

**Polar3™**
**Power MOSFET**
**Current & Temperature Sensing**
**(Electrically Isolated Tab)**

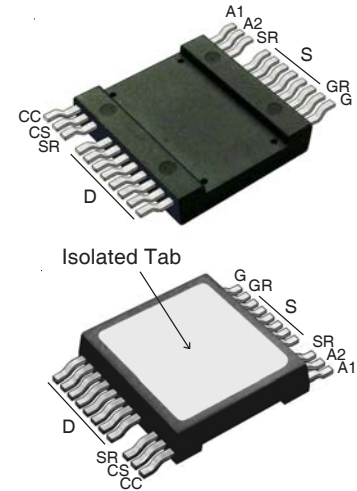
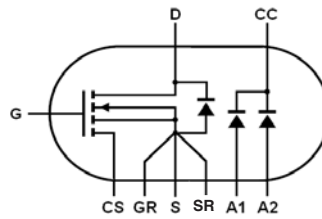
 N-Channel Enhancement Mode  
 Avalanche Rated

**MMIX1T132N50P3**

$$V_{DSS} = 500V$$

$$I_{D25} = 63A$$

$$R_{DS(on)} \leq 43m\Omega$$



**G** - Gate  
**CS** - Current Sense  
**GR** - Gate Return  
**S** - Source  
**SR** - Sense Current Return  
**A1** - Anode 1  
**A2** - Anode 2  
**CC** - Common Cathode  
**D** - Drain

| 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          |
| $I_{D25}$     | $T_C = 25^\circ C$   | 63               | A          |
| $I_{DM}$      | $T_C = 25^\circ C$ , Pulse Width Limited by $T_{JM}$               | 330              | A          |
| $I_A$         | $T_C = 25^\circ C$   | 66               | A          |
| $E_{AS}$      | $T_C = 25^\circ C$   | 2                | J          |
| $dv/dt$       | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ C$ | 35               | V/ns       |
| $P_D$         | $T_C = 25^\circ C$   | 520              | 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              | $^\circ C$ |
| $V_{ISOL}$    | 50/60 Hz, 1 Minute   | 2500             | V~         |
| $F_C$         | Mounting Force   | 50..200 / 11..45 | N/lb.      |
| <b>Weight</b> |  | 8                | g          |

**Features**

- Silicon Chip on Direct-Copper-Bond Substrate
  - High Power Dissipation
  - Isolated Mounting Surface
  - 2500V~ Electrical Isolation
- Avalanche Rated
- Low Package Inductance
- Current Mirror for MOSFET Source & Sensing
- Integrated Diodes for Sensing MOSFET Temperature
- Low  $R_{DS(on)}$

**Advantages**

- Easy to Mount
- Space Savings

**Applications**

- DC-DC Converters
- AC-DC Converters
- PFC
- Connect / Disconnect Load
- Inrush Current Control

| Symbol       | Test Conditions<br>( $T_J = 25^\circ C$ Unless Otherwise Specified) | Characteristic Values |      |                    |
|--------------|---|-----------------------|------|--------------------|
|              |   | Min.                  | Typ. | Max.               |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 3mA$   | 500                   |      | V                  |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 8mA$                                     | 3.0                   |      | 5.0 V              |
| $I_{GSS}$    | $V_{GS} = \pm 30V$ , $V_{DS} = 0V$                                  |                       |      | $\pm 200$ nA       |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$<br>Note 2, $T_J = 125^\circ C$   |                       |      | 50 $\mu A$<br>3 mA |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 66A$ , Note 1                               |                       |      | 43 m $\Omega$      |

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)   | Characteristic Values |      |                         |
|--------------|---|-----------------------|------|-------------------------|
|              |   | Min.                  | Typ. | Max.                    |
| $g_{fs}$     | $V_{DS} = 10\text{V}, I_D = 66\text{A}$ , Note 1  | 68                    | 110  | S                       |
| $C_{iss}$    | $V_{GS} = 0\text{V}, V_{DS} = 25\text{V}, f = 1\text{MHz}$  |                       | 18.6 | nF                      |
| $C_{oss}$    |   |                       | 1710 | pF                      |
| $C_{rss}$    |   |                       | 12   | pF                      |
| $R_{Gi}$     | Gate Input Resistance   |                       | 1.16 | $\Omega$                |
| $t_{d(on)}$  | <b>Resistive Switching Times</b><br>$V_{GS} = 10\text{V}, V_{DS} = 0.5 \cdot V_{DSS}, I_D = 66\text{A}$<br>$R_G = 1\Omega$ (External) |                       | 42   | ns                      |
| $t_r$        |   |                       | 19   | ns                      |
| $t_{d(off)}$ |   |                       | 90   | ns                      |
| $t_f$        |   |                       | 15   | ns                      |
| $Q_{g(on)}$  | $V_{GS} = 10\text{V}, V_{DS} = 0.5 \cdot V_{DSS}, I_D = 66\text{A}$   |                       | 267  | nC                      |
| $Q_{gs}$     |   |                       | 95   | nC                      |
| $Q_{gd}$     |   |                       | 63   | nC                      |
| $R_{thJC}$   |   |                       |      | 0.24 $^\circ\text{C/W}$ |
| $R_{thCS}$   |   | 0.05                  |      | $^\circ\text{C/W}$      |
| $R_{thJA}$   |   | 30                    |      | $^\circ\text{C/W}$      |

**Source-Drain Diode**

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)                       | Characteristic Values |      |               |
|----------|---|-----------------------|------|---------------|
|          |   | Min.                  | Typ. | Max.          |
| $I_S$    | $V_{GS} = 0\text{V}$  |                       |      | 132 A         |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$   |                       |      | 530 A         |
| $V_{SD}$ | $I_F = 100\text{A}, V_{GS} = 0\text{V}$ , Note 1  |                       |      | 1.5 V         |
| $t_{rr}$ | $I_F = 66\text{A}, -di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}, V_{GS} = 0\text{V}$ |                       | 600  | ns            |
| $Q_{RM}$ |   |                       | 12   | $\mu\text{C}$ |
| $I_{RM}$ |   |                       | 40   | A             |

**Notes:**

1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Part must be heatsunk for high-temp  $I_{DSS}$  measurement.

**ADVANCE TECHNICAL INFORMATION**

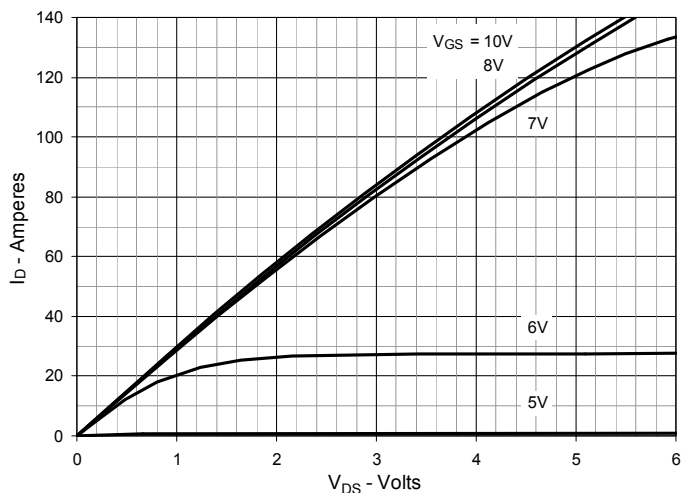
The product presented herein is under development. The Technical Specifications offered are derived from a subjective evaluation of the design, based upon prior knowledge and experience, and constitute a "considered reflection" of the anticipated result. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

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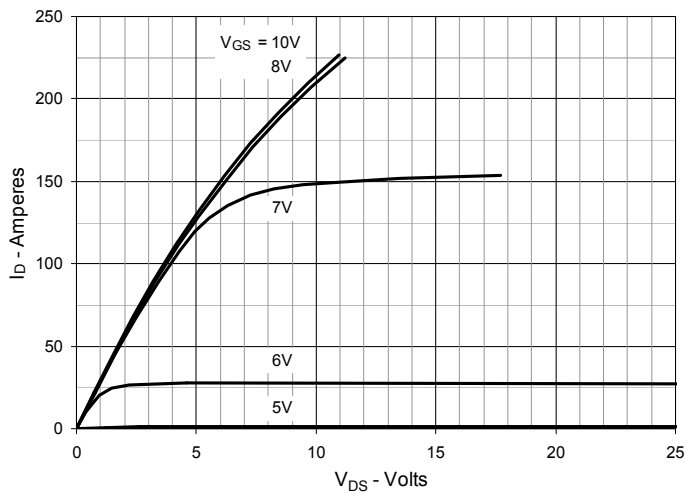
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

|           |           |           |           |              |              |              |              |              |             |
|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 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 | 7,157,338B2 |
| 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    |             |

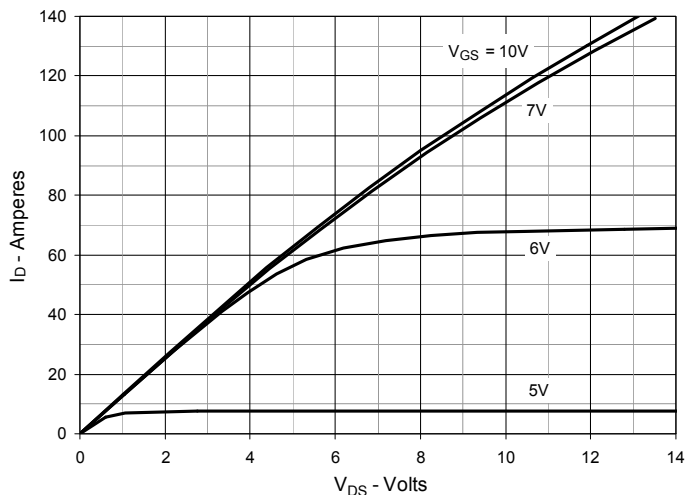
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



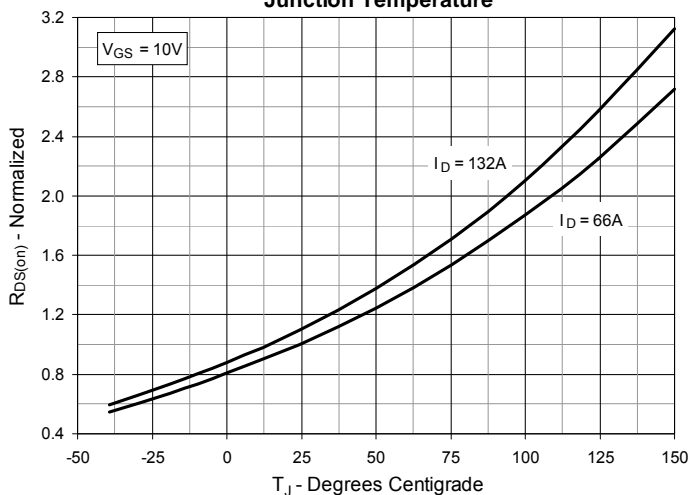
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



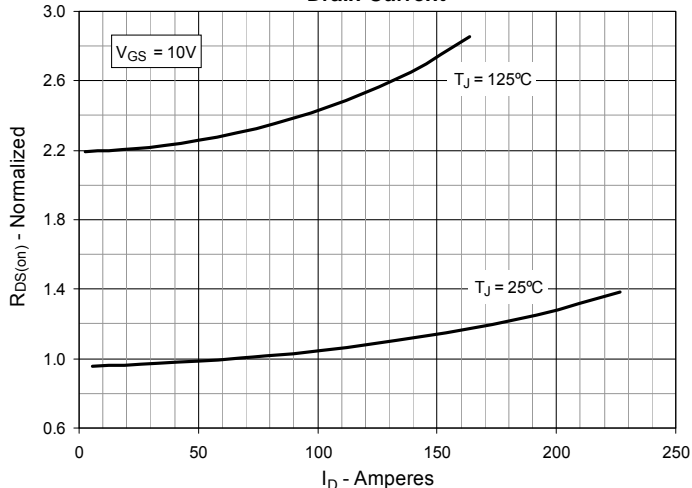
**Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$**



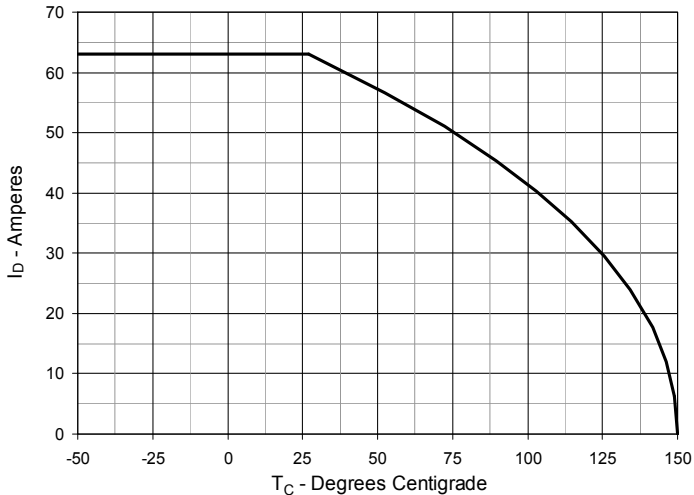
**Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 66\text{A}$  Value vs. Junction Temperature**



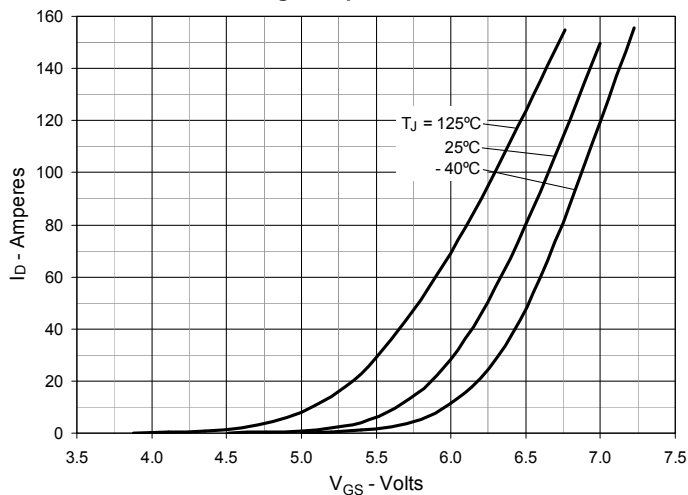
**Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 66\text{A}$  Value vs. Drain Current**



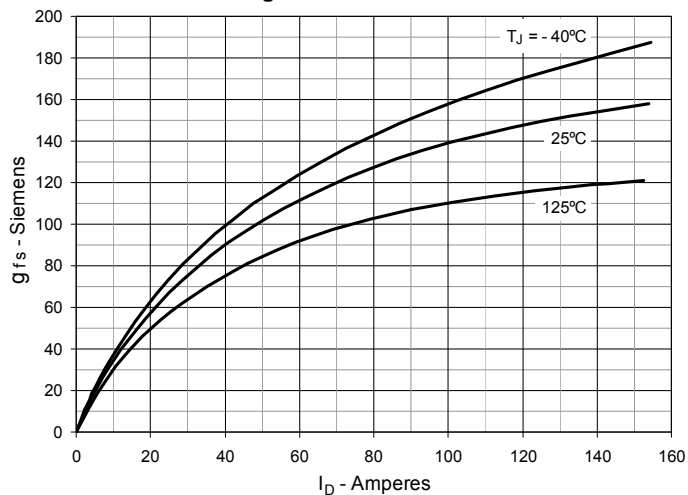
**Fig. 6. Maximum Drain Current vs. Case Temperature**



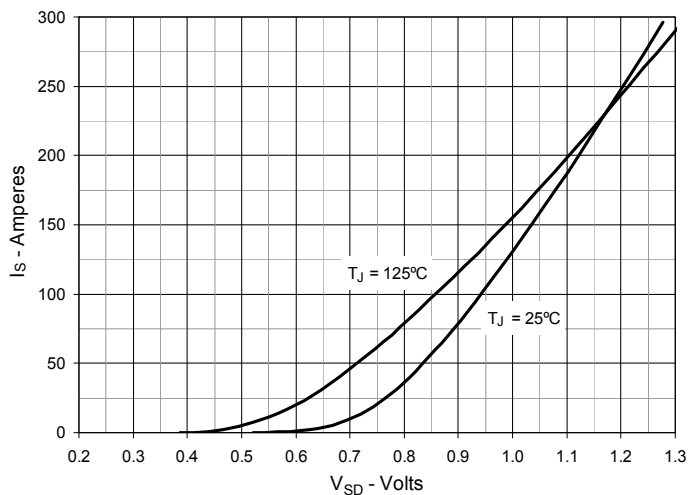
**Fig. 7. Input Admittance**



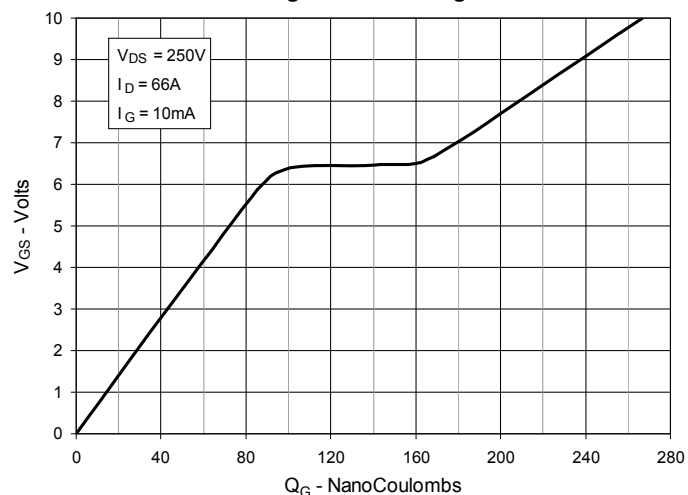
**Fig. 8. Transconductance**



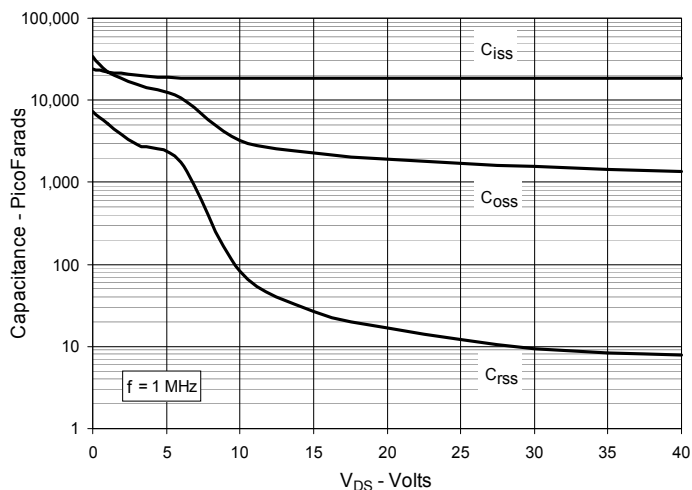
**Fig. 9. Forward Voltage Drop of Intrinsic Diode**



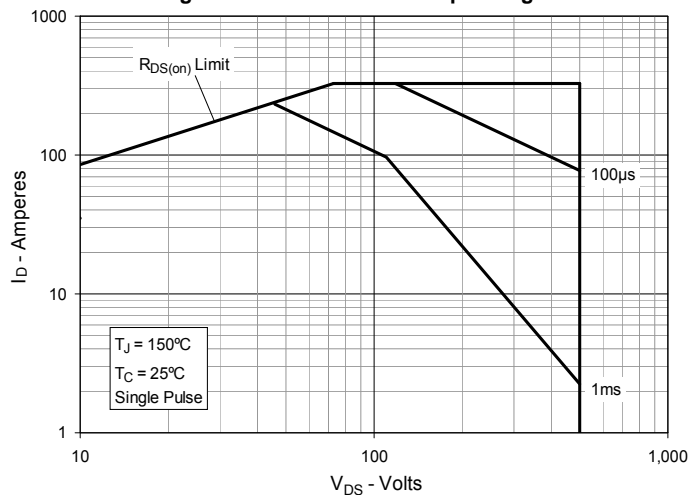
**Fig. 10. Gate Charge**



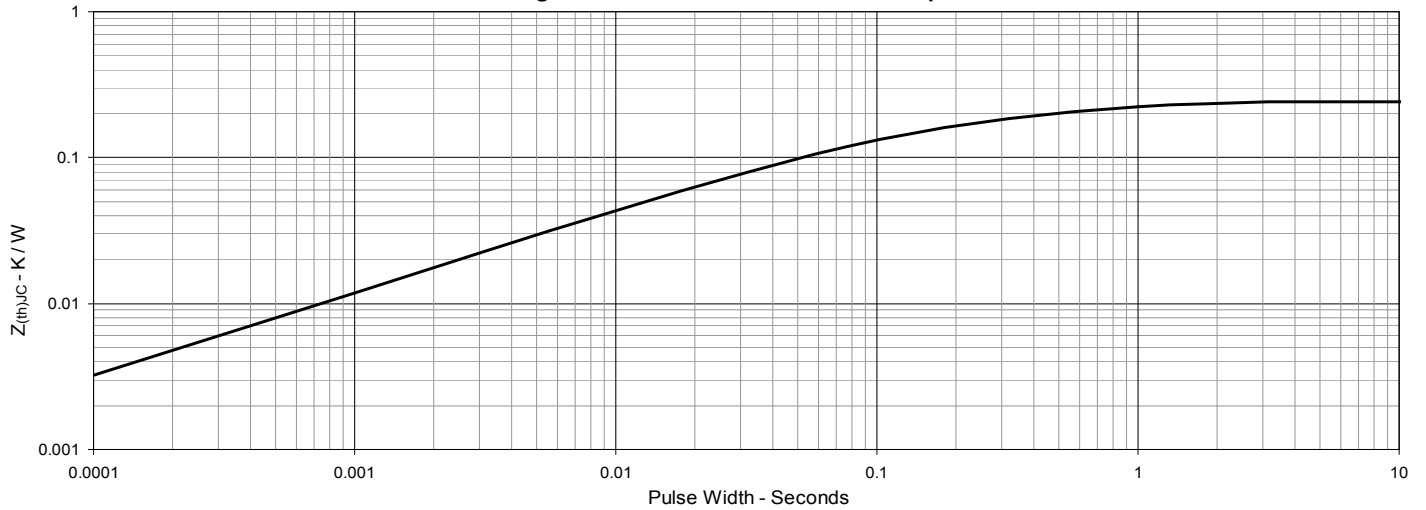
**Fig. 11. Capacitance**



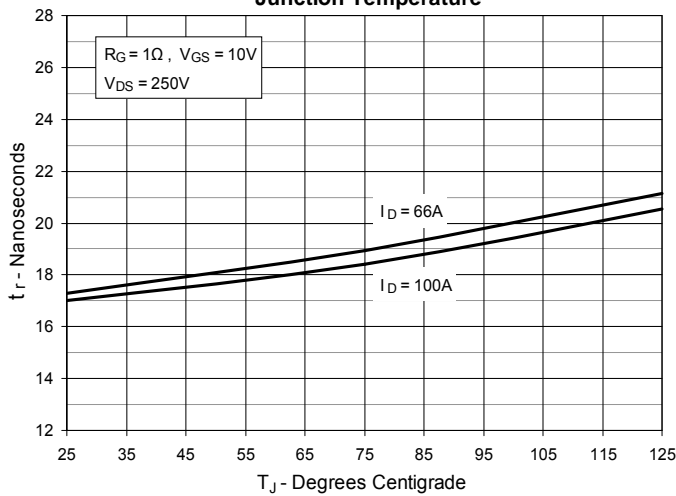
**Fig. 12. Forward-Bias Safe Operating Area**



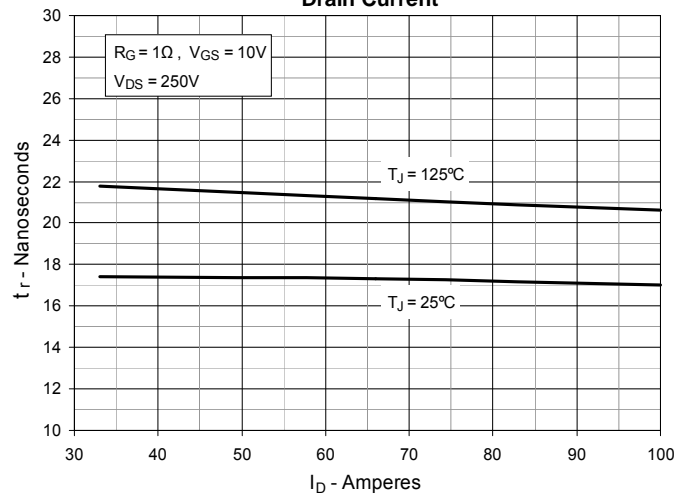
**Fig. 13. Maximum Transient Thermal Impedance**



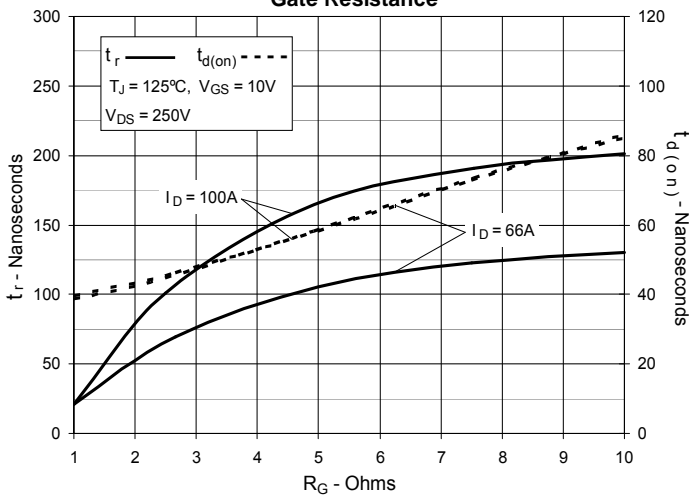
**Fig. 14. Resistive Turn-on Rise Time vs. Junction Temperature**



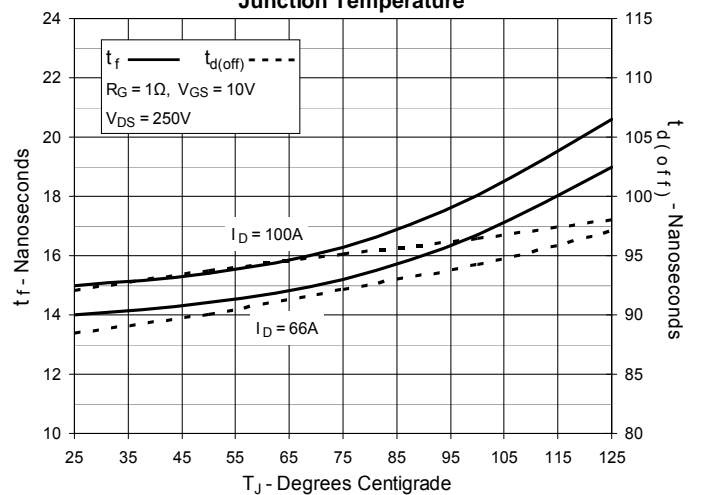
**Fig. 15. Resistive Turn-on Rise Time vs. Drain Current**



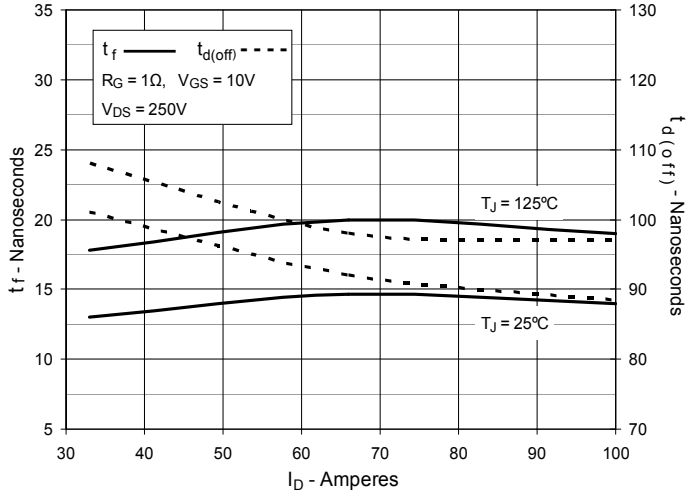
**Fig. 16. Resistive Turn-on Switching Times vs. Gate Resistance**



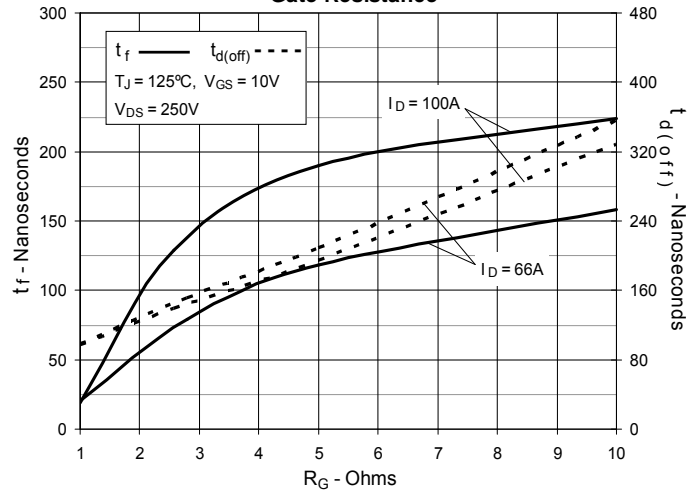
**Fig. 17. Resistive Turn-off Switching Times vs. Junction Temperature**



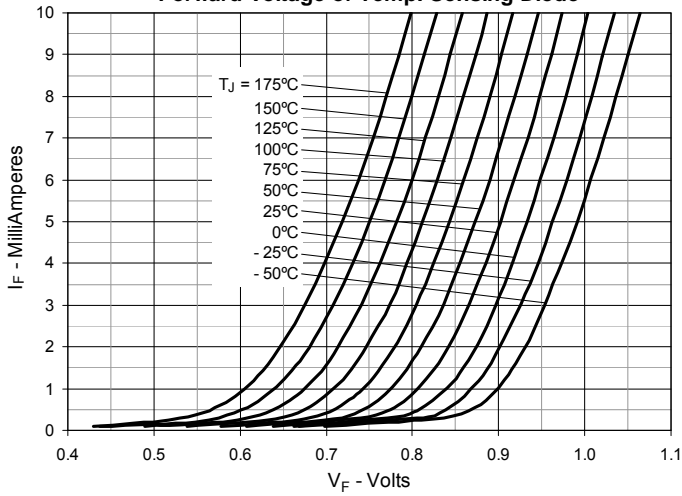
**Fig. 18. Resistive Turn-off Switching Times vs. Drain Current**



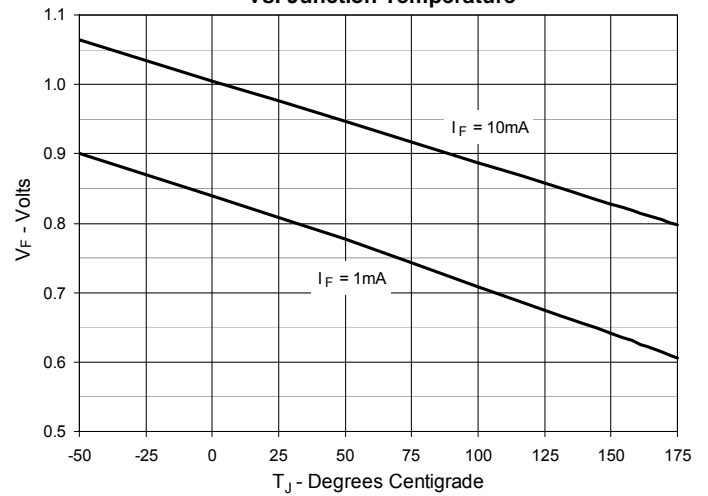
**Fig. 19. Resistive Turn-off Switching Times vs. Gate Resistance**



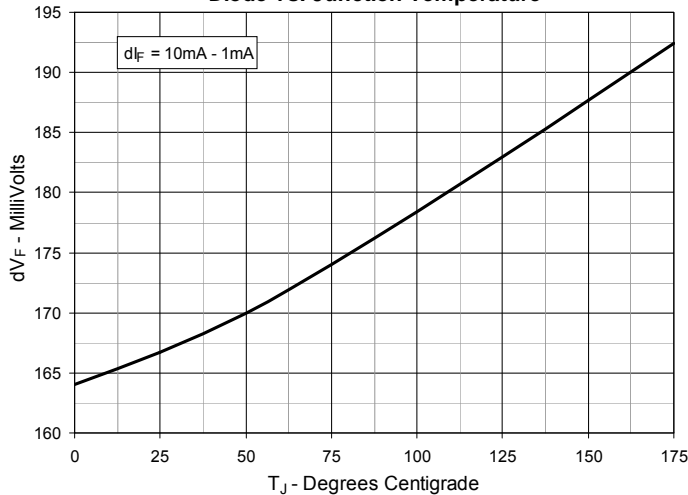
**Fig. 20. Forward Current vs. Forward Voltage of Temp. Sensing Diode**



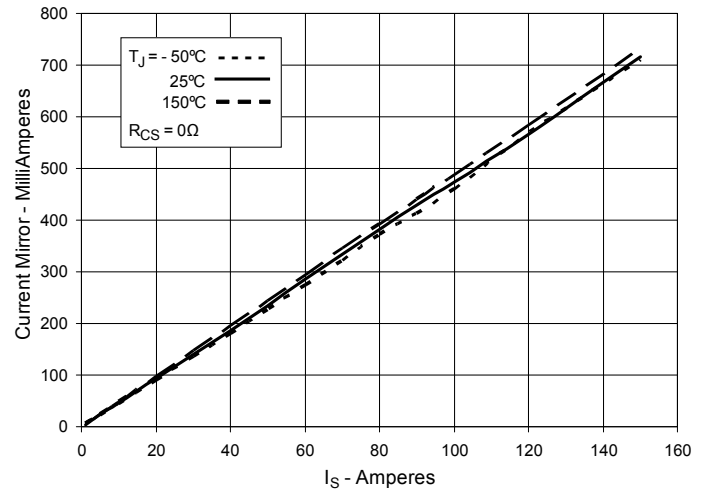
**Fig. 21. Forward Voltage of Temp. Sensing Diode vs. Junction Temperature**

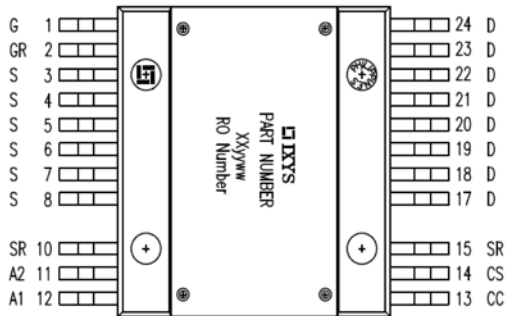
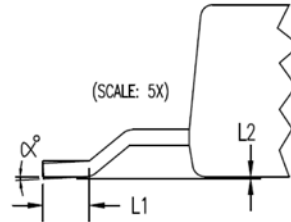
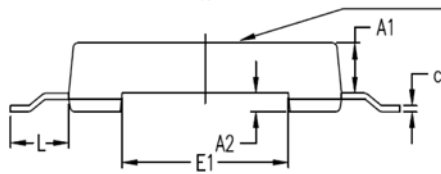
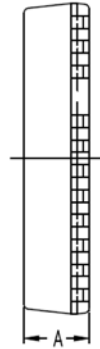
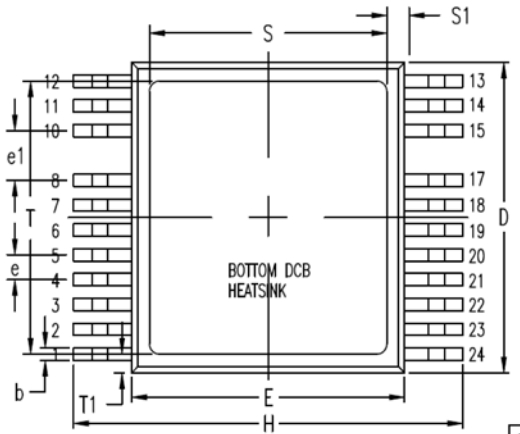


**Fig. 22. Delta Forward Voltage of Temp. Sensing Diode vs. Junction Temperature**



**Fig. 23. Current Mirror vs. Source Current**





| SYM | INCHES   |       | MILLIMETERS |       |
|-----|----------|-------|-------------|-------|
|     | MIN      | MAX   | MIN         | MAX   |
| A   | .209     | .224  | 5.30        | 5.70  |
| A1  | .154     | .161  | 3.90        | 4.10  |
| A2  | .055     | .063  | 1.40        | 1.60  |
| b   | .035     | .045  | 0.90        | 1.15  |
| c   | .018     | .026  | 0.45        | 0.65  |
| D   | .976     | .994  | 24.80       | 25.25 |
| E   | .898     | .915  | 22.80       | 23.25 |
| E1  | .543     | .559  | 13.80       | 14.20 |
| e   | .079 BSC |       | 2.00 BSC    |       |
| e1  | .157 BSC |       | 4.00 BSC    |       |
| H   | 1.272    | 1.311 | 32.30       | 33.30 |
| L   | .181     | .209  | 4.60        | 5.30  |
| L1  | .051     | .067  | 1.30        | 1.70  |
| L2  | .000     | .006  | 0.00        | 0.15  |
| S   | .748     | .807  | 19.00       | 20.50 |
| S1  | .039     | .079  | 1.00        | 2.00  |
| T   | .826     | .886  | 21.00       | 22.50 |
| T1  | .039     | .079  | 1.00        | 2.00  |
| α   | 0        | 4°    | 0           | 4°    |

- G - Gate
- CS - Current Sense
- GR - Gate Return
- S - Source
- SR - Sense Current Return
- A1 - Anode 1
- A2 - Anode 2
- CC - Common Cathode
- D - Drain