

RUH4040M2-VB Datasheet

N-Channel 40 V (D-S) MOSFET

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^f	Q_g (Typ.)
40	0.0045 at $V_{GS} = 10$ V	40 ^g	9.8 nC
	0.0062 at $V_{GS} = 4.5$ V	40 ^g	

FEATURES

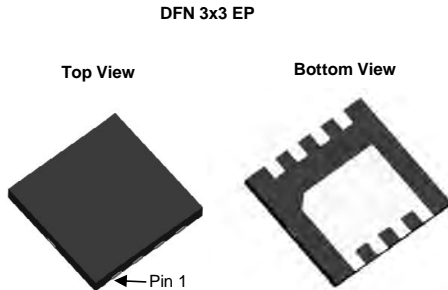
- Trench Power MOSFET
- 100 % R_g and UIS Tested
- Capable of Operating with 5 V Gate Drive



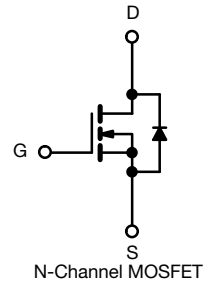
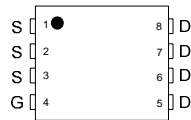
RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Synchronous Rectification
- Synchronous Buck Converters
- ORing
- Load Switching
- Motor Drive Switch



Top View



ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	40	V
Gate-Source Voltage	V_{GS}	± 20	
Continuous Drain Current ($T_J = 150$ °C)	I_D	$T_C = 25$ °C	A
		$T_C = 70$ °C	
		$T_A = 25$ °C	
		$T_A = 70$ °C	
Pulsed Drain Current ($t = 100$ μ s)	I_{DM}	100	A
Continuous Source-Drain Diode Current	I_S	$T_C = 25$ °C	
		$T_A = 25$ °C	mJ
Single Pulse Avalanche Current	I_{AS}	20	
Single Pulse Avalanche Energy	E_{AS}	20	mJ
Maximum Power Dissipation	P_D	$T_C = 25$ °C	
		$T_C = 70$ °C	W
		$T_A = 25$ °C	
		$T_A = 70$ °C	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	°C
Soldering Recommendations (Peak Temperature) ^{c, d}		260	

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{a, e}	R_{thJA}	26	33	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	1.9	2.4	

Notes:

a. Surface mounted on 1" x 1" FR4 board.

b. $t = 10$ s.

c. The DFN 3 x 3 EP is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

d. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components.

e. Maximum under steady state conditions is 81 °C/W.

f. Based on $T_C = 25$ °C.

g. Package limited.

SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	40			V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	I _D = 250 μA		56		mV/°C
V _{GS(th)} Temperature Coefficient	ΔV _{GS(th)} /T _J			- 6		
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	1.1		2.2	V
Gate-Source 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 = 55 °C			10	
On-State Drain Current ^a	I _{D(on)}	V _{DS} ≥ 5 V, V _{GS} = 10 V	20			A
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = 10 V, I _D = 20 A		0.0045		Ω
		V _{GS} = 4.5 V, I _D = 10 A		0.0062		
Forward Transconductance ^a	g _{fs}	V _{DS} = 15 V, I _D = 20 A		65		S
Dynamic ^b						
Input Capacitance	C _{iss}	V _{DS} = 20 V, V _{GS} = 0 V, f = 1 MHz		1330		pF
Output Capacitance	C _{oss}			1200		
Reverse Transfer Capacitance	C _{rss}			66		
Total Gate Charge	Q _g	V _{DS} = 20 V, V _{GS} = 10 V, I _D = 10 A		21.3	32	nC
		V _{DS} = 20 V, V _{GS} = 4.5 V, I _D = 10 A		9.8	15	
Q _{gs}			3.2			
Q _{gd}			2.5			
Output Charge	Q _{oss}	V _{DS} = 20 V, V _{GS} = 0 V		32	48	
Gate Resistance	R _g	f = 1 MHz	0.2	0.9	1.5	Ω
Turn-On Delay Time	t _{d(on)}	V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 4.5 V, R _g = 1 Ω		22	44	ns
Rise Time	t _r			65	120	
Turn-Off Delay Time	t _{d(off)}			24	45	
Fall Time	t _f			9	18	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω		11	22	
Rise Time	t _r			11	22	
Turn-Off Delay Time	t _{d(off)}			22	44	
Fall Time	t _f			9	18	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C			40	A
Pulse Diode Forward Current (t = 100 μs)	I _{SM}				100	
Body Diode Voltage	V _{SD}	I _S = 4 A, V _{GS} = 0 V		0.75	1.2	V
Body Diode Reverse Recovery Time	t _{rr}	I _F = 10 A, dI/dt = 100 A/μs, T _J = 25 °C		31	60	ns
Body Diode Reverse Recovery Charge	Q _{rr}			17	34	nC
Reverse Recovery Fall Time	t _a			13		ns
Reverse Recovery Rise Time	t _b			18		

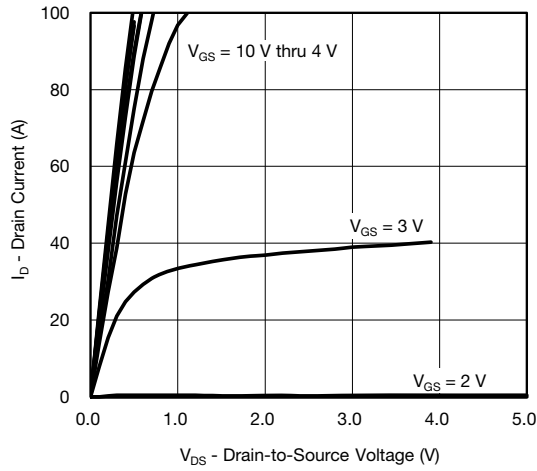
Notes:

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

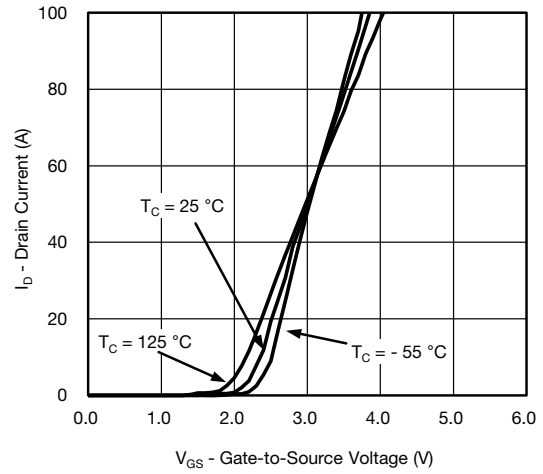
b. Guaranteed by design, not subject to production testing.

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)



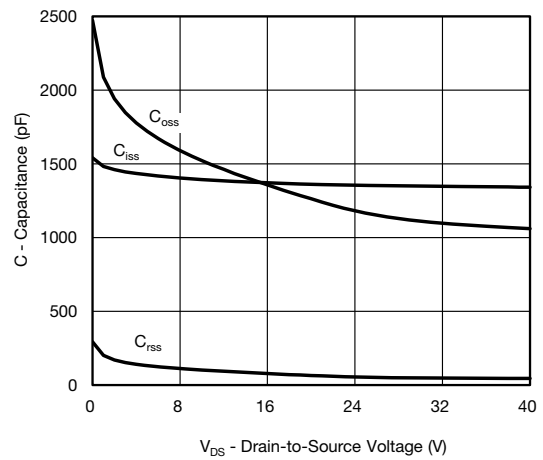
Output Characteristics



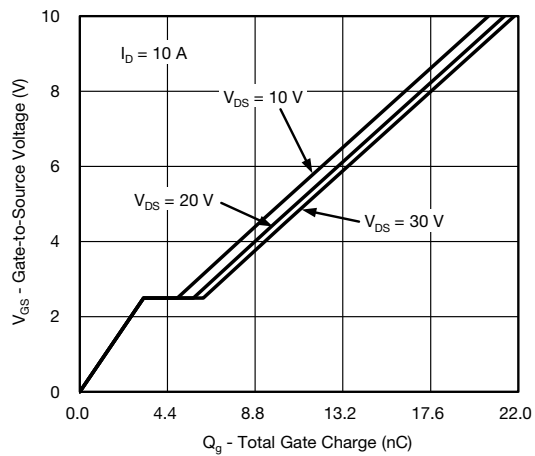
Transfer Characteristics



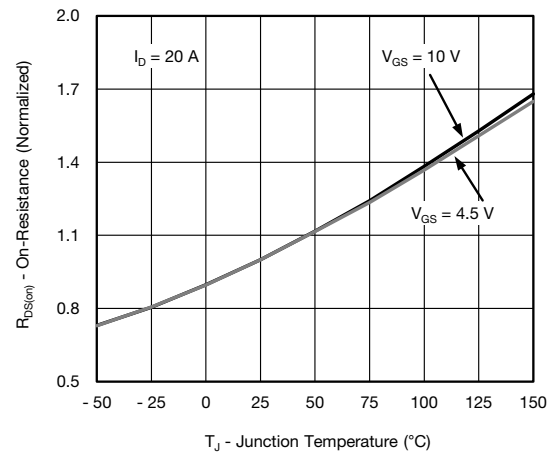
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

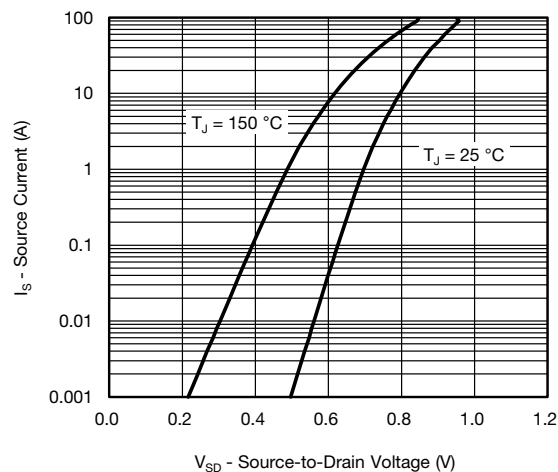


Gate Charge

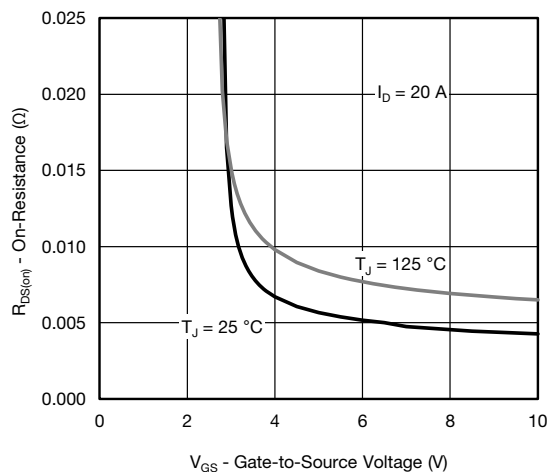


On-Resistance vs. Junction Temperature

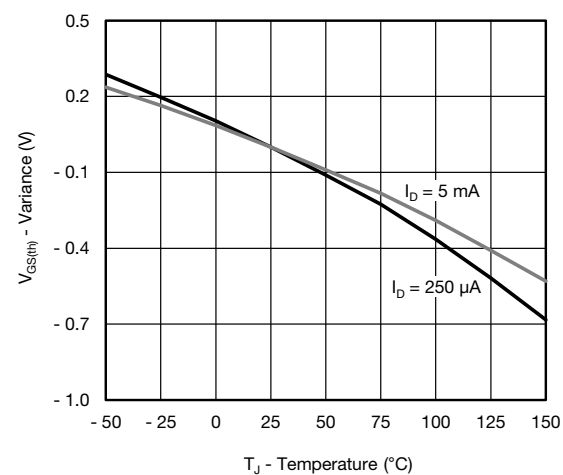
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



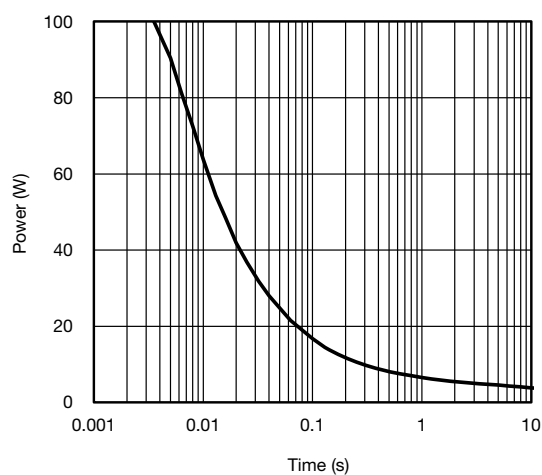
Source-Drain Diode Forward Voltage



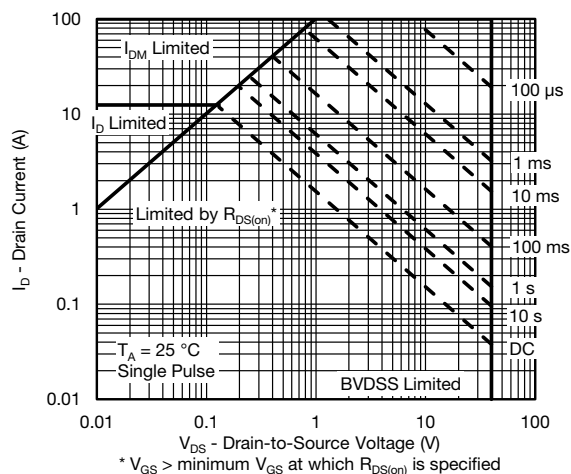
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

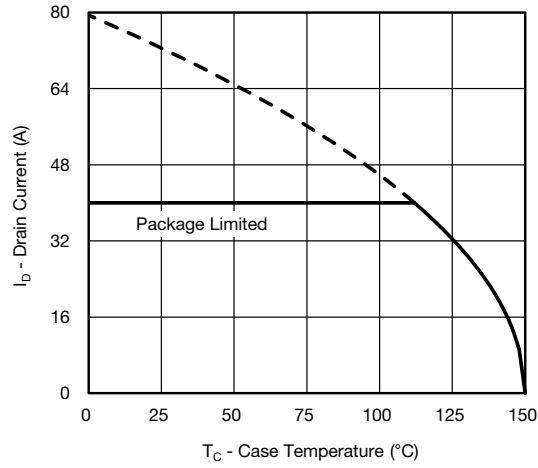


Single Pulse Power, Junction-to-Ambient



Safe Operating Area, Junction-to-Ambient

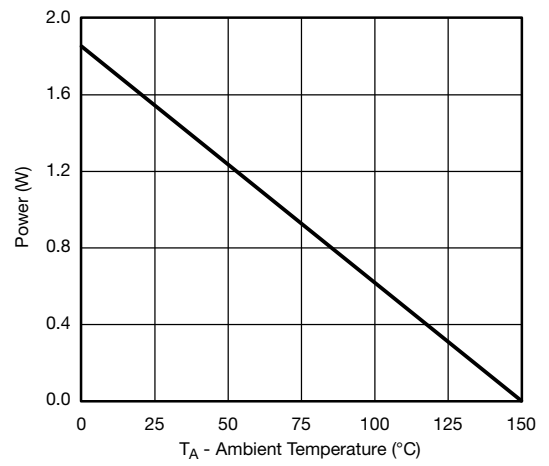
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*



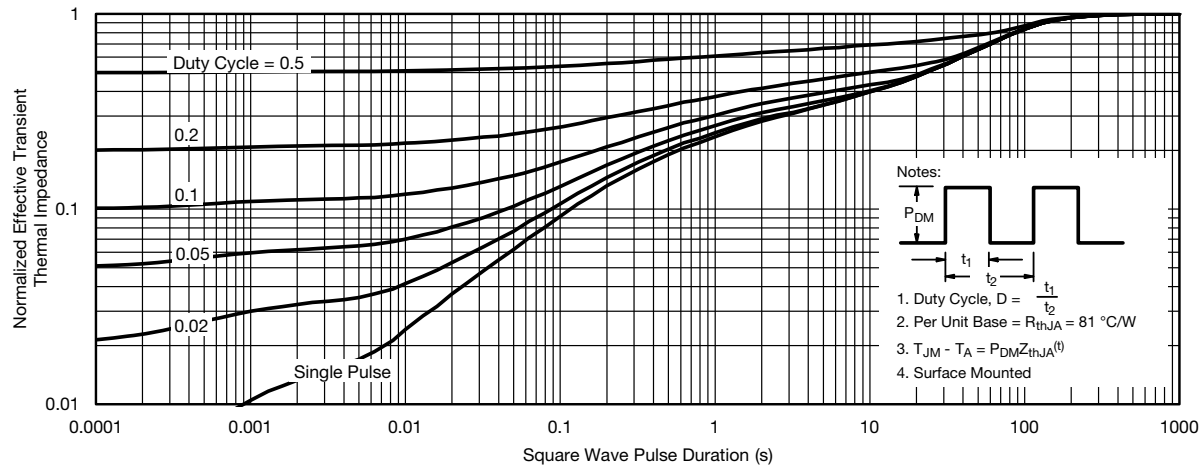
Power, Junction-to-Case



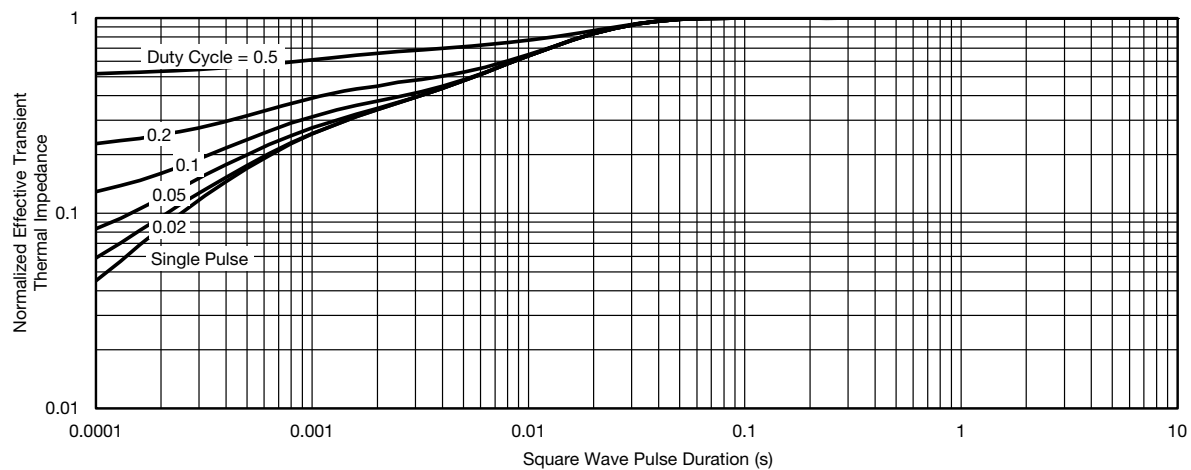
Power, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

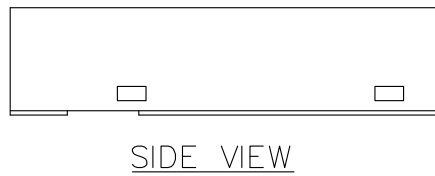
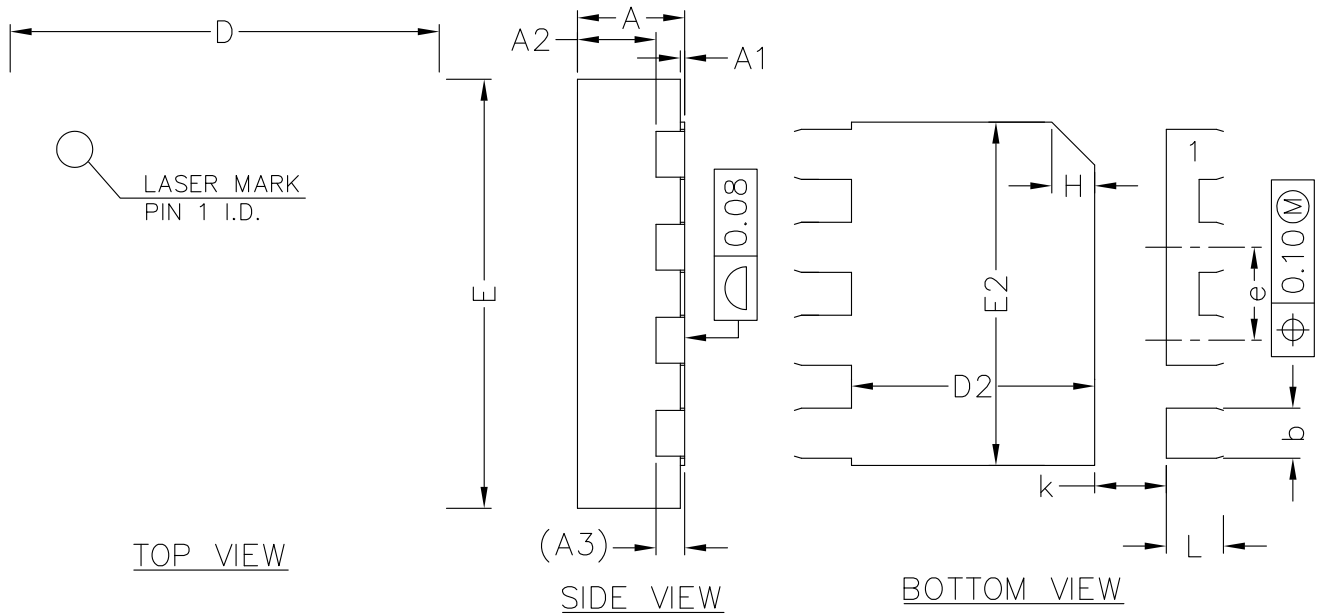
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2	0.50	0.55	0.60
A3	0.20REF		
b	0.30	0.35	0.40
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D2	1.60	1.70	1.80
E2	2.30	2.40	2.50
e	0.55	0.65	0.75
K	0.40	0.50	0.60
L	0.35	0.40	0.45

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