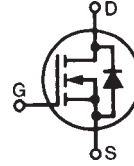


# PolarHV™ HiPerFET Power MOSFETs

N-Channel Enhancement Mode  
Fast Intrinsic Diode  
Avalanche Rated

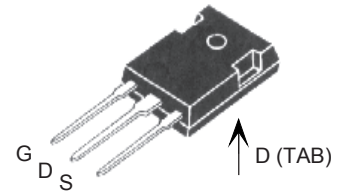
IXFH 22N60P  
IXFV 22N60P  
IXFV 22N60PS

$V_{DSS} = 600 \text{ V}$   
 $I_{D25} = 22 \text{ A}$   
 $R_{DS(on)} \leq 350 \text{ m}\Omega$   
 $t_{rr} \leq 200 \text{ ns}$

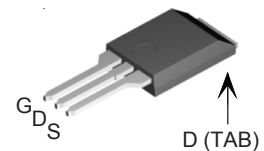


| Symbol     | Test Conditions                                                                                                                       | Maximum Ratings |                  |
|------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|
| $V_{DSS}$  | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                                                                                       | 600             | V                |
| $V_{DGR}$  | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ ; $R_{GS} = 1 \text{ M}\Omega$                                                        | 600             | V                |
| $V_{GS}$   | Continuous                                                                                                                            | $\pm 30$        | V                |
| $V_{GSM}$  | Transient                                                                                                                             | $\pm 40$        | V                |
| $I_{D25}$  | $T_C = 25^\circ\text{C}$                                                                                                              | 22              | A                |
| $I_{DM}$   | $T_C = 25^\circ\text{C}$ , pulse width limited by $T_{JM}$                                                                            | 66              | A                |
| $I_{AR}$   | $T_C = 25^\circ\text{C}$                                                                                                              | 22              | A                |
| $E_{AR}$   | $T_C = 25^\circ\text{C}$                                                                                                              | 40              | mJ               |
| $E_{AS}$   | $T_C = 25^\circ\text{C}$                                                                                                              | 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>$T_J \leq 150^\circ\text{C}$ , $R_G = 4 \Omega$ | 20              | V/ns             |
| $P_D$      | $T_C = 25^\circ\text{C}$                                                                                                              | 400             | W                |
| $T_J$      |                                                                                                                                       | -55 ... +150    | $^\circ\text{C}$ |
| $T_{JM}$   |                                                                                                                                       | 150             | $^\circ\text{C}$ |
| $T_{stg}$  |                                                                                                                                       | -55 ... +150    | $^\circ\text{C}$ |
| $T_L$      | 1.6 mm (0.062 in.) from case for 10 s                                                                                                 | 300             | $^\circ\text{C}$ |
| $T_{SOLD}$ | Plastic body for 10 s                                                                                                                 | 260             | $^\circ\text{C}$ |
| $M_d$      | Mounting torque (TO-247)                                                                                                              | 1.13/10         | Nm/lb.in.        |
| $F_C$      | Mounting Force (PLUS220)                                                                                                              | 11..65/2.5..15  | Nm/lb.           |
| Weight     | TO-247                                                                                                                                | 6               | g                |
|            | PLUS220 & PLUS220SMD                                                                                                                  | 4               | g                |

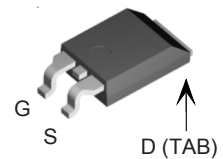
TO-247 (IXFH)



PLUS220 (IXFV)



PLUS220SMD (IXFV...S)



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

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified)                                      | Characteristic Values |      |                                       |
|--------------|------------------------------------------------------------------------------------------------------------------|-----------------------|------|---------------------------------------|
|              |                                                                                                                  | Min.                  | Typ. | Max.                                  |
| $BV_{DSS}$   | $V_{GS} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$                                                                 | 600                   |      | V                                     |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 4 \text{ mA}$                                                                         | 3.0                   |      | 5.5 V                                 |
| $I_{GSS}$    | $V_{GS} = \pm 30 \text{ V}$ , $V_{DS} = 0$                                                                       |                       |      | $\pm 100 \text{ nA}$                  |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$<br>$V_{GS} = 0 \text{ V}$ $T_J = 125^\circ\text{C}$                                           |                       |      | 25 $\mu\text{A}$<br>250 $\mu\text{A}$ |
| $R_{DS(on)}$ | $V_{GS} = 10 \text{ V}$ , $I_D = 0.5 I_{D25}$<br>Pulse test, $t \leq 300 \mu\text{s}$ , duty cycle $d \leq 2 \%$ |                       |      | 350 $\text{m}\Omega$                  |

## Features

- Fast intrinsic diode
- Unclamped Inductive Switching (UIS) rated
- International standard packages
- Low package inductance
- easy to drive and to protect

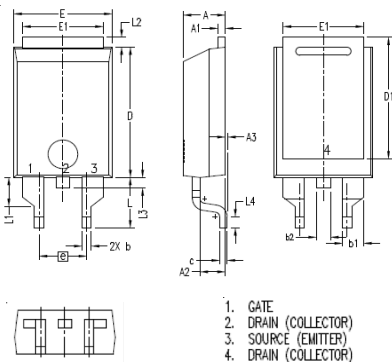
## Advantages

- Easy to mount
- Space savings
- High power density

| Symbol       | Test Conditions                                                                             | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |                        |
|--------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------------------------|
|              |                                                                                             | Min.                                                                              | Typ. | Max.                   |
| $g_{fs}$     | $V_{DS} = 20\text{ V}; I_D = 0.5 I_{D25}$ , pulse test                                      | 15                                                                                | 20   | S                      |
| $C_{iss}$    | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$                               |                                                                                   | 3600 | pF                     |
| $C_{oss}$    |                                                                                             |                                                                                   | 305  | pF                     |
| $C_{rss}$    |                                                                                             |                                                                                   | 38   | pF                     |
| $t_{d(on)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 0.5 V_{DSS}, I_D = I_{D25}$<br>$R_G = 4\ \Omega$ (External) |                                                                                   | 20   | ns                     |
| $t_r$        |                                                                                             |                                                                                   | 20   | ns                     |
| $t_{d(off)}$ |                                                                                             |                                                                                   | 60   | ns                     |
| $t_f$        |                                                                                             |                                                                                   | 23   | ns                     |
| $Q_{g(on)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 0.5 V_{DSS}, I_D = 0.5 I_{D25}$                             |                                                                                   | 58   | nC                     |
| $Q_{gs}$     |                                                                                             |                                                                                   | 20   | nC                     |
| $Q_{gd}$     |                                                                                             |                                                                                   | 22   | nC                     |
| $R_{thJC}$   |                                                                                             |                                                                                   | 0.21 | $0.31^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                             |                                                                                   |      | $^\circ\text{C/W}$     |

| Source-Drain Diode |                                                                                                         | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |               |
|--------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|---------------|
| Symbol             | Test Conditions                                                                                         | Min.                                                                              | Typ. | Max.          |
| $I_S$              | $V_{GS} = 0\text{ V}$                                                                                   |                                                                                   |      | 22 A          |
| $I_{SM}$           | Repetitive                                                                                              |                                                                                   |      | 66 A          |
| $V_{SD}$           | $I_F = I_S, V_{GS} = 0\text{ V}$ ,<br>Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $d \leq 2\%$   |                                                                                   |      | 1.5 V         |
| $t_{rr}$           | $I_F = 26\text{ A}$<br>$-di/dt = 100\text{ A}/\mu\text{s}$<br>$V_R = 100\text{ V}, V_{GS} = 0\text{ V}$ |                                                                                   | 1.0  | 200 ns        |
| $Q_{RM}$           |                                                                                                         |                                                                                   |      | $\mu\text{C}$ |

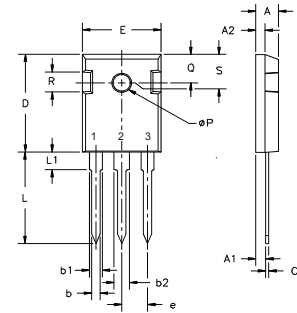
### PLUS220SMD (IXFV\_S) Outline



| SYM | INCHES   |      | MILLIMETER |       |
|-----|----------|------|------------|-------|
|     | MIN      | MAX  | MIN        | MAX   |
| A   | .169     | .185 | 4.30       | 4.70  |
| A1  | .028     | .035 | 0.70       | 0.90  |
| A2  | .098     | .118 | 2.50       | 3.00  |
| A3  | .000     | .010 | 0.00       | 0.25  |
| b   | .035     | .047 | 0.90       | 1.20  |
| b1  | .080     | .095 | 2.03       | 2.41  |
| b2  | .054     | .064 | 1.37       | 1.63  |
| c   | .028     | .035 | 0.70       | 0.90  |
| D   | .551     | .591 | 14.00      | 15.00 |
| D1  | .512     | .539 | 13.00      | 13.70 |
| E   | .394     | .433 | 10.00      | 11.00 |
| E1  | .331     | .346 | 8.40       | 8.80  |
| e   | .200 BSC |      | 5.08 BSC   |       |
| L   | .209     | .228 | 5.30       | 5.80  |
| L1  | .118     | .138 | 3.00       | 3.50  |
| L2  | .035     | .051 | 0.90       | 1.30  |
| L3  | .047     | .059 | 1.20       | 1.50  |
| L4  | .039     | .059 | 1.00       | 1.50  |

1. GATE
2. DRAIN (COLLECTOR)
3. SOURCE (EMITTER)
4. DRAIN (COLLECTOR)

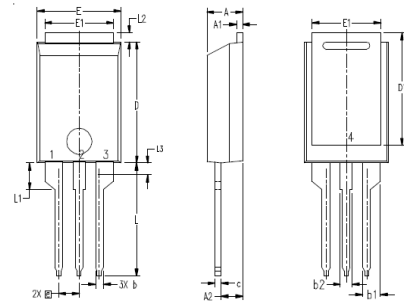
### TO-247 AD (IXFH) Outline



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

| Dim. | Millimeter |       | Inches |       |
|------|------------|-------|--------|-------|
|      | Min.       | Max.  | Min.   | Max.  |
| A    | 4.7        | 5.3   | .185   | .209  |
| A1   | 2.2        | 2.54  | .087   | .102  |
| A2   | 2.2        | 2.6   | .059   | .098  |
| b    | 1.0        | 1.4   | .040   | .055  |
| b1   | 1.65       | 2.13  | .065   | .084  |
| b2   | 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  |
| ØP   | 3.55       | 3.65  | .140   | .144  |
| Q    | 5.89       | 6.40  | 0.232  | 0.252 |
| R    | 4.32       | 5.49  | .170   | .216  |
| S    | 6.15       | BSC   | 242    | BSC   |

### PLUS220 (IXFV) Outline



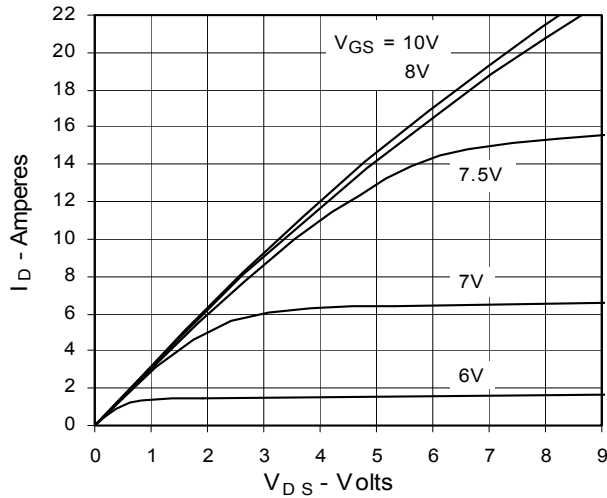
1. GATE
2. DRAIN (COLLECTOR)
3. SOURCE (EMITTER)
4. DRAIN (COLLECTOR)

| SYM | INCHES   |      | MILLIMETER |       |
|-----|----------|------|------------|-------|
|     | MIN      | MAX  | MIN        | MAX   |
| A   | .169     | .185 | 4.30       | 4.70  |
| A1  | .028     | .035 | 0.70       | 0.90  |
| A2  | .098     | .118 | 2.50       | 3.00  |
| b   | .035     | .047 | 0.90       | 1.20  |
| b1  | .080     | .095 | 2.03       | 2.41  |
| b2  | .054     | .064 | 1.37       | 1.63  |
| c   | .028     | .035 | 0.70       | 0.90  |
| D   | .551     | .591 | 14.00      | 15.00 |
| D1  | .512     | .539 | 13.00      | 13.70 |
| E   | .394     | .433 | 10.00      | 11.00 |
| E1  | .331     | .346 | 8.40       | 8.80  |
| e   | .100 BSC |      | 2.54 BSC   |       |
| L   | .512     | .551 | 13.00      | 14.00 |
| L1  | .118     | .138 | 3.00       | 3.50  |
| L2  | .035     | .051 | 0.90       | 1.30  |
| L3  | .047     | .059 | 1.20       | 1.50  |

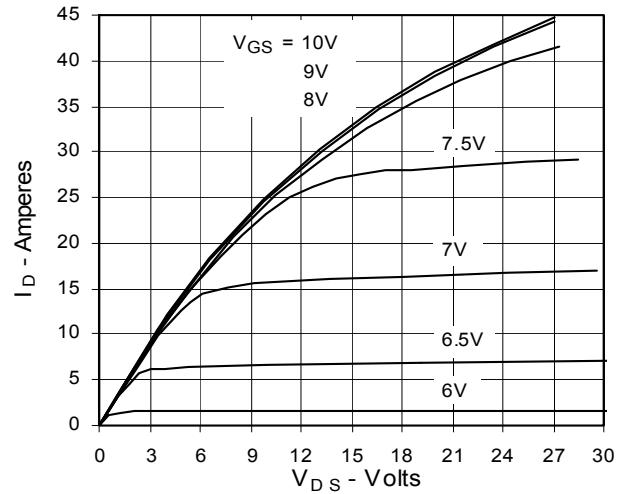
IXYS reserves the right to change limits, test conditions, and dimensions.

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

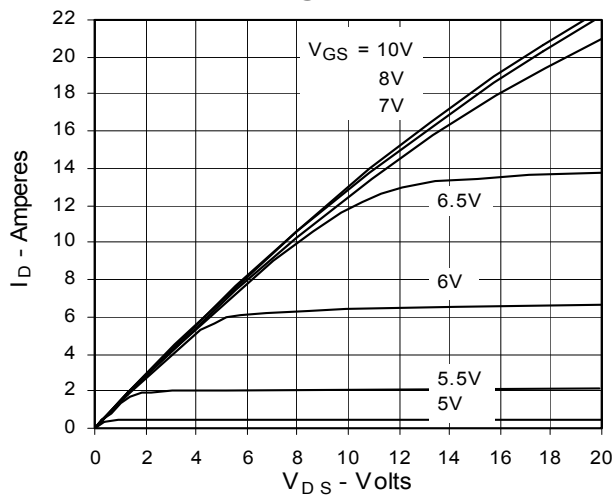
**Fig. 1. Output Characteristics  
@ 25°C**



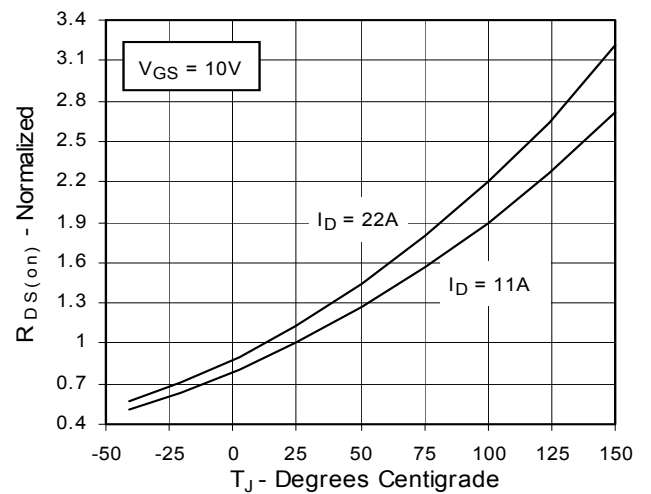
**Fig. 2. Extended Output Characteristics  
@ 25°C**



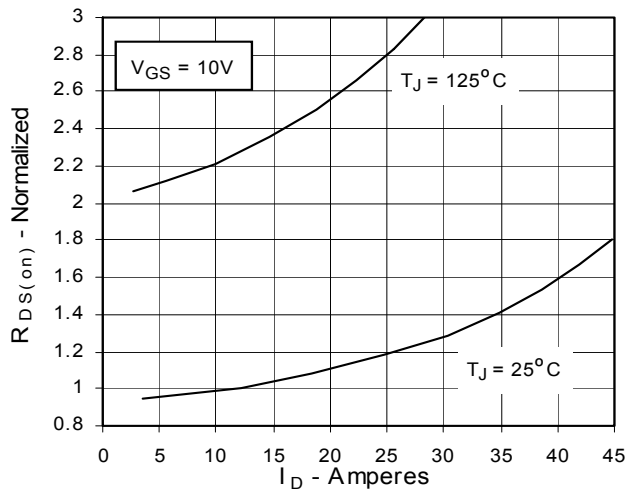
**Fig. 3. Output Characteristics  
@ 125°C**



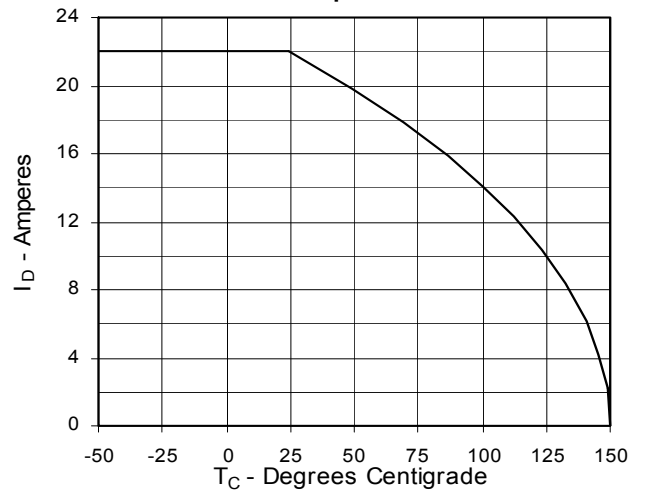
**Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 11A$   
Value vs. Junction Temperature**



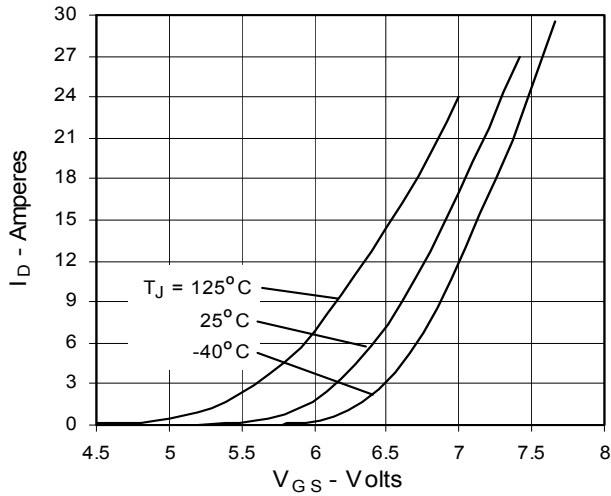
**Fig. 5.  $R_{DS(on)}$  Normalized to  
 $I_D = 11A$  Value vs. Drain Current**



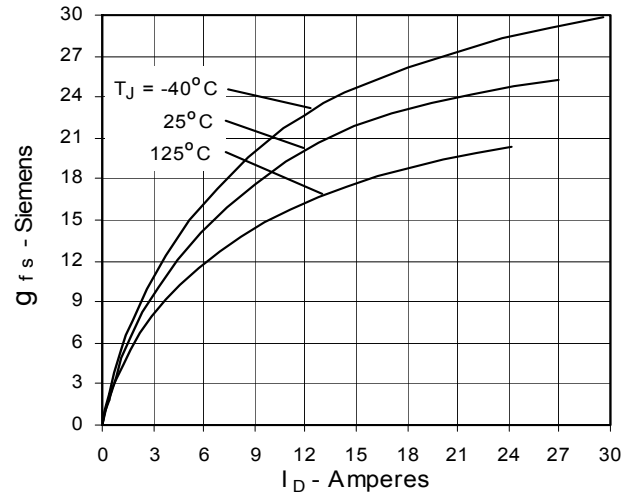
**Fig. 6. Drain Current vs. Case  
Temperature**



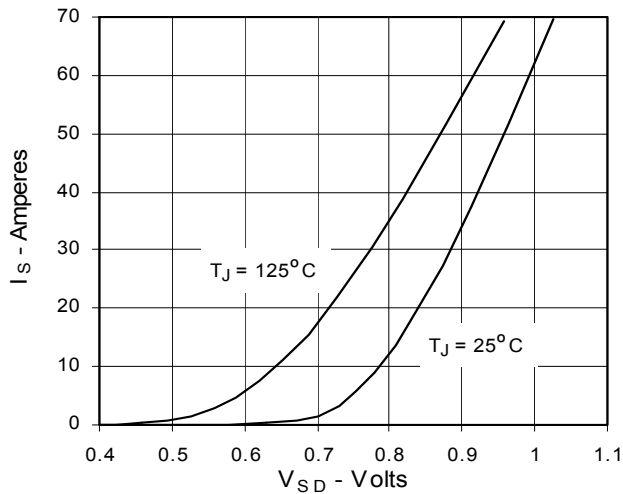
**Fig. 7. Input Admittance**



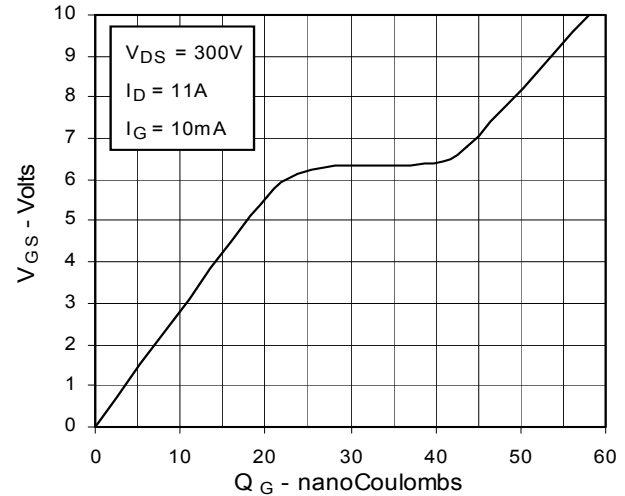
**Fig. 8. Transconductance**



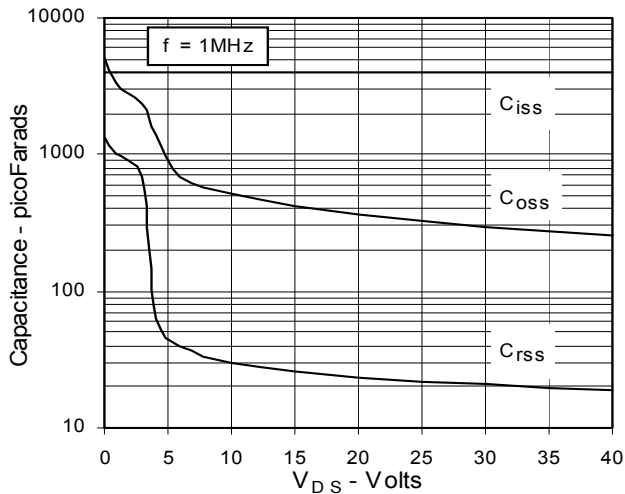
**Fig. 9. Source Current vs. Source-To-Drain Voltage**



**Fig. 10. Gate Charge**



**Fig. 11. Capacitance**



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

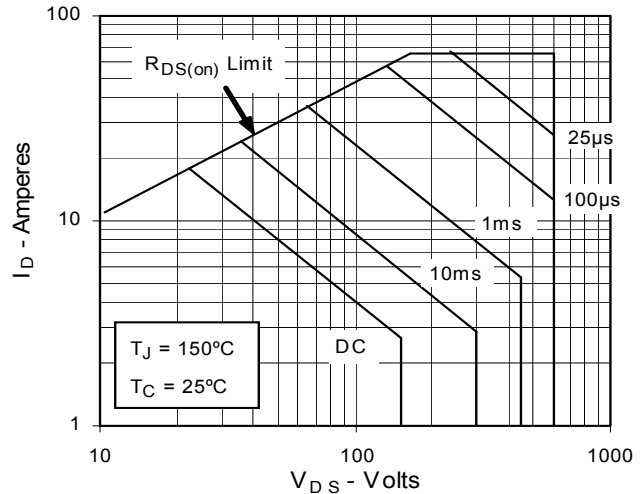
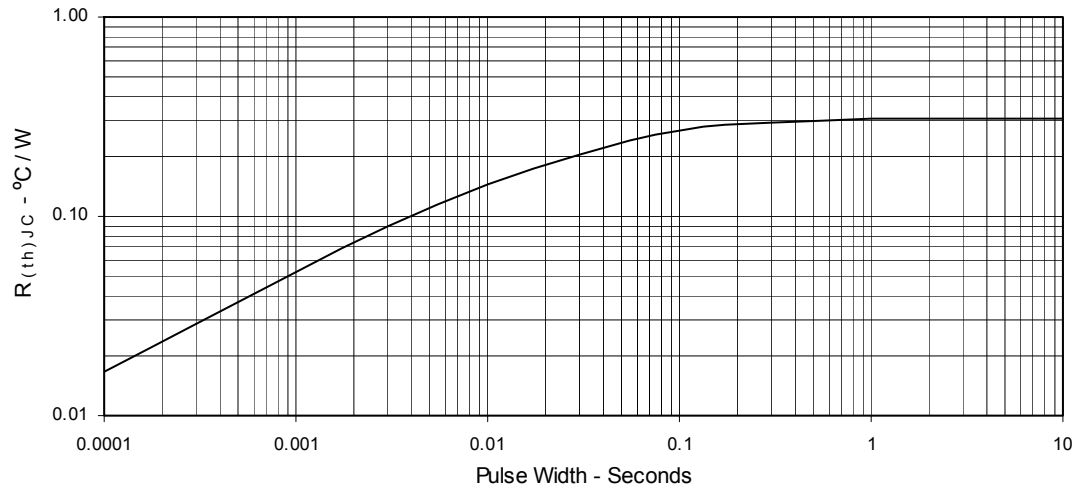


Fig. 13. Maximum Transient Thermal Resistance





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