

V_{DSS}	20V
$R_{DS(on)}$ (Max.)	43mΩ
I_D	3.5A
P_D	1.0W

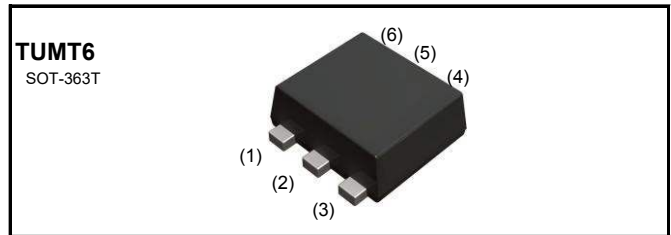
●Features

- 1) Low on - resistance.
- 2) 1.5V Drive.
- 3) Built-in G-S Protection Diode.
- 4) Small Surface Mount Package (TUMT6).
- 5) Pb-free lead plating ; RoHS compliant

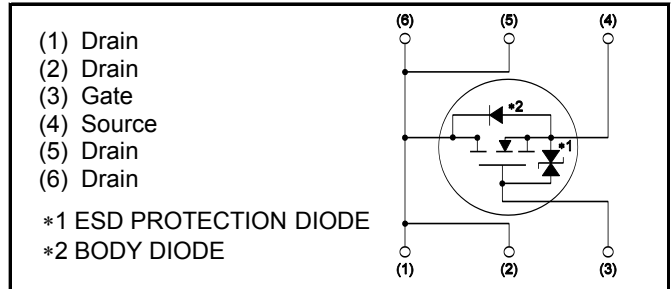
●Application

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	XD

●Absolute maximum ratings($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Value	Unit
Drain - Source voltage	V_{DSS}	20	V
Continuous drain current	I_D^{*1}	±3.5	A
Pulsed drain current	$I_{D,pulse}^{*2}$	±7	A
Gate - Source voltage	V_{GSS}	±10	V
Power dissipation	P_D^{*3}	1.0	W
	P_D^{*4}	0.32	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}	-	-	125	°C/W
	R_{thJA}^{*4}	-	-	391	°C/W

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{V}, I_D = 1\text{mA}$	20	-	-	V
Breakdown voltage temperature coefficient	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	$I_D = 1\text{mA}$ referenced to 25°C	-	20	-	mV/°C
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 20\text{V}, V_{GS} = 0\text{V}$	-	-	1	μA
Gate - Source leakage current	I_{GSS}	$V_{GS} = \pm 10\text{V}, V_{DS} = 0\text{V}$	-	-	±10	μA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = 10\text{V}, I_D = 1\text{mA}$	0.3	-	1.0	V
Gate threshold voltage temperature coefficient	$\frac{\Delta V_{(GS)th}}{\Delta T_j}$	$I_D = 1\text{mA}$ referenced to 25°C	-	-1.9	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}^{*5}$	$V_{GS} = 4.5\text{V}, I_D = 3.5\text{A}$	-	31	43	mΩ
		$V_{GS} = 2.5\text{V}, I_D = 3.5\text{A}$	-	38	53	
		$V_{GS} = 1.8\text{V}, I_D = 1.8\text{A}$	-	50	70	
		$V_{GS} = 1.5\text{V}, I_D = 0.7\text{A}$	-	66	93	
		$V_{GS} = 4.5\text{V}, I_D = 3.5\text{A}, T_j = 125^\circ\text{C}$	-	56	80	
Gate input resistance	R_G	$f = 1\text{MHz}, \text{open drain}$	-	7.5	-	Ω
Transconductance	g_{fs}^{*5}	$V_{DS} = 10\text{V}, I_D = 3.5\text{A}$	3.2	8.5	-	S

*1 Limited only by maximum temperature allowed.

*2 $P_w \leq 10\mu\text{s}$, 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($T_a = 25^\circ\text{C}$)

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}	$f = 1\text{MHz}$	-	60	-	
Turn - on delay time	$t_{d(on)}^{*5}$	$V_{DD} \approx 10V, V_{GS} = 4.5V$	-	10	-	ns
Rise time	t_r^{*5}	$I_D = 1.8A$	-	20	-	
Turn - off delay time	$t_{d(off)}^{*5}$	$R_L = 5.6\Omega$	-	40	-	
Fall time	t_f^{*5}	$R_G = 10\Omega$	-	50	-	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g^{*5}	$V_{DD} \approx 10, I_D = 3.5A$ $V_{GS} = 4.5V$	-	5.7	-	nC
Gate - Source charge	Q_{gs}^{*5}		-	1.1	-	
Gate - Drain charge	Q_{gd}^{*5}		-	0.9	-	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S^{*1}	$T_a = 25^\circ\text{C}$	-	-	0.8	A
Forward voltage	V_{SD}^{*5}	$V_{GS} = 0V, I_S = 0.8A$	-	-	1.2	V

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

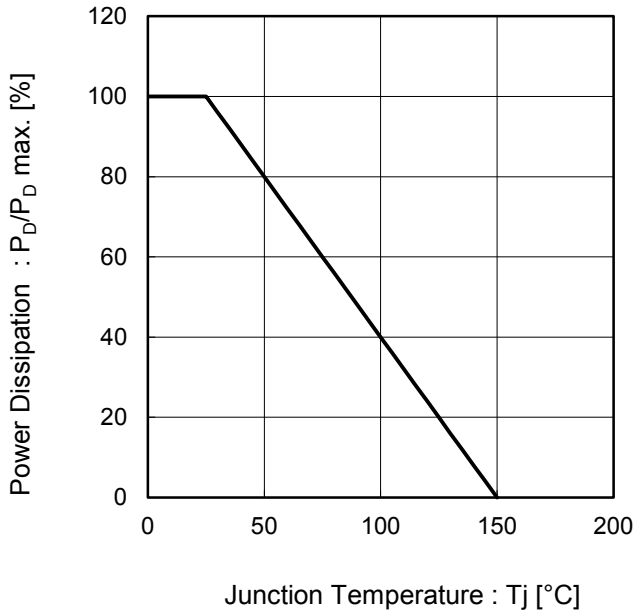


Fig.2 Maximum Safe Operating Area

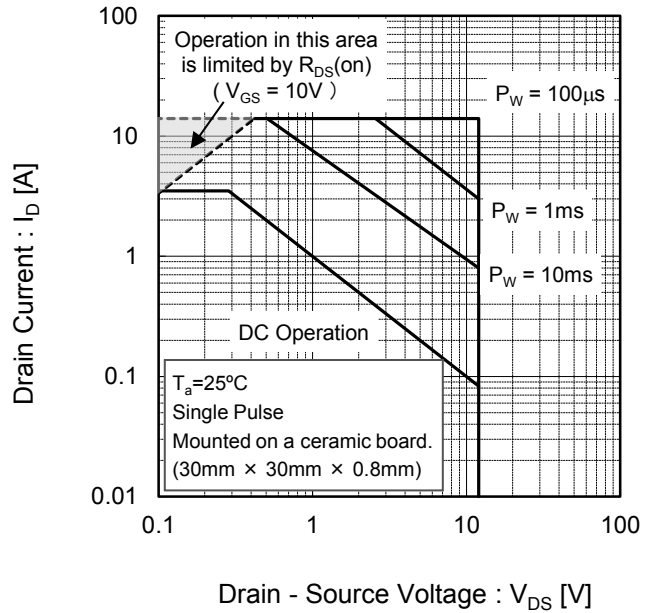


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

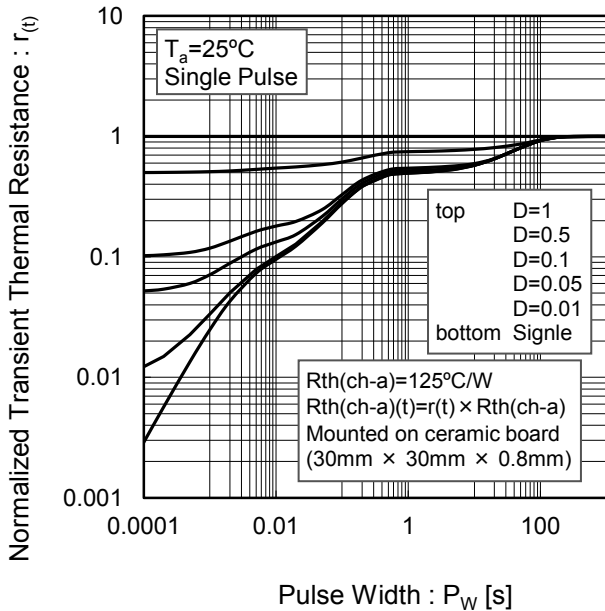
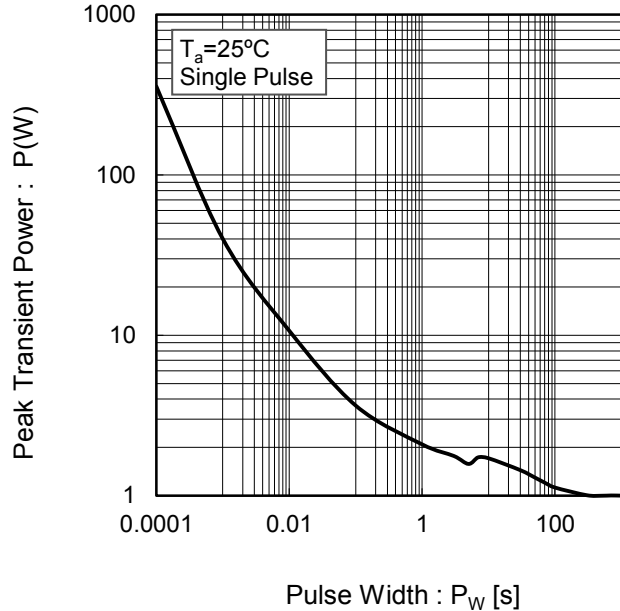


Fig.4 Single Pulse Maximum Power dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

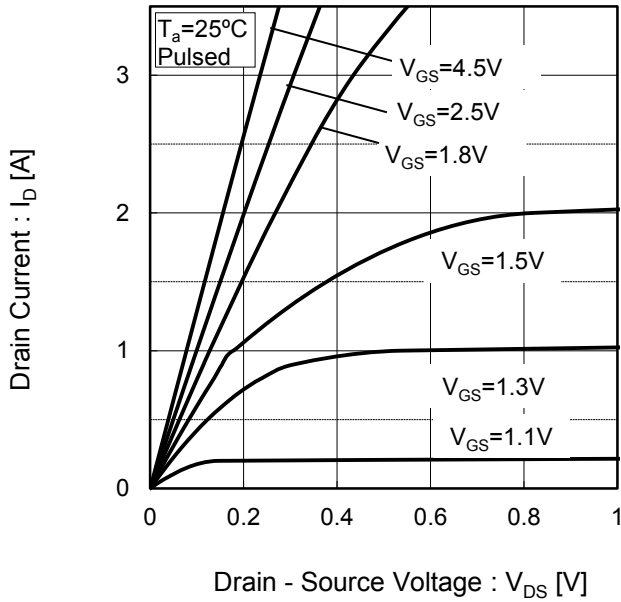


Fig.6 Typical Output Characteristics(II)

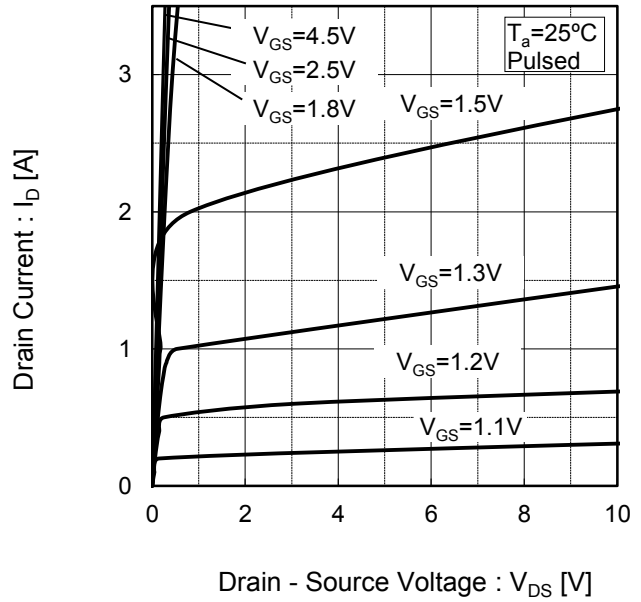


Fig.7 Breakdown Voltage vs. Junction Temperature

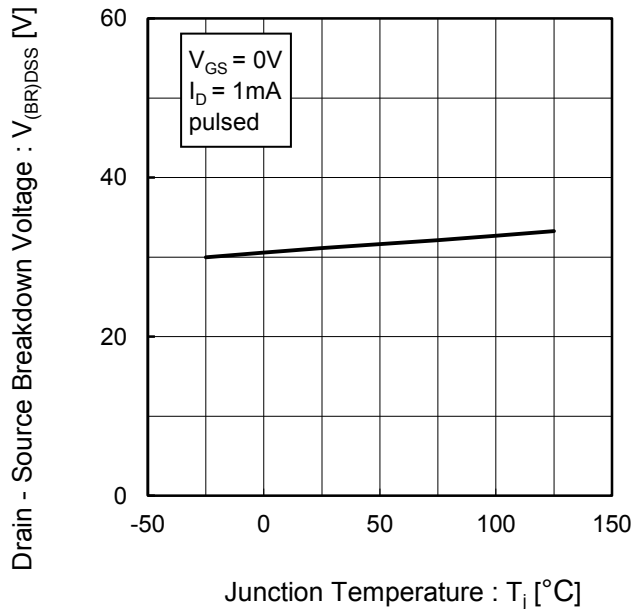
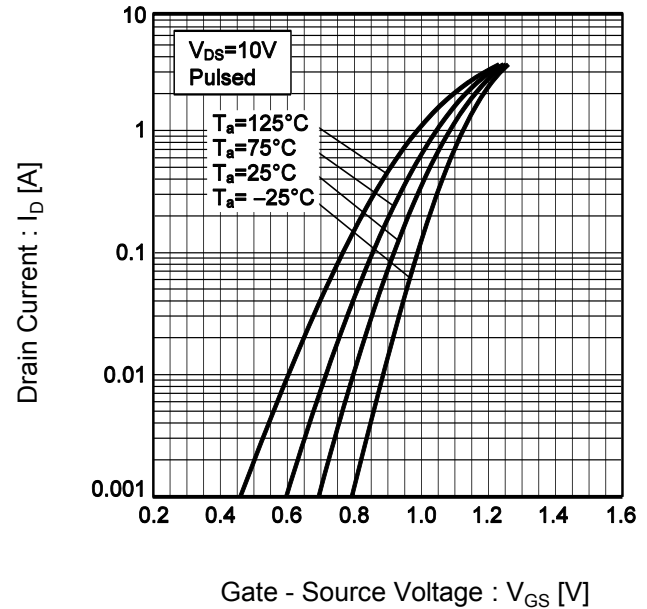


Fig.8 Typical Transfer Characteristics



●Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Junction Temperature

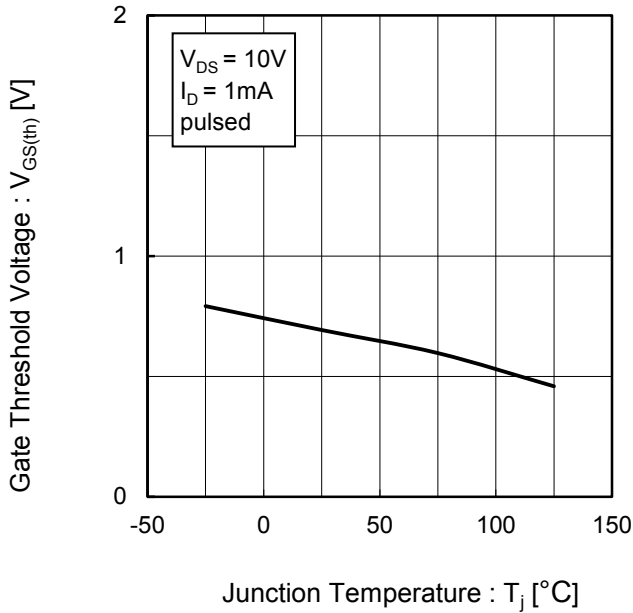


Fig.10 Transconductance vs. Drain Current

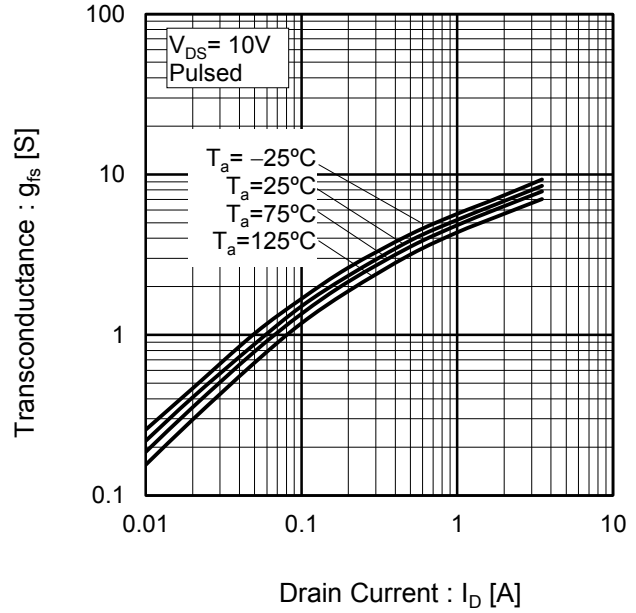


Fig.11 Drain Current Derating Curve

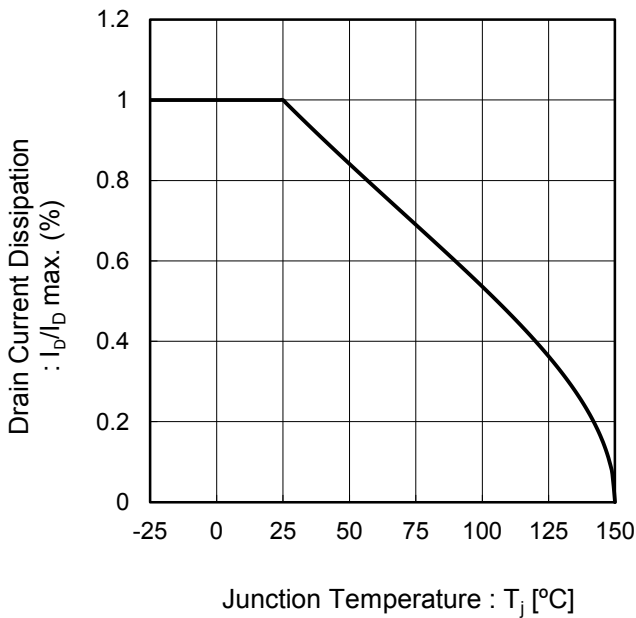
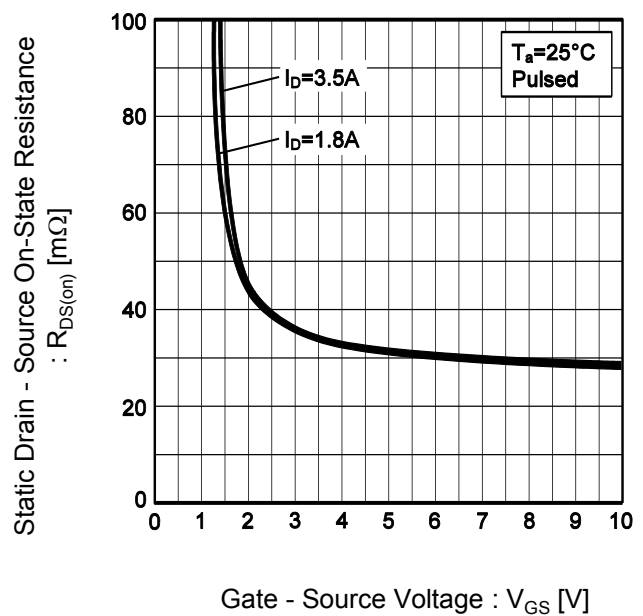


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage



●Electrical characteristic curves

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

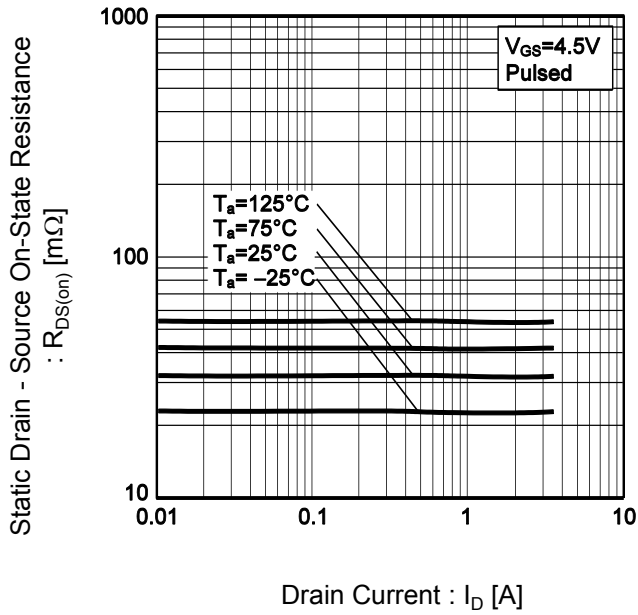
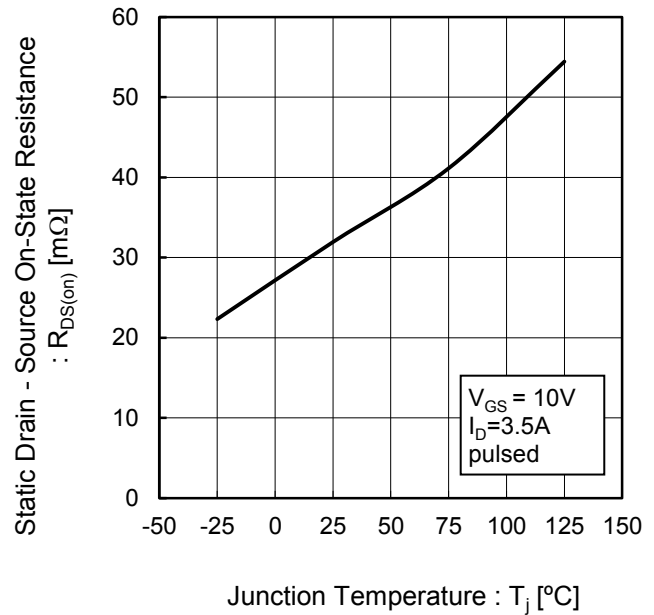


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

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

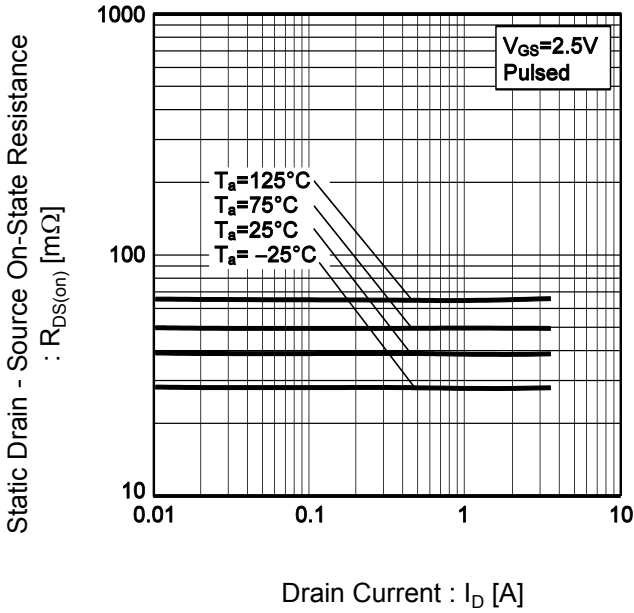


Fig.16 Static Drain-Source On-State Resistance vs. Drain Current(III)

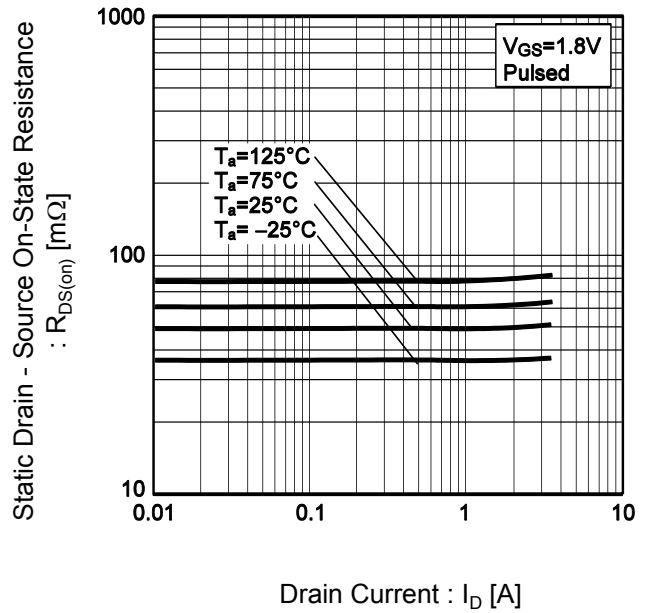


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)

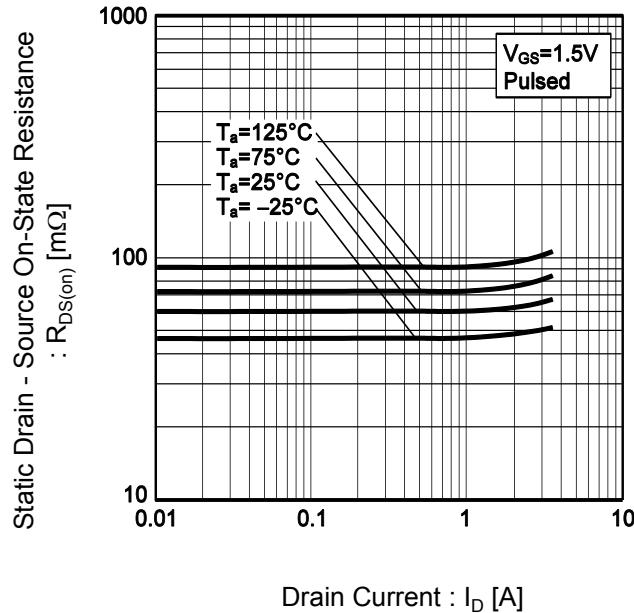
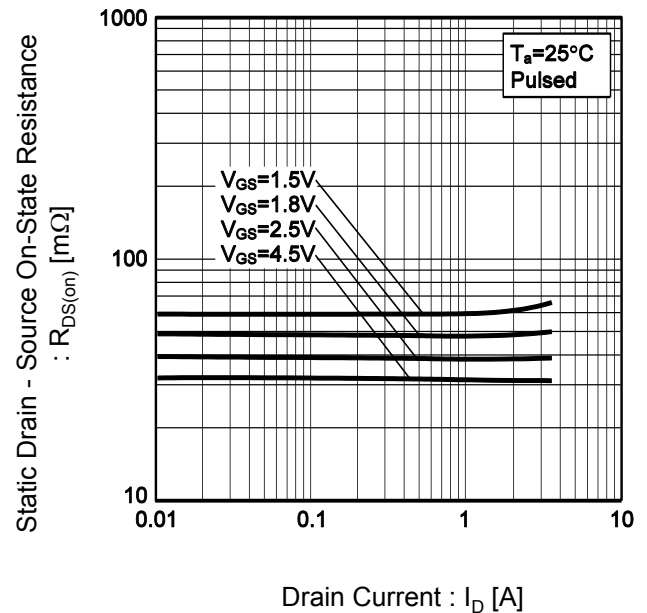


Fig.18 Static Drain - Source On - State Resistance vs. Drain Current(V)



●Electrical characteristic curves

Fig.19 Typical Capacitance vs. Drain - Source Voltage

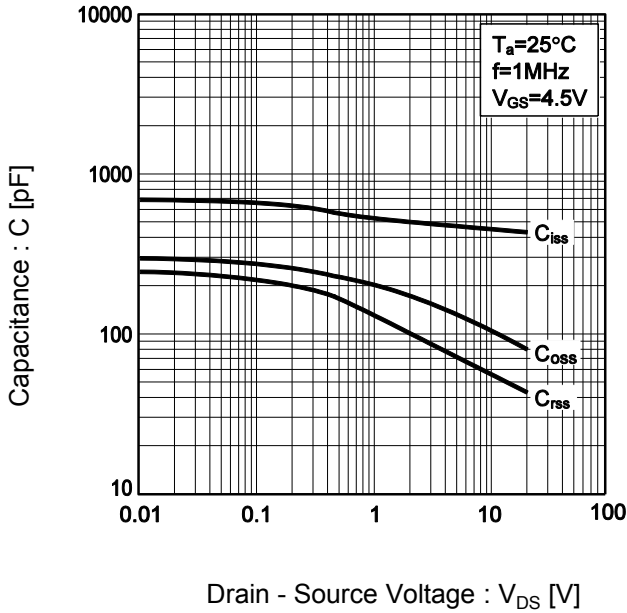


Fig.20 Switching Characteristics

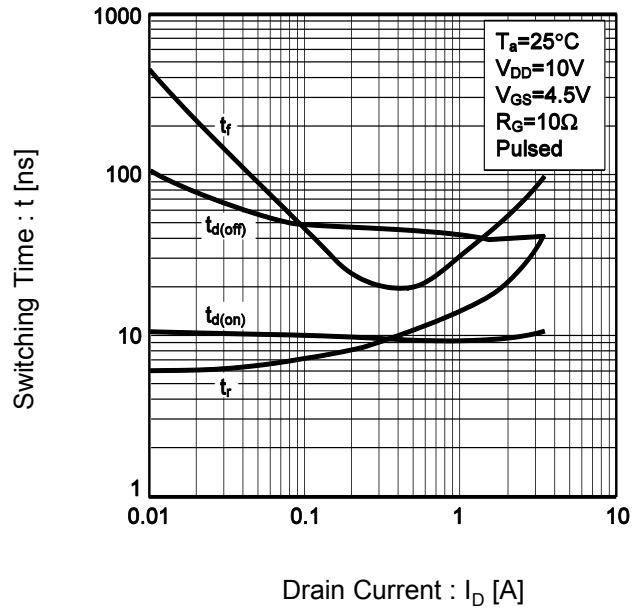


Fig.21 Dynamic Input Characteristics

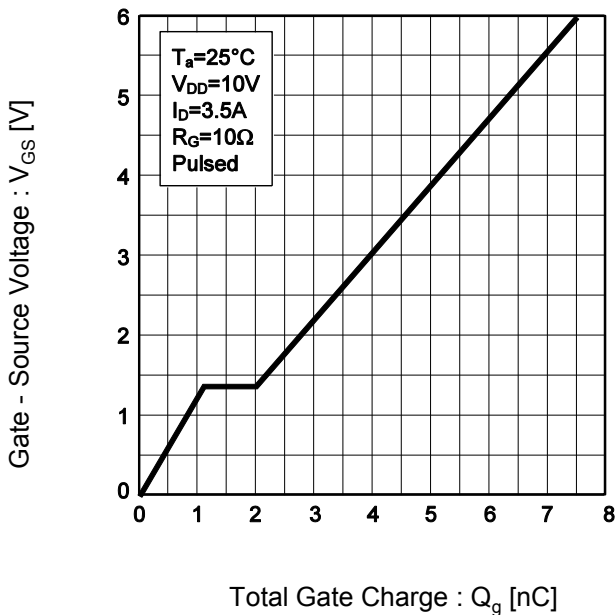
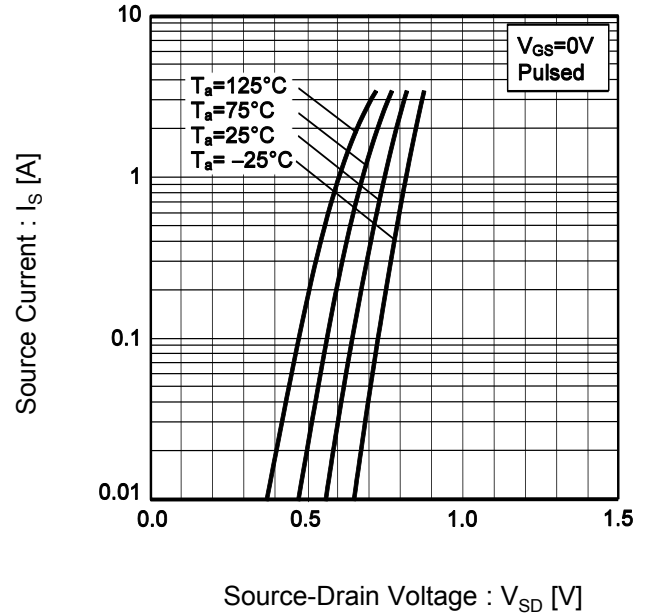


Fig.22 Source Current vs. Source Drain Voltage



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

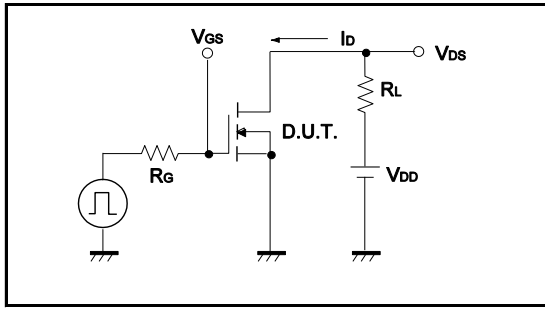


Fig.1-2 Switching Waveforms

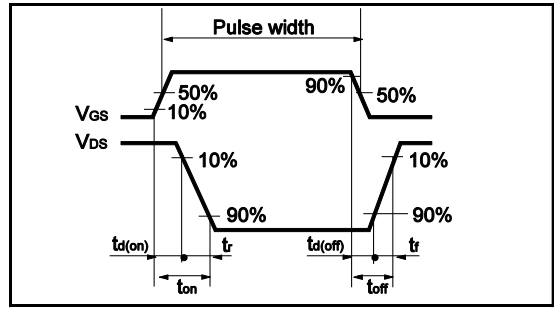


Fig.2-1 Gate Charge Measurement Circuit

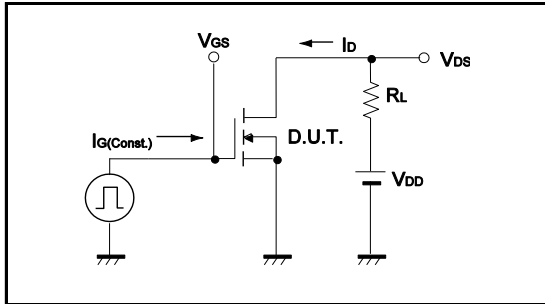
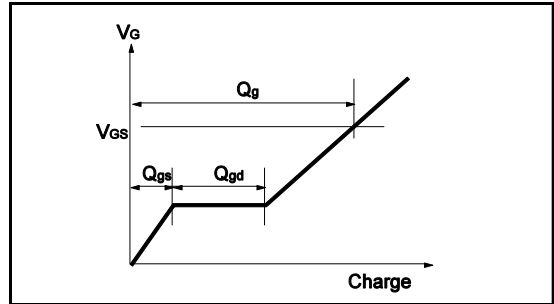
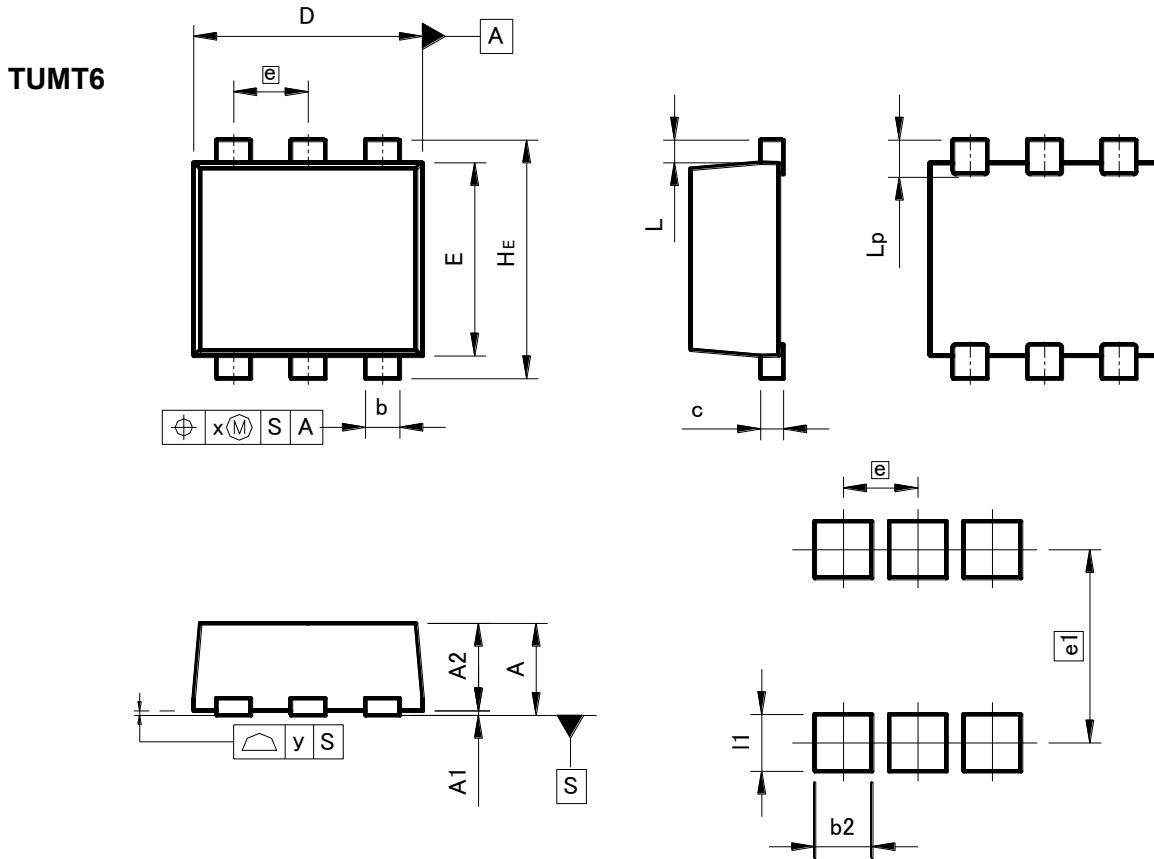


Fig.2-2 Gate Charge Waveform



●Dimensions (Unit : mm)



Pattern of terminal position areas

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	-	0.85	-	0.033
A1	0.00	0.10	0	0.004
A2	0.72	0.82	0.028	0.032
b	0.25	0.40	0.01	0.016
c	0.12	0.22	0.005	0.009
D	1.90	2.10	0.075	0.083
E	1.60	1.80	0.063	0.071
e	0.65		0.03	
HE	2.00	2.20	0.079	0.087
L	0.20		0.01	
Lp	-	0.40	-	0.016
x	-	0.10	-	0.004
y	-	0.10	-	0.004

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
e1	1.70		0.067	
b2	-	0.50	-	0.02
l1	-	0.50	-	0.02

Dimension in mm/inches

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