# SOP-8 Plastic-Encapsulate MOSFETS

**4410**

## N-Channel Enhancement Mode Power MOSFET

### Description

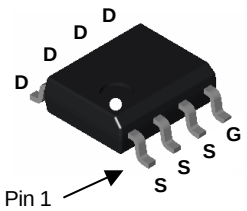
The 4410 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge . The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

### General Features

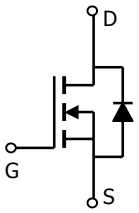
| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DSS}$ | $I_D$ | $R_{DS(on)}$ (mΩ) Max |
| 30V | 10 A | 13.5 @ $V_{GS}$ = 10V |
| | 5 A | 18.0 @ $V_{GS}$ = 4.5V |

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

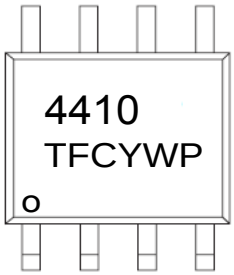
**SO-8L**




**Equivalent Circuit**




**MARKING**




Y :year code W :week code

| **Absolute Maximum Ratings $T_A$=25°C unless otherwise noted** | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Maximum** | **Units** |
| Drain-Source Voltage | | $V_{DS}$ | 30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current [A] | $T_A$=25°C | $I_D$ | 10 | A |
| Pulsed Drain Current [B] | | $I_{DM}$ | 45 | |
| Power Dissipation [A] | $T_A$=25°C | $P_D$ | 2.3 | W |
| | $T_A$=70°C | | 1.6 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | °C |

| **Thermal Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typ** | **Max** | **Units** |
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | 48 | 62.5 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | 74 | 110 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | 35 | 40 | °C/W |

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## 4410

**Electrical Characteristics ($T_J$=25°C unless otherwise noted)**

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $I_D$= 250μA, $V_{GS}$=0V | 30 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$= 24V, $V_{GS}$=0V | | | 500 | nA |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$=±20V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$= 250μA | 1.0 | 1.6 | 2.5 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$= 10V , $V_{DS}$= 5V | | | 45 | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$= 10V, $I_D$= 10A | | 11 | 13.5 | mΩ |
| | | $V_{GS}$= 4.5V, $I_D$= 5A | | 16 | 18.0 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$= 15V, $I_D$= 10A | | 9 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$= 3A , $V_{GS}$=0V | | 0.8 | 1.2 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | 3 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=25V, f=1MHz | | 710 | | pF |
| $C_{oss}$ | Output Capacitance | | | 155 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 145 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | | 3.0 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ (10V) | Total Gate Charge (10V) | $V_{DD}$= 20V, $V_{GEN}$ = 10V, $I_D$= 9A | | 8 | | nC |
| $Q_g$ (4.5V) | Total Gate Charge (4.5V) | | | 6.2 | | nC |
| $Q_{gs}$ | Gate Source Charge | | | 3.3 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 2.7 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{DD}$= 15V, $V_{GEN}$= 10V,$R_L$= 15Ω $R_{GEN}$=3Ω $I_D$= 9A | | 7.0 | | ns |
| $t_r$ | Turn-On Rise Time | | | 7.0 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 22 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 7.0 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$= 10A, dI/dt=100A/μs | | 24 | | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$= 10A, dI/dt=100A/μs | | 14 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1$in^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$=25°C. The value in any given application depends on the user's specific board design. The current rating is based on the t≤ 10s thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.

D. The static characteristics in Figures 1 to 6,12,14 are obtained using 80μs pulses, duty cycle 0.5% max.

E. These tests are performed with the device mounted on 1 $in^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$=25°C. The SOA curve provides a single pulse rating.

## Characteristics Curve

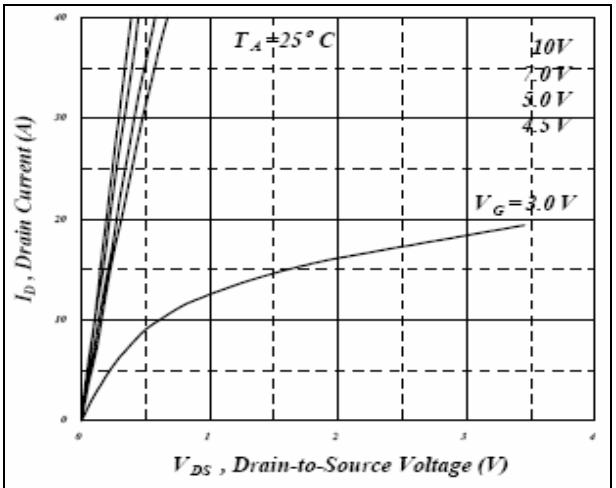


Fig 1. Typical Output Characteristics

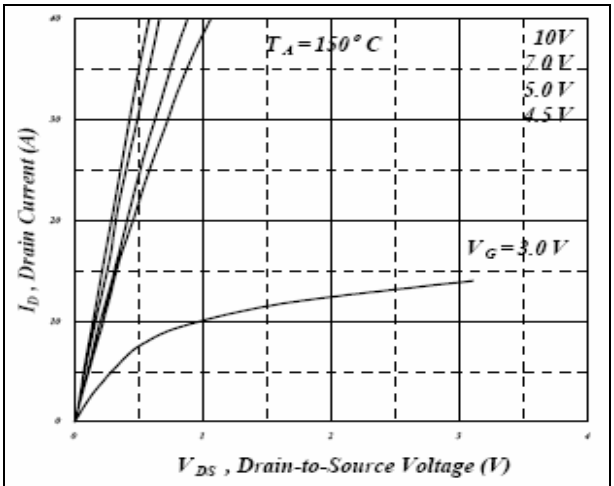


Fig 2. Typical Output Characteristics

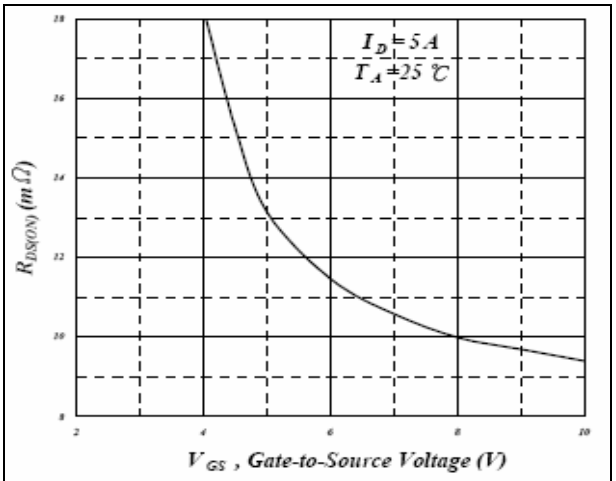


Fig 3. On-Resistance v.s. Gate Voltage

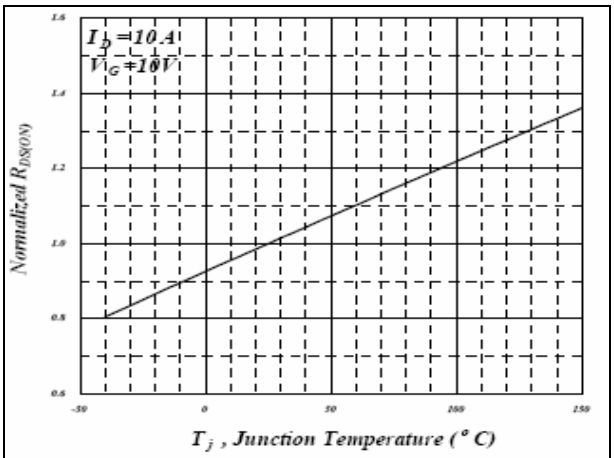


Fig 4. Normalized On-Resistance v.s. Junction Temperature

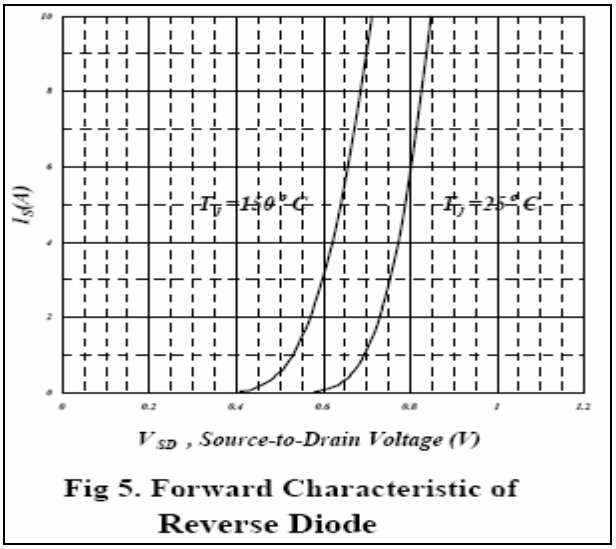


Fig 5. Forward Characteristic of Reverse Diode

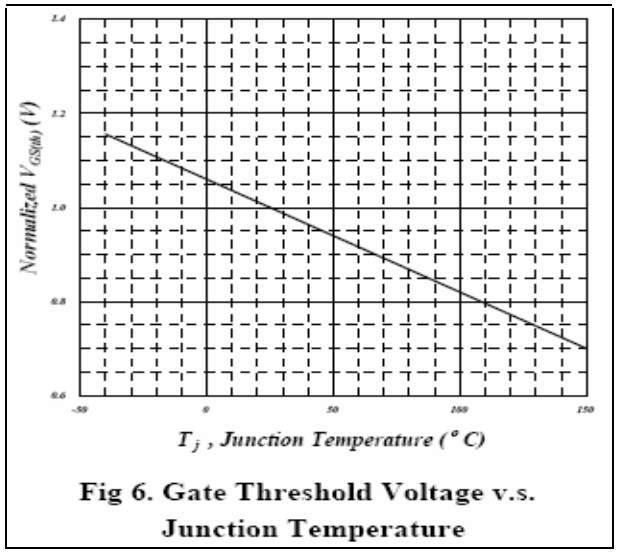


Fig 6. Gate Threshold Voltage v.s. Junction Temperature

## Characteristics Curve

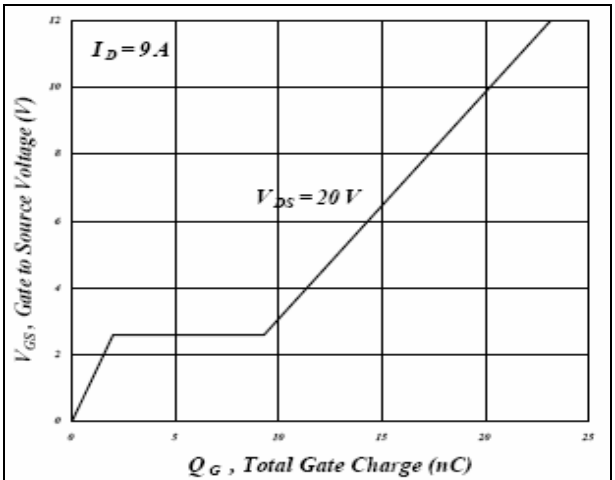


Fig 7. Gate Charge Characteristics

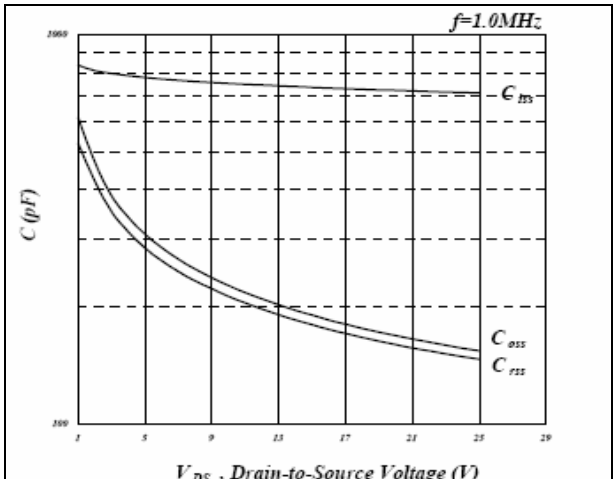


Fig 8. Typical Capacitance Characteristics

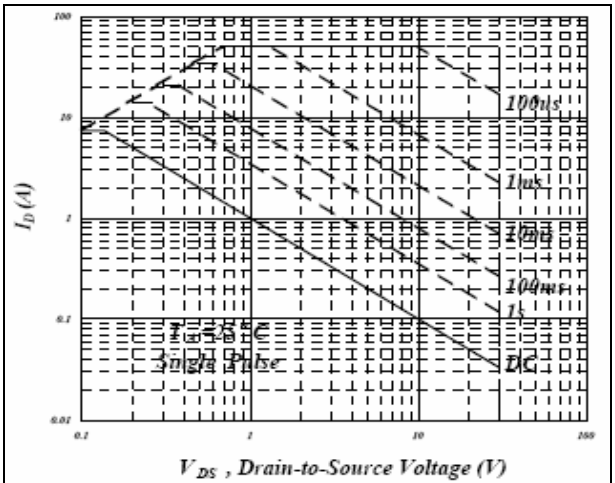


Fig 9. Maximum Safe Operating Area

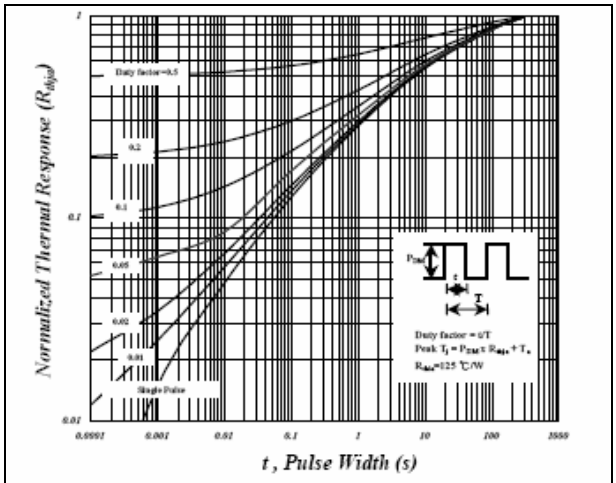


Fig 10. Effective Transient Thermal Impedance

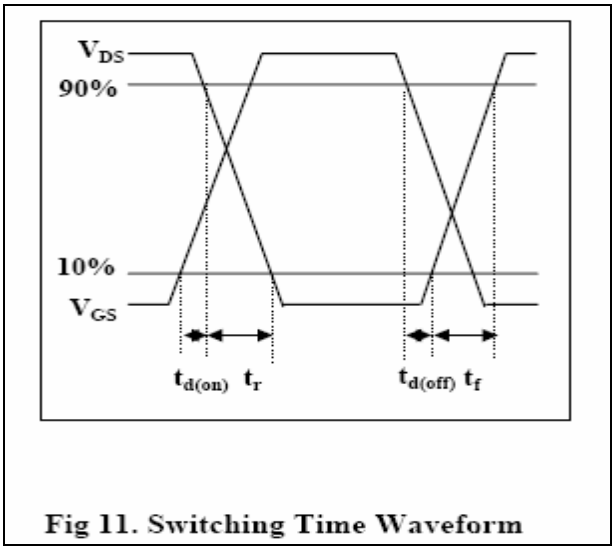


Fig 11. Switching Time Waveform

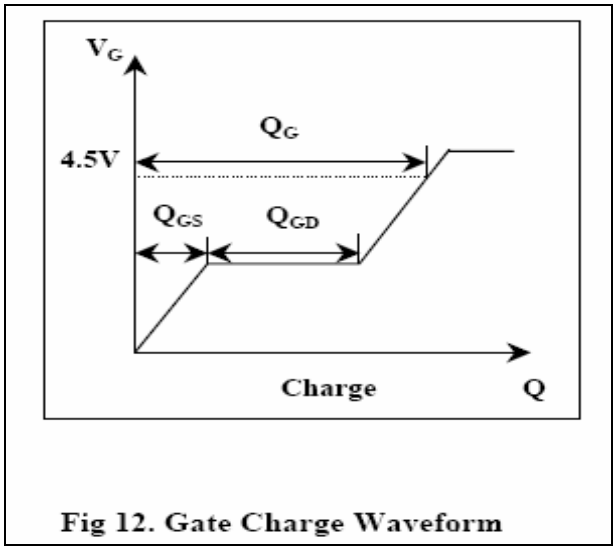


Fig 12. Gate Charge Waveform

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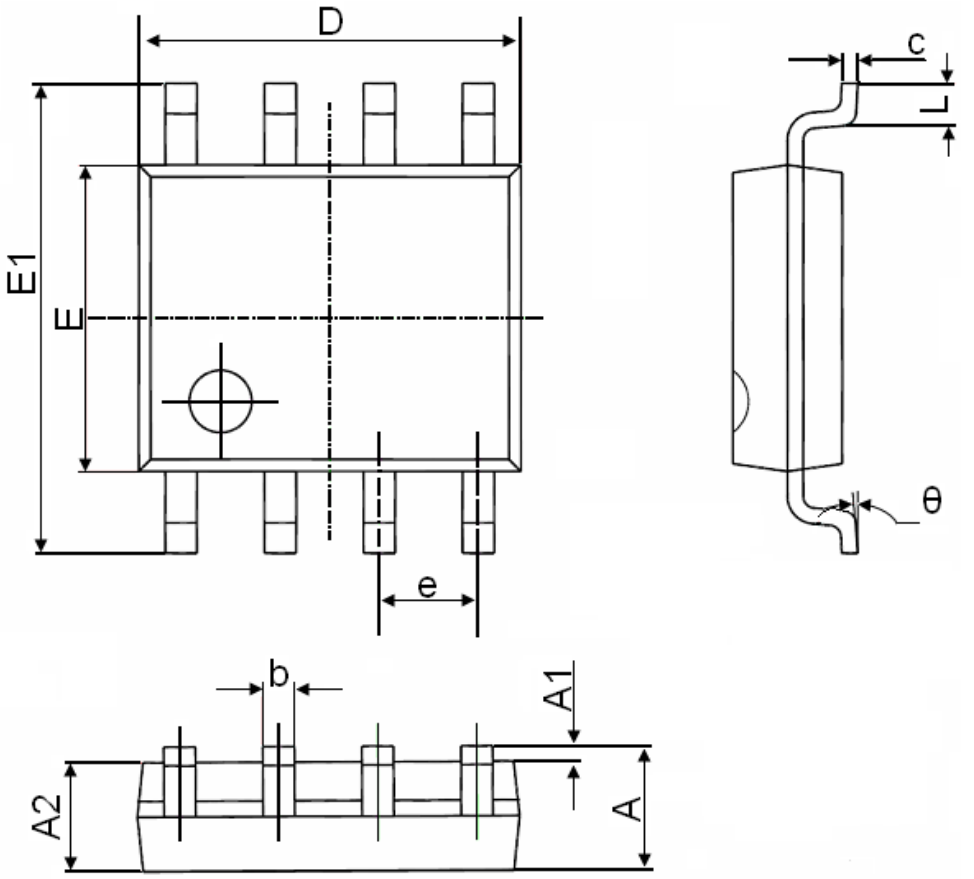
**4410**

## SOP-8 Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.200 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 1.270(BSC) | | 0.050(BSC) | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |