

RF Exposure / SAR Information – FCC KDB 447498

FCC ID: CB2440AHL5 Applicant: Johnson Controls, Inc. Model: 440AHL5

The following describes the use case, user separation for the extremities and head, and conducted power of the 440AHL5 model. Per KDB 447498 section 4.3.1, the module was under the test exclusion thresholds for all bands.

This device is designed to be used while in a seated position inside of a vehicle. The operational condition is shown in the diagram below. It operates while a button is pressed, therefore the finger would be the closest part of the body to the antenna while it is transmitting. This distance is approximately 35mm due to the separation between the button surface and the antenna. The antenna to head distance would conservatively be 200mm away during the transmission.



Antenna - Button Separation: Approximately 35mm Antenna - Head Separation: Conservatively 200mm



Calculations:

As the finger would be inside of the 50mm test separation distance, the following formula would be used for calculating the extremity exclusion threshold:

[(max power in mW) / (min test separation in mm)] * [(f(GHz))^1/2]

The head conservatively would not be closer than 200mm away, which would put it outside of the 50mm test separation distance. Thus the following formulas would be used for calculating the head exclusion threshold:



Step 1 threshold = $\{3 / [(f(GHz))^{1/2}]\}*(50)$

then the limit in mW is given by

[Step 1 threshold + (test separation distance – 50mm) * (f(MHz)/150]mW

Frequency – 288MHz

Measured Conducted Power – 15.39dBm Converting to mW – 15.39dBm = 35mW Extremity Test Separation – 35mm Head Test Separation – 200mm



Conducted Measurement

Agilent 15:36:39 Feb 20, 2013 R Т Peak Search Mkr1 288.00000 MHz Ref 20 dBm Atten 30 dB 15.39 dBm Peak Meas Tools < Ó Log 10 dB/ Next Peak Next Pk Right Marker 288.000000 MHz 15.39 dBm Next Pk Left M1 S2 **S3 FC** Min Search AA Pk-Pk Search More Center 288 MHz Span 1.5 MHz 1 of 2 #Res BW 300 kHz Sweep 5 ms (401 pts) #VBW 1 MHz

10-g Extremity:

 $[(35\text{mW}) / (35\text{mm})] * [(0.288(\text{GHz}))^{1/2}] = 0.537$

Which is less than the 7.5 for 10-g SAR

1-g Head:

 $\{3 / [(0.288(GHz))^{1/2}]\}*(50) = 280$

[280 + (200mm - 50mm) * 288/150]mW = 568mW



35mW max output is less than the 568mW limit for test separation distances > 50mm

Frequency – 310MHz

Measured Conducted Power - 15.28dBm

Converting to mW - 15.28dBm = 34mW

Extremity Test Separation – 35mm

Head Test Separation – 200mm

Conducted Measurement





10-g Extremity:

 $[(34\text{mW}) / (35\text{mm})] * [(0.310(\text{GHz}))^{1/2}] = 0.541$

Which is less than the 7.5 for 10-g SAR

1-g Head:

 $\{3 / [(0.310(GHz))^{1/2}]\}*(50) = 269$

[269 + (200 mm - 50 mm) * 310/150]mW = 579 mW

34mW max output is less than the 579mW limit for test separation distances > 50mm

Frequency – 365MHz

Measured Conducted Power – 14.78dBm Converting to mW – 14.78dBm = 30mW Extremity Test Separation – 35mm Head Test Separation – 200mm



Conducted Measurement





10-g Extremity:

 $[(30mW) / (35mm)] * [(0.365(GHz))^{1/2}] = .518$

Which is less than the 7.5 for 10-g SAR

1-g Head:

 $\{3 / [(0.365(GHz))^{1/2}]\}*(50) = 248$

[248 + (200mm - 50mm) * 365/150]mW = 613mW

30mW max output is less than the 613mW limit for test separation distances > 50mm

Frequency – 433MHz

Measured Conducted Power – 10.57dBm Converting to mW – 10.57dBm = 11mW Extremity Test Separation – 35mm Head Test Separation – 200mm



Conducted Measurement

13:42:22 Feb 21, 2013 Agilent R Т Trace/View Mkr1 433.00000 MHz Ref 20 dBm Atten 30 dB 10.57 dBm Trace Peak 2 <u>3</u> 1 Log 10 dB/ Clear Write Max Hold Center 433.0000000 MHz Min Hold M1 S2 S3 FC View AA Blank More Center 433 MHz Span 1.5 MHz 1 of 2 #Res BW 300 kHz #VBW 1 MHz Sweep 5 ms (401 pts)

10-g Extremity:

[(11mW) / (35mm)] * [(0.433(GHz))^1/2] = **0.207**

Which is less than the 7.5 for 10-g SAR



1-g Head:

 $\{3 / [(0.433(GHz))^{1/2}]\}*(50) = 228$

[228 + (200 mm - 50 mm) * 433/150]mW = 661 mW

11mW max output is less than the 661mW limit for test separation distances > 50mm

Frequency – 902.25MHz

Measured Conducted Power – 12.02dBm Converting to mW – 12.02dBm = 16mW Extremity Test Separation – 35mm Head Test Separation – 200mm



Conducted Measurement

Agilent 13:04:15 Feb 6, 2013 R T Marker Mkr1 902.20125 MHz Ref 20 dBm Atten 30 dB Ext PG -0.274 dB 12.02 dBm Select Marker Peak ı 1 2 3 <u>4</u> ٥ Log 10 dB/ Normal Delta Delta Pair (Tracking Ref) Ref <u>Delta</u> M1 S2 Span Pair S3 FC Span Center AA Off More Center 902.2 MHz Span 1.5 MHz 1 of 2 #Res BW 300 kHz #VBW 1 MHz Sweep 5 ms (401 pts)

10-g Extremity:

 $[(16\text{mW}) / (35\text{mm})] * [(0.90225(\text{GHz}))^{1/2}] = 0.434$

Which is less than the 7.5 for 10-g SAR



1-g Head:

2/21/2013

 $\{3 / [(0.90225(GHz))^{1/2}]\}*(50) = 158$

[158 + (200 mm - 50 mm) * 902.25/150]mW = 1060 mW

16mW max output is less than the 1060mW limit for test separation distances > 50mm

Frequency – 914.75MHz

Measured Conducted Power – 12.04dBm Converting to mW – 12.04dBm = 16mW Extremity Test Separation – 35mm Head Test Separation – 200mm



| 🔆 Agi | lent | 13:20:30 |) Feb 6, | 2013 | | | | | F | R T | Marker |
|----------------------|--|----------|----------|------|--|--------|--|----------------|-------|-----|--|
| Mkr1 914.69375 MHz | | | | | | | | | | | |
| Peak Log | | | Allen | | | -0.211 | | | 12.04 | abm | Select Marker 1 2 3 4 |
| 10 dB/ | | | | | | | | | | | Normal |
| | | | | | | | | | | | Delta |
| | | | | | | | | | | | Delta Pair (Tracking Ref) Ref <u>Delta</u> |
| M1 S2 S3 FC AA | | | | | | | | | | | Span Pair _{Span <u>Center</u>} |
| | | | | | | | | | | | Off |
| Center #Res B | Center 914.8 MHz Span 1.5 MHz #Res BW 300 kHz #VBW 1 MHz Sweep 5 ms (401 pts) | | | | | | | More 1 of 2 | | | |

Conducted Measurement

10-g Extremity:

 $[(16mW) / (35mm)] * [(0.91475(GHz))^{1/2}] = 0.437$

Which is less than the 7.5 for 10-g SAR



1-g Head:

- $\{3 / [(0.91475(GHz))^{1/2}]\}*(50) = 157$
- [157 + (200 mm 50 mm) * 914.75/150]mW = 1072 mW

16mW max output is less than the 1072mW limit for test separation distances > 50mm

Frequency – 926.75MHz

 $Measured\ Conducted\ Power-12.03 dBm$

Converting to mW - 12.03 dBm = 16 mW

Extremity Test Separation – 35mm

Head Test Separation – 200mm



Conducted Measurement

| Mkr1 926.70125 MHz Ref 20 dBm Atten 30 dB Ext PG -0.215 dB 12.03 dBm Select I Peak 1 1 1 1 2 | |
|--|---|
| Ref 20 dBm Atten 30 dB Ext PG -0.215 dB 12.03 dBm Select I Peak 1 1 1 1 2 | |
| Peak 1 2 | Select Marker |
| | <u>3</u> <u>4</u> |
| 10 dB/ | Normal |
| | Delta |
| Under Contraction (Track Ref | e <mark>lta Pair</mark> ing Ref) <u>Delta</u> |
| M1 S2 | Dein |
| S3 FC Span | <u>Center</u> |
| | Off |
| Center 926 8 MHz Span 1 5 MHz | More |
| #Res BW 300 kHz #VBW 1 MHz Sweep 5 ms (401 pts) | 1 of 2 |

10-g Extremity:

[(16mW) / (35mm)] * [(0.92675(GHz))^1/2] = **0.441**

Which is less than the 7.5 for 10-g SAR



1-g Head:

2/21/2013

 $\{3 / [(0.92675(GHz))^{1/2}]\}*(50) = 156$

[156 + (200 mm - 50 mm) * 926.75/150]mW = 1083 mW

16mW max output is less than the 1083mW limit for test separation distances > 50mm