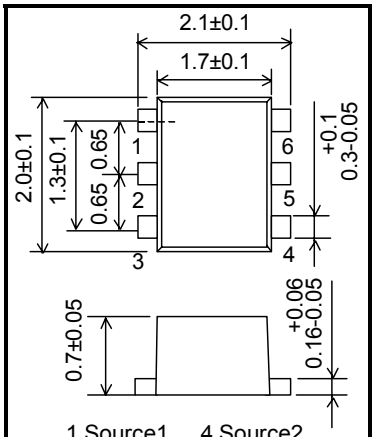
TOSHIBA Field Effect Transistor Silicon P/N Channel MOS Type

SSM6L12TU

High Speed Switching Applications

- Optimum for high-density mounting in small packages
- Low on-resistance Q1: R_{on} = 180mΩ (max) (@V_{GS} = 2.5 V)
  Q2: R_{on} = 430mΩ (max) (@V_{GS} = -2.5 V)

Unit: mm



UF6

JEDEC	—
JEITA	—
TOSHIBA	2-2T1B

Weight: 7.0 mg (typ.)

Q1 Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DS}	30	V
Gate-Source voltage		V_{GSS}	± 12	V
Drain current	DC	I_D	0.5	A
	Pulse	I_{DP}	1.5	

Q2 Maximum Ratings (Ta = 25°C)

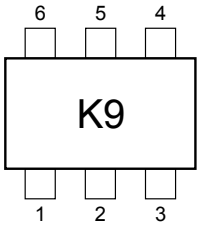
Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DS}	-20	V
Gate-Source voltage		V_{GSS}	± 12	V
Drain current	DC	I_D	-0.5	A
	Pulse	I_{DP}	-1.5	

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

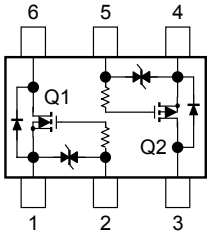
Characteristics	Symbol	Rating	Unit
Drain power dissipation	P_D (Note1)	500	mW
Channel temperature	T_{ch}	150	°C
Storage temperature range	T_{stg}	−55~150	°C

Note1: Mounted on FR4 board. (total dissipation)
(25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 645 mm^2)

Marking



Equivalent Circuit (top view)



Handling Precaution

When handling individual devices (which are not yet mounted on a circuit board), be sure that the environment is protected against electrostatic electricity. Operators should wear anti-static clothing, and containers and other objects that come into direct contact with devices should be made of anti-static materials.

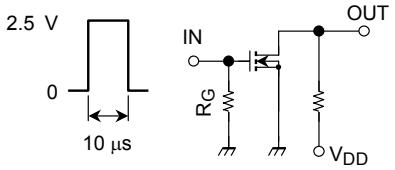
Q1 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±12 V, V_{DS} = 0	—	—	±1	μA
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 1 mA, V_{GS} = 0	30	—	—	V
		$V_{(BR)\ DSX}$	I_D = 1 mA, V_{GS} = −12 V	18	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = 30 V, V_{GS} = 0	—	—	1	μA
Gate threshold voltage		V_{th}	V_{DS} = 3 V, I_D = 0.1 mA	0.5	—	1.1	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 3 V, I_D = 0.25 A (Note2)	1.0	2.0	—	S
Drain-Source on-resistance		$R_{DS\ (ON)}$	I_D = 0.50 A, V_{GS} = 4.5 V (Note2)	—	120	145	mΩ
			I_D = 0.25 A, V_{GS} = 2.5 V (Note2)	—	140	180	
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0, f = 1 MHz	—	245	—	pF
Reverse transfer capacitance		C_{rss}	V_{DS} = 10 V, V_{GS} = 0, f = 1 MHz	—	33	—	pF
Output capacitance		C_{oss}	V_{DS} = 10 V, V_{GS} = 0, f = 1 MHz	—	41	—	pF
Switching time	Turn-on time	t_{on}	V_{DD} = 10 V, I_D = 0.25 A,	—	9	—	ns
	Turn-off time	t_{off}	V_{GS} = 0~2.5 V, R_G = 4.7 Ω	—	15	—	

Note2: Pulse test

Switching Time Test Circuit

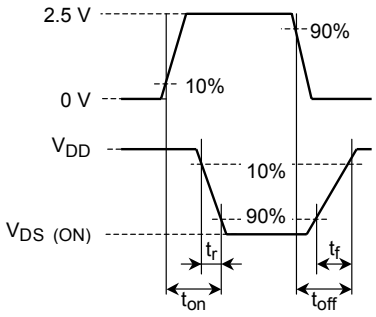
(a) Test Circuit



V_{DD} = 10 V
R_G = 4.7 Ω
D.U. ≦ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

(c) V_{OUT}



Precaution

V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D=100 μA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than V_{th} and $V_{GS\ (off)}$ requires a lower voltage than V_{th}.
(The relationship can be established as follows: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$)

Please take this into consideration when using the device. The V_{GS} recommended voltage for turning on this product is 2.5 V or higher.

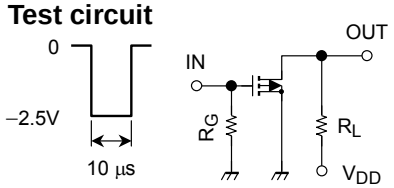
Q2 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ∓ 12V, V_{DS} = 0	—	—	±1	μA
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = -1 mA, V_{GS} = 0	-20	—	—	V
		$V_{(BR)\ DSX}$	I_D = -1 mA, V_{GS} = +12 V	-8	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0	—	—	-1	μA
Gate threshold voltage		V_{th}	V_{DS} = -3 V, I_D = -0.1 mA	-0.5	—	-1.1	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = -3 V, I_D = -0.25 A (Note3)	0.65	1.3	—	S
Drain-Source on-resistance		$R_{DS\ (ON)}$	I_D = -0.25 A, V_{GS} = -4 V (Note3)	—	210	260	mΩ
			I_D = -0.25 A, V_{GS} = -2.5 V (Note3)	—	310	430	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0, f = 1 MHz	—	218	—	pF
Reverse transfer capacitance		C_{rss}	V_{DS} = -10 V, V_{GS} = 0, f = 1 MHz	—	42	—	pF
Output capacitance		C_{oss}	V_{DS} = -10 V, V_{GS} = 0, f = 1 MHz	—	52	—	pF
Switching time	Turn-on time	t_{on}	V_{DD} = -10 V, I_D = -0.25 A,	—	16	—	ns
	Turn-off time	t_{off}	V_{GS} = 0~-2.5 V, R_G = 4.7 Ω	—	15	—	

Note3: Pulse test

Switching Time Test Circuit

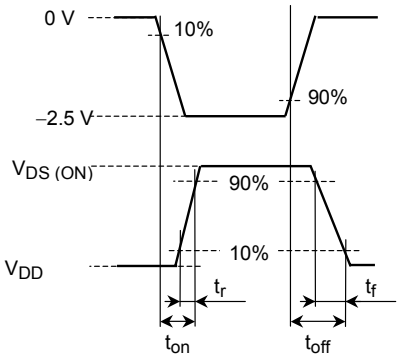
(a) Test circuit



V_{DD} = -10 V
R_G = 4.7 Ω
D.U. ≦ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

(c) V_{OUT}



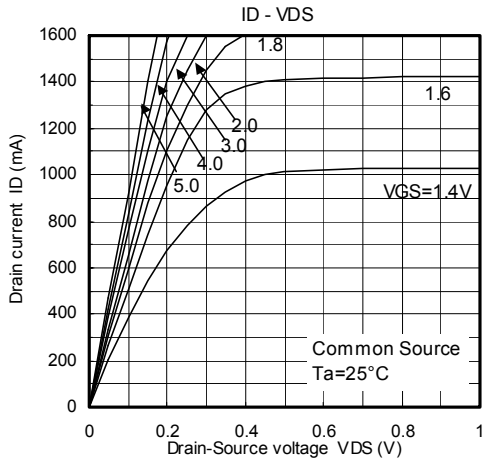
Precaution

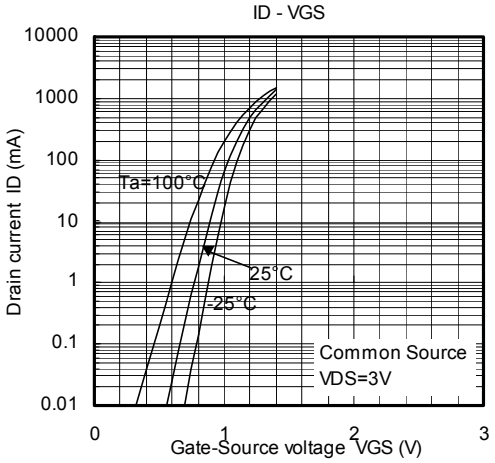
V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D=-100 μA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than V_{th} and $V_{GS\ (off)}$ requires a lower voltage than V_{th}.
(The relationship can be established as follows: $V_{GS\ (off)}$ < V_{th} < $V_{GS\ (on)}$)

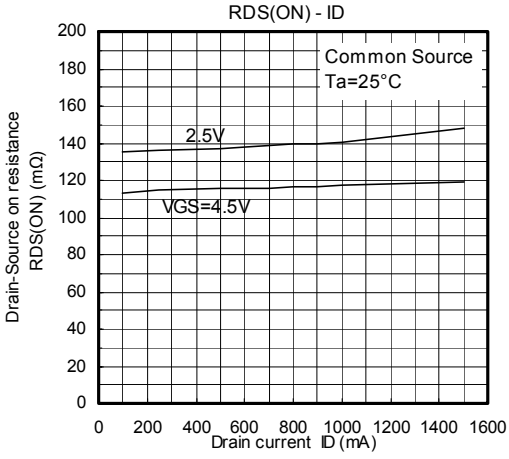
Please take this into consideration when using the device. The V_{GS} recommended voltage for turning on this product is -2.5 V or higher.

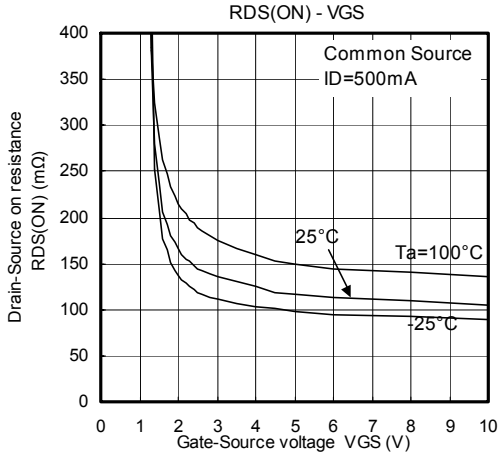
.

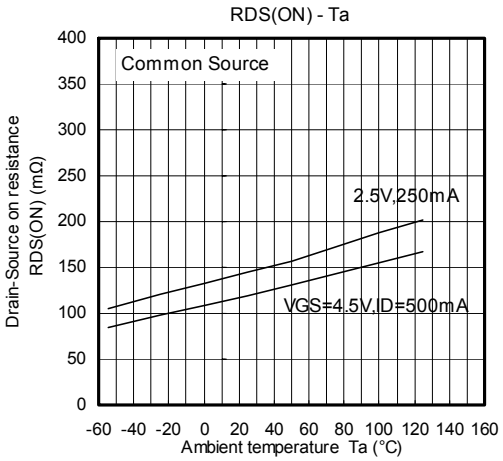
Q1(Nch MOS FET)

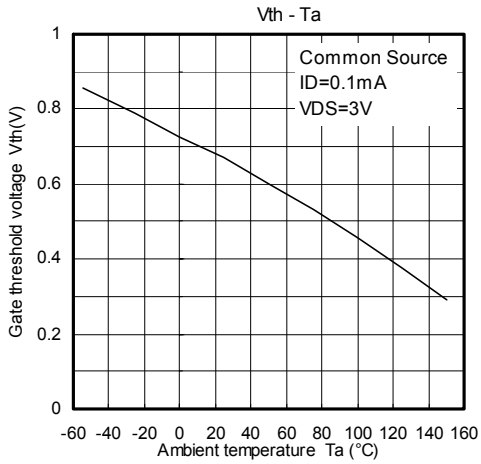




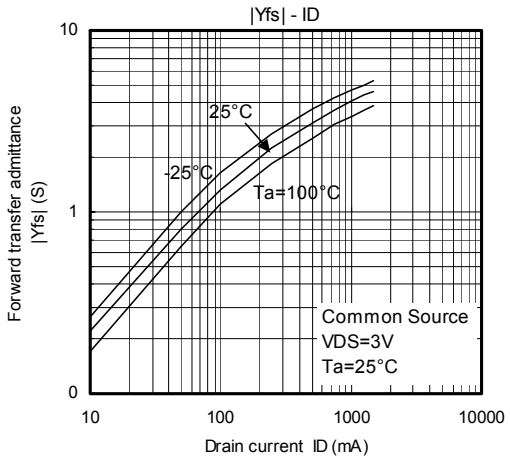


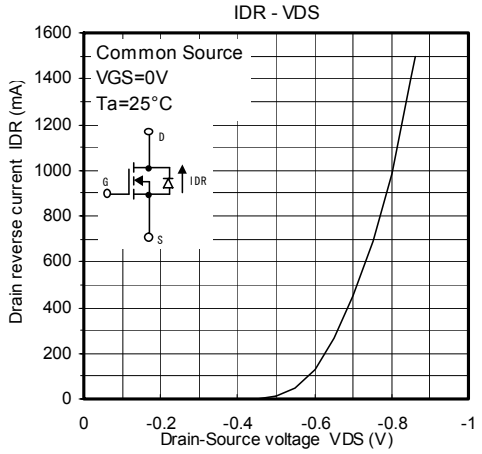


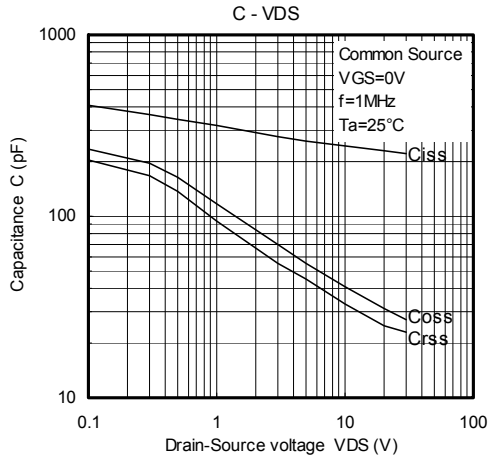


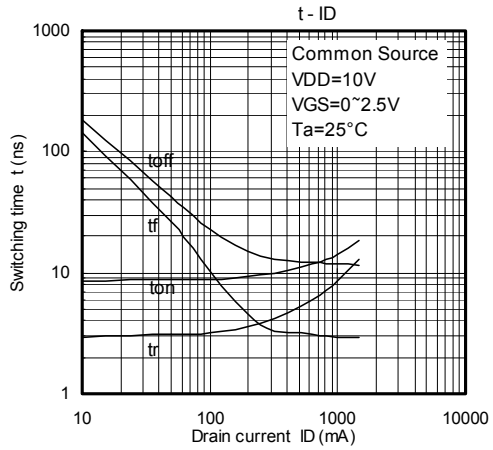


Q1(Nch MOS FET)

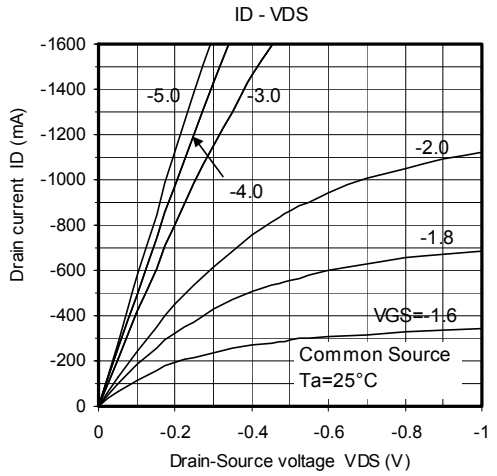


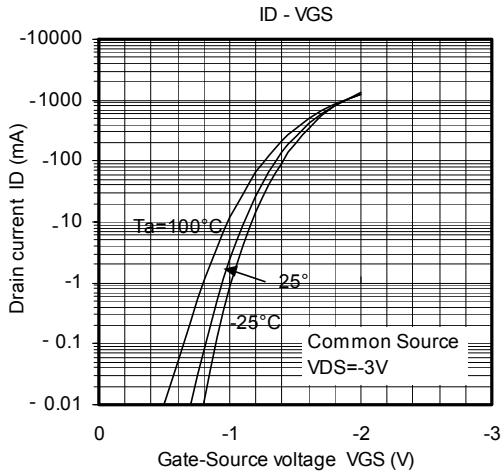


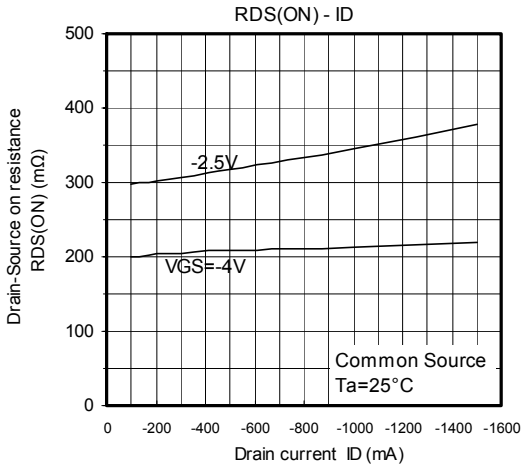


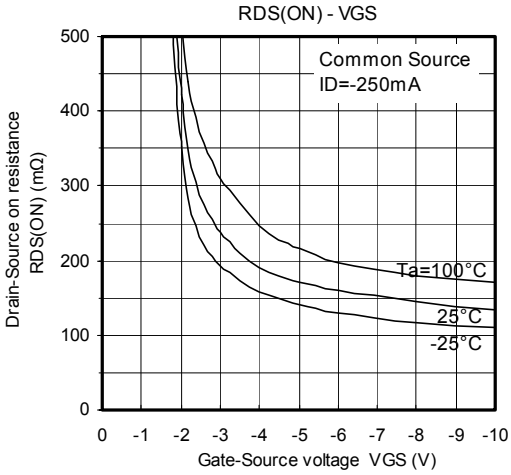


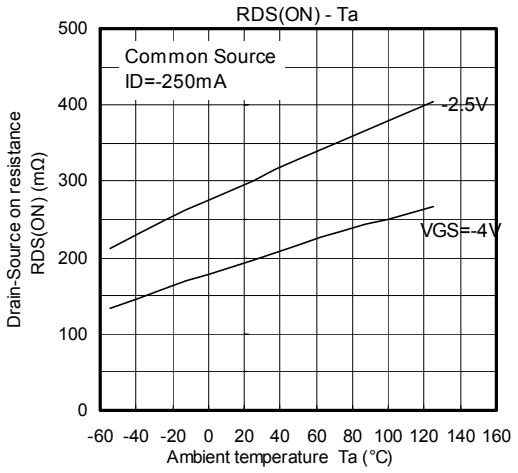
Q2(Pch MOS FET)

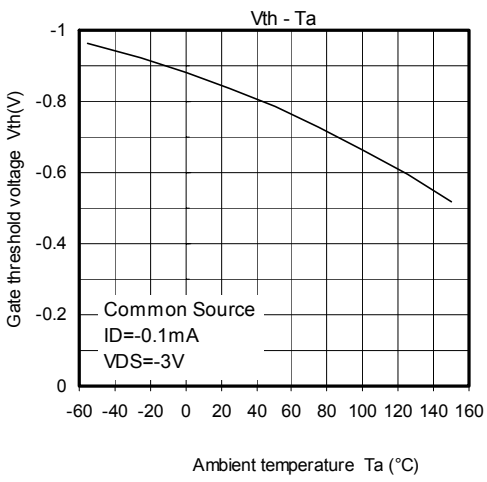




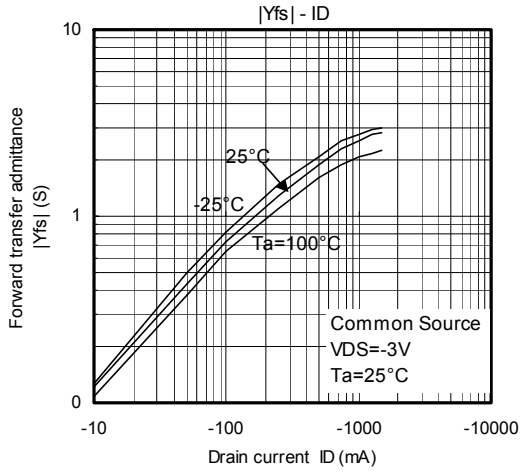


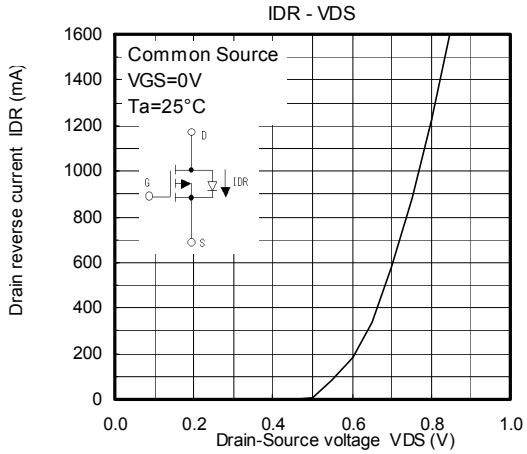


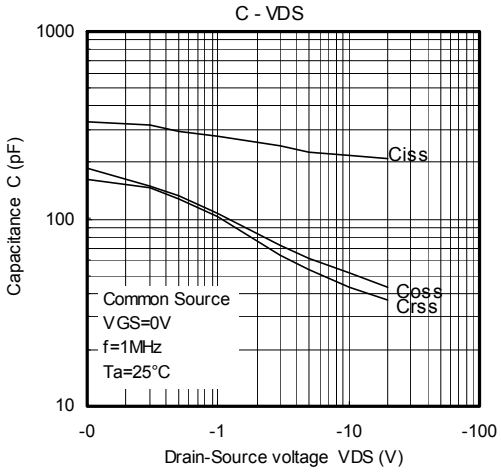


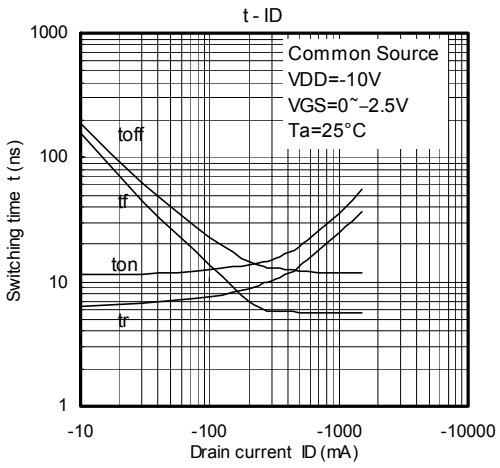


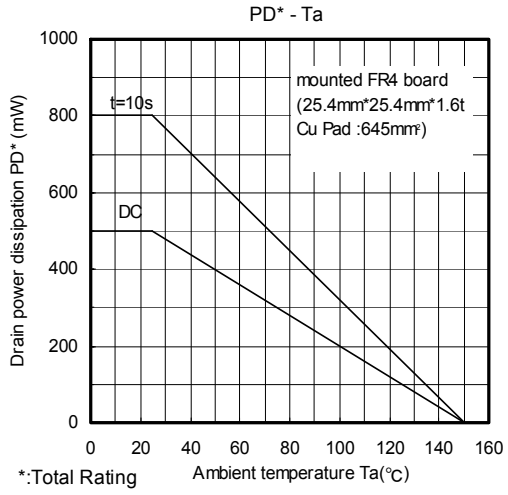
Q2(Pch MOS FET)



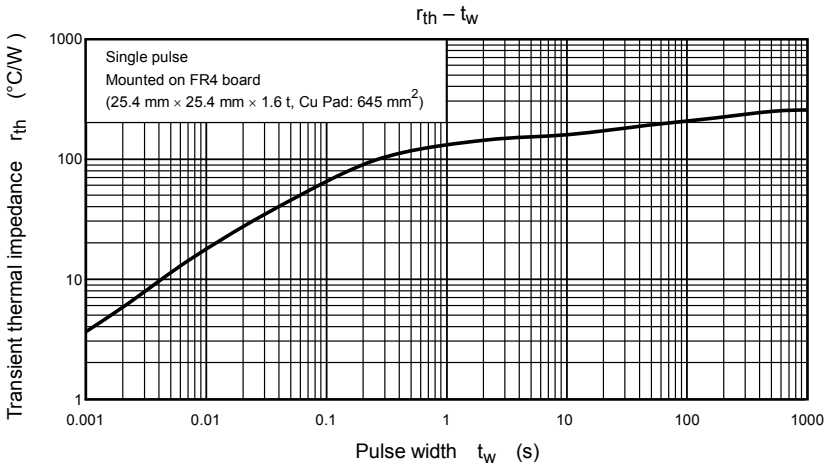








*:Total Rating


$r_{th} - t_w$
Single pulse
Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 645 mm²)
Transient thermal impedance r_{th} (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width t_w (s)

RESTRICTIONS ON PRODUCT USE

030619EAA

- The information contained herein is subject to change without notice.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.