SAR TEST REPORT

Test Report No.: 12322068S-A-R1

Applicant : **Canon Inc.**
Type of Equipment : **Communication Module**
Model No. : **WM601** (*. It was installed into WM601's platform (1).)
FCC ID : **AZD601**
Test Standard : **FCC 47CFR §2.1093**
Test Result : **Complied (Refer to Section 3.3)**

Highest Reported SAR(1g)		SAR type	Platform No.	Platform type	Platform model	Band	Frequency [MHz]	Mode	Burst power [dBm]		Report No.
Tune-up value	(Measured)								Measured	Max.	(*Refer to latest version)
0.27 W/kg	0.171 W/kg	Body-worn	1	Digital camera	PC2366	DTS	2462	b(1Mbps)	9.00	11.0	*. This report.

*. b: IEEE 802.11b.

*. **Highest reported SAR (1g) across all exposure conditions = "0.27 W/kg (body-worn)."**
*. Since highest reported SAR (1g) on a platform of WM601 (EUT) which obtained in accordance with KDB447498 (v06) was kept under 0.8 W/kg, this EUT was approved to operate multi-platform (which were tested in above.).

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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 in Section 2, Section 3, Section 4 and Appendix 1 were provided from the customer. The laboratory is exempted from liability of any test results affected from these information.
10. This report is a revised version of 12322068S-A. 12322068S-A report is replaced with this report.

Date of test: October 15, 2018

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".

JAB Testing RTL02610

REVISION HISTORY

Revision	Test report No.	Date	Page revised	Contents
Original	12322068S-A	January 18, 2019	-	-
-R1	12322068S-A-R1	February 4, 2019	p1,3,4,6~10	Tune-up tolerance is changed.

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

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Contents of appendixes

SECTION 1: Customer information

Company Name	Canon Inc.
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Telephone Number	+81-3-5482-7283
Facsimile Number	+81-3-3757-8431
Contact Person	Tomohiro Suzuki

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

	EUT	Platform
Type of Equipment	Communication Module	Platform (1): Digital camera
Model Number	WM601	PC2366
Serial Number	AT180914-01	No.151
Condition of EUT	Engineering prototype	Engineering prototype
	(*. Not for sale: These samples are equivalent to mass-produced items.)	
Receipt Date of Sample	September 13, 2018 (*.EUT for power measurement. No modification by the Lab.) October 12, 2018 (*. EUT for SAR test. No modification by the Lab.) (*.After power measurement, the EUT was returned to a customer to install into a platform.)	
Country of Mass-production	Japan	Japan
Category Identified	Portable device *. Since EUT may contact and/or very close to a human body during Wi-Fi operation, the partial-body SAR (1g) shall be observed.	
Rating	DC3.3V supplied form the platform (*. The EUT is installed into the specified platform.)	
Feature of EUT	Model: WM601 (referred to as the EUT in this report) is a Communication Module which installs into the specified platform (digital camera).	
SAR Accessory	None	

2.2 Product Description (Model: WM601)

Model	WM601	FCC ID	AZD601	ISED certification number	498J-601	
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	8.0 dBm	8.0 dBm	7.0 dBm	5.0 dBm	5.0 dBm	5.0 dBm
	Maximum	11.0 dBm	11.0 dBm	10.0 dBm	8.0 dBm	8.0 dBm	8.0 dBm
	Remarks	-	-	-	-	-	-
	*. The measured Tx output power (conducted) refers to section 6 in this report.						

Quantity of Antenna	1 piece	Antenna type	Pattern antenna (Meander antenna)	Antenna connector type	Not applicable (printed)
Antenna gain (peak)	1.67 dBi				

*. b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); BLE: Bluetooth Low Energy; BDR: Basic Data Rate; EDR: Enhanced Data Rate; n/a: not applied.
*. 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.

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, Partial-Body (averaged over any 1g of tissue) limit: 1.6 W/kg

3.3 Procedures and Results

Test Procedure	SAR measurement: IEC Std. 1528, IEC 62209-2, KDB 447498, KDB 248227, KDB 865664		
Category	FCC 47CFR §2.1093 (Portable device)	**SAR type**	Body touch

Platform / model	**Digital camera / PC2366 (platform (1))**	
Mode / Band (Operation frequency)	**Bluetooth** ((2402-2480)MHz)	**Wi-Fi** ((2412-2462)MHz)
Results (Reported SAR(1g))	**Complied** (*. lower power, SAR test was exempt.)	**Complied** (*. Refer to Section 7 and Appendix 2)
SAR (1g) Limit [W/kg]	**1.6**	**1.6**
Reported SAR(1g) value	**N/A**	**0.270 W/kg**
Measured SAR value	N/A	0.171 W/kg
Mode, frequency[MHz]	-	IEEE 802.11b, 1 Mbps (DBPSK/DSSS), 2462 MHz (11ch)
Duty cycle [%] (scaled factor)	-	99.9 (×1.00)
Output burst average power [dBm] (max. power, scaled factor)	-	9.00 (max.11.0, ×1.58)

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.

*. EUT operates only with the specified Digital Camera. Therefore, the test was performed with the specified Digital Camera (Platform).

*. Since Wi-Fi and Bluetooth are used a same antenna, Wi-Fi and Bluetooth do not transmit simultaneously.

*. (Calculating formula) Corrected SAR to max.power (W/kg) = (Measured SAR (W/kg)) × (Duty scaled) × (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 new platform (1), 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) of this platform (1) was kept; ≤ 0.8 W/kg.** **Since highest reported SAR (1g) on this EUT's platform obtained in accordance with KDB447498 D01 (v06) was kept under 0.8 W/kg, this EUT was approved to operate multi-platform.**

3.4 Addition, deviation and exclusion to the test procedure

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

3.5 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
JAB Accreditation No. RTL02610
FCC Test Firm Registration Number: 839876

Used?	Place	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
☐	No.1 Semi-anechoic chamber	2973D-1	20.6 × 11.3 × 7.65	20.6 × 11.3	10 m
☐	No.2 Semi-anechoic chamber	2973D-2	20.6 × 11.3 × 7.65	20.6 × 11.3	10 m
☐	No.3 Semi-anechoic chamber	2973D-3	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**	2973D-4	**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	-

3.6 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 result is shown in Section 6.

*. The platform 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.1 Data rate check (*. The power measurement was applied to the following data rate in each operation mode.**)**

b		g				n20 (SS×1)						Bluetooth			
Modulation	**Data rate**	**Modulation**	**Data rate**	**Modulation**	**Data rate**	**MCS Index**	**Data rate**	**Modulation**	**MCS Index**	**Data rate**	**Modulation**	**Type**	**Modulation**	Packet type	**Data rate**
DBPSK/DSSS	1	BPSK/OFDM	6	16QAM/OFDM	24	0	6.5	BPSK/OFDM	4	39	16QAM/OFDM	BLE	GFSK/FHSS	-	1
DQPSK/DSSS	2	BPSK/OFDM	9	16QAM/OFDM	36	1	13	QPSK/OFDM	5	52	64QAM/OFDM	BDR	GFSK/FHSS	DH5	1
CCK/DSSS	5.5	QPSK/OFDM	12	64QAM/OFDM	48	2	19.5	QPSK/OFDM	6	58.5	64QAM/OFDM	EDR2	π/4-DQPSK/FHSS	2DH	2
CCK/DSSS	11	QPSK/OFDM	18	64QAM/OFDM	54	3	26	16QAM/OFDM	7	65	64QAM/OFDM	EDR3	8DPSK/FSSS	3DH5	3

*. Data rate: [Mbps]; SS: Spatial Stream; b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); BLE: Bluetooth Low Energy; BDR: Basic Data Rate; EDR: Enhanced Data Rate.

Step.2 Consideration of SAR test channel

For the SAR test reference, on each operation band, the average output power was measured on the low/middle/upper and specified channels with the worst data rate condition in step 1 in the above.

3.7 Confirmation after SAR testing

It was checked that the power drift [W] is within ±5% in the evaluation procedure of SAR testing. The verification of power drift during the SAR test is that DASY5 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 APPENDIX 2.

*. DASY5 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 DASY5 system must be the less than ±0.21dB.**

3.8 Test setup of EUT and SAR measurement procedure

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

Setup plan	Explanation of SAR test setup plan (*. Refer to Appendix 1 for test setup photographs which had been tested.)	Wi-Fi D [mm]	Wi-Fi SAR Tested /Reduced	Bluetooth D [mm]	Bluetooth SAR Tested /Reduced	SAR type
Front-right	A lower-right grip portion of front of a camera is touched to the Flat phantom.	**4.15**	**Tested**	**4.15**	*Reduced*	Body-touch
Front-grip	A convex of grip on front surface of a camera is touched to the Flat phantom.	**7.56**	**Tested**	**7.56**	*Reduced*	
Right	A right surface of camera is touched to the Flat phantom.	**8.75**	**Tested**	**8.75**	*Reduced*	
Bottom	A bottom surface of camera is touched to the Flat phantom.	**10.51**	**Tested**	**10.51**	*Reduced*	
Front-flat	A lens section of front surface of a camera is touched to the Flat phantom.	**14.0**	**Tested**	**14.0**	*Reduced*	
Rear	A rear of camera is touched to the Flat phantom with closing the LCD.	**29.20**	**Tested**	**29.20**	*Reduced*	
Top-right	A right portion on top surface of a camera is touched to the Flat phantom.	**49.56**	*Reduced*	**49.56**	*Reduced*	
Left	A left surface of camera is touched to the Flat phantom.	**96.25**	*Reduced*	**96.25**	*Reduced*	

*. **D:** Antenna separation distance. It is the distance from the antenna inside EUT to the outer surface of EUT which an operator may touch.
*. Size of EUT (WM601): 20.5 mm (width) × 10.0 mm (height) × 2.0 mm (thickness)
. Size of platform (digital camera): 105.0 mm (width) × 60.85 mm (height) × 43.2 mm (depth) (. the convex portion is not contained in size.)

<u>*. Consideration for SAR evaluation exemption</u>
SAR test exclusion considerations according to KDB447498 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)] × [$\sqrt{f(GHz)}$] ≤ 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] / [$\sqrt{f(GHz)}$] ········ 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.

[SAR exclusion calculations for step 1) antenna ≤50mm from the user, and for step 2) antenna > 50mm from the user.]

Tx mode	Upper frequency [MHz]	Maximum output power [dBm]	Maximum output power [mW]	Step 1) SAR exclusion calculations for antenna ≤50mm from the user. Calculated threshold value: Setup	Front-right	Front-grip	Right	Bottom	Front-flat	Rear	Top-right	Step 2) > 50mm from the user: Left
				D[mm]	≤ 5 (4.15)	8	9	11	14	29	50	96
b	2462	11	**13**	Judge	**<u>4.1, Measure</u>**	2.5, Reduce	2.3, Reduce	1.9, Reduce	1.5, Reduce	0.7, Reduce	0.4, Reduce	≥556 mW, Reduce
g	2462	11	**13**	Judge	**<u>4.1, Measure</u>**	2.5, Reduce	2.3, Reduce	1.9, Reduce	1.5, Reduce	0.7, Reduce	0.4, Reduce	≥556 mW, Reduce
n20	2462	10	**10**	Judge	**<u>3.1, Measure</u>**	2.0, Reduce	1.7, Reduce	1.4, Reduce	1.1, Reduce	0.5, Reduce	0.2, Reduce	≥556 mW, Reduce
BT	2480	8	**6**	Judge	1.9, Reduce	1.2, Reduce	1.0, Reduce	0.9, Reduce	0.7, Reduce	0.3, Reduce	0.2, Reduce	≥555 mW, Reduce

*. D: Antenna separation distance, BT: Bluetooth, b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); n/a: not applied.

<u><Conclusion for consideration for SAR test reduction></u>

1) For Wi-Fi operation, "Front-right", "Front-grip", "Right" and "Bottom" setup which are near an antenna are applied the SAR test in body-liquid. The SAR test of "Front-flat" and "Rear" are tested to search the SAR peak location even if the SAR test exclusion judge value are smaller than "3". The SAR test of other SAR setups ("Top-right" and "Left") is reduced because the SAR test exclusion judge value are smaller than "3" and they have enough antenna separation distance.
2) For Bluetooth operation, the SAR test is reduced for all SAR setups, because the SAR test exclusion judge value are smaller than "3."
3) The SAR test of front-of-face (tested by head liquid) wasn't considered, because the view finder is not existed on the camera.
4) 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.

Worst SAR search by DSSS mode; *. Determine the highest reported SAR(1g) of DSSS mode (IEEE 802.11b). (*. Change the channel, if it is necessary.) *. Check the SAR of OFDM mode at worst reported SAR(1g) condition of DSSS mode (IEEE 802.11b), if it is necessary.

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

SECTION 4: Operation of EUT during testing

4.1 Operating modes for SAR testing

This EUT has IEEE.802.11b, 11g and 11n(20HT) and Bluetooth (BDR/EDR/BLE) continuous transmitting modes.
The frequency and the modulation used in the SAR testing are shown as a following.

Operation mode		BDR	EDR		BLE	b	g	n20
Tx frequency band		2402-2480MHz				2412-2462MHz		
Maximum power [dBm]		8.0	8.0	8.0	8.0	11.0	11.0	10.0
SAR tested condition	Frequency [MHz]		-	-	-	2412, 2437, 2462	-	-
	Modulation	FHSS	FHSS	FHSS	FHSS	DSSS	OFDM	OFDM
	Data rate [Mbps]	1	2	3	1	1	6	6.5(MCS0)
SAR tested/reduced?		Reduced	Reduced	Reduced	Reduced	Tested	Reduced	Reduced
Controlled software		WLAN/BT LE/Bluetooth: Ver1.2.0 31(26) (for power measurement and SAR test) This software was used for both power measurement and SAR test. For Wi-Fi operation, it set Tx parameters which includes; "channel", "BW", "Power(dBm)"and "data rate" via LCD of camera. For BDR/EDR operation, it set Tx parameters which includes; "hopping off" "channel", "Mode (used: DH5/2DH5/3DH5)", "Data pattern (used: PRBS9)" via LCD of camera. For BLE operation, it set Tx parameters which includes; "channel", " payload length (used: 37byte) ", "payload type (used: PRBS9)" via LCD of camera.						
Power setting	Power measurement	fix	fix	fix	fix	9 (tuned)	9 (tuned)	8 (tuned)
	SAR	N/A	N/A	N/A	N/A	9 (tuned)	N/A	N/A

*. b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); BLE: 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.
*. (KDB248227 D01 (v02r02)) Since the reported SAR of the highest measured maximum output power channel is ≤ 0.8 W/kg, the SAR testing for other channels were omitted. However, the SAR testing was applied to lower, middle and upper channels for the worst SAR condition.

SECTION 5: Uncertainty Assessment (SAR measurement)

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 (2.4-6GHz) (*.ε&σ: ≤ ± 5%, DAK3.5, Tx: ≈100% duty cycle) (v08)	1g SAR	10g SAR
Combined measurement uncertainty of the measurement system (k=1)	± 13.7%	± 13.6%
Expanded uncertainty (k=2)	± 27.4%	± 27.2%

	Error Description (2.4-6GHz) (v08)	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	Vi, veff
A	**Measurement System** (DASY5)						(std. uncertainty)	(std. uncertainty)	
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	±2.4 %	Rectangular	√3	1	1	±1.4 %	±1.4 %	∞
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	±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	Device Holder or Positioner Tolerance	±3.6 %	Normal	1	1	1	±3.6 %	±3.6 %	5
17	Test Sample Positioning Error	±5.0 %	Normal	1	1	1	±5.0 %	±5.0 %	145
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						**±13.7** %	**±13.6** %	733
	Expanded Uncertainty (k=2)						**±27.4 %**	**±27.2 %**	

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

SECTION 6: Confirmation before testing

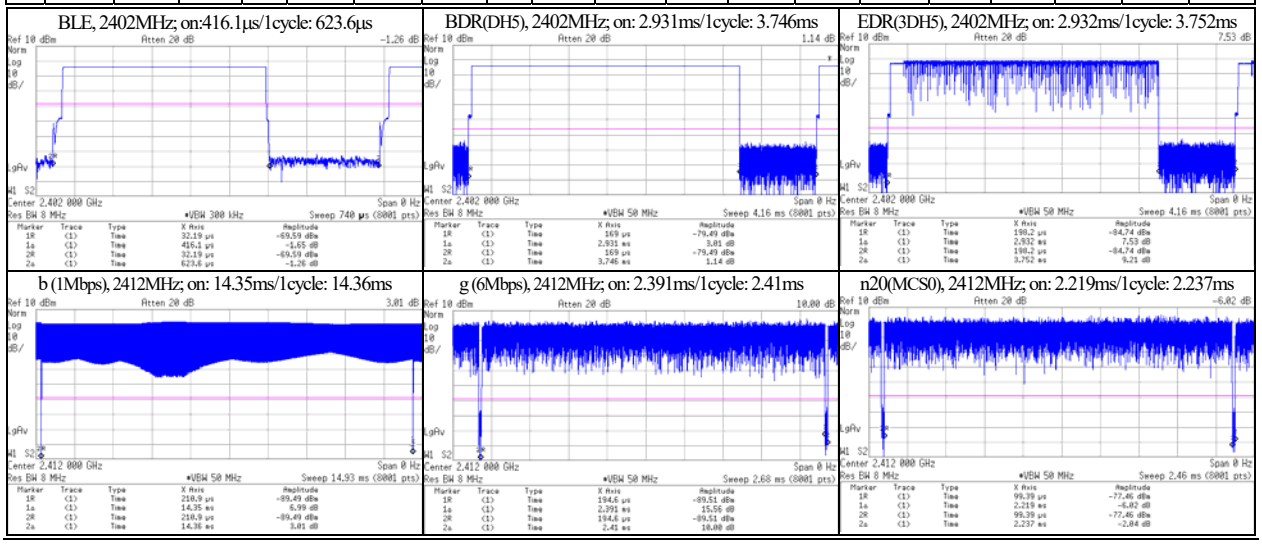
6.1 SAR reference power measurement (antenna terminal conducted average power of EUT) - Worst data rate/channel determination

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): 1.67 dBi (2.4 GHz band
								Time average power		Burst power		Max. power	Δ from max.	Tune-up factor		
	[MHz]	CH	[Mbps]	[-]	[%]	[dB]	[-]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[dB]	[-]		
BDR	2402	0	1(DH5)	fix	78.2	1.07	×1.28	6.05	4.03	**7.12**	5.15	8.0	-0.88	×1.22	n/a (fix)	-
	2440	39	1(DH5)	fix	78.2	1.07	×1.28	6.42	4.39	**7.49**	5.61	8.0	-0.51	×1.12	n/a (fix)	-
	2480	78	1(DH5)	fix	78.2	1.07	×1.28	6.85	4.84	**7.92**	6.19	8.0	-0.08	×1.02	n/a (fix)	-
EDR	2402	0	2(2-DH5)	fix	78.1	1.07	×1.28	6.57	4.54	**7.64**	5.81	8.0	-0.36	×1.09	n/a (fix)	-
	2440	39	2(2-DH5)	fix	78.1	1.07	×1.28	6.74	4.72	**7.81**	6.04	8.0	-0.19	×1.04	n/a (fix)	-
	2480	78	2(2-DH5)	fix	78.1	1.07	×1.28	6.85	4.84	**7.92**	6.19	8.0	-0.08	×1.02	n/a (fix)	-
EDR	2402	0	3(3-DH5)	fix	78.1	1.07	×1.28	6.59	4.56	**7.66**	5.83	8.0	-0.34	×1.08	n/a (fix)	-
	2440	39	3(3-DH5)	fix	78.1	1.07	×1.28	6.77	4.75	**7.84**	6.08	8.0	-0.16	×1.04	n/a (fix)	-
	2480	78	3(3-DH5)	fix	78.1	1.07	×1.28	6.88	4.88	**7.95**	6.24	8.0	-0.05	×1.01	n/a (fix)	-
BLE	2402	0	1	fix	66.7	1.76	×1.50	5.13	3.26	**6.89**	4.89	8.0	-1.11	×1.29	n/a (fix)	-
	2440	19	1	fix	66.7	1.76	×1.50	5.39	3.46	**7.15**	5.19	8.0	-0.85	×1.22	n/a (fix)	-
	2480	39	1	fix	66.7	1.76	×1.50	5.75	3.76	**7.51**	5.64	8.0	-0.49	×1.12	n/a (fix)	-
b	2412	1	1	9	99.9	0.00	×1.00	9.19	8.30	**9.19**	8.30	11.0	-1.81	×1.52	tuned (default: 8)	(*1)
	2437	6	1	9	99.9	0.00	×1.00	9.01	7.96	**9.01**	7.96	11.0	-1.99	×1.58	tuned (default: 8)	(*1)
	2462	11	1	9	99.9	0.00	×1.00	9.00	7.94	**9.00**	7.94	11.0	-2.00	×1.58	tuned (default: 8)	(*1)
g	2412	1	6	9	99.2	0.03	×1.01	9.57	9.06	**9.60**	9.12	11.0	-1.40	×1.38	tuned (default: 8)	(*1)
	2437	6	6	9	99.2	0.03	×1.01	9.52	8.95	**9.55**	9.02	11.0	-1.45	×1.40	tuned (default: 8)	(*1)
	2462	11	6	9	99.2	0.03	×1.01	9.27	8.45	**9.30**	8.51	11.0	-1.70	×1.48	tuned (default: 8)	(*1)
n20	2412	1	MCS0	8	99.2	0.03	×1.01	8.38	6.89	**8.41**	6.93	10.0	-1.59	×1.44	tuned (default: 7)	(*1)
	2437	6	MCS0	8	99.2	0.03	×1.01	8.41	6.93	**8.44**	6.98	10.0	-1.56	×1.43	tuned (default: 7)	(*1)
	2462	11	MCS0	8	99.2	0.03	×1.01	8.18	6.58	**8.21**	6.62	10.0	-1.79	×1.51	tuned (default: 7)	(*1)

*. : 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.
*1. The SAR test power was adjusted to not more than 2dB lower than maximum tune-up power (KDB 447498 D01 (v06) requirement) by the control software.
*. b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); BLE: Bluetooth Low Energy; BDR: Basic Data Rate; EDR: Enhanced Data Rate.
*. The measured duty cycle number of BDR/EDR/BLE was nearly equal to highest theory duty cycle.
*. For Wi-Fi mode, the lowest data rate (lowest modulation) mode was selected for the SAR test which had the highest time-based measured average power. Preliminary tests were performed in different data rate and data rate associated with the highest power were chosen for full test in following tables.

Data rate (D/R, [Mbps]) vs Time average power (dBm)

11b (2412MHz)				11g (2412MHz)								11n(20HT) (2412MHz)							
D/R	Duty cycle (%)	Duty factor (dB)	Power	D/R	Duty cycle (%)	Duty factor (dB)	Power	D/R	Duty cycle (%)	Duty factor (dB)	Power	D/R	Duty cycle (%)	Duty factor (dB)	Power	D/R	Duty cycle (%)	Duty factor (dB)	Power
1	99.9	0.00	**9.19**	**6**	99.2	0.03	**9.57**	24	97.2	0.12	9.44	**MCS0**	99.2	0.03	**8.38**	MCS4	96.1	0.17	8.08
2	99.8	0.01	9.10	9	98.9	0.05	9.56	36	96.6	0.15	9.43	MCS1	98.5	0.07	8.27	MCS5	94.7	0.24	8.15
5.5	99.6	0.02	9.10	12	98.6	0.06	9.47	48	95.6	0.20	9.13	MCS2	97.9	0.09	8.25	MCS6	94.2	0.26	8.21
11	99.1	0.04	9.12	18	98.0	0.09	9.52	56	94.6	0.24	9.07	MCS3	97.1	0.13	8.21	MCS7	93.5	0.29	8.13



*. 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 factor (dBm) = 10 × log (100/(duty cycle, %))
Δ form max. (dB) = (Results-Burst power (average, dBm)) - (Max.-specification output power (average, dBm))
Duty scaled factor (Duty cycle correction factor for obtained SAR value) (unit: (-)) = 100(%) / (duty cycle, %)
Tune-up factor (Power tune-up factor for obtained SAR value) (unit: (-)) = 1 / (10 ^ ("Deviation from max., dB" / 10))
*. Date measured: September 14, 2018 / Measured by: Hiroshi Naka / Place: preparation room of No. 7 shielded room. (25 deg.C. / 58 %RH)
*. Uncertainty of antenna port conducted test; Power measurement uncertainty above 1GHz for this test was: (±) 0.48 dB(Average)/(±) 0.66 dB(Peak).
*. Uncertainty of antenna port conducted test; Duty cycle and time measurement: (±) 0.012 %.

6.2 Comparison of power of SAR samples tested in the past

	WM601's platform		WM601 Serial number	Date power measured	Reference report# (*. UL Japan published.)	Burst average power [dBm] ("*": Higher)						
						Max.	Typ.	Power setting	Mode (Data rate)	Frequency [MHz]		
	No.	Model								2412	2437	2462
EMC (Ref.)	-	(WM601)	02	October 15, 2018	12322067S-G	11.0	8.0	8 (default)	b (1 Mbps)	**8.30***	8.03	8.12
SAR test (1)	1	PC2366	AT180914-01	September 14, 2018	This report (12322068S-A)	11.0	8.0	8 (default)	b (1 Mbps)	8.08	**8.16***	7.97
								9 (*1)		9.19	9.01	9.00

*. b: IEEE 802.11b, Max.: Maximum power, Typ.: Typical power.
*1. The SAR test power was adjusted to not more than 2dB lower than maximum tune-up power (KDB 447498 D01 (v06) requirement) by the control software.

SECTION 7: SAR Measurement results

Measurement date: October 15, 2018 Measurement by: Hiroshi Naka

[Liquid measurement]

Target Frequency [MHz]	Liquid type	Liquid parameters (*a)									ΔSAR Coefficients(*c)		Date measured
		Permittivity (εr) [-]				Conductivity [S/m]							
		Target	Measured		Limit (*b)	Target	Measured		Limit (*b)	Temp. [deg.C.]	Depth [mm]	ΔSAR (1g) [%]	Correction required?	
			Meas.	Δεr [%]			Meas.	Δσ [%]						
2412	Body	52.75	50.70	-3.9	-5% ≤ εr-meas. ≤ 0%	1.914	1.962	+2.5	0% ≤ σ-meas. ≤ +5%	22.3	151	+2.10	not required.	October 15, 2018, before SAR test
2437		52.72	50.59	-4.0		1.938	1.995	+3.0				+2.34	not required.	
2462		52.68	50.49	-4.2		1.967	2.028	+3.1				+2.42	not required.	

[SAR measurement results]

SAR measurement results																Reported SAR (1g) [W/kg]		SAR plot # in Appendix 2-2	Remarks
Mode	Frequency [MHz] (Channel)	Data rate [Mbps]	EUT setup				SAR (1g) [W/kg]			Duty cycle correction		Output burst average power correction			SAR Corrected (*d)			
			Position	Gap [mm]	Battery ID	LCD position	Max.value of multi-peak												
							Meas.	ΔSAR [%]	ΔSAR corrected	Duty [%]	Duty scaled	Meas. [dBm].	Max. [dBm]	Tune-up factor				
b	2412(1)	1	Front-right	0	#1	Op90	0.155	+2.10	n/a (*c)	99.9	×1.00	9.19	11.0	×1.52	0.236		Plot 2	-
	2437(6)	1	Front-right	0	#1	Op90	0.157	+2.34	n/a (*c)	99.9	×1.00	9.01	11.0	×1.58	0.248		Plot 3	-
	2462(11)	1	Front-right	0	#1	Op90	0.171	+2.42	n/a (*c)	99.9	×1.00	9.00	11.0	×1.58	0.270		Plot 1	*.Higher, DSSS.
	2412(1)	1	Front-grip	0	#1	Op90	0.121	+2.10	n/a (*c)	99.9	×1.00	9.19	11.0	×1.52	0.184		Plot 4	-
	2412(1)	1	Right	0	#2	Close	0.035	+2.10	n/a (*c)	99.9	×1.00	9.19	11.0	×1.52	0.053		Plot 5	-
	2412(1)	1	Bottom	0	#2	Close	0.023	+2.10	n/a (*c)	99.9	×1.00	9.19	11.0	×1.52	0.035		Plot 6	-
	2412(1)	1	Front-flat	0	#2	Op90	n/a	*. Since the arear scan was performed to check the SAR peak location (as antenna position), zoom scan was not performed.							n/a		Plot 7	-
	2412(1)	1	Rear	0	#2	Close	n/a								n/a		Plot 8	-

Notes: *. b: IEEE 802.11b; Max.: maximum.; Meas.: Measured.; n/a: not applied; Gap: It is the separation distance between the nearest position of camera outer surface and the bottom outer surface of phantom; Battery ID: Refer to Appendix 1.; LCD position: Refer to Appendix 1 for more detail (Op90: Open 90 degrees).

*. During test, the EUT was operated with full charged battery and without all interface cables.

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

SAR test frequency	Probe calibration frequency	Validity	Conversion factor	Uncertainty
2412, 2437, 2462 MHz	2450MHz	within ±50MHz of calibration frequency	7.32	±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 KDB865664 D01 (v01r04), the dielectric parameters suggested for head and body tissue simulating liquid are given at 2000 and 2450MHz. Parameters for the frequencies 2000-2450MHz were obtained using linear interpolation. (Refer to appendix 3-4.)

*b. Refer to KDB865664 D01 (v01r04), item 2), Clause 2.6; "When nominal tissue dielectric parameters are recorded in the probe calibration data; for example, only target values and tolerance are reported, the measured εr and σ of the liquid used in routine measurements must be: ≤ the target εr and ≥ the target σ values and also within 5% of the required target dielectric parameters."

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

ΔSAR corrected SAR (1g) (W/kg) = (Meas. SAR(1g) (W/kg)) × (100 - (ΔSAR(%)) / 100

*d. Calculating formula: Reported SAR (1g) (W/kg) = (Measured SAR (1g) (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(1g) value		Estimated SAR(1g) value: OFDM [W/kg]	Exclusion limit [W/kg]	Standalone SAR test require?
	DSSS		OFDM							
	[dBm]	[mW] (a)	[dBm]	[mW] (b)		Setup	[W/kg]			
11g	11.0	13	11.0	13	1.000	Front-right	0.270	**0.270**	**≤ 1.2**	**No**
n (20HT)	11.0	13	10.0	10	0.769	Front-right	0.270	**0.208**	**≤ 1.2**	**No**