

Features

- Wide Frequency Range: DC-20 GHz
- On Chip Bias Network
- High Gain : 11 dB
- Gain Flatness: ± 0.75 dB
- Typical P_{sat} : 23 dBm @ 10 GHz
- Return Loss: 12 dB
- Low Bias Current : 100mA
- Low Noise Figure: 3 dB @ 10 GHz

Description

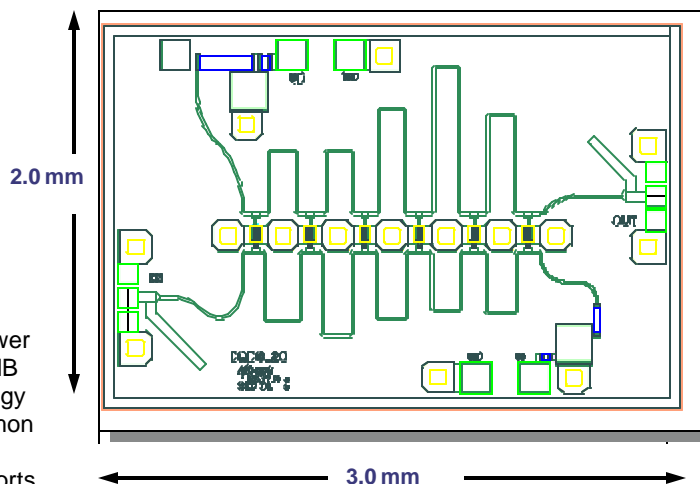
The M/A-COM MAAPSM0015-DIE is a medium power wideband AGC amplifier that typically provides 11 dB of gain with 25 dB of AGC range. The circuit topology is a six-section traveling wave amplifier using common source FETs which provide very wide bandwidth. Typical input and output return loss is 12 dB. RF ports are DC coupled, enabling the user to customize system corner frequencies. DC bias can be provided through the drain termination resistor without the need for an external bias inductor. For higher power applications, an external inductor can be used to bias the amplifier through the RFout or Vd_aux pads. Applications include OC-192 12.5 GBit/s receive AGC amplifier and lithium niobate Mach-Zehnder modulator driver amplifier.

The MAAPSM0015-DIE requires off-chip decoupling and blocking components. Each device is 100% DC and RF tested on wafer to ensure performance compliance. The device is provided in chip form. M/A-Com fabricates the MAAPSM0015-DIE using a 0.5 μ m gate length low noise multi-function self aligned gate (MSAG) MESFET process. This process features silicon nitride passivation and polyimide scratch protection. The die thickness is 0.003".

Ordering Information

| Part Number | Package |
|--------------------|----------------------------------|
| MAAPSM0015-DIE | MAAPSM0015-DIE |
| MAAPSM0015-DIE-SMB | MAAPSM0015-DIE Sample Test Board |

DC-20 GHz GaAs MMIC Amplifier



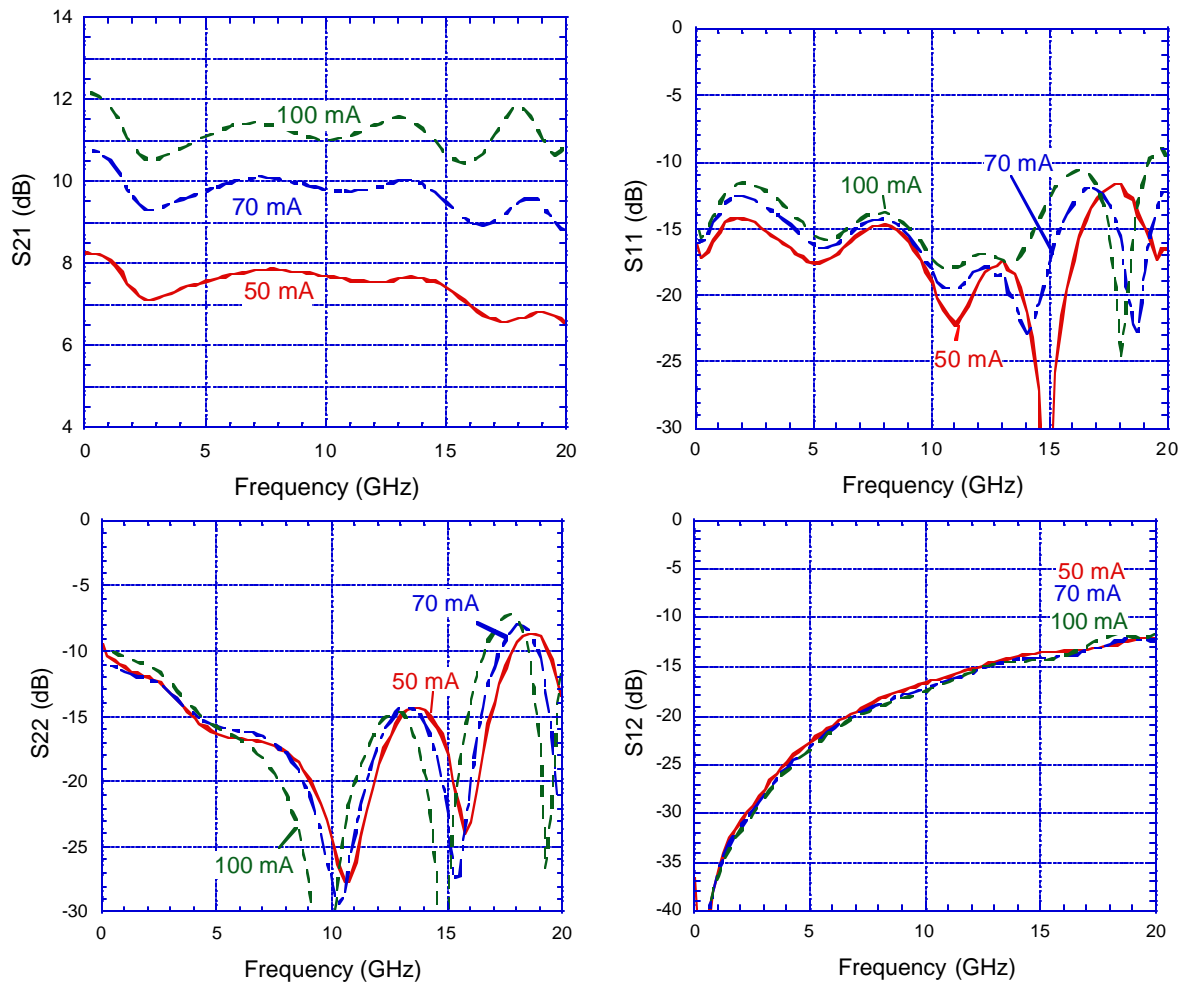
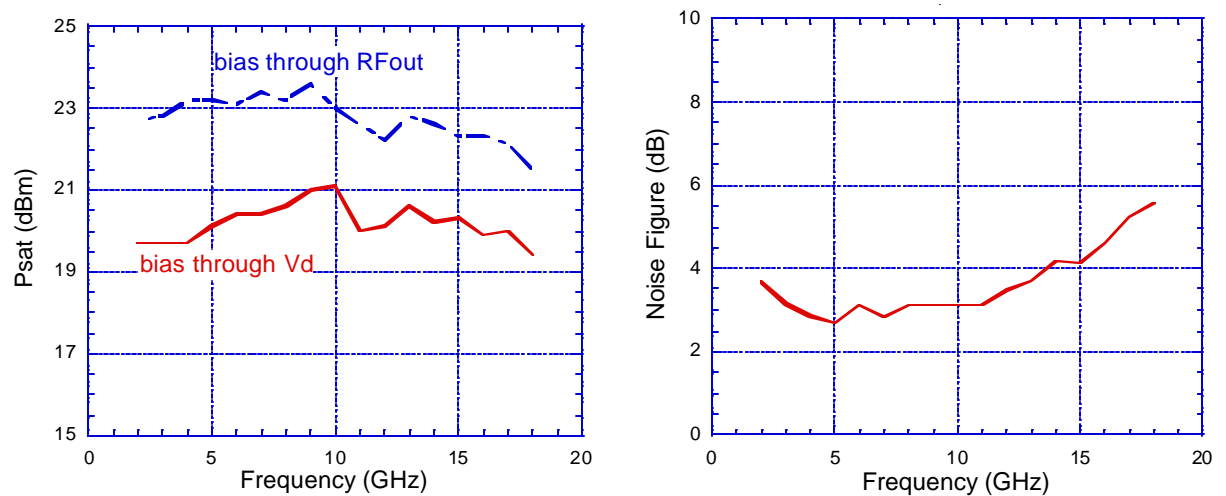
Primary Applications

- 12.5Gbit OC-192 LN/MZ Driver
- 12.4Gbit OC-192 AGC Receiver
- SONET/SDH

Electrical Characteristics

8V, 100 mA

| Parameter | Typ | Units |
|---|------------|-------|
| Bandwidth | DC-20 | GHz |
| Gain | 11 | dB |
| Gain Flatness | ± 0.75 | dB |
| Input Return Loss | -12 | dB |
| Output Return Loss | -12 | dB |
| Reverse Isolation | >-13 | dB |
| P_{sat} (+8V, 100 mA) | 21 | dBm |
| Noise Figure | 7 | dB |
| P_{sat} (Vd-aux = 5V) Biased through external inductor | 23 | dBm |
| P_{sat} (Vd=8V) External inductor not required | 19.5 | dBm |

DC-20GHz Carrier-Mounted Performance $V_{ds} = 8.0V$, $I_{ds} = 50, 70, 100mA$ DC-20GHz Wafer Probe Data $V_{ds} = 8.0V$, $I_{ds} = 100mA$ 

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Operating the MAAPSM0015-DIE

The M/A-COM MAAPSM0015-DIE is a dual-polarity MMIC amplifier requiring positive and negative bias for correct operation. VD is normally 8.0V while VG is -0.4V. Nominal drain current is 100 mA.

This bias provides a nominal small-signal gain of approximately 11 dB.

Biasing the amplifier is accomplished by first biasing VG to -1.5V then applying VD of 8.0V. VG is then adjusted until the drain current is 100 mA. Powering down the amplifier is accomplished first by removing VD then removing VG.

Gain Control

Limited gain control is possible using VG as the control element. For example, biasing VG at -1.0V ($I_D = 50$ mA) reduces gain by 3 dB from the maximum gain of 11 dB. Input and output match do not degrade over this control range.

More extensive gain control is possible by making VG more negative beyond the -1.0 V. However, match will degrade under these conditions and use in this manner is at the discretion of the customer.

Schematic

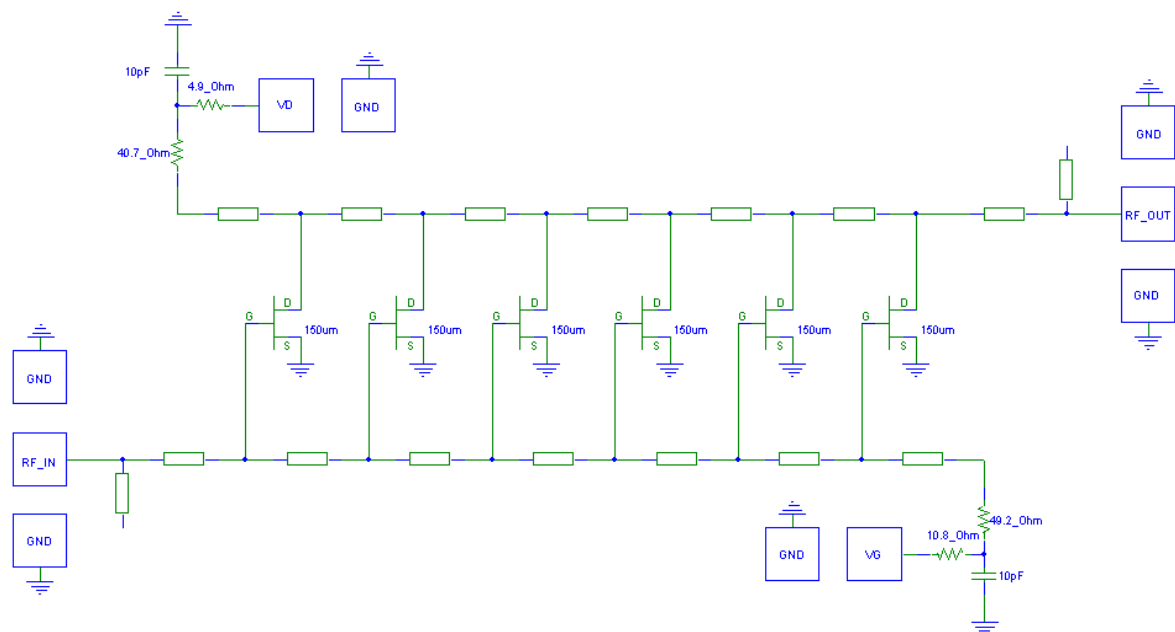


Figure 1. Schematic of M/A-COM MAAPSM0015-DIE DC-20 GHz distributed amplifier.

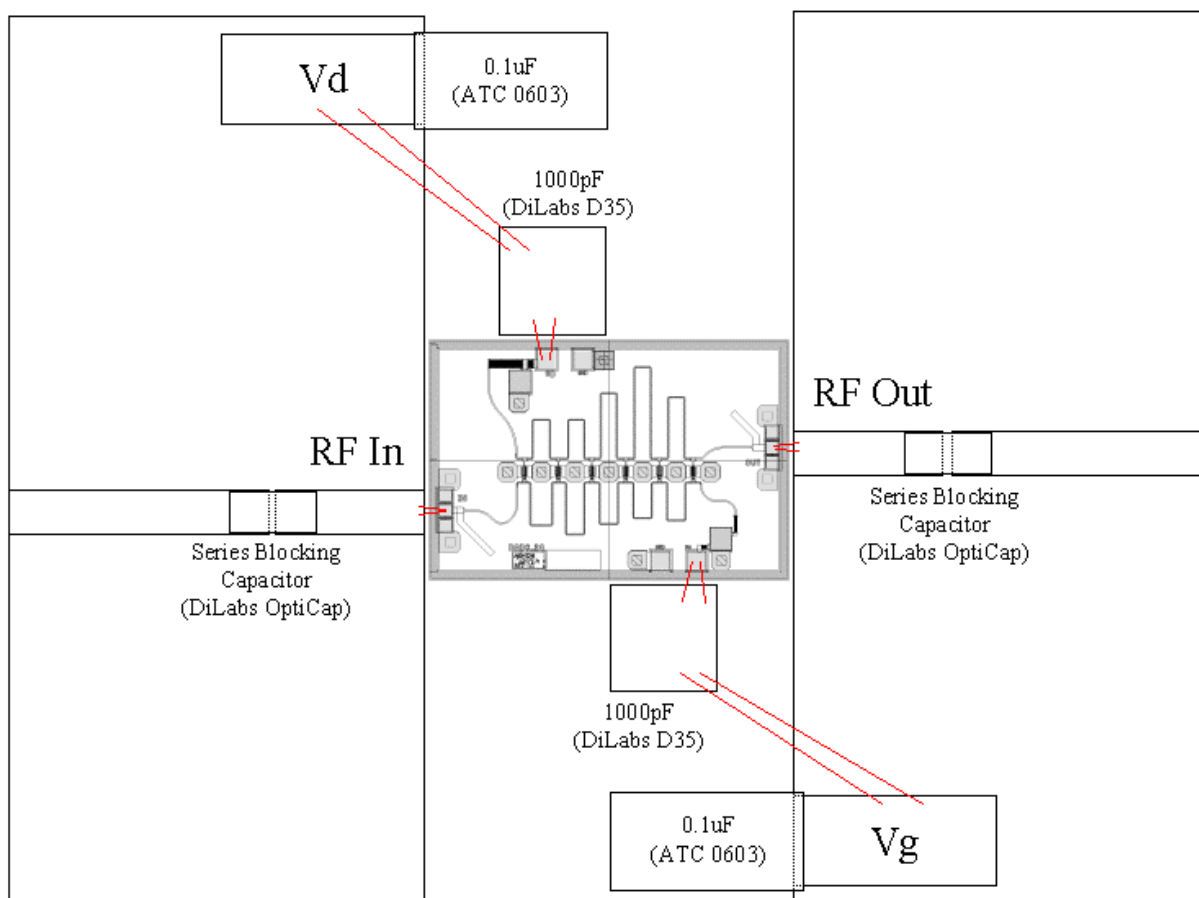


Figure 2.

Figure 2 shows a typical assembly/ bonding diagram for the M/A-COM MAAPSM0015-DIE. This figure shows the part configured for operation to 50 KHz. The corner frequency is set by the choice of blocking capacitor.

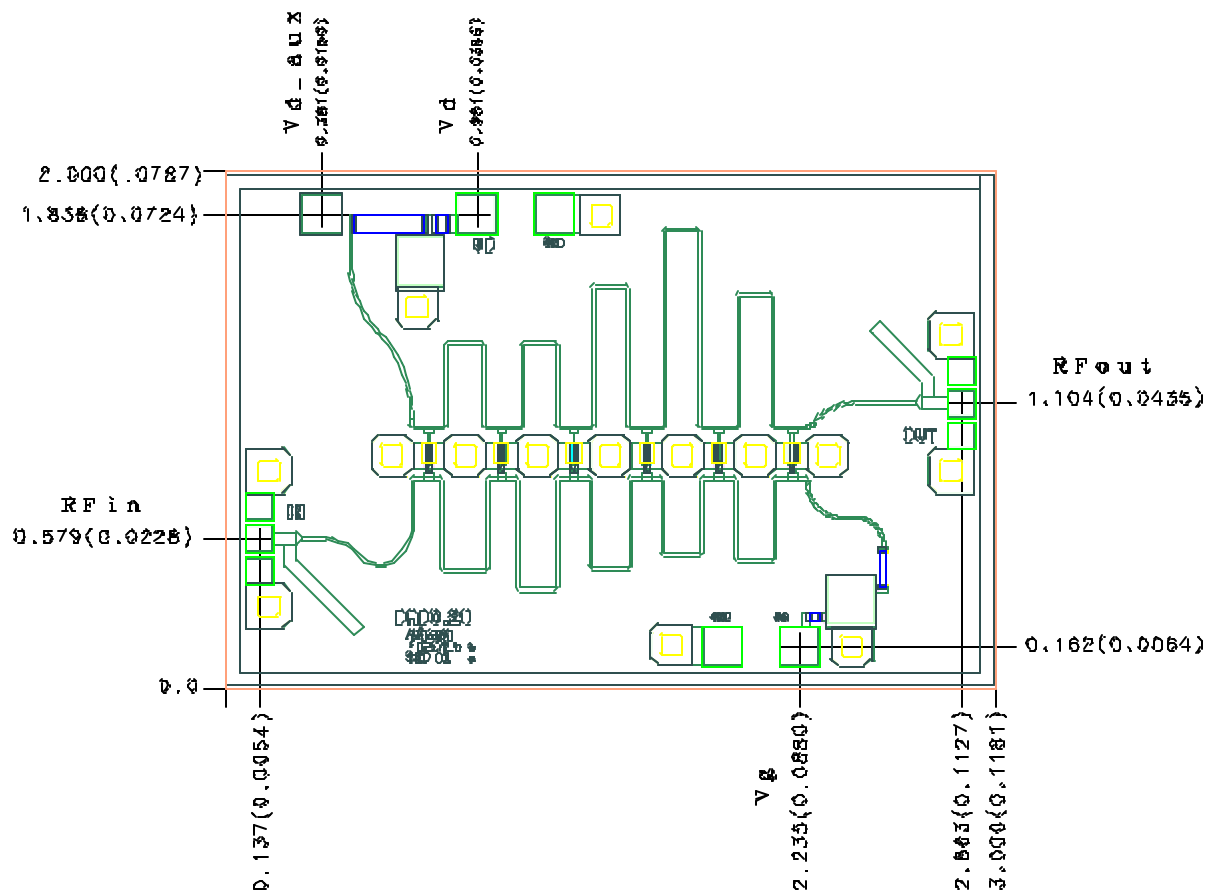
In all instances to ensure good 20 GHz performance, the RF input / output bondwire inductance should be minimized. Two 0.7 mil diameter gold wires are recommended with maximum separation between the wires. Overall wire length should be kept to less than 20 mils to keep lead inductance to less than 0.25 nH. Degradation of gain and match will be evident at higher RF input / output inductance.

Bonding of the VD and VG bias connections is also accomplished using 0.7 mil diameter gold wires. Two wires are sufficient to support the worst-case drain current for the MMIC (200 mA at full Idss).

In all instances, the capacitors noted are provided as examples of components which can be used in the assemblies. Similar components by other manufacturers could work equally well.

MAAPSM0015-DIE Bond Pad Location

All Dimensions are in mm (inches)



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S-Parameters: Vd=8V, Id=100 mA

| Freq(GHz) | S11(dB) | S11(ang) | S21(dB) | S21(ang) | S12(dB) | S12(ang) | S22(dB) | S22(ang) |
|-----------|---------|----------|---------|----------|---------|----------|---------|----------|
| 0.045 | -14.329 | -19.144 | 12.475 | 172.56 | -40.549 | -91.784 | -9.7566 | 178.86 |
| 0.295 | -15.696 | -34.135 | 12.154 | 168.06 | -45.742 | 68.999 | -10.023 | 170.81 |
| 0.545 | -14.942 | -58.347 | 12.089 | 158.48 | -41.141 | 67.324 | -10.155 | 162.97 |
| 0.795 | -14.013 | -80.669 | 11.985 | 149 | -38.213 | 59.749 | -10.308 | 155.62 |
| 1.045 | -13.102 | -100.8 | 11.851 | 139.45 | -36.355 | 51.485 | -10.502 | 148.55 |
| 1.295 | -12.301 | -118.65 | 11.642 | 130.06 | -34.842 | 41.304 | -10.735 | 142.03 |
| 1.545 | -11.873 | -135.36 | 11.365 | 121.05 | -33.465 | 32.477 | -10.856 | 135.45 |
| 1.795 | -11.713 | -150.14 | 11.062 | 112.84 | -32.481 | 25.48 | -10.948 | 127.98 |
| 2.045 | -11.634 | -163.53 | 10.836 | 105.49 | -31.605 | 18.079 | -11.108 | 120 |
| 2.295 | -11.685 | -175.67 | 10.68 | 98.05 | -30.749 | 10.303 | -11.349 | 111.59 |
| 2.545 | -11.806 | 172.58 | 10.569 | 90.837 | -30.034 | 4.5706 | -11.641 | 103.04 |
| 2.795 | -12.036 | 161.9 | 10.55 | 83.724 | -28.983 | -1.5248 | -12.083 | 94.601 |
| 3.045 | -12.296 | 150.99 | 10.565 | 76.367 | -28.369 | -9.6931 | -12.536 | 86.195 |
| 3.295 | -12.568 | 140.35 | 10.618 | 68.82 | -27.575 | -16.774 | -13.042 | 78.041 |
| 3.545 | -12.908 | 129.28 | 10.679 | 61.066 | -26.876 | -23.858 | -13.59 | 70.41 |
| 3.795 | -13.229 | 117.75 | 10.74 | 53.011 | -26.124 | -31.596 | -13.999 | 62.537 |
| 4.045 | -13.634 | 105.05 | 10.832 | 44.842 | -25.563 | -39.751 | -14.462 | 54.662 |
| 4.295 | -14.135 | 91.823 | 10.886 | 36.64 | -24.969 | -47.5 | -14.842 | 46.528 |
| 4.545 | -14.567 | 77.602 | 10.946 | 28.39 | -24.397 | -56.054 | -15.153 | 38.759 |
| 4.795 | -15.057 | 62.55 | 11.021 | 19.928 | -23.831 | -63.964 | -15.5 | 30.175 |
| 5.045 | -15.477 | 46.142 | 11.103 | 11.538 | -23.349 | -71.753 | -15.812 | 21.578 |
| 5.295 | -15.775 | 28.405 | 11.153 | 3.0228 | -22.817 | -80.007 | -16.052 | 12.696 |
| 5.545 | -15.861 | 10.374 | 11.207 | -5.6891 | -22.363 | -88.502 | -16.307 | 3.0301 |
| 5.795 | -15.814 | -8.41 | 11.29 | -14.471 | -21.908 | -97.379 | -16.532 | -5.8722 |
| 6.045 | -15.664 | -26.948 | 11.335 | -23.339 | -21.491 | -105.81 | -16.802 | -15.628 |
| 6.295 | -15.281 | -44.329 | 11.373 | -32.247 | -21.061 | -114.51 | -17.18 | -25.05 |
| 6.545 | -14.976 | -61.616 | 11.4 | -41.231 | -20.709 | -123.31 | -17.485 | -35.501 |
| 6.795 | -14.536 | -78.752 | 11.42 | -50.229 | -20.34 | -131.87 | -17.881 | -44.728 |
| 7.045 | -14.251 | -93.113 | 11.45 | -59.39 | -20.094 | -140.96 | -18.261 | -53.68 |
| 7.295 | -13.919 | -108.69 | 11.422 | -68.625 | -19.825 | -149.86 | -18.808 | -63.327 |
| 7.545 | -13.778 | -122.81 | 11.387 | -77.646 | -19.564 | -158.38 | -19.477 | -71.382 |
| 7.795 | -13.819 | -135.78 | 11.365 | -86.643 | -19.285 | -167.05 | -20.198 | -79.733 |
| 8.045 | -13.766 | -149.69 | 11.325 | -95.629 | -19.105 | -176.13 | -21.021 | -88.891 |
| 8.295 | -13.843 | -163.2 | 11.262 | -104.54 | -18.88 | 175.36 | -22.339 | -96.043 |
| 8.545 | -14.184 | -176.94 | 11.212 | -113.43 | -18.639 | 166.47 | -23.541 | -104.22 |
| 8.795 | -14.491 | 169.43 | 11.178 | -122.18 | -18.411 | 157.73 | -25.509 | -110.02 |
| 9.045 | -14.918 | 154.92 | 11.142 | -131.03 | -18.168 | 149.56 | -28.176 | -114.79 |
| 9.295 | -15.479 | 140.51 | 11.099 | -139.85 | -18.067 | 141.12 | -31.927 | -114.59 |
| 9.545 | -15.969 | 124.6 | 11.05 | -148.6 | -17.844 | 132.6 | -37.889 | -92.705 |
| 9.795 | -16.67 | 107.68 | 11.026 | -157.27 | -17.632 | 124.37 | -37.321 | -23.207 |
| 10.045 | -17.132 | 90.39 | 11.032 | -166.03 | -17.414 | 115.6 | -30.994 | 0.63745 |
| 10.295 | -17.734 | 71.144 | 11.022 | -174.72 | -17.236 | 107.28 | -26.979 | 0.36124 |
| 10.545 | -18.065 | 50.453 | 11.05 | 176.38 | -16.983 | 98.387 | -23.863 | -3.6782 |
| 10.795 | -17.993 | 29.492 | 11.078 | 167.47 | -16.801 | 90.221 | -21.665 | -8.8804 |

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S-Parameters: Vd=8V, Id=100 mA (Continued)

| Freq(GHz) | S11(dB) | S11(ang) | S21(dB) | S21(ang) | S12(dB) | S12(ang) | S22(dB) | S22(ang) |
|-----------|---------|----------|---------|----------|---------|----------|---------|----------|
| 11.045 | -17.932 | 7.3062 | 11.101 | 158.62 | -16.581 | 81.595 | -19.91 | -16.372 |
| 11.295 | -17.792 | -12.604 | 11.176 | 149.46 | -16.274 | 72.716 | -18.654 | -23.603 |
| 11.545 | -17.381 | -32.502 | 11.231 | 140.24 | -16.019 | 64.046 | -17.381 | -31.813 |
| 11.795 | -16.995 | -52.71 | 11.297 | 130.89 | -15.767 | 54.361 | -16.534 | -39.423 |
| 12.045 | -16.929 | -70.497 | 11.372 | 121.18 | -15.501 | 45.075 | -15.586 | -46.617 |
| 12.295 | -16.961 | -90.139 | 11.416 | 111.57 | -15.243 | 35.651 | -15.12 | -57.193 |
| 12.545 | -16.771 | -112.37 | 11.474 | 101.67 | -15.005 | 25.86 | -14.806 | -66.329 |
| 12.795 | -17.229 | -134.19 | 11.552 | 91.561 | -14.881 | 16.05 | -14.686 | -75.962 |
| 13.045 | -17.389 | -153.53 | 11.59 | 81.031 | -14.61 | 5.8079 | -14.691 | -85.321 |
| 13.295 | -17.62 | 177.75 | 11.554 | 70.506 | -14.522 | -4.4738 | -15.389 | -95.481 |
| 13.545 | -17.436 | 152.81 | 11.492 | 59.939 | -14.46 | -14.586 | -16.379 | -104.54 |
| 13.795 | -17.021 | 127.05 | 11.397 | 49.587 | -14.405 | -24.333 | -17.5 | -112.6 |
| 14.045 | -16.245 | 100.76 | 11.274 | 39.157 | -14.386 | -34.632 | -19.498 | -123.93 |
| 14.295 | -15.408 | 79.328 | 11.116 | 28.957 | -14.379 | -45.084 | -22.286 | -132.38 |
| 14.545 | -14.328 | 60.137 | 11.006 | 18.906 | -14.338 | -54.111 | -27.889 | -144.4 |
| 14.795 | -13.585 | 39.787 | 10.809 | 9.198 | -14.315 | -64.019 | -42.793 | -159.79 |
| 15.045 | -12.573 | 24.112 | 10.699 | -0.57751 | -14.346 | -73.77 | -29.44 | 24.144 |
| 15.295 | -11.911 | 9.182 | 10.589 | -10.143 | -14.273 | -82.746 | -22.474 | 15.521 |
| 15.545 | -11.388 | -3.9703 | 10.479 | -19.509 | -14.141 | -92.007 | -18.567 | 6.4613 |
| 15.795 | -11.044 | -18.298 | 10.468 | -28.778 | -14.059 | -100.85 | -16.035 | -1.3294 |
| 16.045 | -10.734 | -30.297 | 10.507 | -38.12 | -13.884 | -110.88 | -13.736 | -11.286 |
| 16.295 | -10.579 | -42.296 | 10.583 | -47.745 | -13.667 | -120.01 | -11.941 | -20.885 |
| 16.545 | -10.7 | -53.876 | 10.698 | -57.431 | -13.426 | -129.82 | -10.506 | -30.011 |
| 16.795 | -11.113 | -67.666 | 10.917 | -67.529 | -13.204 | -140.03 | -9.274 | -39.995 |
| 17.045 | -11.927 | -81.603 | 11.142 | -78.744 | -12.789 | -151.05 | -8.4525 | -50.17 |
| 17.295 | -13.072 | -98.734 | 11.336 | -90.286 | -12.516 | -161.6 | -7.7255 | -61.367 |
| 17.545 | -15.079 | -119.65 | 11.584 | -102.54 | -12.207 | -173.64 | -7.2509 | -73.583 |
| 17.795 | -18.865 | -143.32 | 11.794 | -115.56 | -11.903 | 173.68 | -7.2012 | -87.938 |
| 18.045 | -24.742 | 163.44 | 11.835 | -129.33 | -11.734 | 160.51 | -7.4637 | -101.59 |
| 18.295 | -20.75 | 74.372 | 11.739 | -143.01 | -11.73 | 147.39 | -8.5035 | -116.4 |
| 18.545 | -15.763 | 36.39 | 11.566 | -156.92 | -11.705 | 133.99 | -10.2 | -131.51 |
| 18.795 | -12.992 | 17.123 | 11.319 | -169.77 | -11.85 | 121.54 | -12.871 | -147.21 |
| 19.045 | -10.905 | -3.6692 | 11.009 | 177.98 | -11.984 | 109.35 | -17.182 | -164.29 |
| 19.295 | -9.7506 | -20.807 | 10.781 | 166.29 | -12.056 | 97.969 | -26.612 | 146.77 |
| 19.545 | -9.4313 | -34.432 | 10.67 | 154.85 | -12.081 | 86.333 | -21.217 | 29.596 |
| 19.795 | -8.9748 | -50.439 | 10.739 | 143.27 | -11.829 | 74.576 | -14.161 | 0.86822 |
| 20.045 | -9.9005 | -69.778 | 10.986 | 131.69 | -11.547 | 63.279 | -10.239 | -14.746 |

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