Silicon Carbide (SiC) MOSFET – EliteSiC, 40 mohm, 1200 V, M3S, TO-247-3L

NTHL040N120M3S

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
1200 V	54 mΩ @ 18 V	54 A

Features

- Typ. $R_{DS(on)}$ = 40 mΩ @ V_{GS} = 18 V
- Ultra Low Gate Charge ($Q_{G(tot)}$ = 75 nC)
- High Speed Switching with Low Capacitance (C_{oss} = 80 pF)
- 100% Avalanche Tested
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb−Free 2LI (on second level interconnection)

Typical Applications

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

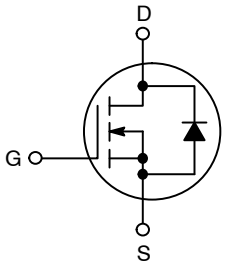
MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

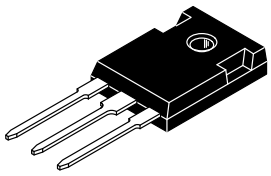
Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	1200	V
Gate−to−Source Voltage			V_{GS}	−10/+22	V
Continuous Drain Current (Notes 1, 3)	Steady State	T_C = 25°C	I_D	54	A
Power Dissipation (Note 1)	Steady State	T_C = 25°C	P_D	231	W
Continuous Drain Current (Notes 1, 3)	Steady State	T_C = 100°C	I_D	38	A
Power Dissipation (Note 1)	Steady State	T_C = 100°C	P_D	115	W
Pulsed Drain Current (Note 2)	T_C = 25°C		I_{DM}	134	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	45	A
Single Pulse Drain−to−Source Avalanche Energy (Note 4)			E_{AS}	143	mJ
Maximum Lead Temperature for Soldering (1/8″ from case for 5 s)			T_L	260	°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. The maximum current rating is based on typical $R_{DS(on)}$ performance.
4. EAS of 143 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 16.9 A, V_{DD} = 100 V, V_{GS} = 18 V.

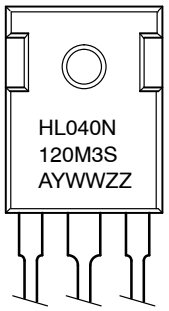
N−CHANNEL MOSFET





TO−247−3LD
CASE 340CX

MARKING DIAGRAM



HL040N120M3S = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

Device	Package	Shipping
NTHL040N120M3S	TO−247−3L	30 Units / Tube

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Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Junction−to−Case − Steady State (Note 1)	$R_{\theta JC}$	0.65	°C/W
Junction−to−Ambient − Steady State (Note 1)	$R_{\theta JA}$	40	

Table 2. RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value	Unit
Operation Values of Gate−to−Source Voltage	V_{GSop}	−5…−3 +18	V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

Table 3. 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 (Note 6)		−	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 = 10 mA		2.04	2.9	4.4	V
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 18 V, I_D = 20 A, T_J = 25°C		−	40	54	mΩ
		V_{GS} = 18 V, I_D = 20 A, T_J = 175°C (Note 6)		−	80	−	
Forward Transconductance	g_{FS}	V_{DS} = 10 V, I_D = 20 A (Note 6)		−	16	−	S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V (Note 6)		−	1700	−	pF
Output Capacitance	C_{OSS}			−	80	−	
Reverse Transfer Capacitance	C_{RSS}			−	7	−	
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −3/18 V, V_{DS} = 800 V, I_D = 20 A (Note 6)		−	75	−	nC
Threshold Gate Charge	$Q_{G(TH)}$			−	4.4	−	
Gate−to−Source Charge	Q_{GS}			−	14	−	
Gate−to−Drain Charge	Q_{GD}			−	22	−	
Gate−Resistance	R_G	f = 1 MHz		−	3.8	−	Ω
SWITCHING CHARACTERISTICS							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = −3/18 V, V_{DS} = 800 V, I_D = 20 A, R_G = 4.7 Ω Inductive load (Notes 5, 6)		−	13	−	ns
Rise Time	t_r			−	32	−	
Turn−Off Delay Time	$t_{d(OFF)}$			−	37	−	
Fall Time	t_f			−	11	−	
Turn−On Switching Loss	E_{ON}			−	412	−	μJ
Turn−Off Switching Loss	E_{OFF}			−	74	−	
Total Switching Loss	E_{tot}			−	486	−	

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Table 3. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
SOURCE−DRAIN DIODE CHARACTERISTICS						
Continuous Source−Drain Diode Forward Current	I_{SD}	V_{GS} = −3 V, T_C = 25°C (Note 6)	−	−	45	A
Pulsed Source−Drain Diode Forward Current (Note 2)	I_{SDM}		−	−	134	
Forward Diode Voltage	V_{SD}	V_{GS} = −3 V, I_{SD} = 20 A, T_J = 25°C	−	4.5	−	V
Reverse Recovery Time	t_{RR}	V_{GS} = −3/18 V, I_{SD} = 20 A, dI_S/dt = 1000 A/μs, V_{DS} = 800 V (Note 6)	−	17	−	ns
Reverse Recovery Charge	Q_{RR}		−	81	−	nC
Reverse Recovery Energy	E_{REC}		−	6.7	−	μJ
Peak Reverse Recovery Current	I_{RRM}		−	9.3	−	A
Charge Time	T_A		−	9.5	−	ns
Discharge Time	T_B		−	7.7	−	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.

5. E_{ON}/E_{OFF} result is with body diode.
6. Defined by design, not subject to production test.

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TYPICAL CHARACTERISTICS

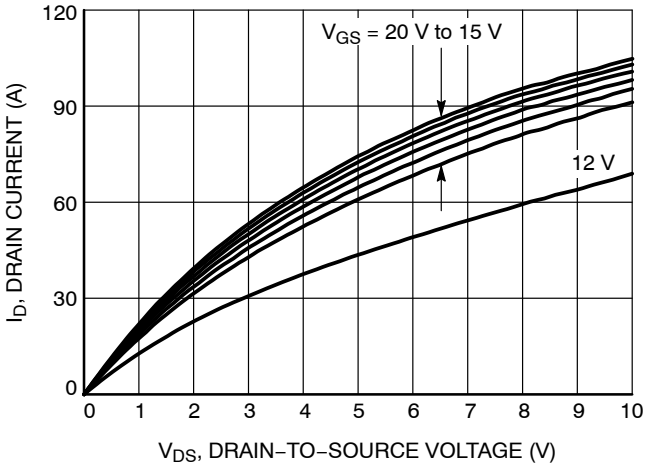


Figure 1. On−Region Characteristics

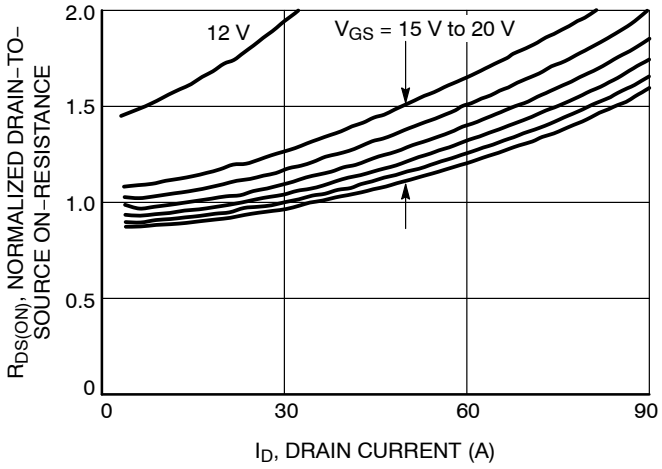


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

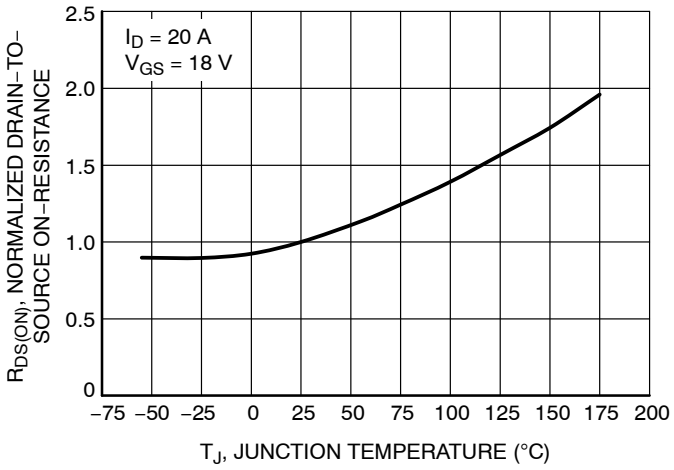


Figure 3. On−Resistance Variation with Temperature

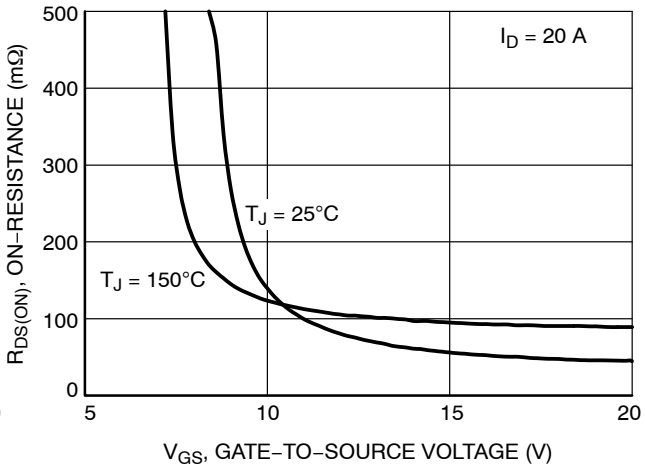


Figure 4. On−Resistance vs. Gate−to−Source Voltage

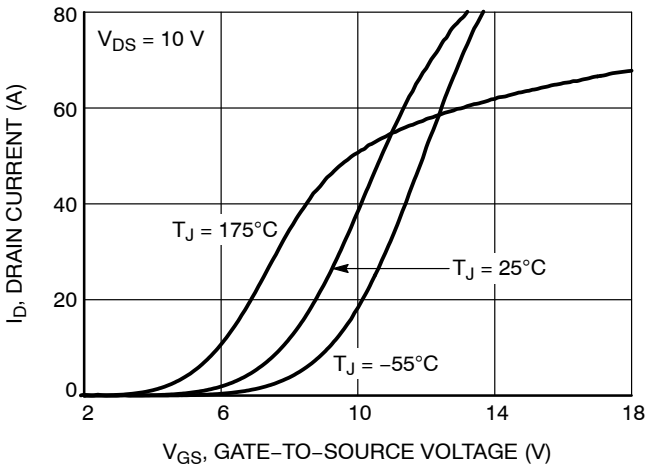


Figure 5. Transfer Characteristics

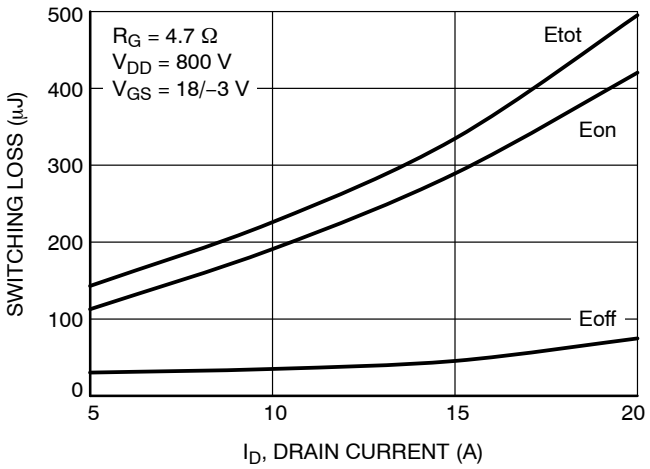


Figure 6. Switching Loss vs. Drain Current

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TYPICAL CHARACTERISTICS

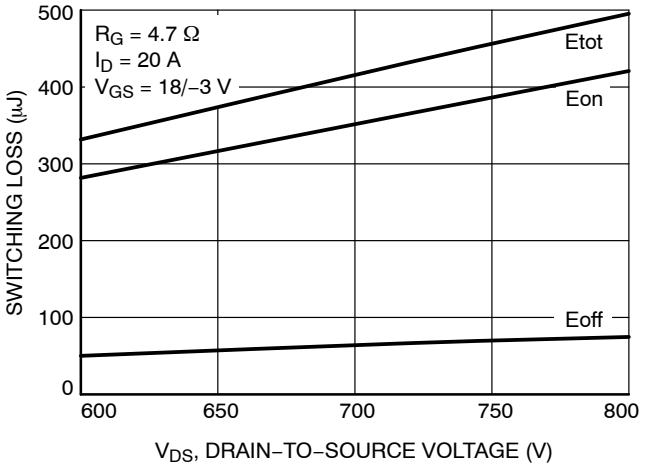


Figure 7. Switching Loss vs. Drain−to−Source Voltage

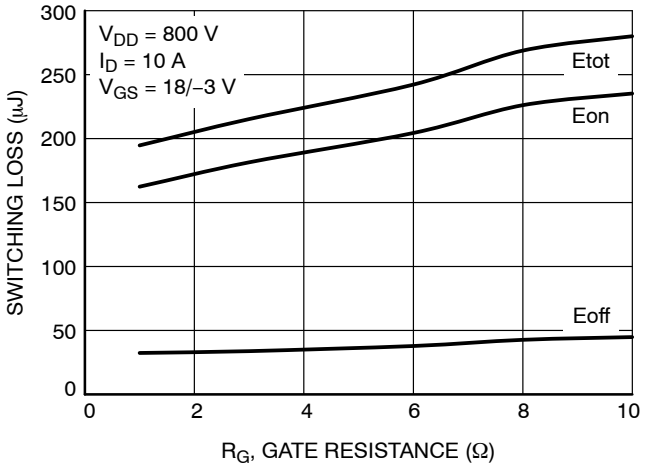


Figure 8. Switching Loss vs. Gate Resistance

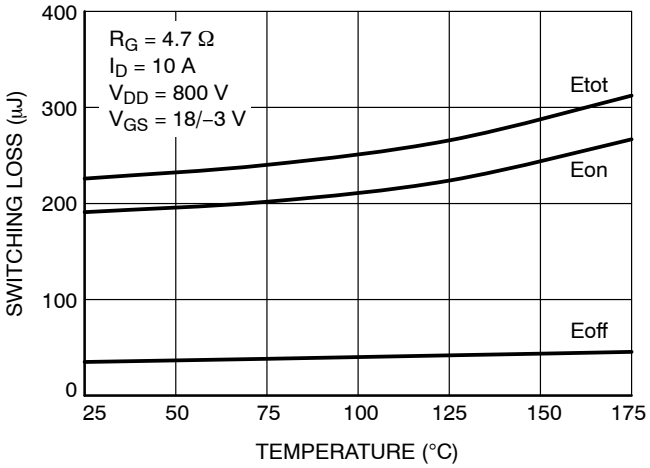


Figure 9. Switching Loss vs. Temperature

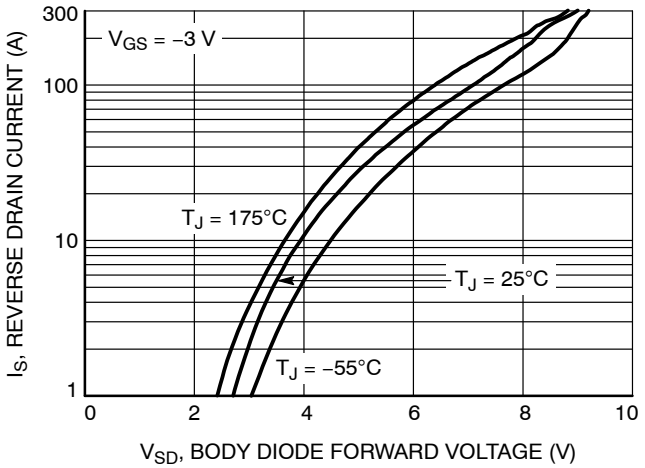


Figure 10. Reverse Drain Current vs. Body Diode Forward Voltage

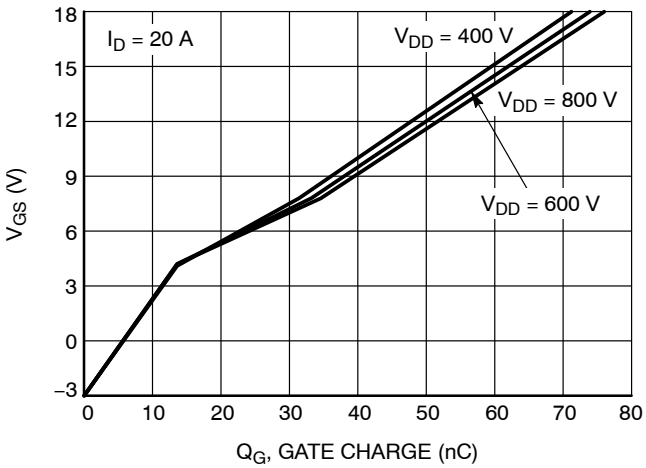


Figure 11. Gate−to−Source Voltage vs. Total Charge

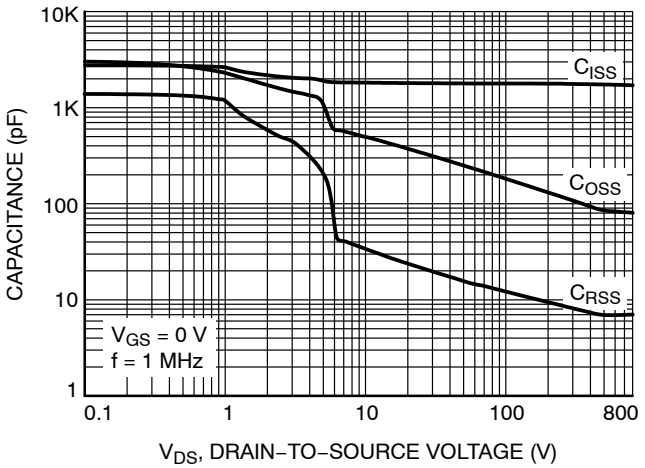


Figure 12. Capacitance vs. Drain−to−Source Voltage

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TYPICAL CHARACTERISTICS

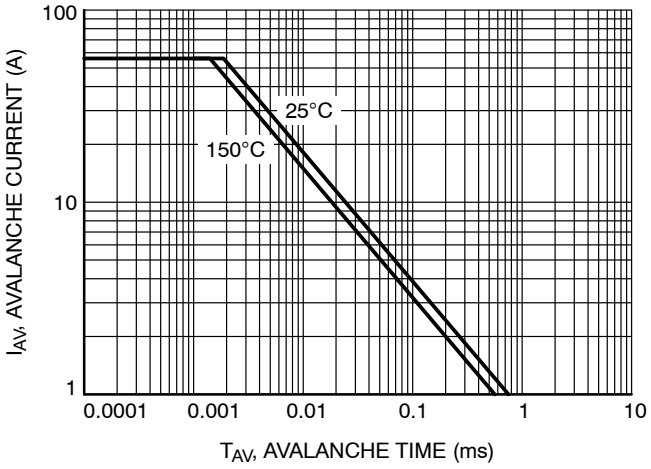


Figure 13. Unclamped Inductive Switching Capability

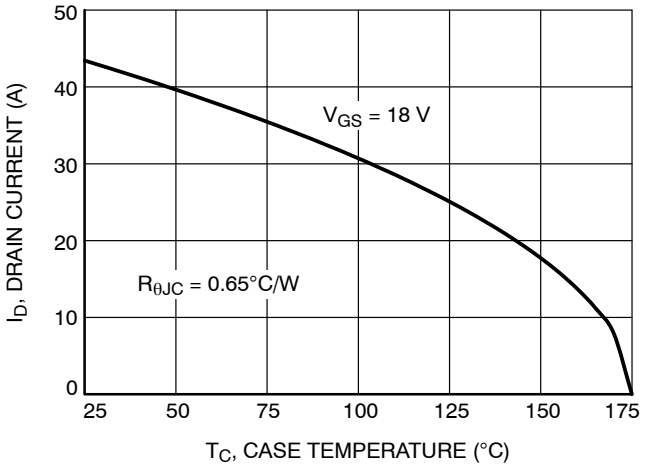


Figure 14. Maximum Continuous Drain Current vs. Case Temperature

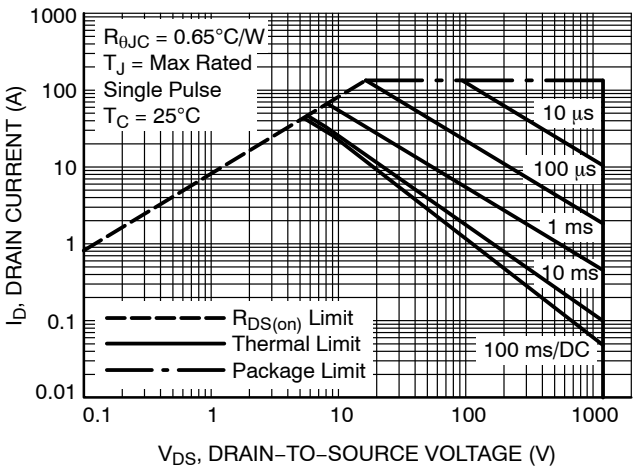


Figure 15. Safe Operating Area

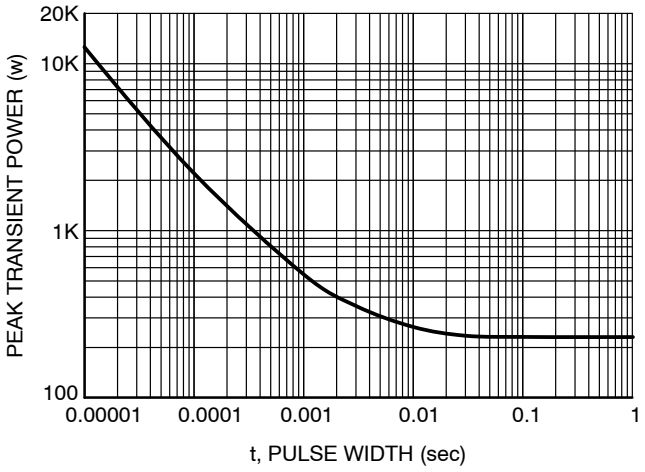


Figure 16. Single Pulse Maximum Power Dissipation

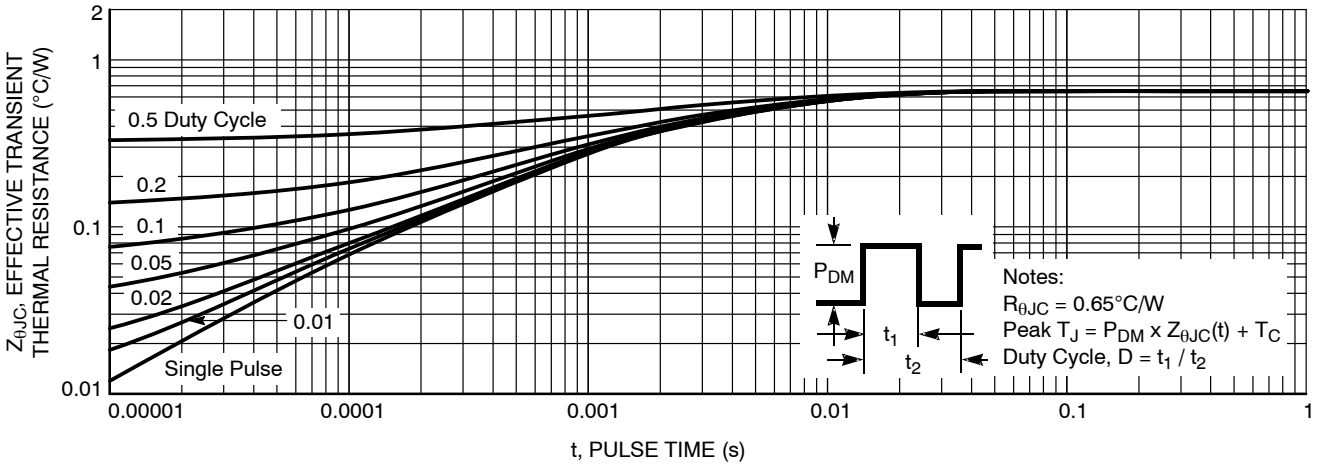


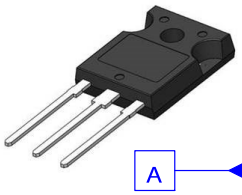
Figure 17. Junction−to−Case Transient Thermal Response

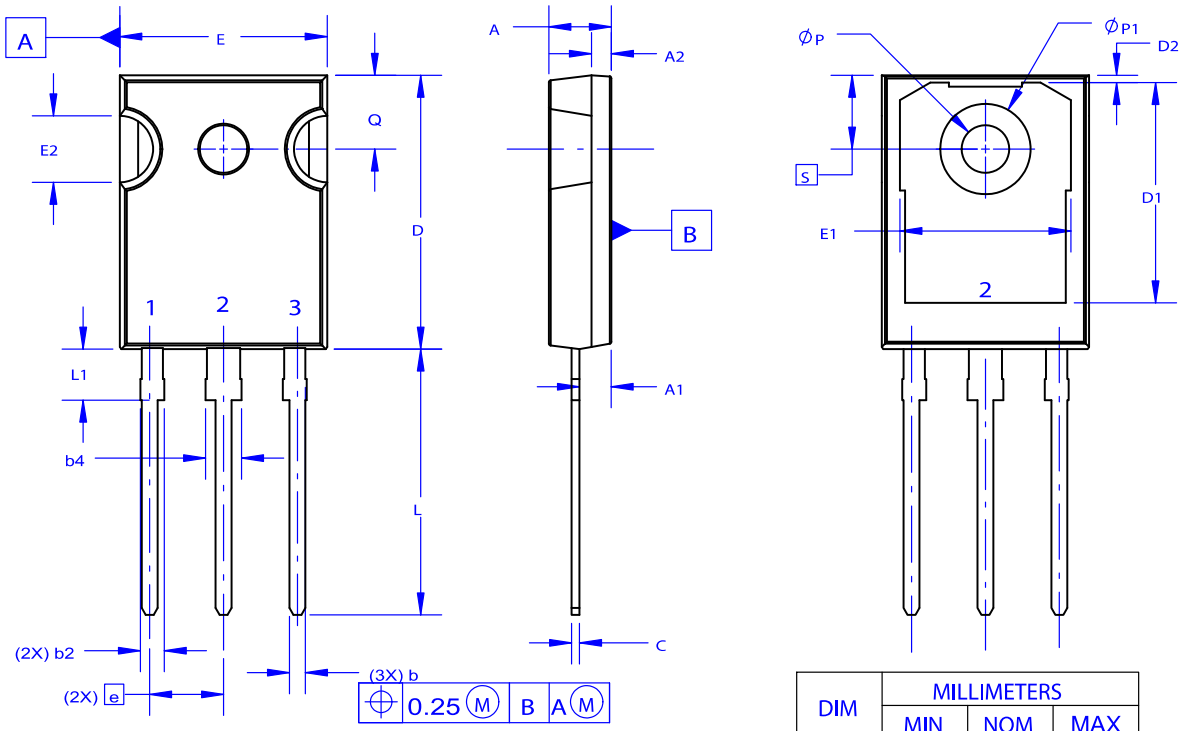
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TO−247−3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020





NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ØP1	6.60	6.80	7.00

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present. Some products may not follow the Generic Marking.

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