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SCT4013DR

N-channel SiC power MOSFET Datasheet

V_{DSS}	750V
$R_{DS(on)}$ (Typ.)	13mΩ
I_D *1	105A
P_D	312W

● Features

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

● Application

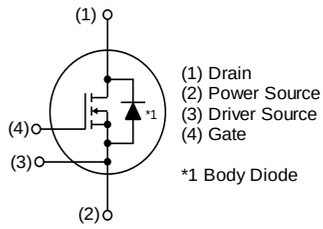
- Solar inverters
- DC/DC converters
- Switch mode power supplies
- Induction heating

●Outline

TO-247-4L



●Inner circuit



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

●Packaging specifications

Type	Packing	Tube
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	30
	Taping code	C15
	Marking	SCT4013DR

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

Parameter			Symbol	Value	Unit
Drain - source voltage			V_{DSS}	750	V
Continuous drain and source current	$V_{GS} = V_{GS_on}$	T_c = 25°C	I_D, I_S *1	105	A
		T_c = 100°C		74	A
Pulsed drain current	$V_{GS} = V_{GS_on}$	T_c = 25°C	$I_{D,pulse}$ *2	233	A
Body diode pulsed forward current		T_c = 25°C, V_{GS} = 0 V	$I_{S,pulse}$ *1,*3	105	A
Body diode surge forward current			$I_{S,pulse}$ *1,*4	233	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

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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} = 0 V, I_D = 18.6mA T_{vj} = 25°C	750	-	-	V
Zero Gate voltage Drain current	I_{DSS}	V_{GS} = 0 V, V_{DS} =750V 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 = 30.8mA	2.8	-	4.8	V
Static Drain - Source on - state resistance	$R_{DS(on)}$ *8	V_{GS} = 18V, I_D = 58A T_{vj} = 25°C T_{vj} = 150°C	- -	13.0 22.2	16.9 -	mΩ
Gate input resistance	R_G	f = 1MHz, open drain	-	1	-	Ω

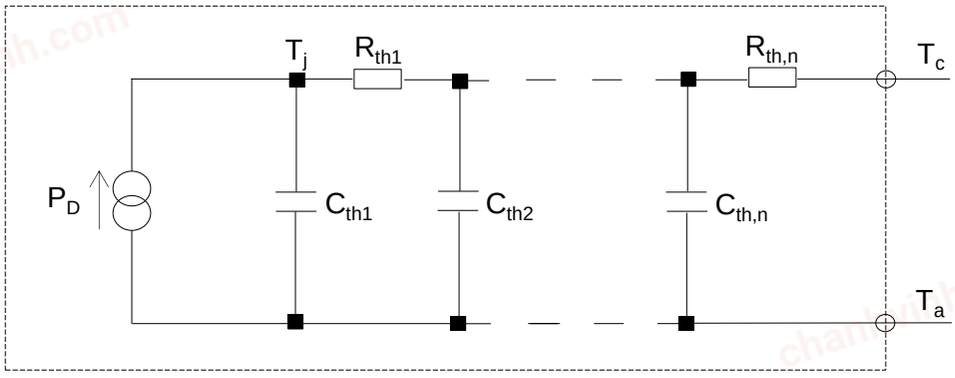
●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC} *9	-	0.37	0.48	K/W

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	4.0 ×10 $^{-2}$	K/W
R_{th2}	1.6 ×10 $^{-1}$	
R_{th3}	1.7 ×10 $^{-1}$	

Symbol	Value	Unit
C_{th1}	1.2 ×10 $^{-3}$	Ws/K
C_{th2}	4.6 ×10 $^{-3}$	
C_{th3}	2.6 ×10 $^{-2}$	



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

Parameter		Symbol	Conditions	Values			Unit
				Min.	Typ.	Max.	
Transconductance		g_{fs} *8	V_{DS} = 10V, I_D = 58A	-	32	-	S
Input capacitance		C_{iss}	V_{GS} = 0V	-	4580	-	pF
Output capacitance		C_{oss}	V_{DS} = 500V	-	203	-	pF
Reverse transfer capacitance		C_{rss}	f = 1MHz	-	10	-	pF
Effective output capacitance, energy related		$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 500V	-	263	-	pF
Total Gate charge		Q_g *8	V_{DS} = 500V I_D = 58A V_{GS} = 18V See Fig. 1-1, 1-2.	-	170	-	nC
Gate - Source charge		Q_{gs} *8		-	39	-	nC
Gate - Drain charge		Q_{gd} *8		-	42	-	nC
Turn - on delay time		$t_{d(on)}$ *8	V_{DS} = 500V I_D = 58A V_{GS} = +18V / 0V R_G = 6.8Ω, L = 250μH E_{on} includes diode reverse recovery L_σ = 50nH, C_σ = 10pF See Fig. 2-1, 2-2, 2-3.	-	17	-	ns
Rise time		t_r *8		-	32	-	ns
Turn - off delay time		$t_{d(off)}$ *8		-	82	-	ns
Fall time		t_f *8		-	17	-	ns
Turn - on switching loss		E_{on} *8		-	500	-	μJ
Turn - off switching loss		E_{off} *8		-	310	-	μJ
Short-circuit withstand time	$V_{GS(on)}$ = +15V	t_{sc} *9	$V_{DS} \leq$ 400V $V_{DS,peak} \leq$ 750V $T_{vj(start)}$ = 25°C R_G = 2.2Ω	-	12.0	-	μs
	$V_{GS(on)}$ = +18V			-	11.5	-	μs

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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.	
Forward voltage	V_{SD} *8	V_{GS} = 0V, I_S = 58A	-	3.3	-	V
Reverse recovery time	t_{rr} *8	I_F = 58A V_R = 500V di/dt = 3300A/μs L_σ = 50nH, C_σ = 10pF See Fig. 3-1, 3-2.	-	16	-	ns
Reverse recovery charge	Q_{rr} *8		-	290	-	nC
Peak reverse recovery current	I_{rrm} *8		-	36	-	A

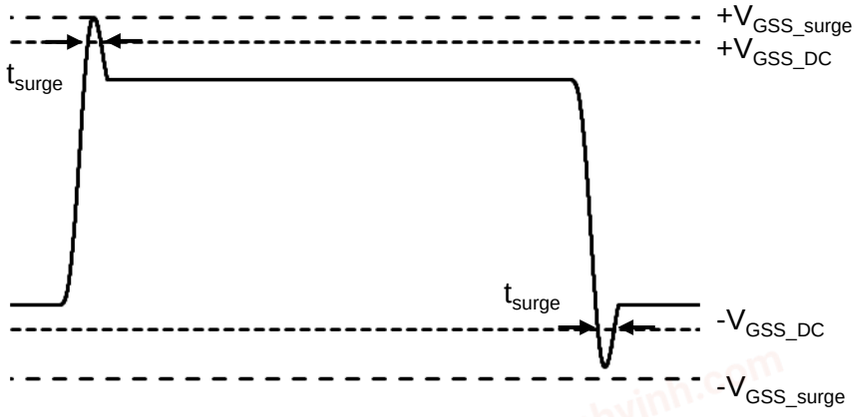
*1 Limited by maximum T_{vj} and for Max. R_{thJC}.

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

*3 Only for body-diode, Repititive 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 The value is based on TO-247 package. Single Pulsed.

*10 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

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●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

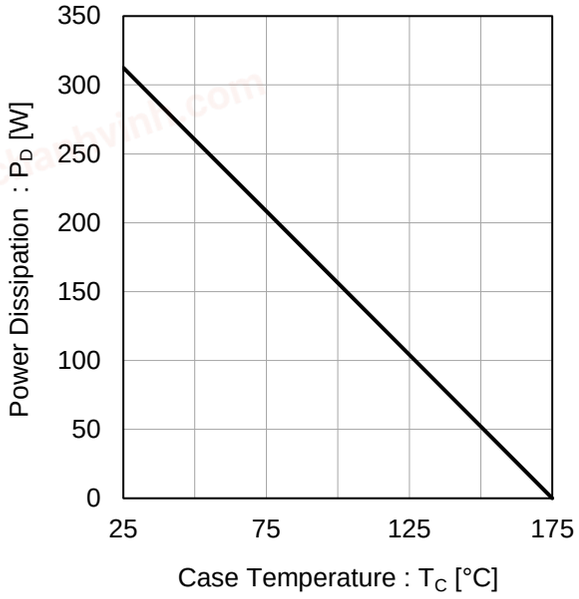


Fig.2 Maximum Safe Operating Area

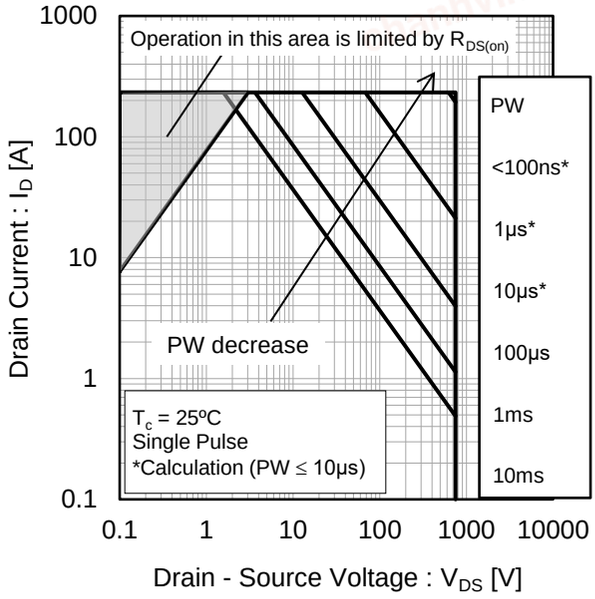
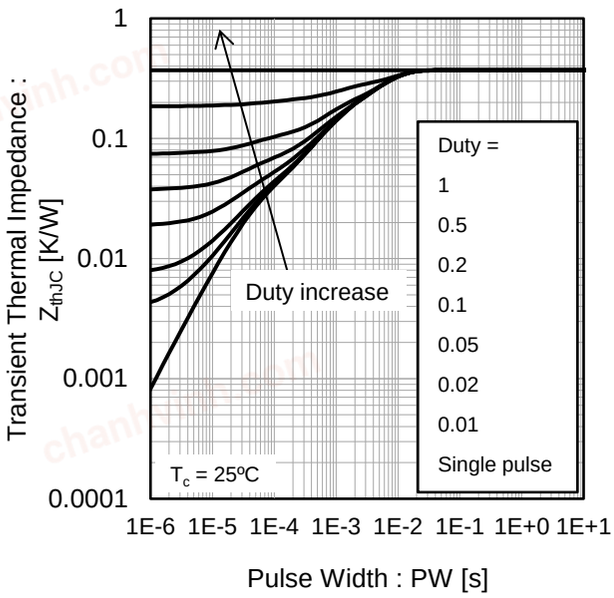


Fig.3 Typical Transient Thermal Impedance vs. Pulse Width



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●Electrical characteristic curves

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

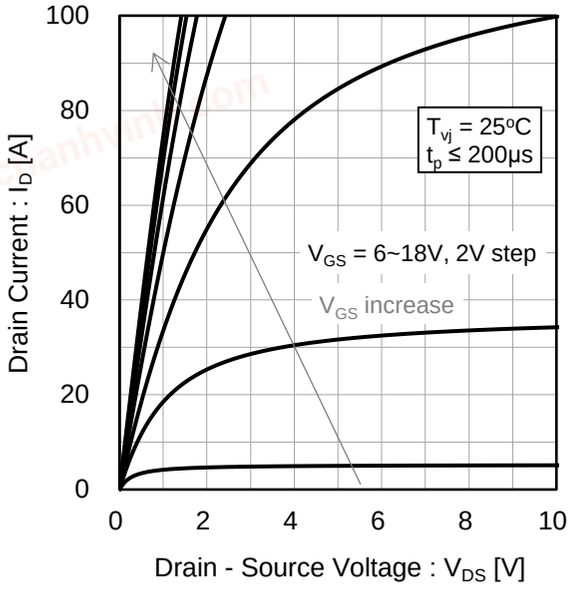
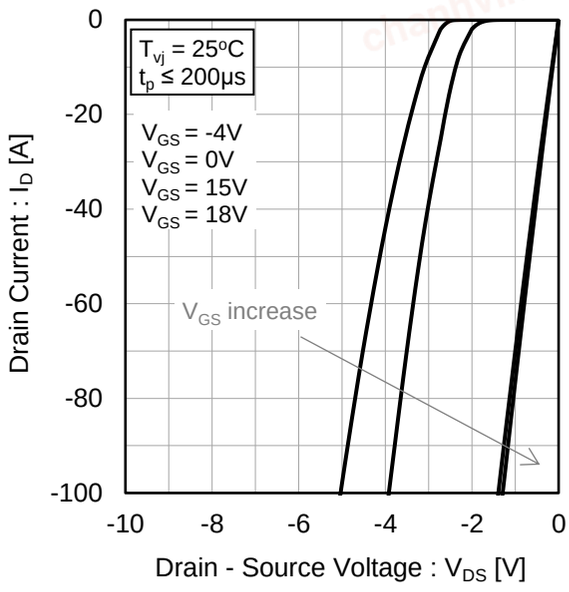


Fig.5 T_{vj} = 25ºC 3rd Quadrant Characteristics



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●Electrical characteristic curves

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

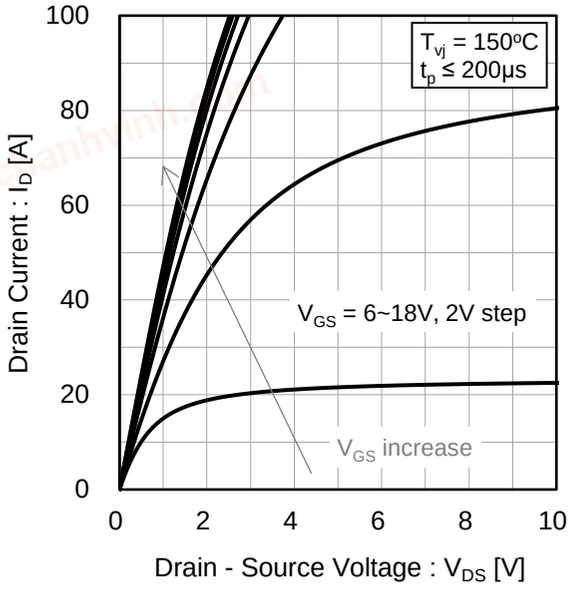


Fig.7 T_{vj} = 150ºC 3rd Quadrant Characteristics

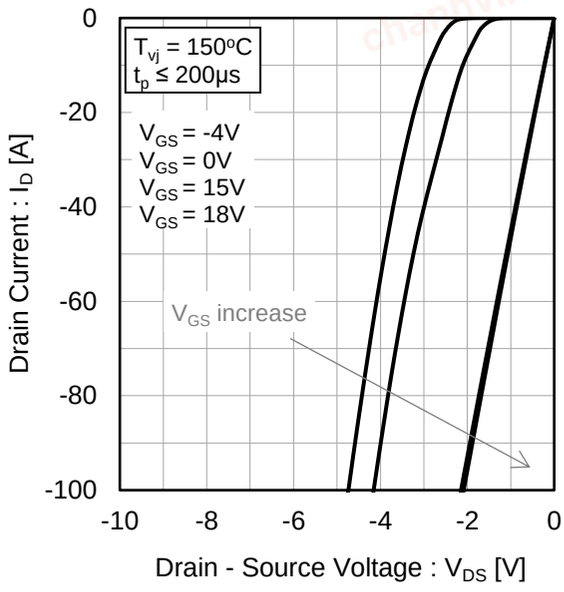
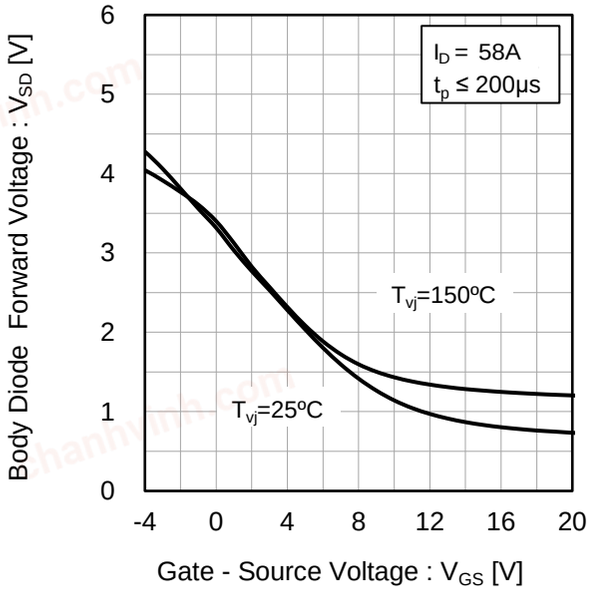


Fig.8 Body Diode Forward Voltage vs. Gate - Source Voltage



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●Electrical characteristic curves

Fig.9 Typical Transfer Characteristics (I)

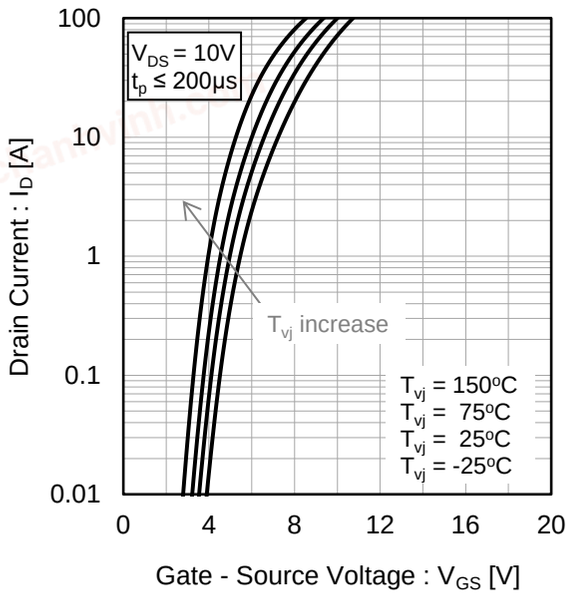


Fig.10 Typical Transfer Characteristics (II)

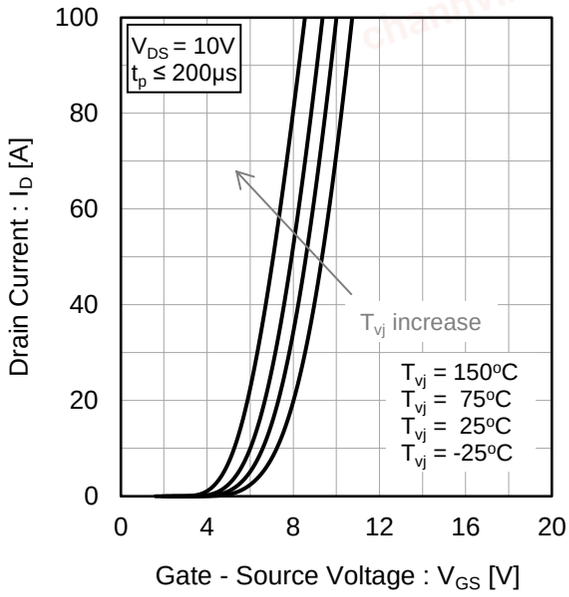


Fig.11 Gate Threshold Voltage vs. Virtual Junction Temperature

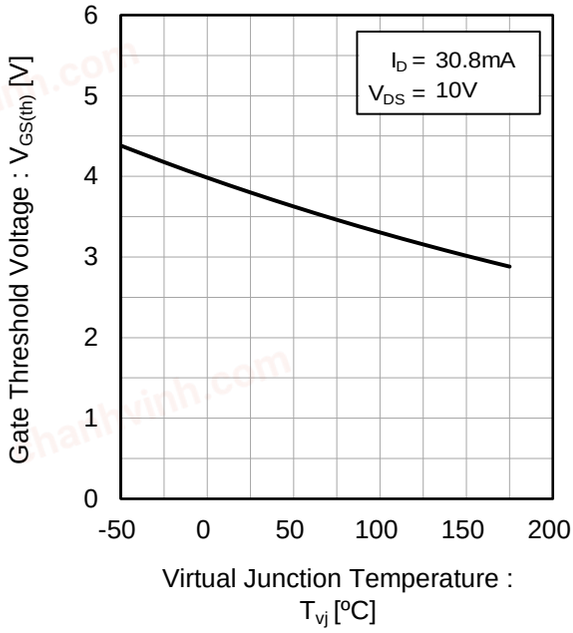
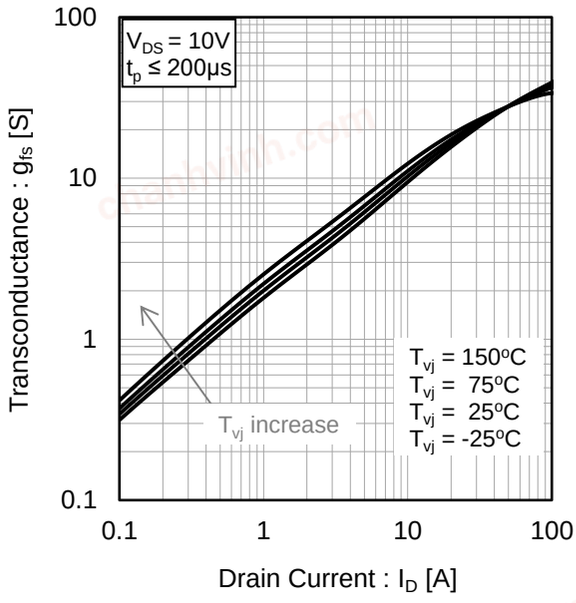


Fig.12 Transconductance vs. Drain Current



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●Electrical characteristic curves

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

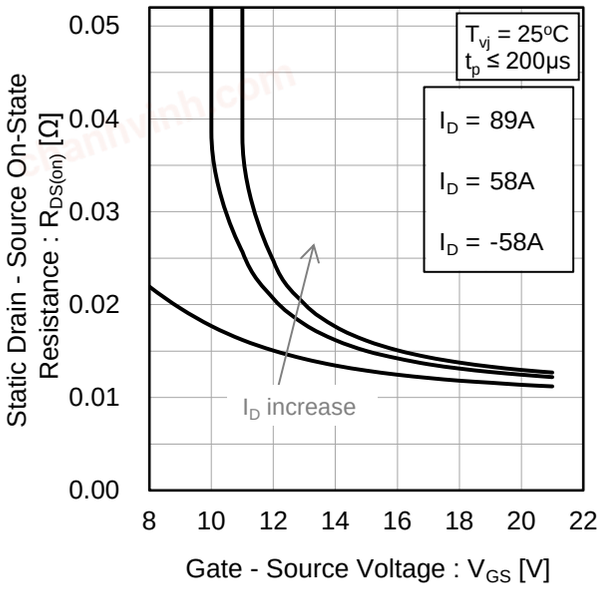


Fig.14 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

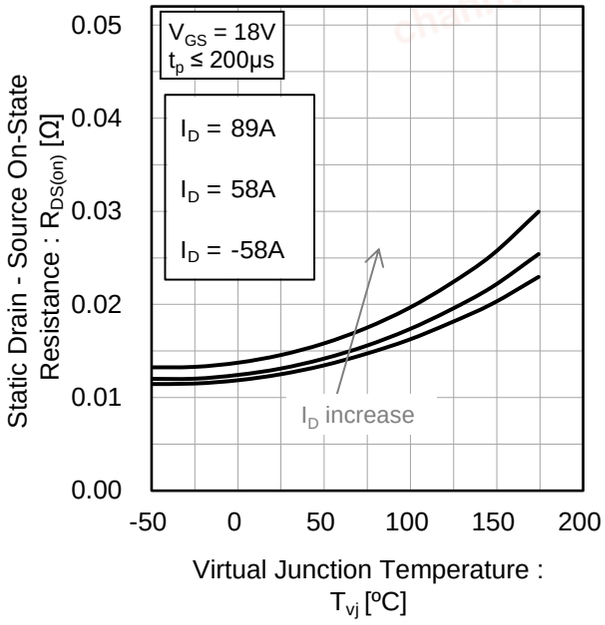


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current

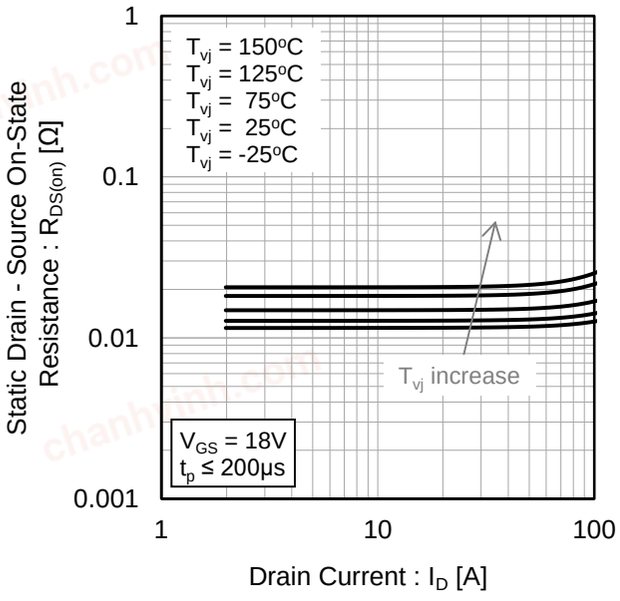
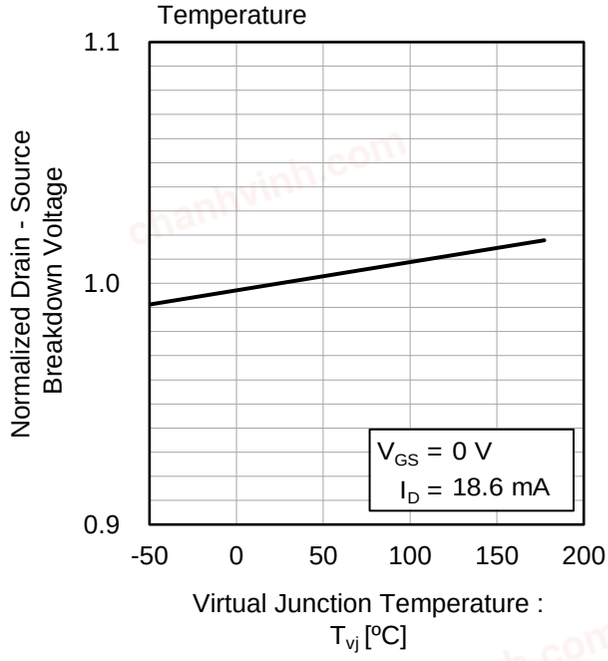


Fig.16 Normalized Drain - Source Breakdown Voltage vs. Virtual Junction Temperature



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●Electrical characteristic curves

Fig.17 Typical Capacitance vs. Drain - Source Voltage

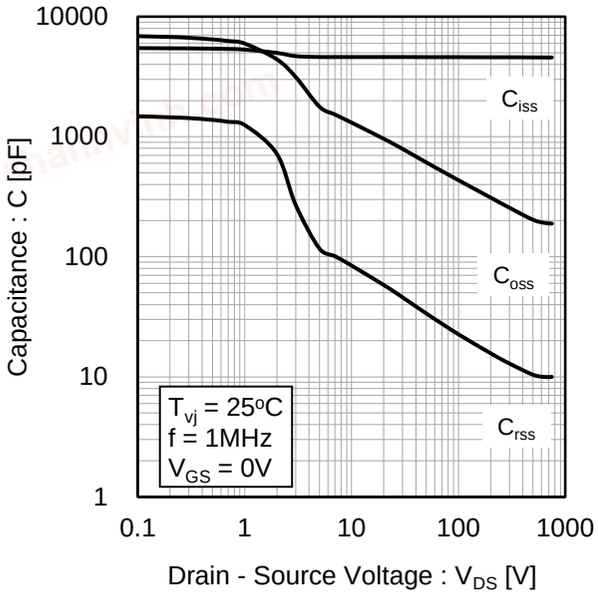


Fig.18 C_{oss} Stored Energy

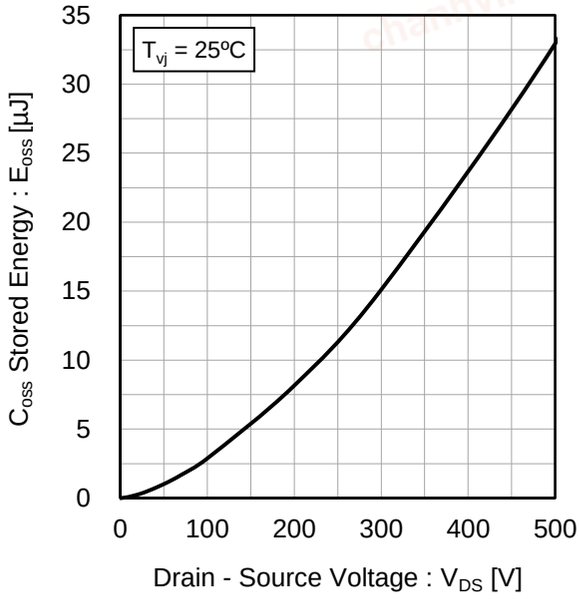
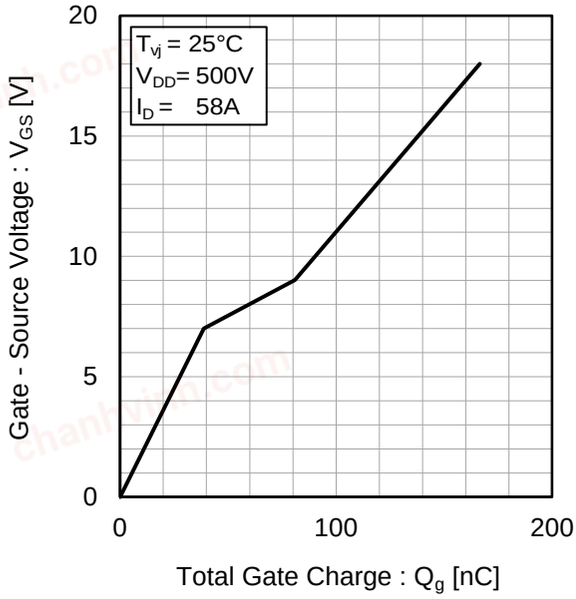


Fig.19 Dynamic Input Characteristics



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●Electrical characteristic curves

Fig.20 Typical Switching Time vs. External Gate Resistance

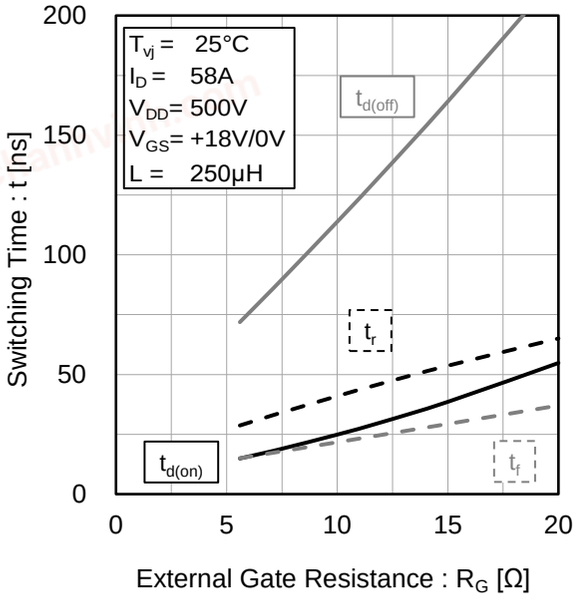


Fig.21 Typical Switching Loss vs. Drain - Source Voltage

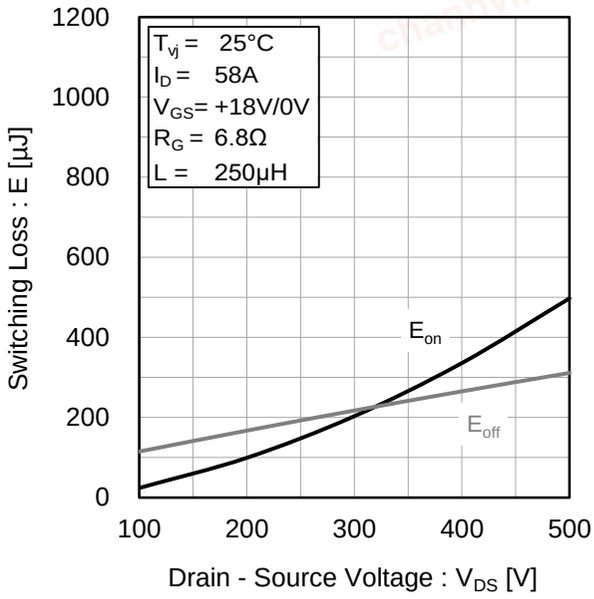


Fig.22 Typical Switching Loss vs. Drain Current

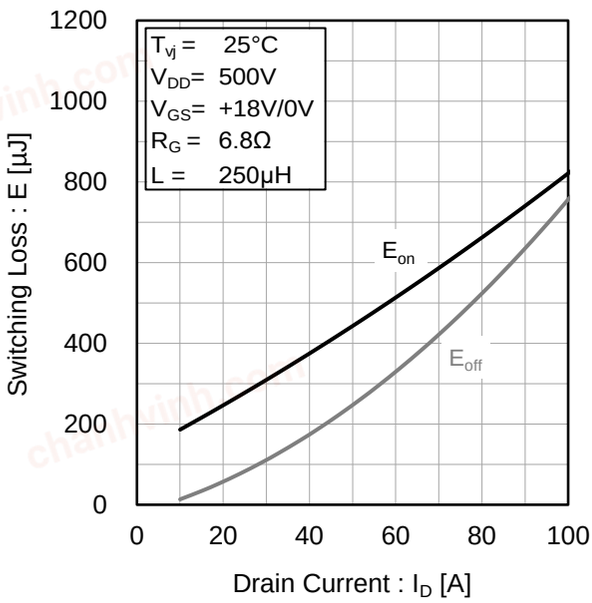
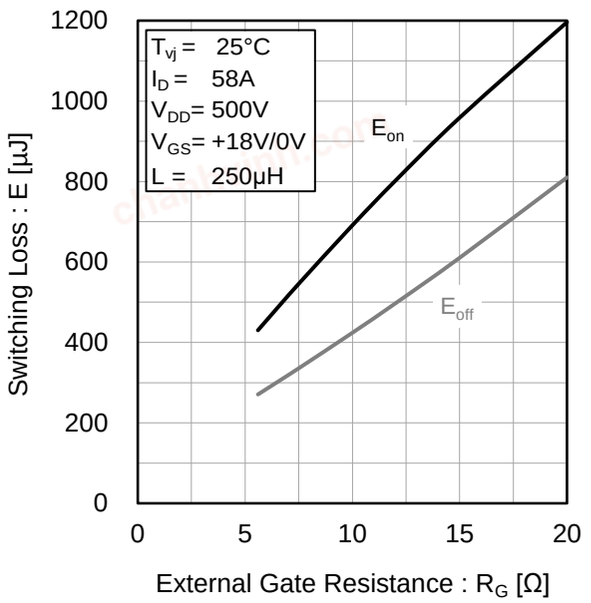


Fig.23 Typical Switching Loss vs. External Gate Resistance



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●Measurement circuits and waveforms

Fig.1-1 Gate Charge Measurement Circuit

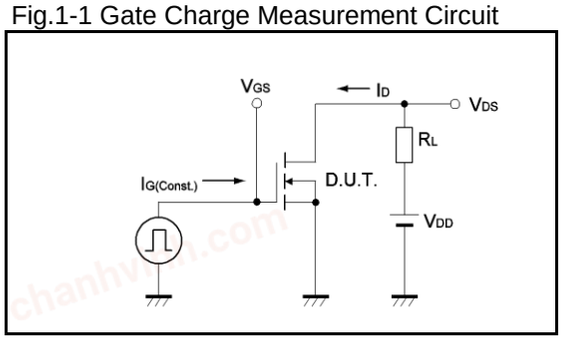


Fig.1-2 Gate Charge Waveform

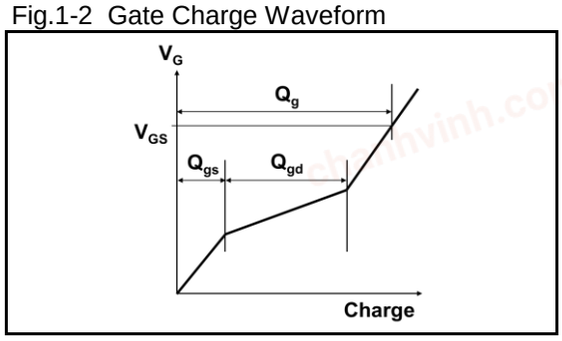


Fig.2-1 Switching Characteristics Measurement Circuit

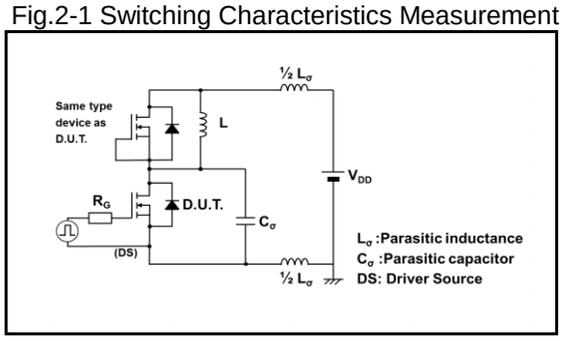


Fig.2-2 Waveforms for Switching Time

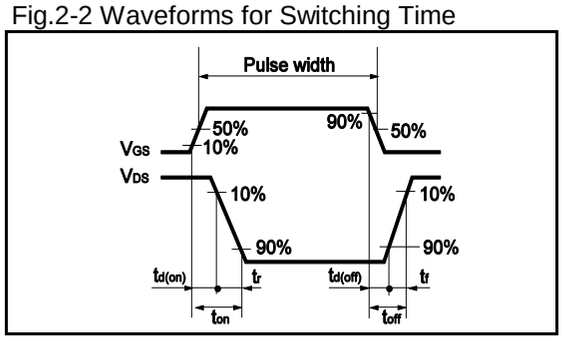


Fig.2-3 Waveforms for Switching Energy Loss

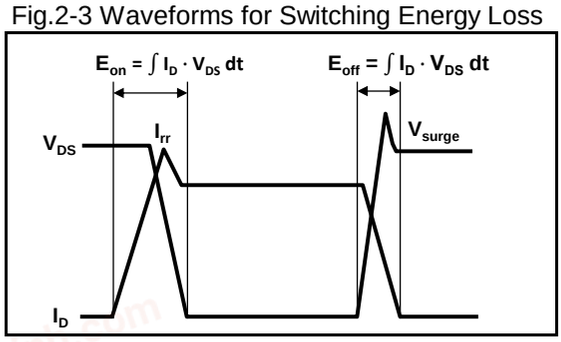


Fig.3-1 Reverse Recovery Time Measurement Circuit

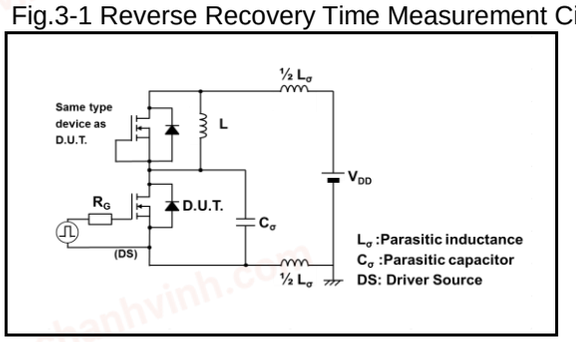
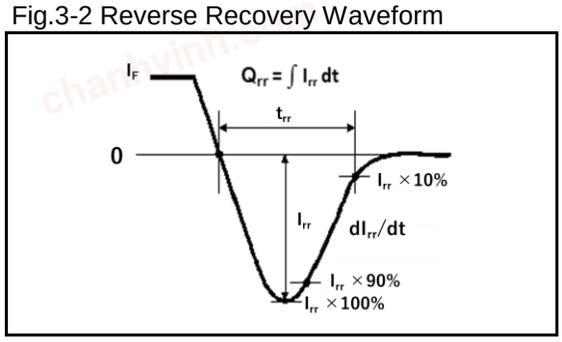


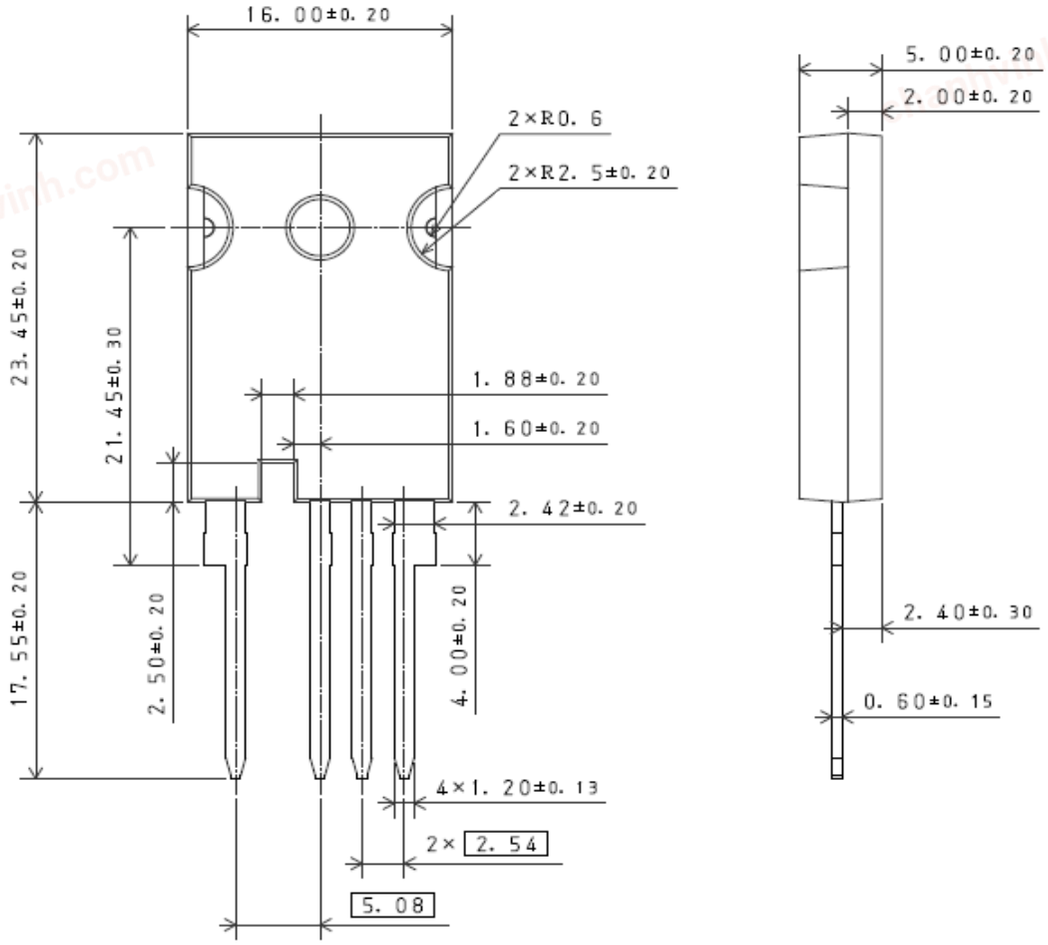
Fig.3-2 Reverse Recovery Waveform



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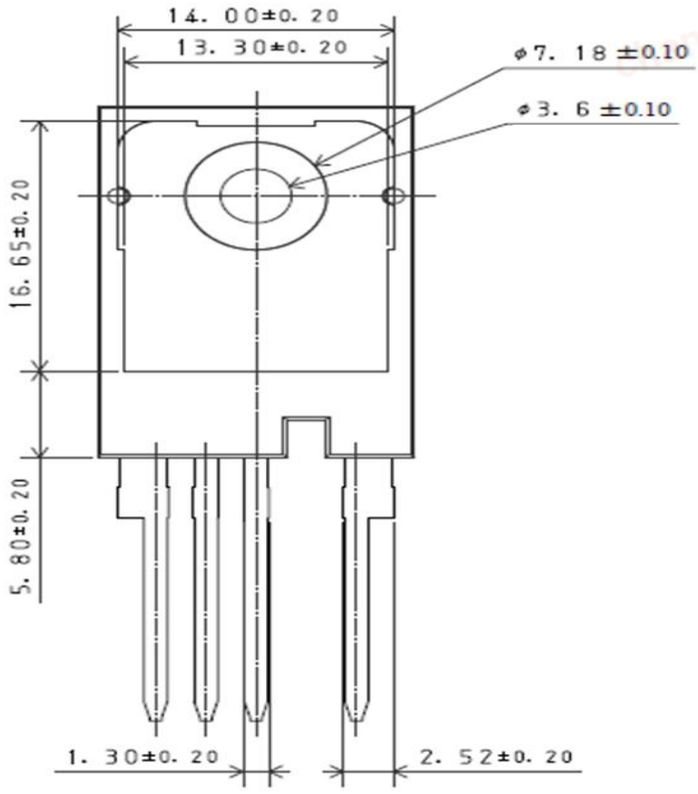
●Package Dimensions



Unit: mm

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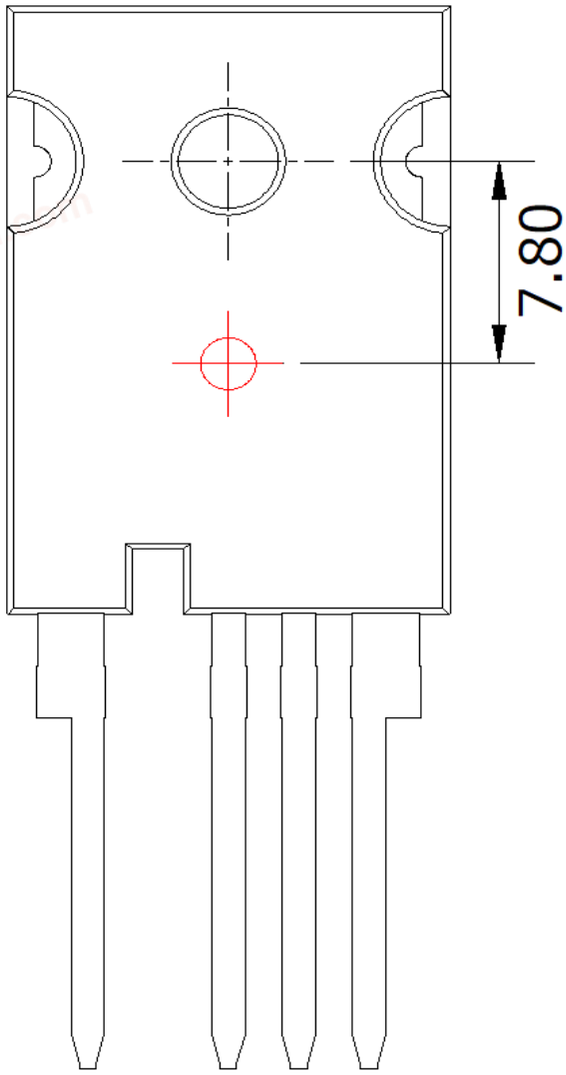


Unit: mm

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●Die Bonding Layout



: Die position

・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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Notes

1) The information contained herein is subject to change without notice.

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

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products specified in this document are not designed to be radiation tolerant.

7) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, and power transmission systems.

8) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

9) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

10) ROHM has used reasonable care to ensure the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.

11) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. ROHM shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.

12) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.

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ROHM SEMICONDUCTOR

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General Precaution

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