

## Polar3™ HiperFET™ Power MOSFET

**IXFT60N50P3**  
**IXFQ60N50P3**  
**IXFH60N50P3**

**$V_{DSS} = 500V$**   
 **$I_{D25} = 60A$**   
 **$R_{DS(on)} \leq 110m\Omega$**

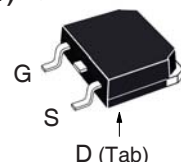
N-Channel Enhancement Mode  
Avalanche Rated  
Fast Intrinsic Rectifier



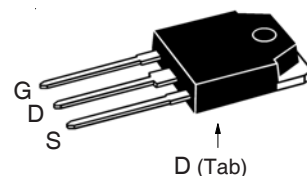
| Symbol     | Test Conditions                                                    | Maximum Ratings |            |
|------------|--------------------------------------------------------------------|-----------------|------------|
| $V_{DSS}$  | $T_J = 25^\circ C$ to $150^\circ C$                                | 500             | V          |
| $V_{DGR}$  | $T_J = 25^\circ C$ to $150^\circ C$ , $R_{GS} = 1M\Omega$          | 500             | V          |
| $V_{GSS}$  | Continuous                                                         | $\pm 30$        | V          |
| $V_{GSM}$  | Transient                                                          | $\pm 40$        | V          |
| $I_{D25}$  | $T_C = 25^\circ C$                                                 | 60              | A          |
| $I_{DM}$   | $T_C = 25^\circ C$ , Pulse Width Limited by $T_{JM}$               | 150             | A          |
| $I_A$      | $T_C = 25^\circ C$                                                 | 30              | A          |
| $E_{AS}$   | $T_C = 25^\circ C$                                                 | 1               | J          |
| $dv/dt$    | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ C$ | 35              | V/ns       |
| $P_D$      | $T_C = 25^\circ C$                                                 | 1040            | 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             | $^\circ C$ |
| $T_{SOLD}$ | Plastic Body for 10s                                               | 260             | $^\circ C$ |
| $M_d$      | Mounting Torque (TO-247 & TO-3P)                                   | 1.13 / 10       | Nm/lb.in   |
| Weight     | TO-268                                                             | 4.0             | 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.               |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 1mA$                                         | 500                   |      | V                  |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 4mA$                                     | 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>$T_J = 125^\circ C$           |                       |      | 25 $\mu A$<br>2 mA |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                 |                       |      | 110 m $\Omega$     |

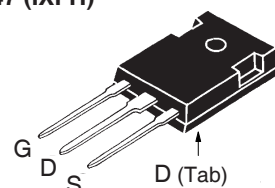
TO-268 (IXFT)



TO-3P (IXFQ)



TO-247 (IXFH)



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

### 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

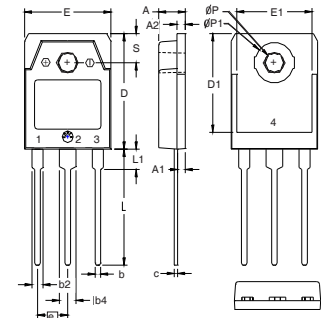
| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                                                                   | Characteristic Values |      |                    |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|--------------------|
|              |                                                                                                                                             | Min.                  | Typ. | Max.               |
| $g_{fs}$     | $V_{DS} = 20\text{V}$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                                                                                  | 35                    | 60   | S                  |
| $C_{iss}$    | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                            |                       | 6250 | pF                 |
| $C_{oss}$    |                                                                                                                                             |                       | 680  | pF                 |
| $C_{rss}$    |                                                                                                                                             |                       | 5    | pF                 |
| $R_{Gi}$     | Gate Input Resistance                                                                                                                       |                       | 1.0  | $\Omega$           |
| $t_{d(on)}$  | Resistive Switching Times<br>$V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$<br>$R_G = 1\Omega$ (External) |                       | 18   | ns                 |
| $t_r$        |                                                                                                                                             |                       | 16   | ns                 |
| $t_{d(off)}$ |                                                                                                                                             |                       | 37   | ns                 |
| $t_f$        |                                                                                                                                             |                       | 8    | ns                 |
| $Q_{g(on)}$  | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$                                                            |                       | 96   | nC                 |
| $Q_{gs}$     |                                                                                                                                             |                       | 28   | nC                 |
| $Q_{gd}$     |                                                                                                                                             |                       | 26   | nC                 |
| $R_{thJC}$   | (TO-247 & TO-3P)                                                                                                                            |                       | 0.12 | $^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                                                                             |                       |      | $^\circ\text{C/W}$ |

## Source-Drain Diode

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                             | Characteristic Values |      |               |
|----------|-------------------------------------------------------------------------------------------------------|-----------------------|------|---------------|
|          |                                                                                                       | Min.                  | Typ. | Max.          |
| $I_S$    | $V_{GS} = 0\text{V}$                                                                                  |                       |      | 60 A          |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$                                                           |                       |      | 240 A         |
| $V_{SD}$ | $I_F = I_S$ , $V_{GS} = 0\text{V}$ , Note 1                                                           |                       |      | 1.4 V         |
| $t_{rr}$ | $I_F = 30\text{A}$ , $-di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}$ , $V_{GS} = 0\text{V}$ |                       | 11   | 250 ns        |
| $I_{RM}$ |                                                                                                       |                       |      | A             |
| $Q_{RM}$ |                                                                                                       |                       |      | $\mu\text{C}$ |

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

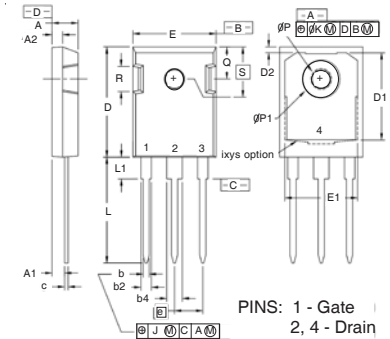
## TO-3P Outline



PINS: 1 - Gate  
2, 4 - Drain  
3 - Source

| 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     | .799 | 19.80       | 20.30 |
| 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  |
| $\phi P$  | .126     | .134 | 3.20        | 3.40  |
| $\phi P1$ | .272     | .280 | 6.90        | 7.10  |
| S         | .193     | .201 | 4.90        | 5.10  |

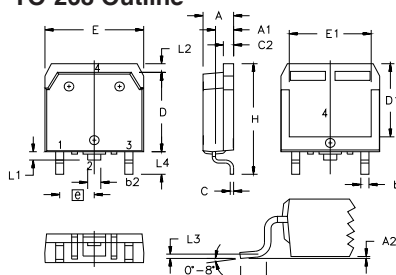
## TO-247 Outline



PINS: 1 - Gate  
2, 4 - Drain  
3 - Source

| 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  |
| $\phi P$  | .140     | .144 | 3.55        | 3.65  |
| $\phi P1$ | .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-268 Outline



Terminals: 1 - Gate  
2, 4 - Drain  
3 - Source

| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .193     | .201 | 4.90        | 5.10  |
| A1  | .106     | .114 | 2.70        | 2.90  |
| A2  | .001     | .010 | 0.02        | 0.25  |
| b   | .045     | .057 | 1.15        | 1.45  |
| b2  | .075     | .083 | 1.90        | 2.10  |
| C   | .016     | .026 | 0.40        | 0.65  |
| C2  | .057     | .063 | 1.45        | 1.60  |
| D   | .543     | .551 | 13.80       | 14.00 |
| D1  | .488     | .500 | 12.40       | 12.70 |
| E   | .624     | .632 | 15.85       | 16.05 |
| E1  | .524     | .535 | 13.30       | 13.60 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| H   | .736     | .752 | 18.70       | 19.10 |
| L   | .094     | .106 | 2.40        | 2.70  |
| L1  | .047     | .055 | 1.20        | 1.40  |
| L2  | .039     | .045 | 1.00        | 1.15  |
| L3  | .010 BSC |      | 0.25 BSC    |       |
| L4  | .150     | .161 | 3.80        | 4.10  |

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

IXYS MOSFETs and IGBTs are covered 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 7,157,338 B2  
by one or more of the following U.S. patents: 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

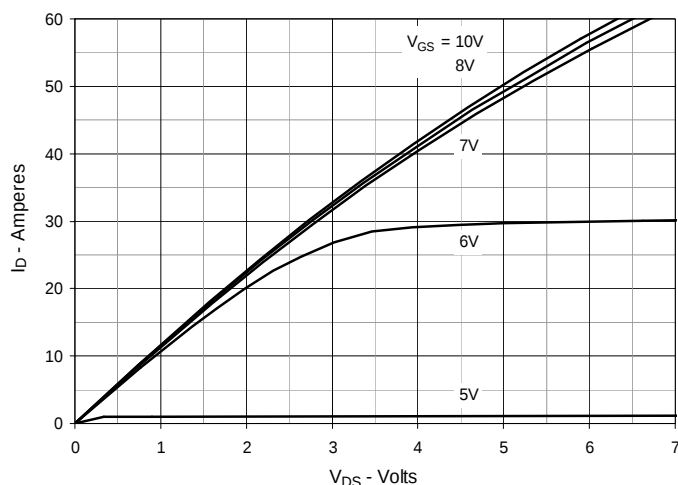
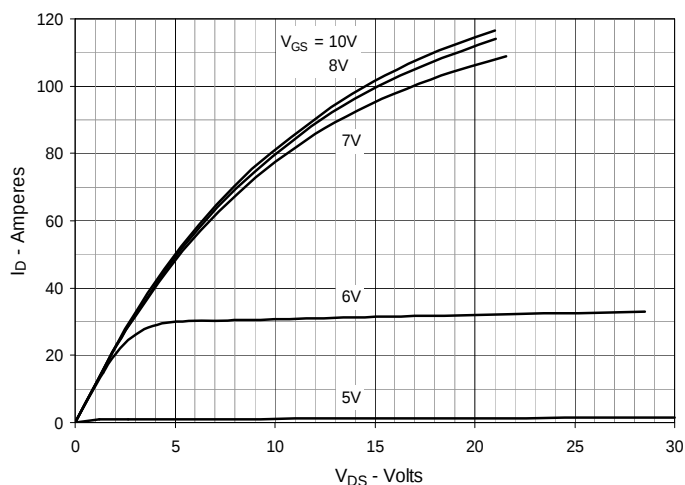
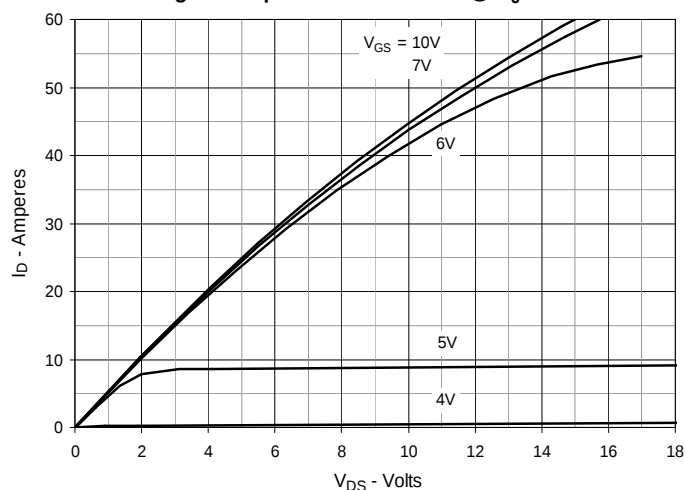
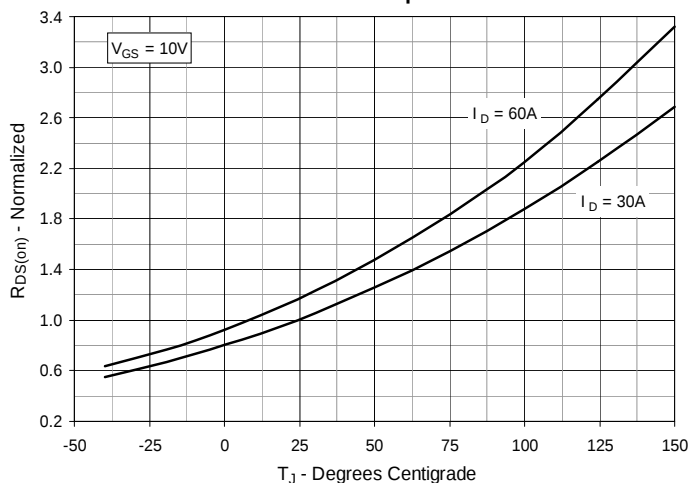
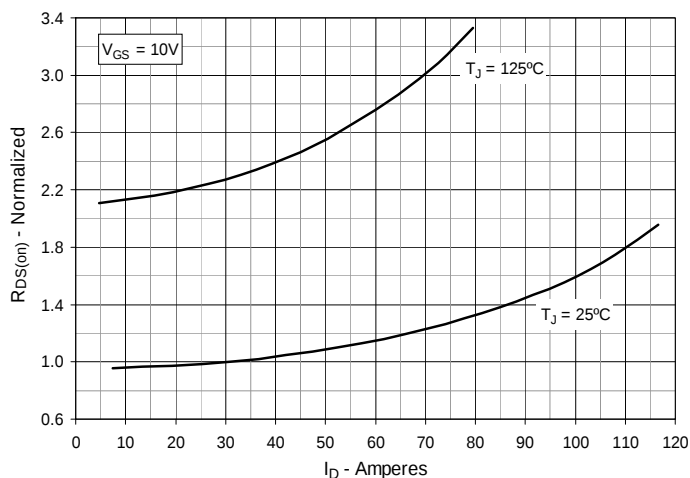
Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$ 

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  $I_D = 30\text{A}$  Value vs. Junction Temperature

Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 30\text{A}$  Value vs. Drain Current


Fig. 6. Maximum Drain Current vs. Case Temperature

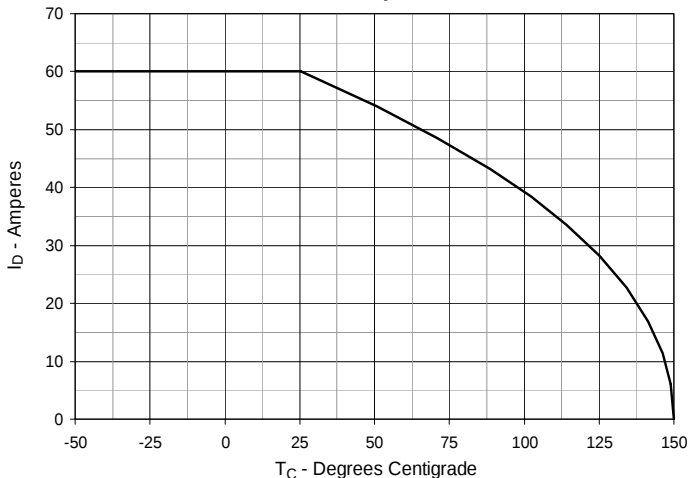


Fig. 7. Input Admittance

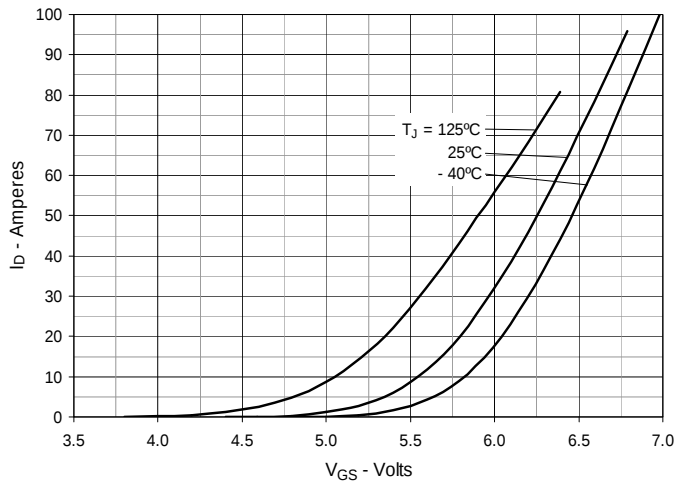


Fig. 8. Transconductance

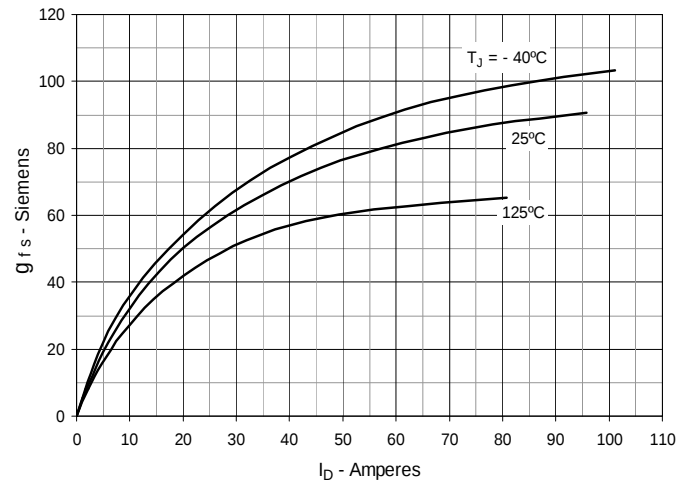


Fig. 9. Forward Voltage Drop of Intrinsic Diode

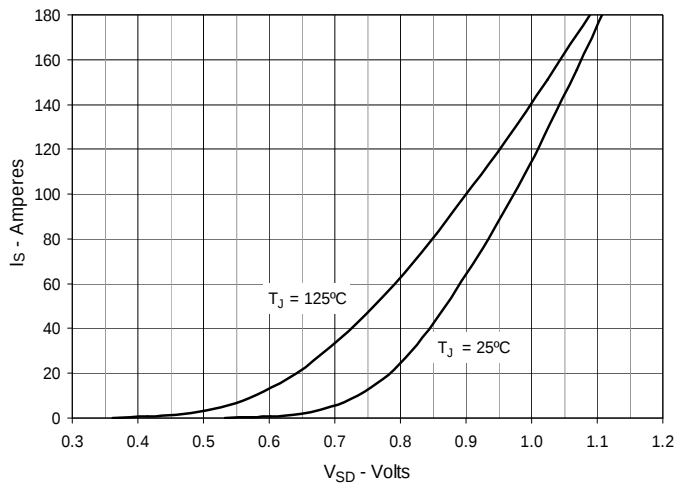


Fig. 10. Gate Charge

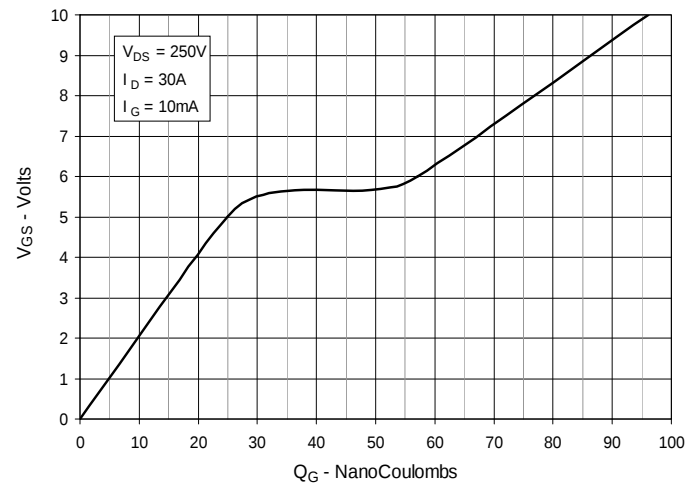


Fig. 11. Capacitance

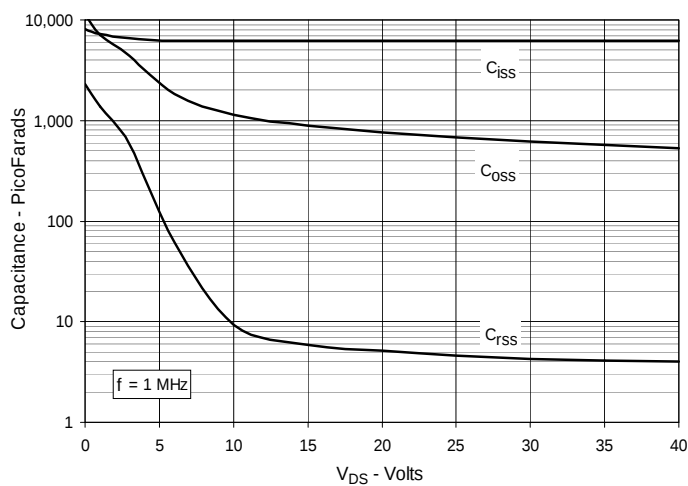


Fig. 12. Forward-Bias Safe Operating Area

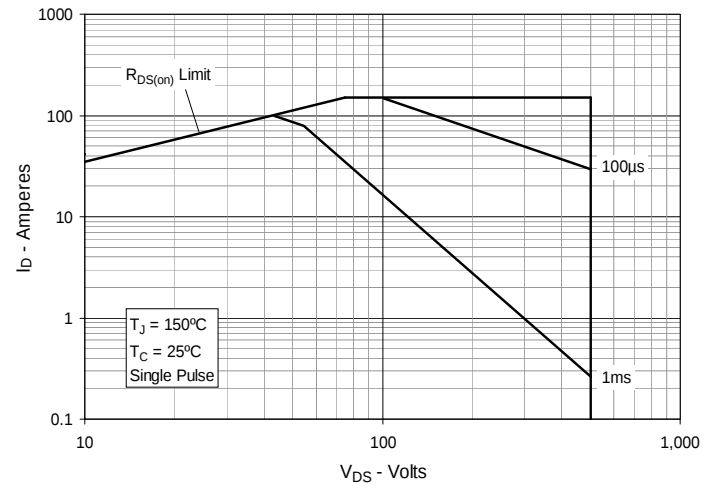
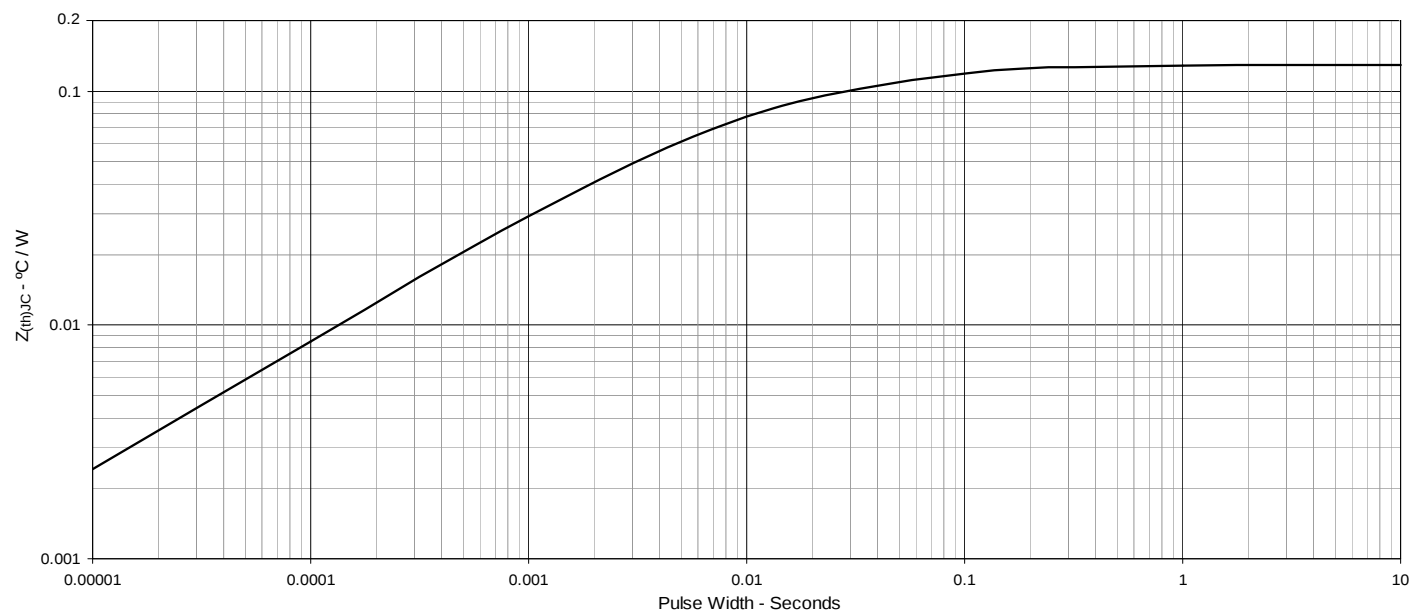


Fig. 13. Maximum Transient Thermal Impedance





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