RADIO TEST REPORT

Test Report No. : 12881156H-A-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 C: 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 above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio 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. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12881156H-A-R1. 12881156H-A-R1 is replaced with this report.

Date of test: August 16, 2019

Representative test engineer:

Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:

Motoya Imura
Leader
Consumer Technology Division

NVLAP TESTING NVLAP LAB CODE 200572-0 ilac-MRA

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.

☒ There is no testing item of "Non-accreditation".

REVISION HISTORY

Original Test Report No.: 12881156H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12881156H-A	September 25, 2019	-	-
1	12881156H-A-R1	November 12, 2019	P.5	Addition of Rating in Clause 2.1
1	12881156H-A-R1	November 12, 2019	P.10	Correction of wording in note * 1) of Clause 4.1 ; From “each type(ANT1, ANT2…)” to “each type(ANT3, ANT4…)”
1	12881156H-A-R1	November 12, 2019	P.10	Deletion of note sentences under the configuration diagram in section 4.2
1	12881156H-A-R1	November 12, 2019	P.17	Correction of distance notation in table title; From 3 m to 10 m
2	12881156H-A-R2	November 13, 2019	P.6	Deletion of ANT1 and ANT2 from Antenna type of Radio Specification [Transmitter part] in Clause 2.2.

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation
AC	Alternating Current
AFH	Adaptive Frequency Hopping
AM	Amplitude Modulation
Amp, AMP	Amplifier
ANSI	American National Standards Institute
Ant, ANT	Antenna
AP	Access Point
ASK	Amplitude Shift Keying
Atten., ATT	Attenuator
AV	Average
BPSK	Binary Phase-Shift Keying
BR	Bluetooth Basic Rate
BT	Bluetooth
BT LE	Bluetooth Low Energy
BW	BandWidth
Cal Int	Calibration Interval
CCK	Complementary Code Keying
Ch., CH	Channel
CISPR	Comite International Special des Perturbations Radioelectriques
CW	Continuous Wave
DBPSK	Differential BPSK
DC	Direct Current
DFS	Dynamic Frequency Selection
DQPSK	Differential QPSK
DSSS	Direct Sequence Spread Spectrum
EDR	Enhanced Data Rate
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	European Norm
ERP, e.r.p.	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
Fac.	Factor
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
FM	Frequency Modulation
Freq.	Frequency
FSK	Frequency Shift Keying
GFSK	Gaussian Frequency-Shift Keying
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
Hori.	Horizontal
ICES	Interference-Causing Equipment Standard
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
ILAC	International Laboratory Accreditation Conference
ISED	Innovation, Science and Economic Development Canada
ISO	International Organization for Standardization
JAB	Japan Accreditation Board
LAN	Local Area Network
LIMS	Laboratory Information Management System
MCS	Modulation and Coding Scheme
MRA	Mutual Recognition Arrangement
NIST	National Institute of Standards and Technology
NS	No signal detect.
NSA	Normalized Site Attenuation
NVLAP	National Voluntary Laboratory Accreditation Program
OBW	Occupied Band Width
OFDM	Orthogonal Frequency Division Multiplexing
OOK	On Off Keying
P/M	Power meter
PCB	Printed Circuit Board
PER	Packet Error Rate
PHY	Physical Layer
PK	Peak
PN	Pseudo random Noise
PRBS	Pseudo-Random Bit Sequence
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadri-Phase Shift Keying
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RSS	Radio Standards Specifications
Rx	Receiving
SA, S/A	Spectrum Analyzer
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
TR	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN

CONTENTS PAGE

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. 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 (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 (Nominal supply voltage)	:	DC 12.0 V
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 (Nominal supply voltage)	:	DC 5.0 V
Voltage Controlled Oscillator	:	3.6 GHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C 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 C Intentional Radiators Section 15.207 Conducted limits Section 15.209 Radiated emission limits; general requirements.

* The revisions made after testing date do not affect the test specification applied to the EUT.

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

3.2 Procedures and results

Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results	Remarks
Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 8.8	<FCC> Section 15.207 <ISED> RSS-Gen 8.8	-	N/A	N/A	N/A	*1)
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.5, 6.12	<FCC> Section 15.209 <ISED> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	6.5 dB 125 kHz 0 deg. AV PK with Duty Factor	Complied a)	-
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.5, 6.6, 6.13	<FCC> Section 15.209 <ISED> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	12.9 dB 127.996 MHz, Vertical, QP	Complied a)	-
-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> -	<FCC> Reference data <ISED> -	Radiated	N/A	N/A	Complied b)	-

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*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.

a) Refer to APPENDIX 1 (data of Radiated emission)
b) Refer to APPENDIX 1 (data of 26dB Bandwidth and 99% Occupied Bandwidth)

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.

FCC 15.31 (e)
The test was performed with the New Battery (DC 12.0 V) and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. Therefore, this 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 vehicle. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
99 % Occupied Band Width	RSS-Gen 6.7	-	Radiated	N/A	N/A	-
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.						

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the following 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.

Test distance	Radiated emission (+/-)
	9 kHz to 30 MHz
3 m	3.3 dB
10 m	3.2 dB

*Measurement distance

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*)(+/-)		(10 m*)(+/-)	
	30 MHz to 200 MHz	200 MHz to 1000 MHz	30 MHz to 200 MHz	200 MHz to 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	5.0 dB	6.3 dB	4.9 dB	5.0 dB

* Measurement distance

Bandwidth
0.96 %

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
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

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.

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

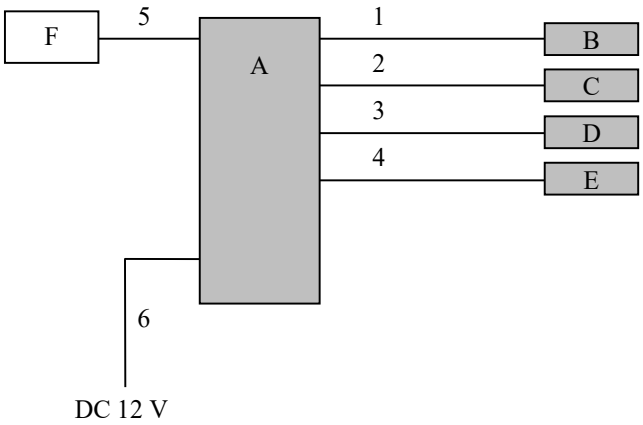
4.1 Operating Modes

Mode	Timing of transmission *2)	Remarks
(1)Transmitting mode (Tx) ANT3: External antenna (Hi-L type)	Pattern #0	*1)
(2)Transmitting mode (Tx) ANT6: External antenna (Normal-L type)	Pattern #0	*1)

*1) The time division transmission was performed with one representative antenna for each type(ANT3, ANT4…) in transmission mode.
For transmitting modes of more than one antenna types, the respective number of representative antennas was used.
This transmission timing was worse than the one using four antennas of normal use.
*2) Refer to "Theory of Operation_Timing of transmission".

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

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 20140530.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	-

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	-

SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

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.

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., 135 deg. and 180 deg.) and horizontal polarization.
*Refer to Figure 1 about Direction of the Loop Antenna.

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.

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

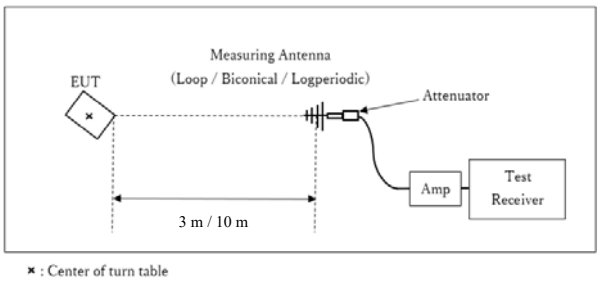
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)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

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.

[Test Setup]
Below 1 GHz



Test Distance: 3 m / 10 m

- 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.

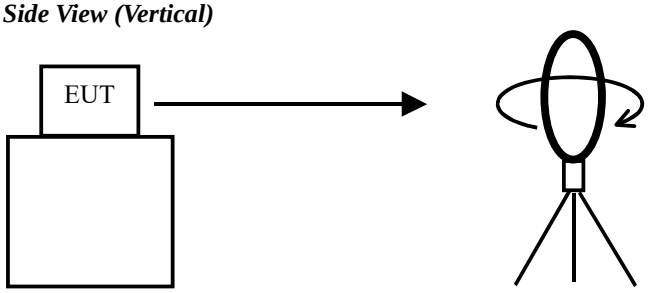
The test results and limit are rounded off to one decimal place, so some differences might be observed.

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

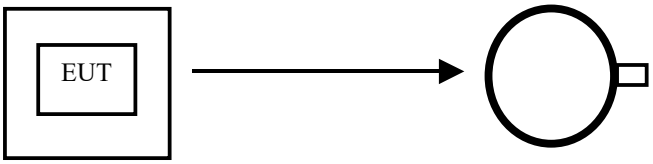
Date: August 16, 2019 Test engineer: Shinya Watanabe

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

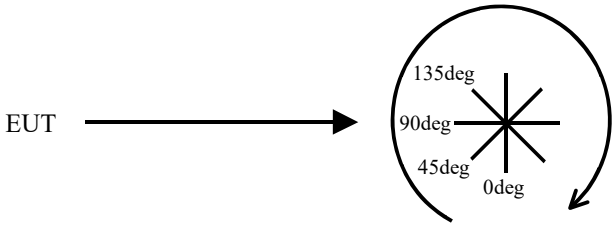


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26dB Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26 dB Bandwidth	50 kHz	100 Hz	300 Hz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 99% Occupied Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Peak hold was applied as Worst-case measurement.							

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Test data

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature/ Humidity	22 deg. C / 69 % RH
Engineer	Shinya Watanabe
Mode	Tx 125kHz ANT3

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.125	PK	84.8	19.7	-53.0	32.3	-	19.1	45.6	26.5	Fundamental
0deg	0.250	PK	43.5	19.7	-53.0	32.3	-	-22.2	39.6	61.8	
0deg	0.375	PK	42.0	19.6	-52.9	32.3	-	-23.5	36.1	59.6	
0deg	0.500	QP	33.3	19.6	-12.9	32.2	-	7.8	33.6	25.8	
0deg	0.625	QP	32.7	19.6	-12.9	32.2	-	7.2	31.7	24.5	
0deg	0.750	QP	32.3	19.6	-12.9	32.3	-	6.8	30.1	23.4	
0deg	0.875	QP	31.9	19.6	-12.9	32.3	-	6.4	28.7	22.3	
0deg	1.000	QP	31.5	19.6	-12.8	32.3	-	6.0	27.6	21.6	
0deg	1.125	QP	31.4	19.6	-12.8	32.3	-	5.9	26.5	20.6	
0deg	1.250	QP	31.2	19.6	-12.8	32.3	-	5.8	25.6	19.8	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier)

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.125	AV	84.8	19.7	-53.0	32.3	0.0	19.1	25.6	6.5	
0deg	0.250	AV	43.5	19.7	-53.0	32.3	0.0	-22.2	19.6	41.8	
0deg	0.375	AV	42.0	19.6	-52.9	32.3	0.0	-23.5	16.1	39.6	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 10 m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.125	PK	84.8	19.7	6.0	32.3	-	78.1	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

* All spurious emissions lower than this result.

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

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature/ Humidity	22 deg. C / 69 % RH
Engineer	Shinya Watanabe
Mode	Tx 125kHz ANT6

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.125	PK	80.6	19.7	-53.0	32.3	-	15.0	45.6	30.6	Fundamental
0deg	0.250	PK	41.3	19.7	-53.0	32.3	-	-24.4	39.6	64.0	
0deg	0.375	PK	39.8	19.6	-52.9	32.3	-	-25.8	36.1	61.9	
0deg	0.500	QP	32.8	19.6	-12.9	32.2	-	7.3	33.6	26.4	
0deg	0.625	QP	32.3	19.6	-12.9	32.2	-	6.8	31.7	25.0	
0deg	0.750	QP	31.7	19.6	-12.9	32.3	-	6.2	30.1	23.9	
0deg	0.875	QP	31.4	19.6	-12.9	32.3	-	5.8	28.7	22.9	
0deg	1.000	QP	31.0	19.6	-12.8	32.3	-	5.5	27.6	22.1	
0deg	1.125	QP	31.0	19.6	-12.8	32.3	-	5.5	26.5	21.0	
0deg	1.250	QP	31.2	19.6	-12.8	32.3	-	5.7	25.6	19.9	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier)

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.125	AV	80.6	19.7	-53.0	32.3	0.0	15.0	25.6	10.6	
0deg	0.250	AV	41.3	19.7	-53.0	32.3	0.0	-24.4	19.6	44.0	
0deg	0.375	AV	39.8	19.6	-52.9	32.3	0.0	-25.8	16.1	41.9	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 10 m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.125	PK	80.6	19.7	6.0	32.3	-	74.0	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

* All spurious emissions lower than this result.

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

Radiated Emission above 30 MHz (Spurious Emission)

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature/ Humidity	22 deg. C / 69 % RH
Engineer	Shinya Watanabe
Mode	Tx 125kHz ANT3

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	95.997	QP	42.7	9.1	8.5	39.1	21.2	43.5	22.3	
Hori.	127.996	QP	45.2	13.2	9.0	39.1	28.3	43.5	15.2	
Hori.	143.995	QP	33.8	14.4	9.2	39.1	18.3	43.5	25.2	
Hori.	159.994	QP	41.3	15.2	9.4	39.1	26.7	43.5	16.8	
Hori.	191.993	QP	33.2	15.9	9.7	39.1	19.7	43.5	23.9	
Hori.	207.992	QP	41.4	11.0	9.9	39.1	23.2	43.5	20.3	
Hori.	215.991	QP	33.8	11.1	9.9	39.1	15.7	43.5	27.8	
Hori.	255.989	QP	45.6	12.0	10.3	39.0	28.9	46.0	17.1	
Vert.	95.997	QP	45.6	9.1	8.5	39.1	24.1	43.5	19.4	
Vert.	127.996	QP	47.5	13.2	9.0	39.1	30.6	43.5	12.9	
Vert.	143.995	QP	41.2	14.4	9.2	39.1	25.6	43.5	17.9	
Vert.	159.994	QP	43.7	15.2	9.4	39.1	29.1	43.5	14.4	
Vert.	191.993	QP	40.3	15.9	9.7	39.1	26.8	43.5	16.7	
Vert.	207.992	QP	45.0	11.0	9.9	39.1	26.7	43.5	16.8	
Vert.	215.991	QP	41.1	11.1	9.9	39.1	23.1	43.5	20.4	
Vert.	255.989	QP	39.9	12.0	10.3	39.0	23.2	46.0	22.8	

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

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 (CABLE + ATT) - GAIN(AMP)

Radiated Emission above 30 MHz (Spurious Emission)

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature/ Humidity	22 deg. C / 69 % RH
Engineer	Shinya Watanabe
Mode	Tx 125kHz ANT6

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	95.998	QP	40.7	9.1	8.5	39.1	19.2	43.5	24.3	
Hori.	127.997	QP	43.9	13.2	9.0	39.1	26.9	43.5	16.6	
Hori.	159.997	QP	40.6	15.2	9.4	39.1	26.1	43.5	17.4	
Hori.	191.996	QP	32.8	15.9	9.7	39.1	19.3	43.5	24.2	
Hori.	223.995	QP	37.5	11.1	10.0	39.1	19.6	46.0	26.4	
Hori.	255.994	QP	45.4	12.0	10.3	39.0	28.7	46.0	17.3	
Hori.	271.993	QP	41.2	12.9	10.5	39.0	25.6	46.0	20.4	
Vert.	95.998	QP	43.6	9.1	8.5	39.1	22.1	43.5	21.4	
Vert.	127.997	QP	46.2	13.2	9.0	39.1	29.3	43.5	14.2	
Vert.	159.997	QP	42.5	15.2	9.4	39.1	27.9	43.5	15.6	
Vert.	191.996	QP	40.2	15.9	9.7	39.1	26.7	43.5	16.9	
Vert.	223.995	QP	43.7	11.1	10.0	39.1	25.8	46.0	20.2	
Vert.	255.994	QP	41.2	12.0	10.3	39.0	24.5	46.0	21.6	
Vert.	271.993	QP	41.7	12.9	10.5	39.0	26.2	46.0	19.8	

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

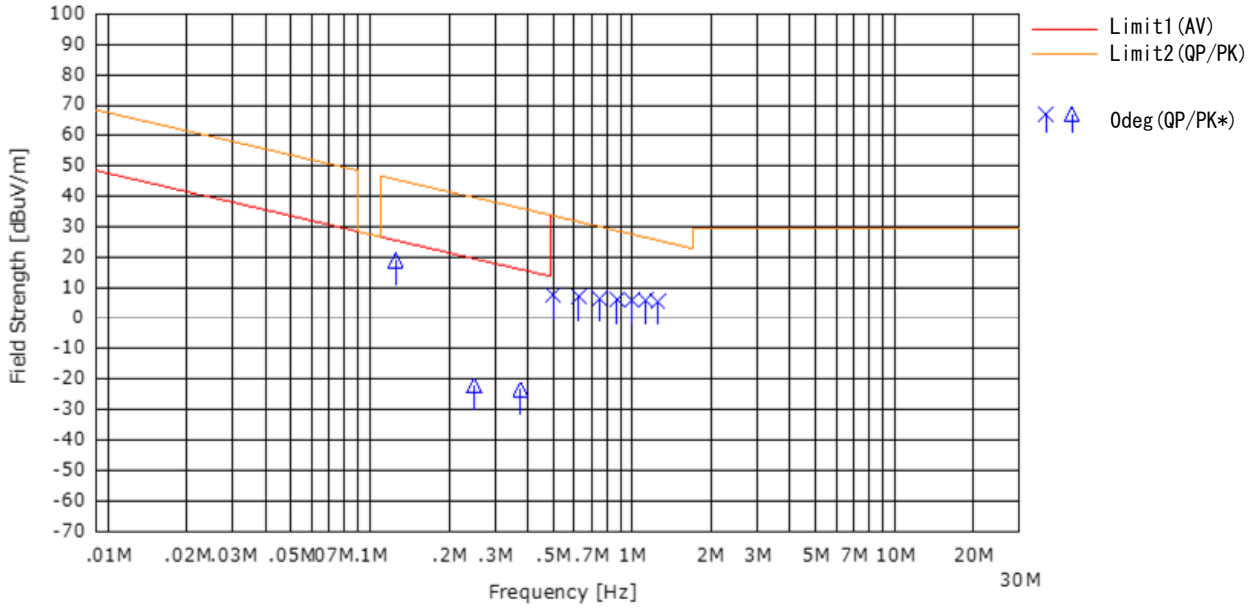
CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE + ATT) - GAIN(AMP)

Radiated Emission Plot data, Worst case

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature/ Humidity	22 deg. C / 69 % RH
Engineer	Shinya Watanabe
Mode	Tx 125kHz ANT3

(below 30MHz)

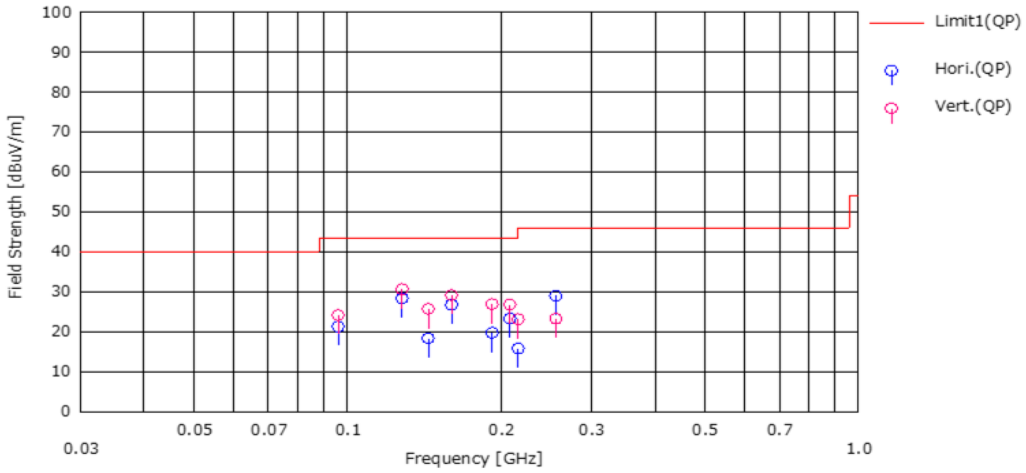
Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



* Data above 490 kHz were measured using a QP detector.

(above 30MHz)

Limit : FCC15.209 3 m, below 1 GHz:QP, above 1 GHz:AV/PK

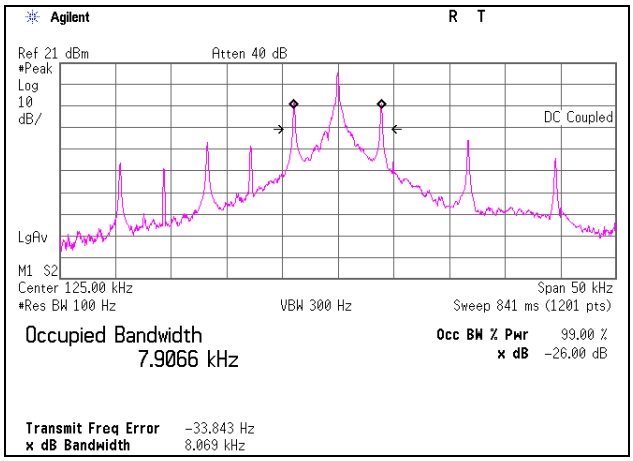


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

26dB Bandwidth and 99% Occupied Bandwidth

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature / Humidity	26 deg. C / 61 % RH
Engineer	Ken Fujita
Mode	ANT3

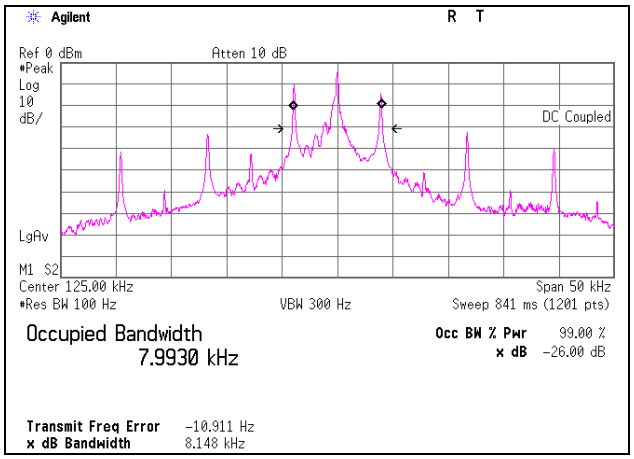
-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
8.069	7.9066



26dB Bandwidth and 99% Occupied Bandwidth

Report No.	12881156H
Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	08/16/2019
Temperature / Humidity	26 deg. C / 61 % RH
Engineer	Ken Fujita
Mode	ANT6

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
8.148	7.9930



APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141574	Digital thermometer	LKM electronic	DTM3000	-	07/03/2019	07/31/2020	12
RE	142226	Measure	KOMELON	KMC-36	-	-	-	-
RE	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	06/18/2018	06/30/2020	24
RE	141585	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	02/08/2019	02/29/2020	12
RE	141350	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	06/27/2019	06/30/2020	12
RE	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	06/27/2019	06/30/2020	12
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2018	10/31/2019	12
RE	141198	Biconical Antenna	Schwarzbeck	VHA9103+BBA9106	2513	08/23/2019	08/31/2020	12
RE	141215	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W/3D-2W/ RG400u/ RFM-E421(SW)	-/01068 (Switcher)	06/27/2019	06/30/2020	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/08/2019	02/29/2020	12
RE	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	11/05/2018	11/30/2019	12
RE	141413	Coaxial Cable	UL Japan	-	-	06/07/2019	06/30/2020	12
RE	141264	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	9111B-189	08/23/2019	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: Spurious emission