Assembléon

Leaders in Electronic Manufacturing Technology

September 2005

MG-1
SPECIFICATIONS

PA 1317/01 MG-1 (FNC) CL
PA 1317/02 MG-1 (SF) CL
PA 1317/03 MG-1 (SF) ITF
PA 1317/04 MG-1 (FNC) CLi
PA 1317/05 MG-1 (SF) CLi

Date of release: September 2005

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Contents

1.0 Introducing the MG-1

The MG-1, the new generation High Speed Multifunctional Production Machine, belongs to the top-of-the-line Assembléon SMD pick & place machines.

With the MG-1 a feeder commonality between all Assembléon machines has been continued which increases the MG-1 flexibility.

The MG-1 is a High Speed Multifunctional machine that can handle a wide range of components at speeds up to 24,000 SMDs per hour. The machine is built around a very rigid, vibration-free frame for improved accuracy and long-term stability and is perfectly suitable for round-the-clock production.

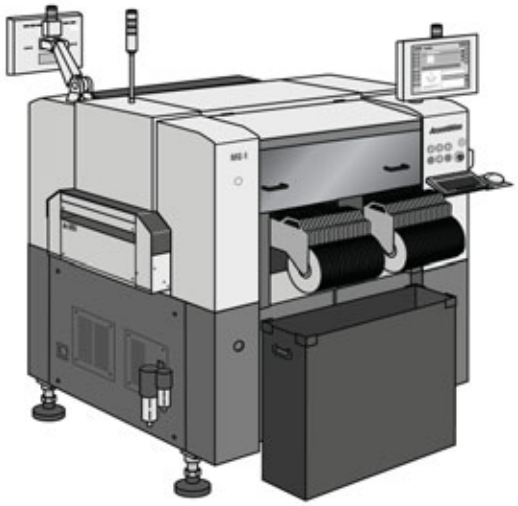


Figure 1 Front view MG-1

The MG-1 features a high precision single placement beam that carries 8 independent Z-servo controlled heads. The placement beam can be configured with 4 Flying Nozzle Change heads (each equipped with 3 nozzles) and 4 high precision heads with exchangeable nozzles or 8 high precision heads with exchangeable nozzles. The placement beam moves in X/Y and Z direction, while the board and component feeders are stationary. A flexible board transport system enables the MG-1 to handle virtually any type of PCB with the use of a double board clamping system. Board conveyor width is automatically adjustable, allowing board dimensions up to 460 x 440mm (18" x 17.2") to be handled.

The newly designed digital vision system with Line Array camera allows fast and accurate "on-the-fly" alignment of a wide range of components from 01005 up to 45x 100mm, including 45 mm square QFPs with lead pitches down to 0.5mm (20 mil). Dark or white background BGAs, μBGAs and CSPs with ball pitches down to 0.4mm (16 mil) and ball diameters down to 0.1 mm (4 mil) can be recognized by the newly developed illumination unit which allows measurement of ball positions and dimensions.
The vision system detects missing, bent or irregular spaced leads or BGA balls; faulty components are rejected.

A separate camera system monitors fiducial marks at the board, circuit and component level, using a combination of white-light and IR LEDs with multi-angle diffusers to provide optimal illumination.

Just six nozzle shapes are required to cover the specified SMD range. High output levels are therefore achieved, as the need for nozzle exchanges is minimal. Standard a 32 position nozzle exchange station enables additional special nozzles to be accommodated.

Up to 96 tape feeders can be loaded on the MG-1. The machine supports tape, stick, bulk and tray feeders. The tape feeder design for the MG-1 allows simultaneous picking from any mix of tape feeders ranging from 8 to 72 mm.

A Windows XP based controller, running a user-friendly Graphical User Interface, allows the MG-1 to be used stand-alone or in-line and can be easily hooked up to the external network. The controller includes a Management Information System (MIS) that continuously gathers production data for management feedback. The unique bad mark sensing capabilities allow a multi-circuit panel to be run as one large board, thus maximizing placement speed while still using bad mark information. A laser-based verification system, which guarantees correct feeder latching, is standard. Feeder indication lights helps the operator during set-up and operation.

Off-line feeder changeover can be achieved by using a 24 position Feederbar Exchange System (FES). An entire feederbar can be conveniently loaded off-line, minimizing change-over time.

A basic program optimization function is also included in the machine as standard which can be used during production. For more advanced line optimization the Advanced Manufacturing Suite AMS, allows you to create and optimize SMD machine programs on a PC instead of using the SMD machine. User interface from machine and AMS software are the same; therefore reducing training requirements.

2.0 General specifications

	MG-1 (FNC)	MG-1 (SF)	
			REMARKS
Tact time:	0.15 sec/chip with line array camera 0.30 sec/SO with line array camera 0.8 sec/QFP with line array camera		Simultaneous pick with 8 heads Simultaneous pick with 4 heads Sequential pick with 4 heads
Optimal placement rate:	24,000 cph		Simultaneous pick with 8 heads
Tact time IPC 9850:	17,400 cph		C0603; all heads, all angles
Nominal placement rate:	14,000- 16,000 cph		Real mounting speed
Applicable Components:	01005 - SOP, SOJ, PLCC 32mm ⍁ (1.26") 01005 - 20mm ⍁ (0.79") with pin pitch down to 0.3mm (12 mil) 20mm - 32mm ⍁ (0.79") with pin pitch down to 0.4mm (16 mil) BGA, μBGA,CSP : 32mm ⍁: Min. ball pitch down to 0.4mm (16mil) Min. ball diameter down to 0.1mm (4mil) Irregularly shaped SMDs, 100mm x 32mm Maximum grid for BGA components is 64x64		Line array camera system (32mm) Ball presence check for ⩾ 0.1mm ball diameter Ball defect check for ⩾ 0.2mm ball diameter
	0201 - SOP, SOJ, PLCC 45mm ⍁ (1.77") 0201 - 20mm ⍁ (0.79") with pin pitch down to 0.4mm (16 mil) 20mm - 45mm ⍁ (1.77") with pin pitch down to 0.5mm (20 mil) BGA, μBGA,CSP : 45mm ⍁ : Min. ball pitch down to 0.4mm (16mil) Min. ball diameter down to 0.15mm (6mil) Irregularly shaped SMDs, 100mm x 45mm		Line array camera system (45mm) Ball presence check for > 0.15mm ball diameter. Ball defect check for > 0.3mm ball diameter.
	Maximum grid for BGA components is 64x64		
Component height:	Max: 15mm	Max: 15 mm	Placing of higher parts is possible if certain conditions are met.
Mounting accuracy (X,Y) μ+3σ:	± 50μ for chips 01005-0201-0402 ± 75μ for chips and SOIC (this is lead dependent) ± 30μ for QFP's		Line array camera system (all placement heads and all placement angles, with special components and board)
Mounting accuracy (φ) 3σ:	For Chips and SOIC (Lead dependent) ±0.1° for QFP's		Line array camera system (all placement heads and all placement angles)
Mounting repeatability X,Y 3σ:	15μ for QFPs		
Mounting angle:	0 up to 360 (programmable in steps of 0.01)		

	MG-1 (FNC)	MG-1 (SF)	
			REMARKS
Number of heads:	One single beam with 4 Flying Nozzle Change heads and 4 high precision standard heads	One single beam with 8 high precision heads	The high precision heads can exchange nozzles with the use of the Nozzle Exchange Station
Alignment system:	Line array camera 32mm with illumination system for Vision on the Fly	Line array camera 45mm with illumination system for Vision on the Fly	Standard
	Second line array camera Side view camera for reliability and quality performance 3D camera for co-planarity check functionality Moving CCD camera for Fiducial alignment		Optional Optional Optional Standard
Type of nozzles:	Type 211F (on FNC head) Type 212F (on FNC head) Type 213F (on FNC head) Type 211 Type 212 Type 213 Type 214 Type 21S (Melf nozzle)	Type 211 Type 212 Type 213 Type 214 Type 215 Type 21S (Melf nozzle)	Standard for the MG-1 (FNC) will be delivered: 4x nozzle 211F, 4x nozzle 212F, 4x nozzle 213F, 4x nozzle 211, 4x nozzle 212, 4x nozzle 214 Standard for the MG-1 (SF) will be delivered: 8x nozzle 211, 8x nozzle 212, 4x nozzle 213, 4x nozzle 214, 1x nozzle 215
	Special nozzle for 01005		Nozzle and feeder for 01005 on special request
Nozzle exchange station:	32 nozzle positions		Standard
Component weight:	Max: 8.5 gr. (with nozzle type 214)	Max: 31 gr. (with nozzle type 215)	
Nozzle cleaning station:	For nozzle types 211F, 212F, 211, 212 and special 01005 nozzle	For nozzle types 211 , 212 and special 01005 nozzle	4 heads at one time
Component mounting interdistance:	01005-0402: 0.25mm or more Chip: 0.5mm or more SOP: 0.5mm or more QFP: 0.25mm or more		
Placement system:	Servo controlled for component height compensation		
Placement force:	0.2N/mm (for nozzles with buffer this value is different)		Pre-tension is 1.67N. (spring loaded)
Number of feeders:	Pneumatic Tape Feeders CI(i) type: 8mm: 96 feeders 12mm: 44 feeders 16mm: 44 feeders 24mm: 32 feeders 32mm: 28 feeders 44mm: 20 feeders 56mm: 16 feeders Stick feeders: Depends on stick dimensions Bulk feeders: 96 feeders		72mm Tape feeder is available on special request
Feeder indicators:	96 LED indicators (Green, Yellow & Red)		Standard (Not available for MG-1 with ITF feeder interface

	MG-1 (FNC)	MG-1 (SF)	
			REMARKS
Number of ITF feeders:		Intelligent Tape Feeders: 8mm: 40 feeders (80 code numbers with Twin tape feeder)12mm: 18 feeders 16mm: 18 feeders 24mm: 20 feeders 32mm: 12 feeders 44mm: 10 feeders 56mm: 8 feeders Stick feeders: Depends on stick dimensions	Standard the MG-1 with ITF feeder interface is a single sided machine. Rear side ITF feederbar only on special request
Component Packaging:	Tape according to IEC/EIA-J/JEDEC: 8-56mm For larger tape feeders such as 72mm please contact your local sales representative		Tape reel diameter max: 380mm (15")
	Single ATS Tray Feeder: Max. tray size: 230mm x 335mm (9.1" x 13.2") Min tray size 90mm x 140mm (3.5" x 5.5")		Optional (factory built in): Single ATS Tray Feeder. Max. number of amount of pallets 2 x 15 with 12.5mm pallet pitch, pick area for all heads from tray 210mm x 325mm (8.3" x 12.8") No PCB width restriction
	Dual ATS Tray Feeder: Max. tray size: 230mm x 335mm (9.1" x 13.2") Min tray size 90mm x 140mm (3.5" x 5.5")		Optional (factory built in): Dual ATS Tray Feeder (Max. board width 330mm (13"), max. number of 8mm feeders 48, amount of pallets 4x 15 with 12.5mm pallet pitch, pick area for all heads 220mm x 312mm (8.7" x 12.3") *(available only on project base)*
	Double Shuttle Tray Sequencer: Max. tray size: 230mm x 335mm (9.1" x 13.2") Min tray size 90mm x 140mm (3.5" x 5.5")		Optional: Double Shuttle Tray Sequencer (no PCB width restrictions). Amount of pallets 4x 15 with 12.5mm pallet pitch, including inspection conveyor.
	Stick and bulk:		Many solutions possible
Maximum height pre-mounted components:	15mm on placement side (0.16") 30mm on non placement side (1.2")		Depending on component neighborhood
PCB Dimensions (x,y):	Min: 50 x 50mm (2.0" x 2.0 ") Max: 460 x 440mm (18" x 17.2") *Special applications upon request, 500 x 570mm (19.7" x 22.4")*		
PCB Weight:	Max. 1.2 Kg Max. 2.0 Kg		Without components With components
PCB Thickness:	Min: 0.4mm (0.015") Max: 4.0mm (0.15") *Special applications upon request*		

	MG-1 (FNC) MG-1 (SF)	
		REMARKS
Non - Mountable area:	Board Top side: 3mm from rear side board edge (0.12") 3mm from front side board edge	Component height restrictions apply in the 4mm (0.40") area from front side edge depending on board thickness
	Board Bottom side: 5mm from front and rear side board edge (0.2”)	Flat edge of 30mm (1.2") is required on bottom right corner for the use of the main stopper, sub and exit stopper. For Ceramic PCBs (optional) the Non-Mountable area can be different.
PCB Material:	Phenolic/FR4/Composite Materials	Ceramic PCB's requires special conveyor section (optional)
PCB positioning:	Two independent Z servo controlled push up systems	Software controlled by PCB thickness
	Two independent Board clamping units	(Max. board size 190mm)
	Push up pins	Adjustable positions
	Sub stop (PCB waiting buffer)	Fixed position
	Exit stop	Fixed position
PCB Transport height:	900mm ± 10mm (35.4" ±0.4")	Standard
	SMEMA 953mm 12.5mm (37.5" ± 0.5")	Standard
PCB Transport direction:	Left to Right	Right to Left is optional
PCB Transport width:	Automatic	Front rail fixed Rear rail moving
PCB loading time:	Approximately 2 sec. for small boards (<180mm) and 4 sec for big boards (>190mm)	PCB loading concurrent to SMD picking and alignment
Control system:	Celeron 2.0 GHz controller Industrial Windows XP width Realtime operating system	512Mb internal memory
	512 Mb flash disk	
	1.44 Mb floppy drive 3.5"	
	CD-ROM	
	RS 232 Serial Interface + LAN interface	
	15" Color User Interface Flatscreen front and rear side	15" touch screen optional
LAN interface	Based on IEEE802.3u, IEEE802.3	
Communication protocol	TCP/IP, NetBEUI	
User Interface:	VGOS (Visual Graphical Operating System) Keyboard and mouse for data editing functions.	Standard
	Operational panel front and rear side	Standard

	MG-1 (FNC) MG-1 (SF)	
		REMARKS
Control system functions:	Max. 127 PCBs	12,800 comp/PCB
	# components types/PCB	255
	Max. blocks/PCB	512
	Backup and restoring data using floppy	
	Supported formats: VIOS, VIOS-TXT,YGX	VIOS: binary format VIOS-TXT: text format YGX: format (preferred)
	MIS data gathering	
	Data teaching	
	Data tracing	
	Component database	16,000 Component packages; user can define and teach vision files
	Mark database	300 Mark shapes
	SMEMA electrical interface	
	On line calibration	
	On line help functions	
	Feeder lock verifier	
Machine dimensions and weight:	Length: 1650mm (5.4 ft) Height: 1850mm (6.1 ft) Width: 1562mm (5.1 ft) Weight: 1630kg (3592 Lbs)	Width including feeders; pneumatic feeders 2376mm (7.83 ft), electrical feeders 2150mm (7.05 ft)
Safety standards:	EN 292, EN 294, EN 349, EN 614, EN 1050, EN 55011, EN 61000-6-2, EN 60204-1	CE-safety is part of system design. Safety measurements are tested on each product in the factory.
	EN 301 489-1, EN 301 489-3, EN 300 330-2, EN 60950	For MG-1 with CLi feeder interface
Warning lights :	White: Emergency stop, safety cover interlock Blue light: Pick up error, out of components Green: In automatic operation	
Electric Power:	Voltage AC: 200/208/220/240/380/400/ 416 V ± 10 %, 3 Phase	
	Frequency: 50/60 Hz	
	Noise peak: 1,500V, 1 sec or less	
	Consumption: 4.6 kVA max.	
	Average power consumption: 0.75KW	
	Floor: Flat, slope is 10mm or less	
Air supply:	Pressure: > 5.5 .10^5 Pa (5.5 bar, 80 PSI) Quality: dust and oil free Consumption: min.350 Nl/min (10 = CFM)	
Operating Temperature:	15-35° C (59° - 95° F)	Specification guaranteed: 20°-28°C (68° - 82° F)
Humidity:	20 - 90 %, no dew	
Noise:	< 78dba	
Clean Room:	Class 10,000 (10 K)	

Table 1

3.0 Features, Accessories and Options

3.1 Features

The standard-MG-1 includes the following features:

- On the fly alignment using a vision system with a Line array camera standard equipped with a side illumination unit for BGA's, μBGA, CSP components.
- Placement beam with 4 Flying Nozzle Change heads (each head standard equipped with 3 nozzles) and 4 high precision heads or 8 high precision heads. All heads have independent Z servo control and for rotation two rack and pinions motors are used.
- Simultaneous picking is possible by all 8 heads from any mix of tape feeders. This allows a much higher nominal placement rate and board throughput.
- Complete component range can be handled with only 6 nozzle shapes.
- Automatic nozzle change station with complete nozzle set.
- Fiducial alignment camera with software controlled illumination unit (white + IR Leds),wide angle diffuser and co-axial illumination. Fiducial camera can also be used as teaching/tracing device and for Bad Mark sensing.
- Automatic width adjustment. The PCB dimension is included in the PCB data.
- Two independent board clamping systems (for PCB length < 190mm).
- Two independent Z servo controlled push up systems including push up pins, for PCB support (for PCB length < 190mm). PCB thickness is included in the PCB data.
- Substopper, allowing an additional PCB to enter the machine for reducing transport time.
- Exit Substopper, providing a buffer section.
- Automatic nozzle cleaning station for small nozzle. Four heads at once (SF or FNC) are positioned in the cleaning station and by air pressure the nozzles will be cleaned.
- Feeder indicators which provide the operator with all the essential information regarding the feeder status (easy set-up).
- Feeder lock verification system to avoid damage to the machine due to incorrectly latched feeders.
- 3.5" FDD for backup purposes.
- CD-ROM drive for software installation.
- Front and rear: 15" LCD, operation panel, keyboard and mouse.
- Component dump box.
- Operator manual, available in different languages.
- User manual.
- Service manual.
- Two empty tape bins.
- Toolset.
- First aid spare parts kit.
- CE safety.
- ESD safety.
- Electrical and Mechanical SMEMA.
- Ethernet communication port.
- RS 232 communication port.

Standard Software features:

- Variable XY axis speed per component.
- Datum angle functionality (especially for stick components, there is no pick angle necessary to recognize the component which results in higher output).
- User Friendly Graphical Human interface VGOS with touch screen capability.
- An On-line help function allows display of detailed descriptions of operations and functions on screen.
- Management Information System (MIS) to gather production history data.
- 4 point fiducial correction, to maintain accuracy for stretched/distorted boards.
- Template (pattern) matching for PCBs that have no fiducials.
- Different mark shapes for fiducial pair possible.
- Fiducial recovery function in case of recognition error or damaged fiducials.
- Data editing functions with the use of the fiducial camera (teaching,tracing).
- A Component database, that can hold up to 16,000 component packages, with the most frequently used components already predefined.
- A Mark database, that can hold up to 300 mark shapes, with the most frequently used mark shapes already predefined.
- Precede pick-up, allowing to pick up components before the PCB is fixed, reducing cycle time.
- Alternative feeder function, reducing operator intervention (empty feeder switching).
- Self Production Control, with use of bad marks the machine can determine which components should be placed. This is ideal for family boards.
- Automatic rework cycle to improve operator efficiency and online optimization, to keep mounting speed during production in case of empty feeders. Detected empty feeders are automatically skipped until end off programs, to allow one time replenishment.
- Product preparation can be done on the machine including basic optimization of the mount program (nozzle and feeder set-up).
- Multi-section PCBs can either be mounted block-by-block or the block data can be combined to achieve the fastest mounting sequence. In the latter case, block badmarks still remain in effect.
- Programmable retry function.
- Adaptive pick-up for automatic correction of feeder pick-up position.
- Task manager to carry out daily maintenance like automatic nozzle cleaning automatically on a pre-defined sequence.

3.2 Accessories and options

Accessories and options MG-1 SF/FNC, CL/CLi	
PA 1905/01	Pre empty warning
PA 1905/02	Set up verification inline CLi
PA 1905/03	Set up verification offline (Inline +CLi soft)
PA 1905/04	Auto program change over
PA 1905/06	PDA for offline hardware
PA 1905/07	PDA for offline softwware
PA 1905/11	Pre empty warning second machine
PA 1905/12	Set up verification inline CLi second machine
PA 1905/13	Set up verification offline (inline + CLi soft) second machine
PA 1912/15	MG adjustment tool
PA 2505/70	Feeder exchange cart 24 pos for MG (CLi version)
PA 2505/71	FES 24 factory built in front side MG (CLi version)
PA 2505/72	FES 24 factory built in rear side MG (CLi version)
PA 2505/74	FES splicing rack 24 position
PA 2505/75	Feeder exchange cart 24 pos for MG serie CL
PA 2505/76	FES 24 factory built in front side MG CL
PA 2505/77	FES 24 factory built in rear side MG CL
PA 2505/78	Modification kit FES24 CLi for MG (front or rear side)
PA 2505/79	Modification kit FES24 CL for MG (front or rear side)
PA 2506/36	Touch screen front side for MG
PA 2506/37	Touch screen rear side for MG
PA 2506/41	Maintenance lamp for MG
PA 2696/27	Single ATS Tray Feeder for MG (including 2 magazines with 30 pallets)
PA 2699/25	Double shuttle Tray Sequencer for MG (including 4 magazines with 60 pallets)
PA 2903/27	16mm Tapefeeder 15" CL
PA 2903/29	16mm Tapefeeder 15" CLi
PA 2903/38	24mm Tapefeeder 15" CL
PA 2903/39	24mm Tapefeeder 15" CLi
PA 2903/48	32mm Tapefeeder 15" CL
PA 2903/49	32mm Tapefeeder 15" CLi
PA 2903/58	44mm Tapefeeder 15" CL
PA 2903/59	44mm Tapefeeder 15" CLi
PA 2903/68	56mm Tapefeeder 15" CL
PA 2903/69	56mm Tapefeeder 15" CLi
PA 2903/77	8mm x 2 Tapefeeder 15" CL 0201
PA 2903/78	8mm x 2 Tapefeeder 15" CL 0402
PA 2903/79	8mm x 4 Tapefeeder 15" CL
PA 2903/88	12mm Tapefeeder 15" FV/GEM CL
PA 2903/89	12mm Tapefeeder 15" FV/GEM CLi
PA 2903/97	8mm x 2 Tapefeeder 15" CLi 0201
PA 2903/98	8mm x 2 Tapefeeder 15" CLi 0402
PA 2903/99	8mm x 4 Tapefeeder 15" CLi
PA 2904/51	Bulk cassette feeder C0603
9466 920 10921	Reject belt feeder for CL Type
PA 2923/00	Set of 20 dummy feeders
PA 2962/00	Nozzle type 211 for MG-1
PA 2962/01	Nozzle type 212 for MG-1

PA 2962/02	Nozzle type 213 for MG-1
PA 2962/03	Nozzle type 214 for MG-1
PA 2962/04	Nozzle type 215 for MG-1
PA 2962/05	Nozzle type 216 for MG-1
PA 2962/06	Nozzle type 219 for MG-1
PA 2969/45	Side view camera MG
PA 2969/35	3D vision system 32mm for MG
PA 2969/36	3D vision system 45mm for MG
PA 2969/37	Second line array 32mm MG
PA 2969/58	Second line array 45mm MG
PA 2981/02	Magazine rack (including 15 pallets)

Table 2

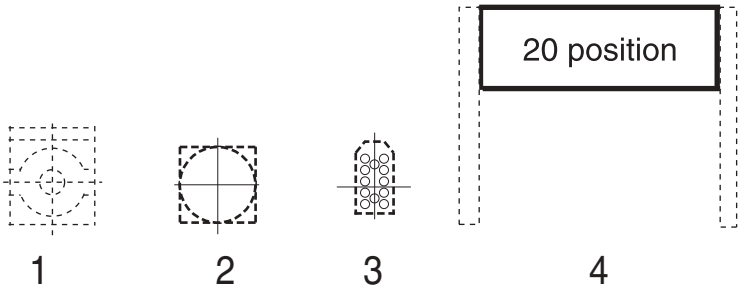
Accessories and options MG-1 SF ITF	
PA 1905/04	Auto program change over
PA 1905/14	Auto program change over second machine
PA 1912/15	MG adjustment tool
PA 2505/52	FES ITF cart 20 position
PA 2506/36	Touch screen front side for MG
PA 2506/37	Touch screen rear side for MG
PA 2506/41	Maintenance lamp for MG
PA 2696/27	Single ATS Tray Feeder for MG (including 2 magazines with
	30 pallets)
PA 2699/25	Double shuttle Tray Sequencer for MG (including 4 magazines
	with 60 pallets)
PA 2601/01	Tape loading unit
PA 2602/01	Feeder storage cart
PA 2654/06	Tapefeeder ITF2 8mm r3
PA 2654/16	Tapefeeder ITF2 12mm r3
PA 2654/26	Tapefeeder ITF2 16mm r3
PA 2654/36	Tapefeeder ITF2 24mm r3
PA 2654/46	Tapefeeder ITF2 32mm r3
PA 2654/56	Tapefeeder ITF2 44mm r3
PA 2654/66	Tapefeeder ITF2 56mm r3
PA 2657/00	Twin tape feeder 8mm
9466 920 10911	Reject belt feeder for ITF Type
PA 2923/10	Set of 10 ITF dummy feeders
PA 2962/00	Nozzle type 211 for MG-1
PA 2962/01	Nozzle type 212 for MG-1
PA 2962/02	Nozzle type 213 for MG-1
PA 2962/03	Nozzle type 214 for MG-1
PA 2962/04	Nozzle type 215 for MG-1
PA 2962/05	Nozzle type 216 for MG-1
PA 2962/06	Nozzle type 219 for MG-1
PA 2969/45	Side view camera MG
PA 2969/35	3D vision system 32mm for MG
PA 2969/36	3D vision system 45mm for MG
PA 2969/37	Second line array 32mm MG
PA 2969/58	Second line array 45mm MG
PA 2981/02	Magazine rack (including 15 pallets)

Table 3

3.3 Machine Configuration examples

On the following pages you can find some machine configuration examples for the MG-1.

Remark 1: In the examples the dotted lines pictures indicate the physical position of the second line array camera, Co-planarity checker. These can be ordered as an option.



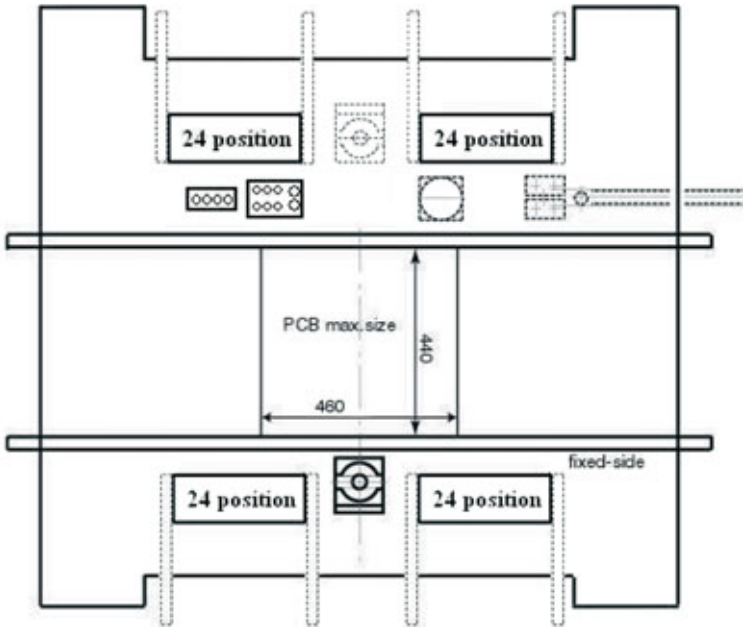
1. Second Line Array Camera
2. 3D Vision System
3. Double Shuttle Tray Sequencer
4. FES 24 position

Remark 2: Standard the MG-1 SF ITF is equipped with front side FES 20 and no rear side feederbar.
Standard all MG-1 machines are equipped with:

 nozzle station and

 nozzle cleaning station

Example 1: MG-1 CL with FNC/SF head and Double Shuttle Tray Sequencer

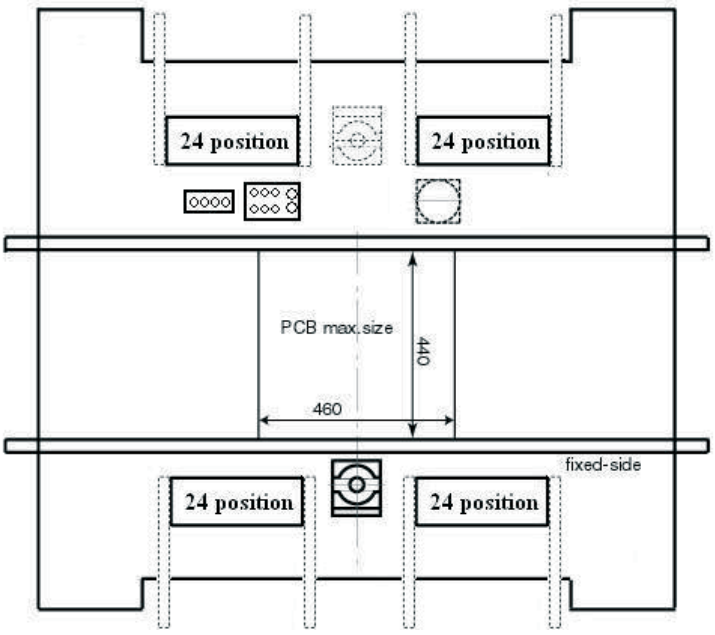


PA 1317/01 MG-1 with FNC head or PA 1317/02 MG-1 with SF head

PA 2505/76	FES 24 factory built in front side CL
PA 2505/77	FES 24 factory built in rear side CL
PA 2699/25	Double Shuttle Tray Sequencer
PA 2969/35-/36	3D Vision System 32mm or 45mm for MG-1*
PA 2969/37-/58	Second line array 32mm or 45mm for MG-1

* Field of view of the 3-D Vision System must match the FOV of the Line Array Camera.

Example 2: MG-1 with FNC/SF head and CLi feeders

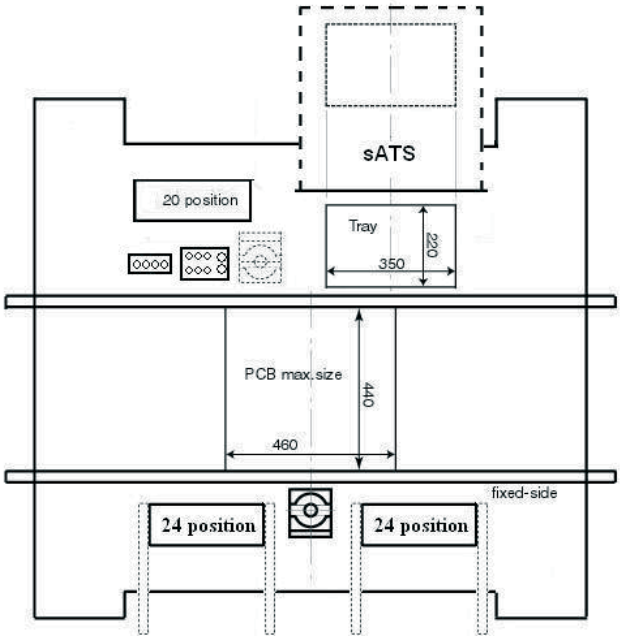


PA 1317/04 MG-1 with FNC head or PA 1317/05 MG-1 with SF head

PA 2505/71	FES 24 factory built in front side CLi
PA 2505/72	FES 24 factory built in rear side CLi
PA 2969/35-/36	3D Vision System 32mm or 45mm for MG-1*
PA 2969/37-/58	Second line array 32mm or 45mm for MG-1

* Field of view of the 3-D Vision System must match the FOV of the Line Array Camera.

Example 3: MG-1 with FNC/SF head, Single ATS Tray Feeder and CLi feeders

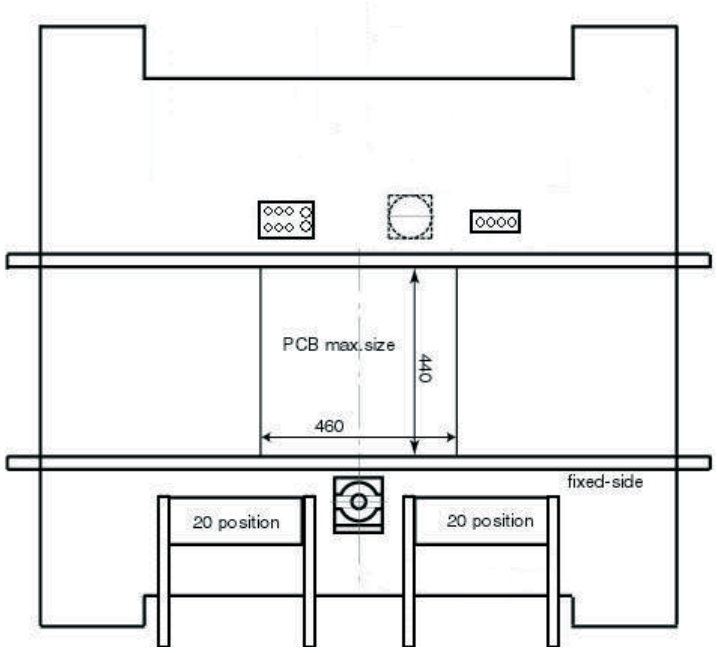


PA 1317/04 MG-1 with FNC head or PA 1317/05 MG-1 with SF head

PA 2505/71	FES 24 factory built in front side CLi
PA 2505/72	FES 24 factory built in rear side CLi
PA 2696/27	Single ATS Tray Feeder for MG
PA 2969/35-/36	3D Vision System 32mm or 45mm for MG-1*

* Field of view of the 3-D Vision System must match the FOV of the Line Array Camera.

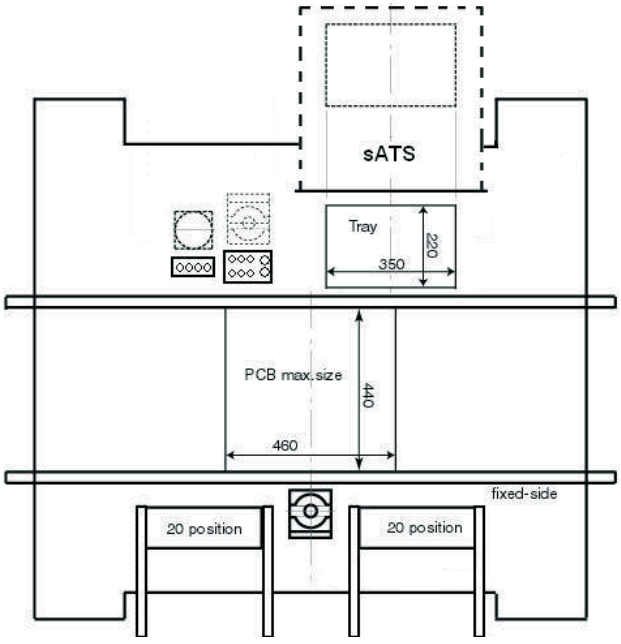
Example 4: MG-1 ITF with SF head



PA 1317/03	MG-1 with SF head and ITF
PA 2969/35-/36	3D Vision System 32mm or 45mm for MG-1*

* Field of view of the 3-D Vision System must match the FOV of the Line Array Camera.

Example 5: MG-1 ITF with SF head and Single ATS Tray Feeder



PA 1317/03	MG-1 with SF head and ITF
PA 2696/27	Single ATS Tray Feeder for MG-1
PA 2969/35-/36	3D Vision System 32mm or 45mm for MG-1*
PA 2969/37-/58	Second line array 32mm or 45mm for MG-1

* Field of view of the 3-D Vision System must match the FOV of the Line Array Camera.

4.0 Mounting Heads Configuration

The MG-1 features a high precision single placement beam which carries 8 independent Z-servo heads and two rotation motors. Two head models are available. One carrying 4 Flying Nozzle Change heads (each equipped with 3 nozzles) and 4 high precision heads with exchangeable nozzles and the second one with 8 high precision heads with exchangeable nozzles.

On both head models (FNC, SF) a separate camera system is attached that monitors fiducial marks at the board, circuit and component level, using white + IR light LEDs and multi-angle diffusers to provide optimal illumination. High placement rates are achieved by simultaneous component picking which reduces head beam travel and thus shortens the mounting cycle.

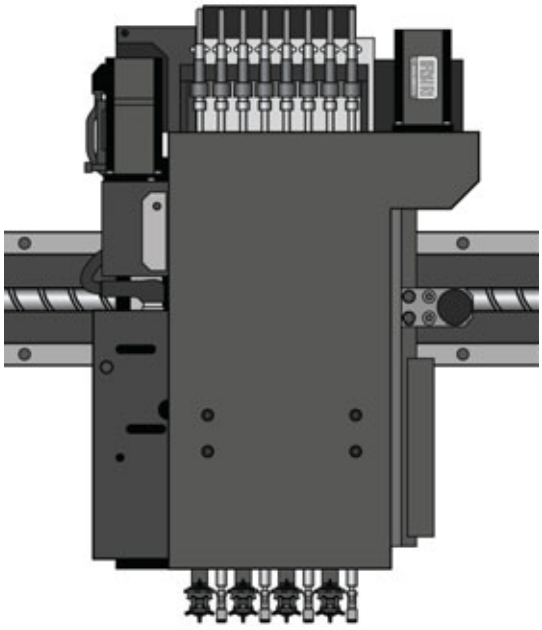


Figure 2 Configuration of head section

The high-precision dual Y drive MG-1 features four-axis (X,Y,Z,R) servo control for accurate, stress-free component mounting. Direct drive, brushless AC motors controlling heavy duty lead screws allow optimal accuracy and high reliability.

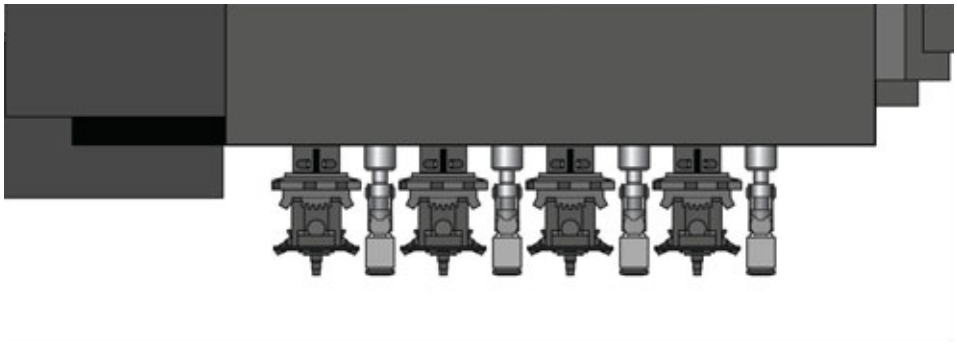


Figure 3 Head section FNC detail

Specifications	
Number of axis:	16
Axis configuration (AC servo):	1 x X axis
	1 x Y axis
	8 independent Z axis
	2 x R axis
	1 x W (automatic width) axis
	2 x Push up plate
Pick-up error detection:	Vacuum check (256 level digital setting)
Mounting angle:	0^{o} - 360^{o} (0.010 step)
Number of mounting head:	8 in-line multi head, FNC or SF
Nozzle types:	5 different shapes
Encoder resolution:	X,Y = 0.0003mm/pulse
	Phi = 0.00180 /pulse
	Z = 0.0023mm/pulse
Head position accuracy:	X = 0.007mm
	Y = 0.007mm
Speed:	X = 1,500mm/sec.
	Y = 1,500mm/sec.
Acceleration:	X = 36,600mm/sec^2
	Y = 27,000mm/sec^2

Table 4

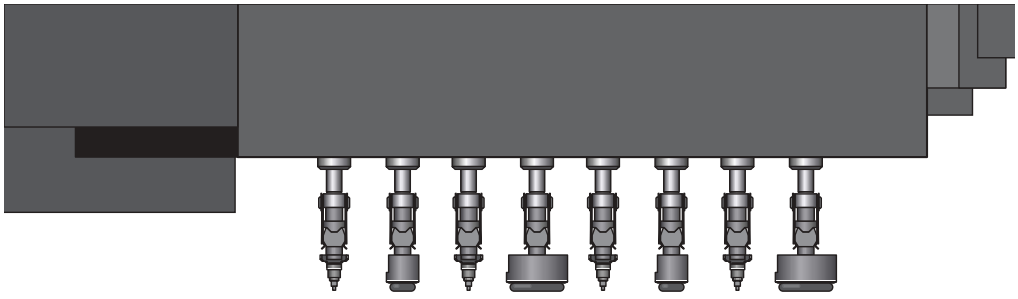


Figure 4 Head section SF detail

5.0 Alignment

5.1 Line Array Camera Alignment

The high speed of the MG-1 is achieved by fast on-the-fly component alignment using a revolutionary Line Array camera system, equipped with a newly developed multi angle illumination unit, significant faster than conventional vision systems. For ultimate speed, the machine can be equipped with a second Line Array camera which reduces head beam travel and thus shortens the mounting cycle on high unique component count per board.

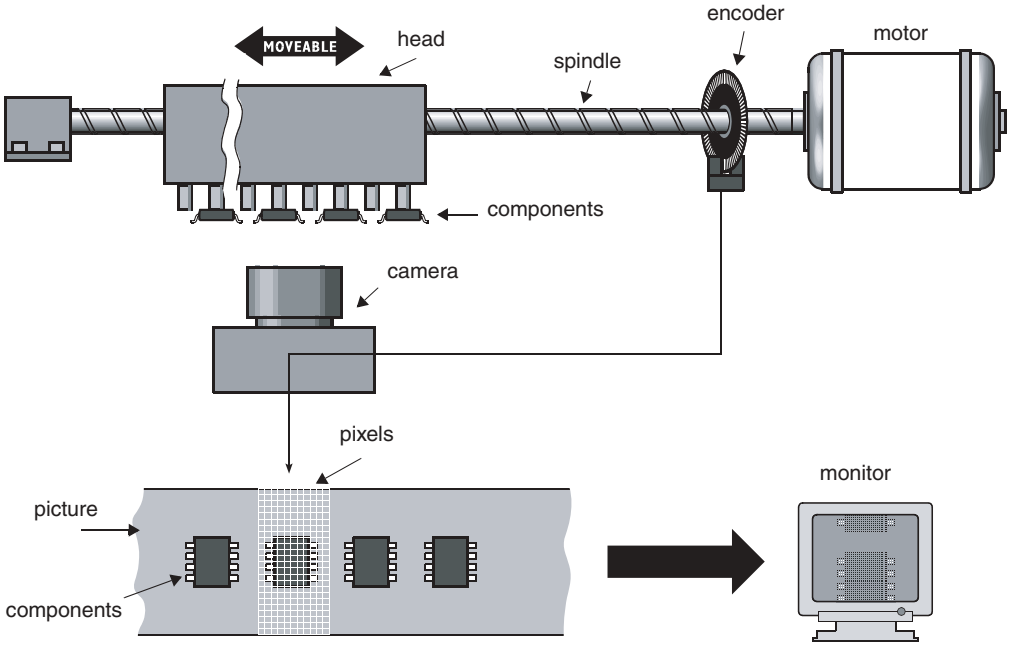


Figure 5 Line sensor vision principle

While moving the beam over the camera, the encoder triggers the camera to capture consecutive lines of pixels. All these lines form the total picture of the components. This picture is processed by a sophisticated vision system. The vision system algorithms inspect the components and calculate position and orientation of the components on the heads.

The SMD components are illuminated by a new developed multi angle side illumination unit which allows high speed recognition of CSP's, μBGA's and Flip Chips. The leads of the components are imaged on the line sensor.

Specifications	
Line array camera:	CCD 2048 x 1 pixels
Max. component size:	32mm square (1.26") for FNC and 45mm square (1.77") for SF
Min. component size:	01005 (0402)
Min. lead pitch:	0.3mm (12 mil)
Min. lead width:	0.12mm (0.005")
Grey scale:	256 levels
Lighting:	Multi angle Fore/side illumination (red LED array) Light intensity is software controlled for each component separately
Recognition:	Reflection. Pattern recognition on all leads
Max. number of lead sides:	4
Max. number of lead groups:	2 per side
Check on:	Lead/ball pitch Lead/ball location Bent/missing leads/balls Total number of leads/balls Cumulative lead/ball pitch

Table 5

5.2 Side view Camera (PA 2969/45)

For quality enhancement, optionally a unique Side View camera system is available. The camera can verify chips from 01005 to 2012 presence and orientation at the nozzle in Z-direction, while the heads fly over the line array camera for X,Y,R component recognition. The Side View camera image can be used for several purposes.

Description	Function name	Details
Pick up condition:	Detection of pick up errors	Detect the pick up and checks component thickness
	Detection of abnormal pick ups	Check for tombstone picking, side picking etc.
Mounting reliability:	Component bring back after mounting (return after place)	Check component presence after mounting
	Component bring back after component dump	Check component presence after dumping
Maintenance:	Dirty nozzles	Checks nozzle surface for contemination

Table 6

Specifications	
Area CCD camera:	CCD 485 x 485 pixels
Grey scale:	256 levels
Illumination:	LED back light
Applicable components:	Chip and Resistor components
Minimum component:	C and R components 01005 (0402)
Maximum component:	C and R components 2012 (0805)
Maximum component thickness:	1.2mm
Applicable nozzles:	211(F) - 212(F) - 219 and 01005 nozzle
Recognition resolution:	20 μm
Cycle time:	No extra cycle time for component pick up check with standard configuration

Table 7

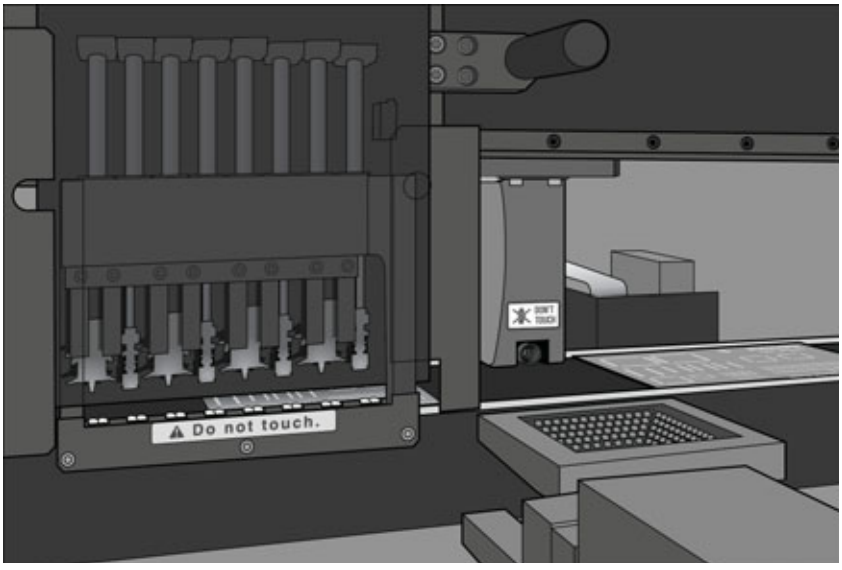


Figure 6 Side View Camera

5.3 3D Vision System (PA 2969/35, PA 2969/36)

In combination with the standard line array camera an on-the-fly optional 3D Vision System can check the co-planarity of any leaded component or the individual ball height for any BGA component with minimal speed penalty.
Combining the images of both cameras will generate a 3D image of the components, and height differences in leads or balls are measured.

Specifications 3D Vision Sytem 32mm (PA 2969/35)	
Line array camera:	CCD 1024 x 1 pixels
Grey scale:	256 levels
Lighting:	Multi angle Fore/side illumination. Light
	intensity is software controlled for each
	component separately
Co-planarity detection resolution:	+/- 25 µm
Applicable components:	Leaded components like SOP, QFP, and connectors
	Ball components using the BGA algorithm
Maximum component size for lead component:	32mm square in normal mode
	32mm width x 100mm long in fast mode
Maximum component size for ball component:	32mm square
Minimum lead pitch:	0.4mm
Minimum lead width:	0.15mm
Minimum ball pitch:	0.4mm
Minimum ball diameter:	0.25mm
Restrictions:	Leaded components max 255 leads in one direction Maximum grid for BGA components is 64x64 J-lead components are not supported Simultaneous recognition only for components that are the same

Table 8

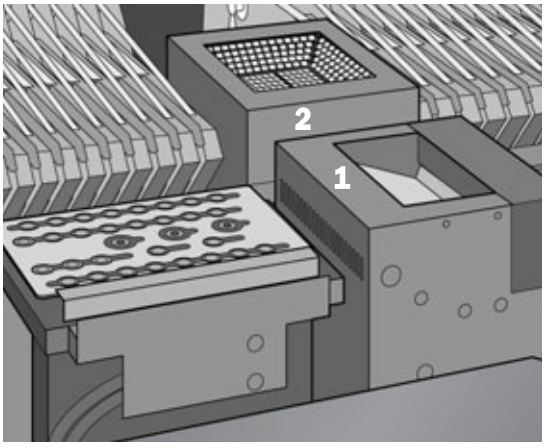


Figure 7 *3D Vision System (1), Line Array System (2)*

Specifications 3D Vision System 45mm (PA 2969/36)	
Line array camera:	CCD 1024 x 1 pixels
Grey scale:	256 levels
Lighting:	Multi angle Fore/side illumination. Light intensity is software controlled for each component separately
Co-planarity detection resolution:	+/- 35 µm
Applicable components:	Leaded components like SOP, QFP, and connectors Ball components using the BGA algorithm
Maximum component size for lead component:	45mm square in normal mode 45mm width x 100mm long in fast mode
Maximum component size for ball component:	45mm square
Minimum lead pitch:	0.5mm
Minimum lead width:	0.2mm
Minimum ball pitch:	0.5mm
Minimum ball diameter:	0.3mm
Restrictions:	Leaded components max 255 leads in one direction Maximum grid for BGA components is 64x64 J-lead components are not supported

Table 9

Specifications Cycle time	
Lead components:	2-3.5 sec/comp in NORMAL mode (1 component) 1.7-2.5 sec/comp in NORMAL mode (4 components at one time) 1.5 sec/comp in FAST mode (1 component) *Remark: excluding recognition time for standard line array camera*
Ball grid components:	1-2.5 sec/comp in NORMAL mode (1 component) 1.0 sec/comp in NORMAL mode (4 components at one time) *Remark: excluding recognition time for standard line array camera*

Table 10

5.4 Fiducial Alignment

The MG-1 comes standard with a fiducial camera. This camera is used to compensate for variations in the position of the circuit pattern relative to the expected position. The fiducial alignment system is an opto-electronic system which performs geometric measurements of fiducial marks on the PCB in order to calculate the deviations from their expected positions. The system can use two fiducials per board. Each sub-circuit can also be aligned using two fiducials. For placement of fine-pitch components two or four local fiducials per component may be used. The individual shapes of a fiducial pair can be different to allow for maximum application flexibility. Also pattern recognition algorithms can be used on traces or pads on the PCB board for cases where fiducials are not available.
The fiducial camera can also be used as a high accurate teaching device for PCB data (if CAD data is not available), automatic calibration and inspection purposes.

Specifications	
Fiducial camera:	CCD
Fiducial camera functionality:	Fiducial detection, Bad mark detection, teaching device (2 or 4 point teaching)
Fiducial illumination:	White + IR LEDs in conjunction with a wide-angle diffuser
Compensation for: (with two fiducials)	Translation Rotation Linear stretch and shrink
Compensation for: (with 2 or 4 fiducials)	Non-linear stretch and shrink
Type of compensation:	PCB , Block, Local
Fiducial size:	Max. 3.0mm (0.12") Min. 0.8mm (0.03")
Fiducial material:	Copper Gold Lead-tin
Fiducial clearance area:	2 * Fiducial size
PCB warpage at fiducial:	Max. 0.5mm (0.02")
Pattern offset:	Max. 1mm (0.04")
Number of different Fiducial pairs per PCB:	128
Number of Fiducial shapes in Mark Database:	300
Examples of Fiducials:	Solid circle (preferred) Square Triangle Donut Binary cross Bow-tie (connected) Template matching
Fiducial definition:	According CAD data

Table 11

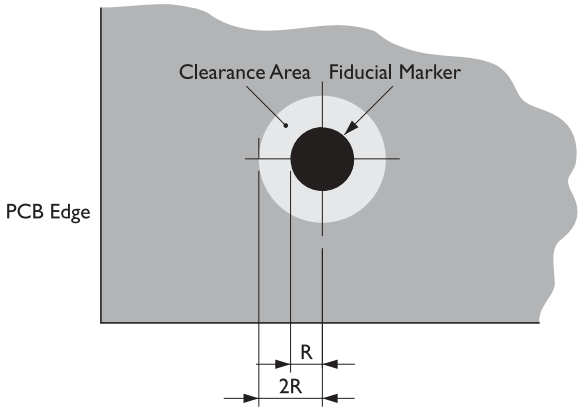
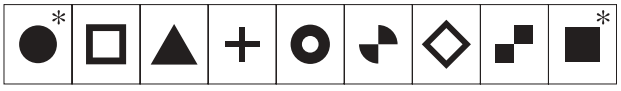


Figure 8 Fiducial free space



* Preferred; others possible but not preferred

Figure 9 Fiducials

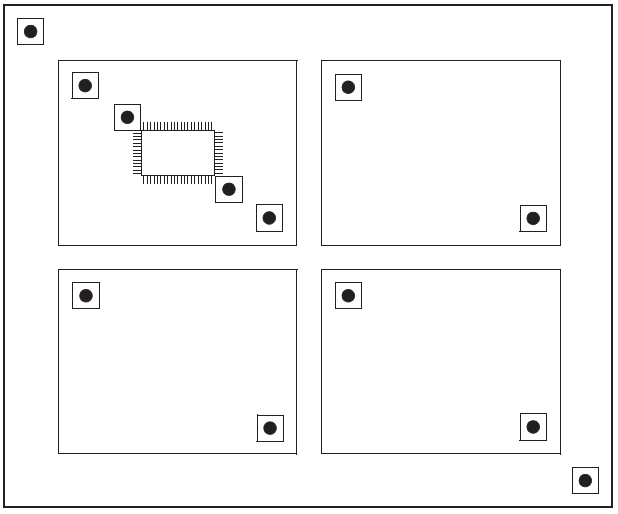


Figure 10 Examples of PCB, block and local fiducials

5.5 Master Bad Mark Sensing

If the PCB contains sub-circuits, one or more of these subcircuits can be skipped for placement by giving them a "Bad Mark" on a designated position on the subcircuit. No parts will be placed on a circuit that has a Bad Mark. Bad Mark sensing, with the use of the fiducial camera, is based on recognition of a difference in contrast in a certain area. This area can be defined in the machine software (position and area-dimensions). This gives maximum freedom in choosing the process or technique to add Bad Marks, for example:

- white or light colored labels of any dimension,
- white paint,

... or any other material that can be applied as long as it contrasts with the PCB surface.

Before checking the Bad Marks on all circuits, the Master Mark may be checked first. Presence of a Master Mark means that one or more Bad Marks are present on the circuits. This allows the machine to skip the Bad Mark sensing process for all circuits if no Bad Marks are located on the circuits, therefore, saving valuable production time.

6.0 Board Handling

PCB boards will be located in the machine by a double board clamping system in combination with a double independent Push-up unit equipped with adjustable Push-up pins to support the PCB.

Change over to a different board size is just a matter of seconds by using the automatic adjustment of the conveyor width and the PCB thickness (all servo controlled).

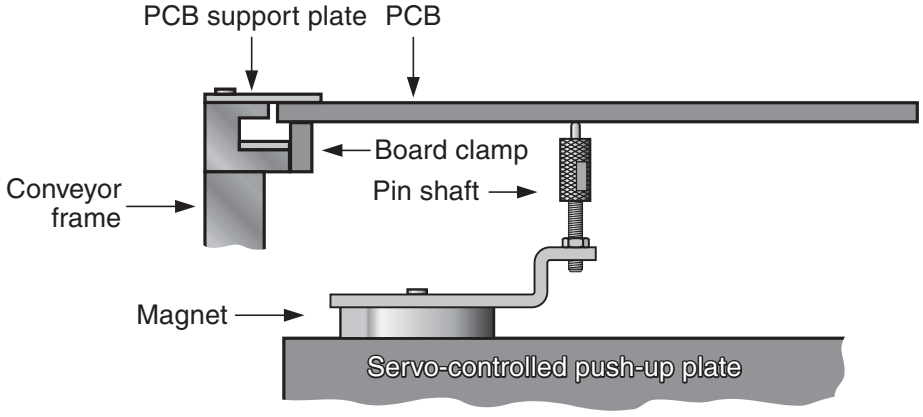


Figure 11 Push up system

A sub-stop enables an additional PCB to enter the machine while the current board is being populated. This reduces time loss during transport and is very useful when operating the machine in a flowline. An exit sub-stop, which can be seen as a transport buffer function, links the entrance sub-stop and main stopper, shortening the PCB transport time and reducing loss from inefficient operation.

For PCBs <190mm the average PCB transport time is cut in half due to the double segment PCB conveyor which makes it possible to transport two PCBs independently from each other.

When using the machine in a flowline it communicates with the unit upstream and downstream over a SMEMA-connection.

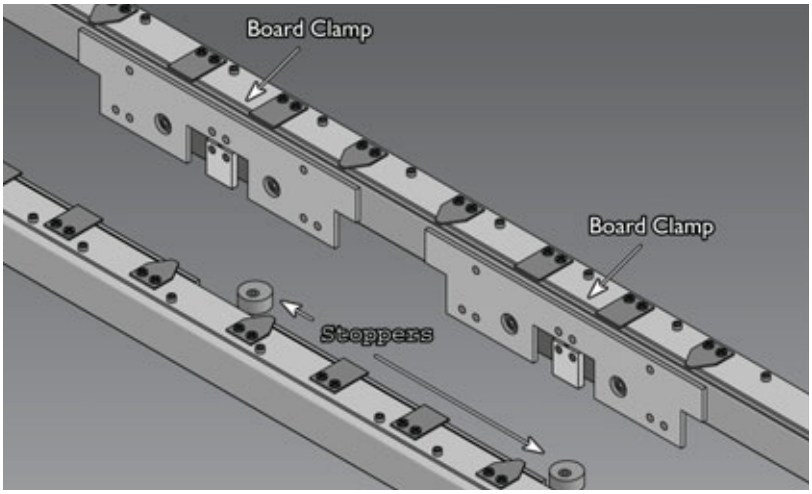


Figure 12 MG-1 Double Board Clamping system

Specifications	
PCB Dimensions (x,y):	Min: 50 x 50mm (2.0" x 2.0 ") Max: 460 x 440mm (18" x 17.2")
PCB Thickness:	Min: 0.4mm (0.015") Max: 4.0mm (0.15")
PCB Maximum warpage:	0.5mm up (0.02") 1.0mm down (0.04")
Maximum height pre-mounted components:	4mm on placement side (0.16") for FNC head (depends on mount position) 15mm on placement side (0. 59") for SF head 30mm on non placement side (1.2")
Non - Mountable area:	Board Top side: 3mm from front and rear side board edge (0.12") Component height restrictions apply in the 4mm (0.16") area from front side edge depending on board thickness Board Bottom side: 5mm from front and rear side board edge (0.2")
PCB Material:	Phenolic/FR4/Composite Materials Ceramic PCB transport is optional
PCB weight:	Max. 1.2 Kg without components Max. 2.0 Kg with components
PCB positioning:	Double independent board clamping unit (for max 190mm board length) Double independent Z servo controlled push up system (software controlled by PCB thickness) Push up pins (adjustable positions) Sub stop (PCB waiting buffer) fixed position Exit stop (fixed position)
PCB Transport height:	900mm ± 10mm (35.4" ± 0.4") SMEMA 953mm ± 12.5mm (37.5" ± 0.5")
PCB Transport direction:	Left to Right standard, optional Right to Left
PCB Transport width:	Automatic
PCB Loading time:	Approximately 2 sec. for PCB $\leqslant$ 190mm and 4 sec. for PCB > 190mm
PCB Transport:	Belt driven, two independent segments

Table 12

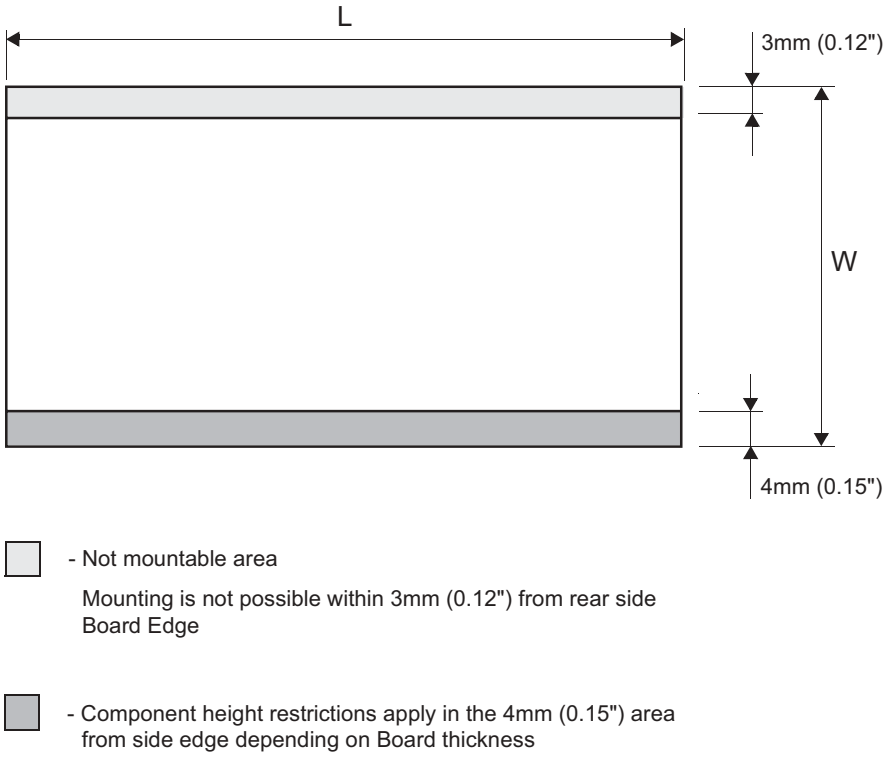


Figure 13 Mountable area

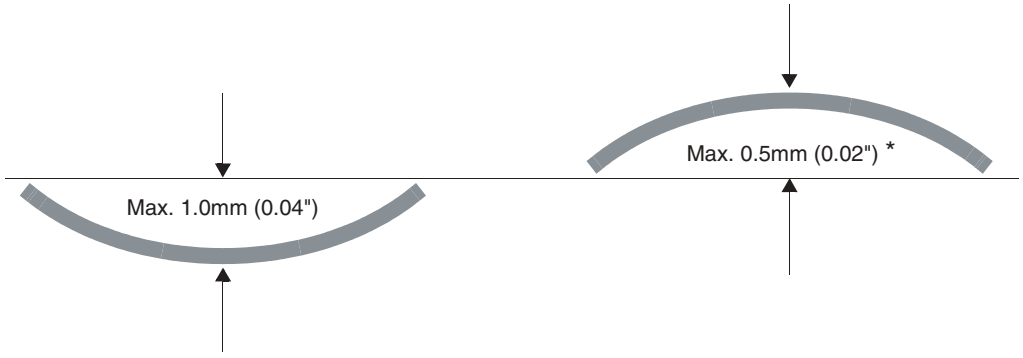


Figure 14 Warp of fixed PCB

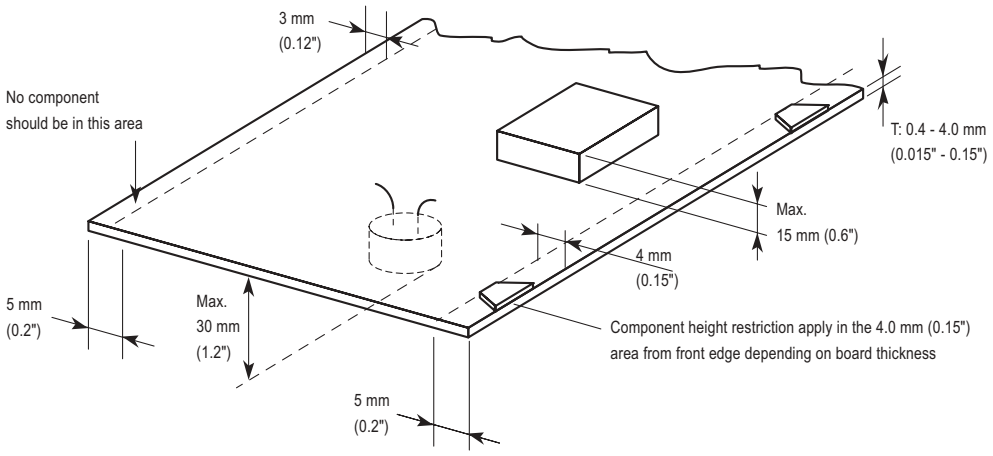


Figure 15 Mountable area

6.1 Automatic Nozzle Exchange station

The MG-1 comes standard with a 32 position automatic nozzle exchange station for both SF and FNC head.

Just six nozzle shapes are required to cover the specified SMD range. High output levels are therefore achieved, as the need for nozzle exchanges is minimal. Nozzle exchange time for one nozzle with nozzle changer is 1.5 sec and 1 sec for the Flying Nozzle Head. The nozzle station enables additional special nozzles to be accommodated including grippers for odd SMD components.

For the Flying Nozzle Head the following nozzle types are present for head 2,4,6,8.

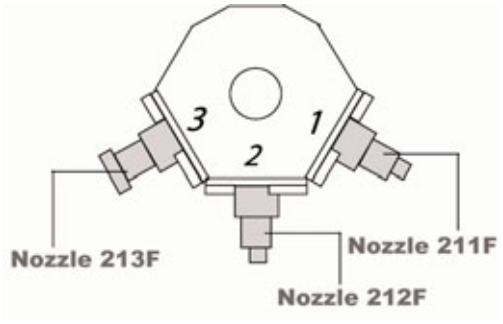


Figure 16 Nozzle

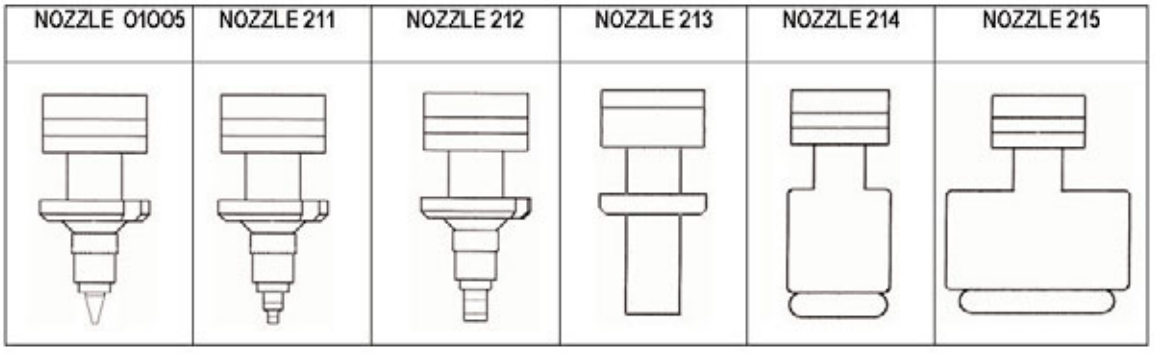


Figure 17 Nozzles

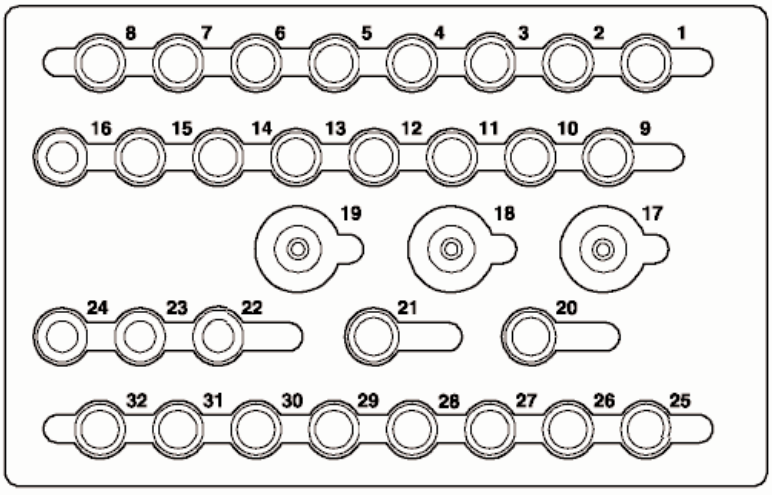


Figure 18 Nozzle Exchange Station

Specifications Automatic nozzle exchange station				
POSITION	**MG-1 SF HEAD**	**NOZZLE TYPE**	**MG-1 FNC HEAD**	**NOZZLE TYPE**
1	1	211	1	211
2	2	211	Free / Special	Free / Special
3	3	211	3	211
4	4	211	Free / Special	Free / Special
5	5	211	5	211
6	6	211	Free / Special	Free / Special
7	7	211	7	211
8	8	211	Free / Special	Free / Special
9	Free / Special	Free / Special	Free / Special	Free / Special
10	Free / Special	Free / Special	Free / Special	Free / Special
11	Free / Special	Free / Special	Free / Special	Free / Special
12	2	213	Free / Special	Free / Special
13	4	213	Free / Special	Free / Special
14	6	213	Free / Special	Free / Special
15	8	213	Free / Special	Free / Special
16	7	214	7	214
17	1	215	Free / Special	Free / Special
18	Free / Special	Free / Special	Free / Special	Free / Special
19	Free / Special	Free / Special	Free / Special	Free / Special
20	Free / Special	Free / Special	Free / Special	Free / Special
21	Free / Special	Free / Special	Free / Special	Free / Special
22	1	214	1	214
23	3	214	3	214
24	5	214	5	214
25	1	212	1	212
26	2	212	Free / Special	Free / Special
27	3	212	3	212
28	4	212	Free / Special	Free / Special
29	5	212	5	212
30	6	212	Free / Special	Free / Special
31	7	212	7	212
32	8	212	Free / Special	Free / Special

Table 13

6.2 Nozzle cleaning station

The MG-1 comes standard with a nozzle cleaning station for both SF and FNC head which can clean 4 heads at one time. High pressure air is used to clean the splines and the nozzles used for small chips such as 0201 and 0402. This will prevent the nozzle and spline to clog with dust and thus a higher and more stable pick performance and less machine down time is accomplished. The automatic cleaning action can be specified at any time interval during production or cleaning can also be done in a manual mode. To clean 16 nozzles on the MG-1 will take approximately 30 seconds which includes the nozzle exchange time for all applicable nozzles.

Specifications	
Applicable nozzles	Nozzle Type 211(F), 212(F) and the special 01005 nozzle
Cycle time	+/- 30 seconds for 16 nozzles (including the automatic nozzle exchange for all applicable nozzles)

Table 14

7.0 Component Feeding

7.1 Smart Feeders CLi

Depending on the machine configuration up to 96 Smart Feeders CLi (8mm) can be loaded. The smart feeders are equipped with the latest RFID technology to speed up and simplify machine setup, and to provide a real-time component inventory check. To use this RFID technology, the main machine must be equipped with CLi feederbars.

Available CLi tapefeeders		
TAPE FEEDER	**FEEDING PITCH (MM)**	**PA#**
Tape Feeder 8mm 15” for 01005	On Special Request	
Tape Feeder 8mm 15" for 0603 (0201) component CLi	2	PA 2903/97
Tape Feeder 8mm 15" for 1005 (0402) CLi	2	PA 2903/98
Tape Feeder 8mm 15" CLi	4	PA 2903/99
Tape Feeder 12mm 15"CLi	4,8,12	PA 2903/89
Tape Feeder 16mm 15"CLi	4,8,12,16	PA 2903/29
Tape Feeder 24mm 15"CLi	4,8,12,16,20,24	PA 2903/39
Tape Feeder 32mm 15"CLi	8,12,16,20,24,28,32	PA 2903/49
Tape Feeder 44mm 15"CLi	8,12,16,20,24,28,32,36	PA 2903/59
Tape Feeder 56mm 15"CLi	8,12,16,20	PA 2903/69
For larger and special tape feeders such as 72mm please contact your local sales representative		

Table 15 The feeding pitch can be adjusted on the feeder side.

Feeder occupation CL and CLi	
FEEDER TYPE	**REQUIRED FEEDER POSITION EQUIVALENT TO TAPE FEEDER 8MM**
Tape feeder 8mm,	1
Tape feeder 12mm, 16mm, 24mm	2-3
Tape feeder 32mm	4
Tape feeder 44mm	5
Tape feeder 56mm	6

Table 16 The above feeder conversion number may differ according to the installation combination.

7.2 Smart Feeder ITF

The MG-1 with ITF Smart Feeders has a fully compatible feeder platform with the GEM Xi(II) and AX Line machines. On the standard MG-1 with ITF Feeder Interface 40 8mm ITF Smart Feeders can be loaded. With the use of the ITF Twin Tape Feeder 80 code numbers can be loaded.
ITF Smart Feeders are available for 8 up to 56mm tape widths. The feeders can be loaded with 13 inch tape reels (optional 15" is available). ITF Smart Feeders are motor driven mechanism allowing a highly reliable uninterrupted feeding process.

To prevent incorrect feeder latching, a laser-based verification system is used.
To load the tapes into the ITF Smart Feeders a Tape Loading Unit is required. The TLU can be used without main power supply, a battery pack (12V DC) allows "stand alone" operation for about 8 hours.

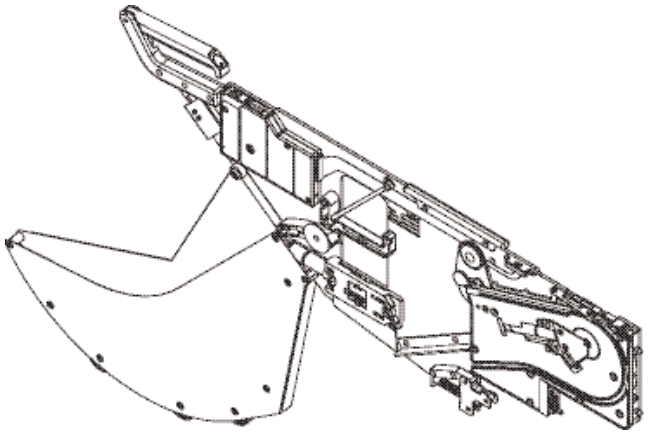


Figure 19 Intelligent Tape Feeder

Available tape feeders		
TAPE FEEDER	**FEEDING INDEX (MM)**	**PA#**
ITF 8mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/06
ITF 12mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/16
ITF 16mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/26
ITF 24mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/36
ITF 32mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/46
ITF 44mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/56
ITF 56mm	2,4,8,12,16,20,24,28, 32,40,44,48,52,56	PA 2654/66
Twin Tape feeder 8mm	2,4,8,12	PA 2657/00

Table 17 The feeding pitch can be adjusted on the feeder side

Feeder occupation	
FEEDER TYPE	**FEEDER SLOTS OCCUPIED**
Tape feeder 8mm	1
Tape feeder 12mm	2
Tape feeder 16mm	2
Tape feeder 24mm	2
Tape feeder 32mm	3
Tape feeder 44mm	4
Tape feeder 56mm	4

Table 18 The above feeder conversion number may differ according to the feeder combination.

The MG-1 comes standard with pneumatic CL feeders which are compatible with all existing GEM models. Depending on the machine configuration up to 96 tape feeders (8mm) can be loaded. The tape feeder design allows simultaneous picking from any mix of tape feeders ranging from 8 to 56mm. To achieve high speed feeding all feeder types are air driven. To prevent incorrect feeder latching, a laser-based verification system is used.

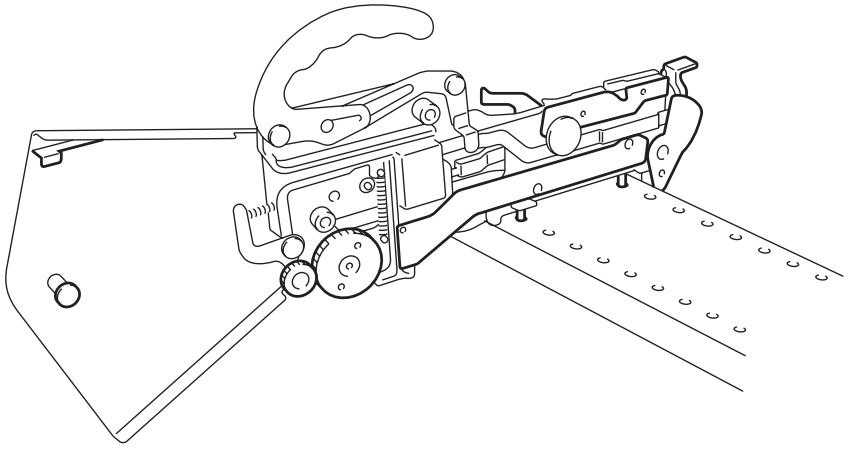


Figure 20 Pneumatic Tape feeder

Available CL tapefeeder		
TAPE FEEDER	**FEEDING PITCH (MM)**	**PA#**
Tape Feeder 8mm 15" for 0603 (0201) component CL	2	PA 2903/77
Tape Feeder 8mm 15" for 1005 (0402) CL	2	PA 2903/78
Tape Feeder 8mm 15" CL	4	PA 2903/79
Tape Feeder 12mm 15"CL	4,8,12	PA 2903/88
Tape Feeder 16mm 15"CL	4,8,12,16	PA 2903/27
Tape Feeder 24mm 15"CL	4,8,12,16,20	PA 2903/38
Tape Feeder 32mm 15"CL	8,12,16,20,24,28,32	PA 2903/41
Tape Feeder 44mm 15"CL	8,12,16,20,24,28,32,36	PA 2903/51
Tape Feeder 56mm 15"CL	8,12,16,20,24,28,32,36	PA 2903/68
For larger and special tape feeders such as 72mm please contact your local sales representative		

Table 19 The feeding pitch can be adjusted on the feeder side

7.3 Feeder Indicators

The MG-1 with CL and CLi feeder interface are standard equipped with feeder LED indicators. The feeder indicators provide the operator with all essential information regarding feeder status. With the use of 3 colors; Green, Yellow and Red the status will be indicated.

	ON	BLINKING
GREEN	Setup OK	
YELLOW	Error (Pickup, Recognition)	Warning
RED	Setup Not Good, Empty	Navigation (Change, Attach)

Table 20

7.4 Double Shuttle Tray Sequencer (PA 2699/25)

The Double Shuttle Tray Sequencer is an auxiliary unit for feeding parts from trays. This feeder can hold a maximum of 60 pallets (in 4 magazines), each being able to hold different trays. Pallets and magazines are compatible within MG-1 trayfeeders.

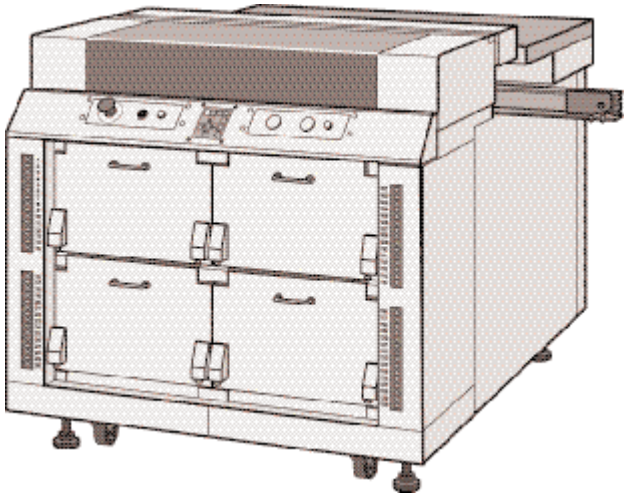


Figure 21 Double Shuttle Tray Sequencer

Two components are picked up from the tray with a 2 in-line head shuttle. This shuttle then moves into the machine where both components are placed on a temporary station. This station can move up and down so that the MG-1 can pickup the components. The parts are then aligned by vision and placed on the PCB. At the same moment when the components are picked by the MG-1 placement head a second shuttle will supply the next components while minimizing any feeding delays.

The component feeding time of the Double Shuttle Tray Sequencer is 4 seconds for 2 parts when using the same tray (pallet 1) and 8 seconds when changing the tray (pallet 30). However, in practice no time is lost because of the simultaneous operation of Tray sequencer and MG-1: while the machine is picking from on-board feeders, the 2 shuttles bring in new components. A part that is rejected by vision will be placed back on a reject belt feeder which means no loss of expensive parts.

The PCB conveyor on the Double Shuttle Tray Sequencer offers the possibility for visual PCB inspection.

- The tray area is fixed and separated into four sections with each 15 pallets.
- A buffer conveyor is standard equipped, so a reflow oven can be connected without additional conveyors.

Double Shuttle Tray Sequencer specifications (PA 2699/25)	
GENERAL	
Max. Tray size (L x W):	335mm x 230mm (13.2" x 9.1")
Min. Tray size (L x W):	140mm x 90mm (5.5" x 3.5")
Component feeding time:	4 sec. for 2 parts (picking from pallet 1) 8 sec. for 2 parts (picking one from pallet 1 and one from pallet 30)
Power and air supply:	Delivered by MG-1
Double Shuttle Tray Sequencer dimensions:	Length: 1,200mm (3.9 ft) Height: 1,006mm (3.3 ft) (with top cover open 1530mm (5.2 ft)) Width: 1,482 mm (4.8 ft) (with door open 1,722mm (5.8 ft))
MG-1 + Tray Feeder Sequencer dimensions:	Length: 2,855mm (9.3 ft) Height: 1,850mm (6.1 ft) Width: 1,650mm (5.6 ft) (with door open and feeders on MG-1 (2,160mm (7.3 ft)
Weight:	± 380 kg (837 Lbs)
APPLICABLE COMPONENTS	
Min. Component dimension:	10mm x 10mm (0.25" x 0.25") Mold size
Max. Component dimension:	45mm x 45mm (1.8" x 1.8")
Max. Tray height included component height:	8.5mm (0.33") from pallets at pitch of 12.5mm (0.5"), total 15 pallets possible per magazine
	16mm (0.63") from pallets at pitch of 25mm (0.98"), total 7x pallets possible per magazine
FEED CAPACITY	
Number of shuttles:	2
Number of heads on each shuttle:	2 (with a pitch of 48mm)
STANDARD COMPONENT CAPACITY	
Max. number of component types:	60 (60 x 1 Jedec tray)
Number of pallets:	Standard 4 magazines each with 15 pallets included (additional magazines available PA 2981/02)

Table 21

7.5 Single ATS Tray Feeder (PA 2696/27)

The Single ATS Tray Feeder is directly connected to the rear of the machine, allowing high-speed feeding of tray components and direct picking from tray. The feeder is equipped with 2 magazines each containing a maximum of 15 pallets, each being able to hold different trays. The magazines are moved with a lift mechanism. Pallet indicators provide easy setup during initial setup or changeover. There is no PCB width restriction with the use of the Single ATS Tray Feeder.

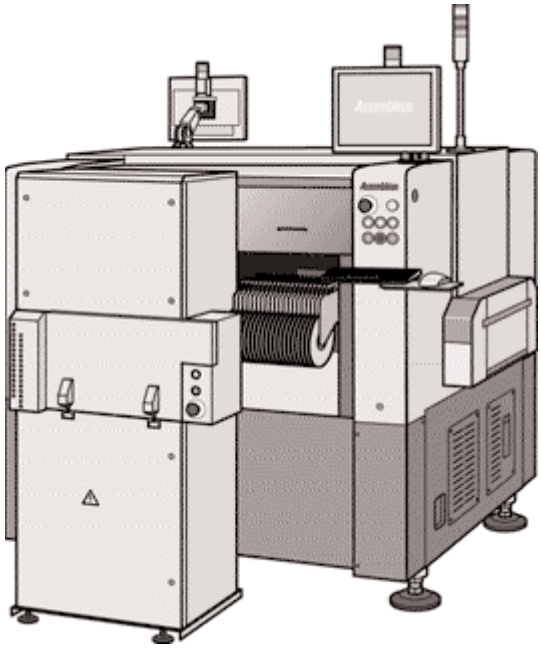


Figure 22 *Single ATS Tray Feeder (2696/27)*

The maximum pallet exchange time for the Single ATS Tray feeder 5 seconds. However, in practice no time is lost because of the simultaneous operation of the Single ATS Tray feeder and MG-1; while the machine is picking from on-board feeders, the Single ATS Tray Feeder brings in new components.

A part rejected by vision will be placed back in its original tray position; this means no loss of expensive parts.

The Single ATS Tray Feeder allows for rapid sequential picking of parts directly from the tray on all 8 heads for IC/QFP shooting applications.

Single ATS Tray Feeder specifications (PA 2696/27)	
GENERAL	
Max. Tray size (L x W):	335mm x 230mm (13.2" x 9.1")
Min. Tray size (L x W):	140mm x 90mm (5.5" x 3.5")
Pallet exchange time:	Changing from magazine 1, pallet 1 to 15; 4 seconds Changing from magazine 1, pallet 1 to 2; 3.5 seconds Changing from magazine 1, pallet 1 to magazine 2, pallet 15; 5 seconds
Weight:	± 140 kg (308 Lbs) without hook)
Power and air supply:	Supplied by MG-1
MG-1 + Single ATS Tray feeder dimensions:	Length: 1,650mm (5.5 ft) Height: 1,850mm (6.2 ft) Width: 1,870mm (6.2 ft) (with ATS 20 door open, 2,115mm (7.2 ft))
Maximum board width:	440mm (17.2")
Maximum amount of feeders on MG-1:	2 x 24 + 20 = 68 or 2x20 for ITF
APPLICABLE COMPONENTS	
Max. Tray height including component height:	8.5mm (0.33") from pallets at pitch of 12.5mm (0.49"), total 15 pallets possible per magazine
	20mm (0.79") from pallets at pitch of 25mm (0.98"), total 7 pallets possible per magazine
Min. Component dimension:	6mm x 6mm (0.24" x 0.24") mold size
Max. Component dimension:	45mm x 45mm (1.8" x 1.8")
STANDARD COMPONENT CAPACITY	
Max. number of component types:	30 (30 x 1 Jedec tray)
Number of pallets:	Standard 2 magazines each with 15 pallets included (additional magazines available PA 2981/02)

Table 22

7.6 Dual ATS Tray Feeder (PA 2696/28)

The Dual ATS Tray Feeder is a new additional internal pallet sequencer build into the machine frame on the rear side allowing high-speed feeding of tray components. The feeder is equipped with 4 magazines each containing a maximum of 15 pallets, each being able to hold different trays. The tray area is fixed and separated into four sections with each 15 pallets. Pallet indicators provide easy set-up during initial setup or changeover. The maximum PCB width is restricted to 330mm (13").

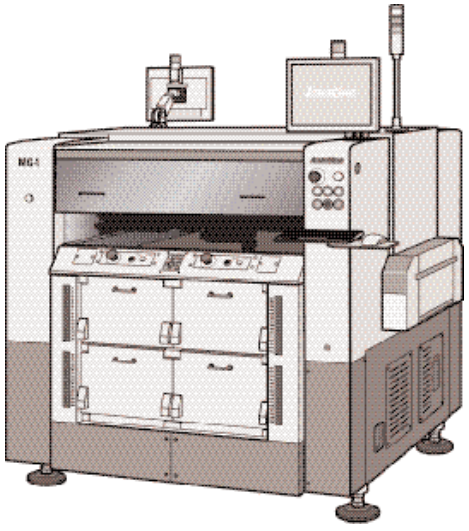


Figure 23 *Dual ATS Tray Feeder (rear side MG-1)*

The maximum pallet exchange time for the Dual ATS Tray feeder is 5.6 seconds. However, in practice no time is lost because of the simultaneous operation of the Dual ATS Tray Feeder and MG-1; while the machine is picking from on-board feeders, the Dual ATS Tray Feeder brings in new components.

A part rejected by vision will be placed back in its original tray position; this means no loss of expensive parts.

Dual ATS Tray Feeder specifications (PA 2696/28)	
GENERAL	
Max. Tray size (L x W):	335mm x 230mm (13.2" x 9.1")
Min. Tray size (L x W):	140mm x 90mm (5.5" x 3.5")
Pallet exchange time:	Changing from magazine1, pallet 1 to 15;
	4 seconds
	Changing from magazine 1, pallet 1 to 2;
	3.5 seconds Changing from magazine 1, pallet 1 to
	magazine 2, pallet 15; 5 seconds
Power and air supply:	Delivered by MG-1
MG-1 + wATS dimensions:	Length: 2,855mm (9.3 ft) Height: 1,850mm (6.1 ft) Width:1,850mm (6.1 ft) (with door open and feeders on MG-1 (2,121mm (7.2 ft))
Weight:	± 1,850 kg (4075 Lbs)
APPLICABLE COMPONENTS	
Min. Component dimension:	6mm x 6 mm (0.24" x 0.24") Mold size
Max. Component dimension:	45mm x 45mm (1.8" x 1.8")
Max. Tray height including component height:	8.5mm (0.33") from pallets at pitch of 12.5mm (0.5"), total 15 pallets possible per magazine
	16mm (0.63") from pallets at pitch of 25mm (0.98"), total 7x pallets possible per magazine
STANDARD COMPONENT CAPACITY	
Max. number of component types:	60 (60 x 1 Jedec tray)
Number of pallets:	Standard 4 magazines each with 15 pallets included (additional magazines available PA 2981/02)

Table 23

7.7 Pallet Indicators

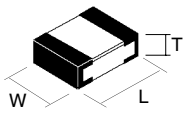
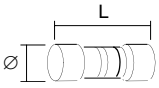
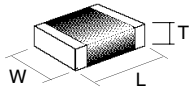
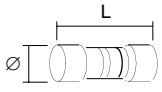
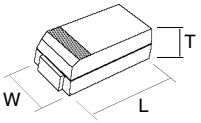
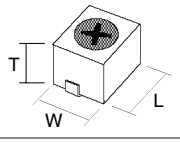
The Double Shuttle Tray Sequencer, Single ATS and Dual ATS Tray Feeder are standard equipped with pallet LED indicators. The pallet indicators provide the operator with all essential information regarding pallet status. With the use of 3 colors; Green, Yellow and Red the status will be indicated.

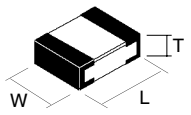
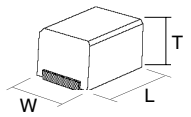
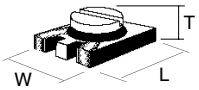
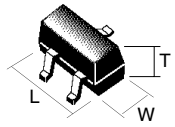
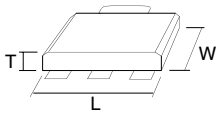
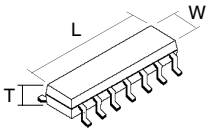
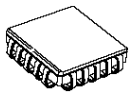
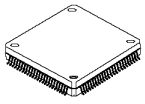
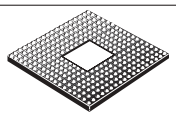
	ON	BLINKING
GREEN	Setup OK	
YELLOW	Error (Pickup, Recognition)	Warning
RED	Setup Not Good, Empty	Navigation (Change, Attach)

Table 24

7.8 Mountable Components & Required Nozzles MG-1

Just five nozzle shapes are required to cover the specified SMD range. High output levels are therefore achieved, as the need for nozzle exchanges is minimal.

Component		Dimensions (mm)			Required nozzle Type
		L	W	T	
	Solid resistor	0.4	0.2	0.2	Special nozzle on request
		0.60	0.30	0.25	211F/211
		1.00	0.50	0.50	211F/211
		1.60	0.80	0.50	212F/212
		2.00	1.25	0.50	212F/212
		3.20	1.60	0.60	212F/212
	Solid resistor	2.00	ϕ 1.25		212F/212
		3.45	ϕ 1.35		212F/212
		5.9	ϕ 2.2		212F/212
	Multi-layered ceramic capacitor	0.4	0.2	0.2	Special nozzle on request
		0.6	0.3	0.3	211F/211
		1.0	0.5	0.5	211F/211
		1.50	0.80	0.80	212F/212
		2.00	1.25	1.25	212F/212
		3.20	1.60	1.25	212F/212
		3.20~4.50	2.50~3.20	1.50~1.90	213F/213
		5.60	5.00	1.90	213F/213
	MELF ceramic capacitor	3.40	ϕ 1.50		213F/213
		5.9	ϕ 2.2		215
	Tantalium electrolytic capacitor	2.90	1.60	1.60	212F/212
		3.80	2.90	1.60	213F/213
		4.70	2.60	2.10	213F/213
		6.00	3.20	2.50	213F/213
		7.30	4.30	2.80	213F/213
	Aluminium electrolytic capacitor	4.3	4.3	5.7	213F/213
		6.6	6.6	5.7	213F/213
		10	10	10.5	214

Component		Dimensions (mm)			Required nozzle Type
		L	W	T	
	Chip film capacitor	7.3	5.3	3.25	213F/213
	Chip inductor	3.2	2.5	2.0	213F/213
		4.5	3.2	3.2	213F/213
	Semi-variable resistor	4.5	3.8	2.4	213F/213
	Transistor (SOT)	2.90	1.5	1.10	212F/212
		4.0	3	1.8	213F/213
	Power transistor	4.6	2.6	1.6	213F/213
	SOP (6 ~ 28 pin)	5.00	4.50	1.50	213F/213
		7.60	4.50	1.50	213F/213
		10.10	4.50	1.50	213F/213
		12.60	5.70	1.50	213F/213
		15.30	7.50	2.00	214
		17.80	7.50	2.00	214
	PLCC	⧄ 5~16			213F/213
		⧄ 15~20			214
		⧄ 15~32			214
		⧄ 32~45			215
	QFP	⧄ 5~16			214
		⧄ 15~20			214
		⧄ 15~32			214
		⧄ 32~45			215
	BGA	⧄ 10~26			214
		⧄ 10~30			214
		⧄ 32~45			215

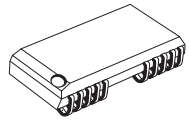
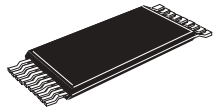
Component		Dimensions (mm)			Required nozzle Type
		L	W	T	
	SOJ (20~42 pin)	⌀ 10~20			213F/213
		⌀ 15~30			214
		⌀ 32~45			215
	TSOP (20~32 pin)	⌀ 10~20			213F/213
		⌀ 15~30			214
		⌀ 32~45			215

Table 25 For information on CSP, BGA, bare chip and other types of components, please consult your local sales representative.

8.0 Feederbar Exchange System

Systems are available depending on the feeder type choosen.

8.1 PA 2505/70

The Feederbar Exchange System (FES) allows fast change-over by switching the complete 24 position CLi feederbar on a MG-1.

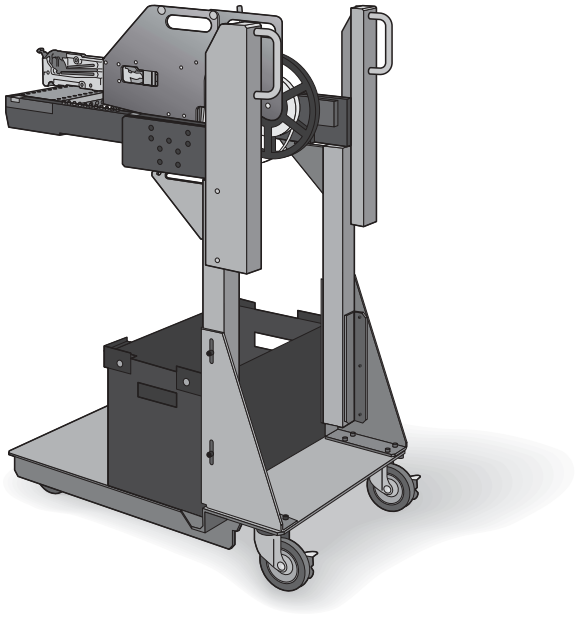


Figure 24 MG-1 CLi FES-24 Cart

Feederbars are mounted on carts for off-line feeder set-up. These carts are easily moved from set-up area to the mounting machines and back. This option is available for the front (PA 2505/71) and rear side (PA 2505/72) of the machine. An empty tape bin will be delivered with each FES cart.

FES 24 CLi Specifications	
	PA 2505/70
FES change over time:	⩽ 60 sec.
FES repeatability:	Pick position ⩽ 0.05mm
Applicable feeders:	Tape, stick, bulk feeders
Number of feeders on FES carriage:	8mm: 24 feeders 12/16mm: 11 feeders 24mm: 8 feeders 32mm: 7 feeders 44mm: 5 feeders 56mm: 4 feeders Stick: depends on stick dimensions
Air and Electrical interface:	Quick coupling (one action)
Electrical power:	Supplied by main system
Air supply:	Supplied by main system

FES 24 dimensions, stand alone without feeders:	Length: 785mm (2.59 ft) Width: 515mm (1.70 ft) Height: 1000mm (3.3 ft)
Weight without feeders:	65 kg (143 Lbs)
Tape waste bin :	Included

Table 26

8.2 PA 2505/75

The Feederbar Exchange System (FES) allows fast change-over by switching the complete 24 position CL feederbar on a MG-1

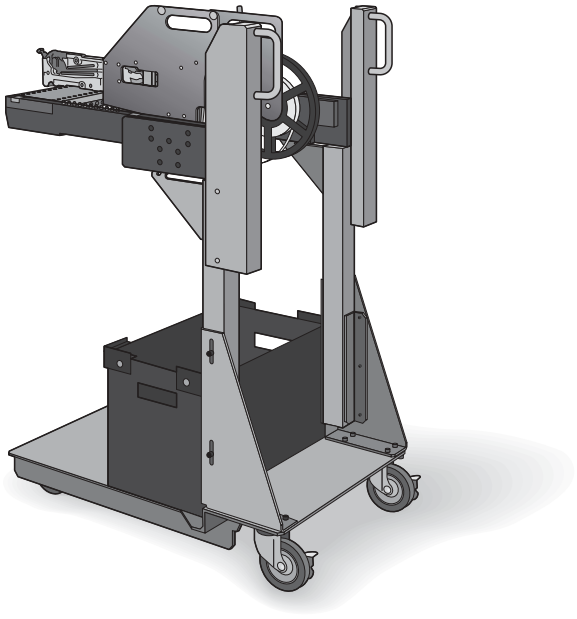


Figure 25 MG-1 CL FES-24 Cart

Feederbars are mounted on carts for off-line feeder set-up. These carts are easily moved from set-up area to the mounting machines and back. This option is available for the front (PA 2505/76) and rear side (PA 2505/77) of the machine. An empty tape bin will be delivered with each FES cart.

FES 24 CL Specifications	
	PA 2505/75
FES change over time:	⩽ 60 sec.
FES repeatability:	Pick position ⩽ 0.05 mm
Applicable feeders:	Tape, stick, bulk feeders
Number of feeders on FES carriage:	8mm: 24 feeders 12/16mm: 11 feeders 24mm: 8 feeders 32mm: 7 feeders 44mm: 5 feeders 56mm: 4 feeders Stick: depends on stick dimensions
Air and Electrical interface:	Quick coupling (one action)
Electrical power:	Supplied by main system
Air supply:	Supplied by main system
FES 24 dimensions, stand alone without feeders:	Length: 785mm (2.59 ft) Width: 515mm (1.70 ft) Height: 1,000mm (3.3 ft)
Weight without feeders:	65 kg (143 Lbs)
Tape waste bin :	Included

Table 27

8.3 PA 2505/52

The Feederbar Exchange System (FES) allows fast change-over by switching the complete 20 position feederbar on a MG-1 with ITF feeders.

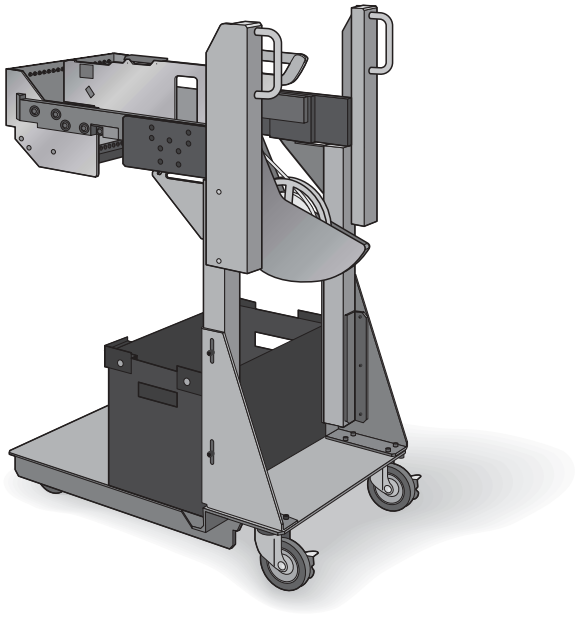


Figure 26 MG-1 ITF FES-20 Cart

Feederbars are mounted on carts for off-line feeder set-up. These carts are easily moved from set-up area to the mounting machines and back. The MG-1 ITF is standard equipped with front side feederbar exchange system.
The MG-1 FES 20 ITF carts are fully compatible with those of the Topaz-Xi, Emerald-Xi, Topaz-Xi II and Emerald-Xi II. An empty tape bin will be delivered with each FES cart.

FES 20 Specifications	
	PA 2505/52
FES change over time:	< 60 sec.
FES accuracy from FES cart fiducials	X= +/- 0.05mm
to pick position ($\mu + 3\sigma$):	Y= +/- 0.05mm
	Z = +/- 0.10
Applicable feeders:	ITF tape feeders
	ITF stick feeders
Number of feeders on FES carriage:	8mm: 20 feeders
	12/16mm: 9 feeders
	24mm: 10 feeders
	32mm: 6 feeders
	44mm: 5 feeders
	56mm: 4 feeders
	Stick: depends on stick dimensions
Air and Electrical interface:	Quick coupling (one action)
Electrical power:	Supplied by main system
Air supply:	No air supply to feeders
FES 20 dimensions, stand alone	Length: 820 mm (2.7 ft)
without feeders:	Width: 470 mm (1.55ft)
	Height: 1050 mm (3.44 ft)
Weight without feeders:	55 kg (121 Lbs)
Tape waste bin :	Included
Compatibility:	Topaz-Xi, Emerald-Xi, Topaz-Xi^{II} and Emerald-Xi^{II}

Table 28

9.0 MG-1 Summary

	Model	MG-1	MG-1	MG-1	MG-1	MG-1
Head	PA Number	PA1317/01	PA 1317/02	PA 1317/03	PA 1317/04	PA 1317/05
	Flying Nozzle Change Head (FNC)	o			o	
	High Precision head (SF)		o	o		o
	Nozzle Exchange station	o	o	o	o	o
	Nozzle cleaning station	o	o	o	o	o
	Special order nozzles	*	*	*	*	*
Recognition system	Line Array camera 45mm		o	o		o
	Line Array camera 32mm	o			o	
	Second line arry camera	#	#	#	#	#
	3D co-planarity checker	#	#	#	#	#
	Side view camera	#	#	#	#	#
	Fiducial camera	o	o	o	o	o
Feeding	Pneumatic Tape Feeder CL	o	o			
	Pneumatic Tape Feeder CLi (RFID)				o	o
	Intelligent tapefeeder			o		
	Bulk Feeder	#	#	#	#	#
	Stick Feeder	#	#	#	#	#
	Single ATS trayfeeder (sATS)	#	#	#	#	#
	Double ATS trayfeeder (wATS)	*	*		*	*
	Double Shuttle inline head Tray Feeder (LCS)	#	#	#	#	#
	Reject station	#	#	#	#	#
	Feeder Exchange System (FES 24)	#	#		#	#
PCB positioning/transport	Main Stopper	o	o	o	o	o
	Double Board Clamp System	o	o	o	o	o
	Z servo controlled double Push Up Plate	o	o	o	o	o
	Adjustable Push up pins	o	o	o	o	o
	Entrance Sub Stopper	o	o	o	o	o
	Exit Sub Stopper	o	o	o	o	o
	Automatic Width Adjustment	o	o	o	o	o
	High Speed soft-stop conveyor	o	o	o	o	o
	Reverse transfer Right to Left	#	#	#	#	#
	Ceramic PCBs	#	#	#	#	#
	Special sized PCBs	*	*	*	*	*
Safety	Feeder Floating Detection	o	o	o	o	o
	Feeder indicators	o	o		o	o
	Conveyor Entrance/Exit covers	o	o	o	o	o
	Safety cover for feeder exchange	o	o	o	o	o
	Dummy Feeders	o	o	o	o	o
	Safety specifications according CE standards	o	o	o	o	o
	Spare parts kit + tools	o	o	o	o	o
	SMEMA kit	o	o	o	o	o
	Front and rear anti-static covers	o	o	o	o	o
	Signal tower + warning buzzer	o	o	o	o	o
Software	Windows XP Graphical User interface	o	o	o	o	o
	Multiple Accuracy Compensation System	o	o	o	o	o
	Fiducial Recovery function	o	o	o	o	o
	Bad Mark / Master Mark Sensing	o	o	o	o	o
	On-line teaching	o	o	o	o	o
	Alternative Feeder Function	o	o	o	o	o
	Self Production Control	o	o	o	o	o
	Variable XY axis speed per component	o	o	o	o	o
	On-line Help function	o	o	o	o	o
	Management Information System	o	o	o	o	o
	Template (pattern matching)	o	o	o	o	o
	Automatic rework cycle	o	o	o	o	o
	On-line data generator	o	o	o	o	o

Table 29

o = Standard
# = Optional
* = Special order