



# FCC SAR Test Report

**APPLICANT** : Chicony Electronics Co., Ltd.  
**EQUIPMENT** : Wireless Digital Camera  
**BRAND NAME** : Chicony  
**MODEL NAME** : DC-D245  
**FCC ID** : E8HDCD245R50  
**STANDARD** : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2003

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager



## SPORTON INTERNATIONAL INC.

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## Table of Contents

1. Statement of Compliance .....	4
2. Administration Data .....	4
3. Guidance Standard .....	4
4. Equipment Under Test (EUT) .....	5
4.1 General Information .....	5
4.2 Maximum Tune-up Limit.....	5
5. RF Exposure Limits.....	6
5.1 Uncontrolled Environment.....	6
5.2 Controlled Environment.....	6
6. Specific Absorption Rate (SAR).....	7
6.1 Introduction .....	7
6.2 SAR Definition.....	7
7. System Description and Setup .....	8
8. Measurement Procedures .....	9
8.1 Spatial Peak SAR Evaluation .....	9
8.2 Power Reference Measurement.....	10
8.3 Area Scan .....	10
8.4 Zoom Scan.....	11
8.5 Volume Scan Procedures.....	11
8.6 Power Drift Monitoring.....	11
9. Test Equipment List.....	12
10. System Verification .....	13
10.1 Tissue Verification .....	13
10.2 System Performance Check Results.....	14
11. RF Exposure Positions .....	14
12. Conducted RF Output Power (Unit: dBm).....	15
13. Antenna Location .....	15
14. SAR Test Results .....	16
14.1 Body SAR .....	16
14.2 Repeated SAR Measurement .....	16
15. Uncertainty Assessment .....	17
16. References.....	19
Appendix A. Plots of System Performance Check	
Appendix B. Plots of High SAR Measurement	
Appendix C. DASY Calibration Certificate	
Appendix D. Test Setup Photos	



## Revision History



## 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Chicony Electronics Co., Ltd., Wireless Digital Camera, DC-D245**, are as follows.

Equipment Class	Frequency Band	Operating Mode	Highest SAR Summary
			Body 1g SAR (W/kg)
DTS	WLAN 2.4GHz Band	Data	<b>1.44</b>
Date of Testing:		03/12/2014 ~ 03/12/2014	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003.

## 2. Administration Data

Testing Laboratory	
<b>Test Site</b>	SPORTON INTERNATIONAL INC.
<b>Test Site Location</b>	No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
<b>Company Name</b>	Chicony Electronics Co., Ltd.
<b>Address</b>	No.25, Wugong 6th Rd., Wugu Dist., New Taipei City 248, Taiwan (R.O.C.)

Manufacturer	
<b>Company Name</b>	Chicony Electronics (Dong Guan ) Co., Ltd.
<b>Address</b>	San Zhong Guan Li Qu, Qingxi Town, Dongguan City Guangdong 523651 China

## 3. Guidance Standard

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2003
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- FCC KDB 865664 D02 SAR Reporting v01r01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r02
- FCC KDB 248227 D01 SAR meas for 802.11abg v01r02



## 4. Equipment Under Test (EUT)

### 4.1 General Information

Product Feature & Specification	
Equipment Name	Wireless Digital Camera
Brand Name	Chicony
Model Name	DC-D245
FCC ID	E8HDCD245R50
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz
Mode	• 802.11b/g
HW Version	B1
SW Version	V100
EUT Stage	Production Unit

**Remark:**

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This product has two kinds of battery, accessories only different is manufacturer, therefore RF exposure evaluation was selected battery1 performed SAR testing.

Specification of Accessory		
Battery 1	Brand Name	BYD
	Model Name	CB-070
Battery 2	Brand Name	FUJI
	Model Name	334031
USB Cable 1	Brand Name	UNEMAC
	Model Name	UAM5M-26CB-004
USB Cable 2	Brand Name	UNEMAC
	Model Name	UAM5M-30CB-010
USB Cable 3	Brand Name	UNEMAC
	Model Name	UAM5M30CB-012
USB Cable 4	Brand Name	UNEMAC
	Model Name	UAM5M26CB-007

### 4.2 Maximum Tune-up Limit

Band / Frequency (MHz)		IEEE 802.11 Average Power (dBm)	
		11b	11g
2.4GHz Band	2412	18	14
	2437	15	15
	2462	20	14



## 5. RF Exposure Limits

### 5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### 5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

#### Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

#### Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.



## 6. Specific Absorption Rate (SAR)

### 6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

### 6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt} \left( \frac{dW}{dm} \right) = \frac{d}{dt} \left( \frac{dW}{\rho dv} \right)$$

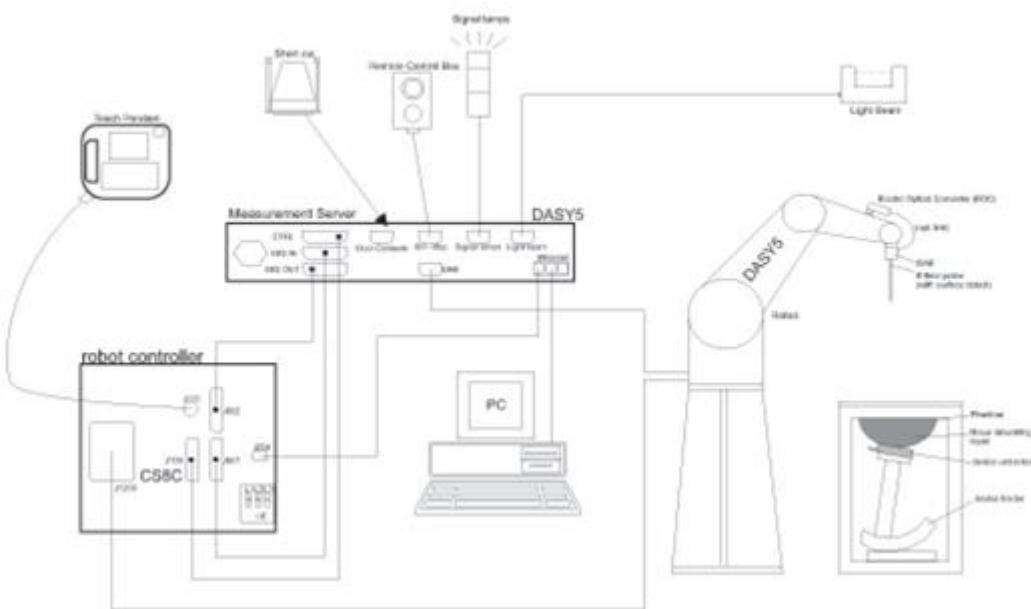
SAR is expressed in units of Watts per kilogram (W/kg)

$$\text{SAR} = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

## **7. System Description and Setup**

**The DASY system used for performing compliance tests consists of the following items:**



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.



## 8. Measurement Procedures

The measurement procedures are as follows:

### <Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
- (d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

### <SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix D demonstrates.
- (c) Set scan area, grid size and other setting on the DASY software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

### 8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g



## 8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

## 8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz v01r01.

	$\leq 3$ GHz	$> 3$ GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5 \pm 1$ mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
	$\leq 2$ GHz: $\leq 15$ mm $2 - 3$ GHz: $\leq 12$ mm	$3 - 4$ GHz: $\leq 12$ mm $4 - 6$ GHz: $\leq 10$ mm
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}$ , $\Delta y_{\text{Area}}$	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	



## 8.4 Zoom Scan

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz v01r01.

		$\leq 3$ GHz	$> 3$ GHz
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$		$\leq 2$ GHz: $\leq 8$ mm $2 - 3$ GHz: $\leq 5$ mm*	$3 - 4$ GHz: $\leq 5$ mm* $4 - 6$ GHz: $\leq 4$ mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$  graded grid	$\leq 5$ mm	$3 - 4$ GHz: $\leq 4$ mm $4 - 5$ GHz: $\leq 3$ mm $5 - 6$ GHz: $\leq 2$ mm
		$\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4$ mm
Minimum zoom scan volume	$x, y, z$	$\geq 30$ mm	$3 - 4$ GHz: $\geq 28$ mm $4 - 5$ GHz: $\geq 25$ mm $5 - 6$ GHz: $\geq 22$ mm

Note:  $\delta$  is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

\* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is  $\leq 1.4$  W/kg,  $\leq 8$  mm,  $\leq 7$  mm and  $\leq 5$  mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

## 8.5 Volume Scan Procedures

The volume scan is used to assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remains in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

**9. Test Equipment List**

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	924	Nov. 13, 2013	Nov. 12, 2014
SPEAG	Data Acquisition Electronics	DAE4	778	Aug. 21, 2013	Aug. 20, 2014
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 24, 2013	Sep. 23, 2014
Wisewind	Thermometer	HTC-1	TM281	Oct. 22, 2013	Oct. 21, 2014
SPEAG	Device Holder	N/A	N/A	NCR	NCR
R&S	Signal Generator	SMF 100A	101107	May. 27, 2013	May. 26, 2014
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Jul. 23, 2013	Jul. 22, 2014
Agilent	ENA Network Analyzer	E5071C	MY46316648	Feb. 07, 2014	Feb. 06, 2015
Anritsu	Power Meter	ML2495A	1349001	Dec. 04, 2013	Dec. 03, 2014
Anritsu	Power Sensor	MA2411B	1306099	Dec. 03, 2013	Dec. 02, 2014
Agilent	Dual Directional Coupler	778D	50422	Note 2	
Woken	Attenuator 1	WK0602-XX	N/A	Note 2	
PE	Attenuator 2	PE7005-10	N/A	Note 2	
PE	Attenuator 3	PE7005- 3	N/A	Note 2	
AR	Power Amplifier	5S1G4M2	0328767	Note 3	
Mini-Circuits	Power Amplifier	ZVE-3W	162601250	Note 3	
Mini-Circuits	Power Amplifier	ZHL-42W+	13440021344	Note 3	
R&S	Spectrum Analyzer	FSP 7	101131	Jul. 09, 2013	Jul. 08, 2014

**General Note:**

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.



## 10. System Verification

### 10.1 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

#### < Tissue Dielectric Parameter Check Results >

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
2450	Body	22.4	2.002	53.172	1.95	52.70	2.67	0.90	±5	2014/3/12

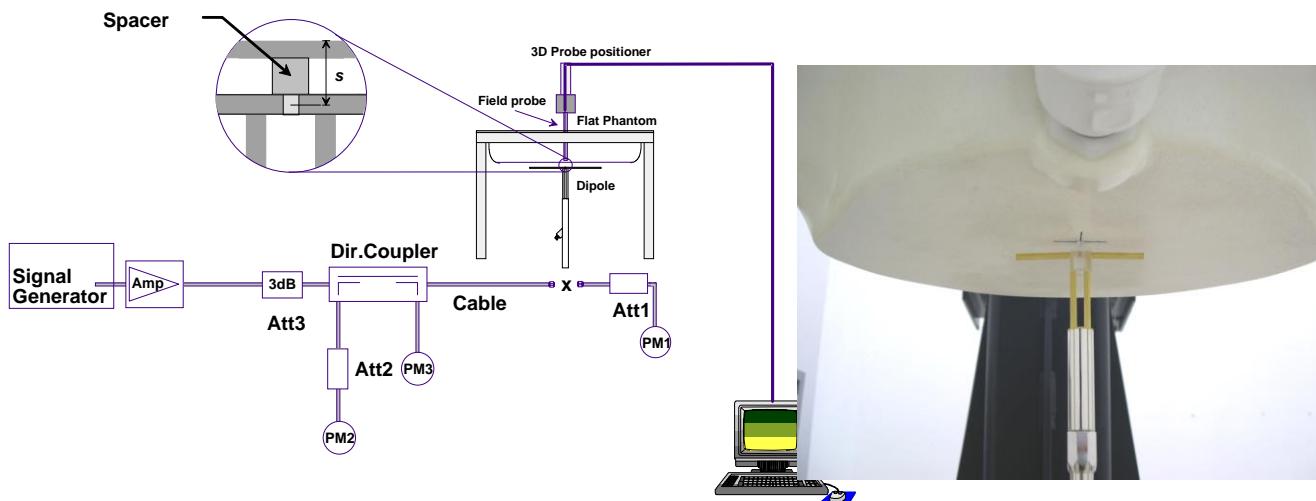
Table 8.2.1 Measuring Results for Simulating Liquid

## 10.2 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 8.3.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
2014/3/12	2450	Body	250	D2450V2-924	3270	778	13.20	50.20	52.8	5.18

**Table 8.3.1 Target and Measurement SAR after Normalized**



**Fig 8.3.1 System Performance Check Setup**

**Fig 8.3.2 Setup Photo**

## 11. RF Exposure Positions

Please refer to Appendix D for the test setup photos.

## 12. Conducted RF Output Power (Unit: dBm)

### <WLAN2.4GHz Conducted Power>

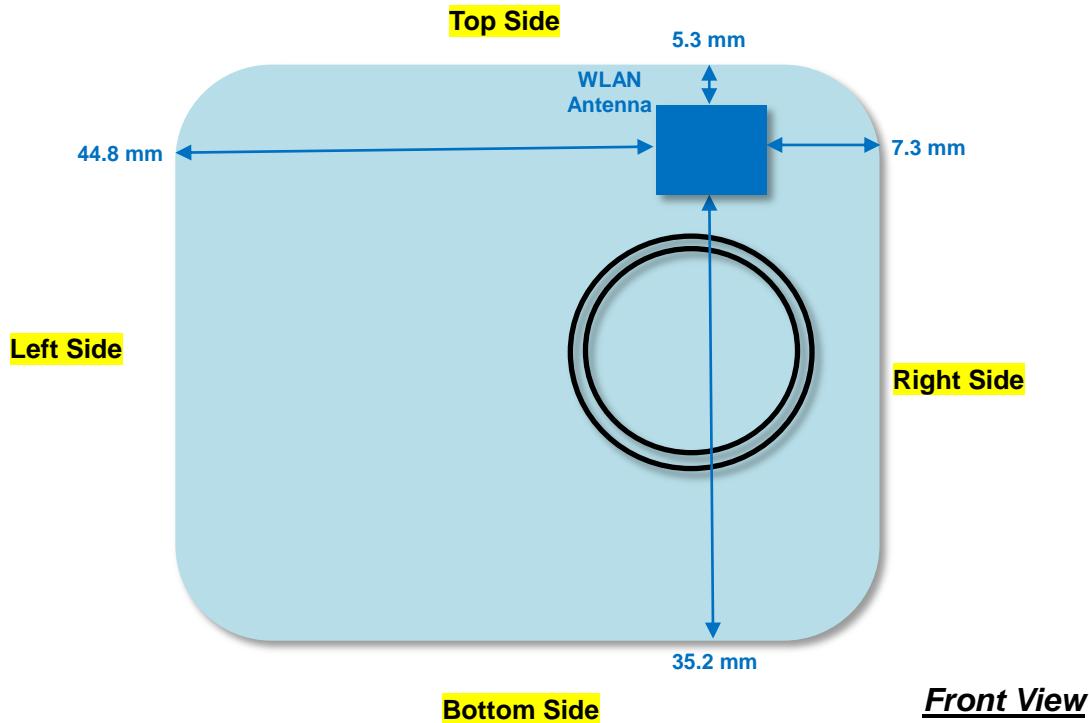
#### General Note:

- For 2.4GHz WLAN SAR testing, highest average RF output power channel for the lowest data rate for 802.11b were selected for SAR evaluation. 802.11g were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of 802.11b mode.

WLAN 2.4GHz 802.11b Average Power (dBm)		
Power vs. Channel		
Channel	Frequency (MHz)	Data Rate
		1Mbps
CH 1	2412	17.40
CH 6	2437	14.15
CH 11	2462	19.64

WLAN 2.4GHz 802.11g Average Power (dBm)		
Power vs. Channel		
Channel	Frequency (MHz)	Data Rate
		6Mbps
CH 1	2412	12.62
CH 6	2437	14.75
CH 11	2462	13.00

## 13. Antenna Location





## 14. SAR Test Results

### General Note:

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - b. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg) \* Tune-up scaling factor
2. Per KDB 447498 D01v05r02, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
  - $\leq 0.8 \text{ W/kg}$  or  $2.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\leq 100 \text{ MHz}$
  - $\leq 0.6 \text{ W/kg}$  or  $1.5 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is between  $100 \text{ MHz}$  and  $200 \text{ MHz}$
  - $\leq 0.4 \text{ W/kg}$  or  $1.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\geq 200 \text{ MHz}$

### 14.1 Body SAR

#### <DTS WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	0cm	11	2462	19.64	20	1.086	-0.08	0.617	0.670
	WLAN2.4GHz	802.11b 1Mbps	Back	0cm	11	2462	19.64	20	1.086	0.09	0.332	0.361
	WLAN2.4GHz	802.11b 1Mbps	Edge 1	0cm	11	2462	19.64	20	1.086	-0.15	0.516	0.561
	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0cm	11	2462	19.64	20	1.086	-0.1	1.070	1.162
	WLAN2.4GHz	802.11b 1Mbps	Edge 3	0cm	11	2462	19.64	20	1.086	0.14	0.217	0.236
	WLAN2.4GHz	802.11b 1Mbps	Edge 4	0cm	11	2462	19.64	20	1.086	0.03	0.346	0.376
	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0cm	1	2412	17.4	18	1.148	-0.14	1.160	1.332
01	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0cm	6	2437	14.15	15	1.216	-0.05	1.180	1.435

### 14.2 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1st	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0cm	6	2437	14.15	15	1.216	-0.05	1.180	- 1.435
2nd	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0cm	6	2437	14.15	15	1.216	-0.09	1.170	1.01 1.423

### General Note:

1. Per KDB 865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8 \text{ W/kg}$
2. Per KDB 865664 D01v01r03, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45 \text{ W/kg}$ , only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

Test Engineer : Tom Jiang



## 15. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observations is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacturer's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 14.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor <sup>(a)</sup>	$1/k^{(b)}$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

- (a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity
- (b)  $k$  is the coverage factor

**Table 14.1. Standard Uncertainty for Assumed Distribution**

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.



Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
<b>Measurement System</b>							
Probe Calibration	6.0	Normal	1	1	1	± 6.0 %	± 6.0 %
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	1.0	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	$\sqrt{3}$	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1	1	± 0.2 %	± 0.2 %
Probe Positioning	2.9	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %
<b>Test Sample Related</b>							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	$\sqrt{3}$	1	1	± 2.9 %	± 2.9 %
<b>Phantom and Setup</b>							
Phantom Uncertainty	4.0	Rectangular	$\sqrt{3}$	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	$\sqrt{3}$	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
<b>Combined Standard Uncertainty</b>						± 11.0 %	± 10.8 %
<b>Coverage Factor for 95 %</b>						K=2	
<b>Expanded Uncertainty</b>						± 22.0 %	± 21.5 %

Table 14.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz



## **16. References**

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- [2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992
- [3] IEEE Std. 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v01r02, "SAR Measurement Procedures for 802.11 a/b/g Transmitters", May 2007
- [6] FCC KDB 447498 D01 v05r02, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Feb 2014
- [7] FCC KDB 865664 D01 v01r03, "SAR Measurement Requirements for 100 MHz to 6 GHz", Feb 2014.
- [8] FCC KDB 865664 D02 v01r01, "RF Exposure Compliance Reporting and Documentation Considerations" May 2013.