





Introduction

It is said that the production of electronic equipment starts from the joint and ends at the joint. Modern electronic equipment has evolved towards more microscopic and higher-density components. As a result of this trend, various connecting methods have been developed. However, soldering remains the most popular means of basic jointing.

The history of soldering goes back some 5,000 years ago, but fundamental soldering has always been the Sn-Pb series solder that consists of tin and lead. However, lead pollution in groundwater has been recognized as an environmental problem and complete elimination of the use of lead is called for.

Realizing that protection of our environment is our task in the 21st century, SMIC has earnestly extended our research in this area and developed Lead-Free solder "ECO SOLDER." Please contact for any problem that relates to Lead-Free soldering. We are thoroughly prepared to introduce a Lead-Free soldering system as we have a comprehensive technology base and have constructed support systems in various phases.

ECO SOLDER

Lead-Free ECO SOLDER developed by SMIC offers high soldering reliability compared with the Sn-Pb series solder of the past and is available in a wide product lineup according to the required soldering temperature.

Product availability may be limited for certain alloy compositions. Please select the appropriate product from the ECO SOLDER Products Guide at right.

* Please inquire about these items.

* 1 : JP PAT No. 3027441, US PAT No. 552762
* 2 : US PAT No. 4879096, CN PAT No. 1299471
* 3 : JP PAT No. 3027441, US PAT No. 5405577
* 4 : US PAT No. 5320272



Comparison of typical Lead-Free alloy M705 and Sn63 characteristics

Item	Alloy composition	Melting temperature (°C)	Tensile strength (MPa)	Elongation (%)	Young's modulus (GPa)	Specific gravity
M705	Sn-3.0Ag-0.5Cu	217~220	53.5	46	41.6	7.4
Sn63	Sn-37Pb	183	56	56	25.8	8.4

ECO SOLDER Products Guide

Itom	Alloy composition	Temp.(℃) Solidus line / Liquidus line		Form				Pomarka	
item	(wt%)			Bar	Wire	Flux Cored	Ball	Paste	nemarks
	M-series Soli	dus line t	emp. 200	to 25	0℃				
M10	Sn-5.0Sb	240	243						
M12	Sn-0.7Cu-0.3Sb	227	229						
M20	Sn-0.75Cu	22	27					*	
M30	Sn-3.5Ag	2	21						
M31	Sn-3.5Ag-0.75Cu	217	219						※ 1
M34	Sn-1.0Ag-0.5Cu	217	227						
M35	Sn-0.7Cu-0.3Ag	217	227					*	
SA2515	Sn-2.5Ag-1.0Bi-0.5Cu	214	221						*2
M41	Sn-2.0Ag-0.5Cu-2.0Bi	211	221					*	*2
M42	Sn-2.0Ag-0.75Cu-3.0Bi	207	218					*	×2
M51	Sn-3.0Ag-0.7Cu-1.0In	214	217						
M706	Sn-3.0Ag-0.7Cu-1Bi-2.5In	204	215						
M702	Sn-3.0Ag-0.7Cu	217	219			*			* 1
M704	Sn-3.35Ag-0.7Cu-0.3Sb	218	220						*3
M705	Sn-3.0Ag-0.5Cu	217	220						※ 1
M707	Sn-2.0Ag-0.5Cu	217	223						
DY Alloy	Sn-1.0Ag-4.0Cu	217	353					*	
M33	Sn-2.0Ag-6.0Cu	217	380					*	
	L-series Solid	dus line te	emp. unde	er 200	℃				
L11	Sn-8.0Zn-3.0Bi	190	197						
L20	Sn-58Bi	1;	39						
L21	Sn-2.0Ag-0.5Cu-7.5Bi	189	213						
L23	Sn-57Bi-1.0Ag	138	204						※ 4



Solder Paste

Solder paste is prepared by kneading solder powder and solder flux and is used for surface mounting PC boards. SMIC solder paste is a combination of solder powder without oxidation in a uniform particle size and flux with excellent chemical stability. Our paste features excellent properties such as high reliability, good preservation stability, excellent solderability, and low generation of microscopic solder ball.

SMIC solder paste is available in print type and dispenser type according to the form of discharge. Also the RA type and RMA type are available. Solder paste is available in normal type, low-residue type and water-soluble type to match the flux residue and cleaning method for various applications.

ECO SOLDER Paste

Lead-Free ECO SOLDER Paste developed by SMIC is a next-generation solder paste that meets environmental requirements. Compared with existing solder paste, ECO SOLDER Paste solves various Lead-Free problems such as preservation stability, supply stability, solder wettability, and heat resistance resulting from the higher melting point.

221BM5 Series Solder Paste

A modified version of our standard Sn-Pb series solder paste 221CM5 for Lead-Free soldering, the 221BM5 series provides excellent printability over extended continuous printing, improved wettability and heat resistance^{*}.

RVM Series Solder Paste

With heat resistance and heating slump property that excel over our solder pastes, the RVM series exhibits exceptional heat resistance^{*} and generates virtually no capillary ball.

*Heat-resistance Lead-Free solder has a relatively higher melting point than Sn-Pb series solder. For reflow soldering, this means high preheat temperature can be maintained to minimize PWB's Δ T.



Print results of ECO SOLDER Paste M705-221BM5-32-11



Heat-resistance* of ECO SOLDER Paste



RVM Series

Solder powder form [M705]



36 μ m to 25 μ m

Typical products of ECO SOLDER Paste

Reflow condition : 190°C / 2 min preheat, Peak: 235°C

Non-heat-resistant product

Products Factor	221BM5	RVM	Remarks / test method
Alloy	M705, N	Ideal for various alloy types	
Flux content	11%	11%	The amount can be modified
Halogen content	0.025%	0.05%	JIS-Z-3197
Powder grain size	#42 (25 to 45 μ m),	#32 (25 to 36 μ m)	Finer grain size is available
Viscosity	190 Pa.S	200 Pa.S	JIS-Z-3284
Feature	Good printability	High heat-resistance	_



Flux

Flux chemically removes oxide film from the metal surface to be soldered, thereby exposing the solderable metal surfaces. Flux is therefore indispensable in all soldering processes, including soldering of PC boards and special metals. It requires high reliability and soldering properties that match the application. SMIC has long experience in developing various types of flux, including PC board flux, all of which provide unrivaled performance.

SPARKLE FLUX ES SERIES

ES series Sparkle Flux is a post-flux developed for the Lead-Free soldering of PC boards. Lead-Free solder has rather poor solder wettability compared with existing Sn-Pb solder. However, solder bridges, icicles, blow holes and other problems in Lead-Free soldering can be reduced to a level equivalent to those of existing Sn-Pb solders with the use of the ES series Sparkle Flux.

SPARKLE FLUX ESR SERIES

ESR series Sparkle Flux is a highly reliable post-flux. If existing flux for Sn-Pb soldering is used for Lead-Free soldering, a large number of solder bridges, icicles and blow holes may be generated. ESR series Sparkle Flux exhibits the highest degree of wettability among RMA type fluxes and produces excellent soldering results.



Properties of Post-Flux

SPARKLE FLUX ES SERIES

Physical property Products	Solid content	Chroline content	Specific gravity (20°C)	Remarks
ES-1060	15%	0.07%	0.822	Standard item Ideal for through-hole PWBs
ES-1040S	14%	0.08%	0.818	Ideal for one-sided PWBs
ES-1020-9B	9%	0.06%	0.808	Low solid content type

SPARKLE FLUX ESR SERIES

Physical property Products	Solid content	Chroline content	Specific gravity (20°C)	Remarks
ESR-250	15%	0.015%	0.820	RMA type, standard item
ESR-213	13.5%	0.015%	0.818	RMA type, low residue

Comparison of Wettability in Lead-Free Soldering and Zero-cross Time (by Temperature)



Recommended soldering conditions

Flux application

Flux must be applied by foaming, spraying, etc.
 Use a stainless steel container for storing flux.

Preheating

 Preheating must be implemented in order to ensure the evaporation of solvent, heating of the PC board pad and parts electrode and activation of the flux.
 Recommended preheating temperature is 110 -120°C (at the soldering surface).

Limit to 100 - 110°C to prevent PC board warping.

3

If through-hole spreading is poor, set the temperature at around 120 - 130° C (at the soldering surface).

3) Although the recommended preheating time is 30 - 60 seconds, solvent can be vaporized with longer preheating. Preliminary heating with hot air is also effective.

Soldering

1) Set soldering temperature at 250 - 255 $^{\circ}\mathrm{C}.$

2) For the wave soldering bath, set the soldering time between 3 - 5 seconds.

Flux Cored Solder

Since SMIC developed its first flux cored solder SPARKLE SOLDER in 1955 in Japan, we have developed a number of flux cored solders for various alloys and applications.

For our ECO SOLDER alloy, SMIC developed a type of flux cored solder with improved wettability, a drawback peculiar to Lead-Free solder.

SPARKLE ESC Superior Wettability

Compared with existing Sn-Pb solder, Lead-Free solder typically has the drawback of poor solder wettability. The spreading factor of Lead-Free solder is approximately 10% less than that of existing Sn-Pb solder.

SPARKLE ESC is a flux cored solder specially developed for Lead-Free soldering. The solder wettability and solderability properties of SPARKLE ESC are significantly improved compared with those of existing Lead-Free flux cored solder, and the soldering workability is comparable to that of existing Sn-Pb solder.

ECO SOLDER RMA98 SUPER Low spattering and high reliability

With stricter fluorocarbon emission regulations, demands for elimination of the cleaning process for flux residue have increased. ECO SOLDER RMA98 Super is a highly reliable flux cored solder. It not only offers high reliability for flux residue after soldering but also exhibits excellent solderability and less spattering of flux or solder particles.

ECO SOLDER NV-1

Excellent stress- and heat-resistant flux

ECO SOLDER NV-1 is a flux-cored wire solder developed with a highly stressresistant flux. Flux residue from fluxcored wire solder cracks when stressed, such as during post-soldering rotation, vibration or bending, and it also softens in high-temperature environments. If flux residue contaminates connector contacts, conduction failures may result.

With its excellent stress and heat resistance, flux-cored ECO SOLDER NV-1 is ideal for PWBs with movable components such as switches and connectors.



Superior wettability of SPARKLE ESC

Through-hole filling count (by temparature)



Land diameter: 2 mm, Through-hole diameter: 1 mm, Through-hole pitch: 2.5 mm, Solder used: M705, Connector lead wire: 0.6 mm x 0.6 mm, PWB oxidation condition: 150°C for 1 hour. In a test of 100 robotsoldered points, through holes that are completely filled with solder pass and incompletely filled holes fail.

Stress- and heat-resistance of ECO SOLDER NV-1

Result of high-temperature rotation test Rotating speed (centrifugal separator) 3000 rpm 80°C 2hr



By increasing the softening point of the flux residue, flux residue flow can be controlled in high-temperature, high-stress conditions. This is an ideal solution for motor PWBs.

Low solder spattering of ECO SOLDER RMA98 SUPER

Result of spattering test

		Distance from the center [mm]									
Products	Type of spatter	10	20 2 30	30 ∼ 40	40 2 50	50	60	70 ∂ 80	80 2 90	90 ~ 100	Total
RMA98 SUPER	Flux	6	6	2	1	0	0	0	0	0	15
	Solder ball	1	1	0	0	0	0	0	0	0	2
Conventional product	Flux	15	12	7	4	3	2	0	0	0	43
Conventional product	Solder ball	4	2	1	0	0	0	0	0	0	7

Test method

Ten mm of solder was fed 50 times every 1 sec. agaist a soldering iron holded vertically toward a testing paper. The number of spatters on the paper was counted according to the distance from the center. Soldering iron temperature was 350°C.

> Soldering iron <u>5mm</u> Flux cored solder <u>5mm</u> Test paper

Lead-Free flux cored ECO SOLDER: Specification and Features

Products Factor	SPARKLE ESC	ECO SOLDER RMA98 SUPER	ECO SOLDER NV-1			
Alloy	Please refer to the	Please refer to the ECO SOLDER Products				
Wire diameter		0.3 ~ 1.6 ¢				
Flux content	3%	2%, 3%, 4%	3%			
Halogen content	0.44%	0.05%	0.45%			
Insulation resistance	Over $5 \times 10^{12} \Omega$	Over $1 \times 10^{13} \Omega$	Over $1 \times 10^{11} \Omega$			
Spreadability	79%(M705)	76%(M705)	75% (M705)			
Feature	Good workability	Low spattering and high reliablity	Excellent stress- and heat-resistant flux			



ECO SOLDER Preform

With improvements in the performance and reliability of electronic equipment, the size of components and printed wiring boards are becoming smaller and their density is increasing. Our solder preform is helps cope with such high-density technologies. Poor solder wettability has been a drawback of existing Lead-Free solder. However, since our solder preform contains very little impurities resulting in less oxidation and contamination on the solder surface, it exhibits good solder wettability without flux when hydrogen gas or foaming gas is used.

Our ECO SOLDER Preform is available in various forms to match any application such as washer, ring, pellet, disk or ribbon.



* Please inquire us for your own alloy, form and size specification.

ECO SOLDER Ball

Solder ball requirements include high purity and roundness. ECO SOLDER ball is widely used for soldering microscopic sections of crystal oscillators and diodes, as an electrode bump for hybrid ICs or power diodes in addition to the microsoldering of BGA, MCM, CSP and flip chips.

Our Lead-Free ECO SOLDER ball exhibits excellent wettability though it contains no lead. ECO SOLDER ball is available in two types. The S-type is a solid solder ball and the C-type has a copper or silver core to prevent ball crushing.

Micro-soldering Fluxes

Micro soldering fluxes ideal for the soldering of our ECO SOLDER Ball. Various fluxes are available to match the method of cleaning and application.



Diameter (mm)	Tolerance (μ m)
φ0.1	
φ0.2	±5
φ0.25	
\$	
¢0.35	+10
φ0.4	10
φ0.45	
¢0.5	
¢0.55	±20
¢0.6	$\pm 10 \mu$ m type is
φ0.76	available off fequest.

	Application method	Product	Property	Solid content	Viscosity (Pa•S25°C)	Flux type (Chlorine content)
	Bin transfer	Deltalux 529D-1	Paste	62.5%	20	RMA (0%)
type	Ball transfer	Deltalux 533	Paste	67%	10	RA (0.2%)
Resin	Dispenser	Deltalux 527N	High viscous liquid	70%	12	RMA (0%)
	Printing	Deltalux 523H	Paste	68%	120	RMA (0.05%)
uble	Bin/ball transfer	Sparkle flux WF-6063B	Paste	70%	7	_
er-soli	Printing	Sparkle flux WF-6050	Paste	70%	85	-
Wate	Dispenser	Sparkle flux WF-6052	High viscous liquid	60%	28	_

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SMIC Automatic Soldering **Machine**

Automatic Soldering Machine for Lead-Free Soldering

Features

Selectable Three Primary Waves Nozzle

You can select a wave nozzle from the three nozzle types, miracle, bumpy and twin, to match your P.W.B. (One touch replacement system)

Rapid Cooling Unit

Cold air at -30°C blown onto the P.W.B. by the cooling system and special nozzle minimize lift-off and shrinkage cavities.

Preheater Unit

The parallel use of far infrared rays and hot air minimizes temperature differences in the P.W.B. (ΔT) to maintain high soldering quality.

Oxide Separation System (optional)

Our unique mechanism separates solder and oxide from the dross.

Flow-up System

The flow-up nozzle ensures excellent through-hole soldering even with Lead-Free alloys.

SPD I- 300 Standard Specification



X

ECOMASTER SPDI-300

[PAT P.]

Dimensions	Length: 3,494 mm Width: 1,326 mm Height: 1,455 mm	• P.W.B. Access	Width: 100 to 300 mm Lenghth: 100 to 350 mm
Soldering bath	Double flow wave	Transfer conveyor	Heat resistant resin finger conveyor
	Solder capacity: 360 kg (ECO SOLDER M705)	Conveyor speed	0.5 to 2.0 m/min. (Variable)
	Heater: 9.75 kw	Conveyor inclination	5° ±1°
Heater	Forced air convection system with far infrared ray	Operation / Control	Seaquential control (Touch Panel)
	Heater: 7kw [3.5 kw × 2 zones]	Power (max.)	AC 200V, 3-Phase, 19 kw

Nitrogen Atmosphere Reflow **Furnace for Lead-Free Soldering**

Features

• Low ΔT is realized through the use of porous ceremic and highly efficient far infrared rays and an alpha flow heating system.

Temparature difference in large multi-layer printed wiring boards ΔT is 10°C or less.

• Temperature can be independently set for the upper heater and lower heater, offering freedom in temperature setting, and enabling trapezoidal temperature profiles to be set.

The vertical heating system produces a highly reproducible reflow profile.

The system has an airtight muffle structure that maintains oxygen content in the furnace at 100 ppm or less.

In every zone, low nitrogen consumption has been realized with 500 ppm at 180 L/min or 100 ppm at 300 L/min

Standard Flux Recovery Mechanism

Flux recovered in the recovery mode is automatically collected when the operation has completed.

Power-efficient Heat Insulating Structure (35 kW/7 zones)

Excellent thermal efficiency reduces start-up times.

ECOREFLOW SX II-2514N2

N2 Reflow Furnace for Lead-Free Soldering using Parallel Infrared and Hot Air Heating [PAT]



Dimensions	Length: 5,340mm Width: 1,140mm Height: 1,465mm	Heater	Far infrared rays panel heaters (14 units)
Conveyor speed	0.3 to 2.0m/min. (variable)	 Cooling unit 	Chiller unit cooling system
Pass line	900 ± 20 mm	Operation / Control	Microcomputer
• P.W.B. access	Width: 50 to 250mm Length: 100 to 400mm	 Weight 	Approx. 1,800kg
Device's access height	Upper: 10 mm Under: 5 mm	 Optional devices 	Requested color, automatic width adjustment
Power (max.)	200V AC, 3-Phase, 35kw		Falling P.W.B. detecting sensor



SX I- 2514N2 Standard Specification



Headquaters:

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Hanamaki, Akita, Sendai, Kohriyama, Takaoka, Suwa, Nagoya, Osaka, Hiroshima, Fukuoka and Kagoshima

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Laboratories: Tochigi, Saitama and Tokyo

Overseas Affiliates

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