

**TO-220**

**ITO-220**

**Pin Definition:**

1. Gate
2. Drain
3. Source

**PRODUCT SUMMARY**

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ ) | $I_D$ (A) |
|--------------|---------------------------|-----------|
| 500          | 0.85 @ $V_{GS}=10V$       | 4.8       |

### General Description

The TSM9N50 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, power factor correction, electronic lamp ballast based on half bridge.

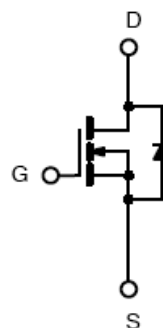
### Features

- Low  $R_{DS(on)}$  0.85 $\Omega$  @  $V_{GS} = 10V$
- Low gate charge typical @ 63nC (Typ.)
- Low  $C_{rss}$  typical @ 120pF (Typ.)
- Fast Switching

### Ordering Information

| Part No.     | Package | Packing      |
|--------------|---------|--------------|
| TSM9N50CZ C0 | TO-220  | 50pcs / Tube |
| TSM9N50CI C0 | ITO-220 | 50pcs / Tube |

### Block Diagram


**N-Channel MOSFET**

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

| Parameter                                    | Symbol     | Limit       | Unit       |
|----------------------------------------------|------------|-------------|------------|
| Drain-Source Voltage                         | $V_{DS}$   | 500         | V          |
| Gate-Source Voltage                          | $V_{GS}$   | $\pm 30$    | V          |
| Continuous Drain Current                     | $I_D$      | 9           | A          |
|                                              |            | 5.1         | A          |
| Pulsed Drain Current*                        | $I_{DM}$   | 36          | A          |
| Single Pulse Avalanche Energy (Note 2)       | $E_{AS}$   | 510         | mJ         |
| Avalanche Current (Repetitive) (Note 1)      | $I_{AR}$   | 8           | A          |
| Repetitive Avalanche Energy (Note 1)         | $E_{AR}$   | 13          | mJ         |
| Total Power Dissipation @ $T_c = 25^\circ C$ | $P_{DTOT}$ | 125         | W          |
| Operating Junction Temperature               | $T_J$      | 150         | $^\circ C$ |
| Storage Temperature Range                    | $T_{STG}$  | -55 to +150 | $^\circ C$ |

### Thermal Performance

| Parameter                                | Symbol          | Limit | Unit         |
|------------------------------------------|-----------------|-------|--------------|
| Thermal Resistance - Junction to Case    | $R_{\theta JC}$ | 3.1   | $^\circ C/W$ |
| Thermal Resistance - Junction to Ambient | $R_{\theta JA}$ | 62.5  | $^\circ C/W$ |

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

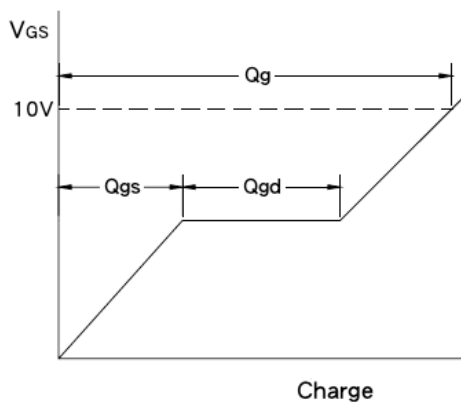
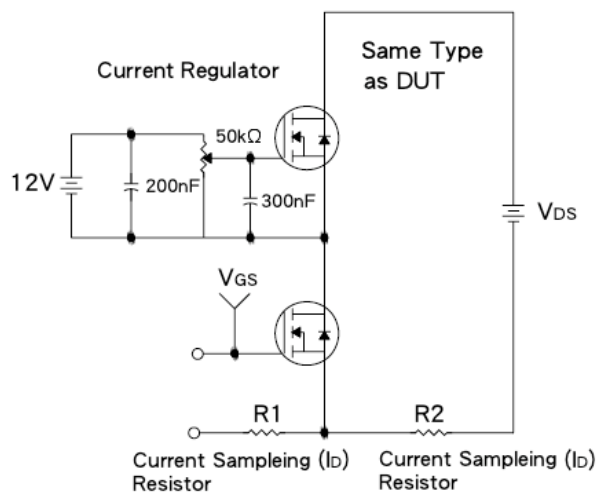
**Electrical Specifications** ( $T_a = 25^\circ\text{C}$  unless otherwise noted)

| Parameter                        | Conditions                                      | Symbol       | Min | Typ  | Max       | Unit     |
|----------------------------------|-------------------------------------------------|--------------|-----|------|-----------|----------|
| Static                           |                                                 |              |     |      |           |          |
| Drain-Source Breakdown Voltage   | $V_{GS} = 0V, I_D = 250\mu A$                   | $BV_{DSS}$   | 500 | --   | --        | V        |
| Drain-Source On-State Resistance | $V_{GS} = 10V, I_D = 4.8A$                      | $R_{DS(ON)}$ | --  | 0.75 | 0.85      | $\Omega$ |
| 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  | $V_{DS} = 500V, V_{GS} = 0V$                    | $I_{DSS}$    | --  | --   | 25        | $\mu A$  |
| Gate Body Leakage                | $V_{GS} = \pm 30V, V_{DS} = 0V$                 | $I_{GSS}$    | --  | --   | $\pm 100$ | nA       |
| Forward Transfer Conductance     | $V_{DS} = 50V, I_D = 4.8A$                      | $g_{fs}$     | 5.9 | --   | --        | S        |
| Dynamic <sup>b</sup>             |                                                 |              |     |      |           |          |
| Total Gate Charge                | $V_{DS} = 400V, I_D = 9A,$<br>$V_{GS} = 10V$    | $Q_g$        | --  | 63   | --        | nC       |
| Gate-Source Charge               |                                                 | $Q_{gs}$     | --  | 9.3  | --        |          |
| Gate-Drain Charge                |                                                 | $Q_{gd}$     | --  | 32   | --        |          |
| Input Capacitance                | $V_{DS} = 25V, V_{GS} = 0V,$<br>$f = 1.0MHz$    | $C_{iss}$    | --  | 1300 | --        | pF       |
| Output Capacitance               |                                                 | $C_{oss}$    | --  | 310  | --        |          |
| Reverse Transfer Capacitance     |                                                 | $C_{rss}$    | --  | 120  | --        |          |
| Switching <sup>c</sup>           |                                                 |              |     |      |           |          |
| Turn-On Delay Time               | $V_{DD} = 250V, I_D = 9A,$<br>$R_G = 9.1\Omega$ | $t_{d(on)}$  | --  | 14   | --        | nS       |
| Turn-On Rise Time                |                                                 | $t_r$        | --  | 23   | --        |          |
| Turn-Off Delay Time              |                                                 | $t_{d(off)}$ | --  | 49   | --        |          |
| Turn-Off Fall Time               |                                                 | $t_f$        | --  | 20   | --        |          |
| Source Drain Diode               |                                                 |              |     |      |           |          |
| Source-drain Current             |                                                 | $I_{SD}$     | --  | --   | 9         | A        |
| Diode Forward Voltage            | $I_S = 9A, V_{GS} = 0V$                         | $V_{SD}$     | --  | --   | 2.0       | V        |
| Reverse Recovery Time            | $V_{GS} = 0V, I_S = 9A,$                        | $t_{fr}$     | --  | 460  | 970       | nS       |
| Reverse Recovery Charge          | $dI_F/dt = 100A/\mu s$                          | $Q_{fr}$     | --  | 4.2  | 8.9       | $\mu C$  |

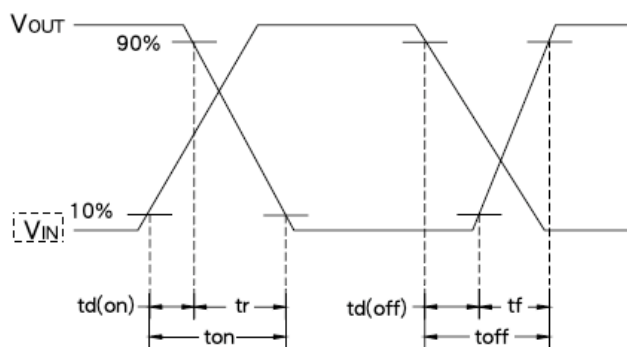
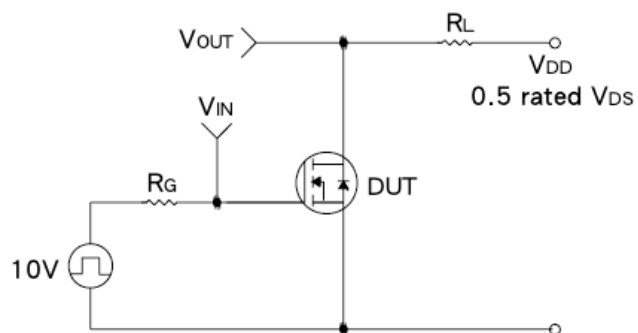
**Notes:**

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2.  $V_{DD} = 50V, I_{AS}=9A, L=5.7mH, R_G=9.1\Omega$ , Starting  $T_J=25^\circ\text{C}$
3. Pulse test: pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
4. Essentially Independent of Operating Temperature

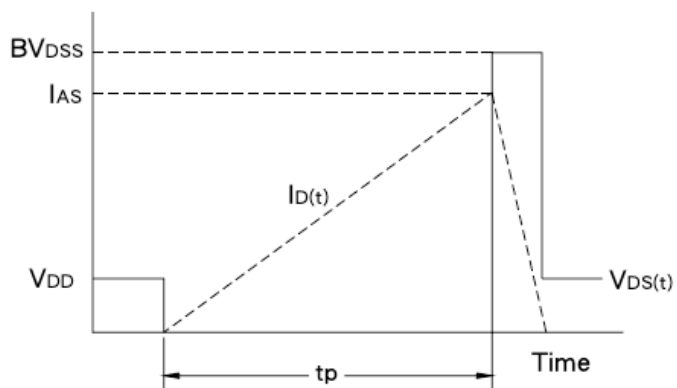
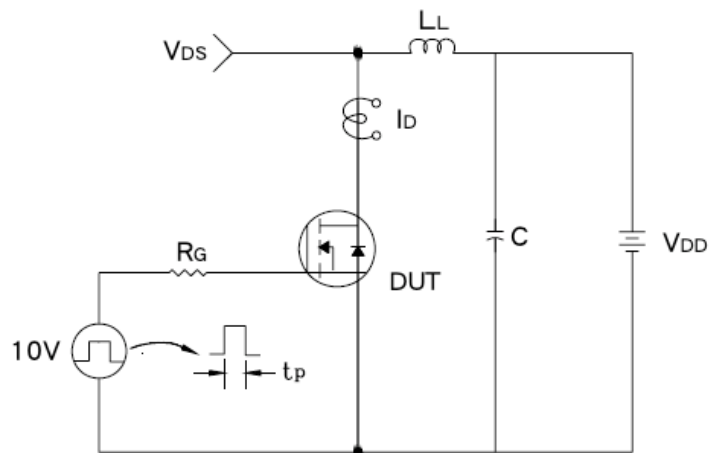
### Gate Charge Test Circuit & Waveform



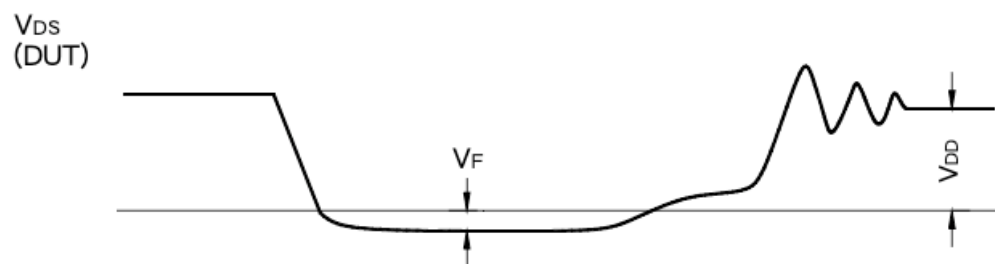
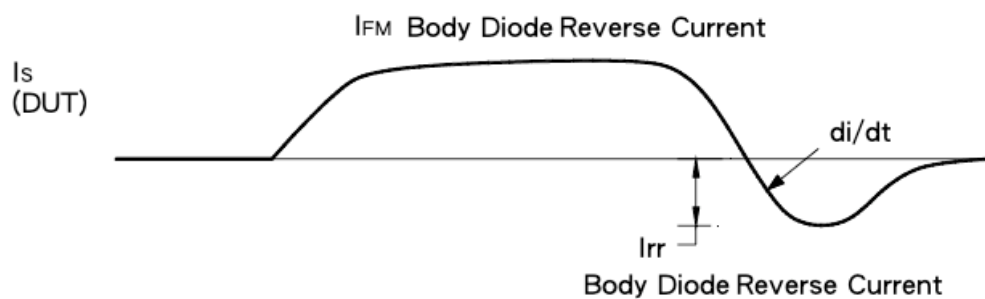
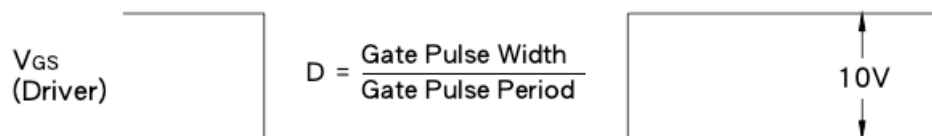
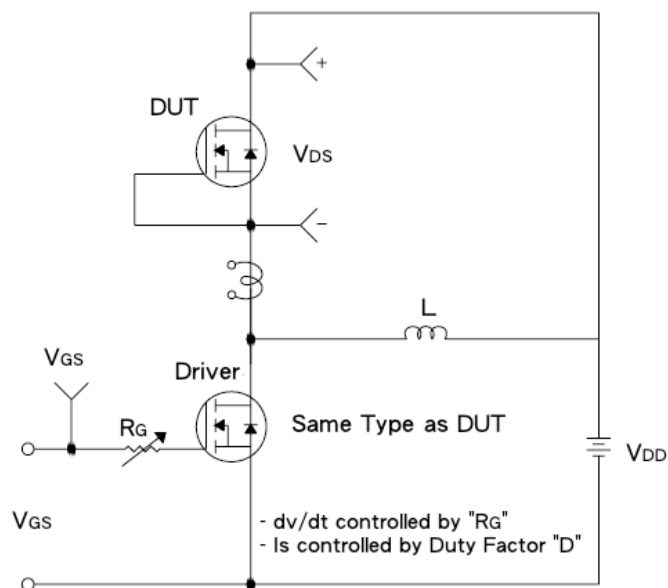
### Resistive Switching Test Circuit & Waveform



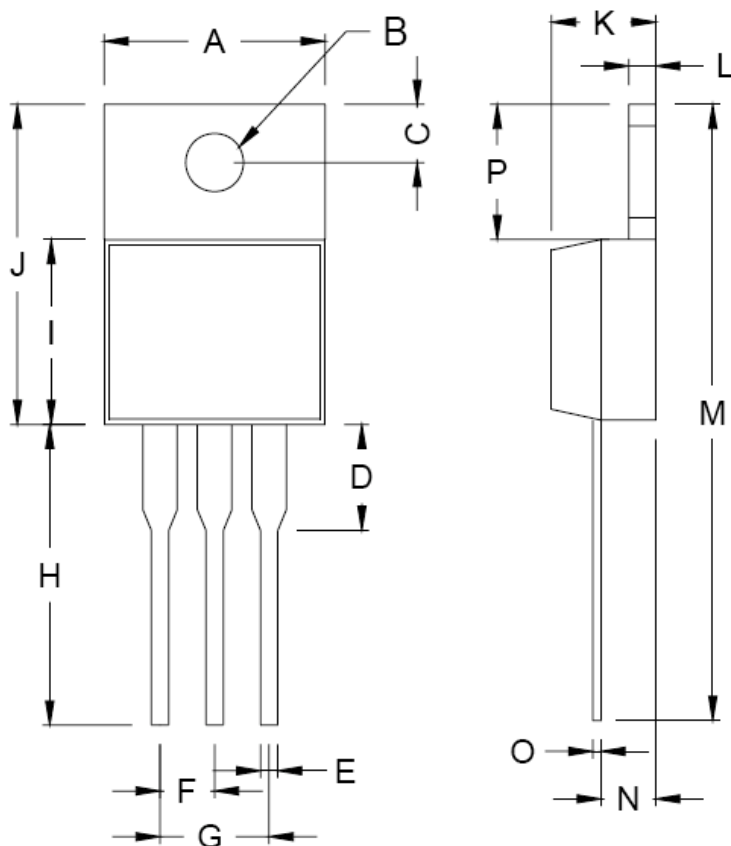
### E<sub>AS</sub> Test Circuit & Waveform



**Diode Reverse Recovery Time Test Circuit & Waveform**

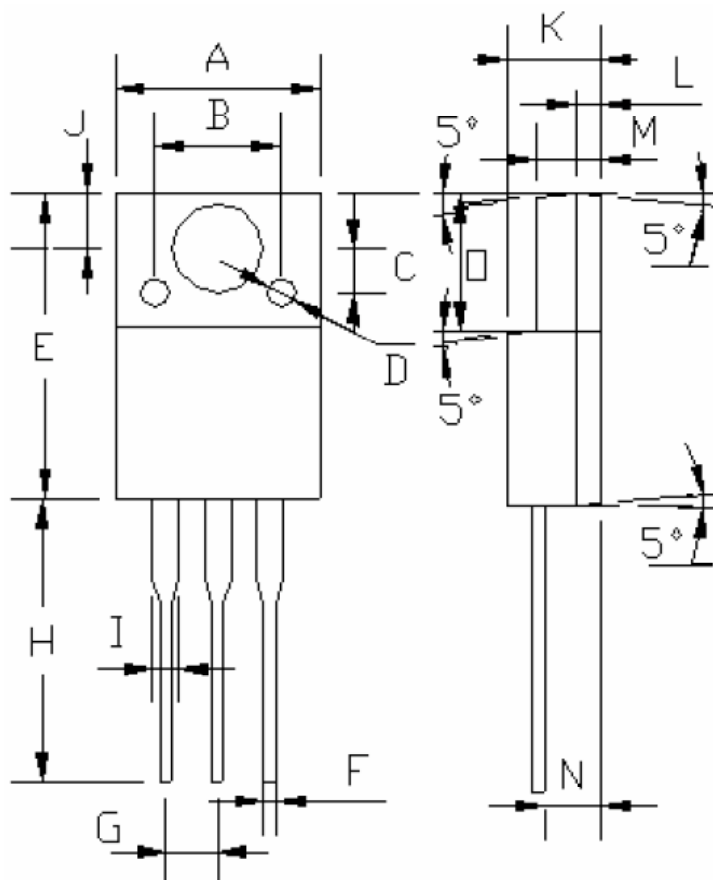


**TO-220 Mechanical Drawing**



| DIM | TO-220 DIMENSION |        |        |       |
|-----|------------------|--------|--------|-------|
|     | MILLIMETERS      |        | INCHES |       |
|     | MIN              | MAX    | MIN    | MAX   |
| A   | 10.000           | 10.500 | 0.394  | 0.413 |
| B   | 3.740            | 3.910  | 0.147  | 0.154 |
| C   | 2.440            | 2.940  | 0.096  | 0.116 |
| D   | -                | 6.350  | -      | 0.250 |
| E   | 0.381            | 1.106  | 0.015  | 0.040 |
| F   | 2.345            | 2.715  | 0.092  | 0.058 |
| G   | 4.690            | 5.430  | 0.092  | 0.107 |
| H   | 12.700           | 14.732 | 0.500  | 0.581 |
| J   | 14.224           | 16.510 | 0.560  | 0.650 |
| K   | 3.556            | 4.826  | 0.140  | 0.190 |
| L   | 0.508            | 1.397  | 0.020  | 0.055 |
| M   | 27.700           | 29.620 | 1.060  | 1.230 |
| N   | 2.032            | 2.921  | 0.080  | 0.115 |
| O   | 0.255            | 0.610  | 0.010  | 0.024 |
| P   | 5.842            | 6.858  | 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                 | Ø 1.40 (typ.) |       | Ø 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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