

$V_{DSS}$	45V
$R_{DS(on)(Max.)}$	53mΩ
$I_D$	±4A
$P_D$	1.5W

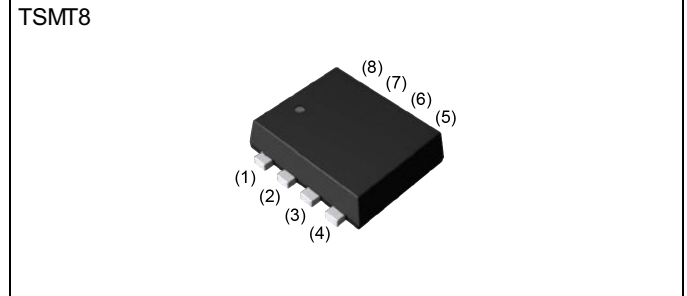
### ●Features

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

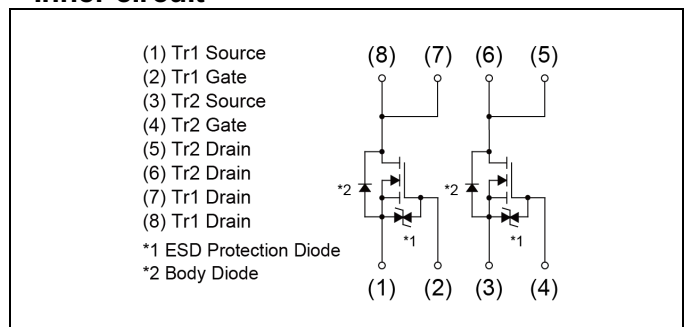
### ●Application

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	K21	

### ●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	$V_{DSS}$	45	V
Continuous drain current	$I_D$	±4	A
Pulsed drain current	$I_{D,pulse}^{*1}$	±12	A
Gate - Source voltage	$V_{GSS}$	±20	V
Power dissipation	total	$P_D^{*2}$	1.5
	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 ( $T_a = 25^{\circ}C$ ) <It is the same characteristics for the Tr1 and Tr2>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 1mA$	45	-	-	V
Breakdown voltage temperature coefficient	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	$I_D = 1mA$ referenced to $25^{\circ}C$	-	46.8	-	mV/°C
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 45V, V_{GS} = 0V$	-	-	1	μA
Gate - Source leakage current	$I_{GSS}$	$V_{DS} = 0V, V_{GS} = \pm 20V$	-	-	±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 $25^{\circ}C$	-	-3.9	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*4}$	$V_{GS} = 10V, I_D = 4A$	-	38	53	mΩ
		$V_{GS} = 4.5V, I_D = 4A$	-	48	67	
		$V_{GS} = 4V, I_D = 4A$	-	53	75	
Gate input resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	6	-	Ω
Forward Transfer Admittance	$ Y_{fs} ^{*4}$	$V_{DS} = 10V, I_D = 4A$	2	-	-	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	$C_{iss}$	$V_{GS} = 0V$	-	460	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 10V$	-	110	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	55	-	
Turn - on delay time	$t_{d(on)}^{*4}$	$V_{DD} \approx 25V, V_{GS} = 10V$	-	9	-	ns
Rise time	$t_r^{*4}$	$I_D = 2A$	-	25	-	
Turn - off delay time	$t_{d(off)}^{*4}$	$R_L = 12.5\Omega$	-	30	-	
Fall time	$t_f^{*4}$	$R_G = 10\Omega$	-	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	$Q_g^{*4}$	$V_{DD} \approx 25V$ $I_D = 4A$	$V_{GS} = 10V$	-	10	-	nC
Gate - Source charge	$Q_{gs}^{*4}$		$V_{GS} = 5V$	-	5.4	-	
Gate - Drain charge	$Q_{gd}^{*4}$			-	1.6	-	

● **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	$V_{SD}^{*4}$	$V_{GS} = 0V, I_S = 4A$	-	-	1.2	V

\*1  $P_w \leq 10\mu\text{s}$ , 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

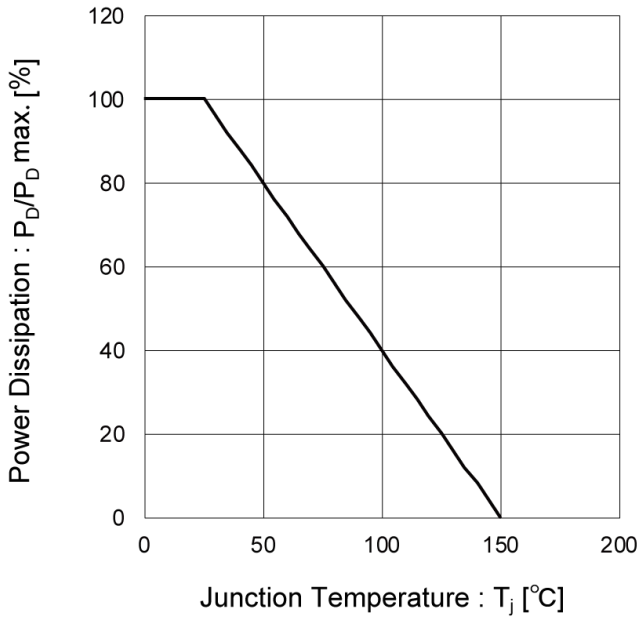


Fig.2 Maximum Safe Operating Area

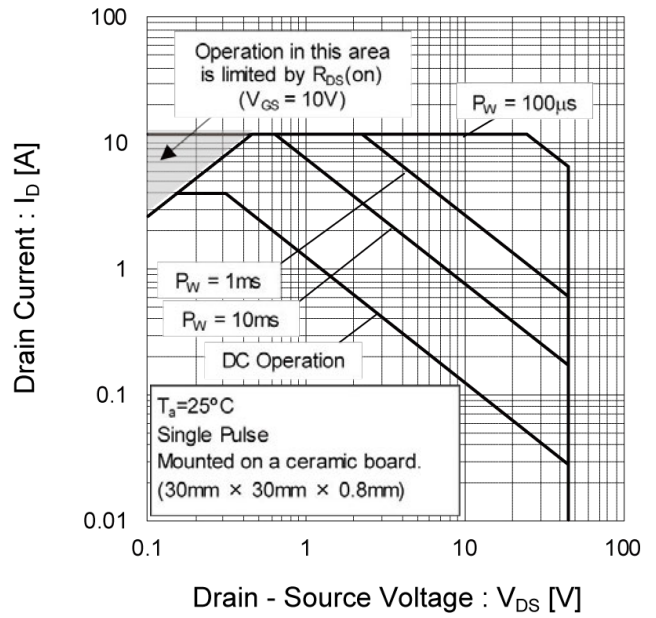


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

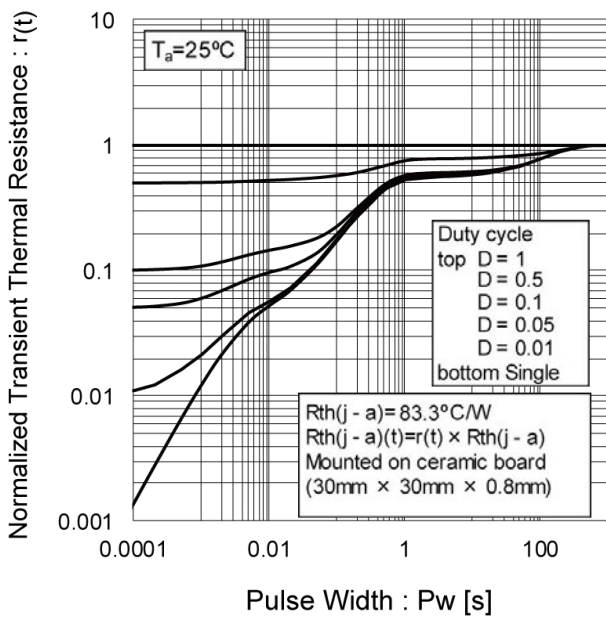
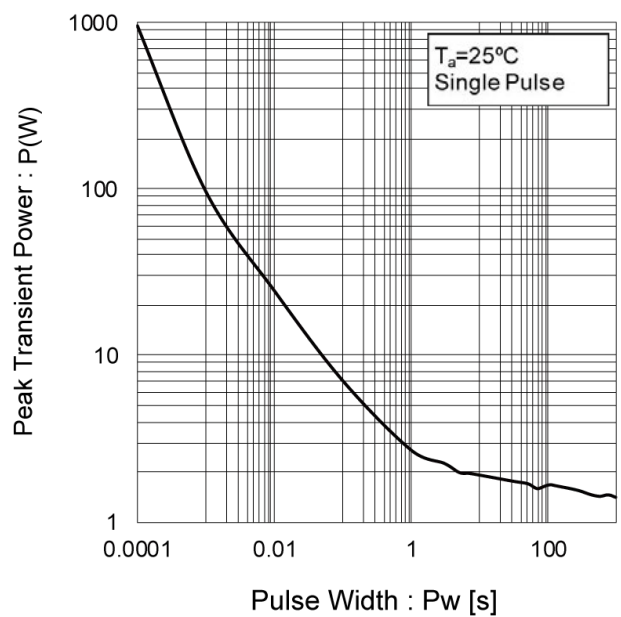


Fig.4 Single Pulse Maximum Power dissipation



● Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

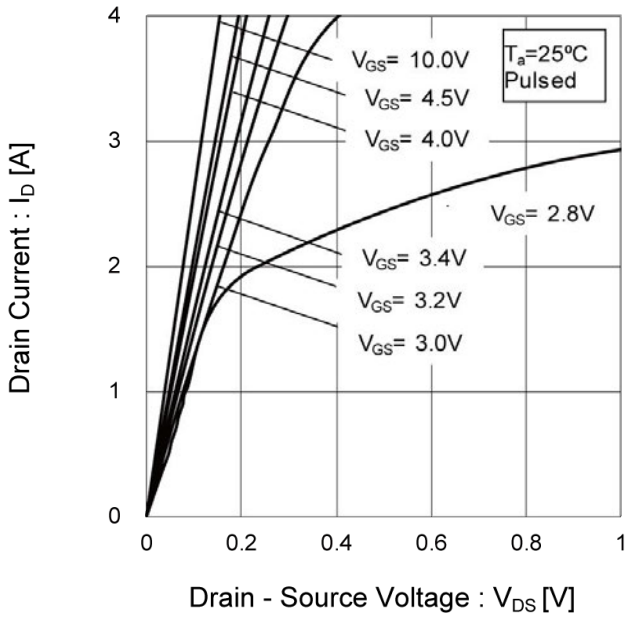


Fig.6 Typical Output Characteristics(II)

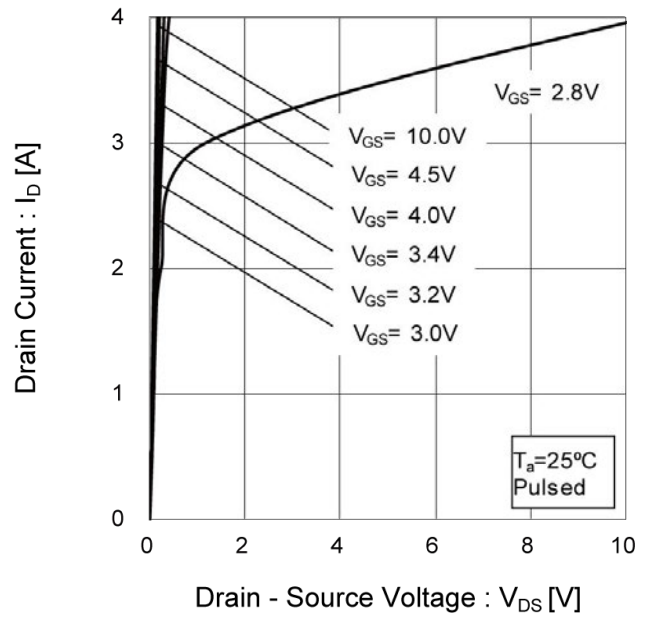


Fig.7 Breakdown Voltage vs. Junction Temperature

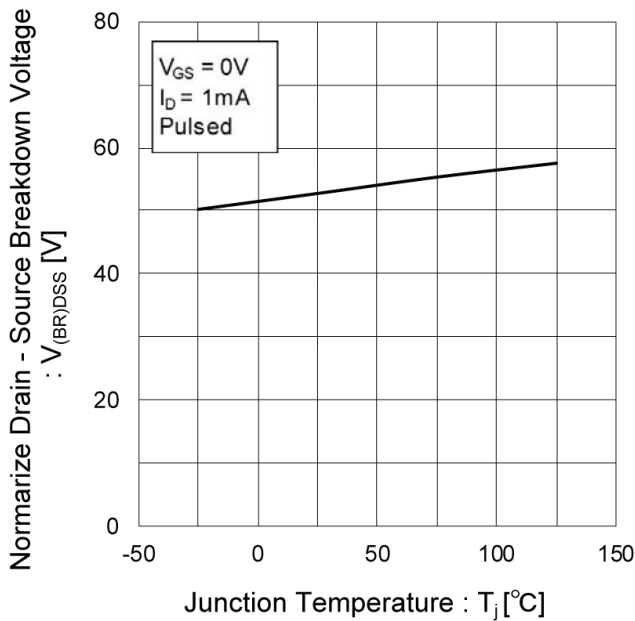
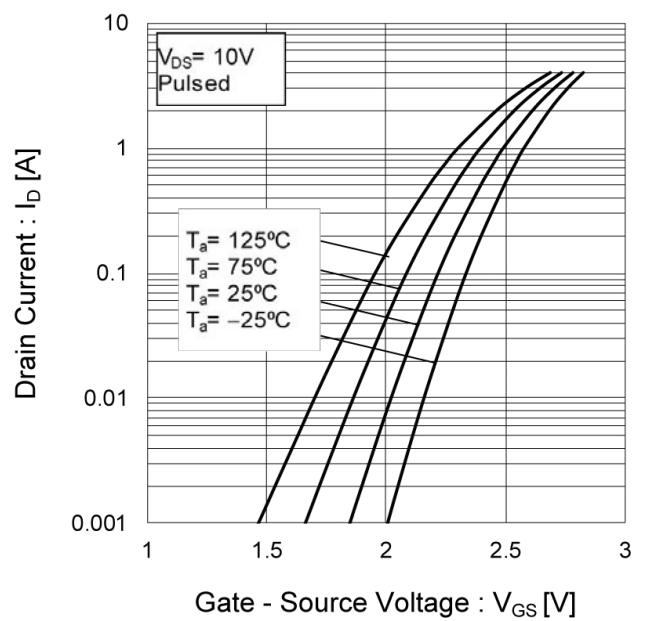


Fig.8 Typical Transfer Characteristics



● Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Junction Temperature

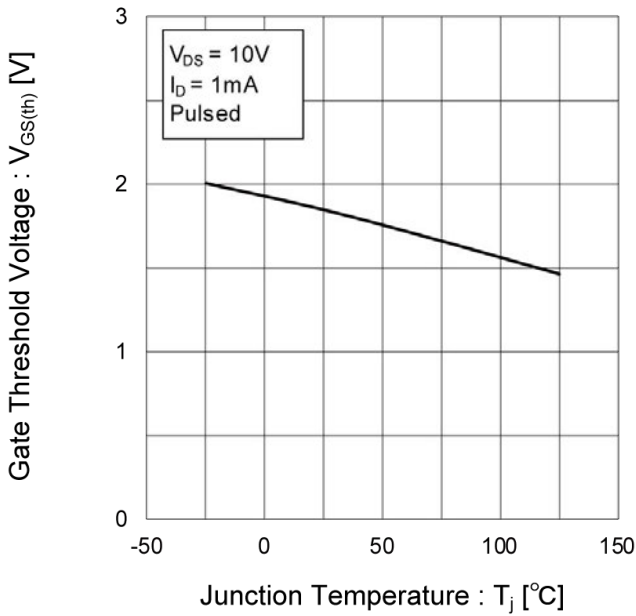


Fig.10 Forward Transfer Admittance vs. Drain Current

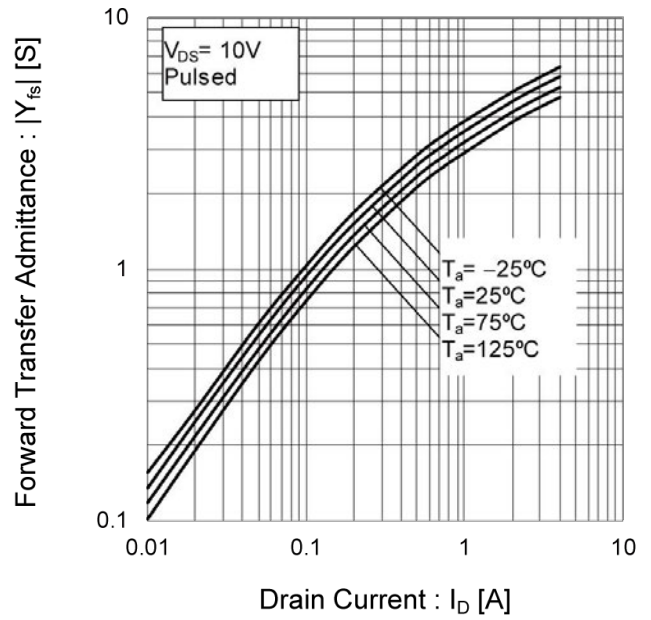


Fig.11 Drain Current Derating Curve

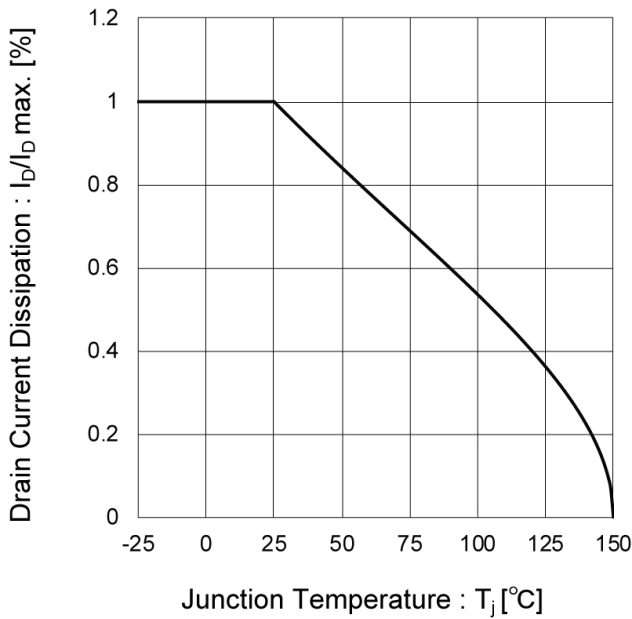
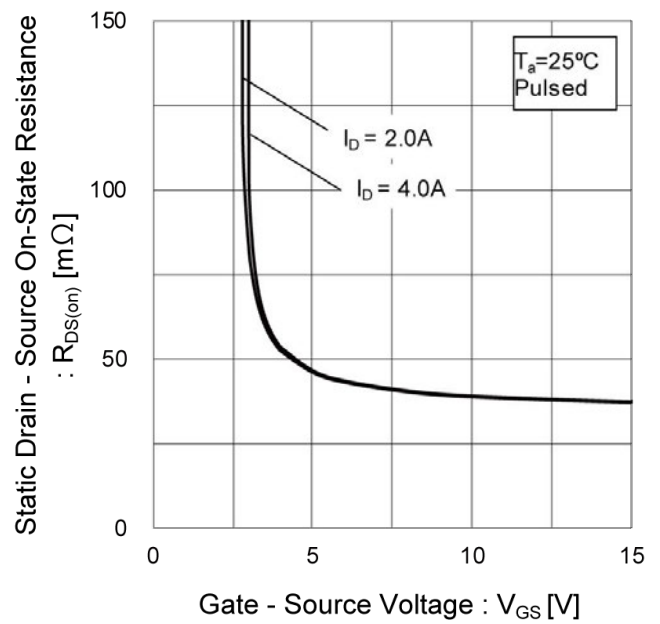


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage



● Electrical characteristic curves

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

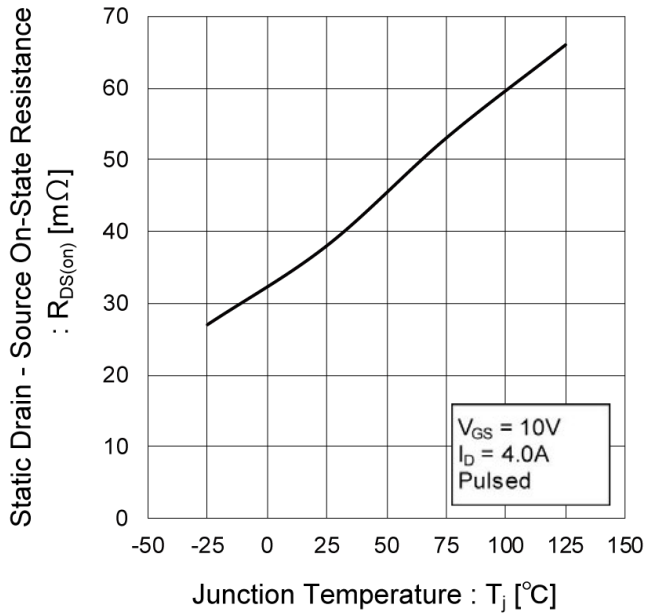
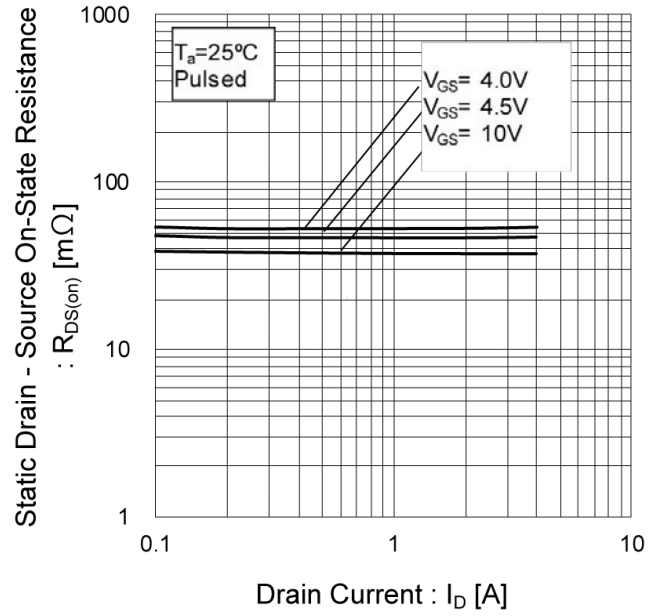


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current (I)



● Electrical characteristic curves

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

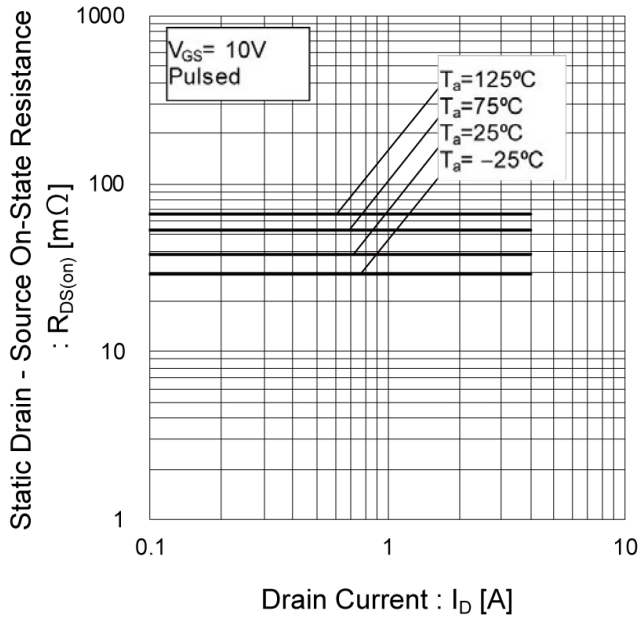


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)

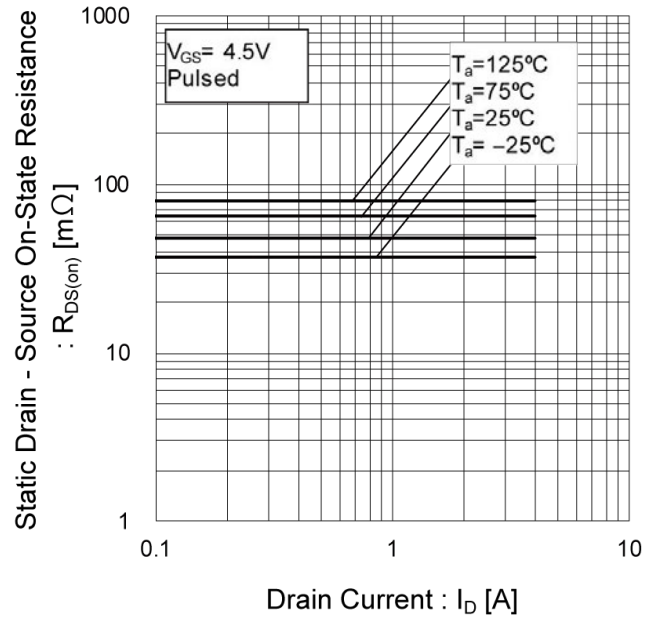
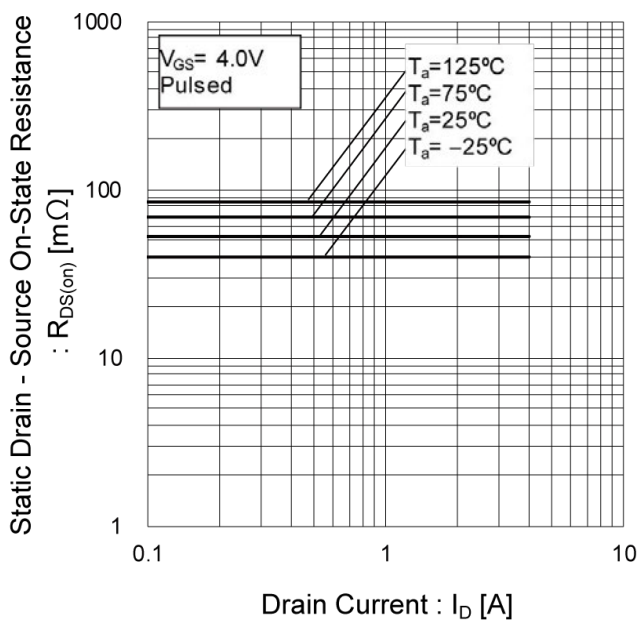


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current (IV)





● Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

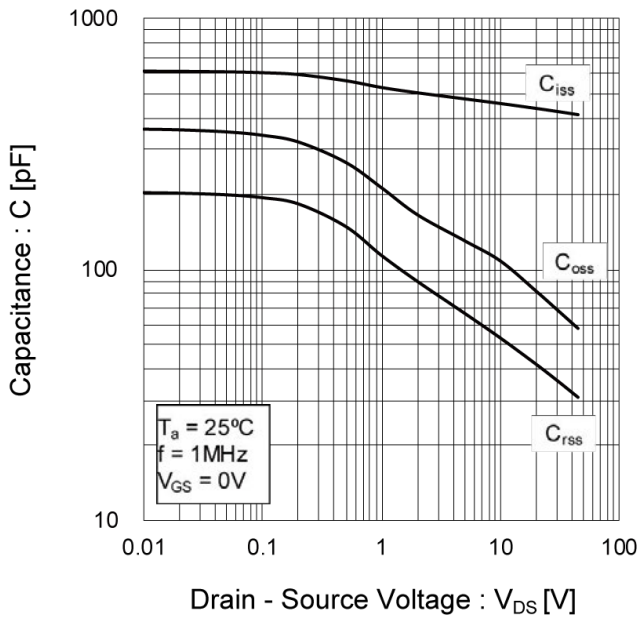


Fig.19 Switching Characteristics

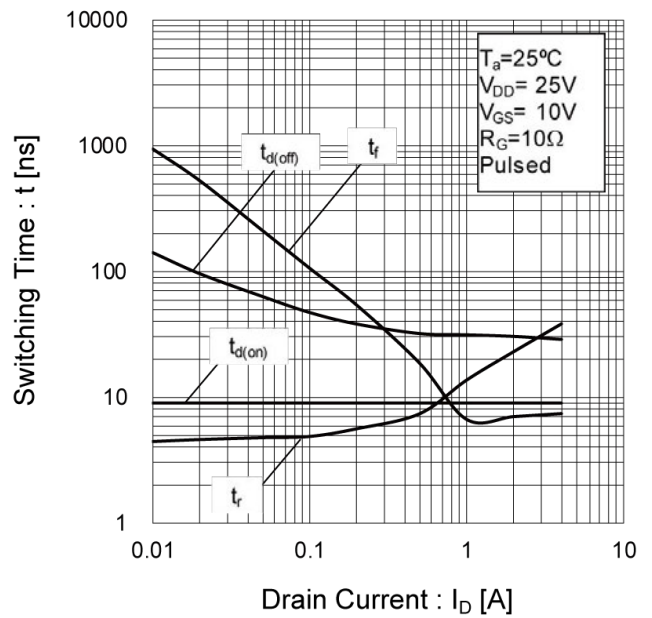


Fig.20 Dynamic Input Characteristics

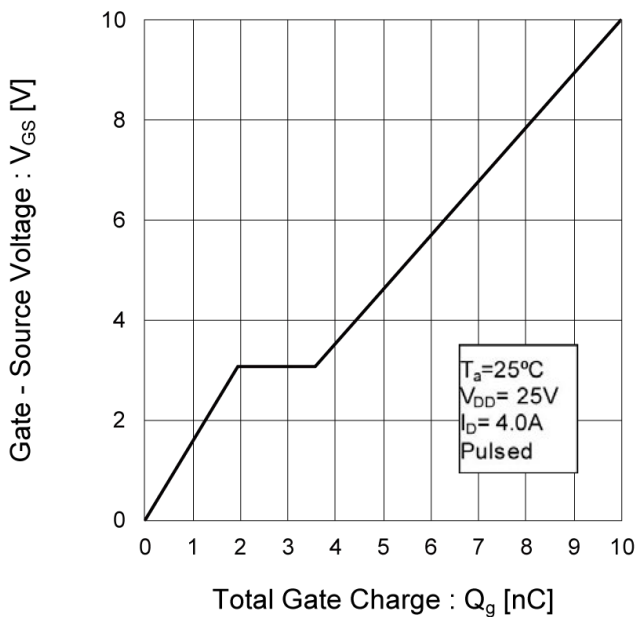
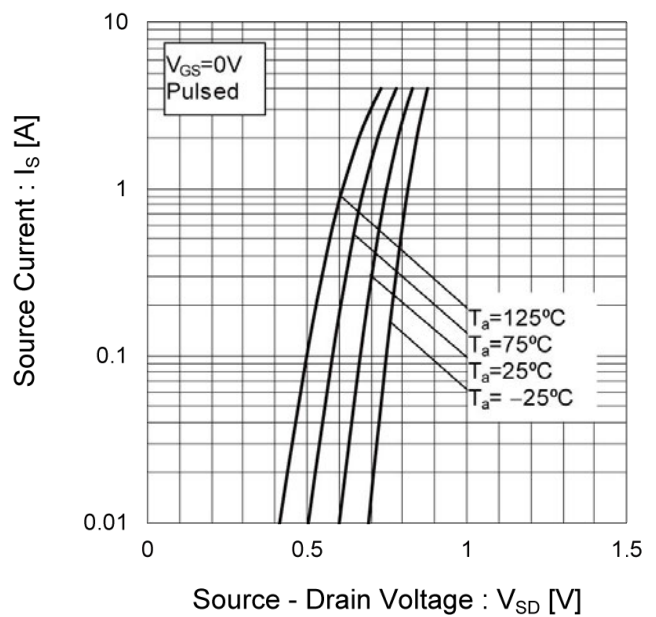


Fig.21 Source Current vs. Source Drain Voltage



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

Fig. 1-1 SWITCHING TIME MEASUREMENT CIRCUIT

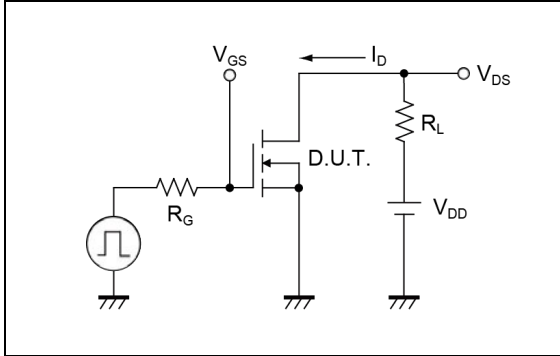


Fig. 1-2 SWITCHING WAVEFORMS

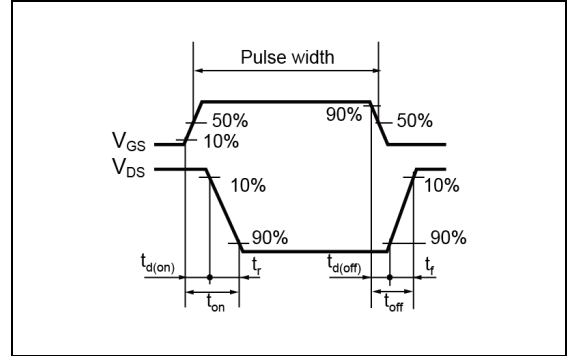


Fig. 2-1 GATE CHARGE MEASUREMENT CIRCUIT

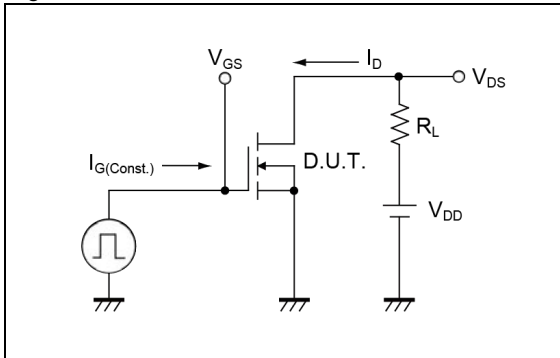
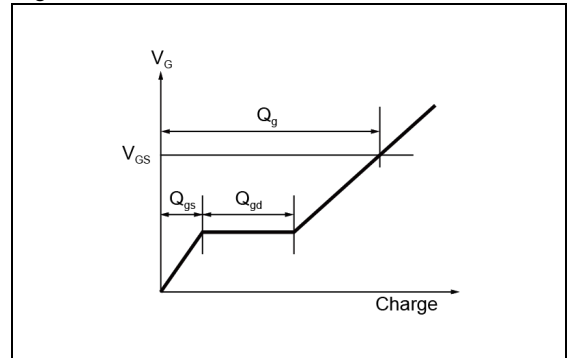
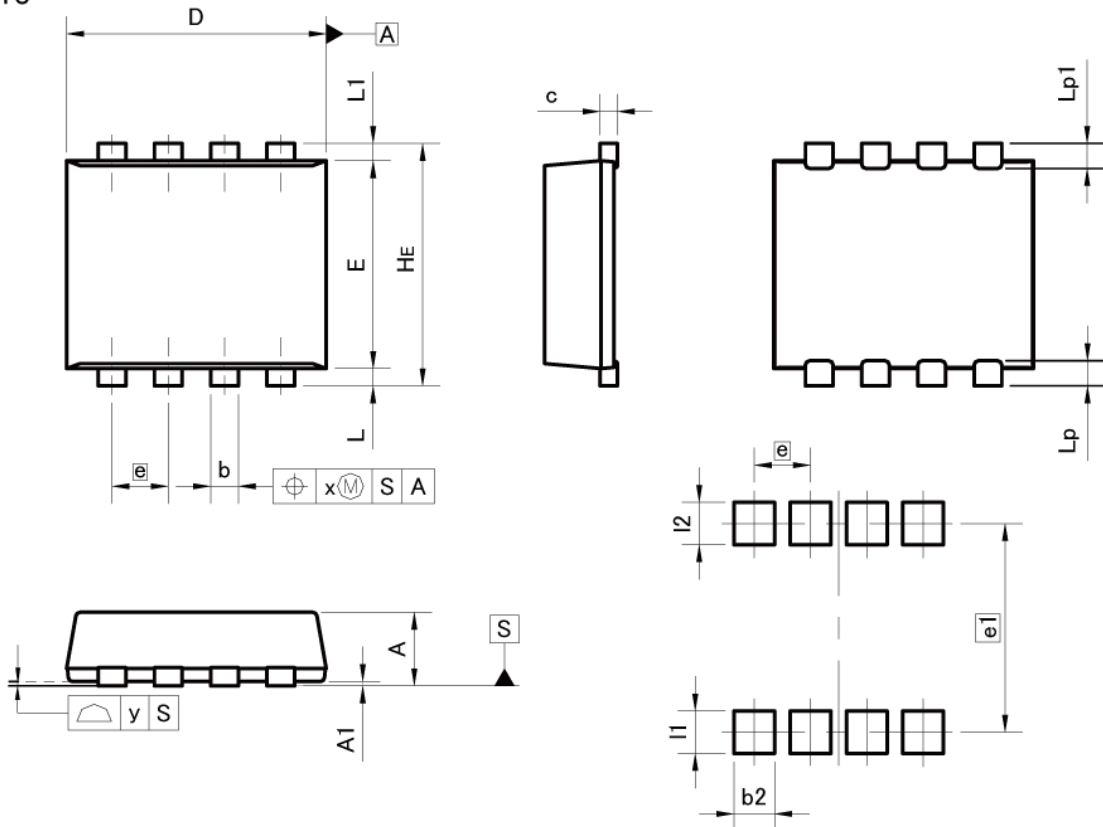


Fig. 2-2 GATE CHARGE WAVEFORM



●Dimensions

TSMT8



Pattern of terminal position areas  
[Not a pattern of soldering pads]

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	
I1	-	0.49	-	0.019
I2	-	0.49	-	0.019

Dimension in mm/inches

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