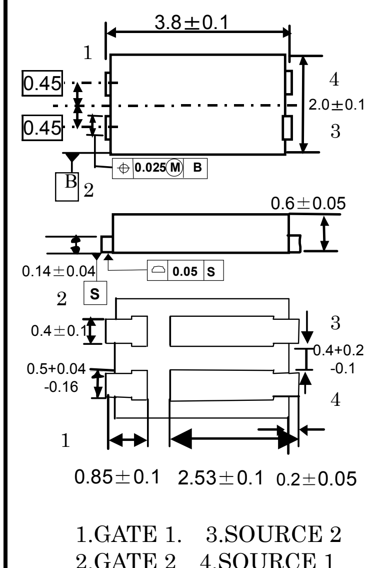
TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (U-MOSIII)

TPCT4202

Lithium Ion Battery Applications

Unit: mm

- Lead (Pb)-free
- Small footprint due to a small and thin package
- Low source-source ON-resistance: $R_{SS\ (ON)}$ = 30.5 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 15 S (typ.)
- Low leakage current: I_{SSS} = 10 μA (max) (V_{SS} = 30 V)
- Enhancement mode: V_{th} = 0.5~1.2 V (V_{SS} = 10 V, I_S = 200 μA)
- Common drain



JEDEC	―
JEITA	―
TOSHIBA	2-2S1A

Weight: 0.012 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

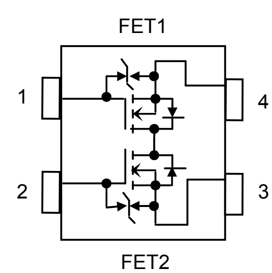
Characteristic		Symbol	Rating	Unit
Source-source voltage		V_{SSS}	30	V
Gate-source voltage		V_{GSS}	±12	V
Source current	DC (Note 1)	I_S	6	A
	Pulse (Note 1)	I_{SP}	24	
Power dissipation (t = 10 s) (Note 2a, 3)		P_D	1.7	W
Power dissipation (t = 10 s) (Note 2b, 3)		P_D	0.51	W
Single-pulse avalanche energy (Note 4)		E_{AS}	46.8	mJ
Avalanche current		I_{AR}	6	A
Repetitive avalanche energy (Note 2a, 5)		E_{AR}	0.17	mJ
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55~150	°C

Note: For Notes 1 to 5, 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).

This transistor is an electrostatic-sensitive device. Handle with care.

Circuit Configuration



⚠ WARNING

【Handling Precaution for Power MOSFET in use of Protection Circuit for Battery Pack】

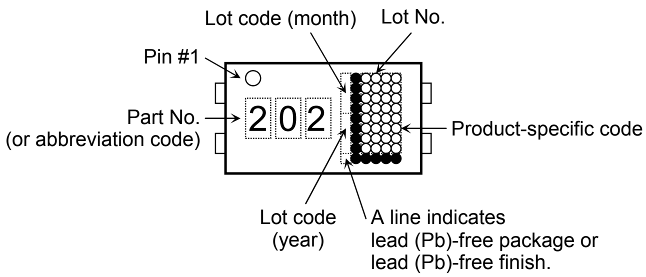
Flame-retardant resins of UL94-V0 flammability class are used in packages, however, they are not noncombustible.

Use a unit, for example PTC Thermistor, which can shut off the power supply if a short-circuit occurs. If the power supply is not shut off on the occurring short-circuit, a large short-circuit current will flow continuously, which may cause the device to catch fire or smoke. The product listed in this document is intended for usage in Lithium Ion Battery charge and discharge control application. So it is responsible for customer when using the product in the different application.

Thermal Characteristics

Characteristic	Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10 s) (Note 2a, 3)	$R_{th\ (ch\text{-}a)}$	76	°C/W
Thermal resistance, channel to ambient (t = 10 s) (Note 2b, 3)	$R_{th\ (ch\text{-}a)}$	244	°C/W

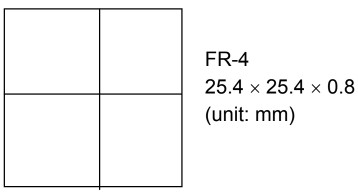
Marking (Note 6)



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

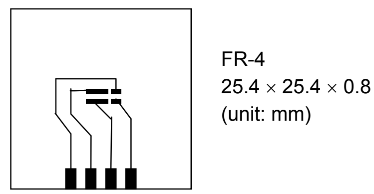
Note 2:

(a) Device mounted on a glass-epoxy board



(a)

(b) Device mounted on a glass-epoxy board



(b)

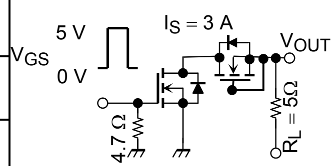
Note 3: The power dissipation and thermal resistance values are shown for both FETs.

Note 4: V_{SS} = 24 V, T_{ch} = 25°C (initial), L = 1.0 mH, R_G = 25 Ω, I_{AR} = 6 A

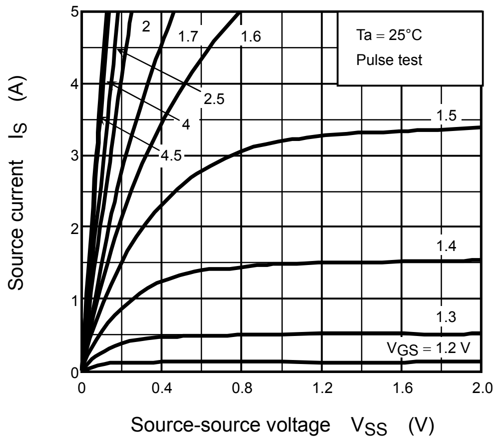
Note 5: Repetitive rating: pulse width is limited by max channel temperature.

Note 6: The circle "○" on the upper left of the marking indicates Pin 1.

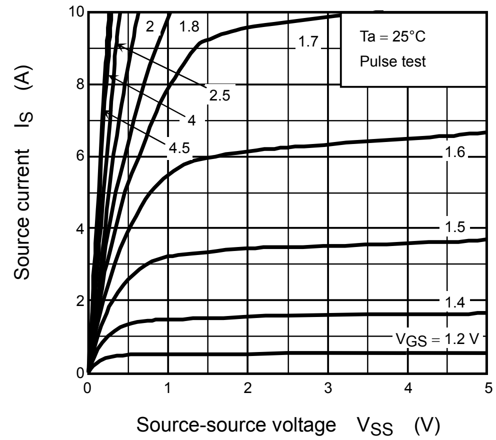
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{SS} = 0 V (Note 8)	—	—	±10	μA
Source cutoff current		I_{SSS}	V_{SS} = 30 V, V_{GS} = 0 V (Note 8)	—	—	10	μA
Source -source breakdown voltage		$V_{(BR)\ SSS}$	I_S = 10 mA, V_{GS} = 0 V (Note 8)	30	—	—	V
		$V_{(BR)\ SSX}$	I_S = 10 mA, V_{GS} = −12 V (Note 8)	15	—	—	
Gate threshold voltage		V_{th}	V_{SS} = 10 V, I_S = 200uA (Note 8)	0.5	—	1.2	V
Source -source ON-resistance		$R_{SS\ (ON)}$	V_{GS} = 2.5 V, I_S= 3 A (Note 7)	30	40	52	mΩ
			V_{GS} = 4.0 V, I_S = 3 A (Note 7)	26	32	39	
			V_{GS} = 4.5 V, I_S = 3 A (Note 7)	24	30.5	38	
Forward transfer admittance		$\|Y_{fs}\|$	Vss = 10 V, I_S = 3 A (Note 8)	7.5	15	—	S
Input capacitance		C_{iss}	V_{SS} = 10 V, V_{GS} = 0 V, f = 1 MHz (Note 8)	—	1540	—	pF
Reverse transfer capacitance		C_{rss}		—	180	—	
Output capacitance		C_{oss}		—	250	—	
Switching time	Rise time	t_r	 V_{SS} ≃ 15 V Duty ≦ 1%, t_w = 10 μs (Note 8)	—	34	—	ns
	Turn-on time	t_{on}		—	67	—	
	Fall time	t_f		—	60	—	
	Turn-on time	t_{off}		—	250	—	
Total gate charge		Q_g	V_{SS} ≃ 24 V, V_{GS} = 5 V, I_D = 6 A (Note 8)	—	21	—	nC
Gate-source charge 1		Q_{gs1}		—	3	—	
Diode (source-source) forward voltage		V_{SSF}	I_{SR} = 6 A, V_{GS} = 0 V (Note 9)	—	—	−1.2	V

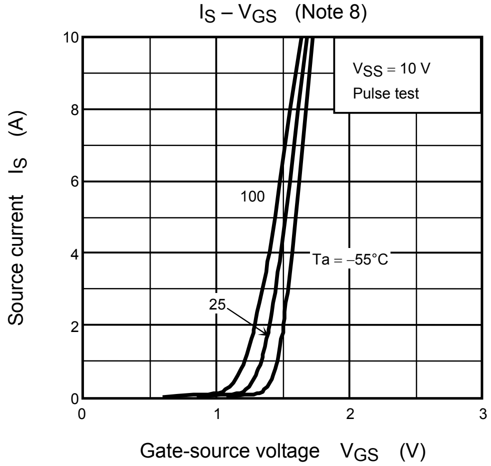
$I_S – V_{SS}$ (Note 7)



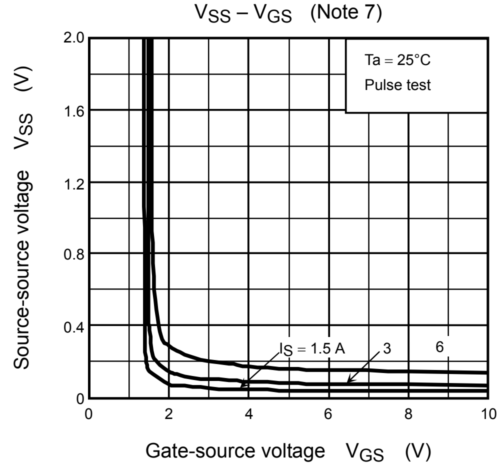
$I_S – V_{SS}$ (Note 7)



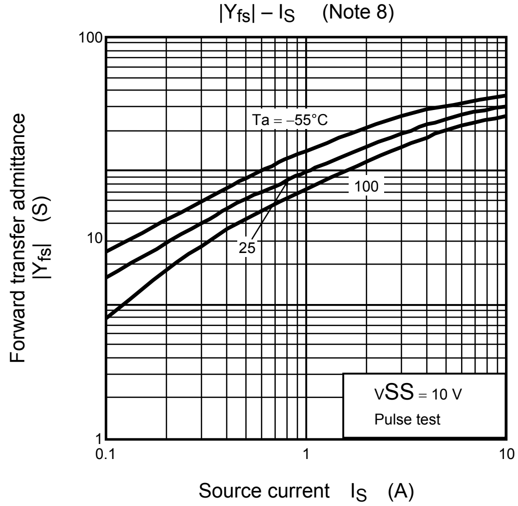
$I_S – V_{GS}$ (Note 8)



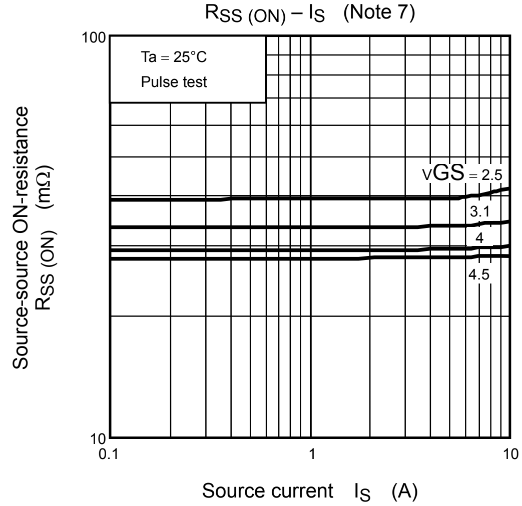
$V_{SS} – V_{GS}$ (Note 7)



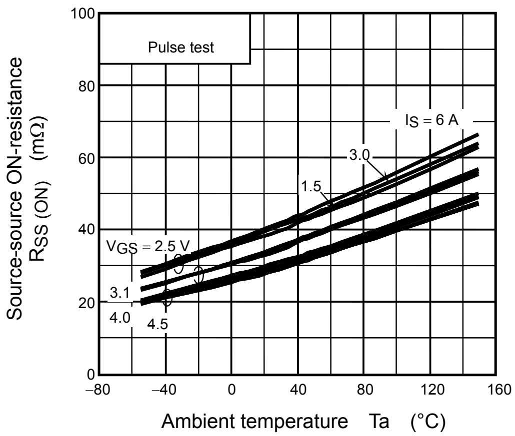
$|Y_{fs}| – I_S$ (Note 8)



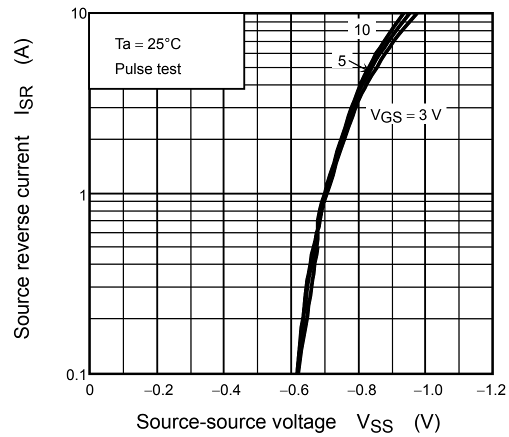
$R_{SS (ON)} – I_S$ (Note 7)



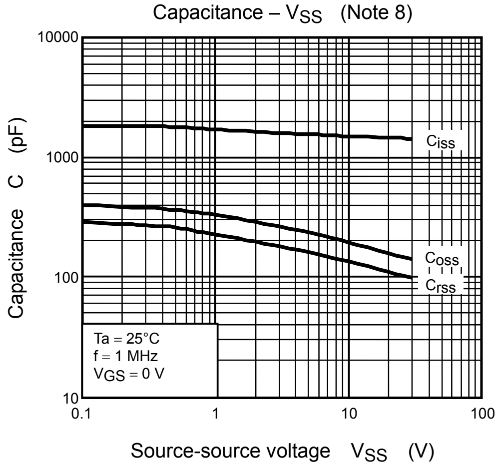
$R_{SS\ (ON)}$ – Ta (Note 7)



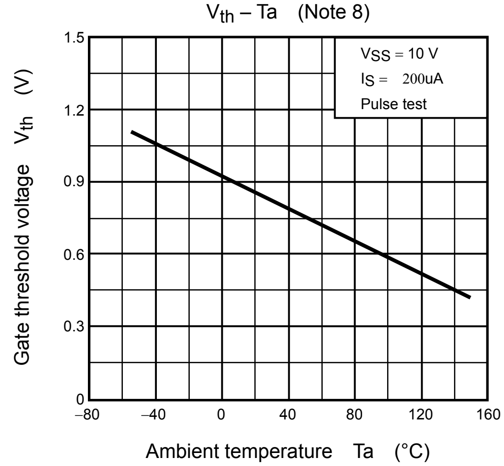
I_{SR} – V_{SS} (Note 10)



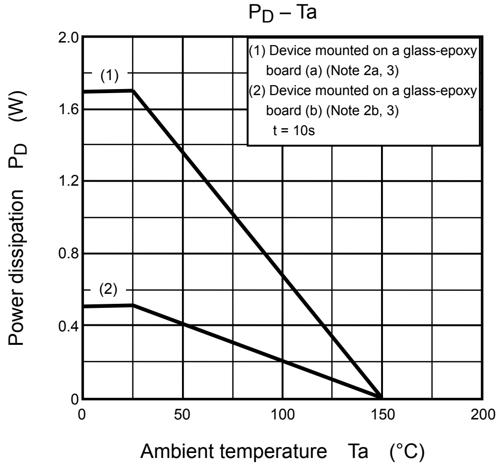
Capacitance – V_{SS} (Note 8)



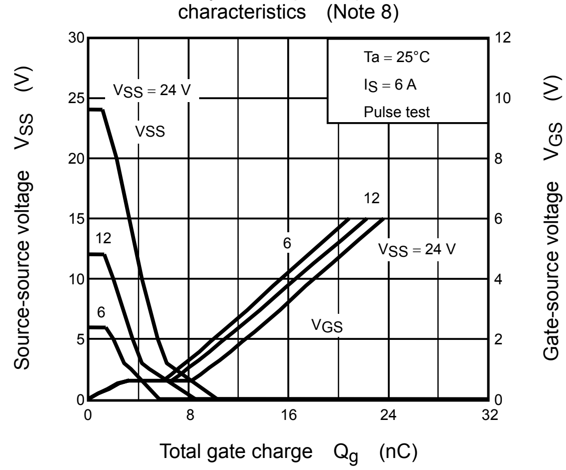
V_{th} – Ta (Note 8)

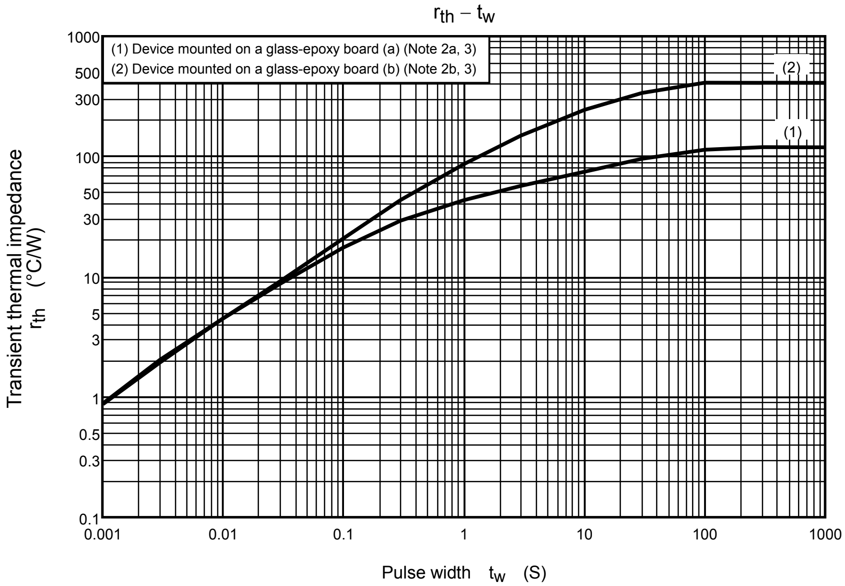


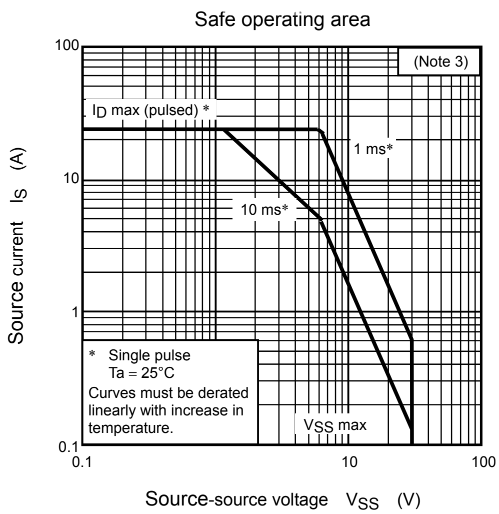
P_D – Ta



Dynamic input/output characteristics (Note 8)







Note 7: Same gate voltage (V_{GS}) is applied to Gate 1 and Gate 2.

Note 8: FET1 measurement: Gate 2 and Source 2 are shorted.

FET2 measurement: Gate 1 and Source 1 are shorted.

Note 9: FET1 measurement: 4.5V (V_{GS}) is applied to Gate 2.

FET2 measurement: 4.5V (V_{GS}) is applied to Gate 1.

Note 10: FET1 measurement: Gate 1 and Source 1 are shorted, V_{GS} is applied between Gate 2 and Source 2.

FET2 measurement: Gate 2 and Source 2 are shorted, V_{GS} is applied between Gate 1 and Source 1.

Note11: 【Mounting condition】

Please reflow within 2 times on our recommended reflow conditions on mounting this product on the substrate.
Please note that second reflow process should be done within 2 weeks after first process reflow.

【Repair soldering iron after reflow】

Repair with soldering iron should be done for end terminal no in the once.
Do not apply stress to a device during repair process by correcting or modifying its location or direction.

・Use of medium infrared ray reflow

(1) Heating the top and bottom with long or medium infrared rays is recommended. (See Figure 1.)

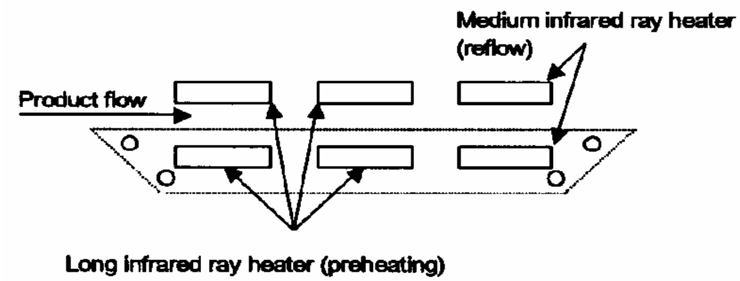


Figure 1. Heating the top and bottom with long or medium infrared rays

(2) Example of a recommended reflow temperature profile

Refer to Figure 2 for the recommended temperature profile for when Eutectic eutectic solder is used. 、Figure 3 shows the recommended temperature profile for when lead (Pb)-free solder is used.

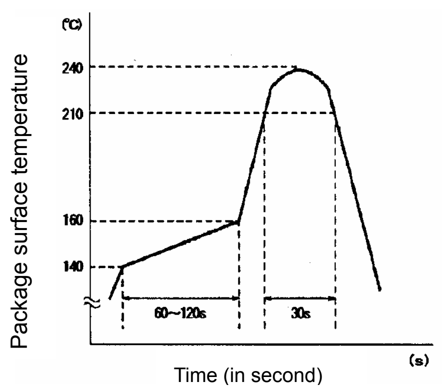


Figure 2. Eutectic recommended temperature profile

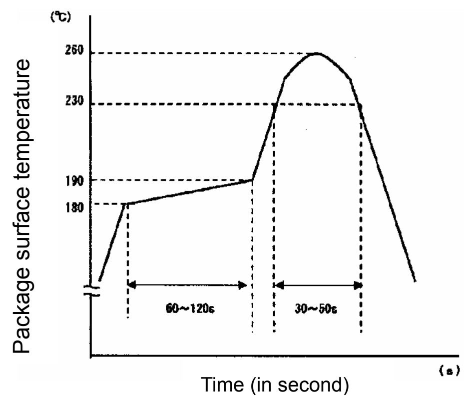


Figure 3. Lead(Pb)-free recommended temperature profile

・ Use of hot air reflow

For an example of a recommended temperature profile, refer to Figures 2 and 3.

・ Use of a soldering iron (for both eutectic lead (Pb)-free solder)

Complete soldering within ten seconds for iron temperatures of up to 260°C,or within three seconds for iron temperature of up to 350°C.
One terminal may be heated with a soldering iron no more than once.

Note12:(1) 【Element mechanical stress】

This product is very small and thin.External stress may cause breakdown of the package and/or chip, please handle this product within the distortion factor less than 2000 $\mu\varepsilon$ or equal in the shaded area shown in the figure 4.However, please confirm that there is no problem on this product embedded in your product, because the applied stress of this product may vary dependently on the substrate shape, the material, the wiring pattern, the mounting parts arrangement and so on. Moreover, please design your product with the space to protect this product on the mounting upper surface (marked side) from the stress.

The distortion factor[ε] is defined by the following expressions.

$\varepsilon = 6\,hS/(L*L)$ h: Board thickness S = Bend L = Support width

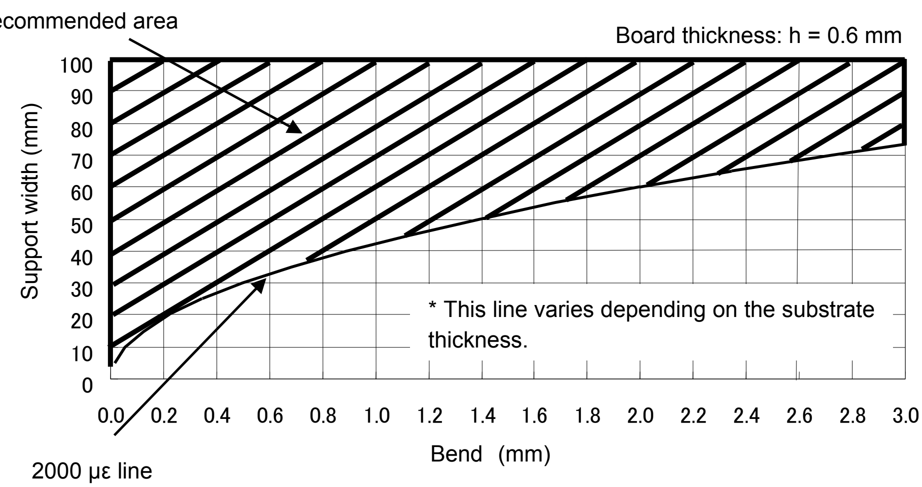


Figure 4. Support width－Bend

Examination method (reference standard JEITA ED-4702A):

The substrate on which the device is mounted is positioned with the product face down on support stands, with a distance of 31 mm between substrate fulcrums as shown in Figure 5 below. Stress is applied as shown in Figure 6.

Mounting substrate: Glass Epoxy substrate FR-4 (JIC C 6484) and size 36 X 6 mm and h = 0.6 mm

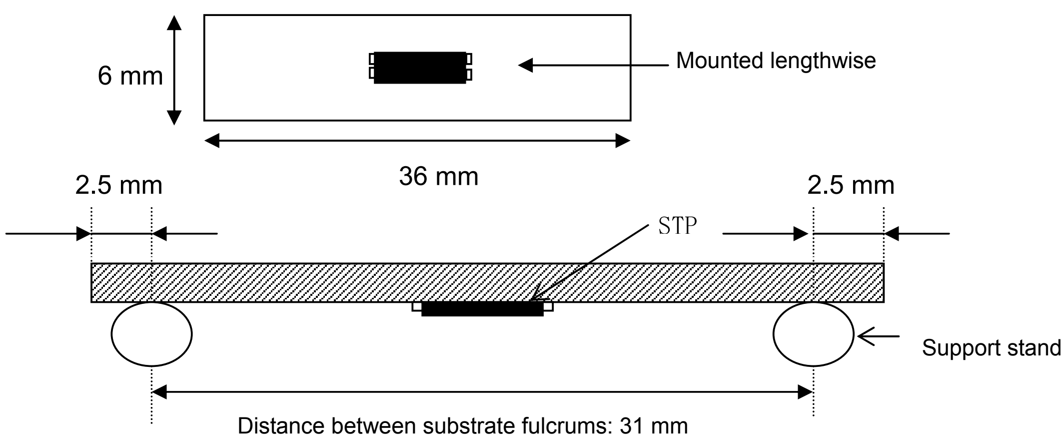


Figure 5. During substrate installation

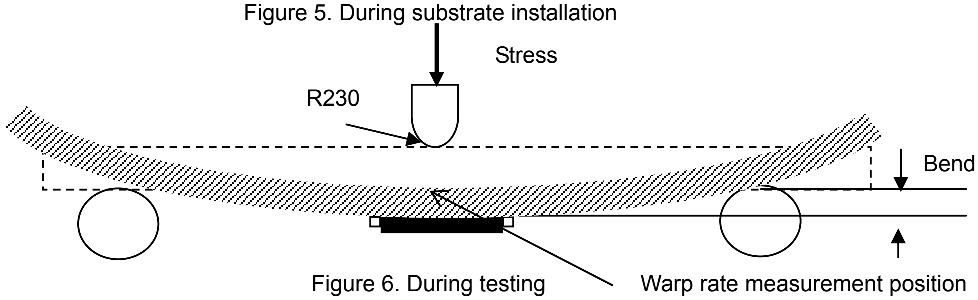


Figure 6. During testing

:(2) Please be aware that rigid printed board in actual application should be thicker than 0.4 mm.

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20070701-EN

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