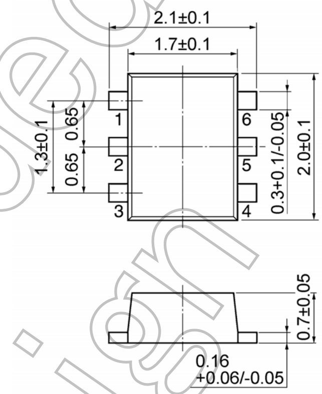
TOSHIBA Field-Effect Transistor Silicon P-Channel MOS Type (U-MOS V)

SSM6J409TU

○ Power Management Switch Applications
○ High-Speed Switching Applications

- 1.5V drive
- Low ON-resistance: R_{on} = 72.3mΩ (max) (@V_{GS} = -1.5 V)
  R_{on} = 46.2mΩ (max) (@V_{GS} = -1.8 V)
  R_{on} = 30.2mΩ (max) (@V_{GS} = -2.5 V)
  R_{on} = 22.1mΩ (max) (@V_{GS} = -4.5 V)

Unit: mm



1,2,5,6 : Drain
3 : Gate
4 : Source

UF6

JEDEC	―
JEITA	―
TOSHIBA	2-2T1D

Weight: 7.6mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

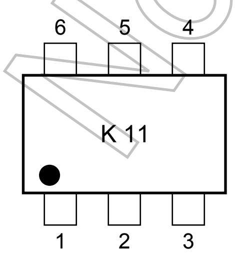
Characteristic		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	−20	V
Gate-Source voltage		V_{GSS}	±8	V
Drain current	DC	I_D (Note 1)	−9.5	A
	Pulse	I_{DP} (Note 1)	−19.0	
Drain power dissipation		P_D (Note 2)	1	W
		t=10s	2	
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55 to 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).

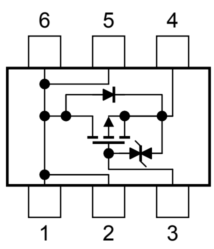
Note 1: The junction temperature should not exceed 150°C during use.

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

Marking



Equivalent Circuit (top view)



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.

Start of commercial production
2009-06

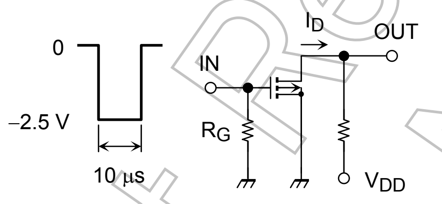
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-Source breakdown voltage		$V_{(BR)DSS}$	I_D = -1 mA, V_{GS} = 0 V	-20	—	—	V
		$V_{(BR)DSX}$	I_D = -1 mA, V_{GS} = +8 V	-12	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V	—	—	-10	μA
Gate leakage current		I_{GSS}	V_{GS} = ±8 V, V_{DS} = 0 V	—	—	±1	μA
Gate threshold voltage		V_{th}	V_{DS} = -3 V, I_D = -1 mA	-0.3	—	-1.0	V
Forward transfer admittance		$\lvert Y_{fs} \rvert$	V_{DS} = -3 V, I_D = -3.0 A (Note 3)	10	20	—	S
Drain–source ON-resistance		$R_{DS(ON)}$	I_D = -3.0 A, V_{GS} = -4.5 V (Note 3)	—	17.8	22.1	mΩ
			I_D = -2.0 A, V_{GS} = -2.5 V (Note 3)	—	23.5	30.2	
			I_D = -1.5 A, V_{GS} = -1.8 V (Note 3)	—	31.5	46.2	
			I_D = -0.8 A, V_{GS} = -1.5 V (Note 3)	—	40.0	72.3	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	1100	—	pF
Output capacitance		C_{oss}		—	240	—	
Reverse transfer capacitance		C_{rss}		—	180	—	
Total Gate Charge		Q_g	V_{DD} = –10 V, I_D = –9.5 A V_{GS} = –4.5 V	—	15.0	—	nC
Gate-Source Charge		Q_{gs}		—	10.9	—	
Gate-Drain Charge		Q_{gd}		—	4.1	—	
Switching time	Turn-on time	t_{on}	V_{DD} = -10 V, I_D = -2.0 A, V_{GS} = 0 to -2.5 V, R_G = 4.7 Ω	—	40	—	ns
	Turn-off time	t_{off}		—	207	—	
Drain-Source forward voltage		V_{DSF}	I_D = 9.5 A, V_{GS} = 0 V (Note 3)	—	0.83	1.2	V

Note3: Pulse test

Switching Time Test Circuit

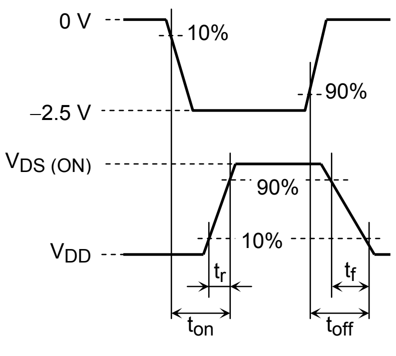
(a) Test Circuit



V_{DD} = – 10 V
R_G = 4.7 Ω
D.U. ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

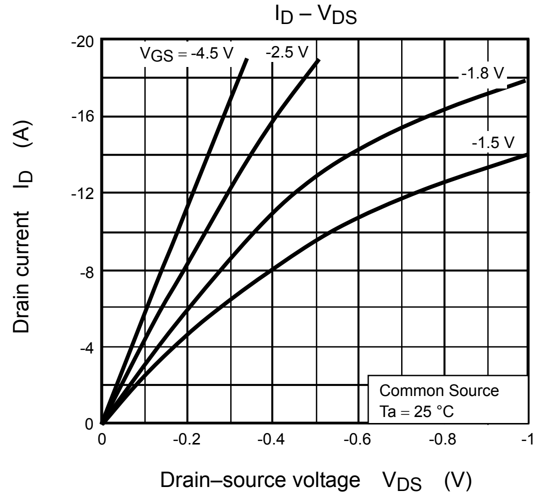
(c) V_{OUT}

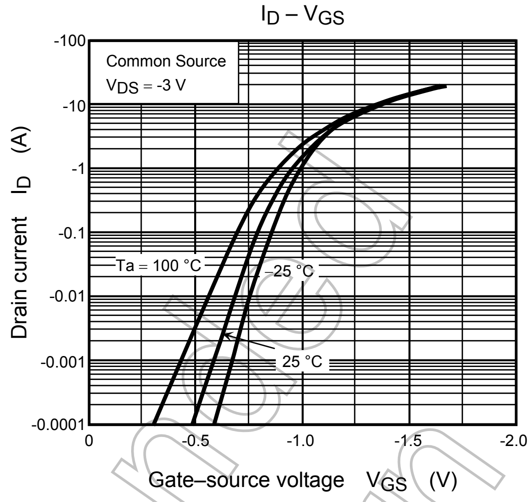


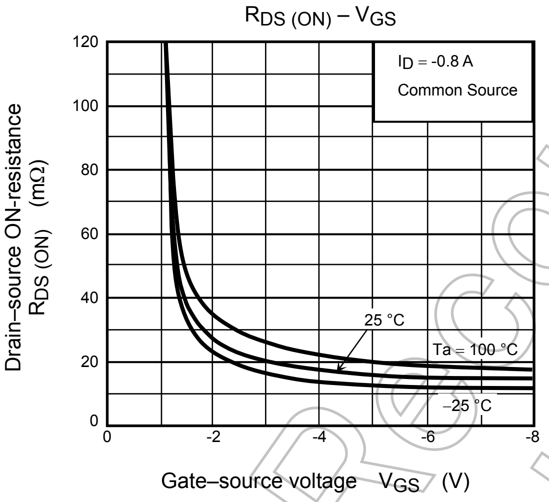
Notice on Usage

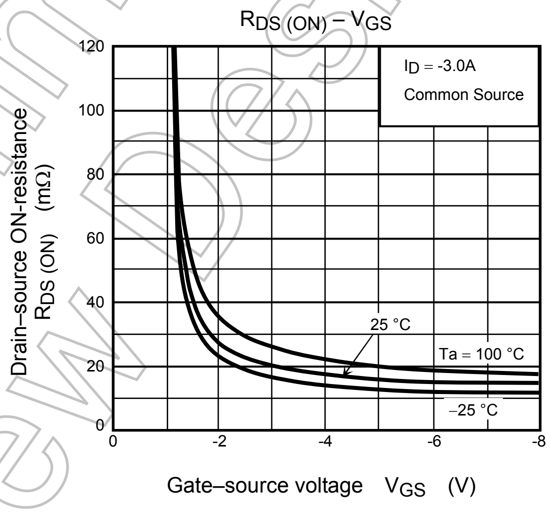
V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D = -1 mA for this product. For normal switching operation, $V_{GS (on)}$ requires a higher voltage than V_{th} and $V_{GS (off)}$ requires a lower voltage than V_{th}. (The relationship can be established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

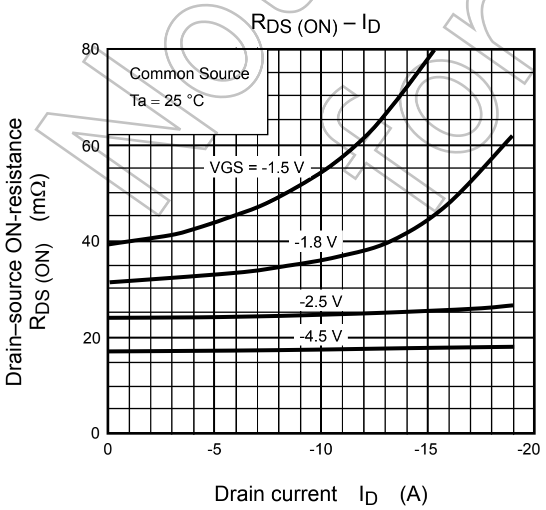
Take this into consideration when using the device.

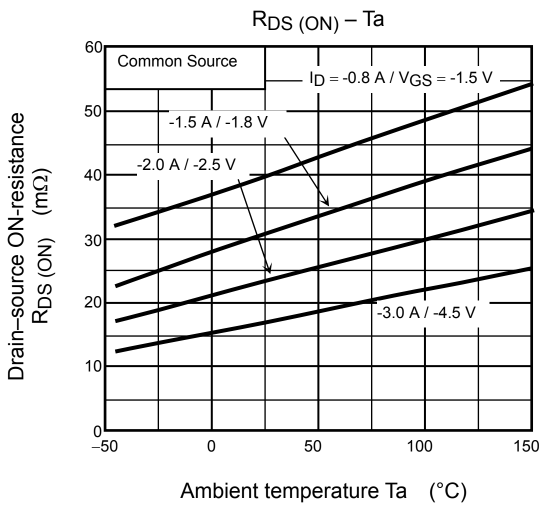

I_D – V_{DS}
V_{GS} = -4.5 V
-2.5 V
-1.8 V
-1.5 V
Common Source
Ta = 25 °C
Drain current I_D (A)
-20
-16
-12
-8
-4
0
0
-0.2
-0.4
-0.6
-0.8
-1
Drain–source voltage V_{DS} (V)


I_D – V_{GS}
Common Source
V_{DS} = -3 V
Ta = 100 °C
–25 °C
25 °C
Drain current I_D (A)
-100
-10
-1
-0.1
-0.01
-0.001
-0.0001
0
-0.5
-1.0
-1.5
-2.0
Gate–source voltage V_{GS} (V)

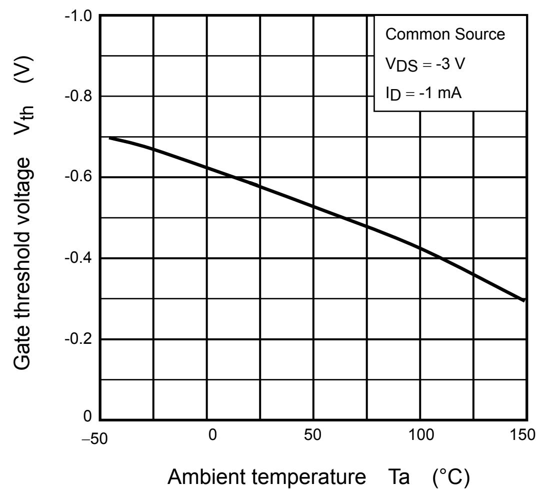

$R_{DS\ (ON)}$ – V_{GS}
I_D = -0.8 A
Common Source
25 °C
Ta = 100 °C
–25 °C
Drain–source ON-resistance $R_{DS\ (ON)}$ (mΩ)
120
100
80
60
40
20
0
0
-2
-4
-6
-8
Gate–source voltage V_{GS} (V)


$R_{DS\ (ON)}$ – V_{GS}
I_D = -3.0A
Common Source
25 °C
Ta = 100 °C
–25 °C
Drain–source ON-resistance $R_{DS\ (ON)}$ (mΩ)
120
100
80
60
40
20
0
0
-2
-4
-6
-8
Gate–source voltage V_{GS} (V)

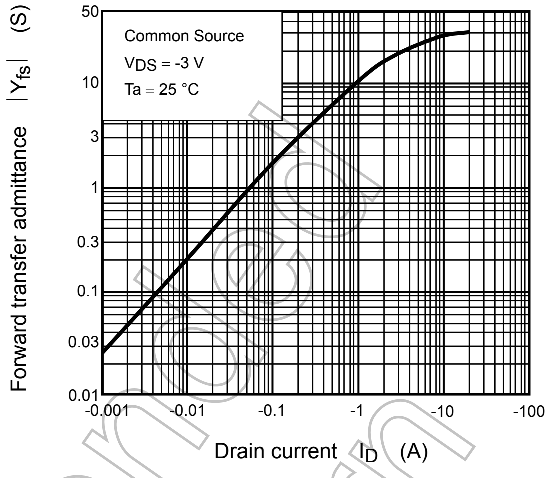

$R_{DS\ (ON)}$ – I_D
Common Source
Ta = 25 °C
VGS = -1.5 V
-1.8 V
-2.5 V
-4.5 V
Drain–source ON-resistance $R_{DS\ (ON)}$ (mΩ)
80
60
40
20
0
0
-5
-10
-15
-20
Drain current I_D (A)


$R_{DS\ (ON)}$ – Ta
Common Source
I_D = -0.8 A / V_{GS} = -1.5 V
-1.5 A / -1.8 V
-2.0 A / -2.5 V
-3.0 A / -4.5 V
Drain–source ON-resistance $R_{DS\ (ON)}$ (mΩ)
60
50
40
30
20
10
0
–50
0
50
100
150
Ambient temperature Ta (°C)

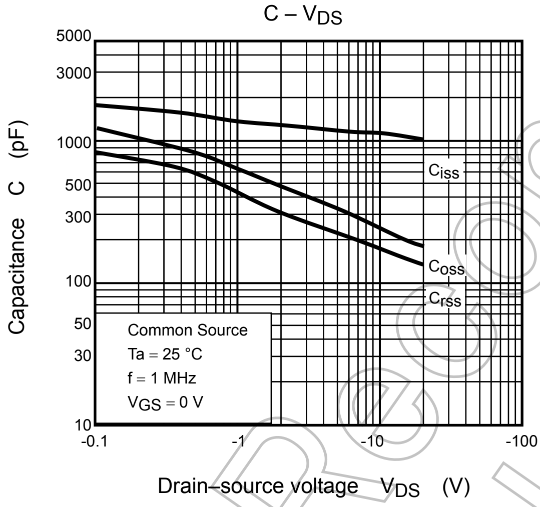
V_{th} – Ta



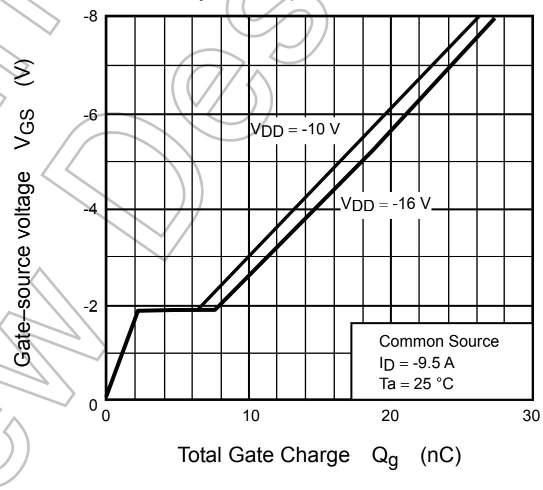
|Y_{fs}| – I_D



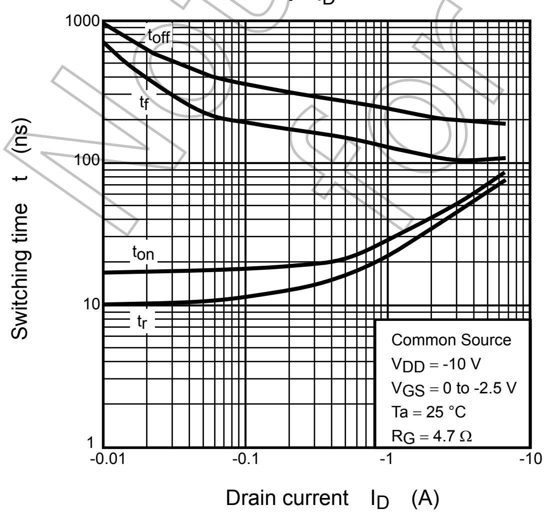
C – V_{DS}



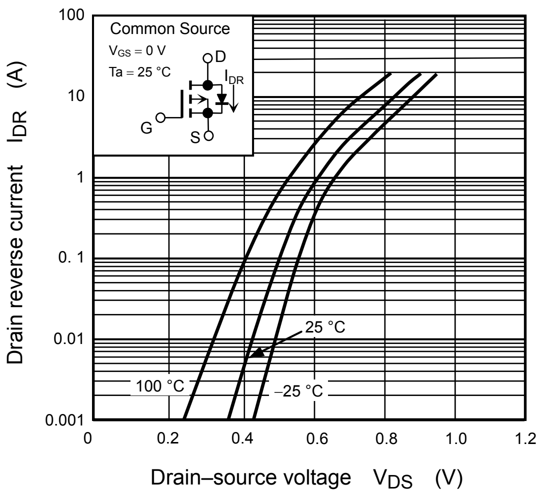
Dynamic Input Characteristic

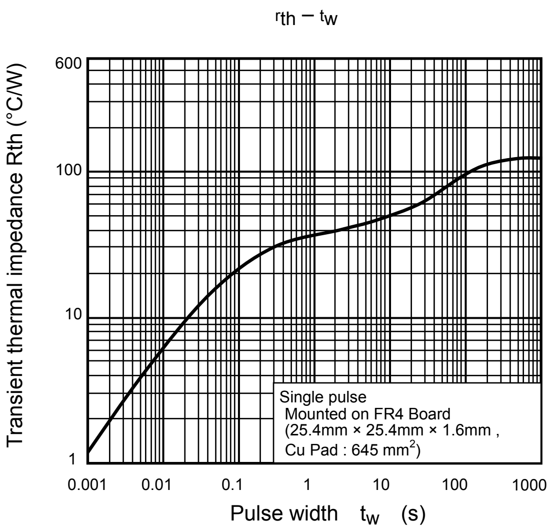


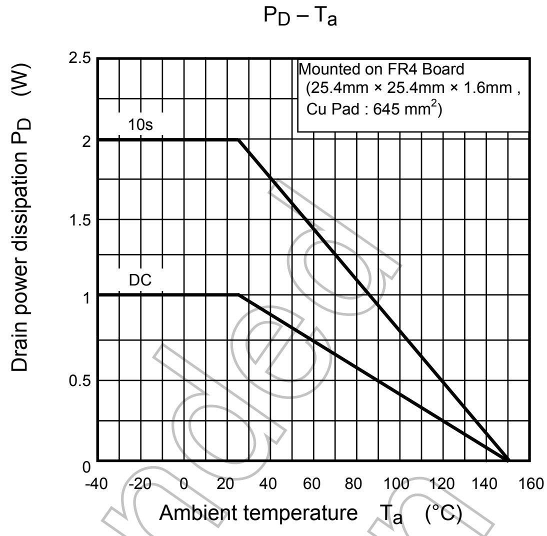
t – I_D



I_{DR} – V_{DS}




rth – tw
Transient thermal impedance Rth (°C/W)
600
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width tw (s)
Single pulse
Mounted on FR4 Board
(25.4mm × 25.4mm × 1.6mm ,
Cu Pad : 645 mm2)


PD – Ta
Drain power dissipation PD (W)
2.5
2
1.5
1
0.5
0
10s
DC
Mounted on FR4 Board
(25.4mm × 25.4mm × 1.6mm ,
Cu Pad : 645 mm2)
-40
-20
0
20
40
60
80
100
120
140
160
Ambient temperature Ta (°C)

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