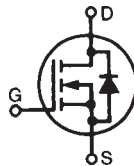


## X2-Class Power MOSFET

**IXTY4N65X2**  
**IXTA4N65X2**  
**IXTP4N65X2**

$V_{DSS} = 650V$   
 $I_{D25} = 4A$   
 $R_{DS(on)} \leq 850m\Omega$

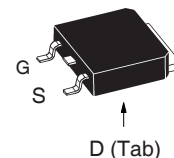
N-Channel Enhancement Mode



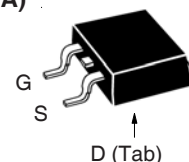
| Symbol     | Test Conditions                                                    | Maximum Ratings    |            |
|------------|--------------------------------------------------------------------|--------------------|------------|
| $V_{DSS}$  | $T_J = 25^\circ C$ to $150^\circ C$                                | 650                | V          |
| $V_{DGR}$  | $T_J = 25^\circ C$ to $150^\circ C$ , $R_{GS} = 1M\Omega$          | 650                | V          |
| $V_{GSS}$  | Continuous                                                         | $\pm 30$           | V          |
| $V_{GSM}$  | Transient                                                          | $\pm 40$           | V          |
| $I_{D25}$  | $T_C = 25^\circ C$                                                 | 4                  | A          |
| $I_{DM}$   | $T_C = 25^\circ C$ , Pulse Width Limited by $T_{JM}$               | 8                  | A          |
| $I_A$      | $T_C = 25^\circ C$                                                 | 2                  | A          |
| $E_{AS}$   | $T_C = 25^\circ C$                                                 | 150                | mJ         |
| $dv/dt$    | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ C$ | 15                 | V/ns       |
| $P_D$      | $T_C = 25^\circ C$                                                 | 80                 | W          |
| $T_J$      |                                                                    | -55 ... +150       | $^\circ C$ |
| $T_{JM}$   |                                                                    | 150                | $^\circ C$ |
| $T_{stg}$  |                                                                    | -55 ... +150       | $^\circ C$ |
| $T_L$      | Maximum Lead Temperature for Soldering                             | 300                | $^\circ C$ |
| $T_{SOLD}$ | 1.6 mm (0.062in.) from Case for 10s                                | 260                | $^\circ C$ |
| $F_C$      | Mounting Force (TO-263)                                            | 10..65 / 2.2..14.6 | N/lb       |
| $M_d$      | 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<br>( $T_J = 25^\circ C$ , Unless Otherwise Specified) | Characteristic Values |      |                          |
|--------------|-----------------------------------------------------------------------|-----------------------|------|--------------------------|
|              |                                                                       | Min.                  | Typ. | Max.                     |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 250\mu A$                                      | 650                   |      | V                        |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 250\mu A$                                  | 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>$T_J = 125^\circ C$             |                       |      | 5 $\mu A$<br>100 $\mu A$ |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                   |                       |      | 850 m $\Omega$           |

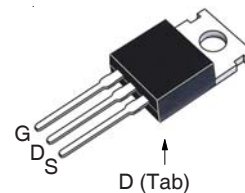
TO-252 (IXTY)



TO-263 (IXTA)



TO-220 (IXTP)



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

### Features

- International Standard Packages
- Low  $R_{DS(ON)}$  and  $Q_G$
- Avalanche Rated
- Low Package Inductance

### Advantages

- High Power Density
- Easy to Mount
- Space Savings

### Applications

- Switch-Mode and Resonant-Mode Power Supplies
- DC-DC Converters
- PFC Circuits
- 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                       |
| $g_{fs}$                            | $V_{DS} = 10\text{V}$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                                                                                          | 2.5                                                  | 4.2  | S                         |
| $R_{Gi}$                            | Gate Input Resistance                                                                                                                               |                                                      | 13   | $\Omega$                  |
| $C_{iss}$                           | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                                    |                                                      | 455  | pF                        |
| $C_{oss}$                           |                                                                                                                                                     |                                                      | 294  | pF                        |
| $C_{rss}$                           |                                                                                                                                                     |                                                      | 0.8  | pF                        |
| <b>Effective Output Capacitance</b> |                                                                                                                                                     |                                                      |      |                           |
| $C_{o(er)}$                         | Energy related                                                                                                                                      | $V_{GS} = 0\text{V}$<br>$V_{DS} = 0.8 \cdot V_{DSS}$ | 32   | pF                        |
| $C_{o(tr)}$                         | Time related                                                                                                                                        |                                                      | 82   | pF                        |
| $t_{d(on)}$                         | <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>$R_G = 50\Omega$ (External) |                                                      | 22   | ns                        |
| $t_r$                               |                                                                                                                                                     |                                                      | 28   | ns                        |
| $t_{d(off)}$                        |                                                                                                                                                     |                                                      | 57   | ns                        |
| $t_f$                               |                                                                                                                                                     |                                                      | 25   | ns                        |
| $Q_{g(on)}$                         | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$                                                                    |                                                      | 8.3  | nC                        |
| $Q_{gs}$                            |                                                                                                                                                     |                                                      | 2.0  | nC                        |
| $Q_{gd}$                            |                                                                                                                                                     |                                                      | 3.0  | nC                        |
| $R_{thJC}$                          | TO-220                                                                                                                                              |                                                      |      | 1.56 $^{\circ}\text{C/W}$ |
| $R_{thCS}$                          |                                                                                                                                                     |                                                      | 0.50 | $^{\circ}\text{C/W}$      |

#### Source-Drain Diode

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)   | Characteristic Values |      |       |
|----------|-------------------------------------------------------------------------------|-----------------------|------|-------|
|          |                                                                               | Min.                  | Typ. | Max   |
| $I_S$    | $V_{GS} = 0\text{V}$                                                          |                       |      | 4 A   |
| $I_{SM}$ | Repetitive, pulse Width Limited by $T_{JM}$                                   |                       |      | 16 A  |
| $V_{SD}$ | $I_F = I_S$ , $V_{GS} = 0\text{V}$ , Note 1                                   |                       |      | 1.4 V |
| $t_{rr}$ | $I_F = 2\text{A}$ , $-di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}$ |                       | 160  | ns    |
| $Q_{RM}$ |                                                                               |                       | 890  | nC    |
| $I_{RM}$ |                                                                               |                       | 11.4 | A     |

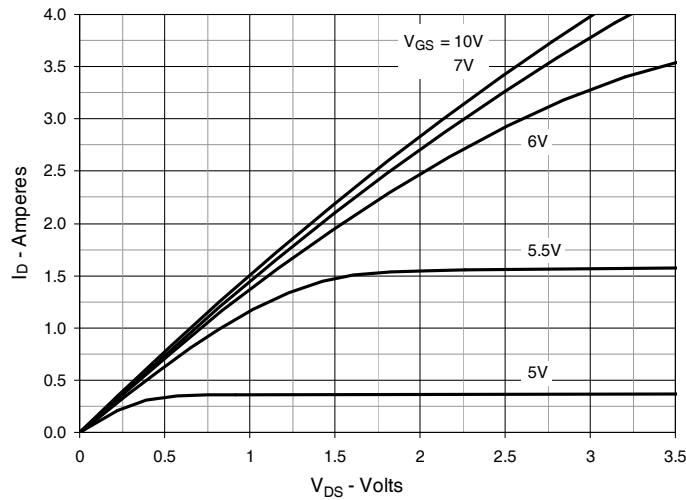
Note 1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .

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

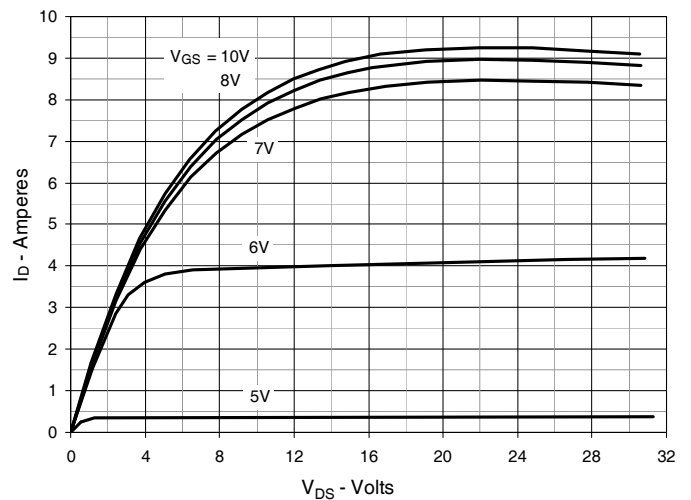
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

|           |           |           |           |             |             |             |             |             |             |
|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| 4,835,592 | 4,931,844 | 5,049,961 | 5,237,481 | 6,162,665   | 6,404,065B1 | 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   |             |

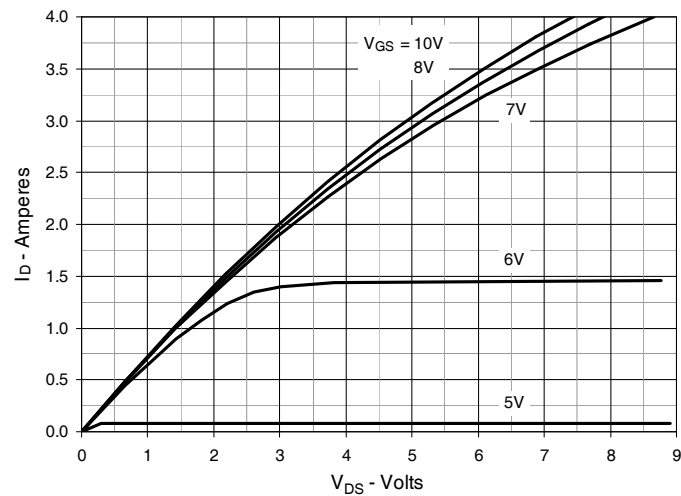
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



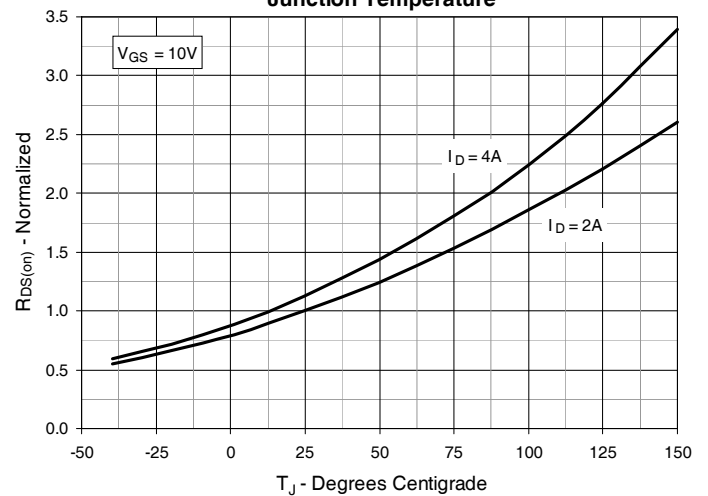
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



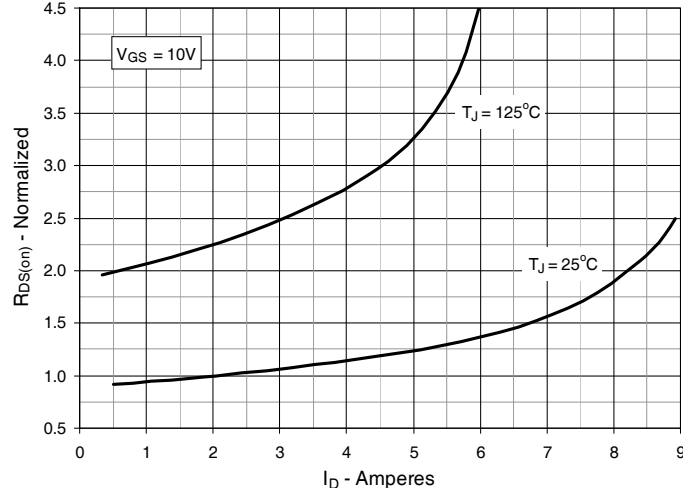
**Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$**



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



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



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

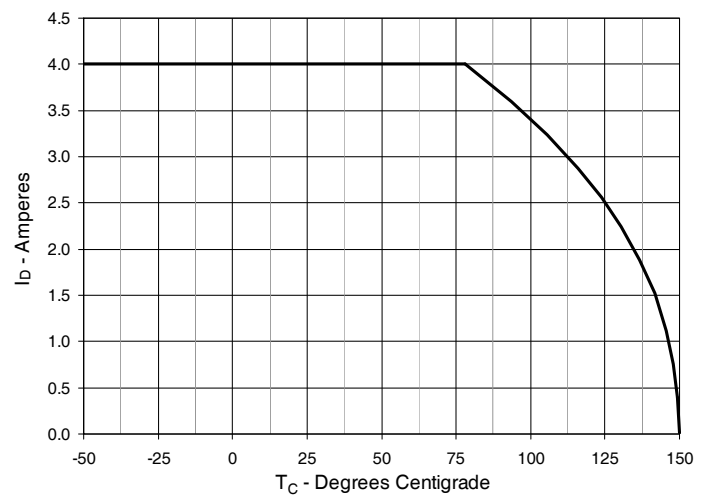


Fig. 7. Input Admittance

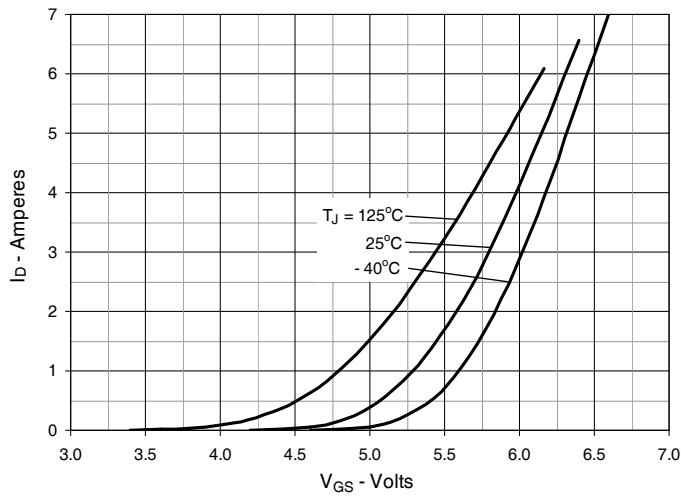


Fig. 8. Transconductance

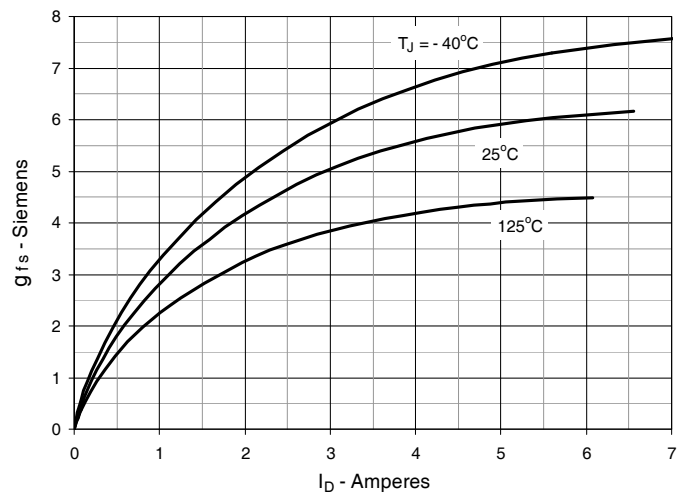


Fig. 9. Forward Voltage Drop of Intrinsic Diode

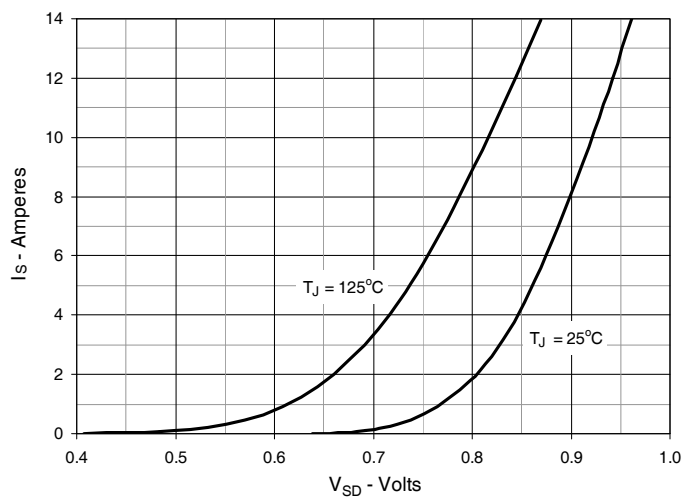


Fig. 10. Gate Charge

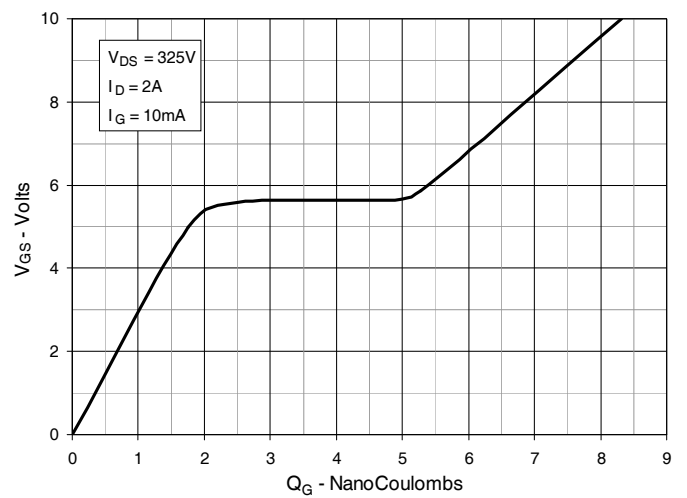


Fig. 11. Capacitance

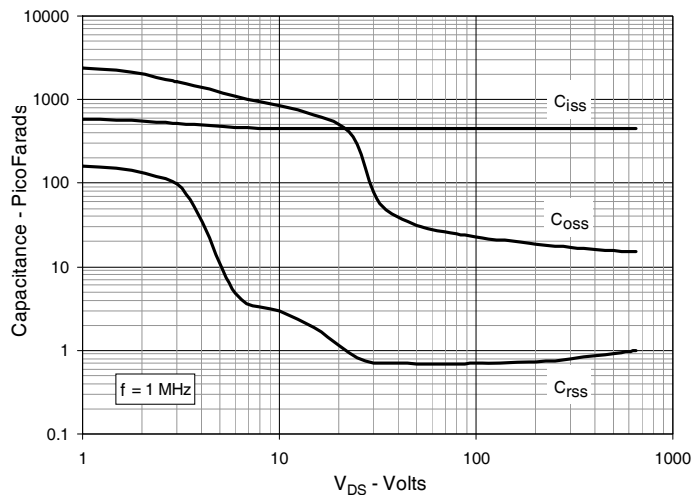


Fig. 12. Output Capacitance Stored Energy

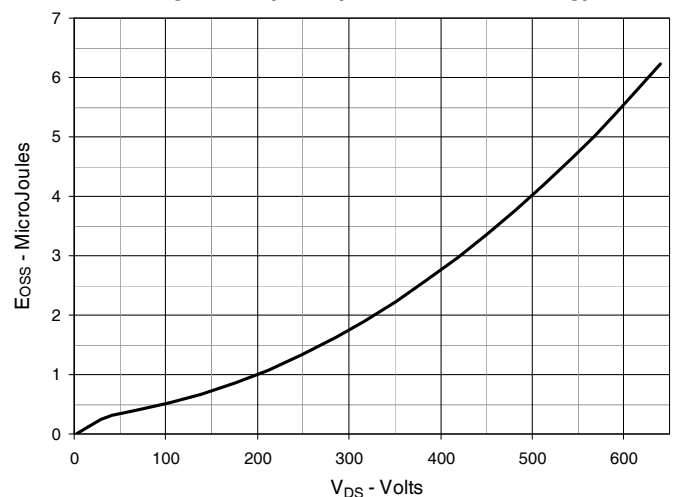


Fig. 13. Forward-Bias Safe Operating Area

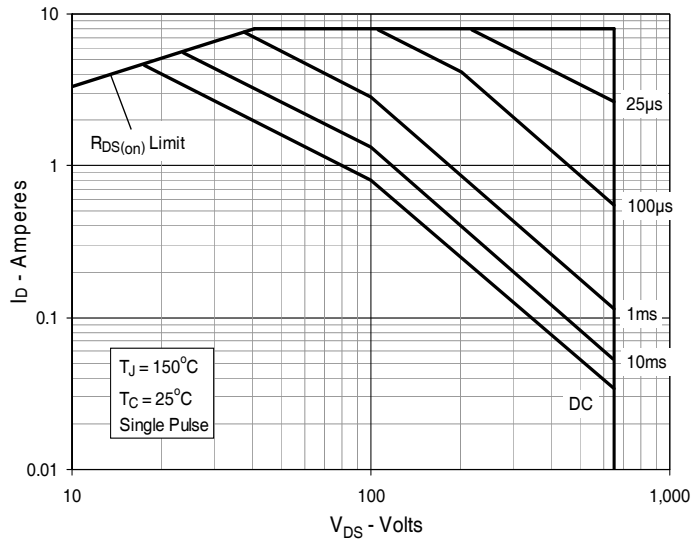
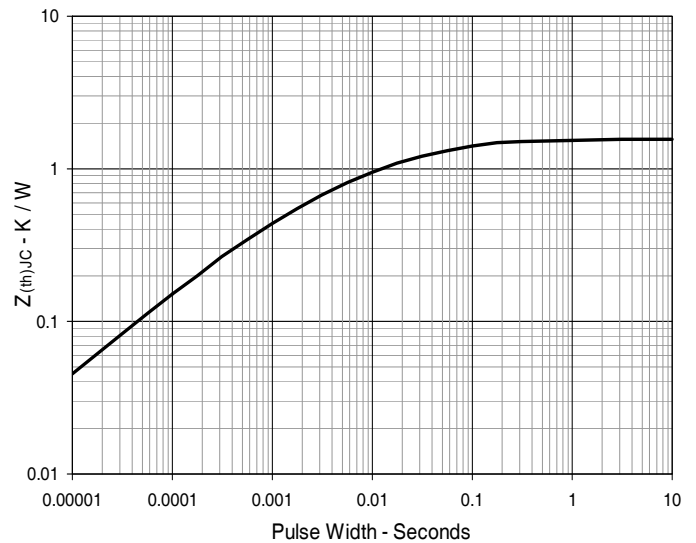
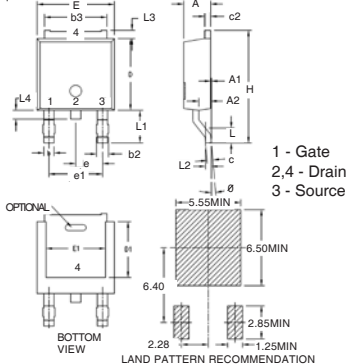


Fig. 14. Maximum Transient Thermal Impedance

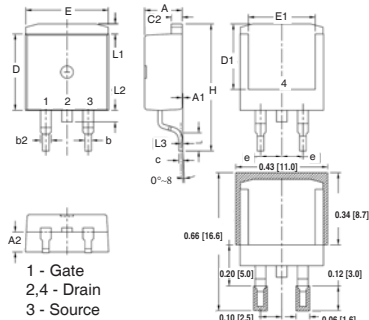


## TO-252 AA Outline



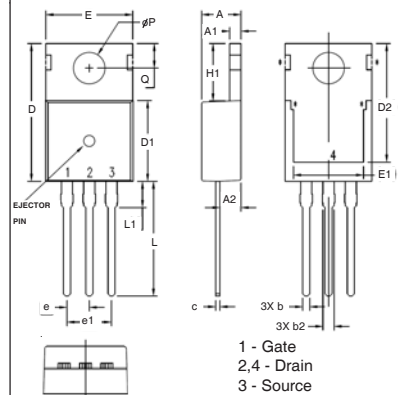
| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .086     | .094 | 2.19        | 2.38  |
| A1  | 0        | .005 | 0           | 0.12  |
| A2  | .038     | .046 | 0.97        | 1.17  |
| b   | .025     | .035 | 0.64        | 0.89  |
| b2  | .030     | .045 | 0.76        | 1.14  |
| b3  | .200     | .215 | 5.08        | 5.46  |
| c   | .018     | .024 | 0.46        | 0.61  |
| c2  | .018     | .023 | 0.46        | 0.58  |
| D   | .235     | .245 | 5.97        | 6.22  |
| D1  | .180     | .205 | 4.57        | 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   | .055     | .070 | 1.40        | 1.78  |
| L1  | .100     | .115 | 2.54        | 2.92  |
| L2  | .020 BSC |      | 0.50 BSC    |       |
| L3  | .025     | .040 | 0.64        | 1.02  |
| L4  | .025     | .040 | 0.64        | 1.02  |
| θ   | 0°       | 10°  | 0°          | 10°   |

## 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  |