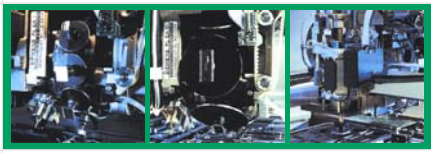
SPECIFICATION



F

SIPLACE F5 HM

High Speed and Flexible Placement of Complex Components

Automation and Drives

SIEMENS

Global network of innovation

High Speed Placement of Large ICs, Flip Chips, Bare Dies and Odd Shaped Components
SIPLACE F^5 HM

Subject to change without notice

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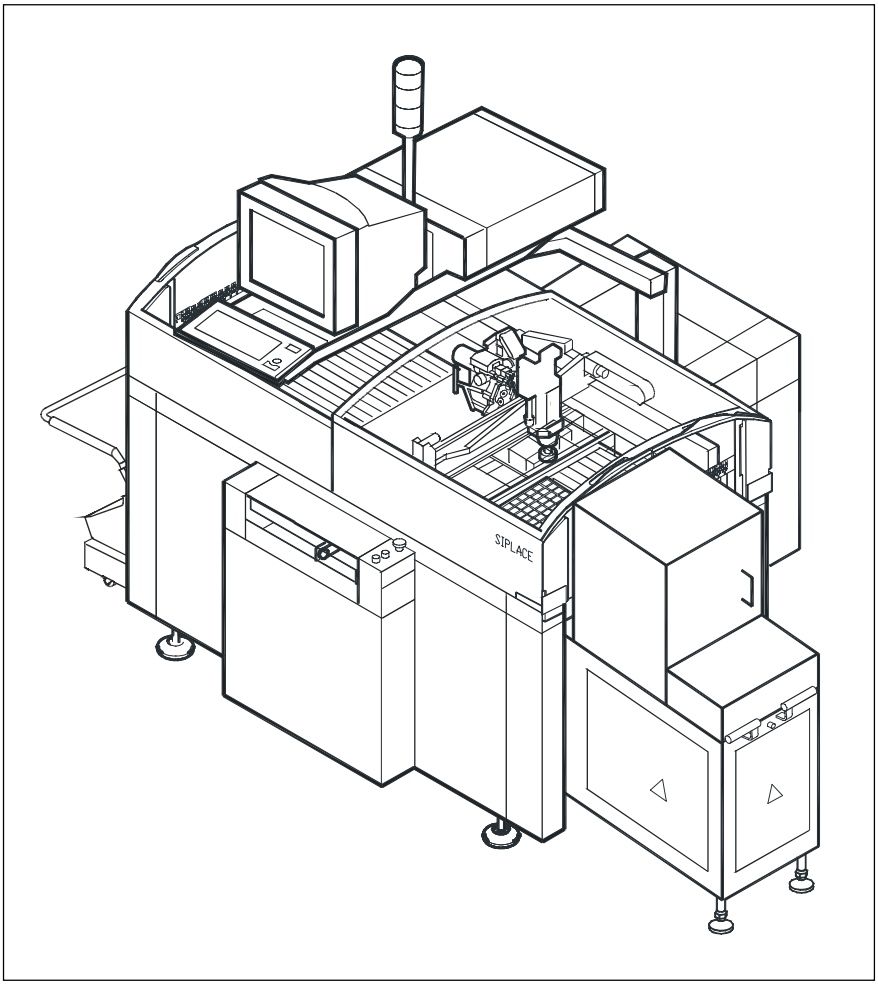
A10002-P141-T23-X-7600

High Speed Placement of Large ICs, Flip Chips, Bare Dies and Odd Shaped Components
SIPLACE F^5 HM



SIPLACE F^5 HM with Waffle Pack Changer

Machine Description

Technical Data

Type of placement head	12-Nozzle Collect & Place Head or 6-Nozzle Collect & Place Head and Pick & Place Head
Number of gantries	1
Benchmark placement rate [a]	12-Nozzle C & P Head 11,000 cph 6-Nozzle C & P Head 8,500 cph Pick & Place Head 1,800 cph
Component Range	0.6 x 0.3 mm² (0201) to 55 x 55 mm²
Max. placement accuracy (at 4 sigma) [a]	90 µm (12-Nozzle Collect & Place Head) 60 µm (6-Nozzle Collect & Place Head) 40 µm (Pick & Place Head)
PCB dimensions (L x W)	
Single conveyor	50 x 50 mm² to 508 x 460 mm² / 2" x 2" to 20" x 18" (optional up to 610 mm length)
Dual conveyor	50 x 50 mm² to 460 x 216 mm² / 2" x 2" to 18" x 8.5"
Feeding capacity	118 tracks, 8 mm tape
Component table	Quick changeover table with integrated wheels, reel holder and scrap bin, SIPLACE WPW
Types of Feeder modules	Tapes, Bulk Cases, Stick Magazines, application-specific OEM feeders
Operating system	Microsoft Windows / RMOS
Power	1.9 kW
Compr. air requirements	5.5 - 10 bar, 300 Nl/min, tube ½"

a) As defined in "Scope of Service and Delivery SIPLACE".

Description

SIPLACE F⁵ HM combines the Pick & Place Head with the Collect & Place Head to unite high precision with high speed. SIPLACE F⁵ HM is capable for stand-alone as well as for integration into a SIPLACE line.

The SIPLACE F⁵ HM holds both the component feeder table and the PCB stationary while populating boards.

While the PCB is transferring from the buffer zone to the stationary population zone, the Collect & Place Head is already picking up components. As soon as the PCB´s exact position is determined by the PCB camera, the Collect & Place Head will move into the population zone and perform its placement sequence.

This step will be repeated until all components assigned to the Collect & Place Head are placed.

As soon as the Collect & Place Head has finished, the Pick & Place Head begins picking up and placing the components assigned to it, until the board is complete.

For a SIPLACE F⁵ HM configured with 6-Nozzle Collect & Place Head a DCA-package is available, which contains a DCA vision module instead of the standard vision module.

A Flip Chip (FC)-package is also available, which contains a FC vision module instead of the standard vision module for the Pick & Place Head.

Line Design

Technical Data

System	SIPLACE SMD placement lines
Modules	SIPLACE HS-60 / SIPLACE S-27 HM / SIPLACE F^5 HM
Peripherals	Input/output station, screen printer, solder oven, inspection conveyor etc., available from Siemens
PCB conveyor	Automatic width adjustment
PCB dimensions (L x W)	
Single conveyor	50 x 50 mm^2 to 368 x 460 mm^2 / 2" x 2" to 20" x 18"
Dual conveyor	50 x 50 mm^2 to 368 x 216 mm^2 / 2" x 2" to 18" x 8.5"
Ceramic substrate dimensions (L x W)	50 x 50 mm^2 to 101.6 x 177.8 mm^2 2" x 2" to 4" x 7"
Placement speed	Depends on layout of modules
Space required	4 m^2 / SIPLACE S & F modules 6.8 m^2 / SIPLACE HS module

Description

Flexibility and adaptability characterize the modular SIPLACE design. Each production line can be individually composed of similar and different modules.

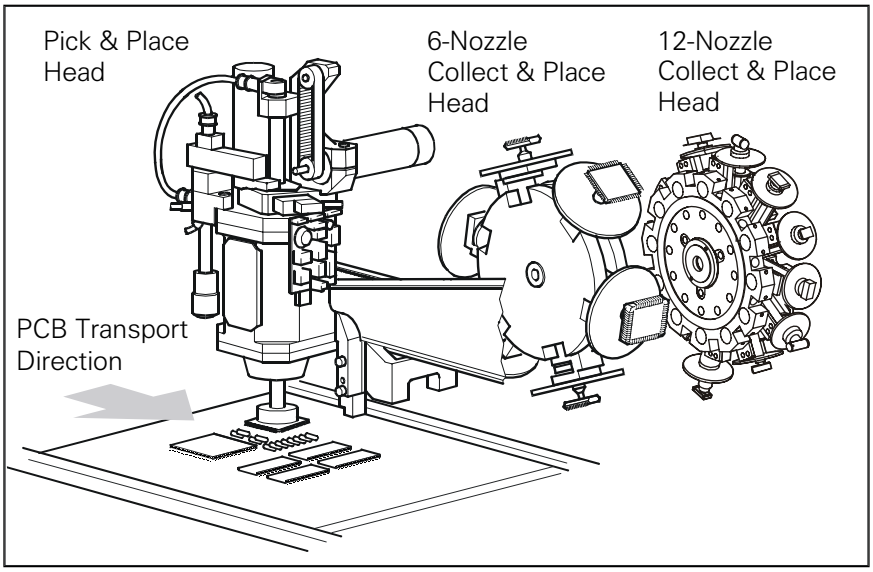
Because of the small size and robust construction of the SIPLACE modules, they can be recombined quickly and easily to accommodate changes in production requirements.

The SIPLACE family of placement machines offers the right product for each purpose – from the very high-speed placement system SIPLACE HS-60 to the high-speed SMD placement system SIPLACE S-27 HM and the flexible placement system SIPLACE F^5 HM.

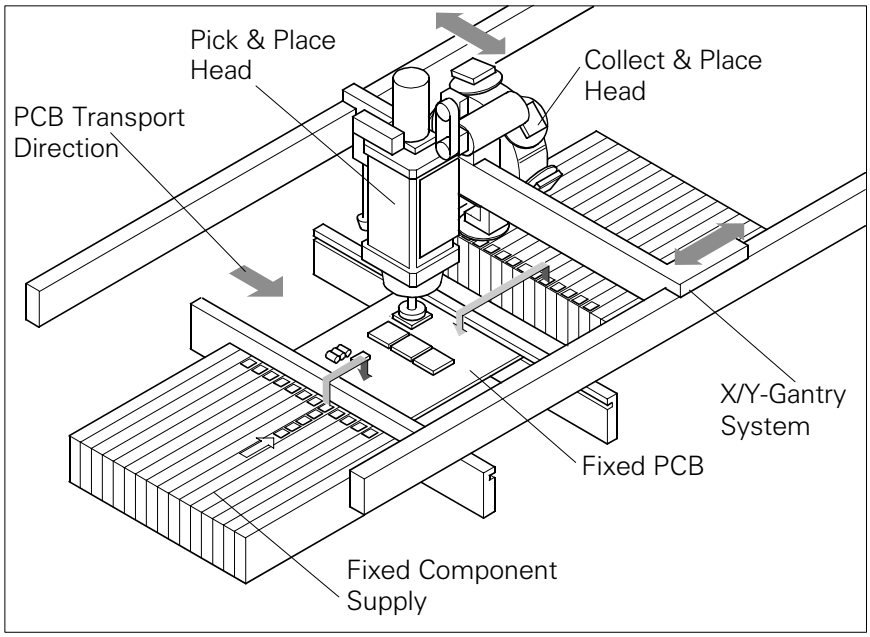
SIPLACE line-level optimization tools generate single set-ups for single products, single set-ups for several products as well as several set-ups for several products. Also, product programs can be transferred from line to line even when the machine configurations are different.

Example of a SIPLACE Placement Line

Placement Heads:
Head Modularity



Placement Heads for SIPLACE F[5] HM



Placement Principle of SIPLACE F[5] HM

Description

Head Modularity offers customized configuration of the Collect & Place Heads. The 6-Nozzle and the 12-Nozzle Collect & Place Head can be interchanged to accommodate changing manufacturing requirements.

The X/Y-gantry features two placement head: the high-precision Pick & Place Head is on one side and the 6-Nozzle or the 12-Nozzle high-speed Collect & Place Head is on the other side of the gantry.

When ordering a SIPLACE F[5] HM it is possible to choose between the 6-Nozzle and the 12-Nozzle high-speed Collect & Place Head. The machines will be built and configured to the requirements.

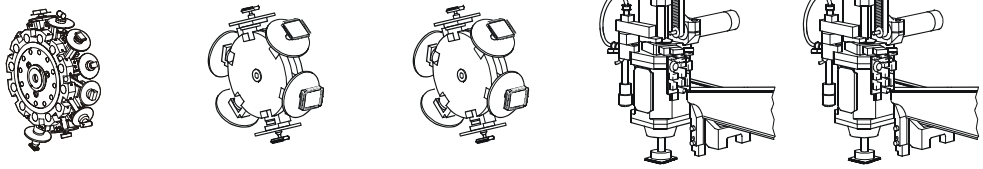
For an exchange of the placement head in the field, ordering the respective head reconfiguration kit (head included) and nozzle changer is recommended.

Exchanging the Collect & Place Heads requires reconfiguration of the station software and recalibration of the machine by trained personnel. Also – if used –the automatic nozzle changer has to be replaced to match the head used. The reconfiguration will take about 8 hours with a trained service technician.

Changing a placement head and reconfiguring a SIPLACE machine when and where required means benefiting from the strength of different placement heads without having the need to invest in several SIPLACE machines.

Placement Heads:
Placement Accuracy
Component Range

Placement Accuracy [a]



Placement Head / Placement Accuracy		12-Nozzle Collect & Place Head	6-Nozzle Collect & Place Head	6-Nozzle Collect & Place Head with DCA	Pick & Place Head	Pick & Place Head with FC
3 Sigma	X/Y Accuracy	67.5 µm	52.5 µm	45.0 µm	37.5 µm	30.0 µm
	Rot.-Accuracy	0.525°	0.225°	0.225°	0.053°	0.053°
4 Sigma	X/Y Accuracy	90.0 µm	70.0 µm	60.0 µm	50.0 µm	40.0 µm
	Rot.-Accuracy	0.700°	0.300°	0.300°	0.070°	0.070°
6 Sigma	X/Y Accuracy	135.0 µm	105.0 µm	90.0 µm	75.0 µm	60.0 µm
	Rot.-Accuracy	1.050°	0.450°	0.450°	0.105°	0.105°

a) As defined in "Scope of Service and Delivery SIPLACE".

Component Range

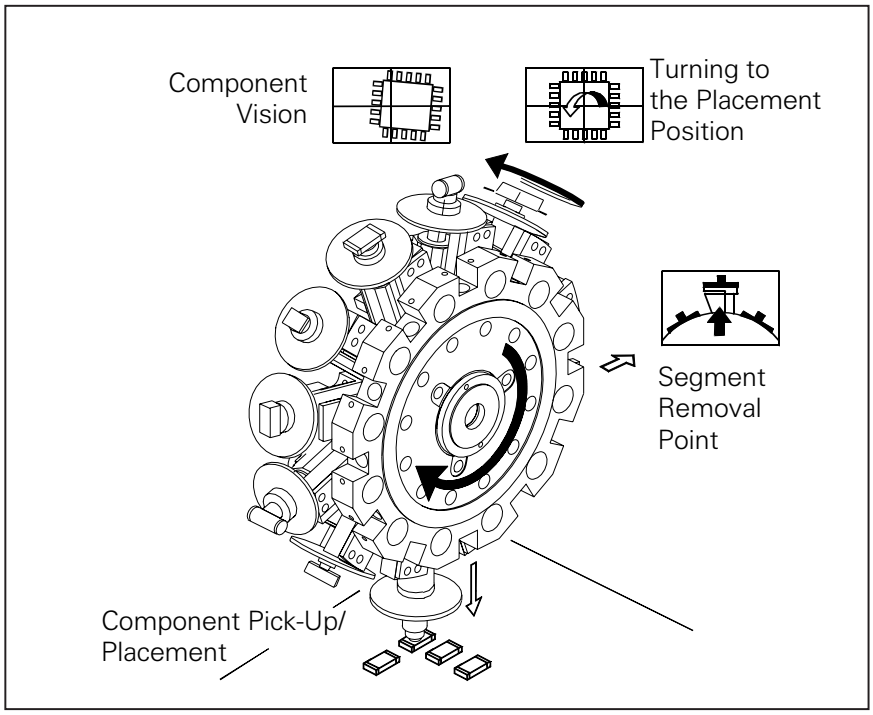
	12-Nozzle Collect & Place Head	6-Nozzle Collect & Place Head	6-Nozzle Collect & Place Head with DCA	Pick & Place Head	Pick & Place Head with FC
Component size	0.6 x 0.3 mm^2 [b] to 18.7 x 18.7 mm^2	1.6 x 0.8 mm^2 to 32 x 32 mm^2	0.6 x 0.3 mm^2 [b] to 13 x 13 mm^2	1.6 x 0.8 mm^2 to 55 x 55 mm^2 92 mm edge length	1.0 x 1.0 mm^2 to 20 x 20 mm^2
Max. component height	6 mm	8.5 mm	8.5 mm	20 mm [c]	20 mm [c]
Max. component weight	2 gr	5 gr	5 gr	25 gr	25 gr
Placement force	2.4 - 5.0 N	2.4 - 5.0 N	2.4 - 5.0 N	1 - 10 N	1 - 10 N
Performance	11,000 cph	8,500 cph	8,500 cph	1,800 cph	1,800 cph
Min. pitch lead / bump	500 / 350 µm	500 / 560 µm	400 / 200 µm	400 / 560 µm	250 / 140 µm
Min. ball / bump diam.	200 µm	320 µm	110 µm	320 µm	80 µm

b) 0201 (recommended to order the special 0201-kit).
c) For components larger than 13.5 mm special mode, for further information please contact SIEMENS.

Placement Heads:
12-Nozzle Collect & Place Head for High Speed Component Placement

Technical Data

Component range	See table on page 6
Stroke of Z-axis	max. 16 mm
Programmable placement force	2.4 to 5.0 N
Benchmark placement rate	11,000 cph
Placement accuracy	See table on page 6



12-Nozzle Collect & Place Head for High Speed Placement

Description

The 12-Nozzle placement head operates on the Collect & Place principle. In contrast to classic chip shooters, the 12 vacuum nozzles of the SIPLACE Collect & Place head rotate around a horizontal axis. This does not only save space:

Due to the small diameter compared to chip shooters, the centrifugal forces are significantly lower. The results are high-speed, reliable placement and the same cycle time for all components.

Components are picked up and placed reliably with the aid of vacuum or a gentle blast of air. A number of vacuum tests indicate whether the component has been picked up and placed accurately.

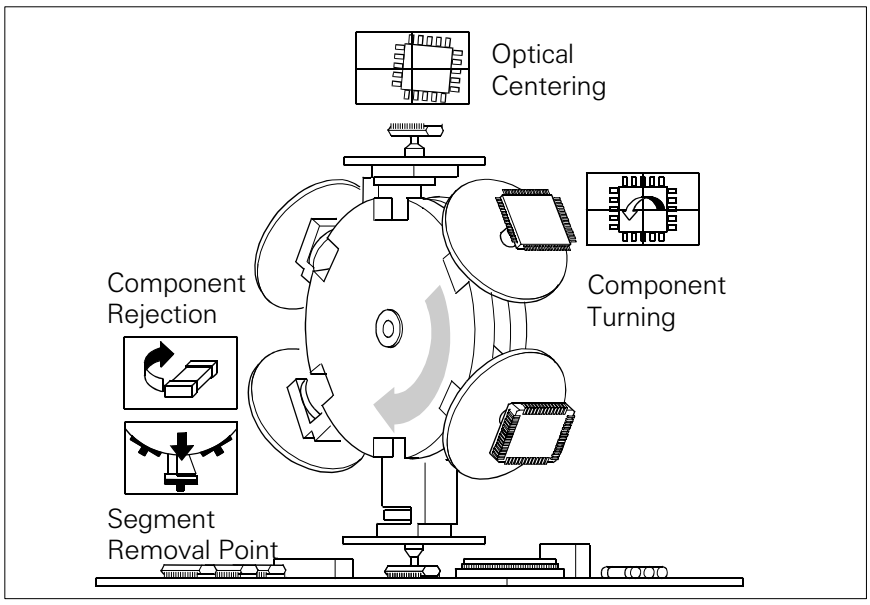
Various control and self-learning functions further enhance the dependability of the system:

- The optical recognition of feeder positions reads the exact position of the feeder table.
- A camera on the placement head (component vision module) determines the exact position of each component on the nozzle.
- Pick-up offsets are corrected prior to placement and subsequent component pick-up points are adjusted by the average of the last ten pick-up offsets. This enables the head to dial-in on the precise pick point for each component.
- In addition, the package form is also checked. If the actual geometric dimensions of the component do not correspond to those programmed, the component is rejected.
- Warpage of the PCB is accommodated by sensor stop activated Z-axis placement. The system also keeps the last ten positions of the z-axis at component placement and uses the average of these values to improve the drive down and place speed of the cycle.
- Components recognized as irregular by the vision system are rejected into a bin, reject feeder or matrix tray and the placements are automatically added during a repair run.

Placement Heads:
6-Nozzle Collect & Place Head for High-Speed Large Component Placement

Technical Data

Component range	See table on page 6
Stroke of Z-axis	max. 16 mm
Programmable placement force	2.4 to 5.0 N
Benchmark placement rate	8,500 cph
Placement accuracy	See table on page 6



6-Nozzle Collect & Place Head for High Speed Placement of large components, Flip Chips and Bare Dies

Description

The 6-Nozzle placement head operates on the Collect & Place principle.

With the standard vision module SIPLACE F^5 HM places components up to a size of 32 mm x 32 mm accurately and rapidly. It greatly enhances performance in the main application range from PLCC 44 to QFP 208.

Equipped with the alternative DCA vision module the 6-Nozzle Collect & Place Head handles components from 0.6 mm x 0.3 mm up to 13 mm x 13 mm. This vision module is part of the DCA-package.

Equipped with the DCA-package SIPLACE F^5 HM is optimized in speed and accuracy for high speed Flip Chip and Bare Die placement. The 6-Nozzle Collect & Place Head with the alternative DCA vision module achieves an accuracy of ± 60 µm at 4 sigma to handle Flip Chips with bump pitch as small as 200 µm.

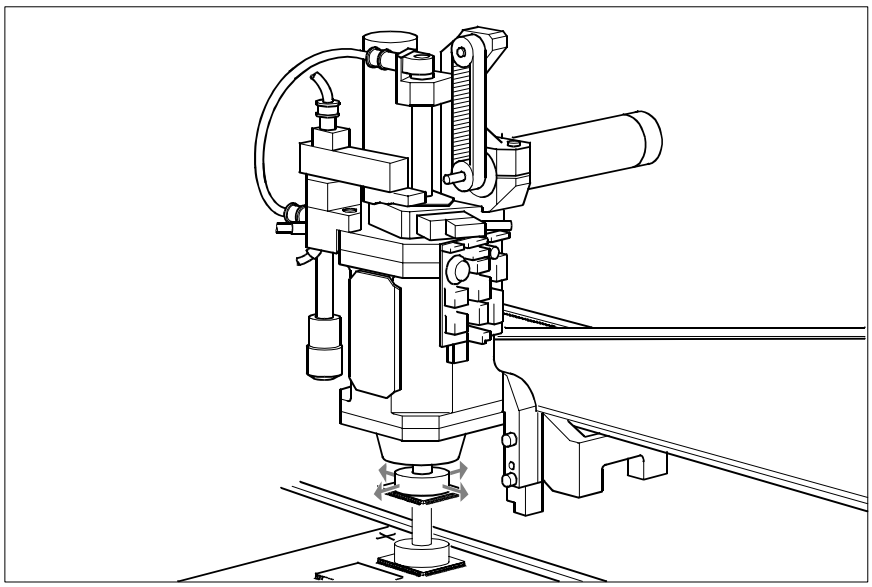
The cycle time of the 6-Nozzle Collect & Place Head – and thus the real achievable performance – depends on the dimensions and the number of leads / bumps of the component.

Mechanically and electrically, the 6-Nozzle Collect & Place Head is structurally very similar to the 12-Nozzle Collect & Place Head.

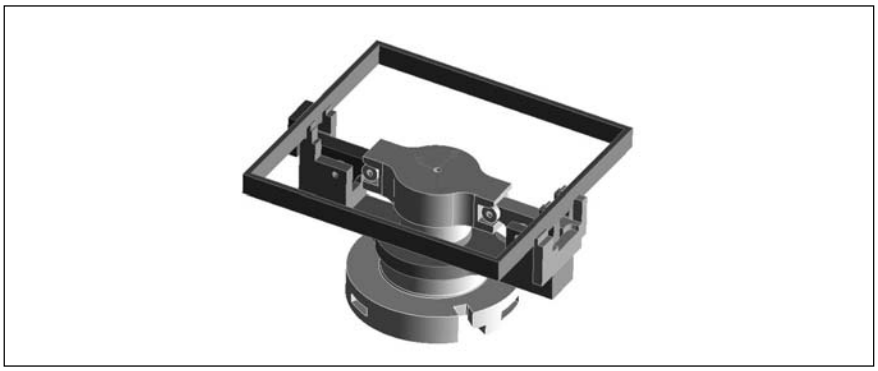
Placement Heads:
Pick & Place Head for High End / High Accuracy Component Placement

Technical Data

Component range	See table on page 6
Programmable placement force	1 to 10 N
Nozzles types	5 standard nozzles including Flip Chip nozzle with nozzle changer, special nozzles and grippers for Odd Shaped Components
Benchmark placement rate	1,800 cph
Resolution of the D-axis	0.005°
Placement accuracy	See table on page 6



Pick & Place Head



Gripper with OSC

Description

This highly developed head operates on the Pick & Place principle. It is suitable for picking up particularly sophisticated or large components as well as non-standard models. High-resolution and intelligent vision modules ensure that the components meet specified tolerances and that the placement position is correct.

The sleeve and nozzle are the heart of the Pick & Place Head. The sleeve is mounted such that it is movable in the longitudinal (Z-axis) and rotational direction (D-axis). Each of the two axes are driven by a DC motor and positioning is done by incremental encoder. Due to the high-resolution glass incremental panel on the sleeve, the Pick & Place Head has an outstanding high rotational position accuracy. The movement of rotation is transmitted directly from the D-axis motor to the driving plate on the sleeve via frictional wheel.

- Special nozzles and grippers increase the component range of SIPLACE F^5 HM. They are either specific for an individual component or for a component family and suitable for the nozzle changer. The gripper can even handle easily components without a surface for vacuum pick-up.
- Flip Chip functionality can be added to the Pick & Place Head with the Flip Chip (FC) component vision module. This FC-package optimizes SIPLACE F5 HM in speed and accuracy for Flip Chip and Bare Die placement. Placement accuracy then reaches ± 40 µm at 4 sigma.

Placement Heads:
Nozzle Changer

Technical Data

12-Nozzle Collect & Place Head

Type of nozzle	All standard nozzles of nozzle series 7xx/9xx (special nozzles must be tested individually)
Capacity	7 magazines, each with 12 nozzles of one nozzle type
Nozzle changing times	About 2 s per nozzle

6-Nozzle Collect & Place Head

Type of nozzle	All standard nozzles of nozzle series 7xx and 8xx (special nozzles must be tested individually)
Capacity	5 magazines, each with 6 nozzles of one nozzle series
Nozzle changing times	About 2 s per nozzle

Pick & Place Head

Type of nozzle	All standard nozzles of nozzle series 4xx (special nozzles must be tested individually)
Capacity	1 to 4 magazines each with 5 nozzles of one nozzle series
Nozzle changing times	About 2 s per nozzle

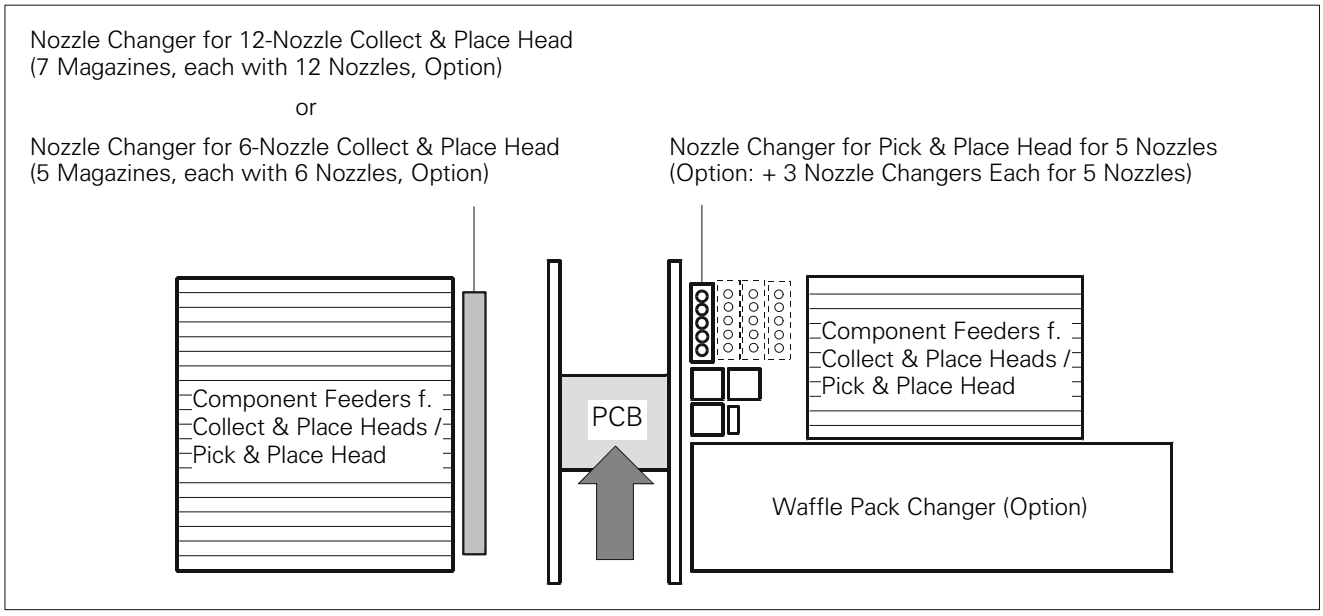
Description

12/6-Nozzle Collect & Place Head

A nozzle changer corresponding to the Collect & Place Head in use can be installed to the left of the PCB conveyor with no loss of feeder capacity. It will change the nozzle set-up of the placement head quickly and reliably for the specific nozzle configuration valid to a job. Damaged or faulty nozzles can be exchanged via the menu function on the station computer.

Pick & Place Head

The SIPLACE F[5] HM is equipped with a nozzle changer for the Pick & Place Head. One nozzle magazine is configured as standard equipment. It can hold 4 standard nozzles and one special nozzle. The changer is mounted on the right-hand side of the PCB conveyor with no loss in feeder capacity. As an option, 3 additional nozzle magazines can be installed with capacity for 5 nozzles each. Nozzles are exchanged automatically during the placement sequence.



Position of Nozzle Changers

Placement Heads:
Flux Dispenser (Option)

Technical Data

Programmable amount	2 µl to 100 µl
Smallest application increment	1 µl
Content of syringe	1 ml
Content of flux reservoir	100 ml
Volume to be applied at the mounting location	Varies by Flip Chip size as well as wetting properties of flux and substrate material
Flip Chip down holding time after placement	0 to 5 s
Increment dwelltime	0.01 s
Minimum waiting time prior to PCB transport	0 to 40 s
Increment waiting time	1 s
Dispensing cycle time	1.5 s including positioning
Rinse cycle	1 to 10 x contents of syringe
Filling level 1	Warning
Filling level 2	Empty (causes machine stop)
Accuracy of dispenser needle positioning	± 0.05 mm

Description

Full Flip Chip capability on the part of the SIPLACE F[5] HM is ensured by a flux dispenser installed directly next to the Pick & Place Head. Immediately prior to placing the component, the placement position is wetted with a low-viscosity flux by means of a dispensing needle.

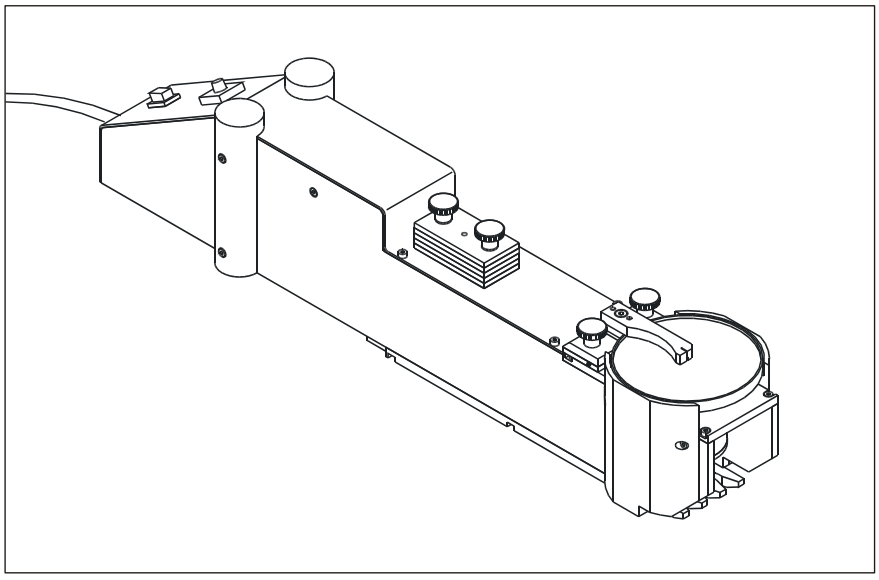
The flux dispenser option essentially comprises one stepping motor with piston, injector and valve to change the operating mode (fill / dispense injector) plus one storage tank. The stepping motor positions the piston over the storage tank to be filled or over the Flip Chip placement location on the PCB for emptying.

A waiting time before start of PCB transport can be programmed, allowing the low-viscosity flux to dry sufficiently. A PCB special conveyor control with adjustable acceleration and deceleration reduces or eliminates the need to hold the board release after placement.

Placement Heads:
Dip Module (Option)

Technical Data (Pick & Place head, 6-Nozzle Collect & Place head)	
Required number of 30 mm feeder slots	3
6 adjustable material film thicknesses by means of precision plates	25, 35, 45, 55, 65. 75 µm
Time consumption for change of material film thickness	< 1 min
Tolerance of gap between blade and disk / tolerance of material of film thickness	±10 µm
Programmable disk rotation time	0 - 10 s (in 0.1 s increments)
Max. rotational speed	0.5 cycles/s (can be attenuated down to 1/3)
Component dip time (dwell time in material film)	0 - 2 s (in 0.1 s increments)
Number of programmable acceleration values for the upward stroke of the nozzle	100
Additional time/comp. for P&P head dipping	Approx. 0.7 s [a]
Additional time/comp. in milliseconds for revolver head dipping versus number of components to be dipped	1 Comp.: 980 2 Comp.: 522 3 Comp.: 370 4 Comp.: 294 5 Comp.: 248 6 Comp.: 217 [b]

a) Depending on distance between Dip Module and Component Camera.
b) Pre-conditions: Travel distance between last pick-up position to first dip position: 160 mm, Maximum speed and no dip time programmed.



Dip Module

Description

The carrier for the material to be transferred is a rotating disk (drum) where a thin film (e.g. 45 µm) of flux or isotropic conductive adhesive is adjusted. This principal is ideal for materials with a high (honeylike) viscosity. Since only the ball/bump bottomside has to be wetted, the transferred amount of material can be brought to a minimum.

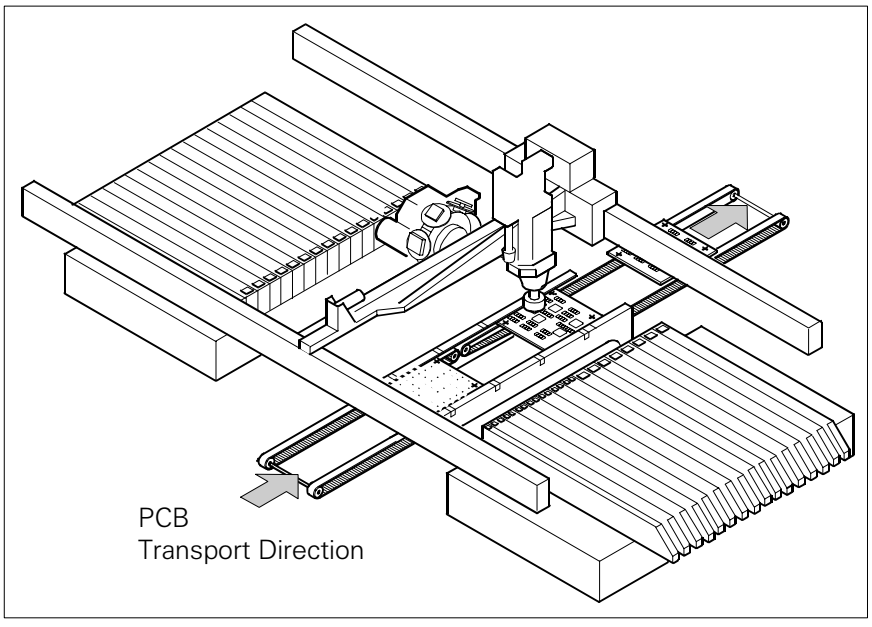
The mechanical and electrical interface of the Dip Module is identical to that one of our feeders. As a result of this, it can be installed at any location in the feeding area.

The flux, respectively the isotropically conductive adhesive is manually applied onto the disk (in the vicinity of the polished, concave area of the blade). The film thickness can be adjusted to a defined value by installing the proper pre-manufactured precision blade plate.

PCB Conveyor:
Single Conveyor

Technical Data

PCB dimensions	See table on page 3
PCB thickness	0.5 to 4.5 mm
Max. PCB weight	3 kg
Max. PCB warpage	Top: 4.5 mm - PCB thickness Bottom: 0.5 mm + PCB thickness
Free space on PCB bottom side	Standard: 25 mm, Option: max. 40 mm
PCB conveyor height	830 ± 15 mm (Standard) 900 ± 15 mm (Option) 930 ± 15 mm (Option) 950 ± 15 mm (Option) SMEMA
Fixed conveyor edge	Right (standard), left (option)
Type of interface	Siemens (standard); SMEMA (option)
Component-free PCB handling edge	3 mm
PCB loading time	2.5 s



PCB Conveyor

Description

On SIPLACE F[5] HM the in-line conveyor system guarantees a quick adjustment to new PCB widths. The change is made either at the station computer using the menu function or from the line computer via the automatic width adjustment unit. Ceramic substrates are also transported and, if necessary, fastened in place with the optional ceramic substrate centering unit.

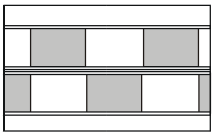
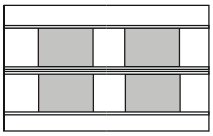
The single conveyor system is standard on SIPLACE placement systems.

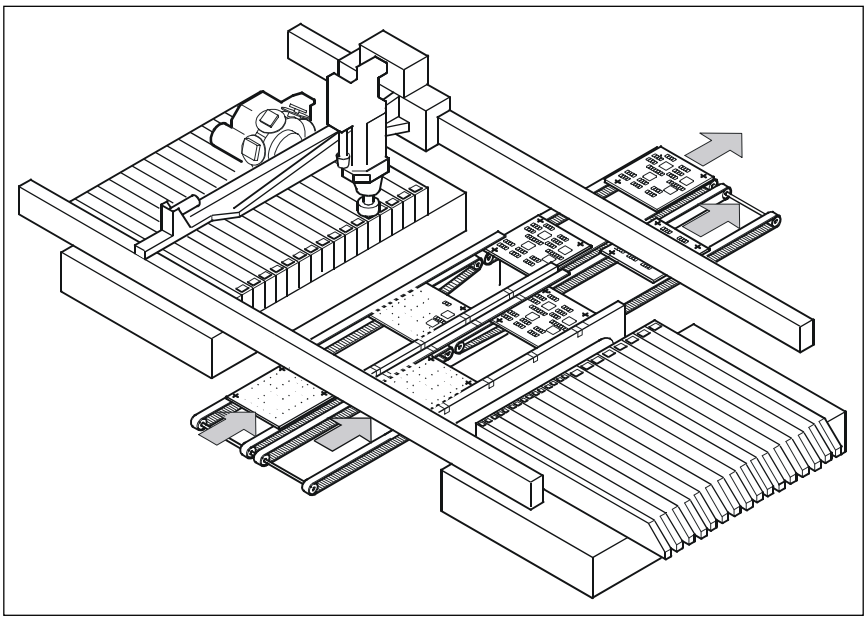
PCB Conveyor:
Dual Conveyor

Technical Data

PCB dimensions	See table on page 3
Fixed conveyor edge	Right (standard), left (option)

Asynchronous and Synchronous Transport on Dual Conveyor

Transport mode	Asynchronous	Synchronous
View		
Placement program per conveyor	same	same or different
PCB width per conveyor	same	same or different
Ink spot recognition	possible	not possible
Automatic width adjustment	possible	not possible



Dual Conveyor with Asynchronous Transport

Description

Thanks to reduced non-productive times the dual PCB conveyor can substantially increase the throughput, depending on the program. It makes it possible to transport two PCBs through the machine simultaneously (synchronous) or alternately (asynchronous).

In the synchronous type of transport it is possible, for example, to finish the top and bottom of the PCB in a single line without using cluster technology.

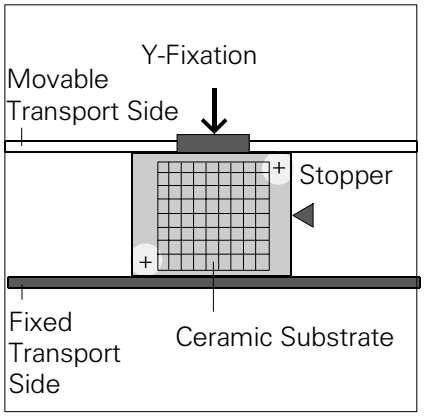
In the asynchronous mode of transport a PCB is moved into the machine in "slack time" while another of the same PCB is being populated. The non-productive time caused by the PCB transport is therefore completely eliminated. The increase in placement speed to be anticipated is between 10% and 30%, depending on the components to be placed on the PCB.

The customer can switch between asynchronous and synchronous dual conveyor with little effort. The optional ceramic substrate centering is possible, but the PCB bar code reading process is not.

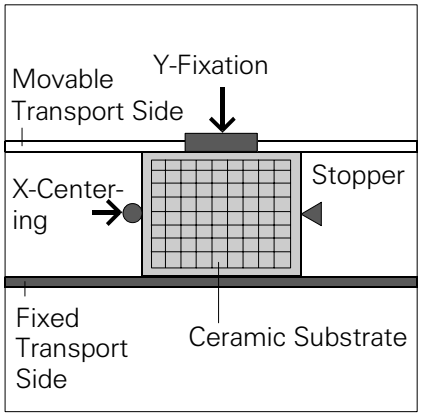
PCB Conveyor:
Ceramic Substrate Centering (Option)

Technical Data

Substrate dimensions	50 x 50 mm² to 101.6 x 177.8 mm² / 2" x 2" to 4" x 7"
Substrate thickness	0.5 to 1.5 mm
Substrate model	Unscribed (no difficulty) Scribed (after test)
Contact in conveyor	2.5 mm
Substrate bottom clearance	12 mm
Compressed air connection	5.5 bar



Optical Centering via PCB Camera



Mechanical Centering

Description

Two methods of ceramic substrate centering are available:

Optical centering

Like the PCB vision module, optical centering of ceramic substrate is conducted with the aid of reference marks (fiducials). Depending on the contrast ratio the machine activates the standard lighting or the oblique lighting contained in the option:

- On ceramic and CM blue light.
- On flexible PCBs using vision module without IF-filter infrared light.

Mechanical centering

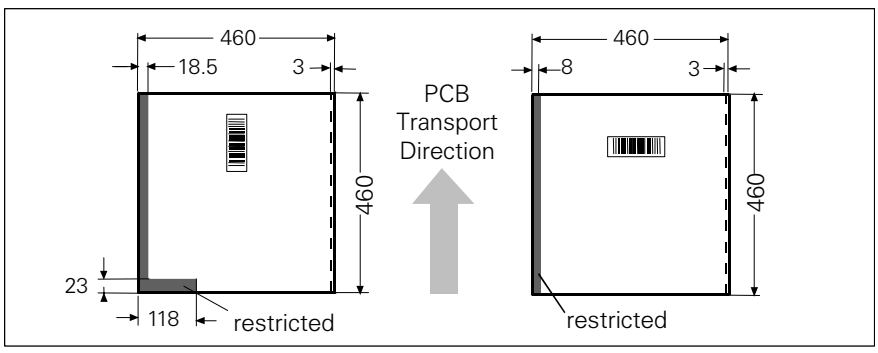
In certain cases, mechanical centering is required, e.g., when placement is to continue to the substrate edge, when handling of the edges of the substrate is to be particularly gentle, or when substrates are scribed. In this gentle, bounce-free procedure, the substrate is fixed in place in the Y-direction between a stop rail and a rocking lever pneumatically centered in the X-direction.

PCB Conveyor:
PCB Bar Code for Production-Controlled Manufacturing (Option)

Technical Data

Bar-code-free PCB edge	3 mm on left and right parallel to PCB transport direction (the additional restrictions shown in figure at the bottom apply for scanning the bar code from above)
Label dimensions	Stroke width: W: 0.19 < W ≤ 0.3 mm (corresponds to high + medium density) Stroke length: ≥ 4 mm [a] Length of scanning window: ≤ 90 mm
Label alignment on PCB [b]	Parallel or at right angles to the PCB transport direction, preferably next to fixed conveyor side
Recommended label colors (contrast ratio > 70% as per DIN 66236)	Color coding: black, dark green or dark blue Background: white, beige, yellow, orange
Code types	Code 39, Code 128 / EAN 128, Codabar, 2/5 IATA 2/5 industrial, 2/5 interleaved, UPC, EAN, Pharma Code, EAN Addendum (more upon request)
Complete bar code	Max. 25 characters Definition of a bar code filter possible
Safety of the laser scanner	Laser diode 670 nm (red) / 1 mW Laser protection class 2, degree of protection IP65
Station and line software	from Version 401.xxx
Scan-in/analysis time	Slack time (T ≤ 1 s), as parallel to the placement of preceding PCB

a) This value can only be met if the bar code label on the PCB moves through the bar code scanner at right angles to the machine's direction of transport.
b) Depending on where the bar code label is located on the PCB, the position of the bar code scanner can be easily adjusted in the input conveyor belt.



Restrictions for Bar Code Reading of PCB Sizes 460 x 460 mm²

Description

Single conveyor

The SIPLACE PCB bar code scanner supports the flexible production of SMD products and enhances placement reliability. It recognizes all code types in general use for industrial applications.

The laser scanner reads the bar code label on the top and/or bottom of each PCB moving during transport. On the basis of the bar code information the line computer automatically selects the correct placement program from the previously prepared bar code assignment list and sends it to the station. This procedure is performed in slack time while a PCB already in the machine is being populated. If a number of PCBs with the same bar code are moved in one after the other, the program is only transferred the first time. The following preconditions apply for all products which are to be manufactured with the aid of the PCB bar code:

- **identical component set-up at the individual machines in the line**
- **all PCBs of same width.**

The bar code filter can be utilized, if only certain information contained in the bar code is relevant.

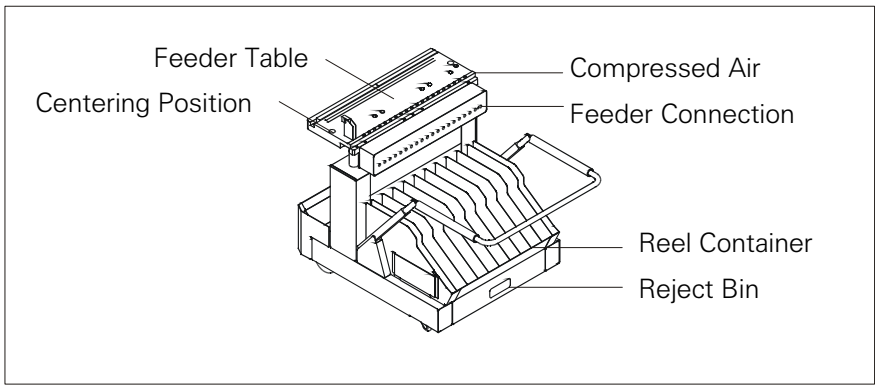
Dual conveyor

With a dual conveyor, the sole purpose of the PCB bar code is to relay the bar code via a GEM interface. This is imperative for utilization. Automatic placement program supply is not possible.

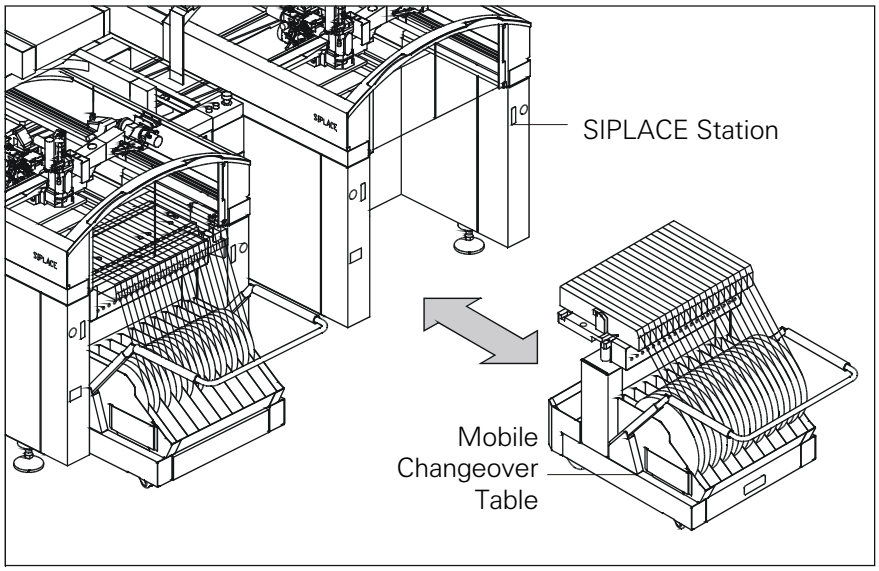
Component Supply: Changeover Table

Technical Data

Insert (exchangeable)	In all SIPLACE placement modules
Feeder locations	59 x 8 mm tracks per table, 118 x 8 mm tracks per machine
Feeder modules	SIPLACE feeders for tapes, stick magazines, Bulk Cases
Accessories	Tape container, waste container, empty tape cutter



Mobile Changeover Table



Exchange of a Feeder Changeover Table

Description

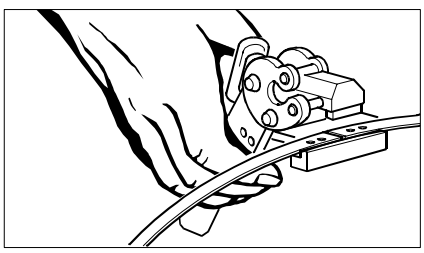
SIPLACE F^5 HM is equipped with two stationary component feeder tables, one on each side of the machine. The component changeover table on the left is standard equipment. As options, either a Waffle Pack Changer with a narrow component table or another changeover table can be placed on the right.

The component feeders are stationary during the placement process, therefore it is possible to refill components or splice tapes without stopping the machine.

Either individual feeders or the entire changeover table can be exchanged during changeover.

Use of component bar codes with the aid of an optional component bar code scanner guarantees the correct assignment of the component to the track.

To make full use of the advantages of the component changeover table, the entire set-up including the check can also be conducted outside the machine at the optional SIPLACE set-up station. The changeover tables are equipped with rollers and have an integrated pneumatic lifting device, eliminating the need for a lifting device. Exchanging the tables takes less than 2 minutes per module.



Splicing Tool

Component Supply:
Tape Feeder

Technical Data

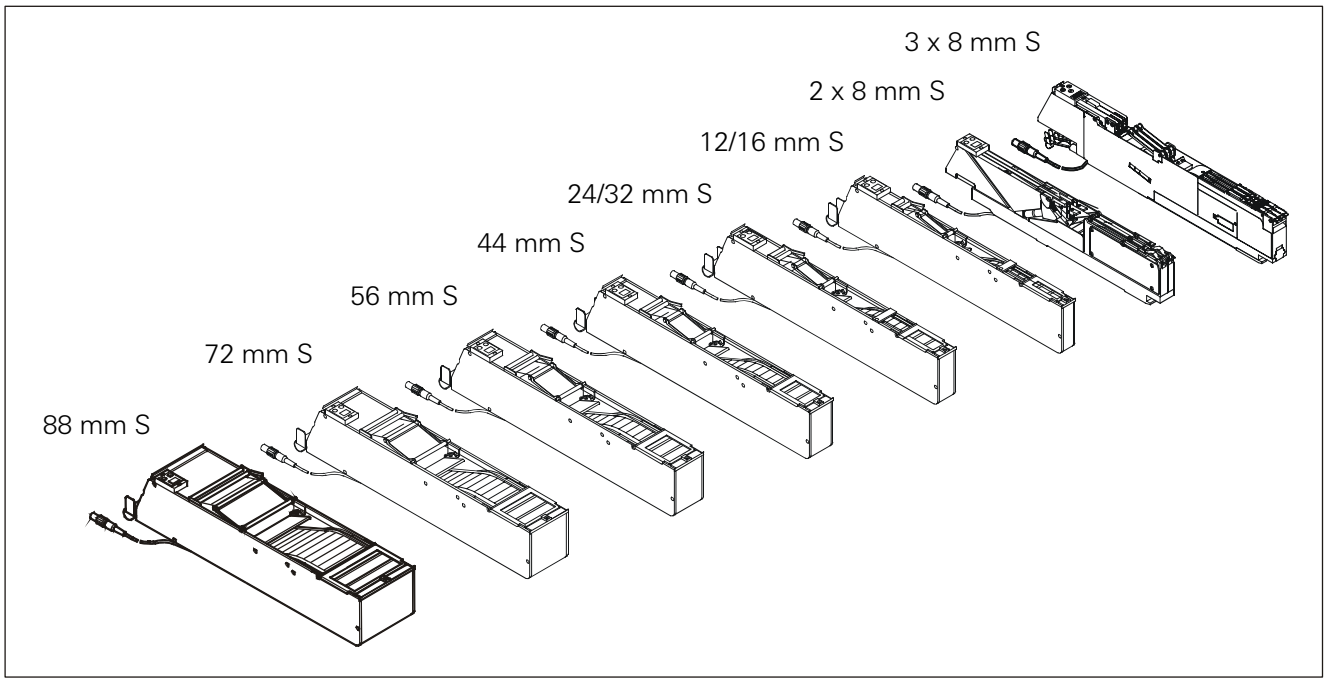
Packaging	Model	Feeder locations	Transport distance	Max. Height of component
Paper and blister tapes	2 x 8 mm S [a]	1	2 or 4 mm	2.5 mm
	3 x 8 mm S	1	2 or 4 mm	2.5 mm
	3 x 8 mm S [b]	1	2 mm	0.7 mm
	12/16 mm S	1	4 - 12 mm [c]	14 mm
Blister tape	24/32 mm S	1.5	4 - 32 mm [c]	14 mm
	1 x 44 mm S	2.5	4 - 44 mm [c]	14 mm
	1 x 56 mm S	2.5	4 - 56 mm [c]	14 mm
	1 x 72 mm S	3	4 - 72 mm [c]	14 mm
	1 x 88 mm S	3	4 - 72 mm [c]	14 mm
Tape reels	ø 7" to 19" (178 - 464 mm)			
Feeder cycle	S-feeder to 20 mm transport distance < 150 ms			

a) Fiducial for recognition of position of feeders;
b) only for 0201 and 0402;
c) adjustable in increments of 4 mm.

Description

The tape reels of the feeder modules are housed in the tape container of the component changeover table. A cutter automatically chops up empty tape coming out of the tape container.

Feeders used on SIPLACE are distinguished by a short cycle time and a high-precision pick-up position. Even product diversity and small batch sizes can be handled easily since the feeder set-up can be changed quickly.
The increment of the tape cycle is just as variable as the use of tape materials. Thanks to the general purpose tape feeding modules which are equally suitable for paper and blister tapes, a small range of module types will be sufficient.
Activated by a signal from the component table, the modules control the entire feeder sequence themselves, including the automatic take-up of the strips.
The S Feeders series feature shorter cycle times and they can handle tapes with 2 mm grids (8 mm S). 8 mm S and 12/16 mm S are equipped with component cover.
The feeders can be used in other SIPLACE machines as well.



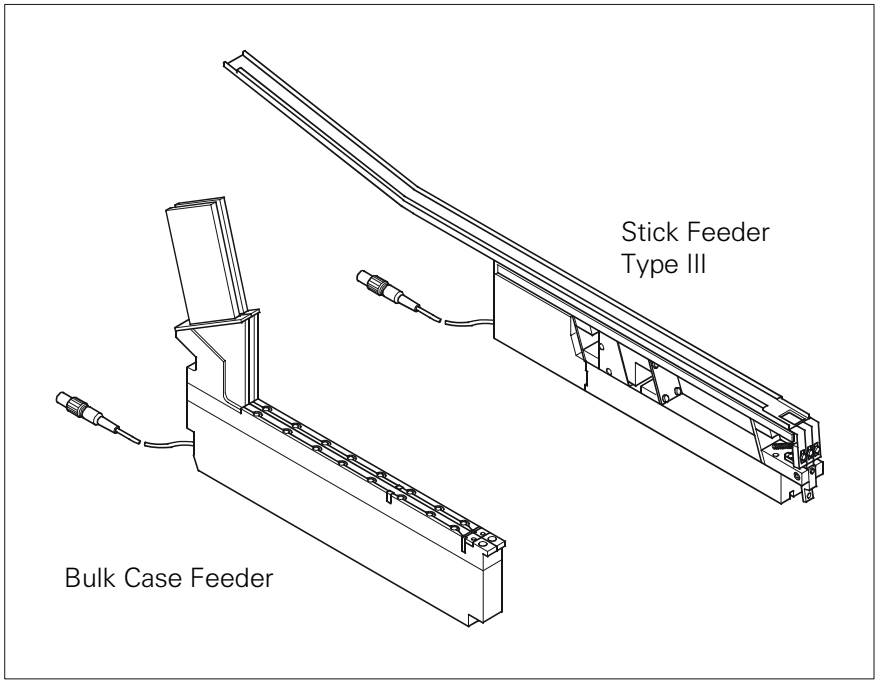
Tape Feeder Modules S

Component Supply:
Bulk Case Feeders, Stick Magazine Feeders

Technical Data

Bulk Case feeder [a] Type of packaging	Bulk Case
Feeder rails for	Chip 0402 component height 0.35 mm Chip 0402 component height 0.50 mm Chip 0603 component height 0.45 mm Chip 0603 component height 0.80 mm Chip 0805 component height 0.45 mm Chip 0805 component height 0.60 mm Chip 0805 component height 0.85 mm Chip 0805 component height 1.25 mm Mini-Melf
Feeder location	1 feeder location for 2 different component types
Stick magazine feeder Type III	With control electronics
Number and width of tracks	3 x 9.5 mm 2 x 15 mm 1 x > 15 mm 1 x 30 mm
Feeder location	1

a) Fiducial to recognize position of feeder.



Bulk Case Feeder and Stick Feeders

Description

The SIPLACE Bulk Case feeder with 2 tracks is used to handle components packaged in standard bulk containers. It transports rectangular and cylindrical passive components to the pick up area of the machine. To replenish the supply, the Bulk Cases are removed and replaced outside the machine eliminating stoppages for replenishment.

Essentially, this feeder module consists of a base which holds 2 feeder rails. The components are separated and transported through the feeder rail via compressed air.

The principle of stationary component tables has been tried and tested specifically with Bulk Case components. Vibrations, which developed when other placement methods are used may cause wear to the components compromising quality and reliability of the components.

The stationary component table also brings decisive advantages for stick magazines. The general purpose vibratory stick feeder can be refilled during the placement process.

The feeders can be used in other SIPLACE machines as well.

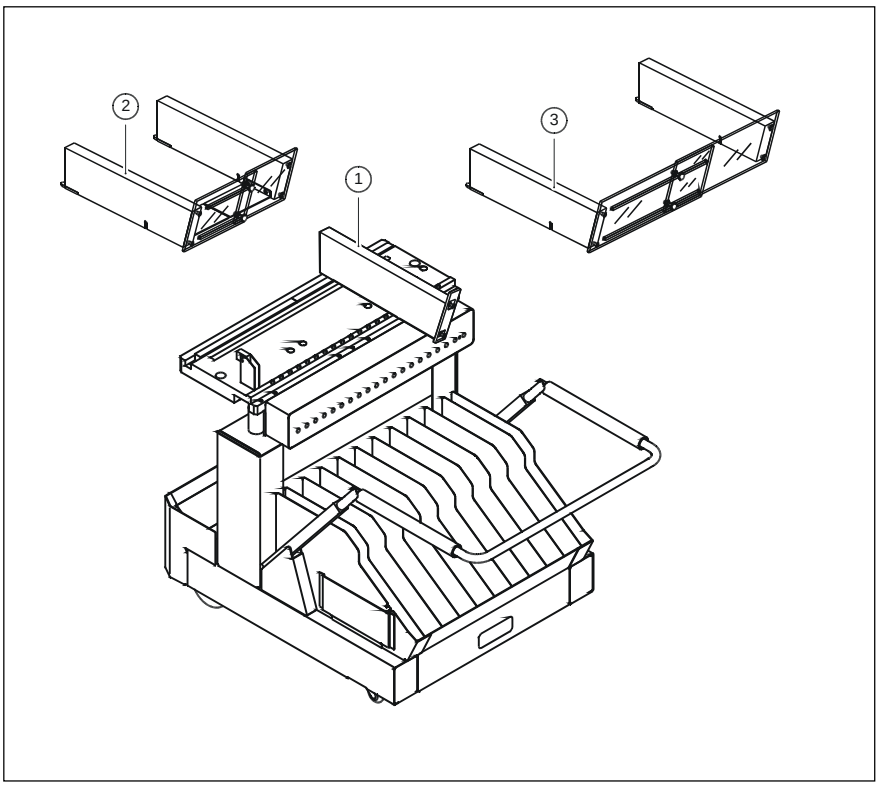
Component Supply:
Guard for Feeder Locations

The following guard-variants can be used:

1	SIPLACE guard for 1 location
2	SIPLACE guard for 6 - 10 locations
3	SIPLACE guard for 11 - 20 locations

Description

Some local safety requirements dictate that all feeder locations must be equipped with feeders. If the feeder set-up does not fill all feeder locations, guards may be used in place of the modules.



Various Guards for Feeder Locations

SAFETY WARNING

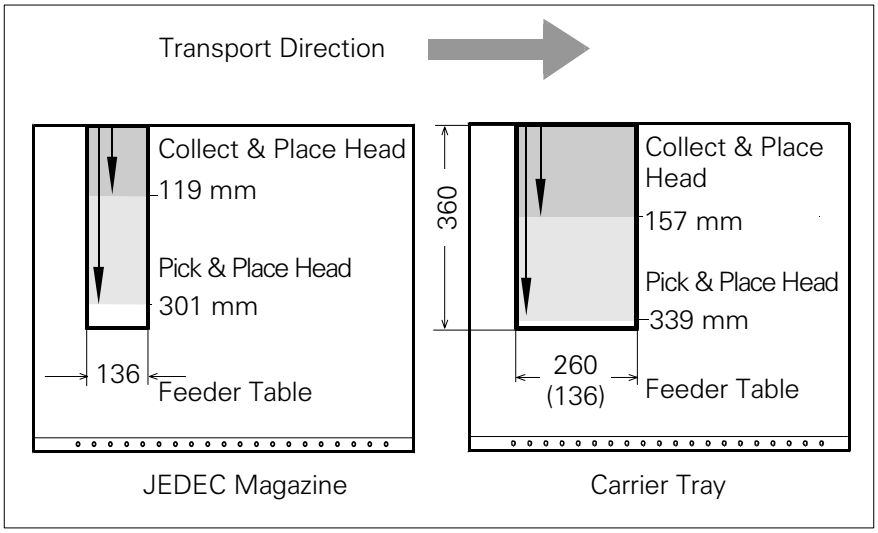
Component Supply: Manual Trays

Technical Data

Sizes	136 x 360 mm²; requires 5 feeder locations 260 x 360 mm²; requires 9 feeder locations
Max. tray height	12.5 mm including component
Parts	Manual tray Carrier tray
JEDEC Waffle Packs	Directly in the manual tray 136 mm wide

Description

The manual tray feeder is one option for picking up components from waffle packs and matrix trays. A number of "manual trays" can be placed on the component changeover tables (right-hand table for Fine Pitch components). This option is recommended if only a few component types are supplied in trays.



Pick & Place Head and Collect & Place Head Access to Manual Tray

Component Supply:
Surf Tape Feeder for Bare Dies

Technical Data

Tape size:	Combi module 8 / 12 / 16 mm
Recommended Bare Die size:	8 mm Surf Tape: 1 x 1 mm^2 up to 2.3 x 2.3 mm^2 12 mm Surf Tape: 2.3 x 2.3 mm^2 up to 5 x 5 mm^2 16 mm Surf Tape: 3.8 x 3.8 mm^2 up to 9.5 x 9.5 mm^2
Component positional requirements:	Size of Bare Die ≤ 2.3 x 2.3 mm^2: ± 100 µm / 6 σ Size of Bare Die ≥ 2.3 x 2.3 mm^2: ± 200 µm / 6 σ (in relation to center of pocket)
Min. space between tape pocket web and edge of die:	0.4 mm (0.015 mil)
Tape specification:	IEC 286-3, DIN-IEC-286, EIA 481 und JIS C 0806
Tape reel diameter:	7" or 15" (178 or 381 mm)
Feeder space	1 slot

Description

The Surf Tape feeder is a specific module for the placement of Bare Dies. The feeding technology is different from a standard feeder and requires a poke-up to remove the component from the carrier.

The Surf Tape feeder is offered as a combination module for 8 / 12 / 16 mm Surf Tape material. To switch from one tape size to the other is done very easily by changing only three parts that are included with the feeder.

The feeding process starts with the transport of the Bare Die to the pick up position. A sensor exactly defines this position. The nozzle moves onto the Bare Die and the vacuum is activated. A poke-up needle moves up and lifts up the Bare Die and the nozzle. At the same time the Surf Tape starts to loose contact with the Bare Die. When there is no contact between the tape and the Bare Die the nozzle moves up and the poke-up needle moves down. The required time for this process depends on different items like storage time of the tape, size of the Bare Die etc. and is adjustable.

For the assembly of Bare Dies please refer also to:

- Surf Tape Feeder
- DCA-Vision
- Flux Dispenser
- Dip Module

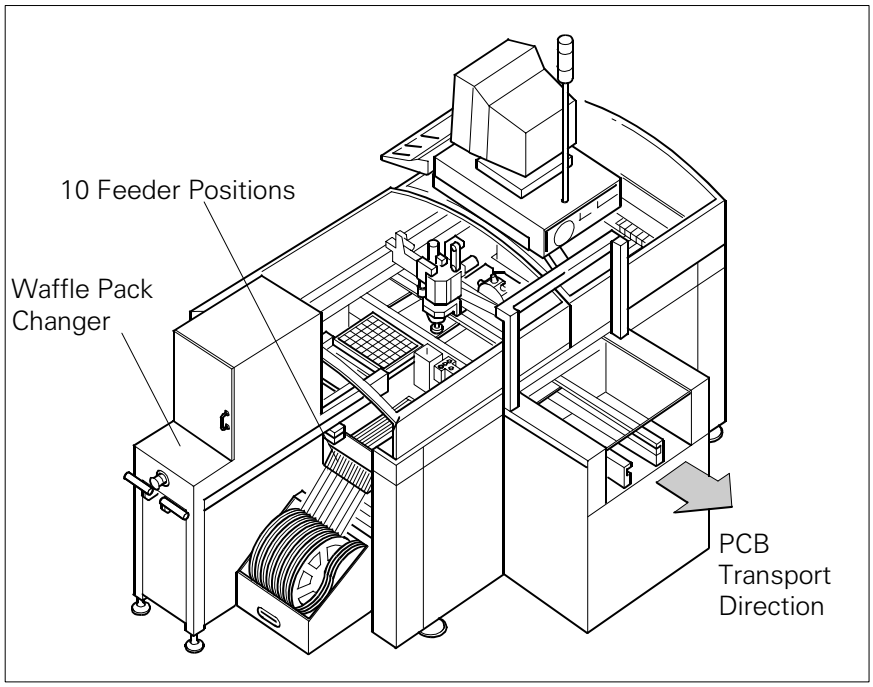
Component Supply:
Waffle Pack Changer (Option)

Technical Data

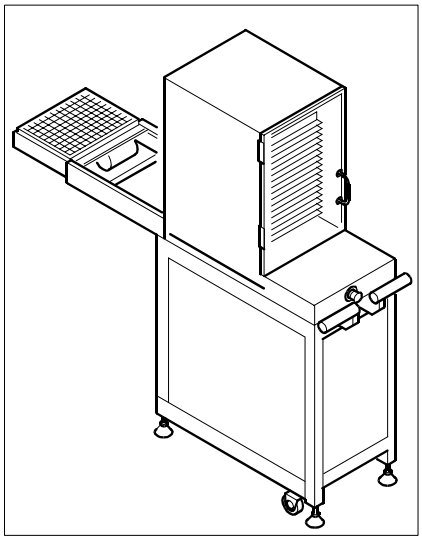
Contents of storage	28 carrier trays for Waffle Packs
Max. magazine size	240 x 340 mm²
Max. tray size 12-Nozzle Collect & Place Head 6-Nozzle Collect & Place Head Pick & Place Head	 ≤ JEDEC Tray ≤ JEDEC Tray ≤ 240 x 340 mm²
Magazine height	15 mm including component
Max. number of component types	200 per Waffle Pack Changer
Changing time per magazine	< 3 s parallel to other substeps during a placement cycle

Description

If a number of Waffle Packs are required during a placement process, the use of the automatic Waffle Pack Changer (WPC) is recommended. The set-up of the WPC is exactly coordinated with the sequence of placement for a work process optimized in terms of path and time. An elevator automatically brings the correct magazine into the access range of the placement head. The magazine for the first component is changed as soon as a PCB moves into the placement conveyor and valid data for cluster and set-up are available.



SIPLACE F⁵ HM with Waffle Pack Changer



Waffle Pack Changer

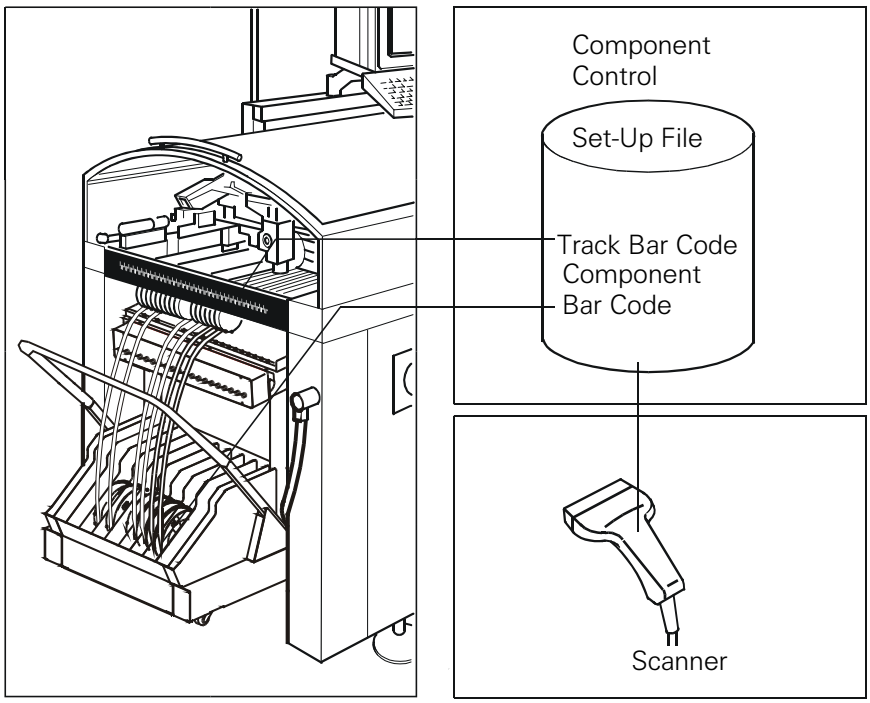
The remaining magazine changes are made in slack time during placement. The magazines can be replenished without any machine idle time. The placement head puts faulty components back where it picked them up.

A narrow component table with 10 locations for feeder modules is also available on the tray changer (sample capacity: 20 tracks of 8 mm each).

Component Supply:
Component Bar Code Scanner for Set-Up and Refill Check (Option)

Technical Data

Connection	Station computer
Data input	Bar code scanner or keyboard
Number of characters	Max. 40
Restrictions	Bar codes beginning with number 1 or 2 and with less than 5 characters
Number of bar codes	Max. 6 per component
Number of filters to extract relevant data	Max. 1 per bar code
Preset code types	Code 39 (standard or full ASCII), Code 2 from 5 interleaved and normal, Code 128, UPC/EAN/JAN codes (more on request)



The scanner checks the corresponding track and the components

Description

The bar code scanner enables a quick and reliable check of component set-up and refill. The bar codes of the tracks and the loaded components assigned to the tracks (bar code labels on tapes, Bulk Cases, etc.) are read in with a hand scanner. An audible and optical signal acknowledges a successful reading operation. If the label is damaged the bar code can be entered at the keyboard.

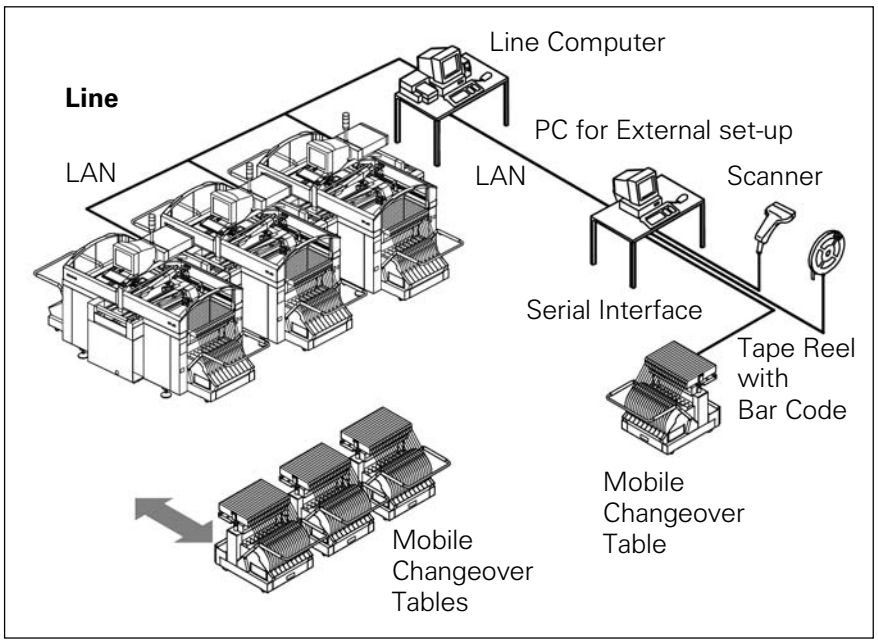
The allocation of the components to their respective track is described in the set-up data. An error message is displayed if the data received from the bar code scanner does not conform to the set-up data.

If the set-up check is switched on, it becomes a mandatory step in the set-up process. If it is switched off the set-up check is optional.

Component Supply:
SIPLACE External Set-Up Station (Option)

Technical Data

Operating system	Windows NT 4.0
Set-up check	Per bar code scanner
Component table change	Time expanded: 2 min / table side



Example for SIPLACE Set-Up Station

Description

The component changeover tables can be set up and checked at an external SIPLACE set-up station quickly and without machine idle time. The costs for production involving a great variety of components are greatly reduced. During the bar code check outside the machine, 10 minutes of machine standstill are eliminated per set-up change. All current data from up to 4 lines are accessible over a link to the line computer via a Local Area Network (LAN).

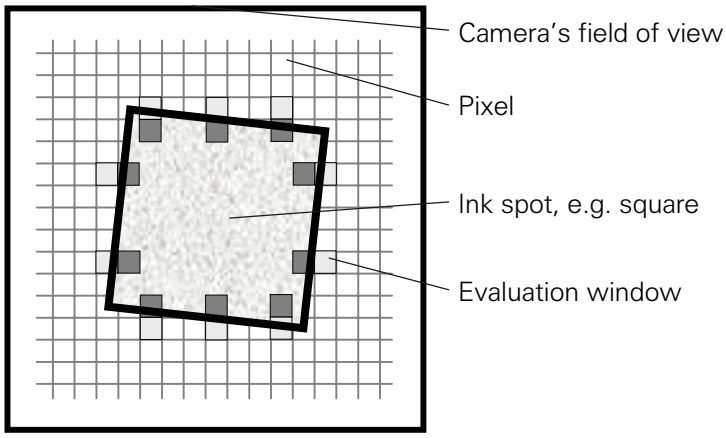
In the case of the SIPLACE F^5 HM a component changeover table is part of the standard equipment. Additional changeover tables are required for optimal use of the set-up station.

Vision Sensor Technology: PCB Vision Module

Technical Data

Reference marks	up to 3 (subpanels and multiple panels)
Local marks	up to 2 per component (may be of different type)
Library memory	up to 255 types of reference marks
Recognition of bad boards	per subpanel
Image analysis	Correlation principle (geometric alignment) based on gray-scale values
Lighting method	Front lighting
Recognition time fiducial/ bad board marks	0.4 s [a]
Camera's field of view	5.7 x 5.7 mm

a) Software 502.xx required.



Geometrical Alignment

Description

The SIPLACE F[5] HM has a number of vision modules and a central vision system to evaluate the recorded image data ensuring high placement accuracy.

At the machine´s X-gantry the PCB vision module is mounted. It is used to find the PCBs´ positioning-offsets within the conveyor system.

This vision module is also required to measure the machine origin and/or the feeder positions on one side of the table. It consists of a single CCD camera with integrated lighting and optics.

The offsets in the position of the PCBs are determined with the help of at least two but generally three reference fiducial marks on the PCB. When the PCB arrives at the placement area the positioning system with its PCB vision module moves to the programmed mark position.

Using the Geometrical Alignment allows to choose predefined marks from a menu (e.g. cross, circle, square). The size of the mark is programmed at the Station Computer. From this time on form and size of the mark is defined and known.

With this data the PCB vision module is able to search and recognize the mark at the predefined position on the PCB or ceramic substrate without further assistance. For this reason it places several small evaluation windows at the assumed border of the mark. Within these evaluation windows the vision system looks for contrast transitions between bright and dark. After finding such contrasts the actual position of the mark can be assigned by comparision with the predefined – and thus known – form and size.

Evaluation operations calculate possible PCB offsets against given values of X-, Y- and Theta-axis.

Saving the mark by teaching is not necessary any more.

Additional functions of the PCB vision module are recognition of the position of the feeders and ceramic substrate (optional) and recording of the machine data including mapping.

In addition, the bad board recognition unit handles "ink spots" with the aid of the PCB vision module.

Vision Sensor Technology: PCB Position Recognition

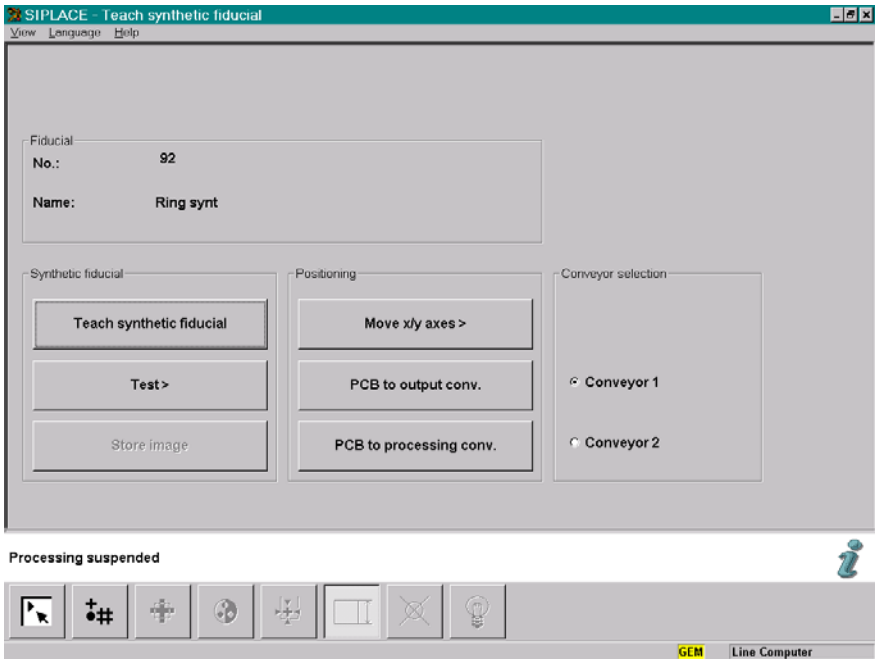
Reference Mark Criteria		
Locate 2 marks Locate 3 marks in addition	X-/Y-position, rotation angle, mean distortion Shear, distortion in X- and Y-direction	
Mark shapes	Synthetic marks e.g., circle, cross, square, rectangle, rhombus, circular ring, square ring, octagonal ring (choose from menu)	
Mark surface: Copper Tin	 Without oxidation and solder resist Warp ≤ 1/10 of structure width, both with good contrast to environment	
Mark dimensions circle cross rectangle/square rhombus	 Diameter: Length and width: Line thickness: Edge length: Edge length:	 0.3 - 3 mm 0.3 - 3 mm 0.1 - 1.5 mm 0.3 - 3 mm 0.3 - 3 mm
Mark environment	Clearance around reference mark not necessary if there is no similar mark structure in the search area	

Description

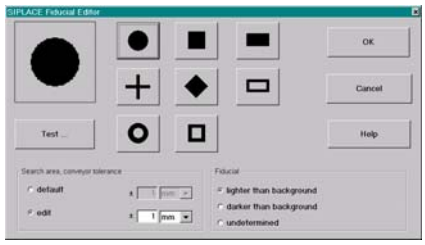
Different reference mark shapes prove to be optimal depending on the condition of the surface.

Particularly advisable for bare copper surfaces with little oxidation is the single cross. Maximum recognition reliability is achieved due to the high information content. Rectangle, square and circle are less "informative" but save space, are rugged, and can even be used when oxidation is at an advanced stage.

Advisable for tinned structures are circle or square because in this case the ratio of the mark dimensions to the presolder thickness is particularly favorable.



Teach Synthetic Fiducial



Fiducial Editor

Vision Sensor Technology: Bad Board Recognition Position Recognition of Feeder

Ink Spot Criteria	
Evaluation method for fiducials for structures	 brightness method contrast method
Shapes and sizes of fiducials/structures for	
brightness method	square or circular forms edge length/diameter 0.3 - 5 mm
contrast method	rectangular forms edge length 0.3 - 5 mm
Masking material	mat dark (light-absorbing) not recommended: white or shiny
Ink spot recognition time	0.3 s for each method

Description

In the cluster technology each subpanel is assigned an ink spot. If this is present during the measurement via the PCB vision module, the corresponding subpanel is populated. It is also possible to accomplish the population of the subpanel when the ink spot is missing. With this function it is possible to eliminate costs due to unnecessary population of faulty subpanels.

Global Ink Spot

Each bad board evaluation needs time, so naturally the consumed time increases with the number of subpanels per PCB. Using a global ink spot can result in a significant reduction of these secondary times.

The PCB vision module searches at positions taught before for the defined fiducial. In case of recognition there is no following evaluation of subpanels. The system allows the customer to choose also the opposite interpretation.

Position Recognition of Feeder

The pick-up position of the components can be determined precisely with the aid of the position recognition of the feeder. It is activated each time after a change of feeder or component table. The offset in position relative to the stored ideal position is determined on the basis of fiducials on the feeder modules using the PCB vision module. This provides a very high pick-up reliability even for the very first component. This is particularly important with small components.

Vision Sensor Technology: Algorithms to determine the X-/Y-Position and the Rotation Angle of Components

Algorithm	Component	Determined on the basis of
Size Driven	Chip	the component's out line (profile/gradients)
Row Driven	IC	several component leads (correlation method)
Corner Driven	IC	all component leads (correlation method)
Lead Driven	Complex IC	each component connection (**H**igh-**A**ccuracy-**L**ead-**E**xtraction method)
Grid/Ball/Bump	BGA, µBGA, Flip Chip	all defined balls and bumps (gradients/ball or bump centering)

Description

The component vision modules perform a critical contribution to placement accuracy and reliability. It dependably recognizes all package forms (= geometric dimensions of the component) illuminated at various angles from a number of planes. To illuminate each component optimally, the luminosity of the individual planes can be adjusted individually in 256 levels.

Aside from the dimension of the SMD component, the vision system determines the lead number and pitch (lateral IC lead bend) as well as the rotation angle and X-/Y-offset. Components which are not suitable are rejected and automatically corrected in a repair cycle. Rotational and X-/Y-offsets are corrected at the turning station of the Collect & Place Head or via the gantry axes. A relevant X-/Y-pick-up offset is calculated from the positions of a number of components from one track. This is factored in accordance with the self-learning principle during the subsequent pick-up of components.

Prior to placement the required geometrical dimensions of one component type are entered into the package form (GF) editor, creating a synthetic model of the SMD module. This task is simplified by the comprehensive on-line information and Help system. Later the central SIPLACE vision system, to which all other vision modules are connected, analyzes the gray-scale picture of the component vision module. To this end, suitable algorithms are used for the pertinent package type. Due to the combination of algorithms, the vision system also functions reliably under the most difficult conditions, e.g., in the case of different reflection behavior by the leads or disruptive influences from the outside.

The algorithms are used for all component vision modules.

Vision Sensor Technology:
Standard Component Vision Modules for 12- and 6-Nozzle Collect & Place Head
DCA-Vision Module for 6-Nozzle Collect & Place Head (Option)

Standard Component Vision Module for the 12-Nozzle C & P Head	
Maximum component size	18.7 x 18.7 mm^2
Component Range	See table on page 6
Camera's field of view	24 x 24 mm^2
Illumination	Front lighting (3 freely programmable planes)

Standard Component Vision Module for the 6-Nozzle C & P Head	
Maximum component size	32 x 32 mm^2
Component Range	See table on page 6
Camera's field of view	39 x 39 mm^2
Illumination	Front light (2 freely programmable planes)

DCA-Vision Module for the 6-Nozzle C & P Head	
Component size:	maximum 13 x 13 mm^2 / minimum 0.6 x 0.3 mm^2 (0201)
Component Range	Flip Chips, Bare Dies, Standard SMDs
Camera's field of view	15.6 x 15.6 mm^2
Illumination	Front light (4 freely programmable planes)

Description

Standard Component Vision Module for 12- and 6-Nozzle Collect & Place Head

The standard component vision module is directly integrated into the Collect & Place Head. While the component is cycling into the next station of the Collect & Place Head, the recorded image is evaluated by the central vision system. The component rotation is then corrected by the appropriate angle based on the position offsets determined with vision inspection.

DCA Vision Module for the 6-Nozzle Collect & Place Head

The DCA vision module was developed specifically for secure, fast and reliable recognition of Flip Chips and Bare Dies. But also standard SMDs can be handled with this vision module including 0201 capacitors and resistors.

The DCA vision module is integrated into the DCA package, which is one of the options available for SIPLACE F^5 HM. This option offers the possibility to process with one machine SMDs, Flip Chips and Bare Dies without problems achieving a maximum of flexibility.

The DCA-Vision Module option replaces the Standard Component Vision Module.

Vision Sensor Technology:
Standard Component Vision Module for the Pick & Place Head
Flip Chip Vision Module for the Pick & Place Head (Option)

Standard Component Vision Module for the Pick & Place Head	
Max. component size	32 x 32 mm² (single measurement) 55 x 55 mm² (multiple measurement) 92 mm edge length
Component range	See table on page 6
Camera's field of view	38 x 38 mm²
Illumination	Front light (4 freely programmable planes)

Flip Chip Vision Module for the Pick & Place Head	
Min. component size	0.6 x 0.3 mm² (0201)
Max. component size	7 x 9 mm² (single measurement) 20 x 20 mm² (multiple measurement)
Placement cycle	min. 2 s (depending on number of bumps)
Camera's field of view	9 x 11.5 mm²
Illumination	Front light (3 freely programmable planes)

Description

Standard Component Vision Module for the Pick & Place Head

The Standard Component Vision Module operates according to a sophisticated lighting technology and utilizes diverse analysis algorithms. Despite the great diversity of components it boasts very high recognition reliability with all SMD modules. Like all other vision modules, this one is also connected to the station's central vision system.

The components are illuminated from four lighting planes whose intensity can be adjusted in 256 increments. This enables an optimal illumination of each component. The gray-scale picture recorded is analyzed using the algorithm best suited for the package form.

ICs, Flip Chips and IC-sockets are centered using leads or bumps. In the case of chips, bare chips for subsequent wire bonding and odd-shaped components, centering is based on outline measurement.

A special inspection mode for the critical IC lead ends (HALE) precisely determines the lateral lead bend as well as pitch error and lead offset. This greatly reduces the risk of short circuit soldering defects.

The rotational angle deviation and the X-/Y-offset of the component relative to the nozzle center is ascertained and factored in during placement. The X-/Y-offset also results in the correction of the pick-up position.

In order to have the vision module center a component, it must first be described geometrically in the package form (GF) file.

The component test software makes it possible to check the component definition at the station to determine whether adjustments, in lighting for example, are necessary. These adjustments are automatically assigned as a file to the pertinent package form which represents a component type. Hence they are valid for all of the machines in a line. As the final step, the GF number of the component type is entered in the component file.

Flip Chip Vision Module for the Pick & Place Head

The Flip Chip Vision Module extends the capability of processing Fine Pitch and Flip Chip components. This add-on module offers a far higher resolution than the Standard Component Vision Module. At optimal illumination, the imaging of the bumps is as large as possible and the orthogonal disruptive structures (e.g., chip printed conductor tracks) are suppressed. In the event of less pronounced disruptive structures, the intensity of each lighting level can be increased. The result is high recognition reliability even with usually square surfaces of bumped Flip Chips used with conductive adhesive technology.

Special search algorithms are used to recognize the bumps (balls) on surfaces where fault conditions usually prevail.

For Flip Chip, CSP, BGA technology see also:

- Surf Tape Feeder
- DCA-Vision
- Flux Dispenser
- Dip Module

Vision Sensor Technology:
Coplanarity Module for the Pick & Place Head (Option)

Accuracy of the coplanarity module
Uncertainty of checking in case of real components

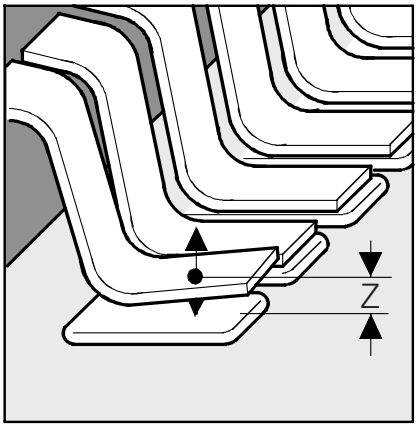
Dimension	Accuracy
55 x 55 mm^2	22 µm/3 σ [a]

a) This accuracy is for big components with tough pin materials. For normal and smaller components accuracy and repeatability are substantially better.

Description

The optional coplanarity check further enhances placement reliability. This check is always conducted right after the deviation of position is ascertained with the Fine Pitch vision module of the Pick & Place head.

The coplanarity module is installed next to the PCB conveyor along with the Fine Pitch vision module of the Pick & Place head.



Effects of coplanarity (lateral bending of leads) of a populated component

One of the biggest problems in Fine Pitch technology, the coplanarity of leads, can be largely eliminated by taking one additional step during inspection. The coplanarity module is employed to conduct a contactless, sequential vertical scanning of the IC lead structure on the basis of the laser triangulation principle. The height profile thus obtained for all of the rows of leads is used to calculate the placement plane of the IC. The programmed tolerance band based on this placement plane then becomes effective.

If even one lead is outside this placement area, the component is excluded from the placement process. It is gently placed back in the Waffle Pack, entered on the repair list and automatically repaired.

The component picked up by the placement head may be crooked, e.g., because one surface of the package is not parallel to the row of leads. The calculation of the placement eliminates any influence this might have on placement however.

As the result of extensive security measures, the laser can only be operated in the closed machine. It then conforms to **Safety Class 1** (not dangerous for eyes and skin).

Barring manipulation of the protective devices, the laser will not operate outside the machine. Following impermissible tampering, the laser complies with Class B.

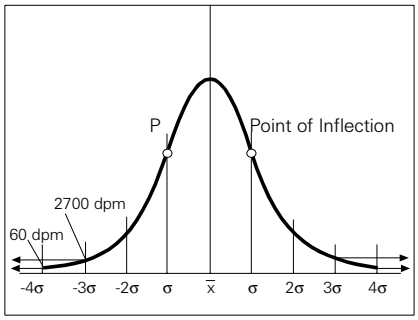
On SIPLACE placement systems the component which is picked up is placed on the PCB immediately after the coplanarity check. This procedure ensures that no change can occur after the check as the result of any subsequent mechanical influence. Unlike other designs, with SIPLACE machines it is not necessary to pick up the component again or to transport it in a special pick-up movement.

Machine Criteria:
Placement Accuracy

Technical Data Gantry

Drive	Brushless AC Temperature Controlled Motor
Position measuring system (X/Y)	Linear scales
Resolution of X-/Y-axis	1 µm
Speed of X-axis	max. 2 m/s
Speed of Y-axis	max. 2.5 m/s

Placement Accuracy see table on page 6



Standard Deviation – dpm

Description

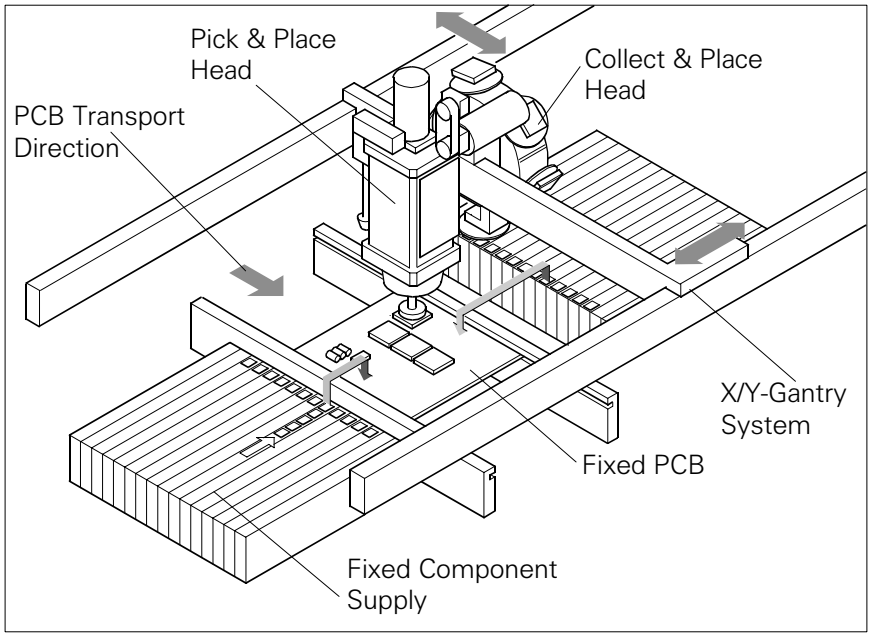
Various factors contribute to the placement accuracy of the SIPLACE F[5] HM machine, e.g., the stationary PCB during the placement process. As no accelerations are acting on the placed components, their position continues unchanged. The PCB moves in and out at a coordinated speed which is automatically reduced just before the nominal position is reached.

A further guarantee for long-term high placement accuracy is the position recognition of the axes of the gantry and placement head by means of optical scanning by incremental encoders. Revolving star and segments of the Collect & Place Head are positioned by means of high-resolution glass incremental panels. The X- and Y-axes are positioned with the help of the metal scales on each gantry axis.

To determine the placement accuracy on SIPLACE machines, highly precision glass components with mounted structures are placed on a dimensionally accurate glass mapping plate. The results are statistically evaluated and presented as a Gaussian standard distribution. In the case of the 6-Nozzle Collect & Place Head the placement accuracy is ± 70 µm at a statistical reliability of 4 sigma. In other words, of one million placed components, 60 are outside the specified tolerance (= 60 dpm). If the accuracy value ± 70 µm is divided by the sigma value 4, the result is the standard deviation S of 1 sigma = ± 17.5 µm.

A machine capability analysis is conducted for each machine acceptance test.

Machine Criteria:
Placement Reliability



Placement Principle SIPLACE F[5] HM

Description

In addition to correct positioning, placement reliability is important.

On the SIPLACE F[5] HM this is ensured through a number of control functions, such as vacuum checks and component vision testing during the placement sequence.

Out of tolerance components are rejected, placed on the repair list and automatically processed during a repair cycle. An offset in the position of the PCB relative to the conveyor system (PCB vision) and an offset of the X-axis, Y-axis or rotation of the component relative to the midpoint of the nozzle (component vision) trigger an immediate correction to ensure placement accuracy.

Since the PCB is fixed, the components remain in the exact position they are placed. The stationary component table ensures a precise pick up. Options, such as the component bar code scanner, can be added to further enhance reliability.

Pick-up errors

All errors that occur between the time the component is picked up and the time it is placed on the PCB are pick-up errors. They include:

- No component in the tape
- Component cannot be removed from the tape.
- Vacuum error
- Vision error due to faulty component
- Vision error due to unrecognized component
- Component out of tolerance

Placement errors

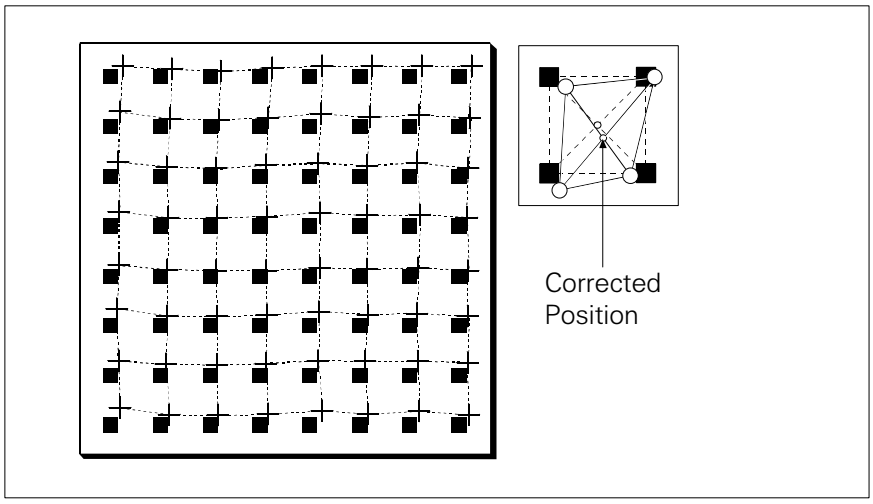
Errors that occur after the component has been placed on the PCB. They include:

- Rotation error
- Too many components on PCB
- X/Y-offset

Machine Criteria: Mapping (Option)

Technical Data

Dimensions of the mapping test plate	520 x 460 mm^2 (for single conveyor) 520 x 215 mm^2 (for dual conveyor)
Number of measurement points	13 x 11 (standard resolution) 26 x 21 (high resolution)
Ambient temperature during calibration	+ 20° ± 3°C
Components of the option	Test plate (special glass) Calculation data (disk) Case for secure storage



Nominal Grid of Mapping Plate and Actual Grid with Deviations Due to Gantry

Description

Despite the highly stable machine frame, slight distortions of the gentry axes cannot always be avoided. With the aid of the mapping process the high placement accuracy of the machine is preserved throughout its entire service life.

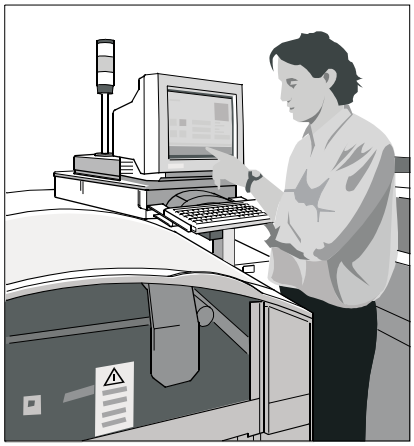
With this calibrating procedure, which can be conducted quickly and easily, the PCB camera recognizes the fiducials on a mapping calibration plate placed in its operating area. Any distortions are revealed by comparing the nominal grid on the glass plate with the actual grid "drawn" by placement head. These distortions are taken into account during all further positioning of X-/Y-axes and thus compensated for.

SIPLACE Software Architecture: Line Computer / Station Computer

Functions

Line computer	Programming Optimization Line control Line monitoring Data management
Station computer	Machine control Machine monitoring Machine operation
Softwareversion	From 406.xx

Line Computer



Station Computer

Description

The UNIX line computer is assigned the following interstation tasks: creation, revision and management of placement programs, job data and component and GF libraries; automatic, optimized generation and administration of machine set-ups (set-up optimization, set-up editors, optional set-up sequence optimization); determination of optimized travel for gantry and nozzle assignments of the Collect & Place Heads; control and supply of data to SIPLACE machines in a line; calculation, storage and display of machine and operating data; data backup on built-in magnetic tape drive.

The Windows station computer in conjunction with the machine controller with its realtime capability performs the following jobs: digital control of the machine gantry systems; control of PCB input and output and of PCB transport; monitoring functions, handling of malfunctions and output of error messages (including Help system); ensuring the optimal quality of the placement process; optional loading control by means of component bar code and optional placement program change by means of PCB bar code.

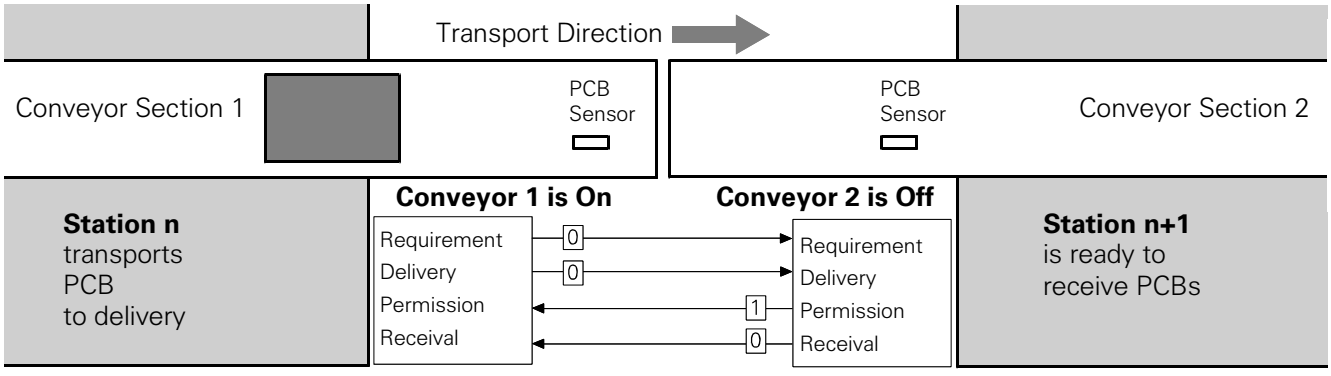
For more detailed information please see “SIPLACE Software Specification”.

Technical Data:
Signal Interfaces

Signal Interface (20-Pin Ribbon Cable Connector)

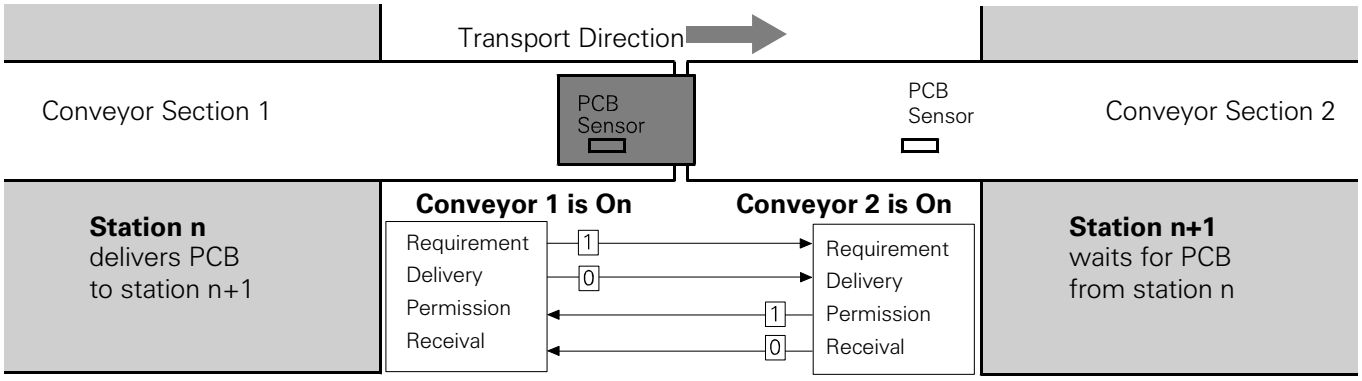
to upstream station x3		to downstream station x4	
Pin 13	GND 24 V	Pin 10	Reserved
Pin 14	Arrived	Pin 9	Reserved
Pin 15	Permission	Pin 8	Reserved
Pin 19	Request	Pin 4	+30 V DC unsaturated
Pin 20	GND 24 V for request / released (contact separation)	Pin 5	GND 24 V
Pin 18	Released	Pin 6	+24 V DC
Pin 12	Trouble signal loop	Pin 11	Trouble signal loop
Pin 11		Pin 12	
Pin 3	+24 V DC	Pin 15	Permission
Pin 2	GND 24 V	Pin 13	GND 24 V for permission / arrived (contact separation)
Pin 1	+30 V DC unsaturated	Pin 14	Arrived
Pin 8	Reserved	Pin 18	Released
Pin 9	Reserved	Pin 19	Released
Pin 10	Reserved	Pin 20	GND 24 V

1. After switching-on the station

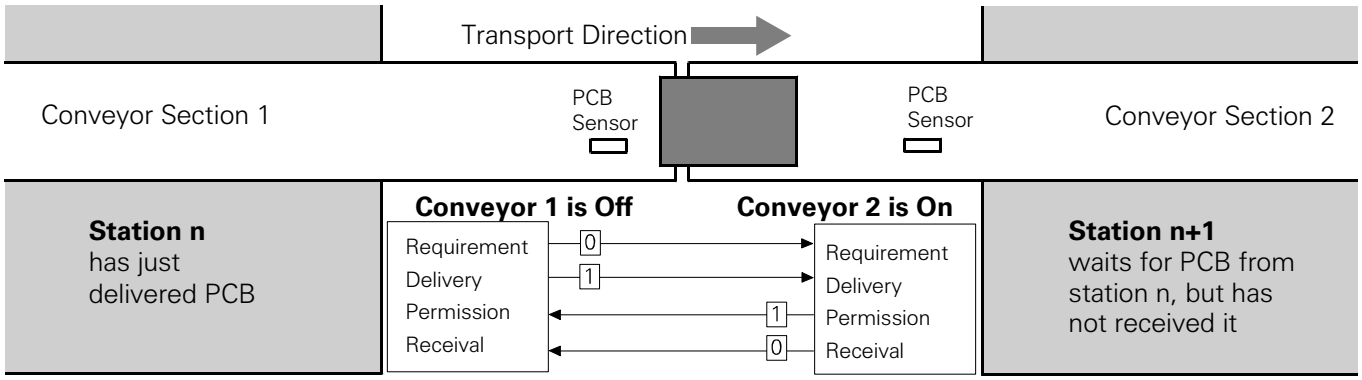


Technical Data:
Signal Interfaces

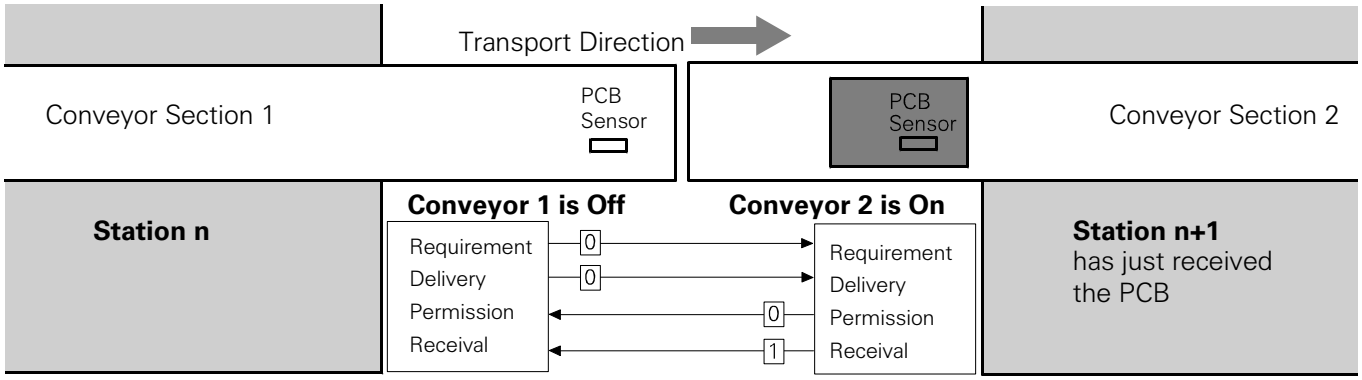
2. PCB handling has started



3. PCB is at delivery



4. PCB transport is finished



A detailed documentation of the PCB transport signal interface is available on request.

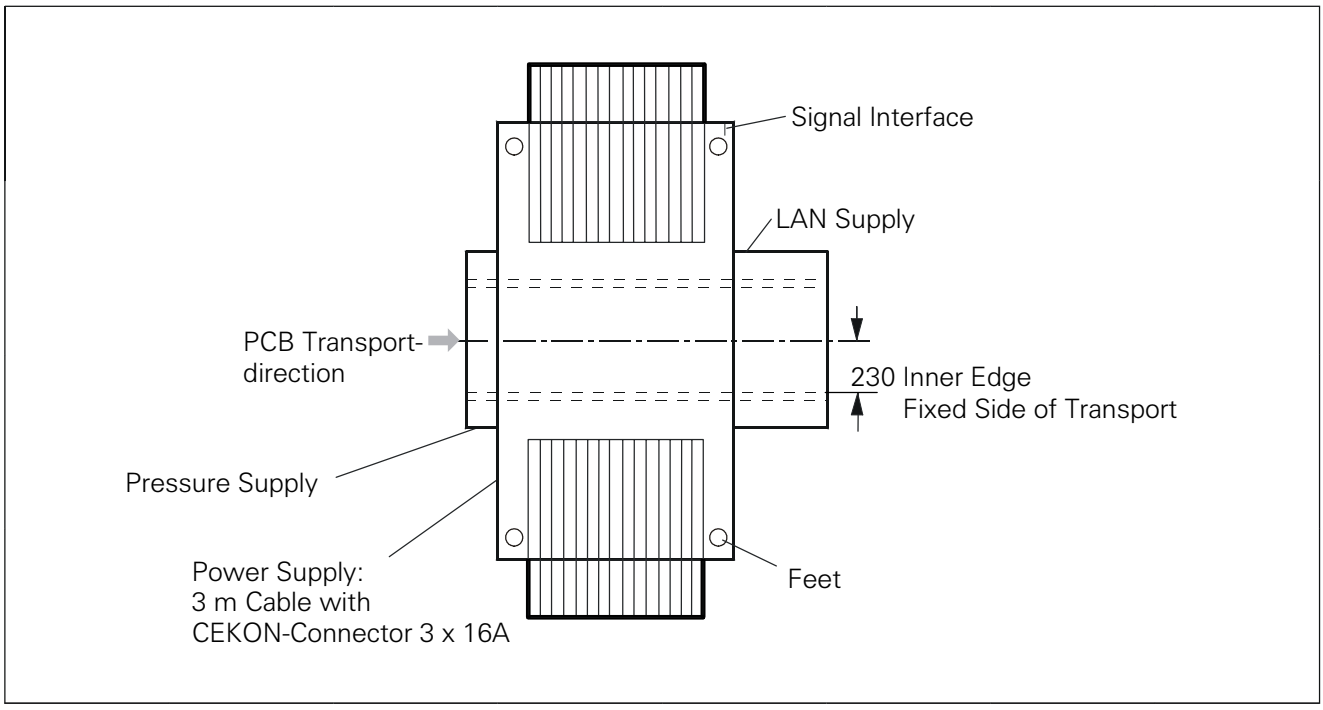
Technical Data:
Connections

Connections and Energy Required

Main voltage requirement	230/400 V~ / 119/208 V~ ± 5%, 50/60 Hz
Power	1.9 kW
Circuit breaker	3 x 16 A
Power outage	max. 20 ms
Compressed air requirements	5.5 - 8 bar, 300 Nl/min (6-Nozzle Head), 400 Nl/min (12-Nozzle Head), ½" tube

Compressed Air Specification

Particles:	max. particle size by density, based on ISO/DIS 8573-1 Class
Particle size Particle density	0.1 µm 0.1 mg/m³
Dew: Pressure dewpoint Dewpoint	 Class 4 + 3° C
Oil: max. oil content Particle density	 Class 1 0.01 mg/m³

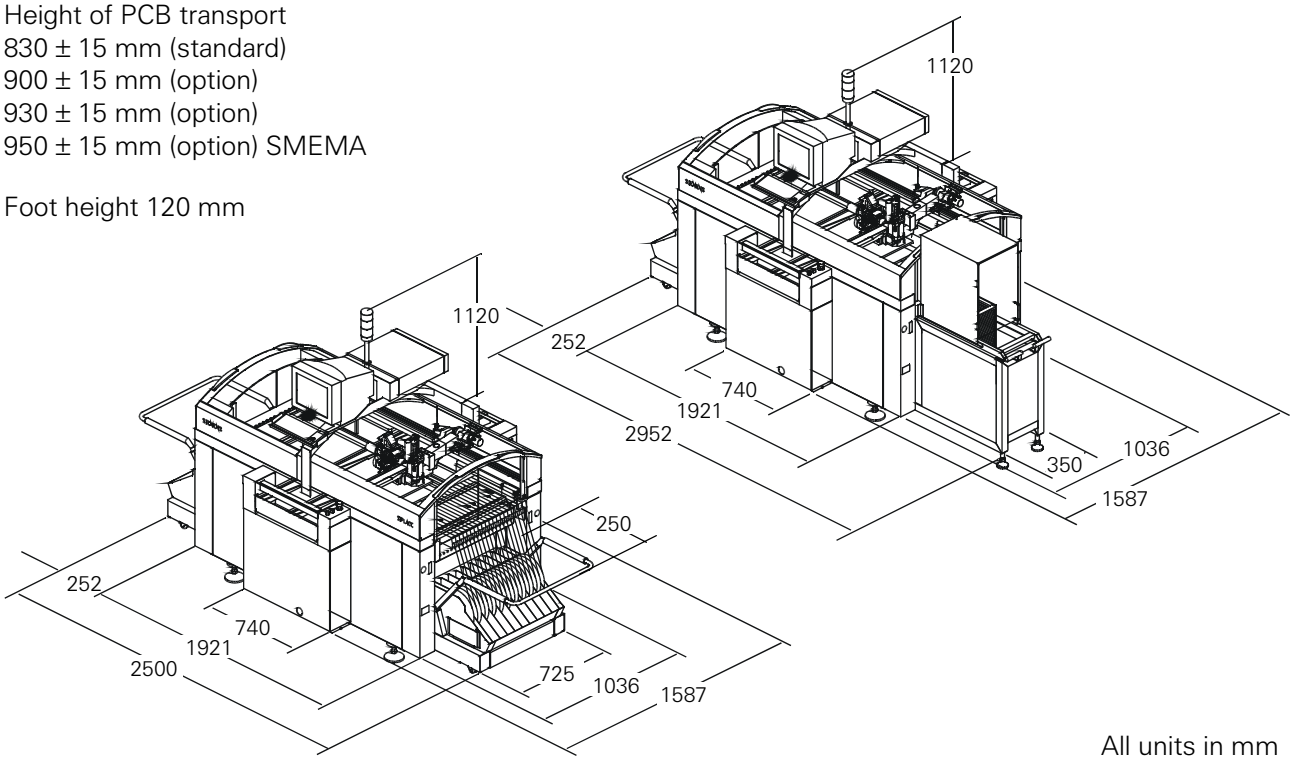


Technical Data:
Dimensions and Set-Up Conditions

Values	
Length	1587 mm
Width excluding Waffle Pack Changer	2425 mm
Width including Waffle Pack Changer	2952 mm
Height from transport to warning lamp	1120 mm
Weight of basic module	1500 kg
Weight fully equipped excluding Waffle Pack Changer	2000 kg
Weight fully equipped including Waffle Pack Changer	2320 kg
Room temperature	Between 15° and 35°C
Humidity	30 - 80%, on average not higher than 45%, so that no condensation can ever form on the machine
Maximum noise development	74 dB_A

Height of PCB transport
830 ± 15 mm (standard)
900 ± 15 mm (option)
930 ± 15 mm (option)
950 ± 15 mm (option) SMEMA

Foot height 120 mm



All units in mm

Technical Data:
Transporting and Commissioning

Transport dimensions	
Length with packing	2150 mm
Width with packing	1850 mm
Height with packing	1600 mm
Center of gravity (X,Y coordinates)	0 mm, 0 mm

Floor load (more details about floor static characteristics on request)	
Total weight of equipped machine	2 metric tons
Permissible surface load sub-floor (load per unit area on mounting feet) (based on assumed distribution of machine weight to three machine legs[a])	9 kg/cm^2

a) Worst case scenario; 4 legs per machine installed, area per leg: 104 cm^2.

Description

Transporting

Use a fork lift with a lifting force of 6 tons to move the SIPLACE F^5 HM placement machine. Forks 2 m long are required for a packed machine, 1.5 m for an unpacked one.

Pick the machine up with the fork lift at the locations especially designed and identified as being for this purpose.

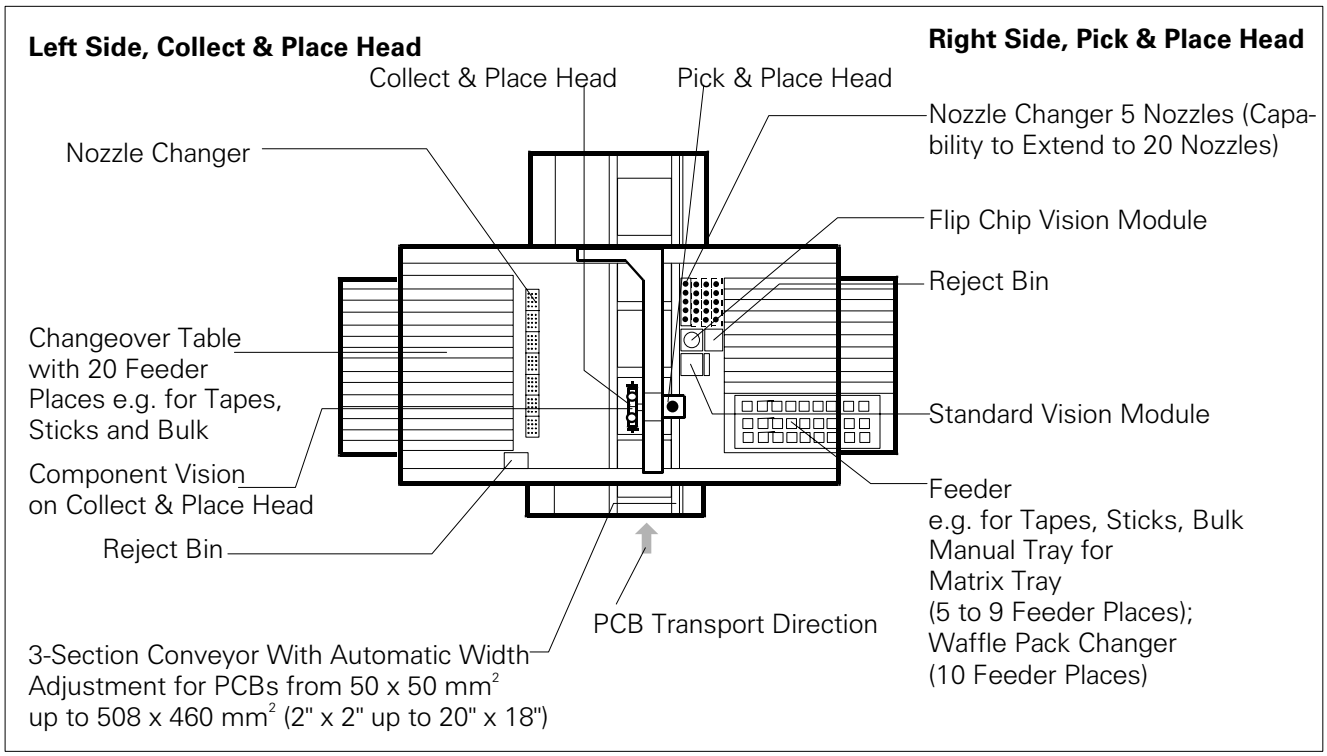
When setting up the SIPLACE F^5 HM, make certain that the surface it is placed on possesses the required load bearing capacity.

Commissioning

For commissioning, install the following components which were not premounted upon delivery:

- Monitor
- Keyboard
- Warning lamp
- Component changeover tables.

Possible Machine Configuration



SMD Placement Systems from Siemens

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