TECHNCIAL DESCRIPTION

SERIES SMD-6000

IN LINE CONVEYORIZED INFRARED SOLDER REFLOW SYSTEM

SPECIFICATION NO. RTC-CR-SMD65-4-112

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1.0 SCOPE

This document specifies the operation, performance and theory of the RTC Series SMD-6000 in-line Conveyorized Infrared Solder Reflow System.

2.0 GENERAL SPECIFICATIONS

2.1 This Infrared Solder Reflow System, RTC Series SMD-6000, is designed for close control of process conditions. It is suitable for reflowing solder paste in the attachment of surface mount devises (SMD) to polymeric or ceramic substrates.

2.2 The furnace is constructed so that the process atmosphere can be controlled to a level of 150 PPM furnace-induced gaseous contaminants and temperature controlled to within ± 2 degrees C.

2.3 The system will provide a load station, followed by a multi-atmosphere infrared heating section, a forced air cooling section and an unload station.

3.0 PHYSICAL SPECIFICATIONS

3.1 Overall Dimensions:

3.1.1 Length: 180 inches (4.57m)

3.1.2 Width:

3.1.2.1 SMD-6010: 27.0 inches (68.6cm)
3.2.2.2 SMD-6015: 32.5 inches (82.6cm)
3.1.2.3 SMD-6024: 41.5 inches (105.4cm)

3.1.3 Height: 65 inches (1.65m)

3.2 Transport Specifications:

3.2.1 Conveyor Width:

3.2.1.1 SMD-6010: 9.5 inches (24.1cm)
3.2.1.2 SMD-6015: 15 inches (38.1cm)
3.2.1.3 SMD-6024: 24 inches (61.0cm)

3.2.2 Conveyor Height: Adjustable 36^{+2}_{-1} inches ($91.4^{+5.1}_{-2.5}$cm)

3.2.3 Conveyor Material: Stainless Steel close weave balanced spiral.

3.3 Handling Stations:

3.3.1 Load Station: 12.5 inches (31.8cm)

3.3.2 Unload Station: 12.5 inches (31.8cm)

3.4 Process Area Dimensions:

3.4.1 Input Curtain and Baffle: 16.0 inches (40.6cm)

3.4.2 Infrared Heated Length: 60.0 inches (152.4cm)

3.4.2.1 Zone One: 10.0 inches (25.4cm)
3.4.2.2 Zone Two: 20.0 inches (50.8cm)
3.4.2.3 Zone Three: 20.0 inches (50.8cm)
3.4.2.4 Zone Four: 10.0 inches (25.4cm)

3.4.3 Exit Curtain: 16.0 inches (40.6cm)

3.4.4 Turbulent Air Cooling Length: 60.0 inches (152cm)

4.0 ELECTRICAL SPECIFICATIONS

4.1 Input Power:

4.1.1 SMD-6010: 208/240V, 3 phase, 60 Hz, 18.5 KW peak (50 Hz and/or 380/480V available)

4.1.2 SMD-6015: 208/240V, 3 phase, 60 Hz, 28.9 KW peak (50 Hz and/or 380/480V available)

4.1.3 SMD-6024: 208/240V, 3 phase, 60 Hz, 47.4 KW Peak (50 Hz available)

4.2 Operating Power: Less than 40% of peak typical.

5.0 EXHAUST SPECIFICATIONS

5.1 Process Exhaust:

5.1.1 Typical Volume

5.1.1.1 SMD-6010: Greater than 180 SCFH (9.4 lpm)
5.1.1.2 SMD-6015: Greater than 275 SCFH (14.0 lpm)
5.1.1.3 SMD-6024: Greater than 455 SCFH (14.0 lpm)

5.1.2 Typicial Composition

5.1.2.1 N_2 Operation: N_2, Flux Vapors
5.1.2.2 Air Operation: Air, Flux Vapors

5.1.3 Typical Temperature: Less than 100°C

5.2 System Exhaust:

5.2.1 Volume:

5.2.1.1 SMD-6010: 500 cfm (14m^3/min) max.
5.2.1.2 SMD-6015: 1000 cfm (28m^3/min) max.
5.2.1.3 SMD-6024: 1500 cfm (42m^3/min) max.

5.2.2 Temperature: Less than 45°C

5.2.3 Composition: Filtered, uncontaminated room air

5.3 Process Cooling Exhaust

5.3.1 Volume:

5.3.1.1 SMD-6010: 900 cfm ($25m^3$/min)
5.3.1.2 SMD-6015: 1200 cfm ($35m^3$/min)
5.3.1.3 SMD-6024: 1500 cfm ($43m^3$/min)

5.3.2 Temperature: Less than 45^oC

5.3.3 Composition: Filtered, uncontaminated room air.

6.0 GAS (ATMOSPHERE) INPUTS

6.1 Nitrogen:

6.1.1 Volume

6.1.1.1 SMD-6010: 1100 SCFH (520 lpm) maximum
6.1.1.2 SMD-6015: 2100 SCFH (990 lpm) maximum
6.1.1.2 SMD-6024: 2100 SCFH (990 lpm) maximum

6.1.2 Composition (recommended)

6.1.2.1 O_2: <8 ppm
6.2.2.2 Total Hydrocarbons: < 100 ppm
6.2.2.3 Moisture: < 20 ppm
6.1.2.4 CO_2: < 100 ppm
6.1.2.5 H_2: < 1000 ppm
6.1.2.6 Other Inert Contaminants: < 1000 ppm

6.1.3 Pressure: 75 psig (517 Kpa) max., 30 psig (207 Kpa) min.

6.2 Dry Air:

6.2.1 Volume

6.2.1.1 SMD-6010: 1100 SCFH (520 lpm) maximum
6.2.1.2 SMD-6015: 2100 SCFH (990 lpm) maximum
6.2.1.3 SMD-6024: 2100 SCFH (990 lpm) maximum

6.2.2 Composition (recommended)

6.2.2.1 Total Hydrocarbons: < 100 ppm
6.2.2.2 Moisture: 20% R.H.

6.2.3 Pressure: 75 psig (517 Kpa) max., 30 psig (207 Kpa) min.

7.0 CONTROLS

7.1 Conveyor speed is controlled by a single, plug-in circuit board. True motor rpm is sensed by an optical interruptor module and

converted to belt speed in inches per minute by digital circuitry. Speed is displayed by a three position, digital LED display with a resolution of .1 ipm. A feed-back circuit maintains motor speed regulation. Speed is infinitely adjustable from 4 to 90 ipm by a ten-turn potentiometer. Accuracy is ±.25%.

7.2 Heat control is accomplished using a closed-loop temperature control system. K-type thermocouples (4) placed in the heating chamber sense process temperature. Plug-in temperature controllers (4) maintain temperature by regulating the output of SCR control modules (4).

Temperature controllers are set with a three digit thumbwheel switch with 1°C resolution and accuracy. SCR power modules are single phase, DC output, full wave rectification bridges utilizing phase angle fired SCR's. 110 amp SCR's are used for reliability and resistance to transients. A deviation meter and alarm circuitry are included in the temperature controller (see Section 9.0).

7.3 Atmosphere control is accomplished with seven flowmeters as follows:

Flowmeter Range	(SMD-6010)	(SMD-6015, SMD-6024)
Entrance Venturi	5-50 SCFH	5-50 SCFH
Entrance Baffle	20-200 SCFH	40-400 SCFH
Zone 1	20-200 SCFH	40-400 SCFH
Zone 2, 3	20-200 SCFH	40-400 SCFH
Zone 4	20-200 SCFH	40-400 SCFH
Exit Baffle	20-200 SCFH	40-400 SCFH
Exit Venturi	5-50 SCFH	5-50 SCFH

8.0 PROCESS SECTIONS

8.1 Heating

The infrared heating section is contained within an aluminum chamber lined with ceramic fiber insulation. The chamber is rated for 600°C. Gas or air is introduced into a plenum between the outer chamber skin and the porous insulation; this gas then passes through the insulation where it is heated and enters the chamber. This method of gas distribution allows a high-volume, low-velocity flow of gas to be achieved without disturbing the temperature profile; the gas flow additionally eliminates build-up of product effluent.

Heating is accomplished by radiating the product with energy produced by tungsten filament quartz lamps. These lamp filaments operate at temperatures from 1000-1900°K, emitting radiant flux with peak wavelengths between 1.5 and 2.9 μ m. The chamber is divided into four zones: Zone 1 is ten (10) inches, Zone 2 is twenty (20) inches, Zone 3 is twenty (20) inches in length and Zone 4 is ten)10) inches in length.

Zone 1 imparts a rapid rate of rise to the product and is a medium intensity zone. The lamps in Zone 1 are spaced at 1.2 inches and are wired to receive a maximum of half rated voltage. The lamps are distributed six above and six below the conveyor, perpendicular to belt travel.

Zones 2 and 3 are a lower intensity zones and the lamps are spaced at 2.3 inches. The wiring permits each lamp to receive a maximum of half rated voltage. The lamps are distributed eight above and eight below the conveyor in each zone perpendicular to the direction of belt travel.

Zone 4 imparts a rapid rate of rise to the product and is a medium intensity zone. The lamps in Zone 4 are spaced at 1.2 inches and are wired to receive a maximum of half rated voltage. The lamps are distributed six above and six below the conveyor, perpendicular to belt travel.

This chamber design allows temperature to be controlled to within $+4^{o}C$ across the belt and throughout the chamber, without trimming. The edge heat trimmers can be further adjusted to maintain $\pm 2^{o}C$ temperature uniformity.

8.2 Cooling

Process cooling is accomplished in a turbulent air cooling section. Fans force filtered ambient air over the parts to remove heat. A controller is provided to vary the cooling rate. Ducts are provided to vent heat removed from the process out of the working area.

Chamber cooling air is drawn through a filter at the rear of the pedestal, then forced across the electronics to remove heat from the SCRs. This air is then forced across the lamp seals. Cooling the lamp seals in this manner affords long lamp life without disturbing the chamber air flow or the profile. A blower with a duct is provided to remove heat from the lamp seals, chamber skin, and electronics and force it out of the working area, maintaining outer skin surface temperatures near ambient.

8.3 Atmosphere

Gas handling within the process area is designed to control the composition of the process atmosphere. Baffle curtains at the entrance and exit of the heated chamber prevent the entrance of trapped or ambient air. The chamber gas is introduced as described in Section 8.1, and travels to the entrance or exit of the chamber, where it is withdrawn through venturi-assisted exhausts. See Section 7.3

9.0 ALARMS

Due to the importance of maintaining a cool lamp termination temperature, a failure or excessive flow reduction of the main system exhaust activates an audible and visible alarm and causes a soft

shutdown of all heating elements. Shutdown is indicated with a panel light and will also be initiated by a conveyor motor failure. Audible and visual alarms further indicate lamp failure (optional) or temperature deviation beyond an operator selected bandwidth. An array of pilot lights indicate the specific alarm conditions that exist.

10.0 FACILITIES IMPACT

10.1 Thermal Load: A properly exhausted system will induce a thermal load of approximately 4640 BTU/hr. (1.36 KW) upon the facility (SMD-6024).

10.2 Inputs:

10.2.1 Electrical: 208, 240, 380 or 480V, 1 phase or 3 phase, 50 or 60 Hz, 3- or 4-wire

10.2.2 Nitrogen:

10.2.2.1 SMD-6010: 600 SCFH Nom., 1100 SCFH max., 75 psi max.

10.2.2.2 SMD-6015: 750 SCFH nom., 2100 SCFH max., 75 psi max.

10.2.2.3 SMD-6024: 1000 SCFH nom., 2100 SCFH max., 75 psi max.

10.2.3 Air: Clean, dry supply as required for process atmosphere only. Volume: See Sec. 10.2.2.

10.2.4 Water: None

10.2.5 Hazardous Exhausts or Products: None

10.2.6 Noise Impact: Negligible

10.3 Exhaust:

10.3.1 1195 cfm max. (SM-6010)
10.3.2 1335 cfm max. (SMD-6015)
10.3.3 1910 cfm max. (SMD-6024)

11.0 OPTIONS

11.1 Lamp Monitor (LM)

This option adds circuitry to sense and display the location of any failed heating element. A diode array monitors current to the lamps and activates an audible and visible alarm upon sensing an element failure. An LED array displays the specific location of the failed lamp and eliminates trouble shooting. The lamp monitor allows the operator to determine immediately whether a lamp has failed and discern its location before process results are appreciably affected.

11.2 Conveyor Extension (CE-SS)

This option allows load or unload stations to be extended (from the standard 12.5 inches each) by any integral multiple of 15".

11.3 Circuit Breaker (CB)

This option provides a single overcurrent protection and disconnect device for the entire system. All inputs and control circuitry are fused in the standard machine, but a single circuit breaker is optional.

11.4 Hermetic Chamber and Controlled Atmosphere Cooling (HC)

This option provides a hermetic chamber that permits operation with atmospheric integrity of 1-5 ppm furnace induced gaseous contaminants. This option must be added before any hydrogen option is included. The option provides a sealed chamber and two-stage cooling section. The cooling section consists of a 30" controlled atmosphere cooling section followed by the standard two-row turbulent air cooling sections. The option adds 30" to overall system length, as well as adding the two flowmeters listed below:

Plenums	20-200 SCFH (SMD-6010)
	20-200 SCFH (SMD-6015, SMD-6024)
Cooling	20-200 SCFH (SMD-6010)
	40-400 SCFH (SMD-6015, SMD-6024)

11.5 Hydrogen Operation (HO)

This option adds the plumbing and electronics to safely use hydrogen (15-100%) as the chamber atmosphere. The system includes nitrogen and hydrogen pressure sensors that allow hydrogen to be introduced only if sufficient pressure exists at both supplies. The electric igniter element is monitored so hydrogen can be shut off in the event of igniter failure. The hydrogen system provides alarms, solenoids and sensors required for a timed nitrogen purge and igniter test prior to the introduction of hydrogen. The option adds four flowmeters:

Zone 1 H_2	20-200 SCFH	9.5" belt
	40-400 SCFH	15" and 24" belt
Zone 2 H_2	20-200 SCFH	9.5 belt
	40-400 SCFH	15" and 24" belt
Zone 3 H_2	20-200 SCFH	9.5" belt
	40-400 SCFH	15" and 24" belt
Plenum H_2	20-200 SCFH	All belt width

The hydrogen option may be selected only on machines equipped

with a hermetic chamber (HC option).

11.6 Cooling Module, Controlled Atmosphere (CC)

This options adds an additional controlled atmosphere cooling module to the system. The module is 30" long and is made of finned aluminum. Fans force filtered, ambient air over the outer surface of the heat exchange, removing heat from the product. The interior of the cooling module is pruged with cover gas through two gas rakes located above the belt. The module will be fed through the existing "cooling" flowmeter if the system is equipped with the HC option. If the system has standard atmosphere control (150 ppm), a flowmeter will be added:

Cooling	20-200 SCFH	9.5" belt
	40-400 SCFH	15" and 24" belt

The module adds 30" to the overall furnace length and adds exhaust of warmed room air as follows:

500 cfm	9.5" belt
1000 cfm	15" belt
1500 cfm	24" belt

11.7 Cooling Module, Forced Air (CM)

This option adds an additional turbulent air cooling module to the system. Fans force filtered ambient air over all surfaces of the product to quickly cool it. This module adds 30" to the overall length of the system and adds exhaust of warmed room air as follows:

450 cfm	9.5" belt
600 cfm	15" belt
750 cfm	24" belt

11.8 Additional Temperature Controlled Zone (TC-1, TC-3)

This option adds an additional zone of control to the existing heated length. This option includes the temperature controller and thermcouple necessary to control the zone together with a single phase (TC-1) or three phase (TC-3) SCR controller that will regulate voltage to the lamps.

11.9 Top/Bottom Proportioning (TBP)

This option will give any or all zones the ability to proportion the power delivered from the top lamps to the power delivered from the bottom lamps or vice versa. A full range of 0-100% through 50%-50% to 100%-0 is achievable. The system adds a switch and a potentiometer that are used to select a master (top or bottom) and a porportional slave. The system adds one additional SCR module for each zone proportioned.

11.10 Oxygen Analyzer (OA)

This option adds a Teledyne Model 316-A oxygen analyzer to the system. A vacuum pump and sampling port are provided. Additional sampling ports can be added with the "AS" (Atmosphere Sample Port) option.

11.11 Atmosphere Sample Port (AS)

This option adds a sampling tube and port to allow chamber gas samples to be taken. If the furnace has no oxygen analyzer, the port will be plumbed to the control panel and closed with a valve. The port will be connected to the oxygen analyzer, if installed, and a valve system will allow selection of the individual port(s).

11.12 Electrical Option (HV-3)

This option selects operation at particular voltages and applies to range from 380 to 480V. This is three phase voltage, phase-to-phase, 50/60 Hz. Standard systems are 190 to 240V, 3 phase, 56/60 Hz.

11.13 Brush Belt Cleaner (BC)

This option adds a passive brush belt cleaner. The belt drive pulls the belt through two facing planar brushes to remove loose particulate.

11.14 Ultrasonic Belt Cleaner (UC)

This option adds an ultrasonic tank and timer to provide cleaning of the belt. The belt is dryed after the cleaning by an infrared section located at the belt return.

11.15 Profiling Accessories Kit (PA)

This option provides the instrumentation and accessories required to profile infrared systems, a chart recorder, Soltec 1240 series, is provided with one to three channels and 300 msec full scale response time. A thermocouple of 20' is provided, 24 ga "K" wire, ceramic fiber insulated and flexible braided with inconel. A thermocouple wheel with mercury slip ring is provided for thermocouple take up. A cart is provided with drawers and storage area for the accessories.

11.16 Reversible Conveyor (RC)

This option provides a switched, dual-motor conveyor system that permits full speed range operation in either direction.

12.0 DOCUMENTATION

12.1 RTC will provide two (2) sets of documentation, to include manual, operating procedures and spare part list.

13.0 CONTACT PEOPLE

16.1 Sales: Carson Richert, Vice President-Marketing, (213) 404-3526 X21

16.2 Engineering: Ahmet Arslancan, Applications Engineer, (213) 404-3526 X25

14.0 FINISH

14.1 All exposed parts will be fabricated of stainless steel or painted in corrosion-resistant epoxy paint.

14.2 Colors will be RTC medium blue, charcoal grey and creme.