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Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



V_{DSS}	30V
$R_{DS(on)}$ (Max.)	28mΩ
I_D	6A
P_D	1.5W

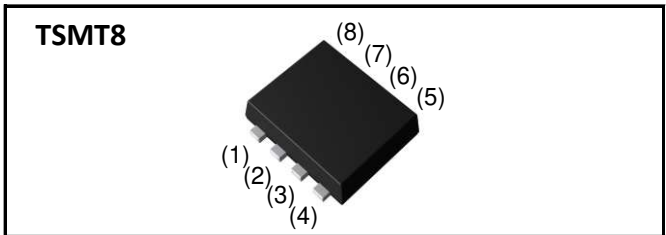
●Features

- 1) Low on - resistance.
- 2) Built-in G-S Protection Diode.
- 3) Small Surface Mount Package (TSMT8).
- 4) Pb-free lead plating ; RoHS compliant

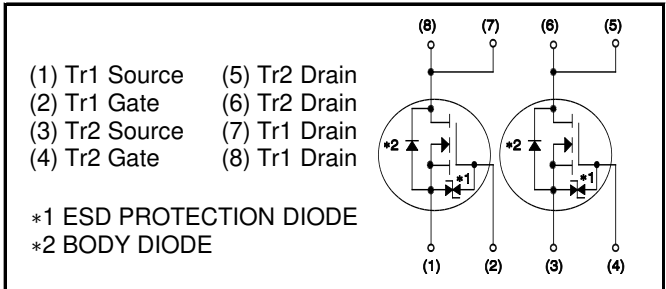
●Application

DC/DC converters

●Outline



●Inner circuit



●Packaging specifications

Type	Packaging	Taping
	Reel size (mm)	180
	Tape width (mm)	8
	Basic ordering unit (pcs)	3,000
	Taping code	TR
	Marking	K13

●Absolute maximum ratings($T_a = 25^\circ\text{C}$) <It is the same ratings for the Tr1 and Tr2>

Parameter	Symbol	Value	Unit
Drain - Source voltage	V_{DSS}	30	V
Continuous drain current	I_D^{*1}	±6	A
Pulsed drain current	$I_{D,pulse}^{*2}$	±18	A
Gate - Source voltage	V_{GSS}	±20	V
Power dissipation	P_D^{*3}	1.5	W
	P_D^{*4}	0.55	W
Junction temperature	T_j	150	°C
Range of storage temperature	T_{stg}	-55 to +150	°C

●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - ambient	R_{thJA}^{*3}	-	-	83.3	°C/W
Thermal resistance, junction - ambient	R_{thJA}^{*4}	-	-	227	°C/W

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

<It is the same characteristics for the Tr1 and Tr2>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 1mA$	30	-	-	V
Breakdown voltage temperature coefficient	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	$I_D = 1mA$ referenced to 25°C	-	35	-	mV/°C
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 30V, V_{GS} = 0V$	-	-	1	μA
Gate - Source leakage current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	±10	μA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = 10V, I_D = 1mA$	1.0	-	2.5	V
Gate threshold voltage temperature coefficient	$\frac{\Delta V_{(GS)th}}{\Delta T_j}$	$I_D = 1mA$ referenced to 25°C	-	-3.3	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*5}$	$V_{GS}=10V, I_D=6A$	-	20	28	mΩ
		$V_{GS}=4.5V, I_D=6A$	-	25	35	
		$V_{GS}=4V, I_D=6A$	-	28	39	
		$V_{GS}=10V, I_D=6A, T_j=125^{\circ}C$	-	30	42	
Gate input resistance	R_G	$f = 1MHz, \text{open drain}$	-	0.6	-	Ω
Transconductance	g_{fs}^{*5}	$V_{DS} = 10V, I_D = 6A$	3.0	8.4	-	S

*1 Limited only by maximum temperature allowed.

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

*3 Mounted on a ceramic board (30×30×0.8mm)

*4 Mounted on a FR4 (20×20×0.8mm)

*5 Pulsed

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

<It is the same characteristics for the Tr1 and Tr2>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input capacitance	C_{iss}	$V_{GS} = 0V$	-	390	-	pF
Output capacitance	C_{oss}	$V_{DS} = 10V$	-	150	-	
Reverse transfer capacitance	C_{rss}	$f = 1\text{MHz}$	-	70	-	
Turn - on delay time	$t_{d(on)}^{*5}$	$V_{DD} \approx 15V, V_{GS} = 10V$	-	8	-	ns
Rise time	t_r^{*5}	$I_D = 3A$	-	40	-	
Turn - off delay time	$t_{d(off)}^{*5}$	$R_L = 5\Omega$	-	35	-	
Fall time	t_f^{*5}	$R_G = 10\Omega$	-	7	-	

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

<It is the same characteristics for the Tr1 and Tr2>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g^{*5}	$V_{DD} \approx 15V, I_D = 6A$ $V_{GS} = 5V$	-	5.5	13.6	nC
		$V_{DD} \approx 15V, I_D = 6A$ $V_{GS} = 10V$	-	10	20	
Gate - Source charge	Q_{gs}^{*5}	$V_{DD} \approx 15V, I_D = 6A$	-	1.5	-	
Gate - Drain charge	Q_{gd}^{*5}	$V_{GS} = 5V$	-	2.1	-	

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

<It is the same characteristics for the Tr1 and Tr2>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_s^{*1}	$T_a = 25^\circ\text{C}$	-	-	1.25	A
Forward voltage	V_{SD}^{*5}	$V_{GS} = 0V, I_s = 6A$	-	-	1.2	V

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

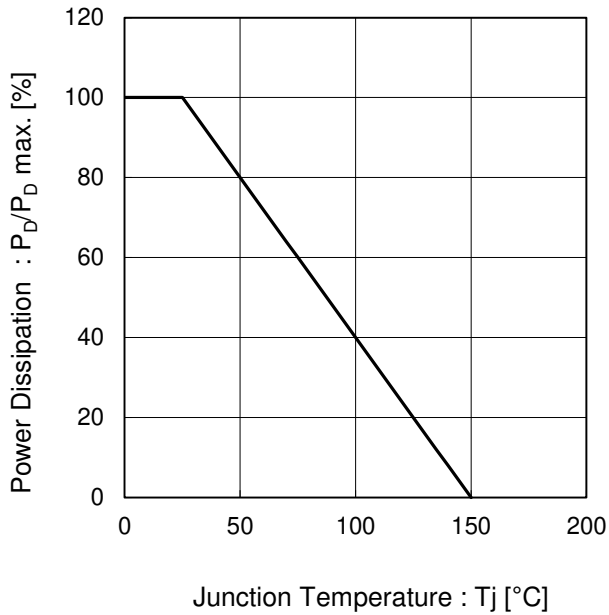


Fig.2 Maximum Safe Operating Area

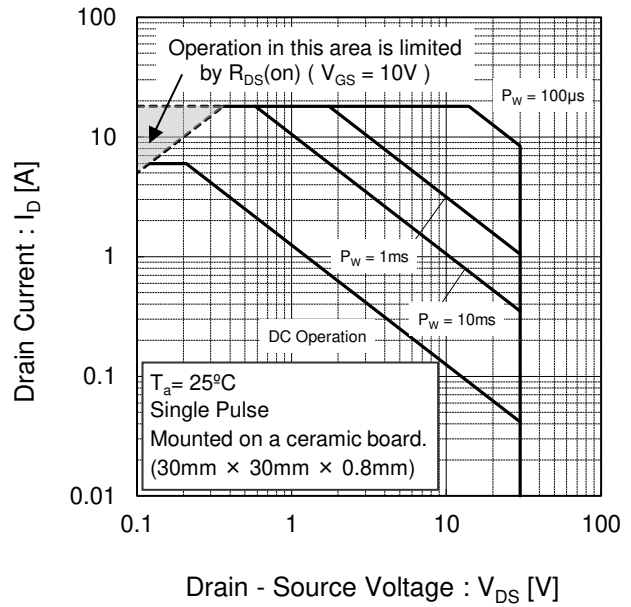


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

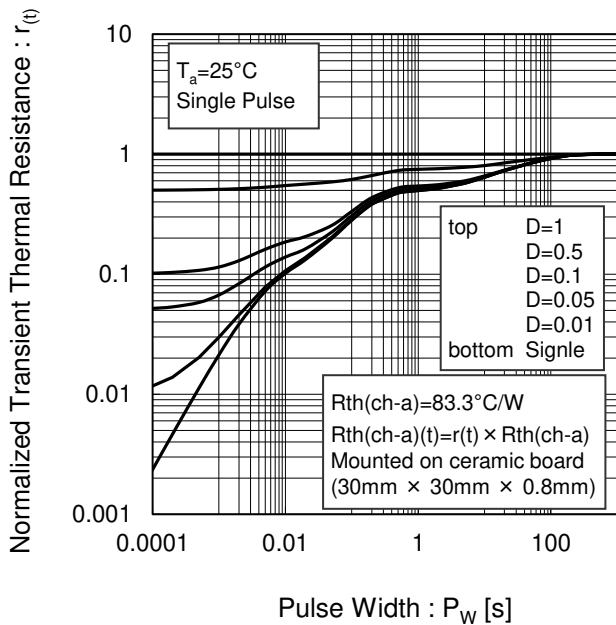
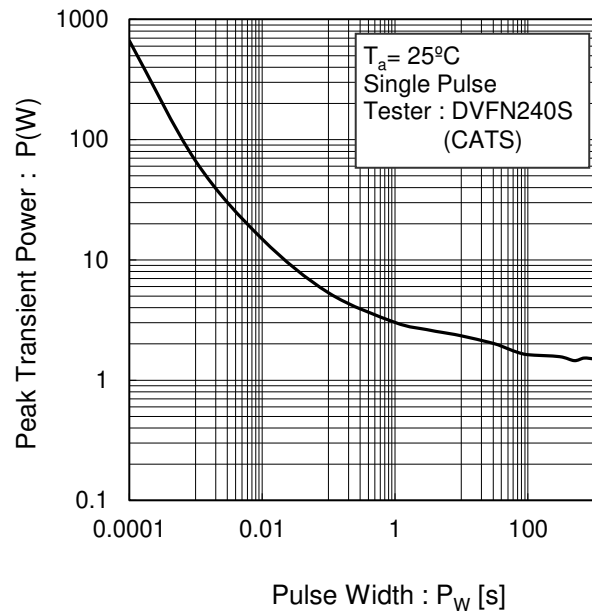


Fig.4 Single Pulse Maximum Power dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

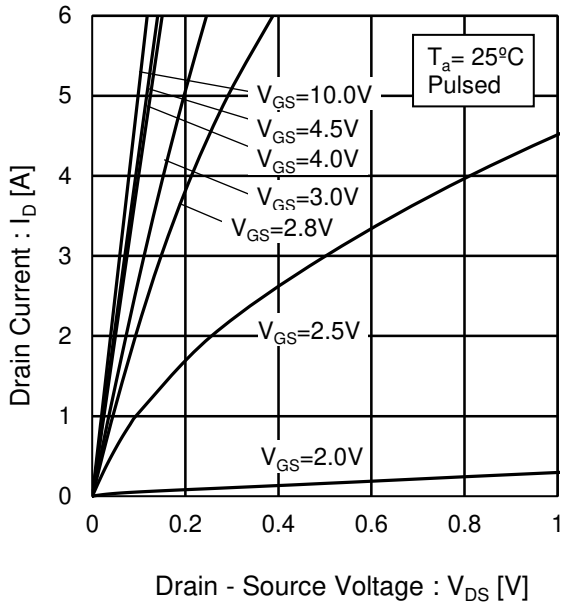
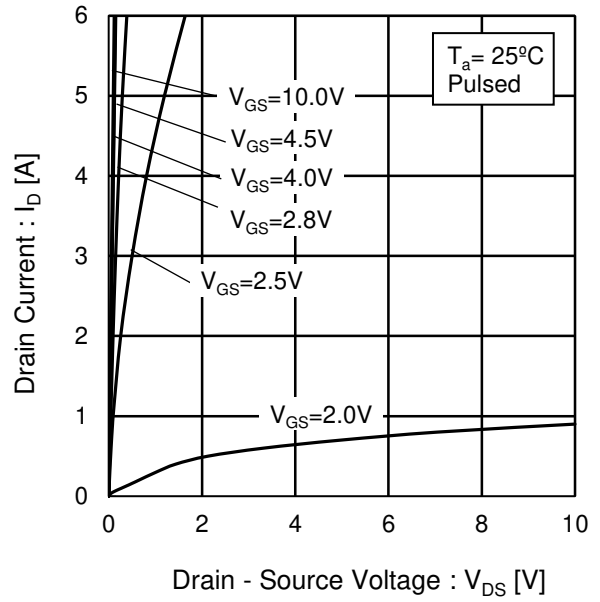


Fig.6 Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.7 Breakdown Voltage vs. Junction Temperature

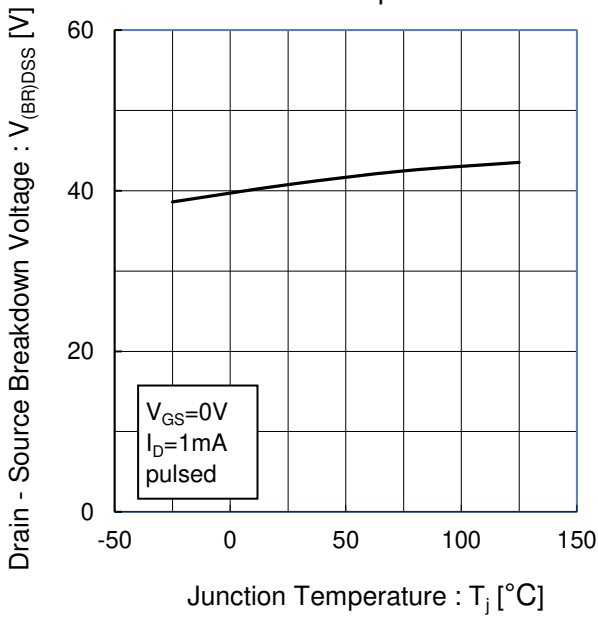


Fig.8 Typical Transfer Characteristics

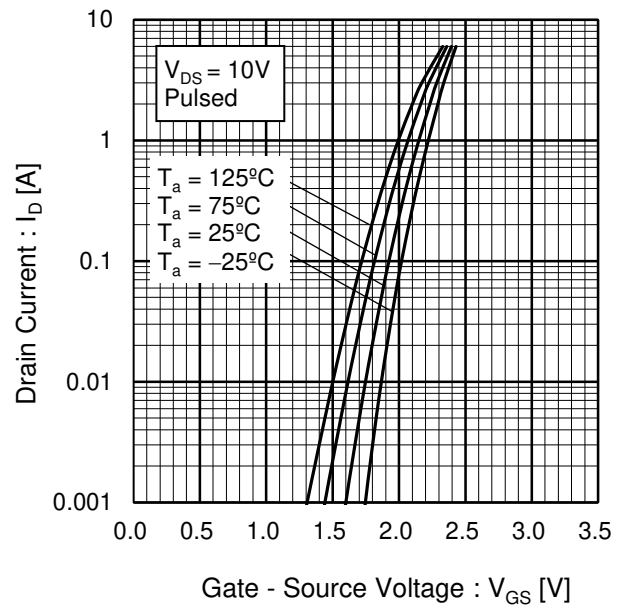


Fig.9 Gate Threshold Voltage vs. Junction Temperature

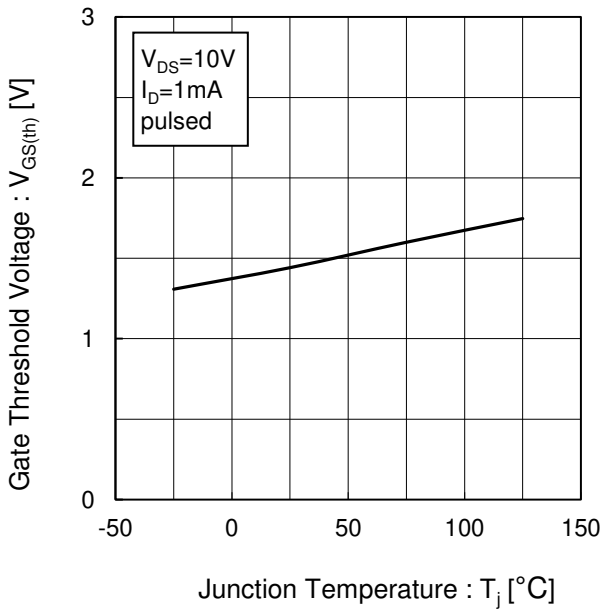
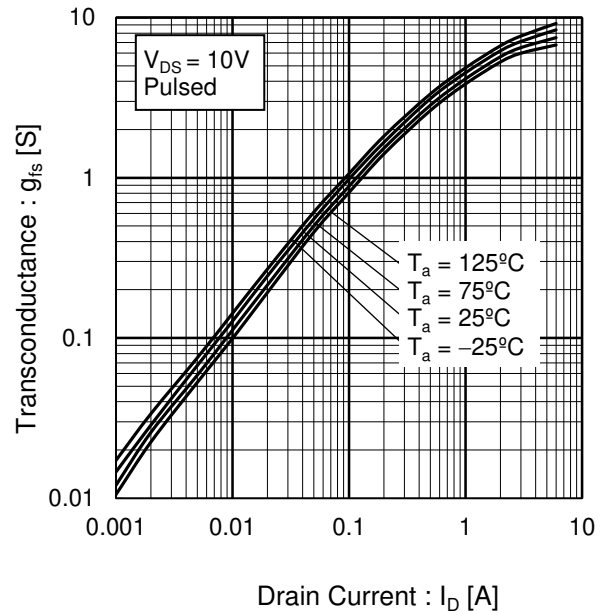


Fig.10 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.11 Drain Current Derating Curve

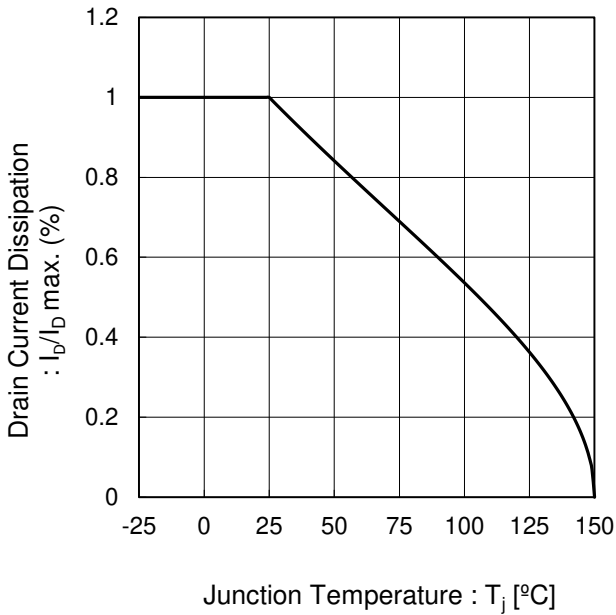


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

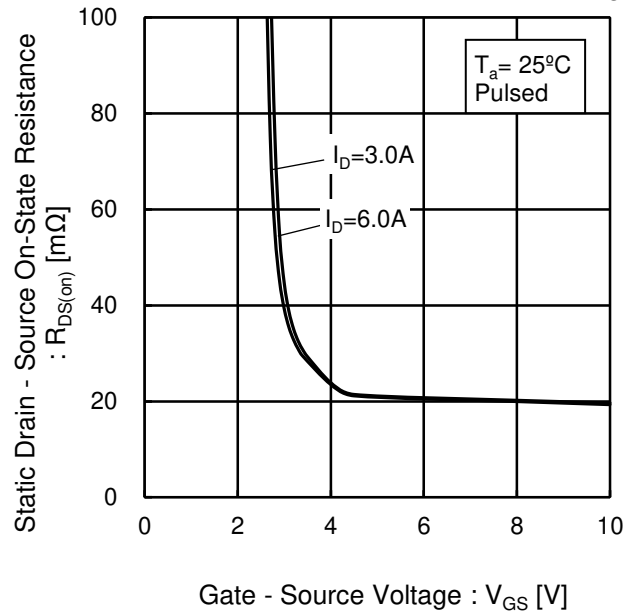


Fig.13 Static Drain - Source On - State Resistance vs. Drain Current (I_D)

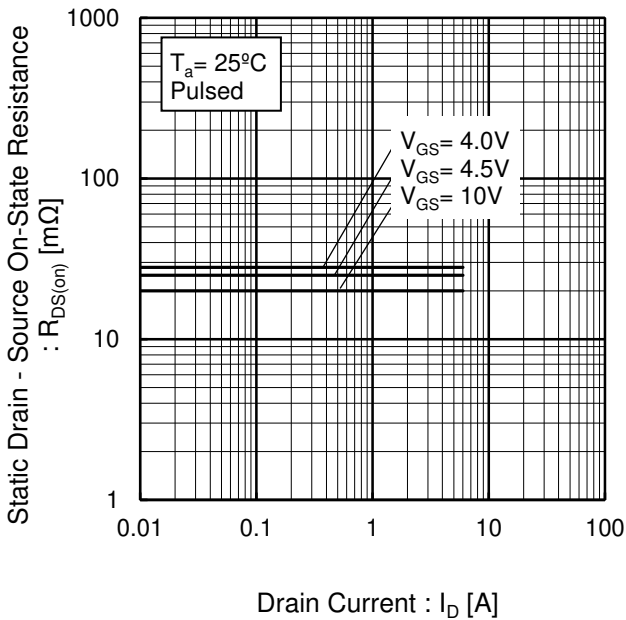
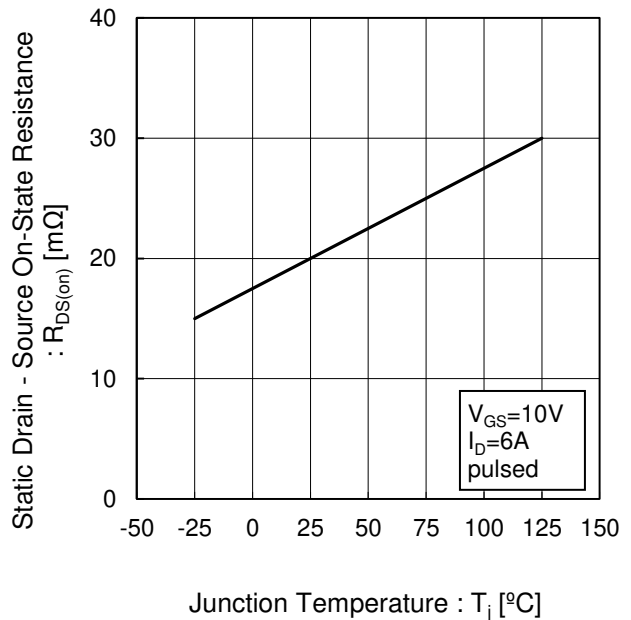


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

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

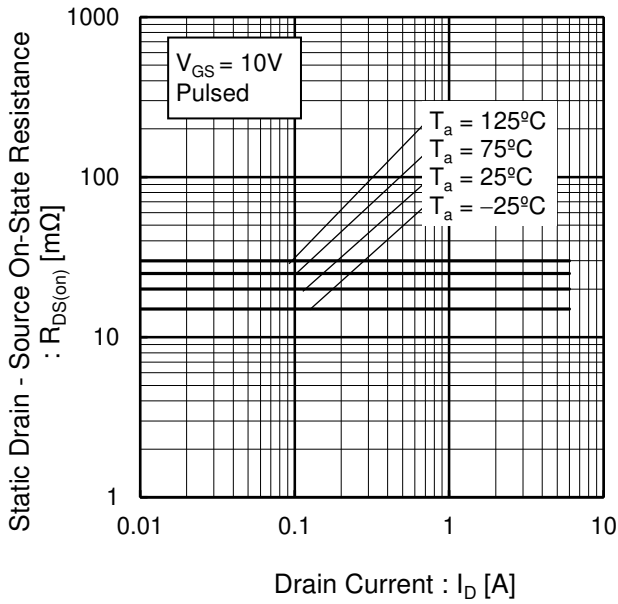


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current(III)

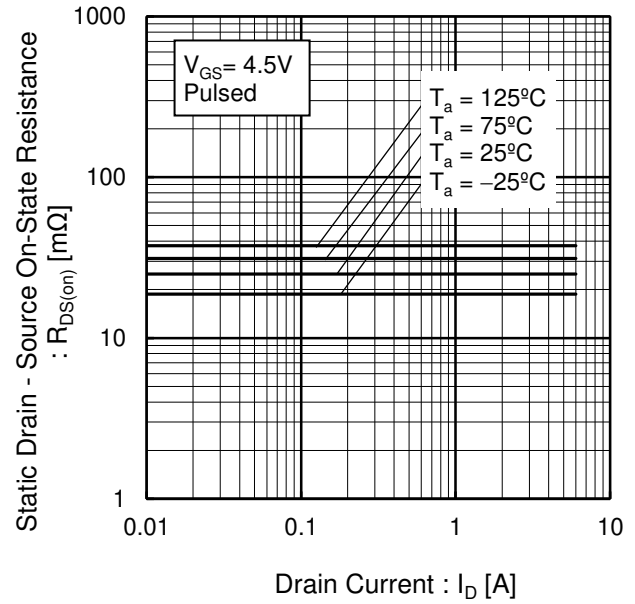
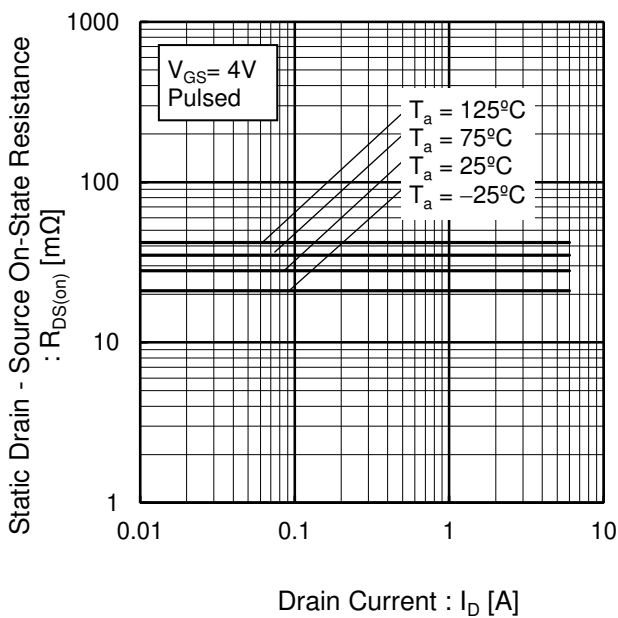


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)



●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

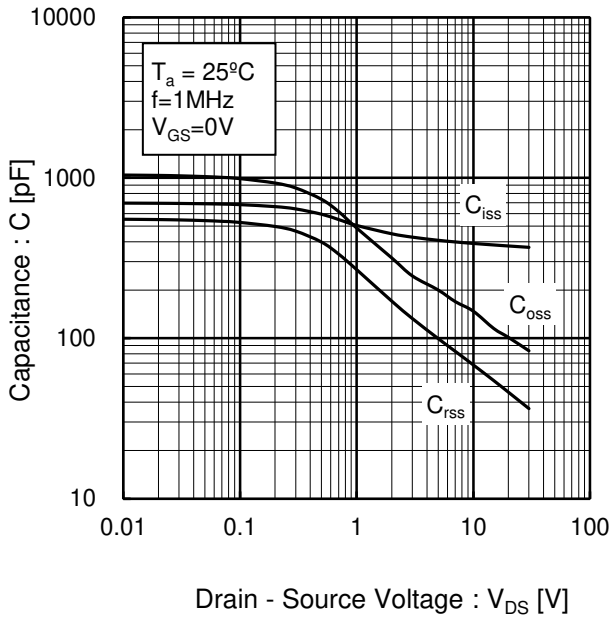


Fig.19 Switching Characteristics

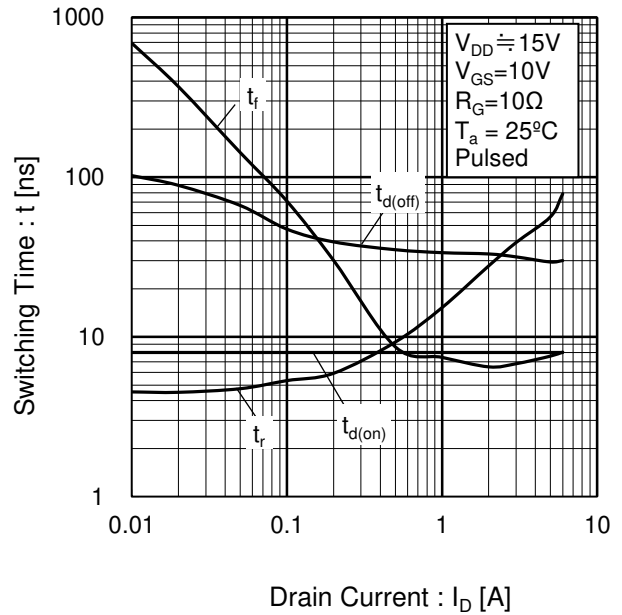


Fig.20 Dynamic Input Characteristics

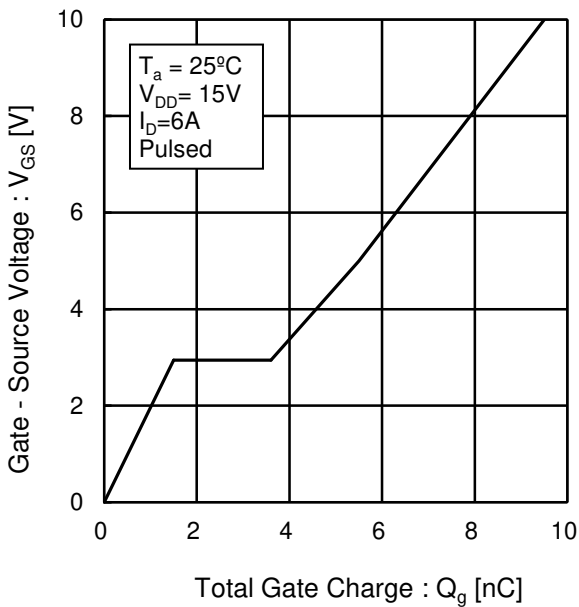
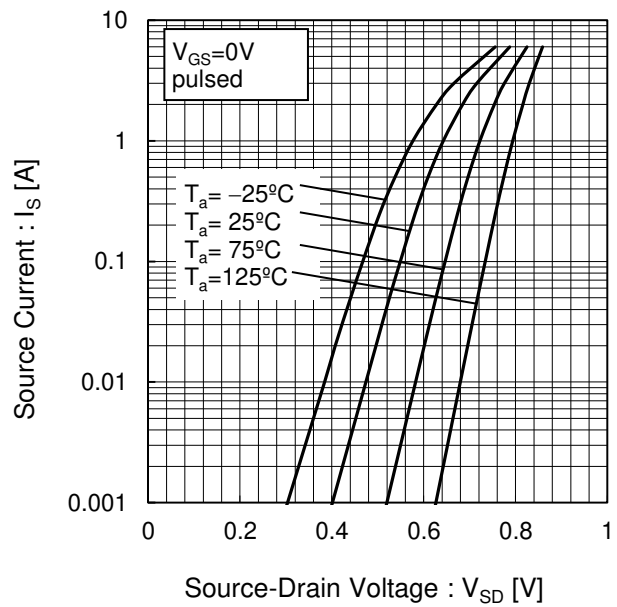


Fig.21 Source Current vs Source Drain Voltage



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

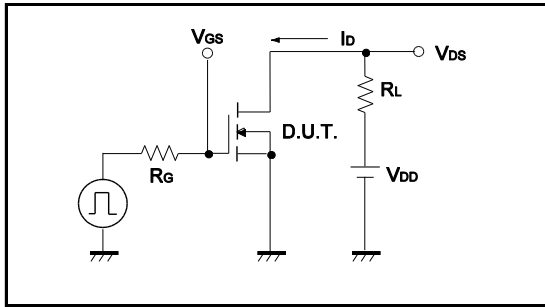


Fig.1-2 Switching Waveforms

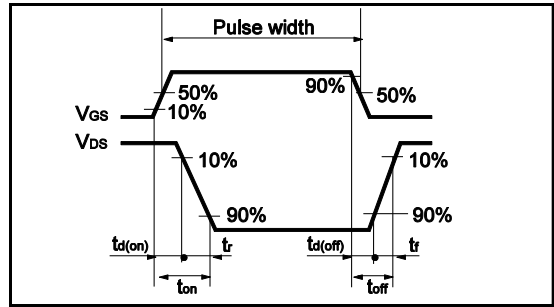


Fig.2-1 Gate Charge Measurement Circuit

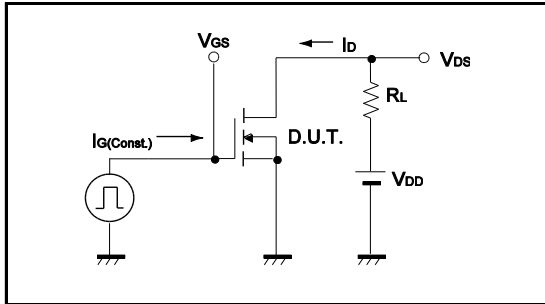
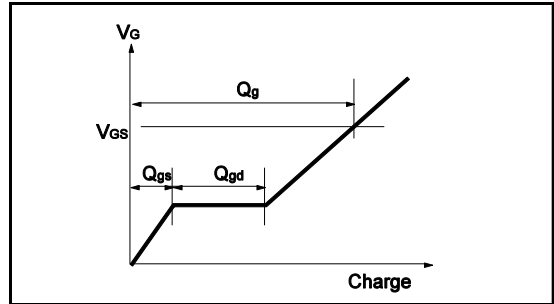
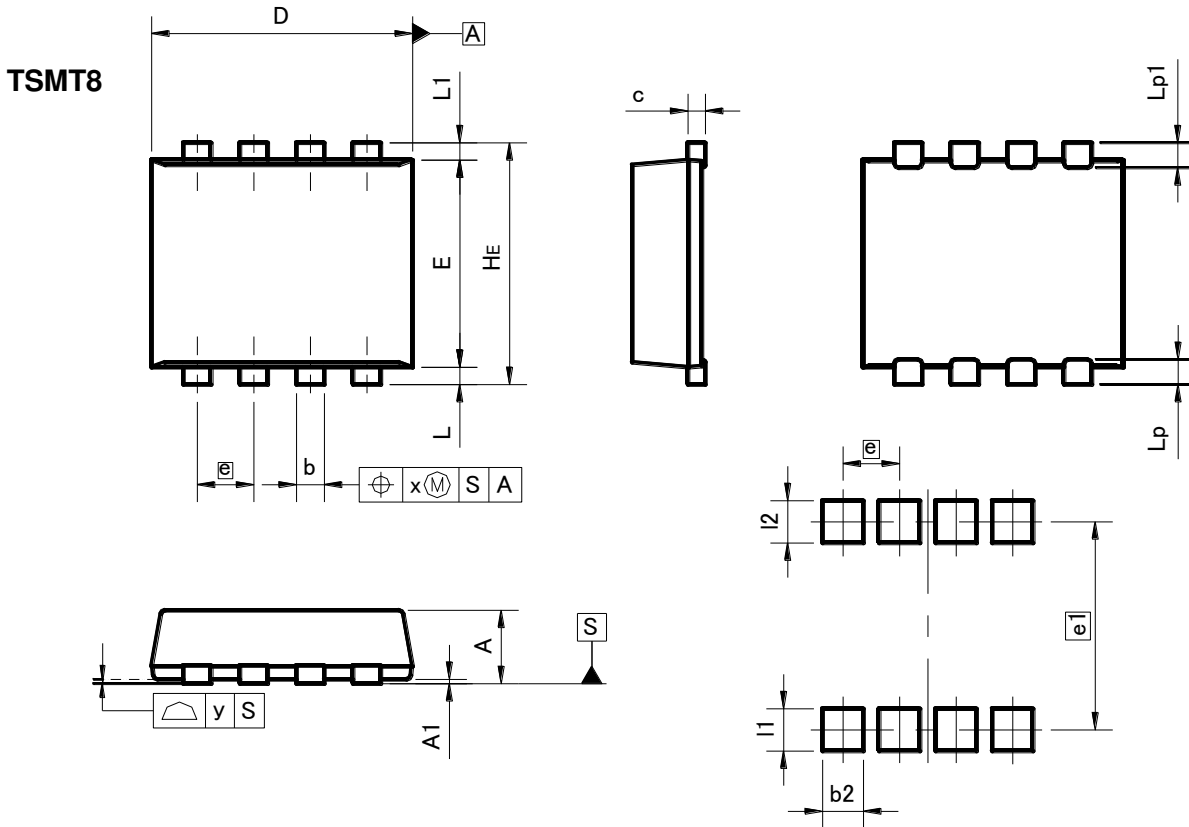


Fig.2-2 Gate Charge Waveform



●Dimensions (Unit : mm)



Pattern of terminal position areas

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.75	0.85	0.03	0.033
A1	0.00	0.05	0	0.002
b	0.27	0.37	0.011	0.015
c	0.12	0.22	0.005	0.009
D	2.90	3.10	0.114	0.122
E	2.30	2.50	0.091	0.098
e	0.65		0.03	
HE	2.70	2.90	0.106	0.114
L	0.10	0.30	0.004	0.012
L1	0.10	0.30	0.004	0.012
Lp	0.19	0.39	0.007	0.015
Lp1	0.19	0.39	0.007	0.015
x	-	0.10	-	0.004
y	-	0.10	-	0.004

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
e1	2.41		0.10	
b3	-	0.47	-	0.019
l1	-	0.49	-	0.019
l2	-	0.49	-	0.019

Dimension in mm/inches

Notes

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