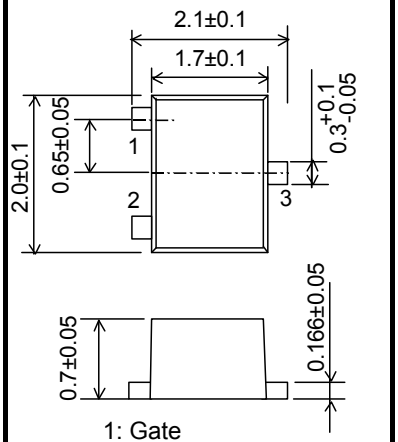
TOSHIBA Field Effect Transistor Silicon P-Channel MOS Type

SSM3J108TU

High Speed Switching Applications

- 1.8V drive
- Low on-resistance: R_{on} = 363mΩ (max) (@V_{GS} = −1.8 V)
  R_{on} = 230mΩ (max) (@V_{GS} = −2.5 V)
  R_{on} = 158mΩ (max) (@V_{GS} = −4.0 V)

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	2-2U1A

Weight: 6.6 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Drain-Source voltage		V_{DS}	−20	V
Gate-Source voltage		V_{GSS}	± 8	V
Drain current	DC	I_D	−1.8	A
	Pulse	I_{DP}	−3.6	
Drain power dissipation		$P_{D\ (Note\ 1)}$	800	mW
		$P_{D\ (Note\ 2)}$	500	
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55~150	°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: Mounted on ceramic board.
(25.4 mm × 25.4 mm × 0.8 mm, Cu Pad: 645 mm^2)

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

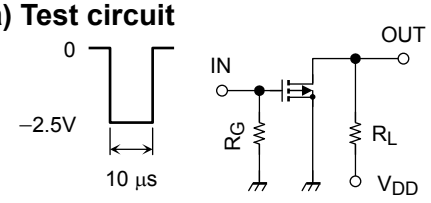
Electrical Characteristics (Ta = 25°C)

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 cut-off current		I_{DSS}	V_{DS} = −20 V, V_{GS} = 0	—	—	−10	μA
Gate leakage current		I_{GSS}	V_{GS} = ±8V, 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 = − 0.8 A (Note3)	1.9	3.2	—	S
Drain-Source on-resistance		$R_{DS\ (ON)}$	I_D = −0.8 A, V_{GS} = −4.0 V (Note3)	—	125	158	mΩ
			I_D = −0.4 A, V_{GS} = −2.5 V (Note3)	—	170	230	
			I_D = −0.1 A, V_{GS} = −1.8 V (Note3)	—	230	363	
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}	V_{DD} = −10 V, I_D = −0.25 A, V_{GS} = 0~−2.5 V, R_G = 4.7 Ω	—	12	—	ns
	Turn-off time	t_{off}		—	18	—	
Drain-Source forward voltage		V_{DSF}	I_D = 1.8A, V_{GS} = 0 V (Note3)	—	0.85	1.2	V

Note3: Pulse test

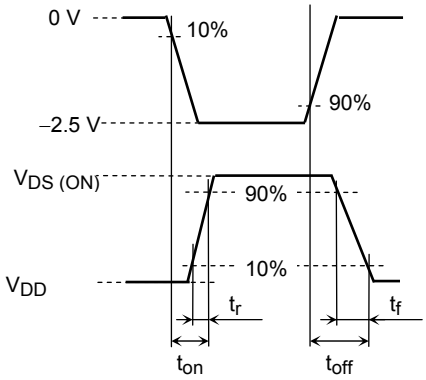
Switching Time Test Circuit

(a) Test circuit



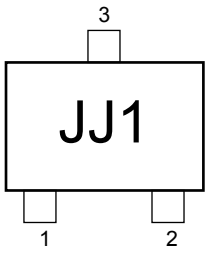
(b) V_{IN}

(c) V_{OUT}

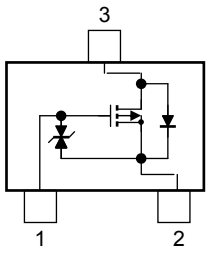


V_{DD} = -10 V
R_G = 4.7 Ω
D.U. ≦ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

Marking



Equivalent Circuit (top view)

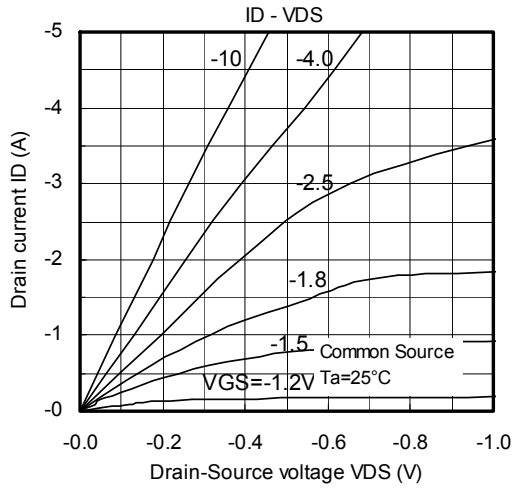


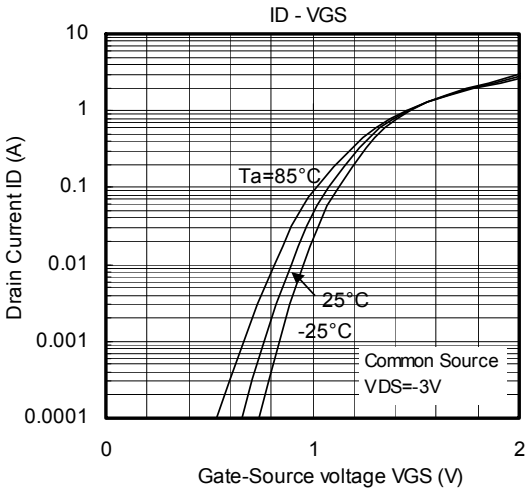
Precaution

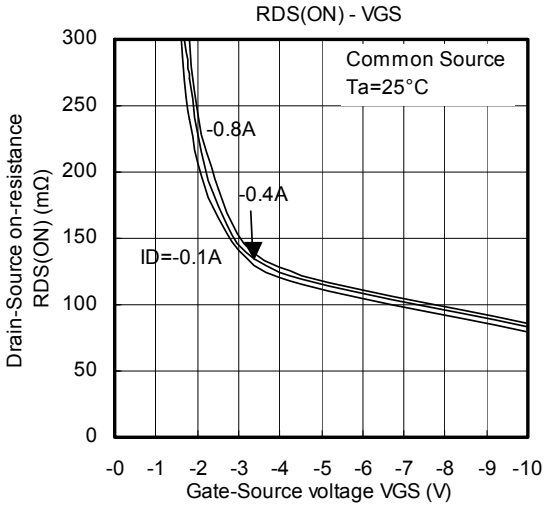
V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D=−1mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than V_{th}, and $V_{GS\ (off)}$ requires a lower voltage than V_{th}.
(The relationship can be established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

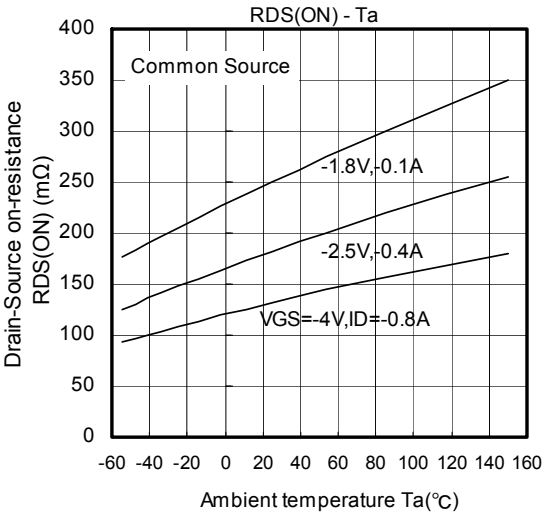
Handling Precaution

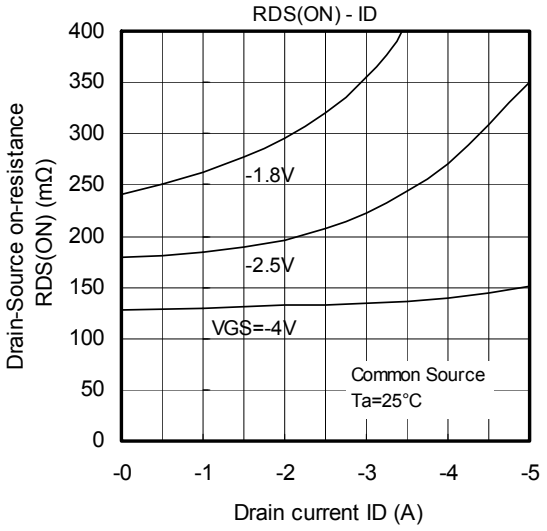
When handling individual devices which are not yet mounted on a circuit board, be sure that the environment is protected against electrostatic discharge. Operators should wear anti-static clothing, and containers and other objects that come into direct contact with devices should be made of anti-static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

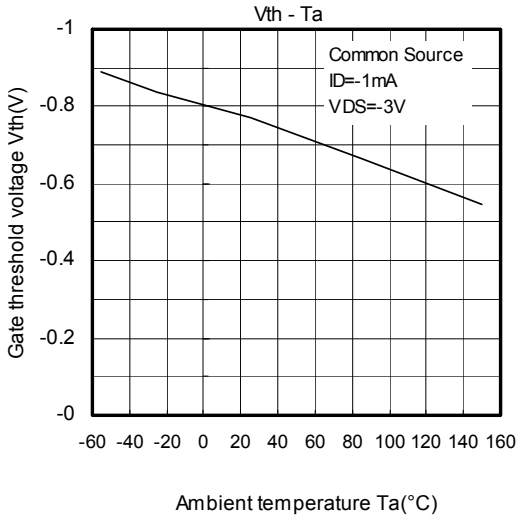

ID - VDS
Drain current ID (A)
Drain-Source voltage VDS (V)
-10
-4.0
-2.5
-1.8
-1.5
-1.2V
Common Source
Ta=25°C
VGS=
-5
-4
-3
-2
-1
-0
-0.0
-0.2
-0.4
-0.6
-0.8
-1.0

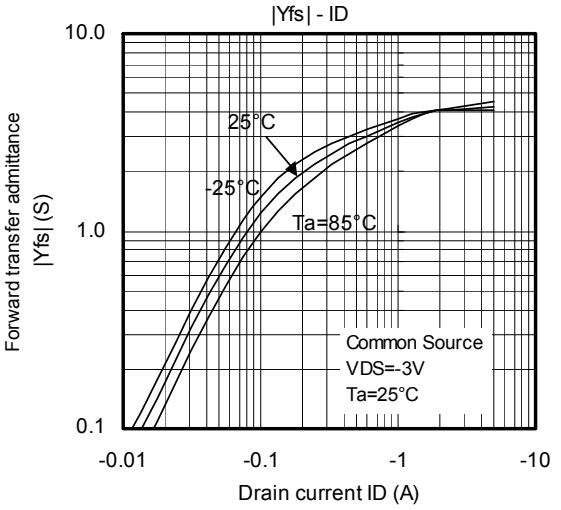

ID - VGS
Drain Current ID (A)
Gate-Source voltage VGS (V)
Ta=85°C
25°C
-25°C
Common Source
VDS=-3V
10
1
0.1
0.01
0.001
0.0001
0
1
2

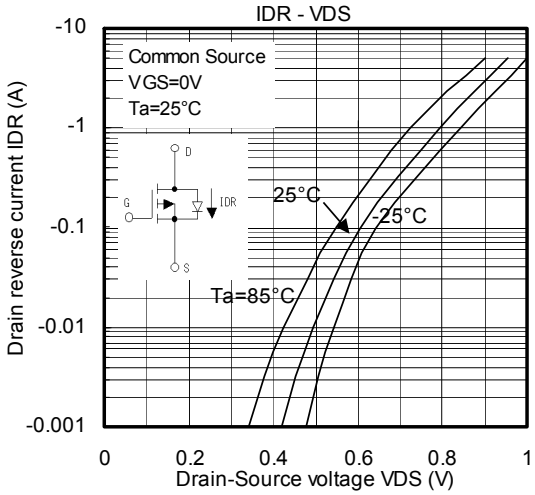

RDS(ON) - VGS
Drain-Source on-resistance
RDS(ON) (mΩ)
Gate-Source voltage VGS (V)
Common Source
Ta=25°C
-0.8A
-0.4A
ID=-0.1A
300
250
200
150
100
50
0
-0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10

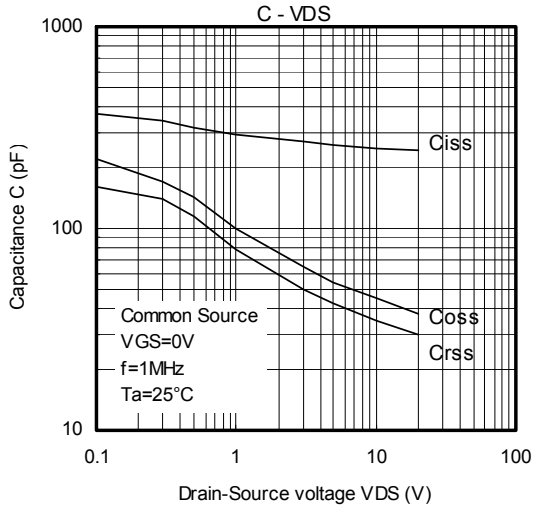

RDS(ON) - Ta
Drain-Source on-resistance
RDS(ON) (mΩ)
Ambient temperature Ta(°C)
Common Source
-1.8V,-0.1A
-2.5V,-0.4A
VGS=-4V,ID=-0.8A
400
350
300
250
200
150
100
50
0
-60
-40
-20
0
20
40
60
80
100
120
140
160

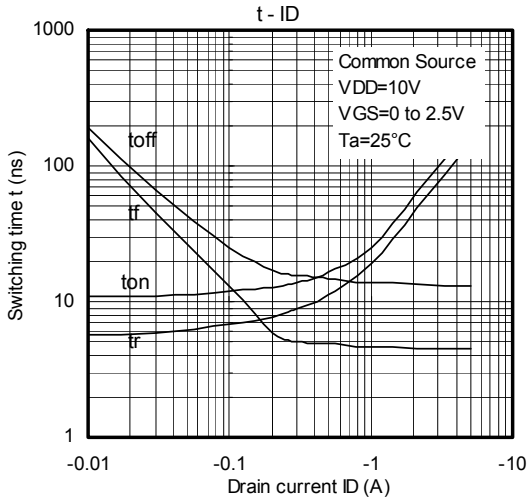

RDS(ON) - ID
Drain-Source on-resistance
RDS(ON) (mΩ)
Drain current ID (A)
-1.8V
-2.5V
VGS=-4V
Common Source
Ta=25°C
400
350
300
250
200
150
100
50
0
-0
-1
-2
-3
-4
-5

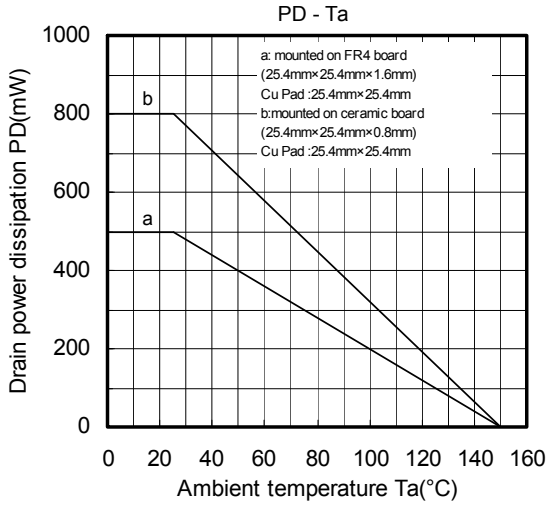

Vth - Ta
Gate threshold voltage Vth(V)
Ambient temperature Ta(°C)
Common Source
ID=-1mA
VDS=-3V
-1
-0.8
-0.6
-0.4
-0.2
-0
-60
-40
-20
0
20
40
60
80
100
120
140
160

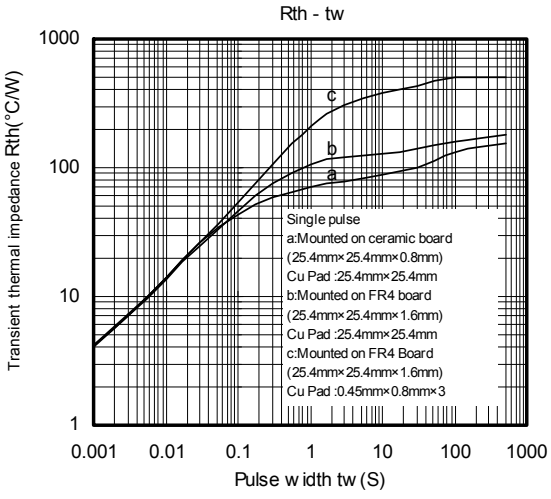

|Yfs| - ID
Forward transfer admittance |Yfs| (S)
10.0
1.0
0.1
25°C
-25°C
Ta=85°C
Common Source
VDS=-3V
Ta=25°C
-0.01
-0.1
-1
-10
Drain current ID (A)


IDR - VDS
Drain reverse current IDR (A)
-10
-1
-0.1
-0.01
-0.001
Common Source
VGS=0V
Ta=25°C
D
G
IDR
S
25°C
-25°C
Ta=85°C
0
0.2
0.4
0.6
0.8
1
Drain-Source voltage VDS (V)


C - VDS
Capacitance C (pF)
1000
100
10
Ciss
Coss
Crss
Common Source
VGS=0V
f=1MHz
Ta=25°C
0.1
1
10
100
Drain-Source voltage VDS (V)


t - ID
Switching time t (ns)
1000
100
10
1
Common Source
VDD=10V
VGS=0 to 2.5V
Ta=25°C
toff
tf
ton
tr
-0.01
-0.1
-1
-10
Drain current ID (A)


PD - Ta
Drain power dissipation PD(mW)
1000
800
600
400
200
0
a: mounted on FR4 board
(25.4mm×25.4mm×1.6mm)
Cu Pad :25.4mm×25.4mm
b:mounted on ceramic board
(25.4mm×25.4mm×0.8mm)
Cu Pad :25.4mm×25.4mm
b
a
0
20
40
60
80
100
120
140
160
Ambient temperature Ta(°C)


Rth - tw
Transient thermal impedance Rth(°C/W)
1000
100
10
1
c
b
a
Single pulse
a:Mounted on ceramic board
(25.4mm×25.4mm×0.8mm)
Cu Pad :25.4mm×25.4mm
b:Mounted on FR4 board
(25.4mm×25.4mm×1.6mm)
Cu Pad :25.4mm×25.4mm
c:Mounted on FR4 Board
(25.4mm×25.4mm×1.6mm)
Cu Pad :0.45mm×0.8mm×3
0.001
0.01
0.1
1
10
100
1000
Pulse w idth tw (S)

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