DATA SHEET

NEC

# NPN SILICON RF TWIN TRANSISTOR

# μPA860TD

## NPN SILICON RF TRANSISTOR (WITH 2 DIFFERENT ELEMENTS) IN A 6-PIN LEAD-LESS MINIMOLD

### FEATURES

- Low voltage operation
- 2 different built-in transistors (2SC5435, 2SC5786)

  Q1: High-gain transistor

  $f_T$ = 12.0 GHz TYP., $|S_{21e}|^2$ = 8.5 dB TYP. @ $V_{CE}$ = 3 V, $I_C$ = 10 mA, f = 2 GHz

  Q2: Low phase distortion transistor suitable for 3 GHz or higher OSC applications

  $f_T$ = 20.0 GHz TYP., $|S_{21e}|^2$ = 13.0 dB TYP. @ $V_{CE}$ = 1 V, $I_C$ = 20 mA, f = 2 GHz

  NF = 1.4 dB TYP. @ $V_{CE}$ = 1 V, $I_C$ = 5 mA, f = 2 GHz, $Z_S = Z_{opt}$
- 6-pin lead-less minimold package

### BUILT-IN TRANSISTORS

| | Q1 | Q2 |
|---|---|---|
| 3-pin thin-type ultra super minimold part No. | 2SC5435 | 2SC5786 |

### ORDERING INFORMATION

| Part Number | Quantity | Supplying Form |
|---|---|---|
| μPA860TD | 50 pcs (Non reel) | • 8 mm wide embossed taping |
| μPA860TD-T3 | 10 kpcs/reel | • Pin 1 (Q1 Collector), Pin 6 (Q1 Base) face the perforation side of the tape |

**Remark** To order evaluation samples, contact your nearby sales office.
The unit sample quantity is 50 pcs.

**Because this product uses high-frequency technology, avoid excessive static electricity, etc.**



Document No. PU10067EJ01V0DS (1st edition)
Date Published January 2002 CP(K)
Printed in Japan

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = +25°C)

| Parameter | Symbol | Ratings | | Unit |
|---|---|---|---|---|
| | | Q1 | Q2 | |
| Collector to Base Voltage | $V_{CBO}$ | 9 | 9 | V |
| Collector to Emitter Voltage | $V_{CEO}$ | 6 | 3 | V |
| Emitter to Base Voltage | $V_{EBO}$ | 2 | 1.5 | V |
| Collector Current | $I_C$ | 30 | 35 | mA |
| Total Power Dissipation | $P_{tot}$ Note | 180 | 105 | mW |
| | | 210 in 2 elements | | |
| Junction Temperature | $T_j$ | 150 | | °C |
| Storage Temperature | $T_{stg}$ | −65 to +150 | | °C |

**Note** Mounted on 1.08 $cm^2 \times$ 1.0 mm (t) glass epoxy PCB

## ELECTRICAL CHARACTERISTICS ($T_A$ = +25°C)

### (1) Q1

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Collector Cut-off Current | $I_{CBO}$ | $V_{CB}$ = 5 V, $I_E$ = 0 mA | – | – | 100 | nA |
| Emitter Cut-off Current | $I_{EBO}$ | $V_{EB}$ = 1 V, $I_C$ = 0 mA | – | – | 100 | nA |
| DC Current Gain | $h_{FE}$ Note 1 | $V_{CE}$ = 3 V, $I_C$ = 10 mA | 75 | – | 150 | – |
| Gain Bandwidth Product | $f_T$ | $V_{CE}$ = 3 V, $I_C$ = 10 mA, f = 2 GHz | 10.0 | 12.0 | – | GHz |
| Insertion Power Gain | $\lvert S_{21e} \rvert^2$ | $V_{CE}$ = 3 V, $I_C$ = 10 mA, f = 2 GHz | 7.0 | 8.5 | – | dB |
| Noise Figure | NF | $V_{CE}$ = 3 V, $I_C$ = 3 mA, f = 2 GHz, $Z_S = Z_{opt}$ | – | 1.5 | 2.5 | dB |
| Reverse Transfer Capacitance | $C_{re}$ Note 2 | $V_{CB}$ = 3 V, $I_E$ = 0 mA, f = 1 MHz | – | 0.4 | 0.7 | pF |

### (2) Q2

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Collector Cut-off Current | $I_{CBO}$ | $V_{CB}$ = 5 V, $I_E$ = 0 mA | – | – | 100 | nA |
| Emitter Cut-off Current | $I_{EBO}$ | $V_{EB}$ = 1 V, $I_C$ = 0 mA | – | – | 100 | nA |
| DC Current Gain | $h_{FE}$ Note 1 | $V_{CE}$ = 1 V, $I_C$ = 5 mA | 50 | 75 | 100 | – |
| Gain Bandwidth Product | $f_T$ | $V_{CE}$ = 1 V, $I_C$ = 20 mA, f = 2 GHz | 17.0 | 20.0 | – | GHz |
| Insertion Power Gain | $\lvert S_{21e} \rvert^2$ | $V_{CE}$ = 1 V, $I_C$ = 20 mA, f = 2 GHz | 11.0 | 13.0 | – | dB |
| Noise Figure | NF | $V_{CE}$ = 1 V, $I_C$ = 5 mA, f = 2 GHz, $Z_S = Z_{opt}$ | – | 1.4 | 2.5 | dB |
| Reverse Transfer Capacitance | $C_{re}$ Note 2 | $V_{CB}$ = 0.5 V, $I_E$ = 0 mA, f = 1 MHz | – | 0.22 | 0.30 | pF |

**Notes 1.** Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%

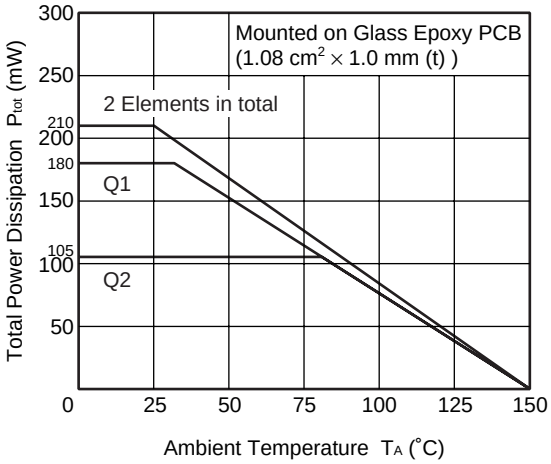
**2.** Collector to base capacitance when the emitter grounded

### $h_{FE}$ CLASSIFICATION

| Rank | FB |
|---|---|
| Marking | vV |
| $h_{FE}$ Value of Q1 | 75 to 150 |
| $h_{FE}$ Value of Q2 | 50 to 100 |

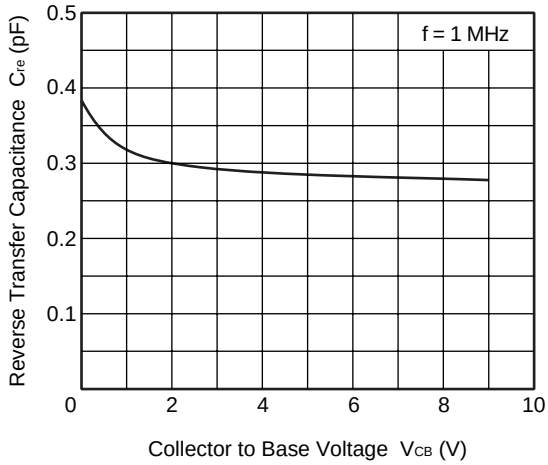
**TYPICAL CHARACTERISTICS (Unless otherwise specified, $T_A$ = +25°C)**

TOTAL POWER DISSIPATION
vs. AMBIENT TEMPERATURE



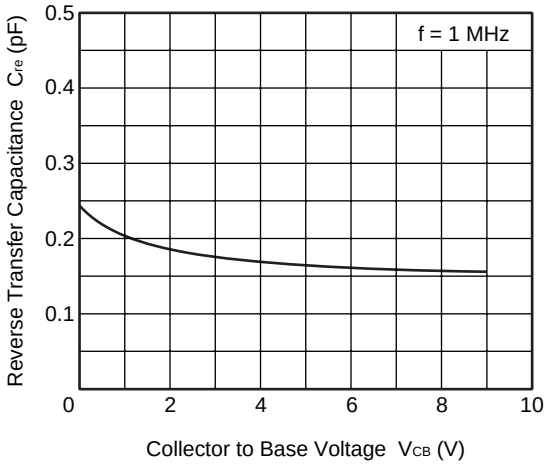

**Q1**

REVERSE TRANSFER CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGE



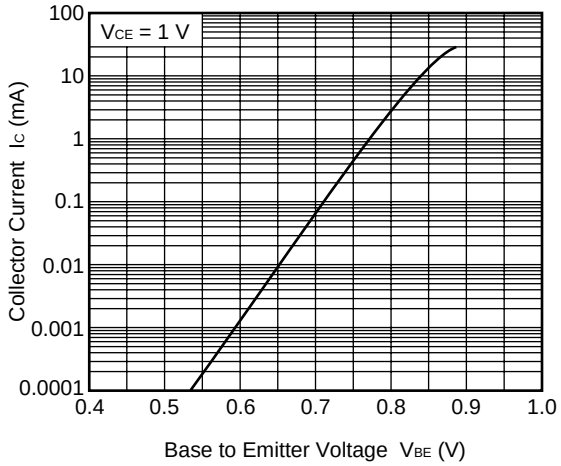

**Q2**

REVERSE TRANSFER CAPACITANCE
vs. COLLECTOR TO BASE VOLTAGE



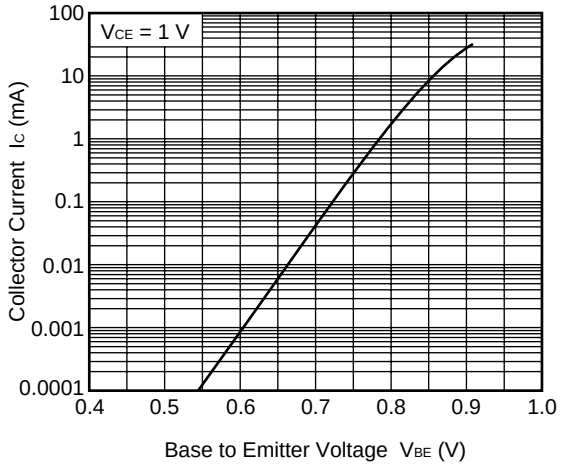
**Q1**

COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE

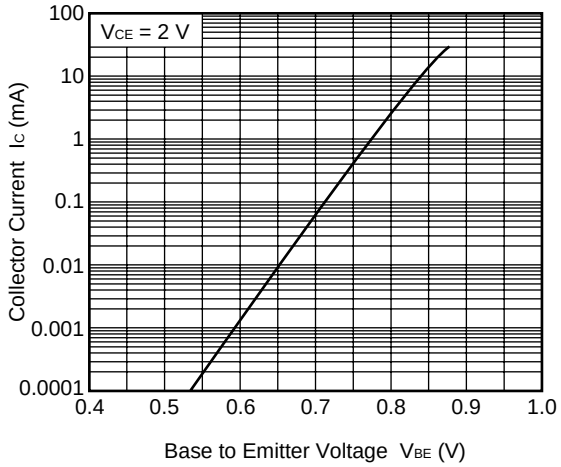



**Q2**

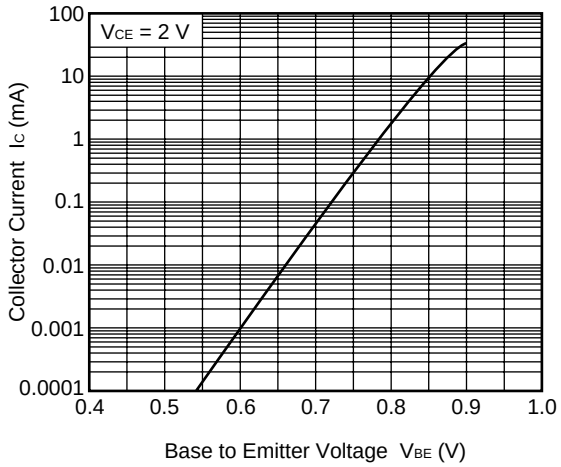
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



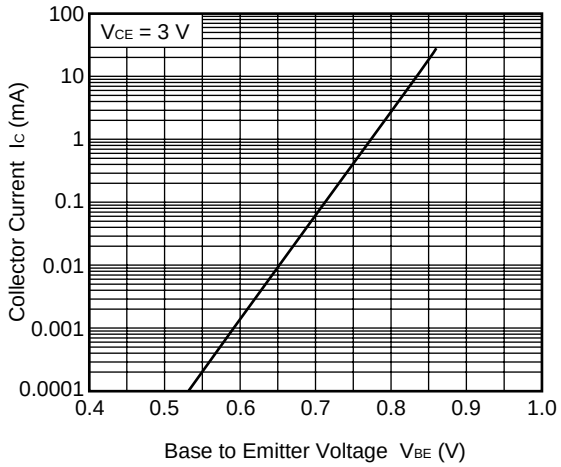

COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE




COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE

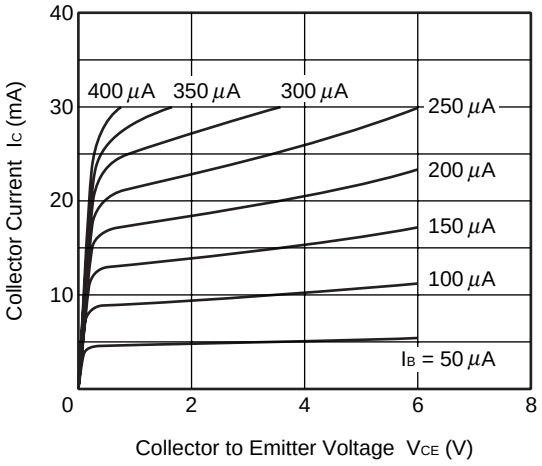



COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



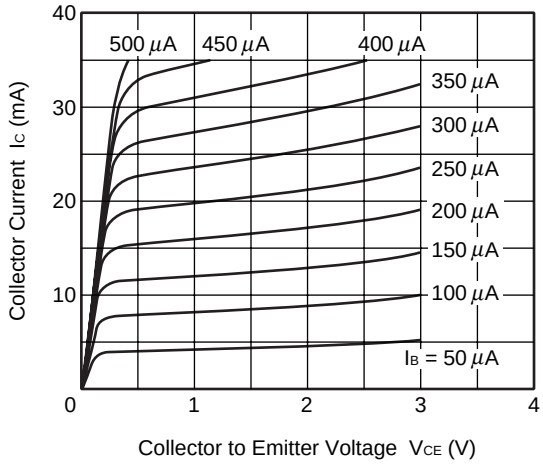
**Q1**

COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE



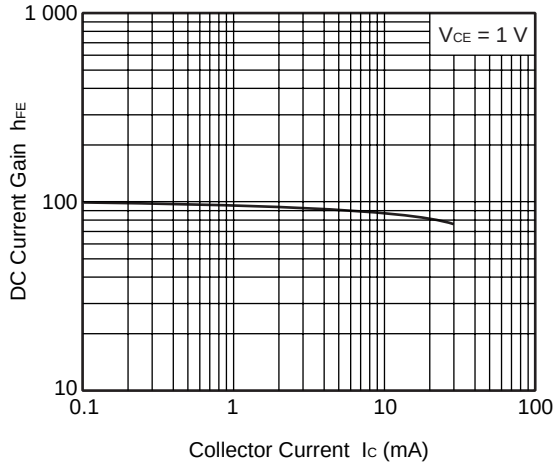

**Q2**

COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE



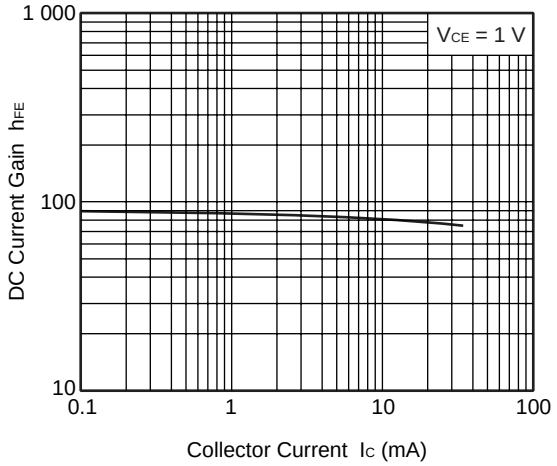
**Q1**

DC CURRENT GAIN vs.
COLLECTOR CURRENT

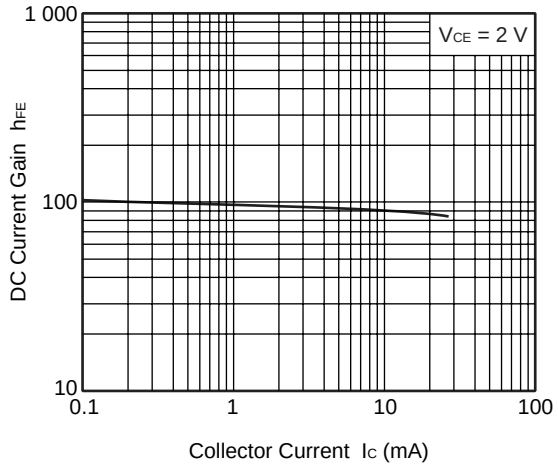



**Q2**

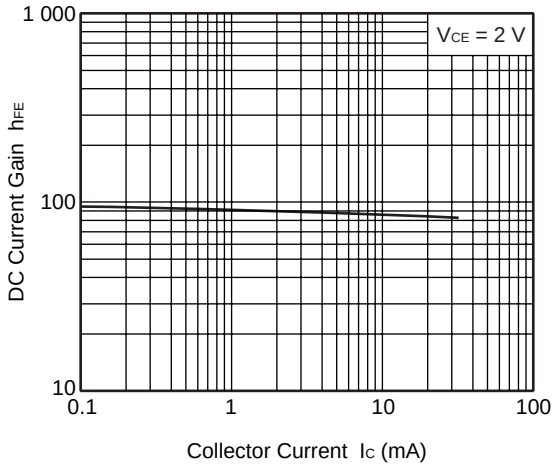
DC CURRENT GAIN vs.
COLLECTOR CURRENT



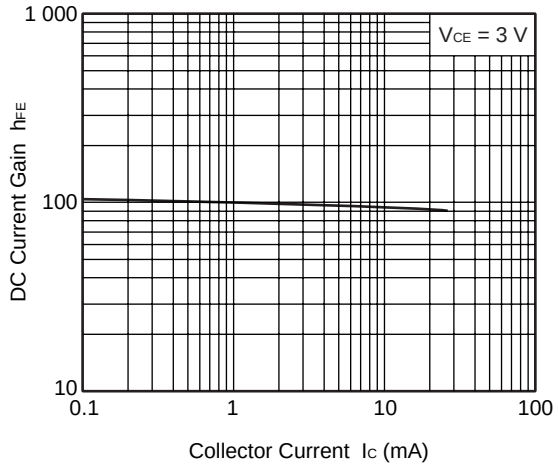

DC CURRENT GAIN vs.
COLLECTOR CURRENT




DC CURRENT GAIN vs.
COLLECTOR CURRENT

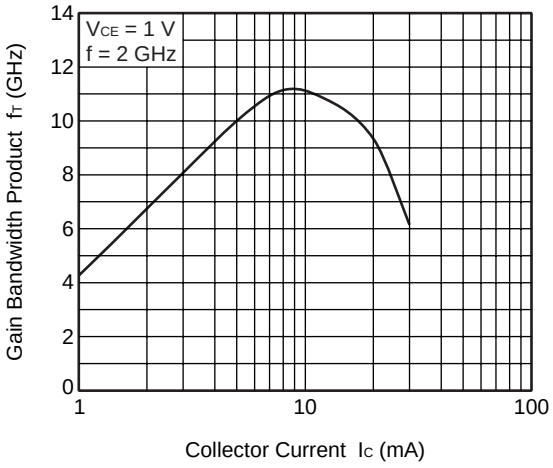



DC CURRENT GAIN vs.
COLLECTOR CURRENT



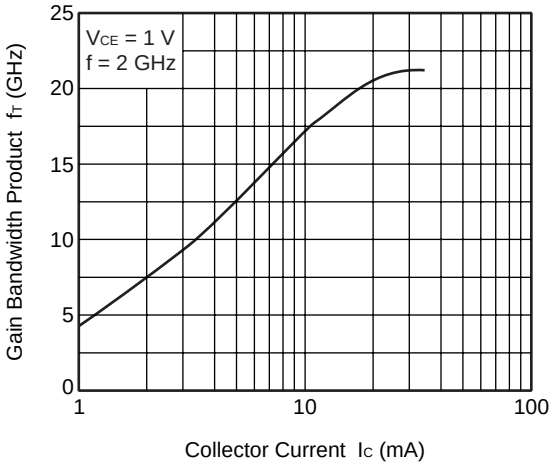
**Q1**

GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

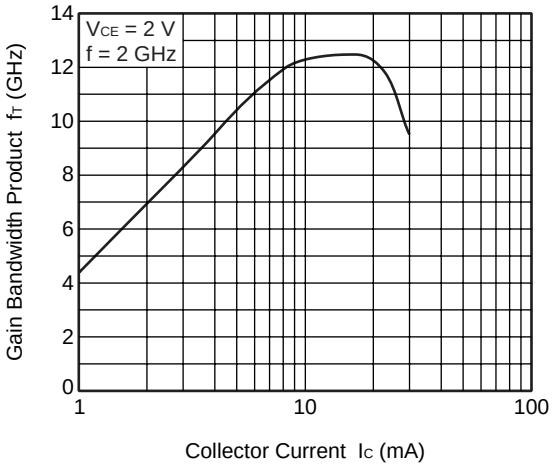



**Q2**

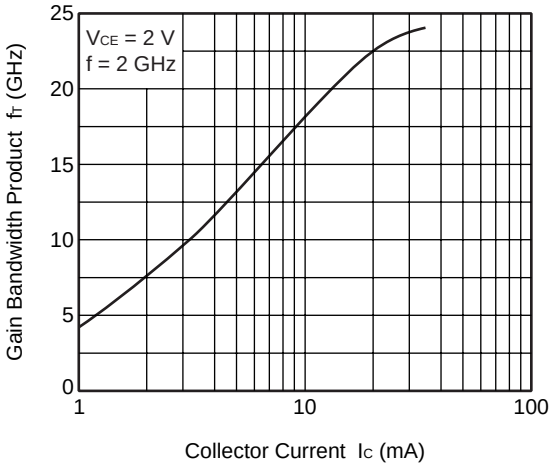
GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT




GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT




GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT




GAIN BANDWIDTH PRODUCT
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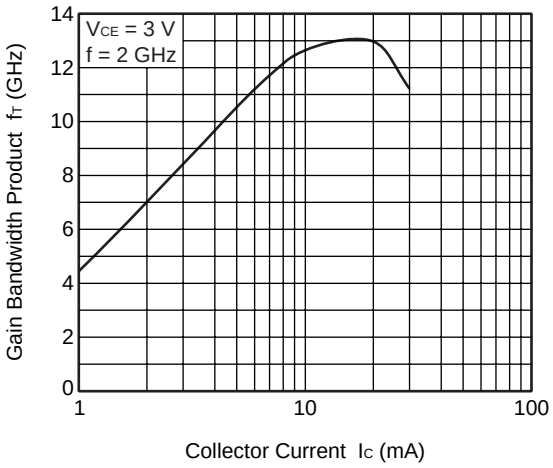
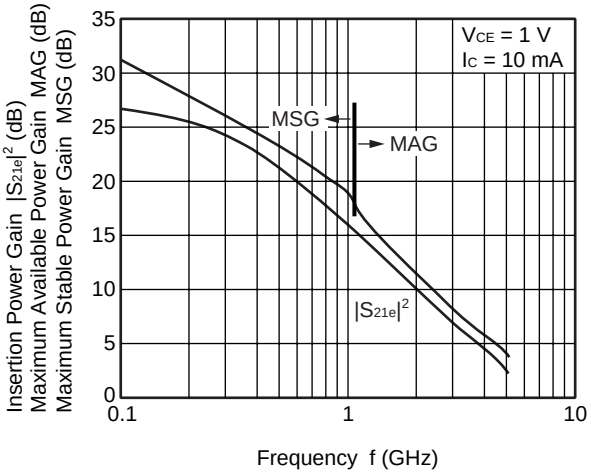


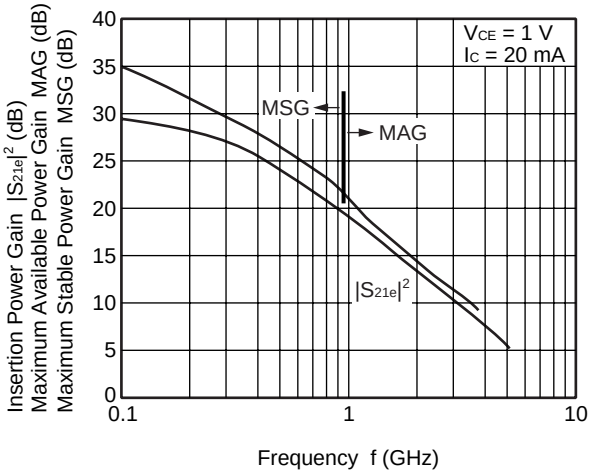
**Q1**

INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY

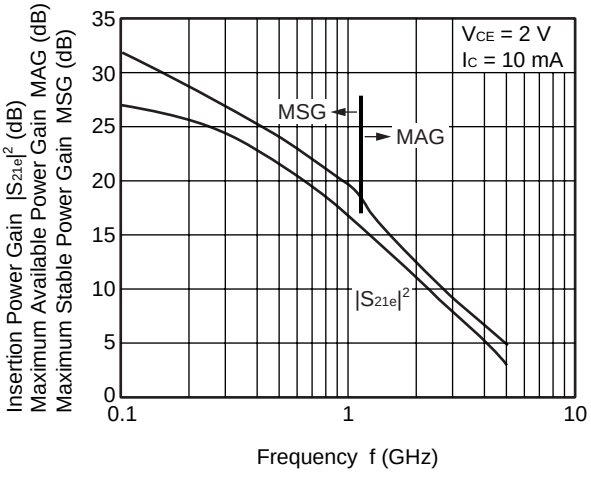



**Q2**

INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY




INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY

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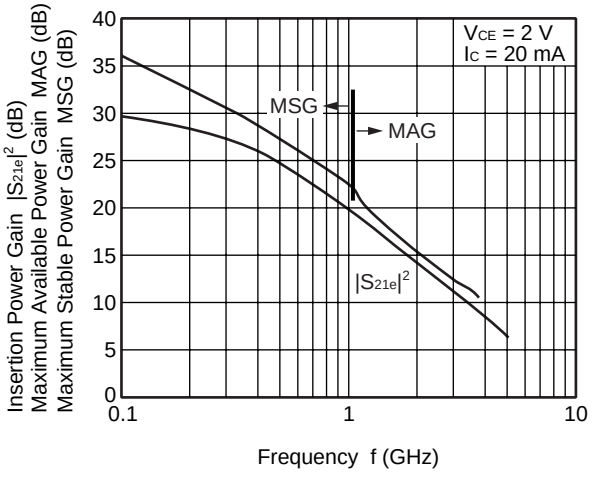


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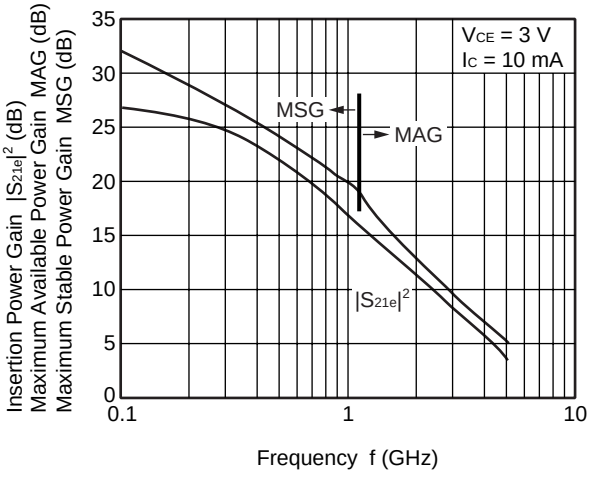
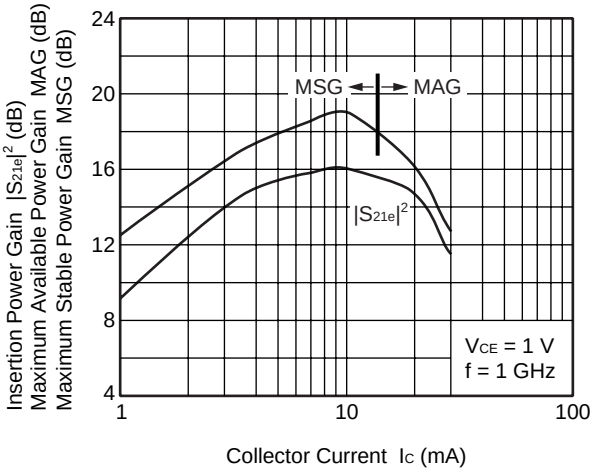


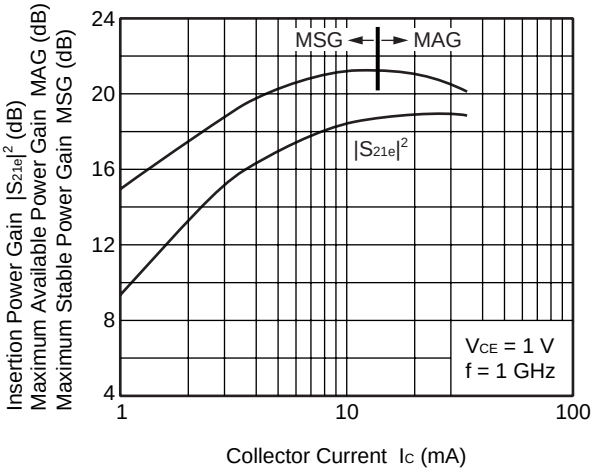
**Q1**

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

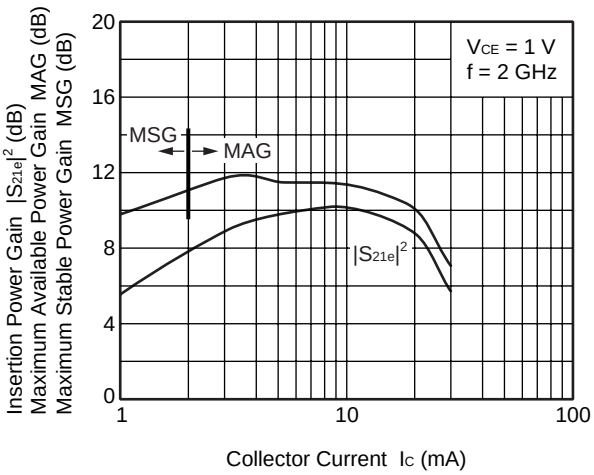



**Q2**

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT




INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT




INSERTION POWER GAIN, MAG, MSG
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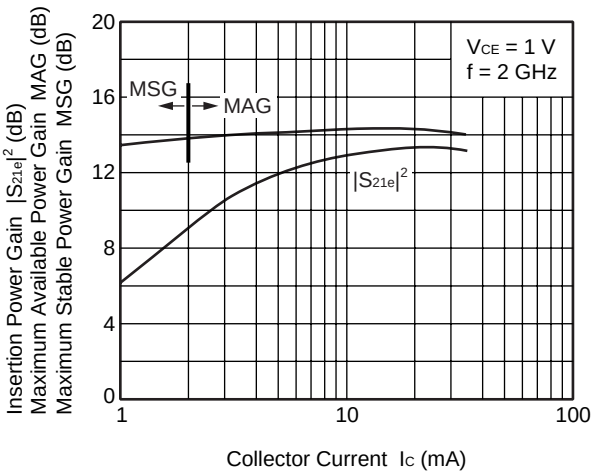
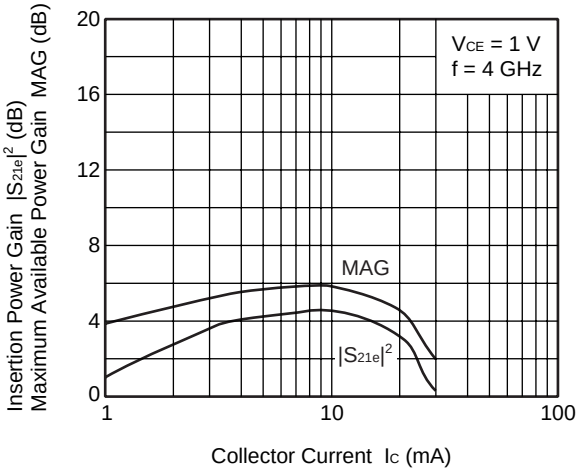
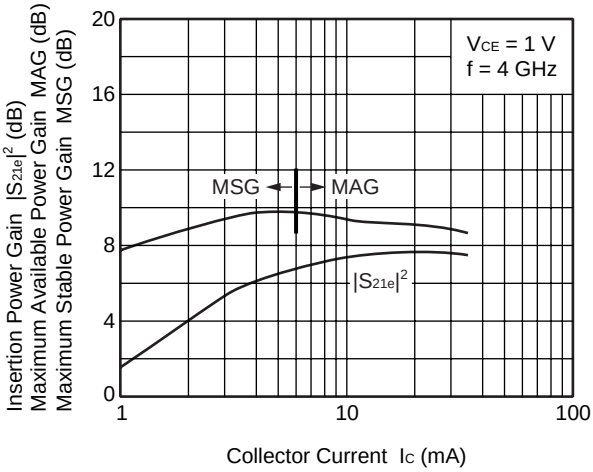



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT




INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



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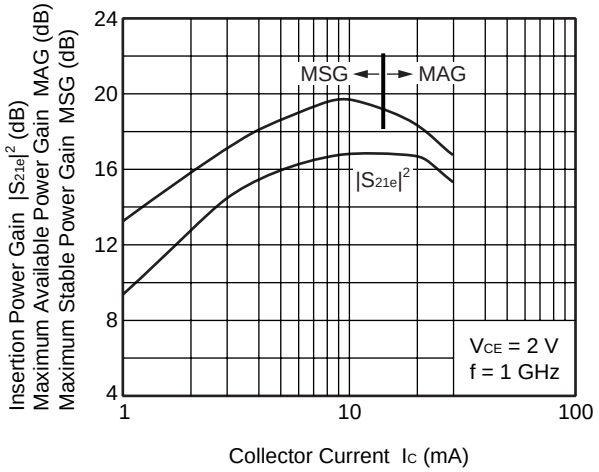
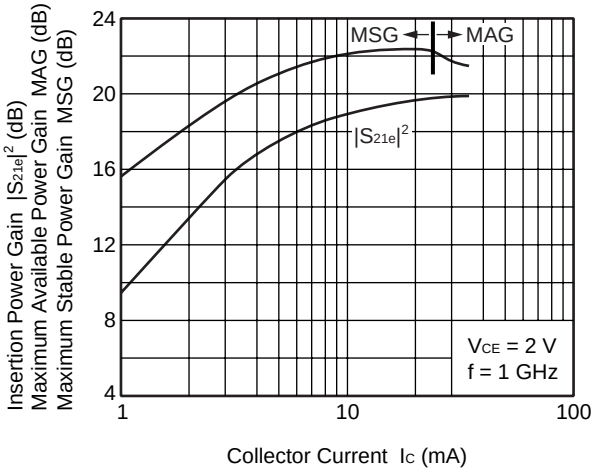
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

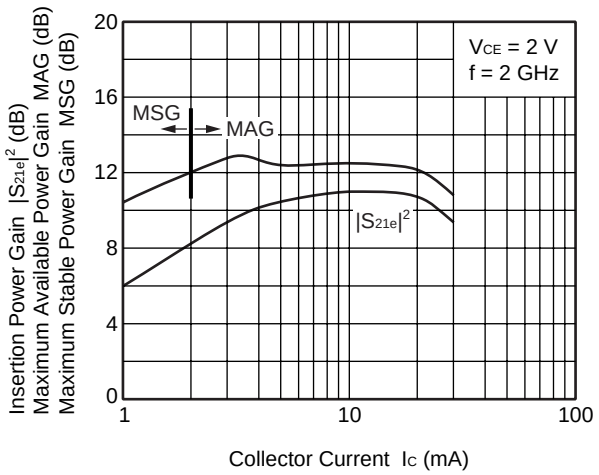



**Q2**

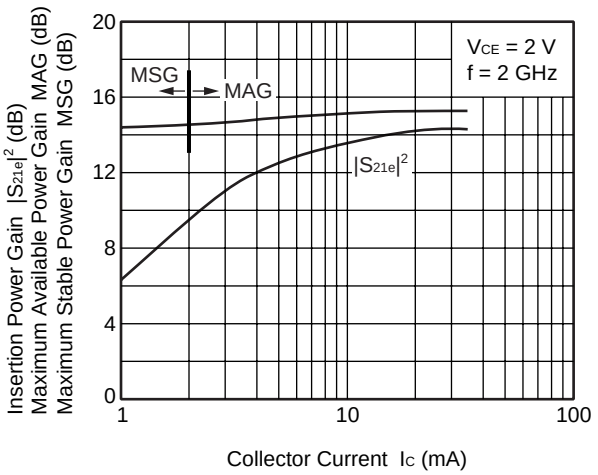
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



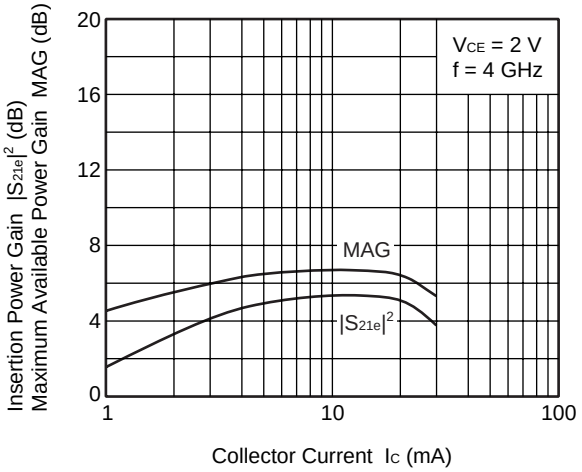

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT



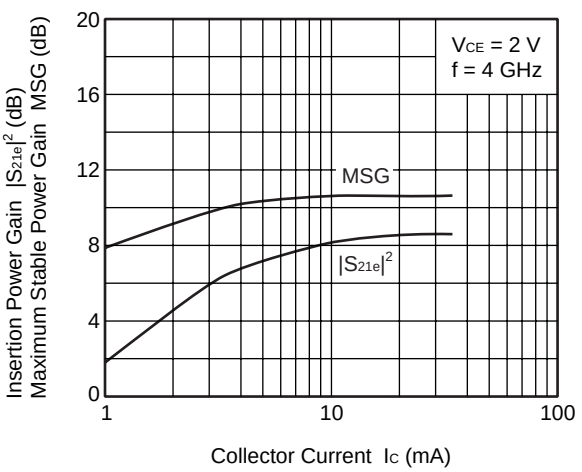

INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT




INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT

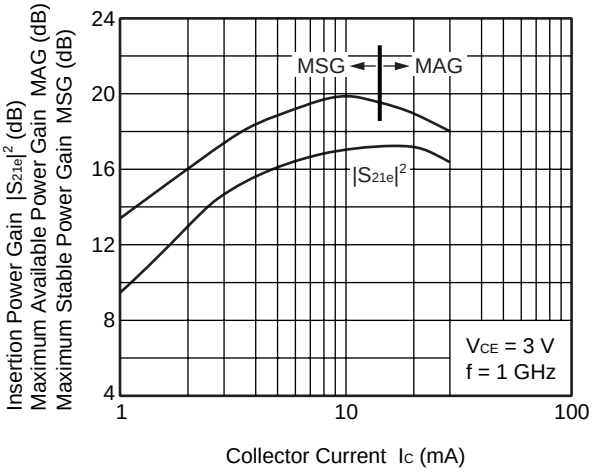



INSERTION POWER GAIN, MSG
vs. COLLECTOR CURRENT

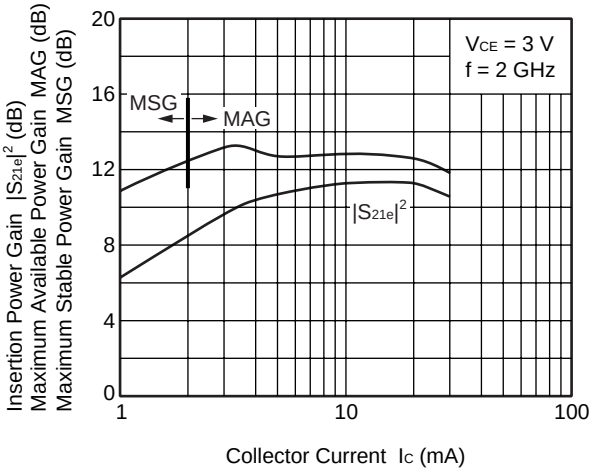


**Q1**

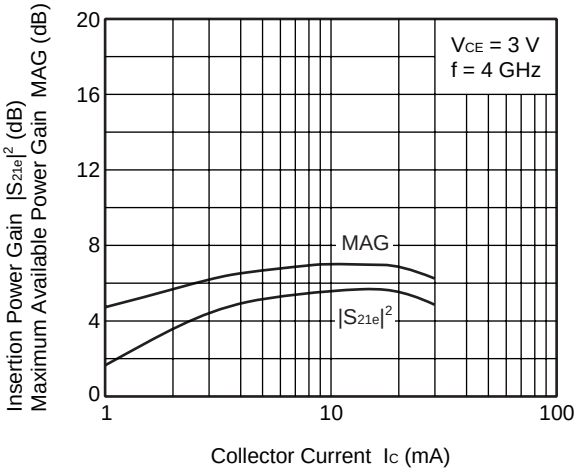
INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT




INSERTION POWER GAIN, MAG, MSG
vs. COLLECTOR CURRENT

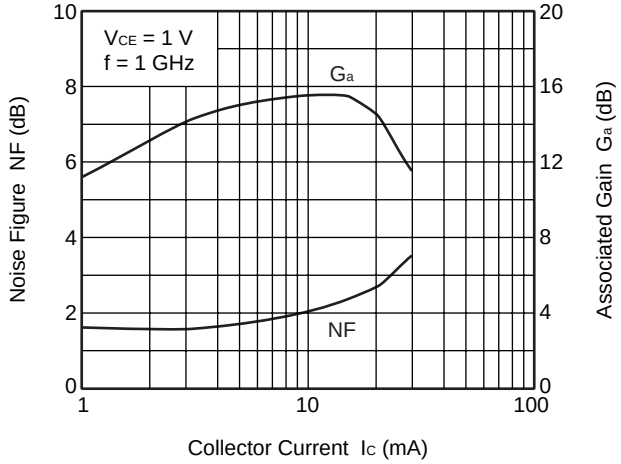



INSERTION POWER GAIN, MAG
vs. COLLECTOR CURRENT



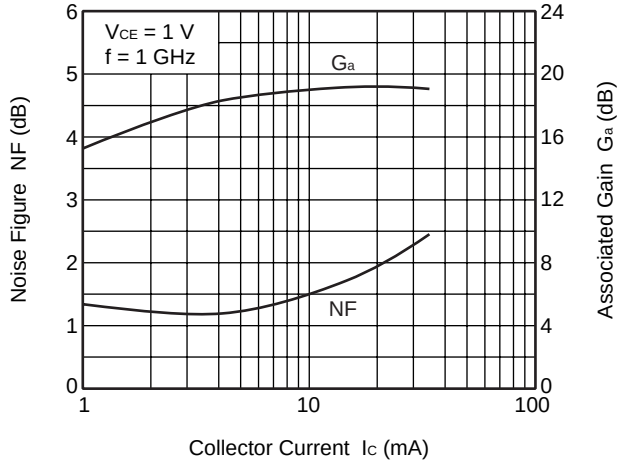
**Q1**

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

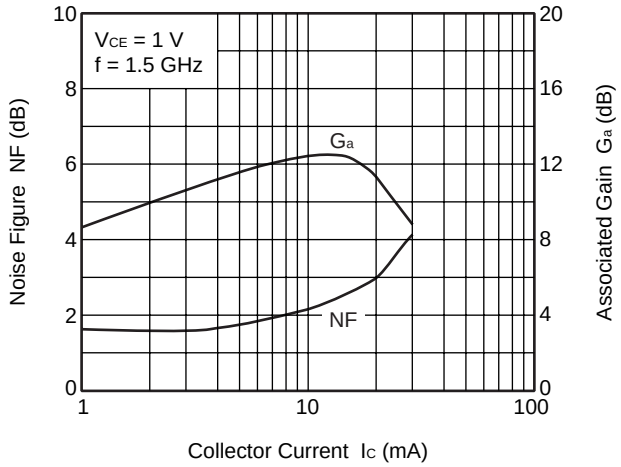



**Q2**

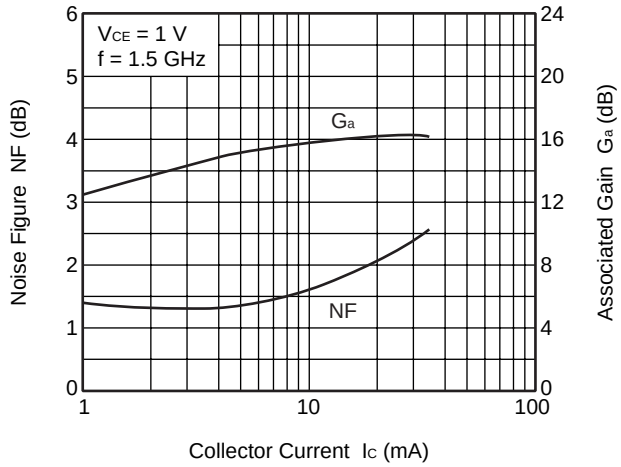
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



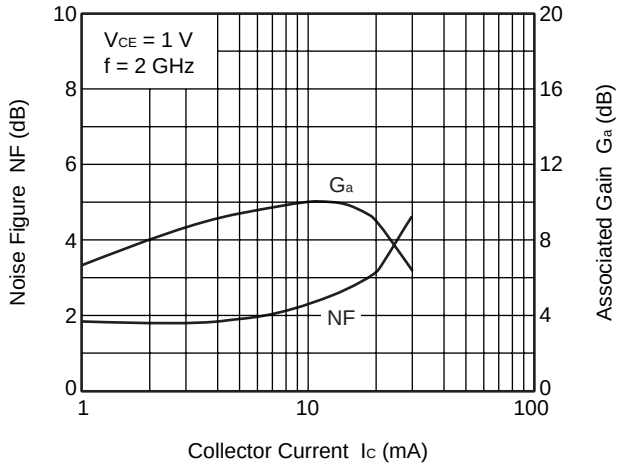

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



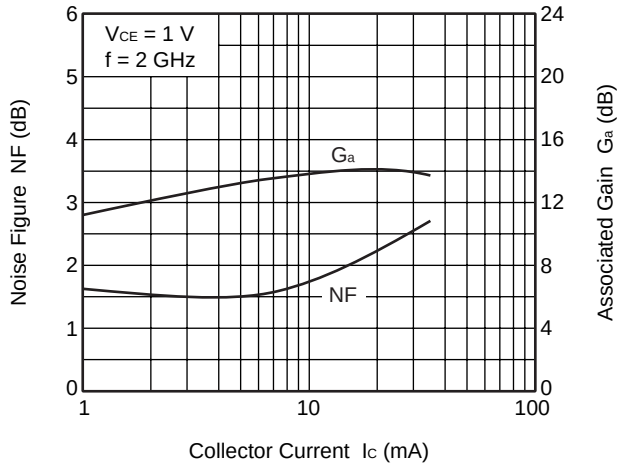

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT




NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

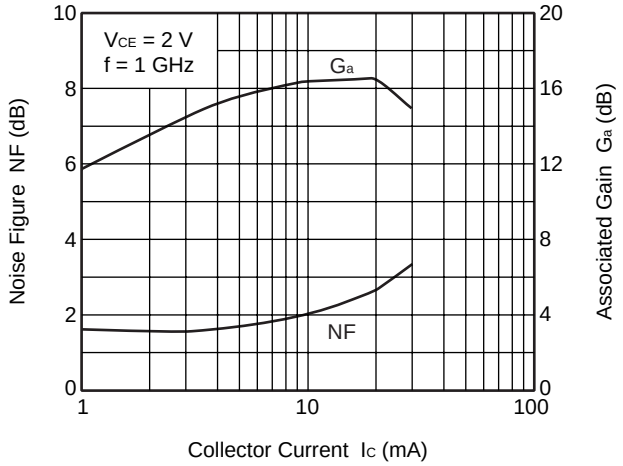



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



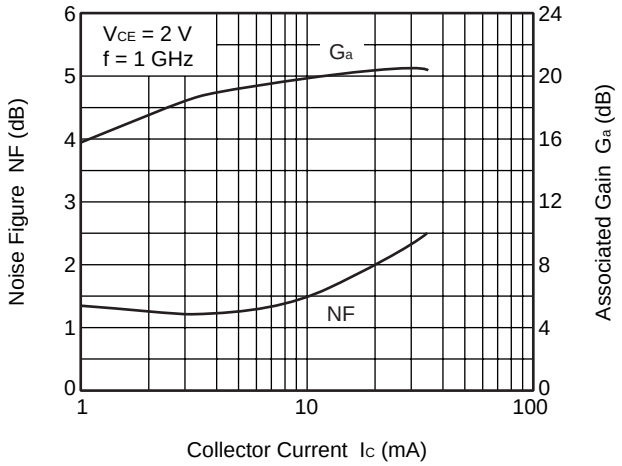
**Q1**

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

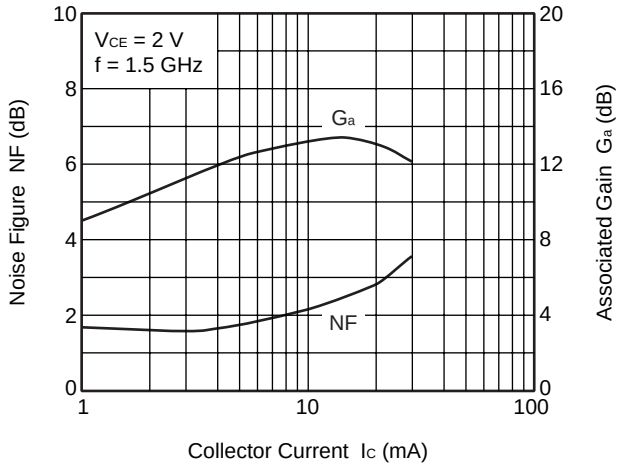



**Q2**

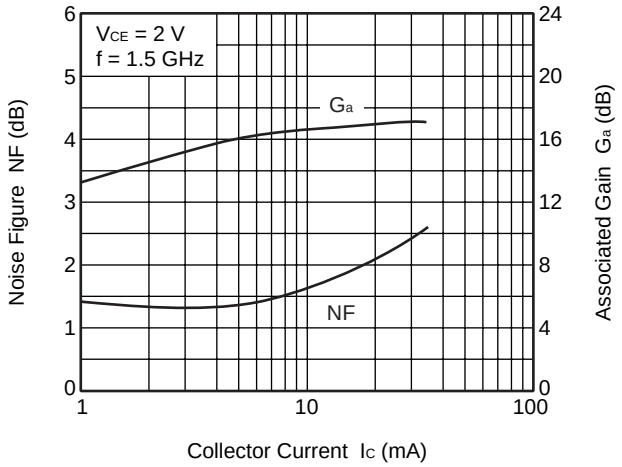
NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



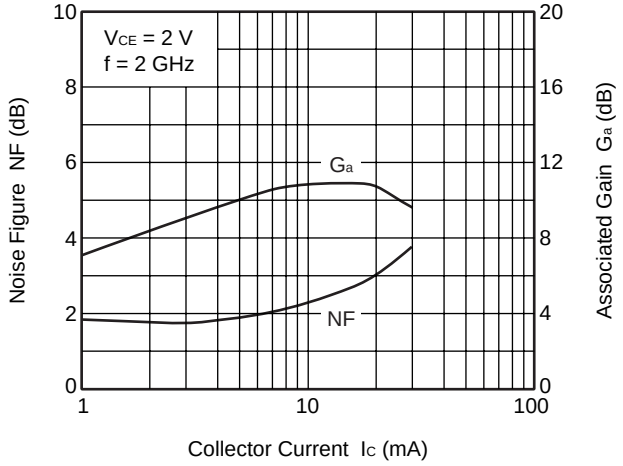

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT



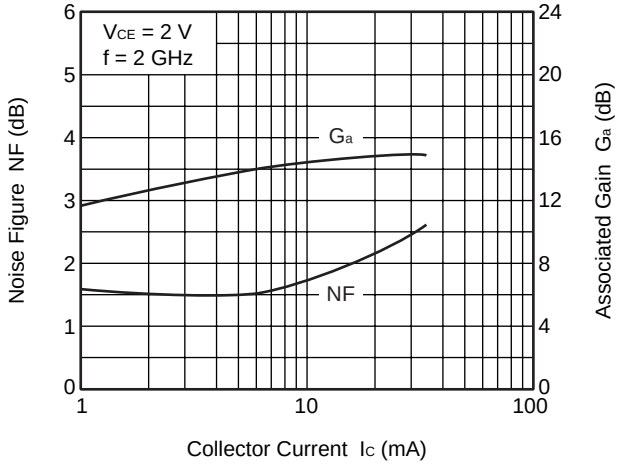

NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT




NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

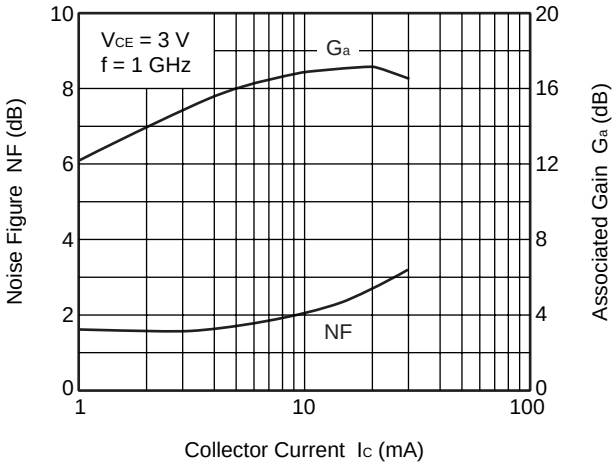



NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT

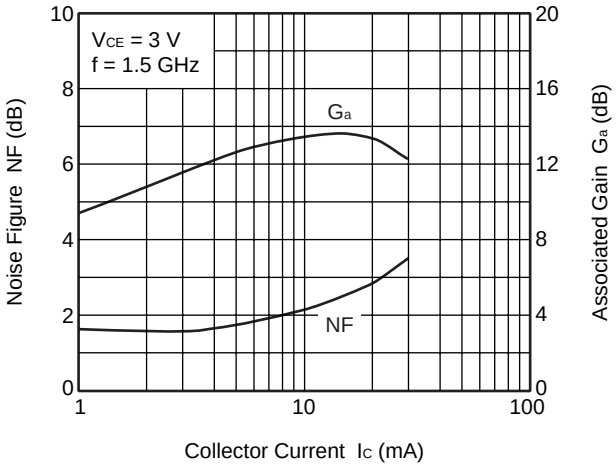


**Q1**

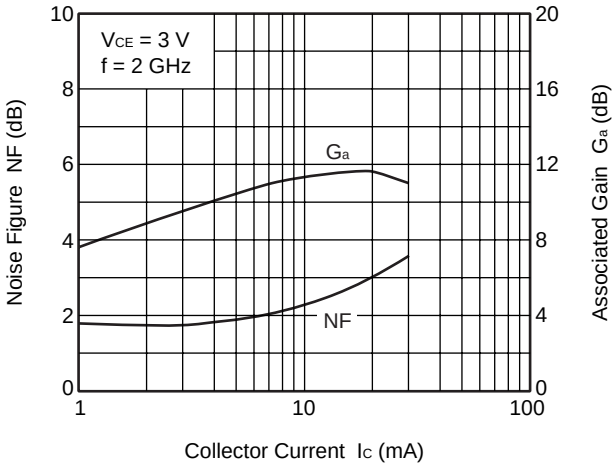
NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT




NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT




NOISE FIGURE, ASSOCIATED GAIN
vs. COLLECTOR CURRENT




**Remark** The graphs indicate nominal characteristics.

## S-PARAMETERS Q1

$V_{CE}$ = 1 V, $I_C$ = 1 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.952 | –7.1 | 3.547 | 172.9 | 0.020 | 86.6 | 0.992 | –3.7 |
| 0.2 | 0.943 | –14.4 | 3.539 | 167.2 | 0.040 | 80.9 | 0.989 | –7.3 |
| 0.3 | 0.931 | –21.5 | 3.494 | 161.1 | 0.060 | 76.6 | 0.971 | –10.6 |
| 0.4 | 0.905 | –28.3 | 3.407 | 154.8 | 0.079 | 72.0 | 0.951 | –14.3 |
| 0.5 | 0.880 | –35.8 | 3.352 | 148.4 | 0.096 | 67.8 | 0.929 | –17.9 |
| 0.6 | 0.845 | –43.0 | 3.274 | 142.1 | 0.112 | 63.4 | 0.900 | –21.6 |
| 0.7 | 0.809 | –50.3 | 3.172 | 136.6 | 0.127 | 59.1 | 0.870 | –25.0 |
| 0.8 | 0.770 | –57.2 | 3.067 | 130.7 | 0.140 | 55.3 | 0.837 | –28.4 |
| 0.9 | 0.731 | –64.5 | 2.965 | 125.0 | 0.152 | 51.5 | 0.807 | –31.9 |
| 1.0 | 0.692 | –71.4 | 2.864 | 119.5 | 0.161 | 48.1 | 0.775 | –34.9 |
| 1.1 | 0.658 | –78.5 | 2.756 | 114.6 | 0.169 | 44.8 | 0.746 | –37.8 |
| 1.2 | 0.626 | –85.5 | 2.640 | 110.0 | 0.177 | 42.1 | 0.717 | –40.4 |
| 1.3 | 0.596 | –92.3 | 2.536 | 105.5 | 0.182 | 39.4 | 0.693 | –42.8 |
| 1.4 | 0.571 | –98.7 | 2.420 | 101.1 | 0.186 | 36.9 | 0.669 | –45.3 |
| 1.5 | 0.549 | –104.8 | 2.325 | 96.9 | 0.190 | 34.8 | 0.648 | –47.3 |
| 1.6 | 0.530 | –110.8 | 2.237 | 93.2 | 0.193 | 32.8 | 0.628 | –49.2 |
| 1.7 | 0.513 | –116.9 | 2.141 | 89.7 | 0.195 | 31.1 | 0.609 | –50.9 |
| 1.8 | 0.498 | –122.2 | 2.059 | 86.1 | 0.196 | 29.5 | 0.592 | –52.3 |
| 1.9 | 0.487 | –127.6 | 1.976 | 83.4 | 0.197 | 28.2 | 0.577 | –53.6 |
| 2.0 | 0.472 | –132.0 | 1.907 | 80.2 | 0.198 | 27.0 | 0.562 | –54.7 |
| 2.1 | 0.468 | –137.5 | 1.844 | 77.5 | 0.198 | 26.1 | 0.552 | –56.3 |
| 2.2 | 0.456 | –141.5 | 1.769 | 74.8 | 0.198 | 25.3 | 0.538 | –57.2 |
| 2.3 | 0.455 | –147.0 | 1.721 | 72.3 | 0.199 | 24.5 | 0.533 | –58.3 |
| 2.4 | 0.447 | –150.7 | 1.663 | 69.8 | 0.200 | 23.9 | 0.518 | –59.2 |
| 2.5 | 0.445 | –155.3 | 1.611 | 67.5 | 0.200 | 23.5 | 0.512 | –60.4 |
| 2.6 | 0.437 | –158.8 | 1.570 | 65.5 | 0.200 | 22.7 | 0.505 | –62.0 |
| 2.7 | 0.437 | –162.3 | 1.517 | 63.2 | 0.200 | 22.3 | 0.499 | –62.7 |
| 2.8 | 0.433 | –166.1 | 1.469 | 61.3 | 0.199 | 22.1 | 0.491 | –64.2 |
| 2.9 | 0.426 | –169.4 | 1.409 | 58.1 | 0.200 | 21.3 | 0.472 | –65.2 |
| 3.0 | 0.419 | –173.8 | 1.381 | 55.7 | 0.200 | 21.3 | 0.465 | –68.0 |
| 4.0 | 0.436 | 149.3 | 1.136 | 34.9 | 0.208 | 23.7 | 0.424 | –88.2 |
| 5.0 | 0.503 | 118.2 | 0.905 | 16.8 | 0.232 | 24.5 | 0.397 | –112.6 |

$V_{CE}$ = 1 V, $I_C$ = 3 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.853 | –13.4 | 9.491 | 169.0 | 0.019 | 83.5 | 0.980 | –7.6 |
| 0.2 | 0.839 | –25.7 | 9.175 | 158.6 | 0.038 | 75.3 | 0.952 | –14.8 |
| 0.3 | 0.791 | –37.4 | 8.690 | 149.4 | 0.054 | 69.5 | 0.897 | –21.0 |
| 0.4 | 0.735 | –48.4 | 8.100 | 140.7 | 0.068 | 64.1 | 0.841 | –27.0 |
| 0.5 | 0.673 | –59.7 | 7.538 | 132.5 | 0.080 | 59.6 | 0.778 | –32.1 |
| 0.6 | 0.617 | –69.9 | 6.973 | 125.3 | 0.089 | 55.5 | 0.717 | –36.6 |
| 0.7 | 0.565 | –79.4 | 6.435 | 119.2 | 0.097 | 52.3 | 0.660 | –40.3 |
| 0.8 | 0.516 | –88.6 | 5.919 | 113.5 | 0.103 | 49.9 | 0.608 | –43.7 |
| 0.9 | 0.475 | –97.9 | 5.470 | 108.4 | 0.109 | 47.9 | 0.564 | –46.8 |
| 1.0 | 0.440 | –106.4 | 5.081 | 103.7 | 0.113 | 46.2 | 0.525 | –49.7 |
| 1.1 | 0.417 | –114.8 | 4.728 | 99.6 | 0.118 | 44.9 | 0.493 | –52.1 |
| 1.2 | 0.397 | –122.6 | 4.398 | 95.9 | 0.122 | 44.2 | 0.463 | –54.3 |
| 1.3 | 0.384 | –130.3 | 4.113 | 92.2 | 0.125 | 43.4 | 0.441 | –56.2 |
| 1.4 | 0.371 | –137.5 | 3.859 | 89.0 | 0.129 | 42.8 | 0.421 | –58.2 |
| 1.5 | 0.364 | –143.4 | 3.637 | 85.8 | 0.132 | 42.3 | 0.404 | –59.7 |
| 1.6 | 0.357 | –149.6 | 3.441 | 83.0 | 0.135 | 42.1 | 0.389 | –61.0 |
| 1.7 | 0.355 | –155.0 | 3.252 | 80.4 | 0.138 | 41.9 | 0.375 | –62.3 |
| 1.8 | 0.352 | –159.9 | 3.090 | 77.7 | 0.141 | 41.8 | 0.362 | –63.2 |
| 1.9 | 0.352 | –164.5 | 2.940 | 75.6 | 0.145 | 41.9 | 0.353 | –64.2 |
| 2.0 | 0.345 | –168.5 | 2.810 | 73.2 | 0.148 | 41.7 | 0.340 | –64.8 |
| 2.1 | 0.355 | –172.8 | 2.697 | 71.1 | 0.151 | 41.8 | 0.334 | –66.0 |
| 2.2 | 0.349 | –176.2 | 2.578 | 69.3 | 0.154 | 41.9 | 0.321 | –66.3 |
| 2.3 | 0.360 | 179.9 | 2.488 | 67.3 | 0.158 | 41.9 | 0.317 | –67.1 |
| 2.4 | 0.357 | 177.4 | 2.396 | 65.4 | 0.162 | 41.9 | 0.304 | –68.2 |
| 2.5 | 0.362 | 174.0 | 2.305 | 63.6 | 0.166 | 42.0 | 0.300 | –69.1 |
| 2.6 | 0.359 | 171.4 | 2.235 | 62.4 | 0.169 | 42.0 | 0.294 | –70.9 |
| 2.7 | 0.367 | 169.1 | 2.155 | 60.6 | 0.173 | 42.0 | 0.287 | –70.9 |
| 2.8 | 0.366 | 165.8 | 2.079 | 59.2 | 0.177 | 41.8 | 0.282 | –73.1 |
| 2.9 | 0.359 | 164.2 | 1.983 | 56.7 | 0.181 | 41.2 | 0.267 | –74.4 |
| 3.0 | 0.358 | 159.3 | 1.937 | 54.8 | 0.185 | 41.3 | 0.267 | –77.6 |
| 4.0 | 0.403 | 131.3 | 1.524 | 36.4 | 0.230 | 39.4 | 0.251 | –102.6 |
| 5.0 | 0.486 | 107.7 | 1.201 | 21.1 | 0.275 | 32.1 | 0.242 | –133.9 |

$V_{CE}$ = 1 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.783 | –18.8 | 14.076 | 165.6 | 0.018 | 80.3 | 0.964 | –10.8 |
| 0.2 | 0.747 | –34.7 | 13.183 | 152.2 | 0.036 | 72.3 | 0.907 | –20.3 |
| 0.3 | 0.673 | –49.8 | 12.003 | 141.1 | 0.049 | 65.6 | 0.823 | –27.8 |
| 0.4 | 0.607 | –62.9 | 10.741 | 131.5 | 0.060 | 61.0 | 0.742 | –34.4 |
| 0.5 | 0.537 | –76.1 | 9.603 | 123.1 | 0.068 | 57.1 | 0.663 | –39.4 |
| 0.6 | 0.481 | –87.4 | 8.612 | 116.2 | 0.075 | 54.3 | 0.594 | –43.5 |
| 0.7 | 0.437 | –98.0 | 7.754 | 110.7 | 0.081 | 52.7 | 0.535 | –46.7 |
| 0.8 | 0.398 | –108.0 | 6.998 | 105.4 | 0.086 | 51.5 | 0.486 | –49.5 |
| 0.9 | 0.372 | –118.1 | 6.348 | 100.9 | 0.091 | 50.6 | 0.444 | –52.1 |
| 1.0 | 0.351 | –127.1 | 5.824 | 96.9 | 0.095 | 50.1 | 0.410 | –54.6 |
| 1.1 | 0.338 | –135.6 | 5.367 | 93.4 | 0.100 | 49.8 | 0.383 | –56.7 |
| 1.2 | 0.332 | –143.4 | 4.940 | 90.4 | 0.104 | 49.8 | 0.359 | –58.8 |
| 1.3 | 0.326 | –151.0 | 4.598 | 87.4 | 0.109 | 49.7 | 0.342 | –60.4 |
| 1.4 | 0.325 | –156.9 | 4.286 | 84.5 | 0.113 | 49.6 | 0.326 | –62.2 |
| 1.5 | 0.322 | –162.3 | 4.028 | 81.7 | 0.117 | 49.5 | 0.313 | –63.7 |
| 1.6 | 0.324 | –167.9 | 3.798 | 79.3 | 0.122 | 49.6 | 0.303 | –64.9 |
| 1.7 | 0.327 | –172.4 | 3.582 | 77.0 | 0.126 | 49.6 | 0.291 | –66.2 |
| 1.8 | 0.326 | –176.7 | 3.393 | 74.6 | 0.131 | 49.6 | 0.282 | –67.0 |
| 1.9 | 0.330 | 179.2 | 3.224 | 72.8 | 0.135 | 49.6 | 0.275 | –68.1 |
| 2.0 | 0.326 | 176.0 | 3.078 | 70.5 | 0.140 | 49.6 | 0.264 | –68.5 |
| 2.1 | 0.338 | 172.5 | 2.946 | 68.7 | 0.144 | 49.6 | 0.260 | –69.7 |
| 2.2 | 0.336 | 170.4 | 2.817 | 67.1 | 0.148 | 49.7 | 0.248 | –70.0 |
| 2.3 | 0.347 | 167.5 | 2.713 | 65.3 | 0.153 | 49.5 | 0.245 | –70.8 |
| 2.4 | 0.345 | 165.2 | 2.609 | 63.6 | 0.159 | 49.4 | 0.234 | –72.1 |
| 2.5 | 0.352 | 162.6 | 2.509 | 62.1 | 0.163 | 49.3 | 0.231 | –72.9 |
| 2.6 | 0.351 | 160.3 | 2.432 | 60.8 | 0.168 | 49.3 | 0.224 | –75.0 |
| 2.7 | 0.358 | 158.5 | 2.340 | 59.2 | 0.173 | 49.0 | 0.219 | –74.9 |
| 2.8 | 0.359 | 155.9 | 2.260 | 57.8 | 0.178 | 48.6 | 0.215 | –77.6 |
| 2.9 | 0.352 | 154.4 | 2.158 | 55.6 | 0.183 | 47.8 | 0.202 | –79.5 |
| 3.0 | 0.353 | 150.0 | 2.104 | 53.8 | 0.188 | 47.8 | 0.205 | –83.1 |
| 4.0 | 0.402 | 125.3 | 1.631 | 36.5 | 0.239 | 43.3 | 0.203 | –111.7 |
| 5.0 | 0.486 | 104.8 | 1.283 | 22.1 | 0.288 | 33.9 | 0.212 | –147.2 |

$V_{CE}$ = 1 V, $I_C$ = 7 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.731 | –22.4 | 17.662 | 162.6 | 0.018 | 78.1 | 0.946 | –13.2 |
| 0.2 | 0.666 | –42.3 | 16.079 | 147.1 | 0.033 | 70.1 | 0.866 | –24.3 |
| 0.3 | 0.585 | –59.7 | 14.117 | 135.1 | 0.045 | 63.9 | 0.761 | –32.4 |
| 0.4 | 0.515 | –74.0 | 12.267 | 125.3 | 0.054 | 59.6 | 0.666 | –38.8 |
| 0.5 | 0.451 | –88.1 | 10.693 | 117.2 | 0.061 | 57.0 | 0.584 | –43.3 |
| 0.6 | 0.402 | –100.5 | 9.403 | 110.6 | 0.067 | 55.3 | 0.515 | –46.9 |
| 0.7 | 0.369 | –111.7 | 8.357 | 105.7 | 0.072 | 54.5 | 0.460 | –49.5 |
| 0.8 | 0.341 | –122.4 | 7.466 | 100.9 | 0.077 | 54.0 | 0.414 | –52.0 |
| 0.9 | 0.326 | –132.1 | 6.722 | 96.9 | 0.082 | 53.8 | 0.378 | –54.2 |
| 1.0 | 0.313 | –141.7 | 6.135 | 93.3 | 0.087 | 54.0 | 0.348 | –56.6 |
| 1.1 | 0.309 | –149.3 | 5.624 | 90.1 | 0.092 | 53.9 | 0.325 | –58.5 |
| 1.2 | 0.309 | –156.8 | 5.163 | 87.3 | 0.097 | 54.2 | 0.304 | –60.5 |
| 1.3 | 0.309 | –163.3 | 4.802 | 84.6 | 0.102 | 54.2 | 0.290 | –62.1 |
| 1.4 | 0.311 | –168.8 | 4.464 | 82.0 | 0.107 | 54.2 | 0.278 | –63.8 |
| 1.5 | 0.312 | –173.7 | 4.191 | 79.4 | 0.112 | 54.3 | 0.267 | –65.3 |
| 1.6 | 0.316 | –178.2 | 3.945 | 77.1 | 0.117 | 54.2 | 0.259 | –66.6 |
| 1.7 | 0.320 | 178.1 | 3.712 | 75.0 | 0.122 | 54.2 | 0.249 | –67.9 |
| 1.8 | 0.320 | 174.4 | 3.516 | 72.8 | 0.127 | 54.2 | 0.241 | –68.7 |
| 1.9 | 0.327 | 170.6 | 3.333 | 71.1 | 0.132 | 54.1 | 0.236 | –69.8 |
| 2.0 | 0.324 | 168.0 | 3.181 | 69.1 | 0.137 | 53.9 | 0.227 | –70.2 |
| 2.1 | 0.338 | 165.7 | 3.047 | 67.3 | 0.142 | 53.9 | 0.224 | –71.4 |
| 2.2 | 0.334 | 162.9 | 2.914 | 65.8 | 0.147 | 53.8 | 0.212 | –71.5 |
| 2.3 | 0.348 | 160.7 | 2.803 | 64.2 | 0.153 | 53.6 | 0.210 | –72.5 |
| 2.4 | 0.345 | 159.0 | 2.694 | 62.5 | 0.158 | 53.3 | 0.199 | –73.9 |
| 2.5 | 0.353 | 156.7 | 2.591 | 61.0 | 0.163 | 53.0 | 0.197 | –74.8 |
| 2.6 | 0.353 | 154.3 | 2.509 | 59.9 | 0.169 | 52.8 | 0.192 | –77.4 |
| 2.7 | 0.359 | 153.2 | 2.414 | 58.3 | 0.174 | 52.4 | 0.186 | –77.2 |
| 2.8 | 0.361 | 150.8 | 2.330 | 57.2 | 0.179 | 51.8 | 0.183 | –80.3 |
| 2.9 | 0.354 | 149.1 | 2.223 | 55.0 | 0.185 | 50.9 | 0.171 | –82.7 |
| 3.0 | 0.355 | 145.1 | 2.167 | 53.2 | 0.191 | 50.7 | 0.175 | –86.6 |
| 4.0 | 0.404 | 122.9 | 1.674 | 36.3 | 0.244 | 45.0 | 0.183 | –117.4 |
| 5.0 | 0.490 | 103.1 | 1.316 | 22.5 | 0.294 | 34.8 | 0.204 | –154.4 |

$V_{CE}$ = 1 V, $I_C$ = 10 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.648 | –29.0 | 21.750 | 159.0 | 0.017 | 76.3 | 0.924 | –16.1 |
| 0.2 | 0.574 | –52.1 | 18.960 | 141.4 | 0.030 | 67.2 | 0.810 | –28.7 |
| 0.3 | 0.489 | –71.7 | 15.944 | 128.7 | 0.040 | 62.5 | 0.686 | –36.9 |
| 0.4 | 0.426 | –88.0 | 13.412 | 119.2 | 0.048 | 59.7 | 0.584 | –42.6 |
| 0.5 | 0.373 | –103.3 | 11.427 | 111.5 | 0.054 | 58.2 | 0.504 | –46.3 |
| 0.6 | 0.340 | –116.3 | 9.904 | 105.5 | 0.060 | 57.8 | 0.440 | –49.0 |
| 0.7 | 0.319 | –127.6 | 8.699 | 101.1 | 0.065 | 57.4 | 0.391 | –51.0 |
| 0.8 | 0.302 | –138.3 | 7.716 | 96.8 | 0.071 | 57.6 | 0.351 | –52.9 |
| 0.9 | 0.297 | –147.7 | 6.924 | 93.2 | 0.076 | 57.8 | 0.320 | –54.9 |
| 1.0 | 0.294 | –156.2 | 6.289 | 90.0 | 0.081 | 58.1 | 0.294 | –57.0 |
| 1.1 | 0.298 | –163.2 | 5.752 | 87.1 | 0.086 | 58.3 | 0.275 | –58.8 |
| 1.2 | 0.302 | –168.7 | 5.272 | 84.8 | 0.092 | 58.6 | 0.258 | –60.8 |
| 1.3 | 0.306 | –175.1 | 4.878 | 82.1 | 0.097 | 58.6 | 0.247 | –62.4 |
| 1.4 | 0.310 | –179.3 | 4.535 | 79.7 | 0.103 | 58.6 | 0.238 | –64.3 |
| 1.5 | 0.313 | 176.2 | 4.245 | 77.4 | 0.109 | 58.5 | 0.229 | –65.8 |
| 1.6 | 0.320 | 172.7 | 4.002 | 75.3 | 0.114 | 58.4 | 0.223 | –67.1 |
| 1.7 | 0.324 | 169.6 | 3.760 | 73.3 | 0.120 | 58.4 | 0.215 | –68.4 |
| 1.8 | 0.327 | 166.6 | 3.562 | 71.2 | 0.125 | 58.1 | 0.209 | –69.4 |
| 1.9 | 0.333 | 163.7 | 3.377 | 69.6 | 0.131 | 57.9 | 0.205 | –70.6 |
| 2.0 | 0.332 | 161.1 | 3.223 | 67.6 | 0.136 | 57.7 | 0.197 | –70.8 |
| 2.1 | 0.343 | 158.8 | 3.086 | 66.0 | 0.142 | 57.4 | 0.195 | –72.2 |
| 2.2 | 0.340 | 156.9 | 2.947 | 64.5 | 0.147 | 57.1 | 0.184 | –72.3 |
| 2.3 | 0.356 | 155.6 | 2.839 | 62.9 | 0.153 | 56.8 | 0.183 | –73.4 |
| 2.4 | 0.353 | 153.7 | 2.728 | 61.4 | 0.159 | 56.3 | 0.173 | –75.0 |
| 2.5 | 0.360 | 151.8 | 2.621 | 60.0 | 0.164 | 56.0 | 0.172 | –76.1 |
| 2.6 | 0.360 | 149.9 | 2.540 | 58.9 | 0.170 | 55.6 | 0.166 | –79.0 |
| 2.7 | 0.367 | 148.7 | 2.445 | 57.5 | 0.175 | 55.0 | 0.161 | –79.1 |
| 2.8 | 0.368 | 146.5 | 2.360 | 56.3 | 0.181 | 54.3 | 0.159 | –82.4 |
| 2.9 | 0.360 | 145.3 | 2.250 | 54.3 | 0.187 | 53.3 | 0.149 | –85.4 |
| 3.0 | 0.361 | 141.2 | 2.191 | 52.6 | 0.193 | 53.0 | 0.154 | –89.3 |
| 4.0 | 0.411 | 120.5 | 1.687 | 35.9 | 0.248 | 46.5 | 0.169 | –122.4 |
| 5.0 | 0.496 | 101.9 | 1.322 | 22.3 | 0.298 | 35.7 | 0.200 | –159.8 |

$V_{CE}$ = 1 V, $I_C$ = 20 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.465 | –48.9 | 26.851 | 149.0 | 0.016 | 74.9 | 0.815 | –23.4 |
| 0.2 | 0.402 | –84.3 | 20.632 | 128.1 | 0.026 | 63.2 | 0.639 | –37.0 |
| 0.3 | 0.351 | –109.5 | 15.878 | 115.8 | 0.033 | 60.8 | 0.504 | –42.6 |
| 0.4 | 0.330 | –127.2 | 12.668 | 107.4 | 0.040 | 61.1 | 0.415 | –45.5 |
| 0.5 | 0.320 | –142.0 | 10.429 | 101.3 | 0.045 | 61.7 | 0.354 | –46.6 |
| 0.6 | 0.313 | –152.8 | 8.867 | 96.4 | 0.051 | 62.6 | 0.309 | –47.3 |
| 0.7 | 0.315 | –161.6 | 7.698 | 92.8 | 0.057 | 63.4 | 0.276 | –47.9 |
| 0.8 | 0.318 | –169.6 | 6.765 | 89.3 | 0.063 | 63.8 | 0.249 | –48.8 |
| 0.9 | 0.324 | –175.5 | 6.024 | 86.4 | 0.069 | 64.1 | 0.230 | –50.1 |
| 1.0 | 0.330 | 179.0 | 5.444 | 83.8 | 0.075 | 64.4 | 0.213 | –52.0 |
| 1.1 | 0.339 | 174.7 | 4.967 | 81.3 | 0.081 | 64.5 | 0.202 | –53.8 |
| 1.2 | 0.348 | 171.3 | 4.529 | 79.1 | 0.087 | 64.5 | 0.192 | –56.2 |
| 1.3 | 0.356 | 167.3 | 4.195 | 76.9 | 0.093 | 64.5 | 0.186 | –58.0 |
| 1.4 | 0.361 | 164.9 | 3.897 | 74.8 | 0.099 | 64.3 | 0.181 | –60.2 |
| 1.5 | 0.367 | 161.8 | 3.642 | 72.6 | 0.105 | 64.1 | 0.177 | –62.0 |
| 1.6 | 0.373 | 159.5 | 3.426 | 70.6 | 0.111 | 63.7 | 0.174 | –63.6 |
| 1.7 | 0.376 | 157.3 | 3.218 | 68.8 | 0.117 | 63.4 | 0.171 | –65.3 |
| 1.8 | 0.380 | 155.1 | 3.046 | 66.8 | 0.123 | 63.0 | 0.167 | –66.4 |
| 1.9 | 0.385 | 153.2 | 2.890 | 65.3 | 0.129 | 62.7 | 0.166 | –68.1 |
| 2.0 | 0.385 | 151.0 | 2.757 | 63.5 | 0.135 | 62.2 | 0.160 | –68.5 |
| 2.1 | 0.398 | 149.9 | 2.640 | 61.9 | 0.141 | 61.7 | 0.161 | –70.4 |
| 2.2 | 0.395 | 148.0 | 2.528 | 60.4 | 0.147 | 61.4 | 0.152 | –70.7 |
| 2.3 | 0.406 | 147.1 | 2.432 | 59.0 | 0.153 | 60.8 | 0.152 | –72.1 |
| 2.4 | 0.404 | 145.6 | 2.339 | 57.5 | 0.159 | 60.3 | 0.144 | –74.4 |
| 2.5 | 0.410 | 144.5 | 2.250 | 56.2 | 0.165 | 59.7 | 0.145 | –75.8 |
| 2.6 | 0.411 | 142.5 | 2.179 | 55.1 | 0.171 | 59.3 | 0.141 | –79.3 |
| 2.7 | 0.416 | 141.9 | 2.100 | 53.8 | 0.177 | 58.6 | 0.136 | –79.2 |
| 2.8 | 0.419 | 139.9 | 2.025 | 52.6 | 0.183 | 57.8 | 0.136 | –83.7 |
| 2.9 | 0.408 | 138.8 | 1.931 | 50.7 | 0.189 | 56.7 | 0.127 | –87.2 |
| 3.0 | 0.411 | 135.4 | 1.881 | 49.0 | 0.196 | 56.3 | 0.133 | –91.9 |
| 4.0 | 0.459 | 116.0 | 1.452 | 32.2 | 0.253 | 48.5 | 0.160 | –127.9 |
| 5.0 | 0.536 | 99.1 | 1.141 | 19.5 | 0.304 | 36.9 | 0.204 | –164.6 |

$V_{CE}$ = 2 V, $I_C$ = 1 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.965 | –7.3 | 3.547 | 173.5 | 0.018 | 87.6 | 0.993 | –3.2 |
| 0.2 | 0.946 | –13.5 | 3.554 | 168.1 | 0.035 | 82.3 | 0.992 | –6.3 |
| 0.3 | 0.930 | –19.9 | 3.510 | 162.4 | 0.051 | 77.9 | 0.976 | –9.0 |
| 0.4 | 0.911 | –26.3 | 3.439 | 156.4 | 0.068 | 73.6 | 0.960 | –12.3 |
| 0.5 | 0.887 | –33.4 | 3.397 | 150.3 | 0.083 | 69.7 | 0.941 | –15.4 |
| 0.6 | 0.855 | –40.2 | 3.321 | 144.3 | 0.097 | 65.6 | 0.917 | –18.7 |
| 0.7 | 0.821 | –46.7 | 3.230 | 139.1 | 0.110 | 61.5 | 0.890 | –21.8 |
| 0.8 | 0.786 | –53.4 | 3.137 | 133.3 | 0.122 | 57.8 | 0.860 | –24.8 |
| 0.9 | 0.746 | –60.4 | 3.039 | 127.8 | 0.132 | 54.1 | 0.835 | –27.8 |
| 1.0 | 0.708 | –67.1 | 2.949 | 122.5 | 0.141 | 50.9 | 0.805 | –30.7 |
| 1.1 | 0.672 | –73.9 | 2.848 | 117.7 | 0.149 | 47.8 | 0.779 | –33.2 |
| 1.2 | 0.642 | –80.6 | 2.738 | 113.1 | 0.156 | 45.1 | 0.753 | –35.5 |
| 1.3 | 0.611 | –87.1 | 2.639 | 108.8 | 0.161 | 42.5 | 0.731 | –37.8 |
| 1.4 | 0.585 | –93.2 | 2.524 | 104.4 | 0.166 | 40.1 | 0.708 | –40.0 |
| 1.5 | 0.562 | –99.3 | 2.430 | 100.2 | 0.169 | 38.0 | 0.689 | –41.9 |
| 1.6 | 0.540 | –105.3 | 2.344 | 96.5 | 0.172 | 36.0 | 0.669 | –43.7 |
| 1.7 | 0.523 | –111.0 | 2.250 | 92.9 | 0.174 | 34.3 | 0.650 | –45.3 |
| 1.8 | 0.506 | –116.6 | 2.161 | 89.4 | 0.175 | 32.8 | 0.634 | –46.6 |
| 1.9 | 0.493 | –121.8 | 2.076 | 86.6 | 0.177 | 31.5 | 0.620 | –47.9 |
| 2.0 | 0.476 | –126.5 | 2.007 | 83.4 | 0.178 | 30.4 | 0.606 | –49.0 |
| 2.1 | 0.468 | –132.1 | 1.939 | 80.7 | 0.178 | 29.5 | 0.596 | –50.4 |
| 2.2 | 0.455 | –136.0 | 1.864 | 78.1 | 0.178 | 28.7 | 0.582 | –51.1 |
| 2.3 | 0.452 | –141.5 | 1.811 | 75.5 | 0.179 | 28.1 | 0.579 | –52.0 |
| 2.4 | 0.446 | –145.2 | 1.753 | 73.1 | 0.180 | 27.5 | 0.564 | –53.0 |
| 2.5 | 0.442 | –150.1 | 1.699 | 70.7 | 0.180 | 27.2 | 0.558 | –54.0 |
| 2.6 | 0.432 | –153.3 | 1.655 | 69.0 | 0.181 | 26.6 | 0.551 | –55.4 |
| 2.7 | 0.432 | –157.3 | 1.598 | 66.7 | 0.181 | 26.2 | 0.545 | –56.1 |
| 2.8 | 0.425 | –161.2 | 1.548 | 64.7 | 0.181 | 25.9 | 0.536 | –57.5 |
| 2.9 | 0.419 | –164.3 | 1.485 | 61.5 | 0.181 | 25.2 | 0.518 | –58.5 |
| 3.0 | 0.410 | –169.1 | 1.455 | 59.1 | 0.182 | 25.3 | 0.509 | –61.0 |
| 4.0 | 0.421 | 152.7 | 1.199 | 38.3 | 0.193 | 28.8 | 0.466 | –79.4 |
| 5.0 | 0.485 | 119.8 | 0.957 | 19.6 | 0.221 | 29.8 | 0.430 | –101.8 |

$V_{CE}$ = 2 V, $I_C$ = 3 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.875 | –11.4 | 9.429 | 169.8 | 0.018 | 86.2 | 0.984 | –6.3 |
| 0.2 | 0.845 | –23.2 | 9.182 | 160.1 | 0.032 | 77.3 | 0.961 | –12.4 |
| 0.3 | 0.804 | –34.0 | 8.752 | 151.4 | 0.046 | 71.7 | 0.914 | –17.7 |
| 0.4 | 0.751 | –44.0 | 8.224 | 143.1 | 0.059 | 66.4 | 0.864 | –22.7 |
| 0.5 | 0.693 | –54.3 | 7.717 | 135.3 | 0.070 | 62.2 | 0.811 | –27.2 |
| 0.6 | 0.636 | –63.9 | 7.192 | 128.2 | 0.078 | 58.4 | 0.756 | –31.1 |
| 0.7 | 0.585 | –72.7 | 6.672 | 122.2 | 0.086 | 55.1 | 0.704 | –34.4 |
| 0.8 | 0.531 | –81.2 | 6.180 | 116.4 | 0.092 | 52.7 | 0.656 | –37.3 |
| 0.9 | 0.490 | –90.1 | 5.735 | 111.2 | 0.097 | 50.6 | 0.616 | –40.0 |
| 1.0 | 0.449 | –98.2 | 5.358 | 106.5 | 0.102 | 49.0 | 0.576 | –42.4 |
| 1.1 | 0.422 | –106.3 | 5.003 | 102.4 | 0.106 | 47.8 | 0.545 | –44.4 |
| 1.2 | 0.398 | –114.0 | 4.659 | 98.7 | 0.110 | 46.9 | 0.516 | –46.2 |
| 1.3 | 0.380 | –121.6 | 4.379 | 95.1 | 0.114 | 46.1 | 0.495 | –47.8 |
| 1.4 | 0.365 | –128.6 | 4.100 | 91.7 | 0.117 | 45.5 | 0.475 | –49.5 |
| 1.5 | 0.353 | –135.1 | 3.879 | 88.5 | 0.120 | 45.1 | 0.457 | –50.8 |
| 1.6 | 0.345 | –141.3 | 3.676 | 85.6 | 0.123 | 44.8 | 0.442 | –51.9 |
| 1.7 | 0.339 | –147.0 | 3.478 | 83.0 | 0.126 | 44.6 | 0.428 | –53.0 |
| 1.8 | 0.333 | –152.0 | 3.303 | 80.3 | 0.129 | 44.5 | 0.417 | –53.8 |
| 1.9 | 0.331 | –157.7 | 3.144 | 78.2 | 0.132 | 44.5 | 0.407 | –54.6 |
| 2.0 | 0.325 | –161.6 | 3.010 | 75.7 | 0.135 | 44.4 | 0.395 | –55.1 |
| 2.1 | 0.332 | –166.5 | 2.886 | 73.7 | 0.138 | 44.5 | 0.388 | –56.2 |
| 2.2 | 0.324 | –169.5 | 2.761 | 71.7 | 0.142 | 44.6 | 0.376 | –56.4 |
| 2.3 | 0.334 | –173.8 | 2.663 | 69.8 | 0.145 | 44.7 | 0.373 | –57.0 |
| 2.4 | 0.330 | –176.8 | 2.564 | 67.9 | 0.149 | 44.7 | 0.361 | –57.7 |
| 2.5 | 0.336 | 179.5 | 2.468 | 66.2 | 0.153 | 44.9 | 0.357 | –58.5 |
| 2.6 | 0.332 | 176.4 | 2.394 | 64.8 | 0.156 | 44.9 | 0.349 | –59.8 |
| 2.7 | 0.340 | 174.1 | 2.306 | 63.0 | 0.160 | 44.9 | 0.344 | –59.8 |
| 2.8 | 0.338 | 170.6 | 2.227 | 61.6 | 0.163 | 44.9 | 0.339 | –61.4 |
| 2.9 | 0.332 | 168.5 | 2.123 | 59.0 | 0.167 | 44.4 | 0.323 | –62.4 |
| 3.0 | 0.329 | 163.7 | 2.071 | 57.1 | 0.171 | 44.4 | 0.321 | –65.2 |
| 4.0 | 0.371 | 133.9 | 1.630 | 39.0 | 0.215 | 43.1 | 0.293 | –86.6 |
| 5.0 | 0.459 | 109.6 | 1.290 | 23.4 | 0.262 | 35.9 | 0.264 | –114.5 |

$V_{CE}$ = 2 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.812 | –16.7 | 14.092 | 166.6 | 0.016 | 84.9 | 0.970 | –8.9 |
| 0.2 | 0.760 | –31.0 | 13.350 | 154.1 | 0.030 | 73.8 | 0.924 | –17.1 |
| 0.3 | 0.690 | –44.5 | 12.274 | 143.6 | 0.042 | 68.2 | 0.851 | –23.4 |
| 0.4 | 0.623 | –56.5 | 11.100 | 134.3 | 0.052 | 63.6 | 0.779 | –29.0 |
| 0.5 | 0.554 | –68.7 | 10.037 | 125.9 | 0.060 | 59.9 | 0.708 | –33.3 |
| 0.6 | 0.494 | –79.0 | 9.066 | 119.0 | 0.067 | 57.2 | 0.643 | –36.8 |
| 0.7 | 0.445 | –89.0 | 8.205 | 113.4 | 0.072 | 55.5 | 0.588 | –39.5 |
| 0.8 | 0.401 | –98.6 | 7.428 | 108.2 | 0.078 | 54.2 | 0.539 | –41.7 |
| 0.9 | 0.370 | –108.4 | 6.770 | 103.5 | 0.082 | 53.2 | 0.500 | –43.8 |
| 1.0 | 0.342 | –117.2 | 6.233 | 99.5 | 0.087 | 52.8 | 0.466 | –45.7 |
| 1.1 | 0.324 | –125.9 | 5.760 | 95.8 | 0.091 | 52.3 | 0.439 | –47.3 |
| 1.2 | 0.316 | –133.7 | 5.318 | 92.9 | 0.095 | 52.3 | 0.415 | –48.9 |
| 1.3 | 0.305 | –141.5 | 4.958 | 89.7 | 0.099 | 52.1 | 0.397 | –50.1 |
| 1.4 | 0.299 | –148.1 | 4.628 | 86.8 | 0.103 | 52.0 | 0.382 | –51.5 |
| 1.5 | 0.296 | –154.5 | 4.343 | 84.1 | 0.107 | 52.0 | 0.369 | –52.6 |
| 1.6 | 0.296 | –160.2 | 4.107 | 81.6 | 0.112 | 52.1 | 0.357 | –53.6 |
| 1.7 | 0.294 | –165.2 | 3.873 | 79.3 | 0.116 | 52.0 | 0.346 | –54.5 |
| 1.8 | 0.295 | –169.9 | 3.673 | 76.9 | 0.120 | 52.1 | 0.337 | –55.1 |
| 1.9 | 0.297 | –174.4 | 3.484 | 75.1 | 0.124 | 52.1 | 0.330 | –55.9 |
| 2.0 | 0.291 | –178.1 | 3.328 | 72.9 | 0.128 | 52.1 | 0.320 | –56.2 |
| 2.1 | 0.304 | 177.7 | 3.185 | 71.1 | 0.132 | 52.2 | 0.315 | –57.2 |
| 2.2 | 0.301 | 175.1 | 3.050 | 69.4 | 0.137 | 52.2 | 0.304 | –57.1 |
| 2.3 | 0.314 | 172.1 | 2.938 | 67.7 | 0.141 | 52.2 | 0.302 | –57.8 |
| 2.4 | 0.310 | 170.1 | 2.825 | 66.0 | 0.146 | 52.0 | 0.291 | –58.5 |
| 2.5 | 0.319 | 167.1 | 2.717 | 64.5 | 0.151 | 52.0 | 0.288 | –59.3 |
| 2.6 | 0.316 | 164.4 | 2.630 | 63.2 | 0.155 | 52.0 | 0.281 | –60.7 |
| 2.7 | 0.324 | 162.5 | 2.533 | 61.7 | 0.160 | 51.7 | 0.277 | –60.4 |
| 2.8 | 0.324 | 159.5 | 2.442 | 60.4 | 0.164 | 51.4 | 0.271 | –62.3 |
| 2.9 | 0.317 | 158.0 | 2.333 | 58.0 | 0.169 | 50.6 | 0.257 | –63.6 |
| 3.0 | 0.316 | 153.6 | 2.272 | 56.2 | 0.175 | 50.6 | 0.257 | –66.7 |
| 4.0 | 0.366 | 127.8 | 1.762 | 39.2 | 0.225 | 46.8 | 0.239 | –91.2 |
| 5.0 | 0.456 | 106.2 | 1.391 | 24.5 | 0.274 | 37.5 | 0.219 | –123.8 |

$V_{CE}$ = 2 V, $I_C$ = 7 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.725 | –19.1 | 17.802 | 163.8 | 0.015 | 80.7 | 0.958 | –11.0 |
| 0.2 | 0.685 | –37.4 | 16.382 | 149.5 | 0.029 | 72.5 | 0.890 | –20.4 |
| 0.3 | 0.607 | –53.1 | 14.584 | 138.0 | 0.039 | 66.6 | 0.798 | –27.3 |
| 0.4 | 0.533 | –66.2 | 12.825 | 128.3 | 0.048 | 62.2 | 0.712 | –32.7 |
| 0.5 | 0.464 | –79.3 | 11.315 | 120.1 | 0.054 | 59.8 | 0.635 | –36.4 |
| 0.6 | 0.410 | –90.2 | 10.021 | 113.5 | 0.060 | 58.2 | 0.569 | –39.2 |
| 0.7 | 0.370 | –101.1 | 8.952 | 108.4 | 0.065 | 56.9 | 0.517 | –41.4 |
| 0.8 | 0.333 | –111.3 | 8.035 | 103.5 | 0.070 | 56.7 | 0.472 | –43.1 |
| 0.9 | 0.310 | –121.5 | 7.261 | 99.4 | 0.075 | 56.3 | 0.436 | –44.8 |
| 1.0 | 0.292 | –130.5 | 6.641 | 95.7 | 0.079 | 56.3 | 0.405 | –46.4 |
| 1.1 | 0.285 | –139.2 | 6.104 | 92.5 | 0.084 | 56.3 | 0.382 | –47.8 |
| 1.2 | 0.279 | –146.9 | 5.613 | 89.7 | 0.089 | 56.3 | 0.362 | –49.3 |
| 1.3 | 0.277 | –154.8 | 5.219 | 86.9 | 0.094 | 56.4 | 0.348 | –50.4 |
| 1.4 | 0.277 | –160.9 | 4.862 | 84.2 | 0.098 | 56.4 | 0.335 | –51.8 |
| 1.5 | 0.277 | –166.2 | 4.553 | 81.8 | 0.103 | 56.3 | 0.324 | –52.8 |
| 1.6 | 0.279 | –171.3 | 4.297 | 79.4 | 0.108 | 56.5 | 0.315 | –53.8 |
| 1.7 | 0.282 | –175.9 | 4.045 | 77.3 | 0.112 | 56.4 | 0.305 | –54.7 |
| 1.8 | 0.284 | –179.7 | 3.836 | 75.1 | 0.117 | 56.4 | 0.298 | –55.3 |
| 1.9 | 0.288 | 176.4 | 3.635 | 73.4 | 0.122 | 56.4 | 0.292 | –56.0 |
| 2.0 | 0.286 | 172.6 | 3.469 | 71.3 | 0.127 | 56.2 | 0.283 | –56.2 |
| 2.1 | 0.297 | 169.8 | 3.321 | 69.6 | 0.131 | 56.1 | 0.280 | –57.3 |
| 2.2 | 0.294 | 166.9 | 3.171 | 68.0 | 0.136 | 56.1 | 0.270 | –57.0 |
| 2.3 | 0.307 | 164.9 | 3.059 | 66.4 | 0.141 | 55.9 | 0.268 | –57.7 |
| 2.4 | 0.306 | 162.7 | 2.941 | 64.8 | 0.146 | 55.7 | 0.257 | –58.4 |
| 2.5 | 0.313 | 160.6 | 2.825 | 63.3 | 0.151 | 55.5 | 0.255 | –59.3 |
| 2.6 | 0.313 | 157.8 | 2.737 | 62.1 | 0.156 | 55.3 | 0.248 | –60.8 |
| 2.7 | 0.318 | 156.6 | 2.635 | 60.6 | 0.161 | 54.9 | 0.244 | –60.6 |
| 2.8 | 0.319 | 153.8 | 2.536 | 59.4 | 0.166 | 54.4 | 0.239 | –62.8 |
| 2.9 | 0.312 | 152.3 | 2.423 | 57.2 | 0.172 | 53.6 | 0.226 | –64.1 |
| 3.0 | 0.315 | 148.1 | 2.362 | 55.5 | 0.177 | 53.5 | 0.227 | –67.5 |
| 4.0 | 0.367 | 124.5 | 1.825 | 39.0 | 0.230 | 48.3 | 0.214 | –94.0 |
| 5.0 | 0.455 | 104.3 | 1.438 | 24.9 | 0.280 | 38.3 | 0.202 | –129.6 |

$V_{CE}$ = 2 V, $I_C$ = 10 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.670 | –23.0 | 22.008 | 160.6 | 0.014 | 77.1 | 0.939 | –13.3 |
| 0.2 | 0.595 | –45.4 | 19.593 | 144.3 | 0.027 | 71.1 | 0.845 | –23.9 |
| 0.3 | 0.510 | –62.4 | 16.792 | 132.0 | 0.035 | 64.8 | 0.734 | –30.8 |
| 0.4 | 0.439 | –77.2 | 14.296 | 122.3 | 0.043 | 62.3 | 0.640 | –35.7 |
| 0.5 | 0.380 | –91.1 | 12.312 | 114.7 | 0.048 | 61.0 | 0.563 | –38.7 |
| 0.6 | 0.336 | –103.6 | 10.745 | 108.5 | 0.054 | 60.2 | 0.501 | –40.8 |
| 0.7 | 0.306 | –115.0 | 9.495 | 103.8 | 0.059 | 59.9 | 0.452 | –42.2 |
| 0.8 | 0.281 | –125.5 | 8.443 | 99.4 | 0.064 | 60.0 | 0.412 | –43.5 |
| 0.9 | 0.269 | –135.7 | 7.598 | 95.8 | 0.069 | 60.0 | 0.382 | –44.7 |
| 1.0 | 0.258 | –145.3 | 6.916 | 92.4 | 0.074 | 60.3 | 0.355 | –46.2 |
| 1.1 | 0.259 | –152.9 | 6.330 | 89.5 | 0.079 | 60.3 | 0.336 | –47.3 |
| 1.2 | 0.260 | –160.4 | 5.811 | 87.0 | 0.085 | 60.5 | 0.318 | –48.7 |
| 1.3 | 0.262 | –166.8 | 5.394 | 84.4 | 0.090 | 60.6 | 0.307 | –49.8 |
| 1.4 | 0.267 | –172.3 | 5.015 | 82.0 | 0.095 | 60.5 | 0.296 | –51.2 |
| 1.5 | 0.269 | –177.0 | 4.702 | 79.5 | 0.100 | 60.4 | 0.287 | –52.2 |
| 1.6 | 0.274 | 178.4 | 4.422 | 77.5 | 0.105 | 60.4 | 0.280 | –53.2 |
| 1.7 | 0.277 | 174.7 | 4.161 | 75.5 | 0.110 | 60.3 | 0.272 | –54.1 |
| 1.8 | 0.280 | 171.1 | 3.940 | 73.5 | 0.115 | 60.0 | 0.266 | –54.8 |
| 1.9 | 0.287 | 168.2 | 3.736 | 71.9 | 0.121 | 59.9 | 0.262 | –55.6 |
| 2.0 | 0.284 | 165.3 | 3.564 | 70.0 | 0.126 | 59.6 | 0.254 | –55.7 |
| 2.1 | 0.296 | 162.6 | 3.410 | 68.3 | 0.131 | 59.5 | 0.252 | –56.8 |
| 2.2 | 0.294 | 160.5 | 3.258 | 66.8 | 0.136 | 59.3 | 0.242 | –56.5 |
| 2.3 | 0.308 | 158.9 | 3.140 | 65.3 | 0.141 | 58.9 | 0.240 | –57.3 |
| 2.4 | 0.304 | 156.9 | 3.017 | 63.8 | 0.147 | 58.5 | 0.230 | –57.9 |
| 2.5 | 0.314 | 154.9 | 2.897 | 62.5 | 0.152 | 58.2 | 0.229 | –59.0 |
| 2.6 | 0.313 | 152.8 | 2.804 | 61.2 | 0.157 | 57.9 | 0.222 | –60.7 |
| 2.7 | 0.321 | 151.4 | 2.699 | 59.7 | 0.163 | 57.3 | 0.218 | –60.5 |
| 2.8 | 0.321 | 148.9 | 2.602 | 58.5 | 0.168 | 56.8 | 0.214 | –62.7 |
| 2.9 | 0.315 | 147.6 | 2.484 | 56.5 | 0.173 | 55.9 | 0.202 | –64.3 |
| 3.0 | 0.317 | 143.3 | 2.421 | 54.9 | 0.179 | 55.6 | 0.204 | –67.9 |
| 4.0 | 0.367 | 121.7 | 1.856 | 38.6 | 0.233 | 49.6 | 0.195 | –96.6 |
| 5.0 | 0.457 | 103.0 | 1.462 | 24.9 | 0.284 | 39.0 | 0.190 | –134.7 |

$V_{CE}$ = 2 V, $I_C$ = 20 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.486 | –36.9 | 29.425 | 153.6 | 0.013 | 79.1 | 0.883 | –18.0 |
| 0.2 | 0.419 | –65.2 | 23.883 | 133.9 | 0.023 | 68.4 | 0.737 | –29.6 |
| 0.3 | 0.345 | –87.4 | 19.002 | 121.4 | 0.029 | 65.7 | 0.608 | –35.0 |
| 0.4 | 0.300 | –104.1 | 15.432 | 112.6 | 0.035 | 64.8 | 0.516 | –37.7 |
| 0.5 | 0.272 | –120.6 | 12.867 | 106.0 | 0.041 | 65.2 | 0.451 | –38.7 |
| 0.6 | 0.254 | –133.4 | 11.011 | 100.8 | 0.046 | 65.3 | 0.402 | –39.2 |
| 0.7 | 0.250 | –145.0 | 9.606 | 97.0 | 0.052 | 65.7 | 0.365 | –39.4 |
| 0.8 | 0.243 | –155.2 | 8.466 | 93.4 | 0.058 | 66.4 | 0.336 | –39.9 |
| 0.9 | 0.247 | –163.0 | 7.570 | 90.3 | 0.063 | 66.5 | 0.314 | –40.6 |
| 1.0 | 0.251 | –170.3 | 6.858 | 87.5 | 0.069 | 66.7 | 0.294 | –41.7 |
| 1.1 | 0.257 | –176.3 | 6.251 | 85.0 | 0.074 | 66.7 | 0.281 | –42.7 |
| 1.2 | 0.268 | 179.4 | 5.716 | 83.0 | 0.080 | 66.7 | 0.268 | –44.2 |
| 1.3 | 0.273 | 174.3 | 5.300 | 80.7 | 0.086 | 66.5 | 0.261 | –45.3 |
| 1.4 | 0.280 | 171.0 | 4.916 | 78.5 | 0.092 | 66.3 | 0.253 | –46.8 |
| 1.5 | 0.284 | 167.4 | 4.605 | 76.4 | 0.097 | 66.1 | 0.248 | –48.0 |
| 1.6 | 0.292 | 164.5 | 4.327 | 74.4 | 0.103 | 65.7 | 0.244 | –49.2 |
| 1.7 | 0.295 | 161.9 | 4.068 | 72.6 | 0.108 | 65.4 | 0.238 | –50.3 |
| 1.8 | 0.299 | 159.5 | 3.851 | 70.7 | 0.114 | 65.0 | 0.234 | –51.0 |
| 1.9 | 0.307 | 156.5 | 3.650 | 69.2 | 0.119 | 64.6 | 0.231 | –52.1 |
| 2.0 | 0.306 | 154.9 | 3.481 | 67.3 | 0.125 | 64.1 | 0.225 | –52.1 |
| 2.1 | 0.319 | 152.8 | 3.334 | 65.8 | 0.130 | 63.8 | 0.224 | –53.6 |
| 2.2 | 0.315 | 151.1 | 3.185 | 64.4 | 0.136 | 63.4 | 0.216 | –53.2 |
| 2.3 | 0.329 | 150.6 | 3.067 | 63.0 | 0.142 | 62.9 | 0.216 | –54.2 |
| 2.4 | 0.325 | 148.9 | 2.944 | 61.6 | 0.148 | 62.3 | 0.206 | –55.0 |
| 2.5 | 0.335 | 147.6 | 2.832 | 60.3 | 0.153 | 61.9 | 0.206 | –56.1 |
| 2.6 | 0.335 | 145.5 | 2.741 | 59.3 | 0.159 | 61.4 | 0.200 | –58.1 |
| 2.7 | 0.340 | 144.9 | 2.639 | 58.0 | 0.164 | 60.7 | 0.197 | –58.0 |
| 2.8 | 0.342 | 142.7 | 2.544 | 56.8 | 0.169 | 60.1 | 0.193 | –60.5 |
| 2.9 | 0.333 | 141.9 | 2.424 | 54.9 | 0.175 | 58.9 | 0.182 | –62.2 |
| 3.0 | 0.337 | 138.0 | 2.363 | 53.2 | 0.182 | 58.5 | 0.184 | –66.3 |
| 4.0 | 0.387 | 118.4 | 1.811 | 37.2 | 0.237 | 51.5 | 0.179 | –97.7 |
| 5.0 | 0.476 | 101.3 | 1.424 | 23.9 | 0.289 | 40.1 | 0.182 | –138.2 |

$V_{CE}$ = 3 V, $I_C$ = 1 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.951 | –6.6 | 3.571 | 173.3 | 0.017 | 87.1 | 0.996 | –2.9 |
| 0.2 | 0.948 | –13.1 | 3.558 | 168.3 | 0.033 | 82.6 | 0.993 | –5.9 |
| 0.3 | 0.935 | –19.4 | 3.515 | 162.8 | 0.048 | 78.4 | 0.975 | –8.6 |
| 0.4 | 0.911 | –25.8 | 3.442 | 156.8 | 0.064 | 74.1 | 0.962 | –11.7 |
| 0.5 | 0.890 | –32.5 | 3.406 | 150.9 | 0.079 | 70.1 | 0.944 | –14.6 |
| 0.6 | 0.858 | –39.1 | 3.337 | 145.0 | 0.092 | 66.2 | 0.920 | –17.8 |
| 0.7 | 0.825 | –45.5 | 3.248 | 139.8 | 0.105 | 62.3 | 0.895 | –20.6 |
| 0.8 | 0.789 | –52.2 | 3.160 | 134.1 | 0.116 | 58.6 | 0.867 | –23.6 |
| 0.9 | 0.752 | –59.0 | 3.066 | 128.7 | 0.126 | 55.1 | 0.842 | –26.6 |
| 1.0 | 0.714 | –65.4 | 2.974 | 123.4 | 0.135 | 51.8 | 0.815 | –29.3 |
| 1.1 | 0.680 | –72.1 | 2.876 | 118.7 | 0.142 | 48.8 | 0.789 | –31.8 |
| 1.2 | 0.646 | –78.7 | 2.769 | 114.2 | 0.149 | 46.2 | 0.765 | –34.1 |
| 1.3 | 0.615 | –85.0 | 2.668 | 109.8 | 0.155 | 43.5 | 0.743 | –36.2 |
| 1.4 | 0.591 | –91.5 | 2.557 | 105.4 | 0.159 | 41.2 | 0.719 | –38.4 |
| 1.5 | 0.566 | –97.4 | 2.463 | 101.2 | 0.163 | 39.1 | 0.701 | –40.3 |
| 1.6 | 0.546 | –103.3 | 2.378 | 97.6 | 0.165 | 37.2 | 0.682 | –42.0 |
| 1.7 | 0.525 | –109.1 | 2.282 | 94.0 | 0.168 | 35.5 | 0.663 | –43.5 |
| 1.8 | 0.507 | –114.2 | 2.195 | 90.5 | 0.169 | 34.0 | 0.647 | –44.8 |
| 1.9 | 0.494 | –119.7 | 2.110 | 87.7 | 0.170 | 32.7 | 0.634 | –46.2 |
| 2.0 | 0.477 | –124.1 | 2.041 | 84.4 | 0.172 | 31.5 | 0.618 | –47.2 |
| 2.1 | 0.467 | –129.8 | 1.973 | 81.8 | 0.172 | 30.6 | 0.609 | –48.6 |
| 2.2 | 0.453 | –133.9 | 1.895 | 79.1 | 0.172 | 30.0 | 0.596 | –49.3 |
| 2.3 | 0.451 | –139.2 | 1.841 | 76.7 | 0.173 | 29.3 | 0.593 | –50.2 |
| 2.4 | 0.442 | –143.2 | 1.782 | 74.2 | 0.174 | 28.8 | 0.578 | –51.1 |
| 2.5 | 0.438 | –148.1 | 1.728 | 71.9 | 0.174 | 28.5 | 0.573 | –52.1 |
| 2.6 | 0.429 | –151.4 | 1.679 | 70.0 | 0.175 | 28.0 | 0.565 | –53.2 |
| 2.7 | 0.429 | –155.5 | 1.627 | 67.6 | 0.175 | 27.7 | 0.560 | –53.8 |
| 2.8 | 0.422 | –159.5 | 1.573 | 65.8 | 0.175 | 27.5 | 0.551 | –55.0 |
| 2.9 | 0.414 | –162.7 | 1.509 | 62.4 | 0.175 | 26.8 | 0.531 | –56.0 |
| 3.0 | 0.405 | –167.3 | 1.480 | 60.1 | 0.176 | 26.9 | 0.523 | –58.6 |
| 4.0 | 0.413 | 153.8 | 1.219 | 39.3 | 0.189 | 30.5 | 0.479 | –76.4 |
| 5.0 | 0.479 | 120.3 | 0.974 | 20.6 | 0.218 | 31.4 | 0.441 | –98.5 |

$V_{CE}$ = 3 V, $I_C$ = 3 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.875 | –11.6 | 9.462 | 170.0 | 0.016 | 80.1 | 0.985 | –6.1 |
| 0.2 | 0.851 | –22.5 | 9.220 | 160.5 | 0.031 | 77.7 | 0.963 | –11.8 |
| 0.3 | 0.810 | –32.9 | 8.796 | 152.0 | 0.044 | 72.2 | 0.918 | –16.7 |
| 0.4 | 0.758 | –42.6 | 8.287 | 143.8 | 0.056 | 67.3 | 0.872 | –21.7 |
| 0.5 | 0.699 | –52.5 | 7.800 | 136.0 | 0.066 | 63.1 | 0.820 | –25.7 |
| 0.6 | 0.641 | –61.9 | 7.283 | 129.0 | 0.075 | 59.2 | 0.767 | –29.6 |
| 0.7 | 0.590 | –70.5 | 6.773 | 123.1 | 0.083 | 56.1 | 0.718 | –32.7 |
| 0.8 | 0.538 | –78.8 | 6.291 | 117.4 | 0.088 | 53.7 | 0.670 | –35.5 |
| 0.9 | 0.491 | –87.3 | 5.841 | 112.1 | 0.094 | 51.6 | 0.629 | –38.1 |
| 1.0 | 0.453 | –95.1 | 5.459 | 107.4 | 0.099 | 50.1 | 0.592 | –40.3 |
| 1.1 | 0.424 | –103.3 | 5.101 | 103.3 | 0.103 | 48.8 | 0.561 | –42.3 |
| 1.2 | 0.398 | –111.0 | 4.754 | 99.7 | 0.106 | 48.0 | 0.532 | –44.1 |
| 1.3 | 0.377 | –118.4 | 4.479 | 96.0 | 0.110 | 47.2 | 0.511 | –45.5 |
| 1.4 | 0.362 | –125.3 | 4.192 | 92.7 | 0.113 | 46.5 | 0.491 | –47.1 |
| 1.5 | 0.349 | –131.7 | 3.968 | 89.4 | 0.116 | 46.1 | 0.474 | –48.4 |
| 1.6 | 0.341 | –138.1 | 3.758 | 86.5 | 0.120 | 45.8 | 0.459 | –49.5 |
| 1.7 | 0.333 | –144.2 | 3.555 | 83.9 | 0.123 | 45.6 | 0.445 | –50.5 |
| 1.8 | 0.327 | –149.3 | 3.383 | 81.1 | 0.126 | 45.4 | 0.433 | –51.2 |
| 1.9 | 0.323 | –154.9 | 3.217 | 79.0 | 0.129 | 45.4 | 0.423 | –52.0 |
| 2.0 | 0.317 | –158.8 | 3.078 | 76.5 | 0.132 | 45.5 | 0.412 | –52.3 |
| 2.1 | 0.322 | –163.8 | 2.952 | 74.5 | 0.135 | 45.5 | 0.405 | –53.4 |
| 2.2 | 0.315 | –167.3 | 2.826 | 72.5 | 0.138 | 45.6 | 0.394 | –53.5 |
| 2.3 | 0.323 | –171.9 | 2.729 | 70.6 | 0.141 | 45.6 | 0.391 | –54.2 |
| 2.4 | 0.321 | –174.5 | 2.623 | 68.7 | 0.145 | 45.8 | 0.378 | –54.8 |
| 2.5 | 0.326 | –178.5 | 2.528 | 67.0 | 0.149 | 45.9 | 0.375 | –55.5 |
| 2.6 | 0.323 | 178.3 | 2.453 | 65.7 | 0.152 | 45.9 | 0.367 | –56.8 |
| 2.7 | 0.329 | 175.8 | 2.363 | 63.9 | 0.155 | 45.8 | 0.362 | –56.8 |
| 2.8 | 0.327 | 172.6 | 2.277 | 62.4 | 0.159 | 45.8 | 0.356 | –58.3 |
| 2.9 | 0.322 | 170.4 | 2.176 | 59.9 | 0.163 | 45.2 | 0.340 | –59.2 |
| 3.0 | 0.318 | 165.6 | 2.124 | 58.0 | 0.167 | 45.4 | 0.338 | –61.9 |
| 4.0 | 0.360 | 135.1 | 1.668 | 40.0 | 0.211 | 44.3 | 0.306 | –82.3 |
| 5.0 | 0.449 | 110.0 | 1.323 | 24.2 | 0.258 | 37.1 | 0.272 | –109.0 |

$V_{CE}$ = 3 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.800 | –14.8 | 14.185 | 166.6 | 0.016 | 81.3 | 0.972 | –8.5 |
| 0.2 | 0.762 | –29.9 | 13.456 | 154.6 | 0.029 | 74.6 | 0.928 | –16.1 |
| 0.3 | 0.699 | –43.3 | 12.386 | 144.2 | 0.040 | 68.8 | 0.859 | –22.2 |
| 0.4 | 0.632 | –54.5 | 11.241 | 135.0 | 0.050 | 64.4 | 0.790 | –27.6 |
| 0.5 | 0.560 | –66.3 | 10.196 | 126.7 | 0.058 | 60.6 | 0.721 | –31.6 |
| 0.6 | 0.500 | –76.5 | 9.233 | 119.8 | 0.064 | 58.2 | 0.657 | –35.0 |
| 0.7 | 0.451 | –86.0 | 8.357 | 114.2 | 0.070 | 56.2 | 0.602 | –37.4 |
| 0.8 | 0.404 | –95.3 | 7.591 | 108.9 | 0.075 | 55.0 | 0.554 | –39.6 |
| 0.9 | 0.369 | –104.6 | 6.941 | 104.4 | 0.079 | 54.2 | 0.516 | –41.6 |
| 1.0 | 0.339 | –113.4 | 6.384 | 100.2 | 0.084 | 53.6 | 0.482 | –43.4 |
| 1.1 | 0.321 | –122.2 | 5.896 | 96.7 | 0.088 | 53.2 | 0.454 | –44.8 |
| 1.2 | 0.309 | –130.1 | 5.456 | 93.6 | 0.092 | 53.1 | 0.431 | –46.3 |
| 1.3 | 0.298 | –137.9 | 5.089 | 90.4 | 0.096 | 53.0 | 0.414 | –47.5 |
| 1.4 | 0.292 | –144.9 | 4.753 | 87.5 | 0.101 | 52.9 | 0.399 | –48.8 |
| 1.5 | 0.285 | –150.8 | 4.461 | 84.7 | 0.105 | 52.9 | 0.386 | –49.8 |
| 1.6 | 0.284 | –157.1 | 4.214 | 82.2 | 0.109 | 52.9 | 0.375 | –50.8 |
| 1.7 | 0.283 | –162.3 | 3.973 | 79.9 | 0.113 | 52.9 | 0.363 | –51.6 |
| 1.8 | 0.282 | –167.1 | 3.771 | 77.6 | 0.117 | 53.0 | 0.354 | –52.2 |
| 1.9 | 0.283 | –171.9 | 3.576 | 75.8 | 0.121 | 53.0 | 0.347 | –52.9 |
| 2.0 | 0.280 | –175.6 | 3.416 | 73.6 | 0.125 | 52.9 | 0.337 | –53.1 |
| 2.1 | 0.290 | –179.7 | 3.275 | 71.7 | 0.129 | 53.0 | 0.333 | –54.1 |
| 2.2 | 0.289 | 177.4 | 3.131 | 70.0 | 0.133 | 53.0 | 0.322 | –53.9 |
| 2.3 | 0.298 | 173.9 | 3.016 | 68.4 | 0.138 | 53.0 | 0.320 | –54.6 |
| 2.4 | 0.297 | 171.5 | 2.900 | 66.7 | 0.143 | 52.8 | 0.308 | –55.2 |
| 2.5 | 0.304 | 168.7 | 2.789 | 65.2 | 0.147 | 52.8 | 0.306 | –56.0 |
| 2.6 | 0.302 | 165.9 | 2.700 | 64.0 | 0.152 | 52.7 | 0.299 | –57.3 |
| 2.7 | 0.309 | 164.1 | 2.600 | 62.4 | 0.156 | 52.4 | 0.294 | –57.3 |
| 2.8 | 0.310 | 161.1 | 2.507 | 61.1 | 0.160 | 52.1 | 0.289 | –58.9 |
| 2.9 | 0.303 | 159.6 | 2.393 | 58.8 | 0.166 | 51.3 | 0.275 | –60.0 |
| 3.0 | 0.304 | 154.7 | 2.335 | 56.9 | 0.171 | 51.3 | 0.274 | –63.0 |
| 4.0 | 0.353 | 128.4 | 1.811 | 40.1 | 0.221 | 47.7 | 0.251 | –85.9 |
| 5.0 | 0.441 | 106.4 | 1.435 | 25.2 | 0.270 | 38.6 | 0.224 | –117.1 |

$V_{CE}$ = 3 V, $I_C$ = 7 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.736 | –18.2 | 17.762 | 164.3 | 0.014 | 81.1 | 0.961 | –10.3 |
| 0.2 | 0.696 | –35.5 | 16.431 | 150.3 | 0.028 | 71.8 | 0.898 | –19.2 |
| 0.3 | 0.619 | –50.5 | 14.686 | 138.8 | 0.038 | 67.4 | 0.810 | –25.7 |
| 0.4 | 0.544 | –63.0 | 12.978 | 129.3 | 0.046 | 63.4 | 0.727 | –31.0 |
| 0.5 | 0.473 | –75.5 | 11.479 | 121.2 | 0.052 | 60.7 | 0.652 | –34.6 |
| 0.6 | 0.418 | –86.5 | 10.202 | 114.6 | 0.058 | 59.0 | 0.588 | –37.3 |
| 0.7 | 0.373 | –96.5 | 9.131 | 109.4 | 0.063 | 57.7 | 0.535 | –39.3 |
| 0.8 | 0.334 | –106.4 | 8.216 | 104.5 | 0.068 | 57.3 | 0.491 | –41.0 |
| 0.9 | 0.310 | –116.3 | 7.430 | 100.4 | 0.073 | 57.0 | 0.456 | –42.5 |
| 1.0 | 0.288 | –125.7 | 6.799 | 96.6 | 0.077 | 57.0 | 0.425 | –44.0 |
| 1.1 | 0.277 | –134.5 | 6.255 | 93.3 | 0.082 | 56.7 | 0.402 | –45.2 |
| 1.2 | 0.271 | –142.6 | 5.762 | 90.5 | 0.087 | 56.9 | 0.381 | –46.6 |
| 1.3 | 0.266 | –150.7 | 5.365 | 87.7 | 0.091 | 56.8 | 0.366 | –47.6 |
| 1.4 | 0.265 | –156.6 | 4.988 | 85.1 | 0.096 | 56.9 | 0.353 | –48.9 |
| 1.5 | 0.262 | –162.8 | 4.679 | 82.5 | 0.101 | 57.0 | 0.342 | –49.9 |
| 1.6 | 0.266 | –168.0 | 4.408 | 80.2 | 0.105 | 57.1 | 0.333 | –50.8 |
| 1.7 | 0.268 | –172.8 | 4.153 | 78.0 | 0.110 | 56.9 | 0.324 | –51.6 |
| 1.8 | 0.270 | –177.0 | 3.940 | 75.8 | 0.114 | 57.0 | 0.316 | –52.1 |
| 1.9 | 0.272 | 178.7 | 3.734 | 74.1 | 0.119 | 56.9 | 0.310 | –52.9 |
| 2.0 | 0.272 | 175.5 | 3.565 | 72.1 | 0.124 | 56.8 | 0.301 | –53.0 |
| 2.1 | 0.282 | 171.9 | 3.415 | 70.4 | 0.128 | 56.7 | 0.298 | –54.0 |
| 2.2 | 0.275 | 169.3 | 3.262 | 68.8 | 0.133 | 56.6 | 0.288 | –53.8 |
| 2.3 | 0.292 | 166.7 | 3.145 | 67.2 | 0.138 | 56.4 | 0.286 | –54.4 |
| 2.4 | 0.290 | 164.8 | 3.021 | 65.6 | 0.143 | 56.2 | 0.275 | –55.0 |
| 2.5 | 0.298 | 162.1 | 2.906 | 64.1 | 0.148 | 56.1 | 0.273 | –55.8 |
| 2.6 | 0.297 | 159.4 | 2.812 | 63.0 | 0.153 | 55.9 | 0.267 | –57.1 |
| 2.7 | 0.302 | 158.0 | 2.709 | 61.5 | 0.158 | 55.6 | 0.263 | –56.8 |
| 2.8 | 0.304 | 155.1 | 2.610 | 60.3 | 0.162 | 55.2 | 0.257 | –58.7 |
| 2.9 | 0.298 | 154.0 | 2.490 | 58.1 | 0.168 | 54.2 | 0.244 | –59.9 |
| 3.0 | 0.299 | 149.4 | 2.429 | 56.4 | 0.173 | 54.1 | 0.244 | –63.2 |
| 4.0 | 0.352 | 125.5 | 1.873 | 39.9 | 0.225 | 49.2 | 0.226 | –88.1 |
| 5.0 | 0.443 | 104.8 | 1.478 | 25.7 | 0.275 | 39.2 | 0.204 | –122.3 |

$V_{CE}$ = 3 V, $I_C$ = 10 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.676 | –22.3 | 22.003 | 161.3 | 0.014 | 82.7 | 0.944 | –12.5 |
| 0.2 | 0.612 | –42.9 | 19.679 | 145.3 | 0.025 | 71.9 | 0.855 | –22.6 |
| 0.3 | 0.526 | –59.1 | 16.963 | 133.1 | 0.034 | 66.5 | 0.749 | –29.2 |
| 0.4 | 0.451 | –73.0 | 14.543 | 123.5 | 0.042 | 63.2 | 0.658 | –33.9 |
| 0.5 | 0.386 | –86.6 | 12.577 | 115.7 | 0.047 | 61.7 | 0.583 | –36.7 |
| 0.6 | 0.340 | –98.4 | 10.996 | 109.6 | 0.053 | 60.8 | 0.521 | –38.8 |
| 0.7 | 0.306 | –109.1 | 9.727 | 104.9 | 0.058 | 60.4 | 0.473 | –40.0 |
| 0.8 | 0.278 | –119.8 | 8.676 | 100.4 | 0.063 | 60.5 | 0.433 | –41.2 |
| 0.9 | 0.263 | –130.2 | 7.819 | 96.7 | 0.068 | 60.4 | 0.402 | –42.4 |
| 1.0 | 0.250 | –139.7 | 7.112 | 93.3 | 0.073 | 60.8 | 0.375 | –43.6 |
| 1.1 | 0.246 | –148.1 | 6.522 | 90.4 | 0.078 | 60.8 | 0.356 | –44.7 |
| 1.2 | 0.246 | –155.8 | 5.980 | 87.9 | 0.083 | 61.0 | 0.337 | –46.0 |
| 1.3 | 0.247 | –163.1 | 5.562 | 85.3 | 0.088 | 61.0 | 0.326 | –47.0 |
| 1.4 | 0.250 | –168.6 | 5.172 | 82.9 | 0.093 | 61.0 | 0.315 | –48.3 |
| 1.5 | 0.252 | –173.7 | 4.838 | 80.5 | 0.098 | 60.8 | 0.306 | –49.2 |
| 1.6 | 0.256 | –178.4 | 4.560 | 78.3 | 0.103 | 60.8 | 0.298 | –50.1 |
| 1.7 | 0.259 | 177.6 | 4.292 | 76.4 | 0.108 | 60.6 | 0.291 | –51.0 |
| 1.8 | 0.264 | 173.8 | 4.069 | 74.3 | 0.113 | 60.4 | 0.284 | –51.6 |
| 1.9 | 0.268 | 169.8 | 3.851 | 72.7 | 0.118 | 60.3 | 0.279 | –52.3 |
| 2.0 | 0.267 | 167.1 | 3.675 | 70.8 | 0.123 | 60.1 | 0.272 | –52.4 |
| 2.1 | 0.280 | 164.5 | 3.517 | 69.1 | 0.128 | 59.9 | 0.269 | –53.4 |
| 2.2 | 0.277 | 161.9 | 3.364 | 67.6 | 0.133 | 59.7 | 0.260 | –53.0 |
| 2.3 | 0.289 | 160.6 | 3.234 | 66.2 | 0.138 | 59.4 | 0.259 | –53.8 |
| 2.4 | 0.288 | 158.7 | 3.110 | 64.7 | 0.144 | 59.0 | 0.248 | –54.3 |
| 2.5 | 0.295 | 156.7 | 2.991 | 63.3 | 0.149 | 58.7 | 0.247 | –55.2 |
| 2.6 | 0.296 | 154.1 | 2.893 | 62.1 | 0.154 | 58.5 | 0.240 | –56.7 |
| 2.7 | 0.302 | 152.9 | 2.786 | 60.6 | 0.159 | 57.9 | 0.237 | –56.3 |
| 2.8 | 0.303 | 150.5 | 2.686 | 59.5 | 0.164 | 57.5 | 0.231 | –58.4 |
| 2.9 | 0.297 | 149.2 | 2.563 | 57.4 | 0.170 | 56.4 | 0.219 | –59.7 |
| 3.0 | 0.299 | 144.6 | 2.496 | 55.7 | 0.176 | 56.1 | 0.220 | –63.4 |
| 4.0 | 0.350 | 122.8 | 1.917 | 39.7 | 0.229 | 50.4 | 0.205 | –90.2 |
| 5.0 | 0.444 | 103.5 | 1.513 | 25.9 | 0.280 | 39.6 | 0.190 | –127.2 |

$V_{CE}$ = 3 V, $I_C$ = 20 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.524 | –31.2 | 29.776 | 154.7 | 0.013 | 79.3 | 0.896 | –16.9 |
| 0.2 | 0.445 | –59.6 | 24.547 | 135.5 | 0.022 | 69.8 | 0.758 | –28.0 |
| 0.3 | 0.363 | –80.1 | 19.730 | 122.9 | 0.029 | 66.8 | 0.631 | –33.4 |
| 0.4 | 0.308 | –95.6 | 16.104 | 113.9 | 0.035 | 65.3 | 0.540 | –36.1 |
| 0.5 | 0.269 | –112.0 | 13.477 | 107.4 | 0.040 | 65.7 | 0.475 | –37.1 |
| 0.6 | 0.247 | –124.7 | 11.550 | 102.1 | 0.046 | 65.9 | 0.424 | –37.7 |
| 0.7 | 0.233 | –136.9 | 10.103 | 98.2 | 0.051 | 66.0 | 0.387 | –37.9 |
| 0.8 | 0.225 | –147.7 | 8.906 | 94.4 | 0.057 | 66.7 | 0.357 | –38.3 |
| 0.9 | 0.226 | –156.8 | 7.971 | 91.4 | 0.062 | 66.8 | 0.334 | –38.9 |
| 1.0 | 0.226 | –164.9 | 7.224 | 88.5 | 0.068 | 67.0 | 0.314 | –39.9 |
| 1.1 | 0.232 | –172.0 | 6.593 | 86.0 | 0.073 | 67.0 | 0.300 | –40.9 |
| 1.2 | 0.239 | –176.8 | 6.038 | 84.0 | 0.079 | 67.0 | 0.287 | –42.1 |
| 1.3 | 0.245 | 177.6 | 5.595 | 81.6 | 0.084 | 66.9 | 0.279 | –43.1 |
| 1.4 | 0.253 | 174.0 | 5.198 | 79.5 | 0.090 | 66.6 | 0.271 | –44.5 |
| 1.5 | 0.258 | 170.1 | 4.867 | 77.4 | 0.095 | 66.3 | 0.265 | –45.6 |
| 1.6 | 0.265 | 166.8 | 4.569 | 75.4 | 0.101 | 65.9 | 0.261 | –46.6 |
| 1.7 | 0.270 | 163.8 | 4.302 | 73.6 | 0.106 | 65.5 | 0.255 | –47.6 |
| 1.8 | 0.273 | 161.0 | 4.071 | 71.7 | 0.112 | 65.3 | 0.250 | –48.3 |
| 1.9 | 0.280 | 158.5 | 3.855 | 70.3 | 0.117 | 64.8 | 0.247 | –49.3 |
| 2.0 | 0.279 | 156.3 | 3.676 | 68.4 | 0.122 | 64.4 | 0.241 | –49.3 |
| 2.1 | 0.291 | 154.3 | 3.521 | 66.9 | 0.128 | 64.0 | 0.240 | –50.6 |
| 2.2 | 0.289 | 152.4 | 3.365 | 65.5 | 0.134 | 63.6 | 0.232 | –50.1 |
| 2.3 | 0.302 | 151.6 | 3.239 | 64.2 | 0.139 | 63.2 | 0.231 | –51.1 |
| 2.4 | 0.299 | 150.2 | 3.110 | 62.8 | 0.145 | 62.6 | 0.222 | –51.7 |
| 2.5 | 0.309 | 148.8 | 2.989 | 61.4 | 0.150 | 62.1 | 0.221 | –52.7 |
| 2.6 | 0.308 | 146.5 | 2.894 | 60.4 | 0.156 | 61.7 | 0.215 | –54.3 |
| 2.7 | 0.313 | 146.2 | 2.788 | 59.1 | 0.161 | 61.1 | 0.212 | –53.8 |
| 2.8 | 0.314 | 143.9 | 2.685 | 58.0 | 0.166 | 60.4 | 0.207 | –56.2 |
| 2.9 | 0.309 | 142.6 | 2.562 | 55.9 | 0.172 | 59.3 | 0.195 | –57.7 |
| 3.0 | 0.311 | 138.8 | 2.494 | 54.4 | 0.178 | 59.0 | 0.197 | –61.8 |
| 4.0 | 0.364 | 119.3 | 1.908 | 38.6 | 0.233 | 52.0 | 0.186 | –91.3 |
| 5.0 | 0.454 | 101.8 | 1.502 | 25.3 | 0.284 | 40.8 | 0.178 | –131.4 |

## S-PARAMETERS Q2

$V_{CE}$ = 1 V, $I_C$ = 1 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.939 | –6.2 | 3.508 | 173.4 | 0.013 | 87.2 | 0.994 | –3.3 |
| 0.2 | 0.938 | –13.5 | 3.434 | 168.0 | 0.025 | 80.8 | 0.988 | –6.8 |
| 0.3 | 0.923 | –20.1 | 3.419 | 162.6 | 0.037 | 76.4 | 0.976 | –10.1 |
| 0.4 | 0.910 | –27.1 | 3.412 | 156.4 | 0.049 | 72.1 | 0.964 | –13.5 |
| 0.5 | 0.885 | –34.2 | 3.341 | 150.4 | 0.059 | 67.9 | 0.947 | –16.8 |
| 0.6 | 0.861 | –41.1 | 3.280 | 144.8 | 0.069 | 63.1 | 0.928 | –20.2 |
| 0.7 | 0.835 | –48.3 | 3.196 | 139.2 | 0.077 | 59.2 | 0.905 | –23.2 |
| 0.8 | 0.811 | –55.4 | 3.129 | 133.7 | 0.084 | 55.3 | 0.882 | –26.4 |
| 0.9 | 0.786 | –62.2 | 3.040 | 128.4 | 0.090 | 51.4 | 0.860 | –29.5 |
| 1.0 | 0.760 | –69.0 | 2.941 | 123.1 | 0.094 | 47.9 | 0.835 | –32.4 |
| 1.1 | 0.734 | –75.6 | 2.845 | 118.3 | 0.098 | 44.7 | 0.813 | –35.2 |
| 1.2 | 0.710 | –81.8 | 2.739 | 113.7 | 0.100 | 41.8 | 0.791 | –38.0 |
| 1.3 | 0.691 | –87.9 | 2.644 | 109.0 | 0.102 | 39.3 | 0.768 | –40.7 |
| 1.4 | 0.675 | –93.4 | 2.534 | 104.6 | 0.102 | 37.1 | 0.749 | –43.3 |
| 1.5 | 0.658 | –98.7 | 2.446 | 100.5 | 0.102 | 35.5 | 0.731 | –46.1 |
| 1.6 | 0.642 | –103.9 | 2.359 | 96.6 | 0.101 | 34.0 | 0.715 | –48.7 |
| 1.7 | 0.629 | –108.4 | 2.269 | 92.7 | 0.099 | 33.0 | 0.700 | –51.4 |
| 1.8 | 0.618 | –113.0 | 2.182 | 89.1 | 0.097 | 32.7 | 0.689 | –54.0 |
| 1.9 | 0.605 | –116.9 | 2.106 | 85.8 | 0.095 | 32.9 | 0.676 | –56.6 |
| 2.0 | 0.599 | –121.0 | 2.037 | 82.7 | 0.092 | 33.4 | 0.666 | –59.2 |
| 2.1 | 0.585 | –125.0 | 1.968 | 79.5 | 0.089 | 34.3 | 0.657 | –61.8 |
| 2.2 | 0.579 | –128.6 | 1.912 | 76.6 | 0.086 | 35.7 | 0.650 | –64.4 |
| 2.3 | 0.568 | –132.6 | 1.851 | 73.7 | 0.083 | 37.8 | 0.644 | –66.9 |
| 2.4 | 0.564 | –136.1 | 1.799 | 70.9 | 0.081 | 40.4 | 0.638 | –69.3 |
| 2.5 | 0.560 | –140.0 | 1.744 | 68.4 | 0.080 | 43.7 | 0.632 | –72.0 |
| 2.6 | 0.555 | –143.3 | 1.683 | 65.7 | 0.079 | 47.7 | 0.628 | –74.7 |
| 2.7 | 0.548 | –147.3 | 1.629 | 62.9 | 0.079 | 52.4 | 0.625 | –76.9 |
| 2.8 | 0.550 | –150.6 | 1.592 | 60.1 | 0.081 | 57.2 | 0.625 | –79.4 |
| 2.9 | 0.546 | –154.0 | 1.566 | 57.6 | 0.083 | 62.6 | 0.620 | –81.1 |
| 3.0 | 0.542 | –157.5 | 1.520 | 55.5 | 0.087 | 67.3 | 0.613 | –83.8 |
| 4.0 | 0.578 | 174.3 | 1.180 | 35.0 | 0.194 | 80.8 | 0.567 | –113.3 |
| 5.0 | 0.647 | 155.0 | 0.908 | 13.4 | 0.336 | 54.9 | 0.451 | –155.8 |

$V_{CE}$ = 1 V, $I_C$ = 3 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.846 | –9.2 | 9.304 | 170.6 | 0.012 | 79.8 | 0.981 | –5.6 |
| 0.2 | 0.823 | –19.6 | 8.965 | 162.0 | 0.024 | 78.1 | 0.960 | –11.2 |
| 0.3 | 0.788 | –29.3 | 8.695 | 154.3 | 0.034 | 72.8 | 0.928 | –16.4 |
| 0.4 | 0.755 | –38.7 | 8.380 | 146.1 | 0.044 | 68.3 | 0.889 | –21.2 |
| 0.5 | 0.706 | –47.8 | 7.899 | 138.8 | 0.051 | 64.3 | 0.844 | –25.5 |
| 0.6 | 0.664 | –56.4 | 7.471 | 132.3 | 0.058 | 60.3 | 0.799 | –29.3 |
| 0.7 | 0.620 | –64.8 | 7.003 | 126.0 | 0.063 | 57.4 | 0.754 | –32.8 |
| 0.8 | 0.581 | –73.1 | 6.609 | 120.4 | 0.067 | 54.9 | 0.713 | –35.7 |
| 0.9 | 0.546 | –80.4 | 6.192 | 115.2 | 0.071 | 52.9 | 0.674 | –38.4 |
| 1.0 | 0.516 | –87.3 | 5.800 | 110.4 | 0.074 | 51.6 | 0.640 | –40.9 |
| 1.1 | 0.492 | –94.4 | 5.459 | 106.1 | 0.076 | 50.6 | 0.607 | –43.1 |
| 1.2 | 0.468 | –100.3 | 5.124 | 102.2 | 0.078 | 50.0 | 0.579 | –45.0 |
| 1.3 | 0.449 | –106.2 | 4.842 | 98.3 | 0.080 | 49.8 | 0.554 | –47.1 |
| 1.4 | 0.437 | –111.6 | 4.556 | 94.8 | 0.082 | 49.9 | 0.532 | –49.0 |
| 1.5 | 0.427 | –116.4 | 4.321 | 91.6 | 0.083 | 50.5 | 0.513 | –50.9 |
| 1.6 | 0.417 | –121.2 | 4.113 | 88.5 | 0.085 | 51.2 | 0.496 | –53.0 |
| 1.7 | 0.406 | –125.4 | 3.910 | 85.3 | 0.087 | 52.0 | 0.481 | –55.0 |
| 1.8 | 0.399 | –128.9 | 3.726 | 82.7 | 0.088 | 52.9 | 0.470 | –57.0 |
| 1.9 | 0.391 | –132.5 | 3.555 | 80.1 | 0.090 | 54.1 | 0.461 | –59.1 |
| 2.0 | 0.388 | –135.7 | 3.410 | 77.6 | 0.092 | 55.6 | 0.451 | –61.1 |
| 2.1 | 0.378 | –139.5 | 3.274 | 75.1 | 0.094 | 57.0 | 0.444 | –63.1 |
| 2.2 | 0.374 | –142.5 | 3.155 | 72.7 | 0.097 | 58.1 | 0.438 | –65.3 |
| 2.3 | 0.370 | –145.8 | 3.035 | 70.3 | 0.100 | 59.4 | 0.435 | –67.2 |
| 2.4 | 0.367 | –148.6 | 2.928 | 68.1 | 0.103 | 60.6 | 0.429 | –69.3 |
| 2.5 | 0.366 | –152.1 | 2.833 | 66.1 | 0.107 | 61.8 | 0.425 | –71.3 |
| 2.6 | 0.361 | –154.9 | 2.724 | 64.1 | 0.111 | 63.1 | 0.422 | –73.5 |
| 2.7 | 0.358 | –158.5 | 2.634 | 61.8 | 0.115 | 64.4 | 0.421 | –75.4 |
| 2.8 | 0.361 | –161.0 | 2.563 | 59.5 | 0.121 | 65.4 | 0.421 | –77.6 |
| 2.9 | 0.360 | –163.8 | 2.504 | 57.5 | 0.125 | 67.0 | 0.417 | –79.0 |
| 3.0 | 0.361 | –166.8 | 2.428 | 55.7 | 0.130 | 67.9 | 0.414 | –81.3 |
| 4.0 | 0.428 | 172.6 | 1.871 | 37.8 | 0.213 | 68.9 | 0.365 | –107.9 |
| 5.0 | 0.552 | 159.7 | 1.458 | 17.2 | 0.317 | 50.2 | 0.312 | –145.9 |

$V_{CE}$ = 1 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.766 | –11.3 | 13.912 | 168.1 | 0.013 | 79.8 | 0.968 | –7.4 |
| 0.2 | 0.736 | –24.0 | 13.080 | 157.4 | 0.022 | 77.6 | 0.930 | –14.6 |
| 0.3 | 0.681 | –35.5 | 12.387 | 148.3 | 0.032 | 71.8 | 0.879 | –20.8 |
| 0.4 | 0.635 | –46.8 | 11.598 | 139.1 | 0.039 | 67.2 | 0.821 | –26.2 |
| 0.5 | 0.574 | –56.6 | 10.628 | 131.4 | 0.046 | 63.7 | 0.762 | –30.6 |
| 0.6 | 0.529 | –65.6 | 9.782 | 124.7 | 0.051 | 61.1 | 0.705 | –34.3 |
| 0.7 | 0.483 | –74.5 | 8.986 | 118.6 | 0.056 | 59.6 | 0.653 | –37.3 |
| 0.8 | 0.445 | –82.9 | 8.274 | 113.4 | 0.060 | 58.2 | 0.607 | –39.8 |
| 0.9 | 0.416 | –90.5 | 7.639 | 108.6 | 0.063 | 57.4 | 0.569 | –42.0 |
| 1.0 | 0.391 | –97.9 | 7.066 | 104.3 | 0.066 | 57.1 | 0.533 | –44.1 |
| 1.1 | 0.372 | –104.6 | 6.569 | 100.5 | 0.070 | 57.1 | 0.503 | –45.7 |
| 1.2 | 0.356 | –110.5 | 6.124 | 97.1 | 0.073 | 57.2 | 0.475 | –47.4 |
| 1.3 | 0.345 | –116.1 | 5.734 | 93.6 | 0.076 | 57.6 | 0.452 | –48.9 |
| 1.4 | 0.337 | –121.5 | 5.372 | 90.7 | 0.079 | 58.1 | 0.434 | –50.6 |
| 1.5 | 0.330 | –126.1 | 5.069 | 87.8 | 0.082 | 59.0 | 0.417 | –52.3 |
| 1.6 | 0.325 | –130.8 | 4.793 | 85.1 | 0.085 | 59.6 | 0.402 | –54.0 |
| 1.7 | 0.316 | –134.4 | 4.541 | 82.4 | 0.088 | 60.4 | 0.390 | –55.8 |
| 1.8 | 0.313 | –137.9 | 4.319 | 80.1 | 0.092 | 61.2 | 0.380 | –57.5 |
| 1.9 | 0.311 | –140.8 | 4.114 | 77.8 | 0.095 | 61.9 | 0.371 | –59.3 |
| 2.0 | 0.309 | –143.8 | 3.932 | 75.6 | 0.099 | 62.9 | 0.364 | –61.0 |
| 2.1 | 0.303 | –147.2 | 3.765 | 73.5 | 0.103 | 63.4 | 0.358 | –62.9 |
| 2.2 | 0.300 | –150.2 | 3.626 | 71.3 | 0.107 | 64.1 | 0.353 | –65.0 |
| 2.3 | 0.296 | –152.7 | 3.488 | 69.2 | 0.111 | 64.6 | 0.351 | –66.9 |
| 2.4 | 0.295 | –155.9 | 3.358 | 67.1 | 0.116 | 65.0 | 0.346 | –68.9 |
| 2.5 | 0.293 | –158.8 | 3.241 | 65.4 | 0.120 | 65.4 | 0.344 | –70.8 |
| 2.6 | 0.293 | –162.2 | 3.114 | 63.3 | 0.125 | 65.9 | 0.341 | –72.8 |
| 2.7 | 0.294 | –165.4 | 3.005 | 61.2 | 0.131 | 66.4 | 0.341 | –74.6 |
| 2.8 | 0.295 | –167.7 | 2.923 | 59.2 | 0.136 | 66.6 | 0.340 | –76.7 |
| 2.9 | 0.296 | –170.1 | 2.853 | 57.3 | 0.141 | 67.4 | 0.338 | –78.1 |
| 3.0 | 0.295 | –173.0 | 2.760 | 55.7 | 0.146 | 67.5 | 0.335 | –80.1 |
| 4.0 | 0.372 | 170.5 | 2.118 | 39.1 | 0.223 | 65.1 | 0.284 | –107.0 |
| 5.0 | 0.507 | 160.6 | 1.662 | 20.5 | 0.314 | 47.7 | 0.246 | –143.8 |

$V_{CE}$ = 1 V, $I_C$ = 7 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.697 | –14.5 | 17.553 | 166.2 | 0.012 | 84.3 | 0.953 | –8.9 |
| 0.2 | 0.654 | –27.9 | 16.248 | 154.0 | 0.021 | 76.3 | 0.904 | –17.2 |
| 0.3 | 0.601 | –40.4 | 15.037 | 143.8 | 0.030 | 70.4 | 0.837 | –24.0 |
| 0.4 | 0.545 | –52.5 | 13.728 | 134.2 | 0.037 | 67.8 | 0.766 | –29.6 |
| 0.5 | 0.482 | –62.8 | 12.356 | 126.3 | 0.043 | 64.9 | 0.698 | –33.7 |
| 0.6 | 0.436 | –72.1 | 11.174 | 119.8 | 0.048 | 62.8 | 0.639 | –37.1 |
| 0.7 | 0.394 | –81.3 | 10.094 | 114.1 | 0.052 | 61.9 | 0.585 | –39.8 |
| 0.8 | 0.364 | –89.7 | 9.213 | 109.1 | 0.056 | 61.5 | 0.541 | –42.0 |
| 0.9 | 0.339 | –97.6 | 8.434 | 104.7 | 0.060 | 61.2 | 0.502 | –43.7 |
| 1.0 | 0.320 | –105.0 | 7.740 | 100.8 | 0.063 | 61.4 | 0.469 | –45.3 |
| 1.1 | 0.306 | –112.0 | 7.160 | 97.2 | 0.067 | 61.6 | 0.441 | –46.7 |
| 1.2 | 0.294 | –118.0 | 6.649 | 94.2 | 0.071 | 62.1 | 0.417 | –48.0 |
| 1.3 | 0.286 | –123.5 | 6.204 | 91.2 | 0.075 | 62.7 | 0.396 | –49.5 |
| 1.4 | 0.282 | –128.3 | 5.812 | 88.3 | 0.079 | 63.0 | 0.378 | –51.0 |
| 1.5 | 0.278 | –132.9 | 5.465 | 85.8 | 0.083 | 63.6 | 0.363 | –52.5 |
| 1.6 | 0.277 | –137.7 | 5.155 | 83.3 | 0.087 | 64.1 | 0.349 | –54.1 |
| 1.7 | 0.275 | –140.7 | 4.878 | 80.8 | 0.091 | 64.6 | 0.338 | –55.7 |
| 1.8 | 0.269 | –144.2 | 4.630 | 78.6 | 0.095 | 65.2 | 0.329 | –57.3 |
| 1.9 | 0.269 | –147.4 | 4.402 | 76.4 | 0.100 | 65.6 | 0.322 | –59.1 |
| 2.0 | 0.272 | –149.4 | 4.206 | 74.4 | 0.104 | 66.0 | 0.315 | –60.9 |
| 2.1 | 0.266 | –152.7 | 4.020 | 72.5 | 0.109 | 66.3 | 0.310 | –62.7 |
| 2.2 | 0.263 | –155.8 | 3.868 | 70.4 | 0.113 | 66.4 | 0.306 | –64.8 |
| 2.3 | 0.260 | –159.1 | 3.714 | 68.4 | 0.118 | 66.5 | 0.304 | –66.5 |
| 2.4 | 0.259 | –161.4 | 3.576 | 66.5 | 0.123 | 66.7 | 0.300 | –68.7 |
| 2.5 | 0.262 | –164.5 | 3.446 | 64.9 | 0.128 | 66.7 | 0.299 | –70.5 |
| 2.6 | 0.260 | –167.2 | 3.319 | 63.1 | 0.133 | 66.8 | 0.296 | –72.7 |
| 2.7 | 0.258 | –170.3 | 3.195 | 61.2 | 0.139 | 67.0 | 0.296 | –74.4 |
| 2.8 | 0.262 | –172.6 | 3.103 | 59.3 | 0.145 | 66.8 | 0.296 | –76.5 |
| 2.9 | 0.263 | –174.8 | 3.029 | 57.6 | 0.150 | 67.3 | 0.293 | –77.7 |
| 3.0 | 0.266 | –177.1 | 2.932 | 55.9 | 0.155 | 67.2 | 0.291 | –79.9 |
| 4.0 | 0.346 | 168.6 | 2.243 | 40.3 | 0.230 | 63.1 | 0.241 | –107.9 |
| 5.0 | 0.485 | 160.5 | 1.761 | 22.7 | 0.313 | 46.0 | 0.208 | –144.4 |

$V_{CE}$ = 1 V, $I_C$ = 10 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.611 | –16.9 | 21.835 | 163.8 | 0.011 | 76.4 | 0.935 | –10.6 |
| 0.2 | 0.565 | –32.0 | 19.735 | 150.0 | 0.020 | 75.8 | 0.868 | –20.1 |
| 0.3 | 0.497 | –45.9 | 17.767 | 139.1 | 0.028 | 71.6 | 0.785 | –27.3 |
| 0.4 | 0.445 | –58.7 | 15.782 | 129.1 | 0.034 | 67.6 | 0.704 | –32.9 |
| 0.5 | 0.388 | –69.6 | 13.915 | 121.5 | 0.040 | 66.6 | 0.631 | –36.7 |
| 0.6 | 0.345 | –79.0 | 12.371 | 115.2 | 0.044 | 65.4 | 0.569 | –39.6 |
| 0.7 | 0.309 | –89.1 | 11.063 | 110.0 | 0.049 | 65.0 | 0.519 | –41.8 |
| 0.8 | 0.286 | –98.0 | 9.996 | 105.2 | 0.054 | 65.3 | 0.476 | –43.6 |
| 0.9 | 0.268 | –106.1 | 9.076 | 101.2 | 0.058 | 65.3 | 0.442 | –44.9 |
| 1.0 | 0.257 | –113.2 | 8.292 | 97.7 | 0.062 | 65.7 | 0.411 | –46.3 |
| 1.1 | 0.250 | –120.6 | 7.645 | 94.5 | 0.067 | 66.1 | 0.385 | –47.5 |
| 1.2 | 0.245 | –126.5 | 7.080 | 91.7 | 0.071 | 66.5 | 0.362 | –48.6 |
| 1.3 | 0.239 | –132.1 | 6.587 | 88.9 | 0.076 | 66.7 | 0.343 | –49.9 |
| 1.4 | 0.239 | –136.6 | 6.142 | 86.3 | 0.080 | 67.1 | 0.327 | –51.2 |
| 1.5 | 0.238 | –140.9 | 5.772 | 84.0 | 0.085 | 67.4 | 0.313 | –52.6 |
| 1.6 | 0.238 | –145.4 | 5.439 | 81.6 | 0.089 | 67.6 | 0.301 | –54.2 |
| 1.7 | 0.236 | –148.3 | 5.136 | 79.4 | 0.094 | 68.0 | 0.291 | –55.7 |
| 1.8 | 0.237 | –150.8 | 4.878 | 77.4 | 0.099 | 68.2 | 0.283 | –57.3 |
| 1.9 | 0.236 | –154.1 | 4.628 | 75.4 | 0.104 | 68.3 | 0.277 | –59.1 |
| 2.0 | 0.237 | –155.8 | 4.424 | 73.6 | 0.109 | 68.2 | 0.271 | –60.8 |
| 2.1 | 0.233 | –159.4 | 4.227 | 71.8 | 0.114 | 68.3 | 0.267 | –62.6 |
| 2.2 | 0.233 | –162.0 | 4.062 | 69.7 | 0.119 | 68.1 | 0.263 | –64.8 |
| 2.3 | 0.232 | –164.1 | 3.900 | 67.9 | 0.125 | 68.0 | 0.262 | –66.6 |
| 2.4 | 0.233 | –166.8 | 3.751 | 66.2 | 0.130 | 67.9 | 0.259 | –68.7 |
| 2.5 | 0.234 | –170.0 | 3.619 | 64.6 | 0.135 | 67.7 | 0.257 | –70.5 |
| 2.6 | 0.234 | –172.6 | 3.483 | 62.8 | 0.141 | 67.4 | 0.256 | –72.8 |
| 2.7 | 0.233 | –175.3 | 3.351 | 61.1 | 0.147 | 67.3 | 0.256 | –74.5 |
| 2.8 | 0.238 | –178.1 | 3.256 | 59.2 | 0.153 | 67.1 | 0.256 | –76.6 |
| 2.9 | 0.240 | –179.0 | 3.173 | 57.5 | 0.158 | 67.2 | 0.254 | –77.9 |
| 3.0 | 0.243 | 178.2 | 3.069 | 56.0 | 0.164 | 66.8 | 0.252 | –80.1 |
| 4.0 | 0.325 | 166.7 | 2.337 | 41.1 | 0.236 | 61.5 | 0.201 | –109.7 |
| 5.0 | 0.463 | 160.2 | 1.834 | 24.5 | 0.314 | 44.4 | 0.174 | –146.6 |

$V_{CE}$ = 1 V, $I_C$ = 20 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.428 | –23.4 | 29.961 | 159.0 | 0.010 | 83.9 | 0.884 | –14.2 |
| 0.2 | 0.373 | –41.7 | 25.683 | 142.5 | 0.018 | 74.9 | 0.782 | –25.8 |
| 0.3 | 0.317 | –58.5 | 21.883 | 130.7 | 0.025 | 72.6 | 0.675 | –33.2 |
| 0.4 | 0.273 | –73.0 | 18.582 | 120.9 | 0.031 | 71.5 | 0.585 | –38.2 |
| 0.5 | 0.236 | –85.5 | 15.880 | 113.9 | 0.036 | 71.2 | 0.513 | –41.1 |
| 0.6 | 0.211 | –96.8 | 13.809 | 108.3 | 0.041 | 71.2 | 0.457 | –43.2 |
| 0.7 | 0.194 | –108.3 | 12.158 | 103.6 | 0.047 | 71.4 | 0.411 | –44.6 |
| 0.8 | 0.186 | –118.2 | 10.857 | 99.6 | 0.052 | 71.7 | 0.374 | –45.8 |
| 0.9 | 0.182 | –126.0 | 9.781 | 96.2 | 0.057 | 71.7 | 0.344 | –46.8 |
| 1.0 | 0.181 | –133.6 | 8.877 | 93.2 | 0.062 | 71.9 | 0.318 | –47.8 |
| 1.1 | 0.183 | –140.6 | 8.151 | 90.5 | 0.068 | 71.9 | 0.297 | –48.7 |
| 1.2 | 0.186 | –145.8 | 7.525 | 88.1 | 0.073 | 72.3 | 0.278 | –49.7 |
| 1.3 | 0.190 | –150.9 | 6.978 | 85.6 | 0.079 | 71.9 | 0.262 | –50.9 |
| 1.4 | 0.194 | –153.9 | 6.493 | 83.4 | 0.084 | 71.9 | 0.248 | –52.2 |
| 1.5 | 0.198 | –157.2 | 6.097 | 81.3 | 0.090 | 71.8 | 0.237 | –53.6 |
| 1.6 | 0.202 | –160.9 | 5.728 | 79.3 | 0.095 | 71.5 | 0.227 | –55.2 |
| 1.7 | 0.202 | –163.3 | 5.406 | 77.2 | 0.101 | 71.4 | 0.218 | –56.9 |
| 1.8 | 0.205 | –165.7 | 5.122 | 75.5 | 0.106 | 71.0 | 0.212 | –58.6 |
| 1.9 | 0.206 | –167.7 | 4.860 | 73.8 | 0.112 | 71.0 | 0.207 | –60.3 |
| 2.0 | 0.208 | –168.6 | 4.642 | 72.1 | 0.118 | 70.5 | 0.202 | –62.4 |
| 2.1 | 0.208 | –172.3 | 4.432 | 70.4 | 0.123 | 70.1 | 0.199 | –64.3 |
| 2.2 | 0.207 | –174.4 | 4.256 | 68.7 | 0.129 | 69.8 | 0.197 | –66.7 |
| 2.3 | 0.208 | –176.5 | 4.083 | 66.9 | 0.135 | 69.3 | 0.195 | –68.6 |
| 2.4 | 0.209 | –179.0 | 3.925 | 65.3 | 0.141 | 68.7 | 0.194 | –71.0 |
| 2.5 | 0.212 | 178.9 | 3.780 | 63.9 | 0.147 | 68.2 | 0.193 | –73.0 |
| 2.6 | 0.214 | 176.6 | 3.637 | 62.3 | 0.153 | 67.6 | 0.192 | –75.5 |
| 2.7 | 0.215 | 174.1 | 3.503 | 60.6 | 0.159 | 67.3 | 0.192 | –77.5 |
| 2.8 | 0.218 | 172.0 | 3.399 | 59.0 | 0.165 | 66.7 | 0.192 | –79.8 |
| 2.9 | 0.222 | 171.1 | 3.304 | 57.4 | 0.171 | 66.5 | 0.190 | –81.1 |
| 3.0 | 0.224 | 168.9 | 3.195 | 55.9 | 0.176 | 65.9 | 0.190 | –83.5 |
| 4.0 | 0.309 | 162.0 | 2.423 | 41.9 | 0.248 | 58.8 | 0.144 | –119.6 |
| 5.0 | 0.444 | 157.3 | 1.886 | 26.8 | 0.317 | 41.7 | 0.131 | –159.9 |

$V_{CE}$ = 2 V, $I_C$ = 1 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.952 | –6.1 | 3.476 | 173.7 | 0.011 | 87.4 | 0.996 | –2.9 |
| 0.2 | 0.939 | –12.5 | 3.416 | 168.6 | 0.021 | 81.5 | 0.990 | –6.1 |
| 0.3 | 0.924 | –19.1 | 3.414 | 163.5 | 0.031 | 76.6 | 0.979 | –9.1 |
| 0.4 | 0.913 | –25.7 | 3.403 | 157.4 | 0.041 | 73.1 | 0.968 | –12.2 |
| 0.5 | 0.891 | –32.4 | 3.339 | 151.8 | 0.050 | 69.1 | 0.954 | –15.1 |
| 0.6 | 0.870 | –38.9 | 3.286 | 146.4 | 0.058 | 64.7 | 0.937 | –18.2 |
| 0.7 | 0.842 | –46.0 | 3.213 | 140.9 | 0.066 | 60.8 | 0.918 | –21.0 |
| 0.8 | 0.819 | –52.7 | 3.152 | 135.6 | 0.072 | 57.2 | 0.897 | –23.9 |
| 0.9 | 0.794 | –59.3 | 3.075 | 130.4 | 0.077 | 53.5 | 0.878 | –26.8 |
| 1.0 | 0.769 | –65.8 | 2.983 | 125.3 | 0.081 | 50.1 | 0.856 | –29.6 |
| 1.1 | 0.745 | –72.3 | 2.888 | 120.4 | 0.084 | 47.1 | 0.836 | –32.2 |
| 1.2 | 0.722 | –78.0 | 2.790 | 116.2 | 0.086 | 44.3 | 0.814 | –34.8 |
| 1.3 | 0.701 | –83.9 | 2.699 | 111.6 | 0.087 | 41.9 | 0.795 | –37.5 |
| 1.4 | 0.682 | –89.5 | 2.591 | 107.3 | 0.087 | 40.0 | 0.777 | –40.1 |
| 1.5 | 0.665 | –94.8 | 2.505 | 103.2 | 0.087 | 38.5 | 0.761 | –42.6 |
| 1.6 | 0.649 | –99.9 | 2.425 | 99.3 | 0.085 | 37.4 | 0.746 | –45.2 |
| 1.7 | 0.635 | –104.5 | 2.334 | 95.2 | 0.084 | 36.9 | 0.732 | –47.7 |
| 1.8 | 0.624 | –108.9 | 2.249 | 91.7 | 0.082 | 36.9 | 0.721 | –50.2 |
| 1.9 | 0.611 | –113.1 | 2.173 | 88.3 | 0.079 | 37.5 | 0.710 | –52.6 |
| 2.0 | 0.603 | –116.8 | 2.104 | 85.3 | 0.077 | 38.6 | 0.698 | –55.2 |
| 2.1 | 0.588 | –121.1 | 2.038 | 82.1 | 0.074 | 40.1 | 0.690 | –57.6 |
| 2.2 | 0.582 | –125.0 | 1.982 | 79.1 | 0.071 | 42.5 | 0.684 | –60.3 |
| 2.3 | 0.570 | –128.8 | 1.918 | 76.2 | 0.069 | 45.5 | 0.678 | –62.6 |
| 2.4 | 0.562 | –132.3 | 1.860 | 73.5 | 0.068 | 49.1 | 0.672 | –65.0 |
| 2.5 | 0.560 | –136.4 | 1.810 | 70.8 | 0.068 | 53.6 | 0.666 | –67.4 |
| 2.6 | 0.552 | –139.8 | 1.745 | 68.2 | 0.068 | 59.0 | 0.661 | –70.0 |
| 2.7 | 0.547 | –143.6 | 1.693 | 65.5 | 0.070 | 64.3 | 0.659 | –72.2 |
| 2.8 | 0.546 | –146.8 | 1.655 | 62.7 | 0.073 | 69.6 | 0.659 | –74.7 |
| 2.9 | 0.540 | –150.4 | 1.629 | 60.1 | 0.077 | 75.2 | 0.654 | –76.3 |
| 3.0 | 0.538 | –153.7 | 1.579 | 58.0 | 0.082 | 79.8 | 0.649 | –78.9 |
| 4.0 | 0.566 | 177.0 | 1.234 | 37.4 | 0.199 | 87.7 | 0.601 | –107.0 |
| 5.0 | 0.638 | 157.6 | 0.955 | 15.3 | 0.345 | 59.3 | 0.479 | –148.8 |

$V_{CE}$ = 2 V, $I_C$ = 3 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.873 | –8.6 | 9.284 | 171.0 | 0.011 | 89.2 | 0.985 | –4.8 |
| 0.2 | 0.835 | –17.7 | 8.953 | 163.0 | 0.020 | 78.4 | 0.966 | –9.8 |
| 0.3 | 0.806 | –26.9 | 8.719 | 155.7 | 0.029 | 74.3 | 0.939 | –14.2 |
| 0.4 | 0.771 | –35.2 | 8.437 | 147.8 | 0.037 | 69.7 | 0.905 | –18.6 |
| 0.5 | 0.724 | –43.8 | 8.004 | 140.8 | 0.044 | 66.2 | 0.867 | –22.4 |
| 0.6 | 0.680 | –51.6 | 7.599 | 134.4 | 0.050 | 62.5 | 0.827 | –25.9 |
| 0.7 | 0.636 | –59.9 | 7.170 | 128.4 | 0.055 | 59.7 | 0.787 | –28.8 |
| 0.8 | 0.596 | –67.1 | 6.784 | 122.8 | 0.059 | 57.4 | 0.748 | –31.6 |
| 0.9 | 0.561 | –74.4 | 6.399 | 117.6 | 0.062 | 55.4 | 0.713 | –34.1 |
| 1.0 | 0.528 | –81.0 | 6.017 | 112.8 | 0.064 | 54.3 | 0.680 | –36.2 |
| 1.1 | 0.500 | –87.5 | 5.679 | 108.5 | 0.066 | 53.4 | 0.651 | –38.4 |
| 1.2 | 0.476 | –93.5 | 5.347 | 104.7 | 0.068 | 52.8 | 0.624 | –40.2 |
| 1.3 | 0.456 | –99.1 | 5.065 | 100.6 | 0.070 | 52.8 | 0.600 | –42.1 |
| 1.4 | 0.440 | –104.2 | 4.769 | 97.2 | 0.071 | 53.2 | 0.579 | –43.9 |
| 1.5 | 0.426 | –109.1 | 4.541 | 93.9 | 0.073 | 53.9 | 0.561 | –45.8 |
| 1.6 | 0.412 | –113.8 | 4.318 | 90.7 | 0.074 | 54.8 | 0.545 | –47.6 |
| 1.7 | 0.403 | –117.6 | 4.117 | 87.6 | 0.076 | 56.0 | 0.531 | –49.5 |
| 1.8 | 0.394 | –121.7 | 3.927 | 84.9 | 0.078 | 57.3 | 0.521 | –51.4 |
| 1.9 | 0.386 | –124.8 | 3.755 | 82.3 | 0.079 | 58.8 | 0.510 | –53.3 |
| 2.0 | 0.380 | –128.3 | 3.604 | 79.9 | 0.081 | 60.3 | 0.501 | –55.0 |
| 2.1 | 0.370 | –131.6 | 3.460 | 77.4 | 0.083 | 62.0 | 0.495 | –57.0 |
| 2.2 | 0.364 | –134.9 | 3.340 | 75.0 | 0.086 | 63.5 | 0.489 | –59.1 |
| 2.3 | 0.357 | –138.1 | 3.214 | 72.6 | 0.089 | 64.8 | 0.485 | –60.9 |
| 2.4 | 0.352 | –141.3 | 3.105 | 70.4 | 0.092 | 66.4 | 0.480 | –62.9 |
| 2.5 | 0.350 | –144.5 | 2.998 | 68.4 | 0.096 | 68.0 | 0.476 | –64.7 |
| 2.6 | 0.345 | –147.7 | 2.887 | 66.3 | 0.100 | 69.3 | 0.473 | –66.9 |
| 2.7 | 0.342 | –151.3 | 2.787 | 64.0 | 0.105 | 70.8 | 0.472 | –68.6 |
| 2.8 | 0.340 | –153.8 | 2.715 | 61.7 | 0.110 | 72.1 | 0.472 | –70.6 |
| 2.9 | 0.342 | –156.9 | 2.657 | 59.7 | 0.115 | 73.8 | 0.469 | –71.8 |
| 3.0 | 0.340 | –159.7 | 2.574 | 57.8 | 0.119 | 74.6 | 0.465 | –74.0 |
| 4.0 | 0.402 | 178.1 | 1.993 | 39.8 | 0.206 | 75.6 | 0.417 | –98.5 |
| 5.0 | 0.538 | 165.0 | 1.576 | 18.6 | 0.319 | 55.8 | 0.358 | –134.4 |

$V_{CE}$ = 2 V, $I_C$ = 5 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.779 | –10.5 | 13.917 | 168.8 | 0.010 | 85.6 | 0.973 | –6.3 |
| 0.2 | 0.746 | –22.0 | 13.213 | 158.7 | 0.019 | 75.8 | 0.942 | –12.6 |
| 0.3 | 0.701 | –31.9 | 12.534 | 150.2 | 0.027 | 73.7 | 0.897 | –17.9 |
| 0.4 | 0.653 | –41.9 | 11.812 | 141.3 | 0.034 | 69.1 | 0.846 | –22.7 |
| 0.5 | 0.595 | –51.1 | 10.927 | 133.6 | 0.040 | 66.4 | 0.795 | –26.5 |
| 0.6 | 0.545 | –59.1 | 10.101 | 127.1 | 0.044 | 63.3 | 0.742 | –29.8 |
| 0.7 | 0.498 | –67.4 | 9.326 | 121.2 | 0.049 | 61.8 | 0.695 | –32.4 |
| 0.8 | 0.461 | –74.8 | 8.643 | 115.8 | 0.052 | 60.9 | 0.653 | –34.7 |
| 0.9 | 0.427 | –82.1 | 8.006 | 111.0 | 0.055 | 60.0 | 0.616 | –36.7 |
| 1.0 | 0.398 | –88.4 | 7.437 | 106.7 | 0.058 | 59.8 | 0.583 | –38.4 |
| 1.1 | 0.374 | –95.0 | 6.931 | 102.8 | 0.061 | 59.9 | 0.555 | –39.9 |
| 1.2 | 0.356 | –101.0 | 6.476 | 99.4 | 0.064 | 60.2 | 0.528 | –41.3 |
| 1.3 | 0.341 | –106.4 | 6.077 | 95.9 | 0.067 | 60.8 | 0.507 | –42.7 |
| 1.4 | 0.328 | –110.9 | 5.698 | 92.8 | 0.069 | 61.4 | 0.488 | –44.1 |
| 1.5 | 0.320 | –115.6 | 5.390 | 90.1 | 0.072 | 62.4 | 0.473 | –45.7 |
| 1.6 | 0.311 | –120.3 | 5.108 | 87.3 | 0.075 | 63.2 | 0.458 | –47.3 |
| 1.7 | 0.303 | –124.2 | 4.840 | 84.6 | 0.078 | 64.2 | 0.445 | –48.8 |
| 1.8 | 0.299 | –127.3 | 4.603 | 82.2 | 0.082 | 65.0 | 0.436 | –50.4 |
| 1.9 | 0.293 | –130.9 | 4.391 | 79.9 | 0.085 | 66.1 | 0.428 | –52.0 |
| 2.0 | 0.290 | –133.8 | 4.206 | 77.7 | 0.088 | 67.0 | 0.421 | –53.6 |
| 2.1 | 0.282 | –137.2 | 4.027 | 75.5 | 0.092 | 67.9 | 0.415 | –55.4 |
| 2.2 | 0.277 | –140.0 | 3.880 | 73.4 | 0.096 | 68.5 | 0.410 | –57.3 |
| 2.3 | 0.273 | –143.2 | 3.726 | 71.3 | 0.100 | 69.0 | 0.408 | –59.0 |
| 2.4 | 0.271 | –146.0 | 3.589 | 69.3 | 0.104 | 69.9 | 0.404 | –60.8 |
| 2.5 | 0.267 | –149.3 | 3.468 | 67.5 | 0.109 | 70.4 | 0.400 | –62.6 |
| 2.6 | 0.267 | –152.4 | 3.336 | 65.6 | 0.114 | 70.9 | 0.398 | –64.6 |
| 2.7 | 0.265 | –154.8 | 3.221 | 63.6 | 0.119 | 71.6 | 0.398 | –66.2 |
| 2.8 | 0.265 | –158.0 | 3.132 | 61.6 | 0.125 | 72.0 | 0.398 | –68.2 |
| 2.9 | 0.265 | –160.6 | 3.055 | 59.7 | 0.130 | 72.8 | 0.395 | –69.3 |
| 3.0 | 0.267 | –163.6 | 2.962 | 58.1 | 0.134 | 73.1 | 0.393 | –71.4 |
| 4.0 | 0.338 | 177.8 | 2.284 | 41.7 | 0.214 | 71.2 | 0.341 | –94.9 |
| 5.0 | 0.485 | 168.0 | 1.819 | 22.8 | 0.311 | 53.3 | 0.296 | –128.4 |

$V_{CE}$ = 2 V, $I_C$ = 7 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.715 | –12.6 | 17.576 | 167.0 | 0.009 | 82.2 | 0.962 | –7.6 |
| 0.2 | 0.678 | –24.4 | 16.393 | 155.5 | 0.018 | 78.5 | 0.920 | –14.6 |
| 0.3 | 0.622 | –35.9 | 15.295 | 145.9 | 0.025 | 72.7 | 0.862 | –20.5 |
| 0.4 | 0.565 | –46.2 | 14.103 | 136.5 | 0.032 | 69.3 | 0.799 | –25.4 |
| 0.5 | 0.504 | –55.6 | 12.794 | 128.9 | 0.037 | 66.8 | 0.738 | –29.1 |
| 0.6 | 0.457 | –63.9 | 11.622 | 122.3 | 0.041 | 65.3 | 0.684 | –32.0 |
| 0.7 | 0.410 | –71.8 | 10.579 | 116.6 | 0.046 | 64.0 | 0.635 | –34.1 |
| 0.8 | 0.375 | –79.4 | 9.702 | 111.5 | 0.049 | 64.0 | 0.593 | –36.1 |
| 0.9 | 0.345 | –86.3 | 8.914 | 107.1 | 0.053 | 63.8 | 0.558 | –37.5 |
| 1.0 | 0.320 | –92.9 | 8.205 | 103.2 | 0.056 | 64.1 | 0.525 | –38.9 |
| 1.1 | 0.302 | –99.7 | 7.608 | 99.7 | 0.060 | 64.5 | 0.499 | –40.2 |
| 1.2 | 0.288 | –105.5 | 7.081 | 96.4 | 0.063 | 64.9 | 0.476 | –41.3 |
| 1.3 | 0.277 | –111.2 | 6.629 | 93.4 | 0.066 | 65.5 | 0.455 | –42.5 |
| 1.4 | 0.268 | –115.4 | 6.199 | 90.6 | 0.070 | 66.0 | 0.437 | –43.7 |
| 1.5 | 0.261 | –119.9 | 5.843 | 87.9 | 0.074 | 66.9 | 0.423 | –45.1 |
| 1.6 | 0.257 | –124.9 | 5.515 | 85.5 | 0.077 | 67.2 | 0.410 | –46.5 |
| 1.7 | 0.251 | –128.4 | 5.237 | 82.9 | 0.081 | 68.1 | 0.399 | –47.9 |
| 1.8 | 0.247 | –131.3 | 4.963 | 80.7 | 0.085 | 68.7 | 0.391 | –49.3 |
| 1.9 | 0.243 | –134.8 | 4.726 | 78.6 | 0.089 | 69.3 | 0.384 | –50.9 |
| 2.0 | 0.244 | –137.4 | 4.522 | 76.7 | 0.093 | 69.8 | 0.377 | –52.4 |
| 2.1 | 0.236 | –140.6 | 4.328 | 74.7 | 0.098 | 70.1 | 0.372 | –54.1 |
| 2.2 | 0.234 | –143.5 | 4.163 | 72.6 | 0.102 | 70.5 | 0.367 | –56.0 |
| 2.3 | 0.230 | –146.3 | 3.999 | 70.7 | 0.106 | 70.8 | 0.366 | –57.6 |
| 2.4 | 0.227 | –148.8 | 3.848 | 68.8 | 0.111 | 71.0 | 0.363 | –59.4 |
| 2.5 | 0.227 | –152.6 | 3.713 | 67.1 | 0.116 | 71.2 | 0.360 | –61.1 |
| 2.6 | 0.225 | –155.1 | 3.567 | 65.4 | 0.121 | 71.4 | 0.358 | –63.1 |
| 2.7 | 0.224 | –158.3 | 3.440 | 63.5 | 0.127 | 71.6 | 0.358 | –64.7 |
| 2.8 | 0.224 | –161.1 | 3.348 | 61.5 | 0.132 | 71.7 | 0.358 | –66.6 |
| 2.9 | 0.225 | –163.8 | 3.264 | 59.8 | 0.137 | 72.3 | 0.355 | –67.7 |
| 3.0 | 0.226 | –166.3 | 3.162 | 58.2 | 0.142 | 72.3 | 0.353 | –69.7 |
| 4.0 | 0.304 | 176.9 | 2.428 | 42.8 | 0.218 | 68.9 | 0.299 | –93.1 |
| 5.0 | 0.457 | 168.5 | 1.940 | 24.8 | 0.308 | 51.7 | 0.261 | –125.6 |

$V_{CE}$ = 2 V, $I_C$ = 10 mA, $Z_O$ = 50 Ω

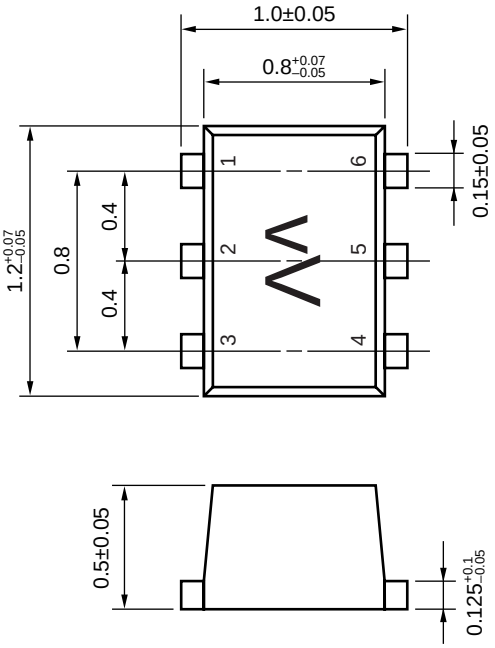
| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.637 | –14.8 | 21.965 | 164.8 | 0.010 | 83.2 | 0.948 | –8.9 |
| 0.2 | 0.587 | –27.8 | 20.062 | 151.7 | 0.017 | 78.8 | 0.889 | –17.0 |
| 0.3 | 0.526 | –39.9 | 18.254 | 141.3 | 0.024 | 73.0 | 0.817 | –23.2 |
| 0.4 | 0.471 | –50.7 | 16.367 | 131.6 | 0.029 | 70.4 | 0.745 | –27.9 |
| 0.5 | 0.408 | –59.7 | 14.570 | 124.0 | 0.035 | 68.7 | 0.679 | –31.1 |
| 0.6 | 0.365 | –68.0 | 13.041 | 117.7 | 0.039 | 67.8 | 0.622 | –33.6 |
| 0.7 | 0.324 | –76.1 | 11.704 | 112.4 | 0.043 | 67.6 | 0.574 | –35.4 |
| 0.8 | 0.292 | –83.8 | 10.634 | 107.7 | 0.047 | 67.6 | 0.534 | –36.8 |
| 0.9 | 0.270 | –90.8 | 9.697 | 103.6 | 0.051 | 67.9 | 0.501 | –38.0 |
| 1.0 | 0.250 | –97.8 | 8.878 | 100.0 | 0.055 | 68.4 | 0.471 | –39.1 |
| 1.1 | 0.236 | –104.3 | 8.203 | 96.8 | 0.059 | 68.6 | 0.447 | –40.0 |
| 1.2 | 0.226 | –110.4 | 7.593 | 93.9 | 0.063 | 69.2 | 0.426 | –40.8 |
| 1.3 | 0.219 | –116.3 | 7.089 | 91.1 | 0.067 | 69.7 | 0.408 | –41.8 |
| 1.4 | 0.215 | –120.8 | 6.617 | 88.4 | 0.071 | 70.1 | 0.392 | –42.8 |
| 1.5 | 0.212 | –125.0 | 6.234 | 86.2 | 0.076 | 70.5 | 0.380 | –44.1 |
| 1.6 | 0.207 | –129.8 | 5.878 | 83.9 | 0.080 | 70.8 | 0.367 | –45.3 |
| 1.7 | 0.204 | –133.1 | 5.564 | 81.5 | 0.084 | 71.2 | 0.358 | –46.7 |
| 1.8 | 0.203 | –135.6 | 5.279 | 79.6 | 0.089 | 71.4 | 0.350 | –48.0 |
| 1.9 | 0.201 | –139.3 | 5.017 | 77.5 | 0.093 | 71.7 | 0.344 | –49.5 |
| 2.0 | 0.202 | –142.3 | 4.776 | 75.6 | 0.098 | 71.9 | 0.338 | –51.0 |
| 2.1 | 0.194 | –145.2 | 4.573 | 73.8 | 0.102 | 72.0 | 0.333 | –52.7 |
| 2.2 | 0.195 | –147.9 | 4.406 | 71.9 | 0.107 | 71.9 | 0.330 | –54.6 |
| 2.3 | 0.193 | –150.6 | 4.229 | 70.0 | 0.112 | 71.9 | 0.329 | –56.1 |
| 2.4 | 0.190 | –153.7 | 4.067 | 68.3 | 0.117 | 71.9 | 0.326 | –58.0 |
| 2.5 | 0.191 | –156.5 | 3.920 | 66.8 | 0.123 | 71.8 | 0.323 | –59.6 |
| 2.6 | 0.189 | –159.7 | 3.771 | 65.0 | 0.128 | 71.7 | 0.322 | –61.6 |
| 2.7 | 0.190 | –162.4 | 3.637 | 63.3 | 0.134 | 71.7 | 0.322 | –63.2 |
| 2.8 | 0.189 | –164.8 | 3.530 | 61.5 | 0.139 | 71.5 | 0.322 | –65.0 |
| 2.9 | 0.193 | –167.3 | 3.439 | 59.9 | 0.144 | 71.8 | 0.320 | –66.2 |
| 3.0 | 0.194 | –169.6 | 3.331 | 58.4 | 0.150 | 71.5 | 0.318 | –68.2 |
| 4.0 | 0.275 | 176.0 | 2.552 | 43.6 | 0.223 | 67.1 | 0.262 | –91.7 |
| 5.0 | 0.430 | 169.3 | 2.036 | 27.1 | 0.306 | 50.3 | 0.228 | –123.4 |

$V_{CE}$ = 2 V, $I_C$ = 20 mA, $Z_O$ = 50 Ω

| Frequency | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| (GHz) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) |
| 0.1 | 0.465 | –18.5 | 30.468 | 160.3 | 0.008 | 84.6 | 0.909 | –11.5 |
| 0.2 | 0.412 | –33.3 | 26.532 | 144.8 | 0.015 | 76.9 | 0.821 | –21.2 |
| 0.3 | 0.352 | –46.4 | 22.972 | 133.3 | 0.021 | 74.2 | 0.726 | –27.4 |
| 0.4 | 0.299 | –57.7 | 19.710 | 123.6 | 0.026 | 73.8 | 0.643 | –31.4 |
| 0.5 | 0.248 | –66.8 | 17.017 | 116.4 | 0.031 | 73.7 | 0.578 | –33.7 |
| 0.6 | 0.219 | –74.6 | 14.874 | 110.9 | 0.036 | 73.7 | 0.525 | –35.2 |
| 0.7 | 0.191 | –83.7 | 13.151 | 106.2 | 0.041 | 74.1 | 0.481 | –36.1 |
| 0.8 | 0.176 | –92.3 | 11.784 | 102.1 | 0.046 | 74.1 | 0.447 | –36.8 |
| 0.9 | 0.162 | –100.2 | 10.656 | 98.7 | 0.050 | 74.3 | 0.419 | –37.4 |
| 1.0 | 0.152 | –108.1 | 9.689 | 95.6 | 0.055 | 74.6 | 0.394 | –38.0 |
| 1.1 | 0.149 | –115.6 | 8.916 | 92.8 | 0.060 | 74.6 | 0.374 | –38.6 |
| 1.2 | 0.145 | –122.6 | 8.232 | 90.4 | 0.064 | 74.8 | 0.356 | –39.1 |
| 1.3 | 0.142 | –127.6 | 7.650 | 88.0 | 0.070 | 74.6 | 0.341 | –39.9 |
| 1.4 | 0.143 | –132.6 | 7.133 | 85.7 | 0.075 | 74.8 | 0.328 | –40.8 |
| 1.5 | 0.146 | –136.6 | 6.697 | 83.6 | 0.080 | 74.7 | 0.317 | –41.9 |
| 1.6 | 0.147 | –141.8 | 6.306 | 81.7 | 0.084 | 74.8 | 0.307 | –43.2 |
| 1.7 | 0.148 | –144.3 | 5.966 | 79.5 | 0.090 | 74.6 | 0.299 | –44.3 |
| 1.8 | 0.148 | –146.9 | 5.653 | 77.8 | 0.095 | 74.4 | 0.292 | –45.6 |
| 1.9 | 0.148 | –149.6 | 5.370 | 76.1 | 0.100 | 74.2 | 0.287 | –47.1 |
| 2.0 | 0.150 | –151.3 | 5.109 | 74.4 | 0.105 | 73.9 | 0.282 | –48.7 |
| 2.1 | 0.147 | –154.5 | 4.885 | 72.7 | 0.110 | 73.6 | 0.279 | –50.3 |
| 2.2 | 0.149 | –157.1 | 4.692 | 71.0 | 0.116 | 73.4 | 0.276 | –52.2 |
| 2.3 | 0.148 | –159.5 | 4.495 | 69.3 | 0.121 | 73.0 | 0.276 | –53.8 |
| 2.4 | 0.149 | –162.6 | 4.322 | 67.7 | 0.126 | 72.5 | 0.273 | –55.7 |
| 2.5 | 0.149 | –165.4 | 4.172 | 66.2 | 0.132 | 72.1 | 0.272 | –57.5 |
| 2.6 | 0.146 | –168.7 | 4.011 | 64.7 | 0.138 | 71.8 | 0.270 | –59.5 |
| 2.7 | 0.148 | –171.5 | 3.863 | 63.1 | 0.143 | 71.5 | 0.271 | –61.2 |
| 2.8 | 0.151 | –173.6 | 3.753 | 61.5 | 0.149 | 70.9 | 0.271 | –63.0 |
| 2.9 | 0.154 | –175.5 | 3.647 | 60.0 | 0.154 | 70.9 | 0.269 | –64.2 |
| 3.0 | 0.158 | –178.1 | 3.532 | 58.6 | 0.160 | 70.6 | 0.268 | –66.2 |
| 4.0 | 0.243 | 173.1 | 2.692 | 44.9 | 0.231 | 64.6 | 0.209 | –90.6 |
| 5.0 | 0.396 | 169.0 | 2.137 | 30.1 | 0.306 | 47.9 | 0.179 | –122.2 |

## PACKAGE DIMENSIONS

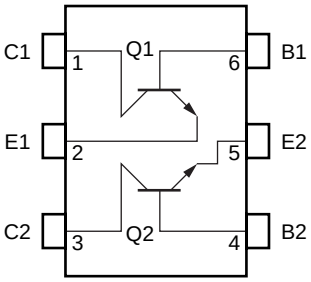
### 6-PIN LEAD-LESS MINIMOLD (UNIT: mm)







(Top View)




### PIN CONNECTIONS

1. Collector (Q1)
2. Emitter (Q1)
3. Collector (Q2)
4. Base (Q2)
5. Emitter (Q2)
6. Base (Q1)

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M8E 00.4-0110

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