Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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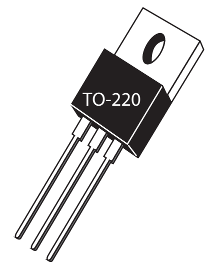
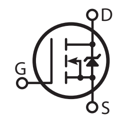
## N-Channel FREDFET

Power MOS 8™ is a high speed, high voltage N-channel switch-mode power MOSFET. This 'FREDFET' version has a drain-source (body) diode that has been optimized for high reliability in ZVS phase shifted bridge and other circuits through reduced $t_{rr}$, soft recovery, and high recovery dv/dt capability. Low gate charge, high gain, and a greatly reduced ratio of $C_{rss}/C_{iss}$ result in excellent noise immunity and low switching loss. The intrinsic gate resistance and capacitance of the poly-silicon gate structure help control di/dt during switching, resulting in low EMI and reliable paralleling, even when switching at very high frequency.




**APT4F120K**

Single die FREDFET




## FEATURES

- **Fast switching with low EMI**
- **Low $t_{rr}$ for high reliability**
- **Ultra low $C_{rss}$ for improved noise immunity**
- **Low gate charge**
- **Avalanche energy rated**
- **RoHS compliant**

## TYPICAL APPLICATIONS

- **ZVS phase shifted and other full bridge**
- **Half bridge**
- **PFC and other boost converter**
- **Buck converter**
- **Single and two switch forward**
- **Flyback**

### Absolute Maximum Ratings

| Symbol | Parameter | Ratings | Unit |
|---|---|---|---|
| $I_D$ | Continuous Drain Current @ $T_C$ = 25°C | 4 | A |
| | Continuous Drain Current @ $T_C$ = 100°C | 3 | |
| $I_{DM}$ | Pulsed Drain Current① | 15 | |
| $V_{GS}$ | Gate - Source Voltage | ±30 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy② | 310 | mJ |
| $I_{AR}$ | Avalanche Current, Repetitive or Non-Repetitive | 2 | A |

### Thermal and Mechanical Characteristics

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $P_D$ | Total Power Dissipation @ $T_C$ = 25°C | - | - | 225 | W |
| $R_{\theta JC}$ | Junction to Case Thermal Resistance | - | - | .56 | °C/W |
| $R_{\theta CS}$ | Case to Sink Thermal Resistance, Flat, Greased Surface | - | .11 | - | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | -55 | - | 150 | °C |
| $T_L$ | Soldering Temperature for 10 Seconds (1.6mm from case) | - | - | 300 | |
| $W_T$ | Package Weight | - | 0.07 | - | oz |
| | | - | 1.22 | - | g |
| Torque | Mounting Torque (TO-220 Package), 4-40 or M3 screw | - | - | 10 | in·lbf |
| | | - | - | 1.1 | N·m |

## Static Characteristics $T_J$ = 25°C unless otherwise specified

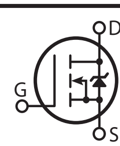


| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{BR(DSS)}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250µA | | 1200 | | | V |
| $\Delta V_{BR(DSS)}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | Reference to 25°C, $I_D$ = 250µA | | | 1.41 | | V/°C |
| $R_{DS(on)}$ | Drain-Source On Resistance ③ | $V_{GS}$ = 10V, $I_D$ = 2A | | | 3.42 | 4.2 | Ω |
| $V_{GS(th)}$ | Gate-Source Threshold Voltage | $V_{GS} = V_{DS}$, $I_D$ = 0.5mA | | 2.5 | 4 | 5 | V |
| $\Delta V_{GS(th)}/\Delta T_J$ | Threshold Voltage Temperature Coefficient | | | | -10 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 1200V<br>$V_{GS}$ = 0V | $T_J$ = 25°C | | | 250 | µA |
| | | | $T_J$ = 125°C | | | 1000 | |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$ = ±30V | | | | ±100 | nA |

## Dynamic Characteristics $T_J$ = 25°C unless otherwise specified

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ | Forward Transconductance | $V_{DS}$ = 50V, $I_D$ = 2A | | 4.5 | | S |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 25V<br>f = 1MHz | | 1385 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 17 | | |
| $C_{oss}$ | Output Capacitance | | | 100 | | |
| $C_{o(cr)}$ ④ | Effective Output Capacitance, Charge Related | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 800V | | 40 | | |
| $C_{o(er)}$ ⑤ | Effective Output Capacitance, Energy Related | | | 20 | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 to 10V, $I_D$ = 2A,<br>$V_{DS}$ = 600V | | 43 | | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 7 | | |
| $Q_{gd}$ | Gate-Drain Charge | | | 20 | | |
| $t_{d(on)}$ | Turn-On Delay Time | **Resistive Switching**<br>$V_{DD}$ = 800V, $I_D$ = 2A<br>$R_G$ = 10Ω ⑥, $V_{GG}$ = 15V | | 7.4 | | ns |
| $t_r$ | Current Rise Time | | | 4.4 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 24 | | |
| $t_f$ | Current Fall Time | | | 6.9 | | |

## Source-Drain Diode Characteristics

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | MOSFET symbol showing the integral reverse p-n junction diode (body diode)   | | | | 4 | A |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | | | | | 15 | |
| $V_{SD}$ | Diode Forward Voltage | $I_{SD}$ = 2A, $T_J$ = 25°C, $V_{GS}$ = 0V | | | 0.8 | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$ = 2A ③,<br>$di_{SD}/dt$ = 100A/µs,<br>$V_{DD}$ = 100V | $T_J$ = 25°C | | 170 | 195 | nS |
| | | | $T_J$ = 125°C | | 330 | 400 | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_J$ = 25°C | | .370 | | µC |
| | | | $T_J$ = 125°C | | .820 | | |
| $I_{rrm}$ | Reverse Recovery Current | | $T_J$ = 25°C | | 4.90 | | A |
| | | | $T_J$ = 125°C | | 5.40 | | |
| dv/dt | Peak Recovery dv/dt | $I_{SD}$ ≤ 2A, di/dt≤1000Aµs, $V_{DD}$ = 800V,<br>$T_J$ = 125°C | | | | 20 | V/ns |

① Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.
② Starting at $T_J$ = 25°C, L = 155.0mH, $R_G$ = 25Ω, $I_{AS}$ = 2A.
③ Pulse test: Pulse Width < 380µs, duty cycle < 2%.
④ $C_{o(cr)}$ is defined as a fixed capacitance with the same stored charge as $C_{OSS}$ with $V_{DS}$ = 67% of $V_{(BR)DSS}$.
⑤ $C_{o(er)}$ is defined as a fixed capacitance with the same stored energy as $C_{OSS}$ with $V_{DS}$ = 67% of $V_{(BR)DSS}$. To calculate $C_{o(er)}$ for any value of $V_{DS}$ less than $V_{(BR)DSS,}$ use this equation: $C_{o(er)} = -8.32E-8/V_{DS}\hat{}2 + 3.49E-8/V_{DS} + 1.30E-10$.
⑥ $R_G$ is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)

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

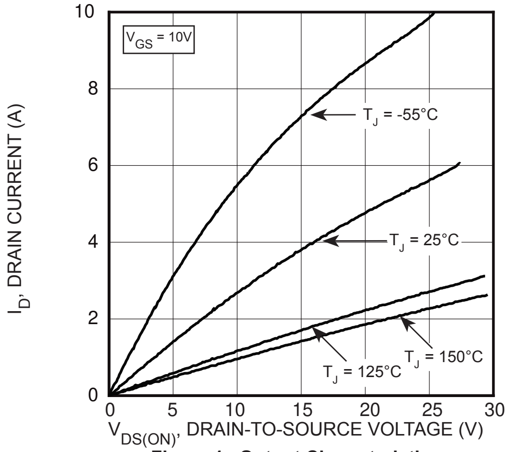



**Figure 1, Output Characteristics**

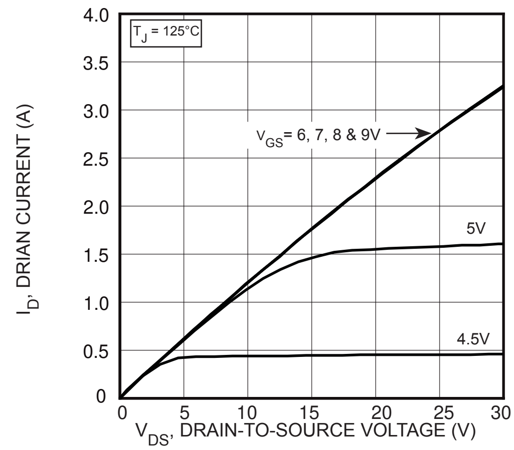



**Figure 2, Output Characteristics**

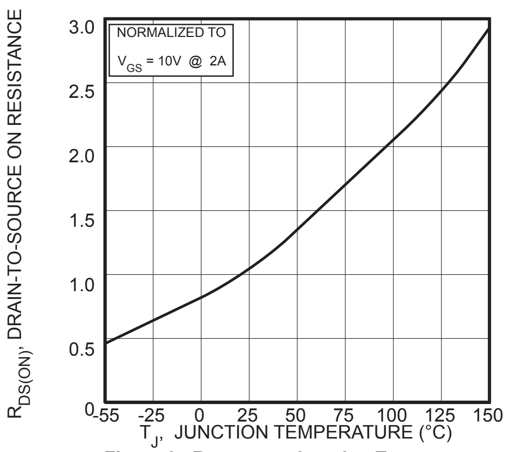



**Figure 3, $R_{DS(ON)}$ vs Junction Temperature**

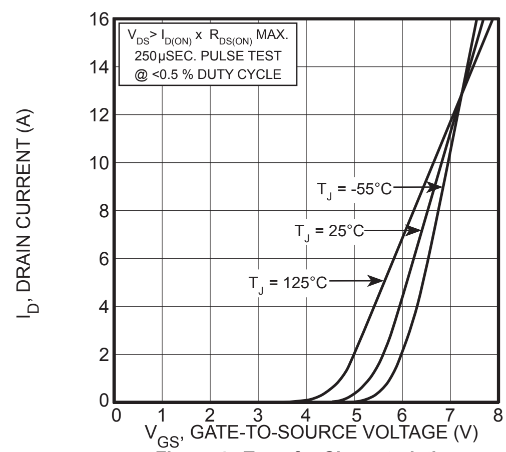



**Figure 4, Transfer Characteristics**

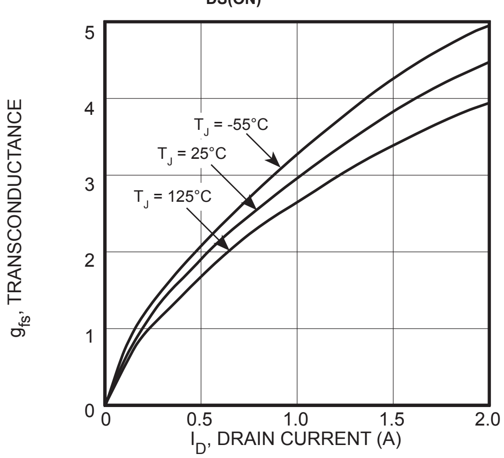



**Figure 5, Gain vs Drain Current**

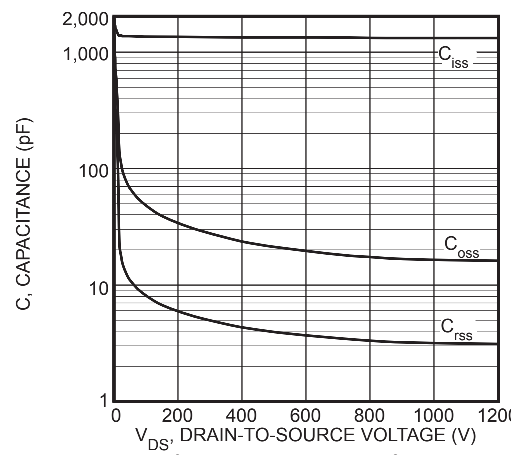



**Figure 6, Capacitance vs Drain-to-Source Voltage**

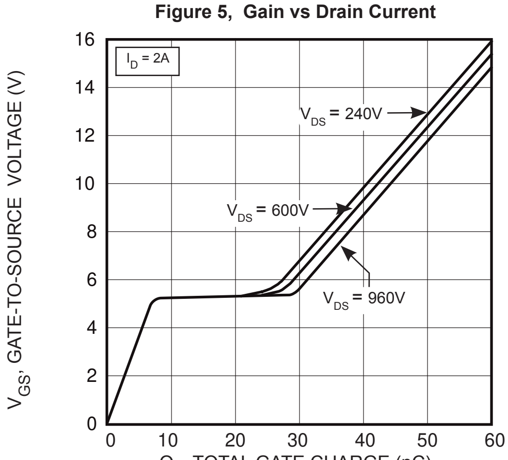



**Figure 7, Gate Charge vs Gate-to-Source Voltage**

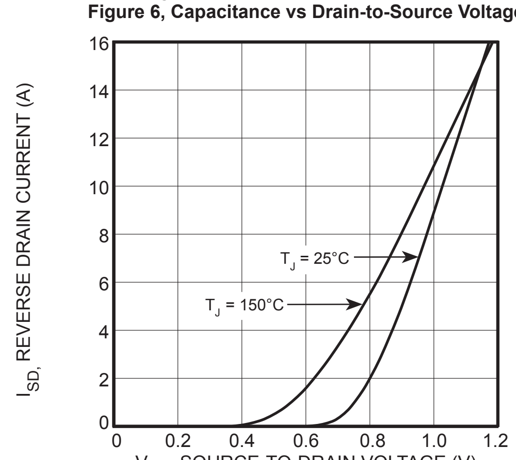



**Figure 8, Reverse Drain Current vs Source-to-Drain Voltage**

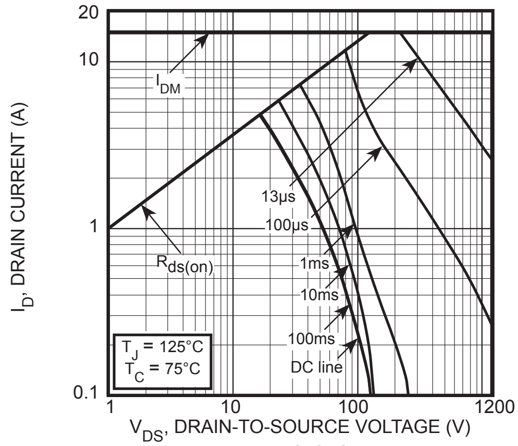



**Figure 9, Forward Safe Operating Area**

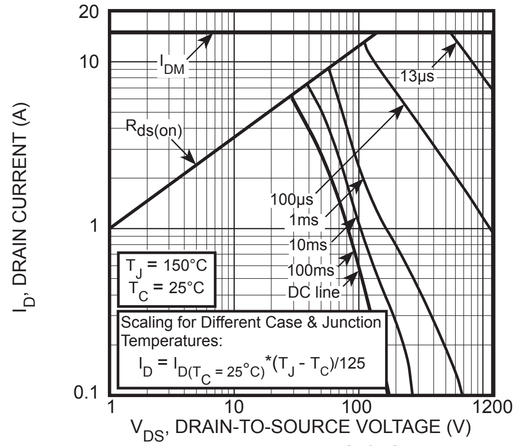



**Figure 10, Maximum Forward Safe Operating Area**

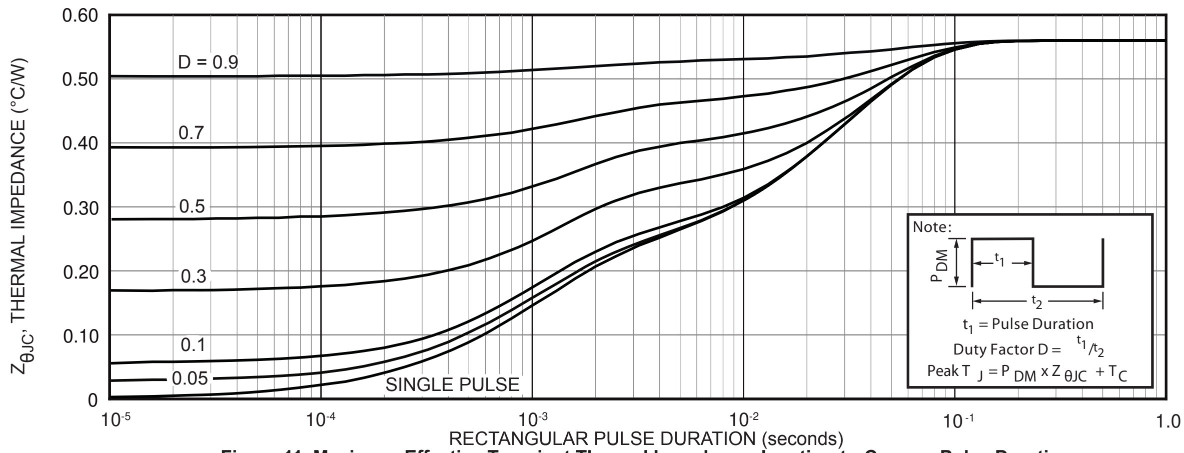
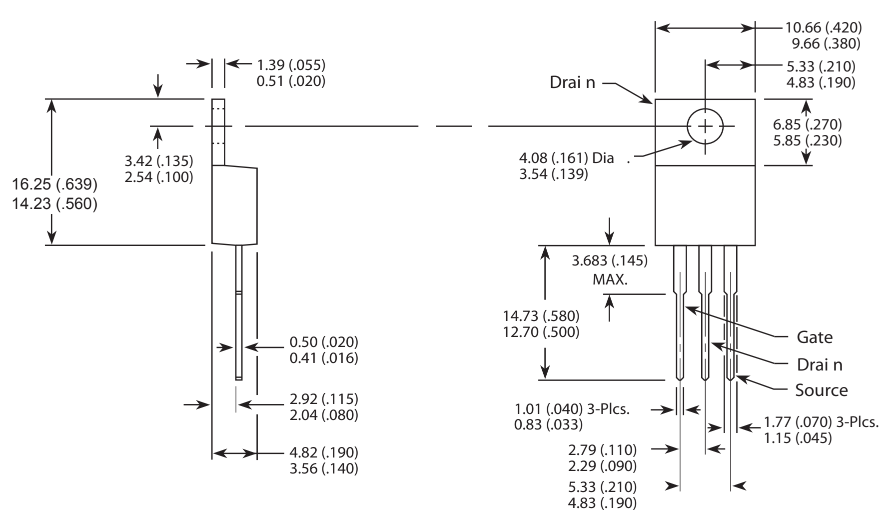



**Figure 11. Maximum Effective Transient Thermal Impedance Junction-to-Case vs Pulse Duration**

## TO-220 (K) Package Outline

e3 100% Sn Plated




Dimensions in Millimeters and (Inches)