

EUMmWV4 - SN:9642

July 10, 2024

| UID   | Rev | Communication System Name                            | Group         | PAR (dB) | Unc <sup>E</sup> k = 2 |
|-------|-----|------------------------------------------------------|---------------|----------|------------------------|
| 10829 | AAF | 5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 30 kHz)      | 5G NR FR1 TDD | 8.40     | ±9.6                   |
| 10830 | AAE | 5G NR (CP-OFDM, 1 RB, 10 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.63     | ±9.6                   |
| 10831 | AAD | 5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.73     | ±9.6                   |
| 10832 | AAE | 5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.74     | ±9.6                   |
| 10833 | AAD | 5G NR (CP-OFDM, 1 RB, 25 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.70     | ±9.6                   |
| 10834 | AAE | 5G NR (CP-OFDM, 1 RB, 30 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.75     | ±9.6                   |
| 10835 | AAF | 5G NR (CP-OFDM, 1 RB, 40 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.70     | ±9.6                   |
| 10836 | AAE | 5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.66     | ±9.6                   |
| 10837 | AAF | 5G NR (CP-OFDM, 1 RB, 60 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.68     | ±9.6                   |
| 10839 | AAF | 5G NR (CP-OFDM, 1 RB, 80 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.70     | ±9.6                   |
| 10840 | AAE | 5G NR (CP-OFDM, 1 RB, 90 MHz, QPSK, 60 kHz)          | 5G NR FR1 TDD | 7.67     | ±9.6                   |
| 10841 | AAF | 5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 60 kHz)         | 5G NR FR1 TDD | 7.71     | ±9.6                   |
| 10843 | AAD | 5G NR (CP-OFDM, 50% RB, 15 MHz, QPSK, 60 kHz)        | 5G NR FR1 TDD | 8.49     | ±9.6                   |
| 10844 | AAE | 5G NR (CP-OFDM, 50% RB, 20 MHz, QPSK, 60 kHz)        | 5G NR FR1 TDD | 8.34     | ±9.6                   |
| 10846 | AAE | 5G NR (CP-OFDM, 50% RB, 30 MHz, QPSK, 60 kHz)        | 5G NR FR1 TDD | 8.41     | ±9.6                   |
| 10854 | AAE | 5G NR (CP-OFDM, 100% RB, 10 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.34     | ±9.6                   |
| 10855 | AAD | 5G NR (CP-OFDM, 100% RB, 15 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.36     | ±9.6                   |
| 10856 | AAE | 5G NR (CP-OFDM, 100% RB, 20 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.37     | ±9.6                   |
| 10857 | AAD | 5G NR (CP-OFDM, 100% RB, 25 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.35     | ±9.6                   |
| 10858 | AAE | 5G NR (CP-OFDM, 100% RB, 30 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.36     | ±9.6                   |
| 10859 | AAF | 5G NR (CP-OFDM, 100% RB, 40 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.34     | ±9.6                   |
| 10860 | AAE | 5G NR (CP-OFDM, 100% RB, 50 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.41     | ±9.6                   |
| 10861 | AAF | 5G NR (CP-OFDM, 100% RB, 60 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.40     | ±9.6                   |
| 10863 | AAF | 5G NR (CP-OFDM, 100% RB, 80 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.41     | ±9.6                   |
| 10864 | AAE | 5G NR (CP-OFDM, 100% RB, 90 MHz, QPSK, 60 kHz)       | 5G NR FR1 TDD | 8.37     | ±9.6                   |
| 10865 | AAF | 5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 60 kHz)      | 5G NR FR1 TDD | 8.41     | ±9.6                   |
| 10866 | AAF | 5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)      | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10868 | AAF | 5G NR (DFT-s-OFDM, 100% RB, 100 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.89     | ±9.6                   |
| 10869 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 120 kHz)     | 5G NR FR2 TDD | 5.75     | ±9.6                   |
| 10870 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 100 MHz, QPSK, 120 kHz)  | 5G NR FR2 TDD | 5.86     | ±9.6                   |
| 10871 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 100 MHz, 16QAM, 120 kHz)    | 5G NR FR2 TDD | 5.75     | ±9.6                   |
| 10872 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 100 MHz, 16QAM, 120 kHz) | 5G NR FR2 TDD | 6.52     | ±9.6                   |
| 10873 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 100 MHz, 64QAM, 120 kHz)    | 5G NR FR2 TDD | 6.61     | ±9.6                   |
| 10874 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 100 MHz, 64QAM, 120 kHz) | 5G NR FR2 TDD | 6.65     | ±9.6                   |
| 10875 | AAE | 5G NR (CP-OFDM, 1 RB, 100 MHz, QPSK, 120 kHz)        | 5G NR FR2 TDD | 7.78     | ±9.6                   |
| 10876 | AAE | 5G NR (CP-OFDM, 100% RB, 100 MHz, QPSK, 120 kHz)     | 5G NR FR2 TDD | 8.39     | ±9.6                   |
| 10877 | AAE | 5G NR (CP-OFDM, 1 RB, 100 MHz, 16QAM, 120 kHz)       | 5G NR FR2 TDD | 7.95     | ±9.6                   |
| 10878 | AAE | 5G NR (CP-OFDM, 100% RB, 100 MHz, 16QAM, 120 kHz)    | 5G NR FR2 TDD | 8.41     | ±9.6                   |
| 10879 | AAE | 5G NR (CP-OFDM, 1 RB, 100 MHz, 64QAM, 120 kHz)       | 5G NR FR2 TDD | 8.12     | ±9.6                   |
| 10880 | AAE | 5G NR (CP-OFDM, 100% RB, 100 MHz, 64QAM, 120 kHz)    | 5G NR FR2 TDD | 8.38     | ±9.6                   |
| 10881 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 50 MHz, QPSK, 120 kHz)      | 5G NR FR2 TDD | 5.75     | ±9.6                   |
| 10882 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 50 MHz, QPSK, 120 kHz)   | 5G NR FR2 TDD | 5.96     | ±9.6                   |
| 10883 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 50 MHz, 16QAM, 120 kHz)     | 5G NR FR2 TDD | 6.57     | ±9.6                   |
| 10884 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 50 MHz, 16QAM, 120 kHz)  | 5G NR FR2 TDD | 6.53     | ±9.6                   |
| 10885 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 50 MHz, 64QAM, 120 kHz)     | 5G NR FR2 TDD | 6.61     | ±9.6                   |
| 10886 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 50 MHz, 64QAM, 120 kHz)  | 5G NR FR2 TDD | 6.65     | ±9.6                   |
| 10887 | AAE | 5G NR (CP-OFDM, 1 RB, 50 MHz, QPSK, 120 kHz)         | 5G NR FR2 TDD | 7.78     | ±9.6                   |
| 10888 | AAE | 5G NR (CP-OFDM, 100% RB, 50 MHz, QPSK, 120 kHz)      | 5G NR FR2 TDD | 8.35     | ±9.6                   |
| 10889 | AAE | 5G NR (CP-OFDM, 1 RB, 50 MHz, 16QAM, 120 kHz)        | 5G NR FR2 TDD | 8.02     | ±9.6                   |
| 10890 | AAE | 5G NR (CP-OFDM, 100% RB, 50 MHz, 16QAM, 120 kHz)     | 5G NR FR2 TDD | 8.40     | ±9.6                   |
| 10891 | AAE | 5G NR (CP-OFDM, 1 RB, 50 MHz, 64QAM, 120 kHz)        | 5G NR FR2 TDD | 8.13     | ±9.6                   |
| 10892 | AAE | 5G NR (CP-OFDM, 100% RB, 50 MHz, 64QAM, 120 kHz)     | 5G NR FR2 TDD | 8.41     | ±9.6                   |
| 10897 | AAE | 5G NR (DFT-s-OFDM, 1 RB, 5 MHz, QPSK, 30 kHz)        | 5G NR FR1 TDD | 5.66     | ±9.6                   |
| 10898 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 10 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.67     | ±9.6                   |
| 10899 | AAB | 5G NR (DFT-s-OFDM, 1 RB, 15 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.67     | ±9.6                   |
| 10900 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 20 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10901 | AAB | 5G NR (DFT-s-OFDM, 1 RB, 25 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10902 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 30 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10903 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10904 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 50 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10905 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 60 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10906 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 80 MHz, QPSK, 30 kHz)       | 5G NR FR1 TDD | 5.68     | ±9.6                   |
| 10907 | AAE | 5G NR (DFT-s-OFDM, 50% RB, 5 MHz, QPSK, 30 kHz)      | 5G NR FR1 TDD | 5.78     | ±9.6                   |
| 10908 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 10 MHz, QPSK, 30 kHz)     | 5G NR FR1 TDD | 5.93     | ±9.6                   |
| 10909 | AAB | 5G NR (DFT-s-OFDM, 50% RB, 15 MHz, QPSK, 30 kHz)     | 5G NR FR1 TDD | 5.96     | ±9.6                   |
| 10910 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 20 MHz, QPSK, 30 kHz)     | 5G NR FR1 TDD | 5.83     | ±9.6                   |

Certificate No: EUMm-9642\_Jul24

Page 16 of 18



EUMmWV4 - SN:9642

July 10, 2024

| UID   | Rev | Communication System Name                           | Group         | PAR (dB) | Unc <sup>E</sup> $k=2$ |
|-------|-----|-----------------------------------------------------|---------------|----------|------------------------|
| 10911 | AAB | 5G NR (DFT-s-OFDM, 50% RB, 25 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.93     | ±9.6                   |
| 10912 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 30 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.84     | ±9.6                   |
| 10913 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 40 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.84     | ±9.6                   |
| 10914 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 50 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.85     | ±9.6                   |
| 10915 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 60 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.83     | ±9.6                   |
| 10916 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 80 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.87     | ±9.6                   |
| 10917 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 100 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.94     | ±9.6                   |
| 10918 | AAE | 5G NR (DFT-s-OFDM, 100% RB, 5 MHz, QPSK, 30 kHz)    | 5G NR FR1 TDD | 5.86     | ±9.6                   |
| 10919 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 10 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.86     | ±9.6                   |
| 10920 | AAB | 5G NR (DFT-s-OFDM, 100% RB, 15 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.87     | ±9.6                   |
| 10921 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 20 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.84     | ±9.6                   |
| 10922 | AAB | 5G NR (DFT-s-OFDM, 100% RB, 25 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.82     | ±9.6                   |
| 10923 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 30 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.84     | ±9.6                   |
| 10924 | AAD | 5G NR (DFT-s-OFDM, 100% RB, 40 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.84     | ±9.6                   |
| 10925 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 50 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.95     | ±9.6                   |
| 10926 | AAD | 5G NR (DFT-s-OFDM, 100% RB, 60 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.84     | ±9.6                   |
| 10927 | AAD | 5G NR (DFT-s-OFDM, 100% RB, 80 MHz, QPSK, 30 kHz)   | 5G NR FR1 TDD | 5.94     | ±9.6                   |
| 10928 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 5 MHz, QPSK, 15 kHz)       | 5G NR FR1 FDD | 5.52     | ±9.6                   |
| 10929 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 10 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.52     | ±9.6                   |
| 10930 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.52     | ±9.6                   |
| 10931 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.51     | ±9.6                   |
| 10932 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 25 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.51     | ±9.6                   |
| 10933 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 30 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.51     | ±9.6                   |
| 10934 | AAC | 5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.51     | ±9.6                   |
| 10935 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 50 MHz, QPSK, 15 kHz)      | 5G NR FR1 FDD | 5.51     | ±9.6                   |
| 10936 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 5 MHz, QPSK, 15 kHz)     | 5G NR FR1 FDD | 5.90     | ±9.6                   |
| 10937 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 10 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.77     | ±9.6                   |
| 10938 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 15 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.90     | ±9.6                   |
| 10939 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 20 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.82     | ±9.6                   |
| 10940 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 25 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.89     | ±9.6                   |
| 10941 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 30 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.83     | ±9.6                   |
| 10942 | AAC | 5G NR (DFT-s-OFDM, 50% RB, 40 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.85     | ±9.6                   |
| 10943 | AAD | 5G NR (DFT-s-OFDM, 50% RB, 50 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.95     | ±9.6                   |
| 10944 | AAD | 5G NR (DFT-s-OFDM, 100% RB, 5 MHz, QPSK, 15 kHz)    | 5G NR FR1 FDD | 5.81     | ±9.6                   |
| 10945 | AAD | 5G NR (DFT-s-OFDM, 100% RB, 10 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.85     | ±9.6                   |
| 10946 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 15 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.83     | ±9.6                   |
| 10947 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 20 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.87     | ±9.6                   |
| 10948 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 25 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.94     | ±9.6                   |
| 10949 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 30 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.87     | ±9.6                   |
| 10950 | AAC | 5G NR (DFT-s-OFDM, 100% RB, 40 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.94     | ±9.6                   |
| 10951 | AAD | 5G NR (DFT-s-OFDM, 100% RB, 50 MHz, QPSK, 15 kHz)   | 5G NR FR1 FDD | 5.92     | ±9.6                   |
| 10952 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 15 kHz)   | 5G NR FR1 FDD | 8.25     | ±9.6                   |
| 10953 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 15 kHz)  | 5G NR FR1 FDD | 8.15     | ±9.6                   |
| 10954 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 15 kHz)  | 5G NR FR1 FDD | 8.23     | ±9.6                   |
| 10955 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 15 kHz)  | 5G NR FR1 FDD | 8.42     | ±9.6                   |
| 10956 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 30 kHz)   | 5G NR FR1 FDD | 8.14     | ±9.6                   |
| 10957 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 30 kHz)  | 5G NR FR1 FDD | 8.31     | ±9.6                   |
| 10958 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 30 kHz)  | 5G NR FR1 FDD | 8.61     | ±9.6                   |
| 10959 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 30 kHz)  | 5G NR FR1 FDD | 8.33     | ±9.6                   |
| 10960 | AAE | 5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 15 kHz)   | 5G NR FR1 TDD | 9.32     | ±9.6                   |
| 10961 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 15 kHz)  | 5G NR FR1 TDD | 9.36     | ±9.6                   |
| 10962 | AAB | 5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 15 kHz)  | 5G NR FR1 TDD | 9.40     | ±9.6                   |
| 10963 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 15 kHz)  | 5G NR FR1 TDD | 9.55     | ±9.6                   |
| 10964 | AAE | 5G NR DL (CP-OFDM, TM 3.1, 5 MHz, 64-QAM, 30 kHz)   | 5G NR FR1 TDD | 9.29     | ±9.6                   |
| 10965 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 10 MHz, 64-QAM, 30 kHz)  | 5G NR FR1 TDD | 9.37     | ±9.6                   |
| 10966 | AAB | 5G NR DL (CP-OFDM, TM 3.1, 15 MHz, 64-QAM, 30 kHz)  | 5G NR FR1 TDD | 9.55     | ±9.6                   |
| 10967 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 20 MHz, 64-QAM, 30 kHz)  | 5G NR FR1 TDD | 9.42     | ±9.6                   |
| 10968 | AAD | 5G NR DL (CP-OFDM, TM 3.1, 100 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.49     | ±9.6                   |
| 10972 | AAC | 5G NR (CP-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)         | 5G NR FR1 TDD | 11.59    | ±9.6                   |
| 10973 | AAD | 5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)     | 5G NR FR1 TDD | 9.06     | ±9.6                   |
| 10974 | AAD | 5G NR (CP-OFDM, 100% RB, 100 MHz, 256-QAM, 30 kHz)  | 5G NR FR1 TDD | 10.28    | ±9.6                   |
| 10978 | AAA | ULLA BDR                                            | ULLA          | 1.16     | ±9.6                   |
| 10979 | AAA | ULLA HDR4                                           | ULLA          | 8.58     | ±9.6                   |
| 10980 | AAA | ULLA HDR8                                           | ULLA          | 10.32    | ±9.6                   |
| 10981 | AAA | ULLA HDRc4                                          | ULLA          | 3.19     | ±9.6                   |
| 10982 | AAA | ULLA HDRc8                                          | ULLA          | 3.43     | ±9.6                   |

Certificate No: EUMm-9642\_Jul24

Page 17 of 18

EUMmWV4 - SN:9642

July 10, 2024

| UID   | Rev | Communication System Name                          | Group         | PAR (dB) | Unc <sup>E</sup> $k = 2$ |
|-------|-----|----------------------------------------------------|---------------|----------|--------------------------|
| 10983 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 15 kHz) | 5G NR FR1 TDD | 9.31     | ±9.6                     |
| 10984 | AAB | 5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 15 kHz) | 5G NR FR1 TDD | 9.42     | ±9.6                     |
| 10985 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.54     | ±9.6                     |
| 10986 | AAB | 5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.50     | ±9.6                     |
| 10987 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 60 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.53     | ±9.6                     |
| 10988 | AAB | 5G NR DL (CP-OFDM, TM 3.1, 70 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.38     | ±9.6                     |
| 10989 | AAC | 5G NR DL (CP-OFDM, TM 3.1, 80 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.33     | ±9.6                     |
| 10990 | AAB | 5G NR DL (CP-OFDM, TM 3.1, 90 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 9.52     | ±9.6                     |
| 11003 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 15 kHz) | 5G NR FR1 TDD | 10.24    | ±9.6                     |
| 11004 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 30 kHz) | 5G NR FR1 TDD | 10.73    | ±9.6                     |
| 11005 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 25 MHz, 64-QAM, 15 kHz) | 5G NR FR1 FDD | 8.70     | ±9.6                     |
| 11006 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 15 kHz) | 5G NR FR1 FDD | 8.55     | ±9.6                     |
| 11007 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 15 kHz) | 5G NR FR1 FDD | 8.46     | ±9.6                     |
| 11008 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 15 kHz) | 5G NR FR1 FDD | 8.51     | ±9.6                     |
| 11009 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 25 MHz, 64-QAM, 30 kHz) | 5G NR FR1 FDD | 8.76     | ±9.6                     |
| 11010 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 30 kHz) | 5G NR FR1 FDD | 8.95     | ±9.6                     |
| 11011 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 30 kHz) | 5G NR FR1 FDD | 8.96     | ±9.6                     |
| 11012 | AAA | 5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 30 kHz) | 5G NR FR1 FDD | 8.88     | ±9.6                     |
| 11013 | AAB | IEEE 802.11be (320 MHz, MCS1, 99pc duty cycle)     | WLAN          | 8.47     | ±9.6                     |
| 11014 | AAB | IEEE 802.11be (320 MHz, MCS2, 99pc duty cycle)     | WLAN          | 8.45     | ±9.6                     |
| 11015 | AAB | IEEE 802.11be (320 MHz, MCS3, 99pc duty cycle)     | WLAN          | 8.44     | ±9.6                     |
| 11016 | AAB | IEEE 802.11be (320 MHz, MCS4, 99pc duty cycle)     | WLAN          | 8.44     | ±9.6                     |
| 11017 | AAB | IEEE 802.11be (320 MHz, MCS5, 99pc duty cycle)     | WLAN          | 8.41     | ±9.6                     |
| 11018 | AAB | IEEE 802.11be (320 MHz, MCS6, 99pc duty cycle)     | WLAN          | 8.40     | ±9.6                     |
| 11019 | AAB | IEEE 802.11be (320 MHz, MCS7, 99pc duty cycle)     | WLAN          | 8.29     | ±9.6                     |
| 11020 | AAB | IEEE 802.11be (320 MHz, MCS8, 99pc duty cycle)     | WLAN          | 8.27     | ±9.6                     |
| 11021 | AAB | IEEE 802.11be (320 MHz, MCS9, 99pc duty cycle)     | WLAN          | 8.46     | ±9.6                     |
| 11022 | AAB | IEEE 802.11be (320 MHz, MCS10, 99pc duty cycle)    | WLAN          | 8.36     | ±9.6                     |
| 11023 | AAB | IEEE 802.11be (320 MHz, MCS11, 99pc duty cycle)    | WLAN          | 8.09     | ±9.6                     |
| 11024 | AAB | IEEE 802.11be (320 MHz, MCS12, 99pc duty cycle)    | WLAN          | 8.42     | ±9.6                     |
| 11025 | AAB | IEEE 802.11be (320 MHz, MCS13, 99pc duty cycle)    | WLAN          | 8.37     | ±9.6                     |
| 11026 | AAB | IEEE 802.11be (320 MHz, MCS0, 99pc duty cycle)     | WLAN          | 8.39     | ±9.6                     |

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



# ANNEX F: D2450V2 Dipole Calibration Certificate



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com http://www.caict.ac.cn



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570



Client TA(Shanghai)

Certificate No: 23J02Z80018

## CALIBRATION CERTIFICATE

Object D2450V2 - SN: 786

Calibration Procedure(s) FF-Z11-003-01  
Calibration Procedures for dipole validation kits

Calibration date: September 12, 2023

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.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%.

Calibration Equipment used (M&amp;TE critical for calibration)

| Primary Standards       | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|-------------------------------------------|-----------------------|
| Power Meter NRP2        | 106277     | 22-Sep-22 (CTTL, No.J22X09561)            | Sep-23                |
| Power sensor NRP8S      | 104291     | 22-Sep-22 (CTTL, No.J22X09561)            | Sep-23                |
| Reference Probe EX3DV4  | SN 3617    | 31-Mar-23(CTTL-SPEAG,No.Z23-60161)        | Mar-24                |
| DAE4                    | SN 1556    | 11-Jan-23(CTTL-SPEAG,No.Z23-60034)        | Jan-24                |
| Secondary Standards     | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 05-Jan-23 (CTTL, No. J23X00107)           | Jan-24                |
| NetworkAnalyzer E5071C  | MY46110673 | 10-Jan-23 (CTTL, No. J23X00104)           | Jan-24                |

|                |             |                    |                                                                                       |
|----------------|-------------|--------------------|---------------------------------------------------------------------------------------|
|                | Name        | Function           | Signature                                                                             |
| Calibrated by: | Zhao Jing   | SAR Test Engineer  |  |
| Reviewed by:   | Lin Hao     | SAR Test Engineer  |  |
| Approved by:   | Qi Dianyuan | SAR Project Leader |  |

Issued: September 16, 2023

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

Certificate No: 23J02Z80018

Page 1 of 6



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com <http://www.caict.ac.cn>



#### Glossary:

|       |                                            |
|-------|--------------------------------------------|
| TSL   | tissue simulating liquid                   |
| ConvF | sensitivity in TSL / NORM <sub>x,y,z</sub> |
| N/A   | not applicable or not measured             |

#### Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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%.



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com <http://www.caict.ac.cn>

### Measurement Conditions

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

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | 52.10.4     |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz     |             |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 38.9 $\pm$ 6 % | 1.81 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | —              | —                    |

### SAR result with Head TSL

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                              |
| SAR measured                                            | 250 mW input power | 13.2 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 52.6 W/kg $\pm$ 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                              |
| SAR measured                                            | 250 mW input power | 6.13 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.5 W/kg $\pm$ 18.7 % (k=2) |





Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com http://www.caict.ac.cn



## Appendix (Additional assessments outside the scope of CNAS L0570)

### Antenna Parameters with Head TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 52.2Ω+ 3.34jΩ |
| Return Loss                          | - 28.2dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.060 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.

### Additional EUT Data

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com http://www.caict.ac.cn



# **DASY5 Validation Report for Head TSL**

Date: 2023-09-12

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 786**

Communication System: UID 0, CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.809$  S/m;  $\epsilon_r = 38.86$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

## **DASY5 Configuration:**

- Probe: EX3DV4 - SN3617; ConvF(7.68, 7.68, 7.68) @ 2450 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.7 V/m; Power Drift = -0.05 dB

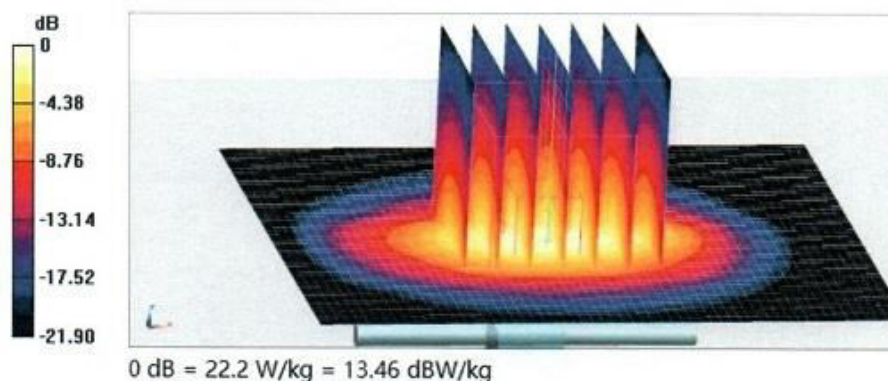
Peak SAR (extrapolated) = 27.6 W/kg

**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg**

Smallest distance from peaks to all points 3 dB below = 8.5 mm

Ratio of SAR at M2 to SAR at M1 = 48.5%

Maximum value of SAR (measured) = 22.2 W/kg

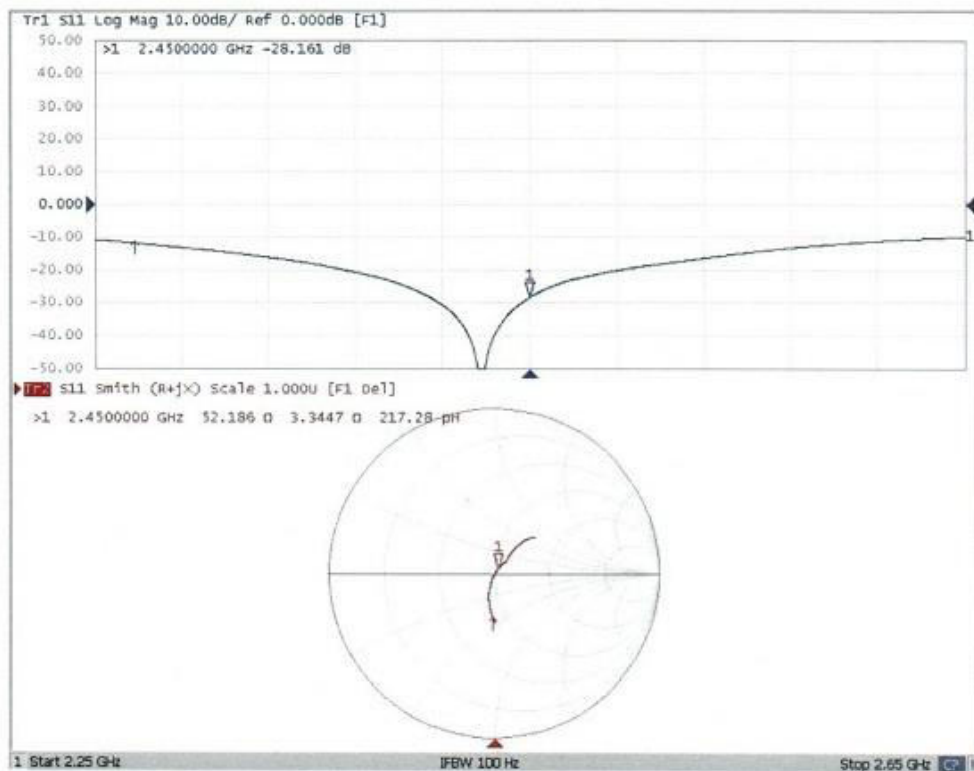






Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com <http://www.caict.ac.cn>

### Impedance Measurement Plot for Head TSL



## ANNEX G: D5GHzV2 Dipole Calibration Certificate

**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 0108**

Client **Auden**

Certificate No: **D5GHzV2-1203\_Dec22**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1203**

Calibration procedure(s) **QA CAL-22.v7**  
**Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **December 09, 2022**

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.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 04-Apr-22 (No. 217-03525/03524)   | Apr-23                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-22 (No. 217-03524)         | Apr-23                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-22 (No. 217-03525)         | Apr-23                 |
| Reference 20 dB Attenuator      | SN: BH9394 (20k)   | 04-Apr-22 (No. 217-03527)         | Apr-23                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528)         | Apr-23                 |
| Reference Probe EX3DV4          | SN: 3503           | 08-Mar-22 (No. EX3-3503_Mar22)    | Mar-23                 |
| DAE4                            | SN: 601            | 31-Aug-22 (No. DAE4-601_Aug22)    | Aug-23                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A           | SN: MY41093315     | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

|                |                       |                                   |               |
|----------------|-----------------------|-----------------------------------|---------------|
| Calibrated by: | Name<br>Michael Weber | Function<br>Laboratory Technician | Signature<br> |
| Approved by:   | Sven Kühn             | Technical Manager                 |               |

Issued: December 13, 2022

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



**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 0108**

**Glossary:**

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

**Calibration is Performed According to the Following Standards:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

### Measurement Conditions

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

|                              |                                                                                              |                                  |
|------------------------------|----------------------------------------------------------------------------------------------|----------------------------------|
| DASY Version                 | DASY52                                                                                       | V52.10.4                         |
| Extrapolation                | Advanced Extrapolation                                                                       |                                  |
| Phantom                      | Modular Flat Phantom V5.0                                                                    |                                  |
| Distance Dipole Center - TSL | 10 mm                                                                                        | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4.0 mm, dz = 1.4 mm                                                                 | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5250 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5750 MHz $\pm$ 1 MHz<br>5850 MHz $\pm$ 1 MHz |                                  |

### Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 35.9           | 4.71 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 36.4 $\pm$ 6 % | 4.61 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Head TSL at 5250 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                          | 100 mW input power | 7.76 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 77.7 W/kg $\pm$ 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR measured                                            | 100 mW input power | 2.24 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.4 W/kg $\pm$ 19.5 % (k=2) |



### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.9 ± 6 %   | 4.98 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5600 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 8.02 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 80.3 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.30 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.0 W/kg ± 19.5 % (k=2) |

### Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.4         | 5.22 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.7 ± 6 %   | 5.14 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5750 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.68 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 76.8 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.19 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.0 W/kg ± 19.5 % (k=2) |

### Head TSL parameters at 5850 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.2         | 5.32 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.6 ± 6 %   | 5.24 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

### SAR result with Head TSL at 5850 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 100 mW input power | 7.90 W/kg                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 79.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 100 mW input power | 2.25 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.5 W/kg ± 19.5 % (k=2) |



## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.5 $\Omega$ - 3.2 j $\Omega$ |
| Return Loss                          | - 29.0 dB                      |

### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.7 $\Omega$ + 2.6 j $\Omega$ |
| Return Loss                          | - 30.4 dB                      |

### Antenna Parameters with Head TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.6 $\Omega$ + 4.3 j $\Omega$ |
| Return Loss                          | - 25.3 dB                      |

### Antenna Parameters with Head TSL at 5850 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 52.4 $\Omega$ + 4.2 j $\Omega$ |
| Return Loss                          | - 26.5 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.191 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|

## DASY5 Validation Report for Head TSL

Date: 09.12.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1203**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5850 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.61$  S/m;  $\epsilon_r = 36.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.98$  S/m;  $\epsilon_r = 35.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5750$  MHz;  $\sigma = 5.14$  S/m;  $\epsilon_r = 35.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5850$  MHz;  $\sigma = 5.24$  S/m;  $\epsilon_r = 35.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(4.99, 4.99, 4.99) @ 5850 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.31 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 26.3 W/kg

**SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.24 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 70.6%

Maximum value of SAR (measured) = 17.6 W/kg

### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.76 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 29.4 W/kg

**SAR(1 g) = 8.02 W/kg; SAR(10 g) = 2.30 W/kg**

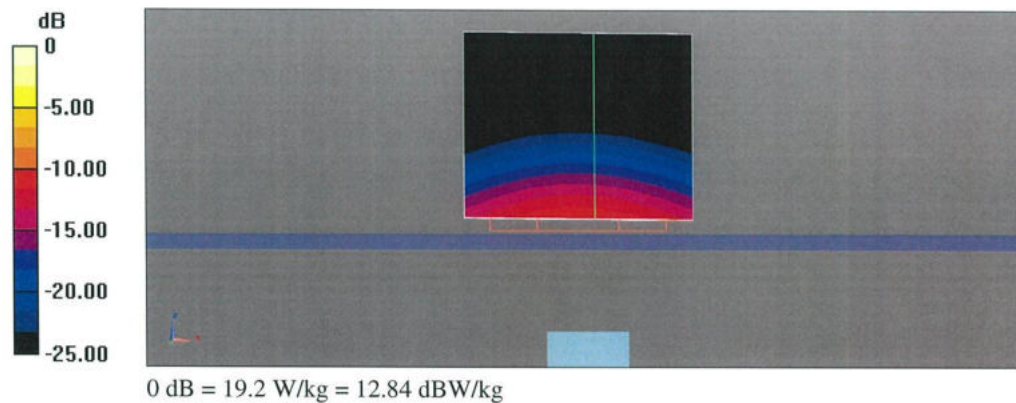
Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 67.9%

Maximum value of SAR (measured) = 18.9 W/kg

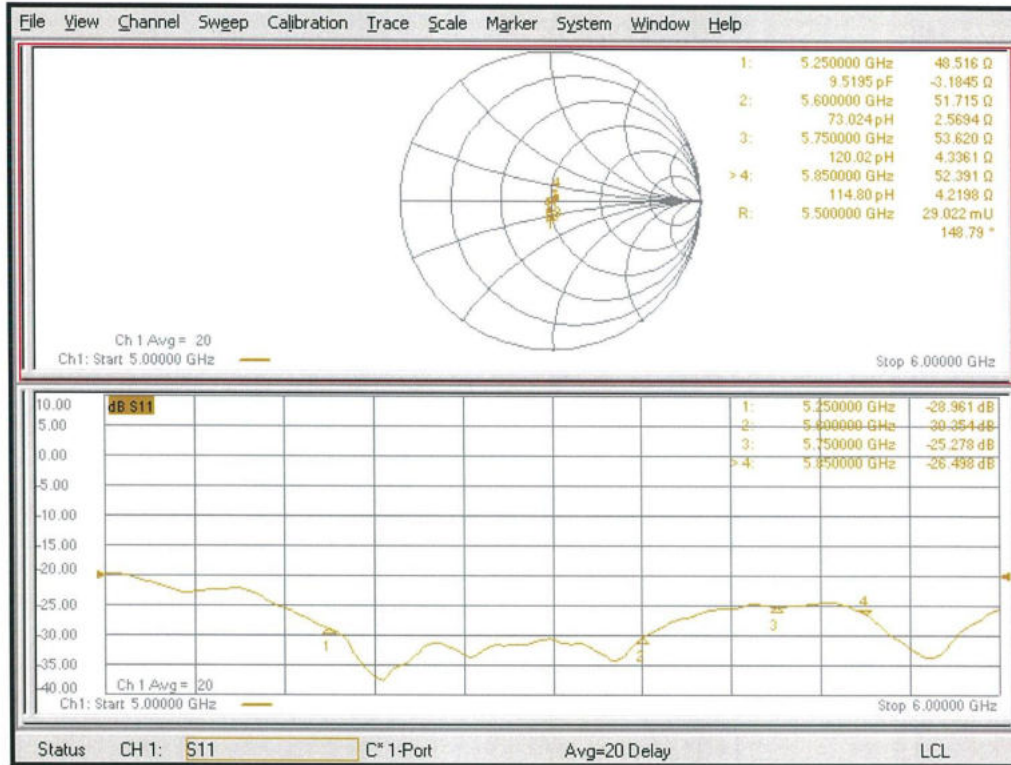
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
 Reference Value = 70.15 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 29.7 W/kg  
**SAR(1 g) = 7.68 W/kg; SAR(10 g) = 2.19 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 7.5 mm  
 Ratio of SAR at M2 to SAR at M1 = 66.2%  
 Maximum value of SAR (measured) = 18.3 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5850 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
 Reference Value = 70.55 V/m; Power Drift = -0.03 dB  
 Peak SAR (extrapolated) = 31.6 W/kg  
**SAR(1 g) = 7.90 W/kg; SAR(10 g) = 2.25 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 7.5 mm  
 Ratio of SAR at M2 to SAR at M1 = 65.2%  
 Maximum value of SAR (measured) = 19.2 W/kg





## Impedance Measurement Plot for Head TSL



# ANNEX H: D6.5GHzV2 Dipole Calibration Certificate

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 0108

Client **TA-SH (Auden)**

Certificate No: **D6.5GHzV2-1046\_Oct21**

## CALIBRATION CERTIFICATE

Object **D6.5GHzV2 - SN:1046**

Calibration procedure(s) **QA CAL-22.v6  
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

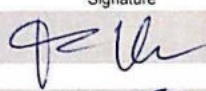
Calibration date: **October 04, 2021**

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.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards                | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|----------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                  | SN: 104778         | 09-Apr-21 (No. 217-03291/03292)   | Apr-22                 |
| Power sensor NRP-Z91             | SN: 103244         | 09-Apr-21 (No. 217-03291)         | Apr-22                 |
| Power sensor NRP-Z91             | SN: 103245         | 09-Apr-21 (No. 217-03292)         | Apr-22                 |
| Power sensor R&S NRP33T          | SN: 100967         | 08-Apr-21 (No. 217-03293)         | Apr-22                 |
| Reference 20 dB Attenuator       | SN: BH9394 (20k)   | 09-Apr-21 (No. 217-03343)         | Apr-22                 |
| Type-N mismatch combination      | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344)         | Apr-22                 |
| Reference Probe EX3DV4           | SN: 7405           | 30-Dec-20 (No. EX3-7405_Dec20)    | Dec-21                 |
| DAE4                             | SN: 908            | 24-Jun-21 (No. DAE4-908_Jun21)    | Jun-22                 |
| Secondary Standards              | ID #               | Check Date (in house)             | Scheduled Check        |
| RF generator Anapico APSIN20G    | SN: 669            | 28-Mar-17 (in house check Dec-18) | In house check: Dec-21 |
| Network Analyzer Keysight E5063A | SN: MY54504221     | 31-Oct-19 (in house check Oct-19) | In house check: Oct-22 |

|                |                |                       |                                                                                       |
|----------------|----------------|-----------------------|---------------------------------------------------------------------------------------|
|                | Name           | Function              | Signature                                                                             |
| Calibrated by: | Jeton Kastrati | Laboratory Technician |   |
| Approved by:   | Katja Pokovic  | Technical Manager     |  |

Issued: October 6, 2021

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

Certificate No: D6.5GHzV2-1046\_Oct21

Page 1 of 6

**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 0108**

**Glossary:**

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

**Calibration is Performed According to the Following Standards:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.

**Additional Documentation:**

- b) DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.
- *The absorbed power density (APD):* The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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%.



### Measurement Conditions

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

|                              |                              |                                  |
|------------------------------|------------------------------|----------------------------------|
| DASY Version                 | DASY6                        | V16.0                            |
| Extrapolation                | Advanced Extrapolation       |                                  |
| Phantom                      | Modular Flat Phantom         |                                  |
| Distance Dipole Center - TSL | 5 mm                         | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 3.4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 6500 MHz $\pm$ 1 MHz         |                                  |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 34.5           | 6.07 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 33.6 $\pm$ 6 % | 6.11 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Head TSL

|                                                       |                    |                             |
|-------------------------------------------------------|--------------------|-----------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                             |
| SAR measured                                          | 100 mW input power | 29.3 W/kg                   |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 291 W/kg $\pm$ 24.7 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 100 mW input power | 5.45 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 54.1 W/kg $\pm$ 24.4 % (k=2) |

## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.5 $\Omega$ + 0.6 j $\Omega$ |
| Return Loss                          | - 42.5 dB                      |

### APD (Absorbed Power Density)

| APD averaged over 1 cm <sup>2</sup> | Condition          |                                          |
|-------------------------------------|--------------------|------------------------------------------|
| APD measured                        | 100 mW input power | 291 W/m <sup>2</sup>                     |
| APD measured                        | normalized to 1W   | 2910 W/m <sup>2</sup> $\pm$ 29.2 % (k=2) |
| APD averaged over 4 cm <sup>2</sup> | condition          |                                          |
| APD measured                        | 100 mW input power | 133 W/m <sup>2</sup>                     |
| APD measured                        | normalized to 1W   | 1330 W/m <sup>2</sup> $\pm$ 28.9 % (k=2) |

### General Antenna Parameters and Design

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|

## DASY6 Validation Report for Head TSL

Measurement Report for D6.5GHz-1046, UID 0 -, Channel 6500 (6500.0MHz)

### Device under Test Properties

| Name, Manufacturer | Dimensions [mm]    | IMEI     | DUT Type |
|--------------------|--------------------|----------|----------|
| D6.5GHz            | 16.0 x 6.0 x 300.0 | SN: 1046 | -        |

### Exposure Conditions

| Phantom<br>Section, TSL | Position, Test<br>Distance<br>[mm] | Band | Group,<br>UID | Frequency<br>[MHz] | Conversion<br>Factor | TSL Cond.<br>[S/m] | TSL<br>Permittivity |
|-------------------------|------------------------------------|------|---------------|--------------------|----------------------|--------------------|---------------------|
| Flat, HSL               | 5.00                               | Band | CW,           | 6500               | 5.75                 | 6.11               | 33.6                |

### Hardware Setup

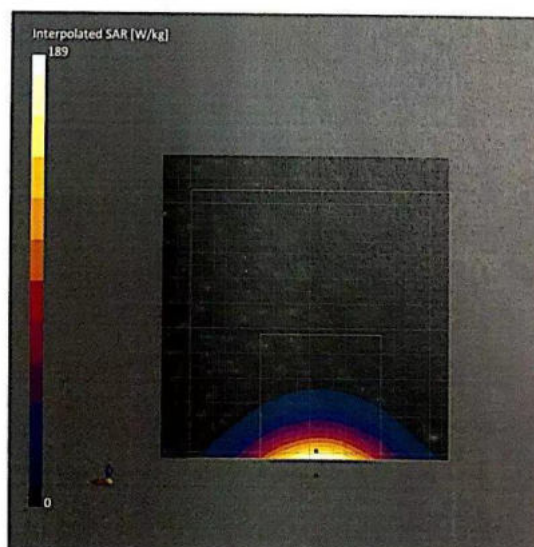
| Phantom                | TSL             | Probe, Calibration Date     | DAE, Calibration Date  |
|------------------------|-----------------|-----------------------------|------------------------|
| MFP V8.0 Center - 1182 | HBBL600-10000V6 | EX3DV4 - SN7405, 2020-12-30 | DAE4 Sn908, 2021-06-24 |

### Scan Setup

|                     | Zoom Scan          |
|---------------------|--------------------|
| Grid Extents [mm]   | 22.0 x 22.0 x 22.0 |
| Grid Steps [mm]     | 3.4 x 3.4 x 1.4    |
| Sensor Surface [mm] | 1.4                |
| Graded Grid         | Yes                |
| Grading Ratio       | 1.4                |
| MAIA                | N/A                |
| Surface Detection   | VMS + 6p           |
| Scan Method         | Measured           |

### Measurement Results

|                     | Zoom Scan        |
|---------------------|------------------|
| Date                | 2021-10-04, 9:30 |
| psSAR1g [W/Kg]      | 29.3             |
| psSAR10g [W/Kg]     | 5.45             |
| Power Drift [dB]    | -0.02            |
| Power Scaling       | Disabled         |
| Scaling Factor [dB] |                  |
| TSL Correction      | No correction    |
| M2/M1 [%]           | 50.1             |
| Dist 3dB Peak [mm]  | 4.8              |

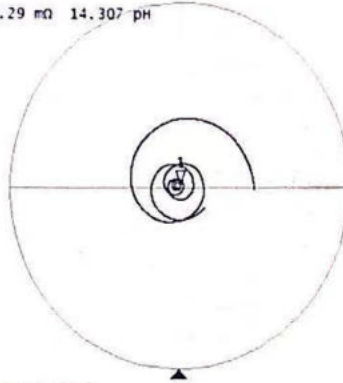




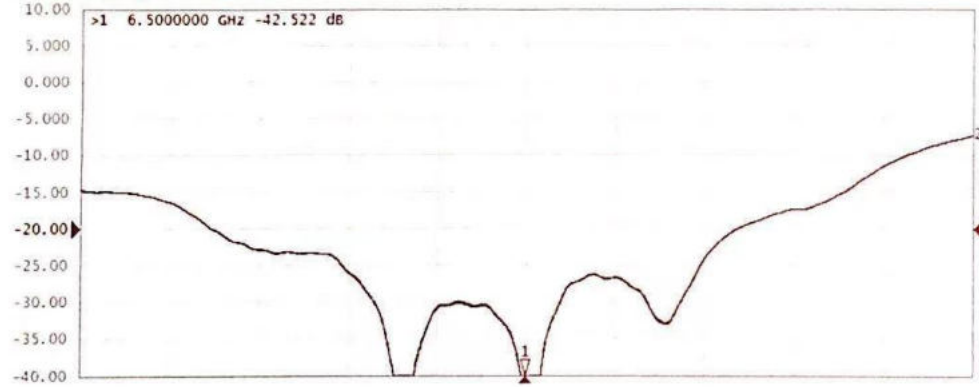
## Impedance Measurement Plot for Head TSL

Tr1 S11 Smith (R+jX) Scale 1.000 U [F1]

>1 6.5000000 GHz 50.473  $\Omega$  584.29 m $\Omega$  14.307 pF



Tr2 S11 Log Mag 5.000 dB/ Ref -20.00 dB [F1]



# ANNEX I: CLA13 Dipole Calibration Certificate

**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 0108**

Client **TA-SH (Auden)**

Certificate No: **CLA13-1024\_Sep22**

## CALIBRATION CERTIFICATE

Object **CLA13 - SN: 1024**

Calibration procedure(s) **QA CAL-15.v9  
Calibration Procedure for SAR Validation Sources below 700 MHz**

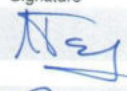
Calibration date: **September 12, 2022**

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.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 04-Apr-22 (No. 217-03525/03524)   | Apr-23                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-22 (No. 217-03524)         | Apr-23                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-22 (No. 217-03525)         | Apr-23                 |
| Reference 20 dB Attenuator      | SN: CC2552 (20x)   | 04-Apr-22 (No. 217-03527)         | Apr-23                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528)         | Apr-23                 |
| Reference Probe EX3DV4          | SN: 3877           | 31-Dec-21 (No. EX3-3877_Dec21)    | Dec-22                 |
| DAE4                            | SN: 654            | 26-Jan-22 (No. DAE4-654_Jan22)    | Jan-23                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB41293874     | 06-Apr-16 (in house check Jun-22) | In house check: Jun-24 |
| Power sensor E4412A             | SN: MY41498087     | 06-Apr-16 (in house check Jun-22) | In house check: Jun-24 |
| Power sensor E4412A             | SN: 000110210      | 06-Apr-16 (in house check Jun-22) | In house check: Jun-24 |
| RF generator HP 8648C           | SN: US3642U01700   | 04-Aug-99 (in house check Jun-22) | In house check: Jun-24 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-20) | In house check: Oct-22 |

|                |                            |                                   |                                                                                                    |
|----------------|----------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------|
| Calibrated by: | Name<br>Aidonia Georgiadou | Function<br>Laboratory Technician | Signature<br> |
| Approved by:   | Sven Kühn                  | Technical Manager                 |               |

Issued: September 12, 2022

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

**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 0108**

**Glossary:**

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

**Calibration is Performed According to the Following Standards:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.



### Measurement Conditions

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

|                      |                                  |                                  |
|----------------------|----------------------------------|----------------------------------|
| DASY Version         | DASY52                           | V52.10.4                         |
| Extrapolation        | Advanced Extrapolation           |                                  |
| Phantom              | ELI4 Flat Phantom                | Shell thickness: $2 \pm 0.2$ mm  |
| EUT Positioning      | Touch Position                   |                                  |
| Zoom Scan Resolution | $dx, dy = 4.0$ mm, $dz = 1.4$ mm | Graded Ratio = 1.4 (Z direction) |
| Frequency            | $13$ MHz $\pm 1$ MHz             |                                  |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity           |
|-----------------------------------------|---------------------|----------------|------------------------|
| Nominal Head TSL parameters             | $22.0$ °C           | 55.0           | $0.75$ mho/m           |
| Measured Head TSL parameters            | $(22.0 \pm 0.2)$ °C | $54.7 \pm 6$ % | $0.74$ mho/m $\pm 6$ % |
| Head TSL temperature change during test | $< 0.5$ °C          | ----           | ----                   |

### SAR result with Head TSL

|                                                           |                     |                                                              |
|-----------------------------------------------------------|---------------------|--------------------------------------------------------------|
| SAR averaged over $1$ cm <sup>3</sup> (1 g) of Head TSL   | Condition           |                                                              |
| SAR measured                                              | $1$ W input power   | $0.566$ W/kg                                                 |
| SAR for nominal Head TSL parameters                       | normalized to $1$ W | <b><math>0.571</math> W/kg <math>\pm 18.4</math> % (k=2)</b> |
| SAR averaged over $10$ cm <sup>3</sup> (10 g) of Head TSL | condition           |                                                              |
| SAR measured                                              | $1$ W input power   | $0.352$ W/kg                                                 |
| SAR for nominal Head TSL parameters                       | normalized to $1$ W | <b><math>0.355</math> W/kg <math>\pm 18.0</math> % (k=2)</b> |

**Appendix (Additional assessments outside the scope of SCS 0108)****Antenna Parameters with Head TSL**

|                                      |                                   |
|--------------------------------------|-----------------------------------|
| Impedance, transformed to feed point | $46.3 \, \Omega + 2.4 \, j\Omega$ |
| Return Loss                          | - 26.9 dB                         |

**Additional EUT Data**

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|

## DASY5 Validation Report for Head TSL

Date: 12.09.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1024**

Communication System: UID 0 - CW; Frequency: 13 MHz

Medium parameters used:  $f = 13$  MHz;  $\sigma = 0.74$  S/m;  $\epsilon_r = 54.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan,

**dist=1.4mm (8x10x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 29.77 V/m; Power Drift = -0.07 dB

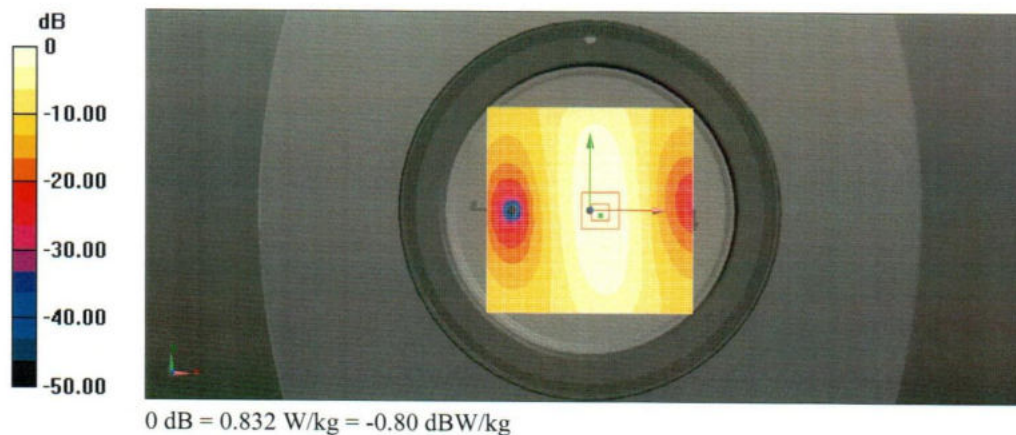
Peak SAR (extrapolated) = 1.14 W/kg

**SAR(1 g) = 0.566 W/kg; SAR(10 g) = 0.352 W/kg**

Smallest distance from peaks to all points 3 dB below = 18.7 mm

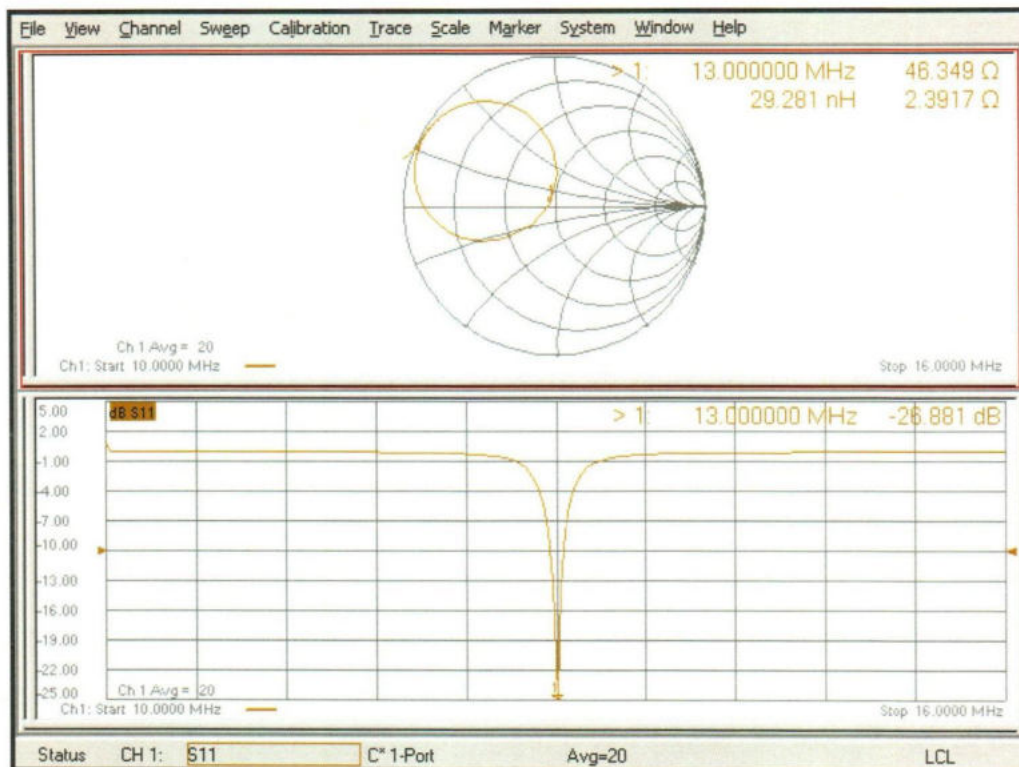
Ratio of SAR at M2 to SAR at M1 = 78.6%

Maximum value of SAR (measured) = 0.832 W/kg





### Impedance Measurement Plot for Head TSL



# ANNEX J: 5G Verification Source 10 GHz Calibration Certificate

**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 0108

Client **TA-SH (Auden)**

Certificate No: 5G-Veri10-1054\_Sep22

## CALIBRATION CERTIFICATE

Object **5G Verification Source 10 GHz - SN: 1054**

Calibration procedure(s) **QA CAL-45.v3  
Calibration procedure for sources in air above 6 GHz**

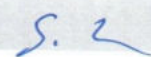
Calibration date: **September 09, 2022**

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.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards             | ID #     | Cal Date (Certificate No.)          | Scheduled Calibration  |
|-------------------------------|----------|-------------------------------------|------------------------|
| Reference Probe EUMmWV3       | SN: 9374 | 2021-12-21 (No. EUMmWV3-9374_Dec21) | Dec-22                 |
| DAE4ip                        | SN: 1602 | 2022-06-27 (No. DAE4ip-1602_Jun22)  | Jun-23                 |
| Secondary Standards           | ID #     | Check Date (in house)               | Scheduled Check        |
| RF generator Anapico APSIN20G | SN: 827  | 18-Dec-18 (in house check Dec-21)   | In house check: Dec-23 |

|                |                             |                                          |                                                                                                    |
|----------------|-----------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------|
| Calibrated by: | Name<br><b>Leif Klysner</b> | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:   | <b>Sven Kühn</b>            | <b>Technical Manager</b>                 |               |

Issued: September 12, 2022

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

**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 0108

## Glossary

CW Continuous wave

## Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45-5Gsources
- IEC TR 63170 ED1, "Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz", January 2018

## Methods Applied and Interpretation of Parameters

- *Coordinate System:* z-axis in the waveguide horn boresight, x-axis is in the direction of the E-field, y-axis normal to the others in the field scanning plane parallel to the horn flare and horn flange.
- *Measurement Conditions:* (1) 10 GHz: The radiated power is the forward power to the horn antenna minus ohmic and mismatch loss. The forward power is measured prior and after the measurement with a power sensor. During the measurements, the horn is directly connected to the cable and the antenna ohmic and mismatch losses are determined by far-field measurements. (2) 30, 45, 60 and 90 GHz: The verification sources are switched on for at least 30 minutes. Absorbers are used around the probe cub and at the ceiling to minimize reflections.
- *Horn Positioning:* The waveguide horn is mounted vertically on the flange of the waveguide source to allow vertical positioning of the EUmmW probe during the scan. The plane is parallel to the phantom surface. Probe distance is verified using mechanical gauges positioned on the flare of the horn.
- *E- field distribution:* E field is measured in two x-y-plane (10mm, 10mm +  $\lambda/4$ ) with a vectorial E-field probe. The E-field value stated as calibration value represents the E-field-maxima and the averaged (1cm<sup>2</sup> and 4cm<sup>2</sup>) power density values at 10mm in front of the horn.
- *Field polarization:* Above the open horn, linear polarization of the field is expected. This is verified graphically in the field representation.

## Calibrated Quantity

- Local peak E-field (V/m) and average of peak spatial components of the poynting vector (W/m<sup>2</sup>) averaged over the surface area of 1 cm<sup>2</sup> and 4cm<sup>2</sup> at the nominal operational frequency of the verification source. Both square and circular averaging results are listed.

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%.



### Measurement Conditions

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

|                                |                               |      |
|--------------------------------|-------------------------------|------|
| DASY Version                   | DASY8 Module mmWave           | V3.0 |
| Phantom                        | 5G Phantom                    |      |
| Distance Horn Aperture - plane | 10 mm                         |      |
| XY Scan Resolution             | dx, dy = 7.5 mm               |      |
| Number of measured planes      | 2 (10mm, 10mm + $\lambda/4$ ) |      |
| Frequency                      | 10 GHz $\pm$ 10 MHz           |      |

### Calibration Parameters, 10 GHz

#### Circular Averaging

| Distance Horn Aperture to Measured Plane | $Prad^1$<br>(mW) | Max E-field<br>(V/m) | Uncertainty<br>(k = 2) | Avg Power Density<br>Avg (psPDn+, psPDtot+, psPDmod+)<br>(W/m <sup>2</sup> ) |                   | Uncertainty<br>(k = 2) |
|------------------------------------------|------------------|----------------------|------------------------|------------------------------------------------------------------------------|-------------------|------------------------|
|                                          |                  |                      |                        | 1 cm <sup>2</sup>                                                            | 4 cm <sup>2</sup> |                        |
| 10 mm                                    | 86.1             | 147                  | 1.27 dB                | 53.2                                                                         | 50.1              | 1.28 dB                |

#### Square Averaging

| Distance Horn Aperture to Measured Plane | $Prad^1$<br>(mW) | Max E-field<br>(V/m) | Uncertainty<br>(k = 2) | Avg Power Density<br>Avg (psPDn+, psPDtot+, psPDmod+)<br>(W/m <sup>2</sup> ) |                   | Uncertainty<br>(k = 2) |
|------------------------------------------|------------------|----------------------|------------------------|------------------------------------------------------------------------------|-------------------|------------------------|
|                                          |                  |                      |                        | 1 cm <sup>2</sup>                                                            | 4 cm <sup>2</sup> |                        |
| 10 mm                                    | 86.1             | 147                  | 1.27 dB                | 53.3                                                                         | 50.0              | 1.28 dB                |

<sup>1</sup> Assessed ohmic and mismatch loss plus numerical offset: 0.55 dB

## DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

### Device under Test Properties

| Name, Manufacturer            | Dimensions [mm]       | IMEI     | DUT Type |
|-------------------------------|-----------------------|----------|----------|
| 5G Verification Source 10 GHz | 100.0 x 100.0 x 172.0 | SN: 1054 | -        |

### Exposure Conditions

| Phantom Section | Position, Test Distance [mm] | Band            | Group, | Frequency [MHz], Channel Number | Conversion Factor |
|-----------------|------------------------------|-----------------|--------|---------------------------------|-------------------|
| 5G -            | 10.0 mm                      | Validation band | CW     | 10000.0, 10000                  | 1.0               |

### Hardware Setup

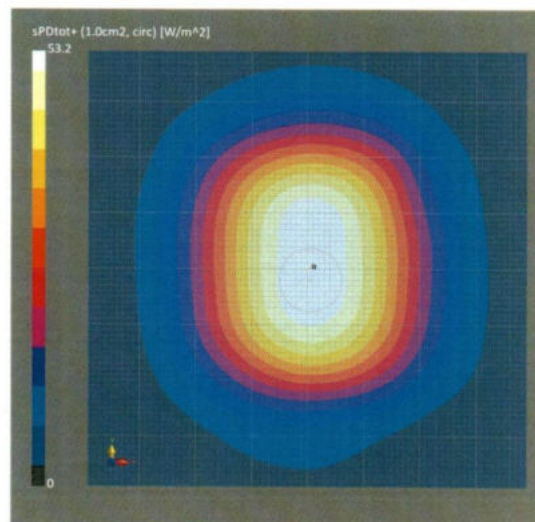
| Phantom               | Medium | Probe, Calibration Date               | DAE, Calibration Date     |
|-----------------------|--------|---------------------------------------|---------------------------|
| mmWave Phantom - 1002 | Air    | EUmmWV3 - SN9374_F1-55GHz, 2021-12-21 | DAE4ip Sn1602, 2022-06-27 |

### Scan Setup

|                     | 5G Scan       |
|---------------------|---------------|
| Grid Extents [mm]   | 120.0 x 120.0 |
| Grid Steps [lambda] | 0.25 x 0.25   |
| Sensor Surface [mm] | 10.0          |
| MAIA                | MAIA not used |

### Measurement Results

|                              | 5G Scan           |
|------------------------------|-------------------|
| Date                         | 2022-09-09, 13:37 |
| Avg. Area [cm <sup>2</sup> ] | 1.00              |
| psPDn+ [W/m <sup>2</sup> ]   | 53.0              |
| psPDtot+ [W/m <sup>2</sup> ] | 53.2              |
| psPDmod+ [W/m <sup>2</sup> ] | 53.3              |
| E <sub>max</sub> [V/m]       | 147               |
| Power Drift [dB]             | 0.04              |



## DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

### Device under Test Properties

| Name, Manufacturer            | Dimensions [mm]       | IMEI     | DUT Type |
|-------------------------------|-----------------------|----------|----------|
| 5G Verification Source 10 GHz | 100.0 x 100.0 x 172.0 | SN: 1054 | -        |

### Exposure Conditions

| Phantom Section | Position, Test Distance [mm] | Band            | Group, | Frequency [MHz], Channel Number | Conversion Factor |
|-----------------|------------------------------|-----------------|--------|---------------------------------|-------------------|
| 5G -            | 10.0 mm                      | Validation band | CW     | 10000.0, 10000                  | 1.0               |

### Hardware Setup

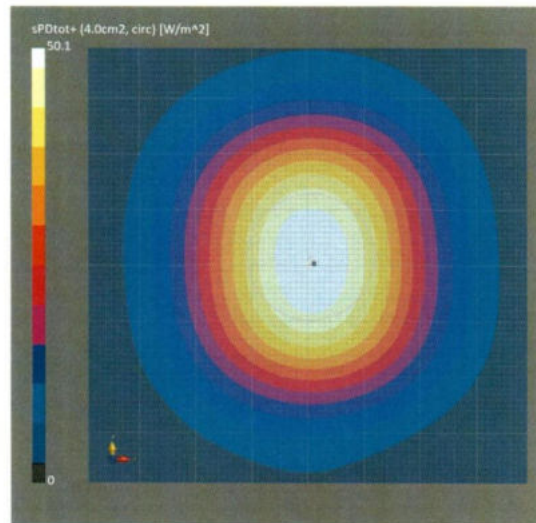
| Phantom               | Medium | Probe, Calibration Date               | DAE, Calibration Date     |
|-----------------------|--------|---------------------------------------|---------------------------|
| mmWave Phantom - 1002 | Air    | EUMmWV3 - SN9374_F1-55GHz, 2021-12-21 | DAE4ip Sn1602, 2022-06-27 |

### Scan Setup

|                     | 5G Scan       |
|---------------------|---------------|
| Grid Extents [mm]   | 120.0 x 120.0 |
| Grid Steps [lambda] | 0.25 x 0.25   |
| Sensor Surface [mm] | 10.0          |
| MAIA                | MAIA not used |

### Measurement Results

|                              | 5G Scan           |
|------------------------------|-------------------|
| Date                         | 2022-09-09, 13:37 |
| Avg. Area [cm <sup>2</sup> ] | 4.00              |
| psPDn+ [W/m <sup>2</sup> ]   | 49.9              |
| psPDtot+ [W/m <sup>2</sup> ] | 50.1              |
| psPDmod+ [W/m <sup>2</sup> ] | 50.3              |
| E <sub>max</sub> [V/m]       | 147               |
| Power Drift [dB]             | 0.04              |





## DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

### Device under Test Properties

| Name, Manufacturer            | Dimensions [mm]       | IMEI     | DUT Type |
|-------------------------------|-----------------------|----------|----------|
| 5G Verification Source 10 GHz | 100.0 x 100.0 x 172.0 | SN: 1054 | -        |

### Exposure Conditions

| Phantom Section | Position, Test Distance [mm] | Band            | Group, | Frequency [MHz], Channel Number | Conversion Factor |
|-----------------|------------------------------|-----------------|--------|---------------------------------|-------------------|
| 5G -            | 10.0 mm                      | Validation band | CW     | 10000.0, 10000                  | 1.0               |

### Hardware Setup

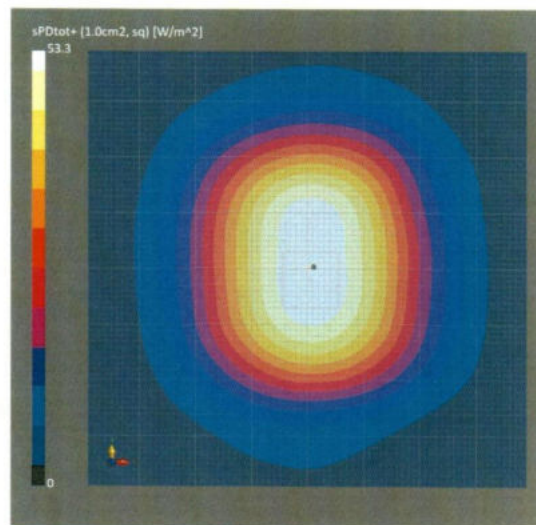
| Phantom               | Medium | Probe, Calibration Date               | DAE, Calibration Date     |
|-----------------------|--------|---------------------------------------|---------------------------|
| mmWave Phantom - 1002 | Air    | EUmmWV3 - SN9374_F1-55GHz, 2021-12-21 | DAE4ip Sn1602, 2022-06-27 |

### Scan Setup

|                     | 5G Scan       |
|---------------------|---------------|
| Grid Extents [mm]   | 120.0 x 120.0 |
| Grid Steps [lambda] | 0.25 x 0.25   |
| Sensor Surface [mm] | 10.0          |
| MAIA                | MAIA not used |

### Measurement Results

|                              | 5G Scan           |
|------------------------------|-------------------|
| Date                         | 2022-09-09, 13:37 |
| Avg. Area [cm <sup>2</sup> ] | 1.00              |
| psPDn+ [W/m <sup>2</sup> ]   | 53.1              |
| psPDtot+ [W/m <sup>2</sup> ] | 53.3              |
| psPDmod+ [W/m <sup>2</sup> ] | 53.5              |
| E <sub>max</sub> [V/m]       | 147               |
| Power Drift [dB]             | 0.04              |



## DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

### Device under Test Properties

| Name, Manufacturer            | Dimensions [mm]       | IMEI     | DUT Type |
|-------------------------------|-----------------------|----------|----------|
| 5G Verification Source 10 GHz | 100.0 x 100.0 x 172.0 | SN: 1054 | -        |

### Exposure Conditions

| Phantom Section | Position, Test Distance [mm] | Band            | Group, | Frequency [MHz], Channel Number | Conversion Factor |
|-----------------|------------------------------|-----------------|--------|---------------------------------|-------------------|
| 5G -            | 10.0 mm                      | Validation band | CW     | 10000.0, 10000                  | 1.0               |

### Hardware Setup

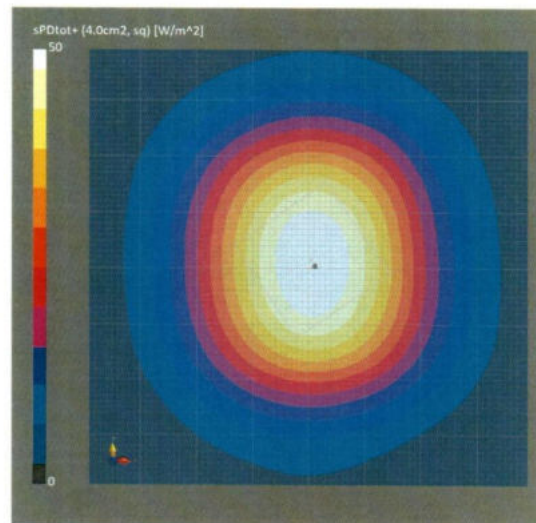
| Phantom               | Medium | Probe, Calibration Date               | DAE, Calibration Date     |
|-----------------------|--------|---------------------------------------|---------------------------|
| mmWave Phantom - 1002 | Air    | EUmmWV3 - SN9374_F1-55GHz, 2021-12-21 | DAE4ip Sn1602, 2022-06-27 |

### Scan Setup

|                     | 5G Scan       |
|---------------------|---------------|
| Grid Extents [mm]   | 120.0 x 120.0 |
| Grid Steps [lambda] | 0.25 x 0.25   |
| Sensor Surface [mm] | 10.0          |
| MAIA                | MAIA not used |

### Measurement Results

|                              | 5G Scan           |
|------------------------------|-------------------|
| Date                         | 2022-09-09, 13:37 |
| Avg. Area [cm <sup>2</sup> ] | 4.00              |
| psPDn+ [W/m <sup>2</sup> ]   | 49.8              |
| psPDtot+ [W/m <sup>2</sup> ] | 50.0              |
| psPDmod+ [W/m <sup>2</sup> ] | 50.2              |
| E <sub>max</sub> [V/m]       | 147               |
| Power Drift [dB]             | 0.04              |



# ANNEX K: DAE4 Calibration Certificate (SN: 1317)

**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 0108

Client **TA**  
 Shanghai City

Certificate No: DAE4-1317\_Sep23

## CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1317**

Calibration procedure(s) **QA CAL-06.v30**  
 Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **September 13, 2023**

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.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards             | ID #               | Cal Date (Certificate No.) | Scheduled Calibration  |
|-------------------------------|--------------------|----------------------------|------------------------|
| Keithley Multimeter Type 2001 | SN: 0810278        | 29-Aug-23 (No:37421)       | Aug-24                 |
| Secondary Standards           | ID #               | Check Date (in house)      | Scheduled Check        |
| Auto DAE Calibration Unit     | SE UWS 053 AA 1001 | 27-Jan-23 (in house check) | In house check: Jan-24 |
| Calibrator Box V2.1           | SE UMS 006 AA 1002 | 27-Jan-23 (in house check) | In house check: Jan-24 |

|                |                           |                                   |               |
|----------------|---------------------------|-----------------------------------|---------------|
| Calibrated by: | Name<br>Dominique Steffen | Function<br>Laboratory Technician | Signature<br> |
| Approved by:   | Sven Kühn                 | Technical Manager                 |               |

Issued: September 13, 2023

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

Certificate No: DAE4-1317\_Sep23

Page 1 of 5



**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 0108

## Glossary

**DAE** data acquisition electronics  
**Connector angle** information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

- **DC Voltage Measurement:** Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- **Connector angle:** The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
  - **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
  - **AD Converter Values with inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
  - **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
  - **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - **Input resistance:** Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
  - **Power consumption:** Typical value for information. Supply currents in various operating modes.

### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1  $\mu$ V , full range = -100...+300 mV  
Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X                         | Y                         | Z                         |
|---------------------|---------------------------|---------------------------|---------------------------|
| High Range          | 403.828 $\pm$ 0.02% (k=2) | 404.593 $\pm$ 0.02% (k=2) | 403.947 $\pm$ 0.02% (k=2) |
| Low Range           | 3.98059 $\pm$ 1.50% (k=2) | 3.99254 $\pm$ 1.50% (k=2) | 3.98124 $\pm$ 1.50% (k=2) |

### Connector Angle

|                                           |                                     |
|-------------------------------------------|-------------------------------------|
| Connector Angle to be used in DASY system | 332.0 $^{\circ}$ $\pm$ 1 $^{\circ}$ |
|-------------------------------------------|-------------------------------------|

## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

| High Range        | Reading ( $\mu\text{V}$ ) | Difference ( $\mu\text{V}$ ) | Error (%) |
|-------------------|---------------------------|------------------------------|-----------|
| Channel X + Input | 200035.87                 | -2.10                        | -0.00     |
| Channel X + Input | 20009.78                  | 2.22                         | 0.01      |
| Channel X - Input | -20003.08                 | 1.96                         | -0.01     |
| Channel Y + Input | 200038.43                 | 1.12                         | 0.00      |
| Channel Y + Input | 20007.38                  | 0.01                         | 0.00      |
| Channel Y - Input | -20005.14                 | 0.15                         | -0.00     |
| Channel Z + Input | 200035.44                 | -1.96                        | -0.00     |
| Channel Z + Input | 20007.06                  | -0.38                        | -0.00     |
| Channel Z - Input | -20005.82                 | -0.50                        | 0.00      |

| Low Range         | Reading ( $\mu\text{V}$ ) | Difference ( $\mu\text{V}$ ) | Error (%) |
|-------------------|---------------------------|------------------------------|-----------|
| Channel X + Input | 2002.30                   | -0.21                        | -0.01     |
| Channel X + Input | 202.91                    | 0.62                         | 0.31      |
| Channel X - Input | -197.09                   | 0.46                         | -0.24     |
| Channel Y + Input | 2001.50                   | -0.93                        | -0.05     |
| Channel Y + Input | 201.49                    | -0.69                        | -0.34     |
| Channel Y - Input | -198.93                   | -1.28                        | 0.65      |
| Channel Z + Input | 2002.15                   | -0.14                        | -0.01     |
| Channel Z + Input | 201.40                    | -0.60                        | -0.30     |
| Channel Z - Input | -198.25                   | -0.54                        | 0.27      |

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | Common mode Input Voltage (mV) | High Range Average Reading ( $\mu\text{V}$ ) | Low Range Average Reading ( $\mu\text{V}$ ) |
|-----------|--------------------------------|----------------------------------------------|---------------------------------------------|
| Channel X | 200                            | 12.18                                        | 10.32                                       |
|           | - 200                          | -9.53                                        | -11.39                                      |
| Channel Y | 200                            | 11.60                                        | 11.04                                       |
|           | - 200                          | -12.39                                       | -13.28                                      |
| Channel Z | 200                            | 1.85                                         | 2.16                                        |
|           | - 200                          | -3.72                                        | -3.91                                       |

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | Input Voltage (mV) | Channel X ( $\mu\text{V}$ ) | Channel Y ( $\mu\text{V}$ ) | Channel Z ( $\mu\text{V}$ ) |
|-----------|--------------------|-----------------------------|-----------------------------|-----------------------------|
| Channel X | 200                | -                           | 1.45                        | -3.50                       |
| Channel Y | 200                | 8.83                        | -                           | 4.46                        |
| Channel Z | 200                | 10.22                       | 5.65                        | -                           |



#### 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | High Range (LSB) | Low Range (LSB) |
|-----------|------------------|-----------------|
| Channel X | 15750            | 15569           |
| Channel Y | 16504            | 16920           |
| Channel Z | 16070            | 16718           |

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M $\Omega$

|           | Average ( $\mu$ V) | min. Offset ( $\mu$ V) | max. Offset ( $\mu$ V) | Std. Deviation ( $\mu$ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | 0.33               | -0.60                  | 1.20                   | 0.43                      |
| Channel Y | -0.09              | -1.84                  | 1.39                   | 0.59                      |
| Channel Z | 0.28               | -0.95                  | 2.09                   | 0.54                      |

#### 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

#### 7. Input Resistance (Typical values for information)

|           | Zeroing (kOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 200            | 200              |
| Channel Y | 200            | 200              |
| Channel Z | 200            | 200              |

#### 8. Low Battery Alarm Voltage (Typical values for information)

| Typical values | Alarm Level (VDC) |
|----------------|-------------------|
| Supply (+ Vcc) | +7.9              |
| Supply (- Vcc) | -7.6              |

#### 9. Power Consumption (Typical values for information)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vcc) | +0.01             | +6            | +14               |
| Supply (- Vcc) | -0.01             | -8            | -9                |

## ANNEX L: The EUT Appearance

The EUT Appearance are submitted separately.

## ANNEX M: Test Setup Photos

The Test Setup Photos are submitted separately.

\*\*\*\*\*END OF REPORT \*\*\*\*\*