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

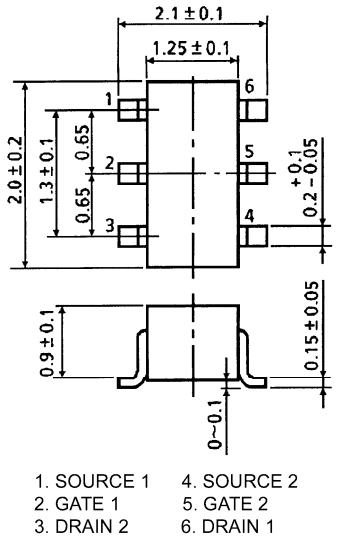
SSM6L09FU

Power Management Switch

High Speed Switching Applications

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

Unit: mm



1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

US6	
JEDEC	—
JEITA	—
TOSHIBA	2-2J1C

Weight: 6.8 mg (typ.)

Q1 Absolute Maximum Ratings (Ta = 25°C)

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

Q2 Absolute Maximum Ratings (Ta = 25°C)

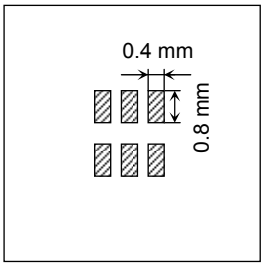
Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	−30	V
Gate-Source voltage		V_{GSS}	±20	V
Drain current	DC	I_D	−200	mA
	Pulse	I_{DP}	−400	

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

Characteristics	Symbol	Rating	Unit
Power dissipation	P_D (Note 1)	300	mW
Channel temperature	T_{ch}	150	°C
Storage temperature range	T_{stg}	−55 to 150	°C

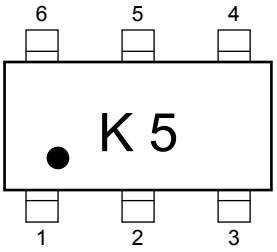
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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 × 25.4 mm × 1.6 mm, Cu Pad: 0.32 mm^2 × 6)

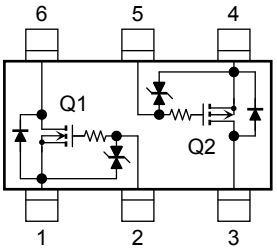


Start of commercial production
2001-02

Marking (top view)



Equivalent Circuit



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.

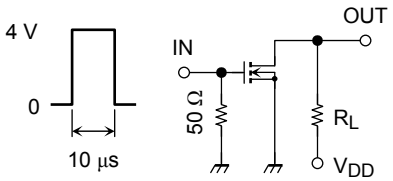
Q1 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0	—	—	±1	μA
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	μA
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 = 200 mA (Note2)	270	—	—	mS
Drain-Source on-resistance		$R_{DS\ (ON)}$	I_D = 200 mA, V_{GS} = 10 V (Note2)	—	0.5	0.7	Ω
			I_D = 200 mA, V_{GS} = 4 V (Note2)	—	0.8	1.2	
			I_D = 200 mA, V_{GS} = 3.3 V (Note2)	—	1.0	1.7	
Input capacitance		C_{iss}	V_{DS} = 5 V, V_{GS} = 0, f = 1 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 V, I_D = 200 mA, V_{GS} = 0 to 4 V	—	72	—	ns
	Turn-off time	t_{off}		—	68	—	

Note2: Pulse test

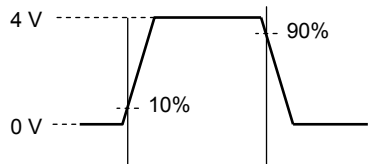
Switching Time Test Circuit

(a) Test circuit

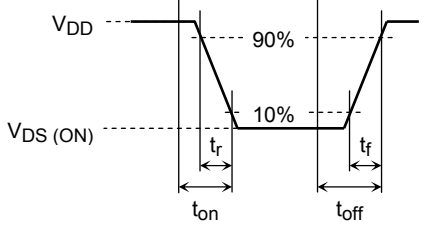


V_{DD} = 5 V
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
(Z_{out} = 50 Ω)
Common Source
Ta = 25°C

(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 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.

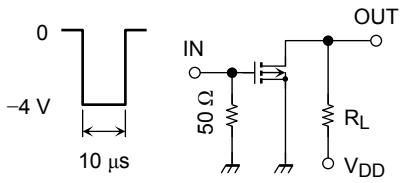
Q2 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0	—	—	±1	μA
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	μA
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 (Note3)	115	—	—	mS
Drain-Source on-resistance		$R_{DS\ (ON)}$	I_D = −100 mA, V_{GS} = −10 V (Note3)	—	2.1	2.7	Ω
			I_D = −100 mA, V_{GS} = −4 V (Note3)	—	3.3	4.2	
			I_D = −100 mA, V_{GS} = −3.3 V(Note3)	—	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 to −4 V	—	85	—	ns
	Turn-off time	t_{off}		—	85	—	

Note3: Pulse test

Switching Time Test Circuit

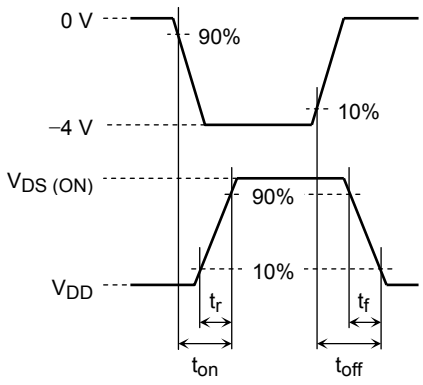
(a) Test circuit



V_{DD} = −5 V
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
(Z_{out} = 50 Ω)
Common Source
Ta = 25°C

(b) V_{IN}

(c) V_{OUT}



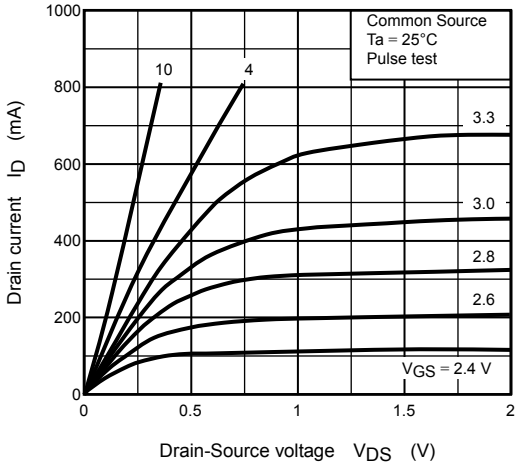
Precaution

V_{th} can be expressed as voltage between gate and source when low operating current value is I_D = −0.1 mA 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: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$)

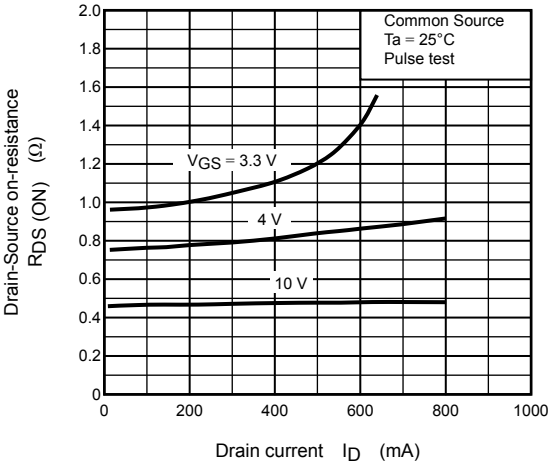
Please take this into consideration for using the device.

Q1 (Nch MOS FET)

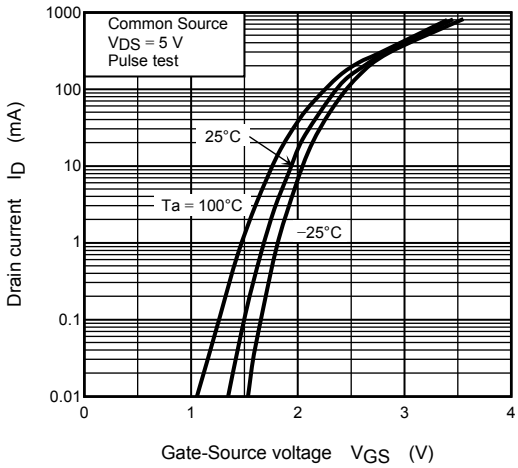
$I_D - V_{DS}$



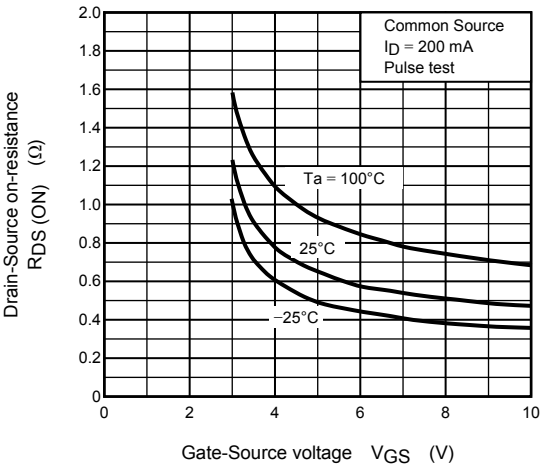
$R_{DS\ (ON)} - I_D$



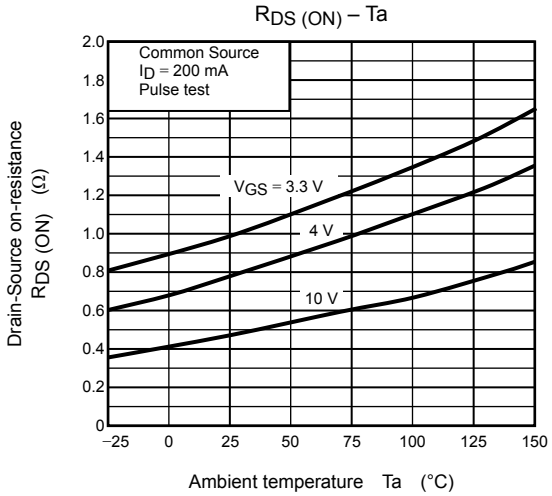
$I_D - V_{GS}$



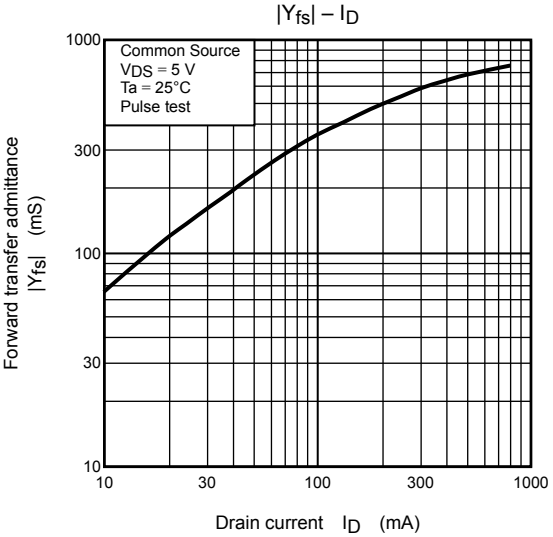
$R_{DS\ (ON)} - V_{GS}$



$R_{DS\ (ON)} - Ta$

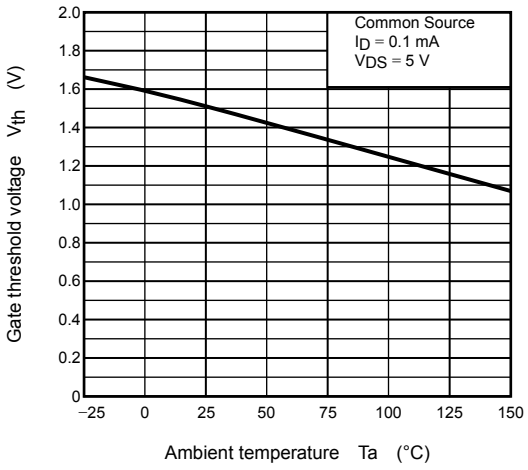


$|Y_{fs}| - I_D$

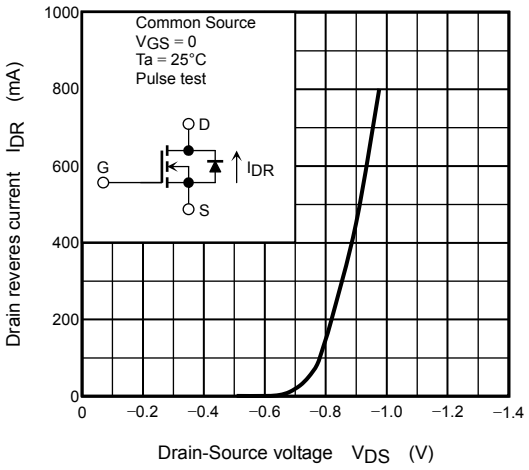


Q1 (Nch MOS FET)

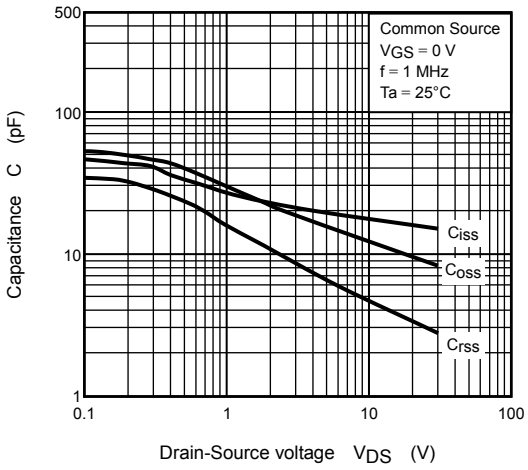
V_{th} – Ta



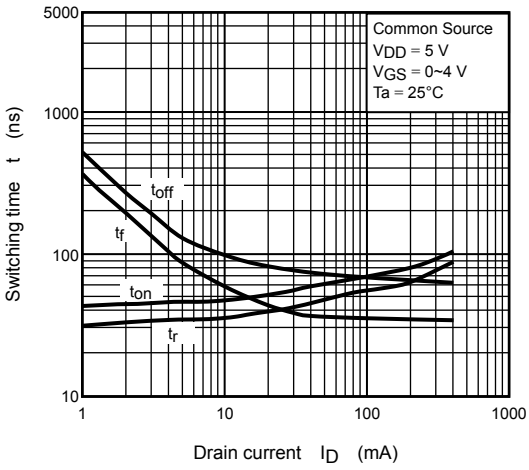
I_{DR} – V_{DS}



C – V_{DS}

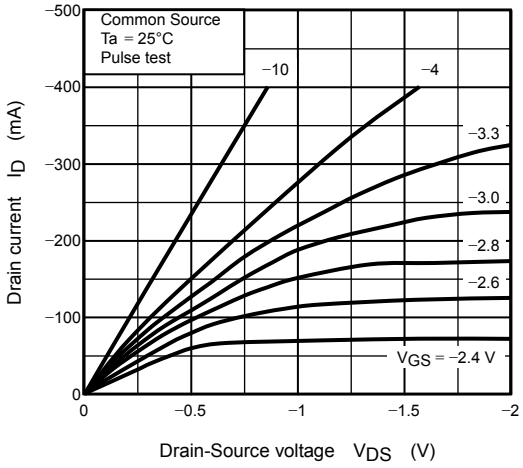


t – I_D

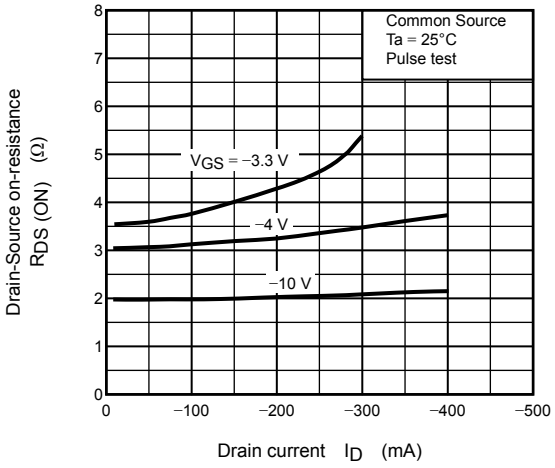


Q2 (Pch MOS FET)

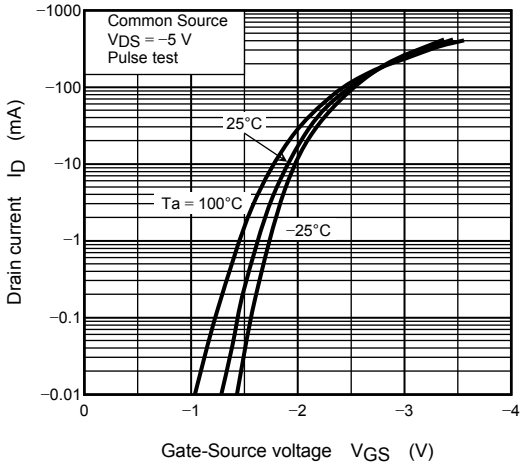
$I_D - V_{DS}$



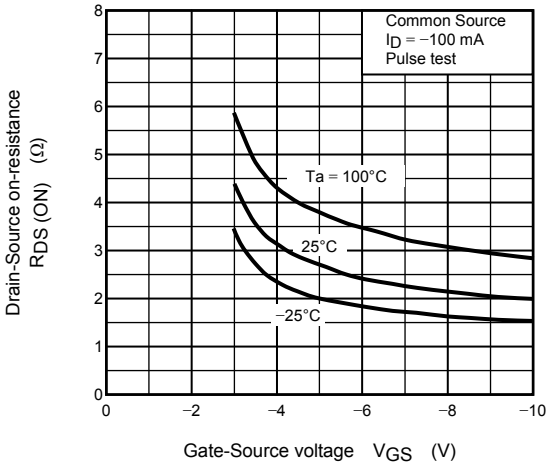
$R_{DS\ (ON)} - I_D$



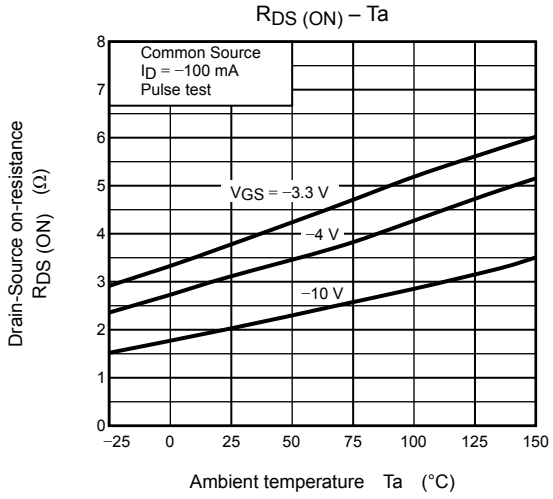
$I_D - V_{GS}$



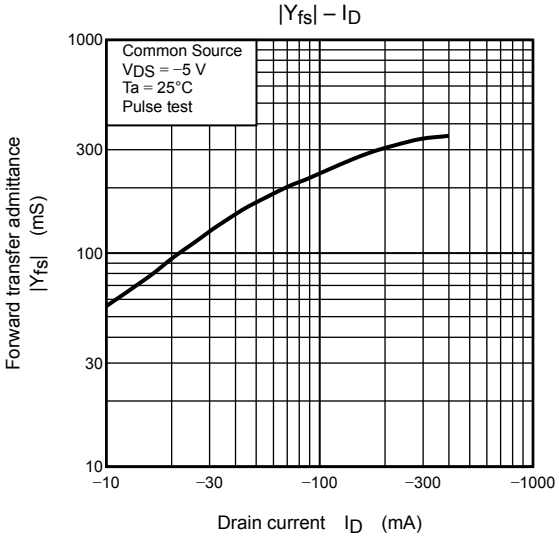
$R_{DS\ (ON)} - V_{GS}$



$R_{DS\ (ON)} - Ta$

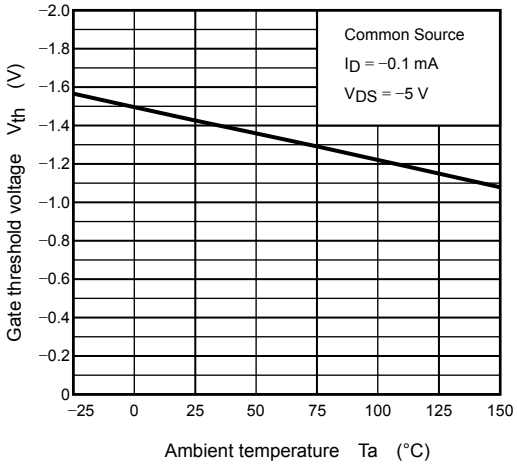


$|Y_{fs}| - I_D$

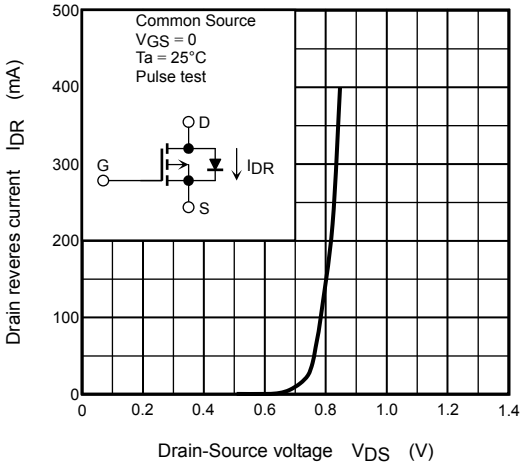


Q2 (Pch MOS FET)

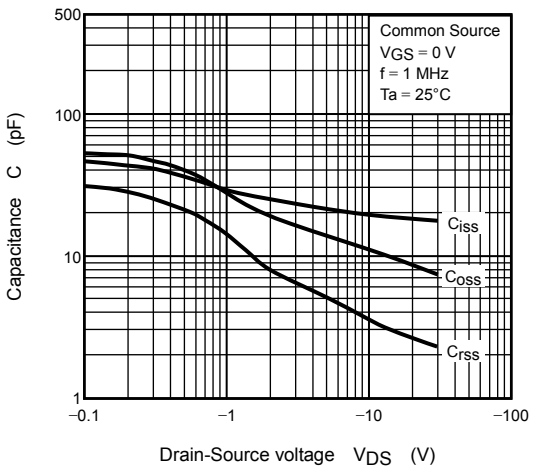
V_{th} – Ta



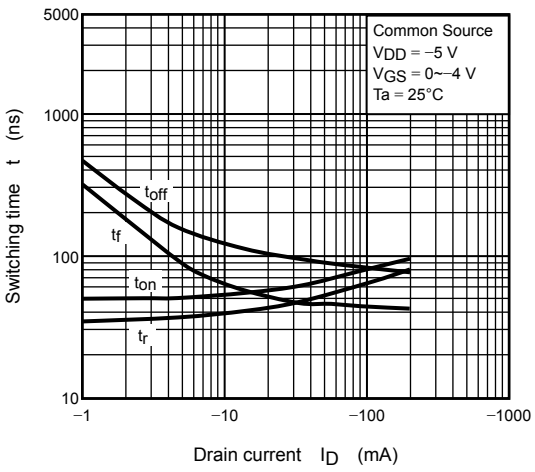
I_{DR} – V_{DS}



C – V_{DS}

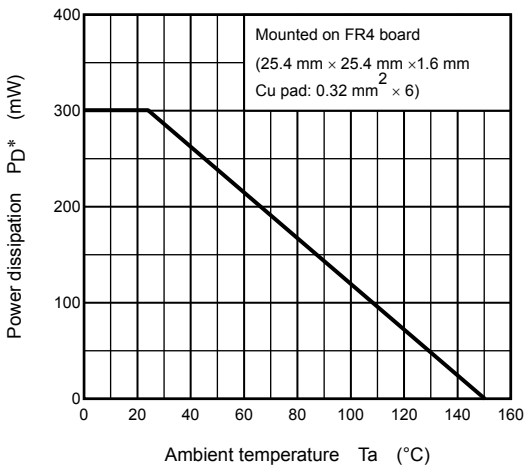


t – I_D



Common Characteristics

P_D* – Ta



*: Total rating

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