Eco+PLUS® series
Lead free SOLUTIONS you can TRUST

TECHNICAL INFORMATION

No-clean Wave Soldering Flux for Lead Free Soldering

JS-EU-02

KOKI COMPANY LIMITED

1. Features

- Designed to work with Sn(Ag)(Bi)Cu lead free solders.
- Ensures excellent solderability even in normal air soldering ensuring realizing no bridging, no solder skips and complete through hole filling.
- Offers thin flux residue by the use of spray fluxer.

2. Specifications

Item		JS-EU-02	Remark
Specific gravity		0.795	JIS Z 3197:8.2.2 (20°C)
Solids content %		2.8	105°C × 5Hr
Acid value KOHmg/g		18.3	Titration
Halogen content %		0	JIS Z 3197:8.1.4.2.1 Potentiometric titration
Qualitative fluoride test		No discoloration	JIS Z 3197:8.1.4.2.4
Copper plate corrosion test		No evidence corrosion	JIS Z 3197:8.4.1
Copper mirror corrosion test		No evidence of breakthrough	JIS Z 3197:8.4.2
Water extract resistivity Ω•m		$> 2 \times 10^2$	JIS Z 3197:8.1.1
Solder spreadability %		> 75	JIS Z 3197:8.3.1.1 Solder: Sn/Ag3.0/Cu0.5
Surface insulation resistance (Ω)	Initial value	$> 1 \times 10^{13}$	After soldering (250°C×4s)
	85°C/85%RH/96Hr	$> 1 \times 10^{10}$	In constant temp./humidity oven
	85°C/85%RH/500Hr	$> 1 \times 10^{10}$	In constant temp./humidity oven
	85°C/85%RH/1000Hr	$> 1 \times 10^{10}$	In constant temp./humidity oven
	85°C/85%RH/1000Hr	$> 1 \times 10^{12}$	Out of constant temp./humidity oven
Voltage applied insulation resistance (Ω)	Initial value	$> 1 \times 10^{13}$	After soldering (250°C×4s)
	85°C/85%RH/96Hr	$> 1 \times 10^{10}$	In oven with DC50V applied
	85°C/85%RH/500Hr	$> 1 \times 10^{10}$	In oven with DC50V applied
	85°C/85%RH/1000Hr	$> 1 \times 10^{10}$	In oven with DC50V applied
	85°C/85%RH/1000Hr	$> 1 \times 10^{12}$	Out of constant temp./humidity oven
	Electromigration	No evidence of electromigration	After 1000 hours
Wettability (sec)	Polished copper plate	0.41	Meniscograph Sn/Ag3.0/Cu0.5 25mm/sec
	Polished nickel plate	0.52	

3. Specific gravity

The test shall be carried out to determine the specific gravity of liquid flux by using the float hydrometer standardized in JIS-B-7525.

Take the sample flux into a cleaned and dried glass tube and put it in a constant temperature bath of temperature 20°C.

Floating the specific hydrometer in the sample flux in the glass tube, measure the specific gravity by reading upper edge of meniscus line.

[Result]

Flux	JS-EU-02
Average	0.795

4. Solids content

The flux shall be sampled approx. 10g and weighted(W1). After heating at 105 ± 2°C for 5 hours, measure the weight again (W2).

$$\text{Solids content (wt\%)} = \frac{\text{Weight after heating (W2; g)}}{\text{Weight before heating (W1;g)}}$$

Repeat the test twice and take an average.

[Result]

Flux		JS-EU-02
n	1	2.80
	2	2.78
Average (%)		2.8

5. Acid value

This test shall be carried out to determine the acid value in the liquid flux by the manual titration method.

Put 2 gs of flux in the precision of 1/1000g into the beaker of 200ml and pour approx. 50ml of ethylalcohol/benzene solution (1:2) or isopropyl alcohol, and drop 2~3 drops of phenolhtalein indicator to obtain the sample.

Titrate it with N/2 potassium hydroxsaide/ethylalcohole standard solution until the end point is obtained, where the sample color turns to pale red from colorless and remains red for more than 30 seconds.
Conduct the blank test through the entire process and calculate the acid value.

$$\text{Acid value [KOHmg/g]} = \frac{28.5 \times (A-B) \times F}{S}$$

A : Quantity (ml) of N/2 potassium hydroxide/ethylalcohol standard solution used this test.
B : Quantity (ml) of N/2 potassium hydroxide/ethylalcohol standard solution used for blank test.
F : Factor of N/2 potassium hydroxide/ethylalcohol standard solution.
S : Quantity (g) of sample.

[Result]

Flux		JS-EU-02
n	1	18.3
	2	18.3
Average [KOHmg/g]		18.3

6. Halogen content (Chloride content)

This test shall be carried out to determine the halogen content in liquid flux by the electric potentiometric titration method.

Put approx. 5gs of flux into the beaker of 200ml and weigh it with the balance in the precision of 1/100gs and pour approx. 100ml of isopropyl alcohol to obtain the sample.

Transfer the sample to the electric potentiometric titration equipment and titrate it with 1/50N silver nitrate standard solution by stirring it with a magnetic stirrer until the end point where electric potential changes largely is determined.

Carry out the blank test through the entire process and calculate the halogen content in the flux from following formula. Repeat the test twice and take an average.

$$\text{Halogen content (\%)} = \frac{(A-B) \times 0.000709 \times f}{\text{Mass of flux (g)}} \times 100$$

A : Amount (ml) of 1/50N silver nitrate solution used for the entire test
B : Amount (ml) of 1/50N silver nitrate solution used for the blank test
0.000709 : Amount (g) of halogen corresponds to 1ml of 1/50N silver nitrate solution
f : Factor of 1/50N silver nitrate solution

$$\text{Halogen content (per solids;\%)} = \frac{\text{Halogen content obtained as above}}{\text{Solids content}} \times 100$$

[Result]

(%)

Flux		JS-EU-02
n	1	0
	2	0
Average (%)		0

7. Qualitative test for fluorides

The zirconium-alizarin purple lake test, a qualitative test for fluorides, shall be performed in accordance with the following procedure :

Prepare a fresh zirconium-alizarin lake on three sections of a white spot plate by adding one drop each of the following :

(1) a solution of 0.05g of sodium alizarin sulphonates thoroughly dissolved and mixed in 50ml of water.

(2) a solution of 0.05g of zirconium nitrate thoroughly dissolved and mixed in 50ml of weater acidified with 10ml of hydrochloric acid.

(3) Pure water

Add one drop of the solution of the flux to be tested to each of the spots. A change in color of the lake to yellow is an indication of fluoride(s) present in the flux sample.

[Result]

Flux	JS-EU-02
Result	No evidence of discoloration

8. Copper plate corrosion

Wash the surface of a copper plate of 0.5×50×50mm in size with metal abrasive, or wash and remove the oxide film.
Remove fat with acetone.
Dip in 5% sulfuric acid of 65 ± 5ºC for 1 minute, and remove oxide films.
Dip in the 250g/L ammonium persulfate of 20-25ºC for 1 minute, and etching on the surface.
Washed with a purified water, washed in the running water for 5 seconds, dip in 5% sulfuric acid of 20-25ºC for 1 minute and washed in the running water for 5 seconds again.
And washed with acetone, leave it in the air to dry completely.

Place solder (1.00±0.05g, Sn-3.0Ag-0.5Cu) and the sample as solid 0..035~0.040g on the copper plate, heat at 250°C and hold about 5 sec from melted. And cool it at room temperature to obtain the test pieces.

Put three test pieces in a thermohygrostat of temperature 40°C×95%RH for 96 hours and compare them with the reference test piece for the evidence of corrosion.

[Result]

Flux		JS-EU-02
n	1	No corrosion
	2	No corrosion
	3	No corrosion
Average		No corrosion / Passed

9. Copper mirror corrosion

This test method is designed to determine the removal effect the flux has (if any) on the bright copper mirror film which has been vacuum deposited on clear glass.

Apply by vacuum deposition, a film of copper metal on one surface of a cleaned glass sized 1.0×52×76mm specified in JIS-R-3703.

Apply a uniform thickness of approximately 50nm and assure that the finished mirror permits 10±5% transmission o normal incident light of nominal wave length of 500nm.

Place one drop of test flux on each copper mirror test panel.

Place test panels in a horizontal position in the dust free cabinet at 23±2°C and 50±5% relative humidity for 24 hours.

At the end of 24 hour period, remove the test panels and remove the test flux and control standard fluxes (isopropyl alcohol solution of 25wt% WW rosin) by isopropyl alcohol.
Carefully examine each test panel for possible copper removal or discoloration.

[Result]

Flux	JS-EU-02	WW rosin 25wt% I.P.A. solution
Result	1 (passed)	No breakthrough

Result Rank

0 : No evidence of mirror breakthrough.
1 : No evidence of mirror breakthrough , but thin at outline of test area.
2 : Breakthrough at outline of test area. (NG)
3 : Breakthrough in less than 50% of test area. (NG)
4 : Breakthrough in less more 50% of test area. (NG)

10. Resistivity of water extract

Extract the flux in purified water and carry out the test on watersoluble conductive components in the flux measuring the conductivity of the extracted water at 20°C.

Take an amount of 0.1ml flux as the sample into a cleaned and dried 100ml beaker.

Put the sample in the beaker with 50ml of purified water, then cover the beaker with a watch glass, heat and boil it for about 5 minutes, and further continue heating for about 1 minute. Cool the beaker for about 10 seconds at room temperature, put it in a water bath of about 20°C to obtain the test solution, and immediately measure the resistivity of this water solution with a conductivity meter.

The cell of 0.1 cell constant shall be used.

The purified water to use shall have more than $5\times10^{3}\Omega\bullet$ m of specific resistance.

The test shall be made 3 times and take the mean value.

[Result]

Flux		JS-EU-02
N	1	2.9×10^2
	2	2.7×10^2
	3	2.7×10^2
Average (Ω• m)		2.8×10^2

*Control standard (without flux) : 5.6×10^3 Ω• m

11. Solder spreadability

Solder powder: Sn96.5, Ag3.0, Cu0.5

Test plate : Use as test plate a phosphor deoxidized copper plate specified in JIS-H-3100, 0.3×50×50mm in size polished by #600 abrasive paper with alcohol dropped and washed by alcohol, subject it to oxidizing treatment in electric furnace maintained at about 150°C for 1 hour.

Test method : Place the solder powder on the test plate, and drop 0.05g of the flux. Then, heat it at 250±5°C on the solder bath and melt it for about 30 sec. After reaching the said temperature, spread the solder over the plate.

After cooling it at ordinary temperature, remove the residual flux with alcohol, and measure the height of solder by a hygrometer and calculate the rate of spread from the following formula :

$$S = \frac{D - H}{D} \times 100$$

S : Rate of solder spreading ..... (%)
H : Height of spread solder ..... (mm)
D : Diameter when the solder used is assumed to be as sphere..... (mm)

$D = 1.2407 \times (\text{weight of solder/specific gravity of solder})^{1/3}$

[Result]

Flux		JS-EU-02
n	1	76.9
	2	77.1
	3	78.1
	4	78.1
	5	78.5
Average (%)		77.7

12. Insulation resistance

As a test piece, use the comb type electrode of the glass fiber-based copper-clad, epoxy resin GE-3 and GE-4, both specified in JIS-C-6480.

*Test piece = Comp-Down, Un-Cleaned (J-STD-004A)

After cleaning with alcohol and thoroughly drying the surface, uniformly apply a specific quantity (0.10ml) of flux onto the electrode and solder at flow-soldering machine. solder a lead wire onto each terminal to obtain the test piece.

*Test piece = Comp-Up, Un-Cleaned (IPC J-STD-004A)

After cleaning with alcohol and thoroughly drying the surface, uniformly apply a specific quantity (JIS type II=0.05ml) of flux onto the electrode and dry it at flow-soldering machine (coupons shall be wave soldered pattern side up). solder a lead wire onto each terminal to obtain the test piece.

***Soldering condition**

Soldering temperature :	100°C *at soldering side. 60sec
Solder used :	Sn3.0Ag0.5Cu
Solder temperature :	255°C ± 2°C
Soldering environment :	Air

Prepare three pieces of the above test piece and measure the insulation resistance under the above specified condition.

Put all the test pieces in a thermohygrostat and connect each lead wire with the terminals outside of the thermohygrostat.

Raise the temperature to a specific temperature first, then increase the humidity up to a specific humidity.

After a specific time,

(1) Measure the insulation resistance keeping the test pieces in the thermohygrostat

(2) Take the test pieces out of the thermohygrostat, and measure the insulation resistance under the normal temperature and humidity.

Voltage to apply shall be DC100V.

Measurement shall be conducted at 4 points between each terminal pair per test piece and be expressed as a mean value.

* Test conditions : 85°C × 85%RH × 1000 hours

[Result]

Time	Place measured	n	Comp-Down (Soldering)	Comp-Up (Dry)
Initial value	Out of thermohygrostat	1	8.3×10^{13}	6.9×10^{13}
		2	6.4×10^{13}	9.8×10^{13}
		3	1.2×10^{14}	4.5×10^{13}
	Average (Ω)		8.6×10^{13}	6.7×10^{13}
24 hours	In thermohygrostat	1	1.0×10^{11}	2.6×10^{11}
		2	7.1×10^{10}	1.3×10^{11}
		3	6.4×10^{10}	8.8×10^{10}
	Average (Ω)		7.7×10^{10}	1.4×10^{11}
96 hours	In thermohygrostat	1	1.4×10^{11}	2.9×10^{11}
		2	8.9×10^{10}	2.2×10^{11}
		3	8.5×10^{10}	2.6×10^{11}
	Average (Ω)		1.0×10^{11}	2.6×10^{11}
168 hours	In thermohygrostat	1	2.2×10^{11}	3.8×10^{11}
		2	1.0×10^{11}	2.6×10^{11}
		3	9.8×10^{10}	3.1×10^{11}
	Average (Ω)		1.3×10^{11}	3.1×10^{11}
500 hours	Out of thermohygrostat	1	3.6×10^{11}	3.9×10^{11}
		2	1.9×10^{11}	3.1×10^{11}
		3	1.3×10^{11}	3.7×10^{11}
	Average (Ω)		2.1×10^{11}	3.6×10^{11}
1000 hours	Out of thermohygrostat	1	4.9×10^{11}	4.2×10^{11}
		2	2.7×10^{11}	3.9×10^{11}
		3	2.6×10^{11}	5.8×10^{11}
	Average (Ω)		3.3×10^{11}	4.6×10^{11}
1000 hours	Out of thermohygrostat	1	4.2×10^{13}	4.1×10^{13}
		2	6.5×10^{13}	5.2×10^{13}
		3	7.3×10^{13}	4.1×10^{13}
	Average (Ω)		5.8×10^{13}	4.4×10^{13}

13. Voltage applied insulation resistance

As a test piece, use the comb type electrode of the glass fiber-based copper-clad, epoxy resin GE-3 and GE-4, both specified in JIS-C-6480.

*Test piece = Comp-Down, Un-Cleaned (J-STD-004A)

After cleaning with alcohol and thoroughly drying the surface, uniformly apply a specific quantity (0.10ml) of flux onto the electrode and solder at flow-soldering machine. solder a lead wire onto each terminal to obtain the test piece.

*Test piece = Comp-Up, Un-Cleaned (IPC J-STD-004A)

After cleaning with alcohol and thoroughly drying the surface, uniformly apply a specific quantity (JIS type II=0.05ml) of flux onto the electrode and dry it at flow-soldering machine (coupons shall be wave soldered pattern side up). solder a lead wire onto each terminal to obtain the test piece.

***Soldering condition**

Soldering temperature :	100°C *at soldering side. 60sec
Solder used :	Sn3.0Ag0.5Cu
Solder temperature :	255°C ± 2°C
Soldering environment :	Air

Prepare three pieces of the above test piece and measure the insulation resistance under the above specified condition.

Put all the test pieces in a thermohygrostat and connect each lead wire with the terminals outside of the thermohygrostat.

Raise the temperature to a specific temperature first, then increase the humidity up to a specific humidity, and apply DC50V.

After a specific time,

(1) Measure the insulation resistance keeping the test pieces in the thermohygrostat.

(2) Take the test pieces out of the thermohygrostat, and measure the insulation resistance under the normal temperature and humidity.

Voltage to apply shall be DC100V for the measurement.

Measurement shall be conducted at 4 points between each terminal pair per test piece and be expressed as a mean value.

* Test conditions : 85°C×85%RH×100 hours voltage applied 50V

[Result]

Time	Place measured	n	Comp-Down (Soldering)	Comp-Up (Dry)
Initial value	Out of thermohygrostat	1	9.5×10^{13}	9.5×10^{13}
		2	1.1×10^{14}	9.9×10^{13}
		3	3.2×10^{13}	5.5×10^{13}
	Average (Ω)		7.0×10^{13}	8.1×10^{13}
24 hours	In thermohygrostat	1	1.7×10^{11}	2.6×10^{11}
		2	9.8×10^{10}	2.3×10^{11}
		3	3.4×10^{10}	2.4×10^{11}
	Average (Ω)		8.2×10^{10}	2.3×10^{11}
96 hours	In thermohygrostat	1	2.6×10^{11}	2.6×10^{11}
		2	8.0×10^{10}	2.8×10^{11}
		3	6.1×10^{10}	2.7×10^{11}
	Average (Ω)		1.1×10^{11}	2.7×10^{11}
168 hours	In thermohygrostat	1	3.6×10^{11}	3.6×10^{11}
		2	2.3×10^{11}	3.6×10^{11}
		3	1.0×10^{11}	3.6×10^{11}
	Average (Ω)		2.0×10^{11}	3.6×10^{11}
500 hours	In thermohygrostat	1	9.2×10^{11}	7.8×10^{11}
		2	5.6×10^{11}	8.1×10^{11}
		3	2.2×10^{11}	7.1×10^{11}
	Average (Ω)		4.8×10^{11}	7.7×10^{11}
1000 hours	In thermohygrosta	1	7.4×10^{11}	7.6×10^{11}
		2	4.7×10^{11}	8.1×10^{11}
		3	2.7×10^{11}	7.3×10^{11}
	Average (Ω)		4.6×10^{11}	7.7×10^{11}
1000 hours	Out of thermohygrostat	1	5.1×10^{13}	5.5×10^{13}
		2	4.4×10^{13}	4.9×10^{13}
		3	1.8×10^{13}	5.3×10^{13}
	Average (Ω)		3.4×10^{13}	5.2×10^{13}
1000 hours Observation of electromigration		1	No electromigration	No electromigration
		2	No electromigration	No electromigration
		3	No electromigration	No electromigration
	Average (Ω)		No electromigration	No electromigration

14. Wetting (Meniscograph)

Test plate : Use as test plate a phosphor deoxidized copper plate and a nickel plate, 0.2×7×30mm in size polished by #600 abrasive paper with alcohol dropped and washed by alcohol.

Condition :
- Solder temperature : 250 ± 2°C
- Dipping depth : 2mm
- Dipping speed : 25mm/sec.
- Dipping time : 10 sec.
- Solder composition : Sn96.5, Ag3.0, Cu0.5

[Result]

Item		Samples			
		Polished copper plate		Polished nickel plate	
		Wetting speed (sec.)	Tensile strength H_{Max} (mN/m)	Wetting speed (sec.)	Tensile strength H_{Max} (mN/m)
n	1	0.40	370	0.44	285
	2	0.41	374	0.47	213
	3	0.41	375	0.53	172
	4	0.42	382	0.56	145
	5	0.41	362	0.58	94
Average		0.41	373	0.52	182

15. Soldering test

1) Spray condition

Amount applied : 1.0 ml/board (on board)

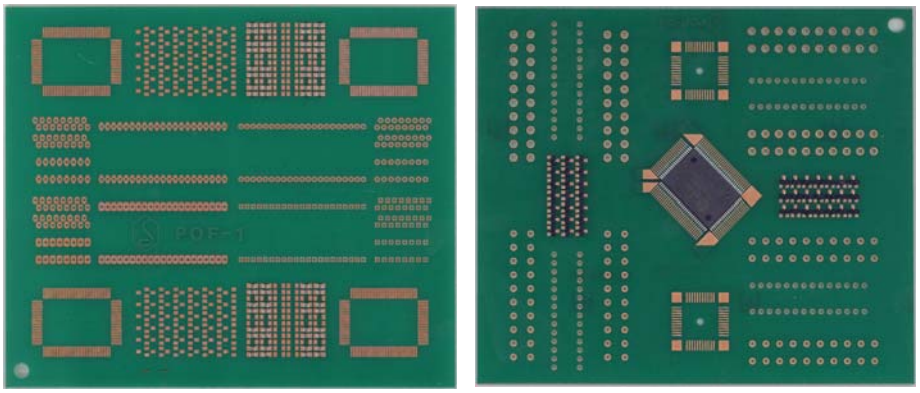
2) Soldering condition

Soldering temperature : 100°C *at soldering side.
Conveyor speed : 1.2m/min.
Conveyor angle : 4.5°
Solder used : Sn3.0Ag0.5Cu
Solder temperature : 255°C ± 2°C
Soldering environment : Air

3) General test board (110×130×1.6t mm)

Transistor SOT23 × 45
1.0mm pitch connector × 2 pcs.
1.8mm pitch/40-pin IC socket × 1
Condenser Chip 0805 (mm size: 2125) × 16

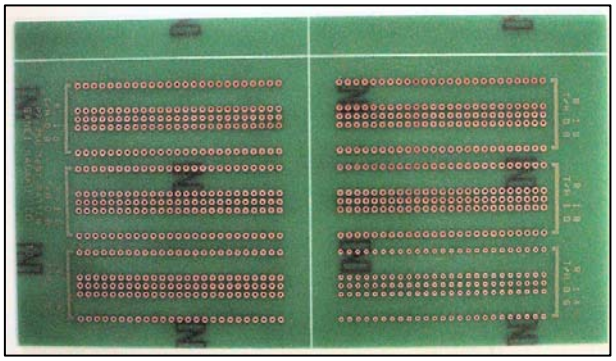
OSP treated.



4) Through hole-fill test board (90×200×1.6t mm)

Pad diameter: 1.8mm × through hole diameter: 0.8mm × 500 points
Pad diameter: 1.8mm × through hole diameter: 1.0mm × 125 points
Pad diameter: 1.4mm × through hole diameter: 0.6mm × 125 points

OSP treated.



5) Heat preconditioning

Reflow × 1 time (Soldering took place 24 hours after reflow.)

Reflow condition (Temperature profile for Pb free solder paste)

a. Hot air convection

b. Pre-heat Ramp-up tenp. 2.5°C/sec

c. Pre-heat temp.: 150~190°C × 110sec.

d. Peak temp. : 236°C (over 220°C × 48sec.)

6) Number of test board : 5 pcs. per each flux

Test result

1) General board

*No. of defects (pc.)

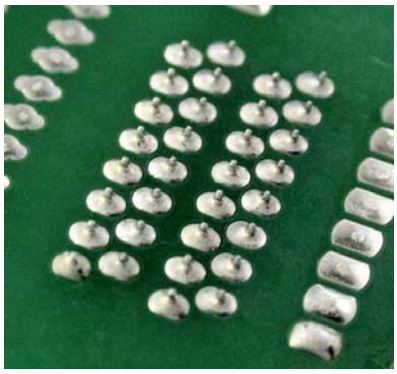
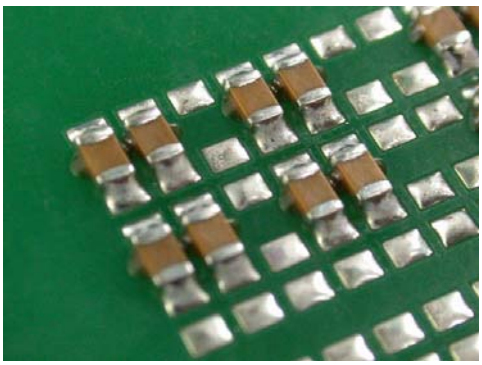
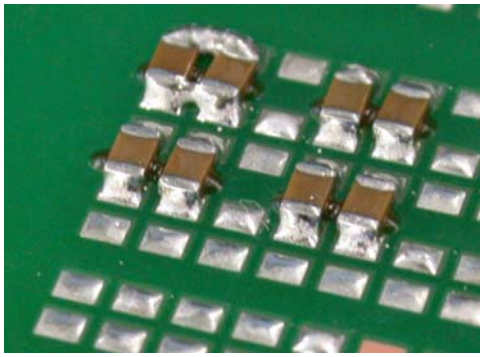
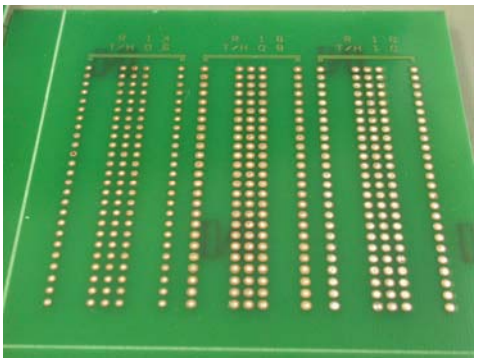
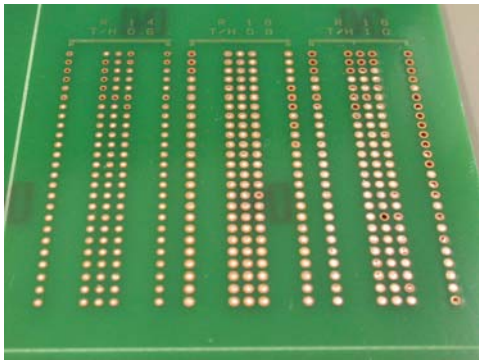
I t e m		JS-EU-02	Our old product
Bridge	Connecter	0	1
	IC socket	0	0
	Transistor	0	0
	Chip C0805	3	6
	TOTAL	**3**	**7**
Non-wetting	Transistor	0	2
	Chip C0805	0	0
	TOTAL	**0**	**2**
Solder Ball	Connecter	20	24
	Transistor	25	29
	TOTAL	**45**	**53**

2) Through hole-fill test board *Fill rate (%)

		JS-EU-02	Our old product
Through Hole-fill	Rank 1	1.8	33.9
	Rank 2	76.6	44.6
	Rank 3	21.6	11.5

*Assessment table

Rank	Assessment criteria	
	Filling condition in through hole	Spreading of solder on top pad.
1	Solder has failed to fill up to top of hole.	— —
2	Solder has reached to top of hole.	No solder has spread.
3	Solder has reached to top of hole.	Solder has spread.

	JS-EU-02	**Competitive product**
Connecter		
Condenser Chip 0805		
Through hole		

16. Recommended soldering conditions

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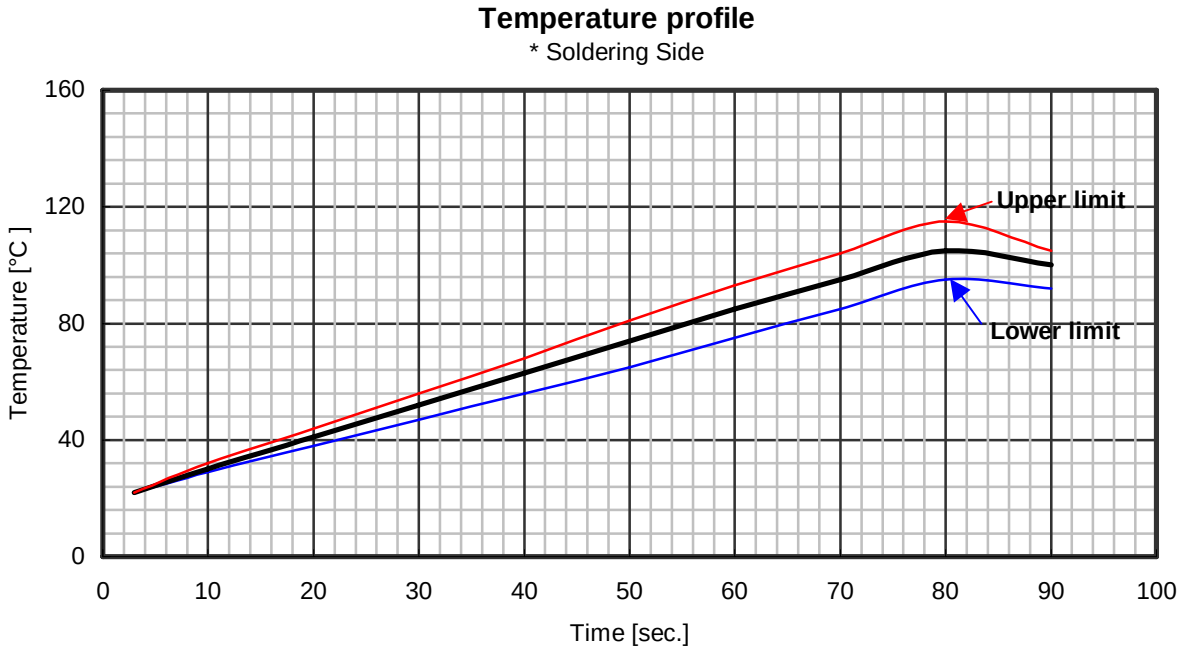
- Solder : SnAgCu or SnCu
- Conveyor speed : 1.0 - 1.8m/min
- Conveyor angle : 3 - 6 degrees
- Pre-heat temp. : 100 - 110°C at soldering side
- Solder temp. : 250 - 260°C
- Dip time. : 5 - 7 sec (total time of first and 2nd wave)



17. Shelf life

- 3 months after opening.
- 1 year without opening after manufacturing time.

18. Package

- 10 liter / poly can
- 20 liter / poly can