# Quad P-Channel 60-V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{(BR)DSS}$ Min (V) | $r_{DS(on)}$ Max (Ω) | $V_{GS(th)}$ (V) | $I_D$ (A) |
| –60 | 5 @ $V_{GS}$ = –10 V | –2 to –4.5 | –0.41 |

## FEATURES

- High-Side Switching
- Low On-Resistance: 2.5 Ω
- Moderate Threshold: –3.4 V
- Fast Switching Speed: 40 ns
- Low Input Capacitance: 75 pF

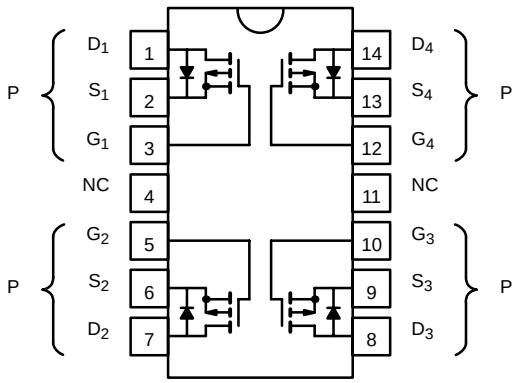
## BENEFITS

- Ease in Driving Switches
- Low Offset (Error) Voltage
- Low-Voltage Operation
- High-Speed Switching
- Easily Driven Without Buffer

## APPLICATIONS

- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Power Supply, Converter Circuits
- Motor Control

**Dual-In-Line**




Top View

Plastic: VQ2004J

Device Marking
Top View

VQ2004J
"S" *fllxxyy*

"S" = Siliconix Logo
*f* = Factory Code
*ll* = Lot Traceability
*xxyy* = Date Code

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C UNLESS OTHERWISE NOTED) | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Single** | **Total Quad** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | –60 | | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | | |
| Continuous Drain Current ($T_J$ = 150°C) | $T_A$= 25°C | $I_D$ | –0.41 | | A |
| | $T_A$= 100°C | | –0.23 | | |
| Pulsed Drain Current[a] | | $I_{DM}$ | –3 | | |
| Power Dissipation | $T_A$= 25°C | $P_D$ | 1.3 | 2 | W |
| | $T_A$= 100°C | | 0.52 | 0.8 | |
| Thermal Resistance, Junction-to-Ambient | | $R_{thJA}$ | 96 | 62.5 | °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.

## SPECIFICATIONS ($T_A$ = 25°C UNLESS OTHERWISE NOTED)

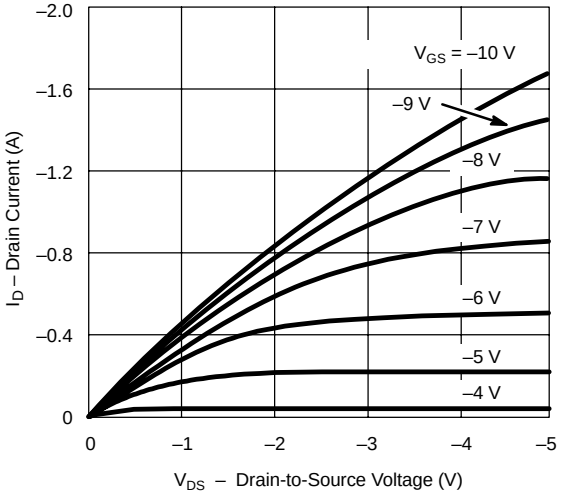
| Parameter | Symbol | Test Conditions | Limits Min | Limits Typ[a] | Limits Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = –10 μA | –60 | –110 | | V |
| Gate-Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = –1 mA | –2 | –3.4 | –4.5 | V |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±30 V | | | ±100 | nA |
| | | $T_J$ = 125°C | | | ±500 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = –60 V, $V_{GS}$ = 0 V | | | –10 | μA |
| | | $V_{DS}$ = –48 V, $V_{GS}$ = 0 V, $T_J$ = 125°C | | | –500 | μA |
| On-State Drain Current[b] | $I_{D(on)}$ | $V_{DS}$ = –10 V, $V_{GS}$ = –10 V | –1 | –2 | | A |
| Drain-Source On-Resistance[b] | $r_{DS(on)}$ | $V_{GS}$ = –10 V, $I_D$ = –1 A | | 2.5 | 5 | Ω |
| | | $T_J$ = 125°C | | 4.4 | 8 | Ω |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = –10 V, $I_D$ = –0.5 A | 200 | 325 | | mS |
| Common Source Output Conductance[b] | $g_{os}$ | $V_{DS}$ = –7.5 V, $I_D$ = –0.1 A | | 0.45 | | mS |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = –25 V, $V_{GS}$ = 0 V<br>f = 1 MHz | | 75 | 150 | pF |
| Output Capacitance | $C_{oss}$ | | | 40 | 60 | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 18 | 25 | pF |
| **Switching[c]** | | | | | | |
| Turn-On Time | $t_{d(on)}$ | $V_{DD}$ = –25 V, $R_L$ = 47 Ω<br>$I_D$ ≅ –0.5 A, $V_{GEN}$ = –10 V<br>$R_G$ = 25 Ω | | 11 | 15 | ns |
| | $t_r$ | | | 30 | 40 | ns |
| Turn-Off Time | $t_{d(off)}$ | | | 20 | 30 | ns |
| | $t_f$ | | | 20 | 30 | ns |

Notes
a. For DESIGN AID ONLY, not subject to production testing.
b. Pulse test: PW ≤ 300 μs duty cycle ≤ 2%.
c. Switching time is essentially independent of operating temperature.

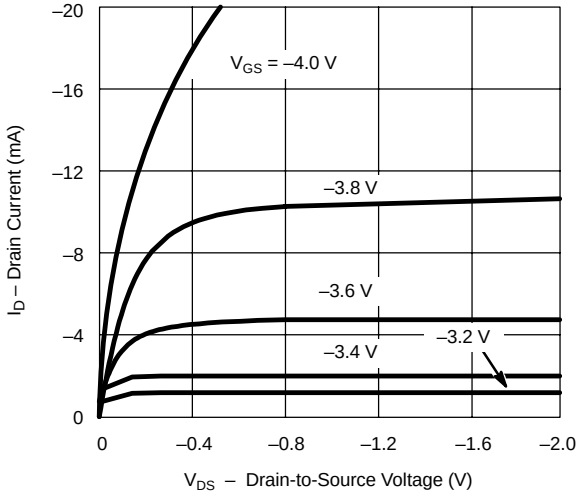
VPDV10

## TYPICAL CHARACTERISTICS ($T_A$ = 25°C UNLESS OTHERWISE NOTED)

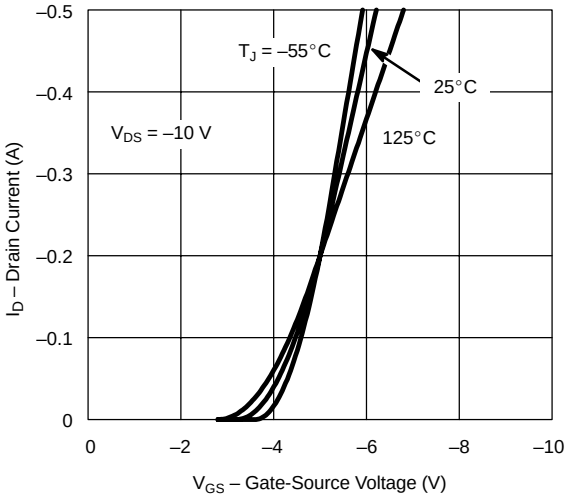
**Ohmic Region Characteristics**



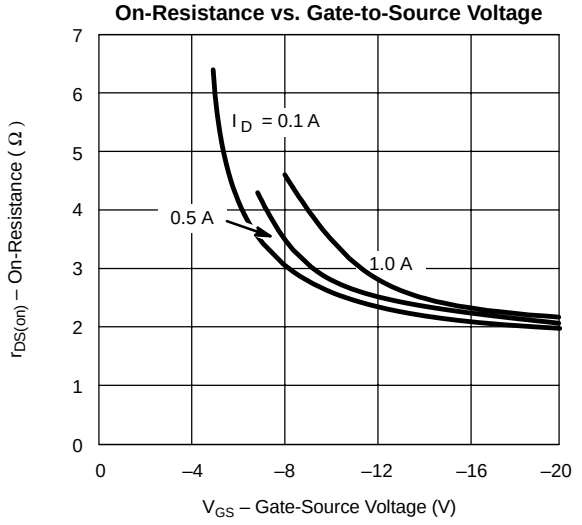

**Output Characteristics for Low Gate Drive**



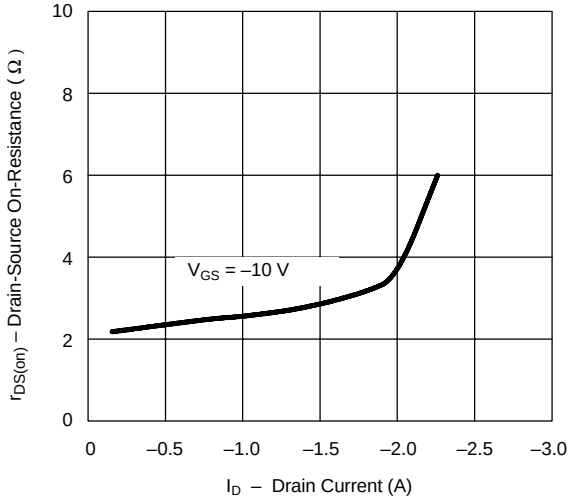

**Transfer Characteristics**



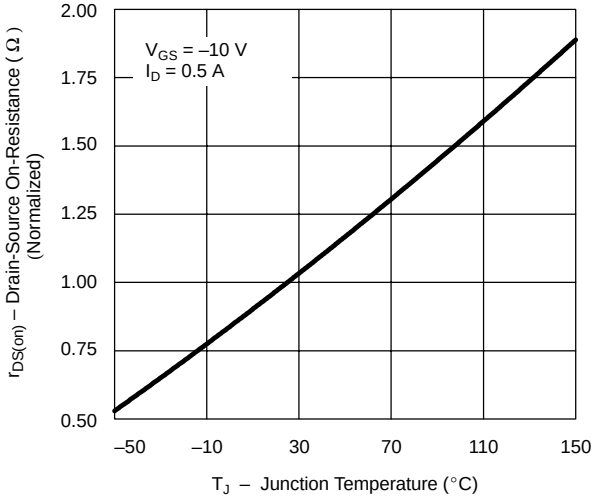

**On-Resistance vs. Gate-to-Source Voltage**




**On-Resistance vs. Drain Current**

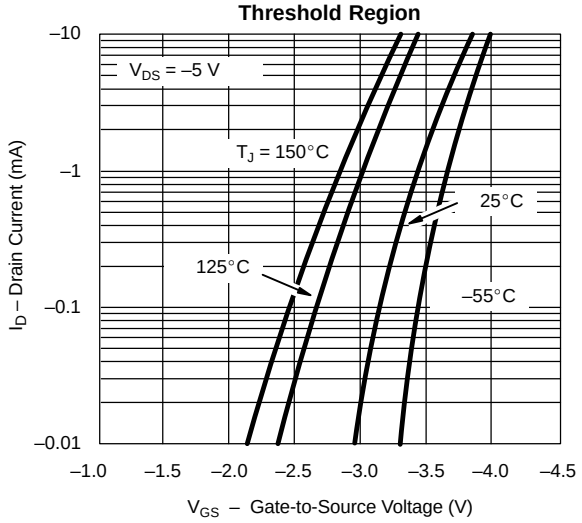



**Normalized On-Resistance vs. Junction Temperature**

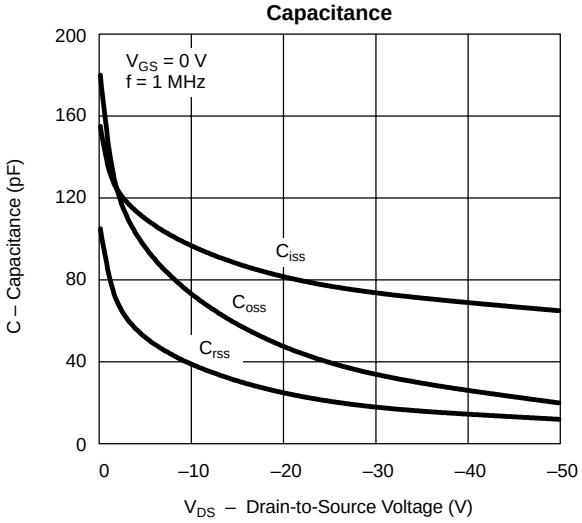


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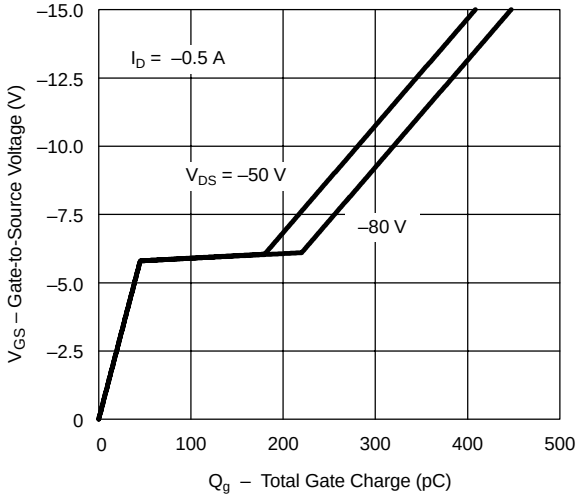
**Threshold Region**



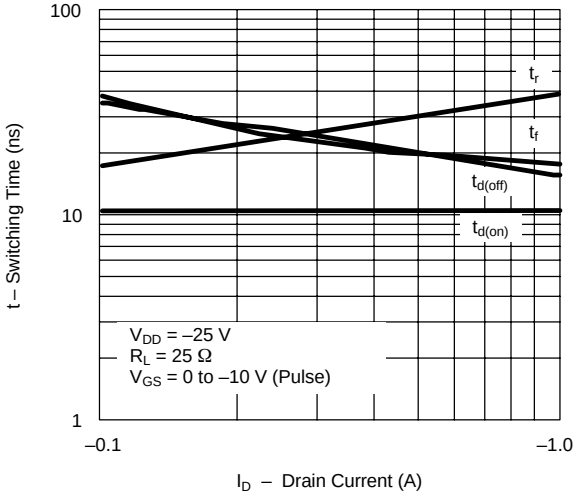

**Capacitance**



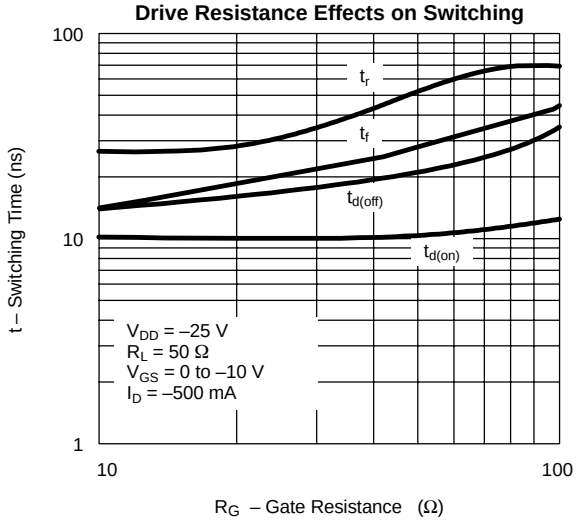

**Gate Charge**



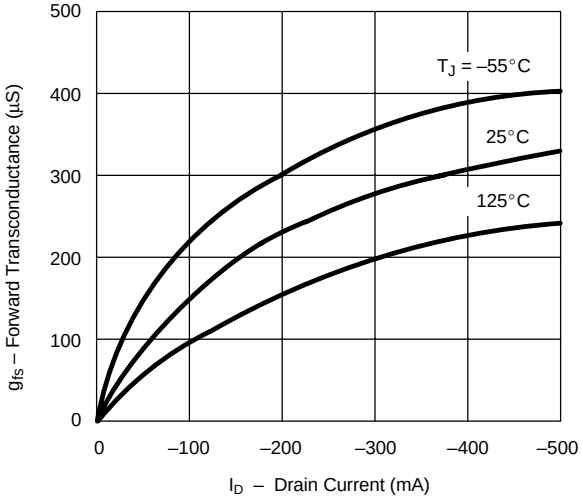

**Load Condition Effects on Switching**




**Drive Resistance Effects on Switching**




**Transconductance**



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