

## 4N04H1-VB Datasheet

### N-Channel 40 V (D-S) 175 °C MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	40
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = 10$ V	0.0015
$I_D$ (A)	200
Configuration	Single
Package	TO-263-7L

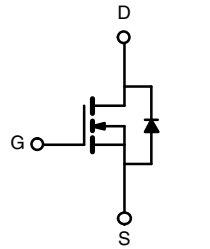
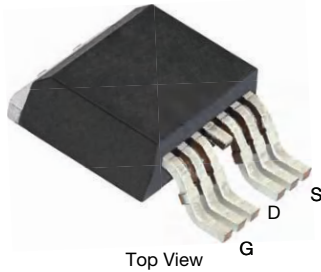
#### FEATURES

- Trench power MOSFET
- Package with low thermal resistance
- 100 %  $R_g$  and UIS tested



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

TO-263 7-Lead



N-Channel MOSFET

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

PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		$V_{DS}$	40	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	
Continuous Drain Current	$T_C = 25\text{ }^{\circ}\text{C}$ <sup>a</sup>	$I_D$	200	A
	$T_C = 125\text{ }^{\circ}\text{C}$		192	
Continuous Source Current (Diode Conduction) <sup>a</sup>		$I_S$	200	
Pulsed Drain Current <sup>b</sup>		$I_{DM}$	600	
Single Pulse Avalanche Current	$L = 0.1\text{ mH}$	$I_{AS}$	85	
Single Pulse Avalanche Energy		$E_{AS}$	361	mJ
Maximum Power Dissipation <sup>b</sup>	$T_C = 25\text{ }^{\circ}\text{C}$	$P_D$	375	W
	$T_C = 125\text{ }^{\circ}\text{C}$		125	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	$^{\circ}\text{C}$

#### THERMAL RESISTANCE RATINGS

PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-Ambient	PCB Mount <sup>c</sup>	$R_{thJA}$	40	$^{\circ}\text{C}/\text{W}$
Junction-to-Case (Drain)		$R_{thJC}$	0.4	

#### Notes

- Package limited.
- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- When mounted on 1" square PCB (FR4 material).
- Parametric verification ongoing.

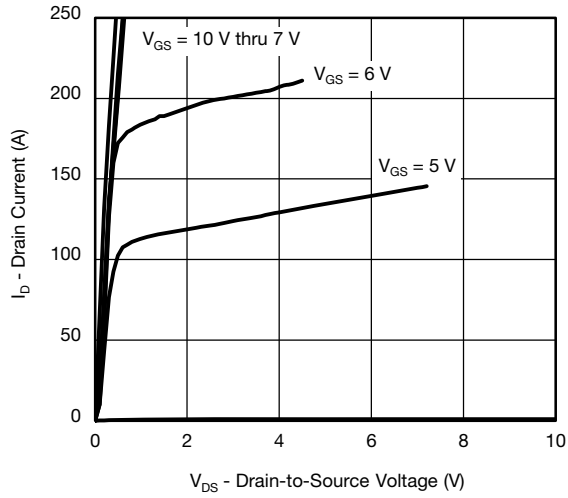
SPECIFICATIONS (T <sub>C</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		40	-	-	V
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		2.5	3.0	3.5	
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 40 V	-	-	1	μA
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 40 V, T <sub>J</sub> = 125 °C	-	-	50	
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 40 V, T <sub>J</sub> = 175 °C	-	-	250	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>GS</sub> = 10 V	V <sub>DS</sub> ≥ 5 V	200	-	-	A
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 30 A	-	0.0015	-	Ω
		V <sub>GS</sub> = 10 V	I <sub>D</sub> = 30 A, T <sub>J</sub> = 125 °C	-	0.0028	-	
		V <sub>GS</sub> = 10 V	I <sub>D</sub> = 30 A, T <sub>J</sub> = 175 °C	-	0.0034	-	
Forward Transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 30 A		-	198	-	S
Dynamic <sup>b</sup>							
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 25 V, f = 1 MHz	-	13 880	17 350	pF
Output Capacitance	C <sub>oss</sub>			-	1414	1770	
Reverse Transfer Capacitance	C <sub>rss</sub>			-	840	1050	
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 120 A	-	206	310	nC
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>			-	50	-	
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>			-	44	-	
Gate Resistance	R <sub>g</sub>	f = 1 MHz		0.25	0.8	1.8	Ω
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = 20 V, R <sub>L</sub> = 0.17 Ω I <sub>D</sub> ≅ 120 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω		-	26	39	ns
Rise Time <sup>c</sup>	t <sub>r</sub>			-	21	32	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>			-	68	102	
Fall Time <sup>c</sup>	t <sub>f</sub>			-	12	18	
Source-Drain Diode Ratings and Characteristics <sup>b</sup>							
Pulsed Current <sup>a</sup>	I <sub>SM</sub>			-	-	600	A
Forward Voltage	V <sub>SD</sub>	I <sub>F</sub> = 80 A, V <sub>GS</sub> = 0 V		-	0.86	1.5	V

**Notes**

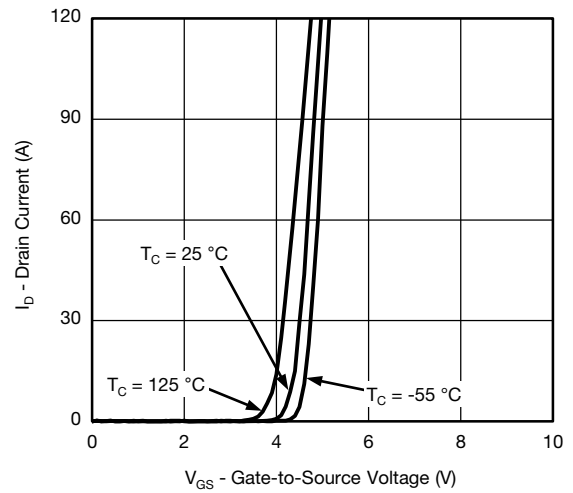
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.  
 c. Independent of operating temperature.

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.

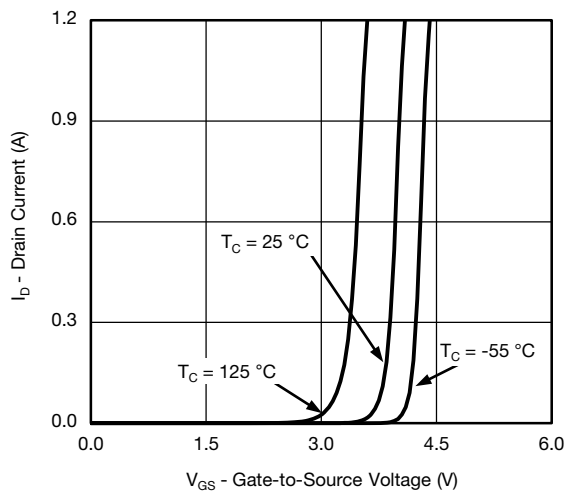
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



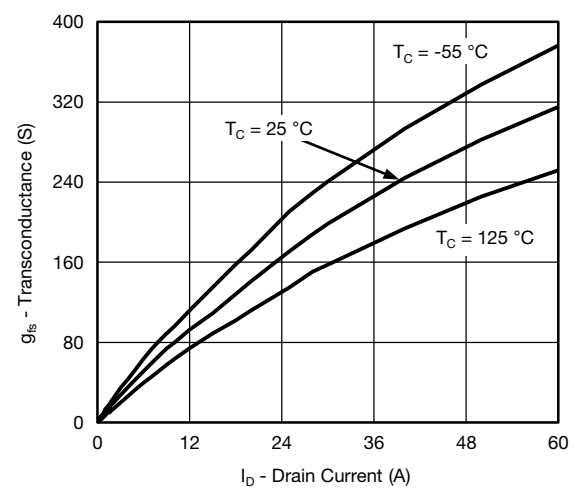
**Output Characteristics**



**Transfer Characteristics**



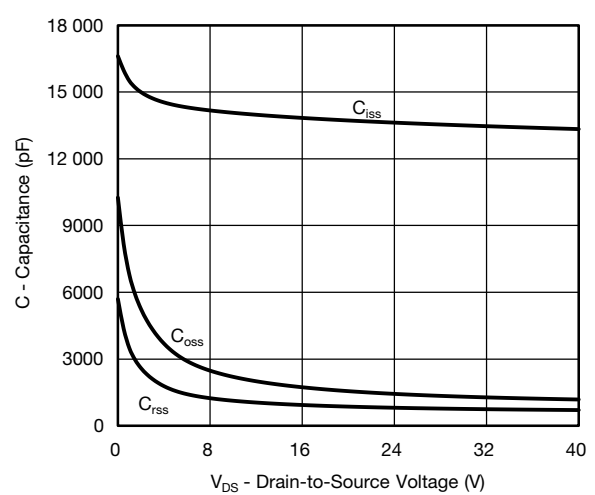
**Transfer Characteristics**



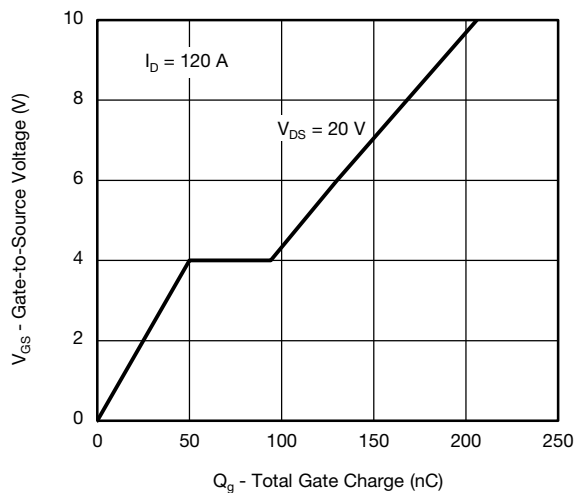
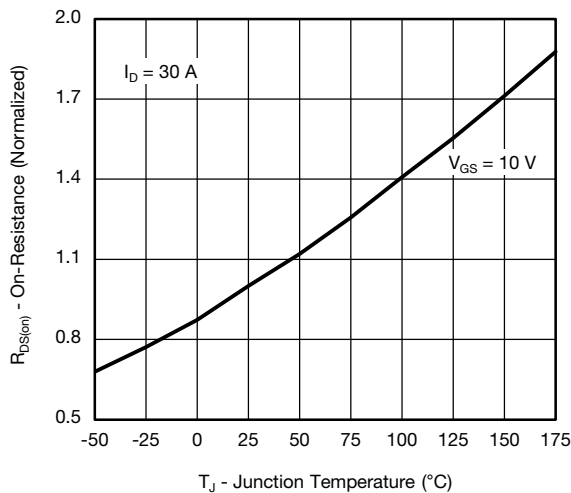
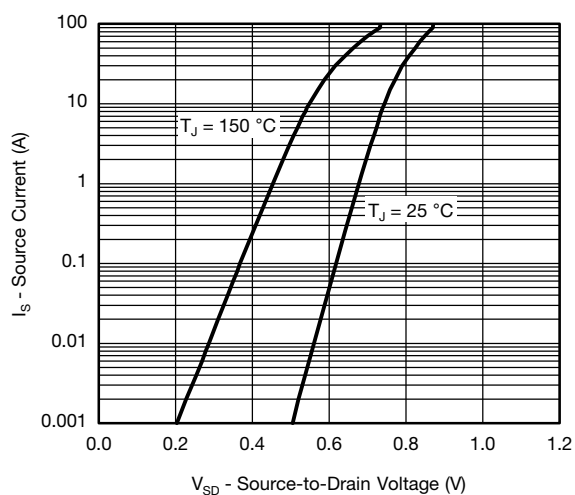
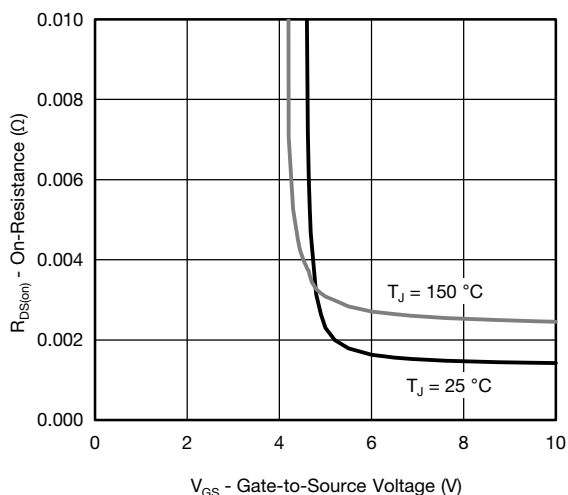
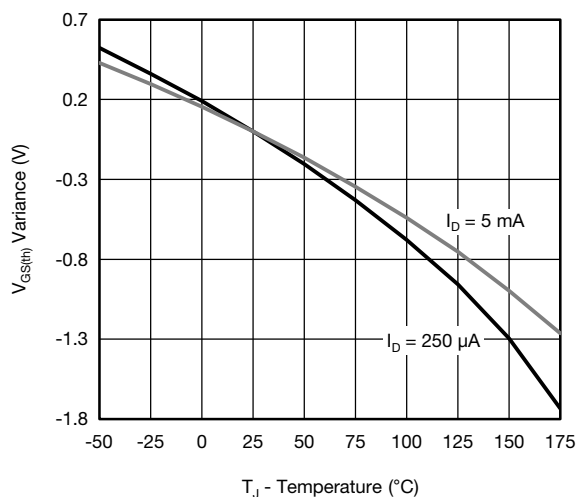
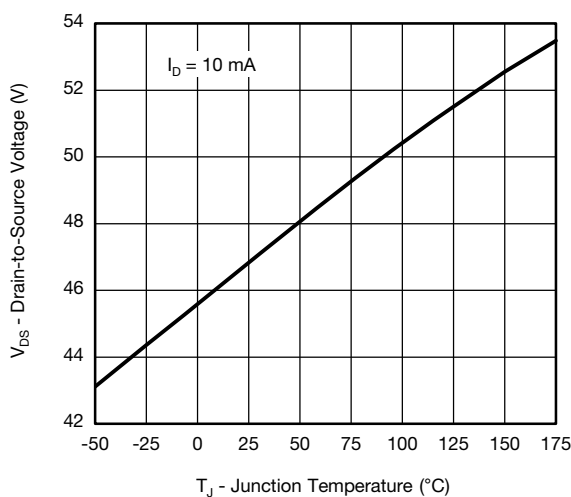
**Transconductance**



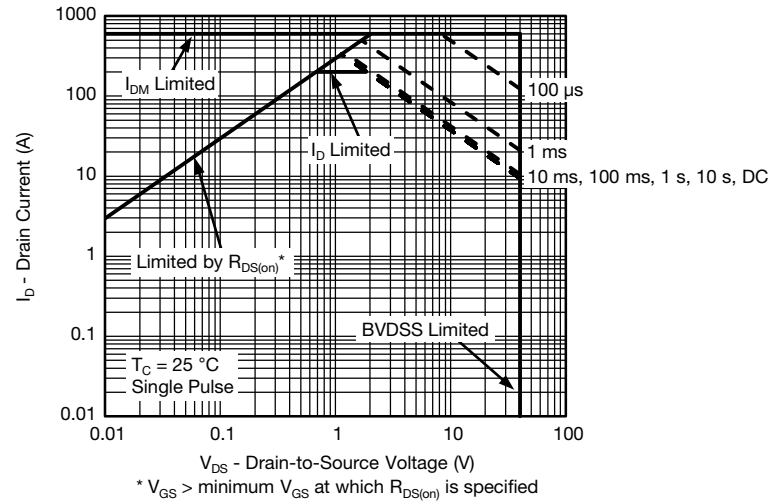
**On-Resistance vs. Drain Current**



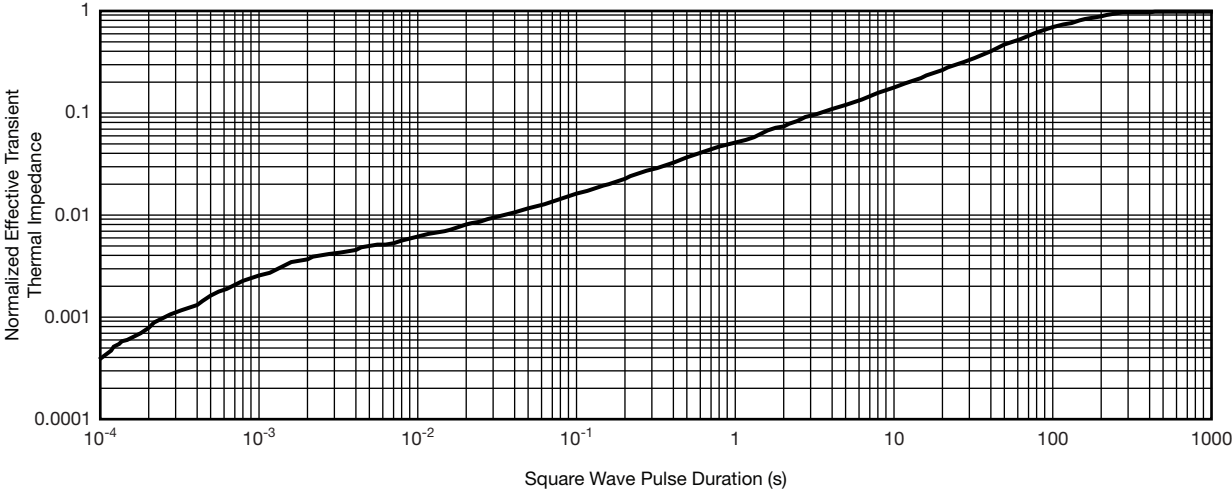
**Capacitance**

**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

**Gate Charge**

**On-Resistance vs. Junction Temperature**

**Source Drain Diode Forward Voltage**

**On-Resistance vs. Gate-to-Source Voltage**

**Threshold Voltage**

**Drain Source Breakdown vs. Junction Temperature**

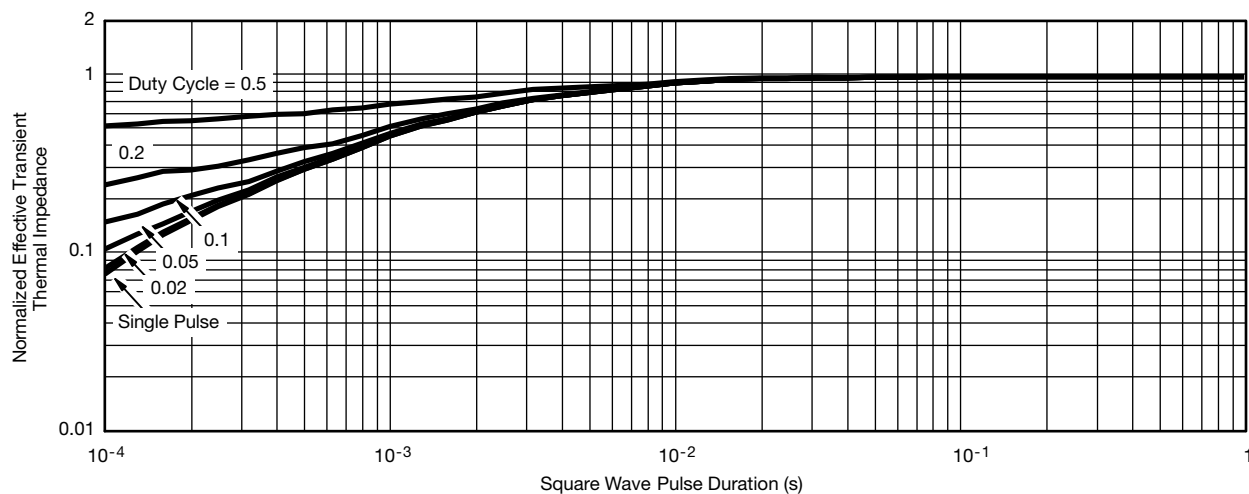
**THERMAL RATINGS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



**Safe Operating Area**



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

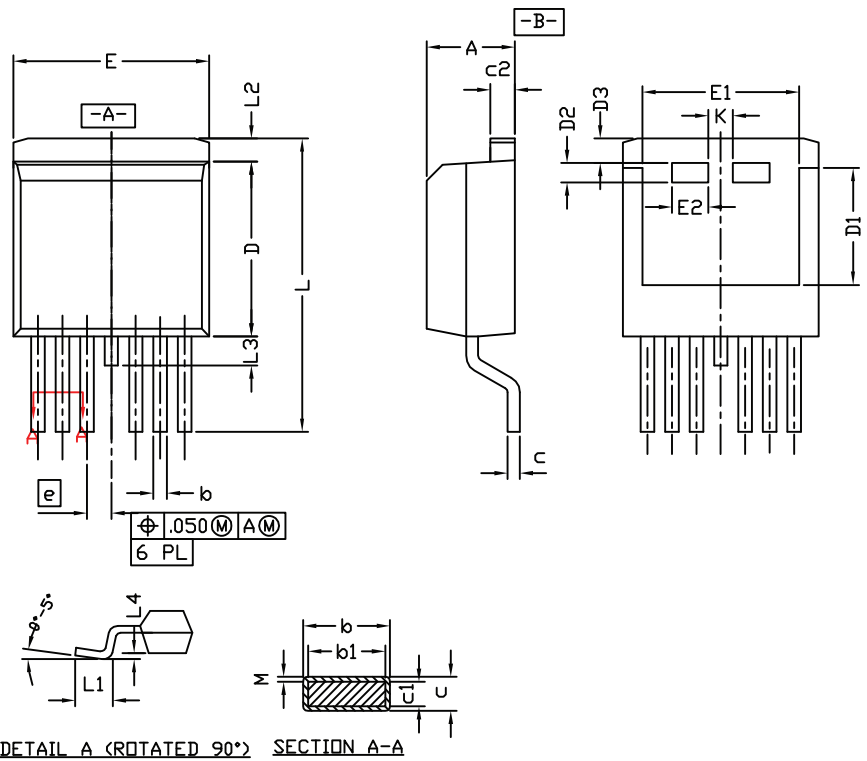
**THERMAL RATINGS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)


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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient ( $25\text{ }^{\circ}\text{C}$ )
  - Normalized Transient Thermal Impedance Junction-to-Case ( $25\text{ }^{\circ}\text{C}$ )
 are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

# D<sup>2</sup>PAK (TO-263-7L) Case Outline



## Notes

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 max. 8 mils.
3. Pin to pin coplanarity max. 4 mils.
4. Lead thickness 25 mils.
5. For SUM part numbers lead thickness is 24 mils to 29 mils.
6. For reference only.
7. Use inches as the primary measurement.
8. This feature is only for SUM.

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.160	0.190	4.064	4.826
b	0.020	0.039	0.508	0.990
b1	0.020	0.035	0.508	0.889
b2	0.045	0.055	1.143	1.397
c* SUB	0.012	0.018	0.305	0.457
c* SUM	0.022	0.028	0.559	0.711
c1	0.018	0.025	0.457	0.635
c2	0.045	0.055	1.143	1.397
D	0.340	0.380	8.636	9.652
D1	0.220	0.240	5.588	6.096
D2	0.038	0.042	0.965	1.067
D3	0.045	0.055	1.143	1.397
E	0.380	0.410	9.652	10.414
E1	0.245	-	6.223	-
E2	0.072	0.078	1.829	1.981
e	0.050 BSC		1.27 BSC	
K	0.045	0.055	1.143	1.397
L	0.575	0.625	14.605	15.875
L1	0.090	0.110	2.286	2.794
L2	0.040	0.055	1.016	1.397
L3	0.050	0.070	1.270	1.778
L4	0.010 BSC		0.254 BSC	
M	-	0.002	-	0.050
ECN: T13-0709-Rev. B, 30-Sep-13				
DWG: 6006				

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