

RF POWER MOSFET N-CHANNEL ENHANCEMENT MODE

250V 750W 40MHz

The ARF1501 is an RF power transistor designed for very high power scientific, commercial, medical and industrial RF power generator and amplifier applications up to 40 MHz.

- **Specified 250 Volt, 27.12 MHz Characteristics:**
 - Output Power = 750 Watts.**
 - Gain = 17dB (Class C)**
 - Efficiency > 75%**
- **High Performance Power RF Package.**
- **Very High Breakdown for Improved Ruggedness.**
- **Low Thermal Resistance.**
- **Nitride Passivated Die for Improved Reliability.**

MAXIMUM RATINGS

All Ratings: $T_C = 25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | ARF1501 | UNIT |
|----------------|-----------------------------------------------------|------------|-------|
| V_{DSS} | Drain-Source Voltage | 1000 | Volts |
| I_D | Continuous Drain Current @ $T_C = 25^\circ\text{C}$ | 30 | Amps |
| V_{GS} | Gate-Source Voltage | ± 30 | Volts |
| P_D | Total Device Dissipation @ $T_C = 25^\circ\text{C}$ | 1500 | Watts |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -55 to 175 | °C |
| T_L | Lead Temperature: 0.063" from Case for 10 Sec. | 300 | |

STATIC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic / Test Conditions | MIN | TYP | MAX | UNIT |
|-----------------|-------------------------------------------------------------------------------------------|------|-----|-----------|---------------|
| BV_{DSS} | Drain-Source Breakdown Voltage ($V_{GS} = 0V, I_D = 250 \mu\text{A}$) | 1000 | | | Volts |
| $V_{DS(ON)}$ | On State Drain Voltage ^① ($I_{D(ON)} = 15A, V_{GS} = 10V$) | | 7.5 | 9 | |
| I_{DSS} | Zero Gate Voltage Drain Current ($V_{DS} = 1000V, V_{GS} = 0V$) | | | 40 | μA |
| | Zero Gate Voltage Drain Current ($V_{DS} = 800V, V_{GS} = 0V, T_C = 125^\circ\text{C}$) | | | 1000 | |
| I_{GSS} | Gate-Source Leakage Current ($V_{GS} = \pm 30V, V_{DS} = 0V$) | | | ± 400 | nA |
| g_{fs} | Forward Transconductance ($V_{DS} = 25V, I_D = 15A$) | 5.5 | 7 | | mhos |
| $V_{isolation}$ | RMS Voltage (60Hz Sinewave from terminals to mounting surface for 1 minute) | TBD | | | Volts |
| $V_{GS(TH)}$ | Gate Threshold Voltage ($V_{DS} = V_{GS}, I_D = 50mA$) | 3 | | 5 | Volts |

THERMAL CHARACTERISTICS

| Symbol | Characteristic (per package unless otherwise noted) | MIN | TYP | MAX | UNIT |
|------------------|---------------------------------------------------------------------------------------------|-----|------|------|------|
| $R_{\theta JC}$ | Junction to Case | | | 0.10 | °C/W |
| $R_{\theta JHS}$ | Junction to Sink (Use High Efficiency Thermal Joint Compound and Planar Heat Sink Surface.) | | 0.16 | | |



CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

| Symbol | Characteristic | Test Conditions | MIN | TYP | MAX | UNIT |
|--------------|------------------------------|-----------------------------------------------------------------------------------------------|-----|------|------|------|
| C_{iss} | Input Capacitance | $V_{GS} = 0V$ $V_{DS} = 200V$ $f = 1\text{ MHz}$ | | 5400 | 6500 | pF |
| C_{oss} | Output Capacitance | | | 300 | 400 | |
| C_{rss} | Reverse Transfer Capacitance | | | 125 | 160 | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{GS} = 15V$ $V_{DD} = 500V$ $I_D = I_{D[Cont.]} @ 25^\circ C$ $R_G = 1.6\ \Omega$ | | 8 | | ns |
| t_r | Rise Time | | | 5 | | |
| $t_{d(off)}$ | Turn-off Delay Time | | | 25 | | |
| t_f | Fall Time | | | 13 | | |

FUNCTIONAL CHARACTERISTICS

| Symbol | Characteristic | Test Conditions | MIN | TYP | MAX | UNIT |
|----------|------------------------------------|-------------------------------|--------------------------------|-----|-----|------|
| G_{PS} | Common Source Amplifier Power Gain | $f = 27.12\text{ MHz}$ | 15 | 17 | | dB |
| η | Drain Efficiency | $V_{GS} = 0V$ $V_{DD} = 250V$ | 70 | 75 | | % |
| Ψ | Electrical Ruggedness VSWR 10:1 | $P_{out} = 750W$ | No Degradation in Output Power | | | |

① Pulse Test: Pulse width < 380 μ S, Duty Cycle < 2%.

Microsemi reserves the right to change, without notice, the specifications and information contained herein.

Per transistor section unless otherwise specified.

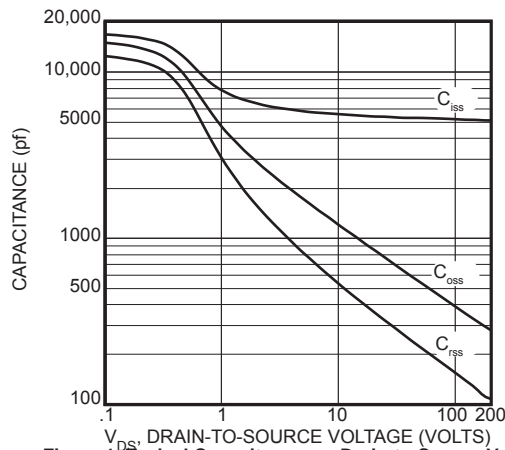


Figure 1, Typical Capacitance vs. Drain-to-Source Voltage

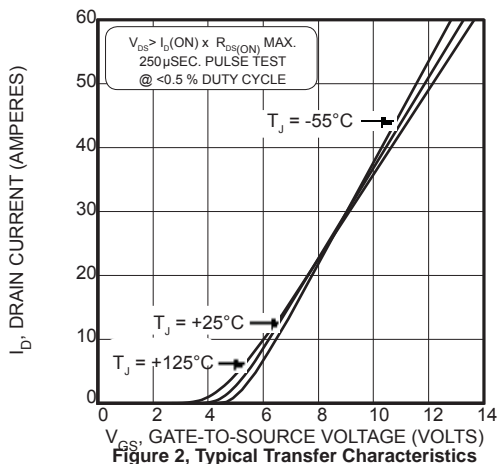


Figure 2, Typical Transfer Characteristics

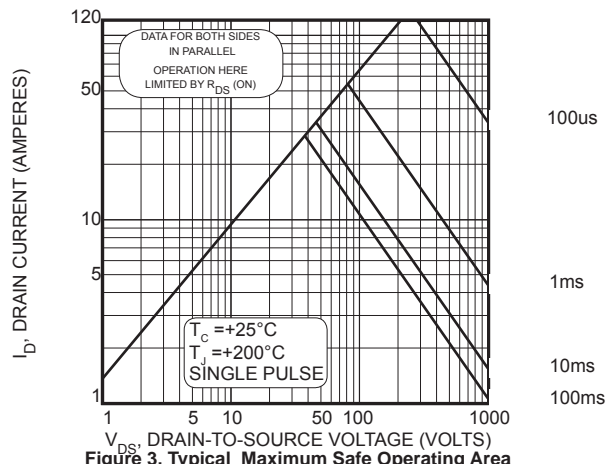


Figure 3, Typical Maximum Safe Operating Area

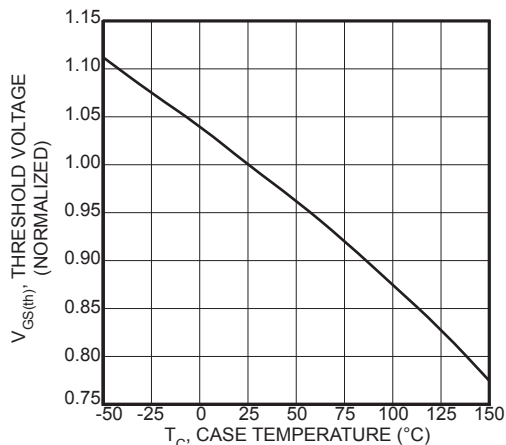


Figure 4, Typical Threshold Voltage vs Temperature

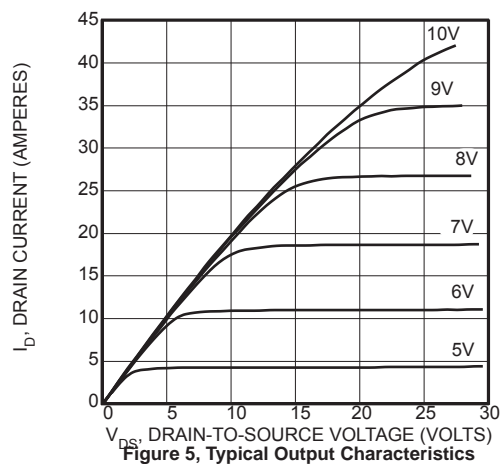


Figure 5, Typical Output Characteristics

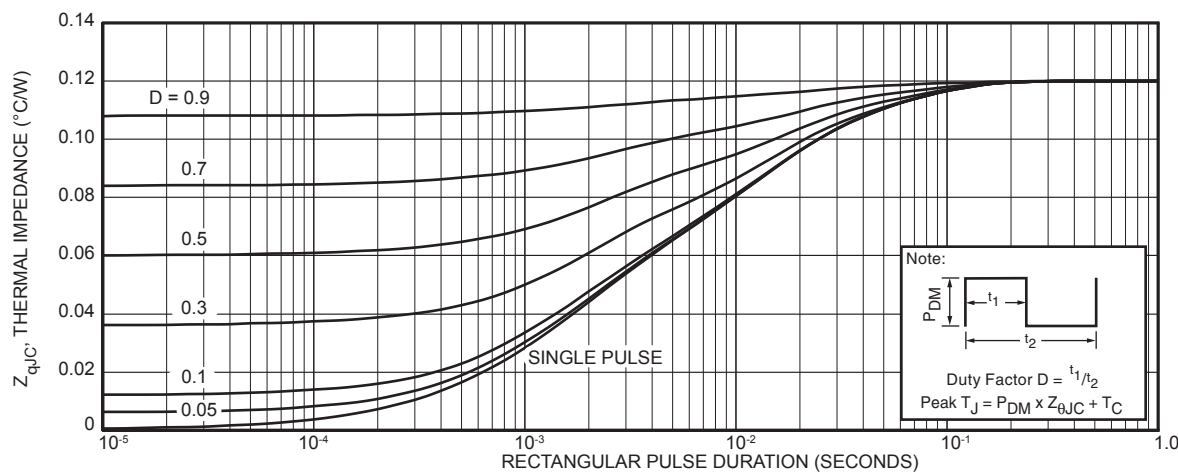


Figure 6, Maximum Effective Transient Thermal Impedance, Junction-to-Case vs. Pulse Duration

Table 1 - Typical Class AB Large Signal Impedance -- ARF1501

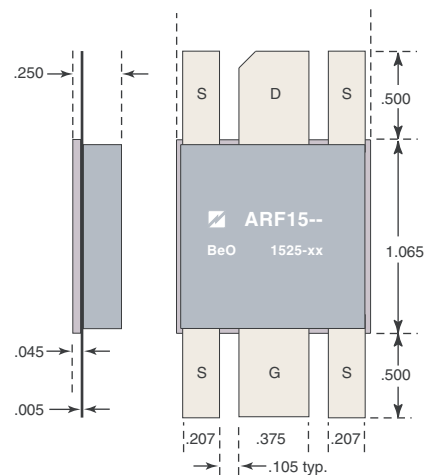
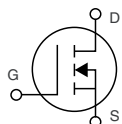
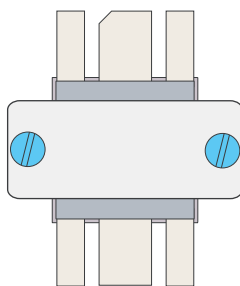
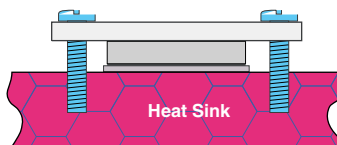
| F (MHz) | Z _{in} (Ω) | Z _{OL} (Ω) |
|---------|---------------------|---------------------|
| 2.0 | 10.6 -j 12.2 | 31 -j 4.7 |
| 13.5 | 0.5 -j 2.7 | 15.6 -j 16 |
| 27 | 0.22 -j 0.8 | 6.2 -j 12.6 |
| 40 | 0.2 +j .12 | 3.1 -j 9.4 |

Z_{in} - Gate shunted with 25Ω I_{DQ} = 100mA
 Z_{OL} - Conjugate of optimum load for 750 Watts output at V_{dd} = 250V

Thermal Considerations and Package Mounting:

The rated 1500W power dissipation is only available when the package mounting surface is at 25°C and the junction temperature is 200°C. The thermal resistance between junctions and case mounting surface is 0.12°C/W. When installed, an additional thermal impedance of 0.1°C/W between the package base and the mounting surface is typical. Insure that the mounting surface is smooth and flat. Thermal joint compound must be used to reduce the effects of small surface irregularities. The heatsink should incorporate a copper heat spreader to obtain best results.

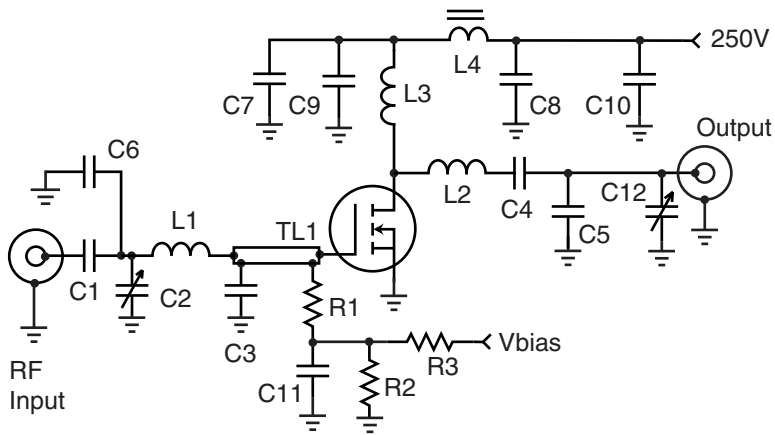
The package is designed to be clamped to a heatsink. A clamped joint maintains the required mounting pressure while allowing for thermal expansion of both the device and the heat sink. A simple clamp, and two 6-32 (M3.5) screws can provide the minimum 125lb required mounting force. T = 12 in-lb.



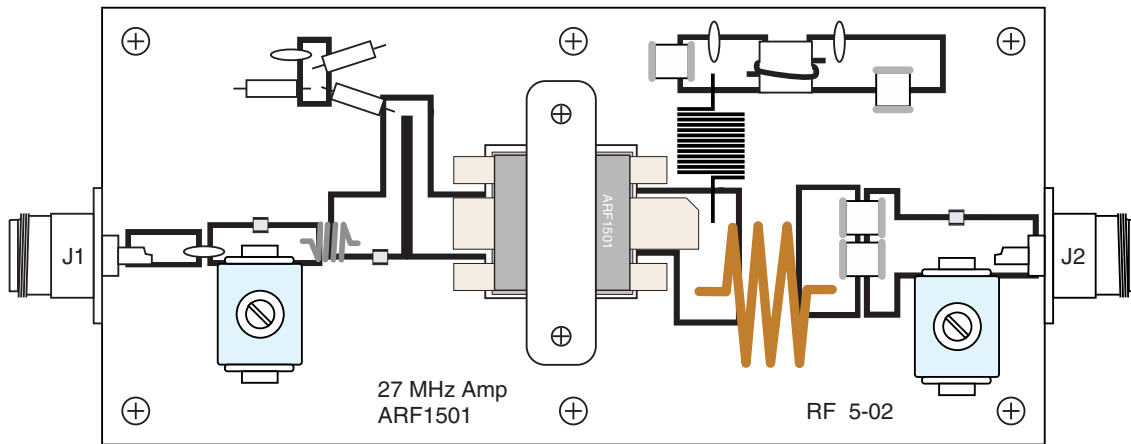
HAZARDOUS MATERIAL WARNING

The ceramic portion of the device between leads and mounting surface is beryllium oxide, BeO. Beryllium oxide dust is toxic when inhaled. Care must be taken during handling and mounting to avoid damage to this area. These devices must never be thrown away with general industrial or domestic waste.

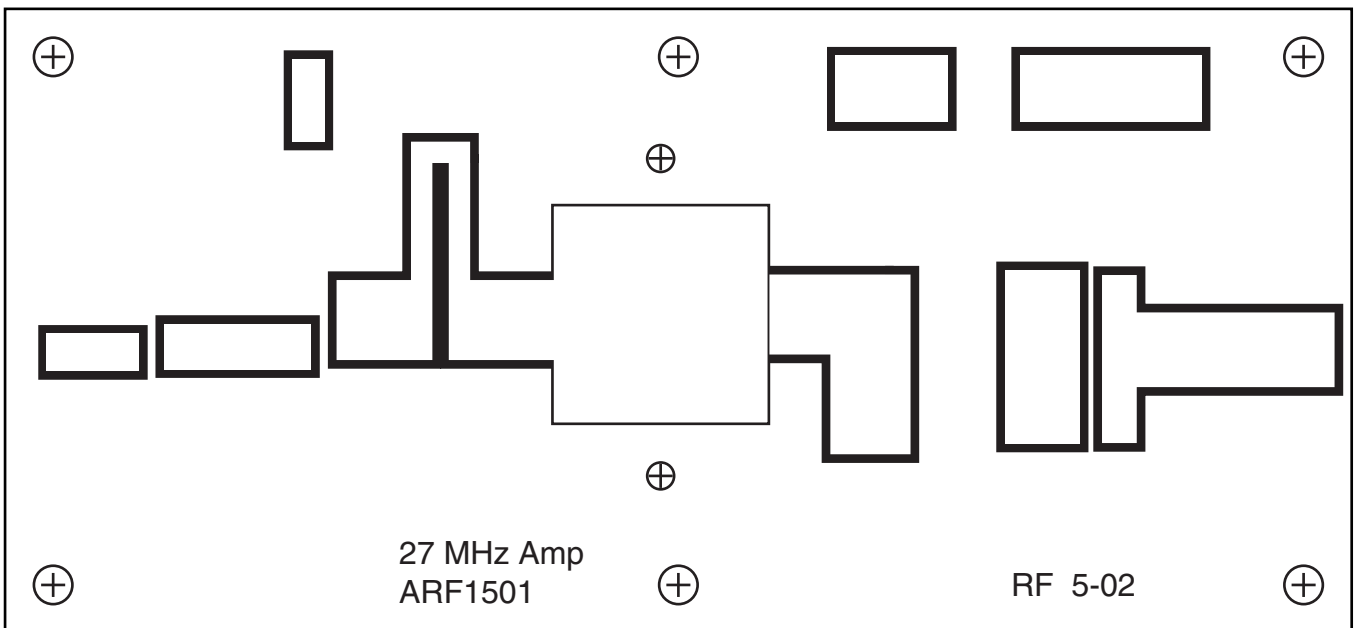
ARF1501 -- 27.12 MHz Test Circuit



- C1, C7, C8, C11 .1uF 250V ceramic chip
- C2, C12 ARCO 465 75-380pF mica trimmer
- C3 4700pF ATC700B
- C4, C9-C11 8200pF 500V NPO ceramic
- C5 - C6 150pF ATC 700B
- L1 90 nH 4t #18 0.25"d .25"l
- L2 175 nH - 3t #10 .75" dia .75" l
- L3 2uH - 22t #24 enam. .312" dia.
- L4 500nH 2t on 850u .5" bead
- R1-R3 1k Ω 1/4W
- TL1 .112" x 1.2" (50 Ω) Stripline



Parts placement



1:1 pcb artwork