	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		<b>Page</b> <b>1(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

## Annex A: Probe sensitivity and reference signal measurement plots

T-Coil Probe

General Mechanical Surface Detection

Name: AM1DV3 - 3062

Type: AM1DV3

Serial number: 3062

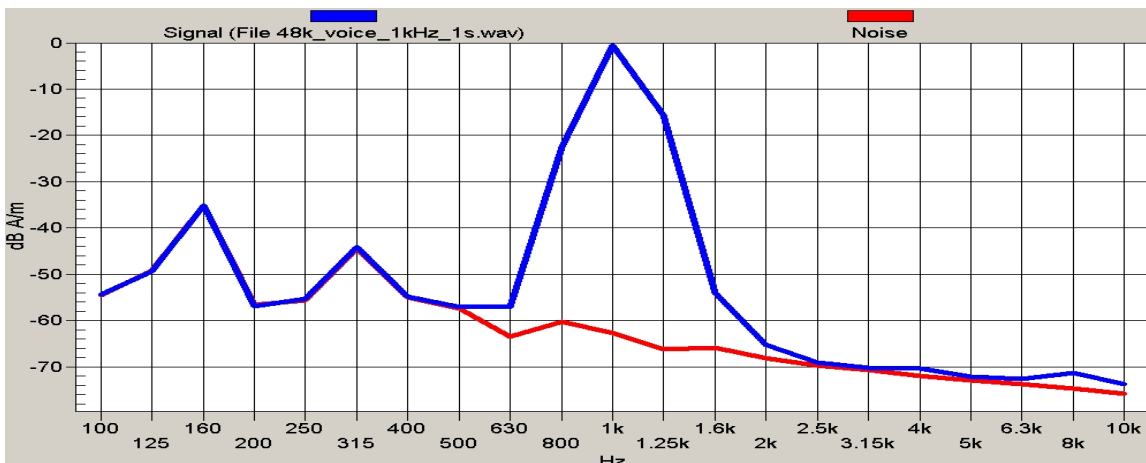
Calibrated:  1/14/2014

Notes: Sensitivity: 0.00741 V/(A/m)

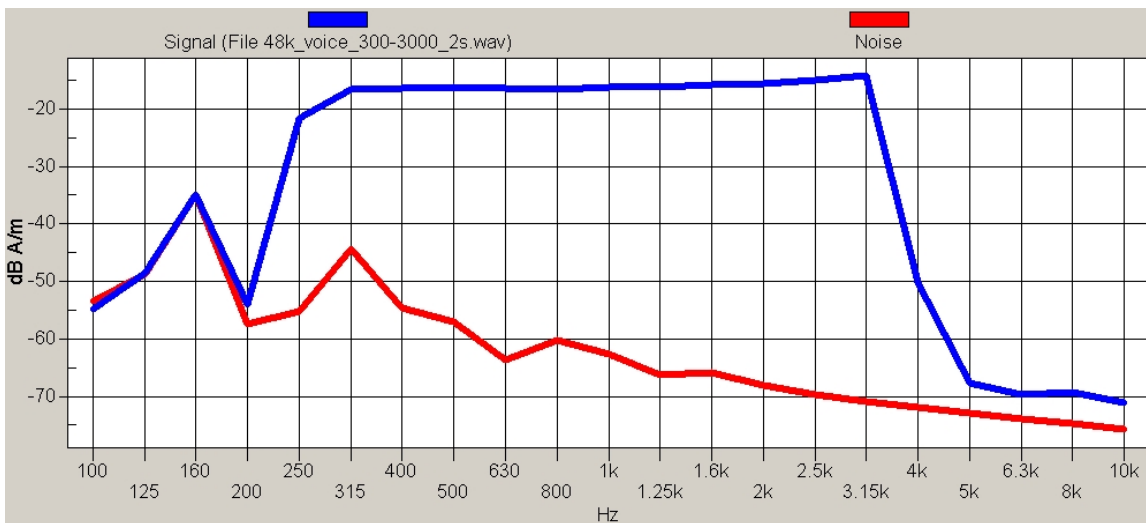
OK

	Coil	Probe
Internal calibration...	2.3887 V	1.1484 V
Probe sensitivity a...		0.007417 V/(A/m)


**Figure A1: Probe calibration data for coil and probe**




**Figure A2: Reference voice 1 kHz signal and noise**



**Figure A3: Reference voice simulated signal and noise**

	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		<b>Page</b> <b>4(53)</b>
<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>	<b>FCC ID</b> <b>L6ARHA110LW</b>

## Annex B: TMFS system validation and ambient data/plots

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>5(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 10:11:25 AM

Test Laboratory: BlackBerry RTS

## HAC T-Coil TMFS\_validation\_07\_14\_14

**DUT: TMFS; Type: TMFS-1; Serial: 1003**

Communication System: UID 0, CW; Frequency: 835 MHz  
Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>  
Phantom section: TCoil Section  
Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface), z = 3.0
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC T-Coil Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS52 52.8.7(1137); SEMCAD X 14.6.10(7164)

### T-Coil scan/TMFS Validation/z (axial) 8 x 8 step 2/ABM Interpolated Signal(x,y,z)

**(41x41x1)**: Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: 1 kHz Sine

Output Gain: 34.95

Measure Window Start: 0ms

Measure Window Length: 1000ms

BWC applied: 0.0029 dB

Device Reference Point: 0, 0, -6.3 mm


#### Cursor:

ABM1 = -20.76 dBA/m

BWC Factor = 0.0029 dB

Location: -0.4, 0.8, 3.7 mm

### T-Coil scan/TMFS Validation/y (transversal) 16 x 52 step 4/ABM Interpolated

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>6(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

**Signal(x,y,z) (41x131x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: 1 kHz Sine

Output Gain: 34.95

Measure Window Start: 0ms

Measure Window Length: 1000ms

BWC applied: 0.0029 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = -26.41 dBA/m

BWC Factor = 0.0029 dB

Location: -1.2, -17.2, 3.7 mm

**T-Coil scan/Background Noise/z (axial) noise/ABM Noise Spectrum(x,y,z,f) (1x1x1):**

Measurement grid: dx=10mm, dy=10mm

Signal Type: Off

Output Gain: 0

Measure Window Start: 2000ms

Measure Window Length: 5000ms

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM = -56.00 dBA/m

Location: 0, 0, 13 mm

**T-Coil scan/Background Noise/y (transversal) noise/ABM Noise Spectrum(x,y,z,f) (1x1x1):**

Measurement grid: dx=10mm, dy=10mm

Signal Type: Off

Output Gain: 0

Measure Window Start: 2000ms


Measure Window Length: 5000ms

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM = -55.94 dBA/m

Location: 0, 0, 13 mm

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>7(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

**T-Coil scan/TMFS Validation/z (axial) wideband multisine at best S/N/ABM Freq**

**Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_multisine\_50\_10k\_10s.wav

Output Gain: 87.87

Measure Window Start: 2000ms

Measure Window Length: 5000ms

BWC applied: 13.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 1.99 dB

BWC Factor = 13.16 dB

Location: -0.4, 0.7, 4.4 mm

**T-Coil scan/TMFS Validation/z (axial) wideband multisine at best S/N 2/ABM Freq**

**Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_multisine\_50\_10k\_10s.wav

Output Gain: 86.87

Measure Window Start: 300ms

Measure Window Length: 4000ms

BWC applied: 13.16 dB

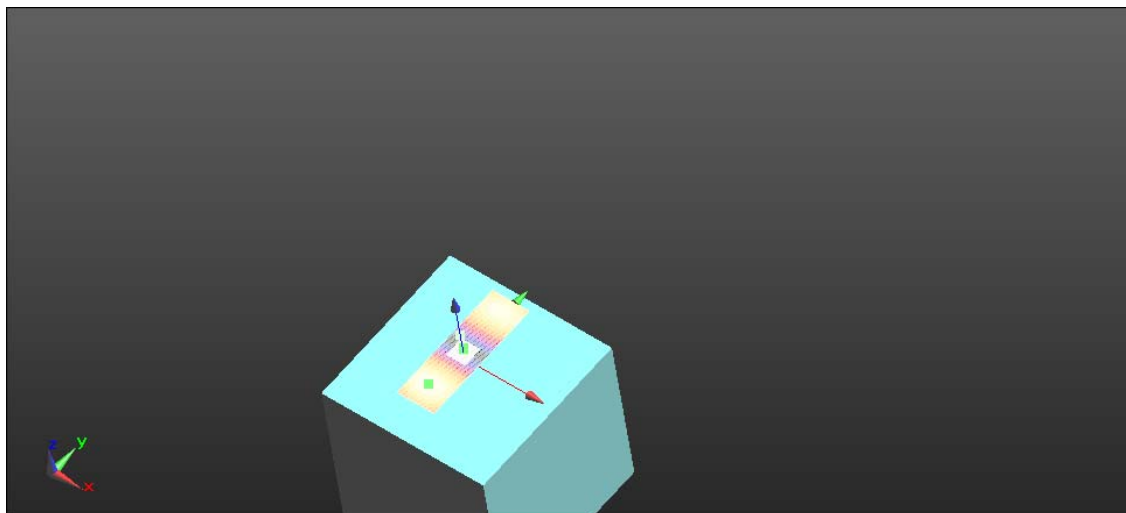
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 1.99 dB

BWC Factor = 13.16 dB

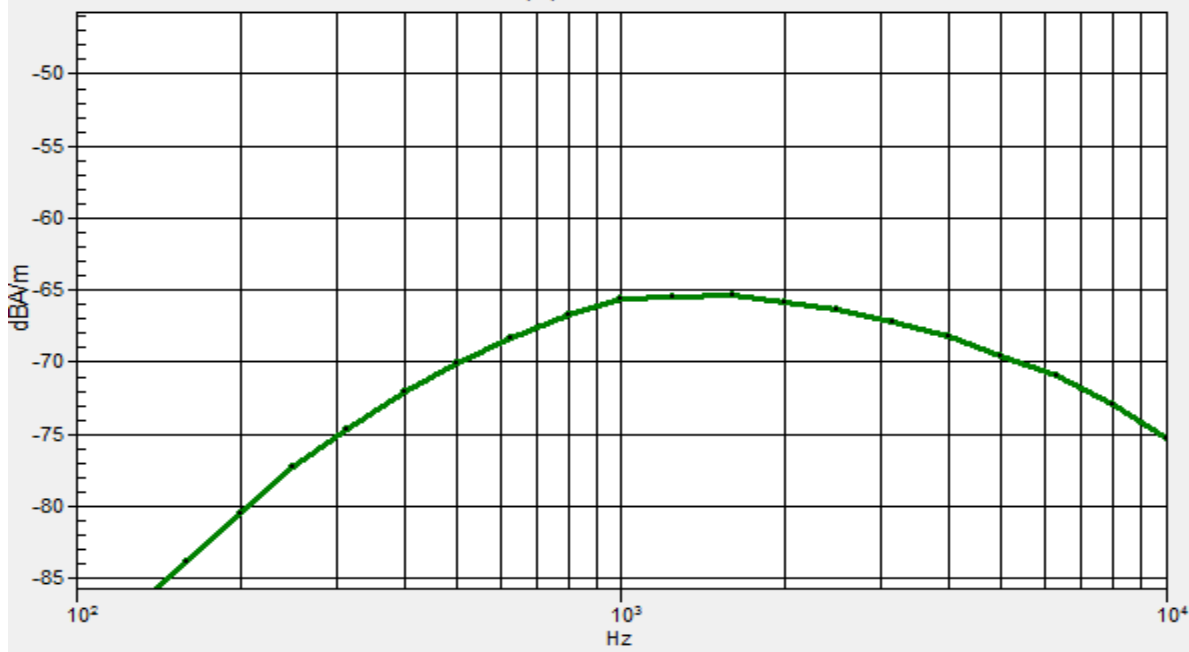
Location: -0.3, 0.7, 5.1 mm



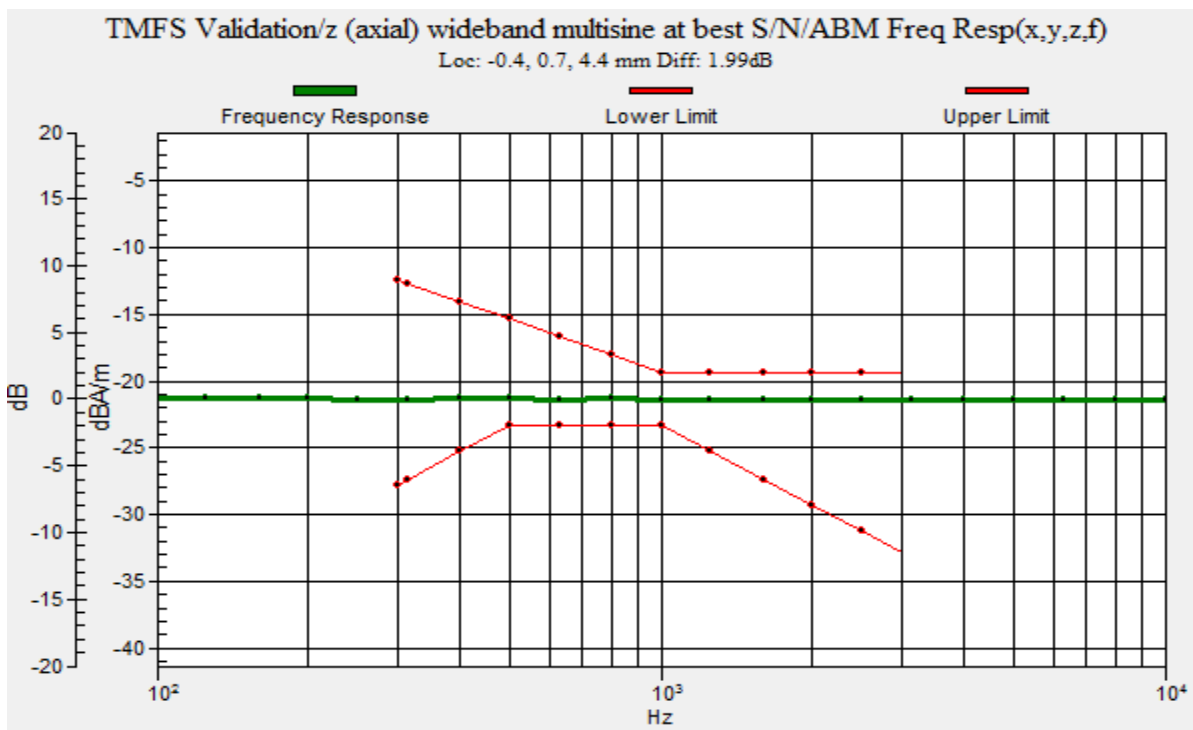
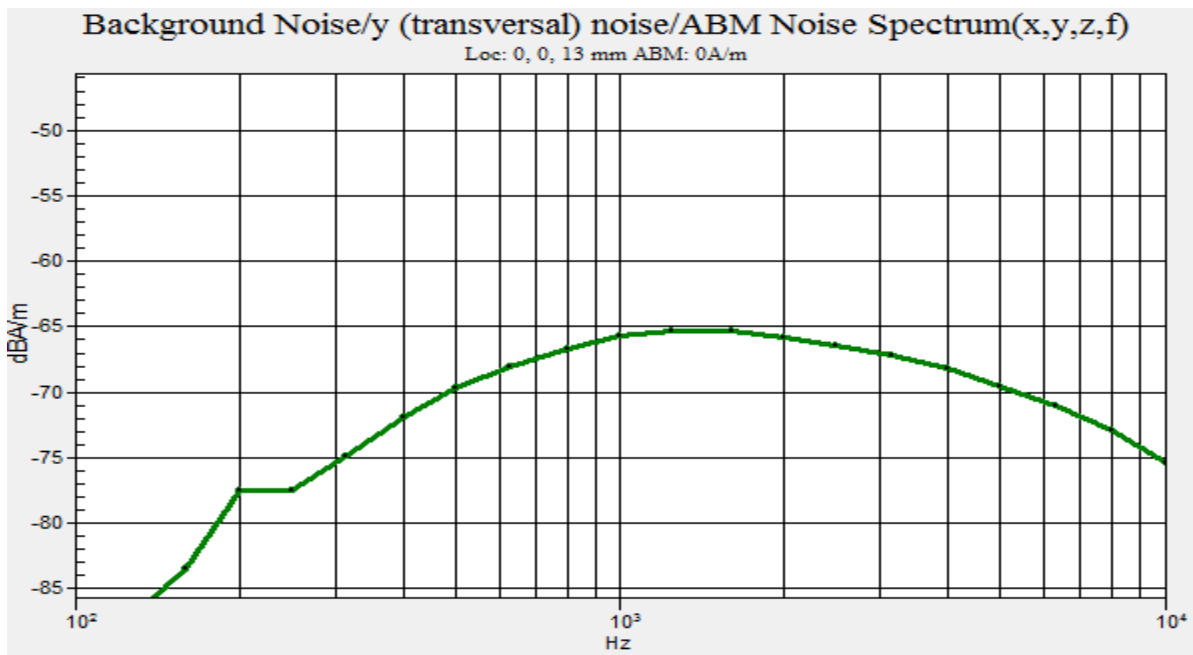
0 dB = 1.000 A/m = 0.00 dBA/m

**Background Noise/z (axial) noise/ABM Noise Spectrum(x,y,z,f)**

Loc: 0, 0, 13 mm ABM: 0A/m







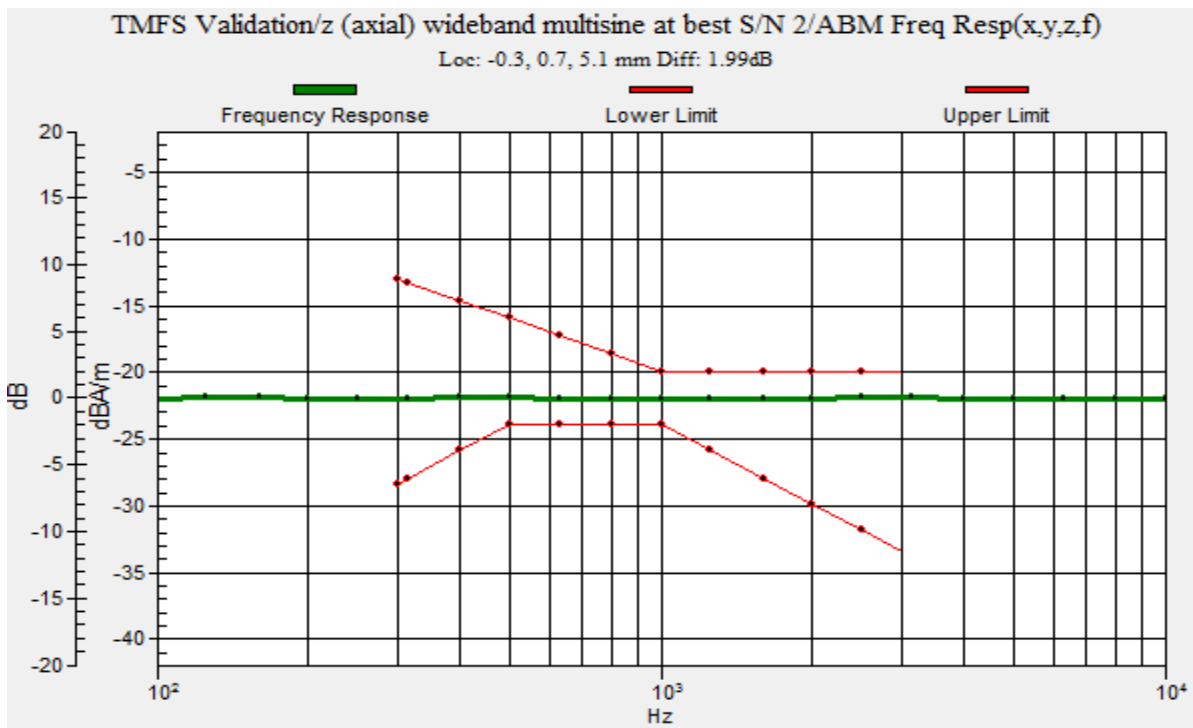



Author Data  
**Daoud Attayi**

Dates of Test  
**July 14-15, 2014**


Report No  
**RTS-6058-1407-07**

FCC ID  
**L6ARHA110LW**



	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		<b>Page</b> <b>11(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

## Annex C: Audio Band Magnetic measurement data and plots

	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>12(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 11:53:20 AM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_axial\_GSM 850

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, GSM 850; Frequency: 824.2 MHz, Frequency: 836.8 MHz, Frequency: 848.8 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface),  $z = 3.0$
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

## T-Coil scan\_GSM850/General Scan - Low channel/z (axial) 5.0mm 50 x 50/ABM

**SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>13(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
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**T-Coil scan\_GSM850/General Scan - Low channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav  
Output Gain: 35.28  
Measure Window Start: 300ms  
Measure Window Length: 1000ms  
BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 36.40 dB  
ABM1 comp = 17.55 dBA/m  
BWC Factor = 0.16 dB  
Location: 3, -5, 4.4 mm

**T-Coil scan\_GSM850/General Scan - Low channel/z (axial) wideband at best S/N/ABM**


**Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav  
Output Gain: 69.12  
Measure Window Start: 300ms  
Measure Window Length: 6000ms  
BWC applied: 10.80 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 0.95 dB  
BWC Factor = 10.80 dB  
Location: 5, -5, 3.7 mm

**T-Coil scan\_GSM850/8x8 Scan - Mid channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav  
Output Gain: 35.28  
Measure Window Start: 300ms  
Measure Window Length: 1000ms

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>14(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 36.22 dB  
ABM1 comp = 17.14 dBA/m  
BWC Factor = 0.16 dB  
Location: 3, -5, 4.4 mm

**T-Coil scan\_GSM850/8x8 Scan - Mid channel/z (axial) wideband at best S/N/ABM Freq**

**Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

Measure Window Length: 6000ms

BWC applied: 10.80 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 1.13 dB  
BWC Factor = 10.80 dB  
Location: 5, -5, 3.7 mm

**T-Coil scan\_GSM850/8x8 Scan - High channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms


BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 37.02 dB  
ABM1 comp = 16.10 dBA/m  
BWC Factor = 0.16 dB  
Location: 3, -7, 4.4 mm

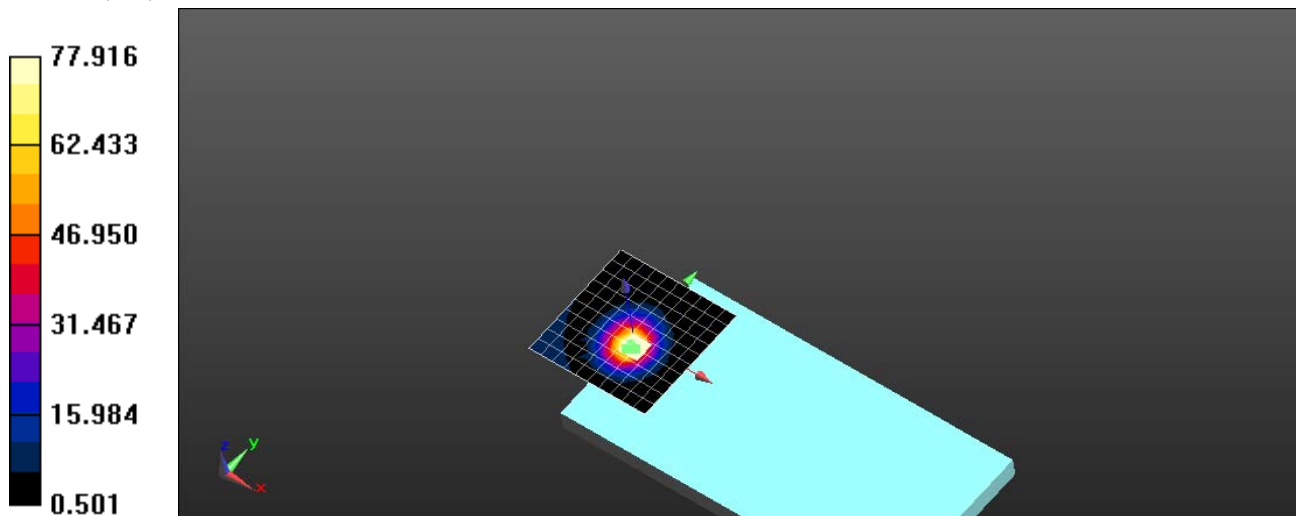
**T-Coil scan\_GSM850/8x8 Scan - High channel/z (axial) wideband at best S/N/ABM Freq**

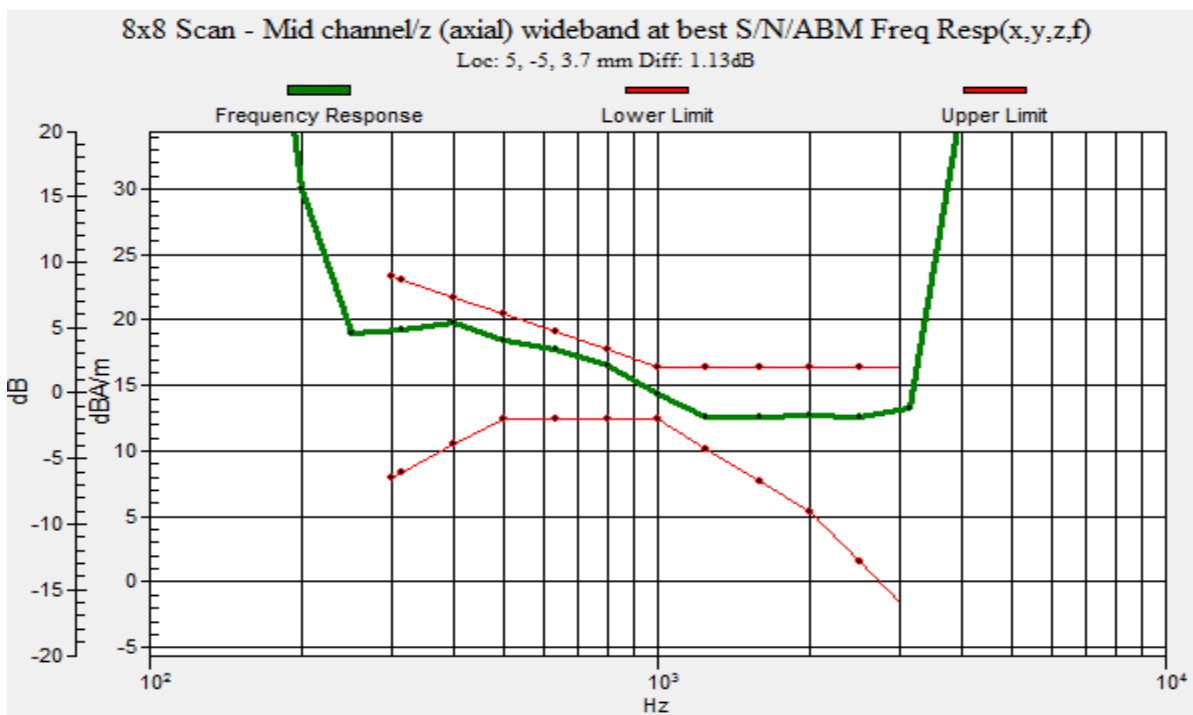
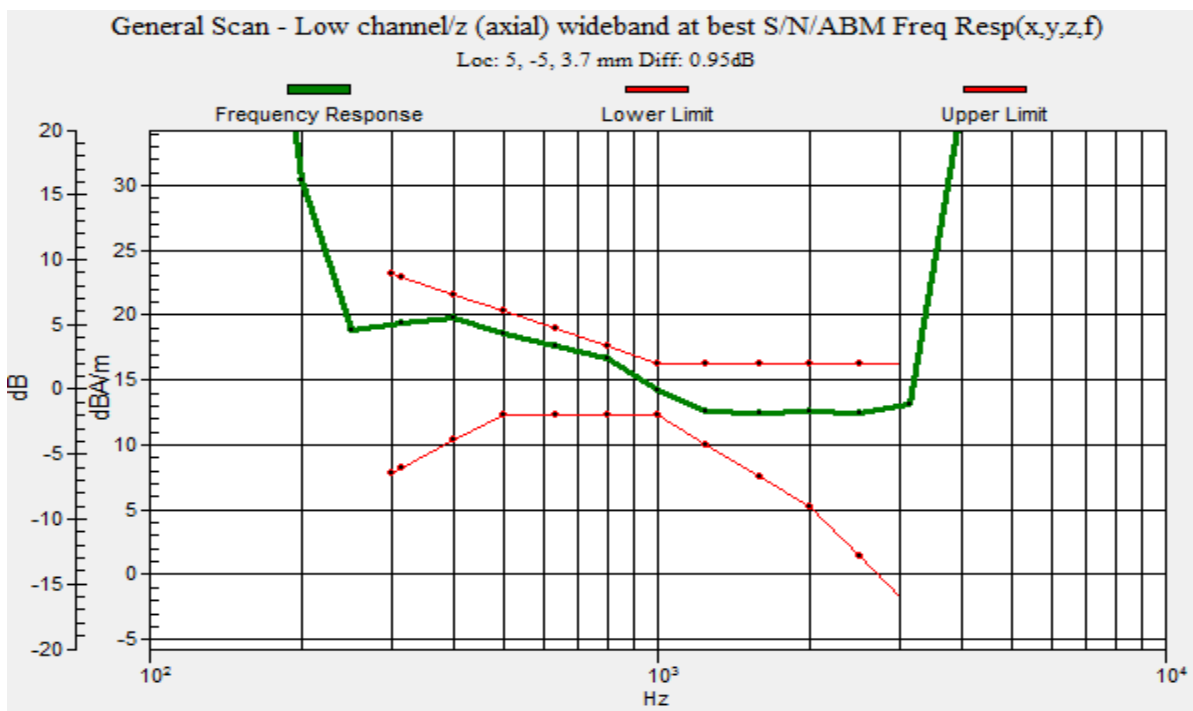
	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>15(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

**Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav  
Output Gain: 69.12  
Measure Window Start: 300ms  
Measure Window Length: 6000ms  
BWC applied: 10.80 dB  
Device Reference Point: 0, 0, -6.3 mm

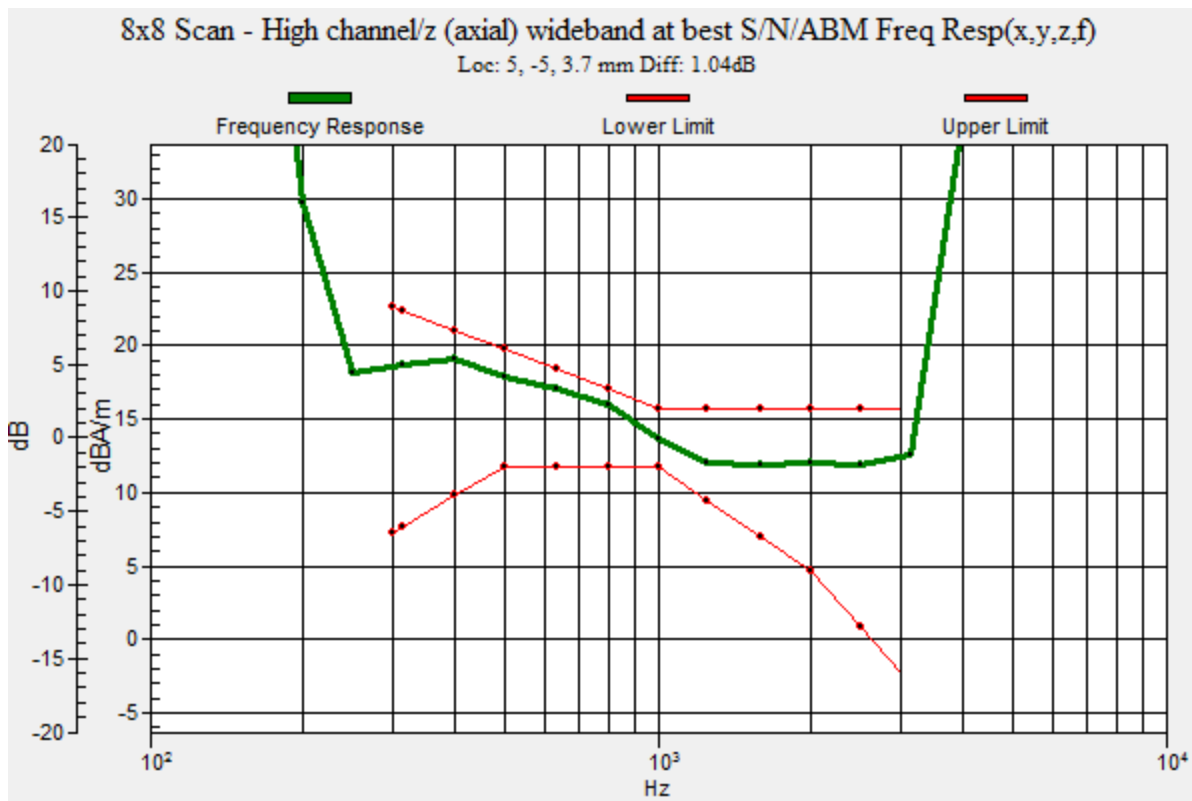
**Cursor:**


Diff = 1.04 dB  
BWC Factor = 10.80 dB  
Location: 5, -5, 3.7 mm









	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>18(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 12:12:25 PM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_Radial\_GSM 850

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, GSM 850; Frequency: 824.2 MHz, Frequency: 836.8 MHz, Frequency: 848.8 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface), z = 3.0
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

## T-Coil scan\_GSM850/General Scan - Low channel/y (transversal) 5.0mm 50 x 50/ABM

**SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>19(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
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**T-Coil scan\_GSM850/General Scan - Low channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 49.08 dB

ABM1 comp = 2.75 dBA/m

BWC Factor = 0.16 dB

Location: -4, 12, 4.4 mm

**T-Coil scan\_GSM850/8x8 Scan - Mid channel/y (transversal) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 48.73 dB

ABM1 comp = 2.64 dBA/m

BWC Factor = 0.16 dB

Location: -4, 12, 4.4 mm


**T-Coil scan\_GSM850/8x8 Scan - High channel/y (transversal) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

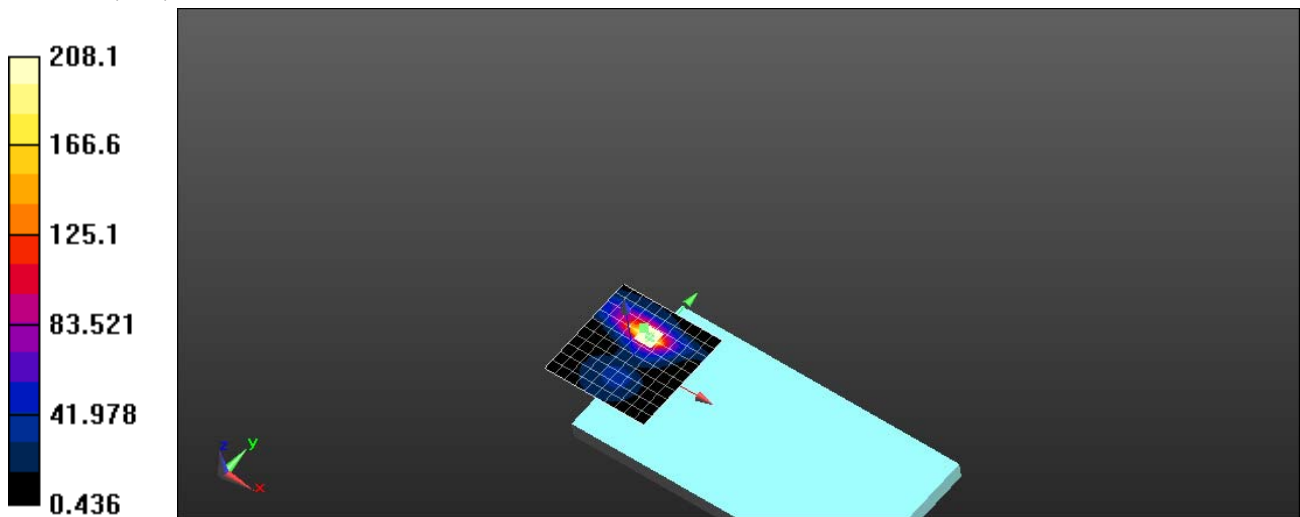
Measure Window Start: 300ms


	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>20(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Measure Window Length: 1000ms  
 BWC applied: 0.16 dB  
 Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 49.13 dB  
 ABM1 comp = 2.35 dBA/m  
 BWC Factor = 0.16 dB  
 Location: -4, 12, 4.4 mm



	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>21(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 1:06:43 PM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_axial\_GSM 1900

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, GSM 1900; Frequency: 1850.2 MHz, Frequency: 1880 MHz, Frequency: 1909.8 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface),  $z = 3.0$
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS 52.8.7(1137); SEMCAD X 14.6.10(7164)

## T-Coil scan\_GSM1900/General Scan - Low channel/z (axial) 5.0mm 50 x 50/ABM

**SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>22(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
-------------	---------

**T-Coil scan\_GSM1900/General Scan - Low channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav  
Output Gain: 35.28  
Measure Window Start: 300ms  
Measure Window Length: 1000ms  
BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 41.57 dB  
ABM1 comp = 15.96 dBA/m  
BWC Factor = 0.16 dB  
Location: 3, -5, 4.4 mm

**T-Coil scan\_GSM1900/General Scan - Low channel/z (axial) wideband at best S/N/ABM**


**Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav  
Output Gain: 69.12  
Measure Window Start: 300ms  
Measure Window Length: 6000ms  
BWC applied: 10.80 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 1.03 dB  
BWC Factor = 10.80 dB  
Location: 5, -5, 3.7 mm

**T-Coil scan\_GSM1900/8x8 Scan - Mid channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav  
Output Gain: 35.28  
Measure Window Start: 300ms  
Measure Window Length: 1000ms

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>23(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 41.70 dB  
ABM1 comp = 15.33 dBA/m  
BWC Factor = 0.16 dB  
Location: 3, -7, 4.4 mm

**T-Coil scan\_GSM1900/8x8 Scan - Mid channel/z (axial) wideband at best S/N/ABM Freq**

**Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

Measure Window Length: 6000ms

BWC applied: 10.80 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 1.04 dB  
BWC Factor = 10.80 dB  
Location: 5, -5, 3.7 mm

**T-Coil scan\_GSM1900/8x8 Scan - High channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**

**(5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms


BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 41.41 dB  
ABM1 comp = 15.93 dBA/m  
BWC Factor = 0.16 dB  
Location: 3, -5, 4.4 mm

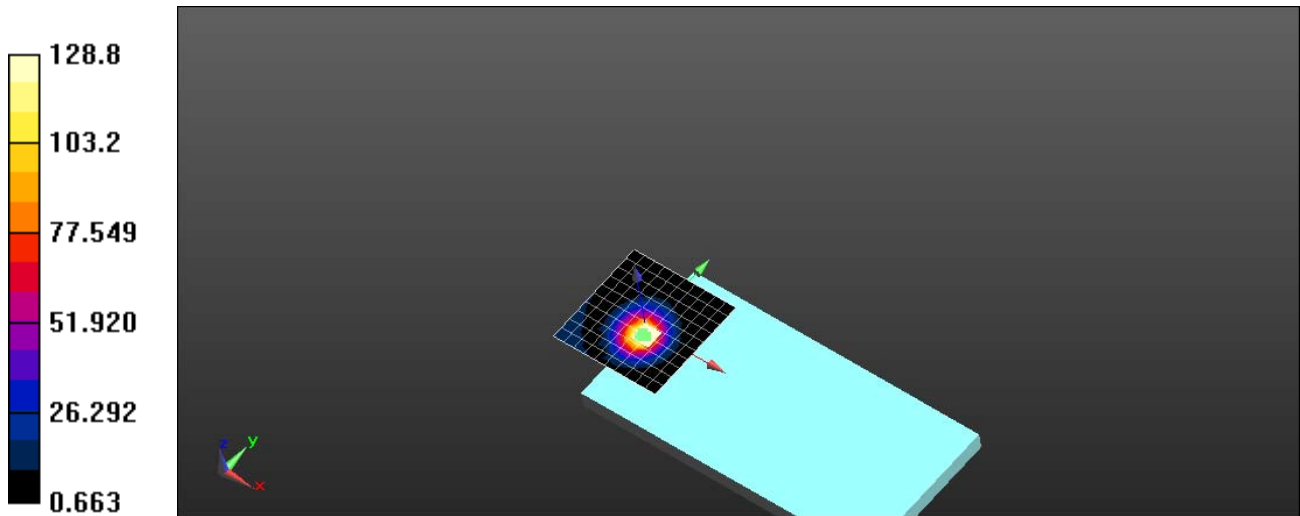
**T-Coil scan\_GSM1900/8x8 Scan - High channel/z (axial) wideband at best S/N/ABM Freq**

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>24(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

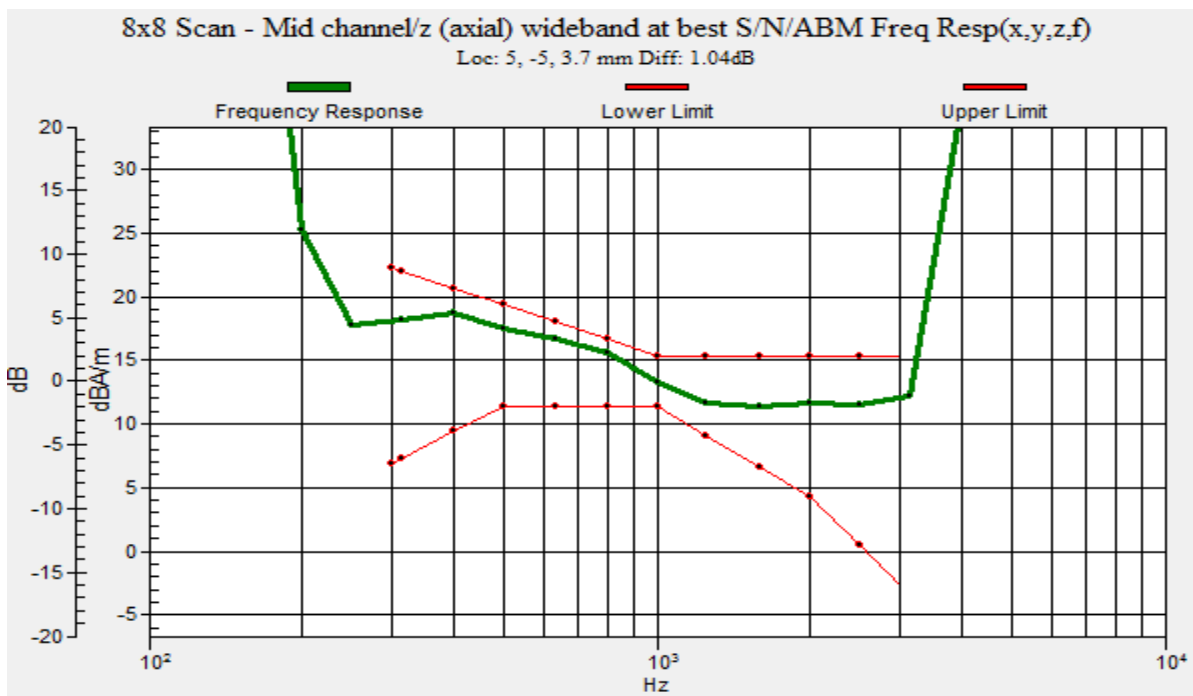
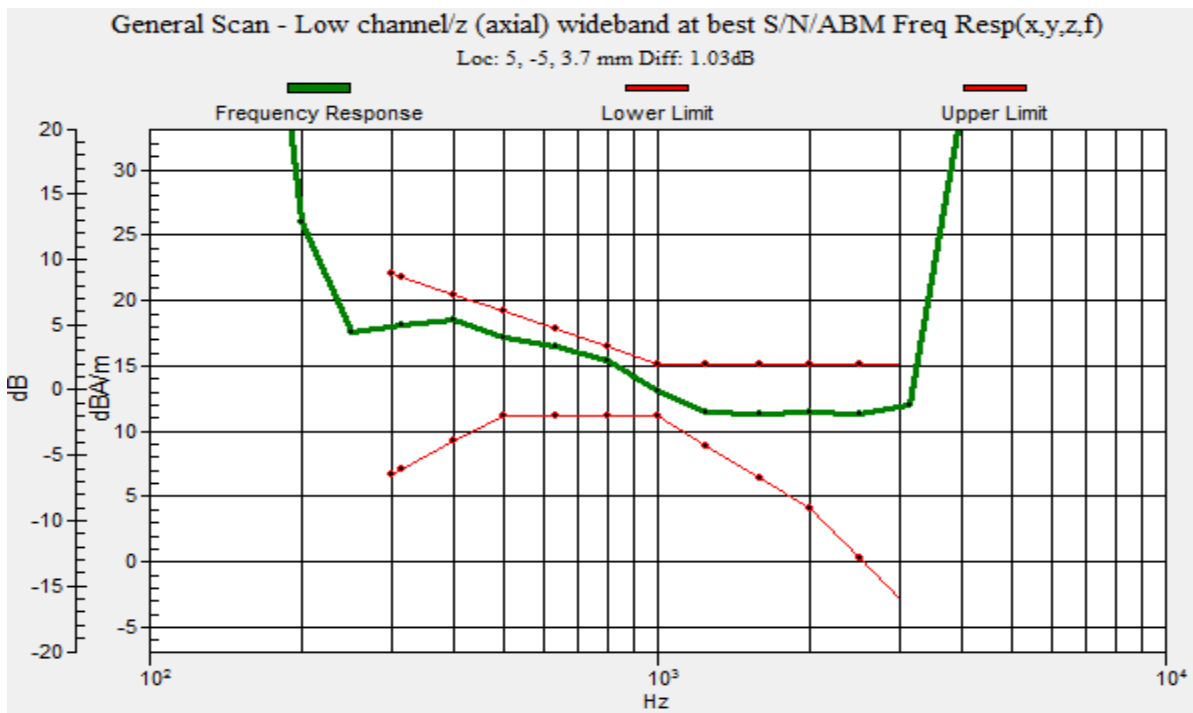
**Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav  
Output Gain: 69.12  
Measure Window Start: 300ms  
Measure Window Length: 6000ms  
BWC applied: 10.80 dB  
Device Reference Point: 0, 0, -6.3 mm

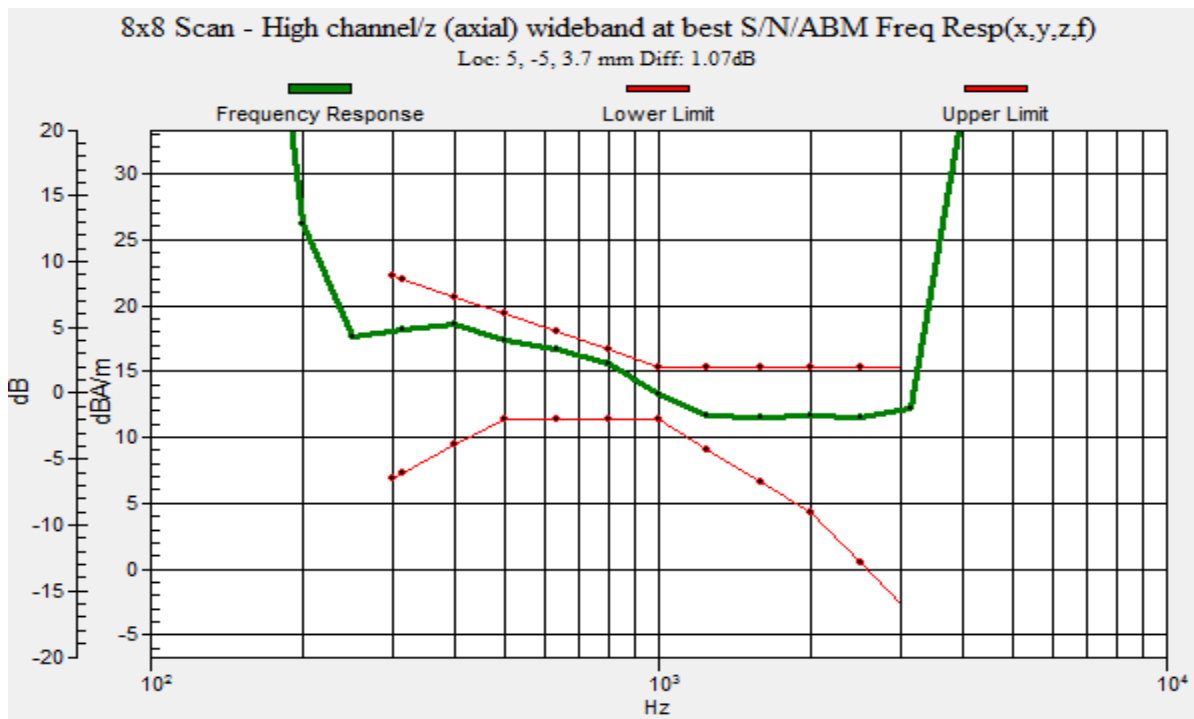
**Cursor:**


Diff = 1.07 dB  
BWC Factor = 10.80 dB  
Location: 5, -5, 3.7 mm









	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>27(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 4:37:13 PM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_axial\_UMTS band V

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, WCDMA FDD V; Frequency: 826.4 MHz, Frequency: 836.4 MHz, Frequency: 846.6 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface), z = 3.0
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

## T-Coil scan\_UMTS\_Band\_V/General Scan - Low channel/z (axial) 5.0mm 50 x 50/ABM

**SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>28(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
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**T-Coil scan\_UMTS\_Band\_V/General Scan - Low channel/z (axial) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 46.70 dB

ABM1 comp = -3.54 dBA/m

BWC Factor = 0.16 dB

Location: -5, 2, 4.4 mm

**T-Coil scan\_UMTS\_Band\_V/General Scan - Low channel/z (axial) wideband at best**

**S/N/ABM Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

Measure Window Length: 6000ms

BWC applied: 10.80 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 0.79 dB

BWC Factor = 10.80 dB

Location: -5, 0, 3.7 mm

**T-Coil scan\_UMTS\_Band\_V/8x8 Scan - Mid channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**


**(5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>29(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 46.53 dB  
ABM1 comp = -7.16 dBA/m  
BWC Factor = 0.16 dB  
Location: -4, -5, 4.4 mm

**T-Coil scan\_UMTS\_Band\_V/8x8 Scan - Mid channel/z (axial) wideband at best S/N/ABM**

**Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

Measure Window Length: 6000ms

BWC applied: 10.80 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 0.79 dB  
BWC Factor = 10.80 dB  
Location: 0, -5, 3.7 mm

**T-Coil scan\_UMTS\_Band\_V/8x8 Scan - High channel/z (axial) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms


BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 46.31 dB  
ABM1 comp = -5.07 dBA/m  
BWC Factor = 0.16 dB  
Location: -4, -3, 4.4 mm

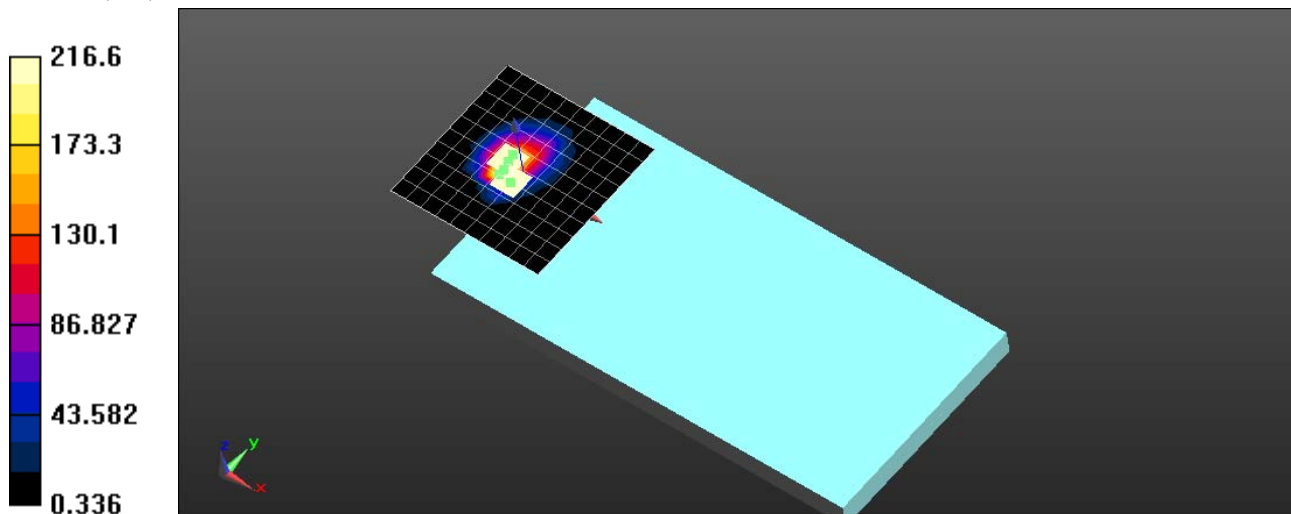
**T-Coil scan\_UMTS\_Band\_V/8x8 Scan - High channel/z (axial) wideband at best S/N**

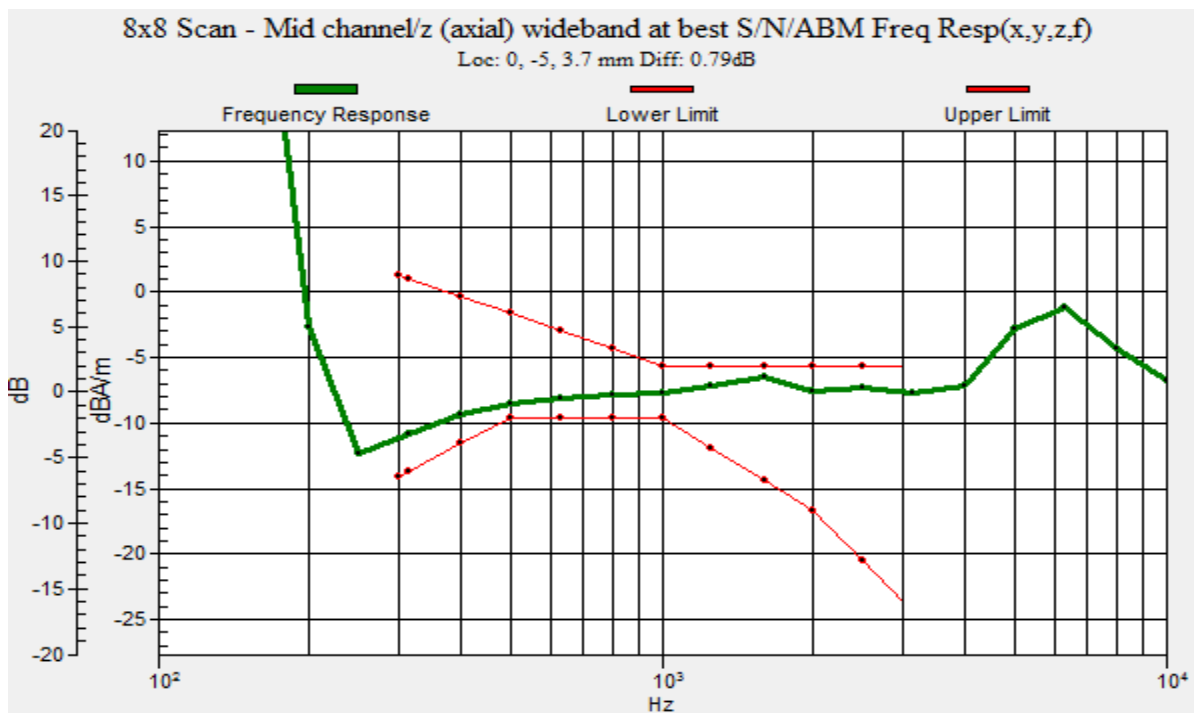
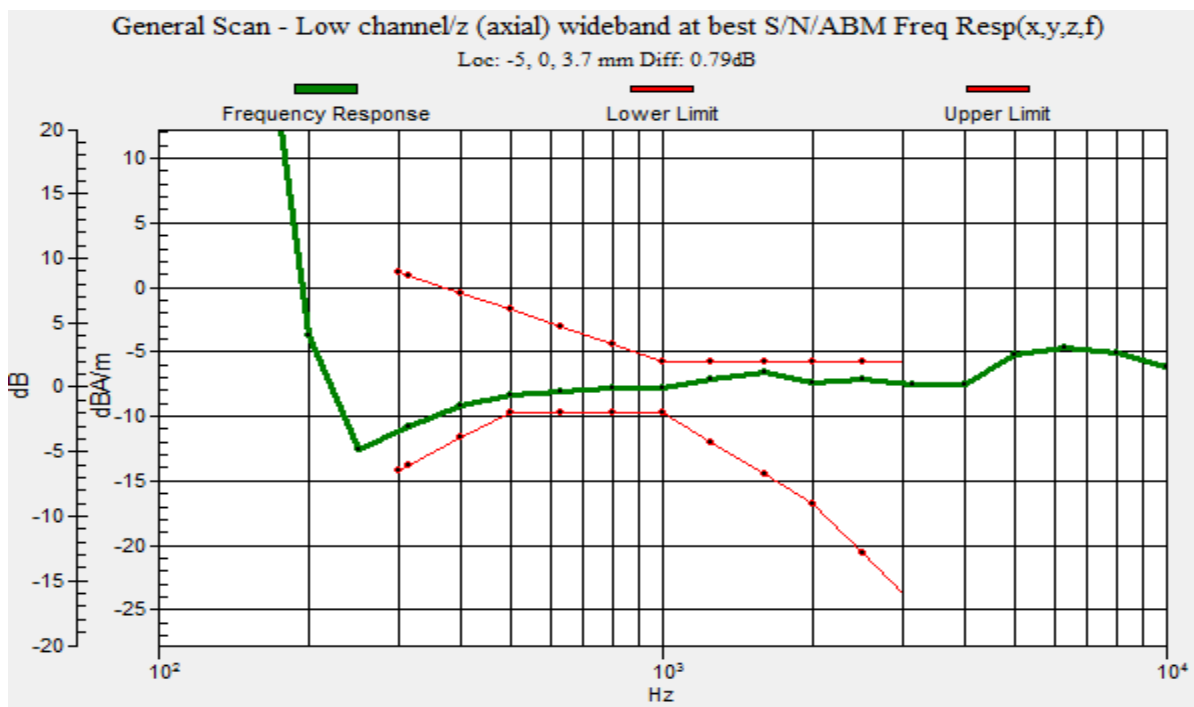
	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>30(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

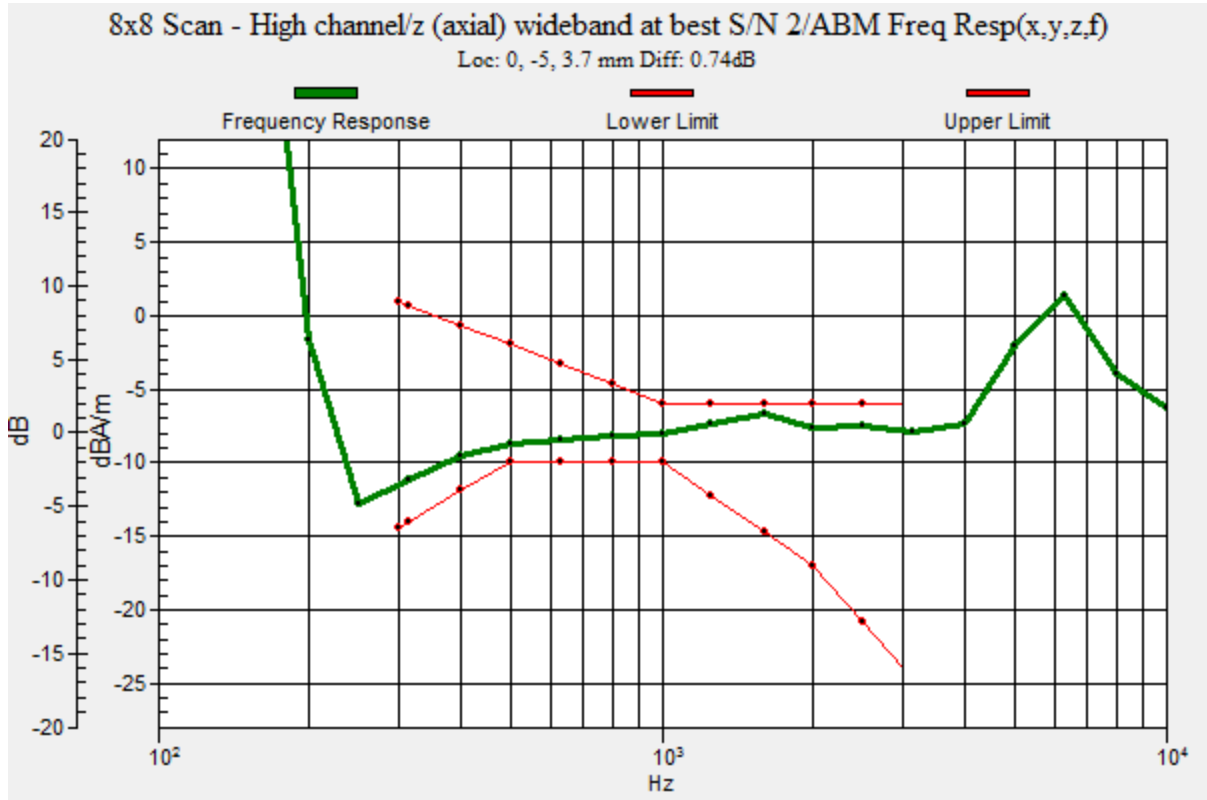
**2/ABM Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm  
Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav  
Output Gain: 69.12  
Measure Window Start: 300ms  
Measure Window Length: 6000ms  
BWC applied: 10.80 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**


Diff = 0.74 dB  
BWC Factor = 10.80 dB  
Location: 0, -5, 3.7 mm









	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>33(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 4:49:48 PM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_radial\_UMTS band V

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, WCDMA FDD V; Frequency: 826.4 MHz, Frequency: 836.4 MHz, Frequency: 846.6 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface), z = 3.0
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

**T-Coil scan\_UMTS\_Band\_V/General Scan - Low channel/y (transversal) 5.0mm 50 x 50/ABM SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>34(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
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**T-Coil scan\_UMTS\_Band\_V/General Scan - Low channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 41.55 dB

ABM1 comp = -11.12 dBA/m

BWC Factor = 0.16 dB

Location: 2, -5, 4.4 mm

**T-Coil scan\_UMTS\_Band\_V/8x8 Scan - Mid channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 40.08 dB

ABM1 comp = -12.80 dBA/m

BWC Factor = 0.16 dB


Location: 6, -8, 4.4 mm

**T-Coil scan\_UMTS\_Band\_V/8x8 Scan - High channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

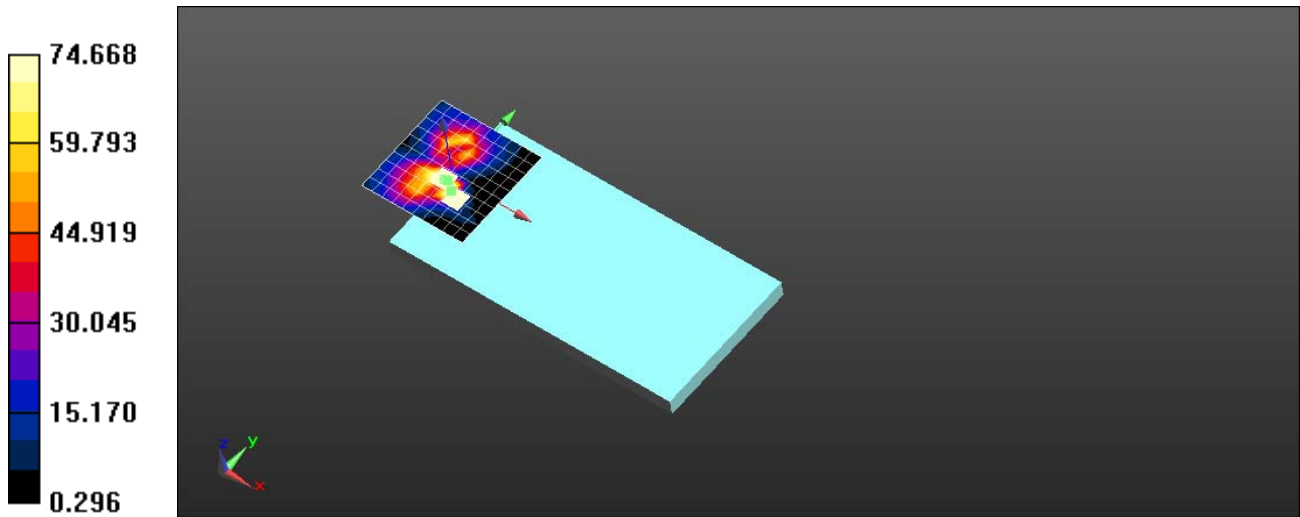
Output Gain: 35.28


	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>35(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Measure Window Start: 300ms  
Measure Window Length: 1000ms  
BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 39.89 dB  
ABM1 comp = -12.86 dBA/m  
BWC Factor = 0.16 dB  
Location: 6, -8, 4.4 mm



	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>36(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 3:36:59 PM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_axial\_UMTS Band II

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, WCDMA FDD II; Frequency: 1852.4 MHz, Frequency: 1880 MHz, Frequency: 1907.6 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface),  $z = 3.0$
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA
- DASYS 52.8.7(1137); SEMCAD X 14.6.10(7164)

## T-Coil scan\_UMTS\_Band\_II/General Scan - Low channel/z (axial) 5.0mm 50 x 50/ABM

**SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>37(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
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**T-Coil scan\_UMTS\_Band\_II/General Scan - Low channel/z (axial) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 45.45 dB

ABM1 comp = -7.03 dBA/m

BWC Factor = 0.16 dB

Location: -5, -3, 4.4 mm

**T-Coil scan\_UMTS\_Band\_II/General Scan - Low channel/z (axial) wideband at best**

**S/N\_probe AM1DV2/ABM Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

Measure Window Length: 6000ms

BWC applied: 10.80 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

Diff = 0.72 dB

BWC Factor = 10.80 dB

Location: -5, -5, 3.7 mm

**T-Coil scan\_UMTS\_Band\_II/8x8 Scan - Mid channel/z (axial) 2mm 8 x 8/ABM SNR(x,y,z)**


**(5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>38(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 45.32 dB  
ABM1 comp = -7.08 dBA/m  
BWC Factor = 0.16 dB  
Location: -5, -3, 4.4 mm

**T-Coil scan\_UMTS\_Band\_II/8x8 Scan - Mid channel/z (axial) wideband at best S/N/ABM**

**Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

Measure Window Length: 6000ms

BWC applied: 10.80 dB

Device Reference Point: 0, 0, -6.3 mm

**T-Coil scan\_UMTS\_Band\_II/8x8 Scan - High channel/z (axial) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 45.14 dB  
ABM1 comp = -7.24 dBA/m  
BWC Factor = 0.16 dB  
Location: -5, -3, 4.4 mm

**T-Coil scan\_UMTS\_Band\_II/8x8 Scan - High channel/z (axial) wideband at best S/N**


**2/ABM Freq Resp(x,y,z,f) (1x1x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_300-3000\_2s.wav

Output Gain: 69.12

Measure Window Start: 300ms

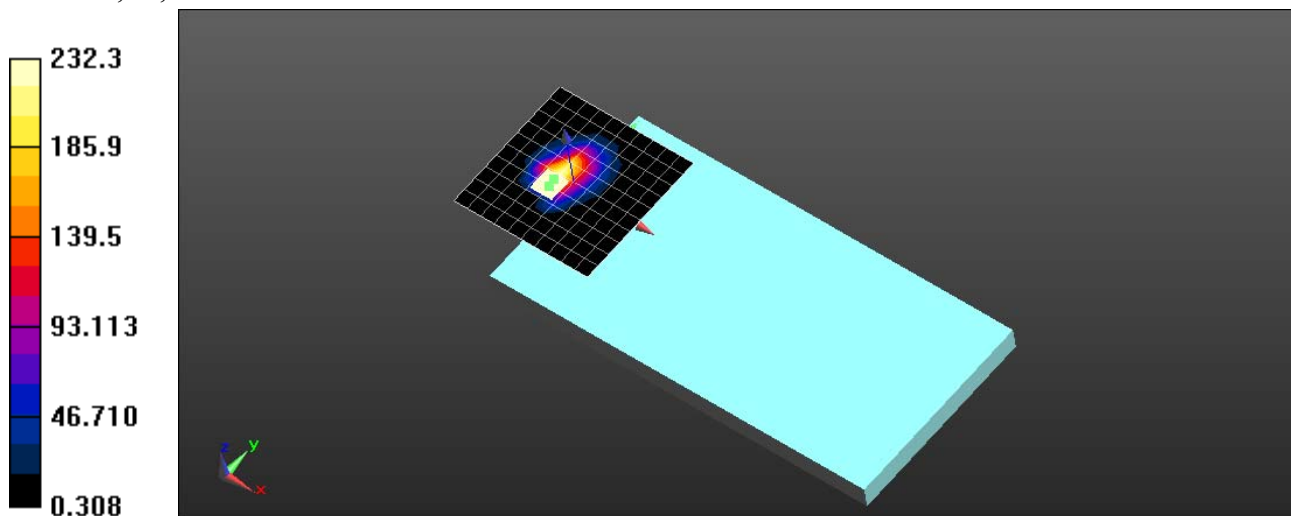
Measure Window Length: 6000ms

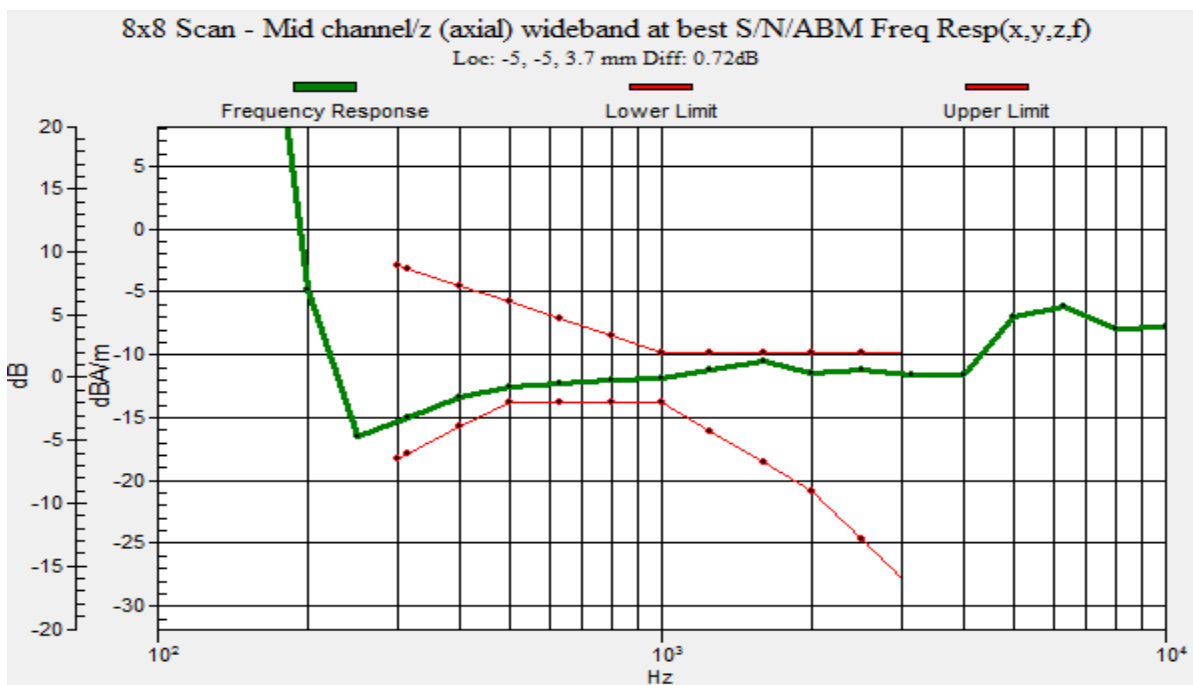
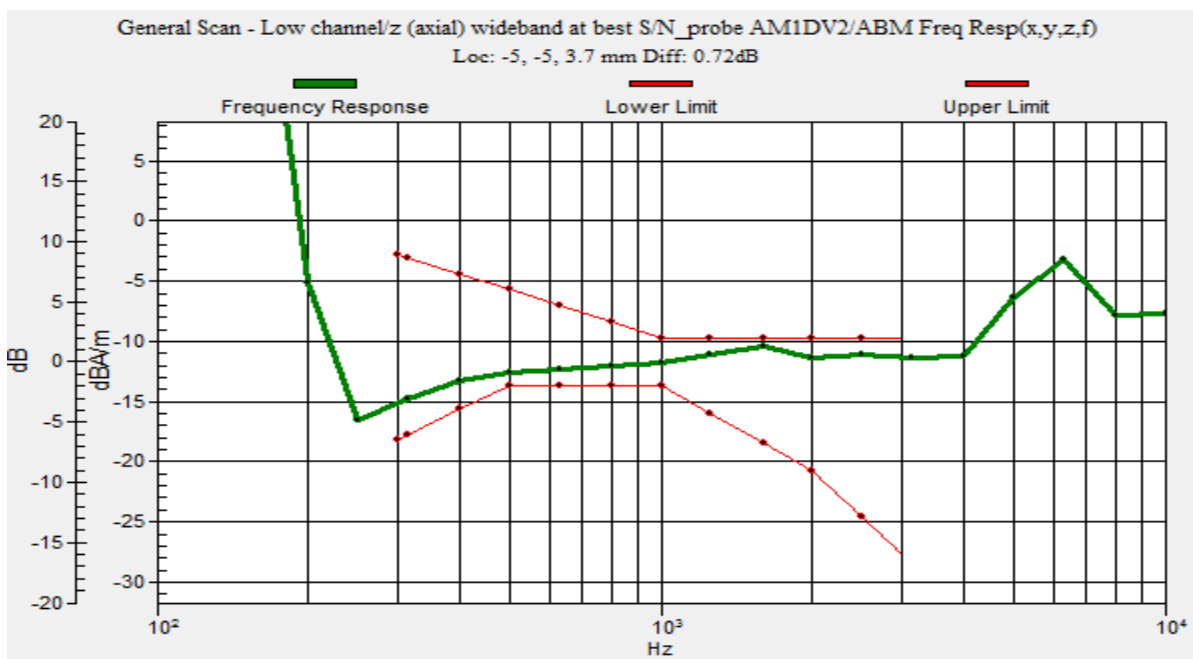
	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>39(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

BWC applied: 10.80 dB  
Device Reference Point: 0, 0, -6.3 mm

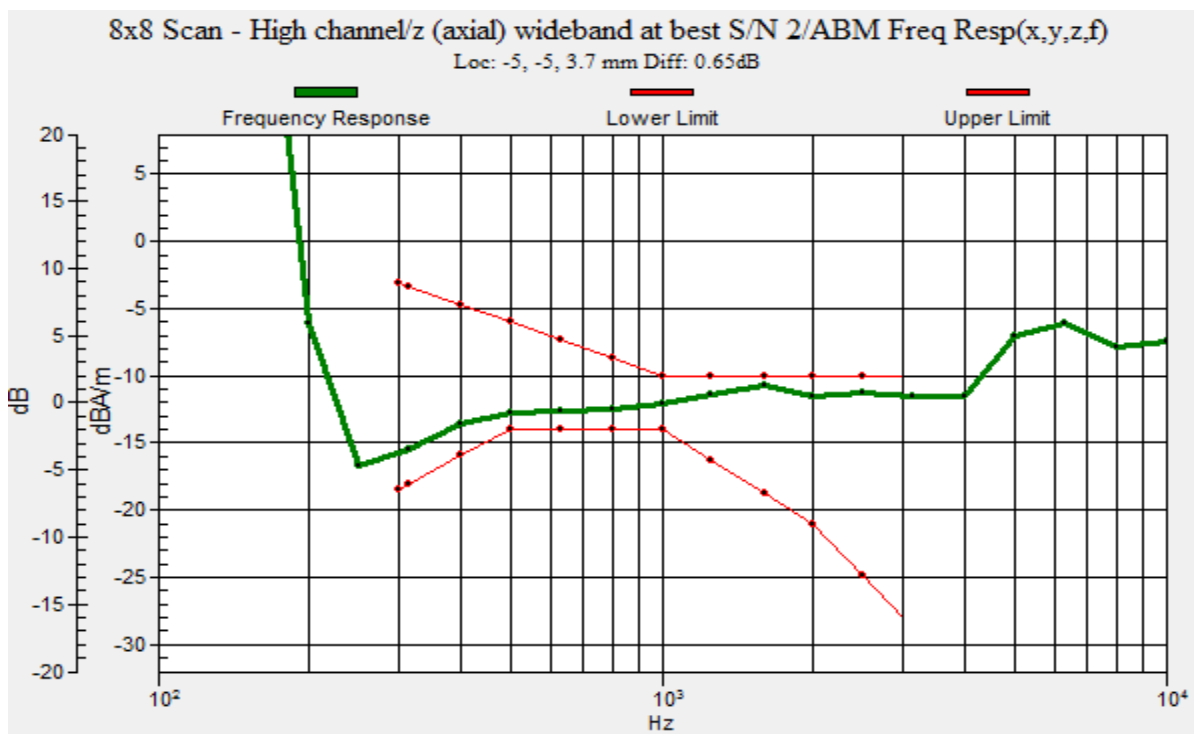
**Cursor:**


Diff = 0.65 dB  
BWC Factor = 10.80 dB  
Location: -5, -5, 3.7 mm









	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>42(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Date/Time: 7/14/2014 3:49:35 PM

Test Laboratory: BlackBerry RTS

## HAC T-Coil\_ABM\_radial\_UMTS Band II

**DUT: BlackBerry Smartphone; Type: Sample ; Serial: 2FFEB292**

Communication System: UID 0, WCDMA FDD II; Frequency: 1852.4 MHz, Frequency: 1880 MHz,  
Frequency: 1907.6 MHz

Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: TCoil Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: AM1DV3 - 3062; ; Calibrated: 1/14/2014
- Sensor-Surface: 0mm (Fix Surface), z = 3.0
- Electronics: DAE3 Sn472; Calibrated: 3/18/2014
- Phantom: HAC RF Test Arch with AMCC; Type: SD HAC P01 BA;
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

### T-Coil scan\_UMTS\_Band\_II/General Scan - Low channel/y (transversal) 5.0mm 50 x

**50/ABM SNR(x,y,z) (11x11x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28


Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

Category	Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		Page <b>43(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>

Category T4	> 30 dB
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**T-Coil scan\_UMTS\_Band\_II/General Scan - Low channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 41.41 dB

ABM1 comp = -11.49 dBA/m

BWC Factor = 0.16 dB

Location: 2, -5, 4.4 mm

**T-Coil scan\_UMTS\_Band\_II/8x8 Scan - Mid channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 35.28

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 41.46 dB

ABM1 comp = -11.40 dBA/m

BWC Factor = 0.16 dB


Location: 2, -5, 4.4 mm

**T-Coil scan\_UMTS\_Band\_II/8x8 Scan - High channel/y (transversal) 2mm 8 x 8/ABM**

**SNR(x,y,z) (5x5x1):** Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

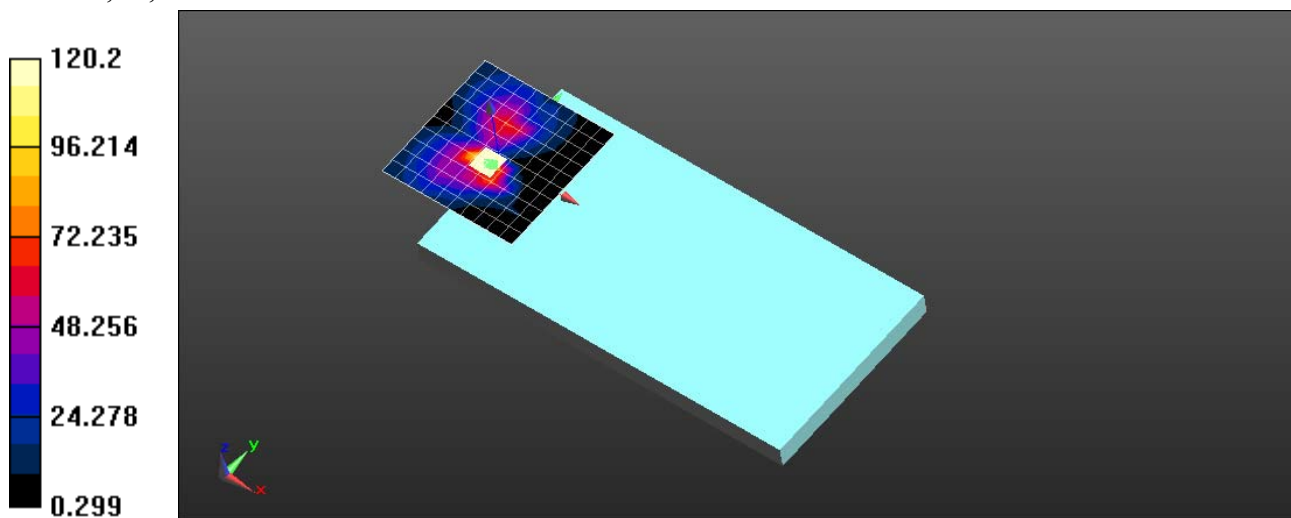
Output Gain: 35.28


	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band</b> <b>Magnetic (ABM) T-Coil Test Report for BlackBerry®</b> <b>Smartphone model RHA111LW</b>		<b>Page</b> <b>44(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

Measure Window Start: 300ms  
Measure Window Length: 1000ms  
BWC applied: 0.16 dB  
Device Reference Point: 0, 0, -6.3 mm


**Cursor:**

ABM1/ABM2 = 40.42 dB  
ABM1 comp = -11.41 dBA/m  
BWC Factor = 0.16 dB  
Location: 2, -5, 4.4 mm



	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		<b>Page</b> <b>45(53)</b>
<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>	<b>FCC ID</b> <b>L6ARHA110LW</b>

**Annex D: Probe/TMFS calibration certificate**

	Document <b>Appendix A-D to Hearing Aid Compatibility Audio Band Magnetic (ABM) T-Coil Test Report for BlackBerry® Smartphone model RHA111LW</b>		Page <b>46(53)</b>
	Author Data <b>Daoud Attayi</b>	Dates of Test <b>July 14-15, 2014</b>	Report No <b>RTS-6058-1407-07</b>
		FCC ID <b>L6ARHA110LW</b>	

**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland





**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service


Accredited by the Swiss Accreditation Service (SAS)  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **AM1DV3-3062\_Jan13**

CALIBRATION CERTIFICATE																															
Object	AM1DV3 - SN: 3062																														
Calibration procedure(s)	QA CAL-24.v3 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range																														
Calibration date:	January 10, 2013																														
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Keithley Multimeter Type 2001</td> <td>SN: 0810278</td> <td>02-Oct-12 (No:12728)</td> <td>Oct-13</td> </tr> <tr> <td>Reference Probe AM1DV2</td> <td>SN: 1008</td> <td>10-Jan-13 (No. AM1D-1008_Jan13)</td> <td>Jan-14</td> </tr> <tr> <td>DAE4</td> <td>SN: 781</td> <td>29-May-12 (No. DAE4-781_May12)</td> <td>May-13</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>AMCC</td> <td>1050</td> <td>12-Oct-11 (in house check Oct-11)</td> <td>Oct-13</td> </tr> <tr> <td>AMMI Audio Measuring Instrument</td> <td>1062</td> <td>26-Sep-12 (in house check Sep-12)</td> <td>Sep-14</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13	Reference Probe AM1DV2	SN: 1008	10-Jan-13 (No. AM1D-1008_Jan13)	Jan-14	DAE4	SN: 781	29-May-12 (No. DAE4-781_May12)	May-13	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	AMCC	1050	12-Oct-11 (in house check Oct-11)	Oct-13	AMMI Audio Measuring Instrument	1062	26-Sep-12 (in house check Sep-12)	Sep-14
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Calibrated by:	Name Dince Iliev	Function Laboratory Technician	Signature 																												
Approved by:	Fin Bomholt	Deputy Technical Manager																													
			Issued: January 10, 2013																												
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	<b>Document</b> <b>Appendix A-D to Hearing Aid Compatibility Audio Band  Magnetic (ABM) T-Coil Test Report for BlackBerry®  Smartphone model RHA111LW</b>		<b>Page</b> <b>47(53)</b>
	<b>Author Data</b> <b>Daoud Attayi</b>	<b>Dates of Test</b> <b>July 14-15, 2014</b>	<b>Report No</b> <b>RTS-6058-1407-07</b>

#### References

- [1] ANSI C63.19-2007  
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] DASY5 manual, Chapter: Hearing Aid Compatibility (HAC) T-Coil Extension

#### Description of the AM1D probe

The AM1D Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1]. The probe includes a symmetric low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines the angle of the sensor when mounted on the DAE. The probe supports mechanical detection of the surface.

The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components when rotating the probe by 120° around its axis. It is aligned with the perpendicular component of the field, if the probe axis is tilted nominally 35.3° above the measurement plane, using the connector rotation and sensor angle stated below.

The probe is fully RF shielded when operated with the matching signal cable (shielded) and allows measurement of audio magnetic fields in the close vicinity of RF emitting wireless devices according to [1] without additional shielding.

#### Handling of the item

The probe is manufactured from stainless steel. In order to maintain the performance and calibration of the probe, it must not be opened. The probe is designed for operation in air and shall not be exposed to humidity or liquids. For proper operation of the surface detection and emergency stop functions in a DASY system, the probe must be operated with the special probe cup provided (larger diameter).

#### Methods Applied and Interpretation of Parameters

- *Coordinate System:* The AM1D probe is mounted in the DASY system for operation with a HAC Test Arch phantom with AMCC Helmholtz calibration coil according to [2], with the tip pointing to "southwest" orientation.
- *Functional Test:* The functional test preceding calibration includes test of Noise level  
RF immunity (1kHz AM modulated signal). The shield of the probe cable must be well connected.  
Frequency response verification from 100 Hz to 10 kHz.
- *Connector Rotation:* The connector at the end of the probe does not carry any signals and is used for fixation to the DAE only. The probe is operated in the center of the AMCC Helmholtz coil using a 1 kHz magnetic field signal. Its angle is determined from the two minima at nominally +120° and -120° rotation, so the sensor in the tip of the probe is aligned to the vertical plane in z-direction, corresponding to the field maximum in the AMCC Helmholtz calibration coil.
- *Sensor Angle:* The sensor tilting in the vertical plane from the ideal vertical direction is determined from the two minima at nominally +120° and -120°. DASY system uses this angle to align the sensor for radial measurements to the x and y axis in the horizontal plane.
- *Sensitivity:* With the probe sensor aligned to the z-field in the AMCC, the output of the probe is compared to the magnetic field in the AMCC at 1 kHz. The field in the AMCC Helmholtz coil is given by the geometry and the current through the coil, which is monitored on the precision shunt resistor of the coil.



Author Data  
**Daoud Attayi**

Dates of Test  
**July 14-15, 2014**

Report No  
**RTS-6058-1407-07**

FCC ID  
**L6ARHA110LW**

**AM1D probe identification and configuration data**

Item	<b>AM1DV3</b> Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	<b>3062</b>

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	20 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland
Manufacturing date	October 30, 2008
Last calibration date	January 12, 2012

**Calibration data**

Connector rotation angle	(in DASY system)	<b>61.0 °</b>	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	<b>0.25 °</b>	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	<b>0.00741 V / (A/m)</b>	+/- 2.2 % (k=2)

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.





Document  
**Appendix A-D to Hearing Aid Compatibility Audio Band  
 Magnetic (ABM) T-Coil Test Report for BlackBerry®  
 Smartphone model RHA111LW**

Page  
**49(53)**

Author Data  
**Daoud Attayi**

Dates of Test  
**July 14-15, 2014**

Report No  
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**Calibration Laboratory of  
 Schmid & Partner  
 Engineering AG**  
 Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**S** Service suisse d'étalonnage  
**C** Servizio svizzero di taratura  
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)  
 The Swiss Accreditation Service is one of the signatories to the EA  
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Blackberry Waterloo**

Certificate No: **TMFS\_1003\_Nov13**

**CALIBRATION CERTIFICATE**

Object / Identification **TMFS – SN: 1003**

Calibration procedure(s) **QA CAL-24.v3  
 Calibration procedure for AM1D magnetic field probes and TMFS in the  
 audio range**

Calibration date **November 14, 2013**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The calibrations have been conducted in the R&D laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&E critical for calibration)

Primary Standards	ID #	Cal Data (Calibrated by, Certificate No.)	Scheduled Calibration
Kethley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13978)	Oct-14
Secondary Standards	ID #	Cal / Check Date	Scheduled Calibration Check
AMCC	1050	01-Oct-13 (in house check Oct-13)	Oct-15
Reference Probe AM1DV2	SN: 1008	10-Jan-13 (No. AM1D-1008_Jan13)	Jan-14
AMMI Audio Measuring Instrument	1062	26-Sep-12 (in house check Sep-12)	Sep-14
Agilent WF Generator 33120A	MY40005266	03-Oct-13 (in house check Oct-13)	Oct-15

Calibrated by: **Name** Claudio Leubler **Function** Laboratory Technician **Signature**

Approved by: **Name** Fin Bomhoff **Deputy Technical Manager**

Issued: November 15, 2013

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**References**

- [1] ANSI-C63.19-2007  
 American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] ANSI-C63.19-2011  
 American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [3] DASY5 manual, Chapter: Hearing Aid Compatibility (HAC) T-Coil Extension

**Methods Applied and Interpretation of Parameters**

- **Coordinate System:** The TMFS is mounted underneath the HAC Test Arch touching equivalently to a wireless device according to [2] 29.2.2.: In "North" orientation, the TMFS signal connector is directed to the north, with x and y axes of TMFS and Test arch coinciding (see fig. 1). The rotational symmetry axis of the TMFS is aligned to the center of the HAC test Arch. For East, South and West configuration, the TMFS has been rotated clockwise in steps of 90°, so the connector locks into the specified direction. The evaluation of the radial direction is referenced to the device orientation (x equivalent to South direction).

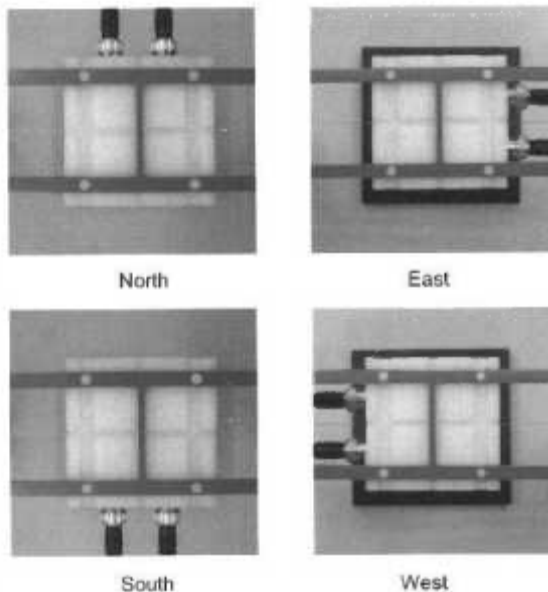


Fig. 1 TMFS scanning measurement configurations

- **Measurement Plane:** In coincidence with standard [1], the measurement plane (probe sensor center) is selected to be at a distance of 10 mm above the surface of the TMFS touching the frame. The 50 x 50 mm scan area is aligned to the center of the unit. The scanning plane is verified to be parallel to the phantom frame before the measurements using the predefined "Geometry and signal check" procedure according to the predefined procedures described in [2].
- **Measurement Conditions:** Calibration of AM1D probe and AMMI are according to [2]. The 1 kHz sine signal for the level measurement is supplied from an external, independent generator via a BNC cable to **TMFS IN** and monitored at **TMFS OUT** with an independent RMS voltmeter or Audio Analyzer. The level is set to 0.5 Vrms and monitored during the scans.
- For the *frequency response*, a higher suppression of the background ambient magnetic field over the full frequency range was achieved by placing the TMFS in a magnetically shielded box. The AM1D probe was fixed without robot positioner near the axial maximum for this measurement. The background noise suppression was typ. 30 dB at 100 Hz (minimum) and 42 dB at 1 kHz. The predefined multisine signal (48k\_multisine\_50-10000\_10s.wav) was used and evaluated in the third-octave bands from 100 Hz to 10000 Hz.



**1 Measurement Conditions**

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52 8.7 (1137)
DASY PP Version	SEMCAD	V14.6.10 (7164)
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance TMFS Top - Probe Centre	10 mm	
Scan resolution	dx, dy = 5 mm	area = 50 x 50 mm
Frequency	for field scans	1 kHz
Signal level to TMFS	for field scans	500 mV RMS
Signal	for frequency response	multisine signal 50-10000 Hz, each third-octave band

Table 1: System configuration

**2 Axial Maximum Field**

Configuration	East	South	West	North	Subset Average	Average
<b>Axial Max</b>	-20.35	-20.35	-20.36	-20.36		<b>-20.36</b>
TMFS Y Axis 1st Max	-26.00	-25.95	-25.94	-25.99		
TMFS Y Axis 2nd Max	-25.93	-25.95	-26.00	-25.96		
<b>Longitudinal Max Avg</b>	-25.97	-25.95	-25.97	-25.98	<b>-25.97</b>	
TMFS X Axis 1st Max	-25.99	-26.04	-25.99	-25.99		
TMFS X Axis 2nd Max	-25.94	-25.91	-25.95	-26.00		
<b>Transversal Max Avg</b>	-25.97	-25.98	-25.97	-26.00	<b>-25.98</b>	
<b>Radial Max</b>						<b>-25.98</b>

Table 2: Axial and radial field maxima measured with probe center at 10mm distance in dB A/m

The maximum was calculated as the average from the values measured in the 4 orientations listed in table 2.

**Axial Maximum -20.36 dB A/m (+/- 0.33dB, k=2)**

**3 Radial Maximum Field**

In addition, the average from the 16 maxima of the radial field listed in table 2 (measured at 10mm) was calculated:

**Radial Maximum -25.98 dB A/m**

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.



#### 4 Appendix

##### 4.1 Frequency response

Max. deviation measured, relative to 1 kHz: min. -0.03, max. 0.02 dB

Frequency [Hz]	Response [dB]
100	0.02
125	-0.02
160	-0.02
200	0.00
250	-0.02
315	0.00
400	0.00
500	0.00
630	0.00
800	0.00
<b>1000</b>	<b>0.00</b>
1250	-0.01
1600	-0.01
2000	-0.01
2500	-0.01
3150	-0.01
4000	-0.02
5000	-0.02
6300	-0.02
8000	-0.03
10000	-0.03

Table 3: Frequency response

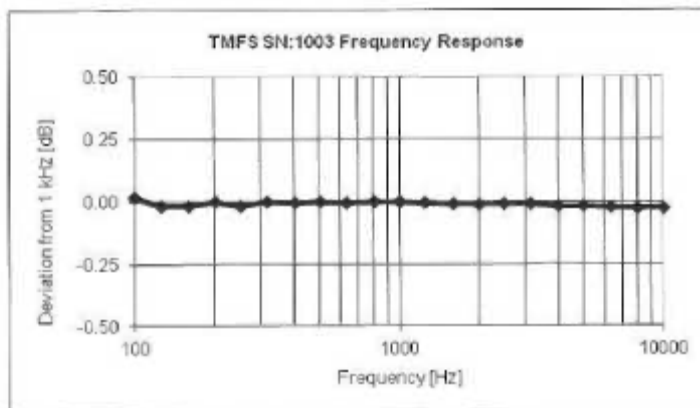


Fig. 2 Frequency response 100 to 10'000 Hz

4.2 Field plots

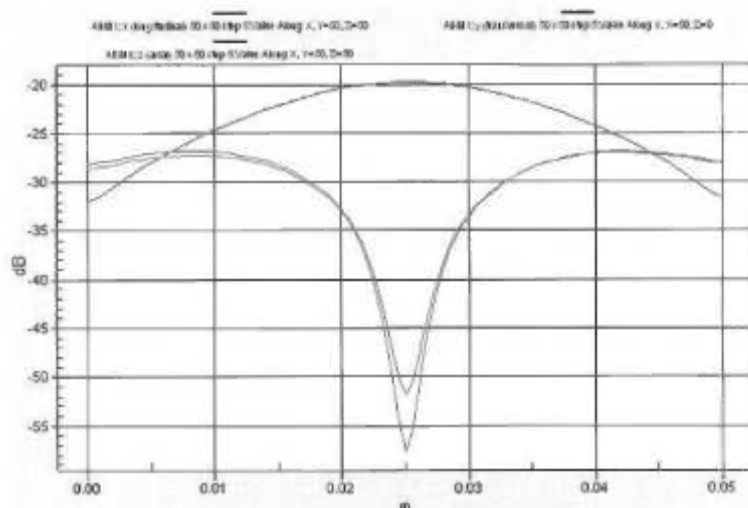


Fig. 3: Typical 2D field plots for x (red), y (green) and z (blue) components

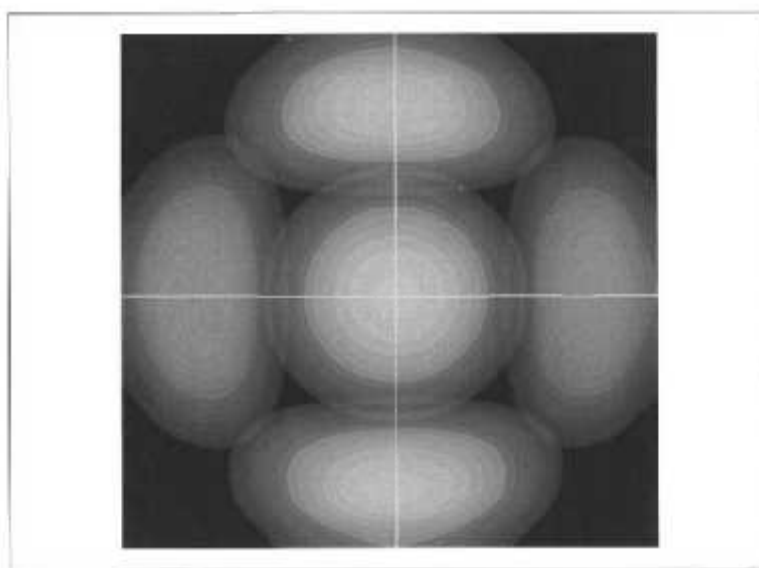


Fig. 4: Superposed field plots of z (axial), x and y radial magnetic field, 50 x 50 mm, individual scaling: white = max. field level, black = -4dB below max. The lines show the position of the 2D field plot of figure 3.