



RADIO EXPOSURE TEST REPORT

FCC ID : TX2-RTL8852CE
Equipment : 11ax RTL8852CE Combo module
Brand Name : REALTEK
Model Name : RTL8852CE
Applicant : Realtek Semiconductor Corp.
No. 2, Innovation Road II, Hsinchu Science Park,
Hsinchu 300, Taiwan
Manufacturer : Realtek Semiconductor Corp.
No. 2, Innovation Road II, Hsinchu Science Park,
Hsinchu 300, Taiwan
Standard : 47 CFR Part 2.1091

The product was received on Nov. 05, 2021, and testing was started from Nov. 24, 2021 and completed on Sep. 01, 2022. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR Part 2.1091 and shown 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. Hsinchu Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory

No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan



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TEL : 886-3-656-9065
FAX : 886-3-656-9085
Report Template No.: CB-A1 1 Ver1.1



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	PASS	-

Declaration of Conformity:

1. The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
2. The measurement uncertainty please refer to report "Measurement Uncertainty".

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen

Report Producer: Sandy Chuang

1 General Description

1.1 EUT General Information

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
2.4GHz WLAN	2400-2483.5	2412-2472	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHRT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850 5725-5895	5180-5250 5250-5320 5500-5720 5745-5825 5815-5885	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
6GHz WLAN	5925-7125	5955-7115	802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Bluetooth	2400-2483.5	2402-2480	BR / EDR: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK) LE: GFSK



1.2 Antenna Information

Ant.	Port			Brand	Model Name	Antenna Type	Connector	Gain (dBi)
	WLAN 2.4GHz	WLAN 5GHz / 6GHz	Bluetooth					
1	1/2	1/2	1	ARISTOTLE	RFA-27-JP378-4B-200	Monopole	I-PEX	Note 1
2	1/2	1/2	1	ARISTOTLE	RFA-27-JP326-MHF4300	PIFA	I-PEX	
3	1/2	1/2	1	ARISTOTLE	RFA-27-C38H1-MHF4300	Dipole	I-PEX	
4	-	1/2	-	ARISTOTLE	RFA-57-JP697-4B-300	Monopole	I-PEX	

Note 1

Ant.	Port			Gain (dBi)		
	WLAN 2.4GHz	WLAN 5GHz / 6GHz	Bluetooth	WLAN 2.4GHz	WLAN 5GHz / 6GHz	Bluetooth
1	1/2	1/2	1	3.38	4.86	3.38
2	1/2	1/2	1	3.50	5.00	3.50
3	1/2	1/2	1	3.00	5.00	3.00
4	-	1/2	-	-	-5	-

Note 2: The above information was declared by manufacturer.

Note 3: For Conducted measurement Test: Only the highest gain antenna "Ant. 2" was selected to perform the test and recorded in this report.

<For WLAN 2.4GHz function>

For IEEE 802.11b/g/n/VHT/ax (1TX/2RX):

For Conducted:

The EUT supports the antenna with TX diversity functions.

Both Port 1 and Port 2 support transmit and receive functions, but only one of them will be used at one time.

The Port 1 generated the worst case, so it was selected to test and record in the report.

Port 1 and Port 2 could receive simultaneously

For Radiated:

The EUT supports the antenna with TX diversity functions.

Both Port 1 and Port 2 support transmit and receive functions, but only one of them will be used at one time.

The Port 2 generated the worst case, so it was selected to test and record in the report.

Port 1 and Port 2 could receive simultaneously

For IEEE 802.11b/g/n/VHT/ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna.

Port 1 and Port 2 could transmit/receive simultaneously.

**<For WLAN 5GHz function>****For IEEE 802.11a/n/ac/ax (1TX/2RX):**

The EUT supports the antenna with TX diversity functions.

Both Port 1 and Port 2 support transmit and receive functions, but only one of them will be used at one time.

The Port 1 generated the worst case, so it was selected to test and record in the report.

Port 1 and Port 2 could receive simultaneously

For IEEE 802.11a/n/ac/ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna.

Port 1 and Port 2 could transmit/receive simultaneously.

<For WLAN 6GHz function>**For IEEE 802.11ax (1TX/2RX):**

The EUT supports the antenna with TX diversity functions.

Both Port 1 and Port 2 support transmit and receive functions, but only one of them will be used at one time.

The Port 1 generated the worst case, so it was selected to test and record in the report.

Port 1 and Port 2 could receive simultaneously

For IEEE 802.11ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna.

Port 1 and Port 2 could transmit/receive simultaneously.

<For Bluetooth function> (1TX/1RX):

Only Port 1 can be used as transmitting/receiving antenna.

Type	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$	$Directional\ IGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$
BF	$Directional\ IGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$	$Directional\ IGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$

Ex.

Directional Gain (NSS1) formula :

$$Directional\ IGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

$$NSS1(g1,1) = 10^{G1/20} ; NSS1(g1,2) = 10^{G2/20}$$

$$g_{j,k} = (NSS1(g1,1) + NSS1(g1,2))^2$$

$$DG = 10 \log[(NSS1(g1,1) + NSS1(g1,2) / N_{ANT})] \Rightarrow 10 \log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$$

Where ;

Monopole Antenna

$$2.4G\ G1 = 3.38\ dBi ; G2 = 3.38\ dBi ; DG = 6.39\ dBi$$

$$5G\ G1 = 4.86\ dBi ; G2 = 4.86\ dBi ; DG = 7.87\ dBi$$

$$6G\ G1 = 4.86\ dBi ; G2 = 4.86\ dBi ; DG = 7.87\ dBi$$

PIFA Antenna

$$2.4G\ G1 = 3.5\ dBi ; G2 = 3.5\ dBi ; DG = 6.51\ dBi$$

$$5G\ G1 = 5\ dBi ; G2 = 5\ dBi ; DG = 8.01\ dBi$$

$$6G\ G1 = 5\ dBi ; G2 = 5\ dBi ; DG = 8.01\ dBi$$

Dipole Antenna

$$2.4G\ G1 = 3\ dBi ; G2 = 3\ dBi ; DG = 6.01\ dBi$$

$$5G\ G1 = 5\ dBi ; G2 = 5\ dBi ; DG = 8.01\ dBi$$

$$6G\ G1 = 5\ dBi ; G2 = 5\ dBi ; DG = 8.01\ dBi$$



1.3 Accessories

N/A

1.4 Testing Location

Testing Location Information	
Test Lab. : Sporton International Inc. Hsinchu Laboratory	
Hsinchu	ADD: No.8, Ln. 724, Bo' ai St., Zhubei City, Hsinchu County 302010, Taiwan
(TAF: 3787)	TEL: 886-3-656-9065 FAX: 886-3-656-9085
	Test site Designation No. TW3787 with FCC.
	Conformity Assessment Body Identifier (CABID) TW3787 with ISED.



2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	*(100)	<6
3.0-30	1842/f	4.89/f	*(900/f ²)	<6
30-300	61.4	0.163	1.0	<6
300-1500	-	-	f/300	<6
1500-100,000	-	-	5	<6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f ²)	<30
30-300	27.5	0.073	0.2	<30
300-1500	-	-	f/1500	<30
1500-100,000	-	-	1.0	<30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

2.2 MPE Calculation Method

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$



2.3 MPE Exemption

Option (A): 1.1307(b)(3)(i)(A): Available maximum time-averaged power is < 1 mW

Option (B): 1.1307(b)(3)(i)(B): Device operates between 300 MHz and 6 GHz and the maximum time-averaged power or effective radiated power (ERP), whichever is greater, <= P_{th}.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

Option (C): 1.1307(b)(3)(i)(C): ERP is below a threshold calculated based on the distance

R between the person and the antenna / radiating structure, where $R > \lambda / 2 \pi$.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.
Note: R is in meters, f is in MHz.	



2.4 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

For WLAN 2.4GHz / WLAN 5G / WLAN 6G: 1TX

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
2.4G;D1D	3.50	22.48	25.98	0.5	26.48	0.44463	20	0.08845	1.00000
5.2G;D1D	5.00	21.81	26.81	0.5	27.31	0.53827	20	0.10708	1.00000
5.3G;D1D	5.00	21.63	26.63	0.5	27.13	0.51642	20	0.10274	1.00000
5.6G;D1D	5.00	21.75	26.75	0.5	27.25	0.53088	20	0.10561	1.00000
5.8G;D1D	5.00	22.43	27.43	0.5	27.93	0.62087	20	0.12352	1.00000
5.81G;D1D	5.00	21.45	26.45	0.5	26.95	0.49545	20	0.09856	1.00000
6.2G;D1D	5.00	23.88	28.88	0.50	29.38	0.86696	20	0.17247	1.00000
6.4G;D1D	5.00	15.19	20.19	0.50	20.69	0.11722	20	0.02332	1.00000
6.7G;D1D	5.00	23.98	28.98	0.50	29.48	0.88716	20	0.17649	1.00000
7.0G;D1D	5.00	15.21	20.21	0.50	20.71	0.11776	20	0.02343	1.00000

For WLAN 2.4GHz / WLAN 5G / WLAN 6G: 2TX

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
2.4G;D1D	6.51	25.16	31.67	0.5	32.17	1.64816	20	0.32788	1.00000
5.2G;D1D	8.01	21.76	29.77	0.5	30.27	1.06414	20	0.21170	1.00000
5.3G;D1D	8.01	21.79	29.80	0.19	29.99	0.99770	20	0.19848	1.00000
5.6G;D1D	8.01	21.9	29.91	0.08	29.99	0.99770	20	0.19848	1.00000
5.8G;D1D	8.01	24.33	32.34	0.5	32.84	1.92309	20	0.38258	1.00000
5.81G;D1D	8.01	20.46	28.47	0.5	28.97	0.78886	20	0.15694	1.00000
6.2G;D1D	8.01	21.93	29.94	0.50	30.44	1.10662	20	0.22015	1.00000
6.4G;D1D	5.00	12.21	17.21	0.50	17.71	0.05902	20	0.01174	1.00000
6.7G;D1D	8.01	21.96	29.97	0.50	30.47	1.11429	20	0.22168	1.00000
7.0G;D1D	5.00	10.03	15.03	0.50	15.53	0.03573	20	0.00711	1.00000

For Bluetooth

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
2.4G;BT-BR	3.50	12.43	15.93	0.50	16.43	0.04395	20	0.00874	1.00000
2.4G;BT-LE	3.50	12.48	15.98	0.50	16.48	0.04446	20	0.00885	1.00000



MPE Exemption Option B							
Mode	Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	MPE Exemption
2.4G;D1D (2TX)	2437	0.2	32.17	30.02	1.005	3.060	Complies
5G;D1D (2TX)	5795		32.84	30.69	1.172	3.060	Complies
BT (1TX)	2440		16.48	14.33	0.027	3.060	Complies
2.4G;D1D (1TX)	2437		26.48	24.33	0.271	3.060	Complies
5G;D1D (1TX)	5825		27.93	25.78	0.378	3.060	Complies

MPE Exemption Option C								
Mode	Frequency (MHz)	$\lambda/2\pi$ (m)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	MPE Exemption
6G;D1D (2TX)	6625	0.0072	0.2	30.47	28.32	0.679	0.768	Complies
6G;D1D (1TX)	6695	0.0071		29.48	27.33	0.541	0.768	Complies

**Simultaneous Transmission Analysis Mode:****Bluetooth + WLAN 5GHz : 2TX**

Simultaneous Transmissions Option B+C								
Option	Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
B	2440	0.2	16.48	14.33	0.027	3.060	0.39	<= 1
B	5795		32.84	30.69	1.172	3.060		

Bluetooth + WLAN 6GHz : 2TX

Simultaneous Transmissions Option B+C								
Option	Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
B	2440	0.2	16.48	14.33	0.027	3.060	0.89	<= 1
C	6625		30.47	28.32	0.679	0.768		

WLAN 2.4GHz: 1TX + WLAN 5GHz : 1TX

Simultaneous Transmissions Option B+C								
Option	Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
B	2437	0.2	26.48	24.33	0.271	3.060	0.21	<= 1
B	5825		27.93	25.78	0.378	3.060		

WLAN 2.4GHz: 1TX + WLAN 6GHz : 1TX

Simultaneous Transmissions Option B+C								
Option	Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
B	2437	0.2	26.48	24.33	0.271	3.060	0.79	<= 1
C	6695		29.48	27.33	0.541	0.768		

Bluetooth + WLAN 5GHz : 1TX + WLAN 6GHz : 1TX

Simultaneous Transmissions Option B+C								
Option	Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
B	2440	0.2	16.48	14.33	0.027	3.060	0.84	<= 1
B	5825		27.93	25.78	0.378	3.060		
C	6695		29.48	27.33	0.541	0.768		

Note: The above antenna gain was declared by manufacturer.

————THE END————