

# Silicon Carbide (SiC) MOSFET, M1, TO-247-4L 1700 V, 28 mOhm NTH4L028N170M1

## Features

- Typ.  $R_{DS(on)}$  = 28 m $\Omega$  @  $V_{GS}$  = 20 V
- Ultra Low Gate Charge ( $Q_{G(tot)}$  = 200 nC)
- High Speed Switching with Low Capacitance ( $C_{oss}$  = 200 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

## Typical Applications

- UPS
- DC/DC Converter
- Boost Converter

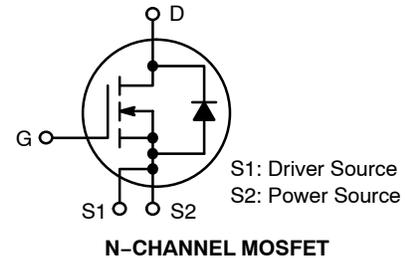
## MAXIMUM RATINGS ( $T_J$ = 25°C unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DSS}$	1700	V	
Gate-to-Source Voltage		$V_{GS}$	-15/+25	V	
Recommended Operation Values of Gate-to-Source Voltage		$T_C < 175^\circ\text{C}$ $V_{GSop}$	-5/+20	V	
Continuous Drain Current (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	81	A
			$P_D$	535	W
Continuous Drain Current (Note 1)	Steady State	$T_C = 100^\circ\text{C}$	$I_D$	57	A
			$P_D$	267	W
Pulsed Drain Current (Note 2)	$T_C = 25^\circ\text{C}$		$I_{DM}$	363	A
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	°C	
Source Current (Body Diode)		$I_S$	124	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)}$ = 30 A, L = 1 mH) (Note 3)		$E_{AS}$	450	mJ	
Maximum Lead Temperature for Soldering (1/8" from case for 5 s)		$T_L$	300	°C	

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3. EAS of 450 mJ is based on starting  $T_J$  = 25°C; L = 1 mH,  $I_{AS}$  = 30 A,  $V_{DD}$  = 120 V,  $V_{GS}$  = 18 V.

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
1700 V	40 m $\Omega$ @ 20 V	81 A



## MARKING DIAGRAM



H4L028N170M1 = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ZZ = Lot Traceability

## ORDERING INFORMATION

Device	Package	Shipping
NTH4L028N170M1	TO247-4L	30 Units / Tube

# NTH4L028N170M1

## THEMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State (Note 1)	$R_{\theta JC}$	0.28	$^{\circ}\text{C}/\text{W}$

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1700	–	–	V	
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$ , referenced to $25^{\circ}\text{C}$	–	0.46	–	$\text{V}/^{\circ}\text{C}$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 1700\text{ V}$	$T_J = 25^{\circ}\text{C}$	–	–	100	$\mu\text{A}$
			$T_J = 175^{\circ}\text{C}$	–	–	1	mA
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +25/-15\text{ V}, V_{DS} = 0\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$	

### ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 20\text{ mA}$	1.8	2.75	4.3	V
Recommended Gate Voltage	$V_{GOP}$		–5	–	+20	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}, I_D = 60\text{ A}, T_J = 25^{\circ}\text{C}$	–	28	40	m $\Omega$
		$V_{GS} = 20\text{ V}, I_D = 60\text{ A}, T_J = 175^{\circ}\text{C}$	–	57	–	
Forward Transconductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 60\text{ A}$	–	31	–	S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 800\text{ V}$	–	4230	–	pF
Output Capacitance	$C_{OSS}$		–	200	–	
Reverse Transfer Capacitance	$C_{RSS}$		–	10	–	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 800\text{ V}, I_D = 60\text{ A}$	–	200	–	nC
Gate-to-Source Charge	$Q_{GS}$		–	77	–	
Gate-to-Drain Charge	$Q_{GD}$		–	46	–	
Gate-Resistance	$R_G$	$f = 1\text{ MHz}$	–	5.8	–	$\Omega$

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -5/20\text{ V}, V_{DS} = 1200\text{ V}, I_D = 60\text{ A}, R_G = 2\text{ }\Omega$ inductive load	–	47	–	ns
Rise Time	$t_r$		–	18	–	
Turn-Off Delay Time	$t_{d(OFF)}$		–	121	–	
Fall Time	$t_f$		–	13	–	$\mu\text{J}$
Turn-On Switching Loss	$E_{ON}$		–	1311	–	
Turn-Off Switching Loss	$E_{OFF}$		–	683	–	
Total Switching Loss	$E_{tot}$		–	1994	–	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Continuous Source-Drain Diode Forward Current	$I_{SD}$	$V_{GS} = -5\text{ V}, T_J = 25^{\circ}\text{C}$	–	–	124	A
Pulsed Source-Drain Diode Forward Current (Note 2)	$I_{SDM}$		–	–	363	
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -5\text{ V}, I_{SD} = 60\text{ A}, T_J = 25^{\circ}\text{C}$	–	4.3	–	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -5/20\text{ V}, I_{SD} = 60\text{ A}, di_S/dt = 1000\text{ A}/\mu\text{s}$	–	34	–	ns
Reverse Recovery Charge	$Q_{RR}$		–	263	–	nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS

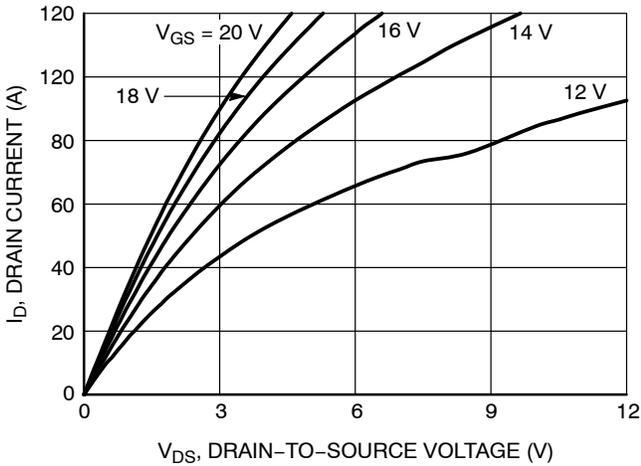


Figure 1. On-Region Characteristics

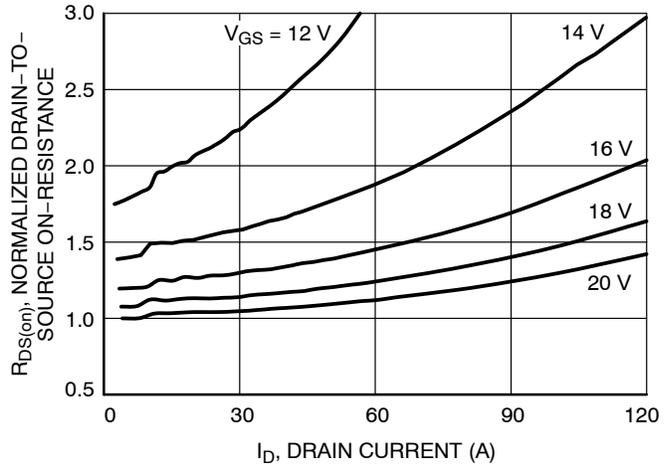


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

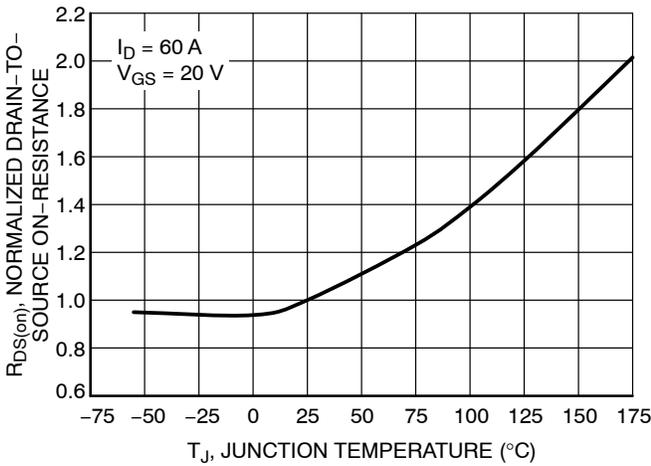


Figure 3. On-Resistance Variation with Temperature

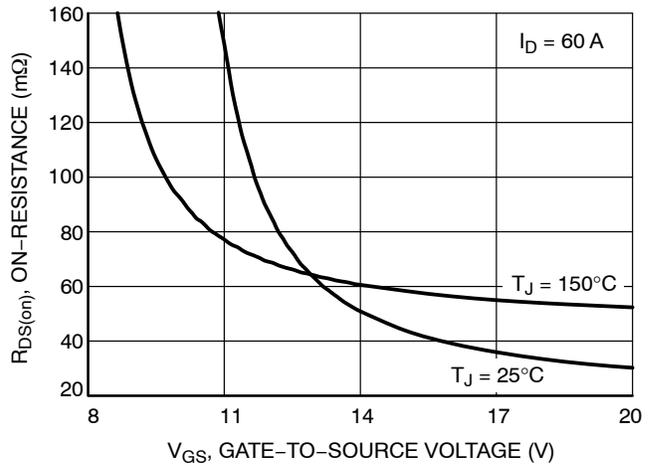


Figure 4. On-Resistance vs. Gate-to-Source Voltage

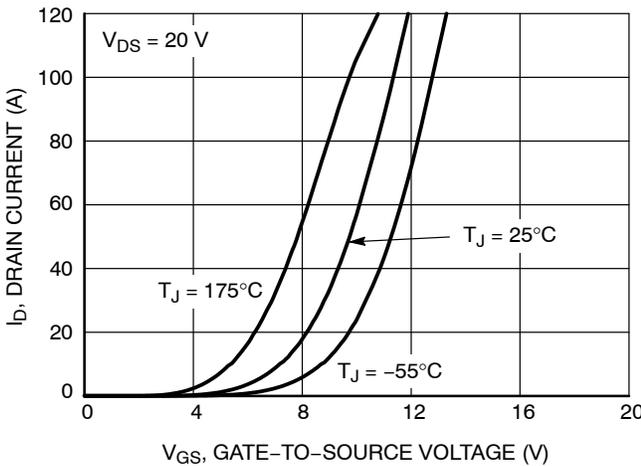


Figure 5. Transfer Characteristics

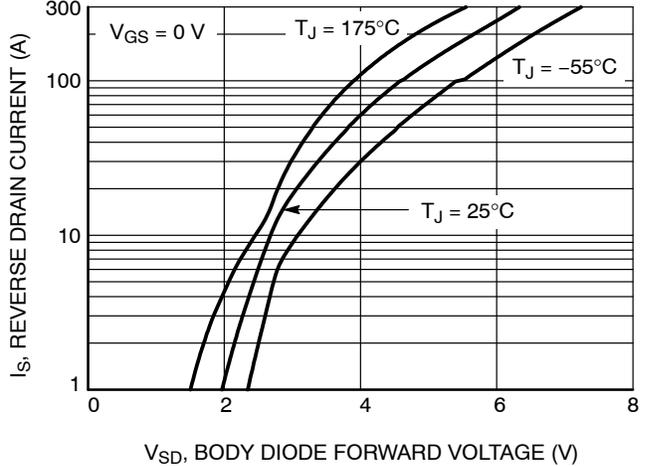
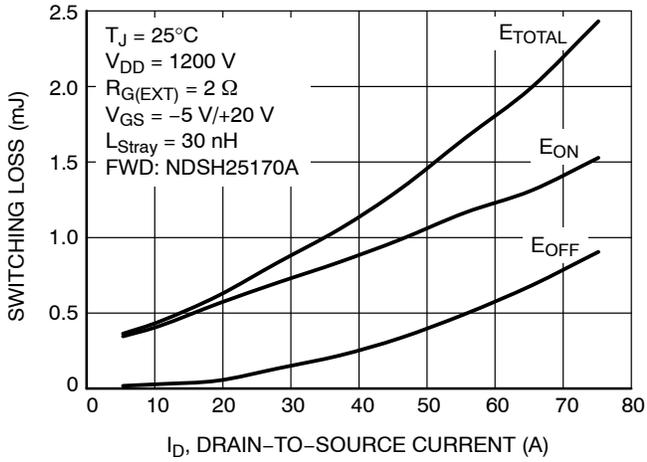


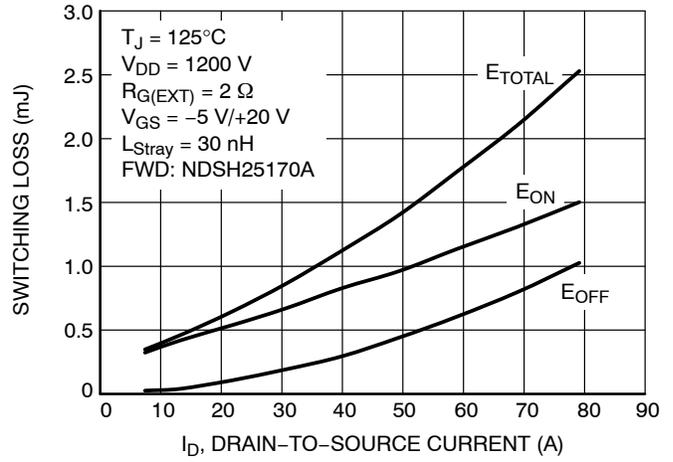
Figure 6. Diode Forward Voltage vs. Current

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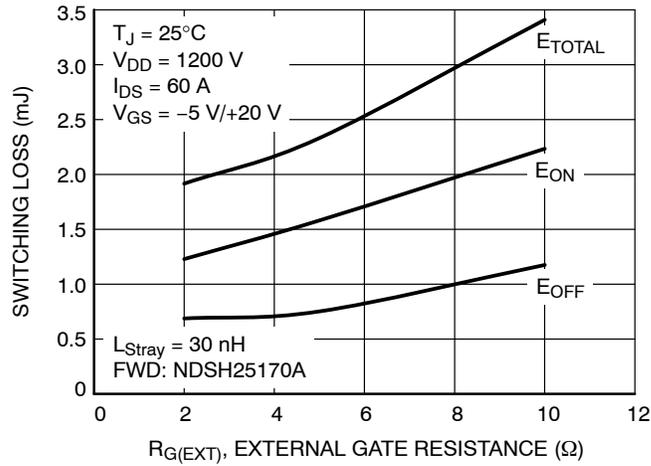
## TYPICAL CHARACTERISTICS



**Figure 7. Switching Loss vs. Drain-to-Source Current (25°C)**



**Figure 8. Switching Loss vs. Drain-to-Source Current (125°C)**



**Figure 9. Switching Loss vs. External Gate Resistance**

TYPICAL CHARACTERISTICS

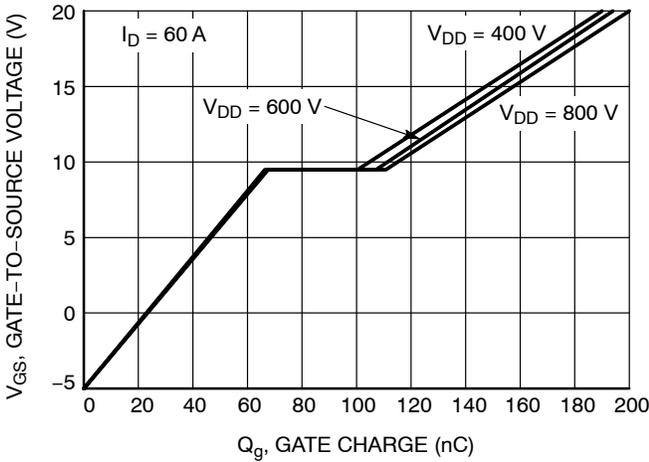


Figure 10. Gate-to-Source Voltage vs. Total Charge

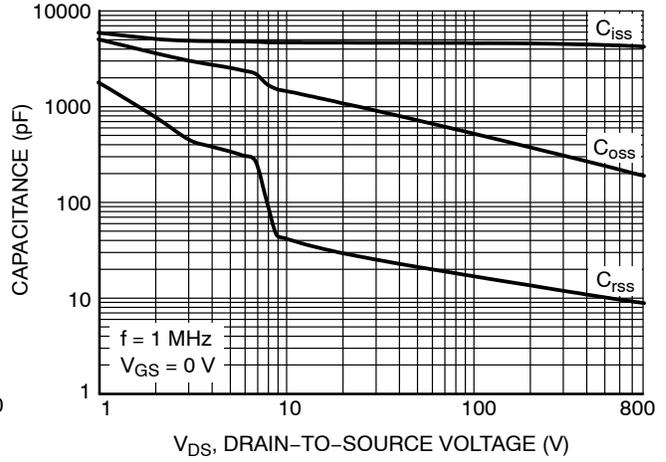


Figure 11. Capacitance vs. Drain-to-Source Voltage

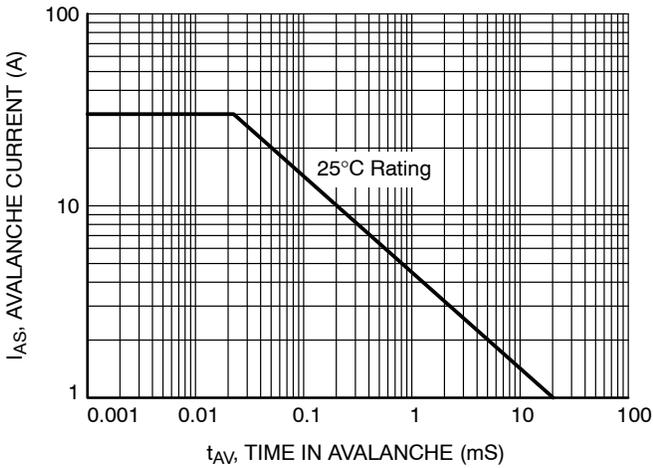


Figure 12. Unclamped Inductive Switching Capability

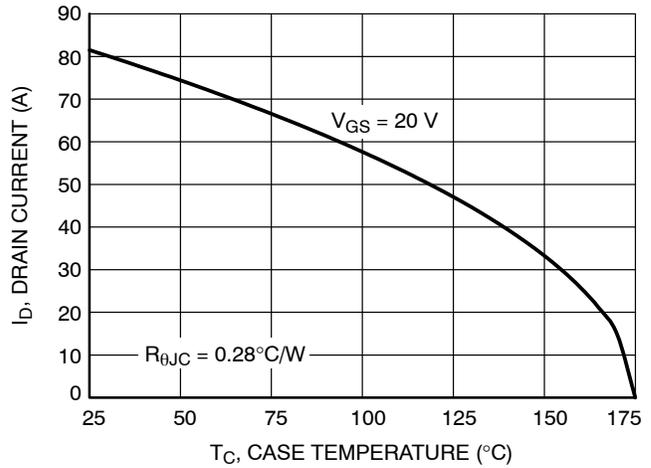


Figure 13. Maximum Continuous Drain Current vs. Case Temperature

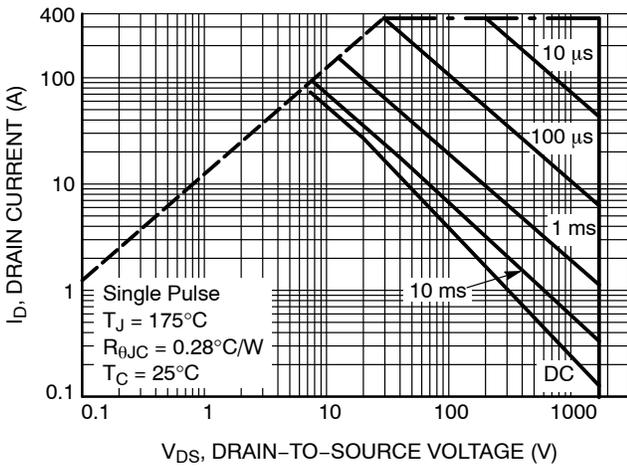


Figure 14. Safe Operating Area

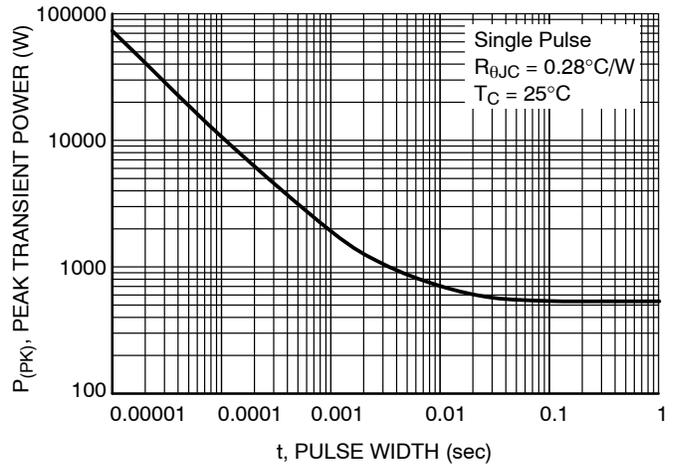


Figure 15. Single Pulse Maximum Power Dissipation

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## TYPICAL CHARACTERISTICS

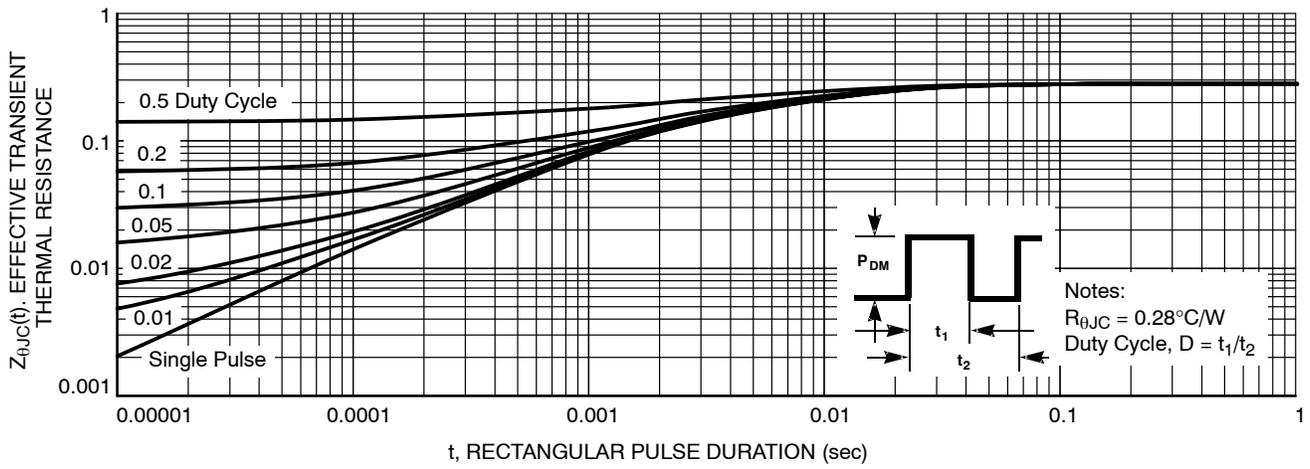
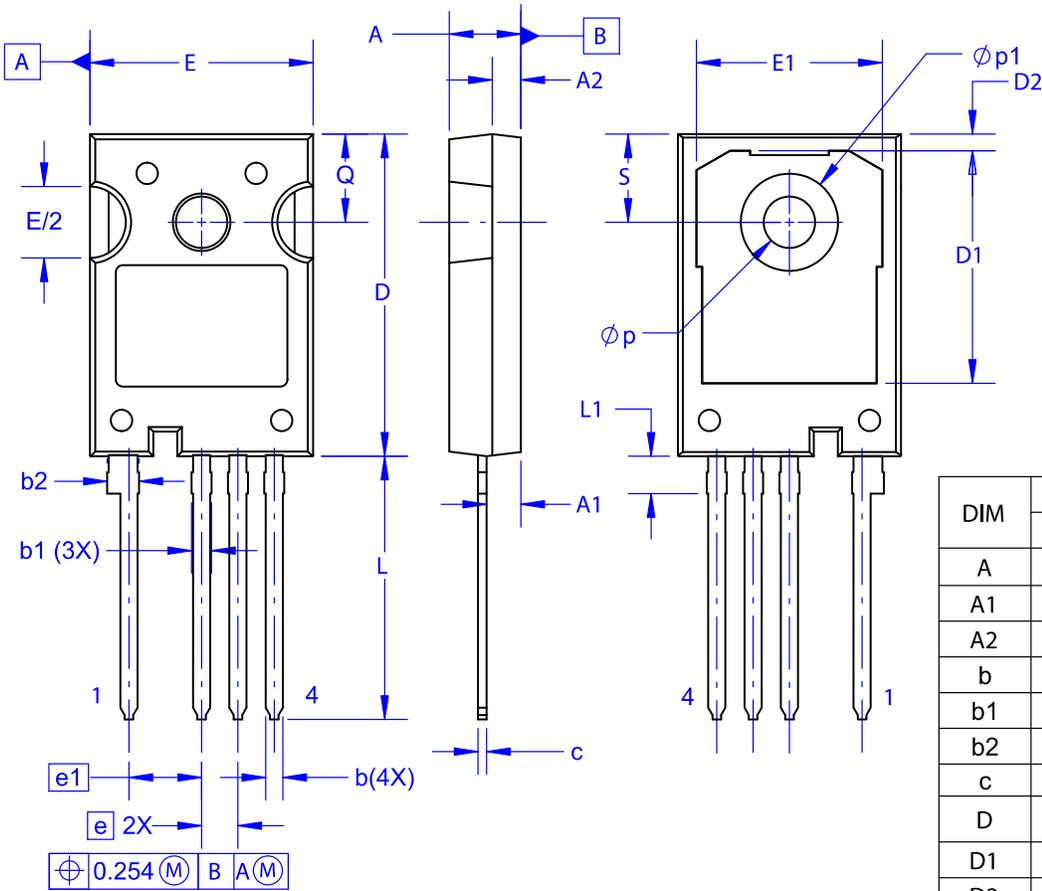


Figure 16. Junction-to-Case Thermal Response

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## PACKAGE DIMENSIONS

TO-247-4LD  
CASE 340CJ  
ISSUE A



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

**NOTES:**

- A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5-2009.

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