SiC Power Module

SCZ4004DTB Datasheet

Features

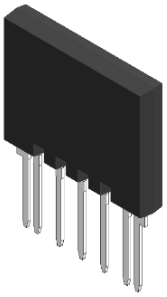
· DOT247 package
with the 4th Generation SiC-MOSFET
· V_{DSS} = 750V
· Low $R_{DS(on)}$
· High-speed switching possible
· Low switching losses
· Tvjmax = 175°C
· Compact design
· High power density

Construction

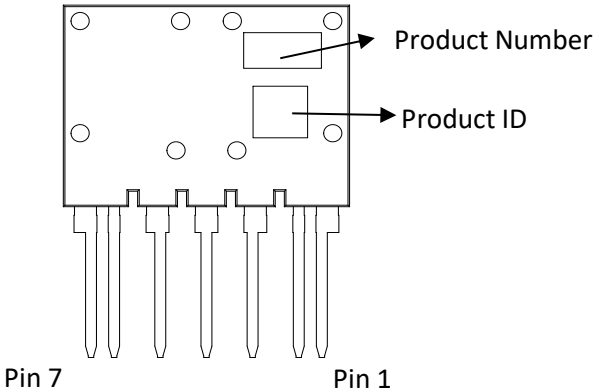
The power module is a common source module which implements SiC-MOSFETs.

Application

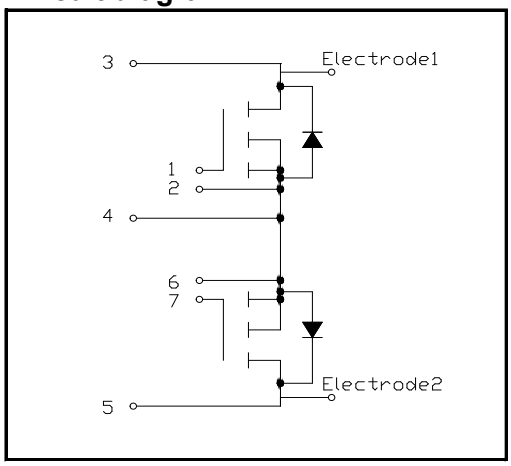
· Inverter, Converter



Outline



Circuit diagram



Pin No.	Pin Name	Function
1	G1	MOSFET Gate
2	S1	MOSFET Source
3	P1	Positive Power
4	N	Negative Power
5	P2	Positive Power
6	S2	MOSFET Source
7	G2	MOSFET Gate

Absolute maximum ratings (Tvj = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Rating	Unit
Drain - source voltage	V_{DSS}	V_{GS} = 0V	750	V
Gate - source voltage (DC)	V_{GSS}		-4 to +21	
Gate - source voltage (t_{surge} < 300ns)	$V_{GSSsurge}$		-4 to +23	
Continuous drain current (DC)	I_D	Tc = 25°C, V_{GS} = 18V	251	A
		Tc = 100°C, V_{GS} = 18V	177	
Pulsed drain current	$I_{D,pulse}$	Pulse 1ms, Tc = 25°C, V_{GS} = 18V Note 2), 5)	459	
		Pulse 1ms, Tc = 100°C, V_{GS} = 18V Note 2), 5)	323	
Continuous source current (DC)	I_S	Tc = 25°C, V_{GS} = 18V	251	
Pulsed source current	$I_{S,pulse}$	Pulse 1.5μs, Tc = 25°C, V_{GS} = 18V Note 2)	459	
Body diode surge forward current	$I_{S,pulse}$	Pulse 1.5μs, Tc = 25°C, V_{GS} = 0V Note 2), 4), 5)	334	
Total power dissipation Note 3), 5)	Ptot	Tc = 25°C	704	W
Virtual junction temperature	Tvj		-40 to +175	°C
Storage temperature	Tstg		-40 to +125	

Note 1) If the product is used beyond absolute maximum ratings defined in the specifications, as its internal structure may be damaged, please replace the product with a new one.
Note 2) Repetition rate should be kept within the range where temperature rise if die should not exceed Tvjmax.
Note 3) Case temperature (Tc) is defined on the cooper surface just under the chips.
Note 4) Repetitive pulse, PW≦1.5μs, Duty cycle≦5%
Note 5) Tvj is less than 175°C.

Figure 1. Example of acceptable V_{GS} waveform

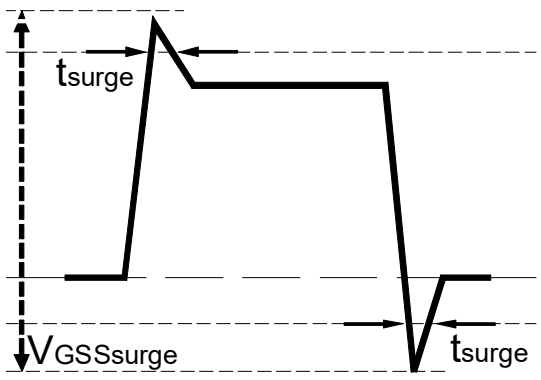
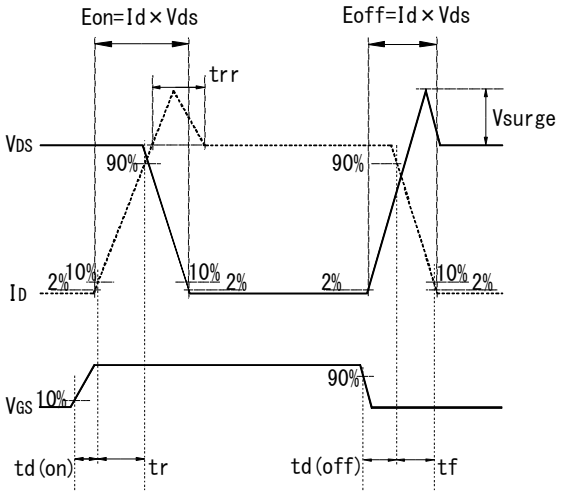


Figure 2. Wavelength for switching test



Module (Tvj = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction - case	$R_{th(j-c)}$	1 arm heating Note 3)	—	0.17	0.22	°C/W

MOSFET electrical characteristics (Tvj = 25°C unless otherwise specified)

Parameter	Symbol	Conditions		Values			Unit
				Min.	Typ.	Max.	
Drain - Source on resistance	$R_{DS(on)}$	I_D = 188A, V_{GS} = 18V	Tvj = 25°C	—	4	5	mΩ
			Tvj = 150°C	—	8	—	
Zero gate voltage drain current	I_{DSS}	V_{DS} = 750V, V_{GS} = 0V		—	—	160	μA
Gate - source threshold voltage	$V_{GS(th)}$	V_{DS} = 10V, I_D = 100mA Note 6)		2.8	—	4.8	V
Gate - source leakage current	I_{GSS}	V_{GS} = +21V, V_{DS} = 0V		—	—	0.2	μA
		V_{GS} = -4V, V_{DS} = 0V		-0.2	—	—	
Turn - on delay time	$t_{d(on)}$	$V_{GS(on)}$ = 18V, $V_{GS(off)}$ = 0V V_{DS} = 400V I_D = 188A $R_{G(on)}$ = 10Ω, $R_{G(off)}$ = 10Ω Inductive load		—	97	—	ns
Rise time	t_r			—	93	—	
Turn - off delay time	$t_{d(off)}$			—	344	—	
Fall time	t_f			—	34	—	
Turn - on switching loss	E_{on}			—	5.0	—	mJ
Turn - off switching loss	E_{off}			—	4.2	—	
Input capacitance	C_{iss}	V_{DS} = 500V, V_{GS} = 0V, 1MHz		—	14.7	—	nF
Total gate charge	Q_g	$V_{GS(on)}$ = 18V, $V_{GS(off)}$ = 0V V_{DS} = 500V I_D = 188A		—	520	—	nC
Gate - source charge	Q_{gs}			—	112	—	
Gate - drain charge	Q_{gd}			—	140	—	
Internal gate resistance	R_{Gint}	Tvj = 25°C		—	0.5	—	Ω

Note 6) Tested after applying V_{GS} = 21V for 100ms.

Body diode electrical characteristics (Tvj = 25°C unless otherwise specified)

Parameter	Symbol	Conditions		Values			Unit
				Min.	Typ.	Max.	
Souce - drain voltage	V_{SD}	V_{GS} = 0V, I_S = 188A	Tvj = 25°C	—	3.3	—	V
			Tvj = 150°C	—	3.4	—	
		V_{GS} =18V, I_S = 188A	Tvj = 25°C	—	0.76	—	
			Tvj = 150°C	—	1.21	—	

Electrical characteristic curves (Typical)

Figure 3. Output characteristic at 25°C (Typ.)

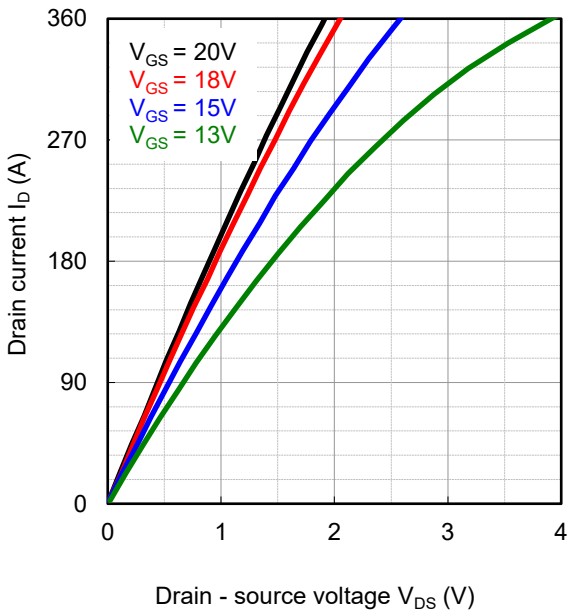


Figure 4. Drain - source voltage characteristic (Typ.)

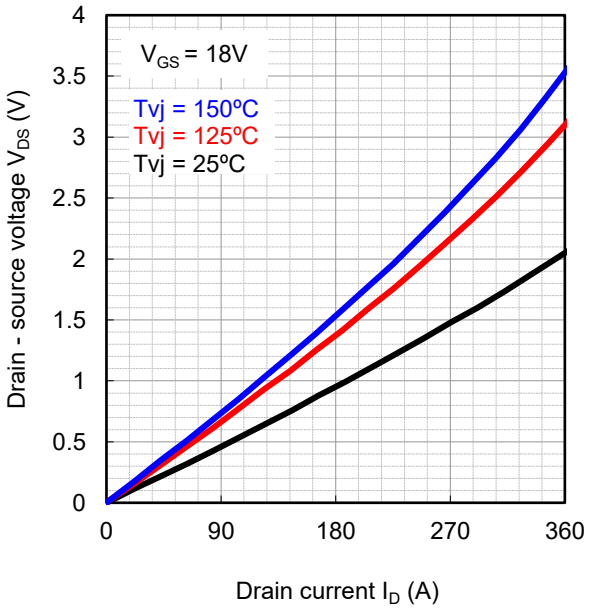
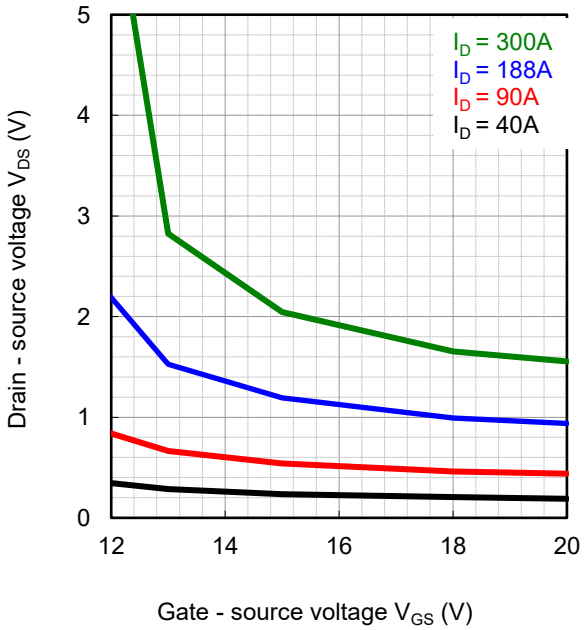


Figure 5. Drain - source voltage characteristic at 25°C (Typ.)



Electrical characteristic curves (Typical)

Figure 6. $R_{DS(on)}$ vs. Tvj characteristic (Typ.)

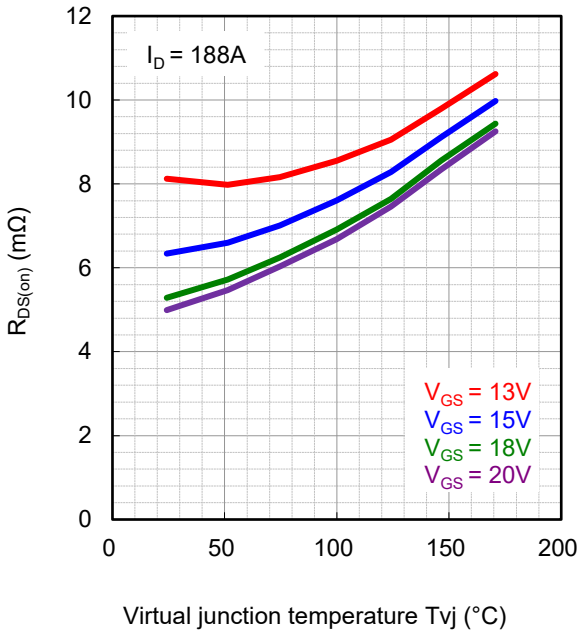


Figure 7. Forward characteristic of diode
V_{GS} = 18V (Typ.)

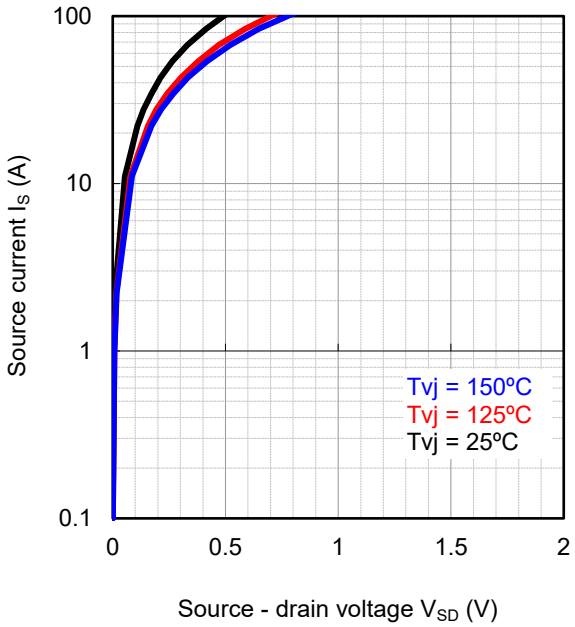
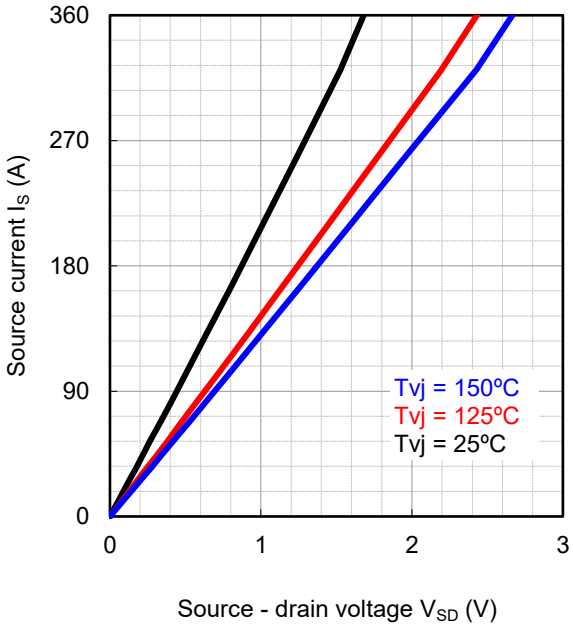


Figure 8. Forward characteristic of diode
V_{GS} = 18V (Typ.)



Electrical characteristic curves (Typical)

Figure 9. Forward characteristic of diode
V_{GS} = 0V (Typ.)

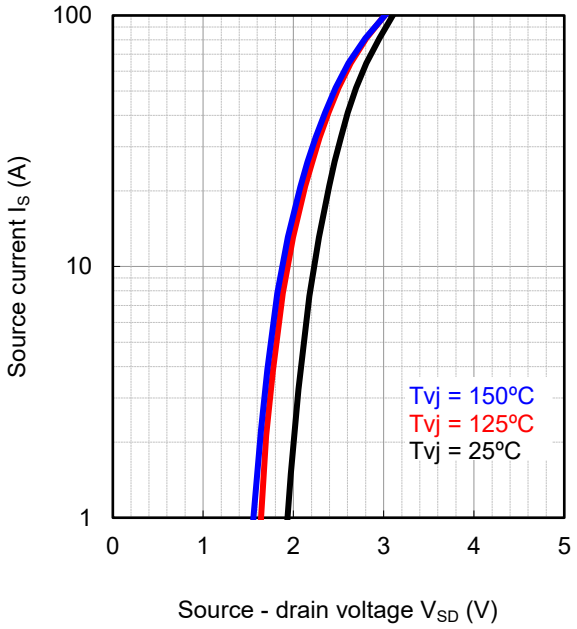


Figure 10. Forward characteristic of diode
V_{GS} = 0V (Typ.)

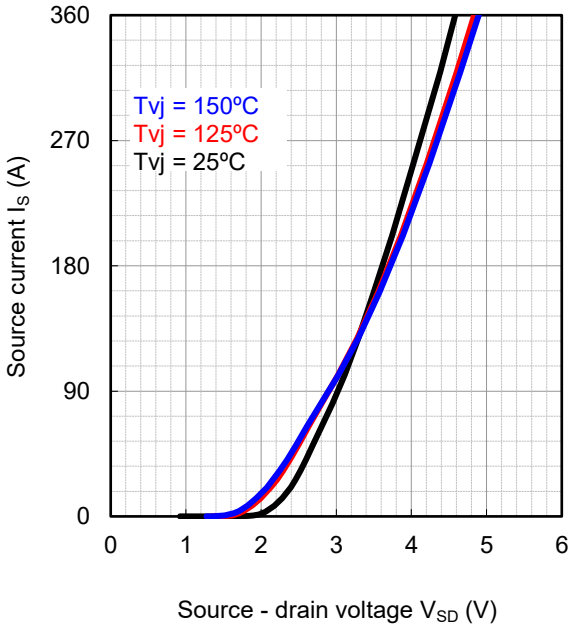


Figure 11. Drain current vs. Gate - source voltage (Typ.)

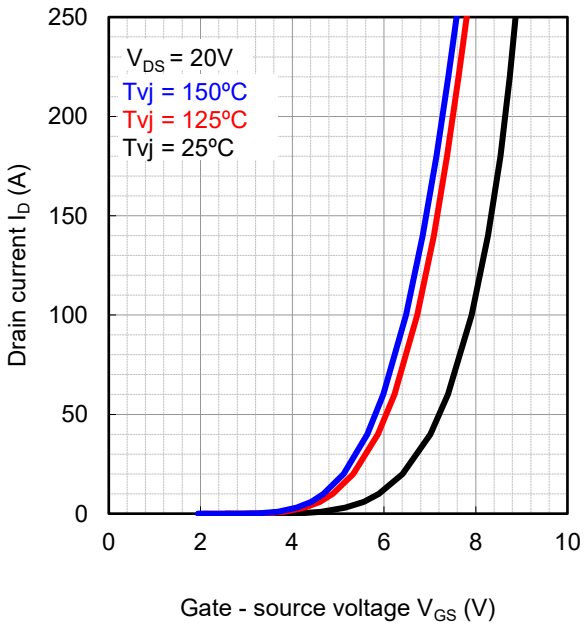
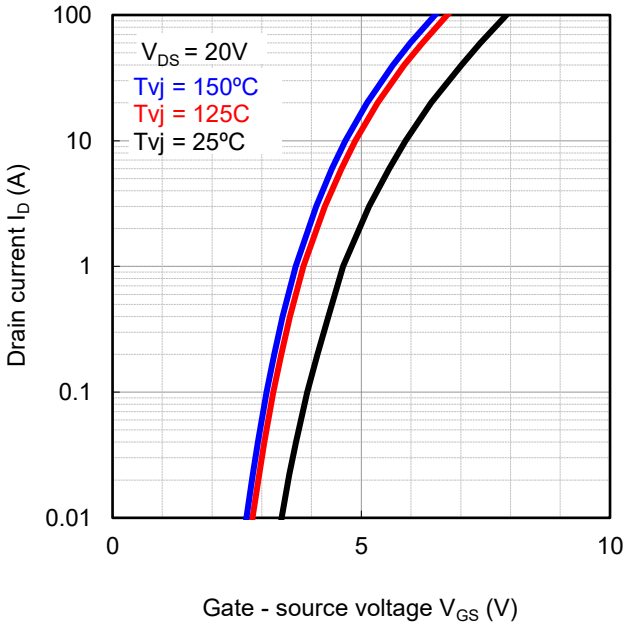


Figure 12. Drain current vs. Gate - source voltage (Typ.)



Electrical characteristic curves (Typical)

Figure 13. Switching time vs. Drain current at 25°C (Typ.)

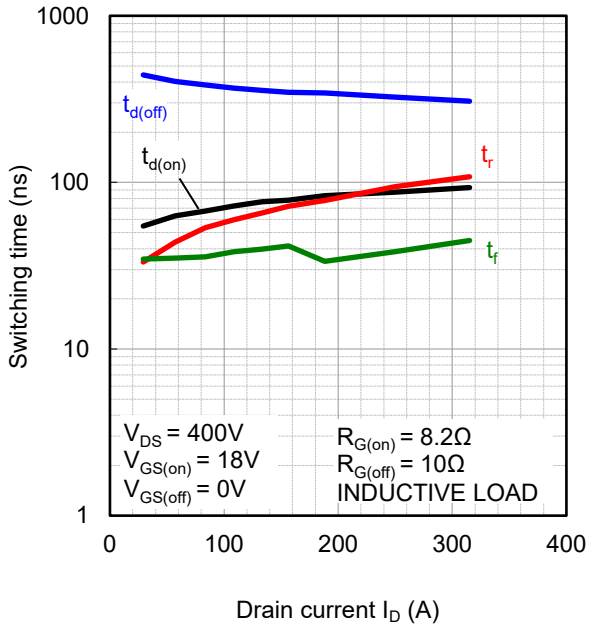


Figure 14. Switching time vs. Drain current at 150°C (Typ.)

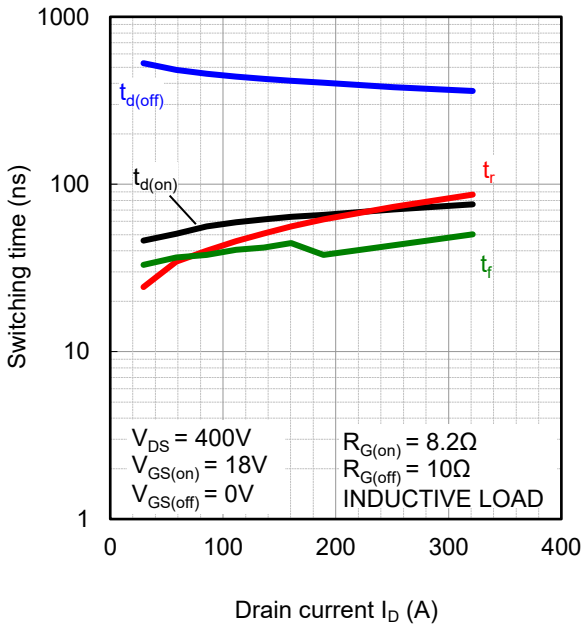


Figure 15. Switching loss vs. Drain current at 25°C (Typ.)

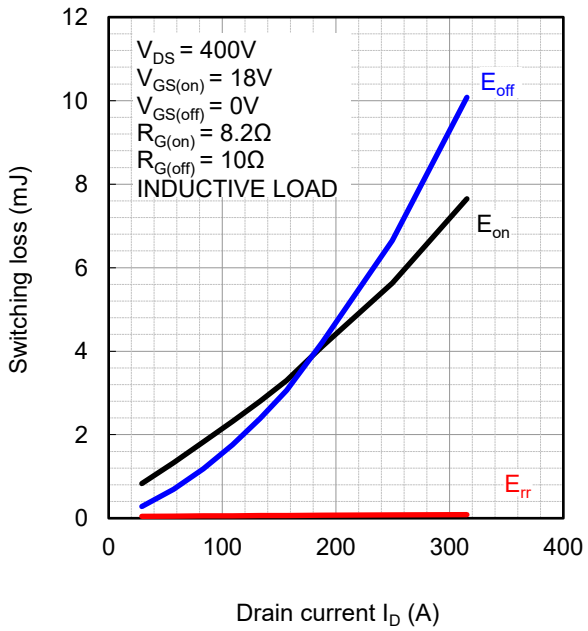
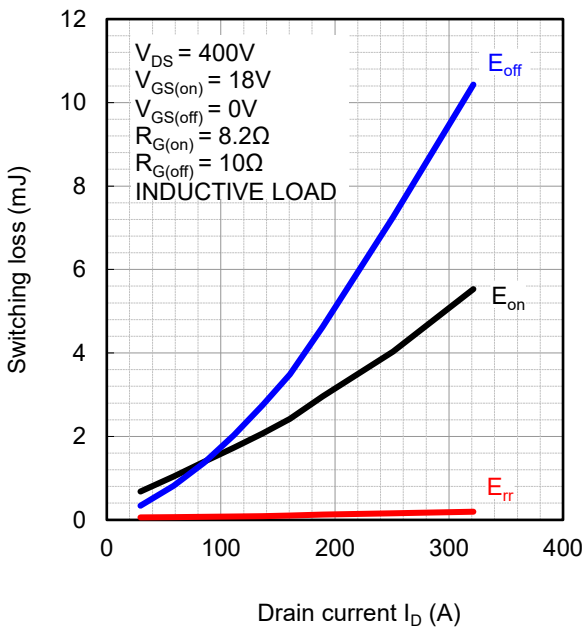


Figure 16. Switching loss vs. Drain current at 150°C (Typ.)



Electrical characteristic curves (Typical)

Figure 17. Recovery characteristic vs. Drain current at 25°C (Typ.)

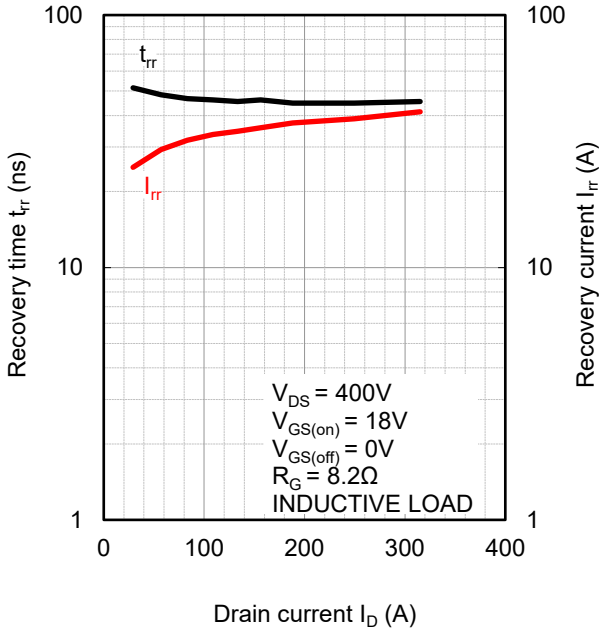


Figure 18. Recovery characteristic vs. Drain current at 150°C (Typ.)

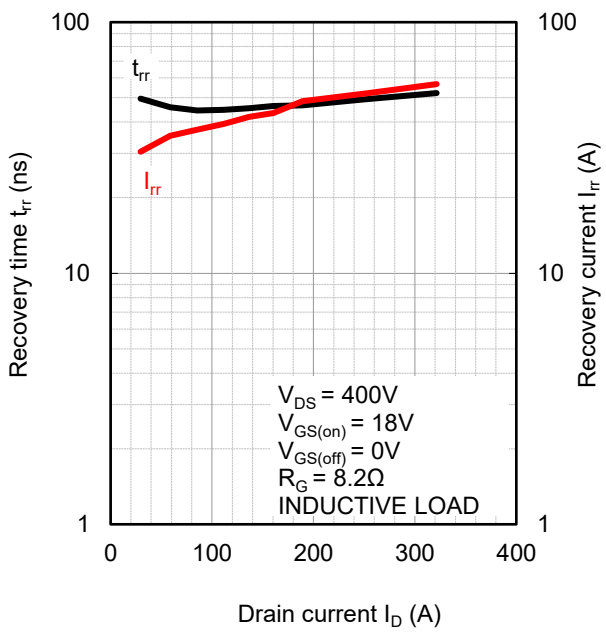


Figure 19. Switching time vs. Gate resistance at 25°C (Typ.)

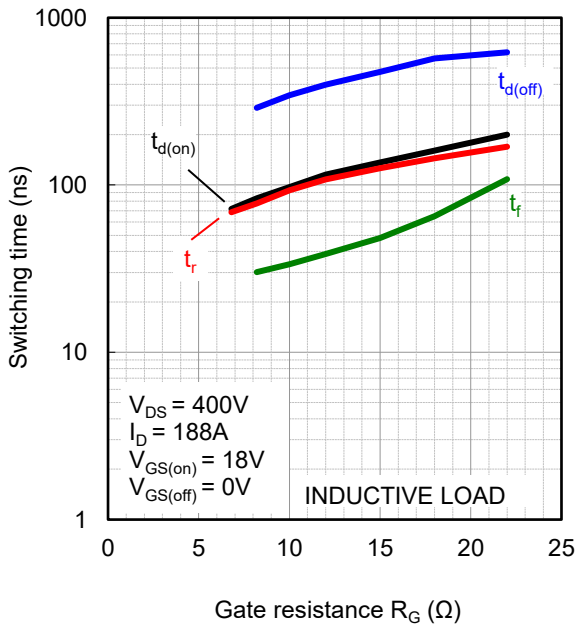
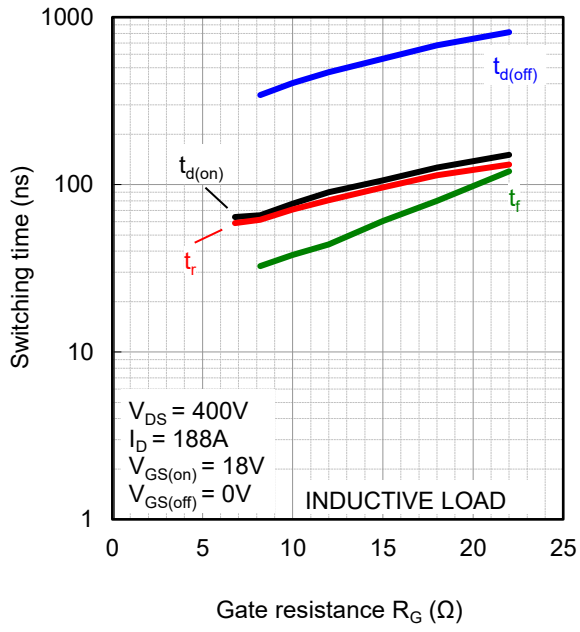


Figure 20. Switching time vs. Gate resistance at 150°C (Typ.)



Electrical characteristic curves (Typical)

Figure 21. Switching loss vs. Gate resistance at 25°C (Typ.)

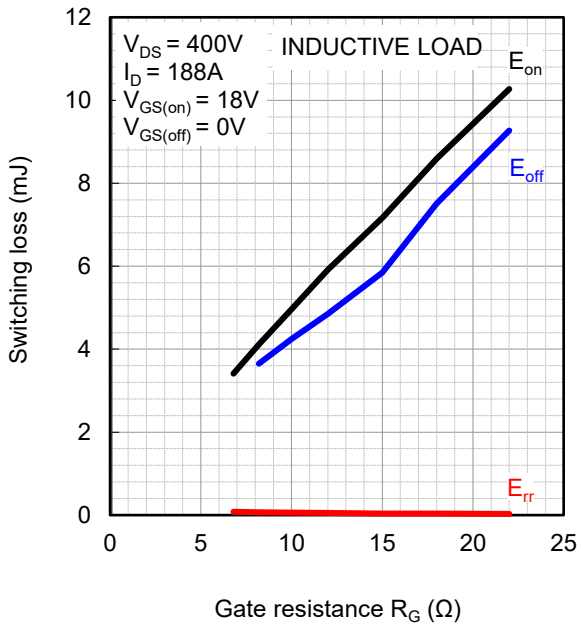


Figure 22. Switching loss vs. Gate resistance at 150°C (Typ.)

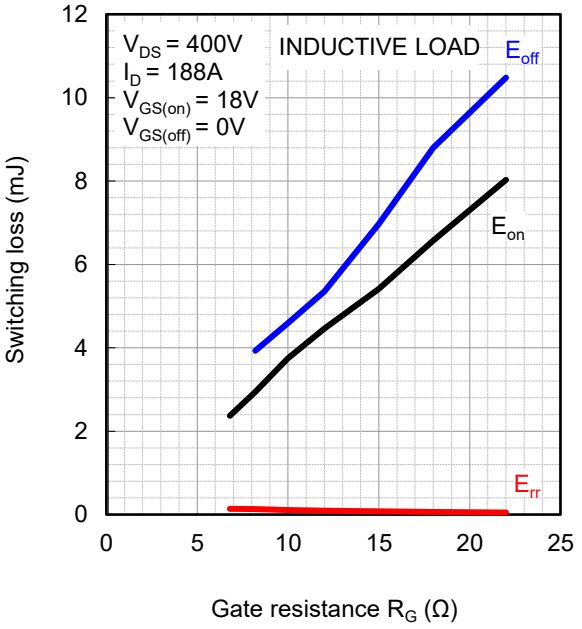


Figure 23. Capacitance vs. Drain - source voltage at 25°C (Typ.)

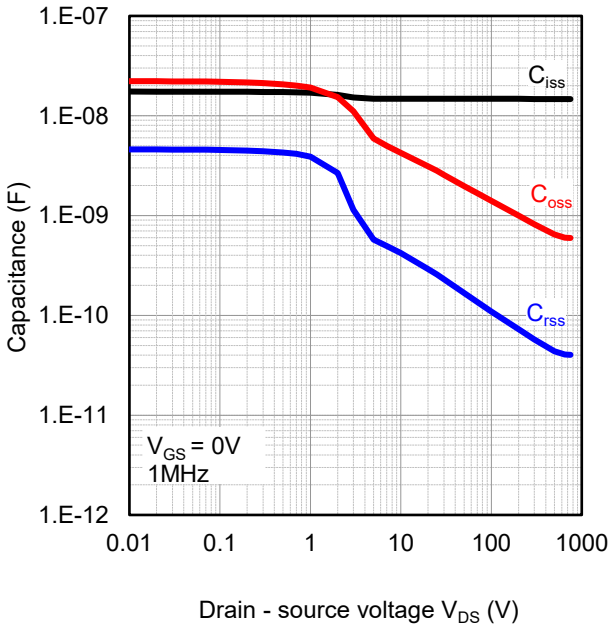
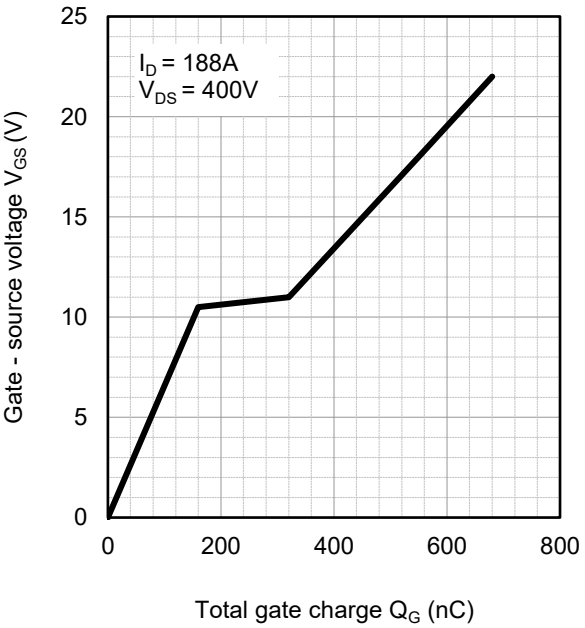
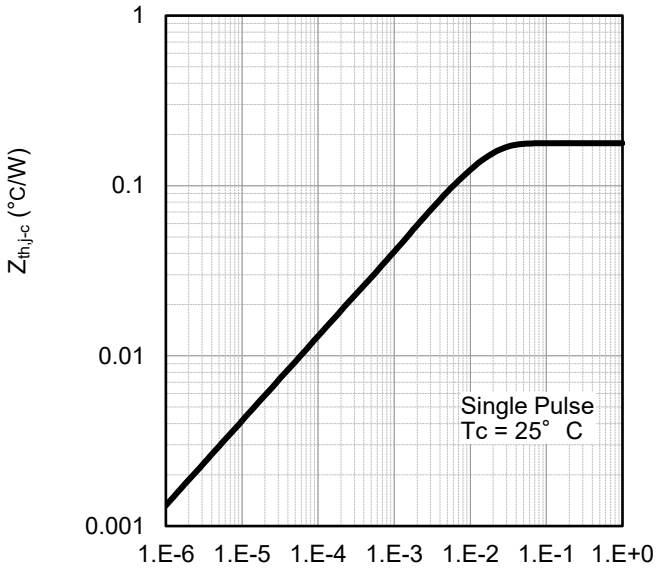


Figure 24. Gate charge characteristic at 25°C (Typ.)



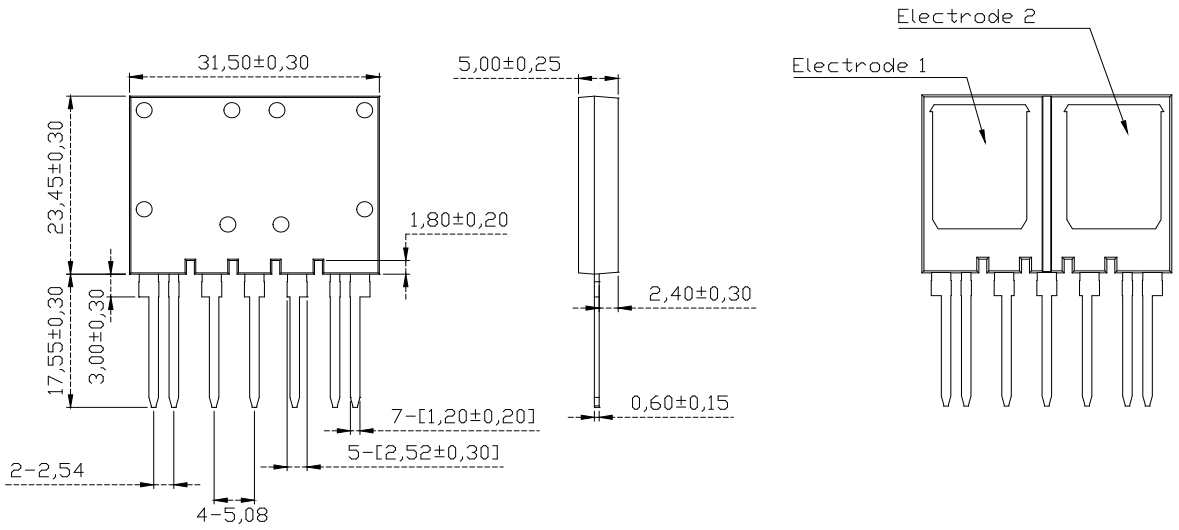
Electrical characteristic curves (Typical)

Figure 25. Transient thermal impedance (Typ.)



Package outlines

Unit : mm



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