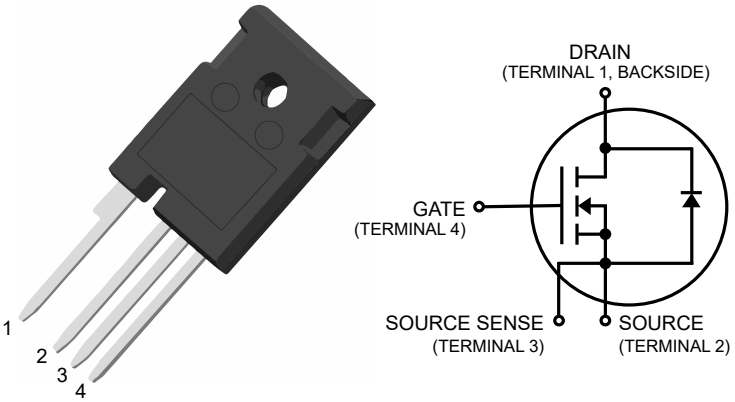
3300V, 25 mΩ N-Channel mSiC™ MOSFET

MSC025SMA330B4N

Product Overview

3300V, 25 mΩ typical at V_{GS} = 20V, 26 mΩ typical at V_{GS} = 18V, Silicon Carbide (SiC) N-Channel MOSFET, TO-247 notched 4-lead with a source sense.



Features

- Low capacitances and low gate charge
- Fast switching speed due to low internal gate resistance (ESR)
- Stable operation at high junction temperature, $T_{J(max)}$ = 150 °C
- Fast and reliable body diode
- 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	3300	V
I_D	Continuous drain current at T_C = 25 °C	106	A
	Continuous drain current at T_C = 100 °C	67	
I_{DM}	Pulsed drain current[1]	240	
V_{GS}	Gate-source voltage	23 to –10	V
	Transient gate-source voltage	25 to –12	
P_D	Total power dissipation at T_C = 25 °C	801	W
	Linear derating factor	6.3	W/°C

Note:

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

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	—	0.12	0.16	°C/W
T_J	Operating junction temperature	–55	—	150	°C
T_{STG}	Storage temperature	–55	—	150	
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.

1.2. Electrical Performance

The following table shows the static characteristics of this device. 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	3300	—	—	V
$R_{DS(on)}$	Drain-source on resistance[1]	V_{GS} = 20V, I_D = 40A	—	25	31	mΩ
		V_{GS} = 18V, I_D = 40A	—	26	—	
$V_{GS(th)}$	Gate-source threshold voltage	V_{GS} = V_{DS}, I_D = 7 mA	1.9	3.0	5.0	V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 3300V, V_{GS} = 0V	—	0.65	45	µA
		V_{DS} = 3300V, V_{GS} = 0V, T_J = 150 °C	—	8.0	—	
I_{GSS}	Gate-source leakage current	V_{GS} = 20V/–10V	—	—	±100	nA

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Note:

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

The following table shows the dynamic characteristics of this device. T_J = 25 °C unless otherwise specified. The dynamic characteristics are characterized, not 100% tested, at the recommended operating V_{GS} = 20V/–5V.

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0V, V_{DD} = 2400V, V_{AC} = 25 mV, ƒ = 200 kHz	—	7080	—	pF
C_{rss}	Reverse transfer capacitance		—	13	—	
C_{oss}	Output capacitance		—	186	—	
Q_G	Total gate charge	V_{GS} = –5V/20V, V_{DD} = 2650V, I_D = 70A	—	410	—	nC
Q_{GS}	Gate-source charge		—	138	—	
Q_{GD}	Gate-drain charge		—	133	—	
$t_{d(on)}$	Turn-on delay time	V_{DD} = 2200V, V_{GS} = –5V/20V, I_D = 50A, $R_{G(ext)}$ = 4Ω, Freewheeling diode = MSC025SMA330B4N (V_{GS} = –5V); reference Figure 1-19	—	32	—	ns
t_r	Voltage rise time		—	26	—	
$t_{d(off)}$	Turn-off delay time		—	79	—	
t_f	Voltage fall time		—	26	—	
E_{on}	Turn-on switching energy		—	5802	—	µJ
E_{off}	Turn-off switching energy		—	694	—	
ESR	Gate equivalent series resistance	f = 1 MHz, 25 mV, drain short	—	0.79	—	Ω

The following table shows the body diode characteristics of this device. T_J = 25 °C unless otherwise specified. The body diode reverse recovery is characterized, not 100% tested.

Table 1-5. Body Diode Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	I_{SD} = 40A, V_{GS} = 0V	—	3.5	—	V
		I_{SD} = 40A, V_{GS} = –5V	—	3.6	5.0	
t_{rr}	Reverse recovery time	I_{SD} = 50A, V_{GS} = –5V, Drive R_G = 4Ω, V_{DD} = 2200V, dI/dt = –10100 A/µs	—	42	—	ns
Q_{rr}	Reverse recovery charge		—	1801	—	nC
I_{RRM}	Reverse recovery current		—	113	—	A

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1.3. Typical Performance Curves

Data for performance curves are characterized, not 100% tested.

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

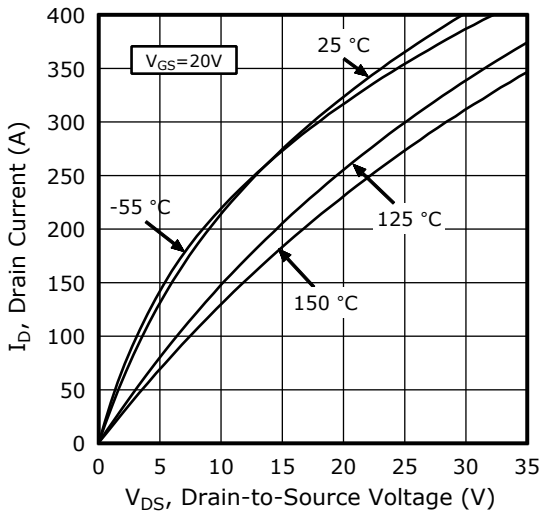


Figure 1-2. Drain Current vs. V_{DS} at V_{GS}

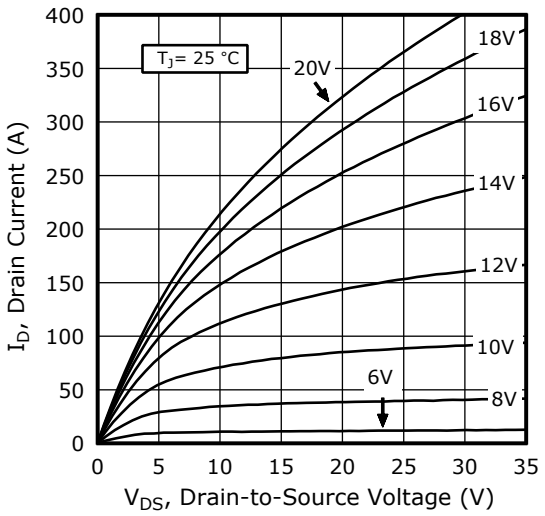


Figure 1-3. Drain Current vs. V_{DS} at V_{GS}

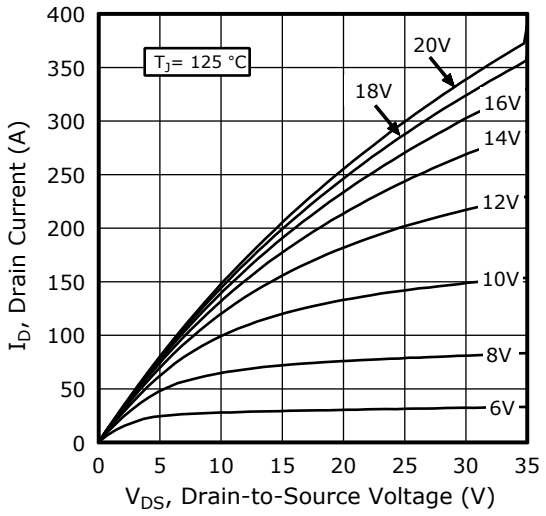
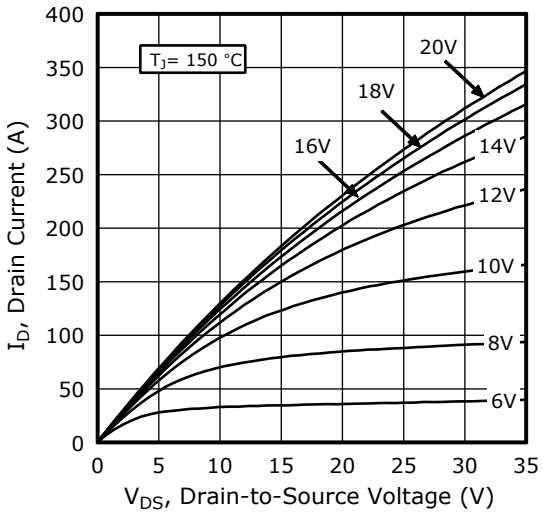


Figure 1-4. Drain Current vs. V_{DS} at V_{GS}



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Figure 1-5. $R_{DS(on)}$ vs. Junction Temperature

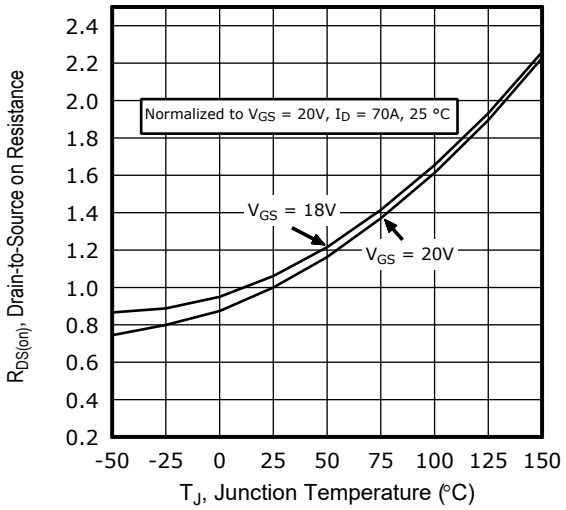


Figure 1-6. Gate Charge Characteristics

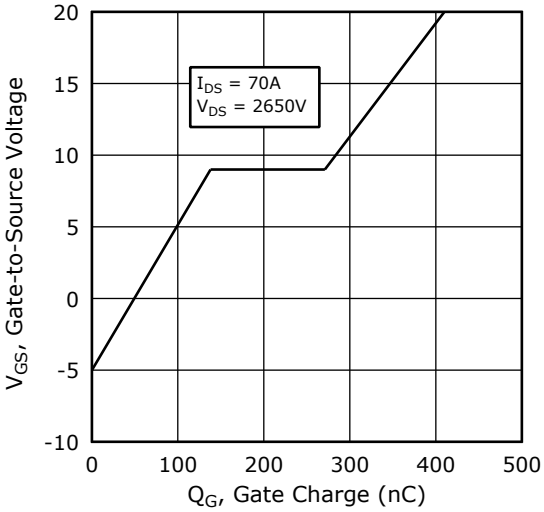


Figure 1-7. Capacitance vs. Drain-to-Source Voltage

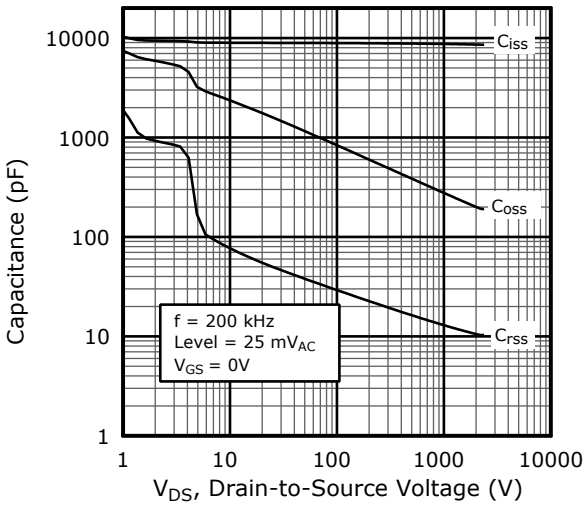
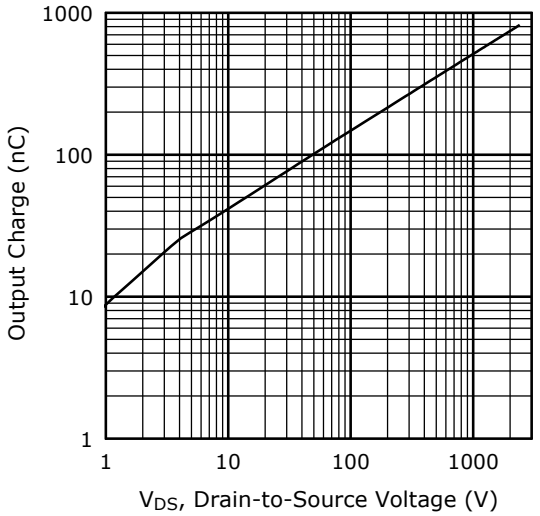


Figure 1-8. Output Charge vs. Drain-to-Source Voltage



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Figure 1-9. Output Stored Energy vs. V_{DS}

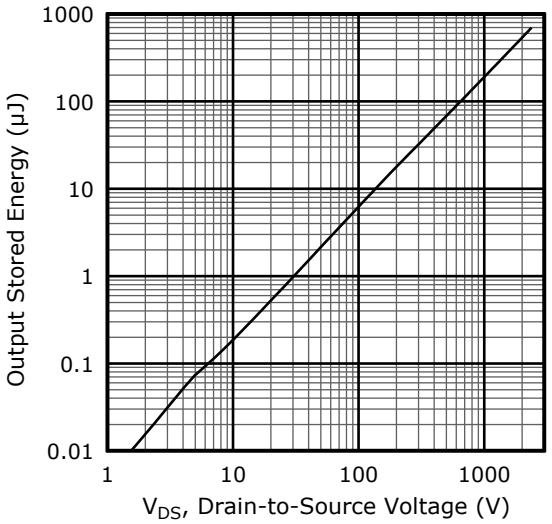


Figure 1-10. I_D vs. V_{DS} 3rd Quadrant Conduction

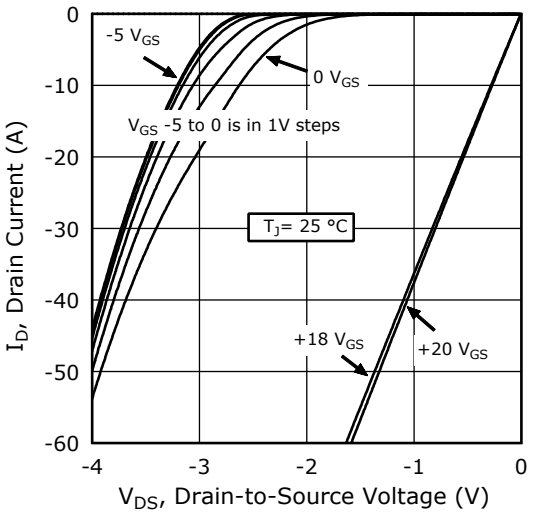


Figure 1-11. I_D vs. V_{DS} 3rd Quadrant Conduction

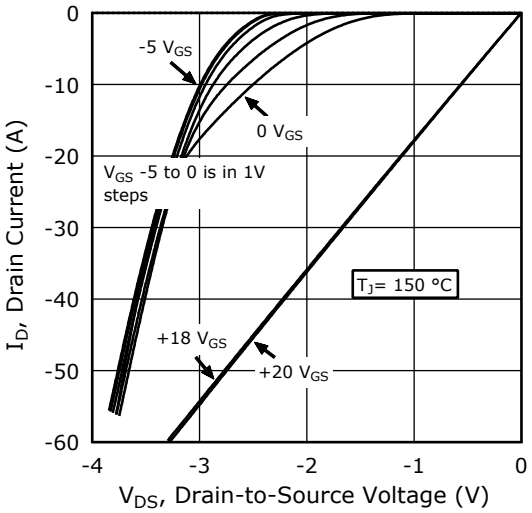
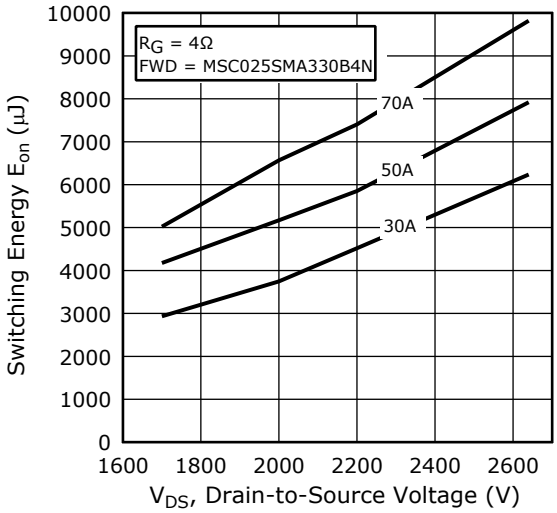


Figure 1-12. Switching Energy E_{on} vs. V_{DS} & I_D



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

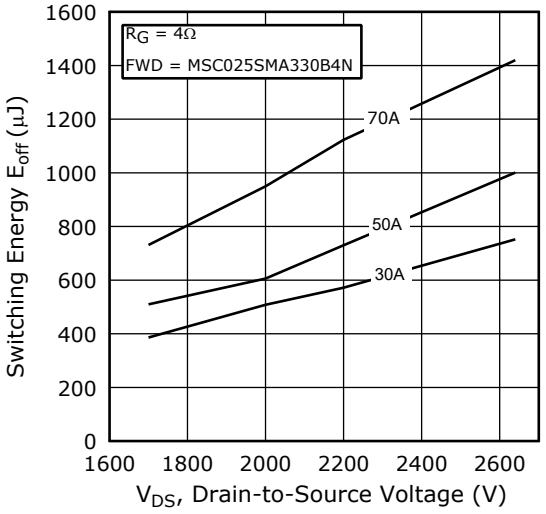


Figure 1-14. Switching Energy vs. R_G

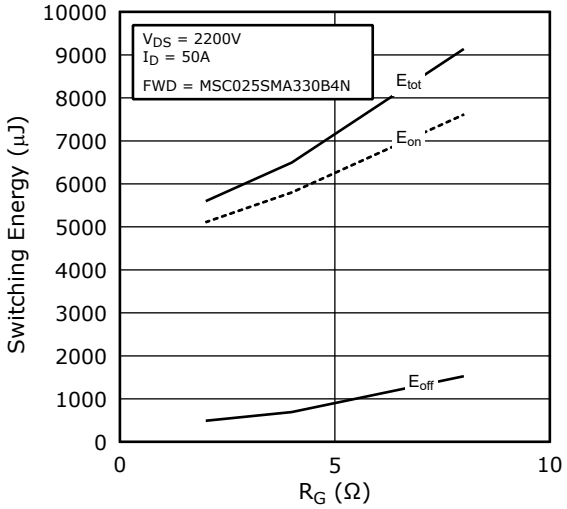


Figure 1-15. Switching Energy vs. Junction Temperature

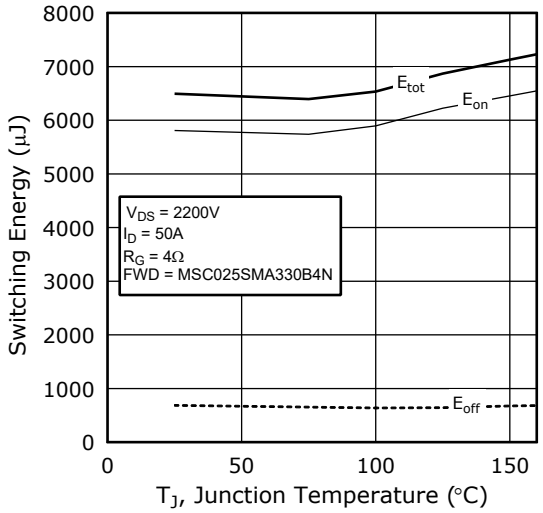
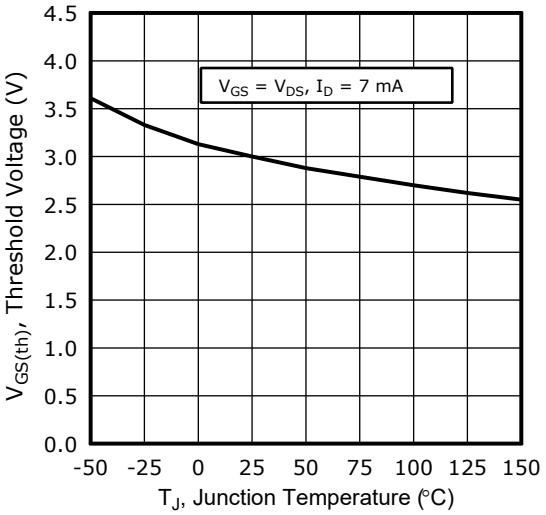


Figure 1-16. Threshold Voltage vs. Junction Temperature



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Figure 1-17. Forward Safe Operating Area

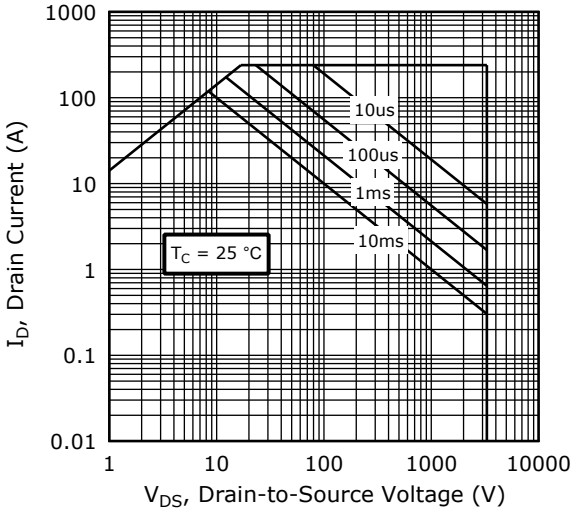
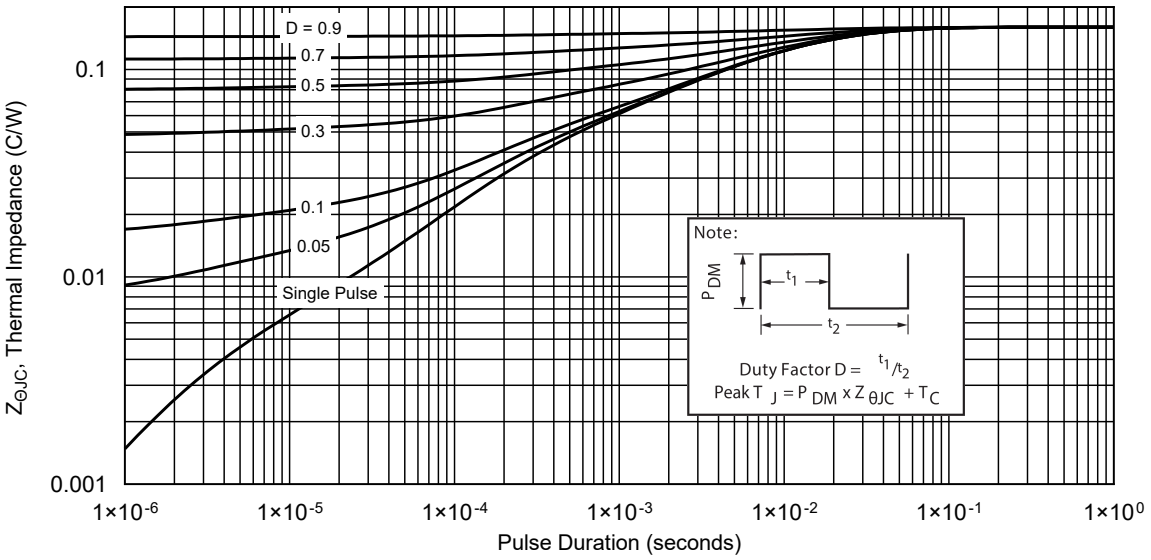
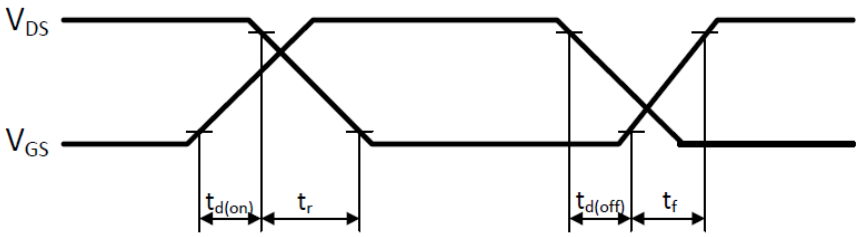


Figure 1-18. Maximum Transient Thermal Impedance



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

Figure 1-19. Switching Waveform



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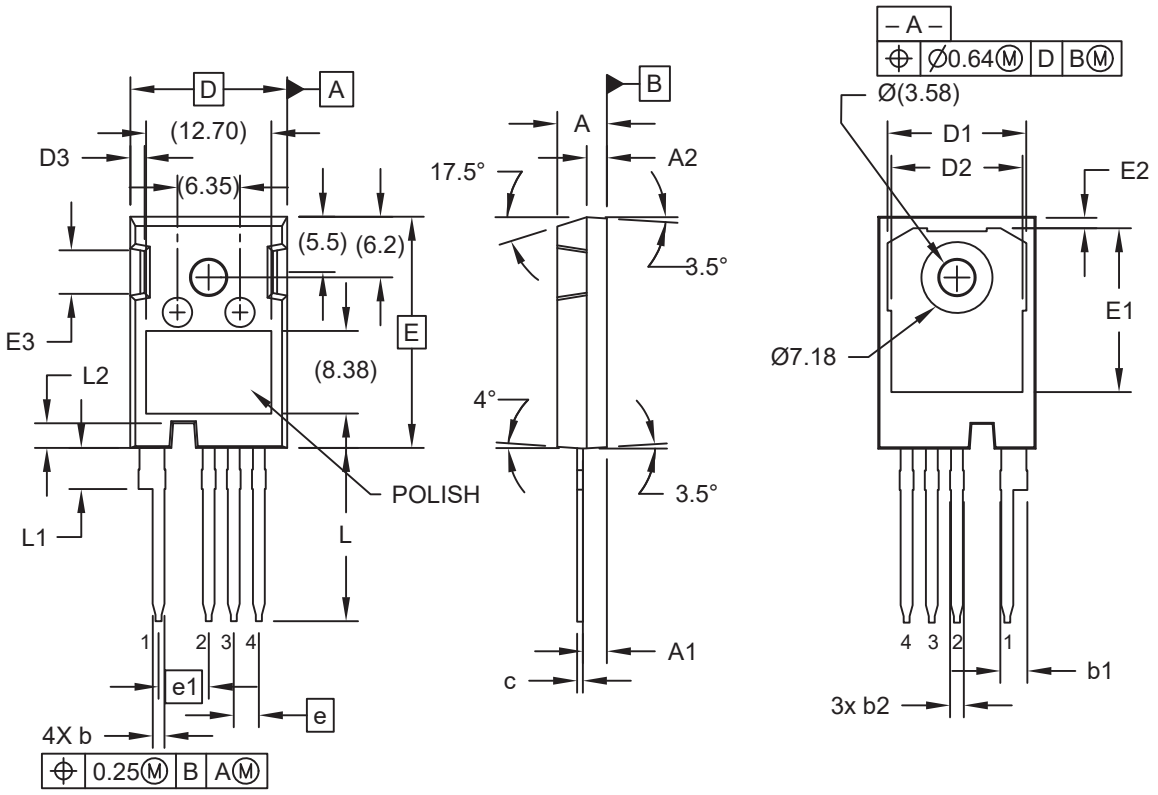
2. Package Specification

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.

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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	06/2025	Updated E_{on} and E_{off} values in Table 1-4.
B	05/2025	The following changes are made in this revision of the document: • Updated I_{DSS} maximum value in Table 1-3. • Updated Figure 1-16 and Figure 1-17.
A	01/2025	Initial revision

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