TOSHIBA Field Effect Transistor Silicon N Channel MOS Type

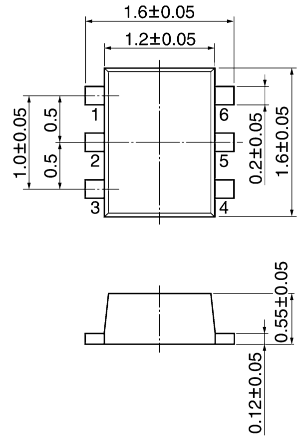
SSM6K31FE

○ High speed switching

○ DC-DC Converter

- 4-V drive
- Low $R_{DS\ (ON)}$: $R_{DS\ (ON)}$ = 320 mΩ (max) (@V_{GS} = 10 V)
  : $R_{DS\ (ON)}$ = 540 mΩ (max) (@V_{GS} = 4 V)

単位: mm



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

ES6

JEDEC	―
JEITA	―
TOSHIBA	2-2N1J

Weight: 3 mg (typ.)

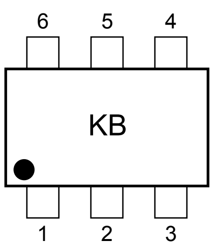
Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DS}	20	V
Gate-Source voltage		V_{GSS}	±20	V
Drain current	DC	I_D	1.2	A
	Pulse	I_{DP}	2.4	
Drain power dissipation		P_D(Note 1)	500	mW
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55 to 150	°C

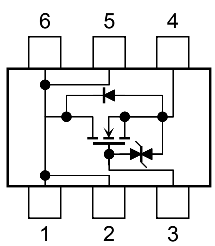
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note 1: Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 mm (t), Cu pad: 645 mm^2)

Marking



Equivalent Circuit (top view)



Handling Precaution

When handling individual devices (which are not yet mounted on a circuit board), ensure that the environment is protected against static electricity. 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.

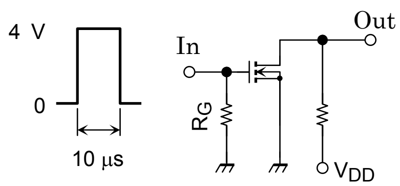
Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0 V	—	—	±1	μA
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 1 mA, V_{GS} = 0 V	20	—	—	V
Drain cut-off current		I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	—	—	1	μA
Gate threshold voltage		V_{th}	V_{DS} = 5 V, I_D = 0.1 mA	1.1	—	2.3	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 5 V, I_D = 0.6 A (Note 2)	0.58	1.16	—	S
Drain-Source on-resistance		$R_{DS\ (ON)}$	I_D = 0.6 A, V_{GS} = 10 V (Note 2)	—	240	320	mΩ
			I_D = 0.6 A, V_{GS} = 4 V (Note 2)	—	400	540	
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	36	—	pF
Reverse transfer capacitance		C_{rss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	10	—	pF
Output capacitance		C_{oss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	30	—	pF
Switching time	Turn-on time	t_{on}	V_{DD} = 10 V, I_D = 0.6 A,	—	21	—	ns
	Turn-off time	t_{off}	V_{GS} = 0 to 4 V, R_G = 10 Ω	—	8	—	

Note 2: Pulse measurement

Switching Time Test Circuit

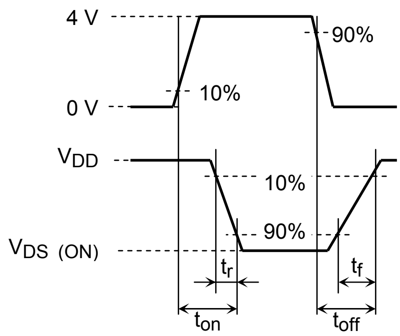
(a) Test circuit



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

(b) V_{IN}

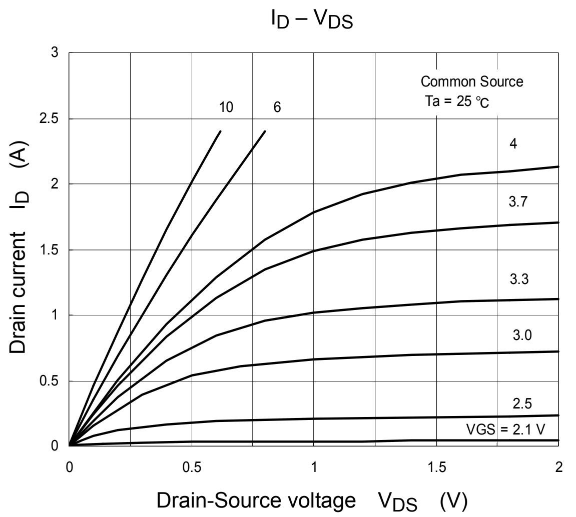
(c) V_{OUT}



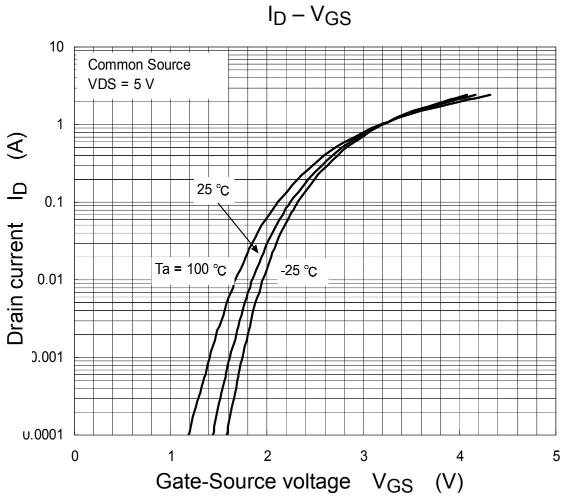
Precaution

V_{th} can be expressed as the voltage between the gate and source when the low operating current value is I_D = 0.1 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: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$.

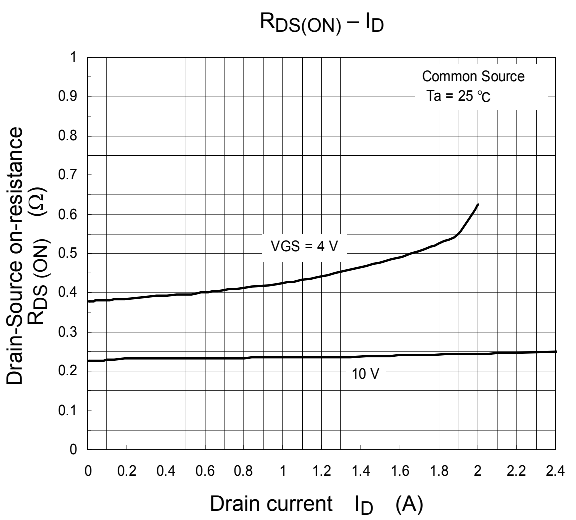
Be sure to take this into consideration when using the device.



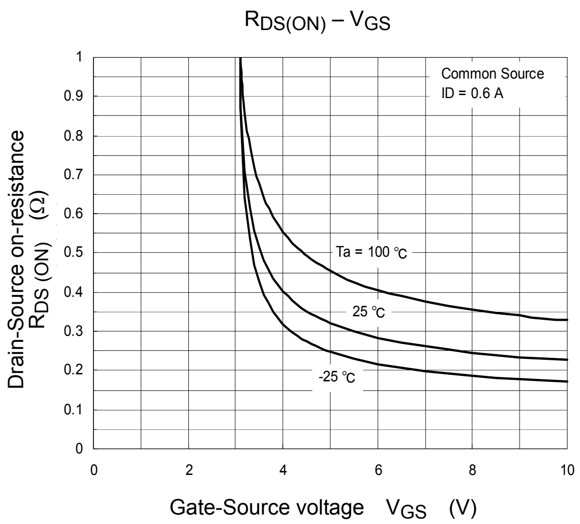
I_D – V_{DS}
Common Source
Ta = 25 °C
10
6
4
3.7
3.3
3.0
2.5
VGS = 2.1 V
Drain current I_D (A)
Drain-Source voltage V_{DS} (V)



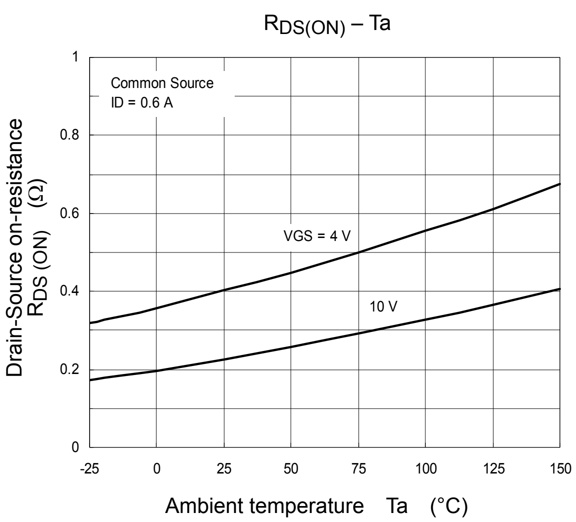
I_D – V_{GS}
Common Source
VDS = 5 V
25 °C
Ta = 100 °C
-25 °C
Drain current I_D (A)
Gate-Source voltage V_{GS} (V)



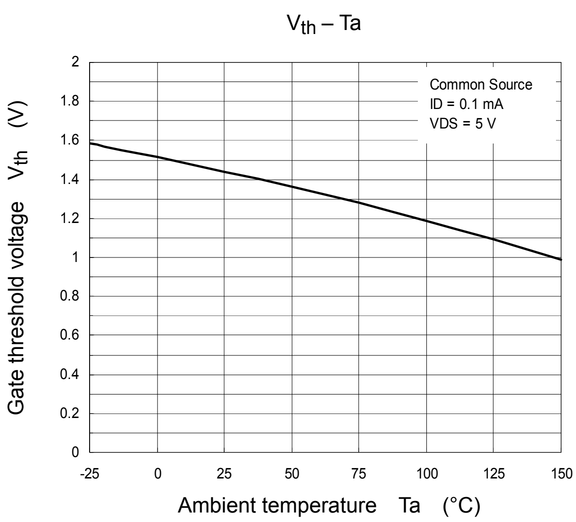
$R_{DS(ON)}$ – I_D
Common Source
Ta = 25 °C
VGS = 4 V
10 V
Drain-Source on-resistance $R_{DS(ON)}$ (Ω)
Drain current I_D (A)



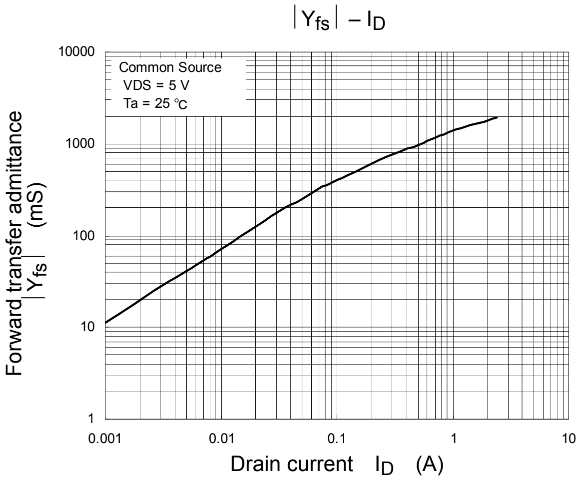
$R_{DS(ON)}$ – V_{GS}
Common Source
ID = 0.6 A
Ta = 100 °C
25 °C
-25 °C
Drain-Source on-resistance $R_{DS(ON)}$ (Ω)
Gate-Source voltage V_{GS} (V)

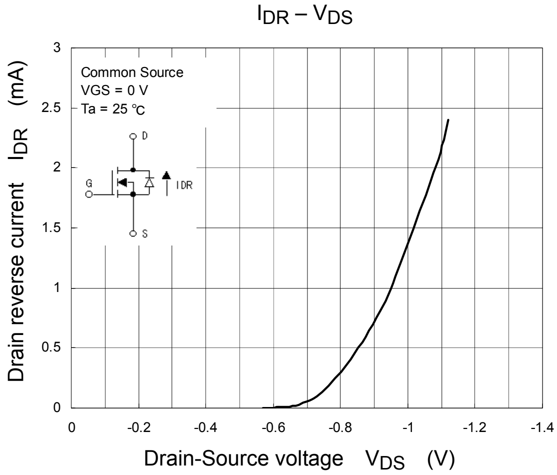


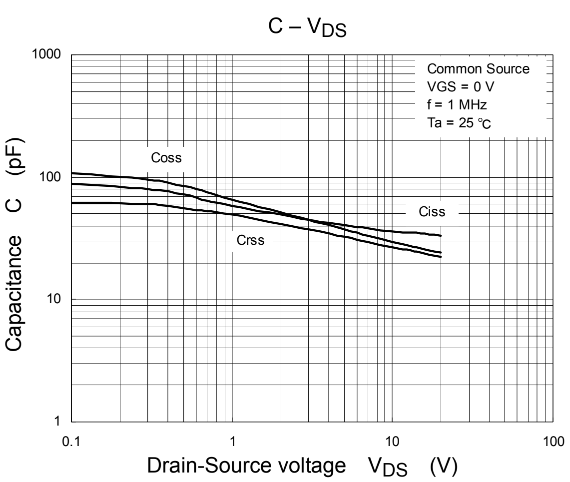
$R_{DS(ON)}$ – Ta
Common Source
ID = 0.6 A
VGS = 4 V
10 V
Drain-Source on-resistance $R_{DS(ON)}$ (Ω)
Ambient temperature Ta (°C)

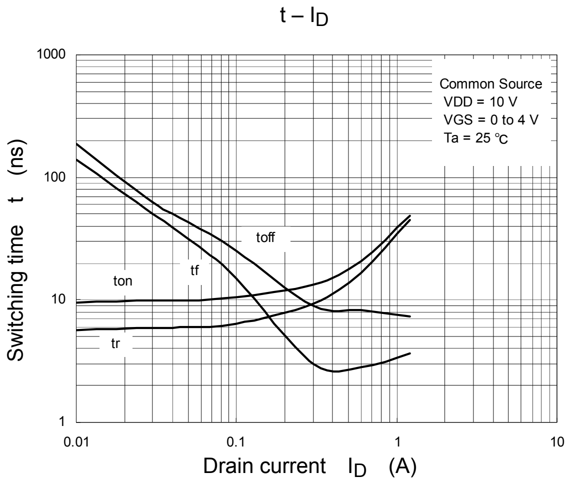


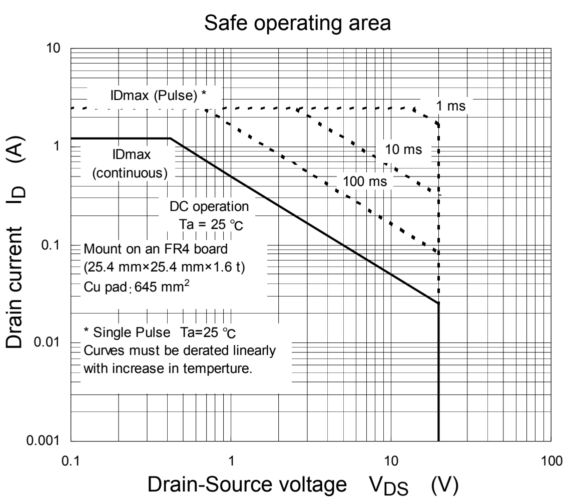
V_{th} – Ta
Common Source
ID = 0.1 mA
VDS = 5 V
Gate threshold voltage V_{th} (V)
Ambient temperature Ta (°C)

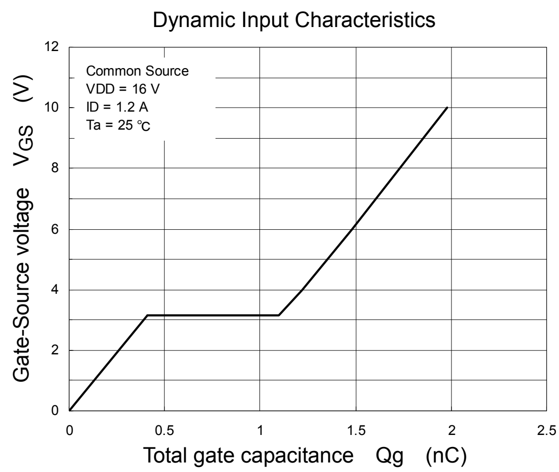

|Yfs| – ID
Common Source
VDS = 5 V
Ta = 25 °C
Forward transfer admittance |Yfs| (mS)
Drain current ID (A)

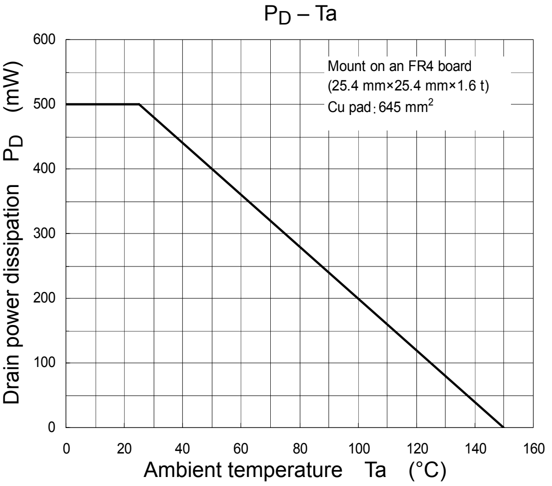

IDR – VDS
Common Source
VGS = 0 V
Ta = 25 °C
Drain reverse current IDR (mA)
Drain-Source voltage VDS (V)

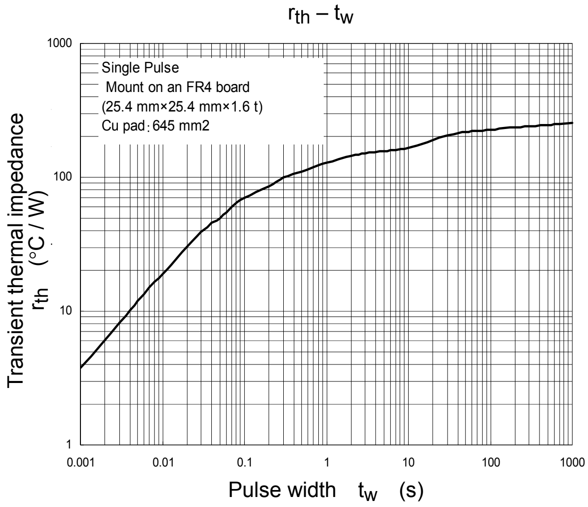

C – VDS
Common Source
VGS = 0 V
f = 1 MHz
Ta = 25 °C
Coss
Ciss
Crss
Capacitance C (pF)
Drain-Source voltage VDS (V)


t – ID
Common Source
VDD = 10 V
VGS = 0 to 4 V
Ta = 25 °C
toff
tf
ton
tr
Switching time t (ns)
Drain current ID (A)


Safe operating area
IDmax (Pulse) *
1 ms
10 ms
100 ms
IDmax (continuous)
DC operation Ta = 25 °C
Mount on an FR4 board (25.4 mm×25.4 mm×1.6 t) Cu pad : 645 mm2
* Single Pulse Ta=25 °C Curves must be derated linearly with increase in temperture.
Drain current ID (A)
Drain-Source voltage VDS (V)


Dynamic Input Characteristics
Common Source
VDD = 16 V
ID = 1.2 A
Ta = 25 °C
Gate-Source voltage VGS (V)
Total gate capacitance Qg (nC)


PD – Ta
Mount on an FR4 board
(25.4 mm×25.4 mm×1.6 t)
Cu pad : 645 mm2
Drain power dissipation PD (mW)
600
500
400
300
200
100
0
0 20 40 60 80 100 120 140 160
Ambient temperature Ta (°C)


rth – tw
Single Pulse
Mount on an FR4 board
(25.4 mm×25.4 mm×1.6 t)
Cu pad : 645 mm2
Transient thermal impedance rth (°C / W)
1000
100
10
1
0.001 0.01 0.1 1 10 100 1000
Pulse width tw (s)

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