

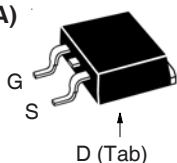
## Polar3™ HiperFET™ Power MOSFET

N-Channel Enhancement Mode  
Avalanche Rated  
Fast Intrinsic Rectifier

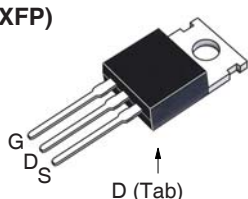
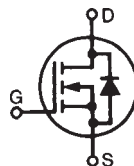
**IXFA22N60P3**  
**IXFP22N60P3**  
**IXFQ22N60P3**  
**IXFH22N60P3**

$$\begin{aligned} V_{DSS} &= 600V \\ I_{D25} &= 22A \\ R_{DS(on)} &\leq 390m\Omega \end{aligned}$$

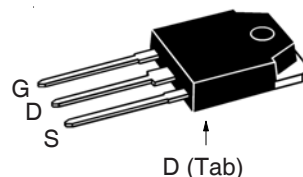
TO-263 (IXFA)



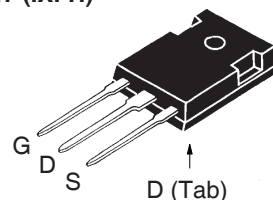
TO-220 (IXFP)



TO-3P (IXFQ)



TO-247 (IXFH)



G = Gate      D = Drain  
S = Source      Tab = Drain

| Symbol     | Test Conditions                                                    | Maximum Ratings    |                  |
|------------|--------------------------------------------------------------------|--------------------|------------------|
| $V_{DSS}$  | $T_J = 25^\circ\text{C to } 150^\circ\text{C}$                     | 600                | V                |
| $V_{DGR}$  | $T_J = 25^\circ\text{C to } 150^\circ\text{C}, R_{GS} = 1M\Omega$  | 600                | V                |
| $V_{GSS}$  | Continuous                                                         | $\pm 30$           | V                |
| $V_{GSM}$  | Transient                                                          | $\pm 40$           | V                |
| $I_{D25}$  | $T_C = 25^\circ\text{C}$                                           | 22                 | A                |
| $I_{DM}$   | $T_C = 25^\circ\text{C}$ , Pulse Width Limited by $T_{JM}$         | 55                 | A                |
| $I_A$      | $T_C = 25^\circ\text{C}$                                           | 11                 | A                |
| $E_{AS}$   | $T_C = 25^\circ\text{C}$                                           | 400                | mJ               |
| $dv/dt$    | $I_S \leq I_{DM}, V_{DD} \leq V_{DSS}, T_J \leq 150^\circ\text{C}$ | 35                 | V/ns             |
| $P_D$      | $T_C = 25^\circ\text{C}$                                           | 500                | W                |
| $T_J$      |                                                                    | -55 ... +150       | $^\circ\text{C}$ |
| $T_{JM}$   |                                                                    | 150                | $^\circ\text{C}$ |
| $T_{stg}$  |                                                                    | -55 ... +150       | $^\circ\text{C}$ |
| $T_L$      | Maximum Lead Temperature for Soldering                             | 300                | $^\circ\text{C}$ |
| $T_{SOLD}$ | 1.6 mm (0.062in.) from Case for 10s                                | 260                | $^\circ\text{C}$ |
| $F_C$      | Mounting Force (TO-263)                                            | 10..65 / 2.2..14.6 | N/lb             |
| $M_d$      | Mounting Torque (TO-247, TO-220 & TO-3P)                           | 1.13 / 10          | Nm/lb.in         |
| Weight     | TO-263                                                             | 2.5                | g                |
|            | TO-220                                                             | 3.0                | g                |
|            | TO-3P                                                              | 5.5                | g                |
|            | TO-247                                                             | 6.0                | g                |

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified) | Characteristic Values |      |                  |
|--------------|---------------------------------------------------------------------------|-----------------------|------|------------------|
|              |                                                                           | Min.                  | Typ. | Max.             |
| $BV_{DSS}$   | $V_{GS} = 0V, I_D = 1mA$                                                  | 600                   |      | V                |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 1.5mA$                                            | 3.0                   |      | 5.0 V            |
| $I_{GSS}$    | $V_{GS} = \pm 30V, V_{DS} = 0V$                                           |                       |      | $\pm 100$ nA     |
| $I_{DSS}$    | $V_{DS} = V_{DSS}, V_{GS} = 0V$<br>$T_J = 125^\circ\text{C}$              |                       |      | 25 $\mu\text{A}$ |
|              |                                                                           |                       |      | 1.25 mA          |
| $R_{DS(on)}$ | $V_{GS} = 10V, I_D = 0.5 \cdot I_{D25}$ , Note 1                          |                       |      | 390 m $\Omega$   |

### Features

- Fast Intrinsic Rectifier
- Avalanche Rated
- Low  $R_{DS(ON)}$  and  $Q_G$
- Low Package Inductance

### Advantages

- High Power Density
- Easy to Mount
- Space Savings

### Applications

- Switch-Mode and Resonant-Mode Power Supplies
- DC-DC Converters
- Laser Drivers
- AC and DC Motor Drives
- Robotics and Servo Controls

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                                                                            | Characteristic Values |      |                        |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|------------------------|
|              |                                                                                                                                                      | Min.                  | Typ. | Max.                   |
| $g_{fs}$     | $V_{DS} = 20\text{V}, I_D = 0.5 \cdot I_{D25}, \text{Note 1}$                                                                                        | 14                    | 24   | S                      |
| $C_{iss}$    | $V_{GS} = 0\text{V}, V_{DS} = 25\text{V}, f = 1\text{MHz}$                                                                                           |                       | 2600 | pF                     |
| $C_{oss}$    |                                                                                                                                                      |                       | 265  | pF                     |
| $C_{rss}$    |                                                                                                                                                      |                       | 3.4  | pF                     |
| $R_{Gi}$     | Gate Input Resistance                                                                                                                                |                       | 2.1  | $\Omega$               |
| $t_{d(on)}$  | <b>Resistive Switching Times</b><br>$V_{GS} = 10\text{V}, V_{DS} = 0.5 \cdot V_{DSS}, I_D = 0.5 \cdot I_{D25}$<br>$R_G = 1\Omega \text{ (External)}$ |                       | 28   | ns                     |
| $t_r$        |                                                                                                                                                      |                       | 17   | ns                     |
| $t_{d(off)}$ |                                                                                                                                                      |                       | 54   | ns                     |
| $t_f$        |                                                                                                                                                      |                       | 19   | ns                     |
| $Q_{g(on)}$  | $V_{GS} = 10\text{V}, V_{DS} = 0.5 \cdot V_{DSS}, I_D = 0.5 \cdot I_{D25}$                                                                           |                       | 38   | nC                     |
| $Q_{gs}$     |                                                                                                                                                      |                       | 10   | nC                     |
| $Q_{gd}$     |                                                                                                                                                      |                       | 11   | nC                     |
| $R_{thJC}$   | (TO-220)<br>(TO-247 & TO-3P)                                                                                                                         |                       | 0.50 | $0.25^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                                                                                      |                       | 0.25 | $^\circ\text{C/W}$     |

#### Source-Drain Diode

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                       | Characteristic Values |      |               |
|----------|-------------------------------------------------------------------------------------------------|-----------------------|------|---------------|
|          |                                                                                                 | Min.                  | Typ. | Max.          |
| $I_S$    | $V_{GS} = 0\text{V}$                                                                            |                       |      | 22 A          |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$                                                     |                       |      | 88 A          |
| $V_{SD}$ | $I_F = I_S, V_{GS} = 0\text{V}, \text{Note 1}$                                                  |                       |      | 1.4 V         |
| $t_{rr}$ | $I_F = 11\text{A}, -di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}, V_{GS} = 0\text{V}$ |                       |      | 250 ns        |
| $I_{RM}$ |                                                                                                 |                       | 8.0  | A             |
| $Q_{RM}$ |                                                                                                 |                       | 0.8  | $\mu\text{C}$ |

Note 1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .

IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

|           |           |           |           |              |              |              |              |              |             |
|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 4,835,592 | 4,931,844 | 5,049,961 | 5,237,481 | 6,162,665    | 6,404,065 B1 | 6,683,344    | 6,727,585    | 7,005,734 B2 | 7,157,338B2 |
| 4,860,072 | 5,017,508 | 5,063,307 | 5,381,025 | 6,259,123 B1 | 6,534,343    | 6,710,405 B2 | 6,759,692    | 7,063,975 B2 |             |
| 4,881,106 | 5,034,796 | 5,187,117 | 5,486,715 | 6,306,728 B1 | 6,583,505    | 6,710,463    | 6,771,478 B2 | 7,071,537    |             |

Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$

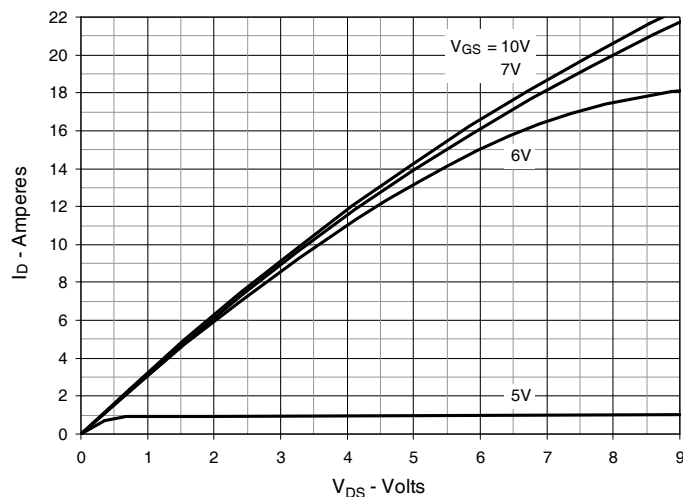


Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$

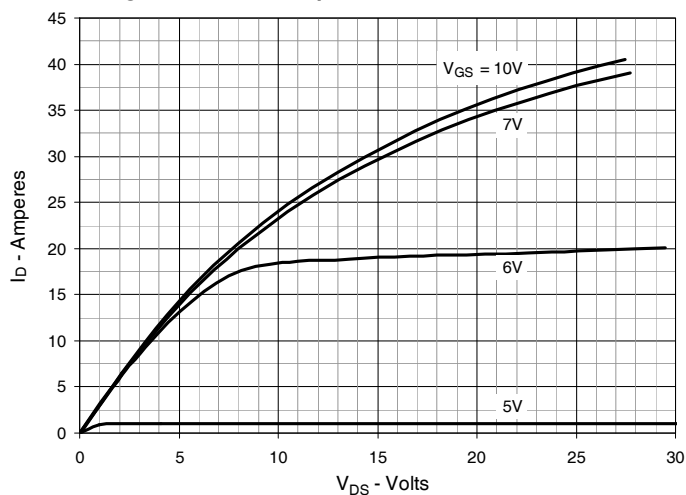


Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$

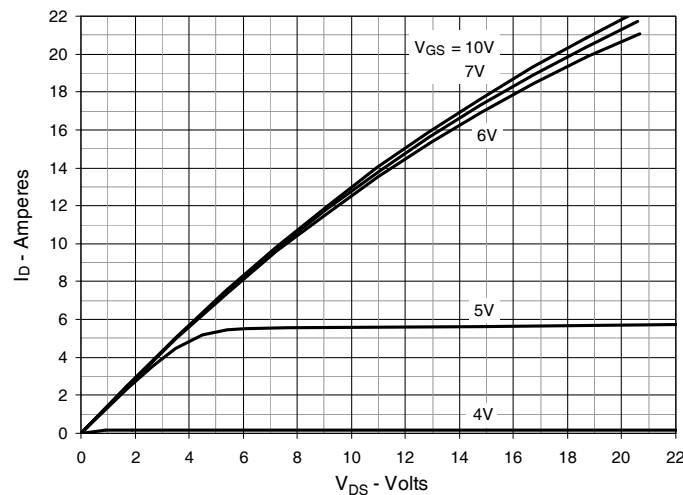


Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 11\text{A}$  Value vs. Junction Temperature

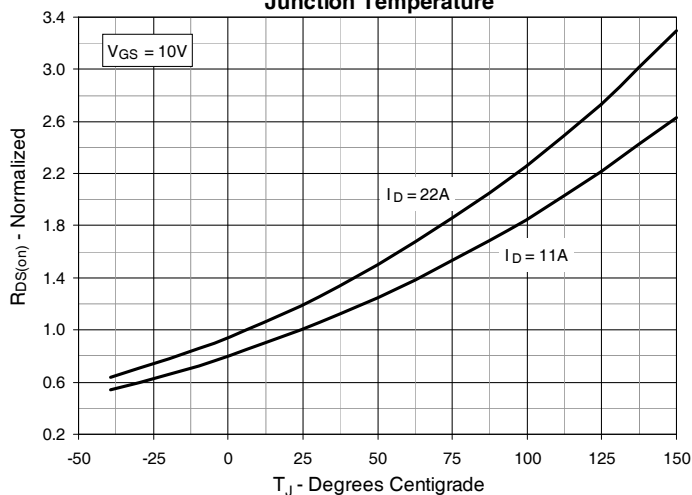


Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 11\text{A}$  Value vs. Drain Current

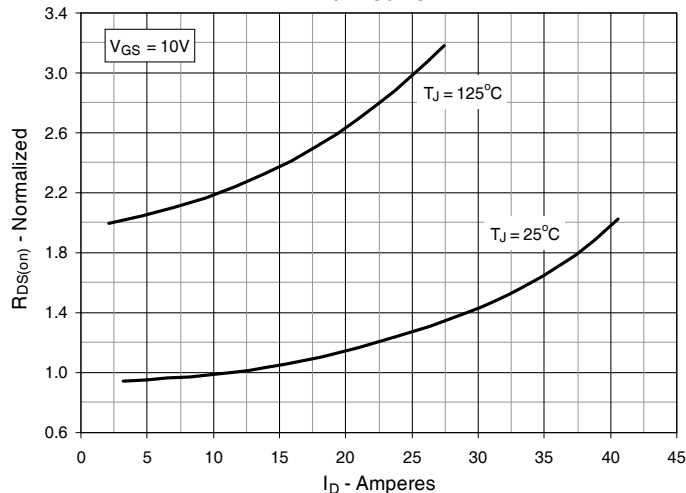


Fig. 6. Maximum Drain Current vs. Case Temperature

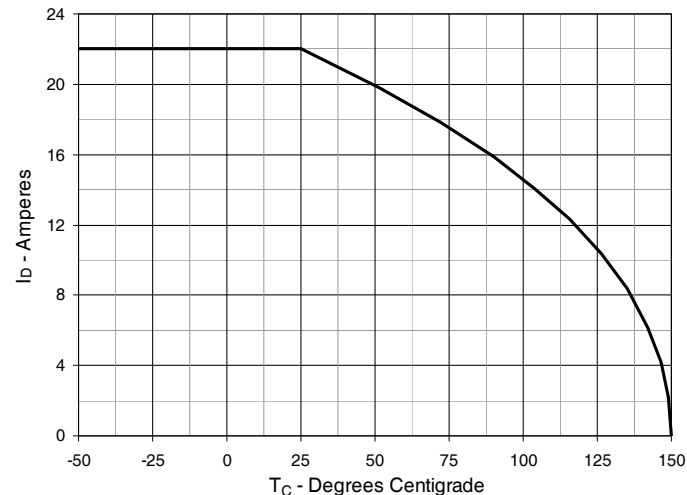


**Fig. 7. Input Admittance**

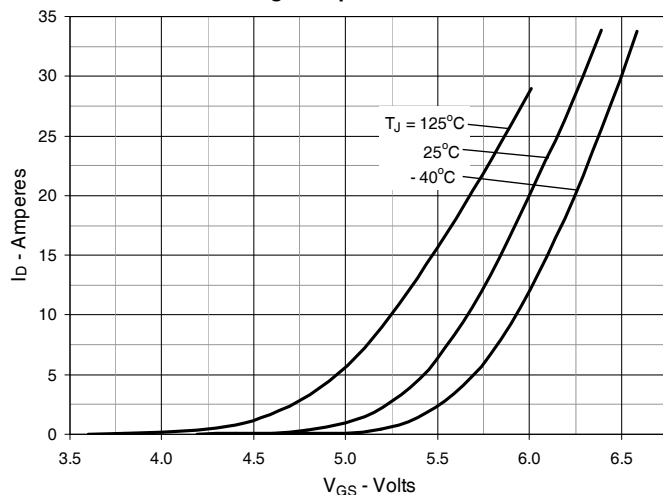


**Fig. 8. Transconductance**

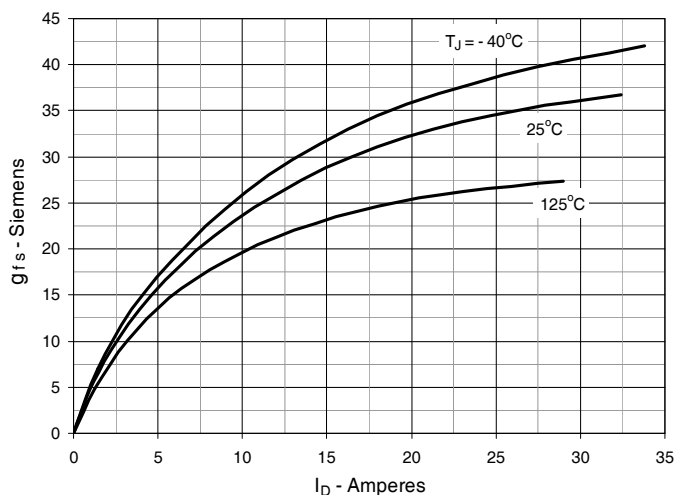


**Fig. 9. Forward Voltage Drop of Intrinsic Diode**

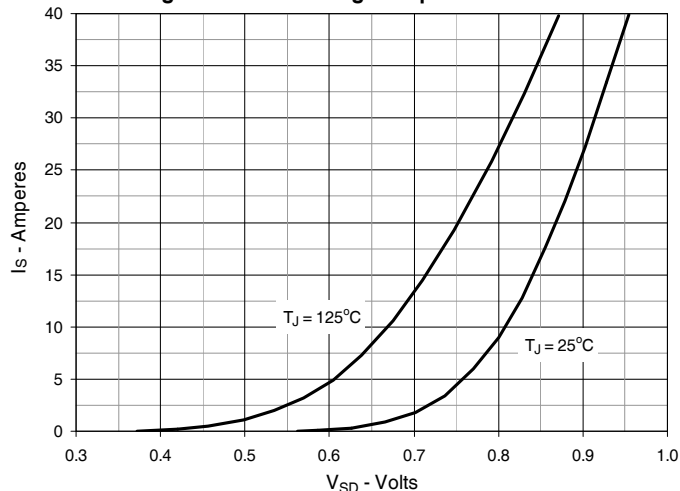


**Fig. 10. Gate Charge**

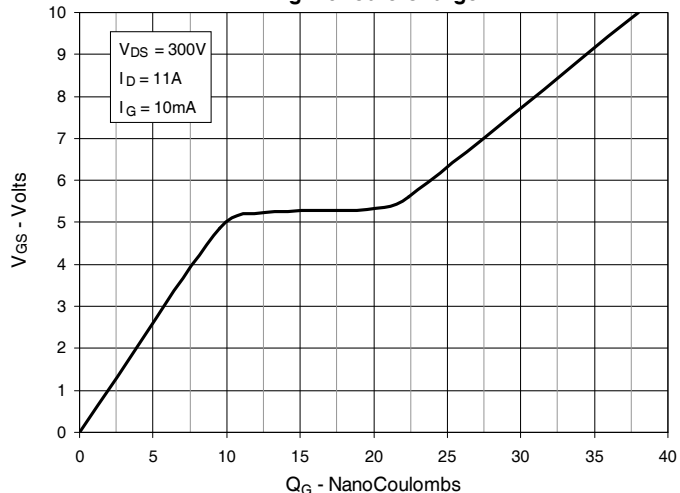


**Fig. 11. Capacitance**

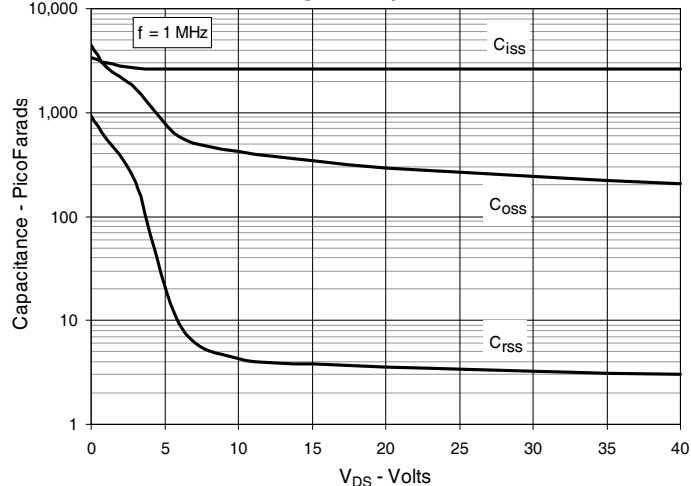


**Fig. 12. Forward-Bias Safe Operating Area**

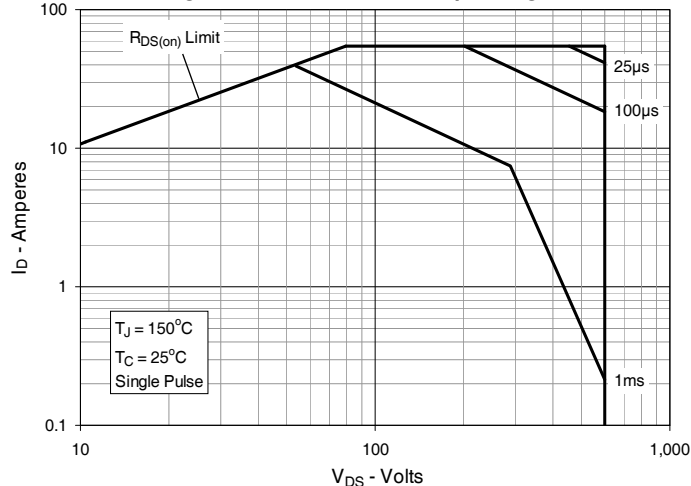
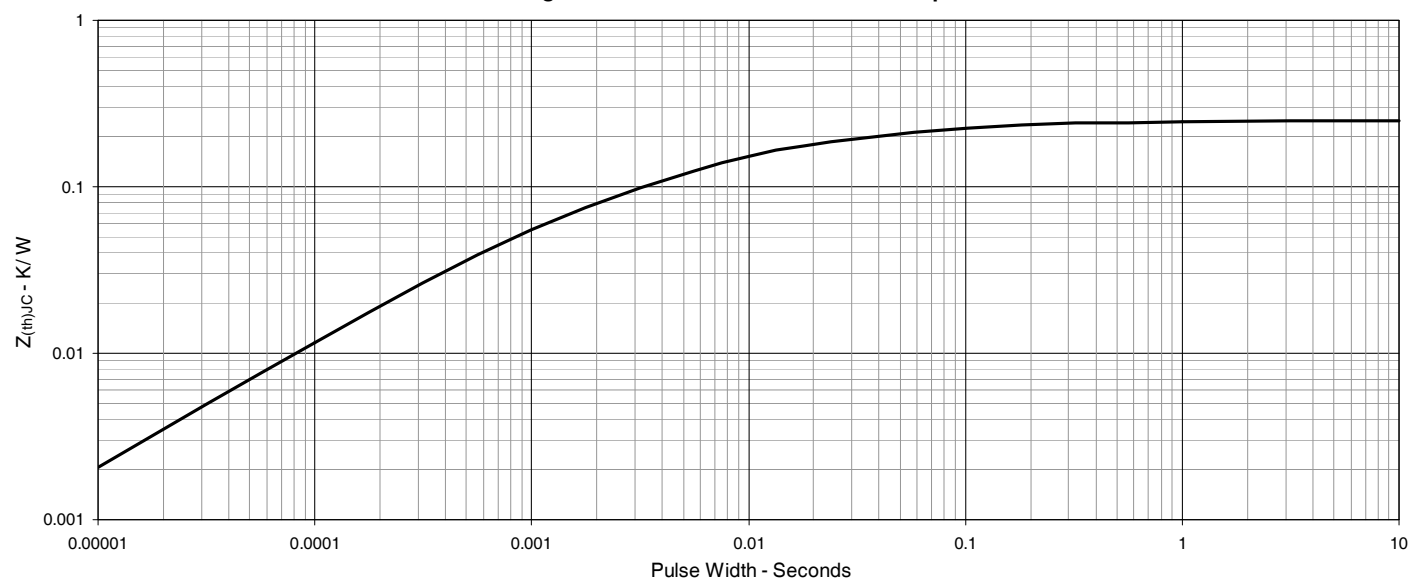
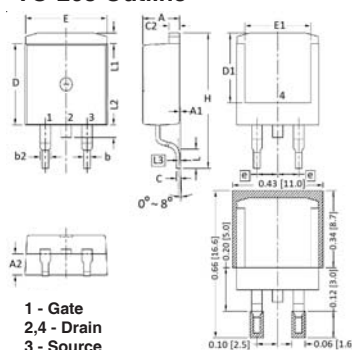


Fig. 13. Maximum Transient Thermal Impedance

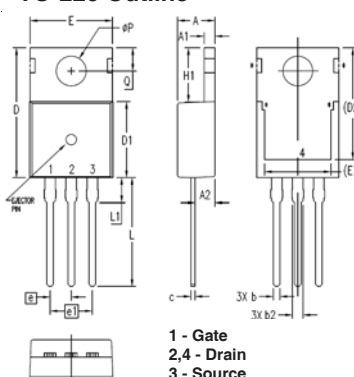


### TO-263 Outline



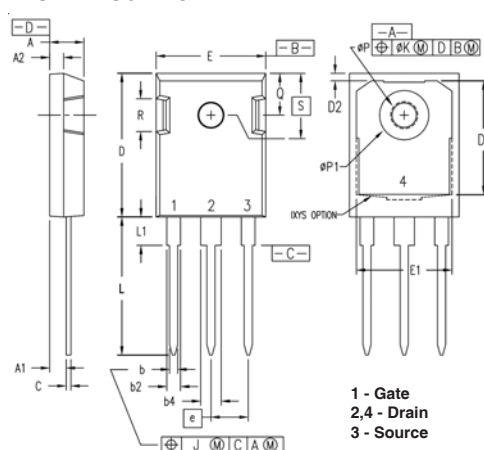
| SYM | INCHES   |      | MILLIMETER |       |
|-----|----------|------|------------|-------|
|     | MIN      | MAX  | MIN        | MAX   |
| A   | .170     | .185 | 4.30       | 4.70  |
| A1  | .000     | .008 | 0.00       | 0.20  |
| A2  | .091     | .098 | 2.30       | 2.50  |
| b   | .028     | .035 | 0.70       | 0.90  |
| b2  | .046     | .060 | 1.18       | 1.52  |
| C   | .018     | .024 | 0.45       | 0.60  |
| C2  | .049     | .060 | 1.25       | 1.52  |
| D   | .340     | .370 | 8.63       | 9.40  |
| D1  | .300     | .327 | 7.62       | 8.30  |
| E   | .380     | .410 | 9.65       | 10.41 |
| E1  | .270     | .330 | 6.86       | 8.38  |
| e   | .100 BSC |      | 2.54 BSC   |       |
| H   | .580     | .620 | 14.73      | 15.75 |
| L   | .075     | .105 | 1.91       | 2.67  |
| L1  | .039     | .060 | 1.00       | 1.52  |
| L2  | —        | .070 | —          | 1.77  |
| L3  | .010 BSC |      | 0.254 BSC  |       |

### TO-220 Outline



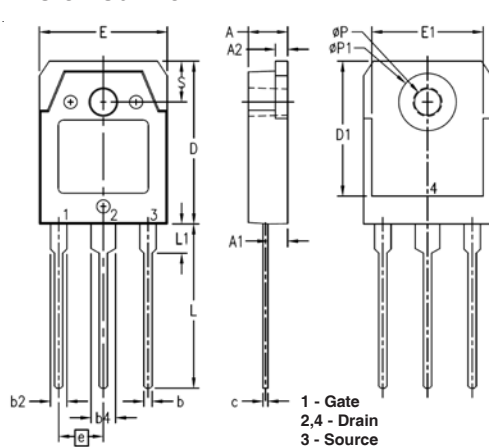
| SYM  | INCHES   |      | MILLIMETERS |       |
|------|----------|------|-------------|-------|
|      | MIN      | MAX  | MIN         | MAX   |
| A    | .169     | .185 | 4.30        | 4.70  |
| A1   | .047     | .055 | 1.20        | 1.40  |
| A2   | .079     | .106 | 2.00        | 2.70  |
| b    | .024     | .039 | 0.60        | 1.00  |
| b2   | .045     | .057 | 1.15        | 1.45  |
| c    | .014     | .026 | 0.35        | 0.65  |
| D    | .587     | .626 | 14.90       | 15.90 |
| D1   | .335     | .370 | 8.50        | 9.40  |
| (D2) | .500     | .531 | 12.70       | 13.50 |
| E    | .382     | .406 | 9.70        | 10.30 |
| (E1) | .283     | .323 | 7.20        | 8.20  |
| e    | .100 BSC |      | 2.54 BSC    |       |
| e1   | .200 BSC |      | 5.08 BSC    |       |
| H1   | .244     | .268 | 6.20        | 6.80  |
| L    | .492     | .547 | 12.50       | 13.90 |
| L1   | .110     | .154 | 2.80        | 3.90  |
| ØP   | .134     | .150 | 3.40        | 3.80  |
| Q    | .106     | .126 | 2.70        | 3.20  |

### TO-247 Outline



| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .190     | .205 | 4.83        | 5.21  |
| A1  | .090     | .100 | 2.29        | 2.54  |
| A2  | .075     | .085 | 1.91        | 2.16  |
| b   | .045     | .055 | 1.14        | 1.40  |
| b2  | .075     | .087 | 1.91        | 2.20  |
| b4  | .115     | .126 | 2.92        | 3.20  |
| C   | .024     | .031 | 0.61        | 0.80  |
| D   | .819     | .840 | 20.80       | 21.34 |
| D1  | .650     | .690 | 16.51       | 17.53 |
| D2  | .035     | .050 | 0.89        | 1.27  |
| E   | .620     | .635 | 15.75       | 16.13 |
| E1  | .545     | .565 | 13.84       | 14.35 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| J   | —        | .010 | —           | 0.25  |
| K   | —        | .025 | —           | 0.64  |
| L   | .780     | .810 | 19.81       | 20.57 |
| L1  | .150     | .170 | 3.81        | 4.32  |
| ØP  | .140     | .144 | 3.55        | 3.65  |
| ØP1 | .275     | .290 | 6.99        | 7.37  |
| Q   | .220     | .244 | 5.59        | 6.20  |
| R   | .170     | .190 | 4.32        | 4.83  |
| S   | .242 BSC |      | 6.15 BSC    |       |

### TO-3P Outline



| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .181     | .197 | 4.60        | 5.00  |
| A1  | .087     | 1.02 | 2.20        | 2.60  |
| A2  | .057     | .065 | 1.45        | 1.65  |
| b   | .031     | .047 | 0.80        | 1.20  |
| b2  | .071     | .087 | 1.80        | 2.20  |
| b4  | .110     | .126 | 2.80        | 3.20  |
| c   | .022     | .031 | 0.55        | 0.80  |
| D   | .776     | .791 | 19.70       | 20.10 |
| D1  | .640     | .680 | 16.26       | 17.27 |
| E   | .606     | .622 | 15.40       | 15.80 |
| E1  | .531     | .539 | 13.50       | 13.70 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| L   | .779     | .795 | 19.80       | 20.20 |
| L1  | .130     | .146 | 3.30        | 3.70  |
| ØP  | .122     | .134 | 3.10        | 3.40  |
| ØP1 | .272     | .280 | 6.90        | 7.10  |
| S   | .189     | .205 | 4.80        | 5.20  |



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