

## N-Channel 40-V (D-S) MOSFET with Sensing Diode

## PRODUCT SUMMARY

$V_{(BR)DSS}$ (V)	$r_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)
40	0.0045 at $V_{GS} = 10$ V	60 <sup>a</sup>
	0.0065 at $V_{GS} = 4.5$ V	20 <sup>a</sup>

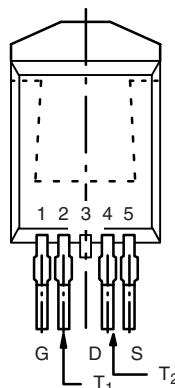
## FEATURES

- TrenchFET® Power MOSFETs Plus Temperature Sensing Diode
- 175 °C Junction Temperature
- Low Thermal Resistance Package



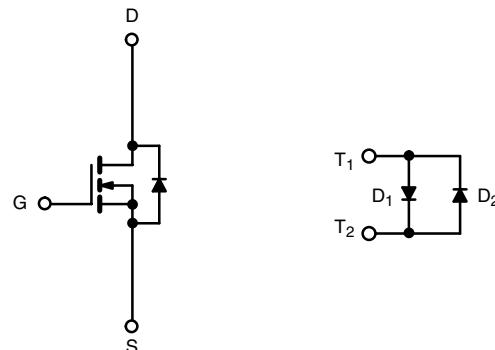
RoHS\*  
COMPLIANT

## D<sup>2</sup>PAK-5L



## APPLICATIONS

- Industrial



**Ordering Information:** SUM60N04-05LT  
SUM60N04-05LT-E3 (Lead (Pb)-free)

## N-Channel MOSFET

**ABSOLUTE MAXIMUM RATINGS**  $T_C = 25^\circ\text{C}$ , unless otherwise noted

Parameter	Symbol	Limit	Unit	
Drain-Source Voltage	$V_{DS}$	40	V	
Gate-Source Voltage	$V_{GS}$	$\pm 20$		
Continuous Drain Current ( $T_J = 175^\circ\text{C}$ ) <sup>d</sup>	$T_C = 25^\circ\text{C}$	$I_D$	60 <sup>a</sup>	
	$T_C = 100^\circ\text{C}$		60 <sup>a</sup>	
Pulsed Drain Current	$I_{DM}$	250	A	
Continuous Diode Current (Diode Conduction) <sup>d</sup>	$I_S$	60 <sup>a</sup>		
Avalanche Current	$I_{AR}$	60 <sup>a</sup>		
Repetitive Avalanche Energy <sup>b</sup>	$L = 0.1 \text{ mH}$	$E_{AR}$	180	mJ
Maximum Power Dissipation <sup>a</sup>	$T_C = 25^\circ\text{C}$	$P_D$	200 <sup>c</sup>	W
	$T_A = 25^\circ\text{C}$		3.75 <sup>d</sup>	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 175	°C	

## **THERMAL RESISTANCE RATINGS**

Parameter	Symbol	Limit	Unit
Junction-to-Ambient <sup>d</sup>	$R_{thJA}$	40	°C/W
Junction-to-Case	$R_{thJC}$	0.75	

## Notes:

- a. Package limited.
- b. Duty cycle  $\leq 1\%$ .
- c. See SOA curve for voltage derating.
- d. When mounted on 1" square PCB (FR-4 material).

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

# SUM60N04-05LT

Vishay Siliconix



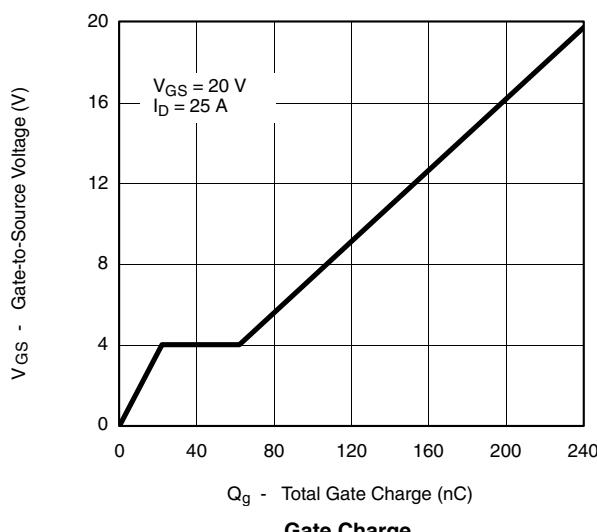
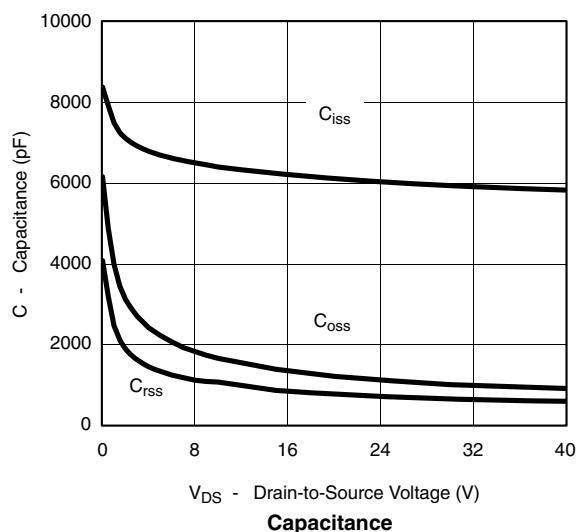
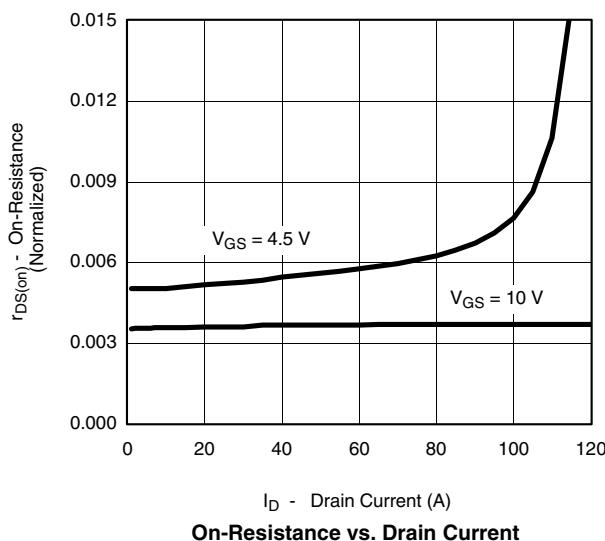
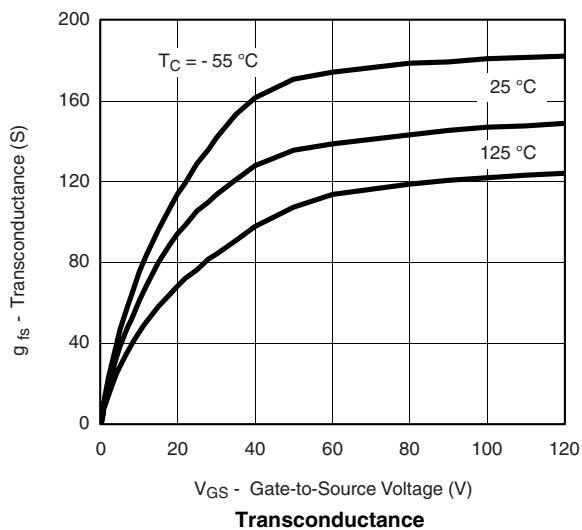
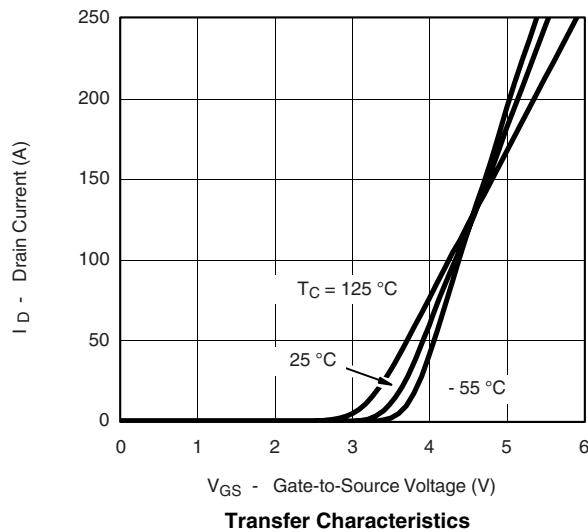
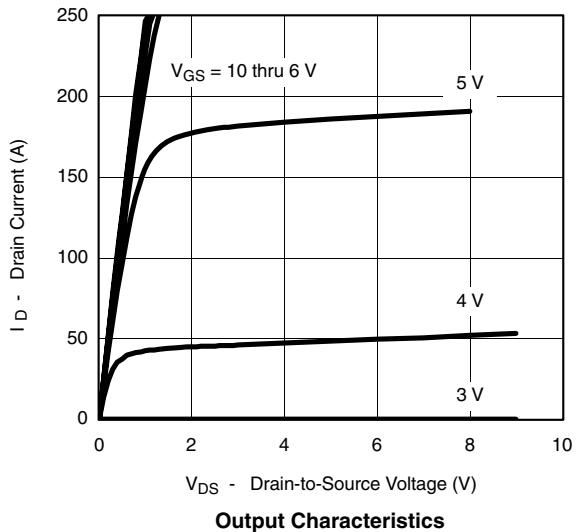
## MOSFET SPECIFICATIONS $T_J = 25^\circ\text{C}$ , unless otherwise noted

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(\text{BR})\text{DSS}}$	$V_{\text{GS}} = 0 \text{ V}, I_D = 250 \mu\text{A}$	40			V
Gate-Threshold Voltage	$V_{\text{GS}(\text{th})}$	$V_{\text{DS}} = V_{\text{GS}}, I_{\text{DS}} = 250 \mu\text{A}$	1		3	
Gate-Body Leakage	$I_{\text{GSS}}$	$V_{\text{DS}} = 0 \text{ V}, V_{\text{GS}} = \pm 20 \text{ V}$			$\pm 100$	$\text{nA}$
Zero Gate Voltage Drain Current	$I_{\text{DSS}}$	$V_{\text{DS}} = 40 \text{ V}, V_{\text{GS}} = 0 \text{ V}$			1	$\mu\text{A}$
		$V_{\text{DS}} = 40 \text{ V}, V_{\text{GS}} = 0 \text{ V}, T_J = 125^\circ\text{C}$			50	
		$V_{\text{DS}} = 40 \text{ V}, V_{\text{GS}} = 0 \text{ V}, T_J = 175^\circ\text{C}$			500	
On-State Drain Current <sup>a</sup>	$I_{\text{D}(\text{on})}$	$V_{\text{DS}} = 5 \text{ V}, V_{\text{GS}} = 10 \text{ V}$	120			A
Drain-Source On-State Resistance <sup>a</sup>	$r_{\text{DS}(\text{on})}$	$V_{\text{GS}} = 10 \text{ V}, I_D = 60 \text{ A}$		0.0035	0.0045	$\Omega$
		$V_{\text{GS}} = 4.5 \text{ V}, I_D = 20 \text{ A}$		0.0051	0.0065	
		$V_{\text{GS}} = 10 \text{ V}, I_D = 60 \text{ A}, T_J = 125^\circ\text{C}$			0.0069	
		$V_{\text{GS}} = 10 \text{ V}, I_D = 60 \text{ A}, T_J = 175^\circ\text{C}$			0.0086	
Sense Diode Forward Voltage	$V_{\text{FD}1}$ and $V_{\text{FD}2}$	$I_F = 50 \mu\text{A}$	655		715	$\text{mV}$
		$I_F = 25 \mu\text{A}$	600		660	
Sense Diode Forward Voltage Increase	$\Delta V_F$	From $I_F = 25 \mu\text{A}$ to $I_F = 50 \mu\text{A}$	30		80	
Forward Transconductance <sup>a</sup>	$g_{\text{fs}}$	$V_{\text{DS}} = 15 \text{ V}, I_D = 20 \text{ A}$		35		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{\text{iss}}$	$V_{\text{GS}} = 0 \text{ V}, V_{\text{DS}} = 25 \text{ V}, f = 1 \text{ MHz}$		6000		$\text{pF}$
Output Capacitance	$C_{\text{oss}}$			1100		
Reverse Transfer Capacitance	$C_{\text{rss}}$			700		
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{\text{DS}} = 20 \text{ V}, V_{\text{GS}} = 10 \text{ V}, I_D = 25 \text{ A}$		130		$\text{nC}$
Gate-Source Charge <sup>c</sup>	$Q_{\text{gs}}$			25		
Gate-Drain Charge <sup>c</sup>	$Q_{\text{gd}}$			40		
Turn-On Delay Time <sup>c</sup>	$t_{\text{d}(\text{on})}$	$V_{\text{DD}} = 20 \text{ V}, R_L = 0.8 \Omega$ $I_D \geq 25 \text{ A}, V_{\text{GEN}} = 10 \text{ V}, R_g = 2.5 \Omega$		15	20	$\text{ns}$
Rise Time <sup>c</sup>	$t_r$			80	120	
Turn-Off Delay Time <sup>c</sup>	$t_{\text{d}(\text{off})}$			100	150	
Fall Time <sup>c</sup>	$t_f$			100	150	
<b>Source-Drain Diode Ratings and Characteristics <math>T_C = 25^\circ\text{C}</math><sup>b</sup></b>						
Continuous Current	$I_S$	$I_F = 60 \text{ A}, V_{\text{GS}} = 0 \text{ V}$ $I_F = 60 \text{ A}, \text{di/dt} = 100 \text{ A}/\mu\text{s}$			60	$\text{A}$
Pulsed Current	$I_{\text{SM}}$				200	
Forward Voltage <sup>a</sup>	$V_{\text{SD}}$			1.0	1.5	V
Reverse Recovery Time	$t_{\text{rr}}$			60	90	ns
Peak Reverse Recovery Current	$I_{\text{RM}(\text{REC})}$			2.1	4	A
Reverse Recovery Charge	$Q_{\text{rr}}$			0.065	0.18	$\mu\text{C}$

Notes:

- a. Pulse test; pulse width  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2\%$ .
- b. Guaranteed by design, not subject to production testing.
- c. 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.

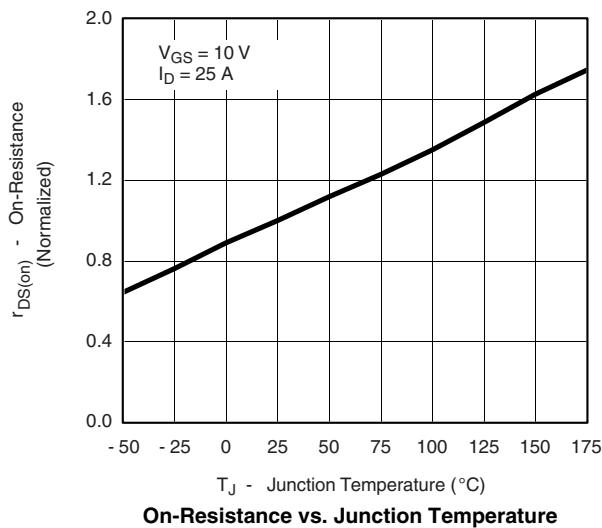
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted


# SUM60N04-05LT

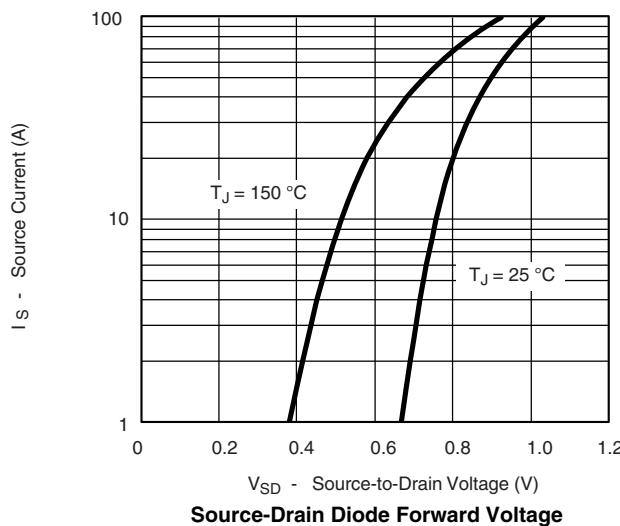
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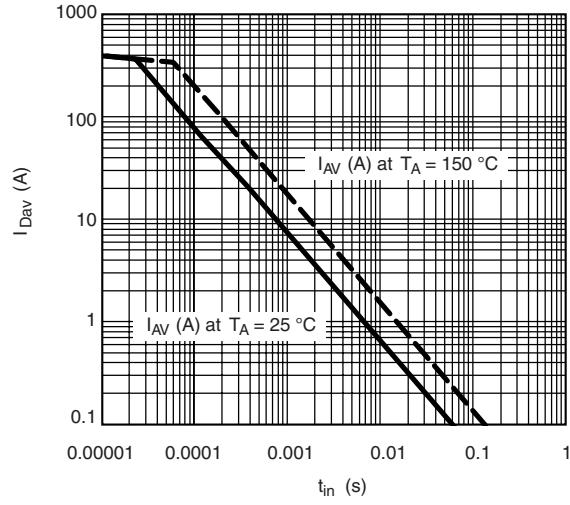
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



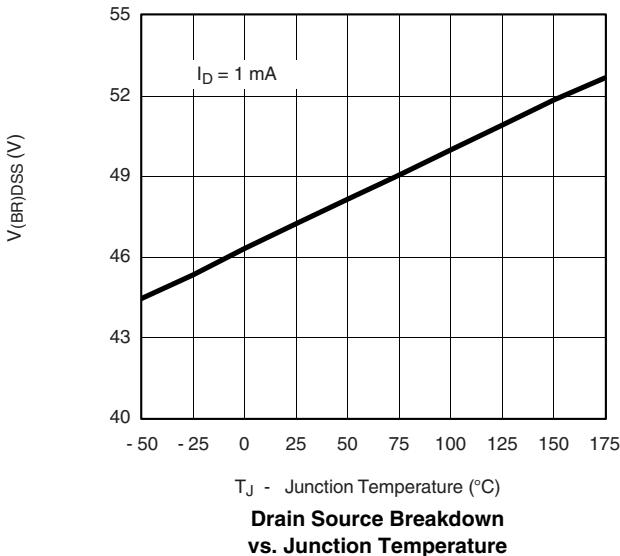
On-Resistance vs. Junction Temperature



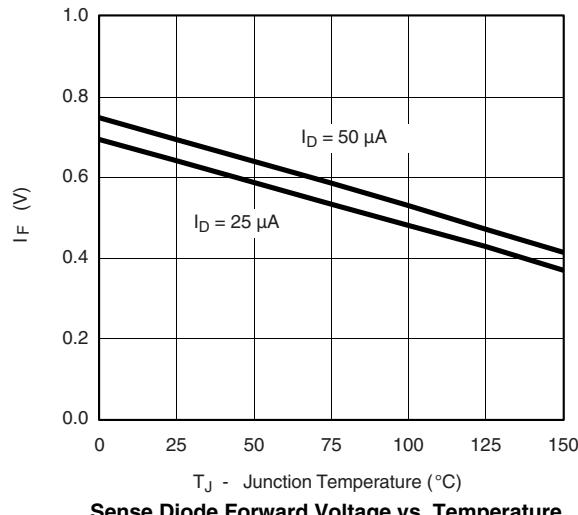
Source-Drain Diode Forward Voltage



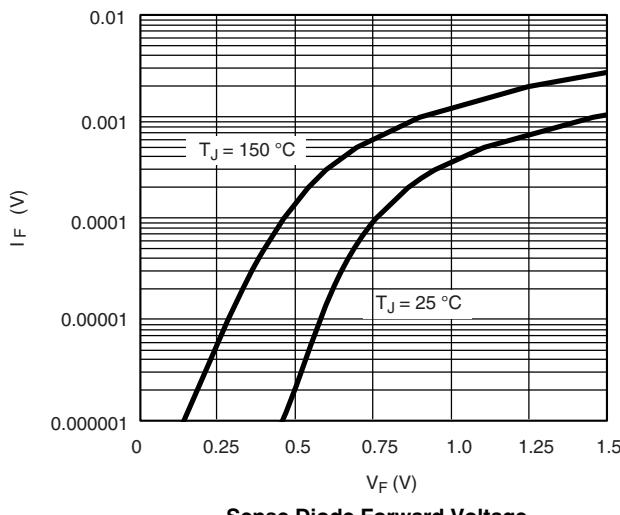
Avalanche Current vs. Time



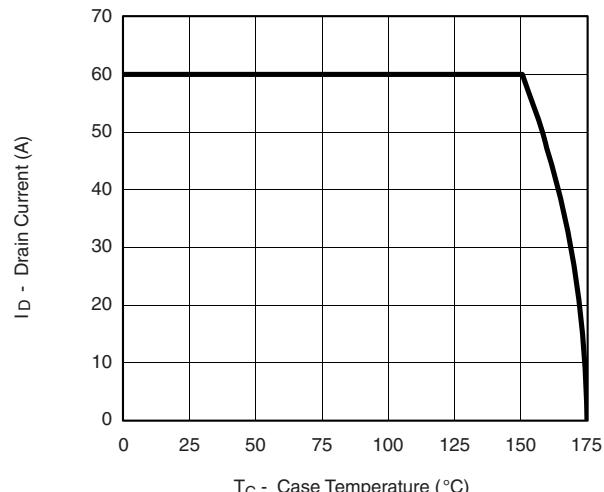
Drain Source Breakdown vs. Junction Temperature



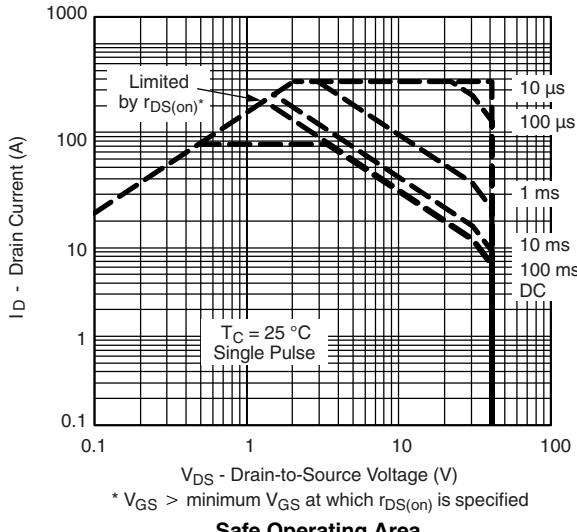
Sense Diode Forward Voltage vs. Temperature



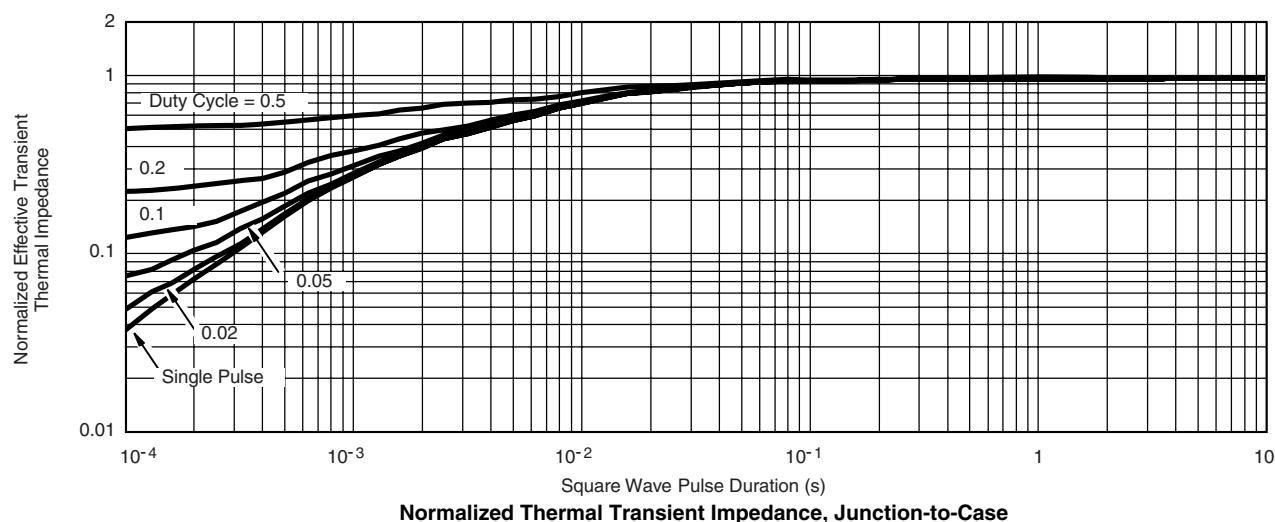
Sense Diode Forward Voltage

**THERMAL RATINGS**


**Maximum Avalanche and Drain Current vs. Case Temperature**



**Safe Operating Area**

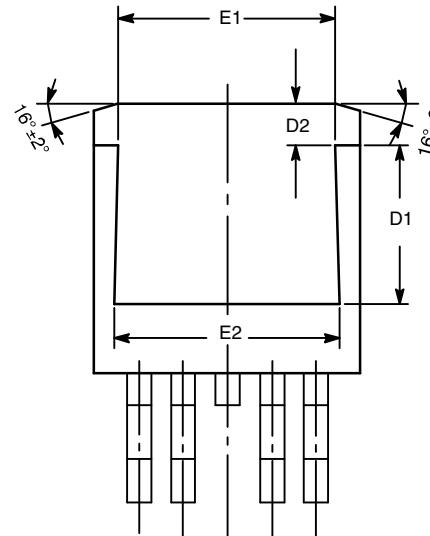
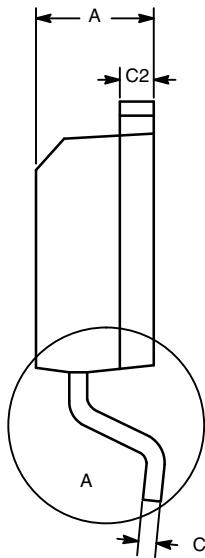
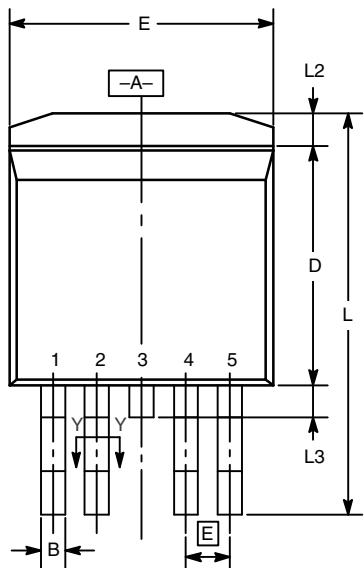


**Normalized Thermal Transient Impedance, Junction-to-Case**

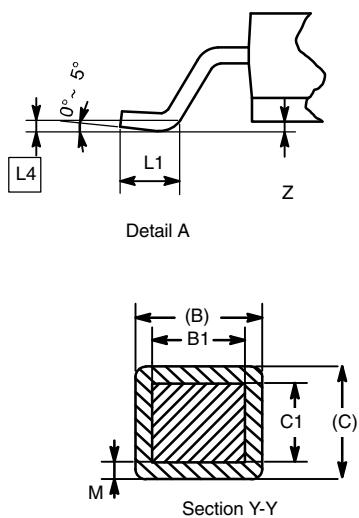
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### TO-263 (D<sup>2</sup>PAK): 5 Leads

(for Lead Thickness 25 mil)



⊕ 0.010 M A M



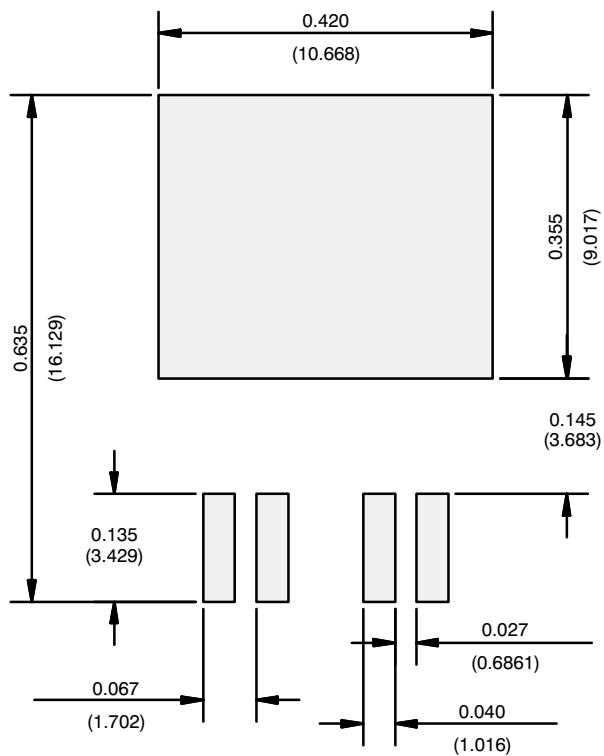
1. Plane B includes maximum features of heat sink tab and plastic.
2. No more than 25 % of L1 can fall above seating plane by maximum 8 mils.
3. Pin-to-pin coplanarity maximum 4 mils. Z not to exceed 10 mils.
4. Z not to exceed 10 mils.

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	-	0.170	0.185
B	-	-	0.028	0.039
B1	-	-	0.028	0.035
C	-	-	0.018	0.028
C1	-	-	0.018	0.025
C2	-	-	0.045	0.055
D	-	-	0.340	0.380
D1	-	-	0.220	0.255
D2	-	-	0.044	0.052
E	-	-	0.385	0.405
E1	-	-	0.245	-
E2 <sup>(1)</sup>	-	-	0.355	0.375
<b>E</b>	-		0.067 BSC	
L	-	-	0.575	0.625
L1	-	-	0.090	0.110
L2	-	-	0.040	0.055
L3	-	-	0.050	0.070
<b>L4</b>	-		0.010 BSC	
M	-	-	-	0.002

ECN: T13-0708-Rev. D, 30-Sep-13  
DWG: 5864

#### Note

<sup>(1)</sup> Dimension E2 is for reference only.

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 5-Lead**

Recommended Minimum Pads  
Dimensions in Inches/(mm)

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