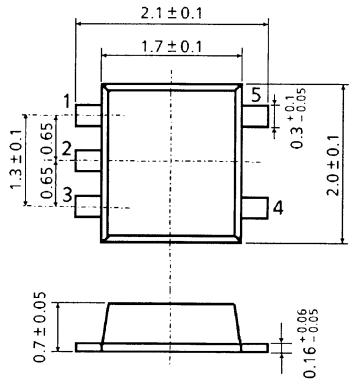
Silicon P Channel MOS Type (U-MOSII)/Silicon Epitaxial Schottky Barrier Diode

SSM5G02TU

DC-DC Converter

- Combined Pch MOSFET and Schottky Diode into one Package.
- Low $R_{DS\ (ON)}$ and Low V_F

Unit: mm



1 : GATE 4 : CATHODE
2 : SOURCE 5 : DRAIN
3 : ANODE

UFV	
JEDEC	—
JEITA	—
TOSHIBA	2-2R1A

Weight: 7 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C) MOSFET

Characteristics		Symbol	Rating	Unit
Drain-Source voltage		V_{DS}	−12	V
Gate-Source voltage		V_{GSS}	±12	V
Drain current	DC	I_D	−1.0	A
	Pulse	I_{DP} (Note 2)	−2.0	
Drain power dissipation		P_D (Note 1)	0.5	W
		t = 10s	0.8	
Channel temperature		T_{ch}	150	°C

Absolute Maximum Ratings (Ta = 25°C) SCHOTTKY DIODE

Characteristics	Symbol	Rating	Unit
Maximum (peak) reverse voltage	V_{RM}	15	V
Reverse voltage	V_R	12	V
Average forward current	I_O	0.5	A
Peak one cycle surge forward current (non-repetitive)	I_{FSM}	2 (50 Hz)	A
Junction temperature	T_j	125	°C

Absolute Maximum Ratings (Ta = 25°C) MOSFET, DIODE COMMON

Characteristics	Symbol	Rating	Unit
Storage temperature	T_{stg}	−55 to 125	°C
Operating temperature	T_{opr} (Note 3)	−40 to 85	°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).

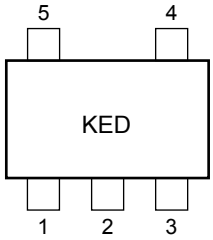
Note 1: Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 t, Cu pad: 645 mm^2)

Note 2: The pulse width limited by max channel temperature.

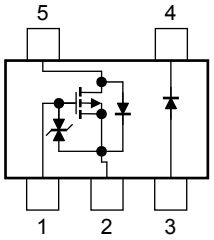
Note 3: Operating temperature limited by max channel temperature and max junction temperature.

Start of commercial production
2002-05

Marking



Equivalent Circuit



Handling Precaution

When handling individual devices (which are not yet mounting on a circuit board), be sure that the environment is protected against electrostatic discharge. Operators should wear anti-static clothing and use containers and other objects that are made of anti-static materials.

The Channel-to-Ambient thermal resistance $R_{th\ (ch\text{-}a)}$ and the drain power dissipation P_D vary according to the board material, board area, board thickness and pad area. When using this device, please take heat dissipation fully into account.

MOSFET

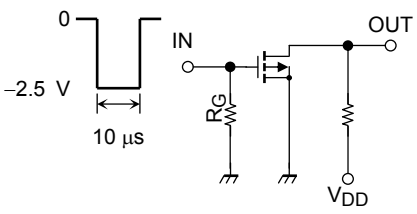
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0	—	—	±1	μA
Drain-Source breakdown voltage		$V_{(BR)\ DSS}$	I_D = −1 mA, V_{GS} = 0	−12	—	—	V
		$V_{(BR)\ DSX}$	I_D = −1 mA, V_{GS} = +8 V	−4	—	—	
Drain Cut-off current		I_{DSS}	V_{DS} = −12 V, V_{GS} = 0	—	—	−1	μA
Gate threshold voltage		V_{th}	V_{DS} = −3V, I_D = −0.1 mA	−0.4	—	−1.1	V
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = −3 V, I_D = −0.5 A (Note 4)	1.3	2.5	—	S
Drain-Source ON resistance		$R_{DS\ (ON)}$	I_D = −0.5 A, V_{GS} = −4 V (Note 4)	—	125	160	mΩ
			I_D = −0.5 A, V_{GS} = −2.5 V (Note 4)	—	180	240	
Input capacitance		C_{iss}	V_{DS} = −10 V, V_{GS} = 0, f = 1 MHz	—	310	—	pF
Reverse transfer capacitance		C_{rss}	V_{DS} = −10 V, V_{GS} = 0, f = 1 MHz	—	70	—	pF
Output capacitance		C_{oss}	V_{DS} = −10 V, V_{GS} = 0, f = 1 MHz	—	110	—	pF
Switching time	Turn-on time	t_{on}	V_{DD} = −10 V, I_D = −0.5 A	—	20	—	ns
	Turn-off time	t_{off}	V_{GS} = 0 to −2.5 V, R_G = 4.7 Ω	—	32	—	

Note 4: Pulse measurement

Switching Time Test Circuit

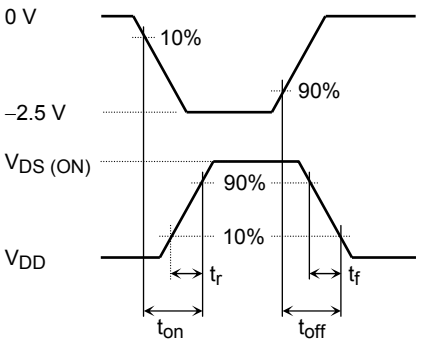
(a) Test circuit



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 = −100 μA 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 Diode

Electrical Characteristics (Ta = 25°C)

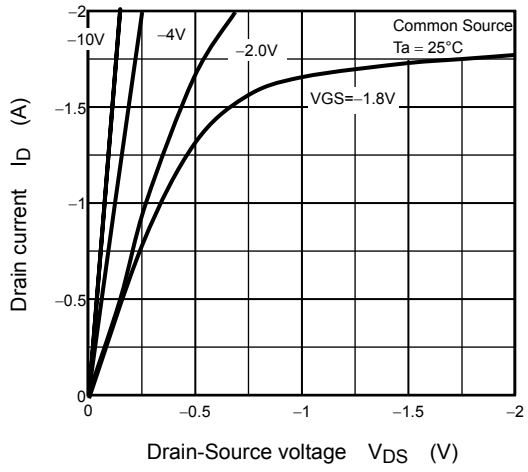
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage	$V_{F\ (1)}$	I_F = 0.3 A	—	0.33	0.39	V
	$V_{F\ (2)}$	I_F = 0.5 A	—	0.37	0.43	V
Reverse current	I_R	V_R = 12 V	—	—	100	μA
Total capacitance	C_T	V_R = 0 V, f = 1 MHz	—	80	—	pF

Precaution

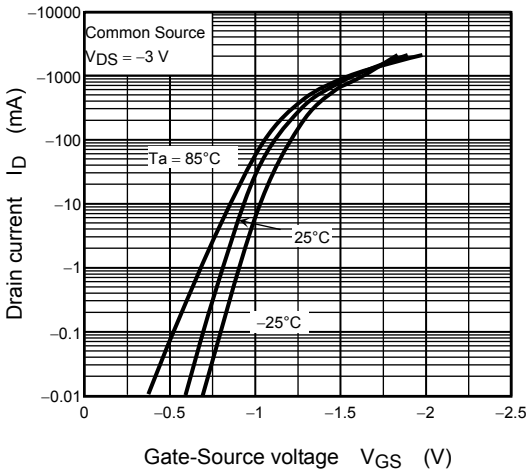
The schottky barrier diode of this product are having large-reverse-current-leakage characteristic compare to the other switching diodes. This current leakage and not proper operating temperature or voltage may cause thermal runaway. Please take forward and reverse loss into consideration when you design.

MOSFET Electrical Characteristics Graph

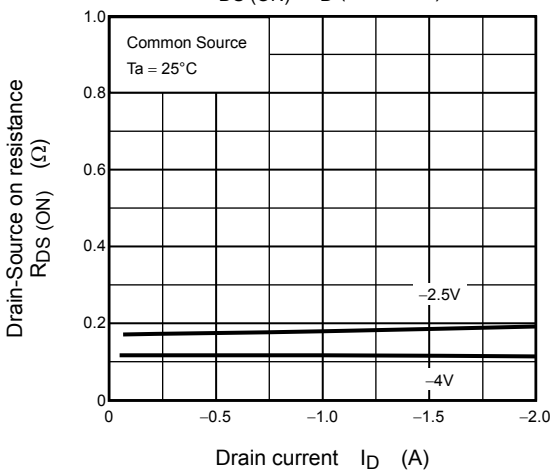
I_D – V_{DS} (MOSFET)



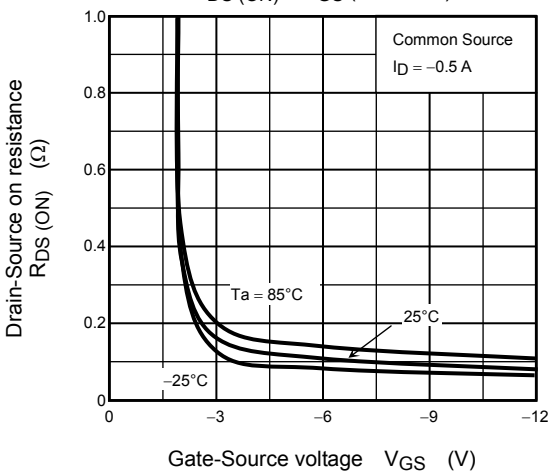
I_D – V_{GS} (MOSFET)



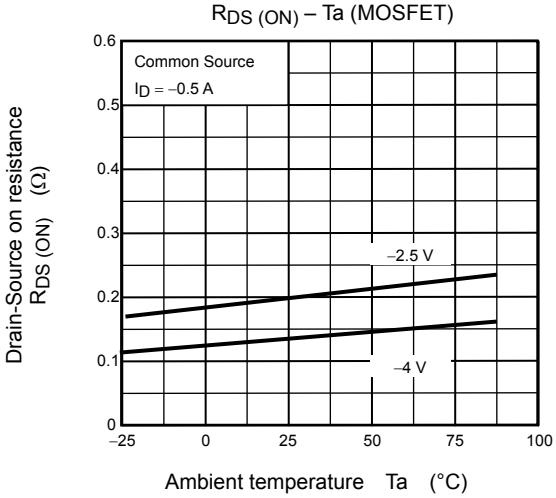
$R_{DS\ (ON)}$ – I_D (MOSFET)



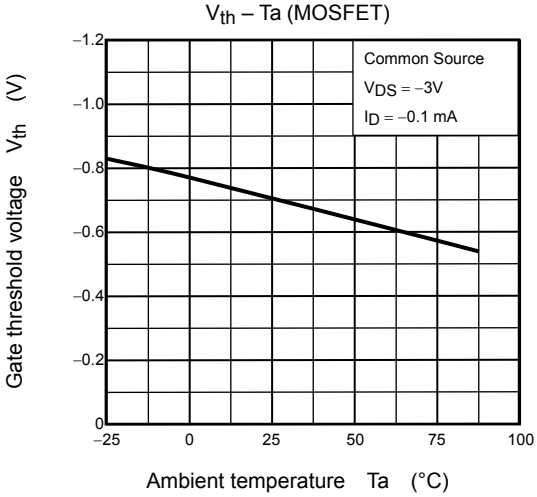
$R_{DS\ (ON)}$ – V_{GS} (MOSFET)



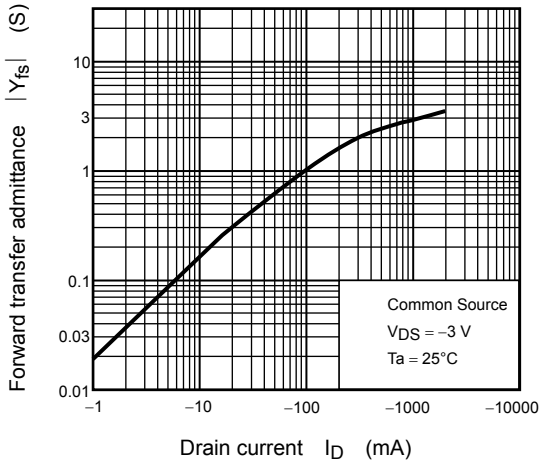
$R_{DS\ (ON)}$ – Ta (MOSFET)



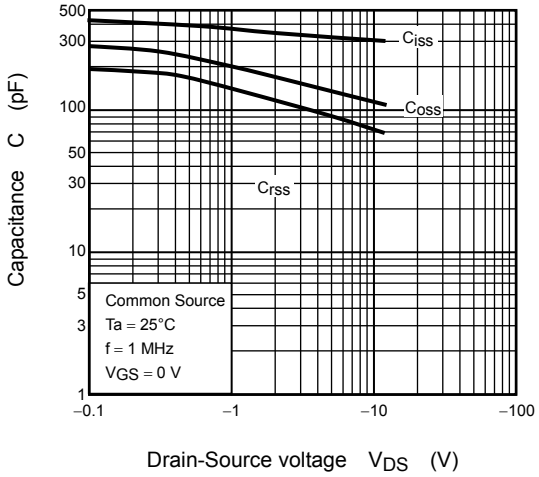
V_{th} – Ta (MOSFET)



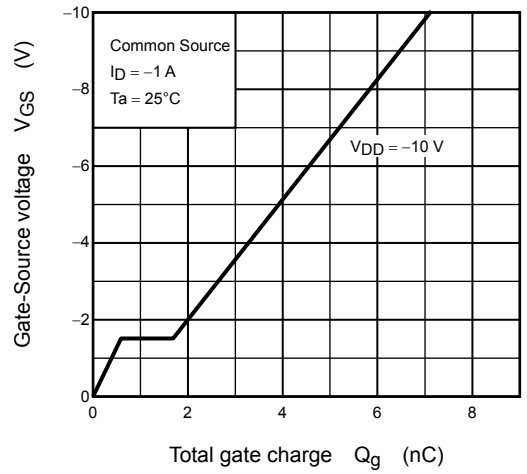
$|Y_{fs}| - I_D$ (MOSFET)



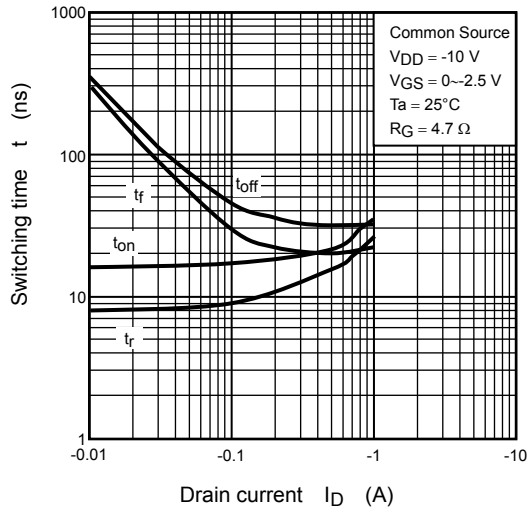
$C - V_{DS}$ (MOSFET)



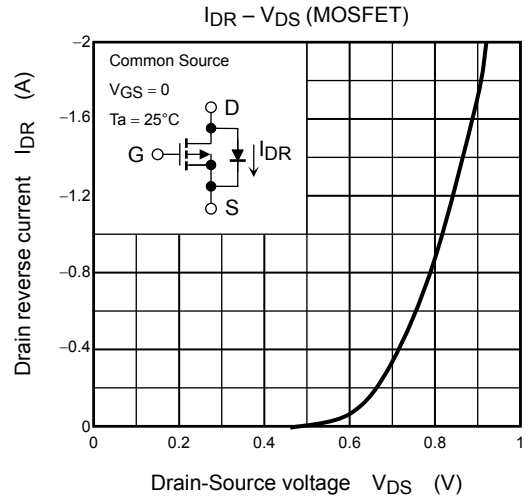
Dynamic input characteristic (MOSFET)



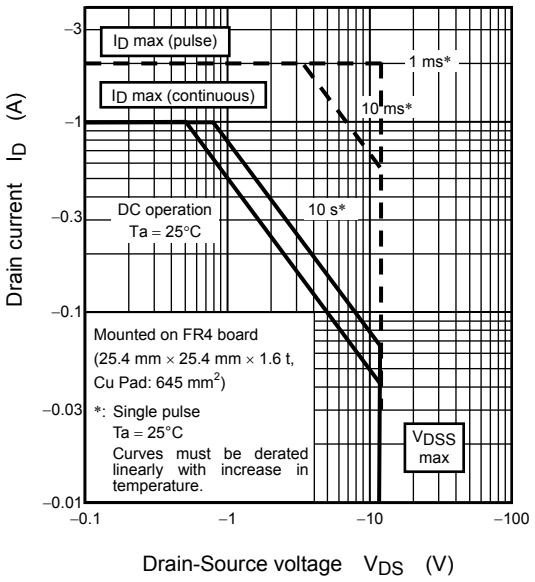
$t - I_D$ (MOSFET)



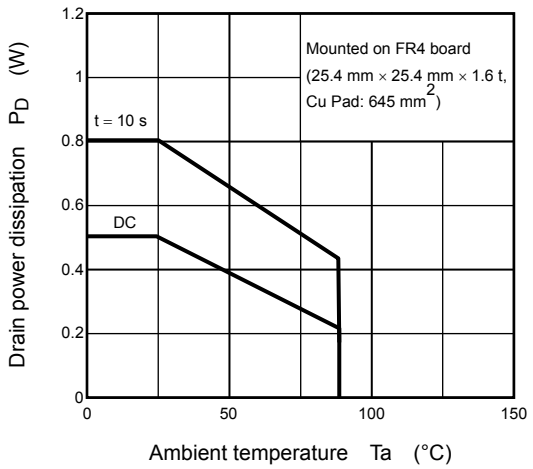
$I_{DR} - V_{DS}$ (MOSFET)



Safe operating area (MOSFET)

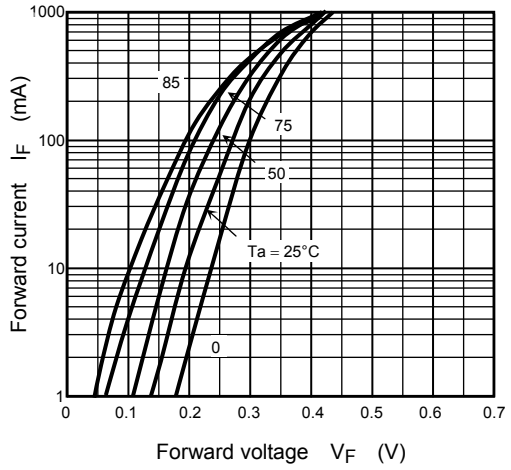


P_D – Ta (MOSFET)

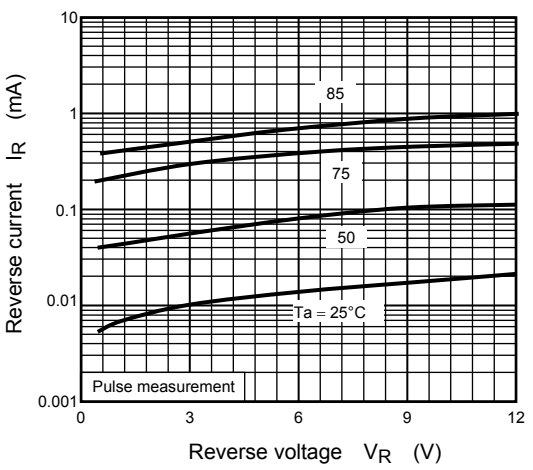


SBD Electrical Characteristics Graph

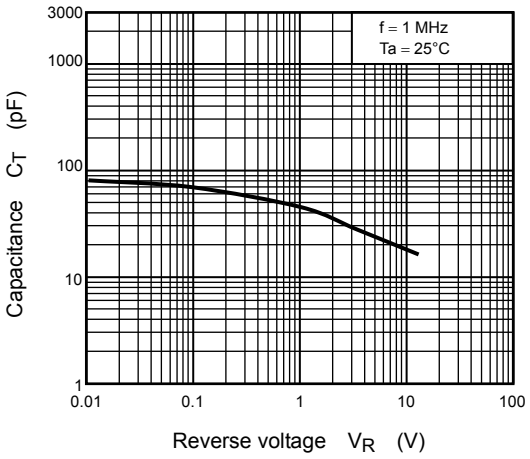
$I_F – V_F$ (SBD)



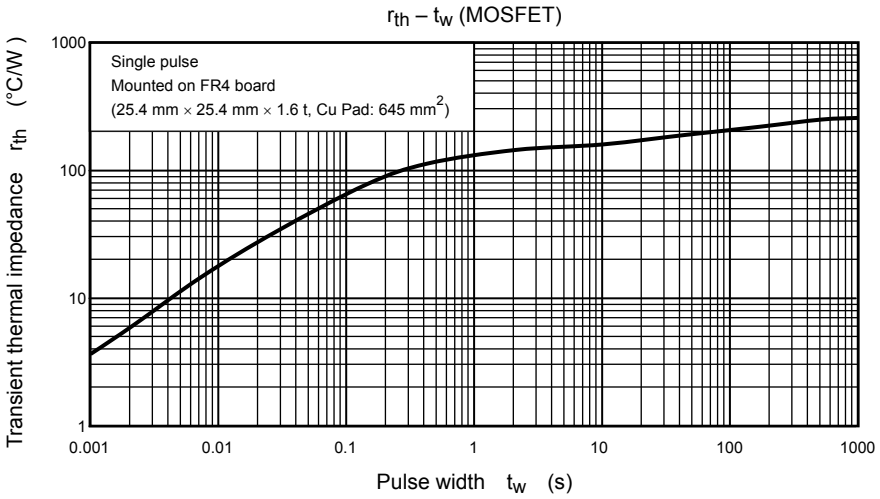
$I_R – V_R$ (SBD)

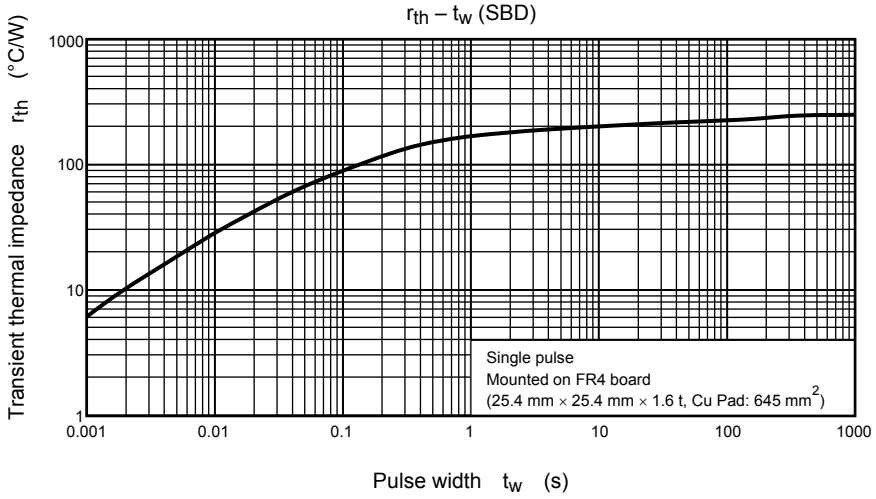


$C_T – V_R$ (SBD)



Transient thermal impedance Graph





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