

## TM05G06S

## N+P-Channel Enhancement Mode Mosfet

### General Description

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

### Applications

- Load switch
- PWM

### General Features

#### N Channel

$V_{DS} = 60V, I_D = 5A$   
 $R_{DS(ON)} = 65m\Omega @ V_{GS} = 10V$

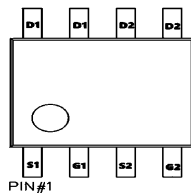
#### P Channel

$V_{DS} = -60V, I_D = -4.8A$   
 $R_{DS(ON)} = 70m\Omega @ V_{GS} = -10V$

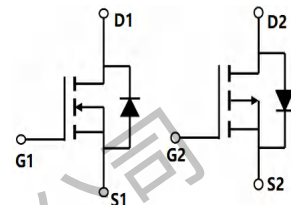
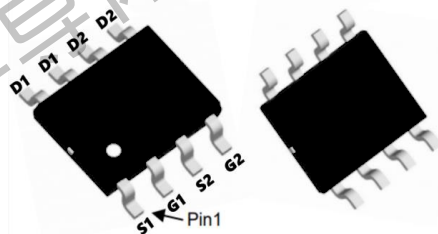
100% UIS Tested  
100%  $R_g$  Tested



S: SOP-8L



Marking: 4559



### Absolute Maximum Ratings ( $T_c = 25^\circ C$ unless otherwise noted)

| Symbol                   | Parameter                                  | Rating     |            | Units      |
|--------------------------|--------------------------------------------|------------|------------|------------|
|                          |                                            | N-Channel  | P-Channel  |            |
| $V_{DS}$                 | Drain-Source Voltage                       | 60         | -60        | V          |
| $V_{GS}$                 | Gate-Source Voltage                        | $\pm 20$   | $\pm 20$   | V          |
| $I_D @ T_A = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 5.0        | -4.8       | A          |
| $I_D @ T_A = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 3.8        | -3.1       | A          |
| $I_{DM}$                 | Pulsed Drain Current <sup>2</sup>          | 17         | -13        | A          |
| EAS                      | Single Pulse Avalanche Energy <sup>3</sup> | 22.5       | 35.3       | mJ         |
| $I_{AS}$                 | Avalanche Current                          | 22.6       | -26.6      | A          |
| $P_D @ T_A = 25^\circ C$ | Total Power Dissipation <sup>4</sup>       | 2.5        | 2.5        | W          |
| $T_{STG}$                | Storage Temperature Range                  | -55 to 175 | -55 to 175 | $^\circ C$ |
| $T_J$                    | Operating Junction Temperature Range       | -55 to 175 | -55 to 175 | $^\circ C$ |

### Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit         |
|-----------------|--------------------------------------------------|------|------|--------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 85   | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 62.5 | $^\circ C/W$ |

**TM05G06S**
**N+P-Channel Enhancement Mode Mosfet**
**N-Channel Electrical Characteristics ( $T_J=25^\circ\text{C}$  , unless otherwise noted)**

| Symbol                                                 | Parameter                                                | Test Condition                                                                          | Min. | Typ. | Max. | Units |
|--------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------|------|------|------|-------|
| Off Characteristic                                     |                                                          |                                                                                         |      |      |      |       |
| V <sub>(BR)DSS</sub>                                   | Drain-Source Breakdown Voltage                           | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                              | 60   | -    | -    | V     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                          | V <sub>DS</sub> =60V, V <sub>GS</sub> = 0V,                                             | -    | -    | 1.0  | μA    |
| I <sub>GSS</sub>                                       | Gate to Body Leakage Current                             | V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V                                             | -    | -    | ±100 | nA    |
| On Characteristics                                     |                                                          |                                                                                         |      |      |      |       |
| V <sub>GS(th)</sub>                                    | Gate Threshold Voltage                                   | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                | 1.0  | 2.0  | 3.0  | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source on-Resistance<br>note3               | V <sub>GS</sub> =10V, I <sub>D</sub> =5A                                                | -    | 65   | 69   | mΩ    |
|                                                        |                                                          | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A                                               | -    | 70   | 82   |       |
| Dynamic Characteristics                                |                                                          |                                                                                         |      |      |      |       |
| C <sub>iss</sub>                                       | Input Capacitance                                        | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                  | -    | 1148 | -    | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                                       |                                                                                         | -    | 58.5 | -    | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                             |                                                                                         | -    | 49.4 | -    | pF    |
| Q <sub>g</sub>                                         | Total Gate Charge                                        | V <sub>DS</sub> =30V, I <sub>D</sub> =2.5A,<br>V <sub>GS</sub> =10V                     | -    | 20.3 | -    | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                       |                                                                                         | -    | 3.7  | -    | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain(“Miller”) Charge                              |                                                                                         | -    | 5.3  | -    | nC    |
| Switching Characteristics                              |                                                          |                                                                                         |      |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-on Delay Time                                       | V <sub>DS</sub> =30V, I <sub>D</sub> =5A,<br>R <sub>G</sub> =1.8Ω, V <sub>GS</sub> =10V | -    | 7.6  | -    | ns    |
| t <sub>r</sub>                                         | Turn-on Rise Time                                        |                                                                                         | -    | 20   | -    | ns    |
| t <sub>d(off)</sub>                                    | Turn-off Delay Time                                      |                                                                                         | -    | 15   | -    | ns    |
| t <sub>f</sub>                                         | Turn-off Fall Time                                       |                                                                                         | -    | 24   | -    | ns    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                          |                                                                                         |      |      |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain to Source Diode Forward Current |                                                                                         | -    | -    | 5    | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                                         | -    | -    | 20   | A     |
| V <sub>SD</sub>                                        | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> =0V, I <sub>S</sub> =5A                                                 | -    | -    | 1.2  | V     |
| t <sub>rr</sub>                                        | Body Diode Reverse Recovery Time                         | I <sub>F</sub> =5A, dI/dt=100A/μs                                                       | -    | 29   | -    | ns    |
| Q <sub>rr</sub>                                        | Body Diode Reverse Recovery Charge                       |                                                                                         | -    | 43   | -    | nC    |

Notes:1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

 2. EAS condition :  $T_J=25^\circ\text{C}, V_{DD}=30V, V_G=10V, L=0.5mH, R_G=25\Omega, I_{AS}=8.7A$ 

 3. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 0.5\%$

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**P-Channel Electrical Characteristics ( $T_J=25^\circ\text{C}$  , unless otherwise noted)**

| Symbol       | Parameter                                      | Conditions                                                     | Min. | Typ. | Max.      | Unit      |
|--------------|------------------------------------------------|----------------------------------------------------------------|------|------|-----------|-----------|
| $BV_{DSS}$   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V$ , $I_D=-250\mu A$                                  | -60  | ---  | ---       | V         |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=-10V$ , $I_D=-3.5A$                                    | ---  | 70   | 80        | $m\Omega$ |
|              |                                                | $V_{GS}=-4.5V$ , $I_D=-3.1A$                                   | ---  | 81   | 95        |           |
| $V_{GS(th)}$ | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=-250\mu A$                              | -1.0 | -2.0 | -3.0      | V         |
| $I_{DSS}$    | Drain-Source Leakage Current                   | $V_{DS}=-48V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$           | ---  | ---  | 1         | $\mu A$   |
|              |                                                | $V_{DS}=-48V$ , $V_{GS}=0V$ , $T_J=55^\circ\text{C}$           | ---  | ---  | 5         |           |
| $I_{GSS}$    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V$ , $V_{DS}=0V$                                 | ---  | ---  | $\pm 100$ | nA        |
| $g_{fs}$     | Forward Transconductance                       | $V_{DS}=-5V$ , $I_D=-3A$                                       | ---  | 8.5  | ---       | S         |
| $Q_g$        | Total Gate Charge (-4.5V)                      | $V_{DS}=-48V$ , $V_{GS}=-4.5V$ , $I_D=-3A$                     | ---  | 12.1 | ---       | nC        |
| $Q_{gs}$     | Gate-Source Charge                             |                                                                | ---  | 2.2  | ---       |           |
| $Q_{gd}$     | Gate-Drain Charge                              |                                                                | ---  | 6.3  | ---       |           |
| $T_{d(on)}$  | Turn-On Delay Time                             | $V_{DD}=-15V$ , $V_{GS}=-10V$ , $R_G=3.3\Omega$ ,<br>$I_D=-1A$ | ---  | 9.2  | ---       | ns        |
| $T_r$        | Rise Time                                      |                                                                | ---  | 20.1 | ---       |           |
| $T_{d(off)}$ | Turn-Off Delay Time                            |                                                                | ---  | 46.7 | ---       |           |
| $T_f$        | Fall Time                                      |                                                                | ---  | 9.4  | ---       |           |
| $C_{iss}$    | Input Capacitance                              | $V_{DS}=-15V$ , $V_{GS}=0V$ , $f=1\text{MHz}$                  | ---  | 1137 | ---       | pF        |
| $C_{oss}$    | Output Capacitance                             |                                                                | ---  | 76   | ---       |           |
| $C_{rss}$    | Reverse Transfer Capacitance                   |                                                                | ---  | 50   | ---       |           |

**Diode Characteristics**

| Symbol   | Parameter                                | Conditions                                       | Min. | Typ. | Max. | Unit |
|----------|------------------------------------------|--------------------------------------------------|------|------|------|------|
| $I_S$    | Continuous Source Current <sup>1,5</sup> | $V_G=V_D=0V$ , Force Current                     | ---  | ---  | -4.8 | A    |
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup>       | $V_{GS}=0V$ , $I_S=-1A$ , $T_J=25^\circ\text{C}$ | ---  | ---  | -1.2 | V    |

Note :

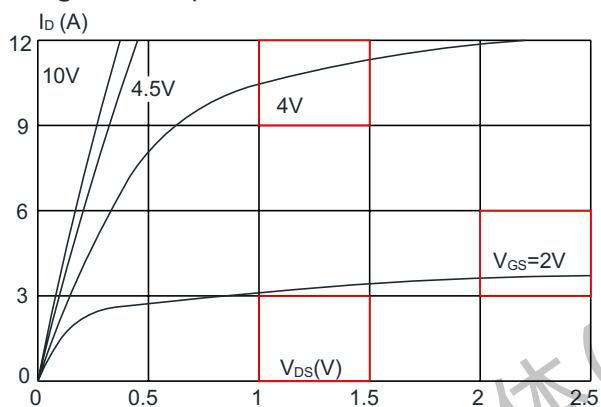
- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
- 2.The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$
- 3.The EAS data shows Max. rating . The test condition is  $V_{DD}=-25V$  ,  $V_{GS}=-10V$  ,  $L=0.1mH$  ,  $I_{AS}=-24A$
- 4.The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
- 5.The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.

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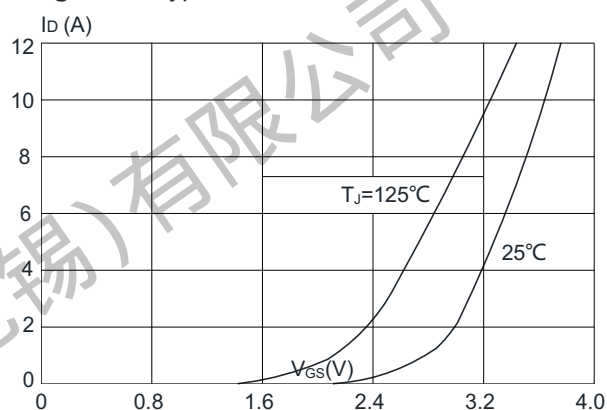
## N+P-Channel Enhancement Mode Mosfet

### N-Channel Typical Characteristics

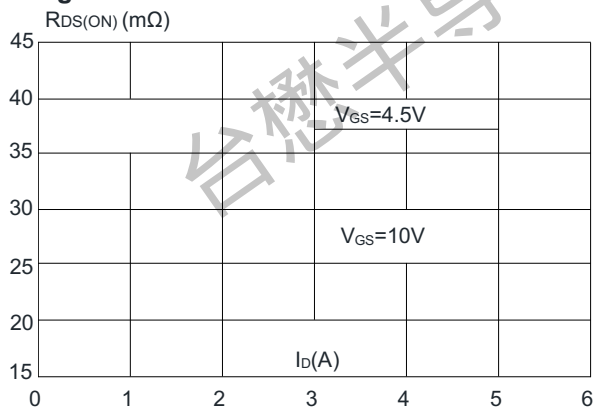
**Figure 1: Output Characteristics**



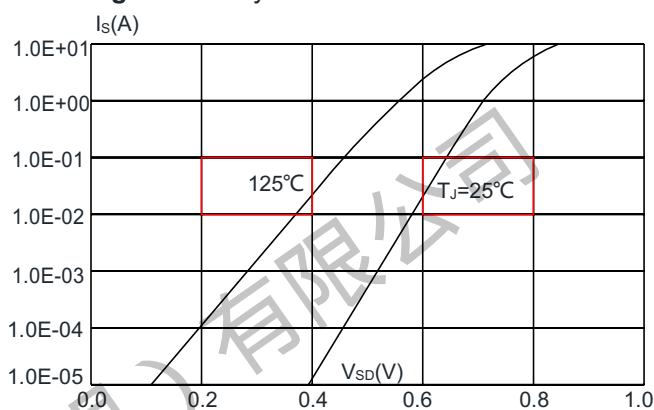
**Figure 2: Typical Transfer Characteristics**



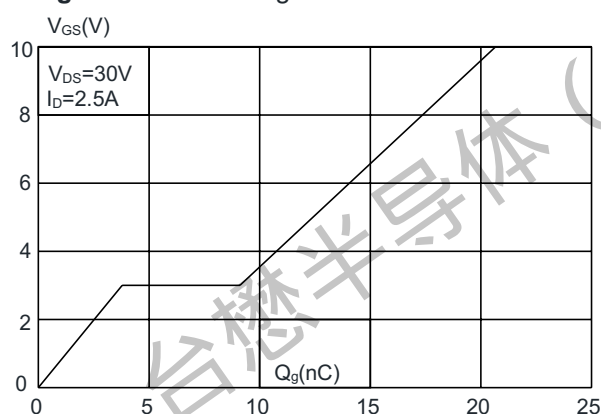
**Figure 3: On-resistance vs. Drain Current**



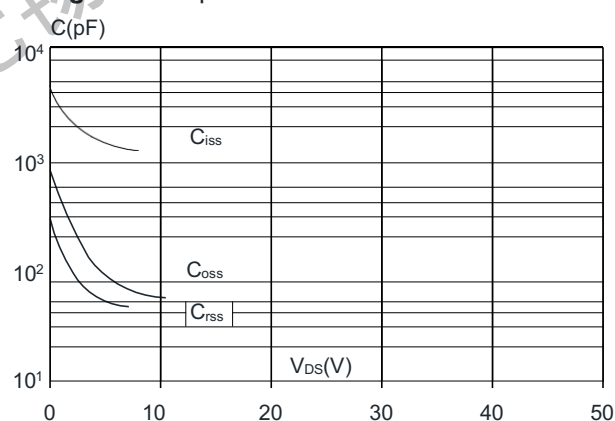
**Figure 4: Body Diode Characteristics**



**Figure 5: Gate Charge Characteristics**



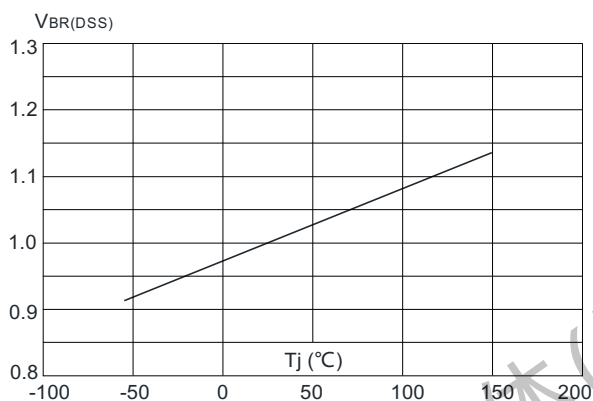
**Figure 6: Capacitance Characteristics**



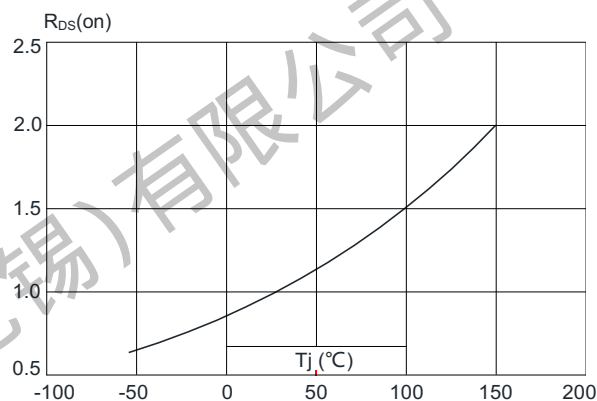
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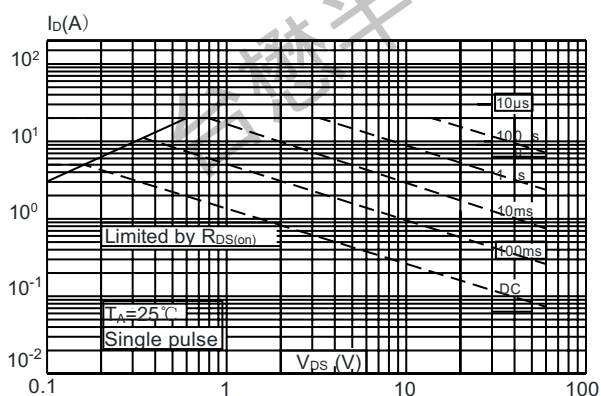
**Figure 7: Normalized Breakdown Voltage vs. Junction Temperature**



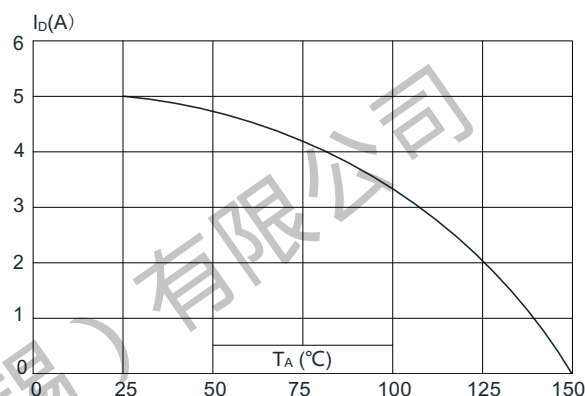
**Figure 8: Normalized on Resistance vs. Junction Temperature**



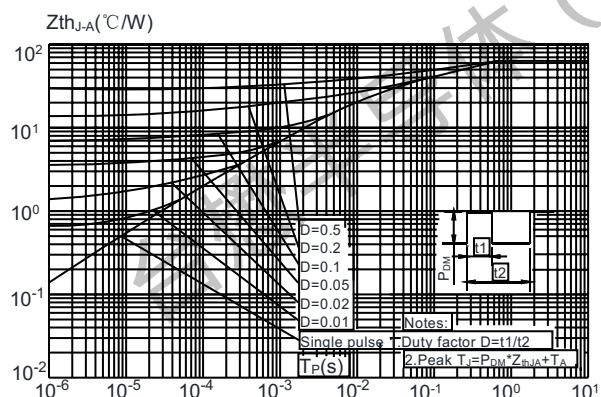
**Figure 9: Maximum Safe Operating Area**



**Figure 10: Maximum Continuous Drain Current vs. Ambient Temperature**



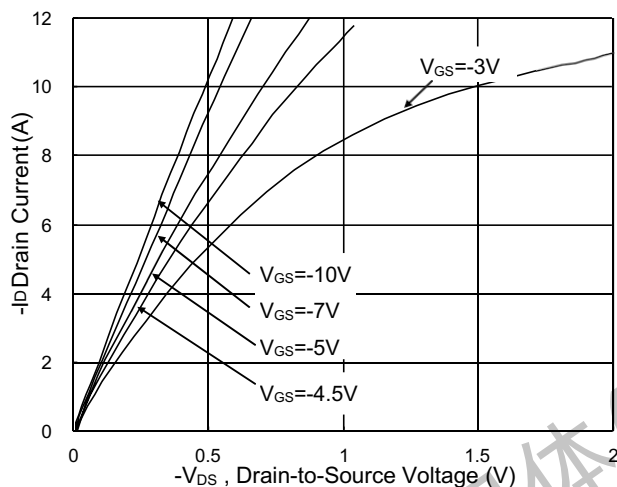
**Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Ambient**



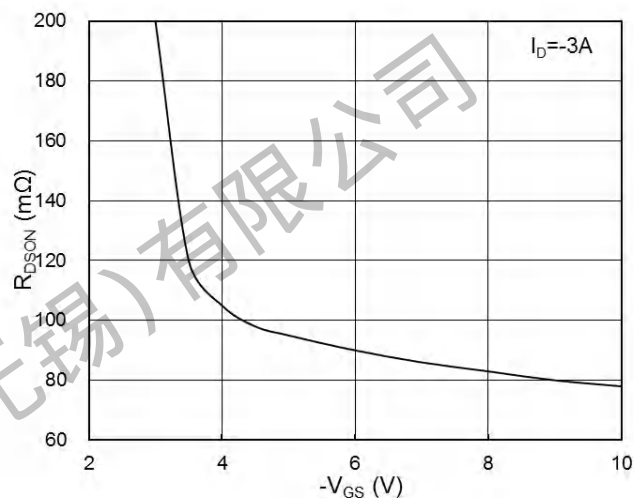
## TM05G06S

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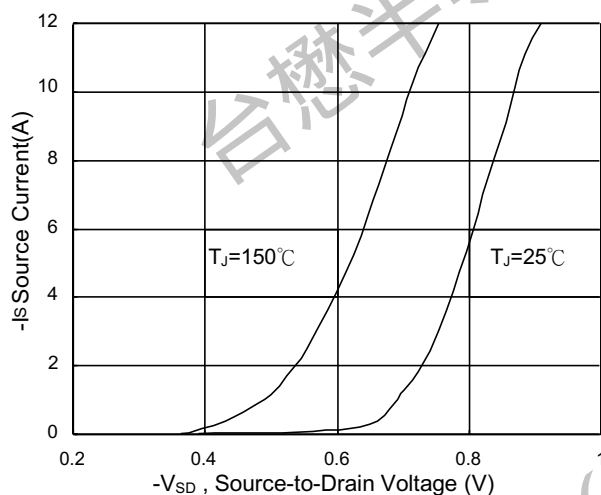
### P-Channel Typical Characteristics



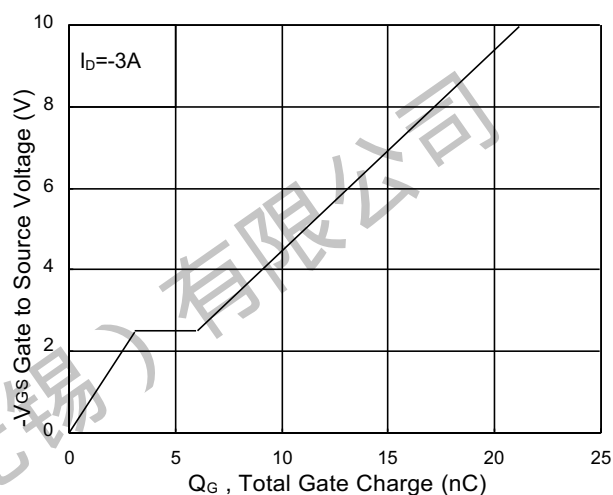
**Fig.1 Typical Output Characteristics**



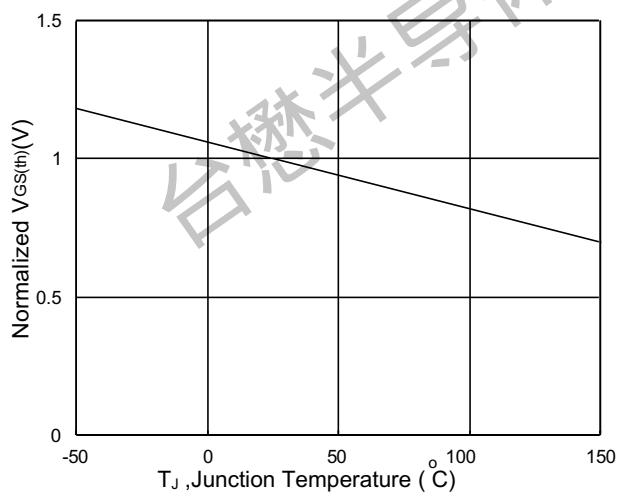
**Fig.2 On-Resistance vs. G-S Voltage**



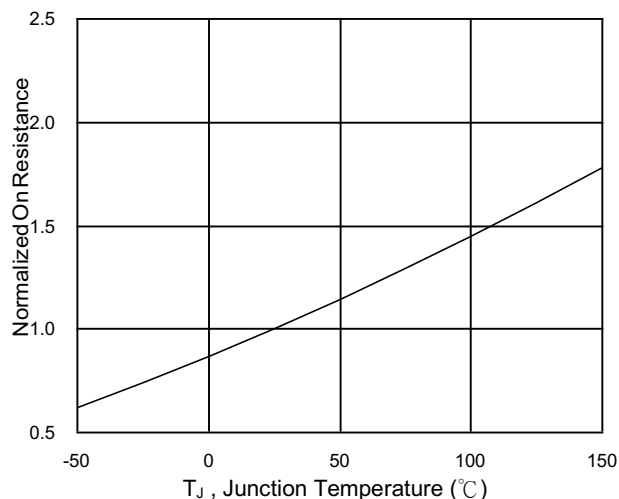
**Fig.3 Source Drain Forward Characteristics**



**Fig.4 Gate-Charge Characteristics**



**Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$**



**Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$**



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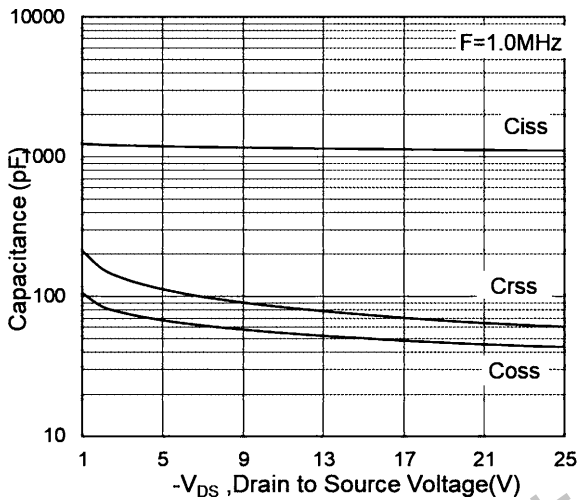


Fig.7 Capacitance

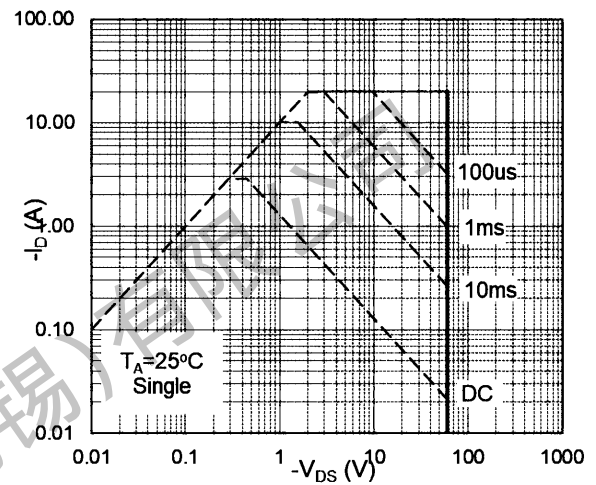


Fig.8 Safe Operating Area

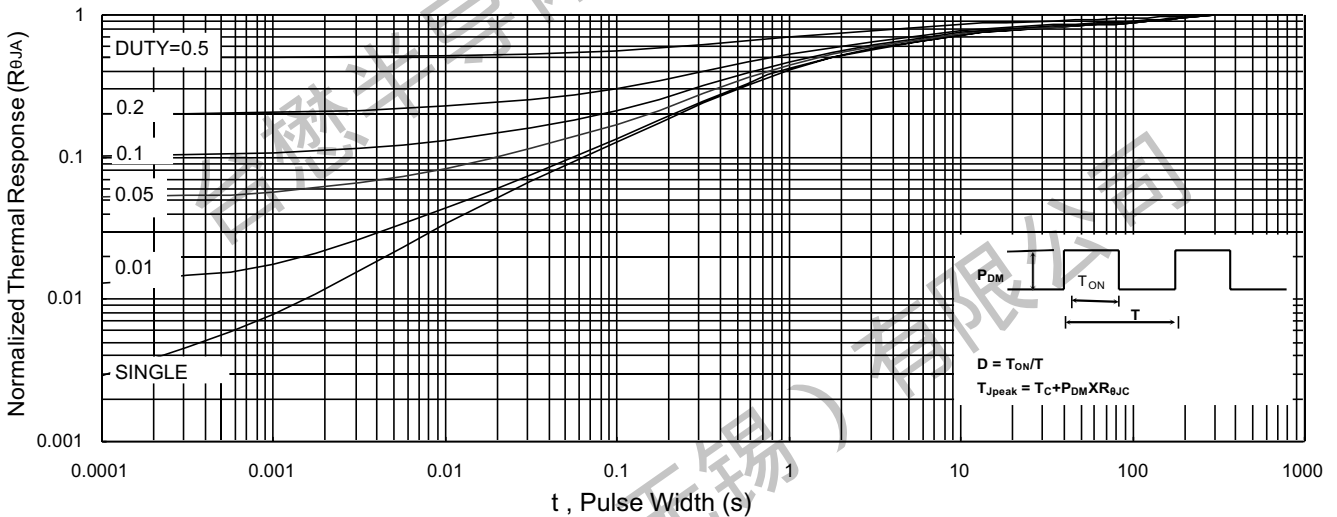


Fig.9 Normalized Maximum Transient Thermal Impedance

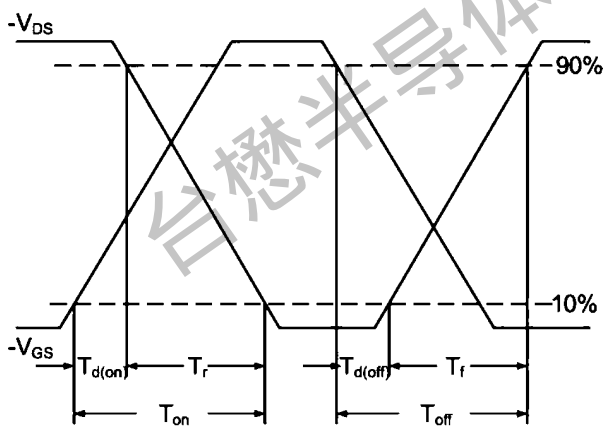


Fig.10 Switching Time Waveform

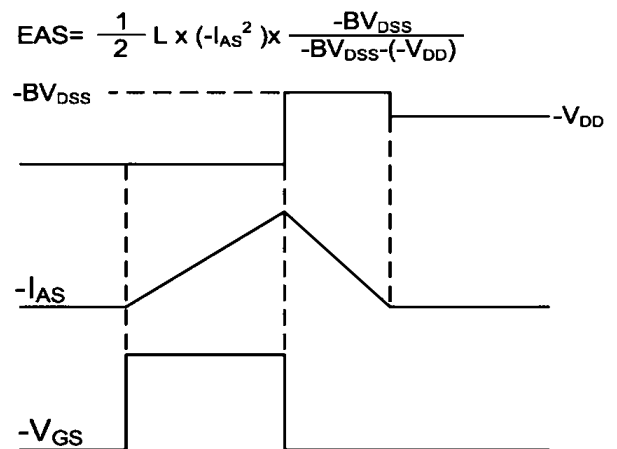
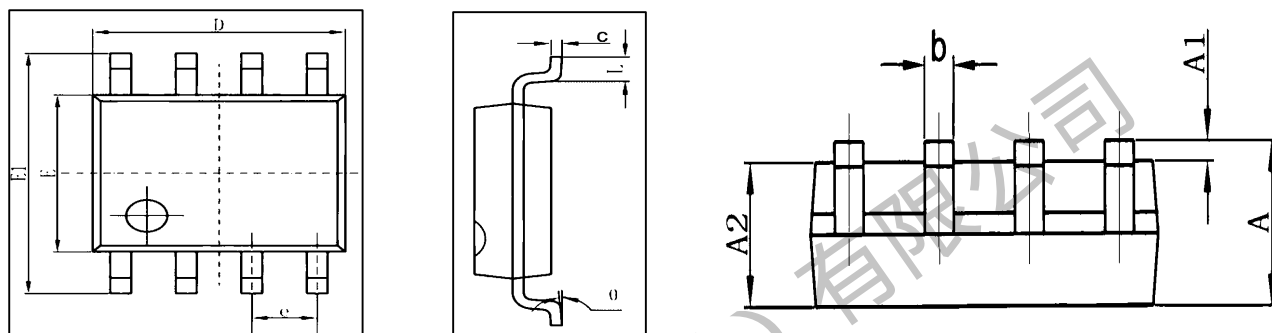


Fig.11 Unclamped Inductive Waveform

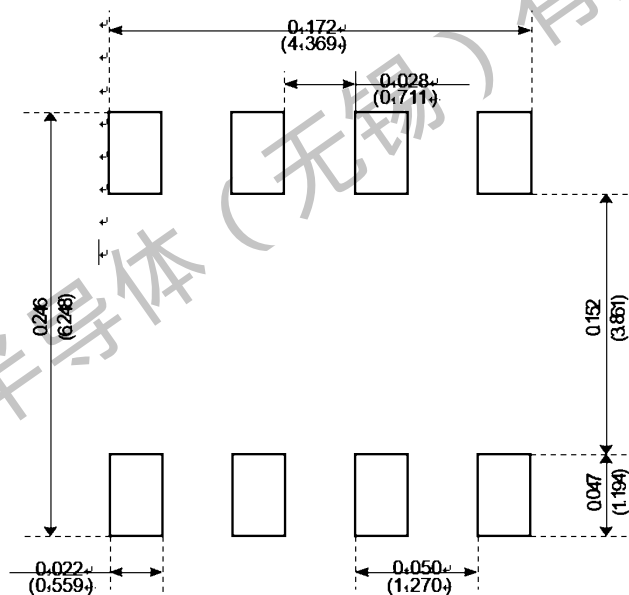
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## N+P-Channel Enhancement Mode Mosfet

### Package Mechanical Data:SOP-8L



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.350                     | 1.750 | 0.053                | 0.069 |
| A1     | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2     | 1.350                     | 1.550 | 0.053                | 0.061 |
| b      | 0.330                     | 0.510 | 0.013                | 0.020 |
| c      | 0.170                     | 0.250 | 0.006                | 0.010 |
| D      | 4.700                     | 5.100 | 0.185                | 0.200 |
| E      | 3.800                     | 4.000 | 0.150                | 0.157 |
| E1     | 5.800                     | 6.200 | 0.228                | 0.244 |
| e      | 1.270 (BSC)               |       | 0.050 (BSC)          |       |
| L      | 0.400                     | 1.270 | 0.016                | 0.050 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |

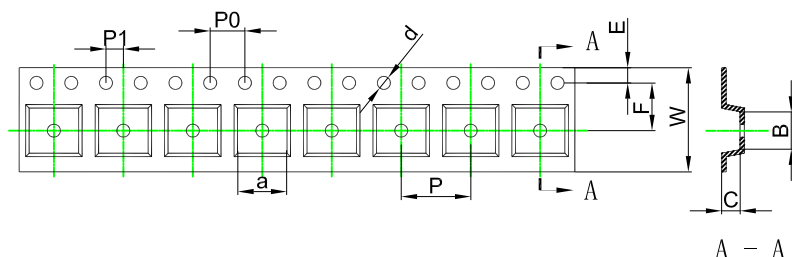


Recommended Minimum Pads

## TM05G06S

## N+P-Channel Enhancement Mode Mosfet

### SOP-8L Embossed Carrier Tape



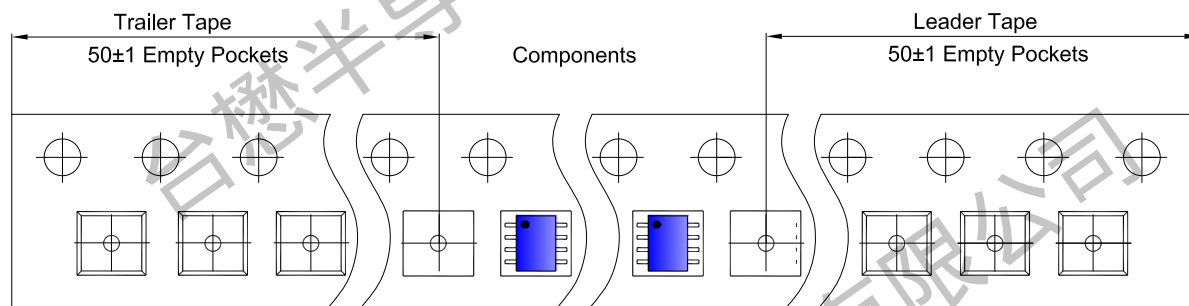
#### Packaging Description:

SOP-8L parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 2,500 units per 13" or 33cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

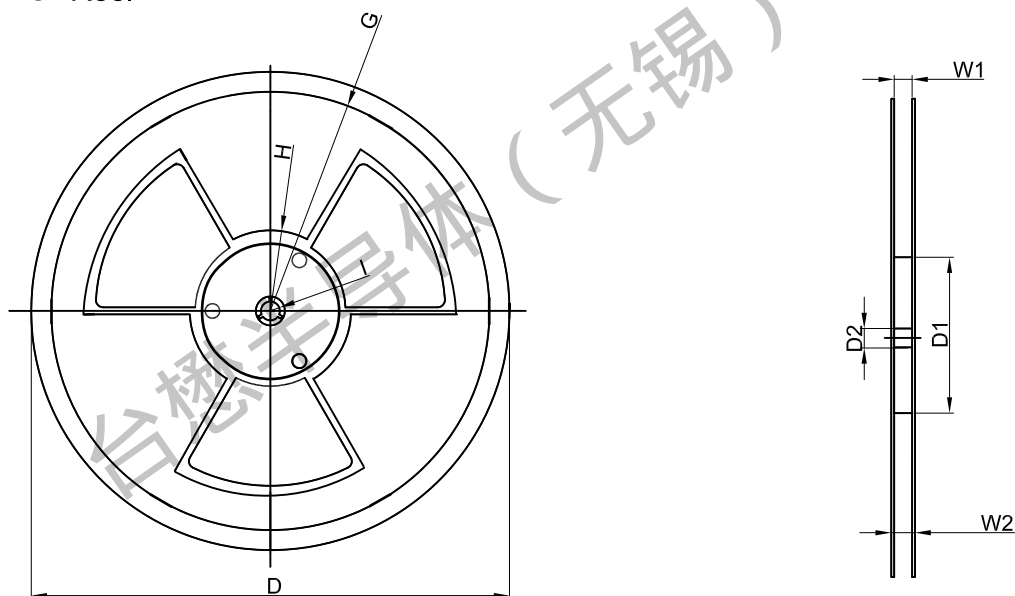
ALL DIM IN mm

| Dimensions are in millimeter |      |      |      |       |      |      |      |      |      |       |
|------------------------------|------|------|------|-------|------|------|------|------|------|-------|
| Pkg type                     | a    | B    | C    | d     | E    | F    | P0   | P    | P1   | W     |
| SOP-8L                       | 6.40 | 5.40 | 2.10 | Ø1.50 | 1.75 | 5.50 | 4.00 | 8.00 | 2.00 | 12.00 |

### SOP-8L Tape Leader and Trailer



### SOP-8L Reel



| Dimensions are in millimeter |         |        |       |         |        |       |       |       |
|------------------------------|---------|--------|-------|---------|--------|-------|-------|-------|
| Reel Option                  | D       | D1     | D2    | G       | H      | I     | W1    | W2    |
| 13"Dia                       | Ø330.00 | 100.00 | 13.00 | R135.00 | R55.00 | R6.50 | 12.00 | 14.00 |

| REEL      | Reel Size | Box       | Box Size(mm) | Carton     | Carton Size(mm) | G.W.(kg) |
|-----------|-----------|-----------|--------------|------------|-----------------|----------|
| 3,000 pcs | 13 inch   | 6,000 pcs | 370×355×52   | 48,000 pcs | 400×360×368     |          |

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Revision history:

| Date       | Rev   | Description | Page |
|------------|-------|-------------|------|
| 2023.07.14 | 23.07 | Original    |      |