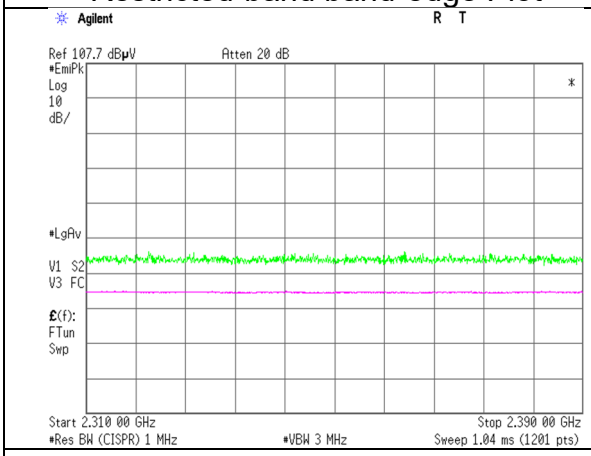
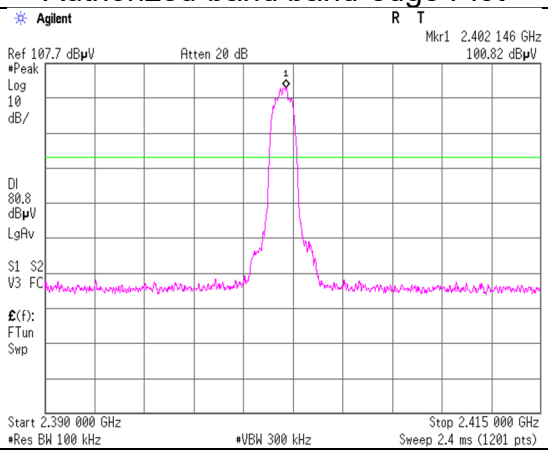
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	98.42	27.45	13.22	46.25	2.26	95.10	-	-	Carrier
Hori.	2400.000	PK	45.62	27.44	13.22	46.25	2.26	42.29	75.1	32.8	-
Vert.	2402.000	PK	100.82	27.45	13.22	46.25	2.26	97.50	-	-	Carrier
Vert.	2400.000	PK	46.26	27.44	13.22	46.25	2.26	42.93	77.5	34.5	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Kashima EMC Lab.			
Semi Anechoic Chamber	No.11	No.11	No.11	No.11
Date	March 13, 2024	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(30 MHz to 1 GHz)	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz			

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	307.330	QP	43.50	13.68	7.66	31.95	0.00	32.89	46.0	13.1	132	312	
Hori.	816.000	QP	34.90	22.62	9.63	31.75	0.00	35.40	46.0	10.6	111	155	
Hori.	947.679	QP	31.20	23.95	10.06	30.96	0.00	34.25	46.0	11.7	143	214	
Hori.	1481.760	PK	54.63	25.52	12.44	46.47	2.26	48.38	73.9	25.5	218	140	
Hori.	4882.000	PK	51.22	32.59	5.68	45.76	2.26	45.99	73.9	27.9	150	0	Floor noise
Hori.	7323.000	PK	49.10	37.39	7.00	44.64	2.26	51.11	73.9	22.7	150	0	Floor noise
Hori.	9764.000	PK	48.18	37.92	7.96	43.12	2.26	53.20	73.9	20.7	150	0	Floor noise
Hori.	1481.760	AV	43.19	25.52	12.44	46.47	2.26	36.94	53.9	16.9	218	140	VBW 10 Hz
Hori.	4882.000	AV	39.91	32.59	5.68	45.76	2.26	34.68	53.9	19.2	150	0	Floor noise
Hori.	7323.000	AV	38.03	37.39	7.00	44.64	2.26	40.04	53.9	13.8	150	0	Floor noise
Hori.	9764.000	AV	36.36	37.92	7.96	43.12	2.26	41.38	53.9	12.5	150	0	Floor noise
Vert.	30.239	QP	38.10	12.60	5.66	32.18	0.00	24.18	40.0	15.8	100	114	
Vert.	36.247	QP	44.90	12.90	5.74	32.17	0.00	31.37	40.0	8.6	100	281	
Vert.	139.998	QP	36.50	13.31	6.69	32.09	0.00	24.41	43.5	19.0	100	231	
Vert.	317.098	QP	39.30	13.98	7.71	31.94	0.00	29.05	46.0	16.9	100	355	
Vert.	816.000	QP	37.70	22.62	9.63	31.75	0.00	38.20	46.0	**7.8**	149	200	
Vert.	947.604	QP	27.60	23.95	10.06	30.96	0.00	30.65	46.0	15.3	157	311	
Vert.	1481.760	PK	54.52	25.52	12.44	46.47	2.26	48.27	73.9	25.6	152	178	
Vert.	4882.000	PK	51.84	32.59	5.68	45.76	2.26	46.61	73.9	27.2	150	0	Floor noise
Vert.	7323.000	PK	49.14	37.39	7.00	44.64	2.26	51.15	73.9	22.7	150	0	Floor noise
Vert.	9764.000	PK	47.75	37.92	7.96	43.12	2.26	52.77	73.9	21.1	150	0	Floor noise
Vert.	1481.760	AV	44.02	25.52	12.44	46.47	2.26	37.77	53.9	16.1	152	178	VBW 10 Hz
Vert.	4882.000	AV	40.02	32.59	5.68	45.76	2.26	34.79	53.9	19.1	150	0	Floor noise
Vert.	7323.000	AV	38.08	37.39	7.00	44.64	2.26	40.09	53.9	13.8	150	0	Floor noise
Vert.	9764.000	AV	36.31	37.92	7.96	43.12	2.26	41.33	53.9	12.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	1481.760	PK	55.38	25.52	12.44	46.47	2.26	49.13	73.9	24.7	236	158	
Hori.	2483.500	PK	54.50	27.94	13.29	46.16	2.26	51.83	73.9	22.0	193	233	
Hori.	4960.000	PK	51.82	32.75	5.72	45.75	2.26	46.80	73.9	27.1	150	0	Floor noise
Hori.	7440.000	PK	50.31	37.35	7.06	44.58	2.26	52.40	73.9	21.5	150	0	Floor noise
Hori.	9920.000	PK	48.25	38.08	8.03	43.21	2.26	53.41	73.9	20.4	150	0	Floor noise
Hori.	1481.760	AV	45.11	25.52	12.44	46.47	2.26	38.86	53.9	15.0	236	158	VBW 10 Hz
Hori.	2483.500	AV	42.70	27.94	13.29	46.16	2.26	40.03	53.9	13.8	193	233	VBW 360 Hz
Hori.	4960.000	AV	39.95	32.75	5.72	45.75	2.26	34.93	53.9	18.9	150	0	Floor noise
Hori.	7440.000	AV	38.81	37.35	7.06	44.58	2.26	40.90	53.9	13.0	150	0	Floor noise
Hori.	9920.000	AV	35.96	38.08	8.03	43.21	2.26	41.12	53.9	**12.7**	150	0	Floor noise
Vert.	1481.760	PK	54.94	25.52	12.44	46.47	2.26	48.69	73.9	25.2	246	151	
Vert.	2483.500	PK	55.61	27.94	13.29	46.16	2.26	52.94	73.9	20.9	236	211	
Vert.	4960.000	PK	51.82	32.75	5.72	45.75	2.26	46.80	73.9	27.1	150	0	Floor noise
Vert.	7440.000	PK	50.90	37.35	7.06	44.58	2.26	52.99	73.9	20.9	150	0	Floor noise
Vert.	9920.000	PK	48.05	38.08	8.03	43.21	2.26	53.21	73.9	20.6	150	0	Floor noise
Vert.	1481.760	AV	43.31	25.52	12.44	46.47	2.26	37.06	53.9	16.8	246	151	BW 10 Hz
Vert.	2483.500	AV	42.64	27.94	13.29	46.16	2.26	39.97	53.9	13.9	236	211	VBW 360 Hz
Vert.	4960.000	AV	39.93	32.75	5.72	45.75	2.26	34.91	53.9	18.9	150	0	Floor noise
Vert.	7440.000	AV	38.74	37.35	7.06	44.58	2.26	40.83	53.9	13.0	150	0	Floor noise
Vert.	9920.000	AV	36.04	38.08	8.03	43.21	2.26	41.20	53.9	**12.7**	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

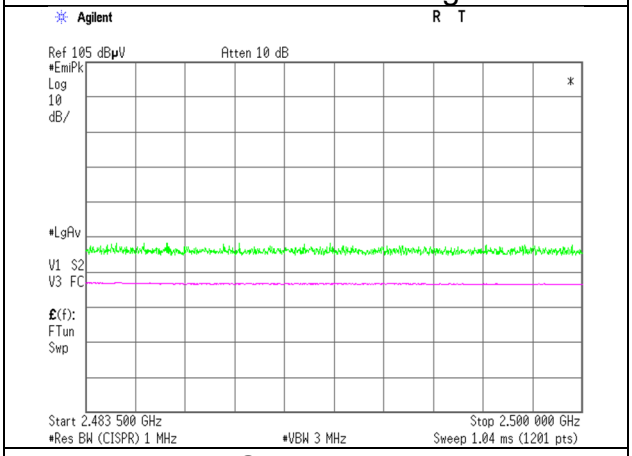
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz

Horizontal

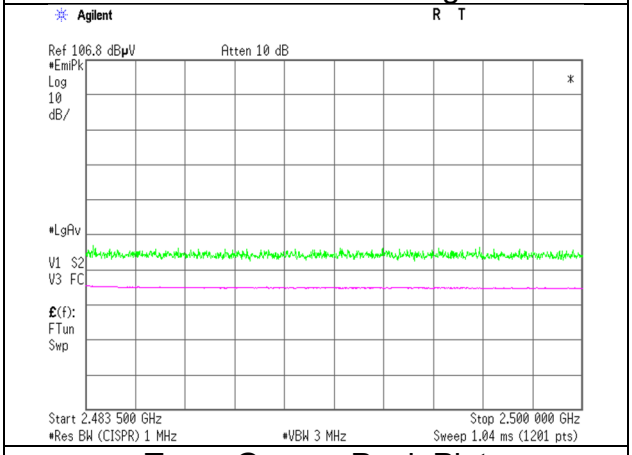
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

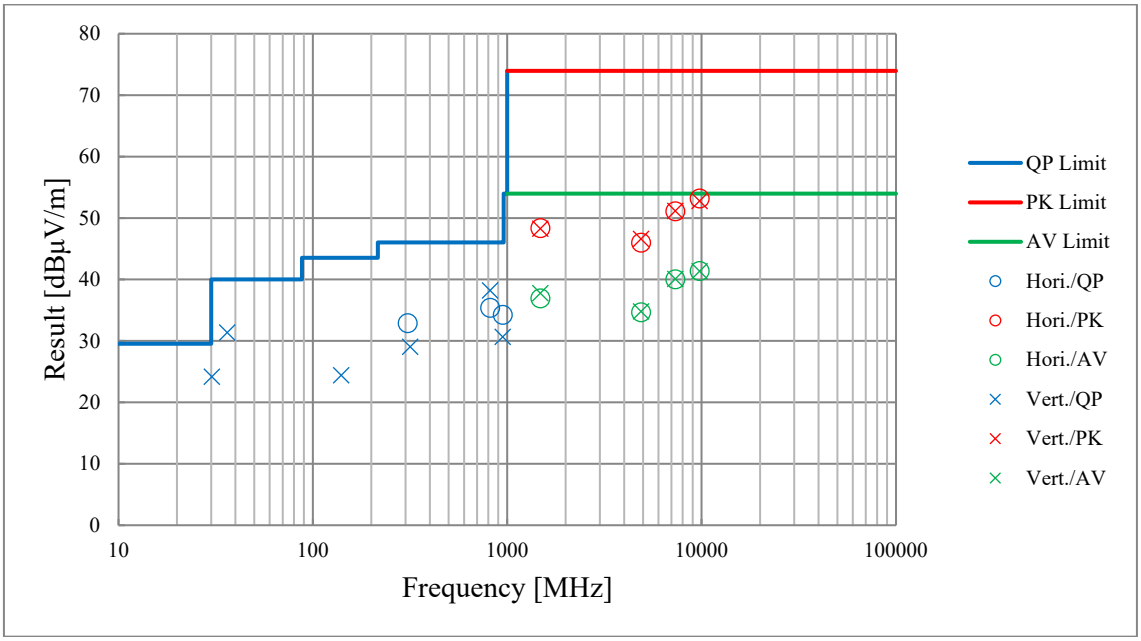


Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Kashima EMC Lab.			
Semi Anechoic Chamber	No.11	No.11	No.11	No.11
Date	March 13, 2024	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(30 MHz to 1 GHz)	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz			



*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz with Tx 11a 5180 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	52.73	27.46	13.21	46.26	2.26	49.40	73.9	24.5	187	240	
Hori.	2390.000	AV	41.70	27.46	13.21	46.26	2.26	38.37	53.9	**15.5**	187	240	VBW 360 Hz
Vert.	2390.000	PK	52.70	27.46	13.21	46.26	2.26	49.37	73.9	24.5	144	297	
Vert.	2390.000	AV	41.09	27.46	13.21	46.26	2.26	37.76	53.9	16.1	144	297	VBW 360 Hz

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	98.02	27.45	13.22	46.25	2.26	94.70	-	-	Carrier
Hori.	2400.000	PK	45.99	27.44	13.22	46.25	2.26	42.66	74.7	32.0	-
Vert.	2402.000	PK	99.57	27.45	13.22	46.25	2.26	96.25	-	-	Carrier
Vert.	2400.000	PK	46.73	27.44	13.22	46.25	2.26	43.40	76.3	32.8	-

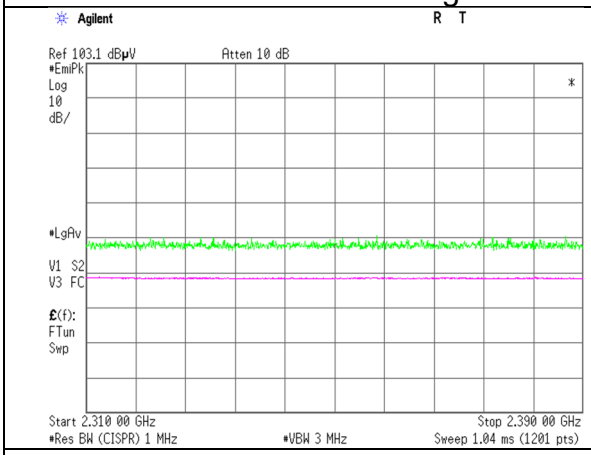
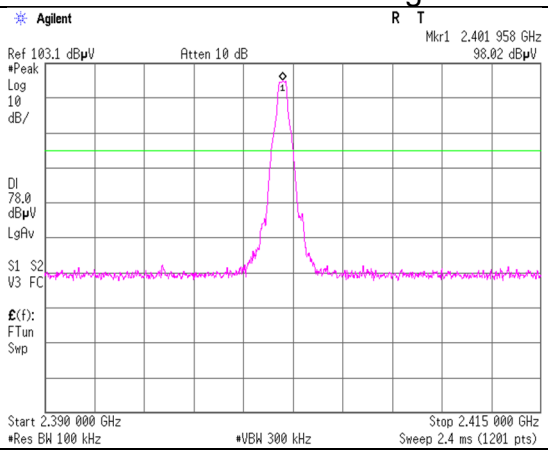
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

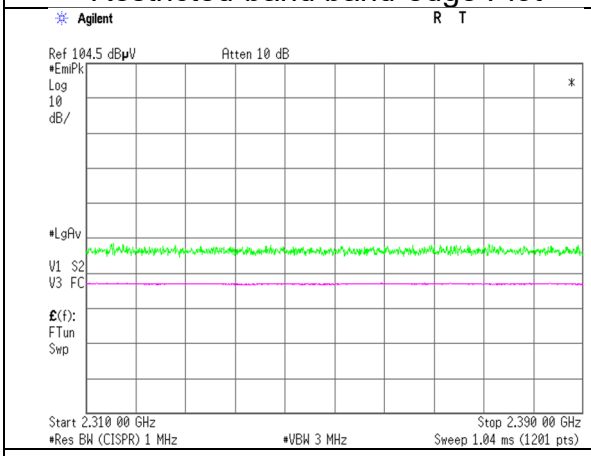
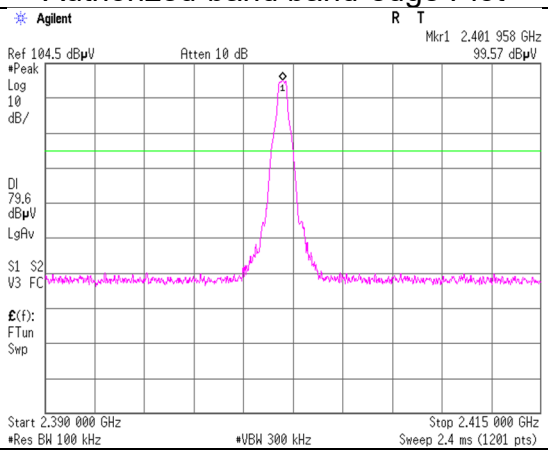
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz with Tx 11a 5180 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz with Tx 11a 5180 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	52.94	27.94	13.29	46.16	2.26	50.27	73.9	23.6	203	53	
Hori.	2483.500	AV	42.06	27.94	13.29	46.16	2.26	39.39	53.9	14.5	203	53	VBW 360 Hz
Vert.	2483.500	PK	53.08	27.94	13.29	46.16	2.26	50.41	73.9	23.4	129	297	
Vert.	2483.500	AV	42.22	27.94	13.29	46.16	2.26	39.55	53.9	**14.3**	129	297	VBW 360 Hz

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

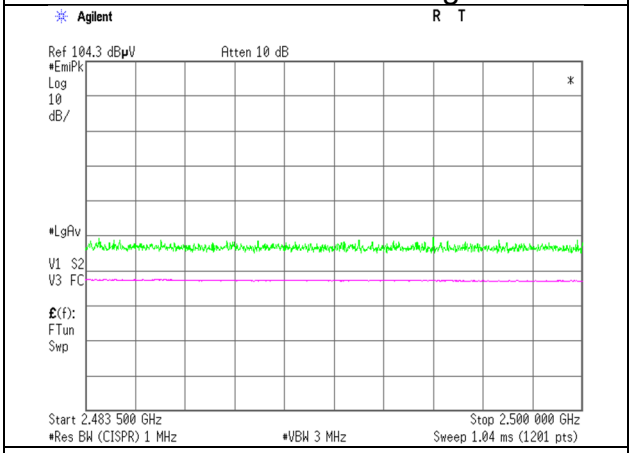
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for bandto edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz with Tx 11a 5180 MHz

Horizontal

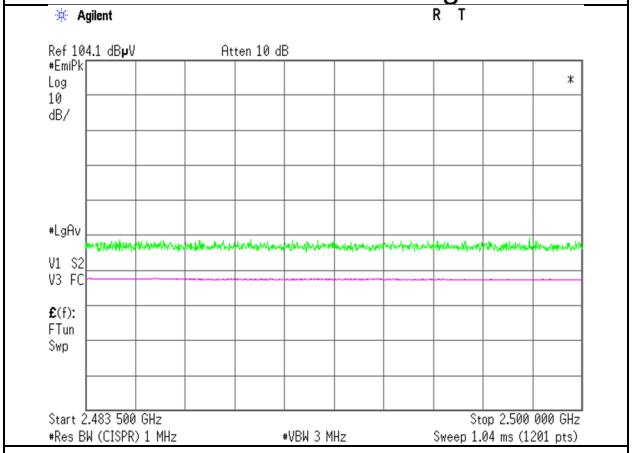
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz with Tx 11a 5180 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	53.60	27.46	13.21	46.26	2.26	50.27	73.9	23.6	243	50	
Hori.	2390.000	AV	41.79	27.46	13.21	46.26	2.26	38.46	53.9	**15.4**	243	50	VBW 360 Hz
Vert.	2390.000	PK	53.01	27.46	13.21	46.26	2.26	49.68	73.9	24.2	153	243	
Vert.	2390.000	AV	41.81	27.46	13.21	46.26	2.26	38.48	53.9	**15.4**	153	243	VBW 360 Hz

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.62	27.45	13.22	46.25	2.26	96.30	-	-	Carrier
Hori.	2400.000	PK	48.52	27.44	13.22	46.25	2.26	45.19	76.3	31.1	-
Vert.	2402.000	PK	101.22	27.45	13.22	46.25	2.26	97.90	-	-	Carrier
Vert.	2400.000	PK	50.08	27.44	13.22	46.25	2.26	46.75	77.9	31.1	-

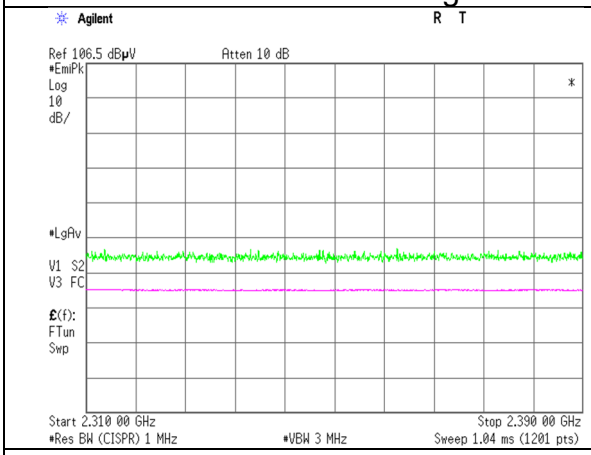
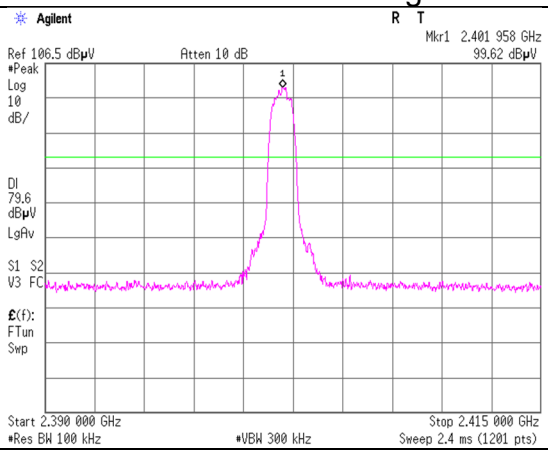
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

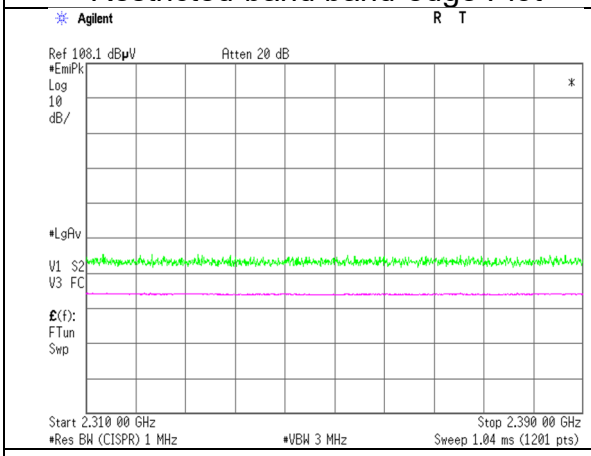
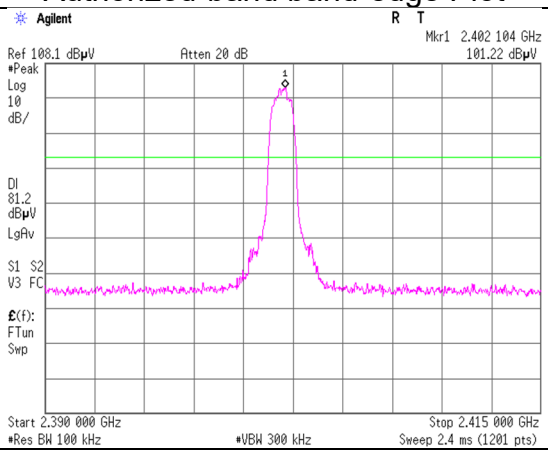
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz with Tx 11a 5180 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Kashima EMC Lab.			
Semi Anechoic Chamber	No.11	No.11	No.11	No.11
Date	March 13, 2024	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(30 MHz to 1 GHz)	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz with Tx 11a 5180 MHz			

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	307.091	QP	43.70	13.68	7.66	31.95	0.00	33.09	46.0	12.9	110	305	
Hori.	816.000	QP	33.50	22.62	9.63	31.75	0.00	34.00	46.0	12.0	100	172	
Hori.	947.586	QP	30.80	23.95	10.06	30.96	0.00	33.85	46.0	12.1	143	214	
Hori.	1481.760	PK	54.53	25.52	12.44	46.47	2.26	48.28	73.9	25.6	234	174	
Hori.	4882.000	PK	51.61	32.59	5.68	45.76	2.26	46.38	73.9	27.5	150	0	Floor noise
Hori.	7323.000	PK	50.07	37.39	7.00	44.64	2.26	52.08	73.9	21.8	150	0	Floor noise
Hori.	9764.000	PK	48.49	37.92	7.96	43.12	2.26	53.51	73.9	20.3	150	0	Floor noise
Hori.	1481.760	AV	44.13	25.52	12.44	46.47	2.26	37.88	53.9	16.0	234	174	VBW 10 Hz
Hori.	4882.000	AV	40.11	32.59	5.68	45.76	2.26	34.88	53.9	19.0	150	0	Floor noise
Hori.	7323.000	AV	38.06	37.39	7.00	44.64	2.26	40.07	53.9	13.8	150	0	Floor noise
Hori.	9764.000	AV	36.46	37.92	7.96	43.12	2.26	41.48	53.9	12.4	150	0	Floor noise
Vert.	31.635	QP	40.20	12.56	5.68	32.18	0.00	26.26	40.0	13.7	100	113	
Vert.	36.250	QP	45.90	12.91	5.74	32.17	0.00	32.38	40.0	**7.6**	100	245	
Vert.	139.998	QP	36.50	13.31	6.69	32.09	0.00	24.41	43.5	19.0	100	219	
Vert.	315.619	QP	40.40	13.95	7.70	31.94	0.00	30.11	46.0	15.8	100	355	
Vert.	816.000	QP	37.60	22.62	9.63	31.75	0.00	38.10	46.0	7.9	147	201	
Vert.	864.000	QP	36.20	22.97	9.78	31.53	0.00	37.42	46.0	8.5	127	210	
Vert.	947.589	QP	27.90	23.95	10.06	30.96	0.00	30.95	46.0	15.0	158	313	
Vert.	1481.760	PK	54.40	25.52	12.44	46.47	2.26	48.15	73.9	25.7	148	57	
Vert.	4882.000	PK	51.26	32.59	5.68	45.76	2.26	46.03	73.9	27.8	150	0	Floor noise
Vert.	7323.000	PK	49.53	37.39	7.00	44.64	2.26	51.54	73.9	22.3	150	0	Floor noise
Vert.	9764.000	PK	47.49	37.92	7.96	43.12	2.26	52.51	73.9	21.3	150	0	Floor noise
Vert.	1481.760	AV	43.28	25.52	12.44	46.47	2.26	37.03	53.9	16.8	148	57	VBW 10 Hz
Vert.	4882.000	AV	40.34	32.59	5.68	45.76	2.26	35.11	53.9	18.8	150	0	Floor noise
Vert.	7323.000	AV	38.03	37.39	7.00	44.64	2.26	40.04	53.9	13.8	150	0	Floor noise
Vert.	9764.000	AV	36.36	37.92	7.96	43.12	2.26	41.38	53.9	12.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz with Tx 11a 5180 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	54.01	27.94	13.29	46.16	2.26	51.34	73.9	22.5	180	59	
Hori.	2483.500	AV	41.81	27.94	13.29	46.16	2.26	39.14	53.9	**14.7**	180	59	VBW 360 Hz
Vert.	2483.500	PK	53.99	27.94	13.29	46.16	2.26	51.32	73.9	22.5	150	240	
Vert.	2483.500	AV	41.78	27.94	13.29	46.16	2.26	39.11	53.9	**14.7**	150	240	VBW 360 Hz

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

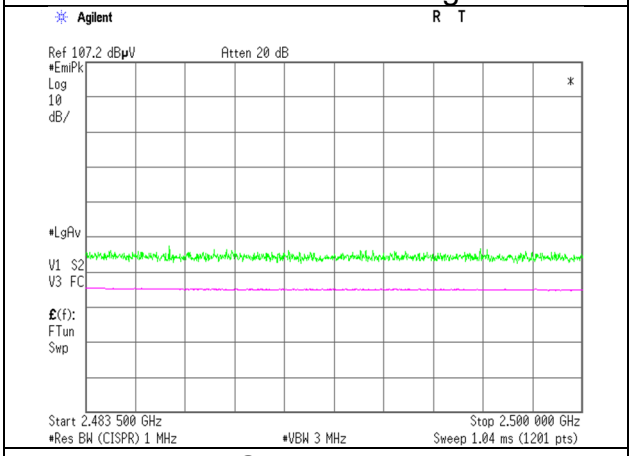
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.11
Date	March 11, 2024
Temperature / Humidity	21 deg. C / 40 % RH
Engineer	Kazuhiro Ando
	(1 GHz to 2.8 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz with Tx 11a 5180 MHz

Horizontal

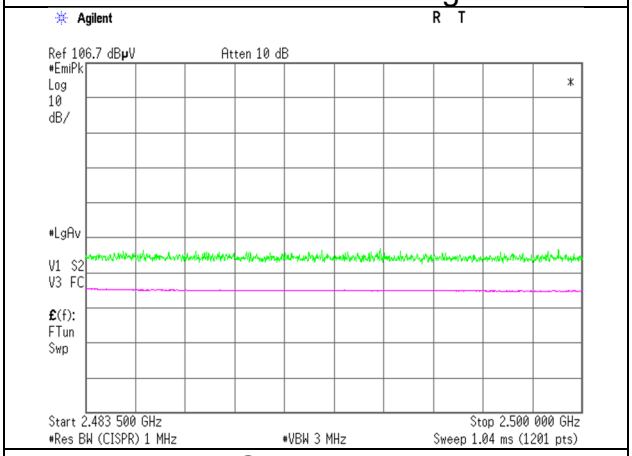
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

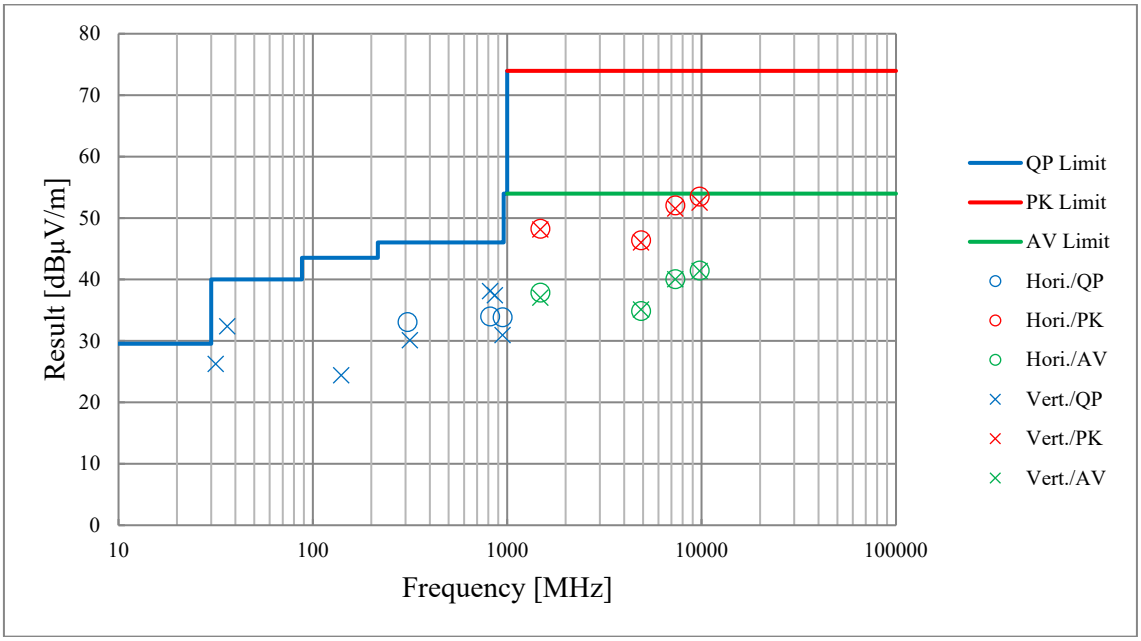


Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Kashima EMC Lab.			
Semi Anechoic Chamber	No.11	No.11	No.11	No.11
Date	March 13, 2024	March 11, 2024	March 12, 2024	March 12, 2024
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 40 % RH	18 deg. C / 41 % RH	18 deg. C / 41 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando	Kazuhiro Ando
	(30 MHz to 1 GHz)	(1 GHz to 2.8 GHz)	(2.8 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz with Tx 11a 5180 MHz			



*These plots data contain sufficient number to show the trend of characteristic features for EUT.

APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	143122	LOGBICON	Schwarzbeck Mess-Elektronik OHG	VULB 9168	508	2023/04/18	12
RE	178807	5dB Fixed Atten.	Pasternack Enterprises	PE7047-5	none	2023/04/18	12
RE	143169	11Site RE 3m System	N/A	none(No.11 RE)	none	2023/11/15	12
RE	142936	Pre-Amplifier	SONOMA INSTRUMENT	310N	325015	2023/05/23	12
RE	144193	Test Receiver	Rohde & Schwarz	ESU40	100426	2023/04/20	12
RE	144648	Semi Anechoic Chamber	TDK	NSA (No.11)	11	2023/05/11	12
RE	143456	Double Ridged Wave Guide	ETS-Lindgren (Cedar Park, Texas)	3115	00204573	2024/02/09	12
RE	175395	Pre Amplifier	Erzia Technologies S.L.	ERZ-LNA-0100-2700-45-4	16A2001702002	2023/12/07	12
RE	192241	Microwave Cable	Huber+Suhner	SF104/PC35m/PC35m/1000mm	805411/4	2024/01/19	12
RE	231901	Micro Wave Cable	Junkosha	MWX221	FEB-20-23-020	2023/03/10	12
RE	143642	Spectrum Analyzer	Keysight Technologies Inc	N9030A	MY53310670 Version A.13.12	2023/05/23	12
RE	143643	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY52490024	2023/06/21	12
RE	235556	10dB Fixed Attenuator	Weinschel Associates	WA54-10-1314	0H3E9	2023/06/13	12
RE	143442	HPF	Micro-Tronics	HPM50111-02	009	2023/05/24	12
RE	143438	Double Ridged Horn	ETS-Lindgren (Cedar Park, Texas)	3160-09	00166043	2023/06/19	12
RE	142937	Pre-Amplifier	TOYO	HAP18-26W	00000035	2023/06/19	12
RE	142992	Micro Wave Cable	Suhner	SUCOFLEX102	MY010/2A	2023/06/04	12
RE	222746	Measure	SHINWA RULES CO., LTD.	80862	none	-	-
RE	200033	Temperature & Humidity Logger	HIOKI E.E. CORPORATION	LR5001/LR9504	200636447/200699543	2023/07/18	12
RE	143133	Barometer	Sanoh Co., Ltd	SBR-151	001439	2023/03/10	36
RE	144215	Digital Multimeter	Fluke Corporation	FLK-83-V	14610320	2023/10/24	12
RE	178804	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3 (RE,CE,ME,PE)	Ver 3.1.0484	-	-

***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:
RE: Radiated Emission