TOSHIBA Multi-Chip Device Silicon N Channel MOS Type (U-MOS III) / Schottky Barrier Diode

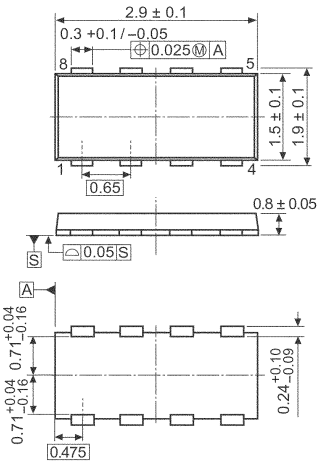
TPCF8A01

Notebook PC Applications

Portable Equipment Applications

- Low drain-source ON resistance: $R_{DS\ (ON)}$ = 38 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 5.4 S (typ.)
- Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 20 V)
- Enhancement mode: V_{th} = 0.5 to 1.2 V (V_{DS} = 10 V, I_D = 200 μA)
- Low forward voltage: $V_{FM(2)}$ = 0.46V(typ.)

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	2-3U1C

Weight: 0.011 g (typ.)

Absolute Maximum Ratings

MOSFET (Ta = 25°C)

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	20	V
Drain-gate voltage (R_{GS} = 20 kΩ)			V_{DGR}	20	V
Gate-source voltage			V_{GSS}	±12	V
Drain current	DC	(Note 1)	I_D	3	A
	Pulse	(Note 1)	I_{DP}	12	
Single pulse avalanche energy		(Note 4)	E_{AS}	1.46	mJ
Avalanche current			I_{AR}	1.5	A
Repetitive avalanche energy Single-device value at dual operation		(Note 2a, 3b, 5)	E_{AR}	0.11	mJ

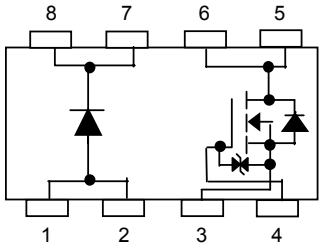
SBD (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Repetitive peak reverse voltage	V_{RRM}	20	V
Average forward current (Note 2a, 6)	$I_{F(AV)}$	1.0	A
Peak one cycle surge forward current (non-repetitive)	I_{FSM}	7(50Hz)	A

Absolute Maximum Ratings for MOSFET and SBD (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain power dissipation (t = 5 s) (Note 2a)	Single-device operation (Note 3a)	$P_{D\ (1)}$	1.35	W
	Single-device value at dual operation (Note 3b)	$P_{D\ (2)}$	1.12	
Drain power dissipation (t = 5 s) (Note 2b)	Single-device operation (Note 3a)	$P_{D\ (1)}$	0.53	
	Single-device value at dual operation (Note 3b)	$P_{D\ (2)}$	0.33	
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	-55~150	°C

Circuit Configuration



Note: (Note 1), (Note 2), (Note 3), (Note 4), (Note 5), (Note 6) and (Note 7): See the next page.

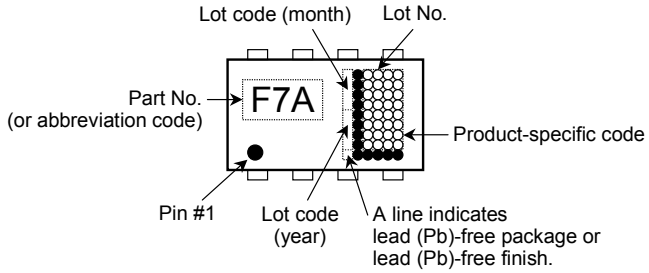
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within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

Thermal Characteristics for MOSFET and SBD

Characteristics		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 5 s) (Note 2a)	Single-device operation (Note 3a)	$R_{th\ (ch\text{-}a)\ (1)}$	92.6	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th\ (ch\text{-}a)\ (2)}$	111.6	
Thermal resistance, channel to ambient (t = 5 s) (Note 2b)	Single-device operation (Note 3a)	$R_{th\ (ch\text{-}a)\ (1)}$	235.8	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th\ (ch\text{-}a)\ (2)}$	378.8	

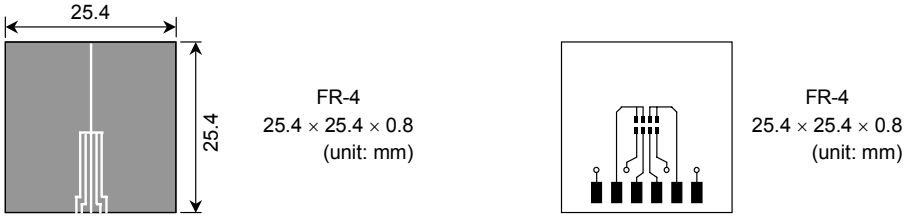
This transistor is an electrostatic-sensitive device. Please handle with caution.
Schottky barrier diodes have large-reverse-current-leakage characteristic compared to other rectifier products. This current leakage and improper operating temperature or voltage may cause thermal runaway. Please take forward and reverse loss into consideration during design.

Marking (Note 7)



Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: (a) Device mounted on a glass-epoxy board (a) (b) Device mounted on a glass-epoxy board (b)



Note 3: a) The power dissipation and thermal resistance values are shown for a single device (During single-device operation, power is only applied to one device.).

b) The power dissipation and thermal resistance values are shown for a single device (During dual operation, power is evenly applied to both devices.).

Note 4: V_{DD} = 16 V, T_{ch} = 25°C (initial), L = 0.5 mH, R_G = 25 Ω, I_{AR} = 1.5 A

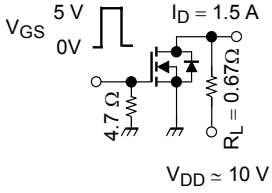
Note 5: Repetitive rating: pulse width limited by maximum channel temperature

Note 6: Rectangular waveform (α =180°), V_R =15V.

Note 7: ●on the lower left of the marking indicates Pin 1.

Electrical Characteristics (Ta = 25°C)

MOSFET

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0 V	—	—	±10	μA
Drain cut-off current		I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	—	—	10	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	20	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = -12 V	8	—	—	
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 200 μA	0.5	—	1.2	V
Drain-source ON resistance		$R_{DS\ (ON)}$	V_{GS} = 2.0 V, I_D = 1.5 A	—	62	100	mΩ
		$R_{DS\ (ON)}$	V_{GS} = 2.5 V, I_D = 1.5 A	—	50	66	
		$R_{DS\ (ON)}$	V_{GS} = 4.5 V, I_D = 1.5 A	—	38	49	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 1.5 A	2.7	5.4	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	590	—	pF
Reverse transfer capacitance		C_{rss}		—	70	—	
Output capacitance		C_{oss}		—	85	—	
Switching time	Rise time	t_r	 Duty ≦ 1%, t_w = 10 μs	—	3.0	—	ns
	Turn-on time	t_{on}		—	7.5	—	
	Fall time	t_f		—	4.4	—	
	Turn-off time	t_{off}		—	26	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≃ 16 V, V_{GS} = 5 V, I_D = 3.0 A	—	7.5	—	nC
Gate-source charge1		Q_{gs1}		—	1.3	—	
Gate-drain (“miller”) charge		Q_{gd}		—	2.1	—	

MOSFET Source-Drain Ratings and Characteristics

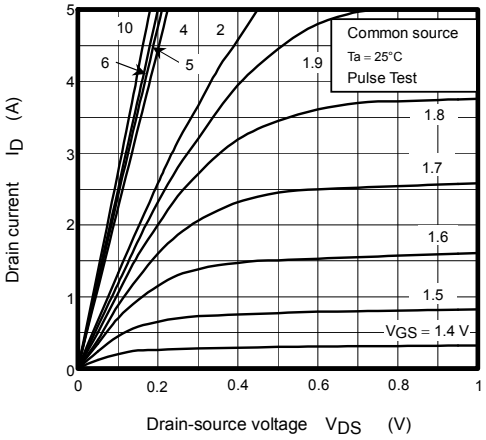
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	12	A
Forward voltage (diode)		V_{DSF}	I_{DR} = 3.0 A, V_{GS} = 0 V	—	—	-1.2	V

SBD

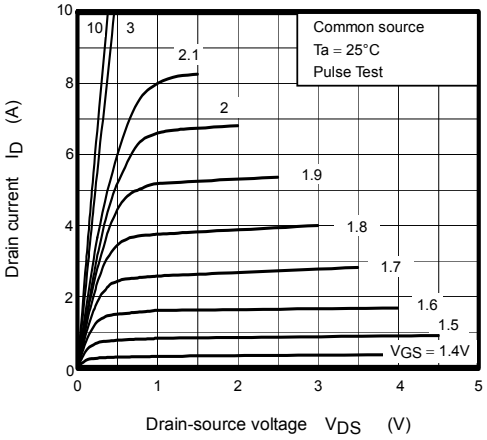
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Peak forward voltage	$V_{FM(1)}$	I_{FM} = 0.7 A	—	0.43	—	V
	$V_{FM(2)}$	I_{FM} = 1.0 A	—	0.46	0.49	V
Repetitive peak reverse current	I_{RRM}	V_{RRM} = 20 V	—	—	50	□A
Junction capacitance	C_j	V_R = 10 V, f = 1 MHz	—	54	—	pF

MOSFET

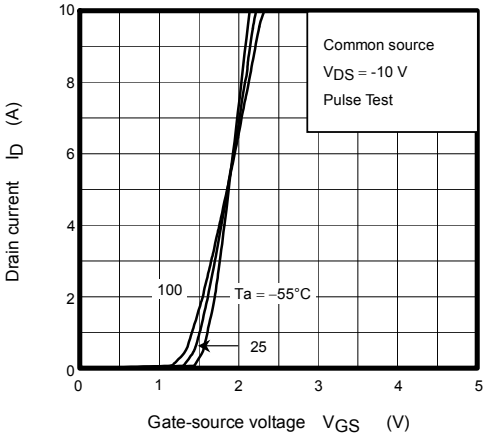
$I_D - V_{DS}$



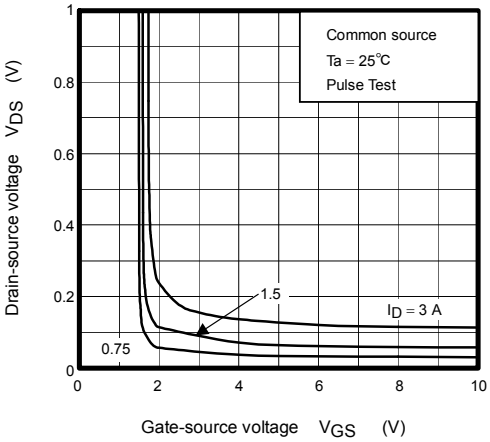
$I_D - V_{DS}$



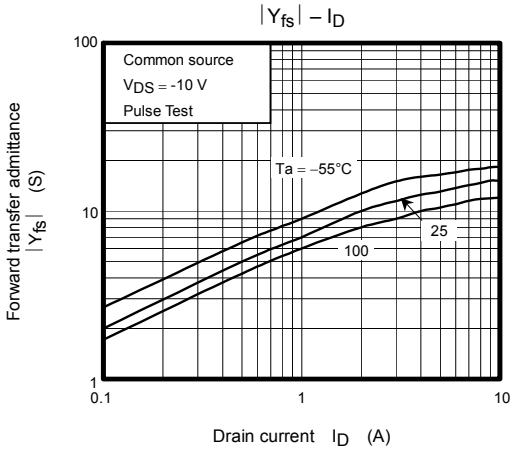
$I_D - V_{GS}$



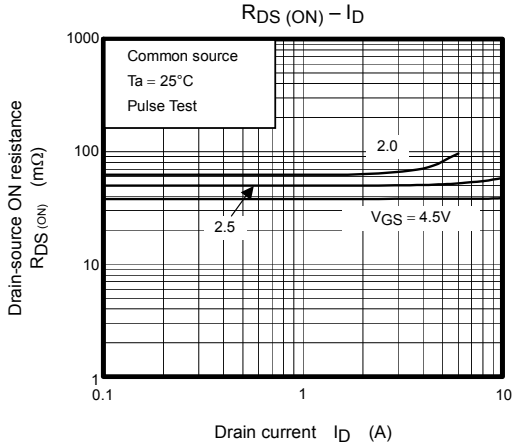
$V_{DS} - V_{GS}$



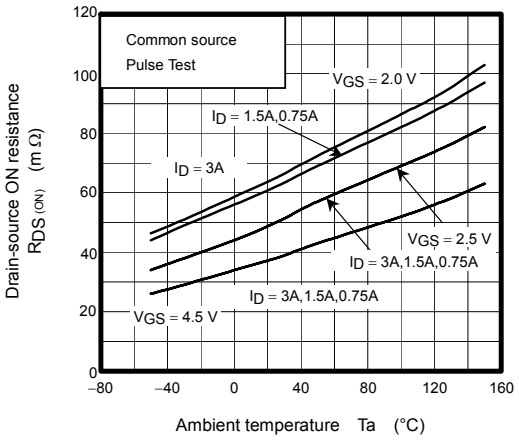
$|Y_{fs}| - I_D$



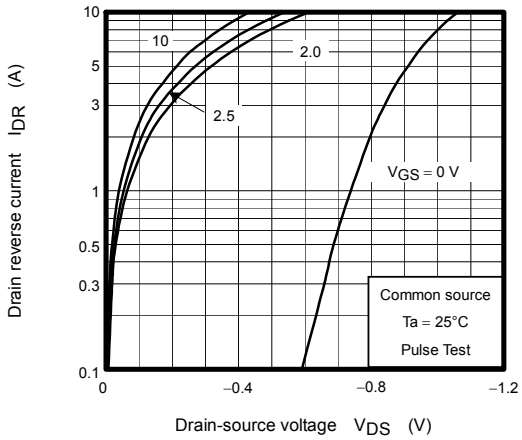
$R_{DS\ (ON)} - I_D$



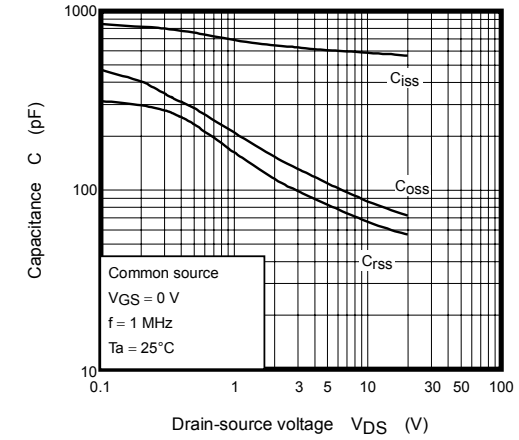
$R_{DS\ (ON)}$ – Ta



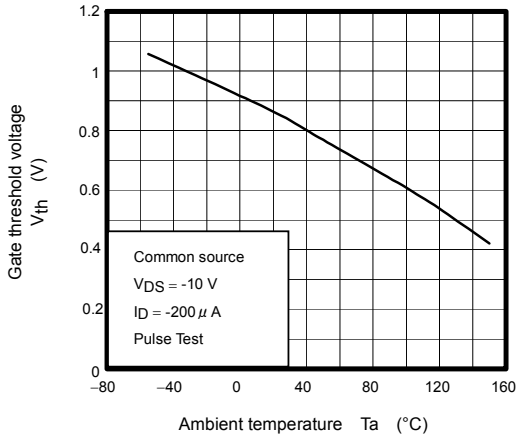
I_{DR} – V_{DS}



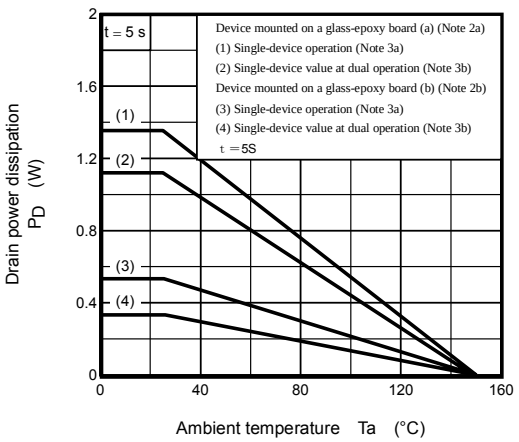
Capacitance – V_{DS}



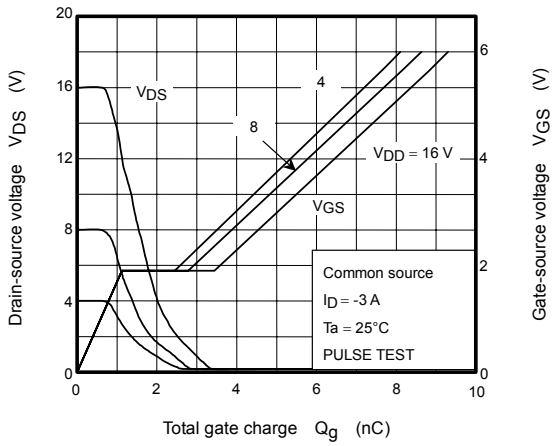
V_{th} – Ta

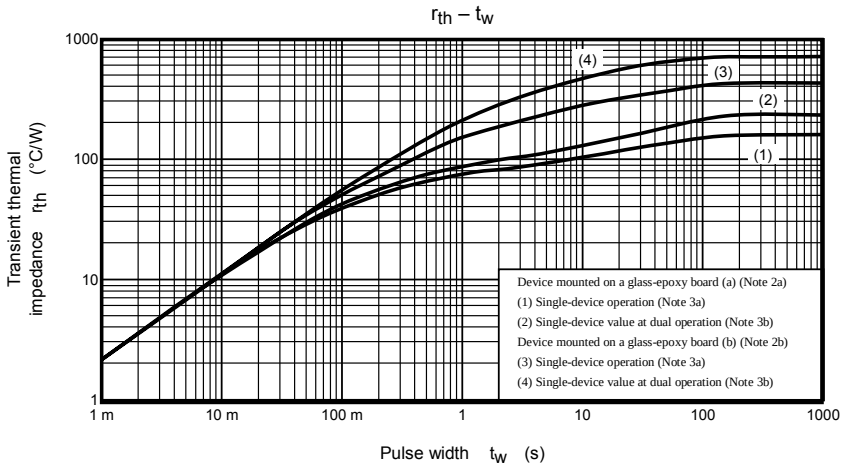


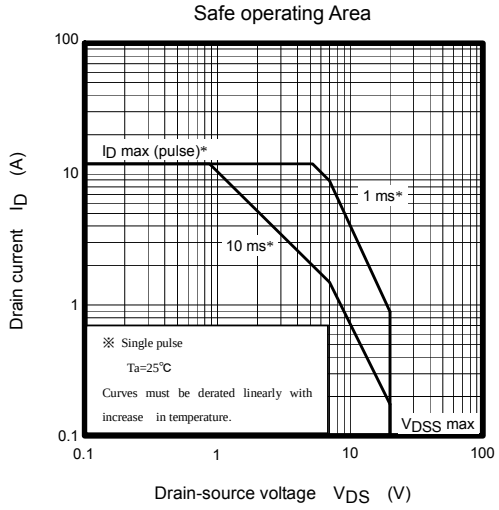
P_D – Ta



Dynamic input / output characteristics

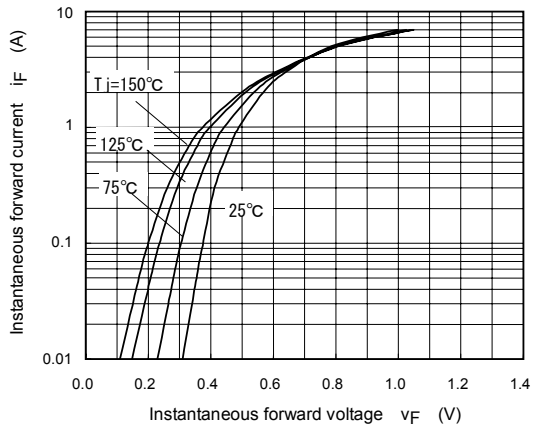



$r_{th} - t_w$
Transient thermal impedance r_{th} (°C/W)
1000
100
10
1
1 m
10 m
100 m
1
10
100
1000
(4)
(3)
(2)
(1)
Device mounted on a glass-epoxy board (a) (Note 2a)
(1) Single-device operation (Note 3a)
(2) Single-device value at dual operation (Note 3b)
Device mounted on a glass-epoxy board (b) (Note 2b)
(3) Single-device operation (Note 3a)
(4) Single-device value at dual operation (Note 3b)
Pulse width t_w (s)

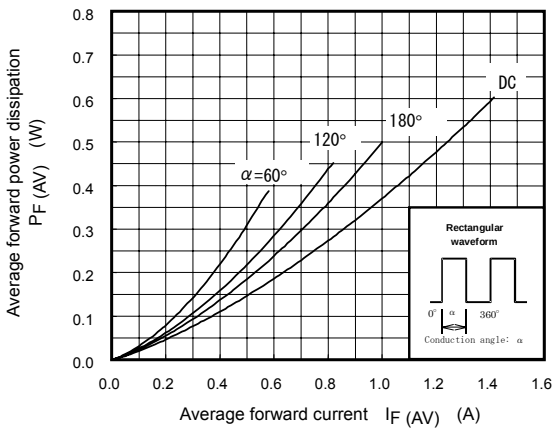

Safe operating Area
Drain current I_D (A)
100
10
1
0.1
I_D max (pulse)*
1 ms*
10 ms*
※ Single pulse
Ta=25℃
Curves must be derated linearly with increase in temperature.
V_{DSS} max
0.1
1
10
100
Drain-source voltage V_{DS} (V)

SBD

$i_F - v_F$

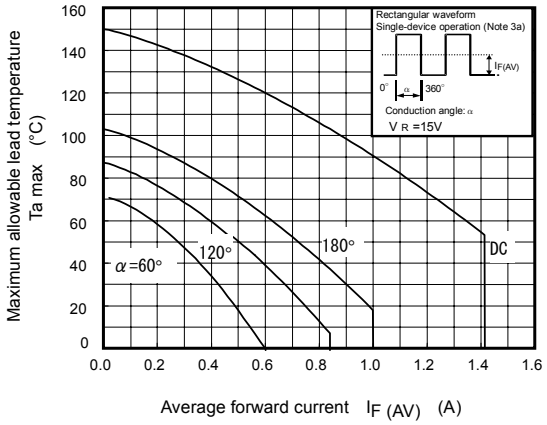


$P_{F\,(AV)} - I_{F\,(AV)}$

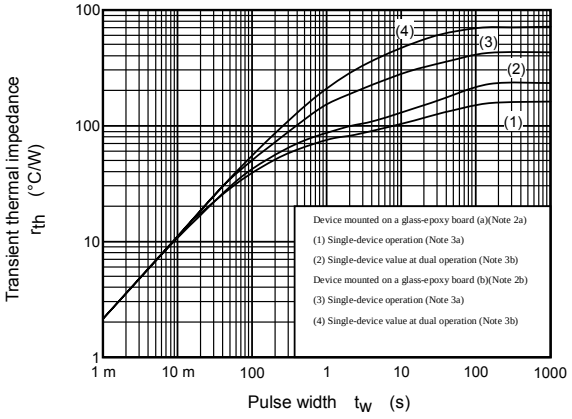


Ta max – $I_{F\,(AV)}$

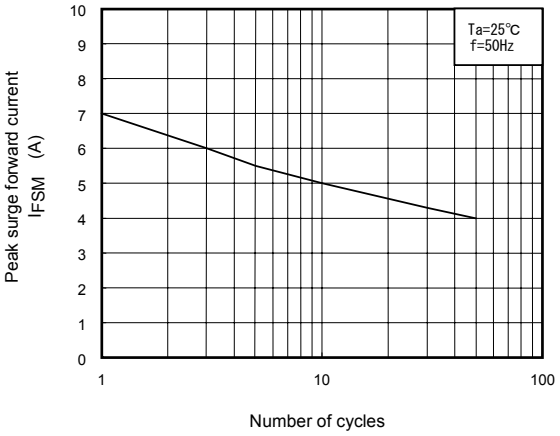
Device mounted on a glass-epoxy board (a) (Note 2a)



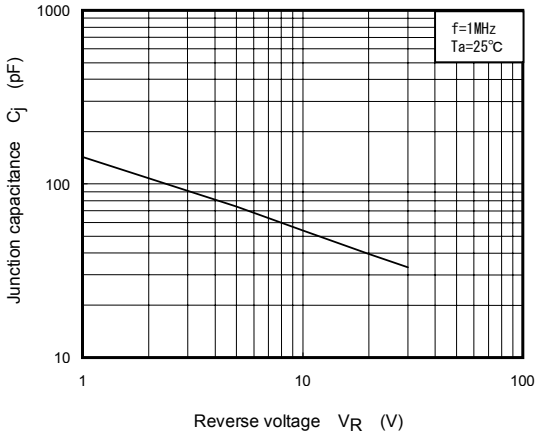
r_{th}– t_w



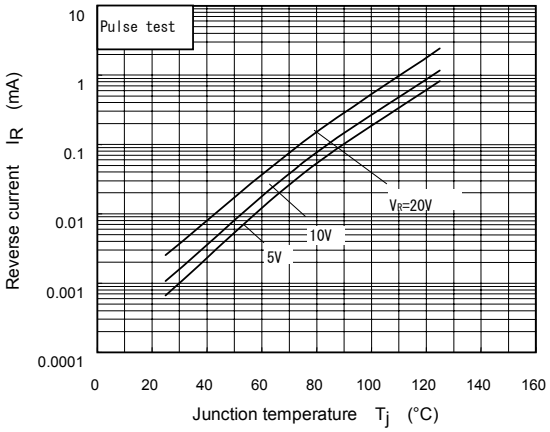
Surge forward current (non-repetitive)



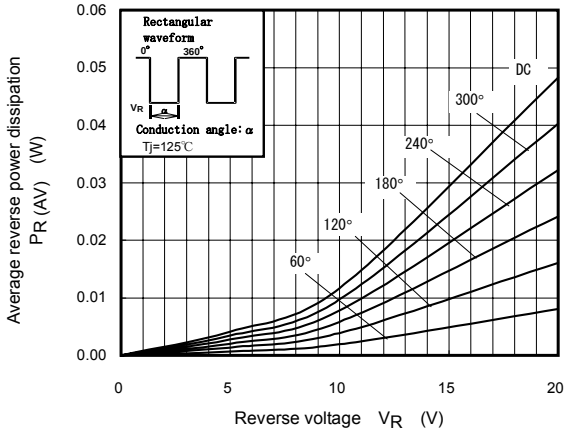
$C_j - V_R$ (typ.)



$I_R - T_j$ (typ.)



$P_{R\ (AV)} - V_R$ (typ.)



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