

$V_{DSS}$	-12V
$R_{DS(on)}$ (Max.)	105mΩ
$I_D$	-2A
$P_D$	1.25W

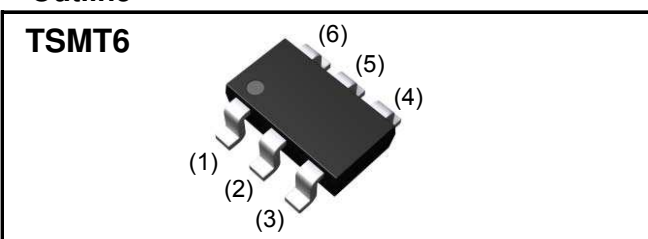
### ●Features

- 1) Low on - resistance.
- 2) Built-in G-S Protection Diode.
- 3) Small Surface Mount Package (TSMT6).
- 4) Pb-free lead plating ; RoHS compliant

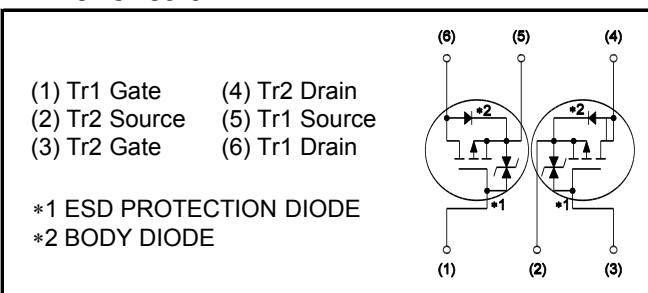
### ●Application

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	J11

### ●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	$V_{DSS}$	-12	V
Continuous drain current	$I_D^{*1}$	±2	A
Pulsed drain current	$I_{D,pulse}^{*2}$	±8	A
Gate - Source voltage	$V_{GSS}$	±10	V
Power dissipation	$P_D^{*3}$	1.25	W
	$P_D^{*4}$	0.6	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	$R_{thJA}^{*3}$	-	-	100	°C/W
Thermal resistance, junction - ambient	$R_{thJA}^{*4}$	-	-	208	°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	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = -1mA$	-12	-	-	V
Breakdown voltage temperature coefficient	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	$I_D = -1mA$ referenced to 25°C	-	-17	-	mV/°C
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = -12V, V_{GS} = 0V$	-	-	-1	μA
Gate - Source leakage current	$I_{GSS}$	$V_{GS} = \pm 10V, V_{DS} = 0V$	-	-	±10	μA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = -6V, I_D = -1mA$	-0.3	-	-1.0	V
Gate threshold voltage temperature coefficient	$\frac{\Delta V_{(GS)th}}{\Delta T_j}$	$I_D = -1mA$ referenced to 25°C	-	2.4	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*5}$	$V_{GS} = -4.5V, I_D = -2A, T_j = 25^{\circ}C$	-	75	105	mΩ
		$V_{GS} = -2.5V, I_D = -1A, T_j = 25^{\circ}C$	-	105	145	
		$V_{GS} = -1.8V, I_D = -1A, T_j = 25^{\circ}C$	-	150	225	
		$V_{GS} = -4.5V, I_D = -2A, T_j = 25^{\circ}C$	-	200	400	
		$V_{GS} = -10V, I_D = -9A, T_j = 125^{\circ}C$	-	120	170	
Gate input resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	3	-	Ω
Transconductance	$g_{fs}^{*5}$	$V_{DS} = -6V, I_D = -2A$	2.0	4.8	-	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 (15×20×0.8mm)

\*5 Pulsed

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

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V	-	770	-	pF
Output capacitance	C <sub>oss</sub>	V <sub>DS</sub> = -6V	-	75	-	
Reverse transfer capacitance	C <sub>rss</sub>	f = 1MHz	-	60	-	
Turn - on delay time	t <sub>d(on)</sub> <sup>*5</sup>	V <sub>DD</sub> ≈ -6V, V <sub>GS</sub> = -4.5V	-	10	-	ns
Rise time	t <sub>r</sub> <sup>*5</sup>	I <sub>D</sub> = -1A	-	17	-	
Turn - off delay time	t <sub>d(off)</sub> <sup>*5</sup>	R <sub>L</sub> = 6Ω	-	65	-	
Fall time	t <sub>f</sub> <sup>*5</sup>	R <sub>GS</sub> = 10Ω	-	35	-	

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

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q <sub>g</sub> <sup>*5</sup>	V <sub>DD</sub> ≈ -6V, I <sub>D</sub> = -2A V <sub>GS</sub> = -4.5V	-	6.5	-	nC
Gate - Source charge	Q <sub>gs</sub> <sup>*5</sup>	V <sub>DD</sub> ≈ -6V, I <sub>D</sub> = -2A	-	1.3	-	
Gate - Drain charge	Q <sub>gd</sub> <sup>*5</sup>	V <sub>GS</sub> = -4.5V	-	0.8	-	

●Body diode electrical characteristics (Source-Drain)(T<sub>a</sub> = 25°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 <sub>s</sub> <sup>*1</sup>	T <sub>a</sub> = 25°C	-	-	-0.75	A
Forward voltage	V <sub>SD</sub> <sup>*5</sup>	V <sub>GS</sub> = 0V, I <sub>s</sub> = -2A	-	-	-1.2	V

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

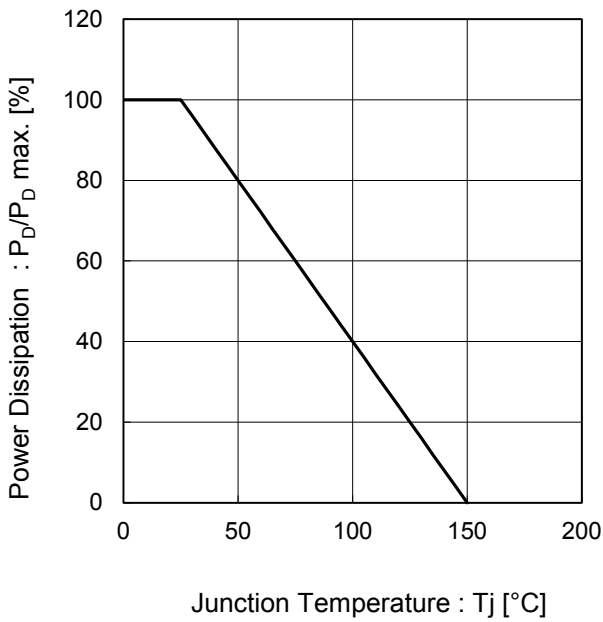


Fig.2 Maximum Safe Operating Area

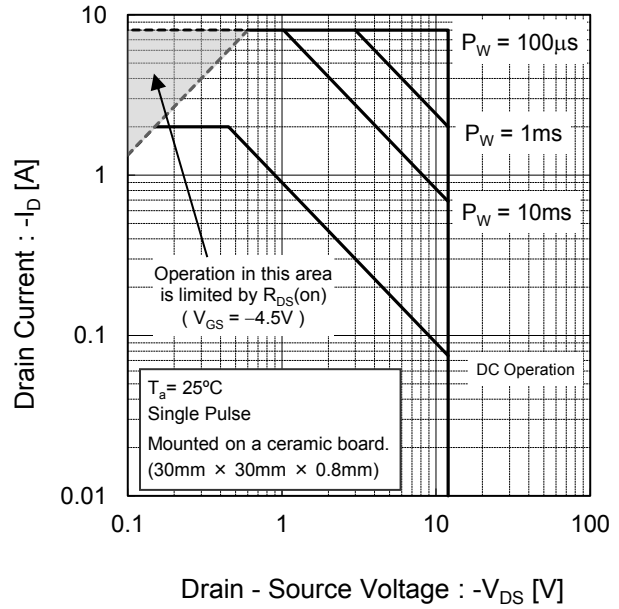


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

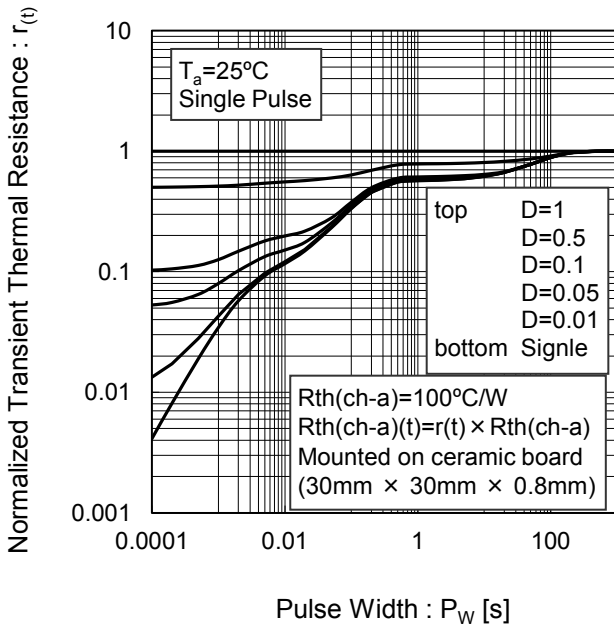
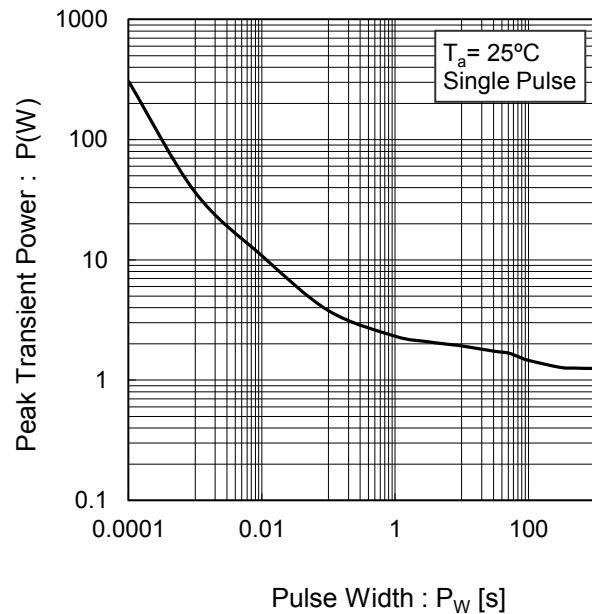


Fig.4 Single Pulse Maximum Power dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

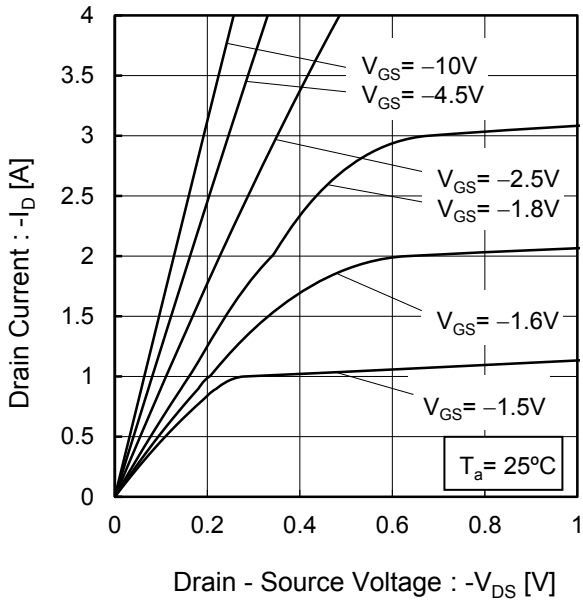
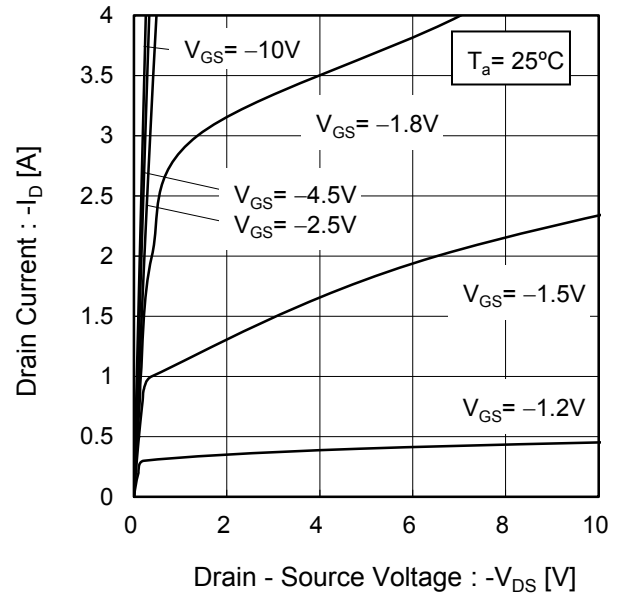


Fig.6 Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.7 Breakdown Voltage vs. Junction Temperature

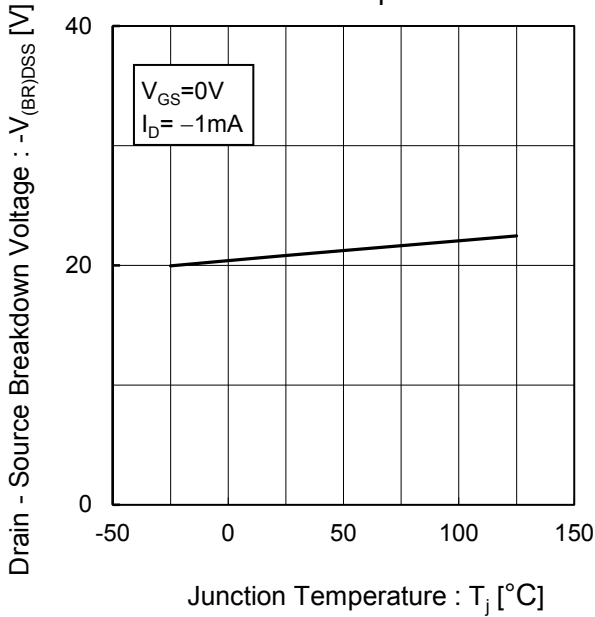


Fig.8 Typical Transfer Characteristics

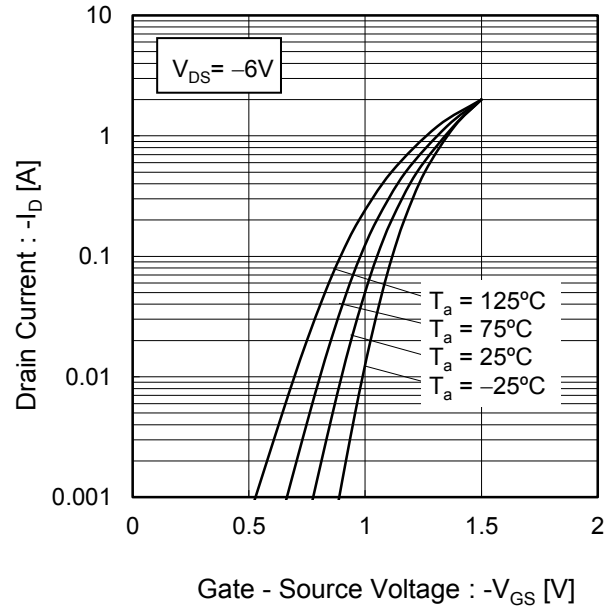


Fig.9 Gate Threshold Voltage vs. Junction Temperature

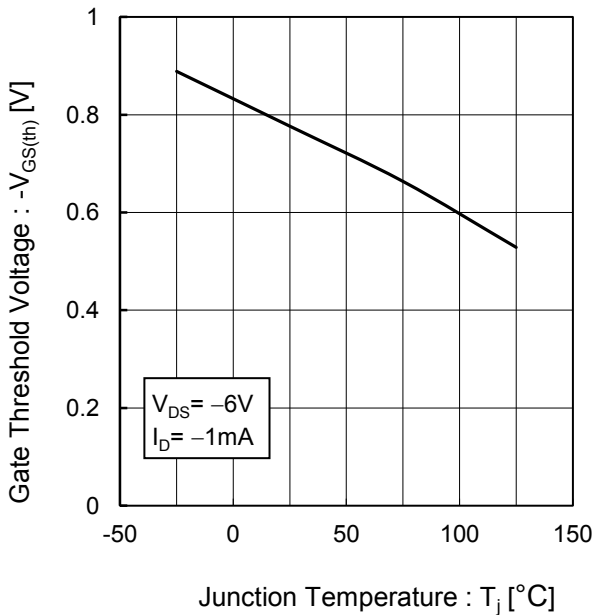
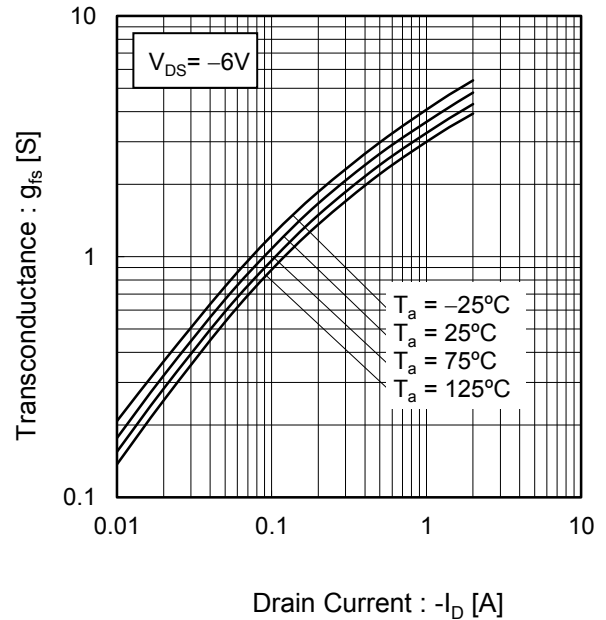


Fig.10 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.11 Drain Current Derating Curve

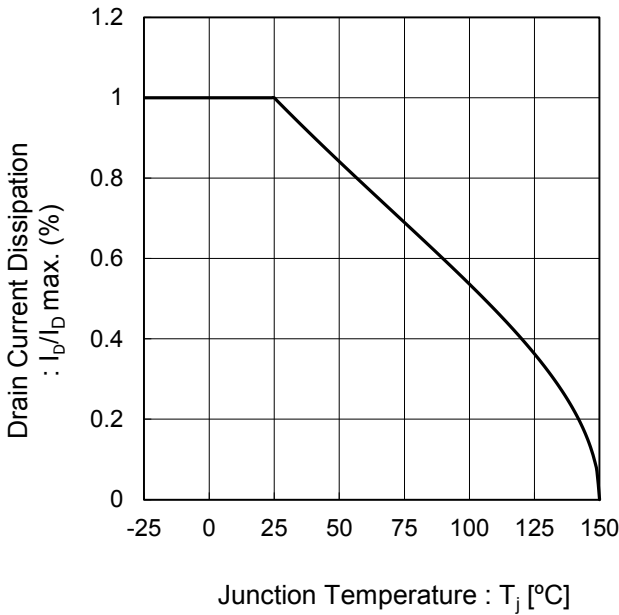


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

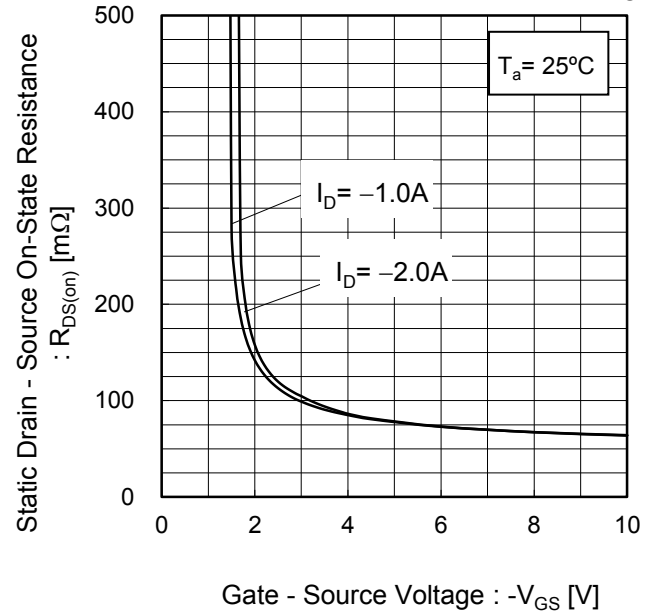


Fig.13 Static Drain - Source On - State Resistance vs. Drain Current(I)

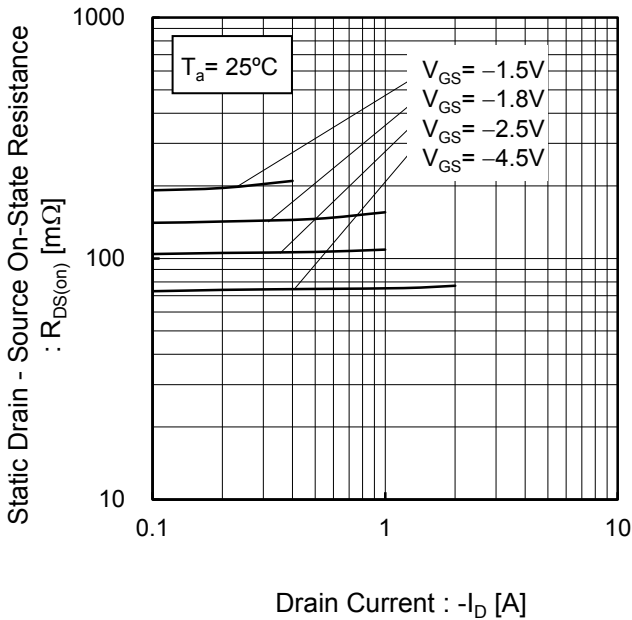
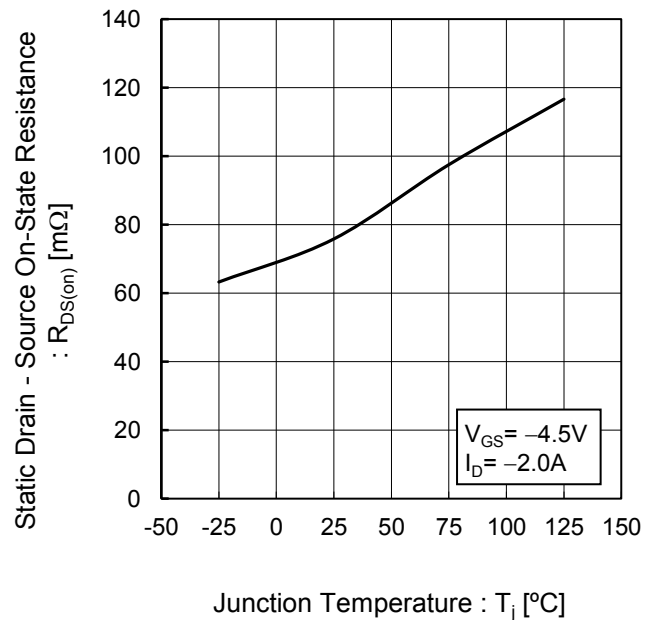


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

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

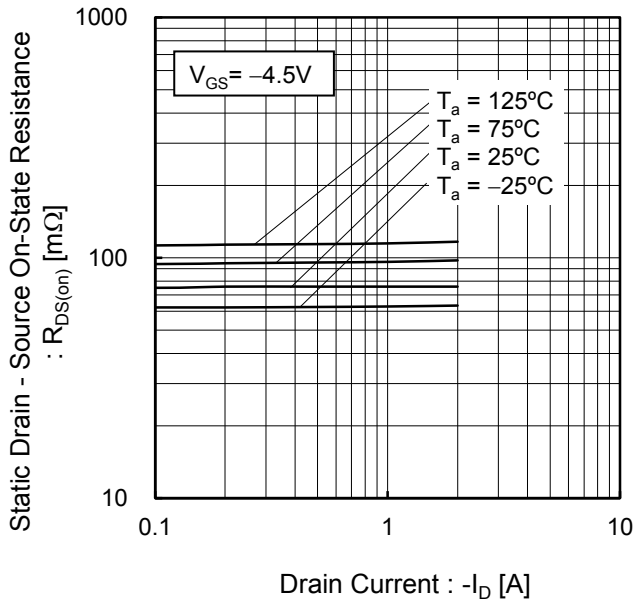


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current(III)

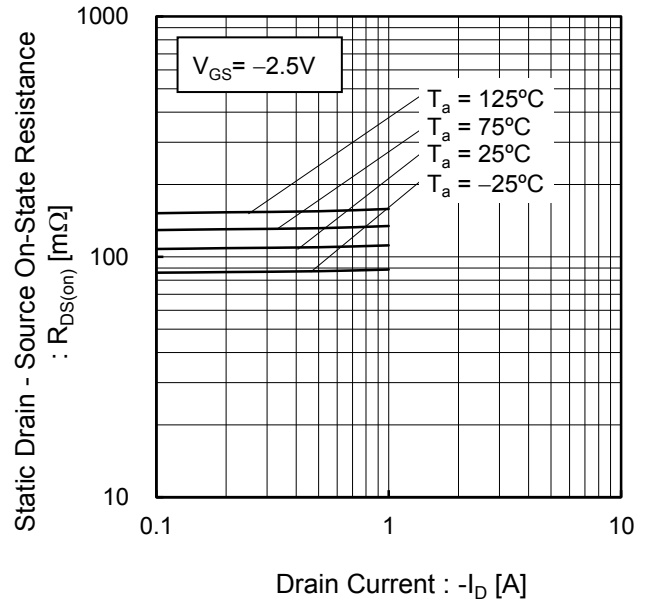
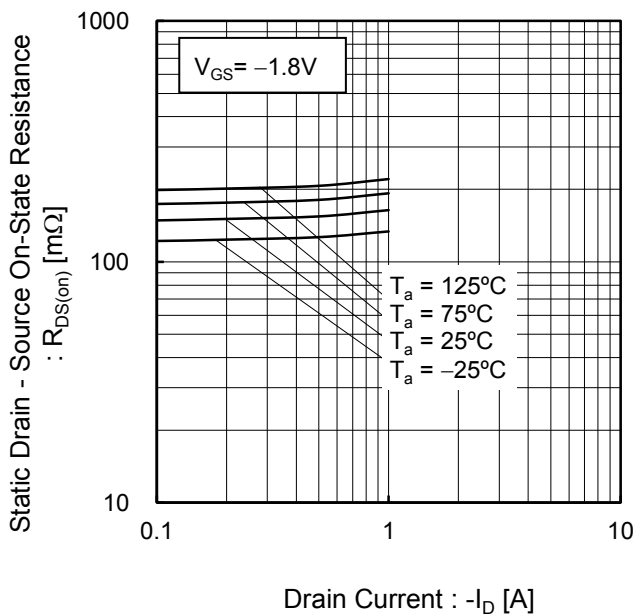


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)





●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

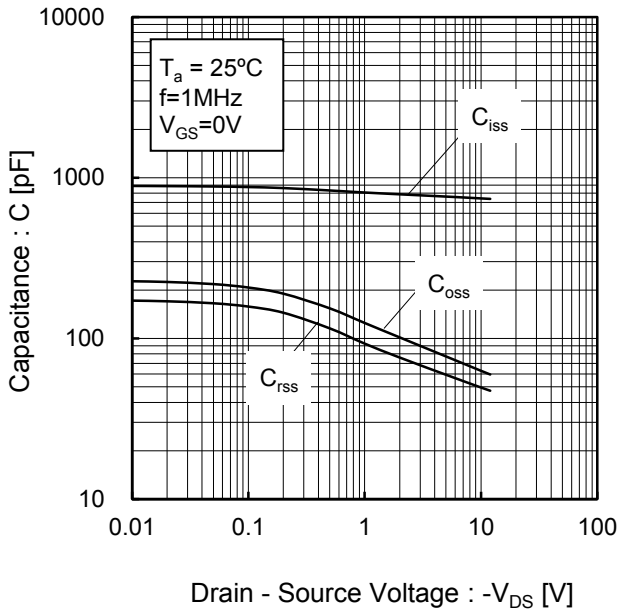


Fig.19 Switching Characteristics

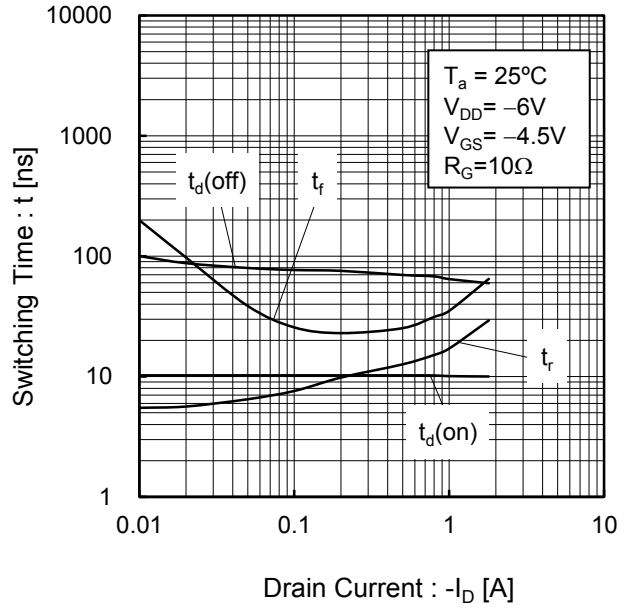


Fig.20 Dynamic Input Characteristics

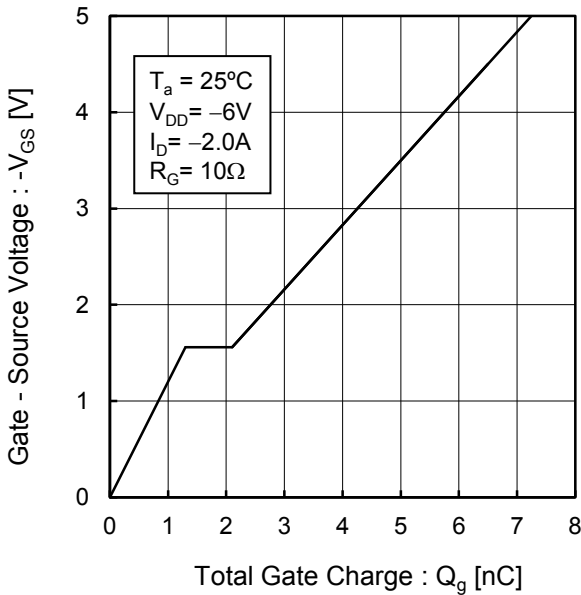
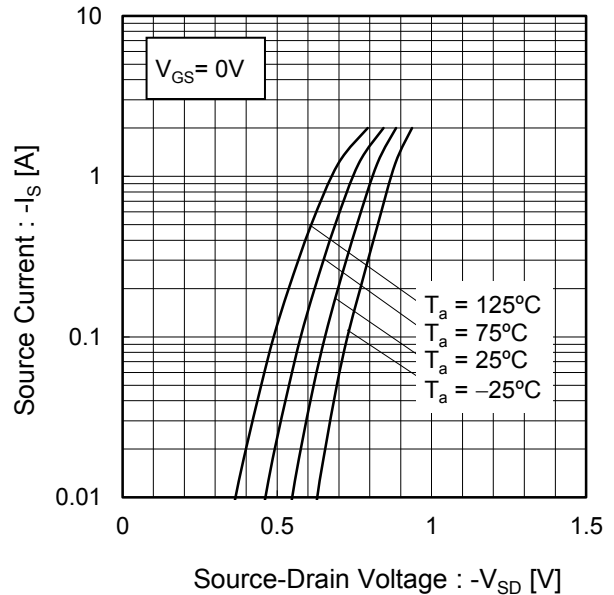


Fig.21 Source Current vs. Source Drain Voltage



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

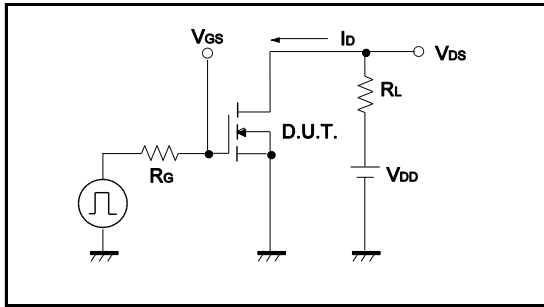


Fig.1-2 Switching Waveforms

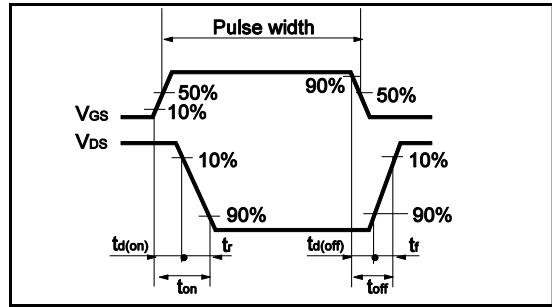


Fig.2-1 Gate Charge Measurement Circuit

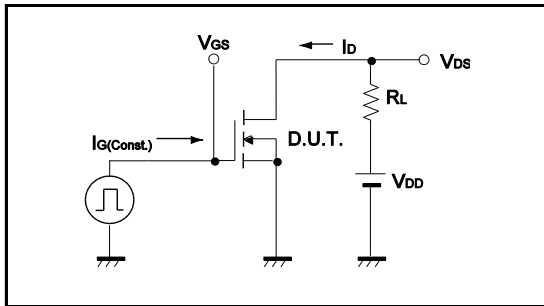
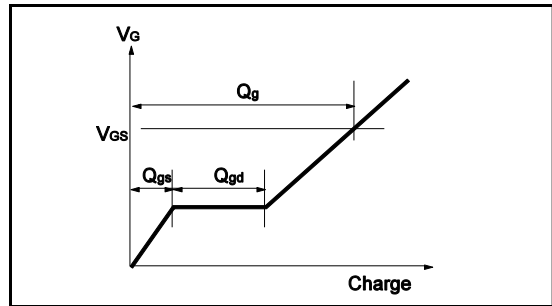
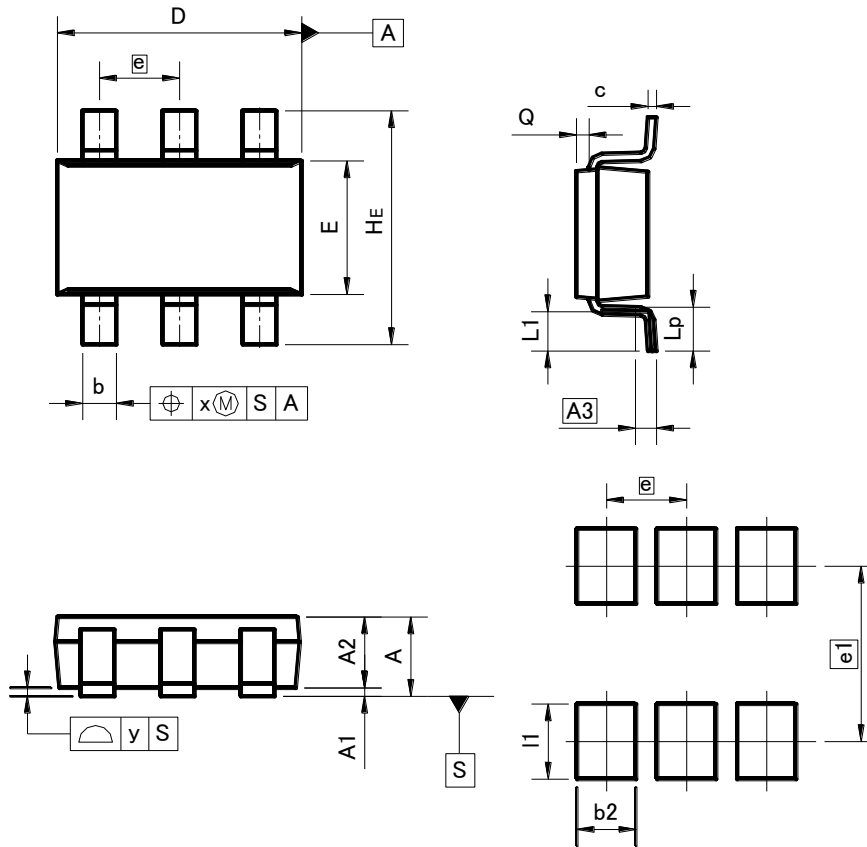


Fig.2-2 Gate Charge Waveform



●Dimensions (Unit : mm)

TSMT6



**Pattern of terminal position areas**

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	-	1.00	-	0.039
A1	0.00	0.10	0	0.004
A2	0.75	0.95	0.03	0.037
A3	0.25		0.01	
b	0.35	0.50	0.014	0.02
c	0.10	0.26	0.004	0.01
D	2.80	3.00	0.11	0.118
E	1.50	1.80	0.059	0.071
e	0.95		0.04	
HE	2.60	3.00	0.102	0.118
L1	0.30	0.60	0.012	0.024
Lp	0.40	0.70	0.016	0.028
Q	0.05	0.25	0.002	0.01
x	-	0.20	-	0.008
y	-	0.10	-	0.004

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
e1	2.10		0.08	
b2	-	0.70	-	0.028
I1	-	0.90	-	0.035

Dimension in mm/inches

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