Silicon P Channel MOS Type / Silicon Epitaxial Schottky Barrier Diode

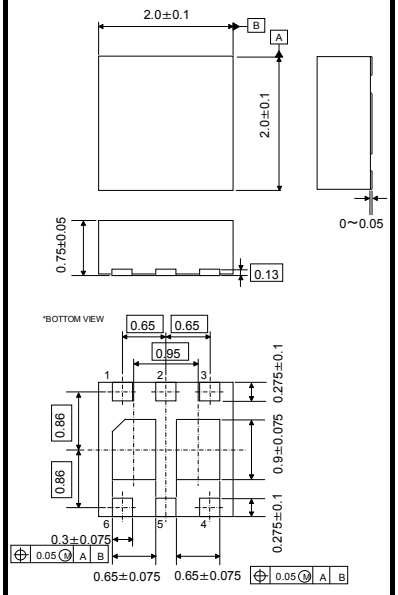
SSM6G18NU

Power Management Switch Applications

- Combined a P-channel MOSFET and a schottky barrier diode in one package.
- Low $R_{DS\ (ON)}$ and Low V_F

  $R_{DS(ON)}$ = 261 mΩ (max) (@V_{GS} = -1.5V)
  $R_{DS(ON)}$ = 185 mΩ (max) (@V_{GS} = -1.8 V)
  $R_{DS(ON)}$ = 143 mΩ (max) (@V_{GS} = -2.5 V)
  $R_{DS(ON)}$ = 112 mΩ (max) (@V_{GS} = -4.5 V)

Unit: mm



1. Anode 4. Source
2. NC 5. Gate
3. Drain 6. Cathode

UDFN6	
JEDEC	—
JEITA	—
TOSHIBA	2-2Y1A

Weight: 8.5 mg (typ.)

Absolute Maximum Ratings

MOSFET (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DSS}	−20	V
Gate-Source voltage		V_{GSS}	±8	V
Drain current	DC	I_D (Note 1)	−2.0	A
	Pulse	I_{DP} (Note 1)	−4.0	
Power dissipation		P_D(Note 2)	1	W
		t ＜10s	2	
Channel temperature		T_{ch}	150	°C

Schottky Barrier Diode(Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Reverse voltage	V_R	30	V
Average forward current	I_O	1.0	A
Peak one cycle surge forward current(10ms)	I_{FSM}	5.0	A
Junction temperature	T_j	150	°C

MOSFET and Diode (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
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 FR4 board.
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645mm^2)

MOSFET

Electrical Characteristics (Ta = 25°C)

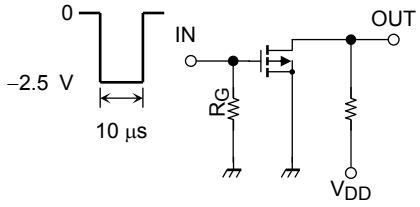
Characteristic		Symbol	Test Conditions	Min	Typ.	Max	Unit
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = -1 mA, V_{GS} = 0 V	-20	—	—	V
		$V_{(BR)\ DSX}$	I_D = -1 mA, V_{GS} = 5 V (Note 4)	-15	—	—	
Drain cut-off current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V	—	—	-1	μA
Gate leakage current		I_{GSS}	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 = -1.0 A (Note 3)	2.7	5.4	—	S
Drain–source ON-resistance		$R_{DS\ (ON)}$	I_D = -1.0 A, V_{GS} = -4.5 V (Note 3)	—	89	112	mΩ
			I_D = -0.6A, V_{GS} = -2.5 V (Note 3)	—	107	143	
			I_D = -0.4 A, V_{GS} = -1.8 V (Note 3)	—	128	185	
			I_D = -0.2 A, V_{GS} = -1.5 V (Note 3)	—	148	261	
Input capacitance		C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	270	—	pF
Output capacitance		C_{oss}		—	40	—	
Reverse transfer capacitance		C_{rss}		—	32	—	
Total Gate Charge		Q_g	V_{DD} = –10 V, I_D = –2.0 A, V_{GS} = –4.5 V	—	4.6	—	nC
Gate-Source Charge		Q_{gs1}		—	0.4	—	
Gate-Drain Charge		Q_{gd}		—	0.9	—	
Switching time	Turn-on time	t_{on}	V_{DD} = -10 V, I_D = -1.0 A, V_{GS} = 0 to -2.5 V, R_G = 4.7 Ω	—	17	—	ns
	Turn-off time	t_{off}		—	43	—	
Drain-Source forward voltage		V_{DSF}	I_D = 2.0 A, V_{GS} = 0 V (Note 3)	—	0.86	1.2	V

Note 3: Pulse test

Note 4: If a forward bias is applied between gate and source, this device enters V(BR)DSX mode. Note that the drain-source breakdown voltage is lowered in this mode

Switching Time Test Circuit

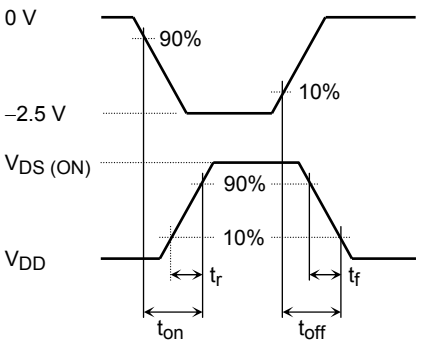
(a) Test circuit



V_{DD} = –10 V
R_G = 4.7 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 voltage between gate and source when low operating current value is I_D = −1mA for this product. For normal switching operation, $V_{GS\ (on)}$ requires higher voltage than V_{th} and $V_{GS\ (off)}$ requires lower voltage than V_{th}.

(Relationship can be established as follows: $V_{GS\ (off)} < V_{th} < V_{GS\ (on)}$)

Please take this into consideration for using the device.

Schottky Barrier Diode

Electrical Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Conditions	Min	Typ.	Max	Unit
Forward voltage	$V_{F\ (1)}$	I_F = 100 mA	—	0.31	—	V
	$V_{F\ (2)}$	I_F = 200 mA	—	0.36	—	
	$V_{F\ (3)}$	I_F = 500 mA	—	0.38	0.45	
	$V_{F\ (4)}$	I_F = 1000 mA		0.48	0.58	
Reverse current	I_R	V_R = 30 V	—	5	50	μA
Total capacitance	C_T	V_R = 0 V, f = 1 MHz	—	120	—	pF

Precaution

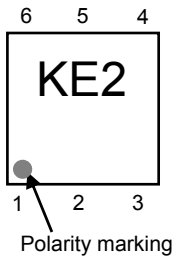
The Schottky barrier diode in this device has large reverse current leakage compared to typical switching diodes. Thus, excessive operating temperature or voltage may cause thermal runaway. To avoid this problem, be sure to take both forward and reverse loss into consideration.

Handling Precaution

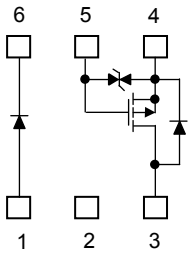
When handling individual devices that are not yet mounted on a circuit board, make sure that the environment is protected against electrostatic discharge. Operators should wear antistatic clothing, and containers and other objects that come into direct contact with devices should be made of antistatic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

Thermal resistance $R_{th\ (ch\text{-}a)}$ and power dissipation P_D vary depending on board material, board area, board thickness and pad area. When using this device, please take heat dissipation into consideration

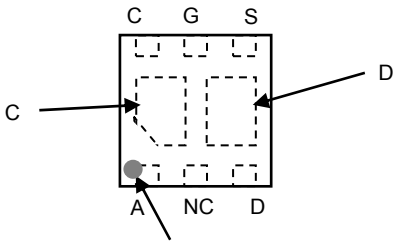
Marking(Top View)



Equivalent Circuit(Top View)



Pin Condition(Top View)

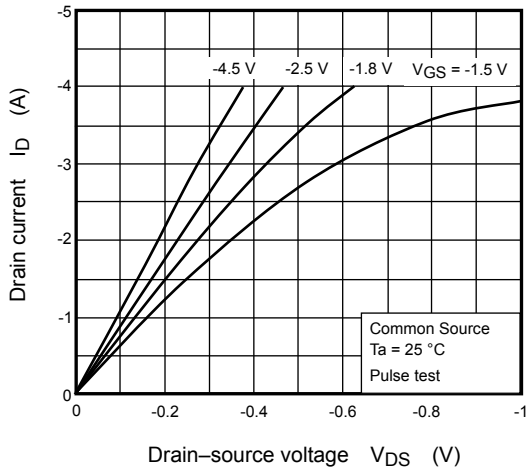


Polarity marking (on the top)

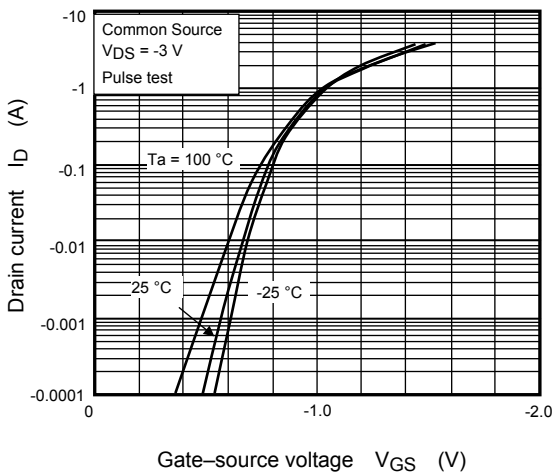
*Electrodes : on the bottom

·MOSFET

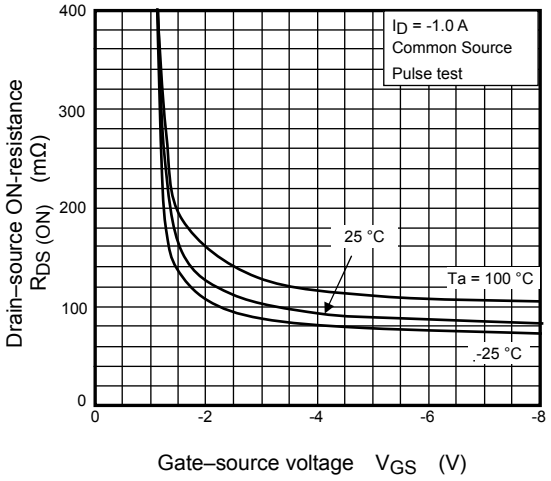
$I_D - V_{DS}$



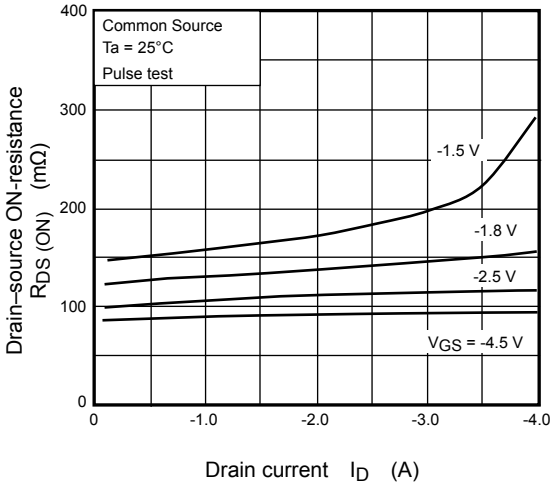
$I_D - V_{GS}$



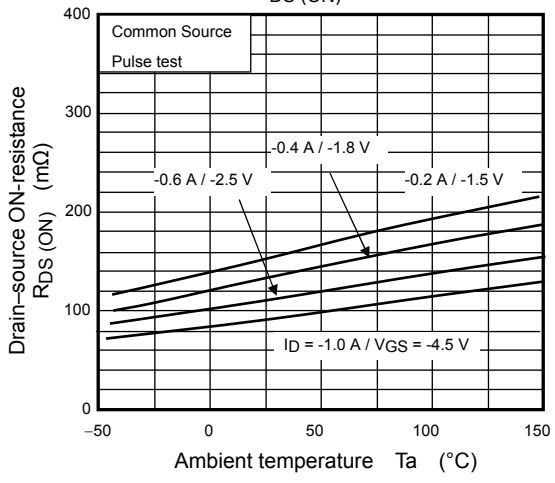
$R_{DS\ (ON)} - V_{GS}$



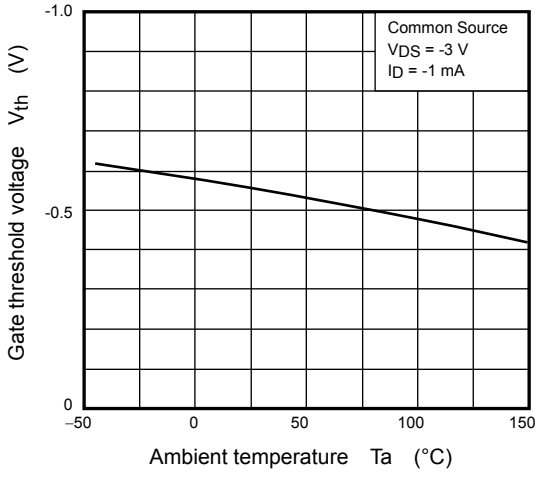
$R_{DS\ (ON)} - I_D$



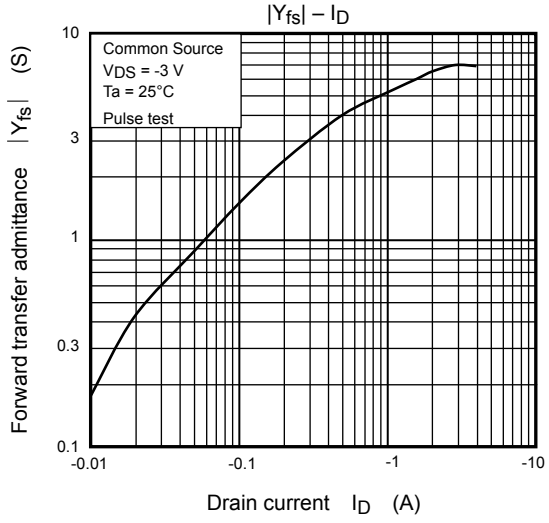
$R_{DS\ (ON)} - Ta$



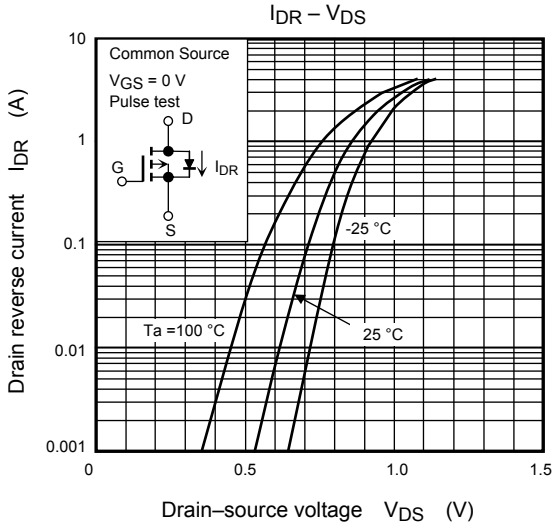
$V_{th} - Ta$



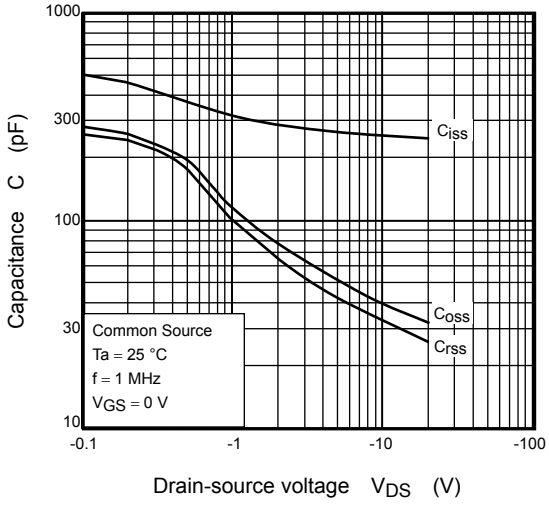
$|Y_{fs}| - I_D$



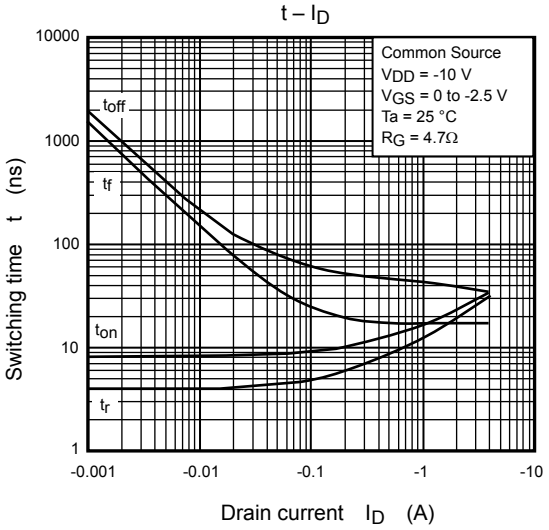
$I_{DR} - V_{DS}$



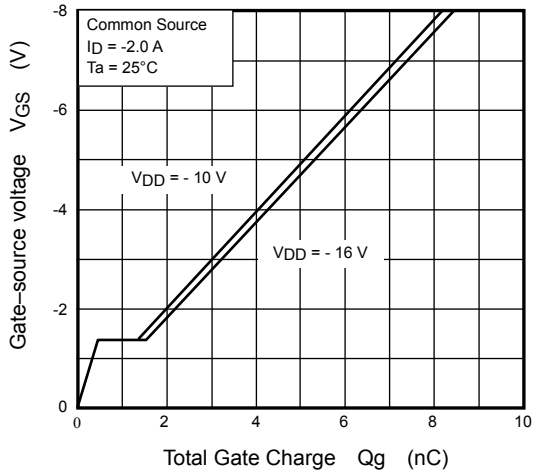
$C - V_{DS}$



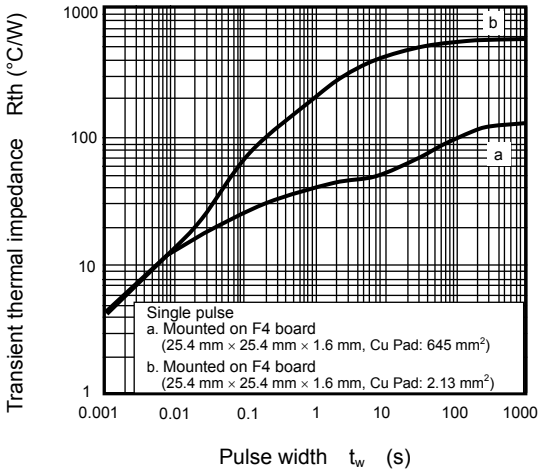
$t - I_D$



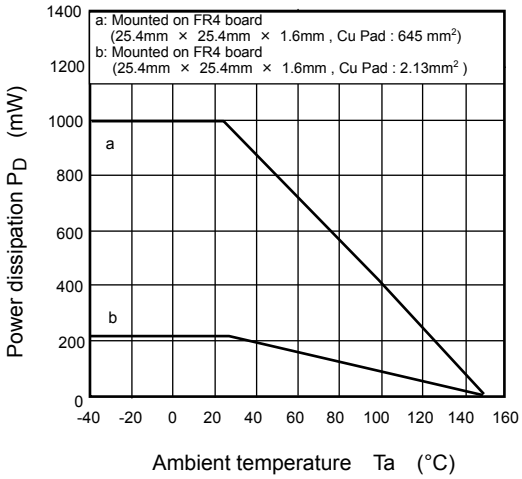
Dynamic Input Characteristic



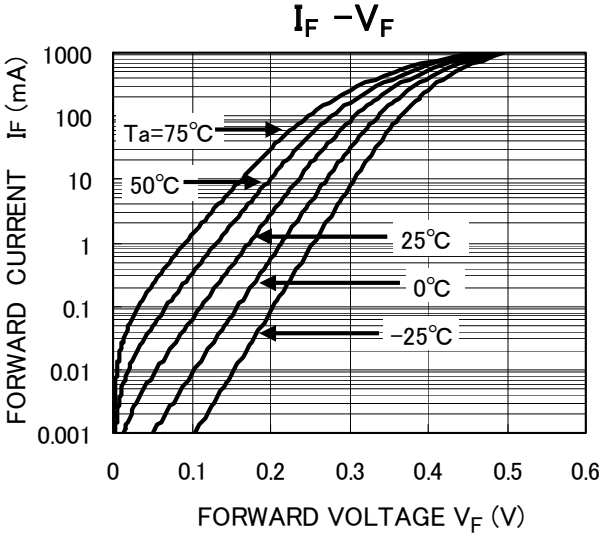
$r_{th} – t_w$

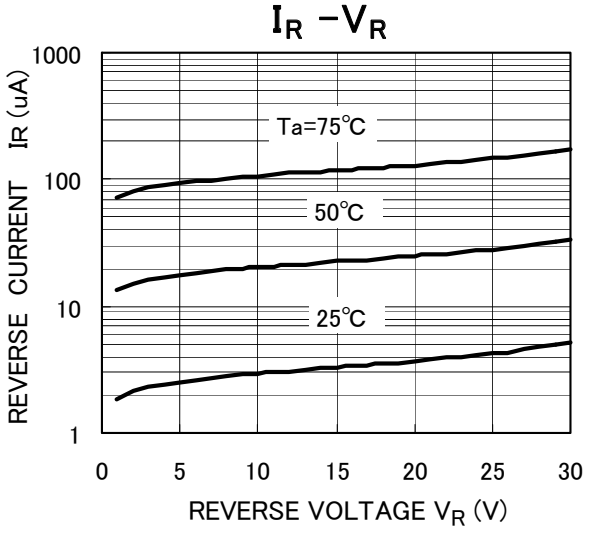

Transient thermal impedance Rth (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
b
a
Single pulse
a. Mounted on F4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm²)
b. Mounted on F4 board
(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 2.13 mm²)
Pulse width t_w (s)

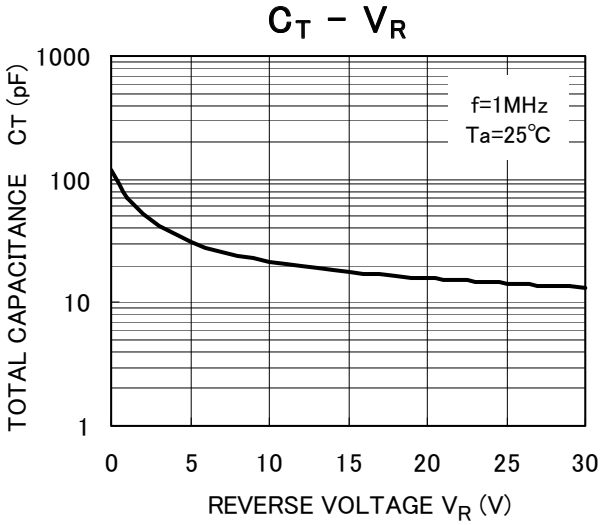
$P_D – Ta$


Power dissipation P_D (mW)
1400
1200
1000
800
600
400
200
0
-40
-20
0
20
40
60
80
100
120
140
160
a: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6mm , Cu Pad : 645 mm²)
b: Mounted on FR4 board
(25.4mm × 25.4mm × 1.6mm , Cu Pad : 2.13mm²)
a
b
Ambient temperature Ta (°C)

Schottky Barrier Diode







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