

Silicon N Channel MOS Type (U-MOS^{III})/Silicon Epitaxial Schottky Barrier Diode

SSM5H05TU

DC-DC Converter

- Combined Nch MOSFET and Schottky Diode in one package.
- Low R_{DS (ON)} and low V_F

Absolute Maximum Ratings (Ta = 25°C) MOSFET

Characteristics	Symbol	Rating	Unit
Drain-Source voltage	V _{DS}	20	V
Gate-Source voltage	V _{GSS}	±12	V
Drain current	DC	I _D	1.5
	Pulse	I _{DP} (Note 2)	6.0
Drain power dissipation	P _D (Note 1)		0.5
		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}	-55~125	°C
Operating temperature	T _{opr} (Note 3)	-40~85	°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.

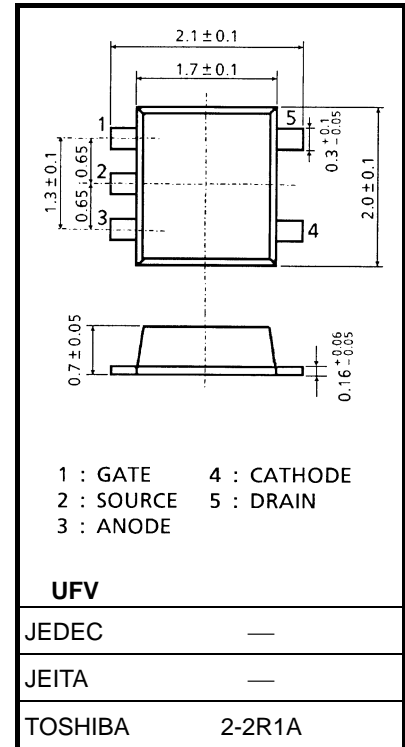
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Mounted on FR4 board
(25.4 mm × 25.4 mm × 1.6 t, Cu pad: 645 mm²)

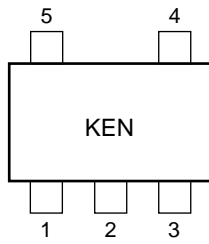
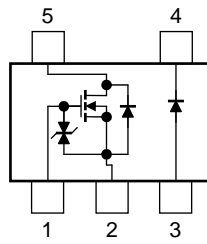
Note 2: The pulse width is limited by max channel temperature.

Note 3: The operating temperature is limited by max channel temperature and max junction temperature.

Unit: mm



Weight: 7 mg (typ.)

Marking**Equivalent Circuit****Handling Precaution**

When handling individual devices (which are not yet mounted on a circuit board), ensure that the environment is protected against static 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 $R_{th(ch-a)}$ and the drain power dissipation P_D vary according to the board material, board area, board thickness and pad area. When using this device, be sure to take heat dissipation fully into account.

MOSFET

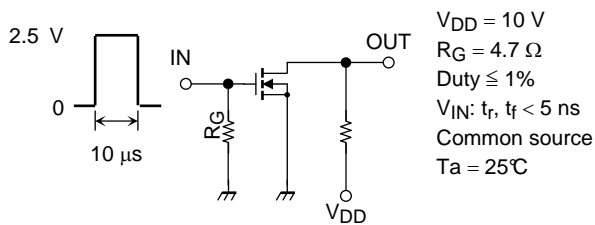
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	$V_{GS} = \pm 12\text{ V}, V_{DS} = 0$	—	—	± 1	μA
Drain-Source breakdown voltage		$V_{(BR)DSS}$	$I_D = 1\text{ mA}, V_{GS} = 0$	20	—	—	V
		$V_{(BR)DSX}$	$I_D = 1\text{ mA}, V_{GS} = -12\text{ V}$	12	—	—	
Drain Cut-off current		I_{DSS}	$V_{DS} = 20\text{ V}, V_{GS} = 0$	—	—	1	μA
Gate threshold voltage		V_{th}	$V_{DS} = 3\text{ V}, I_D = 0.1\text{ mA}$	0.4	—	1.1	V
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 3\text{ V}, I_D = 0.75\text{ A}$ (Note 4)	1.4	2.8	—	S
Drain-Source on-resistance		$R_{DS(ON)}$	$I_D = 0.75\text{ A}, V_{GS} = 4\text{ V}$ (Note 4)	—	140	160	m Ω
			$I_D = 0.75\text{ A}, V_{GS} = 2.5\text{ V}$ (Note 4)	—	180	220	
Input capacitance		C_{iss}	$V_{DS} = 10\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	125	—	pF
Reverse transfer capacitance		C_{rss}	$V_{DS} = 10\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	17	—	pF
Output capacitance		C_{oss}	$V_{DS} = 10\text{ V}, V_{GS} = 0, f = 1\text{ MHz}$	—	42	—	pF
Switching time	Turn-on time	t_{on}	$V_{DD} = 10\text{ V}, I_D = 0.75\text{ A}$	—	15.5	—	ns
	Turn-off time	t_{off}	$V_{GS} = 0\text{--}2.5\text{ V}, R_G = 4.7\ \Omega$	—	8.5	—	

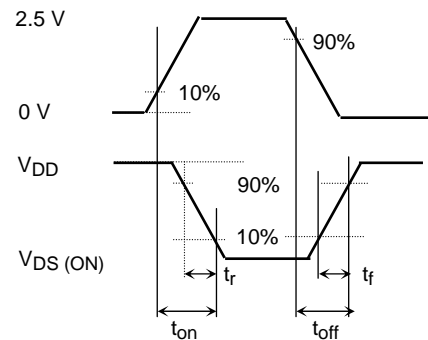
Note 4: Pulse measurement

Switching Time Test Circuit

(a) Test circuit



(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 $I_D = 100\ \mu\text{A}$ 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.

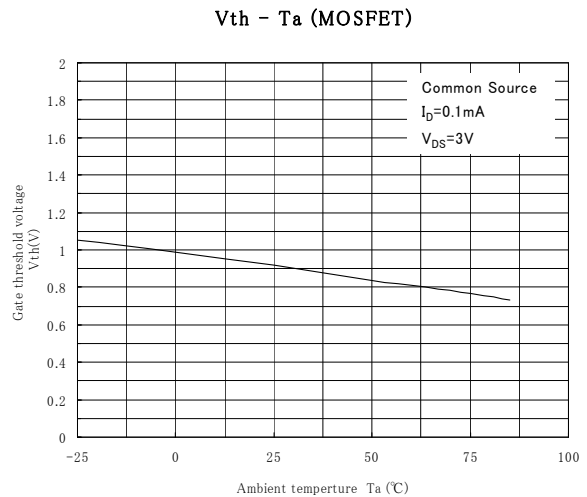
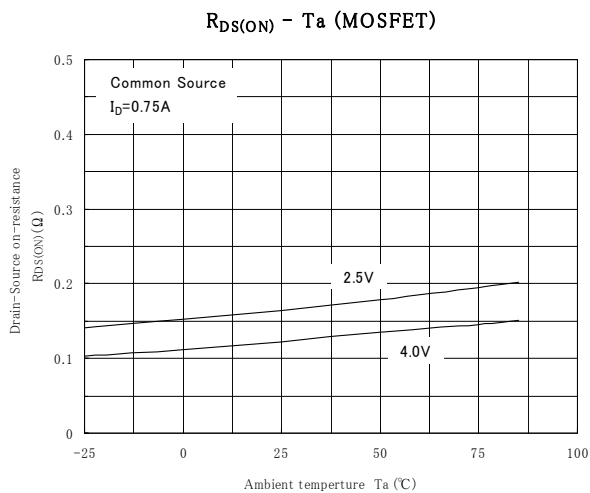
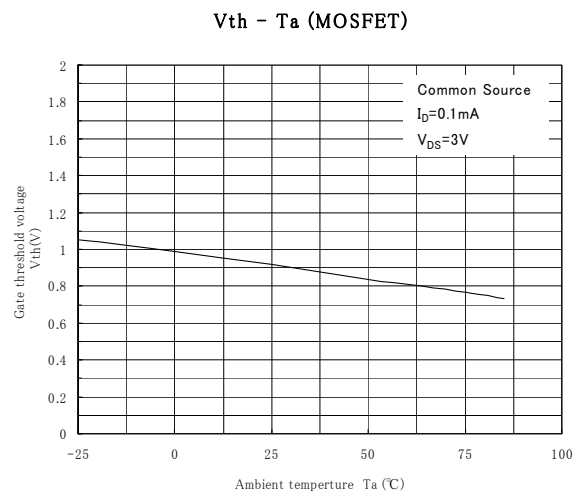
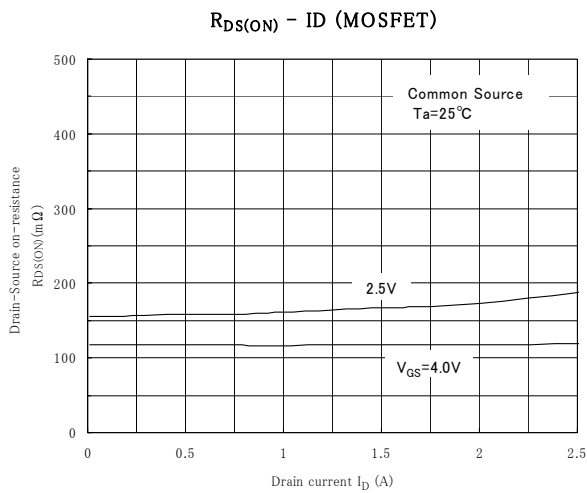
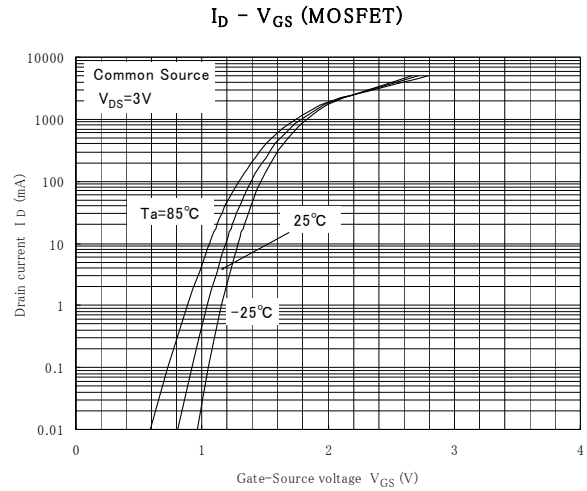
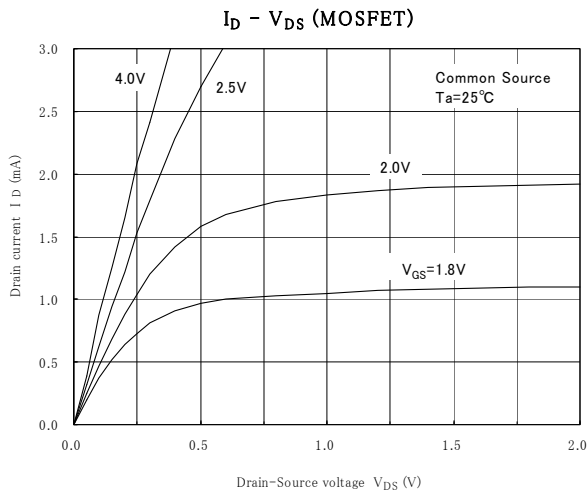
Schottky Diode**Electrical Characteristics (Ta = 25°C)**

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

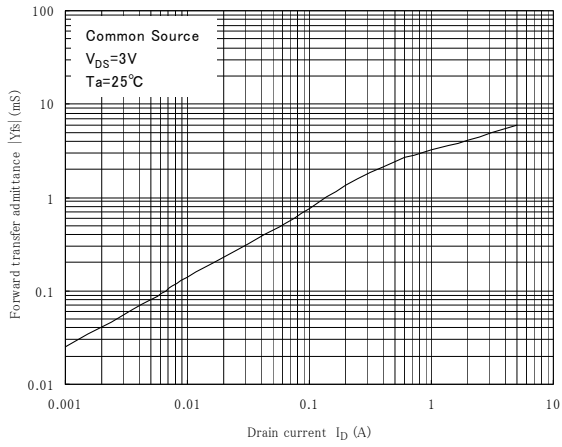
Precaution

The schottky barrier diode of this product has large reverse current leakage characteristics compared to other switching diodes. This current leakage, combined with improper operating temperature or voltage, may cause thermal runaway. Be sure to take forward and reverse loss into consideration during you design.

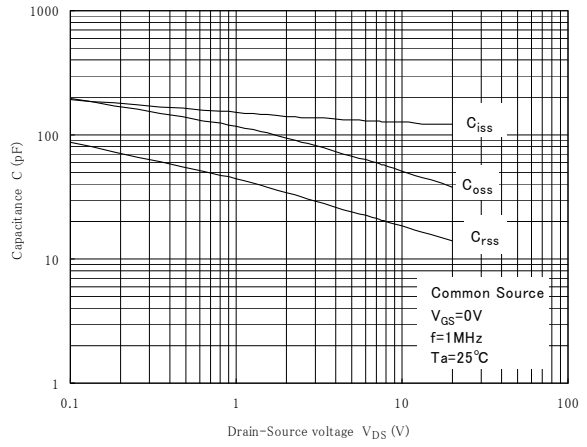
MOSFET Electrical Characteristics



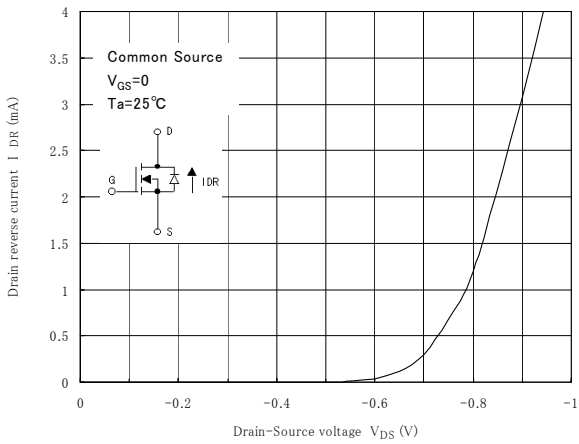
$|Y_{fs}| - I_D$ (MOSFET)



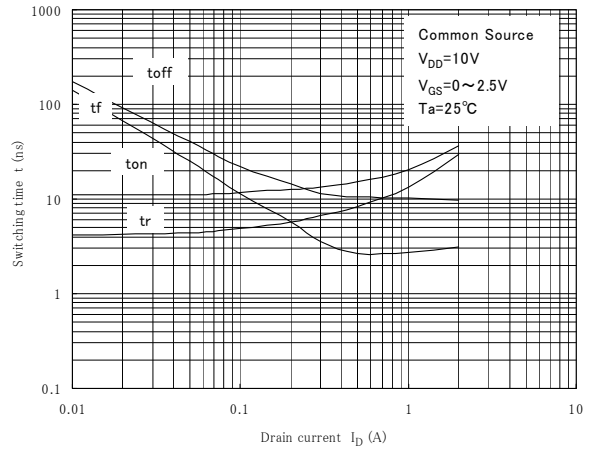
C - V_{DS} (MOSFET)



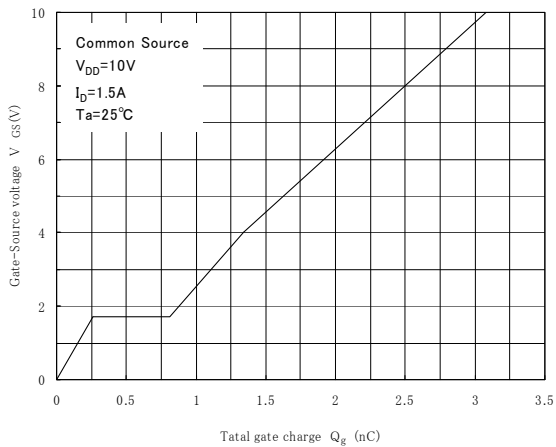
$I_{DR} - V_{DS}$ (MOSFET)



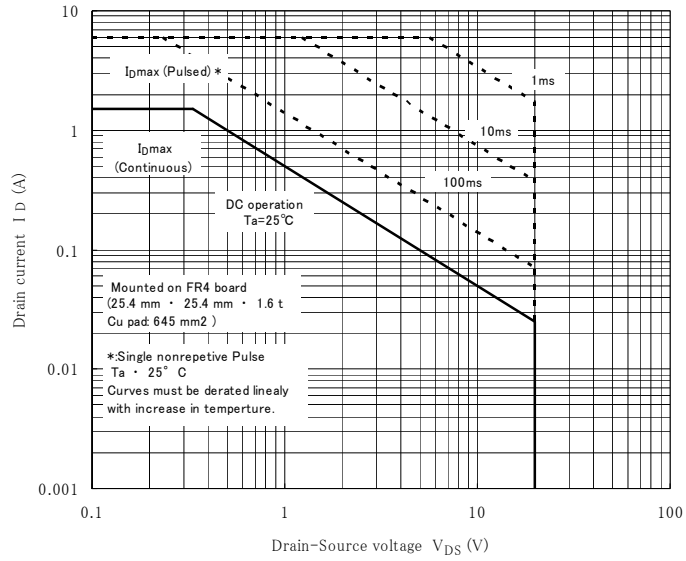
t - I_D (MOSFET)



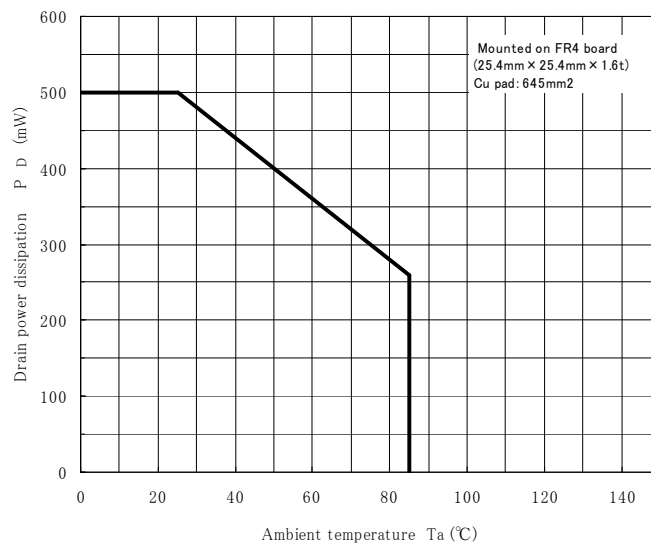
Dynamic Input Characteristic (MOSFET)



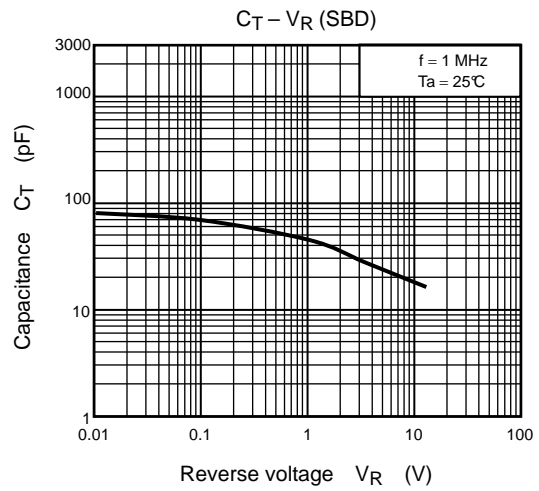
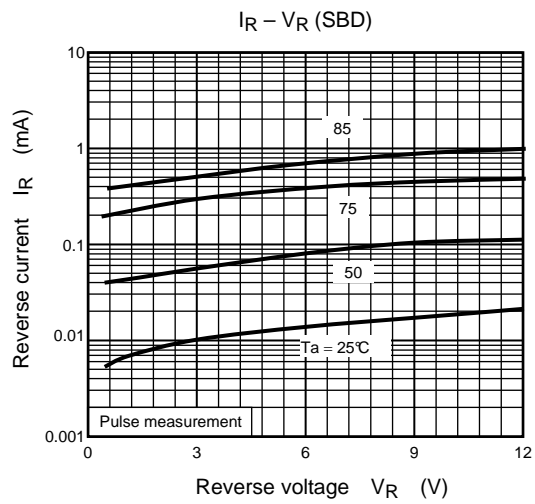
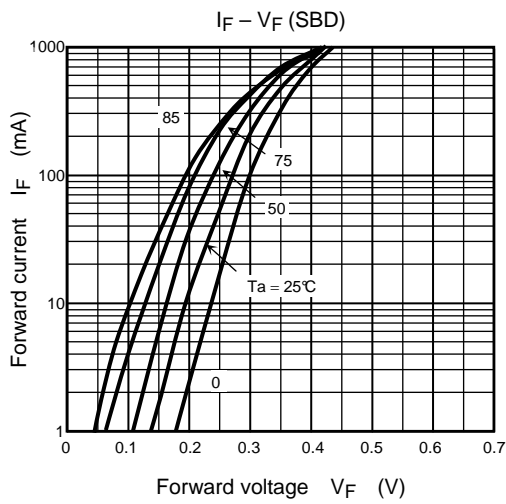
Safe operating area (MOSFET)



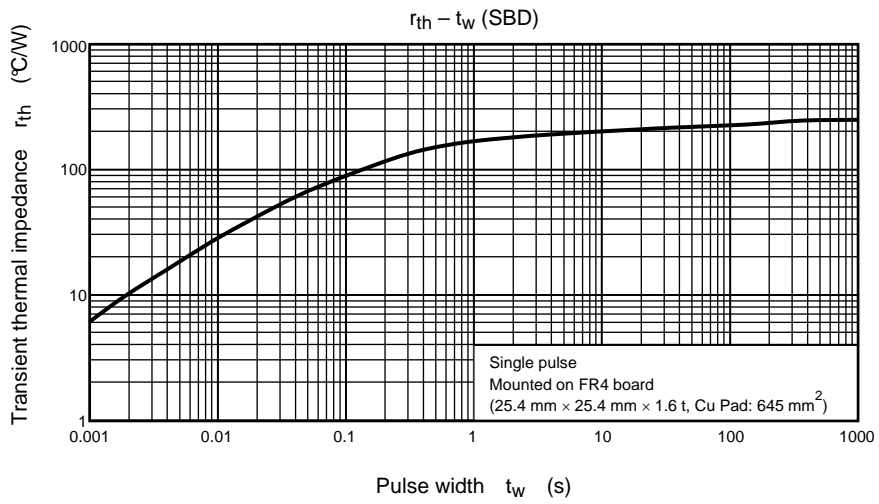
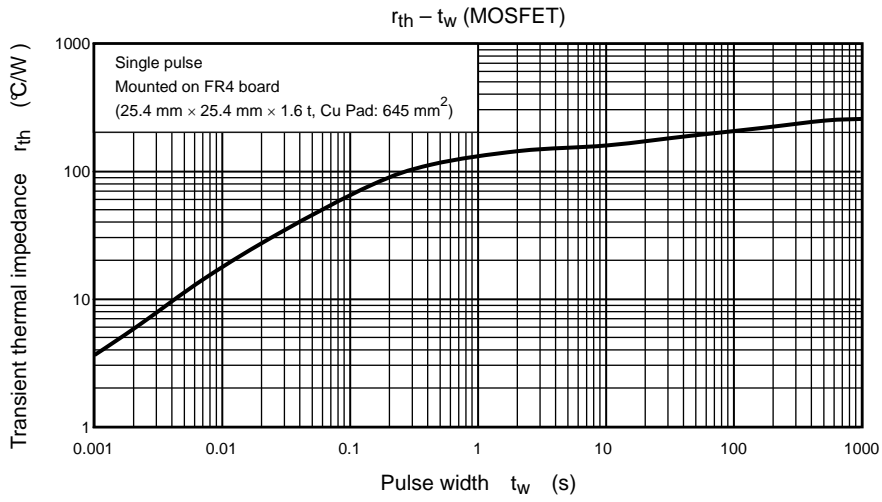
$P_D - T_a$ (MOSFET)



SBD Electrical Characteristics



Transient Thermal Impedance



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