

$V_{DSS}$	30V
$R_{DS(on)}$ (Max.)	50mΩ
$I_D$	3.5A
$P_D$	1.5W

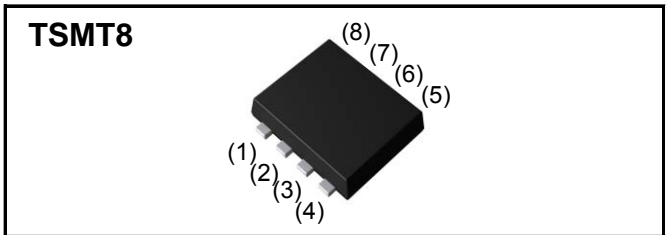
#### ●Features

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

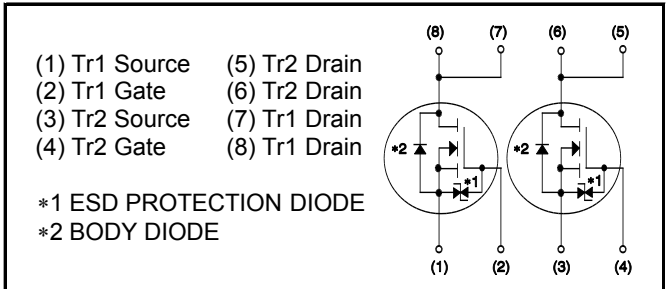
#### ●Application

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	K11

#### ●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	$I_D^{*1}$	±3.5	A
Pulsed drain current	$I_{D,pulse}^{*2}$	±12	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 $25^{\circ}C$	-	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 $25^{\circ}C$	-	-3.3	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*5}$	$V_{GS}=10V, I_D=3.5A$	-	35	50	mΩ
		$V_{GS}=4.5V, I_D=3.5A$	-	45	65	
		$V_{GS}4.0V, I_D=3.5A$	-	50	70	
		$V_{GS}=10V, I_D=3.5A, T_j=125^{\circ}C$	-	53	75	
Gate input resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	2	-	Ω
Transconductance	$g_{fs}^{*5}$	$V_{DS} = 10V, I_D = 3.5A$	2.2	4.4	-	S

\*1 Limited only by maximum temperature allowed.

\*2  $P_w \leq 10\mu s$ , 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	$C_{iss}$	$V_{GS} = 0V$	-	180	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 10V$	-	70	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	35	-	
Turn - on delay time	$t_{d(on)}^{*5}$	$V_{DD} \approx 15V, V_{GS} = 10V$	-	10	-	ns
Rise time	$t_r^{*5}$	$I_D = 1.7A$	-	25	-	
Turn - off delay time	$t_{d(off)}^{*5}$	$R_L = 8.87\Omega$	-	25	-	
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	$Q_g^{*5}$	$V_{DD} \approx 15V, I_D = 3.5A$ $V_{GS} = 5V$	-	3.3	-	nC
		$V_{DD} \approx 15V, I_D = 3.5A$ $V_{GS} = 10V$	-	7	-	
Gate - Source charge	$Q_{gs}^{*5}$	$V_{DD} \approx 15V, I_D = 3.5A$	-	1.0	-	
Gate - Drain charge	$Q_{gd}^{*5}$	$V_{GS} = 5V$	-	1.0	-	

●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	A
Forward voltage	$V_{SD}^{*5}$	$V_{GS} = 0V, I_s = 3.5A$	-	-	1.2	V

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

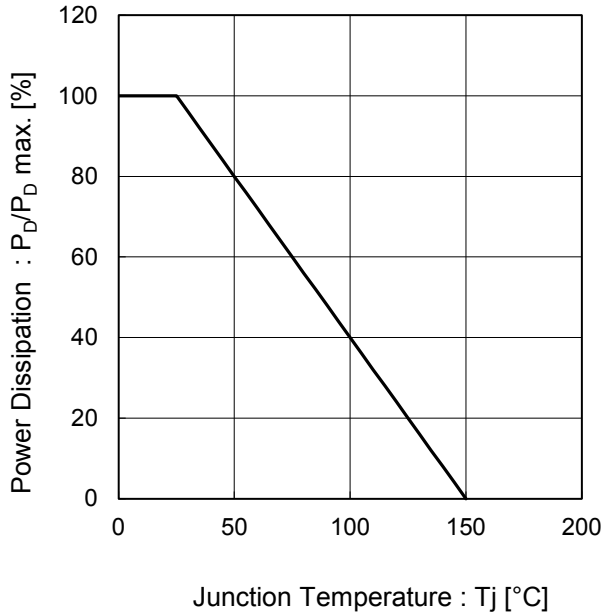


Fig.2 Maximum Safe Operating Area

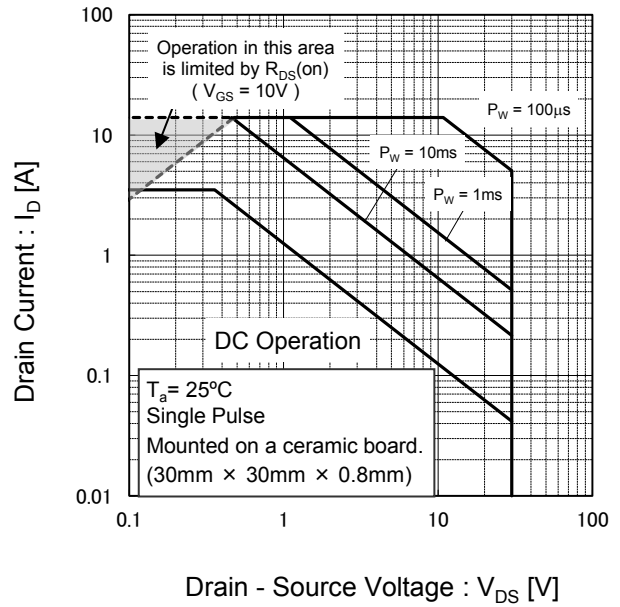


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

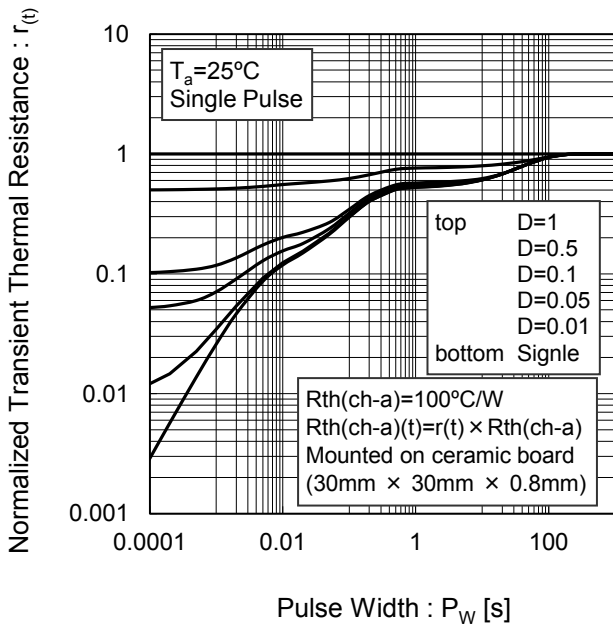
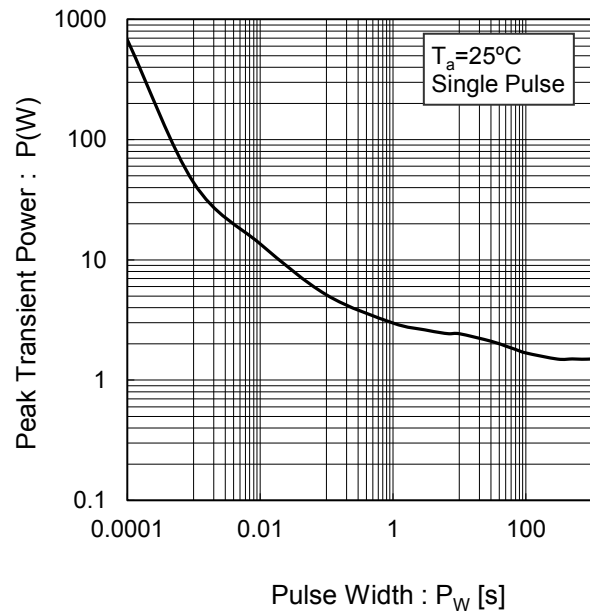


Fig.4 Single Pulse Maximum Power dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

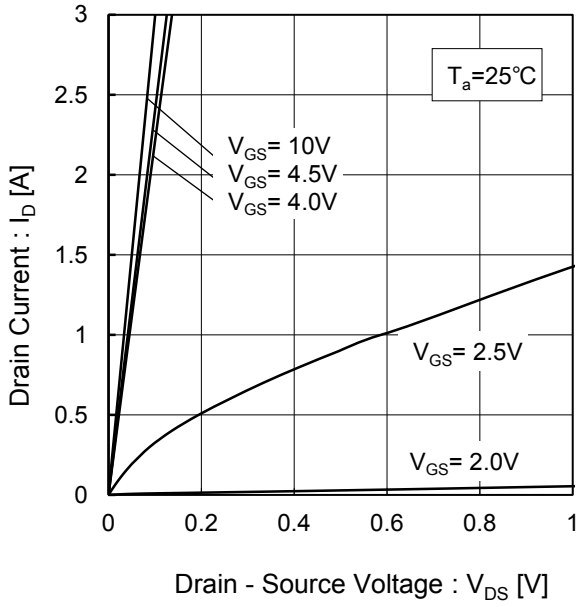
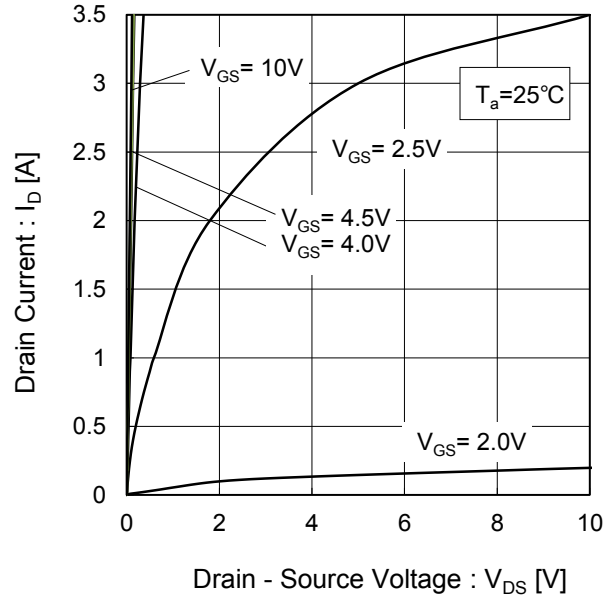


Fig.6 Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.7 Breakdown Voltage vs. Junction Temperature

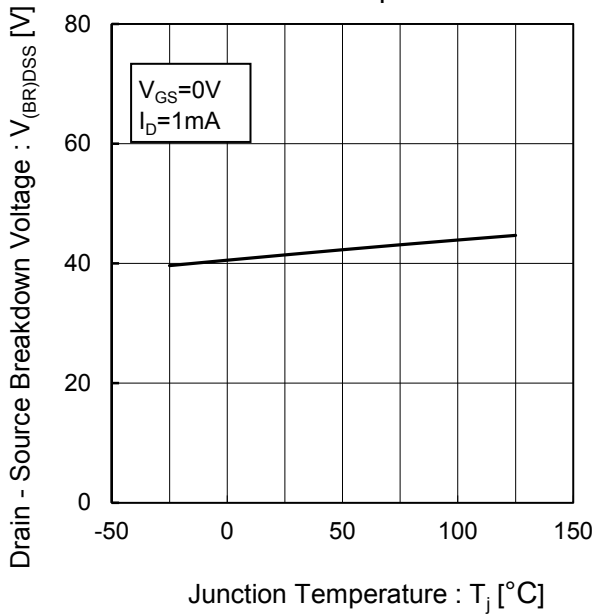


Fig.8 Typical Transfer Characteristics

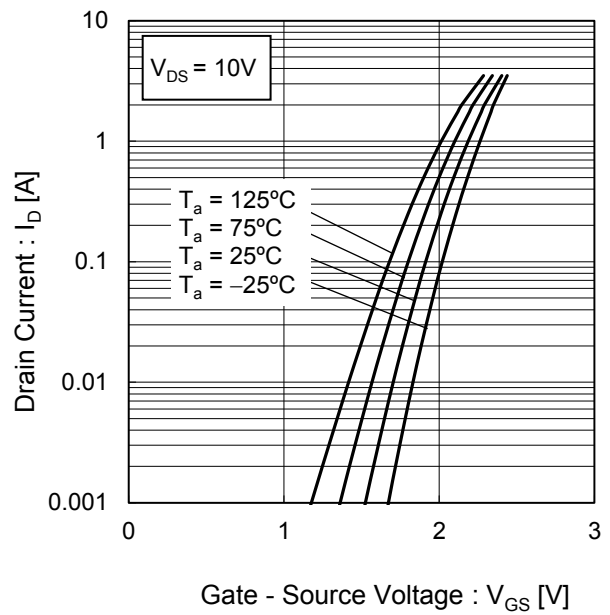


Fig.9 Gate Threshold Voltage vs. Junction Temperature

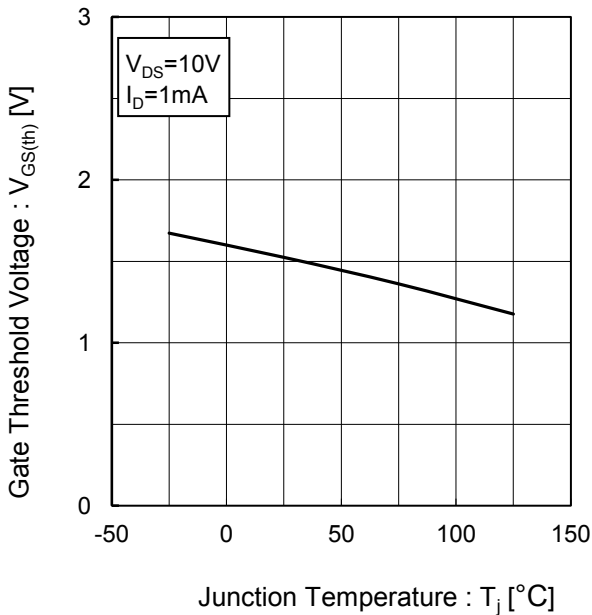
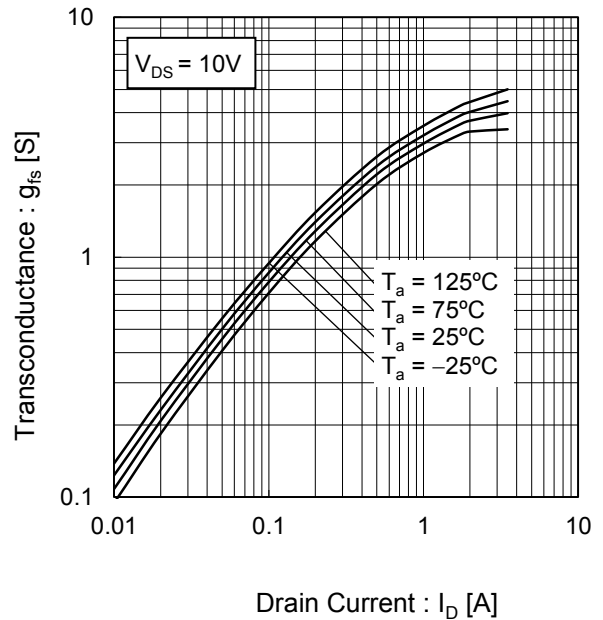


Fig.10 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.11 Drain Current Derating Curve

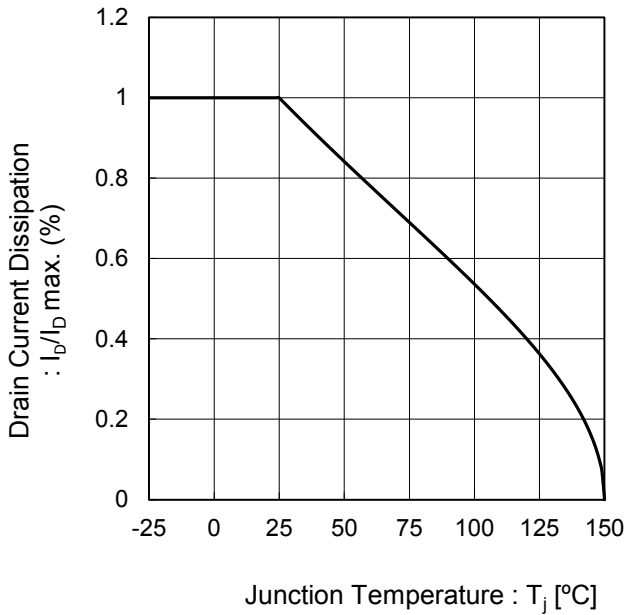


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

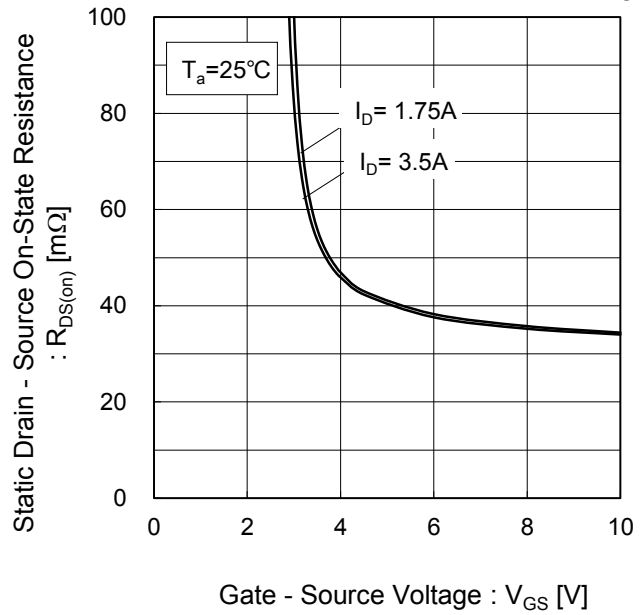


Fig.13 Static Drain - Source On - State Resistance vs. Drain Current(I)

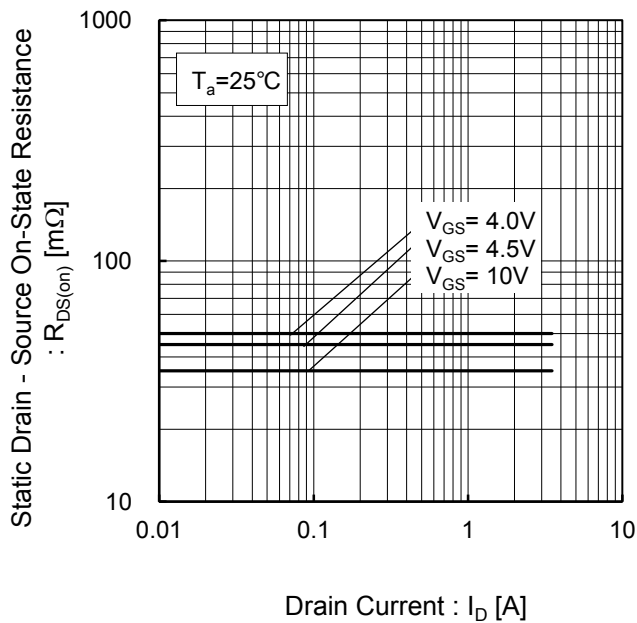
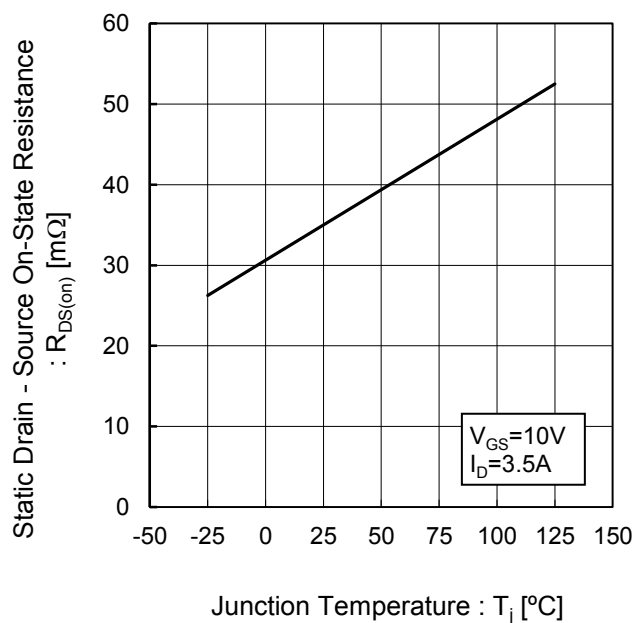


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

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

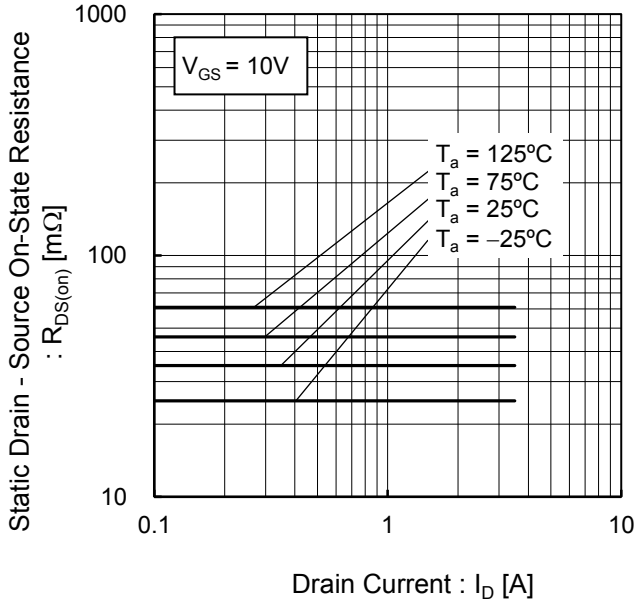


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current(III)

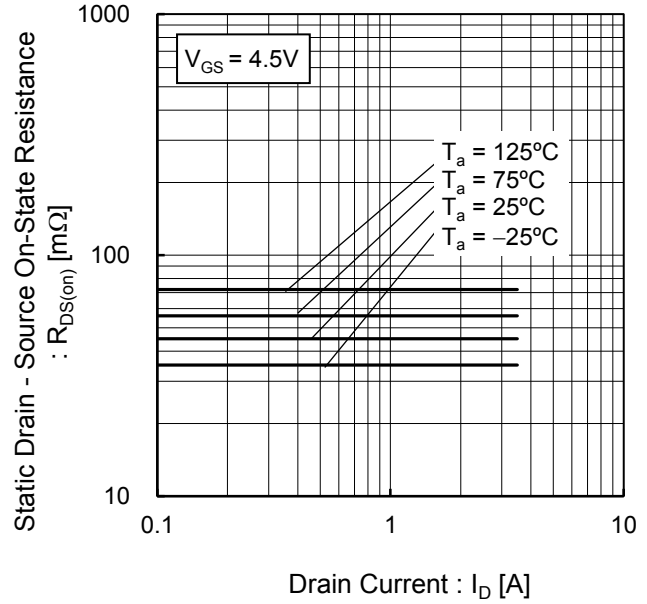
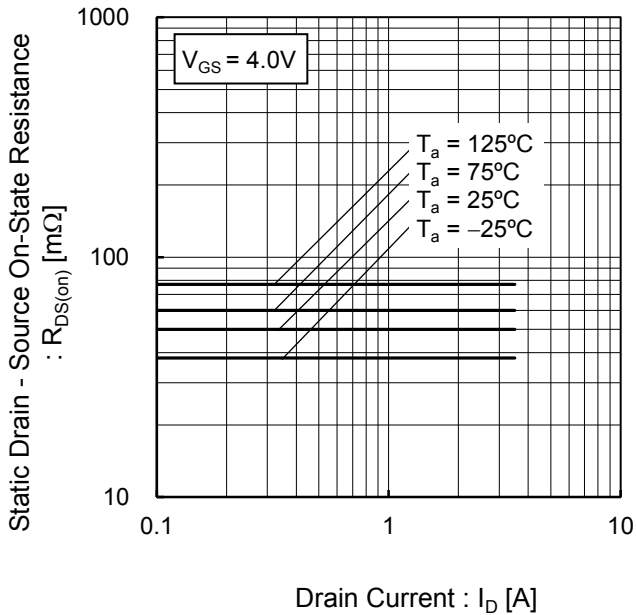


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)





●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

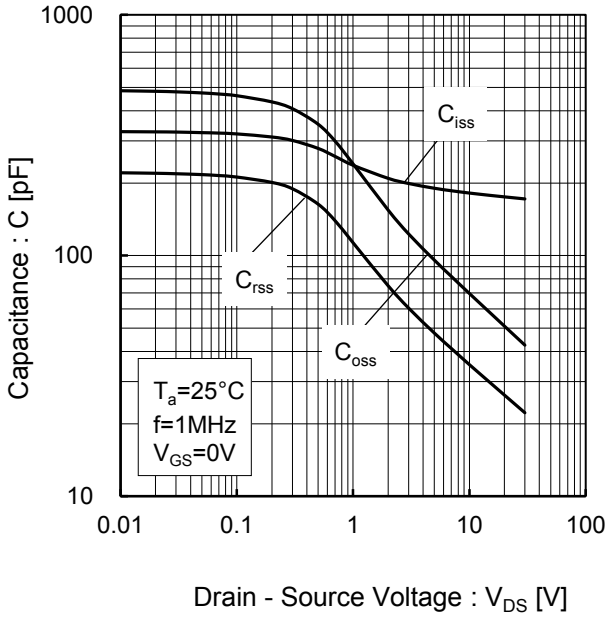


Fig.19 Switching Characteristics

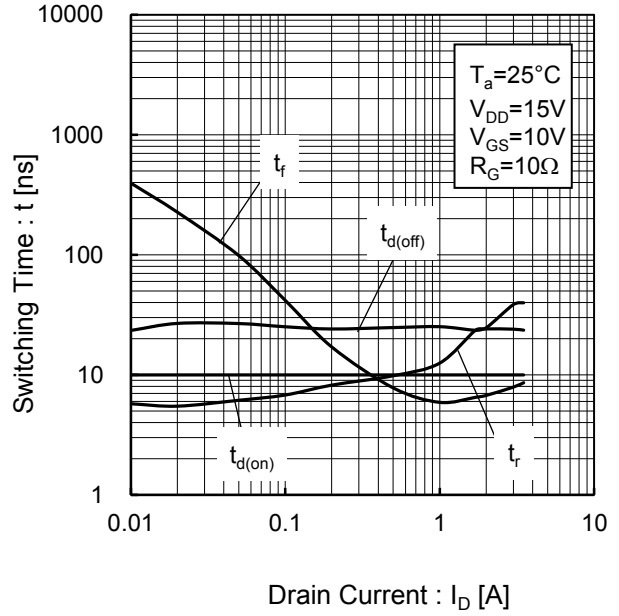


Fig.20 Dynamic Input Characteristics

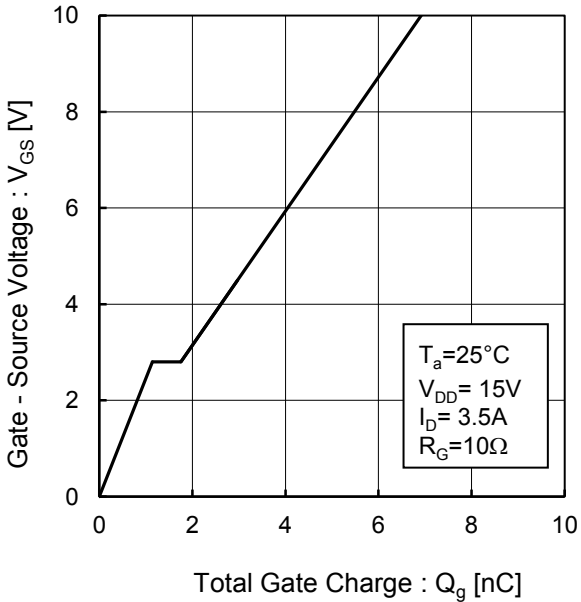
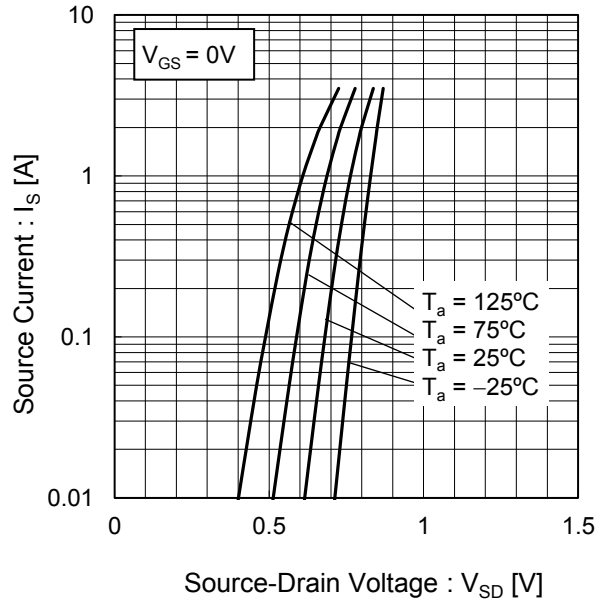


Fig.21 Source Current vs. Source Drain Voltage



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

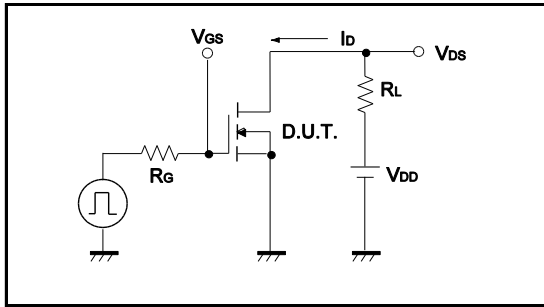


Fig.1-2 Switching Waveforms



Fig.2-1 Gate Charge Measurement Circuit

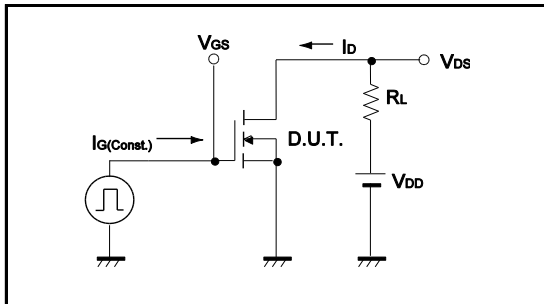
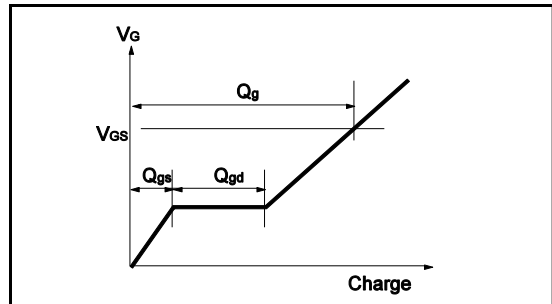
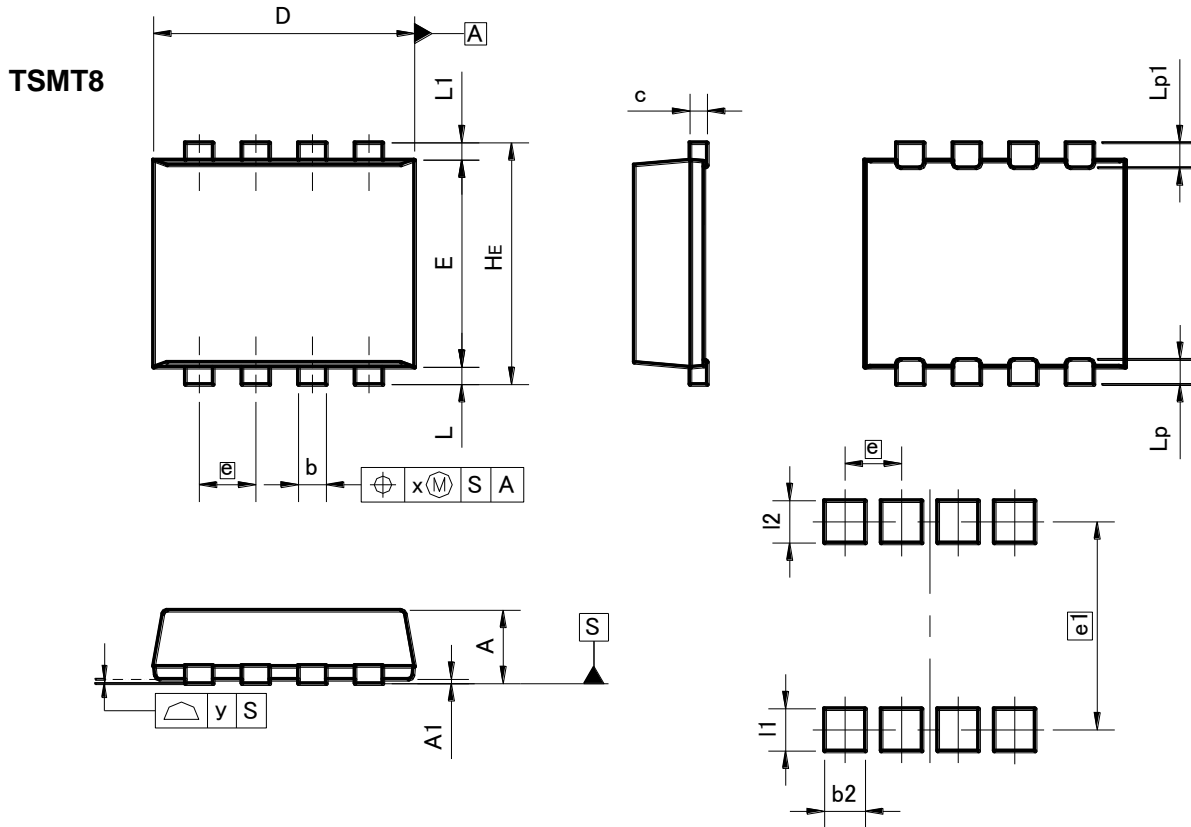


Fig.2-2 Gate Charge Waveform



●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

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