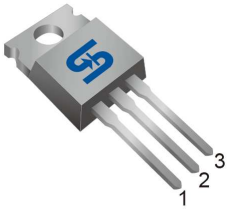
TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

# TSM3N90

## 900V N-Channel Power MOSFET

TO-220

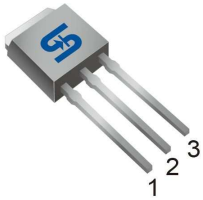



ITO-220

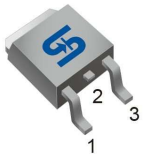



**Pin Definition:**
1. Gate
2. Drain
3. Source

TO-251 (IPAK)




TO-252 (DPAK)




### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$(Ω) | $I_D$ (A) |
|---|---|---|
| 900 | 5.1 @ $V_{GS}$ =10V | 1.5 |

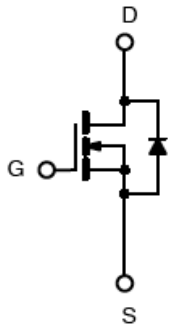
### General Description

The TSM3N90 N-Channel Power MOSFET is produced by new advance planar process. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

### Features

- Low $R_{DS(ON)}$ 4.3Ω (Typ.)
- Low gate charge typical @ 17nC (Typ.)
- Low Crss typical @ 8.7pF (Typ.)

### Block Diagram




N-Channel MOSFET

### Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TSM3N90CH C5G | TO-251 | 75pcs / Tube |
| TSM3N90CP ROG | TO-252 | 2.5Kpcs / 13" Reel |
| TSM3N90CZ C0 | TO-220 | 50pcs / Tube |
| TSM3N90CI C0 | ITO-220 | 50pcs / Tube |

**Note:** "G" denotes for Halogen Free

### Absolute Maximum Rating (Ta = 25°C unless otherwise noted)

| Parameter | | Symbol | Limit | | | Unit |
|---|---|---|---|---|---|---|
| | | | IPAK/DPAK | ITO-220 | TO-220 | |
| Drain-Source Voltage | | $V_{DS}$ | 900 | | | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | | | V |
| Continuous Drain Current | Tc = 25ºC | $I_D$ | 2.5 | | | A |
| | Tc = 100ºC | | 1.6 | | | A |
| Pulsed Drain Current * | | $I_{DM}$ | 10 | | | A |
| Single Pulse Avalanche Energy (Note 2) | | $E_{AS}$ | 16.6 | | | mJ |
| Avalanche Current (Repetitive) (Note 1) | | $I_{AR}$ | 2.5 | | | A |
| Repetitive Avalanche Energy (Note 1) | | $E_{AR}$ | 9.4 | | | mJ |
| Peak Diode Recovery dv/dt (Note 3) | | dv/dt | 4.5 | | | V/ns |
| Total Power Dissipation @ $T_C$ = 25°C | | $P_{TOT}$ | 94 | 32 | 94 | W |
| Operating Junction Temperature | | $T_J$ | 150 | | | ºC |
| Storage Temperature Range | | $T_{STG}$ | -55 to +150 | | | °C |

**Note:** Limited by maximum junction temperature

## Thermal Performance

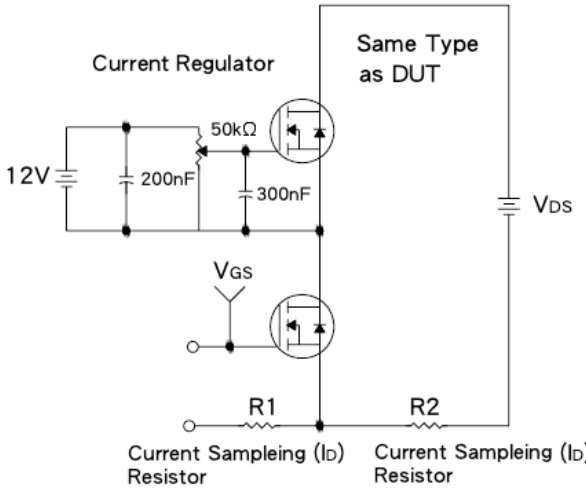
| Parameter | Symbol | IPAK/DPAK | ITO-220 | TO-220 | Unit |
|---|---|---|---|---|---|
| Thermal Resistance - Junction to Case | $R\Theta_{JC}$ | 1.33 | 1.33 | 3.9 | °C/W |
| Thermal Resistance - Junction to Ambient | $R\Theta_{JA}$ | 110 | 62.5 | | |

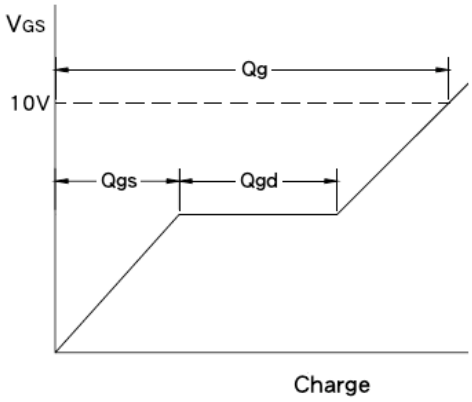
## Electrical Specifications (Ta = 25°C unless otherwise noted)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250uA | $BV_{DSS}$ | 900 | -- | -- | V |
| Drain-Source On-State Resistance | $V_{GS}$ = 10V, $I_D$ = 1.25A | $R_{DS(ON)}$ | -- | 4.3 | 5.1 | Ω |
| Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250uA | $V_{GS(TH)}$ | 2.0 | -- | 4.0 | V |
| Zero Gate Voltage Drain Current | $V_{DS}$ = 900V, $V_{GS}$ = 0V | $I_{DSS}$ | -- | -- | 10 | uA |
| Gate Body Leakage | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Forward Transfer Conductance | $V_{DS}$ = 30V, $I_D$ = 1.25A | $g_{fs}$ | -- | 3 | -- | S |
| **Dynamic** | | | | | | |
| Total Gate Charge | $V_{DS}$ = 720V, $I_D$ = 2.5A, $V_{GS}$ = 10V | $Q_g$ | -- | 17 | -- | nC |
| Gate-Source Charge | | $Q_{gs}$ | -- | 2.4 | -- | |
| Gate-Drain Charge | | $Q_{gd}$ | -- | 6.6 | -- | |
| Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1.0MHz | $C_{iss}$ | -- | 748 | -- | pF |
| Output Capacitance | | $C_{oss}$ | -- | 55 | -- | |
| Reverse Transfer Capacitance | | $C_{rss}$ | -- | 8.7 | -- | |
| **Switching** | | | | | | |
| Turn-On Delay Time | $V_{GS}$ = 10V, $I_D$ = 2.5A, $V_{DD}$ = 450V, $R_G$ = 25Ω | $t_{d(on)}$ | -- | 16 | -- | nS |
| Turn-On Rise Time | | $t_r$ | -- | 25 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 63 | -- | |
| Turn-Off Fall Time | | $t_f$ | -- | 31 | -- | |
| **Source-Drain Diode Ratings and Characteristic** | | | | | | |
| Source Current | Integral reverse diode in the MOSFET | $I_S$ | -- | -- | 2.5 | A |
| Source Current (Pulse) | | $I_{SM}$ | -- | -- | 10 | A |
| Diode Forward Voltage | $I_S$ = 2.5A, $V_{GS}$ = 0V | $V_{SD}$ | -- | -- | 1.5 | V |
| Reverse Recovery Time | $V_{GS}$ = 0V, $I_S$ =2.5A, $dI_F/dt$ = 100A/us | $t_{fr}$ | -- | 355 | -- | nS |
| Reverse Recovery Charge | | $Q_{fr}$ | -- | 1.8 | -- | uC |

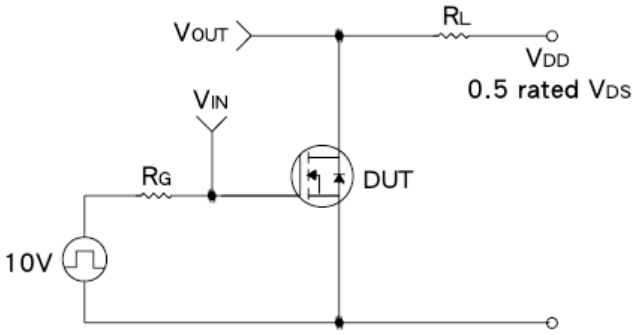
**Note 1:** Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
**Note 2:** $V_{DD}$ = 50V, $I_{AS}$=2.5A, L=5mH, $R_G$ =25Ω, Starting $T_J$=25ºC
**Note 3:** $I_{SD}$≤2.5A, di/dt≤200A/uS, $V_{DD}$≤$BV_{DSS}$, Starting $T_J$=25ºC
**Note 4:** Pulse test: pulse width ≤300uS, duty cycle ≤2%
**Note 5:** Essentially Independent of Operating Temperature

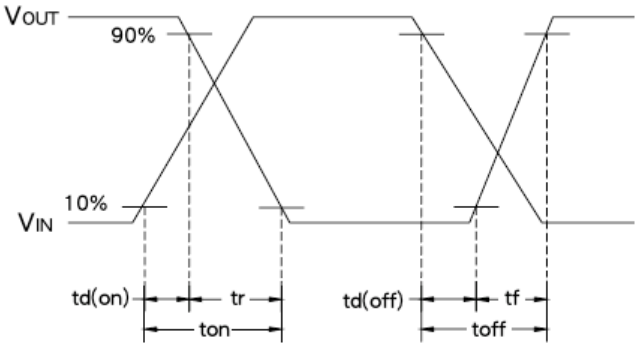
## Gate Charge Test Circuit & Waveform



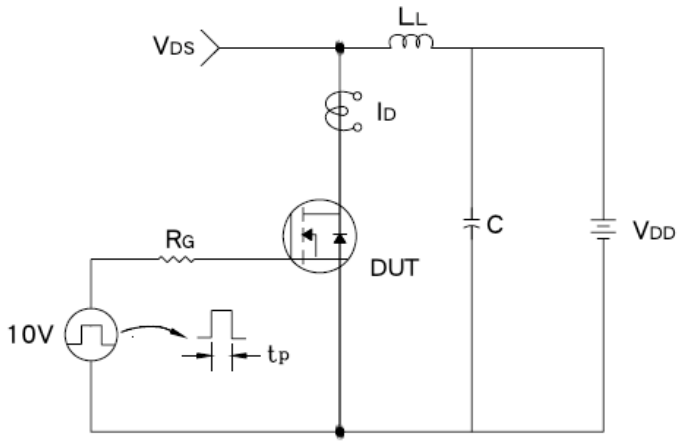



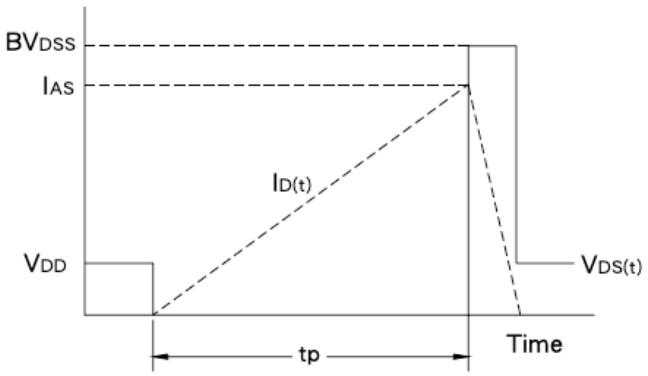

## Resistive Switching Test Circuit & Waveform



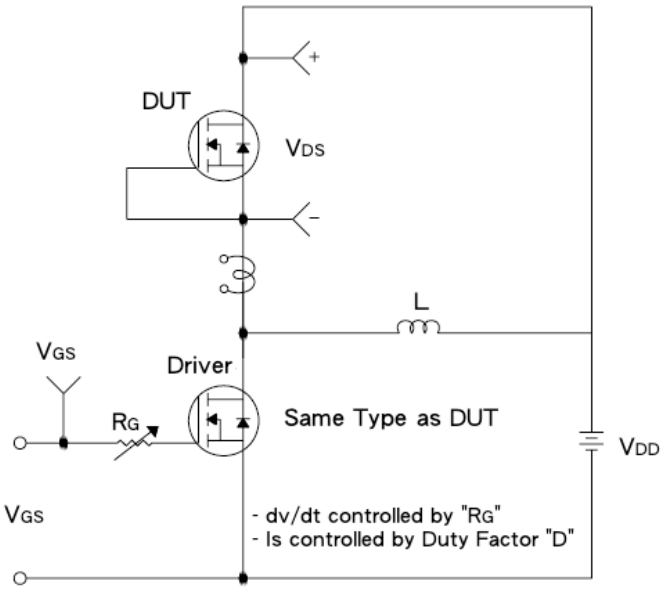



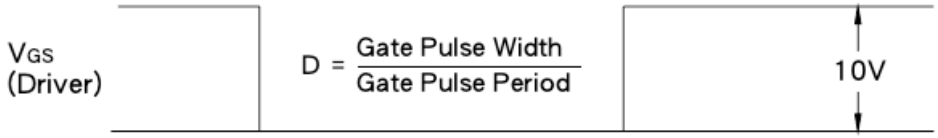

## $E_{AS}$ Test Circuit & Waveform

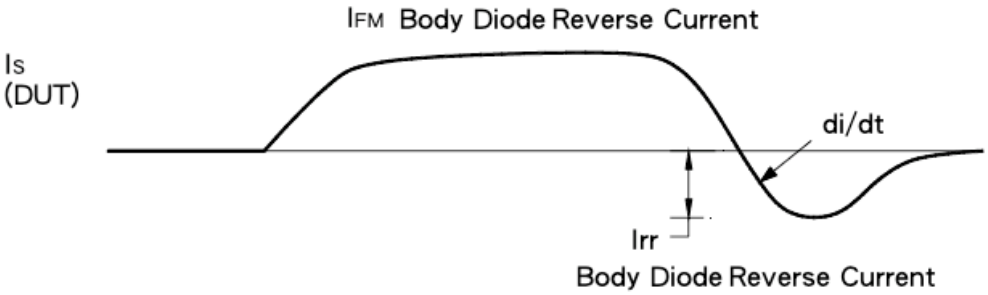


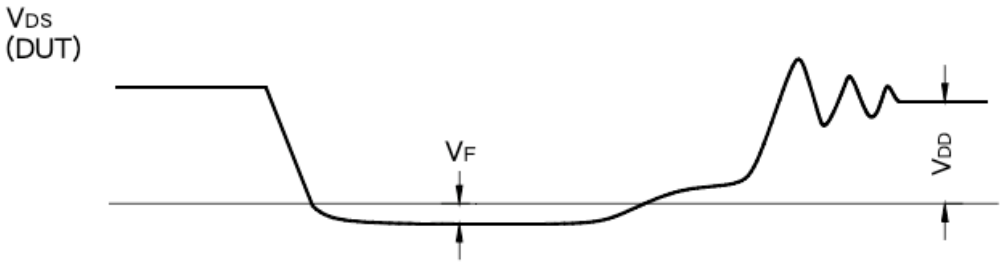



## Diode Reverse Recovery Time Test Circuit & Waveform



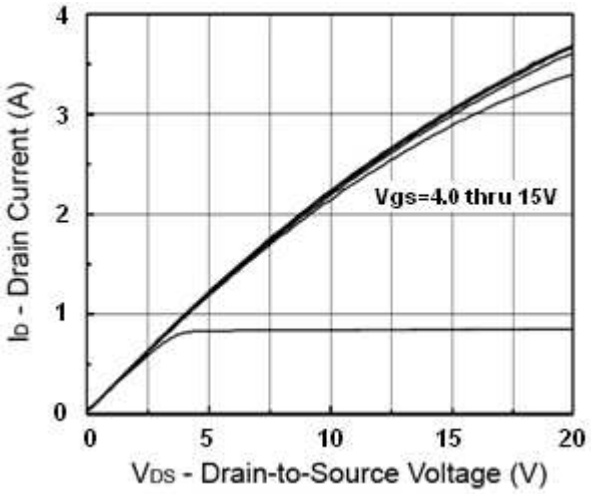



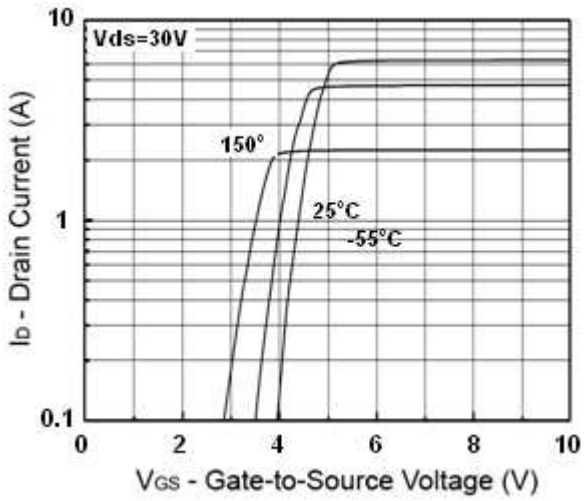



## Electrical Characteristics Curve (Tc = 25°C, unless otherwise noted)

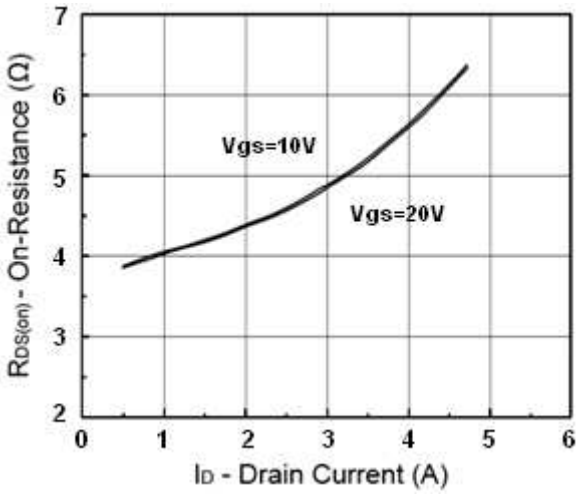
### Output Characteristics



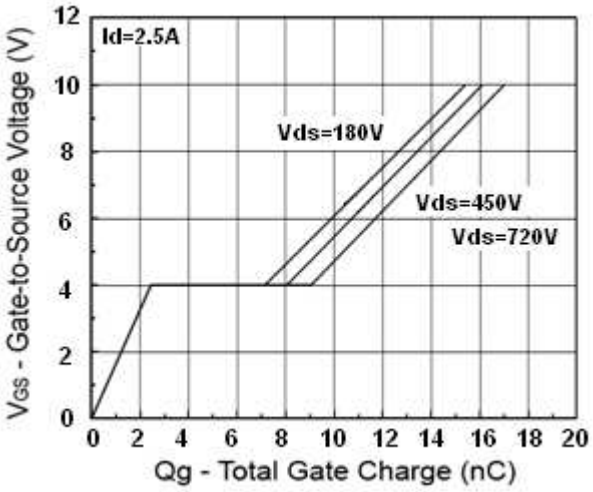

### Transfer Characteristics



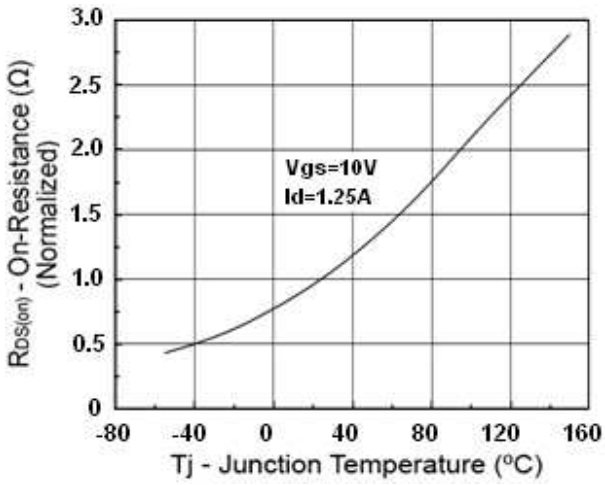

### On-Resistance vs. Drain Current



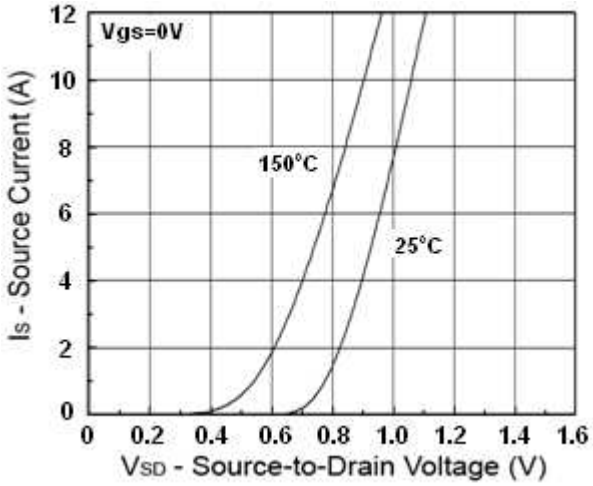

### Gate Charge




### On-Resistance vs. Junction Temperature

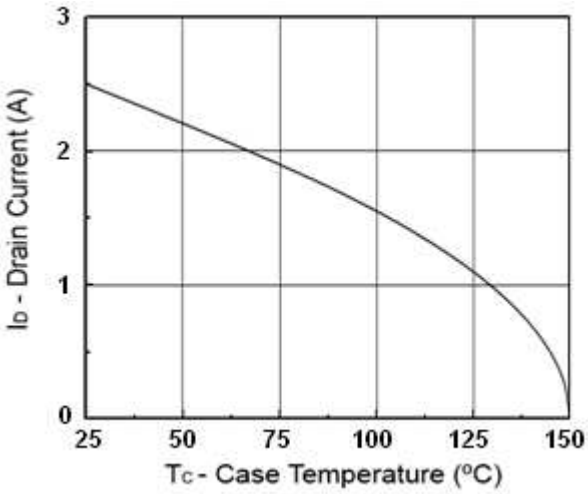



### Source-Drain Diode Forward Voltage

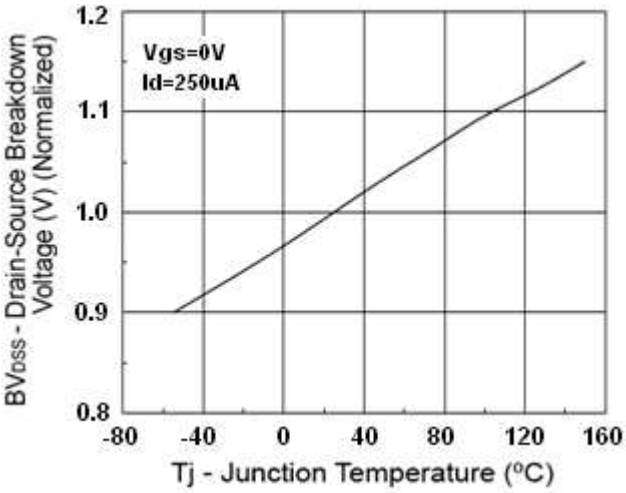


## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

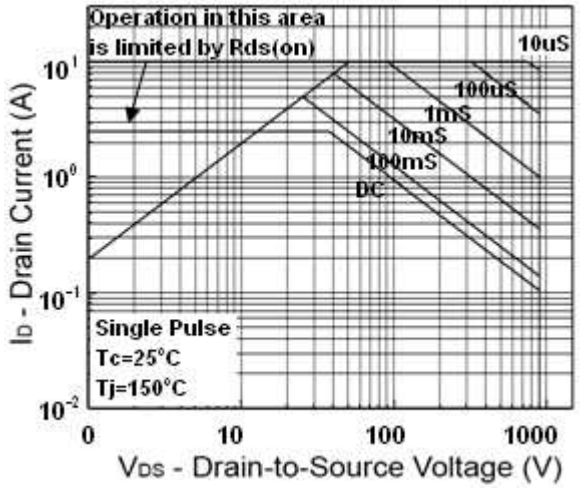
### Drain Current vs. Case Temperature



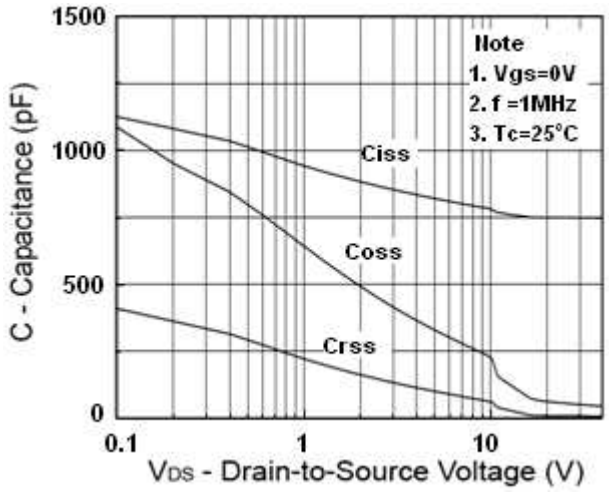

### $BV_{DSS}$ vs. Junction Temperature



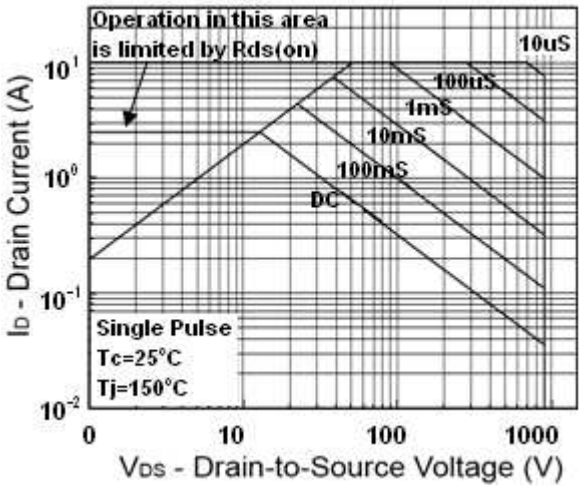

### Maximum Safe Operating Area




### Capacitance vs. Drain-Source Voltage

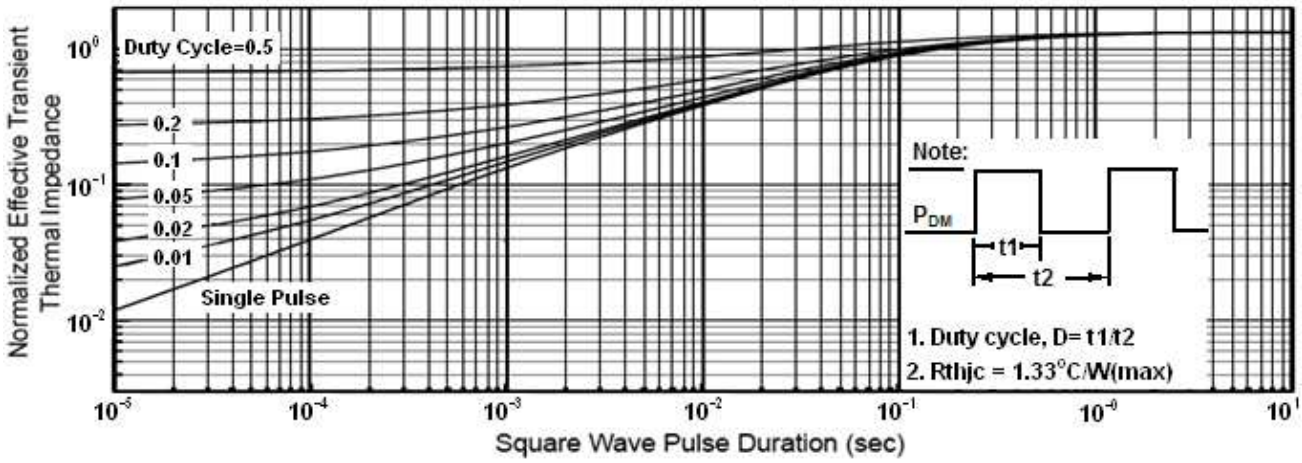



### Maximum Safe Operating Area (ITO-220)

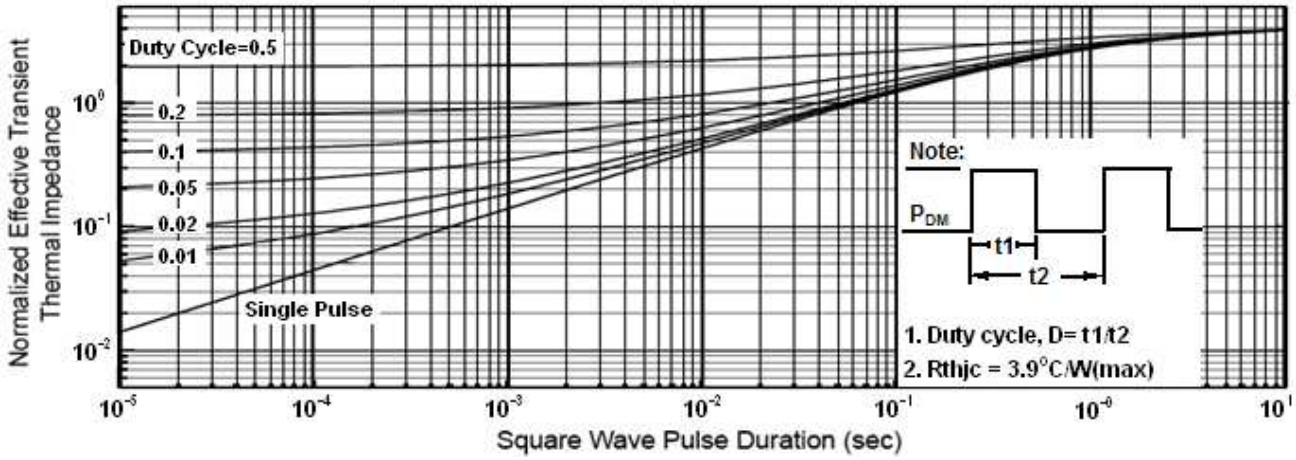


## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

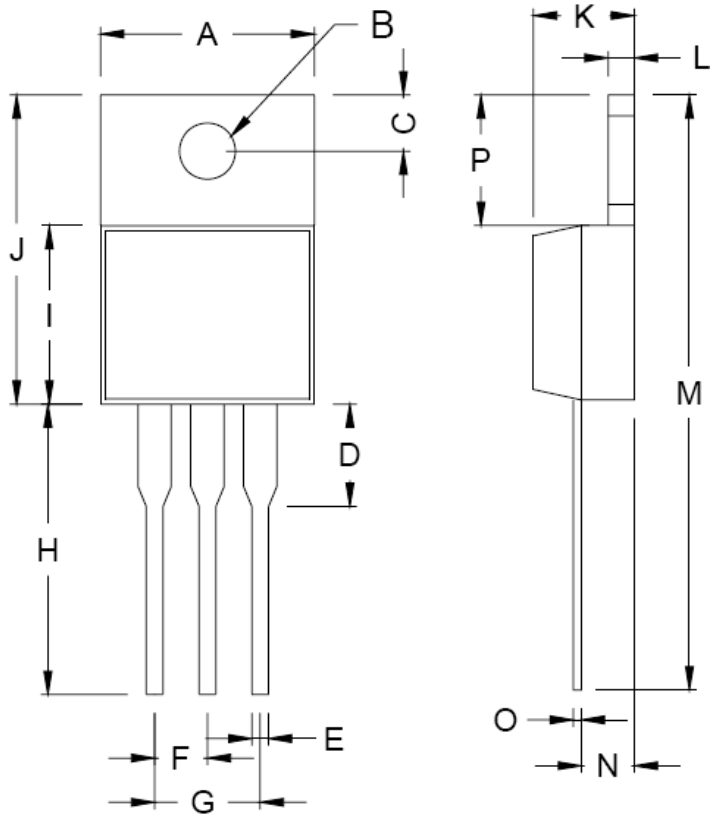
**Normalized Thermal Transient Impedance, Junction-to-Ambient**




**Normalized Thermal Transient Impedance, Junction-to-Ambient (ITO-220)**

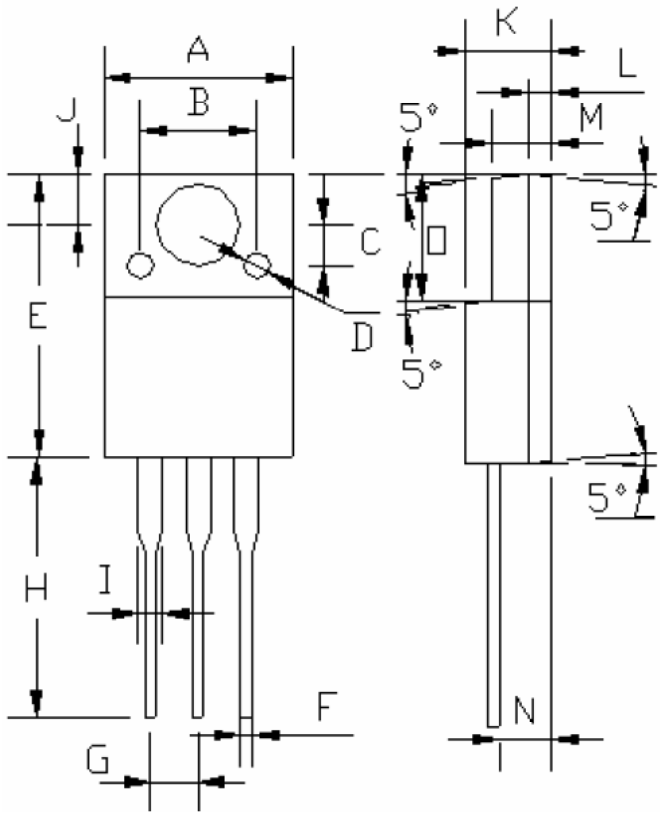


## TO-220 Mechanical Drawing



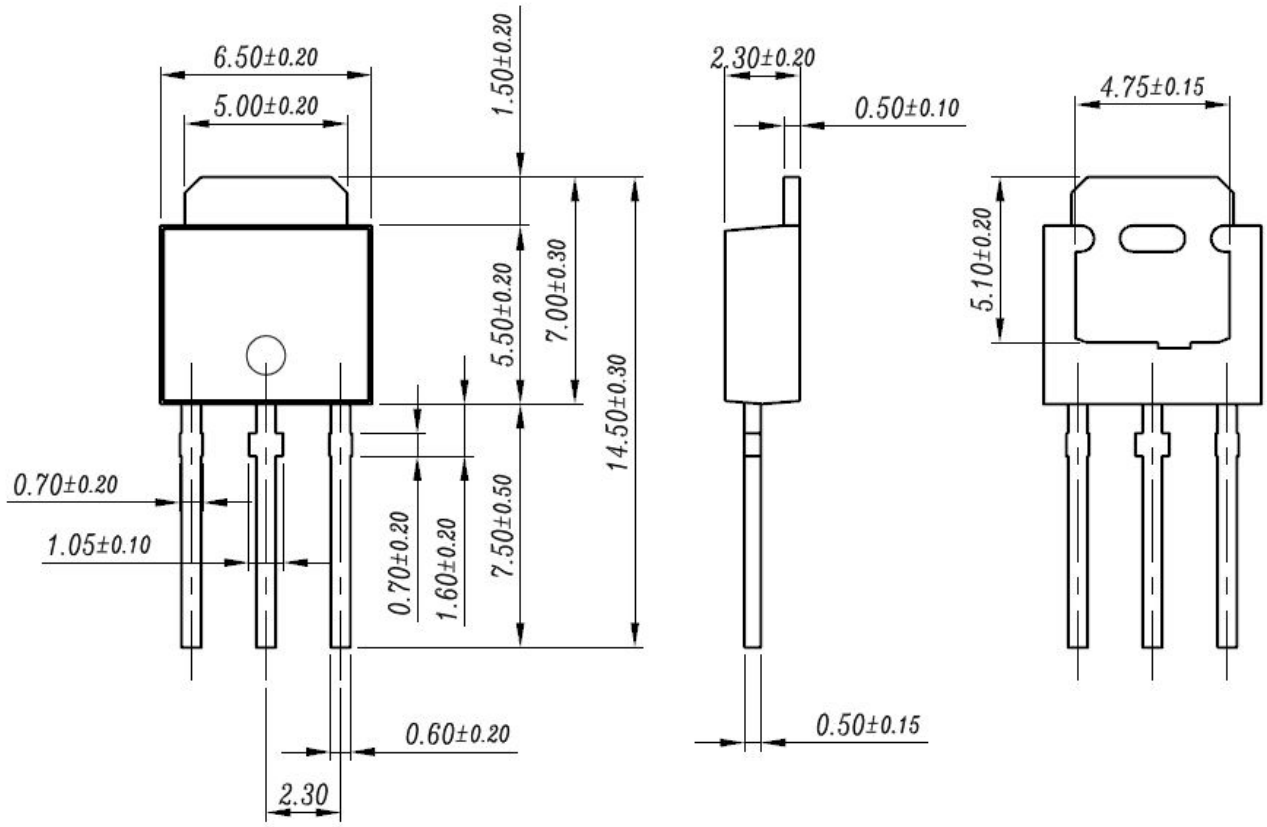

| TO-220 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 10.00 | 10.50 | 0.394 | 0.413 |
| B | 3.74 | 3.91 | 0.147 | 0.154 |
| C | 2.44 | 2.94 | 0.096 | 0.116 |
| D | -- | 6.35 | -- | 0.250 |
| E | 0.38 | 1.10 | 0.015 | 0.043 |
| F | 2.34 | 2.71 | 0.092 | 0.107 |
| G | 4.69 | 5.43 | 0.185 | 0.214 |
| H | 12.70 | 14.73 | 0.500 | 0.580 |
| J | 8.38 | 9.38 | 0.330 | 0.369 |
| K | 14.22 | 16.51 | 0.560 | 0.650 |
| L | 3.55 | 4.82 | 0.140 | 0.190 |
| M | 1.16 | 1.40 | 0.046 | 0.055 |
| N | 27.70 | 29.62 | 1.091 | 1.166 |
| O | 2.03 | 2.92 | 0.080 | 0.115 |
| P | 0.25 | 0.61 | 0.010 | 0.024 |

## ITO-220 Mechanical Drawing

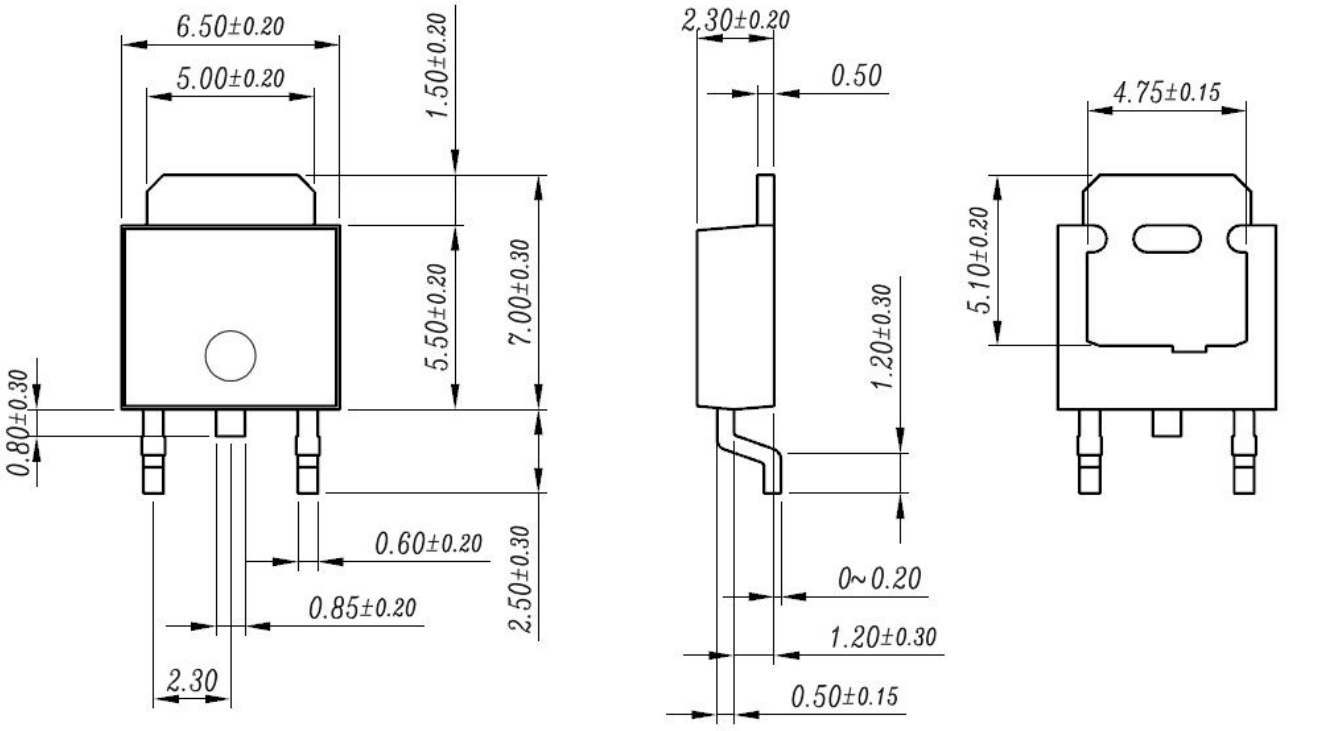



| ITO-220 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 10.04 | 10.07 | 0.395 | 0.396 |
| B | 6.20 (typ.) | | 0.244 (typ.) | |
| C | 2.20 (typ.) | | 0.087 (typ.) | |
| D | ∮ 1.40 (typ.) | | ∮ 0.055 (typ.) | |
| E | 15.0 | 15.20 | 0.591 | 0.598 |
| F | 0.52 | 0.54 | 0.020 | 0.021 |
| G | 2.35 | 2.73 | 0.093 | 0.107 |
| H | 13.50 | 13.55 | 0.531 | 0.533 |
| I | 1.11 | 1.49 | 0.044 | 0.058 |
| J | 2.60 | 2.80 | 0.102 | 0.110 |
| K | 4.49 | 4.50 | 0.176 | 0.177 |
| L | 1.15 (typ.) | | 0.045 (typ.) | |
| M | 3.03 | 3.05 | 0.119 | 0.120 |
| N | 2.60 | 2.80 | 0.102 | 0.110 |
| O | 6.55 | 6.65 | 0.258 | 0.262 |

## TO-251 Mechanical Drawing



## TO-252 Mechanical Drawing




Unit: Millimeters

## Notice

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