

## PRODUCT DATA SHEET



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**Datasheet**



**Resources**

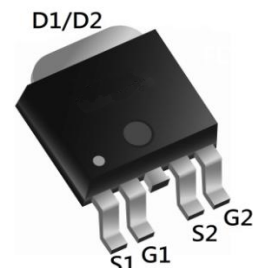


**Samples**

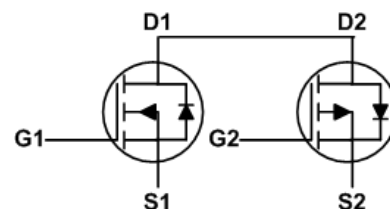
Please note: Please check the JINGAO Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at [www.jg-semi.cn](http://www.jg-semi.cn). Please email any questions regarding the system integration to [JINGAO\\_questions@jgsemi.com](mailto:JINGAO_questions@jgsemi.com).

**Product Summary**

| BVDSS | RDSON | ID   |
|-------|-------|------|
| 40V   | 17mΩ  | 25A  |
| -40V  | 32mΩ  | -25A |


**TO252-4L**

- 100% EAS Guaranteed
- Green Device Available
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- Advanced high cell density Trench technology


**Absolute Maximum Ratings**

| Symbol                                | Parameter                                                    | Rating     |            | Units |
|---------------------------------------|--------------------------------------------------------------|------------|------------|-------|
|                                       |                                                              | N-Ch       | P-Ch       |       |
| V <sub>DS</sub>                       | Drain-Source Voltage                                         | 40         | -40        | V     |
| V <sub>GS</sub>                       | Gate-Source Voltage                                          | ± 20       | ± 20       | V     |
| I <sub>D</sub> @T <sub>C</sub> =25°C  | Continuous Drain Current, V <sub>GS</sub> @ 10V <sup>1</sup> | 25         | -25        | A     |
| I <sub>D</sub> @T <sub>C</sub> =100°C | Continuous Drain Current, V <sub>GS</sub> @ 10V <sup>1</sup> | 18         | -16        | A     |
| I <sub>DM</sub>                       | Pulsed Drain Current <sup>2</sup>                            | 46         | -40        | A     |
| EAS                                   | Single Pulse Avalanche Energy <sup>3</sup>                   | 28         | 66         | mJ    |
| I <sub>AS</sub>                       | Avalanche Current                                            | 17.8       | -27.2      | A     |
| P <sub>D</sub> @T <sub>C</sub> =25°C  | Total Power Dissipation <sup>4</sup>                         | 25         | 31.3       | W     |
| T <sub>STG</sub>                      | Storage Temperature Range                                    | -55 to 150 | -55 to 150 | °C    |
| T <sub>J</sub>                        | Operating Junction Temperature Range                         | -55 to 150 | -55 to 150 | °C    |

**Thermal Data**

| Symbol           | Parameter                                        | Typ. | Max. | Unit |
|------------------|--------------------------------------------------|------|------|------|
| R <sub>θJA</sub> | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 62   | °C/W |
| R <sub>θJC</sub> | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 5    | °C/W |

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

| 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                                               | 40   | -    | -    | V     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                          | V <sub>DS</sub> =40V, 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  | 1.5  | 2.5  | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source on-Resistance<br>note3               | V <sub>GS</sub> =10V, I <sub>D</sub> =8A                                                 | -    | 17   | 22   | mΩ    |
|                                                        |                                                          | V <sub>GS</sub> =4.5V, I <sub>D</sub> =5A                                                | -    | 25   | 35   | mΩ    |
| Dynamic Characteristics                                |                                                          |                                                                                          |      |      |      |       |
| C <sub>iss</sub>                                       | Input Capacitance                                        | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                   | -    | 633  | -    | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                                       |                                                                                          | -    | 67   | -    | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                             |                                                                                          | -    | 58   | -    | pF    |
| Q <sub>g</sub>                                         | Total Gate Charge                                        | V <sub>DS</sub> =20V, I <sub>D</sub> =8A,<br>V <sub>GS</sub> =10V                        | -    | 12   | -    | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                       |                                                                                          | -    | 3.2  | -    | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain(“Miller”) Charge                              |                                                                                          | -    | 3.1  | -    | nC    |
| Switching Characteristics                              |                                                          |                                                                                          |      |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-on Delay Time                                       | V <sub>DD</sub> = 20V, R <sub>L</sub> =2.5Ω<br>V <sub>GS</sub> =10V,R <sub>REN</sub> =3Ω | -    | 4    | -    | ns    |
| t <sub>r</sub>                                         | Turn-on Rise Time                                        |                                                                                          | -    | 3    | -    | ns    |
| t <sub>d(off)</sub>                                    | Turn-off Delay Time                                      |                                                                                          | -    | 15   | -    | ns    |
| t <sub>f</sub>                                         | Turn-off Fall Time                                       |                                                                                          | -    | 2    | -    | ns    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                          |                                                                                          |      |      |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain to Source Diode Forward Current |                                                                                          | -    | -    | 20   | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                                          | -    | -    | 32   | A     |
| V <sub>SD</sub>                                        | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> =0V, I <sub>S</sub> = 8A                                                 | -    | -    | 1.2  | V     |

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

2. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=20V, V_G=10V, L=0.5mH, R_g=25\Omega, I_{AS}=7.2A$

$T_J=25^{\circ}\text{C}, V_{DD}=-20V, V_G=-10V, L=0.5mH, R_g=25\Omega, I_{AS}=-8.4A$

3. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 2\%$

**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                 | $V_{GS}=0V$ , $I_D=-250\mu A$                                  | -40  | ---    | ---       | V                   |
| $\Delta BV_{DSS}/\Delta T_J$ | $BV_{DSS}$ Temperature Coefficient             | Reference to $25^\circ\text{C}$ , $I_D=-1\text{mA}$            | ---  | -0.012 | ---       | $V/^\circ\text{C}$  |
| $R_{DS(ON)}$                 | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=-10V$ , $I_D=-8A$                                      | ---  | 32     | 45        | $m\Omega$           |
|                              |                                                | $V_{GS}=-4.5V$ , $I_D=-4A$                                     | ---  | 47     | 70        |                     |
| $V_{GS(th)}$                 | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=-250\mu A$                              | -1.0 | -1.6   | -2.5      | V                   |
| $\Delta V_{GS(th)}$          | $V_{GS(th)}$ Temperature Coefficient           |                                                                | ---  | 4.32   | ---       | $mV/^\circ\text{C}$ |
| $I_{DSS}$                    | Drain-Source Leakage Current                   | $V_{DS}=-32V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$           | ---  | ---    | 1         | $\mu A$             |
|                              |                                                | $V_{DS}=-32V$ , $V_{GS}=0V$ , $T_J=55^\circ\text{C}$           | ---  | ---    | 5         |                     |
| $I_{GSS}$                    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V$ , $V_{DS}=0V$                                 | ---  | ---    | $\pm 100$ | nA                  |
| $g_{fs}$                     | Forward Transconductance                       | $V_{DS}=-5V$ , $I_D=-8A$                                       | ---  | 12.6   | ---       | S                   |
| $R_g$                        | Gate Resistance                                | $V_{DS}=0V$ , $V_{GS}=0V$ , $f=1\text{MHz}$                    | ---  | 13     | 16        | $\Omega$            |
| $Q_g$                        | Total Gate Charge (-4.5V)                      | $V_{DS}=-20V$ , $V_{GS}=-4.5V$ , $I_D=-12A$                    | ---  | 9      | ---       | nC                  |
| $Q_{gs}$                     | Gate-Source Charge                             |                                                                | ---  | 2.54   | ---       |                     |
| $Q_{gd}$                     | Gate-Drain Charge                              |                                                                | ---  | 3.1    | ---       |                     |
| $T_{d(on)}$                  | Turn-On Delay Time                             | $V_{DD}=-15V$ , $V_{GS}=-10V$ , $R_G=3.3\Omega$ ,<br>$I_D=-1A$ | ---  | 19.2   | ---       | ns                  |
| $T_r$                        | Rise Time                                      |                                                                | ---  | 12.8   | ---       |                     |
| $T_{d(off)}$                 | Turn-Off Delay Time                            |                                                                | ---  | 48.6   | ---       |                     |
| $T_f$                        | Fall Time                                      |                                                                | ---  | 4.6    | ---       |                     |
| $C_{iss}$                    | Input Capacitance                              | $V_{DS}=-15V$ , $V_{GS}=0V$ , $f=1\text{MHz}$                  | ---  | 1004   | ---       | pF                  |
| $C_{oss}$                    | Output Capacitance                             |                                                                | ---  | 108    | ---       |                     |
| $C_{rss}$                    | Reverse Transfer Capacitance                   |                                                                | ---  | 80     | ---       |                     |

**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                     | ---  | ---  | -20  | A    |
| $I_{SM}$ | Pulsed Source Current <sup>2,5</sup>     |                                                  | ---  | ---  | -40  | A    |
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup>       | $V_{GS}=0V$ , $I_S=-1A$ , $T_J=25^\circ\text{C}$ | ---  | ---  | -1   | V    |

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ 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  $V_{DD}=-25V$ ,  $V_{GS}=-10V$ ,  $L=0.1mH$ ,  $I_{AS}=-27.2A$
- 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.

## Typical Performance Characteristics-N

**Figure1: Output Characteristics**

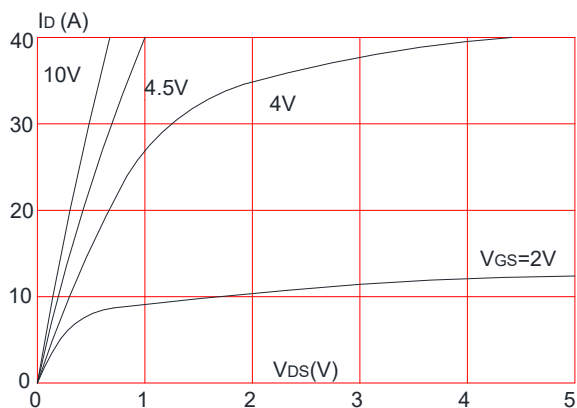


**Figure 2: Typical Transfer Characteristics**

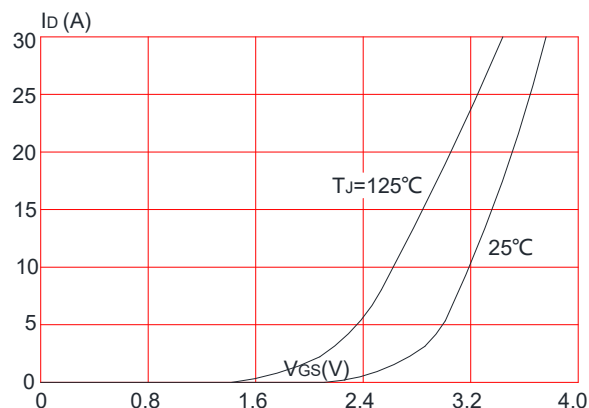


**Figure 3: On-resistance vs. Drain Current**

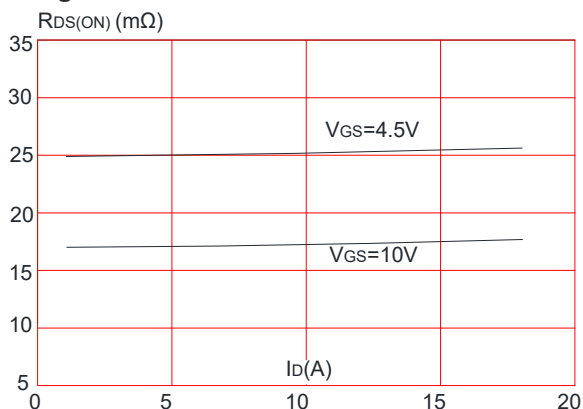


**Figure 4: Body Diode Characteristics**

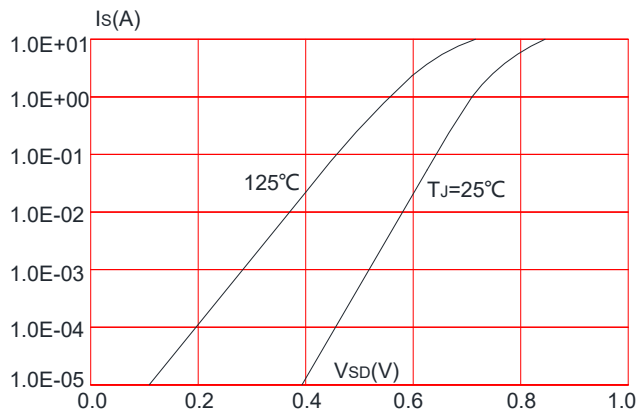


**Figure 5: Gate Charge Characteristics**

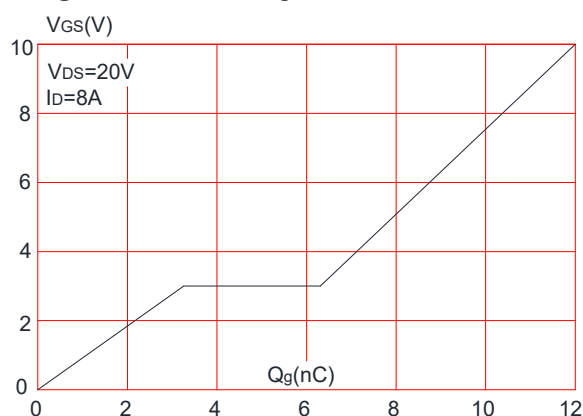


**Figure 6: Capacitance Characteristics**

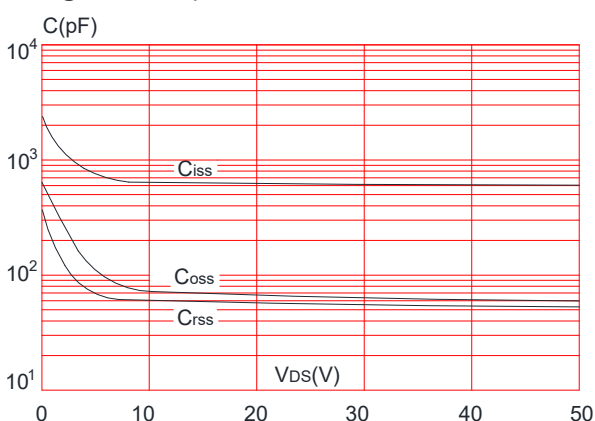


**Figure 7: Normalized Breakdown Voltage vs. Junction Temperature**

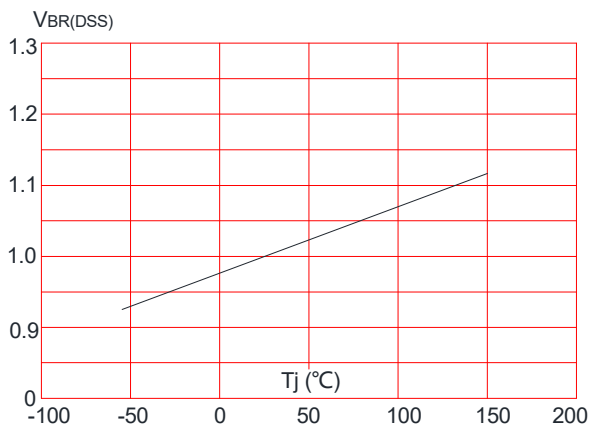


**Figure 8: Normalized on Resistance vs. Junction Temperature**

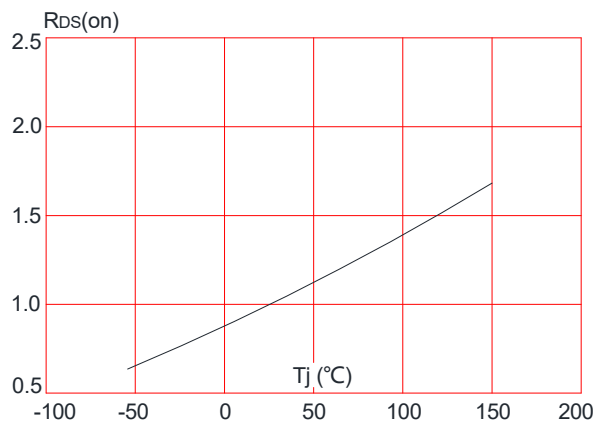


**Figure 9: Maximum Safe Operating Area**

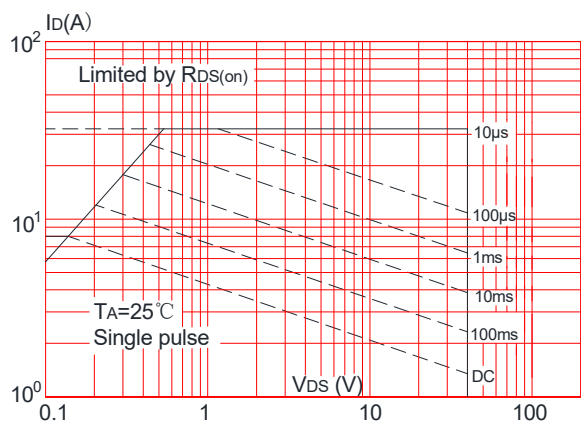


**Figure 10: Maximum Continuous Drain Current vs. Ambient Temperature**

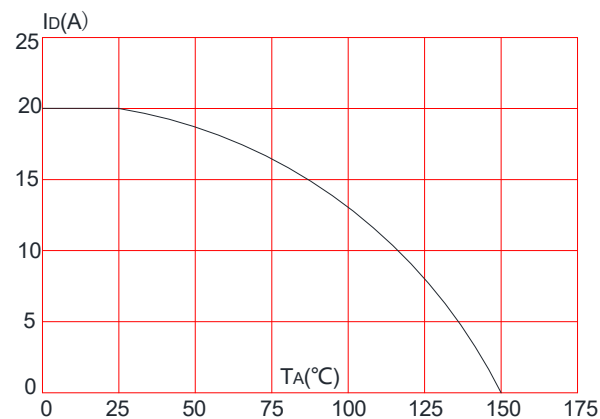
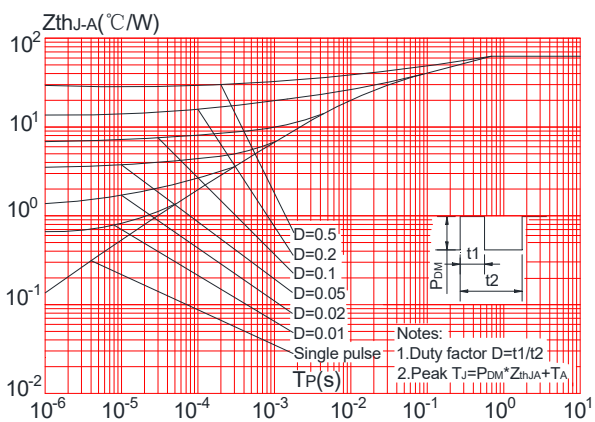
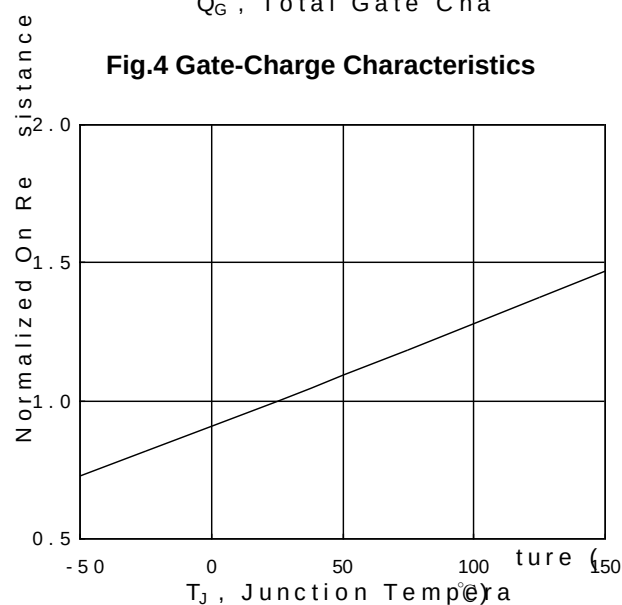
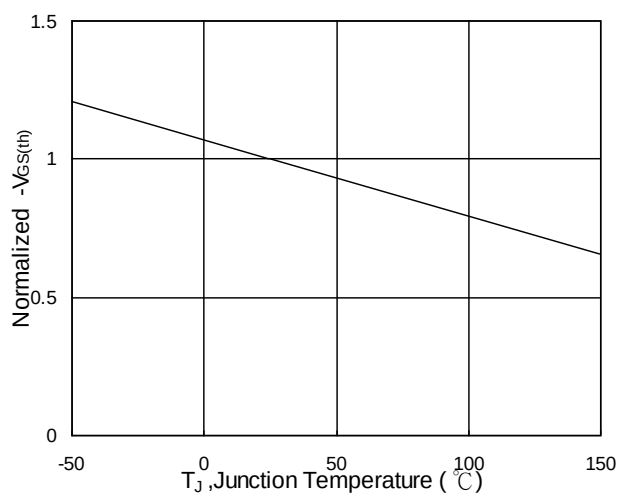
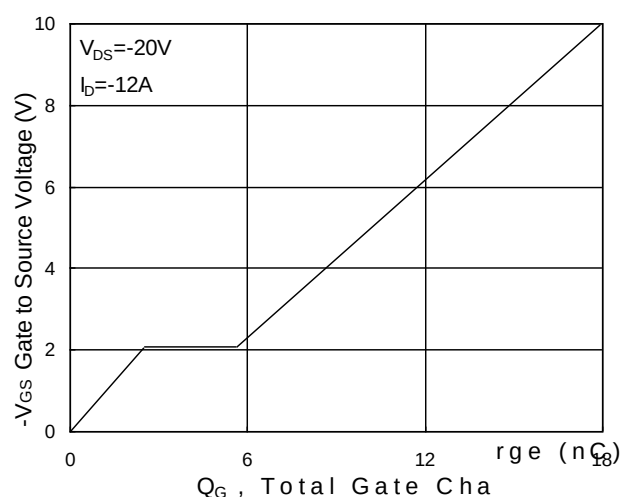
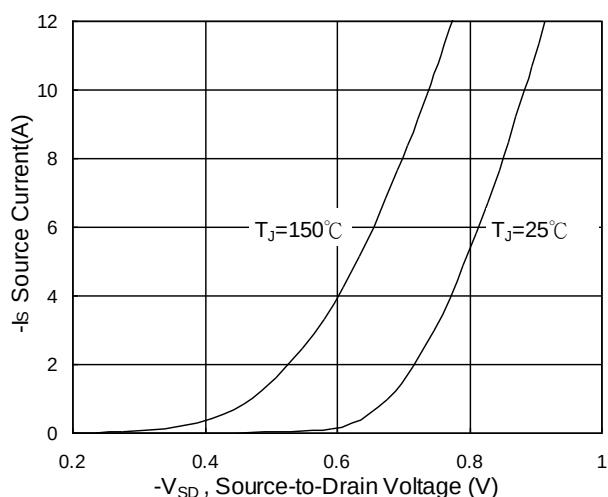
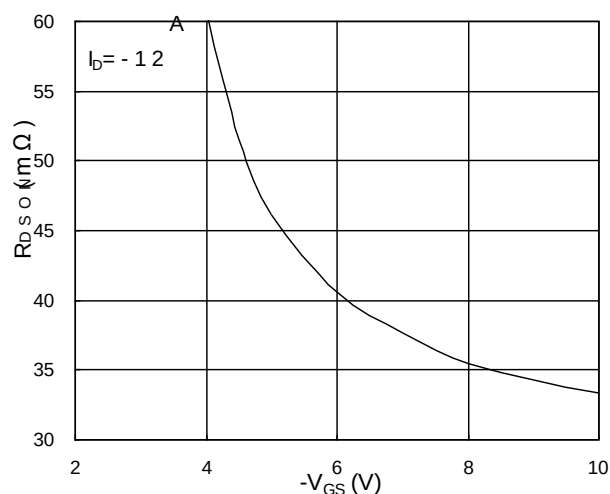
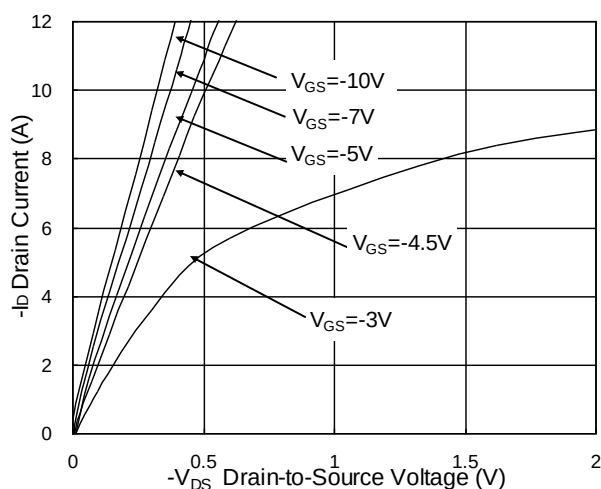
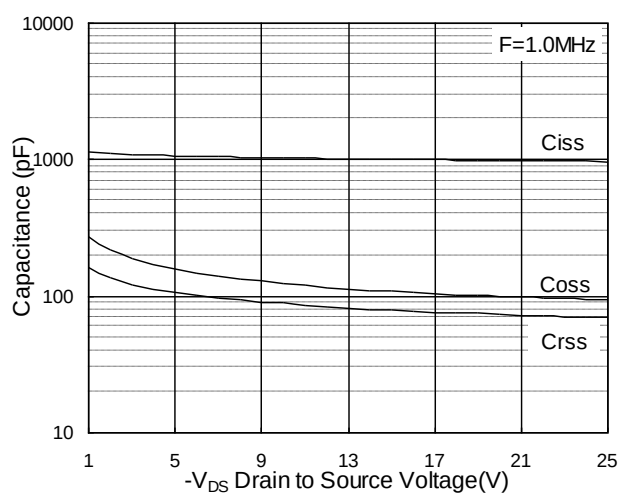
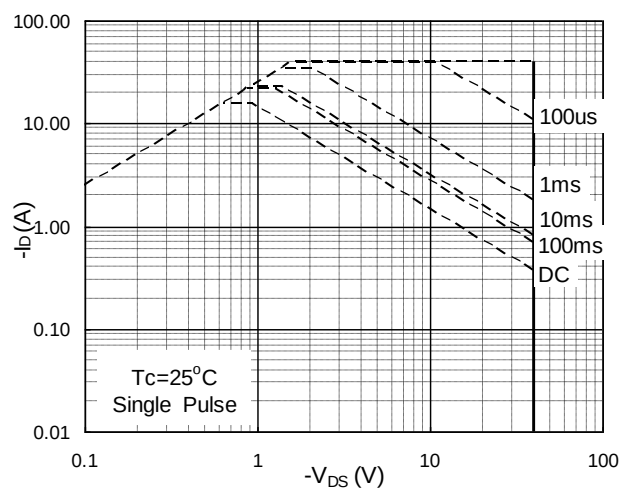
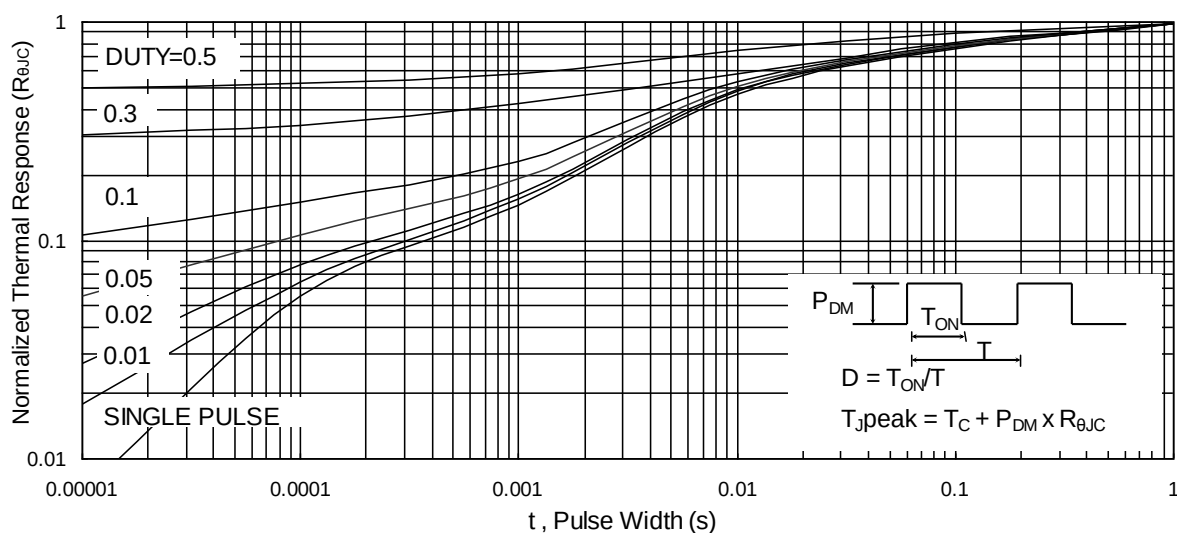
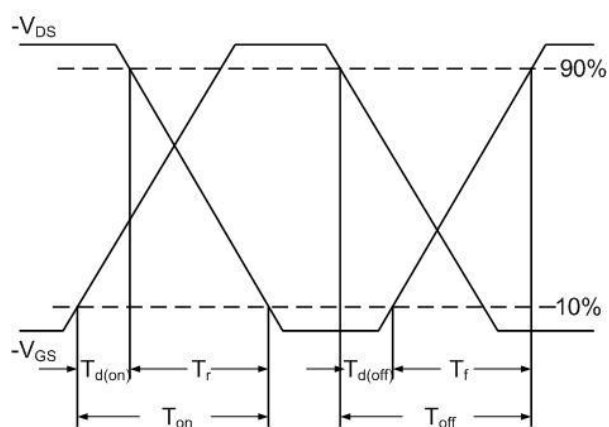
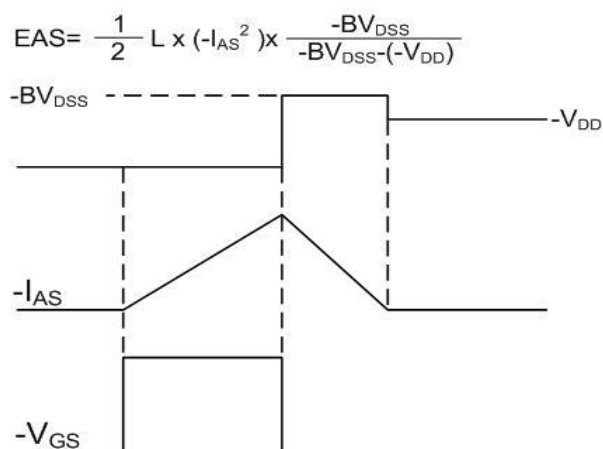


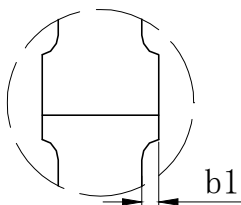
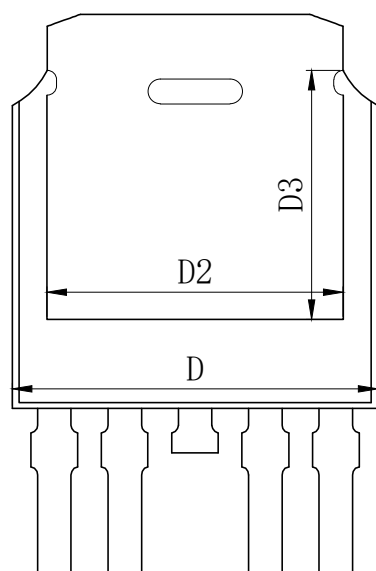
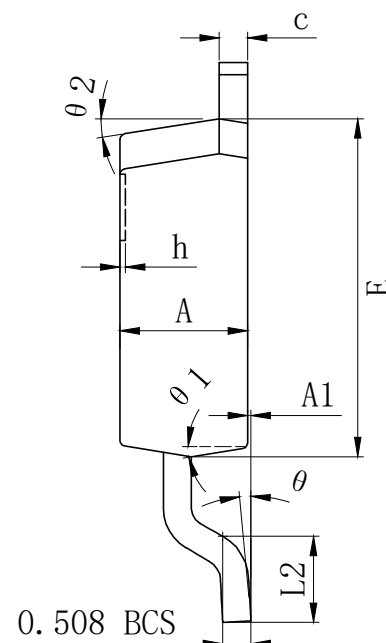
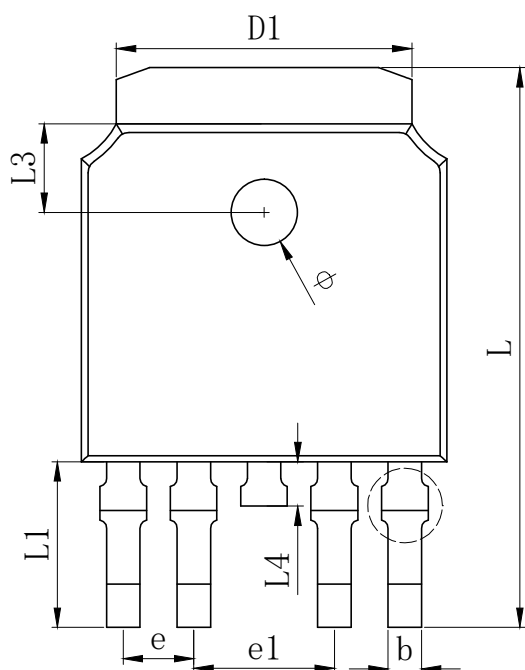
**Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Ambient**



## P-Channel Typical Characteristics




**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**

**Mechanical Dimensions for TO-252-4L**


| SYMBOL  | MILLIMETER |        |        |
|---------|------------|--------|--------|
|         | MIN        | Typ.   | MAX    |
| A       | 2.200      | 2.300  | 2.400  |
| A1      | 0.000      |        | 0.127  |
| b       | 0.550      | 0.600  | 0.650  |
| b1      | 0.000      |        | 0.120  |
| c (电镀后) | 0.460      | 0.520  | 0.580  |
| D       | 6.500      | 6.600  | 6.700  |
| D1      | 5.334 REF  |        |        |
| D2      | 5.346 REF  |        |        |
| D3      | 4.490 REF  |        |        |
| E       | 6.000      | 6.100  | 6.200  |
| e       | 1.270 TYP  |        |        |
| e1      | 2.540 TYP  |        |        |
| h       | 0.000      | 0.100  | 0.200  |
| L       | 9.900      | 10.100 | 10.300 |
| L1      | 2.988 REF  |        |        |
| L2      | 1.400      | 1.550  | 1.700  |
| L3      | 1.600 REF  |        |        |
| L4      | 0.700      | 0.800  | 0.900  |
| Φ       | 1.100      | 1.200  | 1.300  |
| θ       | 0°         |        | 8°     |
| θ 1     | 9° TYP     |        |        |
| θ 2     | 9° TYP     |        |        |

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