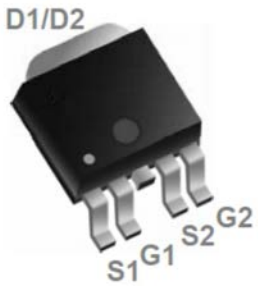
**40V N+P Channel Mosfet**

## FEATURES

- N-Channel: 40V
  $R_{DS(ON)}$=19mΩ (Typ.) @ $V_{GS}$=10V
  $R_{DS(ON)}$=27mΩ (Typ.) @ $V_{GS}$=4.5V
- P-Channel: -40V
  $R_{DS(ON)}$=28mΩ (Typ.) @ $V_{GS}$=-10V
  $R_{DS(ON)}$=36mΩ (Typ.) @ $V_{GS}$=-4.5V

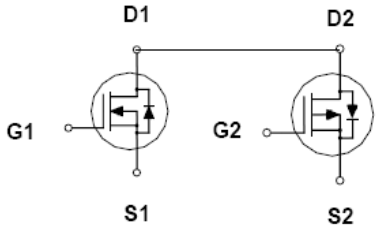
## TO-252-4L




## APPLICATIONS

- DC FAN
- Networking DC-DC Power System
- Motor Control

## N+P CHANNEL MOSFET




## Absolute Maximum Ratings ($T_C$=25℃ unless otherwise specified)

| 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 | $T_C$=25°C | $I_D$ | 23 | -20 | A |
| | $T_C$=100°C | | 16.1 | -14.0 | |
| Pulsed Drain Current | | $I_{DM}$ | 46 | -40 | A |
| Single Pulse Avalanche Energy | | EAS | 8.45 | 18.05 | mJ |
| Avalanche Current | | $I_{AS}$ | 13.0 | -19.0 | A |
| Power Dissipation | $T_C$=25°C | $P_D$ | 20.8 | | W |
| | $T_C$=100°C | | 8.3 | | |
| Operating Junction and Storage Temperature Range | | $T_J$,$T_{STG}$ | -55 to 150 | | °C |

## THERMAL RESISTANCE RATINGS

| Thermal Resistance | Symbol | Typ. | Maximum | Unit |
|---|---|---|---|---|
| Maximum Junction-to-Ambient | $R_{\theta JA}$ | - | 60 | °C/W |
| Maximum Junction-to-Case | $R_{\theta JC}$ | - | 6 | °C/W |

## N-Channel Electrical Characteristics ($T_C$=25℃ unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristic** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V,$I_D$=250μA | 40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ =32V, $V_{GS}$ = 0V, $T_J$= 25℃ | - | - | 1.0 | μA |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{DS}$ =0V,$V_{GS}$ = ±20V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$= $V_{GS}$, $I_D$=250μA | 1.0 | 1.5 | 2.2 | V |
| $R_{DS(on)}$ | Static Drain-Source on-Resistance note2 | $V_{GS}$ =10V, $I_D$ =6A | - | 19 | 24 | mΩ |
| | | $V_{GS}$ =4.5V, $I_D$ =5A | - | 27 | 37 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ =5V, $I_D$ =6A | - | 15 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 20V, $V_{GS}$ = 0V, f = 1.0MHz | - | 255 | 310 | pF |
| $C_{oss}$ | Output Capacitance | | - | 45 | 60 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 35 | 50 | pF |
| $Q_g$ | Total Gate Charge | $V_{DS}$ =20V, $I_D$ =6A, $V_{GS}$ =10V | - | 5.2 | - | nC |
| $Q_{gs}$ | Gate-Source Charge | | - | 1.0 | - | nC |
| $Q_{gd}$ | Gate-Drain(“Miller”) Charge | | - | 1.4 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{GS}$=10V, $V_{DS}$=20V, $R_L$=2.5Ω, $R_G$ =3Ω | - | 4.5 | - | ns |
| $t_r$ | Turn-on Rise Time | | - | 2.5 | - | ns |
| $t_{d(off)}$ | Turn-off Delay Time | | - | 14.5 | - | ns |
| $t_f$ | Turn-off Fall Time | | - | 3.5 | - | ns |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 23 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 46 | A |

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

2. Pulse Test: Pulse Width≤300μs, Duty Cycle≤2%
3. EAS condition: TJ=25℃, VGS=10V, RG=25Ω, L=0.1mH

## P-Channel Electrical Characteristics ($T_C$=25℃ unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristic** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V,$I_D$= -250μA | -40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = -32V, $V_{GS}$ = 0V, | - | - | -1 | μA |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{DS}$ =0V, $V_{GS}$ = ±20V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$= $V_{GS}$, $I_D$= -250μA | -1.0 | -1.6 | -2.5 | V |
| $R_{DS(on)}$ | Static Drain-Source on-Resistance note2 | $V_{GS}$ =-10V, $I_D$ =-6A | - | 28 | 36 | mΩ |
| | | $V_{GS}$ =-4.5V, $I_D$ =-5A | - | 36 | 50 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ =-5V, $I_D$ = -6A | - | 18 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = -20V, $V_{GS}$ = 0V, f = 1.0MHz | - | 760 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 140 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 95 | - | pF |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = -20V, $I_D$ = -6A, $V_{GS}$ = -10V | - | 13.6 | - | nC |
| $Q_{gs}$ | Gate-Source Charge | | - | 2.5 | - | nC |
| $Q_{gd}$ | Gate-Drain(“Miller”) Charge | | - | 3.2 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DS}$ = -20V, $R_L$=2.3Ω, $R_{GEN}$=3Ω,$V_{GS}$=-10V, | - | 11 | - | ns |
| $t_r$ | Turn-on Rise Time | | - | 35 | - | ns |
| $t_{d(off)}$ | Turn-off Delay Time | | - | 30 | - | ns |
| $t_f$ | Turn-off Fall Time | | - | 10 | - | ns |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | -20 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | -40 | A |

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

2. Pulse Test: Pulse Width≤300μs, Duty Cycle≤2%
3. EAS condition: TJ=25℃, VGS=-10V, RG=25Ω, L=0.1mH

## N-Channel Typical Performance Characteristics

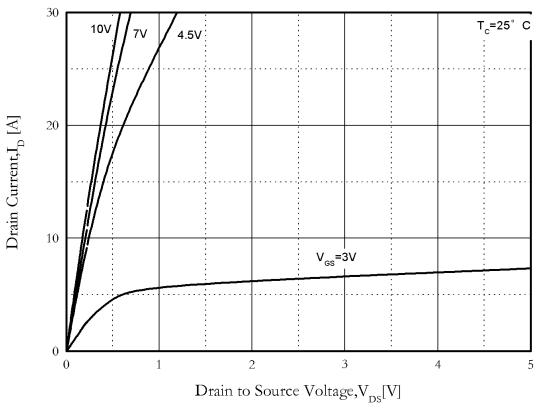



Figure1. Output Characteristics

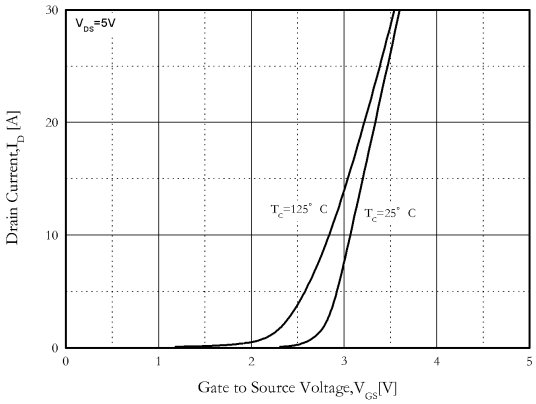



Figure2. Transfer Characteristics

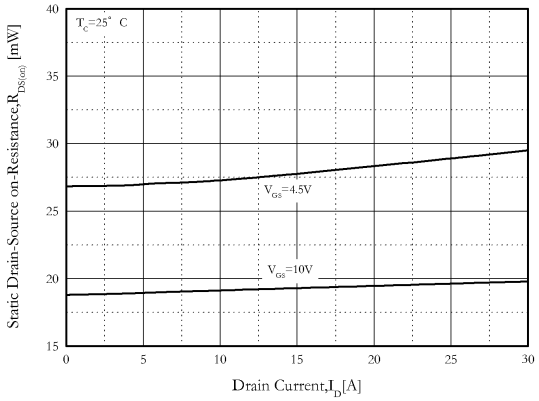



Figure3. Rdson-Drain Current

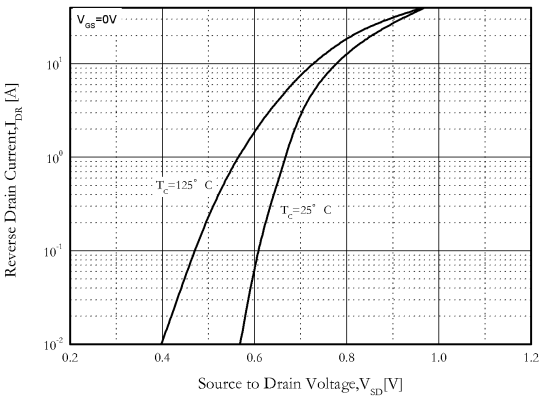



Figure4. Typical Source-Drain Diode Forward Voltage

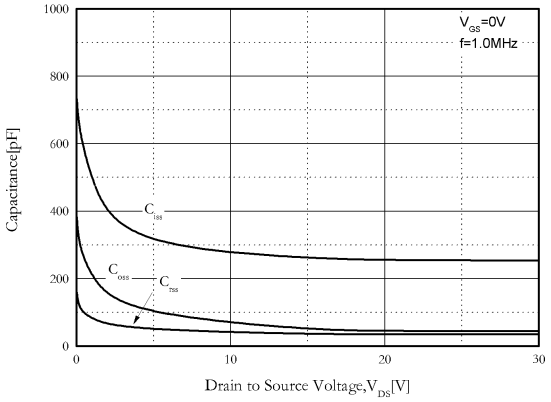



Figure5. Capacitance Characteristics

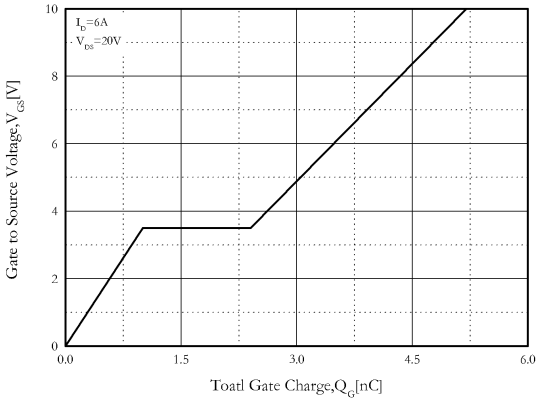



Figure6. Gate Charge

## N-Channel Typical Performance Characteristics

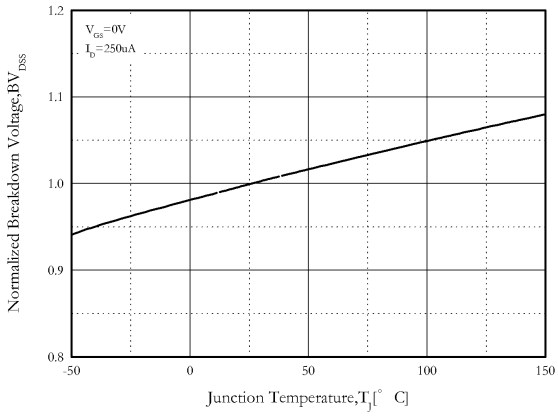



Figure7. Normalized Breakdown Voltage vs. Temperature

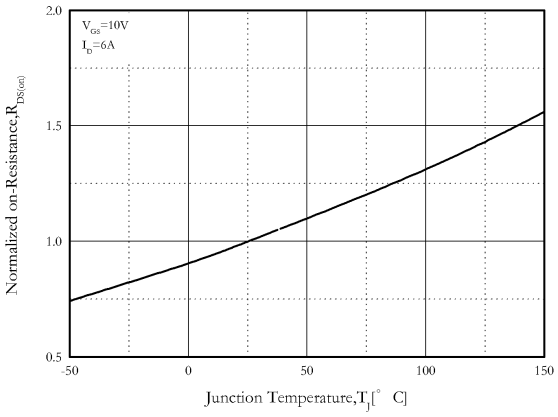



Figure8. Normalized on Resistance vs. Temperature

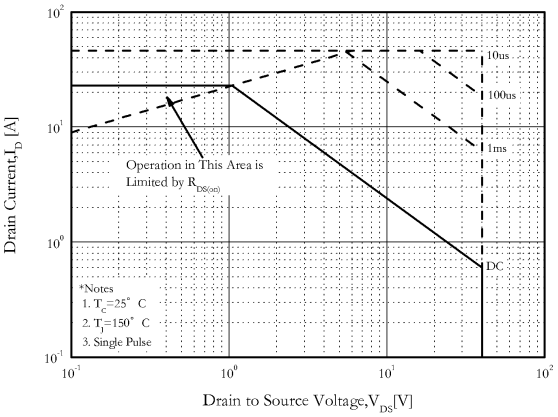



Figure9. Safe Operation Area

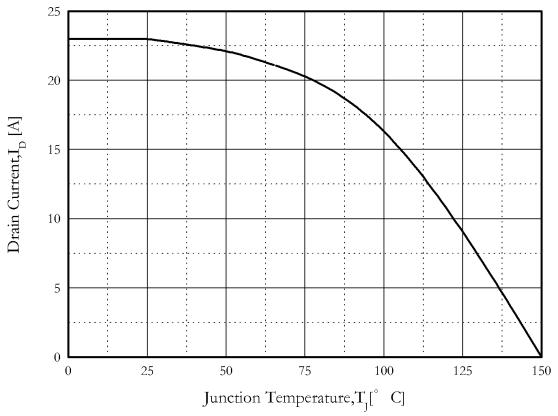



Figure10. Drain Current vs. Junction Temperature

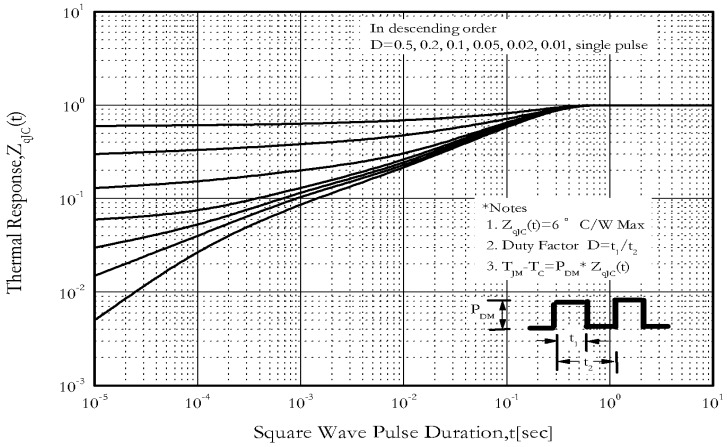



Figure11. Transient Thermal Response Curve

## P-Channel Typical Performance Characteristics

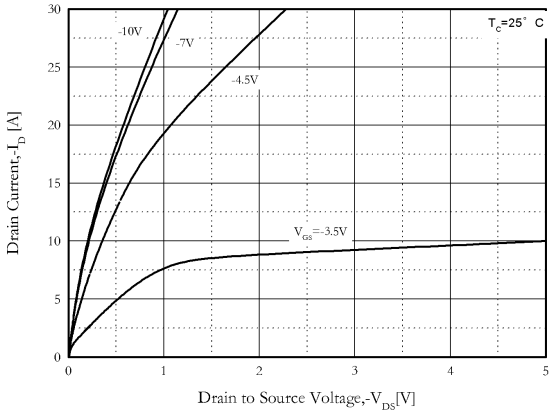



Figure1. Output Characteristics

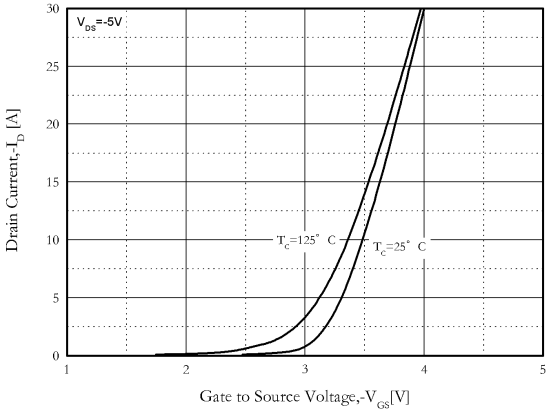



Figure2. Transfer Characteristics

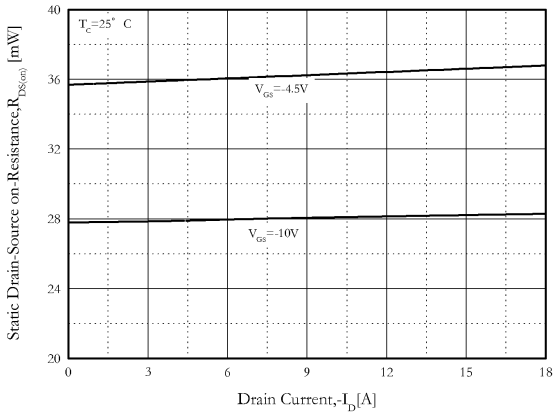



Figure3. Rdson-Drain Current

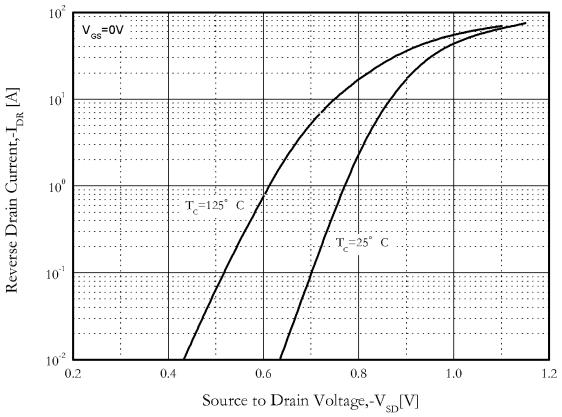



Figure4. Typical Source-Drain Diode Forward Voltage

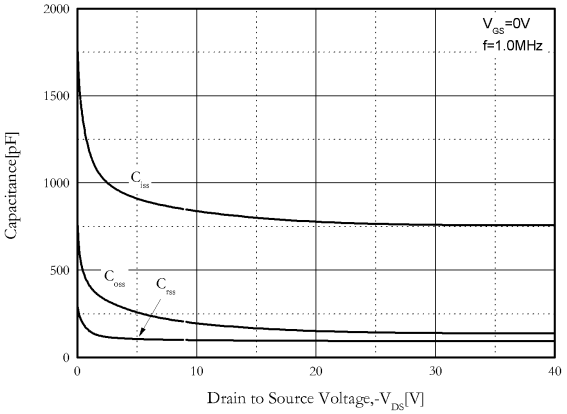



Figure5. Capacitance Characteristics

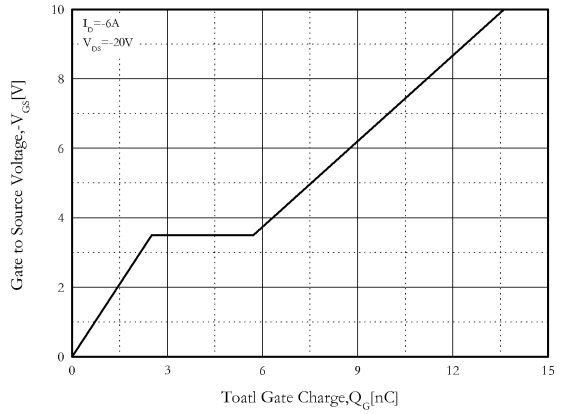



Figure6. Gate Charge

## P-Channel Typical Performance Characteristics

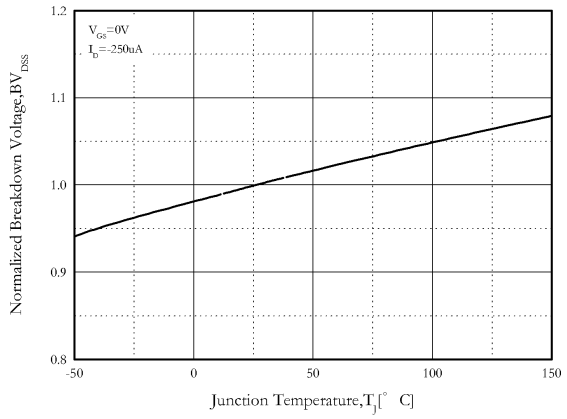



Figure7. Normalized Breakdown Voltage vs. Temperature

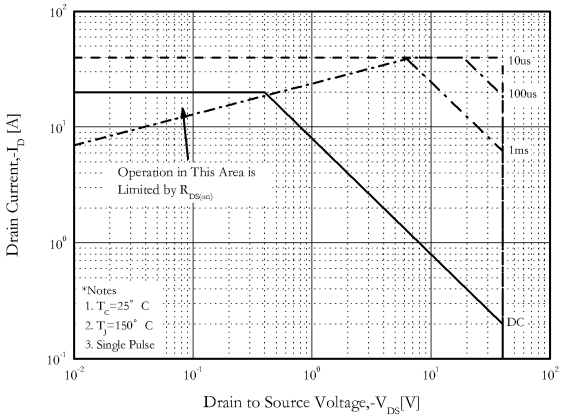



Figure8. Normalized on Resistance vs. Temperature

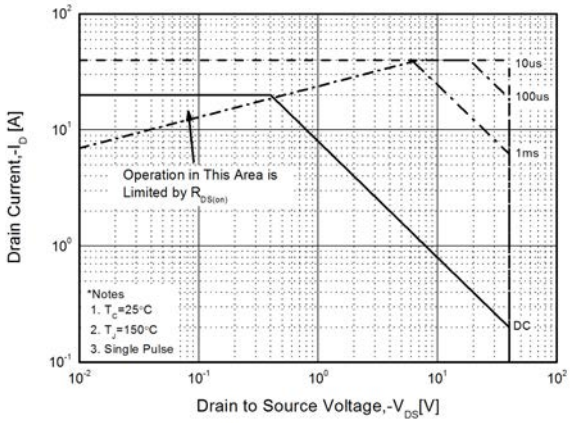



Figure9. Safe Operation Area

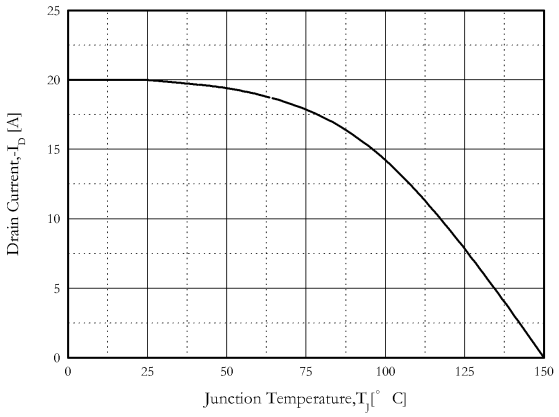



Figure10. Maximum Drain Current vs. Junction Temperature

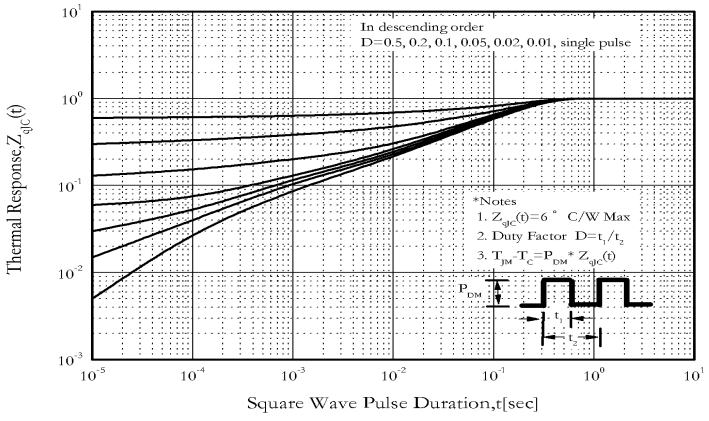
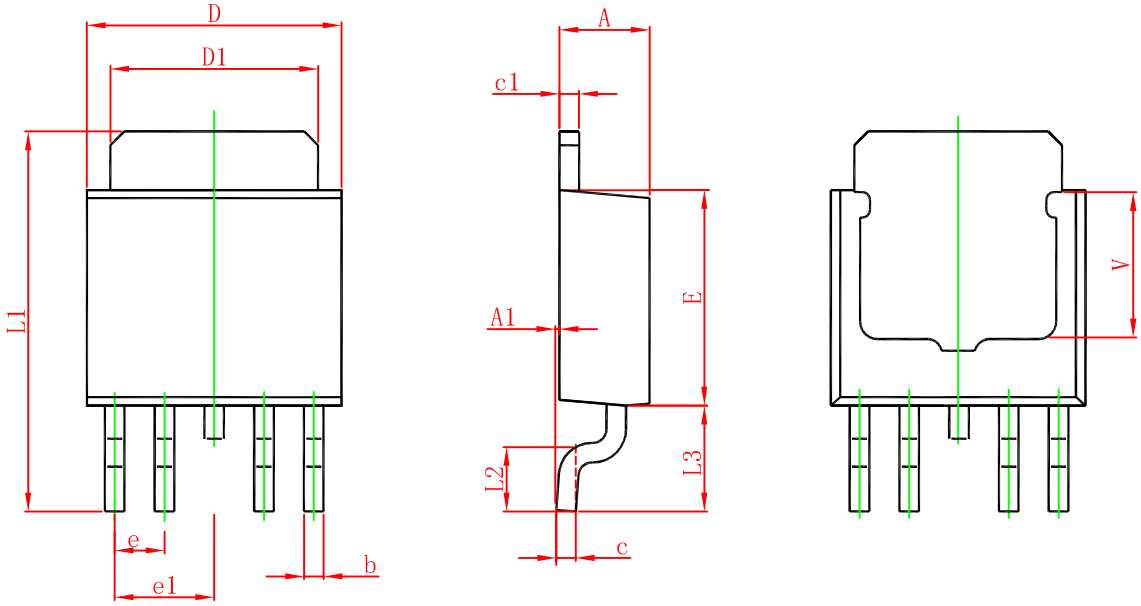



Figure11. Transient Thermal Response Curve

## TO-252-4L PACKAGE OUTLINE DRAWING




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 2.200 | 2.400 | 0.087 | 0.094 |
| A1 | 0.000 | 0.127 | 0.000 | 0.005 |
| b | 0.400 | 0.600 | 0.016 | 0.024 |
| c | 0.430 | 0.580 | 0.017 | 0.023 |
| c1 | 0.430 | 0.580 | 0.017 | 0.023 |
| D | 6.350 | 6.650 | 0.250 | 0.262 |
| D1 | 5.200 | 5.400 | 0.205 | 0.213 |
| E | 5.400 | 5.700 | 0.213 | 0.224 |
| e | 1.270 TYP | | 0.050 TYP | |
| e1 | 2.540 TYP | | 1.000 TYP | |
| L1 | 9.500 | 9.900 | 0.374 | 0.390 |
| L2 | 1.400 | 1.780 | 0.055 | 0.070 |
| L3 | 2.550 | 2.900 | 0.100 | 0.114 |
| V | 3.45 REF | | 0.136 REF | |