



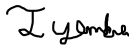
RADIO TEST REPORT

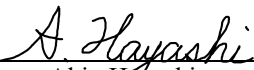
Test Report No. : 13101083S-A

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : Watch
Model No. : GST-B300
FCC ID : BBQS0EW
Test regulation : FCC Part 15 Subpart C: 2019
Test item : Radiated Spurious Emission
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 limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.

Date of test: November 11, 2019

Representative test engineer: 
Toshinori Yamada
Engineer
Consumer Technology Division

Approved by: 
Akio Hayashi
Leader
Consumer Technology Division



CERTIFICATE 1266.03

- ☐ 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.
Shonan EMC Lab.

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REVISION HISTORY

Original Test Report No.: 13101083S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13101083S-A	January 16, 2020	-	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MCS	Modulation and Coding Scheme
AC	Alternating Current	MRA	Mutual Recognition Arrangement
AFH	Adaptive Frequency Hopping	N/A	Not Applicable
AM	Amplitude Modulation	NIST	National Institute of Standards and Technology
Amp, AMP	Amplifier	NS	No signal detect.
ANSI	American National Standards Institute	NSA	Normalized Site Attenuation
Ant, ANT	Antenna	NVLAP	National Voluntary Laboratory Accreditation Program
AP	Access Point	OBW	Occupied Band Width
ASK	Amplitude Shift Keying	OFDM	Orthogonal Frequency Division Multiplexing
Atten., ATT	Attenuator	P/M	Power meter
AV	Average	PCB	Printed Circuit Board
BPSK	Binary Phase-Shift Keying	PER	Packet Error Rate
BR	Bluetooth Basic Rate	PHY	Physical Layer
BT	Bluetooth	PK	Peak
BT LE	Bluetooth Low Energy	PN	Pseudo random Noise
BW	BandWidth	PRBS	Pseudo-Random Bit Sequence
Cal Int	Calibration Interval	PSD	Power Spectral Density
CCK	Complementary Code Keying	QAM	Quadrature Amplitude Modulation
Ch., CH	Channel	QP	Quasi-Peak
CISPR	Comite International Special des Perturbations Radioelectriques	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	RBW	Resolution Band Width
DBPSK	Differential BPSK	RDS	Radio Data System
DC	Direct Current	RE	Radio Equipment
D-factor	Distance factor	RF	Radio Frequency
DFS	Dynamic Frequency Selection	RMS	Root Mean Square
DQPSK	Differential QPSK	RSS	Radio Standards Specifications
DSSS	Direct Sequence Spread Spectrum	Rx	Receiving
EDR	Enhanced Data Rate	SA, S/A	Spectrum Analyzer
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SG	Signal Generator
EMC	ElectroMagnetic Compatibility	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
EU	European Union	Vert.	Vertical
EUT	Equipment Under Test	WLAN	Wireless LAN
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		

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SECTION 1: Customer information

Company Name	:	CASIO COMPUTER CO., LTD.
Address	:	2-1, Sakaecho 3 chome, Hamura-shi, Tokyo 205-8555 Japan
Telephone Number	:	+81-42-579-7282
Facsimile Number	:	+81-42-579-7702
Contact Person	:	Hiroaki Suzuki

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	:	Watch
Model No.	:	GST-B300
Serial No.	:	Refer to SECTION 4.2
Rating	:	Typical: DC 2.5 V, Min.: DC 1.9 V, Max.: DC 2.7 V CW5537 (Module): Normal: DC 3.0 V, Min.: DC 1.9 V, Max.: DC 3.3 V
Receipt Date of Sample (Information from test lab.)	:	October 28, 2019
Country of Mass-production	:	China, Japan 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: GST-B300 (referred to as the EUT in this report) is a Watch.

* GST-B300 has alternative name as R028.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz – 2480 MHz
Modulation	:	GFSK
Antenna type	:	Chip antenna (Mono Pole)
Antenna Gain	:	2.5 dBi
Clock frequency (Maximum)	:	26 MHz

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 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section15.247(d)	0.6 dB 12010.000 MHz, PK, Vert. Tx BT LE 2402 MHz	Complied# a)	Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.					
*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.					
a) Refer to APPENDIX 1 (data of Radiated Spurious 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.			

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

FCC Part 15.31 (e)

The EUT provides the stable voltage constantly to the wireless transmitter regardless of input voltage.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

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

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 $k=2$.

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Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4,5,6,8 SR
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.0 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.0 dB	-
	1 GHz-6 GHz	4.9 dB	4.9 dB	4.9 dB	-
	6 GHz-18 GHz	5.5 dB	5.5 dB	5.5 dB	-
	18 GHz-40 GHz	5.4 dB	5.4 dB	5.4 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.8 dB	5.8 dB	5.8 dB	-
	18 GHz-40 GHz	5.7 dB	5.7 dB	5.7 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

3.5 Test Location

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Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401

A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	8.1 x 5.1 x 3.55	8.1 x 5.1	-
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	-	-

3.6 Test data, Test instruments, and Test set up

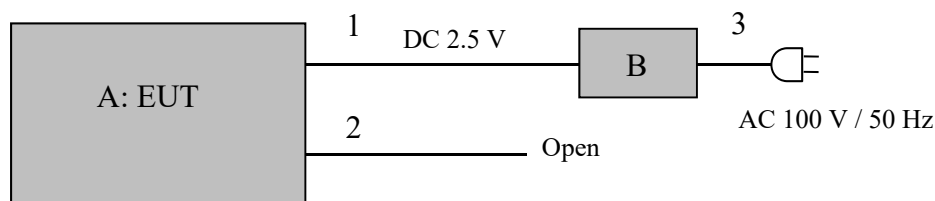
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Bluetooth Low Energy (BT LE)	2402 MHz, 2440 MHz, 2480 MHz	PRBS9
*Power of the EUT was set by the software as follows; - Power Setting : Fixed - Software : BLE RF Test Version 9.9 *The test was performed with the worst case that can be set in Test mode, The worst case in actual operation mode is applied to Peak with Duty factor of Spurious emission. 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.		

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Watch	GST-B300	63	CASIO COMPUTER CO., LTD.	EUT
B	Power Supply (DC)	PAN35-10A	NA000955	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.1 + 2.0	Unshielded	Unshielded	*1)
2	Signal Cable	0.1	Unshielded	Unshielded	*2)
3	AC	1.8	Unshielded	Unshielded	-

*1) Cable for test operation

*2) Cable for system reset during the development, not used for the product

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 1 GHz]

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.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

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

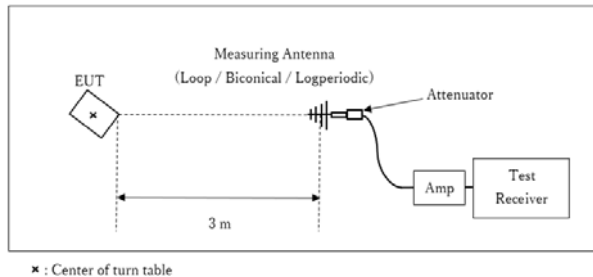
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	-	RBW: 100 kHz VBW: 300 kHz

*1) Measurement with Average detector was not performed. The limit for Average detector is applied to the measurement value with Peak detector used Duty cycle correction factor (DCCF).

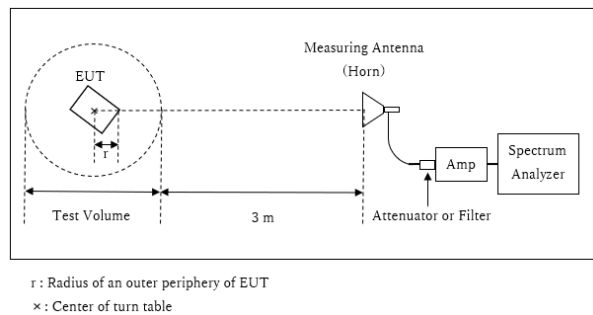
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 13 GHz



Distance Factor: $20 \times \log (3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

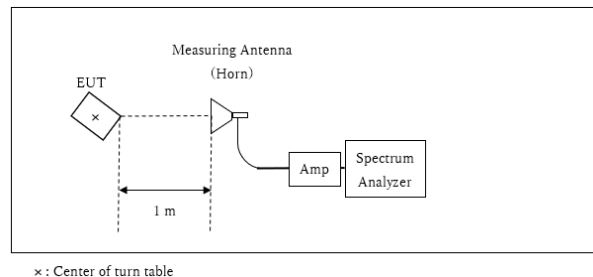
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.975 \text{ m}$

Test Volume : 2.0 m

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

$r = 0.025 \text{ m}$

13 GHz – 26.5 GHz



Distance Factor: $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

*Test Distance: 1 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.

Antenna polarization	Frequency	Spurious				
		Below 1 GHz	1 GHz – 2.8 GHz	2.8 GHz – 13 GHz	13 GHz-18 GHz	18 GHz-26 GHz
Horizontal		X	Y	X	X	X
Vertical		X	Z	Y	X	X

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

Measurement range : 30 MHz - 26.5 GHz

Test data : APPENDIX

Test result : Pass

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APPENDIX 1: Test data

Radiated Spurious Emission

Report No. 13101083S-A
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3 No.3
Date November 11, 2019 November 11, 2019
Temperature / Humidity 24 deg. C / 40 % RH 23 deg. C / 36 % RH
Engineer Toshinori Yamada Makoto Hosaka
(below 1 GHz) (1 GHz – 26.5 GHz)
Mode Tx BT LE 2402 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	52.000	QP	22.42	10.37	6.79	32.19	0.00	7.39	40.0	32.6	246	83	
Hori.	182.000	QP	22.49	15.94	7.87	32.09	0.00	14.21	43.5	29.2	131	89	
Hori.	260.000	QP	21.87	11.94	8.49	32.01	0.00	10.29	46.0	35.7	100	0	
Hori.	936.000	QP	21.12	21.60	11.13	30.77	0.00	23.08	46.0	22.9	100	0	
Hori.	988.000	QP	20.73	22.07	11.29	30.34	0.00	23.75	53.9	30.1	100	0	
Hori.	2390.000	PK	47.23	28.33	14.21	41.59	2.44	50.62	73.9	23.2	343	176	*1)
Hori.	4804.000	PK	52.45	31.62	6.57	42.88	2.44	50.20	73.9	23.7	151	315	
Hori.	12010.000	PK	49.60	39.37	10.81	42.29	2.44	59.93	73.9	13.9	150	0	
Vert.	52.000	QP	22.88	10.37	6.79	32.19	0.00	7.85	40.0	32.1	100	357	
Vert.	182.000	QP	23.18	15.94	7.87	32.09	0.00	14.90	43.5	28.6	100	356	
Vert.	260.000	QP	22.05	11.94	8.49	32.01	0.00	10.47	46.0	35.5	100	0	
Vert.	936.000	QP	21.08	21.60	11.13	30.77	0.00	23.04	46.0	22.9	100	0	
Vert.	988.000	QP	20.74	22.07	11.29	30.34	0.00	23.76	53.9	30.1	100	0	
Vert.	2390.000	PK	47.31	28.33	14.21	41.59	2.44	50.70	73.9	23.2	152	234	*1)
Vert.	4804.000	PK	54.69	31.62	6.57	42.88	2.44	52.44	73.9	21.4	257	356	
Vert.	12010.000	PK	50.07	39.37	10.81	42.29	2.44	60.40	73.9	13.5	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

Peak measurement value with duty cycle correction factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	PK	47.23	28.33	14.21	41.59	-7.11	2.44	43.51	53.9	10.3	*1)
Hori.	4804.000	PK	52.45	31.62	6.57	42.88	-7.11	2.44	43.09	53.9	10.8	
Hori.	12010.000	PK	49.60	39.37	10.81	42.29	-7.11	2.44	52.82	53.9	1.0	
Vert.	2390.000	PK	47.31	28.33	14.21	41.59	-7.11	2.44	43.59	53.9	10.3	*1)
Vert.	4804.000	PK	54.69	31.62	6.57	42.88	-7.11	2.44	45.33	53.9	8.5	
Vert.	12010.000	PK	50.07	39.37	10.81	42.29	-7.11	2.44	53.29	53.9	0.6	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

Averaging factor refer to APPENDIX4.

*1) Not out of band emission (Leakage Power)

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	79.26	28.31	14.22	41.60	2.44	82.63	-	-	Carrier
Hori.	2399.687	PK	44.47	28.31	14.21	41.60	2.44	47.83	62.63	14.8	
Hori.	2400.000	PK	40.54	28.31	14.21	41.60	2.44	43.90	62.63	18.7	
Hori.	7206.000	PK	44.04	37.23	8.34	42.92	2.44	49.13	62.63	13.5	
Hori.	9608.000	PK	41.61	38.84	9.50	43.17	2.44	49.22	62.63	13.4	
Vert.	2402.000	PK	79.74	28.31	14.22	41.60	2.44	83.11	-	-	Carrier
Vert.	2399.687	PK	42.53	28.31	14.21	41.60	2.44	45.89	63.11	17.2	
Vert.	2400.000	PK	39.66	28.31	14.21	41.60	2.44	43.02	63.11	20.0	
Vert.	7206.000	PK	43.20	37.23	8.34	42.92	2.44	48.29	63.11	14.8	
Vert.	9608.000	PK	40.72	38.84	9.50	43.17	2.44	48.33	63.11	14.7	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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Shonan EMC Lab.

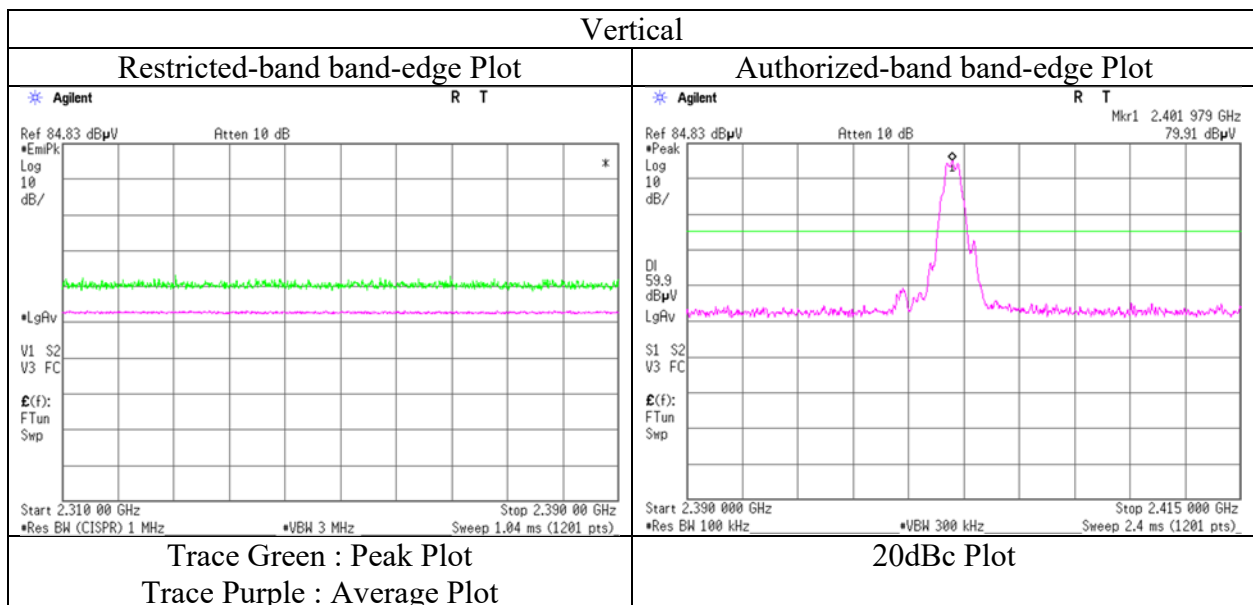
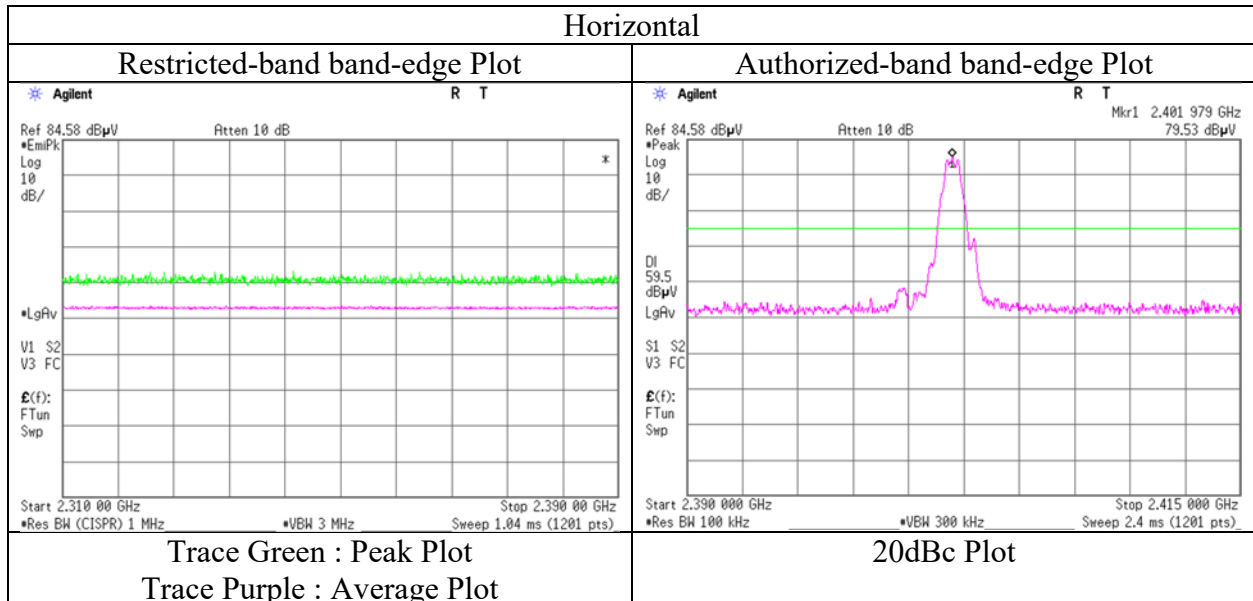
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13101083S-A
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	November 11, 2019
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Makoto Hosaka
	(1 GHz – 13 GHz)
Mode	Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Report No. 13101083S-A
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date November 11, 2019 November 11, 2019
Temperature / Humidity 24 deg. C / 40 % RH 23 deg. C / 36 % RH
Engineer Toshinori Yamada Makoto Hosaka
(below 1 GHz) (1 GHz – 26.5 GHz)
Mode Tx BT LE 2440 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	52.000	QP	22.41	10.37	6.79	32.19	0.00	7.38	40.0	32.6	242	90	
Hori.	182.000	QP	22.66	15.94	7.87	32.09	0.00	14.38	43.5	29.1	232	108	
Hori.	260.000	QP	21.93	11.94	8.49	32.01	0.00	10.35	46.0	35.6	100	0	
Hori.	936.000	QP	21.17	21.60	11.13	30.77	0.00	23.13	46.0	22.8	100	0	
Hori.	988.000	QP	20.75	22.07	11.29	30.34	0.00	23.77	53.9	30.1	100	0	
Hori.	4880.000	PK	54.24	31.71	6.59	42.89	2.44	52.09	73.9	21.8	110	7	
Hori.	7320.000	PK	51.06	37.38	8.37	43.15	2.44	56.10	73.9	17.8	133	27	
Hori.	12200.000	PK	47.25	39.45	10.94	42.19	2.44	57.89	73.9	16.0	150	0	
Vert.	52.000	QP	23.08	10.37	6.79	32.19	0.00	8.05	40.0	31.9	100	359	
Vert.	182.000	QP	23.52	15.94	7.87	32.09	0.00	15.24	43.5	28.2	100	357	
Vert.	260.000	QP	22.02	11.94	8.49	32.01	0.00	10.44	46.0	35.5	100	0	
Vert.	936.000	QP	21.15	21.60	11.13	30.77	0.00	23.11	46.0	22.8	100	0	
Vert.	988.000	QP	20.79	22.07	11.29	30.34	0.00	23.81	53.9	30.0	100	0	
Vert.	4880.000	PK	54.19	31.71	6.59	42.89	2.44	52.04	73.9	21.8	246	6	
Vert.	7320.000	PK	52.12	37.38	8.37	43.15	2.44	57.16	73.9	16.7	387	12	
Vert.	12200.000	PK	47.94	39.45	10.94	42.19	2.44	58.58	73.9	15.3	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

Peak measurement value with duty cycle correction factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	PK	54.24	31.71	6.59	42.89	-7.11	2.44	44.98	53.9	8.9	100ave
Hori.	7320.000	PK	51.06	37.38	8.37	43.15	-7.11	2.44	48.99	53.9	4.9	100ave
Hori.	12200.000	PK	47.25	39.45	10.94	42.19	-7.11	2.44	50.78	53.9	3.1	100ave
Vert.	4880.000	PK	54.19	31.71	6.59	42.89	-7.11	2.44	44.93	53.9	8.9	100ave
Vert.	7320.000	PK	52.12	37.38	8.37	43.15	-7.11	2.44	50.05	53.9	3.8	100ave
Vert.	12200.000	PK	47.94	39.45	10.94	42.19	-7.11	2.44	51.47	53.9	2.4	100ave

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

Averaging factor refer to APPENDIX4.

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2440.000	PK	81.49	28.27	14.25	41.61	2.44	84.84	-	-	Carrier
Hori.	9760.000	PK	41.60	39.33	9.47	43.01	2.44	49.83	64.84	15.0	20dBc
Vert.	2440.000	PK	79.64	28.27	14.25	41.61	2.44	82.99	-	-	Carrier
Vert.	9760.000	PK	38.93	39.33	9.47	43.01	2.44	47.16	62.99	15.8	20dBc

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

UL Japan, Inc.

Shonan EMC Lab.

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Radiated Spurious Emission

Report No. 13101083S-A
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date November 11, 2019
Temperature / Humidity 24 deg. C / 40 % RH
Engineer Toshinori Yamada
(below 1 GHz) Makoto Hosaka
(1 GHz – 26.5 GHz)
Mode Tx BT LE 2480 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	52.000	QP	22.41	10.37	6.79	32.19	0.00	7.38	40.0	32.6	232	101	
Hori.	182.000	QP	22.52	15.94	7.87	32.09	0.00	14.24	43.5	29.2	235	106	
Hori.	260.000	QP	21.91	11.94	8.49	32.01	0.00	10.33	46.0	35.6	100	0	
Hori.	936.000	QP	21.18	21.60	11.13	30.77	0.00	23.14	46.0	22.8	100	0	
Hori.	988.000	QP	20.76	22.07	11.29	30.34	0.00	23.78	53.9	30.1	100	0	
Hori.	2483.500	PK	49.01	28.24	14.29	41.62	2.44	52.36	73.9	21.5	296	206	*1)
Hori.	4960.000	PK	55.06	31.96	6.62	42.91	2.44	53.17	73.9	20.7	116	354	
Hori.	7440.000	PK	51.86	37.56	8.39	43.38	2.44	56.87	73.9	17.0	165	17	
Hori.	12400.000	PK	46.39	38.86	11.05	42.08	2.44	56.66	73.9	17.2	150	0	
Vert.	52.000	QP	23.02	10.37	6.79	32.19	0.00	7.99	40.0	32.0	100	358	
Vert.	182.000	QP	23.31	15.94	7.87	32.09	0.00	15.03	43.5	28.4	100	355	
Vert.	260.000	QP	22.04	11.94	8.49	32.01	0.00	10.46	46.0	35.5	100	0	
Vert.	936.000	QP	21.16	21.60	11.13	30.77	0.00	23.12	46.0	22.8	100	0	
Vert.	988.000	QP	20.79	22.07	11.29	30.34	0.00	23.81	53.9	30.0	100	0	
Vert.	2483.500	PK	48.12	28.24	14.29	41.62	2.44	51.47	73.9	22.4	106	228	*1)
Vert.	4960.000	PK	55.12	31.96	6.62	42.91	2.44	53.23	73.9	20.6	164	0	
Vert.	7440.000	PK	53.40	37.56	8.39	43.38	2.44	58.41	73.9	15.4	306	29	
Vert.	12400.000	PK	46.20	38.86	11.05	42.08	2.44	56.47	73.9	17.4	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

Peak measurement value with duty cycle correction factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	PK	49.01	28.24	14.29	41.62	-7.11	2.44	45.25	53.9	8.6	*1)
Hori.	4960.000	PK	55.06	31.96	6.62	42.91	-7.11	2.44	46.06	53.9	7.8	
Hori.	7440.000	PK	51.86	37.56	8.39	43.38	-7.11	2.44	49.76	53.9	4.1	
Hori.	12400.000	PK	46.39	38.86	11.05	42.08	-7.11	2.44	49.55	53.9	4.3	
Vert.	2483.500	PK	48.12	28.24	14.29	41.62	-7.11	2.44	44.36	53.9	9.5	*1)
Vert.	4960.000	PK	55.12	31.96	6.62	42.91	-7.11	2.44	46.12	53.9	7.7	
Vert.	7440.000	PK	53.40	37.56	8.39	43.38	-7.11	2.44	51.30	53.9	2.6	
Vert.	12400.000	PK	46.20	38.86	11.05	42.08	-7.11	2.44	49.36	53.9	4.5	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

Averaging factor refer to APPENDIX4.

*1) Not out of band emission (Leakage Power)

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2480.000	PK	80.51	28.24	14.28	41.62	2.44	83.85	-	-	
Hori.	9920.000	PK	38.42	39.18	9.44	42.84	2.44	46.64	63.85	17.2	
Vert.	2480.000	PK	80.03	28.24	14.28	41.62	2.44	83.37	-	-	
Vert.	9920.000	PK	38.51	39.18	9.44	42.84	2.44	46.73	63.37	16.6	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.975 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$

13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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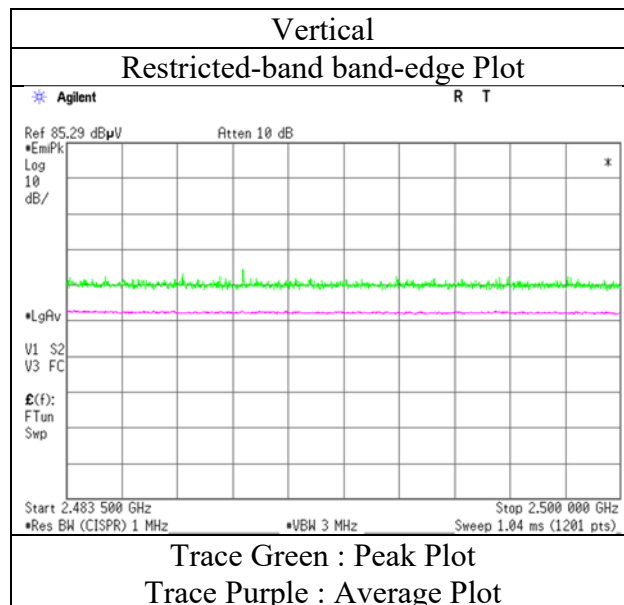
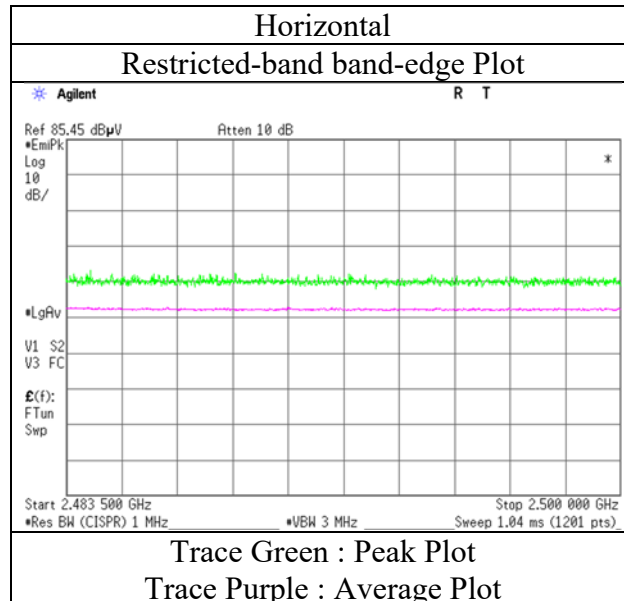
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

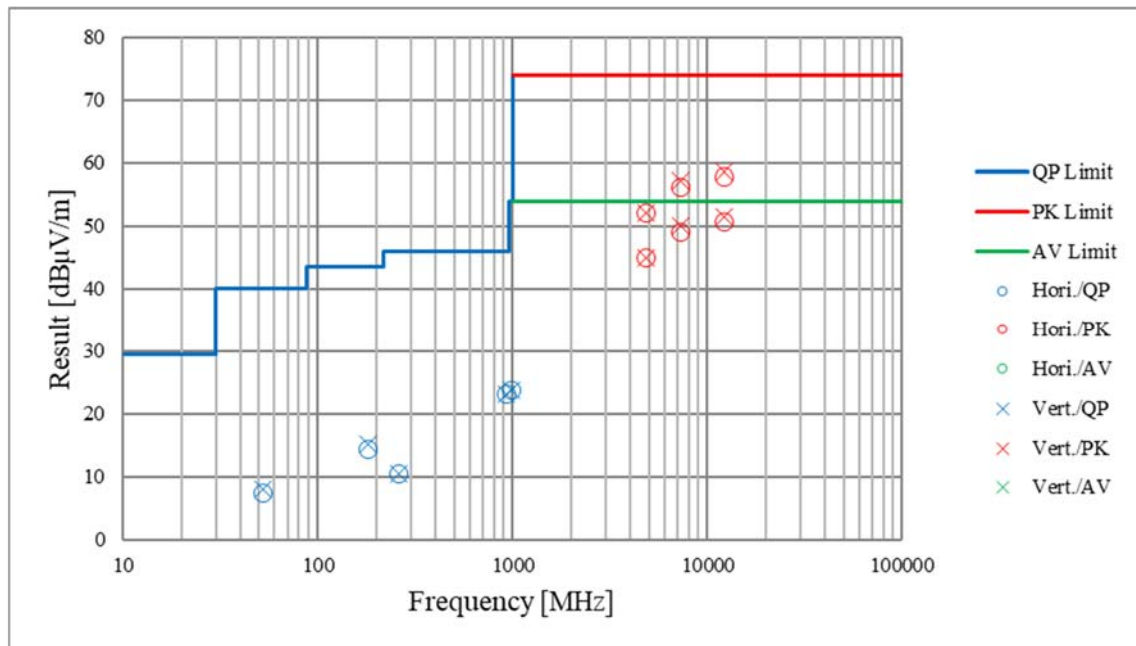
Report No.	13101083S-A
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	November 11, 2019
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Makoto Hosaka (1 GHz – 13 GHz)
Mode	Tx BT LE 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	13101083S-A	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	November 11, 2019	November 11, 2019
Temperature / Humidity	24 deg. C / 40 % RH	23 deg. C / 36 % RH
Engineer	Toshinori Yamada (below 1 GHz)	Makoto Hosaka (1 GHz – 26.5 GHz)
Mode	Tx BT LE 2440 MHz	



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

APPENDIX 2: Test instruments

Test Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
COTS-SEMI-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-	-
KJM-02	RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
SAEC-03(NSA)	RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2019/4/8	2020/4/30	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2019/5/3	2020/5/31	12
SAF-03	RE	145126	Pre Amplifier	SONOMA	310N	290213	2019/2/5	2020/2/29	12
SAF-06	RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2019/2/8	2020/2/29	12
SAF-08	RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2019/3/5	2020/3/31	12
SAT10-05	RE	145136	Attenuator(above1GHz)	AGILENT	8493C-010	74864	2018/11/25	2019/11/30	12
SAT6-13	RE	167094	Attenuator	JFW	50HF-006N	-	2019/2/5	2020/2/29	12
SBA-03	RE	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2019/5/7	2020/5/31	12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-271(RF Selector)	2019/4/19	2020/4/30	12
SCC-G41	RE	151617	Coaxial Cable	Junkosha	MWX221-01000NFSN MS/B	1612S006	2019/1/25	2020/1/31	12
SCC-G43	RE	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	SN MY 13406/4E	2019/7/3	2020/7/31	12
SCC-G45	RE	168301	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102 E	800137/2E A	2019/3/26	2020/3/31	12
SCC-G57	RE	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2019/5/16	2020/5/31	12
SCC-G58	RE	183047	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800287/4A	2019/7/23	2020/7/31	12
SFL-02	RE	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2018/11/16	2019/11/30	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2019/6/26	2020/6/30	12
SHA-04	RE	145512	Horn Antenna	ETS LINDGREN	3160-09	94868	2019/6/26	2020/6/30	12
SLA-07	RE	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2019/5/7	2020/5/31	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2019/10/8	2020/10/31	12
STR-08	RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2018/11/28	2019/11/30	12
STS-03	RE	146210	Digital Hitester	HIOKI	3805-50	80997823	2019/10/1	2020/10/31	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 test

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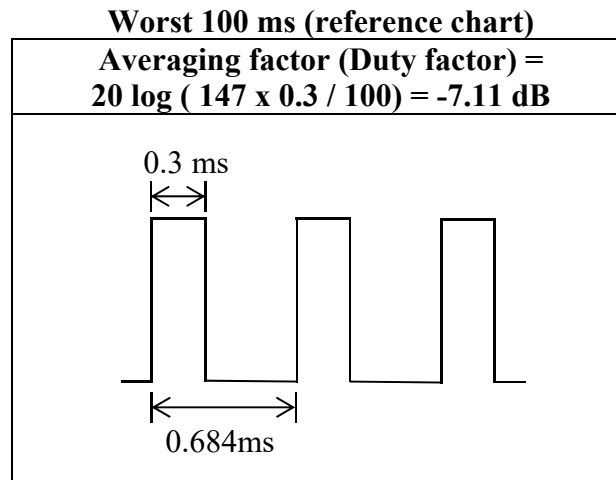
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APPENDIX 4: Average factor (Duty factor)



- * Worst Transmit Duty cycle BLE is Data communication mode which max on time is 0.3 ms and Minimum interval is 0.684 ms (Refer to BLE Worst Transmit Duty sheet).
The ON time (0.3 ms) appears 147 times ($100 / 0.684$) in 100 ms.
The actual measurement value was applied as Averaging factor (Duty factor).
(This specification is from customer)

End of Report