

TOSHIBA Field Effect Transistor Silicon P/N Channel MOS Type( $\pi$ -MOSVI)

# SSM6L16FE

High Speed Switching Applications

Analog Switch Applications

- Small package
- Low on-resistance Q1:  $R_{DS(ON)} = 4\ \Omega$  (max) (@ $V_{GS} = 2.5\ V$ )  
Q2:  $R_{DS(ON)} = 12\ \Omega$  (max) (@ $V_{GS} = -2.5\ V$ )

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

Characteristics	Symbol	Rating	Unit
Drain-Source voltage	$V_{DSS}$	20	V
Gate-Source voltage	$V_{GSS}$	$\pm 10$	V
Drain current	DC	$I_D$	mA
	Pulse	$I_{DP}$	
		100	
		200	

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

Characteristics	Symbol	Rating	Unit
Drain-Source voltage	$V_{DSS}$	-20	V
Gate-Source voltage	$V_{GSS}$	$\pm 10$	V
Drain current	DC	$I_D$	mA
	Pulse	$I_{DP}$	
		-100	
		-200	

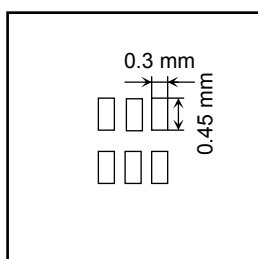
## Absolute Maximum Ratings (Q1, Q2 Common) ( $T_a = 25^\circ\text{C}$ )

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

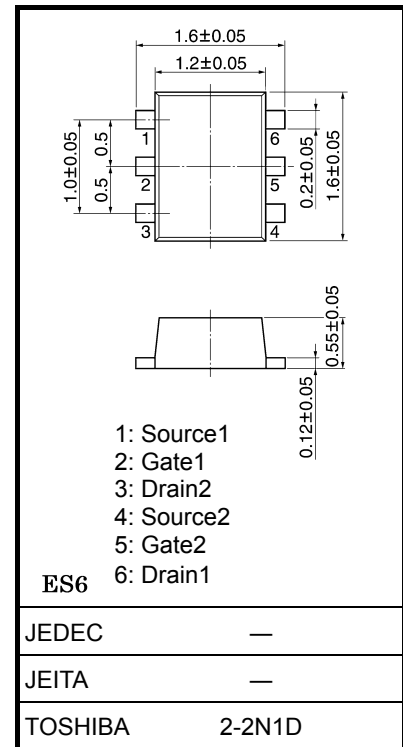
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

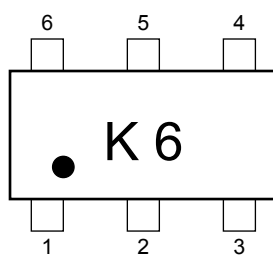
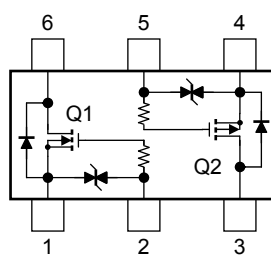
Note 1: Total rating, mounted on FR4 board  
(25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu Pad: 0.135 mm<sup>2</sup>  $\times$  6)



Unit: mm



Weight: 3 mg (typ.)

**Marking****Equivalent Circuit (top view)****Handling Precaution**

When handling individual devices (which are not yet mounted on a circuit board), ensure that the environment is protected against static 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.

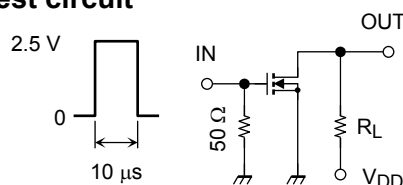
## Q1 Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	MIN.	TYP.	MAX.	UNIT
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 10 \text{ V}, V_{DS} = 0$	—	—	$\pm 1$	$\mu\text{A}$
Drain-Source breakdown voltage	$V_{(BR) DSS}$	$I_D = 0.1 \text{ mA}, V_{GS} = 0$	20	—	—	V
Drain cut-off current	$I_{DSS}$	$V_{DS} = 20 \text{ V}, V_{GS} = 0$	—	—	1	$\mu\text{A}$
Gate threshold voltage	$V_{th}$	$V_{DS} = 3 \text{ V}, I_D = 0.1 \text{ mA}$	0.6	—	1.1	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 3 \text{ V}, I_D = 10 \text{ mA}$ (Note2)	40	—	—	mS
Drain-Source on-resistance	$R_{DS(ON)}$	$I_D = 10 \text{ mA}, V_{GS} = 4 \text{ V}$ (Note2)	—	1.5	3.0	$\Omega$
		$I_D = 10 \text{ mA}, V_{GS} = 2.5 \text{ V}$ (Note2)	—	2.2	4.0	
		$I_D = 1 \text{ mA}, V_{GS} = 1.5 \text{ V}$ (Note2)	—	5.2	15	
Input capacitance	$C_{iss}$	$V_{DS} = 3 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$	—	9.3	—	pF
Reverse transfer capacitance	$C_{rss}$		—	4.5	—	pF
Output capacitance	$C_{oss}$		—	9.8	—	pF
Switching time	Turn-on time	$V_{DD} = 3 \text{ V}, I_D = 10 \text{ mA},$ $V_{GS} = 0 \sim 2.5 \text{ V}$	—	70	—	ns
	Turn-off time		—	125	—	

Note2: Pulse test

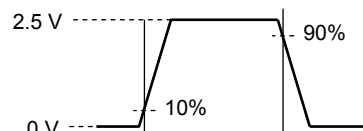
## Switching Time Test Circuit

### (a) Test circuit

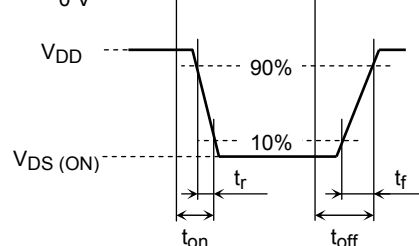


$V_{DD} = 3 \text{ V}$   
Duty  $\leq 1\%$   
 $V_{IN}$ :  $t_r, t_f < 5 \text{ ns}$   
( $Z_{out} = 50 \Omega$ )  
Common Source  
 $T_a = 25^\circ\text{C}$

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



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



## Precaution

$V_{th}$  can be expressed as the voltage between the gate and source when the low operating current value is  $I_D = 0.1 \text{ mA}$  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:  $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$ .)

Be sure to take this into consideration when using the device.

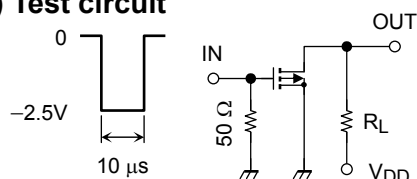
## Q2 Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	MIN.	TYP.	MAX.	UNIT
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 10 \text{ V}, V_{DS} = 0$	—	—	$\pm 1$	$\mu\text{A}$
Drain-Source breakdown voltage	$V_{(BR) DSS}$	$I_D = -0.1 \text{ mA}, V_{GS} = 0$	-20	—	—	V
Drain cut-off current	$I_{DSS}$	$V_{DS} = -20 \text{ V}, V_{GS} = 0$	—	—	-1	$\mu\text{A}$
Gate threshold voltage	$V_{th}$	$V_{DS} = -3 \text{ V}, I_D = -0.1 \text{ mA}$	-0.6	—	-1.1	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = -3 \text{ V}, I_D = -10 \text{ mA}$ (Note3)	25	—	—	mS
Drain-Source on-resistance	$R_{DS(ON)}$	$I_D = -10 \text{ mA}, V_{GS} = -4 \text{ V}$ (Note3)	—	6	8	$\Omega$
		$I_D = -10 \text{ mA}, V_{GS} = -2.5 \text{ V}$ (Note3)	—	8	12	
		$I_D = -1 \text{ mA}, V_{GS} = -1.5 \text{ V}$ (Note3)	—	18	45	
Input capacitance	$C_{iss}$	$V_{DS} = -3 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$	—	11	—	pF
Reverse transfer capacitance	$C_{rss}$		—	3.7	—	pF
Output capacitance	$C_{oss}$		—	10	—	pF
Switching time	Turn-on time	$t_{on}$	$V_{DD} = -3 \text{ V}, I_D = -10 \text{ mA},$ $V_{GS} = 0 \sim -2.5 \text{ V}$	—	130	ns
	Turn-off time	$t_{off}$		—	190	

Note3: Pulse test

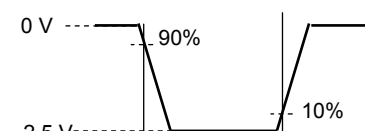
## Switching Time Test Circuit

### (a) Test circuit

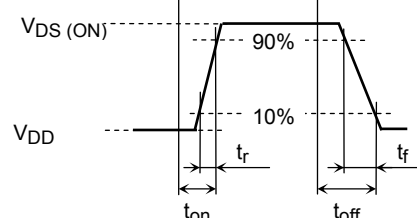


$V_{DD} = -3 \text{ V}$   
 Duty  $\leq 1\%$   
 $V_{IN}$ :  $t_r, t_f < 5 \text{ ns}$   
 $(Z_{out} = 50 \Omega)$   
 Common Source  
 $T_a = 25^\circ\text{C}$

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



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

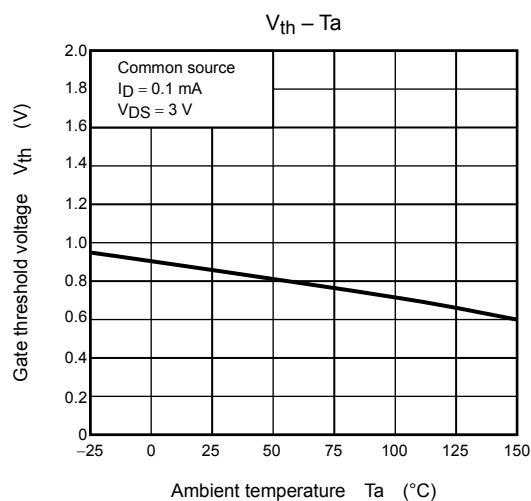
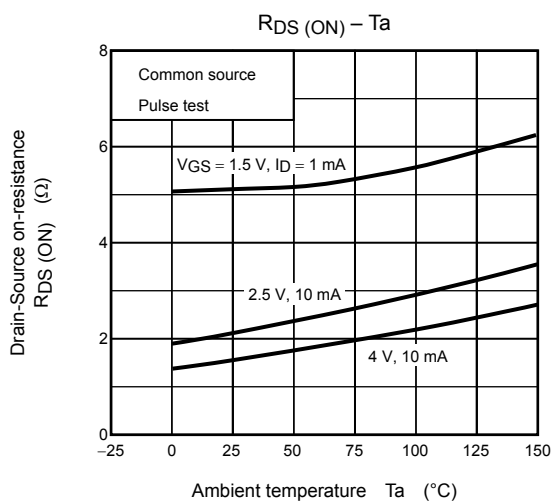
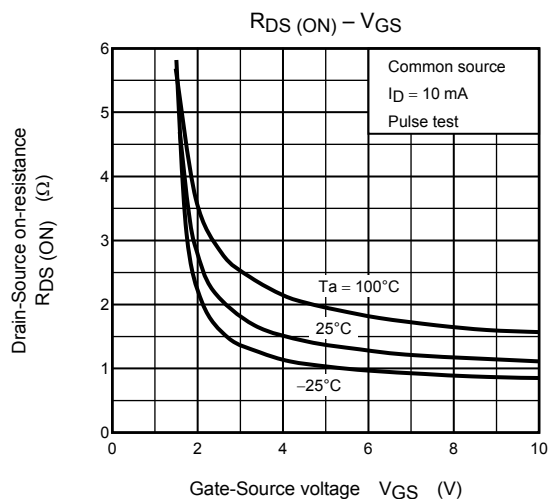
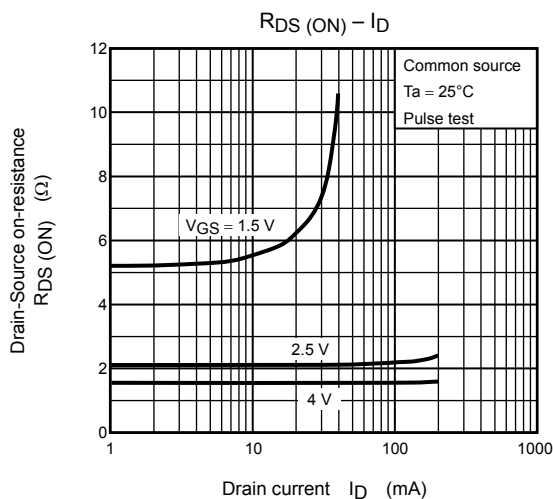
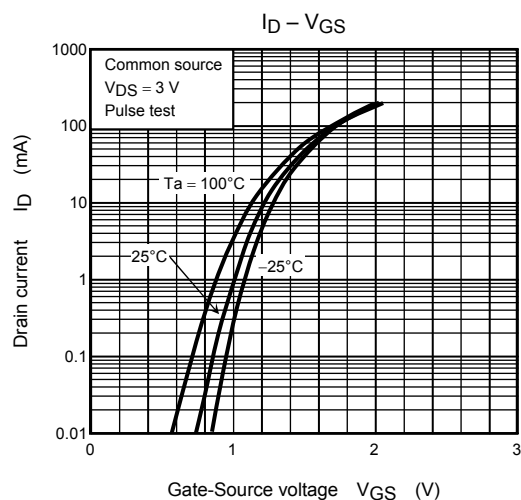
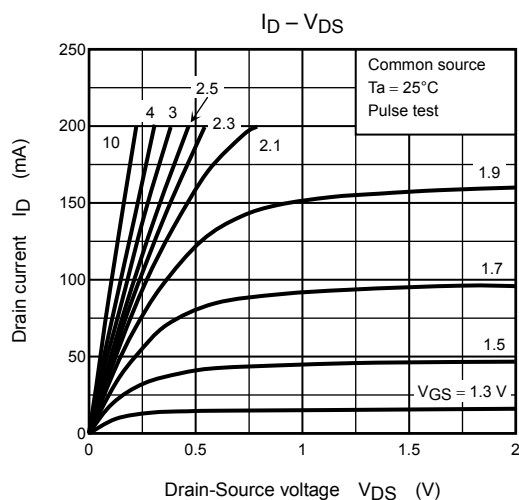


## Precaution

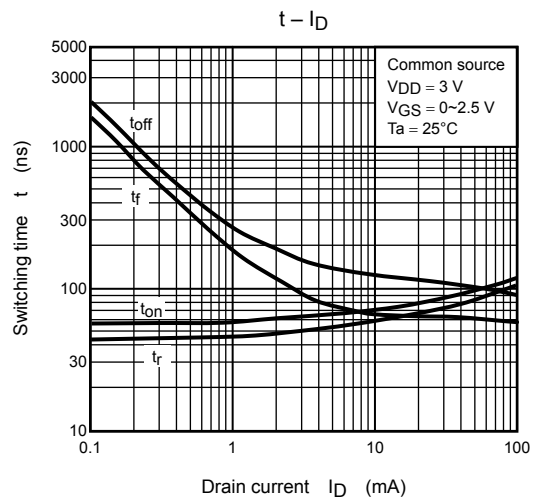
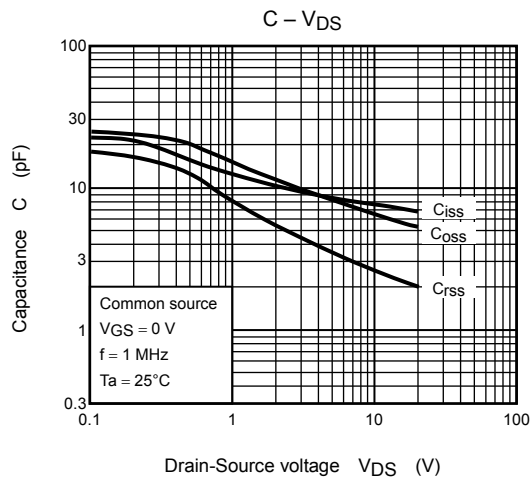
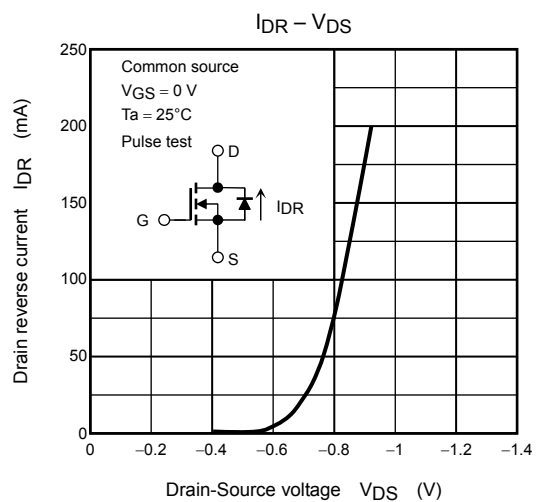
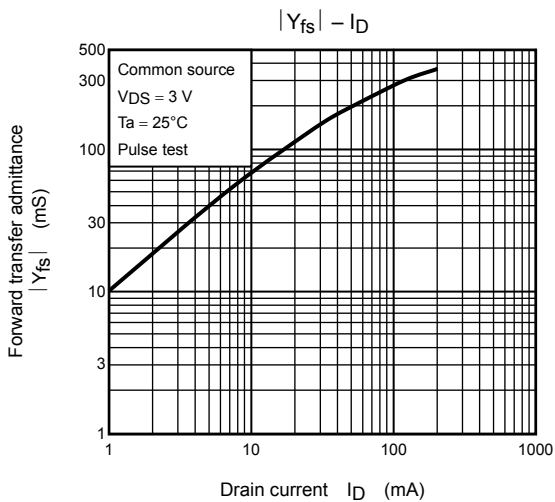
$V_{th}$  can be expressed as the voltage between the gate and source when the low operating current value is  $I_D = -0.1 \text{ mA}$  for this product. For normal switching operation,  $V_{GS(ON)}$  requires a higher voltage than  $V_{th}$  and  $V_{GS(OFF)}$  requires a lower voltage than  $V_{th}$ . (The relationship can be established as follows:  $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$ .)

Be sure to take this into consideration when using the device.

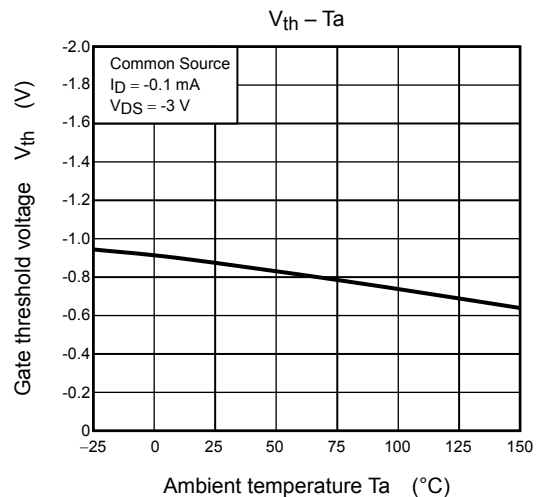
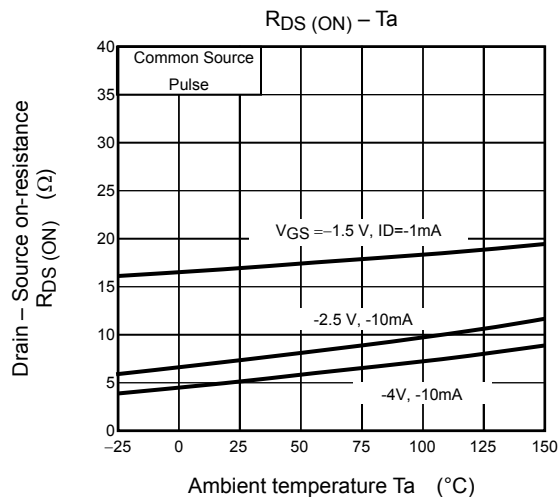
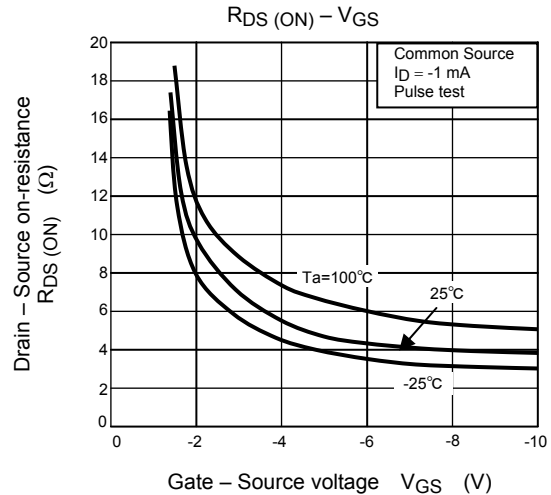
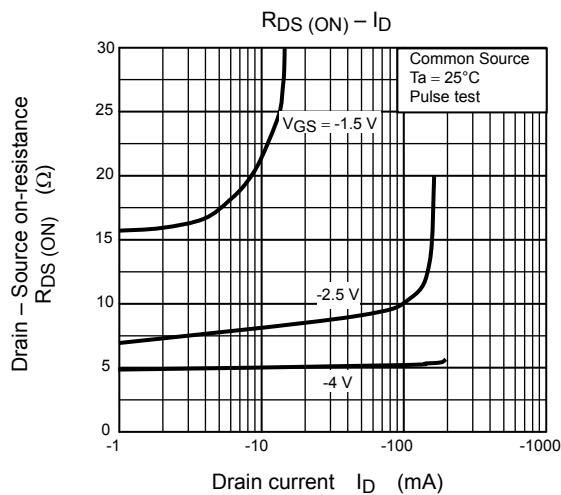
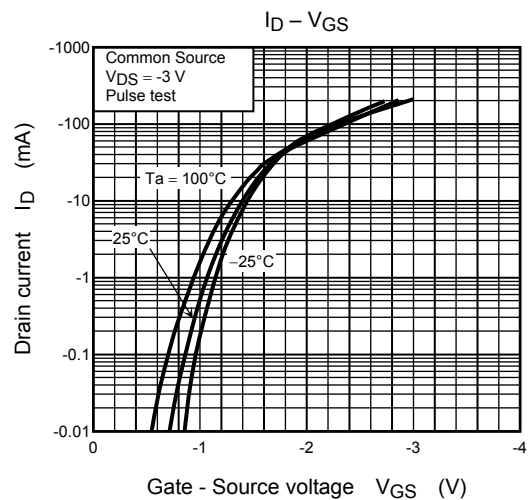
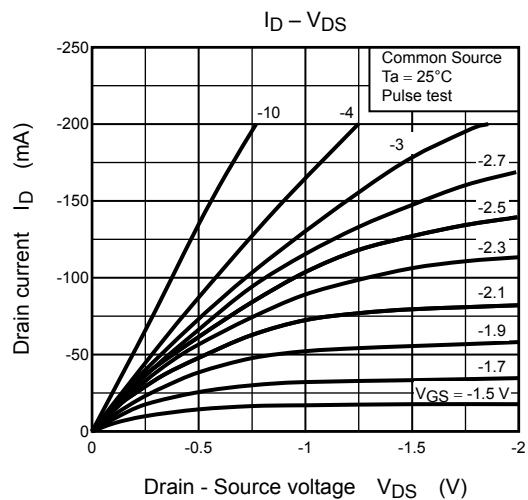
## Q1 (N-ch MOSFET)



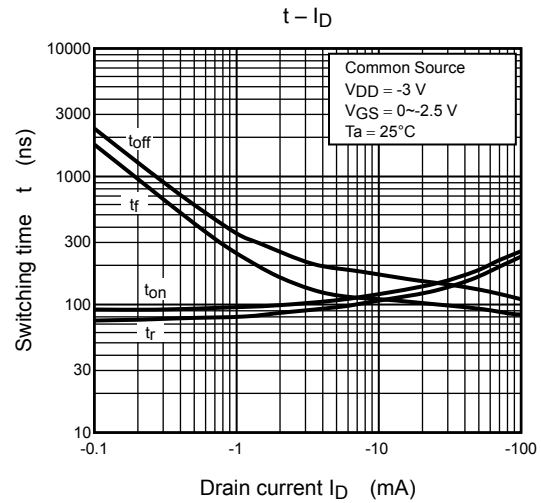
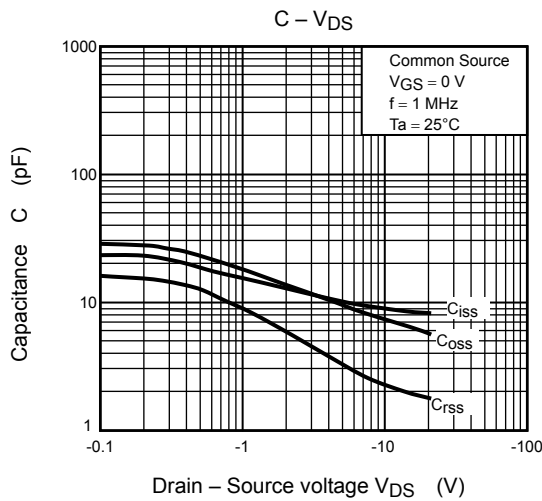
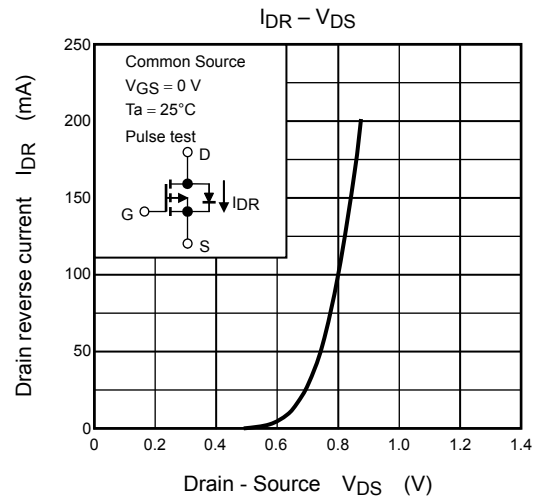
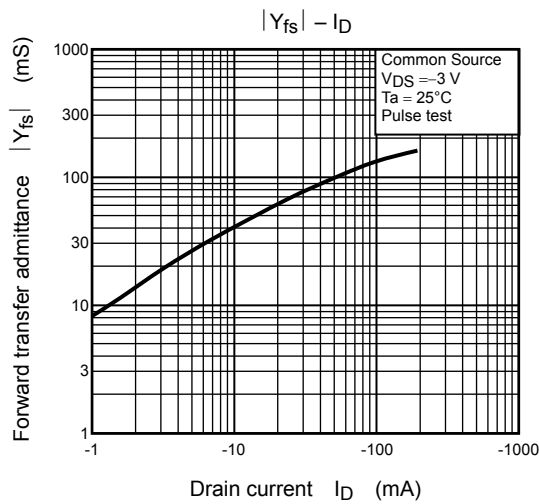
Q1 (N-ch MOSFET)



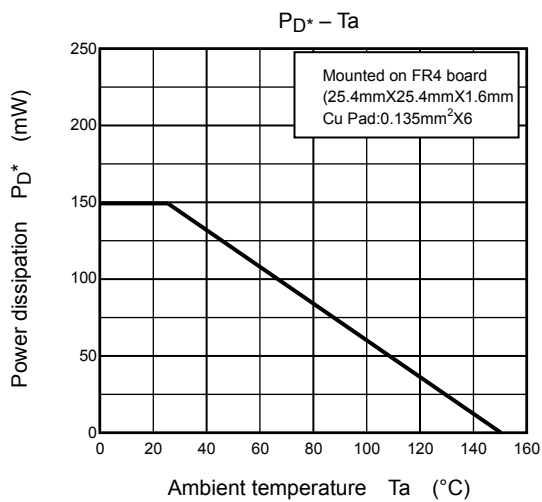
Q2 (P-ch MOSFET)



## Q2 (P-ch MOSFET)



## Common Characteristics



\*: Total rating



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