

Analysis report for SAR test exclusion according to KDB 447498

1. General information

The “ReDS System” is a non-invasive bedside monitor connected to a wearable vest and used for the measurement of lung fluid. The “ReDS System” transmitter of wearable vest is a portable device operating in the 957 MHz -1718 MHz range using stepped CW modulation. It is equipped with a body-coupled shielded EM transducer (antenna) located at 1.5 mm from the human body.

2. SAR test exclusion justification

The applicability SAR limits and RF exposure analysis was performed under the following conditions representing the worst-case scenario in terms of Peak power (no average factors or duty cycle were applied), conducted power was evaluated for the exclusion and the allowance was made for the applicable tune-up tolerances:

- 1) Peak conducted power measurements were taken accordingly.
- 2) Tune-up tolerance limits for conducted power were also evaluated accordingly.
- 3) A minimum separation distance is taken as 1.5mm (although according to KDB 447498 section 4.3.1 (a) a 5 mm minimal separation distance should be applied)

The following formulas are used:

- (1) Transmitter power [dBm] = 10log(Transmitter power [mW])

The SAR exclusion threshold was calculated as follows:

$$\frac{P(mW) \times \sqrt{f(GHz)}}{D(mm)} \leq 3.0 \text{ for } 1 - g \text{ SAR}$$

P – is the maximum allowed power including manufacturing tune up tolerance in mW;

D - is the minimum separation distance required for exclusion from SAR testing in mm;

f – is the transmitter carrier frequency in GHz.

Converting the equation into the power threshold exclusion for the given separation distance of 1.5 mm will get:

$$P_{SAR \text{ exclusion}}(mW) \leq \frac{3.0 \times D(mm)}{\sqrt{f(GHz)}} \text{ for } 1 - g \text{ SAR}$$

The SAR exclusion threshold for the investigated frequencies at 1.5 mm test separation distance is provided in the table below:

Carrier frequency, MHz	Power, mW	Power, dBm
957	4.6	6.6
958	4.6	6.6
1242	4.0	6.1
1636	3.5	5.5
1718	3.4	5.2

3. Measurement results

3.1 Conducted output power measurements

The conducted power measurements test setup is provided in the Photograph 3.1.1 below.

Photograph 3.1.1 Power measurements test setup



According to the tune-up procedure the conducted power levels in production have to be within the ranges shown in Table 3.1.2.

Table 3.1.2 Power levels in production (including tolerances)

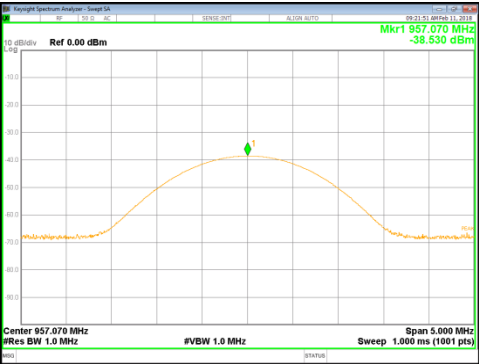
Carrier frequency, MHz	Min level of peak conducted power, dBm	Nominal level of peak conducted power, dBm	Max level of peak conducted power, dBm
957.0625	-40.1	-38.9	-37.8
958.0625	-40.1	-38.9	-37.8
1242.0625	-28.8	-27.5	-26.3
1636.0625	-31.0	-29.7	-28.4
1718.0625	-31.8	-30.4	-29.0

Conducted power measurements (refer to plots below) were performed to verify the values of the single sample are within the applicable ranges of the power including the relevant tolerances, however the SAR exclusion evaluation was performed based on the maximum values that could be reached after ATP in the mass production.

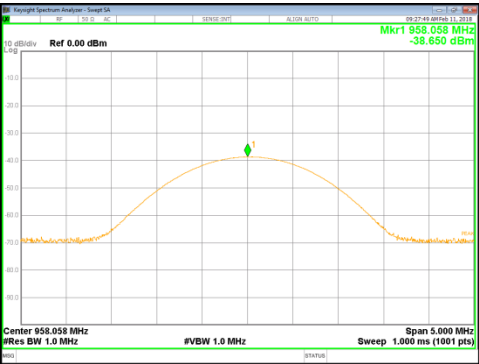
Table 3.1.3 Conducted output power levels test results

Carrier frequency, MHz	Measured power		Tune-up max power		1-g SAR exclusion threshold, mW	1-g SAR evaluation	1-g SAR test exclusion threshold	Verdict
	dBm	mW	dBm	mW				
957.0625	-38.53	0.000140281	-37.8	0.0001663	4.6	0.003429819	3.0	Pass
958.0625	-38.65	0.000136458	-37.8	0.0001661	4.6	0.003427483		Pass
1242.0625	-27.46	0.001794734	-26.3	0.0023512	4.0	0.055242082		Pass
1636.0625	-29.71	0.001068071	-28.4	0.0014495	3.5	0.039086511		Pass
1718.0625	-30.25	0.000944931	-29.0	0.0012500	3.4	0.034541265		Pass

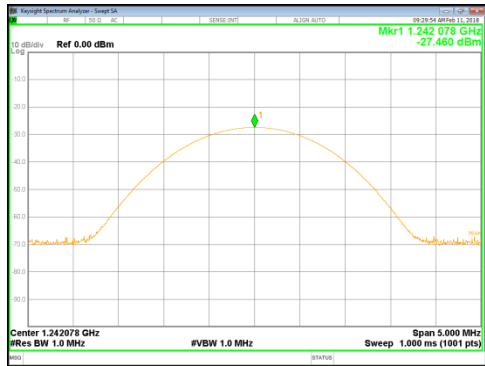
Plot 3.1.1 Power measurements at 957 MHz



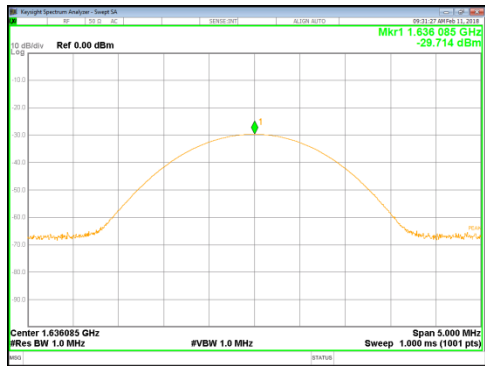
Plot 3.1.2 Power measurements at 958 MHz



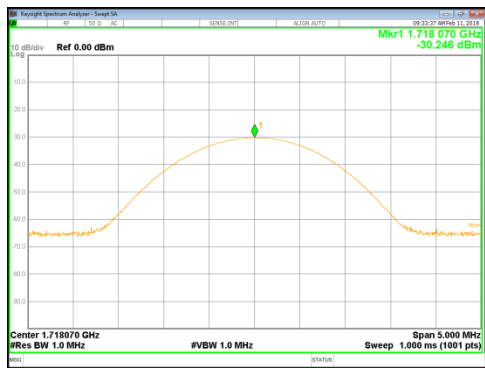
Plot 3.1.3 Power measurements at 1242 MHz



Plot 3.1.4 Power measurements at 1636 MHz



Plot 3.1.5 Power measurements at 1718 MHz



Conclusion:

According to KDB 447498 D01 v06 the device is excluded from SAR evaluation.