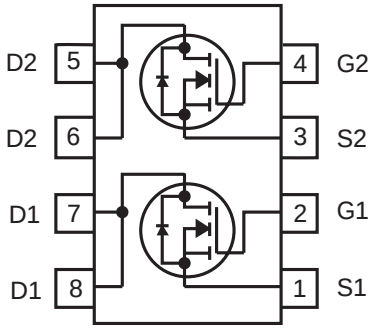
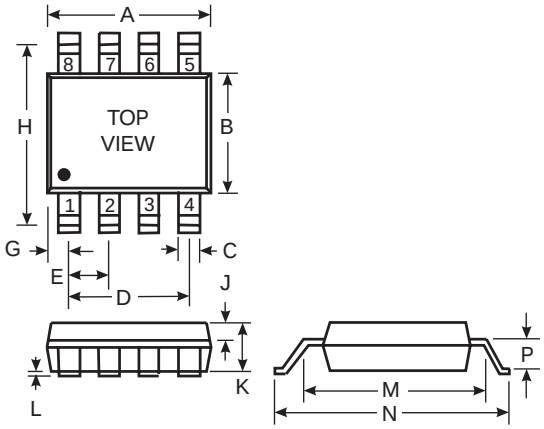
# DI9956

## DUAL N-CHANNEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR

## Features

- High Cell Density DMOS Technology
- Lower On-State Resistance
- High Power and Current Capability
- Fast Switching Speed
- High Transient Tolerance




| SO-8 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | 3.94 | 4.19 |
| **B** | 3.20 | 3.40 |
| **C** | 0.381 | 0.495 |
| **D** | 2.67 | 3.05 |
| **E** | 0.89 | 1.02 |
| **G** | 0.527 | 0.679 |
| **J** | 0.41 Nominal | |
| **K** | 0.94 | 1.09 |
| **L** | 0.025 | 0.152 |
| **M** | 4.37 | 4.62 |
| **N** | 4.39 | 4.70 |
| **P** | 0.939 Nominal | |
| **All Dimensions in mm** | | |

## Mechanical Data

- SO-8 Plastic Case
- Terminal Connections: See Outline Drawing and Internal Circuit Diagram above

## Maximum Ratings @ $T_A$ = 25°C unless otherwise specified

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 30 | V |
| Gate-Source Voltage | $V_{GSS}$ | ±20 | V |
| Drain Current — Note 1a Continuous<br>Pulsed | $I_D$ | ±3.7<br>±15 | A |
| Power Dissipation for:<br>Dual Operation (Note 1d)<br>Single Operation (Note 1a)<br>(Note 1b)<br>(Note 1c) | $P_d$ | <br>2.0<br>1.6<br>1.0<br>0.9 | W |
| Operating and Storage Temperature Range | $T_j$, $T_{STG}$ | -55 to +150 | °C |

## Thermal Characteristics @ $T_A$ = 25°C unless otherwise specified

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Thermal Resistance, Junction-to-Ambient | Note 1a | $R_{\Theta JA}$ | 78 | °C/W |
| Thermal Resistance, Junction-to-Case | Note 1 | $R_{\Theta JC}$ | 40 | °C/W |

Notes: 1. $R_{\Theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance ($R_{\Theta JC}$ + $R_{\Theta CA}$) where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\Theta JC}$ in this instance is 40°C/W but is dependent on the specific circuit board thermal design.

1a. With 0.5 $in^2$ of 2 oz. copper mounting pad $R_{\Theta JA}$ = 78°C\W.

1b. With 0.02 $in^2$ of 2 oz. copper mounting pad $R_{\Theta JA}$ = 125°C\W.

1c. With 0.003 $in^2$ of 2 oz. copper mounting pad $R_{\Theta JA}$ = 135°C\W.

1d. With 1.0 $in^2$ of 2 oz. copper mounting pad, total power dissipation of up to 2W for dual operation can be achieved

## Electrical Characteristics @ $T_A$ = 25°C unless otherwise specified

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 30 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| Zero Gate Voltage Drain Current<br>$T_j$ = 55°C | $I_{DSS}$ | — | — | 2.0<br>25 | µA | $V_{DS}$ = 24V, $V_{GS}$ = 0V |
| Gate-Body Leakage, Forward | $I_{GSSF}$ | — | — | 100 | nA | $V_{GS}$ = 20V, $V_{DS}$ = 0V |
| Gate-Body Leakage, Reverse | $I_{GSSR}$ | — | — | -100 | nA | $V_{GS}$ = -20V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 2)** | | | | | | |
| Gate Threshold Voltage<br>$T_j$ = 125°C | $V_{GS(th)}$ | 1.0<br>0.7 | 1.7<br>1.2 | 2.8<br>2.2 | V | VDS = $V_{GS}$, $I_D$ = 250µA |
| Static Drain-Source On-Resistance<br>$T_j$ = 125°C<br><br>$T_j$ = 125°C | $R_{DS\ (ON)}$ | — | 0.06<br>0.08<br>0.08<br>0.11 | 0.08<br>0.13<br>0.11<br>0.18 | Ω | $V_{GS}$ = 10V, $I_D$ = 2.2A<br>$V_{GS}$ = 10V, $I_D$ = 2.2A<br>$V_{GS}$ = 4.5V, $I_D$ = 1.0A<br>$V_{GS}$ = 4.5V, $I_D$ = 1.0A |
| On-State Drain Current | $I_{D(ON)}$ | 15<br>3.5 | — | — | A | $V_{GS}$ = 10V, $V_{DS}$ = 10V<br>$V_{GS}$ = 4.5V, $V_{DS}$ = 10V |
| Forward Transconductance | $g_{FS}$ | — | 6.0 | — | ℧ | $V_{DS}$ = 15V, $I_D$ = 3.7A |
| **DYNAMIC CHACTERISTICS** | | | | | | |
| Input Capacitance | $C_{ISS}$ | — | 320 | — | pF | $V_{DS}$ = 10V, $V_{GS}$ = 0V<br>f = 1.0MHz |
| Output Capacitance | $C_{OSS}$ | — | 225 | — | pF | |
| Reverse Transfer Capacitance | $C_{RSS}$ | — | 85 | — | pF | |
| **SWITCHING CHARACTERISTICS (Note 2)** | | | | | | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 10 | 20 | ns | $V_{DD}$ = 10V, $I_D$ = 1.0A<br>$V_{GEN}$ = 10V, $R_{GEN}$ = 6.0Ω |
| Turn-On Rise Time | $t_r$ | — | 13 | 20 | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 21 | 50 | ns | |
| Turn-Off Fall Time | $t_f$ | — | 5.0 | 50 | ns | |
| Total Gate Charge | $Q_g$ | — | 9.5 | 27 | nC | $V_{DS}$ =10V, $I_D$ = 3.7A.<br>$V_{GS}$ = 10V |
| Gate-Source Charge | $Q_{gs}$ | — | 1.5 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 3.3 | — | nC | |
| **DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS** | | | | | | |
| Max Continuous Drain-Source Diode Forward Current | $I_S$ | — | — | 1.2 | A | |
| Drain-Source Diode Forward Voltage | $V_{SD}$ | — | 0.8 | 1.3 | V | $V_{GS}$ = 0V, $I_S$ = 1.25A<br>(Note 2) |
| Reverse Recovery Time | $t_{rr}$ | — | — | 100 | ns | $V_{GS}$ = 0V, $I_F$ = 1.25A,<br>$dI_F/dt$ = 100A/µs |

Note: 2. Pulse Test: Pulse width ≤ 300 µs duty cycle ≤ 2%.

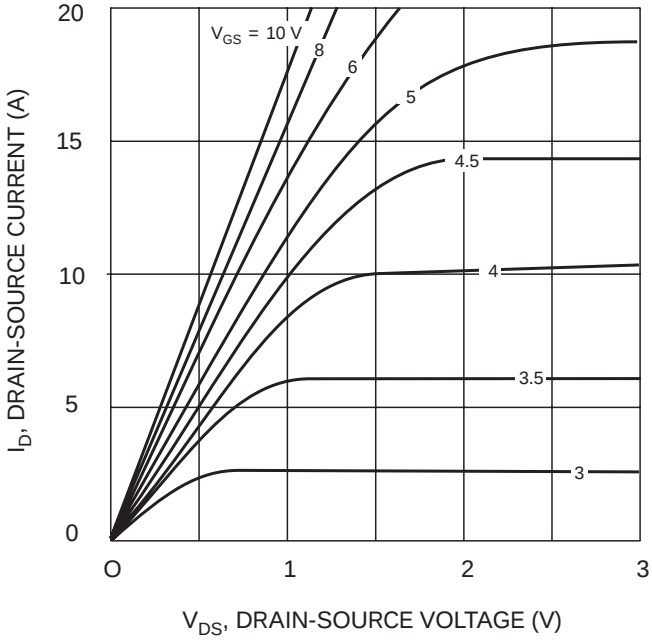



Fig. 1, On-Region Characteristics

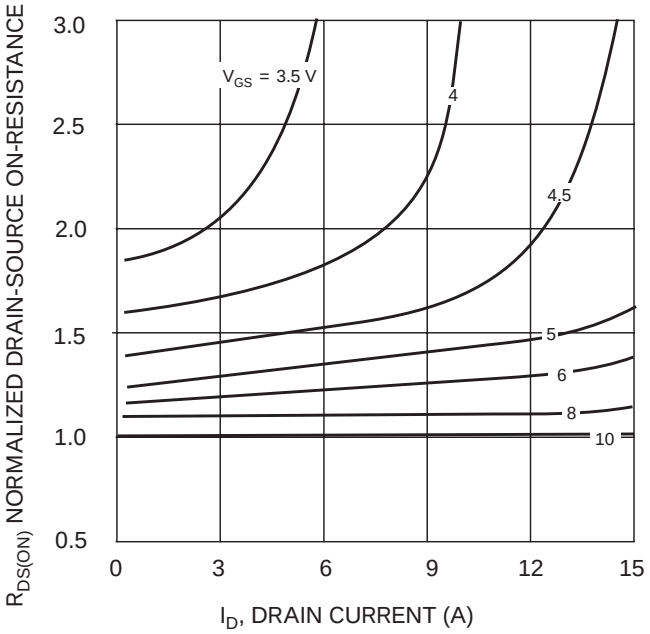



Fig. 2, On-Resistance vs Gate Voltage and Drain Current

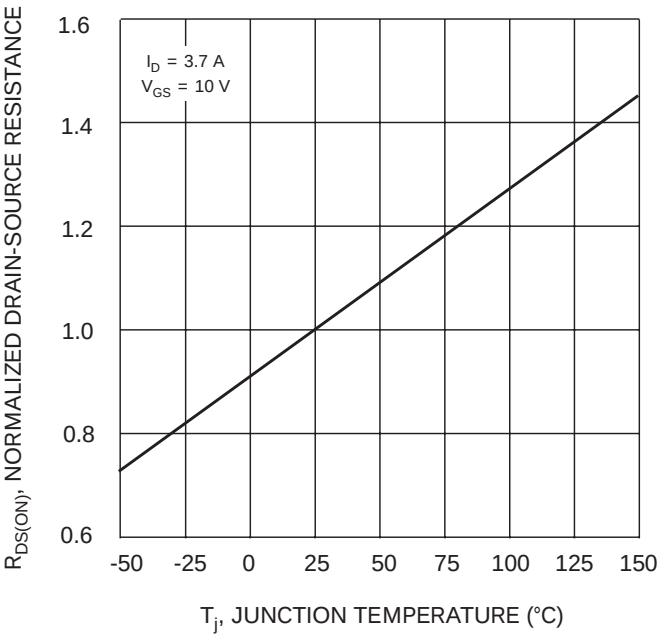



Fig. 3, On-Resistance vs Temperature

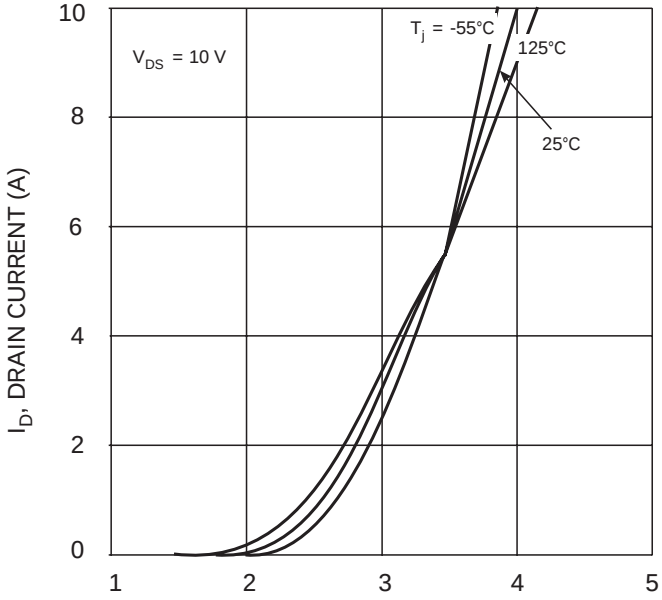



Fig. 4, Transfer Characteristics

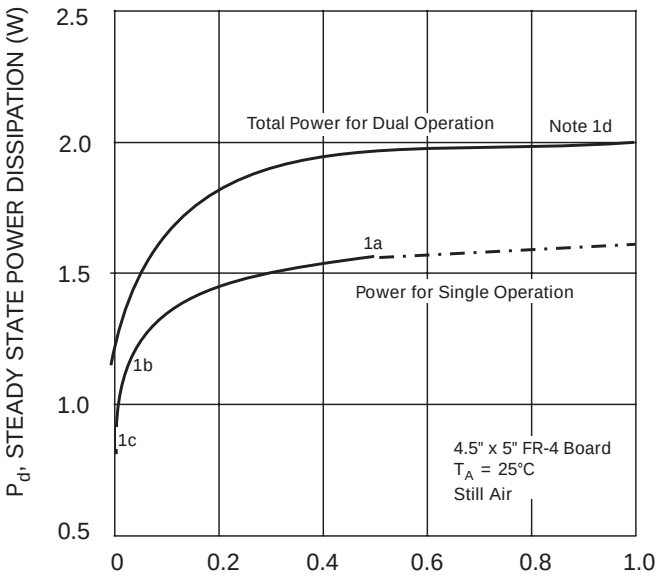



Fig. 5, Steady State Pwr Dissipation vs Copper Mtg Pad Area

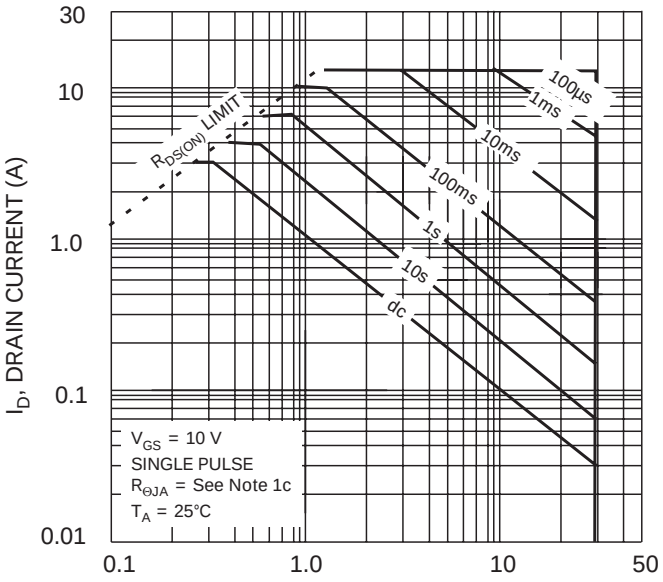



Fig. 6, Maximum Safe Operating Area

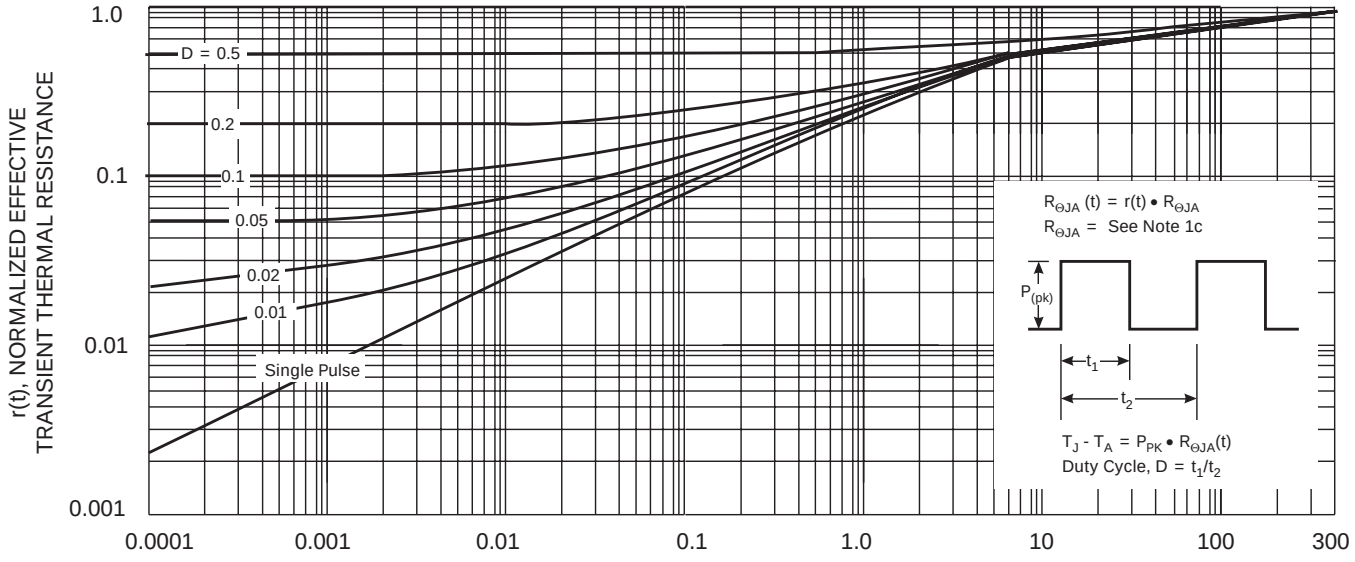



Fig. 7, Typical Normalized Transient Thermal Impedance Curves

Remark: Thermal characterization performed under conditions of Note 1c. Better thermal design such as shown in Notes 1a and 1b or 1d will offer lower $R_{\Theta JA}$ values and allow junction to reach thermal equilibrium sooner.