1200V, 80 mΩ N-Channel mSiC™ MOSFET

MSC080SMB120B4N

Product Overview

1200V, 80 mΩ typical at V_{GS} = 18V, 98 mΩ typical at V_{GS} = 15V, Silicon Carbide (SiC) N-Channel MOSFET, TO-247 notched 4-lead with a source sense.

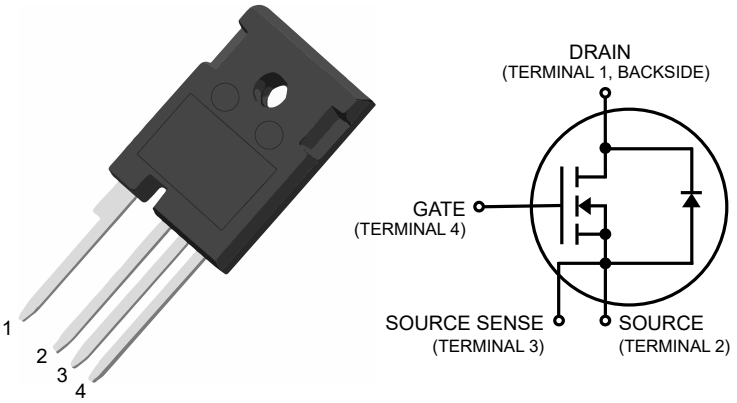


Table 1. Ordering Information

Catalog Part Number (CPN)	Package	Packing Media (Qty.)	Qualification
MSC080SMB120B4N	TO-247 notched 4-lead	Tube (30)	Industrial
MSC080SMB120B4NVAO	TO-247 notched 4-lead	Tube (30)	AEC-Q101

Features

- Low capacitances and low gate charge
- Fast switching speed due to low internal gate resistance (ESR)
- Stable operation at high junction temperature, $T_{J(max)}$ = 175 °C
- Fast and reliable body diode
- Superior avalanche ruggedness (100% UIS production tested)
- Creepage distance (Typ. > 8 mm)
- RoHS compliant

Benefits

- High efficiency to enable lighter and more compact system
- Simple to drive and easy to parallel
- Improved thermal capabilities and lower switching losses
- Eliminates the need for external freewheeling diode
- Lower system cost of ownership

Applications

- Photovoltaic (PV) inverter, converter, and industrial motor drives
- Smart grid transmission and distribution
- Induction heating and welding
- Hybrid Electric Vehicle (HEV) powertrain and Electric Vehicle (EV) charger
- Power supply and distribution

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1. Device Specifications

This section shows the specifications of this device.

1.1. Absolute Maximum Ratings

The following table shows the absolute maximum ratings of this device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain source voltage	1200	V
I_D	Continuous drain current at T_C = 25 °C	30	A
	Continuous drain current at T_C = 100 °C	21	
I_{DM}	Pulsed drain current[1]	63	
V_{GS}	Gate-source voltage	21/–10	V
	Transient gate-source voltage	23/–12	
	Recommended turn-on gate-source voltage	15 to 18	
	Recommended turn-off gate-source voltage	–5	
P_D	Total power dissipation at T_C = 25 °C	161	W
	Linear derating factor	1.1	W/°C

Note:

1. Repetitive rating: Pulse width and case temperature are limited by the maximum junction temperature.

1.2. Thermal and Mechanical Characteristics

The following table shows the thermal and mechanical characteristics of this device.

Table 1-2. Thermal and Mechanical Characteristics

Symbol	Characteristic/Test Conditions	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance	—	0.72	0.93	°C/W
T_J	Operating junction temperature	–55	—	175	°C
T_{STG}	Storage temperature	–55	—	175	
T_L	Lead temperature for 10 seconds	—	—	300	°C
τ_M	Mounting torque, M3 screw for heat sink attachment (requires 1, not included)	—	0.8	—	N·m
Wt	Package weight	—	6.2	—	g

ESD practices should comply with JESD-625.

1.3. Electrical Performance

The following table shows the static characteristics of this device at T_J = 25 °C unless otherwise specified.

Table 1-3. Static Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0V, I_D = 100 µA	1200	—	—	V
$R_{DS(on)}$	Drain-source on resistance[1]	V_{GS} = 18V, I_D = 6A	—	80	107	mΩ
		V_{GS} = 15V, I_D = 6A	—	98	—	
		V_{GS} = 18V, I_D = 6A, T_J = 175 °C	—	132	—	

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Table 1-3. Static Characteristics (continued)

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate-source threshold voltage	$V_{GS} = V_{DS}$, I_D = 0.75 mA	1.9	3.0	5.0	V
		V_{DS} = 960V, I_D = 0.75 mA	1.5	—	—	
I_{DSS}	Zero gate voltage drain current	V_{DS} = 1200V, V_{GS} = 0V	—	0.02	3.75	µA
		V_{DS} = 1200V, V_{GS} = 0V, T_J = 175 °C	—	0.30	—	
I_{GSS}	Gate-source leakage current	V_{GS} = 21V/–10V	—	—	±100	nA

Note:

1. Pulse test: pulse width < 380 µs, duty cycle < 2%.

The following table shows the dynamic characteristics of the device at T_J = 25 °C unless otherwise specified.

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0V, V_{DD} = 1000V, V_{AC} = 25 mV, f = 100 kHz	—	884	—	pF
C_{rss}	Reverse transfer capacitance		—	3.0	—	
C_{oss}	Output capacitance		—	41	—	
Q_G	Total gate charge	V_{GS} = 18V/–5V, V_{DD} = 800V, I_D = 6A	—	34	—	nC
Q_{GS}	Gate-source charge		—	8.0	—	
Q_{GD}	Gate-drain charge		—	6.0	—	
$t_{d(on)}$	Turn-on delay time	V_{DD} = 850V, V_{GS} = 18V/–5V, I_D = 20A, R_G = 8Ω, Freewheeling diode = MSC080SMB120B4N (V_{GS} = –5V); reference Figure 1-19	—	11	—	ns
t_r	Rise time		—	8	—	
$t_{d(off)}$	Turn-off delay time		—	17	—	
t_f	Fall time		—	8	—	
E_{on}	Turn-on switching energy		—	167	—	µJ
E_{off}	Turn-off switching energy		—	62	—	
ESR	Gate equivalent series resistance	f = 1 MHz, 25 mV, drain-to-source short	—	2.7	—	Ω
SCWT	Short circuit withstand time	V_{DS} = 960V, V_{GS} = 18V/0V, R_G = 20Ω	—	2	—	µs
E_{AS}	Avalanche energy, single pulse	I_D = 1.9A, 100% UIS production tested	280	—	—	mJ
$E_{AS\ CHAR}$		I_D = 8.0A, last typical pass	—	800	—	

The following table shows the body diode characteristics of the device at T_J = 25 °C unless otherwise specified.

Table 1-5. Body Diode Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	I_{SD} = 6A, V_{GS} = 0V	—	3.5	—	V
		I_{SD} = 6A, V_{GS} = –5V	—	3.9	5.0	
t_{rr}	Reverse recovery time	I_{SD} = 20A, V_{GS} = –5V, Drive R_G = 8Ω, V_{DD} = 850V, dI/dt = –9000 A/µs	—	22	—	ns
Q_{rr}	Reverse recovery charge		—	70	—	nC
I_{RRM}	Reverse recovery current		—	23	—	A

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1.4. Typical Performance Curves

Figure 1-1. Drain Current vs. V_{DS} at T_J

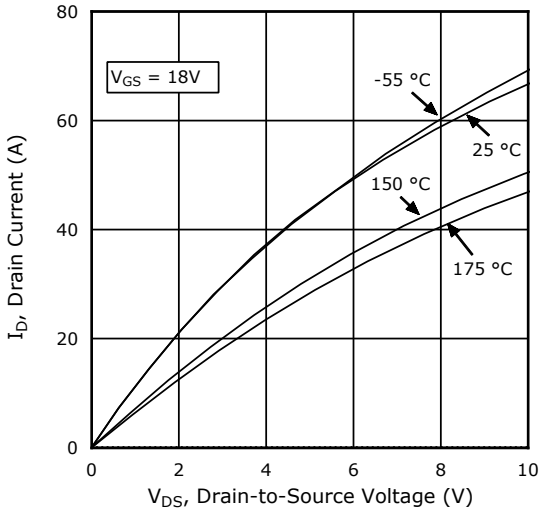


Figure 1-2. Drain Current vs. V_{DS} at V_{GS}

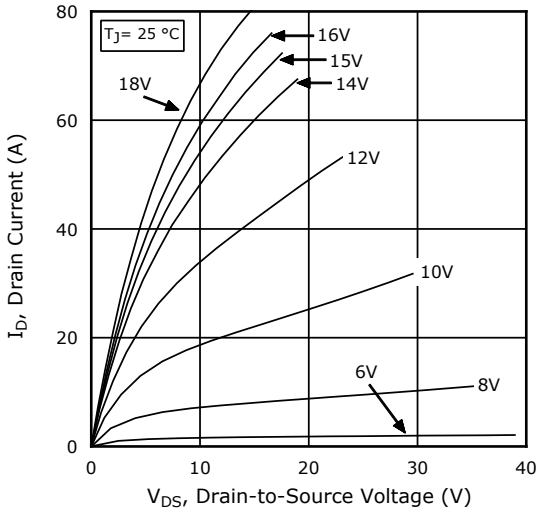


Figure 1-3. Drain Current vs. V_{DS} at V_{GS}

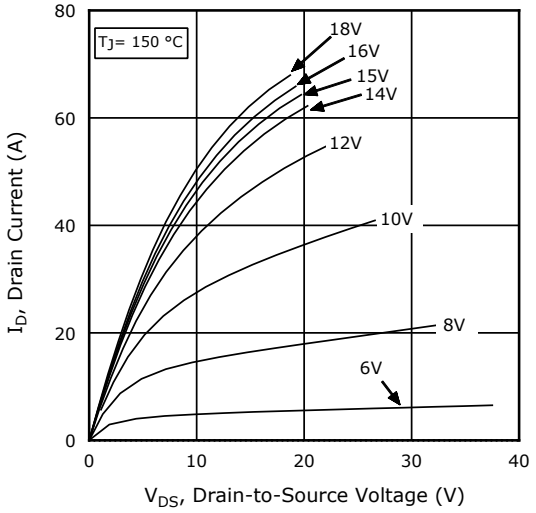
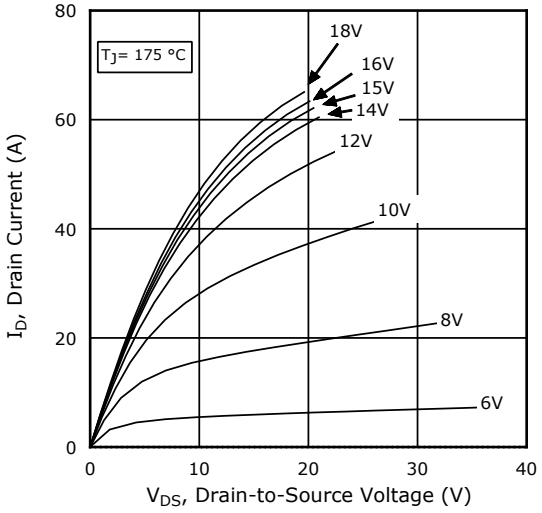


Figure 1-4. Drain Current vs. V_{DS} at V_{GS}



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Figure 1-5. I_D vs. V_{DS} 3rd Quadrant Conduction

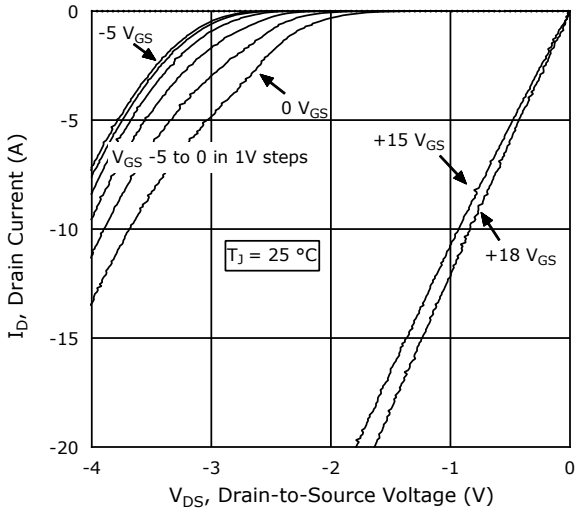


Figure 1-6. I_D vs. V_{DS} 3rd Quadrant Conduction

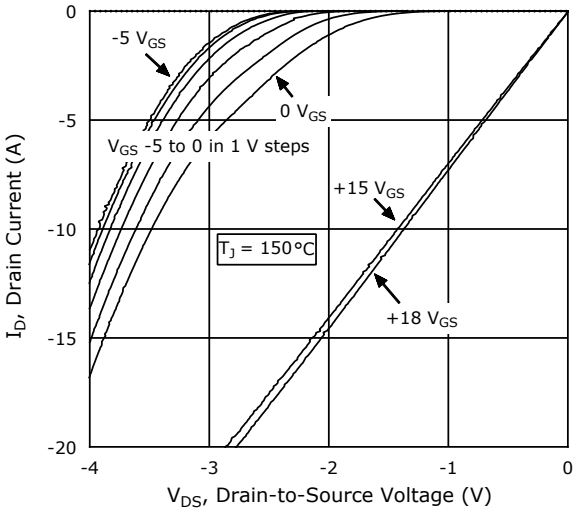


Figure 1-7. $R_{DS(on)}$ vs. Junction Temperature

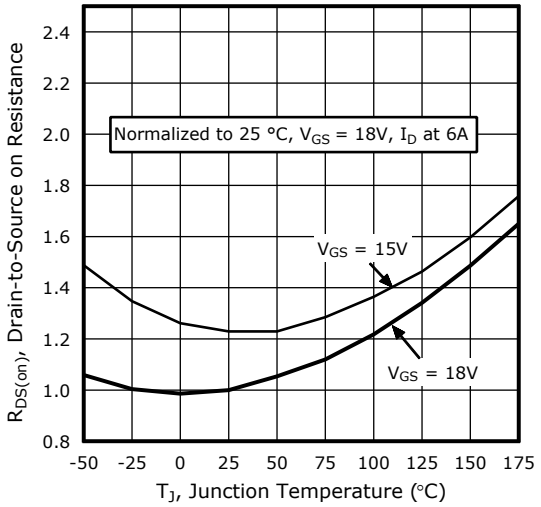
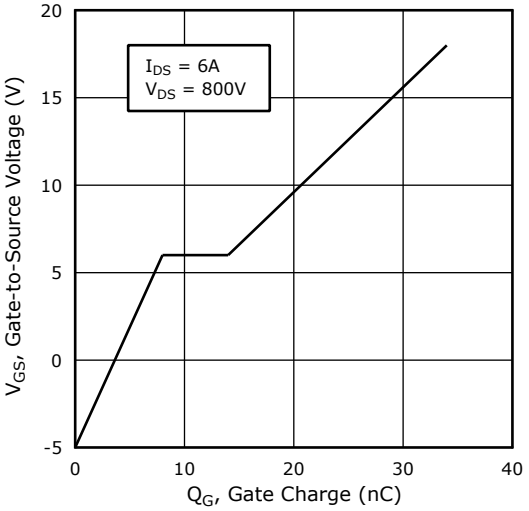


Figure 1-8. Gate Charge Characteristics



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Figure 1-9. Capacitance vs. Drain-to-Source Voltage

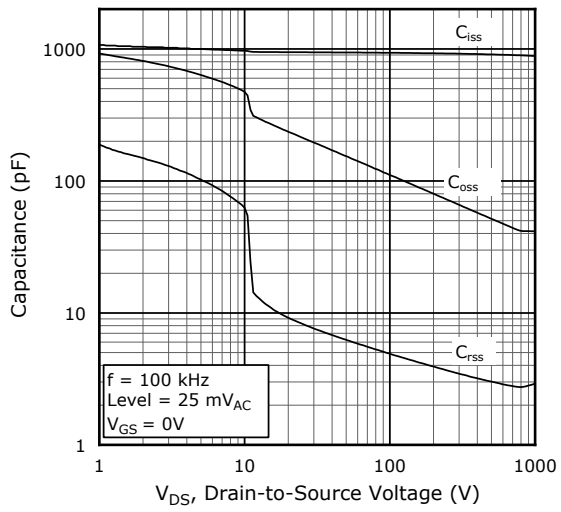


Figure 1-10. Q_{oss} vs. Drain-to-Source Voltage

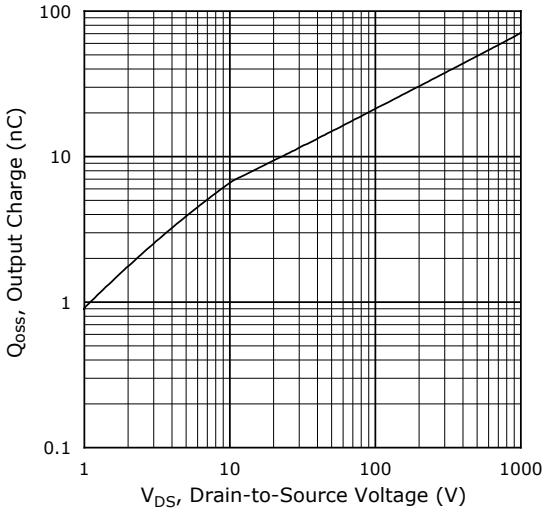


Figure 1-11. E_{oss} vs. Drain-to-Source Voltage

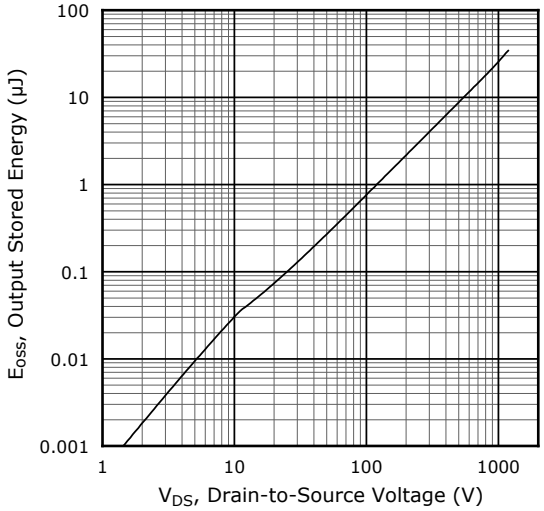
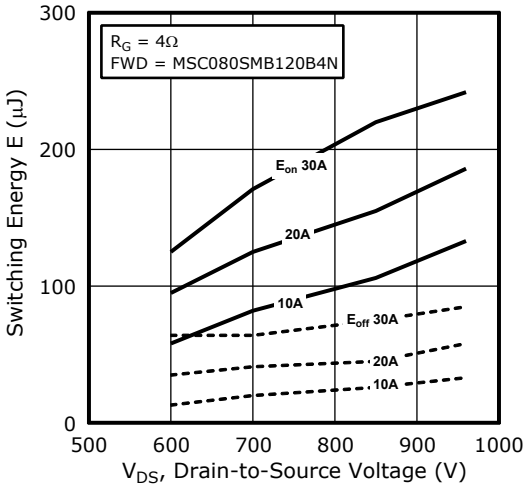


Figure 1-12. Switching Energy vs. V_{DS} & I_D



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Figure 1-13. Switching Energy vs. V_{DS} & I_D

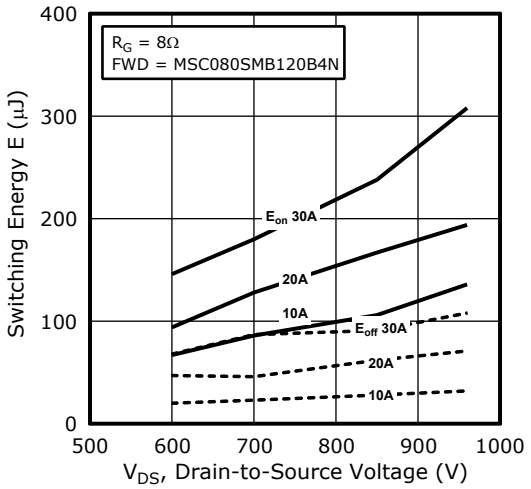


Figure 1-14. Switching Energy vs. V_{DS} & I_D

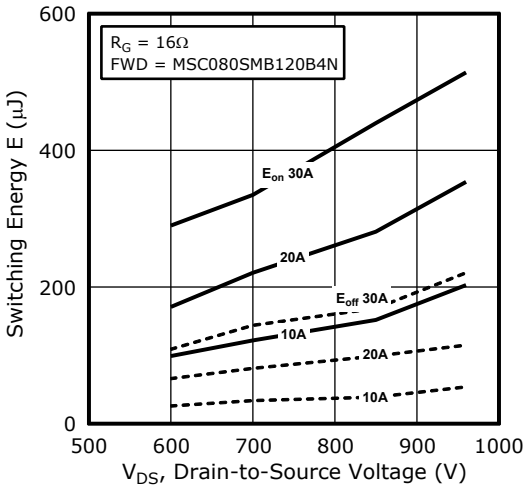


Figure 1-15. Switching Energy vs. Junction Temperature

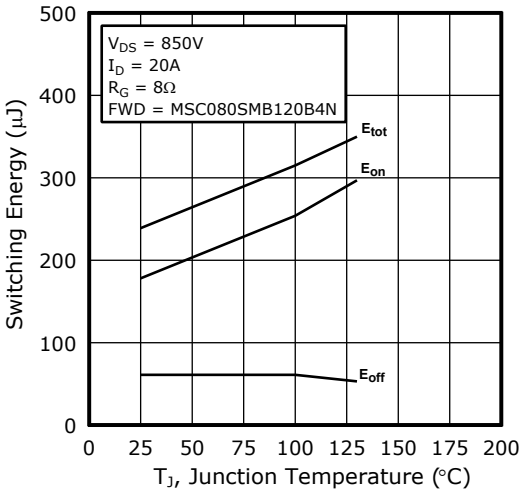
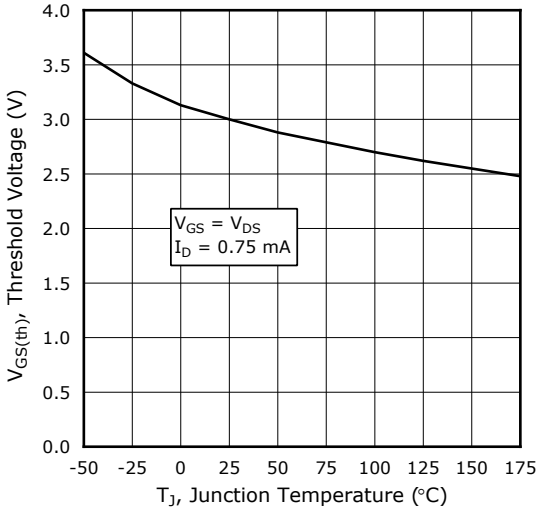


Figure 1-16. Threshold Voltage vs. Junction Temperature



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Figure 1-17. Forward Safe Operating Area

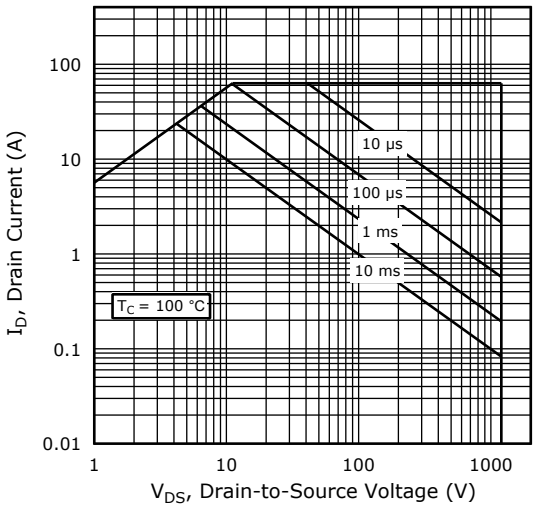
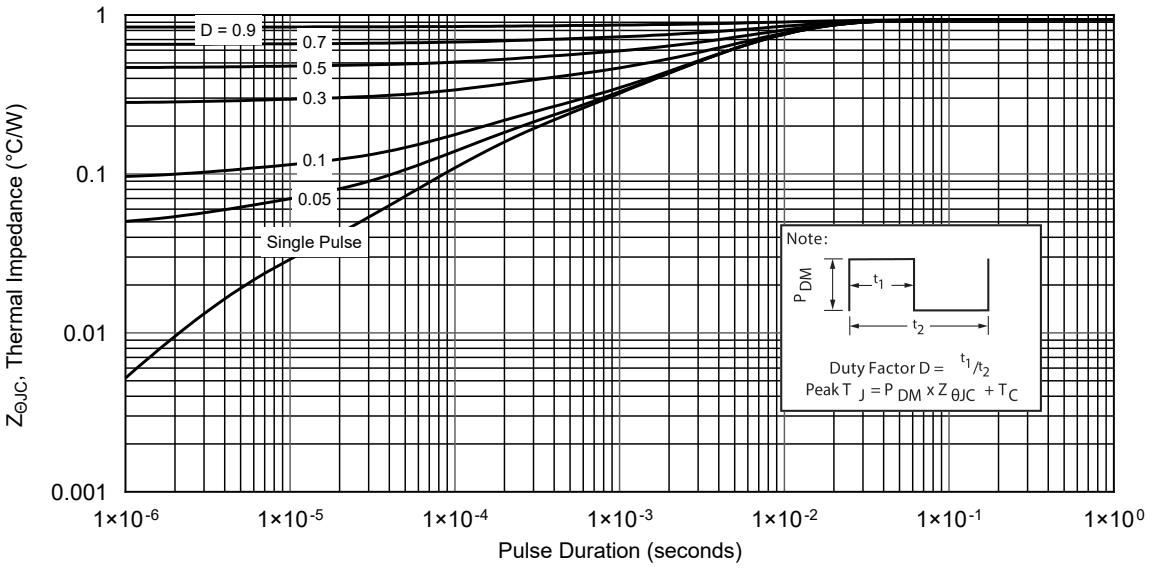
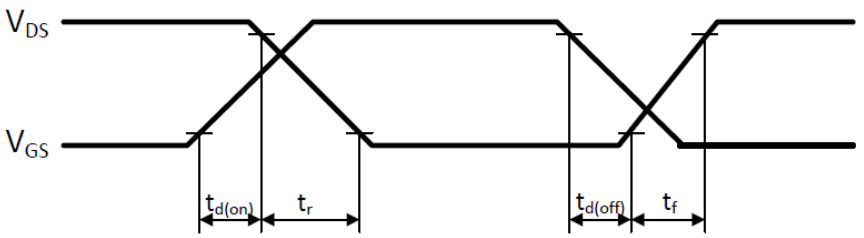


Figure 1-18. Maximum Transient Thermal Impedance



The following figure shows the switching waveform diagram of this device.

Figure 1-19. Switching Waveform



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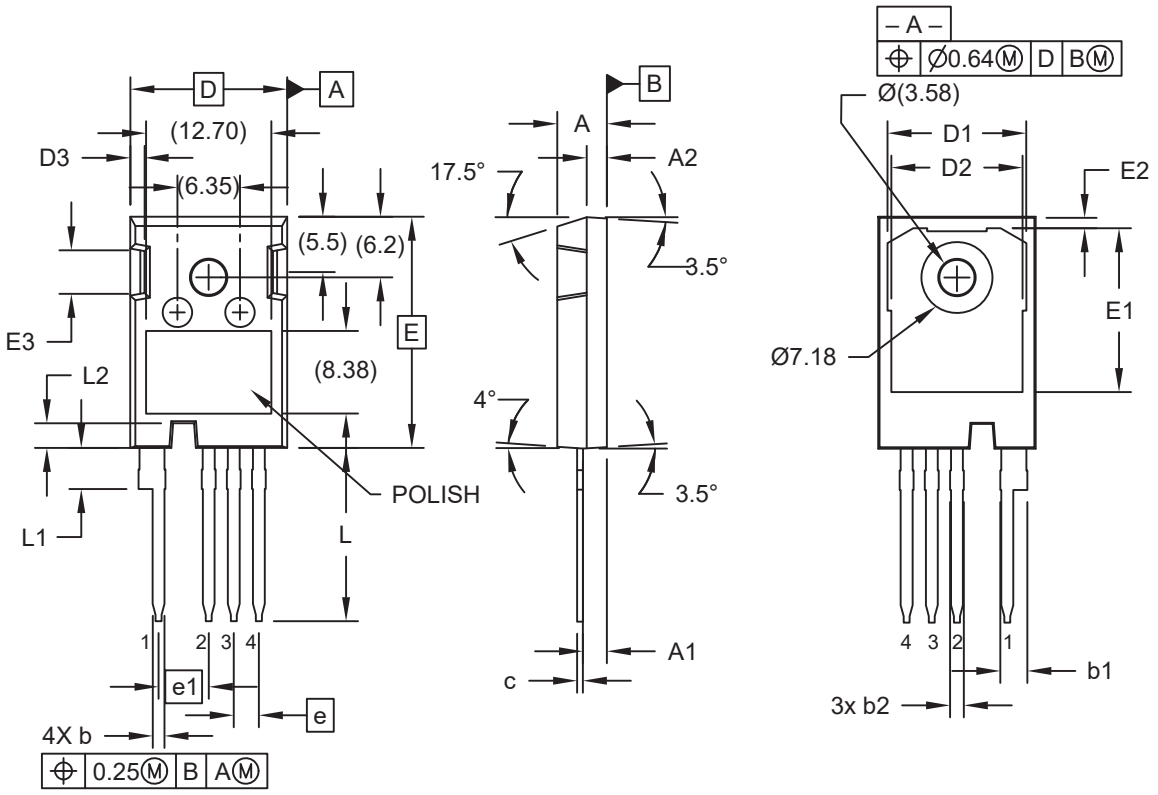
2. Package Specification

This section shows the package specification of this device.

2.1. Package Outline Drawing

The following figure illustrates the TO-247 notched-4L package outline of this device.

Figure 2-1. Package Outline Drawing



The following table shows the TO-247 notched-4L dimensions and should be used in conjunction with the package outline drawing.

Table 2-1. TO-247 Notched-4L Dimensions

Symbol	Description	Min. (mm)	Nom. (mm)	Max. (mm)
N	Number of terminals	4		
e	Pitch	2.54 BSC		
e1		5.08 BSC		
A	Overall height	4.83	5.02	5.21
A1	Standoff	2.29	2.41	2.54
A2	Exposed pad thickness	1.91	2.03	2.16
c	Terminal thickness	0.55	0.60	0.68
D	Overall length	15.75	15.94	16.13

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Table 2-1. TO-247 Notched-4L Dimensions (continued)

Symbol	Description	Min. (mm)	Nom. (mm)	Max. (mm)
D1	Exposed pad length	13.10	13.62	14.15
D2		12.38	12.90	13.43
D3	Cutout length	1.00	1.45	1.90
E	Overall width	23.30	23.45	23.60
E1	Exposed pad width	16.25	16.95	17.65
E2	Exposed pad gap to edge	0.95	1.10	1.25
E3	Cutout width	3.68	4.39	5.10
b	Terminal width	1.07	1.20	1.33
b1	Terminal shoulder width (X1)	2.39	2.66	2.94
b2	Terminal shoulder width (X3)	1.07	1.33	1.60
L	Terminal length	17.31	17.56	17.82
L1	Terminal shoulder length	3.97	4.17	4.37
L2	Notch depth	2.35	2.50	2.65

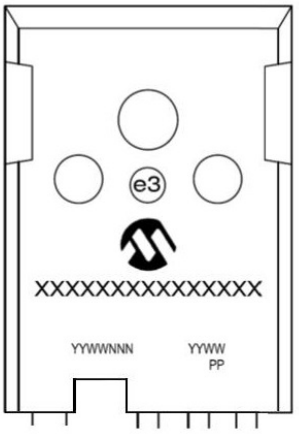
Note:
Dimensioning and tolerancing per ASME Y14.5M.

- BSC: Basic dimension. Theoretically exact value shown without tolerances.

2.2. Product Marking Information

The following figure shows the product marking information of this device.

Figure 2-2. Product Marking Information



Marking	Marking Identifier	Description
XXXXXXXXXX	Catalog Part Number (CPN)	This is the unique catalog number for the finished device. **Note:** For automotive-grade device, the VAO identifier is not shown.
YYWWNNN	Traceability code	A unique identifier assigned by Microchip to track and verify the manufacturing history of the device.
YYWW	Date code	A four-digit number which reflects the year and work week of manufacturing. It is the first four digits of the traceability code.
PP	Country of origin	Two-character code per ISO 3166-1-Alpha-2, indicating the manufacturing country.
e3	ROHS category (Lead finish code)	This code specifies the type of finish applied to the device's leads. **Note:** e3 indicates a 100% Matte Tin (Sn) finish.

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3. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Table 3-1. Revision History

Revision	Date	Description
C	12/2025	Added $R_{DS(on)}$ value at 175 °C in Table 1-3.
B	07/2025	The following changes are made in this revision of the document: • Updated data sheet type from advance information to final data sheet. • Updated the Features section to include 100% UIS production tested in Product Overview. • Updated I_D values in Table 1-1. • Updated tables in Electrical Performance. • Updated figures in Typical Performance Curves.
A	12/2024	Initial revision (advance information)

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