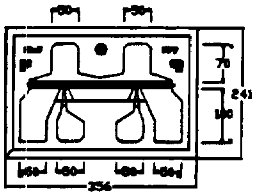
# MwT - A7

## 18 GHz High Gain, Low Noise GaAs FET

**MicroWave Technology** *4268 Solar Way Fremont, CA 94538 510-651-6700 FAX 510-651-2208*



CHIP THICKNESS - 125 MICRONS

MwT-A7

## FEATURES

- HIGH AVAILABLE GAIN WHEN BIASED FOR LOW-NOISE
- EXCELLENT FOR BROADBAND GAIN OR OSCILLATOR BUFFER APPLICATIONS
- 0.3 MICRON REFRACTORY METAL / GOLD GATE
- 250 MICRON GATE WIDTH
- CHOICE OF CHIP AND TWO PACKAGE TYPES

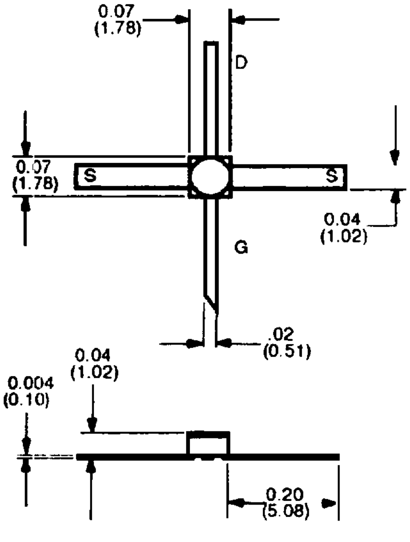
## DESCRIPTION

The MwT-A7 is a GaAs MESFET device whose nominal quarter-micron gate length and 250 micron gate width make it ideally suited to applications requiring high-gain in the 500 MHz to 18 GHz frequency range while exhibiting low noise figure. The straight gate geometry of the MwT-A7 makes it equally effective for either wideband (ex. 6 to 18 GHz) or narrow-band applications. Processing which guarantees low phase noise makes the MwT-A7 particularly attractive for oscillator applications. The chip is produced using MwT's reliable metal system and all devices are screened to insure reliability. All chips are passivated using MwT's patented "Diamond-Like Carbon" process for durability with no degradation in performance. Designers can use MwT's unique BIN selection feature to choose devices from narrow Idss ranges, insuring consistent circuit operation.

## RF SPECIFICATIONS AT Ta = 25°C

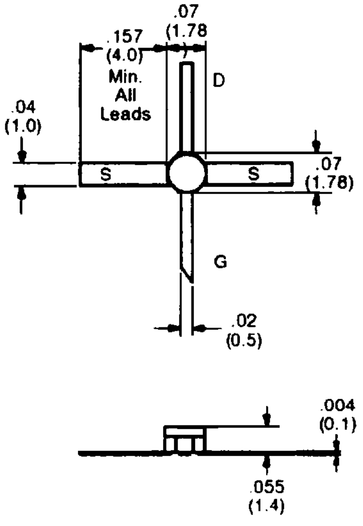
| | | | | MwT-A7GN<br>MwT-A770GN<br>MwT-A773GN | | | MwT-A7SN<br>MwT-A770SN<br>MwT-A773SN | | | MwT-A7LN<br>MwT-A770LN<br>MwT-A773LN | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYMBOL | PARAMETERS AND CONDITIONS | FREQ | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| NFopt | Optimum Noise Figure<br>VDS = 3.0 V IDS = 10 mA | 12 GHz | dB | | 2.0 | 2.2 | | 1.7 | 2.0 | | 1.5 | 1.8 |
| GA | Gain at Optimum Noise Figure<br>VDS = 3.0 V IDS = 10 mA | 12 GHz | dB | 7.0 | 8.0 | | 7.0 | 8.0 | | 7.0 | 8.0 | |
| P1dB | Output Power at 1dB Compression<br>VDS=5.0V IDS= 0.6 IDSS | 12 GHz | dBm | | 16.0 | | | 17.0 | | | 17.0 | |
| SSG | Small Signal Gain<br>VDS=5.0V IDS=0.6 IDSS | 12 GHz | dB | 9.0 | 10.0 | | 9.5 | 11.0 | | 9.5 | 11.0 | |

MwT-A770



[(Units in Inches and (mm)]

MwT-A773



# MwT-A7
## 18 GHz High Gain, Low Noise GaAs FET

## DC SPECIFICATIONS AT Ta = 25 °C

| SYMBOL | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX |
|---|---|---|---|---|---|
| Idss | Saturated Drain Current<br>Vds = 3.0 V VGS = 0.0 V | mA | 26 | | 98 |
| Gm | Transconductance<br>Vds = 3.0 V VGS = 0.0 V | mS | 36 | 45 | |
| Vp | Pinch-off Voltage<br>Vds = 3.0 V IDS = 1.0 mA | V | | -1.5 | - 4.5 |
| BVGSO | Gate-to-Source Breakdown Voltage<br>Igs = -0.4 mA, Igd = 0 | V | -5.0 | -8.0 | |
| BVGDO | Gate-to-Drain Breakdown Voltage<br>Igd = -0.4 mA, Igs = 0 | V | -6.0 | -8.0 | |
| Rth | Thermal Resistance MwT-A7 Chip<br>MwT-A770, A773 | °C/W | | | 180<br>380* |

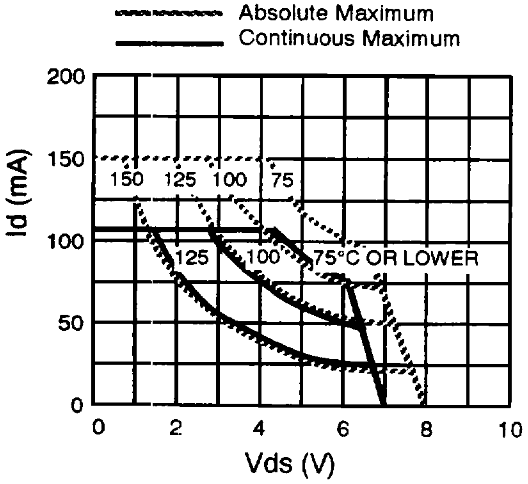
*** Overall Rth depends on case mounting**

## MAXIMUM RATINGS AT Ta = 25 ° C

| SYMBOL | PARAMETER | UNITS | CONT MAX [1] | ABSOLUTE MAX [2] |
|---|---|---|---|---|
| VDS | Drain to Source Voltage | V | See Safe Operating Limits | |
| Tch | Channel Temperature | °C | +150 | +175 |
| Tst | Storage Temperature | °C | -65 to +150 | +175 |
| Pin | RF Input Power | mW | 125 | 250 |

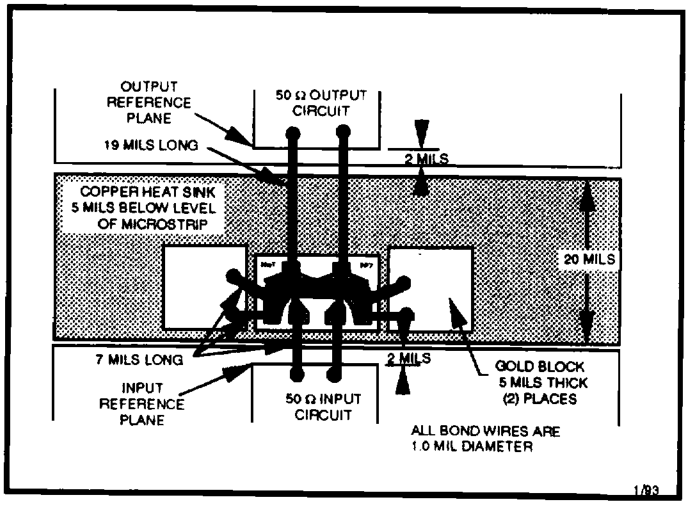
NOTES: 1. Exceeding any one of these limits in continuous operation may reduce the mean-time-to-failure below the design goals.
2. Exceeding any one of these limits may cause permanent damage.

### SAFE OPERATING LIMITS
vs. Case Temperature



### RECOMMENDED ASSEMBLY CONFIGURATION

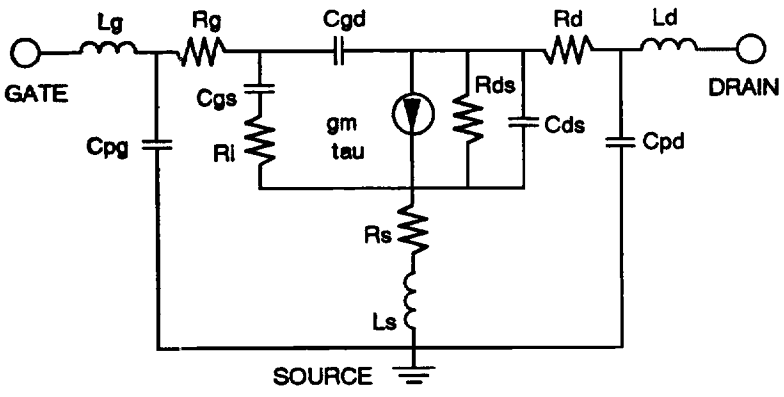
Shown below is the assembly and bonding configuration used for S-Parameter measurements of the MwT-A7 Chip and is recommended for optimum performance. For self-bias applications the gold blocks may be replaced by capacitors. Contact MwT for additional applications information.



# MwT-A7

**18 GHz High Gain, Low Noise GaAs FET**

## DEVICE EQUIVALENT CIRCUIT MODEL



| PARAMETER | | VALUE |
|---|---|---|
| Gate Bond Wire Inductance | Lg | .084 nH |
| Gate Pad Capacitance | Cpg | .134 pF |
| Gate Resistance | Rg | 0.19 Ω |
| Gate-Source Capacitance | Cgs | .227 pF |
| Channel Resistance | Ri | 6.1 Ω |
| Gate-Drain Capacitance | Cgd | .017 pF |
| Transconductance | gm | 57 mS |
| Transit time | tau | 1.53 psec |
| Source Resistance | Rs | 3.75 Ω |
| Source Inductance | Ls | .061 nH |
| Drain-Source Resistance | Rds | 184 Ω |
| Drain-Source Capacitance | Cds | .020 pF |
| Drain Resistance | Rd | 3.89 Ω |
| Drain Pad Capacitance | Cpd | .076 pF |
| Drain Inductance | Ld | .175 nH |

## BIN SELECTION

Every MwT-A7 wafer produced is 100% DC probed, binned by Idss in 4 ma increments, and sample devices are evaluated for RF performance. Users may select devices from 18 Idss bins to insure consistent matched performance in the circuit. The shaded bins are typically available in smaller quantity and caution is advised before designing these bins into high production applications. Availability in three visual grades insures the most economical solution for the application.

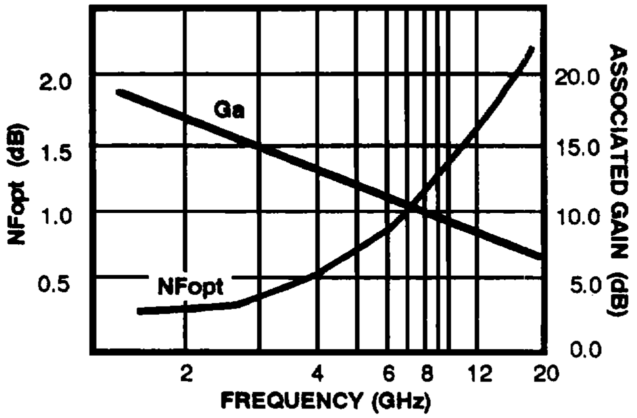
| BIN # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IDSS (mA) | 26-30 | 30-34 | 34-38 | 38-42 | 42-46 | 46-50 | 50-54 | 54-58 | 58-62 | 62-66 | 66-70 | 70-74 | 74-78 | 78-82 | 82-86 | 86-90 | 90-94 | 94-98 |

## TYPICAL NOISE PARAMETERS

MwT-A7LN Chip: VDS = 3.0 V, IDS = 12 mA

| FREQUENCY MHz | NF MIN dB | GAMMA OPT MAG | GAMMA OPT ANGLE | Rn/50 |
|---|---|---|---|---|
| 1000 | 0.30 | 0.95 | 3.7 | 0..55 |
| 2000 | 0.33 | 0.86 | 19.1 | 0.48 |
| 4000 | 0.60 | 0.73 | 38.5 | 0.41 |
| 6000 | 0.86 | 0.62 | 58.3 | 0.37 |
| 10000 | 1.33 | 0.51 | 98.6 | 0.33 |
| 12000 | 1.55 | 0.49 | 117.7 | 0.31 |
| 16000 | 1.96 | 0.51 | 150.4 | 0.29 |
| 18000 | 2.15 | 0.53 | 163.7 | 0.27 |

**NOISE FIGURE AND ASSOCIATED GAIN VS. FREQUENCY**



## TYPICAL COMMON SOURCE SCATTERING PARAMETERS

MwT-A7 CHIP BIASED FOR LOW NOISE FIGURE: VDS = 3.0 V, IDS = 10 mA

| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 1.00 | .98 | -11.5 | 2.26 | 168.5 | .02 | 78.0 | .66 | -5.7 |
| 2.00 | .95 | -21.3 | 2.20 | 160.2 | .04 | 73.0 | .65 | -11.9 |
| 3.00 | .95 | -31.6 | 2.18 | 151.1 | .06 | 67.3 | .64 | -17.8 |
| 4.00 | .93 | -42.2 | 2.12 | 141.7 | .08 | 61.3 | .63 | -23.5 |
| 5.00 | .91 | -52.1 | 2.05 | 133.2 | .09 | 55.6 | .61 | -29.2 |
| 6.00 | .89 | -61.2 | 1.99 | 125.4 | .11 | 50.2 | .59 | -34.3 |
| 7.00 | .88 | -70.4 | 1.93 | 117.3 | .12 | 44.7 | .58 | -39.4 |
| 8.00 | .86 | -79.5 | 1.85 | 109.1 | .13 | 39.2 | .56 | -44.6 |
| 9.00 | .84 | -87.5 | 1.77 | 102.1 | .14 | 33.6 | .54 | -49.8 |
| 10.00 | .84 | -96.2 | 1.71 | 95.1 | .14 | 27.4 | .51 | -55.1 |
| 12.00 | .80 | -110.8 | 1.57 | 81.4 | .14 | 17.6 | .48 | -64.6 |
| 14.00 | .78 | -121.7 | 1.45 | 69.5 | .15 | 13.9 | .45 | -73.8 |
| 16.00 | .78 | -130.9 | 1.34 | 58.8 | .15 | 6.2 | .44 | -85.4 |
| 18.00 | .80 | -139.4 | 1.28 | 48.2 | .15 | -1.0 | .43 | -95.4 |
| 20.00 | .79 | -148.5 | 1.18 | 37.4 | .14 | -9.6 | .41 | -107.3 |
| 22.00 | .76 | -152.9 | 1.09 | 28.6 | .14 | -10.5 | .46 | -117.5 |
| 24.00 | .76 | -155.7 | 1.05 | 19.7 | .14 | -17.8 | .47 | -126.4 |
| 26.00 | .76 | -160.1 | 1.02 | 10.2 | .14 | -30.2 | .47 | -135.4 |

MwT-A7 CHIP BIASED FOR GAIN & POWER: VDS = 5.0 V, IDS =.5 IDSS = 29 mA

| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 1.00 | .98 | -14.3 | 3.66 | 167.1 | .02 | 76.5 | .70 | -5.4 |
| 2.00 | .95 | -26.7 | 3.53 | 157.7 | .03 | 71.3 | .69 | -11.3 |
| 3.00 | .94 | -39.5 | 3.46 | 147.4 | .04 | 65.2 | .68 | -16.7 |
| 4.00 | .91 | -52.1 | 3.29 | 137.4 | .06 | 59.1 | .66 | -21.8 |
| 5.00 | .88 | -63.7 | 3.13 | 128.3 | .06 | 53.5 | .64 | -26.6 |
| 6.00 | .86 | -74.0 | 2.98 | 120.2 | .07 | 49.2 | .62 | -30.8 |
| 7.00 | .84 | -84.3 | 2.83 | 112.0 | .08 | 44.2 | .61 | -34.9 |
| 8.00 | .82 | -93.9 | 2.66 | 104.0 | .08 | 39.3 | .59 | -39.2 |
| 9.00 | .81 | -102.2 | 2.51 | 97.2 | .09 | 34.7 | .57 | -43.4 |
| 10.00 | .80 | -111.4 | 2.40 | 90.4 | .09 | 28.9 | .55 | -47.6 |
| 12.00 | .77 | -125.6 | 2.15 | 77.4 | .08 | 21.9 | .52 | -54.9 |
| 14.00 | .76 | -135.5 | 1.94 | 66.6 | .08 | 24.0 | .51 | -62.9 |
| 16.00 | .77 | -143.9 | 1.79 | 56.2 | .09 | 18.4 | .49 | -73.3 |
| 18.00 | .79 | -151.8 | 1.68 | 46.0 | .08 | 15.2 | .49 | -81.8 |
| 20.00 | .78 | -160.3 | 1.53 | 35.8 | .07 | 9.4 | .47 | -91.7 |
| 22.00 | .76 | -164.1 | 1.43 | 27.2 | .08 | 16.3 | .53 | -102.4 |
| 24.00 | .76 | -166.7 | 1.37 | 18.4 | .08 | 11.4 | .55 | -111.4 |
| 26.00 | .75 | -171.6 | 1.32 | 8.9 | .08 | -1.5 | .53 | -121.3 |

# TYPICAL COMMON SOURCE SCATTERING PARAMETERS

MwT-A770 BIASED FOR LOW NOISE FIGURE: VDS = 3.0 V, IDS = 10 mA

| FREQUENCY (GHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG |
|---|---|---|---|---|---|---|---|---|
| 1.00 | .97 | -23.1 | 2.06 | 158.1 | .02 | 68.9 | .67 | -18.6 |
| 2.00 | .93 | -42.8 | 1.88 | 139.1 | .04 | 55.9 | .66 | -33.6 |
| 3.00 | .88 | -58.8 | 1.70 | 123.1 | .06 | 46.2 | .66 | -45.2 |
| 4.00 | .82 | -73.5 | 1.58 | 108.8 | .07 | 34.3 | .63 | -54.9 |
| 5.00 | .76 | -86.4 | 1.51 | 97.2 | .06 | 25.2 | .60 | -61.0 |
| 6.00 | .75 | -102.2 | 1.53 | 83.5 | .06 | 28.9 | .59 | -70.5 |
| 8.00 | .71 | -141.3 | 1.61 | 54.3 | .11 | -5.3 | .48 | -97.7 |
| 10.00 | .74 | 171.4 | 1.65 | 15.6 | .08 | -37.2 | .42 | -138.1 |
| 12.00 | .85 | 132.3 | 1.46 | -20.3 | .06 | -40.2 | .49 | 170.2 |
| 14.00 | .93 | 110.3 | 1.18 | -51.2 | .06 | -52.6 | .66 | 139.5 |
| 16.00 | .81 | 92.4 | 1.00 | -81.2 | .05 | -65.8 | .74 | 126.3 |
| 18.00 | .70 | 63.2 | .81 | -110.2 | .04 | -52.8 | .68 | 107.0 |
| 20.00 | .65 | 33.4 | .94 | -146.2 | .07 | -125.0 | .67 | 83.4 |

MwT-A770 BIASED FOR GAIN & POWER: VDS = 5.0 V, IDS = 0.5 IDSS = 29 mA

| FREQUENCY (GHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG |
|---|---|---|---|---|---|---|---|---|
| 1.00 | .96 | -26.6 | 3.63 | 156.0 | .02 | 69.0 | .71 | -17.5 |
| 2.00 | .91 | -49.1 | 3.24 | 135.5 | .03 | 55.0 | .70 | -32.0 |
| 3.00 | .84 | -66.5 | 2.85 | 118.6 | .04 | 47.9 | .68 | -42.9 |
| 4.00 | .77 | -82.3 | 2.58 | 103.7 | .04 | 36.5 | .65 | -52.2 |
| 5.00 | .70 | -95.8 | 2.43 | 91.8 | .04 | 31.6 | .62 | -57.4 |
| 6.00 | .68 | -111.5 | 2.40 | 77.9 | .03 | 55.2 | .62 | -66.1 |
| 8.00 | .63 | -154.2 | 2.42 | 48.5 | .06 | 10.4 | .53 | -91.0 |
| 10.00 | .67 | 159.1 | 2.41 | 10.7 | .04 | 3.8 | .52 | -124.5 |
| 12.00 | .80 | 120.2 | 2.15 | -24.6 | .06 | 22.2 | .55 | -172.8 |
| 14.00 | .86 | 98.2 | 1.71 | -57.9 | .07 | -2.0 | .71 | 150.5 |
| 16.00 | .72 | 79.8 | 1.42 | -89.0 | .08 | -22.1 | .81 | 131.9 |
| 18.00 | .59 | 53.3 | 1.09 | -118.6 | .08 | -25.5 | .77 | 110.1 |
| 20.00 | .51 | 24.3 | 1.19 | -153.7 | .07 | -76.9 | .78 | 88.0 |

# TYPICAL COMMON SOURCE SCATTERING PARAMETERS

MwT-A773 BIASED FOR LOW NOISE FIGURE: VDS = 3.0 V, IDS = 10 mA

| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 1.00 | .97 | -20.2 | 1.74 | 161.2 | .03 | 72.2 | .65 | -14.8 |
| 2.00 | .94 | -37.8 | 1.63 | 144.4 | .05 | 59.8 | .64 | -27.4 |
| 3.00 | .91 | -52.3 | 1.53 | 129.3 | .07 | 50.4 | .63 | -38.0 |
| 4.00 | .85 | -65.7 | 1.45 | 115.4 | .08 | 39.8 | .60 | -46.7 |
| 5.00 | .79 | -76.6 | 1.39 | 104.8 | .09 | 31.8 | .58 | -51.9 |
| 6.00 | .76 | -91.3 | 1.44 | 92.5 | .10 | 28.8 | .56 | -60.1 |
| 8.00 | .70 | -129.6 | 1.55 | 67.2 | .15 | 2.5 | .42 | -86.1 |
| 10.00 | .70 | -179.0 | 1.61 | 31.4 | .14 | -29.3 | .32 | -131.8 |
| 12.00 | .81 | 139.1 | 1.41 | -0.9 | .11 | -41.9 | .38 | -176.0 |
| 14.00 | .90 | 118.0 | 1.20 | -28.8 | .10 | -55.4 | .49 | 159.7 |
| 16.00 | .82 | 94.4 | 1.03 | -62.3 | .09 | -68.3 | .54 | 134.7 |
| 18.00 | .70 | 65.1 | .79 | -88.1 | .07 | -59.5 | .55 | 115.7 |
| 20.00 | .73 | 36.2 | .77 | -115.1 | .09 | -85.9 | .64 | 98.0 |

MwT-A773 BIASED FOR GAIN & POWER: VDS = 5.0 V, IDS = 0.5 IDSS = 29 mA

| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 1.00 | .96 | -24.4 | 3.79 | 158.7 | .02 | 70.8 | .71 | -14.6 |
| 2.00 | .91 | -45.4 | 3.46 | 139.9 | .04 | 57.2 | .69 | -27.2 |
| 3.00 | .85 | -62.1 | 3.12 | 123.7 | .05 | 49.7 | .67 | -36.6 |
| 4.00 | .77 | -77.7 | 2.87 | 109.0 | .06 | 39.6 | .64 | -44.4 |
| 5.00 | .68 | -90.2 | 2.68 | 98.1 | .05 | 32.9 | .61 | -47.6 |
| 6.00 | .65 | -106.9 | 2.70 | 85.6 | .05 | 38.1 | .60 | -53.8 |
| 8.00 | .60 | -153.1 | 2.73 | 59.9 | .08 | 11.5 | .46 | -73.3 |
| 10.00 | .63 | 157.8 | 2.66 | 25.0 | .06 | -8.9 | .38 | -108.7 |
| 12.00 | .78 | 121.3 | 2.27 | -5.0 | .06 | 4.8 | .41 | -155.1 |
| 14.00 | .85 | 103.4 | 1.90 | -33.2 | .08 | -8.2 | .52 | 177.1 |
| 16.00 | .75 | 78.6 | 1.63 | -67.0 | .09 | -20.4 | .59 | 149.0 |
| 18.00 | .61 | 48.4 | 1.22 | -94.9 | .10 | -20.3 | .60 | 127.9 |
| 20.00 | .64 | 20.4 | 1.17 | -121.5 | .12 | -46.2 | .71 | 109.5 |