



## N and P Channel Enhancement Mode Power MOSFET

### Description

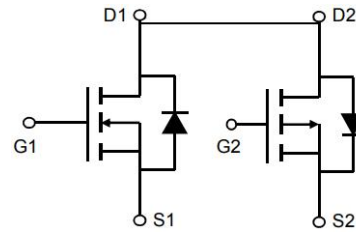
The PE4025KC uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. It can be used in a wide variety of applications.

### General Features

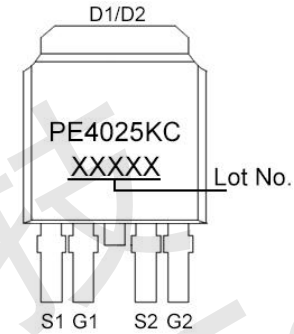
- **N-Channel**
- $V_{DS} = 40V, I_D = 16A$
- $R_{DS(ON)} < 18m\Omega @ V_{GS}=10V$
- $R_{DS(ON)} < 25m\Omega @ V_{GS}=4.5V$
- **P-Channel**
- $V_{DS} = -40V, I_D = -13A$
- $R_{DS(ON)} < 32m\Omega @ V_{GS}=-10V$
- $R_{DS(ON)} < 48m\Omega @ V_{GS}=-4.5V$
- High Power and current handing capability
- Lead free product is acquired
- Surface Mount Package

### Application

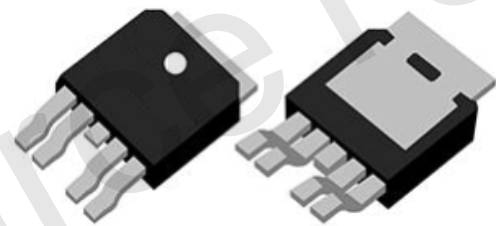
- DC motor
- PWM applications



Schematic diagram



Marking and pin assignment



TO-252-4L

### Absolute Maximum Ratings (TC=25°C unless otherwise noted)

| Parameter  | Symbol         | N-Channel  | P-Channel | Unit |
|--|----------------|------------|-----------|------|
| Drain-Source Voltage                             | $V_{DS}$       | 40         | -40       | V    |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | $\pm 20$  | V    |
| Drain Current-Continuous (TC=25°C)               | $I_D$          | 16         | -13       | A    |
| Drain Current-Continuous (TC=100°C)              | $I_D$          | 11         | -9        | A    |
| Pulsed Drain Current (Note 1)                    | $I_{DM}$       | 48         | -39       | A    |
| Maximum Power Dissipation                        | $P_D$          | 27         | 21        | W    |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 175 |           | °C   |

### Thermal Characteristic

| Parameter                                     | Symbol          | N-Channel | P-Channel | Unit |
|---|-----------------|-----------|-----------|------|
| Thermal Resistance, Junction-to-Case (Note 2) | $R_{\theta JC}$ | 5.5       | 7.1       | °C/W |



**N-Channel Electrical Characteristics (TC=25°C unless otherwise noted)**

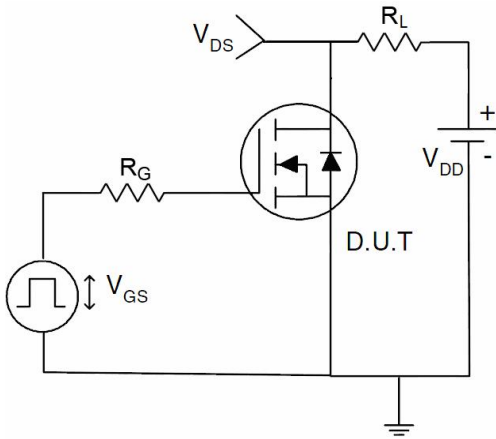
| Parameter                                 | Symbol       | Condition   | Min | Typ  | Max       | Unit       |
|---|--------------|---|-----|------|-----------|------------|
| <b>Off Characteristics</b>                |              |   |     |      |           |            |
| Drain-Source Breakdown Voltage            | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                               | 40  | -    | -         | V          |
| Zero Gate Voltage Drain Current           | $I_{DSS}$    | $V_{DS}=40V, V_{GS}=0V$                                 | -   | -    | 1         | $\mu A$    |
| Gate-Body Leakage Current                 | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                             | -   | -    | $\pm 100$ | nA         |
| <b>On Characteristics (Note 3)</b>        |              |   |     |      |           |            |
| Gate Threshold Voltage                    | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                           | 1.2 | 1.5  | 2.2       | V          |
| Drain-Source On-State Resistance          | $R_{DS(on)}$ | $V_{GS}=10V, I_D=8A$                                    | -   | 12.5 | 18        | m $\Omega$ |
|   |              | $V_{GS}=4.5V, I_D=6A$                                   | -   | 17.5 | 25        | m $\Omega$ |
| Forward Transconductance                  | $g_{FS}$     | $V_{DS}=5V, I_D=8A$                                     | -   | 25   | -         | S          |
| <b>Dynamic Characteristics (Note 4)</b>   |              |   |     |      |           |            |
| Input Capacitance                         | $C_{iss}$    | $V_{DS}=20V, V_{GS}=0V,$<br>$F=1.0MHz$                  | -   | 1314 | -         | pF         |
| Output Capacitance                        | $C_{oss}$    |   | -   | 120  | -         | pF         |
| Reverse Transfer Capacitance (Note 4)     | $C_{rss}$    |   | -   | 88   | -         | pF         |
| <b>Switching Characteristics</b>          |              |   |     |      |           |            |
| Turn-on Delay Time                        | $t_{d(on)}$  | $V_{DD}=20V, R_L=1\Omega,$<br>$V_{GS}=10V, R_G=3\Omega$ | -   | 8.6  | -         | nS         |
| Turn-on Rise Time                         | $t_r$        |   | -   | 3.4  | -         | nS         |
| Turn-Off Delay Time                       | $t_{d(off)}$ |   | -   | 25   | -         | nS         |
| Turn-Off Fall Time                        | $t_f$        |   | -   | 2.2  | -         | nS         |
| Total Gate Charge                         | $Q_g$        | $V_{DS}=20V, I_D=6A,$<br>$V_{GS}=10V$                   | -   | 22   | -         | nC         |
| Gate-Source Charge                        | $Q_{gs}$     |   | -   | 3.2  | -         | nC         |
| Gate-Drain Charge                         | $Q_{gd}$     |   | -   | 4.2  | -         | nC         |
| <b>Drain-Source Diode Characteristics</b> |              |   |     |      |           |            |
| Diode Forward Voltage (Note 3)            | $V_{SD}$     | $V_{GS}=0V, I_S=1A$                                     | -   | -    | 1.2       | V          |
| Diode Forward Current (Note 2)            | $I_S$        |   | -   | -    | 16        | A          |

**Notes:**

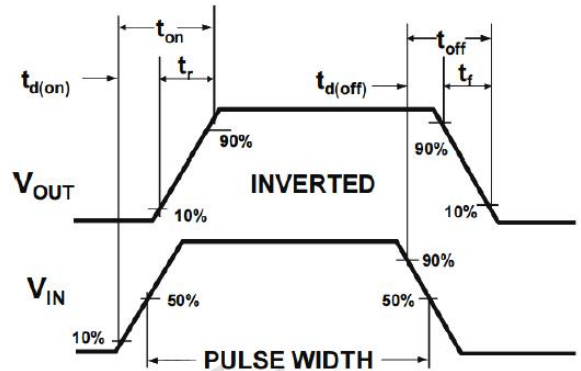
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to product.



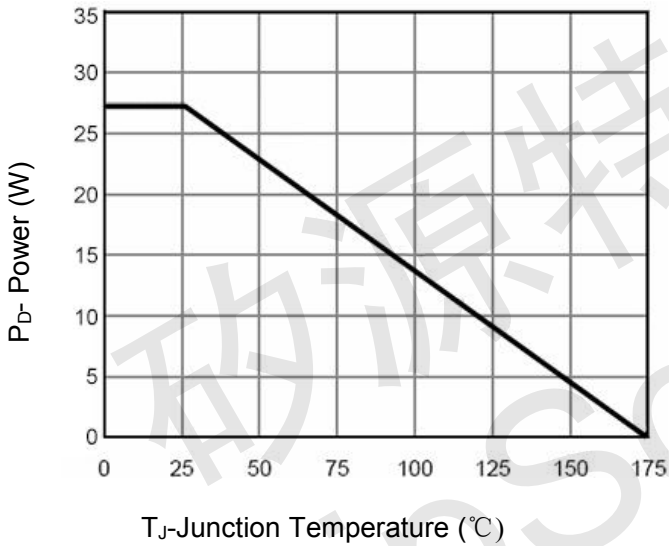
**Typical Electrical and Thermal Characteristics**



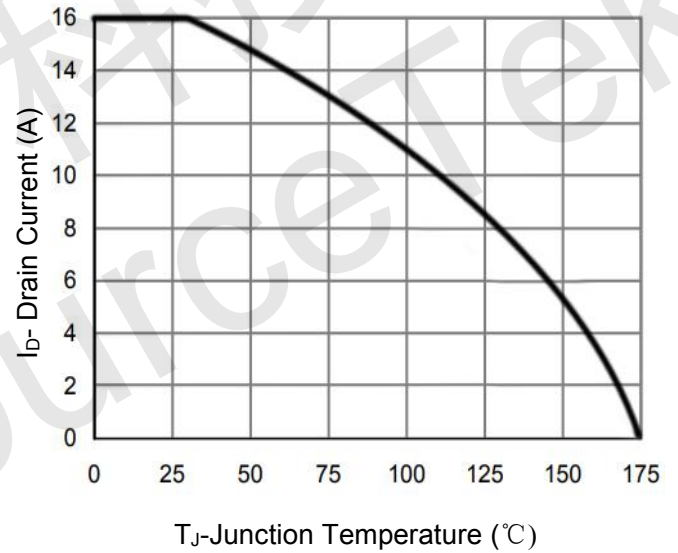
**Figure 1 Switching Test Circuit**



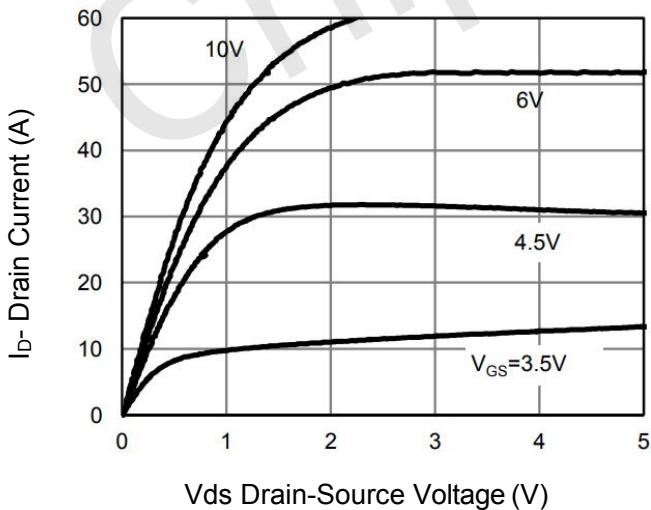
**Figure 2 Switching Waveform**



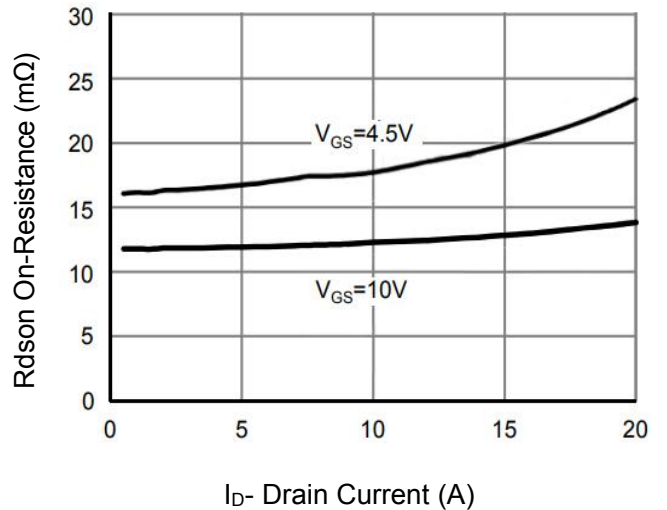
**Figure 3 Power De-rating**



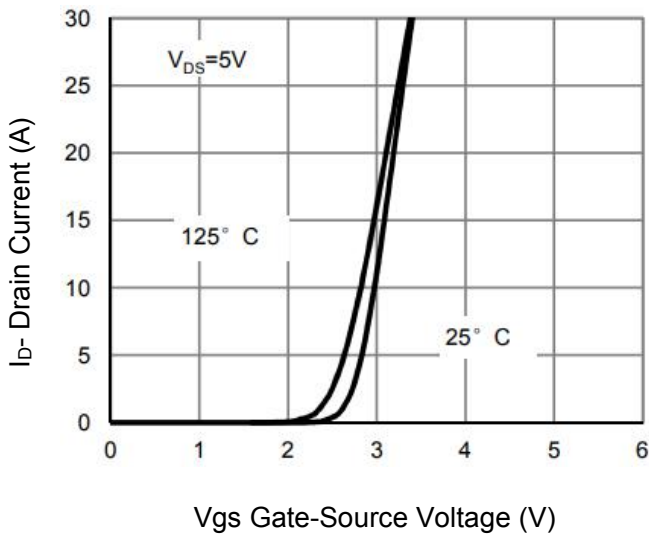
**Figure 4 Drain Current**



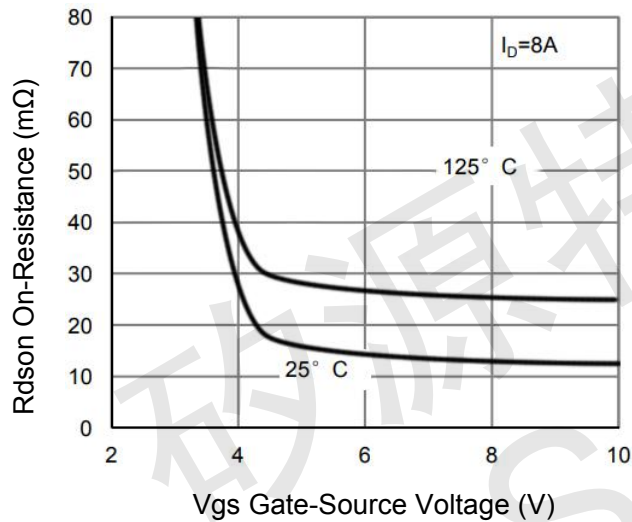
**Figure 5 Output Characteristics**



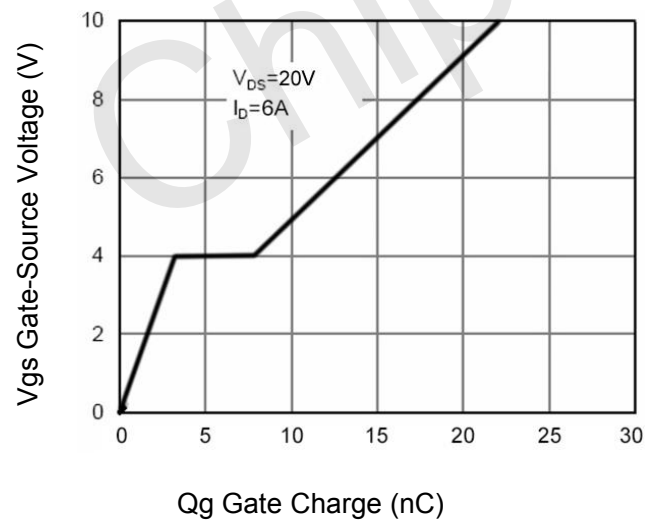
**Figure 6 R<sub>dson</sub> vs Drain Current**



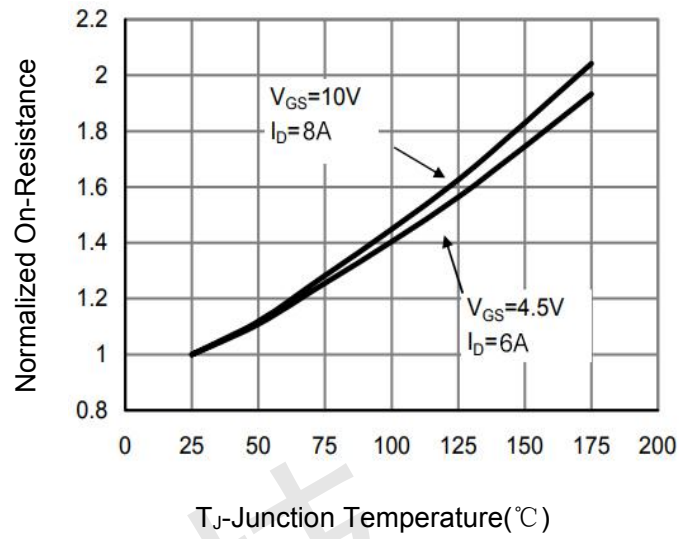
**Figure 7 Transfer Characteristics**



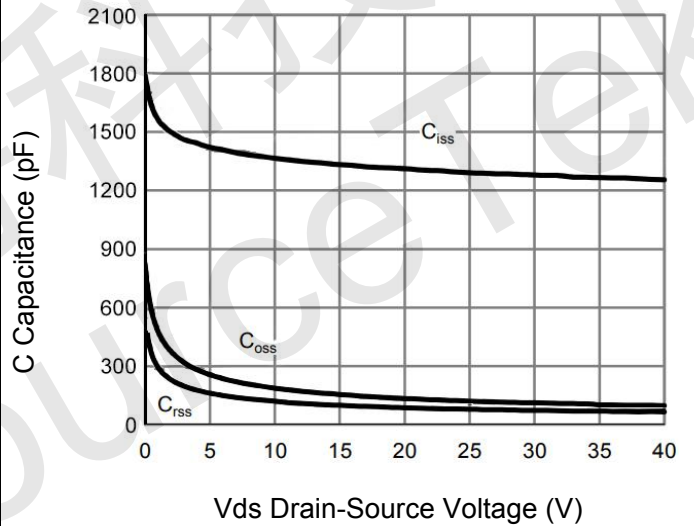
**Figure 9 Rdson vs Vgs**



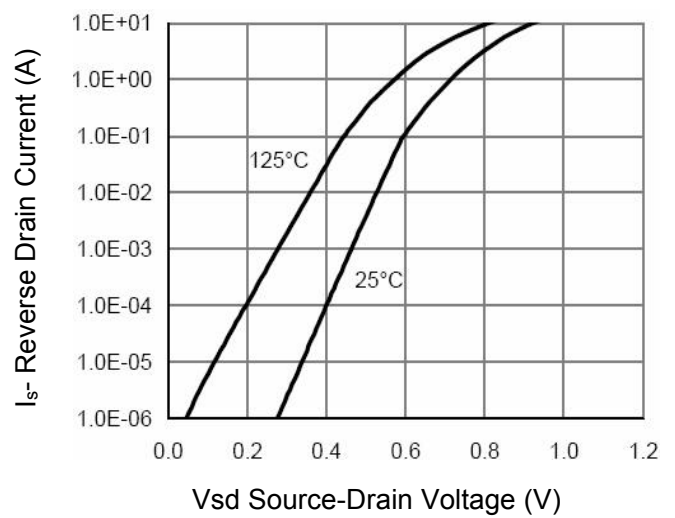
**Figure 11 Gate Charge**



**Figure 8 Rdson vs Junction Temperature**



**Figure 10 Capacitance vs Vds**



**Figure 12 Source- Drain Diode Forward**

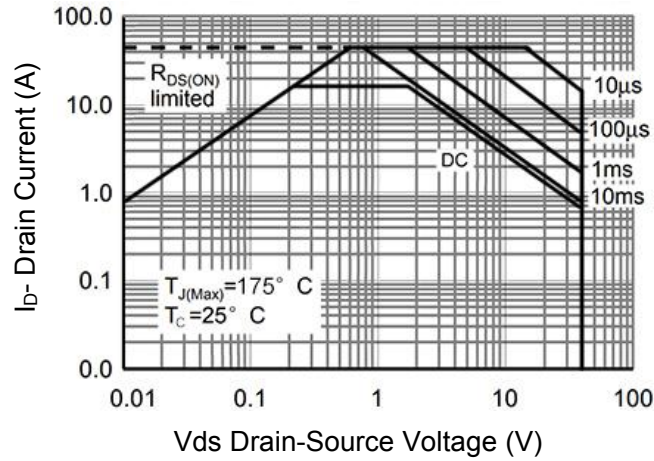


Figure 13 Safe Operation Area

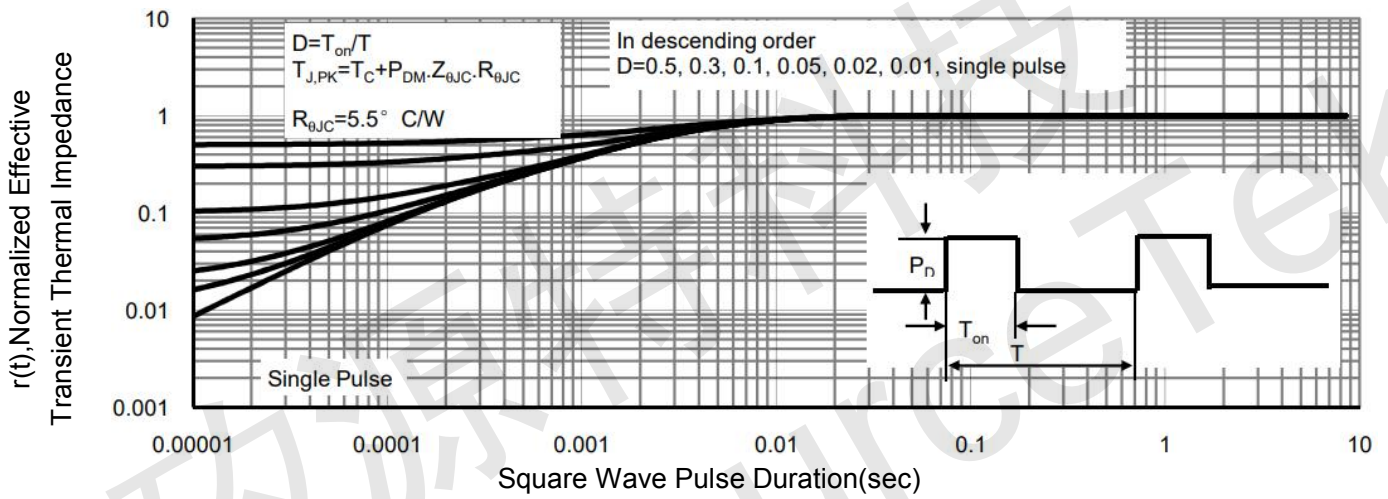


Figure 14 Normalized Maximum Transient Thermal Impedance



**P-Channel Electrical Characteristics (TC=25°C unless otherwise noted)**

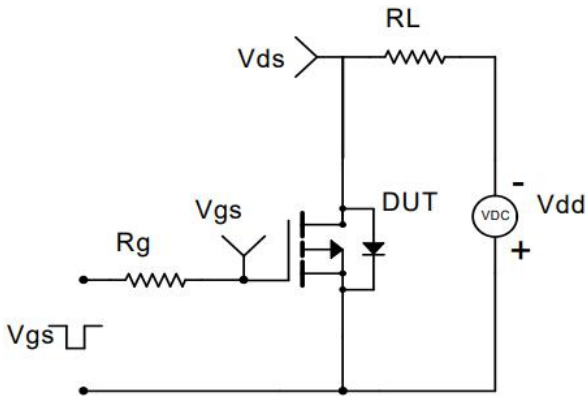
| Parameter                                 | Symbol       | Condition   | Min  | Typ  | Max       | Unit       |
|---|--------------|---|------|------|-----------|------------|
| <b>Off Characteristics</b>                |              |   |      |      |           |            |
| Drain-Source Breakdown Voltage            | $BV_{DSS}$   | $V_{GS}=0V, I_D=-250\mu A$                                | -40  | -    | -         | V          |
| Zero Gate Voltage Drain Current           | $I_{DSS}$    | $V_{DS}=-40V, V_{GS}=0V$                                  | -    | -    | 1         | $\mu A$    |
| Gate-Body Leakage Current                 | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                               | -    | -    | $\pm 100$ | nA         |
| <b>On Characteristics (Note 3)</b>        |              |   |      |      |           |            |
| Gate Threshold Voltage                    | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$                            | -1.2 | -1.8 | -2.2      | V          |
| Drain-Source On-State Resistance          | $R_{DS(on)}$ | $V_{GS}=-10V, I_D=-7A$                                    | -    | 24.5 | 32        | m $\Omega$ |
|   |              | $V_{GS}=-4.5V, I_D=-5A$                                   | -    | 35   | 48        | m $\Omega$ |
| Forward Transconductance                  | $g_{FS}$     | $V_{DS}=-10V, I_D=-6A$                                    | -    | 20   | -         | S          |
| <b>Dynamic Characteristics (Note 4)</b>   |              |   |      |      |           |            |
| Input Capacitance                         | $C_{iss}$    | $V_{DS}=-20V, V_{GS}=0V,$<br>$F=1.0MHz$                   | -    | 1004 | -         | pF         |
| Output Capacitance                        | $C_{oss}$    |   | -    | 108  | -         | pF         |
| Reverse Transfer Capacitance (Note 4)     | $C_{rss}$    |   | -    | 80   | -         | pF         |
| <b>Switching Characteristics</b>          |              |   |      |      |           |            |
| Turn-on Delay Time                        | $t_{d(on)}$  | $V_{DD}=-20V, R_L=1\Omega,$<br>$V_{GS}=-10V, R_G=3\Omega$ | -    | 19   | -         | nS         |
| Turn-on Rise Time                         | $t_r$        |   | -    | 13   | -         | nS         |
| Turn-Off Delay Time                       | $t_{d(off)}$ |   | -    | 49   | -         | nS         |
| Turn-Off Fall Time                        | $t_f$        |   | -    | 4.6  | -         | nS         |
| Total Gate Charge                         | $Q_g$        | $V_{DS}=-20V, I_D=-6A,$<br>$V_{GS}=-10V$                  | -    | 18   | -         | nC         |
| Gate-Source Charge                        | $Q_{gs}$     |   | -    | 2.5  | -         | nC         |
| Gate-Drain Charge                         | $Q_{gd}$     |   | -    | 3.1  | -         | nC         |
| <b>Drain-Source Diode Characteristics</b> |              |   |      |      |           |            |
| Diode Forward Voltage (Note 3)            | $V_{SD}$     | $V_{GS}=0V, I_S=-1A$                                      | -    | -    | -1.2      | V          |
| Diode Forward Current (Note 2)            | $I_S$        |   | -    | -    | -13       | A          |

**Notes:**

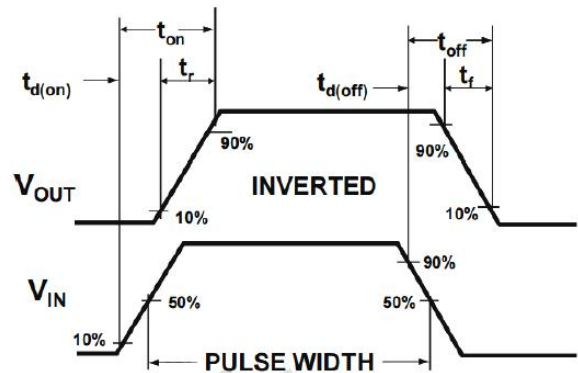
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2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
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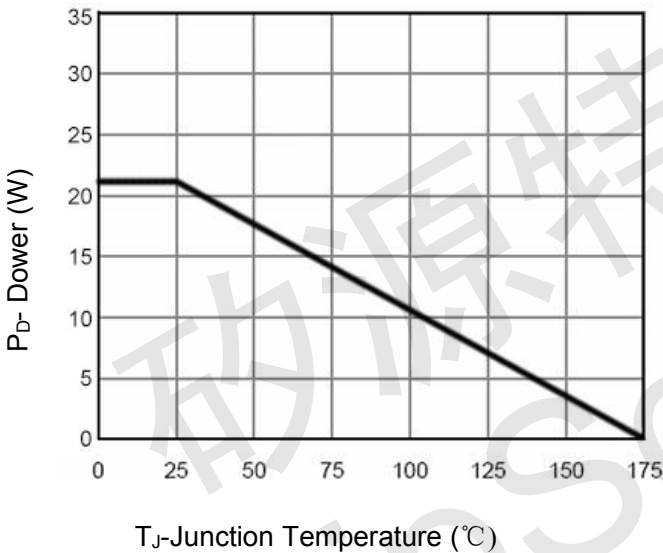
**Typical Electrical and Thermal Characteristics**



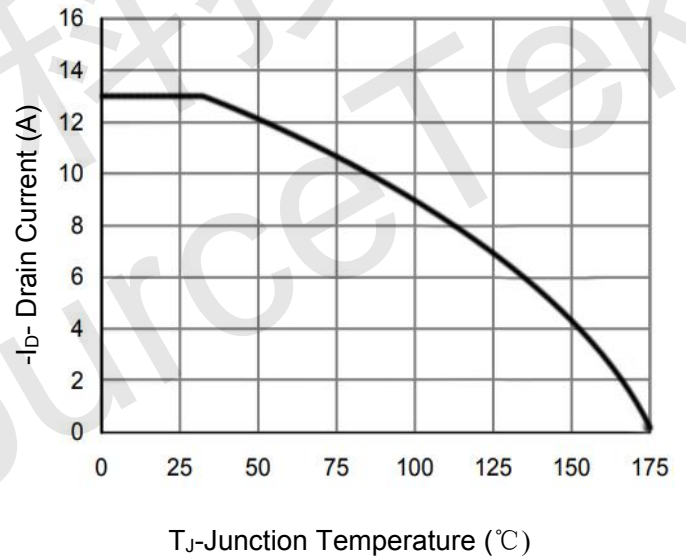
**Figure 1 Switching Test Circuit**



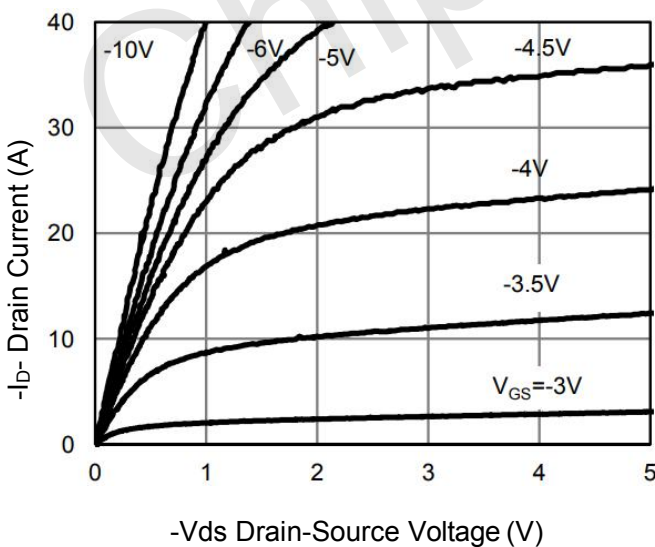
**Figure 2 Switching Waveform**



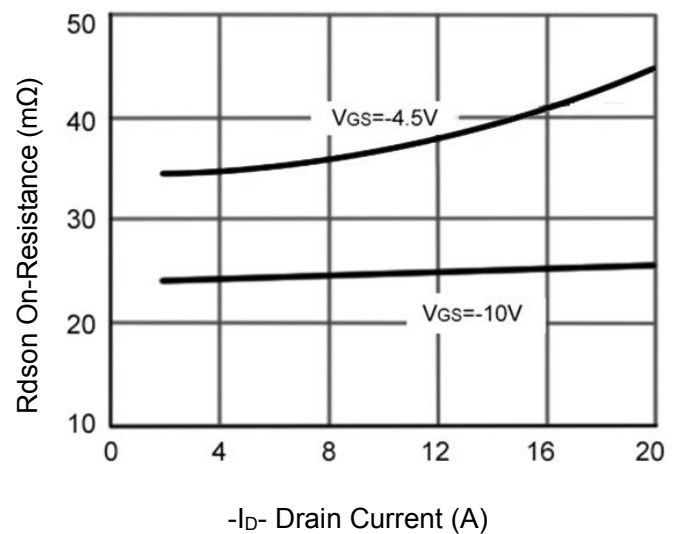
**Figure 3 Power De-rating**



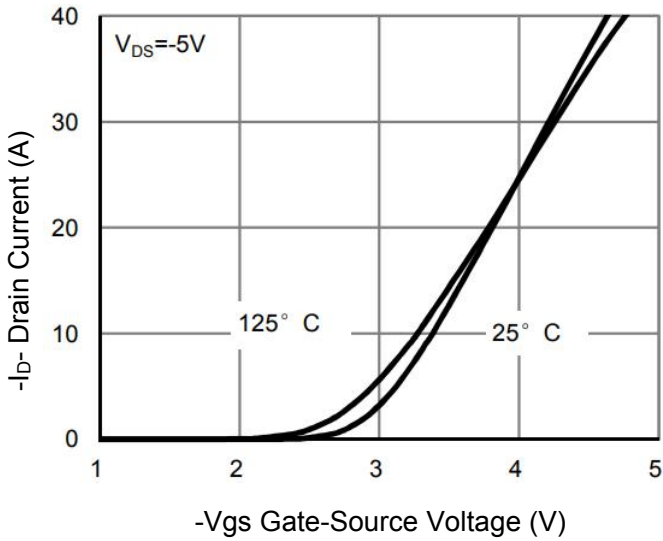
**Figure 4 Drain Current**



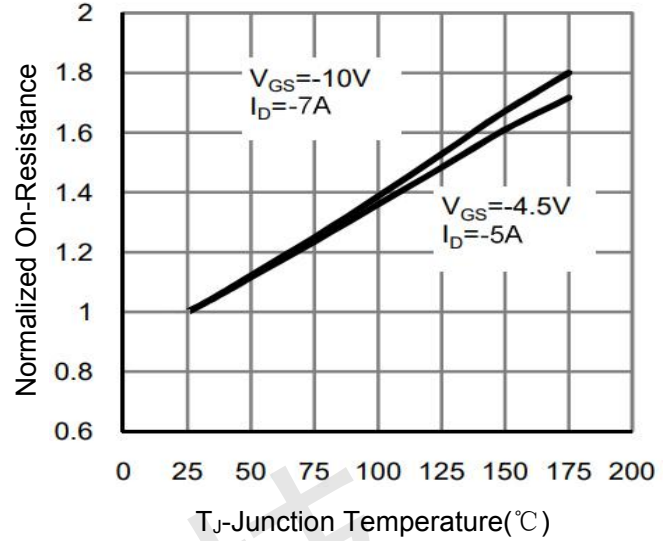
**Figure 5 Output Characteristics**



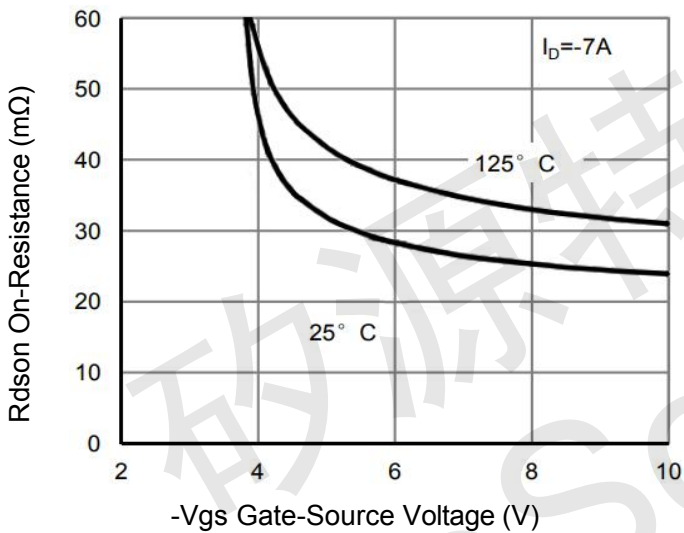
**Figure 6 Rdson vs Drain Current**



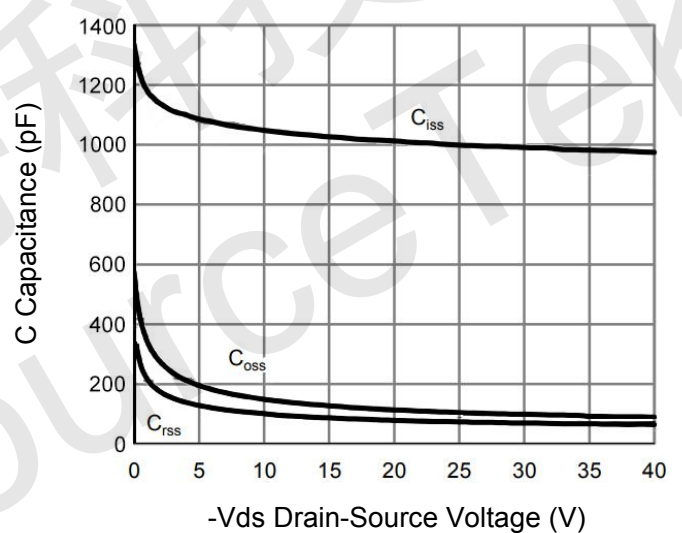
**Figure 7 Transfer Characteristics**



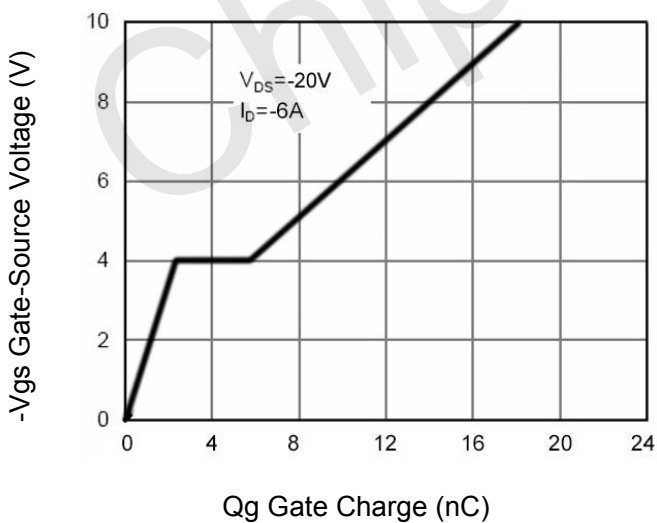
**Figure 8 Rdson vs Junction Temperature**



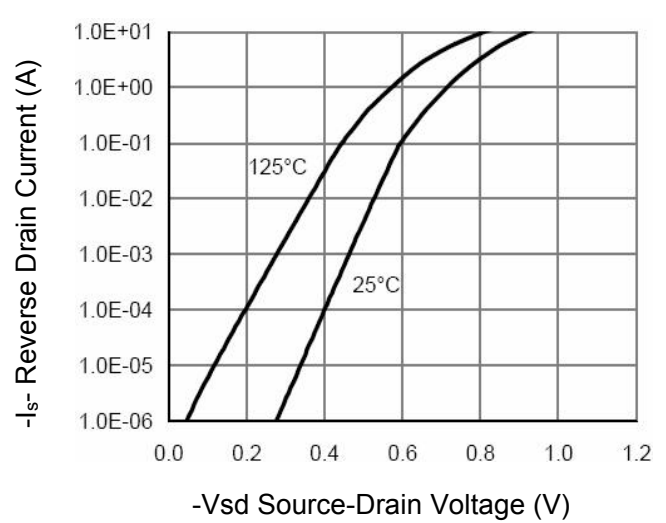
**Figure 9 Rdson vs Vgs**



**Figure 10 Capacitance vs Vds**

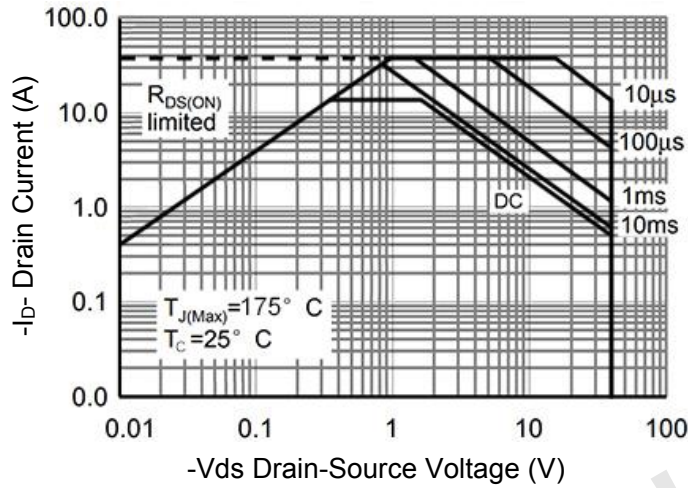


**Figure 11 Gate Charge**

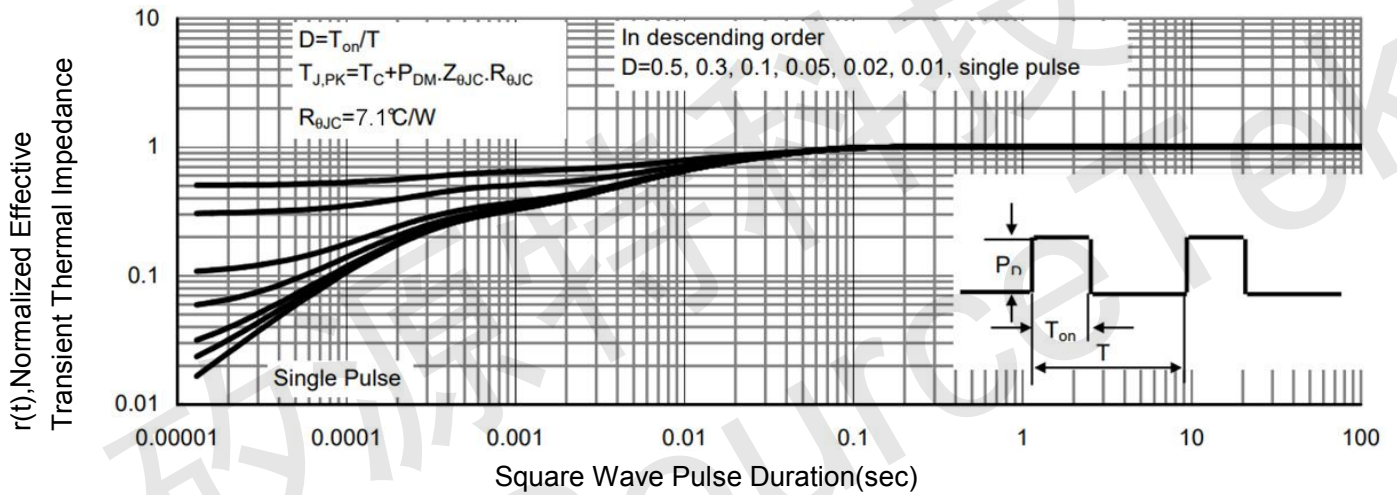


**Figure 12 Source- Drain Diode Forward**





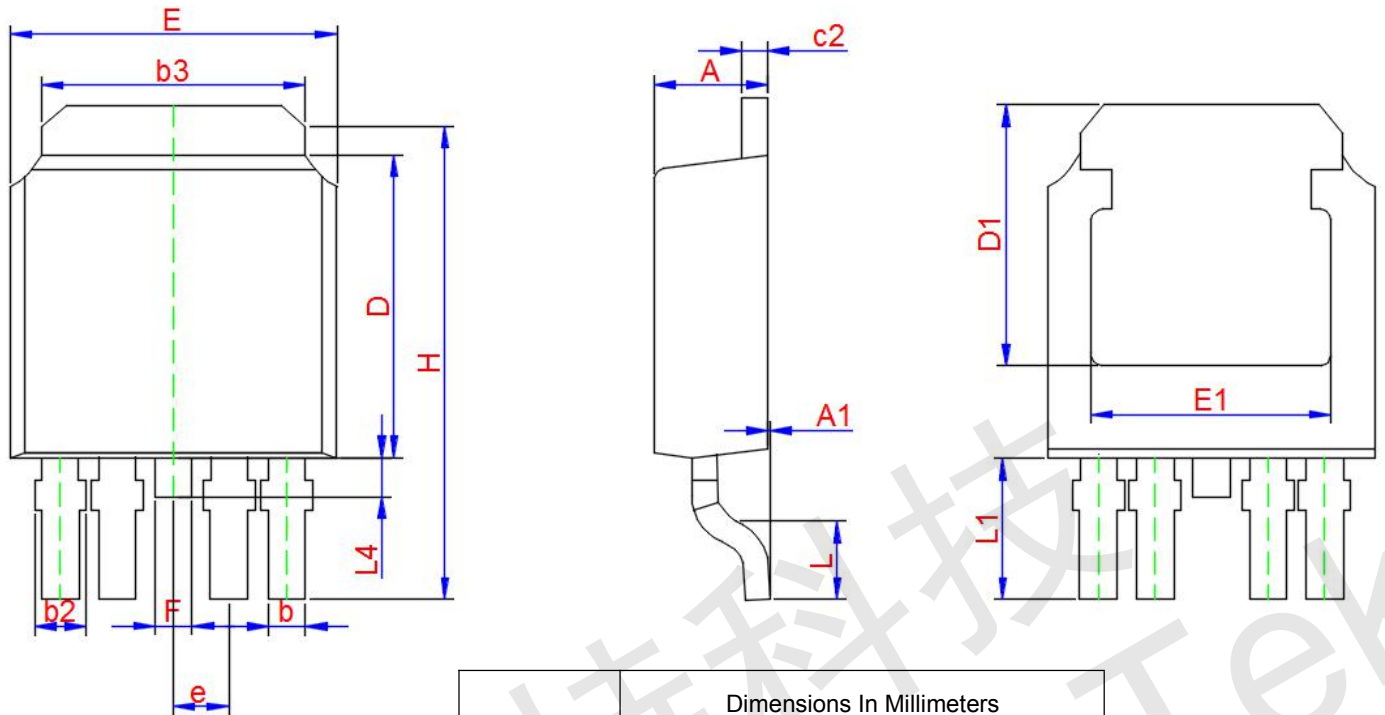
**Figure 13 Safe Operation Area**



**Figure 14 Normalized Maximum Transient Thermal Impedance**



**TO-252-4L Package Information**



| Symbol | Dimensions In Millimeters |       |        |
|--------|---------------------------|-------|--------|
|        | Min.                      | Typ.  | Max.   |
| A      | 2.200                     | 2.300 | 2.400  |
| A1     | 0.000                     | 0.080 | 0.150  |
| b      | 0.450                     | 0.530 | 0.600  |
| b2     | 0.500                     | 0.650 | 0.800  |
| b3     | 5.200                     | 5.350 | 5.500  |
| c2     | 0.450                     | 0.500 | 0.550  |
| D      | 5.400                     | 5.600 | 5.800  |
| D1     | 4.570                     | -     | -      |
| E      | 6.400                     | 6.600 | 6.800  |
| E1     | 3.810                     | -     | -      |
| e      | 1.27TYP.                  |       |        |
| F      | 0.400                     | 0.500 | 0.600  |
| H      | 9.400                     | 9.800 | 10.200 |
| L      | 1.400                     | 1.590 | 1.770  |
| L1     | 2.400                     | 2.700 | 3.000  |
| L4     | 0.800                     | 1.000 | 1.200  |