APPENDIX C: ANTENNA SPECIFICATIONS

Please refer to the following pages.

ZBR3 Bluetooth Radio Antenna Gains

Notes:

The RF source for these measurements was a CC15380-1 2.4 GHz short-range radio. The same source was used to drive the calibrated source antenna and all product antennas. Measurements were taken every 10 degrees on three orthogonal axes. The same receive antenna and spectrum analyzer were used for all measurements. In all cases the polarization of the receive antenna was aligned to that of the source antenna.

The product antennas were contained in fully assembled products with extra long antenna cables brought outside the product through a hole drilled in the packaging. These extra long test cables resulted in additional attenuation that has been accounted for in these calculations. Gain measurements were all taken at a frequency of 2.483 GHz, the transmit frequency of CC15380-1.

Measurements were taken at different times. In some instances multiple antennas were evaluated at the same time. Dates of all measurements are shown. In all cases two gains are calculated: Maximum and average.

Measurements Taken On January 17, 2003

Source Antenna Measurement:

Source antenna reading = 56.37dBuV

Cable correction factor = .6 dB attenuation in the source antenna cable

Corrected reading = 56.37 + .6 = 56.97 dBuV = 57 dBuV

TEST antenna gain = 6.65 dBi @ 2.483 MHz

Therefore a reading of 57 dBuV corresponds to a gain of 6.65 dBi.

QL Family Antenna Gain Measurement (CC16203-2):

Max antenna reading = 53.8 dBuV (there was no need to correct this reading)

Max antenna gain = 6.65 – (57.0 – 53.8) = 6.65 – 3.2 dBi = **3.5 dBi**

Average antenna reading = 43.8 dBuV (there was no need to correct this reading)

Average antenna gain =6.65 – (57.0 – 43.8) = 6.65 – 13.2 = **-6.6 dBi**

Measurements Taken On March 24, 2003

Source Antenna Measurement:

Source antenna reading = 53.6 dBuV (measurements taken on 3/24/2003)

Cable correction factor = .6 dB attenuation in the source antenna cable

Corrected reading = 53.6 + .6 = 54.2 dBuV.

TEST antenna gain = 6.65 dBi @ 2.483 GHz

Therefore a reading of 54.2 dBuV corresponds to a gain of 6.65 dBi.

Cameo 2 Antenna Gain (CQ15731-1):

Max antenna reading = 55.7 dBuV

Cable correction factor = .55 dB attenuation in the extra test cable

Corrected reading = 55.7 + .55 = 56.25 dBuV

Max antenna gain = 6.65 – (54.2 – 56.25) = 6.65 + 1.45 = **8.7 dBi**

Average antenna reading = 47.3 dBuV

Corrected reading = 47.3 + .55 = 47.85 dBi

Average antenna gain = 6.65 – (54.2 – 47.85) = 6.65 – 6.35 = **.3 dBi**

Cameo 3 Antenna Gain (CQ15352-1):

Max antenna reading = 55.4 dBuV

Cable correction factor = .73 dB attenuation in the extra test cable length

Corrected reading = 55.4 + .73 = 56.13 dBuV

Max antenna gain = 6.65 – (54.2 – 56.13) = 6.65 + 1.93 = **8.6 dBi**

Average antenna reading = 47.4 dBuV

Corrected reading = 47.4 + .73 = 48.13 dBi

Average antenna gain = 6.65 – (54.2 – 48.13) = 6.65 – 6.07 = **0.6 dBi**

Cameo 3 SC Antenna Gain (CQ16142-1):

Max antenna reading = 53.4 dBuV

Cable correction factor = .42 dB attenuation in the extra test cable length

Corrected reading = 53.4 + .42 = 53.82 dBuV

Max antenna gain = 6.65 – (54.2 – 53.82) = 6.65 – .38 = **6.3 dBi**

Average antenna reading = 44.8 dBuV

Corrected reading = 44.8 + .42 = 45.22 dBuV

Average antenna gain = 6.5 – (54.2 – 45.22) = 6.65 – 8.98 = **-2.3 dBi**

ZPR Pod Antenna Gain (CQ15813-1):

Max antenna reading = 54.3 dBuV

Cable correction factor = .79 dB attenuation in the extra test cable length

Corrected reading = 54.3 + .79 = 55.09 dBuV

Max antenna gain = 6.65 – (54.2 – 55.09) = 6.65 + .89 = **7.5 dBi**

Average antenna reading = 47.4 dBuV

Corrected reading = 47.4 + .79 = 48.19 dBuV

Average antenna gain = 6.5 – (54.2 – 48.19) = 6.65 – 6.01 = **0.6 dBi**

Measurements Taken On August 11, 2004

Source Antenna Measurement:

Test antenna reading = 53.54dBuV

Cable correction factor = .6 dB attenuation in the source antenna cable

Corrected reading = 53.54 + .6 = 54.14 dBuV

TEST antenna gain = 6.65 dBi @ 2483 MHz

Therefore a reading of 54.1 dBuV corresponds to a gain of 6.65 dBi.

RW420 Side Antenna Gain (CQ17109-1):

Max antenna reading = 52.2 dBuV

Cable correction factor = .43 dB attenuation in the extra test cable

Corrected reading = 52.2 dBuV + .43 dB = 52.63 dBuV

Max antenna gain = 6.65 – (54.1 – 52.63) = 6.65 – 1.47 dBi = **5.2 dBi**

Ave antenna reading = 44.3 dBuV

Corrected reading = 44.3 + .43 = 44.73 dBuV

Average antenna gain = 6.65 – (54.1 – 44.73) = 6.65 – 9.37 dBi = **-2.7 dBi**

ZBR3 Bluetooth Radio Antenna Gains

Measurements Taken On October 4, 2004

Source Antenna Measurement:

Test antenna reading = 55.7dBuV

Cable correction factor = .6 dB attenuation in the source antenna cable

Corrected reading = 55.7 + .6 = 56.3 dBuV

TEST antenna gain = 6.65 dBi @ 2483 MHz

Therefore a reading of 56.3 dBuV corresponds to a gain of 6.65 dBi.

Cameo 3 PEP Antenna Gain (CQ15729-1):

Max antenna reading = 51.3 dBuV

Cable correction factor = .55 dB attenuation in the extra test cable

Corrected reading = 51.3 dBuV + .55 dB = 51.85 dBuV

Max antenna gain = 6.65 – (56.3 – 51.85) = 6.65 – 4.45 dBi = **2.2 dBi**

Ave antenna reading = 42.8 dBuV

Corrected reading = 42.8 + .55 = 43.35 dBuV

Average antenna gain = 6.65 – (56.3 – 43.35) = 6.65 – 12.95 dBi = **-6.3 dBi**

QL Family 2nd Generation Bluetooth Antenna Gain (CQ17383-1):

Max antenna reading = 55.9 dBuV

Cable correction factor = .68 dB attenuation in the extra test cable

Corrected reading = 55.9 + .68 = 56.58 dBuV

Max antenna gain = 6.65 – (56.3 – 56.58) = 6.65 + .15 dBi = **6.9 dBi**

Ave antenna reading = 45.1 dBuV

Corrected reading = 45.1 + .68 = 45.78 dBuV

Average antenna gain = 6.65 – (56.3 – 45.78) = 6.65 – 10.52 dBi = **-3.9 dBi**

ZBR3 Bluetooth Radio Antenna Gains

Test Equipment Utilized (Same for all tests):

Spectrum analyzer – HP8593E

Receiving antenna – AH Systems model SAS-200/510

Source antenna – AH Systems model SAS-200/511

Appendix 1: Cable Correction Factors:

Antennas included in the ZBR3 Bluetooth modular approval:

Product	Part Number	Cable Length	Test Length	Extra Attenuation
Cameo 2	CQ15731-1	4"	10"	6" = 0.55 dB
Cameo 3	CQ15352-1	2"	10"	8" = 0.73 dB
Cameo 3 SC	CQ16142-1	5.375"	10"	4.625" = 0.42 dB
Cameo 3 PEP	CQ15729-1	4"	10"	6" = 0.55 dB
QL Family	CC16203-2	2.25"	10"	7.75" = 0.71 dB
QL Family	CQ17383-1	2.5"	10"	7.5" = 0.68 dB
ZPR	CQ15813-1	1.375"	10"	8.625" = 0.79 dB
RW420	CQ17109-1	5.25"	10"	4.75" = 0.43 dB

Extra attenuation at 2.483 GHz is calculated at 1.1 dB / foot based on the SSMT coaxial cable specification. The test antennas provided to the lab all had 10-inch cables, allowing the cable end to be brought outside the product. The above table shows the production cable length and computes an extra attenuation based on the difference between the test cable length and the production cable length. This extra attenuation is used in the computations.

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