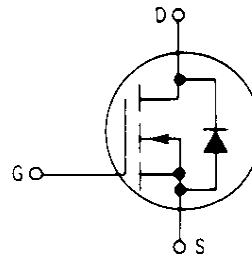


# Power Field Effect Transistor

## N-Channel Enhancement-Mode Silicon Gate

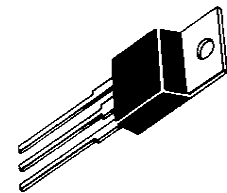
This TMOS Power FET is designed for low voltage, high speed power switching applications such as switching regulators, converters, solenoid and relay drivers.

- Silicon Gate for Fast Switching Speeds
- Low  $R_{DS(on)}$  to Minimize On-Losses. Specified at Elevated Temperature
- Rugged — SOA is Power Dissipation Limited
- Source-to-Drain Diode Characterized for Use With Inductive Loads



**IRF640**

TMOS POWER FET  
18 AMPERES  
 $R_{DS(on)} = 0.18 \text{ OHM}$   
200 VOLTS



CASE 221A-06  
(TO-220AB)

### MAXIMUM RATINGS

| Rating  | Symbol         | Value      | Unit                         |
|---|----------------|------------|------------------------------|
| Drain-Source Voltage  | $V_{DSS}$      | 200        | Vdc                          |
| Drain-Gate Voltage<br>( $R_{GS} = 20 \text{ k}\Omega$ )                               | $V_{DGR}$      | 200        | Vdc                          |
| Gate-Source Voltage   | $V_{GS}$       | $\pm 20$   | Vdc                          |
| Drain Current   | $I_D$          |            | Adc                          |
| Continuous, $T_C = 25^\circ\text{C}$  |                | 18         |                              |
| Peak, $T_C = 25^\circ\text{C}$  |                | 72         |                              |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 125<br>1   | Watts<br>W/ $^\circ\text{C}$ |
| Operating and Storage Temperature Range   | $T_J, T_{stg}$ | -55 to 150 | $^\circ\text{C}$             |

### THERMAL CHARACTERISTICS

|   |                                    |           |                    |
|---|------------------------------------|-----------|--------------------|
| Thermal Resistance — Junction to Case<br>— Junction to Ambient              | $R_{\theta JC}$<br>$R_{\theta JA}$ | 1<br>62.5 | $^\circ\text{C/W}$ |
| Maximum Lead Temp. for Soldering Purposes,<br>1/8" from Case for 10 Seconds | $T_L$                              | 260       | $^\circ\text{C}$   |

See the MTP20N20E Designer's Data Sheet for a complete set of design curves for the product on this data sheet.

**ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

| Characteristic  | Symbol        | Min | Max      | Unit |
|---|---------------|-----|----------|------|
| <b>OFF CHARACTERISTICS</b>  |               |     |          |      |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0, I_D = 0.25 \text{ mA}$ )   | $V_{(BR)DSS}$ | 200 | —        | Vdc  |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = \text{Rated } V_{DSS}, V_{GS} = 0$ )<br>( $V_{DS} = 0.8 \text{ Rated } V_{DSS}, V_{GS} = 0, T_J = 125^\circ\text{C}$ ) | $I_{DSS}$     | —   | 0.2<br>1 | mAdc |
| Gate-Body Leakage Current, Forward<br>( $V_{GSF} = 20 \text{ Vdc}, V_{DS} = 0$ )  | $I_{GSSF}$    | —   | 100      | nAdc |
| Gate-Body Leakage Current, Reverse<br>( $V_{GSR} = 20 \text{ Vdc}, V_{DS} = 0$ )  | $I_{GSSR}$    | —   | 100      | nAdc |

**ON CHARACTERISTICS\***

|  |              |    |      |      |
|--|--------------|----|------|------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}, I_D = 0.25 \text{ mA}$ )                   | $V_{GS(th)}$ | 2  | 4    | Vdc  |
| Static Drain-Source On-Resistance<br>( $V_{GS} = 10 \text{ Vdc}, I_D = 10 \text{ Adc}$ ) | $R_{DS(on)}$ | —  | 0.18 | Ohm  |
| On-State Drain Current ( $V_{GS} = 10 \text{ V}$ )<br>( $V_{DS} \geq 3.2 \text{ Vdc}$ )  | $I_{D(on)}$  | 18 | —    | Adc  |
| Forward Transconductance<br>( $V_{DS} \geq 3.2 \text{ V}, I_D = 10 \text{ A}$ )          | $g_{FS}$     | 6  | —    | mhos |

**DYNAMIC CHARACTERISTICS**

|                              |  |           |   |      |    |
|------------------------------|--|-----------|---|------|----|
| Input Capacitance            | $(V_{DS} = 25 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz})$ | $C_{iss}$ | — | 1600 | pF |
| Output Capacitance           |  | $C_{oss}$ | — | 750  |    |
| Reverse Transfer Capacitance |  | $C_{rss}$ | — | 300  |    |

**SWITCHING CHARACTERISTICS\***

|                     |   |              |          |    |    |
|---------------------|---|--------------|----------|----|----|
| Turn-On Delay Time  | $(V_{DD} \approx 30 \text{ V}, I_D = 15 \text{ Apk}, R_{gen} = 4.7 \text{ Ohms})$         | $t_{d(on)}$  | —        | 30 | ns |
| Rise Time           |   | $t_r$        | —        | 60 |    |
| Turn-Off Delay Time |   | $t_{d(off)}$ | —        | 80 |    |
| Fall Time           |   | $t_f$        | —        | 60 |    |
| Total Gate Charge   | $(V_{DS} = 0.8 \text{ Rated } V_{DSS}, V_{GS} = 10 \text{ Vdc}, I_D = \text{Rated } I_D)$ | $Q_g$        | 36 (Typ) | 60 | nC |
| Gate-Source Charge  |   | $Q_{gs}$     | 16 (Typ) | —  |    |
| Gate-Drain Charge   |   | $Q_{gd}$     | 22 (Typ) | —  |    |

**SOURCE DRAIN DIODE CHARACTERISTICS\***

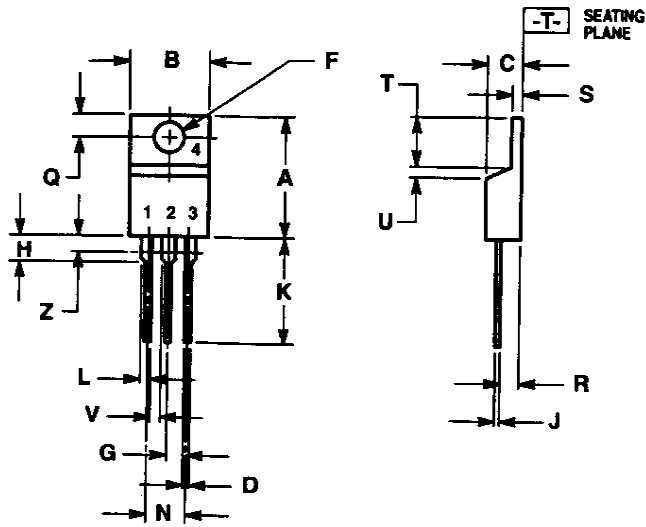
|                       |   |          |                             |     |     |
|-----------------------|---|----------|-----------------------------|-----|-----|
| Forward On-Voltage    | $(I_S = \text{Rated } I_D, V_{GS} = 0)$ | $V_{SD}$ | 1.8 (Typ)                   | 2.0 | Vdc |
| Forward Turn-On Time  |   | $t_{on}$ | Limited by stray inductance |     |     |
| Reverse Recovery Time |   | $t_{rr}$ | 450 (Typ)                   | —   | ns  |

**INTERNAL PACKAGE INDUCTANCE**

|  |       |                        |   |    |
|--|-------|------------------------|---|----|
| Internal Drain Inductance<br>(Measured from the contact screw on tab to center of die)<br>(Measured from the drain lead 0.25" from package to center of die) | $L_d$ | 3.5 (Typ)<br>4.5 (Typ) | — | nH |
| Internal Source Inductance<br>(Measured from the source lead 0.25" from package to source bond pad)  | $L_s$ | 7.5 (Typ)              | — |    |

\*Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

**PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)**

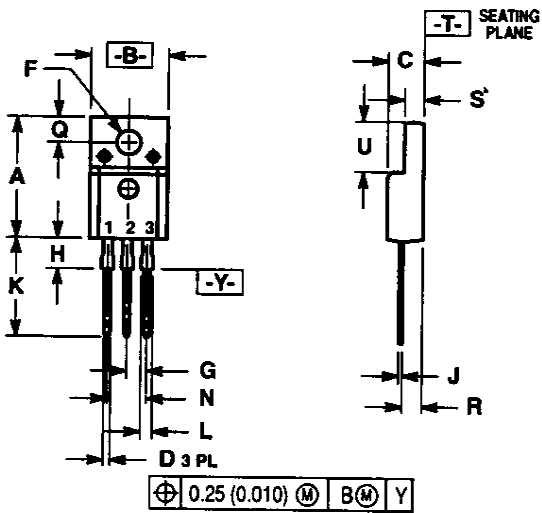


STYLE 5:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.  
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.035 | 0.64        | 0.88  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.018  | 0.025 | 0.46        | 0.64  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 0.060  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.060  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | —     | 1.15        | —     |
| Z   | —      | 0.080 | —           | 2.04  |

**CASE 221A-06  
(TO-220AB)  
ISSUE Y**



STYLE 1:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.621     | 0.629 | 15.78       | 15.97 |
| B   | 0.394     | 0.402 | 10.01       | 10.21 |
| C   | 0.181     | 0.189 | 4.60        | 4.80  |
| D   | 0.026     | 0.034 | 0.67        | 0.86  |
| F   | 0.121     | 0.129 | 3.08        | 3.27  |
| G   | 0.100 BSC | —     | 2.54 BSC    | —     |
| H   | 0.123     | 0.129 | 3.13        | 3.27  |
| J   | 0.018     | 0.025 | 0.46        | 0.64  |
| K   | 0.500     | 0.562 | 12.70       | 14.27 |
| L   | 0.045     | 0.060 | 1.14        | 1.52  |
| N   | 0.200 BSC | —     | 5.08 BSC    | —     |
| Q   | 0.126     | 0.134 | 3.21        | 3.40  |
| R   | 0.107     | 0.111 | 2.72        | 2.81  |
| S   | 0.096     | 0.104 | 2.44        | 2.64  |
| U   | 0.259     | 0.267 | 6.58        | 6.78  |

**CASE 221D-02  
(ISOLATE TO-220 TYPE)  
ISSUE D**

⊕ 0.25 (0.010) (M) B(M) Y