

## TP2003

### N and P-Channel Power Mosfet

#### Description

The TAP2003 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

#### General Features

##### ● N-Channel

$$V_{DS} = 20V, I_D = 3A$$

$$R_{DS(ON)} < 35m\Omega @ V_{GS}=4.5V$$

$$R_{DS(ON)} < 55m\Omega @ V_{GS}=2.5V$$

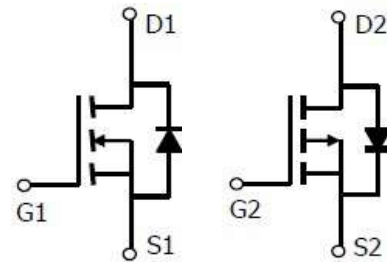
##### ● P-Channel

$$V_{DS} = -20V, I_D = -3A$$

$$R_{DS(ON)} < 75m\Omega @ V_{GS}=-4.5V$$

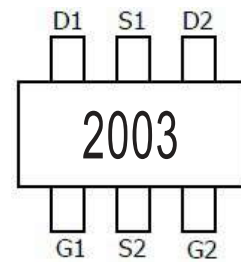
$$R_{DS(ON)} < 100m\Omega @ V_{GS}=-2.5V$$

- High power and current handing capability
- Lead free product is acquired
- Surface mount package
- Halogen-free

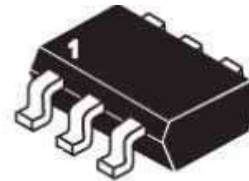


N-channel

P-channel



Marking and pin Assignment



SOT-23-6L top view

#### Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity   |
|----------------|--------|----------------|-----------|------------|------------|
| 2003           | TP2003 | SOT-23-6L      | Ø180mm    | 8mm        | 3000 units |

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

| Parameter                                        |                        | Symbol         | N-Channel  | P-Channel  | Unit             |
|--------------------------------------------------|------------------------|----------------|------------|------------|------------------|
| Drain-Source Voltage                             |                        | $V_{DS}$       | 20         | -20        | V                |
| Gate-Source Voltage                              |                        | $V_{GS}$       | $\pm 12$   | $\pm 12$   | V                |
| Continuous Drain Current                         | $T_A=25^\circ\text{C}$ | $I_D$          | 3          | -3         | A                |
|                                                  | $T_A=70^\circ\text{C}$ |                | 2.4        | -2.4       |                  |
| Pulsed Drain Current <sup>(Note 1)</sup>         |                        | $I_{DM}$       | 13         | -13        | A                |
| Maximum Power Dissipation                        | $T_A=25^\circ\text{C}$ | $P_D$          | 0.8        | 0.8        | 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 <sup>(Note 2)</sup> | $R_{\theta JA}$ | N-Ch | 156 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup> | $R_{\theta JA}$ | P-Ch | 156 | $^\circ\text{C/W}$ |

## 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                                                 | 20  | 22   | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V                                                 | -   | -    | 1    | μA   |
| Gate-Body Leakage Current                     | I <sub>GSS</sub>    | V <sub>GS</sub> =±12V, V <sub>DS</sub> =0V                                                | -   | -    | ±100 | nA   |
| On Characteristics <sup>(Note 3)</sup>        |                     |                                                                                           |     |      |      |      |
| Gate Threshold Voltage                        | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                  | 0.5 | 0.75 | 1.2  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =2.5V, I <sub>D</sub> =2.8A                                               | -   | 29   | 55   | mΩ   |
|                                               |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A                                                 | -   | 23   | 35   | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =3A                                                   | -   | 8    | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                           |     |      |      |      |
| Input Capacitance                             | C <sub>Iss</sub>    | V <sub>DS</sub> =10V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                    | -   | 260  | -    | PF   |
| Output Capacitance                            | C <sub>Oss</sub>    |                                                                                           | -   | 48   | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                           | -   | 27   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                           |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =10V, R <sub>L</sub> =3.3Ω<br>V <sub>GS</sub> =4.5V, R <sub>GEN</sub> =6Ω | -   | 2.5  | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                           | -   | 3.2  | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                           | -   | 21   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                           | -   | 3    | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =10V, I <sub>D</sub> =3A,<br>V <sub>GS</sub> =4.5V                        | -   | 2.9  | 5    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                           | -   | 0.4  | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                           | -   | 0.6  | -    | nC   |
| Drain-Source Diode Characteristics            |                     |                                                                                           |     |      |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =3 A                                                  | -   | -    | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                           | -   | -    | 3    | A    |

### 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

## P-CH Electrical Characteristics (TA=25°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                                                | -20  |      | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =-20V, V <sub>GS</sub> =0V                                                | -    | -    | -1   | μA   |
| Gate-Body Leakage Current                     | I <sub>GSS</sub>    | V <sub>GS</sub> =±12V, V <sub>DS</sub> =0V                                                | -    | -    | ±100 | nA   |
| On Characteristics <sup>(Note 3)</sup>        |                     |                                                                                           |      |      |      |      |
| Gate Threshold Voltage                        | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                 | -0.4 | -0.7 | -1   | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2.5 A                                            | -    | 66   | 75   | mΩ   |
|                                               |                     | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2A                                               | -    | 81   | 100  | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =-5V, I <sub>D</sub> =-2.5A                                               | -    | 9.5  | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                           |      |      |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =-10V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -    | 325  | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                           | -    | 63   | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                           | -    | 37   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                           |      |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =-10V, R <sub>L</sub> =5Ω<br>V <sub>GS</sub> =-4.5V, R <sub>GEN</sub> =3Ω | -    | 11   | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                           | -    | 5.5  | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                           | -    | 22   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                           | -    | 8    | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =-10V, I <sub>D</sub> =-2A,<br>V <sub>GS</sub> =-4.5V                     | -    | 3.2  | -    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                           | -    | 0.6  | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                           | -    | 0.9  | -    | nC   |
| Drain-Source Diode Characteristics            |                     |                                                                                           |      |      |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =-3A                                                  | -    | -    | -1.2 | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                           | -    | -    | -3   | A    |

### 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)

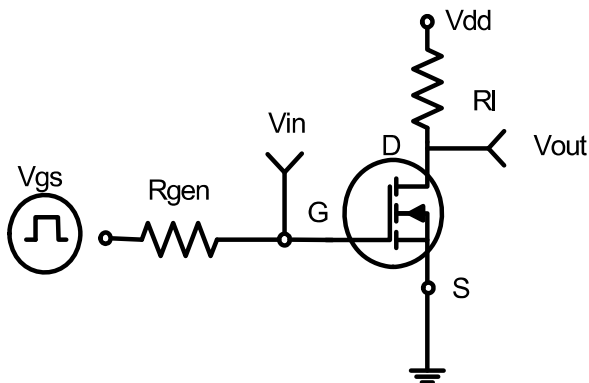


Figure 1: Switching Test Circuit

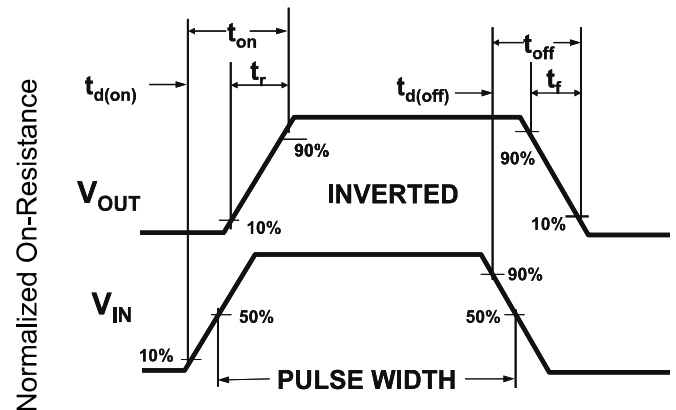


Figure 2: Switching Waveforms

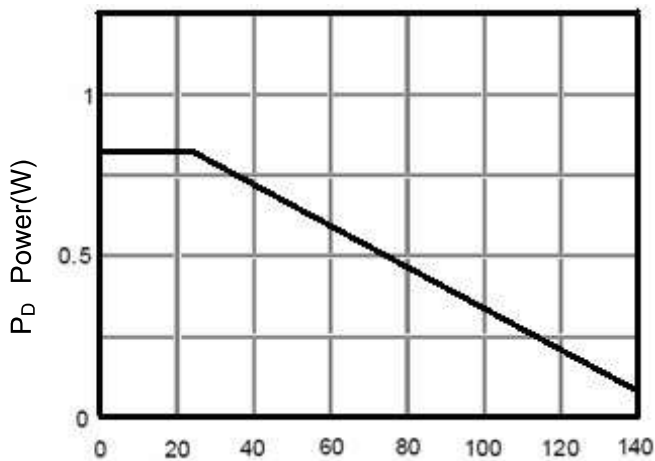


Figure 3 Power Dissipation

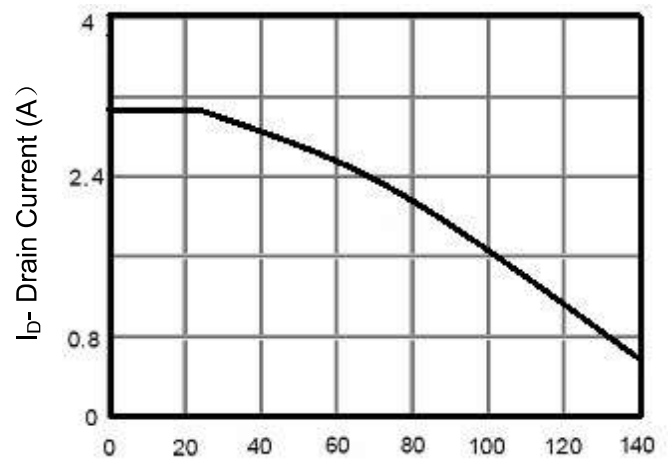


Figure 4 Drain Current

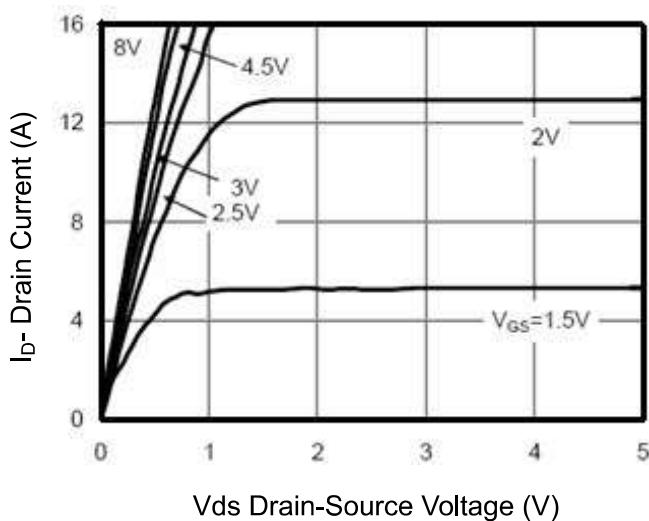


Figure 5 Output Characteristics

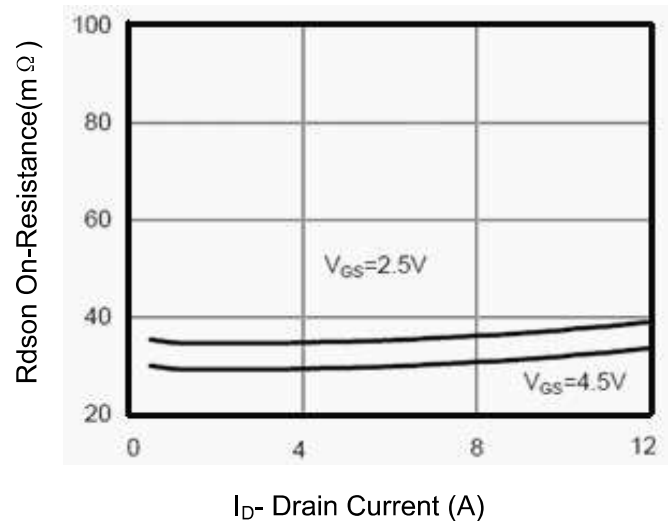
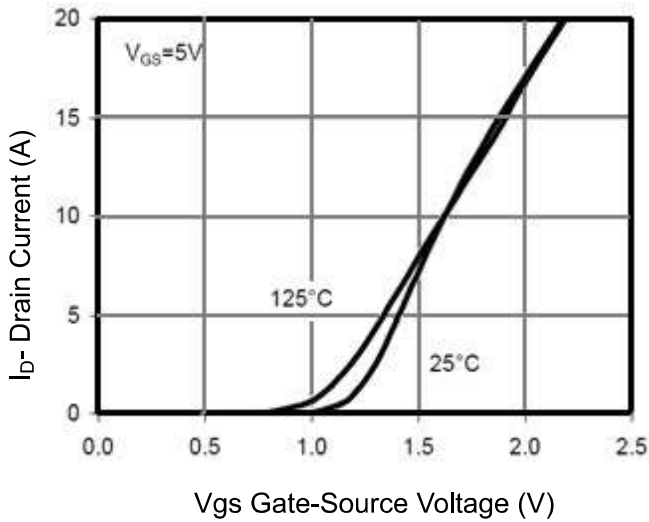
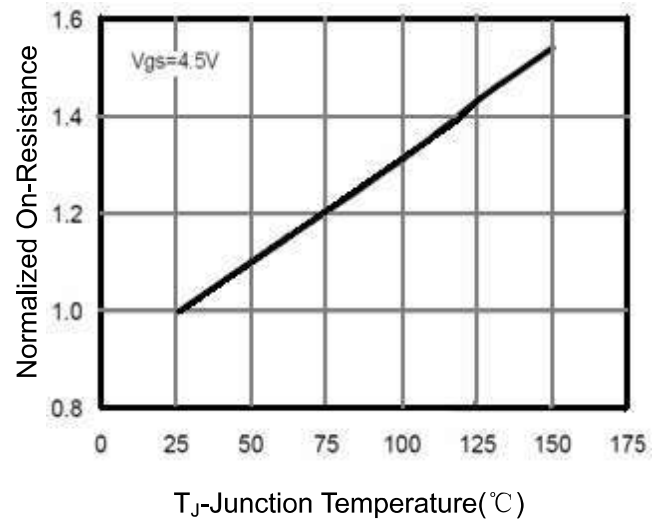


Figure 6 Drain-Source On-Resistance

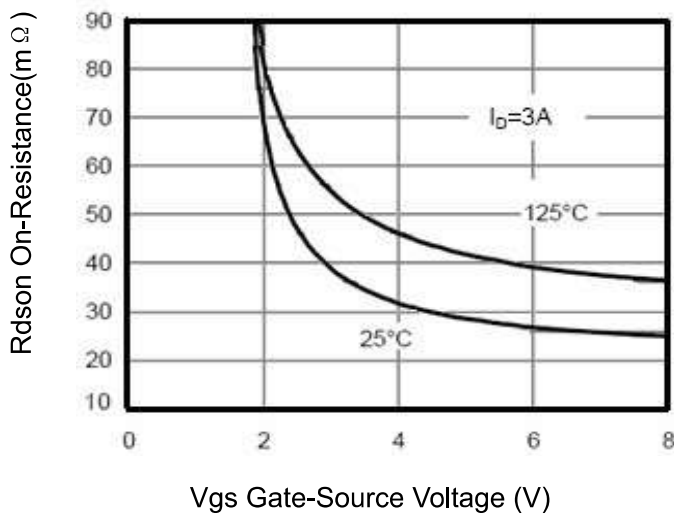
## N- Channel Typical Electrical and Thermal Characteristics (Curves)



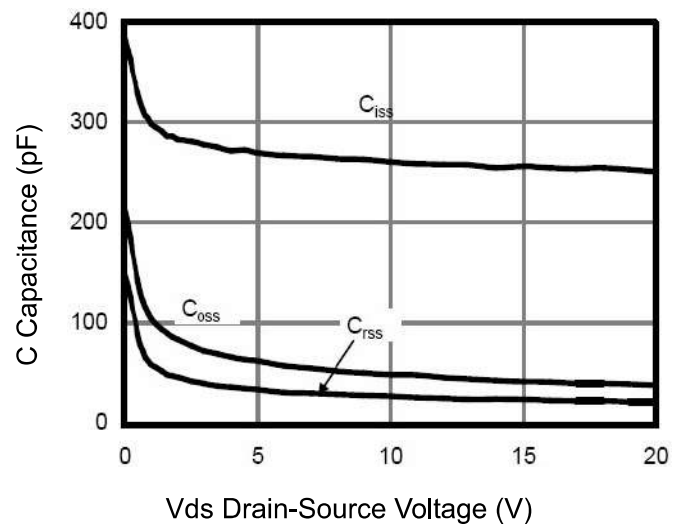
**Figure 7 Transfer Characteristics**



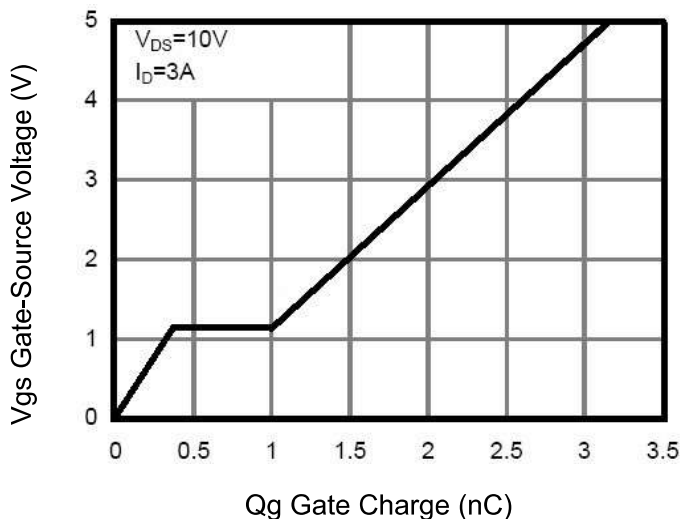
**Figure 8 Drain-Source On-Resistance**



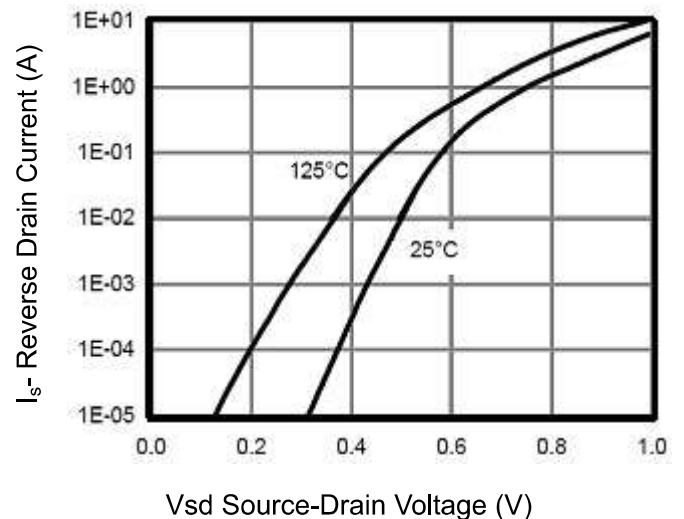
**Figure 9 Rdson vs Vgs**



**Figure 10 Capacitance vs Vds**



**Figure 11 Gate Charge**



**Figure 12 Source- Drain Diode Forward**

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

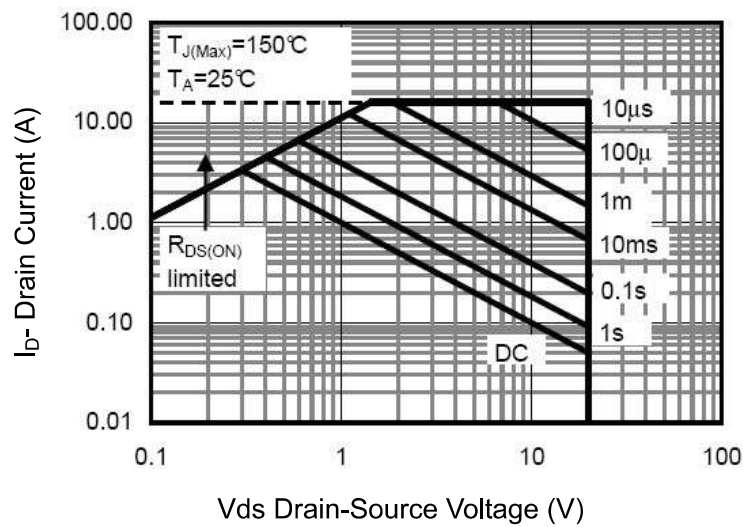


Figure 13 Safe Operation Area

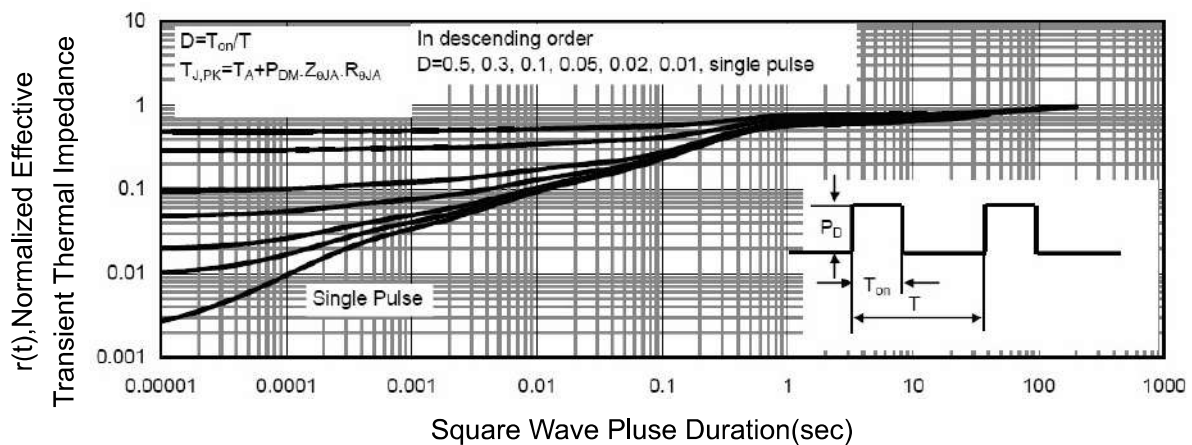


Figure 14 Normalized Maximum Transient Thermal Impedance

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

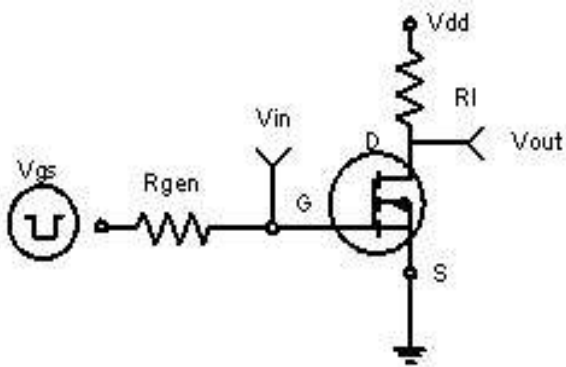


Figure 1: Switching Test Circuit

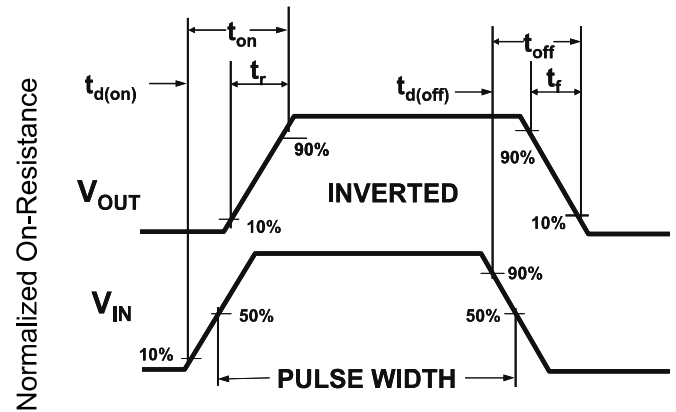
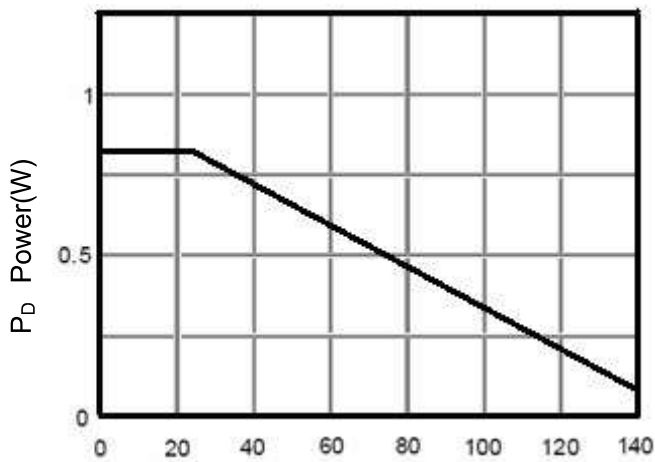
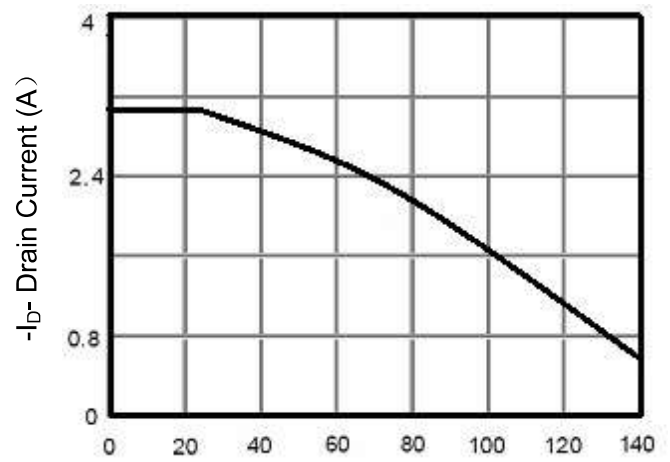


Figure 2: Switching Waveforms



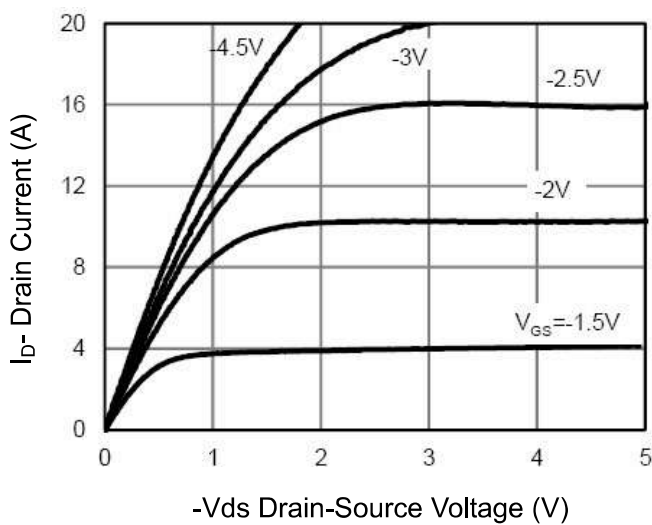
T<sub>J</sub>-Junction Temperature(°C)

Figure 3 Power Dissipation



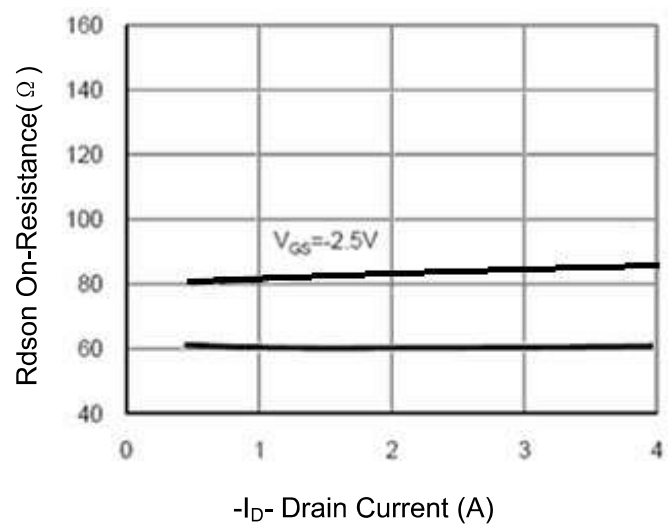
T<sub>J</sub>-Junction Temperature(°C)

Figure 4 Drain Current



-V<sub>DS</sub> Drain-Source Voltage (V)

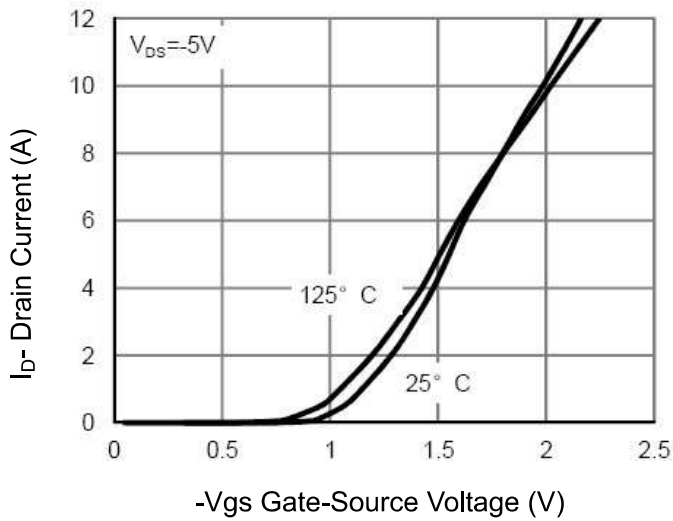
Figure 5 Output Characteristics



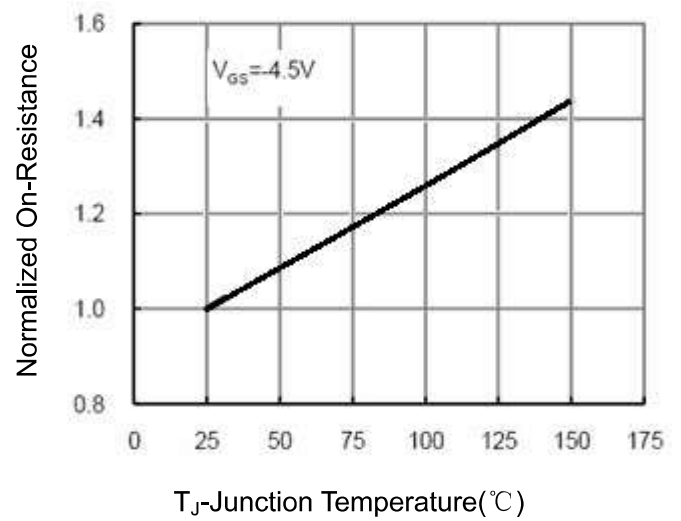
-I<sub>D</sub> Drain Current (A)

Figure 6 Drain-Source On-Resistance

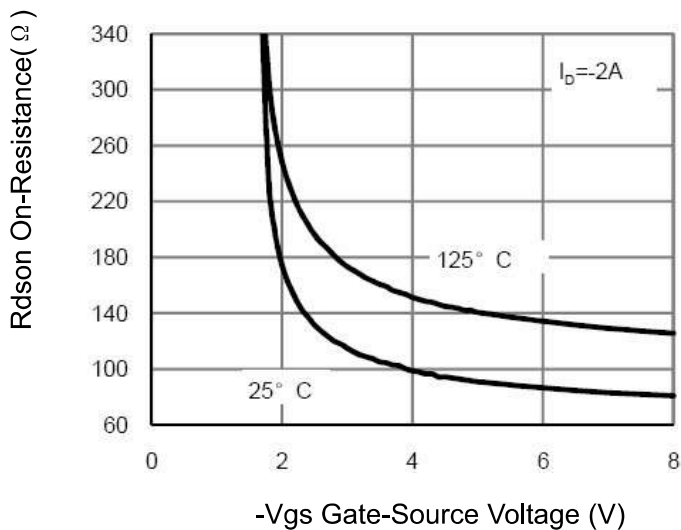
## P- Channel Typical Electrical and Thermal Characteristics (Curves)



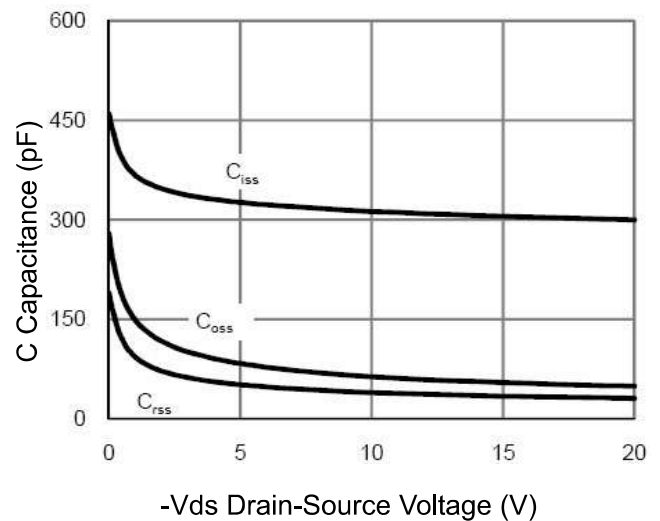
**Figure 7 Transfer Characteristics**



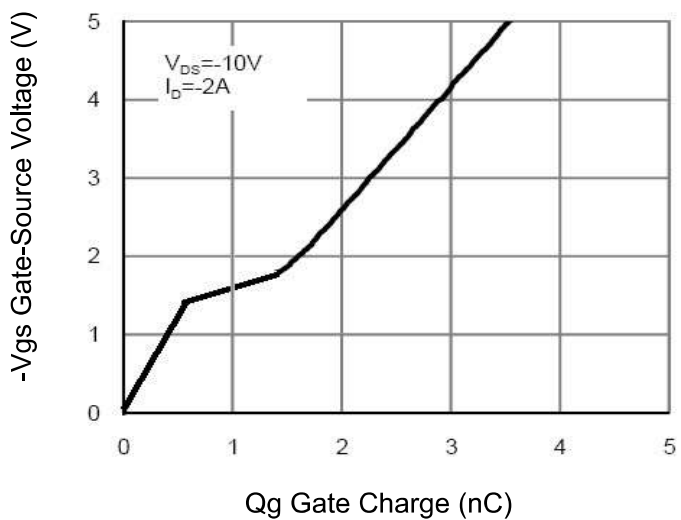
**Figure 8 Drain-Source On-Resistance**



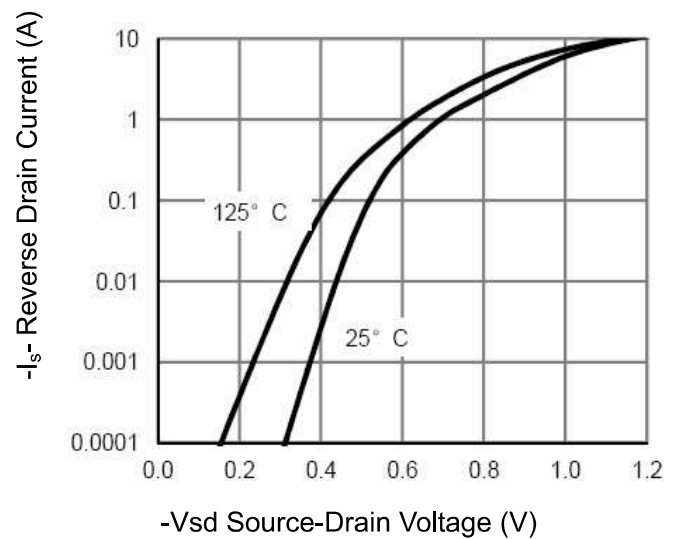
**Figure 9 Rdson vs Vgs**



**Figure 10 Capacitance vs Vds**

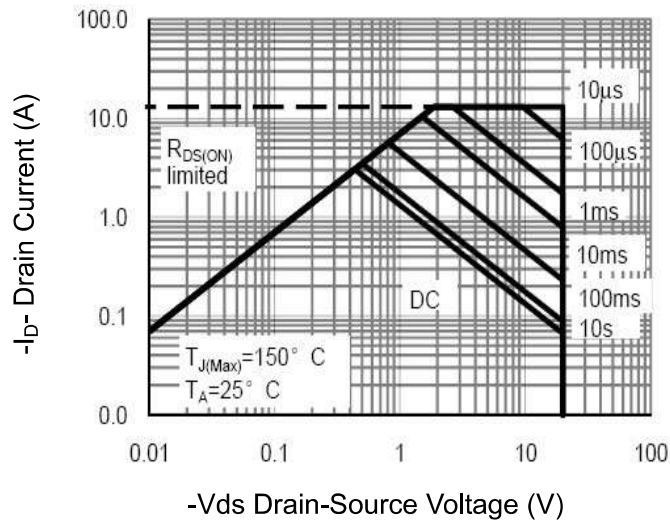


**Figure 11 Gate Charge**

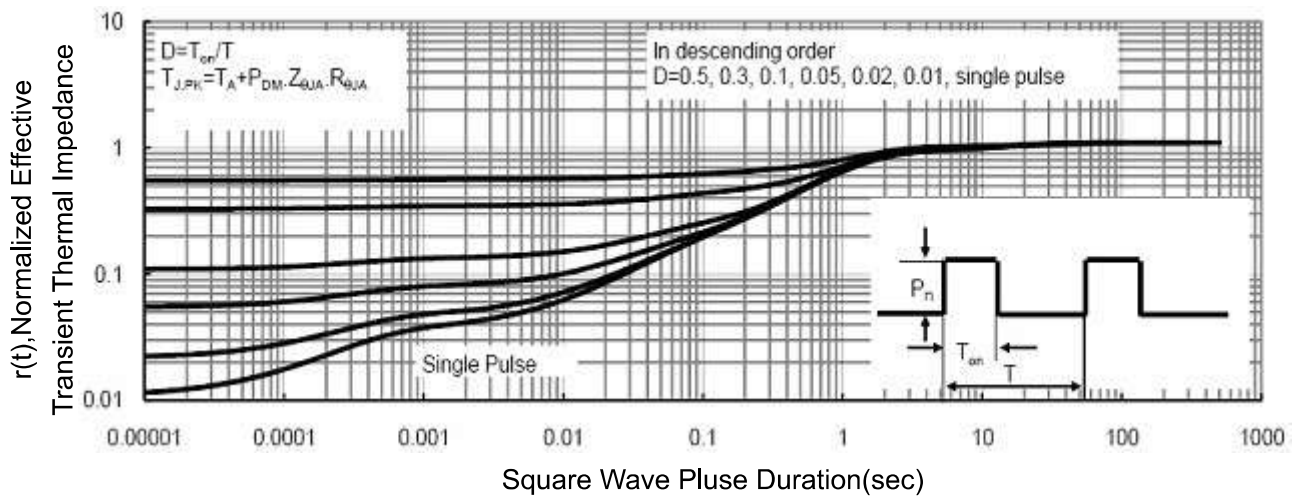


**Figure 12 Source- Drain Diode Forward**

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

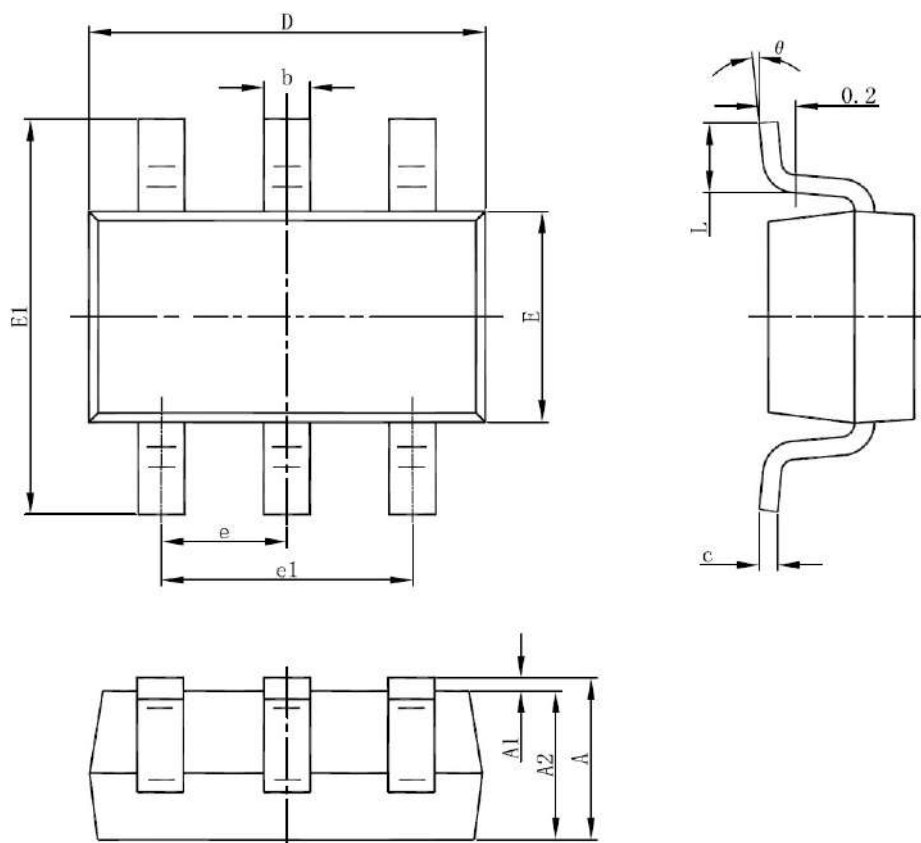


**Figure 13 Safe Operation Area**



**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 |
| $\theta$ | 0°                        | 8°    | 0°                   | 8°    |