SCT4090KRHR

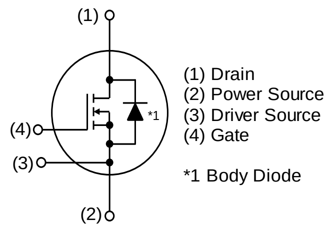
Automotive Grade N-channel SiC power MOSFET Datasheet

V_{DSS}	1200V
$R_{DS(on)}$ (Typ.)	90mΩ
I_D *1	19A
P_D	88W

● Outline

TO-247-4L

● Inner circuit



Please note Driver Source and Power Source are not exchangeable. Their exchange might lead to malfunction.

● 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	C15
	Marking	SCT4090KR

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

Parameter			Symbol	Value	Unit
Drain - source voltage			V_{DSS}	1200	V
Continuous drain and source current	$V_{GS} = V_{GS\_on}$	T_c = 25°C	I_D, I_S *1	19	A
		T_c = 100°C		13	A
Pulsed drain current	$V_{GS} = V_{GS\_on}$	T_c = 25°C	$I_{D,pulse}$ *2	45	A
Body diode pulsed forward current		T_c = 25°C, V_{GS} = 0 V	$I_{S,pulse}$ *1,*3	19	A
Body diode surge forward current			$I_{S,pulse}$ *1,*4	45	A
Gate - source voltage (DC)			V_{GSS_DC}	-4 to +21	V
Gate - source surge voltage (t_{surge} < 300ns)			V_{GSS_surge} *5	-4 to +23	V
Recommended turn-on gate - source drive voltage			V_{GS_on} *6	+15 to +18	V
Recommended turn-off gate - source drive voltage			V_{GS_off}	0	V
Virtual junction temperature			T_{vj}	175	°C
Range of storage temperature			T_{stg}	-40 to +175	°C

●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} = 0 V, I_D = 3.7mA T_{vj} = 25°C	1200	-	-	V
Zero Gate voltage Drain current	I_{DSS}	V_{GS} = 0 V, V_{DS} =1200V T_{vj} = 25°C T_{vj} = 150°C	- -	1 10	80 -	μA
Gate - Source leakage current	I_{GSS+}	V_{GS} = +21V , V_{DS} = 0V	-	-	100	nA
Gate - Source leakage current	I_{GSS-}	V_{GS} = -4V , V_{DS} = 0V	-	-	-100	nA
Gate threshold voltage	$V_{GS(th)}$ *7	V_{DS} = 10V, I_D = 4.44mA	2.8	-	4.8	V
Static Drain - Source on - state resistance	$R_{DS(on)}$ *8	V_{GS} = 18V, I_D = 8.3A T_{vj} = 25°C T_{vj} = 150°C	- -	90 180	117 -	mΩ
Gate input resistance	R_G	f = 1MHz, open drain	-	4	-	Ω

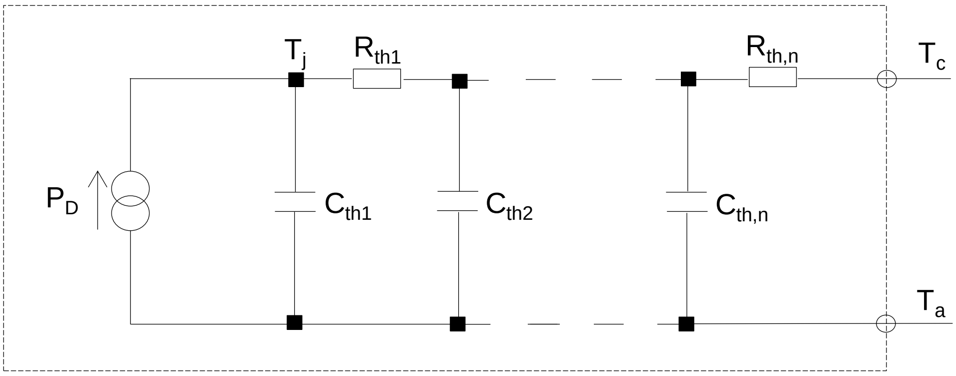
●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC} *9	-	1.3	1.7	K/W

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	1.8×10^{-1}	K/W
R_{th2}	6.7×10^{-1}	K/W
R_{th3}	4.8×10^{-1}	K/W

Symbol	Value	Unit
C_{th1}	4.2×10^{-4}	Ws/K
C_{th2}	1.9×10^{-3}	Ws/K
C_{th3}	4.8×10^{-2}	Ws/K



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

Parameter		Symbol	Conditions	Values Min.	Values Typ.	Values Max.	Unit
Transconductance		g_{fs} *8	V_{DS} = 10V, I_D = 8.3A	-	4.1	-	S
Input capacitance		C_{iss}	V_{GS} = 0V V_{DS} = 800V f = 1MHz	-	1026	-	pF
Output capacitance		C_{oss}		-	35	-	
Reverse transfer capacitance		C_{rss}		-	3	-	
Effective output capacitance, energy related		$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 800V	-	44	-	pF
Total Gate charge		Q_g *8	V_{DS} = 800V I_D = 8.3A V_{GS} = 18V See Fig. 1-1, 1-2.	-	48	-	nC
Gate - Source charge		Q_{gs} *8		-	11	-	
Gate - Drain charge		Q_{gd} *8		-	16	-	
Turn - on delay time		$t_{d(on)}$ *8	V_{DS} = 800V I_D = 8.3A V_{GS} = +18V / 0V R_G = 0Ω, L = 250μH E_{on} includes diode reverse recovery $L_σ$ = 50nH, $C_σ$ = 10pF See Fig. 2-1, 2-2, 2-3.	-	4.4	-	ns
Rise time		t_r *8		-	9.8	-	
Turn - off delay time		$t_{d(off)}$ *8		-	19	-	
Fall time		t_f *8		-	16	-	
Turn - on switching loss		E_{on} *8		-	100	-	μJ
Turn - off switching loss		E_{off} *8		-	9	-	
Short-circuit withstand time	$V_{GS(on)}$ = +15V	t_{sc} *10	V_{DS} ≦ 800V $V_{DS,peak}$ ≦ 1200V $T_{vj(start)}$ = 25°C R_G = 2.2Ω	-	4.5	-	μs
	$V_{GS(on)}$ = +18V			-	4.0	-	μs

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{SD} *8	V_{GS} = 0V, I_S = 8.3A	-	3.3	-	V
Reverse recovery time	t_{rr} *8	I_F = 8.3A V_R = 800V di/dt = 3000A/μs $L_σ$ = 50nH, $C_σ$ = 10pF See Fig. 3-1, 3-2.	-	8.5	-	ns
Reverse recovery charge	Q_{rr} *8		-	90	-	nC
Peak reverse recovery current	I_{rrm} *8		-	21	-	A

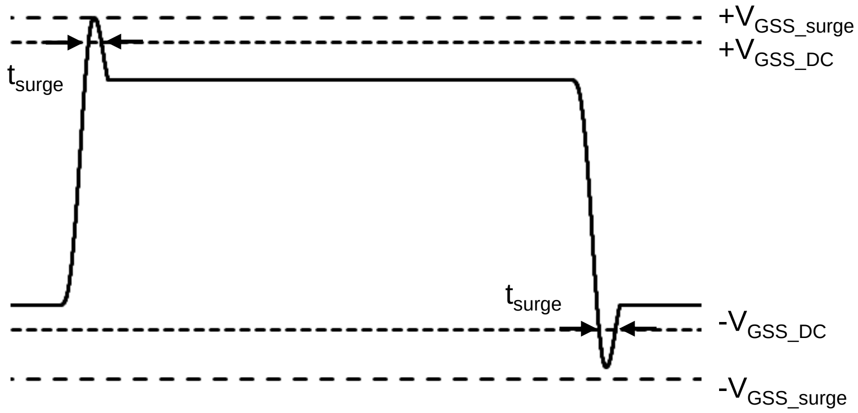
*1 Limited by maximum T_{vj} and for Max. R_{thJC}.

*2 Pulse width and duty cycle are limited by $T_{vj,max}$.

*3 Only for body-diode, Repetitive pulse, PW ≤ 1.5μs, Duty cycle ≤ 5%

*4 When used as a protective function, PW ≤ 10μs

*5 Example of acceptable V_{GS} waveform



Please note especially when using driver source that V_{GSS_surge} must be in the range of absolute maximum rating.

*6 Please be advised not to use SiC-MOSFETs with V_{GS} below 10V as doing so may cause thermal runaway.

*7 Tested after applying V_{GS} = 21V for 100ms.

*8 Pulsed

*9 Measured conformable to JESD51-14.

See the application note "rthjc_measurement_and_usage_an-e.pdf". Link

URL: https://fscdn.rohm.com/en/products/databook/applinote/discrete/common/rthjc_measurement_and_usage_an-e.pdf

*10 Single pulsed.

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

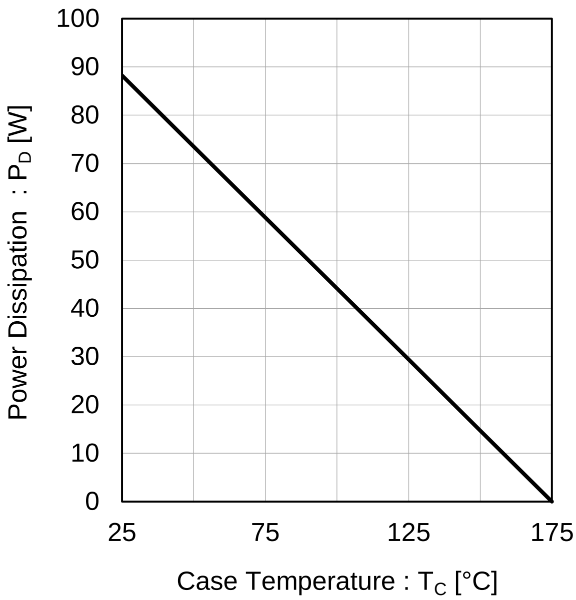


Fig.2 Maximum Safe Operating Area

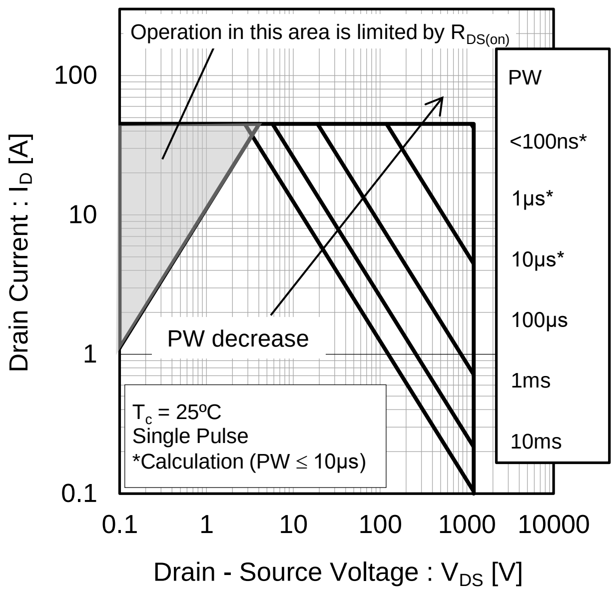
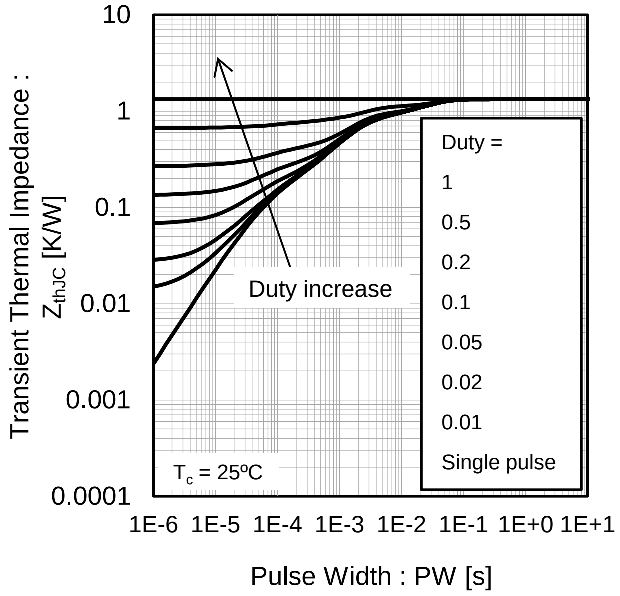


Fig.3 Typical Transient Thermal Impedance vs. Pulse Width



●Electrical characteristic curves

Fig.4 T_{vj} = 25ºC Typical Output Characteristics

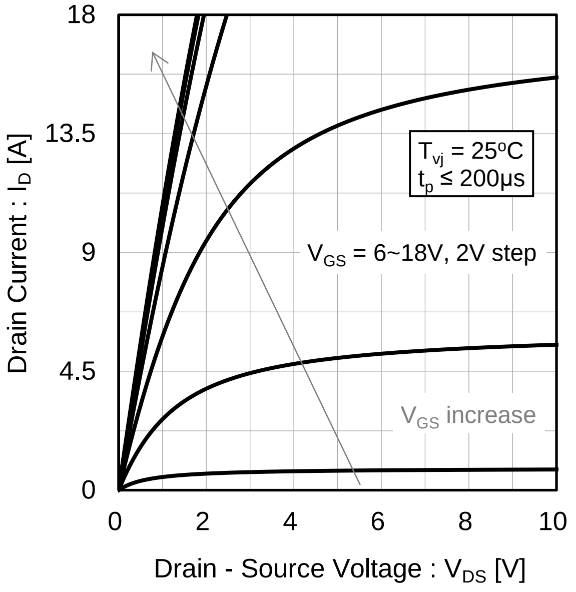
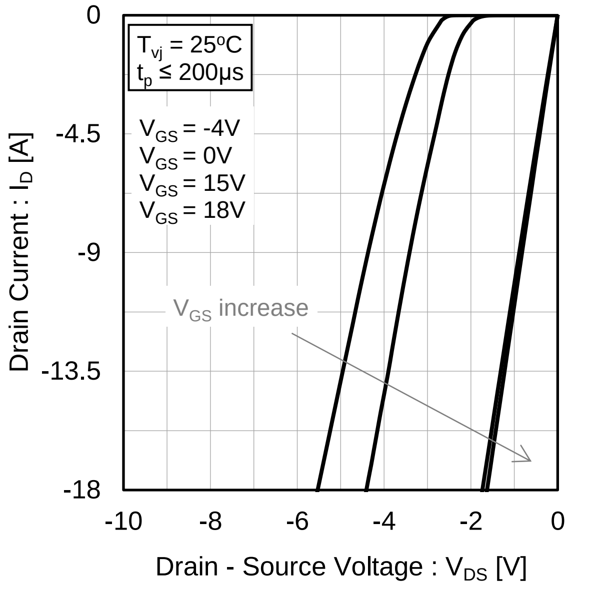


Fig.5 T_{vj} = 25ºC 3rd Quadrant Characteristics



●Electrical characteristic curves

Fig.6 T_{vj} = 150ºC Typical Output Characteristics

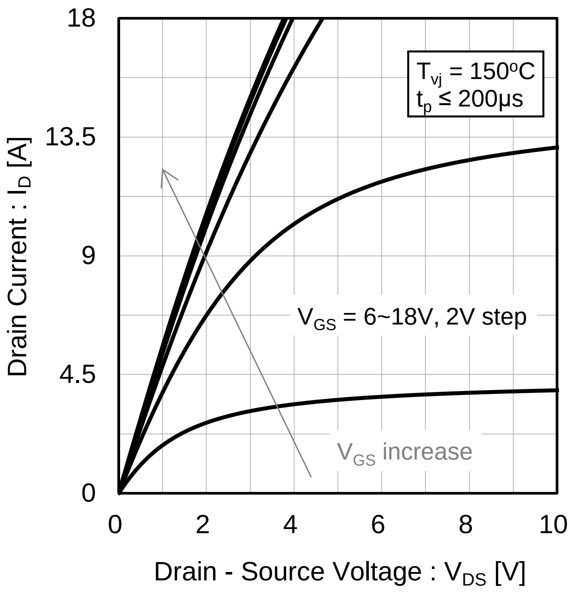


Fig.7 T_{vj} = 150ºC 3rd Quadrant Characteristics

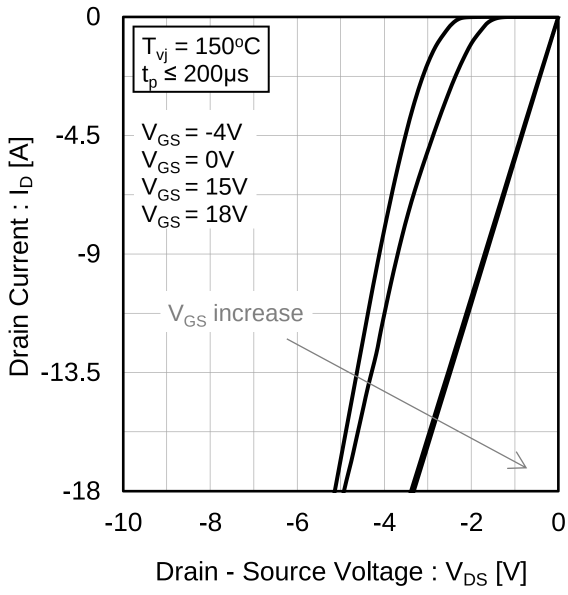
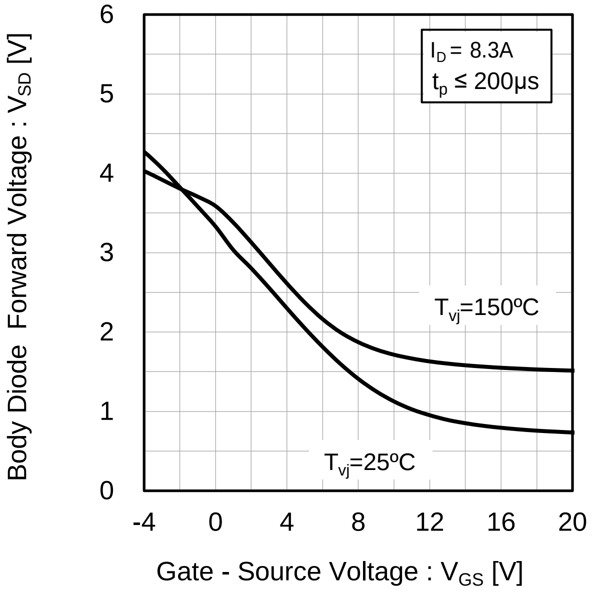


Fig.8 Body Diode Forward Voltage vs. Gate - Source Voltage



●Electrical characteristic curves

Fig.9 Typical Transfer Characteristics (I)

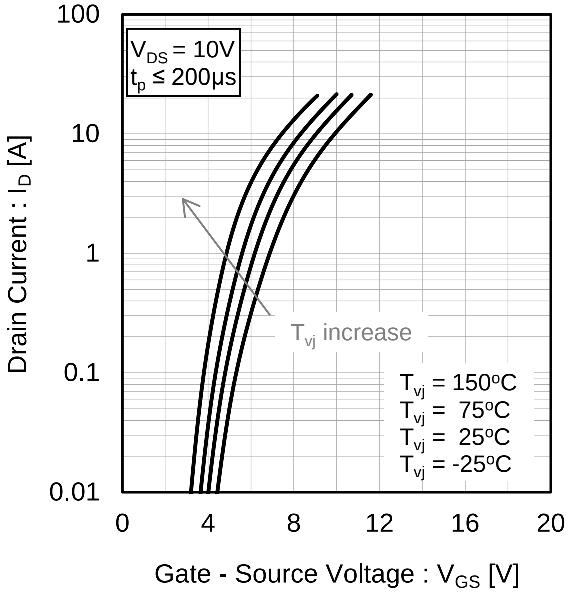


Fig.10 Typical Transfer Characteristics (II)

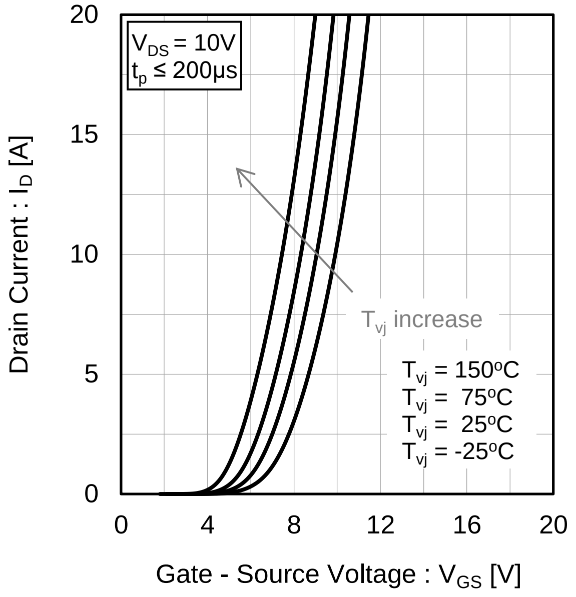


Fig.11 Gate Threshold Voltage vs. Virtual Junction Temperature

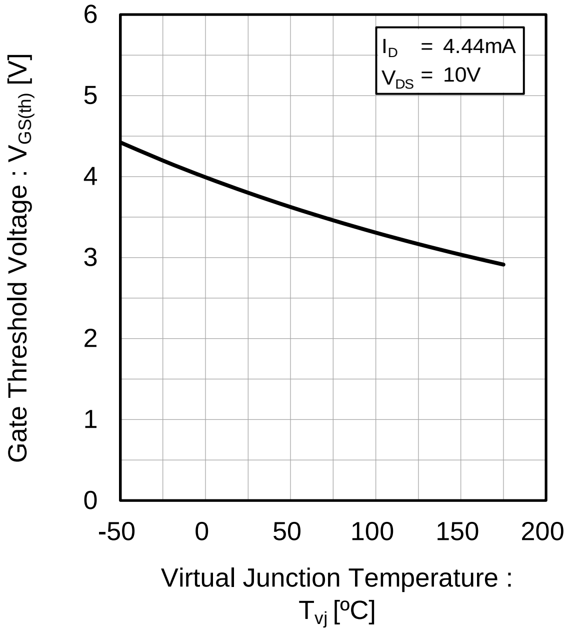
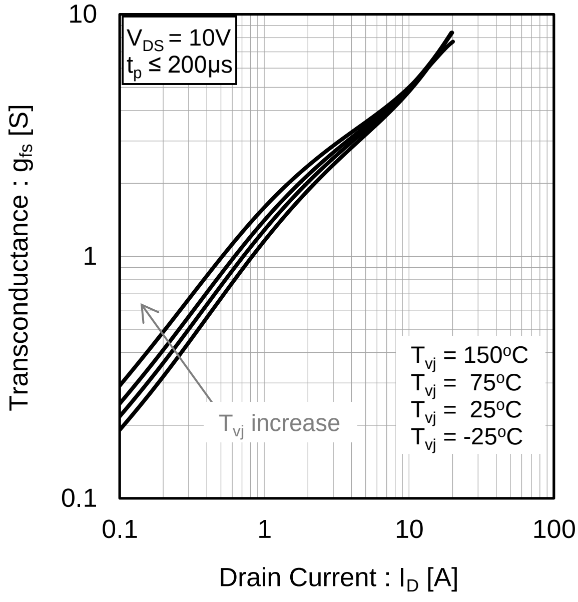


Fig.12 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.13 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

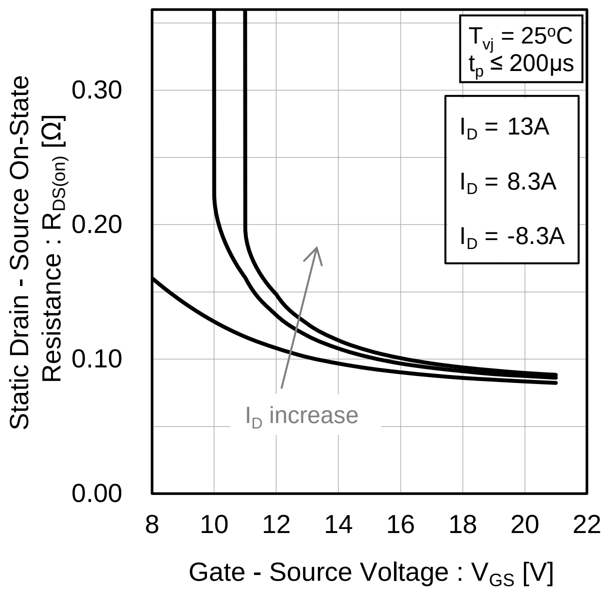


Fig.14 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

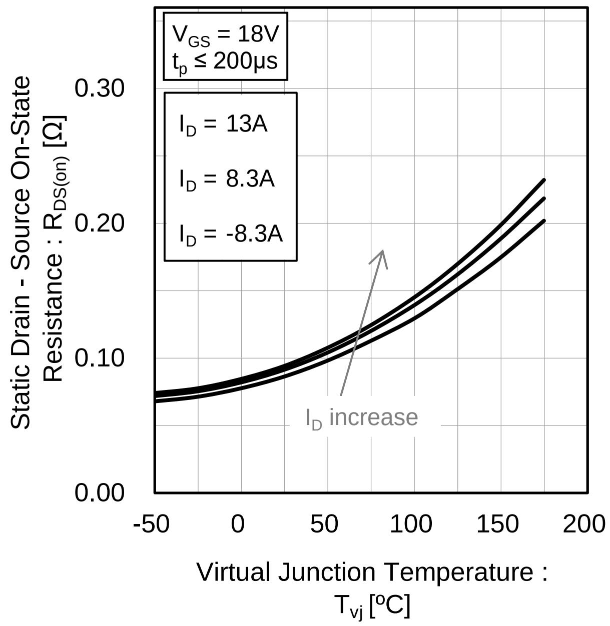


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current

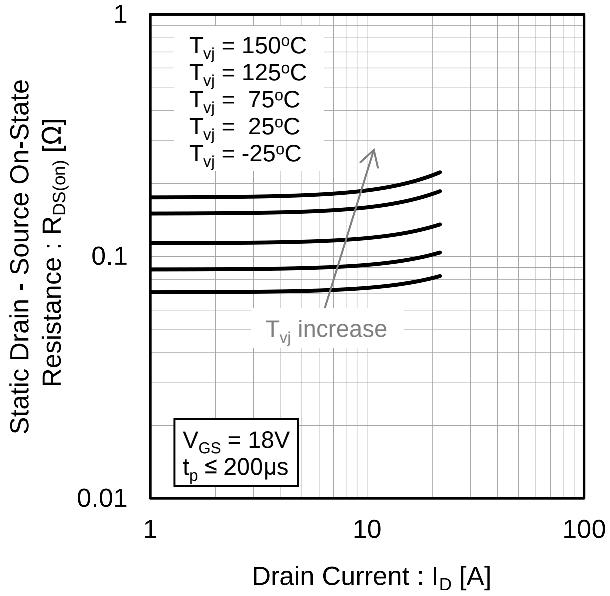
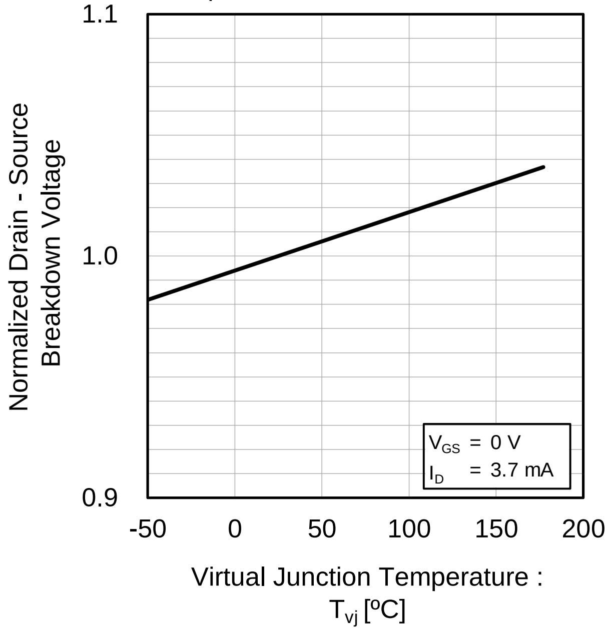


Fig.16 Normalized Drain - Source Breakdown Voltage vs. Virtual Junction Temperature



●Electrical characteristic curves

Fig.17 Typical Capacitance vs. Drain - Source Voltage

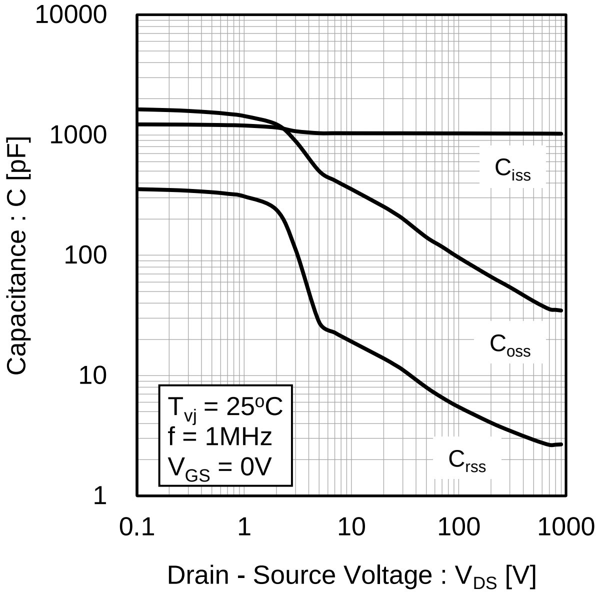


Fig.18 C_{oss} Stored Energy vs. Drain - Source Voltage

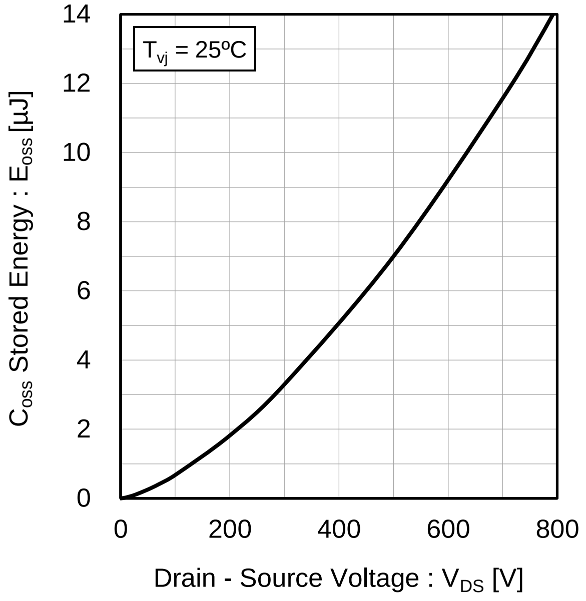
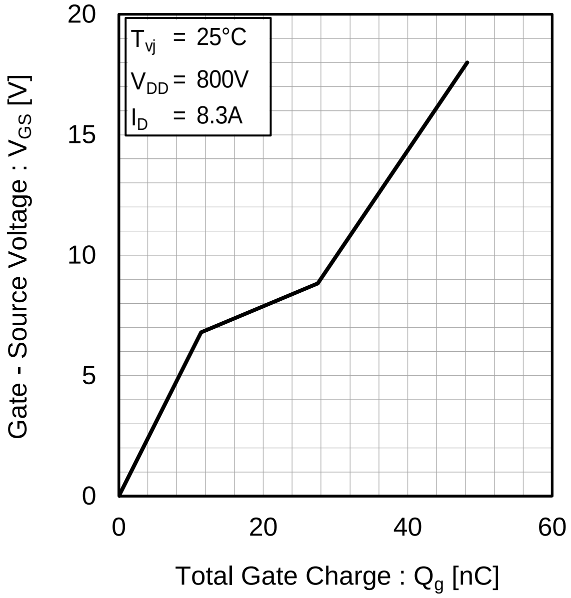


Fig.19 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.20 Typical Switching Time vs. External Gate Resistance

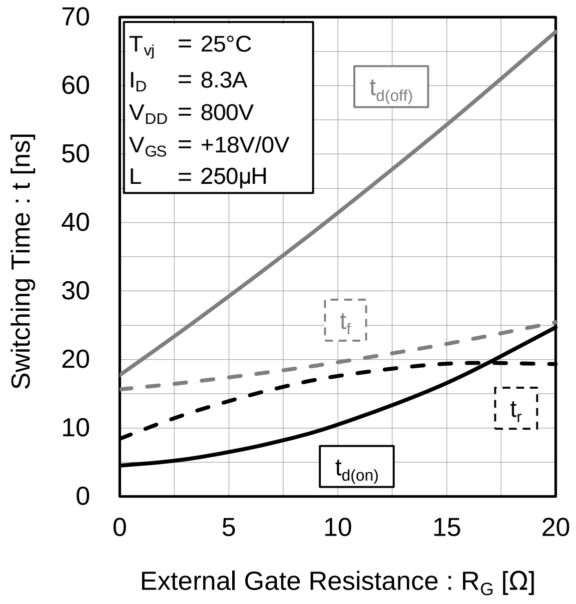


Fig.21 Typical Switching Loss vs. Drain - Source Voltage

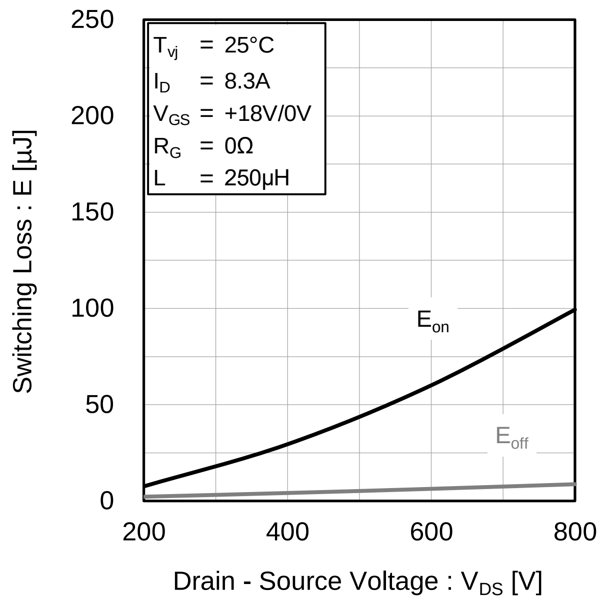


Fig.22 Typical Switching Loss vs. Drain Current

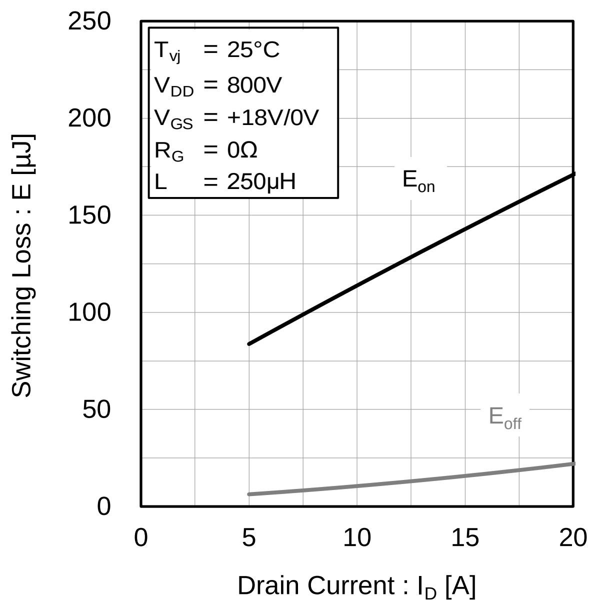
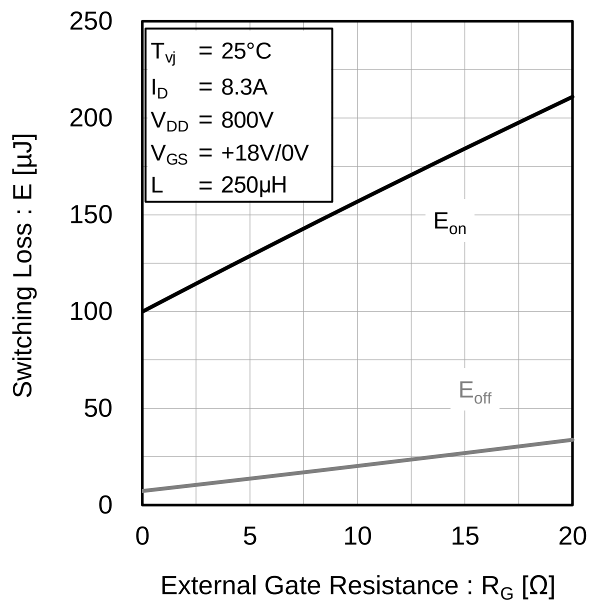


Fig.23 Typical Switching Loss vs. External Gate Resistance



●Measurement circuits and waveforms

Fig.1-1 Gate Charge Measurement Circuit

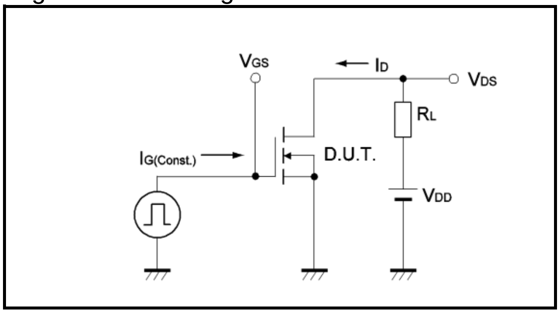


Fig.1-2 Gate Charge Waveform

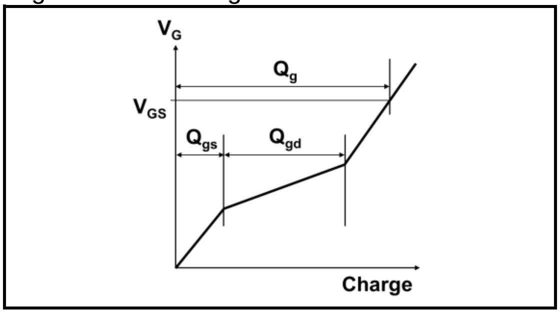


Fig.2-1 Switching Characteristics Measurement Circuit

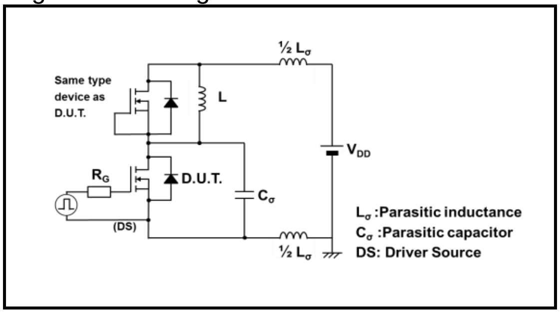


Fig.2-2 Waveforms for Switching Time

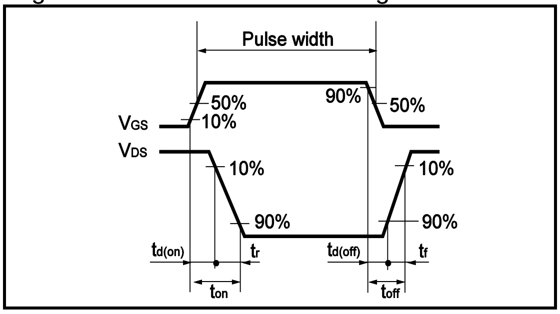


Fig.2-3 Waveforms for Switching Energy Loss

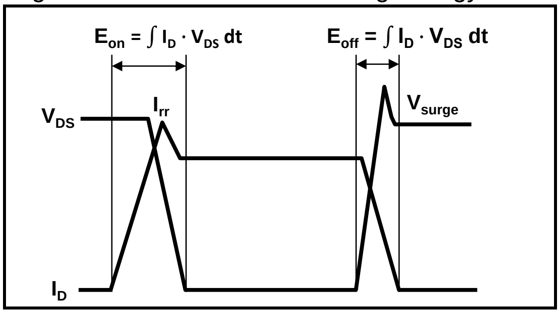


Fig.3-1 Reverse Recovery Time Measurement Circuit

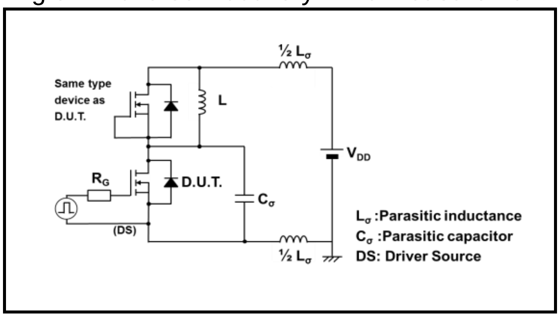
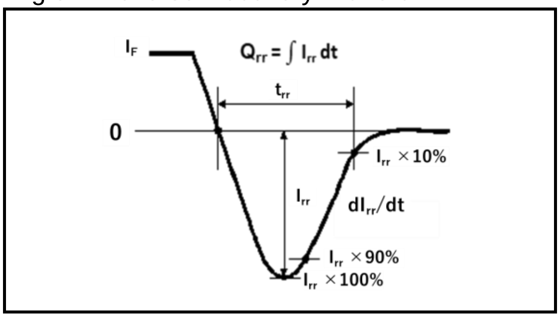
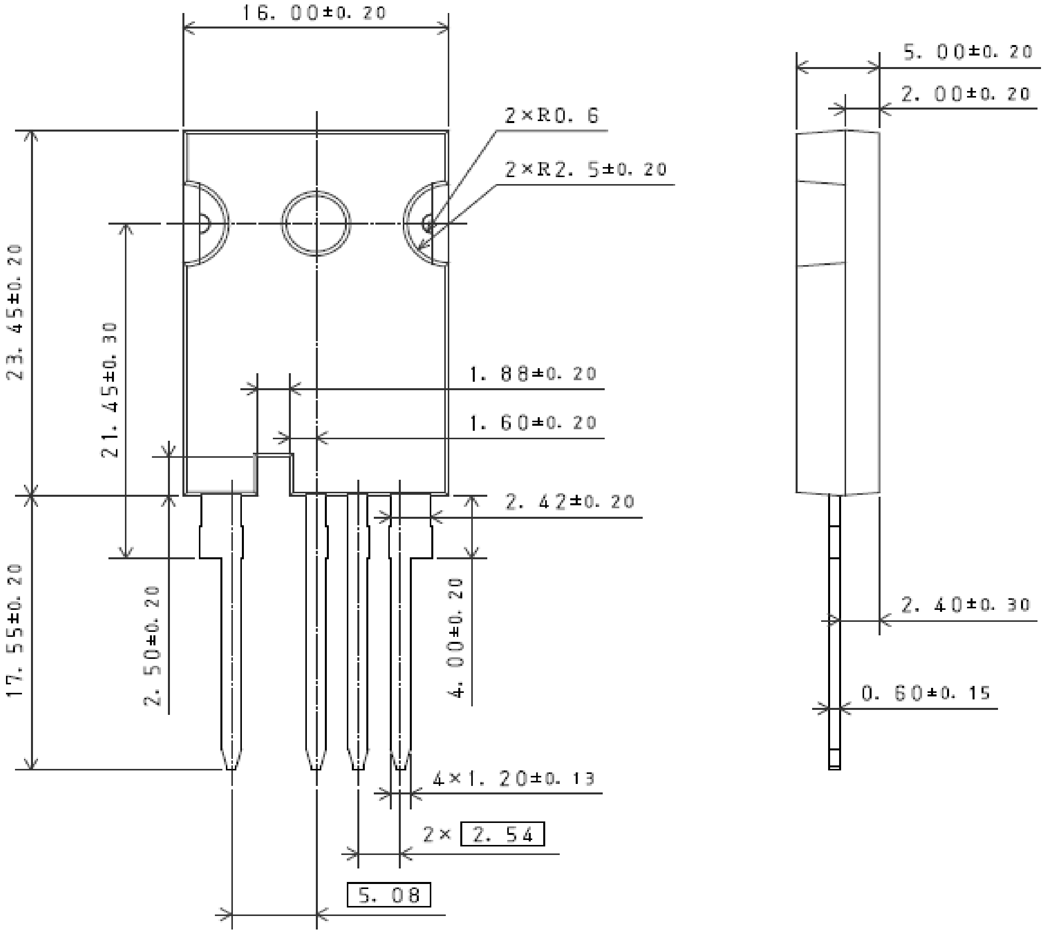


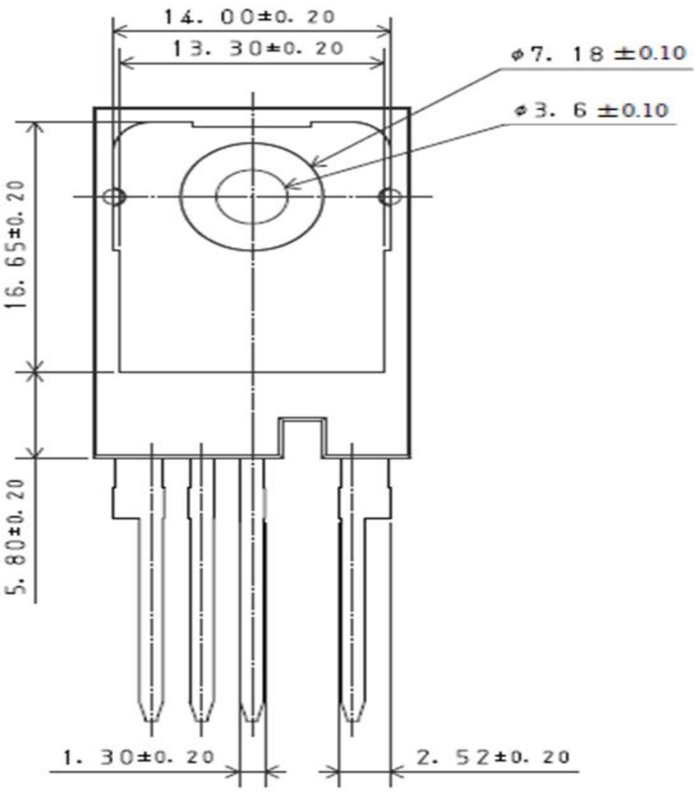
Fig.3-2 Reverse Recovery Waveform



●Package Dimensions



Unit: mm



Unit: mm

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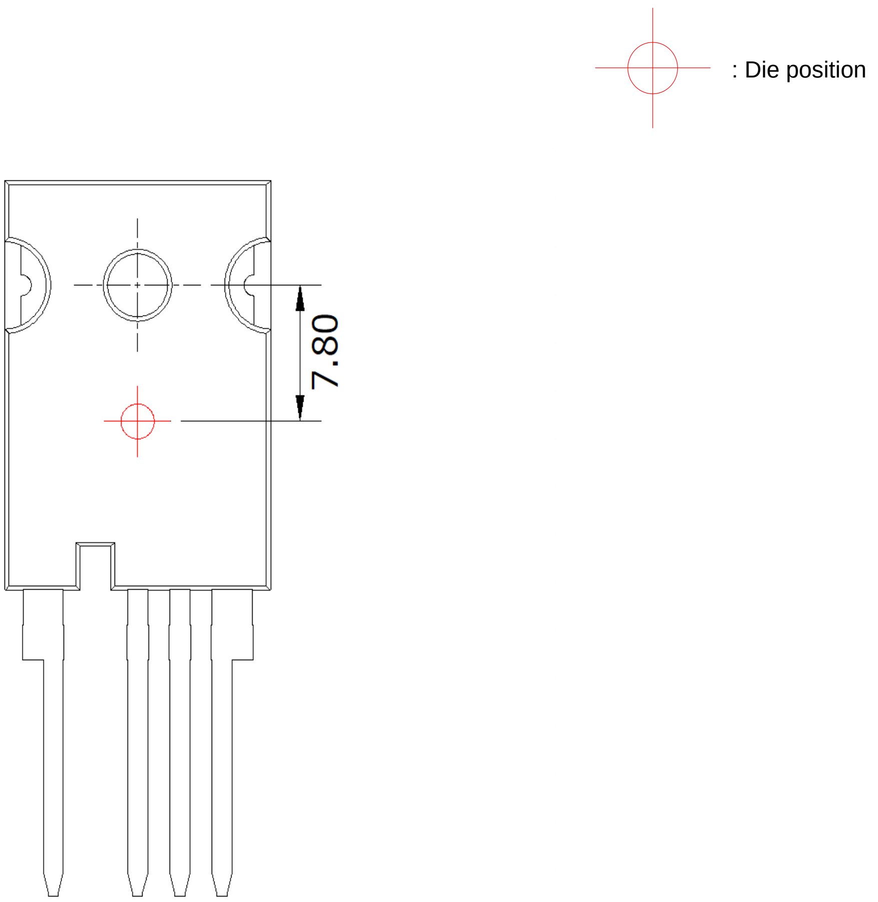
●Die Bonding Layout



・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

Notes

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2) Before you use our Products, please contact our sales representative and verify the latest specifications.

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