STH (SMD Through Hole)

From wave soldering to STH technology

In recent years, component mounting and soldering technologies on PCB have evolved towards automated systems, passing from traditional techniques to new SMT (Surface Mounting Technology) techniques.
The use of traditional components such as terminal blocks and connectors on PCB has become really critical, as they do not fit with robotic system requirements and high temperature soldering process needs.
In order to satisfy these requirements, after years of research SAURO has tuned up new terminal blocks and connectors called SAURO STH products (**S**MD **T**hrough **H**ole), that can be used with the SMT technology.

PRESENT TECHNOLOGY

Process phases:
1 - High precision **SMD** components positioning by means of robotic systems (Pick-and-Place);
2 - Passage through oven Reflow for soldering;
3 - Terminal blocks or male connectors manually positioned in through holes, **THT** (**T**hrough **H**ole **T**echnology);
4 - Passage through wave oven for terminal blocks or male connectors soldering.

STH SAURO TECHNOLOGY

Process phases:
SAURO has tuned up a new technology, combining the SMT and THT ones, and called it STH (SMD Through Hole), that reduces production costs and the occurrence mistakes percentage.
The NEW STH TECHNOLOGY presents only two phases:
1 - High precision SMD components positioning both STH terminal blocks and/or male connectors, by means of Pick-and-Place;
2 - PCB passage through oven for Reflow soldering; all components are already positioned.
In the STH technology 2 phases are skipped: No 3 and 4 of the present technology.
SAURO is at the forefront in this new technology with its new STH products, with a constant extending range, to be identified with the family initials of the standard parts followed by H (High Temperature).
With this technology, the entire PCB is subject to a particular thermal cycle (in the lead-free process, sold ering temperatures can rise up to 270ºC) in which a solder paste first melts, attaching one or more components to the board, and then solidifies with a characteristic "flux" pattern, visible at the soldering joints (from which the name "Reflow" is derived).
Inserting the pins though the holes in the PCB creates a mechanical resistance which balances out the torque force, used to close the screw for wire retention on the soldering joints.

STH SAURO PRODUCTS

SAURO High Temperature terminal blocks and connectors have been studied and manufactured to be expressly used with **SMT** **S**urface **M**ounting **T**echnology the part-number results from their family identification initials followed by H (High Temperature).
Such components are suitable for being welded through the Reflow technique, as the insulating body has been planned utilising a substance stable even above 270°C; said substance contains glass fibre which obviously makes its colour tone different from the standard material's.
In contrast to SMD traditional components, pins of male connectors and terminal blocks are inserted into PCB metallized holes, previously filled with soldering paste, and then soldered with Reflow technology.
With this technology, the entire PCB is exposed to a special thermic cycle (which temperature peaks set around 270°C, High Temperature) that enables first the casting of the soldering paste, then its solidification with a characteristic “reflow” that is visible on solder beads (which explains its name). The pin insertion into PCB holes, which enables a high mechanical resistance, balances relevant stresses on solder beads caused by connecting wire operations when screwing down.
STH components are also compatible with the “Pick-and Place” automated mounting robotics, due to packaging solutions such as Tube, Tape-on-Reel and Tray.

SAURO STH products are realized with insulating material withstanding up to 270°C peak temperatures. The plastic material is UL94 V-0 self-extinguishing and is halogen free.
When exposed to high temperatures, the insulating material presents performances similar to those of the PCBS ones, so during Reflow or wave soldering there isn't any permanent deformation.

Glossary

Wave Soldering (Traditional soldering) Pin passing through the PCB soldered with a cast tin bath in the lower part;
Reflow Soldering Soldering technique based on the passage in oven of the entire PCB with the soldering paste and the mounted components above;
SMT (Surface Mounting Technology) Component mounted system directly onto the PCB surface using Pick-and-Place systems;
SMD (Surface Mounting Device) Component designed for the SMT surface mounting;
THT (Through Hole Technology) Component positioning system into the PCB through holes;
THR (Through Hole Reflow) THT component Reflow soldering.
The following are THR synonyms:
PIHR (Pin-in-hole Intrusive Reflow)
ROT (Reflow of Through Hole)
SCRS (Single Centre Reflow Soldering)
Intrusive Reflow Soldering
Pin-in-Paste
STH (SMD Through Hole)
New technology for Through Hole products which, withstanding high temperatures, can be mounted and soldered at same time of traditional SMD components.

PCB characteristics

The best soldering performance is obtained when holes are completely filled with soldering paste; in order to use STH SAURO products for Reflow soldering on th PCB, it is necessary that the PCB meets the following important requirements:

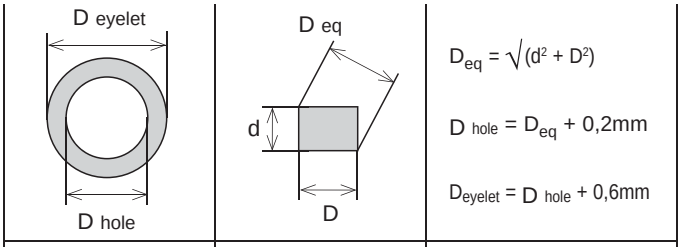
1) Holes: they must be metallized and present soldering eyelets on both sides of the board;

2) Hole diameter: depends on the tolerance that the machine can achieve whenever positioning automatically on the board. The main need is to maintain holes as small as possible, so as to minimize the paste quantity to deposit. Furthermore the air bubble outlet from the hole during the fusion is aided.

3) Soldering eyelets: the dimension must be sized to the paste quantity that has to reflow towards the hole. The process is supported by the small diameter of the soldering eyelets, as the cast paste must cover a smaller distance to fill in the through hole.

Approximate values are shown as follows:

PRODUCT	D x d	D eq	hole D	D eyelet
MTB	0.9x0.5 mm	1 mm	Ø 1.1 (+0.1/ 0.0) mm	1.8 mm
MMT	0.9x0.3 mm	0.95 mm	Ø 1.1 (+0.1/ 0.0) mm	1.8 mm
MSB	0.9x0.5 mm	1 mm	Ø 1.1 (+0.1/ 0.0) mm	1.8 mm
MSG	1x0.8 mm	1.3 mm	Ø 1.4 (+0.1/ 0.0) mm	2 mm
MPS	1x0.9 mm	1.35 mm	Ø 1.5 (+0.1/ 0.0) mm	2 mm
MPP	1.2x1.2 mm	1.7 mm	Ø 1.8 (+0.1/ 0.0) mm	2.4 mm
CTM	0.8x0.8 mm	1.13 mm	Ø 1.3 (+0.1/ 0.0) mm	1.8 mm
CLM	Ø 1.3 mm	1.3 mm	Ø 1.4 (+0.1/ 0.0) mm	2 mm
CSM	Ø 1.3 mm	1.3 mm	Ø 1.4 (+0.1/ 0.0) mm	2 mm
CIM	1x1 mm	1.4 mm	Ø 1.45 (+0.1/ 0.0) mm	2 mm
CGF	1x1 mm	1.4 mm	Ø 1.45 (+0.1/ 0.0) mm	2 mm



Soldering paste quantity to be used

Factors to take into account when calculating the paste quantity to be used:

a) PCB thickness: a bigger PCB thickness requires a bigger quantity of paste to be deposited. The optimum thickness is set approximately at 1.6 mm;

b) Stencil hole thickness: even if the Reflow technology advantage is related to the possibility to position both SMD and STH components at the same phase, these two component types feature important pin dimensions differences.
A bigger stencil hole thickness defines a bigger quantity of paste, but could be too different between traditional SMD components and those using PCB through holes (STH). For this reason stencils with different thickness and a double doctor passage is often necessary.
The first doctor passage is made on a thin stencil, whereas the second one is on a thicker stencil and positioned only on those PCB areas where STH components have to be placed.
In case there should be both differences between the various component types and a critical layout, the use of a dispenser to distribute the paste may be required.

c) Soldering paste type (evaporation factor, density)**:** usually the volume of paste to deposit is 50% more than the one required for the soldering process. The use of a “no clean” paste is suggested, as it leaves no residual soldering material and so doesn't require any cleaning with special chemical products.

d) Doctor speed: it must be chosen accurately, in respect to the used tools and to the paste type used. It could range from 30 to 150 mm/s.

e) Doctor angle: by changing the angle, the deposited paste quantity can be modified.

f) Pin section: the square shape is particularly suitable.

To improve the soldering quality, the pin length should be almost touching the PCBS lower surface, so as to avoid some paste to be pushed out of the holes and not be Reflow solderable. An optimum pin length offers also the possibility to mount the components on both sides of the PCB. In case the soldering process is performed on only one side, projections on the lower side up to 0.8 mm can be tolerated. Longer pins can also be soldered but can introduce soldering defects so as to influence the optimum electrical range.

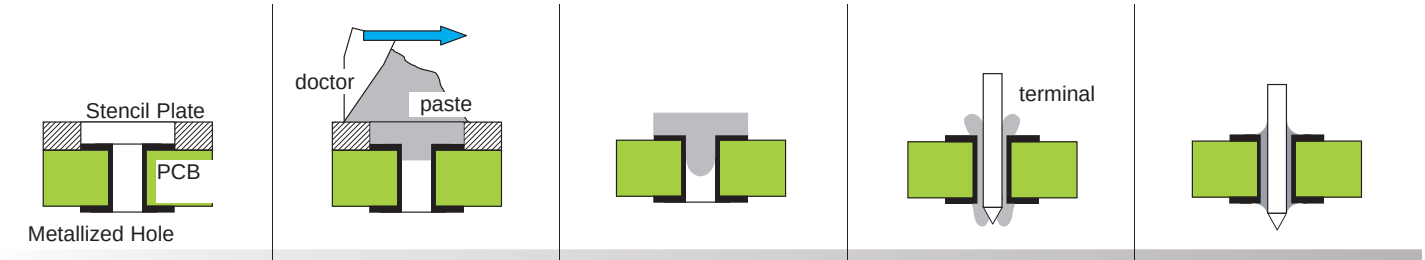
For an approximate calculation of the soldering paste volume needed for the STH components, the below formula can be used:

$$V_f = \left[\frac{\pi \cdot d_f^{\,2}}{4} \cdot S \right]$$

$$V_n = V_f - V_p$$

Paste volume = $V_n * K$

Where:
V_f = Hole volume



1 Stencil plate positioning on the PCB.

2 The soldering paste is deposited on the eyelets by means of a Doctor.

3 Once the stencil plate is removed, the paste remains in the hole.

4 The pin insertion drags part of the paste through the hole, till it overflows.

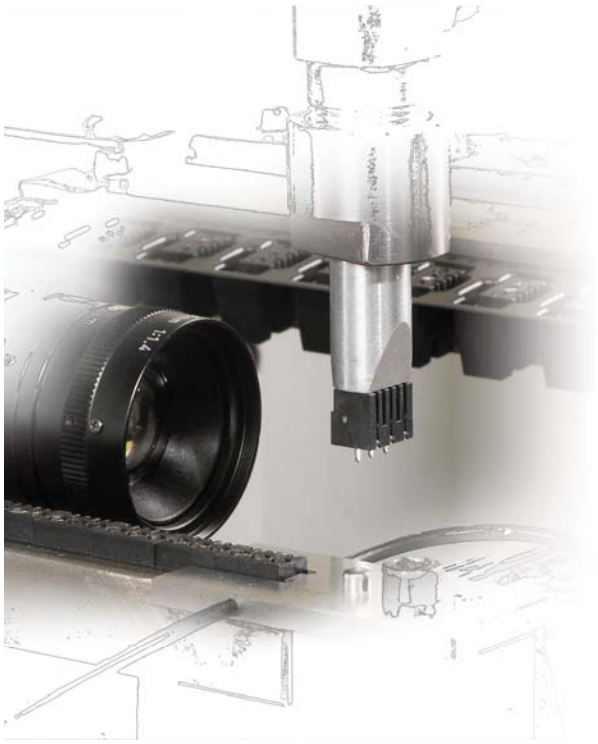
5 Passage in the oven and paste’s reflow through the metallized hole.

Soldering reflow system characteristics

SAURO STH products can be used in all Reflow soldering processes, such as IR, hot-air convection or nitrogens. These last two ones are suggested as the plastic material absorbs IR radiation much more than traditional SMD components, therefore it can result in a local plastic overheating and an insufficient heating of the soldering bead.
Hot-air convection ovens are free from any possible “screening” effects due to plastic material and enable a uniform heat distribution.

As the air temperature-speed couple determines the heat quantity that is necessary for the casting process, it is evident that on equal time the results that can be obtained are clearly the same, both with air high temperatures and low speed and with high speed and low temperatures.
Between these two solutions the second one is technologically the best, as the thermal load is lower.

PACKAGING

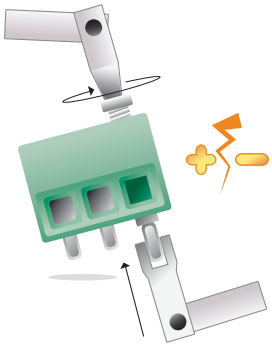


SAURO products can be supplied in different packaging in order to integrate perfectly with the mounting technologies used by the customers.
Four packaging types are available:

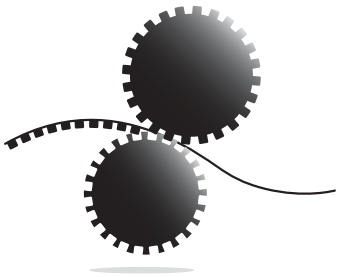
PACKAGING TYPE	PRODUCT	QUANTITY
Standard packages	All products	standard
Tape on Reel	CIMH 2÷8 poles CTMH 2÷12 poles MTBH 2÷8 poles	250 pieces
Tube	MSGH (p. 5/5.08)	120 poles
Tray	Upon request	-
Other solutions	Upon request	-

	Lead free soldering paste
Wave soldering	**Standard** Products in PA 6.6 with temperatures up to 260°C/500°F **STH** Products in PPA with temperatures up to 270°C/518°F.
Reflow soldering	**STH** Products in PPA with temperatures up to 270°C/518°F.

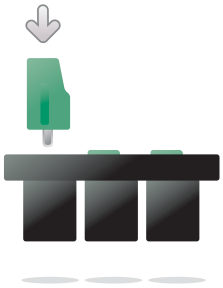
All in Sauro!



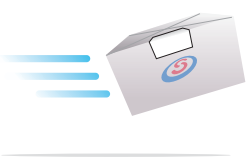
1) Automatic assembly and testing of products



2) Embossed “Tape” forming



3) Product packaging



4) Shipment

Terminal Blocks

pitch (mm)		3.5 - 3.81			5 - 5.08		7 - 7.62			10 - 10.16		5 - 5.08		10 - 10.16				15		
height (mm)		8.5		14.85	10		12.6		14.85	10		13.5		13.5	29.3			39		
		MTB		MMT	MSB		MTB		MMT	MSB		MSG		MSG	MPS			MPP		
Technology		rising clamp		spring	rising clamp		rising clamp		spring	rising clamp		rising clamp		rising clamp	rising clamp			rising clamp		
Rated voltage Rated current Cross section		300V 17.5A 1.5mm² 16 AWG		300V 10A 1.5mm² 16 AWG	300V 17.5A 1.5mm² 15 AWG		750V 17.5A 1.5mm² 14 AWG		300V 10A 1.5mm² 16 AWG	750V 17.5A 1.5mm² 15 AWG		300V 24A 2.5mm² 13 AWG		750V 24A 2.5mm² 13 AWG	1000V 76A 16mm² 6 AWG			1000V 125A 35mm² 2 AWG		
Versions (poles)		modular	side stackable	side stackable	modular	side stackable	modular	side stackable	side stackable	modular	side stackable	modular	side stackable	modular	modular	side stackable	mounting flange	modular	side stackable	mounting flange
Straight	Metric	2 ÷ 12	2 ÷ 12	2 ÷ 16	2 ÷ 12	2 ÷ 12	2 ÷ 6	2 ÷ 6	2 ÷ 8	2 ÷ 6	2 ÷ 6	2 ÷ 3	2 ÷ 3	2				2 ÷ 5	2 ÷ 5	1 ÷ 5
	Imperial	2 ÷ 12	2 ÷ 12	2 ÷ 16	2 ÷ 8	2 ÷ 8	2 ÷ 6	2 ÷ 6	2 ÷ 8	2 ÷ 4	2 ÷ 4	2 ÷ 3	2 ÷ 3	2	2 ÷ 6	2 ÷ 6	1 ÷ 6			
Angled	Metric	2 ÷ 12	2 ÷ 12		2 ÷ 8	2 ÷ 8	2 ÷ 6	2 ÷ 6		2 ÷ 4	2 ÷ 4	2 ÷ 3	2 ÷ 3	2						
	Imperial				2 ÷ 12	2 ÷ 12				2 ÷ 6	2 ÷ 6	2 ÷ 3	2 ÷ 3	2						
90°	Metric				2 ÷ 22	2 ÷ 22				2 ÷ 11	2 ÷ 11									
	Imperial				2 ÷ 8	2 ÷ 8				2 ÷ 4	2 ÷ 4									

Connectors

pitch		3.5 - 3.81					5 - 5.08												7.5 - 7.62						
		CTM				CLM	CTM				CSM	CSMD	CIM						CGF	CIM						CGF
Rated voltage Rated current Cross section		300V 13.5A 1.5mm² 14 AWG				300V 4A 1.5mm² 14 AWG	300V 13.5A 1.5mm² 14 AWG				300V 15A 2.5mm² 14 AWG	300V 15A 2.5mm² 14 AWG	300V 16A 2.5mm² 12 AWG						300V 16A 2.5mm² 12 AWG	300V 16A 2.5mm² 12 AWG						500V 16A 2.5mm² 12 AWG
Versions (poles)		modular	polarized	flanges	fixing pins	side stackable	modular	polarized	with flanges	with fixing pins	side stackable	side stackable	modular	polarized	side stackable	with flanges	with fixing pins	self-alignment	modular	modular	polarized	side stackable	with flanges	with fixing pins	self-alignment	modular
straight	Metric		2 ÷ 12	2 ÷ 12		2 ÷ 4	2 ÷ 22	2 ÷ 22	2 ÷ 20	2 ÷ 20	2 ÷ 12	2 ÷ 3	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 3	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 3
	Imperial		2 ÷ 12	2 ÷ 12			2 ÷ 8	2 ÷ 8	2 ÷ 6	2 ÷ 6			2 ÷ 8	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12		2 ÷ 3	2 ÷ 8	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12		2 ÷ 3
angled	Metric																									
	Imperial	2 ÷ 16	2 ÷ 16	2 ÷ 16	2 ÷ 16																					
90°	Metric		2 ÷ 12	2 ÷ 12			2 ÷ 22	2 ÷ 22	2 ÷ 20	2 ÷ 20	2 ÷ 12	2 ÷ 3	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 3	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 3
	Imperial		2 ÷ 12	2 ÷ 12			2 ÷ 8	2 ÷ 8	2 ÷ 6	2 ÷ 6			2 ÷ 8	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12		2 ÷ 3	2 ÷ 8	2 ÷ 12	2 ÷ 12	2 ÷ 12	2 ÷ 12		2 ÷ 3

pitch		7 - 7.62					10 - 10.16											
Rated voltage Rated current Cross section		750V 13.5A 1.5mm² 14 AWG				750V 4A 1.5mm² 14 AWG	750V 13.5A 1.5mm² 14 AWG				750V 15A 2.5mm² 14 AWG	750V 15A 2.5mm² 14 AWG	750V 16A 2.5mm² 12 AWG						750V 16A 2.5mm² 12 AWG						
straight	Metric		2 ÷ 6	2 ÷ 6		2	2 ÷ 11	2 ÷ 11	2 ÷ 11	2 ÷ 11	2 ÷ 6	2	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6	2							
	Imperial		2 ÷ 6	2 ÷ 6			2 ÷ 4	2 ÷ 4	2 ÷ 3	2 ÷ 3			2 ÷ 4	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6		2							
angled	Metric																									
	Imperial	2 ÷ 8	2 ÷ 8	2 ÷ 8	2 ÷ 8																					
90°	Metric		2 ÷ 6	2 ÷ 6			2 ÷ 11	2 ÷ 11	2 ÷ 11	2 ÷ 11	2 ÷ 6	2	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6	2							
	Imperial		2 ÷ 6	2 ÷ 6			2 ÷ 4	2 ÷ 4	2 ÷ 3	2 ÷ 3			2 ÷ 4	2 ÷ 6	2 ÷ 6	2 ÷ 6	2 ÷ 6		2							