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

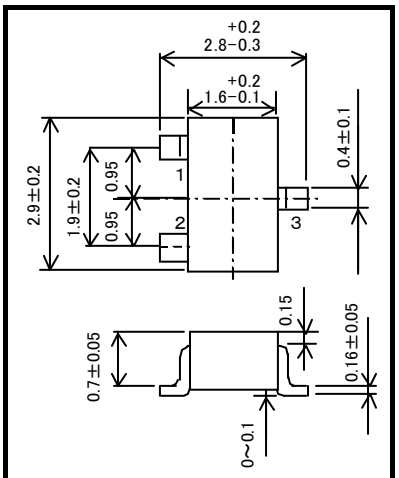
SSM3J307T

○ Power Management Switch Applications

○ High-Speed Switching Applications

- 1.5 V drive
- Low ON-resistance: R_{on} = 83 mΩ (max) (@V_{GS} = -1.5 V)
  R_{on} = 56 mΩ (max) (@V_{GS} = -1.8 V)
  R_{on} = 40 mΩ (max) (@V_{GS} = -2.5 V)
  R_{on} = 31 mΩ (max) (@V_{GS} = -4.5 V)

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	2-3S1A

Weight: 10 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

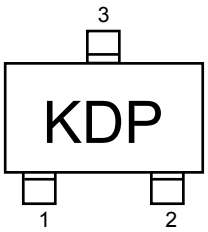
Characteristic		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	-20	V
Gate-Source voltage		V_{GSS}	±8	V
Drain current	DC	I_D (Note 1)	-5.0	A
	Pulse	I_{DP} (Note 1)	-10	
Drain power dissipation		P_D (Note 2)	700	mW
		t = 10 s	1250	
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−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).

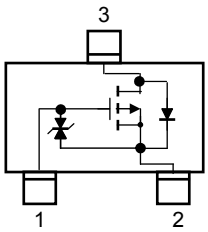
Note 1: The junction temperature should not exceed 150°C during use.

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)



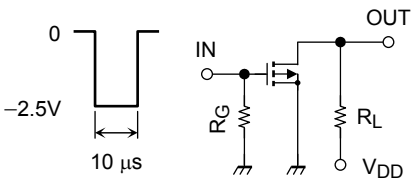
Electrical Characteristics (Ta = 25°C)

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} = -20V, 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		$\|Y_{fs}\|$	V_{DS} = -3 V, I_D = -4.0 A (Note 3)	9.8	—	—	S
Drain–source ON-resistance		$R_{DS\ (ON)}$	I_D = -4.0 A, V_{GS} = -4.5 V (Note 3)	—	25	31	mΩ
			I_D = -4.0 A, V_{GS} = -2.5 V (Note 3)	—	31	40	
			I_D = -1.5 A, V_{GS} = -1.8 V (Note 3)	—	38	56	
			I_D = -0.75 A, V_{GS} = -1.5 V (Note 3)	—	46	83	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	1170	—	pF
Output capacitance		C_{oss}		—	250	—	
Reverse transfer capacitance		C_{rss}		—	200	—	
Total Gate Charge		Q_g	V_{DS} = −10 V, I_D = −5.0 A, V_{GS} = −4.5 V	—	19	—	nC
Gate-Source Charge		Q_{gs}		—	14.2	—	
Gate-Drain Charge		Q_{gd}		—	4.8	—	
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	—	35	—	ns
	Turn-off time	t_{off}		—	160	—	
Drain-Source forward voltage		V_{DSF}	I_D = 5.0 A, V_{GS} = 0 V (Note 3)	—	0.83	1.2	V

Note 3: Pulse test

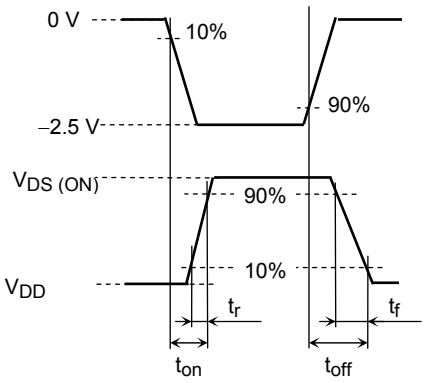
Switching Time Test Circuit

(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}

Usage Considerations

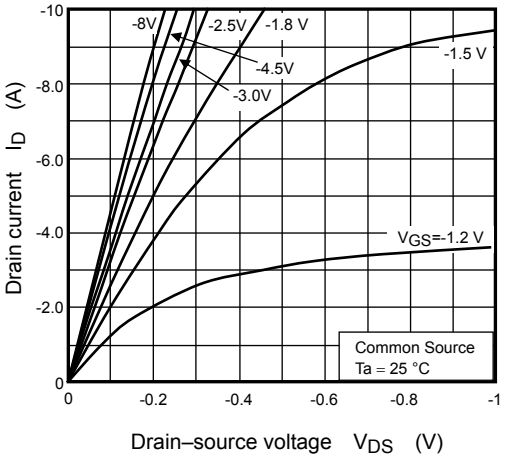
Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below −1 mA for the SSM3J307T. Then, for normal switching operation, $V_{GS(on)}$ must be higher than V_{th}, and $V_{GS(off)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(off)} < V_{th} < V_{GS(on)}$.

Take this into consideration when using the device.

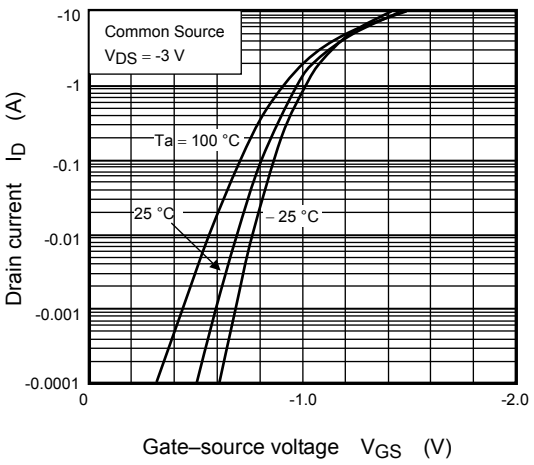
Handling Precaution

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.

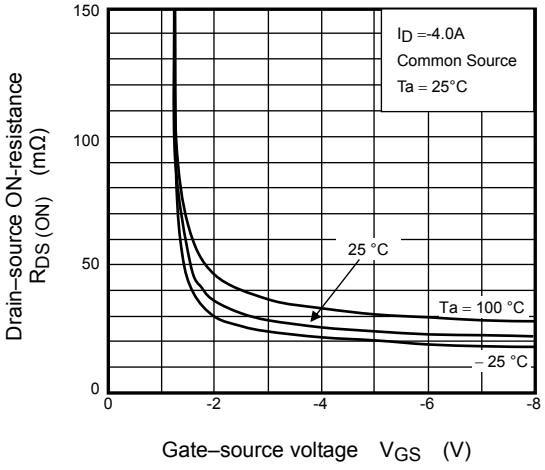
$I_D - V_{DS}$



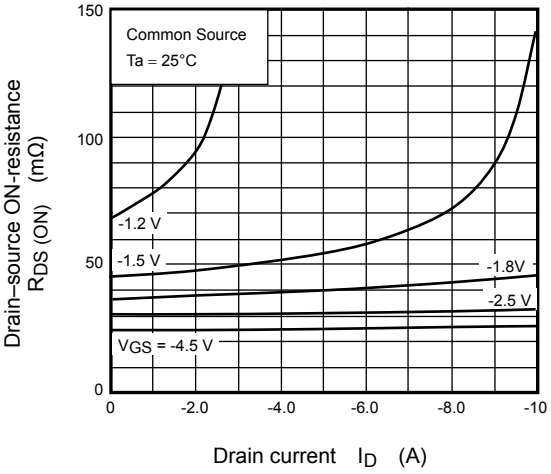
$I_D - V_{GS}$



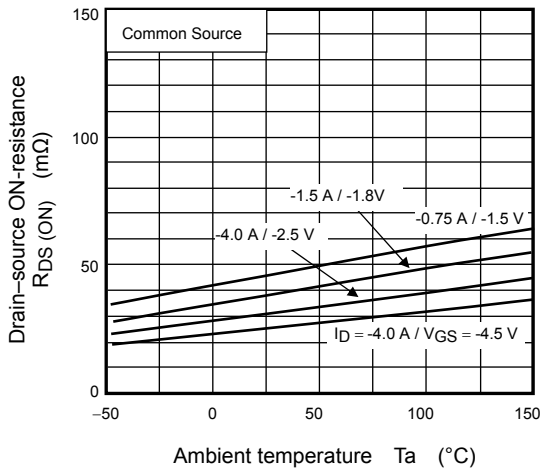
$R_{DS\ (ON)} - V_{GS}$



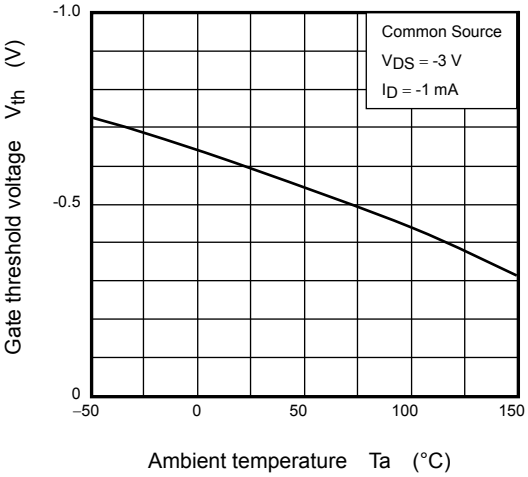
$R_{DS\ (ON)} - I_D$

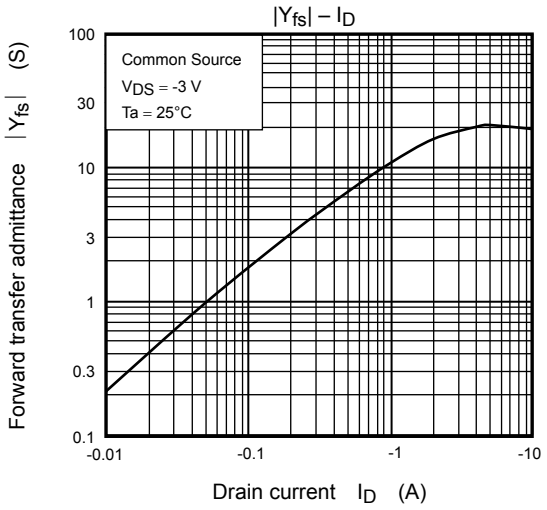


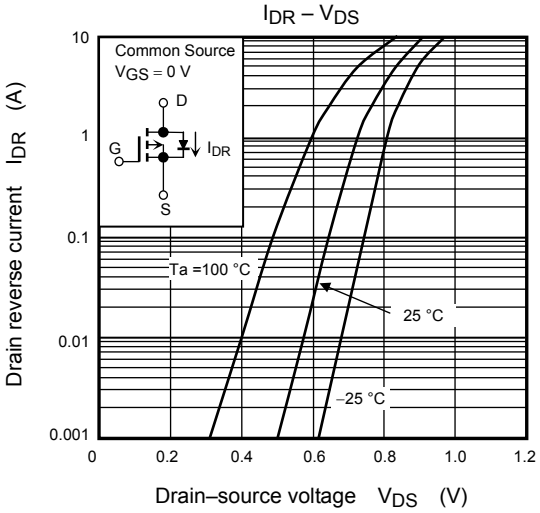
$R_{DS\ (ON)} - Ta$

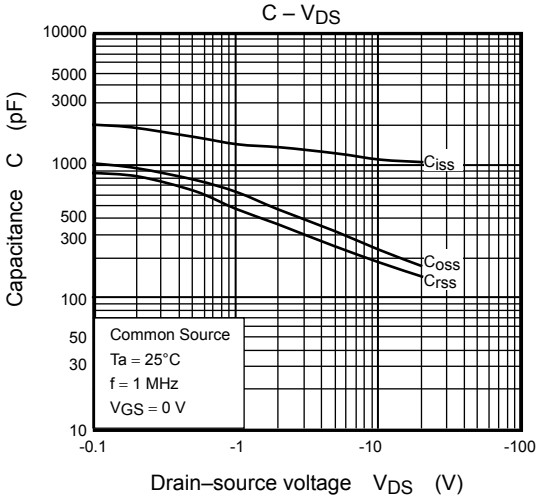


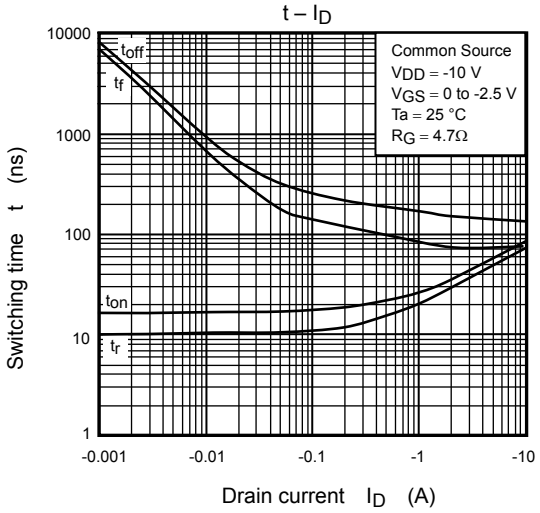
$V_{th} - Ta$

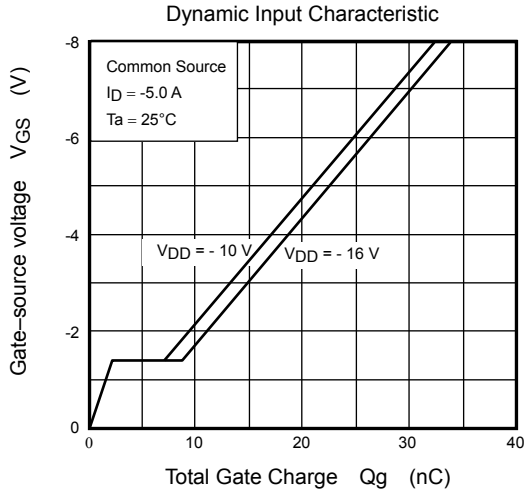



|Yfs| – ID
Common Source
VDS = -3 V
Ta = 25°C
Forward transfer admittance |Yfs| (S)
Drain current ID (A)
100
30
10
3
1
0.3
0.1
-0.01
-0.1
-1
-10

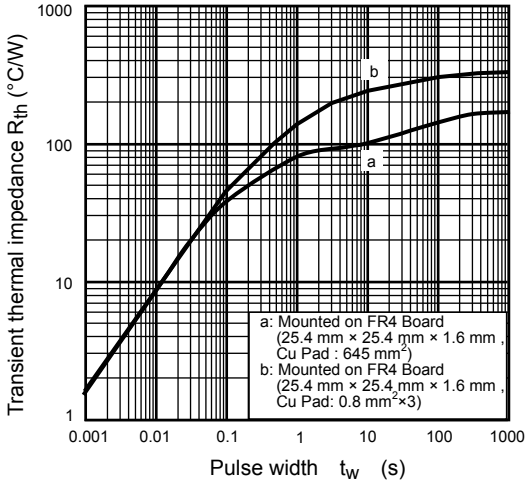

IDR – VDS
Common Source
VGS = 0 V
D
G
S
IDR
Ta =100 °C
25 °C
−25 °C
Drain reverse current IDR (A)
Drain–source voltage VDS (V)
10
1
0.1
0.01
0.001
0
0.2
0.4
0.6
0.8
1.0
1.2


C – VDS
Ciss
Coss
Crss
Common Source
Ta = 25°C
f = 1 MHz
VGS = 0 V
Capacitance C (pF)
Drain–source voltage VDS (V)
10000
5000
3000
1000
500
300
100
50
30
10
-0.1
-1
-10
-100

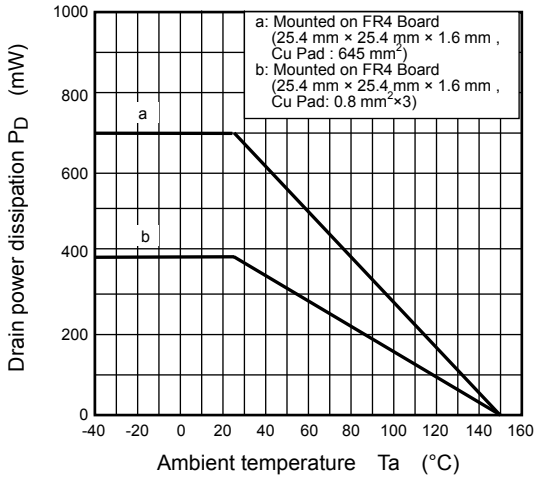

t – ID
toff
tf
ton
tr
Common Source
VDD = -10 V
VGS = 0 to -2.5 V
Ta = 25 °C
RG = 4.7Ω
Switching time t (ns)
Drain current ID (A)
10000
1000
100
10
1
-0.001
-0.01
-0.1
-1
-10


Dynamic Input Characteristic
Common Source
ID = -5.0 A
Ta = 25°C
VDD = - 10 V
VDD = - 16 V
Gate–source voltage VGS (V)
Total Gate Charge Qg (nC)
-8
-6
-4
-2
0
0
10
20
30
40

$R_{th} - t_w$


Transient thermal impedance R_{th} (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width t_w (s)
a: Mounted on FR4 Board
(25.4 mm × 25.4 mm × 1.6 mm ,
Cu Pad : 645 mm²)
b: Mounted on FR4 Board
(25.4 mm × 25.4 mm × 1.6 mm ,
Cu Pad: 0.8 mm²×3)
a
b

$P_D - T_a$


Drain power dissipation P_D (mW)
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
Ambient temperature Ta (°C)
a: Mounted on FR4 Board
(25.4 mm × 25.4 mm × 1.6 mm ,
Cu Pad : 645 mm²)
b: Mounted on FR4 Board
(25.4 mm × 25.4 mm × 1.6 mm ,
Cu Pad: 0.8 mm²×3)
a
b

RESTRICTIONS ON PRODUCT USE

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.