

## Product Features

- DC – 6000 MHz
- +16 dBm P1dB at 900 MHz
- +29 dBm OIP3 at 900 MHz
- 20 dB Gain at 900 MHz
- Single Voltage Supply
- SOT-86 SMT Package
- Internally matched to 50  $\Omega$

## Applications

- Mobile Infrastructure
- CATV / DBS
- W-LAN / ISM
- RFID
- Defense / Homeland Security
- Fixed Wireless

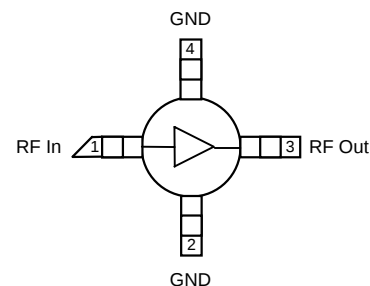
## Product Description

The AG503-86 is a general-purpose buffer amplifier that offers high dynamic range in a low-cost surface-mount package. At 900 MHz, the AG503-86 typically provides 20 dB of gain, +29 dBm Output IP3, and +16 dBm P1dB. The device combines dependable performance with consistent quality to maintain MTTF values exceeding 100 years at mounting temperatures of +85° C and is housed in a SOT-86 (micro-X) industry-standard SMT package.

The AG503-86 consists of Darlington pair amplifiers using the high reliability InGaP/GaAs HBT technology process technology and only requires DC-blocking capacitors, a bias resistor, and an inductive RF choke for operation.

The broadband MMIC amplifier can be directly applied to various current and next generation wireless technologies such as GPRS, GSM, CDMA, and W-CDMA. In addition, the AG503-86 will work for other various applications within the DC to 6 GHz frequency range such as CATV and fixed wireless.

## Functional Diagram



| Function    | Pin No. |
|-------------|---------|
| Input       | 1       |
| Output/Bias | 3       |
| Ground      | 2, 4    |

## Specifications

| Parameter                | Units  | Min  | Typ   | Max  |
|--------------------------|--------|------|-------|------|
| Frequency Range          | MHz    | DC   | 900   | 6000 |
| Gain (900 MHz)           | dB     |      | 20.2  |      |
| Gain (1900 MHz)          | dB     | 16.8 | 17.8  | 18.8 |
| Input Return Loss        | dB     |      | 20    |      |
| Output Return Loss       | dB     |      | 20    |      |
| Output P1dB              | dBm    |      | +15.9 |      |
| Output IP3 (2)           | dBm    |      | +28.8 |      |
| Output IP2               | dBm    |      | +37   |      |
| Noise Figure             | dB     |      | 2.9   |      |
| Device Voltage           | V      |      | 5.0   |      |
| Device Current           | mA     |      | 45    |      |
| Thermal Resistance       | °C / W |      |       | 257  |
| Junction Temperature (3) | °C     |      |       | 177  |

Test conditions unless otherwise noted.

1. T = 25° C, Supply Voltage = +6 V, R<sub>bias</sub> = 22.1  $\Omega$ , Frequency = 900 MHz, 50  $\Omega$  System.
2. 3OIP measured with two tones at an output power of 0 dBm/tone separated by 10 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. The junction temperature ensures a minimum MTTF rating of 1 million hours of usage.

## Typical Performance

| Parameter    | Units | Typical | Typical | Typical | Typical |
|--------------|-------|---------|---------|---------|---------|
| Frequency    | MHz   | 500     | 900     | 1900    | 2140    |
| S21          | dB    | 20.8    | 20.2    | 17.8    | 17.6    |
| S11          | dB    | -20     | -20     | -18     | -18     |
| S22          | dB    | -21     | -20     | -15     | -13     |
| Output P1dB  | dBm   | +16.0   | +15.9   | +14.6   | +14.3   |
| Output IP3   | dBm   | +28.9   | +28.8   | +27.8   | +27.4   |
| Noise Figure | dB    | 2.9     | 2.9     | 3.1     | 3.1     |

Test conditions: T = 25° C, Supply Voltage = +6 V, R<sub>bias</sub> = 22.1  $\Omega$ , 50  $\Omega$  System.

## Absolute Maximum Rating

| Parameter                   | Rating         |
|-----------------------------|----------------|
| Operating Case Temperature  | -40 to +85 °C  |
| Storage Temperature         | -55 to +125 °C |
| DC Voltage                  | +5.8 V         |
| RF Input Power (continuous) | +10 dBm        |
| Junction Temperature        | +250° C        |

Operation of this device above any of these parameters may cause permanent damage.

## Ordering Information

| Part No.    | Description                                |
|-------------|--------------------------------------------|
| AG503-86    | InGaP HBT Gain Block                       |
| AG503-86PCB | 700 – 2400 MHz Fully Assembled Eval. Board |

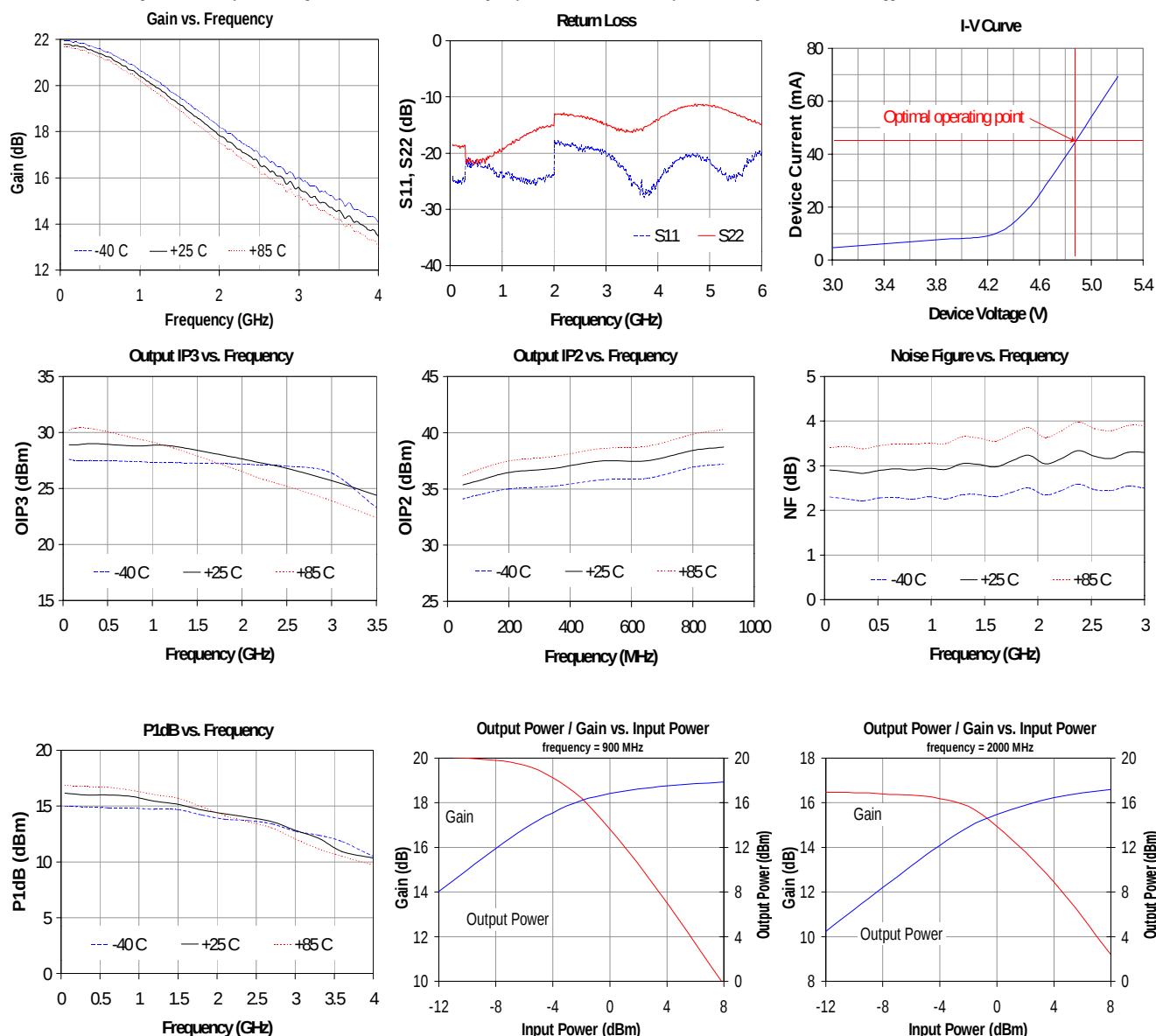


## Typical Device RF Performance

Supply Bias = 6 V,  $R_{bias} = 22.1 \Omega$ ,  $I_{cc} = 45 \text{ mA}$

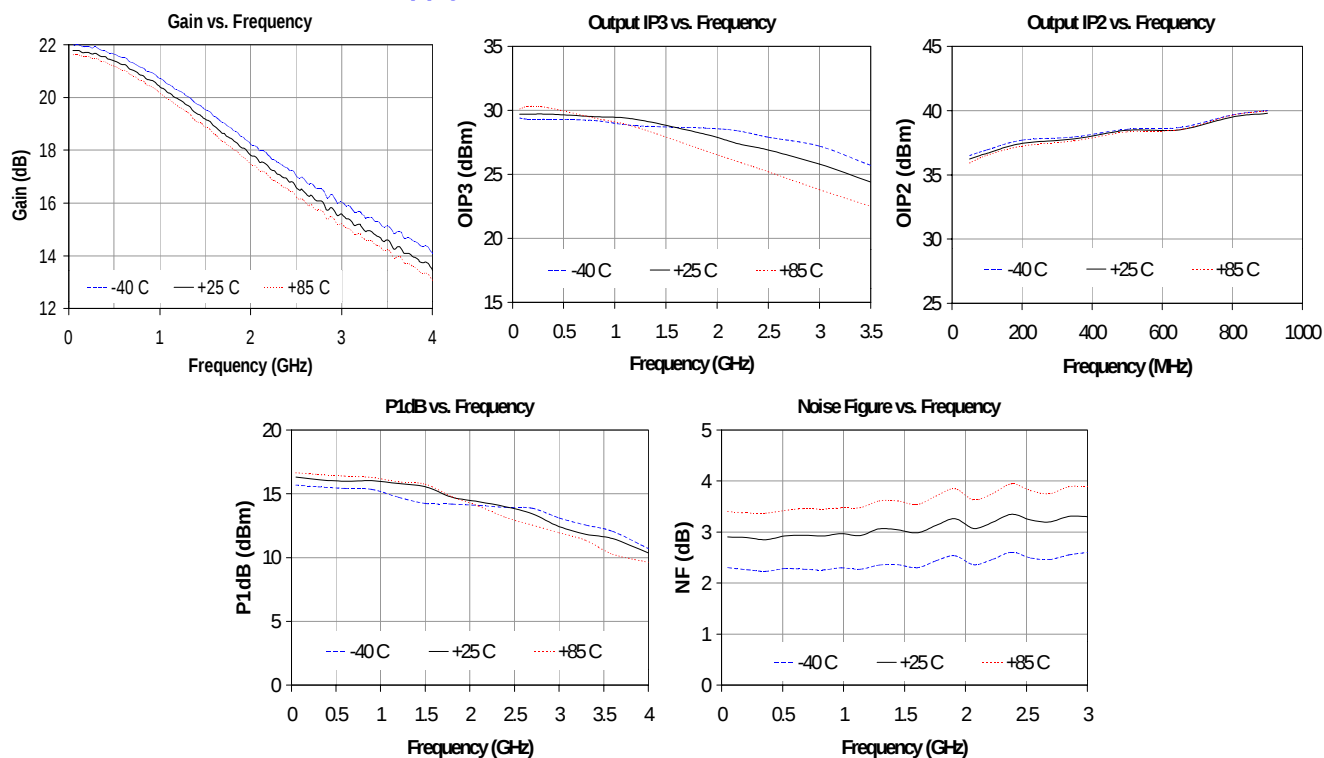
| Frequency    | MHz | 100   | 500   | 900   | 1900  | 2140  | 2400  | 3500  | 5800 |
|--------------|-----|-------|-------|-------|-------|-------|-------|-------|------|
| S21          | dB  | 21.0  | 20.8  | 20.2  | 17.8  | 17.6  | 17.2  | 15.3  | 11.8 |
| S11          | dB  | -20   | -20   | -20   | -18   | -18   | -18   | -20   | -20  |
| S22          | dB  | -18   | -21   | -20   | -15   | -13   | -13   | -16   | -14  |
| Output P1dB  | dBm | +16.2 | +16.0 | +15.9 | +14.6 | +14.3 | +14.0 | +11.0 |      |
| Output IP3   | dBm | +28.9 | +28.9 | +28.8 | +27.8 | +27.4 | +27.0 | +24.4 |      |
| Noise Figure | dB  | 2.9   | 2.9   | 2.9   | 3.1   | 3.1   | 3.2   |       |      |

1. Test conditions:  $T = 25^\circ \text{C}$ , Supply Voltage = +6 V, Device Voltage = 6.0 V,  $R_{bias} = 22.1 \Omega$ ,  $I_{cc} = 45 \text{ mA}$  typical,  $50 \Omega$  System.
2. 3OIP measured with two tones at an output power of 0 dBm/tones separated by 10 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. Data is shown as device performance only. Actual implementation for the desired frequency band will be determined by external components shown in the application circuit.

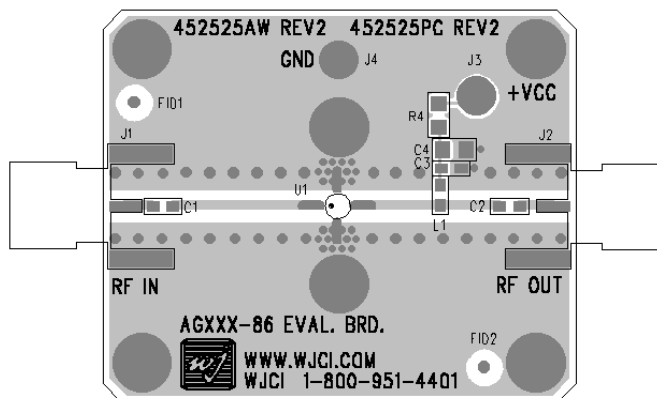
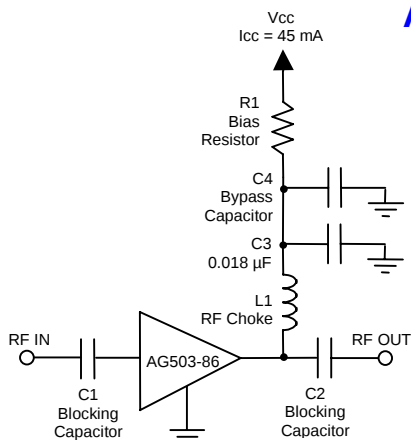


## Typical Device RF Performance

Supply Bias = +8 V, R<sub>bias</sub> = 44 Ω, I<sub>cc</sub> = 45 mA



## Application Circuit



### Recommended Component Values

| Reference Designator | Frequency (MHz) |         |        |       |       |       |       |
|----------------------|-----------------|---------|--------|-------|-------|-------|-------|
|                      | 50              | 500     | 900    | 1900  | 2200  | 2500  | 3500  |
| L1                   | 820 nH          | 220 nH  | 68 nH  | 27 nH | 22 nH | 18 nH | 15 nH |
| C1, C2, C4           | .018 μF         | 1000 pF | 100 pF | 68 pF | 68 pF | 56 pF | 39 pF |

- The proper values for the components are dependent upon the intended frequency of operation.
- The following values are contained on the evaluation board to achieve optimal broadband performance:

| Ref. Desig. | Value / Type             | Size |
|-------------|--------------------------|------|
| L1          | 39 nH wirewound inductor | 0603 |
| C1, C2      | 56 pF chip capacitor     | 0603 |
| C3          | 0.018 μF chip capacitor  | 0603 |
| C4          | Do Not Place             |      |
| R1          | 22.1 Ω 1% tolerance      | 0805 |

### Recommended Bias Resistor Values

| Supply Voltage | R1 value  | Size |
|----------------|-----------|------|
| 6 V            | 22.2 ohms | 0603 |
| 7 V            | 44.4 ohms | 0805 |
| 8 V            | 67 ohms   | 1206 |
| 9 V            | 89 ohms   | 1210 |
| 10 V           | 111 ohms  | 1210 |
| 12 V           | 156 ohms  | 2010 |

The proper value for R1 is dependent upon the supply voltage and allows for bias stability over temperature. WJ recommends a minimum supply bias of +6 V. A 1% tolerance resistor is recommended.

Specifications and information are subject to change without notice



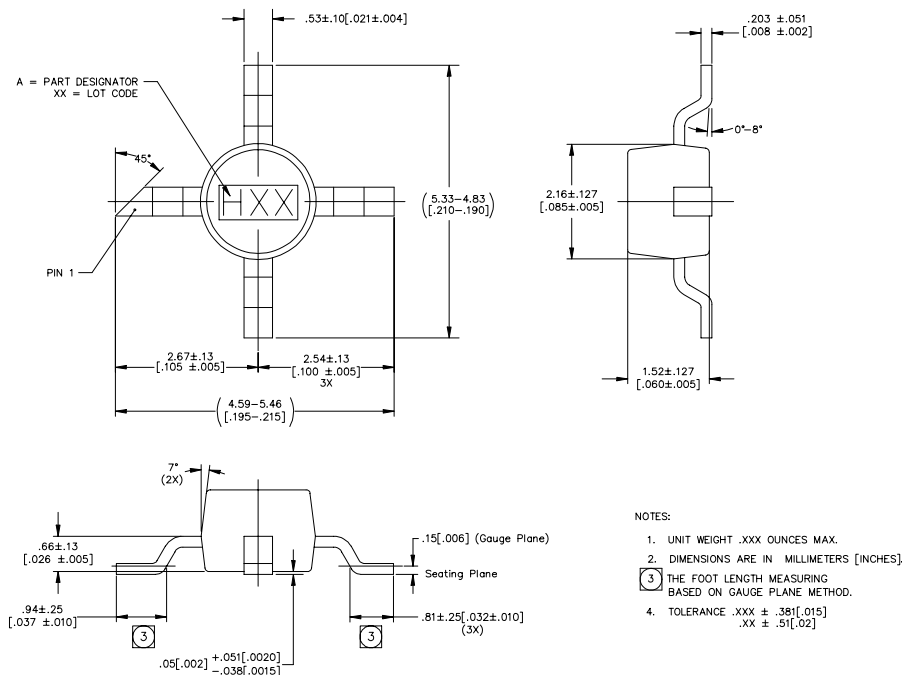
# AG503-86

## InGaP HBT Gain Block

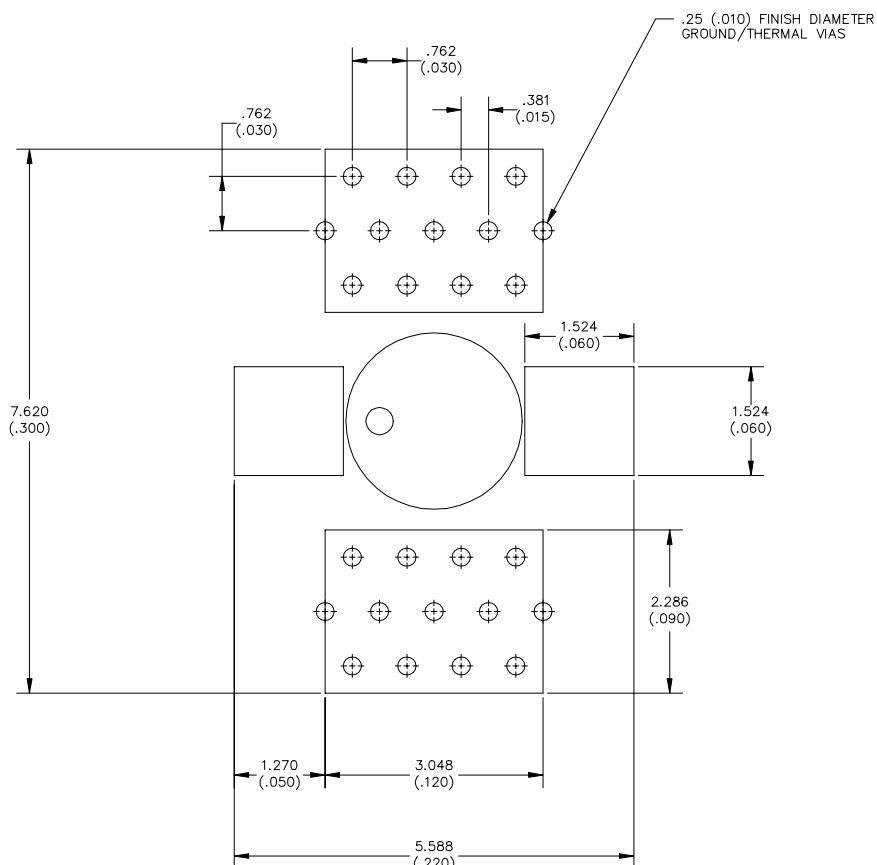
The Communications Edge™

Product Information

### Outline Drawing



### Land Pattern



### Product Marking

The component will be marked with an "H" designator followed by a two-digit numeric lot code on the top surface of the package.

Tape and reel specifications for this part are located on the website in the "Application Notes" section.

### MSL / ESD Rating



Caution! ESD sensitive device.

ESD Rating: Class 0

Value: Passes at 150 V

Test: Human Body Model (HBM)

Standard: JEDEC Standard JESD22-A114

ESD Rating: Class II

Value: Passes at 250 V

Test: Charged Device Model (CDM)

Standard: JEDEC Standard JESD22-C101

MSL Rating: Level 1

Standard: JEDEC Standard J-STD-020A

### Mounting Config. Notes

1. GROUND/THERMAL VIAS ARE CRITICAL FOR THE PROPER PERFORMANCE OF THIS DEVICE. VIAS SHOULD USE A .35mm (#80/.0135") DIAMETER DRILL AND HAVE A FINAL, PLATED THRU DIAMETER OF .25mm (.010").
2. ADD AS MUCH COPPER AS POSSIBLE TO INNER AND OUTER LAYERS NEAR THE PART TO ENSURE OPTIMAL THERMAL PERFORMANCE.
3. ADD MOUNTING SCREWS NEAR THE PART TO FASTEN THE BOARD TO A HEATSINK. ENSURE THAT THE GROUND/THERMAL VIA REGION CONTACTS THE HEATSINK.
4. DO NOT PUT SOLDER MASK ON THE BACK SIDE OF THE PC BOARD IN THE REGION WHERE THE BOARD CONTACTS THE HEATSINK.
5. RF TRACE WIDTH DEPENDS UPON THE PC BOARD MATERIAL AND CONSTRUCTION.
6. USE 1 OZ. COPPER MINIMUM.
7. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES). ANGLES ARE IN DEGREE

Specifications and information are subject to change without notice



### Typical Device Data

S-Parameters ( $V_{\text{device}} = +5.0 \text{ V}$ ,  $I_{\text{CC}} = 45 \text{ mA}$ ,  $T = 25^\circ \text{ C}$ , calibrated to device leads)

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 50         | -24.44   | -177.67   | 21.67    | 177.30    | -24.34   | 2.97      | -18.52   | -7.18     |
| 200        | -24.97   | 161.24    | 21.58    | 169.62    | -24.66   | -1.44     | -18.91   | -15.37    |
| 400        | -22.55   | 152.96    | 21.44    | 159.32    | -25.01   | -0.38     | -21.70   | -40.13    |
| 600        | -22.43   | 143.75    | 21.25    | 149.48    | -24.73   | -1.98     | -21.33   | -56.19    |
| 800        | -22.93   | 129.21    | 21.00    | 139.89    | -24.50   | -2.66     | -20.61   | -77.42    |
| 1000       | -23.48   | 111.38    | 20.63    | 130.59    | -24.93   | -5.89     | -19.50   | -92.91    |
| 1200       | -24.33   | 98.77     | 20.26    | 121.50    | -24.42   | -3.17     | -18.00   | -106.75   |
| 1400       | -25.14   | 74.35     | 19.87    | 113.09    | -24.39   | -4.08     | -17.09   | -114.96   |
| 1600       | -25.10   | 49.75     | 19.41    | 104.82    | -24.17   | -5.19     | -16.09   | -122.05   |
| 1800       | -24.38   | 26.33     | 18.98    | 97.11     | -24.37   | -3.84     | -15.42   | -128.18   |
| 2000       | -22.62   | 10.74     | 18.53    | 89.57     | -23.97   | -4.87     | -14.85   | -133.04   |
| 2200       | -18.64   | 3.69      | 18.07    | 82.98     | -23.73   | -6.76     | -13.01   | -123.42   |
| 2400       | -18.67   | -5.44     | 17.69    | 75.99     | -23.50   | -7.22     | -13.44   | -130.42   |
| 2600       | -19.40   | -11.24    | 17.43    | 71.42     | -23.68   | -12.02    | -13.67   | -136.66   |
| 2800       | -19.35   | -18.41    | 17.05    | 64.89     | -22.72   | -10.71    | -14.16   | -144.06   |
| 3000       | -19.99   | -20.82    | 16.72    | 58.14     | -22.51   | -11.38    | -14.84   | -155.04   |
| 3200       | -21.42   | -16.89    | 16.35    | 51.88     | -22.46   | -12.44    | -15.75   | -168.96   |
| 3400       | -23.62   | -11.68    | 16.03    | 45.40     | -22.41   | -13.56    | -15.91   | 174.07    |
| 3600       | -25.69   | 8.48      | 15.68    | 39.01     | -21.91   | -17.86    | -15.70   | 153.21    |
| 3800       | -26.88   | 39.32     | 15.36    | 32.99     | -21.83   | -19.36    | -15.19   | 136.25    |
| 4000       | -24.77   | 70.07     | 14.98    | 26.44     | -21.57   | -22.70    | -14.12   | 122.06    |
| 4200       | -23.00   | 83.84     | 14.62    | 20.40     | -21.23   | -26.03    | -12.99   | 111.56    |
| 4400       | -21.17   | 91.33     | 14.28    | 14.49     | -21.26   | -28.48    | -12.02   | 104.63    |
| 4600       | -20.44   | 96.19     | 13.96    | 8.42      | -20.86   | -29.14    | -11.57   | 100.01    |
| 4800       | -20.51   | 103.41    | 13.62    | 2.96      | -20.72   | -32.21    | -11.39   | 97.58     |
| 5000       | -21.16   | 110.99    | 13.39    | -2.78     | -20.46   | -36.07    | -11.55   | 96.81     |
| 5200       | -22.85   | 127.46    | 13.12    | -8.07     | -20.14   | -38.83    | -11.90   | 96.89     |
| 5400       | -24.42   | 155.32    | 12.81    | -13.24    | -19.88   | -41.02    | -12.71   | 100.22    |
| 5600       | -23.84   | -176.50   | 12.65    | -18.36    | -19.67   | -43.82    | -13.52   | 102.93    |
| 5800       | -21.50   | -151.45   | 12.44    | -23.54    | -19.47   | -44.54    | -14.22   | 108.50    |
| 6000       | -20.00   | -137.16   | 12.19    | -28.69    | -19.34   | -49.46    | -14.74   | 111.53    |

Device S-parameters are available for download off of the website at: <http://www.wj.com>