SAR TEST REPORT

Test Report No.: 13282403S-A-R1

Applicant : **CASIO COMPUTER CO., LTD.**
Type of EUT : **Wireless Module**
Model Number of EUT : **GSW-H1000** (*. It was installed into a limited host device as listed in below.)
FCC ID : **BBQ-GSWH1000**
Test Standard : **FCC 47CFR §2.1093**
Test Result : **Complied** (Refer to Section 3.5)

RF Exposure Condition	Platform		Highest Reported SAR Value			Remarks			Output power (average)	
	Type	Model	Type	Tune-up value	Limit	Band	Frequency	Mode	Measured	Maximum
Extremity (Wrist)	Smart Watch	GSW-H1000	SAR (10g)	**< 0.10 W/kg**	**4**	DTS	2437 MHz	11b (1Mbps)	16.73 dBm	17.15 dBm
Next-to-Mouth			SAR (1g)	**< 0.10 W/kg**	**1.6**	DTS	2437 MHz	11b (1Mbps)	16.73 dBm	17.15 dBm

*. 11b: IEEE 802.11b

***. Highest reported SAR across all exposure conditions and on this platform is "< 0.10 W/kg (10g, Wrist)" and "< 0.10 W/kg (1g, Next-of-mouth)".**

*. This Wireless Module: GSW-H1000 was only installed into the Smart Watch which were listed in above.

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3. This sample tested is in compliance with the limits of the above regulation.
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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.
10. This report (-R1) is a revised version of 13282403S-A. 13282403S-A reports are replaced with this report.

Date of test: May 14 and 15, 2020

Test engineer: H. Naka
Hiroshi Naka
Engineer, Consumer Technology Division

Approved by: T. Imamura
Toyokazu Imamura
Leader, Consumer Technology Division

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

CERTIFICATE 1266.03

REVISION HISTORY

Revision	Test report No.	Date	Page revised	Contents
Original	13282403S-A	June 1, 2020	-	--
-R1	13282403S-A-R1	June 10, 2020	p1	p1(in table, comment); Corrected a mistake. (was: GSW-H10000 -> GSW-H1000)

*. By issue of new revision report, the report of an old revision becomes invalid.

Reference : Abbreviations (Including words undescribed in this report) (radio_r0v03_200214)

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
D-factor	Distance factor
DFS	Dynamic Frequency Selection
DQPSK	Differential QPSK
DSSS	Direct Sequence Spread Spectrum
DUT	Device Under Test
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
N/A	Not Applicable
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
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	Quadrature 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
SAR	Specific Absorption Rate
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
TR	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN

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Contents of appendixes

SECTION 1: Customer information

Company Name	CASIO COMPUTER CO., LTD.
Address	2-1, Sakaecho 3-chome, Hamura-shi, Tokyo, 205-8555 Japan
Telephone Number	+81-42-579-7249
Contact Person	Munetaka Seo

The information provided from the customer is as follows;
- Applicant, Type of EUT, Model Number of EUT, FCC ID, on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT)
- SECTION 4: Operation of EUT during testing
- Appendix 1: The part of Antenna location information, Description of EUT and Support Equipment

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2, SECTION 4 and Appendix 1.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

	EUT	Platform
Type of EUT and Platform	Wireless Module	Smart Watch
Model Number	GSW-H1000	GSW-H1000 (*1)
Serial Number	237	237
Condition of EUT	Production prototype	Production prototype
	*. Not for sale: These samples are equivalent to mass-produced items.	
Receipt Date of Sample	April 20, 2020 (*. EUT for power measurement.) *. No modification by the Lab. May 11, 2020 (*. EUT for SAR test.) *. No modification by the Lab. (*. After power measurement, the EUT was returned to the customer, and the RF wiring was changed to the original antenna line from the antenna conducted power measurement line by the customer.)	
Country of Mass-production	Japan, Thailand	
Category Identified	Portable device	
Feature of EUT	Model number: GSW-H1000 (referred to as the EUT in this report) is a Wireless Module which installs into the Smart Watch (Wristwatch, Model number: GSW-H1000). This platform: GSW-H1000 supports some operations and functions (e.g. responding to mail and SMS messages, etc.) by using the voice command.	
SAR Accessory (Platform)	Removable wrist band: non-metallic. *. For the SAR test, the wrist band was removed to make the back of wristwatch touch to the flat phantom directly. (Refer to Appendix 1-1 for more detail.)	

*.1 The platform (model number: GSW-H1000) has alternative name as "S001." Model number: GSW-H1000 was used for distinction in this report.

2.2 Product Description (EUT: Wireless Module, model No.: GSW-H1000)

Equipment type	Transceiver						
Operation mode	Wi-Fi				Bluetooth (Ver. 4.2 with EDR function)		
Frequency of operation	(2412~2462) MHz (b, g, n20)				(2402~2480) MHz (BDR (Basic Data Rate), EDR (Enhanced Data Rate), BLE (Low Energy mode))		
Channel spacing	5 MHz				1MHz (BDR, EDR), 2MHz (BLE)		
Bandwidth	20 MHz (b, g, n20)				79MHz		
Type of modulation	(b) DSSS: DBPSK, DQPSK, CCK (g, n20)) OFDM: BPSK, QPSK, 16QAM, 64QAM				FHSS: GFSK (*. EDR: GFSK+π/4-DQPSK, GFSK+8DPSK)		
Transmit typical power and maximum tune-up tolerance limit	**Mode**	**b**	**g**	**n(20HT)**	**BDR**	**EDR**	**BLE**
	Typical	n/a	n/a	n/a	n/a	n/a	n/a
	Maximum	17.15 dBm	13.41 dBm	12.04 dBm	9.26 dBm	6.53 dBm	7.36 dBm
	Remarks	-	-	-	-	-	-
	*. The measured Tx output power (conducted) refers to section 6 in this report.						

Quantity of Antenna	1 piece	Antenna model	TX-501ANT	Antenna connector type	Soldering
Antenna gain (peak)	-3.70 dBi			Antenna type	Inverted F

*. b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT)
*. The EUT do not use the special transmitting technique such as "beam-forming" and "time-space code diversity."
*. Since Wi-Fi and Bluetooth are used a same antenna, Wi-Fi and Bluetooth do not transmit simultaneously.

SECTION 3: Test specification, procedures and results

3.1 Test specification

FCC47CFR §2.1093: Radiofrequency radiation exposure evaluation: portable devices.

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1992. The device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling in accordance with the following measurement procedures.

The tests documented in this report were performed in accordance with FCC 47 CFR Parts 2, IEEE Std.1528-2013 (latest), the following FCC Published RF exposure KDB procedures, and TCB workshop updates.

KDB 447498 D01 (v06):	General RF exposure guidance
KDB 248227 D01 (v02r02):	SAR Guidance for IEEE 802.11 (Wi-Fi) transmitters
KDB 865664 D01 (v01r04):	SAR measurement 100MHz to 6GHz
IEEE Std. 1528-2013:	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

3.2 Exposure limit

Environments of exposure limit	Whole-Body (averaged over the entire body)	Partial-Body (averaged over any 1g of tissue)	Hands, Wrists, Feet and Ankles (averaged over any 10g of tissue)
(A) Limits for Occupational /Controlled Exposure (W/kg)	0.4	8.0	20.0
(B) Limits for General population /Uncontrolled Exposure (W/kg)	0.08	1.6	4.0

***. Occupational/Controlled Environments:** are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

***. General Population/Uncontrolled Environments:** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

The limit applied in this test report is;

General population / uncontrolled exposure, Extremity (averaged over any 10g of tissue) limit: 4 W/kg (Wrist)
General population / uncontrolled exposure, Partial-Body (averaged over any 1g of tissue) limit: 1.6 W/kg (Next-to-Mouth)

***. Tested platform is a wristwatch which support the voice command.**

3.3 Addition, deviation and exclusion to the test procedure

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

3.4 Test Location

UL Japan, Inc., Shonan EMC Lab.
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone number: +81 463 50 6400 / Facsimile number: +81 463 50 6401
A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Used?	Place	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 × 11.3 × 7.65	20.6 × 11.3	10 m
☐	No.2 Semi-anechoic chamber	20.6 × 11.3 × 7.65	20.6 × 11.3	10 m
☐	No.3 Semi-anechoic chamber	12.7 × 7.7 × 5.35	12.7 × 7.7	5 m
☐	No.4 Semi-anechoic chamber	8.1 × 5.1 × 3.55	8.1 × 5.1	-
☐	No.1 Shielded room	6.8 × 4.1 × 2.7	6.8 × 4.1	-
☐	No.2 Shielded room	6.8 × 4.1 × 2.7	6.8 × 4.1	-
☐	No.3 Shielded room	6.3 × 4.7 × 2.7	6.3 × 4.7	-
☐	No.4 Shielded room	4.4 × 4.7 × 2.7	4.4 × 4.7	-
☐	No.5 Shielded room	7.8 × 6.4 × 2.7	7.8 × 6.4	-
☐	No.6 Shielded room	7.8 × 6.4 × 2.7	7.8 × 6.4	-
☒	**No.7 Shielded room**	**2.76 × 3.76 × 2.4**	**2.76 × 3.76**	-
☐	No.8 Shielded room	3.45 × 5.5 × 2.4	3.45 × 5.5	-
☐	No.1 Measurement room	2.55 × 4.1 × 2.5	2.55 × 4.1	-

3.5 Procedures and Results

Test Procedure	SAR measurement; KDB 447498, KDB 248227, KDB 865664, IEEE Std.1528			
Category	FCC 47CFR §2.1093 (Portable device)			
Platform / model	Smart Watch (Model number: GSW-H1000)			
RF Exposure condition	Extremity (Wrist)		Partial-body (Next-to-Mouth)	
Limit	4 W/kg (SAR(10g))		1.6 W/kg (SAR(1g))	
Results	Bluetooth	Wi-Fi	Bluetooth	Wi-Fi
	Complied (*. lower power, SAR test was exempt.)	Complied (*. Refer to Section 7)	Complied (*. lower power, SAR test was exempt.)	Complied (*. Refer to Section 7)
Reported SAR value (*. Scaled)	N/A	0.058 W/kg	N/A	0.053 W/kg
Measured SAR value	N/A	0.052 W/kg	N/A	0.048 W/kg
Liquid type	N/A	Body	N/A	Head
Setup (separation distance)	N/A	0 mm	N/A	10 mm
Operation mode, channel	-	11b (1Mbps, DSSS), 2437 MHz (6ch)	-	11b (1Mbps, DSSS), 2437 MHz (6ch)
Duty cycle (duty cycle factor)	-	99.1 % (×1.01)	-	99.1 % (×1.01)
Power measured / max. power [dBm]	-	16.73 / max.17.15	-	16.73 / max.17.15
Power scaled factor		×1.10		×1.10

Note: UL Japan's SAR Work Procedures No.13-EM-W0429 and 13-EM-W0430. No addition, deviation nor exclusion has been made from standards
*. (mode) b: IEEE 802.11b, max.:maximum, n/a: not applied.
*. Since Bluetooth and Wii-Fi are used a same antenna, Bluetooth and Wi-Fi do not transmit simultaneously.
*. (Calculating formula) Corrected SAR to max.power(as Reported SAR) (W/kg) = (Measured SAR (W/kg)) × (Duty scaled factor) × (Tune-up factor) where; Tune-up factor [-] = 1 / (10 ^ ("Δmax (max.power - burst average power), dB" / 10)), Duty scaled factor [-] = 100(%) / (duty cycle, %)

Test outline: Where the EUT is built into a platform, it was verified whether multi-platform conditions can be suited in according with section 2) of 5.2.2 in KDB447498 D01 (v06).

Consideration of the test results:	**The highest reported SAR (1g) and SAR (10g) of this platform was kept; ≤ 0.4 W/kg.** Since highest reported SAR (1g) on this EUT's platform obtained in accordance with KDB447498 D01 (v06) was kept under 0.4 W/kg, this EUT was approved to operate multi-platform (limited to use the specified model in listed above table.).

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for partial body (next-to-mouth), 4.0 W/kg for extremity (wrist) specified in FCC 47 CFR part 2 (2.1093), and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

3.6 SAR measurement procedure

3.6.1 Normal SAR measurement procedure

Step 1: Confirmation before SAR testing

Before SAR test, the RF wiring for the sample had been switched to the antenna conducted power measurement line from the antenna line and the average power was measured. The SAR test reference power measurement and the SAR test were proceeded with the lowest data rate (which has the higher time-based average power typically) on each operation mode. Therefore, the average output power was measured on the lower, middle (or near middle), upper and specified channels with the lowest data rate of each operation mode. The power of other data rate was also measured to confirm the time-base average power and when it's required. The power measurement result is shown in Section 6.

*. The EUT transmission power was verified that it was within 2dB lower than the maximum tune-up tolerance limit when it was set the rated power. (Clause 4.1, KDB447498 D01 (v06))

Step 2: Power reference measurement

Measurement of the E-field at a fixed location above the central position of flat phantom (or/and furthermore an interpolated peak SAR location of area scan in step 2) was used as a reference value for assessing the power drop.

Step 3: Area Scan (Area scan parameters: KDB 865664 D01 (v01r04).)

The SAR distribution at the exposed side of head or body position was measured at a distance of each device from the inner surface of the shell. The area covered the entire dimension of the antenna of EUT and suitable horizontal grid spacing of EUT. Based on these data, the area of the maximum absorption was determined by splines interpolation.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 4: Zoom Scan and post-processing (Zoom scan parameters: KDB 865664 D01 (v01r04).)

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.

A volume of 30 mm (X) × 30 mm (Y) × 30 mm (Z) (or more) was assessed by measuring 7×7×7 points (or more), ≤ 3GHz.

A volume of 28 mm (X) × 28 mm (Y) × 24mm (Z) (or more) was assessed by measuring 8×8×7 points (or more) (by "Ratio step" method (*1)), > 3 GHz.

When the SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are proceeded for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR. If the zoom scan measured as defined above complies with both of the following criteria. or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed.

*. The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x and y directions and recorded.

*. The ratio of the SAR at the second measured point to the SAR at the closest measured point at the x-y location of the measured maximum SAR value shall be at least 30 % and recorded.

				f ≤ 3 GHz	3 GHz < f ≤ 6 GHz
1	Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
2	Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
3		graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
4			$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm	
5	Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
	* The asterisk table-footnote is per KDB Pub. 865664 D01 v01r04. NOTE For uniformity purposes the integer frequency increments of rows 1 to 3 and 5 apply, rather than the corresponding variable and fixed parameters given in IEC 62209-1:2016 and IEC 62209-2:2010/AMD1:2019.				

Step 5: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 2. It was checked that the power drift is within ±5% in the evaluation procedure of SAR testing. The verification of power drift during the SAR test is that DASY system calculates the power drift by measuring the e-filed at the same location at beginning and the end of the scan measurement for each test position. The result is shown in SAR plot data of APPENDIX 2.

*. DASY system calculation Power drift value[dB] =20log(Ea)/(Eb) (where, Before SAR testing: Eb[V/m] / After SAR testing: Ea[V/m])
Limit of power drift[W] = ±5%; Power drift limit (X) [dB] = 10log(P_drift)=10log(1.05/1) = 10log(1.05)-10log(1) = 0.21dB
from E-filed relations with power; S=E×H=E^2/η=P/(4×π×r^2) (η: Space impedance) → P=(E^2×4×π×r^2)/η
Therefore, The correlation of power and the E-filed
Power drift limit (X) dB=10log(P_drift) = 10log(E_drift)^2=20log(E_drift)
From the above mentioned, **the calculated power drift of DASY system must be the less than (±) 0.21dB.**

Step 6: Z-Scan

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

*. The all SAR tests were conservatively performed with test separation distance 0 mm. The phantom bottom thickness is approx. 2mm. Typical distance from probe tip to dipole centers is 1mm. The distance between the SAR probe tip to the surface of test device which is touched the bottom surface of the phantom is approx. 3 mm for 2.4GHz band and 2.4 mm for 5GHz band.

*1. "Ratio step" method parameters used; the first measurement point: "1.4mm" from the phantom surface, the initial z grid separation: "1.4mm", subsequent graded grid ratio: "1.4". These parameters comply with the requirement of KDB 865664 D01and recommended by Schmid & Partner Engineering AG (DASY5 manual).

SECTION 4: Operation of EUT during testing

4.1 Operation mode for SAR testing

The EUT has Bluetooth (BDR/EDR/BT-LE) and IEEE 802.11b, IEEE 802.11g, IEEE 802.11n(20HT) continuous transmitting modes. The frequency and the modulation used in the SAR testing are shown as a following.

Operation mode		BDR	EDR		BT-LE	b	g	n20
Tx frequency band		(2402~2480) MHz				(2412~2462) MHz		
Maximum power [dBm]		9.26	6.53	6.53	7.36	17.15	13.41	12.04
			(*. lower power than BDR.)				(*. lower power than 11b mode)	
(Head) SAR tested condition	Frequency [MHz]	n/a (lower power, SAR test was exempt.) (*2)				2437 (*1)	n/a	n/a
	Modulation	GFSK	GFSK+π/4-DQPSK	GFSK +8DPSK	GFSK	DSSS	OFDM	OFDM
	Data rate [Mbps]	1	2	3	1	1 (*. lowest modulation)	6 (*. lowest modulation)	MCS0 (*. lowest modulation)
SAR tested/reduced?		Reduced (*2)	Reduced (*2)	Reduced (*2)	Reduced (*2)	Tested	Reduced (*1)	Reduced (*1)
(Wrist) SAR tested condition	Frequency [MHz]	n/a (lower power, SAR test was exempt.) (*2)				2437 (*1)	n/a	n/a
	Modulation	GFSK	GFSK+π/4-DQPSK	GFSK +8DPSK	GFSK	DSSS	OFDM	OFDM
	Data rate [Mbps]	1	2	3	1	1 (*. lowest modulation)	6 (*. lowest modulation)	MCS0 (*. lowest modulation)
SAR tested/reduced?		Reduced (*2)	Reduced (*2)	Reduced (*2)	Reduced (*2)	Tested	Reduced (*1)	Reduced (*1)

Controlled software	Test name	Software name	Version	Date	Storage location
	Power measurement, SAR	(Wi-Fi) 666241 CY WLTEST (*3)	7.45.98.30	2020/04/24	Memory of platform (firmware)
		(Bluetooth) BCM4343A1.hcd (*3)	001	2020/04/24	Memory of platform (firmware)

*. (mode) b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); BT-LE: Bluetooth Low Energy; BDR: Basic Data Rate; EDR: Enhanced Data Rate; n/a: not applied.
*. Any output power reducing for channel 1 and 11 to meet restricted band requirements was not observed.
*1. (KDB248227 D01 (v02r02)) Since the reported SAR of the highest measured maximum output power channel of DSSS mode was ≤ 0.8 W/kg, the SAR testing for other channels of DSSS mode and SAR test of OFDM modes were omitted.
*2. For Bluetooth mode, since it was enough lower power, SAR test for this mode was exempt.
*3. This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.

4.2 Test setup

Antenna separation distances in each test setup plan are shown as follows.

		Mode->	Wi-Fi	Bluetooth	
Setup plan	Explanation of SAR test setup plan (*. Refer to Appendix 1 for test setup photographs which had been tested.)	D [mm]	SAR Tested /Reduced	SAR Tested /Reduced	SAR type (*4)
Back	The back flat-surface of watch is touched to the Flat phantom.	3.95	Tested	Reduced	Wrist-touch (*4)
Front	The front surface of watch is set parallel to the Flat phantom **with 10mm separation gap**.	11.26 (*. 21.26, including 10 mm gap)	Tested	Reduced	Next-to-Mouth (*4)
Bezel-left	The left side of bezel of watch is touched to the Flat phantom.	10.9	Reduced	Reduced	Not applied (*4)
Near side	The near side of bezel of watch is touched to the Flat phantom.	16.2	Reduced	Reduced	
Far side	The far side of bezel of watch is touched to the Flat phantom.	37.22	Reduced	Reduced	
Bezel-right	The right side of bezel of watch is touched to the Flat phantom.	42.8	Reduced	Reduced	

*. **D:** Antenna separation distance. It is the distance from the EUT antenna inside a platform to the outer surface of platform which an operator may touch.
. Size of platform: round shape, 65.54 mm (length) × 56.28 mm (width) × 19.41 mm (thickness) (. excluding wrist band.)

***4. It was applied the SAR test procedure "KDB447498 D01 (v06), Clause 6.2. Wrist watch and wrist-worn transmitters", because this platform which has EUT built-in is a wristwatch and the voice command is supported.**
According to KDB447498 D01 (v06), Clause 6.2. Wrist watch and wrist-worn transmitters;
Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR and the wrist-worn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evaluated with the back of the device positioned in direct contact against a flat phantom filled with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions; otherwise, if applicable, the neck or a curved head region of the SAM phantom may be used, provided the device positioning and SAR probe access issues have been addressed through a KDB inquiry. When other device positioning and SAR measurement considerations are necessary, a KDB inquiry is also required for the test results to be acceptable; for example, devices with rigid wrist bands or electronic circuitry and/or antenna(s) incorporated in the wrist bands. These test configurations are applicable only to devices that are worn on the wrist and cannot support other use conditions; therefore, the operating restrictions must be fully demonstrated in both the test reports and user manuals.

4.3 SAR test exclusion considerations accordance to KDB 447498 D01

The following is based on KDB447498D01;

Step 1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max.power of channel, including tune-up tolerance, mW) / (min.test separation distance, mm)] × [√f(GHz)] **≤ 3.0 (for SAR(1g)), 7.5(for SAR(10g))** ····· formula (1)
If power is calculated from the upper formula (1);
[SAR(1g) test exclusion thresholds, mW] = 3 × [test separation distance, mm] / [√f(GHz)] ····· formula (2)

1. The upper frequency of the frequency band was used in order to calculate standalone SAR test exclusion considerations.
2. Power and distance are rounded to the nearest mW and mm before calculation
3. The result is rounded to one decimal place for comparison
4. The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

When the calculated threshold value by a numerical formula above-mentioned in the following table is 3.0 or less, SAR test can be excluded.

Step 2) At 1500 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following,
[test exclusion thresholds, mW] = [(Power allowed at numeric threshold for 50mm in formula (1))] + [(test separation distance, mm) - (50mm)] × 10 ····· formula (3)

1. The upper frequency of the frequency band was used in order to calculate standalone SAR test exclusion considerations.
2. Power and distance are rounded to the nearest mW and mm before calculation

When output power is less than the calculated threshold value by a numerical formula above-mentioned in the following table, SAR test is excluded.

[Table 1: SAR exclusion calculations]

Band	Tx mode	Upper frequency [MHz]	Maximum output power		Step 1) SAR exclusion calculations for antenna ≤50mm from the user.							
					Calculated threshold value							
					Setup	Back	Front		Bezel-right	Near-side	Far-side	Bezel-right
					SAR type	SAR(10g), wrist	SAR(1g), head		-	-	-	-
					Limit	≤ 7.5	≤ 3.0		-	-	-	-
			[dBm]	[mW]	D[mm]	≤ 5 (4)	11	21 (*. including 10 mm separation gap)	11	16	37	43
2.4GHz	b	2462	17.15	**52**	Judge	**16.3, Measure**	**7.4, Measure**	**3.9, Measure**	Reduce, KDB 447498 D01, Clause 6.2			
2.4GHz	g	2462	13.41	**22**	Judge	6.9, Reduce	**3.1, Measure**	1.6, Reduce	Reduce, KDB 447498 D01, Clause 6.2			
2.4GHz	n20	2462	12.04	**16**	Judge	5.0, Reduce	2.3, Reduce	1.23, Reduce	Reduce, KDB 447498 D01, Clause 6.2			
2.4GHz	BDR	2480	9.26	**8**	Judge	2.5, Reduce	1.1, Reduce	0.6, Reduce	Reduce, KDB 447498 D01, Clause 6.2			
2.4GHz	BT-LE	2480	7.36	**5**	Judge	1.6, Reduce	0.7, Reduce	0.4, Reduce	Reduce, KDB 447498 D01, Clause 6.2			
2.4GHz	EDR	2480	6.53	**4**	Judge	1.3, Reduce	0.6, Reduce	0.3, Reduce	Reduce, KDB 447498 D01, Clause 6.2			

*. D: Antenna separation distance, (mode) b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); BT-LE: Bluetooth Low Energy; BDR: Basic Data Rate; EDR: Enhanced Data Rate.
Notes: 1. Power and distance are rounded to the nearest mW and mm before calculation.

<Conclusion for consideration for SAR test reduction>

Tested platform is a wristwatch with the watch-wristband. This platform is usually worn on the wrist. Since the platform has sound responsive function, the platform is used in front of the mouth when a voice input is operated.

1) For Wi-Fi operation, "Back" setup is considered extremity (wrist) SAR (touch) and is applied the SAR test in body-liquid.
2) For Wi-Fi operation, "Front" setup is considered partial body SAR (next-to-mouth, 10 mm separation gap) and is applied the SAR test in head-liquid.
3) The SAR test of other SAR setups (side edge of platform) are reduced, because they are not operator accessible area for long time continuously in normal use. (KDB 447498 D01, Clause 6.2)
4) For Bluetooth operation, the SAR test was reduced, because the SAR test exclusion judge was "test can be reduced". (Refer to table 1)
5) The all SAR tests were conservatively performed with test separation distance 0mm.

By the determined test setup shown above, the SAR test was applied in the following procedures.

Step 1	(KDB 447498 D01, Clause 6.2) Measure extremity SAR(10g) (wrist) of DSSS mode on "Back" setup with a maximum power channel by using body liquid; Determine the highest reported SAR(10g) of DSSS mode by changing the channels, if it is necessary. (*. In addition, change the operation mode, if it is necessary.)
Step 2	(KDB 447498 D01, Clause 6.2) Measure partial body SAR(1g) (next-to-mouth) of DSSS mode on "Front" setup with 10 mm separation gap by using head liquid; Determine the highest reported SAR(1g) of DSSS mode by changing the channels, if it is necessary. (*. In addition, change the operation mode, if it is necessary.)

*. During SAR test, the radiated power is always monitored by Spectrum Analyzer.

SECTION 5: Uncertainty Assessment (SAR measurement/Daily check)

*. Although this standard determines only the limit value of uncertainty, there is no applicable rule of uncertainty in this. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

Uncertainty of SAR measurement (2.4GHz~6GHz) (*.ε&σ: ≤±5%, DAK3.5, Tx: ≈100% duty cycle) (v09)	1g SAR	10g SAR
Combined measurement uncertainty of the measurement system (k=1)	± 13.0 %	± 12.9 %
Expanded uncertainty (k=2)	± 26.0 %	± 25.8 %

	Error Description (2.4-6GHz)	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g) (std. uncertainty)	ui (10g) (std. uncertainty)	Vi, veff
A	**Measurement System** (DASY5)								
1	Probe Calibration Error	±6.55 %	Normal	1	1	1	±6.55 %	±6.55 %	∞
2	Axial isotropy Error	±4.7 %	Rectangular	√3	√0.5	√0.5	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy Error	±9.6 %	Rectangular	√3	√0.5	√0.5	±3.9 %	±3.9 %	∞
4	Linearity Error	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
5	Probe modulation response (v09)	±5.5 %	Rectangular	√3	1	1	±3.2 %	±3.2 %	∞
6	Sensitivity Error (detection limit)	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	Boundary effects Error	±4.3%	Rectangular	√3	1	1	±2.5 %	±2.5 %	∞
8	Readout Electronics Error(DAE)	±0.3 %	Rectangular	√3	1	1	±0.3 %	±0.3 %	∞
9	Response Time Error	±0.8 %	Normal	1	1	1	±0.8 %	±0.8 %	∞
10	Integration Time Error (≈100% duty cycle)	±0 %	Rectangular	√3	1	1	0 %	0 %	∞
11	RF ambient conditions-noise (v09)	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
12	RF ambient conditions-reflections	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
13	Probe positioner mechanical tolerance	±3.3 %	Rectangular	√3	1	1	±1.9 %	±1.9 %	∞
14	Probe Positioning with respect to phantom shell	±6.7 %	Rectangular	√3	1	1	±3.9 %	±3.9 %	∞
15	Max. SAR evaluation (Post-processing)	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
B	**Test Sample Related**								
16	Device Holder or Positioner Tolerance (v09)	±3.2 %	Normal	1	1	1	±3.2 %	±3.2 %	5
17	Test Sample Positioning Error (v09)	±2.1 %	Normal	1	1	1	±2.1 %	±2.1 %	10
18	Power scaling	±0%	Rectangular	√3	1	1	±0 %	±0 %	∞
19	Drift of output power (measured, <0.2dB)	±2.3%	Rectangular	√3	1	1	±2.9 %	±2.9 %	∞
C	**Phantom and Setup**								
20	Phantom uncertainty (shape, thickness tolerances)	±7.5 %	Rectangular	√3	1	1	±4.3 %	±4.3 %	∞
21	Algorithm for correcting SAR (e',σ: ≤5%)	±1.2 %	Normal	1	1	0.84	±1.2 %	±0.97 %	∞
22	Measurement Liquid Conductivity Error (DAK3.5)	±3.0 %	Normal	1	0.78	0.71	±2.3 %	±2.1 %	7
23	Measurement Liquid Permittivity Error (DAK3.5)	±3.1 %	Normal	1	0.23	0.26	±0.7 %	±0.8 %	7
24	Liquid Conductivity-temp.uncertainty (≤2deg.C.)	±5.3 %	Rectangular	√3	0.78	0.71	±2.4 %	±2.2 %	∞
25	Liquid Permittivity-temp.uncertainty (≤2deg.C.)	±0.9 %	Rectangular	√3	0.23	0.26	±0.1 %	±0.1 %	∞
	Combined Standard Uncertainty (v09)						**± 13.0** %	**± 12.9** %	945
	Expanded Uncertainty (k=2) (v09)						**± 26.0 %**	**± 25.8 %**	

*. This measurement uncertainty budget is suggested by IEEE Std.1528(2013) and determined by Schmid & Partner Engineering AG (DASY5 Uncertainty Budget). Per KDB 865664 D01 (v01r04) SAR Measurement 100 MHz to 6 GHz, Section 2.8.1., when the highest measured SAR(1g) within a frequency band is < 1.5W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std.1528 (2013) is not required in SAR reports submitted for equipment approval.

Uncertainty of daily check (2.4GHz~6GHz) (*.ε&σ tolerance: ≤±5%, DAK3.5, CW) (v08)	1g SAR	10g SAR
Combined measurement uncertainty of the measurement system (k=1)	± 11.0 %	± 10.9 %
Expanded uncertainty (k=2)	± 22.1 %	± 21.8 %

	Error Description (v08)	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g) (std. uncertainty)	ui (10g) (std. uncertainty)	Vi, veff
A	**Measurement System** (DASY5)								
1	Probe Calibration Error	±6.55 %	Normal	1	1	1	±6.55 %	±6.55 %	∞
2	Axial isotropy error	±4.7 %	Rectangular	√3	√0.5	√0.5	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy error	±9.6 %	Rectangular	√3	0	0	0 %	0 %	∞
4	Probe linearity	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
5	Probe modulation response (CW)	±0.0 %	Rectangular	√3	1	1	0 %	0 %	∞
6	System detection limit	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	Boundary effects	±4.8 %	Rectangular	√3	1	1	±2.8 %	±2.8 %	∞
8	System readout electronics (DAE)	±0.3 %	Normal	1	1	1	±0.3 %	±0.3 %	∞
9	Response Time Error (<5ms/100ms wait)	±0.0 %	Rectangular	√3	1	1	0 %	0 %	∞
10	Integration Time Error (CW)	±0.0 %	Rectangular	√3	1	1	0 %	0 %	∞
11	RF ambient conditions-noise	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
12	RF ambient conditions-reflections	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
13	Probe positioner mechanical tolerance	±3.3 %	Rectangular	√3	1	1	±1.9 %	±1.9 %	∞
14	Probe positioning with respect to phantom shell	±6.7 %	Rectangular	√3	1	1	±3.9 %	±3.9 %	∞
15	Max. SAR evaluation (Post-processing)	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
B	**Test Sample Related**								
16	Deviation of the experimental source	±3.5 %	Normal	1	1	1	±3.5 %	±3.5 %	∞
17	Dipole to liquid distance (10mm±0.2mm,<2deg.)	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2 %	∞
18	Drift of output power (measured, <0.2dB)	±2.3 %	Rectangular	√3	1	1	±1.3 %	±1.3 %	∞
C	**Phantom and Setup**								
19	Phantom uncertainty	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2%	∞
20	Algorithm for correcting SAR (e',σ: ≤5%)	±1.2 %	Normal	1	1	0.84	±1.2 %	±0.97 %	∞
21	Liquid conductivity (meas.) (DAK3.5)	±3.0 %	Normal	1	0.78	0.71	±2.3 %	±2.1 %	∞
22	Liquid permittivity (meas.) (DAK3.5)	±3.1 %	Normal	1	0.23	0.26	±0.7 %	±0.8 %	∞
23	Liquid Conductivity-temp.uncertainty (≤2deg.C.)	±5.3 %	Rectangular	√3	0.78	0.71	±2.4 %	±2.2 %	∞
24	Liquid Permittivity-temp.uncertainty (≤2deg.C.)	±0.9 %	Rectangular	√3	0.23	0.26	±0.1 %	±0.1 %	∞
	Combined Standard Uncertainty						**±11.0** %	**±10.9** %	
	Expanded Uncertainty (k=2)						**±22.1** %	**±21.8** %	

*. This measurement uncertainty budget is suggested by IEEE Std. 1528(2013) and determined by Schmid & Partner Engineering AG (DASY5 Uncertainty Budget).

*. Table of uncertainties are listed for ISO/IEC 17025.

SECTION 6: Confirmation before testing

6.1 SAR reference power measurement (*. Antenna terminal conducted average power)

Mode	Frequency		Data rate	Power Setting (software)	Duty cycle	Duty factor	Duty scaled factor	Measurement Result				Power correction				Power tuning applied?	Remarks *. Antenna gain (peak): -3.70 dBi
								Time average power		Burst power		Typical power	Max. power	Δ from max.	Tune-up factor		
	[MHz]	CH	[Mbps]	[-]	[%]	[dB]	[-]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[dBm]	[dB]	[-]		
BDR	2402	0	1(DH5)	fix	78.1	1.07	1.28	7.79	6.01	**8.86**	7.69	-	9.26	-0.40	1.10	n/a (fix)	-
	2441	39	1(DH5)	fix	78.1	1.07	1.28	7.60	5.75	**8.67**	7.36	-	9.26	-0.59	1.15	n/a (fix)	-
	2480	78	1(DH5)	fix	78.1	1.07	1.28	7.31	5.38	**8.38**	6.89	-	9.26	-0.88	1.22	n/a (fix)	-
EDR	2402	0	2(2DH5)	fix	78.1	1.07	1.28	4.25	2.66	**5.32**	3.40	-	6.53	-1.21	1.32	n/a (fix)	-
	2441	39	2(2DH5)	fix	78.1	1.07	1.28	4.27	2.67	**5.34**	3.42	-	6.53	-1.19	1.32	n/a (fix)	-
	2480	78	2(2DH5)	fix	78.1	1.07	1.28	4.86	3.06	**5.93**	3.92	-	6.53	-0.60	1.15	n/a (fix)	-
EDR	2402	0	3(3DH5)	fix	78.1	1.07	1.28	4.26	2.67	**5.33**	3.41	-	6.53	-1.20	1.32	n/a (fix)	-
	2441	39	3(3DH5)	fix	78.1	1.07	1.28	4.27	2.67	**5.34**	3.42	-	6.53	-1.19	1.32	n/a (fix)	-
	2480	78	3(3DH5)	fix	78.1	1.07	1.28	4.88	3.08	**5.95**	3.94	-	6.53	-0.58	1.14	n/a (fix)	-
BT-LE	2402	0	1	fix	60.5	2.18	1.65	4.67	2.93	**6.85**	4.84	-	7.36	-0.51	1.12	n/a (fix)	-
	2440	19	1	fix	60.5	2.18	1.65	4.52	2.83	**6.70**	4.68	-	7.36	-0.66	1.16	n/a (fix)	-
	2480	39	1	fix	60.5	2.18	1.65	4.40	2.75	**6.58**	4.55	-	7.36	-0.78	1.20	n/a (fix)	-
b	2412	1	1	fix	99.1	0.04	1.01	16.53	44.98	**16.57**	45.39	-	17.15	-0.58	1.14	n/a (fix)	-
	2437	6	1	fix	99.1	0.04	1.01	16.69	46.67	**16.73**	47.10	-	17.15	-0.42	1.10	n/a (fix)	-
	2462	11	1	fix	99.1	0.04	1.01	16.54	45.08	**16.58**	45.50	-	17.15	-0.57	1.14	n/a (fix)	-
g	2412	1	6	fix	93.7	0.28	1.07	12.54	17.95	**12.82**	19.14	-	13.41	-0.59	1.15	n/a (fix)	-
	2437	6	6	fix	93.7	0.28	1.07	12.53	17.91	**12.81**	19.10	-	13.41	-0.60	1.15	n/a (fix)	-
	2462	11	6	fix	93.7	0.28	1.07	12.54	17.95	**12.82**	19.14	-	13.41	-0.59	1.15	n/a (fix)	-
n20	2412	1	MCS0	fix	93.3	0.30	1.07	11.06	12.76	**11.36**	13.68	-	12.04	-0.68	1.17	n/a (fix)	-
	2437	6	MCS0	fix	93.3	0.30	1.07	11.06	12.76	**11.36**	13.68	-	12.04	-0.68	1.17	n/a (fix)	-
	2462	11	MCS0	fix	93.3	0.30	1.07	10.98	12.53	**11.28**	13.43	-	12.04	-0.76	1.19	n/a (fix)	-

*. : SAR test was applied.; *. xx.xx highlight is shown the maximum measured output power in each mode.; CH: channel, max: maximum, n/a: not applied.

*. **The SAR test power was not more than 2dB lower than maximum tune-up power (KDB 447498 D01 (v06) requirement).**

*. **For Wi-Fi mode, the lowest data rate (lowest modulation) mode was selected for the SAR test which had the highest duty cycle. (KDB 447498 D01 (v06))**

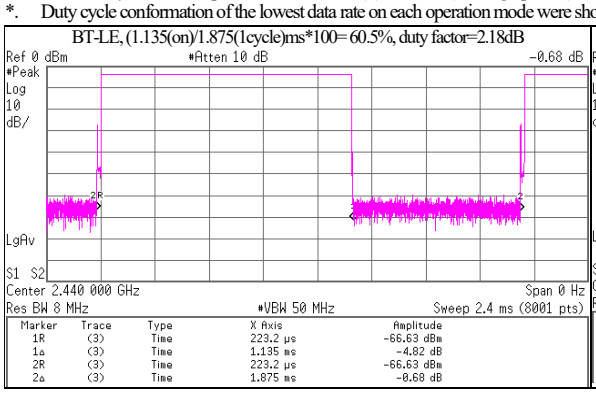
*. CH: channel, Max. power: Maximum tune-up power, n/a: not applicable, (mode) b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT), BT-LE: Bluetooth Low Energy; BDR: Basic Data Rate; EDR: Enhanced Data Rate.

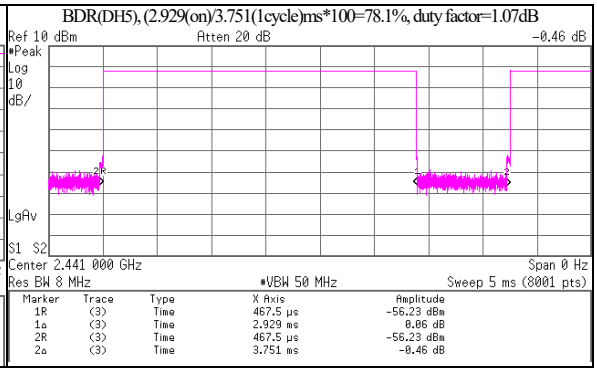
*. The measured duty cycle number of BDR/EDR/BT-LE was nearly equal to highest theory duty cycle.

*. Calculating formula: Result-Time average power (dBm) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)
Result-Burst power (dBm) (*.equal to 100% duty cycle) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)+(duty factor, dB)
Duty cycle: (duty cycle, %) = (Tx on time, ms) / (1 cycle time, ms) × 100, where Duty factor (dBm) = 10 × log (100/(duty cycle, %))
Duty cycle scaled factor: Duty cycle correction factor for obtained SAR value, Duty scaled factor [-] = 100(%) / (duty cycle, %)
Δ form max. (dB) = (Results-Burst power (average, dBm)) - (Max.-specification output power (average, dBm))
Tune-up factor (Power tune-up factor for obtained SAR value) (unit: (-)) = 1 / (10 ^ ("Deviation from max., dB" / 10))

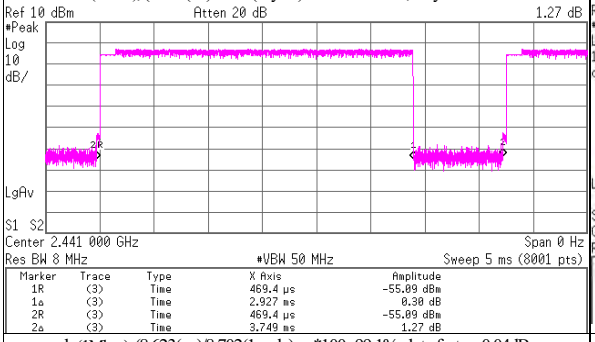
*. Date measured: April 24, 2020 / Measured by: H. Naka/ Place: Preparation room of No. 7 shield room. (23 deg.C./ 45 %RH)
Uncertainty of antenna port conducted test; (±) 0.98 dB (Average power), (±) 0.262 % (duty cycle).

*. Duty cycle conformation of the lowest data rate on each operation mode were shown in the below chart.

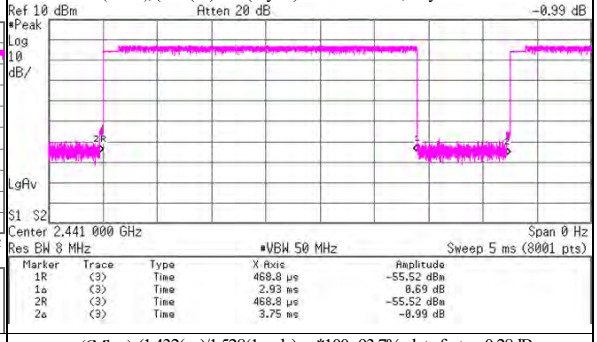




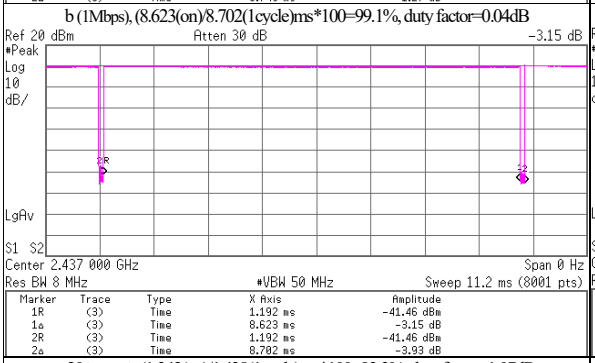
EDR(2DH5), (2.927(on)/3.749(1cycle)ms*100=78.1%, duty factor=1.07dB



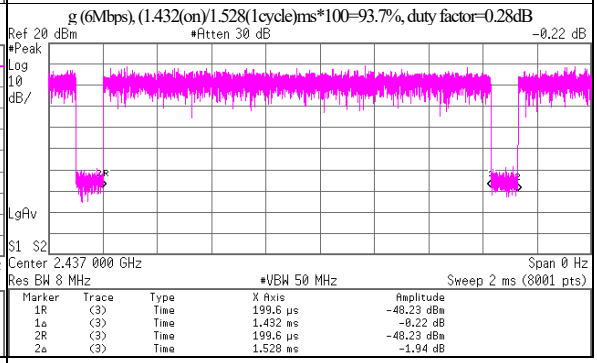
EDR(3DH5), (2.93(on)/3.75(1cycle)ms*100=78.1%, duty factor=1.07dB



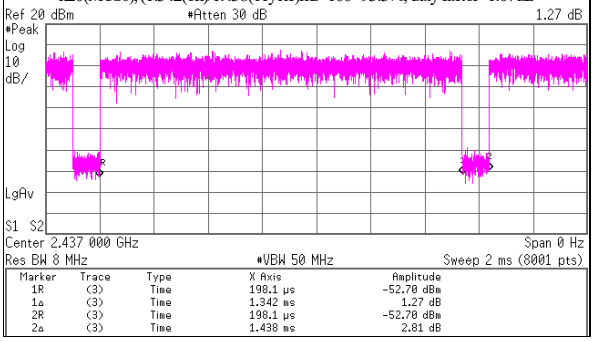
b (1Mbps), (8.623(on)/8.702(1cycle)ms*100=99.1%, duty factor=0.04dB



g (6Mbps), (1.432(on)/1.528(1cycle)ms*100=93.7%, duty factor=0.28dB



n20(MCS0), (1.342(on)/1.438(1cycle)ms*100=93.3%, duty factor=1.07dB



SECTION 7: SAR Measurement results

Measurement date: May 14 and 15, 2020 Measurement by: Hiroshi Naka

[Liquid measurement]

Frequency [MHz] (Channel)	Liquid type	Liquid parameters (*a)								Temp. [deg.C.]	Depth [mm]	ΔSAR Coefficients(*b)			Date measured
		Permittivity (εr) [-]				Conductivity [S/m]						ΔSAR			
		Target	Measured		Limit	Target	Measured		Limit			1g [%]	10g [%]	Correction required?	
			Meas.	Δεr [%]			Meas.	Δσ [%]							
2437 (6)	Head	*39.22*	38.29	-2.4	±5	*1.788*	1.846	+3.2	±5	24.0	150	+2.09	+1.22	not required.	May 14, 2020, before SAR test
2437 (6)	Body	*52.72*	50.60	-4.0	±5	*1.938*	1.954	+0.9	±5	22.9	149	+1.32	+0.86	not required.	May 15, 2020, before SAR test

SAR measurement results]

SAR measurement results											Reported SAR [W/kg]							
Test setup			Mode	Frequency [MHz] (Channel)	Data rate [Mbps] or [Index]	SAR [W/kg]				SAR plot # in Appendix 2-2	Duty cycle correction		Output burst average power correction			Tune-up SAR Corrected (*c)	Limit [W/kg]	Remarks
Position	Gap [mm]	Source power				Max.value of multi-peak					Duty [%]	Duty scaled	Meas. [dBm].	Max. [dBm]	Tune-up factor			
						SAR type	Meas.	ΔSAR sign	ΔSAR corrected									
Step 1: Worst partial head SAR(1g) (next-to-mouth) in Head liquid																		
Front	10	Battery	b	2437(6)	1	1g	**0.048**	Positive	n/a (*b)	Plot 1-1	99.1	1.01	16.73	17.15	1.10	**0.053**	1.6	-
Step 2: Worst extremity SAR(10g) (wrist) in Body liquid																		
Back	0	Battery	b	2437(6)	1	10g	**0.052**	Positive	n/a (*b)	Plot 2-1	99.1	1.01	16.73	17.15	1.10	**0.058**	4	-

Notes: *. (mode) b: IEEE 802.11b; Max.: maximum.; Meas.: Measured.; n/a: not applied.

*. Gap: It is the separation distance between the nearest position of platform outer surface and the bottom outer surface of phantom; During test, the platform was operated by full-charged build-in rechargeable Li-ion battery.

*. Calibration frequency of the SAR measurement probe (and used conversion factors)

Liquid	SAR test frequency	Probe calibration frequency	Validity	Conversion factor	Uncertainty
Head	2437 MHz	2450 MHz	within ±50MHz of calibration frequency	7.26	±12.0%
Body	2437 MHz	2450 MHz	within ±50MHz of calibration frequency	7.49	±12.0%

*. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

*a. The target value is a parameter defined in Appendix A of KDB 865664 D01 (v01r04), the dielectric parameters suggested are given at 2000, 2450, 3000MHz. Parameters for the frequencies between 2000 and 3000 MHz were obtained using linear interpolation.

*b. Calculating formula: $\Delta SAR(1g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon = -7.854E\text{-}4 \times f^3 + 9.402E\text{-}3 \times f^2 - 2.742E\text{-}2 \times f - 0.2026$ / $C\sigma = 9.804E\text{-}3 \times f^3 - 8.661E\text{-}2 \times f^2 + 2.981E\text{-}2 \times f + 0.7829$

*c. Since the calculated ΔSAR values of the tested liquid had shown positive correction, the measured SAR was not converted by ΔSAR correction.
Calculating formula: ΔSAR corrected SAR (W/kg) = (Meas. SAR (W/kg)) × (100 - (ΔSAR(%)) / 100

*d. Calculating formula: Reported SAR (W/kg) = (Measured SAR (W/kg)) × (Duty scaled) × (Tune-up factor)
Duty scaled = Duty scaled factor: Duty cycle correction factor for obtained SAR value, Duty scaled factor [-] = 100(%) / (duty cycle, %)
Tune-up factor: Power tune-up factor for obtained SAR value, Tune-up factor [-] = 1 / (10 ^ ("Deviation from max., dB" / 10))

(Clause 5.2, 2.4GHz SAR Procedures, in KDB248227 D01 (v02r02))

5.2.1 802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

5.2.2 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3, including sub-sections). SAR is not required for the following 2.4 GHz OFDM conditions.

1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

*. SAR test of OFDM mode was reduced, because the estimate reported SAR of OFDM mode was ≤ 1.2 W/kg by using the highest reported SAR of DSSS mode.

OFDM mode	Maximum tune-up tolerance limit				OFDM scaled factor [-] (b)/(a)×100	DSSS reported SAR value				Estimated SAR value: OFDM [W/kg]	Exclusion limit [W/kg]	Standalone SAR test require?
	DSSS		OFDM			SAR type		Setup	[W/kg]			
	[dBm]	[mW] (a)	[dBm]	[mW] (b)								
11g	17.15	52	13.41	22	0.423	1g	Next-to-mouse	Front	0.053	**0.022**	**≤ 1.2**	**No**
n(20HT)	17.15	52	12.04	16	0.301	1g		Front	0.053	**0.016**	**≤ 1.2**	**No**
11g	17.15	52	13.41	22	0.423	10g	Wrist	Back	0.058	**0.025**	**≤ 1.2**	**No**
n(20HT)	17.15	52	12.04	16	0.301	10g		Back	0.058	**0.017**	**≤ 1.2**	**No**