RUL035N02FRA

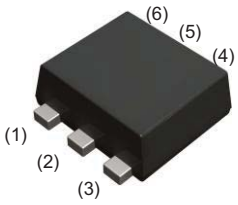
Nch 20V 3.5A Power MOSFET

Datasheet

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

●Outline

TUMT6



●Features

1) Low on - resistance.

2) 1.5V Drive.

3) Built-in G-S Protection Diode.

4) Small Surface Mount Package (TUMT6).

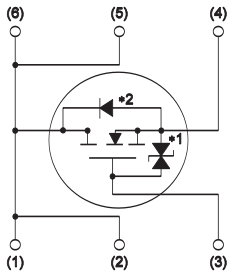
5) Pb-free lead plating ; RoHS compliant

6) AEC-Q101 Qualified

●Inner circuit

(1) Drain
(2) Drain
(3) Gate
(4) Source
(5) Drain
(6) Drain

∗1 ESD PROTECTION DIODE
∗2 BODY DIODE



●Application

DC/DC converters

●Packaging specifications

Type	Packaging	Taping
	Reel size (mm)	180
	Tape width (mm)	8
	Quantity (pcs)	3,000
	Taping code	TR
	Marking	XD

●Absolute maximum ratings(T_a = 25°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

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●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°C)

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

*1 Limited only by maximum temperature allowed.

*2 Pw ≤ 10μs, Duty cycle ≤ 1%

*3 Mounted on a seramic board (30×30×0.8mm)

*4 Mounted on a FR4 (15×20×0.8mm)

*5 Pulsed

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●Electrical characteristics(T_a = 25°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 = 1MHz	-	60	-	
Turn - on delay time	$t_{d(on)}$ *5	$V_{DD} \simeq$ 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 = 5.6Ω	-	40	-	
Fall time	t_f *5	R_G = 10Ω	-	50	-	

●Gate Charge characteristics(T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *5	$V_{DD} \simeq$ 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°C)

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

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●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

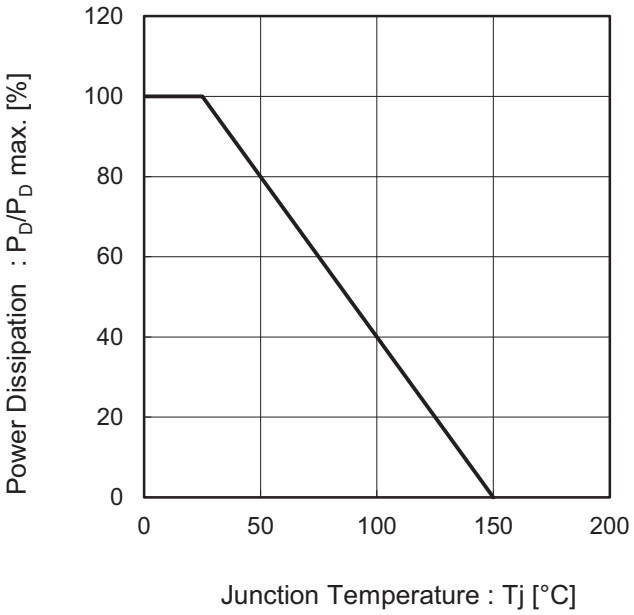


Fig.2 Maximum Safe Operating Area

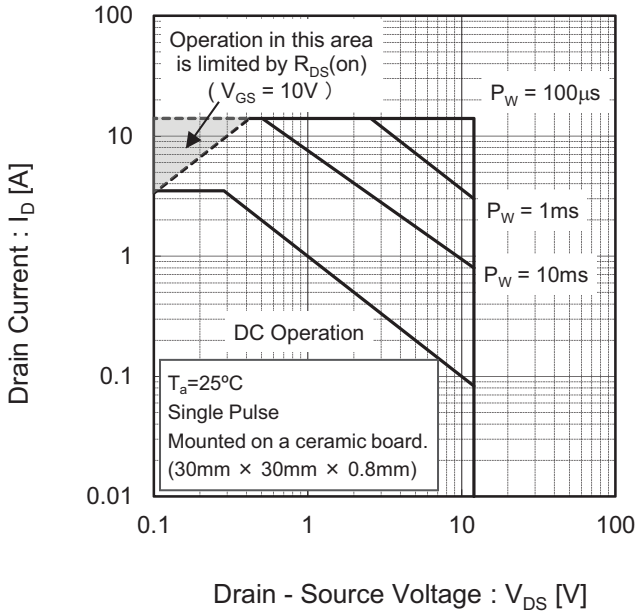


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

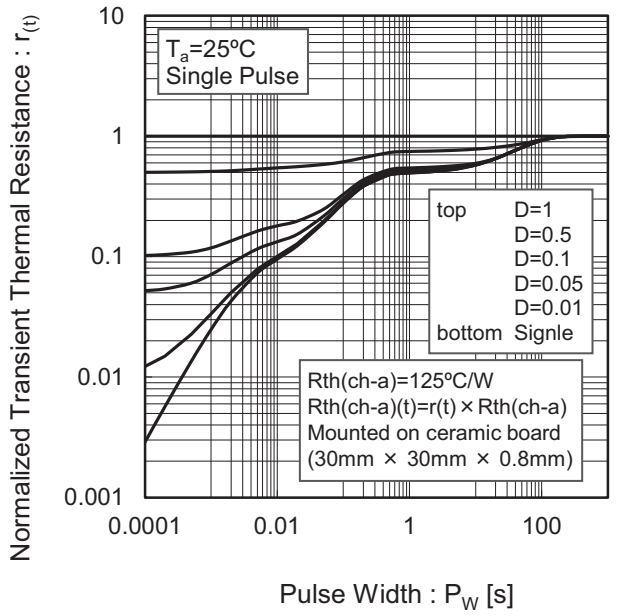
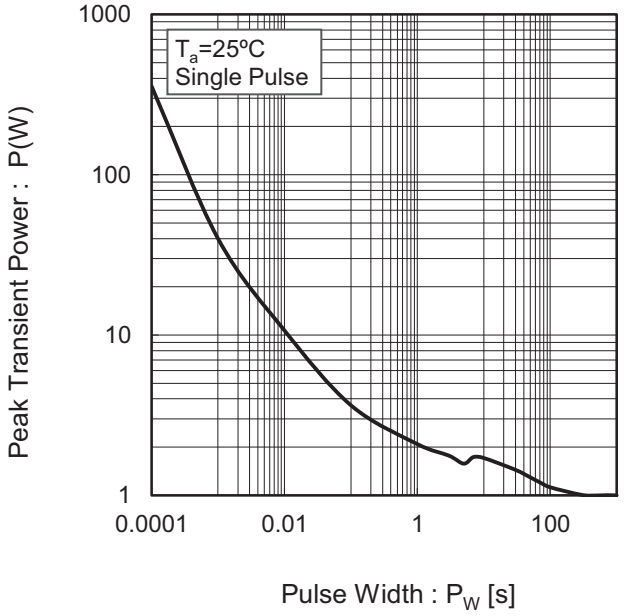


Fig.4 Single Pulse Maxmum Power dissipation



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●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

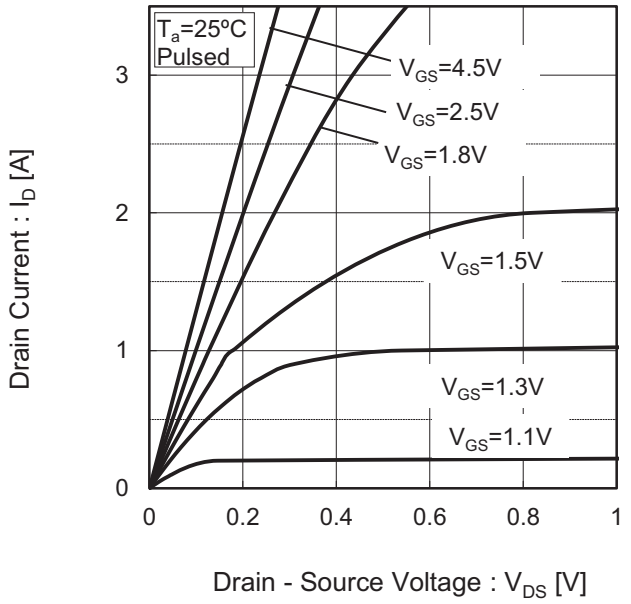


Fig.6 Typical Output Characteristics(II)

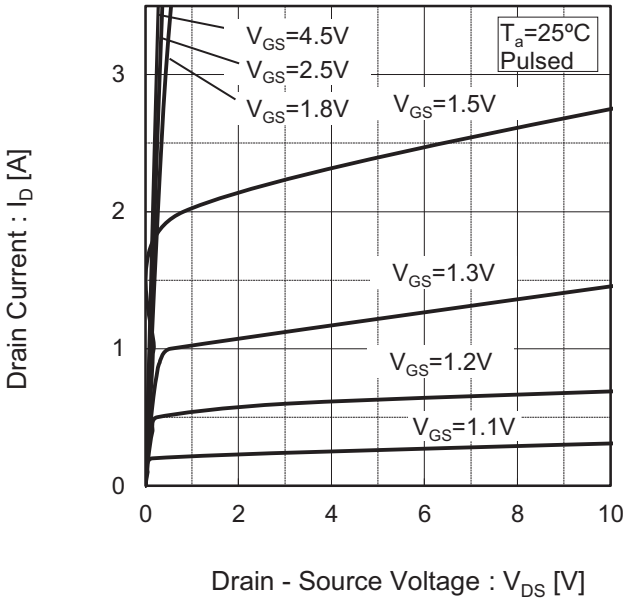


Fig.7 Breakdown Voltage vs. Junction Temperature

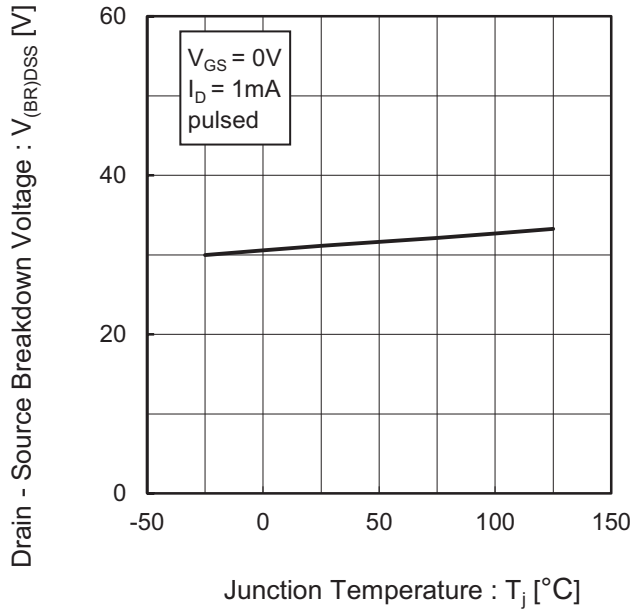
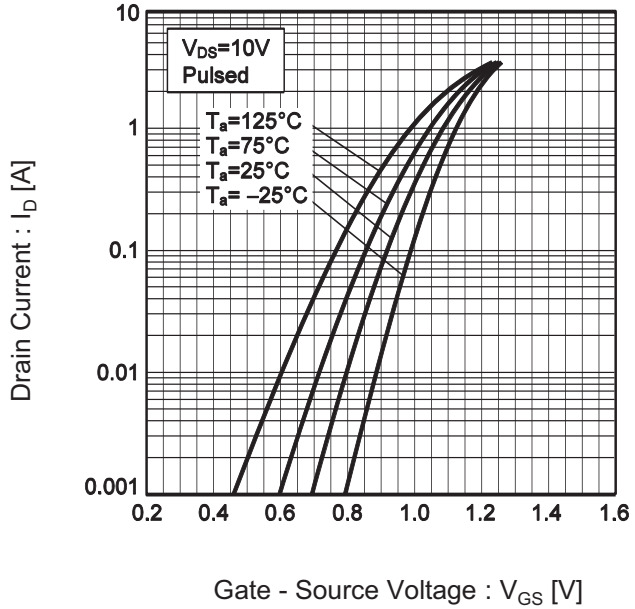


Fig.8 Typical Transfer Characteristics



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●Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Junction Temperature

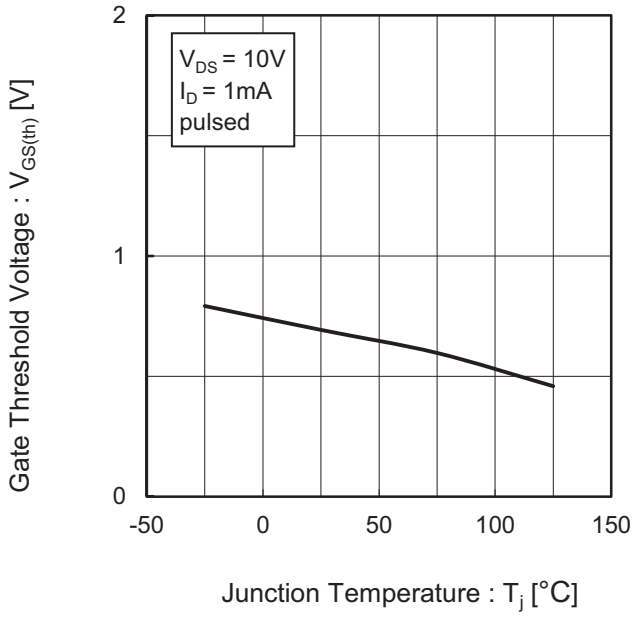


Fig.10 Transconductance vs. Drain Current

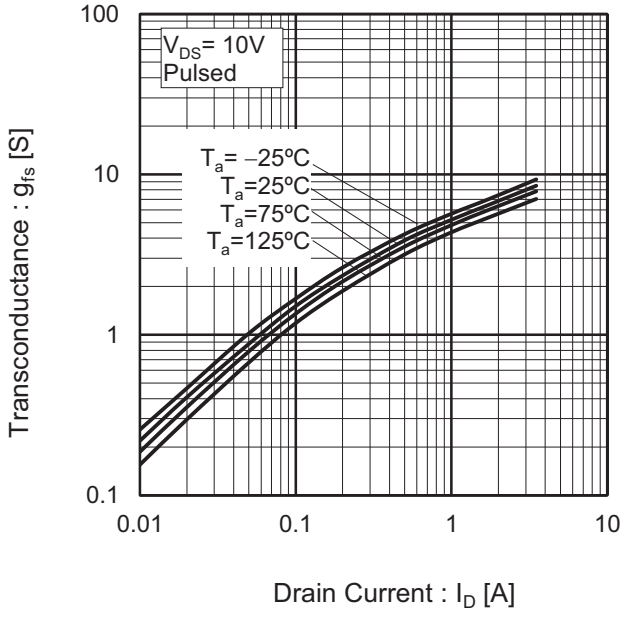


Fig.11 Drain CurrentDerating Curve

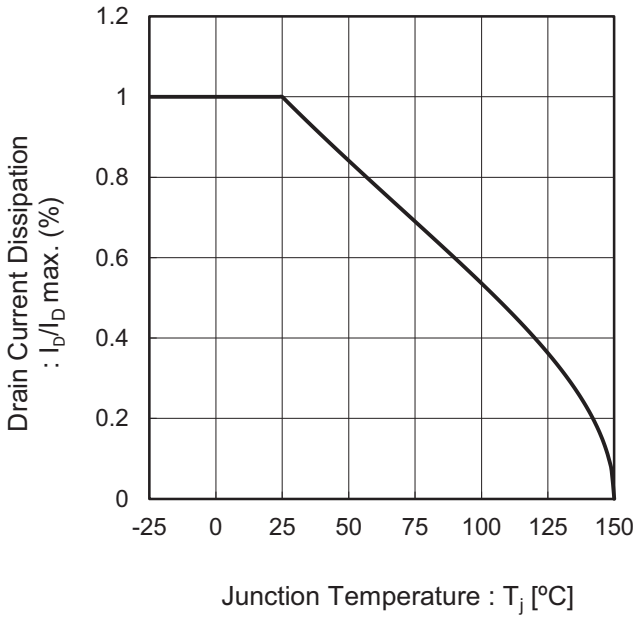
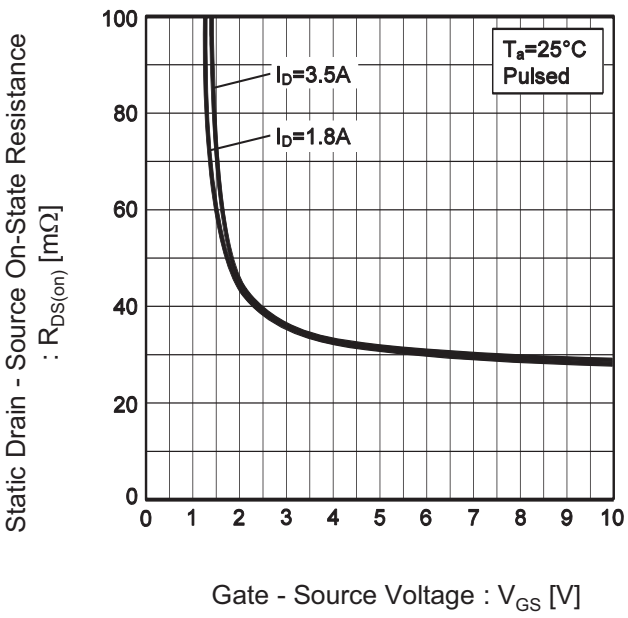


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage



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●Electrical characteristic curves

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

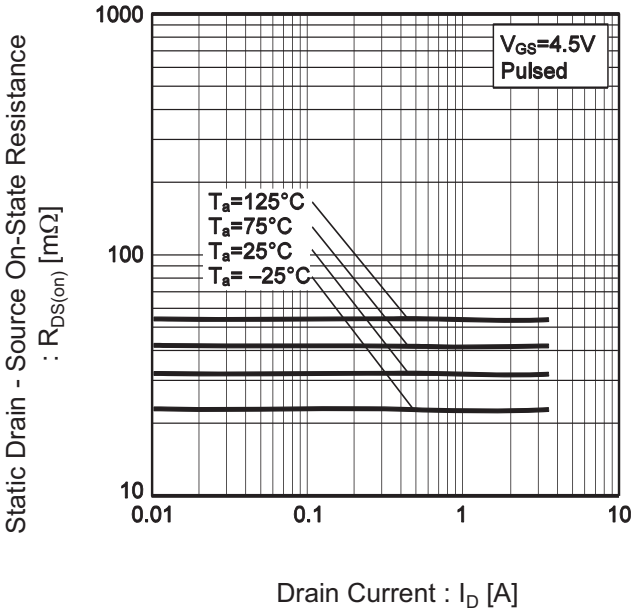
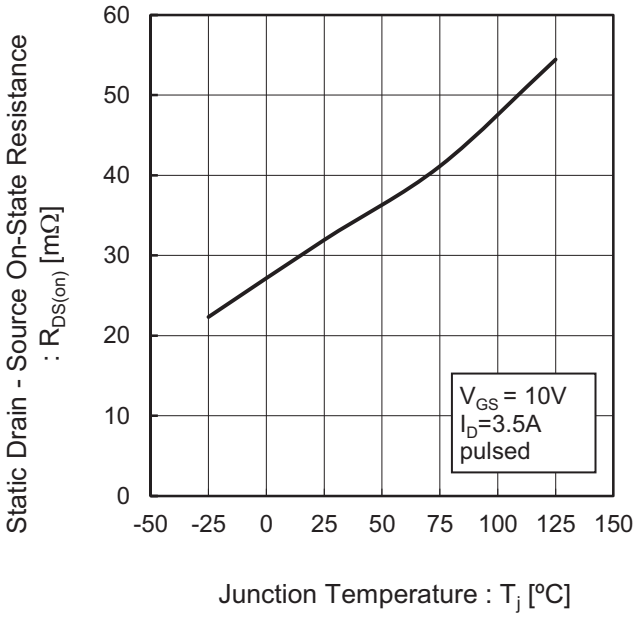


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature



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●Electrical characteristic curves

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

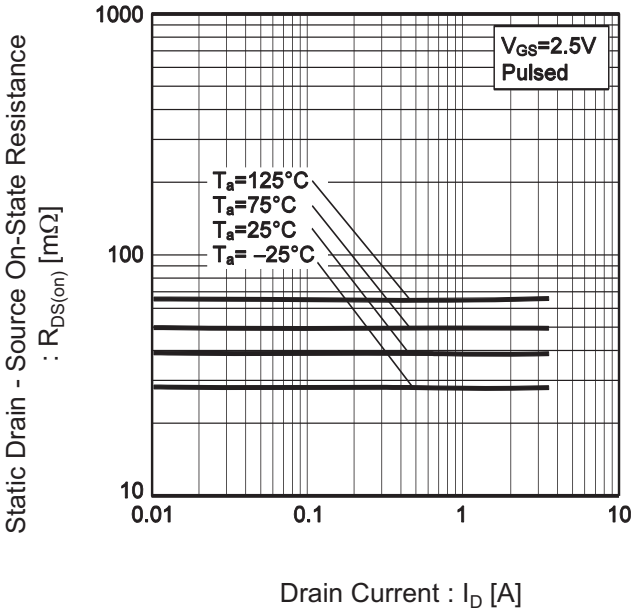


Fig.16 Static Drain-Source On-State Resistance vs. Drain Current(III)

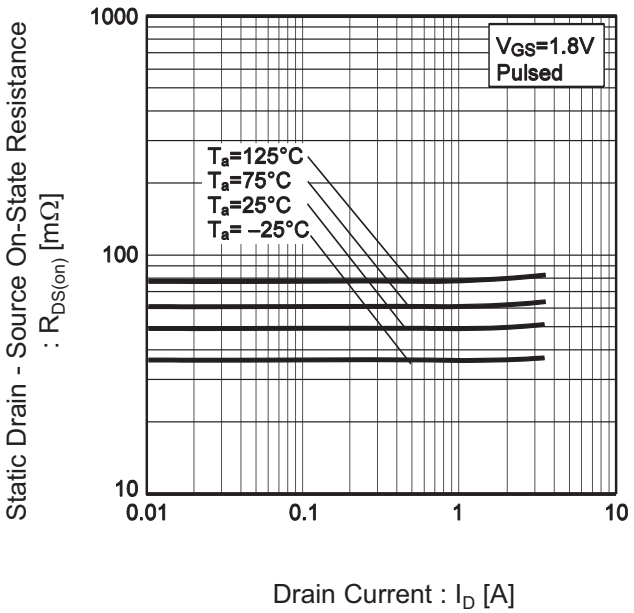


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)

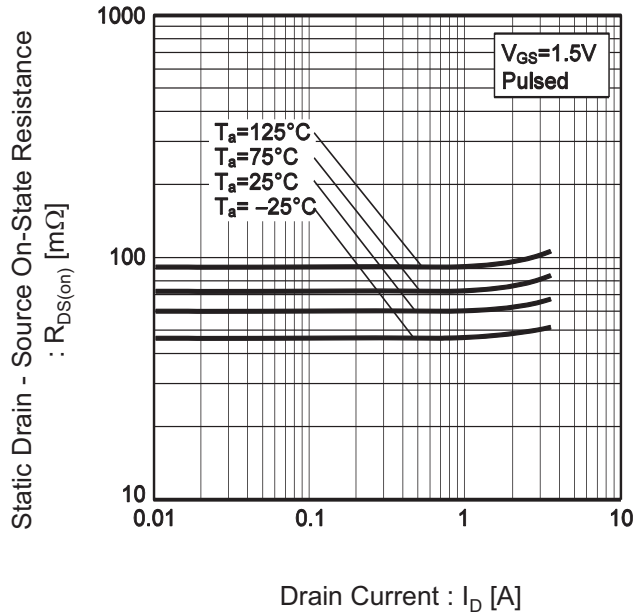
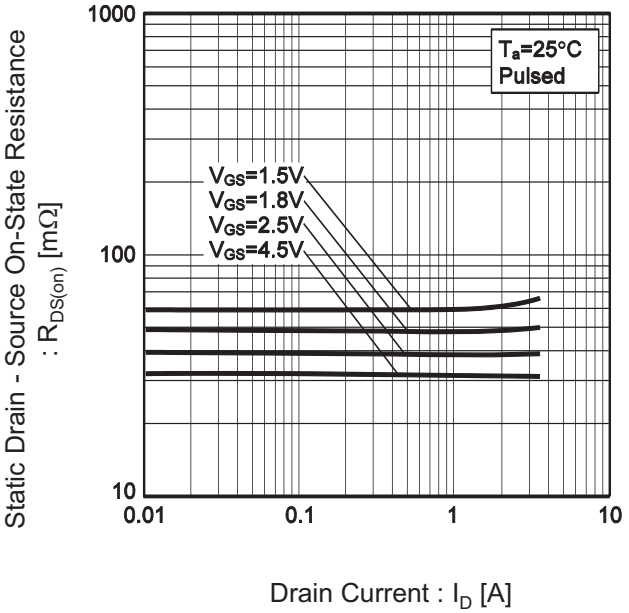


Fig.18 Static Drain - Source On - State Resistance vs. Drain Current(V)



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●Electrical characteristic curves

Fig.19 Typical Capacitance vs. Drain - Source Voltage

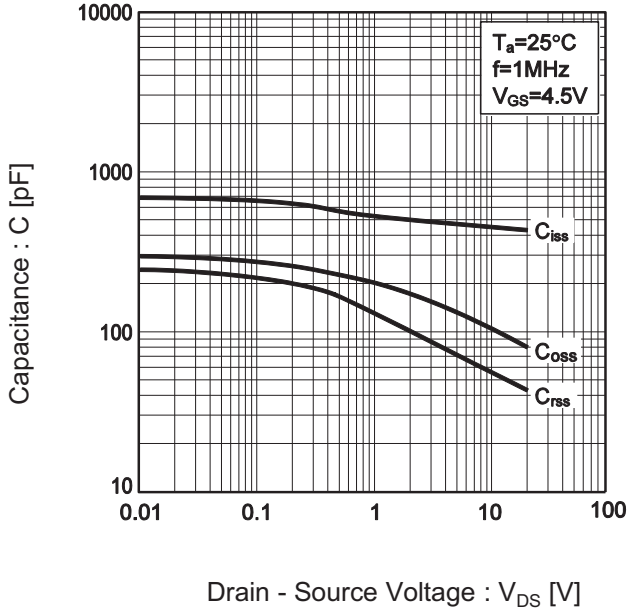


Fig.20 Switching Characteristics

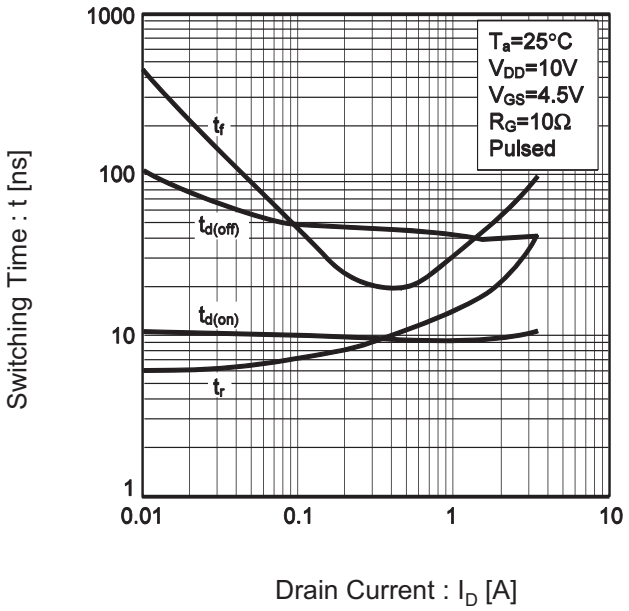


Fig.21 Dynamic Input Characteristics

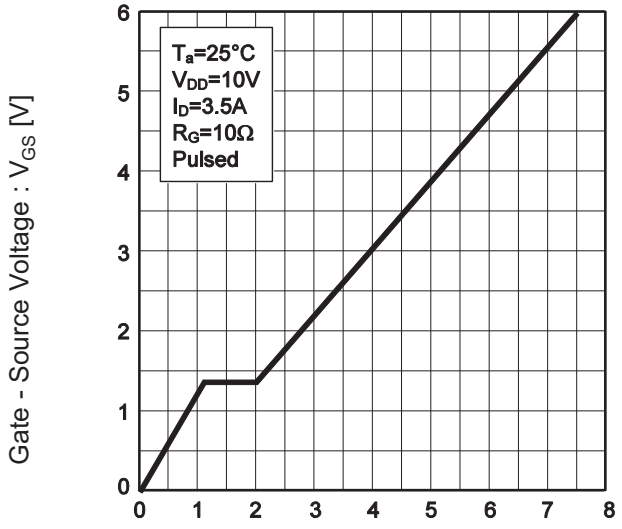
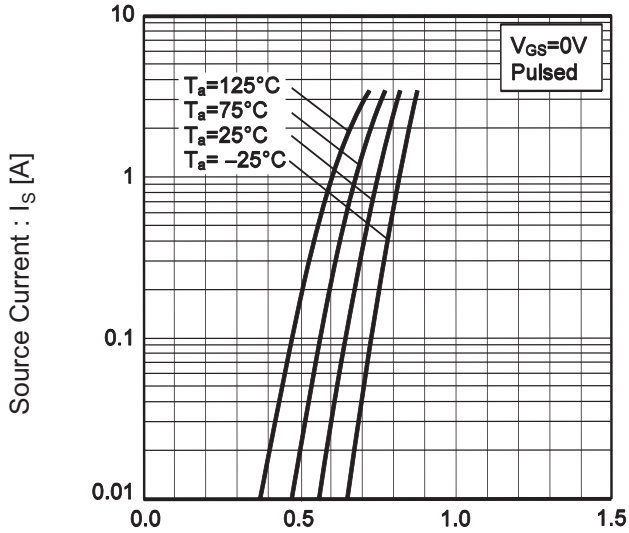


Fig.22 Source Current vs. Source Drain Voltage



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●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

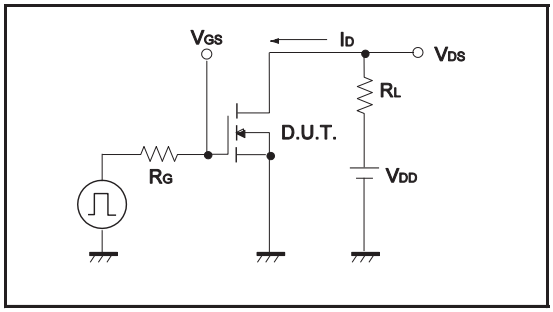


Fig.1-2 Switching Waveforms

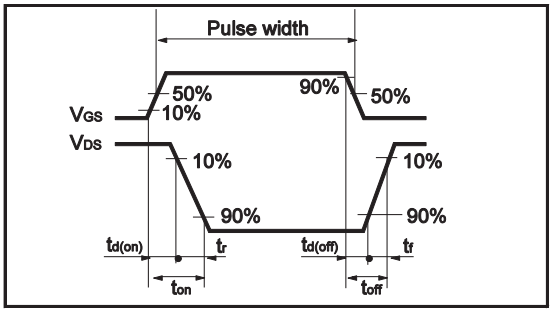


Fig.2-1 Gate Charge Measurement Circuit

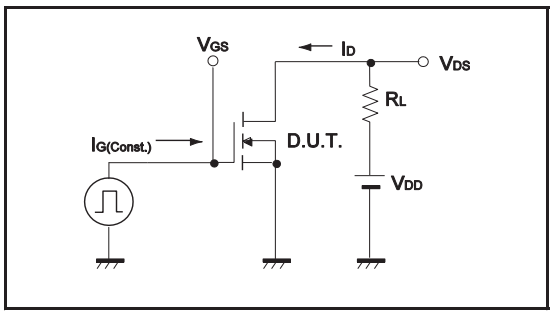
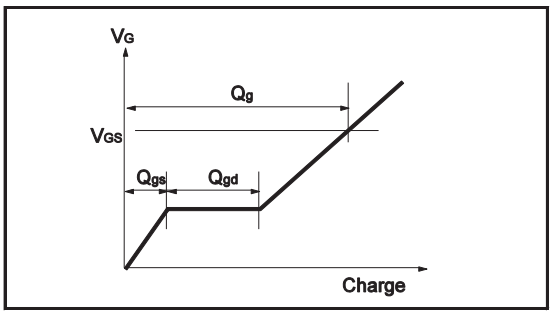


Fig.2-2 Gate Charge Waveform

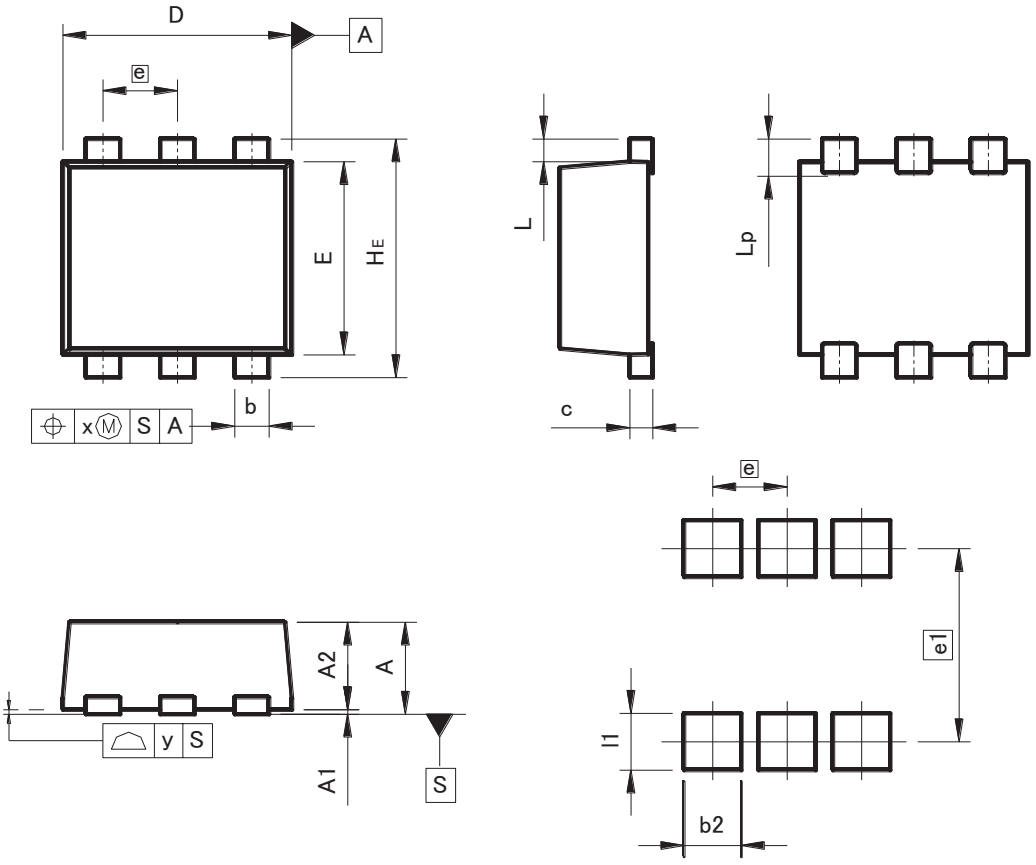


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●**Dimensions** (Unit : mm)

TUMT6



Patterm 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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