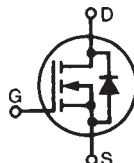


# X3-Class HiPerFET™ Power MOSFET

**IXFP90N20X3**  
**IXFQ90N20X3**  
**IXFH90N20X3**

$V_{DSS} = 200V$   
 $I_{D25} = 90A$   
 $R_{DS(on)} \leq 12.8m\Omega$

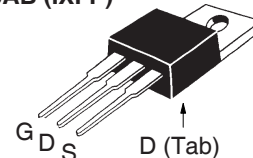
N-Channel Enhancement Mode  
Avalanche Rated



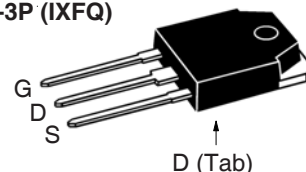
| Symbol     | Test Conditions                                                    | Maximum Ratings |            |
|------------|--------------------------------------------------------------------|-----------------|------------|
| $V_{DSS}$  | $T_J = 25^\circ C$ to $150^\circ C$                                | 200             | V          |
| $V_{DGR}$  | $T_J = 25^\circ C$ to $150^\circ C$ , $R_{GS} = 1M\Omega$          | 200             | V          |
| $V_{GSS}$  | Continuous                                                         | $\pm 20$        | V          |
| $V_{GSM}$  | Transient                                                          | $\pm 30$        | V          |
| $I_{D25}$  | $T_C = 25^\circ C$                                                 | 90              | A          |
| $I_{DM}$   | $T_C = 25^\circ C$ , Pulse Width Limited by $T_{JM}$               | 220             | A          |
| $I_A$      | $T_C = 25^\circ C$                                                 | 45              | A          |
| $E_{AS}$   | $T_C = 25^\circ C$                                                 | 1.5             | J          |
| $dv/dt$    | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ C$ | 20              | V/ns       |
| $P_D$      | $T_C = 25^\circ C$                                                 | 390             | 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             | $^\circ C$ |
| $M_d$      | Mounting Torque                                                    | 1.13 / 10       | Nm/lb.in   |
| Weight     | TO-220                                                             | 3.0             | g          |
|            | TO-3P                                                              | 5.5             | g          |
|            | TO-247                                                             | 6.0             | g          |

| Symbol       | Test Conditions<br>( $T_J = 25^\circ C$ , Unless Otherwise Specified) | Characteristic Values |      |                          |
|--------------|-----------------------------------------------------------------------|-----------------------|------|--------------------------|
|              |                                                                       | Min.                  | Typ. | Max.                     |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 250\mu A$                                      | 200                   |      | V                        |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 1.5mA$                                     | 2.5                   |      | 4.5 V                    |
| $I_{GSS}$    | $V_{GS} = \pm 20V$ , $V_{DS} = 0V$                                    |                       |      | $\pm 100$ nA             |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$<br>$T_J = 125^\circ C$             |                       |      | 5 $\mu A$<br>300 $\mu A$ |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                   | 10.5                  |      | 12.8 $m\Omega$           |

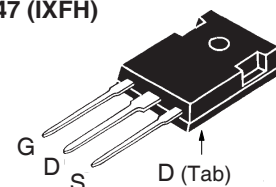
TO-220AB (IXFP)



TO-3P (IXFQ)



TO-247 (IXFH)



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                                                                                         | 40                                                   | 67   | S                         |
| $R_{Gi}$                            | Gate Input Resistance                                                                                                                              |                                                      | 1.4  | $\Omega$                  |
| $C_{iss}$                           | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                                   |                                                      | 5420 | pF                        |
| $C_{oss}$                           |                                                                                                                                                    |                                                      | 930  | pF                        |
| $C_{rss}$                           |                                                                                                                                                    |                                                      | 4    | pF                        |
| <b>Effective Output Capacitance</b> |                                                                                                                                                    |                                                      |      |                           |
| $C_{o(er)}$                         | Energy related                                                                                                                                     | $V_{GS} = 0\text{V}$<br>$V_{DS} = 0.8 \cdot V_{DSS}$ | 420  | pF                        |
| $C_{o(tr)}$                         | Time related                                                                                                                                       |                                                      | 1300 | 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>$R_G = 5\Omega$ (External) |                                                      | 22   | ns                        |
| $t_r$                               |                                                                                                                                                    |                                                      | 26   | ns                        |
| $t_{d(off)}$                        |                                                                                                                                                    |                                                      | 62   | ns                        |
| $t_f$                               |                                                                                                                                                    |                                                      | 13   | ns                        |
| $Q_{g(on)}$                         | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$                                                                   |                                                      | 78   | nC                        |
| $Q_{gs}$                            |                                                                                                                                                    |                                                      | 23   | nC                        |
| $Q_{gd}$                            |                                                                                                                                                    |                                                      | 22   | nC                        |
| $R_{thJC}$                          |                                                                                                                                                    |                                                      |      | 0.32 $^{\circ}\text{C/W}$ |
| $R_{thCS}$                          | TO-220                                                                                                                                             |                                                      | 0.50 | $^{\circ}\text{C/W}$      |
|                                     | TO-247 & TO-3P                                                                                                                                     |                                                      | 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   |
| $I_S$    | $V_{GS} = 0\text{V}$                                                           |                       |      | 90 A  |
| $I_{SM}$ | Repetitive, pulse Width Limited by $T_{JM}$                                    |                       |      | 360 A |
| $V_{SD}$ | $I_F = I_S$ , $V_{GS} = 0\text{V}$ , Note 1                                    |                       |      | 1.4 V |
| $t_{rr}$ | $I_F = 45\text{A}$ , $-di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}$ |                       | 95   | ns    |
| $Q_{RM}$ |                                                                                |                       | 360  | nC    |
| $I_{RM}$ |                                                                                |                       | 7.6  | 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 @  $T_J = 25^\circ\text{C}$

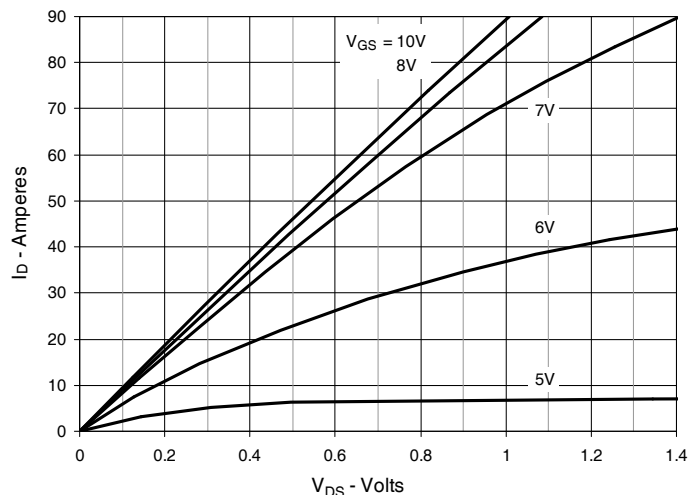


Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$

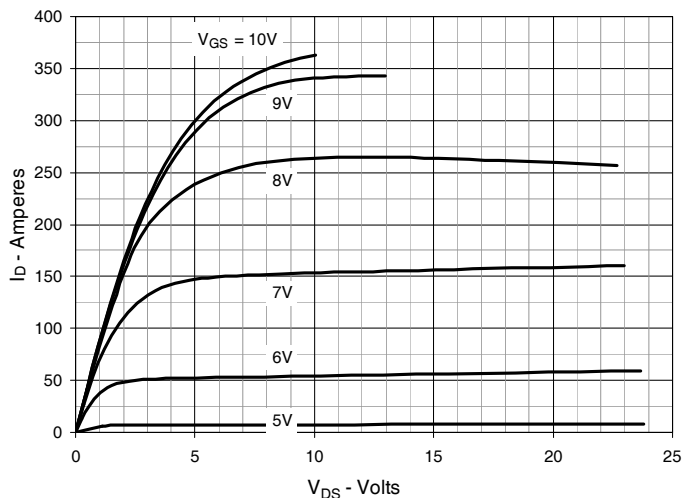


Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$

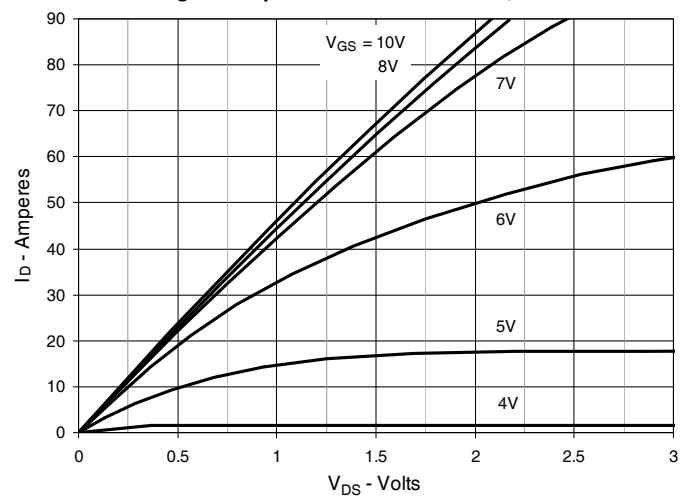


Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 45\text{A}$  Value vs. Junction Temperature

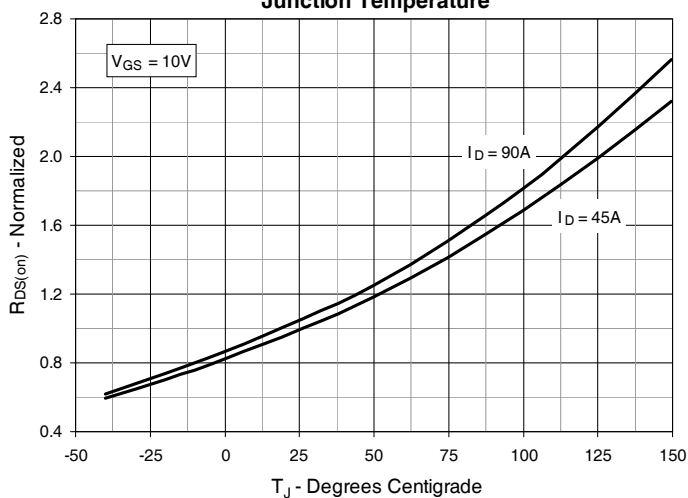


Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 45\text{A}$  Value vs. Drain Current

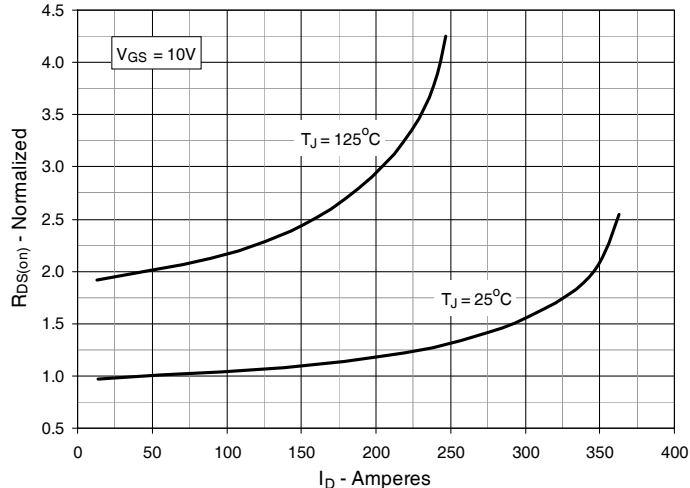


Fig. 6. Normalized Breakdown & Threshold Voltages vs. Junction Temperature

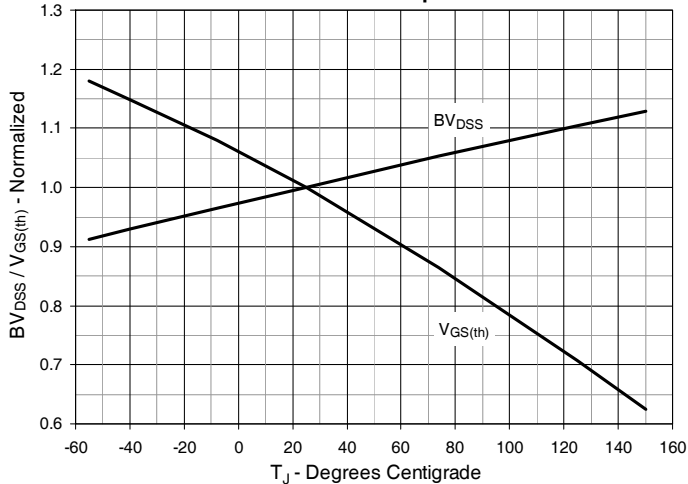


Fig. 7. Maximum Drain Current vs. Case Temperature

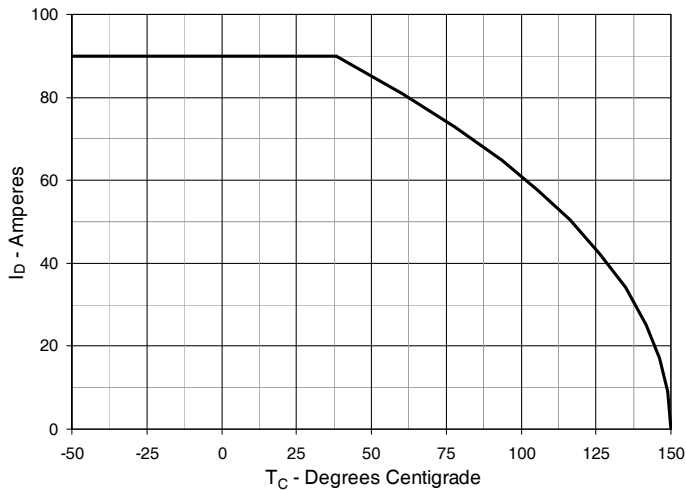


Fig. 8. Input Admittance

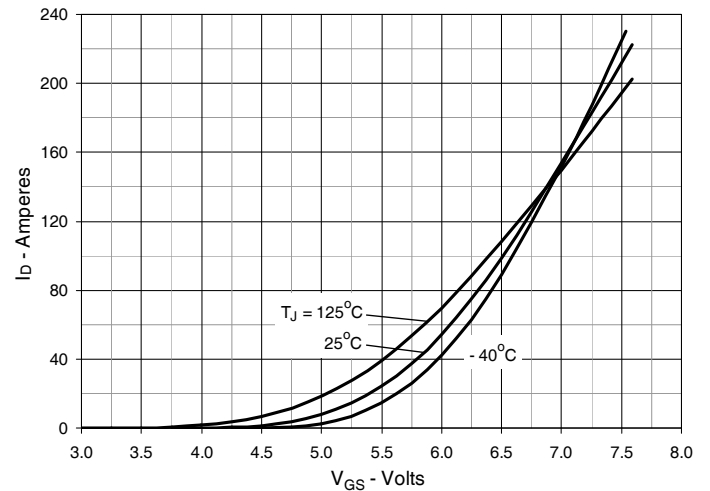


Fig. 9. Transconductance

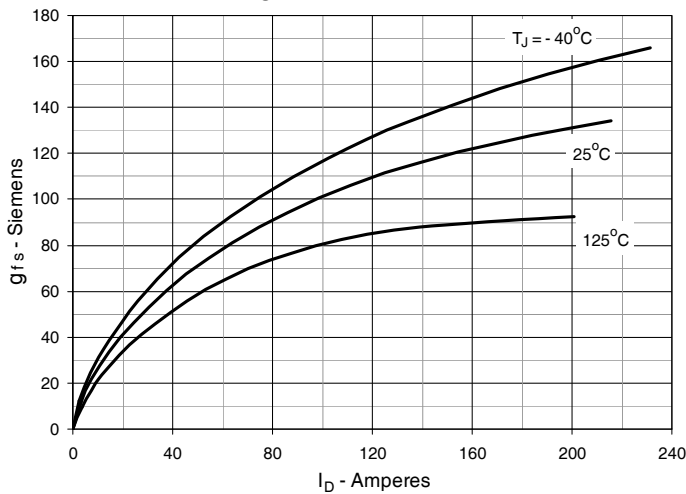


Fig. 10. Forward Voltage Drop of Intrinsic Diode

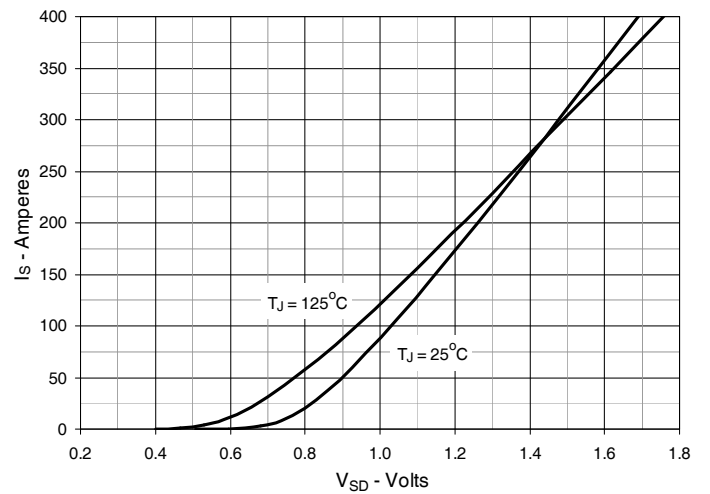


Fig. 11. Gate Charge

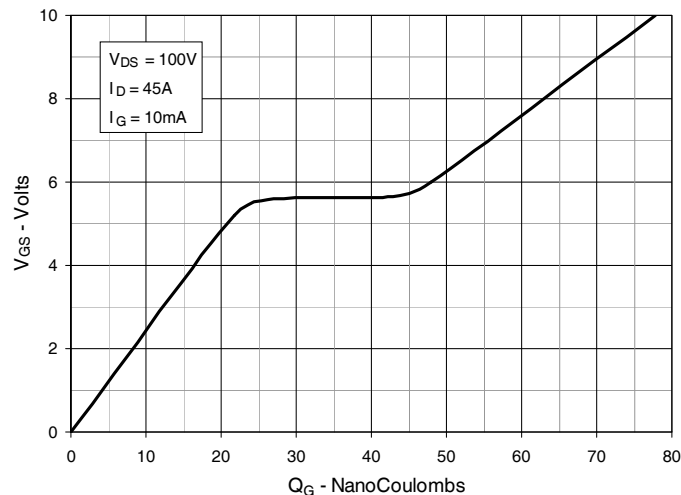


Fig. 12. Capacitance

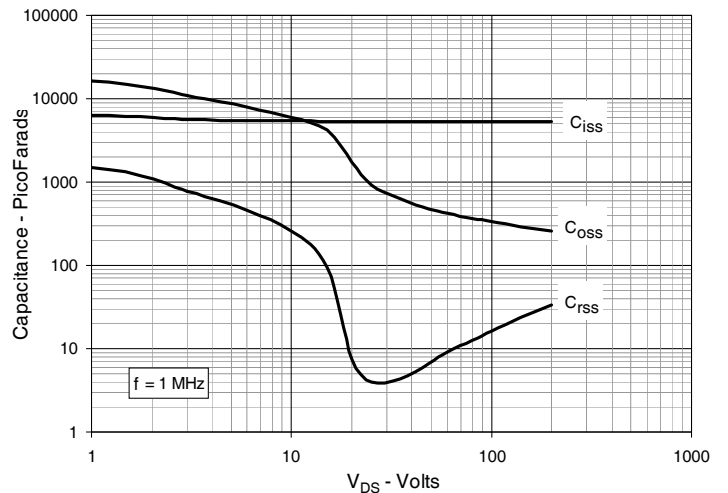


Fig. 13. Output Capacitance Stored Energy

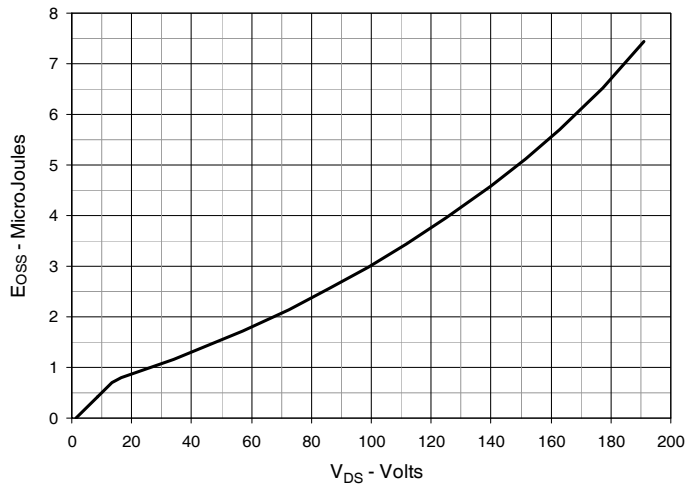


Fig. 14. Forward-Bias Safe Operating Area

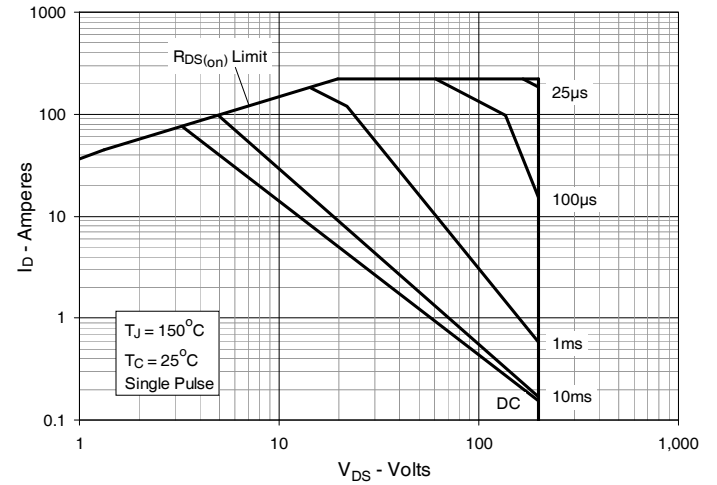
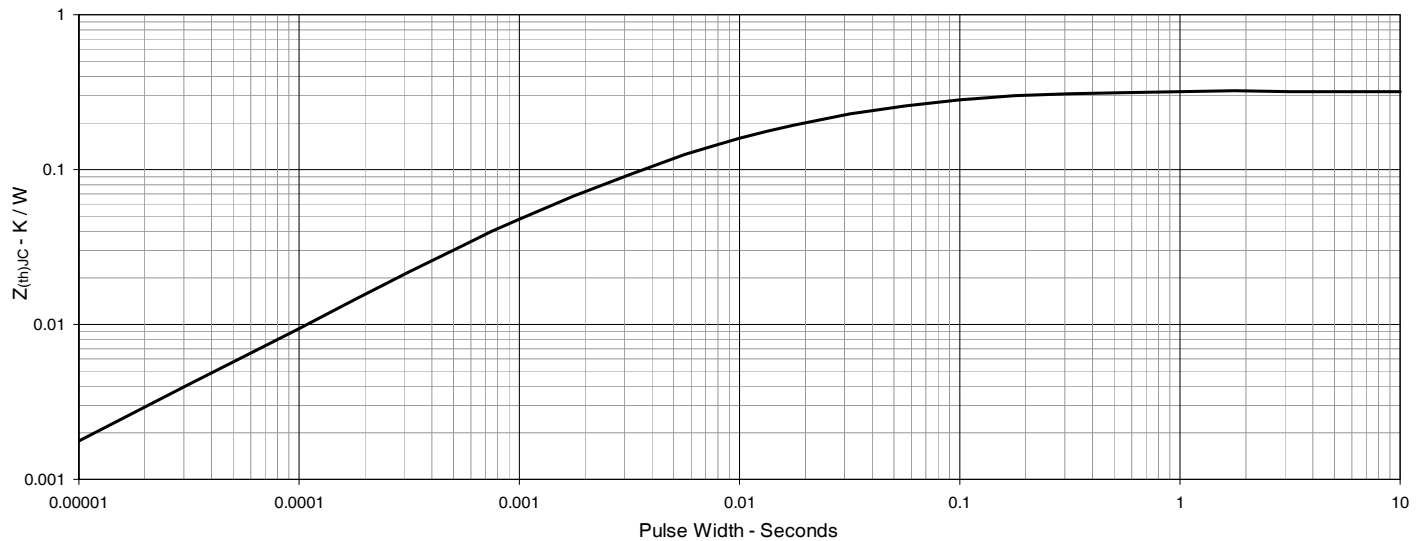
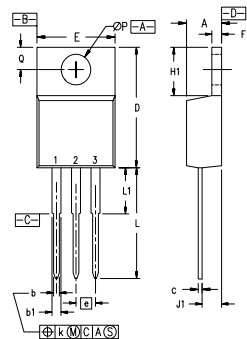


Fig. 15. Maximum Transient Thermal Impedance



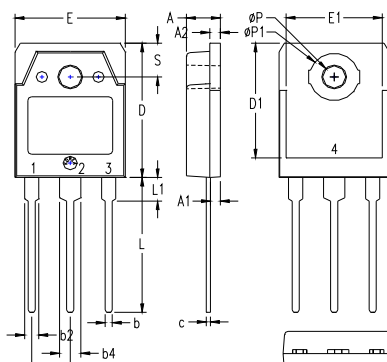
## TO-220 Outline



Pins: 1 - Gate 2 - Drain  
3 - Source

| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .170     | .190 | 4.32        | 4.83  |
| b   | .025     | .040 | 0.64        | 1.02  |
| b1  | .045     | .065 | 1.15        | 1.65  |
| c   | .014     | .022 | 0.35        | 0.56  |
| D   | .580     | .630 | 14.73       | 16.00 |
| E   | .390     | .420 | 9.91        | 10.66 |
| e   | .100 BSC |      | 2.54 BSC    |       |
| F   | .045     | .055 | 1.14        | 1.40  |
| H1  | .230     | .270 | 5.85        | 6.85  |
| J1  | .090     | .110 | 2.29        | 2.79  |
| k   | 0        | .015 | 0           | 0.38  |
| L   | .500     | .550 | 12.70       | 13.97 |
| L1  | .110     | .230 | 2.79        | 5.84  |
| ØP  | .139     | .161 | 3.53        | 4.08  |
| Q   | .100     | .125 | 2.54        | 3.18  |

## TO-3P Outline

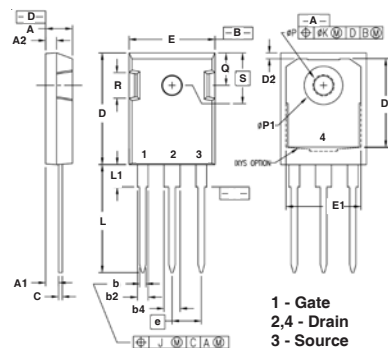


Pins: 1 - Gate 2 - Drain  
3 - Source 4 - Drain

| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .185     | .193 | 4.70        | 4.90  |
| A1  | .051     | .059 | 1.30        | 1.50  |
| A2  | .057     | .065 | 1.45        | 1.65  |
| b   | .035     | .045 | 0.90        | 1.15  |
| b2  | .075     | .087 | 1.90        | 2.20  |
| b4  | .114     | .126 | 2.90        | 3.20  |
| c   | .022     | .031 | 0.55        | 0.80  |
| D   | .780     | .791 | 19.80       | 20.10 |
| D1  | .665     | .677 | 16.90       | 17.20 |
| E   | .610     | .622 | 15.50       | 15.80 |
| E1  | .531     | .539 | 13.50       | 13.70 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| L   | .779     | .795 | 19.80       | 20.20 |
| L1  | .134     | .142 | 3.40        | 3.60  |
| ØP  | .126     | .134 | 3.20        | 3.40  |
| ØP1 | .272     | .280 | 6.90        | 7.10  |
| S   | .193     | .201 | 4.90        | 5.10  |

All metal area are tin plated.

## TO-247 Outline



1 - Gate  
2,4 - Drain  
3 - Source

| Dim. | Millimeter |       | Inches    |       |
|------|------------|-------|-----------|-------|
|      | min        | max   | min       | max   |
| A    | 4.70       | 5.30  | 0.185     | 0.209 |
| A1   | 2.21       | 2.59  | 0.087     | 0.102 |
| A2   | 1.50       | 2.49  | 0.059     | 0.098 |
| b    | 0.99       | 1.40  | 0.039     | 0.055 |
| b2   | 1.65       | 2.39  | 0.065     | 0.094 |
| b4   | 2.59       | 3.43  | 0.102     | 0.135 |
| c    | 0.38       | 0.89  | 0.015     | 0.035 |
| D    | 20.79      | 21.45 | 0.819     | 0.845 |
| D1   | 13.07      | -     | 0.515     | -     |
| D2   | 0.51       | 1.35  | 0.020     | 0.053 |
| E    | 15.48      | 16.24 | 0.610     | 0.640 |
| E1   | 13.45      | -     | 0.53      | -     |
| E2   | 4.31       | 5.48  | 0.170     | 0.216 |
| e    | 5.45 BSC   |       | 0.215 BSC |       |
| L    | 19.80      | 20.30 | 0.078     | 0.800 |
| L1   | -          | 4.49  | -         | 0.177 |
| ØP   | 3.55       | 3.65  | 0.140     | 0.144 |
| ØP1  | -          | 7.39  | -         | 0.290 |
| Q    | 5.38       | 6.19  | 0.212     | 0.244 |
| S    | 6.14 BSC   |       | 0.242 BSC |       |