TOSHIBA Field-Effect Transistor Silicon N / P Channel MOS Type

SSM6L39TU

- Power Management Switch Applications
- High-Speed Switching Applications

N-ch: 1.5-V driveP-ch: 1.8-V drive

• N-ch, P-ch, 2-in-1

• Low ON-resistance Q1 N-ch: $R_{on} = 247 \text{ m}\Omega \text{ (max) (@V}_{GS} = 1.5 \text{ V)}$

 $R_{on} = 190 \text{ m}\Omega \text{ (max) (@V_{GS} = 1.8 V)}$

 $R_{on} = 139 \text{ m}\Omega \text{ (max) (@V_{GS} = 2.5 V)}$

Q2 P-ch: $R_{on} = 430 \text{ m}\Omega \text{ (max) (@V}_{GS} = -1.8 \text{ V)}$

 $R_{on} = 294 \text{ m}\Omega \text{ (max) (@V_{GS} = -2.5 V)}$

Q1 Absolute Maximum Ratings (Ta = 25°C)

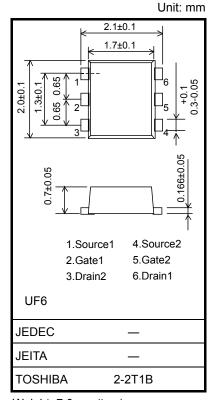
Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	20	V
Gate-source voltage		V_{GSS}	±10	V
Drain current	DC	I _D	1.6	۸
	Pulse	I _{DP}	3.2	A

Q2 Absolute Maximum Ratings (Ta = 25°C)

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Characteristics		Symbol	Rating	Unit		
Drain-source voltage		V_{DSS}	-20	V		
Gate-source voltage		V _{GSS}	±8	٧		
Drain current	DC	ID	-1.5	Α		
	Pulse	I _{DP}	-3			

Absolute Maximum Ratings (Ta = 25 °C) (Q1, Q2 Common)

<u>_</u>			
Characteristics	Symbol	Rating	Unit
Drain power dissipation	P _D (Note 1)	500	mW
Channel temperature	T _{ch}	150	°C
Storage temperature range	T _{stg}	-55 to 150	°C



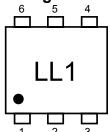
Weight: 7.0 mg (typ.)

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

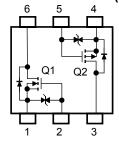
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note1: Mounted on an FR4 board. (total dissipation) (25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm²)

Marking



Equivalent Circuit (top view)



Start of commercial production 2008-01



Q1 Electrical Characteristics (Ta = 25°C)

Chara	acteristics	Symbol	Test Conditions	Min	Тур.	Max	Unit
Drain-source breakdown voltage		V _{(BR)DSS}	$I_D = 1$ mA, $V_{GS} = 0$ V	20	_	_	V
		V _{(BR) DSX}	I _D = 1 mA, V _{GS} = -10 V	12	_	_	
Drain cutoff currer	nt	I _{DSS}	V _{DS} =20 V, V _{GS} = 0 V	_	_	1	μА
Gate leakage curr	ent	I _{GSS}	$V_{GS} = \pm 10 \text{ V}, V_{DS} = 0 \text{ V}$	_	_	±1	μА
Gate threshold vo	Itage	V _{th}	$V_{DS} = 3 \text{ V}, I_D = 1 \text{ mA}$	0.35	_	1.0	V
Forward transfer a	admittance	Y _{fs}	$V_{DS} = 3 \text{ V}, I_D = 1A$ (Note 2)	2.5	5.0	_	S
			$I_D = 1 \text{ A}, V_{GS} = 4.0 \text{ V}$ (Note 2)	_	87	119	
Drain aguras ON	raciatanas	D	I _D = 1 A, V _{GS} = 2.5 V (Note 2)	_	105	139	
Drain-source ON-resistance		R _{DS} (ON)	I _D = 0.8 A, V _{GS} = 1.8 V (Note 2)		125	190	mΩ
			I _D = 0.3 A, V _{GS} = 1.5 V (Note 2)		145	247	
Input capacitance		C _{iss}	V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz		260	_	pF
Output capacitance		Coss		_	45	_	
Reverse transfer capacitance		C _{rss}		_	37	_	
Total Gate Charge		Qg	V _{DS} = 10 V, I _D = 1.6 A, V _{GS} = 4 V		7.5	_	nC
Gate-Source Charge		Q _{gs}		_	5.6	_	
Gate-Drain Charge		Q _{gd}		_	1.9	_	
Switching time	Turn-on time	t _{on}	$V_{DD} = 10 \text{ V}, I_D = 0.5 \text{ A}$ $V_{GS} = 0 \text{ to } 2.5 \text{ V}, R_G = 4.7 \Omega$	_	8.3	_	- ns
	Turn-off time	t _{off}		_	11.5	_	
Drain-source forward voltage \		V _{DSF}	$I_D = -1.6 \text{ A}, V_{GS} = 0 \text{ V}$ (Note 2)	_	-0.8	-1.2	V

Q2 Electrical Characteristics (Ta = 25°C)

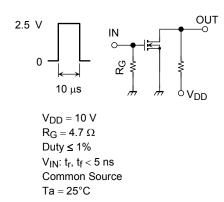
Chara	cteristics	Symbol	Test Conditions	Min	Тур.	Max	Unit
Drain-source breakdown voltage		V (BR) DSS	$I_D = -1 \text{ mA}, V_{GS} = 0 \text{ V}$	-20	_	_	V
		V (BR) DSX	$I_D = -1 \text{ mA}, V_{GS} = +8 \text{ V}$	-12	_	_	
Drain cutoff currer	nt	I _{DSS}	V _{DS} = -20 V, V _{GS} = 0 V	_	_	-10	μА
Gate leakage curr	ent	I _{GSS}	$V_{GS} = \pm 8 \text{ V}, V_{DS} = 0 \text{ V}$	_	_	±1	μА
Gate threshold vo	Itage	V _{th}	$V_{DS} = -3 \text{ V}, I_{D} = -1 \text{ mA}$	-0.3	_	-1.0	V
Forward transfer a	admittance	Y _{fs}	$V_{DS} = -3 \text{ V}, I_D = -1 \text{ A}$ (Note 2)	1.6	3.2	_	S
Drain-source ON-resistance			$I_D = -1.0 \text{ A}, V_{GS} = -4 \text{ V}$ (Note 2)	_	160	213	mΩ
		R _{DS} (ON)	$I_D = -0.8 \text{ A}, V_{GS} = -2.5 \text{ V}$ (Note 2)	_	210	294	
			$I_D = -0.1 \text{ A}, V_{GS} = -1.8 \text{ V}$ (Note 2)	_	280	430	
Input capacitance		C _{iss}		_	250	_	pF
Output capacitance		Coss	V _{DS} = -10 V, V _{GS} = 0 V, f = 1 MHz	_	43	_	
Reverse transfer capacitance		C _{rss}			35	_	
Total Gate Charge		Qg		_	6.4	_	nC
Gate-Source Charge		Q _{gs}	V _{DS} = -10 V, I _D = -1.5 A, V _{GS} = -4 V		4.5	_	
Gate-Drain Charge		Q _{gd}			1.9	_	
Switching time	Turn-on time	t _{on}	$V_{DD} = -10 \text{ V}, I_D = -1 \text{ A},$ $V_{GS} = 0 \text{ to } -2.5 \text{ V}, R_G = 4.7 \Omega$	_	12	_	
	Turn-off time	t _{off}		_	11.2	_	ns
Drain-source forward voltage		V _{DSF}	$I_D = 1.5 \text{ A}, V_{GS} = 0 \text{ V}$ (Note 2)	_	0.88	1.2	٧

Note 2: Pulse test

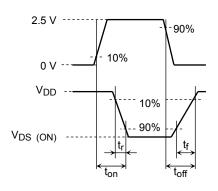
Q1 Switching Time Test Circuit

(a) Test Circuit





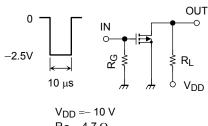




Q2 Switching Time Test Circuit

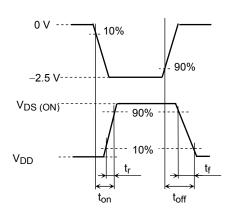
(a) Test Circuit





$$\begin{split} &V_{DD} = -\ 10\ V\\ &R_G = 4.7\ \Omega\\ &Duty \leq 1\%\\ &V_{IN} \colon t_f,\ t_f < 5\ ns \end{split}$$

 V_{IN} : t_r , $t_f < 5$ ns Common Source Ta = 25°C (c) V_{OUT}



Q1 Usage Considerations

Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (1 mA for the Q1 of the SSM6L359TU). Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th} , and $V_{GS(off)}$ must be lower than V_{th} . This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$.

Take this into consideration when using the device.

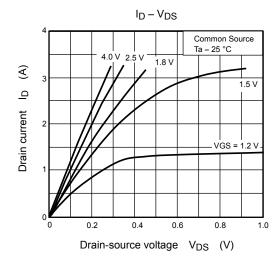
Q2 Usage Considerations

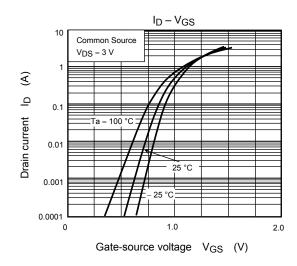
Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (-1 mA for the Q2 of the SSM6L39TU). Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th} , and $V_{GS(off)}$ must be lower than V_{th} . This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$. Take this into consideration when using the device.

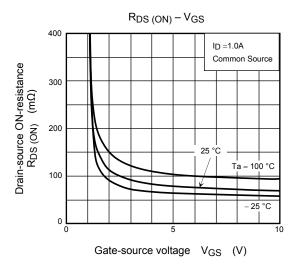
Handling Precaution

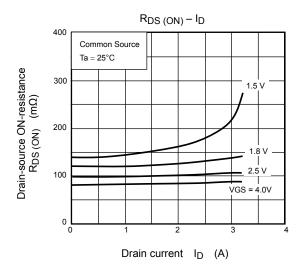
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic materials.

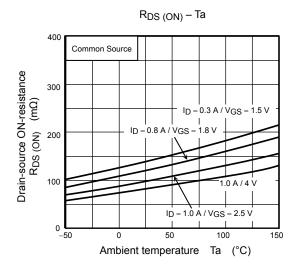
Q1 (N-ch MOSFET)

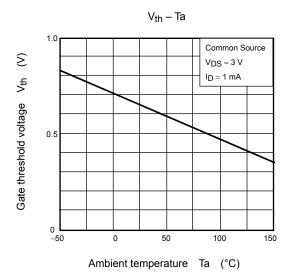




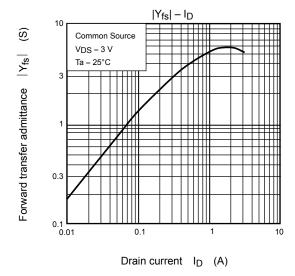


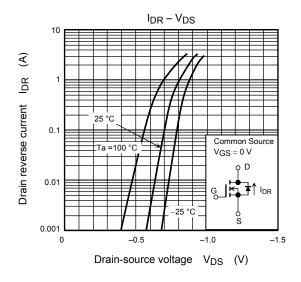


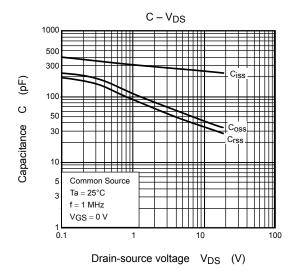


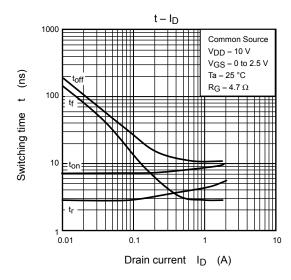


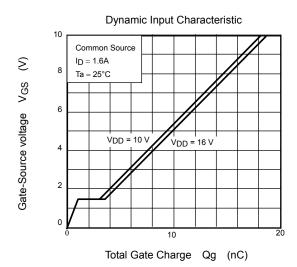
Q1 (N-ch MOSFET)



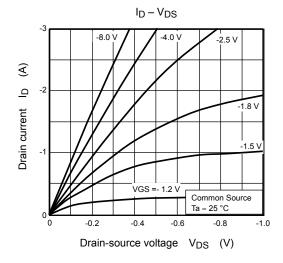


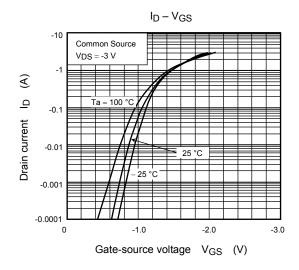


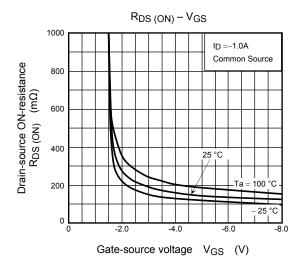


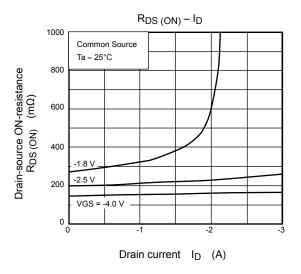


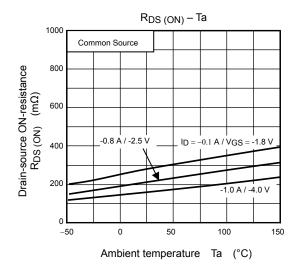
Q2 (P-ch MOSFET)

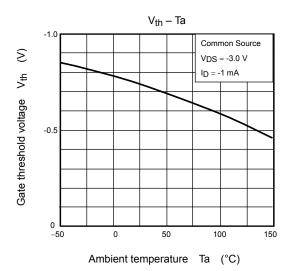






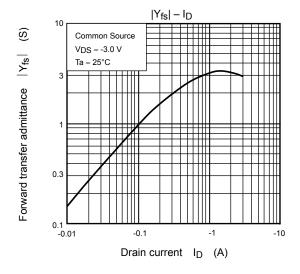


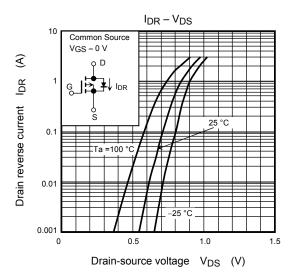


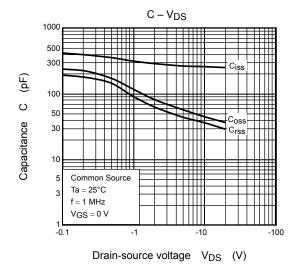


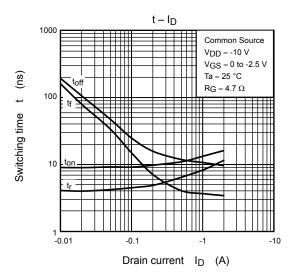
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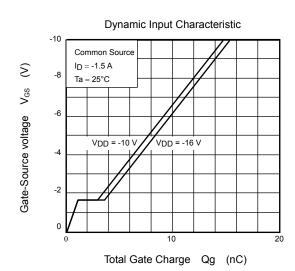
Q2 (P-ch MOSFET)



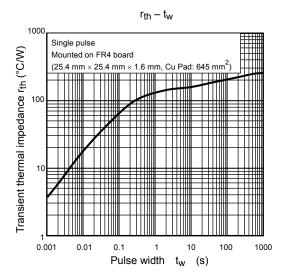


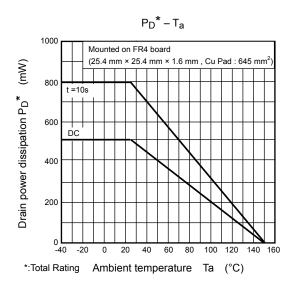






Q1,Q2 Common





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