

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

PRODUCT SUMMARY

$V_{(BR)DSS}$ (V)	$r_{DS(on)}$ (Ω)	I_D (A)
40	0.0045 at $V_{GS} = 10$ V	60 ^a
	0.0065 at $V_{GS} = 4.5$ V	20 ^a

FEATURES

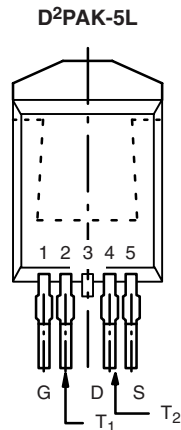
- TrenchFET® Power MOSFETS Plus Temperature Sensing Diode
- 175 °C Junction Temperature
- Low Thermal Resistance Package



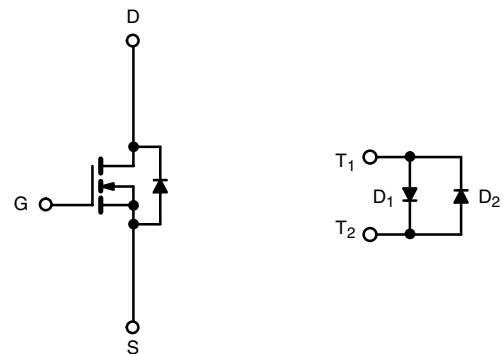
Available
RoHS*
COMPLIANT

APPLICATIONS

- Industrial



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



N-Channel MOSFET

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

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

THERMAL RESISTANCE RATINGS

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

Notes:

- Package limited.
- Duty cycle ≤ 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.

MOSFET SPECIFICATIONS T _J = 25 °C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0 V, I _D = 250 μA	40			V
Gate-Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _{DS} = 250 μA	1		3	
Gate-Body Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V			± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 40 V, V _{GS} = 0 V			1	μA
		V _{DS} = 40 V, V _{GS} = 0 V, T _J = 125 °C			50	
		V _{DS} = 40 V, V _{GS} = 0 V, T _J = 175 °C			500	
On-State Drain Current ^a	I _{D(on)}	V _{DS} = 5 V, V _{GS} = 10 V	120			A
Drain-Source On-State Resistance ^a	r _{DS(on)}	V _{GS} = 10 V, I _D = 60 A		0.0035	0.0045	Ω
		V _{GS} = 4.5 V, I _D = 20 A		0.0051	0.0065	
		V _{GS} = 10 V, I _D = 60 A, T _J = 125 °C			0.0069	
		V _{GS} = 10 V, I _D = 60 A, T _J = 175 °C			0.0086	
Sense Diode Forward Voltage	V _{FD1} and V _{FD2}	I _F = 50 μA	655		715	mV
		I _F = 25 μA	600		660	
Sense Diode Forward Voltage Increase	ΔV _F	From I _F = 25 μA to I _F = 50 μA	30		80	
Forward Transconductance ^a	g _{fs}	V _{DS} = 15 V, I _D = 20 A		35		S
Dynamic ^b						
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 25 V, f = 1 MHz		6000		pF
Output Capacitance	C _{oss}			1100		
Reverse Transfer Capacitance	C _{rss}			700		
Total Gate Charge ^c	Q _g	V _{DS} = 20 V, V _{GS} = 10 V, I _D = 25 A		130		nC
Gate-Source Charge ^c	Q _{gs}			25		
Gate-Drain Charge ^c	Q _{gd}			40		
Turn-On Delay Time ^c	t _{d(on)}	V _{DD} = 20 V, R _L = 0.8 Ω I _D ≅ 25 A, V _{GEN} = 10 V, R _g = 2.5 Ω		15	20	ns
Rise Time ^c	t _r			80	120	
Turn-Off Delay Time ^c	t _{d(off)}			100	150	
Fall Time ^c	t _f			100	150	
Source-Drain Diode Ratings and Characteristics T _C = 25 °C ^b						
Continuous Current	I _S				60	A
Pulsed Current	I _{SM}				200	
Forward Voltage ^a	V _{SD}	I _F = 60 A, V _{GS} = 0 V		1.0	1.5	V
Reverse Recovery Time	t _{rr}	I _F = 60 A, di/dt = 100 A/μs		60	90	ns
Peak Reverse Recovery Current	I _{RM(REC)}			2.1	4	A
Reverse Recovery Charge	Q _{rr}				0.065	0.18

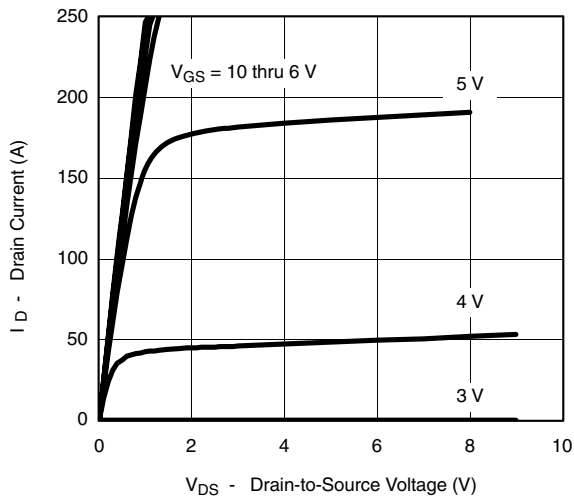
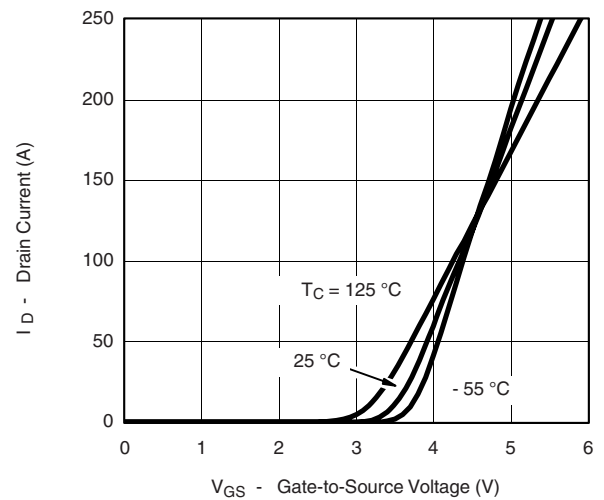
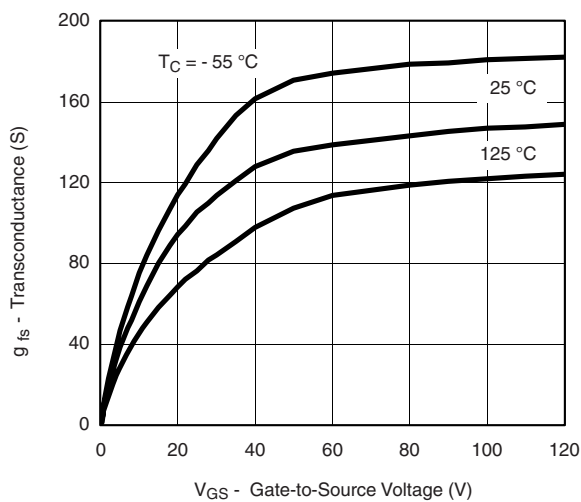
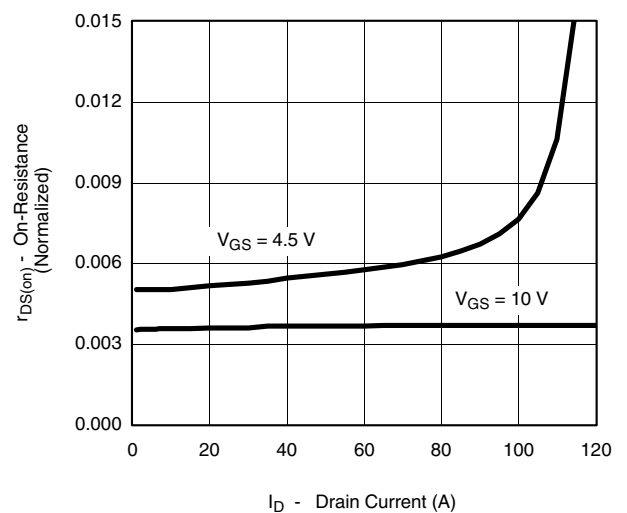
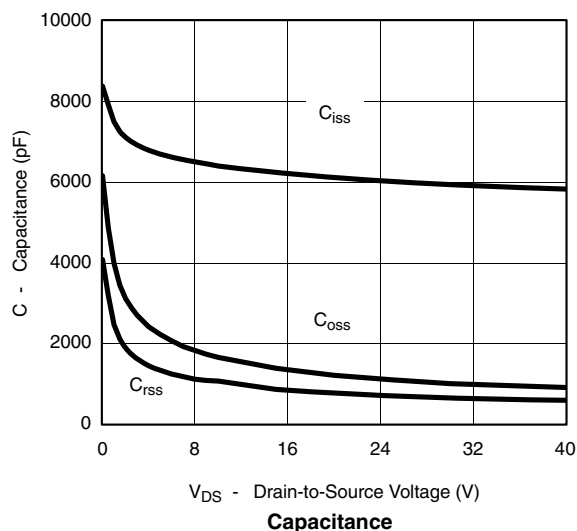
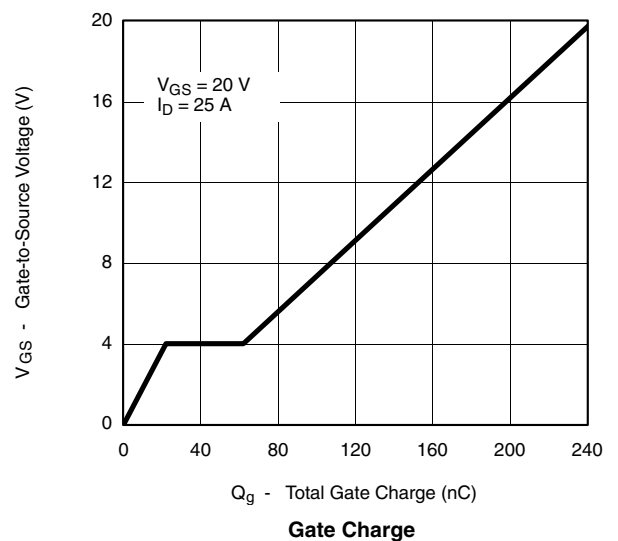
Notes:

a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

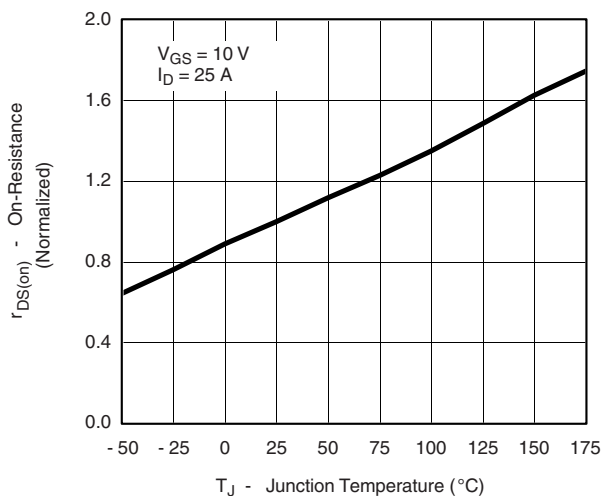
b. Guaranteed by design, not subject to production testing.

c. Independent of operating temperature.

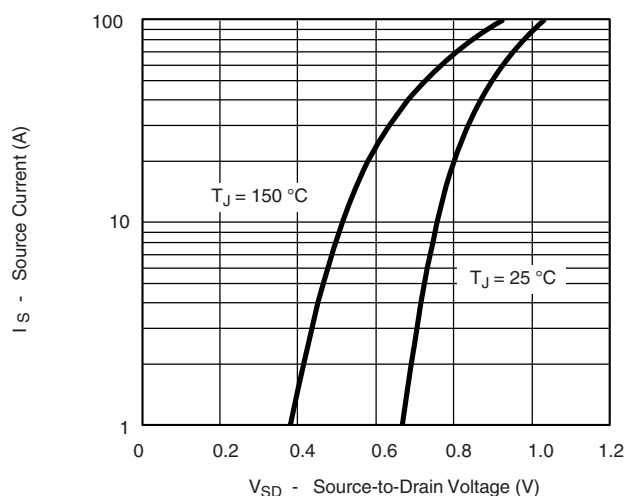
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Output Characteristics****Transfer Characteristics****Transconductance****On-Resistance vs. Drain Current****Capacitance****Gate Charge**

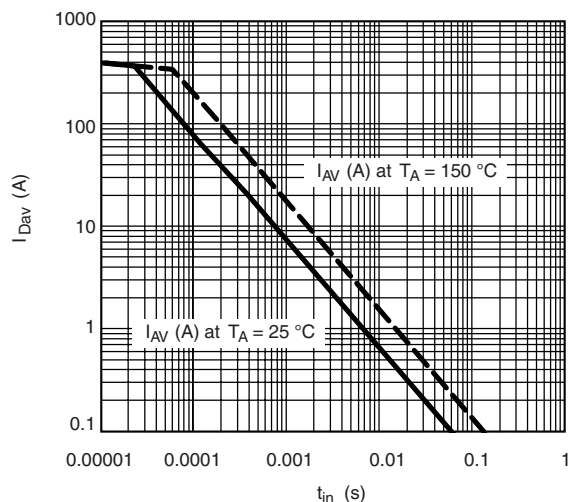
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



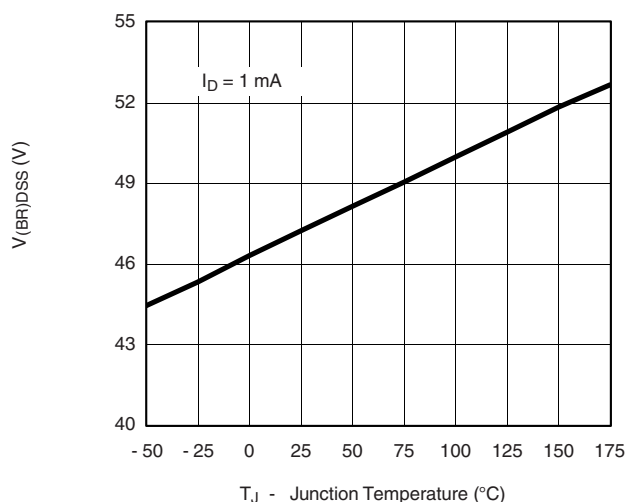
On-Resistance vs. Junction Temperature



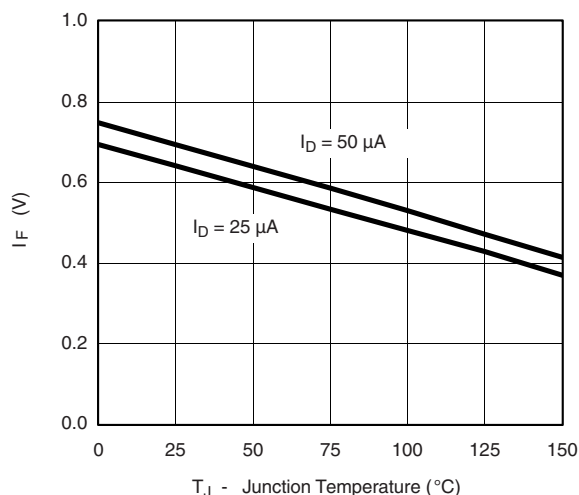
Source-Drain Diode Forward Voltage



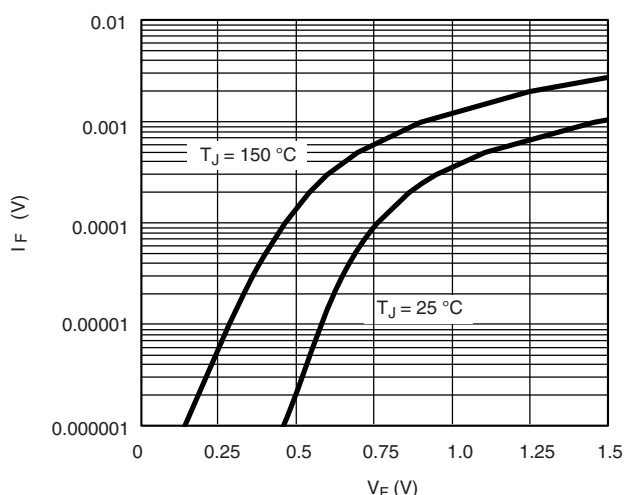
Avalanche Current vs. Time



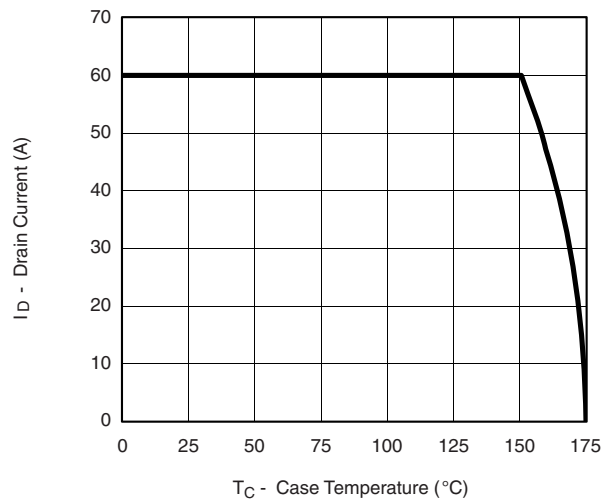
Drain Source Breakdown vs. Junction Temperature



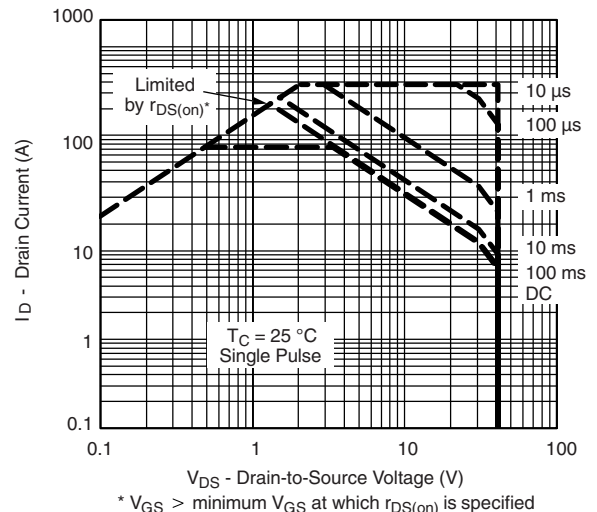
Sense Diode Forward Voltage vs. Temperature



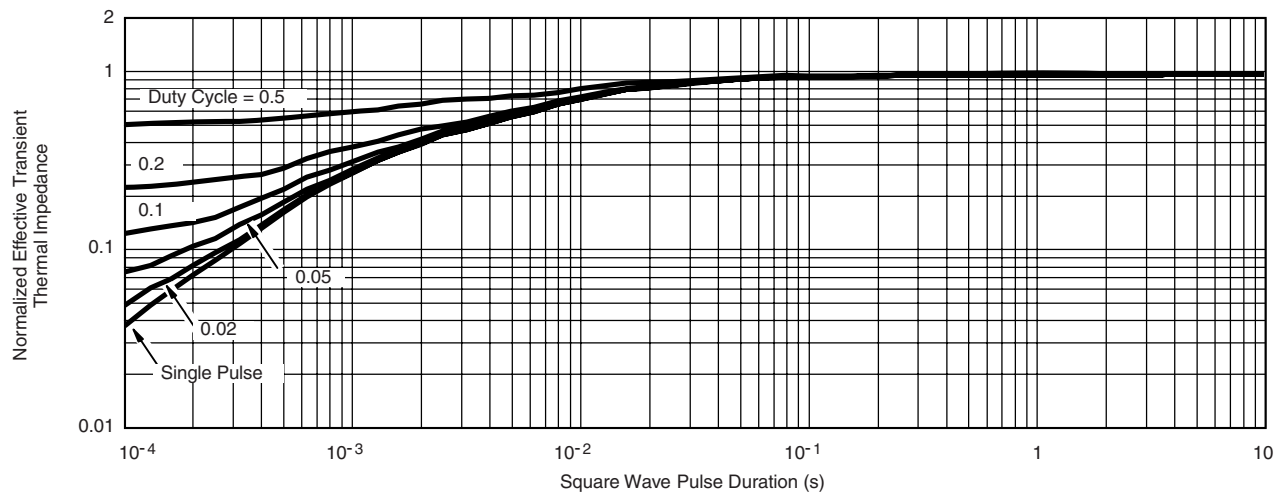
Sense Diode Forward Voltage

**THERMAL RATINGS**

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



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

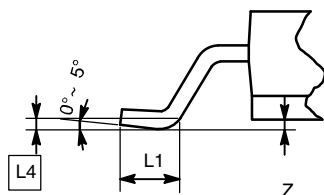
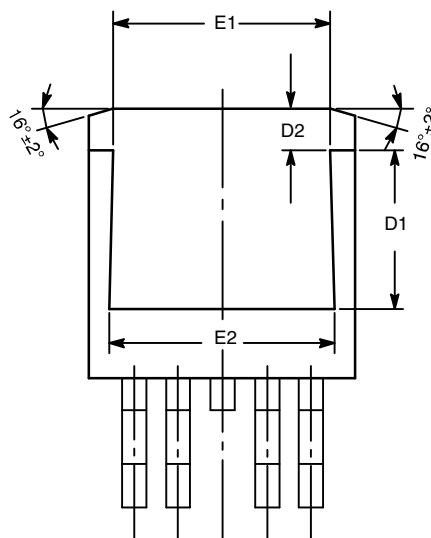
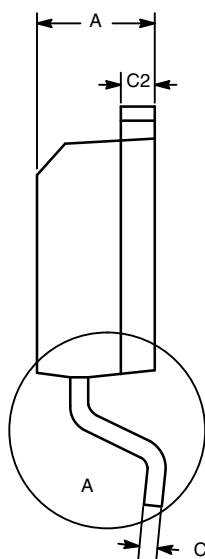
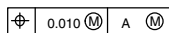
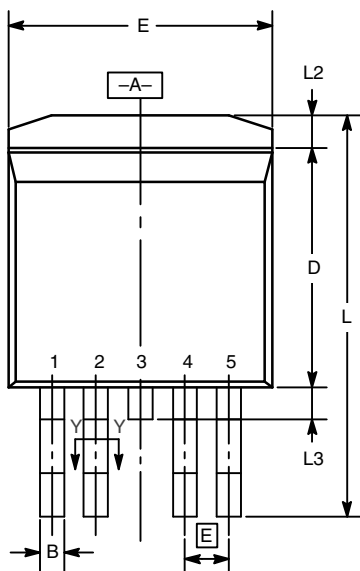


Normalized Thermal Transient Impedance, Junction-to-Case

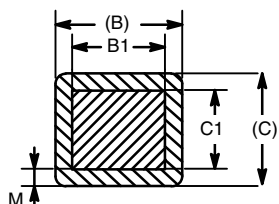
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TO-263 (D²PAK): 5 Leads

(for Lead Thickness 25 mil)



Detail A



Section Y-Y

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

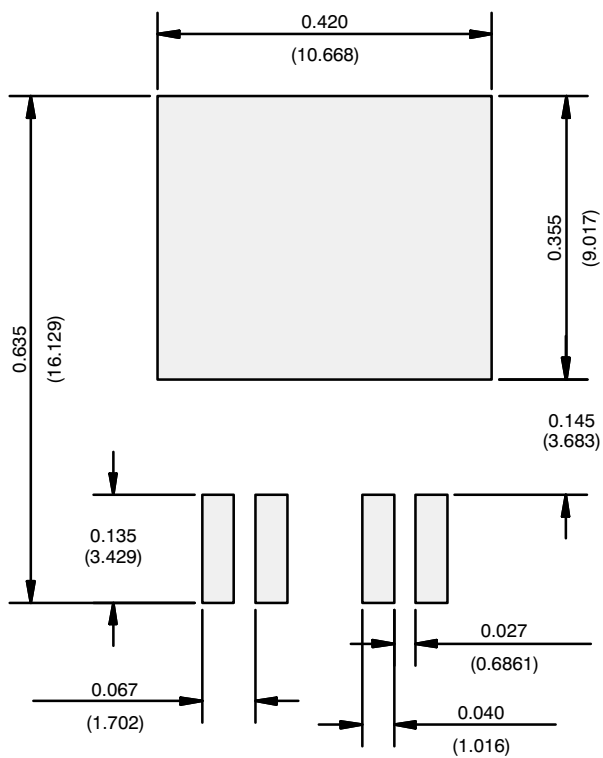
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	-	0.170	0.185
B	-	-	0.028	0.039
B1	-	-	0.028	0.035
C	-	-	0.018	0.028
C1	-	-	0.018	0.025
C2	-	-	0.045	0.055
D	-	-	0.340	0.380
D1	-	-	0.220	0.255
D2	-	-	0.044	0.052
E	-	-	0.385	0.405
E1	-	-	0.245	-
E2 ⁽¹⁾	-	-	0.355	0.375
E	-		0.067 BSC	
L	-	-	0.575	0.625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

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

Note

⁽¹⁾ Dimension E2 is for reference only.

RECOMMENDED MINIMUM PADS FOR D²PAK: 5-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

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