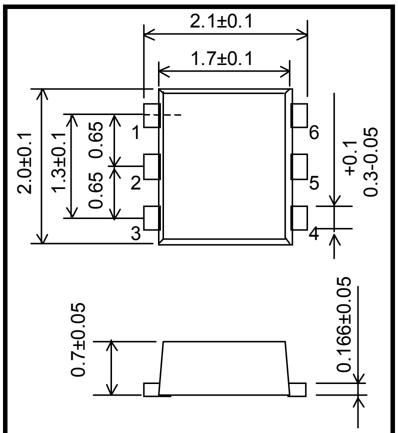
TOSHIBA Field-Effect Transistor Silicon N / P Channel MOS Type

SSM6L40TU

○ Power Management Switch Applications

○ High-Speed Switching Applications

Unit: mm



1.Source1 4.Source2
2.Gate1 5.Gate2
3.Drain2 6.Drain1

UF6

JEDEC	―
JEITA	―
TOSHIBA	2-2T1B

Weight: 7.0 mg (typ.)

- N-ch: 4.0-V drive
  P-ch: 4.0 -V drive
- N-ch, P-ch, 2-in-1
- Low ON-resistance Q1 N-ch: R_{on} = 182 mΩ (max) (@V_{GS} = 4 V)
  R_{on} = 122 mΩ (max) (@V_{GS} = 10 V)
  Q2 P-ch: R_{on} = 403 mΩ (max) (@V_{GS} = -4 V)
  R_{on} = 226 mΩ (max) (@V_{GS} = -10 V)

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	1.6	A
	Pulse	I_{DP}	3.2	

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	−1.4	A
	Pulse	I_{DP}	−2.8	

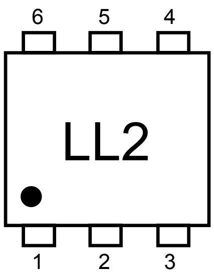
Absolute Maximum Ratings (Ta = 25 °C) (Q1, Q2 Common)

Characteristics	Symbol	Rating	Unit
Drain power dissipation	P_D(Note 1)	500	mW
Channel temperature	T_{ch}	150	°C
Storage temperature range	T_{stg}	−55 to 150	°C

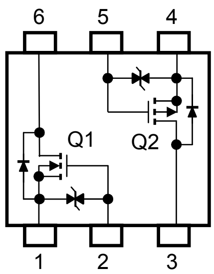
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note1: Mounted on an FR4 board. (total dissipation)
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad : 645 mm^2)

Marking



Equivalent Circuit (top view)



Start of commercial production
2008-02

Q1 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-source breakdown voltage		$V_{(BR)DSS}$	I_D = 1 mA, V_{GS} = 0 V	30	—	—	V
		$V_{(BR)DSX}$	I_D = 1 mA, V_{GS} = -20 V	15	—	—	
Drain cutoff current		I_{DSS}	V_{DS} =30 V, V_{GS} = 0 V	—	—	1	μA
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0 V	—	—	±1	μA
Gate threshold voltage		V_{th}	V_{DS} = 5 V, I_D = 1 mA	1.0	—	2.6	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 5 V, I_D = 1A (Note 2)	1.9	3.7	—	S
Drain-source ON-resistance		$R_{DS(ON)}$	I_D = 1 A, V_{GS} = 10 V (Note 2)	—	96	122	mΩ
			I_D = 0.5 A, V_{GS} = 4 V (Note 2)	—	130	182	
Input capacitance		C_{iss}	V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz	—	180	—	pF
Output capacitance		C_{oss}		—	34	—	
Reverse transfer capacitance		C_{rss}		—	27	—	
Total Gate Charge		Q_g	V_{DS} = 15 V, I_D = 1.6 A, V_{GS} = 10 V	—	5.1	—	nC
Gate–Source Charge		Q_{gs}		—	3.9	—	
Gate–Drain Charge		Q_{gd}		—	1.2	—	
Switching time	Turn-on time	t_{on}	V_{DD} = 15 V, I_D = 0.5 A V_{GS} = 0 to 4 V, R_G = 10 Ω	—	9.5	—	ns
	Turn-off time	t_{off}		—	9.0	—	
Drain-source forward voltage		V_{DSF}	I_D = -1.6 A, V_{GS} = 0 V (Note 2)	—	-0.8	-1.2	V

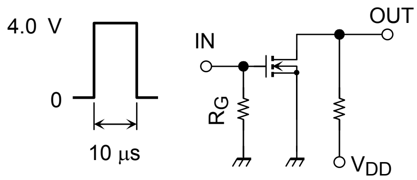
Q2 Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-source breakdown voltage		$V_{(BR)DSS}$	I_D = -1 mA, V_{GS} = 0 V	-30	—	—	V
		$V_{(BR)DSX}$	I_D = -1 mA, V_{GS} = +20 V	-15	—	—	
Drain cutoff current		I_{DSS}	V_{DS} = -30 V, V_{GS} = 0 V	—	—	-10	μA
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0 V	—	—	±1	μA
Gate threshold voltage		V_{th}	V_{DS} = -5 V, I_D = -1 mA	-0.8	—	-2.0	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = -5 V, I_D = -1 A (Note 2)	1.0	2.0	—	S
Drain-source ON-resistance		$R_{DS(ON)}$	I_D = -1.0 A, V_{GS} = -10 V (Note 2)	—	175	226	mΩ
			I_D = -0.5 A, V_{GS} = -4.0 V (Note 2)	—	290	403	
Input capacitance		C_{iss}	V_{DS} = -15 V, V_{GS} = 0 V, f = 1 MHz	—	120	—	pF
Output capacitance		C_{oss}		—	32	—	
Reverse transfer capacitance		C_{rss}		—	21	—	
Total Gate Charge		Q_g	V_{DS} = -15 V, I_D = -1.4 A, V_{GS} = -10 V	—	2.9	—	nC
Gate–Source Charge		Q_{gs}		—	2.2	—	
Gate–Drain Charge		Q_{gd}		—	0.7	—	
Switching time	Turn-on time	t_{on}	V_{DD} = -15 V, I_D = -1 A, V_{GS} = 0 to -4 V, R_G = 10 Ω	—	12	—	ns
	Turn-off time	t_{off}		—	8.5	—	
Drain-source forward voltage		V_{DSF}	I_D = 1.4 A, V_{GS} = 0 V (Note 2)	—	0.87	1.2	V

Note 2: Pulse test

Q1 Switching Time Test Circuit

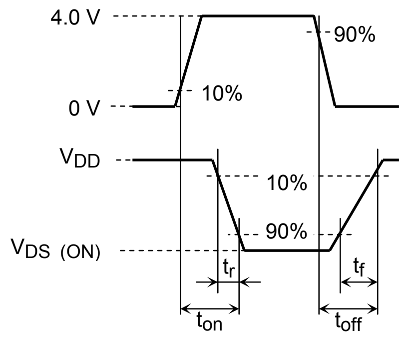
(a) Test Circuit



V_{DD} = 15 V
R_G = 10 Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

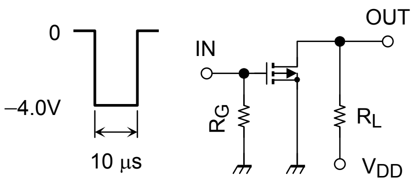
(b) V_{IN}

(c) V_{OUT}



Q2 Switching Time Test Circuit

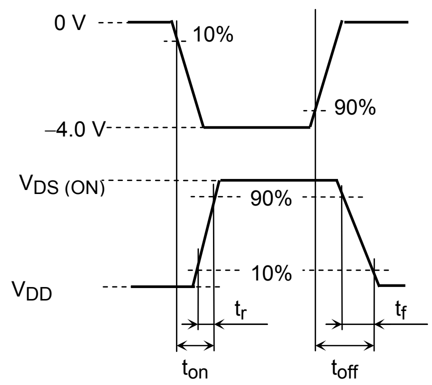
(a) Test Circuit



V_{DD} = − 15 V
R_G = 10 Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

(c) V_{OUT}



Q1 Usage Considerations

Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (1 mA for the Q1 of the SSM6L40TU). Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th}, and $V_{GS(off)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$.

Take this into consideration when using the device.

Q2 Usage Considerations

Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (−1 mA for the Q2 of the SSM6L40TU). Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th}, and $V_{GS(off)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$.

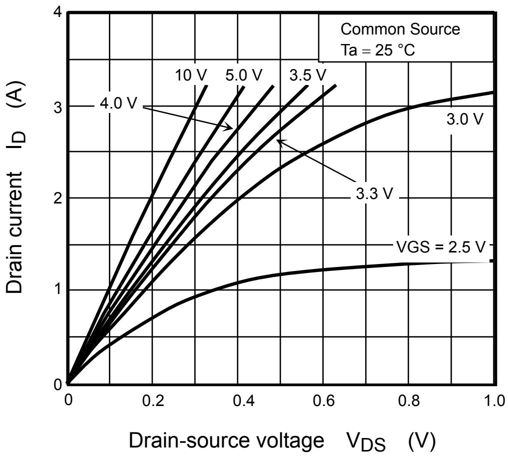
Take this into consideration when using the device.

Handling Precaution

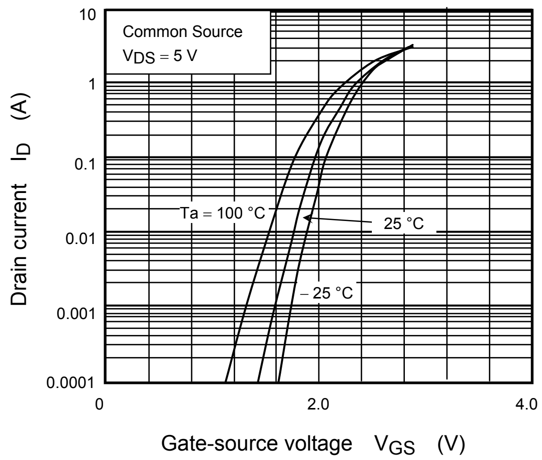
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic materials.

Q1 (N-ch MOSFET)

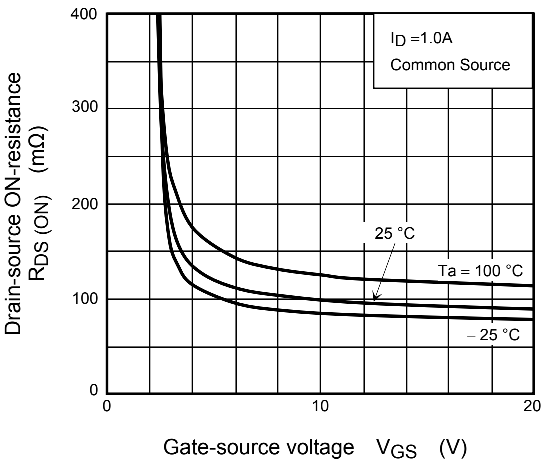
I_D – V_{DS}



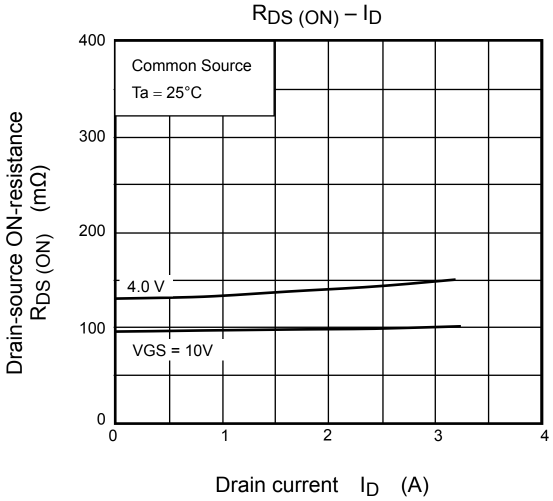
I_D – V_{GS}



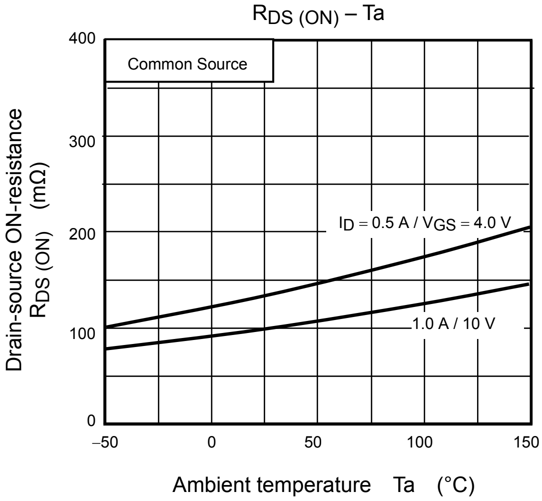
$R_{DS (ON)}$ – V_{GS}



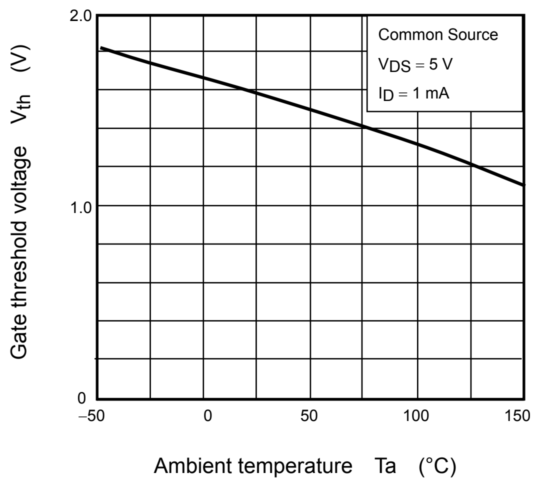
$R_{DS (ON)}$ – I_D



$R_{DS (ON)}$ – Ta

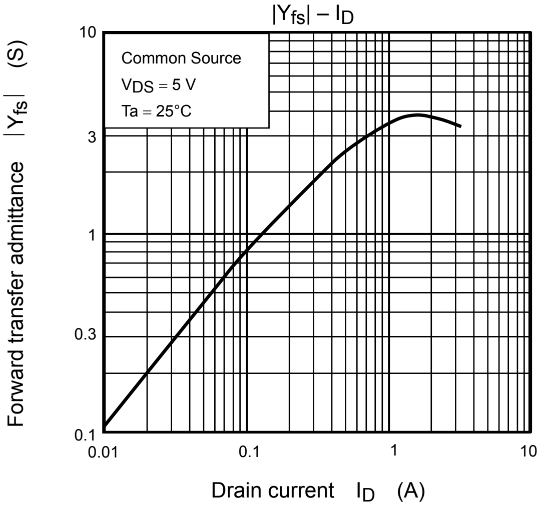


V_{th} – Ta

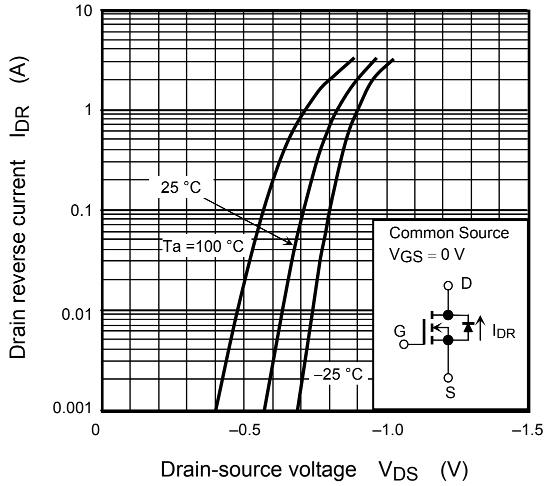


Q1 (N-ch MOSFET)

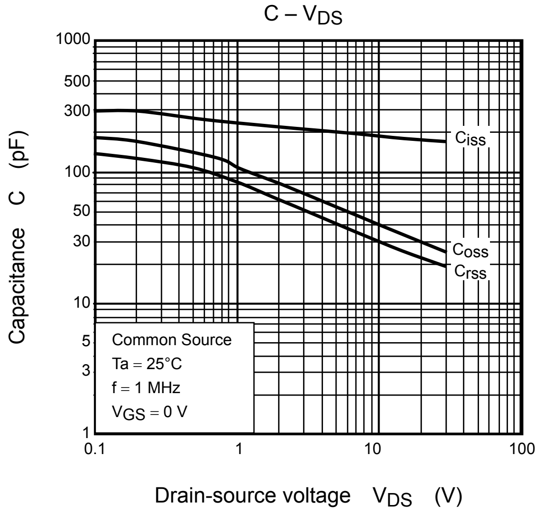
|Yfs| – ID



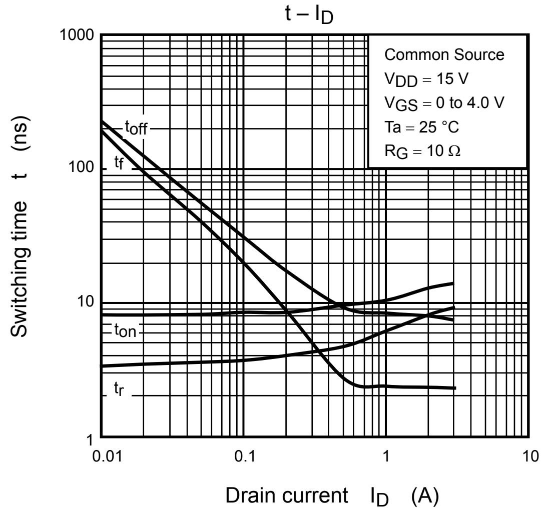
IDR – VDS



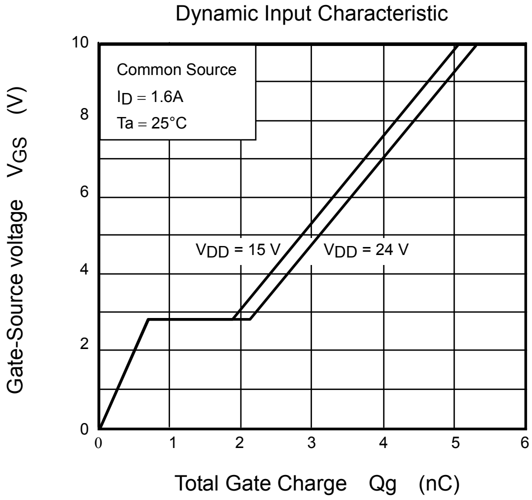
C – VDS



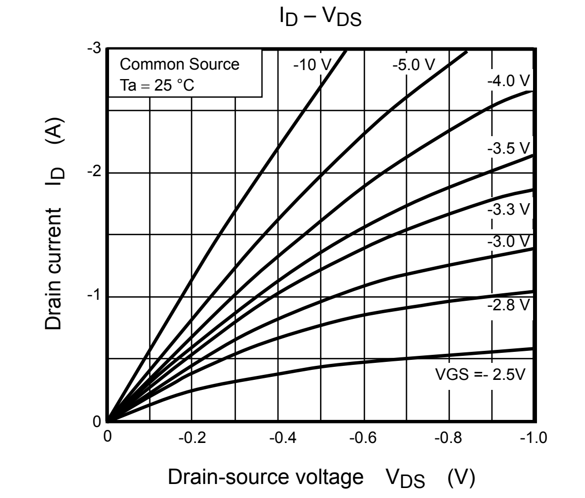
t – ID

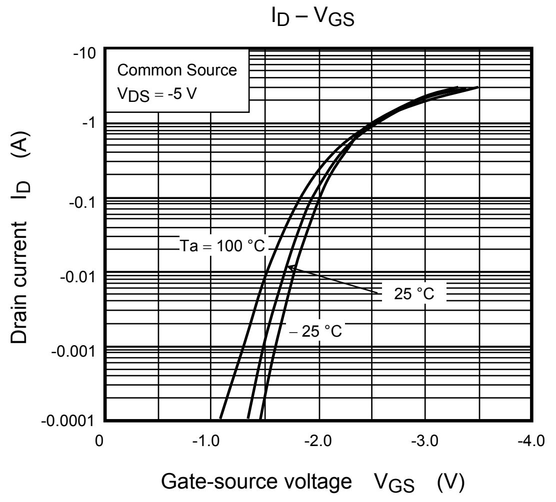


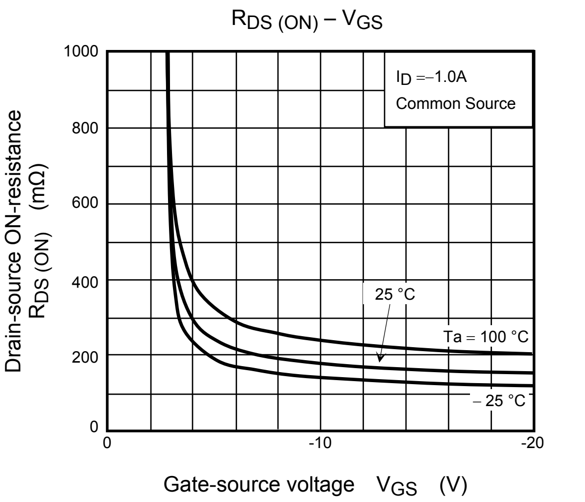
Dynamic Input Characteristic

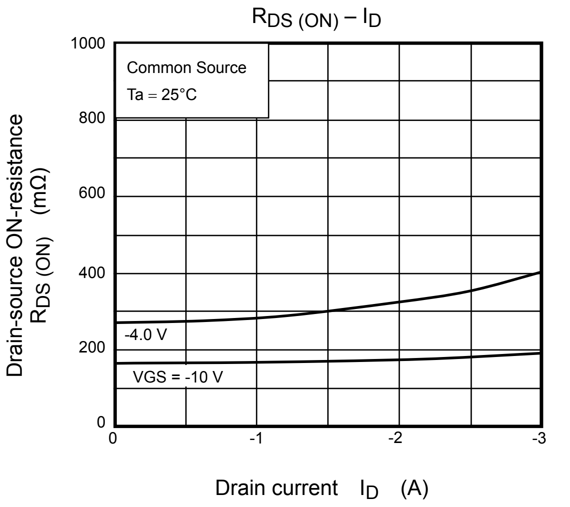


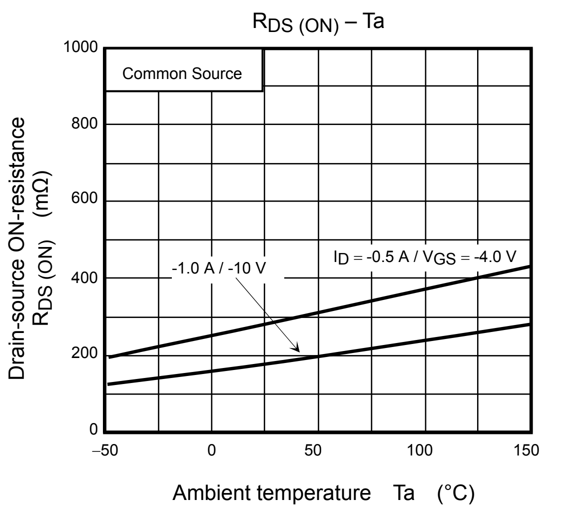
Q2 (P-ch MOSFET)

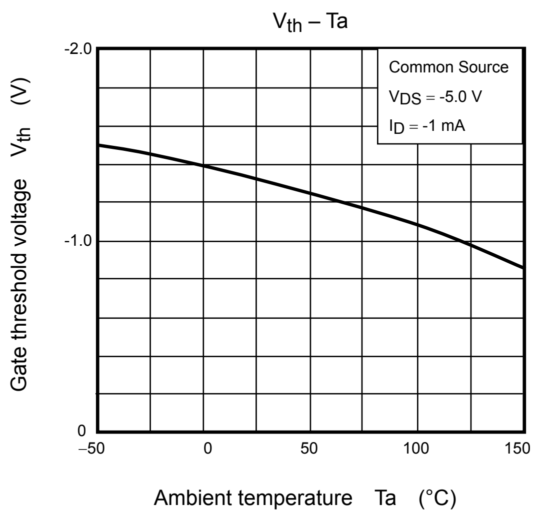




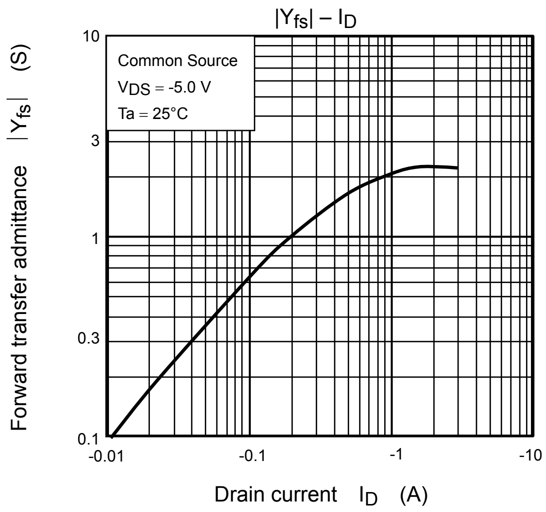


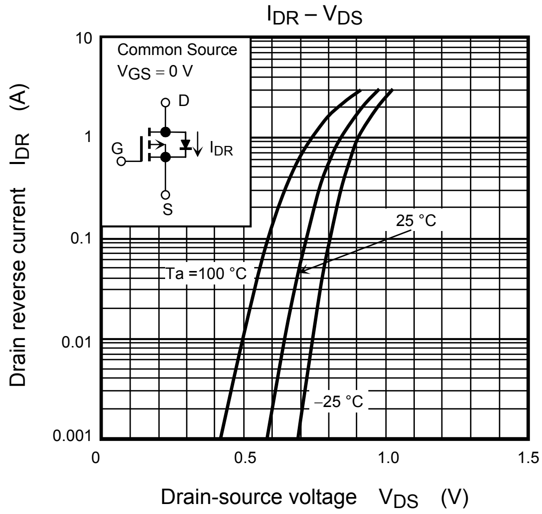


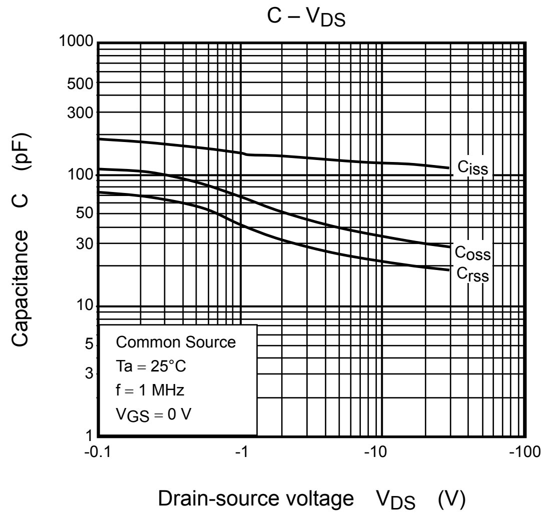


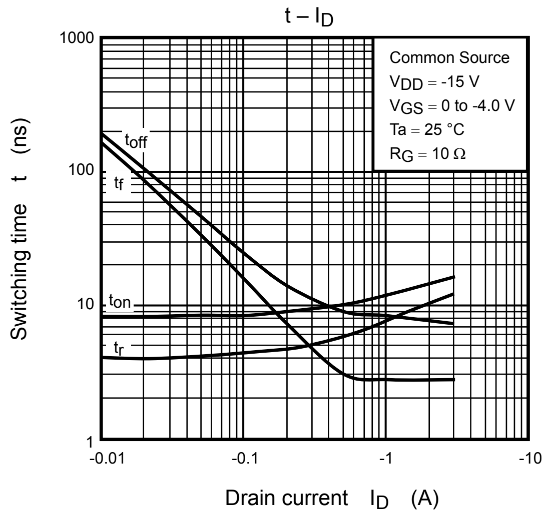


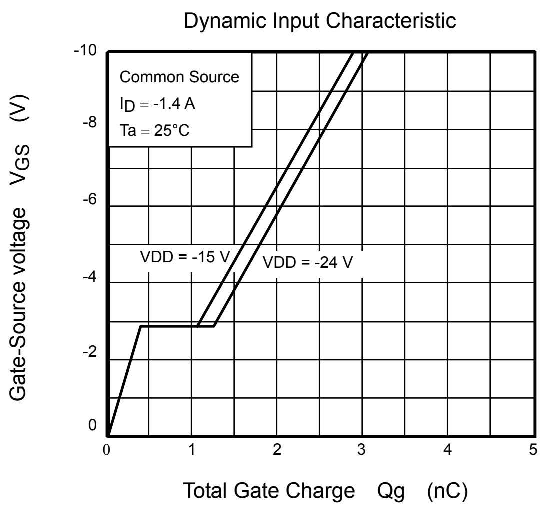
Q2 (P-ch MOSFET)



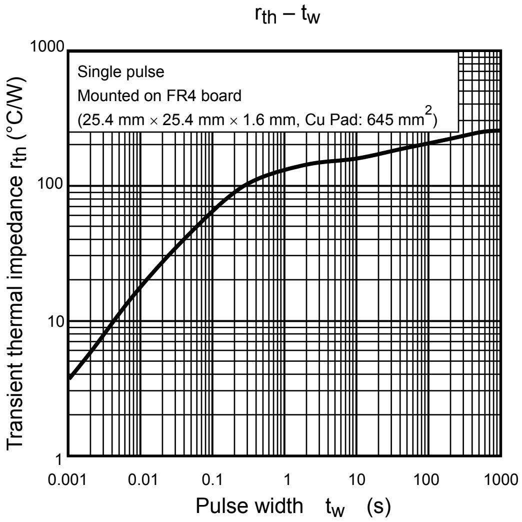


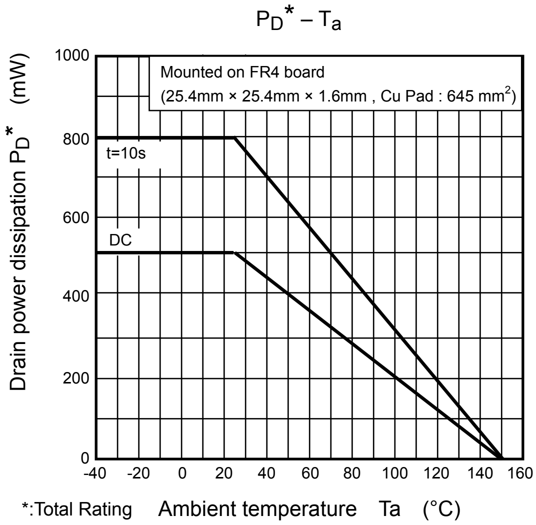






Q1, Q2 Common


r_th – t_w
Single pulse
Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm2)
Transient thermal impedance r_th (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width t_w (s)


P_D* – T_a
Mounted on FR4 board
(25.4mm × 25.4mm × 1.6mm , Cu Pad : 645 mm2)
t=10s
DC
Drain power dissipation P_D* (mW)
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
*:Total Rating
Ambient temperature Ta (°C)

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