



EMI TEST REPORT

Test Report No. : 12881156H-B-R2

Applicant : DENSO CORPORATION
Type of Equipment : Passive Entry Passive Start System
(LF Transmitter)
Model No. : U21A0
FCC ID : HYQU21A0
Test regulation : FCC Part 15 Subpart B: 2019
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers EMC technical requirements. It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. This report is a revised version of 12881156H-B-R1. 12881156H-B-R1 is replaced with this report.

Date of test: August 20, 2019

Representative test engineer:

T. Nakagawa

Tomohisa Nakagawa
Engineer
Consumer Technology Division

Approved by:

M. Imura

Motoya Imura
Leader
Consumer Technology Division



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REVISION HISTORY

Original Test Report No.: 12881156H-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12881156H-B	September 25, 2019	-	-
1	12881156H-B-R1	November 12, 2019	P.5	Addition of Rating in Clause 2.1
1	12881156H-B-R1	November 12, 2019	P.11	Correction of the Frequency range in Clause 5.3; From 1000 MHz - 10000 MHz to 1 GHz - 18 GHz
1	12881156H-B-R1	November 12, 2019	P.12	Correction of the Frequency range of the Figure 2 in Clause 5.3; From 1 GHz - 10 GHz to 1 GHz - 18 GHz
2	12881156H-B-R2	November 13, 2019	P.6	Deletion of ANT1 and ANT2 from Antenna type of Radio Specification [Transmitter part] in Clause 2.2.

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Reference: Abbreviations (Including words undescribed in this report)

AAN	Asymmetric Artificial Network	ISED	Innovation, Science and Economic Development Canada
AC	Alternating Current	ISN	Impedance Stabilization Network
AM	Amplitude Modulation	ISO	International Organization for Standardization
AMN	Artificial Mains Network	JAB	Japan Accreditation Board
Amp, AMP	Amplifier	LAN	Local Area Network
ANSI	American National Standards Institute	LCL	Longitudinal Conversion Loss
Ant, ANT	Antenna	LIMS	Laboratory Information Management System
AP	Access Point	LISN	Line Impedance Stabilization Network
ASK	Amplitude Shift Keying	MRA	Mutual Recognition Arrangement
Atten., ATT	Attenuator	NIST	National Institute of Standards and Technology
AV	Average	NS	No signal detect.
BPSK	Binary Phase-Shift Keying	NSA	Normalized Site Attenuation
BR	Bluetooth Basic Rate	NVLAP	National Voluntary Laboratory Accreditation Program
BT	Bluetooth	OBW	Occupied Band Width
BT LE	Bluetooth Low Energy	OFDM	Orthogonal Frequency Division Multiplexing
BW	BandWidth	OOK	On Off Keying
C.F	Correction Factor	PK	Peak
Cal Int	Calibration Interval	P _{LT}	long-term flicker severity
CAV	CISPR AV	POHC(A)	Partial Odd Harmonic Current
CCK	Complementary Code Keying	Pol., Pola.	Polarization
CDN	Coupling Decoupling Network	PR-ASK	Phase Reversal ASK
Ch., CH	Channel	P _{ST}	short-term flicker severity
CISPR	Comite International Special des Perturbations Radioelectriques	QAM	Quadrature Amplitude Modulation
Corr.	Correction	QP	Quasi-Peak
CPE	Customer premise equipment	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	r.m.s., RMS	Root Mean Square
DBPSK	Differential BPSK	RBW	Resolution Band Width
DC	Direct Current	RE	Radio Equipment
DET	Detector	REV	Reverse
Dmax	maximum absolute voltage change during an observation period	RF	Radio Frequency
DQPSK	Differential QPSK	RFID	Radio Frequency Identifier
DSSS	Direct Sequence Spread Spectrum	RSS	Radio Standards Specifications
EDR	Enhanced Data Rate	Rx	Receiving
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power	SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
EM clamp	Electromagnetic clamp	S/N	Signal to Noise ratio
EMC	ElectroMagnetic Compatibility	SA, S/A	Spectrum Analyzer
EMI	ElectroMagnetic Interference	SG	Signal Generator
EMS	ElectroMagnetic Susceptibility	SVSWR	Site-Voltage Standing Wave Ratio
EN	European Norm	THC(A)	Total Harmonic Current
e.r.p., ERP	Effective Radiated Power	THD(%)	Total Harmonic Distortion
EU	European Union	TR	Test Receiver
EUT	Equipment Under Test	Tx	Transmitting
Fac.	Factor	VBW	Video BandWidth
FCC	Federal Communications Commission	Vert.	Vertical
FHSS	Frequency Hopping Spread Spectrum	WLAN	Wireless LAN
FM	Frequency Modulation	xDSL	Generic term for all types of DSL technology (DSL: Digital Subscriber Line)
Freq.	Frequency		
FSK	Frequency Shift Keying		
Fund	Fundamental		
FWD	Forward		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
I/O	Input/Output		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		

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SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1 Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan
Telephone Number	:	+81-566-61-2524
Facsimile Number	:	+81-566-25-4837
Contact Person	:	TAKESHI KUMAZAKI

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. 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 (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Passive Entry Passive Start System (LF Transmitter)
Model No.	:	U21A0
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample (Information from test lab.)	:	July 31, 2019
Country of Mass-production	:	United states of America
Condition of EUT	:	Production model
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: U21A0 (referred to as the EUT in this report) is a Passive Entry Passive Start System (LF Transmitter).

Radio Specification

[Transmitter part]

Radio Type	:	LF Transmitter
Frequency of Operation	:	125 kHz
Oscillation circuit	:	Ceramic resonator
Oscillator frequency	:	8 MHz (Ceramic resonator)
Modulation	:	OOK (A1D)
Antenna type	:	ANT3: External antenna (Hi-L type) ANT4: External antenna (Normal-L type) ANT5: External antenna (Normal-L type) ANT6: External antenna (Normal-L type)
Antenna Specification	:	Ferrite antenna coil
Power supply	:	DC 12.0 V
(Nominal supply voltage)	:	
Clock Frequency (maximum)	:	21.948717 MHz

[Receiver part]

Frequency of Operation	:	314.90 MHz
Oscillator frequency	:	21.948717 MHz
Type of receiving system	:	Super-heterodyne
Antenna Specification	:	Internal antenna (Loop antenna)
Power supply	:	DC 5.0 V
(Nominal supply voltage)	:	
Voltage Controlled Oscillator	:	3.6 GHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart B
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258
Title : FCC 47CFR Part15 Radio Frequency Device
Subpart B Unintentional Radiators

3.2 Procedures and results

Item	Test Procedure	Limits	Deviation	Worst margin	Result	Remarks
Conducted emission	FCC: ANSI C63.4: 2014 7. AC power - line conducted emission measurements	FCC:Part 15 Subpart B 15.107(a)	N/A	N/A	N/A	*1)
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.3				
Radiated emission	FCC: ANSI C63.4: 2014 8. Radiated emission measurements	FCC: Part 15 Subpart B 15.109(a)	N/A	27.6 dB 1538.400 MHz, Horizontal	Complied a)	-
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.3				
Antenna Terminal	FCC: ANSI C63.4: 2014 12. Measurement of unintentional radiators other than ITE	FCC: Part 15 Subpart B 15.111(a)	N/A	N/A	N/A	*2)
	ISED: - RSS-Gen 7.1	ISED: RSS-Gen 7.4				
*Note: UL Japan, Inc’s EMI Work Procedure 13-EM-W0420. *1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line. *2) The receiving antenna (of this EUT) is installed inside the EUT and cannot be removed (permanently attached). Therefore, Radiated emission test was performed.						
a) Refer to APPENDIX 1 (data of Radiated Emission)						
Symbols:						
Complied		The data of this test item has enough margin, more than the measurement uncertainty.				
Complied#		The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.				

3.3 Addition to standard

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

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB

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3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of E.U.T. during testing

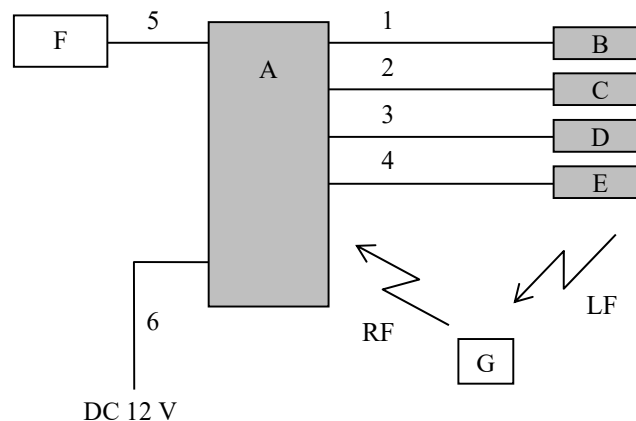
4.1 Operating Mode(s)

Mode	Remarks
Smart Operating mode	-

Justification: The system was configured in typical fashion (as a user would normally use it) for testing.

* It was confirmed by using checker that the EUT receives the signal from the transmitter (pair of EUT).

4.2 Configuration and peripherals



* 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	Remarks
A	Passive Entry Passive Start System (LF Transmitter)	U21A0	SV20 20140312.S	DENSO CORPORATION	EUT
B	ANT3 (External antenna (Hi-L type))	-	180402UB	DENSO CORPORATION	EUT
C	ANT4 (External antenna (Normal-L type))	-	130802UA	DENSO CORPORATION	EUT
D	ANT5 (External antenna (Normal-L type))	-	130802UA	DENSO CORPORATION	EUT
E	ANT6 (External antenna (Normal-L type))	-	170304UC	DENSO CORPORATION	EUT
F	Checker Bench	-	-	DENSO CORPORATION	-
G	Keyless Transmitter	U21A0	0811	DENSO CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna Cable	3.0	Unshielded	Unshielded	-
2	Antenna Cable	3.0	Unshielded	Unshielded	-
3	Antenna Cable	3.0	Unshielded	Unshielded	-
4	Antenna Cable	3.0	Unshielded	Unshielded	-
5	Signal Cable	3.0	Unshielded	Unshielded	-
6	DC Cable	3.0	Unshielded	Unshielded	-

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SECTION 5: Radiated Emission

5.1. Operating environment

Test place : No.4 semi anechoic chamber
Temperature : See data
Humidity : See data

5.2. Test configuration

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 EUT was set on the edge of the tabletop.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.

Photographs of the set up are shown in Appendix 3.

5.3. Test conditions

Frequency range : 30 MHz - 200 MHz (Biconical antenna) / 200 MHz - 1000 MHz (Logperiodic antenna)
1 GHz - 18 GHz (Horn antenna)
Test distance : 3 m
EUT position : Table top
EUT operation mode : See Clause 4.1

5.4. Test procedure

The height of the measuring antenna 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 with the Test Receiver, or the Spectrum Analyzer.

The radiated emission measurements were made with the following detector function of the Test Receiver and the Spectrum Analyzer.

For above 1 GHz, 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.

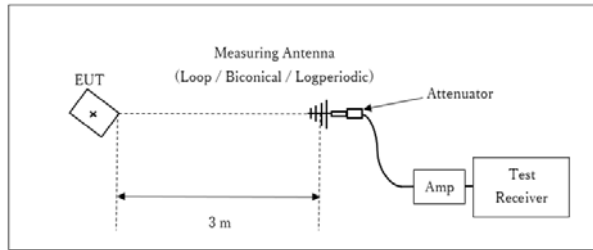
Frequency	Below 1GHz	Above 1GHz *1)
Instrument used	Test Receiver	Test Receiver
IF Bandwidth	QP: BW 120 kHz	PK: BW 1 MHz, CISPR AV: BW 1 MHz

*1) The measurement data was adjusted to a 3 m distance using the following Distance Factor.

Distance Factor: $20 \times \log(3.3 \text{ m} / 3 \text{ m}) = 0.83 \text{ dB}$

Figure 2: Test Setup

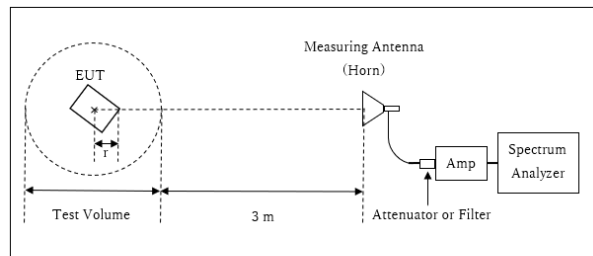
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 18 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log(3.3 \text{ m}^*/3.0 \text{ m}) = 0.83 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.3 \text{ m}$

Test Volume: 2 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.7 \text{ m}$

- The 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.

5.5. Test result

Summary of the test results: Pass

The limit is rounded down to one decimal place.

The test result is rounded off to one or two decimal places, so some differences might be observed.

Date: August 20, 2019

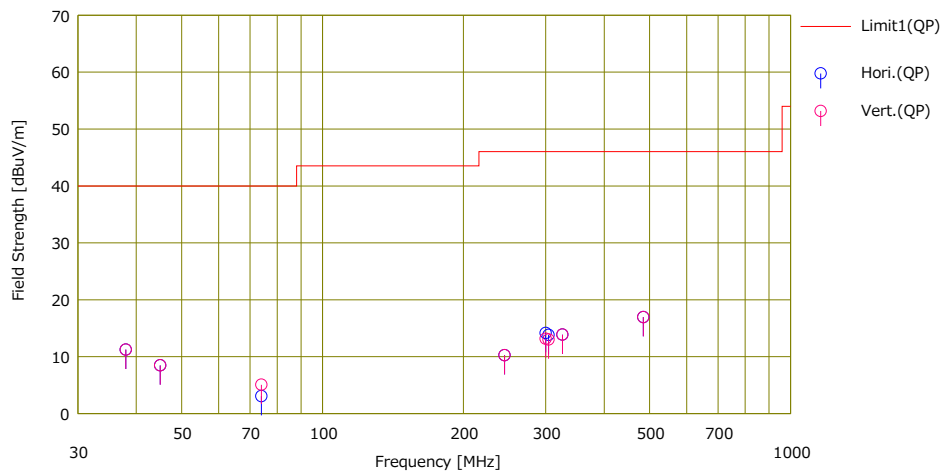
Test engineer: Tomohisa Nakagawa

APPENDIX 1: Test data

Radiated Emission

Report No. 12881156H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date August 20, 2019
Temperature / Humidity 20 deg. C / 59 % RH
Engineer Tomohisa Nakagawa
(Below 1 GHz)
Mode Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading [dBP]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result [dBP]	Limit [dBP]	Margn [dBP]	Polz. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	38,000	27.30	15.28	7.59	38.94	11.23	40.00	28.7	Hori.	100	0	BC	
2	45,000	26.90	12.80	7.71	38.94	8.47	40.00	31.5	Hori.	100	0	BC	
3	74,000	27.90	6.06	8.12	39.01	3.07	40.00	36.9	Hori.	100	0	BC	
4	245,000	27.90	11.66	9.71	39.01	10.26	46.00	35.7	Hori.	100	0	LA23	
5	300,000	29.40	13.53	10.12	38.89	14.16	46.00	31.8	Hori.	100	0	LA23	
6	304,200	28.90	13.65	10.15	38.88	13.82	46.00	32.1	Hori.	100	0	LA23	
7	325,600	28.00	14.42	10.28	38.82	13.88	46.00	32.1	Hori.	100	0	LA23	
8	485,000	27.00	17.21	11.29	38.55	16.95	46.00	29.0	Hori.	100	0	LA23	
9	38,000	27.30	15.28	7.59	38.94	11.23	40.00	28.7	Vert.	100	0	BC	
10	45,000	26.90	12.80	7.71	38.94	8.47	40.00	31.5	Vert.	100	0	BC	
11	74,000	29.90	6.06	8.12	39.01	5.07	40.00	34.9	Vert.	100	0	BC	
12	245,000	27.90	11.66	9.71	39.01	10.26	46.00	35.7	Vert.	100	0	LA23	
13	300,000	28.40	13.53	10.12	38.89	13.16	46.00	32.8	Vert.	100	0	LA23	
14	304,200	28.10	13.65	10.15	38.88	13.02	46.00	32.9	Vert.	100	0	LA23	
15	325,600	28.00	14.42	10.28	38.82	13.88	46.00	32.1	Vert.	100	0	LA23	
16	485,000	27.00	17.21	11.29	38.55	16.95	46.00	29.0	Vert.	100	0	LA23	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

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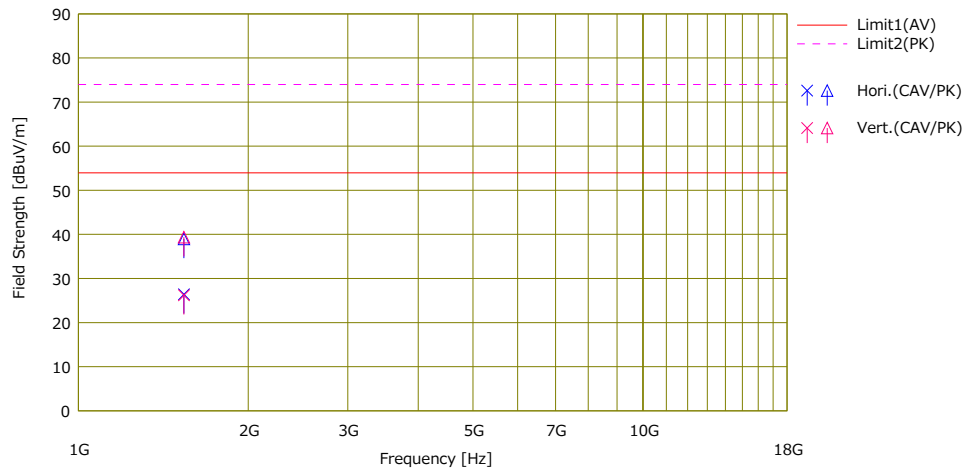
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Radiated Emission

Report No. 12881156H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date August 20, 2019
Temperature / Humidity 20 deg. C / 59 % RH
Engineer Tomohisa Nakagawa
(Above 1 GHz)
Mode Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading		Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(CAV) [dBuV]	(PK) [dBuV]				(CAV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	1538.400	30.30	42.85	25.84	2.96	32.70	26.40	38.95	54.00	74.00	27.6	35.0	Hori.	100	0	H21	
2	1538.400	30.10	43.24	25.84	2.96	32.70	26.20	39.34	54.00	74.00	27.8	34.6	Vert.	100	0	H21	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE - GAIN(AMP) + D-factor)

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APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141508	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	05/16/2019	05/31/2020	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/04/2018	10/31/2019	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	06/17/2019	06/30/2020	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/28/2018	06/30/2020	24
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-201	0010	01/11/2019	01/31/2020	12
RE	141855	Spectrum Analyzer	AGILENT	E4440A	MY46187750	11/09/2018	11/30/2019	12
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	01/29/2019	01/31/2020	12
RE	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/04/2019	04/30/2021	24
RE	141585	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	02/08/2019	02/29/2020	12
RE	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	9111B-192	08/24/2019	08/31/2020	12
RE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/08/2019	08/31/2020	12
RE	141397	Coaxial Cable	UL Japan	-	-	06/18/2019	06/30/2020	12
RE	141331	Attenuator(6dB)	TME	UFA-01	-	02/05/2019	02/29/2020	12
RE	141425	Biconical Antenna	Schwarzbeck	VHA9103+BBA9106	1302	08/24/2019	08/31/2020	12

*Hyphens for Last Calibration Date, Calibration Due 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.

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

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

Test item:

RE: Radiated emission

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