



Low Noise and Medium Power GaAs FETs

FEATURES

- Low Noise Figure:
NF = 0.5 dB Typical at 12 GHz
- High Associated Gain:
Ga = 12 dB Typical at 12 GHz
- High Dynamic Range:
1 dB Compression Power P_{-1} = 18 dBm at 12 GHz
- Breakdown Voltage: $BV_{DGO} \geq 9$ V
- $L_g = 0.25 \mu\text{m}$, $W_g = 160 \mu\text{m}$
- All-Gold Metallization for High Reliability
- 100 % DC Tested

PHOTO ENLARGEMENT



DESCRIPTION

The TC1101 is a GaAs Pseudomorphic High Electron Mobility Transistor (PHEMT) chip, which has very low noise figure, high associated gain and high dynamic range. The device can be used in circuits up to 40 GHz and suitable for low noise and medium power amplifier applications including a wide range of commercial and military applications. All devices are 100% DC tested to assure consistent quality. All bond pads are gold plated for either thermo-compression or thermo-sonic wire bonding.

ELECTRICAL SPECIFICATIONS ($T_A=25^\circ\text{C}$)

| Symbol | Conditions | MIN | TYP | MAX | UNIT |
|------------|--|-----|------|-----|---------------------------|
| NF | Noise Figure at $V_{DS} = 2$ V, $I_{DS} = 10$ mA, $f = 12$ GHz | | 0.5 | 0.7 | dB |
| G_a | Associated Gain at $V_{DS} = 2$ V, $I_{DS} = 10$ mA, $f = 12$ GHz | 10 | 12 | | dB |
| P_{1dB} | Output Power at 1dB Gain Compression Point, $f = 12$ GHz $V_{DS} = 4$ V, $I_{DS} = 25$ mA | 17 | 18 | | dBm |
| G_L | Linear Power Gain, $f = 12$ GHz $V_{DS} = 4$ V, $I_{DS} = 25$ mA | 12 | 14 | | dB |
| I_{DSS} | Saturated Drain-Source Current at $V_{DS} = 2$ V, $V_{GS} = 0$ V | | 40 | | mA |
| g_m | Transconductance at $V_{DS} = 2$ V, $V_{GS} = 0$ V | | 55 | | mS |
| V_p | Pinch-off Voltage at $V_{DS} = 2$ V, $I_D = 0.32$ mA | | -1.0 | | Volts |
| BV_{DGO} | Drain-Gate Breakdown Voltage at $I_{DGO} = 0.08$ mA | 9 | 12 | | Volts |
| R_{th} | Thermal Resistance | | 90 | | $^\circ\text{C}/\text{W}$ |

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ABSOLUTE MAXIMUM RATINGS (T_A=25 °C)

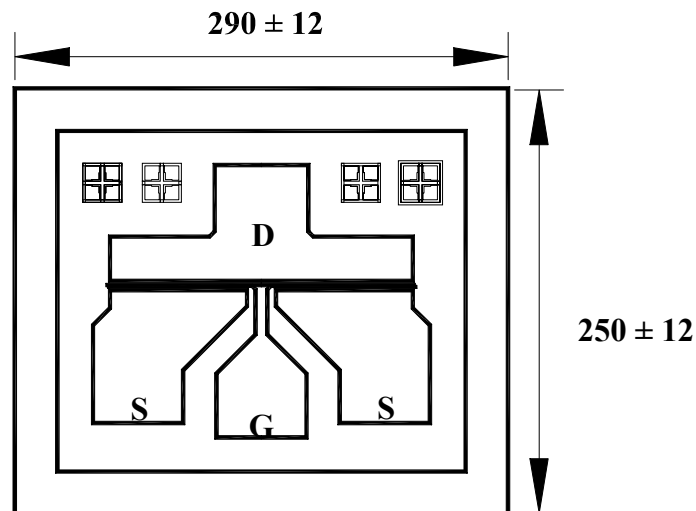
| Symbol | Parameter | Rating |
|------------------|------------------------|--------------------|
| V _{DS} | Drain-Source Voltage | 7.0 V |
| V _{GS} | Gate-Source Voltage | -3.0 V |
| I _{DS} | Drain Current | I _{DSS} |
| I _{GS} | Gate Current | 160 μA |
| P _{in} | RF Input Power, CW | 14 dBm |
| P _T | Continuous Dissipation | 150 mW |
| T _{CH} | Channel Temperature | 175 °C |
| T _{STG} | Storage Temperature | - 65 °C to +175 °C |

TYPICAL NOISE PARAMETERS (T_A=25 °C)

V_{DS} = 2 V, I_{DS} = 10 mA

| Frequency (GHz) | NF _{opt} (dB) | G _A (dB) | Γ _{opt} | | Rn/50 |
|--------------------|---------------------------|------------------------|------------------|-----|-------|
| | | | MAG | ANG | |
| 2 | 0.38 | 19.8 | 0.99 | 4 | 1.52 |
| 4 | 0.40 | 17.5 | 0.90 | 9 | 1.05 |
| 6 | 0.42 | 15.6 | 0.82 | 18 | 0.77 |
| 8 | 0.45 | 13.9 | 0.76 | 29 | 0.61 |
| 10 | 0.50 | 13.1 | 0.69 | 43 | 0.51 |
| 12 | 0.55 | 12.4 | 0.63 | 55 | 0.44 |
| 14 | 0.64 | 11.7 | 0.56 | 65 | 0.37 |
| 16 | 0.78 | 11.1 | 0.45 | 76 | 0.30 |
| 18 | 0.95 | 10.6 | 0.34 | 90 | 0.24 |

CHIP DIMENSIONS



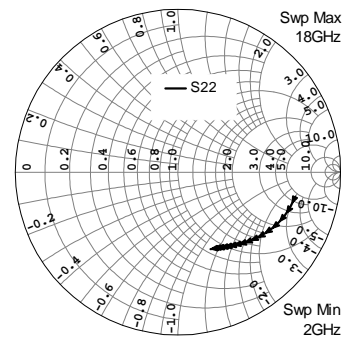
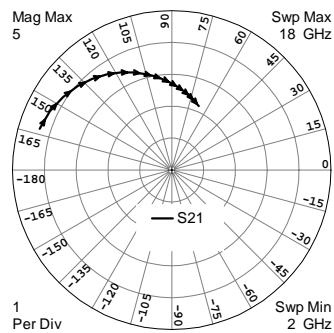
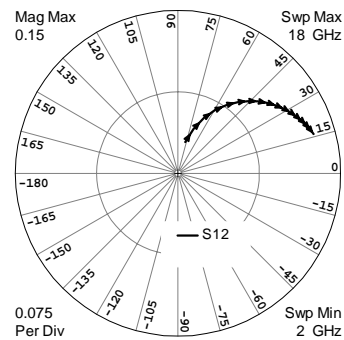
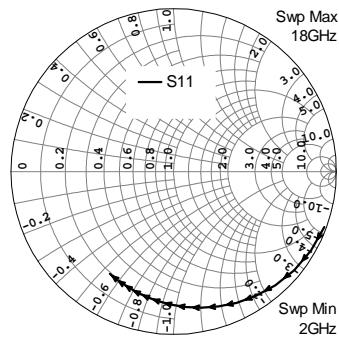
Units: Micrometers
Chip Thickness: 100

Gate Pad: 55 x 50
Drain Pad: 55 x 50
Source Pad: 55 x 60



TYPICAL SCATTERING PARAMETERS (T_A=25 °C)

V_{DS} = 2 V, I_{DS} = 10 mA



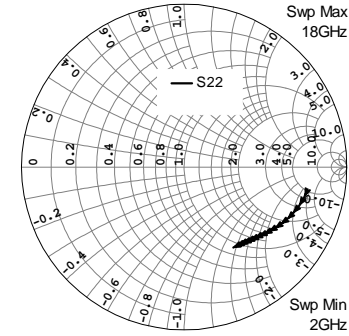
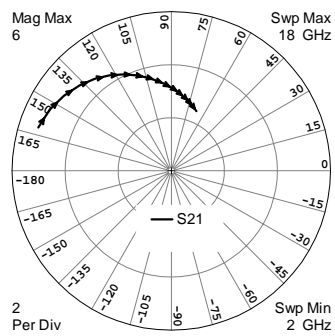
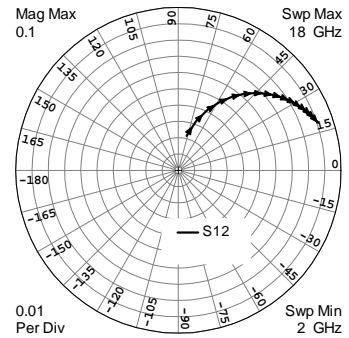
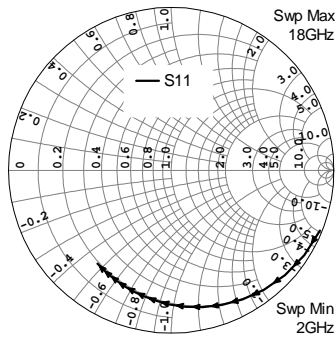
| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | |
|--------------------|--------|---------|--------|--------|--------|-------|--------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 2 | 0.9879 | -20.21 | 4.3485 | 162.66 | 0.0296 | 77.08 | 0.7367 | -11.76 |
| 3 | 0.9740 | -29.96 | 4.2452 | 154.28 | 0.0434 | 70.91 | 0.7235 | -17.37 |
| 4 | 0.9564 | -39.31 | 4.1126 | 146.20 | 0.0560 | 65.04 | 0.7068 | -22.68 |
| 5 | 0.9364 | -48.20 | 3.9594 | 138.48 | 0.0674 | 59.53 | 0.6877 | -27.66 |
| 6 | 0.9152 | -56.56 | 3.7943 | 131.15 | 0.0774 | 54.40 | 0.6676 | -32.28 |
| 7 | 0.8939 | -64.40 | 3.6242 | 124.22 | 0.0861 | 49.66 | 0.6472 | -36.54 |
| 8 | 0.8732 | -71.72 | 3.4546 | 117.66 | 0.0937 | 45.29 | 0.6276 | -40.46 |
| 9 | 0.8536 | -78.52 | 3.2894 | 111.45 | 0.1002 | 41.27 | 0.6090 | -44.06 |
| 10 | 0.8354 | -84.84 | 3.1312 | 105.57 | 0.1058 | 37.57 | 0.5919 | -47.37 |
| 11 | 0.8188 | -90.72 | 2.9813 | 99.99 | 0.1106 | 34.16 | 0.5764 | -50.43 |
| 12 | 0.8037 | -96.18 | 2.8406 | 94.68 | 0.1148 | 31.00 | 0.5627 | -53.28 |
| 13 | 0.7901 | -101.25 | 2.7092 | 89.60 | 0.1183 | 28.08 | 0.5506 | -55.93 |
| 14 | 0.7780 | -105.98 | 2.5868 | 84.74 | 0.1214 | 25.36 | 0.5402 | -58.41 |
| 15 | 0.7671 | -110.39 | 2.4731 | 80.07 | 0.1241 | 22.82 | 0.5313 | -60.76 |
| 16 | 0.7575 | -114.51 | 2.3676 | 75.57 | 0.1264 | 20.44 | 0.5239 | -62.99 |
| 17 | 0.7491 | -118.37 | 2.2697 | 71.21 | 0.1284 | 18.20 | 0.5179 | -65.12 |
| 18 | 0.7416 | -121.99 | 2.1788 | 66.99 | 0.1302 | 16.08 | 0.5132 | -67.16 |

• The data does not include gate, drain and source bond wires.

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TYPICAL SCATTERING PARAMETERS (T_A=25 °C)

V_{DS} = 4 V, I_{DS} = 25 mA



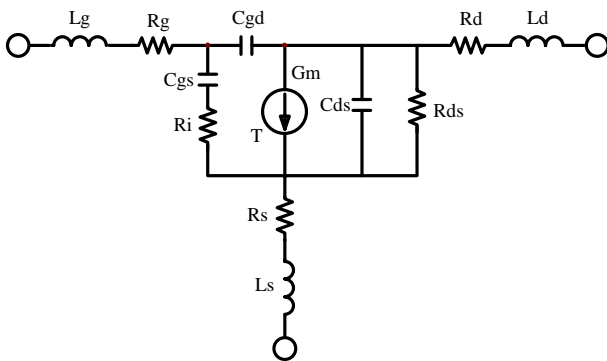
| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | |
|--------------------|--------|---------|--------|--------|--------|-------|--------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 2 | 0.9861 | -22.03 | 5.2729 | 161.97 | 0.0218 | 76.68 | 0.7718 | -10.24 |
| 3 | 0.9704 | -32.59 | 5.1264 | 153.31 | 0.0318 | 70.37 | 0.7586 | -15.08 |
| 4 | 0.9507 | -42.66 | 4.9406 | 145.03 | 0.0408 | 64.44 | 0.7422 | -19.62 |
| 5 | 0.9288 | -52.16 | 4.7291 | 137.18 | 0.0488 | 58.94 | 0.7239 | -23.82 |
| 6 | 0.9059 | -61.05 | 4.5045 | 129.78 | 0.0558 | 53.89 | 0.7050 | -27.69 |
| 7 | 0.8834 | -69.32 | 4.2765 | 122.83 | 0.0618 | 49.28 | 0.6865 | -31.23 |
| 8 | 0.8618 | -76.97 | 4.0524 | 116.31 | 0.0669 | 45.10 | 0.6690 | -34.49 |
| 9 | 0.8418 | -84.05 | 3.8370 | 110.19 | 0.0712 | 41.30 | 0.6530 | -37.49 |
| 10 | 0.8234 | -90.59 | 3.6330 | 104.41 | 0.0749 | 37.85 | 0.6386 | -40.28 |
| 11 | 0.8068 | -96.63 | 3.4418 | 98.96 | 0.0781 | 34.72 | 0.6260 | -42.90 |
| 12 | 0.7919 | -102.23 | 3.2639 | 93.79 | 0.0807 | 31.86 | 0.6150 | -45.37 |
| 13 | 0.7786 | -107.40 | 3.0990 | 88.86 | 0.0830 | 29.24 | 0.6057 | -47.73 |
| 14 | 0.7668 | -112.21 | 2.9466 | 84.16 | 0.0850 | 26.83 | 0.5978 | -49.99 |
| 15 | 0.7564 | -116.69 | 2.8058 | 79.65 | 0.0867 | 24.60 | 0.5913 | -52.18 |
| 16 | 0.7471 | -120.86 | 2.6758 | 75.31 | 0.0882 | 22.54 | 0.5861 | -54.32 |
| 17 | 0.7389 | -124.76 | 2.5557 | 71.12 | 0.0895 | 20.62 | 0.5821 | -56.41 |
| 18 | 0.7316 | -128.41 | 2.4446 | 67.06 | 0.0906 | 18.82 | 0.5790 | -58.46 |

• The data does not include gate, drain and source bond wires.



SMALL SIGNAL MODEL, $V_{DS} = 2\text{ V}$, $I_{DS} = 10\text{ mA}$

SCHEMATIC

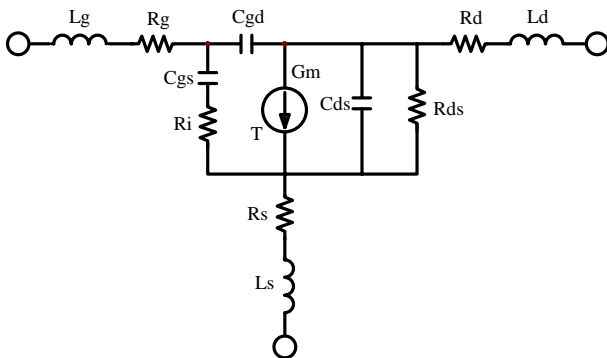


PARAMETERS

| Parameters | | Parameters | |
|------------|------------|------------|-----------|
| Lg | 0.04708 nH | Rs | 1.29 Ohm |
| Rg | 1.46 Ohm | Ls | 0.001 nH |
| Cgs | 0.207 pF | Cds | 0.0684 pF |
| Ri | 3.68 Ohm | Rds | 321.5 Ohm |
| Cgd | 0.0269 pF | Rd | 1.525 Ohm |
| Gm | 54.8 mS | Ld | 0.0379 nH |
| T | 3.34 psec | | |

SMALL SIGNAL MODEL, $V_{DS} = 4\text{ V}$, $I_{DS} = 25\text{ mA}$

SCHEMATIC



PARAMETERS

| Parameters | | Parameters | |
|------------|------------|------------|-----------|
| Lg | 0.04708 nH | Rs | 1.25 Ohm |
| Rg | 1.46 Ohm | Ls | 0.001 nH |
| Cgs | 0.254 pF | Cds | 0.0666 pF |
| Ri | 5.91 Ohm | Rds | 377.8 Ohm |
| Cgd | 0.0192 pF | Rd | 1.525 Ohm |
| Gm | 66.0 mS | Ld | 0.0379 nH |
| T | 3.64 psec | | |

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CHIP HANDLING

DIE ATTACHMENT: Conductive epoxy or eutectic die attach is recommended. Eutectic die attach can be accomplished with Au-Sn (80% Au-20% Sn) perform at stage temperature: $290^{\circ}\text{C} \pm 5^{\circ}\text{C}$; Handling Tool: Tweezers; Time: less than 1 min.

WIRE BONDING: The recommended wire bond method is thermocompression bonding with 0.7 to 1.0 mil (0.018 to 0.025 mm) gold wire. Stage temperature: 220°C to 250°C ; Bond Tip Temperature: 150°C ; Bond Force: 20 to 30 gms depending on size of wire and Bond Tip Temperature.

HANDLING PRECAUTIONS: The user must operate in a clean, dry environment. Care should be exercised during handling avoid damage to the devices. Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing. The static discharge must be less than 300V.