

4V+2.5V Drive Nch+Nch MOSFET

US6M1

●Structure

Silicon N-channel / P-channel MOSFET

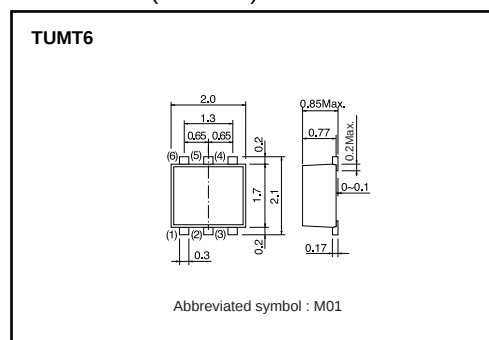
●Features

- 1) Low on-resistance.
- 2) Built-in G-S Protection Diode.
- 3) Small Surface Mount Package (TUMT6).

●Application

Power switching, DC / DC converter.

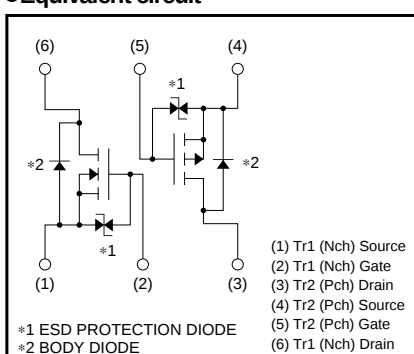
●Dimensions (Unit : mm)



●Packaging specifications

Type	Package	Taping
	Code	TR
	Basic ordering unit (pieces)	3000
US6M1		○

●Equivalent circuit



●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits		Unit
		Tr1 : Nchannel	Tr2 : Pchannel	
Drain-source voltage	V_{DS}	30	-20	V
Gate-source voltage	V_{GS}	20	-12	V
Drain current	Continuous	I_D	± 1.4	A
	Pulsed	I_{DP}^{*1}	± 5.6	A
Source current (Body diode)	Continuous	I_S	0.6	A
	Pulsed	I_{SP}^{*1}	5.6	A
Total power dissipation	P_D^{*2}	1		W / TOTAL
		0.7		W / ELEMENT
Channel temperature	T_{ch}	150		°C
Storage temperature	T_{stg}	-55 to +150		°C

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

*2 Mounted on a ceramic board.

●Thermal resistance

Parameter	Symbol	Limits	Unit
Channel to ambient	$R_{th}(ch-a)^*$	125	°C / W / TOTAL
		179	°C / W / ELEMENT

*2 Mounted on a ceramic board.

Transistors

N-ch

●Electrical characteristics (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Gate-source leakage	I _{GSS}	—	—	10	μA	V _{GS} =20V, V _{DS} =0V
Drain-source breakdown voltage	V _{(BR) DSS}	30	—	—	V	I _D =1mA, V _{GS} =0V
Zero gate voltage drain current	I _{DSS}	—	—	1	μA	V _{DS} =30V, V _{GS} =0V
Gate threshold voltage	V _{GS(th)}	1.0	—	2.5	V	V _{DS} =10V, I _D =1mA
Static drain-source on-state resistance	R _{DS(on)} *	—	170	240	mΩ	I _D =1.4A, V _{GS} =10V
		—	250	350		I _D =1.4A, V _{GS} =4.5V
		—	270	380		I _D =1.4A, V _{GS} =4V
Forward transfer admittance	Y _{fs} *	1.0	—	—	S	I _D =1.4A, V _{DS} =10V
Input capacitance	C _{iss}	—	70	—	pF	V _{DS} =10V
Output capacitance	C _{oss}	—	15	—	pF	V _{GS} =0V
Reverse transfer capacitance	C _{rss}	—	12	—	pF	f=1MHz
Turn-on delay time	t _{d(on)} *	—	6	—	ns	I _D =0.7A, V _{DD} ≐15V
Rise time	t _r *	—	6	—	ns	V _{GS} =10V
Turn-off delay time	t _{d(off)} *	—	13	—	ns	R _L =21Ω
Fall time	t _f *	—	8	—	ns	R _G =10Ω
Total gate charge	Q _g *	—	1.4	2.0	nC	V _{DD} ≐15V R _L =11Ω
Gate-source charge	Q _{gs} *	—	0.6	—	nC	V _{GS} =5V R _G =10Ω
Gate-drain charge	Q _{gd} *	—	0.3	—	nC	I _D =1.4A

*Pulsed

●Body diode characteristics (Source-Drain) (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Forward voltage	V _{SD}	—	—	1.2	V	I _S =0.6A, V _{GS} =0V

Transistors

P-ch

●Electrical characteristics (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Gate-source leakage	I _{GSS}	—	—	−10	μA	V _{GS} =12V, V _{DS} =0V
Drain-source breakdown voltage	V _{(BR) DSS}	−20	—	—	V	I _D = −1mA, V _{GS} =0V
Zero gate voltage drain current	I _{DSS}	—	—	−1	μA	V _{DS} = −20V, V _{GS} =0V
Gate threshold voltage	V _{GS(th)}	−0.7	—	−2.0	V	V _{DS} = −10V, I _D = −1mA
Static drain-source on-state resistance	R _{DS(on)} *	—	280	390	mΩ	I _D = −1A, V _{GS} = −4.5V
		—	310	430		I _D = −1A, V _{GS} = −4V
		—	570	800		I _D = −0.5A, V _{GS} = −2.5V
Forward transfer admittance	Y _{fs} *	0.7	—	—	S	I _D = −0.5A, V _{DS} = −10V
Input capacitance	C _{iss}	—	150	—	pF	V _{DS} = −10V
Output capacitance	C _{oss}	—	20	—	pF	V _{GS} =0V
Reverse transfer capacitance	C _{rss}	—	20	—	pF	f=1MHz
Turn-on delay time	t _{d(on)} *	—	9	—	ns	I _D = −0.5A, V _{DD} ≐ −15V
Rise time	t _r *	—	8	—	ns	V _{GS} = −4.5V
Turn-off delay time	t _{d(off)} *	—	25	—	ns	R _L =30Ω
Fall time	t _f *	—	10	—	ns	R _G =10Ω
Total gate charge	Q _g *	—	2.1	—	nC	V _{DD} ≐ −15V R _L =15Ω
Gate-source charge	Q _{gs} *	—	0.5	—	nC	V _{GS} = −4.5V R _G =10Ω
Gate-drain charge	Q _{gd} *	—	0.5	—	nC	I _D = −1A

*Pulsed

●Body diode characteristics (Source-Drain) (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Forward voltage	V _{SD}	—	—	−1.2	V	I _S = −0.4A, V _{GS} =0V

Transistors

N-ch

●Electrical characteristic curves

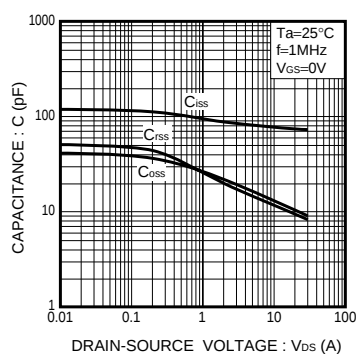


Fig.1 Typical Capacitance vs. Drain-Source Voltage

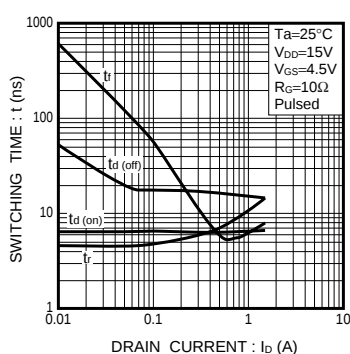


Fig.2 Switching Characteristics

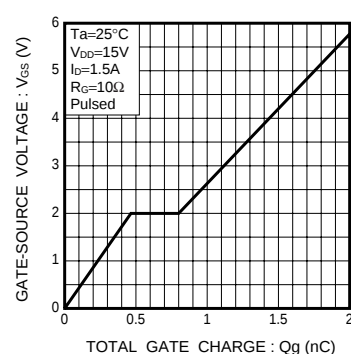


Fig.3 Dynamic Input Characteristics

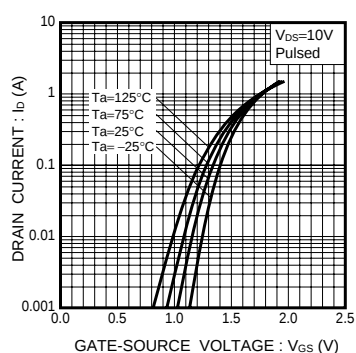


Fig.4 Typical Transfer Characteristics

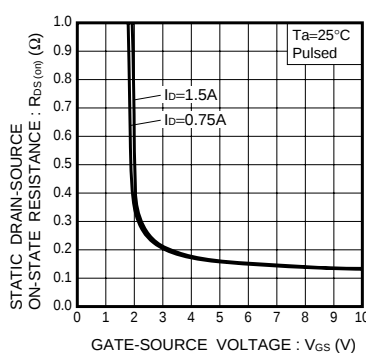


Fig.5 Static Drain-Source On-State Resistance vs. Gate-Source Voltage

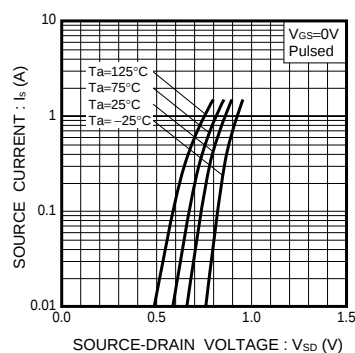


Fig.6 Source Current vs. Source-Drain Voltage

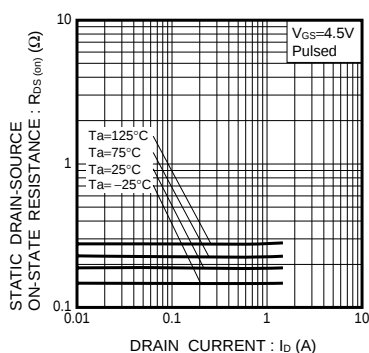


Fig.7 Static Drain-Source On-State Resistance vs. Drain Current (I)

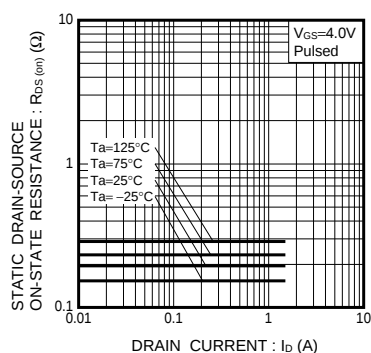


Fig.8 Static Drain-Source On-State Resistance vs. Drain Current (II)

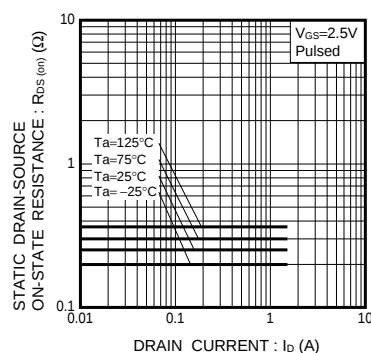


Fig.9 Static Drain-Source On-State Resistance vs. Drain Current (III)

Transistors

P-ch

●Electrical characteristic curves

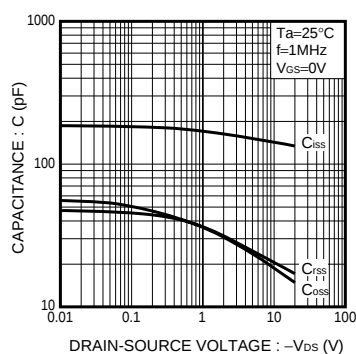


Fig.1 Typical Capacitance vs. Drain-Source Voltage

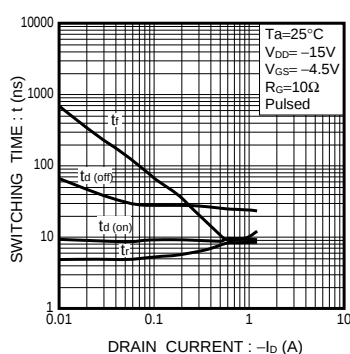


Fig.2 Switching Characteristics

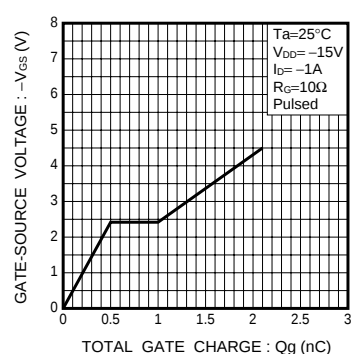


Fig.3 Dynamic Input Characteristics

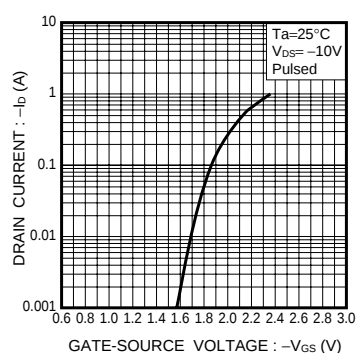


Fig.4 Typical Transfer Characteristics

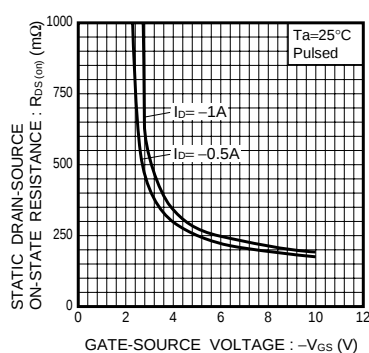


Fig.5 Static Drain-Source On-State Resistance vs. Gate-Source Voltage

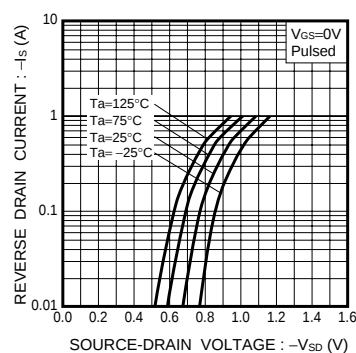


Fig.6 Source Current vs. Source-Drain Voltage

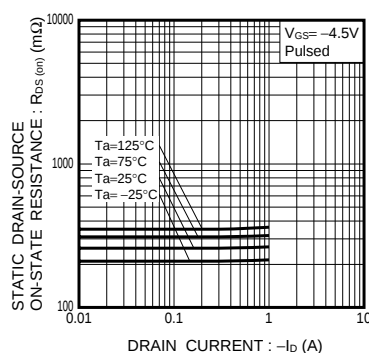


Fig.7 Static Drain-Source On-State Resistance vs. Drain Current (I)

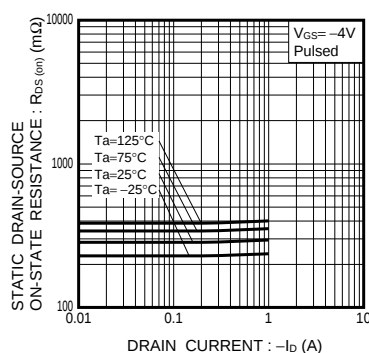


Fig.8 Static Drain-Source On-State Resistance vs. Drain Current (II)

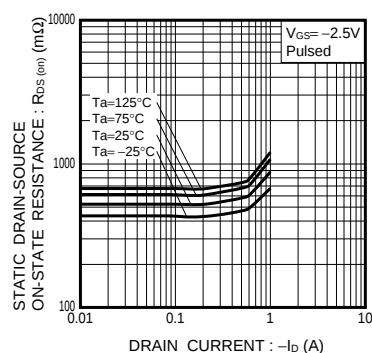


Fig.9 Static Drain-Source On-State Resistance vs. Drain Current (III)

Transistors

N-ch

●Measurement circuit

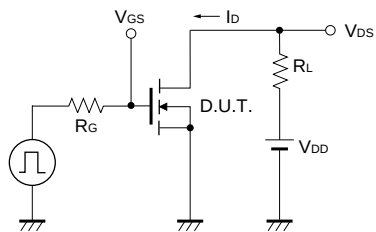


Fig.1-1 Switching Time Measurement Circuit

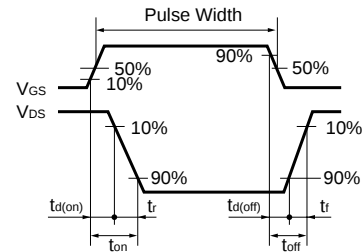


Fig.1-2 Switching Waveforms

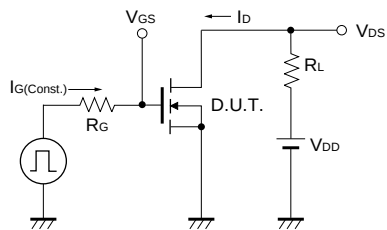


Fig.2-1 Gate Charge Measurement Circuit

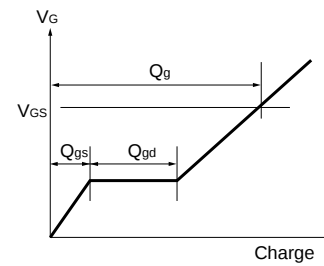


Fig.2-2 Gate Charge Waveform

Transistors

P-ch

●Measurement circuit

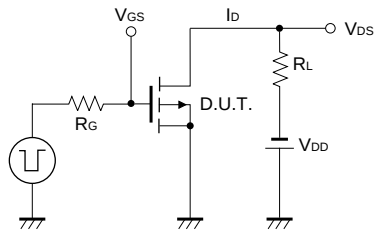


Fig.3-1 Switching Time Measurement Circuit

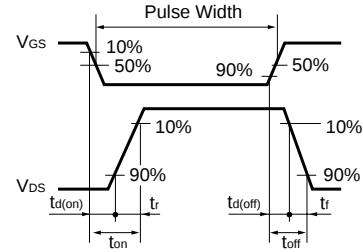


Fig.3-2 Switching Waveforms

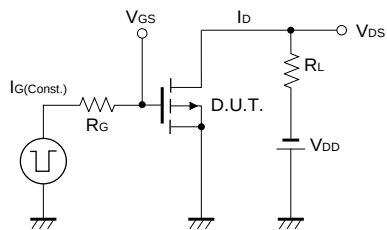


Fig.4-1 Gate Charge Measurement Circuit

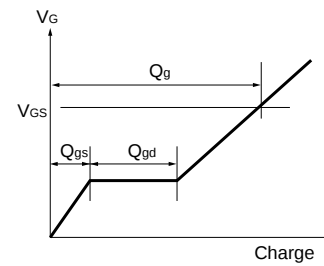


Fig.4-2 Gate Charge Waveform

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