
**Pin Definition:**

- |           |          |
|-----------|----------|
| 1. Source | 8. Drain |
| 2. Source | 7. Drain |
| 3. Source | 6. Drain |
| 4. Gate   | 5. Drain |

**PRODUCT SUMMARY**

| $V_{DS}$ (V) | $R_{DS(on)}$ (m $\Omega$ ) | $I_D$ (A) |
|--------------|----------------------------|-----------|
| -60          | 155 @ $V_{GS} = -10V$      | -3.5      |
|              | 200 @ $V_{GS} = 4.5V$      | -3.1      |

**Features**

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

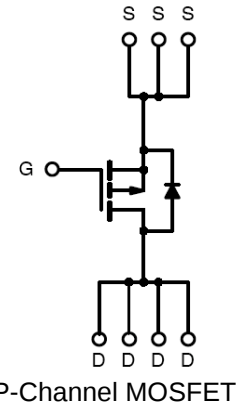
**Application**

- Load Switch
- PA Switch

**Ordering Information**

| Part No.      | Package | Packing            |
|---------------|---------|--------------------|
| TSM9409CS RLG | SOP-8   | 2.5Kpcs / 13" Reel |

**Note:** "G" denote for Halogen Free Product

**Block Diagram**

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

| Parameter                                                   | Symbol         | Limit        | Unit       |
|-------------------------------------------------------------|----------------|--------------|------------|
| Drain-Source Voltage                                        | $V_{DS}$       | -60          | V          |
| Gate-Source Voltage                                         | $V_{GS}$       | $\pm 20$     | V          |
| Continuous Drain Current                                    | $I_D$          | -3.5         | A          |
| Pulsed Drain Current                                        | $I_{DM}$       | -30          | A          |
| Continuous Source Current (Diode Conduction) <sup>a,b</sup> | $I_S$          | -2.5         | A          |
| Maximum Power Dissipation                                   | $P_D$          | 3.0          | W          |
|                                                             |                | 2.1          |            |
| Operating Junction Temperature                              | $T_J$          | +150         | $^\circ C$ |
| Operating Junction and Storage Temperature Range            | $T_J, T_{STG}$ | - 55 to +150 | $^\circ C$ |

**Thermal Performance**

| Parameter                                            | Symbol          | Limit | Unit         |
|------------------------------------------------------|-----------------|-------|--------------|
| Junction to Case Thermal Resistance                  | $R_{\theta JC}$ | 30    | $^\circ C/W$ |
| Junction to Ambient Thermal Resistance (PCB mounted) | $R_{\theta JA}$ | 50    | $^\circ C/W$ |

**Notes:**

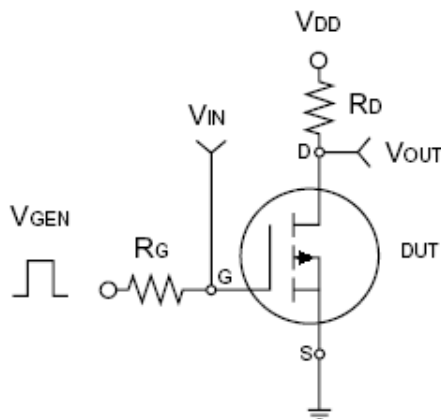
- a. Pulse width limited by the Maximum junction temperature
- b. Surface Mounted on FR4 Board,  $t \leq 10$  sec.

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

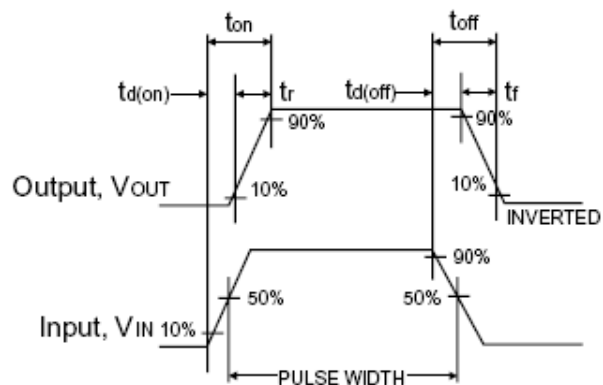
| Parameter                                     | Conditions                                                                                                             | Symbol              | Min  | Typ   | Max  | Unit |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------|------|-------|------|------|
| Static                                        |                                                                                                                        |                     |      |       |      |      |
| Drain-Source Breakdown Voltage                | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250uA                                                                          | BV <sub>DSS</sub>   | -60  | --    | --   | V    |
| Gate Threshold Voltage                        | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA                                                            | V <sub>GS(TH)</sub> | -1.0 | --    | --   | V    |
| Gate Body Leakage                             | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                                                           | I <sub>GSS</sub>    | --   | --    | ±100 | nA   |
| Zero Gate Voltage Drain Current               | V <sub>DS</sub> = -60V, V <sub>GS</sub> = 0V                                                                           | I <sub>DSS</sub>    | --   | --    | -1.0 | μA   |
| On-State Drain Current <sup>a</sup>           | V <sub>DS</sub> = -5V, V <sub>GS</sub> = -10V                                                                          | I <sub>D(ON)</sub>  | -20  | --    | --   | A    |
| Drain-Source On-State Resistance <sup>a</sup> | V <sub>GS</sub> = -10V, I <sub>D</sub> = -3.5A                                                                         | R <sub>DS(ON)</sub> | --   | 125   | 155  | mΩ   |
|                                               | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -3.1A                                                                        |                     | --   | 153   | 200  |      |
| Forward Transconductance <sup>a</sup>         | V <sub>DS</sub> = -15V, I <sub>D</sub> = -3.5A                                                                         | g <sub>fs</sub>     | --   | 8     | --   | S    |
| Diode Forward Voltage                         | I <sub>S</sub> = -2.5A, V <sub>GS</sub> = 0V                                                                           | V <sub>SD</sub>     | --   | -1.25 | -1.5 | V    |
| Dynamic <sup>b</sup>                          |                                                                                                                        |                     |      |       |      |      |
| Total Gate Charge                             | V <sub>DS</sub> = -15V, I <sub>D</sub> = -3.5A,<br>V <sub>GS</sub> = -10V                                              | Q <sub>g</sub>      | --   | 6     | --   | nC   |
| Gate-Source Charge                            |                                                                                                                        | Q <sub>gs</sub>     | --   | 1.7   | --   |      |
| Gate-Drain Charge                             |                                                                                                                        | Q <sub>gd</sub>     | --   | 1.5   | --   |      |
| Input Capacitance                             | V <sub>DS</sub> = -30V, V <sub>GS</sub> = 0V,<br>f = 1.0MHz                                                            | C <sub>iSS</sub>    | --   | 540   | --   | pF   |
| Output Capacitance                            |                                                                                                                        | C <sub>oSS</sub>    | --   | 60    | --   |      |
| Reverse Transfer Capacitance                  |                                                                                                                        | C <sub>rSS</sub>    | --   | 30    | --   |      |
| Switching <sup>c</sup>                        |                                                                                                                        |                     |      |       |      |      |
| Turn-On Delay Time                            | V <sub>DD</sub> = -15V, R <sub>L</sub> = 15Ω,<br>I <sub>D</sub> = -1A, V <sub>GEN</sub> = -10V,<br>R <sub>G</sub> = 6Ω | t <sub>d(on)</sub>  | --   | 7     | --   | nS   |
| Turn-On Rise Time                             |                                                                                                                        | t <sub>r</sub>      | --   | 9     | --   |      |
| Turn-Off Delay Time                           |                                                                                                                        | t <sub>d(off)</sub> | --   | 19    | --   |      |
| Turn-Off Fall Time                            |                                                                                                                        | t <sub>f</sub>      | --   | 4     | --   |      |

**Notes:**

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



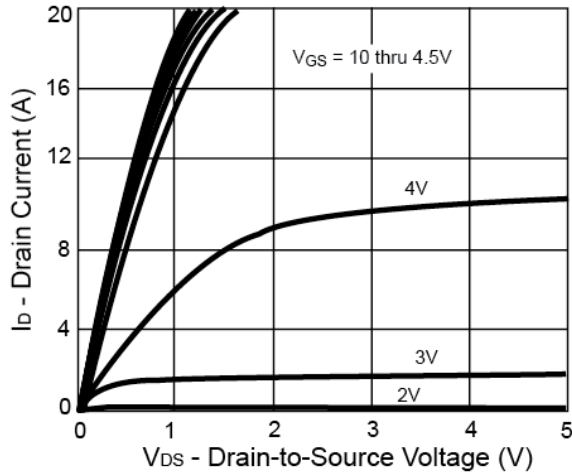
**Switching Test Circuit**



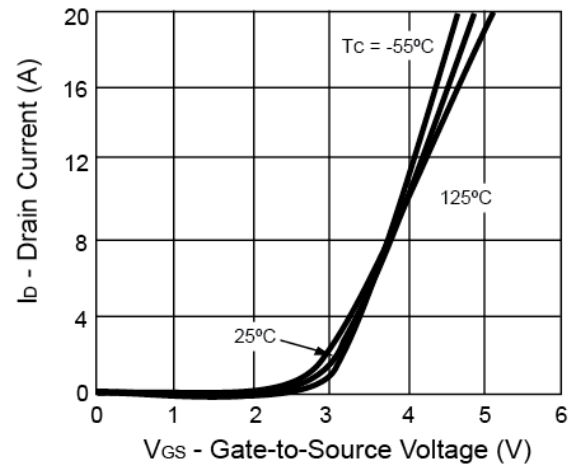
**Switchin Waveforms**

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

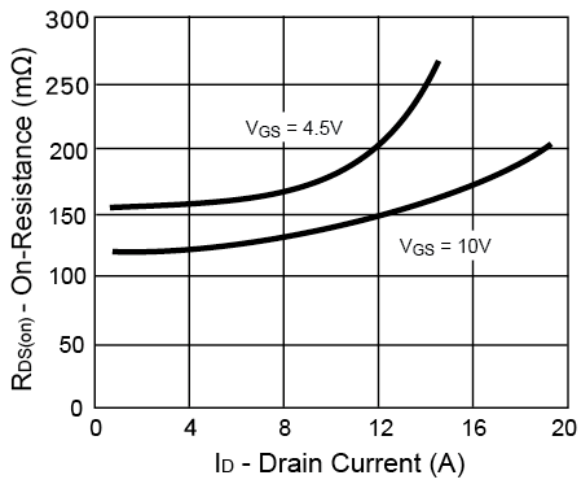
**Output Characteristics**



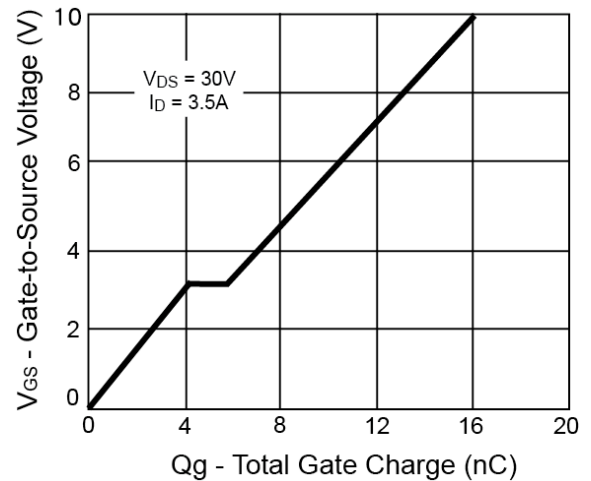
**Transfer Characteristics**



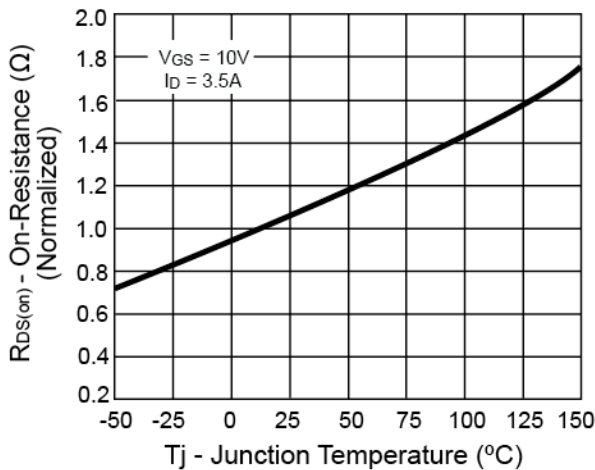
**On-Resistance vs. Drain Current**



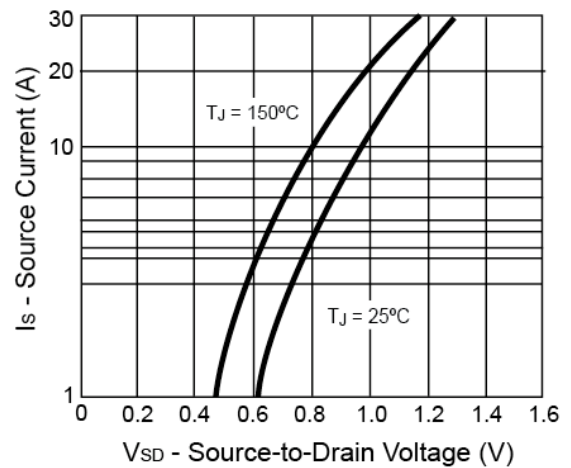
**Gate Charge**



**On-Resistance vs. Junction Temperature**

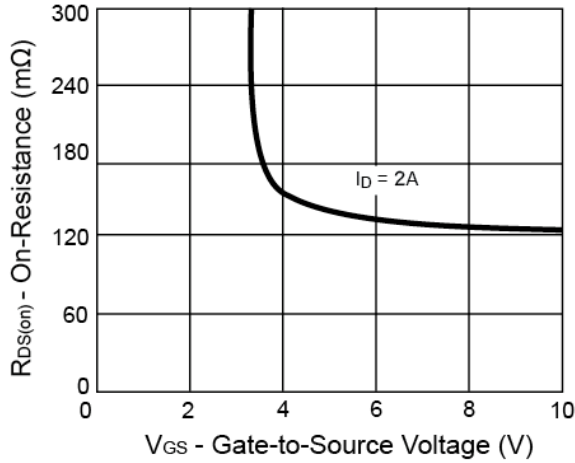


**Source-Drain Diode Forward Voltage**

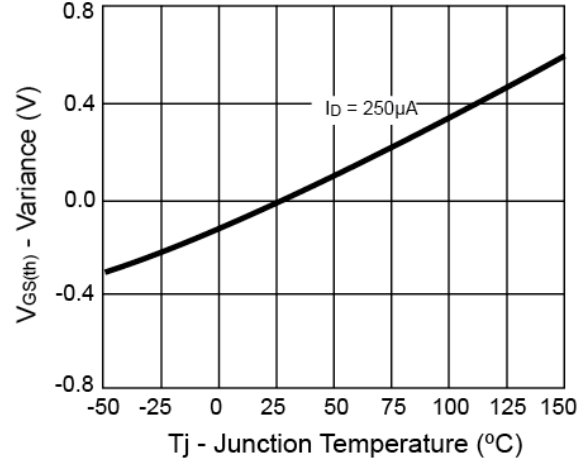


**Electrical Characteristics Curve** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

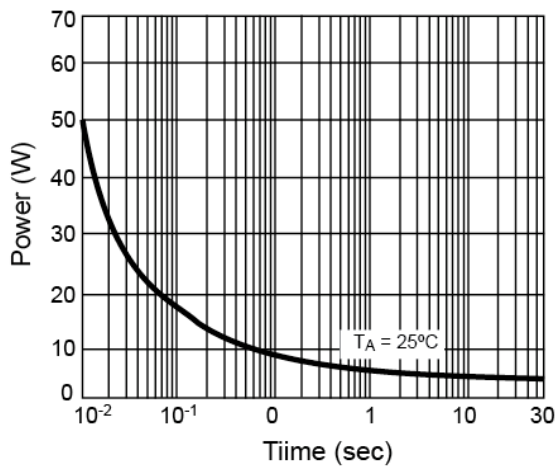
**On-Resistance vs. Gate-Source Voltage**



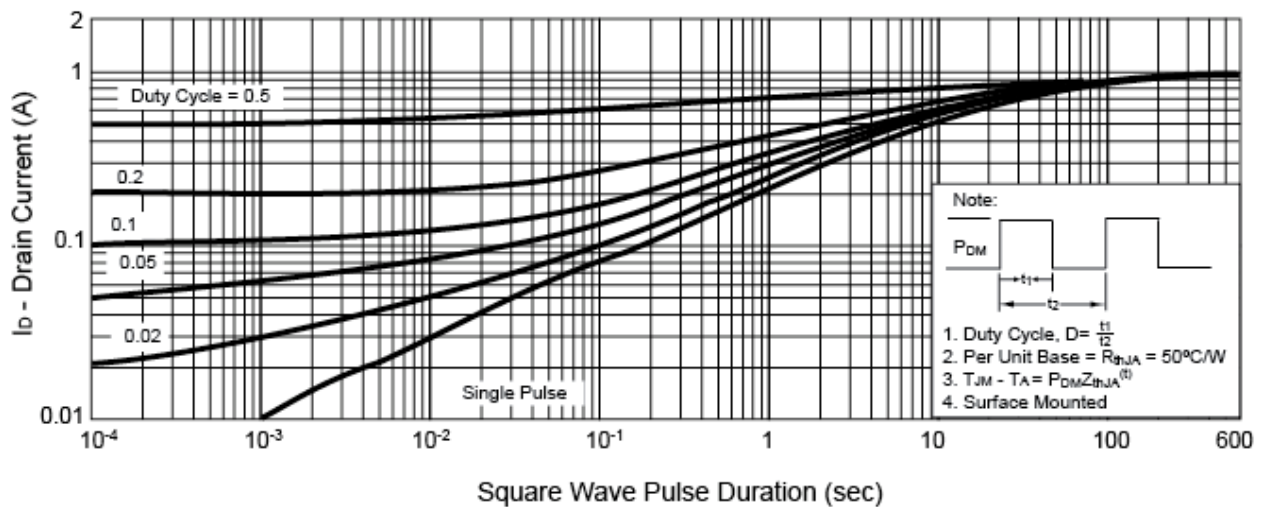
**Threshold Voltage**



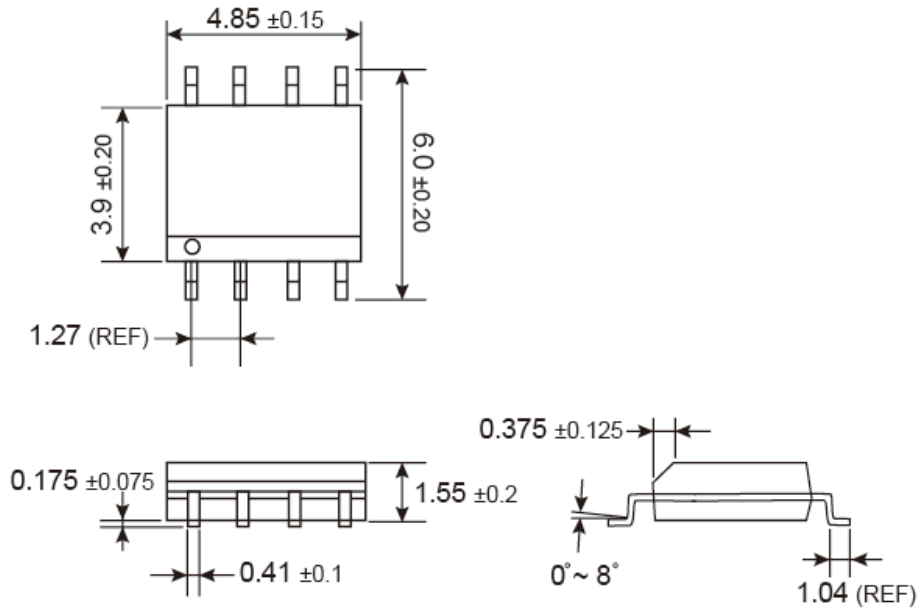
**Single Pulse Power**



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

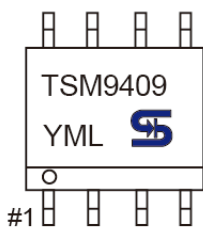


## SOP-8 Mechanical Drawing



Unit: Millimeters

## Marking Diagram



**Y** = Year Code  
**M** = Month Code for Halogen Free Product  
**O** =Jan   **P** =Feb   **Q** =Mar   **R** =Apr  
**S** =May   **T** =Jun   **U** =Jul   **V** =Aug  
**W** =Sep   **X** =Oct   **Y** =Nov   **Z** =Dec  
**L** = Lot Code

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# TSM9409

## 60V P-Channel MOSFET