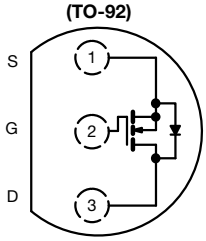
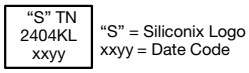
# N-Channel 240 V (D-S) MOSFET

**TO-226AA (TO-92)**



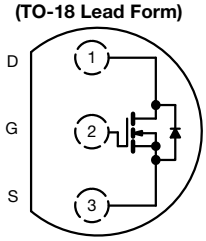

Top View
**TN2404KL**

Device Marking
Front View




"S" = Siliconix Logo
xxyy = Date Code

**TO-92-18RM (TO-18 Lead Form)**




Top View
**BS107KL**

Device Marking
Front View




"S" = Siliconix Logo
xxyy = Date Code

## FEATURES

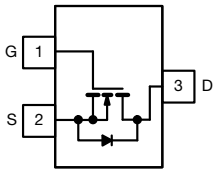
- Low on-resistance: 4 Ω
- Secondary breakdown free: 260 V
- Low power / voltage driven
- Low input and output leakage
- Excellent thermal stability
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE

## APPLICATIONS

- High-voltage drivers: relays, solenoids, lamps, hammers, displays, transistors, etc.
- Telephone mute switches, ringer circuits
- Power Supply, Converters
- Motor Control

**TO-236 (SOT-23)**




Top View
**TN2404K**

Marking Code: K1ywl
K1 = Part Number Code for TN2404K
y = Year Code
w = Week Code
l = Lot Traceability

## BENEFITS

- Low offset voltage
- Full-voltage operation
- Easily driven without buffer
- Low error voltage
- No high-temperature ''Run-Away''

| PRODUCT SUMMARY | | |
|---|---|---|
| **PART NUMBER** | **TN2404K** | **TN2404K, BS107KL** |
| $V_{DS}$ (V) | 240 | |
| $R_{DS(on)}$ max. (Ω) at $V_{GS}$ = 10 V | 4 | |
| $Q_g$ typ. (nC) | 4.87 | |
| $I_D$ (A) [a, e] | 0.2 | 0.3 |
| Configuration | Single | |

| ORDERING INFORMATION | | | |
|---|---|---|---|
| Package | TO-236 (SOT-23) | TO-226AA (TO-92) | TO-92-18RM (TO-18 Lead Form) |
| Lead (Pb)-free | TN2404K-T1-E3 | | |
| Lead (Pb)-free and halogen-free | TN2404K-T1-GE3 | | |
| Tape and Reel | | TN2404KL-TR1-E3 | BS107KL-TR1-E3 |
| Alternate manufacturing location | TN2404K-T1-BE3 | | |



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| **ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25 °C, unless otherwise noted) | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **TN2404K** | **TN2404KL/BS107KL** | **SYMBOL** |
| Drain-source voltage | | $V_{DS}$ | 240 | | V |
| Gate-source voltage | | $V_{GS}$ | ± 20 | | |
| Continuous drain current ($T_J$ = 150 °C) | $T_A$ = 25 °C | $I_D$ | 0.2 | 0.3 | A |
| | $T_A$ = 70 °C | | 0.16 | 0.25 | |
| Pulsed drain current (t = 300 µs) | | $I_{DM}$ | 0.8 | 1.4 | |
| Maximum power dissipation | $T_A$ = 25 °C | $P_D$ | 0.36 | 0.8 | W |
| | $T_A$ = 70 °C | | 0.23 | 0.51 | |
| Thermal resistance junction-to-ambient | | $R_{thJA}$ | 350b | 156 | °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. Surface mounted on an FR4 board

| **SPECIFICATIONS** ($T_A$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **LIMITS** | | | |
| | | | **MIN.** | **TYP.** [a] | **MAX.** | **UNIT** |
| **Static** | | | | | | |
| Drain-source breakdown voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 100 µA | 240 | 257 | - | V |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 0.8 | 1.65 | 2 | |
| Gate-source leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | - | - | ± 100 | nA |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 192 V, $V_{GS}$ = 0 V | - | - | 1 | µA |
| | | $V_{DS}$ = 192 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | - | - | 10 | |
| On-state drain current [a] | $I_{D(on)}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 10 V | 0.8 | - | - | A |
| | | $V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V | 0.5 | - | - | |
| Drain-source on-state resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 0.3 A | - | 2.2 | 4 | Ω |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 0.2 A | - | 2.3 | 4 | |
| | | $V_{GS}$ = 2.5 V, $I_D$ = 0.1 A | - | 2.4 | 6 | |
| Forward transconductance [a] | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 0.3 A | - | 1.6 | - | S |
| Diode forward voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 0.3 A | - | 0.8 | 1.2 | V |
| **Dynamic** [b] | | | | | | |
| Total gate charge | $Q_g$ | $V_{DS}$ = 192 V, $V_{GS}$ = 10 V, $I_D$ = 0.5 A | - | 4.87 | 8 | nC |
| Gate-source charge | $Q_{gs}$ | | - | 0.56 | - | |
| Gate-drain charge | $Q_{gd}$ | | - | 1.53 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$ = 60 V, $R_L$ = 200 Ω<br>$I_D$ ≅ 0.3 A, $V_{GEN}$ = 10 V, $R_g$ = 25 Ω | - | 5 | 10 | ns |
| Rise time | $t_r$ | | - | 12 | 20 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 35 | 60 | |
| Fall time | $t_f$ | | - | 16 | 25 | |

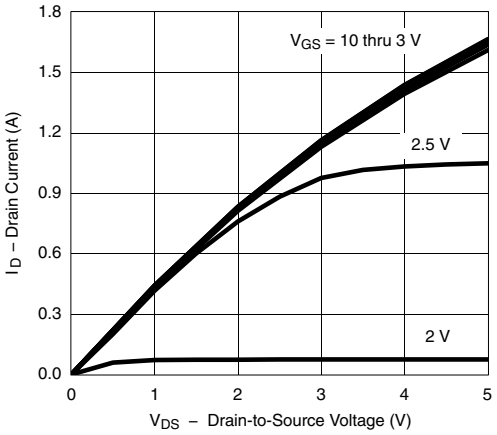
**Notes**

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %
b. Guaranteed by design, not subject to production testing

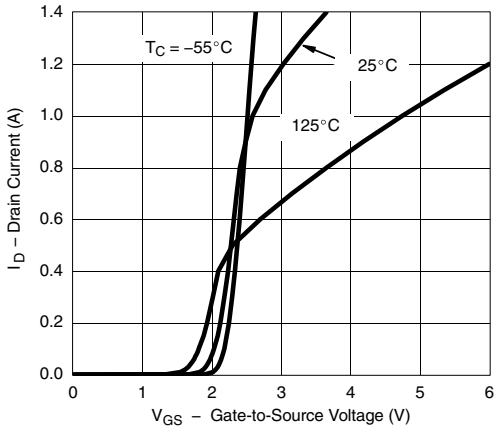
*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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


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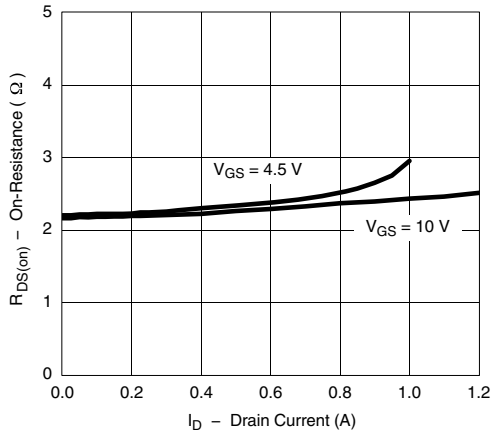
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



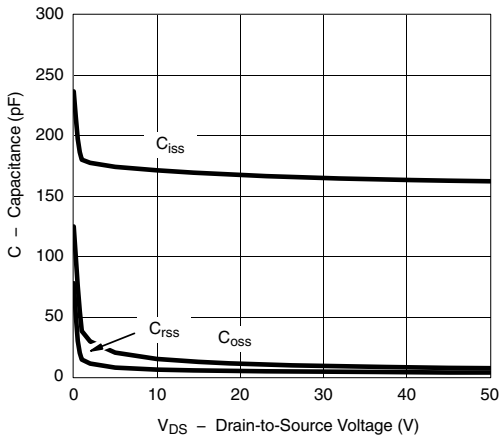

**Output Characteristics**



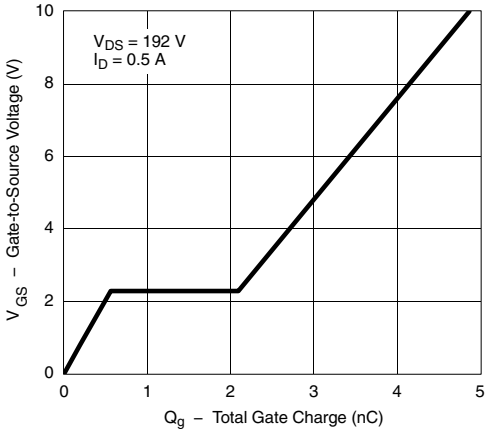

**Transfer Characteristics**



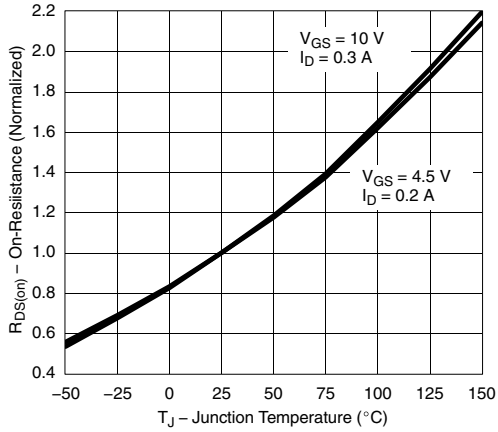

**On-Resistance vs. Drain Current**




**Capacitance**



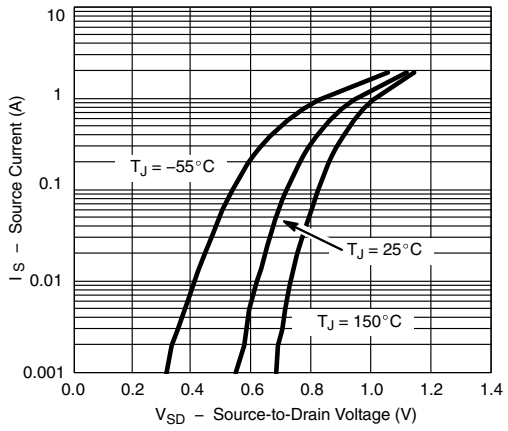

**Gate Charge**



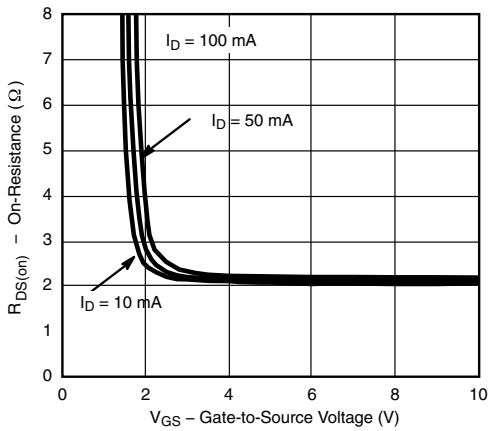

**On-Resistance vs. Junction Temperature**


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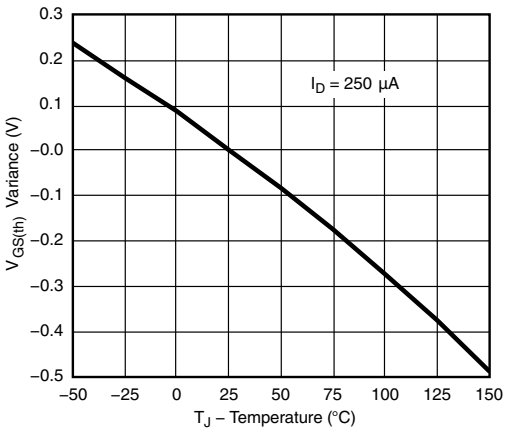
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




**Source-Drain Diode Forward Voltage**



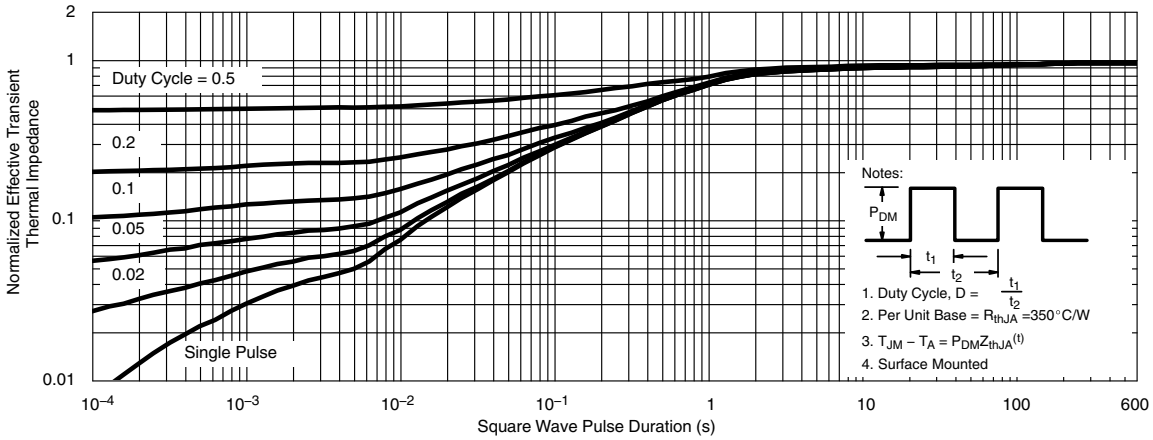

**On-Resistance vs. Gate-to-Source Voltage**



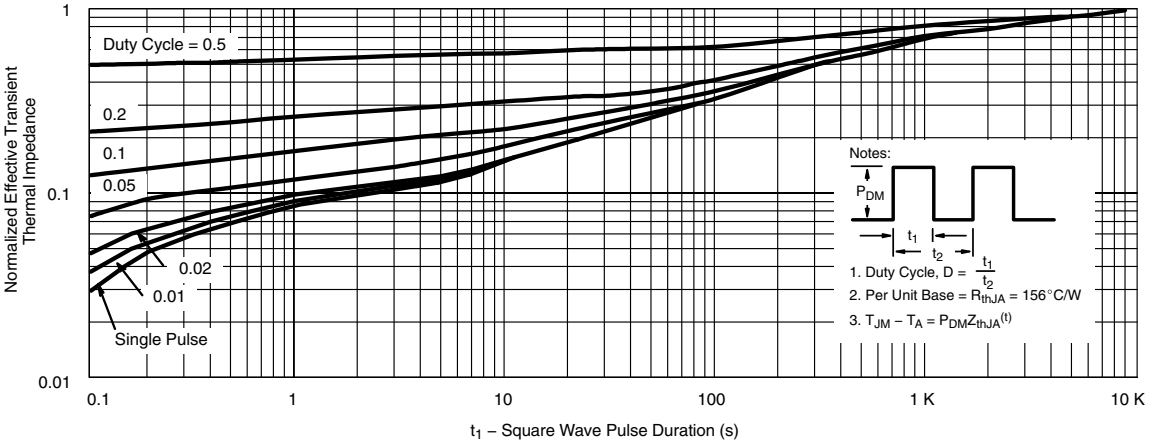

**Threshold Voltage**


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**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)




**Normalized Thermal Transient Impedance, Junction-to-Ambient**
**(TO-236, TN2404K only)**

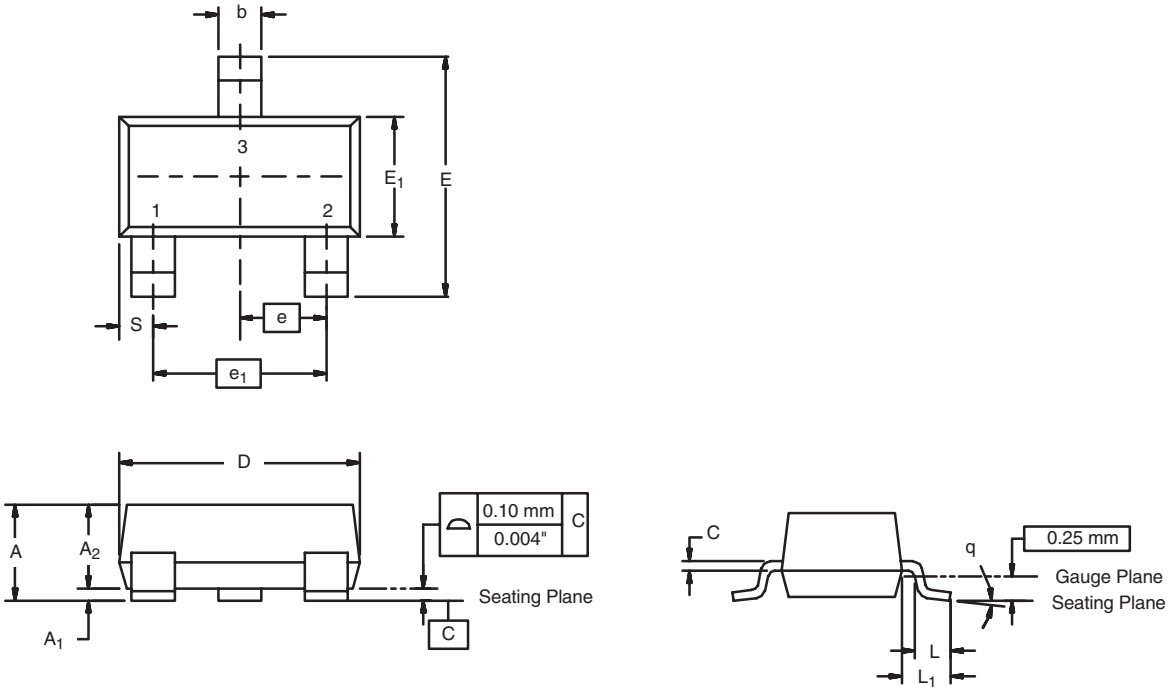



**Normalized Thermal Transient Impedance, Junction-to-Ambient**
**(TO-226AA, TN2404KL and TO-92-18RM, BS107KL only)**

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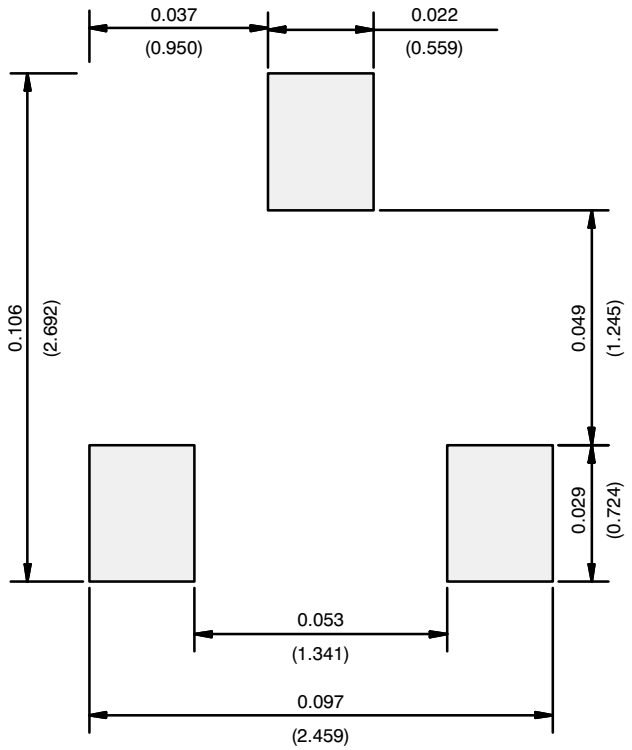

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## SOT-23 (TO-236): 3-LEAD




| 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)

Return to Index

APPLICATION NOTE

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