

APPENDIX E: MULTI-TX AND ANTENNA SAR CONSIDERATIONS

E.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D04v01 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

E.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D04v014.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

(*) Test positions that were reused from a higher power level as more conservative evaluation.

Qualcomm Smart Transmit algorithm in WWAN directly adds the time-averaged RF exposure from 4G and time-averaged RF exposure from 5G NR. Smart Transmit algorithm controls the total RF exposure from both 4G and 5G NR to not exceed FCC limit. Therefore, simultaneous transmission compliance between 4G+5G operations is demonstrated in the Part 2 Report during algorithm validation.

E.3 Body Simultaneous Transmission Analysis - Tablet

Table E-1
Simultaneous Transmission Scenarios of WLAN/BT (Tablet at 0.0 cm)

| Configuration | 2.4 GHz WLAN Ant 1 at Reduced Power Level 1 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 3 SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 3 SAR (W/kg) | 5 GHz WLAN Ant 1 at Reduced Power Level 1 SAR (W/kg) | 5 GHz WLAN Ant 1 at Reduced Power Level 2 SAR (W/kg) | 5 GHz WLAN Ant 2 at Reduced Power Level 1 SAR (W/kg) | 5 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 5 GHz WLAN Ant 2 at Reduced Power Level 3 SAR (W/kg) | 6 GHz WLAN Ant 1 at Reduced Power Level 1 SAR (W/kg) | 6 GHz WLAN Ant 1 at Reduced Power Level 2 SAR (W/kg) | 6 GHz WLAN Ant 2 at Reduced Power Level 1 SAR (W/kg) | 6 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz Bluetooth SAR (W/kg) |
|---------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Back | 0.233 | 0.043 | 0.028 | 0.145 | 0.071 | 0.019 | 0.160 | 0.040 | 0.223 | 0.062 | 0.039 | 0.083 | 0.031 | 0.091 | 0.034 | 0.065 |
| Top | 0.008 | 0.001 | 0.000 | 0.012 | 0.001 | 0.000 | 0.000 | 0.000* | 0.004 | 0.004* | 0.004* | - | - | - | - | 0.000 |
| Bottom | 0.003 | 0.000 | 0.000* | 0.004 | 0.000 | 0.000* | 0.034 | 0.005 | 0.000 | 0.000* | 0.000* | - | - | - | - | 0.000 |
| Right | 0.000 | 0.000* | 0.000* | 0.752 | 0.245 | 0.139 | 0.003 | 0.003* | 1.088 | 0.359 | 0.233 | 0.000 | 0.000* | 0.997 | 0.399 | 0.000 |
| Left | 0.685 | 0.265 | 0.139 | 0.000 | 0.000* | 0.000* | 1.047 | 0.238 | 0.004 | 0.004* | 0.004* | 1.143 | 0.228 | 0.000 | 0.000* | 0.256 |

Table E-2
Simultaneous Transmission Scenarios with WLAN/BT (Tablet at 0.0 cm)

| Configuration | 2.4 GHz WLAN Ant 1 at Reduced Power Level 1 + 2.4 GHz WLAN Ant 2 at Reduced Power Level 1 SAR (W/kg) | 5 GHz WLAN Ant 1 at Reduced Power Level 1 + 5 GHz WLAN Ant 2 at Reduced Power Level 1 SAR (W/kg) | 6 GHz WLAN Ant 1 at Reduced Power Level 1 + 6 GHz WLAN Ant 2 at Reduced Power Level 1 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 2 + 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 2 + 6 GHz WLAN Ant 1 at Reduced Power Level 2 + 6 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 6 GHz WLAN Ant 1 at Reduced Power Level 2 + 6 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) |
|---------------|--|--|--|--|--|--|--|--|
| | 1+4 | 7+9 | 12+14 | 2+8+10 | 5+8+10 | 2+5+8+10 | 2+13+15 | 5+13+15 |
| Back | 0.378 | 0.383 | 0.174 | 0.145 | 0.173 | 0.216 | 0.108 | 0.136 |
| Right | 0.752 | 1.091 | 0.997 | 0.362 | 0.607 | 0.607 | 0.399 | 0.644 |
| Left | 0.685 | 1.051 | 1.143 | 0.507 | 0.242 | 0.507 | 0.493 | 0.228 |

| Configuration | 2.4 GHz WLAN Ant 1 at Reduced Power Level 2 + 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 6 GHz WLAN Ant 1 at Reduced Power Level 2 + 6 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 1 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 2.4 GHz Bluetooth SAR (W/kg) | 5 GHz WLAN Ant 1 at Reduced Power Level 1 + 5 GHz WLAN Ant 2 at Reduced Power Level 1 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 2 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 2.4 GHz Bluetooth SAR (W/kg) | 6 GHz WLAN Ant 1 at Reduced Power Level 1 + 6 GHz WLAN Ant 2 at Reduced Power Level 1 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 6 GHz WLAN Ant 1 at Reduced Power Level 2 + 6 GHz WLAN Ant 2 at Reduced Power Level 2 + 2.4 GHz Bluetooth SAR (W/kg) |
|---------------|--|------------------------------|--|--|--|--|--|--|--|
| | 2+5+13+15 | 16 | 4+16 | 5+10+16 | 7+9+16 | 5+8+10+16 | 5+15+16 | 12+14+16 | 5+13+15+16 |
| Back | 0.179 | 0.065 | 0.210 | 0.198 | 0.448 | 0.238 | 0.170 | 0.239 | 0.201 |
| Right | 0.644 | 0.000 | 0.752 | 0.604 | 1.091 | 0.607 | 0.644 | 0.997 | 0.644 |
| Left | 0.493 | 0.256 | 0.256 | 0.260 | 1.307 | 0.498 | 0.256 | 1.399 | 0.484 |

| | | |
|---|------------------------------|--|
| FCC ID: C3K1997 | SAR EVALUATION REPORT | Approved by: Technical Manager |
| DUT Type: Portable Computing Device | | APPENDIX E: Page 1 of 3 |

Table E-3

Simultaneous Transmission Scenarios with WLAN/BT during WWAN Active Scenarios (Tablet at 0.0 cm)

| Configuration | 2.4 GHz WLAN Ant 1 at Reduced Power Level 2 + 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 3 + 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 3 SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 3 + 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 3 SAR (W/kg) | 2.4 GHz WLAN Ant 1 at Reduced Power Level 3 + 2.4 GHz WLAN Ant 2 at Reduced Power Level 3 SAR (W/kg) | 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 2 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 3 + 5 GHz WLAN Ant 2 at Reduced Power Level 3 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 at Reduced Power Level 3 + 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 3 GHz WLAN Ant 2 at Reduced Power Level 3 + 2.4 GHz Bluetooth SAR (W/kg) | 5 GHz WLAN Ant 1 at Reduced Power Level 2 + 5 GHz WLAN Ant 2 at Reduced Power Level 2 + 2.4 GHz Bluetooth SAR (W/kg) | WLAN/BT Worst-case Combination SAR (W/kg) |
|---------------|--|--|--|--|--|------------------------------|--|--|--|--|---|
| | 2+5 | 8+10 | 3+8+11 | 6+8+11 | 3+5+8+11 | 16 | 5+16 | 6+11+16 | 6+8+11+16 | 8+10+16 | |
| Back | 0.114 | 0.102 | 0.107 | 0.098 | 0.126 | 0.065 | 0.136 | 0.123 | 0.163 | 0.167 | 0.167 |
| Top | 0.002 | 0.004 | 0.004 | 0.004 | 0.004 | 0.000 | 0.001 | 0.004 | 0.004 | 0.004 | 0.004 |
| Bottom | 0.000 | 0.005 | 0.005 | 0.005 | 0.005 | 0.000 | 0.000 | 0.000 | 0.005 | 0.005 | 0.005 |
| Right | 0.245 | 0.362 | 0.375 | 0.375 | 0.375 | 0.000 | 0.245 | 0.372 | 0.375 | 0.362 | 0.375 |
| Left | 0.265 | 0.242 | 0.381 | 0.242 | 0.381 | 0.256 | 0.256 | 0.260 | 0.498 | 0.498 | 0.498 |

Table E-4

Simultaneous Transmission Scenarios with WWAN and WLAN/BT (Tablet at 0.0 cm)

| Body SAR | Configuration | Licensed SAR (W/kg) | WLAN/BT Worst-case Combination SAR (W/kg) | Licensed + WLAN/BT SAR (W/kg) |
|----------|---------------|---------------------|---|-------------------------------|
| | Back | 0.928 | 0.167 | 1.095 |
| | Top | 1.194 | 0.004 | 1.198 |
| | Bottom | 0.042 | 0.005 | 0.047 |
| | Right | 0.713 | 0.375 | 1.088 |
| | Left | 0.756 | 0.498 | 1.254 |

E.4 Body Simultaneous Transmission Analysis - Laptop

Table E-5

Simultaneous Transmission Scenarios of WLAN/BT (Laptop at 0.0 cm)

| Configuration | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | 6 GHz WLAN Ant 1 SAR (W/kg) | 6 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth SAR (W/kg) |
|---------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Bottom | 0.016 | 0.056 | 0.138 | 0.078 | 0.117 | 0.047 | 0.004 |

| | | |
|--|-----------------------|-----------------------------------|
| FCC ID: C3K1997 | SAR EVALUATION REPORT | Approved by: Technical Manager |
| DUT Type: Portable Computing Device | | APPENDIX E: Page 2 of 3 |

Table E-6
Simultaneous Transmission Scenarios with WLAN/BT (Laptop at 0.0 cm)

| | | | | | | | | |
|---------------|--|--|---|---|---|--|--|---|
| Configuration | 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 SAR (W/kg) | 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 6 GHz WLAN Ant 1 + 6 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 + 6 GHz WLAN Ant 1 + 6 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 2 + 6 GHz WLAN Ant 1 + 6 GHz WLAN Ant 2 SAR (W/kg) |
| | 1+2 | 3+4 | 5+6 | 1+3+4 | 2+3+4 | 1+2+3+4 | 1+5+6 | 2+5+6 |
| Bottom | 0.072 | 0.216 | 0.164 | 0.232 | 0.272 | 0.288 | 0.180 | 0.220 |
| Configuration | 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN Ant 1 + 6 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz Bluetooth + 2.4 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth + 6 GHz WLAN Ant 1 + 6 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN Ant 1 + 6 GHz WLAN Ant 2 SAR (W/kg) |
| | 1+2+5+6 | 7 | 7+2 | 7+3+4 | 7+5+6 | 7+2+4 | 7+2+3+4 | 7+2+6 |
| Bottom | 0.236 | 0.004 | 0.060 | 0.220 | 0.168 | 0.138 | 0.276 | 0.107 |

Table E-7
Simultaneous Transmission Scenarios with WLAN/BT during WWAN Active Scenarios (Laptop at 0.0 cm)

| | | | | | | | | | | | |
|---------------|--|--|---|---|--|------------------------------|---|--|---|--|---|
| Configuration | 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 SAR (W/kg) | 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 SAR (W/kg) | 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 2 + 2.4 GHz Bluetooth SAR (W/kg) | 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 2.4 GHz Bluetooth SAR (W/kg) | 5 GHz WLAN Ant 1 + 5 GHz WLAN Ant 2 + 2.4 GHz Bluetooth SAR (W/kg) | WLAN/BT Worst-case Combination SAR (W/kg) |
| | 1+2 | 3+4 | 1+3+4 | 2+3+4 | 1+2+3+4 | 7 | 2+7 | 2+4+7 | 2+3+4+7 | 3+4+7 | 0.288 |
| Bottom | 0.072 | 0.216 | 0.232 | 0.272 | 0.288 | 0.004 | 0.060 | 0.138 | 0.276 | 0.220 | 0.288 |

Table E-8
Simultaneous Transmission Scenarios with WWAN and WLAN/BT (Laptop at 0.0 cm)

| Body SAR | Configuration | Licensed SAR (W/kg) | WLAN/BT Worst-case Combination SAR (W/kg) | Licensed + WLAN/BT SAR (W/kg) |
|----------|---------------|---------------------|---|-------------------------------|
| | Bottom | 0.163 | 0.288 | 0.451 |

E.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results are sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D04v01 and IEEE 1528- 2013 Section 6.3.4.1.

| | | |
|---|------------------------------|--|
| FCC ID: C3K1997 | SAR EVALUATION REPORT | Approved by: Technical Manager |
| DUT Type: Portable Computing Device | | APPENDIX E: Page 3 of 3 |