S4008

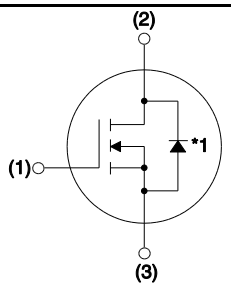
N-channel SiC power MOSFET bare die Datasheet

V_{DSS}	650V
$R_{DS(on)}$ (Typ.)	60mΩ
I_D	39A[*1]

●Features

1) Low on-resistance
2) Fast switching speed
3) Fast reverse recovery
4) Easy to parallel
5) Simple to drive

●Inner circuit



(1) Gate
(2) Drain
(3) Source

*1 Body Diode

●Application

・Solar inverters
・DC/DC converters
・Switch mode power supplies
・Induction heating
・Motor drives

●Absolute maximum ratings (T_a = 25°C)

Parameter		Symbol	Value	Unit
Drain - Source voltage		V_{DSS}	650	V
Continuous drain current	T_c = 25°C	I_D [*1]	39	A
Pulsed drain current		$I_{D,pulse}$ [*2]	97	A
Gate - Source voltage (DC)		V_{GSS}	−4 to +22	V
Gate-Source Surge Voltage (t_{surge} < 300nsec)		V_{GSS_surge} [*3]	−4 to +26	V
Recommended Drive Voltage		V_{GS_op} [*4]	0 / +18	V
Junction temperature		T_j	175	°C
Range of storage temperature		T_{stg}	−55 to +175	°C

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 1mA	650	-	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS} = 650V, V_{GS} = 0V T_j = 25°C T_j = 150°C	 - -	 1 2	 10 -	μA
Gate - Source leakage current	I_{GSS+}	V_{GS} = +22V, V_{DS} = 0V	-	-	100	nA
Gate - Source leakage current	I_{GSS-}	V_{GS} = −4V, V_{DS} = 0V	-	-	−100	nA
Gate threshold voltage	$V_{GS\ (th)}$	V_{DS} = 10V, I_D = 6.67mA	2.7	-	5.6	V
Static drain - source on - state resistance	$R_{DS(on)}$ *5	V_{GS} = 18V, I_D = 13A T_j = 25°C T_j = 125°C	 - -	 60 79.2	 75 -	mΩ
Gate input resistance	R_G	f = 1MHz, open drain	-	12	-	Ω

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *5	V_{DS} = 10V, I_D = 13A	-	4.9	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	852	-	pF
Output capacitance	C_{oss}	V_{DS} = 500V	-	55	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	24	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 300V	-	126	-	pF
Turn - on delay time	$t_{d(on)}$ *5	V_{DD} = 300V, I_D = 13A	-	19	-	ns
Rise time	t_r *5	V_{GS} = 18V/0V	-	37	-	
Turn - off delay time	$t_{d(off)}$ *5	R_L = 23Ω	-	34	-	
Fall time	t_f *5	R_G = 0Ω	-	21	-	
Turn - on switching loss	E_{on} *5	V_{DD} = 300V, I_D=13A V_{GS} = 18V/0V R_G = 0Ω L=500μH *E_{on} includes diode reverse recovery	-	70	-	μJ
Turn - off switching loss	E_{off} *5		-	10	-	

●Gate Charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *5	V_{DD} = 300V	-	58	-	nC
Gate - Source charge	Q_{gs} *5	I_D = 13A	-	15	-	
Gate - Drain charge	Q_{gd} *5	V_{GS} = 18V	-	23	-	
Gate plateau voltage	$V_{(plateau)}$	V_{DD} = 300V, I_D = 13A	-	9.6	-	V

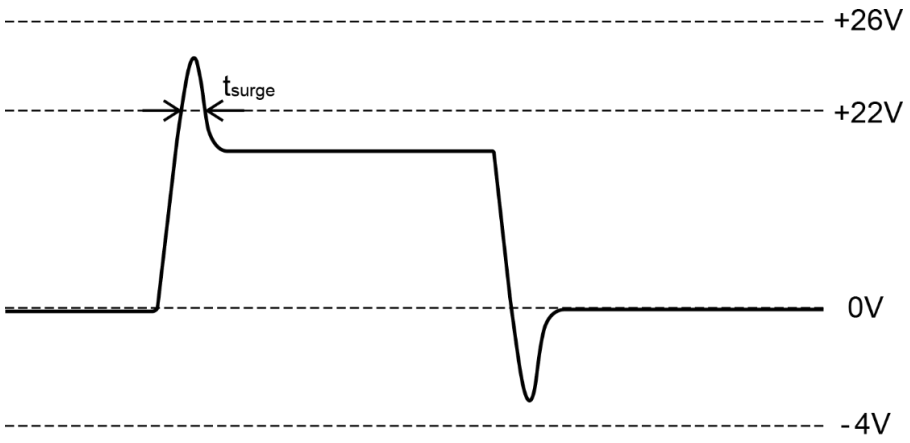
●**Body diode electrical characteristics** (Source-Drain) (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S *1	T_c = 25°C	-	-	39	A
Inverse diode direct current, pulsed	I_{SM} *2		-	-	97	A
Forward voltage	V_{SD} *5	V_{GS} = 0V, I_S = 13A	-	3.2	-	V
Reverse recovery time	t_{rr} *5	I_F = 13A, V_R = 300V di/dt = 1100A/μs	-	15	-	ns
Reverse recovery charge	Q_{rr} *5		-	55	-	nC
Peak reverse recovery current	I_{rrm} *5		-	8	-	A

*1 For T_j=175°C and thermal dissiparion to ambience of 165W or more.
Limited only by maximum temperature allowed.

*2 PW ≤ 10μs, Duty cycle ≤ 1%

*3 Example of acceptable Vgs waveform



*4 Please be advised not to use SiC-MOSFETs with V_{gs} below 13V as doing so may cause thermal runaway.

*5 Pulsed

●Electrical characteristic curves

Fig.1 Typical Output Characteristics(I)

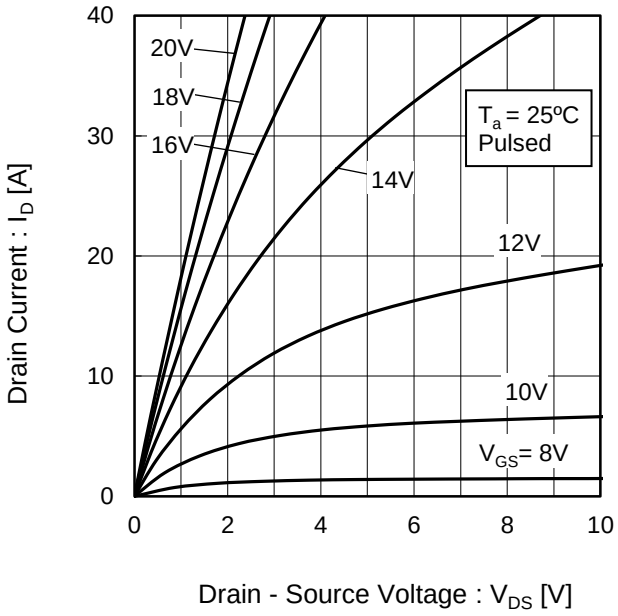


Fig.2 Typical Output Characteristics(II)

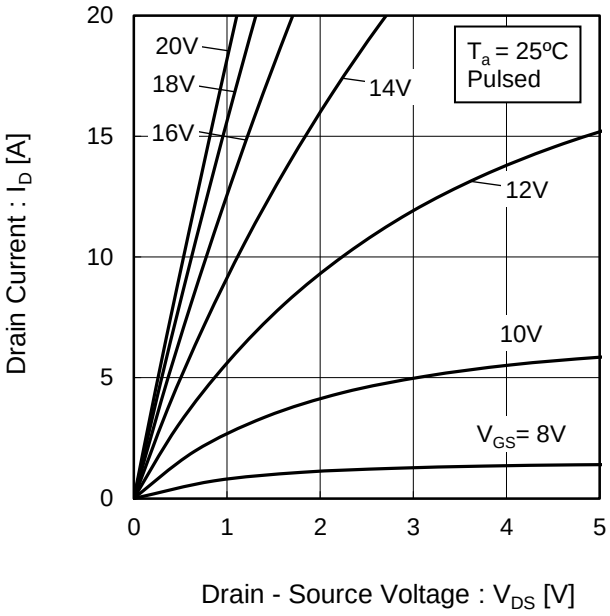


Fig.3 T_j = 150ºC Typical Output Characteristics(I)

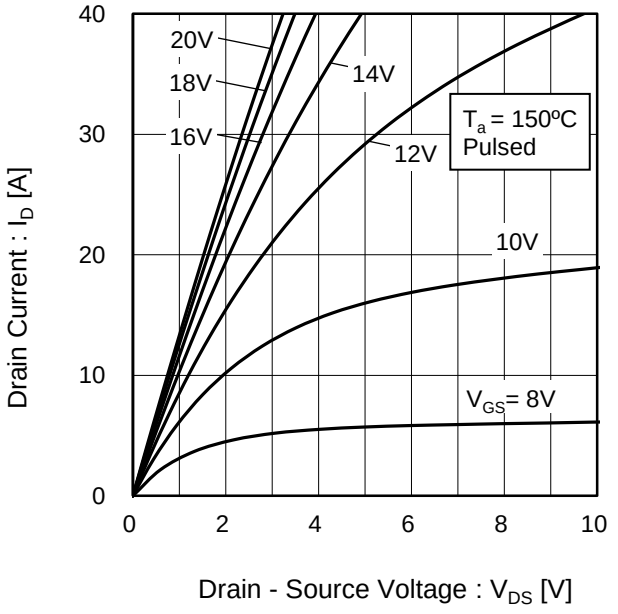
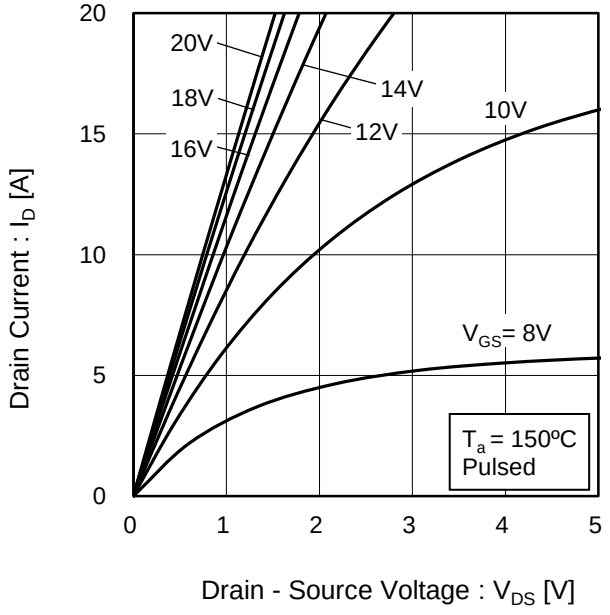


Fig.4 T_j = 150ºC Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.5 Typical Transfer Characteristics (I)

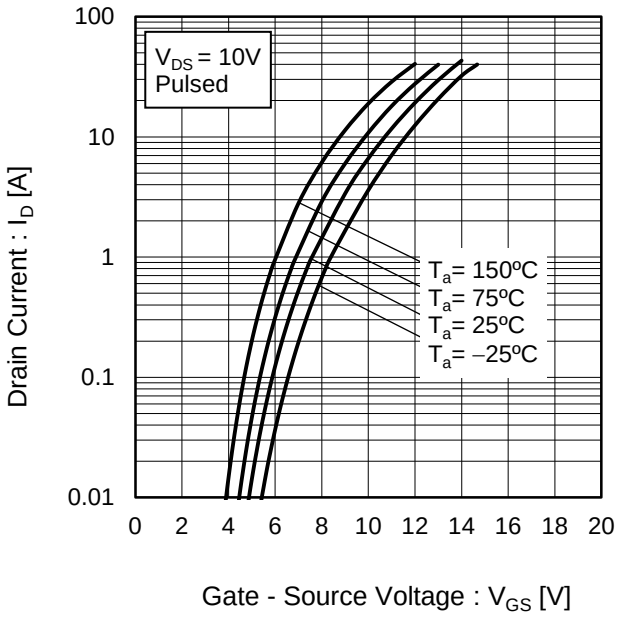


Fig.6 Typical Transfer Characteristics (II)

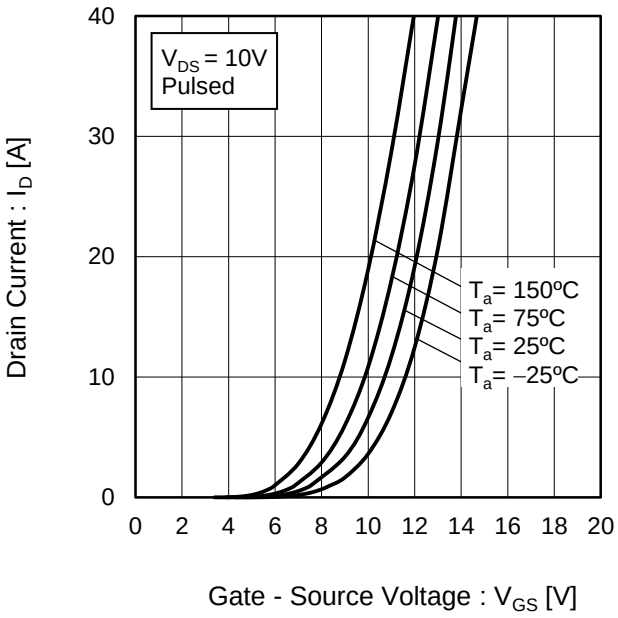


Fig.7 Gate Threshold Voltage vs. Junction Temperature

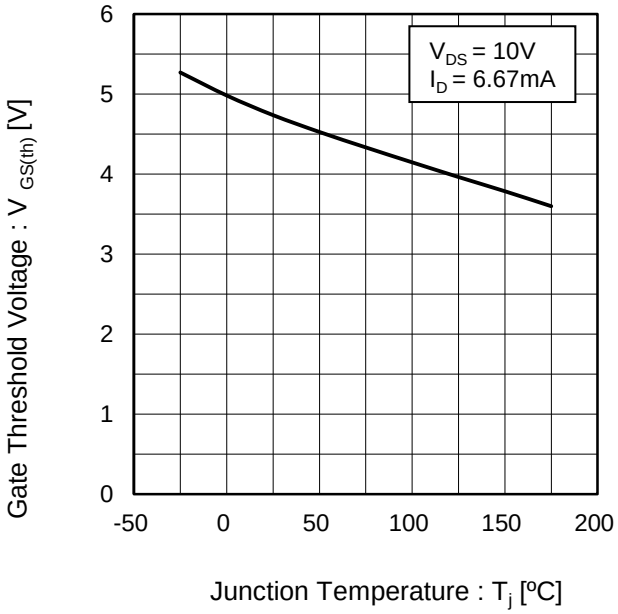
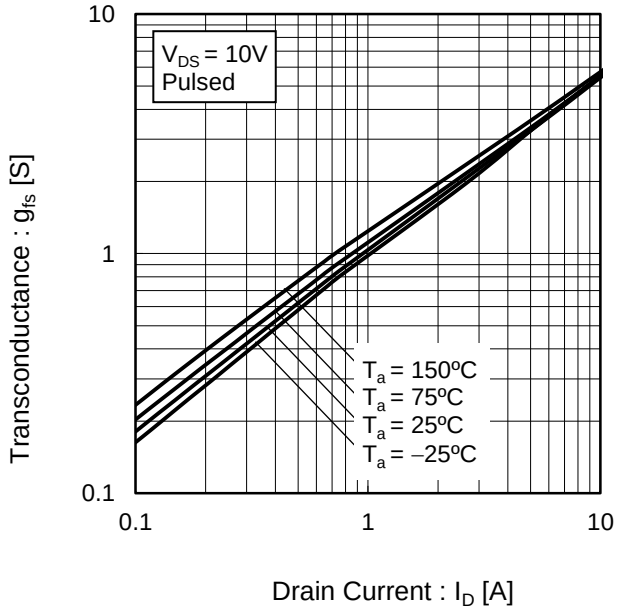


Fig.8 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.9 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

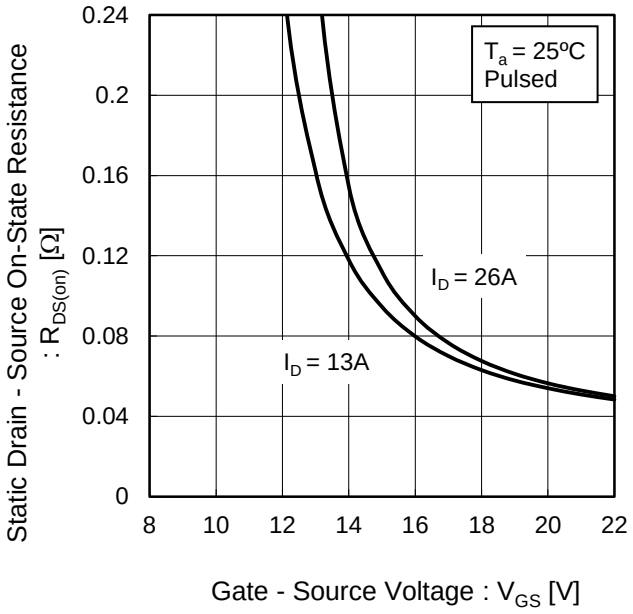


Fig.10 Static Drain - Source On - State Resistance vs. Junction Temperature

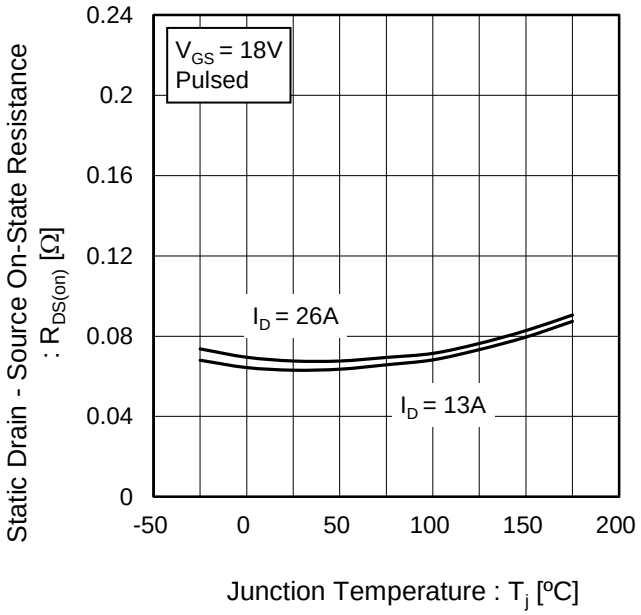
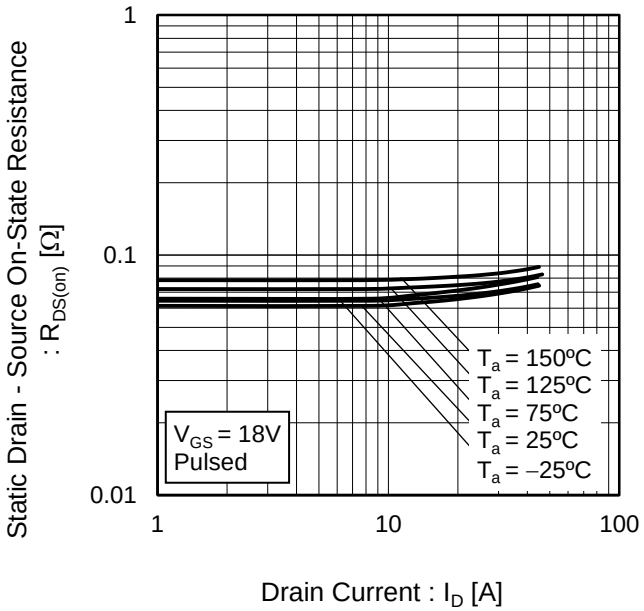


Fig.11 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.12 Typical Capacitance vs. Drain - Source Voltage

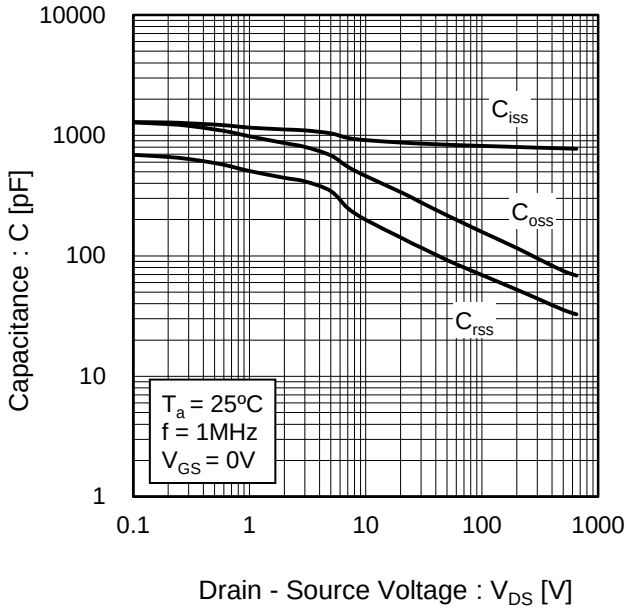


Fig.13 Coss Stored Energy

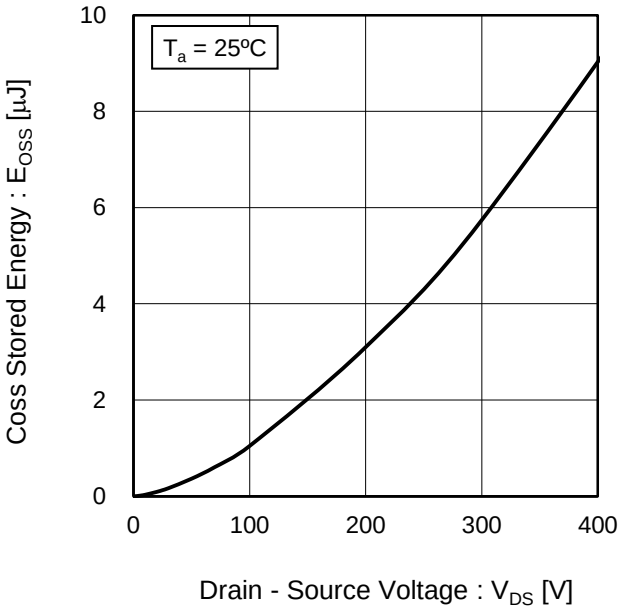


Fig.14 Switching Characteristics

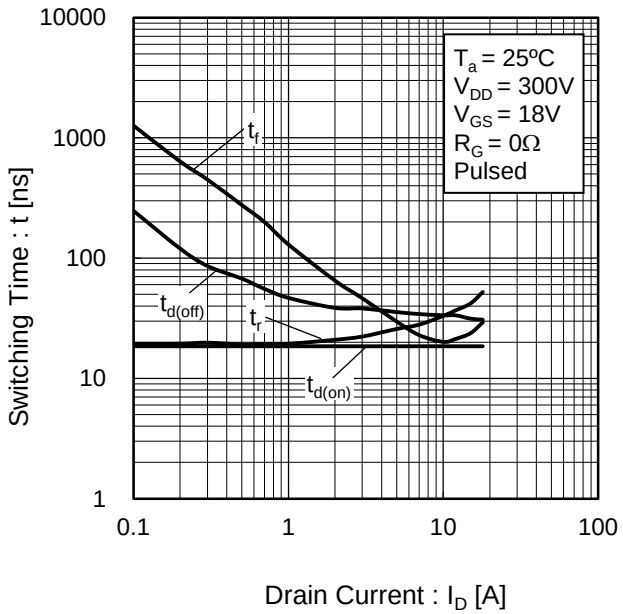
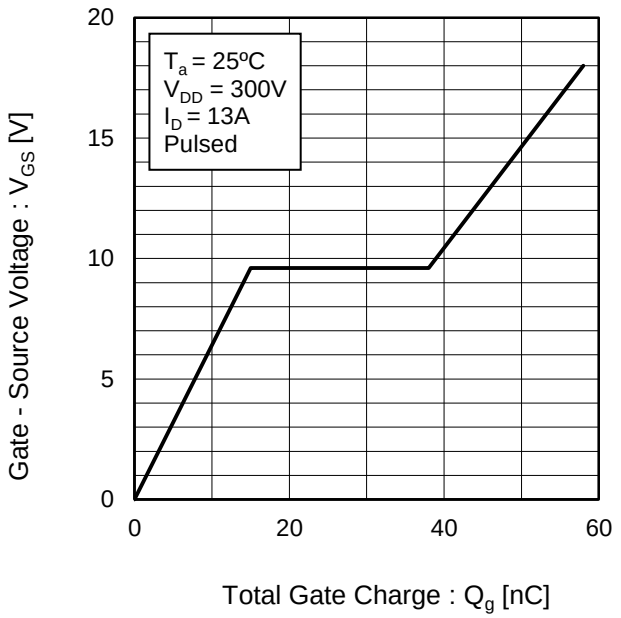


Fig.15 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.16 Typical Switching Loss vs. Drain - Source Voltage

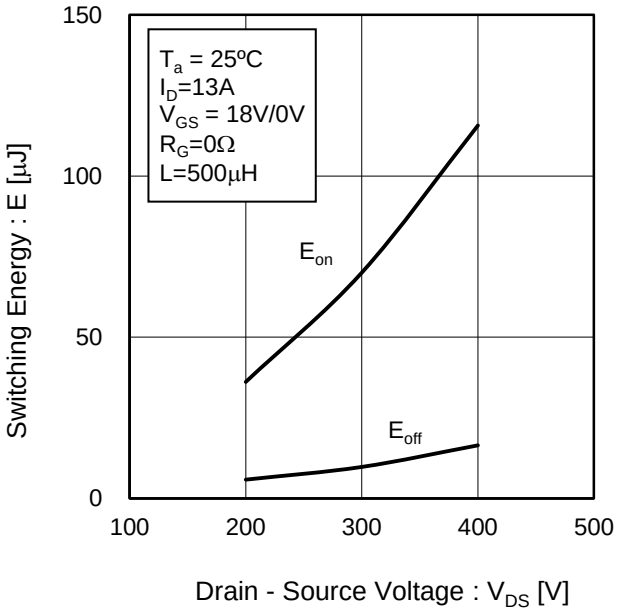


Fig.17 Typical Switching Loss vs. Drain Current

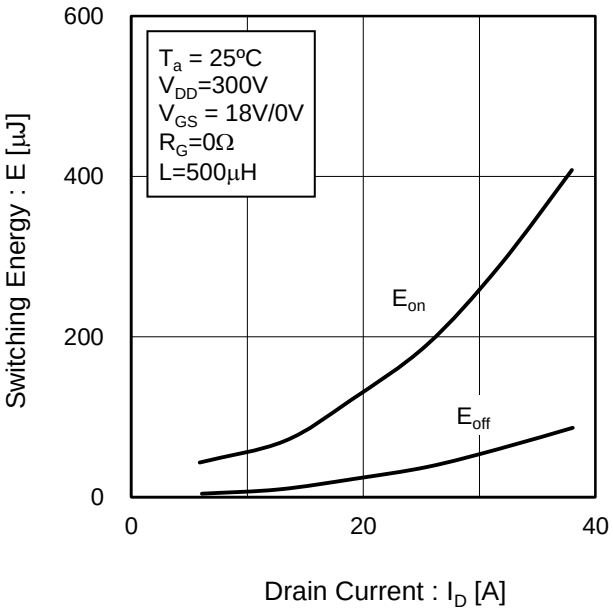
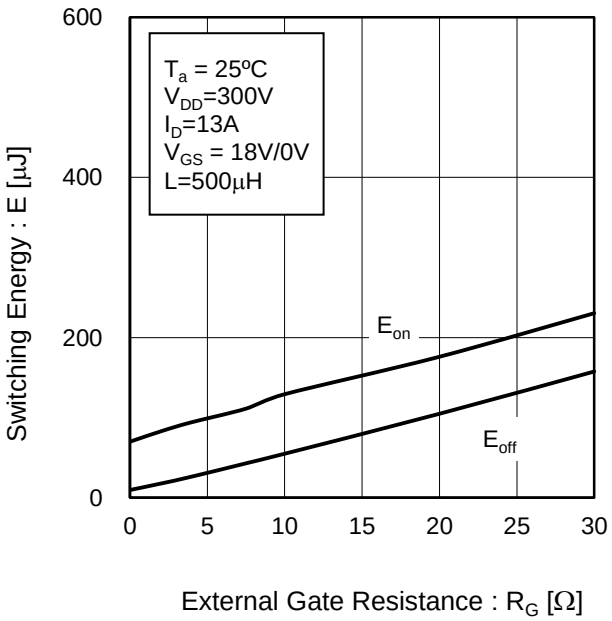


Fig.18 Typical Switching Loss vs. External Gate Resistance



●Electrical characteristic curves

Fig.19 Inverse Diode Forward Current vs. Source - Drain Voltage

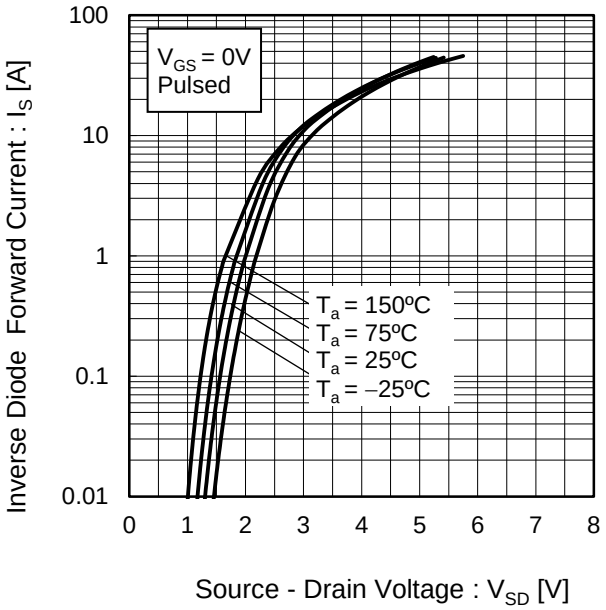
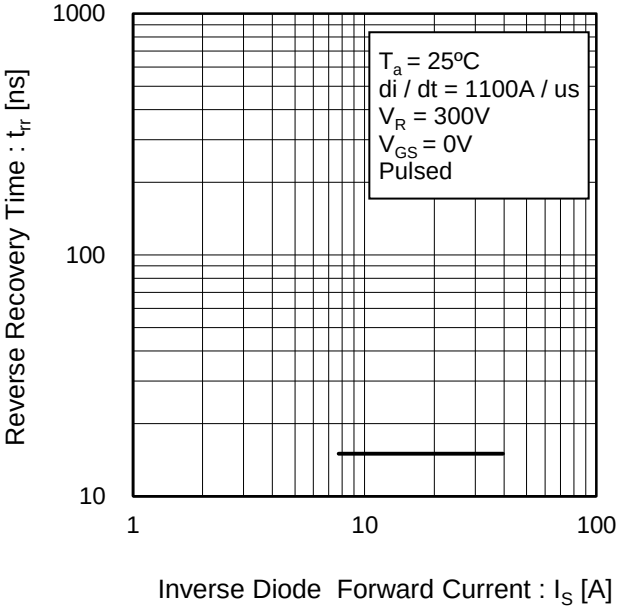


Fig.20 Reverse Recovery Time vs.Inverse Diode Forward Current



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

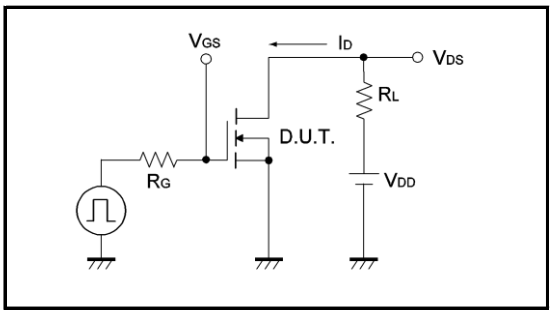


Fig.1-2 Switching Waveforms

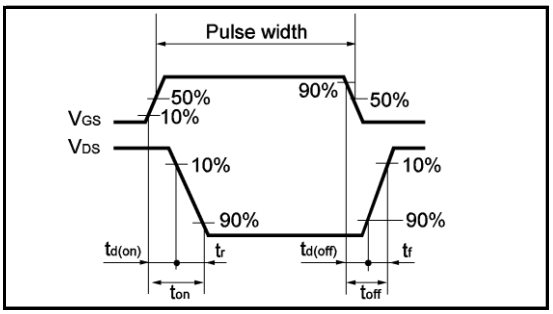


Fig.2-1 Gate Charge Measurement Circuit

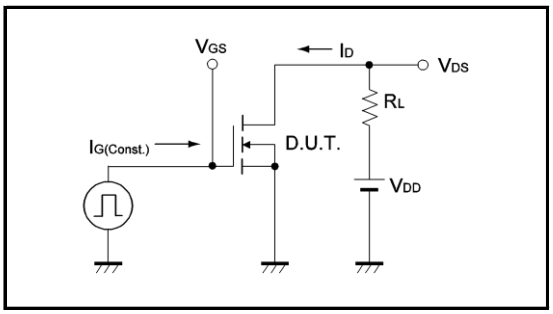


Fig.2-2 Gate Charge Waveform

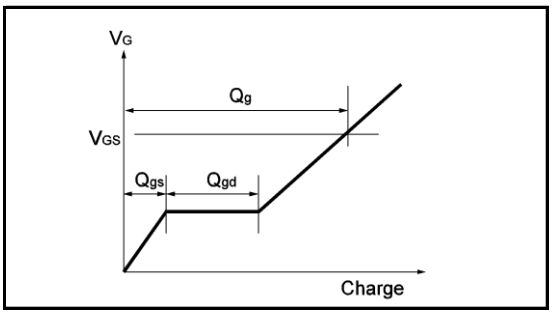


Fig.3-1 Switching Energy Measurement Circuit

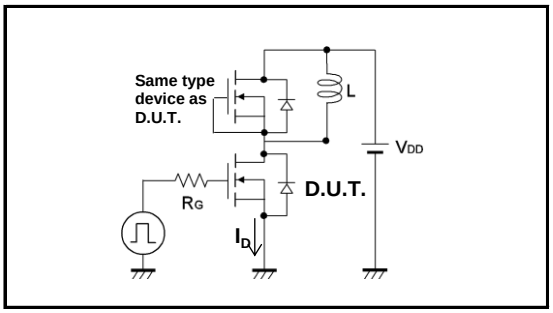


Fig.3-2 Switching Waveforms

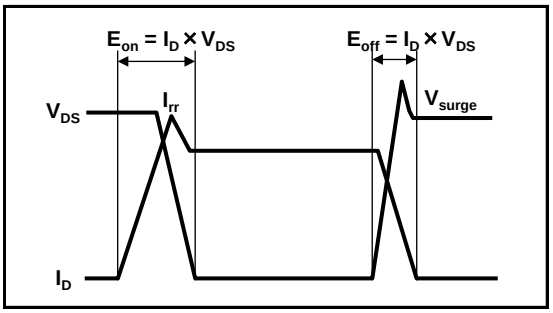


Fig.4-1 Reverse Recovery Time Measurement Circuit

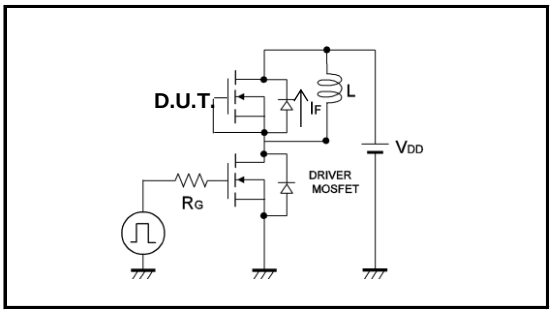
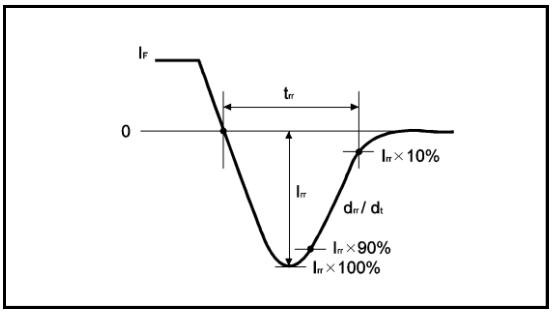


Fig.4-2 Reverse Recovery Waveform



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