

# MOSFET - SiC Power, Single N-Channel, TO247-4L

## 1200 V, 22 mΩ, 68 A

### NTH4L022N120M3S

#### Features

- Typ.  $R_{DS(on)}$  = 22 mΩ @  $V_{GS} = 18$  V
- Low Switching Losses (Typ. EON 490 μJ at 40 A, 800 V)
- 100% Avalanche Tested
- These Devices are RoHS Compliant

#### Typical Applications

- Solar Inverters
- Electric Vehicle Charging Stations
- UPS (Uninterruptible Power Supplies)
- Energy Storage Systems
- SMPS (Switch Mode Power Supplies)

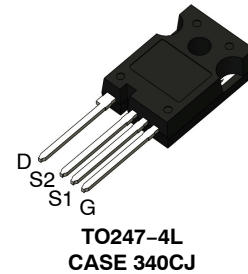
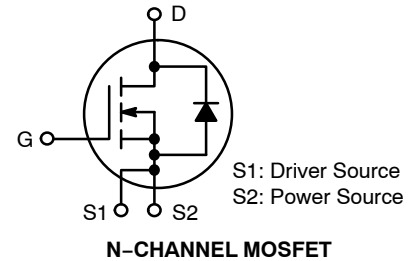
#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit		
Drain-to-Source Voltage	$V_{DSS}$	1200	V		
Gate-to-Source Voltage	$V_{GS}$	-10/+22	V		
Recommended Operation Values of Gate-to-Source Voltage	$T_C < 175^\circ\text{C}$	$V_{GSop}$	-3/+18 V		
Continuous Drain Current (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	68	A
Power Dissipation (Note 1)			$P_D$	352	W
Continuous Drain Current (Note 1)	Steady State	$T_C = 100^\circ\text{C}$	$I_D$	48	A
Power Dissipation (Note 1)			$P_D$	176	W
Pulsed Drain Current (Note 2)	$T_C = 25^\circ\text{C}$		$I_{DM}$	246	A
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175			$^\circ\text{C}$
Source Current (Body Diode) $T_C = 25^\circ\text{C}, V_{GS} = -3$ V	$I_S$	72			A
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 23.1$ A, $L = 1$ mH) (Note 3)	$E_{AS}$	267			mJ
Maximum Lead Temperature for Soldering (1/8" from case for 5 s)	$T_L$	300			$^\circ\text{C}$

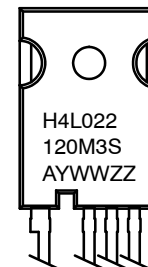
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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 267 mJ is based on starting  $T_J = 25^\circ\text{C}$ ;  $L = 1$  mH,  $I_{AS} = 23.1$  A,  $V_{DD} = 100$  V,  $V_{GS} = 18$  V.

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
1200 V	30 mΩ @ 18 V	68 A



#### MARKING DIAGRAM



H4L022120M3S = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ZZ = Lot Traceability

#### ORDERING INFORMATION

Device	Package	Shipping
NTH4L022N120M3S	TO247-4L	30 Units / Tube

# NTH4L022N120M3S

## THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Unit
Junction-to-Case – Steady State (Note 1)	$R_{\theta JC}$	0.33	0.43	°C/W
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$		40	

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200	-	-	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$ , referred to $25^\circ\text{C}$	-	0.3	-	V/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$ $T_J = 25^\circ\text{C}$	-	-	100	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = +22/-10\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 1$	$\mu\text{A}$

### ON-STATE CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 20\text{ mA}$	2.04	2.72	4.4	V
Recommended Gate Voltage	$V_{GOP}$		-3	-	+18	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 25^\circ\text{C}$	-	22	30	m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 175^\circ\text{C}$	-	47	-	
Forward Transconductance	$g_{FS}$	$V_{DS} = 10\text{ V}, I_D = 40\text{ A}$	-	34	-	S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 800\text{ V}$	-	3175	-	pF
Output Capacitance	$C_{OSS}$		-	146	-	
Reverse Transfer Capacitance	$C_{RSS}$		-	12	-	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -3/18\text{ V}, V_{DS} = 800\text{ V}, I_D = 40\text{ A}$	-	151	-	nC
Threshold Gate Charge	$Q_{G(TH)}$		-	20	-	
Gate-to-Source Charge	$Q_{GS}$		-	34	-	
Gate-to-Drain Charge	$Q_{GD}$		-	40	-	
Gate-Resistance	$R_G$		$f = 1\text{ MHz}$	-	1.5	

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -3/18\text{ V}, V_{DS} = 800\text{ V}, I_D = 40\text{ A}, R_G = 4.5\text{ }\Omega$ inductive load (Note 4)	-	18	-	ns
Rise Time	$t_r$		-	24	-	
Turn-Off Delay Time	$t_{d(OFF)}$		-	48	-	
Fall Time	$t_f$		-	13	-	
Turn-On Switching Loss	$E_{ON}$		-	490	-	$\mu\text{J}$
Turn-Off Switching Loss	$E_{OFF}$		-	221	-	
Total Switching Loss	$E_{tot}$		-	771	-	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Continuous Source-Drain Diode Forward Current	$I_{SD}$	$V_{GS} = -3\text{ V}, T_C = 25^\circ\text{C}$	-	-	72	A
Pulsed Source-Drain Diode Forward Current (Note 2)	$I_{SDM}$		-	-	246	
Forward Diode Voltage	$V_{SD}$	$V_{GS} = -3\text{ V}, I_{SD} = 40\text{ A}, T_J = 25^\circ\text{C}$	-	4.5	-	V

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>SOURCE-DRAIN DIODE CHARACTERISTICS</b>						
Reverse Recovery Time	$t_{RR}$	$V_{GS} = -3/18\text{ V}, I_{SD} = 40\text{ A},$ $di_S/dt = 1000\text{ A}/\mu\text{s}, V_{DS} = 800\text{ V}$	-	22	-	ns
Reverse Recovery Charge	$Q_{RR}$		-	138	-	nC
Reverse Recovery Energy	$E_{REC}$		-	5	-	$\mu\text{J}$
Peak Reverse Recovery Current	$I_{RRM}$		-	13	-	A
Charge time	$T_A$		-	13	-	ns
Discharge time	$T_B$		-	9	-	ns

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.

4.  $E_{ON}/E_{OFF}$  result is with body diode

TYPICAL CHARACTERISTICS

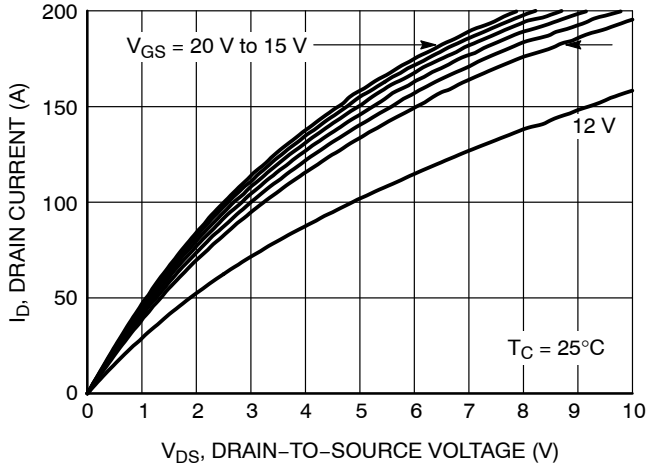


Figure 1. On-Region Characteristics

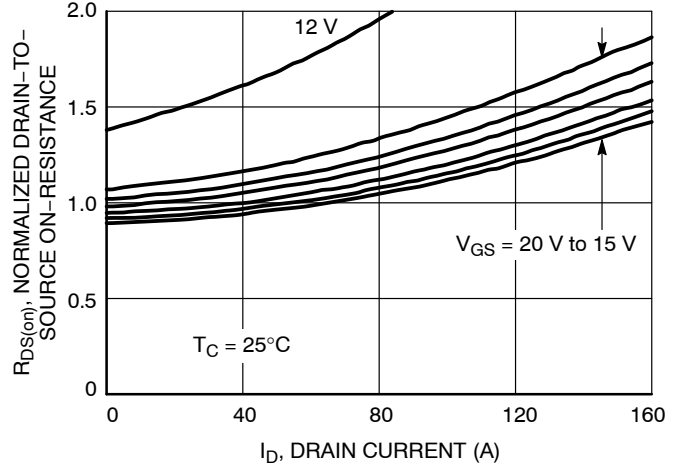


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

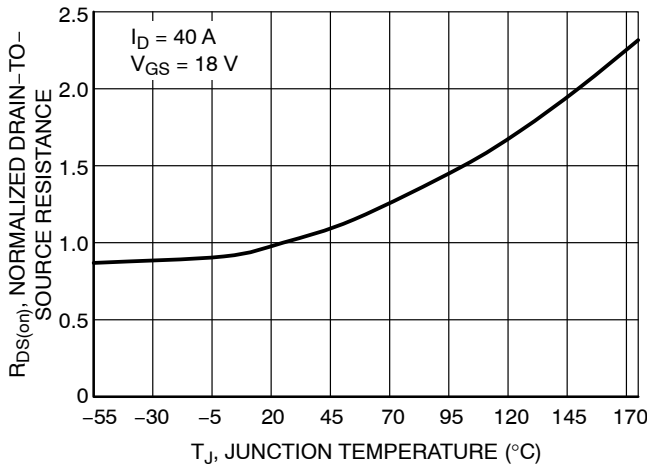


Figure 3. On-Resistance Variation with Temperature

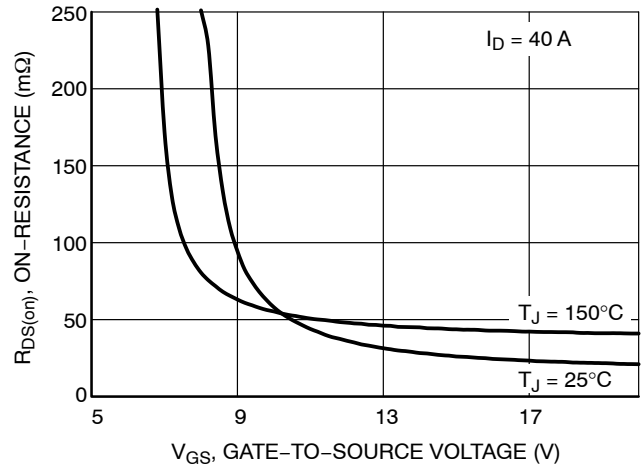


Figure 4. On-Resistance vs. Gate-to-Source Voltage

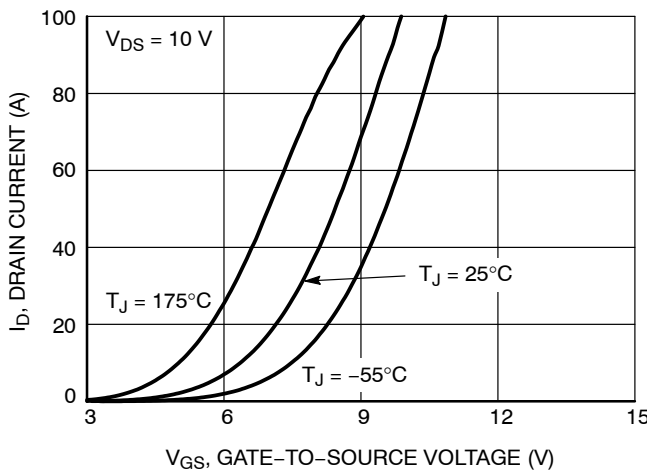


Figure 5. Transfer Characteristics

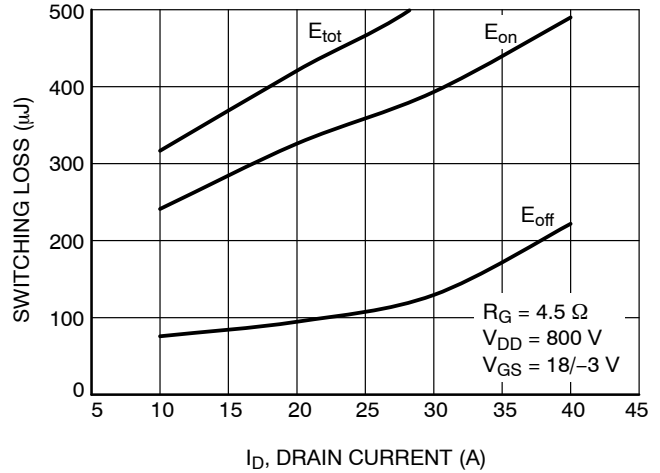


Figure 6. Switching Loss vs. Drain Current

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## TYPICAL CHARACTERISTICS

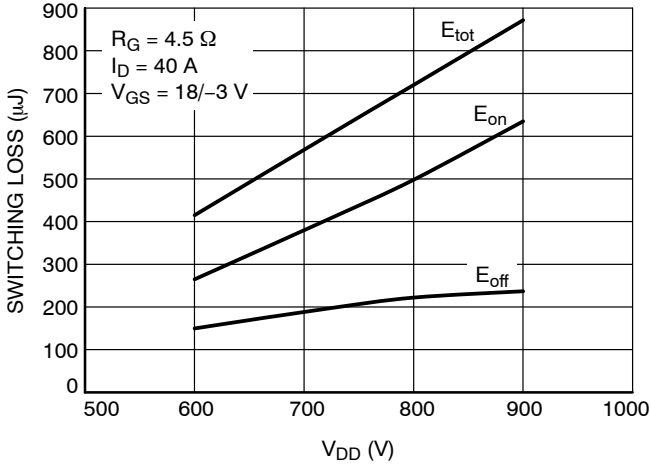


Figure 7. Switching Loss vs. Drain Voltage

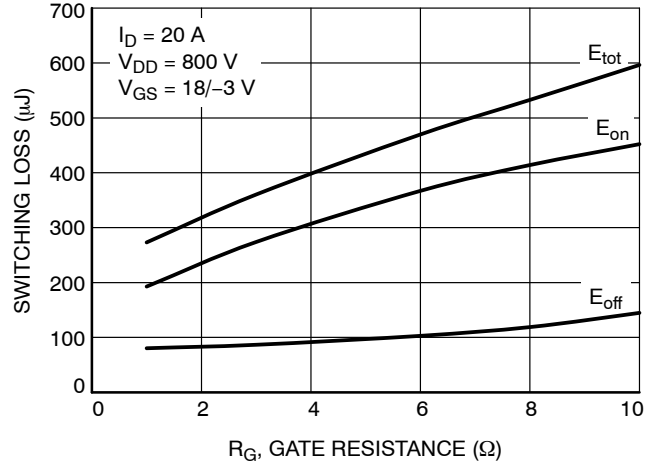


Figure 8. Switching Loss vs. Gate Resistance

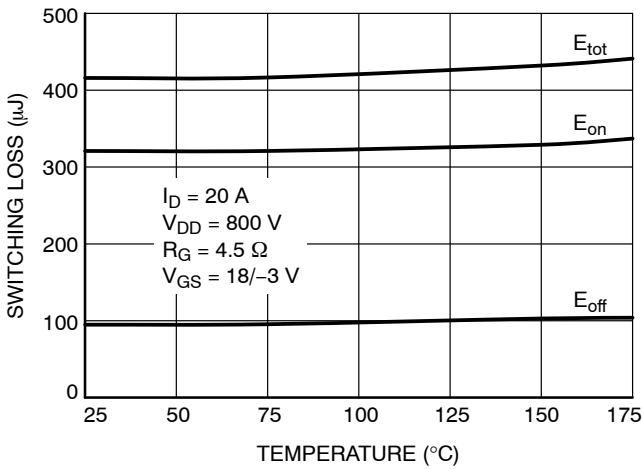


Figure 9. Switching Loss vs. Temperature

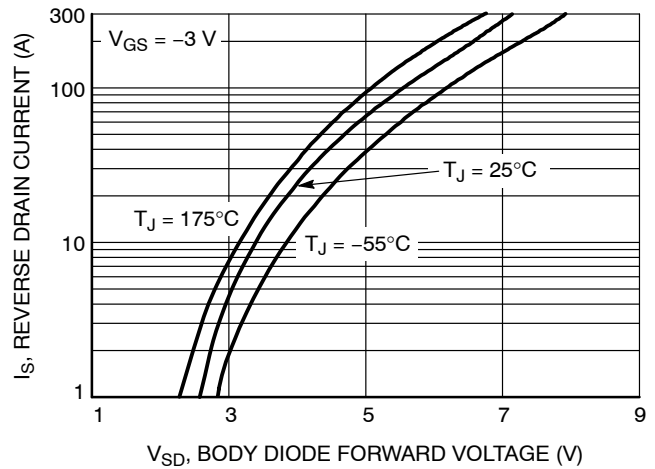
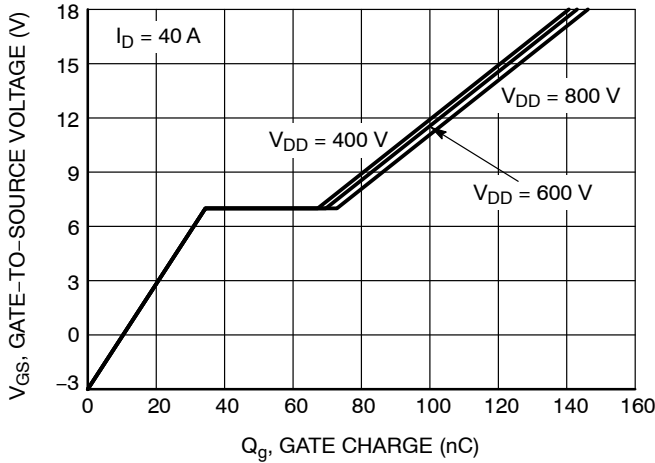


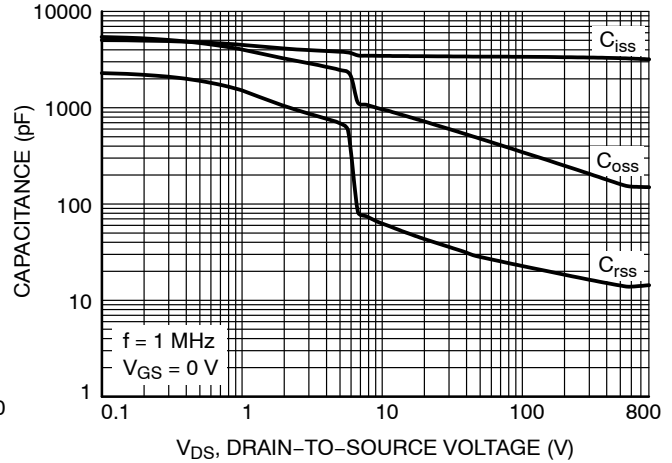
Figure 10. Diode Forward Voltage vs. Current

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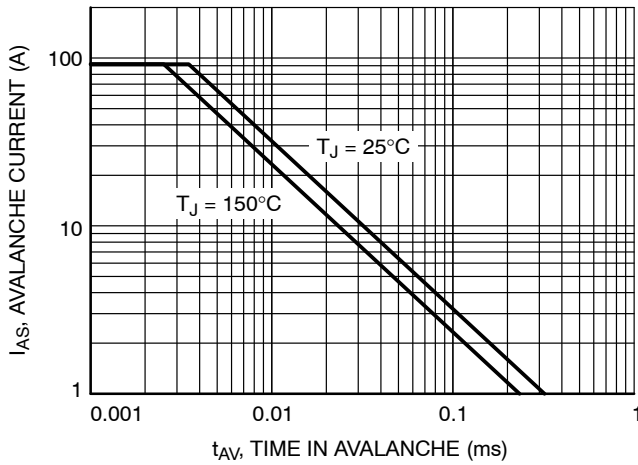
## TYPICAL CHARACTERISTICS



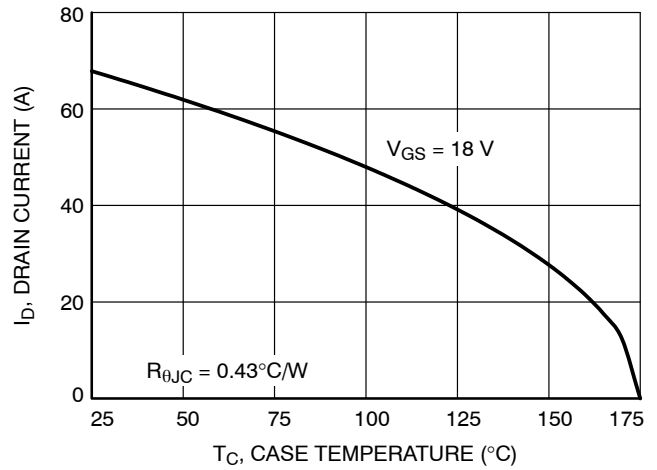
**Figure 11. Gate-to-Source Voltage vs. Total Charge**



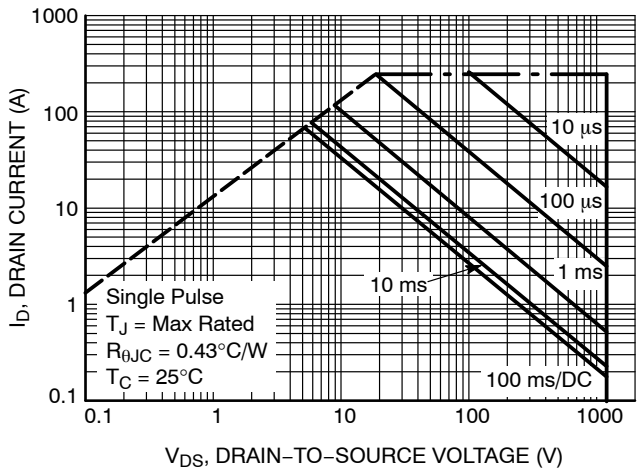
**Figure 12. Capacitance vs. Drain-to-Source Voltage**



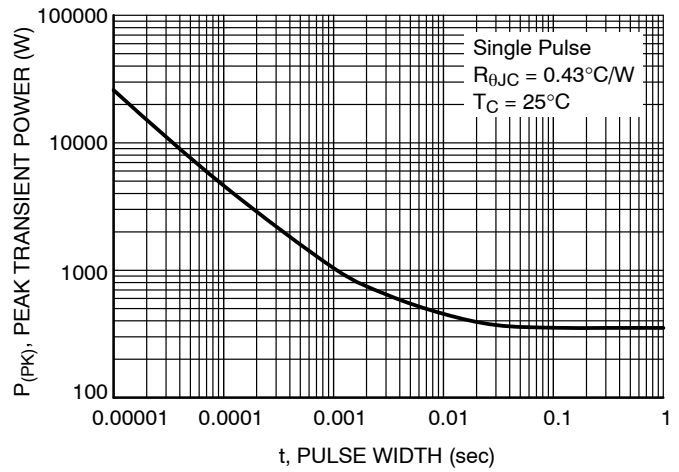
**Figure 13. Unclamped Inductive Switching Capability**



**Figure 14. Maximum Continuous Drain Current vs. Case Temperature**



**Figure 15. Safe Operating Area**



**Figure 16. Single Pulse Maximum Power Dissipation**

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## TYPICAL CHARACTERISTICS

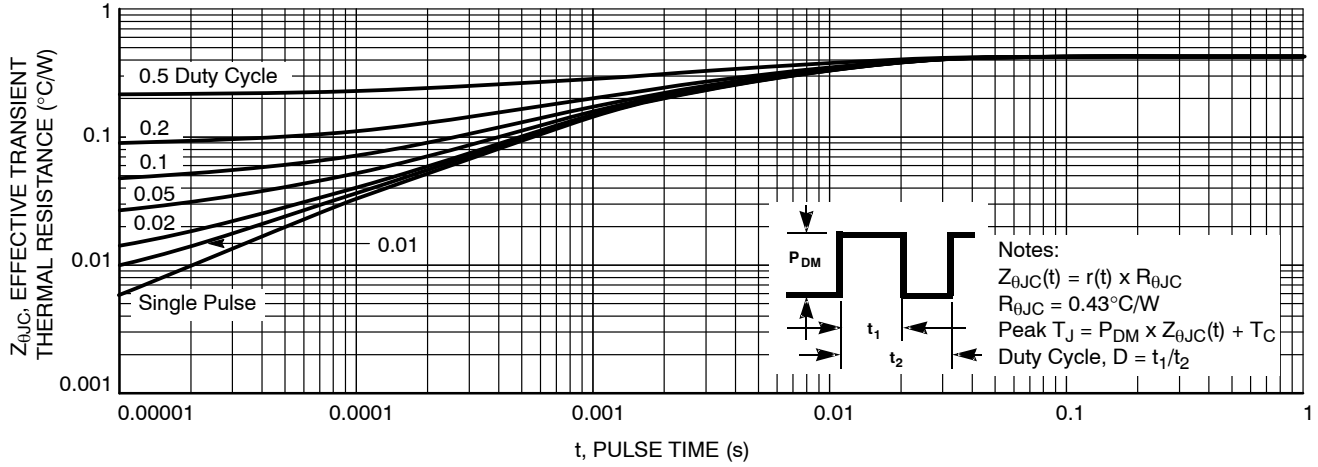
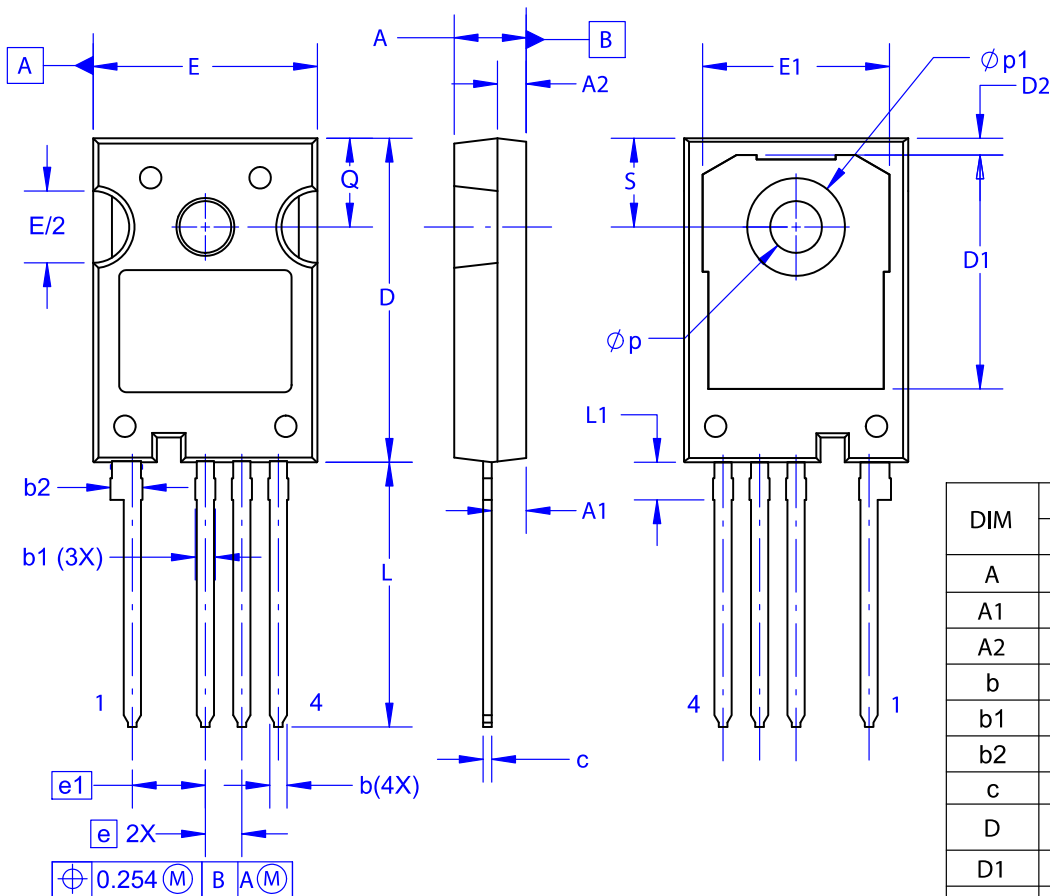


Figure 17. Junction-to-Case Transient Thermal Response

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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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