RADIO TEST REPORT

Test Report No. 15561327S-A-R2

Customer	**Toshiba Tec Corporation**
Description of EUT	**HF RFID Option**
Model Number of EUT	**BX704-RFID-H3-QM-S**
FCC ID	**BJI-BX704H3**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**December 5, 2024**
Remarks	**-**

Representative test engineer	Approved by
Hiromasa Sato Engineer	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".

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REVISION HISTORY

Original Test Report No. 15561327S-A

This report is a revised version of 15561327S-A-R1. 15561327S-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15561327S-A	November 19, 2024	-
1	15561327S-A-R1	November 29, 2024	Sec.1: Correction of “contact person name” From: Yukihiro Nedu To: Yukihiro Nezu
			Sec.3.2: Correction of “FCC Part 15.31 (e)” From: “The RF Module has its own regulator. The RF Module is constantly provided with voltage through the regulator regardless of input voltage. To: “This EUT provides stable voltage constantly to RF Module regardless of input voltage.”
			Sec.3.2: Correction of “Antenna requirement” From: FCC Part 15.203/212 Antenna requirement To: FCC Part 15.203 Antenna requirement
2	15561327S-A-R2	December 5, 2024	Sec 4.1: Corrected the description of "Without Tag" to "Without tag ISO 14443 ". The following has been added to the notes for the Test item. * After the comparison of the test data between with Tag (ISO 14443 or ISO 15693) and without Tag (ISO 14443 or ISO 15693), the tests were performed with the worst case.
			Sec 4.1: Deleted “1)” from the operating mode column of “Electric Field Strength of Spurious Emission” in the operating mode table.

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

Company Name	Toshiba Tec Corporation
Address	6-78 Minami-cho, Mishima City, Shizuoka Prefecture,411-8520 Japan
Telephone Number	+81-80-4372-9942
Contact Person	Yukihiro Nezu

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	HF RFID Option
Model Number	BX704-RFID-H3-QM-S
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	July 9, 2024
Test Date	July 10 to 12, 2024

2.2 Product Description

General Specification

Rating	DC 5 V
Operating temperature	5 deg. C to 40 deg. C

Radio Specification

Radio Type	Transceiver
Frequency of Operation	13.56 MHz
Modulation	ASK

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 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.225 Operation within the band 13.110-14.010 MHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.207	0.5 dB 13.56000 MHz, Average, N Mode: 2	Complied	-
	<ISED> RSS-Gen 8.8	<ISED> RSS-Gen 8.8			
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.225(a)	44.7 dB, 13.560 MHz, QP, 90 deg. Mode: 3	Complied	Radiated
	<ISED> RSS-Gen 6.4, 6.12	<ISED> RSS-210 B.6			
Spectrum Mask	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.225(b)(c)	25.8 dB, 13.567 MHz, QP, 90 deg. Mode: 3	Complied	Radiated
	<ISED> RSS-Gen 6.4, 6.13	<ISED> RSS-210 B.6			
20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section15.215(c)	See data	Complied	Radiated
	<ISED> -	<ISED> -			
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.209, Section 15.225 (d)	0.3 dB 169.010 MHz, Horizontal, QP Mode: 3	Complied	Radiated
	<ISED> RSS-Gen 6.4, 6.13	<ISED> RSS-210 B.6 RSS-Gen 8.9			
Frequency Tolerance	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.225(e)	See data	Complied	Radiated
	<ISED> RSS-Gen 6.11, 8.11	<ISED> RSS-210 B.6			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.					

FCC Part 15.31 (e)

This EUT provides stable voltage constantly to RF Module regardless of input voltage.
Therefore, the EUT complies with the requirement.
However, the supply voltage was varied and tested at 90 % and 110 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e).

FCC Part 15.203 Antenna requirement

The EUT has a unique coupling/antenna connector (PH connector). Therefore the equipment complies with the requirement of 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% emission bandwidth	<ISED>RSS-Gen 6.7	-	N/A	-	Radiated
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.					

Other than above, 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.

Item	Frequency range	Uncertainty (+/-)
Conducted Emission (AC Mains) LISN	150 kHz to 30 MHz	3.2 dB
Radiated Emission (Measurement distance: 3 m)	9 kHz to 30 MHz	3.3 dB
	30 MHz to 200 MHz	4.9 dB
	200 MHz to 1 GHz	6.2 dB
	1 GHz to 6 GHz	4.7 dB
	6 GHz to 18 GHz	5.3 dB
	18 GHz to 40 GHz	5.5 dB

Antenna terminal test	Uncertainty (+/-)
Frequency Measurement (13.56 MHz)	1.7 x 10^-7
Bandwidth Measurement	0.012 %
Temperature	0.96 deg.C.
Humidity	4.0 %
Voltage	0.74 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN
Telephone: +81-463-50-6400
A2LA Certificate Number: 1266.03

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

The mode is used:

Test mode	Remarks
1) Transmitting mode (Tx)	With tag ISO 14443
2) Transmitting mode (Tx)	With tag ISO 15693
3) Transmitting mode (Tx)	Without tag ISO 14443
The EUT was operated in a manner similar to typical use during the tests.	
*Power of the EUT was set by the software as follows; Software: EUT firmware Ver: 1.053 (Date: 2024.06.16, Storage location: EUT memory) ISO 14443 Soft: Data Transceiver Ver: 1.05.0006 (Date: 2023.04 28, Storage location: Driven by connected PC) ISO 15693 Soft: TR3RW Manager Ver: 3.9.0.0 (Date: 2023.01 01, Storage location: Driven by connected PC) Printer Soft: Data Transceiver Ver: 1.05.0006 (Date: 2015.06 08, 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.	
Justification: The system was configured in typical fashion (as a user would normally use it) for testing.	

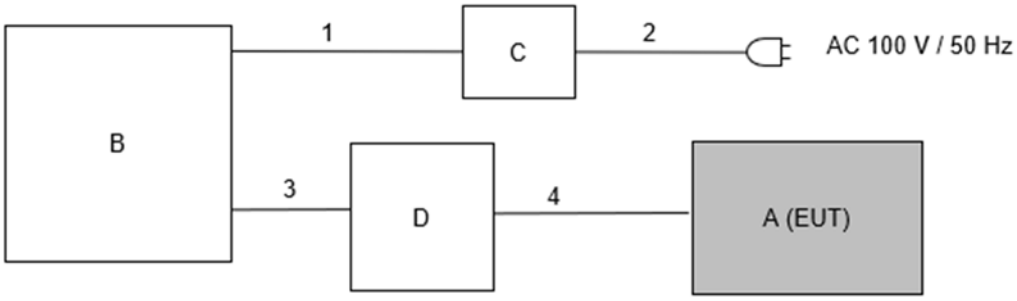
Test Item	Operating mode*
Conducted Emission	2)
Electric Field Strength of Fundamental Emission	3)
Spectrum Mask	3)
20 dB Bandwidth and 99 % Occupied Bandwidth	1),2)
Electric Field Strength of Spurious Emission	3)
Frequency Tolerance	3)

* After the comparison of the test data between with Tag (ISO 14443 or ISO 15693) and without Tag (ISO 14443 or ISO 15693), the tests were performed with the worst case.

Frequency Tolerance	
Temperature	+5 deg. C to +40 deg. C Step 10 deg. C (+5 deg. C to +10 deg. C step 5 deg. C)
Voltage	Normal Voltage DC 5 V Maximum Voltage DC 5.5 V (DC 5V +10 %) Minimum Voltage DC 4.5 V (DC 5 V -10 %)
*This EUT provides stable voltage constantly to RF Part regardless of input voltage	

4.2 Configuration and peripherals

Test for Radiated Emission and Antenna Terminal Conducted Tests



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

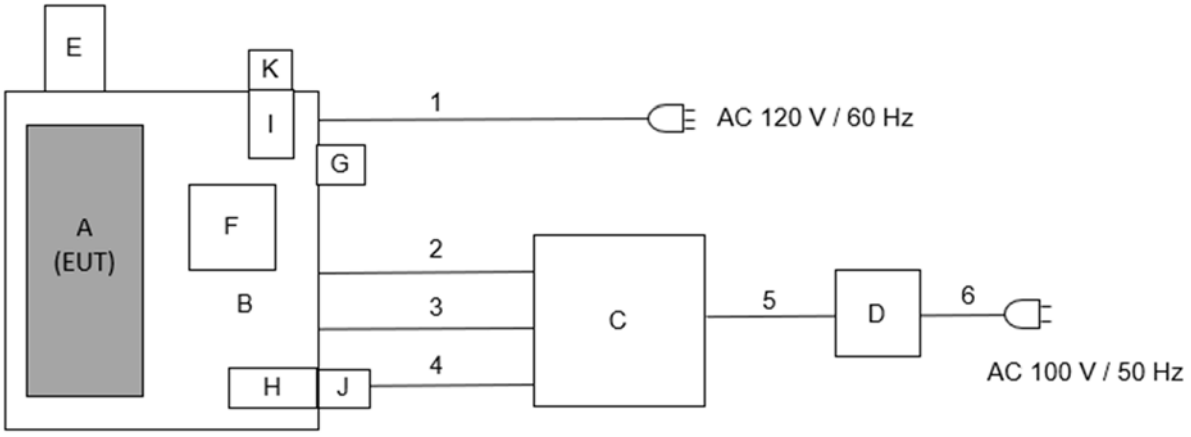
Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remark
A	HF RFID Option	BX704-RFID-H3-QM-S	2823D	Toshiba Tec Corporation	EUT
B	Laptop PC	dynabook R73/D	PR73DBJADA7AD11	TOSHIBA	-
C	AC Adapter	PA51770-1ACA	G71C000GZ210HX16(0NSCC	TOSHIBA	-
D	JIG	-	-	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC	2.0	Unshielded	Unshielded	-
2	AC	1.0	Unshielded	Unshielded	-
3	USB	3.0	Shielded	Shielded	-
4	Signal	0.1	Unshielded	Unshielded	-

Test for Conducted Emission



* Cabling and setup were taken into consideration and test data was taken under worse case conditions.
*As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 120 V of the worst voltage as representative.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remark
A	HF RFID Option	BX704-RFID-H3-QM-S	2823D	Toshiba Tec Corporation	EUT
B	Barcode Printer	BX410T-TS02-QM-S	2323S600002	Toshiba Tec Corporation	Host *1)
C	Laptop PC	POTEGE R30-C	PR73DBJADA7AD11	TOSHIBA	-
D	AC Adapter	PA51770-1ACA	G71C000GZ210HX 160020NSCC	TOSHIBA	-
E	USB Memory	-	-	KIOXIA	-
F	Disc cutter module	BX204-QM-S	-	Toshiba Tec Corporation	-
G	Wireless communication module	BX700-WLBT-QM-S	-	Toshiba Tec Corporation	-
H	Serial I/F board	B-EX700-RS-QM-R	-	Toshiba Tec Corporation	-
I	Expansion I/O boards	BX700-IO-QM-S	-	Toshiba Tec Corporation	-
J	USB-RS232C Converter	USB-CVRS9H	Z3KA-227A1-1392	SANWA Supply	-
K	Loopback jig	-	-	Toshiba Tec Corporation	-

*1) The EUT was installed in the typical host device for testing.

List of Cables Used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	AC	2.0	Unshielded	Unshielded	-
2	LAN	2.0	Unshielded	Unshielded	-
3	USB	3.0	Shielded	Shielded	-
4	RS-232C+USB	2.4	Shielded	Shielded	-
5	DC	2.0	Unshielded	Unshielded	-
6	AC	1.0	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

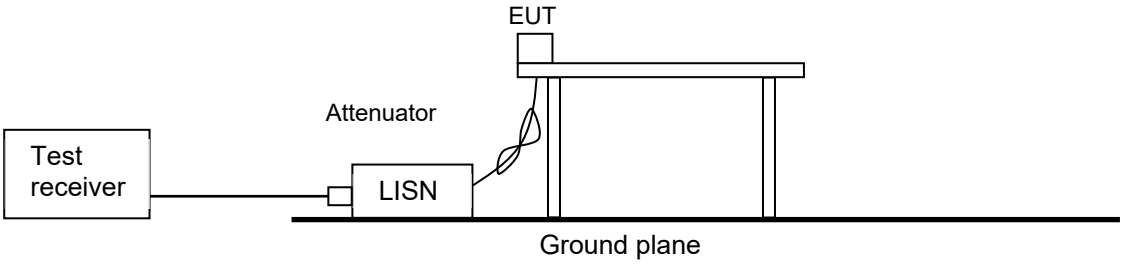
Test Procedure and conditions

EUT was placed on a wooden table of nominal size,1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane.
The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Shielded room.
The EUT was connected to a LISN (AMN).
An overview sweep with peak detection has been performed.

Figure 1: Test Setup



The test results and limit are rounded off to one decimal place, so some differences might be observed.

Detector : QP and CISPR AV
Measurement range : 0.15 MHz to 30 MHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Radiated Emission (Fundamental, Spurious Emission and Spectrum Mask)

Test Procedure

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 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.

[Limit conversion]

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

[Frequency: From 9 kHz to 30 MHz]

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., and 135 deg.) and horizontal polarization.
*Refer to Figure 3 about Direction of the Loop Antenna.

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane. However test results were confirmed to pass against standard limit.

[Frequency: From 30 MHz to 1 GHz]

The measuring antenna height varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.

[Test instruments and test settings]

Frequency	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz
Antenna Type	Loop	Biconical	Logperiodic

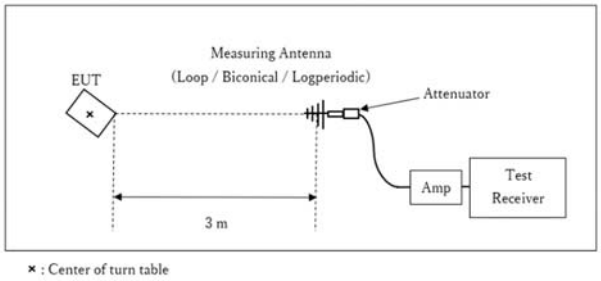
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m

*1) Distance Factor: 40 x log (3 m / 300 m) = -80 dB
*2) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Figure 2: Test Setup

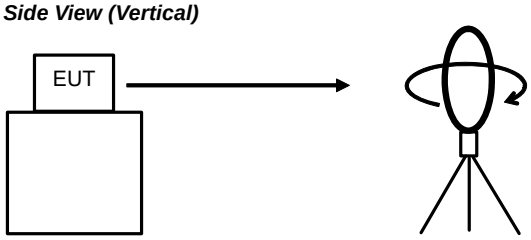
Below 1 GHz



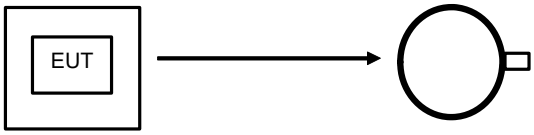
Test Distance: 3 m

Figure 3: Direction of the Loop Antenna

Side View (Vertical)

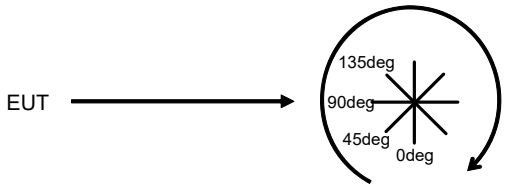


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Module

Frequency / Test / Antenna	Below 1 GHz	Above 1 GHz
Horizontal	X	X
Vertical	X	X

Antenna

Frequency / Test / Antenna	Below 1 GHz	Above 1 GHz
Horizontal	Y	Z
Vertical	Z	Z

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 9 kHz to 1 GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Other tests

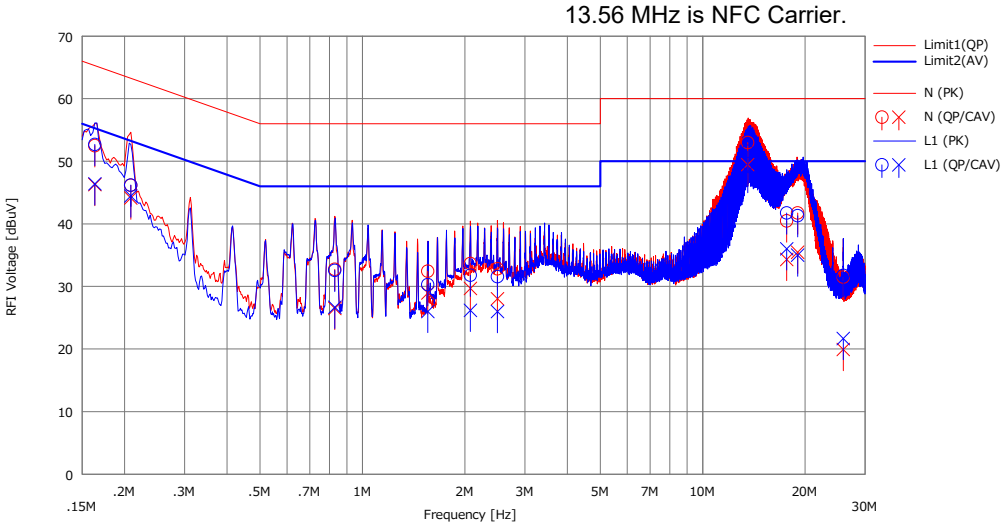
Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	100 kHz	1 kHz	3 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 kHz	3 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Frequency Tolerance	-	-	-	-	-	-	Spectrum Analyzer
Peak hold was applied as Worst-case measurement.							

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Test place	Shonan EMC Lab. No.6 Shielded room
Date	July 10, 2024
Temperature / Humidity	26 deg. C / 42 % RH
Engineer	Yohsuke Matsuzawa
Mode	Mode 2



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		〈QP〉	〈CAV〉		〈QP〉	〈CAV〉	〈QP〉	〈AV〉	〈QP〉	〈AV〉		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.16349	40.01	33.81	12.47	52.48	46.28	65.28	55.28	12.8	9.0	N	
2	0.20848	33.67	31.64	12.49	46.16	44.13	63.27	53.27	17.1	9.1	N	
3	0.82925	20.21	13.96	12.53	32.74	26.49	56.00	46.00	23.2	19.5	N	
4	1.55594	19.83	16.37	12.59	32.42	28.96	56.00	46.00	23.5	17.0	N	
5	2.07525	21.04	17.07	12.61	33.65	29.68	56.00	46.00	22.3	16.3	N	
6	2.49373	20.17	15.40	12.63	32.80	28.03	56.00	46.00	23.2	17.9	N	
7	13.56000	39.80	36.27	13.18	52.98	49.45	60.00	50.00	7.0	0.5	N	
8	17.65565	27.12	20.97	13.34	40.46	34.31	60.00	50.00	19.5	15.6	N	
9	19.01897	28.34	22.06	13.39	41.73	35.45	60.00	50.00	18.2	14.5	N	
10	25.89386	17.83	6.26	13.65	31.48	19.91	60.00	50.00	28.5	30.0	N	
11	0.16349	40.22	33.93	12.47	52.69	46.40	65.28	55.28	12.5	8.8	L1	
12	0.20848	33.73	31.98	12.46	46.19	44.44	63.27	53.27	17.0	8.8	L1	
13	0.82925	20.04	14.14	12.53	32.57	26.67	56.00	46.00	23.4	19.3	L1	
14	1.55594	17.68	13.40	12.59	30.27	25.99	56.00	46.00	25.7	20.0	L1	
15	2.07525	19.19	13.58	12.60	31.79	26.18	56.00	46.00	24.2	19.8	L1	
16	2.49373	18.93	13.34	12.64	31.57	25.98	56.00	46.00	24.4	20.0	L1	
17	13.56000	38.50	35.26	13.09	51.59	48.35	60.00	50.00	8.4	1.6	L1	
18	17.65565	28.55	22.84	13.18	41.73	36.02	60.00	50.00	18.2	13.9	L1	
19	19.01897	28.10	21.80	13.20	41.30	35.00	60.00	50.00	18.7	15.0	L1	
20	25.89386	18.33	8.24	13.44	31.77	21.68	60.00	50.00	28.2	28.3	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=145539

Fundamental Emission and Spectrum Mask

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	SAC3
Date	July 11, 2024
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Makoto Hosaka
Mode	Mode 3

Remarks: : [Ver] Module:X, Antnna:Z, without Tag, Vertical polarization (antenna angle) of the worst case: 90 deg
: [Hor] Module:X, Antnna:Y, without Tag

Fundamental emission

No.	FREQ	Test Receiver Reading		Antenna Factor	Loss	AMP GAIN	Distance factor	RESULT		LIMIT (30m)	MARGIN	
		Hor	Ver					Hor	Ver		Hor	Ver
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
1	13.560	72.0	85.6	19.4	6.4	32.2	-40.0	25.6	39.2	83.9	58.3	44.7

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]+Distance factor[dB]

Distance factor: 40 x log (3 m/30 m) = -40 dB

Limits (30 m)

・13.553 MHz to 13.567 MHz : 83.9 dBuV/m (FCC 15.225(a))

Spurious emission within the band

No.	FREQ	Test Receiver Reading		Antenna Factor	Loss	AMP GAIN	Distance factor	RESULT		LIMIT (30m)	MARGIN	
		Hor	Ver					Hor	Ver		Hor	Ver
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
1	13.110	30.4	30.4	19.5	6.4	32.2	-40.0	-16.0	-16.0	29.5	45.5	45.5
2	13.348	32.1	37.5	19.4	6.4	32.2	-40.0	-14.3	-8.86	40.5	54.8	49.4
3	13.410	31.5	35.9	19.4	6.4	32.2	-40.0	-14.9	-10.5	40.5	55.4	51.0
4	13.482	34.1	41.2	19.4	6.4	32.2	-40.0	-12.3	-5.2	50.4	62.7	55.6
5	13.553	57.3	70.7	19.4	6.4	32.2	-40.0	10.9	24.34	50.4	39.5	26.1
6	13.567	57.5	71.0	19.4	6.4	32.2	-40.0	11.1	24.64	50.4	39.3	25.8
7	13.636	35.5	42.8	19.4	6.4	32.2	-40.0	-10.9	-3.56	50.4	61.3	54.0
8	13.710	33.4	39.3	19.4	6.4	32.2	-40.0	-13.0	-7.1	40.5	53.5	47.6
9	13.771	36.0	43.6	19.4	6.4	32.2	-40.0	-10.4	-2.8	40.5	50.9	43.3
10	14.010	30.4	30.4	19.4	6.4	32.2	-40.0	-16.0	-15.97	29.5	45.5	45.5
11	14.194	31.2	35.6	19.4	6.4	32.2	-40.0	-15.2	-10.76	29.5	44.7	40.3

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]+Distance factor[dB]

Outside filed strength frequencies

・Fc±7kHz:13.553 MHz to 13.567 MHz

・Fc±150 kHz:13.410 MHz to 13.710 MHz

・Fc±450 kHz:13.110 MHz to 14.010 MHz

Fc = 13.56 MHz

Limits (30 m)

・13.410 MHz to 13.553 MHz and 13.567 MHz to 13.710 MHz : 50.4 dBuV/m (FCC 15.225(b))

・13.110 MHz to 13.410 MHz and 13.710 MHz to 14.010 MHz : 40.5 dBuV/m (FCC 15.225(c))

・Below 13.110 MHz and Above 14.010 MHz : 29.5 dBuV/m (FCC 15.225(d)and FCC 15.209)

Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC3	SAC2
Date	July 11, 2024	July 11, 2024
Temperature / Humidity	24 deg. C / 53 % RH	25 deg. C / 50 % RH
Engineer	Makoto Hosaka	Hiromasa Sato
	(Below 30 MHz)	(Above 30 MHz)
Mode	Mode 3	

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.	27.12	QP	31.3	20.0	6.7	32.2	-40.0	-14.2	29.5	43.7	-	2	* Limit: 30 m
Hori.	63.488	QP	35.2	7.5	7.1	31.9	0.0	17.8	40.0	22.2	315	160	
Hori.	144.866	QP	42.5	14.6	8.6	31.9	0.0	33.8	43.5	9.7	210	124	
Hori.	169.010	QP	50.6	15.6	8.9	31.8	0.0	43.2	43.5	**0.3**	194	292	
Hori.	235.663	QP	32.9	11.2	6.1	31.8	0.0	18.4	46.0	27.7	100	160	
Hori.	265.592	QP	52.0	12.1	6.3	31.8	0.0	38.6	46.0	7.4	100	341	
Hori.	298.321	QP	45.0	12.8	6.6	31.7	0.0	32.7	46.0	13.3	100	339	
Hori.	313.877	QP	53.1	13.3	6.7	31.7	0.0	41.3	46.0	4.7	100	348	
Vert.	17.93	QP	37.7	19.6	6.5	32.2	-40.0	-8.4	29.5	37.9	-	279	* Limit: 30 m
Vert.	18.22	QP	39.2	19.6	6.5	32.2	-40.0	-6.9	29.5	36.4	-	263	* Limit: 30 m
Vert.	27.12	QP	34.4	20.0	6.7	32.2	-40.0	-11.1	29.5	40.6	-	101	* Limit: 30 m
Vert.	120.722	QP	48.4	13.2	8.1	31.9	0.0	37.7	43.5	5.8	100	234	
Vert.	144.866	QP	50.3	14.6	8.6	31.9	0.0	41.6	43.5	1.9	100	135	
Vert.	169.013	QP	47.8	15.6	8.9	31.8	0.0	40.4	43.5	3.1	100	185	
Vert.	313.878	QP	46.9	13.3	6.7	31.7	0.0	35.2	46.0	10.9	173	278	

Result = Reading + Ant Factor + Loss (Cable+ATT+ΔAF(above 30 MHz)) - Gain(Amprifier) + Distance factor(below 30 MHz)

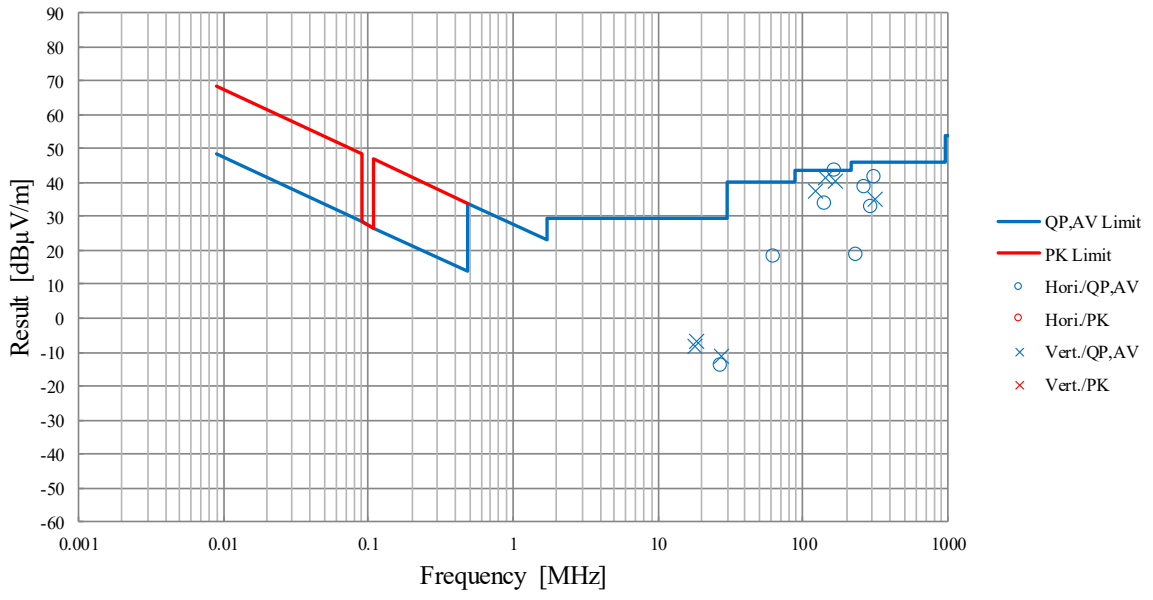
* Other frequency noises omitted in this report were not seen or have enough margin (more than 20 dB).

* Carrier level (Result at 3 m): Hor= 65.6 dBuV/m, Ver= 79.2 dBuV/m

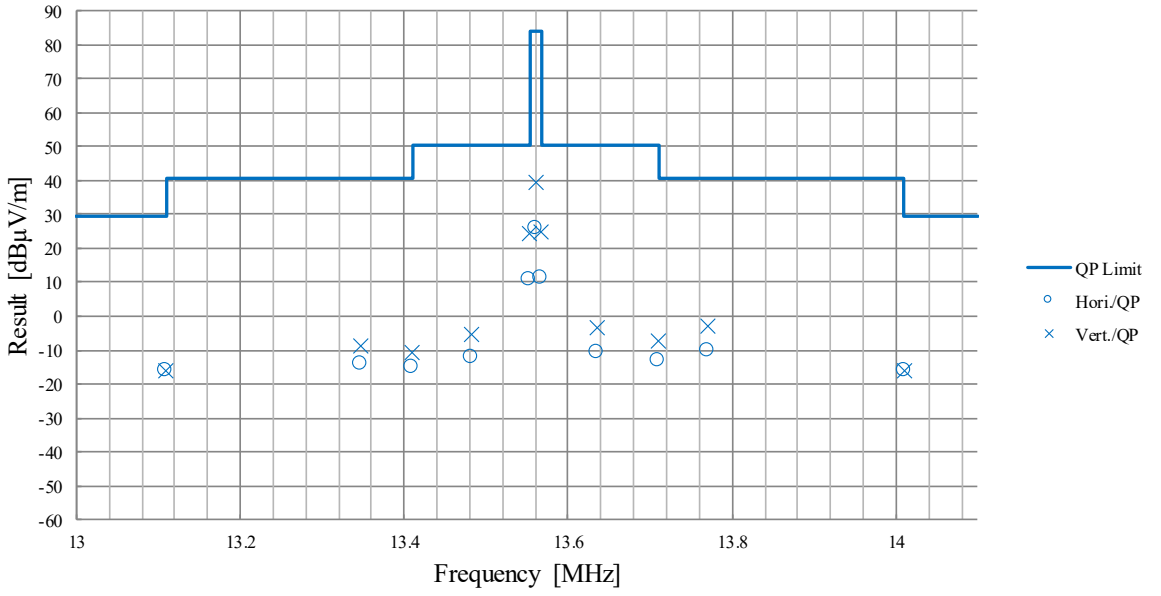
Radiated Spurious Emission
(Plot data, Worst case for Spurious Emission)

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC3	SAC2
Date	July 11, 2024	July 11, 2024
Temperature / Humidity	24 deg. C / 53 % RH	25 deg. C / 50 % RH
Engineer	Makoto Hosaka (Below 30 MHz)	Hiromasa Sato (Above 30 MHz)
Mode	Mode 3	

Spurious emission plot



Within band plot

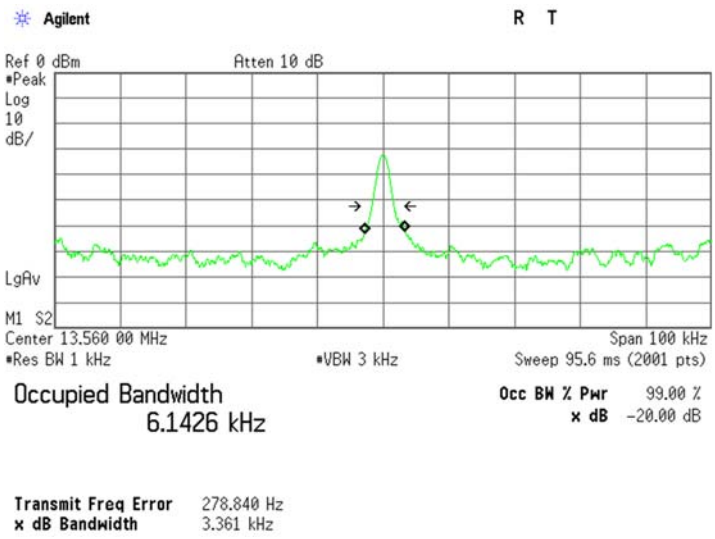


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded Room
Date	July 11, 2024
Temperature / Humidity	25 deg. C / 46 % RH
Engineer	Hiromasa Sato
Mode	Mode 2

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.36	6.14

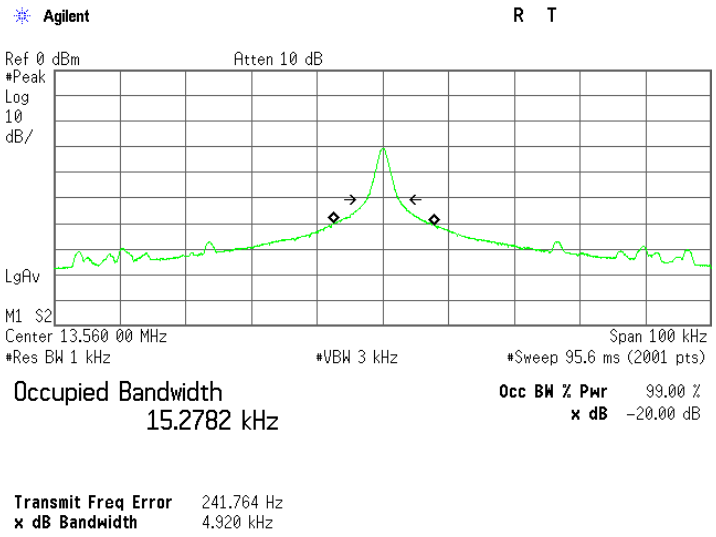


Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded Room
Date	July 12, 2024
Temperature / Humidity	25 deg. C / 46 % RH
Engineer	Hiromasa Sato
Mode	Mode 1

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	4.92	15.28



Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

Frequency Tolerance

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded Room
Date	July 12, 2024
Temperature / Humidity	25 deg. C / 46 % RH
Engineer	Hiromasa Sato
Mode	Mode 3

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	[+/- %]
+40	5	Power on	13.559989	-0.000011	-0.00008	-0.8	0.01
		+ 2 min.	13.559985	-0.000015	-0.00011	-1.1	0.01
		+ 5 min.	13.559984	-0.000016	-0.00012	-1.2	0.01
		+ 10 min.	13.559984	-0.000016	-0.00012	-1.2	0.01
+30	5	Power on	13.560024	0.000024	0.00018	1.8	0.01
		+ 2 min.	13.560020	0.000020	0.00015	1.5	0.01
		+ 5 min.	13.560020	0.000020	0.00015	1.5	0.01
		+ 10 min.	13.560020	0.000020	0.00015	1.5	0.01
+20	5	Power on	13.560062	0.000062	0.00045	4.5	0.01
		+ 2 min.	13.560058	0.000058	0.00043	4.3	0.01
		+ 5 min.	13.560058	0.000058	0.00043	4.3	0.01
		+ 10 min.	13.560056	0.000056	0.00041	4.1	0.01
+20	4.5 (5V -10 %)	Power on	13.560052	0.000052	0.00038	3.8	0.01
		+ 2 min.	13.560051	0.000051	0.00038	3.8	0.01
		+ 5 min.	13.560050	0.000050	0.00037	3.7	0.01
		+ 10 min.	13.560050	0.000050	0.00037	3.7	0.01
+20	5.5 (5V +10 %)	Power on	13.560058	0.000058	0.00043	4.3	0.01
		+ 2 min.	13.560057	0.000057	0.00042	4.2	0.01
		+ 5 min.	13.560048	0.000048	0.00035	3.5	0.01
		+ 10 min.	13.560046	0.000046	0.00034	3.4	0.01
+10	5	Power on	13.560083	0.000083	0.00061	6.1	0.01
		+ 2 min.	13.560082	0.000082	0.00060	6.0	0.01
		+ 5 min.	13.560081	0.000081	0.00060	6.0	0.01
		+ 10 min.	13.560080	0.000080	0.00059	5.9	0.01
+5	5	Power on	13.560088	0.000088	0.00065	6.5	0.01
		+ 2 min.	13.560088	0.000088	0.00065	6.5	0.01
		+ 5 min.	13.560088	0.000088	0.00065	6.5	0.01
		+ 10 min.	13.560088	0.000088	0.00065	6.5	0.01

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Tested frequency: 13.56 MHz
Limit (+/-): 0.01 % (+/- 100 ppm)

*The test was begun from 40 deg. C and the temperature was lowered each 10 deg. C.
(+10 deg. C to +5 deg. C in 5 deg. C increments).
*The test results are listed at +40 deg. C from +5 deg. C of the product specifications.

APPENDIX 2: Test instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	145033	Coaxial Cable	Fujikura Shoji Co., LTD	5D2W	-	2024/04/10	12
CE	145110	Digital Tester	SANWA	PC500	7019240	2024/05/29	12
CE	145538	LISN	Rohde & Schwarz	ENV216	100511	2024/02/06	12
CE	145539	LISN	Rohde & Schwarz	ENV216	100512	2024/02/06	12
CE	145762	Terminator	TME	CT-01 BP	-	2023/12/08	12
CE	146293	Thermo-Hygrometer	A&D Company	AD-5681	4062518	2023/08/03	12
CE	147480	Tape Measure	ASKUL	-	-	-	-
CE	150923	Attenuator	JFW	50HF-003N	-	2024/02/13	12
CE,RE	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	Ver 3.1.0546	-	-
CE,RE	213530	Test Receiver	Rohde & Schwarz	ESW44	103068	2024/02/22	12
RE	144975	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	2024/04/10	12
RE	144976	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	2024/04/10	12
RE	145004	Pre Amplifier	SONOMA	310N	290212	2024/02/13	12
RE	145022	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032665	2024/04/10	12
RE	145126	Pre Amplifier	SONOMA	310N	290213	2024/02/07	12
RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2024/04/01	12
RE	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2024/04/10	12
RE	145563	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	2024/03/22	12
RE	145568	Semi Anechoic Chamber(ME)	TDK	Semi Anechoic Chamber 3m/10m	1, 2, 3	2022/12/24	24
RE	145792	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997812	2023/09/25	12
RE	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2023/09/25	12
RE	146432	Tape Measure	TAJIMA	GL19-55	-	-	-
RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2023/08/25	12
RE	150921	Attenuator	JFW	50HF-003N	-	2024/02/13	12
RE	167095	Attenuator	JFW	50HF-006N	-	2024/02/13	12
RE	167096	Attenuator	JFW	50HF-006N	-	2024/02/13	12
RE	191838	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/03	12
RE	191840	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/03	12
RE	194601	Coaxial Cable	Fjikura	5D-2W	-	2023/12/08	12
RE	207277	Measuring	ASKUL	-	-	-	-
RE	236418	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VULP 9118 B	00975	2024/07/03	12
FT,BW	145200	Temperature and Humidity Chamber	Espec	PL-1KT	14020837	2024/04/26	12
FT,BW	146178	Search coil	Langer	RF-R 400-1	02-0634	-	-
FT,BW	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2024/03/25	12
FT,BW	175823	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/01	12
FT,BW	235639	DIGITAL MULTIMETER	HIOKI E.E. CORPORATION	DT4261	230313156	2024/05/29	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:

CE: Conducted Emission
RE: Radiated Emission
FT:Frequency Tolerance
BW: 20 dB Bandwidth and 99% Occupied Bandwidth