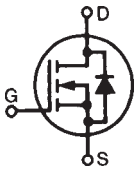
IXYS

# Polar3 ™ HiPerFET™ Power MOSFET

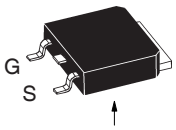
# IXFY4N60P3
# IXFA4N60P3
# IXFP4N60P3

$V_{DSS}$ = 600V
$I_{D25}$ = 4A
$R_{DS(on)}$ ≤ 2.4Ω

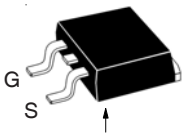
N-Channel Enhancement Mode
Avalanche Rated
Fast Intrinsic Rectifier



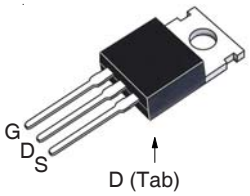

**TO-252 (IXFY)**




**TO-263 (IXFA)**




**TO-220 (IXFP)**




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

| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{DSS}$ | $T_J$ = 25°C to 150°C | 600 | V |
| $V_{DGR}$ | $T_J$ = 25°C to 150°C, $R_{GS}$ = 1MΩ | 600 | V |
| $V_{GSS}$ | Continuous | ±30 | V |
| $V_{GSM}$ | Transient | ±40 | V |
| $I_{D25}$ | $T_C$ = 25°C | 4 | A |
| $I_{DM}$ | $T_C$ = 25°C, Pulse Width Limited by $T_{JM}$ | 8 | A |
| $I_A$ | $T_C$ = 25°C | 2 | A |
| $E_{AS}$ | $T_C$ = 25°C | 200 | mJ |
| dv/dt | $I_S$ ≤ $I_{DM}$, $V_{DD}$ ≤ $V_{DSS}$, $T_J$ ≤ 150°C | 35 | V/ns |
| $P_D$ | $T_C$ = 25°C | 114 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering | 300 | °C |
| $T_{SOLD}$ | Plastic Body for 10s | 260 | °C |
| $M_d$ | Mounting Torque (TO-220) | 1.13 / 10 | Nm/lb.in. |
| Weight | TO-252 | 0.35 | g |
| | TO-263 | 2.50 | g |
| | TO-220 | 3.00 | g |

| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $BV_{DSS}$ | $V_{GS}$ = 0V, $I_D$ = 1mA | 600 | | | V |
| $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 3.0 | | 5.0 | V |
| $I_{GSS}$ | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | | | ±100 | nA |
| $I_{DSS}$ | $V_{DS}$ = $V_{DSS}$, $V_{GS}$ = 0V | | | 10 | μA |
| | $T_J$ = 125°C | | | 100 | μA |
| $R_{DS(on)}$ | $V_{GS}$ = 10V, $I_D$ = 0.5 • $I_{D25}$, Note 1 | | | 2.4 | Ω |

**Features**

- International Standard Packages
- 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

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| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max | |
|---|---|---|---|---|---|
| $g_{fs}$ | $V_{DS}$ = 20V, $I_D$ = 0.5 • $I_{D25}$, Note 1 | 2.2 | 3.7 | | S |
| $R_{Gi}$ | Gate Input Resistance | | 6.0 | | Ω |
| $C_{iss}$ | $V_{GS}$ = 0V, $V_{DS}$ = 25V, f = 1MHz | | 365 | | pF |
| $C_{oss}$ | | | 46 | | pF |
| $C_{rss}$ | | | 3 | | pF |
| $t_{d(on)}$ | **Resistive Switching Times** $V_{GS}$ = 10V, $V_{DS}$ = 0.5 • $V_{DSS}$, $I_D$ = 0.5 • $I_{D25}$ $R_G$ = 30Ω (External) | | 15 | | ns |
| $t_r$ | | | 24 | | ns |
| $t_{d(off)}$ | | | 24 | | ns |
| $t_f$ | | | 23 | | ns |
| $Q_{g(on)}$ | $V_{GS}$ = 10V, $V_{DS}$ = 0.5 • $V_{DSS}$, $I_D$ = 0.5 • $I_{D25}$ | | 6.9 | | nC |
| $Q_{gs}$ | | | 1.7 | | nC |
| $Q_{gd}$ | | | 2.8 | | nC |
| $R_{thJC}$ | | | | 1.10 | °C/W |
| $R_{thCS}$ | TO-220 | | 0.50 | | °C/W |

**Source-Drain Diode**

| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max | |
|---|---|---|---|---|---|
| $I_S$ | $V_{GS}$ = 0V, Note1 | | | 4 | A |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$ | | | 16 | A |
| $V_{SD}$ | $I_F$ = $I_S$, $V_{GS}$ = 0V, Note 1 | | | 1.4 | V |
| $t_{rr}$ | $I_F$ = 4A, -di/dt = 25A/μs $V_R$ = 100V | | | 250 | ns |
| $Q_{RM}$ | | | 0.35 | | μC |
| $I_{RM}$ | | | 2.15 | | A |

Note 1. Pulse test, t ≤ 300μs, duty cycle, d ≤ 2%.

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

**Fig. 1. Output Characteristics @ $T_J$ = 25°C**

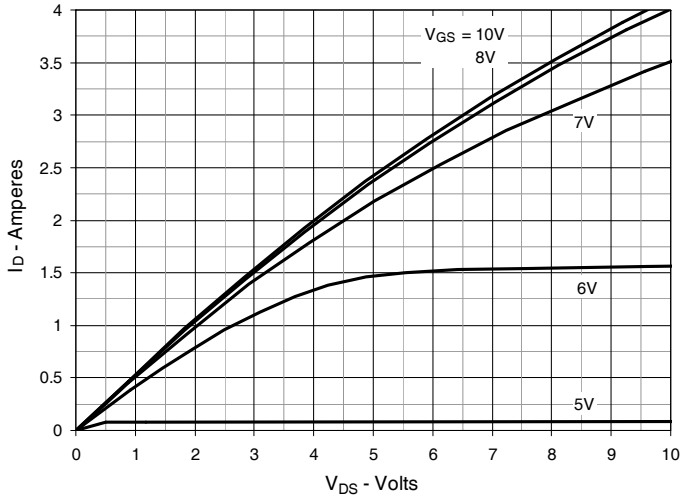


**Fig. 2. Extended Output Characteristics @ $T_J$ = 25°C**

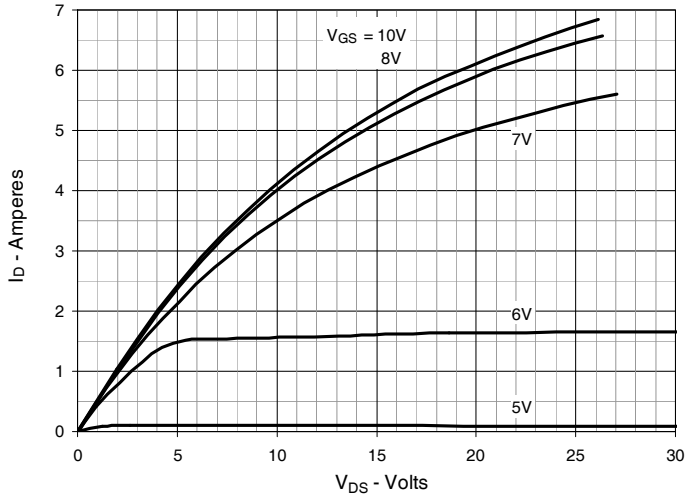


**Fig. 3. Output Characteristics @ $T_J$ = 125°C**

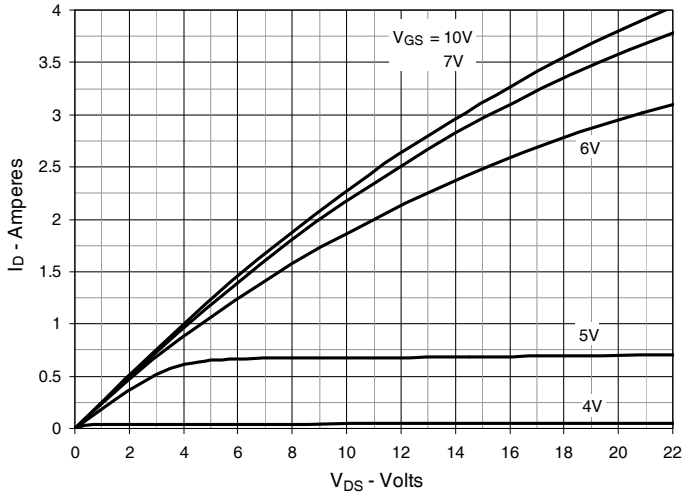


**Fig. 4. $R_{DS(on)}$ Normalized to $I_D$ = 2A Value vs. Junction Temperature**

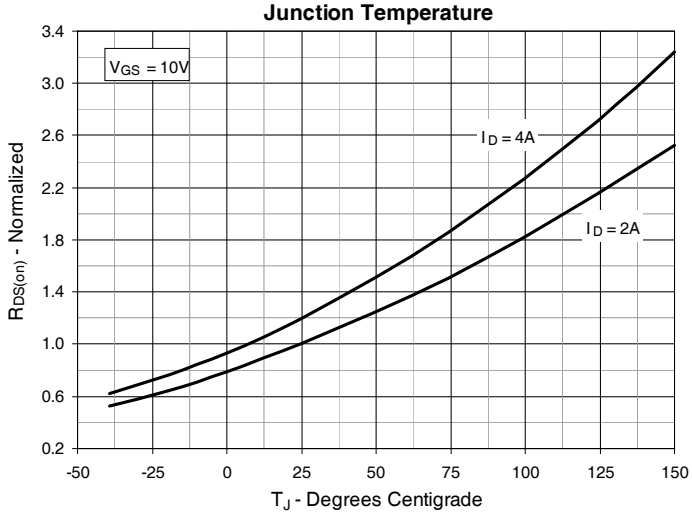


**Fig. 5. $R_{DS(on)}$ Normalized to $I_D$ = 2A Value vs. Drain Current**

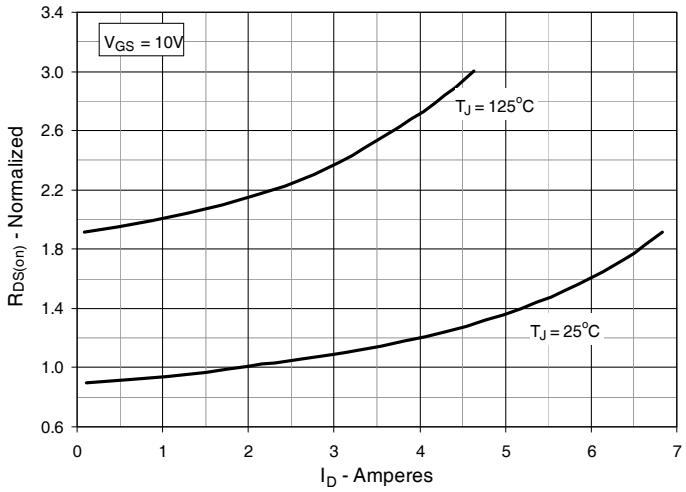


**Fig. 6. Maximum Drain Current vs. Case Temperature**

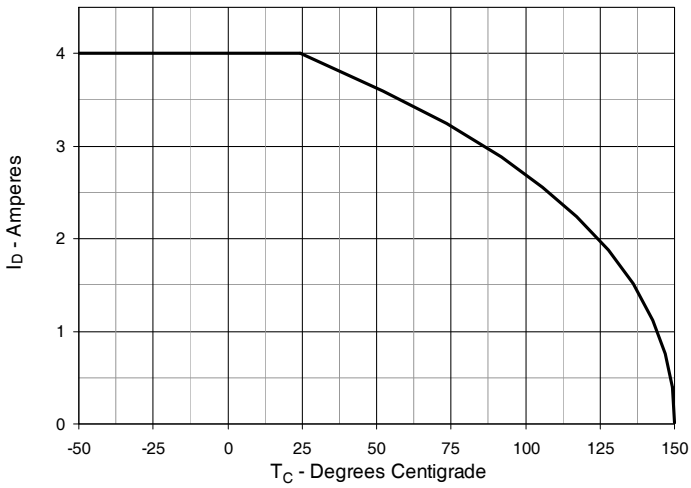


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**Fig. 7. Input Admittance**

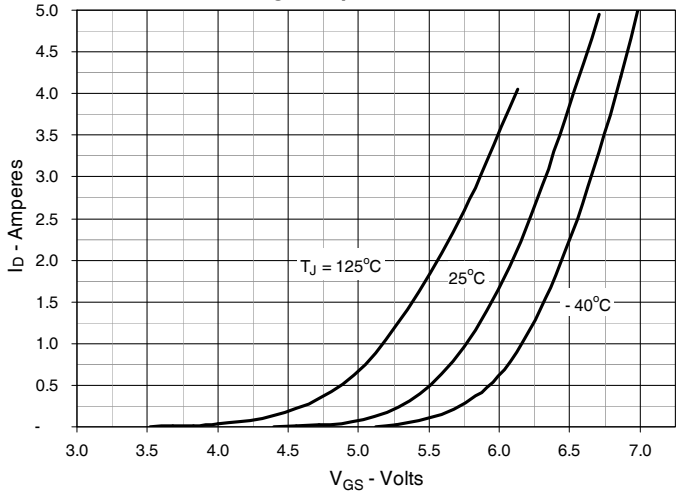


**Fig. 8. Transconductance**

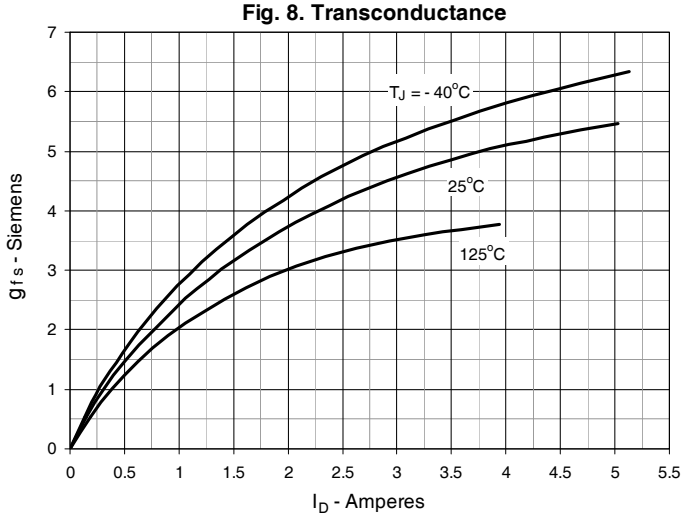


**Fig. 9. Forward Voltage Drop of Intrinsic Diode**

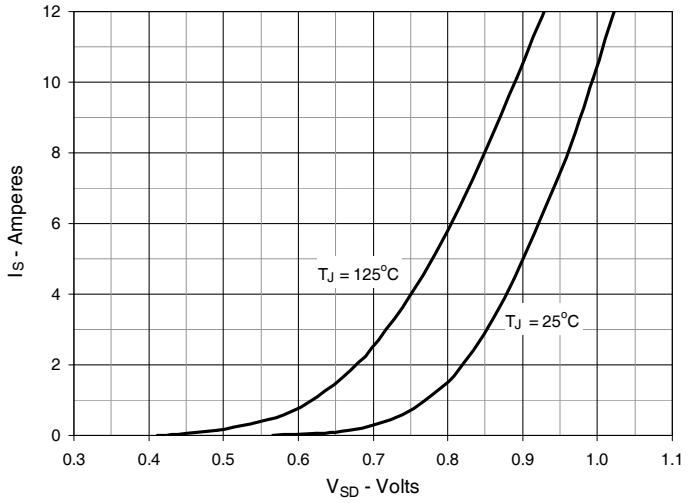


**Fig. 10. Gate Charge**

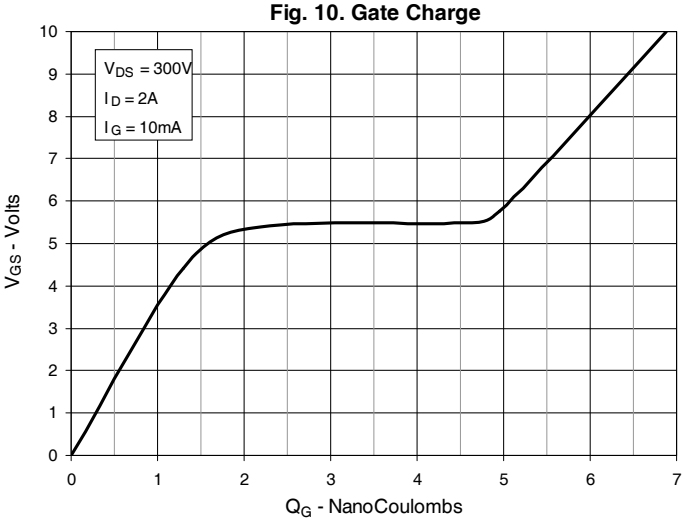


**Fig. 11. Capacitance**

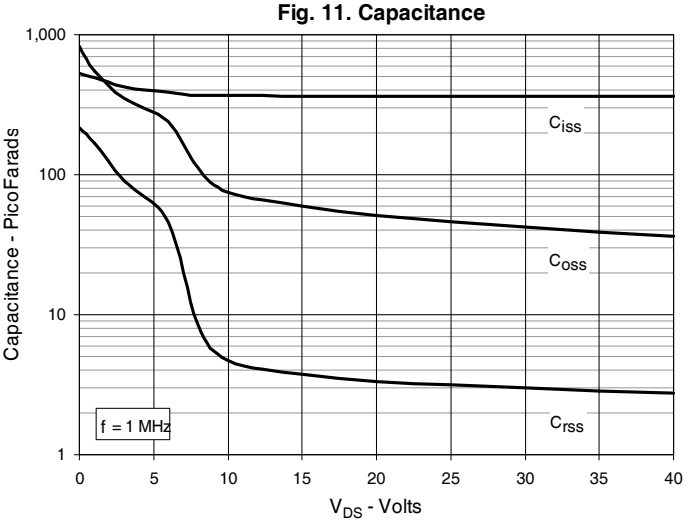


**Fig. 12. Forward-Bias Safe Operating Area**

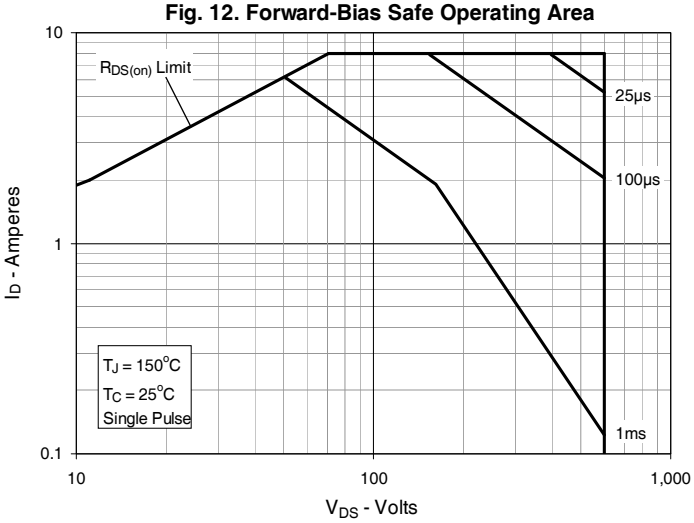


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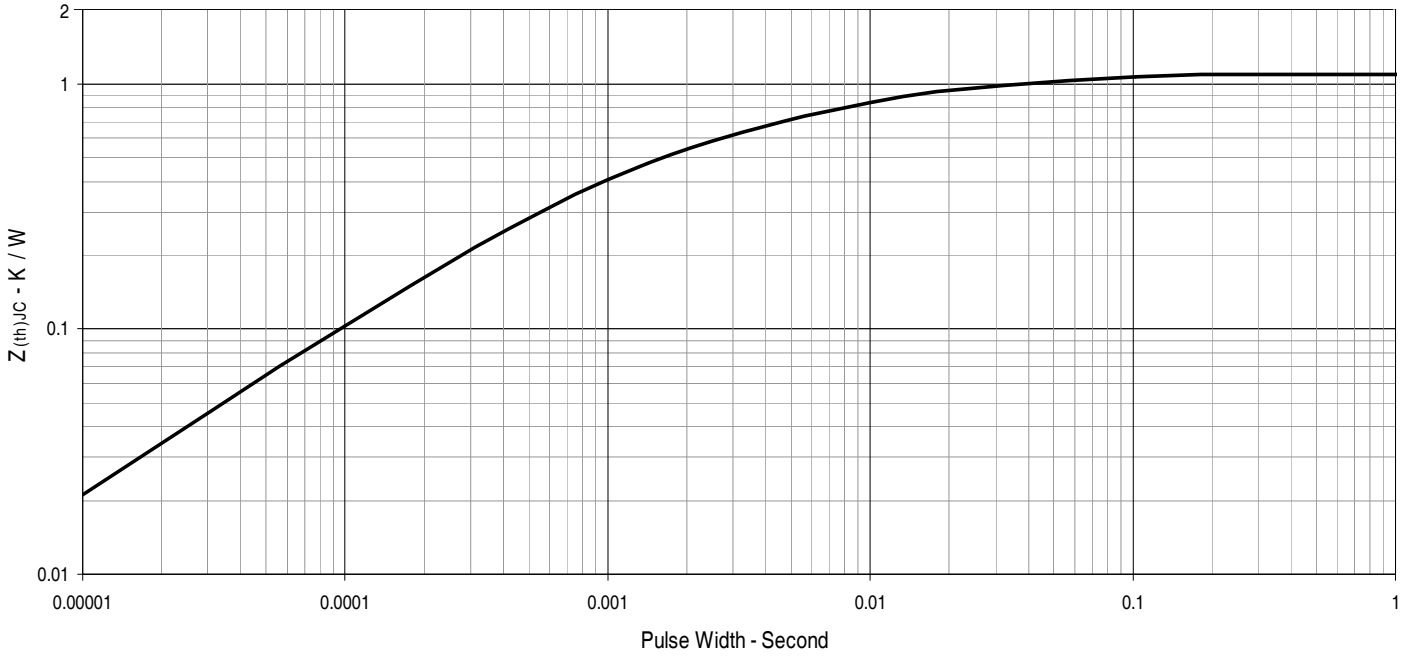
**Fig. 13. Maximum Transient Thermal Impedance**

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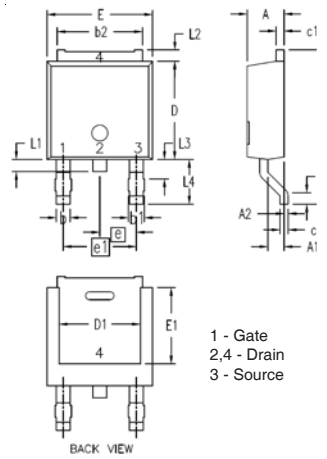
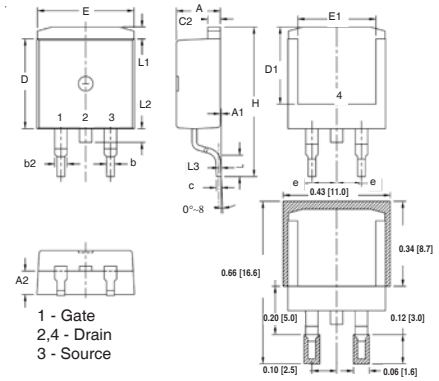
## TO-252 Outline




1 - Gate
2,4 - Drain
3 - Source

| SYM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | .086 | .094 | 2.19 | 2.38 |
| A1 | .035 | .045 | 0.89 | 1.14 |
| A2 | 0 | .004 | 0 | 0.10 |
| b | .025 | .035 | 0.64 | 0.89 |
| b1 | .030 | .045 | 0.76 | 1.14 |
| b2 | .205 | .215 | 5.21 | 5.46 |
| c | .018 | .023 | 0.46 | 0.58 |
| c1 | .018 | .023 | 0.46 | 0.58 |
| D | .235 | .245 | 5.97 | 6.22 |
| D1 | .170 | .205 | 4.32 | 5.21 |
| E | .250 | .265 | 6.35 | 6.73 |
| E1 | .170 | .205 | 4.32 | 5.21 |
| e | .090 BSC | | 2.28 BSC | |
| e1 | .180 BSC | | 4.57 BSC | |
| H | .370 | .410 | 9.40 | 10.42 |
| L | .020 | .040 | 0.51 | 1.02 |
| L1 | .025 | .040 | 0.64 | 1.02 |
| L2 | .024 | .036 | 0.60 | 0.90 |
| L3 | .045 | .060 | 1.15 | 1.52 |
| L4 | .100 | .115 | 2.54 | 2.92 |

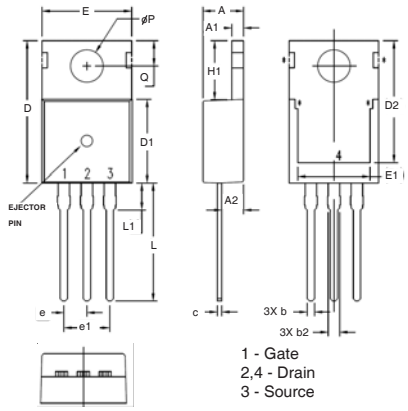
## TO-263 Outline




1 - Gate
2,4 - Drain
3 - Source

| 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




1 - Gate
2,4 - Drain
3 - Source

| 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 |

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