# 10 W SiC RF Power MESFET

# PRELIMINARY

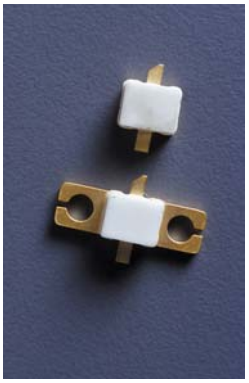
## Features

- 12 dB Small Signal Gain
- 10 W Minimum $P_{1dB}$
- 48 V Operation
- High Breakdown Voltage
- High Temperature Operation
- Up to 3 GHz Operation
- High Efficiency

## Applications

- Class A, AB Amplifiers
- TDMA, EDGE, CDMA, and W-CDMA
- Broadband Amplifiers
- CATV Amplifiers
- MMDS

CASE STYLE 001
CRF-22010-001



CASE STYLE 101
CRF-22010-101

Angled lead = Gate
Non-angled lead = Drain
Case/Flange = Source

## Description

Cree's CRF-22010 is a silicon carbide (SiC) RF power Metal-Semiconductor Field-Effect Transistor (MESFET). SiC has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. SiC MESFETs offer greater power density and increased reliability compared to Si and GaAs transistors.

### Absolute Maximum Ratings (not simultaneous) at 25°C Case Temperature

| Parameter | Symbol | Rating | Units |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 120 | VDC |
| Gate-Source Voltage | $V_{GS}$ | -25, +3 | VDC |
| Total Device Dissipation | $P_D$ | 62.5 | W |
| Storage Temperature | $T_{STG}$ | -40, 150 | °C |
| Operating Junction Temperature | $T_J$ | 250 | °C |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 3.6 | °C/W |
| Soldering Temperature | $T_S$ | 250 | °C |

## Electrical Characteristics ($T_C$ = 25°C)

| Characteristic | Symbol | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -12 | -10 | - | VDC | $V_{DS}$ = 10 V, $I_D$ = 0.5 mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | - | -6 | - | VDC | $V_{DS}$ = 48 V, $I_D$ = 500 mA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | 1.1 | 1.5 | 1.8 | A | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | 100 | 110 | 120 | VDC | $V_{GS}$ = -26 V, $I_D$ = 3 mA |
| Forward Transconductance | $g_m$ | - | 150 | - | mS | $V_{DS}$ = 48 V, $I_D$ = 500 mA |
| Case Operating Temperature | $T_C$ | -30 | - | 120 | °C | |
| Screw Torque (101 Style Package) | T | 0.33 | - | 0.37 | ft·lb | |
| **RF CHARACTERISTICS** | | | | | | |
| Gain | $G_{SS}$ | 10 | 12 | - | dB | $V_{DD}$ = 48 V, $I_{DQ}$ = 500 mA, f = 2000 MHz |
| Power Output at 1 dB Compression | $P_{1dB}$ | 10 | 12 | - | W | $V_{DD}$ = 48 V, $I_{DQ}$ = 500 mA, f = 2000 MHz |
| Drain Efficiency[1, 2] | $\eta$ | 40 | 45 | - | % | $V_{DD}$ = 48 V, $I_{DQ}$ = 500 mA, f = 2000 MHz, $P_{OUT}$ = $P_{1dB}$ |
| Intermodulation Distortion | $IMD_3$ | - | -30 | - | dBc | $V_{DD}$ = 48 V, $I_{DQ}$ = 500 mA, $f_1$ = 2000.0 MHz, $f_2$ = 2000.1 MHz, $P_{OUT}$ = 10 W PEP |

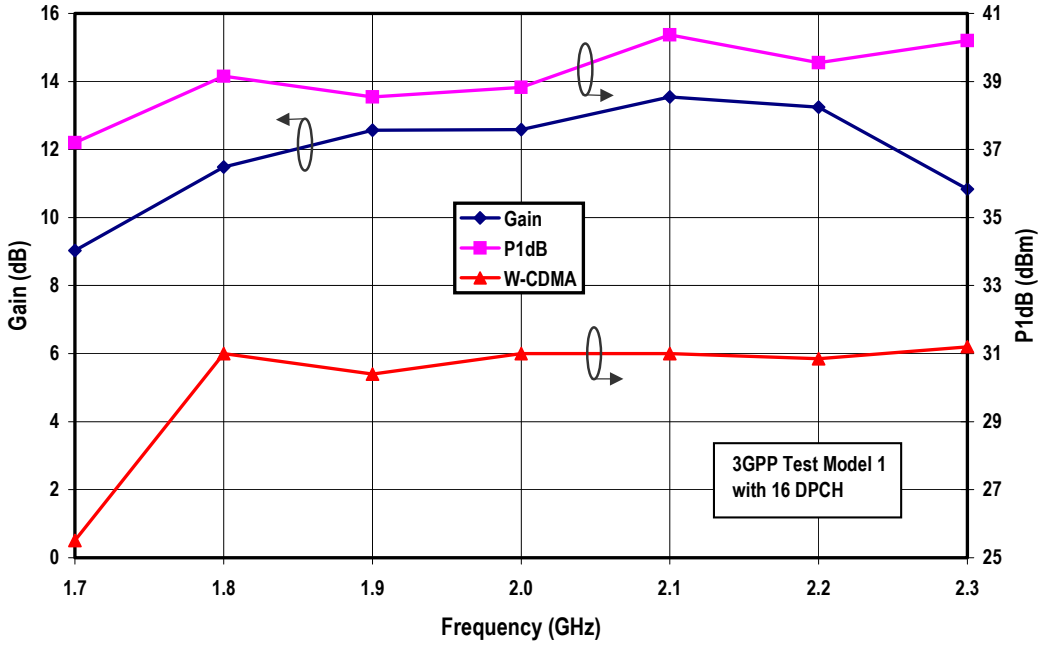
Notes:

[1] Drain Efficiency = $P_{OUT}/P_{DC}$

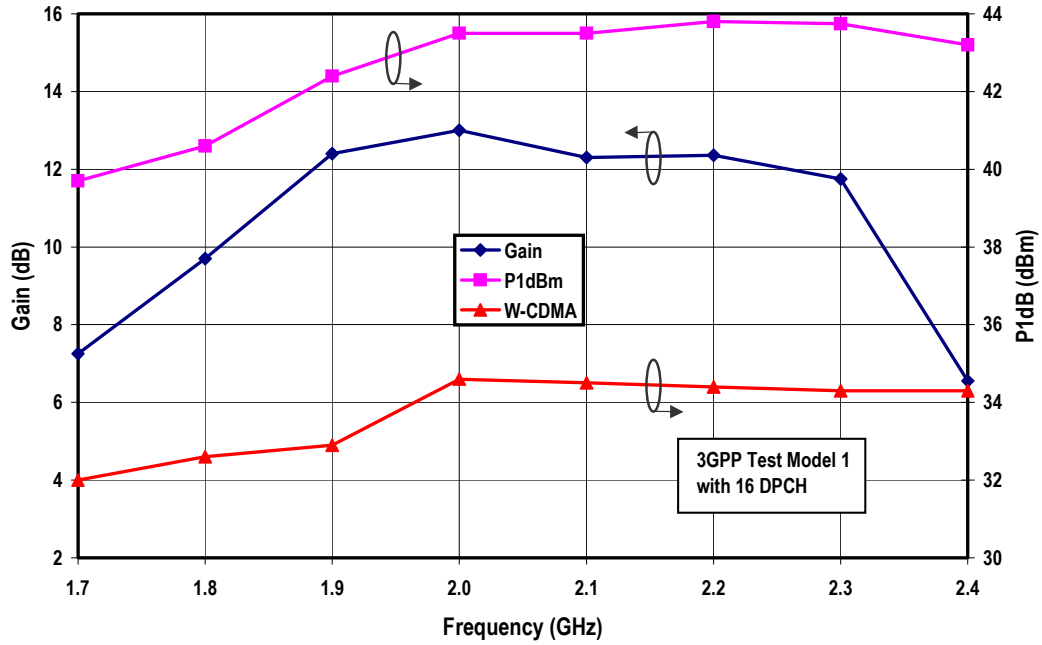
[2] Power Added Efficiency (PAE) = $(P_{OUT} - P_{IN})/P_{DC}$

## Typical Broadband Performance ($T_C$ = 25°C, $V_{DS}$ = 48 V, $I_{DQ}$ = 500 mA)

CR22010 Single-Ended Broadband Amp; Untuned Prototype

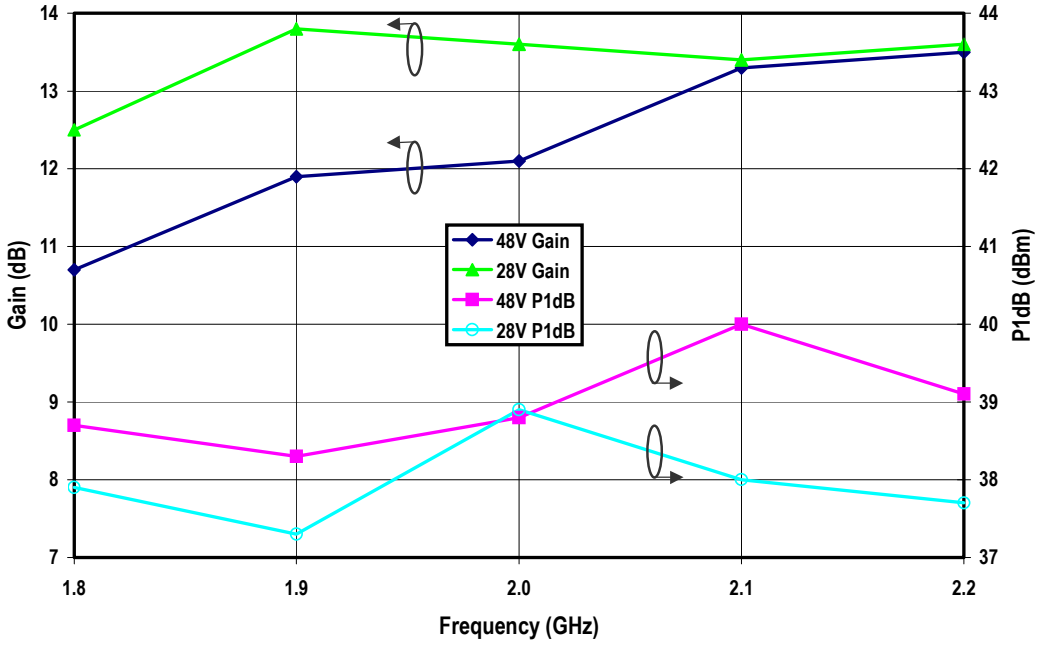



CR22010 Balanced Broadband Amp
Vds=48V, Idq=500mA/Device; Untuned Prototype

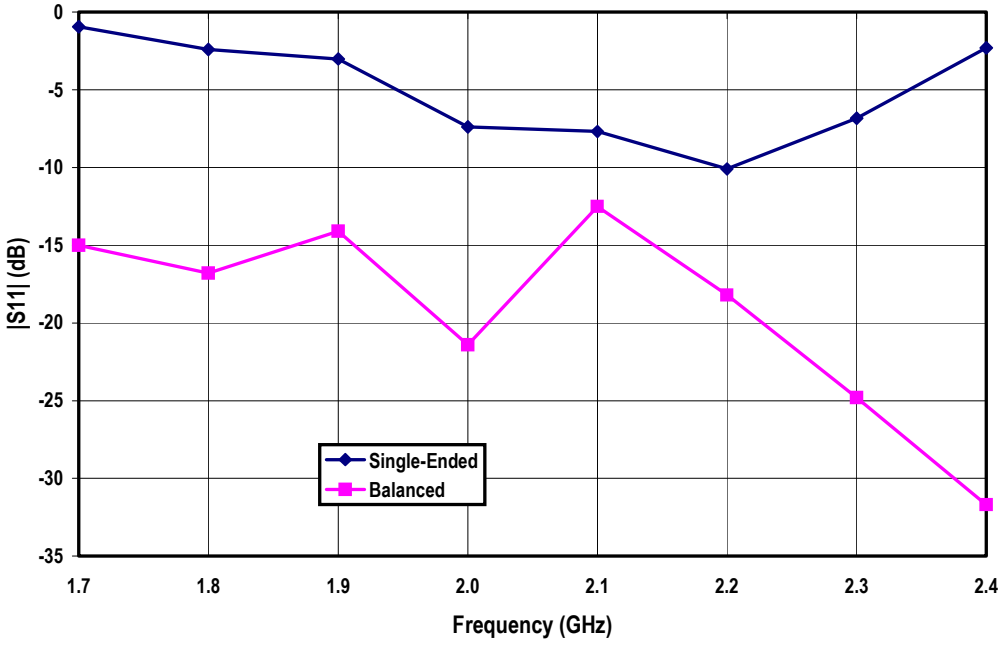


## Typical Broadband Performance ($T_C$ = 25°C, $V_{DS}$ = 48 V, $I_{DQ}$ = 500 mA)

CR22010 Single-Ended Broadband Amp
Vds=48V and 28V, Idq=500mA; Untuned Prototype

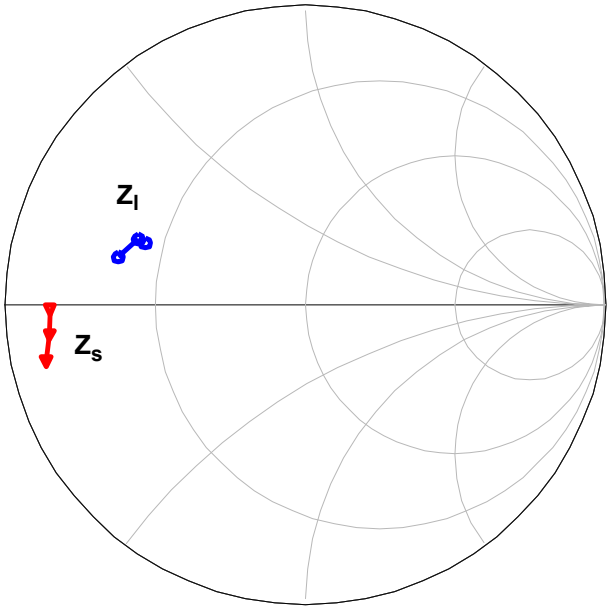


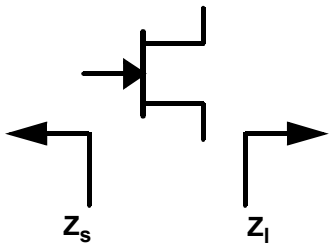

CR22010 Single-Ended and Balanced Amp |S11|; Untuned Prototype



## Typical Scattering Parameters (Small Signal Class A, $V_{DS}$=48 V, $I_{DQ}$ = 500 mA, ang in deg)

| freq | S(1,1) | S(1,2) | S(2,1) | S(2,2) |
|---|---|---|---|---|
| 100.0MHz | 0.992 / -24.815 | 0.022 / 75.220 | 8.534 / 164.613 | 0.222 / -38.721 |
| 200.0MHz | 0.972 / -47.553 | 0.041 / 61.737 | 7.928 / 150.522 | 0.260 / -68.263 |
| 300.0MHz | 0.948 / -67.048 | 0.056 / 50.220 | 7.153 / 138.396 | 0.299 / -88.841 |
| 400.0MHz | 0.925 / -83.140 | 0.066 / 40.689 | 6.372 / 128.258 | 0.332 / -103.288 |
| 500.0MHz | 0.907 / -96.226 | 0.074 / 32.845 | 5.664 / 119.807 | 0.357 / -113.709 |
| 600.0MHz | 0.893 / -106.865 | 0.079 / 26.326 | 5.053 / 112.682 | 0.376 / -121.434 |
| 700.0MHz | 0.882 / -115.585 | 0.082 / 20.818 | 4.535 / 106.568 | 0.391 / -127.302 |
| 800.0MHz | 0.874 / -122.815 | 0.085 / 16.078 | 4.099 / 101.223 | 0.403 / -131.859 |
| 900.0MHz | 0.868 / -128.889 | 0.087 / 11.925 | 3.730 / 96.466 | 0.413 / -135.472 |
| 1.000GHz | 0.864 / -134.057 | 0.088 / 8.226 | 3.416 / 92.163 | 0.423 / -138.389 |
| 1.100GHz | 0.860 / -138.512 | 0.089 / 4.884 | 3.148 / 88.219 | 0.431 / -140.787 |
| 1.200GHz | 0.858 / -142.398 | 0.090 / 1.826 | 2.916 / 84.559 | 0.439 / -142.792 |
| 1.300GHz | 0.856 / -145.826 | 0.091 / -1.003 | 2.714 / 81.130 | 0.447 / -144.496 |
| 1.400GHz | 0.854 / -148.880 | 0.091 / -3.644 | 2.538 / 77.890 | 0.454 / -145.970 |
| 1.500GHz | 0.853 / -151.628 | 0.091 / -6.129 | 2.383 / 74.807 | 0.461 / -147.264 |
| 1.600GHz | 0.852 / -154.123 | 0.092 / -8.483 | 2.245 / 71.857 | 0.468 / -148.418 |
| 1.700GHz | 0.852 / -156.406 | 0.092 / -10.726 | 2.122 / 69.019 | 0.475 / -149.464 |
| 1.800GHz | 0.852 / -158.512 | 0.092 / -12.874 | 2.011 / 66.278 | 0.482 / -150.425 |
| 1.900GHz | 0.852 / -160.468 | 0.092 / -14.939 | 1.912 / 63.621 | 0.489 / -151.320 |
| 2.000GHz | 0.852 / -162.297 | 0.092 / -16.932 | 1.822 / 61.038 | 0.495 / -152.164 |
| 2.100GHz | 0.852 / -164.018 | 0.092 / -18.863 | 1.741 / 58.520 | 0.502 / -152.968 |
| 2.200GHz | 0.852 / -165.647 | 0.092 / -20.737 | 1.667 / 56.060 | 0.509 / -153.743 |
| 2.300GHz | 0.853 / -167.196 | 0.092 / -22.562 | 1.599 / 53.651 | 0.515 / -154.496 |
| 2.400GHz | 0.853 / -168.678 | 0.092 / -24.342 | 1.537 / 51.289 | 0.521 / -155.233 |
| 2.500GHz | 0.853 / -170.102 | 0.092 / -26.083 | 1.480 / 48.968 | 0.528 / -155.958 |
| 2.600GHz | 0.854 / -171.477 | 0.092 / -27.787 | 1.427 / 46.686 | 0.534 / -156.675 |
| 2.700GHz | 0.854 / -172.809 | 0.092 / -29.460 | 1.379 / 44.439 | 0.540 / -157.389 |
| 2.800GHz | 0.855 / -174.106 | 0.092 / -31.103 | 1.334 / 42.223 | 0.546 / -158.100 |
| 2.900GHz | 0.855 / -175.372 | 0.091 / -32.720 | 1.293 / 40.035 | 0.552 / -158.811 |
| 3.000GHz | 0.856 / -176.613 | 0.091 / -34.313 | 1.255 / 37.874 | 0.557 / -159.525 |
| 3.100GHz | 0.856 / -177.833 | 0.091 / -35.884 | 1.219 / 35.738 | 0.563 / -160.241 |
| 3.200GHz | 0.857 / -179.037 | 0.091 / -37.437 | 1.186 / 33.622 | 0.568 / -160.962 |
| 3.300GHz | 0.857 / 179.772 | 0.091 / -38.972 | 1.155 / 31.527 | 0.573 / -161.688 |
| 3.400GHz | 0.857 / 178.591 | 0.091 / -40.492 | 1.127 / 29.450 | 0.578 / -162.421 |
| 3.500GHz | 0.858 / 177.416 | 0.091 / -41.999 | 1.100 / 27.389 | 0.583 / -163.160 |
| 3.600GHz | 0.858 / 176.245 | 0.091 / -43.494 | 1.075 / 25.342 | 0.588 / -163.906 |
| 3.700GHz | 0.858 / 175.074 | 0.091 / -44.979 | 1.052 / 23.309 | 0.592 / -164.661 |
| 3.800GHz | 0.859 / 173.902 | 0.091 / -46.456 | 1.031 / 21.286 | 0.597 / -165.424 |
| 3.900GHz | 0.859 / 172.726 | 0.092 / -47.927 | 1.011 / 19.273 | 0.601 / -166.196 |
| 4.000GHz | 0.859 / 171.543 | 0.092 / -49.393 | 0.993 / 17.267 | 0.605 / -166.977 |




$Z_s$ - Input match from gate

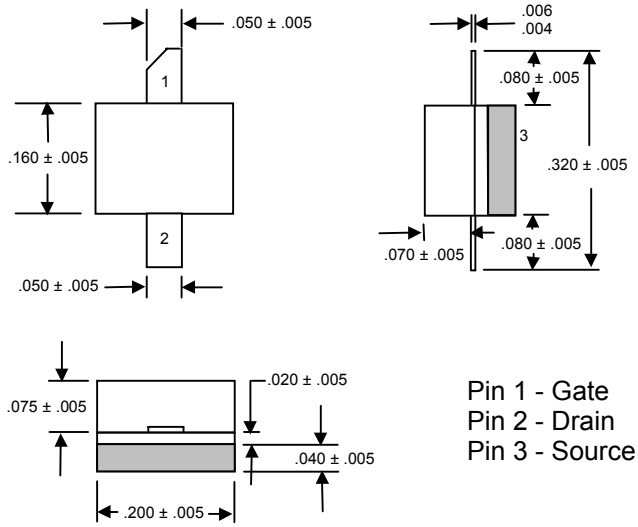
$Z_l$ - Output match from drain

## 10 W Class A Impedance Data, $V_{DS}$ = 48 V, $I_{DQ}$ = 500 mA, 101 Style Package

| Frequency | $Z_s$ (ohms) | | $Z_l$ (ohms) | |
|---|---|---|---|---|
| MHz | R | jX | R | jX |
| 1805 | 4.0 | -0.5 | 14 | 8.7 |
| 1990 | 3.8 | -3.0 | 13 | 9.0 |
| 2170 | 3.1 | -5.4 | 11 | 6.0 |

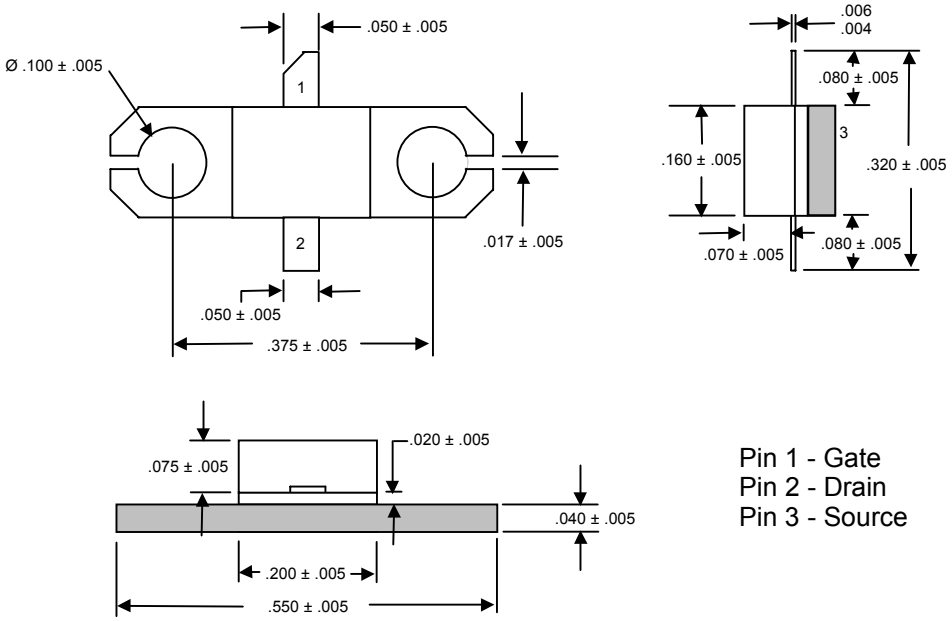
## PACKAGE DIMENSIONS (UNITS IN INCHES)

### STYLE 001




Pin 1 - Gate
Pin 2 - Drain
Pin 3 - Source

### STYLE 101




Pin 1 - Gate
Pin 2 - Drain
Pin 3 - Source

All products conform to the listed mechanical specifications within the tolerances shown.

**Contact Information:**

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