



SAR TEST REPORT

Test Report No.: 11972359S-A

Applicant : Canon INC.
Type of Equipment : Wireless Module
Model No. : WM600 (*. It was installed into WM600's platform (2).)
FCC ID : AZD600
Test Standard : FCC 47CFR §2.1093
Test Result : Complied

Highest Reported SAR(1g)		SAR type	Platform No.	Platform type	Platform model	Band	Frequency [MHz]	Mode	Burst power [dBm]		Report No. (*Refer to latest version)
Tune-up value	(Measured)								Measured	Max.	
0.35 W/kg	0.220 W/kg	Body-worn	#2	Digital camera	PC2352	DTS	2437	g(6Mbps)	8.83	10	*. This report.

*. This Wireless Module had installed into the following platforms under 1.2W/kg of reported SAR(1g) (KDB447498 D01 (v06); single-platform operation requirement).

< 0.10 W/kg	0.030 W/kg	Body-worn	#1	Digital camera	PC2328	DTS	2412	b(1Mbps)	8.43	10	11759357H-A
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- *. **Highest reported SAR (1g) across all exposure conditions and on the platforms = "0.35 W/kg (body-worn)."**
*. Since highest reported SAR (1g) on a platform of WM600 (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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Date of test: October 10, 2017

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



REVISION HISTORY

Revision	Test report No.	Date	Page revised	Contents
Original	11972359S-A	October 26, 2017	-	-
-r01	11972359S-A	April 12, 2018	1,2,3,8,11	(p1,3,8,11) Error correcting, Up-dated customer information.
-r02	11972359S-A	April 17, 2018	1,2,4,8	(p4,8) Error correcting.

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

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SECTION 1: Customer information

Company Name	Canon INC.
Brand Name	Canon
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SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

	EUT	Platform
Type of Equipment	Wireless Module	Platform (2): Digital camera
Model Number	WM600	PC2352
Serial Number	05	051
Condition of EUT	Engineering prototype (*: Not for sale: These samples are equivalent to mass-produced items.)	Engineering prototype
Receipt Date of Sample	October 6, 2017 (*. EUT for SAR test.) *. No modification by the Lab. (*: The EUT that had been measured the power of SAR test reference. The EUT was installed into a platform which SAR tested, by the customer.)	
Country of Mass-production	China, 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 from the platform *. The EUT is installed into the specified platform that was operated by the re-chargeable Li-ion battery.	
Feature of EUT	Model: WM600 (referred to as the EUT in this report) is a Wireless Module which installs into the specified platform (digital camera).	
SAR Accessory	None	

2.2 Product Description (Model: WM600)

Model	WM600			FCC ID	AZD600	IC number	498J-600
Equipment type	Transceiver						
Operation mode	Wi-Fi				Bluetooth (Ver. 4.1 with EDR function)		
Frequency of operation	2412-2472 MHz (b,g,n(20HT))				2402-2480 MHz (BDR (Basic Data Rate), EDR (Enhanced Data Rate), LE (Low Energy mode))		
Channel spacing	5 MHz				1MHz (BDR, EDR), 2MHz (LE)		
Bandwidth	20 MHz (b,g,n(20HT))				79MHz		
Type of modulation	(b) DSSS: DBPSK, DQPSK, CCK (g,n(20HT)) OFDM: BPSK, QPSK, 16QAM, 64QAM				FHSS: GFSK (*. EDR: GFSK+ $\pi/4$ -DQPSK, GFSK+ 8DPSK)		
Transmit typical power and maximum tune-up tolerance limit	Mode	b	g	n(20HT)	BDR	EDR	LE
	Typical	8.0 dBm	8.0 dBm	7.0 dBm	6.0 dBm	6.0 dBm	6.0 dBm
	Maximum	10.0 dBm	10.0 dBm	9.0 dBm	8.0 dBm	8.0 dBm	8.0 dBm
	*. The measured Tx output power (conducted) refers to section 6 in this report.						
Power rating	PA: DC3.3V / LNA: DC2.5V (*. There are supplied from the platform via constant voltage circuit..)						
Quantity of Antenna	1 piece	Antenna type	Pattern antenna		Antenna connector type		Not applicable (printed)
Antenna gain (peak)	1.7 dBi						

- *. 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
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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 / PC2352 (platform #2)		
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
SAR (1g) Limit [W/kg]	1.6		1.6
Reported SAR(1g) value	N/A		0.35 W/kg
Measured SAR value	N/A		0.267 W/kg
Mode, frequency [MHz]	-		802.11g, 6 Mbps (BPSK/OFDM), 2437 MHz (6ch)
Duty cycle [%] (scaled factor)	-		98.6 (×1.01)
Output burst average power [dBm] (max. power, scaled factor)	-		8.83 (max.10.0, ×1.31)

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 (Host/Platform) in which the distance to the exterior surface is shortest.
- *. The sample used by the SAR test is not more than 2 dB lower than the maximum tune-up tolerance limit. That is, measured power is included the tune-up tolerance range.
- *. 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 [-] = $1 / (10^{(\Delta_{\text{max}}(\text{max.power} - \text{burst average power, dB}) / 10)})$, Duty scaled factor [-] = $100(\%) / (\text{duty cycle, } \%)$

Test outline: Where this product is built into a new platform (2), 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 (2) 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 Test Location

No.7 shielded room (2.76 m (Width) × 3.76 m (Depth) × 2.4 m (Height)) for SAR testing.

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3.5 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.

Step.1 Data rate check (*, The EUT supported the following data rate in each operation mode.)

802.11b		802.11g		802.11a		802.11n(20HT) (1×SS)		Bluetooth		
Modulation	Data rate	Modulation	Data rate	Modulation	Data rate	MCS Index	Data rate	Modulation	Type	Packet type
DBPSK/DSSS	1	BPSK/OFDM	6	BPSK/OFDM	6	0	6.5	BPSK/OFDM	LE	LE (1Mbps)
DQPSK/DSSS	2	BPSK/OFDM	9	BPSK/OFDM	9	1	13	QPSK/OFDM		GFSSK/FHSS DH1 (1Mbps)
CCK/DSSS	5.5	QPSK/OFDM	12	QPSK/OFDM	12	2	19.5	QPSK/OFDM	BDR	GFSSK/FHSS DH3 (1Mbps)
CCK/DSSS	11	QPSK/OFDM	18	QPSK/OFDM	18	3	26	16QAM/OFDM		GFSSK/FHSS DH5 (1Mbps)
		16QAM/OFDM	24	16QAM/OFDM	24	4	39	16QAM/OFDM	EDR2	$\pi/4$ -DQPSK/FHSS 2DH1 (2Mbps)
		16QAM/OFDM	36	16QAM/OFDM	36	5	52	64QAM/OFDM		$\pi/4$ -DQPSK/FHSS 2DH3 (2Mbps)
		64QAM/OFDM	48	64QAM/OFDM	48	6	58.5	64QAM/OFDM		$\pi/4$ -DQPSK/FHSS 2DH5 (2Mbps)
		64QAM/OFDM	54	64QAM/OFDM	54	7	65	64QAM/OFDM	EDR3	8DPSK/FSSS 3DH1 (3Mbps)
										8DPSK/FSSS 3DH3 (3Mbps)
										8DPSK/FSSS 3DH5 (3Mbps)

SS: Spatial Stream

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.

3.6 Confirmation after SAR testing

It was checked that the power drift [W] is within $\pm 5\%$ 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] = $20\log(E_a)/(E_b)$ (where, Before SAR testing: $E_b[V/m]$ / After SAR testing: $E_a[V/m]$)
Limit of power drift[W] = $\pm 5\%$; Power drift limit (X) [dB] = $10\log(P_drift) = 10\log(1.05/1) = 10\log(1.05) - 10\log(1) = 0.21\text{dB}$
from E-filed relations with power; $S = E \times H = E^2/\eta = P/(4 \times \pi \times r^2)$ (η : Space impedance) $\rightarrow P = (E^2 \times 4 \times \pi \times r^2)/\eta$
Therefore, The correlation of power and the E-filed
Power drift limit (X) dB = $10\log(P_drift) = 10\log(E_drift)^2 = 20\log(E_drift)$
From the above mentioned, **the calculated power drift of DASY5 system must be the less than $\pm 0.21\text{dB}$.**

3.7 Test setup of EUT and SAR measurement procedure

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	D [mm]	SAR Tested /Reduced	SAR type	
Top	A top surface of a camera is touched to the Flat phantom.	3.4	Tested	3.4	Reduced	Body-touch	
Top-rear	A rear edge of top surface of a camera is touched to the Flat phantom.	6.42	Reduced	6.42	Reduced		
Rear	A rear of camera (LCD side) is touched to the Flat phantom.	8.45	Reduced	8.45	Reduced		
Top-front	A front edge of top surface of a camera is touched to the Flat phantom.	12.65	Reduced	12.65	Reduced		
Front	A front surface (lens) of a camera is touched to the Flat phantom.	24.7	Reduced	24.7	Reduced		
Left	A left surface of camera is touched to the Flat phantom.	36.0	Reduced	36.0	Reduced		
Bottom	A bottom surface of camera is touched to the Flat phantom.	60.4	Reduced	60.4	Reduced		
Right	A right surface of camera is touched to the Flat phantom.	74.1	Reduced	74.1	Reduced		
Rear	A rear of camera (LCD side) is touched to the Flat phantom.	8.45	Reduced	8.45	Reduced	front-of-face	

*. 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 (WM600): 20 mm (width) × 10 mm (height) × 2 mm (thickness)

*. Size of platform (digital camera): 110.1mm (width) × 63.8 mm (height) × 39.9 mm (depth) (This size is when the lens unit is retracted in the body. The convex portion is not contained in size.)

***. Consideration for SAR evaluation exemption**

SAR test exclusion considerations according to KDB447498 D01

The following is based on KDB447498D01.

- 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:

$$[(\text{max.power of channel, including tune-up tolerance, mW}) / (\text{min.test separation distance, mm})] \times [\sqrt{f} (\text{GHz})] \leq 3.0 \text{ (for SAR(1g)), 7.5 (for SAR(10g))} \quad \text{-- formula (1)}$$

If power is calculated from the upper formula (1);

$$[\text{SAR(1g) test exclusion thresholds, mW}] = 3 \times [\text{test separation distance, mm}] / [\sqrt{f} (\text{GHz})] \quad \text{..... formula (2)}$$

$$[\text{SAR(1g) test exclusion thresholds, mW}] = 3 \times 50 / \text{SQRT}(2.462) = 96\text{mW, where test separation distance} = 50\text{mm}$$
 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.
 5. "N/A" displayed on below exclusion calculation means not applicable this formula since distance between antenna and surface is > 50 mm.

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.

[SAR exclusion calculations for antenna ≤ 50 mm from the user.]

Antenna	Tx interface	Upper frequency [MHz]	Maximum output power		Calculated threshold value								
			[dBm]	[mW]	Setup	Top	Top-rear	Rear	Top-front	Front	Left	Bottom,	Right
					D[mm]	$\leq 5(3.4)$	6	8	13	25	36	60	74
Main	11b	2462	10.00	10	Judge	3.1, Measure	2.6, Reduce	2.0, Reduce	1.2, Reduce	0.6, Reduce	0.4, Reduce	N/A	N/A
Main	11g	2462	10.00	10	Judge	3.1, Measure	2.6, Reduce	2.0, Reduce	1.2, Reduce	0.6, Reduce	0.4, Reduce	N/A	N/A
Main	11n20	2462	9.00	8	Judge	2.5, Reduce	2.1, Reduce	1.6, Reduce	1.0, Reduce	0.5, Reduce	0.3, Reduce	N/A	N/A
Main	BDR	2480	8.00	6	Judge	1.9, Reduce	1.6, Reduce	1.2, Reduce	0.7, Reduce	0.4, Reduce	0.3, Reduce	N/A	N/A
Main	EDR	2480	8.00	6	Judge	1.9, Reduce	1.6, Reduce	1.2, Reduce	0.7, Reduce	0.4, Reduce	0.3, Reduce	N/A	N/A
Main	LE	2480	8.00	6	Judge	1.9, Reduce	1.6, Reduce	1.2, Reduce	0.7, Reduce	0.4, Reduce	0.3, Reduce	N/A	N/A

- 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.

$$[\text{test exclusion thresholds, mW}] = [(\text{Power allowed at numeric threshold for 50mm in formula (1)}) + [(\text{test separation distance, mm}) - (50\text{mm})] \times 10] \quad \text{formula (3)}$$
 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
 3. "N/A" displayed on below exclusion calculation means not applicable this formula since distance between antenna and surface is ≤ 50 mm.

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 antenna > 50 mm from the user.]

Antenna	Tx interface	Upper frequency [MHz]	Maximum output power		Calculated threshold value								
			[dBm]	[mW]	Setup	Top	Top-rear	Rear	Top-front	Front	Left	Bottom,	Right
					D[mm]	$\leq 5(3.4)$	6	8	13	25	36	60	74
Main	11b	2462	10.00	10	Judge	N/A	N/A	N/A	N/A	N/A	N/A	196mW, Reduce	336mW, Reduce
Main	11g	2462	10.00	10	Judge	N/A	N/A	N/A	N/A	N/A	N/A	196mW, Reduce	336mW, Reduce
Main	11n20	2462	9.00	8	Judge	N/A	N/A	N/A	N/A	N/A	N/A	196mW, Reduce	336mW, Reduce
Main	BDR	2480	8.00	6	Judge	N/A	N/A	N/A	N/A	N/A	N/A	195mW, Reduce	335mW, Reduce
Main	EDR	2480	8.00	6	Judge	N/A	N/A	N/A	N/A	N/A	N/A	195mW, Reduce	335mW, Reduce
Main	LE	2480	8.00	6	Judge	N/A	N/A	N/A	N/A	N/A	N/A	195mW, Reduce	335mW, Reduce

<Conclusion for consideration for SAR test reduction>

- 1) For Wi-Fi operation, the "Top" setup which is nearest an antenna is applied the SAR test in body-liquid.
The SAR test of other SAR setups ("Top-rear", "Rear", "Top-front", "Front", "Left", "Bottom" and "Right") are reduced because the SAR test exclusion judge value are smaller than "3."
- 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 (which tested by head liquid) wasn't considered, because this platform didn't have a view-finder port.
- 4) The test was conservatively performed with test 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. (. Change the channel, if it is necessary.)

*. Check the SAR of OFDM mode at worst reported SAR(1g) condition of 11b mode, 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/LE) continuous transmitting modes. The frequency and the modulation used in the SAR testing are shown as a following.

Operation mode		BDR	EDR		BLE	11b	11g	11n(20HT)
Tx frequency band		2402-2480MHz				2412-2462MHz		
Maximum power [dBm]		8.00	8.00	8.00	8.00	10.0	10.0	9.00
SAR tested condition	Frequency [MHz]	-	-	-	-	2412, 2437, 2462	2412, 2437, 2462	2437 (*1)
	Modulation	FHSS	FHSS	FHSS	FHSS	DSSS	OFDM	OFDM
	Data rate [Mbps]	1(DH5)	2(2DH5)	3(3DH5)	1	1	6	6.5(MCS0)
SAR tested/reduced?		Reduced	Reduced	Reduced	Reduced	Tested	Tested	Tested
Controlled software		WLAN/BT LE/ Bluetooth: Ver1.2.0 31(26) (for SAR test) This software was used for SAR measurement. For Wi-Fi operation, it set Tx parameters which includes; "channel", "BW(20MHz or 40MHz)", "Power(dBm)" and "data rate" via LCD of platform. For Bluetooth (BDR/EDR) operation, it set Tx parameters which includes; "hopping on/off" "channel", "Mode", "Data pattern (*, PRBS9 was used)" via LCD of platform.						
Power setting	Power measurement	fix	fix	fix	fix	default=8 (tunable)	default=8 (tunable)	default=7 (tunable)
	SAR	N/A	N/A	N/A	N/A	8	8	7

*. N/A: not applied.

*. Any output power reducing for channel 1 and 11 to meet restricted band requirements was not observed. Therefore channel 1 and 11 was tested.

*. (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.

*1. This channel has a highest reported SAR(1g) in DSSS mode.

SECTION 5: Uncertainty Assessment (SAR measurement)

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 (ε,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 Uncertaintyv (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 < 1.5 W/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

*. Antenna gain (peak): 1.7 dBi (2.4 GHz band)

Mode	Frequency		Data rate	Power Setting (software)	Duty cycle	Duty factor	Duty scaled factor	Measurement Result				Power correction			Power Tune-up?	Remarks
	[MHz]	CH						Time average power		Burst power		Max. power	Δ from max.	Tune-up factor		
			[Mbps]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[dBm]	[dB]	[dB]		
BDR	2402	0	1(DH5)	fix	79.0	1.02	×1.26	5.92	3.91	6.94	4.94	8.0	-1.06	×1.28	n/a (fix)	(*)1
	2441	39	1(DH5)	fix	79.0	1.02	×1.26	6.34	4.31	7.36	5.45	8.0	-0.64	×1.16	n/a (fix)	(*)1
	2480	78	1(DH5)	fix	79.0	1.02	×1.26	6.49	4.46	7.51	5.64	8.0	-0.49	×1.12	n/a (fix)	(*)1
EDR	2402	0	2(2-DH5)	fix	79.0	1.02	×1.26	6.43	4.40	7.45	5.56	8.0	-0.55	×1.14	n/a (fix)	(*)1
	2441	39	2(2-DH5)	fix	79.0	1.02	×1.26	6.48	4.45	7.50	5.62	8.0	-0.50	×1.12	n/a (fix)	(*)1
	2480	78	2(2-DH5)	fix	79.0	1.02	×1.26	6.49	4.46	7.51	5.64	8.0	-0.49	×1.12	n/a (fix)	(*)1
EDR	2402	0	3(3-DH5)	fix	78.7	1.04	×1.27	6.44	4.41	7.48	5.60	8.0	-0.52	×1.13	n/a (fix)	(*)1
	2441	39	3(3-DH5)	fix	78.7	1.04	×1.27	6.53	4.50	7.57	5.71	8.0	-0.43	×1.10	n/a (fix)	(*)1
	2480	78	3(3-DH5)	fix	78.7	1.04	×1.27	6.52	4.49	7.56	5.70	8.0	-0.44	×1.11	n/a (fix)	(*)1
LE	2402	0	1	fix	66.1	1.80	×1.51	4.90	3.09	6.70	4.68	8.0	-1.30	×1.35	n/a (fix)	(*)1
	2440	19	1	fix	66.1	1.80	×1.51	4.87	3.07	6.67	4.65	8.0	-1.33	×1.36	n/a (fix)	(*)1
	2480	39	1	fix	66.1	1.80	×1.51	5.19	3.30	6.99	5.00	8.0	-1.01	×1.26	n/a (fix)	(*)1
11b	2412	1	1	8	99.8	0.01	×1.00	8.42	6.95	8.43	6.97	10.0	-1.57	×1.44	n/a (default)	
	2437	6	1	8	99.8	0.01	×1.00	8.09	6.44	8.10	6.46	10.0	-1.90	×1.55	n/a (default)	
	2462	11	1	8	99.8	0.01	×1.00	8.14	6.52	8.15	6.53	10.0	-1.85	×1.53	n/a (default)	
11g	2412	1	6	8	98.6	0.06	×1.01	9.07	8.07	9.13	8.18	10.0	-0.87	×1.22	n/a (default)	
	2437	6	6	8	98.6	0.06	×1.01	8.77	7.53	8.83	7.64	10.0	-1.17	×1.31	n/a (default)	
	2462	11	6	8	98.6	0.06	×1.01	8.68	7.38	8.74	7.48	10.0	-1.26	×1.34	n/a (default)	
11n (20HT)	2412	1	MCS0	7	98.8	0.05	×1.01	7.49	5.61	7.54	5.68	9.0	-1.46	×1.40	n/a (default)	
	2437	6	MCS0	7	98.8	0.05	×1.01	7.69	5.87	7.74	5.94	9.0	-1.26	×1.34	n/a (default)	
	2462	11	MCS0	7	98.8	0.05	×1.01	7.60	5.75	7.65	5.82	9.0	-1.35	×1.36	n/a (default)	

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

*. For Wi-Fi mode, the lowest data rate (lowest modulation) mode was selected.

*1. The measured duty cycle number of BDR/EDR/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 factor (dBm) = $10 \times \log(100/(\text{duty cycle, \%}))$
Δ from 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: (-)) = $100(\%) / (\text{duty cycle, \%})$
Tune-up factor (Power tune-up factor for obtained SAR value) (unit: (-)) = $1 / (10^{(\text{"Deviation from max., dB"} / 10)})$

*. Date measured: April 26, 2017. The original power measurement data refers the test report as 11706542H-A published by UL Japan, Inc.

6.2 Comparison of power of EMC sample

	WM600's platform		WM600 Serial number	Date power measured	Reference report#	Burst average power [dBm] ^(***) : Highest								
	No.	Model				Max.	Typ	Power setting	Mode b(1Mbps)			Mode g(6Mbps)		
									Frequency [MHz]			Frequency [MHz]		
									2412	2437	2462	2412	2437	2462
EMC (Ref.)	-	-	05	April, 2017	11706542H-A	10.0	8	8	8.43*	8.10	8.15	9.13*	8.83	8.74
SAR test	1	PC2328	05 (same as above)	April, 2017	11759357H-A	10.0	8	8	8.43*	8.10	8.15	9.13*	8.83	8.74
SAR test	2	PC2352	05 (same as above)	April, 2017	This report	10.0	8	8	8.43*	8.10	8.15	9.13*	8.83	8.74

*. b: IEEE 802.11b, g: IEEE 802.11g, n20: IEEE 802.11n(20HT); Max.: Maximum power; Typ: Typical power; n/a: not applicable.

SECTION 7: SAR Measurement results

Measurement date: October 10, 2017

Measurement by: Hiroshi Naka

[Liquid measurement]

Target Frequency [MHz]	Liquid type	Liquid parameters (*a)								ASAR Coefficients(*c)		Date measured		
		Permittivity (εr) [-]				Conductivity [S/m]				Temp. [deg.C.]	Depth [mm]		ΔSAR (1g) [%]	Correction required?
		Target	Measured		Limit (*b)	Target	Measured		Limit (*b)					
			Meas.	Δεr [%]			Meas.	Δσ [%]						
2412	Body	52.75	50.78	-3.7	-5% ≤	1.914	1.949	+1.9	0% ≤	22.2	152	+1.75	not required.	October 10, 2017, before SAR test
2437		52.72	50.64	-3.9	εr-meas.	1.938	1.975	+1.9	σ-meas.			+1.83	not required.	
2462		52.68	50.60	-4.0	≤ 0%	1.967	2.012	+2.3	≤ +5%			+1.98	not required.	

[SAR measurement results]

SAR measurement results										Reported SAR (1g) [W/kg]							Remarks
Mode	Frequency [MHz] (Channel)	Data rate [Mbps]	EUT setup				SAR (1g) [W/kg]			SAR plot # in Appendix 2-2	Duty cycle correction		Output burst average power correction			SAR Corrected (*d)	
			Position	Gap [mm]	Battery ID	LCD position	Max.value of multi-peak				Duty [%]	Duty scaled	Meas. [dBm]	Max. [dBm]	Tune-up factor		
							Meas.	ASAR [%]	ASAR corrected								
11b	2412(1)	1	Top	0	#1	Close	0.202	+1.75	n/a (*c)	Plot 2	99.8	×1.00	8.43	10.0	×1.44	0.291	-
	2437(6)			0	#1	Close	0.220	+1.83	n/a (*c)	Plot 3	99.8	×1.00	8.10	10.0	×1.55	0.341	-
	2462(11)			0	#1	Close	0.210	+1.98	n/a (*c)	Plot 4	99.8	×1.00	8.15	10.0	×1.53	0.321	-
	2437(6)			0	#2	Op90	0.217	+1.98	n/a (*c)	Plot 5	99.8	×1.00	8.10	10.0	×1.55	0.336	*. LCD open.
11g	2437(6)	6	Top	0	#1	Close	0.267	+1.83	n/a (*c)	Plot 1	98.6	×1.01	8.83	10.0	×1.31	0.353	Higher.
	2412(1)			0	#2	Close	0.244	+1.75	n/a (*c)	Plot 6	98.6	×1.01	9.13	10.0	×1.22	0.301	-
	2462(11)			0	#3	Close	0.248	+1.98	n/a (*c)	Plot 7	98.6	×1.01	8.74	10.0	×1.34	0.336	-
11n(20HT)	2437(6)	MCS0	Top	0	#1	Close	0.207	+1.83	n/a (*c)	Plot 8	98.8	×1.01	7.74	9.0	×1.34	0.280	-

Notes:

- *. Gap: It is the separation distance between the nearest position of platform outer surface and the bottom outer surface of phantom; Battery ID: Battery ID No.#1 and #2 are same. Refer to Appendix 1 for more detail.; Max.: maximum, Meas.: Measured; n/a: not applied.
- *. LCD position; Op90: Open with 90 degrees. Refer to Appendix 1 for more detail.
- *. 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	7.38	±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: $ASAR(1g) = C_{\sigma} \times \Delta \epsilon_r + C_{\sigma} \times \Delta \sigma$, $C_{\sigma} = 7.854E-4 \times f^3 + 9.402E-3 \times f^2 - 2.742E-2 \times f + 0.2026$, $C_{\sigma} = 9.804E-3 \times f^3 - 8.661E-2 \times f^2 + 2.981E-2 \times f + 0.7829$
 $ASAR \text{ corrected SAR (1g) (W/kg)} = (\text{Meas. SAR (1g) (W/kg)}) \times (100 - (\Delta \text{ASAR}(\%) / 100)$
- *d. Calculating formula: $\text{Reported SAR (1g) (W/kg)} = (\text{Measured SAR (1g) (W/kg)}) \times (\text{Duty scaled}) \times (\text{Tune-up factor})$
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 (section 3.1) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

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.

Notes:

- *. 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 [-]		DSSS highest reported SAR(1g) value	Estimated SAR(1g) value: OFDM [W/kg]	Exclusion limit [W/kg]	Standalone SAR test require for OFDM mode?	Actual SAR (1g) value [W/kg]	
	DSSS [dBm]	OFDM [mW] (a)							Measured	Reported
11g	10.0	10.00	10.0	10.00	1.000	Top 0.341	≤ 1.2	No	0.267	0.353
n(HT20)	10.0	10.00	9.0	7.94	0.794	Top 0.341	≤ 1.2	No	0.207	0.280