

## P-Channel 55-V (D-S) MOSFET with Sensing Diode

PRODUCT SUMMARY		
$V_{(BR)DSS}$ (V)	$r_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)
- 55	0.011 at $V_{GS} = - 10$ V	- 60 <sup>a</sup>
	0.0175 at $V_{GS} = - 4.5$ V	- 60 <sup>a</sup>

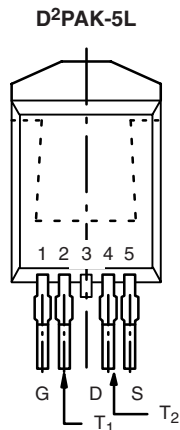
### FEATURES

- TrenchFET<sup>®</sup> Power MOSFETS Plus Temperature Sensing Diode
- 175 °C Junction Temperature
- Low Thermal Resistance Package

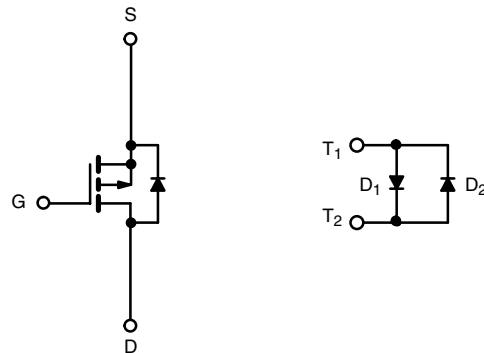

**RoHS\***  
COMPLIANT

### APPLICATIONS

- Industrial



Ordering Information: SUM60P05-11LT  
SUM60P05-11LT-E3 (Lead (Pb)-free)



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted			
Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	- 55	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current ( $T_J = 175$ °C) <sup>d</sup>	$I_D$	$T_C = 25$ °C	- 60 <sup>a</sup>
		$T_C = 100$ °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>	$E_{AR}$	180	mJ
Maximum Power Dissipation <sup>a</sup>	$P_D$	$T_C = 25$ °C	200 <sup>c</sup>
		$T_A = 25$ °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:

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

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

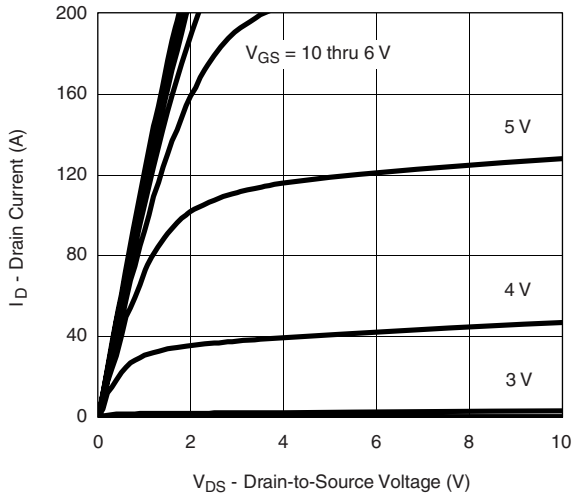
<b>MOSFET SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	- 55			V
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_{DS} = -250\text{ }\mu\text{A}$	- 1			
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -44\text{ V}, V_{GS} = 0\text{ V}$			- 1	$\mu\text{A}$
		$V_{DS} = -44\text{ V}, V_{GS} = 0\text{ V}, T_J = 175\text{ }^\circ\text{C}$			- 250	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = -5\text{ V}, V_{GS} = -10\text{ V}$	- 120			A
Drain-Source On-State Resistance <sup>a</sup>	$r_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -30\text{ A}$		0.009	0.011	$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -30\text{ A}, T_J = 125\text{ }^\circ\text{C}$			0.0175	
		$V_{GS} = -10\text{ V}, I_D = -30\text{ A}, T_J = 175\text{ }^\circ\text{C}$			0.022	
		$V_{GS} = -4.5\text{ V}, I_D = -20\text{ A}$			0.0175	
Sense Diode Forward Voltage	$V_{FD}$	$V_{DS} = -25\text{ V}, I_F = -250\text{ }\mu\text{A}$	- 770		- 830	mV
Sense Diode Forward Voltage Increase	$\Delta V_F$	From $I_F = -125\text{ }\mu\text{A}$ to $I_F = -250\text{ }\mu\text{A}$	- 25		- 55	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -25\text{ V}, I_D = -30\text{ A}$		50		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = -25\text{ V}, f = 1\text{ MHz}$		6450		$\mu\text{F}$
Output Capacitance	$C_{oss}$			1050		
Reverse Transfer Capacitance	$C_{rss}$			520		
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{DS} = -30\text{ V}, V_{GS} = -10\text{ V}, I_D = -60\text{ A}$		107		nC
Gate-Source Charge <sup>c</sup>	$Q_{gs}$			28		
Gate-Drain Charge <sup>c</sup>	$Q_{gd}$			22		
Turn-On Delay Time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 0.6\text{ }\Omega$ $I_D \cong -60\text{ A}, V_{GEN} = -10\text{ V}, R_G = 2.5\text{ }\Omega$		15	25	ns
Rise Time <sup>c</sup>	$t_r$			190	325	
Turn-Off Delay Time <sup>c</sup>	$t_{d(off)}$			145	220	
Fall Time <sup>c</sup>	$t_f$			265	450	
<b>Source-Drain Diode Ratings and Characteristics</b> $T_C = 25\text{ }^\circ\text{C}$ <sup>b</sup>						
Continuous Current	$I_S$				- 60	A
Pulsed Current	$I_{SM}$				- 200	
Forward Voltage <sup>a</sup>	$V_{SD}$	$I_F = -60\text{ A}, V_{GS} = 0\text{ V}$		- 1.1	- 1.5	V
Reverse Recovery Time	$t_{rr}$	$I_F = -60\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		55	110	ns
Peak Reverse Recovery Current	$I_{RM(REC)}$			- 1.6	- 2.0	A
Reverse Recovery Charge	$Q_{rr}$			0.04	12	$\mu\text{C}$

**Notes:**

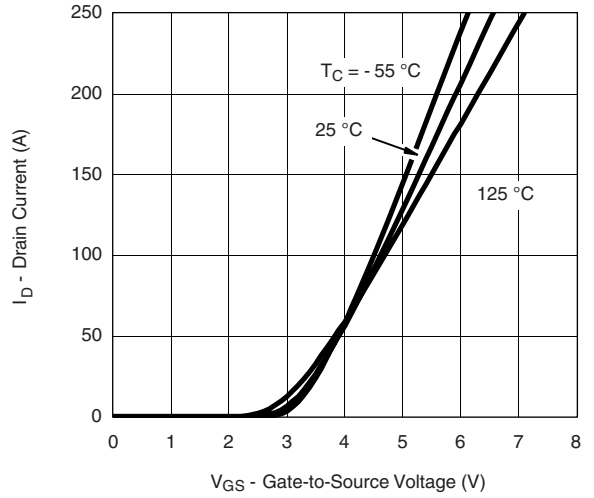
- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production testing.
- Independent of operating temperature.

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.

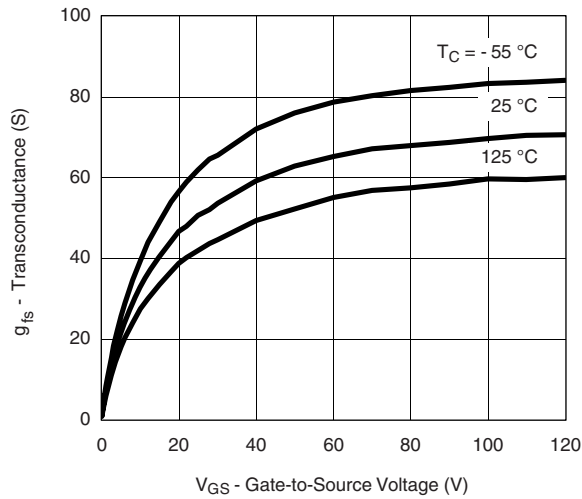
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



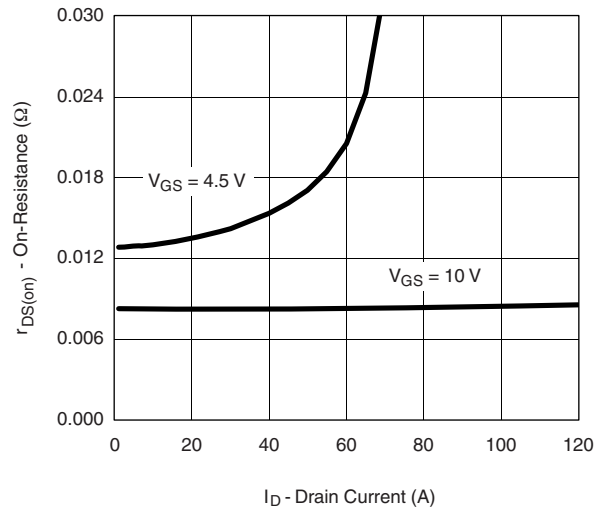
**Output Characteristics**



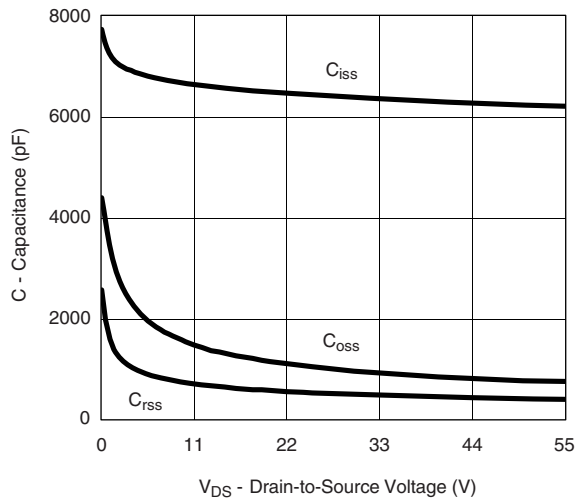
**Transfer Characteristics**



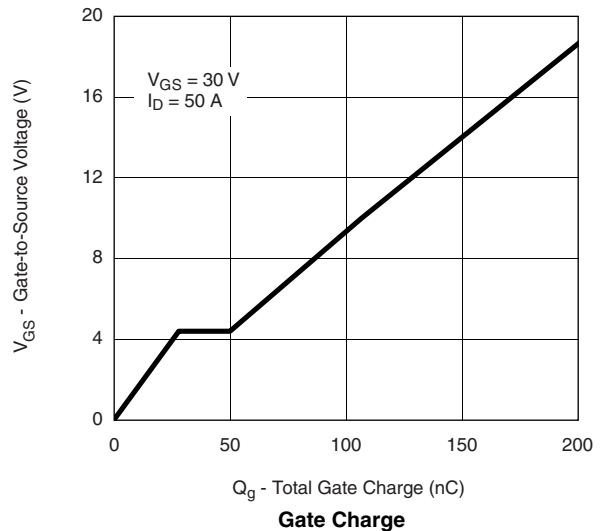
**Transconductance**



**On-Resistance vs. Drain Current**

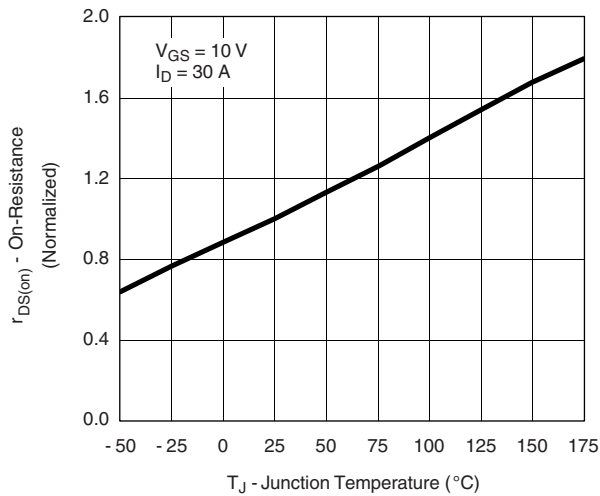


**Capacitance**

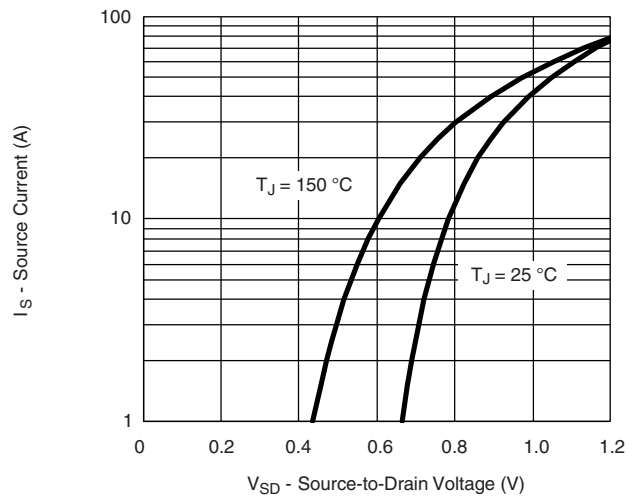


**Gate Charge**

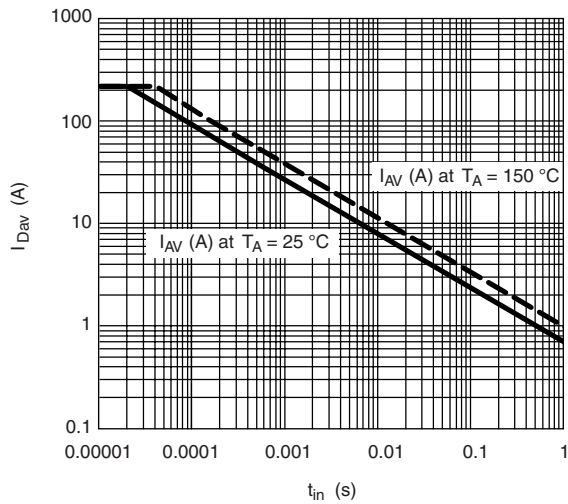
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



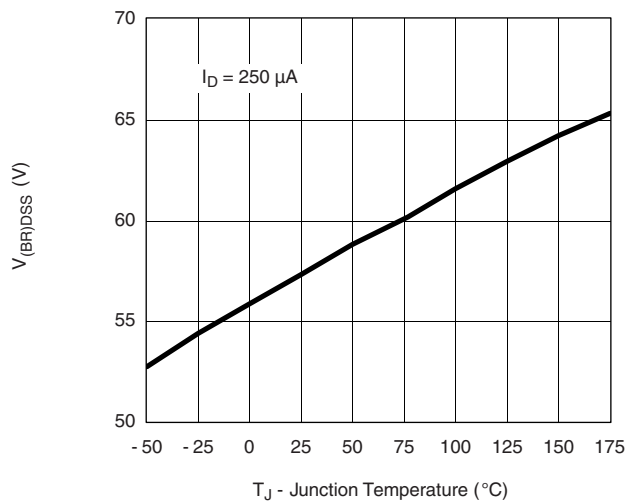
**On-Resistance vs. Junction Temperature**



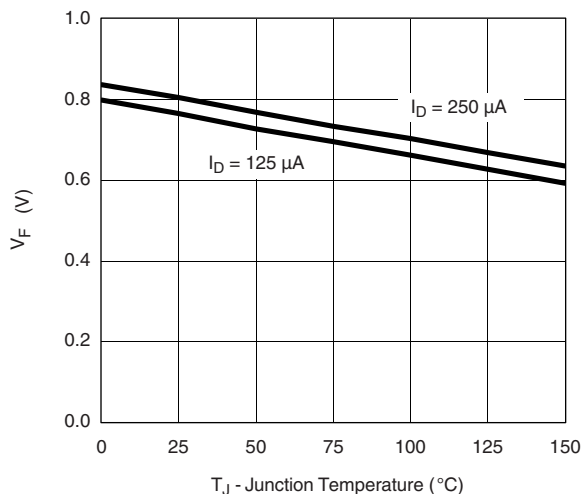
**Source-Drain Diode Forward Voltage**



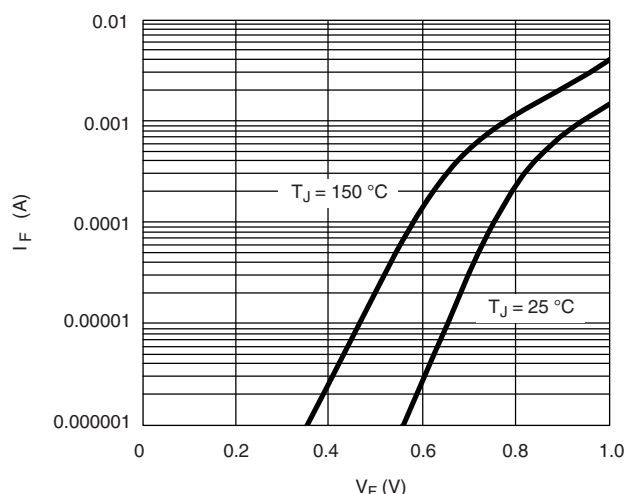
**Avalanche Current vs. Time**



**Drain Source Breakdown vs. Junction Temperature**



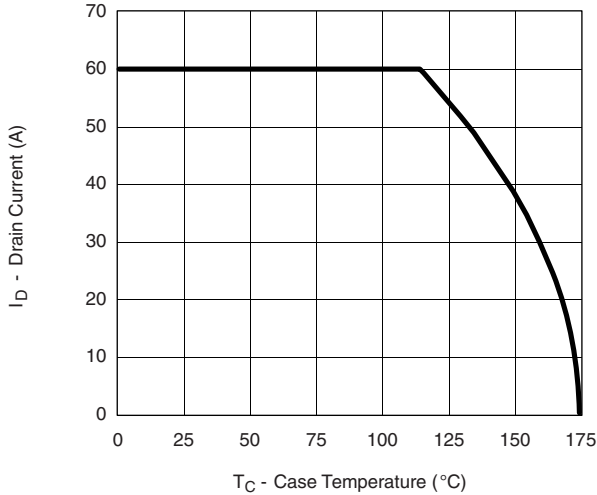
**Sense Diode Forward Voltage vs. Temperature**



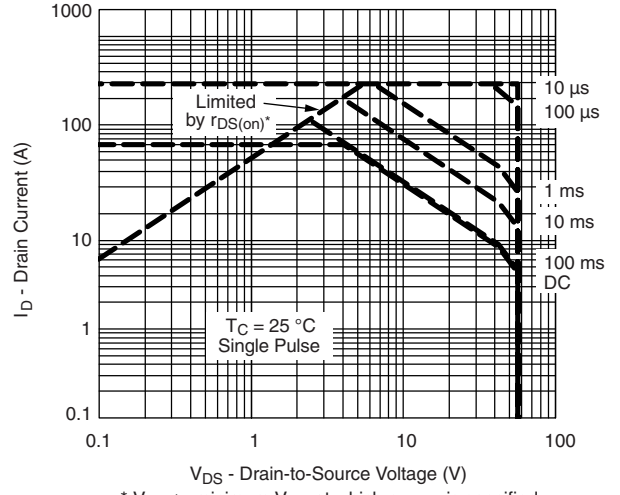
**Sense Diode Forward Voltage**



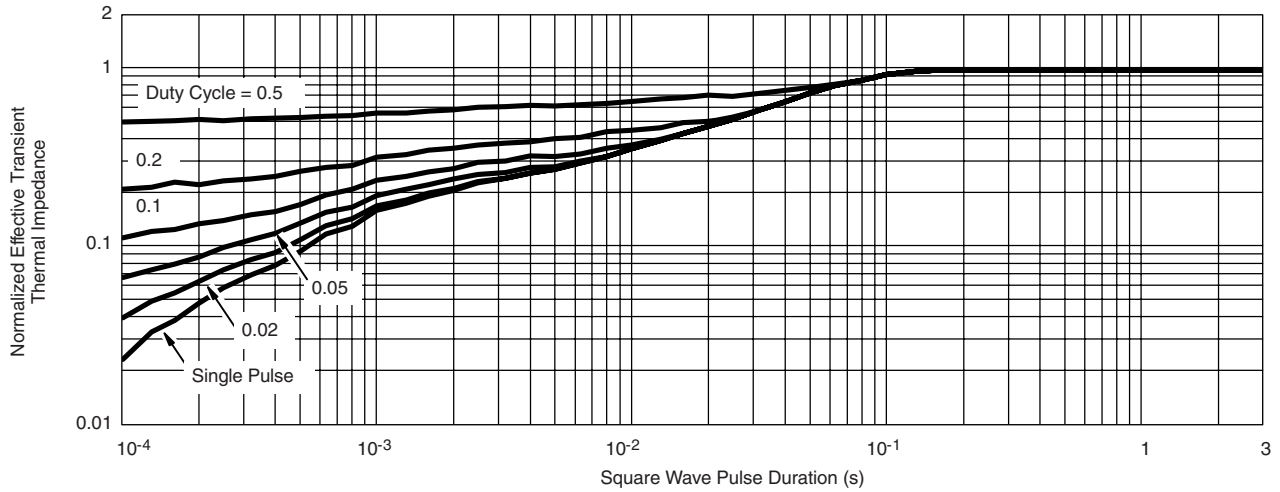
**THERMAL RATINGS**



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



**Safe Operating Area**  
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified



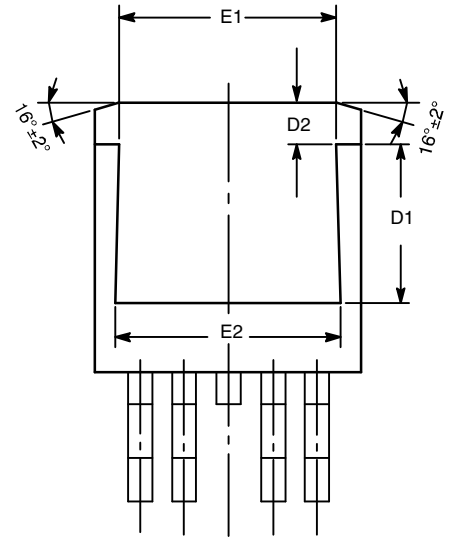
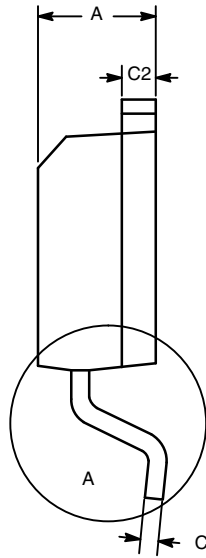
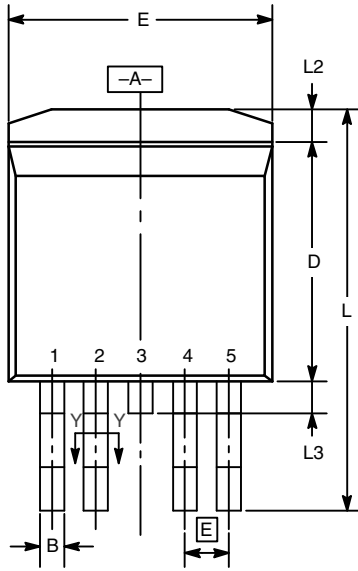
**Normalized Thermal Transient Impedance, Junction-to-Case**

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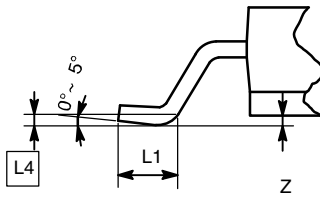


# TO-263 (D<sup>2</sup>PAK): 5 Leads

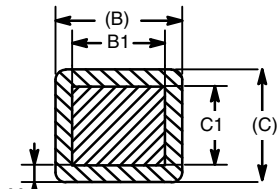
(for Lead Thickness 25 mil)



⊕ 0.010 (M) A (M)



Detail A



Section Y-Y

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.

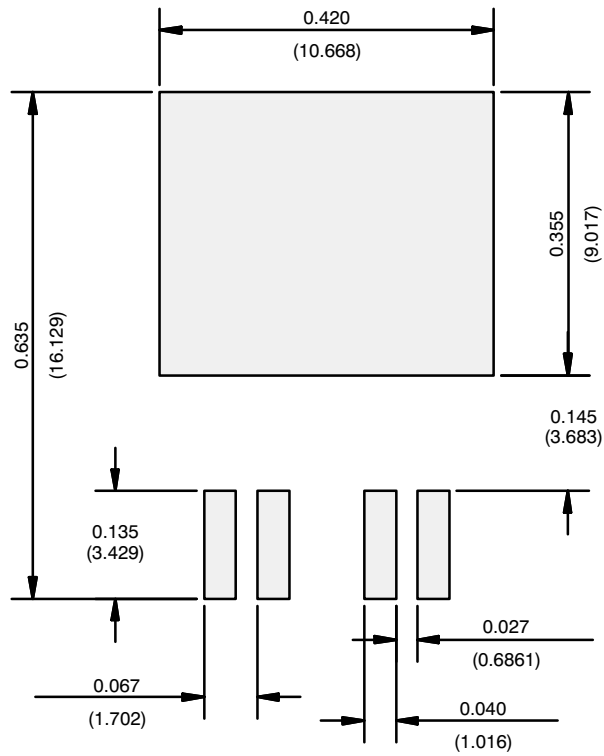
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	-	0.170	0.185
B	-	-	0.028	0.039
B1	-	-	0.028	0.035
C	-	-	0.018	0.028
C1	-	-	0.018	0.025
C2	-	-	0.045	0.055
D	-	-	0.340	0.380
D1	-	-	0.220	0.255
D2	-	-	0.044	0.052
E	-	-	0.385	0.405
E1	-	-	0.245	-
E2 <sup>(1)</sup>	-	-	0.355	0.375
<b>E</b>	-		0.067 BSC	
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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