

TOSHIBA Field Effect Transistor Silicon N/P Channel MOS Type

# SSM6L09FU

Power Management Switch  
High Speed Switching Applications

- Small package
- Low on resistance      Q1:  $R_{on} = 0.7 \Omega$  (max) (@ $V_{GS} = 10 V$ )  
                                    Q2:  $R_{on} = 2.7 \Omega$  (max) (@ $V_{GS} = -10 V$ )

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

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		$V_{DS}$	30	V
Gate-Source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC	$I_D$	400	mA
	Pulse	$I_{DP}$	800	

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

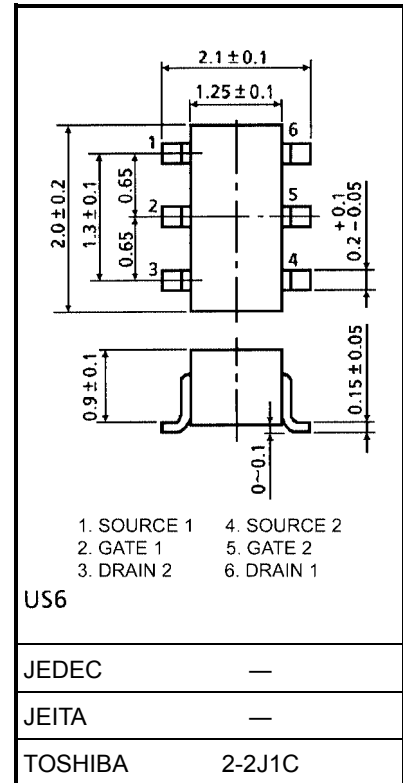
Characteristics		Symbol	Rating	Unit
Drain-Source voltage		$V_{DS}$	-30	V
Gate-Source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC	$I_D$	-200	mA
	Pulse	$I_{DP}$	-400	

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

Characteristics	Symbol	Rating	Unit
Drain power dissipation ( $T_a = 25^\circ C$ )	$P_D$ (Note1)	300	mW
Channel temperature	$T_{ch}$	150	$^\circ C$
Storage temperature range	$T_{stg}$	-55~150	$^\circ C$

Note1: Total rating, mounted on FR4 board  
(25.4 mm  $\times$  25.4 mm  $\times$  1.6 t, Cu Pad: 0.32 mm<sup>2</sup>  $\times$  6) Figure 1.

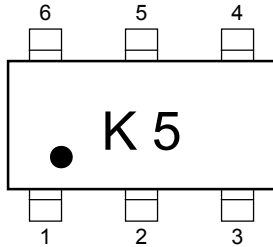
Unit: mm



## Handling Precaution

When handling individual devices (which are not yet mounting 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.

## Marking



## Equivalent Circuit (top view)

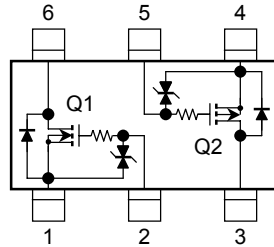
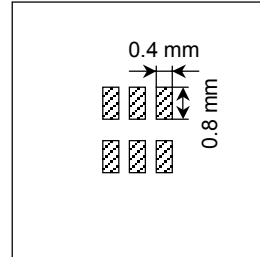


Figure 1: 25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 0.32 mm<sup>2</sup> × 6



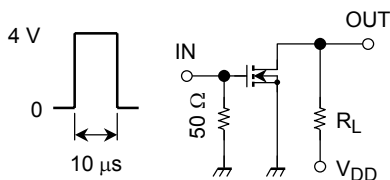
## Q1 Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit	
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0$	—	—	$\pm 1$	$\mu\text{A}$	
Drain-Source breakdown voltage	$V_{(BR)DSS}$	$I_D = 1\text{ mA}, V_{GS} = 0$	30	—	—	V	
Drain cut-off current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0$	—	—	1	$\mu\text{A}$	
Gate threshold voltage	$V_{th}$	$V_{DS} = 5\text{ V}, I_D = 0.1\text{ mA}$	1.1	—	1.8	V	
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 5\text{ V}, I_D = 200\text{ mA}$ (Note2)	270	—	—	mS	
Drain-Source ON resistance	$R_{DS(ON)}$	$I_D = 200\text{ mA}, V_{GS} = 10\text{ V}$ (Note2)	—	0.53	0.7	$\Omega$	
		$I_D = 200\text{ mA}, V_{GS} = 4\text{ V}$ (Note2)	—	0.8	1.2		
		$I_D = 200\text{ mA}, V_{GS} = 3.3\text{ V}$ (Note2)	—	1.0	1.7		
Input capacitance	$C_{iss}$	$V_{DS} = 5\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	20	—	pF	
Reverse transfer capacitance	$C_{rss}$		—	7	—	pF	
Output capacitance	$C_{oss}$		—	16	—	pF	
Switching time	Turn-on time	$t_{on}$	$V_{DD} = 5\text{ V}, I_D = 200\text{ mA}, V_{GS} = 0\sim 4\text{ V}$	—	72	—	ns
	Turn-off time	$t_{off}$		—	68	—	

Note2: Pulse test

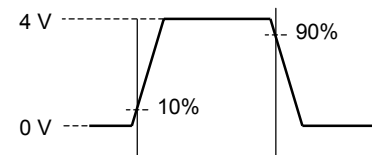
## Switching Time Test Circuit (Q1: Nch MOS FET)

### (a) Test circuit

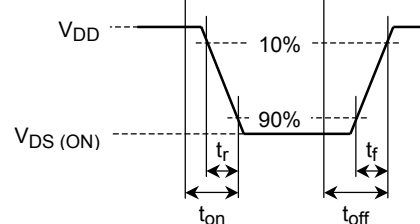


$V_{DD} = 5\text{ V}$   
 Duty  $\leq 1\%$   
 $V_{IN}$ :  $t_r, t_f < 5\text{ ns}$   
 $(Z_{out} = 50\ \Omega)$   
 Common Source  
 $T_a = 25^\circ\text{C}$

### (b) $V_{IN}$



### (c) $V_{OUT}$



## Precaution

$V_{th}$  can be expressed as voltage between gate and source when low operating current value is  $I_D = 100 \mu A$  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.  $V_{GS}$  recommended voltage of 4 V or higher to turn on this product.

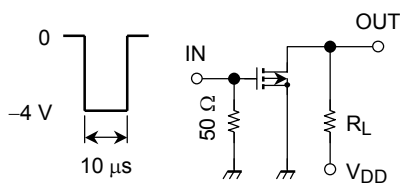
## Q2 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16 V, V_{DS} = 0$	—	—	$\pm 1$	$\mu A$
Drain-Source breakdown voltage		$V_{(BR)DSS}$	$I_D = -1 mA, V_{GS} = 0$	-30	—	—	V
Drain cut-off current		$I_{DSS}$	$V_{DS} = -30 V, V_{GS} = 0$	—	—	-1	$\mu A$
Gate threshold voltage		$V_{th}$	$V_{DS} = -5 V, I_D = -0.1 mA$	-1.1	—	-1.8	V
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -5 V, I_D = -100 mA$ (Note2)	115	—	—	mS
Drain-Source ON resistance		$R_{DS(ON)}$	$I_D = -100 mA, V_{GS} = -10 V$ (Note2)	—	2.1	2.7	$\Omega$
			$I_D = -100 mA, V_{GS} = -4 V$ (Note2)	—	3.3	4.2	
			$I_D = -100 mA, V_{GS} = -3.3 V$ (Note2)	—	4.0	6.0	
Input capacitance		$C_{iss}$	$V_{DS} = -5 V, V_{GS} = 0, f = 1 MHz$	—	22	—	pF
Reverse transfer capacitance		$C_{rss}$	$V_{DS} = -5 V, V_{GS} = 0, f = 1 MHz$	—	5	—	pF
Output capacitance		$C_{oss}$	$V_{DS} = -5 V, V_{GS} = 0, f = 1 MHz$	—	14	—	pF
Switching time	Turn-on time	$t_{on}$	$V_{DD} = -5 V, I_D = -100 mA,$ $V_{GS} = 0 \sim -4 V$	—	85	—	ns
	Turn-off time	$t_{off}$		—	85	—	

Note2: Pulse test

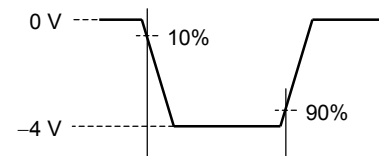
## Switching Time Test Circuit (Q2: Pch MOS FET)

### (a) Test circuit

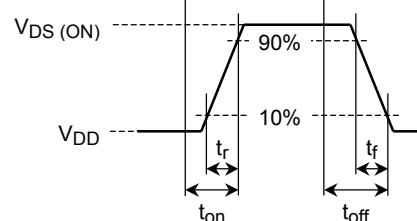


$V_{DD} = -5 V$   
 Duty  $\leq 1\%$   
 $V_{IN}$ :  $t_r, t_f < 5 ns$   
 ( $Z_{out} = 50 \Omega$ )  
 Common Source  
 $T_a = 25^\circ C$

### (b) $V_{IN}$



### (c) $V_{OUT}$

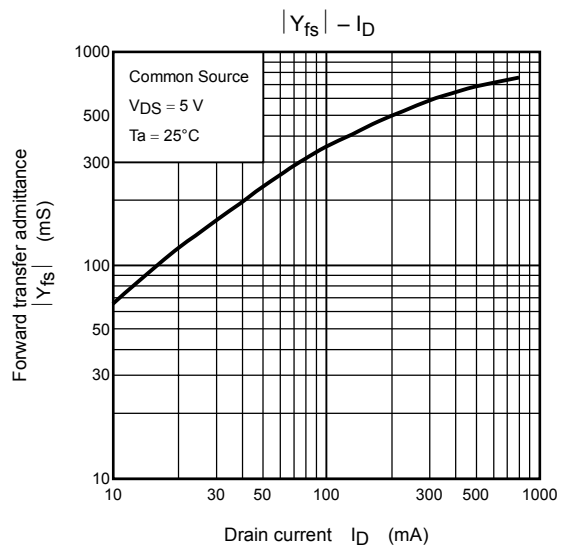
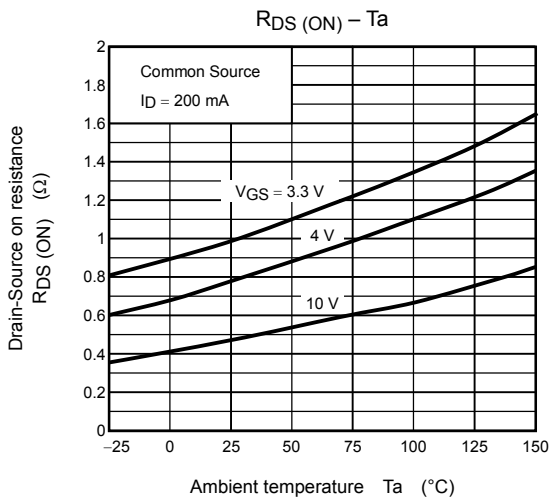
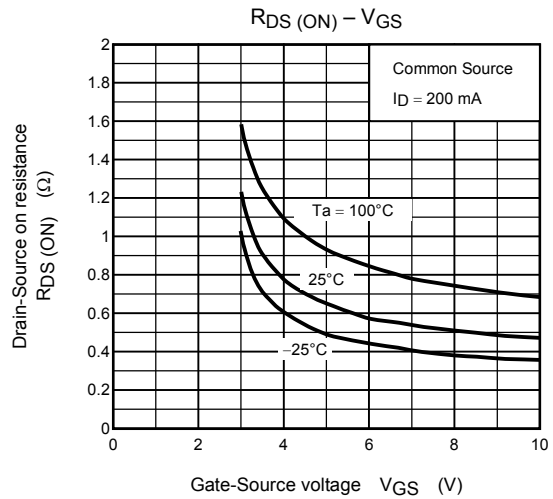
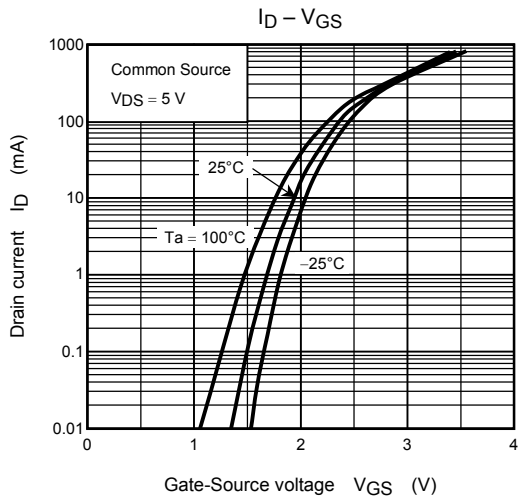
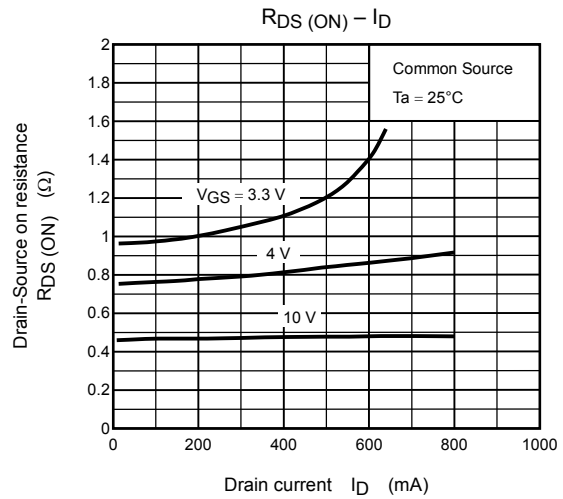
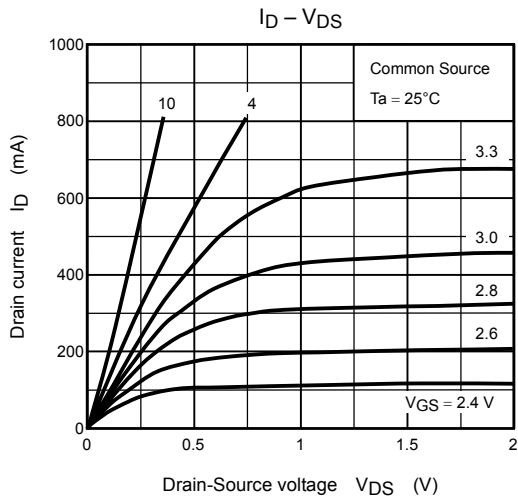


## Precaution

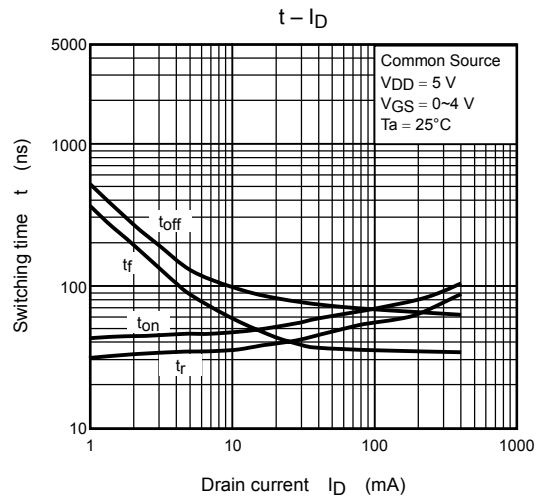
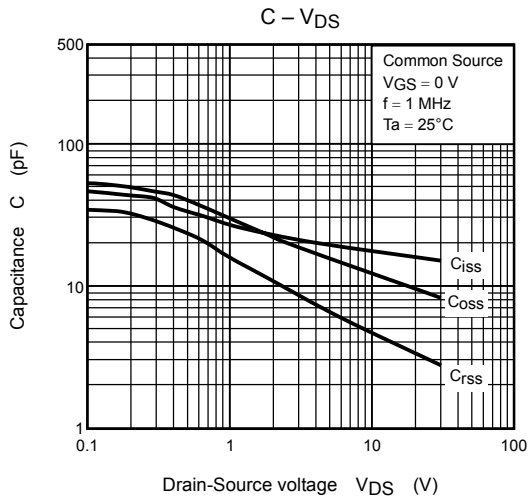
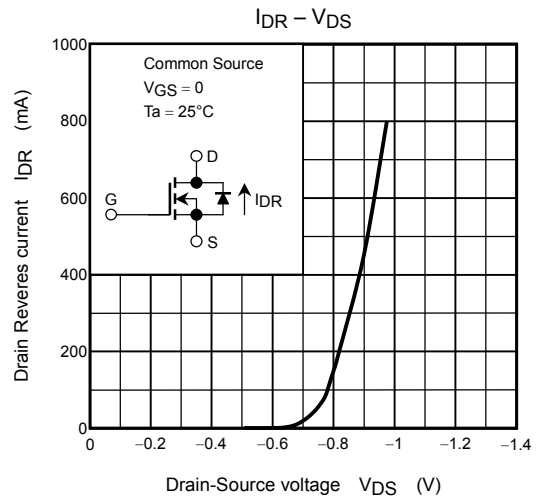
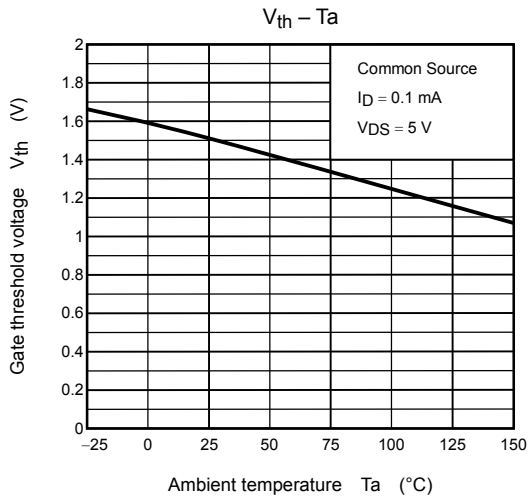
$V_{th}$  can be expressed as voltage between gate and source when low operating current value is  $I_D = -100 \mu A$  for this product. For normal switching operation,  $V_{GS(on)}$  requires higher voltage than  $V_{th}$  and  $V_{GS(off)}$  requires lower voltage than  $V_{th}$ . (Relationship can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

Please take this into consideration for using the device.  $V_{GS}$  recommended voltage of -4 V or higher to turn on this product.

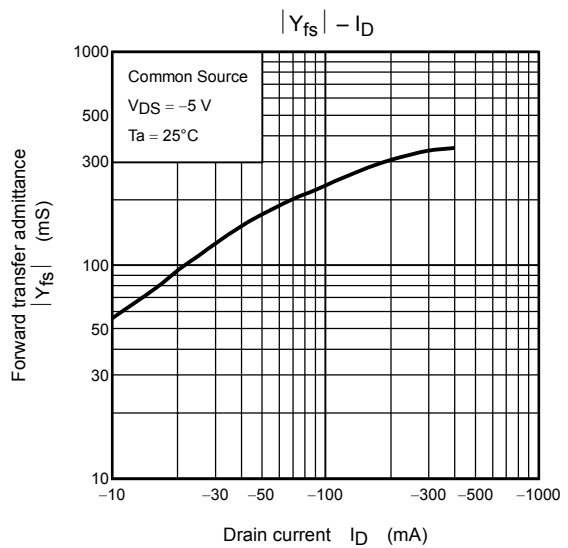
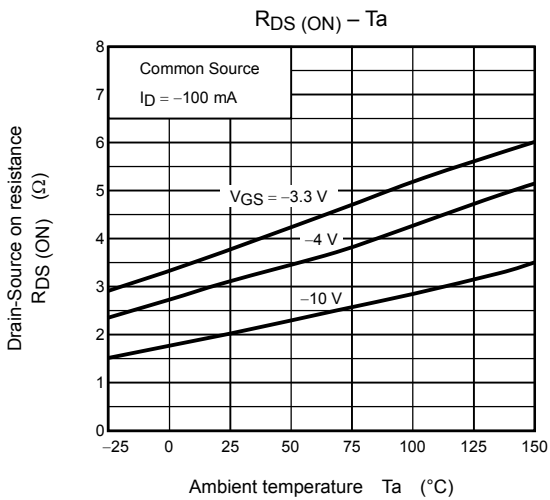
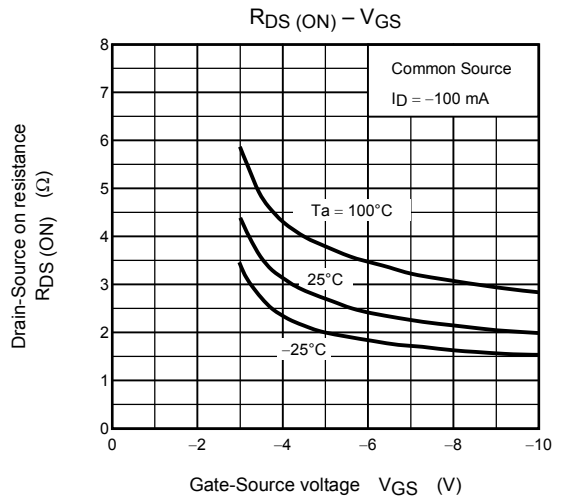
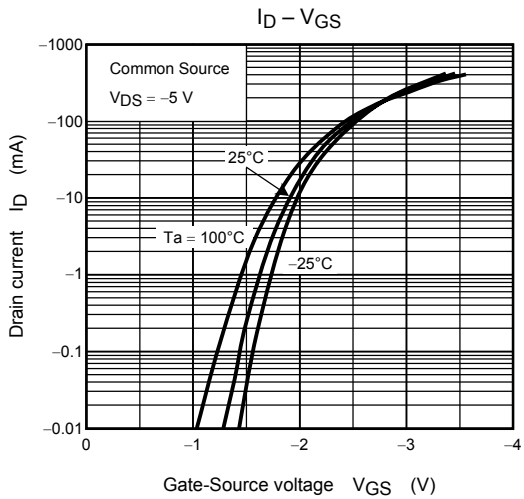
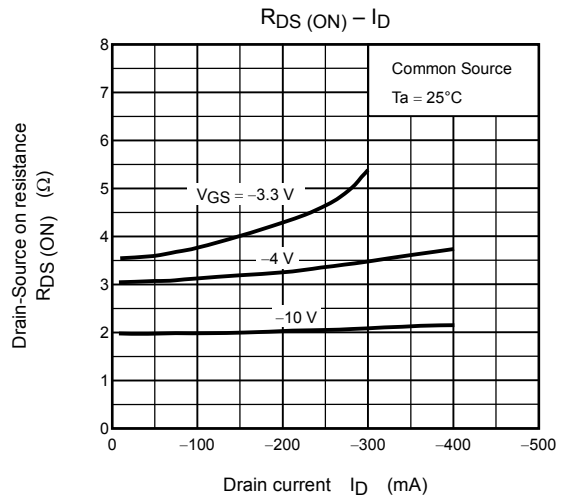
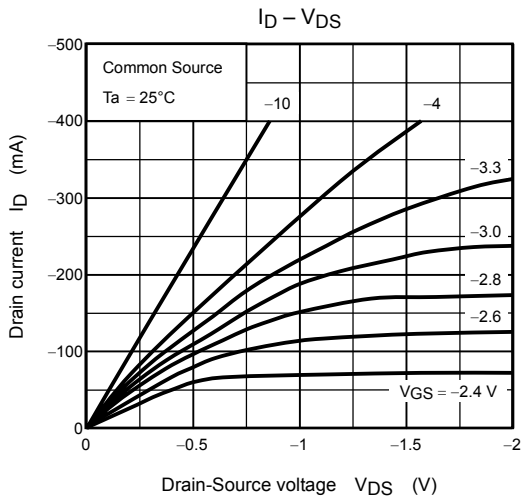
## Q1 (Nch MOS FET)



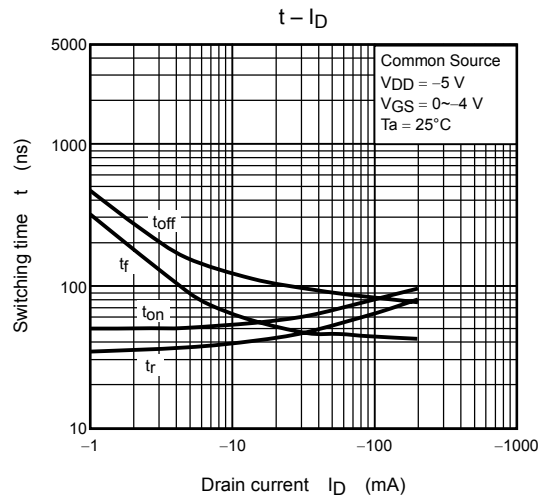
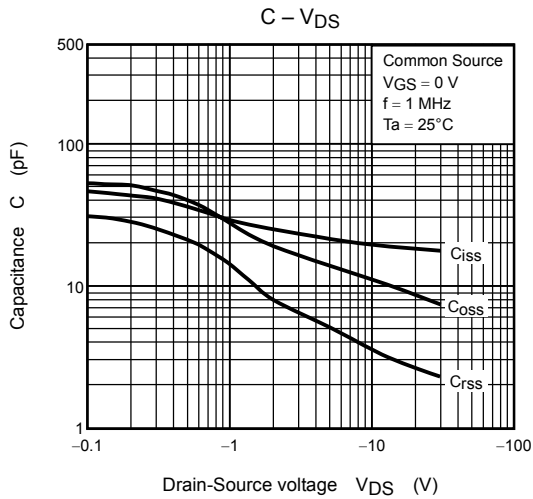
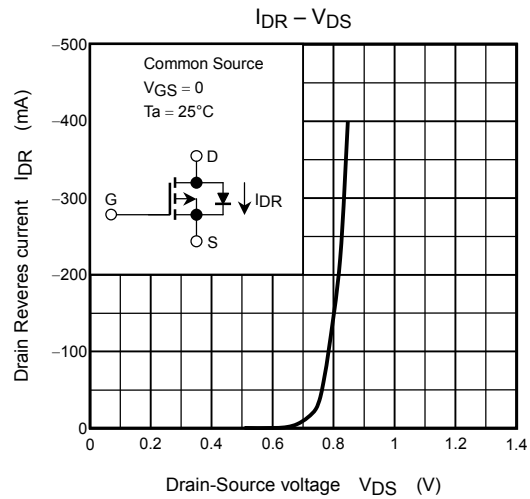
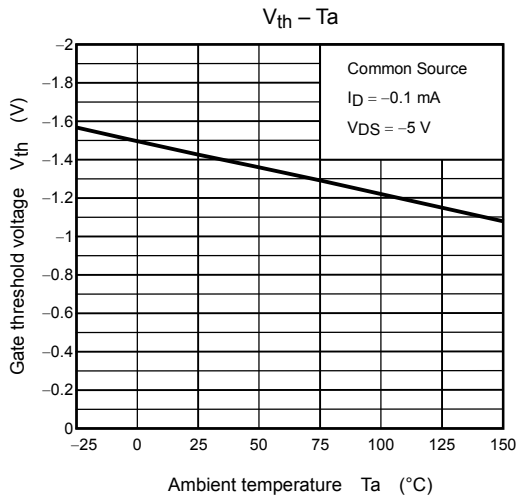
## Q1 (Nch MOS FET)



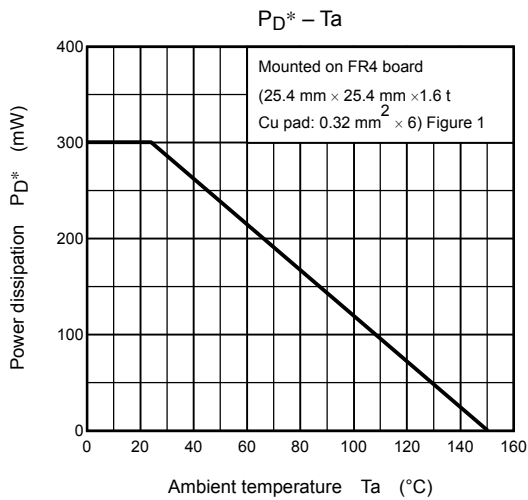
## Q2 (Pch MOS FET)



## Q2 (Pch MOS FET)



### Q1, Q2 common



\*: Total rating

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