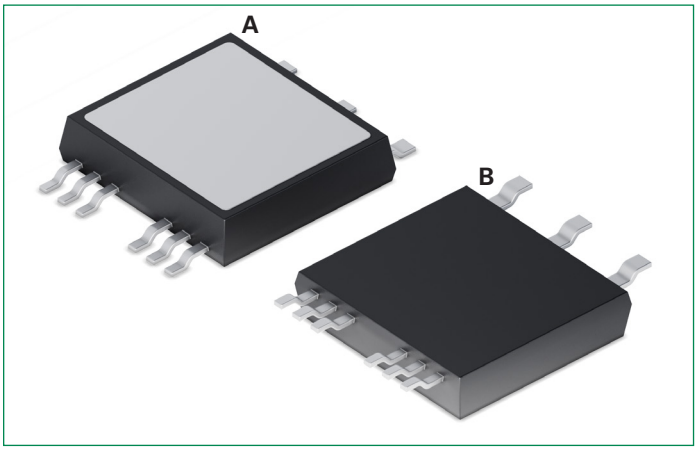
MCL10P1200LB

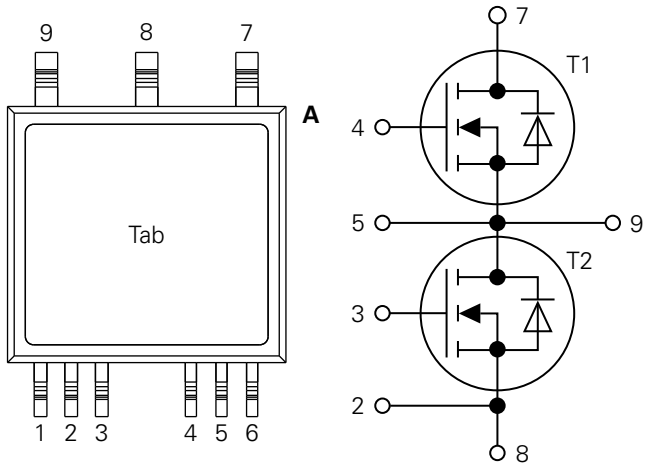
1200 V, 160 mΩ, 19.5 A SiC Power MOSFET in Phase-Leg Configuration

E72873 Pending



A: Top, **B:** Bottom

Pinout Diagram (SMPD-B)



1: Not Connected; **2:** Kelvin Source T2; **3:** Gate T2; **4:** Gate T1; **5:** Kelvin Source T1; **6:** Not Connected; **7:** DC+; **8:** DC−; **9:** Output; **Tab:** Electrically Isolated

Features & Benefits:

- High speed switching with low capacitances
- High blocking voltage with low $R_{DS(on)}$
- Easy to parallel and simple to drive
- Resistant to latch-up

SMPD Package:

- DCB based isolated package improves thermal resistance and power handling capability
- Isolation voltage 2500V AC (RMS), 1 minute
- Low drain-to-tab stray capacitance
- Optimized package with separate driver source pin
- Advanced topside cooled packaging simplifies thermal management
- RoHS compliant
- Epoxy meets UL 94V-0

Applications:

- Solar Inverters
- High Voltage DC/DC converters
- Motor Drives
- Switch Mode Power Supplies
- UPS
- Battery Chargers
- Induction Heating

Product Summary

Characteristic	Value	Unit
I_{D25}	19.5	A
V_{DSS}	1200	V
$R_{DS(on)typ}$	160	mΩ

Revised: XZ 09/08/2023

MOSFET Characteristics

Symbol	Characteristics	Conditions		Ratings			Unit
				Min.	Typ.	Max.	
BV_{DSS}	Drain-Source Breakdown Voltage	I_D = 100 µA		1200	–	–	V
I_{D25}	Drain Current	V_{GS} = 20 V	T_C = 25°C	–	–	19.5	A
I_{D80}			T_C = 80°C	–	–	15	
I_{D100}			T_C = 100°C	–	–	13.5	
V_{GS}	Gate-Source Voltage	Continuous	T_{VJ} = 25°C	–30	–	30	V
		Transient		–5	–	+20	
$V_{GS(th)}$	Gate Threshold Voltage	I_D = 5 mA, V_{GS} = V_{DS}	T_{VJ} = 25°C	1.8	2.8	4.0	V
			T_{VJ} = 175°C	–	1.8	–	
$T_{VJ,op}$	Virtual Junction Temperature	–		–55	–	150	°C
I_{DSS}	Drain-Source Leakage Current	V_{DS} = 1200 V, V_{GS} = 0 V	T_{VJ} = 25°C	–	1	100	µA
			T_{VJ} = 175°C	–	1	–	
I_{GSS}	Gate-Source Leakage Current	V_{DS} = 0 V, V_{GS} = 22 V	T_{VJ} = 25°C	–	–	100	nA
		V_{GS} = –6 V	T_{VJ} = 25°C	–	–	100	
$R_{DS(on)}$	Drain-Source On-State Resistance	I_D = 10 A, V_{GS} = 20 V	T_{VJ} = 25°C	–	160	200	mΩ
			T_{VJ} = 175°C	–	230	–	
$R_{G(int)}$	Internal Gate Resistance	f = 1 MHz, V_{AC} = 25 mV, ESR of C_{iss}		–	0.85	–	Ω
C_{iss}	Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, f = 1 MHz	T_{VJ} = 25°C	–	890	–	pF
C_{oss}	Output Capacitance			–	45	–	
C_{rss}	Reverse Transfer (Miller) Capacitance			–	5	–	
E_{oss}	C_{OSS} stored energy			–	14	–	µJ
Q_g	Total Gate Charge	V_{DS} = 800 V, I_D = 10 A, V_{GS} = –5/20 V	T_{VJ} = 25°C	–	50	–	nC
Q_{gs}	Gate Source Charge			–	15	–	
Q_{gd}	Gate Drain (Miller) Charge			–	17	–	
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching** Free Wheeling Diode: Body Diode V_{GS} = –5 V, V_{DS} = 800 V, I_D = 10 A V_{GS} = –5/20 V, $R_{G(ext)}$ = 18 Ω	T_{VJ} = 25°C	–	9.4	–	ns
			T_{VJ} = 150°C	–	8.7	–	
t_r	Current Rise Time		T_{VJ} = 25°C	–	4	–	ns
			T_{VJ} = 150°C	–	3.1	–	
$t_{d(off)}$	Turn-off Delay Time		T_{VJ} = 25°C	–	24.5	–	ns
			T_{VJ} = 150°C	–	30.2	–	
t_f	Current Fall Time		T_{VJ} = 25°C	–	31	–	ns
			T_{VJ} = 150°C	–	31.8	–	
E_{on}	Turn-on Energy per Pulse		T_{VJ} = 25°C	–	310	–	µJ
			T_{VJ} = 150°C	–	405	–	
E_{off}	Turn-off Energy per Pulse		T_{VJ} = 25°C	–	19.7	–	µJ
			T_{VJ} = 150°C	–	22.7	–	
$R_{th, JC}$	Thermal Resistance, junction-to-case	–		–	–	1.4	K/W
$R_{th, JS}$	Thermal Resistance, junction-to-sink	per MOSFET with heatsink compound λ = 0.67 W/mK		–	2.2	–	K/W

Source-Drain Diode of MOSFET Characteristics

Symbol	Characteristics	Conditions		Ratings			Unit
				Min.	Typ.	Max.	
V_{SD}	Forward Voltage Drop	I_F = 5 A, V_{GS} = -5 V	T_{VJ} = 25°C	–	4.2	–	V
			T_{VJ} = 175°C	–	3.7	–	
t_{rr}	Reverse Recovery Time	V_{GS} = –5 V, I_F = 10 A, V_R = 800 V, MOSFET gate drive: V_{GS} = –5/20 V, R_G = 18 Ω (external)	T_{VJ} = 25°C	–	11.9	–	ns
			T_{VJ} = 150°C	–	18.2	–	
Q_{rr}	Reverse Recovery Charge		T_{VJ} = 25°C	–	182	–	nC
			T_{VJ} = 150°C	–	334	–	
I_{rr}	Max. Reverse Recovery Current		T_{VJ} = 25°C	–	14.7	–	A
			T_{VJ} = 150°C	–	20.5	–	
dI_F/dt	Current Slew Rate		T_{VJ} = 25°C	–	2320	–	A/µs
			T_{VJ} = 150°C	–	2840	–	
$E_{rec(off)}$	Turn-off Energy of Intrinsic Diode per Pulse		T_{VJ} = 25°C	–	50.6	–	µJ
			T_{VJ} = 150°C	–	69.0	–	

SMPD Package

Symbol	Characteristics	Conditions		Value			Unit
				Min.	Typ.	Max.	
I_{RMS}	RMS Current	Wide Terminal		–	–	100	A
		Standard Terminal		–	–	60	
T_{stg}	Storage Temperature	–		–55	–	150	°C
T_{op}	Operation Temperature	–		–55	–	150	
F_C	Mounting Force with Clip	–		40	–	130	N
$d_{Spp/App}$ $d_{Spb/Apb}$	Creepage Distance on Surface / Clearance Distance Through Air	Terminal to Terminal	Between Pin 1 to 3	1.6	–	–	mm
			Between Pin 4 to 6				
			Between Pin 3 to 4	6.8	–	–	mm
			Between Pin 7 to 9				
	Clearance Distance Through Air	Terminal to Backside Plane	For All Terminals	4	–	–	mm
	Creepage Distance on Surface	Terminal to Backside Tab		5.17	–	–	mm
V_{ISOL}	Isolation Voltage	50/60 Hz; RMS; I_{ISOL} < 1 mA, t = 1 second		–	3000	–	V
		50/60 Hz; RMS; I_{ISOL} < 1 mA, t = 1 minute		–	2500	–	
W	Weight	–		–	8	–	g

Characteristic Curves

Fig.1. Maximum Power Dissipation (T_{VJ} = 175 ºC)

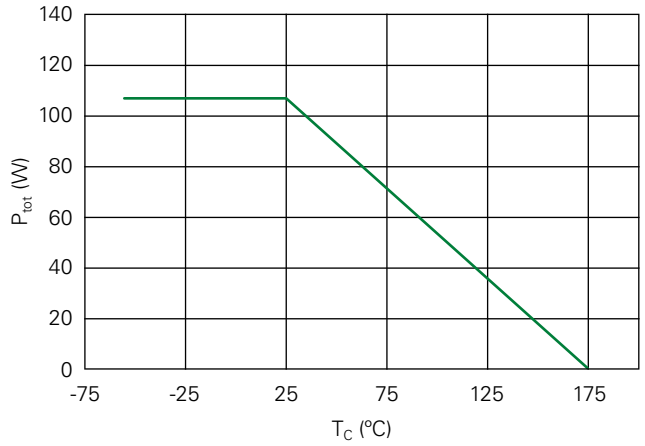


Fig. 2. Typical Transfer Characteristics

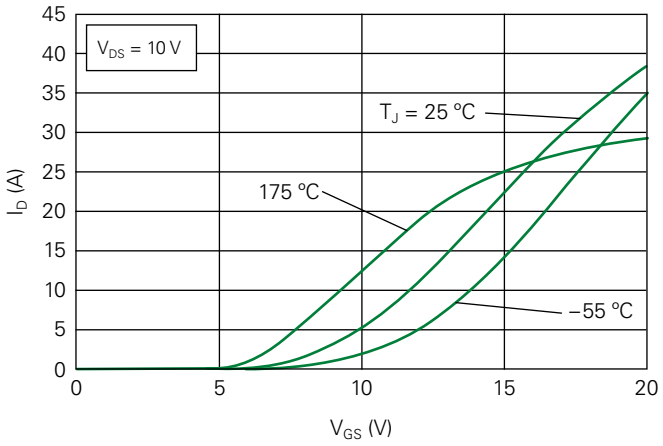


Fig. 3. Typical Output Characteristics (T_{VJ} = 25 ºC)

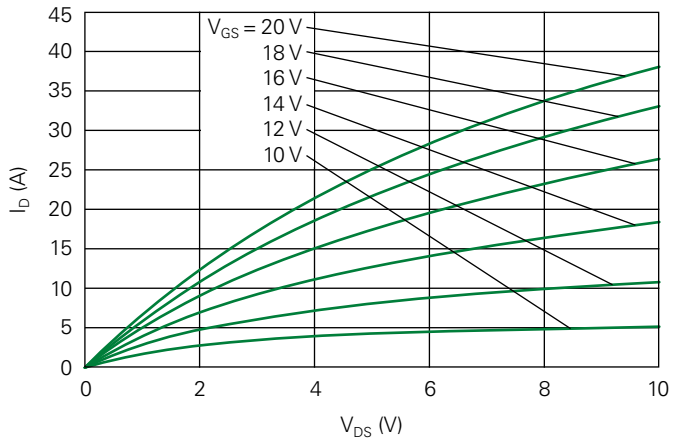


Fig. 4. Typical Output Characteristics (T_{VJ} = 175 ºC)

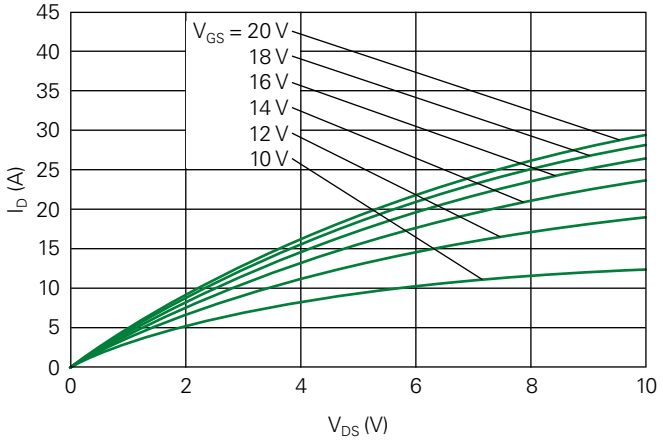


Fig. 5. Typical Output Characteristics (T_{VJ} = –55 ºC)

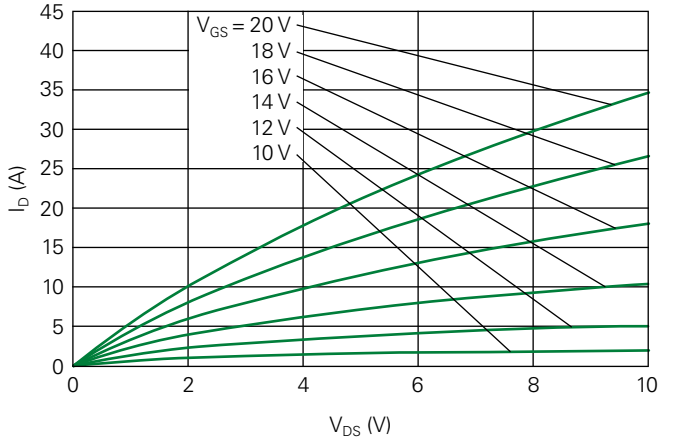
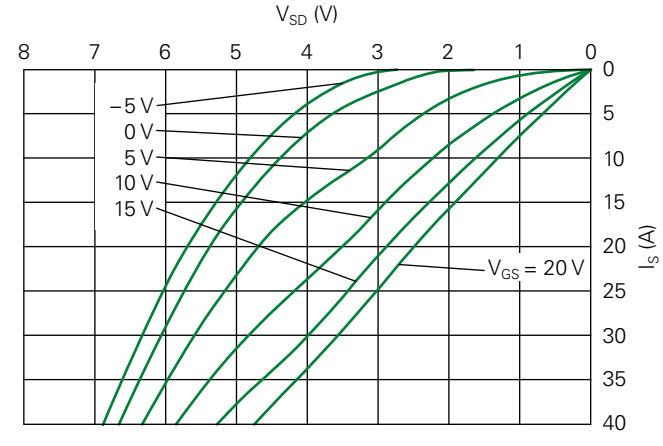


Fig. 6. Typical Reverse Conduction Characteristics (T_{VJ} = 25 ºC)



Characteristic Curves

Fig. 7. Typical Reverse Conduction Charateristics (T_{VJ} = 175 °C)

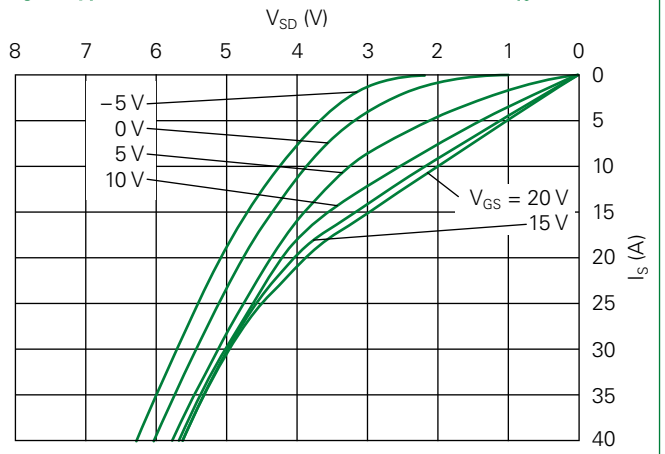


Fig. 8. Typical Reverse Conduction Characteristics (T_{VJ} = −55°C)

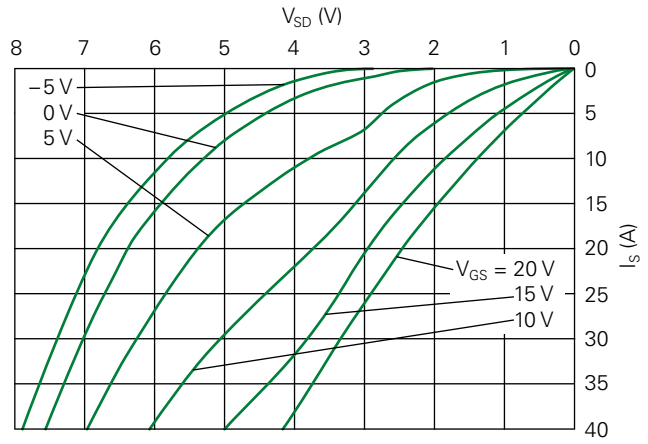


Fig. 9. Typical Transient Thermal Response Junction to Heat Sink

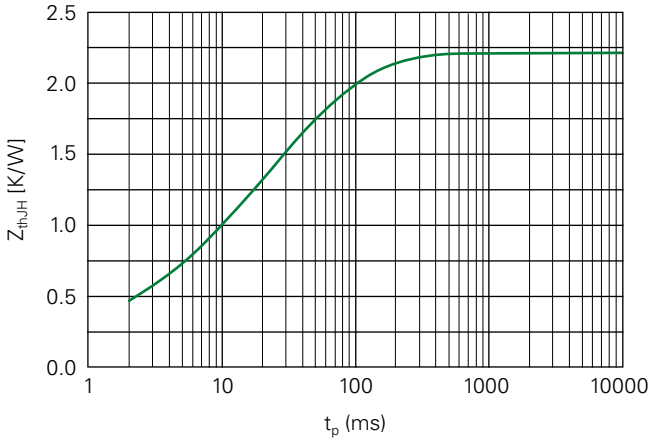


Fig. 10. Drain-Source On-State Resistance vs. Drain Current

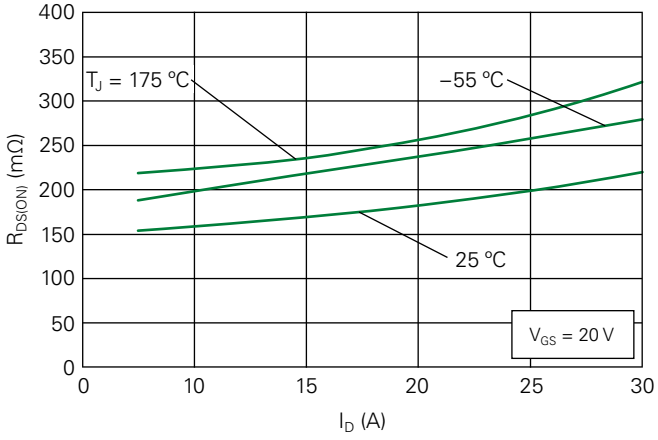


Fig. 11. Normalized On-State Resistance vs. Junction Temperature

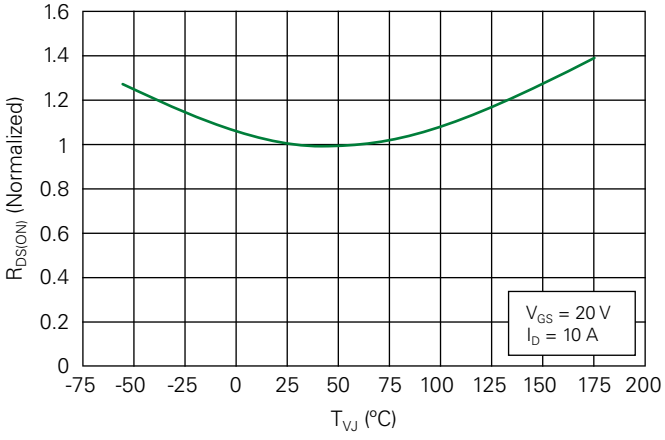


Fig. 12. Typical On-State Resistance vs. Junction Temperature

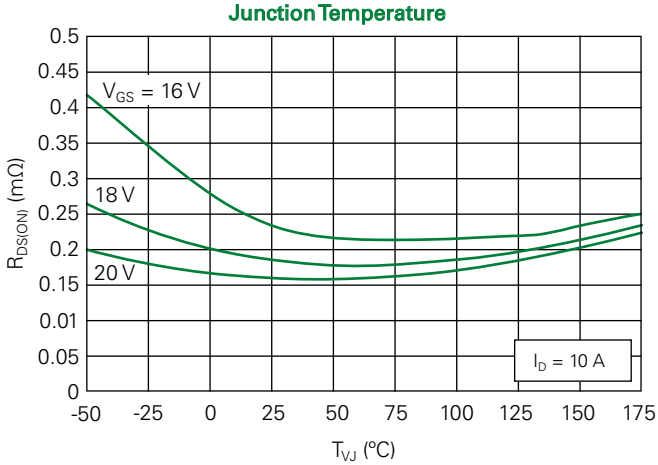


Fig. 13. Typical Threshold Voltage

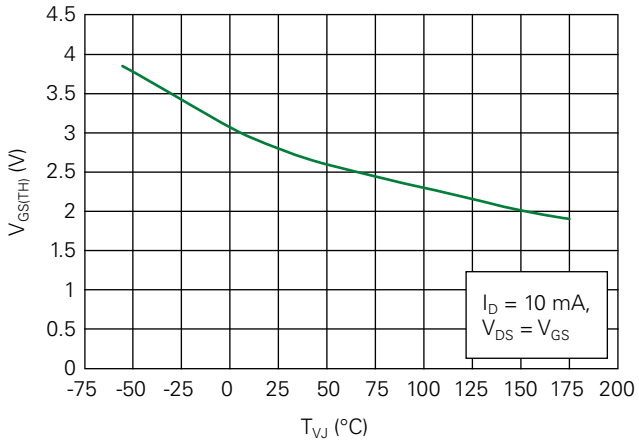


Fig. 14. Typical Junction Capacitance up to 1000 V

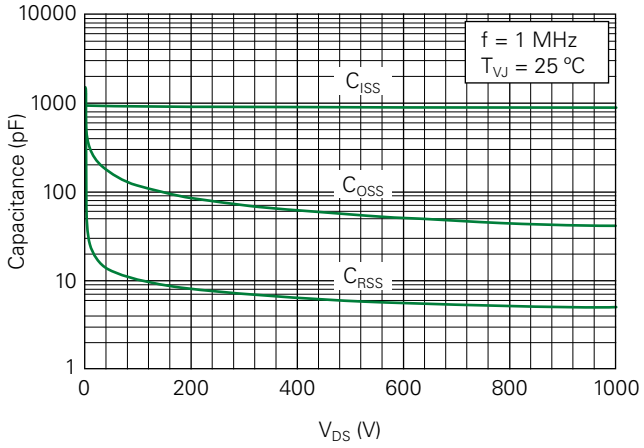


Fig. 15. Typical Junction Capacitance up to 200 V

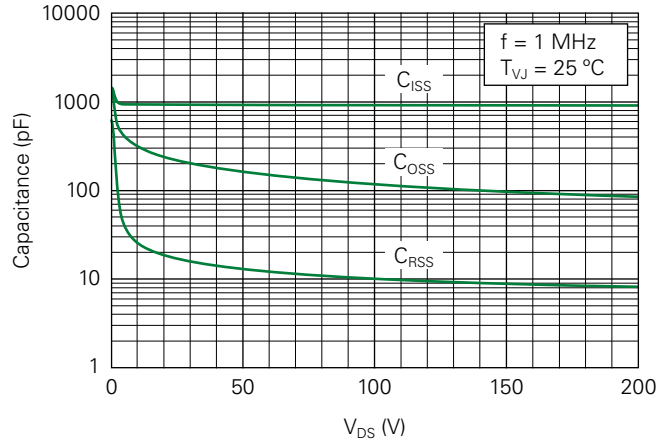


Fig. 16. Typical C_{oss} Stored Energy E_{oss}

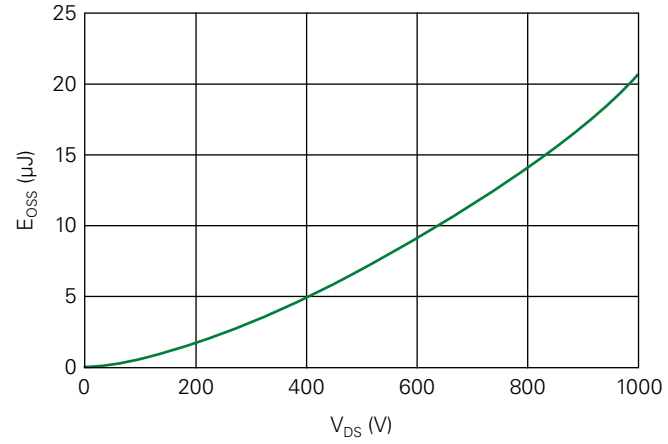


Fig. 17. Typical Switching Energy at 25 °C vs. Drain Current

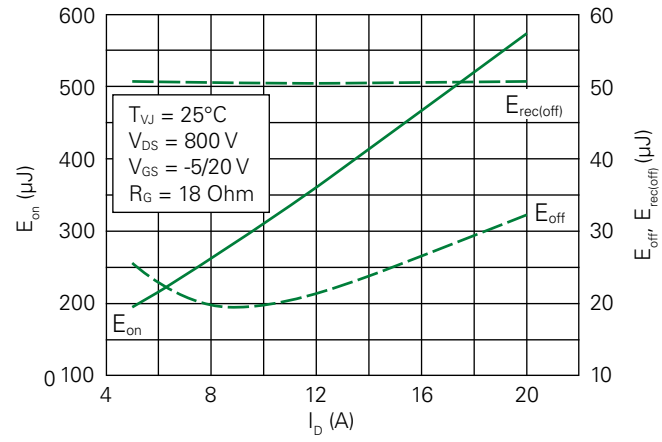


Fig. 18. Typical Switching Energy at 150 °C vs. Drain Current

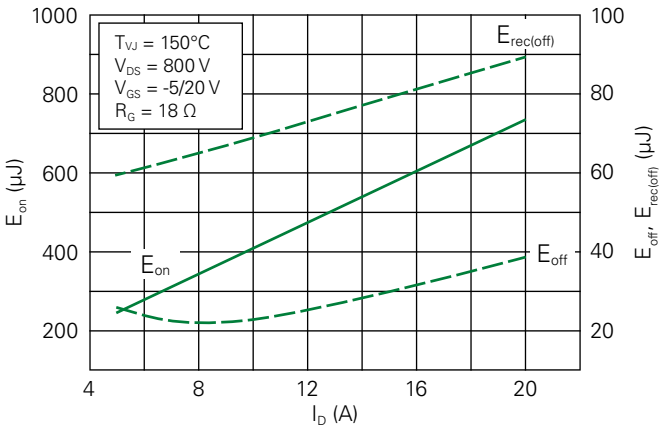


Fig. 19. Typical Switching Energy at 25 °C vs. External Gate Resistor

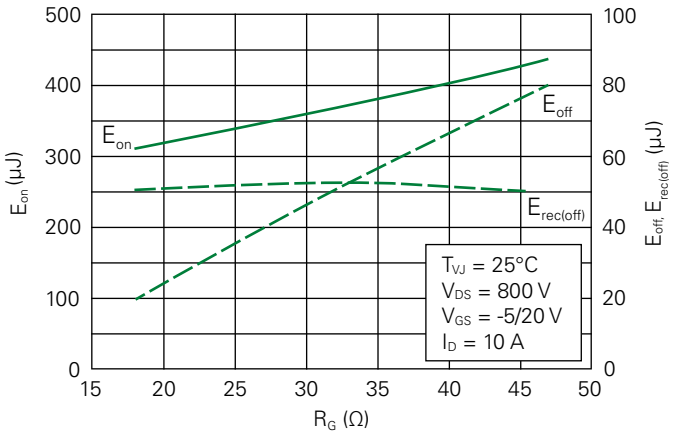


Fig. 20. Typical Switching Energy at 150 °C vs. External Gate Resistor

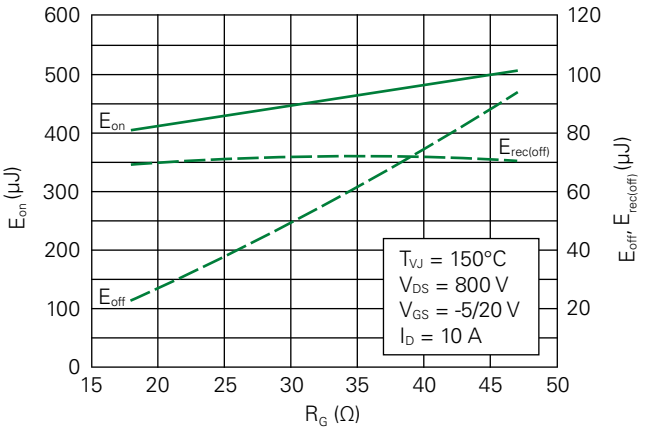


Fig. 21. Typical Switching Energy vs. Temperature

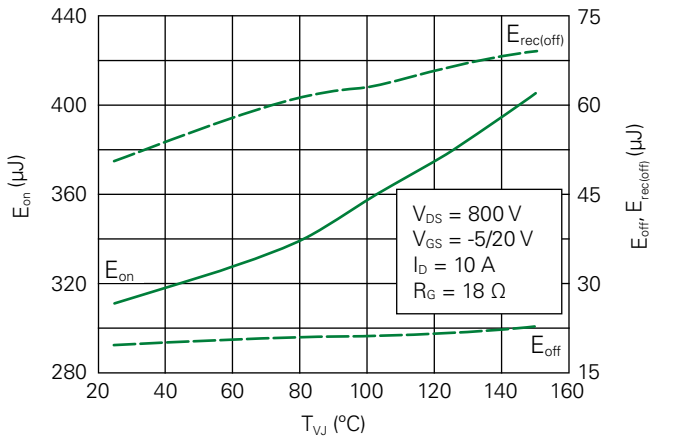


Fig. 22. Typical Switching Times at 25°C vs. Drain Current

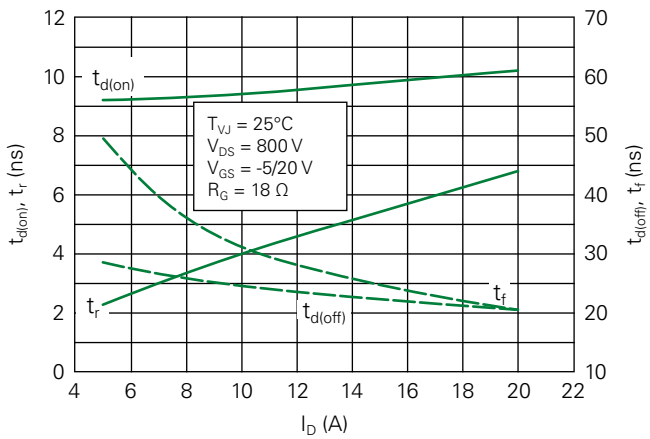


Fig. 23. Typical Switching Times at 150°C vs. Drain Current

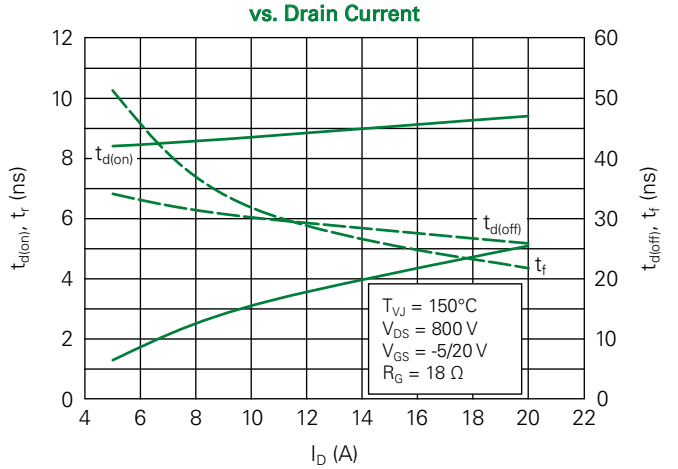


Fig. 24. Typical Switching Times at 25°C vs. External Gate Resistor

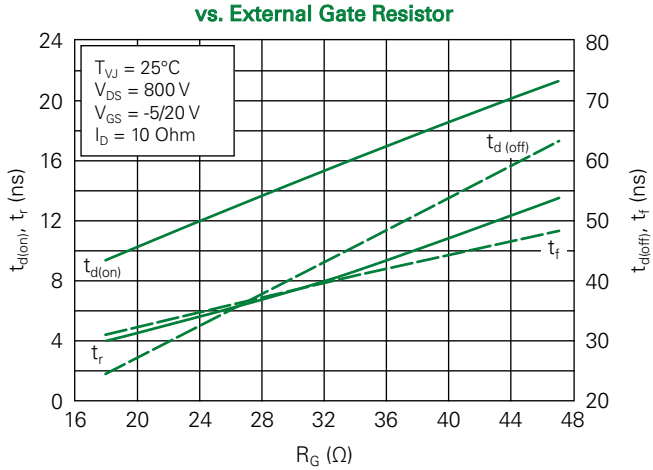


Fig. 25. Typical Switching Times at 150ºC vs. External Gate Resistor

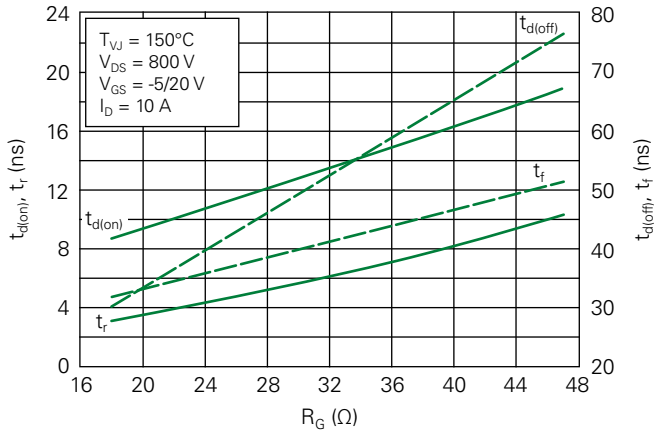


Fig. 26. Typical Switching Times vs. Temperature

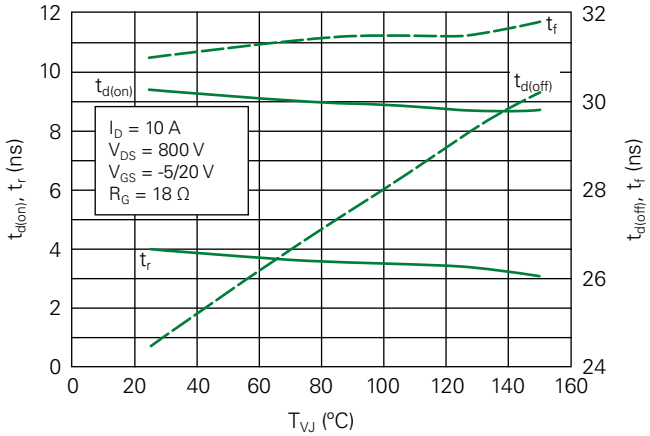


Fig. 27. Typical Reverse Recovery Characteristic of Intrinsic Diode at 25ºC vs. Drain Current

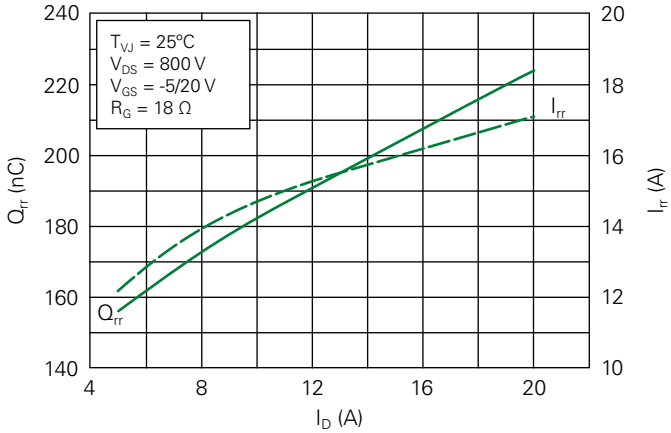


Fig. 28. Typical Reverse Recovery Characteristic of Intrinsic Diode at 150ºC vs. Drain Current

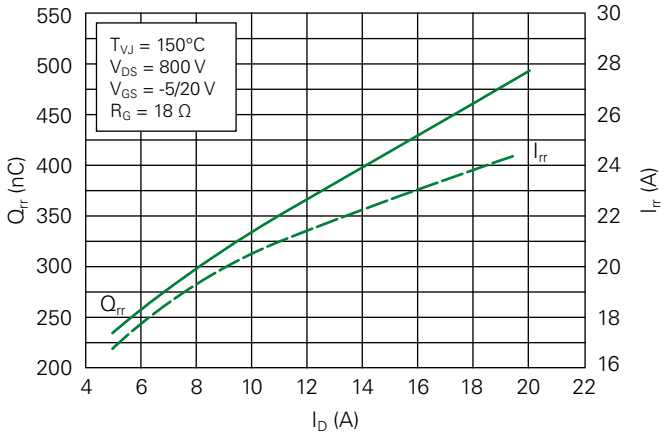


Fig. 29. Typical Reverse Recovery Characteristic of Intrinsic Diode at 25ºC vs. External Gate Resistor

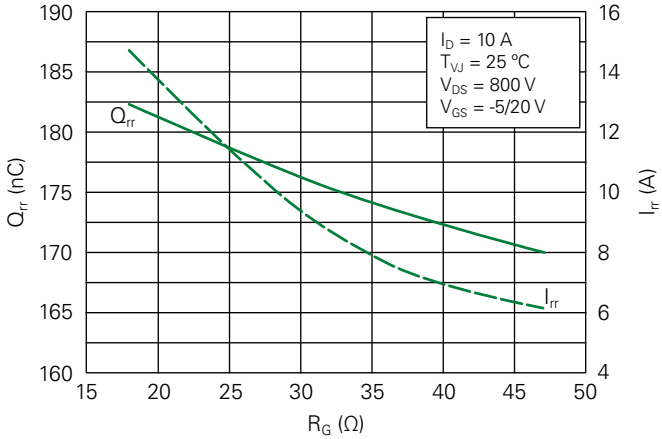


Fig. 30. Typical Reverse Recovery Characteristic of Intrinsic Diode at 150ºC vs. External Gate Resistor

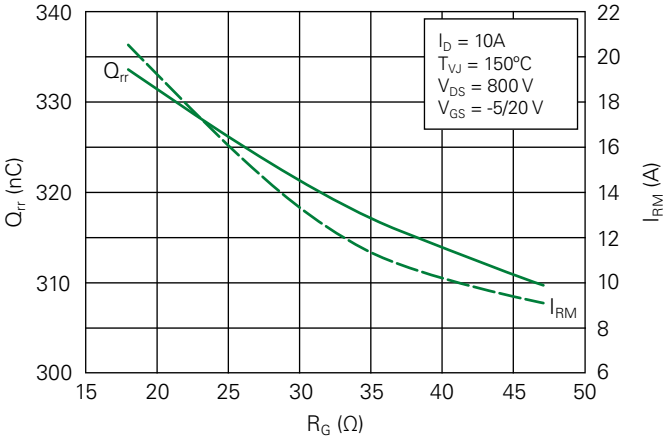


Fig. 31. Typical Reverse Recovery Characteristic of Intrinsic Diode vs. Temperature

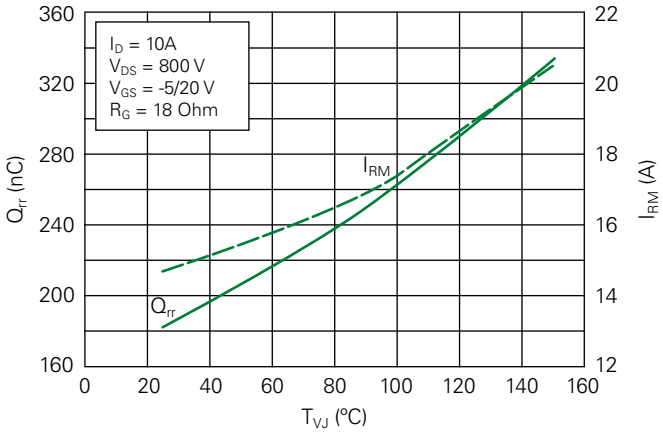


Fig. 32. Typical Reverse Recovery Characteristic of Intrinsic Diode at 25°C vs. Drain Current

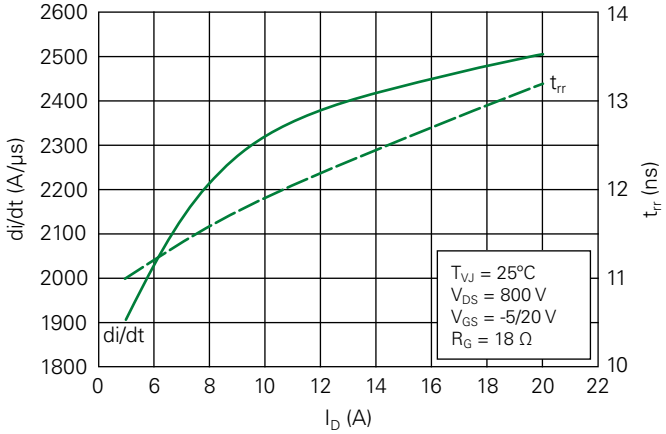


Fig. 33. Typical Reverse Recovery Characteristic of Intrinsic Diode at 150°C vs. Drain Current

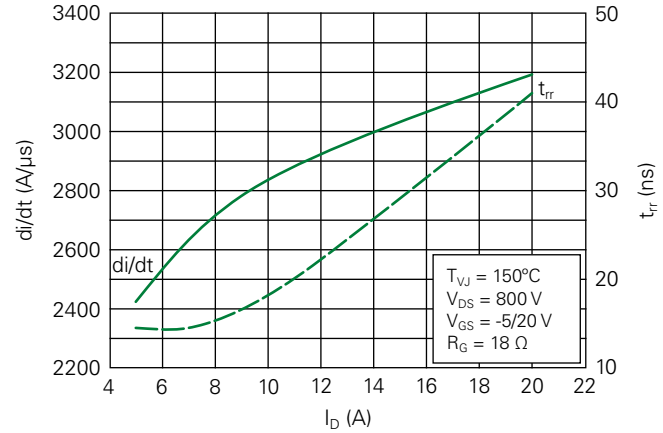


Fig. 34. Typical Reverse Recovery Characteristic of Intrinsic Diode at 25°C vs. External Gate Resistor

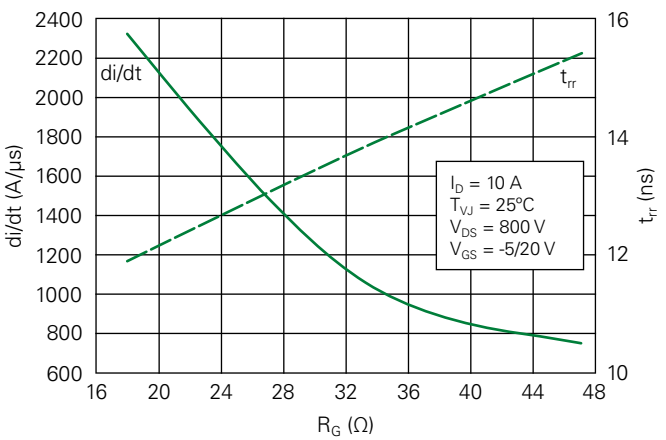


Fig. 35. Typical Reverse Recovery Characteristic of Intrinsic Diode at 150°C vs. External Gate Resistor

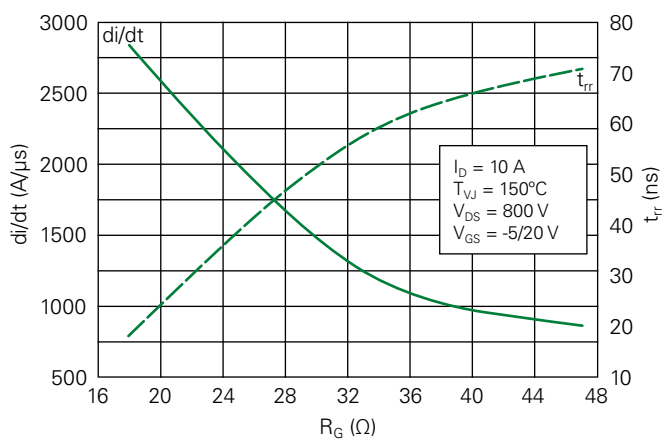
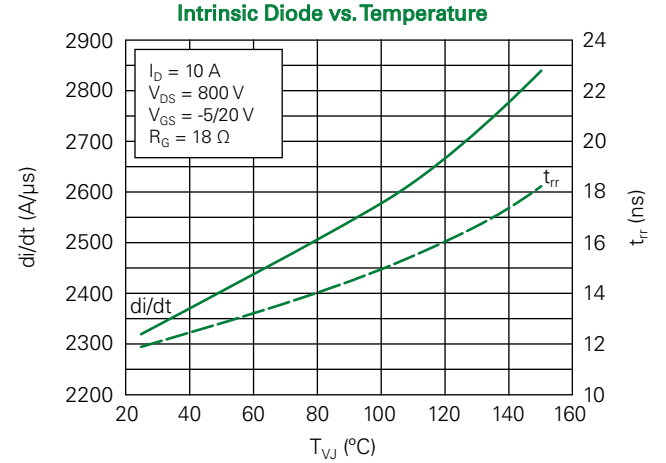
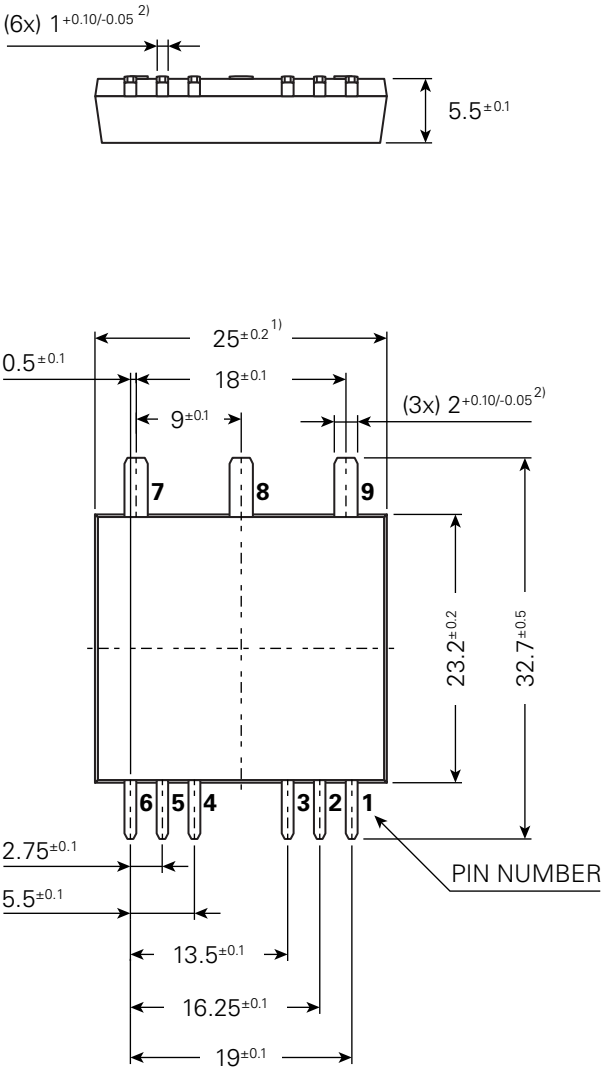


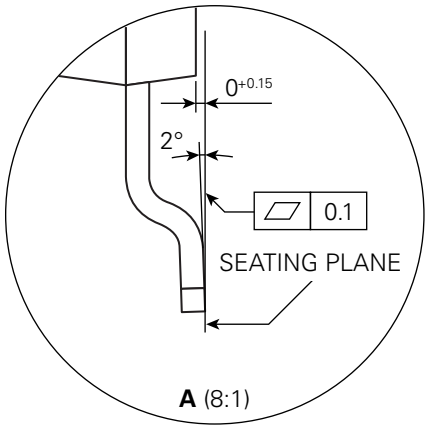
Fig. 36. Typical Reverse Recovery Characteristic of Intrinsic Diode vs. Temperature

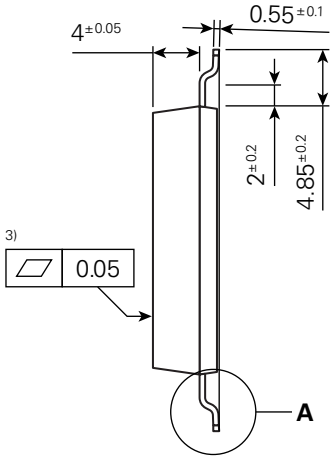


Part Outline Drawing



Dimensions in mm (1 mm = 0.0394")

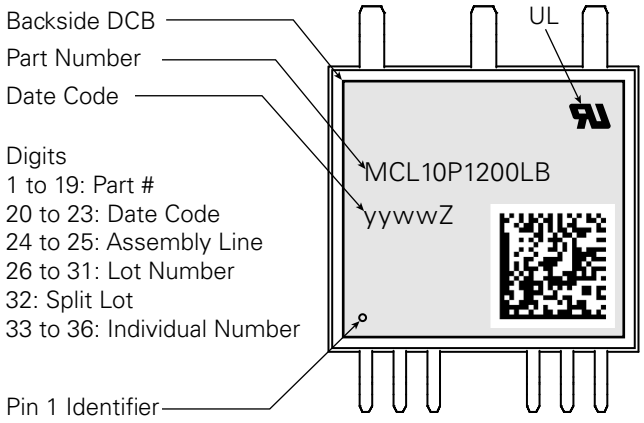




NOTES:

1. Protrusion may add 0.2 mm max. on each side
2. Additional max. 0.05 mm per side by punching misalignment or overlap of dam bar or bending compression
3. DCB AREA 10 to 50 µm convex; position of DCB area in relation to plastic rim: ±25 µm (measured 2 mm from Cu rim)
4. Terminal plating: 2 - 6 µm Ni + 10 - 25µm Sn (galv.) cutting edges may be partially free of plating

Part Number and Marking



M = MOSFET
C = SiC MOSFET
L = Monolith Gen 1
10 = Current Rating [A]
P = Phase Leg
1200 = Reverse Voltage [V]
LB = SMPD-B
yy = Year
ww = Work Week
Z = Location

Ordering Information

Ordering	Part Number	Marking on Product	Delivering Mode	Base Quantity	Ordering Code
Standard	MCL10P1200LB-TUB	MCL10P1200LB	Tube	20	MCL10P1200LB-TUB
Alternative	MCL10P1200LB-TRR	MCL10P1200LB	Tape & Reel	200	MCL10P1200LB-TRR

REVISION HISTORY		
08/09/2023	XZ	▪ Updated SMPD Package section. Updated Product Summary section. Updated Pinout Diagram. Updated SMPD Package table. Updated Characterization Curves subtitles.