N-Channel 240 V (D-S) MOSFET

PRODUCT SUMMARY

Part Number	V_{DS} (V)	$R_{DS(on)}$ (Ω)	$V_{GS(th)}$ (A)	I_D (A)	Q_g (Typ.)
TN2404K	240	4 at V_{GS} = 10 V	0.8 to 2	0.2	4.87 nC
TN2404K, BS107KL				0.3	

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 Available

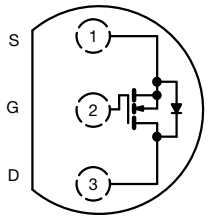
APPLICATIONS

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

BENEFITS

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

TO-226AA (TO-92)



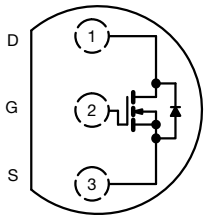
Top View
TN2404KL

Device Marking Front View



“S” = Siliconix Logo
xxyy = Date Code

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



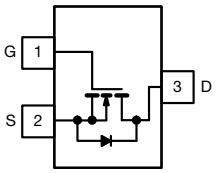
Top View
BS107KL

Device Marking Front View



“S” = Siliconix Logo
xxyy = Date Code

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

ORDRING INFORMATION

Standard Partnumber	Ordering Part Number	Option
TN2404K	TN2404K-T1-E3	Lead (Pb) free
	TN2404K-T1-GE3	Lead (Pb) free and Halogen free
TN2404KL	TN2404KL-TR1-E3	With Tape and Reel Spool Option
BS107KL	BS107KL-TR1-E3	

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}	350[b]	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.

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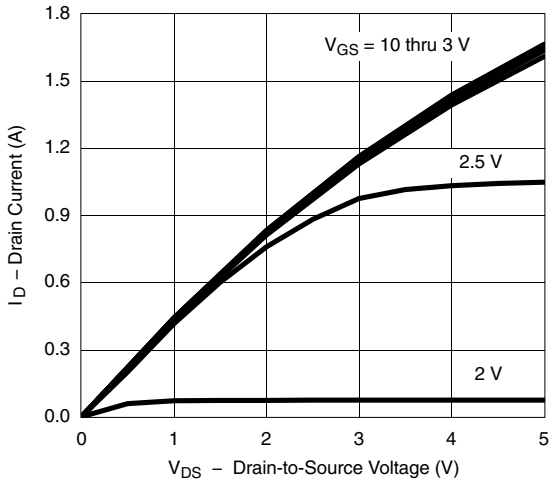
SPECIFICATIONS (T_A = 25 °C, unless otherwise noted)						
Parameter	**Symbol**	**Test Conditions**	**Limits**			
			Min.	**Typ.[a]**	**Max.**	**Unit**
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 100 µA	240	257		V
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, 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 $I_D \cong$ 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.

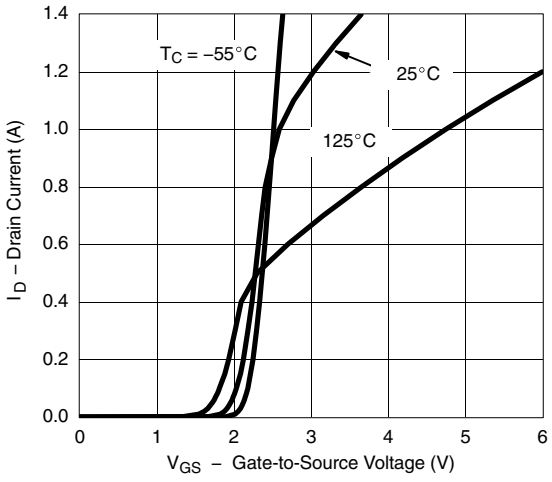
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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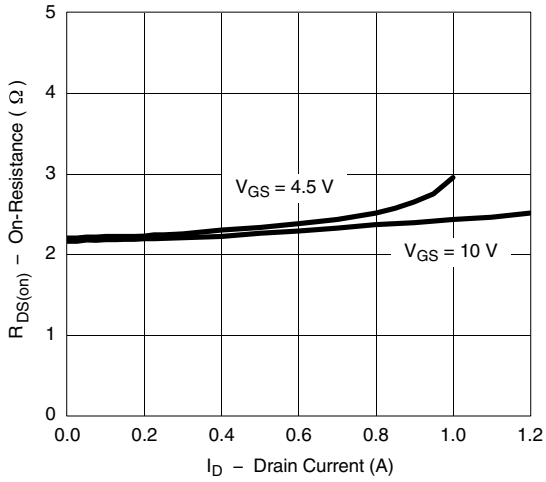
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



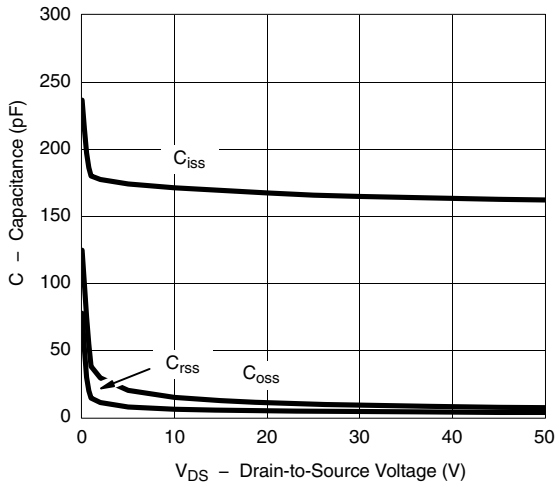
Output Characteristics



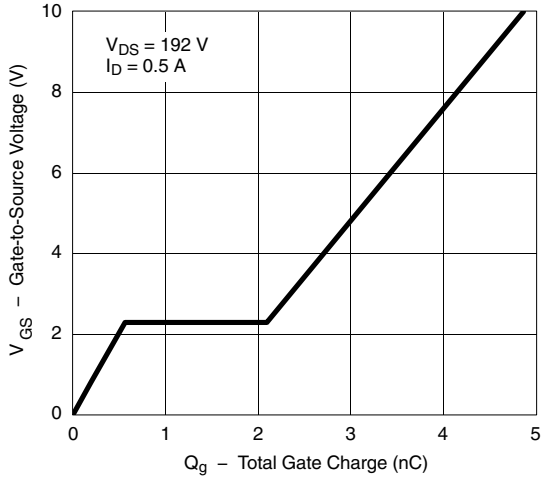
Transfer Characteristics



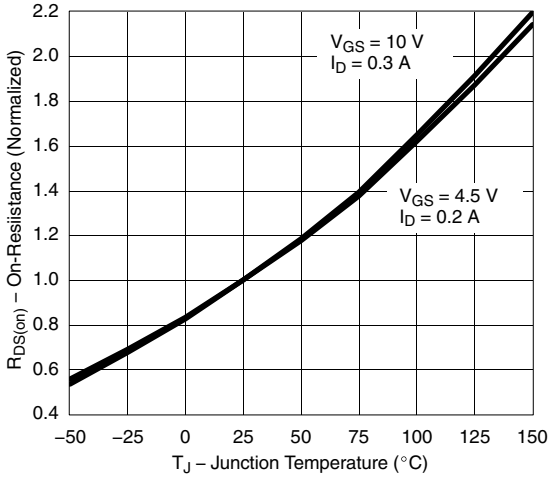
On-Resistance vs. Drain Current



Capacitance



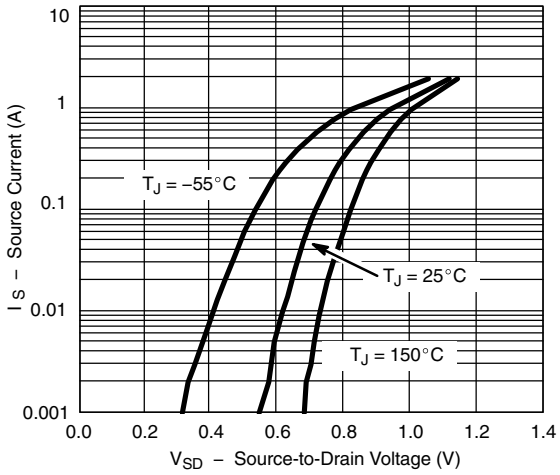
Gate Charge



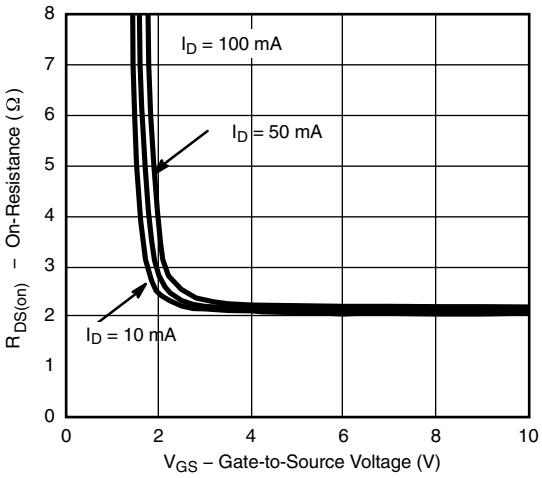
On-Resistance vs. Junction Temperature

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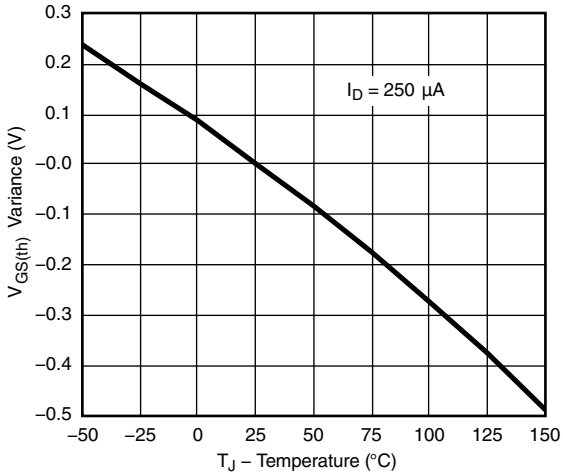
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Source-Drain Diode Forward Voltage



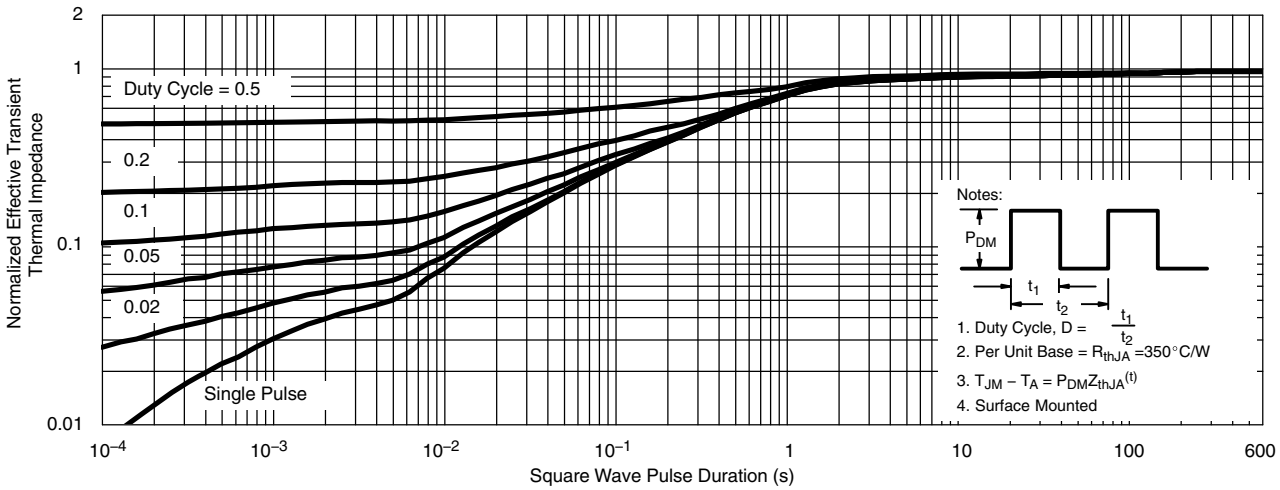
On-Resistance vs. Gate-to-Source Voltage



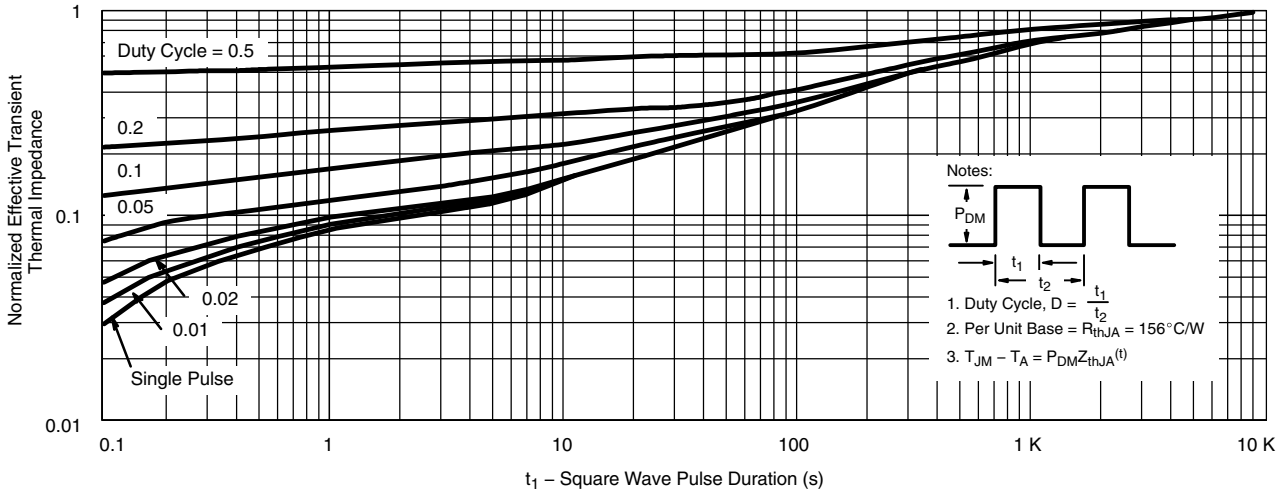
Threshold Voltage

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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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

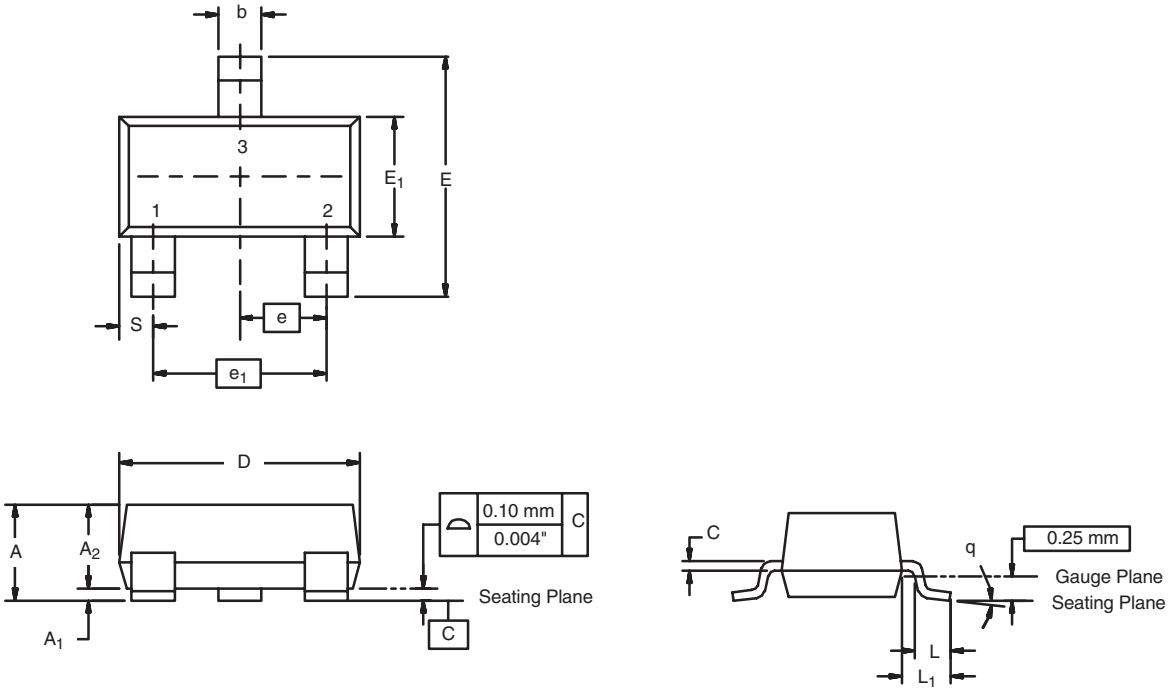


Normalized Thermal Transient Impedance, Junction-to-Ambient
(TO-226AA, TN2404KL and TO-92-18RM, BS107KL only)

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?72225.

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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 DWG: 5479				

Mounting LITTLE FOOT® SOT-23 Power MOSFETs

Wharton McDaniel

Surface-mounted LITTLE FOOT power MOSFETs use integrated circuit and small-signal packages which have been been modified to provide the heat transfer capabilities required by power devices. Leadframe materials and design, molding compounds, and die attach materials have been changed, while the footprint of the packages remains the same.

See Application Note 826, *Recommended Minimum Pad Patterns With Outline Drawing Access for Vishay Siliconix MOSFETs*, (http://www.vishay.com/doc?72286), for the basis of the pad design for a LITTLE FOOT SOT-23 power MOSFET footprint . In converting this footprint to the pad set for a power device, designers must make two connections: an electrical connection and a thermal connection, to draw heat away from the package.

The electrical connections for the SOT-23 are very simple. Pin 1 is the gate, pin 2 is the source, and pin 3 is the drain. As in the other LITTLE FOOT packages, the drain pin serves the additional function of providing the thermal connection from the package to the PC board. The total cross section of a copper trace connected to the drain may be adequate to carry the current required for the application, but it may be inadequate thermally. Also, heat spreads in a circular fashion from the heat source. In this case the drain pin is the heat source when looking at heat spread on the PC board.

Figure 1 shows the footprint with copper spreading for the SOT-23 package. This pattern shows the starting point for utilizing the board area available for the heat spreading copper. To create this pattern, a plane of copper overlies the drain pin and provides planar copper to draw heat from the drain lead and start the process of spreading the heat so it can be dissipated into the ambient air. This pattern uses all the available area underneath the body for this purpose.

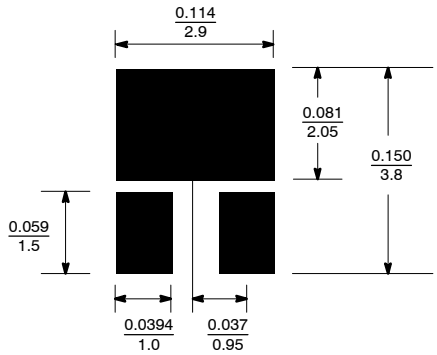
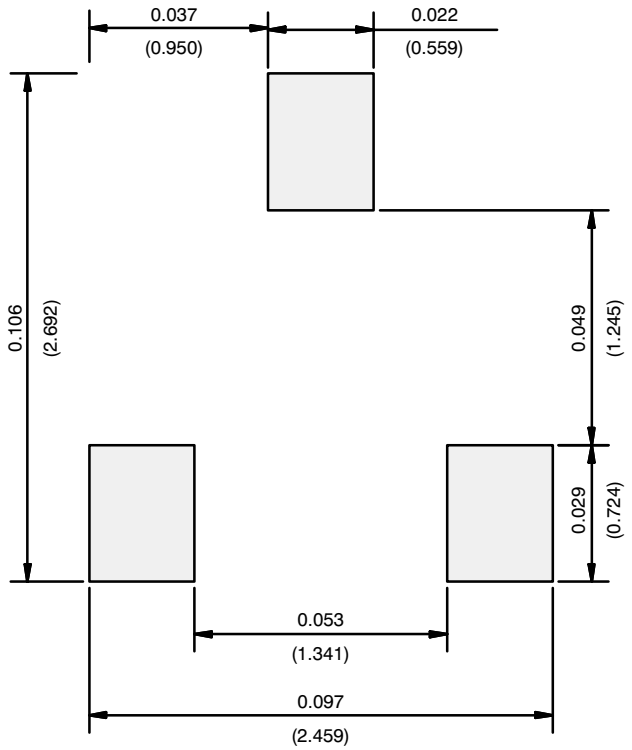


FIGURE 1. Footprint With Copper Spreading

Since surface-mounted packages are small, and reflow soldering is the most common way in which these are affixed to the PC board, “thermal” connections from the planar copper to the pads have not been used. Even if additional planar copper area is used, there should be no problems in the soldering process. The actual solder connections are defined by the solder mask openings. By combining the basic footprint with the copper plane on the drain pins, the solder mask generation occurs automatically.

A final item to keep in mind is the width of the power traces. The absolute minimum power trace width must be determined by the amount of current it has to carry. For thermal reasons, this minimum width should be at least 0.020 inches. The use of wide traces connected to the drain plane provides a low-impedance path for heat to move away from the device.

RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads
Dimensions in Inches/(mm)

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APPLICATION NOTE

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