

## N and P-Channel Enhancement Mode Power MOSFET

### Description

The HM6602 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. This device is suitable for use as a Battery protection or in other Switching application.

### General Features

#### ● N-Channel

$$V_{DS} = 30V, I_D = 3.6A$$

$$R_{DS(ON)} < 73m\Omega @ V_{GS}=4.5V$$

$$R_{DS(ON)} < 58m\Omega @ V_{GS}=10V$$

#### ● P-Channel

$$V_{DS} = -30V, I_D = -2.5A$$

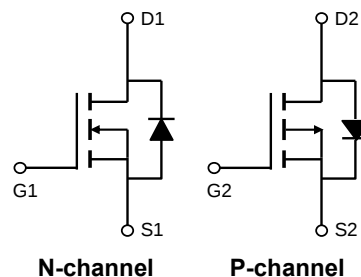
$$R_{DS(ON)} < 130m\Omega @ V_{GS}=-10V$$

$$R_{DS(ON)} < 180m\Omega @ V_{GS}=-4.5V$$

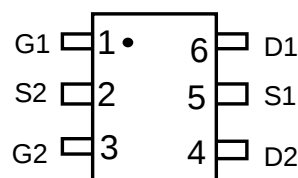
- High Power and current handing capability
- Lead free product is acquired
- Surface Mount Package

### Application

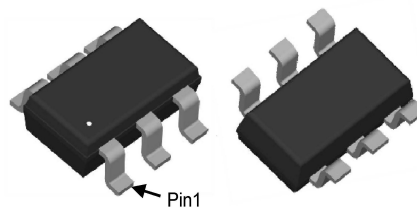
- PWM applications
- Load switch
- Power management



Schematic diagram



Marking and pin Assignment



SOT-23-6L top view

### Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity   |
|----------------|--------|----------------|-----------|------------|------------|
| HM6602         | HM6602 | SOT-23-6L      | Ø180mm    | 8 mm       | 3000 units |

### Absolute Maximum Ratings ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                        | Symbol         | N-Channel  | P-Channel  | Unit             |
|--------------------------------------------------|----------------|------------|------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 30         | -30        | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | $\pm 20$   | V                |
| Continuous Drain Current                         | $I_D$          | 3.6        | -2.5       | A                |
| Pulsed Drain Current (Note 1)                    | $I_{DM}$       | 30         | -30        | A                |
| Maximum Power Dissipation                        | $P_D$          | 1.4        | 1.2        | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 150 | -55 To 150 | $^\circ\text{C}$ |

## Thermal Characteristic

|                                                 |                 |      |     |                      |
|-------------------------------------------------|-----------------|------|-----|----------------------|
| Thermal Resistance, Junction-to-Ambient (Note2) | $R_{\theta JA}$ | N-Ch | 1.0 | $^{\circ}\text{C/W}$ |
|                                                 |                 | P-Ch | 104 |                      |

## N-CH Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)

| Parameter                          | Symbol              | Condition                                                                                | Min | Typ  | Max  | Unit |
|------------------------------------|---------------------|------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                |                     |                                                                                          |     |      |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                | 30  | 33   | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V                                                | -   | -    | 1    | μA   |
| Gate-Body Leakage Current          | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                               | -   | -    | ±100 | nA   |
| On Characteristics (Note 3)        |                     |                                                                                          |     |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                 | 1.2 | 1.5  | 2.2  | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3.1A                                              | -   | 58   | 73   | mΩ   |
|                                    |                     | V <sub>GS</sub> =10V, I <sub>D</sub> =3.6A                                               | -   | 40   | 58   | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =2.9A                                                | 10  | -    | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                          |     |      |      |      |
| Input Capacitance                  | C <sub>iss</sub>    | V <sub>DS</sub> =15V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -   | 623  | -    | PF   |
| Output Capacitance                 | C <sub>oss</sub>    |                                                                                          | -   | 99   | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                          | -   | 77   | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                          |     |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =15V, I <sub>D</sub> =2.9A<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =3Ω | -   | 3.3  | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                          | -   | 4.8  | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                          | -   | 26   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                          | -   | 4    | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =15V, I <sub>D</sub> =3.6A,<br>V <sub>GS</sub> =4.5V                     | -   | 9.5  | -    | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                          | -   | 1.5  | -    | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                          | -   | 3    | -    | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                          |     |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =2.9A                                                | -   | 0.75 | 1.2  | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                          | -   | -    | 2.9  | A    |

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

| Parameter                          | Symbol       | Condition                                                  | Min | Typ  | Max       | Unit       |
|------------------------------------|--------------|------------------------------------------------------------|-----|------|-----------|------------|
| Off Characteristics                |              |                                                            |     |      |           |            |
| Drain-Source Breakdown Voltage     | $BV_{DSS}$   | $V_{GS}=0V, I_D=-250\mu A$                                 | -30 |      | -         | V          |
| Zero Gate Voltage Drain Current    | $I_{DSS}$    | $V_{DS}=-24V, V_{GS}=0V$                                   | -   | -    | -1        | $\mu A$    |
| Gate-Body Leakage Current          | $I_{GSS}$    | $V_{GS}=\pm 12V, V_{DS}=0V$                                | -   | -    | $\pm 100$ | nA         |
| On Characteristics (Note 3)        |              |                                                            |     |      |           |            |
| Gate Threshold Voltage             | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$                             | -1  | -1.6 | -2.5      | V          |
| Drain-Source On-State Resistance   | $R_{DS(ON)}$ | $V_{GS}=-10V, I_D=-2.5A$                                   | -   | 72   | 130       | m $\Omega$ |
|                                    |              | $V_{GS}=-4.5V, I_D=-1.5A$                                  | -   | 110  | 180       | m $\Omega$ |
| Forward Transconductance           | $g_{FS}$     | $V_{DS}=-5V, I_D=-2.5A$                                    | -   | 10   | -         | S          |
| Dynamic Characteristics (Note4)    |              |                                                            |     |      |           |            |
| Input Capacitance                  | $C_{iss}$    | $V_{DS}=-15V, V_{GS}=0V,$<br>$F=1.0MHz$                    | -   | 950  | -         | PF         |
| Output Capacitance                 | $C_{oss}$    |                                                            | -   | 115  | -         | PF         |
| Reverse Transfer Capacitance       | $C_{rss}$    |                                                            | -   | 75   | -         | PF         |
| Switching Characteristics (Note 4) |              |                                                            |     |      |           |            |
| Turn-on Delay Time                 | $t_{d(on)}$  | $V_{DD}=-15V, I_D=-3.2A$<br>$V_{GS}=-10V, R_{GEN}=6\Omega$ | -   | 7    | -         | nS         |
| Turn-on Rise Time                  | $t_r$        |                                                            | -   | 3    | -         | nS         |
| Turn-Off Delay Time                | $t_{d(off)}$ |                                                            | -   | 30   | -         | nS         |
| Turn-Off Fall Time                 | $t_f$        |                                                            | -   | 12   | -         | nS         |
| Total Gate Charge                  | $Q_g$        | $V_{DS}=-15V, I_D=-4A, V_{GS}=-4.5V$                       | -   | 9.5  | -         | nC         |
| Gate-Source Charge                 | $Q_{gs}$     |                                                            | -   | 2    | -         | nC         |
| Gate-Drain Charge                  | $Q_{gd}$     |                                                            | -   | 3    | -         | nC         |
| Drain-Source Diode Characteristics |              |                                                            |     |      |           |            |
| Diode Forward Voltage (Note 3)     | $V_{SD}$     | $V_{GS}=0V, I_S=-1A$                                       | -   | -    | -1.2      | V          |

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

## N- Channel Typical Electrical and Thermal Characteristics (Curves)

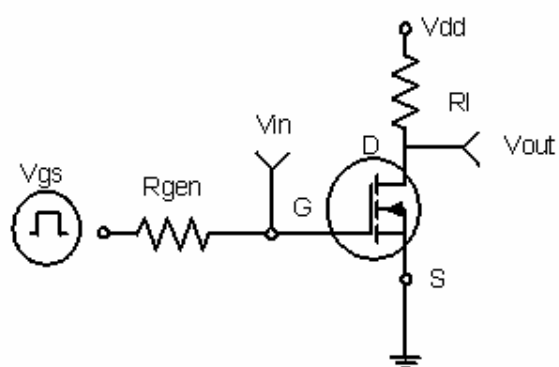


Figure 1: Switching Test Circuit

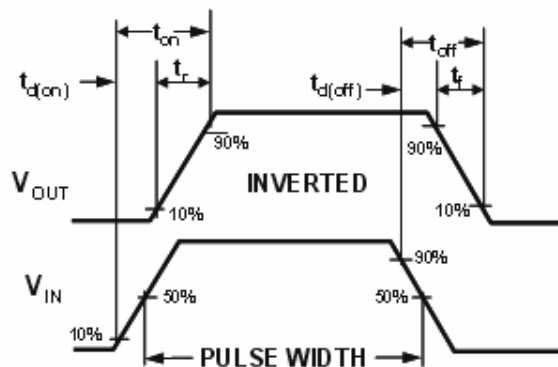


Figure 2: Switching Waveforms

P-Channel Typical Electrical and Thermal Characteristics

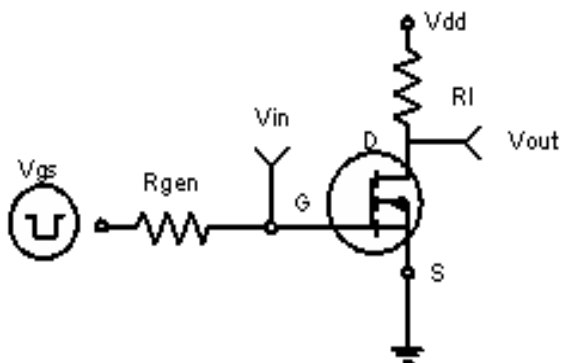


Figure 1:Switching Test Circuit

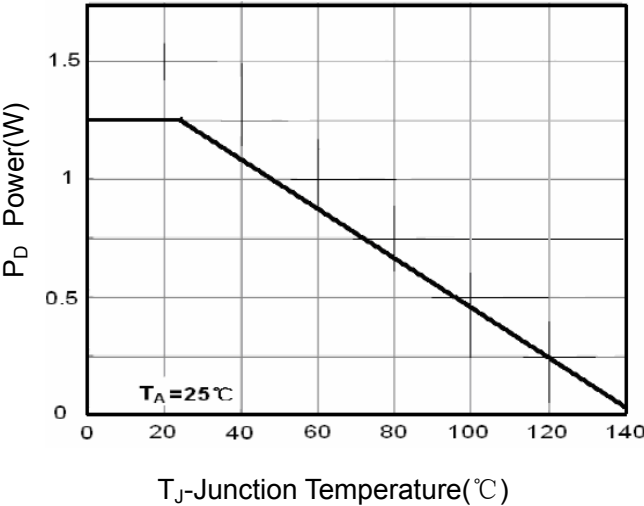


Figure 3 Power Dissipation

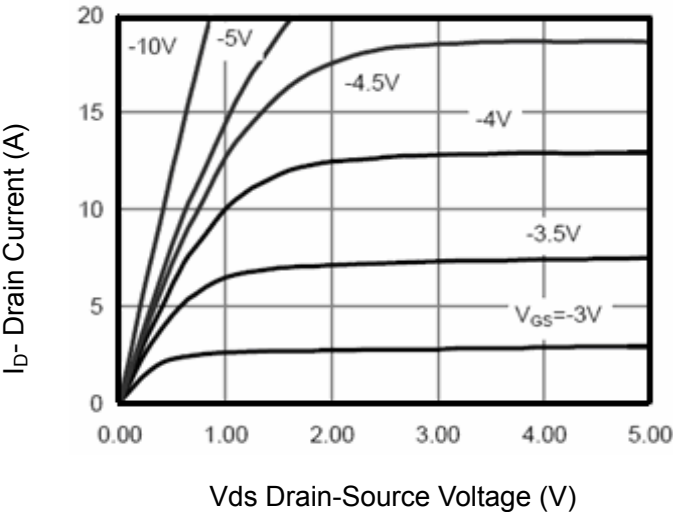


Figure 5 Output CHARACTERISTICS

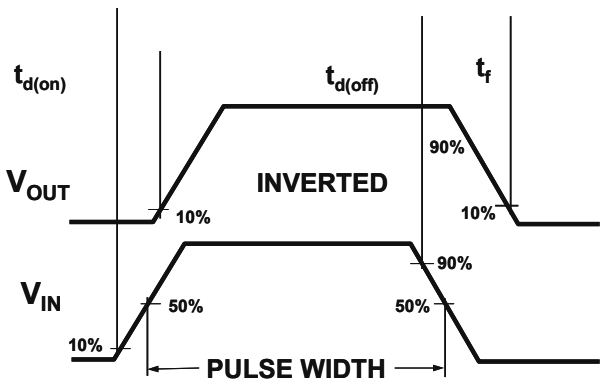


Figure 2:Switching Waveforms

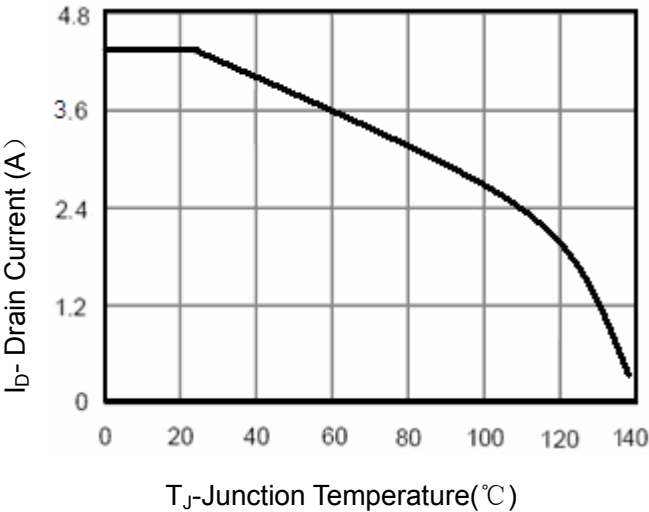


Figure 4 Drain Current

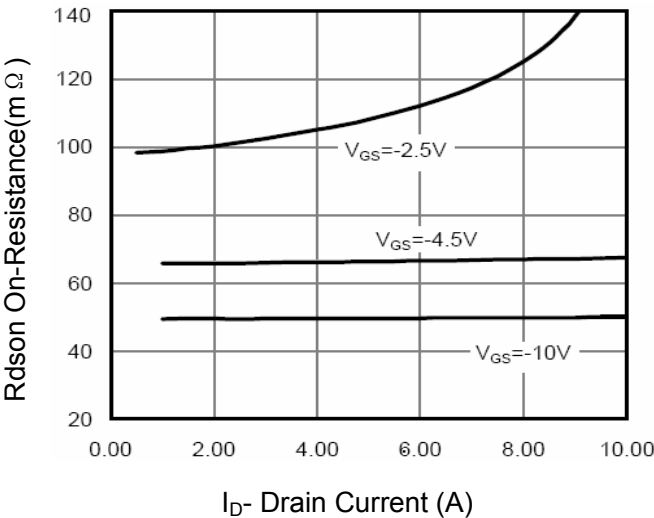


Figure 6 Drain-Source On-Resistance

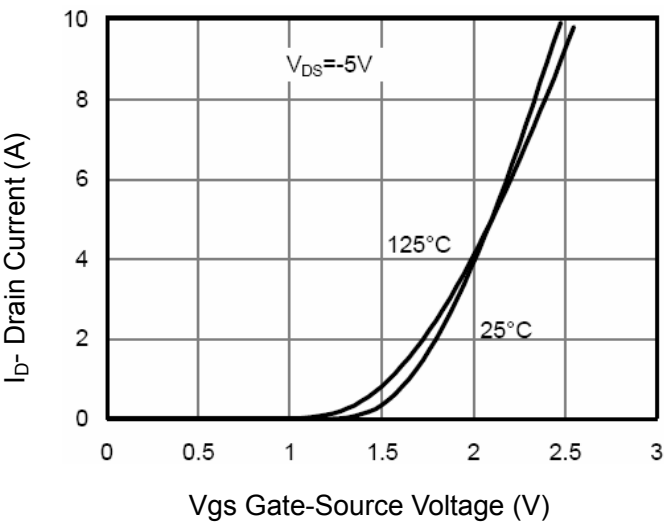


Figure 7 Transfer Characteristics

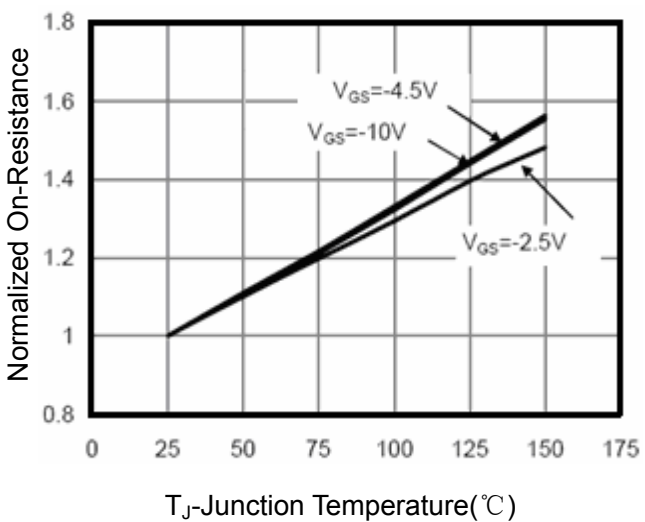


Figure 8 Drain-Source On-Resistance

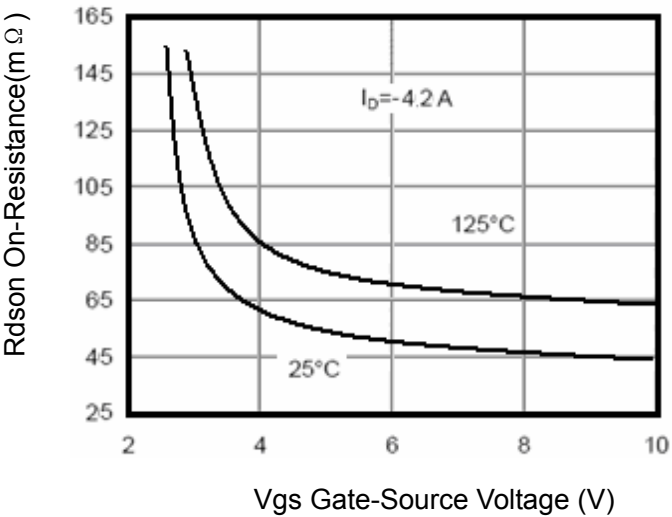


Figure 9 Rdson vs Vgs

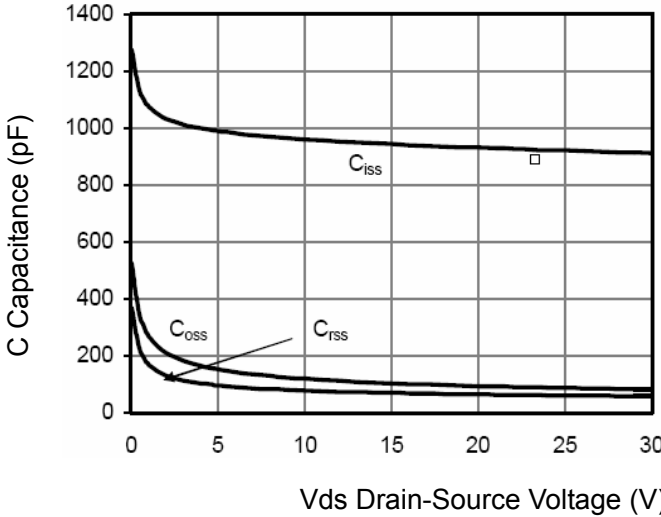


Figure 10 Capacitance vs Vds

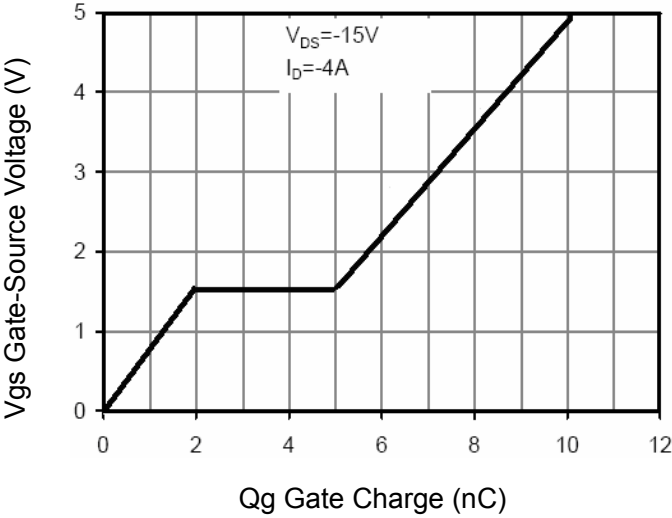


Figure 11 Gate Charge

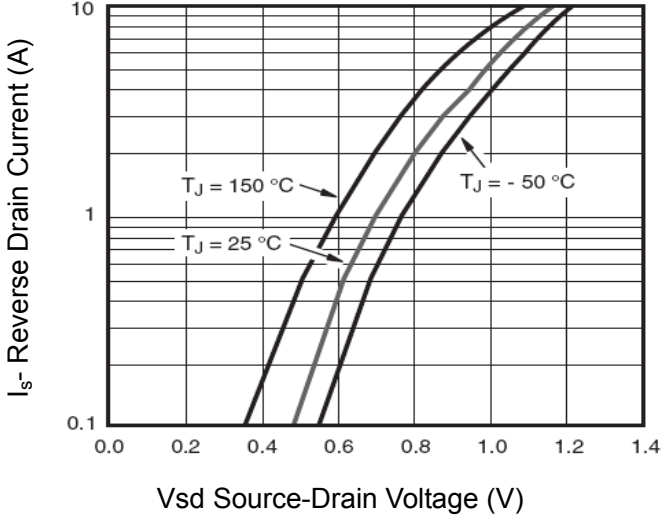


Figure 12 Source- Drain Diode Forward

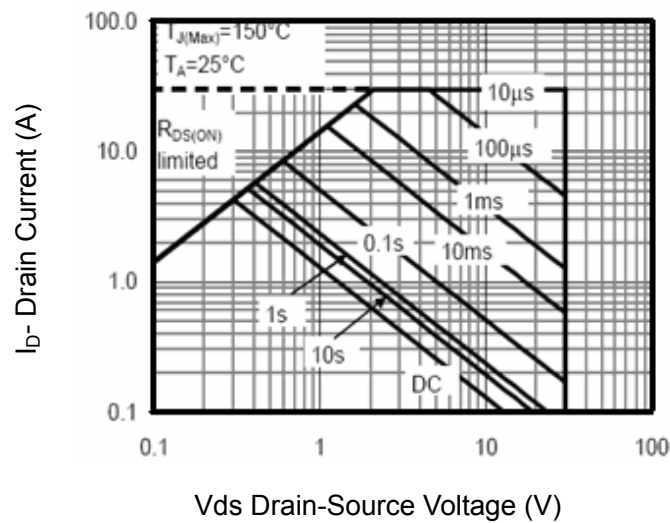


Figure 13 Safe Operation Area

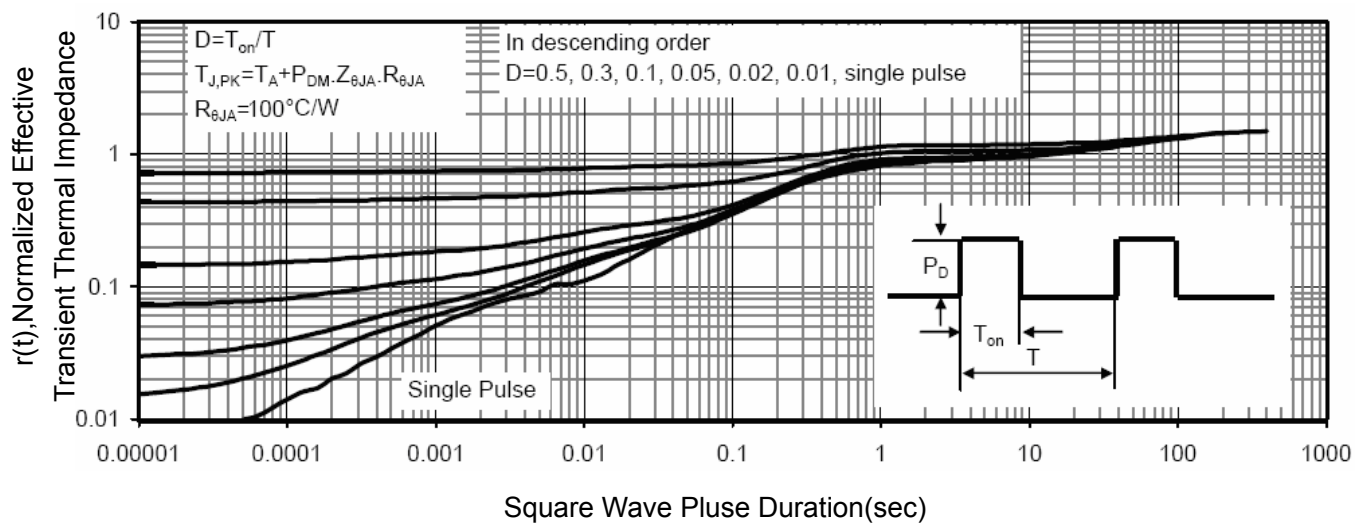
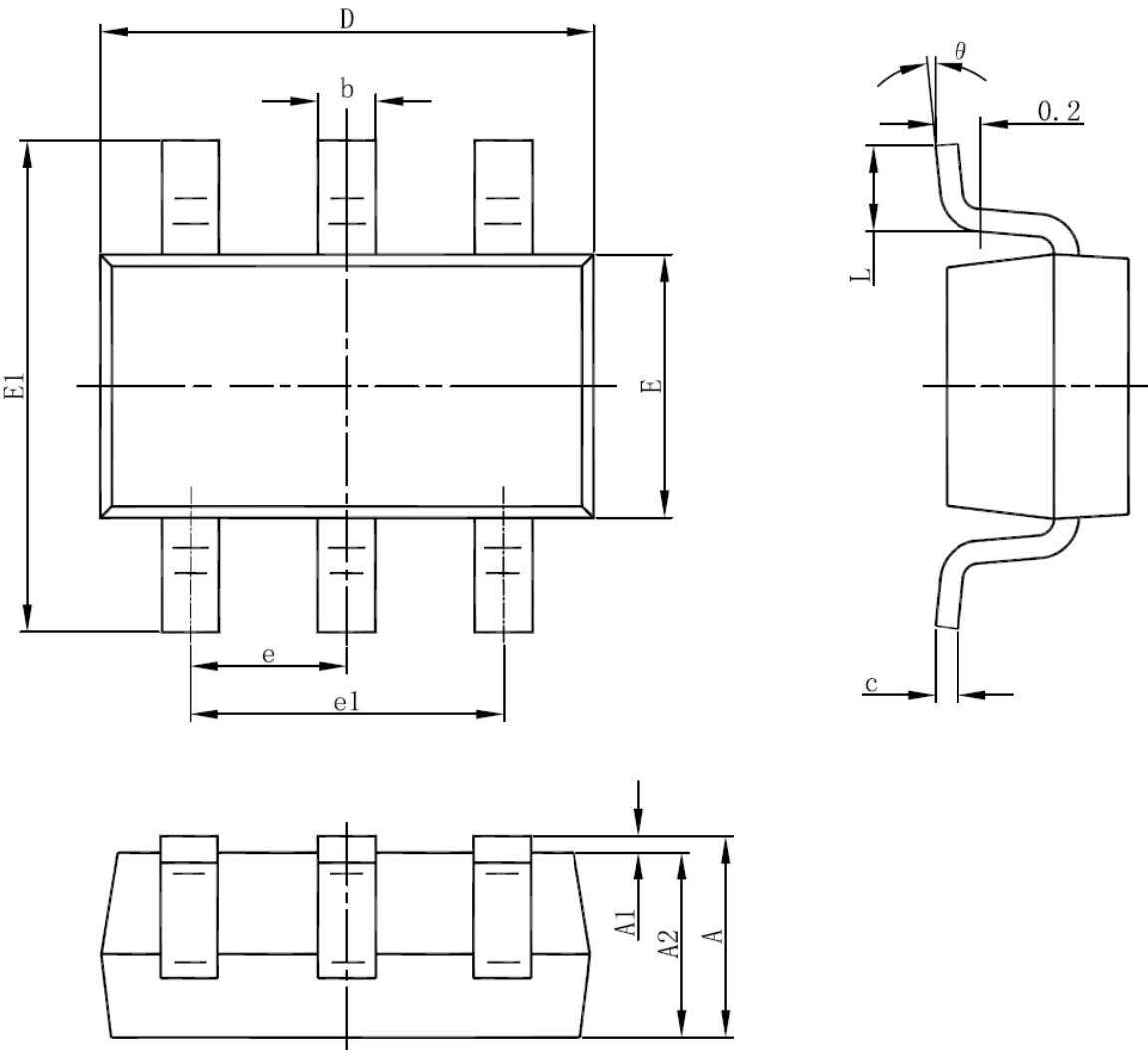


Figure 14 Normalized Maximum Transient Thermal Impedance

SOT23-6L PACKAGE INFORMATION



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.050                     | 1.250 | 0.041                | 0.049 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 1.050                     | 1.150 | 0.041                | 0.045 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.100                     | 0.200 | 0.004                | 0.008 |
| D      | 2.820                     | 3.020 | 0.111                | 0.119 |
| E      | 1.500                     | 1.700 | 0.059                | 0.067 |
| E1     | 2.650                     | 2.950 | 0.104                | 0.116 |
| e      | 0.950(BSC)                |       | 0.037(BSC)           |       |
| e1     | 1.800                     | 2.000 | 0.071                | 0.079 |
| L      | 0.300                     | 0.600 | 0.012                | 0.024 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |