TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

# TSM1N45

## 450V N-Channel Power MOSFET

**TO-92**


**SOT-223**


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

**PRODUCT SUMMARY**

| $V_{DS}$ (V) | $R_{DS(on)}$(Ω) | $I_D$ (A) |
|---|---|---|
| 450 | 4.25 @ $V_{GS}$ =10V | 0.25 |

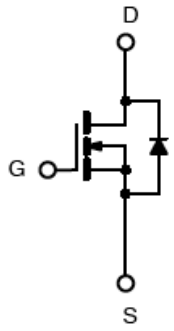
## General Description

The TSM1N45 is N-Channel enhancement mode power field effect transistors are produced using planar DMOS technology process. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand higher energy pulse in the avalanche and commutation mode. There devices are well suited for electronic ballasts base and half bridge configuration.

## Features

- Low gate charge @ typical 6.5nC
- Low Crss @ typical 6.5pF
- Avalanche energy specified
- Improved dv/dt capability
- Gate-Source Voltage ±30V guaranteed

## Block Diagram




N-Channel MOSFET

## Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TSM1N45CT B0 | TO-92 | 1Kpcs / Bulk |
| TSM1N45CT A3 | TO-92 | 2Kpcs / Ammo |
| TSM1N45CW RP | SOT-223 | 2.5Kpcs / 13” Reel |

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

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 450 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | V |
| Continuous Drain Current | | $I_D$ | 0.5 | A |
| Pulsed Drain Current (Note 1) | | $I_{DM}$ | 4 | A |
| Single Pulse Drain to Source Avalanche Energy (Note 2) | | $E_{AS}$ | 108 | mJ |
| Avalanche Current (Note 1) | | $I_{AR}$ | 0.5 | A |
| Repetitive Avalanche Energy (Note 1) | | $E_{AR}$ | 0.25 | mJ |
| Peak Diode Recovery dv/dt (Note 3) | | dv/dt | 5.5 | V/ns |
| Total Power Dissipation @$T_C$ =25°C | TO-92 | $P_{DTOT}$ | 2 | W |
| | SOT-223 | | 15 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

*Surface Mounted on 1”x1” FR4 board

## Thermal Performance

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Thermal Resistance - Junction to Lead | TO-92 | $R\Theta_{JL}$ | 50 | °C/W |
| Thermal Resistance - Junction to Case | SOT-223 | $R\Theta_{JC}$ | 8.5 | |
| Thermal Resistance - Junction to Ambient * | TO-92 | $R\Theta_{JA}$ | 140 | °C/W |
| | SOT-223 | | 60 | |

*When mounted on the minimum pad size recommended (PCB mount)

# TSM1N45

450V N-Channel Power MOSFET

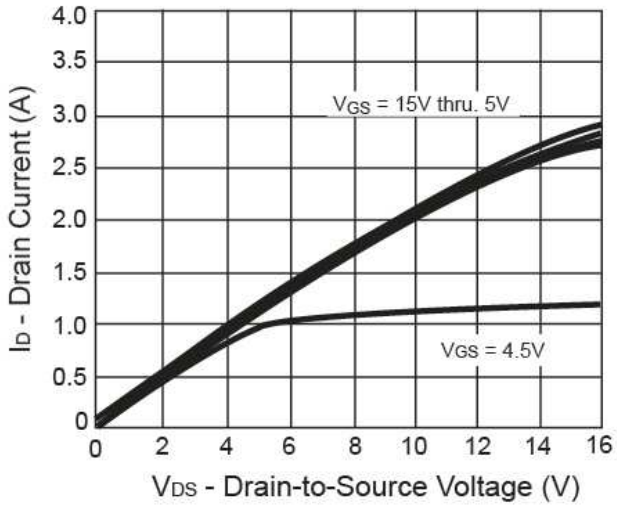
## Electrical Specifications (Ta=25°C, unless otherwise noted)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250uA | $BV_{DSS}$ | 450 | -- | -- | V |
| Drain-Source On-State Resistance | $V_{GS}$ = 10V, $I_D$ = 0.25A | $R_{DS(ON)}$ | -- | 3.7 | 4.25 | Ω |
| Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250uA | $V_{GS(TH)}$ | 2.3 | 3.0 | 3.7 | V |
| | $V_{DS}$ = $V_{GS}$, $I_D$ = 250mA | | 3.2 | 4.0 | 4.8 | |
| Zero Gate Voltage Drain Current | $V_{DS}$ = 450V, $V_{GS}$ = 0V | $I_{DSS}$ | -- | -- | 10 | uA |
| Gate Body Leakage | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Forward Transconductance | $V_{DS}$ = 50V, $I_D$ = 0.25A | $g_{fs}$ | -- | 0.7 | -- | S |
| **Dynamic** | | | | | | |
| Total Gate Charge | $V_{DS}$ = 360V, $I_D$ = 0.5A, $V_{GS}$ = 10V (Note 4,5) | $Q_g$ | -- | 6.5 | 10 | nC |
| Gate-Source Charge | | $Q_{gs}$ | -- | 1.3 | -- | |
| Gate-Drain Charge | | $Q_{gd}$ | -- | 3.2 | -- | |
| Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1.0MHz | $C_{iss}$ | -- | 235 | -- | pF |
| Output Capacitance | | $C_{oss}$ | -- | 29 | -- | |
| Reverse Transfer Capacitance | | $C_{rss}$ | -- | 6.5 | -- | |
| **Switching** | | | | | | |
| Turn-On Delay Time | $V_{GS}$ = 25V, $I_D$ = 0.5A, $V_{DS}$ = 225V, $R_G$ = 25Ω (Note 4,5) | $t_{d(on)}$ | -- | 14.7 | -- | nS |
| Turn-On Rise Time | | $t_r$ | -- | 32.8 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 25.2 | -- | |
| Turn-Off Fall Time | | $t_f$ | -- | 23.7 | -- | |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| Maximum Continuous Drain-Source Diode Forward Current | | $I_S$ | -- | -- | 0.5 | A |
| Maximum Pulsed Drain-Source Diode Forward Current | | $I_{SM}$ | -- | -- | 4.0 | A |
| Drain-Source Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 0.5A | $V_{SD}$ | -- | -- | 1.4 | V |
| Reverse Recovery Time | $V_{GS}$ = 0V, $I_S$ = 1A, $dI_F/dt$ = 100A/μS (Note 4) | $t_{rr}$ | -- | 110 | -- | nS |
| Reverse Recovery Charge | | $Q_{rr}$ | -- | 0.35 | -- | μC |

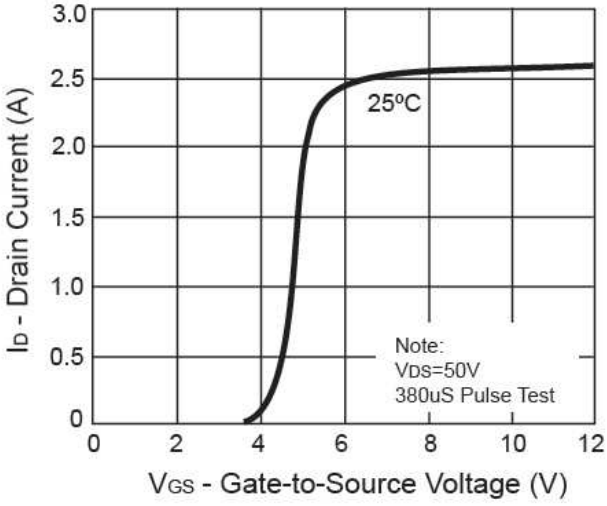
Notes:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=75mH, $I_{AS}$=1.6A, $V_{DD}$=50V, $R_G$=25Ω, Starting $T_J$=25ºC
3. $I_{SD}$ ≤ 0.5A, di/dt ≤ 300A/μS, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$=25ºC
4. Pulse test: pulse width ≤ 300uS.
5. Essentially independent of operating temperature
6. a) Reference point of the is the drain $R\Theta_{JL}$ lead
   b) When mounted on 3"x4.5" FR-4 PCB without any pad copper in a still air environment
   ($R\Theta_{JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance. $R\Theta_{CA}$ is determined by the user's board design)

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

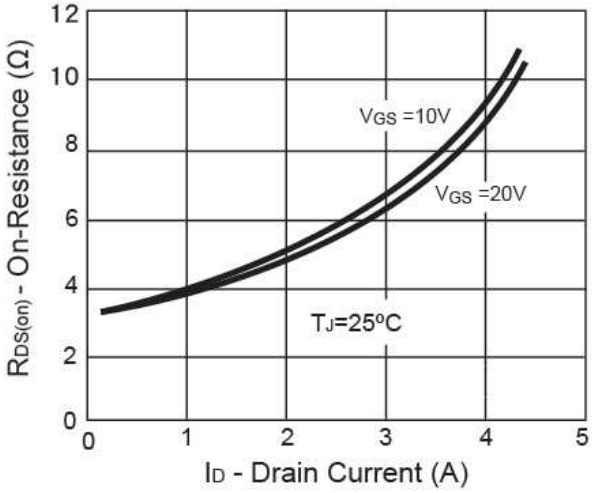
### Output Characteristics



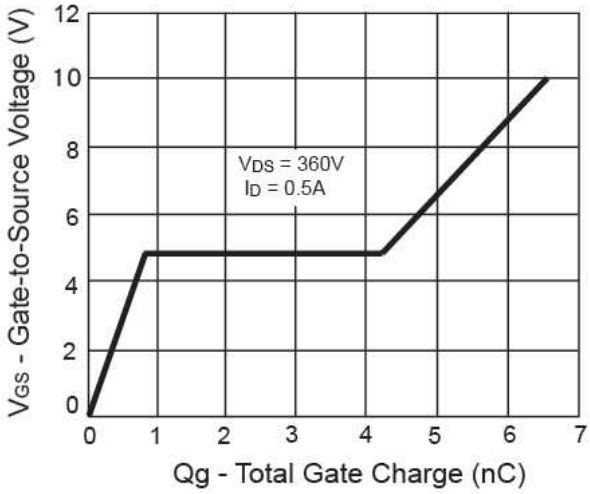

### Transfer Characteristics



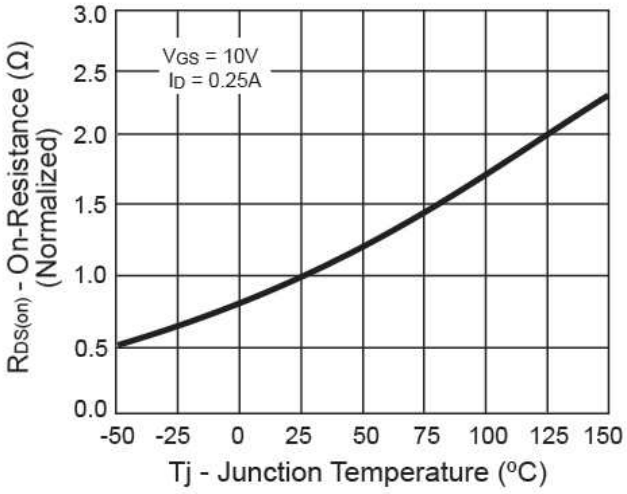

### On-Resistance vs. Drain Current



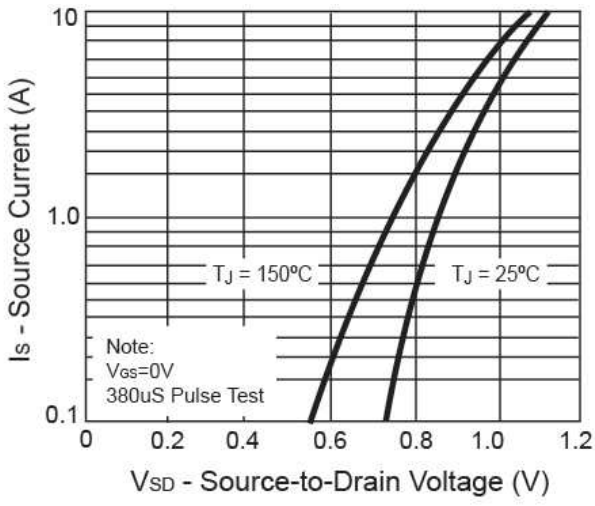

### Gate Charge




### On-Resistance vs. Junction Temperature

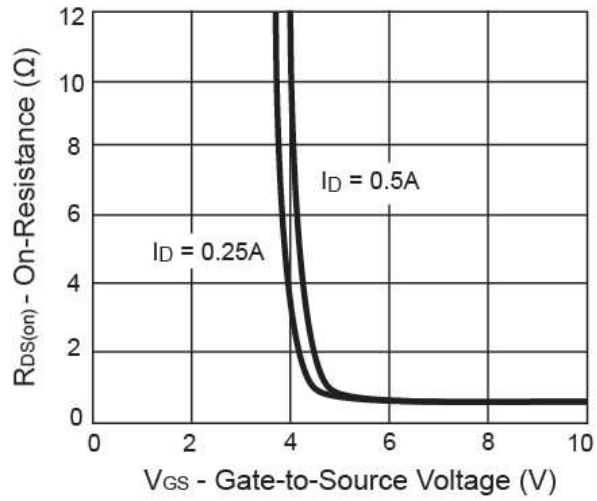



### Source-Drain Diode Forward Voltage

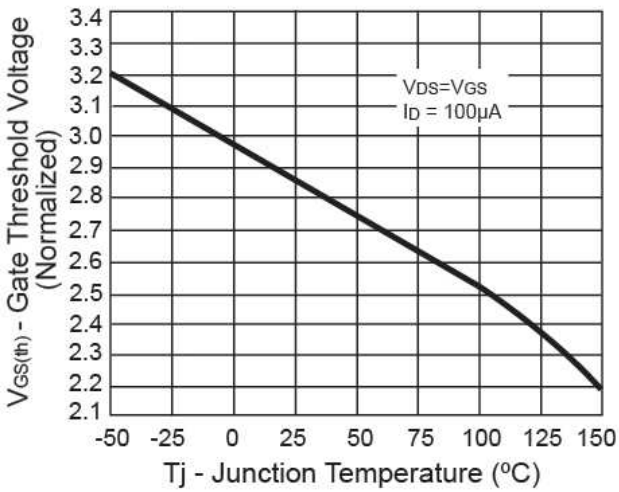


## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

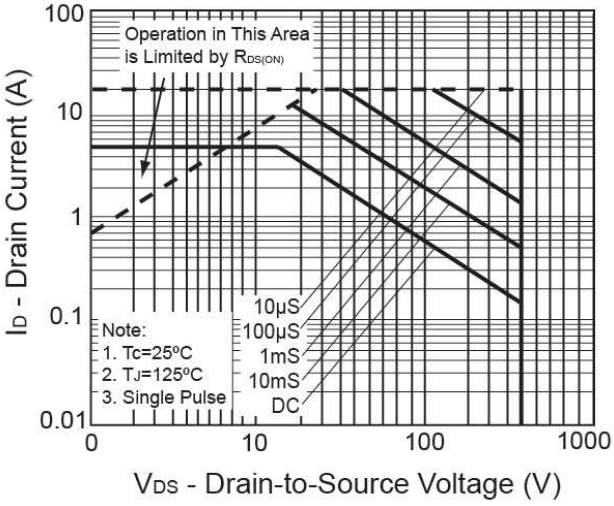
### On-Resistance vs. Gate-Source Voltage



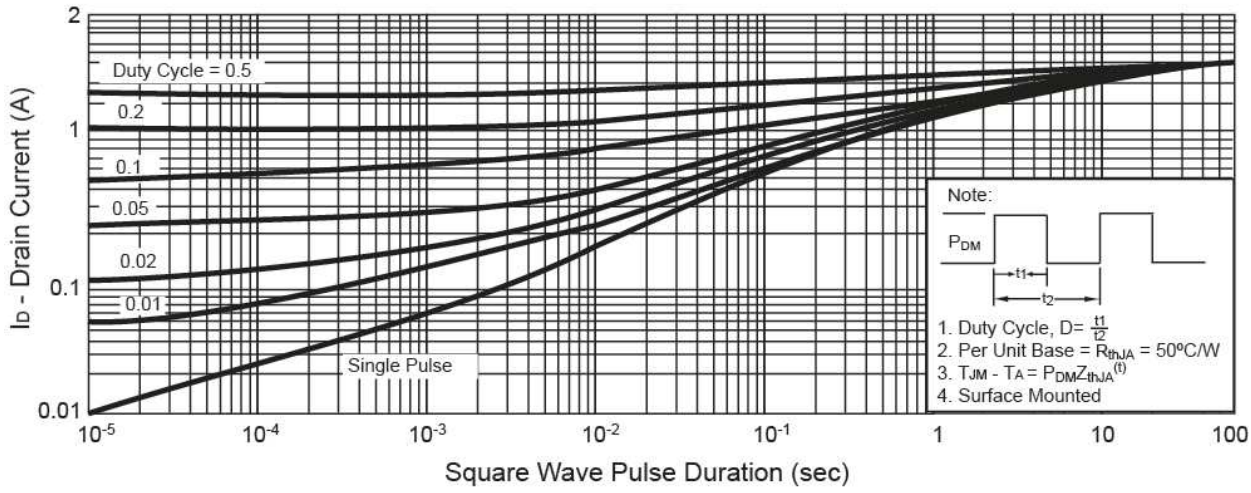

### Threshold Voltage



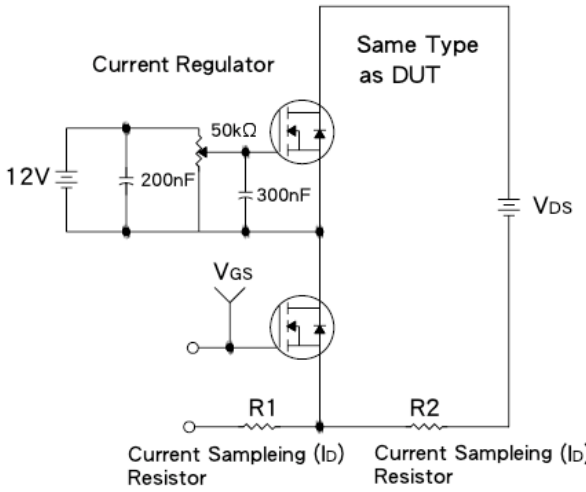

### Maximum Safe Operating Area

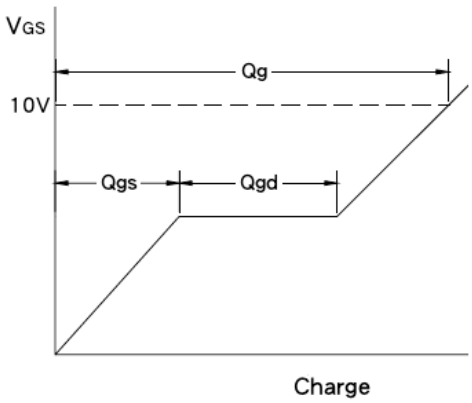



### Normalized Thermal Transient Impedance, Junction-to-Ambient

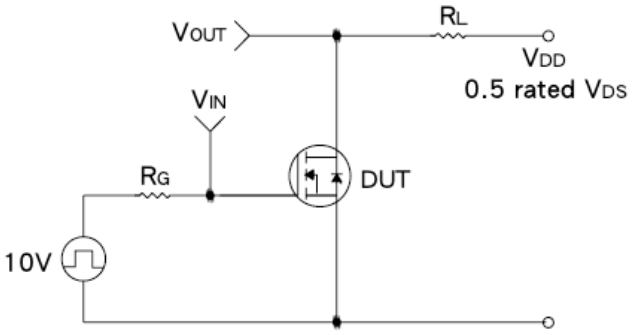


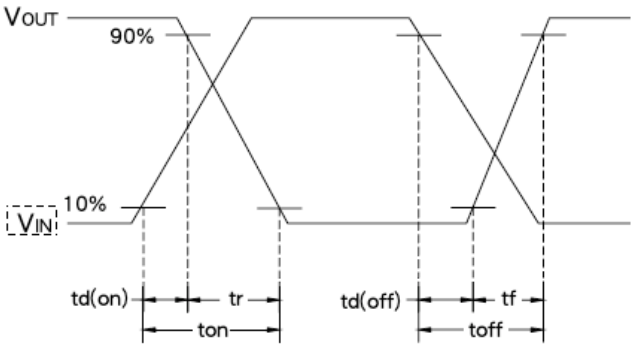
## Gate Charge Test Circuit & Waveform



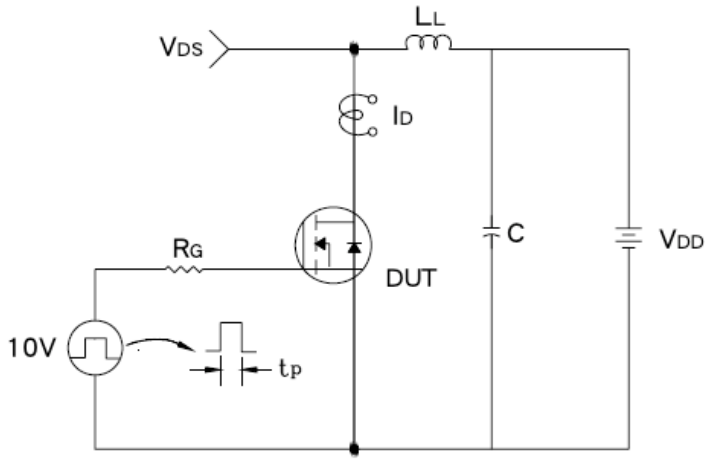



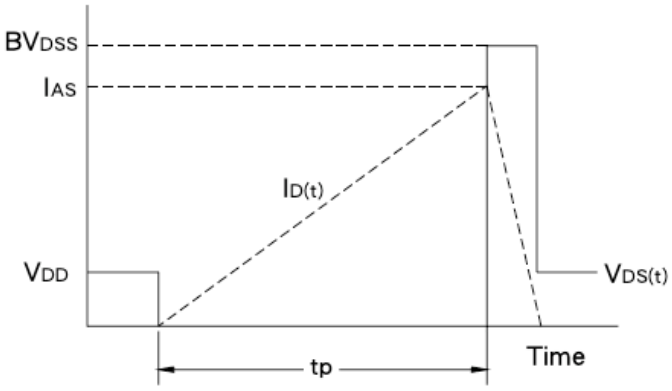

## Resistive Switching Test Circuit & Waveform



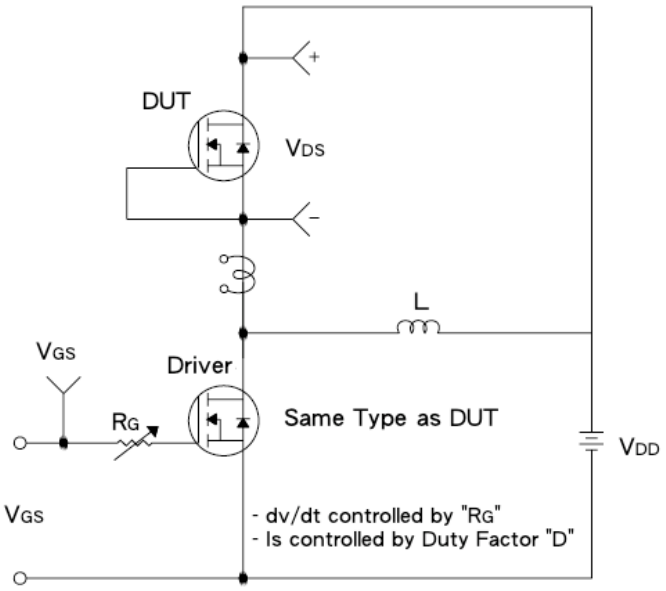



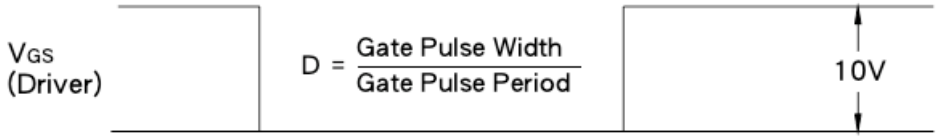

## $E_{AS}$ Test Circuit & Waveform

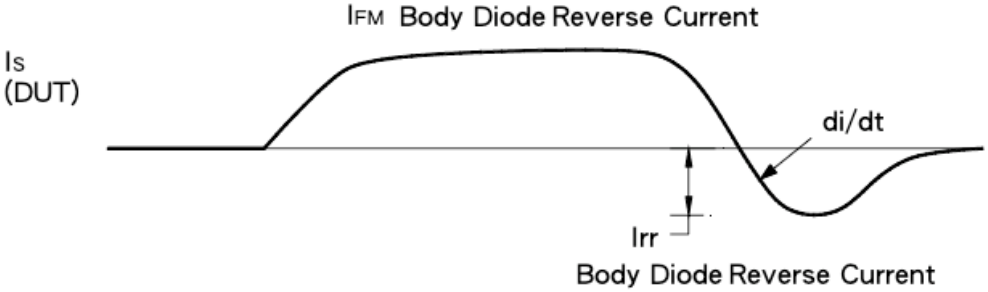


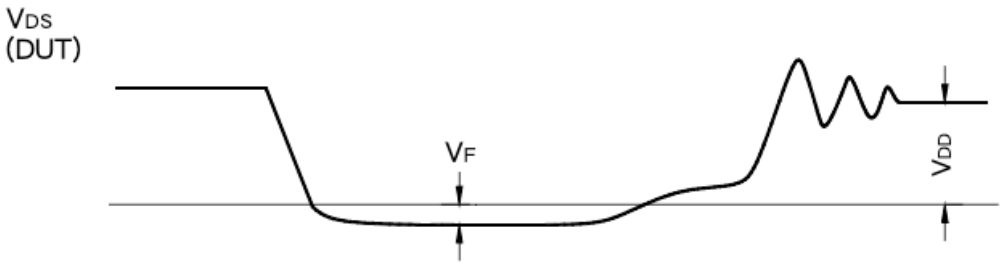



## Diode Reverse Recovery Time Test Circuit & Waveform

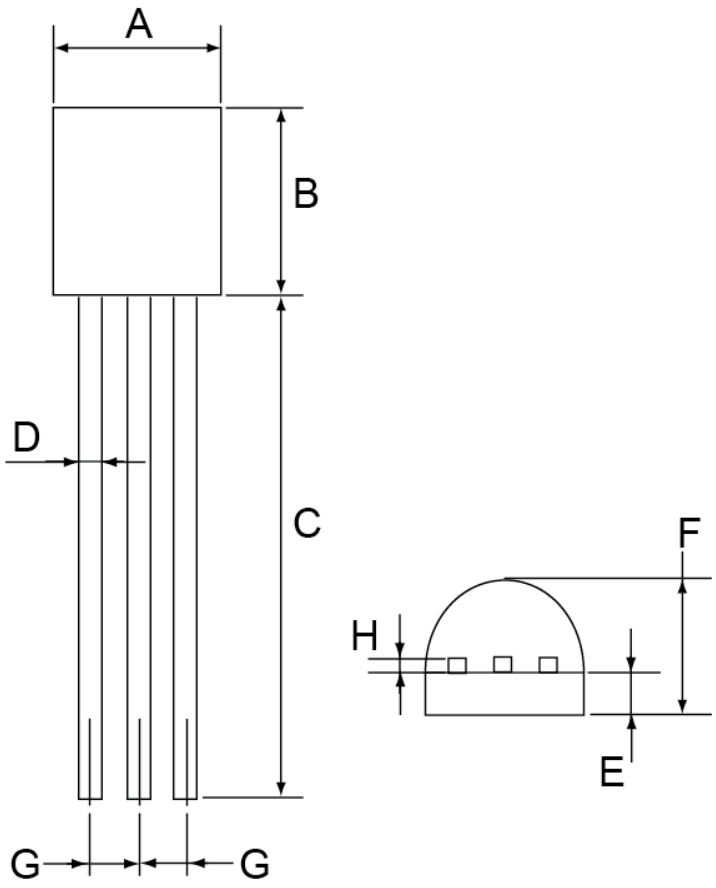


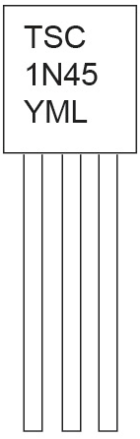



## TO-92 Mechanical Drawing




| TO-92 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 4.30 | 4.70 | 0.169 | 0.185 |
| B | 4.30 | 4.70 | 0.169 | 0.185 |
| C | 13.53 (typ) | | 0.532 (typ) | |
| D | 0.39 | 0.49 | 0.015 | 0.019 |
| E | 1.18 | 1.28 | 0.046 | 0.050 |
| F | 3.30 | 3.70 | 0.130 | 0.146 |
| G | 1.27 | 1.31 | 0.050 | 0.051 |
| H | 0.33 | 0.43 | 0.013 | 0.017 |

## Marking Diagram




**Y** = Year Code
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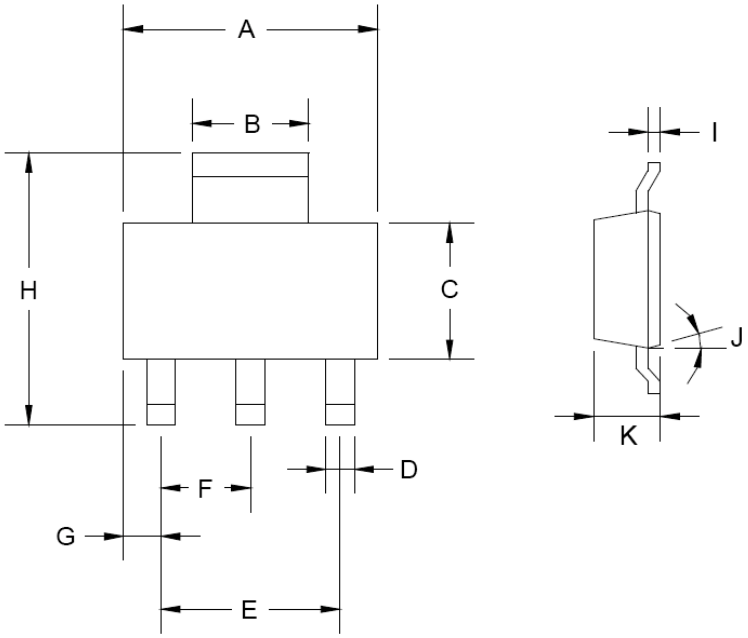
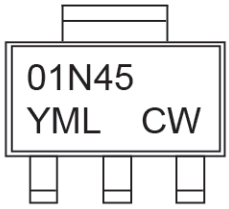
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apl, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
**L** = Lot Code

## SOT-223 Mechanical Drawing




| SOT-223 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 6.350 | 6.850 | 0.250 | 0.270 |
| B | 2.900 | 3.100 | 0.114 | 0.122 |
| C | 3.450 | 3.750 | 0.136 | 0.148 |
| D | 0.595 | 0.635 | 0.023 | 0.025 |
| E | 4.550 | 4.650 | 0.179 | 0.183 |
| F | 2.250 | 2.350 | 0.088 | 0.093 |
| G | 0.835 | 1.035 | 0.032 | 0.041 |
| H | 6.700 | 7.300 | 0.263 | 0.287 |
| I | 0.250 | 0.355 | 0.010 | 0.014 |
| J | 10° | 16° | 10° | 16° |
| K | 1.550 | 1.800 | 0.061 | 0.071 |

## Marking Diagram

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