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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 wireless remote control for industrial machinery. This is a hand-held device that the user interacts with during normal operation. The transmitter antenna is located inside the unit such that the user cannot be closer than 5mm to the antenna during normal operation. During continuous transmission the device operates under a low duty cycle packet scheme.

**Duty Cycle Correction Factor Measurement:**

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.
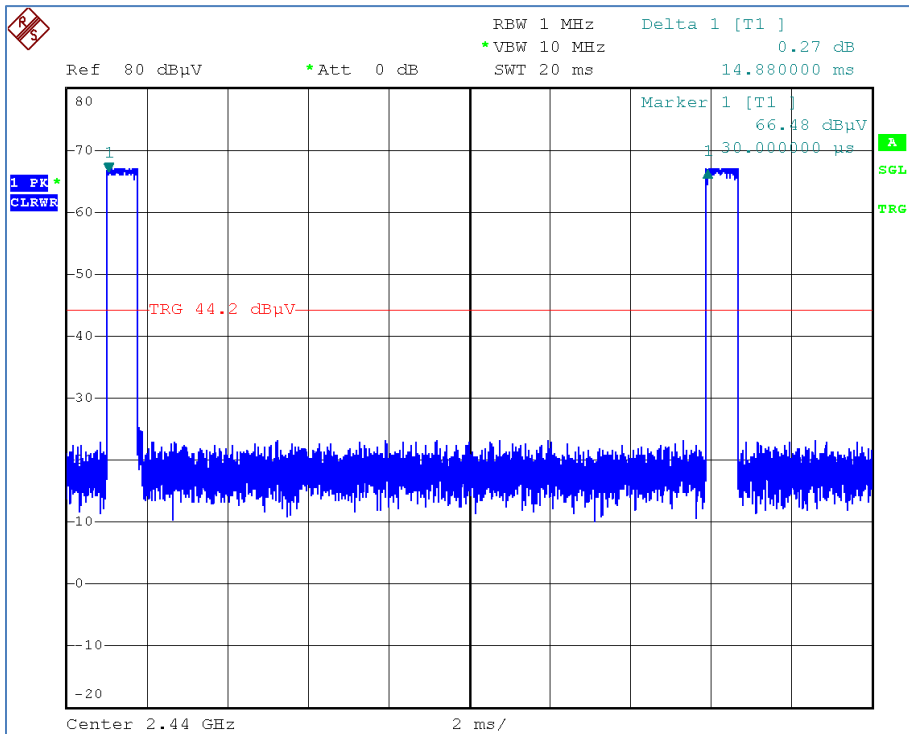
Table 4.3.2 Exposure Source Duty Cycle Results				
Measured On Time (msec)	Measured Time Interval (msec)	Exposure Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
0.77475	14.88	$= 10 * \text{Log}_{10} (0.77475 \text{ msec} / 14.88 \text{ msec})$	-12.83	-12.83

Duty Cycle Measurement

Plotted measurements appear below:
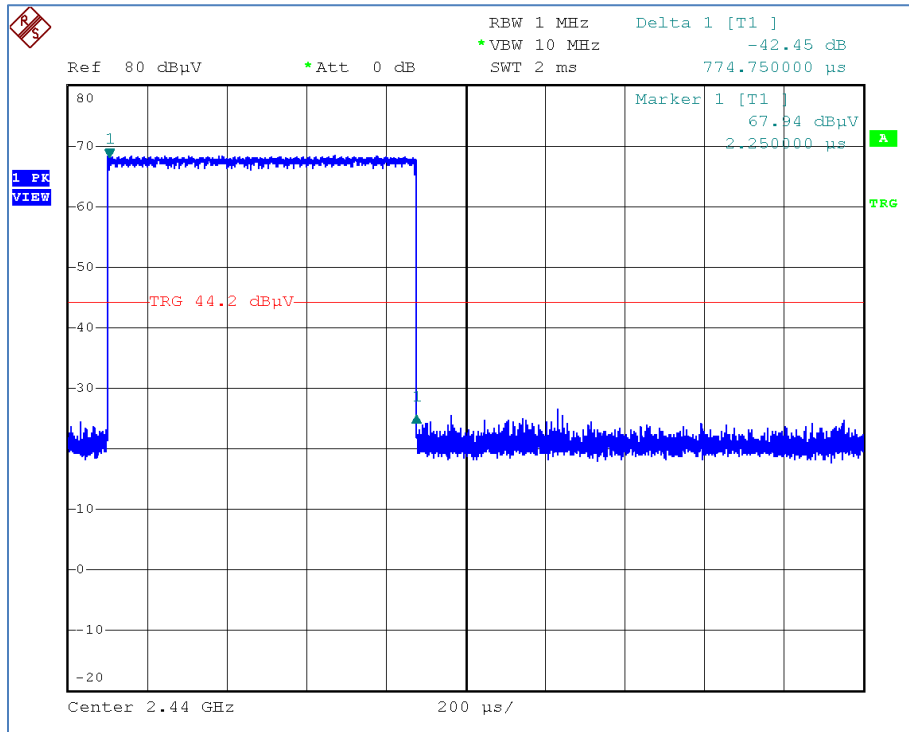
Transmit Time

Transmit Period

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.

Table 1.4.1 Power Calculation for Exposure, 2.4 GHz 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
14.0	-12.83	N/A	1.17	1.31

1.5 SAR Exemption Calculation – FCC

Applicable requirement: KDB 447498 Clause 4.3.1 Section 1

Calculated power (max power including tune up tolerance = 1.31 mW):

$$[(1.31 \text{ mW})/(5 \text{ mm})] \cdot [\sqrt{2.4} \text{ (GHz)}] = 0.17$$

$0.17 \leq 6.0$ (Limb exposure)
$0.17 \leq 3.0$ (Non-Limb exposure)

1.6 SAR Exemption Calculation – IC

Applying Table 1 of clause 2.5.1 applying 0.5cm (or 5mm) spacing column and row 2450 MHz. The exemption limit is 4 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

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance[4,5]

1.31 mW < 4 mW

1.7   Conclusion

The exposure limit is satisfied.

Signed:

Larry Finn

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