IXYS

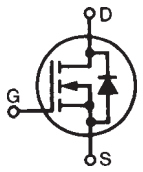
Advance Technical Information

# Polar3™ HiPerFET™ Power MOSFET

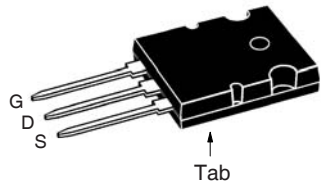
# IXFK78N50P3
# IXFX78N50P3

$V_{DSS}$ = 500V
$I_{D25}$ = 78A
$R_{DS(on)}$ ≤ 68mΩ
$t_{rr}$ ≤ 250ns

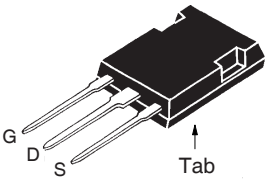
N-Channel Enhancement Mode
Avalanche Rated
Fast Intrinsic Diode




**TO-264 (IXFK)**




**PLUS247 (IXFX)**




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

| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{DSS}$ | $T_J$ = 25°C to 150°C | 500 | V |
| $V_{DGR}$ | $T_J$ = 25°C to 150°C, $R_{GS}$ = 1MΩ | 500 | V |
| $V_{GSS}$ | Continuous | ± 30 | V |
| $V_{GSM}$ | Transient | ± 40 | V |
| $I_{D25}$ | $T_C$ = 25°C | 78 | A |
| $I_{DM}$ | $T_C$ = 25°C, Pulse Width Limited by $T_{JM}$ | 200 | A |
| $I_A$ | $T_C$ = 25°C | 39 | A |
| $E_{AS}$ | $T_C$ = 25°C | 1.5 | J |
| $P_D$ | $T_C$ = 25°C | 1130 | W |
| dV/dt | $I_S \le I_{DM}$, $V_{DD} \le V_{DSS}$, $T_J \le 150°C$ | 35 | V/ns |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| $T_L$ | 1.6mm (0.062 in.) from Case for 10s | 300 | °C |
| $T_{SOLD}$ | Plastic Body for 10s | 260 | °C |
| $M_d$ | Mounting Torque (TO-264) | 1.13/10 | Nm/lb.in. |
| $F_C$ | Mounting Force (PLUS247) | 20..120 /4.5..27 | N/lb. |
| Weight | TO-264 | 10 | g |
| | PLUS247 | 6 | g |

| Symbol | Test Conditions ($T_J$ = 25°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 |
| $I_{GSS}$ | $V_{GS}$ = ± 30V, $V_{DS}$ = 0V | | | ± 200 | nA |
| $I_{DSS}$ | $V_{DS} = V_{DSS}$, $V_{GS}$= 0V | | | 25 | μA |
| | $T_J$ = 125°C | | | 3 | mA |
| $R_{DS(on)}$ | $V_{GS}$ = 10V, $I_D = 0.5 \bullet I_{D25}$, Note 1 | | | 68 | mΩ |

## Features

- Dynamic dv/dt Rating
- Avalanche Rated
- Fast Intrinsic Diode
- Low $Q_G$
- Low $R_{DS(on)}$
- Low Drain-to-Tab Capacitance
- Low Package Inductance

## Advantages

- Easy to Mount
- Space Savings

## Applications

- DC-DC Converters
- Battery Chargers
- Switch-Mode and Resonant-Mode Power Supplies
- Uninterrupted Power Supplies
- AC Motor Drives
- High Speed Power Switching Applications

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| Symbol | Test Conditions ($T_J$ = 25°C Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $V_{DS}$ = 10V, $I_D$ = 0.5 • $I_{D25}$, Note 1 | 40 | 75 | | S |
| $C_{iss}$ | $V_{GS}$ = 0V, $V_{DS}$ = 25V, f = 1MHz | | 9.9 | | nF |
| $C_{oss}$ | | | 970 | | pF |
| $C_{rss}$ | | | 5.0 | | pF |
| $R_{Gi}$ | Gate Input Resistance | | 1.1 | | Ω |
| $t_{d(on)}$ | **Resistive Switching Times** | | 30 | | ns |
| $t_r$ | $V_{GS}$ = 10V, $V_{DS}$ = 0.5 • $V_{DSS}$, $I_D$ = 0.5 • $I_{D25}$ | | 10 | | ns |
| $t_{d(off)}$ | $R_G$ = 1Ω (External) | | 60 | | ns |
| $t_f$ | | | 7 | | ns |
| $Q_{g(on)}$ | $V_{GS}$ = 10V, $V_{DS}$ = 0.5 • $V_{DSS}$, $I_D$ = 0.5 • $I_{D25}$ | | 147 | | nC |
| $Q_{gs}$ | | | 50 | | nC |
| $Q_{gd}$ | | | 38 | | nC |
| $R_{thJC}$ | | | | 0.11 | °C/W |
| $R_{thCS}$ | | | 0.15 | | °C/W |

**Source-Drain Diode**

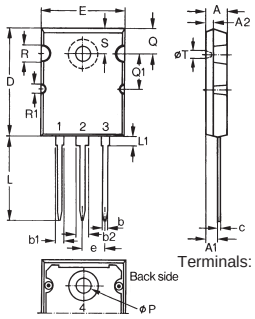
| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $I_S$ | $V_{GS}$ = 0V | | | 78 | A |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$ | | | 310 | A |
| $V_{SD}$ | $I_F$ = $I_S$ , $V_{GS}$ = 0V, Note 1 | | | 1.5 | V |
| $t_{rr}$ | $I_F$ = 39A, -di/dt = 100A/μs | | | 250 | ns |
| $Q_{RM}$ | $V_R$ = 100V, $V_{GS}$ = 0V | | 1.2 | | μC |
| $I_{RM}$ | | | 13.0 | | A |

Note 1. Pulse test, t ≤ 300μs, duty cycle, d ≤ 2%.

**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.

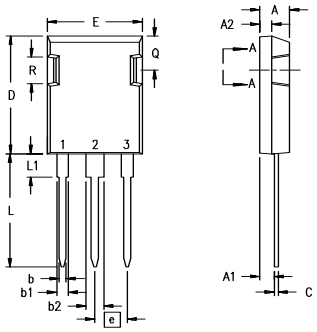
**TO-264 AA Outline**




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

| Dim. | Millimeter Min. | Max. | Inches Min. | Max. |
|---|---|---|---|---|
| A | 4.82 | 5.13 | .190 | .202 |
| A1 | 2.54 | 2.89 | .100 | .114 |
| A2 | 2.00 | 2.10 | .079 | .083 |
| b | 1.12 | 1.42 | .044 | .056 |
| b1 | 2.39 | 2.69 | .094 | .106 |
| b2 | 2.90 | 3.09 | .114 | .122 |
| c | 0.53 | 0.83 | .021 | .033 |
| D | 25.91 | 26.16 | 1.020 | 1.030 |
| E | 19.81 | 19.96 | .780 | .786 |
| e | 5.46 BSC | | .215 BSC | |
| J | 0.00 | 0.25 | .000 | .010 |
| K | 0.00 | 0.25 | .000 | .010 |
| L | 20.32 | 20.83 | .800 | .820 |
| L1 | 2.29 | 2.59 | .090 | .102 |
| P | 3.17 | 3.66 | .125 | .144 |
| Q | 6.07 | 6.27 | .239 | .247 |
| Q1 | 8.38 | 8.69 | .330 | .342 |
| R | 3.81 | 4.32 | .150 | .170 |
| R1 | 1.78 | 2.29 | .070 | .090 |
| S | 6.04 | 6.30 | .238 | .248 |
| T | 1.57 | 1.83 | .062 | .072 |

**PLUS 247™ Outline**




Terminals: 1 - Gate
2 - Drain
3 - Source

| Dim. | Millimeter Min. | Max. | Inches Min. | Max. |
|---|---|---|---|---|
| A | 4.83 | 5.21 | .190 | .205 |
| $A_1$ | 2.29 | 2.54 | .090 | .100 |
| $A_2$ | 1.91 | 2.16 | .075 | .085 |
| b | 1.14 | 1.40 | .045 | .055 |
| $b_1$ | 1.91 | 2.13 | .075 | .084 |
| $b_2$ | 2.92 | 3.12 | .115 | .123 |
| C | 0.61 | 0.80 | .024 | .031 |
| D | 20.80 | 21.34 | .819 | .840 |
| E | 15.75 | 16.13 | .620 | .635 |
| e | 5.45 BSC | | .215 BSC | |
| L | 19.81 | 20.32 | .780 | .800 |
| L1 | 3.81 | 4.32 | .150 | .170 |
| Q | 5.59 | 6.20 | .220 | 0.244 |
| R | 4.32 | 4.83 | .170 | .190 |

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 4,850,072 4,881,106 4,931,844 5,017,508 5,034,796 5,049,961 5,063,307 5,187,117 5,237,481 5,381,025 5,486,715 6,162,665 6,259,123 B1 6,306,728 B1 6,404,065 B1 6,534,343 6,583,505 6,683,344 6,710,405 B2 6,710,463 6,727,585 6,759,692 6,771,478 B2 7,005,734 B2 7,063,975 B2 7,071,537 7,157,338B2

**Fig. 1. Output Characteristics @ $T_J$ = 25ºC**

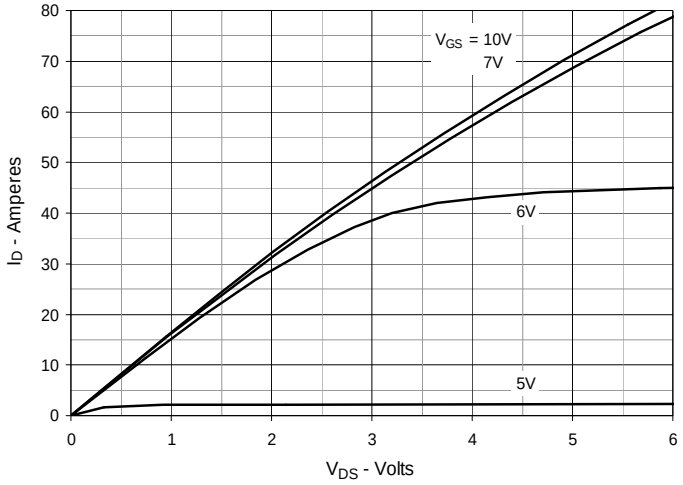



**Fig. 2. Extended Output Characteristics @ $T_J$ = 25ºC**

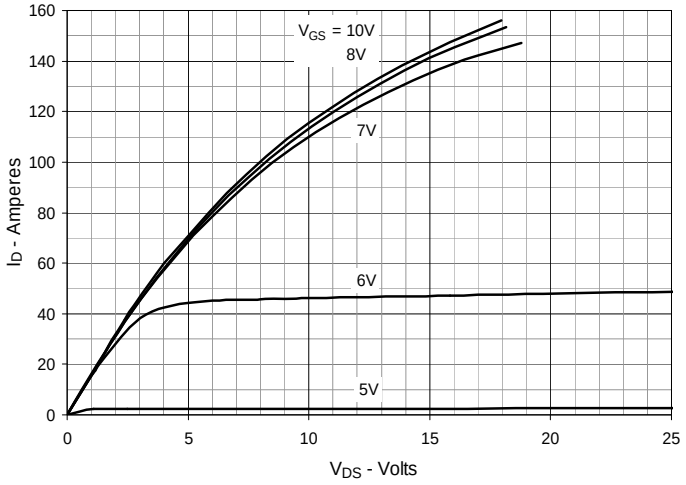



**Fig. 3. Output Characteristics @ $T_J$ = 125ºC**

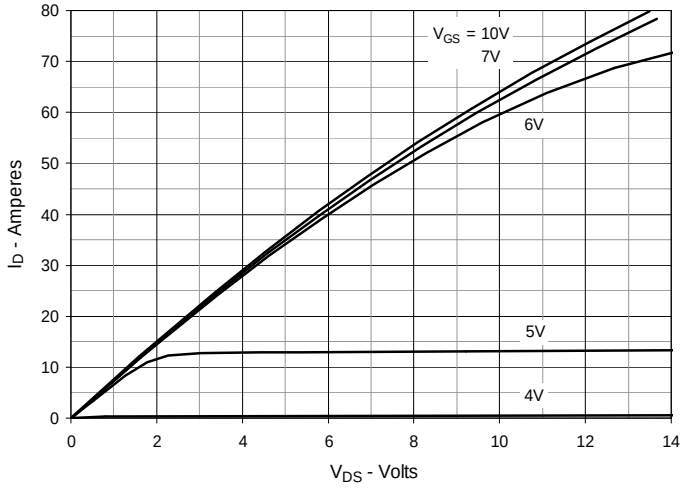



**Fig. 4. $R_{DS(on)}$ Normalized to $I_D$ = 39A Value vs. Junction Temperature**

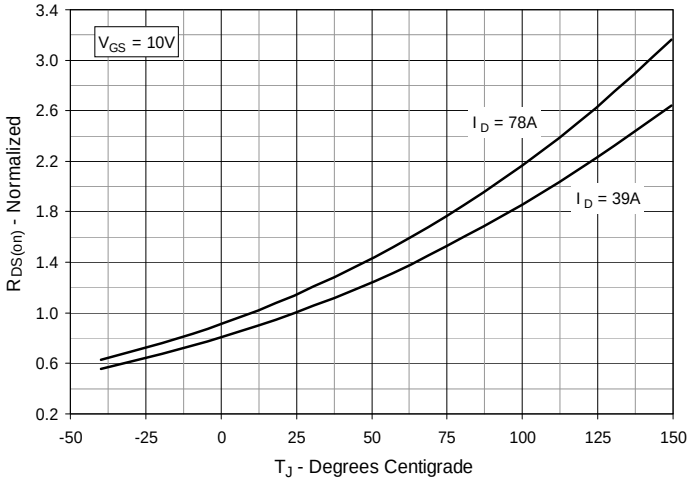



**Fig. 5. $R_{DS(on)}$ Normalized to $I_D$ = 39A Value vs. Drain Current**

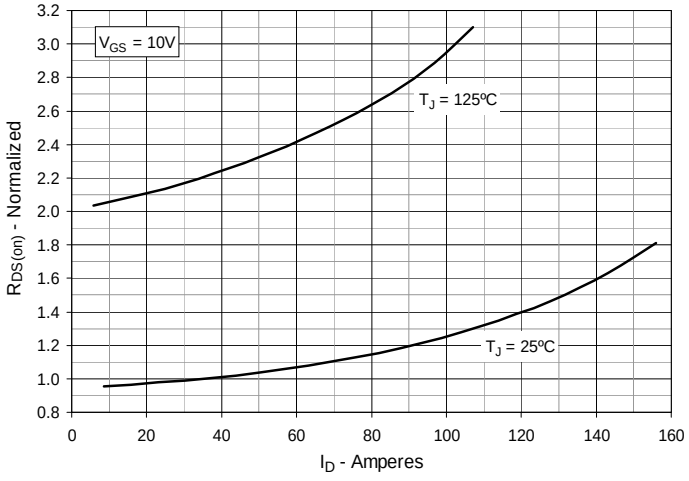
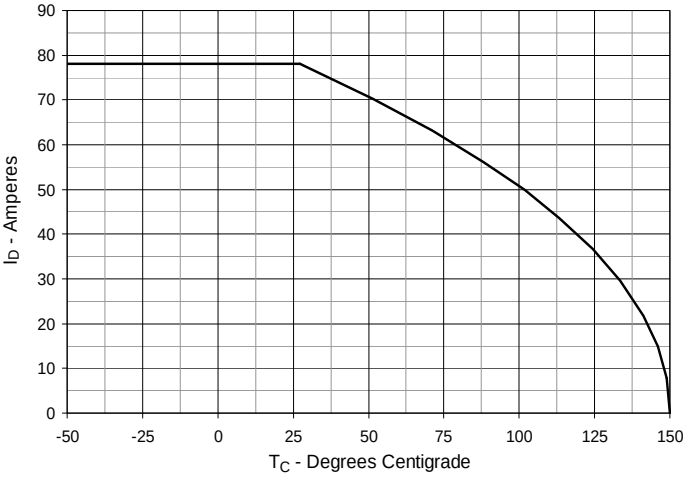



**Fig. 6. Maximum Drain Current vs. Case Temperature**




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**Fig. 7. Input Admittance**

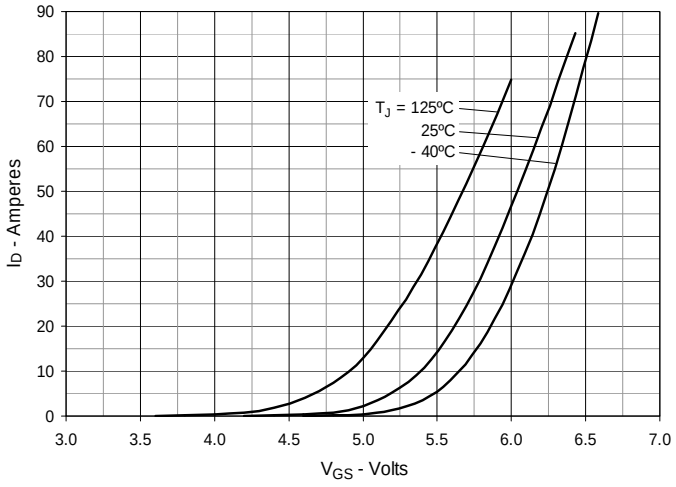



**Fig. 8. Transconductance**

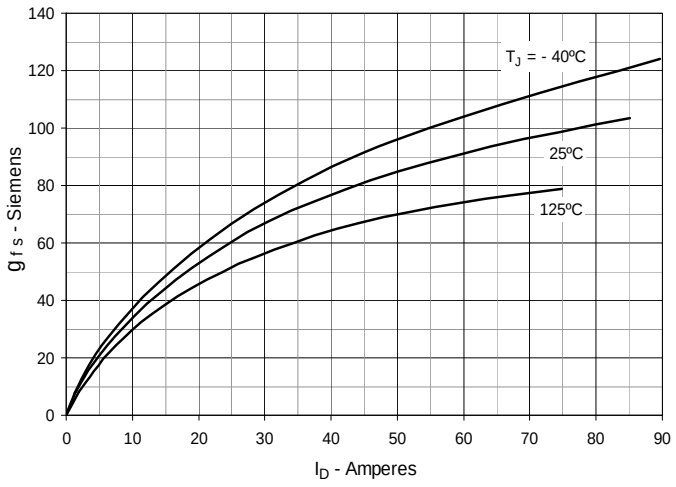



**Fig. 9. Forward Voltage Drop of Intrinsic Diode**

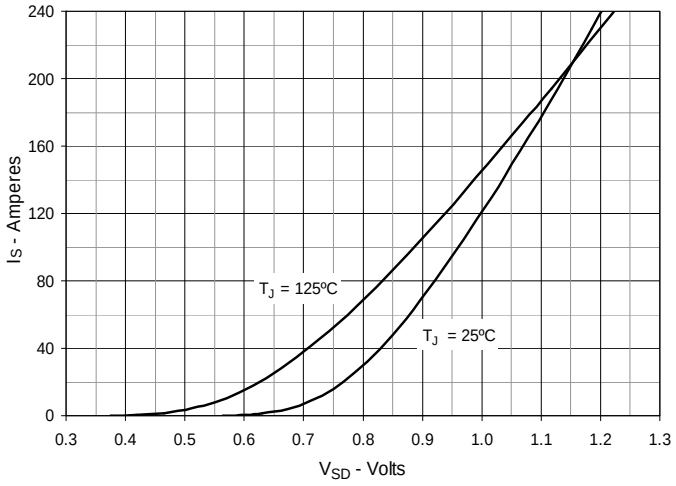



**Fig. 10. Gate Charge**

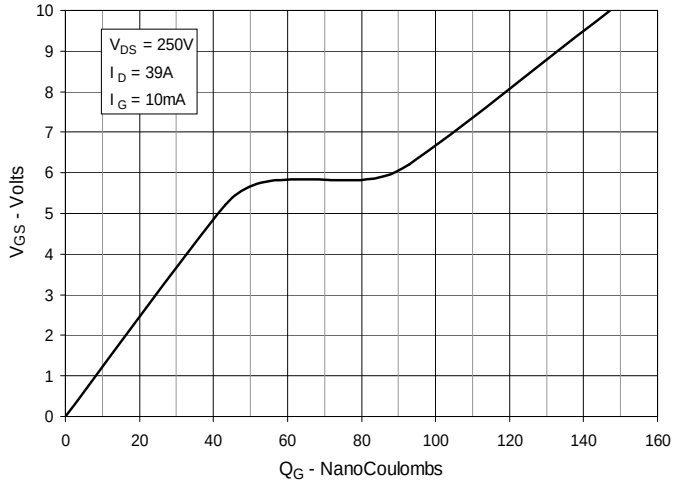



**Fig. 11. Capacitance**

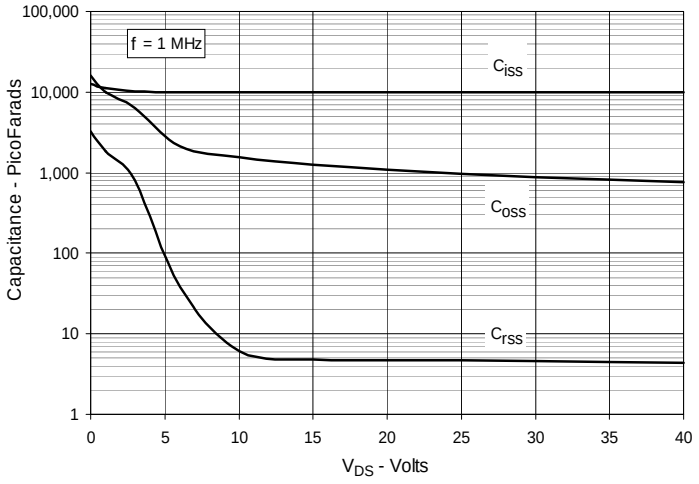
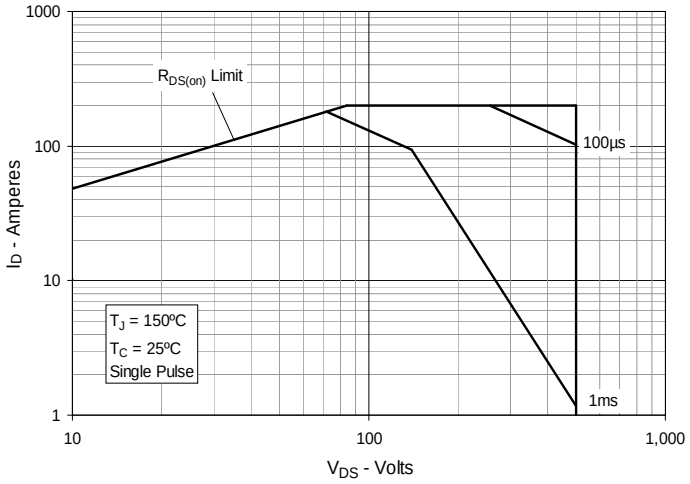
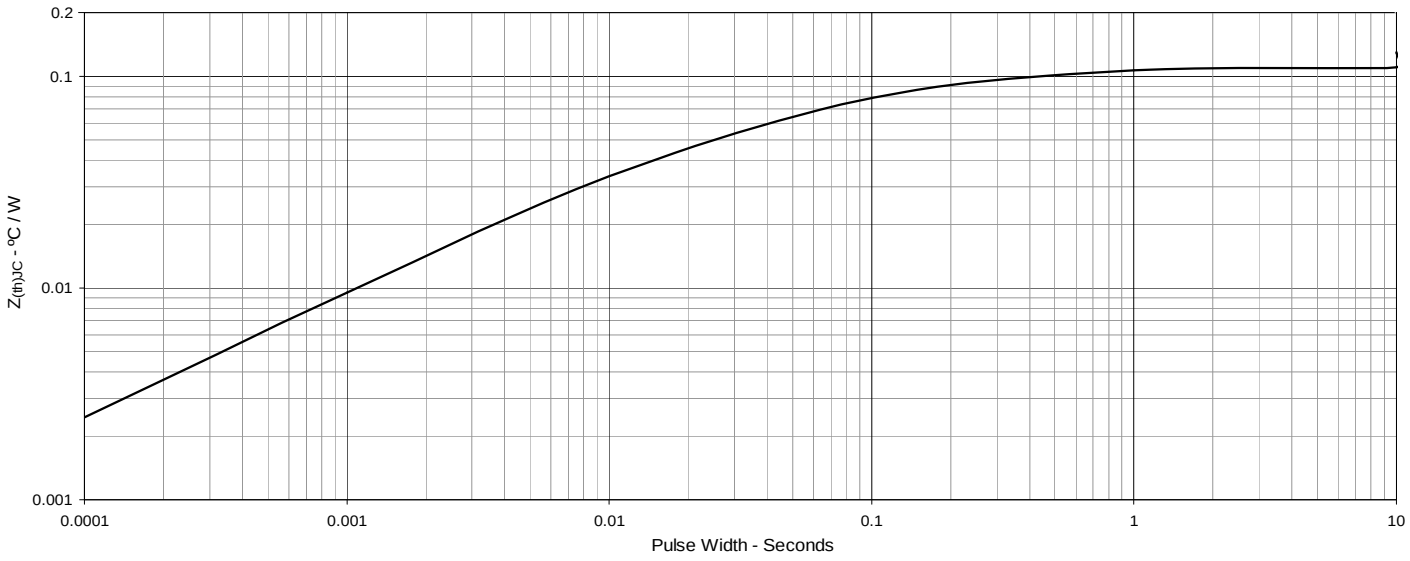



**Fig. 12. Forward-Bias Safe Operating Area**




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




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