# N-Channel Power MOSFET

450V, 0.5A, 4.25Ω

## FEATURES

- Low gate charge @typical 6.5nC
- Low Crss @ typical 6.5pF
- Avalanche energy specified
- Improved dV/dt capability
- Pb-free plating
- Compliant to RoHS Directive 2011/65/EU and in accordance to WEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21 definition

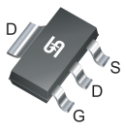
| KEY PERFORMANCE PARAMETERS | | |
|---|---|---|
| **PARAMETER** | **VALUE** | **UNIT** |
| $V_{DS}$ | 450 | V |
| $R_{DS(on)}$ (max) | 4.25 | Ω |
| $Q_g$ | 6.5 | nC |

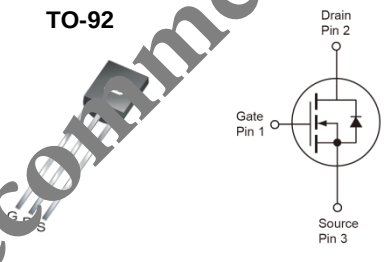
Pb-Free RoHS COMPLIANT HALOGEN FREE

## APPLICATION

- Power Supply
- Lighting

**SOT-223** **TO-92**




**Notes:** MSL 3 (Moisture Sensitivity Level) per J-STD-020



| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 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 (Note 1) | $T_C$ = 25°C | $I_D$ | 0.5 | A |
| Pulsed Drain Current (Note 2) | | $I_{DM}$ | 4 | A |
| Total Power Dissipation @ $T_C$ = 25°C | TO-92 | $P_{DTOT}$ | 2 | W |
| | SOT-223 | | 15 | |
| Single Pulsed Avalanche Energy (Note 3) | | $E_{AS}$ | 108 | mJ |
| Single Pulsed Avalanche Current (Note 3) | | $I_{AS}$ | 1.6 | A |
| Repetitive Avalanche Energy (Note 3) | | $E_{AR}$ | 0.25 | mJ |
| Repetitive Avalanche Current (Note 3) | | $I_{AR}$ | 0.5 | A |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | - 55 to +150 | °C |

| THERMAL PERFORMANCE | | | | |
|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **Limit** | **UNIT** |
| Junction to Lead Thermal Resistance | TO-92 | $R_{\Theta JL}$ | 50 | °C/W |
| Junction to Case Thermal Resistance | SOT-223 | $R_{\Theta JC}$ | 8.5 | |
| Junction to Ambient Thermal Resistance | TO-92 | $R_{\Theta JA}$ | 140 | |
| | SOT-223 | | 60 | |

**Notes:** $R_{\Theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistances. The case thermal reference is defined at the solder mounting surface of the drain pins. $R_{\Theta JA}$ is guaranteed by design while $R_{\Theta CA}$ is determined by the user's board design. $R_{\Theta JA}$ shown below for single device operation on FR-4 PCB with minimum recommended footprint in still air.

| **ELECTRICAL SPECIFICATIONS** ($T_A$ = 25°C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **CONDITIONS** | **SYMBOL** | **MIN** | **TYP** | **MAX** | **UNIT** |
| **Static** (Note 4) | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | $BV_{DSS}$ | 450 | -- | -- | V |
| Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | $V_{GS(TH)}$ | 2.3 | -- | 4.25 | V |
| Gate Body Leakage | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Zero Gate Voltage Drain Current | $V_{DS}$ = 450V, $V_{GS}$ = 0V | $I_{DSS}$ | -- | -- | 10 | μA |
| Drain-Source On-State Resistance | $V_{GS}$ = 10V, $I_D$ = 0.25A | $R_{DS(on)}$ | -- | 3.7 | 4.25 | Ω |
| **Dynamic** (Note 5) | | | | | | |
| Total Gate Charge | $V_{DS}$ = 360V, $I_D$ = 0.5A, $V_{GS}$ = 10V | $Q_g$ | -- | 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** (Note 6) | | | | | | |
| Turn-On Delay Time | $V_{DD}$ = 225V, $R_{GEN}$ = 25Ω, $I_D$ = 0.5A, $V_{GS}$ = 10V, | $t_{d(on)}$ | -- | 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 | -- | |
| **Source-Drain Diode** (Note 4) | | | | | | |
| Maximum Continuous Drain-Source Diode Forward Current | | $I_S$ | -- | -- | 0.5 | A |
| Maximum Pulsed Drain-Source Diode Forward Current | | $I_{SM}$ | -- | -- | 4 | A |
| Forward On Voltage | $I_S$ = 0.5A, $V_{GS}$ = 0V | $V_{SD}$ | -- | -- | 1.4 | V |
| Reverse Recovery Time | $V_{GS}$ = 0V, $I_S$ = 1A $dI_F/dt$ = 100A/μs | $t_{rr}$ | -- | 110 | -- | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | -- | 0.35 | -- | μC |



**Notes:**

1. Current limited by package.
2. Pulse width limited by the maximum junction temperature.
3. L = 75mH, $I_{AS}$ = 1.6A, $V_{DD}$ = 50V, $R_G$ = 25Ω, Starting $T_J$ = 25°C
4. Pulse test: PW ≤ 300μs, duty cycle ≤ 2%.
5. For DESIGN AID ONLY, not subject to production testing.
6. Switching time is essentially independent of operating temperature.

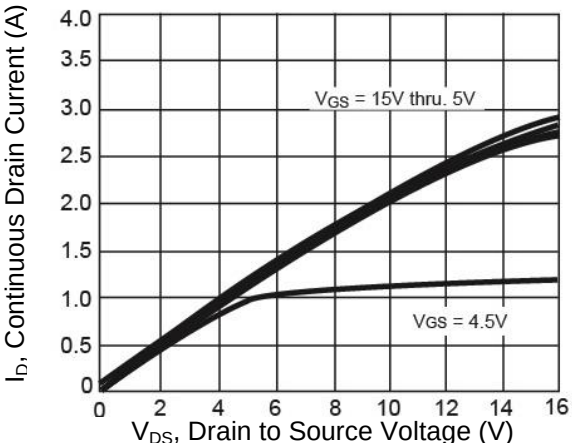
## ORDERING INFORMATION

| PART NO. | PACKAGE | PACKING |
|---|---|---|
| TSM1N45CT B0G | TO-92 | 1,000pcs / Bulk |
| TSM1N45CT A3G | TO-92 | 2,000pcs / Ammo |
| TSM1N45CW RPG | SOT-223 | 2,500pcs / 13” Reel |

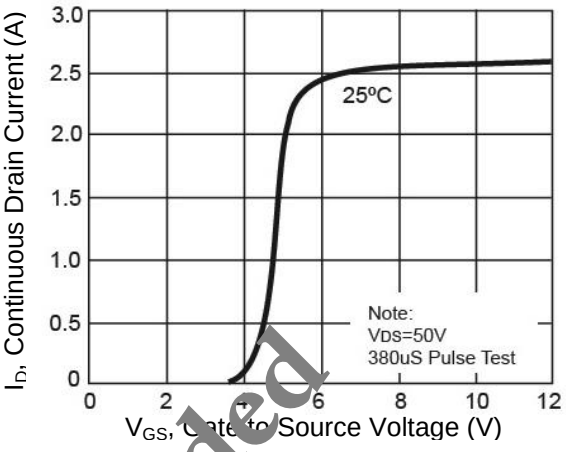
## CHARACTERISTICS CURVES

($T_C$ = 25°C unless otherwise noted)

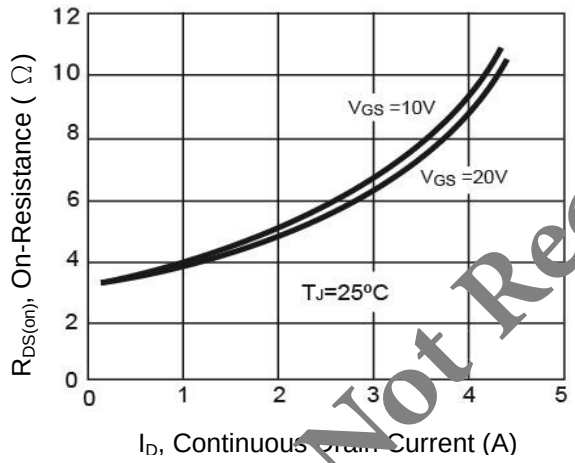
**Output Characteristics**



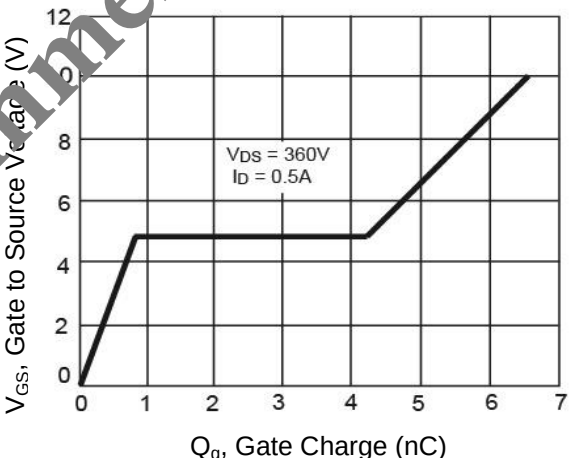

**Transfer Characteristics**



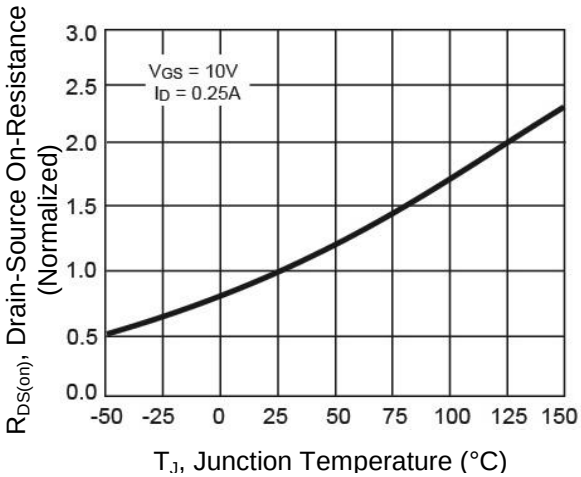

**On-Resistance vs. Drain Current**



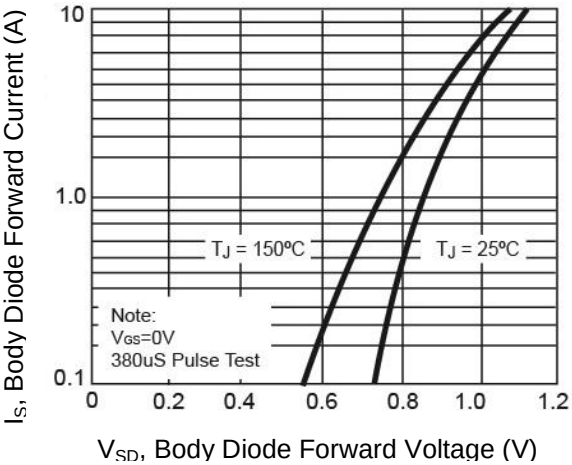

**Gate-Source Voltage vs. Gate Charge**




**On-Resistance vs. Junction Temperature**




**Source-Drain Diode Forward Current vs. Voltage**



## CHARACTERISTICS CURVES

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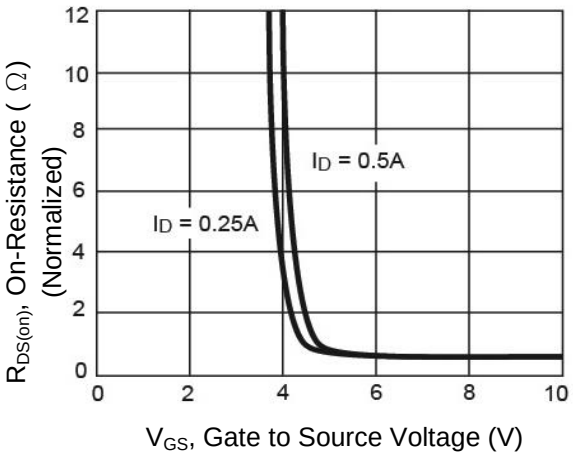
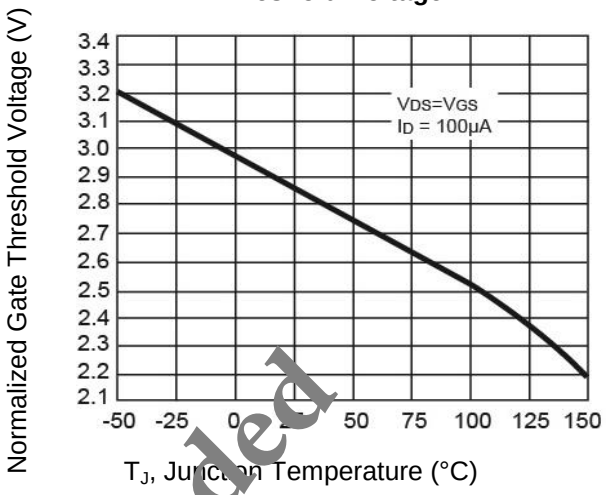
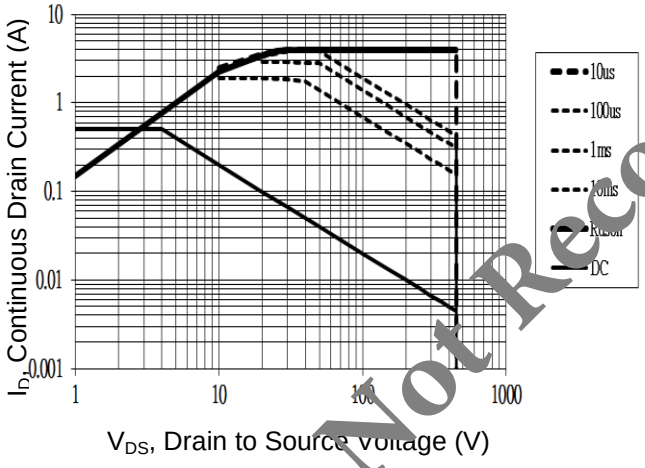
**On-Resistance vs. Gate-Source Voltage**




**Threshold Voltage**

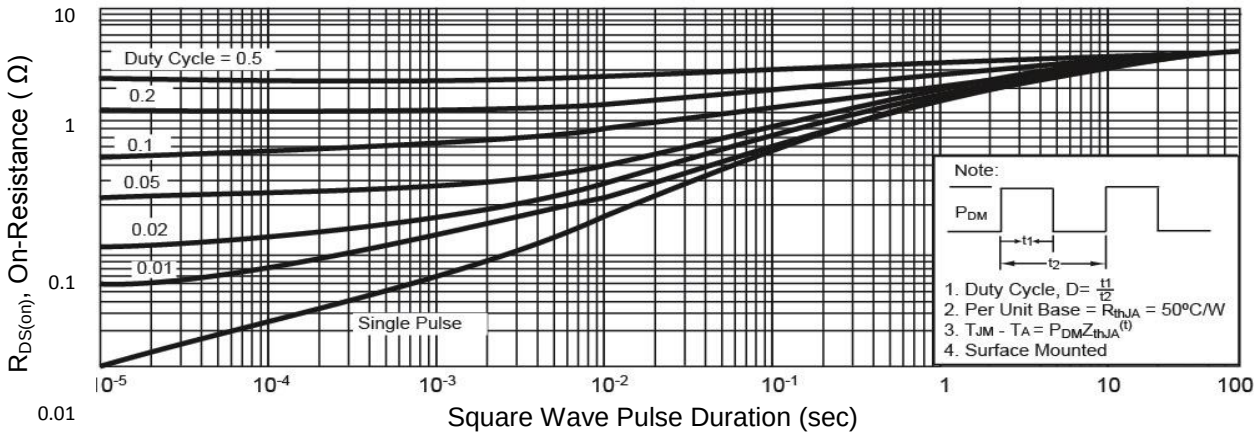



**Maximum Safe Operating Area**



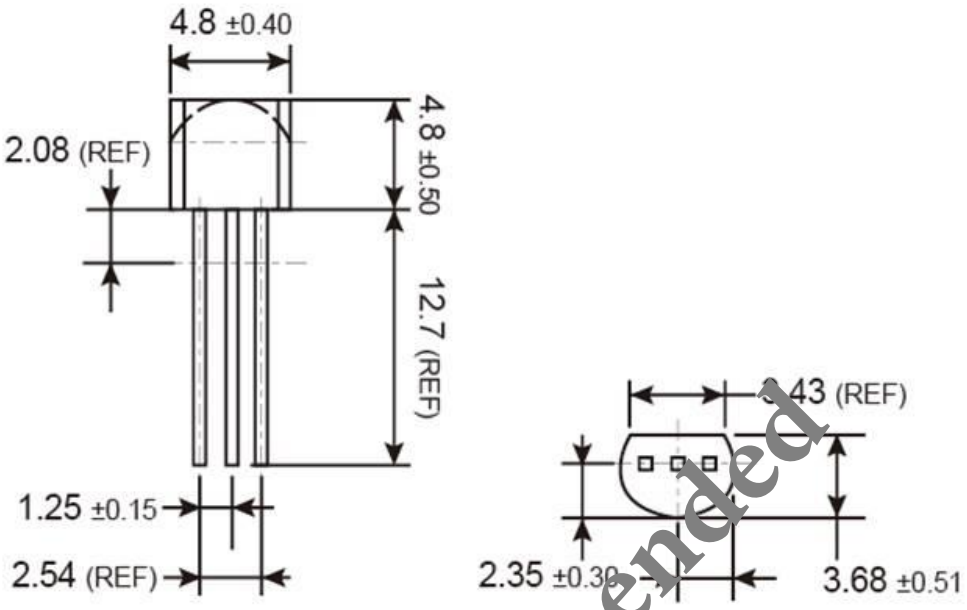



**Thermal Transient Impedance, Junction-to-Ambient**



## PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

**TO-92**






## MARKING DIAGRAM


**Y** = Year Code

**M** = Month Code for Halogen Free Product

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **O** | =Jan | **P** | =Feb | **Q** | =Mar | **R** | =Apr |
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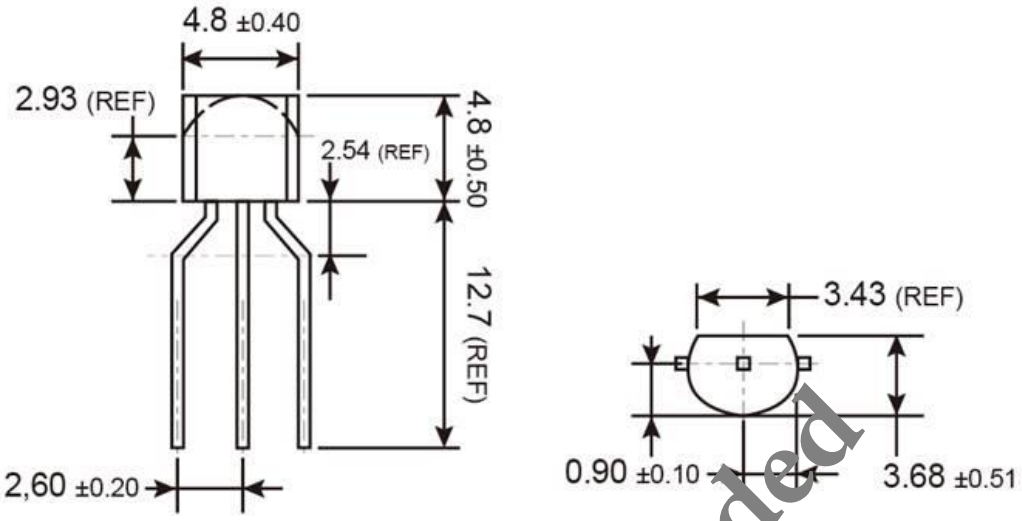


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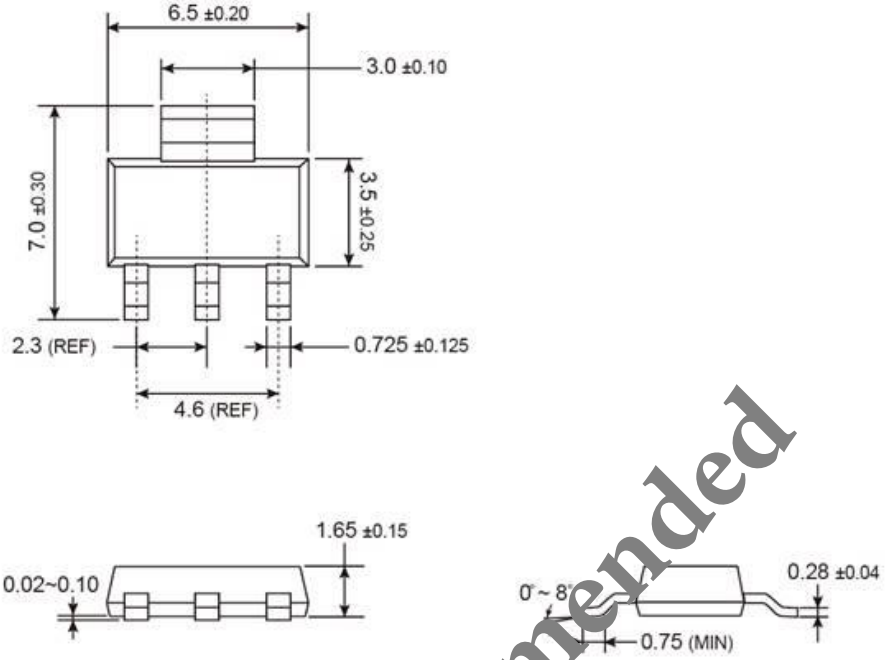
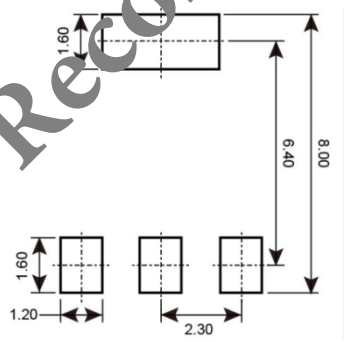





## SUGGESTED PAD LAYOUT

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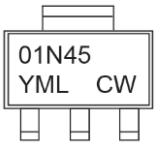


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