

HS-10B, HS-10C SAR Exclusion Calculation - FCC

Reference documents

- KDB 447498 D01 General RF Exposure Guidance V06

General Information:

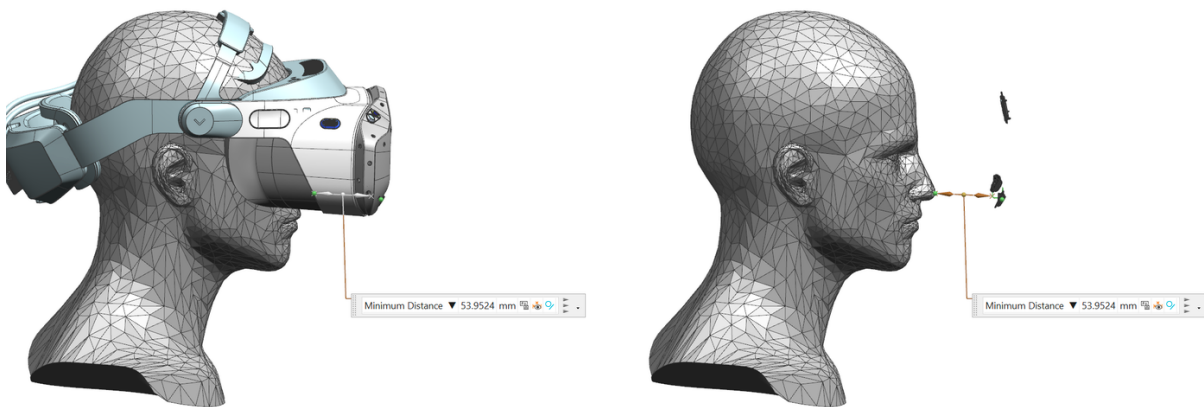
HS-10B and HS-10C contain a total of 3 radio transmitters that can in theory transmit simultaneously:

Transmitter 1: Varjo Controller radio, certified as a part of host FCC ID: 2AROD-005, IC: 24483-005

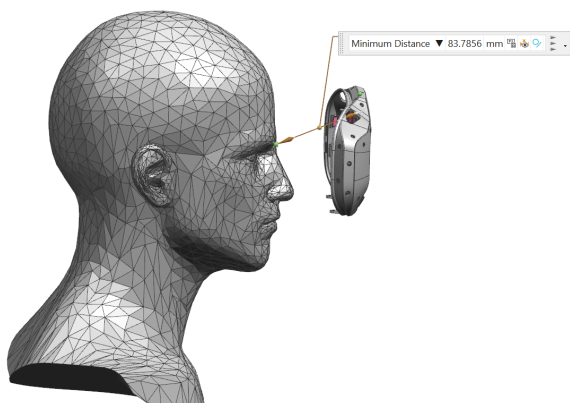
Transmitters 2 & 3: Raytac MDBT50Q-P1MV2, certified modules. FCC ID: SH6MDBT50Q, IC: 8017A-MDBT50Q

Stand-alone configuration

The device is a head-worn device, and it is stated in the user guide that the area of use should be cleared from people. Hence the minimum separation distance for head SAR is the distance of the antenna to the user's face when wearing the headset. This distance is measured as 54 mm for transmitter 1 as seen in the picture below, however as face proportions are different between people, the distance has been reduced to 40 mm to cover all possible use cases.



For transmitters 2 & 3 the distance to the users head is measured as approximately 84 mm as seen in picture below, but there are different physical proportions between people, a distance of 70mm was used to cover all possible use cases.



It is possible for the user to touch the headset with hands during use, so for the extremity SAR the minimum separation distance is the distance between the antennas and the external surfaces of the HMD. This distance is less than 5 mm for all three transmitters, so the minimum test separation used for the extremity SAR the calculations is 5 mm according to 4.1 f) of the General RF Exposure Guidance.

The tune-up tolerance has been declared as ± 0.5 dB, this value has been added to the measured output powers to cover the variation between devices.

This calculation for transmitter 1 has been made according to Section 4.3.1a) for 100 MHz to 6 GHz and test separation distances ≤ 50 mm. According to this section of the General Exposure guidance V06 the SAR test exclusion thresholds are determined by the following:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. separation distance, mm})] * [\sqrt{f_{\text{(GHz)}}}] \leq 3.0$$

This calculation for transmitter 2 and 3 has been made according to Section 4.3.1 b) for 100 MHz to 6 GHz and test separation distance > 50 mm. According to this section of the General Exposure guidance V06 of the SAR test exclusion thresholds are determined by the following:

$$\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) * 10]\} \text{ mW}$$

The calculated test exclusion threshold is compared to the threshold limits:

1. Limit for 1-g head or body worn devices: ≤ 3
2. Limit for 10-g extremity worn devices: ≤ 7.5

Stand-alone transmitters:

Standalone transmitters	Channel frequency [GHz]	Maximum peak conducted output power [dBm]	Maximum output power EIRP with Tune-up tolerance [dBm]	Maximum output power EIRP with Tune-up tolerance [mW]	Head SAR			Extremity SAR	
					Separation distance [mm]	Calculated Threshold (Limit ≤ 3)	Power threshold for > 50 mm [mW]	Separation distance [mm]	Calculated Threshold (Limit ≤ 7.5)
Transmitter 1	2,402	3,8	7,1829	5,2	40	0,2	NA for ≤ 50 mm	5	1,6
	2,44	4,3	7,6829	5,9	40	0,2	NA for ≤ 50 mm	5	1,8
	2,48	3,9	7,2829	5,3	40	0,2	NA for ≤ 50 mm	5	1,7
Transmitter 2	2,402	N/A *	8,07	6,4	70	NA for > 50mm	296,8	5	2
	2,44	N/A *	8,26	6,7	70	NA for > 50mm	296,0	5	2,1
	2,48	N/A *	8,31	6,8	70	NA for > 50mm	295,3	5	2,1
Transmitter 3	2,402	N/A *	8,07	6,4	70	NA for > 50mm	296,8	5	2
	2,44	N/A *	8,26	6,7	70	NA for > 50mm	296,0	5	2,1
	2,48	N/A *	8,31	6,8	70	NA for > 50mm	295,3	5	2,1

* The test report for the Raytac modules does not list this value.

Simultaneous transmitters:

	Channel frequency [GHz]	Maximum output power EIRP with Tune-up tolerance [mW]	Estimated 1-g Head SAR Level [W/kg]	Estimated 10-g Extremity SAR Level [W/kg]
Transmitter 1	2,402	5,2	0,03	0,09
	2,44	5,9	0,03	0,10
	2,48	5,3	0,03	0,09
Transmitter 2	2,402	6,4	0,40 *	0,11
	2,44	6,7	0,40 *	0,11
	2,48	6,8	0,40 *	0,11
Transmitter 3	2,402	6,4	0,40 *	0,11
	2,44	6,7	0,40 *	0,11
	2,48	6,8	0,40 *	0,11

* The values 0,4 has been used for distances above 50mm as instructed in the KDB 477498 D01 Section

	Channel frequency [MHz]	Estimated 1-g Head SAR Level [W/kg]	Estimated 10-g Extremity SAR Level [W/kg]
All transmitters summed	2402	0,83	0,30
	2440	0,83	0,32
	2480	0,83	0,32

Conclusion

All transmitters meet the exemption limit requirements for test exclusion in stand-alone and simultaneous transmission configurations.

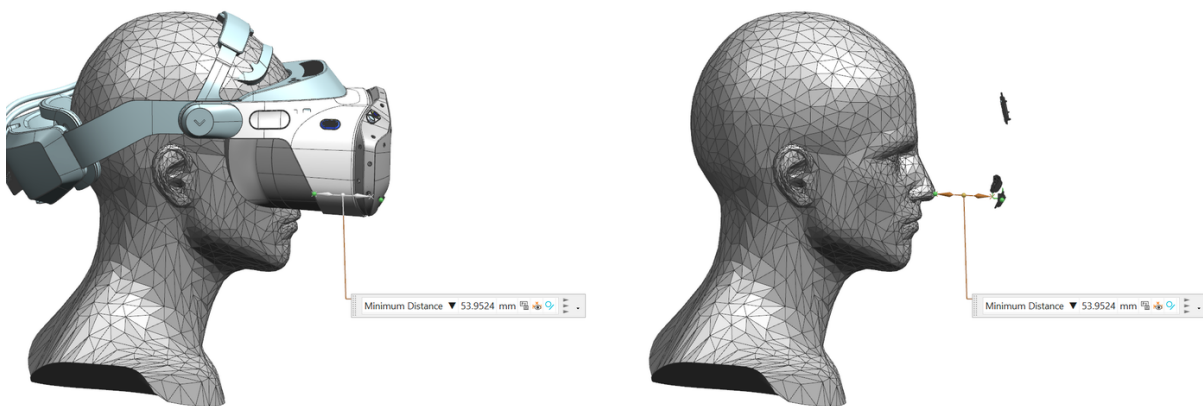
HS-10B, HS-10C SAR Exclusion Calculation - ISED

Reference documents

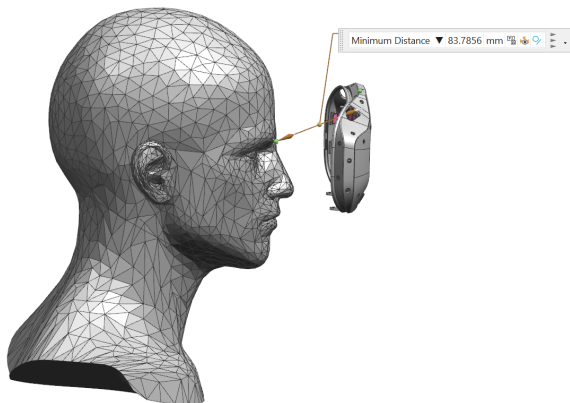
- RSS-102 Radio Frequency (RF) ~Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 6

The device contains three separate RF transmitters with operating frequencies between 2402 – 2480 MHz. Therefore, only the SAR requirements are applicable to the device.

The device is a head-worn device, and it is stated in the user guide that the area of use should be cleared from people. Hence the minimum separation distance for head SAR is the distance of the antenna to the user's face when wearing the headset. This distance is measured as 54 mm for transmitter 1 as seen in the picture below, however as face proportions are different between people, the distance has been reduced to 40 mm to cover all possible use cases.



For transmitters 2 & 3 the distance to the users head is measured as approximately 84 mm as seen in picture below, but there are different physical proportions between people, a distance of 70mm was used to cover all possible use cases.



It is possible for the user to touch the headset with hands during use, so for the extremity SAR the minimum separation distance is the distance between the antennas and the external surfaces of the HMD. This distance is less than 5 mm for all three transmitters, so the minimum test separation used for the extremity SAR the calculations is 5 mm.

The tune-up tolerance has been declared as ± 0.5 dB, this value has been added to the measured output powers to cover the variation between devices.

Estimated SAR levels for each transmitter

	Channel frequency [GHz]	Maximum output power EIRP with Tune-up tolerance [mW]	Linear extrapolation of exemption limit for 1-g SAR [40mm / 70mm]*	Estimated Head SAR level [W/kg]	SAR based Exposure Ratio	Linear extrapolation of exemption limit for 10-g SAR [≤ 5 mm]	Estimated Extremity SAR level [W/kg]	SAR based Exposure Ratio
Transmitter 1	2,402	5,2	172,09	0,01	0,00755	8,15	0,64	0,159
	2,44	5,9	170,44	0,01	0,00865	7,64	0,77	0,193
	2,48	5,3	168,40	0,01	0,00787	7,43	0,71	0,178
Transmitter 2	2,402	6,4	251,81	0,01	0,00635	8,15	0,78	0,196
	2,44	6,7	246,42	0,01	0,00680	7,64	0,88	0,219
	2,48	6,8	242,51	0,01	0,00701	7,43	0,92	0,229
Transmitter 3	2,402	6,4	251,81	0,01	0,00635	8,15	0,78	0,196
	2,44	6,7	246,42	0,01	0,00680	7,64	0,88	0,219
	2,48	6,8	242,51	0,01	0,00701	7,43	0,92	0,229

*) The distance for 1-g SAR is 40 mm for Transmitter 1 and 70 mm for Transmitters 2 & 3, which is the distance between the antennas and the users head when the headset is worn.

Exemption limits in mW for 2402 MHz, 2440 MHz and 2480 MHz has been calculated using linear interpolation. The exemption limit for limb-worn has been calculated by multiplying the interpolated value for 5 mm distance with 2.5 as instructed in clause 6.3 of RSS-102 Issue 6. The estimated SAR level has been calculated according to clause 7.1.8 of RSS-102 Issue 6. SAR exposure ratio has been calculated according to 8.2.2.1 of RSS-102 Issue 6.

Multiple transmitters:

The total exposure ratio has been calculated according to clause 8.2.3 for low, mid and high channels by summing the SAR based exposure ratios of all three transmitters.

Total Exposure Ratio		
Channel [MHz]	Head 1-g TER _{therm}	Extremity 10-g TER _{therm}
2402	0,02	0,55
2440	0,02	0,63
2480	0,02	0,64

Conclusion

The transmitter meets the exemption limit requirements for test exclusion in a stand-alone configuration. The summed thermal exposure ratio is under the limit of 1 for both 1-g and 10-g.

