RADIO TEST REPORT

Test Report No. : 12541470H-R1

Applicant	:	**Panasonic Corporation of North America**
Type of Equipment	:	**WAM LO**
Model No.	:	**IM2005BB**
FCC ID	:	**ACJ932IM2005BB**
Test regulation	:	**FCC Part 15 Subpart C: 2018**
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 12541470H. 12541470H is replaced with this report.

Date of test: January 30 and 31, 2019

Representative test engineer:
Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:
Shinichi Miyazono
Engineer
Consumer Technology Division

NVLAP TESTING
NVLAP LAB CODE: 200572-0

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.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

UL Japan, Inc.
Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
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REVISION HISTORY

Original Test Report No.: 12541470H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12541470H	February 13, 2019	-	-
1	12541470H-R1	March 5, 2019	P.13	Correction of the Reading value in “Result of the fundamental emission at 3m without Distance factor” table; From 83.9 to 83.6

CONTENTS PAGE

SECTION 1: Customer information

Company Name	:	Panasonic Corporation of North America*1)
Address	:	Two Riverfront Plaza, 9th Floor Newark, NJ 07102-5490
Telephone Number	:	+1-201-348-7760
Facsimile Number	:	+1-201-348-7760
Contact Person	:	Ben Botros

*1) Panasonic Corporation of North America designates Panasonic Automotive Systems Asia Pacific Co.,Ltd as manufacturer of the product (WAM LO).

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No. on the cover and other 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	:	WAM LO
Model No.	:	IM2005BB
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample (Information from test lab.)	:	December 27, 2018
Country of Mass-production	:	Thailand
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model No: IM2005BB, (referred to as the EUT in this report), is the WAM LO.

Radio Specification

[Transmitter]

Radio Type	:	Transmitter
Frequency of Operation	:	125 kHz
Modulation	:	ASK
Antenna type	:	Air core coil inductive antenna
Clock frequency (Maximum)	:	4 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.209 Radiated emission limits; general requirements.

3.2 Procedures and results

Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 8.8	<FCC> Section 15.207 <IC> RSS-Gen 8.8	-	N/A	N/A *1)	N/A
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.12	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	28.6 dB 125 kHz 0 deg. PK with Duty factor	Complied a)
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.6, 6.13	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	5.0 dB 45.761 MHz, QP, Vertical	Complied a)
-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> -	<FCC> Reference data <IC> -	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 -26 dB 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)
This EUT provides stable voltage constantly to RF Module regardless of input voltage. 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

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99 % Occupied Band Width	RSS-Gen 6.7	-	Radiated	N/A	N/A	Complied

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.

Other than above, 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 following results are derived depending on whether or not laboratory uncertainty is applied.

EMI
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	3.8 dB
10 m	3.6 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.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124
NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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 m x 2.0m 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

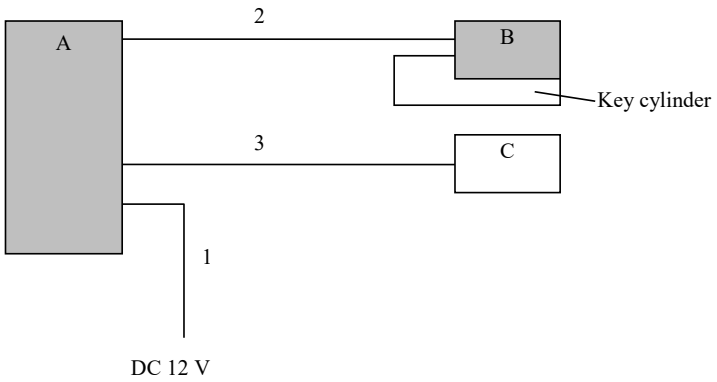
Refer to APPENDIX.

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

4.1 Operating Modes

Test mode	Remarks
Continuous transmitting 125kHz	-
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	WAM LO	IM2005BB	500033-0 181003	Panasonic Automotive Systems Asia Pacific Co.,Ltd	EUT
B	Immobilizer	898394787Y	003	TOKAI RIKA CO., LTD	EUT
C	Antenna Test Box	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal Cable	2.0	Unshielded	Unshielded	-
3	Signal Cable	2.0	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

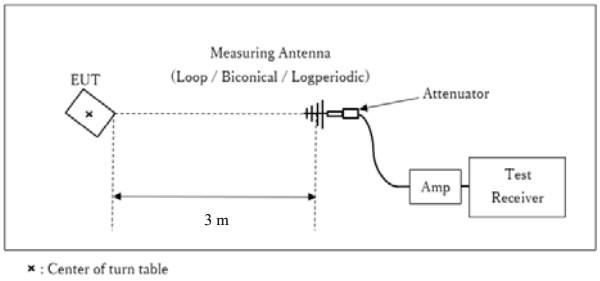
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)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

- 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.

This EUT has two modes which transponder key is inserted or not. The worst case was confirmed with and without transponder key, as a result, the test without transponder key was the worst case. Therefore the test without transponder key was performed only.

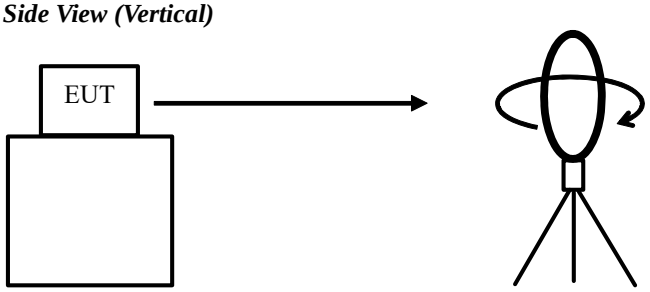
The test results and limit are rounded off to one decimal place, so some differences might be observed.

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

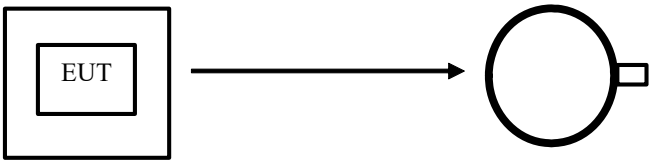
Date: January 30 and 31, 2019 Test engineer: Shinya Watanabe

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

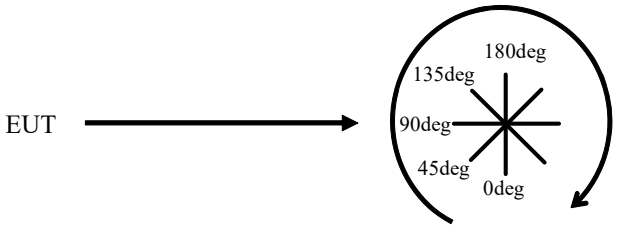


Top View (Horizontal)



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	200 kHz	1 kHz	3 kHz	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 *1)	Max Hold *1)	Spectrum Analyzer
*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %. 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.	12541470H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	January 30, 2019
Temperature/ Humidity	21 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Continuous transmitting 125kHz

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
0	0.12500	PK	83.6	19.7	-74.0	32.3	-	-3.0	45.6	48.6	Fundamental
0	0.25000	PK	42.0	19.7	-74.0	32.3	-	-44.6	39.6	84.2	
0	0.37500	PK	46.2	19.6	-74.0	32.3	-	-40.5	36.1	76.6	
0	0.50000	QP	32.2	19.6	-33.9	32.2	-	-14.3	33.6	47.9	
0	0.62500	QP	37.5	19.6	-33.9	32.2	-	-9.0	31.7	40.7	
90	28.00770	QP	47.2	20.0	-33.0	32.3	-	1.9	29.5	27.6	

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
0	0.12500	AV	83.6	19.7	-74.0	32.3	0.0	-3.0	25.6	28.6	Fundamental
0	0.25000	AV	42.0	19.7	-74.0	32.3	0.0	-44.6	19.6	64.2	
0	0.37500	AV	46.2	19.6	-74.0	32.3	0.0	-40.5	16.1	56.6	

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 3m 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	0.12500	PK	83.6	19.7	6.0	32.3	-	77.0	-	-	Fundamental

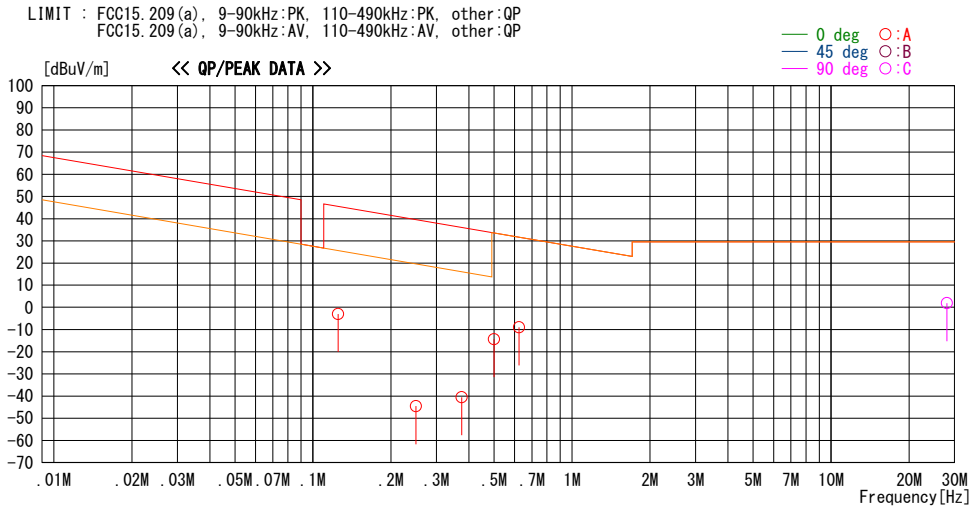
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

* 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.
*Other spurious emissions were less than 20dB for the limit.

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)
(Plot data, Worst case)

Report No.	12541470H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	January 30, 2019
Temperature/ Humidity	21 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Continuous transmitting 125kHz

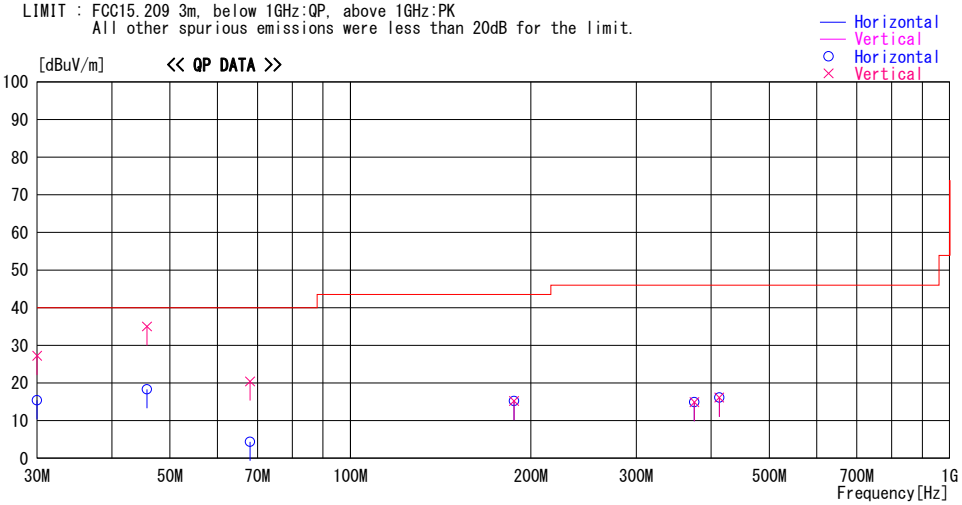


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Radiated Emission above 30 MHz (Spurious Emission)

Report No.	12541470H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	January 30, 2019
Temperature/ Humidity	21 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Continuous transmitting 125kHz

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency [MHz]	Reading [dBuV]	DET	Antenna Factor [dB/m]	Loss& Gain [dB]	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
30.008	22.1	QP	18.5	-25.2	15.4	0	349	Hori.	40.0	24.6	
30.008	33.9	QP	18.5	-25.2	27.2	0	100	Vert.	40.0	12.8	
45.761	30.3	QP	12.8	-24.8	18.3	186	400	Hori.	40.0	21.7	
45.761	47.0	QP	12.8	-24.8	35.0	202	100	Vert.	40.0	5.0	
68.018	22.3	QP	6.5	-24.4	4.4	0	300	Hori.	40.0	35.6	
68.018	38.3	QP	6.5	-24.4	20.4	214	100	Vert.	40.0	19.6	
187.500	21.7	QP	16.5	-23.0	15.2	0	300	Hori.	43.5	28.3	
187.500	21.7	QP	16.5	-23.0	15.2	0	100	Vert.	43.5	28.3	
375.000	21.2	QP	15.2	-21.5	14.9	0	200	Hori.	46.0	31.1	
375.000	21.2	QP	15.2	-21.5	14.9	0	100	Vert.	46.0	31.1	
412.500	21.2	QP	16.1	-21.2	16.1	0	100	Hori.	46.0	29.9	
412.500	21.2	QP	16.1	-21.2	16.1	0	100	Vert.	46.0	29.9	

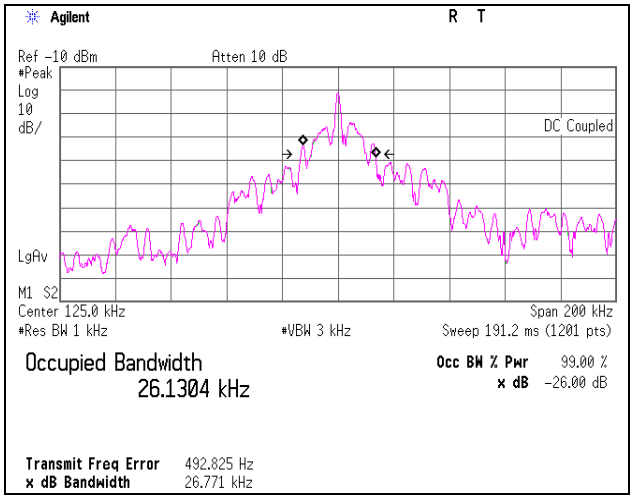
CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
ALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

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

-26 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	12541470H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	January 31, 2019
Temperature/ Humidity	20 deg. C / 35 % RH
Engineer	Shinya Watanabe
Mode	Continuous transmitting 125kHz

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
26.771	26.1304



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/ sucoform141-PE/ 421-010	-/00640	07/03/2018	07/31/2019	12
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2018	10/31/2019	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/06/2018	08/31/2019	12
RE	142180	Measure	KOMELON	KMC-36	-	-	-	-
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/11/2019	01/31/2020	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/28/2018	06/30/2020	24
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/20/2018	12/31/2019	12
RE	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	06/04/2018	06/30/2019	12
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	06/04/2018	06/30/2019	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/29/2019	01/31/2020	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/27/2018	02/28/2019	12
RE	141413	Coaxial Cable	UL Japan	-	-	06/12/2018	06/30/2019	12
RE	141323	Coaxial cable	UL Japan	-	-	07/03/2018	07/31/2019	12
RE	141855	Spectrum Analyzer	AGILENT	E4440A	MY46187750	11/09/2018	11/30/2019	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