

V_{DSS}	-12V
$R_{DS(on)}(Max.)$	43mΩ
I_D	±3.5A
P_D	1.5W

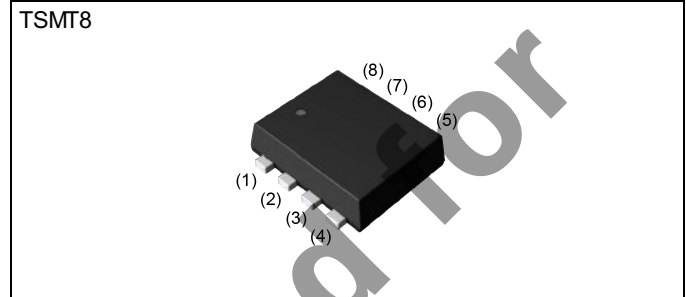
●Features

- 1) Low on - resistance.
- 2) -1.5V Drive.
- 3) Built-in G-S protection diode.
- 4) Small surface mount package(TSMT8)
- 5) Pb-free lead plating ; RoHS compliant

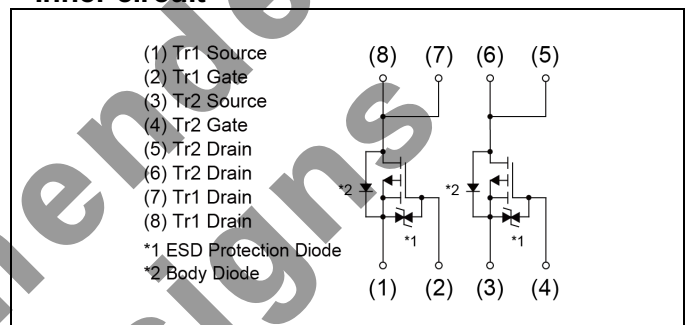
●Application

Switching

●Outline



●Inner circuit



●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	180
	Tape width (mm)	8
	Basic ordering unit (pcs)	3000
	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	±3.5	A
Pulsed drain current		$I_{D,pulse}^{*1}$	±12	A
Gate - Source voltage		V_{GSS}	0~-8	V
Power dissipation	total	P_D^{*2}	1.5	W
	element		1.25	
	total	P_D^{*3}	0.7	
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	total	R_{thJA}^{*2}	-	-	83.3	°C/W
	element		-	-	100	
	total	R_{thJA}^{*3}	-	-	178	

●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.	
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	-	-5.0	-	mV/°C
Zero gate voltage drain current	I_{DSS}	$V_{DS} = -12V, V_{GS} = 0V$	-	-	-10	μA
Gate - Source leakage current	I_{GSS}	$V_{DS} = 0V, V_{GS} = -8V$	-	-	-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	-	2.7	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*4}$	$V_{GS} = -4.5V, I_D = -3.5A$	-	31	43	mΩ
		$V_{GS} = -2.5V, I_D = -1.7A$	-	41	57	
		$V_{GS} = -1.8V, I_D = -1.7A$	-	55	82	
		$V_{GS} = -1.5V, I_D = -0.7A$	-	75	150	
Gate input resistance	R_G	$f = 1MHz, \text{open drain}$	-	10	-	Ω
Forward Transfer Admittance	$ Y_{fs} ^{*4}$	$V_{DS} = -6V, I_D = -3.5A$	5	-	-	S

● **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}	$V_{GS} = 0V$	-	2600	-	pF
Output capacitance	C_{oss}	$V_{DS} = -6V$	-	170	-	
Reverse transfer capacitance	C_{rss}	$f = 1\text{MHz}$	-	150	-	
Turn - on delay time	$t_{d(on)}^{*4}$	$V_{DD} \approx -6V, V_{GS} = -4.5V$	-	15	-	ns
Rise time	t_r^{*4}	$I_D = -1.7A$	-	30	-	
Turn - off delay time	$t_{d(off)}^{*4}$	$R_L = 3.5\Omega$	-	170	-	
Fall time	t_f^{*4}	$R_G = 10\Omega$	-	60	-	

● **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^{*4}	$V_{DD} \approx -6V$	-	22	-	nC
Gate - Source charge	Q_{gs}^{*4}	$I_D = -3.5A$	-	3.8	-	
Gate - Drain charge	Q_{gd}^{*4}	$V_{GS} = -4.5V$	-	3.0	-	

● **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.	
Body diode continuous forward current	I_S	$T_a = 25^\circ\text{C}$	-	-	-1	A
Body diode pulse current	I_{SP}^{*1}		-	-	-12	
Forward voltage	V_{SD}^{*4}	$V_{GS} = 0V, I_S = -3.5A$	-	-	-1.2	V

*1 $P_w \leq 10\mu s$, Duty cycle $\leq 1\%$

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

*3 Mounted on a FR4 (20×20×0.8mm)

*4 Pulsed

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

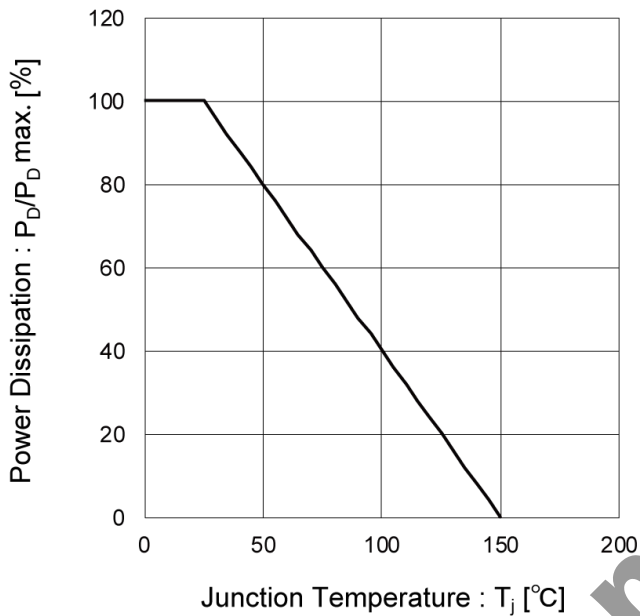


Fig.2 Maximum Safe Operating Area

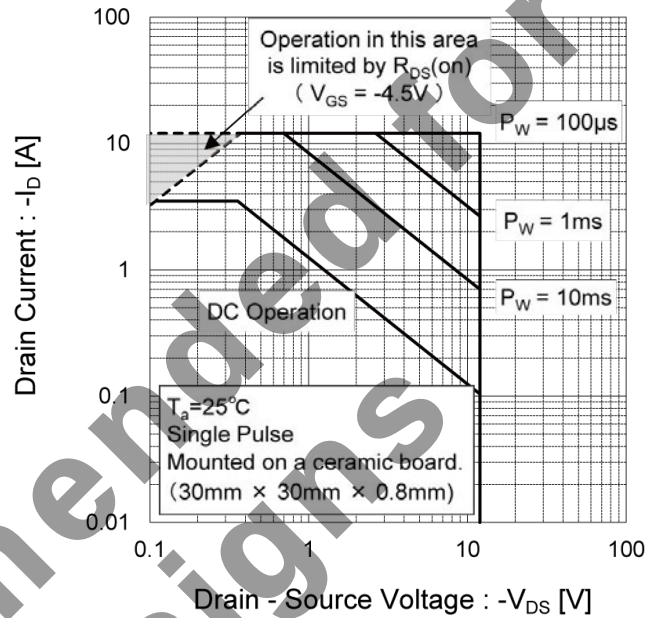


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

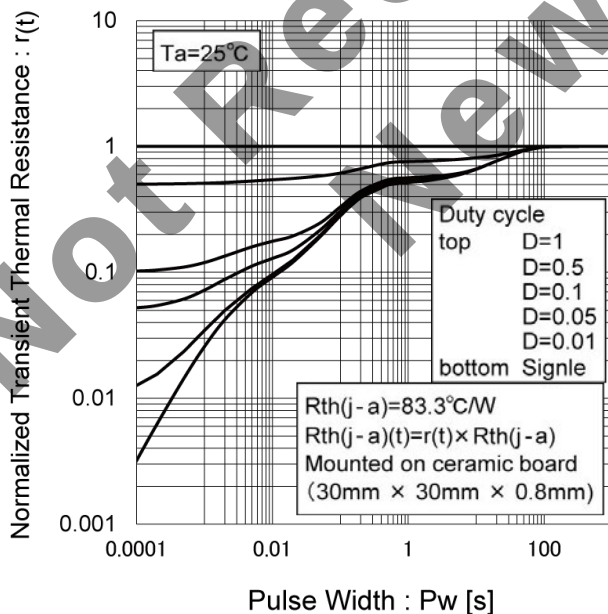
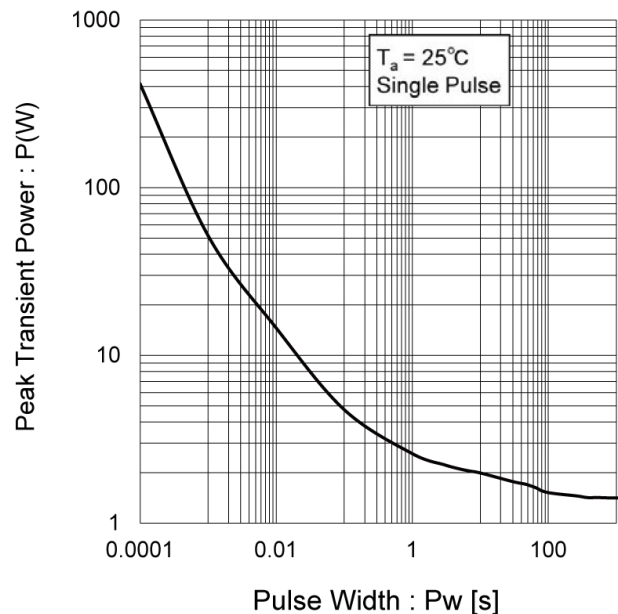


Fig.4 Single Pulse Maximum Power dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

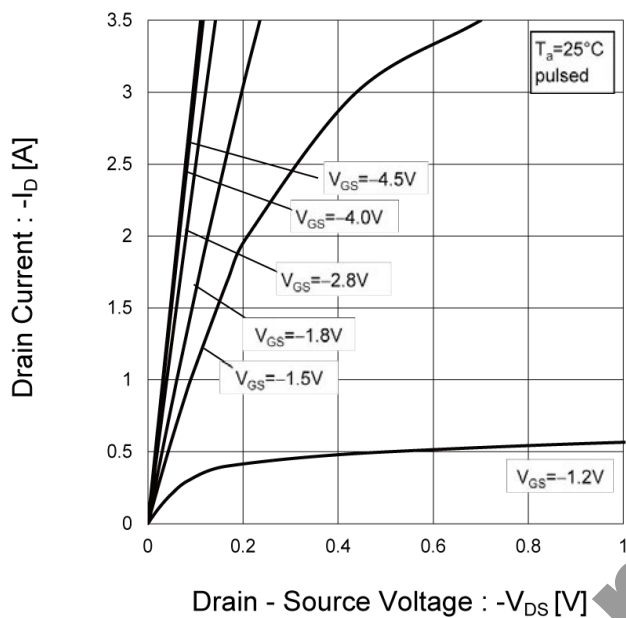


Fig.6 Typical Output Characteristics(II)

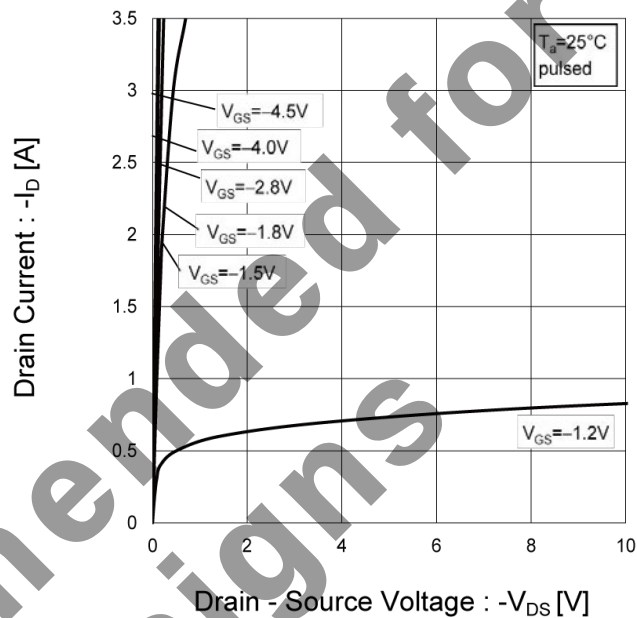


Fig.7 Breakdown Voltage vs. Junction Temperature

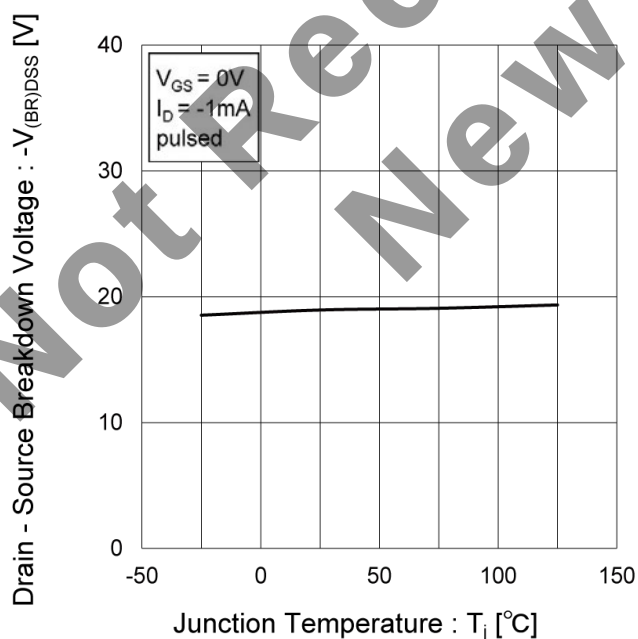
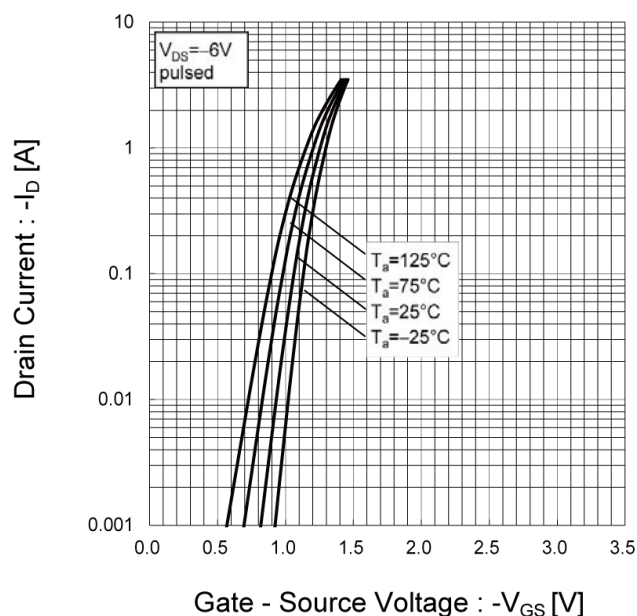


Fig.8 Typical Transfer Characteristics



●Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Junction Temperature

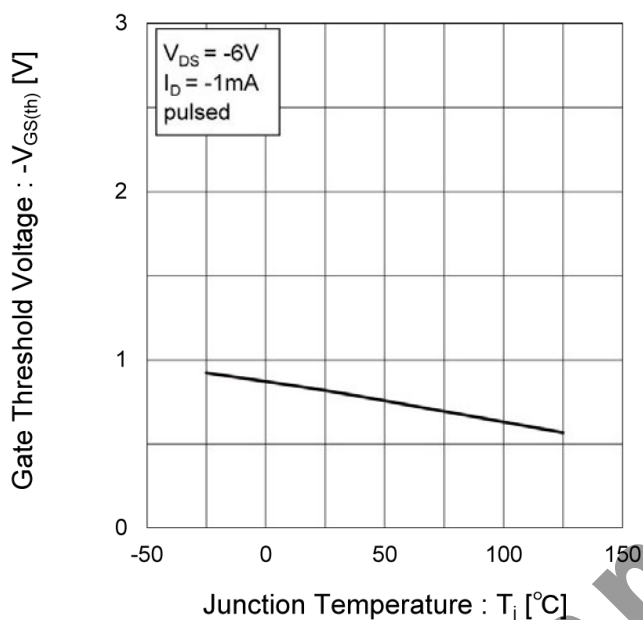


Fig.10 Forward Transfer Admittance vs. Drain Current

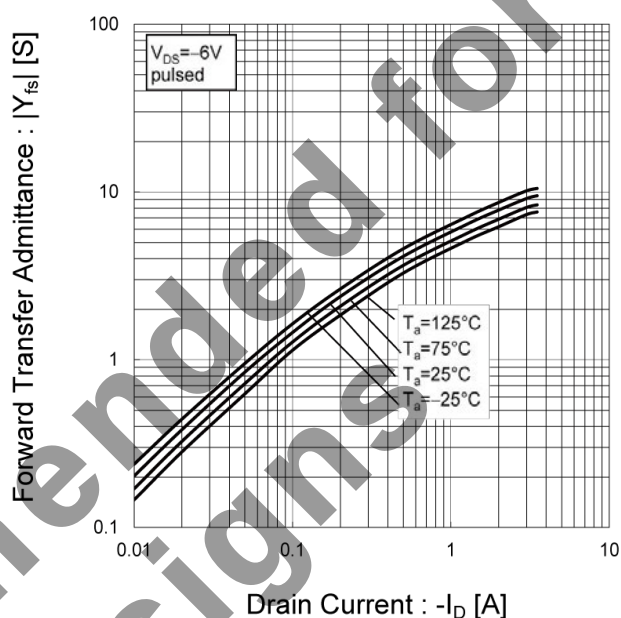


Fig.11 Drain Current Derating Curve

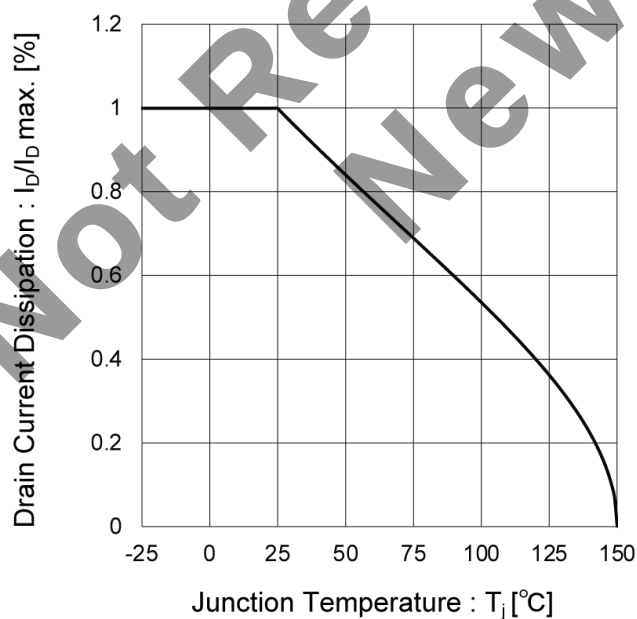
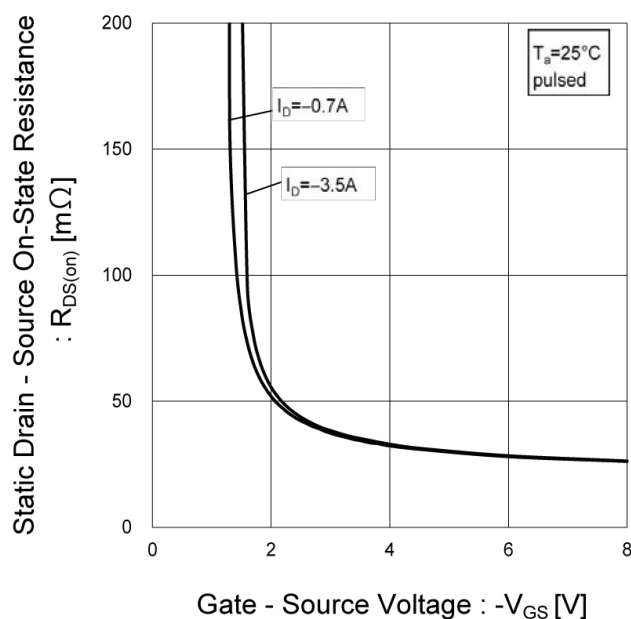


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage



●Electrical characteristic curves

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

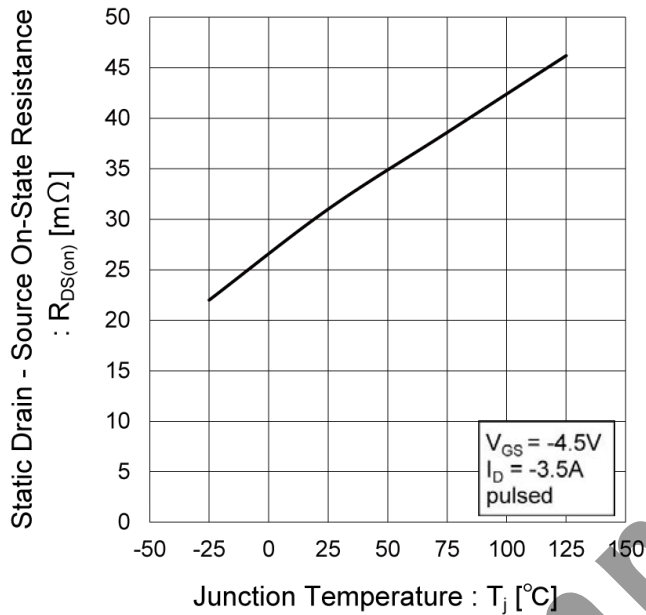
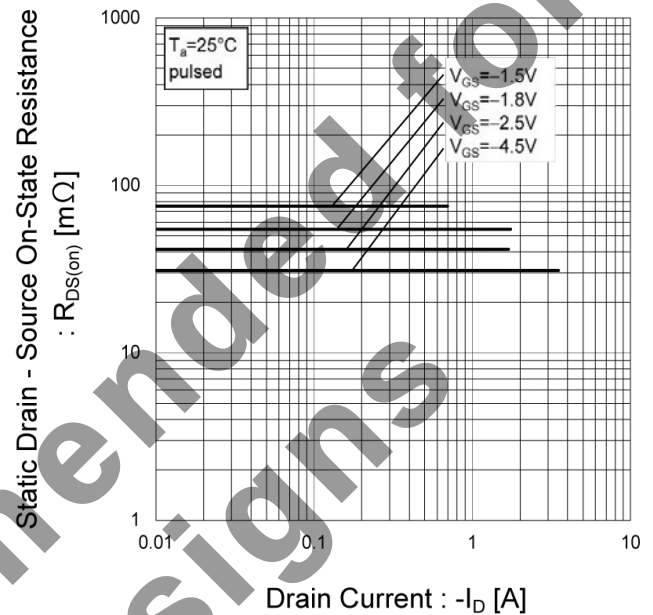


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current (I)



●Electrical characteristic curves

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

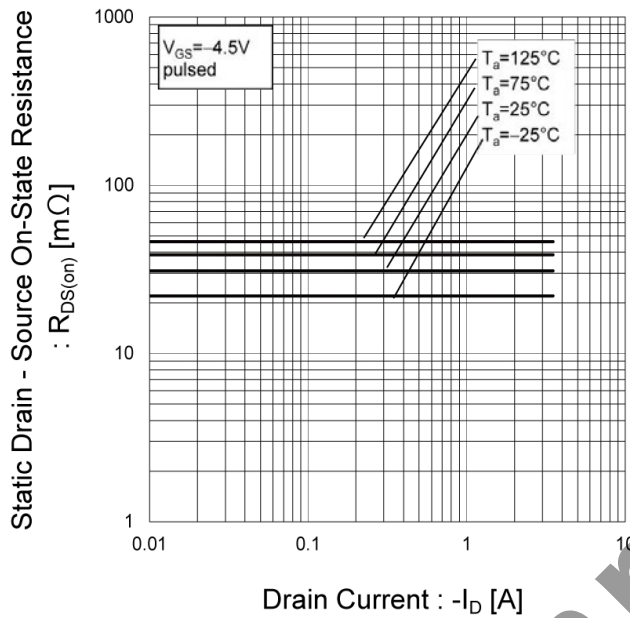


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)

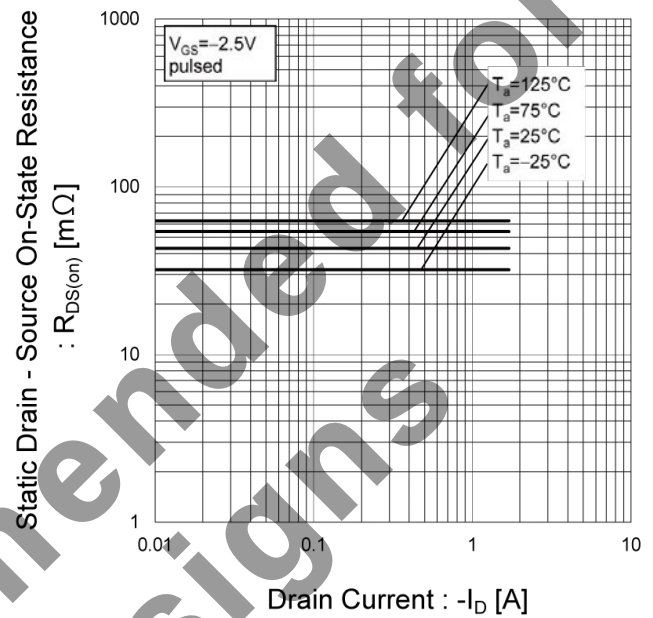


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current (IV)

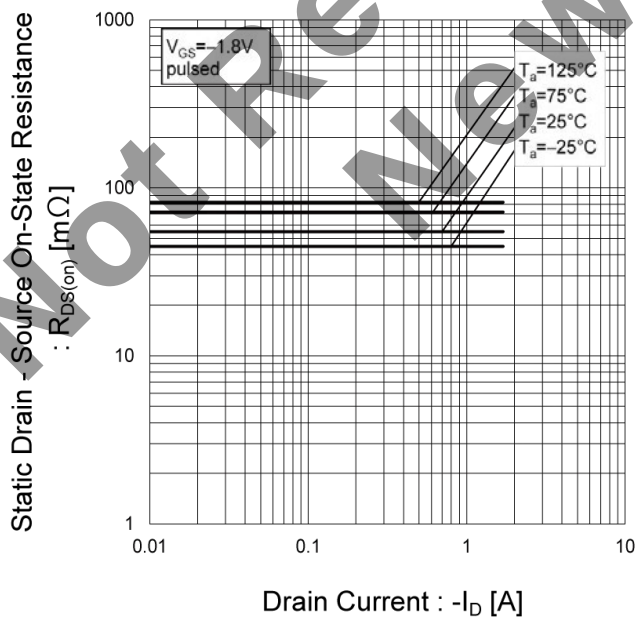
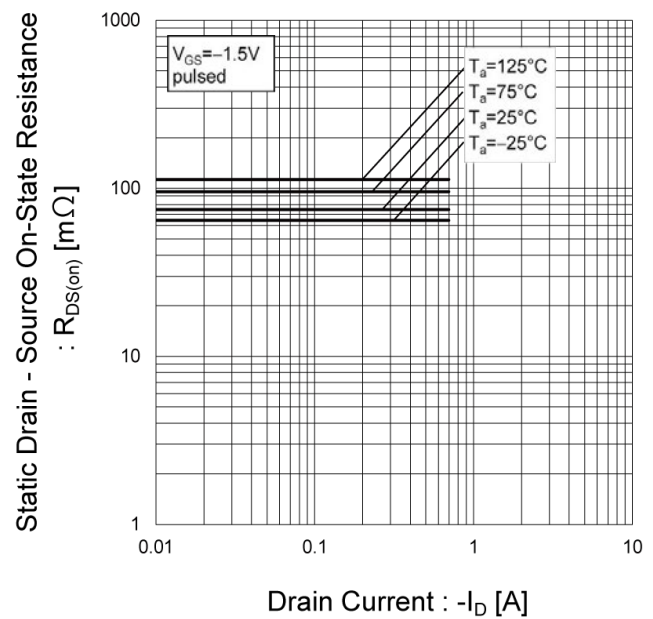


Fig.18 Static Drain - Source On - State Resistance vs. Drain Current (V)



●Electrical characteristic curves

Fig.19 Typical Capacitance vs.
Drain - Source Voltage

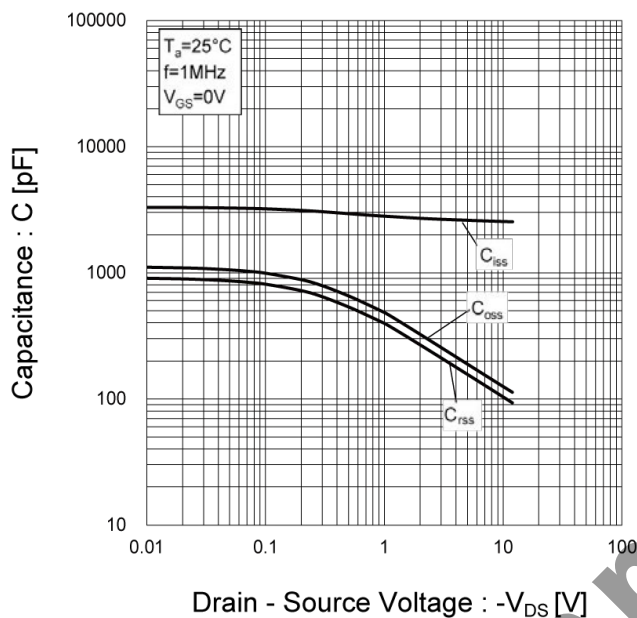


Fig.20 Switching Characteristics

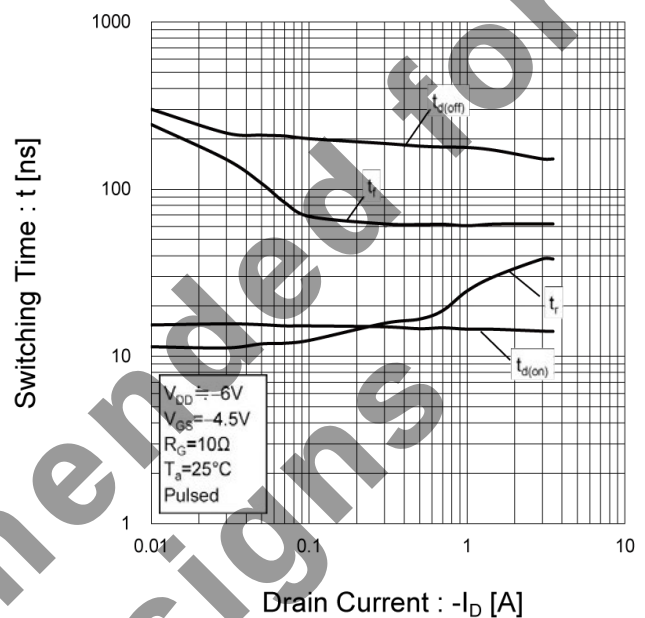


Fig.21 Dynamic Input Characteristics

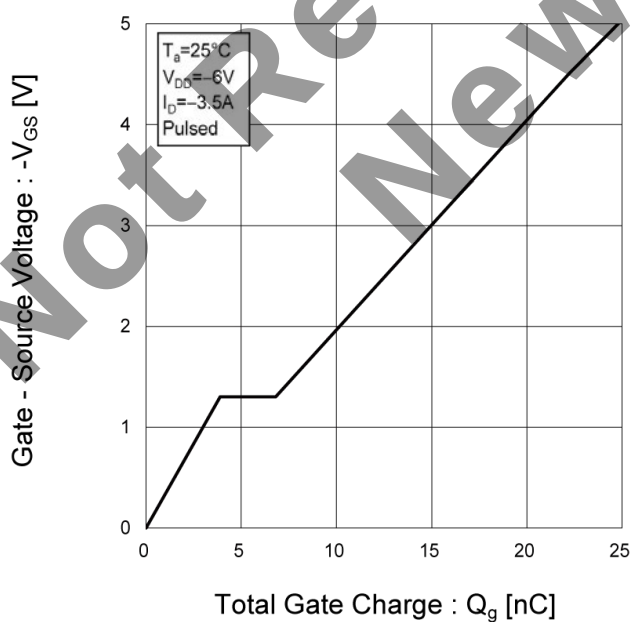
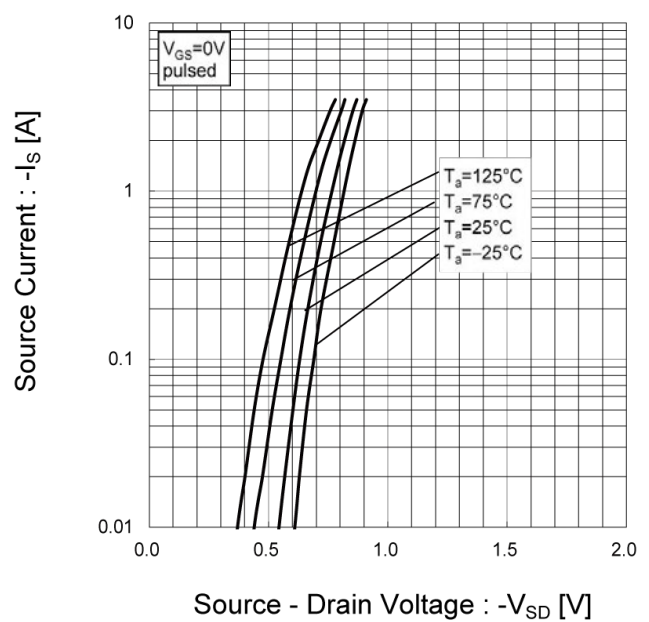


Fig.22 Source Current vs.
Source Drain Voltage



● **Measurement circuits** <It is the same for the Tr1 and Tr2>

Fig. 1-1 SWITCHING TIME MEASUREMENT CIRCUIT

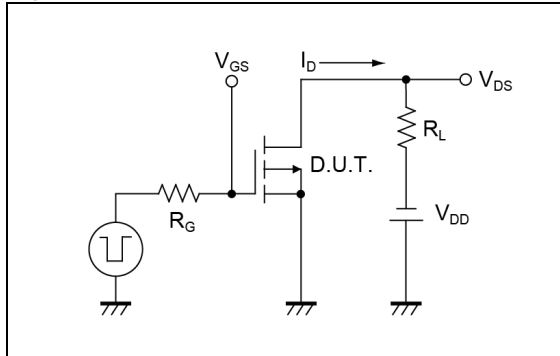


Fig. 1-2 SWITCHING WAVEFORMS

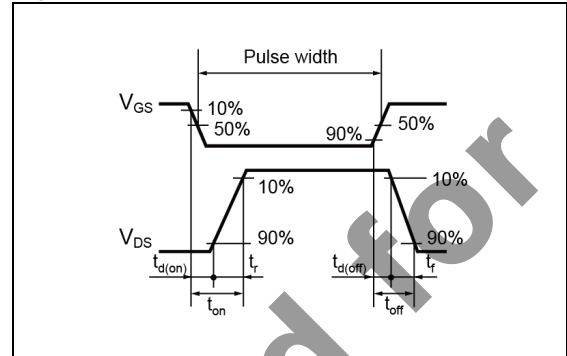


Fig. 2-1 GATE CHARGE MEASUREMENT CIRCUIT

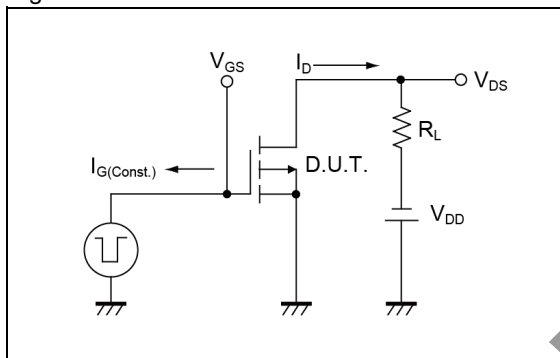
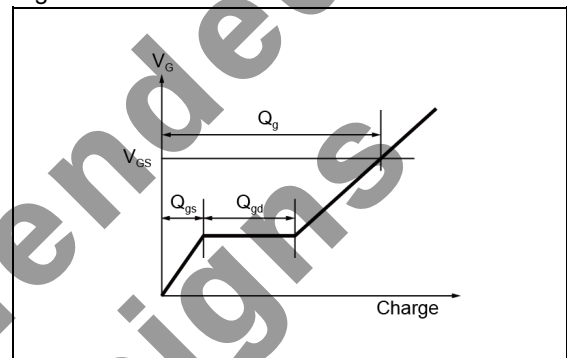


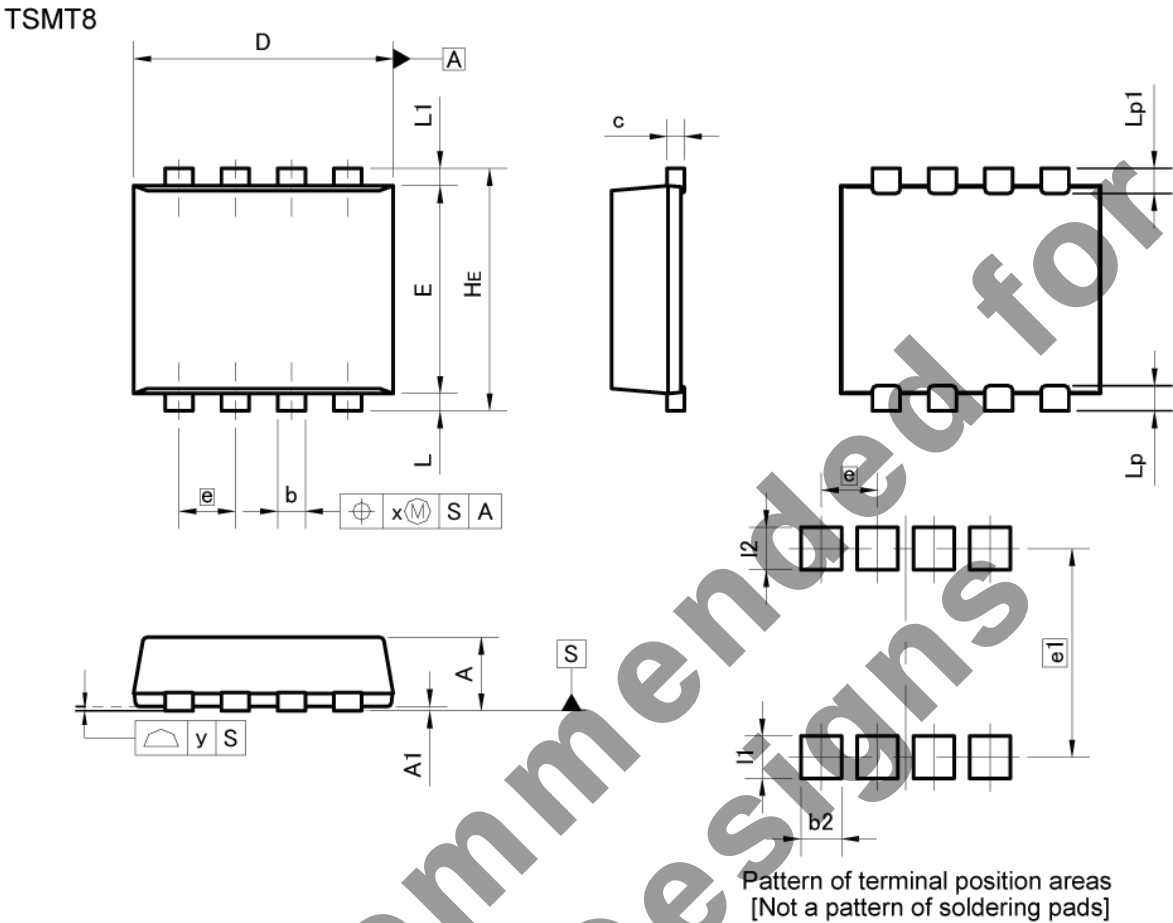
Fig. 2-2 GATE CHARGE WAVEFORM



● **Notice**

This product might cause chip aging and breakdown under the large electrified environment.
Please consider to design ESD protection circuit.

●Dimensions



DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.75	0.85	0.030	0.033
A1	0.00	0.05	0.000	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		0.026	
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
b2	-	0.47	-	0.019
e1	2.41		0.095	
l1	-	0.49	-	0.019
l2	-	0.49	-	0.019

Dimension in mm/inches

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