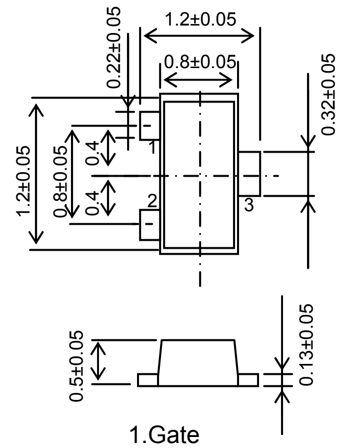
TOSHIBA Field-Effect Transistor Silicon N-Channel MOS Type

SSM3K37MFV

High Speed Switching Applications
Analog Switch Applications

- 1.5-V drive
- Low ON-resistance $R_{DS(ON)}$ = 5.60Ω (max) (@V_{GS} = 1.5 V)
  $R_{DS(ON)}$ = 4.05Ω (max) (@V_{GS} = 1.8 V)
  $R_{DS(ON)}$ = 3.02Ω (max) (@V_{GS} = 2.5 V)
  $R_{DS(ON)}$ = 2.20Ω (max) (@V_{GS} = 4.5 V)

nit: mm



1.Gate
2.Source
3.Drain

VESM

JEDEC	-
JEITA	-
TOSHIBA	2-1L1B

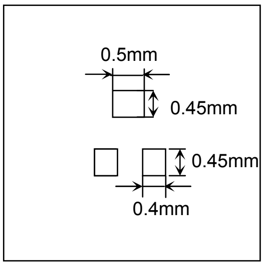
Weight: 1.5mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

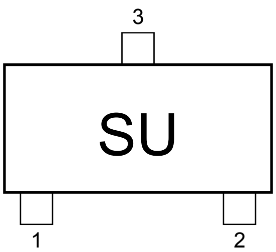
Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	20	V
Gate-source voltage		V_{GSS}	±10	V
Drain current	DC	I_D	250	mA
	Pulse	I_{DP}	500	
Drain power dissipation (Ta = 25°C)		P_D (Note 1)	150	mW
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	−55 to 150	°C

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).

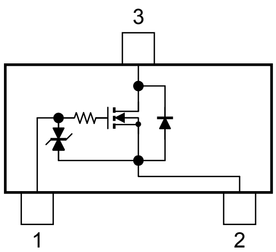
Note 1:Mounted on a FR4 board (25.4 mm × 25.4 mm × 1.6 mm)



Marking



Equivalent Circuit



Start of commercial production
2010-02

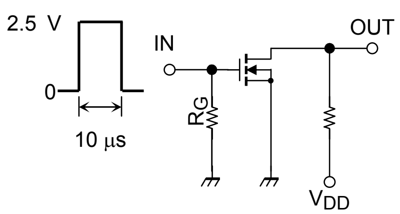
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	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} = -10 V	12	—	—	
Drain cutoff current		I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	—	—	1	μA
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0 V	—	—	±1	μA
Gate threshold voltage		V_{th}	V_{DS} = 3 V, I_D = 1 mA	0.35	—	1.0	V
Forward transfer admittance		$\lvert Y_{fs} \rvert$	V_{DS} = 3 V, I_D = 100mA (Note 2)	0.14	0.28	—	S
Drain-source ON-resistance		$R_{DS\ (ON)}$	I_D = 100 mA, V_{GS} = 4.5 V (Note 2)	—	1.65	2.20	Ω
			I_D = 50 mA, V_{GS} = 2.5 V (Note 2)	—	2.16	3.02	
			I_D = 20 mA, V_{GS} = 1.8 V (Note 2)	—	2.66	4.05	
			I_D = 10 mA, V_{GS} = 1.5 V (Note 2)	—	3.07	5.60	
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	12	—	pF
Output capacitance		C_{oss}		—	5.5	—	
Reverse transfer capacitance		C_{rss}		—	4.1	—	
Switching time	Turn-on time	t_{on}	V_{DD} = 10 V, I_D = 100 mA	—	18	—	ns
	Turn-off time	t_{off}	V_{GS} = 0 to 2.5 V, R_G = 50 Ω	—	36	—	
Drain-source forward voltage		V_{DSF}	I_D = -250 mA, V_{GS} = 0 V (Note 2)	—	-0.9	-1.2	V

Note2: Pulse test

Switching Time Test Circuit

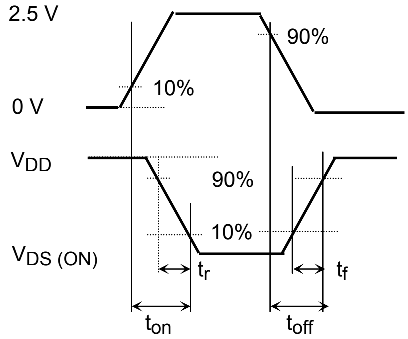
(a) Test Circuit



V_{DD} = 10 V
R_G = 50 Ω
Duty ≤ 1%
V_{IN}: t_r, t_f < 5 ns
Common Source
Ta = 25°C

(b) V_{IN}

(c) V_{OUT}



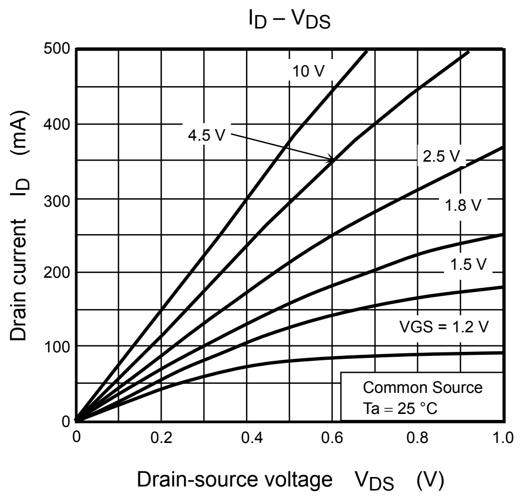
Precaution

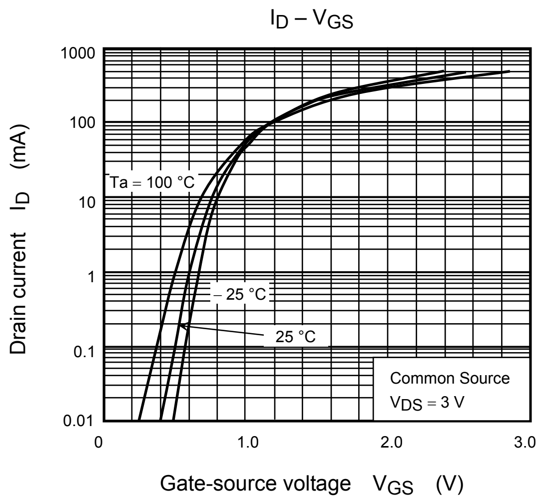
V_{th} can be expressed as the voltage between gate and source when the low operating current value is I_D = 1 mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires a higher voltage than V_{th} and $V_{GS\ (off)}$ requires a lower voltage than V_{th}. (The relationship can be established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

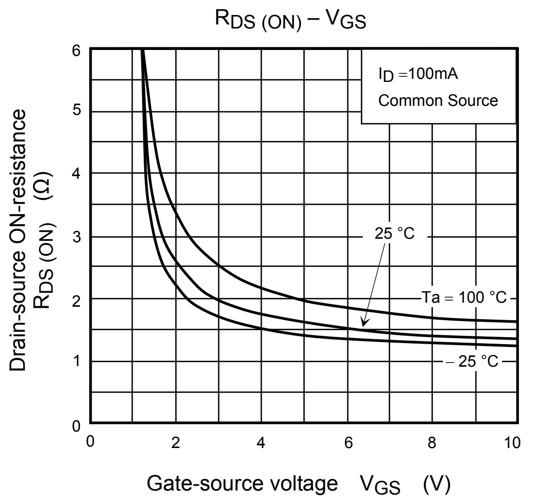
Do not use this device under avalanche mode. It may cause the device to break down.

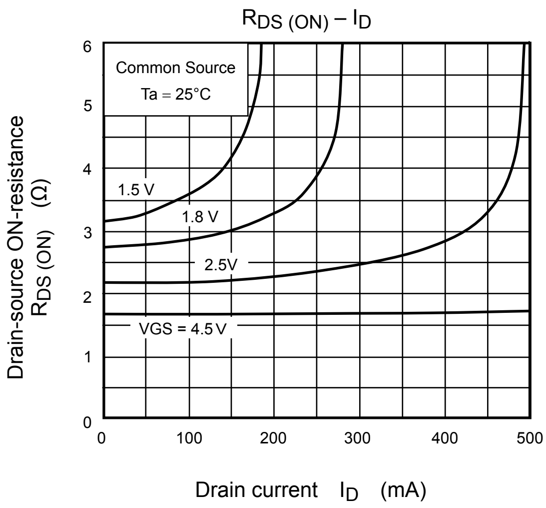
Handling Precaution

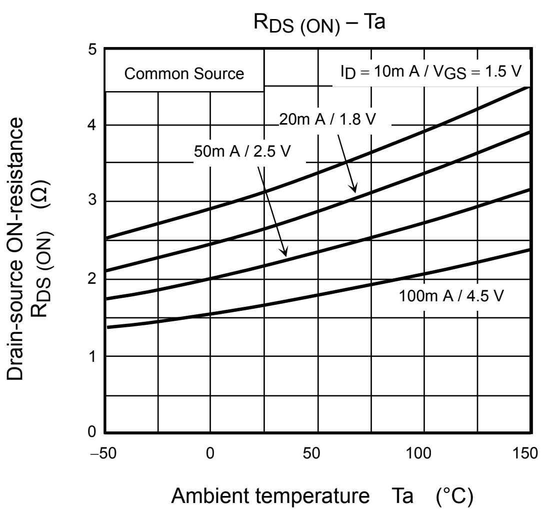
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

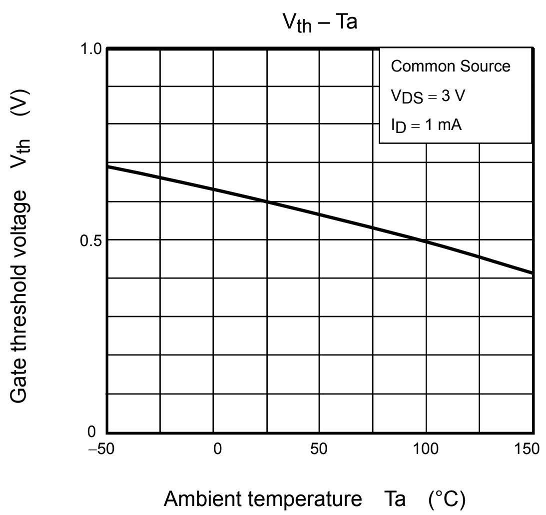

ID – VDS
Drain current ID (mA)
Drain-source voltage VDS (V)
10 V
4.5 V
2.5 V
1.8 V
1.5 V
VGS = 1.2 V
Common Source
Ta = 25 °C
500
400
300
200
100
0
0.2
0.4
0.6
0.8
1.0

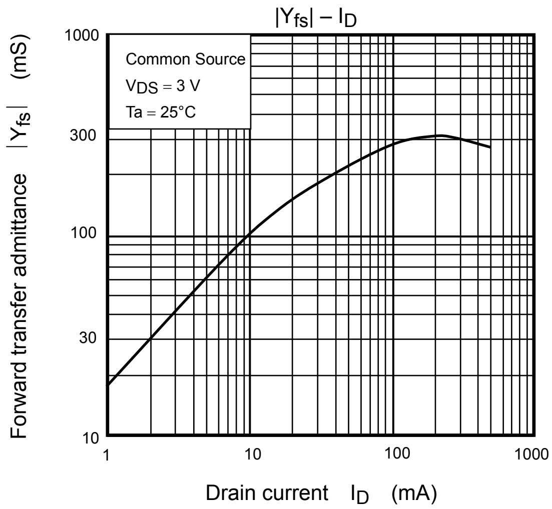

ID – VGS
Drain current ID (mA)
Gate-source voltage VGS (V)
Ta = 100 °C
− 25 °C
25 °C
Common Source
VDS = 3 V
1000
100
10
1
0.1
0.01
0
1.0
2.0
3.0

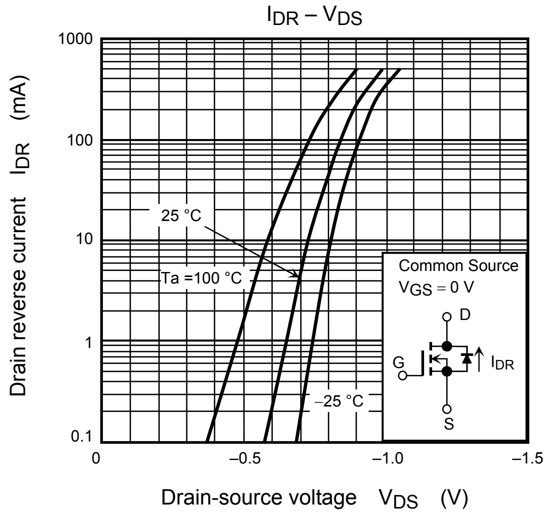

RDS (ON) – VGS
Drain-source ON-resistance RDS (ON) (Ω)
Gate-source voltage VGS (V)
ID =100mA
Common Source
25 °C
Ta = 100 °C
− 25 °C
6
5
4
3
2
1
0
2
4
6
8
10

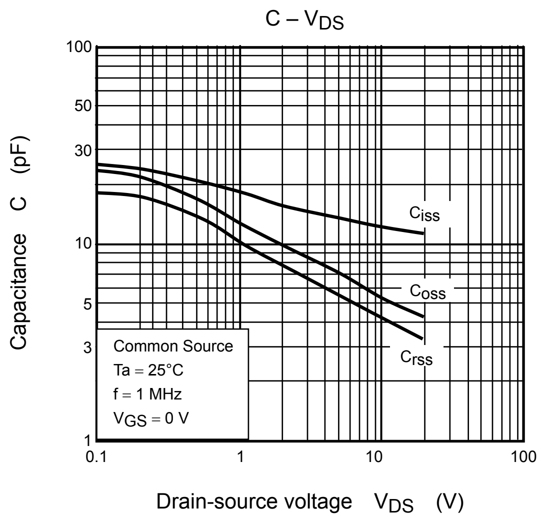

RDS (ON) – ID
Drain-source ON-resistance RDS (ON) (Ω)
Drain current ID (mA)
Common Source
Ta = 25°C
1.5 V
1.8 V
2.5V
VGS = 4.5 V
6
5
4
3
2
1
0
100
200
300
400
500

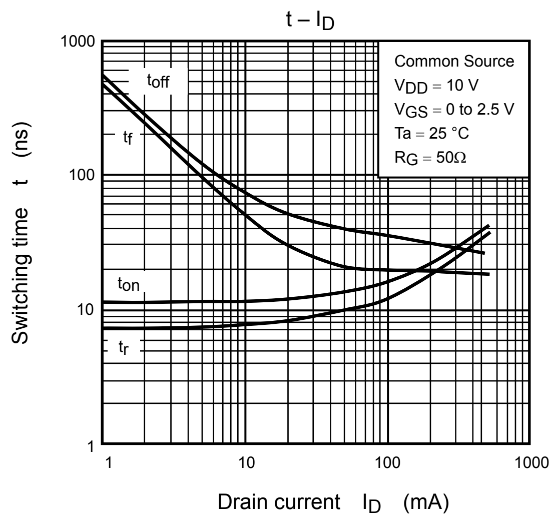

RDS (ON) – Ta
Drain-source ON-resistance RDS (ON) (Ω)
Ambient temperature Ta (°C)
Common Source
ID = 10m A / VGS = 1.5 V
20m A / 1.8 V
50m A / 2.5 V
100m A / 4.5 V
5
4
3
2
1
0
−50
0
50
100
150

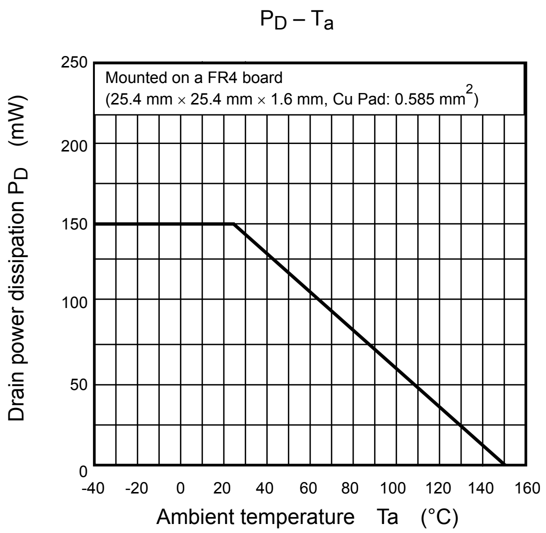

Vth – Ta
Gate threshold voltage Vth (V)
Ambient temperature Ta (°C)
Common Source
VDS = 3 V
ID = 1 mA
1.0
0.5
0
−50
0
50
100
150


|Yfs| – ID
Common Source
VDS = 3 V
Ta = 25°C
Forward transfer admittance |Yfs| (mS)
1000
300
100
30
10
1
10
100
1000
Drain current ID (mA)


IDR – VDS
Common Source
VGS = 0 V
D
G
S
IDR
25 °C
Ta =100 °C
−25 °C
Drain reverse current IDR (mA)
1000
100
10
1
0.1
0
−0.5
−1.0
−1.5
Drain-source voltage VDS (V)


C – VDS
Ciss
Coss
Crss
Common Source
Ta = 25°C
f = 1 MHz
VGS = 0 V
Capacitance C (pF)
100
50
30
10
5
3
1
0.1
1
10
100
Drain-source voltage VDS (V)


t – ID
Common Source
VDD = 10 V
VGS = 0 to 2.5 V
Ta = 25 °C
RG = 50Ω
toff
tf
ton
tr
Switching time t (ns)
1000
100
10
1
1
10
100
1000
Drain current ID (mA)


PD – Ta
Mounted on a FR4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 0.585 mm2)
Drain power dissipation PD (mW)
250
200
150
100
50
0
-40
-20
0
20
40
60
80
100
120
140
160
Ambient temperature Ta (°C)

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