

TOSHIBA Field Effect Transistor Silicon P/N Channel MOS Type(π -MOSVI)

SSM6L16FE

High Speed Switching Applications

Analog Switch Applications

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

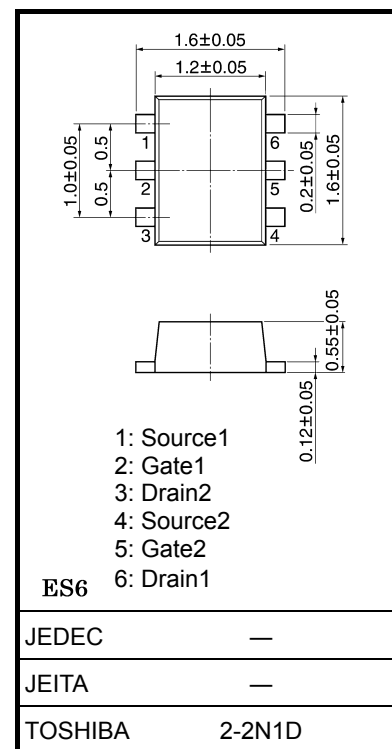
Unit: mm

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}	± 10	V
Drain current	DC	I_D	100	mA
	Pulse	I_{DP}	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}	± 10	V
Drain current	DC	I_D	-100	mA
	Pulse	I_{DP}	-200	



Weight: 3 mg (typ.)

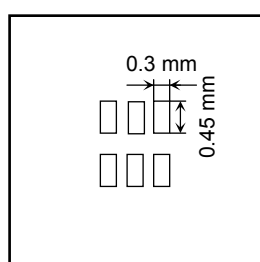
Absolute Maximum Ratings (Q1, Q2 Common) ($T_a = 25^\circ\text{C}$)

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 to 150	$^\circ\text{C}$

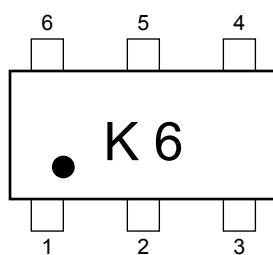
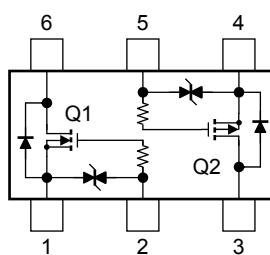
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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: $0.135\text{ mm}^2 \times 6$)



Start of commercial production
2002-03

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.

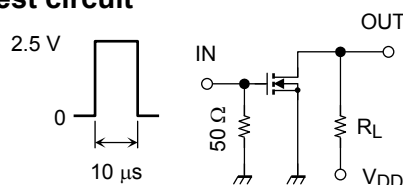
Q1 Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	MIN.	TYP.	MAX.	UNIT
Gate leakage current	I_{GSS}	$V_{GS} = \pm 10 \text{ V}, V_{DS} = 0$	—	—	± 1	μA
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	μA
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	Ω
		$I_D = 10 \text{ mA}, V_{GS} = 2.5 \text{ V}$ (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	t_{on}	$V_{DD} = 3 \text{ V}, I_D = 10 \text{ mA},$ $V_{GS} = 0 \text{ to } 2.5 \text{ V}$	—	70	ns
	Turn-off time	t_{off}		—	125	

Note2: Pulse test

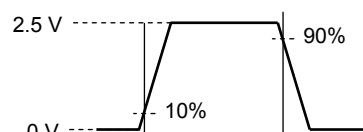
Switching Time Test Circuit

(a) Test circuit

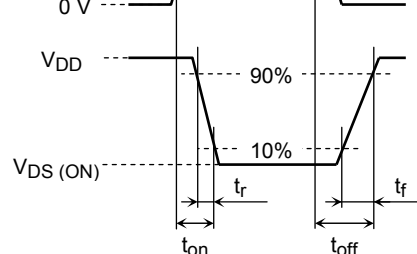


$V_{DD} = 3 \text{ V}$
 Duty $\leq 1\%$
 V_{IN} : $t_r, t_f < 5 \text{ ns}$
 $(Z_{out} = 50 \Omega)$
 Common Source
 $T_a = 25^\circ\text{C}$

(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.

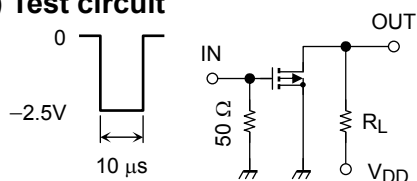
Q2 Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	MIN.	TYP.	MAX.	UNIT
Gate leakage current		I_{GSS}	$V_{GS} = \pm 10 \text{ V}, V_{DS} = 0$	—	—	± 1	μA
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	μA
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	Ω
			$I_D = -10 \text{ mA}, V_{GS} = -2.5 \text{ V}$ (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}	$V_{DD} = -3 \text{ V}, I_D = -10 \text{ mA},$ $V_{GS} = 0 \text{ to } -2.5 \text{ V}$	—	130	—	ns
	Turn-off time	t_{off}		—	190	—	

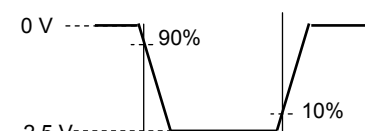
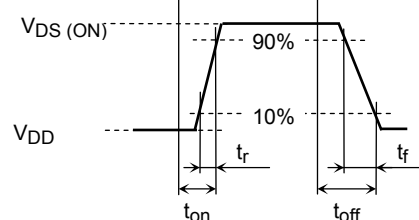
Note3: Pulse test

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
 $T_a = 25^\circ\text{C}$

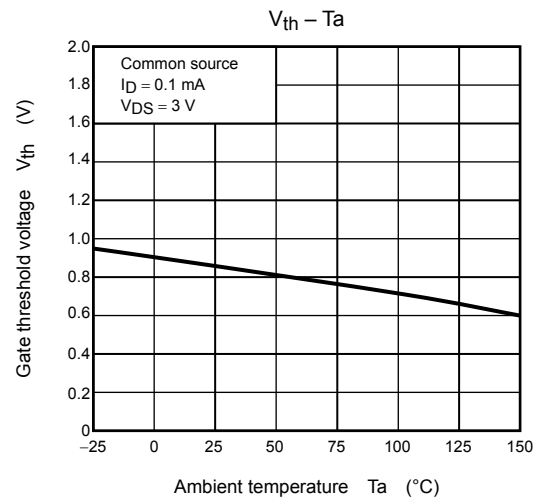
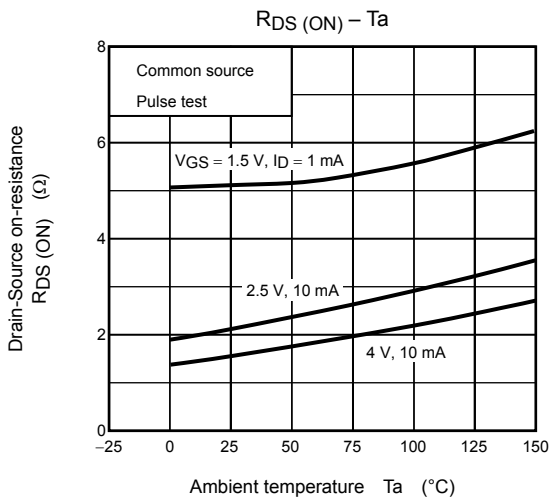
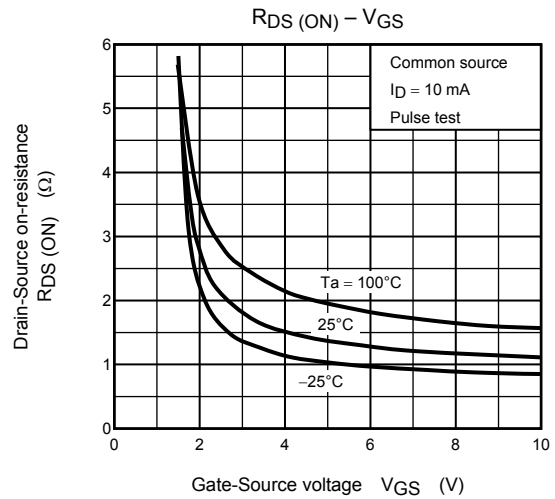
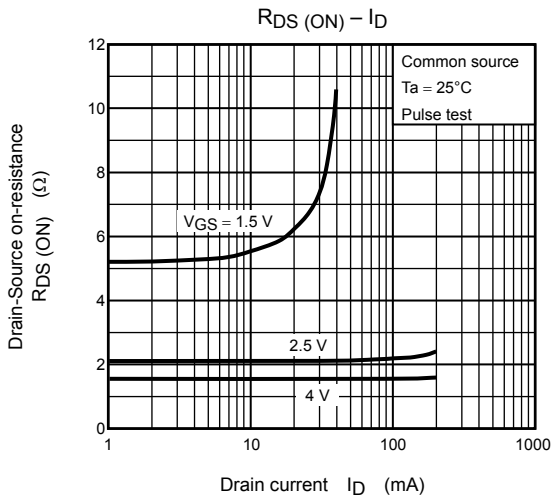
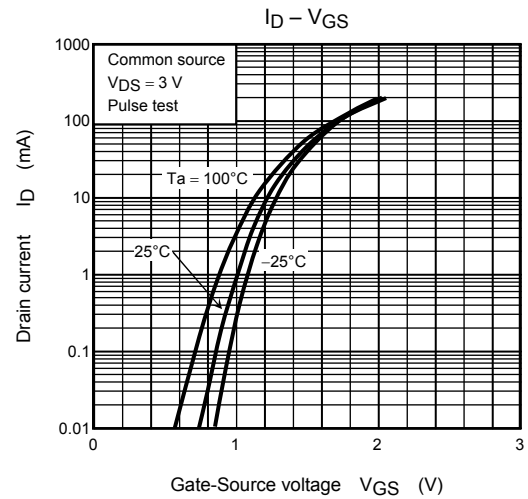
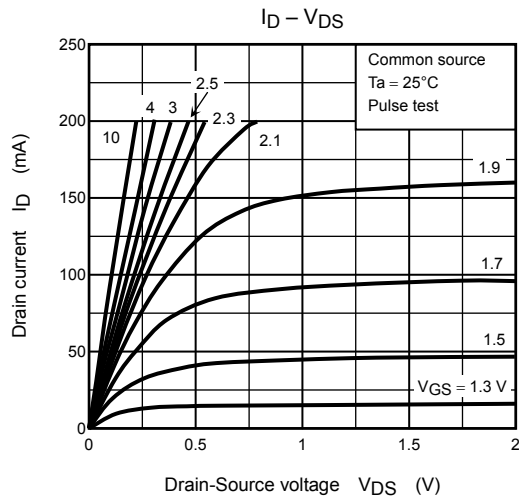
(b) V_{IN} (c) V_{OUT} 

Precaution

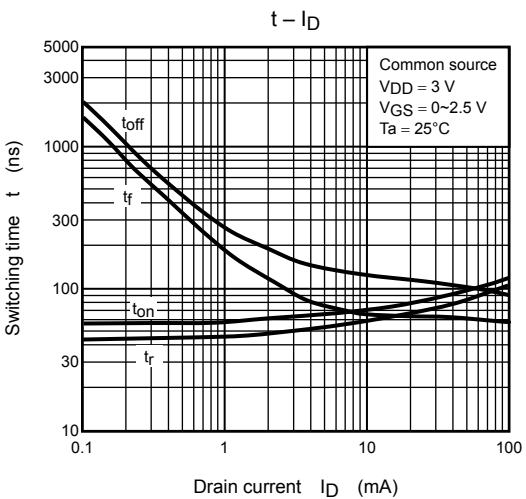
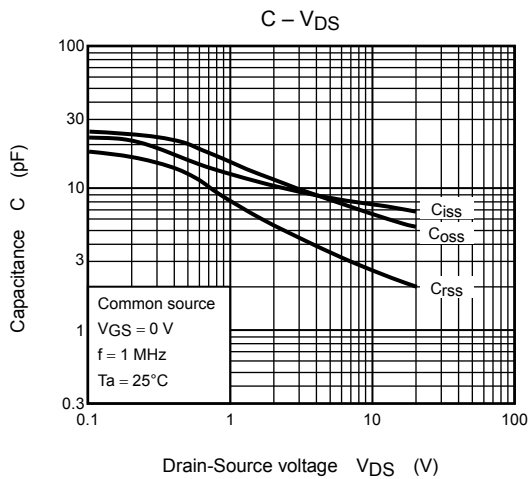
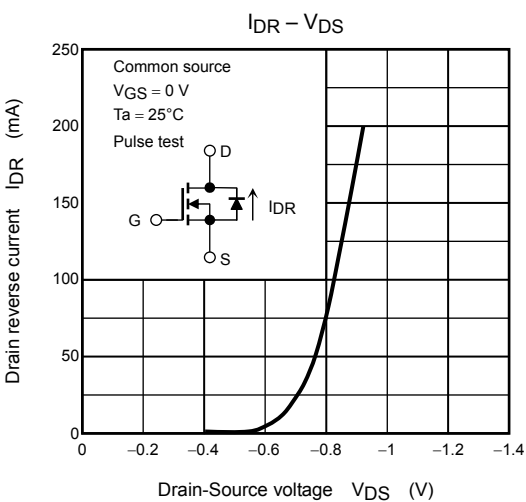
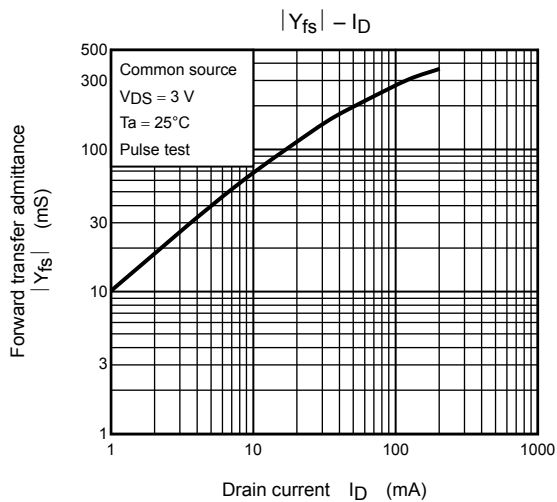
V_{th} can be expressed as the voltage between the gate and source when the low operating current value is $I_D = -0.1 \text{ mA}$ for this product. For normal switching operation, $V_{GS(on)}$ requires a higher voltage than V_{th} and $V_{GS(off)}$ requires a lower voltage than V_{th} . (The relationship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

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

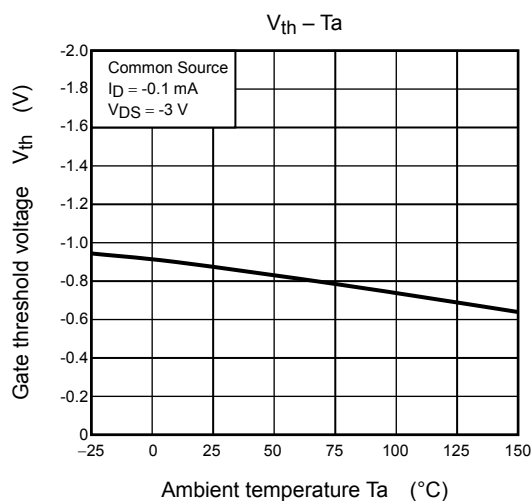
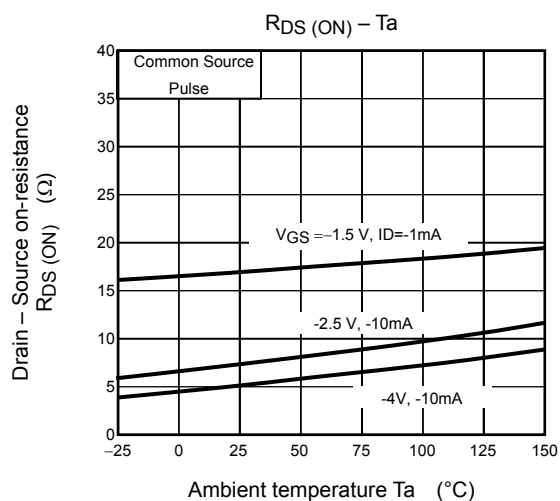
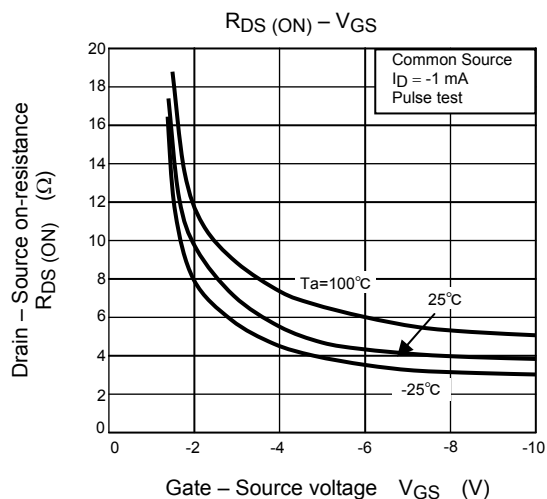
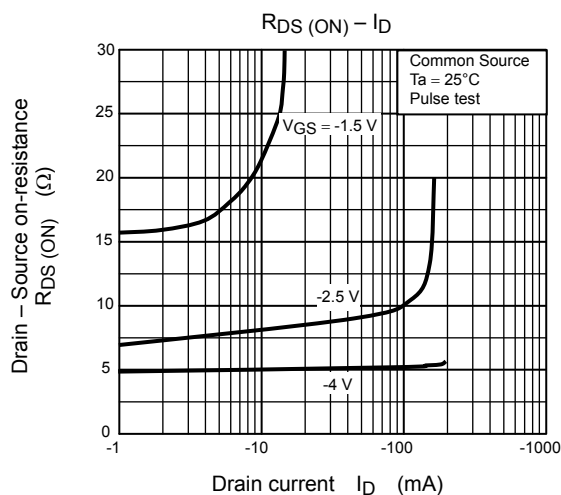
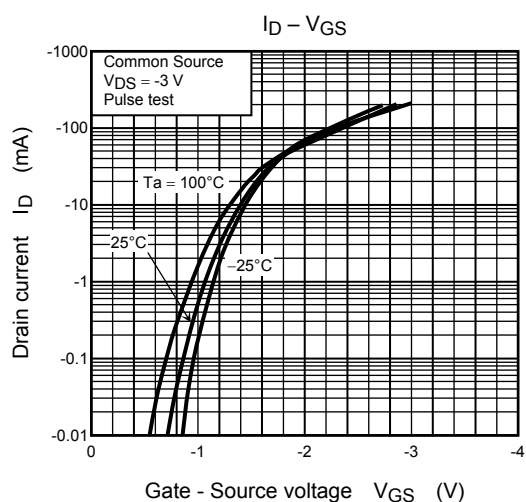
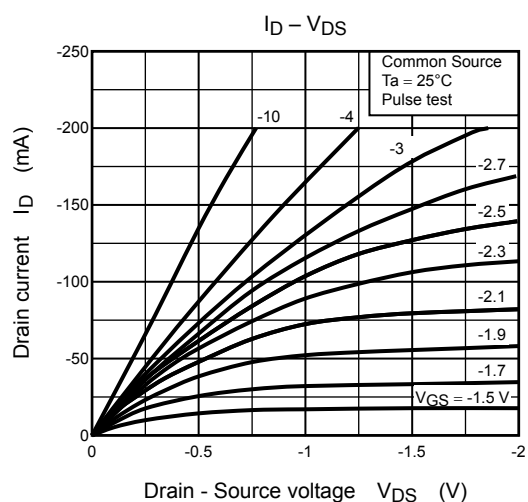
Q1 (N-ch MOSFET)



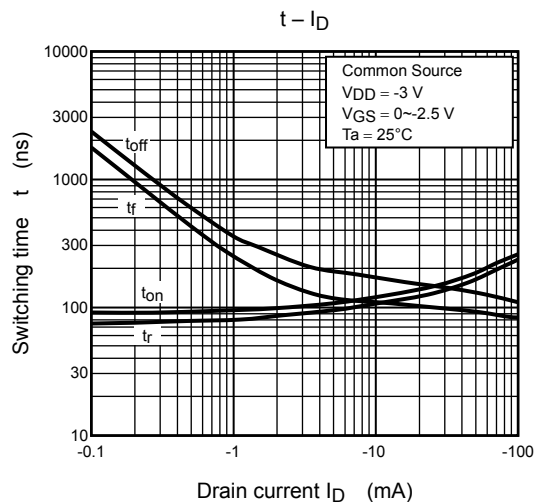
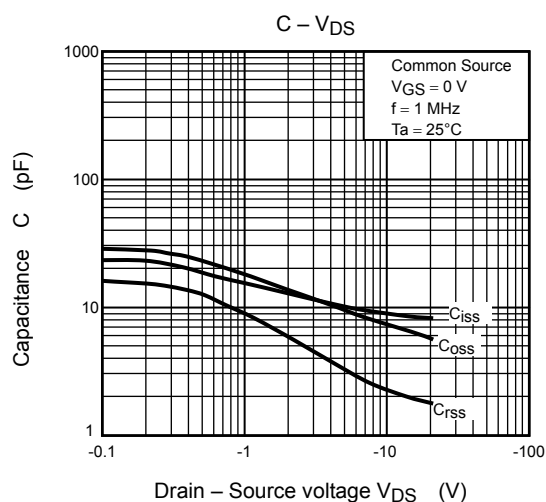
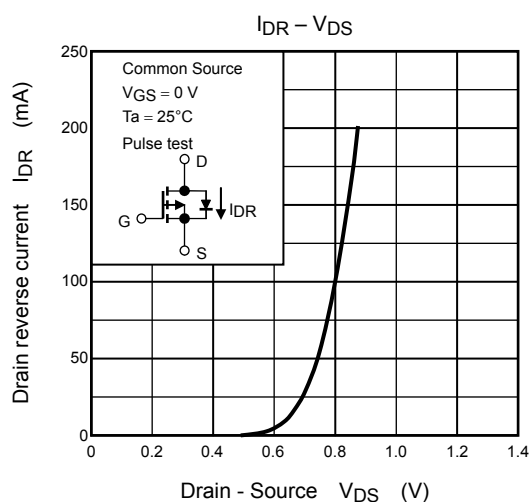
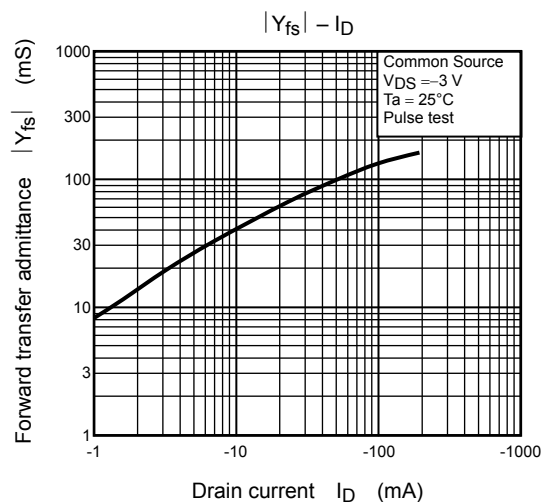
Q1 (N-ch MOSFET)



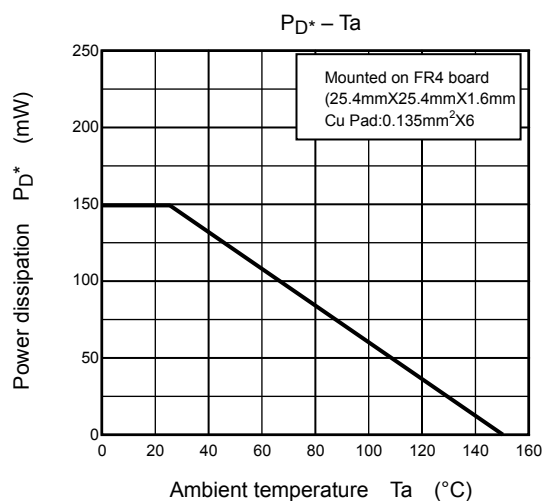
Q2 (P-ch MOSFET)



Q2 (P-ch MOSFET)



Common Characteristics



*: Total rating

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