

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

●Features

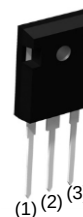
- 1) Low on-resistance
- 2) Fast switching speed
- 3) Fast reverse recovery
- 4) Easy to parallel
- 5) Simple to drive
- 6) Pb-free lead plating ; RoHS compliant
- 7) Qualified to AEC-Q101

●Application

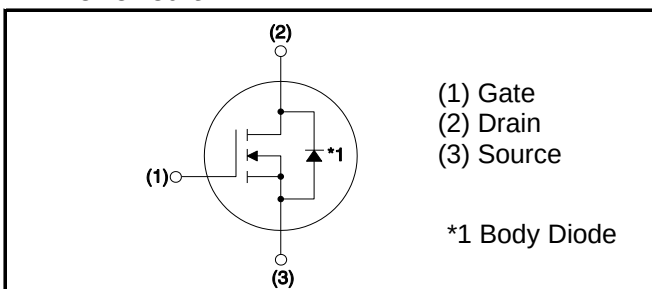
- Automobile
- Switch mode power supplies

●Outline

TO-247N



●Inner circuit



●Packaging specifications

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

●Absolute maximum ratings ($T_a = 25^\circ\text{C}$)

Parameter		Symbol	Value	Unit
Drain - Source voltage		V_{DSS}	1200	V
Continuous drain current	$T_c = 25^\circ\text{C}$	I_D^{*1}	22	A
	$T_c = 100^\circ\text{C}$	I_D^{*1}	16	A
Pulsed drain current		$I_{D,pulse}^{*2}$	55	A
Gate - Source voltage (DC)		V_{GSS}	-6 to 22	V
Gate - Source surge voltage ($T_{surge} < 300\text{nsec}$)		$V_{GSS,surge}^{*3}$	-10 to 26	V
Power dissipation ($T_c = 25^\circ\text{C}$)		P_D	165	W
Junction temperature		T_j	175	$^\circ\text{C}$
Range of storage temperature		T_{stg}	-55 to +175	$^\circ\text{C}$

●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}	$V_{DS} = 1200V, V_{GS} = 0V$ $T_j = 25^\circ\text{C}$	-	1	10	μA
		$T_j = 150^\circ\text{C}$	-	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

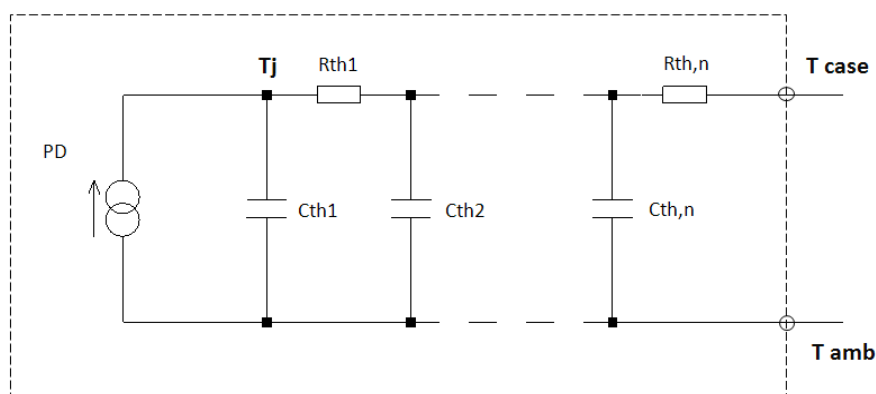
●Thermal resistance

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 ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Static drain - source on - state resistance	$R_{DS(on)}^{*4}$	$V_{GS} = 18\text{V}, I_D = 7\text{A}$				
		$T_j = 25^\circ\text{C}$	-	160	208	$\text{m}\Omega$
		$T_j = 125^\circ\text{C}$	-	226	-	
Gate input resistance	R_G	$f = 1\text{MHz}$, open drain	-	13.7	-	Ω
Transconductance	g_{fs}^{*4}	$V_{DS} = 10\text{V}, I_D = 7\text{A}$	-	2.4	-	S
Input capacitance	C_{iss}	$V_{GS} = 0\text{V}$	-	1200	-	pF
Output capacitance	C_{oss}	$V_{DS} = 800\text{V}$	-	45	-	
Reverse transfer capacitance	C_{rss}	$f = 1\text{MHz}$	-	7	-	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$ $V_{DS} = 0\text{V to } 500\text{V}$	-	71	-	pF
Turn - on delay time	$t_{d(on)}^{*4}$	$V_{DD} = 400\text{V}, I_D = 7\text{A}$	-	23	-	ns
Rise time	t_r^{*4}	$V_{GS} = 18\text{V}/0\text{V}$	-	25	-	
Turn - off delay time	$t_{d(off)}^{*4}$	$R_L = 57\Omega$	-	67	-	
Fall time	t_f^{*4}	$R_G = 0\Omega$	-	27	-	
Turn - on switching loss	E_{on}^{*4}	$V_{DD} = 600\text{V}, I_D = 7\text{A}$ $V_{GS} = 18\text{V}/0\text{V}$ $R_G = 0\Omega, L = 500\mu\text{H}$	-	126	-	μJ
Turn - off switching loss	E_{off}^{*4}	$*E_{on}$ includes diode reverse recovery	-	55	-	

●Gate Charge characteristics ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g^{*4}	$V_{DD} = 400\text{V}$	-	62	-	nC
Gate - Source charge	Q_{gs}^{*4}	$I_D = 7\text{A}$	-	14	-	
Gate - Drain charge	Q_{gd}^{*4}	$V_{GS} = 18\text{V}$	-	20	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 400\text{V}, I_D = 7\text{A}$	-	9.6	-	V

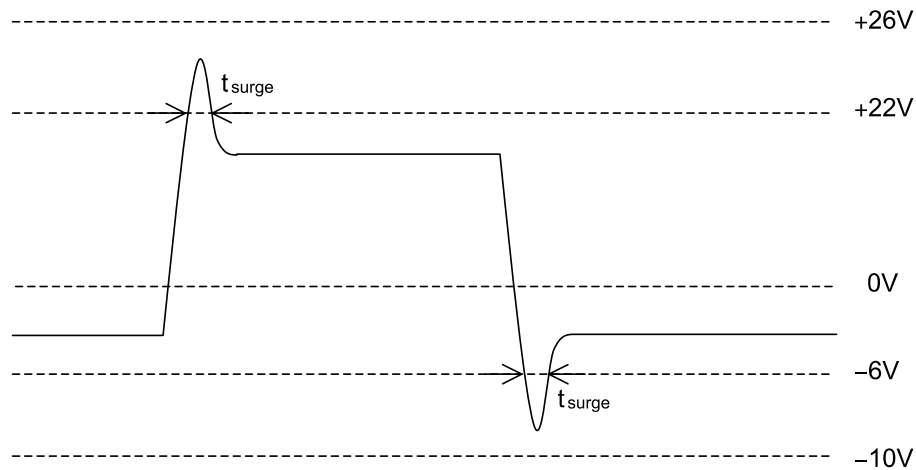
●Body diode electrical characteristics (Source-Drain) ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S^{*1}	$T_c = 25^\circ\text{C}$	-	-	22	A
Inverse diode direct current, pulsed	I_{SM}^{*2}		-	-	55	A
Forward voltage	V_{SD}^{*4}	$V_{GS} = 0\text{V}, I_S = 7\text{A}$	-	4.1	-	V
Reverse recovery time	t_{rr}^{*4}	$I_F = 7\text{A}, V_R = 400\text{V}$ $di/dt = 160\text{A}/\mu\text{s}$	-	26	-	ns
Reverse recovery charge	Q_{rr}^{*4}		-	39	-	nC
Peak reverse recovery current	I_{rrm}^{*4}		-	3.0	-	A

*1 Limited only by maximum temperature allowed.

*2 $PW \leq 10\mu\text{s}$, Duty cycle $\leq 1\%$

*3 Example of acceptable V_{GS} waveform



*4 Pulsed

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

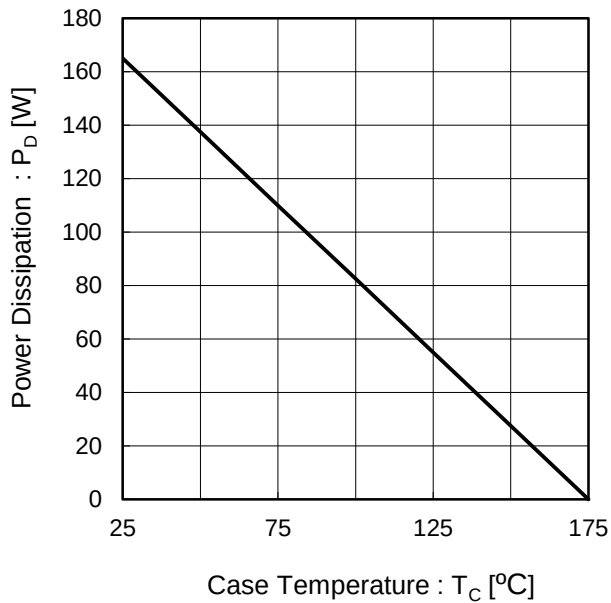


Fig.2 Maximum Safe Operating Area

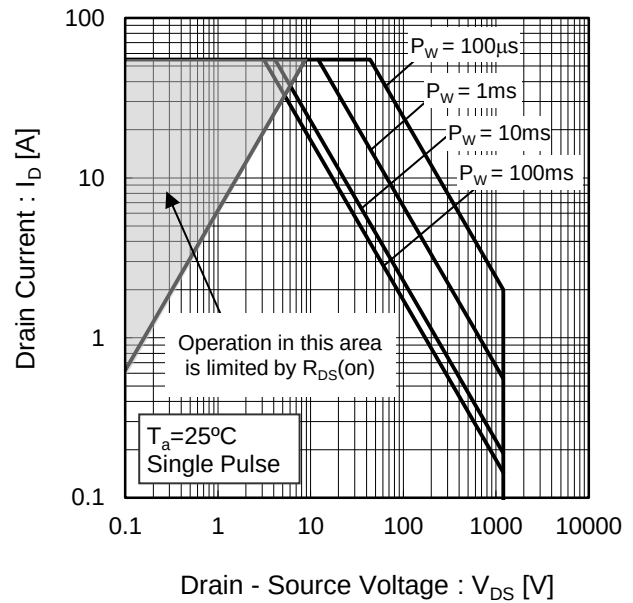
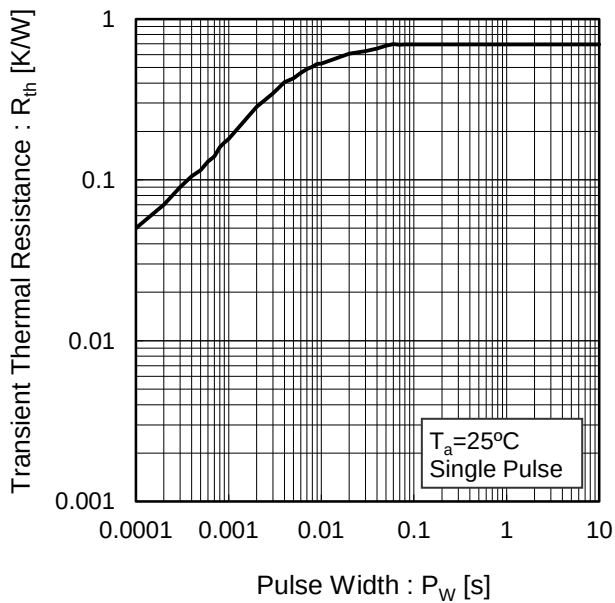


Fig.3 Typical Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

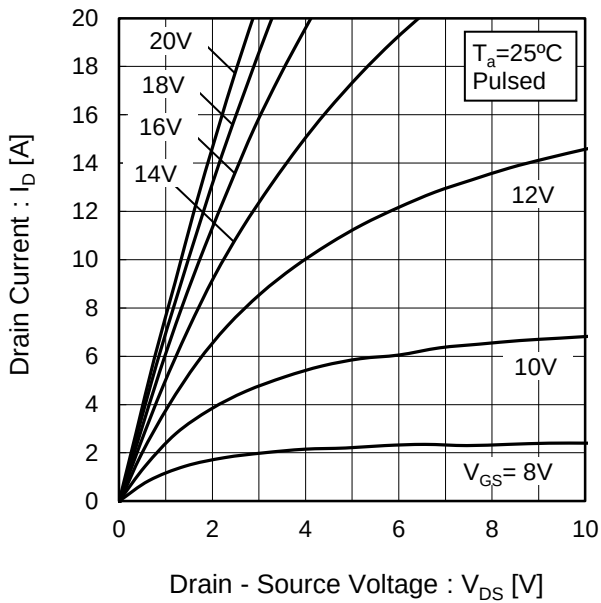
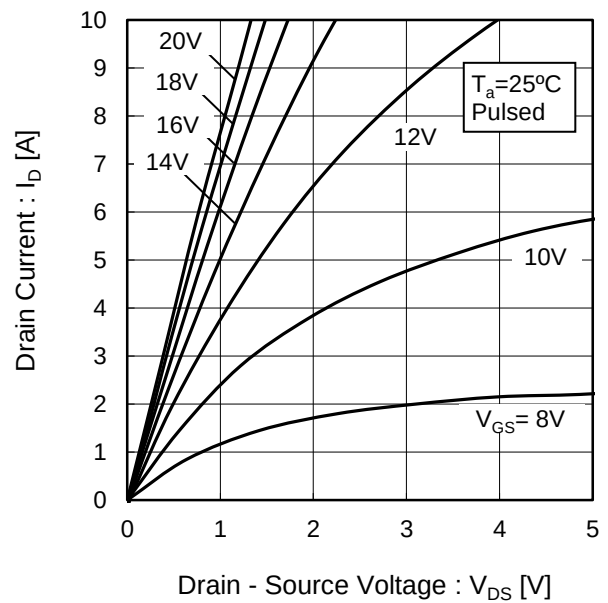
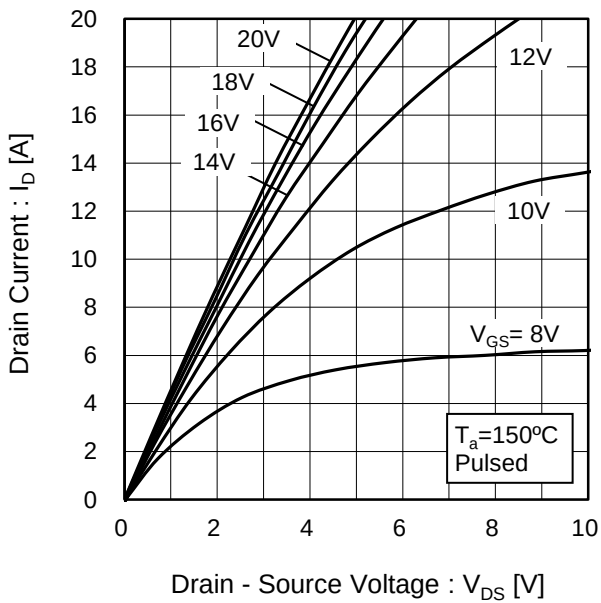
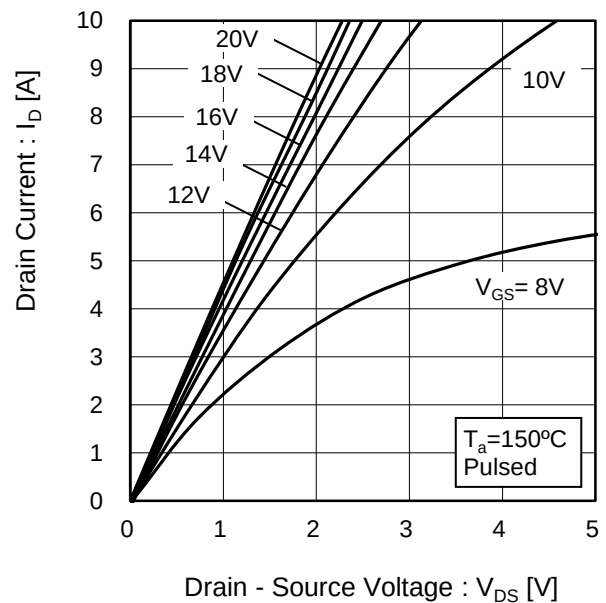


Fig.5 Typical Output Characteristics(II)

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)

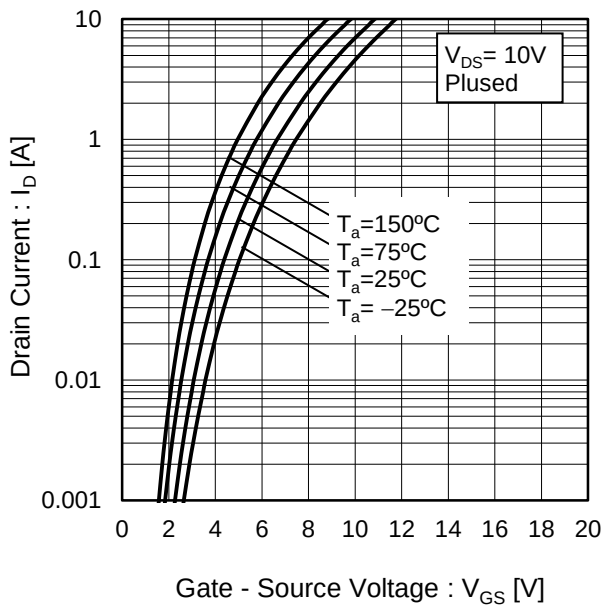


Fig.9 Typical Transfer Characteristics (II)

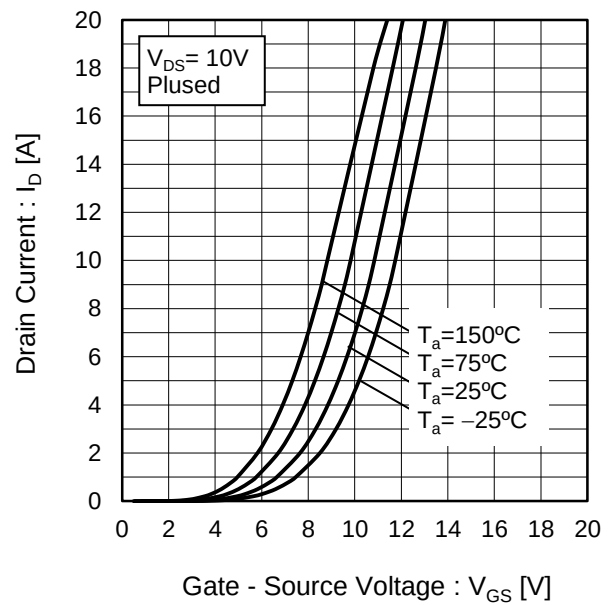


Fig.10 Gate Threshold Voltage vs. Junction Temperature

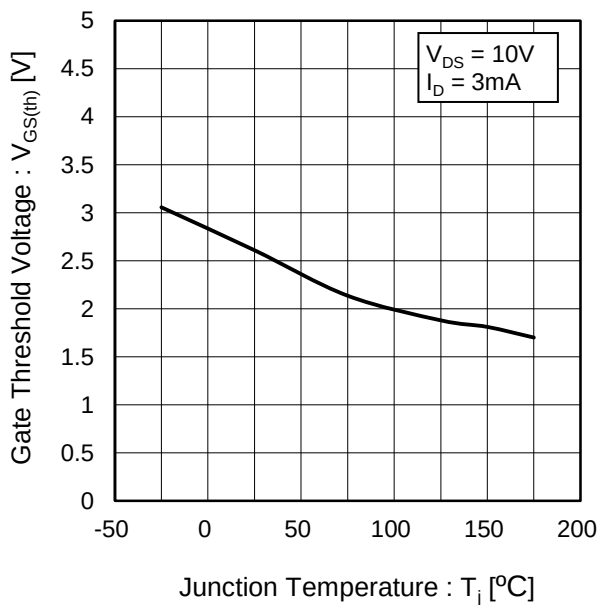
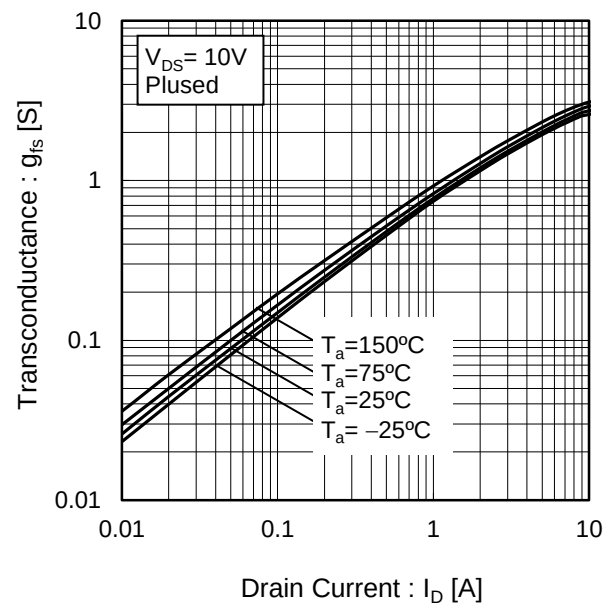


Fig.11 Transconductance vs. Drain Current



●Electrical characteristic curves

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

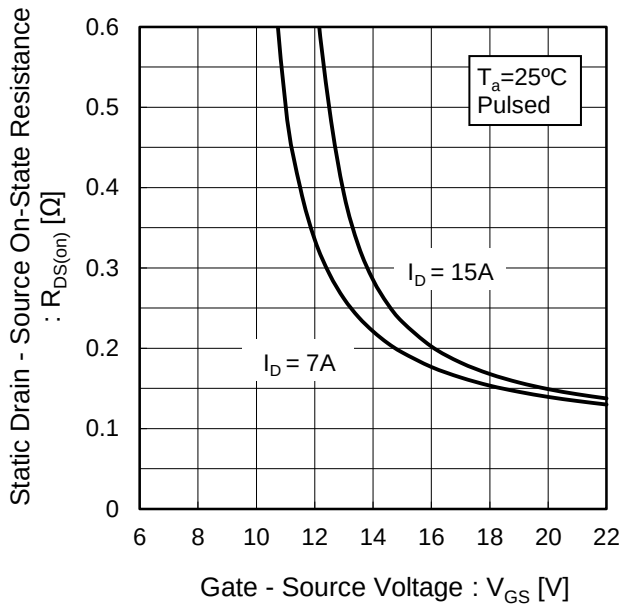


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature

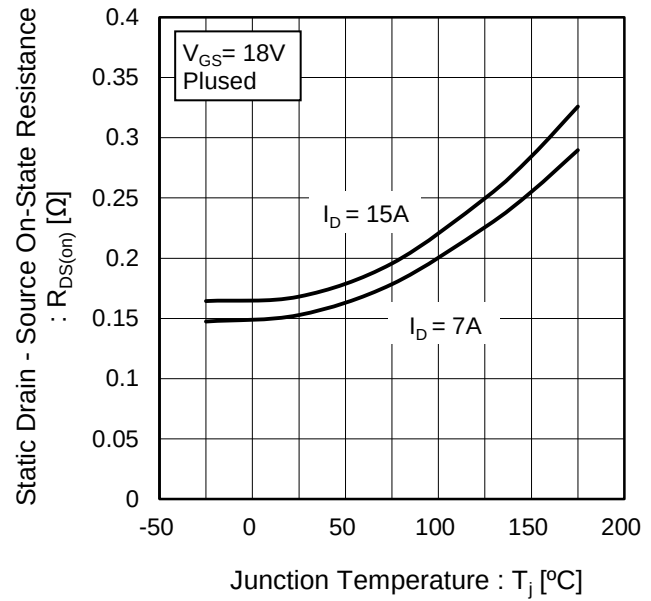
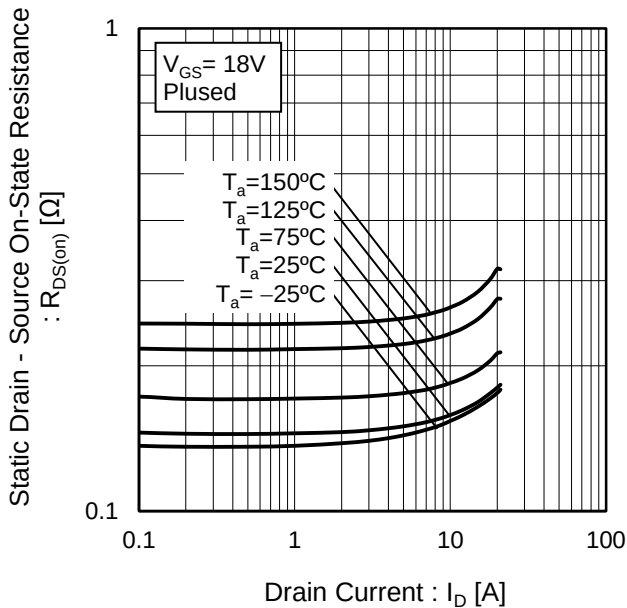


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.15 Typical Capacitance
vs. Drain - Source Voltage

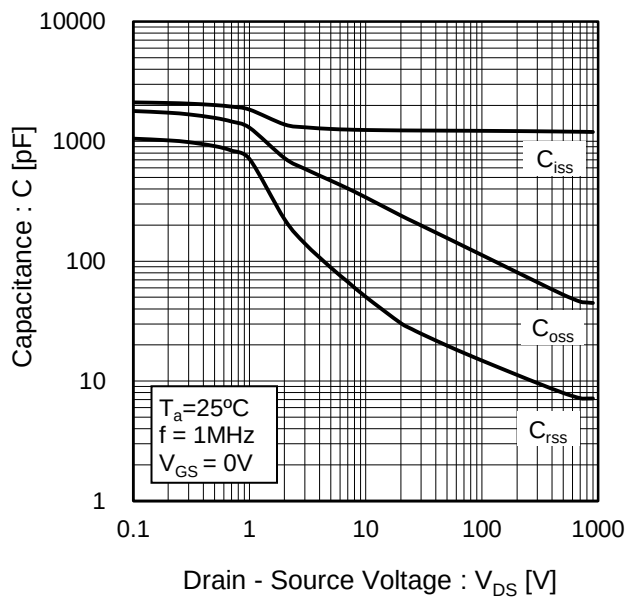


Fig.16 C_{OSS} Stored Energy

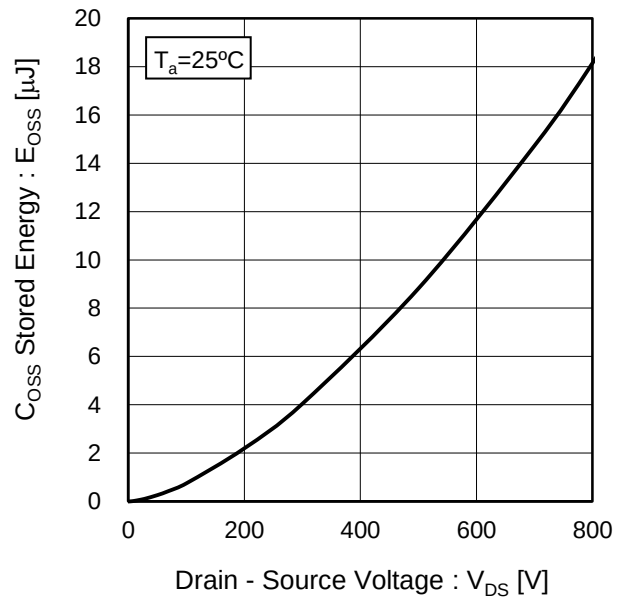


Fig.17 Switching Characteristics

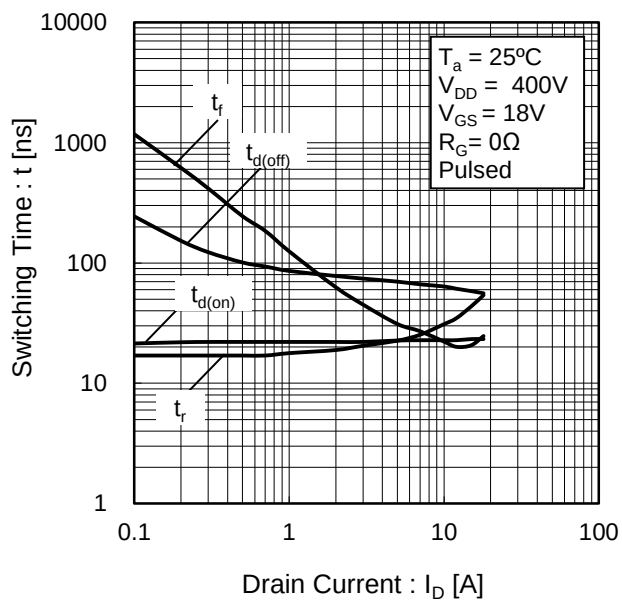
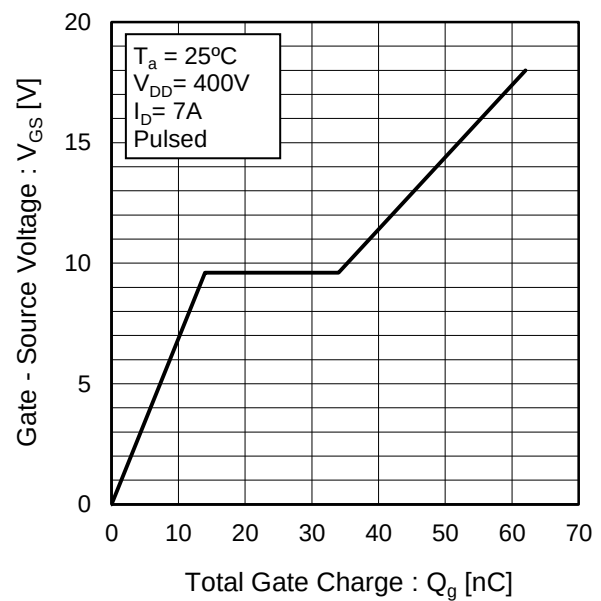


Fig.18 Dynamic Input Characteristics



●Electrical characteristic curves

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

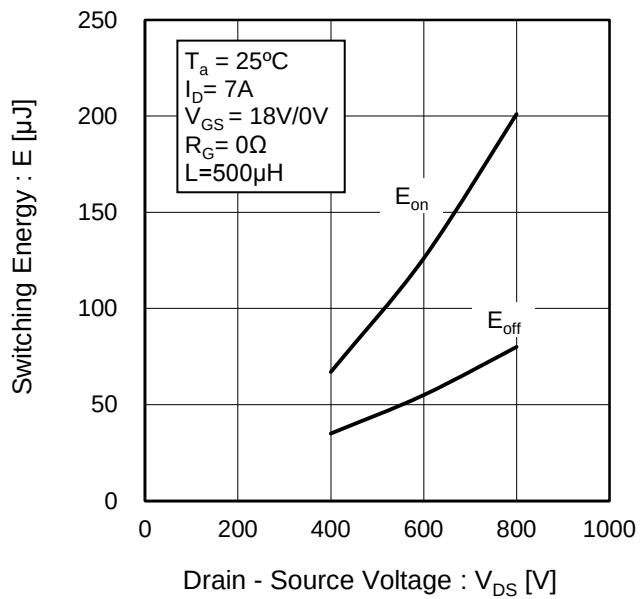


Fig.20 Typical Switching Loss
vs. Drain Current

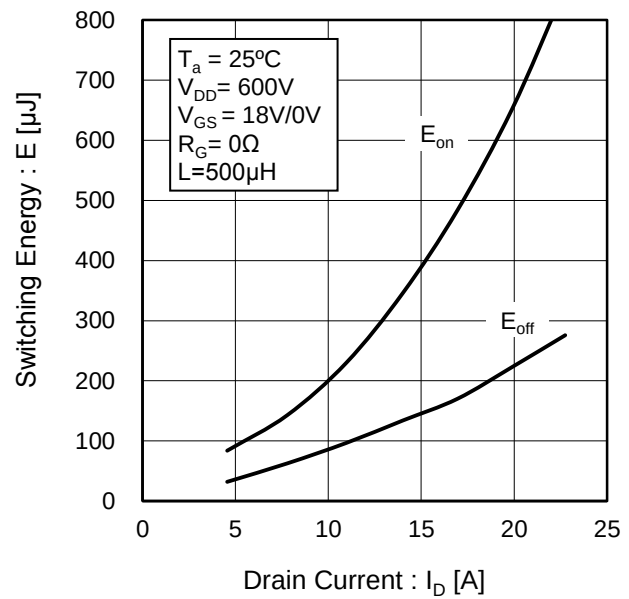
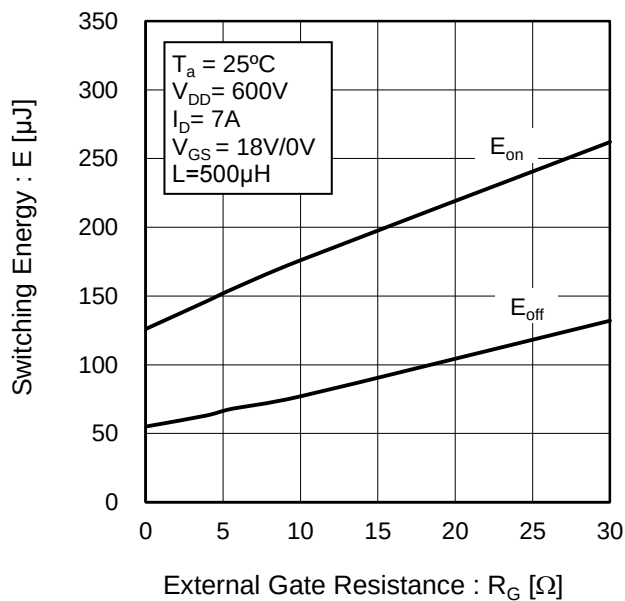


Fig.21 Typical Switching Loss
vs. External Gate Resistance



●Electrical characteristic curves

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

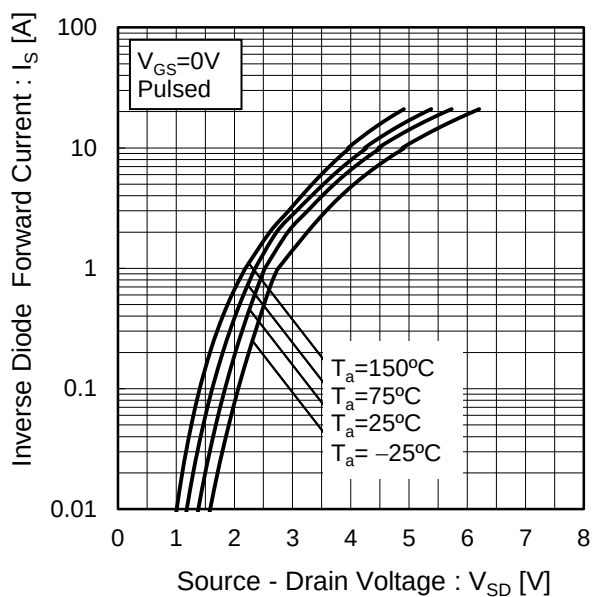
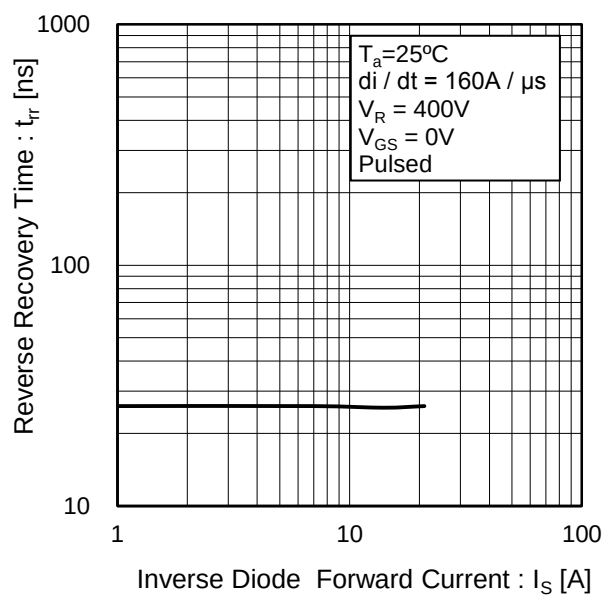


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

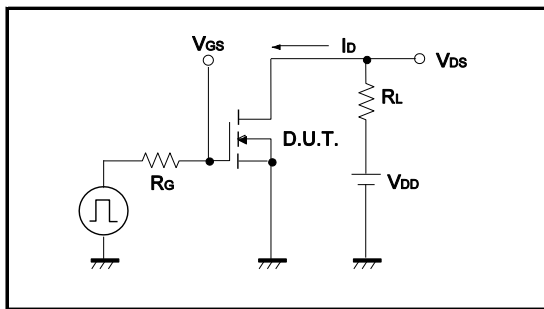


Fig.1-2 Switching Waveforms

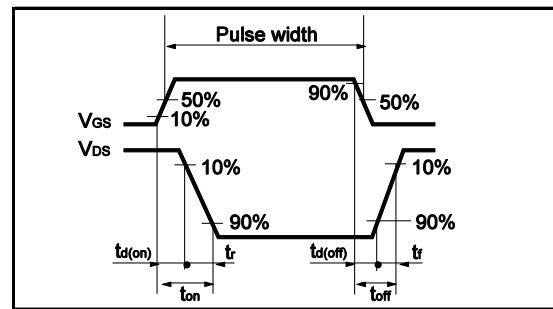


Fig.2-1 Gate Charge Measurement Circuit

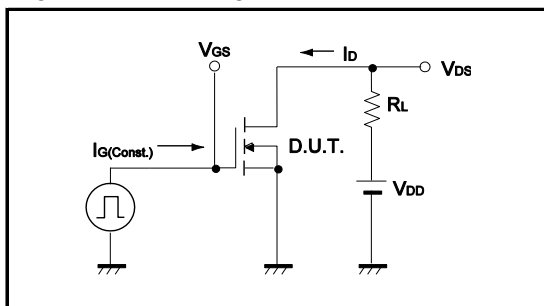


Fig.2-2 Gate Charge Waveform

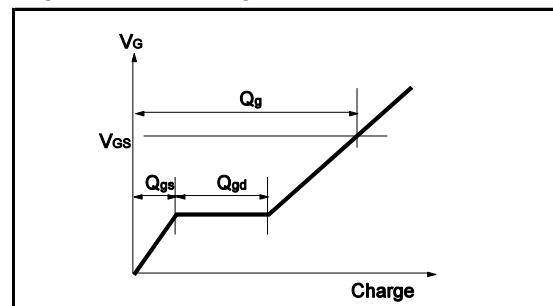


Fig.3-1 Switching Energy Measurement Circuit

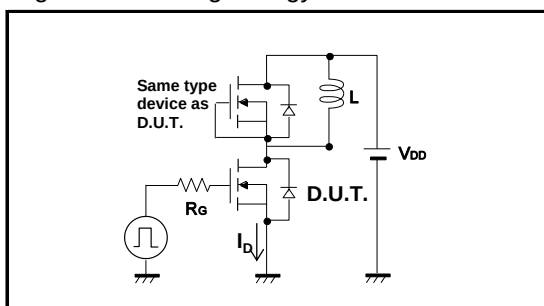


Fig.3-2 Switching Waveforms

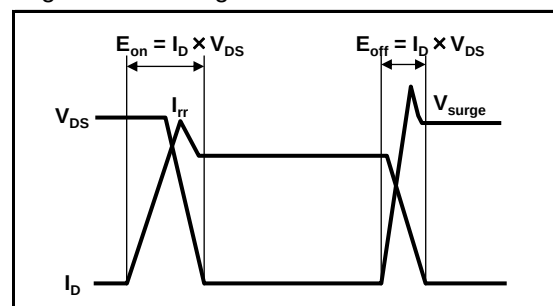


Fig.4-1 Reverse Recovery Time Measurement Circuit

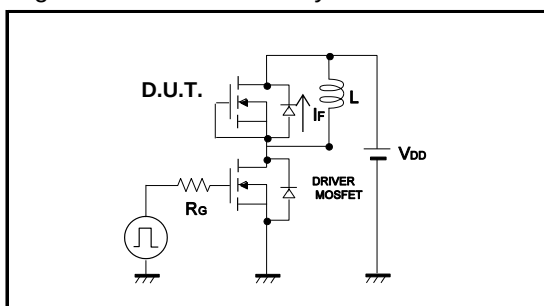
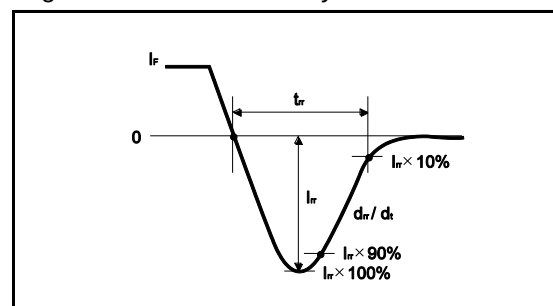


Fig.4-2 Reverse Recovery Waveform



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