OPEN-WIRE IMPEDANCE, ATTENUATION, PHASE
**080, 104, 128, 165-Mil Copper-Steel (40%)-8" Spacing - S and P**

080-Mil Side

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 1485 | 1334 | 1996 | 41.9 | .0147 | .128 | .0164 | .0052 |
| 300 | 1230 | 1068 | 1629 | 40.9 | .0177 | .153 | .0205 | .0065 |
| 500 | 1016 | 780 | 1281 | 37.5 | .0215 | .187 | .0280 | .0089 |
| 1000 | 812 | 488 | 947 | 31.0 | .0270 | .235 | .0448 | .0143 |
| 1500 | 740 | 358 | 822 | 25.8 | .0297 | .258 | .0596 | .0190 |
| 2000 | 702 | 284 | 757 | 22.0 | .0314 | .272 | .0775 | .0247 |
| 2500 | 681 | 235 | 721 | 19.0 | .0326 | .282 | .0944 | .0300 |
| 3000 | 669 | 200 | 698 | 16.6 | .0333 | .289 | .1100 | .0350 |

104-Mil Side

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 1139 | 958 | 1489 | 40.1 | .0110 | .0955 | .0134 | .0043 |
| 300 | 945 | 710 | 1181 | 36.9 | .0130 | .1130 | .0172 | .0055 |
| 500 | 821 | 538 | 981 | 33.2 | .0154 | .1340 | .0238 | .0076 |
| 1000 | 691 | 324 | 763 | 25.1 | .0187 | .1620 | .0402 | .0128 |
| 1500 | 652 | 232 | 692 | 19.6 | .0200 | .1740 | .0566 | .0180 |
| 2000 | 636 | 180 | 661 | 15.8 | .0207 | .1800 | .0732 | .0233 |
| 2500 | 626 | 148 | 643 | 13.3 | .0213 | .1850 | .0900 | .0287 |
| 3000 | 621 | 124 | 633 | 11.3 | .0216 | .1880 | .1070 | .0341 |

104-Mil Phantom

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 706 | 555 | 898 | 38.2 | .0089 | .0770 | .0110 | .0035 |
| 300 | 610 | 415 | 738 | 34.2 | .0104 | .0900 | .0145 | .0046 |
| 500 | 528 | 299 | 607 | 29.5 | .0120 | .1040 | .0210 | .0067 |
| 1000 | 467 | 172 | 498 | 20.2 | .0138 | .1200 | .0370 | .0118 |
| 1500 | 450 | 121 | 466 | 15.1 | .0145 | .1260 | .0540 | .0172 |
| 2000 | 443 | 93 | 453 | 11.9 | .0149 | .1290 | .0710 | .0226 |
| 2500 | 439 | 75 | 445 | 9.7 | .0151 | .1310 | .0870 | .0277 |
| 3000 | 437 | 63 | 442 | 8.2 | .0153 | .1330 | .1040 | .0331 |

128-Mil Side

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 943 | 736 | 1197 | 38.0 | .0088 | .0765 | .0115 | .0037 |
| 300 | 820 | 575 | 1001 | 35.0 | .0102 | .0890 | .0148 | .0047 |
| 500 | 714 | 397 | 817 | 29.1 | .0119 | .1030 | .0215 | .0068 |
| 1000 | 635 | 230 | 676 | 19.9 | .0138 | .1200 | .0379 | .0121 |
| 1500 | 611 | 162 | 632 | 14.9 | .0146 | .1270 | .0552 | .0176 |
| 2000 | 601 | 124 | 613 | 11.6 | .0150 | .1300 | .0714 | .0227 |
| 2500 | 596 | 102 | 604 | 9.7 | .0152 | .1320 | .0884 | .0282 |
| 3000 | 593 | 86 | 599 | 8.2 | .0154 | .1340 | .1060 | .0338 |

128-Mil Phantom

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 598 | 423 | 733 | 35.3 | .0069 | .0600 | .0100 | .0032 |
| 300 | 535 | 315 | 621 | 30.5 | .0078 | .0680 | .0130 | .0041 |
| 500 | 474 | 216 | 521 | 24.5 | .0089 | .0770 | .0190 | .0061 |
| 1000 | 438 | 120 | 454 | 15.3 | .0099 | .0860 | .0360 | .0115 |
| 1500 | 428 | 83 | 436 | 11.0 | .0104 | .0900 | .0530 | .0169 |
| 2000 | 424 | 63 | 429 | 8.5 | .0105 | .0910 | .0700 | .0223 |
| 2500 | 422 | 51 | 425 | 6.9 | .0106 | .0920 | .0870 | .0277 |
| 3000 | 421 | 43 | 423 | 5.8 | .0107 | .0930 | .1040 | .0331 |

165-Mil Side

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 761 | 516 | 919 | 34.1 | .0065 | .0566 | .0098 | .0031 |
| 300 | 683 | 373 | 778 | 28.6 | .0073 | .0630 | .0125 | .0040 |
| 500 | 618 | 258 | 670 | 22.7 | .0082 | .0708 | .0195 | .0062 |
| 1000 | 572 | 143 | 590 | 14.0 | .0090 | .0784 | .0361 | .0115 |
| 1500 | 566 | 99 | 575 | 9.9 | .0094 | .0815 | .0532 | .0169 |
| 2000 | 562 | 75 | 567 | 7.6 | .0096 | .0830 | .0703 | .0224 |
| 2500 | 559 | 61 | 562 | 6.2 | .0097 | .0842 | .0874 | .0278 |
| 3000 | 558 | 51 | 560 | 5.2 | .0098 | .0852 | .1050 | .0334 |

165-Mil Phantom

| Freq. | Impedance | | | | Attenuation | | Phase Shift | |
|---|---|---|---|---|---|---|---|---|
| | R | X | Z | Angle | $\alpha$ | db/mi | $\beta$ | B |
| 200 | 501 | 290 | 579 | 30.1 | .0050 | .0430 | .0090 | .0029 |
| 300 | 460 | 211 | 506 | 24.6 | .0054 | .0465 | .0120 | .0038 |
| 500 | 429 | 137 | 450 | 17.7 | .0059 | .0510 | .0180 | .0057 |
| 1000 | 411 | 73 | 417 | 10.1 | .0063 | .0550 | .0350 | .0111 |
| 1500 | 407 | 50 | 410 | 7.0 | .0064 | .0560 | .0520 | .0166 |
| 2000 | 406 | 38 | 408 | 5.4 | .0066 | .0570 | .0690 | .0220 |
| 2500 | 405 | 31 | 406 | 4.4 | .0067 | .0580 | .0860 | .0274 |
| 3000 | 404 | 26 | 405 | 3.7 | .0068 | .0590 | .1030 | .0328 |

Note: All reactances are negative. Angles are in degrees and negative. Values based on dry weather, average temperature conditions.

$\beta$ = Phase shift in radians per circuit mile.
B = Phase shift in cycles per circuit mile, out and back = $\frac{2\beta}{2\pi}$