SCT3040KLHR

Automotive Grade N-channel SiC power MOSFET Datasheet

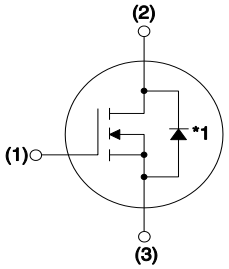
V_{DSS}	1200V
$R_{DS(on)}$ (Typ.)	40mΩ
I_D *1	55A
P_D	262W

●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	SCT3040KL

●Absolute maximum ratings (T_{vj} = 25°C unless otherwise specified)

Parameter		Symbol	Value	Unit
Drain - Source Voltage		V_{DSS}	1200	V
Continuous Drain current	T_c = 25°C	I_D *1	55	A
	T_c = 100°C	I_D *1	39	A
Pulsed Drain current (T_c = 25°C)		$I_{D,pulse}$ *2	137	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
Virtual Junction temperature		T_{vj}	175	°C
Range of storage temperature		T_{stg}	-55 to +175	°C

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●Electrical characteristics (T_{vj} = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 1mA T_{vj} = 25°C T_{vj} = -55°C	 1200 1200	 - -	 - -	V
Zero Gate voltage Drain current	I_{DSS}	V_{GS} = 0V, V_{DS} =1200V T_{vj} = 25°C T_{vj} = 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 = 10mA	2.7	-	5.6	V
Static Drain - Source on - state resistance	$R_{DS(on)}$ *5	V_{GS} = 18V, I_D = 20A T_{vj} = 25°C T_{vj} = 150°C	 - -	 40 68	 52 -	mΩ
Gate input resistance	R_G	f = 1MHz, open drain	-	7	-	Ω

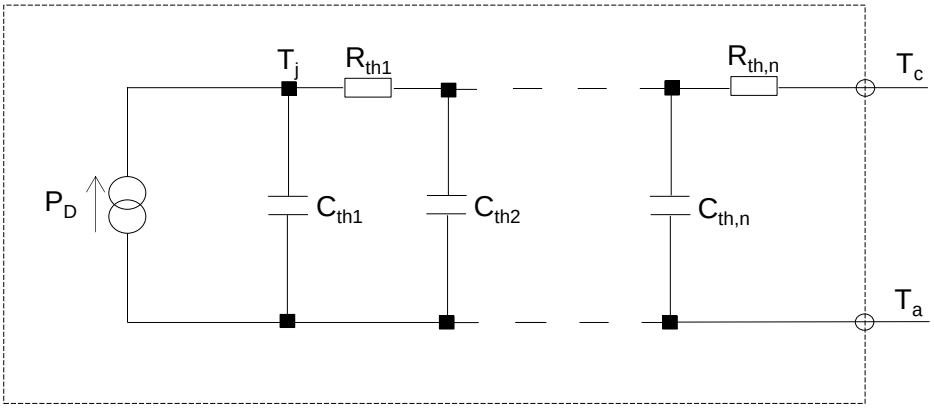
●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC}	-	0.44	0.57	K/W

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	2.56E-02	K/W
R_{th2}	1.95E-01	
R_{th3}	2.20E-01	

Symbol	Value	Unit
C_{th1}	1.39E-03	Ws/K
C_{th2}	1.00E-02	
C_{th3}	3.57E-02	



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●**Electrical characteristics** (T_{vj} = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *5	V_{DS} = 10V, I_D = 20A	-	8.3	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	1337	-	pF
Output capacitance	C_{oss}	V_{DS} = 800V	-	76	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	27	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 600V	-	122	-	pF
Total Gate charge	Q_g *5	V_{DS} = 600V I_D = 20A V_{GS} = 18V See Fig. 1-1.	-	107	-	nC
Gate - Source charge	Q_{gs} *5		-	17	-	
Gate - Drain charge	Q_{gd} *5		-	56	-	
Turn - on delay time	$t_{d(on)}$ *5	V_{DS} = 400V I_D = 18A V_{GS} = 0V/+18V R_G = 0Ω R_L = 22Ω See Fig. 1-1, 1-2.	-	21	-	ns
Rise time	t_r *5		-	39	-	
Turn - off delay time	$t_{d(off)}$ *5		-	49	-	
Fall time	t_f *5		-	24	-	
Turn - on switching loss	E_{on} *5	V_{DS} = 600V V_{GS}=0V/18V, I_D = 20A R_G = 0Ω, L = 250μH E_{on} includes diode reverse recovery L_σ = 50nH, C_σ = 200pF See Fig. 2-1, 2-2.	-	283	-	μJ
Turn - off switching loss	E_{off} *5		-	118	-	

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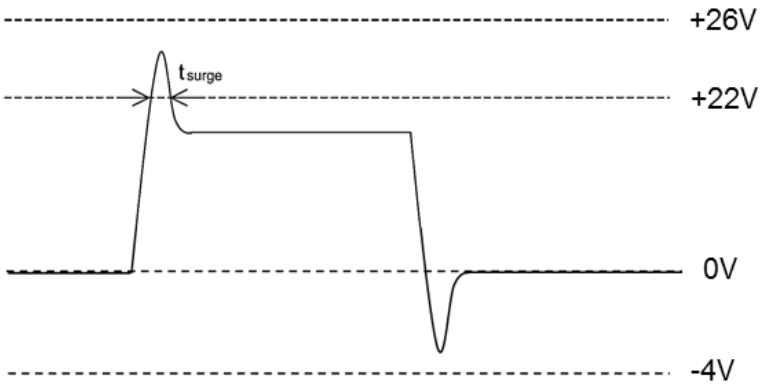
●**Body diode electrical characteristics** (Source-Drain) (T_{vj} = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Body diode continuous, forward current	I_S *1	T_c = 25°C	-	-	55	A
Body diode direct current, pulsed	I_{SM} *2		-	-	137	A
Forward voltage	V_{SD} *5	V_{GS} = 0V, I_S = 20A	-	3.2	-	V
Reverse recovery time	t_{rr} *5	I_F = 20A V_R = 600V di/dt = 1100A/μs L_σ = 50nH, C_σ = 200pF See Fig. 3-1, 3-2.	-	25	-	ns
Reverse recovery charge	Q_{rr} *5		-	115	-	nC
Peak reverse recovery current	I_{rrm} *5		-	9	-	A

*1 Limited by maximum T_{vj} and for Max. R_{thJC}.

*2 PW ≤ 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

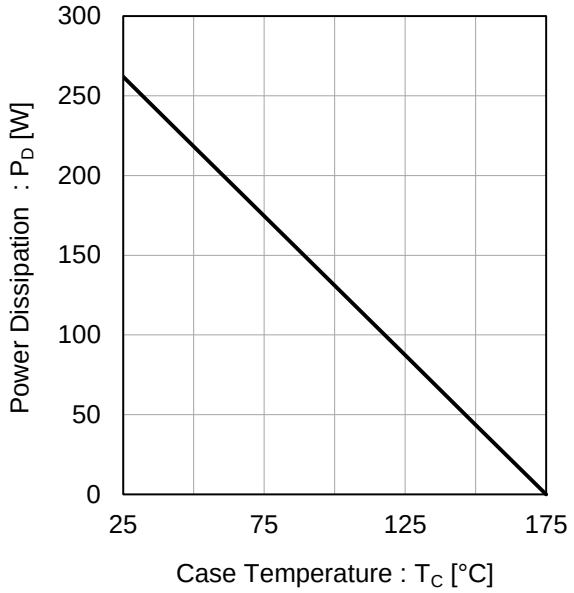


Fig.2 Maximum Safe Operating Area

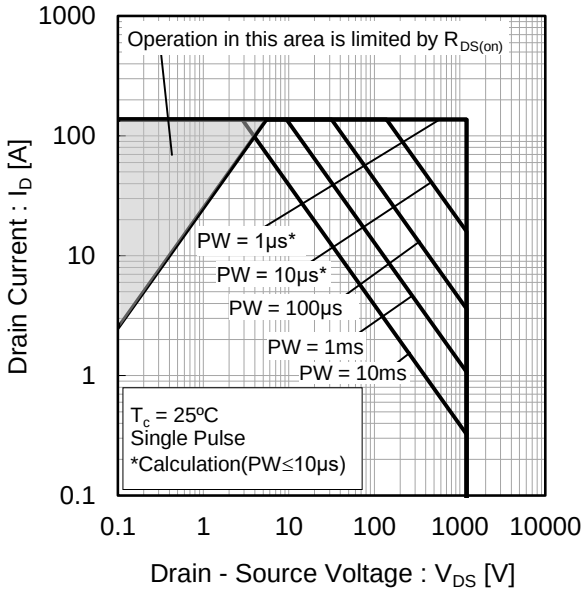
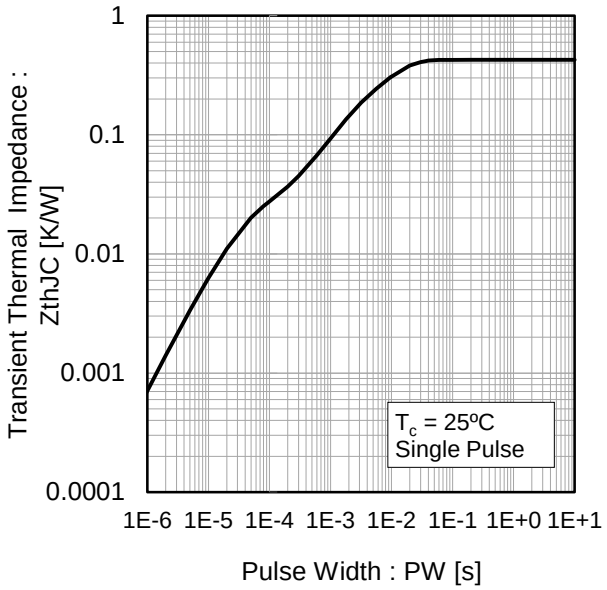


Fig.3 Typical Transient Thermal Resistance vs. Pulse Width



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Fig.4 Typical Output Characteristics(I)

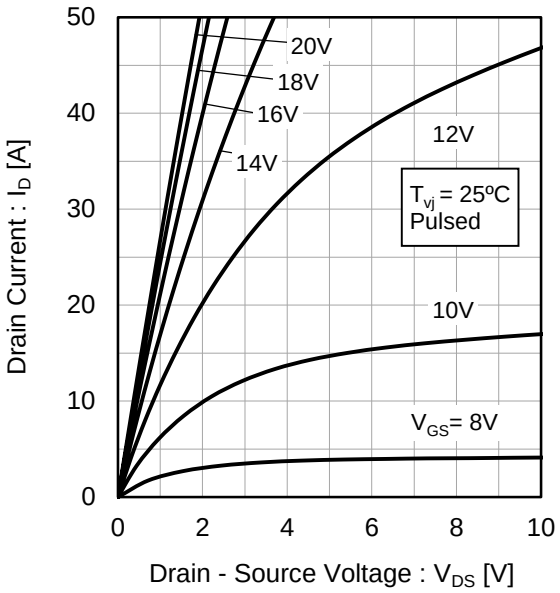


Fig.5 Typical Output Characteristics(II)

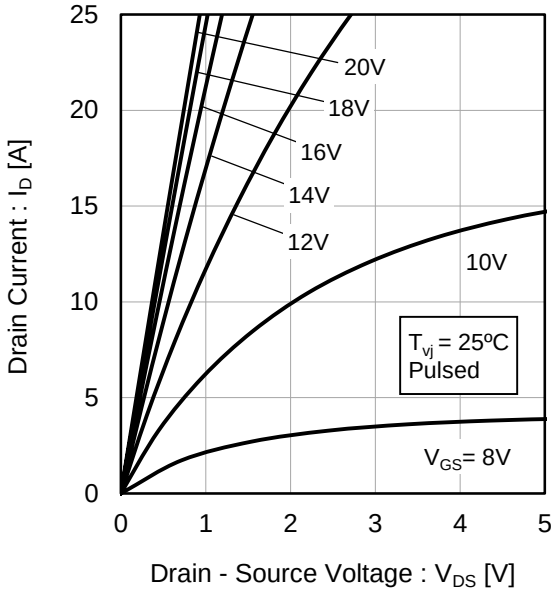
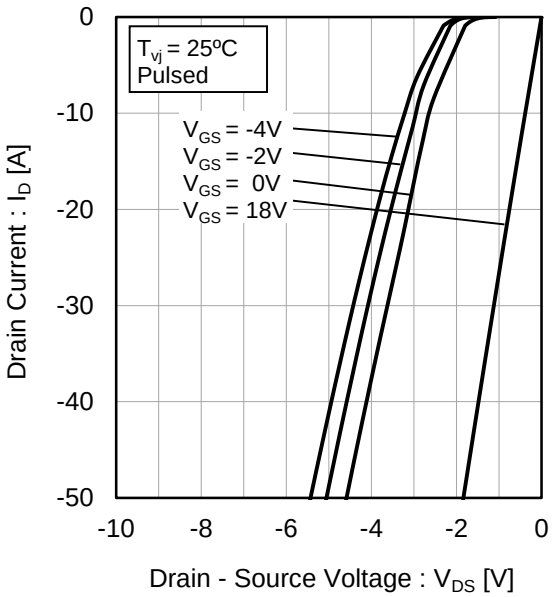


Fig.6 T_{vj} = 25ºC 3rd Quadrant Characteristics



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●Electrical characteristic curves

Fig.7 T_{vj} = 150ºC Typical Output Characteristics(I)

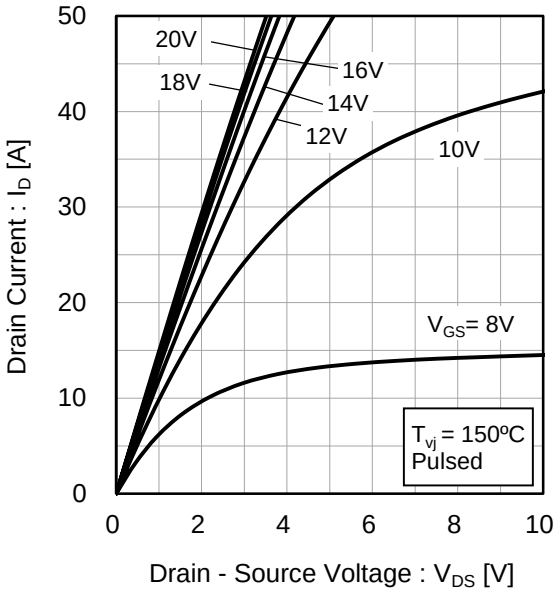


Fig.8 T_{vj} = 150ºC Typical Output Characteristics(II)

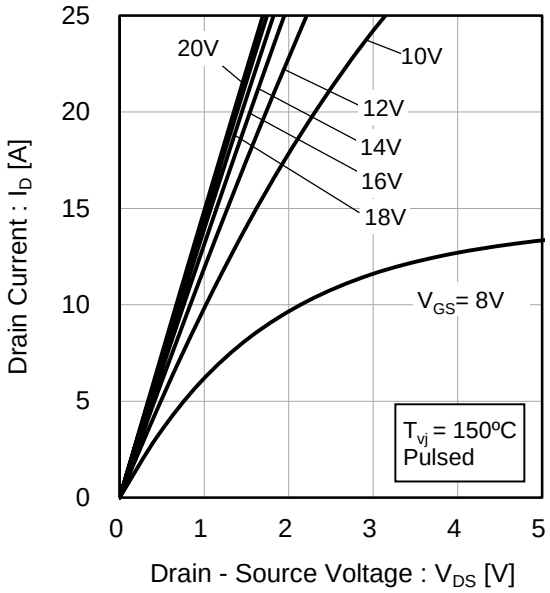


Fig.9 T_{vj} = 150ºC 3rd Quadrant Characteristics

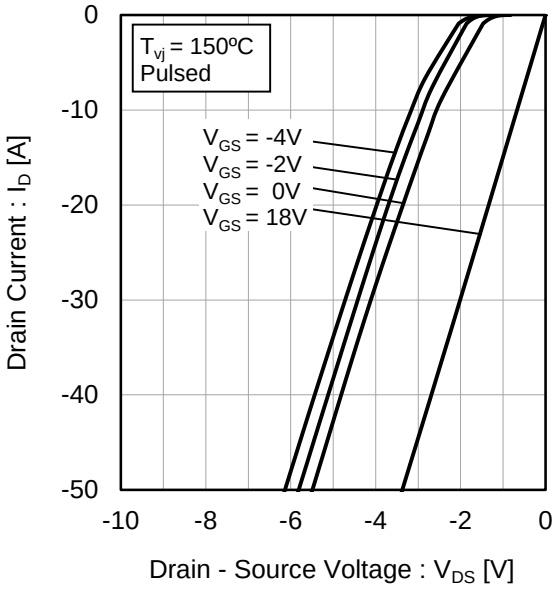
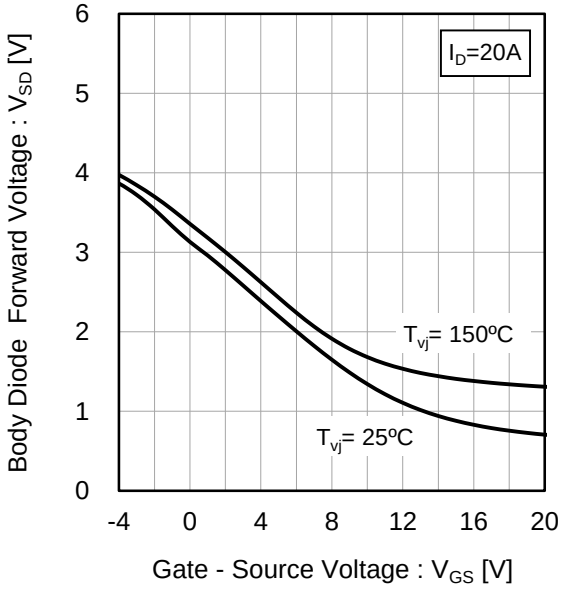


Fig.10 Body Diode Forward Voltage vs. Gate - Source Voltage



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Fig.11 Typical Transfer Characteristics (I)

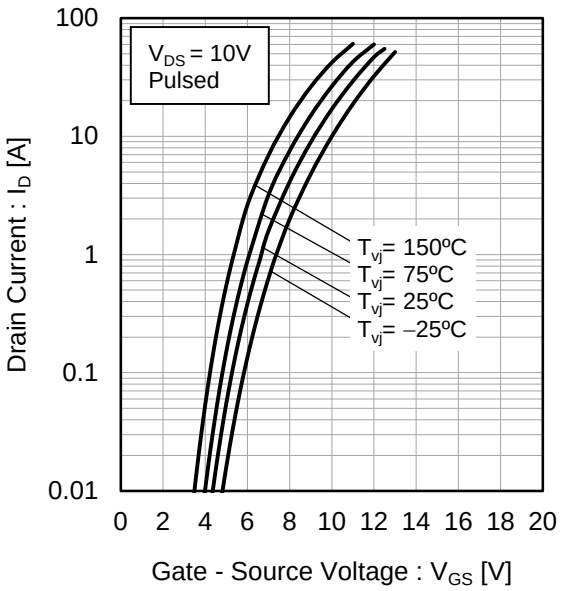


Fig.12 Typical Transfer Characteristics (II)

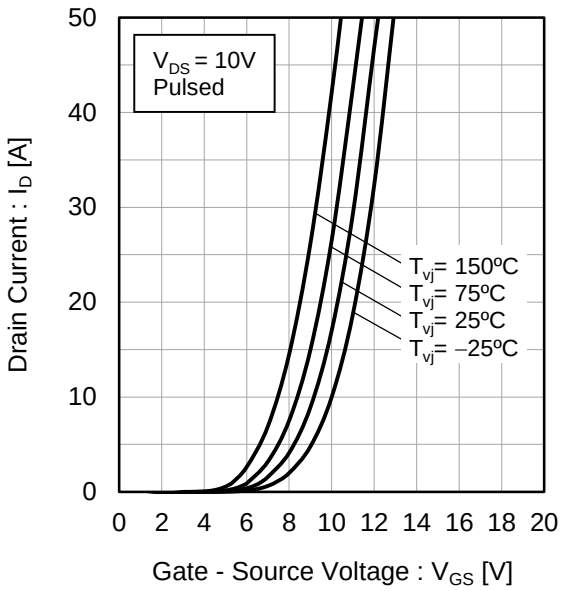


Fig.13 Gate Threshold Voltage vs. Junction Temperature

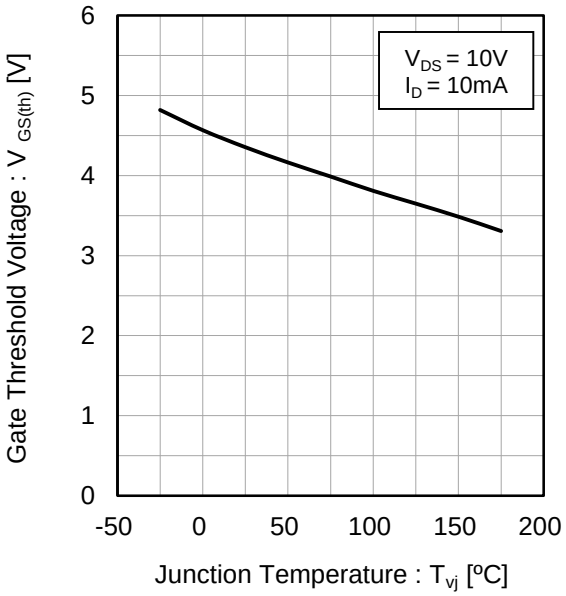
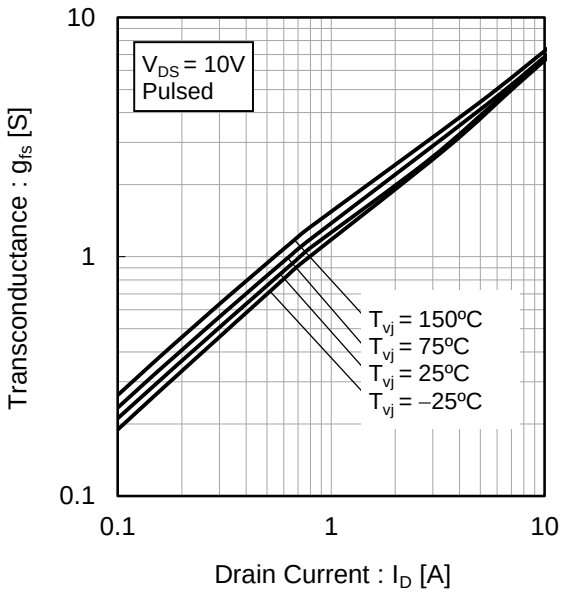


Fig.14 Transconductance vs. Drain Current



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●Electrical characteristic curves

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

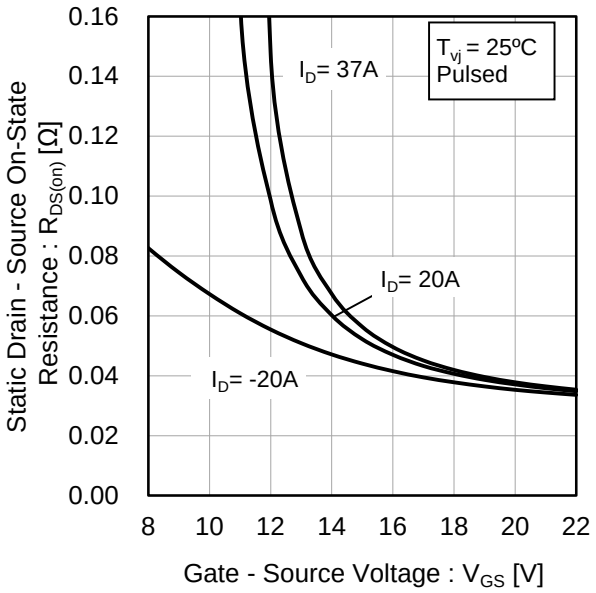


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

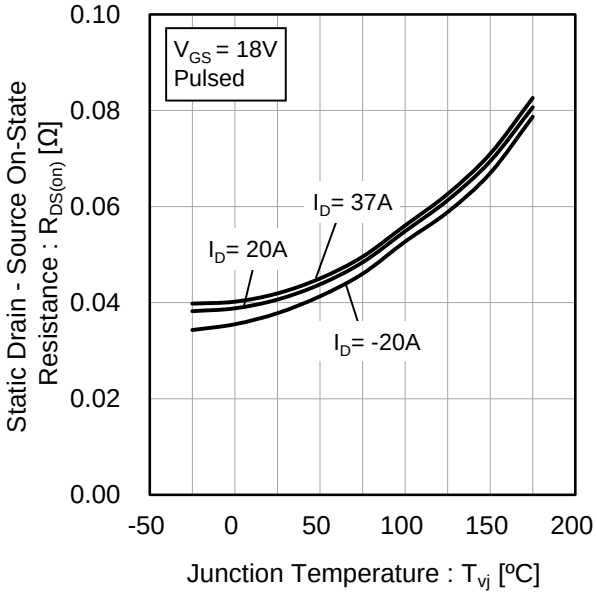


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current

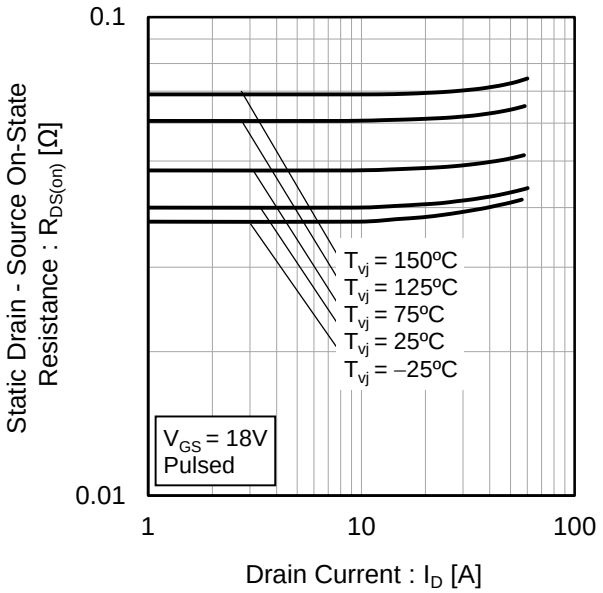
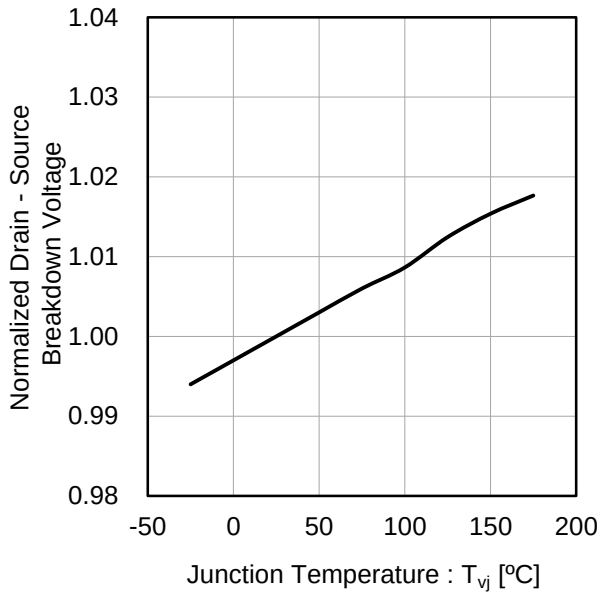


Fig.18 Normalized Drain - Source Breakdown Voltage vs. Junction Temperature



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●Electrical characteristic curves

Fig.19 Typical Capacitance vs. Drain - Source Voltage

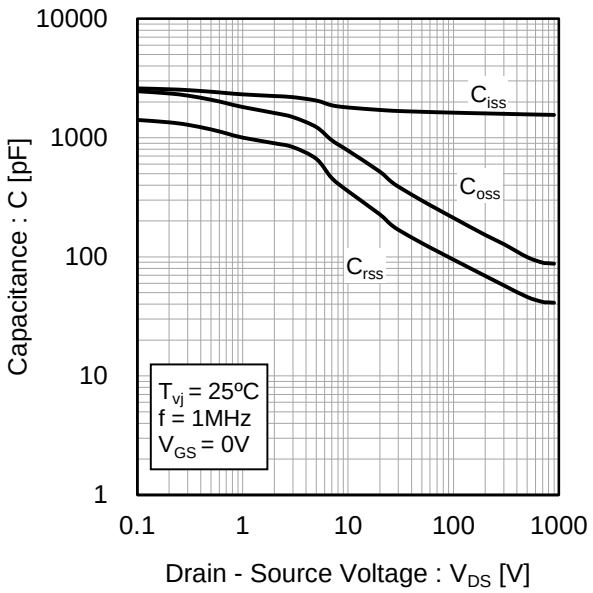


Fig.20 C_{oss} Stored Energy

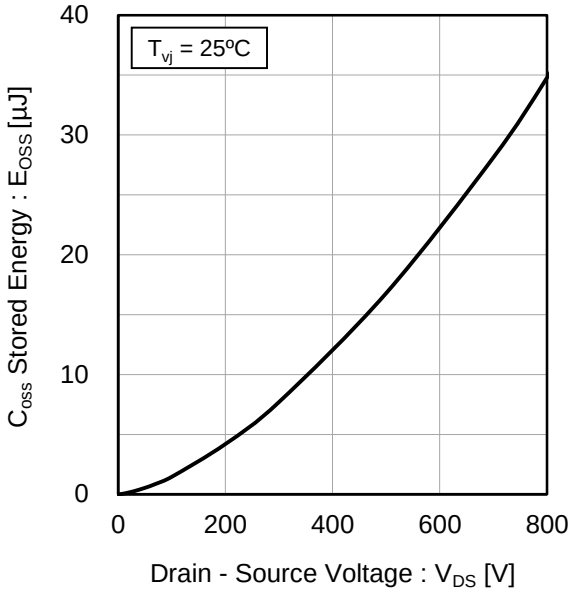
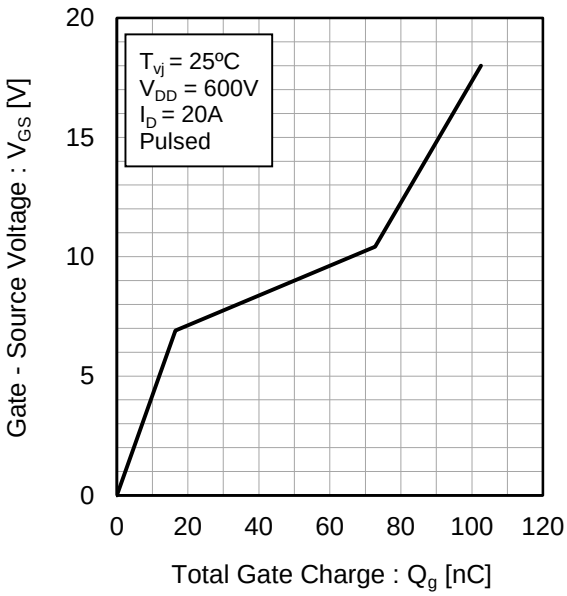
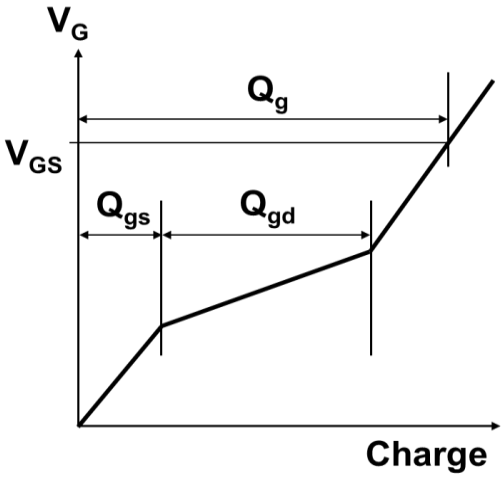


Fig.21 Dynamic Input Characteristics



*Gate Charge Waveform



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●Electrical characteristic curves

Fig.19 Typical Switching Time vs. Drain Current

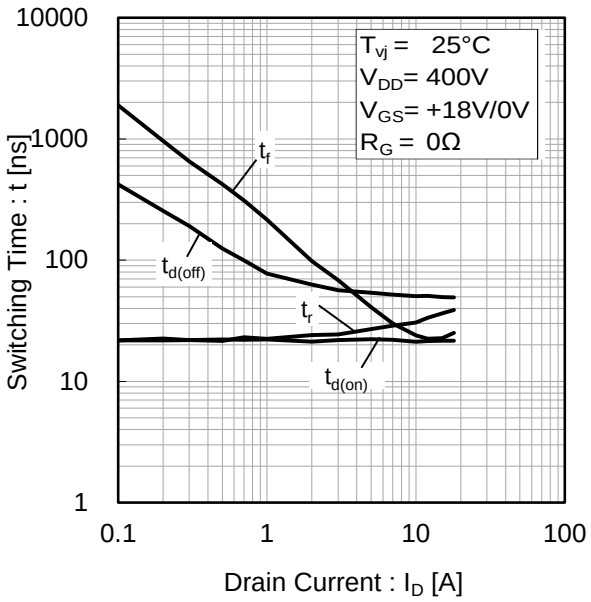


Fig.20 Typical Switching Loss vs. Drain - Source Voltage

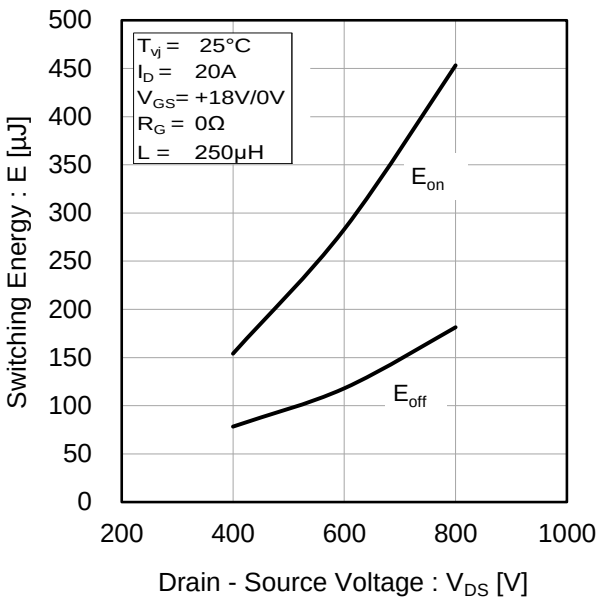


Fig.21 Typical Switching Loss vs. Drain Current

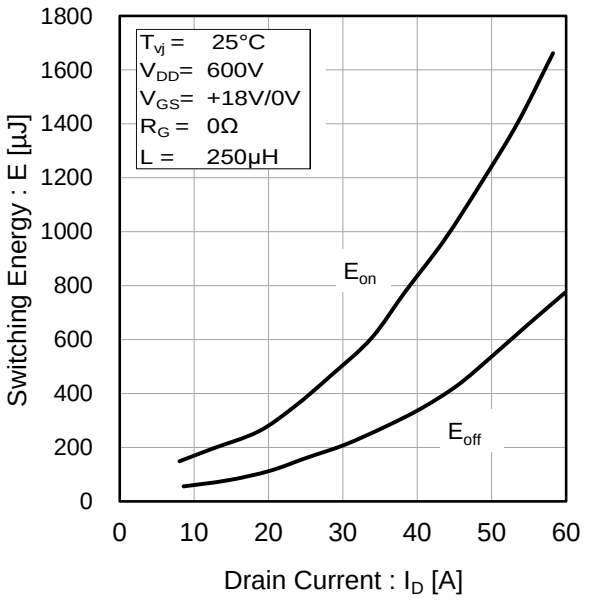
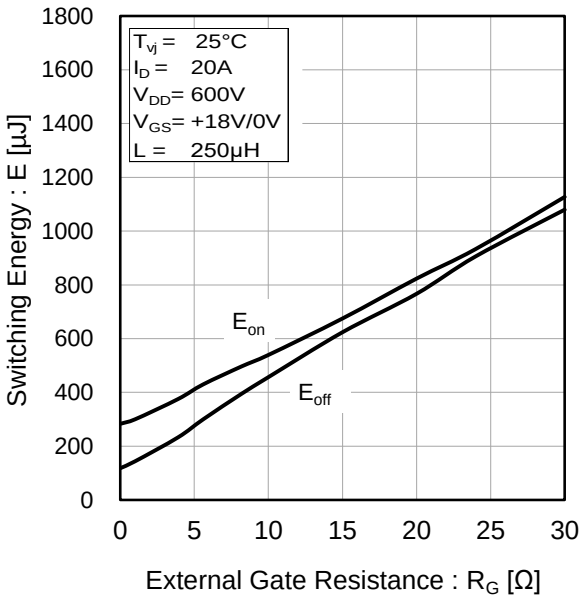


Fig.22 Typical Switching Loss vs. External Gate Resistance



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●Measurement circuits and waveforms

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

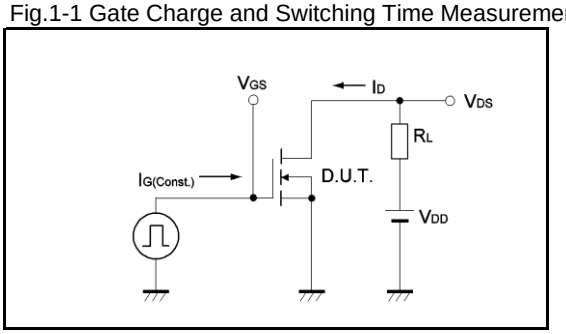


Fig.1-2 Waveforms for Switching Time

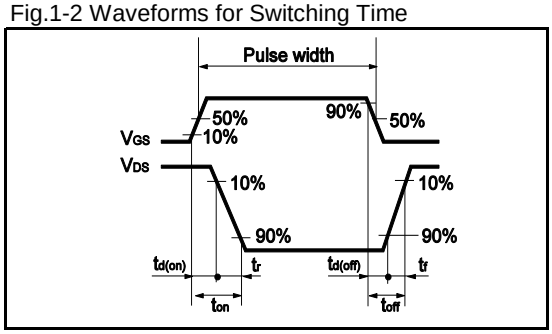


Fig.2-1 Switching Energy Measurement Circuit

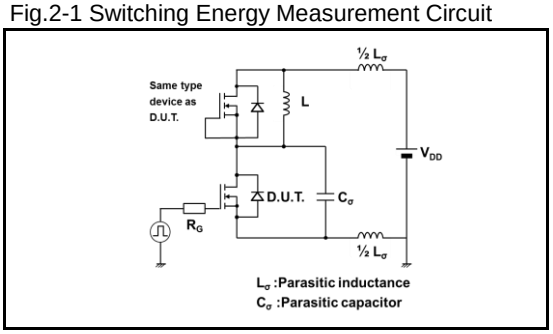


Fig.2-2 Waveforms for Switching Energy Loss

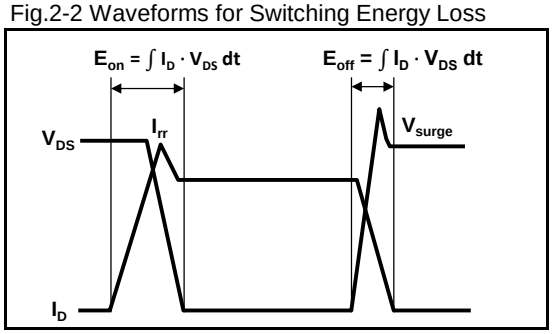


Fig.3-1 Reverse Recovery Time Measurement Circuit

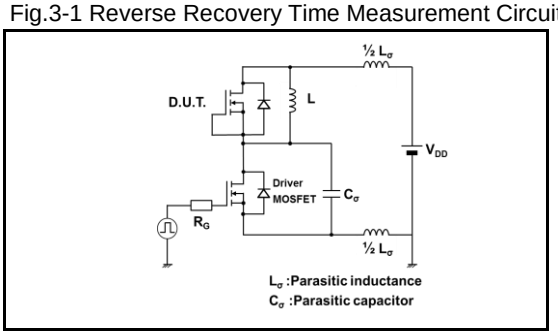
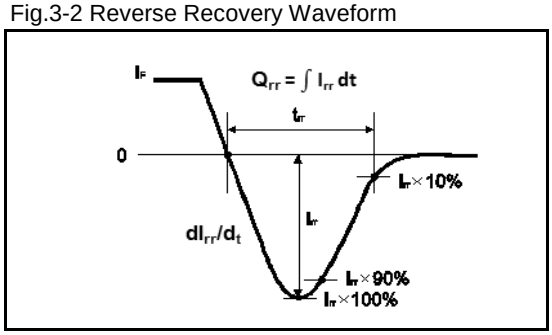


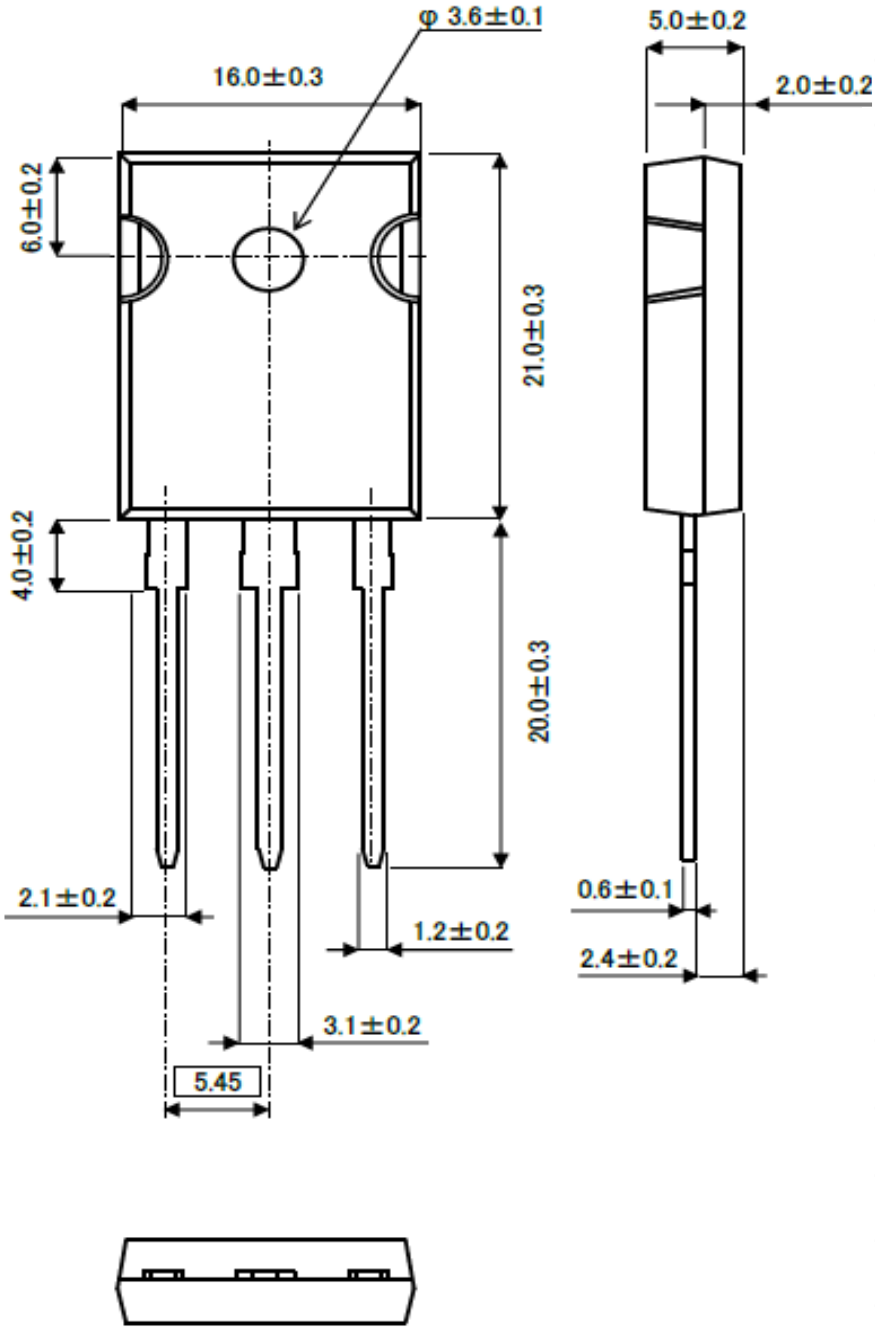
Fig.3-2 Reverse Recovery Waveform



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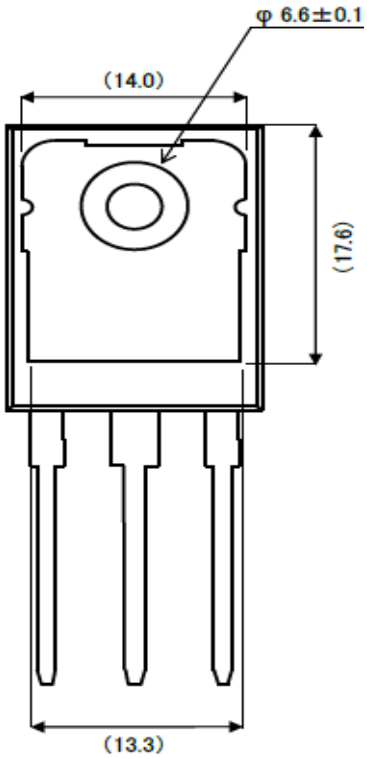
●Package Dimensions



Unit: mm

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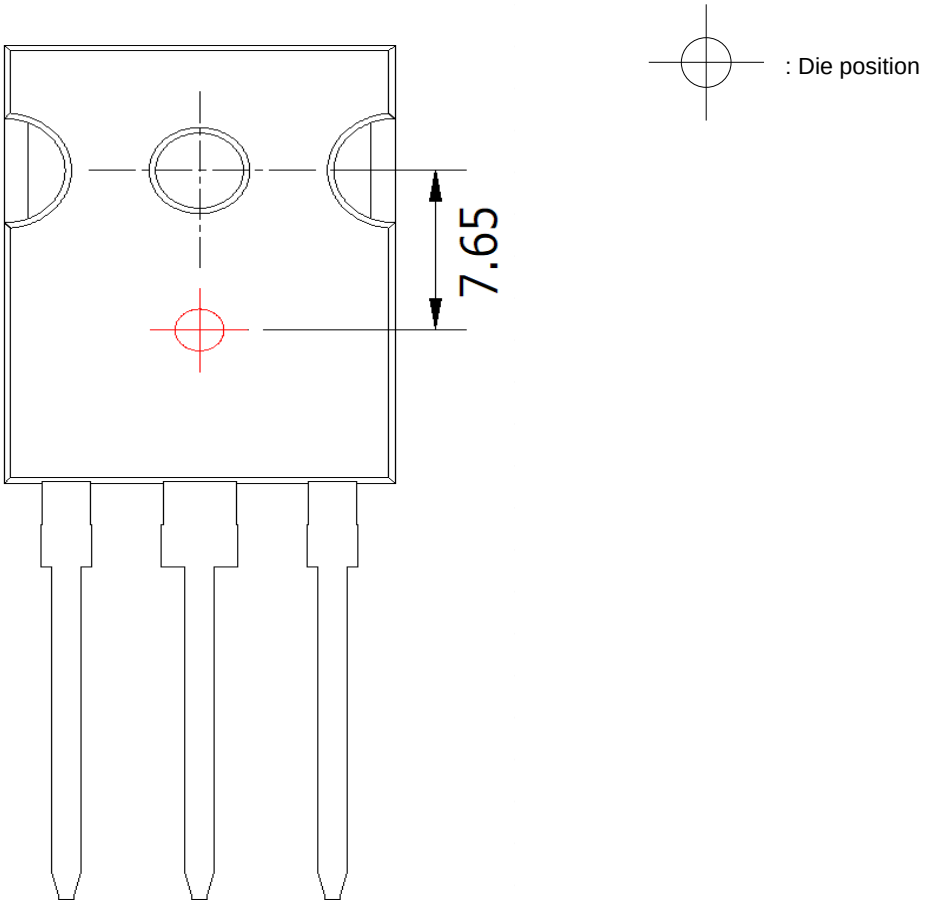


Unit: mm

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●Die Bonding Layout



・Front view of the packaging.

・Dimensions are design values.

・If the heat sink is to be installed, it should be in contact with the die bonding point.

Unit: mm

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