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1.0 Maximum Permissible Exposure Evaluation (Supplements the test report.)

The measured power is considered for the intended use of the device and resulting RF exposure to the user.

1.2 Criteria

Section Reference	Date
447498 D01 General RF Exposure Guidance v06 // RSS-102 Issue 5	21 Oct 2021

1.3 Procedure

Using measurement of peak power and considering the intended application, determine the permissible exposure level, applicability of exclusion, or whether additional exposure tests (SAR) are indicated. When applicable justify conclusion for selected exposure level and separation distance.

This transmitter is used as a fixed table-top mounted base station to control irrigation valves. User contact with the device is not required for operation. Typical operation involves applying power and configuring with a remote WLAN connection. The device contains a BLE radio and a WLAN certified radio module. These radios do not transmit simultaneously, so collocated RF Exposure is not considered. 40mm is assumed as a worst-case user proximity considering the chip antenna is mounted inside the chassis and no external contact is required to operate the device.

WLAN Radio Details:

FCCID: 2AHMR-ESP12F

IC ID: 23236-ESP12F

RF Exposure Report No.: EED32J00186202

Date of Issue: September 13, 2017

Duty Cycle Correction Factor Measurement (BLE Radio):

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

Continuous packet transmission mode was used for the duty cycle measurement, which would represent a worst-case operating scenario. Duty Cycle measurement was performed on 18 Oct, 2021.

Duty Cycle - Conducted Test Data																		
Environmental Conditions:			Temperature		22	°C	Humidity		52	RH	Barometric Pressure		30.00	in Hg				
Measurement Parameters:			RBW		1 MHz		VBW		3 MHz		Span		0 Hz		Detector		Peak	
Measured On Time (ms)		Max On Time Allowed (ms)		On Time Result		Measured Time Interval (ms)		Duty Cycle Factor (dB) (20 * Log(On time/Interval))				Duty Cycle Factor Allowed (dB)						
2.113		100		N/A		4.226		-6.02				-6.02						
RF Exposure Allowable Duty Cycle Reduction (10*Log(On time/Interval):												-3.01						

Agilent 15:33:38 Oct 18, 2021										Trace			
Ref 0 dBm Atten 10 dB												Trace 1 2 3	
Peak Log 10 dB/												Clear Write	
Marker Δ 2.113 ms 0.97 dB												Max Hold	
LgAv												Min Hold	
M1 S2 S3 VC AA												View	
E(f): FTun												Blank	
Center 2.440 000 GHz Span 0 Hz												More 1 of 2	
Res BW 1 MHz VBW 3 MHz Sweep 2.928 ms (8001 pts)													
File Operation Status, A:\SCREEN17.61F file saved													

Agilent 16:01:19 Oct 18, 2021										Trace			
Ref 0 dBm Atten 10 dB												Trace 1 2 3	
Peak Log 10 dB/												Clear Write	
Marker Δ 4.226 ms -0.01 dB												Max Hold	
LgAv												Min Hold	
M1 S2 S3 VC AA												View	
E(f): FTun												Blank	
Center 2.440 000 GHz Span 0 Hz												More 1 of 2	
Res BW 1 MHz VBW 3 MHz Sweep 10.13 ms (8001 pts)													
File Operation Status, A:\SCREEN19.61F file saved													

Transmit Event Time										Transmit Interval									
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Duty Cycle Measurement

1.4 Power to Exposure Calculation

For 2.4 GHz radio power is determined by conducted measurement. Safe exposure distance was calculated for the allowed maximum uncontrolled public exposure limit.

BLE Radio Output Power:

Table 1.4.1 Power Calculation for Exposure, 2.4 GHz BLE Radio (Highest frequency 2.480 GHz)				
Measured Conducted Peak Power dBm	Source Duty Cycle Factor dB	Antenna Gain dBi	Calculated EIRP dBm	EIRP In Linear Terms mW
12.56	-3.01	0.5	10.05	10.12

WLAN Radio Output Power:

Table 1.4.2 Power Calculation for Exposure, 2.4 GHz WLAN Radio (Highest frequency 2.480 GHz)				
Measured Conducted Peak Power dBm	Source Duty Cycle Factor dB	Antenna Gain dBi	Calculated EIRP dBm	EIRP In Linear Terms mW
16.39	0	2.0	18.39	69.02

The WLAN radio is selected for worst-case RF Exposure consideration since the BLE and WLAN radios do not transmit simultaneously, and 69.02mW > 10.12 mW.

1.5 SAR Exemption Calculation – FCC

Applicable requirement: KDB 447498 Clause 4.3.1 Section 1

Calculated power (max power including tune up tolerance = 69.02 mW):

$$[(69.02 \text{ mW})/(40 \text{ mm})] \cdot [\sqrt{2.4 \text{ (GHz)}}] = 2.67$$

$$2.67 \leq 6.0 \text{ (Limb exposure)}$$

$$2.67 \leq 3.0 \text{ (Non-Limb exposure)}$$

1.6 SAR Exemption Calculation – IC

Applying Table 1 of clause 2.5.1 applying 4cm (or 40mm) spacing column and row 2450 MHz. The exemption limit is 173 mW.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

51.17 mW < 173 mW

1.7 Conclusion

The exposure limit is satisfied.

Signed:



Larry Finn
