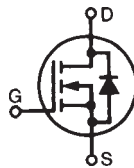


# TrenchT2™ Power MOSFET

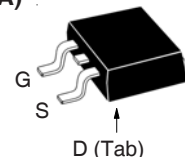
## IXTA220N04T2 IXTP220N04T2

N-Channel Enhancement Mode  
Avalanche Rated

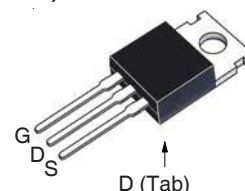


$$\begin{aligned} V_{DSS} &= 40V \\ I_{D25} &= 220A \\ R_{DS(on)} &\leq 3.5m\Omega \end{aligned}$$

TO-263 (IXTA)



TO-220 (IXTP)



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

| Symbol       | Test Conditions                                                       | Maximum Ratings    |                  |
|--------------|-----------------------------------------------------------------------|--------------------|------------------|
| $V_{DSS}$    | $T_J = 25^\circ\text{C}$ to $175^\circ\text{C}$                       | 40                 | V                |
| $V_{DGR}$    | $T_J = 25^\circ\text{C}$ to $175^\circ\text{C}$ , $R_{GS} = 1M\Omega$ | 40                 | V                |
| $V_{GSM}$    | Transient                                                             | $\pm 20$           | V                |
| $I_{D25}$    | $T_C = 25^\circ\text{C}$                                              | 220                | A                |
| $I_{L(RMS)}$ | External Lead Current Limit                                           | 120                | A                |
| $I_{DM}$     | $T_C = 25^\circ\text{C}$ , Pulse Width Limited by $T_{JM}$            | 660                | A                |
| $I_A$        | $T_C = 25^\circ\text{C}$                                              | 110                | A                |
| $E_{AS}$     | $T_C = 25^\circ\text{C}$                                              | 600                | mJ               |
| $P_D$        | $T_C = 25^\circ\text{C}$                                              | 360                | W                |
| $T_J$        |                                                                       | -55 ... +175       | $^\circ\text{C}$ |
| $T_{JM}$     |                                                                       | 175                | $^\circ\text{C}$ |
| $T_{stg}$    |                                                                       | -55 ... +175       | $^\circ\text{C}$ |
| $T_L$        | Maximum Lead Temperature for Soldering                                | 300                | $^\circ\text{C}$ |
| $T_{SOLD}$   | 1.6 mm (0.062in.) from Case for 10s                                   | 260                | $^\circ\text{C}$ |
| $F_C$        | 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-263                                                                | 2.5                | g                |
|              | TO-220                                                                | 3.0                | g                |

## Features

- International Standard Packages
- Avalanche Rated
- Low Package Inductance
- Fast Intrinsic Rectifier
- 175°C Operating Temperature
- High Current Handling Capability
- ROHS Compliant
- High Performance Trench Technology for extremely low  $R_{DS(on)}$

## Advantages

- High Power Density
- Easy to Mount
- Space Savings

## Applications

- Automotive Engine Control
- Synchronous Buck Converter (for Notebook SystemPower & General Purpose Point & Load)
- DC/DC Converters
- High Current Switching Applications
- Power Train Management
- Distributed Power Architecture

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified) | Characteristic Values |      |              |
|--------------|---------------------------------------------------------------------------|-----------------------|------|--------------|
|              |                                                                           | Min.                  | Typ. | Max.         |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 250\mu A$                                          | 40                    |      | V            |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 250\mu A$                                      | 2.0                   |      | 4.0 V        |
| $I_{GSS}$    | $V_{GS} = \pm 20V$ , $V_{DS} = 0V$                                        |                       |      | $\pm 200$ nA |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$<br>$T_J = 150^\circ\text{C}$           |                       |      | 5 $\mu A$    |
|              |                                                                           |                       |      | 50 $\mu A$   |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 50A$ , Notes 1 & 2                                | 2.8                   | 3.5  | m $\Omega$   |

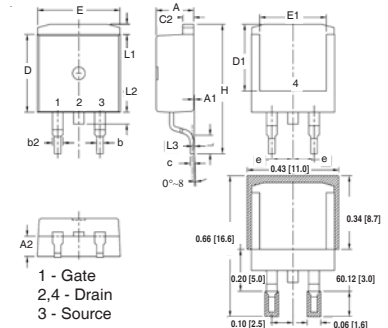
| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                                                              | Characteristic Values |      |                        |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|------------------------|
|              |                                                                                                                                        | Min.                  | Typ. | Max.                   |
| $g_{fs}$     | $V_{DS} = 10\text{V}$ , $I_D = 60\text{A}$ , Note 1                                                                                    | 40                    | 66   | S                      |
| $C_{iss}$    | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                       |                       | 6820 | pF                     |
| $C_{oss}$    |                                                                                                                                        |                       | 1185 | pF                     |
| $C_{rss}$    |                                                                                                                                        |                       | 250  | pF                     |
| $t_{d(on)}$  | <b>Resistive Switching Times</b><br>$V_{GS} = 10\text{V}$ , $V_{DS} = 20\text{V}$ , $I_D = 50\text{A}$<br>$R_G = 3.3\Omega$ (External) |                       | 15   | ns                     |
| $t_r$        |                                                                                                                                        |                       | 21   | ns                     |
| $t_{d(off)}$ |                                                                                                                                        |                       | 31   | ns                     |
| $t_f$        |                                                                                                                                        |                       | 21   | ns                     |
| $Q_{g(on)}$  | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{DSS}$                                                       |                       | 112  | nC                     |
| $Q_{gs}$     |                                                                                                                                        |                       | 33   | nC                     |
| $Q_{gd}$     |                                                                                                                                        |                       | 30   | nC                     |
| $R_{thJC}$   | TO-220                                                                                                                                 |                       | 0.50 | $0.42^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                                                                        |                       |      | $^\circ\text{C/W}$     |

## Source-Drain Diode

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                               | Characteristic Values |      |       |
|----------|---------------------------------------------------------------------------------------------------------|-----------------------|------|-------|
|          |                                                                                                         | Min.                  | Typ. | Max.  |
| $I_S$    | $V_{GS} = 0\text{V}$                                                                                    |                       |      | 220 A |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$                                                             |                       |      | 660 A |
| $V_{SD}$ | $I_F = 50\text{A}$ , $V_{GS} = 0\text{V}$ , Note 1                                                      |                       |      | 1.1 V |
| $t_{rr}$ | $I_F = 110\text{A}$ , $V_{GS} = 0\text{V}$ ,<br>$-di/dt = 100\text{A}/\mu\text{s}$ , $V_R = 20\text{V}$ |                       | 45   | ns    |
| $I_{RM}$ |                                                                                                         |                       | 1.8  | A     |
| $Q_{RM}$ |                                                                                                         |                       | 32   | nC    |

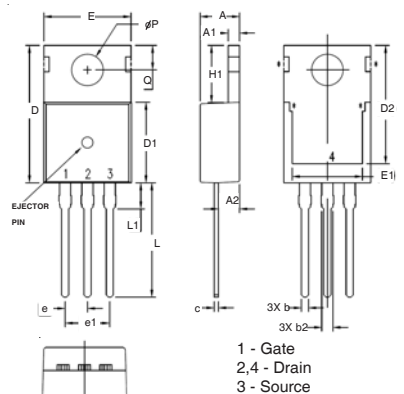
- Notes: 1. Pulse test,  $t \leq 300\mu\text{s}$ ; duty cycle,  $d \leq 2\%$ .  
2. On through-hole packages,  $R_{DS(on)}$  Kelvin test contact location must be 5mm or less from the package body.

## 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

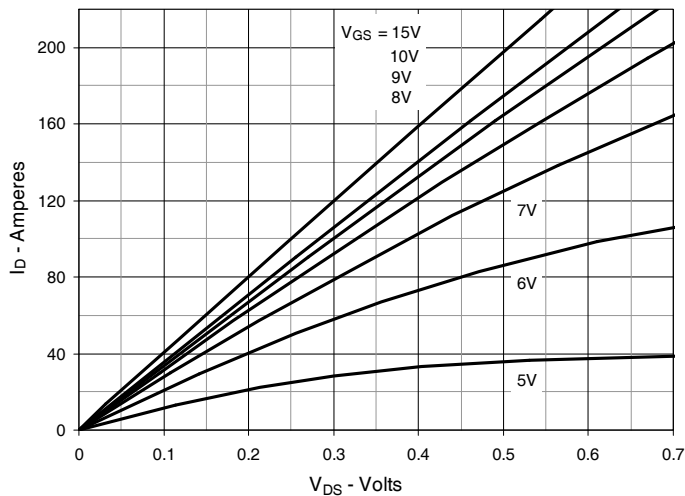


| SYM  | INCHES   |      | MILLIMETERS |       |
|------|----------|------|-------------|-------|
|      | MIN      | MAX  | MIN         | MAX   |
| A    | .169     | .185 | 4.30        | 4.70  |
| A1   | .047     | .055 | 1.20        | 1.40  |
| A2   | .079     | .106 | 2.00        | 2.70  |
| b    | .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  |

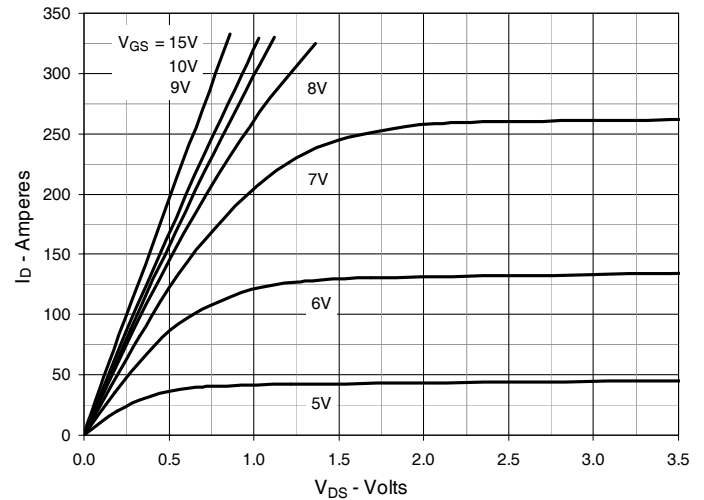
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

|                                                                                  |           |           |           |           |             |             |             |             |             |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| 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   |             |

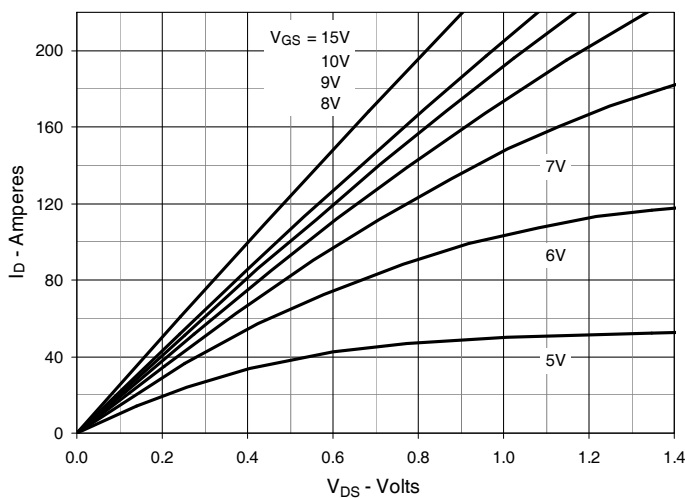
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



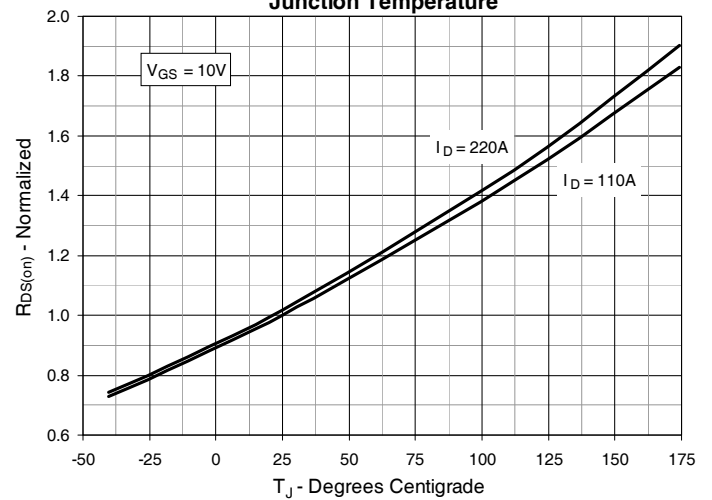
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



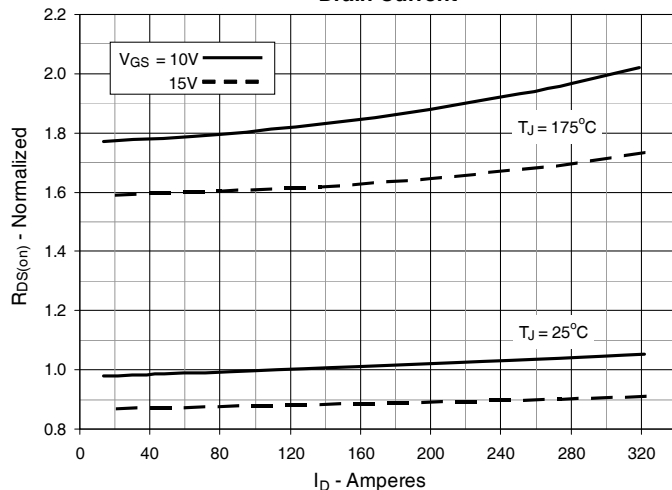
**Fig. 3. Output Characteristics @  $T_J = 150^\circ\text{C}$**



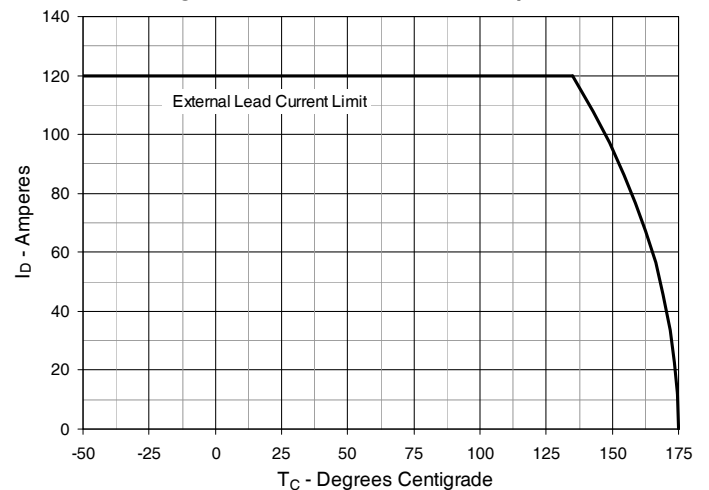
**Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 110\text{A}$  Value vs. Junction Temperature**



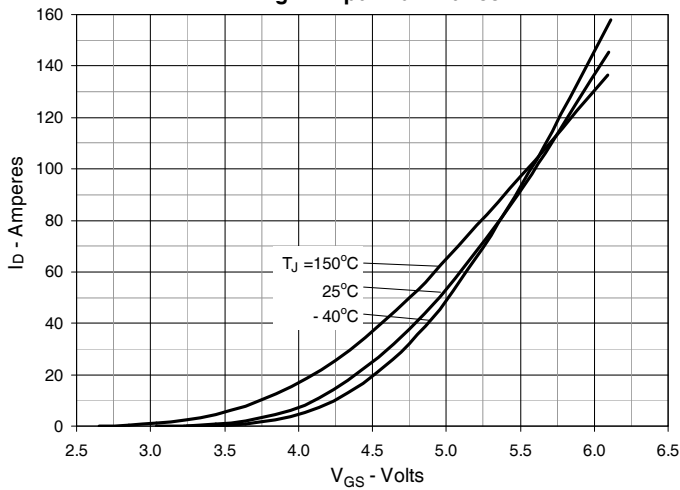
**Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 110\text{A}$  Value vs. Drain Current**



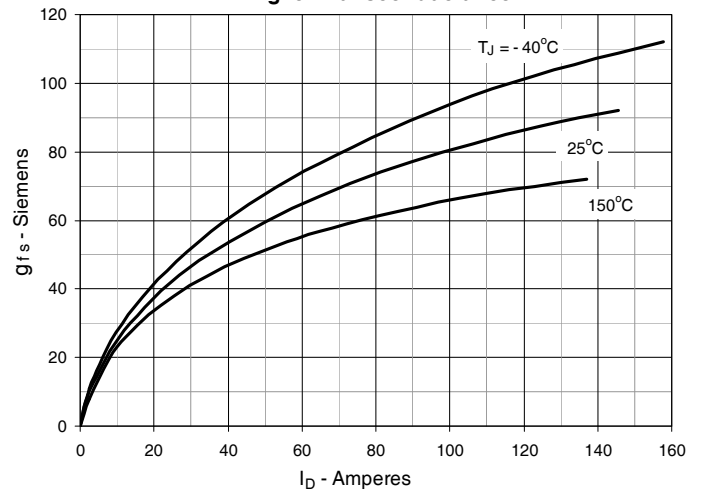
**Fig. 6. Drain Current vs. Case Temperature**



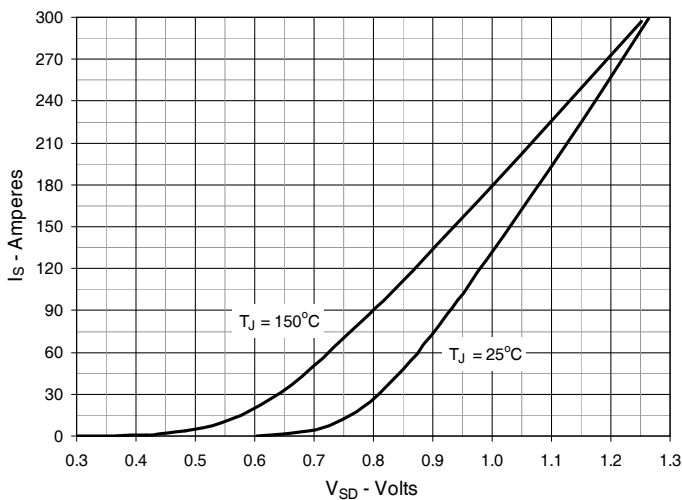
**Fig. 7. Input Admittance**



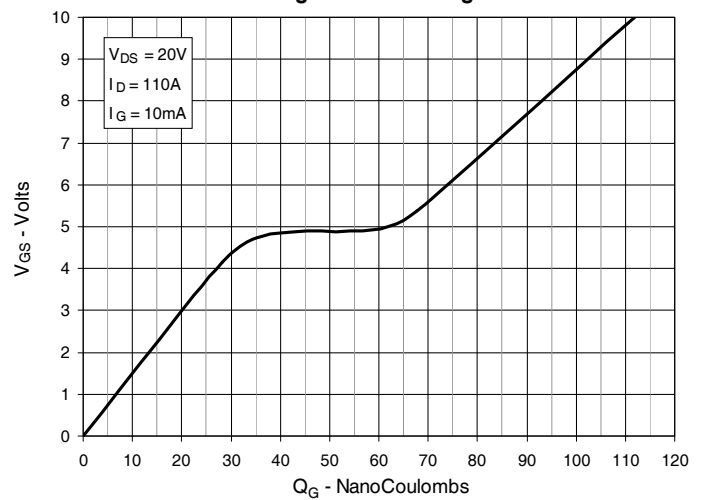
**Fig. 8. Transconductance**



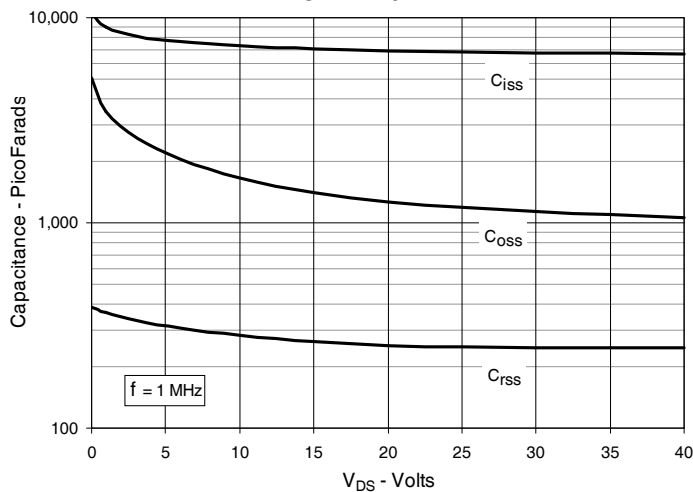
**Fig. 9. Forward Voltage Drop of Intrinsic Diode**



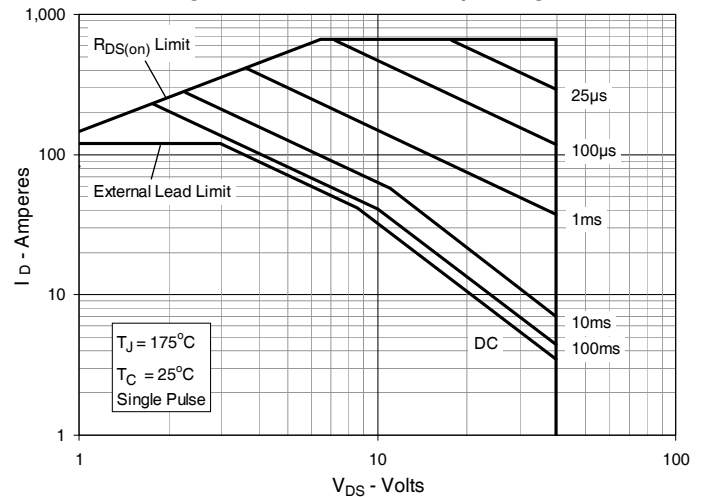
**Fig. 10. Gate Charge**



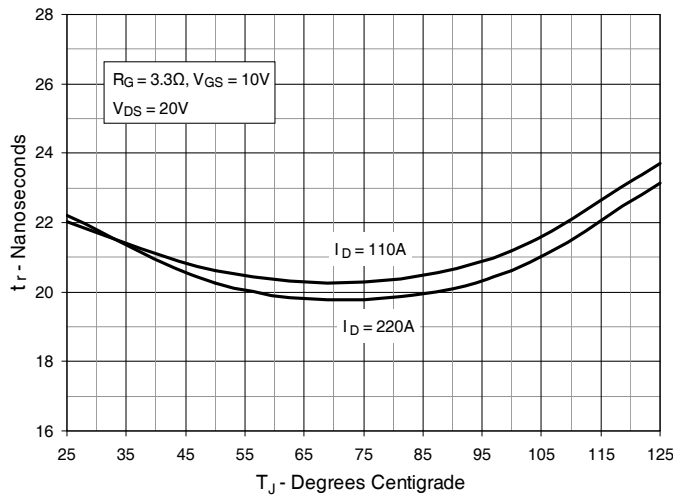
**Fig. 11. Capacitance**



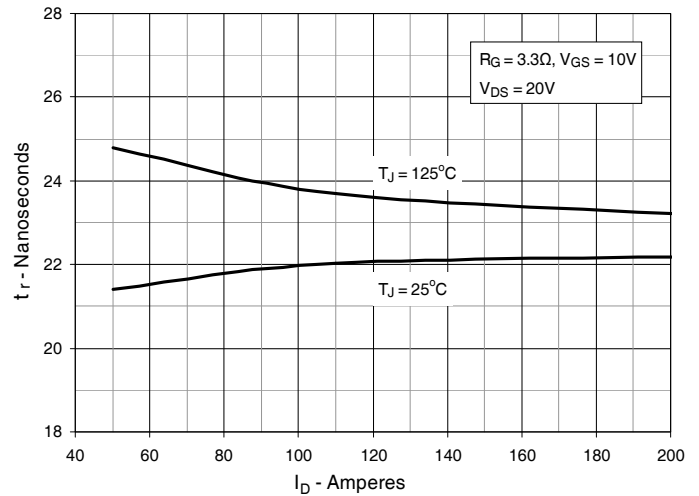
**Fig. 12. Forward-Bias Safe Operating Area**



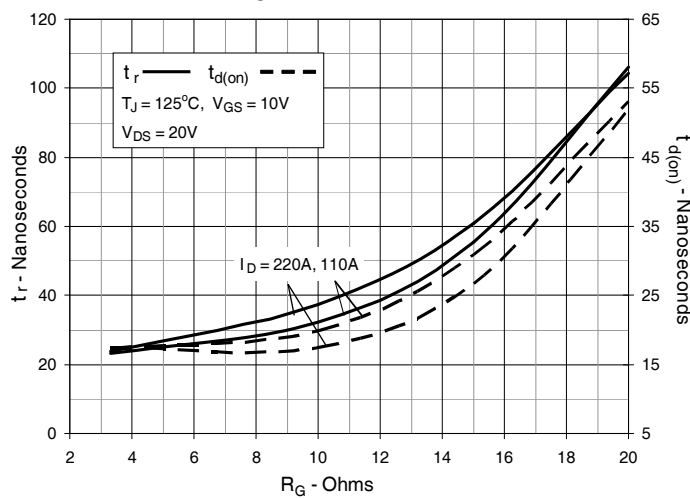
**Fig. 13. Resistive Turn-on**  
**Rise Time vs. Junction Temperature**



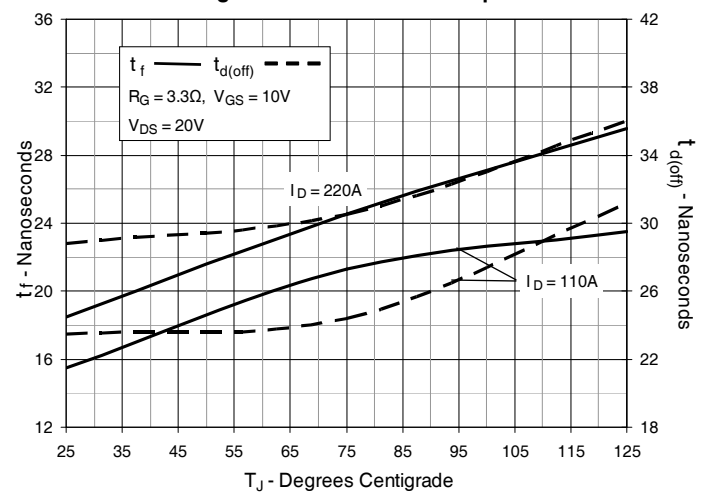
**Fig. 14. Resistive Turn-on**  
**Rise Time vs. Drain Current**



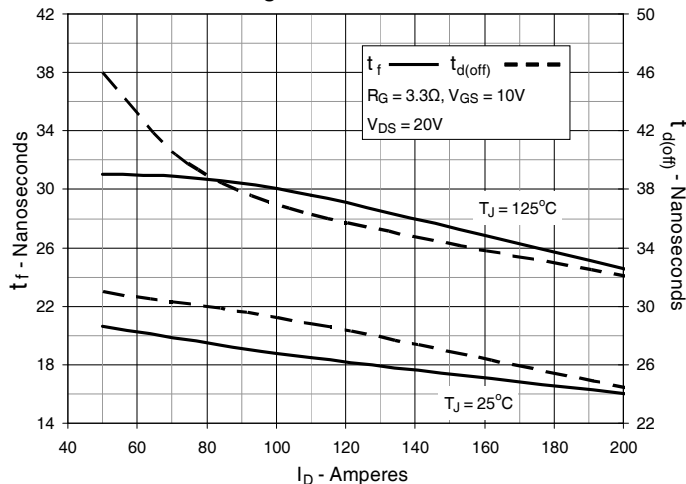
**Fig. 15. Resistive Turn-on**  
**Switching Times vs. Gate Resistance**



**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**

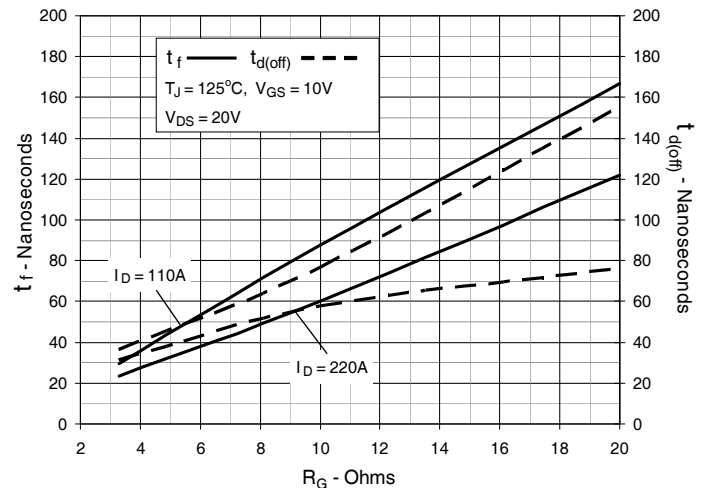
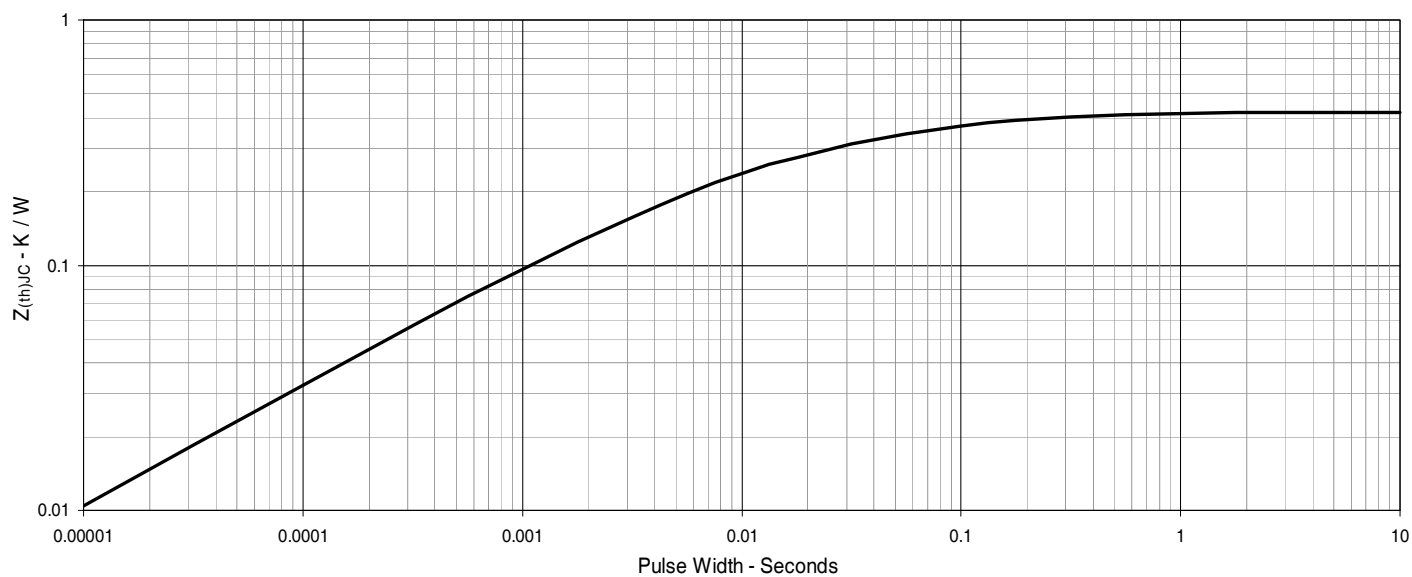


Fig. 19. Maximum Transient Thermal Impedance





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