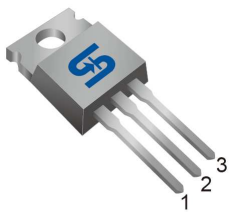
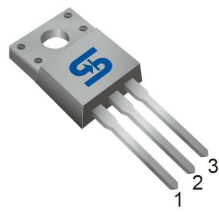




TO-220



ITO-220



Pin Definition:

1. Gate
2. Drain
3. Source

PRODUCT SUMMARY

| V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (A) |
|--------------|---------------------------|-----------|
| 900 | 1.4 @ $V_{GS}=10V$ | 9 |

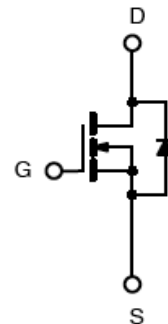
General Description

The TSM9N90 N-Channel enhancement mode Power MOSFET is produced by planar stripe DMOS technology. 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. These devices are well suited for high efficiency switch mode power supply, electronic lamp ballast based on half bridge.

Features

- Low $R_{DS(ON)}$ 1.4 Ω (Max.)
- Low gate charge typical @ 65nC (Typ.)
- Improve dv/dt capability

Block Diagram



N-Channel MOSFET

Ordering Information

| Part No. | Package | Packing |
|--------------|---------|--------------|
| TSM9N90CZ C0 | TO-220 | 50pcs / Tube |
| TSM9N90CI C0 | ITO-220 | 50pcs / Tube |

Absolute Maximum Rating ($T_a = 25^\circ C$ unless otherwise noted)

| Parameter | Symbol | TO-220 | ITO-220 | Unit |
|---|-----------|----------------------------|---------|------------|
| Drain-Source Voltage | V_{DS} | 900 | | V |
| Gate-Source Voltage | V_{GS} | ± 30 | | V |
| Continuous Drain Current | I_D | $T_c = 25^\circ C$ | 9 | 9 * |
| | | $T_c = 100^\circ C$ | 5.7 | 5.7 * |
| Pulsed Drain Current * | I_{DM} | 36 | 36 * | A |
| Peak Diode Recovery dv/dt (Note 3) | dv/dt | 4.5 | | V |
| Single Pulse Avalanche Energy (Note 2) | E_{AS} | 857 | | mJ |
| Avalanche Current (Repetitive) (Note 1) | I_{AR} | 9 | | A |
| Repetitive Avalanche Energy (Note 1) | E_{AR} | 29 | | mJ |
| Power Dissipation | P_D | $T_c = 25^\circ C$ | 290 | 48 |
| | | Derate above 25 $^\circ C$ | 2.32 | 0.38 |
| Operating Junction Temperature | T_J | 150 | | $^\circ C$ |
| Storage Temperature Range | T_{STG} | -55 to +150 | | $^\circ C$ |

* Limited by maximum junction temperature

Thermal Performance

| Parameter | Symbol | TO-220 | ITO-220 | Unit |
|--|----------------|--------|---------|------|
| Thermal Resistance - Junction to Case | $R\theta_{JC}$ | 0.43 | 2.6 | °C/W |
| Thermal Resistance - Junction to Ambient | $R\theta_{JA}$ | 62.5 | | |

Notes: Surface mounted on FR4 board $t \leq 10\text{sec}$

Electrical Specifications (Tc = 25°C unless otherwise noted)

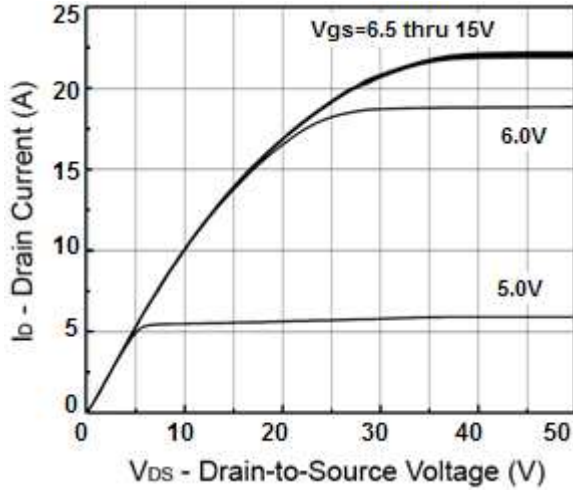
| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|----------------------------------|---|--------------|-----|------|-----------|----------|
| Static | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS} = 0V, I_D = 250\mu A$ | BV_{DSS} | 900 | -- | -- | V |
| Drain-Source On-State Resistance | $V_{GS} = 10V, I_D = 4.5A$ | $R_{DS(ON)}$ | -- | 1.13 | 1.4 | Ω |
| Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = 250\mu A$ | $V_{GS(TH)}$ | 2.0 | -- | 4.0 | V |
| Zero Gate Voltage Drain Current | $V_{DS} = 900V, V_{GS} = 0V$ | I_{DSS} | -- | -- | 10 | μA |
| Gate Body Leakage | $V_{GS} = \pm 30V, V_{DS} = 0V$ | I_{GSS} | -- | -- | ± 100 | nA |
| Forward Transconductance | $V_{DS} = 30V, I_D = 4.5A$ | g_{fs} | -- | 10 | -- | S |
| Diode Forward Voltage | $I_S = 9A, V_{GS} = 0V$ | V_{SD} | -- | -- | 1.5 | V |
| Dynamic^b | | | | | | |
| Total Gate Charge | $V_{DS} = 720V, I_D = 9A, V_{GS} = 10V$ | Q_g | -- | 65 | -- | nC |
| Gate-Source Charge | | Q_{gs} | -- | 11 | -- | |
| Gate-Drain Charge | | Q_{gd} | -- | 23 | -- | |
| Input Capacitance | $V_{DS} = 25V, V_{GS} = 0V, f = 1.0\text{MHz}$ | C_{iss} | -- | 2324 | -- | pF |
| Output Capacitance | | C_{oss} | -- | 184 | -- | |
| Reverse Transfer Capacitance | | C_{rss} | -- | 29 | -- | |
| Switching^c | | | | | | |
| Turn-On Delay Time | $V_{GS} = 10V, I_D = 9A, V_{DD} = 450V, R_G = 25\Omega$ | $t_{d(on)}$ | -- | 61 | -- | nS |
| Turn-On Rise Time | | t_r | -- | 49 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 318 | -- | |
| Turn-Off Fall Time | | t_f | -- | 100 | -- | |
| Reverse Recovery Time | $V_{GS} = 0V, I_S = 9A,$ | t_{fr} | -- | 470 | -- | nS |
| Reverse Recovery Charge | $di_F/dt = 100A/\mu s$ | Q_{fr} | -- | 4.9 | -- | μC |

Notes:

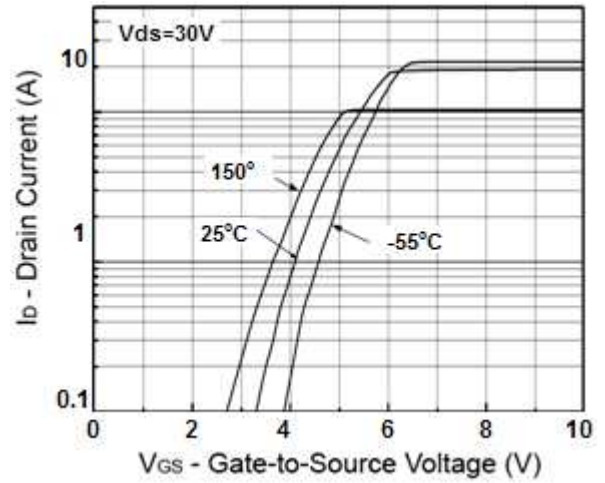
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. $V_{DD} = 50V, I_{AS} = 9A, L = 20\text{mH}, R_G = 25\Omega, \text{Starting } T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 9A, di/dt \leq 200A/\mu S, V_{DD} \leq BV, \text{Starting } T_J = 25^\circ\text{C}$
4. Pulse test: pulse width $\leq 300\mu S, \text{duty cycle } \leq 2\%$
5. b For design reference only, not subject to production testing.
6. c Switching time is essentially independent of operating temperature.

Electrical Characteristics Curve ($T_c = 25^\circ\text{C}$, unless otherwise noted)

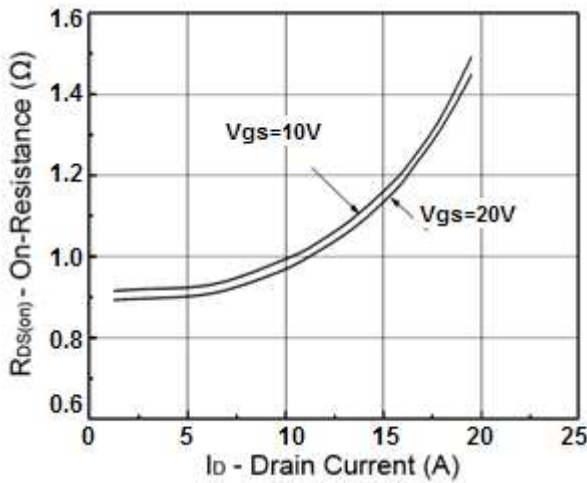
Output Characteristics



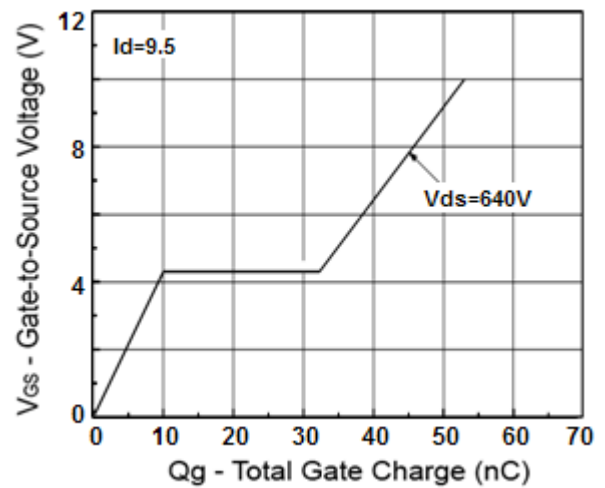
Transfer Characteristics



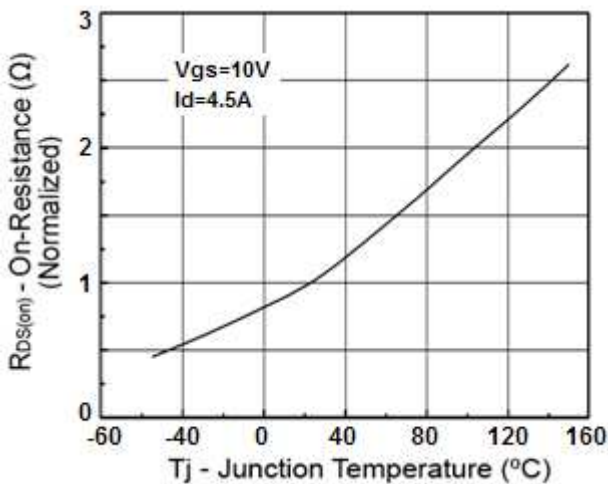
On-Resistance vs. Drain Current



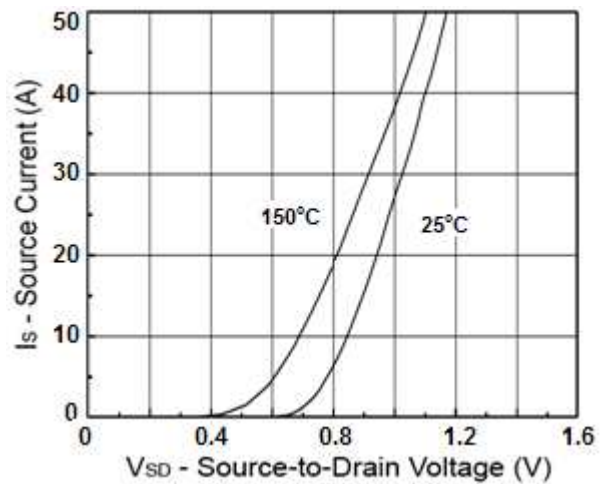
Gate Charge



On-Resistance vs. Junction Temperature

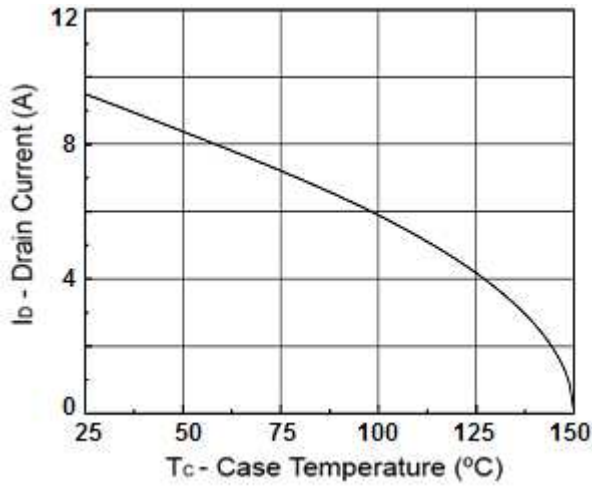


Source-Drain Diode Forward Voltage

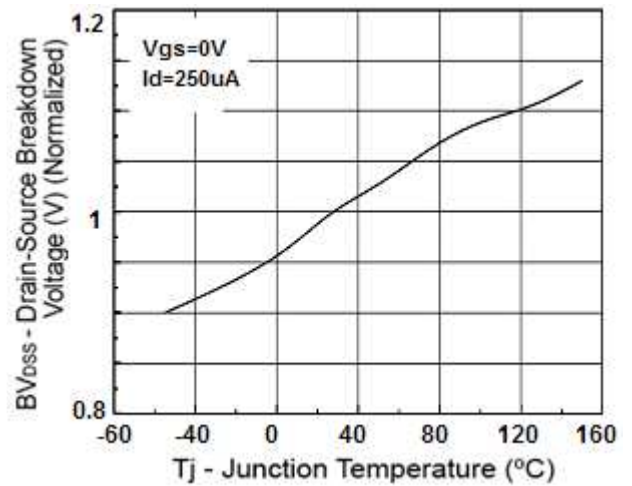


Electrical Characteristics Curve ($T_a = 25^\circ\text{C}$, unless otherwise noted)

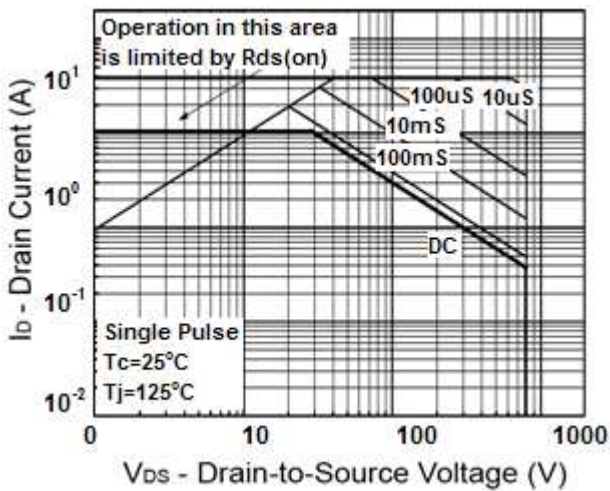
Drain Current vs. Case Temperature



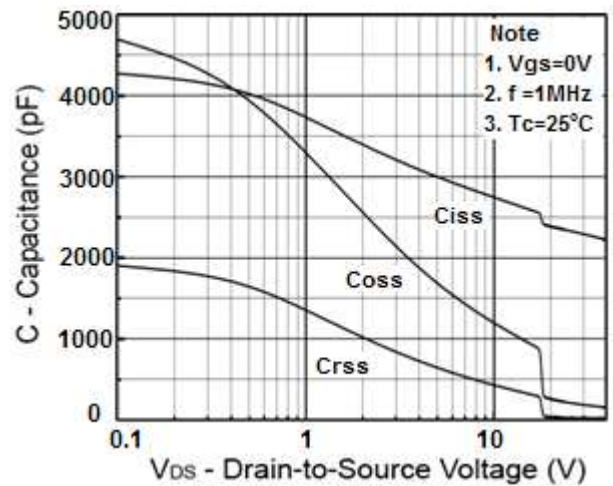
BV_{DSS} vs. Junction Temperature



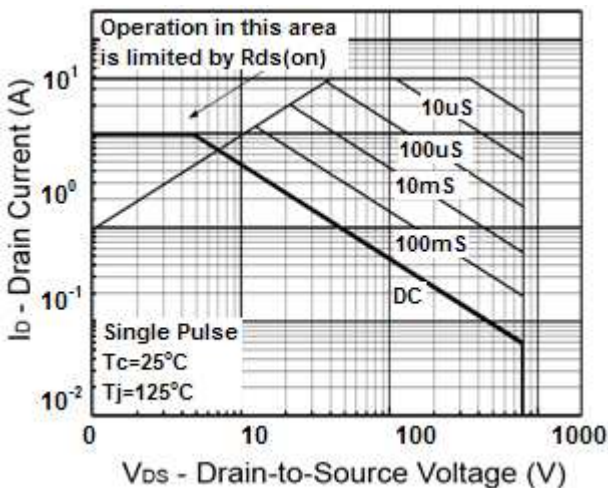
Maximum Safe Operating Area



Capacitance vs. Drain-Source Voltage

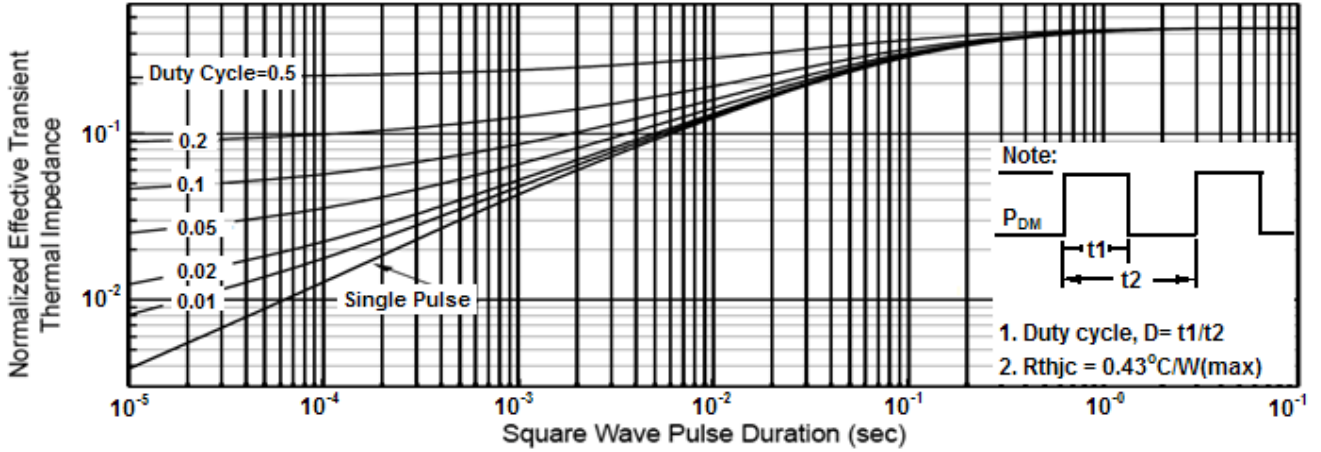


Maximum Safe Operating Area (ITO-220)

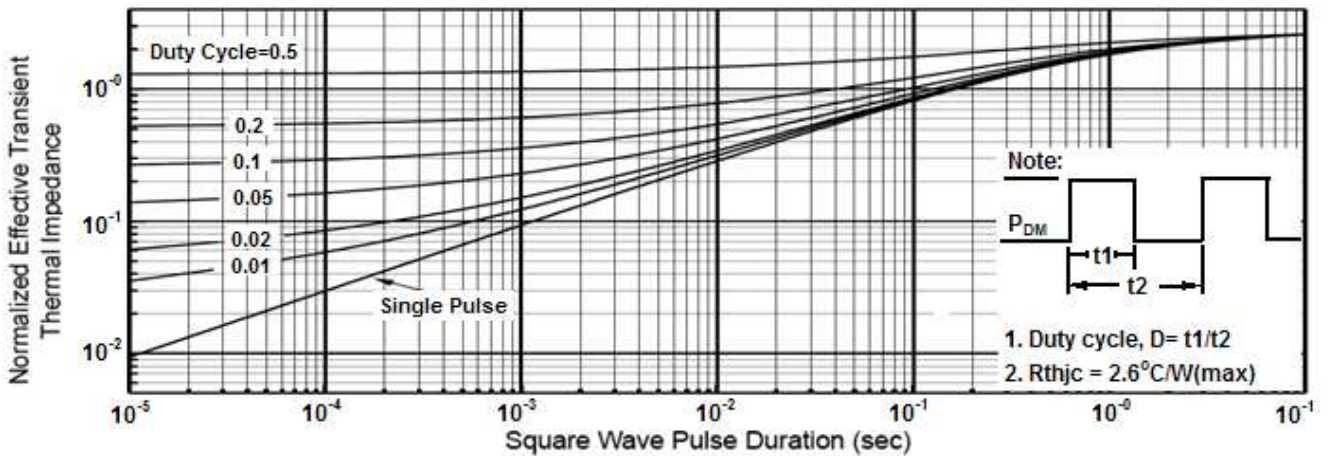


Electrical Characteristics Curve ($T_a = 25^{\circ}\text{C}$, unless otherwise noted)

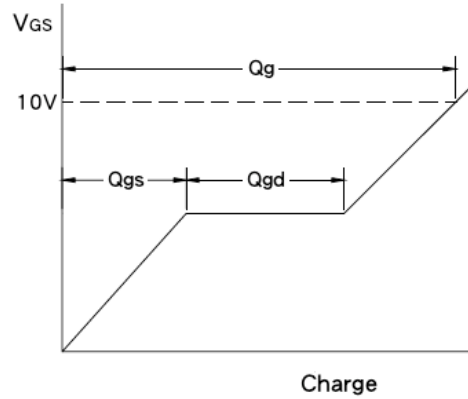
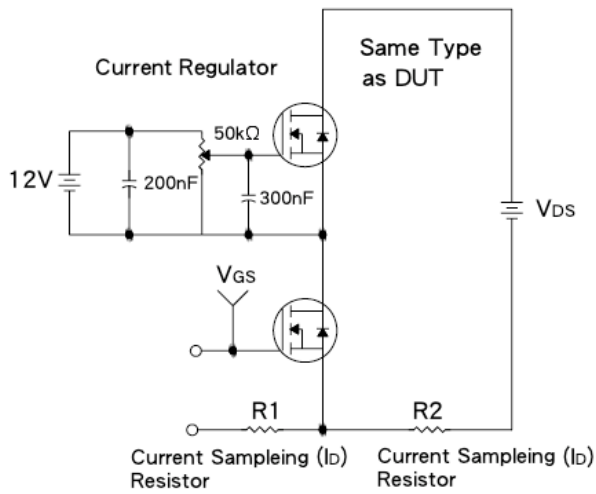
Normalized Thermal Transient Impedance, Junction-to-Ambient



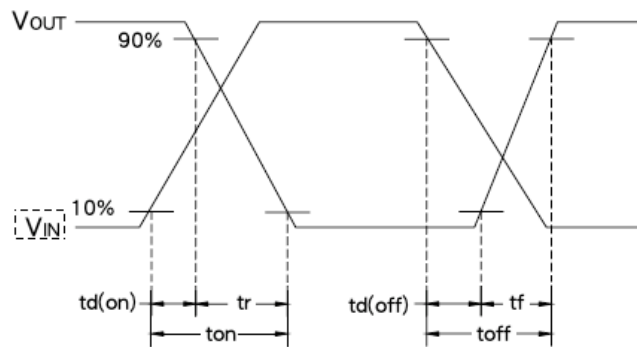
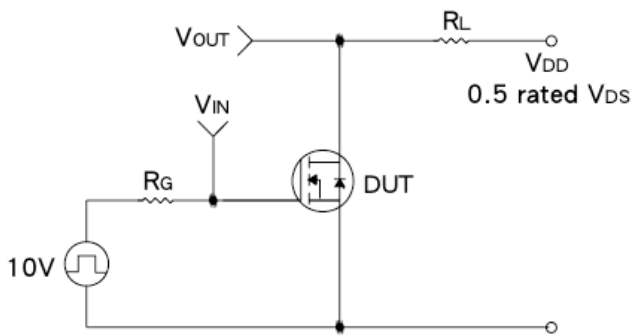
Normalized Thermal Transient Impedance, Junction-to-Ambient(ITO-220)



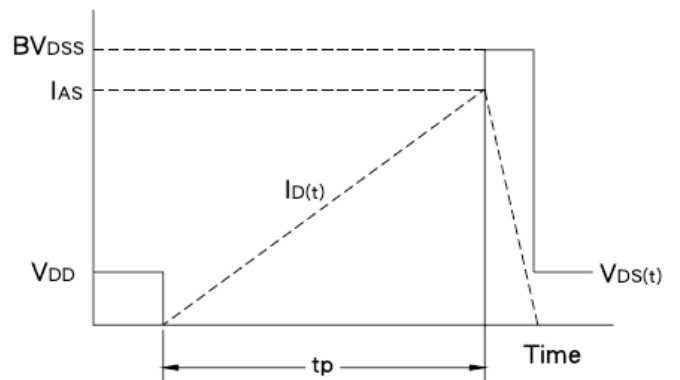
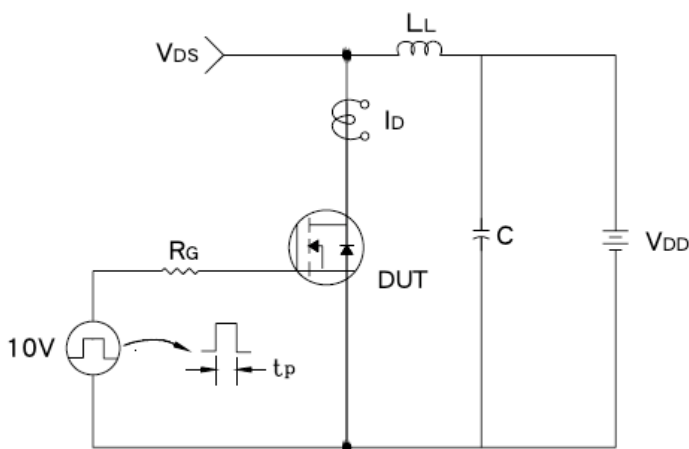
Gate Charge Test Circuit & Waveform



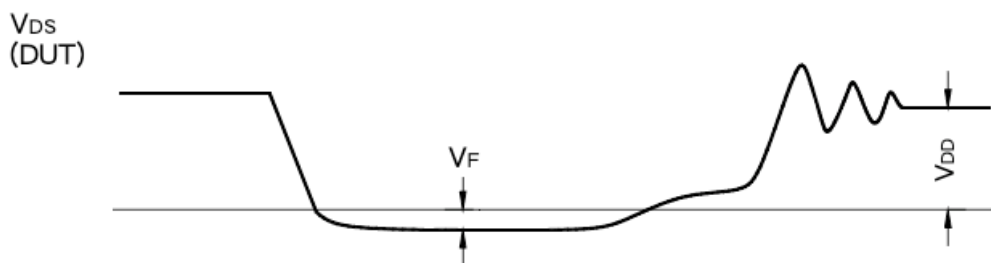
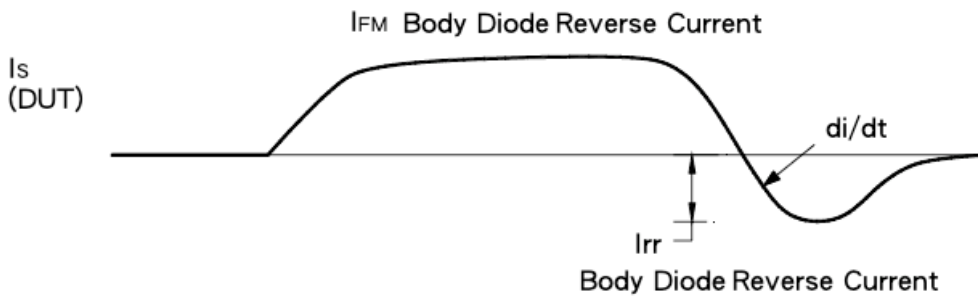
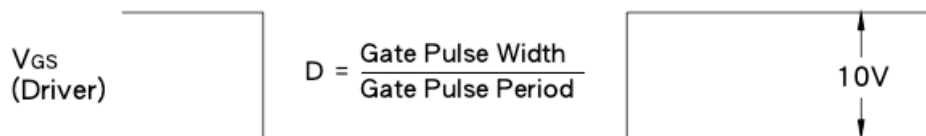
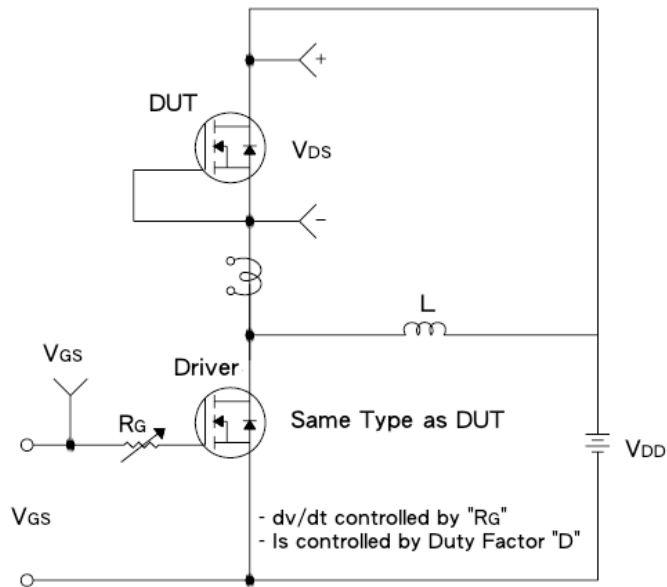
Resistive Switching Test Circuit & Waveform



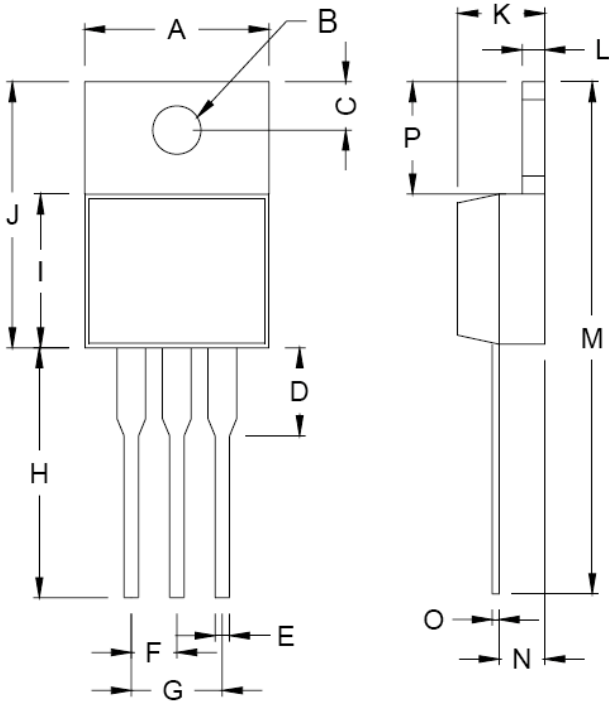
E_{AS} Test Circuit & Waveform



Diode Reverse Recovery Time Test Circuit & Waveform

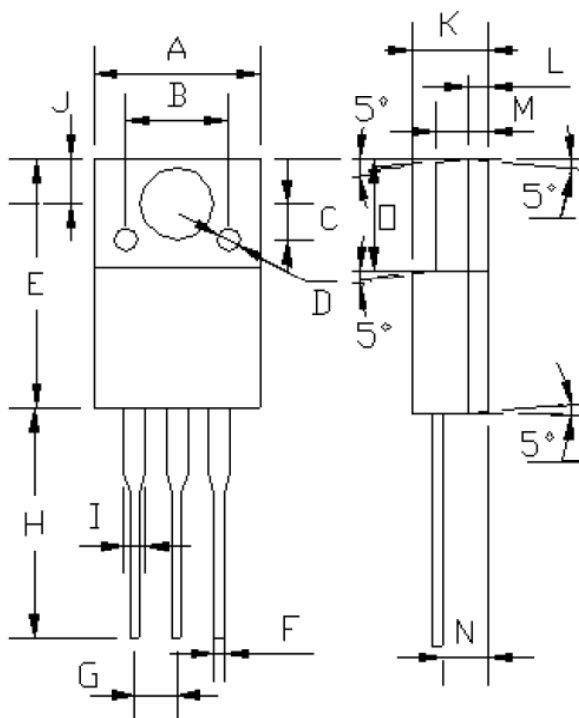


TO-220 Mechanical Drawing



| 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 |
| I | 8.38 | 9.38 | 0.330 | 0.369 |
| J | 14.22 | 16.51 | 0.560 | 0.650 |
| K | 3.55 | 4.82 | 0.140 | 0.190 |
| L | 1.16 | 1.40 | 0.046 | 0.055 |
| M | 27.70 | 29.62 | 1.091 | 1.166 |
| N | 2.03 | 2.92 | 0.080 | 0.115 |
| O | 0.25 | 0.61 | 0.010 | 0.024 |
| P | 5.84 | 6.85 | 0.230 | 0.270 |

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 |

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