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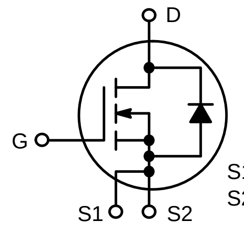
Silicon Carbide (SiC) MOSFET – EliteSiC, 14 mohm, 1200 V, M3P, TO-247-4L

NTH4L014N120M3P

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
1200 V	20 mΩ @ 18 V	127 A



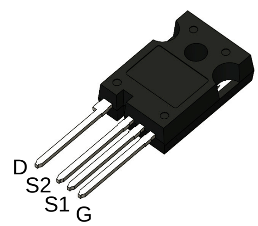
N−CHANNEL MOSFET

Features

- Typ. $R_{DS(on)}$ = 14 mΩ @ V_{GS} = 18 V
- Low Switching Losses (Typ. EON 1308 μJ at 74 A, 800 V)
- 100% Avalanche Tested
- These Devices are RoHS Compliant

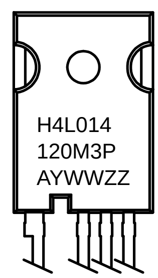
Typical Applications

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



TO−247−4L
CASE 340CJ

MARKING DIAGRAM



H4L014120M3P = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

Device	Package	Shipping
NTH4L014N120M3P	TO−247−4L	30 Units / Tube

MAXIMUM RATINGS (T_J = 25°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°C	V_{GSop}	−3/+18	V
Continuous Drain Current (Note 1)	Steady State	T_C = 25°C	I_D	127	A
Power Dissipation (Note 1)			P_D	686	W
Continuous Drain Current (Note 1)	Steady State	T_C = 100°C	I_D	90	A
Power Dissipation (Note 1)			P_D	343	W
Pulsed Drain Current (Note 2)	T_C = 25°C		I_{DM}	407	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode) T_C = 25°C, V_{GS} = −3 V			I_S	129	A
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 28.9 A, L = 1 mH) (Note 3)			E_{AS}	418	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 418 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 28.9 A, V_{DD} = 100 V, V_{GS} = 18 V.

January, 2023 − Rev. 3

Publication Order Number:
NTH4L014N120M3P/D

THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Unit
Junction−to−Case − Steady State (Note 1)	$R_{\theta JC}$	0.17	0.22	°C/W
Junction−to−Ambient − Steady State (Note 1)	$R_{\theta JA}$		40	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
OFF−STATE CHARACTERISTICS							
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1 mA		1200	−	−	V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = 1 mA, referenced to 25°C		−	0.3	−	V/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 1200 V	T_J = 25°C	−	−	100	μA
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = +22/−10 V, V_{DS} = 0 V		−	−	±1	μA
ON−STATE CHARACTERISTICS (Note 2)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 37 mA		2.08	3.0	4.63	V
Recommended Gate Voltage	V_{GOP}			−3	−	+18	V
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 18 V, I_D = 74 A, T_J = 25°C		−	14	20	mΩ
		V_{GS} = 18 V, I_D = 74 A, T_J = 175°C		−	29	−	
		V_{GS} = 15 V, I_D = 74 A, T_J = 25°C		−	16	27	
		V_{GS} = 15 V, I_D = 74 A, T_J = 150°C		−	27	−	
Forward Transconductance	g_{FS}	V_{DS} = 10 V, I_D = 74 A		−	29	−	S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V		−	6230	−	pF
Output Capacitance	C_{OSS}			−	262	−	
Reverse Transfer Capacitance	C_{RSS}			−	29	−	
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −3/18 V, V_{DS} = 800 V, I_D = 74 A		−	329	−	nC
Threshold Gate Charge	$Q_{G(TH)}$			−	41	−	
Gate−to−Source Charge	Q_{GS}			−	79	−	
Gate−to−Drain Charge	Q_{GD}			−	98	−	
Gate−Resistance	R_G	f = 1 MHz		−	1.4	−	Ω
SWITCHING CHARACTERISTICS							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = −3/18 V, V_{DS} = 800 V, I_D = 74 A, R_G = 2 Ω inductive load (Note 4)		−	26	−	ns
Rise Time	t_r			−	40	−	
Turn−Off Delay Time	$t_{d(OFF)}$			−	68	−	
Fall Time	t_f			−	13	−	
Turn−On Switching Loss	E_{ON}			−	1308	−	μJ
Turn−Off Switching Loss	E_{OFF}			−	601	−	
Total Switching Loss	E_{tot}			−	1909	−	
SOURCE−DRAIN DIODE CHARACTERISTICS							
Continuous Source−Drain Diode Forward Current	I_{SD}	V_{GS} = −3 V, T_C = 25°C		−	−	127	A
Pulsed Source−Drain Diode Forward Current (Note 2)	I_{SDM}			−	−	407	
Forward Diode Voltage	V_{SD}	V_{GS} = −3 V, I_{SD} = 74 A, T_J = 25°C		−	5.2	−	V

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
SOURCE−DRAIN DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −3/18 V, I_{SD} = 74 A, dI_S/dt = 1000 A/µs, V_{DS} = 800 V	−	36	−	ns
Reverse Recovery Charge	Q_{RR}		−	332	−	nC
Reverse Recovery Energy	E_{REC}		−	14	−	µJ
Peak Reverse Recovery Current	I_{RRM}		−	19	−	A
Charge time	T_A		−	20	−	ns
Discharge time	T_B		−	16	−	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

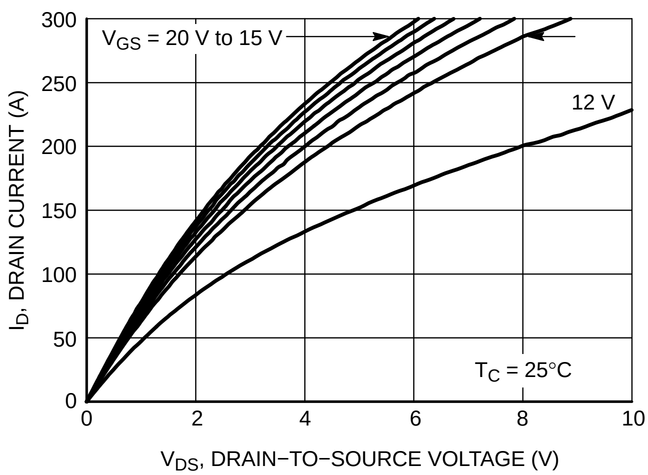


Figure 1. On−Region Characteristics

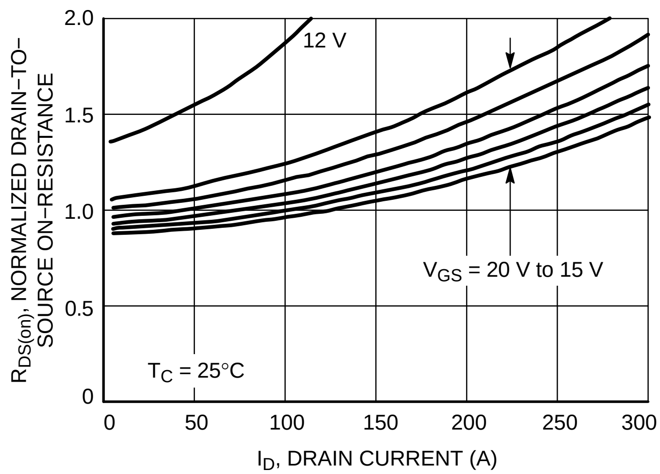


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

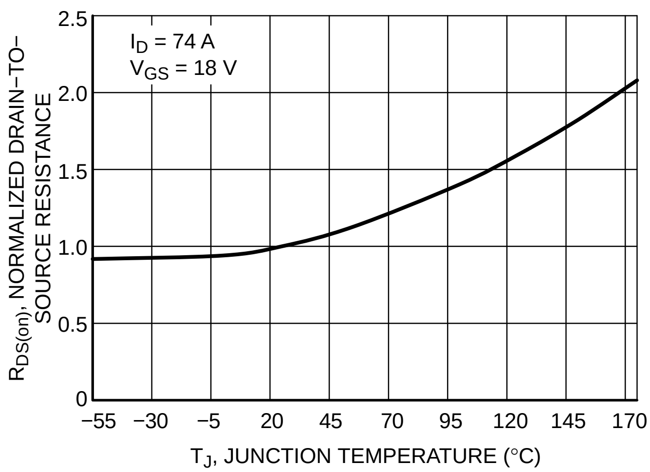


Figure 3. On−Resistance Variation with Temperature

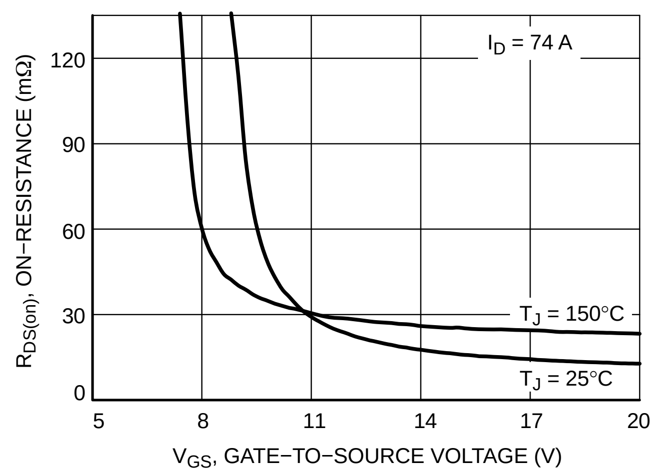


Figure 4. On−Resistance vs. Gate−to−Source Voltage

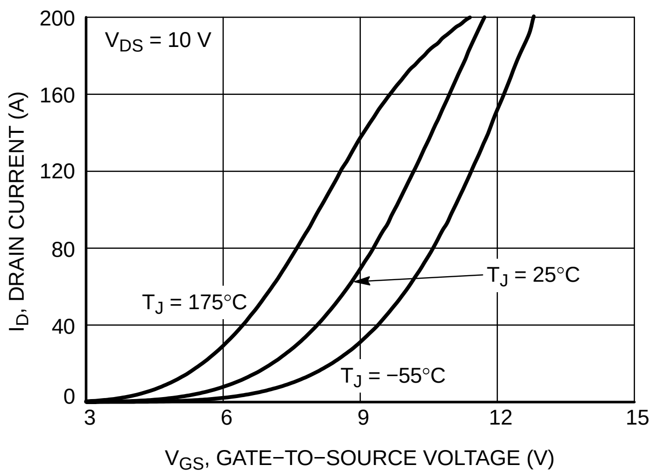


Figure 5. Transfer Characteristics

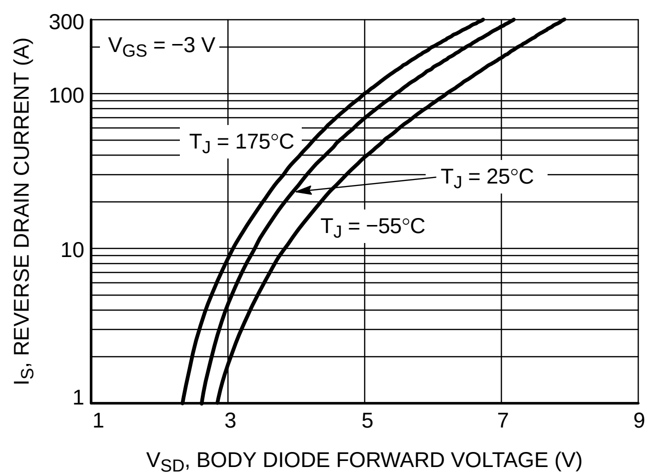


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

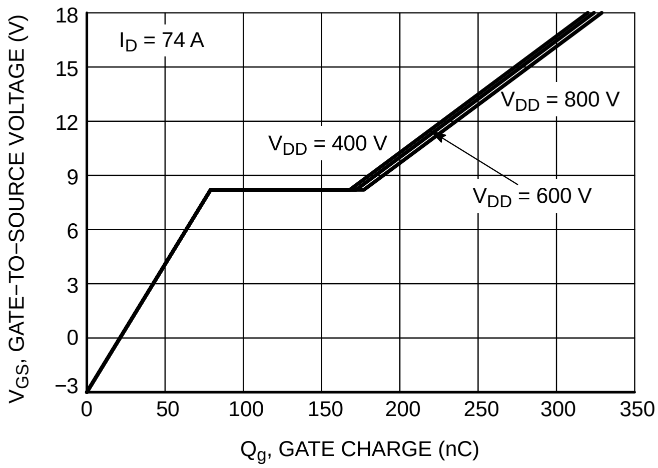


Figure 7. Gate−to−Source Voltage vs. Total Charge

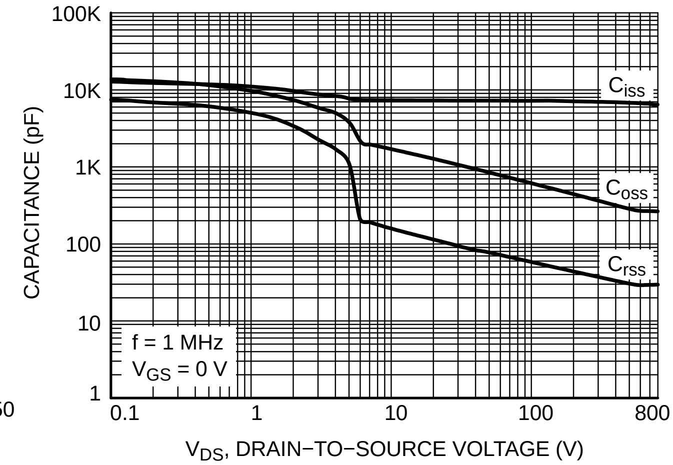


Figure 8. Capacitance vs. Drain−to−Source Voltage

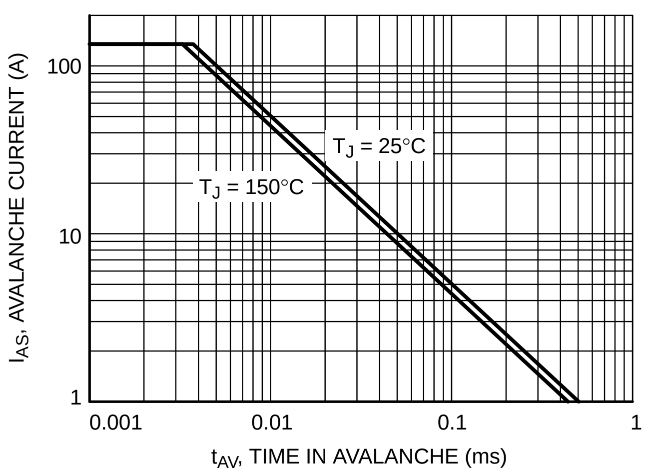


Figure 9. Unclamped Inductive Switching Capability

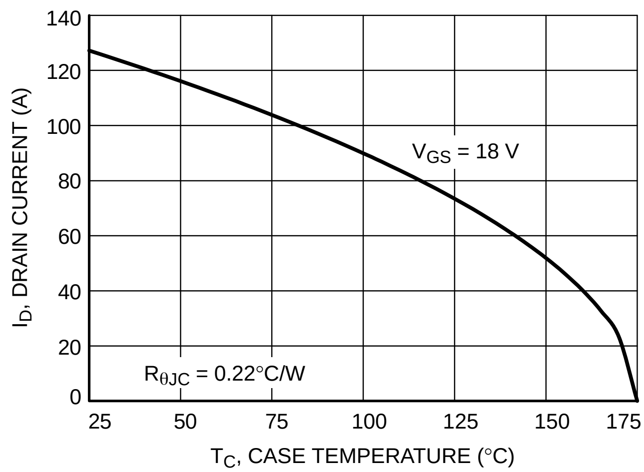


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

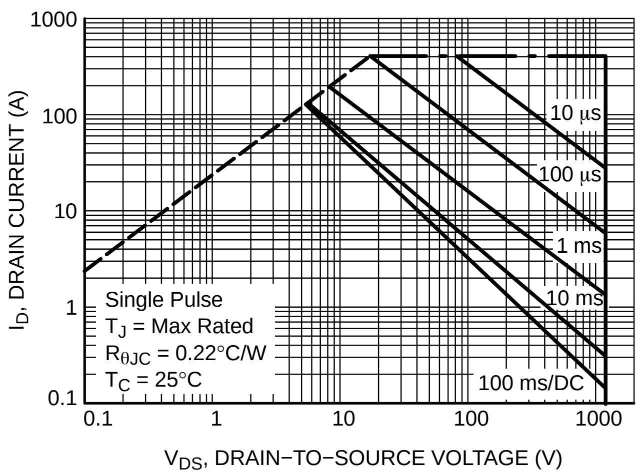


Figure 11. Safe Operating Area

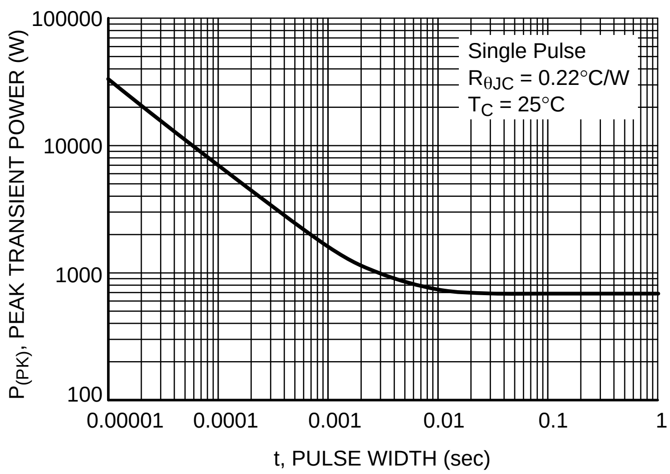


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

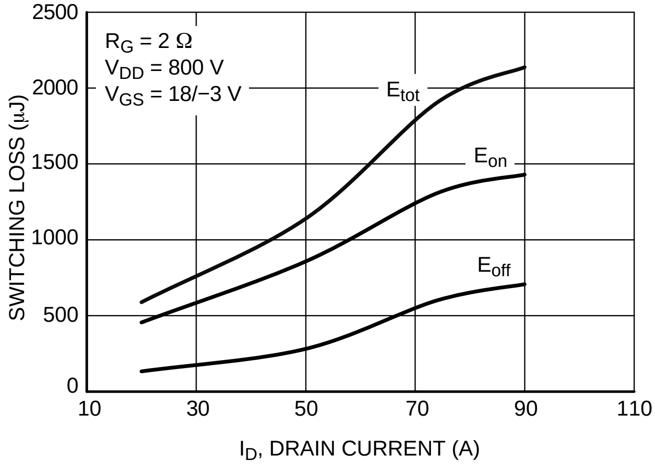


Figure 13. Switching Loss vs. Drain Current

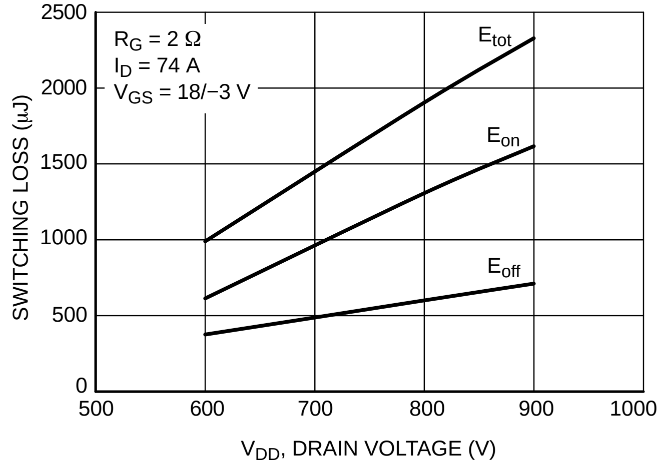


Figure 14. Switching Loss vs. Drain Voltage

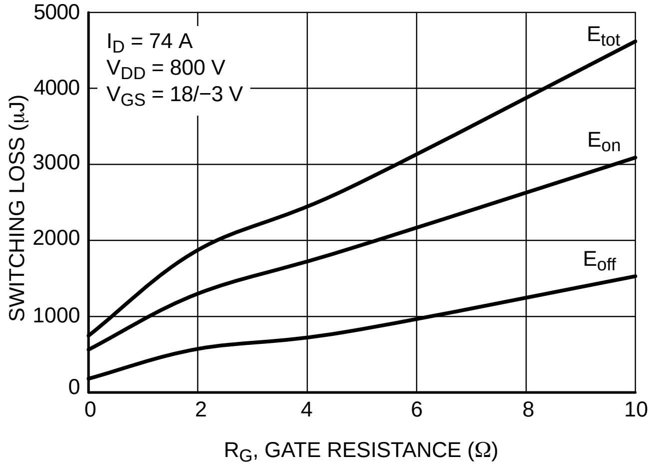


Figure 15. Switching Loss vs. Gate Resistance

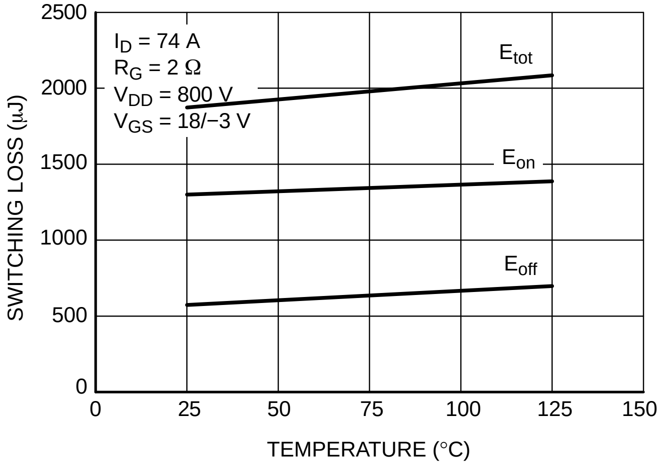


Figure 16. Switching Loss vs. Temperature

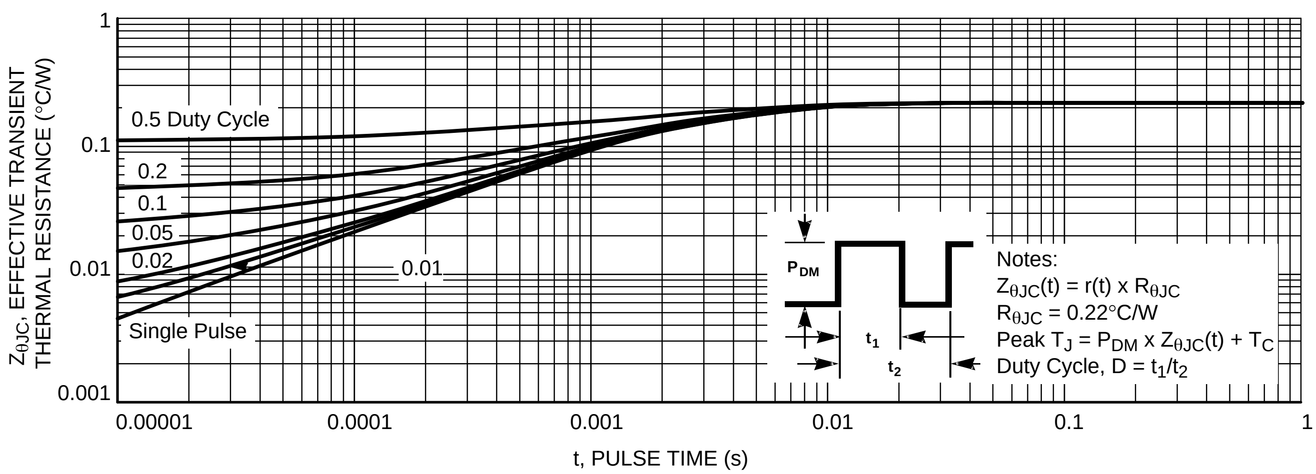
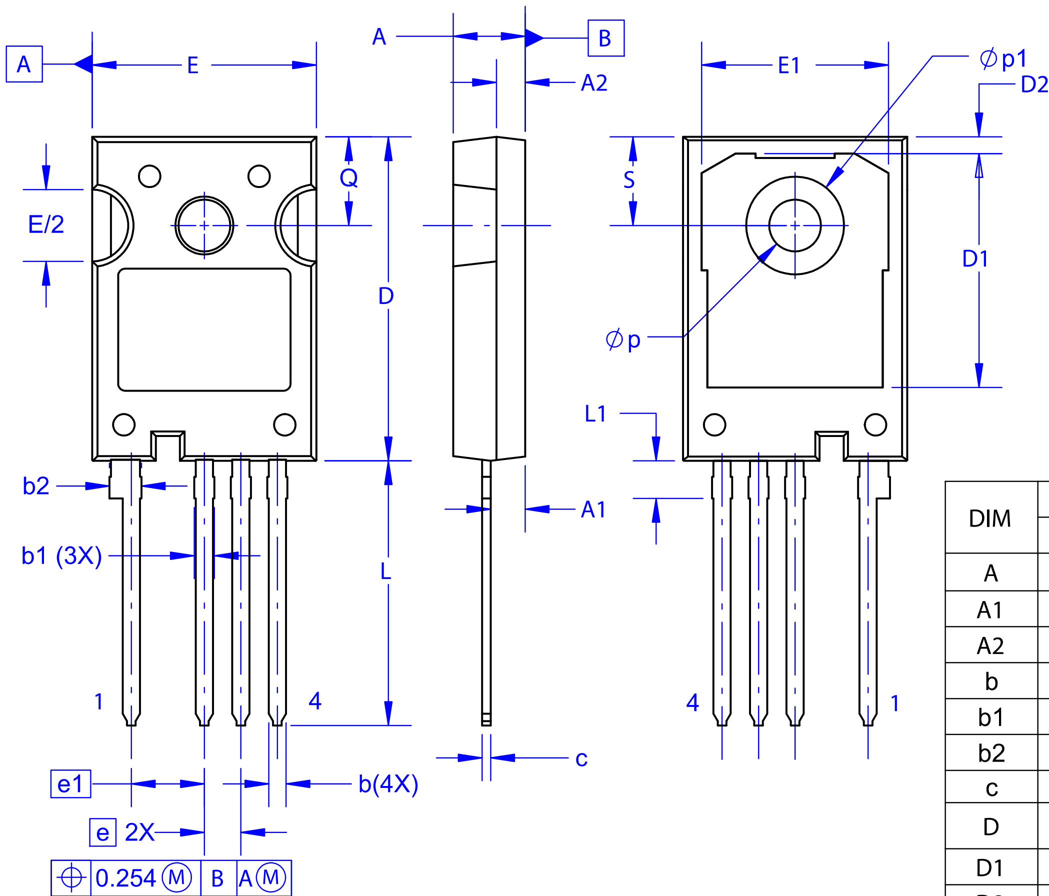


Figure 17. Junction−to−Case Transient Thermal Response

TO−247−4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019



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.
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