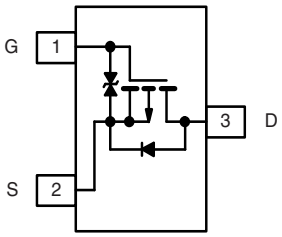
# P-Channel 60 V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $V_{GS(th)}$ (V) | $I_D$ (mA) |
| - 60 | 6 at $V_{GS}$ = - 10 V | - 1 to - 3 | - 185 |

TO-236
(SOT-23)




Top View

Marking Code: 6Kwll

6K = Part Number Code for TP0610K
w = Week Code
ll = Lot Traceability

**Ordering Information:** TP0610K-T1-E3 (Lead (Pb)-free)
TP0610K-T1-GE3 (Lead (Pb)-free and Halogen-free)

## FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- High-Side Switching
- Low On-Resistance: 6 Ω
- Low Threshold: - 2 V (typ.)
- Fast Swtiching Speed: 20 ns (typ.)
- Low Input Capacitance: 20 pF (typ.)
- 2000 V ESD Protection
- Compliant to RoHS Directive 2002/95/EC

Pb-free
RoHS COMPLIANT
HALOGEN FREE Available

## APPLICATIONS

- Drivers: Relays, Solenoids, Lamps, Hammers, Display, Memories, Transistors, etc.
- Battery Operated Systems
- Power Supply Converter Circuits
- Solid-State Relays

## BENEFITS

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

**ABSOLUTE MAXIMUM RATINGS** $T_A$ = 25 °C, unless otherwise noted

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | - 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current[a] | $T_A$ = 25 °C | $I_D$ | - 185 | mA |
| | $T_A$ = 100 °C | | - 115 | |
| Pulsed Drain Current[b] | | $I_{DM}$ | - 800 | |
| Power Dissipation[a] | $T_A$ = 25 °C | $P_D$ | 350 | mW |
| | $T_A$ = 100 °C | | 140 | |
| Maximum Junction-to-Ambient[a] | | $R_{thJA}$ | 350 | °C/W |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |

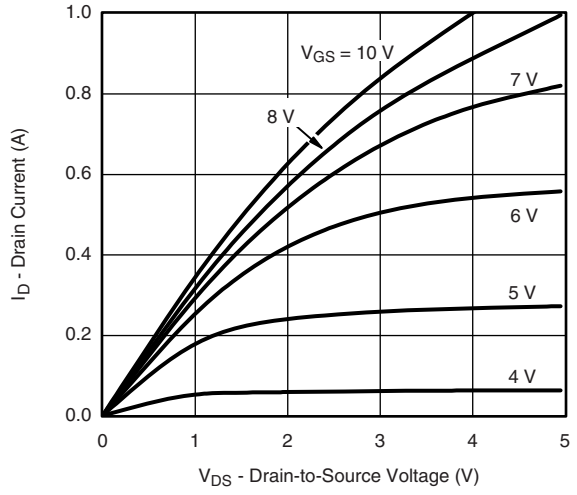
Notes:
a. Surface mounted on FR4 board.
b. Pulse width limited by maximum junction temperature.

| **SPECIFICATIONS** $T_A$ = 25 °C, unless otherwise noted | | | | | | |
|---|---|---|---|---|---|---|
| | | | Limits | | | |
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.[a]** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = - 10 µA | - 60 | | | V |
| Gate-Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = - 250 µA | - 1 | | - 3 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 10 | µA |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 10 V | | | ± 200 | nA |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 10 V, $T_J$ = 85 °C | | | ± 500 | |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 5 V | | | ± 100 | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V | | | - 25 | |
| | | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V, $T_J$ = 85 °C | | | - 250 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = - 10 V, $V_{DS}$ = - 4.5 V | - 50 | | | mA |
| | | $V_{GS}$ = - 10 V, $V_{DS}$ = - 10 V | - 600 | | | |
| Drain-Source On-Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = - 4.5 V, $I_D$ = - 25 mA | | | 10 | Ω |
| | | $V_{GS}$ = - 10 V, $I_D$ = - 500 mA | | | 6 | |
| | | $V_{GS}$ = - 10 V, $I_D$ = - 500 mA, $T_J$ =125 °C | | | 9 | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = - 10 V, $I_D$ = - 100 mA | 80 | | | mS |
| Diode Forward Voltage | $V_{SD}$ | $I_S$ = - 200 mA, $V_{GS}$ = 0 V | | | - 1.4 | V |
| **Dynamic** | | | | | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = - 30 V, $V_{GS}$ = - 15 V<br>$I_D \cong$ - 500 mA | | 1.7 | | nC |
| Gate-Source Charge | $Q_{gs}$ | | | 0.26 | | |
| Gate-Drain Charge | $Q_{gd}$ | | | 0.46 | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = - 25 V, $V_{GS}$ = 0 V<br>f = 1 MHz | | 23 | | pF |
| Output Capacitance | $C_{oss}$ | | | 10 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 5 | | |
| **Switching[b]** | | | | | | |
| Turn-On Time | $t_{d(on)}$ | $V_{DD}$ = - 25 V, $R_L$ = 150 Ω<br>$I_D \cong$ - 200 mA, $V_{GEN}$ = - 10 V, $R_g$ = 10 Ω | | 20 | | ns |
| Turn-Off Time | $t_{d(off)}$ | | | 35 | | |

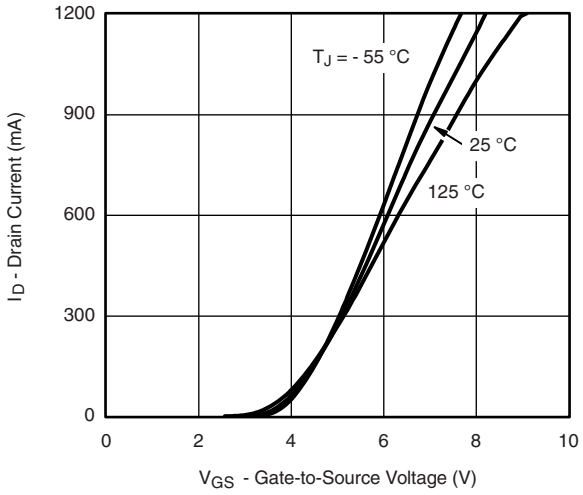
Notes:
a. Pulse test: PW ≤ 300 µs duty cycle ≤ 2 %.
b. Switching time is essentially independent of operating temperature.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

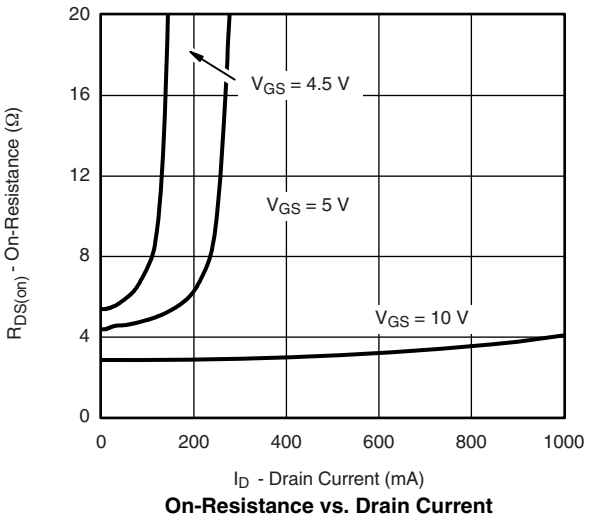
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



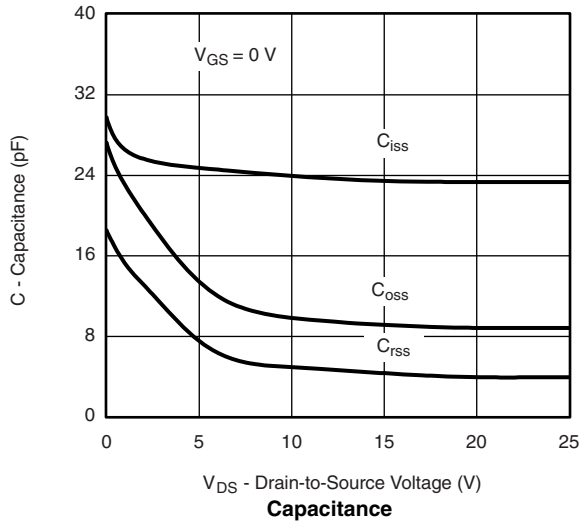

**Output Characteristics**



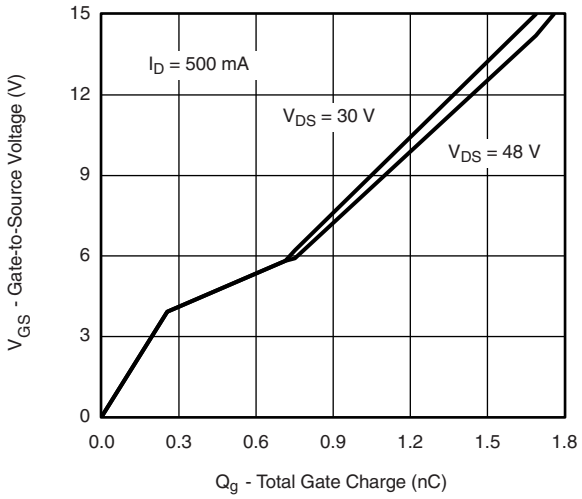

**Transfer Characteristics**



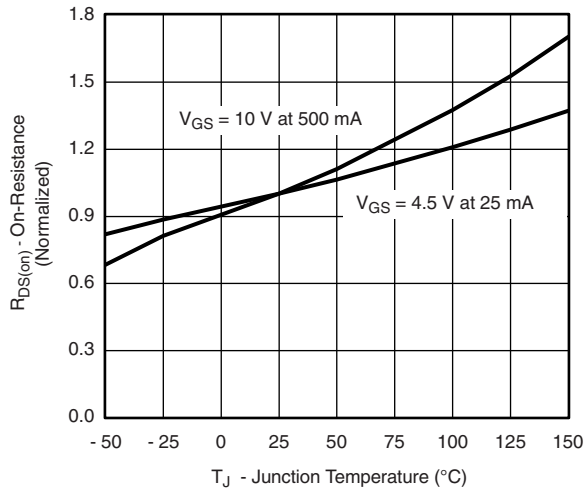

**On-Resistance vs. Drain Current**




**Capacitance**

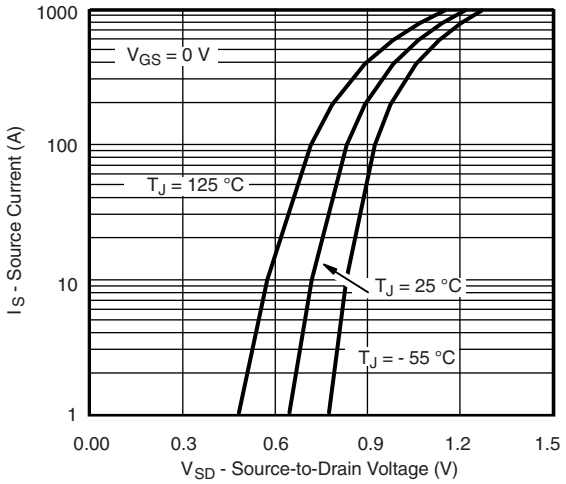



**Gate Charge**

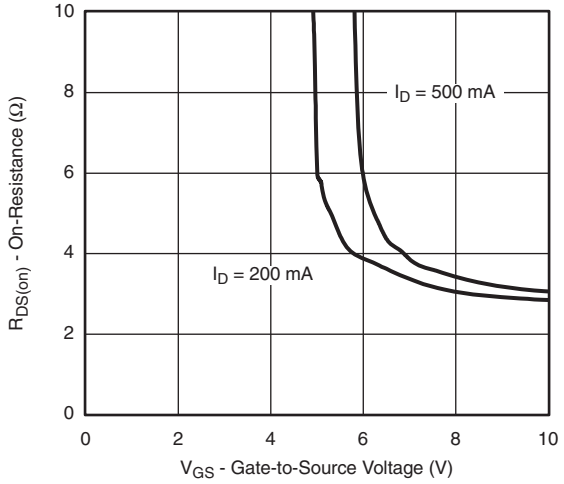



**On-Resistance vs. Junction Temperature**

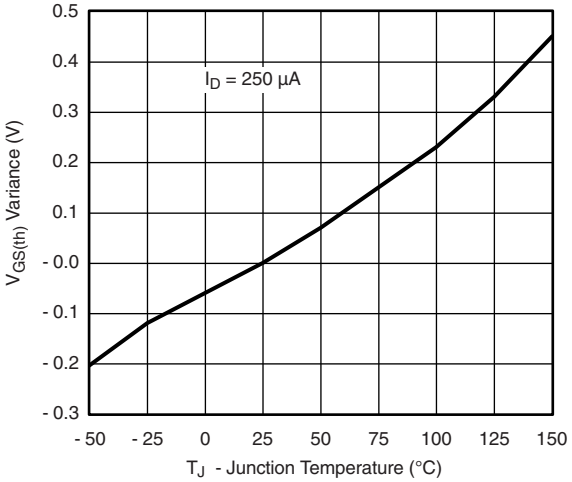
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



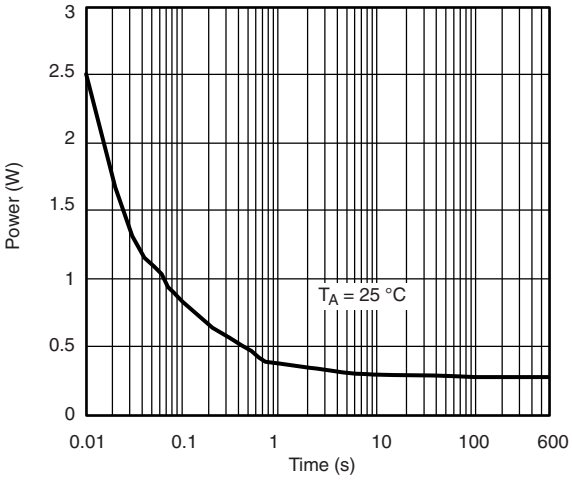

**Source-Drain Diode Forward Voltage**



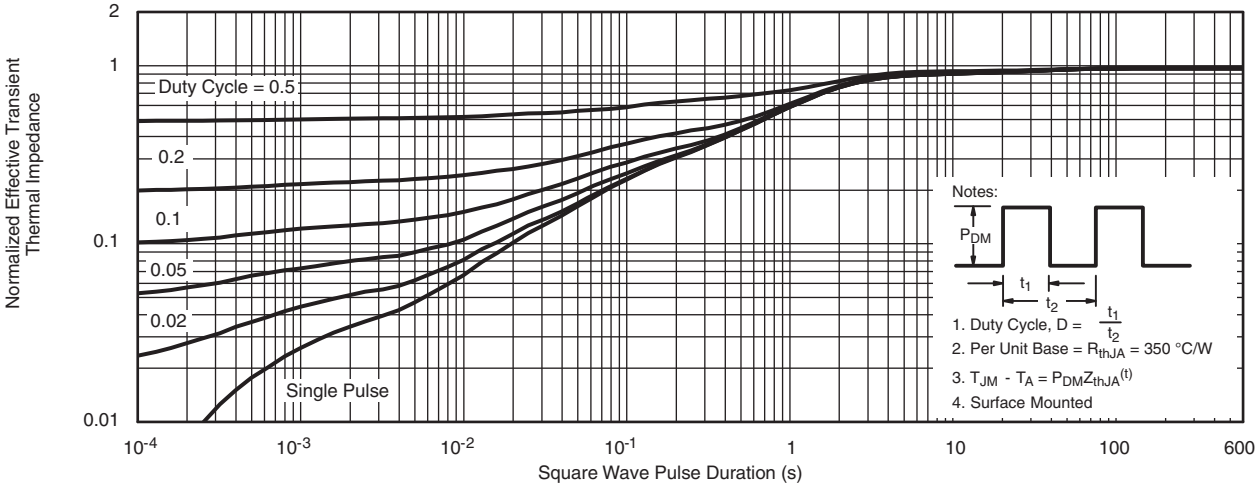

**On-Resistance vs. Gate-Source Voltage**




**Threshold Voltage Variance Over Temperature**



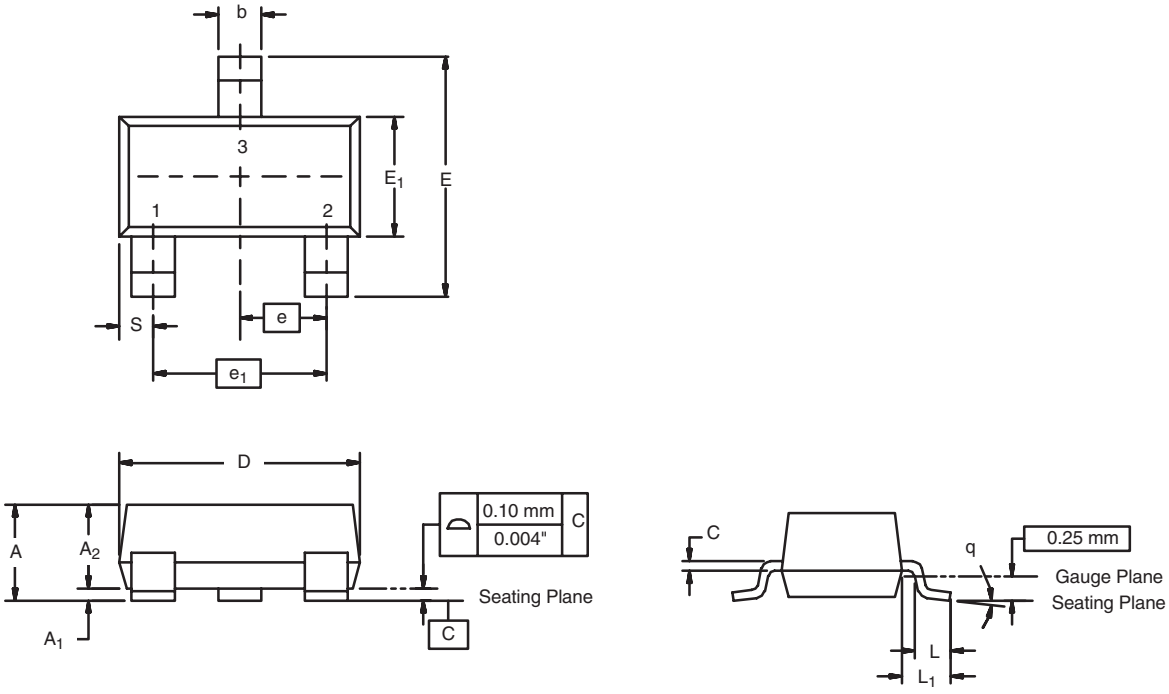

**Single Pulse Power, Junction-to-Ambient**




**Normalized Thermal Transient Impedance, Junction-to-Ambient**

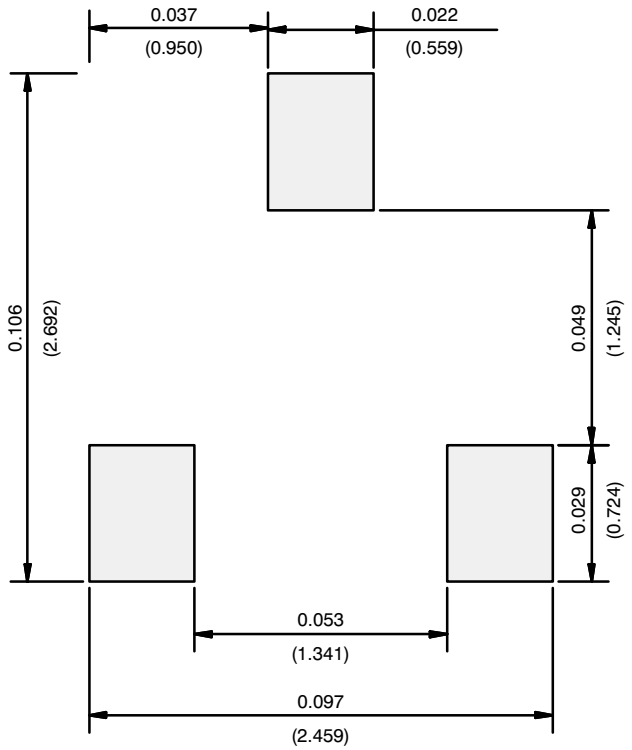
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## SOT-23 (TO-236): 3-LEAD




| Dim | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.89 | 1.12 | 0.035 | 0.044 |
| $A_1$ | 0.01 | 0.10 | 0.0004 | 0.004 |
| $A_2$ | 0.88 | 1.02 | 0.0346 | 0.040 |
| b | 0.35 | 0.50 | 0.014 | 0.020 |
| c | 0.085 | 0.18 | 0.003 | 0.007 |
| D | 2.80 | 3.04 | 0.110 | 0.120 |
| E | 2.10 | 2.64 | 0.083 | 0.104 |
| $E_1$ | 1.20 | 1.40 | 0.047 | 0.055 |
| e | 0.95 BSC | | 0.0374 Ref | |
| $e_1$ | 1.90 BSC | | 0.0748 Ref | |
| L | 0.40 | 0.60 | 0.016 | 0.024 |
| $L_1$ | 0.64 Ref | | 0.025 Ref | |
| S | 0.50 Ref | | 0.020 Ref | |
| q | 3° | 8° | 3° | 8° |
| ECN: S-03946-Rev. K, 09-Jul-01<br>DWG: 5479 | | | | |

## RECOMMENDED MINIMUM PADS FOR SOT-23




Recommended Minimum Pads
Dimensions in Inches/(mm)

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APPLICATION NOTE

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