

# TrenchMV™ Power MOSFET

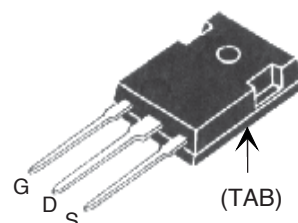
**IXTH220N075T**  
**IXTQ220N075T**

$$\begin{aligned} V_{DSS} &= 75 \text{ V} \\ I_{D25} &= 220 \text{ A} \\ R_{DS(on)} &\leq 4.5 \text{ m}\Omega \end{aligned}$$

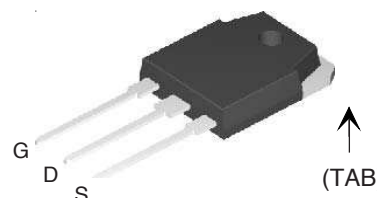
N-Channel Enhancement Mode  
Avalanche Rated



TO-247 (IXTH)



TO-3P (IXTQ)



G = Gate      D = Drain  
S = Source      TAB = Drain

| Symbol     | Test Conditions                                                                                                                         | Maximum Ratings |                  |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|
| $V_{DSS}$  | $T_J = 25^\circ\text{C}$ to $175^\circ\text{C}$                                                                                         | 75              | V                |
| $V_{DGR}$  | $T_J = 25^\circ\text{C}$ to $175^\circ\text{C}$ ; $R_{GS} = 1 \text{ M}\Omega$                                                          | 75              | V                |
| $V_{GSM}$  | Transient                                                                                                                               | $\pm 20$        | V                |
| $I_{D25}$  | $T_C = 25^\circ\text{C}$                                                                                                                | 220             | A                |
| $I_{LRMS}$ | Lead Current Limit, RMS                                                                                                                 | 75              | A                |
| $I_{DM}$   | $T_C = 25^\circ\text{C}$ , pulse width limited by $T_{JM}$                                                                              | 600             | A                |
| $I_{AR}$   | $T_C = 25^\circ\text{C}$                                                                                                                | 25              | A                |
| $E_{AS}$   | $T_C = 25^\circ\text{C}$                                                                                                                | 1.0             | J                |
| $dv/dt$    | $I_S \leq I_{DM}$ , $di/dt \leq 100 \text{ A}/\mu\text{s}$ , $V_{DD} \leq V_{DSS}$<br>$T_J \leq 175^\circ\text{C}$ , $R_G = 3.3 \Omega$ | 3               | V/ns             |
| $P_D$      | $T_C = 25^\circ\text{C}$                                                                                                                | 480             | W                |
| $T_J$      |                                                                                                                                         | -55 ... +175    | $^\circ\text{C}$ |
| $T_{JM}$   |                                                                                                                                         | 175             | $^\circ\text{C}$ |
| $T_{stg}$  |                                                                                                                                         | -55 ... +175    | $^\circ\text{C}$ |
| $T_L$      | 1.6 mm (0.062 in.) from case for 10 s                                                                                                   | 300             | $^\circ\text{C}$ |
| $T_{SOLD}$ | Plastic body for 10 seconds                                                                                                             | 260             | $^\circ\text{C}$ |
| $M_d$      | Mounting torque                                                                                                                         | 1.13 / 10       | Nm/lb.in.        |
| Weight     | TO-3P                                                                                                                                   | 5.5             | g                |
|            | TO-247                                                                                                                                  | 6               | g                |

## Features

- Ultra-low On Resistance
- Unclamped Inductive Switching (UIS) rated
- Low package inductance
  - easy to drive and to protect
- 175  $^\circ\text{C}$  Operating Temperature

## Advantages

- Easy to mount
- Space savings
- High power density

## Applications

- Automotive
  - Motor Drives
  - 42V Power Bus
  - ABS Systems
- DC/DC Converters and Off-line UPS
- Primary Switch for 24V and 48V Systems
- High Current Switching Applications

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ unless otherwise specified) | Characteristic Values |      |                      |
|--------------|---------------------------------------------------------------------------|-----------------------|------|----------------------|
|              |                                                                           | Min.                  | Typ. | Max.                 |
| $BV_{DSS}$   | $V_{GS} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$                          | 75                    |      | V                    |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$                               | 2.0                   |      | 4.0 V                |
| $I_{GSS}$    | $V_{GS} = \pm 20 \text{ V}$ , $V_{DS} = 0 \text{ V}$                      |                       |      | $\pm 200 \text{ nA}$ |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$                                                        |                       |      | 5 $\mu\text{A}$      |
|              | $V_{GS} = 0 \text{ V}$ $T_J = 150^\circ\text{C}$                          |                       |      | 250 $\mu\text{A}$    |
| $R_{DS(on)}$ | $V_{GS} = 10 \text{ V}$ , $I_D = 25 \text{ A}$ , Notes 1, 2               | 3.6                   | 4.5  | $\text{m}\Omega$     |

| Symbol                                             | Test Conditions                                                                        | Characteristic Values |      |           |
|----------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------|------|-----------|
|                                                    |                                                                                        | Min.                  | Typ. | Max.      |
| (T <sub>J</sub> = 25°C unless otherwise specified) |                                                                                        |                       |      |           |
| <b>g<sub>fs</sub></b>                              | V <sub>DS</sub> = 10 V; I <sub>D</sub> = 60 A, Note 1                                  | 75                    | 120  | S         |
| <b>C<sub>iss</sub></b>                             | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1 MHz                               |                       | 7700 | pF        |
| <b>C<sub>oss</sub></b>                             |                                                                                        |                       | 1100 | pF        |
| <b>C<sub>rss</sub></b>                             |                                                                                        |                       | 230  | pF        |
| <b>t<sub>d(on)</sub></b>                           | <b>Resistive Switching Times</b>                                                       |                       | 29   | ns        |
| <b>t<sub>r</sub></b>                               | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 0.5 V <sub>DSS</sub> , I <sub>D</sub> = 25 A |                       | 65   | ns        |
| <b>t<sub>d(off)</sub></b>                          | R <sub>G</sub> = 3.3 Ω (External)                                                      |                       | 55   | ns        |
| <b>t<sub>f</sub></b>                               |                                                                                        |                       | 47   | ns        |
| <b>Q<sub>g(on)</sub></b>                           | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 0.5 V <sub>DSS</sub> , I <sub>D</sub> = 25 A |                       | 165  | nC        |
| <b>Q<sub>gs</sub></b>                              |                                                                                        |                       | 40   | nC        |
| <b>Q<sub>gd</sub></b>                              |                                                                                        |                       | 50   | nC        |
| <b>R<sub>thJC</sub></b>                            |                                                                                        | 0.25                  |      | 0.31 °C/W |
| <b>R<sub>thCH</sub></b>                            |                                                                                        |                       |      | °C/W      |

#### Source-Drain Diode

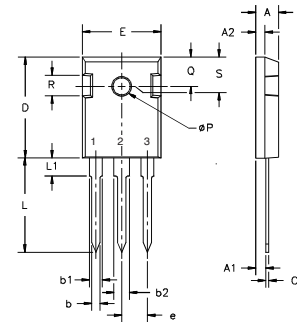
| Symbol                                            | Test Conditions                                                                          | Characteristic Values |      |       |
|---------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------|------|-------|
| T <sub>J</sub> = 25°C unless otherwise specified) |                                                                                          | Min.                  | Typ. | Max.  |
| I <sub>S</sub>                                    | V <sub>GS</sub> = 0 V                                                                    |                       |      | 220 A |
| I <sub>SM</sub>                                   | Pulse width limited by T <sub>JM</sub>                                                   |                       |      | 600 A |
| V <sub>SD</sub>                                   | I <sub>F</sub> = 25 A, V <sub>GS</sub> = 0 V, Note 1                                     |                       |      | 1.0 V |
| t <sub>rr</sub>                                   | I <sub>F</sub> = 25 A, -di/dt = 100 A/μs<br>V <sub>R</sub> = 40 V, V <sub>GS</sub> = 0 V |                       | 80   | ns    |

- Notes: 1. Pulse test, t ≤ 300 μs, duty cycle d ≤ 2 %;  
2. On through-hole packages, R<sub>DS(on)</sub> Kelvin test contact location must be 5 mm or less from the package body.

#### PRELIMINARY TECHNICAL INFORMATION

The product presented herein is under development. The Technical Specifications offered are derived from data gathered during objective characterizations of preliminary engineering lots; but also may yet contain some information supplied during a pre-production design evaluation. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

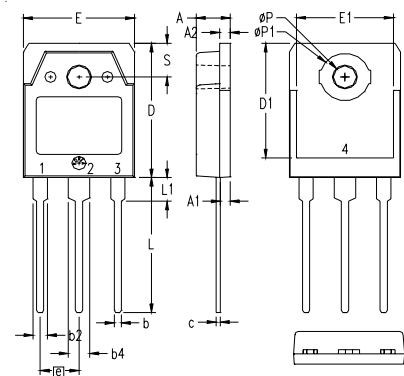
#### TO-247 AD Outline



Terminals: 1 - Gate  
2 - Drain  
3 - Source  
Tab - Drain

| Dim.           | Millimeter |       | Inches |       |
|----------------|------------|-------|--------|-------|
|                | Min.       | Max.  | Min.   | Max.  |
| A              | 4.7        | 5.3   | .185   | .209  |
| A <sub>1</sub> | 2.2        | 2.54  | .087   | .102  |
| A <sub>2</sub> | 2.2        | 2.6   | .059   | .098  |
| b              | 1.0        | 1.4   | .040   | .055  |
| b <sub>1</sub> | 1.65       | 2.13  | .065   | .084  |
| b <sub>2</sub> | 2.87       | 3.12  | .113   | .123  |
| C              | .4         | .8    | .016   | .031  |
| D              | 20.80      | 21.46 | .819   | .845  |
| E              | 15.75      | 16.26 | .610   | .640  |
| e              | 5.20       | 5.72  | 0.205  | 0.225 |
| L              | 19.81      | 20.32 | .780   | .800  |
| L1             |            | 4.50  |        | .177  |
| Q              | 3.55       | 3.65  | .140   | .144  |
| Q <sub>P</sub> | 5.89       | 6.40  | 0.232  | 0.252 |
| R              | 4.32       | 5.49  | .170   | .216  |
| S              | 6.15       | BSC   | 242    | BSC   |

#### TO-3P (IXTQ) Outline



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

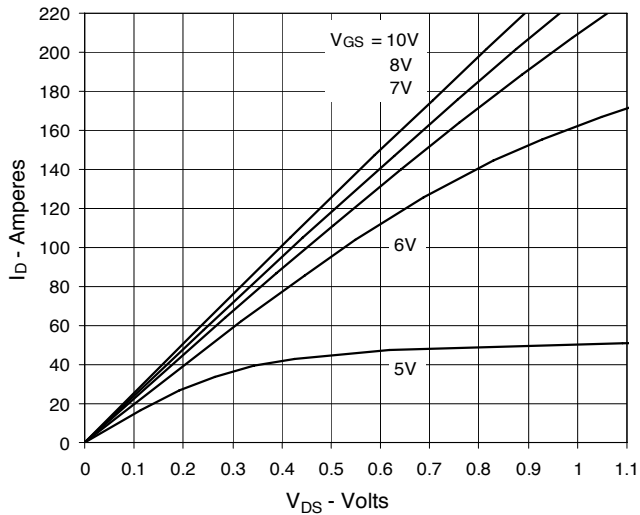
| SYM             | INCHES   |      | MILLIMETERS |       |
|-----------------|----------|------|-------------|-------|
|                 | MIN      | MAX  | MIN         | MAX   |
| A               | .185     | .193 | 4.70        | 4.90  |
| A1              | .051     | .059 | 1.30        | 1.50  |
| 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  |
| Q <sub>P</sub>  | .126     | .134 | 3.20        | 3.40  |
| Q <sub>P1</sub> | .272     | .280 | 6.90        | 7.10  |
| S               | .193     | .201 | 4.90        | 5.10  |

All metal area are tin plated.

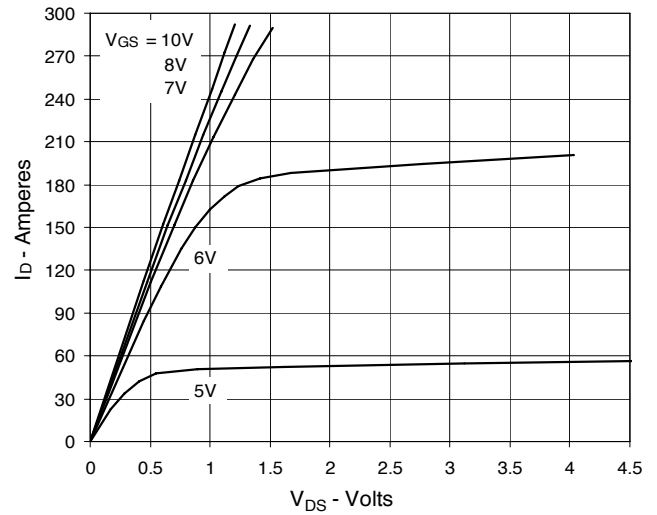
IXYS reserves the right to change limits, test conditions, and dimensions.

|                                                                                  |           |           |           |           |              |              |              |              |              |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|
| 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 |
|                                                                                  | 4,850,072 | 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    |

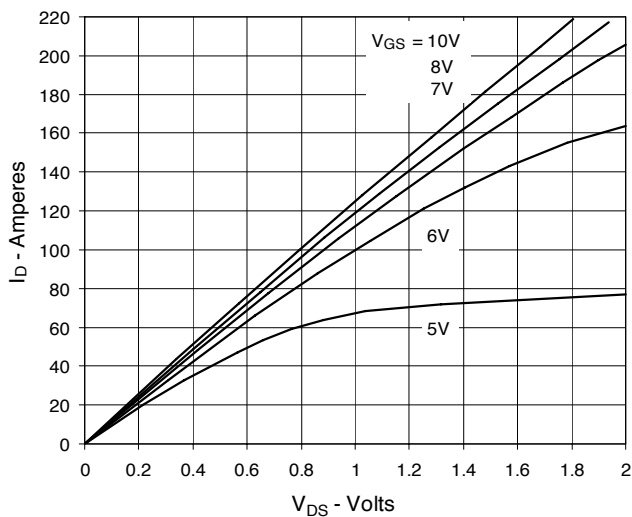
**Fig. 1. Output Characteristics**  
**@ 25°C**



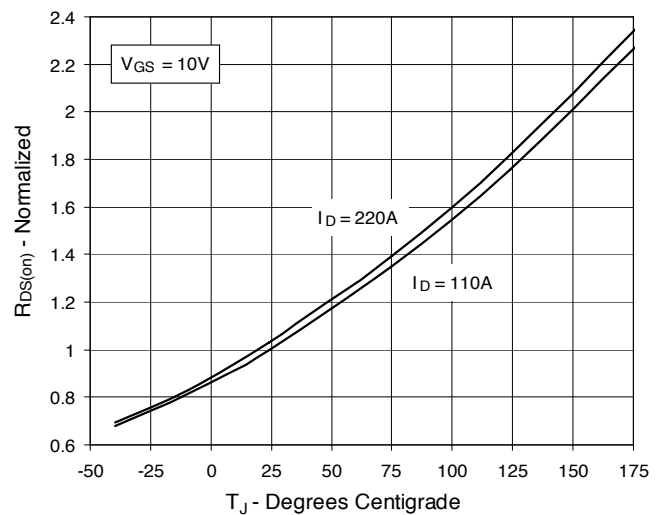
**Fig. 2. Extended Output Characteristics**  
**@ 25°C**



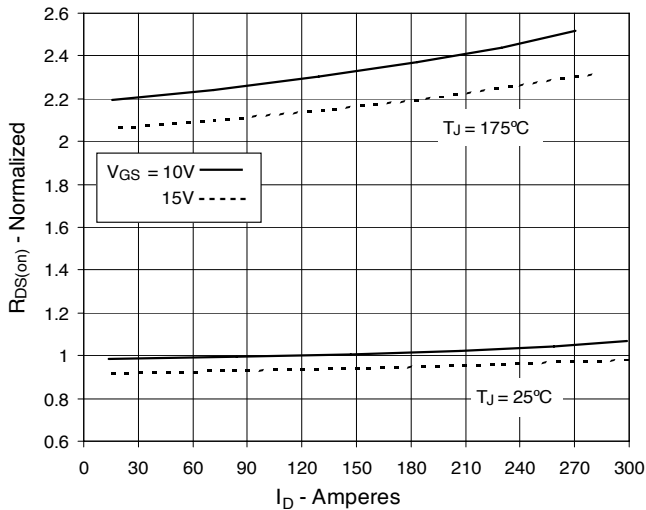
**Fig. 3. Output Characteristics**  
**@ 150°C**



**Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 110A$  Value**  
**vs. Junction Temperature**



**Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 110A$  Value**  
**vs. Drain Current**



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

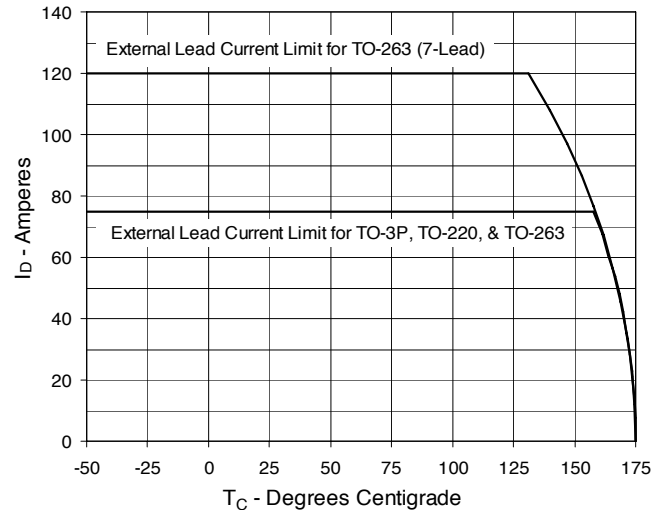


Fig. 7. Input Admittance

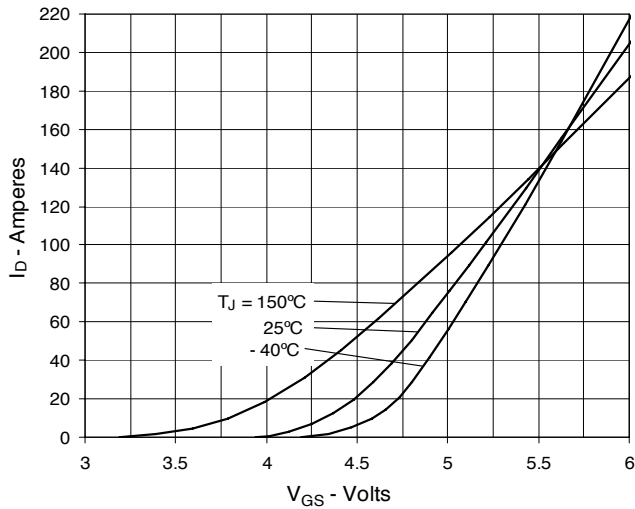


Fig. 8. Transconductance

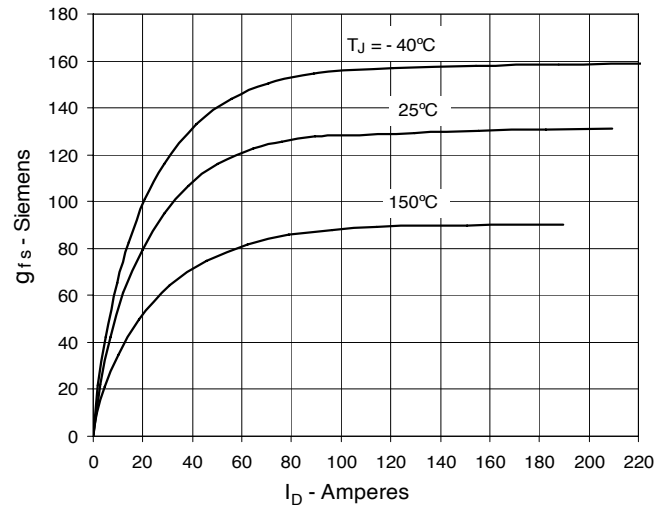


Fig. 9. Forward Voltage Drop of Intrinsic Diode

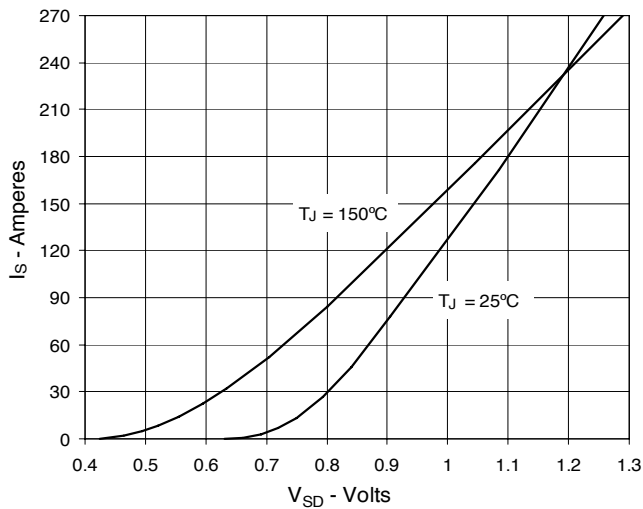


Fig. 10. Gate Charge

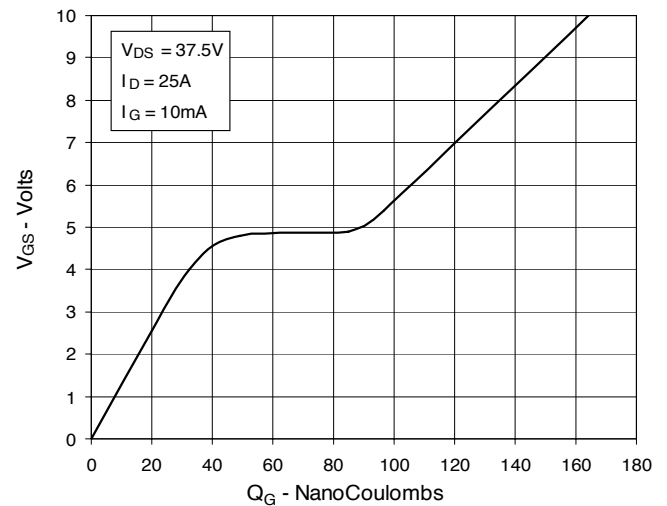


Fig. 11. Capacitance

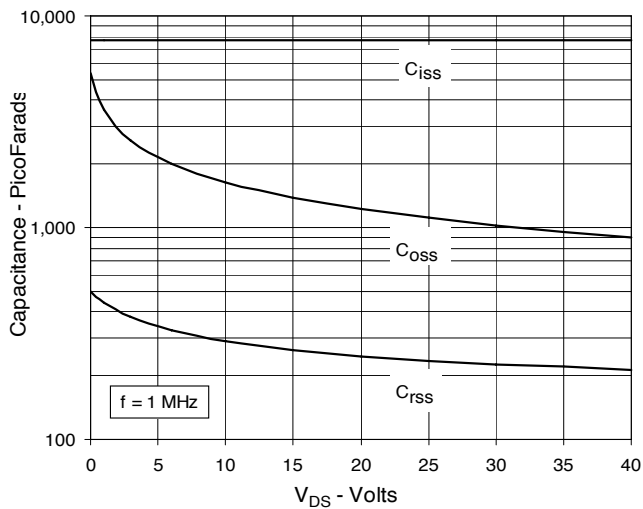
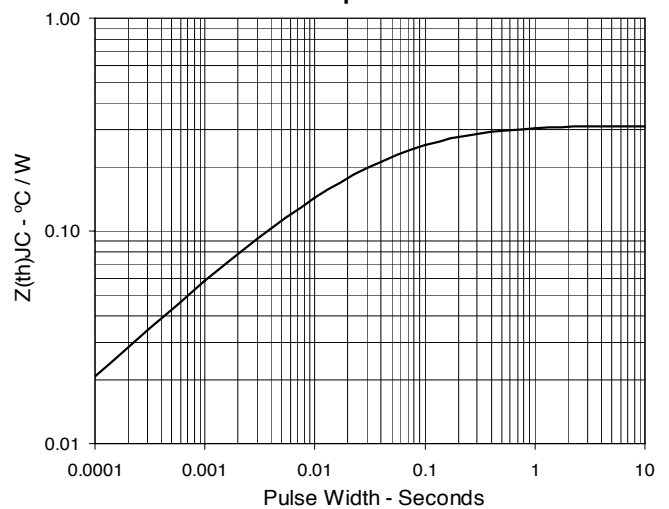
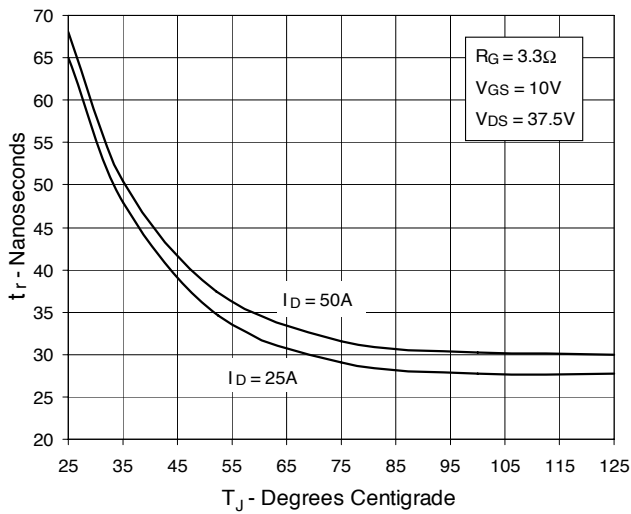


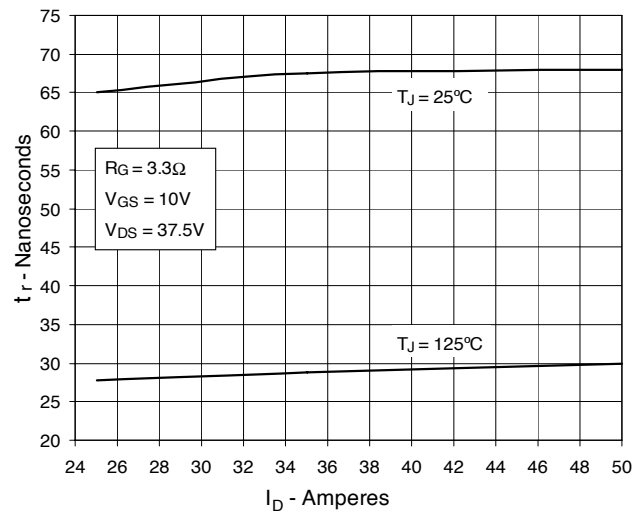
Fig. 12. Maximum Transient Thermal Impedance



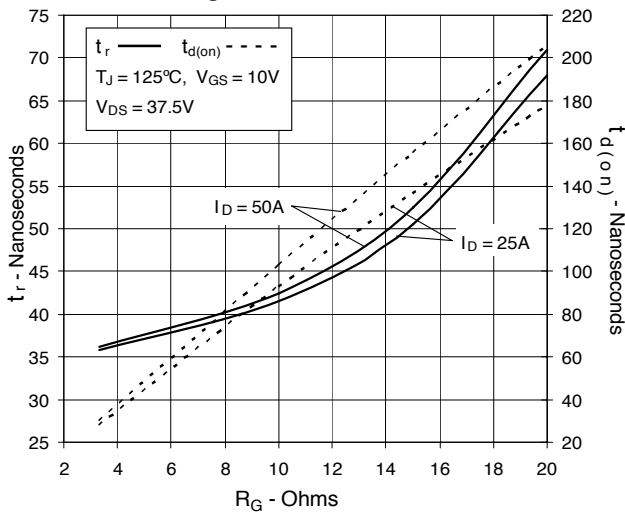
**Fig. 13. Resistive Turn-on  
Rise Time vs. Junction Temperature**



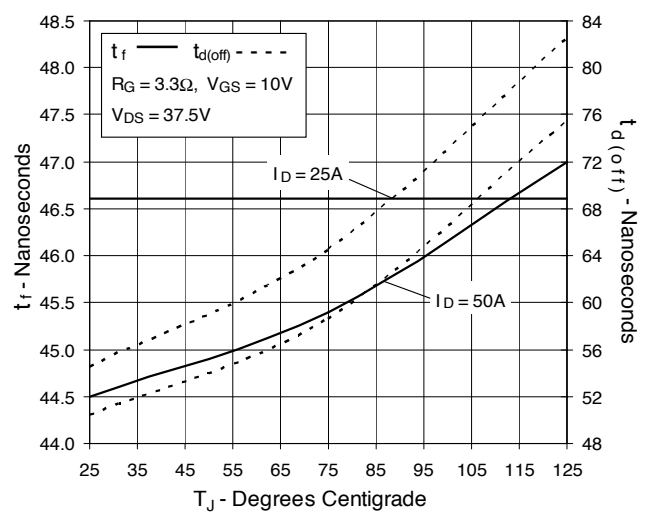
**Fig. 14. Resistive Turn-on  
Rise Time vs. Drain Current**



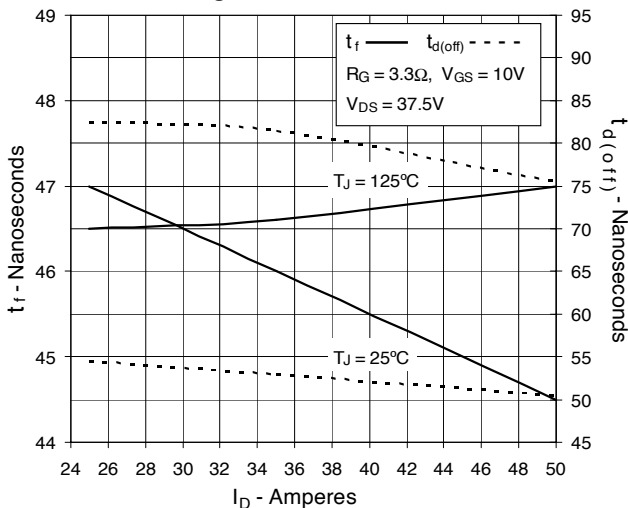
**Fig. 15. Resistive Turn-on  
Switching Times vs. Gate Resistance**



**Fig. 16. Resistive Turn-off  
Switching Times vs. Junction Temperature**



**Fig. 17. Resistive Turn-off  
Switching Times vs. Drain Current**



**Fig. 18. Resistive Turn-off  
Switching Times vs. Gate Resistance**

