

$V_{DSS}$	1200V
$R_{DS(on)}$ (Typ.)	160mΩ
$I_D$	22A
$P_D$	165W

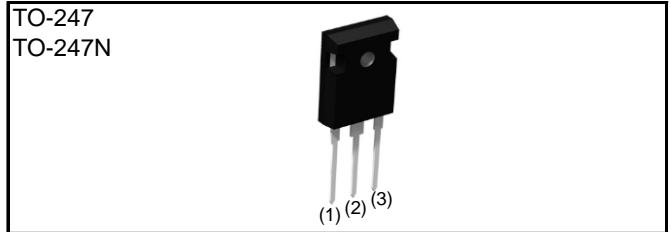
#### ●Features

- 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

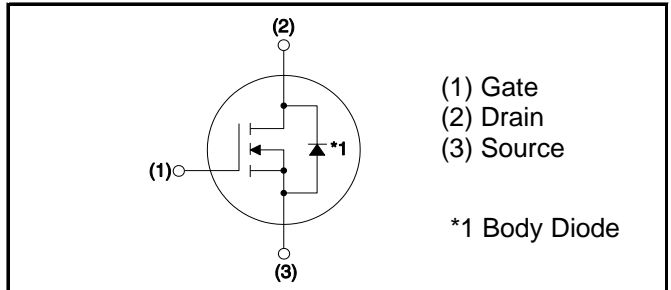
#### ●Application

- Solar inverters
- DC/DC converters
- Induction heating
- Motor drives

#### ●Outline



#### ●Inner circuit



#### ●Packaging specifications<sup>\*1</sup>

Package		TO-247	TO-247N
Type	Packing	Tube	
	Reel size (mm)	-	
	Tape width (mm)	-	
	Basic ordering unit (pcs)	30	
	Packing code	C	C11
	Marking	SCT2160KE	

#### ●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Value	Unit
Drain - Source voltage	$V_{DSS}$	1200	V
Continuous drain current	$T_c = 25^\circ\text{C}$	$I_D^{*2}$ 22	A
	$T_c = 100^\circ\text{C}$	$I_D^{*2}$ 16	A
Pulsed drain current	$I_{D,pulse}^{*3}$	55	A
Gate - Source voltage (DC)	$V_{GSS}$	-6 to 22	V
Gate - Source surge voltage ( $T_{surge} < 300\text{nsec}$ )	$V_{GSS-surge}^{*4}$	-10 to 26	V
Power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	165	W
Junction temperature	$T_j$	175	°C
Range of storage temperature	$T_{stg}$	-55 to +175	°C

**●Electrical characteristics** ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 1mA$	1200	-	-	V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 1200V, V_{GS} = 0V$ $T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	-	1	10	$\mu\text{A}$
			-	2	-	
Gate - Source leakage current	$I_{GSS+}$	$V_{GS} = +22V, V_{DS} = 0V$	-	-	100	nA
Gate - Source leakage current	$I_{GSS-}$	$V_{GS} = -6V, V_{DS} = 0V$	-	-	-100	nA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 2.5mA$	1.6	2.8	4.0	V

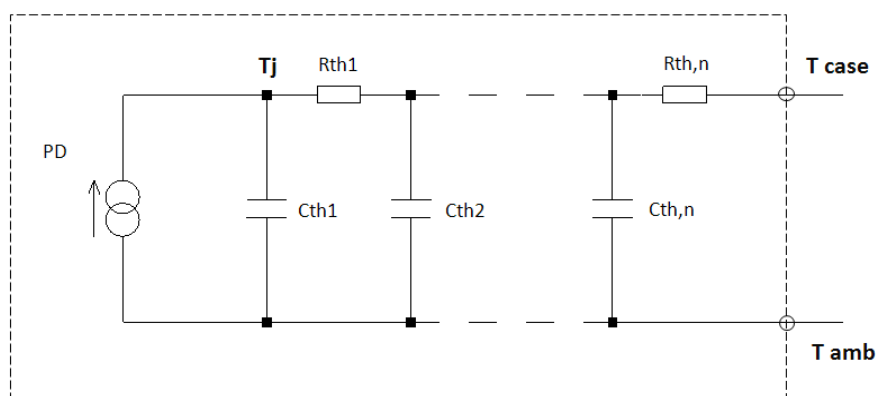
**●Thermal resistance**

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	$R_{thJC}$	-	0.70	0.91	$^\circ\text{C/W}$
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	50	$^\circ\text{C/W}$
Soldering temperature, wavesoldering for 10s	$T_{sold}$	-	-	265	$^\circ\text{C}$

**●Typical Transient Thermal Characteristics**

Symbol	Value	Unit
$R_{th1}$	9.61E-02	K/W
$R_{th2}$	4.04E-01	
$R_{th3}$	1.96E-01	

Symbol	Value	Unit
$C_{th1}$	1.55E-03	Ws/K
$C_{th2}$	5.23E-03	
$C_{th3}$	8.33E-02	



**●Electrical characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Static drain - source on - state resistance	R <sub>DS(on)</sub> <sup>*5</sup>	V <sub>GS</sub> = 18V, I <sub>D</sub> = 7A	-	160	208	mΩ
		T <sub>j</sub> = 25°C	-	226	-	
Gate input resistance	R <sub>G</sub>	f = 1MHz, open drain	-	13.7	-	Ω
Transconductance	g <sub>fs</sub> <sup>*5</sup>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 7A	-	2.4	-	S
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V	-	1200	-	pF
Output capacitance	C <sub>oss</sub>	V <sub>DS</sub> = 800V	-	45	-	
Reverse transfer capacitance	C <sub>rss</sub>	f = 1MHz	-	7	-	
Effective output capacitance, energy related	C <sub>o(er)</sub>	V <sub>GS</sub> = 0V V <sub>DS</sub> = 0V to 500V	-	71	-	pF
Turn - on delay time	t <sub>d(on)</sub> <sup>*5</sup>	V <sub>DD</sub> = 400V, I <sub>D</sub> = 7A	-	23	-	ns
Rise time	t <sub>r</sub> <sup>*5</sup>	V <sub>GS</sub> = 18V/0V	-	25	-	
Turn - off delay time	t <sub>d(off)</sub> <sup>*5</sup>	R <sub>L</sub> = 57Ω	-	67	-	
Fall time	t <sub>f</sub> <sup>*5</sup>	R <sub>G</sub> = 0Ω	-	27	-	
Turn - on switching loss	E <sub>on</sub> <sup>*5</sup>	V <sub>DD</sub> = 600V, I <sub>D</sub> = 7A V <sub>GS</sub> = 18V/0V	-	126	-	μJ
Turn - off switching loss	E <sub>off</sub> <sup>*5</sup>	R <sub>G</sub> = 0Ω, L = 500μH *E <sub>on</sub> includes diode reverse recovery	-	55	-	

**●Gate Charge characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q <sub>g</sub> <sup>*5</sup>	V <sub>DD</sub> = 400V	-	62	-	nC
Gate - Source charge	Q <sub>gs</sub> <sup>*5</sup>	I <sub>D</sub> = 7A	-	14	-	
Gate - Drain charge	Q <sub>gd</sub> <sup>*5</sup>	V <sub>GS</sub> = 18V	-	20	-	
Gate plateau voltage	V <sub>(plateau)</sub>	V <sub>DD</sub> = 400V, I <sub>D</sub> = 7A	-	9.6	-	V

**●Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )**

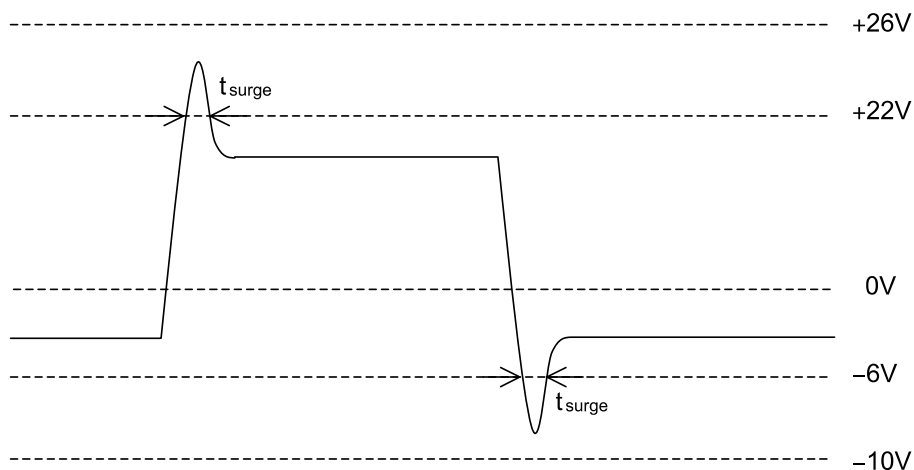
Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	$I_S^{*2}$	$T_c = 25^\circ\text{C}$	-	-	22	A
Inverse diode direct current, pulsed	$I_{SM}^{*3}$		-	-	55	A
Forward voltage	$V_{SD}^{*5}$	$V_{GS} = 0\text{V}, I_S = 7\text{A}$	-	4.1	-	V
Reverse recovery time	$t_{rr}^{*5}$	$I_F = 7\text{A}, V_R = 400\text{V}$ $di/dt = 160\text{A}/\mu\text{s}$	-	26	-	ns
Reverse recovery charge	$Q_{rr}^{*5}$		-	39	-	nC
Peak reverse recovery current	$I_{rrm}^{*5}$		-	3.0	-	A

\*1 Tolerances of dimensions and packing specifications slightly differ between TO-247 and TO-247N, which is unlikely to influence compatibility for mounting. Please refer to corresponding specifications of dimensions for more details.

\*2 Limited only by maximum temperature allowed.

\*3  $PW \leq 10\mu\text{s}$ , Duty cycle  $\leq 1\%$

\*4 Example of acceptable  $V_{gs}$  waveform



\*5 Pulsed

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

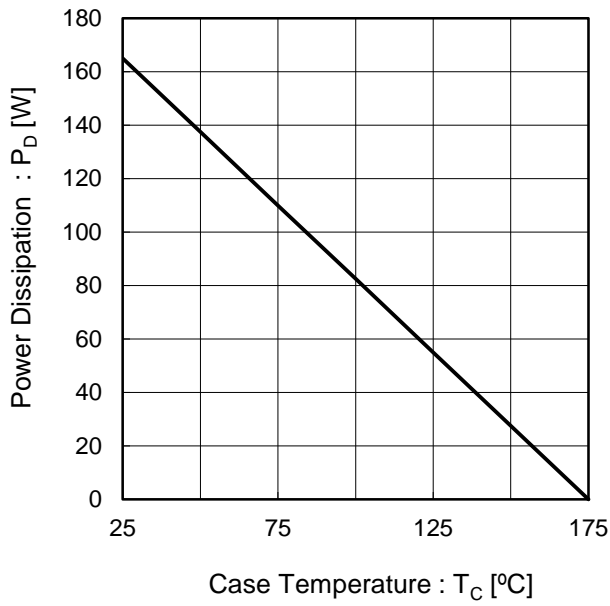


Fig.2 Maximum Safe Operating Area

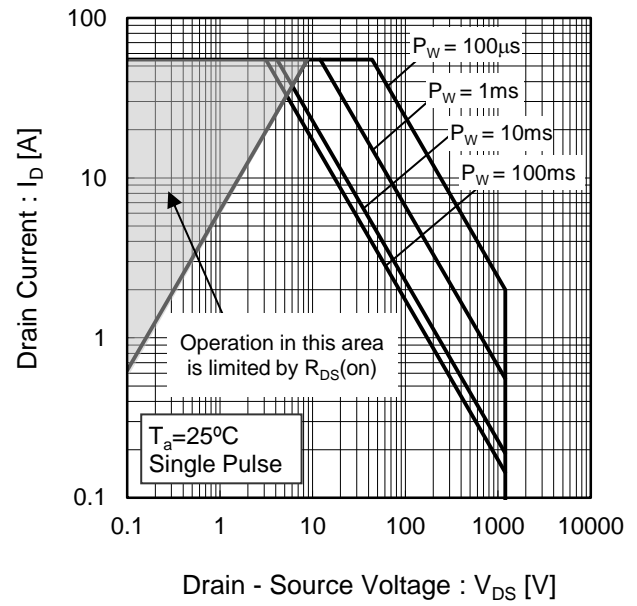
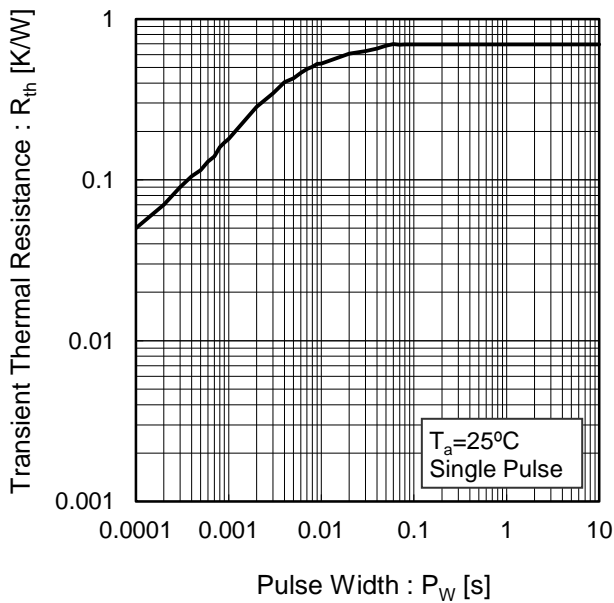


Fig.3 Typical Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

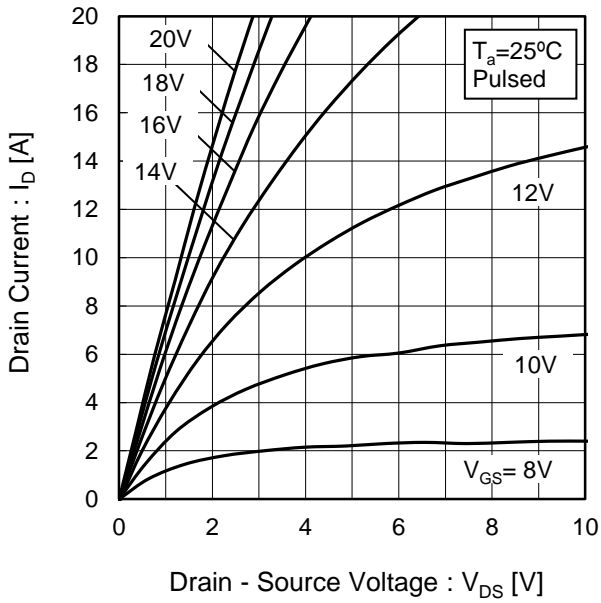


Fig.5 Typical Output Characteristics(II)

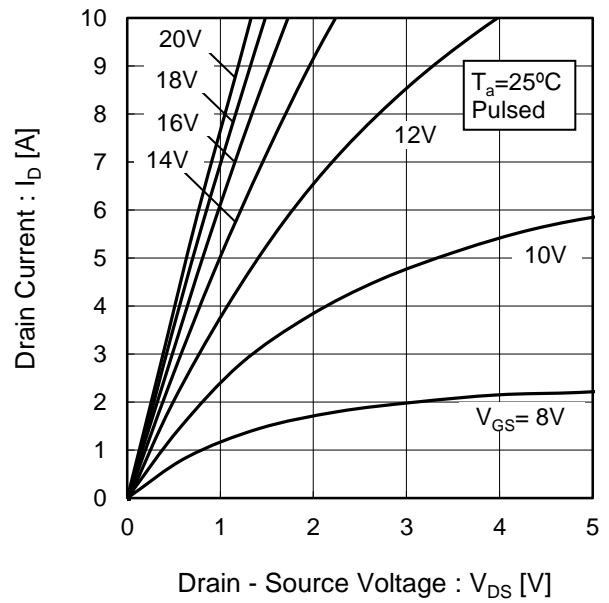


Fig.6  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(I)

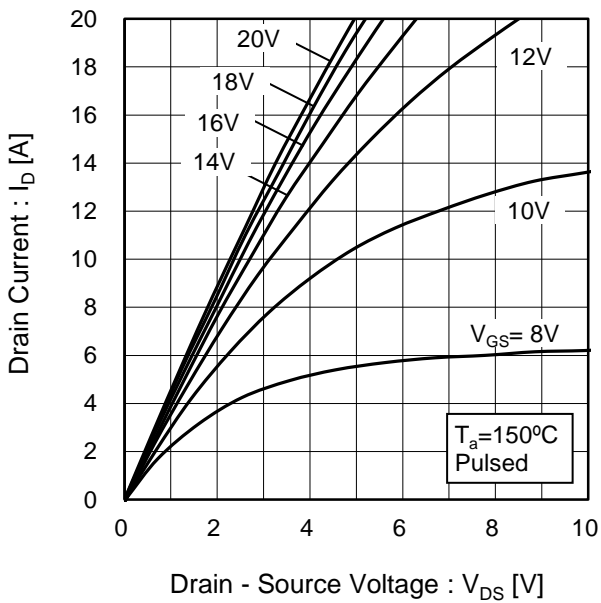
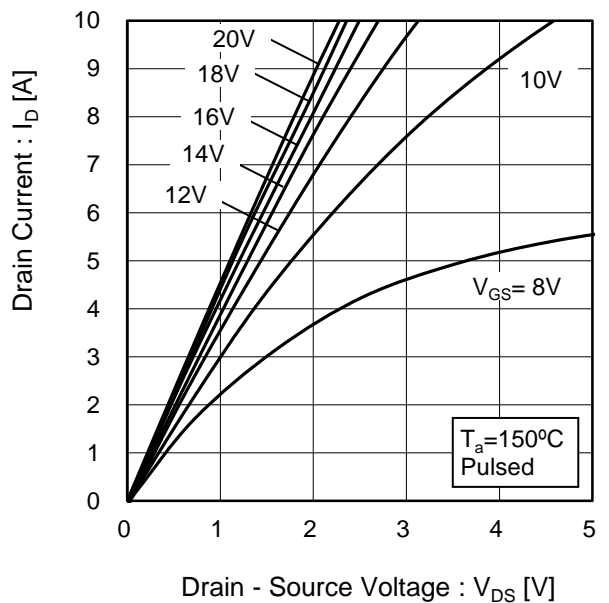


Fig.7  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.8 Typical Transfer Characteristics (I)

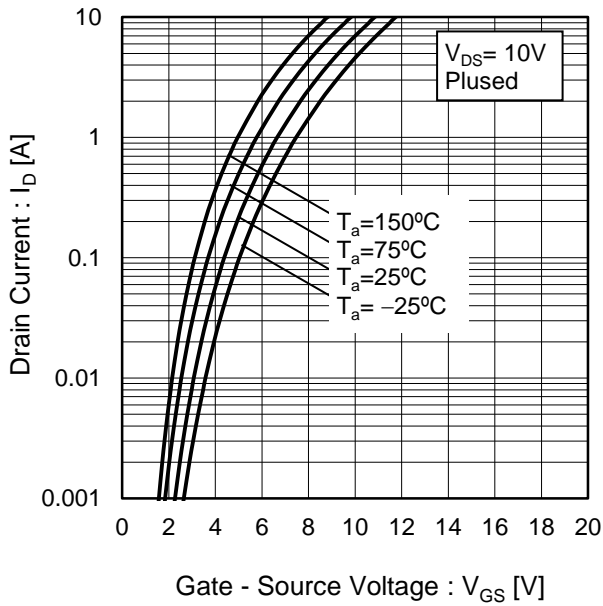


Fig.9 Typical Transfer Characteristics (II)

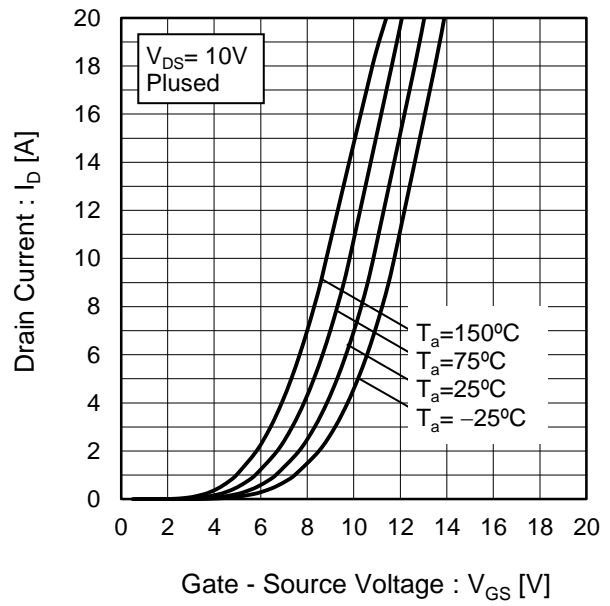


Fig.10 Gate Threshold Voltage vs. Junction Temperature

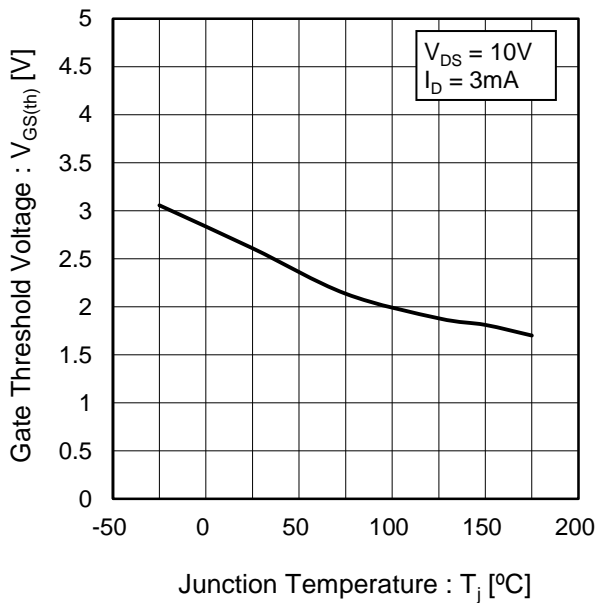
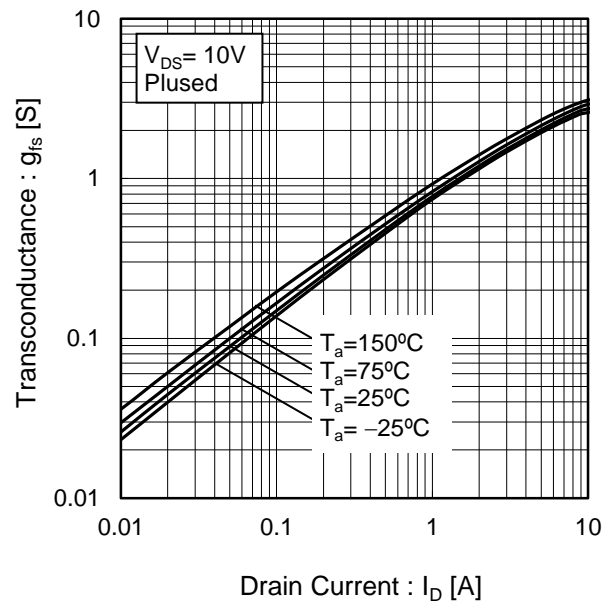


Fig.11 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

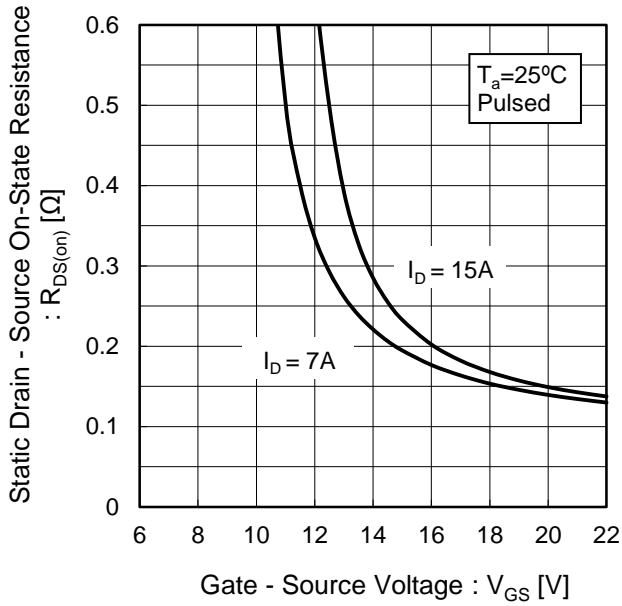


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature

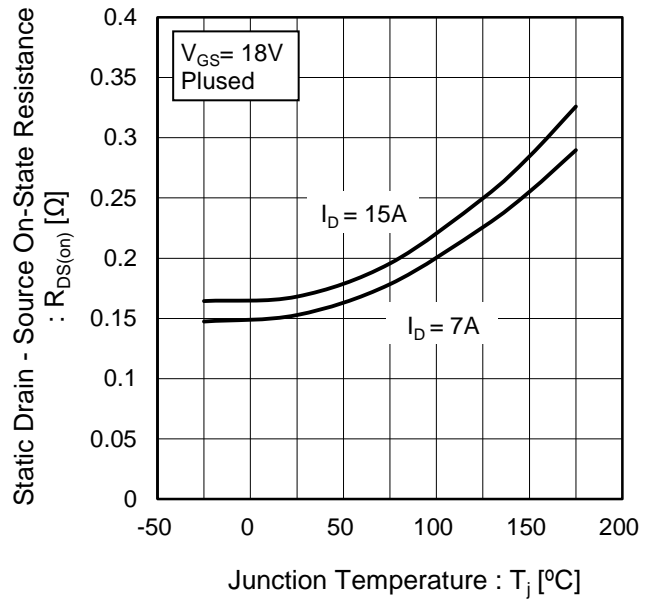
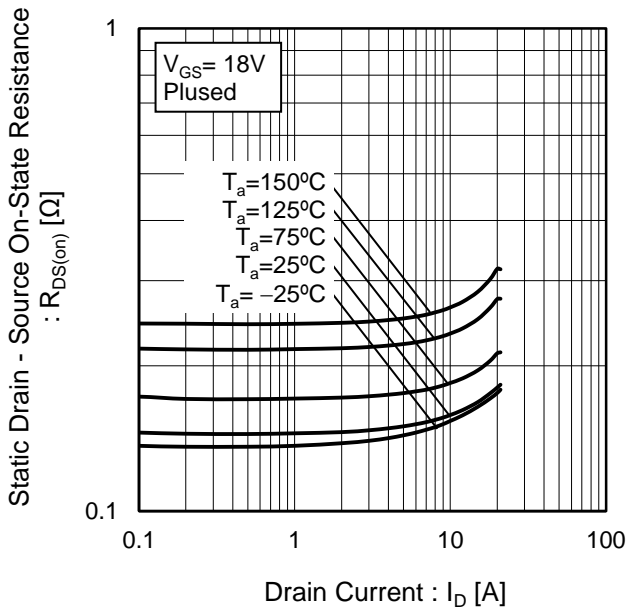


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current





●Electrical characteristic curves

Fig.15 Typical Capacitance vs. Drain - Source Voltage

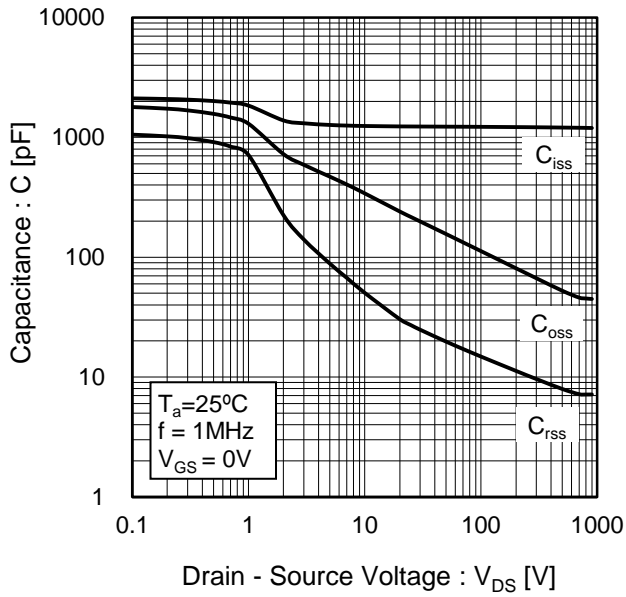


Fig.16 C<sub>OSS</sub> Stored Energy

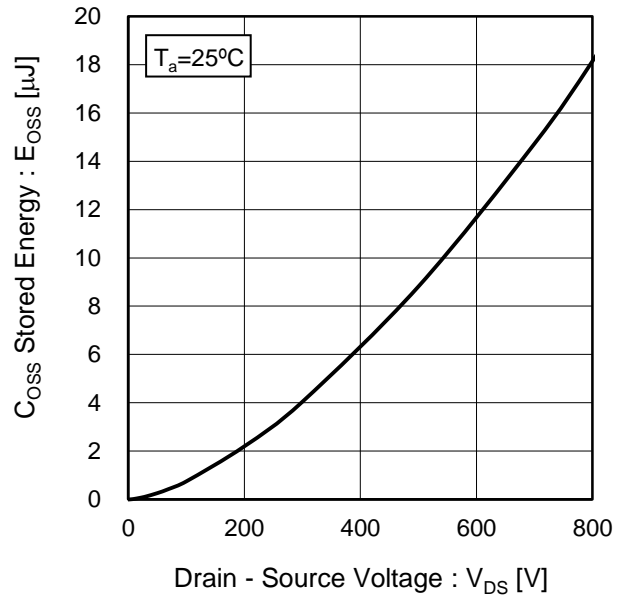


Fig.17 Switching Characteristics

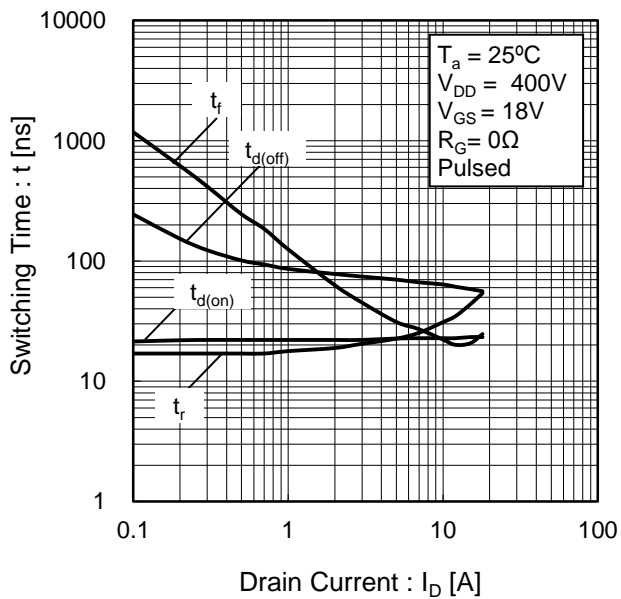
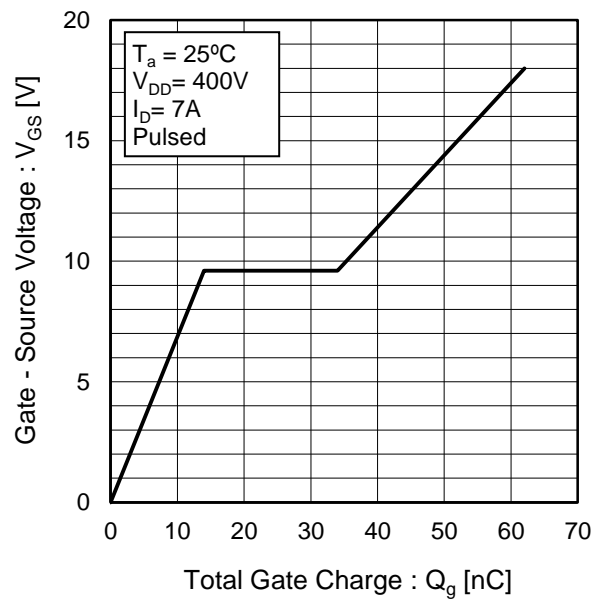


Fig.18 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.19 Typical Switching Loss vs. Drain - Source Voltage

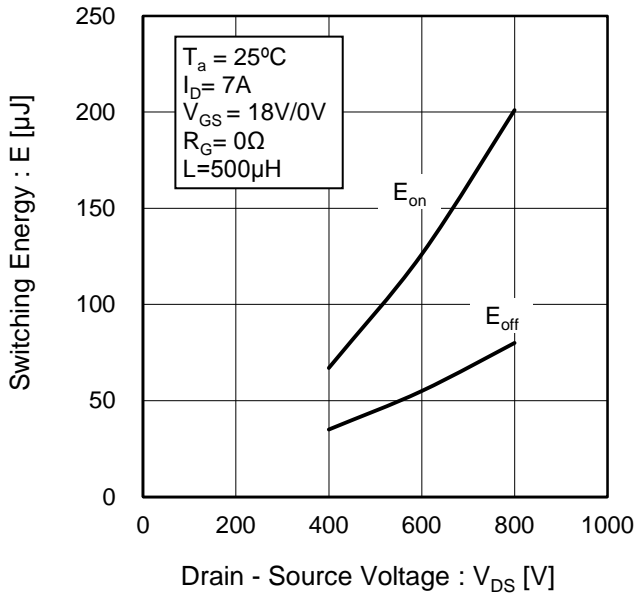


Fig.20 Typical Switching Loss vs. Drain Current

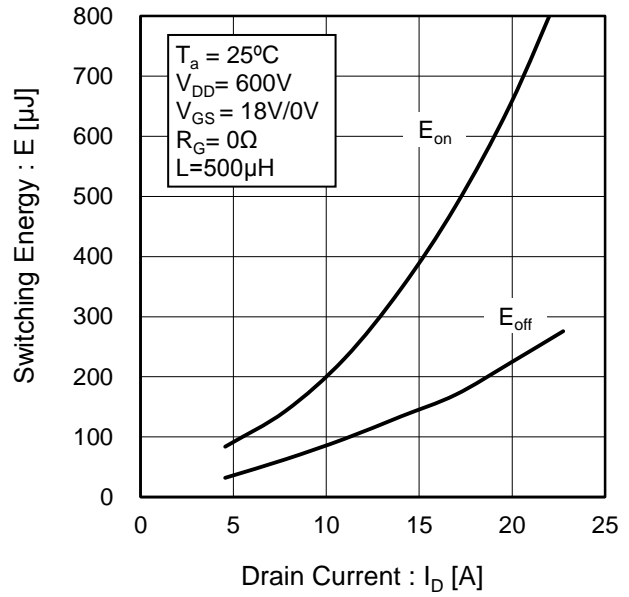
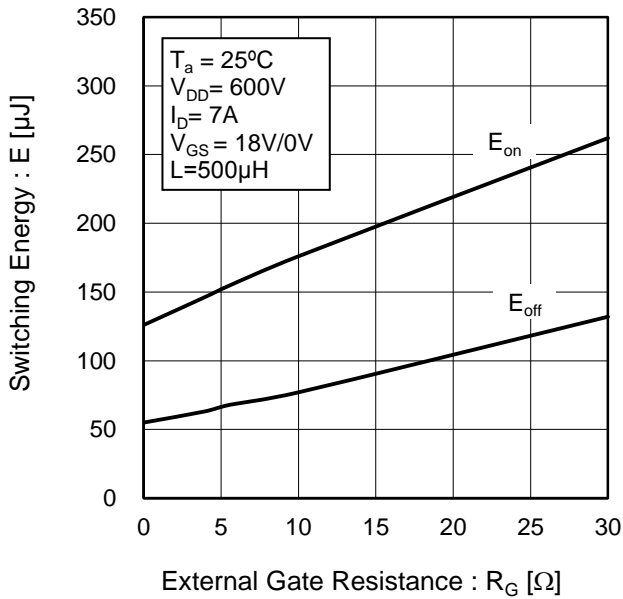


Fig.21 Typical Switching Loss vs. External Gate Resistance



●Electrical characteristic curves

Fig.22 Inverse Diode Forward Current vs. Source - Drain Voltage

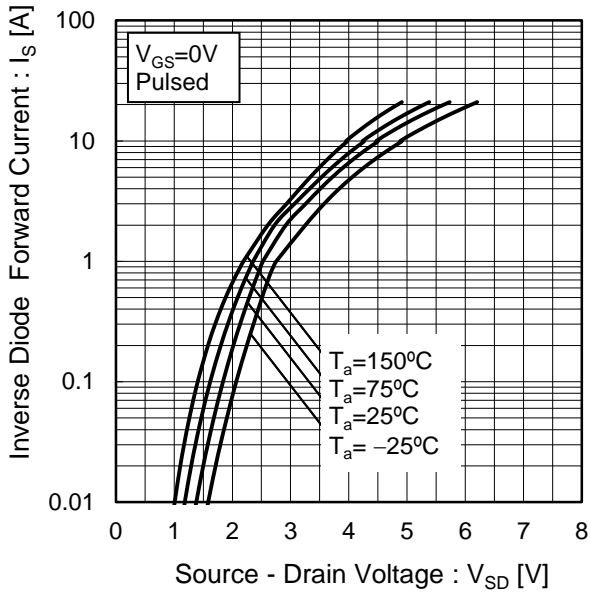
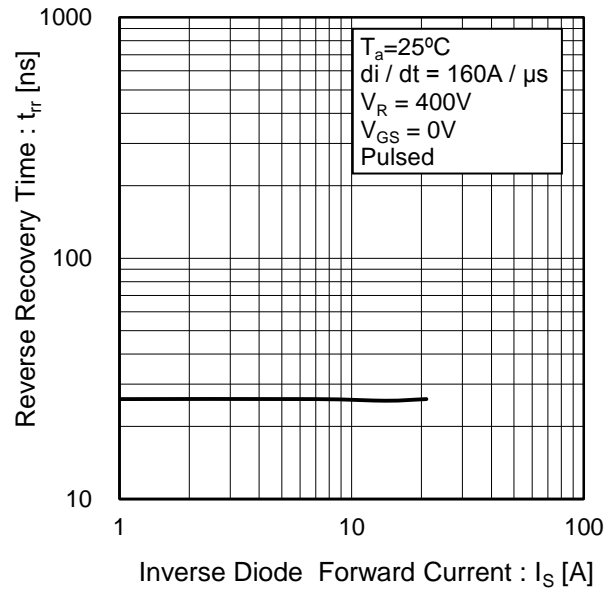


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

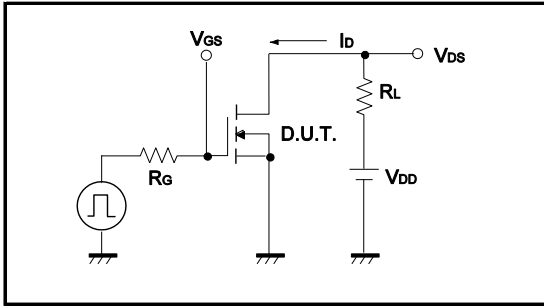


Fig.1-2 Switching Waveforms

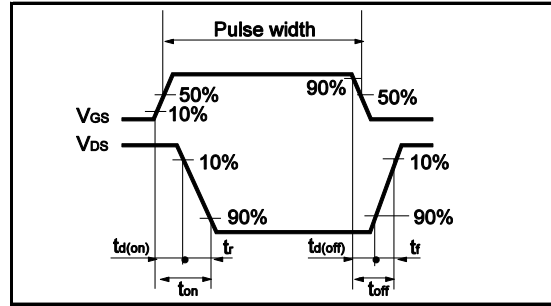


Fig.2-1 Gate Charge Measurement Circuit

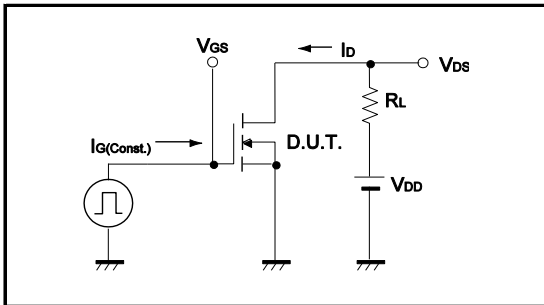


Fig.2-2 Gate Charge Waveform

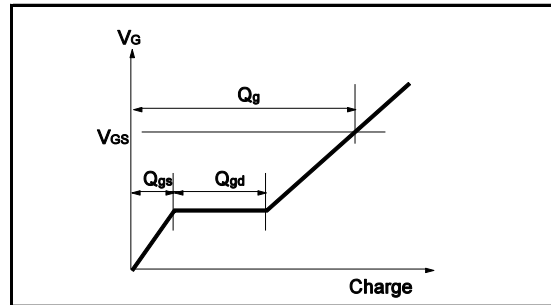


Fig.3-1 Switching Energy Measurement Circuit

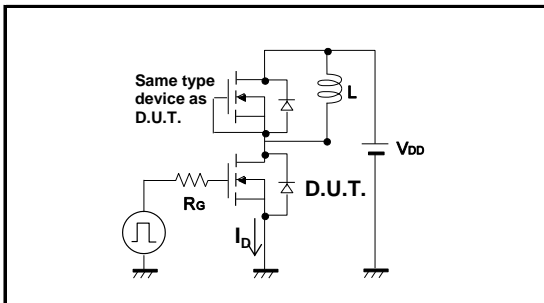


Fig.3-2 Switching Waveforms

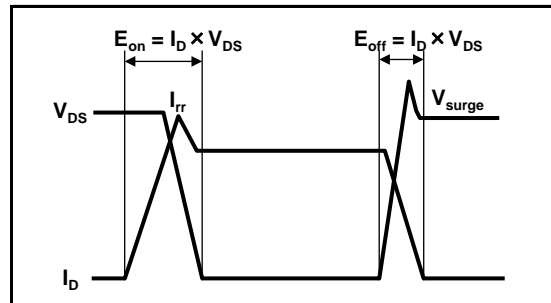


Fig.4-1 Reverse Recovery Time Measurement Circuit

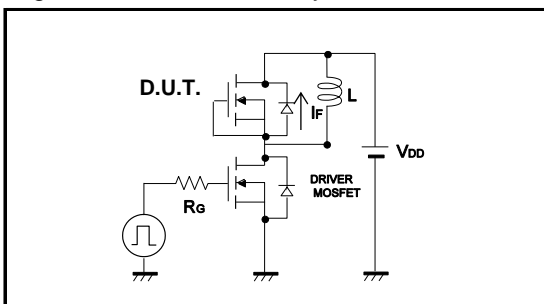
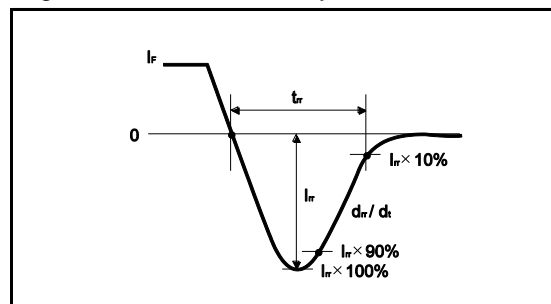


Fig.4-2 Reverse Recovery Waveform



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