SCT3120ALHR

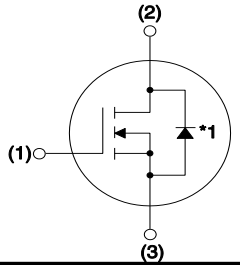
Automotive Grade N-channel SiC power MOSFET Datasheet

V_{DSS}	650V
$R_{DS(on)}$ (Typ.)	120mΩ
I_D *1	21A
P_D	103W

●Outline

TO-247N

●Inner circuit



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

*Body Diode

●Features

1) Qualified to AEC-Q101
2) Low on-resistance
3) Fast switching speed
4) Fast reverse recovery
5) Easy to parallel
6) Simple to drive
7) Pb-free lead plating ; RoHS compliant

●Application

・Automobile
・Switch mode power supplies

●Packaging specifications

Type	Packing	Tube
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	30
	Taping code	C11
	Marking	SCT3120AL

●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	21	A
	T_c = 100°C	I_D *1	15	A
Pulsed Drain current		$I_{D,pulse}$ *2	52	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

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●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 T_j = 25°C T_j = -55°C	 650 650	 - -	 - -	V
Zero Gate voltage Drain current	I_{DSS}	V_{GS} = 0V, V_{DS} =650V 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 = 3.33mA	2.7	-	5.6	V
Static Drain - Source on - state resistance	$R_{DS(on)}$ *5	V_{GS} = 18V, I_D = 6.7A T_j = 25°C T_j = 150°C	 - -	 120 172	 156 -	mΩ
Gate input resistance	R_G	f = 1MHz, open drain	-	18	-	Ω

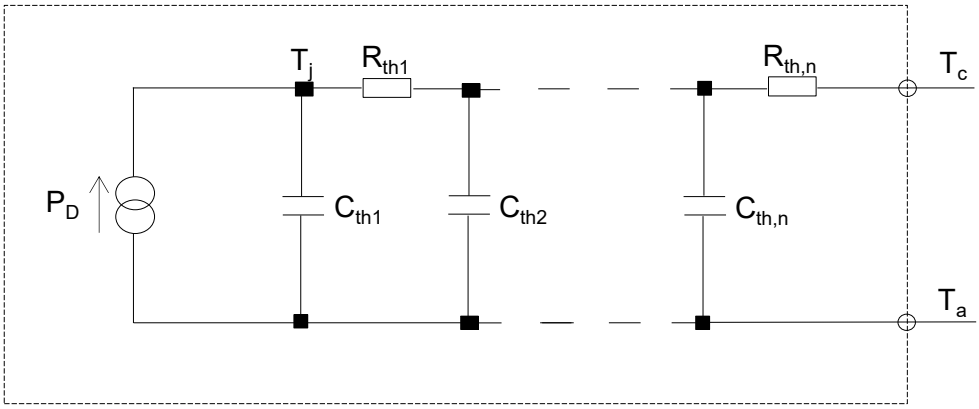
●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC}	-	1.12	1.46	°C/W

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	1.11E-01	K/W
R_{th2}	7.09E-01	
R_{th3}	3.01E-01	

Symbol	Value	Unit
C_{th1}	8.73E-04	Ws/K
C_{th2}	5.10E-03	
C_{th3}	2.94E-02	



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●**Electrical characteristics** (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *5	V_{DS} = 10V, I_D = 6.7A	-	2.7	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	460	-	pF
Output capacitance	C_{oss}	V_{DS} = 500V	-	35	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	16	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 300V	-	70	-	pF
Total Gate charge	Q_g *5	V_{DS} = 300V	-	38	-	nC
Gate - Source charge	Q_{gs} *5	I_D = 6.7A V_{GS} = 18V	-	10	-	
Gate - Drain charge	Q_{gd} *5	See Fig. 1-1.	-	18	-	
Turn - on delay time	$t_{d(on)}$ *5	V_{DS} = 300V	-	14	-	ns
Rise time	t_r *5	I_D = 6.7A V_{GS} = 0V/+18V	-	21	-	
Turn - off delay time	$t_{d(off)}$ *5	R_G = 0Ω	-	23	-	
Fall time	t_f *5	R_L = 45Ω See Fig. 1-1, 1-2.	-	14	-	
Turn - on switching loss	E_{on} *5	V_{DS} = 300V V_{GS}=0V/18V, I_D = 6.7A R_G = 0Ω, L = 500μH	-	29	-	μJ
Turn - off switching loss	E_{off} *5	E_{on} includes diode reverse recovery L_σ = 50nH, C_σ = 200pF See Fig. 2-1, 2-2.	-	3	-	

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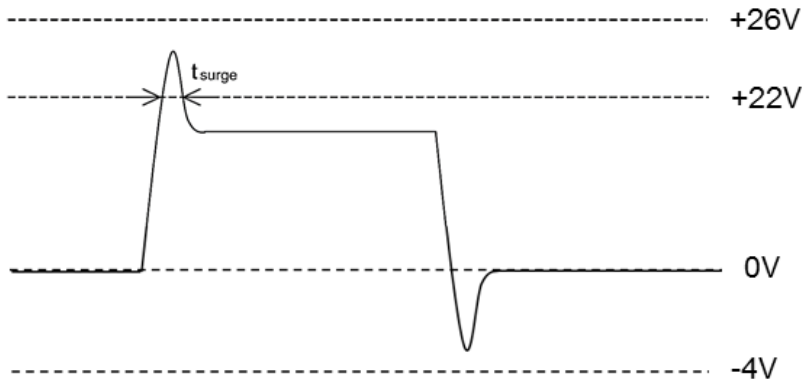
●**Body diode electrical characteristics** (Source-Drain) (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Body diode continuous, forward current	I_S *1	T_c = 25°C	-	-	21	A
Body diode direct current, pulsed	I_{SM} *2		-	-	52	A
Forward voltage	V_{SD} *5	V_{GS} = 0V, I_D = 6.7A	-	3.2	-	V
Reverse recovery time	t_{rr} *5	I_F = 6.7A V_R = 300V di/dt = 1100A/μs L_σ = 50nH, C_σ = 200pF See Fig. 3-1, 3-2.	-	13	-	ns
Reverse recovery charge	Q_{rr} *5		-	35	-	nC
Peak reverse recovery current	I_{rrm} *5		-	6	-	A

*1 Limited by maximum temperature allowed.

*2 $P_W \leq$ 10μs, Duty cycle ≤ 1%

*3 Example of acceptable V_{GS} waveform



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

*5 Pulsed

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●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

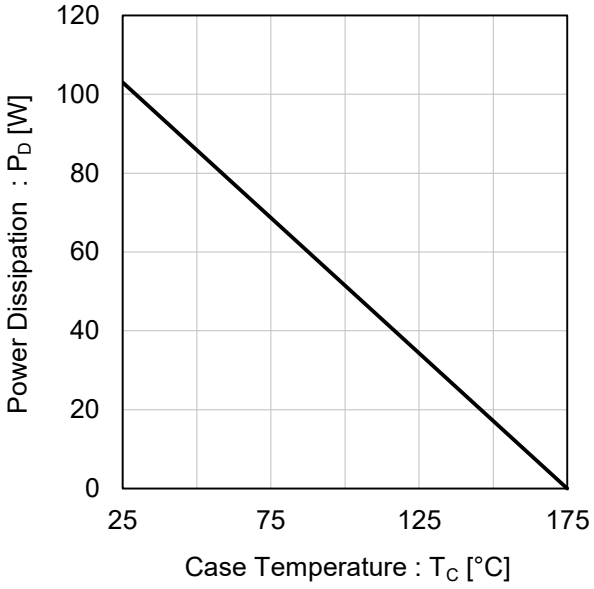


Fig.2 Maximum Safe Operating Area

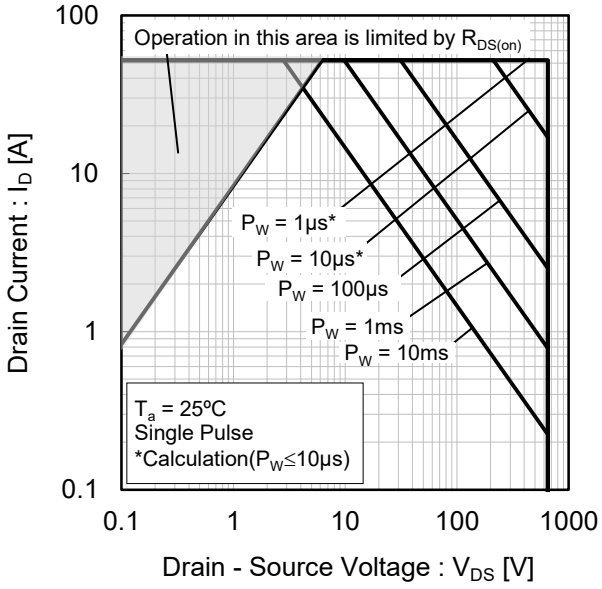
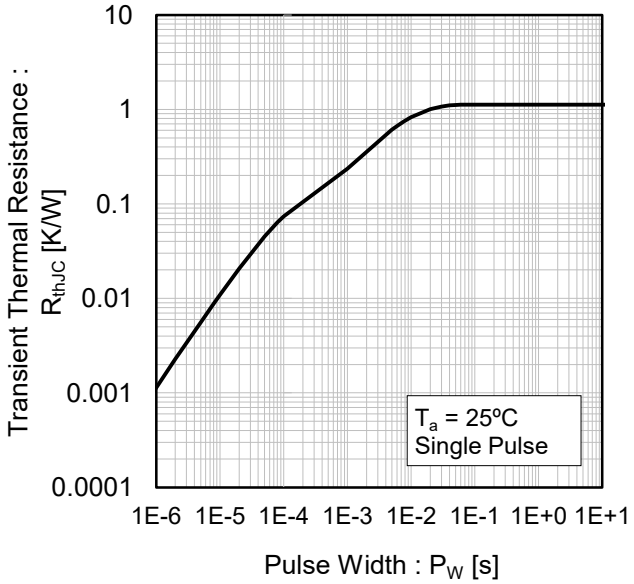


Fig.3 Typical Transient Thermal Resistance vs. Pulse Width



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●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

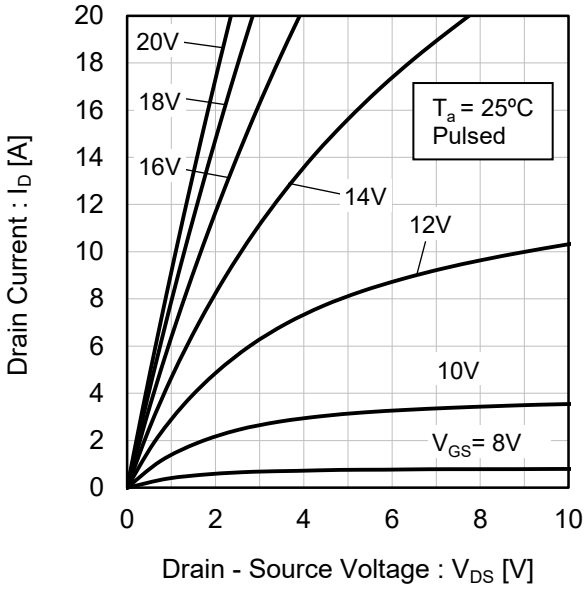


Fig.5 Typical Output Characteristics(II)

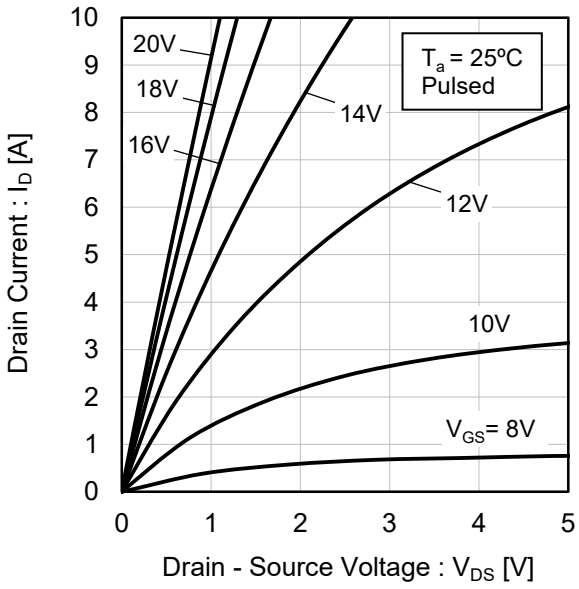
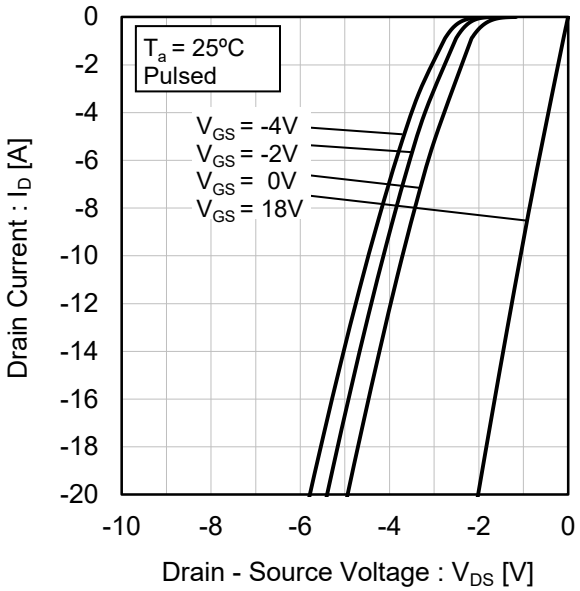


Fig.6 T_j = 25ºC 3rd Quadrant Characteristics



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●Electrical characteristic curves

Fig.7 T_j = 150ºC Typical Output Characteristics(I)

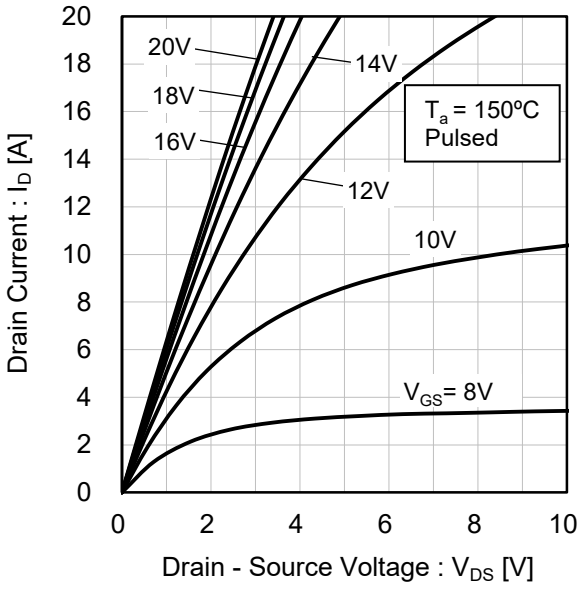


Fig.8 T_j = 150ºC Typical Output Characteristics(II)

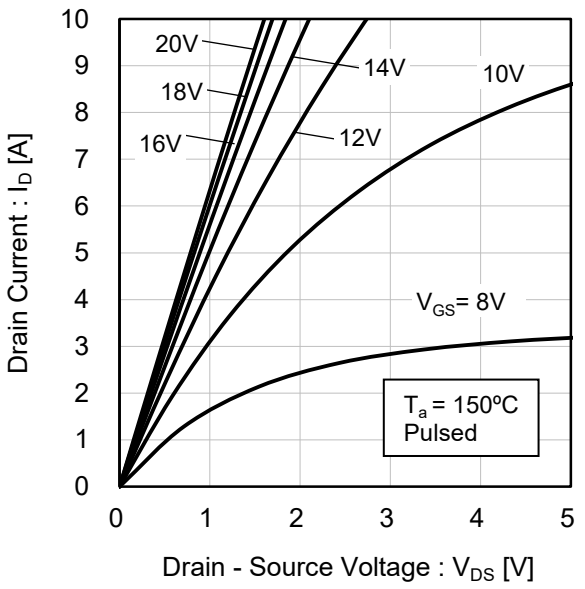


Fig.9 T_j = 150ºC 3rd Quadrant Characteristics

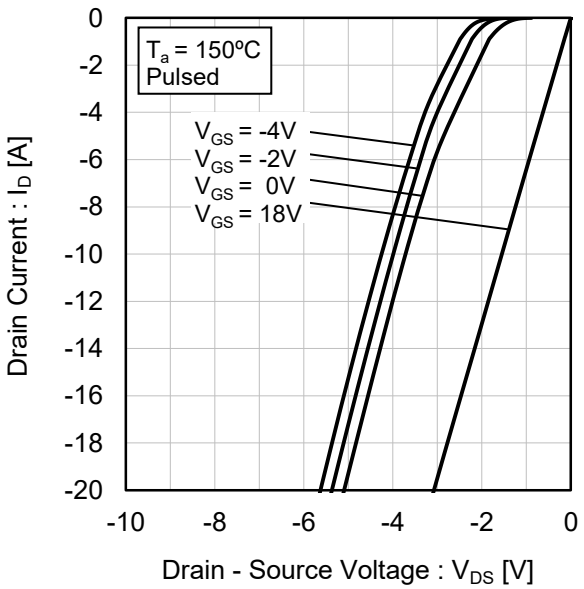
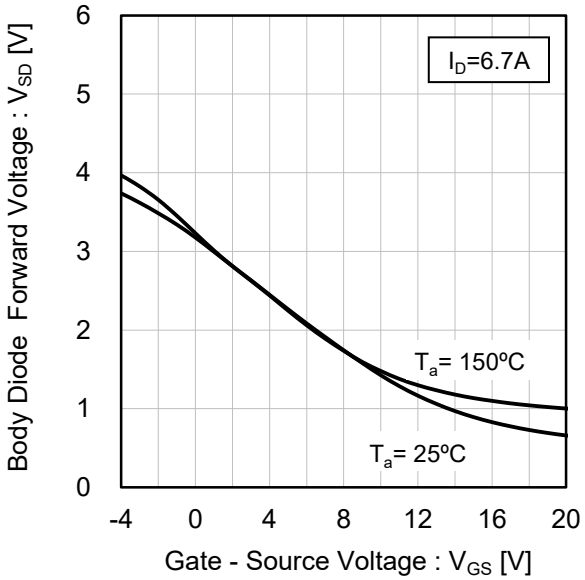


Fig.10 Body Diode Forward Voltage vs. Gate - Source Voltage



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●Electrical characteristic curves

Fig.11 Typical Transfer Characteristics (I)

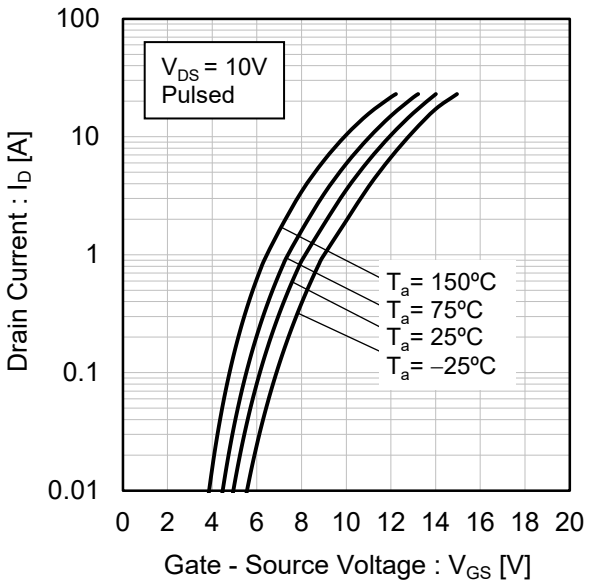


Fig.12 Typical Transfer Characteristics (II)

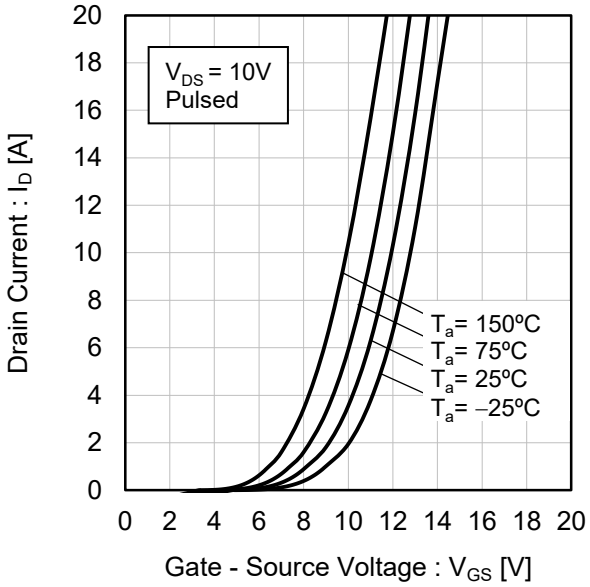


Fig.13 Gate Threshold Voltage vs. Junction Temperature

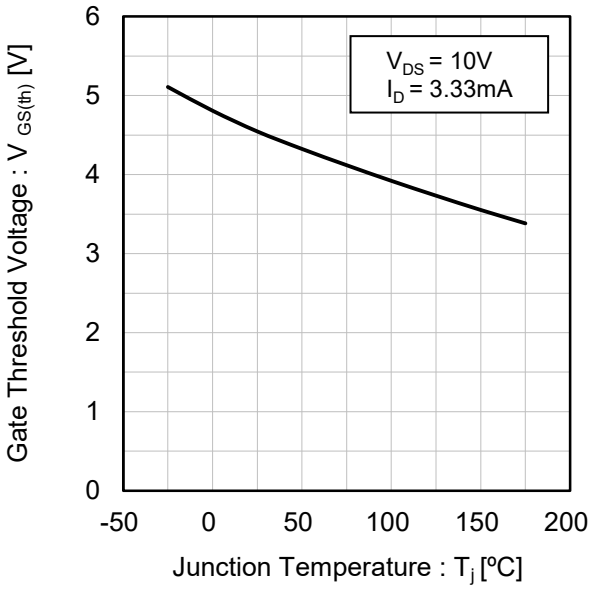
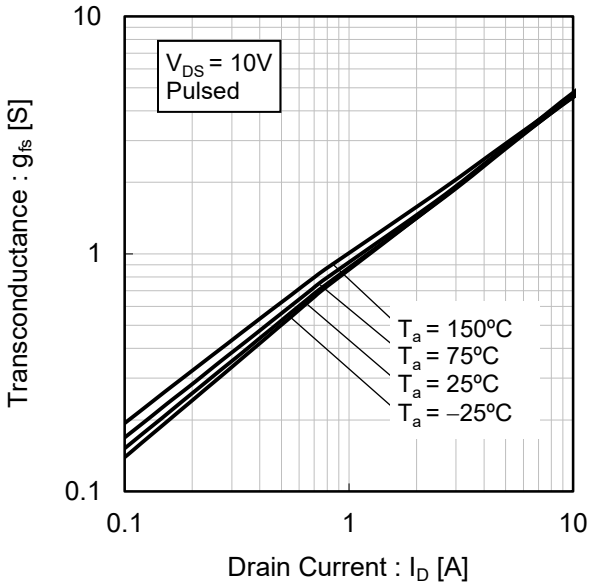


Fig.14 Transconductance vs. Drain Current



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●Electrical characteristic curves

Fig.15 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

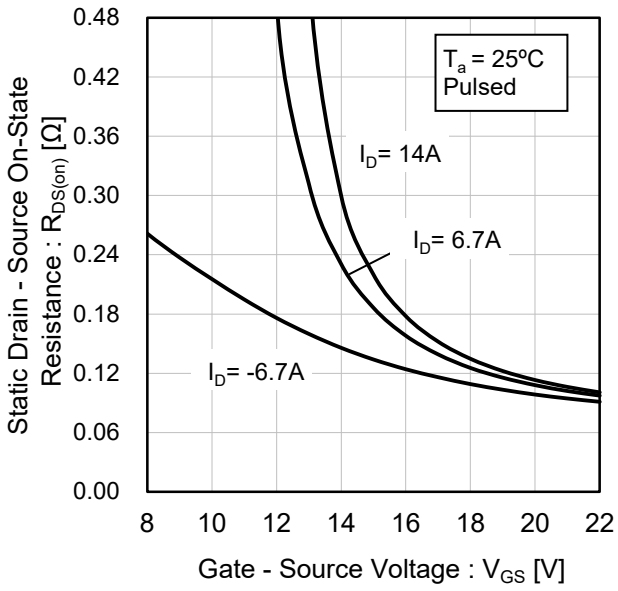


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

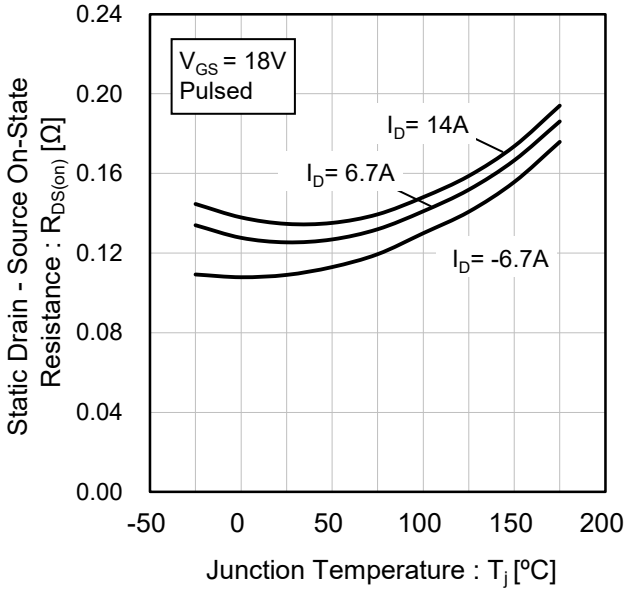


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current

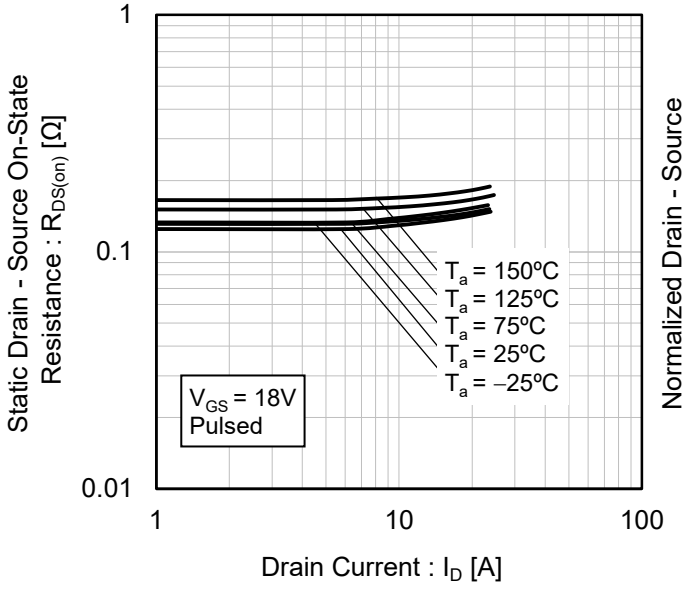
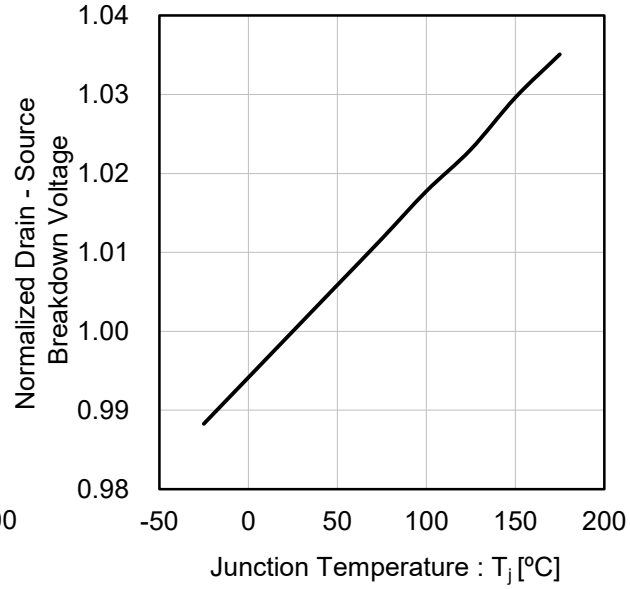


Fig.18 Normalized Drain - Source Breakdown Voltage vs. Junction Temperature



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●Electrical characteristic curves

Fig.19 Typical Capacitance vs. Drain - Source Voltage

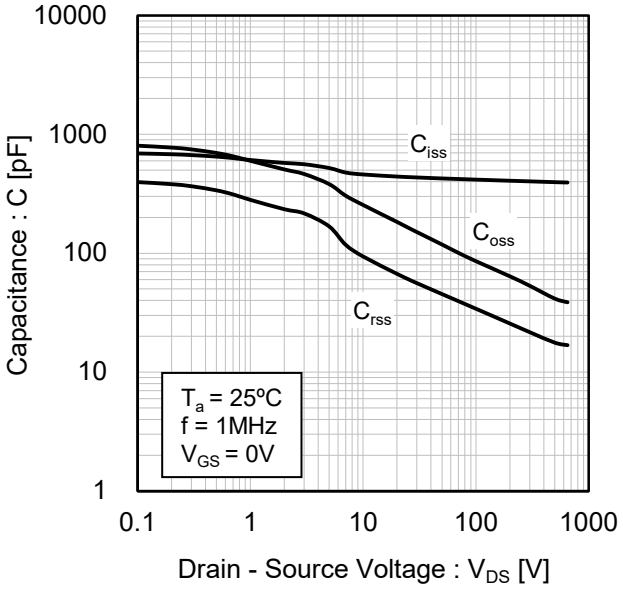


Fig.20 C_{oss} Stored Energy

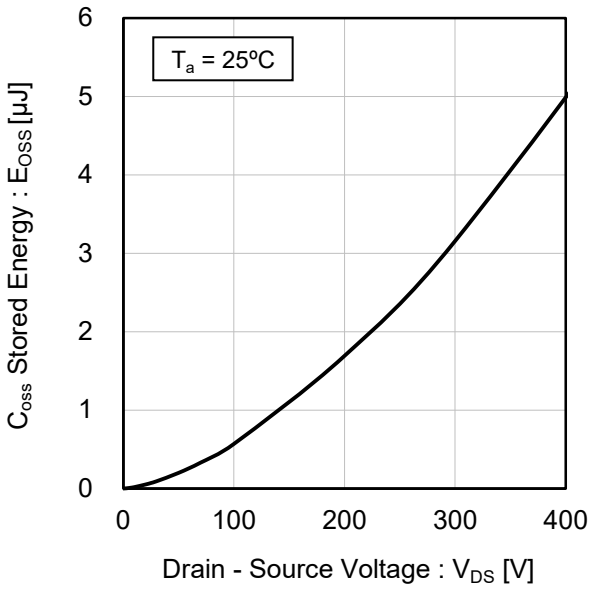
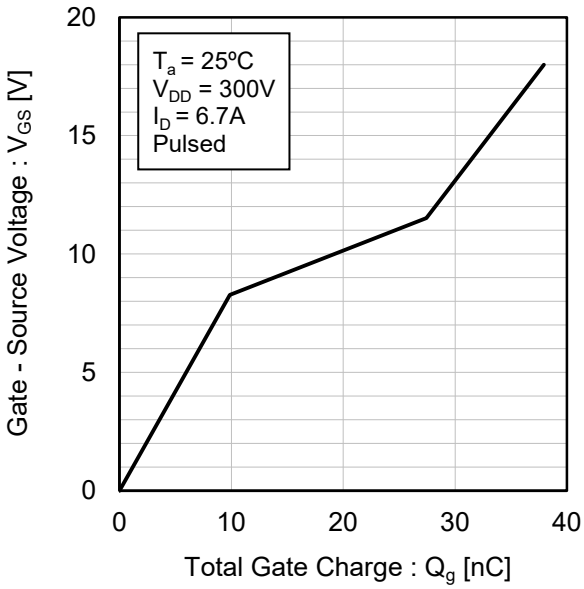
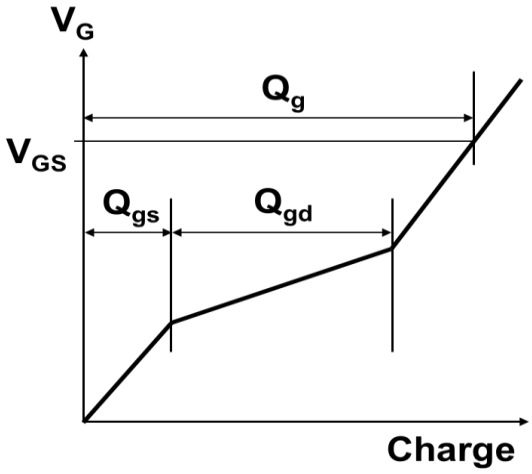


Fig.21 Dynamic Input Characteristics



*Gate Charge Waveform



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●Electrical characteristic curves

Fig.19 Typical Switching Time vs. Drain Current

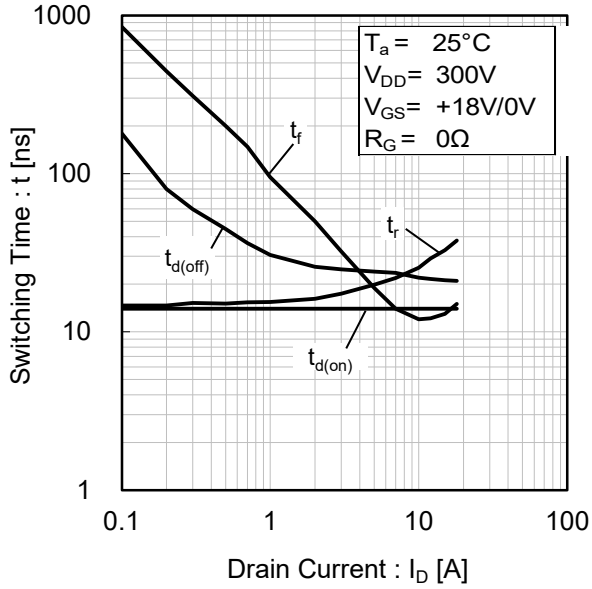


Fig.20 Typical Switching Loss vs. Drain - Source Voltage

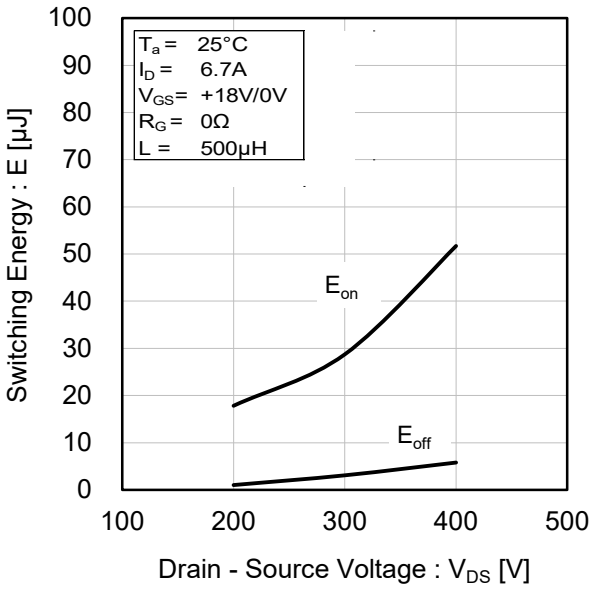


Fig.21 Typical Switching Loss vs. Drain Current

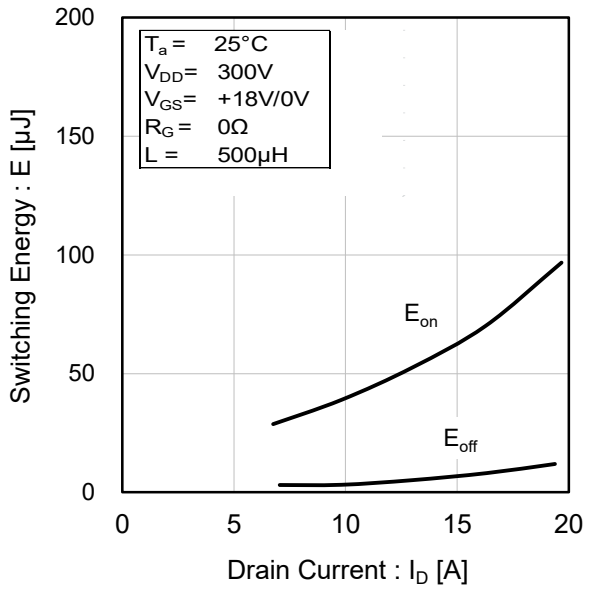
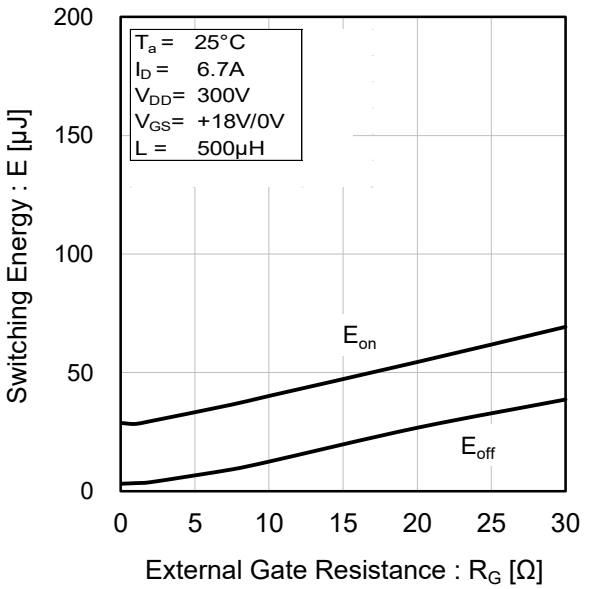


Fig.22 Typical Switching Loss vs. External Gate Resistance



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●Measurement circuits and waveforms

Fig.1-1 Gate Charge and Switching Time Measurement Circuit

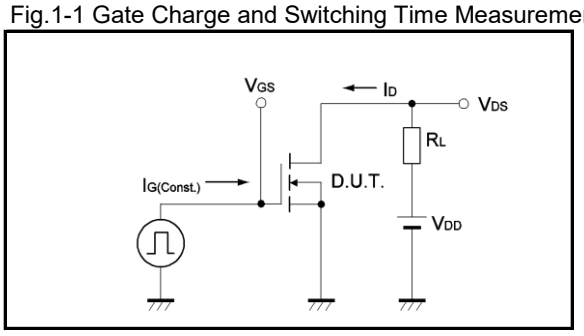


Fig.1-2 Waveforms for Switching Time

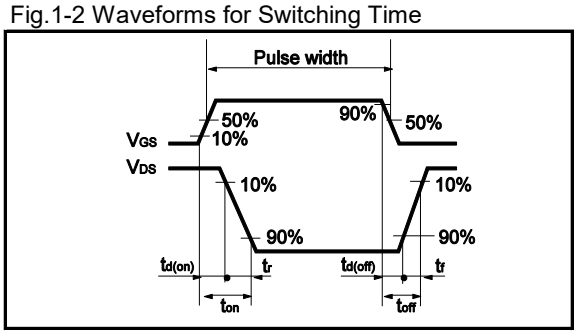


Fig.2-1 Switching Energy Measurement Circuit

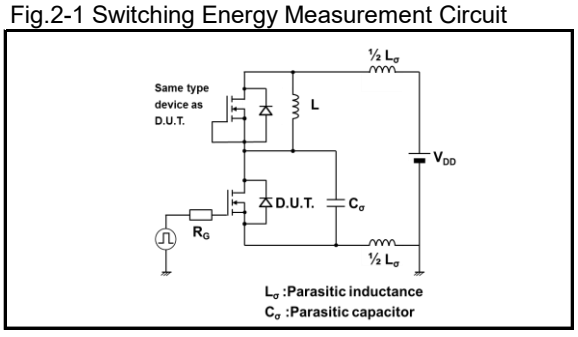


Fig.2-2 Waveforms for Switching Energy Loss

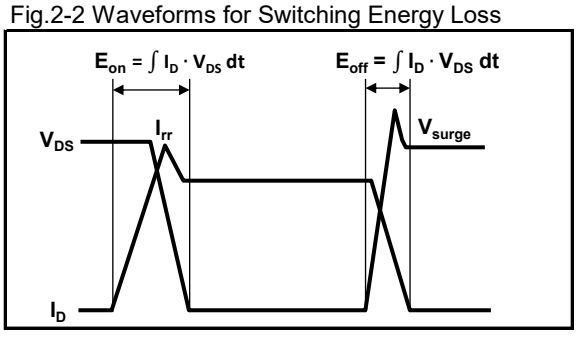


Fig.3-1 Reverse Recovery Time Measurement Circuit

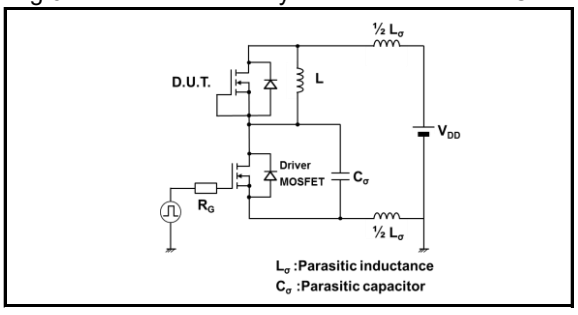
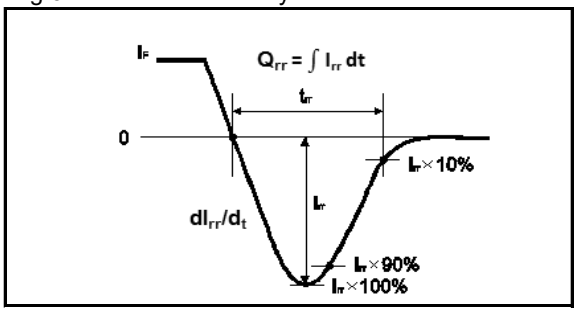


Fig.3-2 Reverse Recovery Waveform



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