

TOSHIBA Multi-Chip Device  
Silicon P-Channel MOS Type (U-MOS II) + N-Channel MOS Type (Planer)

# SSM6E01TU

## Load Switch Applications

- P-channel MOSFET and N-channel MOSFET incorporated into one package.
- Low power dissipation due to P-channel MOSFET that features low  $R_{DS}$  (ON) and low-voltage operation

### Q1 Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Drain-Source voltage	$V_{DS}$	-12	V
Gate-Source voltage	$V_{GSS}$	$\pm 12$	V
Drain current	DC	$I_D$	A
	Pulse	$I_{DP}$ (Note 2)	

### Q2 Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Drain-Source voltage	$V_{DS}$	20	V
Gate-Source voltage	$V_{GSS}$	10	V
Drain current	DC	$I_D$	A
	Pulse	$I_{DP}$ (Note 2)	

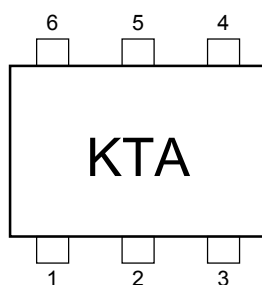
### Maximum Ratings (Q1, Q2 common) ( $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Drain power dissipation	$P_D$ (Note 1)	0.5	W
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	-55~150	$^\circ\text{C}$

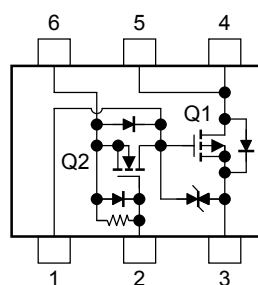
Note 1: Mounted on an FR4 board ( $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ t}$ , Cu pad:  $645\text{ mm}^2$ )

Note 2: Pulse width limited by maximum channel temperature.

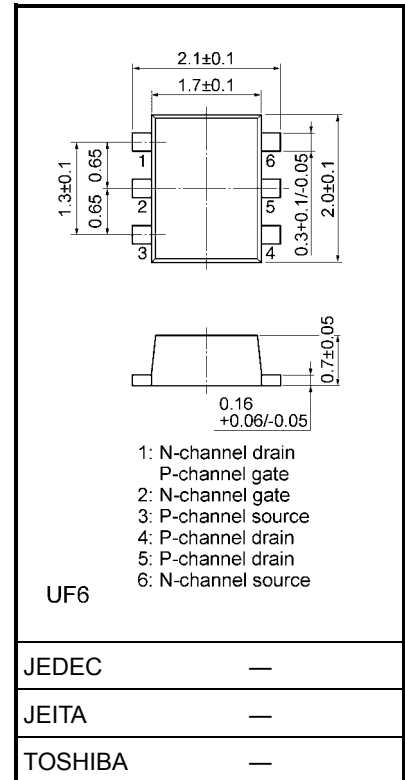
## Marking



## Equivalent Circuit (top view)



Unit: mm



Weight: 7.0 mg (typ.)

**Handling Precaution**

This product has a MOS structure and is sensitive to electrostatic discharge. When handling individual devices (that have not yet been mounted on a PCB), ensure that the environment is protected against static electricity. Operators should wear anti-static clothing, containers and other objects which may come into direct contact with devices should be made of anti-static materials.

Thermal resistance  $R_{th(j-a)}$  and drain power dissipation  $P_D$  vary depending on board material, board area, board thickness and pad area. When using this device, please take heat dissipation into consideration.

## Q1 Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 1.0 \text{ A}$ , $V_{GS} = 0 \text{ V}$	—	—	1.2	V
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 10 \text{ V}$ , $V_{DS} = 0$	—	—	$\pm 1$	$\mu\text{A}$
Drain-Source breakdown voltage	$V_{(BR)DSS}$	$I_D = -1 \text{ mA}$ , $V_{GS} = 0$	-12	—	—	V
Drain cut-off current	$I_{DSS}$	$V_{DS} = -12 \text{ V}$ , $V_{GS} = 0$	—	—	-1	$\mu\text{A}$
Gate threshold voltage	$V_{th}$	$V_{DS} = -3 \text{ V}$ , $I_D = -0.1 \text{ mA}$	-0.4	—	-1.1	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = -3 \text{ V}$ , $I_D = -0.5 \text{ A}$ (Note 3)	1.3	2.5	—	S
Drain-Source ON resistance	$R_{DS(ON)}$	$I_D = -0.5 \text{ A}$ , $V_{GS} = -4 \text{ V}$ (Note 3)	—	125	160	$\text{m}\Omega$
		$I_D = -0.5 \text{ A}$ , $V_{GS} = -2.5 \text{ V}$ (Note 3)	—	180	240	
Input capacitance	$C_{iss}$	$V_{DS} = -10 \text{ V}$ , $V_{GS} = 0$ , $f = 1 \text{ MHz}$	—	310	—	pF

Note 3: Pulse test

## Q2 Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = 10 \text{ V}$ , $V_{DS} = 0$	—	—	15	$\mu\text{A}$
Drain-Source breakdown voltage	$V_{(BR)DSS}$	$I_D = 0.1 \text{ mA}$ , $V_{GS} = 0$	20	—	—	V
Drain cut-off current	$I_{DSS}$	$V_{DS} = 20 \text{ V}$ , $V_{GS} = 0$	—	—	1	$\mu\text{A}$
Gate threshold voltage	$V_{th}$	$V_{DS} = 3 \text{ V}$ , $I_D = 0.1 \text{ mA}$	0.7	—	1.3	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 3 \text{ V}$ , $I_D = 10 \text{ mA}$ (Note 3)	25	50	—	mS
Drain-Source ON resistance	$R_{DS(ON)}$	$I_D = 10 \text{ mA}$ , $V_{GS} = 2.5 \text{ V}$ (Note 3)	—	4	10	$\Omega$
Input capacitance	$C_{iss}$	$V_{DS} = 3 \text{ V}$ , $V_{GS} = 0$ , $f = 1 \text{ MHz}$	—	11	—	pF
Gate-Source resistance	$R_{GS}$	$V_{GS} = 0 \sim 10 \text{ V}$	0.7	1.0	1.3	$\text{M}\Omega$

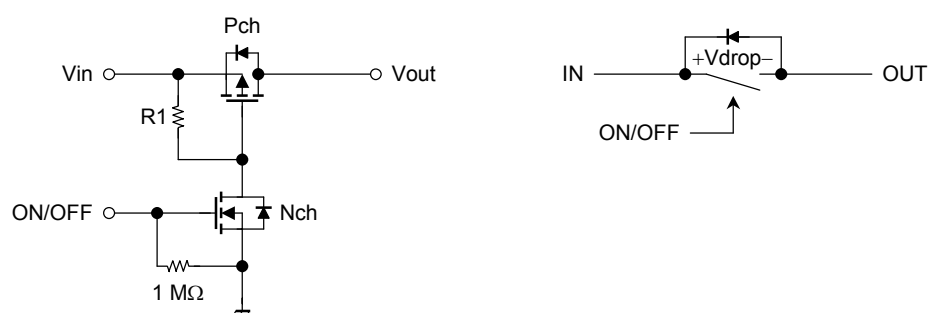
Note 3: Pulse test

## Precaution

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

Please take this into consideration for using the device. 2.5 V or higher is recommended for  $V_{GS}$  voltage to turn on the N-channel MOSFET of this product.

## Load Switch Application



## Load Switch Ratings (Ta = 25°C)

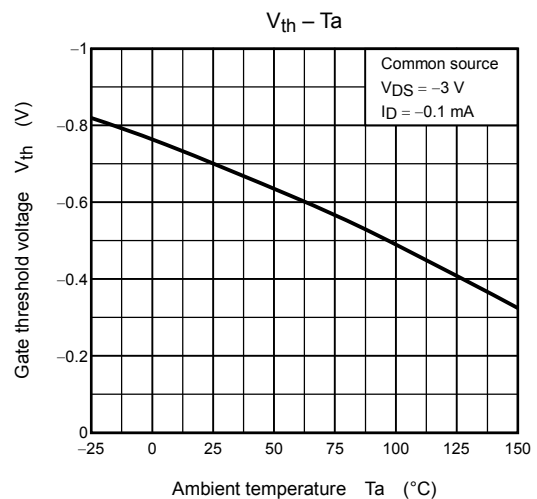
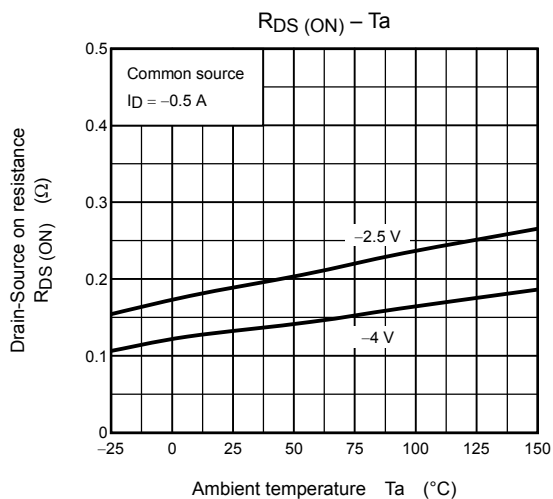
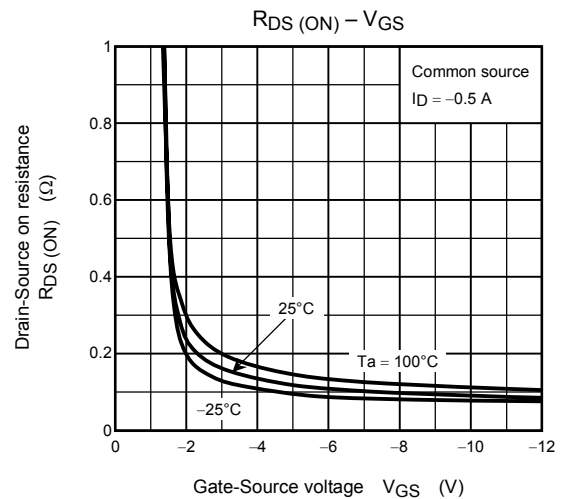
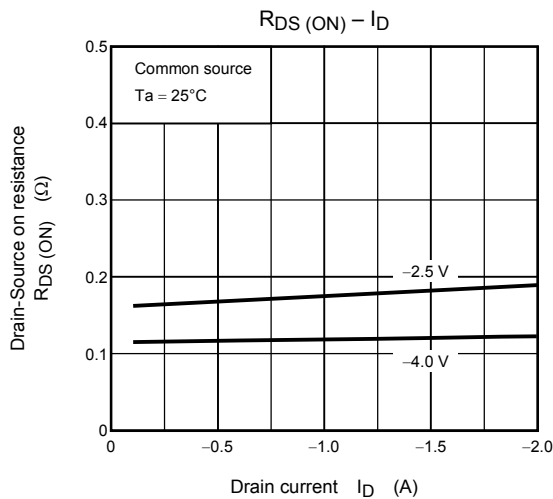
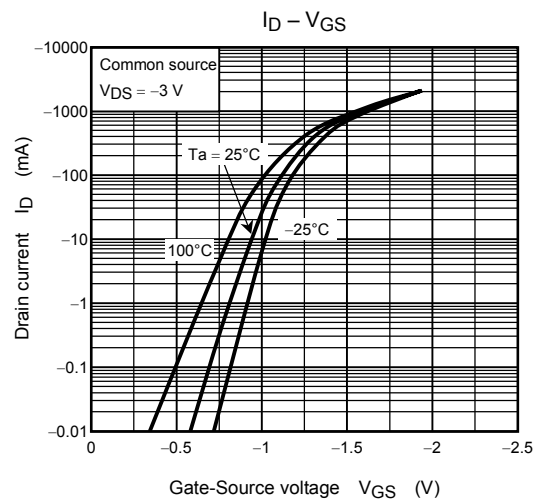
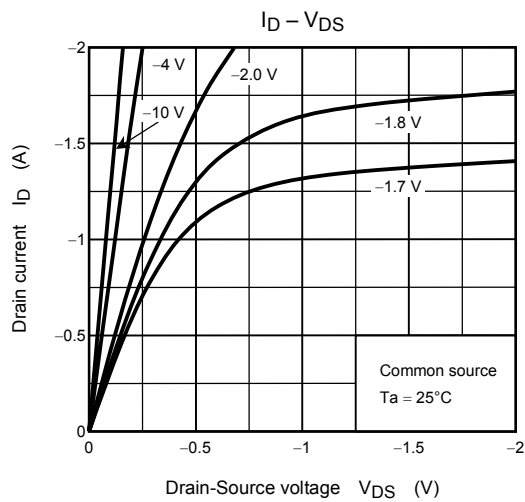
Characteristics	Symbol	Rating	Unit
Input voltage	$V_{in}$	2.5~12	V
ON/OFF voltage	$V_{on/off}$	2.5~10	V
Load current (DC)	$I_L$	1	A
Load current (pulse)	$I_{LP}$ (Note 4)	2	A
Channel temperature	$T_{ch}$	150	°C

Note 4: Pulse width limited by maximum channel temperature.

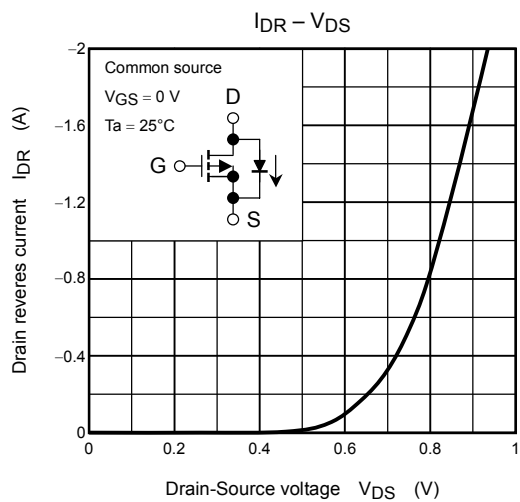
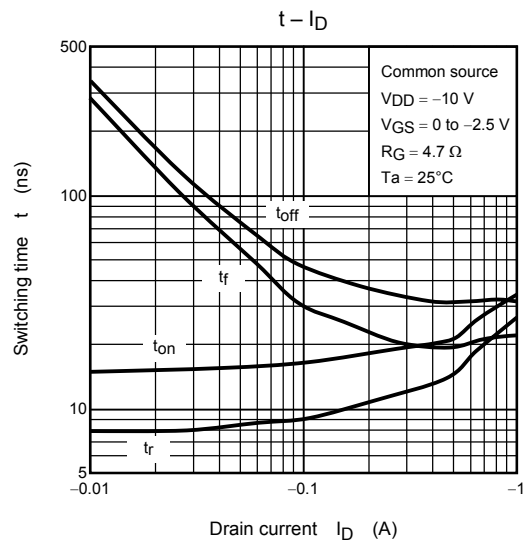
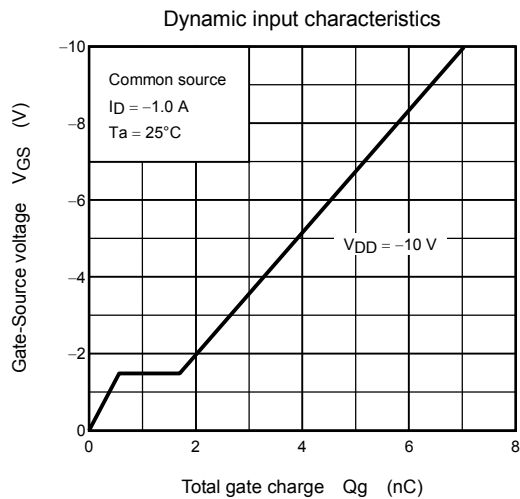
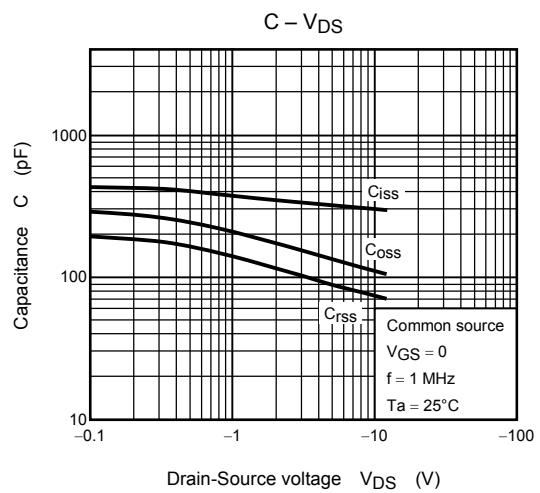
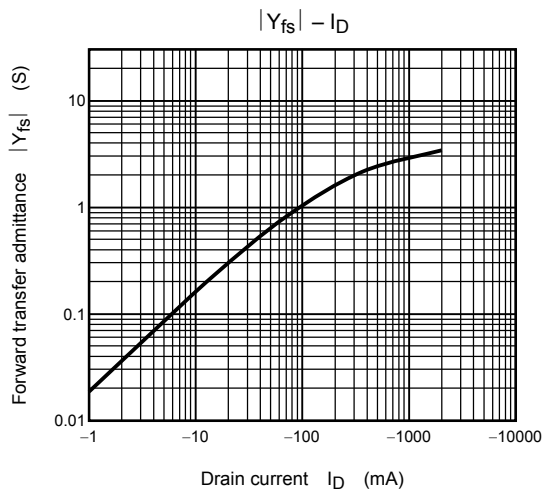
## Load Switch Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Leakage current	$I_{FL}$	$V_{in} = 8\text{ V}$ , $V_{ON/OFF} = 0$	—	—	1	$\mu\text{A}$
P-channel drop voltage	$V_{DROP (1)}$	$V_{in} = 3.0\text{ V}$ , $V_{ON/OFF} = 2.5\text{ V}$ , $I_L = 0.5\text{ A}$	—	0.09	0.12	V
	$V_{DROP (2)}$	$V_{in} = 5.0\text{ V}$ , $V_{ON/OFF} = 2.5\text{ V}$ , $I_L = 1.0\text{ A}$	—	0.13	0.16	
N-channel drive voltage	$V_{on/off}$	$V_{DS} = 3\text{ V}$ , $I_D = 0.1\text{ mA}$	0.7	—	1.3	V

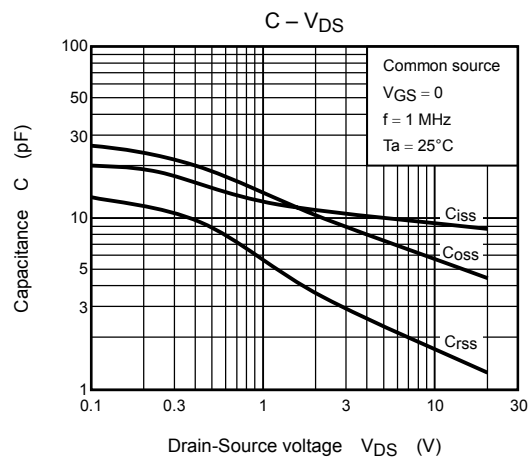
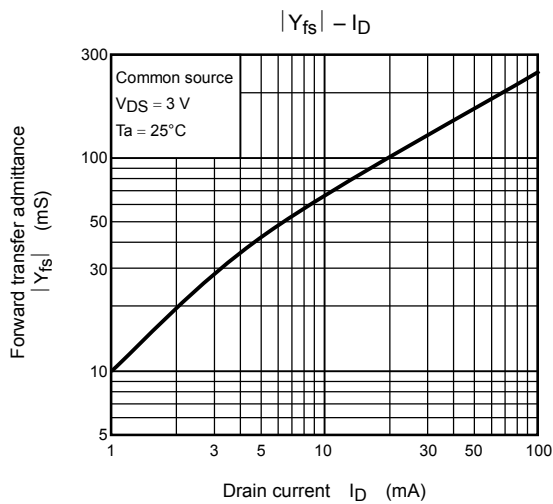
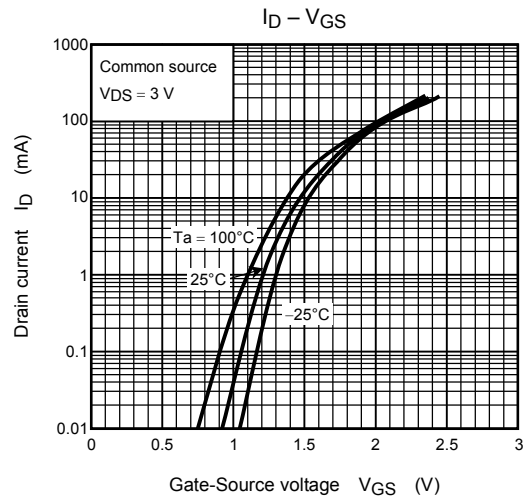
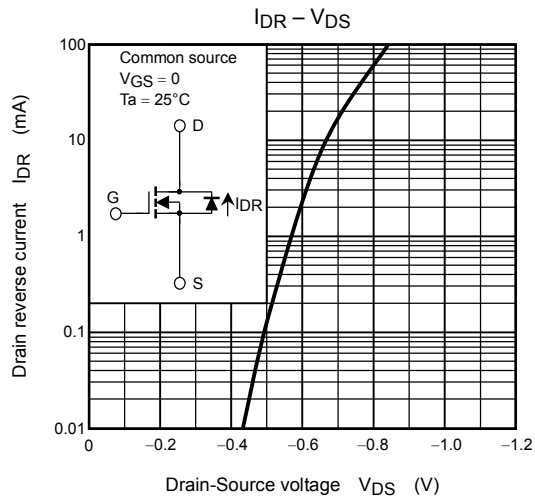
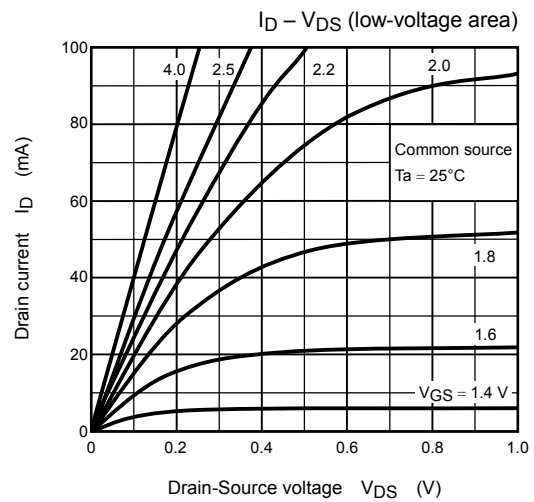
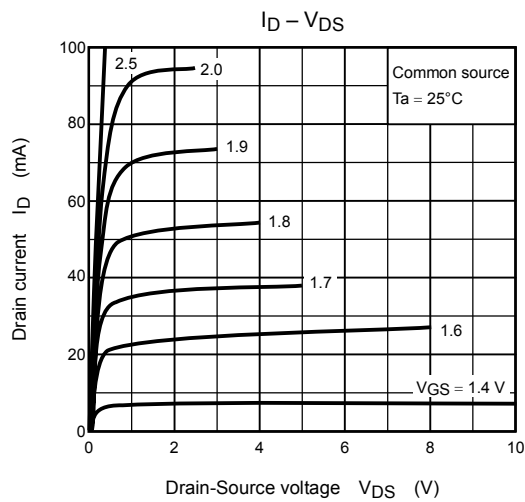
## Q1 (Pch MOSFET)



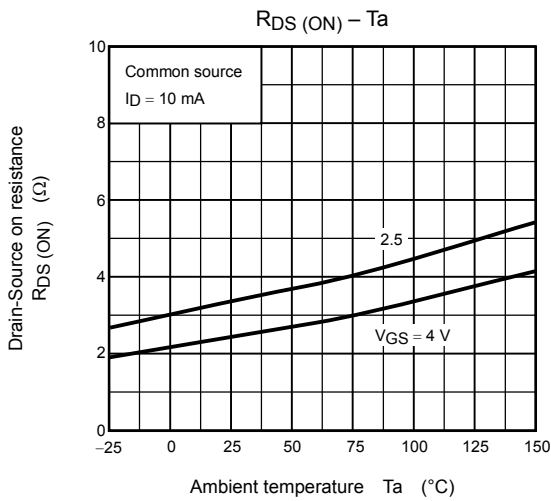
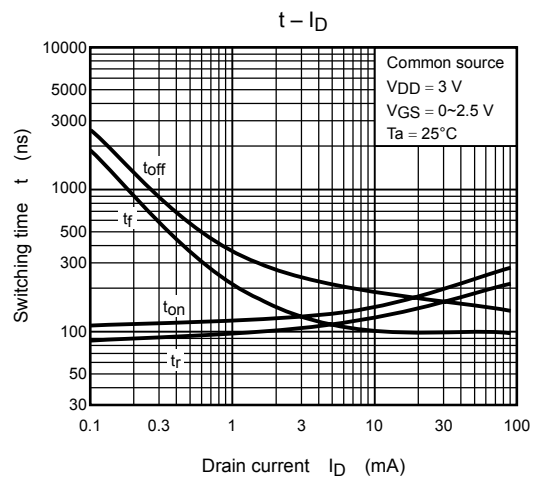
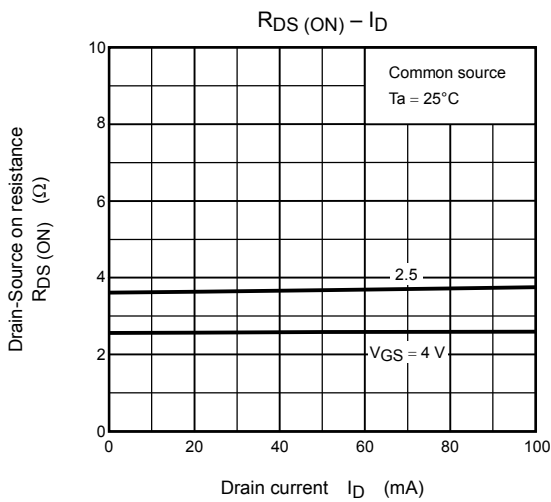
## Q1 (Pch MOSFET)



## Q2 (Nch MOSFET)



Q2 (Nch MOSFET)



**RESTRICTIONS ON PRODUCT USE**

000707EAA

- 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.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.