

Silicon Carbide (SiC) MOSFET – EliteSiC, 22 mohm, 1200 V, M3S, TO-247-4L

Preliminary Document NTH4LN022N120M3S

Features

- Typ. $R_{DS(on)} = 22\text{ m}\Omega$ @ $V_{GS} = 18\text{ V}$
- Ultra Low Gate Charge ($Q_{G(tot)} = 137\text{ nC}$)
- High Speed Switching with Low Capacitance ($C_{oss} = 146\text{ pF}$)
- 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)

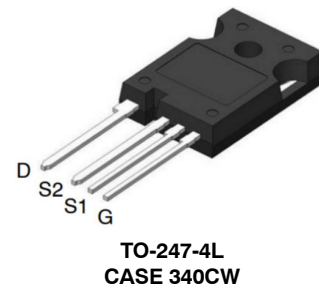
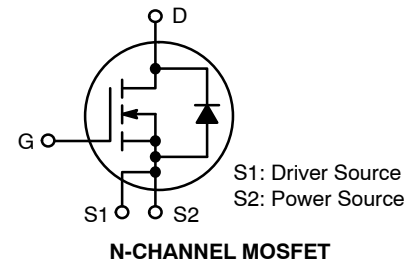
MAXIMUM RATINGS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			V_{DSS}	1200	V
Gate-to-Source Voltage			V_{GS}	-10/+22	V
Continuous Drain Current (Notes 1, 3)	Steady State	$T_C = 25\text{ }^{\circ}\text{C}$	I_D	75	A
Power Dissipation (Note 1)			P_D	348	W
Continuous Drain Current (Notes 1, 3)	Steady State	$T_C = 100\text{ }^{\circ}\text{C}$	I_D	53	A
Power Dissipation (Note 1)			P_D	174	W
Pulsed Drain Current (Note 2)	$T_C = 25\text{ }^{\circ}\text{C}$		I_{DM}	227	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	-55 to +175	$^{\circ}\text{C}$
Source Current (Body Diode) $T_C = 25\text{ }^{\circ}\text{C}$, $V_{GS} = -3\text{ V}$ (Note 1)			I_S	54	A
Single Pulse Drain-to-Source Avalanche Energy ($I_{L(pk)} = 23.1\text{ A}$, $L = 1\text{ mH}$) (Note 4)			E_{AS}	267	mJ
Maximum Lead Temperature for Soldering (1/25" from case for 10 s)			T_L	270	$^{\circ}\text{C}$

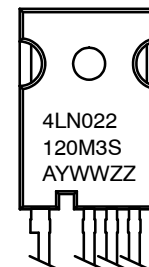
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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. Single pulse, limited by max junction temperature.
3. The maximum current rating is based on typical $R_{DS(on)}$ performance.
4. EAS of 267 mJ is based on starting $T_J = 25\text{ }^\circ\text{C}$; $L = 1\text{ mH}$, $I_{AS} = 23.1\text{ A}$, $V_{DD} = 100\text{ V}$, $V_{GS} = 18\text{ V}$.

$V_{(BR)DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
1200 V	30 m Ω @ 18 V	89 A



MARKING DIAGRAM



4LN022120M3S = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability

ORDERING INFORMATION

Device	Package	Shipping
NTH4LN022N120M3S	TO-247-4L	30 Units / Tube

This Preliminary document is for informational purposes only. onsemi may update or withdraw it without notice. Content and referenced products are under development and subject to change.

Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State (Note 1)	$R_{\theta JC}$	0.43	°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 ($T_J = 25\text{ °C}$ 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	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}$, referenced to 25 °C (Note 6)		0.3		V/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}, T_J = 25\text{ °C}$			100	μA
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = +22/-10\text{ V}, V_{DS} = 0\text{ V}$			±1	μA

ON-STATE CHARACTERISTICS

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 20\text{ mA}$		2.72		V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 25\text{ °C}$		19		mΩ
		$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 175\text{ °C}$ (Note 6)		43		
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 40\text{ A}$ (Note 6)		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}			14		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -3/18\text{ V}, V_{DS} = 800\text{ V}, I_D = 40\text{ A}$		140		nC
Gate-to-Source Charge	Q_{GS}			37		
Gate-to-Drain Charge	Q_{GD}			31		
Gate-Resistance	R_G	$f = 1\text{ MHz}$		1.5		Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -3/18\text{ V}, V_{DS} = 800\text{ V}, I_D = 40\text{ A}, R_G = 4.5\text{ Ω}$ Inductive load (Notes 5, 6)		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		μJ
Turn-Off Switching Loss	E_{OFF}			221		
Total Switching Loss	E_{tot}			711		

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Table 3. ELECTRICAL CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
SOURCE-DRAIN DIODE CHARACTERISTICS						
Forward Diode Voltage	V_{SD}	$V_{GS} = -3\text{ V}, I_{SD} = 40\text{ A}, T_J = 25\text{ }^{\circ}\text{C}$		4.5		V
Reverse Recovery Time	t_{RR}	$V_{GS} = -3/18\text{ V}, I_{SD} = 40\text{ A},$ $dI_S/dt = 1000\text{ A}/\mu\text{s}, V_{DS} = 800\text{ V}$ (Note 6)		22		ns
Reverse Recovery Charge	Q_{RR}			138		nC
Reverse Recovery Energy	E_{REC}			5		μJ
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.

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

6. Defined by design, not subject to production test.

TYPICAL CHARACTERISTICS

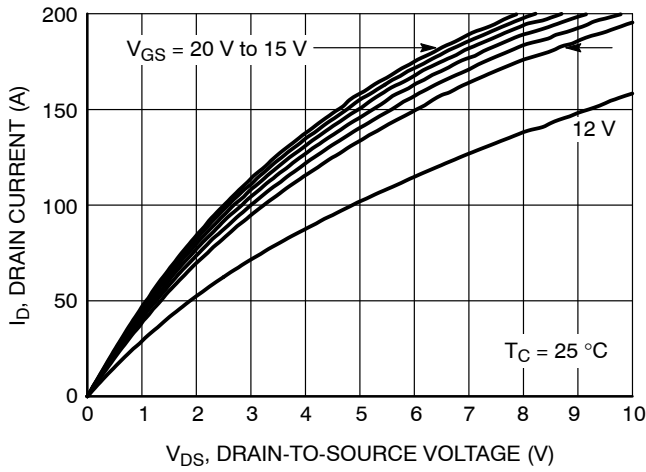


Figure 1. On-Region Characteristics

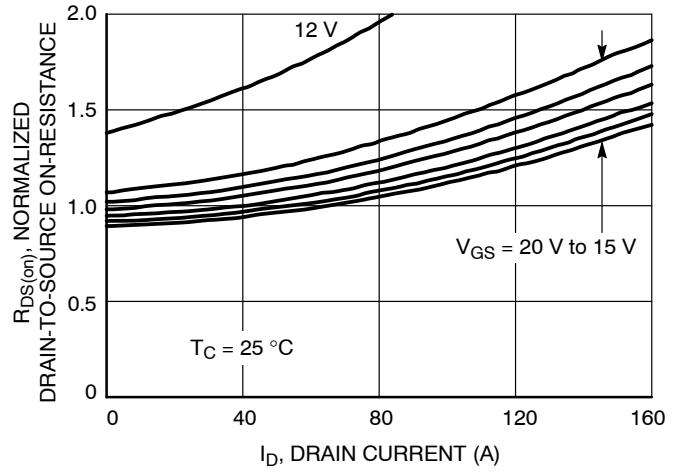


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

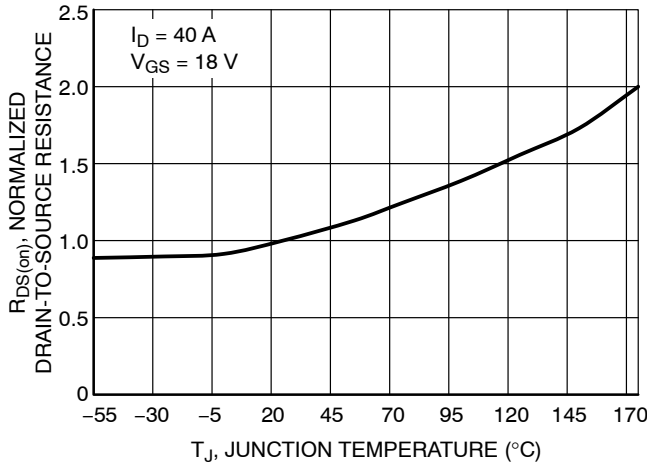


Figure 3. On-Resistance Variation with Temperature

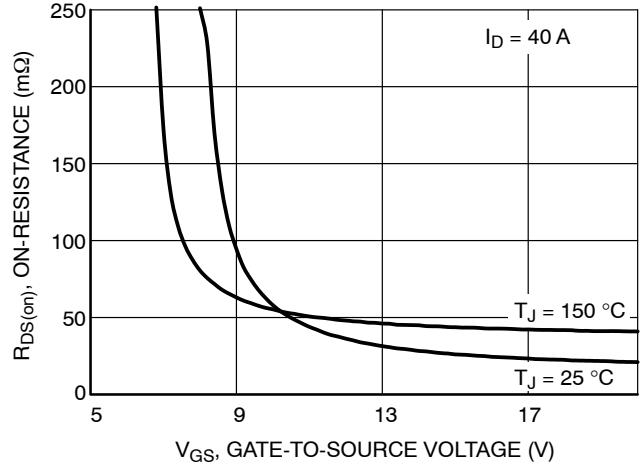


Figure 4. On-Resistance vs. Gate-to-Source Voltage

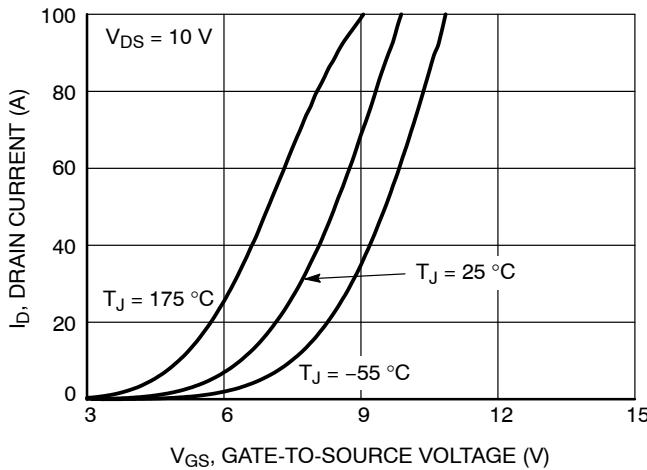


Figure 5. Transfer Characteristics

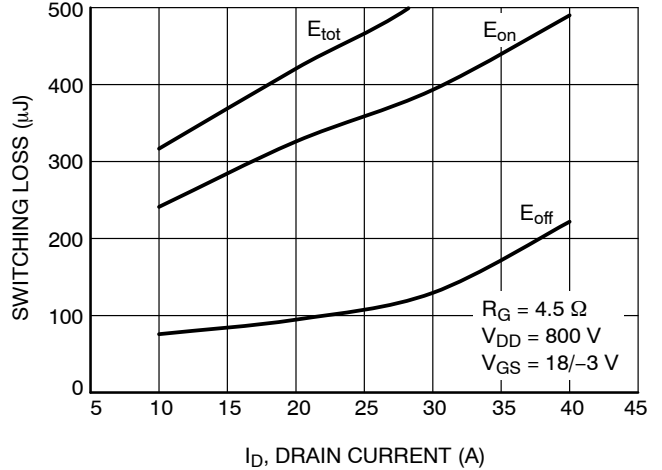


Figure 6. Switching Loss vs. Drain Current

TYPICAL CHARACTERISTICS (CONTINUED)

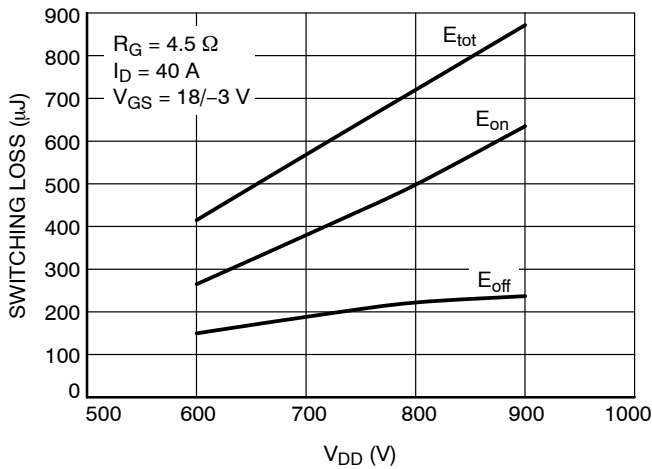


Figure 7. Switching Loss vs. Drain Voltage

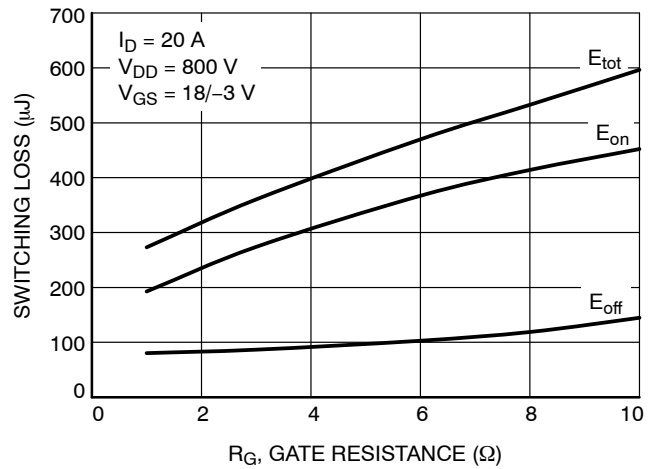


Figure 8. Switching Loss vs. Gate Resistance

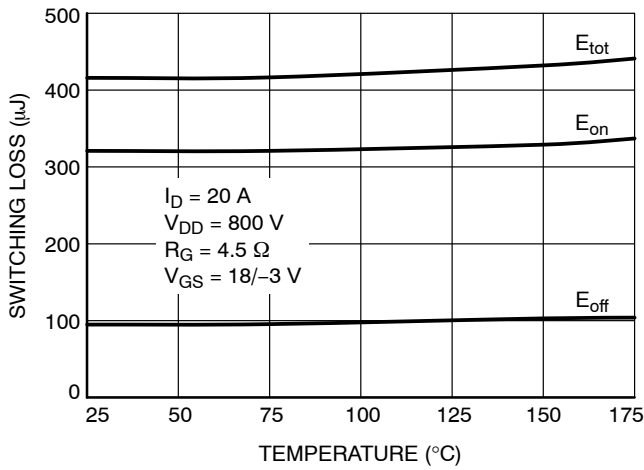


Figure 9. Switching Loss vs. Temperature

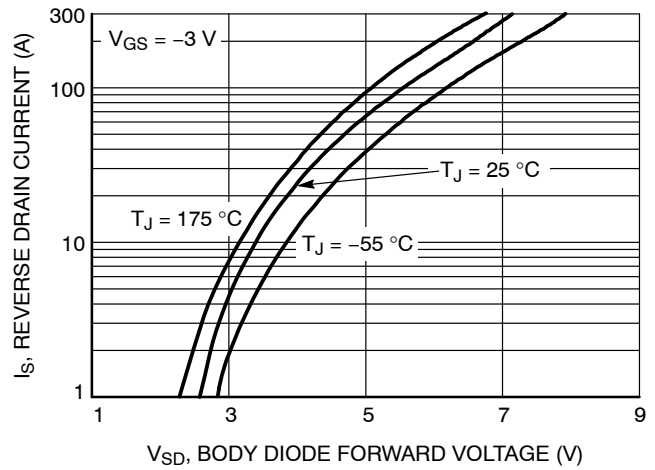


Figure 10. Diode Forward Voltage vs. Current

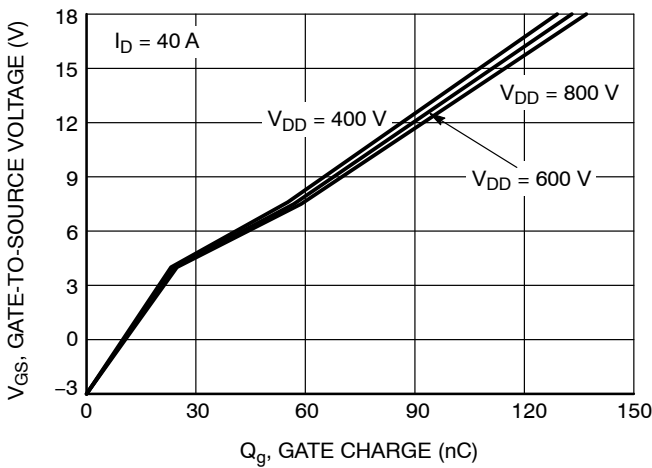


Figure 11. Gate-to-Source Voltage vs. Total Charge

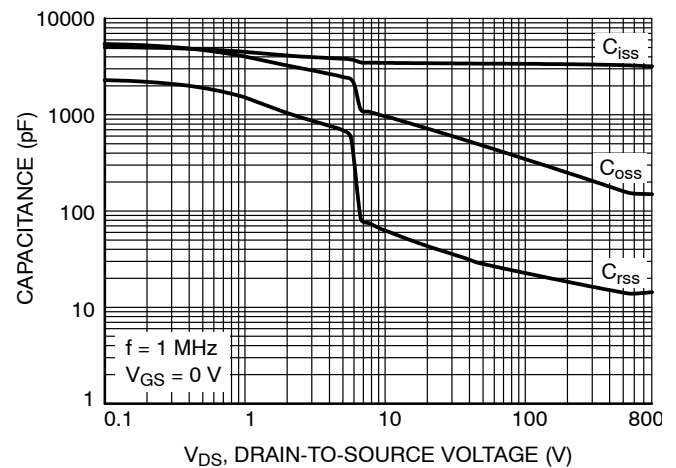


Figure 12. Capacitance vs. Drain-to-Source Voltage

TYPICAL CHARACTERISTICS (CONTINUED)

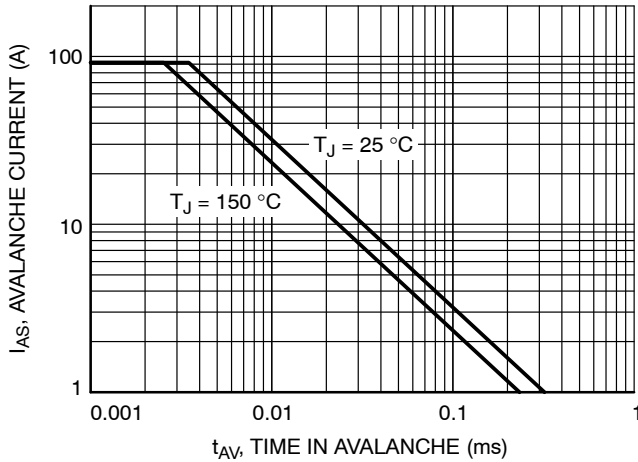


Figure 13. Unclamped Inductive Switching Capability

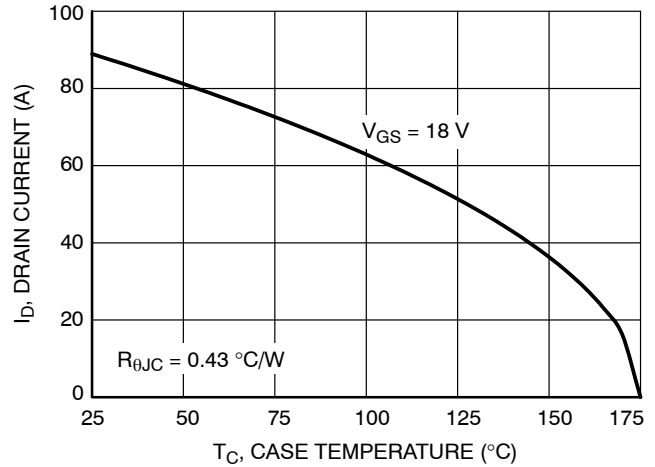


Figure 14. Maximum Continuous Drain Current vs. Case Temperature

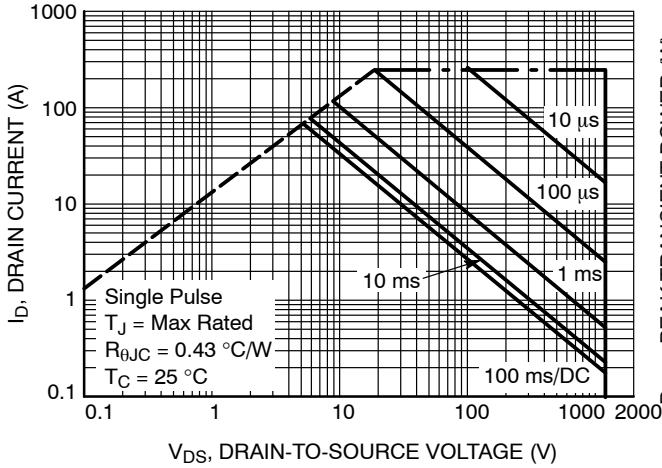


Figure 15. Safe Operating Area

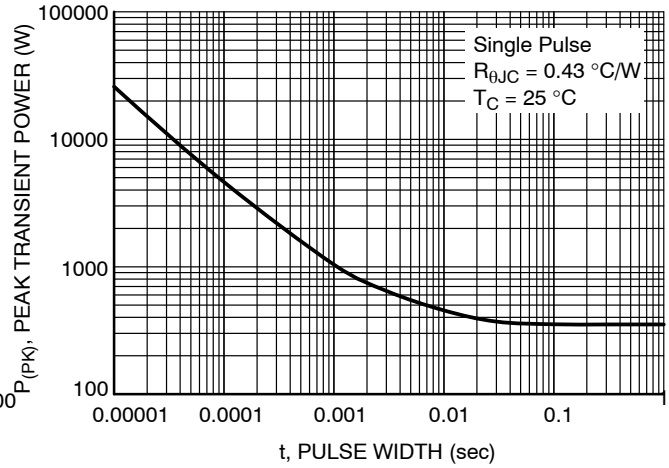


Figure 16. Single Pulse Maximum Power Dissipation

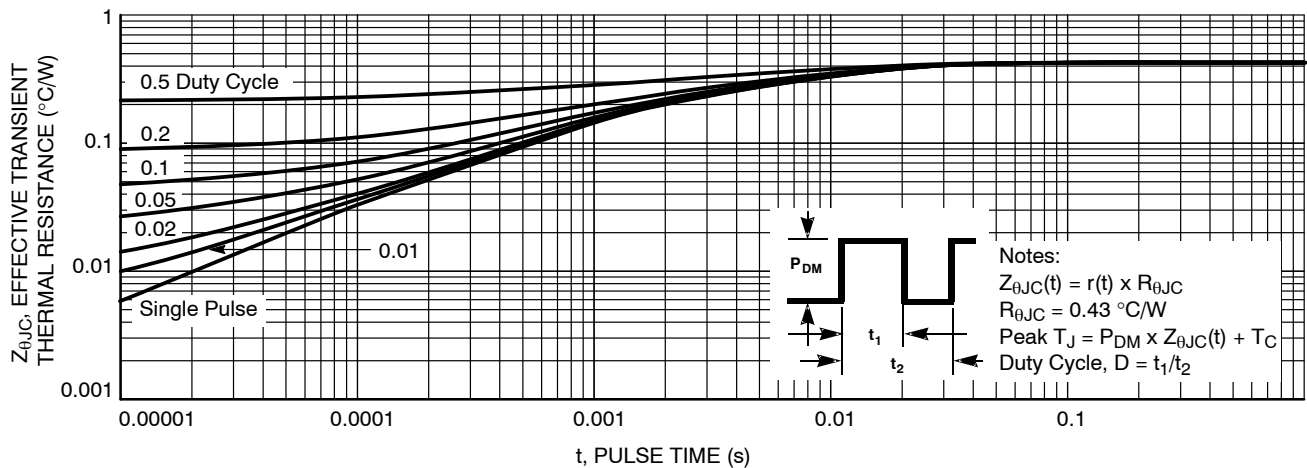


Figure 17. Junction-to-Case Transient Thermal Response

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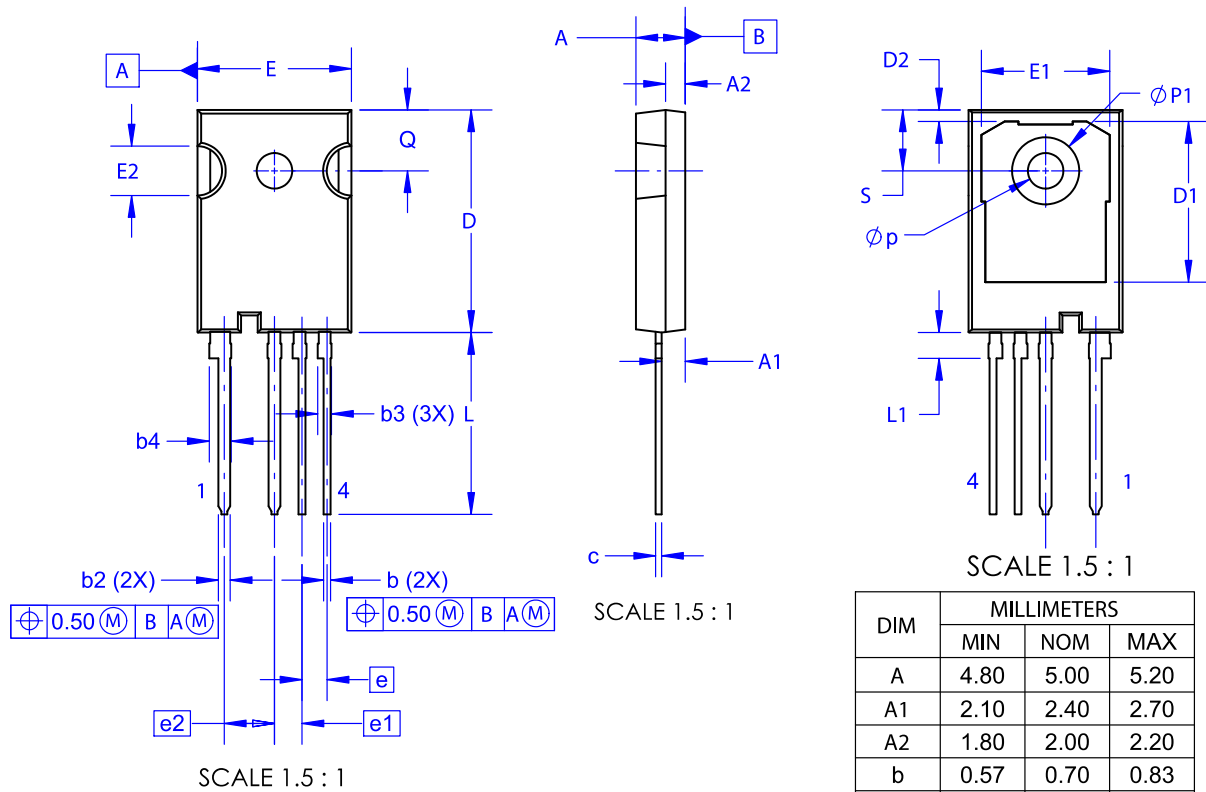
REVISION HISTORY

Revision	Description of Changes	Date
P0	Initial Preliminary document release.	1/20/2026
P1	Updated package dimensions drawing and removed min/max values.	5/1/2026

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PACKAGE DIMENSIONS

TO-247 4-LEAD, THIN LEADS
CASE 340CW
ISSUE A



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.

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	0.57	0.70	0.83
b2	1.07	1.20	1.33
b3	1.20	1.40	1.60
b4	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.30	16.50
D2	0.97	1.17	1.37
e		2.54	
e1		2.79	
e2		5.08	
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E2	4.80	5.00	5.20
L	18.12	18.42	18.72
L1	2.42	2.62	2.82
ϕp	3.40	3.60	3.80
$\phi P1$	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

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