1601 North A.W. Grimes Blvd., Suite B
Round Rock, TX 78665
e-mail: info@ptitest.com
(512) 244-3371 Fax: (512) 244-1846

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

The results of power measurement and intended use are compared to the RF exposure exemption criteria.

1.2 Criteria

Section Reference	Date
KDB 447498 D01 Mobile Portable RF Exposure v05r01	3 Oct 2018

1.3 Procedure

Measured peak power, calculated average, and spacing for the intended application are used to determine the maximum permissible exposure.

1.4 Exposure Calculation

This is an aircraft transponder which is mounted within the airframe with an installer-supplied antenna on the exterior of the aircraft surface. The modulation of the transmitted signal is OOK. The distance evaluated is 20 cm (200 mm) for uncontrolled exposure at 1090 MHz and controlled exposure at 1030 MHz. By design the device stops transmitting when the aircraft is on the ground. As such RF exposure would only occur if the installer left the airframe and inspected the area around the antenna during installation or testing.

Table 1.4.1 Peak Power Measured In 10 MHz RBW, 50 MHz VBW	
1090 MHz; Top Port	55.8 dBm or 380 Watts
1090 MHz; Bottom Port	55.4 dBm or 347 Watts
1030 MHz; Top Port	*Not supported, not applicable.*
1030 MHz; Bottom Port	57.2 dBm or 525 Watts

Table 1.4.2 Calculated Duty Cycle and Average Power; 1090 MHz	
Measured Power (peak)	55.8 dBm or 380 Watts
Transmit Times (µs)	Per DO-181E: 500 Mode A/C, 50 Mode S replies, 6.2 Squitters/second
Total Transmit Time	7215 **µs**
Maximum Duty Cycle	0.72 %
Averaging Factor	10 $\log_{10}$ (0.72%) = -21.4 dB
Average Power; 1090 MHz	P_{peak} + $Factor_{avg}$ = 55.8 – 21.4 = 34.4 dBm or 2754 mW

Table 1.4.3 Calculated Duty Cycle and Average Power; 1030 MHz	
Measured Power (peak)	55.8 dBm or 380 Watts
Transmit Times (µs)	Per DO-181E: 500 Mode A/C, 50 Mode S replies, 6.2 Squitters/second
Total Transmit Time	25.8 **µs**
Maximum Duty Cycle	0.29 %
Averaging Factor	10 $\log_{10}$ (0.29%) = -25.4 dB
Average Power; 1030 MHz	P_{peak} + $Factor_{avg}$ = 57.2 – 25.4 = 31.8 dBm or 1514 mW

Additionally, as this is an on/off pulsed transmitter, there is no power during half of the transmitted pulse train, so a factor of -3.0 dB is applied as a Pulse Modulation Factor considering the nature of the modulation.

Table 1.4.4 Power Calculation for Exposure

Frequency	Average Power dBm	Maximum Antenna Gain dBi	Pulse Modulation Factor dB	Calculated EIRP dBm	EIRP In Linear Terms mW
1090 MHz	34.4	3.1*	-3.0	34.5	2818
1030 MHz	31.8	3.1*	-3.0	31.9	1549

*The manufacturer does not supply antennas. Monopole is typical antenna type where monopole gain would be 2.19 dBi.

1090 MHz

Find safe Distance for maximum exposure of f/1500 = 1090/1500 = 0.73 mW/cm^2:

$Distance_{safe} = \sqrt{(P \cdot G / 4 \cdot \pi \cdot S)}$ given Pwr_{avg} = 2818 mW, Gain = 1*, S = 0.73 mW/cm.
**Gain included in term P.*

$Distance_{safe} = \sqrt{(2818 / 4 \cdot \pi \cdot 0.73)} = 17.5$ cm.

Find field density at 20 cm for General Population (uncontrolled) exposure:

Limit S = 1090/1500 = 0.73 mW/cm^2:

$S = (P \cdot G) / (4 \cdot \pi \cdot [Distance]^2)$ = given Pwr_{avg} = 2818 mW, Gain = 1*, Distance = 20 cm.
**Gain included in term P.*

$S = (2818) / (4 \cdot \pi \cdot [20\text{ cm}]^2) = 0.6$ mW/cm^2

0.6 mW/cm^2 < 0.73 mW/cm^2

1030 MHz

Find safe Distance for maximum exposure of f/1500 = 1030/1500 = 0.69 mW/cm^2:

$Distance_{safe} = \sqrt{(P \cdot G / 4 \cdot \pi \cdot S)}$ given Pwr_{avg} = 1549 mW, Gain = 1*, S = 0.69 mW/cm.
**Gain included in term P.*

$Distance_{safe} = \sqrt{(1549 / 4 \cdot \pi \cdot 0.69)} = 13.4$ cm.

Find field density at 20 cm for General Population (uncontrolled) exposure:

Limit S = 1030/1500 = 0.69 mW/cm^2:

$S = (P \cdot G) / (4 \cdot \pi \cdot [Distance]^2)$ = given Pwr_{avg} = 1549 mW, Gain = 1*, Distance = 20 cm.
**Gain included in term P.*

$S = (1549) / (4 \cdot \pi \cdot [20\ cm]^2) = 0.31\ mW/cm^2$

$0.31\ mW/cm^2 < 0.69\ mW/cm^2$

Therefore, the exposure meets the applicable FCC SAR exemption requirements for a distance of 20 cm for uncontrolled public exposure.

Signed:

Eric Lifsey

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