# TN2410L, VN2406/2410 Series

## N-Channel Enhancement-Mode MOSFET Transistors

**TN2410L VN2406D VN2410L**
**VN2406L VN2410M**
**VN2406M**

## Product Summary

| Part Number | $V_{(BR)DSS}$ Min (V) | $r_{DS(on)}$ Max (Ω) | $V_{GS(th)}$ (V) | $I_D$ (A) |
|---|---|---|---|---|
| TN2410L | 240 | 10 @ $V_{GS}$ = 4.5 V | 0.5 to 1.8 | 0.18 |
| VN2406D | | 6 @ $V_{GS}$ = 10 V | 0.8 to 2 | 1.12 |
| VN2406L | | 6 @ $V_{GS}$ = 10 V | 0.8 to 2 | 0.18 |
| VN2406M | | 6 @ $V_{GS}$ = 10 V | 0.8 to 2 | 0.19 |
| VN2410L | | 10 @ $V_{GS}$ = 10 V | 0.8 to 2 | 0.18 |
| VN2410M | | 10 @ $V_{GS}$ = 10 V | 0.8 to 2 | 0.19 |

## Features

- Low On-Resistance: 3.5 Ω
- Secondary Breakdown Free: 260 V
- Low Power/Voltage Driven
- Low Input and Output Leakage
- Excellent Thermal Stability

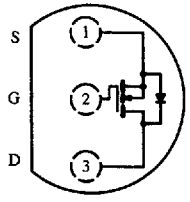
## Benefits

- Low Offset Voltage
- Full-Voltage Operation
- Easily Driven Without Buffer
- Low Error Voltage
- No High-Temperature "Run-Away"

## Applications

- High-Voltage Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Transistors, etc.
- Telephone Mute Switches, Ringer Circuits
- Power Supply, Converters
- Motor Control

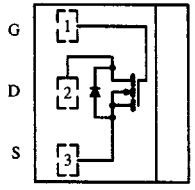
TO-226AA
(TO-92)




Top View

TN2410L
VN2406L
VN2410L

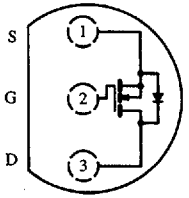
TO-220AB
(Tab Drain)




Top View

VN2406D

TO-237
(Tab Drain)




Top View

VN2406M
VN2410M

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70204.

## Absolute Maximum Ratings ($T_A$ = 25°C Unless Otherwise Noted)

| Parameter | | Symbol | TN2410L | VN2406D[b] | VN2406L | VN2406M | VN2410L | VN2410M | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 240 | 240 | 240 | 240 | 240 | 240 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | ±20 | ±20 | ±20 | ±20 | ±20 | |
| Continuous Drain Current ($T_J$ = 150°C) | $T_A$= 25°C | $I_D$ | 0.18 | 1.12 | 0.18 | 0.19 | 0.18 | 0.19 | A |
| | $T_A$= 100°C | | 0.11 | 0.7 | 0.11 | 0.12 | 0.11 | 0.12 | |
| Pulsed Drain Current[a] | | $I_{DM}$ | 1 | 3 | 1.7 | 2 | 1.7 | 2 | |
| Power Dissipation | $T_A$= 25°C | $P_D$ | 0.8 | 20 | 0.8 | 1 | 0.8 | 1 | W |
| | $T_A$= 100°C | | 0.32 | 8 | 0.32 | 0.4 | 0.32 | 0.4 | |
| Maximum Junction-to-Ambient | | $R_{thJA}$ | 156 | 6.25[c] | 156 | 125 | 156 | 125 | °C/W |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | −55 to 150 | | | | | | °C |

Notes
a. Pulse width limited by maximum junction temperature.
b. Reference case for all temperature testing.
c. Maximum junction-to-case

## Specifications[a]

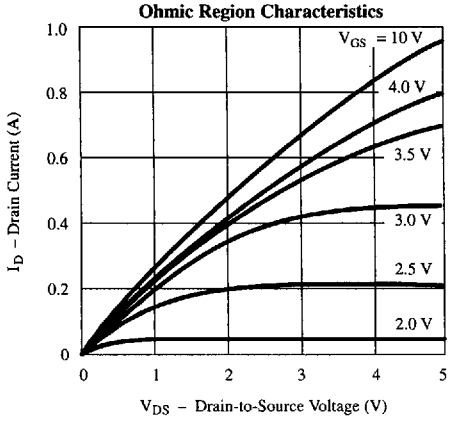
| Parameter | Symbol | Test Conditions | Typ[b] | Limits TN2410L Min | TN2410L Max | VN2406D/L/M Min | VN2406D/L/M Max | VN2410L/M Min | VN2410L/M Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Static** | | | | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 100 µA | 260 | 240 | | 240 | | 240 | | V |
| Gate-Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA | 1.4 | 0.5 | 1.8 | 0.8 | 2 | 0.8 | 2 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±15 V | | | | | ±100 | | ±100 | nA |
| | | $T_J$ = 125°C | | | | | ±500 | | ±500 | |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | ±10 | | | | | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 192 V, $V_{GS}$ = 0 V | 0.01 | | 1 | | | | | µA |
| | | $T_J$ = 125°C | 1 | | 100 | | | | | |
| | | $V_{DS}$ = 120 V, $V_{GS}$ = 0 V | | | | | 10 | | 10 | |
| | | $T_J$ = 125°C | | | | | 500 | | 500 | |
| On-State Drain Current[c] | $I_{D(on)}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V | 0.8 | 0.25 | | | | | | A |
| | | $V_{DS}$ = 15 V, $V_{GS}$ = 10 V | 1.5 | | | 1 | | 1 | | |
| Drain-Source On-Resistance[c] | $r_{DS(on)}$ | $V_{GS}$ = 2.5 V, $I_D$ = 0.1 A | 7.5 | | | | 10 | | 10 | Ω |
| | | $V_{GS}$ = 3.5 V, $I_D$ = 0.05 A | 4.5 | | 15 | | | | | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 0.2 A | 4 | | 10 | | | | | |
| | | $T_J$ = 125°C | 7.5 | | 20 | | | | | |
| | | $V_{GS}$ = 10 V, $I_D$ = 0.5 A | 3.5 | | | | 6 | | 10 | |
| | | $T_J$ = 125°C | 6.5 | | | | 14.8 | | 24.7 | |
| Forward Transconductance[c] | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 0.2 A | 500 | 100 | | | | | | mS |
| | | $V_{DS}$ = 10 V, $I_D$ = 0.5 A | 530 | | | 300 | | 300 | | |

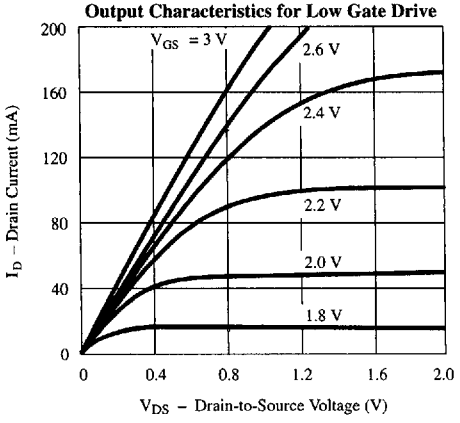
## Specifications[a]

| Parameter | Symbol | Test Conditions | Typ[b] | Limits TN2410L Min | TN2410L Max | VN2406D/L/M Min | VN2406D/L/M Max | VN2410L/M Min | VN2410L/M Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Dynamic** | | | | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V f = 1 MHz | 115 | | 135 | | 135 | | 135 | pF |
| Output Capacitance | $C_{oss}$ | | 30 | | 50 | | 50 | | 50 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | 5 | | 20 | | 20 | | 20 | |
| **Switching[d]** | | | | | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{DD}$ = 60 V, $R_L$ = 150 Ω $I_D$ ≅ 0.4 A, $V_{GEN}$ = 10 V $R_G$ = 25 Ω | 5 | | 35 | | | | | ns |
| | $t_{d(on)}$ | | 3 | | | | 8 | | 8 | |
| | $t_r$ | | 2 | | | | 8 | | 8 | |
| Turn-Off Time | $t_{OFF}$ | | 26 | | 60 | | | | | |
| | $t_{d(off)}$ | | 20 | | | | 23 | | 23 | |
| | $t_f$ | | 6 | | | | 24 | | 34 | |

Notes
a. $T_A$ = 25°C unless otherwise noted. VNDB24
b. For DESIGN AID ONLY, not subject to production testing.
c. Pulse test: PW ≤ 300 µs duty cycle ≤ 2%.
d. Switching time is essentially independent of operating temperature.

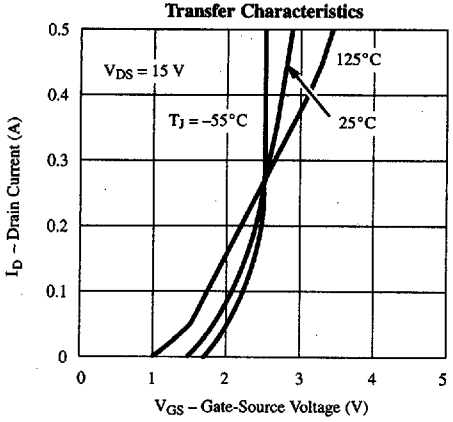
## Typical Characteristics (25°C Unless Otherwise Noted)



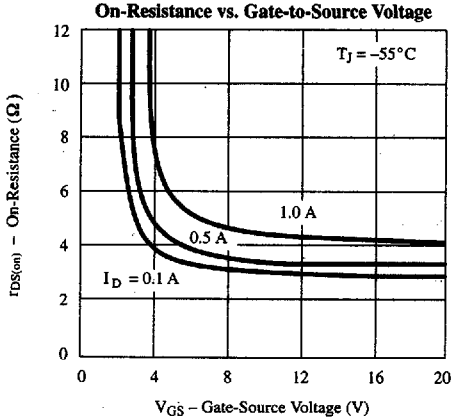



## Typical Characteristics (25°C Unless Otherwise Noted) (Cont'd)

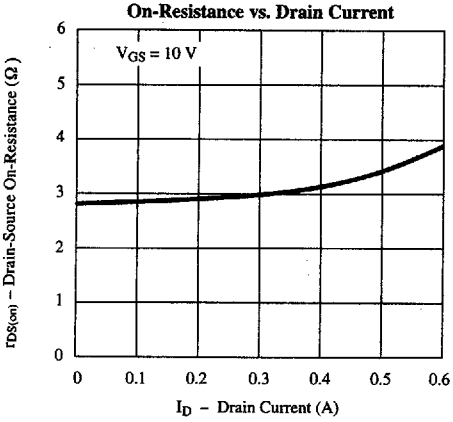
**Transfer Characteristics**



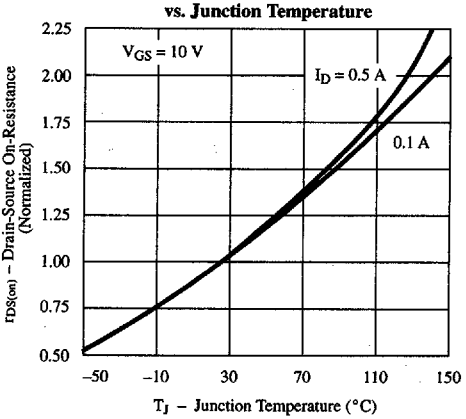

**On-Resistance vs. Gate-to-Source Voltage**



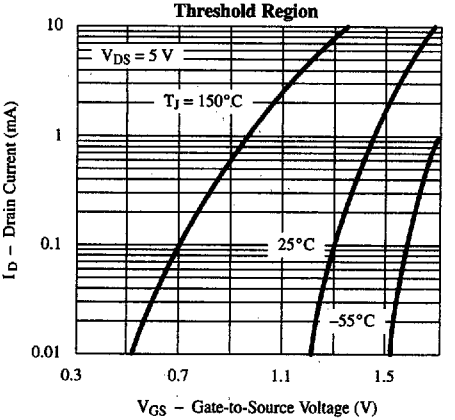

**On-Resistance vs. Drain Current**



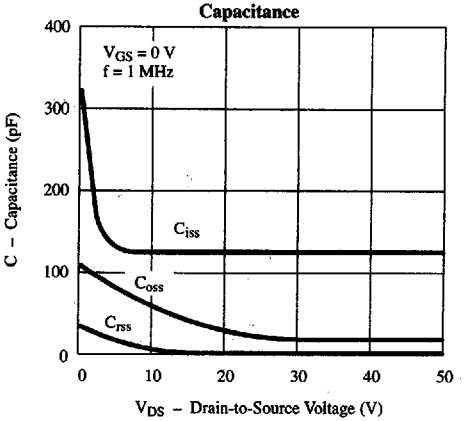

**Normalized On-Resistance vs. Junction Temperature**




**Threshold Region**

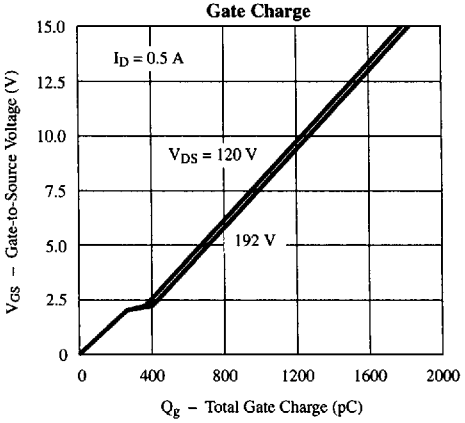



**Capacitance**

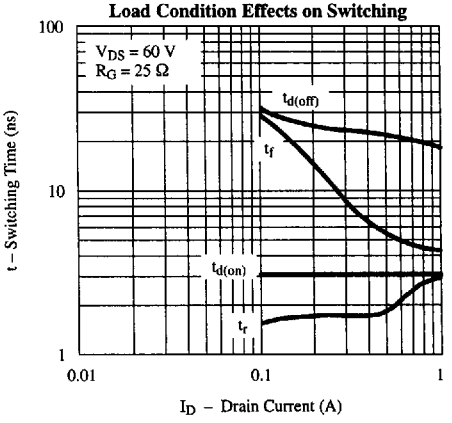


## Typical Characteristics (25°C Unless Otherwise Noted) (Cont'd)

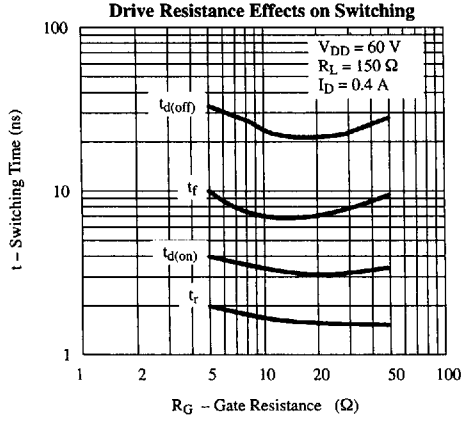
**Gate Charge**



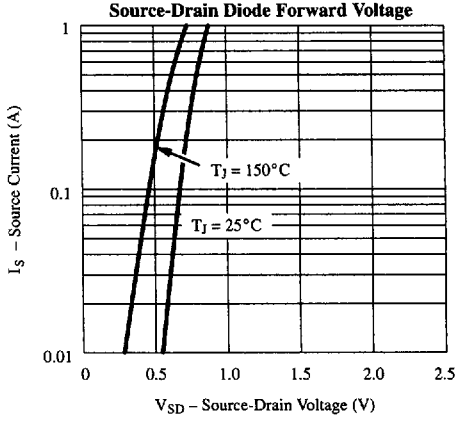

**Load Condition Effects on Switching**




**Drive Resistance Effects on Switching**




**Source-Drain Diode Forward Voltage**




**Normalized Effective Transient Thermal Impedance, Junction-to-Ambient (TO-226AA)**