

SAR Exclusion Calculation

Project: C10004

Report number: C16897TR1

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Customer Details

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Equipment Under Test: Highway1 Rev B

FCC ID: 2BD8H-HIGHWAY1

IC: 35374-HIGHWAY1

HVIN: A10000-1001

FVIN: 2.0.0

Operating frequency bands: RFID: 13.11 to 14.01MHz

SAR Exclusion Calculation - FCC

The calculation is according to the FCC Knowledge Database (KDB) document KDB 447498 D01 General RF Exposure Guidance V06.

For equipment operating below 100MHz section 4.3.1 c) for <100MHz and test separation distances ≤50mm was specifically applied. According to this section the SAR test exclusion thresholds are determined by the following:

$$\text{Threshold} = 0.5 \cdot \left[\frac{P(\text{mW}) \cdot \sqrt{f(\text{GHz})}}{d(\text{mm})} + \frac{(d(\text{mm}) - 50) \cdot f(\text{MHz})}{150} \right] \cdot \left[1 + \log \left(\frac{100}{f(\text{MHz})} \right) \right]$$

Where

P is the maximum power of the channel including tune-up tolerance in mW

d is the minimum test separation distance in mm

f is the RF channel frequency in GHz

The minimum test separation distance was considered to be 50mm for the RFID in consultation with Section 4.2.2 *Body-worn accessory exposure conditions*.

This evaluation of the threshold is compared to the threshold limit.

- a. Limit for 1-g head or body worn devices: threshold limit ≤3
- b. Limit for 10-g extremity worn devices: threshold limit ≤7.5

Since the device can be touched by hand, the limit b applies.

For this apparatus, the calculated threshold was evaluated using a distance of 50mm, and the results are tabulated in the table below.

The power level values are taken from testing report C16896TR1.

Frequency (MHz)	Power (mW)	Dist (mm)	Calculated Threshold	Threshold Limit
13.56	0.000023	50	5x10 ⁻⁸	7.5

Table 1 Calculation of threshold RFID

Note: The radiated Power (ERP) of the device was calculated from the radiated field strength:

$$\text{ERP (dBm)} = \text{Radiated field strength (dB}\mu\text{V/m)} + 20\log(d) - 104.77 - 2.15$$

where d is the distance of measurement for field strength in metres.

Conclusion

For the required stated distance the apparatus met the exclusion requirements for SAR testing (FCC).

SAR Exclusion Calculation - ISED**Standard:****RSS-102 Radio Frequency (RF) ~Exposure Compliance of Radio communication Apparatus (All Frequency Bands)**

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From RSS-102: 6.3 SAR exemption limits

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 11.

Table 11: Power limits for exemption from routine SAR evaluation based on the separation distance

Frequency (MHz)	≤ 5 mm(mW)	10 mm (mW)	15 mm(mW)	20 mm(mW)	25 mm(mW)	30 mm(mW)	35 mm(mW)	40 mm(mW)	45 mm(mW)	> 50 mm(mW)
≤ 300	45	116	139	163	189	216	246	280	319	362
450	32	71	87	104	124	147	175	208	248	296
835	21	32	41	54	72	96	129	172	228	298
1900	6	10	18	33	57	92	138	194	257	323
2450	3	7	16	32	56	89	128	170	209	245
3500	2	6	15	29	50	72	94	114	134	158
5800	1	5	13	23	32	41	54	74	102	128

For limb-worn devices where the 10 gram of tissue applies, the exemption limits for routine evaluation in table 11 are multiplied by a factor of 2.5.

For controlled-use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in table 11 Table 11 are multiplied by a factor of 5.

When the operating frequency of the device is between two frequencies located in table 11, linear interpolation shall be applied for the applicable separation distance. If the separation distance of the device is between two distances located in table 11, linear interpolation may be applied for the applicable frequency. Alternatively, the limit corresponding to the smaller distance may be employed.

RFID

The power level values are taken from testing report C16896TR1.

Frequency (GHz)	Max EIRP (dBm)	Max EIRP (mW)	Dist (mm)	Exemption Limit (mW)	SAR Test required
0.01356	-46.4	0.000023	50.0	362	No

Conclusion

For the required stated distances, the apparatus met the exclusion requirements for SAR testing (ISED).

Prepared by:



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