SAR TEST REPORT

Test Report No.: 32KE0289-SH-02-A

Applicant	:	**Welcat Inc.**
Type of Equipment	:	**Wireless 2D-code Handy Terminal**
Model No.	:	**GTX-221-G**
FCC ID	:	**Q98GTX221G**
Test Standard	:	**FCC 47CFR §2.1093, Supplement C (Edition 01-01) to OET Bulletin 65**
Test Result	:	**Complied**
Highest SAR(1g) Value	:	**0.72 W/kg** ((DTS) IEEE 802.11b, 1Mbps(DBPSK/OFDM), 2462MHz)

*. **Highest SAR(1g) across exposure conditions = 0.72 W/kg = grant listing.**

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Date of test: August 27, 2012

Test engineer: H. Naka
Hiroshi Naka
Engineer of WiSE Japan, UL Verification Service

Approved by: T. Imamura
Toyokazu Imamura
Leader of WiSE Japan, UL Verification Service

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

JAB Testing RTL02610

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REVISION HISTORY

Revision	Test report No.	Date	Page revised	Contents
Original	32KE0289-SH-02-A	September 5, 2012	-	-

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

SECTION 1: Customer information

Company Name	Welcat Inc.
Brand Name	Welcat
Address	4-12-8 Higashi-Shinagawa, Shinagawa Seaside East Tower 6F, Shinagawa-ku, Tokyo 140-0002 Japan
Telephone Number	+81-3-5463-8582
Facsimile Number	+81-3-3763-8587
Contact Person	Masakiyo Yamazaki

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type of Equipment	Wireless 2D-code Handy Terminal
Model Number	GTX-221-G
Serial Number	21C15 (Chassis for the antenna terminal conducted measurement. It had RF cable holes in additionally.) 21C04 (Normal chassis for the SAR conducted measurement)
Condition of EUT	Production prototype (*. Not for sale: This sample is equivalent to mass-produced items.)
Receipt Date of Sample	August 2, 2012 (*. EUT for the power measurement.) August 24, 2012 (*. EUT for the SAR test. The RF modules that had been measured the power of SAR test reference, were installed into the EUT from the beginning.) *. After power measurement, the EUT was returned to the customer, and the RF wiring was changed to the original antenna line form the antenna conducted power measurement line of the SAR test. These RF modules were installed in the EUT which SAR tested, by the customer. *. No modification by the Lab.
Country of Mass-production	Japan
Category Identified, Feature of EUT	Portable device *. The EUT is a Wireless 2D-code Handy Terminal. The EUT is used as hand-held and hand-operated device with output power < 645 mW (1000×[2.4GHz]$^{-0.5}$). Therefore, the hand-SAR is not required (KDB447498). *. The EUT may contact a human body during Wi-Fi and/or Bluetooth operation.
Rating	DC3.8V (*. The EUT is operated by a re-chargeable Li-ion battery.)
Accessory of EUT	Portable holder (nonmetal, in optional), Impact-resistant protective cover (nonmetal, in optional) *. Refer to Appendix 1 for more detail in this report.

2.2 Product Description (*. Wireless module and antenna)

	Wi-Fi	Bluetooth
RF model number	WM-G-MR-09 <Manufacture: USI>	FC04UAB-C <Manufacture: Kyocera>
Equipment type	Transceiver	Transceiver
Frequency of operation	2412-2462MHz	2402-2480MHz
Channel spacing	5MHz	1MHz
Bandwidth	20MHz	79MHz
ITU code	G1D(11b), D1D(11g,)	F1D, G1D
Type of modulation	DSSS(11b): CCK, DQPSK, DBPSK OFDM(11g,): 64QAM, 16QAM, QPSK, BPSK	FHSS: GFSK, π/4-DQPSK, 8DPSK
Q'ty of Antenna	1 pc.	1 pc.
Antenna model number	AN1001	ACA7636A1S <Manufacture: INPAQ>
Antenna type	Inverted-F antenna (PCB Pattern)	Chip antenna
Antenna connector type	None	None
Antenna gain (peak)	-0.90dBi	1.0dBi
Transmit power	*. Refers to section 6 in this report.	*. Refers to section 6 in this report.
Power supply	DC3.8V	DC3.8V
Operation temperature range	-5 to +45 deg.C.	-5 to +45 deg.C.

*. The EUT do not use the special transmitting technique such as "beam-forming" and "time-space code diversity."
*. Simultaneous transmission of the two transmitters may be carried out.

SECTION 3: Test specification, procedures and results

3.1 Requirements for compliance testing defined by the FCC / 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. According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, 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.

1. Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).
2. IEEE/ANSI Std. C95.1-1992 limits are used to determine compliance with FCC ET Docket 93-62.

Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01):

Supplement C (Edition 01-01) - Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions
OET Bulletin 65 (Edition 97-01) - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

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 Supplement C

In additions;

☒ **KDB 447498 D01 (v04) (11/13/2009):**	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
☒ **KDB 248227 (rev.1.2) (5/29/2007):**	SAR Measurement Procedures for 802.11a/b/g Transmitters
☒ **KDB 450824 D01 (v01r01) (Jan.2007):**	SAR Probe Calibration and System Verification Considerations for Measurements at 150MHz-3GHz
☒ **KDB 450824 D02 (v01) (11/13/2009):**	Dipole Requirements for SAR System Validation and Verification
☒ **KDB 648474 D01 (v01r05) (Sept.2008):**	SAR evaluation considerations for handsets with multiple transmitters and antennas.
☒ **KDB 447498 DR01 (4/23/2012):**	General RF Exposure Polices for Equipment Authorization (Appendix A, SAR exclusion Threshholds , for the reference purpose only.)

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)	Bluetooth (DTS)
Test Procedure		FCC OET Bulletin 65, Supplement C	FCC OET Bulletin 65, Supplement C
		SAR	SAR
Category		FCC 47CFR §2.1093	FCC 47CFR §2.1093
Results (SAR(1g))	(Built-in)	**Complied (0.72 W/kg)**	**Complied (0.01 W/kg)**

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

Consideration of simultaneous transmission:

In the top-front of EUT which acquired the maximum SAR value of Wi-Fi, the SAR value with 48 mm of separation distance of Bluetooth was not able to be observed. For this reason, it was considered that the greatest SAR value in this direction was 0.72W/kg obtained only by Wi-Fi.
The very small SAR value (0.01W/kg) of Bluetooth was observed only in the left of EUT. The SAR value of Wi-Fi in the left side of EUT was 0.18W/kg. Since the 1g cube of SAR of Wi-Fi and the 1g cube of SAR of Bluetooth do not overlap, it is considered that the maximum SAR value of the left side of EUT is 0.18W/kg obtained only by Wi-Fi. Even if it assumes that it thinks conservative and is the sum of Wi-Fi and Bluetooth, a result is 0.19W/kg.
For this reason, **the maximum SAR value of EUT was determined in 0.72W/kg in the top-front of EUT.**

3.4 Test Location

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

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

3.5 Confirmation before SAR testing

3.5.1 Correlation of Output Power between EMC and SAR tests

It was checked that the antenna port power was correlated within 0~+5% (FCC requirements).
The result is shown in Section 6.

Test	Remarks	Serial number
SAR	Before SAR test, the RF wiring for the sample that was actually used for the SAR test, had been switched to the antenna conducted power measurement line from the antenna line, and then the average power was measured. The average and peak power of specified operation mode(s) were measured at default channel. After power measurement, the EUT was returned to the customer, and the RF wiring was changed to the original antenna line form the antenna conducted power measurement line of the SAR test. *. The power was measured by the calibrated power sensor and power meter (65MHz measurement bandwidth).	WiFi: Lot No.1214 Bluetooth: Lot No.1208
EMC	The EUT of the EMC test (as same as SAR tested sample) was measured for the peak power. The average power that was reference of SAR test was also measured additionally.	WiFi: Lot No.1214 Bluetooth: Lot No.1208

***. The EUT that was used for this SAR test was identical with the EUT that was used for the EMC test.**
Refer to the Section 6 in this report for the power measurement result.

3.5.2 Average power for SAR tests

Step.1 Data rate check
The average powers related with all data rate were measured on a middle channel of each operation mode. The EUT supported the following data rate in each operation mode.

11b		11g				Bluetooth	
Modulation	Data rate [Mbps]	Modulation	Data rate [Mbps]	Modulation	Data rate [Mbps]	Modulation	Data rate
DBPSK/DSSS	1	BPSK/OFDM	6	16QAM/OFDM	24	GFSK/FHSS	DH5
DQPSK/DSSS	2	BPSK/OFDM	9	16QAM/OFDM	36		
CCK/DSSS	5.5	QPSK/OFDM	12	64QAM/OFDM	48		
CCK/DSSS	11	QPSK/OFDM	18	64QAM/OFDM	54		

Step.2 Channel dependence
The average powers related with channels were measured on low, middle and high channels of each operation mode.

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 DASY4 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.

*. DASY4 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 DASY4 system must be the less than ±0.21dB.

3.7 Test setup of EUT and SAR measurement procedure

After considering the outline of EUT, the SAR test was carried out on the following setup conditions.
*. Refer to Appendix 1 for test setup photographs.

Setup	Explanation of EUT setup position	Wi-Fi antenna to user distance	Bluetooth antenna to user distance	SAR test	SAR test type
Front	The front surface (LCD) of EUT was touched to the Flat phantom.	≈ 12 mm	≈ 12 mm	applied	Body (touch)
Top-front	The top-front surface of EUT was touched to the Flat phantom. This section is the closest to a Wi-Fi antenna.	≈ 7 mm	≈ 48 mm		
Left	The left surface of EUT was touched to the Flat phantom. This section is the closest to a Bluetooth antenna.	≈ 18 mm	≈ 7.5 mm		
Right	The right surface of EUT was touched to the Flat phantom.	≈ 16 mm	≈ 47 mm		
Back	The rear section of EUT was touched to the Flat phantom.	≈ 35 mm	≈ 30 mm		
Bottom	This means SAR test for the bottom surface of EUT.	≈ 155 mm	≈ 108 mm	not applied (*1)	

***. Size of EUT: 58 mm (width) × 171 mm (depth) × 29 mm (height)**

*1. Since the average power of EUT was less than 13dBm, this separation distance was enough far for the SAR test exclusion.
"Appendix A, SAR Exclusion Thresholds", KDB 447498 General RF Exposure Guideline DR01.

MHz	5	10	15	20	25	30	35	40	45	50	mm
2450	10	19	29	38	48	57	67	77	86	96	SAR Test Exclusion Threshold (mW)

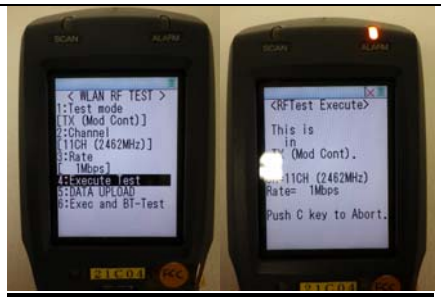
By the determined test setup shown above, the SAR test was applied in the following procedures.

Step 1	Worst position search. (*. SAR of Wi-Fi and SAR of Bluetooth were checked in each position.)
Step 2	Change the channels..

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

SECTION 4: Operation of EUT during testing

This EUT has IEEE.802.11b, 11g and Bluetooth continuous transmitting modes.
The frequency and the modulation used in the SAR testing are shown as a following.

Operation mode	11b (*1)	Bluetooth
Tx frequency band	2412-2462MHz	2402-2480MHz
Tested frequency	2412, 2437, 2462MHz	2480MHz
Modulation	DBPSK/DSSS (*2)	GFSK/FHSS
Data rate	1Mbps (*2)	DH5
Crest factor (DSAY4)	1.0	
Controlled software	 For Wi-Fi operation, it was used "WLAN RF TEST (Ver 1.04)" operation mode that was pre-installed into the EUT.	 For Bluetooth operation, it was used "Bluetooth RF Test (Ver 1.04)" operation mode that was pre-installed into the EUT.

*. The following is requirement of default test channel of 11b/g operation. (Table 1, KDB248227)

Mode	MHz	Channel	default	SAR tested channel	
			11b/g	11b	11g
802.11 b/g	2412	1	√	#	n/a (*1)
	2437	6	√	#	n/a (*1)
	2462	11	√	#	n/a (*1)

√ = "default test channels of requested by KDB248227", n/a: SAR test was not applied, # = SAR test was applied.

*1. Since the maximum average power of 11g was less than 0.25dB higher than the corresponded 11b channel, the SAR test was only considered at the 11b mode. (KDB 248227) (The average power is shown in Section 6.)
*2. For 11b, the average power of higher data rate was less than 0.25dB higher than the lowest data rate. Therefore, SAR test was only considered the lowest data rate. (KDB 248227) (The average power is shown in Section 6.)

SECTION 5: Uncertainty Assessment (SAR measurement)

Uncertainty of SAR measurement system (v04)	Under 3 GHz (v04)	
	1g SAR	10g SAR
combined measurement uncertainty of the measurement system (k=1)	± 12.3%	± 12.0%
expanded uncertainty (k=2)	± 24.6%	± 24.0%

	Error Description (Under 3GHz) (v04)	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	Vi, veff
A	**Measurement System**						(std. uncertainty)	(std. uncertainty)	
1	Probe Calibration Error	±6.0 %	Normal	1	1	1	±6.0 %	±6.0 %	∞
2	Axial isotropy Error	±4.7 %	Rectangular	√3	0.7	0.7	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy Error (<5deg, flat phantom)	±9.6 %	Rectangular	√3	0.7	0.7	±3.9 %	±3.9 %	∞
4	Boundary effects Error	±1.4 %	Rectangular	√3	1	1	±0.8 %	±0.8 %	∞
5	Linearity Error	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
6	Sensitivity Error (detection limit)	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	Response Time Error (<5ms/100ms wait)	±0.0 %	Normal	1	1	1	±0.0 %	±0.0 %	∞
8	Integration Time Error(100% duty cycle)	±0.0 %	Rectangular	√3	1	1	±0.0 %	±0.0 %	∞
9	Readout Electronics Error(DAE)	±0.3 %	Rectangular	√3	1	1	±0.3 %	±0.3 %	∞
10	RF ambient conditions-noise (<0.01mW/g)	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
11	RF ambient conditions-reflections (<0.12mW/g)	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
12	Probe positioner mechanical tolerance	±1.1 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
13	Probe Positioning with respect to phantom shell	±2.9 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
14	Errors: Extrapol., Interpol. & Integration Algorithms	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
B	**Test Sample Related**								
15	Test Sample Positioning Error	±5.0 %	Normal	1	1	1	±5.0 %	±5.0 %	145
16	Device Holder or Positioner Tolerance	±3.6 %	Normal	1	1	1	±3.6 %	±3.6 %	5
17	Test Sample Output Power Drift Error	±5.0 %	Rectangular	√3	1	1	±2.9 %	±2.9 %	∞
C	**Phantom and Setup**								
18	Phantom uncertainty (shape, thickness tolerances)	±7.5 %	Rectangular	√3	1	1	±4.3 %	±4.3 %	∞
19	Target Liquid Conductivity Tolerance	±5.0 %	Rectangular	√3	0.64	0.43	±1.8 %	±1.2 %	∞
20	Measurement Liquid Conductivity Error	±2.9 %	Normal	1	0.64	0.43	±1.9 %	±1.2 %	3
21	Target Liquid Permittivity Tolerance	±5.0 %	Rectangular	√3	0.6	0.49	±1.7 %	±1.4 %	∞
22	Measurement Liquid Permittivity Error	±2.9 %	Normal	1	0.6	0.49	±1.7 %	±1.4 %	3
	Combined Standard Uncertainty						**±12.3** %	**±12.0** %	479
	Expanded Uncertainty (k=2)						**±24.6** %	**±24.0** %	

*. This measurement uncertainty budget is suggested by IEEE 1528 and determined by Schmid & Partner Engineering AG (DASY4 Uncertainty Budget). [6]

SECTION 6: Confirmation before testing

6.1 Assessment for the conducted power of EUT

Worst data rate & worst channel determination of SAR, correction of the power at SAR test and EMC test

*. 0≦⊿(sar-emc) ≦0.21dB

【Output power】 Tx mode: 11b *.factory set=14dBm *.PAR=Peak(dB)-Ave(dB)[dB]

Ch.	Freq. [MHz]	D/R [Mbps]	Ant. No.	Max.Ave. pwr.:o	Modulation		P/M Reading Ave.[dBm]	P/M Reading Pk[dB]	Cable Loss [dB]	Attenuator [dB]	duty factor [dB]	Power Reading Results Ave[dBm]	Pk[dBm]	Ave[mW]	Pk[mW]	⊿worst ave.[dB]	PAR [dB]	Power at EMC test Ave. [dB]	⊿(sar-emc)	Pk [dB]	⊿(sar-emc)	on time [ms]	1cycle [ms]	duty cycle [%]
1	2412	1	x1		CCK/PBCC	DSSS	2.75	4.88	0.85	10.00	0.00	13.60	15.73	22.91	37.41	-1.19	2.13	13.44	0.16	15.54	0.19			
6	2437	1	x1		CCK/PBCC	DSSS	3.59	5.62	0.85	10.00	0.00	14.44	16.47	27.80	44.36	-0.35	2.03	14.25	0.19	16.32	0.15			
11	2462	1	x1	o	CCK/PBCC	DSSS	3.94	5.91	0.85	10.00	0.00	**14.79**	16.76	30.13	47.42	(max)	1.97	14.64	0.15	16.59	0.17			
																⊿low rate			⊿ave		⊿pk			
6	2437	1	x1	o	DBPSK	DSSS	3.59	5.62	0.85	10.00	0.00	**14.44**	16.47	27.80	44.36	0.00	2.03	14.25	0.19	16.32	0.15	100% duty cycle		100.0%
6	2437	2	x1		DQPSK	DSSS	3.53	5.60	0.85	10.00	0.00	14.38	16.45	27.42	44.16	-0.06	2.07	14.23	0.15	16.29	0.16	100% duty cycle		100.0%
6	2437	5.5	x1		CCK/PBCC	DSSS	3.37	5.01	0.85	10.00	0.00	14.22	15.86	26.42	38.55	-0.22	1.64	14.09	0.13	15.70	0.16	100% duty cycle		100.0%
6	2437	11	x1		CCK/PBCC	DSSS	3.44	5.46	0.85	10.00	0.00	14.29	16.31	26.85	42.76	-0.15	2.02	14.12	0.17	16.14	0.17	100% duty cycle		100.0%

【Output power】 Tx mode: 11g *.factory set=12dBm *.PAR=Peak(dB)-Ave(dB)[dB]

Ch.	Freq. [MHz]	D/R [Mbps]	Ant. No.	Max.Ave. pwr.:o	Modulation		P/M Reading Ave.[dBm]	P/M Reading Pk[dB]	Cable Loss [dB]	Attenuator [dB]	duty factor [dB]	Power Reading Results Ave[dBm]	Pk[dBm]	Ave[mW]	Pk[mW]	⊿worst ave.[dB]	PAR [dB]	Power at EMC test Ave. [dB]	⊿(sar-emc)	Pk [dB]	⊿(sar-emc)	on time [ms]	1cycle [ms]	duty cycle [%]
1	2412	6	x1		16QAM	DSSS	-1.29	8.64	0.85	10.00	0.00	9.56	19.49	9.04	88.92	-1.27	9.93	9.38	0.18	19.33	0.16			
6	2437	6	x1		16QAM	DSSS	-0.41	9.34	0.85	10.00	0.00	10.44	20.19	11.07	104.47	-0.39	9.75	10.29	0.15	20.02	0.17			
11	2462	6	x1	o	16QAM	DSSS	-0.02	9.78	0.85	10.00	0.00	**10.83**	20.63	12.11	115.61	(max)	9.80	10.64	0.19	20.45	0.18			
																⊿low rate			⊿ave		⊿pk			
6	2437	6	x1	o	BPSK	OFDM	-0.41	9.34	0.85	10.00	0.00	**10.44**	20.19	11.07	104.47	0.00	9.75	10.29	0.15	20.02	0.17	100% duty cycle		100.0%
6	2437	9	x1		BPSK	OFDM	-0.44	9.02	0.85	10.00	0.00	10.41	19.87	10.99	97.05	-0.03	9.46	10.26	0.15	19.70	0.17	100% duty cycle		100.0%
6	2437	12	x1		QPSK	OFDM	-0.44	9.06	0.85	10.00	0.00	10.41	19.91	10.99	97.95	-0.03	9.50	10.24	0.17	19.73	0.18	100% duty cycle		100.0%
6	2437	18	x1		QPSK	OFDM	-0.45	8.56	0.85	10.00	0.00	10.40	19.41	10.96	87.30	-0.04	9.01	10.24	0.16	19.24	0.17	100% duty cycle		100.0%
6	2437	24	x1		16QAM	OFDM	-0.62	9.32	0.85	10.00	0.00	10.23	20.17	10.54	103.99	-0.21	9.94	10.04	0.19	20.00	0.17	100% duty cycle		100.0%
6	2437	36	x1		16QAM	OFDM	-0.67	9.07	0.85	10.00	0.00	10.18	19.92	10.42	98.17	-0.26	9.74	9.99	0.19	19.74	0.18	100% duty cycle		100.0%
6	2437	48	x1		64QAM	OFDM	-0.66	8.54	0.85	10.00	0.00	10.19	19.39	10.45	86.90	-0.25	9.20	10.03	0.16	19.21	0.18	100% duty cycle		100.0%
6	2437	54	x1		64QAM	OFDM	-0.72	8.80	0.85	10.00	0.00	10.13	19.65	10.30	92.26	-0.31	9.52	9.97	0.16	19.45	0.20	100% duty cycle		100.0%

*. 0≦⊿(sar-emc) ≦0.21dB

【Output power】 Tx mode: Bluetooth *.PAR=Peak(dB)-Ave(dB)[dB]

Ch.	Freq. [MHz]	D/R [Mbps]	Ant. No.	Max.Ave. pwr.:o	Modulation		P/M Reading Ave.[dBm]	P/M Reading Pk[dB]	Cable Loss [dB]	Attenuator [dB]	duty factor [dB]	Power Reading Results Ave[dBm]	Pk[dBm]	Ave[mW]	Pk[mW]	⊿worst ave.[dB]	PAR [dB]	Power at EMC test Ave. [dB]	⊿(sar-emc)	Pk [dB]	⊿(sar-emc)	on time [ms]	1cycle [ms]	duty cycle [%]
1	2402	1	x1		DH5	GFSK	-10.57	-8.39	0.85	10.00	1.04	1.32	2.46	1.36	1.76	-0.43	1.14	1.21	0.11	2.46	0.00	2.97	3.774	78.7%
41	2441	1	x1		DH5	GFSK	-10.27	-8.11	0.85	10.00	1.04	1.62	2.74	1.45	1.88	-0.13	1.12	1.44	0.18	2.71	0.03	2.97	3.774	78.7%
79	2480	1	x1	o	DH5	GFSK	-10.14	-7.99	0.85	10.00	1.04	**1.75**	2.86	1.50	1.93	(max)	1.11	1.58	0.17	2.85	0.01	2.97	3.774	78.7%

*. <The serial number of RF module> For both SAR test and EMC test: Wi-Fi: Lot No.1214 / Bluetooth: Lot No.1208
*. Since the maximum average power of 11g was less than 0.25dB higher than the corresponded 11b channel, the SAR test was only considered at the 11b mode. (KDB 248227)
*. For 11b, the average power of higher data rate was less than 0.25dB higher than the lowest data rate. Therefore, SAR test was only considered the lowest data rate. (KDB 248227)
*. Calculating formula: Result (Ave) = [P/M Reading]+[Cable loss]+[Attenuator]+[duty factor] / Result (Pk) = [P/M Reading]+[Cable loss]+[Attenuator]
*. The difference between the SAR reference power and the power of EMC test was not less than 0dB and not higher than 0.21dB.
*. SAR reference; Date tested: August 20, 2012 / measured by: Hiroshi Naka / Place: preparation room of No. 7 shielded room. (24 deg.C / 51 %RH)
The RF modules that were measured the power was shipped back to the customer, and were installed into the EUT platform of the SAR test.
*. The data of "Power/EMC test" column; this reference is described in the test report of 32KE0289-SH-01-A (Bluetooth), 32KE0289-SH-01-B (Wi-Fi).

SECTION 7: SAR Measurement results

Measurement date: August 27, 2012 Measurement by: Hiroshi Naka

[Liquid measurement (Body tissue)]

Used Target Frequency [MHz]	Target Body Tissue		Measured Body Tissue				Environment		Measured Date
	Permittivity [-]	Conductivity [S/m]	Permittivity (εr) [-]	Conductivity (σ) [S/m]	Temp. [deg.C.]	Depth [mm]	Temp. [deg.C.]	Humidity [%RH]	
2450	**52.7**	**1.95**	50.63 (-3.9%)	1.967 (+0.9%)	23.0	154	23.9	58	August 27, 2012, before SAR test.
2412	***52.75***	***1.914***	50.71 (-3.9%)	1.925 (+0.6%)					
2437	***52.72***	***1.938***	50.62 (-4.0%)	1.947 (+0.5%)					
2462	***52.68***	***1.967***	50.59 (-4.0%)	1.994 (+1.4%)					

*. The target value is a parameter defined in OET65 Supplement C. In the current standards (e.g., IEEE 1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given at 2450MHz. As an intermediate solution, dielectric parameters for the frequencies between 2000 to 2450 MHz and 2450 to 3000MHz were obtained using linear interpolation. (Refer to Appendix 3-7 in this report)

[SAR measurement results]

SAR measurement results (Body tissue)													
Mode	Frequency		Modulation / Data rate / crest factor	EUT setup conditions			Liquid temp. [deg.C]		Power drift [dB]	SAR(1g) [W/kg] max. value of multi-peak	Data# in Appendix 2-2	Remarks
	Ch.	[MHz]		Position	Separation distance	Battery	Before	After				
(1) Wi-Fi (IEEE 802.11b)												
Step 1: Worst position search												
11b	(Wi-Fi) 11	2462	DBPSK&DSSS / 1Mbps / 1.0	Front	0 mm (touch)	#1	22.9	22.9	-0.136	**0.402**	Step 1-1	-
				Top-front		#2	22.8	22.7	-0.20	**0.720**	Step 1-2	Worst SAR of Wi-Fi.
				Left		#3	22.7	22.7	-0.20	**0.183**	Step 1-3a	-
				Right		#1	22.7	22.8	-0.20	**0.251**	Step 1-4	-
				Back		#2	22.8	22.8	-0.141	**0.074**	Step 1-5	-
Step 2: Change the channels												
11b	1	2412	DBPSK&DSSS / 1Mbps / 1.0	Top-front	0 mm (touch)	#3	22.7	22.7	-0.139	**0.452**	Step 2-1	-
	6	2437				#2	22.7	22.7	-0.068	**0.588**	Step 2-2	-
(2) Bluetooth												
Step 1: Worst position search												
Blue-tooth	(Blue-tooth) 79	2480	GFSK/FHSSS / DH5 / 1.0	Front	0 mm (touch)	#1	22.9	22.8	-	not observed	-	-
				Top-front		#2	22.7	22.7	-	not observed	-	-
				Left		#3	22.7	22.7	0.20	**0.00985**	Step 1-3b	Worst SAR of Bluetooth.
				Right		#1	22.8	22.8	-	not observed	-	-
				Back		#2	22.8	22.8	-	not observed	-	-

Consideration of simultaneous transmission:

In the top-front of EUT which acquired the maximum SAR value of Wi-Fi, the SAR value with 48 mm of separation distance of Bluetooth was not able to be observed. For this reason, it was considered that the greatest SAR value in this direction was 0.72W/kg obtained only by Wi-Fi.

The very small SAR value (0.01W/kg) of Bluetooth was observed only in the left of EUT. The SAR value of Wi-Fi in the left side of EUT was 0.18W/kg. Since the 1g cube of SAR of Wi-Fi and the 1g cube of SAR of Bluetooth do not overlap, it is considered that the maximum SAR value of the left side of EUT is 0.18W/kg obtained only by Wi-Fi. Even if it assumes that it thinks conservative and is the sum of Wi-Fi and Bluetooth, a result is 0.19W/kg. (*. Refer to Appendix 2-2, Step 1-3a&1-3b.)

For this reason, **the maximum SAR value of EUT was determined in 0.72W/kg in the top-front of EUT.**

Notes:

*. Since the maximum average power of 11g was less than 0.25dB higher than the corresponded 11b channel, the SAR test was only considered at the 11b mode. (KDB 248227)
*. Since the separation distance between antenna and body was enough large in the bottom of EUT, the SAR test was not applied to the bottom of EUT.
*. During test, the EUT was operated with full-charged battery and without all signal interface cables.
*. Calibration frequency of the SAR measurement probe

SAR test frequency[MHz]	Probe calibration frequency [MHz]	Validity [MHz]	Used conversion factor	Uncertainty
2412	2450	-38MHz, within ±50 of cal.frequency	6.77	±12.0%
2437	2450	-13MHz, within ±50 of cal.frequency	6.77	±12.0%
2462	2450	+12MHz, within ±50 of cal.frequency	6.77	±12.0%
2480	2450	+30MHz, within ±50 of cal.frequency	6.77	±12.0%

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