# AP2716KD

**N and P-Channel Enhancement Mosfet**

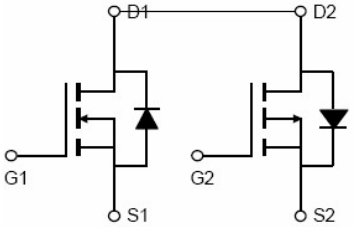
**DATA SHEET**

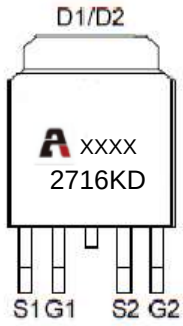
## Feature

- **N-Channel**
  $V_{DD}$=40V,$I_D$=20A
  $R_{DS\ (ON)}$ <22mΩ @$V_{GS}$=10V
  $R_{DS\ (ON)}$ <30mΩ @$V_{GS}$=4.5V

- **P-Channel**
  $V_{DD}$=-40V,$I_D$=-15A
  $R_{DS\ (ON)}$ <34mΩ @$V_{GS}$=-10V
  $R_{DS\ (ON)}$ <46mΩ @$V_{GS}$=-4.5V

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




**Marking and pin assignment**

## Application

- PWM applications
- Load Switch
- Power management

## Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity (PCS) |
|---|---|---|---|---|---|
| 2716KD | AP2716KD | TO-252-4 | | - | 2500 |

## ABSOLUTE MAXIMUM RATINGS ($T_a$=25℃ unless otherwise noted)

| Parameter | Symbol | N-Channel | P-Channel | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 40 | -40 | V |
| Gate-Source Voltage | $V_{GS}$ | ±20 | ±20 | V |
| Continuous Drain Current ($T_a$ =25℃) | $I_D$ | 20 | -15 | A |
| Continuous Drain Current ($T_a$ =100℃) | $I_D$ | 14 | -10 | A |
| Pulsed Drain Current [1] | $I_{DM}$ | 60 | -50 | A |
| Power Dissipation | $P_D$ | 31.5 | 25 | W |
| Thermal Resistance from Junction to Ambient | $R_{\theta JA}$ | 80 | 80 | ℃/W |
| Junction Temperature | $T_J$ | 150 | 150 | ℃ |
| Storage Temperature | $T_{STG}$ | -55~ +150 | -55~ +150 | ℃ |

## N-CH ELECTRICAL CHARACTERISTICS($T_a$=25℃ unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Type | Max | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0V, $I_D$ =-250μA | 40 | | | V |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ =40V, $V_{GS}$ = 0V | | | 1 | μA |
| Gate-body leakage current | $I_{GSS}$ | $V_{GS}$ =±20V, $V_{DS}$ = 0V | | | ±100 | nA |
| Gate threshold voltage(2) | $V_{GS(th)}$ | $V_{DS}$ =$V_{GS}$, $I_D$ =250μA | 1 | 1.6 | 2.5 | V |
| Drain-source on-resistance(2) | $R_{DS(on)}$ | $V_{GS}$ =10V, $I_D$ =4A | | 16 | 22 | mΩ |
| | | $V_{GS}$ =4.5V, $I_D$ =6A | | 22 | 30 | |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ =20V, $V_{GS}$ =0V, f =1MHz | | 1050 | | pF |
| Output Capacitance | $C_{oss}$ | | | 84 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 72 | | |
| **Switching characteristics** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=20V, $I_D$=5A, $R_L$=6Ω<br>$V_{GS}$=10V, $R_G$=1Ω | | 11 | | ns |
| Turn-on rise time | $t_r$ | | | 13 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 36 | | |
| Turn-off fall time | $t_f$ | | | 9 | | |
| Total Gate Charge | Qg | VDS=20V, ID=5A,<br>VGS=10V | | 11 | | nC |
| Gate-Source Charge | Qgs | | | 1.9 | | |
| Gate-Drain Charge | Qgd | | | 2.2 | | |
| **Source-Drain Diode characteristics** | | | | | | |
| Diode Forward voltage(2) | $V_{DS}$ | $V_{GS}$ =0V, $I_S$=10A | | | 1.2 | V |
| Diode Forward current(3) | $I_S$ | | - | - | 10 | A |

## P-CH ELECTRICAL CHARACTERISTICS($T_a$=25℃ unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Type | Max | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0V, $I_D$ =-250μA | -40 | | | V |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ =-40V, $V_{GS}$ = 0V | | | 1 | μA |
| Gate-body leakage current | $I_{GSS}$ | $V_{GS}$ =±20V, $V_{DS}$ = 0V | | | ±100 | nA |
| Gate threshold voltage(2) | $V_{GS(th)}$ | $V_{DS}$ =$V_{GS}$, $I_D$ =-250μA | -1 | -1.6 | -2.5 | V |
| Drain-source on-resistance(2) | $R_{DS(on)}$ | $V_{GS}$ =-10V, $I_D$ =-10A | | 26 | 34 | mΩ |
| | | $V_{GS}$ =-4.5V, $I_D$ =-6A | | 35 | 46 | |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ =-20V, $V_{GS}$ =0V, f =1MHz | | 1160 | | pF |
| Output Capacitance | $C_{oss}$ | | | 155 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 98 | | |
| **Switching characteristics** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=-20V, $I_D$=-5A, $R_L$=6Ω $V_{GS}$=-10V, $R_G$=1Ω | | 8 | | ns |
| Turn-on rise time | $t_r$ | | | 15 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 23 | | |
| Turn-off fall time | $t_f$ | | | 9 | | |
| Total Gate Charge | Qg | VDS=-20V, ID=-5A, VGS=-10V | | 20 | | nC |
| Gate-Source Charge | Qgs | | | 3.5 | | |
| Gate-Drain Charge | Qgd | | | 4.2 | | |
| **Source-Drain Diode characteristics** | | | | | | |
| Diode Forward voltage(2) | $V_{DS}$ | $V_{GS}$ =0V, $I_S$=-10A | | | 1.2 | V |
| Diode Forward current(3) | $I_S$ | | - | - | -10 | A |

**Notes:**

1. Repetitive Rating: pulse width limited by maximum junction temperature
2. Pulse Test: pulse width≤300μs, duty cycle≤2%
3. Surface Mounted on FR4 Board,t≤10 sec

N-Channel

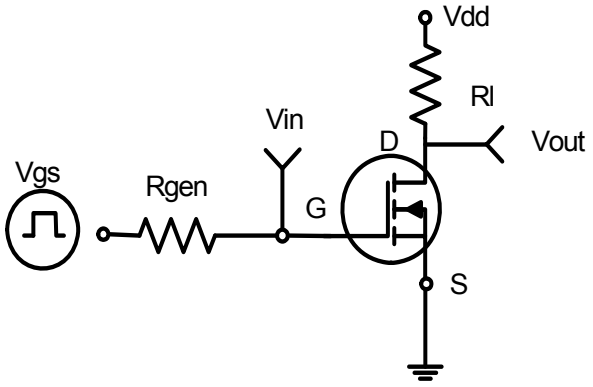



**Figure 1:Switching Test Circuit**

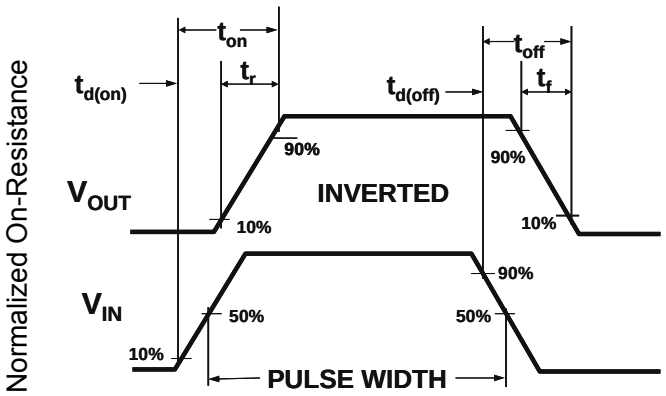



**Figure 2:Switching Waveforms**

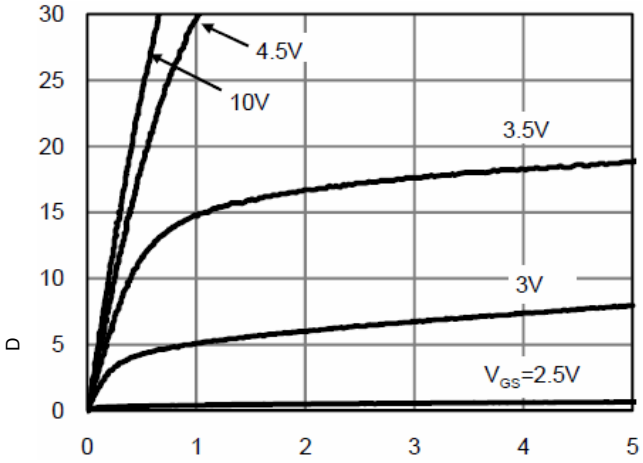



**Figure 3 Output Characteristics**

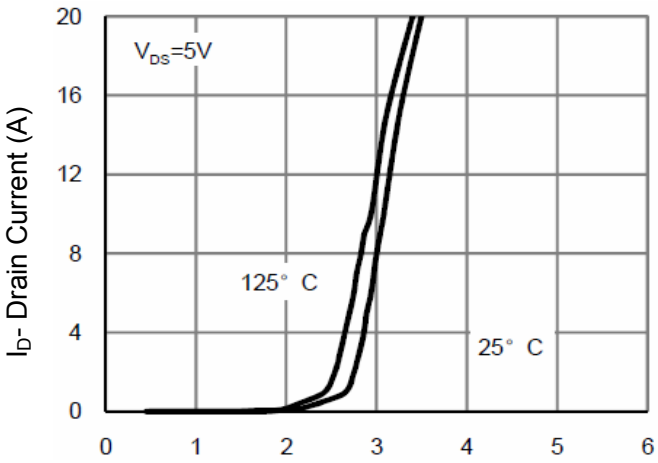



**Figure 4 Transfer Characteristics**

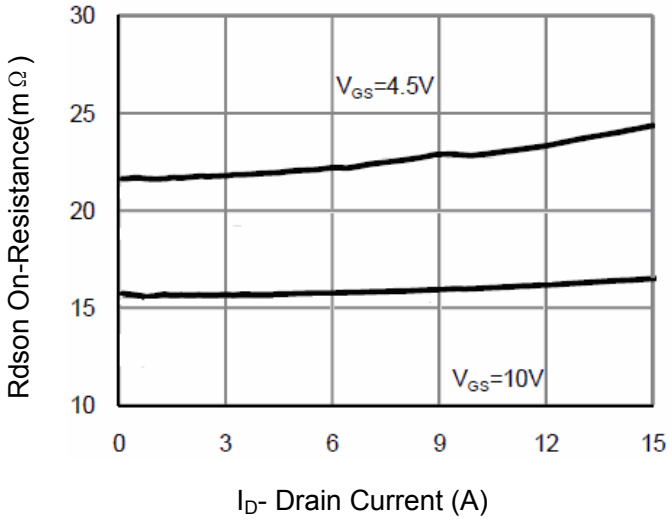



**Figure 5 Drain-Source On-Resistance**

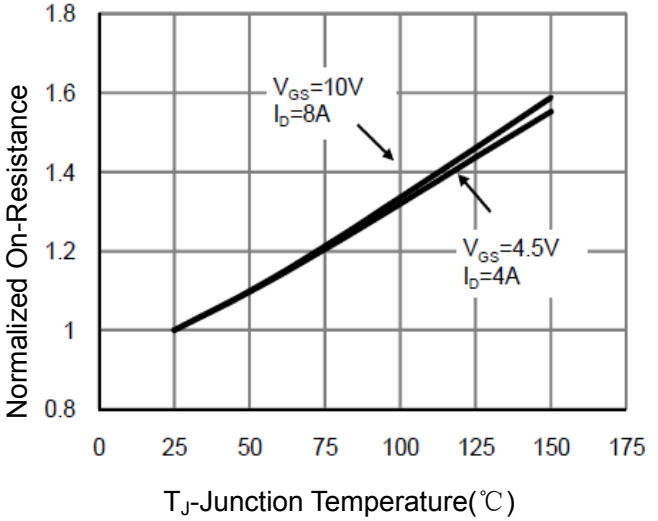



**Figure 6 Drain-Source On-Resistance**

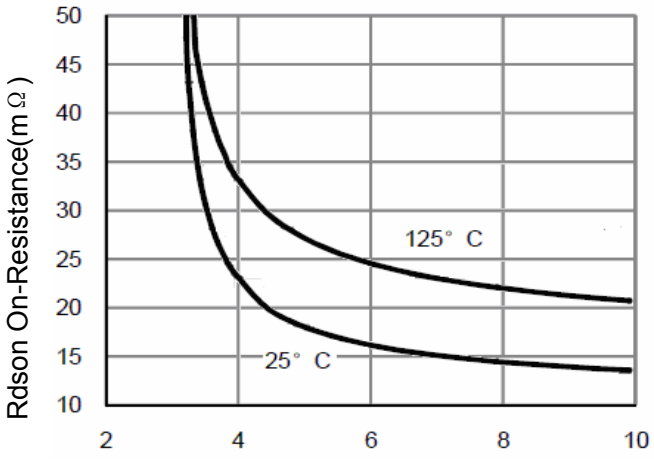



**Figure7 Rdson vs Vgs**

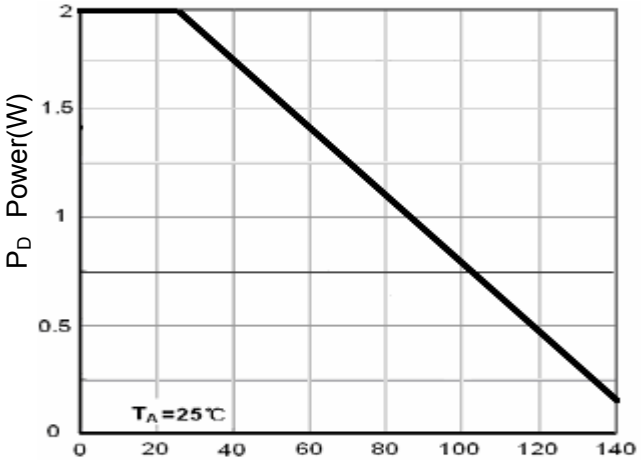



**Figure 8 Power Dissipation**

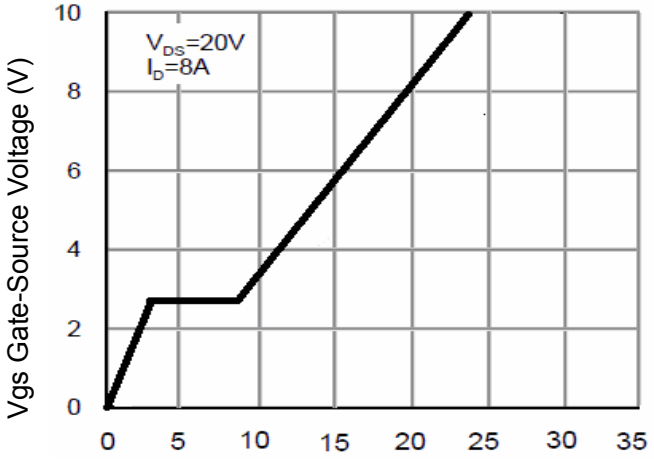



**Figure 9 Gate Charge**

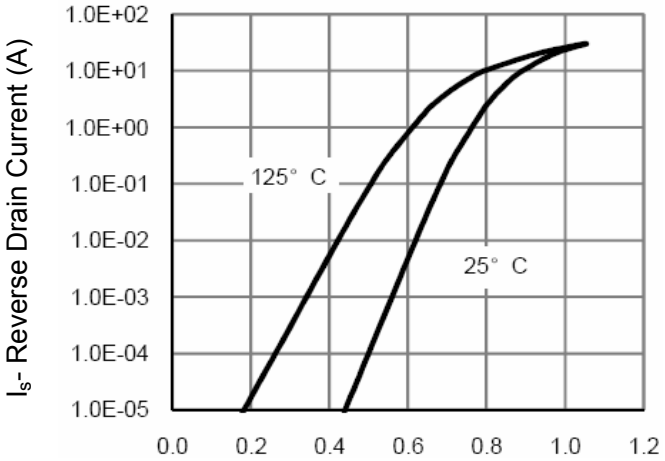



**Figure 10 Source- Drain Diode Forward**

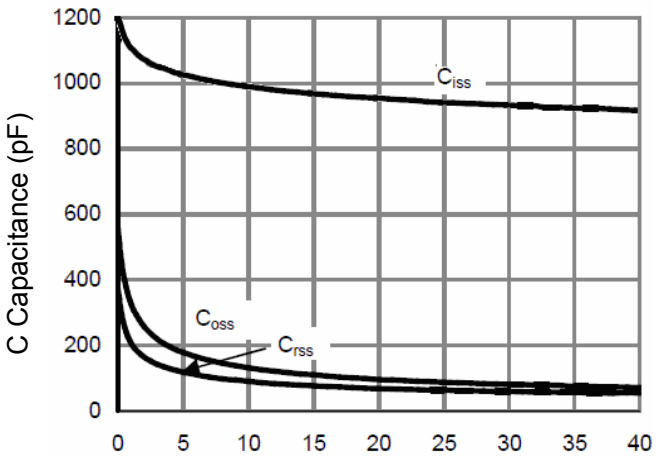



**Figure 11 Capacitance vs Vds**

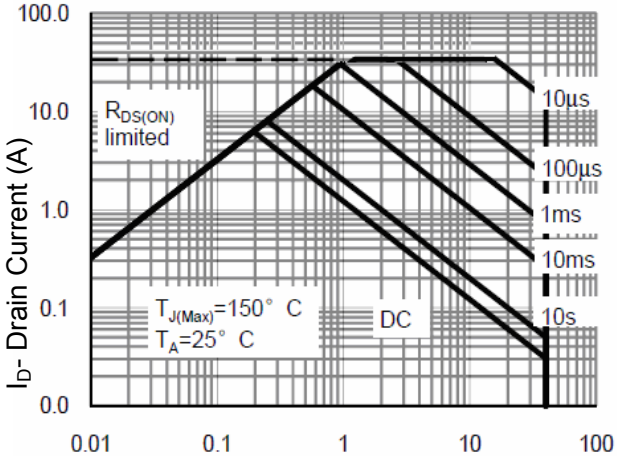



**Figure 12 Safe Operation Area**

P-Channel

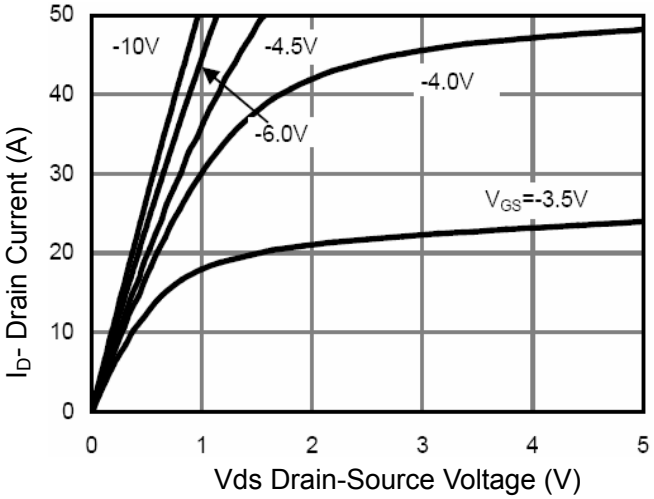



**Figure 1 Output Characteristics**

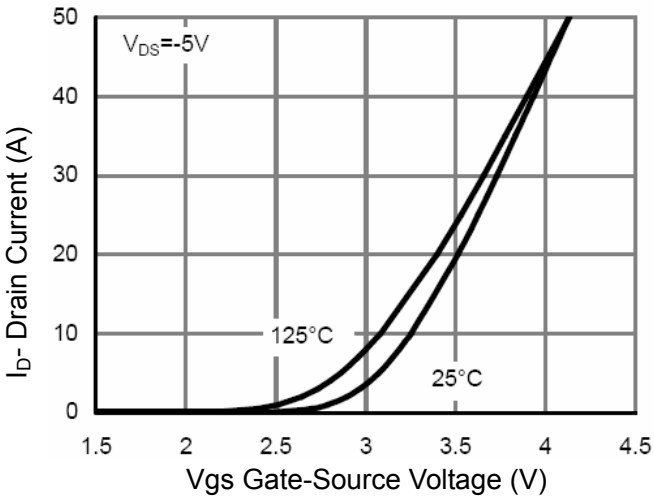



**Figure 2 Transfer Characteristics**

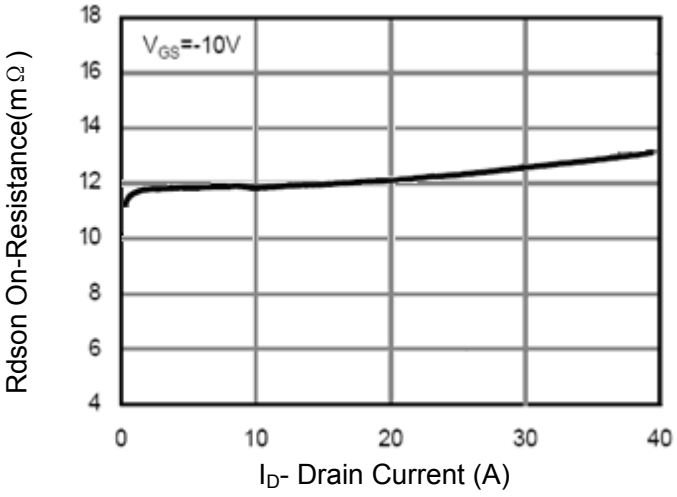



**Figure 3 Rdson- Drain Current**

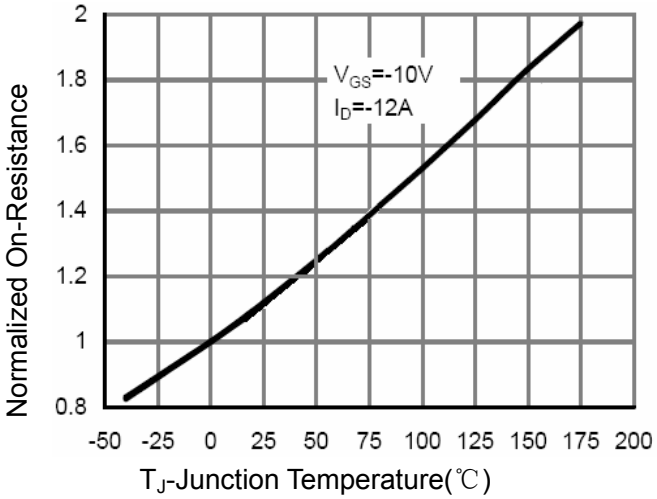



**Figure 4 Rdson-Junction Temperature**

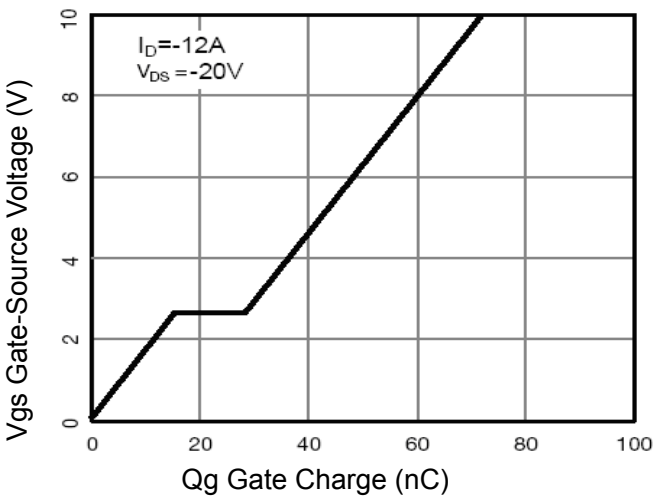



**Figure 5 Gate Charge**

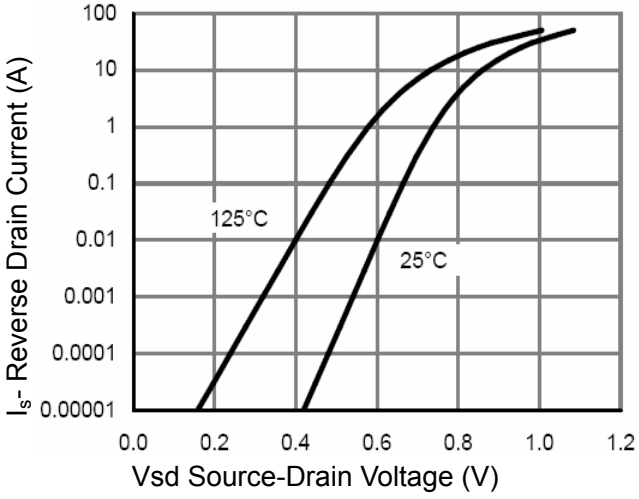



**Figure 6 Source- Drain Diode Forward**

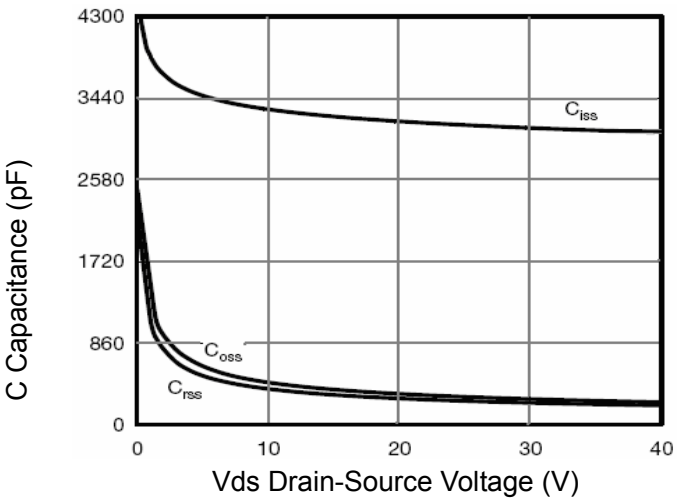



**Figure 7 Capacitance vs Vds**

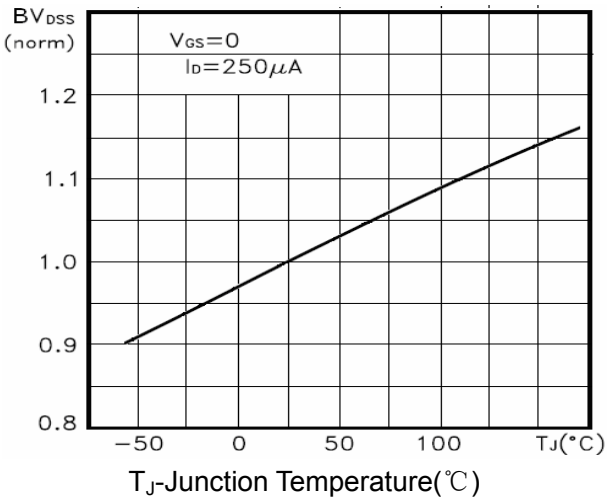



**Figure 9 $BV_{DSS}$ vs Junction Temperature**

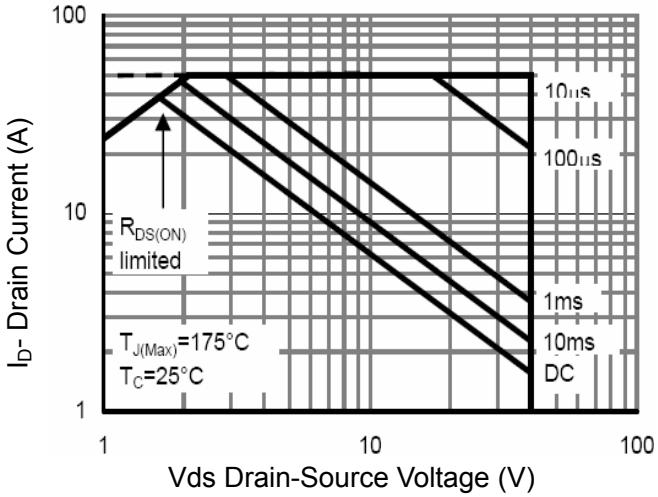



**Figure 8 Safe Operation Area**

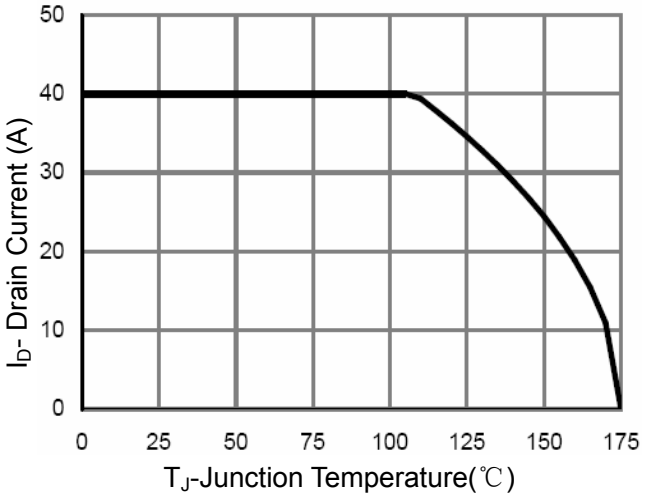



**Figure 10 ID Current Derating vs Junction Temperature**

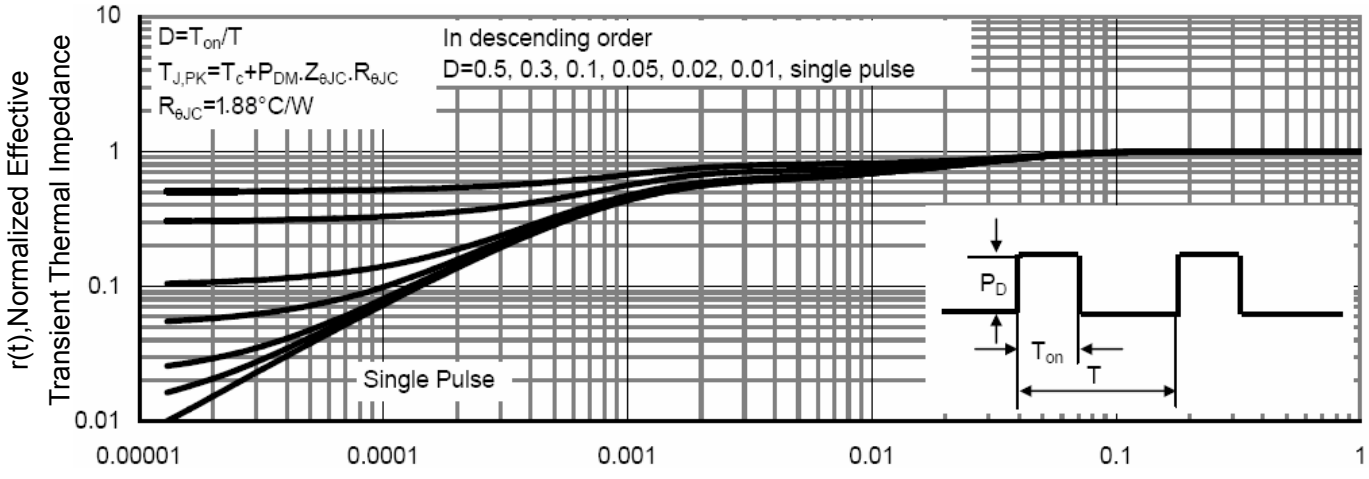
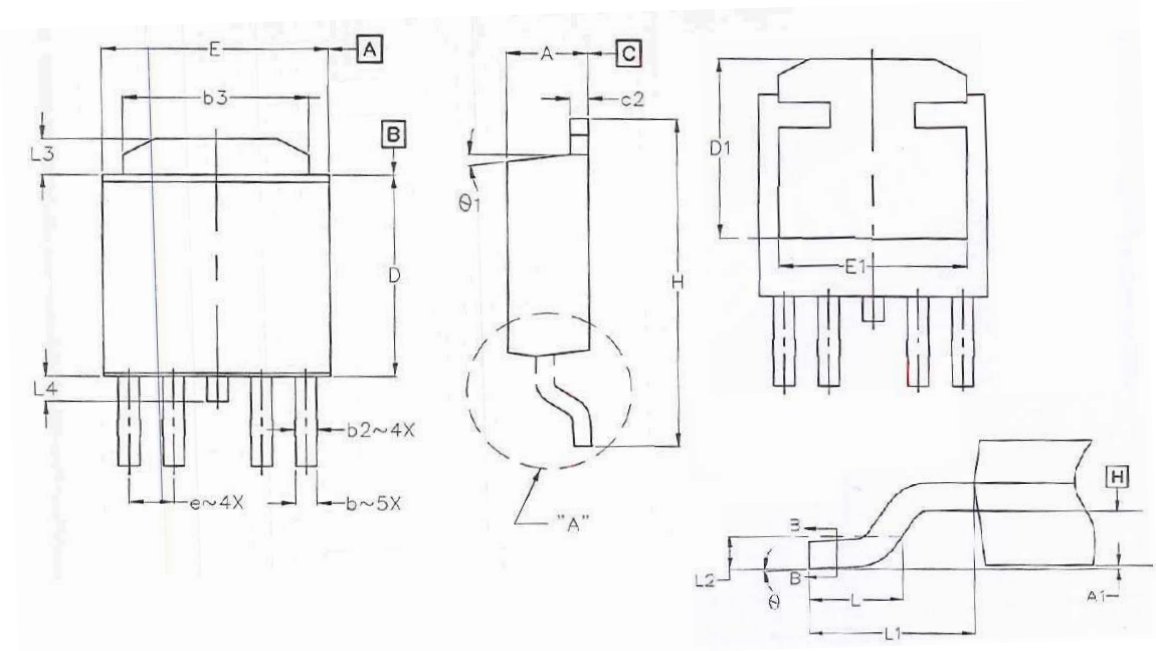



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-252-4 Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 2.184 | 2.387 | 0.086 | 0.094 |
| A1 | - | 0.127 | - | 0.094 |
| b | 0.508 | 0.711 | 0.020 | 0.028 |
| b1 | 0.508 | 0.660 | 0.020 | 0.026 |
| b2 | 0.610 | 0.787 | 0.024 | 0.031 |
| b3 | 4.953 | 5.461 | 0.195 | 0.215 |
| c | 0.460 | 0.610 | 0.018 | 0.024 |
| c1 | 0.410 | 0.559 | 0.016 | 0.022 |
| C2 | 0.460 | 12.950 | 0.498 | 0.510 |
| D | 4.980 | 5.180 | 0.196 | 0.204 |
| D1 | 2.650 | 2.950 | 0.104 | 0.116 |
| E | 7.900 | 8.100 | 0.311 | 0.319 |
| E1 | 0.000 | 0.300 | 0.000 | 0.012 |
| e | 12.900 | 13.400 | 0.508 | 0.528 |
| H | 2.850 | 3.250 | 0.112 | 0.128 |
| L | 1.397 | 1.778 | 0.055 | 0.070 |
| L1 | 2.743 | BSC | 0.108 | BSC |
| L2 | 0.508 | BSC | 0.020 | BSC |
| L3 | 0.889 | 1.270 | 0.035 | 0.050 |
| L4 | - | 1.015 | - | 0.040 |
| θ | 0° | 10° | 0° | 10° |
| θ1 | 0° | 15° | 0° | 15° |