

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

SSM6L13TU

Power Management Switch Applications

High-Speed Switching Applications

- 1.8 V drive
- P-ch , N-ch 2-in-1
- Low ON-resistance: Pch $R_{on} = 460 \text{ m}\Omega$ (max) (@ $V_{GS} = -1.8 \text{ V}$)
- $R_{on} = 306 \text{ m}\Omega$ (max) (@ $V_{GS} = -2.5 \text{ V}$)
- : Nch $R_{on} = 235 \text{ m}\Omega$ (max) (@ $V_{GS} = 1.8 \text{ V}$)
- $R_{on} = 178 \text{ m}\Omega$ (max) (@ $V_{GS} = 2.5 \text{ V}$)

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

Characteristic	Symbol	Rating	Unit
Drain-source voltage	V_{DS}	20	V
Gate-source voltage	V_{GSS}	± 12	V
Drain current	DC	I_D	A
	Pulse	I_{DP}	
		0.8	
		1.6	

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

Characteristic	Symbol	Rating	Unit
Drain-source voltage	V_{DS}	-20	V
Gate-source voltage	V_{GSS}	± 8	V
Drain current	DC	I_D	A
	Pulse	I_{DP}	
		-0.8	
		-1.6	

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

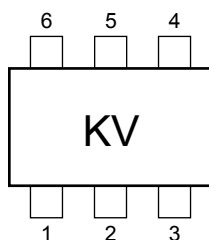
Characteristic	Symbol	Rating	Unit
Drain power dissipation	P_D (Note 1)	500	mW
Channel temperature	T_{ch}	150	$^\circ\text{C}$
Storage temperature range	T_{stg}	-55 to 150	$^\circ\text{C}$

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.

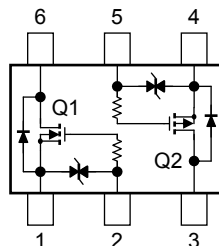
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 1: Mounted on an FR4 board (total dissipation)
(25.4 mm $\times$ 25.4 mm $\times$ 1.6 mm, Cu Pad: 645 mm²)

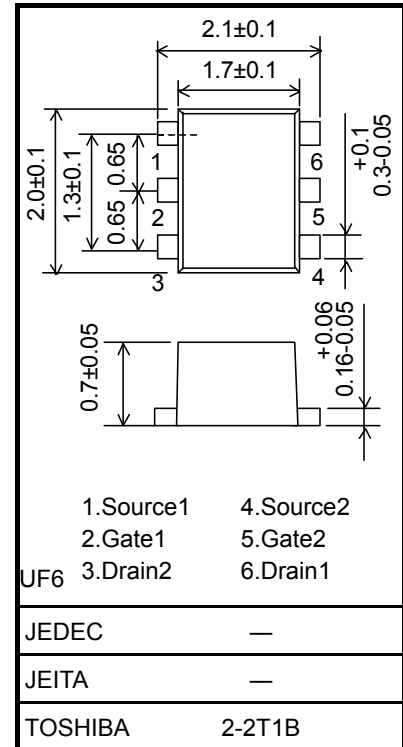
Marking



Equivalent Circuit (top view)



Unit: mm



Weight: 7 mg (typ.)

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 Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-source breakdown voltage	V _{(BR) DSS}	I _D = 1 mA, V _{GS} = 0	20	—	—	V
	V _{(BR) DSX}	I _D = 1 mA, V _{GS} = -12 V	10	—	—	
Drain cutoff current	I _{DSS}	V _{DS} = 20 V, V _{GS} = 0	—	—	1	μA
Gate leakage current	I _{GSS}	V _{GS} = ±12 V, V _{DS} = 0	—	—	±1	μA
Gate threshold voltage	V _{th}	V _{DS} = 3 V, I _D = 1 mA	0.4	—	1.0	V
Forward transfer admittance	Y _{fs}	V _{DS} = 3 V, I _D = 0.6 A (Note 2)	2.3	3.75	—	S
Drain-source ON-resistance	R _{DS (ON)}	I _D = 0.6 A, V _{GS} = 4.0 V (Note 2)	—	116	143	mΩ
		I _D = 0.4 A, V _{GS} = 2.5 V (Note 2)	—	134	178	
		I _D = 0.2 A, V _{GS} = 1.8 V (Note 2)	—	160	235	
Input capacitance	C _{iss}	V _{DS} = 10 V, V _{GS} = 0, f = 1 MHz	—	268	—	pF
Output capacitance	C _{oss}	V _{DS} = 10 V, V _{GS} = 0, f = 1 MHz	—	44	—	pF
Reverse transfer capacitance	C _{rss}	V _{DS} = 10 V, V _{GS} = 0, f = 1 MHz	—	34	—	pF
Switching time	Turn-on time	t _{on}	—	9	—	ns
	Turn-off time	t _{off}		16	—	
Drain-source forward voltage	V _{DSF}	I _D = -0.8 A, V _{GS} = 0 V (Note 2)	—	-0.8	-1.15	V

Note 2 : Pulse test

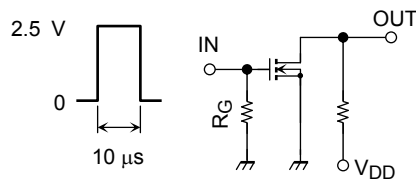
Q2 Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-source breakdown voltage	V _{(BR) DSS}	I _D = -1 mA, V _{GS} = 0	-20	—	—	V
	V _{(BR) DSX}	I _D = -1 mA, V _{GS} = +8 V	-12	—	—	
Drain cutoff current	I _{DSS}	V _{DS} = -20 V, V _{GS} = 0	—	—	-10	μA
Gate leakage current	I _{GSS}	V _{GS} = ±8 V, V _{DS} = 0	—	—	±1	μA
Gate threshold voltage	V _{th}	V _{DS} = -3 V, I _D = -1 mA	-0.3	—	-1.0	V
Forward transfer admittance	Y _{fs}	V _{DS} = -3 V, I _D = -0.6 A (Note 2)	1.5	2.5	—	S
Drain-source ON-resistance	R _{DS (ON)}	I _D = -0.6 A, V _{GS} = -4.0 V (Note 2)	—	175	234	mΩ
		I _D = -0.4 A, V _{GS} = -2.5 V (Note 2)	—	230	306	
		I _D = -0.1 A, V _{GS} = -1.8 V (Note 2)	—	300	460	
Input capacitance	C _{iss}	V _{DS} = -10 V, V _{GS} = 0, f = 1 MHz	—	250	—	pF
Output capacitance	C _{oss}	V _{DS} = -10 V, V _{GS} = 0, f = 1 MHz	—	45	—	pF
Reverse transfer capacitance	C _{rss}	V _{DS} = -10 V, V _{GS} = 0, f = 1 MHz	—	35	—	pF
Switching time	Turn-on time	t _{on}	—	12	—	ns
	Turn-off time	t _{off}		18	—	
Drain-source forward voltage	V _{DSF}	I _D = 0.8 A, V _{GS} = 0 V (Note 2)	—	0.85	1.2	V

Note 2: Pulse test

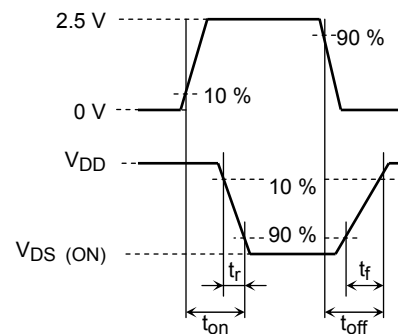
Q1 Switching Time Test Circuit

(a) Test Circuit

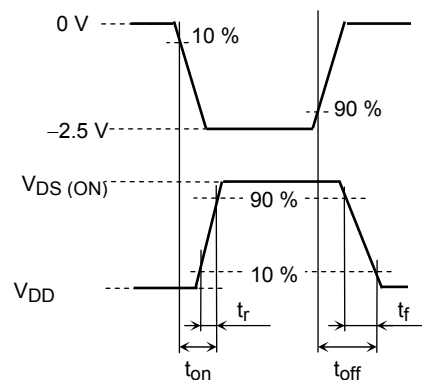


$V_{DD} = 10 \text{ V}$
 $R_G = 4.7 \text{ } \Omega$
 $D.U. \leq 1\%$
 $V_{IN}: t_r, t_f < 5 \text{ ns}$
 Common Source
 $T_a = 25 \text{ } ^\circ\text{C}$

(b) V_{IN}

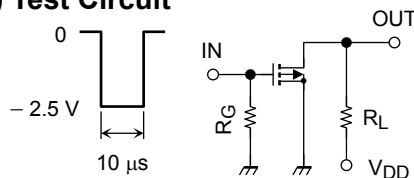


(c) V_{OUT}



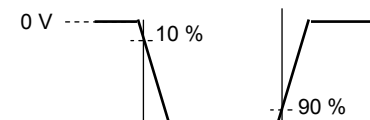
Q2 Switching Time Test Circuit

(a) Test Circuit

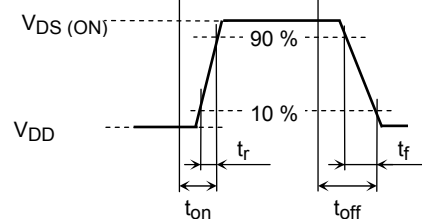


$V_{DD} = -10 \text{ V}$
 $R_G = 4.7 \text{ } \Omega$
 $D.U. \leq 1\%$
 $V_{IN}: t_r, t_f < 5 \text{ ns}$
 Common Source
 $T_a = 25 \text{ } ^\circ\text{C}$

(b) V_{IN}



(c) V_{OUT}



Q1 Precaution

V_{th} can be expressed as the voltage between gate and source when the low operating current value is $I_D = 1 \text{ mA}$ 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: $V_{GS (off)} < V_{th} < V_{GS (on)}$.)

Take this into consideration when using the device.

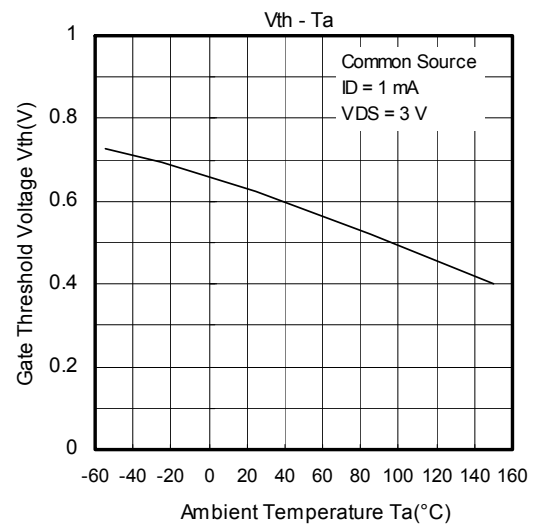
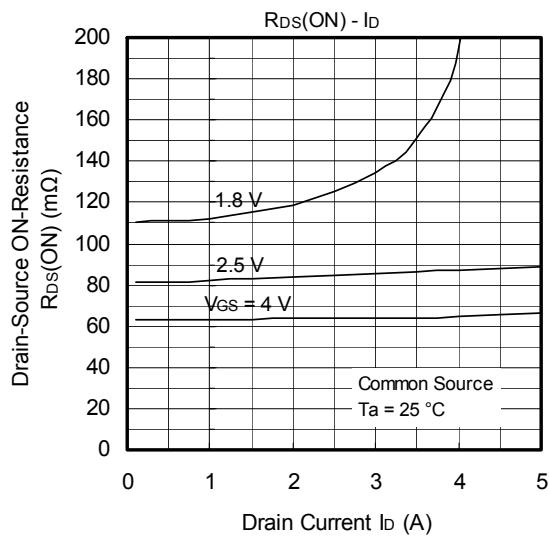
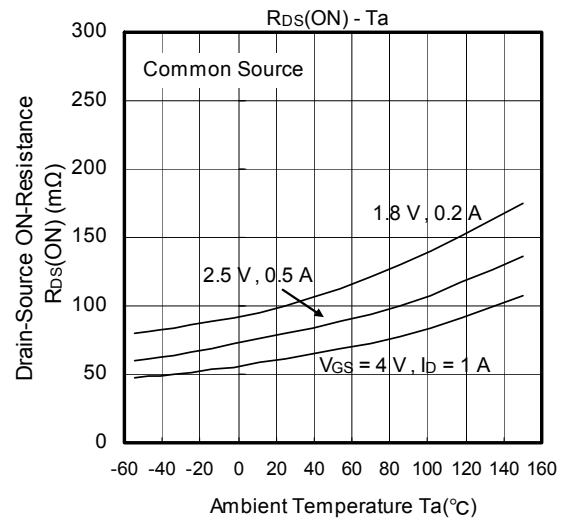
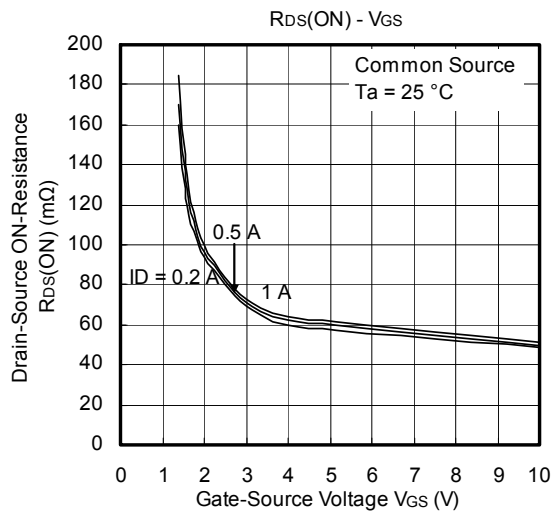
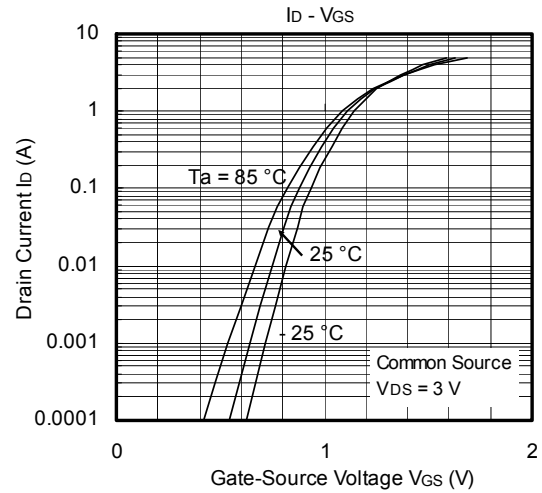
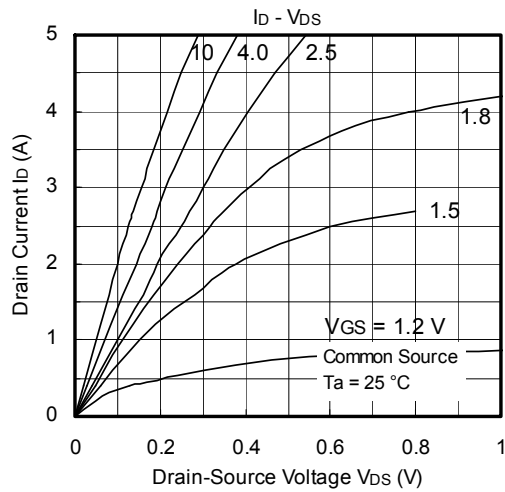
Q2 Precaution

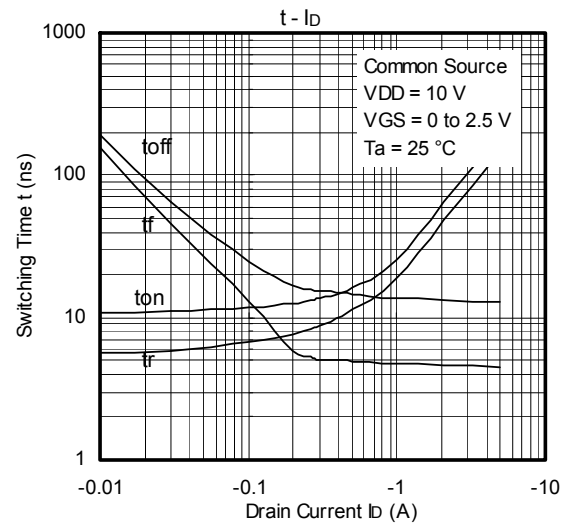
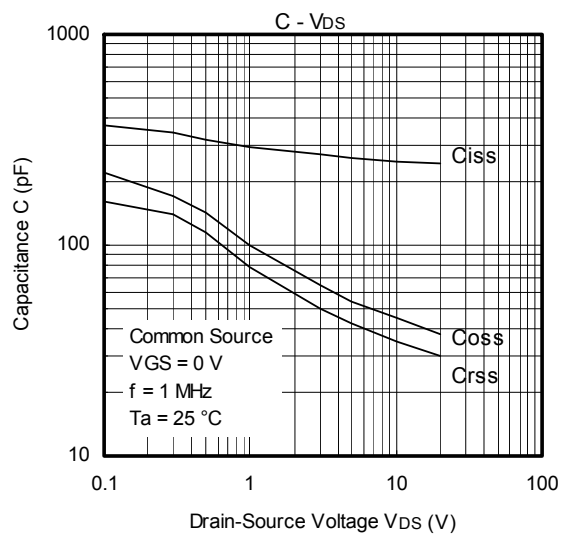
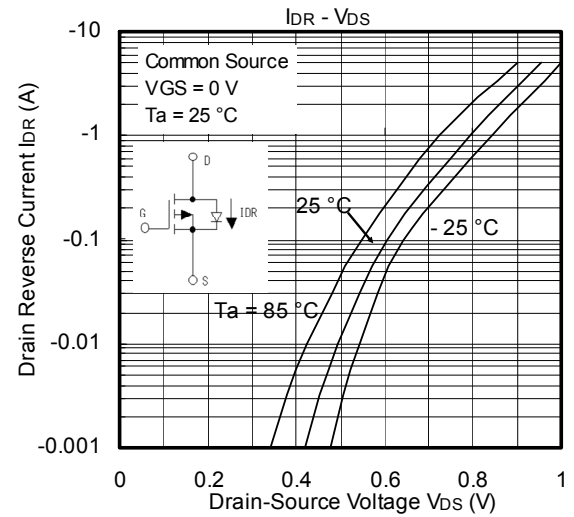
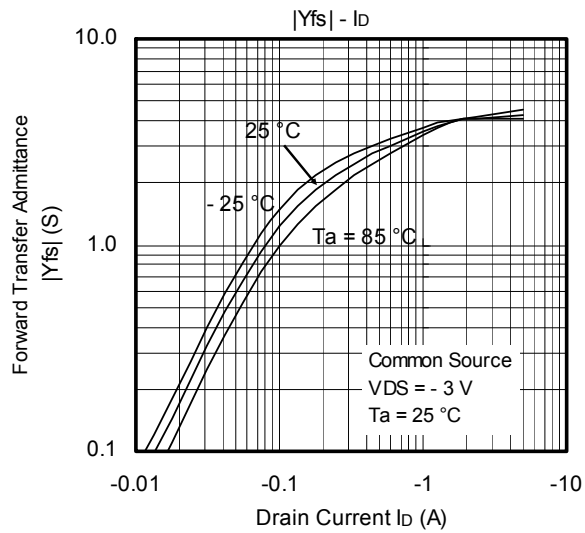
V_{th} can be expressed as the voltage between gate and source when the low operating current value is $I_D = -1 \text{ mA}$ for this product. For normal switching operation, $V_{GS (on)}$ requires a higher voltage than V_{th} , and $V_{GS (off)}$ requires a lower voltage than V_{th} .

(The relationship can be established as follows: $V_{GS (off)} < V_{th} < V_{GS (on)}$.)

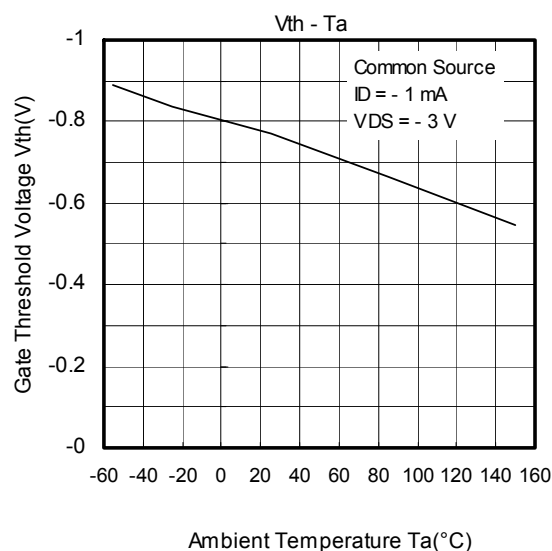
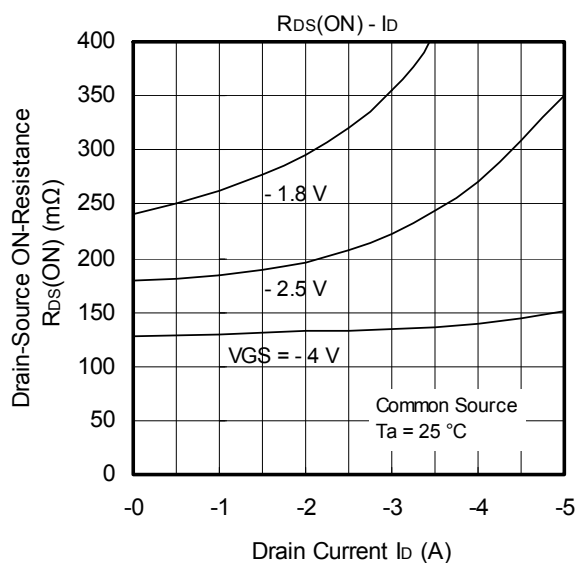
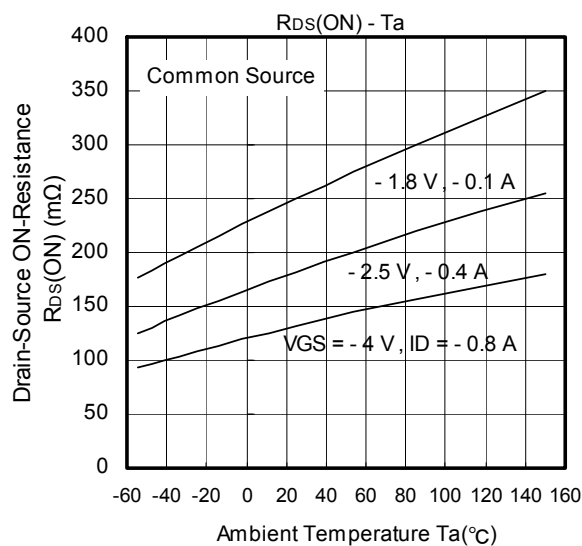
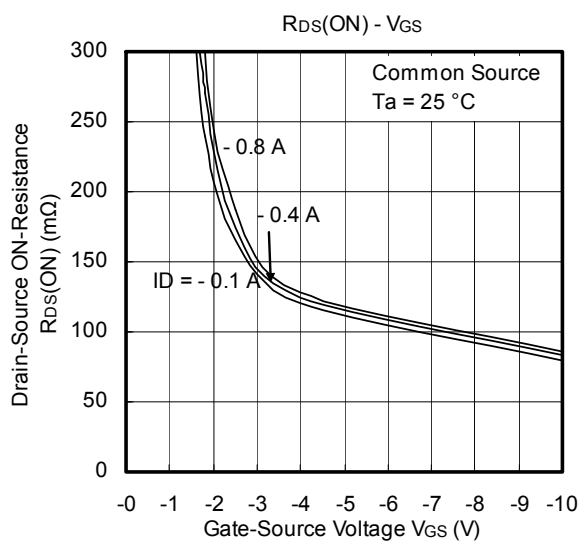
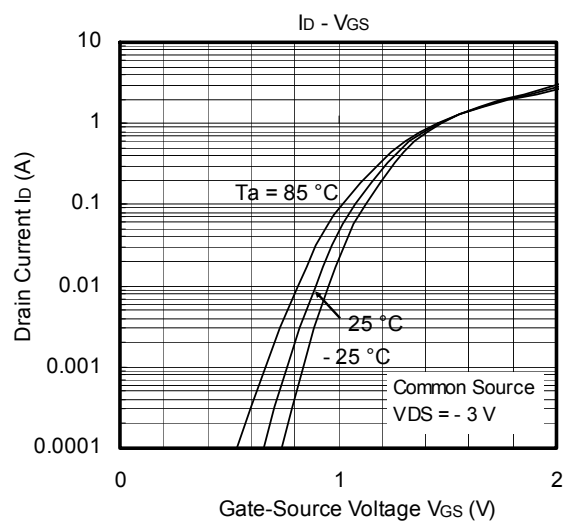
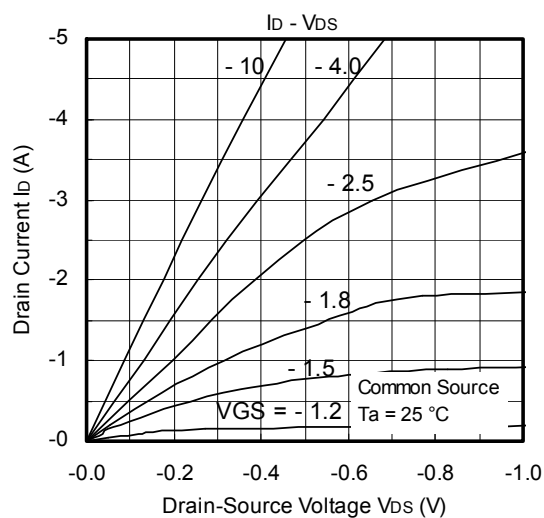
Take this into consideration when using the device.

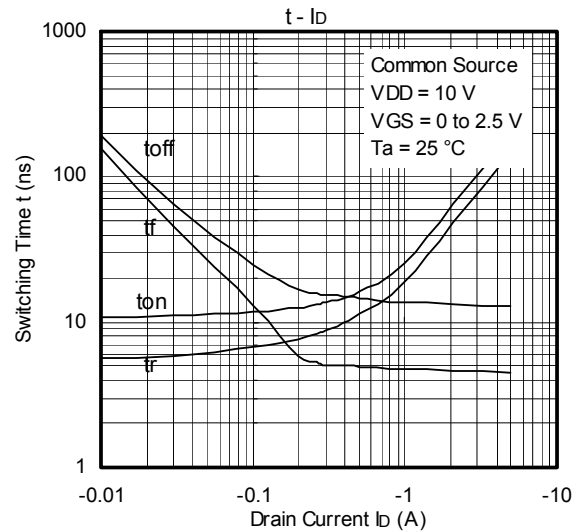
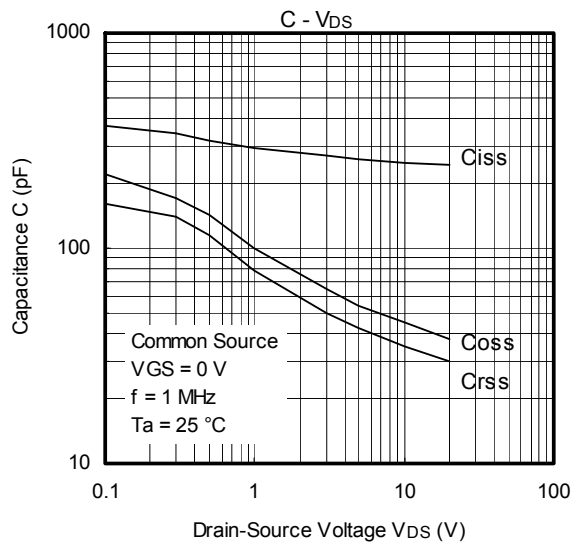
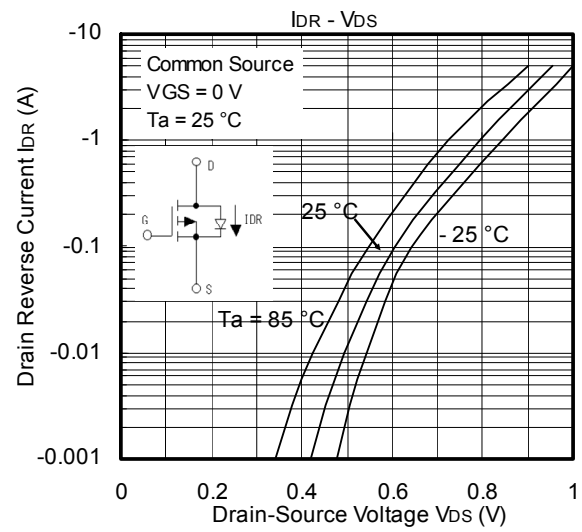
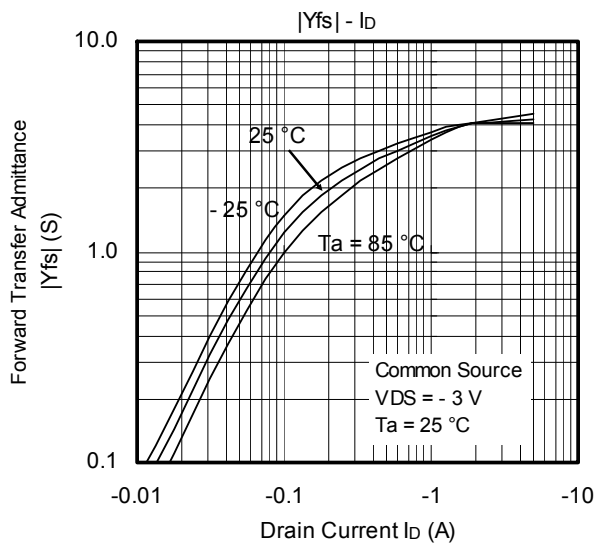
Q1 Data



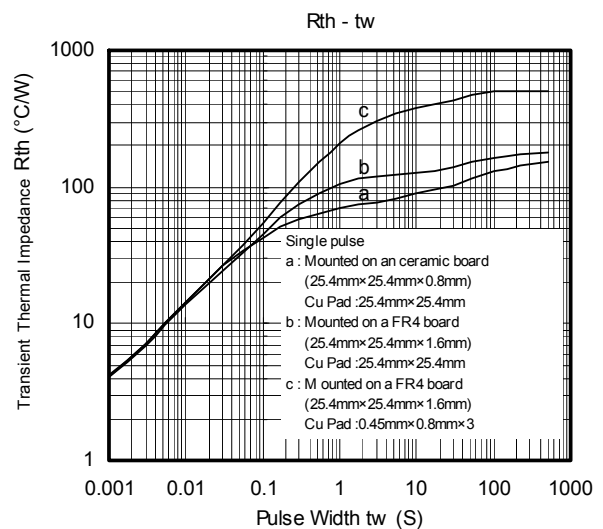
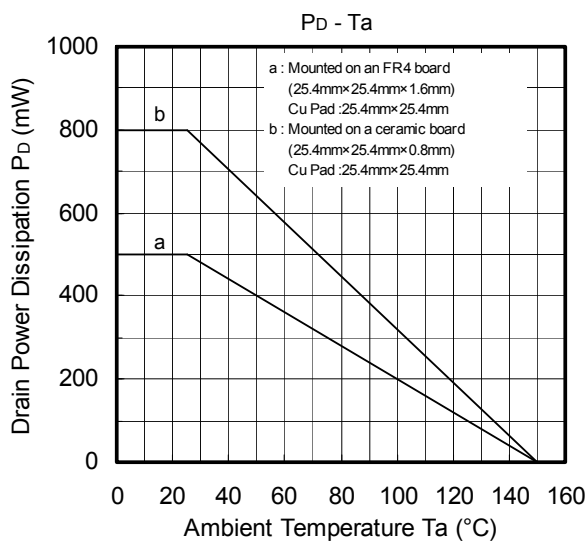


Q2 Data





Q1 , Q2 Data



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20070701-EN GENERAL

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