SAR TEST REPORT

Test Report No.: 10847263S-A

Applicant : **Canon Inc.**

Type of Equipment : **Wireless Module**

Model No. : **WM234** (*. Installed into the limited platform)

FCC ID : **AZD234**

Test Standard : **FCC 47CFR §2.1093**

Test Result : **Complied**

Highest Reported SAR(1g) Value	Platform type	Platform model	Remarks
1.35 W/kg (Measured: 0.941 W/kg)	Digital camera	PC2286	(DTS) 2462MHz, IEEE 802.11b (1Mbps, DBPSK/DSSS) (output power: 12.44 dBm).

*. **Highest reported SAR (1g) across this platform and exposure conditions (body-touch) = "1.35 W/kg" = grant listing.**
*. Since highest reported SAR (1g) on a platform for WM234 (EUT) which obtained in accordance with KDB447498 (v05) was > 1.2 W/kg, this EUT is limited to operate internally within the dedicated host configurations tested for compliance.

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Date of test: August17, 2015

Test engineer: H. Naka

Hiroshi Naka
Engineer, Consumer Technology Division

Approved by: T. Imamura

Toyokazu Imamura
Leader, Consumer Technology Division

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☒ There is no testing item of "Non-accreditation".

ilac-MRA LAB JAB Testing RTL02610

REVISION HISTORY

Revision	Test report No.	Date	Page revised	Contents
Original	10847263S-A	August 21, 2015	-	-

*. 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.
Brand Name	Canon
Address	30-2, Shimomaruko 3-chome, Ohta-ku, Tokyo 146-8501 Japan
Telephone Number	+81-3-5482-8070
Facsimile Number	+81-3-3757-8431
Contact Person	Hironobu Saida

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

	EUT	Platform
Type of Equipment	Wireless Module	Digital camera
Model Number	WM234	PC2286
Serial Number	60128BD8FD1C	78
Condition of EUT	Engineering prototype	Engineering prototype
	(*. Not for sale: These samples are equivalent to mass-produced items.)	
Receipt Date of Sample	June 13, 2015 (*. EUT for power measurement.) *. No modification by the Lab. August 1, 2015 (*. EUT for SAR test.) *. No modification by the Lab. (*. The EUT that had been measured the power of SAR test reference, was installed into the platform-digital camera (model: PC2286) from the beginning. 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 for SAR test. The EUT was installed into a platform which SAR tested, by the customer.)	
Country of Mass-production	Philippines	China
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 and DC1.8V supplied form the platform *. The EUT is installed into the specified the platform that was operated by the re-chargeable Li-ion battery. Therefore, each SAR test, the platform which had built-in EUT was operated with full-charged battery.	
Feature of EUT	The EUT is a Wireless Module which installs into the specified platform: digital camera.	
SAR Accessory	None	

2.2 Product Description (Wireless module: WM234)

Equipment type	Transceiver		
Frequency of operation	2412-2462MHz (11b, 11g,, 11n(20HT))		
Channel spacing	5MHz		
Bandwidth	20MHz		
Type of modulation	DSSS(11b): CCK, DQPSK, DBPSK OFDM(11g, 11n(20HT): 64QAM, 16QAM, QPSK, BPSK		
Q'ty of Antenna	1 pc.		
Antenna type	Monopole type chip antenna (Parts No.: AMD0302-ST01T, Manufacture: Mitsubishi Material Corp.)		
Antenna gain (peak)	-3.10dBi (2442MHz)		
Transmit power and tolerance (Manufacture variation)	11b: 12dBm +2dB/-2.5dB	11g: 12dB m +2dB/-2.5dB	11n(20HT): 12dBm +2dB/-2.5dB
	*. Refer to clause 2.3 for more detail.		
	*. The measured Tx output power (conducted) refers to section 6 in this report.		
Maximum output power which may possible	11b: 14dBm	11g: 14dBm	11n(20HT): 14dBm
	*. Refer to clause 2.4 for more detail.		
Power supply	DC 3.3V, DC1.8V (*. The power of DC3.3V and DC1.8V are supplied from the platform via constant voltage circuit.)		
Operation temperature range	-20 to +85 deg.C.		

*. The EUT do not use the special transmitting technique such as "beam-forming" and "time-space code diversity."

2.3 Tx output power specification (antenna port terminal conducted)

		Typical power [dBm] (average)																											
		11b				11g								11n(20HT)															
[MHz]	CH	1	2	5.5	11	6	9	12	18	24	36	48	54	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
2412	1	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2417	2	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2422	3	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2427	4	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2432	5	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2437	6	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2442	7	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2447	8	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2452	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2457	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
2462	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-

2.4. Maximum output power which may possible

		Maximum output power [dBm] (average)																											
		11b				11g								11n(20HT)															
[MHz]	CH	1	2	5.5	11	6	9	12	18	24	36	48	54	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
2412	1	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2417	2	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2422	3	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2427	4	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2432	5	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2437	6	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2442	7	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2447	8	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2452	9	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2457	10	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-
2462	11	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	-	-	-	-	-	-	-	-

SECTION 3: Test specification, procedures and results

3.1 Test specification

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 (v05r02): General RF exposure guidance
KDB 248227 D01 (v02r01): SAR Guidance for IEEE 802.11 (Wi-Fi) transmitters
KDB 865664 D01 (v01r03): SAR measurement 100MHz to 6GHz
IEEE Std. 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
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.
(*. The reference for Uncertainty in SAR correction for deviations in permittivity and conductivity, in clause E.3.2.)

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

	Wi-Fi (DTS) / in Platform: digital camera
Test Procedure	SAR measurement; KDB 447498, KDB 248227, KDB 865664, IEEE Std.1528
Category	FCC 47CFR §2.1093 (Portable device)
Results (SAR(1g))	**Complied**
Reported SAR value (*. Scaled)	**1.35 W/kg**
Measured SAR value	0.941 W/kg
Operation mode, channel	11b, 1Mbps, 2462MHz (11ch)
Power measured/max. (scaled factor)	12.44 dBm/14dBm (×1.43)

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

Test outline: Where this product is built into a new platform, it was verified whether multiplatform conditions can be suited in according with section 2) of 5.2.2 2 in KDB447498 D01 (v05).

Consideration of the test results: Since highest reported SAR (1g) on a platform for WM234 (EUT) which obtained in accordance with KDB447498 (v05) was > 1.2 W/kg, this EUT is limited to operate internally within the dedicated host configurations tested for compliance (PC2286).

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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Telephone number: +81 463 50 6400 / Facsimile number: +81 463 50 6401

3.5 Confirmation before SAR testing

3.5.1 Average power for SAR tests

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 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(v05))

Step.1 Check the power by data rate and operation channel

The data rate check was measured for all modes in one of default channel. For the SAR test reference, the average output power was measured on the low/middle/high channels with the worst data rate condition in.

11b		11g		11n(20HT)		
Modulation	Data rate [Mbps]	Modulation	Data rate [Mbps]	MCS Index	Spatial Stream	Modulation
DBPSK/DSSS	1	BPSK/OFDM	6	MCS0	1	BPSK/OFDM
DQPSK/DSSS	2	BPSK/OFDM	9	MCS1	1	QPSK/OFDM
CCK/DSSS	5.5	QPSK/OFDM	12	MCS2	1	QPSK/OFDM
CCK/DSSS	11	QPSK/OFDM	18	MCS3	1	16QAM/OFDM
		16QAM/OFDM	24	MCS4	1	16QAM/OFDM
		16QAM/OFDM	36	MCS5	1	64QAM/OFDM
		64QAM/OFDM	48	MCS6	1	64QAM/OFDM
		64QAM/OFDM	54	MCS7	1	64QAM/OFDM

Step.2 Consideration of SAR test channel

For the SAR test reference, the average output power was measured on the low/middle/high 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 ±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.**

3.7 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.)	D [mm]	SAR Tested /Reduced (*1)	SAR type
Top	When test is required, near the antenna on the top surface of a digital camera is touched to the Flat phantom.	**3.85**	**Tested**	Body-touch
Top-front	When test is required, the front portion of top surface of a digital camera is touched to the Flat phantom with tilted.	**6.7**	**Tested**	
Top-rear	When test is required, the rear portion of top surface of a digital camera is touched to the Flat phantom with tilted.	**8.2**	**Tested**	
Front (Lens)	When test is required, the front side (Lens) of a digital camera is touched to the Flat phantom.	**10.8**	**Tested**	
Rear (LCD)	When test is required, the rear side (LCD) of digital camera is touched to the Flat phantom.	**12.1**	**Tested**	
Left	When test is required, the left-hand grip surface of a digital camera is touched to the Flat phantom.	**33.2**	**Tested**	
Bottom	When test is required, the bottom flat surface of digital camera is touched to the Flat phantom.	**52.95**	**Tested**	
Right	When test is required, the right-hand grip surface of digital camera is touched to the Flat phantom.	**60.3**	**Tested**	

*. **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 EUT (WM234): 22.5 mm (width) × 11.5 mm (depth) × 2.05 mm max (thickness)
*. Size of platform: 95.3 mm (width) × 56.8 mm (height) × 23.6 mm (depth) (This size is when the lens is in closed position. The convex portion is not contained in size.)

***1. KDB 447498 D01 (v05) was taken into consideration to reduce SAR test.**

Consideration of SAR test reduction by the antenna separation distance (100MHz~6GHz, ≤50mm)											
Band, Mode	Position	Minimum distance		Upper frequency	Maximum tune-up power			Calculation of exclusion: ≤ 3.0 (*2)	Standalone SAR test Required?		Remarks
		[mm]	[mm] (rounded)	[GHz]	[dBm]	[mW]	[mW] (rounded)				
WLAN2.4GHz	Top	3.85	≤ 5	2.462	14.00	25.12	25	7.8	>3.0	Tested	-
	Top-front	6.7	7	2.462	14.00	25.12	25	5.6	>3.0	Tested	-
	Top-rear	8.2	8	2.462	14.00	25.12	25	4.9	>3.0	Tested	-
	Front (Lens)	10.8	11	2.462	14.00	25.12	25	3.6	>3.0	Tested	-
	Rear (LCD)	12.1	12	2.462	14.00	25.12	25	3.3	>3.0	Tested	
	Left	33.2	33	2.462	14.00	25.12	25	1.2	<3.0	Reduced	*.SAR test was applied. (*4)

Consideration of SAR test reduction by the antenna separation distance (100MHz~6GHz, >50mm)										
Band, Mode	Position	Minimum distance		Upper frequency	Maximum tune-up power			Calculation of test exclusion thresholds [mW] (*3)	Standalone SAR test	Remarks
		[mm]	[mm] (rounded)	[GHz]	[dBm]	[mW]	[mW] (rounded)			
WLAN2.4GHz	Bottom	52.95	53	2.462	14.00	25.12	25	125.6	Reduced	*.SAR test was applied. (*4)
	Right	60.3	60	2.462	14.00	25.12	25	195.6	Reduced	*.SAR test was applied. (*4)

*2. Parenthesis 1), Clause 4.3.1, KDB 447498 D01 (v05r01) gives the following formula to calculate the SAR(1g) test exclusion thresholds for 100MHz-6GHz at test separation distance ≤50mm.
[(max.power of channel, including tune-up tolerance, mW) / (min.test separation distance, mm)] × [√f (GHz)] ≤ 3.0 (for SAR(1g)) ····· 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)
[SAR(1g) test exclusion thresholds, mW] = 3 × 50 / SQRT(2.462) = 96mW, where test separation distance=50mm
*3. Parenthesis 2), Clause 4.3.1, KDB 447498 D01 (v05r01) gives the following formula to calculate the SAR(1g) test exclusion thresholds for 1.5-6GHz at test separation distance >50mm.
[test exclusion thresholds, mW] = [(Power allowed at numeric threshold for 50mm in formula (1))] + [(test separation distance, mm) - (50mm)] × 10 formula (3)
*4. Even if a SAR test was judged exclusion by SAR threshold power, all setup conditions are considered body-touch SAR and are applied the SAR test in body-liquid, because the platform is small size of a compact digital camera.

<Conclusion for consideration for SAR test reduction>

1) Even if a SAR test was judged exclusion by SAR threshold power, all setup conditions which includes Top, Top-front, Top-rear, Front(Lens), Rear(LCD), Left, Bottom and Right of a platform are considered body-touch SAR and are applied the SAR test in body-liquid, because the platform is small size of a compact digital camera.

2) Since a platform of digital camera does not have a view finder, the SAR test of head liquid (front of face setup) was reduced.

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

Step 1	Worst SAR search of OFDM mode Searching "Initial test position" of OFDM mode. Determine the highest reported SAR(1g) of OFDM mode. (*. Change the channel, if it is necessary.)
Step 2	Worst SAR search of DSSS mode Determine the highest reported SAR(1g) of DSSS mode by using "Initial test position.". (*. Change the channel, if it is necessary.)
Step 3	Check SAR Measurement Variability, when if the measured SAR(1g) was ≥ 0.80 W/kg.

*. 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) continuous transmitting modes.
The frequency and the modulation used in the SAR testing are shown as a following.

Operation mode		11b	11g	11n(20HT)
Tx frequency band		2412-2462MHz		
SAR tested/reduced?		Tested	Tested	Tested
Tested condition	Frequency	2412, 2437, 2462 MHz	2412, 2437, 2462 MHz	2412, 2437, 2462 MHz
	Modulation	DBPSK/DSSS	BPSK/OFDM	BPSK/OFDM
	Data rate	1 Mbps	6 Mbps	MCS0
Controlled software		"RF TEST" mode.		
Power setting (power measurement)		default: 12	default: 12 Tune-up: 13	default: 12 Tune-up: 13
Power setting (SAR)		default: 12	Tune-up: 13	Tune-up: 13

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 (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 SAR Measurement 100 MHz to 6 GHz v01r01 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	Freq.	Data rate	Power Setting	Duty cycle	Duty factor	Duty scaled factor	Average power			PAR	Power tolerance & correction			SAR Tested/ Reduced	Remarks (WM234 Serial number: 60128BD**8FD1C**)	Power Tune-up?
							Result		ΔRef.		Target & (+)tolerance	Deviation from max	Tune-up factor			
	[MHz]	[Mbps]	[dBm]	[%]	[dB]	[-]	[dBm]	[mW]	[dB]	[dB]	[dBm]	(-2≤x<0)[dB]	[-]			
11b	2412	**1**	12	100	0.00	×1.00	12.24	16.7	-0.30	2.61	12.0 +2	-1.76	x1.50	**Tested**	-	default
	2437	**1**	12	100	0.00	×1.00	**12.54**	17.9	Ref.b12	2.62	12.0 +2	-1.46	x1.40	**Tested**	Higher pwr-D/R&ch.(11b)	default
	2437	2	12	100	0.00	×1.00	12.53	17.9	-0.01	2.64	12.0 +2	-1.47	x1.40	-	-	default
	2437	5.5	12	100	0.00	×1.00	12.54	17.9	0.00	2.00	12.0 +2	-1.46	x1.40	-	-	default
	2437	11	12	100	0.00	×1.00	12.50	17.8	-0.04	2.59	12.0 +2	-1.50	x1.41	-	-	default
	2462	**1**	12	100	0.00	×1.00	12.44	17.5	-0.10	2.63	12.0 +2	-1.56	x1.43	**Tested**	-	default
11g	2412	**6**	12	100	0.00	×1.00	11.82	15.2	-0.27	9.38	12.0 +2	-2.18	x1.65	-	-	default
	2437	**6**	12	100	0.00	×1.00	12.09	16.2	Ref.g12	9.34	12.0 +2	-1.91	x1.55	-	Higher pwr-D/R.(11g)	default
	2437	9	12	100	0.00	×1.00	12.03	16.0	-0.06	9.12	12.0 +2	-1.97	x1.57	-	-	default
	2437	12	12	100	0.00	×1.00	12.03	16.0	-0.06	9.45	12.0 +2	-1.97	x1.57	-	-	default
	2437	18	12	100	0.00	×1.00	12.05	16.0	-0.04	8.62	12.0 +2	-1.95	x1.57	-	-	default
	2437	24	12	100	0.00	×1.00	12.01	15.9	-0.08	9.68	12.0 +2	-1.99	x1.58	-	-	default
	2437	36	12	100	0.00	×1.00	11.96	15.7	-0.13	9.54	12.0 +2	-2.04	x1.60	-	-	default
	2437	48	12	100	0.00	×1.00	11.99	15.8	-0.10	10.23	12.0 +2	-2.01	x1.59	-	-	default
	2437	56	12	100	0.00	×1.00	11.96	15.7	-0.13	8.62	12.0 +2	-2.04	x1.60	-	-	default
	2462	**6**	12	100	0.00	×1.00	11.99	15.8	-0.10	9.36	12.0 +2	-2.01	x1.59	-	-	default
	2412	**6**	13	100	0.00	×1.00	12.71	18.7	-0.26	9.71	12.0 +2	-1.29	x1.35	**Tested**	-	tune-up
	2437	**6**	13	100	0.00	×1.00	**12.97**	19.8	Ref.g13	9.09	12.0 +2	-1.03	x1.27	**Tested**	Higher pwr-ch.(11g)	tune-up
	2462	**6**	13	100	0.00	×1.00	12.87	19.4	-0.10	9.12	12.0 +2	-1.13	x1.30	**Tested**	-	tune-up
11n (20HT)	2412	**MCS0**	12	100	0.00	×1.00	11.85	15.3	-0.31	9.10	12.0 +2	-2.15	x1.64	-	-	default
	2437	**MCS0**	12	100	0.00	×1.00	12.16	16.4	Ref.2n12	9.04	12.0 +2	-1.84	x1.53	-	Higher pwr-D/R.(n20)	default
	2437	MCS1	12	100	0.00	×1.00	12.11	16.3	-0.05	9.01	12.0 +2	-1.89	x1.55	-	-	default
	2437	MCS2	12	100	0.00	×1.00	12.08	16.1	-0.08	9.71	12.0 +2	-1.92	x1.56	-	-	default
	2437	MCS3	12	100	0.00	×1.00	12.06	16.1	-0.10	9.21	12.0 +2	-1.94	x1.56	-	-	default
	2437	MCS4	12	100	0.00	×1.00	12.06	16.1	-0.10	8.82	12.0 +2	-1.94	x1.56	-	-	default
	2437	MCS5	12	100	0.00	×1.00	11.99	15.8	-0.17	9.93	12.0 +2	-2.01	x1.59	-	-	default
	2437	MCS6	12	100	0.00	×1.00	11.99	15.8	-0.17	10.79	12.0 +2	-2.01	x1.59	-	-	default
	2437	MCS7	12	100	0.00	×1.00	12.09	16.2	-0.07	9.88	12.0 +2	-1.91	x1.55	-	-	default
	2462	**MCS0**	12	100	0.00	×1.00	11.97	15.7	-0.19	9.08	12.0 +2	-2.03	x1.60	-	-	default
	2412	**MCS0**	13	100	0.00	×1.00	12.70	18.6	-0.32	9.14	12.0 +2	-1.30	x1.35	**Tested**	-	tune-up
	2437	**MCS0**	13	100	0.00	×1.00	**13.02**	20.0	Ref.2n13	9.08	12.0 +2	-0.98	x1.25	**Tested**	Higher pwr-ch.(n20)	tune-up
	2462	**MCS0**	13	100	0.00	×1.00	12.91	19.5	-0.11	8.91	12.0 +2	-1.09	x1.29	**Tested**	-	tune-up

*. : SAR test was applied.

*. Freq.: Frequency, PAR: Peak average ratio ("Peak power"-"Average power", in dBm), Ch: channel, D/R: Data Rate, pwr: power, Ref: Reference.
*. Calculating formula: Average power-result: Results (dBm) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)+(duty factor, dB)
Duty factor: (duty factor, dBm) = 10 × log (100/(duty cycle, %))
Deviation form max.: (Power deviation, dB) = (results power (average, dBm)) - (Max.-specification output power (average, dBm))
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))
*. Date measured: July 7, 2015 / Measured by: Hiroshi Naka / Place: preparation room of No. 7 shielded room. (25 deg.C. / 55 %RH)
*. Uncertainty of antenna port conducted test; Power measurement uncertainty above 1GHz for this test was: (±) 1.5dB

6.2 Comparison of power of EMC sample

	Platform#	Platform model No.	RF serial No.	Date power measured	Reference report#	Tx mode	Data rate	Average power [dBm] ("*": Highest)			
								Power setting	Frequency [MHz]		
							[Mbps]		2412	2437	2462
EMC (Ref.)	-	-	F48139F1C455	Aug. 19, 2014	10407961S-J	11b	5.5	default	13.03	**13.37***	13.28
						11g	18	default	12.05	12.40	12.71
SAR test	(Limited)	PC2286	60128BD8FD1C	July 7, 2015	10847263S-A (This report)	11b	1	default	12.24	**12.54***	12.44
						11g	6	default	11.82	12.09	11.99

SECTION 7: SAR Measurement results

Measurement date: August 17, 2015 Measurement by: Hiroshi Naka

[Liquid measurement]

Target Frequency [MHz]	Liquid type	Liquid parameters (*a)								Temp. [deg.C.]	Depth [mm]	ΔSAR Coefficients(*c)		Date measured
		Permittivity (εr) [-]				Conductivity [S/m]								
		Target	Measured		Limit (*b)	Target	Measured		Limit (*b)			ΔSAR (1g) [%]	Correction required?	
			Meas.	Δεr [%]			Meas.	Δσ [%]						
2412	Body	52.75	50.98	-3.4	-5% ≤ εr-meas. ≤ 0%	1.914	1.921	+0.4	0% ≤ σ-meas. ≤ +5%	22.5	152	+0.94	not required.	August 17, 2015 before SAR test
2437		52.72	50.86	-3.5		1.938	1.953	+0.8				+1.17	not required.	
2462		52.68	50.76	-3.7		1.967	1.990	+1.2				+1.39	not required.	

[Searching initial test position (OFDM)]

Mode	Freq. [MHz]	Data rate	EUT setup					Liq. temp. [deg.C.]	SAR [W/kg] (max.value of multi-peak)			Remarks
			Position	LCD (*1)	Antenna Distance [mm]	Gap [mm]	Bty. ID		A/S max. (measured) (as pos..#1)	A/S max. (interpolated) (as pos..#2)	Peak (extrapolated) (at pos.#2)	
11g (*2)	2462	6Mbps /OFDM	Top	fix	3.85	0	#1	22.5±0.2	1.19	1.77	**2.50**	***. Initial test position.**
			Top-front	fix	6.7	0	#4	22.5±0.2	0.499	0.798	1.73	2nd
			Top-rear	fix	8.2	0	#4	22.5±0.2	0.729	0.757	1.06	3rd
			Rear	fix	12.1	0	#1	22.5±0.2	0.150	0.157	0.232	4th
			Front	fix	10.8	0	#1	22.5±0.2	0.0852	0.103	0.133	5th
			Right	fix	60.3	0	#2	22.5±0.2	0.0336	0.0565	0.0493	-
			Left	fix	33.2	0	#2	22.5±0.2	0.0151	0.0200	0.0157	-
			Bottom	fix	52.95	0	#2	22.5±0.2	0.0316	0.0384	0.0418	-

[SAR measurement results]

Mode	Freq. [MHz]	Data rate	EUT setup			Liq. temp. [deg.C.]	Power drift [dB]	SAR (1g) [W/kg] Max.value of multi-peak			SAR plot # in Appendix 2-2	Reported SAR (1g) [W/kg]						Remarks
			Position	Gap [mm]	Bty. ID	Before /After		Meas.	ΔSAR [%]	ΔSAR corrected		Conducted power [dBm] Ave.	Conducted power [dBm] Max.	Scaled factor	Tuned-up SAR (*d)	Duty scaled factor [-]	SAR duty corrected	
Step 1: Worst SAR search of OFDM mode.																		
11g	2437	6Mbps /OFDM	Top	0	#1	22.6/22.6	-0.12	**0.975**	+1.17	n/a (*c)	Plot 1-1	12.97	14.0	×1.27	**1.24**	×1.00	n/a (*e)	Initial test pos.
	2412			0	#1	22.6/22.6	-0.11	**0.826**	+0.94	n/a (*c)	Plot 1-2	12.71	14.0	×1.35	**1.12**	×1.00	n/a (*e)	-
	2462			0	#1	22.6/22.6	0	**0.965**	+1.39	n/a (*c)	Plot 1-3	12.87	14.0	×1.30	**1.25**	×1.00	n/a (*e)	-
	2437		Top-front	0	#4	22.5/22.5	-0.05	**0.580**	+1.17	n/a (*c)	Plot 1-4	12.97	14.0	×1.27	**0.74**	×1.00	n/a (*e)	-
			Top-rear	0	#4	22.5/22.4	-0.02	**0.452**	+1.17	n/a (*c)	Plot 1-5	12.97	14.0	×1.27	**0.57**	×1.00	n/a (*e)	-
			Rear	0	#1	22.4/22.4	0	**0.100**	+1.17	n/a (*c)	Plot 1-6	12.97	14.0	×1.27	**0.13**	×1.00	n/a (*e)	-
			Front	0	#1	22.4/22.4	-0.11	**0.064**	+1.17	n/a (*c)	Plot 1-7	12.97	14.0	×1.27	**0.08**	×1.00	n/a (*e)	-
			Right	0	#2	22.4/22.4	-	**n/a**	*. Since measured interpolated maximum value of area scan was small enough, zoom scan was not performed.						**-**	×1.00	n/a (*e)	-
			Left	0	#2	22.4/22.4	-	**n/a**							**-**	×1.00	n/a (*e)	-
			Bottom	0	#2	22.5/22.5	-	**n/a**							**-**	×1.00	n/a (*e)	-
11n (20HT)	2437	MCS0 /OFDM	Top	0	#2	22.6/22.6	0	**0.983**	+1.17	n/a (*c)	Plot 1-8	13.02	14.0	×1.25	**1.23**	×1.00	n/a (*e)	Initial test pos.
	2412			0	#2	22.6/22.6	0.03	**0.849**	+0.94	n/a (*c)	Plot 1-9	12.70	14.0	×1.35	**1.15**	×1.00	n/a (*e)	-
	2462			0	#2	22.6/22.5	0.03	**0.997**	+1.39	n/a (*c)	Plot 1-10	12.91	14.0	×1.29	**1.29**	×1.00	n/a (*e)	*. Highest measured SAR.
Step 2: Worst SAR search of DSSS mode																		
11b	2437	1Mbps /DSSS	Top	0	#3	22.5/22.5	-0.01	**0.917**	+1.17	n/a (*c)	Plot 2-1	12.54	14.0	×1.40	**1.29**	×1.00	n/a (*e)	Initial test pos.
	2412			0	#3	22.5/22.5	0.01	**0.788**	+0.94	n/a (*c)	Plot 2-2	12.24	14.0	×1.50	**1.18**	×1.00	n/a (*e)	-
	2462			0	#3	22.5/22.5	-0.01	**0.941**	+1.39	n/a (*c)	Plot 2-3	12.44	14.0	×1.43	**1.35**	×1.00	n/a (*e)	*. Highest reported SAR.
Step 3: SAR Measurement Variability (*1)																		
11n (20HT)	2462	MCS0 /OFDM	Top	0	#4	22.5/22.5	-0.03	**1.01**	+1.39	n/a (*c)	Plot 3-1	12.91	14.0	×1.29	**1.30**	×1.00	n/a (*e)	+1.3% vs. Plot 1-10

Notes:

*. Gap: It is the separation distance between the nearest position of platform outer surface and the bottom outer surface of phantom;
Freq.: Frequency; Bty.: Battery; Liq.temp: Liquid temperature; Max.: maximum, Meas.: Measured value; Ave.: Average; n/a: not applied.

*. Battery ID No.#1, #2, #3 and #4 were same model.; Refer to Appendix 1.

*. 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	7.17	±12.0%

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

(cont'd)

SECTION 7: SAR Measurement results (cont'd)

(cont'd)

*a. The target value is a parameter defined in Appendix A of KDB865664 D01, 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, 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. The coefficients are parameters defined in clause E.3.3.2, IEEE Std 1528(2013). Since the measured liquid parameters were ≤ the target εr and ≥ the target σ values and also within 5% of the required target dielectric parameters, the measured SAR was not compensated by ΔSAR coefficients (. Clause 2) of 2.6, KDB865664 D01).

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

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

*d. Tuned-up SAR by scaled factor: Accordance with KDB 447498 D01; "When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance (clause 4, 4.1, 4))." (Refer to section 6 in this report for "Scaled factor" of channels, each operation mode.)

Calculating formula: Tuned-up SAR (1g) (W/kg) = (ΔSAR corrected SAR (1g) (W/kg)) × (Scaled factor)

*e. (KDB248227 D01v02)(Clause 2.2; Duty Factor Control)

When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. The reported SAR must be scaled to the maximum transmission duty factor to determine compliance.

Calculating formula: Reported SAR (1g) (=SAR duty corrected SAR (1g)) (W/kg) = (Tuned-up SAR (1g) (W/kg)) × (Duty scaled factor)

(Clause 5: SAR TEST PROCEDURE, in KDB248227 D01v02)

5.1.1 Initial Test Position SAR Test Reduction Procedure

1) When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other (remaining) test positions in that exposure configuration and 802.11 transmission mode combination within the frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).

2) When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest extrapolated or estimated 1-g SAR conditions determined by area scans or next closest/smallest test separation distance and maximum RF coupling test positions based on manufacturer justification, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.

3) For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

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.

***1. SAR Measurement Variability**

In accordance with published RF Exposure KDB procedure 865664 D01_v01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Mode	Freq. [MHz]	Data rate	EUT setup	Measured SAR (1g) [W/kg]		Largest to Smallest SAR Ratio	Remarks
				Original	Repeated		
11n (20HT)	2462	MCS0 /OFDM	Top	0.997	1.01	1.013	*. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.