

**TO-252**

**Pin Definition:**

1. Gate
2. Drain
3. Source

**PRODUCT SUMMARY**

| $V_{DS}$ (V) | $R_{DS(on)}$ (m $\Omega$ ) | $I_D$ (A) |
|--------------|----------------------------|-----------|
| 20           | 30 @ $V_{GS} = 10V$        | 8         |
|              | 40 @ $V_{GS} = 4.5V$       | 6         |

**Features**

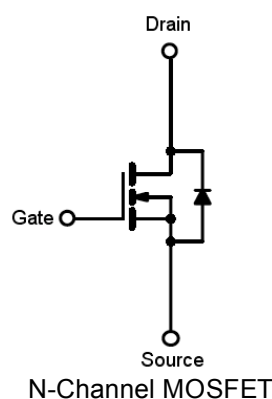
- Advance Trench Process Technology
- High Density Cell Design for Ultra Low On-resistance

**Application**

- Load Switch
- PA Switch

**Ordering Information**

| Part No.      | Package | Packing |
|---------------|---------|---------|
| TSM12N02CP RO | TO-252  | T&R     |

**Block Diagram**

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

| Parameter   | Symbol         | Limit                    | Unit             |
|---|----------------|--------------------------|------------------|
| Drain-Source Voltage  | $V_{DS}$       | 20                       | V                |
| Gate-Source Voltage   | $V_{GS}$       | $\pm 12$                 | V                |
| Continuous Drain Current, $V_{GS} @ 4.5V$ .                 | $I_D$          | 12                       | A                |
| Pulsed Drain Current, $V_{GS} @ 4.5V$                       | $I_{DM}$       | 30                       | A                |
| Continuous Source Current (Diode Conduction) <sup>a,b</sup> | $I_S$          | 1.7                      | A                |
| Maximum Power Dissipation                                   | $P_D$          | $T_a = 25^\circ\text{C}$ | 60               |
|   |                | $T_a = 70^\circ\text{C}$ | 23               |
| Operating Junction Temperature                              | $T_J$          | +150                     | $^\circ\text{C}$ |
| Operating Junction and Storage Temperature Range            | $T_J, T_{STG}$ | -55 to +150              | $^\circ\text{C}$ |

**Thermal Performance**

| Parameter  | Symbol          | Limit | Unit               |
|--|-----------------|-------|--------------------|
| Lead Temperature (1/8" from case)                    | $T_L$           | 10    | S                  |
| Junction to Case Thermal Resistance                  | $R_{\theta JC}$ | 2.2   | $^\circ\text{C/W}$ |
| Junction to Ambient Thermal Resistance (PCB mounted) | $R_{\theta JA}$ | 50    | $^\circ\text{C/W}$ |

**Notes:**

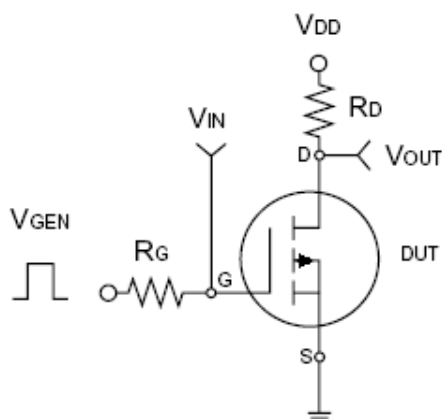
- a. Maximum DC current limited by the package
- b. Surface Mounted on 1" x 1" FR4 Board,  $t \leq 10$  sec.

### Electrical Specifications

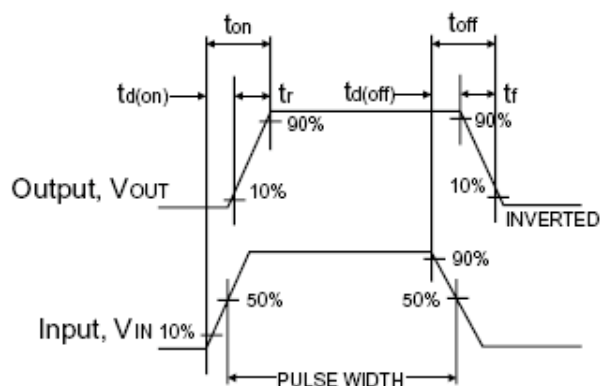
| Parameter                        | Conditions  | Symbol       | Min | Typ   | Max       | Unit       |
|----------------------------------|---|--------------|-----|-------|-----------|------------|
| <b>Static</b>                    |   |              |     |       |           |            |
| Drain-Source Breakdown Voltage   | $V_{GS} = 0V, I_D = 250\mu A$                           | $BV_{DSS}$   | 20  | --    | --        | V          |
| Gate Threshold Voltage           | $V_{DS} = V_{GS}, I_D = 250\mu A$                       | $V_{GS(TH)}$ | 0.6 | --    | --        | V          |
| Gate Body Leakage                | $V_{GS} = \pm 12V, V_{DS} = 0V$                         | $I_{GSS}$    | --  | --    | $\pm 100$ | nA         |
| Zero Gate Voltage Drain Current  | $V_{DS} = 20V, V_{GS} = 0V$                             | $I_{DSS}$    | --  | --    | 1.0       | $\mu A$    |
| On-State Drain Current           | $V_{DS} \geq 5V, V_{GS} = 10V$                          | $I_{D(ON)}$  | 12  | --    | --        | A          |
| Drain-Source On-State Resistance | $V_{GS} = 4.5V, I_D = 6A$                               | $R_{DS(ON)}$ | --  | 30    | 40        | m $\Omega$ |
|                                  | $V_{GS} = 10V, I_D = 8A$                                |              | --  | 21    | 30        |            |
| Forward Transconductance         | $V_{DS} = 10V, I_D = 6A$                                | $g_{fs}$     | 7   | 13    | --        | S          |
| Diode Forward Voltage            | $I_S = 1.7A, V_{GS} = 0V$                               | $V_{SD}$     | --  | --    | 1.2       | V          |
| <b>Dynamic<sup>b</sup></b>       |   |              |     |       |           |            |
| Total Gate Charge                | $V_{DS} = 10V, I_D = 6A, V_{GS} = 4.5V$                 | $Q_g$        | --  | 4.86  | --        | nC         |
| Gate-Source Charge               |   | $Q_{gs}$     | --  | 0.92  | --        |            |
| Gate-Drain Charge                |   | $Q_{gd}$     | --  | 1.4   | --        |            |
| Input Capacitance                | $V_{DS} = 8V, V_{GS} = 0V, f = 1.0MHz$                  | $C_{iss}$    | --  | 562   | --        | pF         |
| Output Capacitance               |   | $C_{oss}$    | --  | 106   | --        |            |
| Reverse Transfer Capacitance     |   | $C_{rss}$    | --  | 75    | --        |            |
| <b>Switching<sup>c</sup></b>     |   |              |     |       |           |            |
| Turn-On Delay Time               | $V_{DD} = 10V, I_D = 1A, V_{GEN} = 10V, R_G = 16\Omega$ | $t_{d(on)}$  | --  | 8.1   | --        | nS         |
| Turn-On Rise Time                |   | $t_r$        | --  | 9.95  | --        |            |
| Turn-Off Delay Time              |   | $t_{d(off)}$ | --  | 21.85 | --        |            |
| Turn-Off Fall Time               |   | $t_f$        | --  | 5.35  | --        |            |

**Notes:**

- a. pulse test:  $PW \leq 300\mu s$ , duty cycle  $\leq 2\%$
- b. For DESIGN AID ONLY, not subject to production testing.
- b. Switching time is essentially independent of operating temperature.



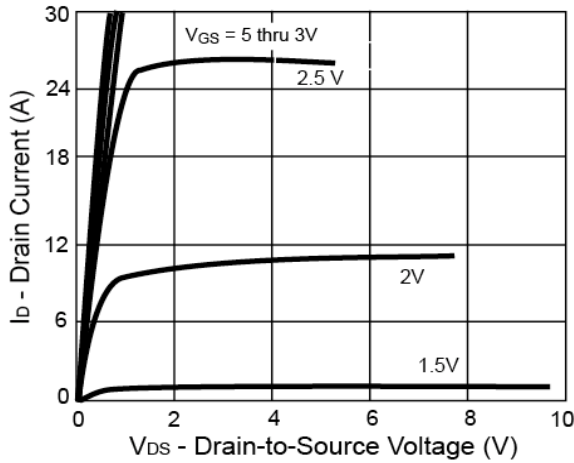
**Switching Test Circuit**



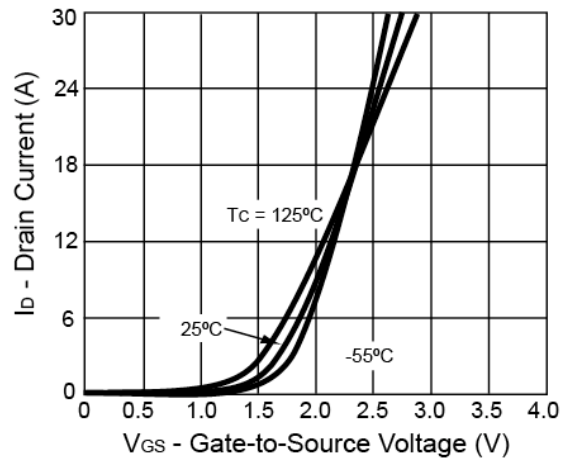
**Switchin Waveforms**

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

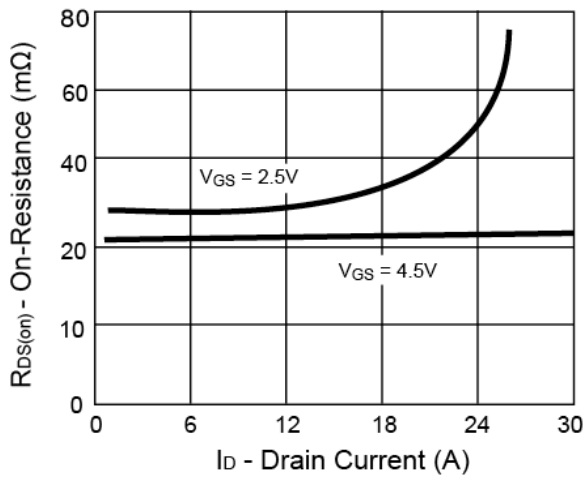
**Output Characteristics**



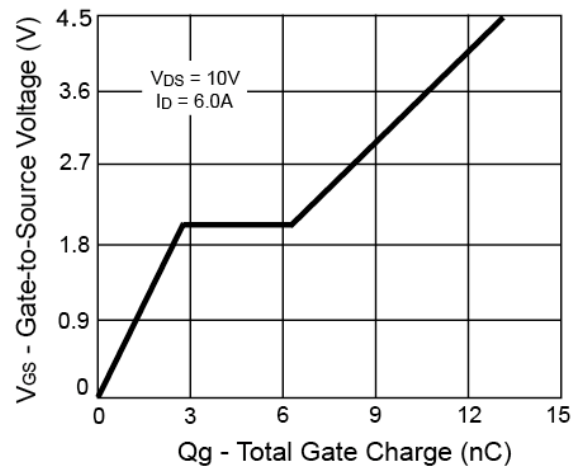
**Transfer Characteristics**



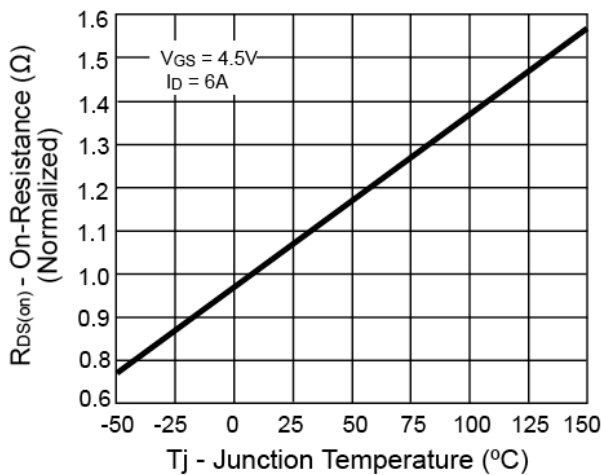
**On-Resistance vs. Drain Current**



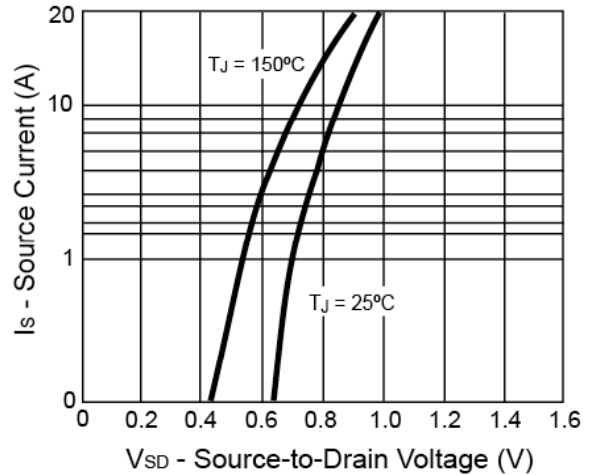
**Gate Charge**



**On-Resistance vs. Junction Temperature**

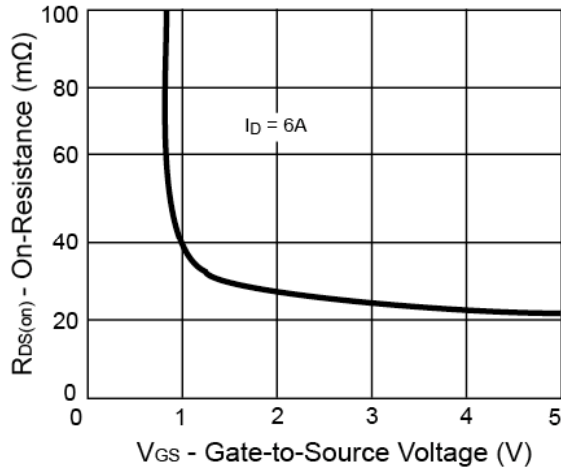


**Source-Drain Diode Forward Voltage**

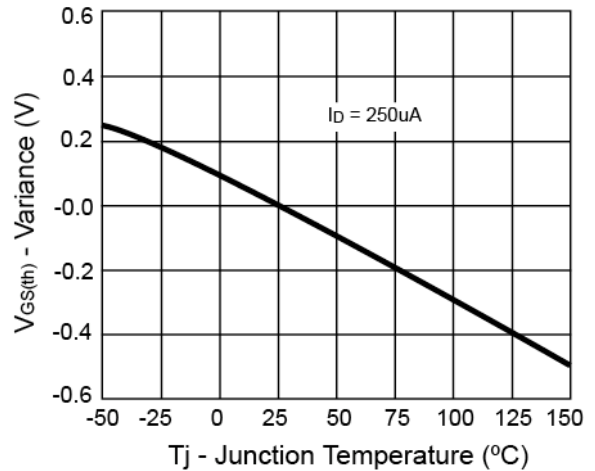


**Electrical Characteristics Curve** ( $T_a = 25^\circ\text{C}$ , unless otherwise noted)

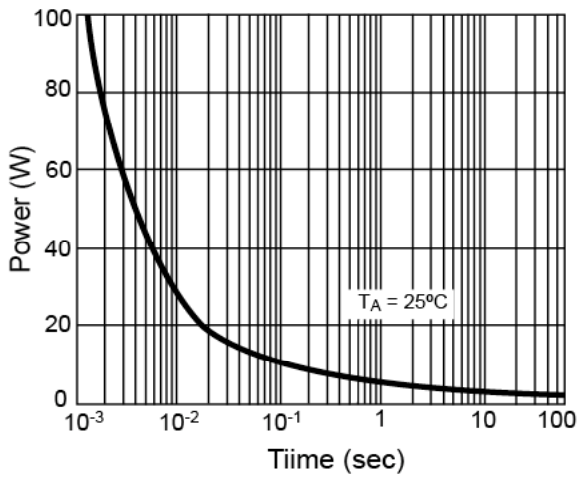
**On-Resistance vs. Gate-Source Voltage**



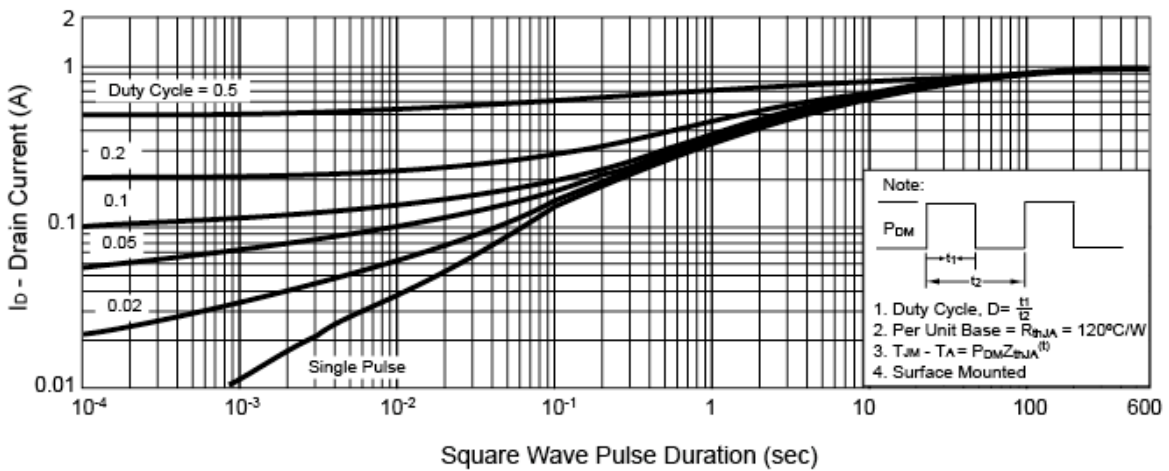
**Threshold Voltage**



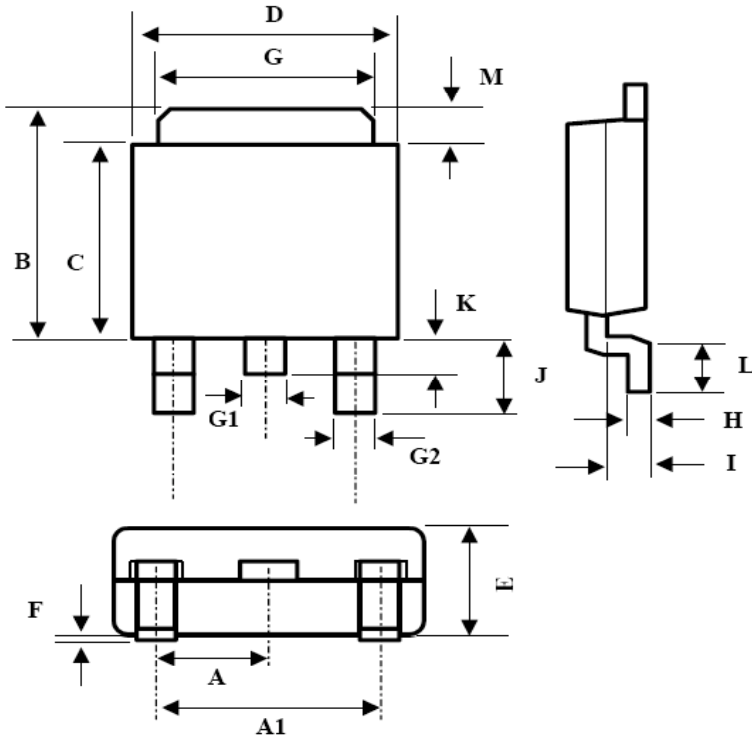
**Single Pulse Power**



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



**SOT-252 Mechanical Drawing**



| TO-252 DIMENSION |             |      |         |       |
|------------------|-------------|------|---------|-------|
| DIM              | MILLIMETERS |      | INCHES  |       |
|                  | MIN         | MAX  | MIN     | MAX   |
| A                | 2.3BSC      |      | 0.09BSC |       |
| A1               | 4.6BSC      |      | 0.18BSC |       |
| B                | 6.80        | 7.20 | 0.268   | 0.283 |
| C                | 5.40        | 5.60 | 0.213   | 0.220 |
| D                | 6.40        | 6.65 | 0.252   | 0.262 |
| E                | 2.20        | 2.40 | 0.087   | 0.094 |
| F                | 0.00        | 0.20 | 0.000   | 0.008 |
| G                | 5.20        | 5.40 | 0.205   | 0.213 |
| G1               | 0.75        | 0.85 | 0.030   | 0.033 |
| G2               | 0.55        | 0.65 | 0.022   | 0.026 |
| H                | 0.35        | 0.65 | 0.014   | 0.026 |
| I                | 0.90        | 1.50 | 0.035   | 0.059 |
| J                | 2.20        | 2.80 | 0.087   | 0.110 |
| K                | 0.50        | 1.10 | 0.020   | 0.043 |
| L                | 0.90        | 1.50 | 0.035   | 0.059 |
| M                | 1.30        | 1.70 | 0.051   | 0.67  |

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