Assembléon

Integrated electronics manufacturing solutions

September 2006

MG-2 SPECIFICATIONS

PA 1319/01 MG-2 CL with SF head
PA 1319/02 MG-2 CL with FNC head
PA 1319/03 MG-2 CLi with SF head
PA 1319/04 MG-2 CLi with FNC head

Date of release: September 2006

9498 392 0035.1

Contents

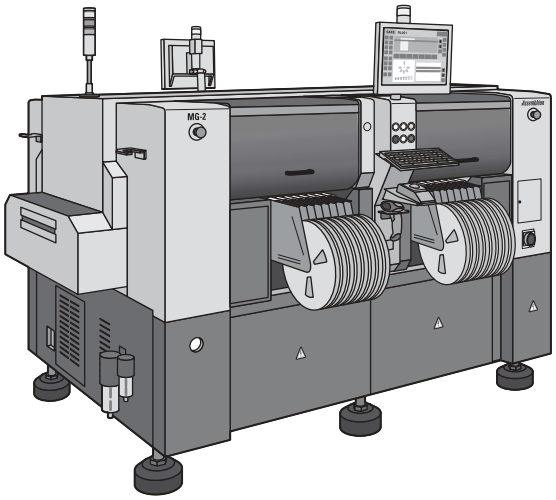
1.0 Introducing the MG-2

The MG-2, the new generation High Speed Chip-Shooter Production Machines, belongs to the top-of-the-line Assembléon SMD Pick & Place machines.

With the MG-2 a feeder commonality between all GEM Series machines has been continued which increases the MG-2 flexibility

The MG-2 is a high speed chip-shooter that is capable of placing components at speeds up to 42000 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-2

The MG-2 employs four independent placement beams each equipped with 3 Flying Nozzle Change heads (each equipped with 3 nozzles) and 3 standard heads with exchangeable nozzles or 6 Super Fine heads with exchangeable nozzles. Two boards are processed in parallel. The placement beam moves in X, Y and Z direction, while the boards move in Y direction.
A flexible board transport system enables the MG-2 to handle virtually any type of PCB with the use of a board clamping system. Board conveyor width is automatically adjustable, allowing board dimensions up to 420 x 330mm (16.5" x 13") to be handled.

Each placement beam has its own newly designed digital vision system with a line array camera which allows fast and accurate "on-the-fly" alignment of a wide range of components from 01005 (0402) up to 14mm square. Dark background BGAs with ball pitches down to 0.4 mm (16mil) and ball diameters down to 0.1 mm (4 mil) can be recognized with the use of 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, on each placement beam, 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 four nozzle shapes are required to cover the specified SMD range. High output levels are therefore achieved, as the need for nozzle exchanges is minimal.

Up to 96 tape feeders can be loaded on the MG-2. The machine supports tape, stick, and bulk feeders. The tape feeder design for the MG-2 allows simultaneous picking from any mix of tape feeders ranging from 8 to 56 mm.

A Windows XP based controller, running a user-friendly Graphical User Interface, allows the MG-2 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 help 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-2 (FNC)	MG-2 (SF)	
			REMARKS
Tact time:	0.086 sec/chip		Under optimal conditions
Optimal placement rate:	42,000 cph		Simultaneous pick (at best conditions)
Tact time IPC 9850:	31,200 cph		C0603; all heads, all angles
	16,500 cph	19,500 cph	SOIC; MG-2 (FNC) with 3 SOIC on each head, MG-2 (SF) with 6 SOIC on each head
Nominal placement rate:	26,000- 30,000 cph		Real mounting speed
Applicable Components:	01005 - SOP, SOJ, PLCC 14mm square (1.0"), QFP 14mm square (1.0") with pin pitch down to 0.4mm (16 mil) Dark background BGA: 6mm - 14mm: Min. ball pitch down to 0.4mm (16 mil) Min. ball diameter down to 0.1mm (4 mil) Irregularly shaped SMDs		Line array camera system Ball presence check for ⩾ 0.1mm ball diameter. Ball defect check for ⩾ 0.2mm ball diameter
Component height:	Max: 6.5mm		
Mounting accuracy (X,Y) $\mu+3\sigma$:	± 50µ for chips 01005-0201-0402 ± 75µ for chips and SOIC		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 QFPs		Line array camera system (all placement heads and all placement angles)
Mounting repeatability (X, Y) 3σ:	15µ for QFPs		One head and one mounting angle
Mounting angle:	0 up to 360 (programmable in steps of 0.01)		
Number of heads:	Four single beams each with 3 Flying Nozzle Change heads and 3 standard heads	Four single beams each with 6 standard heads	
Alignment system:	4 x line array cameras with illumination system for Vision on the Fly 4 x Moving CCD cameras for Fiducial alignment		Standard
Type of nozzles for MG-2:	Type 201F (on FCN head) Type 202F (on FNC head) Type 203F (on FNC head) Type 201 Type 202 Type 203 Type 206 (Melf nozzle)	Type 201 Type 202 Type 203 Type 206 (Melf nozzle)	Standard for the MG-2 (FNC) will be delivered: 12x nozzle 201F, 12x nozzle 202F, 12x nozzle 203F, 3x nozzle 201, 9x nozzle 202 (in the spare part kit: 1x nozzle 201, 1x nozzle 202, 1x nozzle 203, 2x nozzle 201F, 2x nozzle 202F, 2x nozzle 203F, 1x nozzle 206 (MELF) Standard for the MG-2 (SF) will be delivered: 3x nozzle 201, 21x nozzle 202 (in the spare kit: 3x nozzle 201, 3x nozzle 202, 3x nozzle 203, 1x nozzle 206 (MELF)
	Special nozzle for 01005		Nozzle and feeder for 01005 on special request

	MG-2 (FNC)	MG-2 (SF)	
			REMARKS
Nozzle Cleaning Station:	For nozzle types 201F, 201, 202F, 202, 202, 203F, 206 and special 01005 nozzle	For nozzle types 201, 202, 203, 206 and special 01005 nozzle	6 heads at one time
Component weight:	Max.: 3.0 gr		With the use of Nozzle type 203
Component mounting interdistance:	01005-0402: 0.25mm or more Chip: 0.5mm or more SOP: 0.5mm or more		
Placement system:	Pneumatic control for component height compenstation		
Placement force:	24gram/mm (for nozzles with buffer this value is different)		Pre-tension is 200gr. (spring loaded)
Number of feeders:	Pneumatic Tape Feeders CL(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 x 8mm positions		
Feeder indicators:	96 LED indicators (Green, Yellow & Red)		Standard
Component Packaging:	Tape according to IEC/EIA-J/JEDEC: 8-56mm		Tape reel diameter max: 380mm (15”)
	Stick and bulk		Many solutions possible
Maximum height pre-mounted components:	4.0mm on placement side (0.16”) 25mm on non placement side (1.0”)	6.5mm on placement side (0.26”) 25mm on non placement side (1.0”)	Depending on component neighborhood
PCB Dimensions (x,y):	Min.: 50 x 50mm (2.0” x 2.0”) Max.: 420 x 330mm (16.5” x 13”)		
PCB Weight:	Max.: 0.65kg		With components
PCB Thickness:	Min.: 0.4mm (0.015”) Max.: 4.0mm (0.12”) *Special applications upon request*		
Non - Mountable area:	Board Top side: 3mm from 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: 3mm from front and rear side board edge (0.12”)		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 PCBs requires special conveyor section (optional)

	MG-2 (FNC) MG-2 (SF)	
		REMARKS
PCB positioning:	Two independent Board Clamping units Two independent push up systems Push up pins Sub stop (PCB waiting buffer) Exit Stop	Standard Standard Adjustable positions Fixed position Fixed position
PCB Transport height:	900mm ± 10mm (35.4" ± 0.4") 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 5 sec.	PCB loading concurrent to SMD picking and alignment
LAN interface:	Based on IEEE802.3u, IEEE802.3	
Communication Protocol	TCP/IP, NetBEUI	
Control system:	Celeron 1.2 GHz controller Industrial Windows XP operating system 1 Gb flash disk USB port CD-ROM RS 232 Serial Interface + LAN interface 15" touch screen LCD monitor front and rear	 Standard
User Interface	VGOS (Visual Graphical Operating System) 2x keyboard and trackball for data editing functions Operational panel front and rear side	 Standard Standard
Control system functions:	Max. 127 PCBs Number components types/PCB Max. blocks/PCB Backup and restoring data using USB stick Supported formats: VIOS, VIOS-TXT, YGX MIS data gathering Data teaching Data tracing Component database Mark database SMEMA electrical interface On-line calibration On-line help functions Feeder lock verifier	12,800 comp/PCB 255 512 VIOS: binary format VIOS-TXT: text format YGX: format (preferred) 16,000 Component packages: user can define and teach vision files 300 Mark shapes
Machine dimensions and weight:	Length: 2330mm (7.6ft) Height: 1850mm (6.1ft) Width: 1723mm (5.6ft) Weight: 2450kg (5399Lbs)	 Width including feeders: 2423mm (7.9ft)

	MG-2 (FNC) MG-2 (SF)	
		REMARKS
Safety standards:	EN 292, EN 294, EN 349, EN 614, EN 1050, EN 55011, EN 61000-6-2, EN 60204-1 EN 301 489-1, EN 301 489-3, EN 300 330-2, EN 60950	CE-safety is part of system design. Safety measurements are tested on each product in the factory. For MG-2 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 Consumption: 7.1 kVA max. Noise peak: 1.500V, 1msec or less Average power consumption: 1.1kw Floor: Flat, slope is 10mm or less	
Air supply:	Pressure: > 5.5 .105 Pa (5.5 bar, 80 PSI) Quality: dust and oil free Consumption: min.400 Nl/min	
Operating Temperature:	15-35° C (59° - 95° F)	Specification guaranteed: 20° - 28° C (68° - 82° F)
Humidity:	20 - 90%, no dew	
Noise:	< 78dba	

Table 1

3.0 Features, Accessories and Options

3.1 Features

The Standard MG-2 includes the following features:

- On the fly alignment using a vision system with four Line array cameras
- Four independent placement beams each with 3 Flying Nozzle Change heads (each head standard equipped with 3 nozzles) and 3 standard heads or 6 Super Fine heads.
- Simultaneous picking is possible by all 6 heads from any mix of tape feeders.
- Complete component range can be handled with only 4 nozzles shapes.
- Four fiducial alignment cameras with improved software controlled illumination unit (white + IR Leds), that also can be used as teaching/tracing device and for Bad Mark sensing.
- Automatic width adjustment. The PCB dimension is included in your PCB data.
- Two PCB board clamping systems
- Two PCB push up plates with 12 push up pins, for PCB support.
- Substopper, allowing a third PCB to enter the machine for reducing transport time.
- Exit Substopper, allowing a new PCB to enter the work area of the machine while the downstream machine is still not ready to accept a new PCB.
- Four automatic nozzle cleaning stations for all nozzles types. Six 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.
- USB stick for backup purposes (256 Mb)
- CD-ROM drive for software installation
- Front and rear : 15" touch screen LCD, operation panel, keyboard and trackball
- Four component dump boxes.
- Operator manual, available in different languages.
- User manual.
- Service manual.
- CD contains: all manuals, help files and calibration files
- Two empty tape bins.
- Toolset.
- First aid spare parts kit.
- CE safety.
- ESD safety.
- Electrical and Mechanical SMEMA.
- Ethernet communication port.
- RS232 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 (Visual-Graphical-Operating-System). 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.
- Box teaching to recover fiducial recognition error.
- Data editing functions with the use of the fiducial camera (teaching,tracing).
- A Component database, that can hold up to 16000 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.
- Product preparation can be done on the machine including basic optimization of the mount program. (nozzle and feeder set-up).
- Multi-section PCBs can be 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

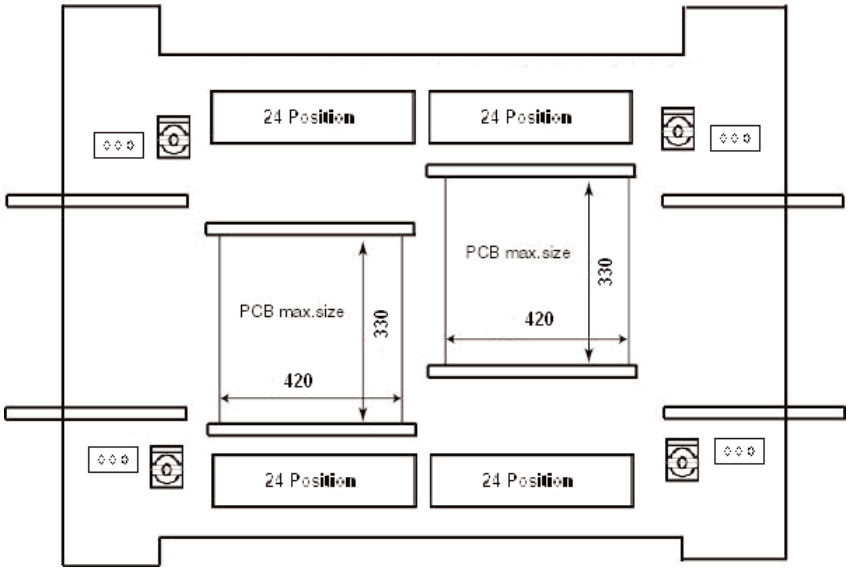
ACCESSORIES AND OPTIONS MG-2 FNC/SF, CL/CLi	
PA 1905/01	Pre empty warning first machine
PA 1905/02	Set up veification inline first machine
PA 1905/03	Set up verification offline first machine
PA 1905/05	Lot Traceability first machine
PA 1905/06	PDA for offline USA
PA 1905/07	Auto program change over fist machine MG-2
PA 1905/10	Auto program change over standalone first machine MG-2
PA 1905/11	Pre empty warning next machine
PA 1905/12	Set up veification inline next machine
PA 1905/13	Set up verification offline next machine
PA 1905/15	Lot Traceability next machine
PA 1905/16	PDA for offline EUR
PA 1905/17	Auto program change over next machine MG-2
PA 1905/20	Auto program change over standalone next machine MG-2
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 2505/75	Feeder exchange cart 24 pos for MG (Cl version)
PA 2505/76	FES 24 factory built in front side MG (Cl version)
PA 2505/77	FES 24 factory built in rear side MG (Cl version)
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	Tapefeeder 8x2 15" CL 0201
PA 2903/78	Tapefeeder 8x2 15" CL 0402
PA 2903/79	Tapefeeder 8x4 15" CL
PA 2903/88	Tapefeeder 12mm 15" FV/GEM CL
PA 2903/89	Tapefeeder 12mm 15" FV/GEM CLi
PA 2903/97	Tapefeeder 8x2 15" CLi 0201
PA 2903/98	Tapefeeder 8x2 15" CLi 0402
PA 2903/99	Tapefeeder 8x4 15" CLi
PA 2904/51	Gem bulk cassette feeder C0603 long
PA 2923/00	Set of 20 dummy feeders
PA 2962/26	Nozzle type 201 for MG-2
PA 2962/27	Nozzle type 202 for MG-2
PA 2962/28	Nozzle type 203 for MG-2
PA 2962/29	Nozzle type 206 for MG-2

Table 2

3.3 Machine Configuration examples

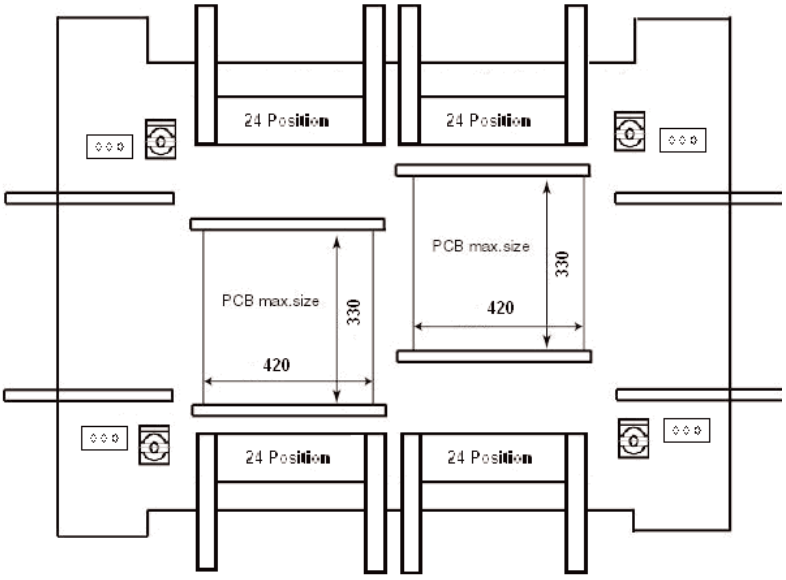
On the following pages you can find some machine configuration examples for the MG-2 series.

Example 1: MG-2 FNC/SF



PA 1319/01	MG-2 CL with SF head
Or	
PA 1319/02	MG-2 CL with FNC head
Or	
PA 1319/03	MG-2 CLi with SF head
Or	
PA 1319/04	MG-2 CLi with FNC head

Example 2: MG-2 FNC/SF with Feeder Exchange System



0	
PA 1319/01	MG-2 CL with SF head
PA 2505/76	Feederbar exchange system front side including two FES 24 CL carts
PA 2505/77	Feederbar exchange system rear side including two FES 24 CL carts
Or	
PA 1319/02	MG-2 CL with FNC head
PA 2505/76	Feederbar exchange system front side including two FES 24 CL carts
PA 2505/77	Feederbar exchange system rear side including two FES 24 CL carts
Or	
PA 1319/03	MG-2 CLi with SF head
PA 2505/71	Feederbar exchange system front side including two FES 24 CLi carts
PA 2505/72	Feederbar exchange system rear side including two FES 24 CLi carts
Or	
PA 1319/04	MG-2 CLi with FNC head
PA 2505/71	Feederbar exchange system front side including two FES 24 CLi carts
PA 2505/72	Feederbar exchange system rear side including two FES 24 CLi carts

4.0 Mounting Heads Configuration

The MG-2 employs four independent placement beams each carrying 3 Flying Nozzle Change heads (each equipped with 3 nozzles) and 3 standard heads with exchangeable nozzles or 6 Super Fine 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.

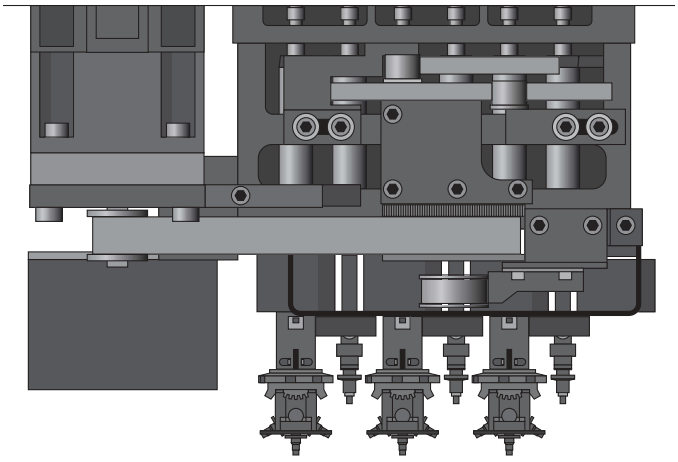


Figure 2 Head section FNC detail

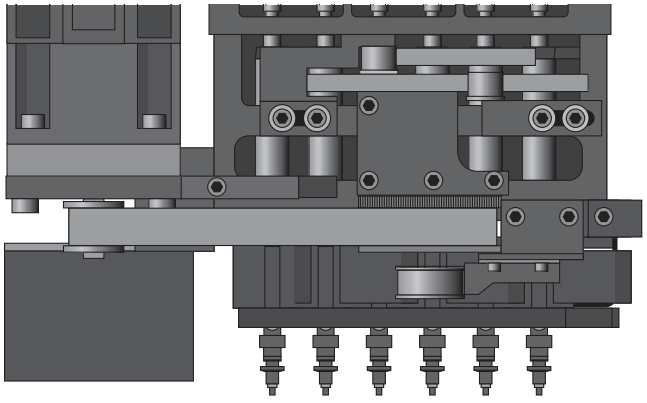


Figure 3 Head section SF detail

The high-precision MG-2 features sixteen-axis (X,Y,Z,R,W,YT) servo control for accurate, stress-free device mounting. The MG-2 incorporates direct drive, brushless AC motors controlling heavy duty lead screws. This sturdy design allows high positional accuracy in combination with high reliability.

Specifications	
Number of axis:	20
Axis configuration:	4 x X axis AC servo 2 x Y axis AC servo 4 x Z, 4 x R axis AC servo 4 x W (automatic width) axis AC servo 2 x YT (board Y position) axis AC servo
Pick-up error detection:	Vacuum check (256 level digital setting)
Mounting angle:	0^{o} - 360^{o} (0.01^{o} step)
Number of mounting head:	6 in-line multi head, FNC or SF
Nozzle types:	4 different shapes
Encoder resolution:	X = 0.00183 mm/pulse Y = 0.00122 mm/pulse Phi =0.0146 ^{o} /pulse Z = 0.00048 mm/pulse
Head position accuracy:	X = 0.010 mm Y = 0.010 mm
Speed:	X = 1666 mm/sec. Y = 1500 mm/sec.
Acceleration:	X = 36764 mm/sec^2 Y = 28647 mm/sec^2

Table 3

Due to the concept of the machine, when one head is picking components the opposite head is placing components, a high nominal output can be reached in relation to the specified maximum output.

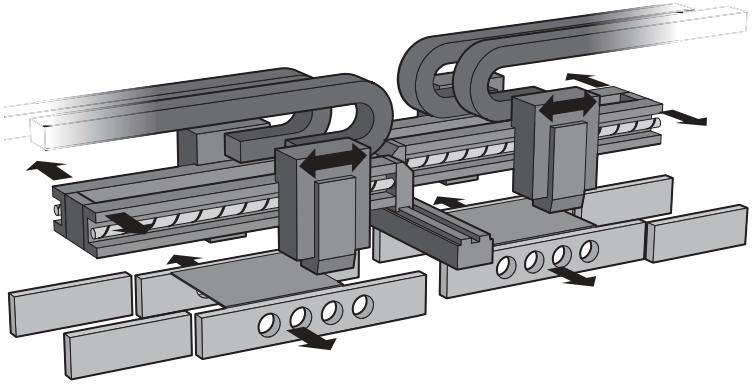


Figure 4 MG-2 placement concept

5.0 Alignment

5.1 Line Array Camera Alignment

The high speed of the MG-2 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. Each placement beam has its own dedicated line array camera, fiducial camera and vision processing system eliminating any possible waiting times.

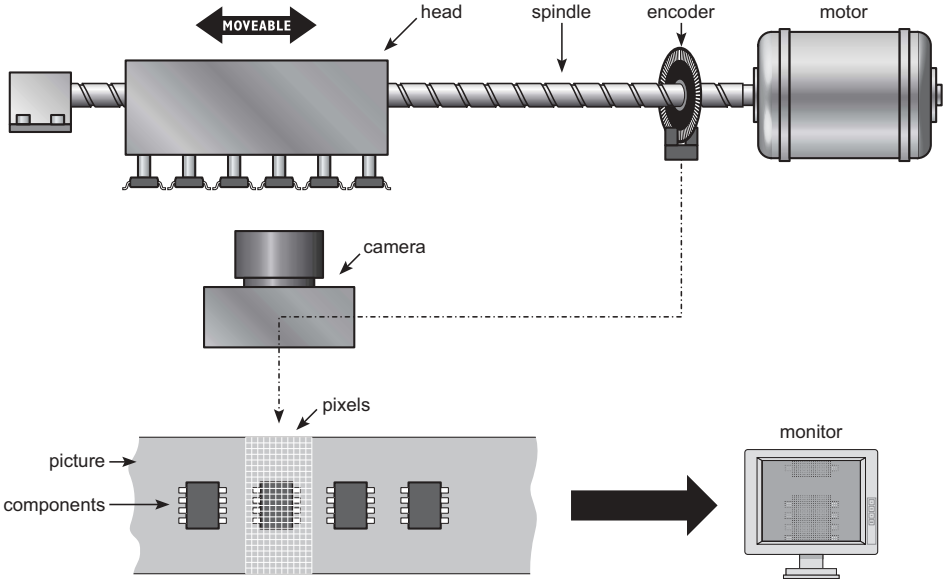


Figure 5 Line sensor vision principle

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.

Specifications	
Line array camera:	CCD 1024 x 1 pixels
Max. component size:	14 mm square (0.55")
Min. component size:	01005 (0402)
Min. lead pitch:	0.5 mm (20 mil)
Min. lead width:	0.2 mm (0.008")
Grey scale:	256 levels
Lighting:	Multi angle Fore 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 4

5.2 Fiducial alignment

Each placement beam of the MG-2 is standard equipped 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 or four fiducials per board. Each sub-circuit can also be aligned using two fiducials. For placement of fine-pitch components two 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 4point 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. 3.0 mm (0.12") Min. 0.8 mm (0.03")
Fiducial material:	Copper Gold Lead-tin
Fiducial clearance area:	2 * Fiducial size
PCB warpage at fiducial:	Max. 0.5 mm (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 5

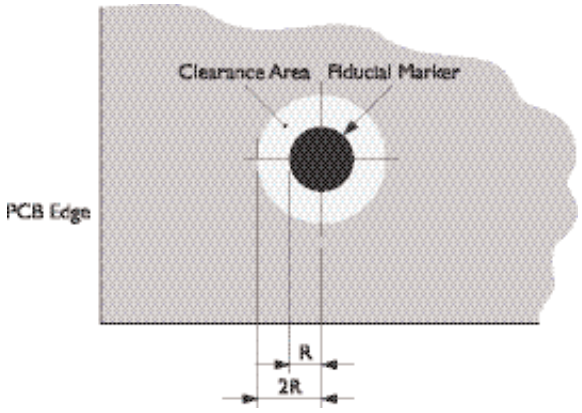
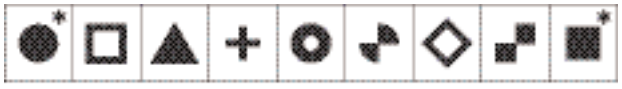


Figure 6 Fiducial free space



* Preferred; others possible but not preferred

Figure 7 Fiducials

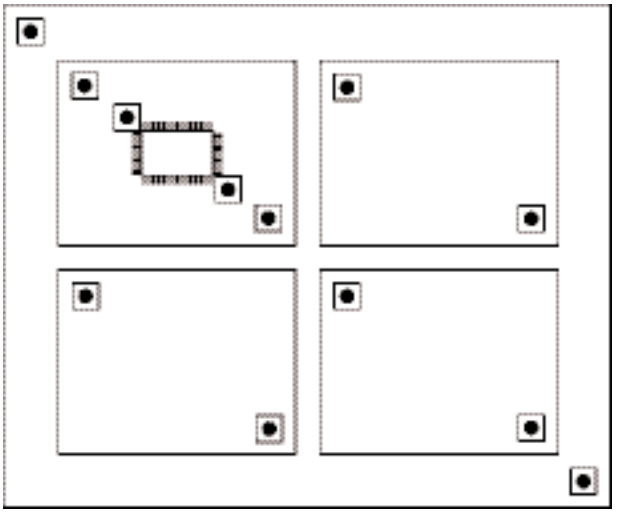


Figure 8 Examples of PCB, block and local fiducials

5.3 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 fixed as long as it contrast 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

The MG-2 can advance up to two boards simultaneously while at the same time components are being picked and aligned.
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.

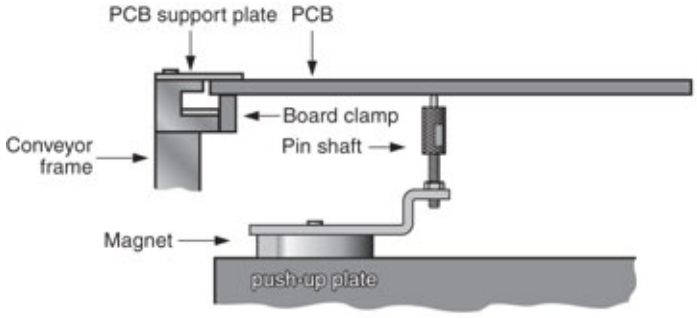


Figure 9 Push up system

A sub-stop enables an additional PCB to enter the machine while the current boards are being populated. This reduces time loss during transport and is very useful when operating the machine in a flowline.

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

Specifications	
PCB Dimensions (x,y):	Min: 50 x 50 mm (2.0" x 2.0 ") Max: 420 x 330mm (16.5" x 13")
PCB Thickness:	Min: 0.4mm (0.015") Max: 4.0mm (0.15")
PCB Maximum warpage:	0.5 mm up (0.02") 1.0 mm down (0.04")
Maximum height pre-mounted components:	4.0 mm on placement side (0.26") for FNC heads 6.5 mm on placement side (0.26") for SF heads 25 mm on non placement side (0.98")
Non - Mountable area:	Board Top side: 3 mm from front and rear side board edge (0.12") Component height restrictions apply in the 4 mm (0.16") area from front side edge depending on board thickness Board Bottom side: 3 mm from front and rear side board edge (0.12") Flat edge of 30mm (1.2") is required on bottom right corner for the use of the main stopper and exit stopper For ceramic boards (optional) the non-mountable area can be different.
PCB Material:	Phenolic/FR4/Composite Materials Ceramic boards require special conveyor sections (optional)
PCB positioning:	Two independent board clamping units Double independent push up system Push up pins (adjustable positions) Sub stop (PCB waiting buffer) fixed position Exit stop (fixed position)
PCB Transport height:	900 mm ± 10mm (35.4" ± 0.4") SMEMA 953 mm ± 12.5 mm (37.5" ± 0.5")
PCB Transport direction:	Left to Right standard, optional Right to Left
PCB Transport width:	Automatic
PCB loading time:	Approximately ± 5 sec.
PCB Transport:	Belt driven, 4 independent segments
PCB Weight:	Max: 0.65 Kg (for PCB weight > 0.65 please contact you local sales organization)

Table 6

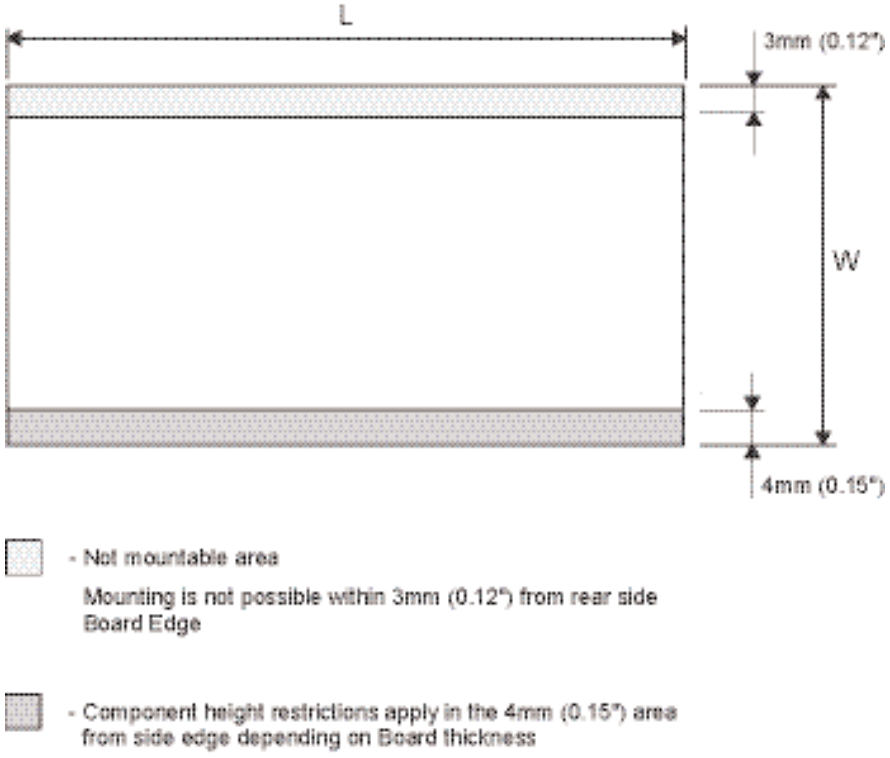


Figure 10 Mountable area

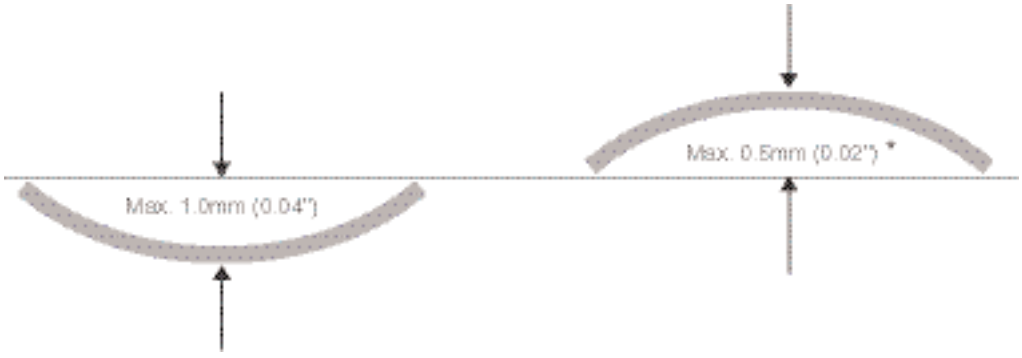


Figure 11 Warp of fixed PCB

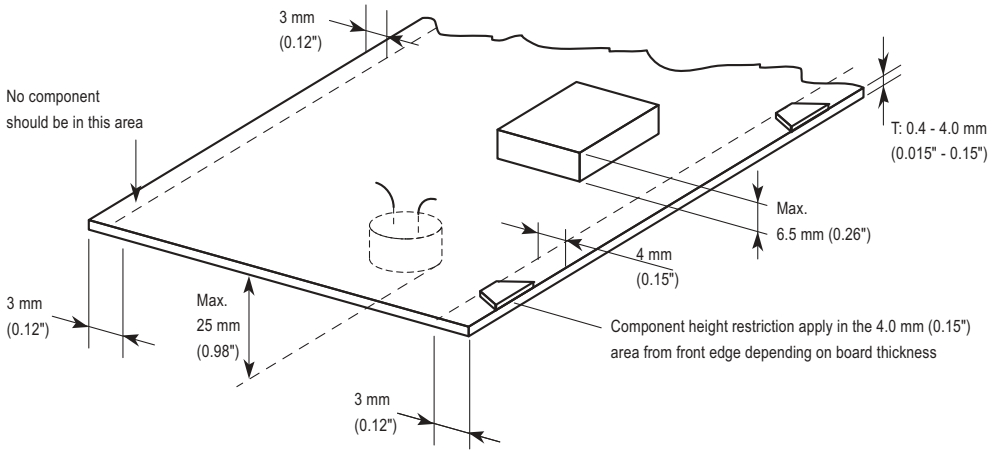


Figure 12 Mountable area

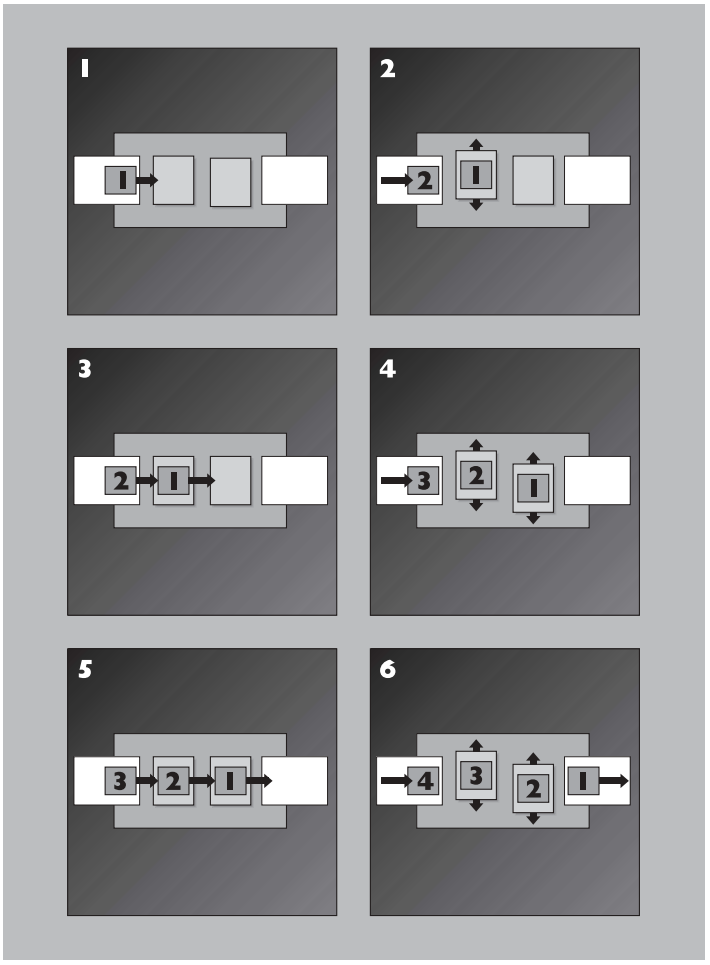


Figure 13 Board Handling MG-2

7.0 Component Handling

7.1 Nozzle types

For the Flying Nozzle heads (FNC) the following nozzle types are present for head 2,4,6.

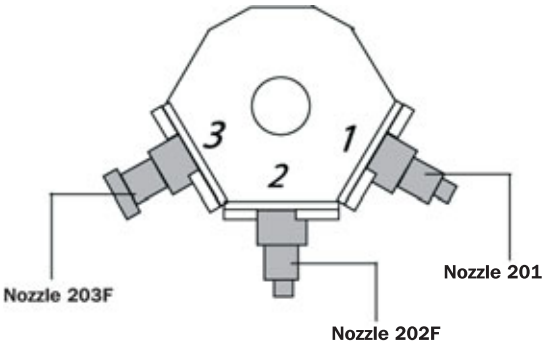


Figure 14 FNC Nozzle types

For the SF heads the following nozzles types/shapes are available.

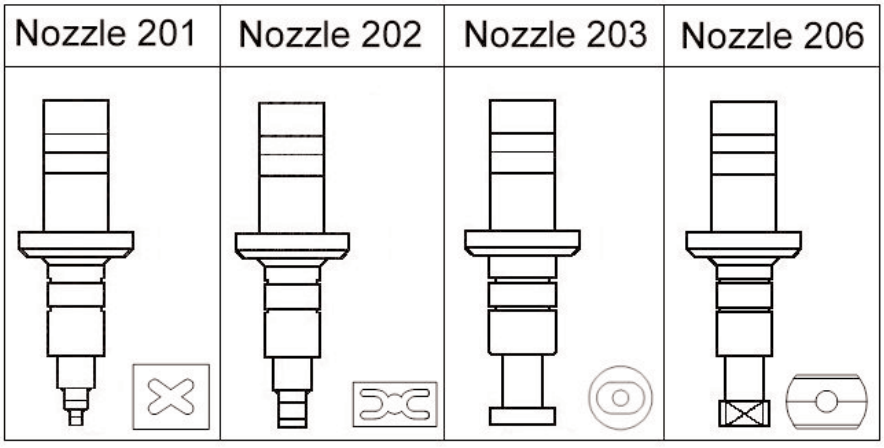


Figure 15 SF Nozzle types

7.2 Nozzle Cleaning Station

The MG-2 comes standard with four nozzle cleaning stations for both SF and FNC heads which can clean 6 heads at one time. High pressure air is used to clean the splines and the nozzles. 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.

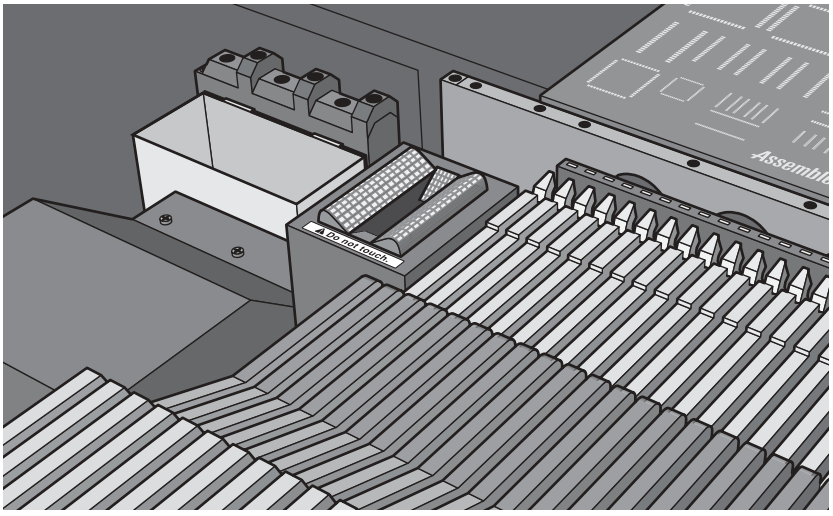


Figure 16 *Camera with nozzle cleaning system, feeder indicator and waste basket.*

8.0 Component Feeding

8.1 Smart Feeders CLi

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)**	**POCKET DEPTH (MM)**	**PA#**
Tape Feeder 8mm 15" for 01005 (0402) CLi	2	2.5	On special request
Tape Feeder 8mm 15" for 0201 (0603) CLi	2	2.5	PA 2903/77
Tape Feeder 8mm 15" for 0402 (1005) CLi	2	2.5	PA 2903/78
Tape Feeder 8mm 15" CLi	4	2.5	PA 2903/79
Tape Feeder 12mm 15"CLi	4,8,12	7	PA 2903/88
Tape Feeder 16mm 15"CLi	4,8,12,16	11	PA 2903/27
Tape Feeder 24mm 15"CLi	4,8,12,16,20,24	15	PA 2903/38
Tape Feeder 32mm 15"CLi	8,12,16,20,24,28,32	15	PA 2903/41
Tape Feeder 44mm 15"CLi	8,12,16,20,24,28,32,36	15	PA 2903/51
Tape Feeder 56mm 15"CLi	8,12,16,20	15	PA 2903/68
For larger and special tape feeders such as 72mm please contact your local sales representative			

Table 7 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	3
Tape feeder 32mm	4
Tape feeder 44mm	5
Tape feeder 56mm	6

Table 8 The above feeder conversion number may differ according to the installation combination.

The MG-2 comes standard with pneumatic CL feeders which are compatible with all existing GEM models. Up to 96 tape feedes (8mm) can be loaded. The tape feeder design allows simultaneous picking from any mix of tape feeders ranging from 8mm to 56mm. To achieve high speed feeding all feeders types are air driven. To prevent incorrect feeder latching, a laser-based verification system is used.

Available CL tapefeeders			
TAPE FEEDER	**FEEDING PITCH (MM)**	**POCKET DEPTH (MM)**	**PA#**
Tape Feeder 8mm 15" for 01005 (0402) CL	2	2.5	On special request
Tape Feeder 8mm 15" for 0201 (0603) CL	2	2.5	PA 2903/77
Tape Feeder 8mm 15" for 0402 (1005) CL	2	2.5	PA 2903/78
Tape Feeder 8mm 15" CL	4	2.5	PA 2903/79
Tape Feeder 12mm 15"CL	4,8,12	7	PA 2903/88
Tape Feeder 16mm 15"CL	4,8,12,16	11	PA 2903/27
Tape Feeder 24mm 15"CL	4,8,12,16,20,24	15	PA 2903/38
Tape Feeder 32mm 15"CL	8,12,16,20,24,28,32	15	PA 2903/41
Tape Feeder 44mm 15"CL	8,12,16,20,24,28,32,36	15	PA 2903/51
Tape Feeder 56mm 15"CL	8,12,16,20	15	PA 2903/68
For larger and special tape feeders such as 72mm please contact your local sales representative			

Table 9 The feeding pitch can be adjusted on the feeder side.

8.2 Feeder Indicators

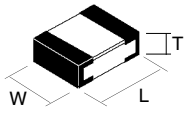
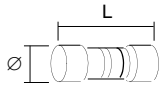
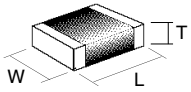
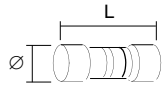
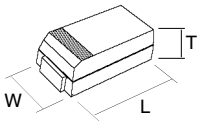
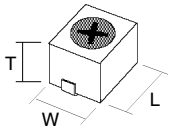
The MG-2 with CL and CLI feeder interface are standard equipped with feeder LED indicators. The feeder indicators provide the operator with all essential information regarding feeder status. With the use of 3 colors; Green, Yellow and Red the status will be indicated.

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

Table 10

8.3 Mountable Components & Required Nozzles MG-2

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	201F/201
		1.00	0.50	0.50	201F/201
		1.60	0.80	0.50	202F/202
		2.00	1.25	0.50	202F/202
		3.20	1.60	0.60	202F/202
	Solid resistor	2.00	ϕ 1.25		202F/202
		3.45	ϕ 1.35		202F/202
		5.9	ϕ 2.2		202F/202
	Multi-layered ceramic capacitor	0.4	0.2	0.2	Special nozzle on request
		0.6	0.3	0.3	201F/201
		1.0	0.5	0.5	201F/201
		1.50	0.80	0.80	202F/202
		2.00	1.25	1.25	202F/202
		3.20	1.60	1.25	202F/202
		3.20~4.50	2.50~3.20	1.50~1.90	203F/203
		5.60	5.00	1.90	203F/203
	MELF ceramic capacitor	3.40	ϕ 1.50		203F/203
		5.9	ϕ 2.2		216
	Tantalium electrolytic capacitor	2.90	1.60	1.60	202F/202
		3.80	2.90	1.60	203F/203
		4.70	2.60	2.10	203F/203
		6.00	3.20	2.50	203F/203
		7.30	4.30	2.80	203F/203
	Aluminium electrolytic capacitor	4.3	4.3	5.7	203F/203
		6.6	6.6	5.7	203F/203
		10	10	6.5	203F/203

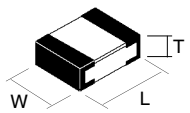
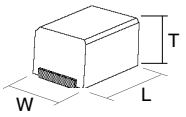
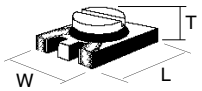
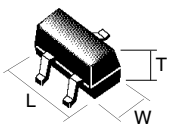
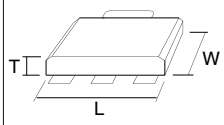
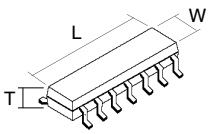
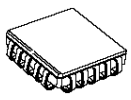
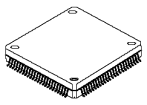
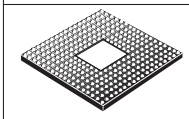
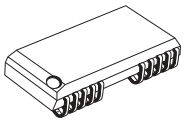
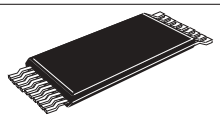
Component		Dimensions (mm)			Required nozzle Type
		L	W	T	
	Chip film capacitor	7.3	5.3	3.25	203F/203
	Chip inductor	3.2	2.5	2.0	203F/203
		4.5	3.2	3.2	203F/203
	Semi-variable resistor	4.5	3.8	2.4	203F/203
	Transistor (SOT)	2.90	1.5	1.10	202F/202
		4.0	3	1.8	203F/203
	Power transistor	4.6	2.6	1.6	203F/203
	SOP (6 ~ 28 pin)	5.00	4.50	1.50	203F/203
		7.60	4.50	1.50	203F/203
		10.10	4.50	1.50	203F/203
		12.60	5.70	1.50	203F/203
	PLCC	5~14			203F/203
	QFP	5~14			203F/203
	BGA	10~14			203F/203
	SOJ (20~42 pin)	10~14			203F/203
	TSOP (20~32 pin)	10~14			203F/203

Table 11 *For information on CSP, BGA, bare chip and other types of components, please consult your local sales representative.*

9.0 Feederbar Exchange System

Depending on the chosen feeder platform for the MG-2, different feederbar exchange systems are possible:

9.1 PA 2505/70

The Feederbar Exchange System (FES) allows fast change-over by switching the complete 24 position CLi feederbar on a MG-2

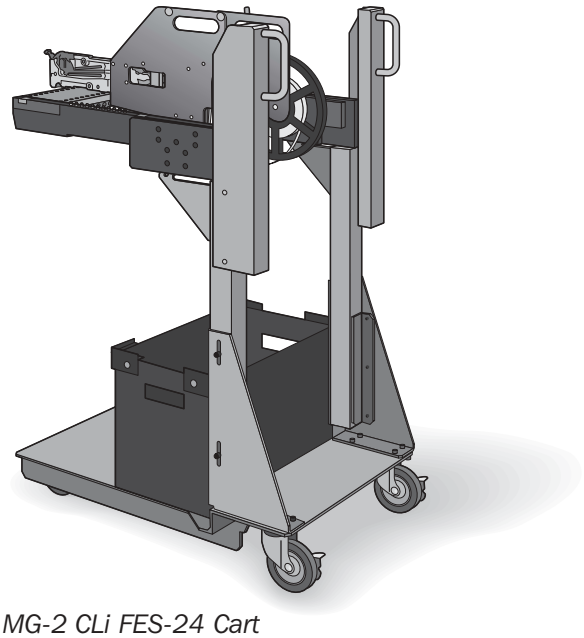


Figure 17 MG-2 CLi FES-24 Cart

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
Min. component size:	0201 (0603) (0.6mm x 0.3mm) Smaller components should be used with pick-up teaching function

Table 12

9.2 PA 2505/75

The Feederbar Exchange System (FES) allows fast change-over by switching the complete 24 position CL feederbar on a MG-2.

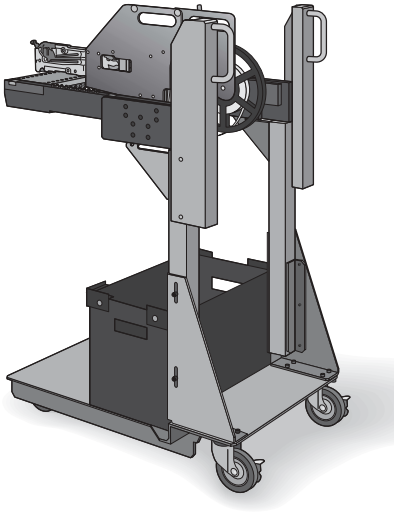


Figure 18 MG-2 CL FES-24 Cart

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
Min. componet size:	0201 (0603) (0.6mm x 0.3mm) Smaller components should be used with pick-up teaching function

Table 13

10.0 MG-2 Summary

	Model	MG-2	MG-2	MG-2	MG-2
	PA number	**PA1319/01**	**PA 1319/02**	**PA 1319/03**	**PA 1319/04**
Head	Flying Nozzle Change Head (FNC)		o		o
	Super Fine head 4 x SF	o		o	
	Nozzle Exchange station	na	na	na	na
	Nozzle cleaning station	o	o	o	o
	Special order nozzles	*	*	*	*
Recognition system	Line Array camera 14mm	o	o	o	o
	Line Array camera 32mm	na	na	na	na
	Second line arry camera	na	na	na	na
	3D co-planarity checker	na	na	na	na
	Side view camera	na	na	na	na
	Fiducial camera	o	o	o	o
Feeding	Pneumatic Tape Feeder CL	o	o		
	Pneumatic Tape Feeder CLi (RFID)			o	o
	Intelligent tapefeeder	na	na	na	na
	Bulk Feeder	#	#	#	#
	Stick Feeder	#	#	#	#
	Single ATS trayfeeder (sATS)	na	na	na	na
	Double ATS trayfeeder (wATS)	na	na	na	na
	Double Shuttle inline head Tray Feeder (LCS)	na	na	na	na
	Reject station	#	#	#	#
	Feeder Exchange System (FES 24)	#	#	#	#
PCB positioning/transport	Main Stopper	o	o	o	o
	Double Board Clamp System	o	o	o	o
	Double Push Up Plate	o	o	o	o
	Adjustable Push up pins	o	o	o	o
	Entrance Sub Stopper	o	o	o	o
	Exit Sub Stopper	o	o	o	o
	Automatic Width Adjustment	o	o	o	o
	High Speed soft-stop conveyor	o	o	o	o
	Reverse transfer Right to Left	#	#	#	#
	Ceramic PCBs	#	#	#	#
	Special sized PCBs	na	na	na	na
Safety	Feeder Floating Detection	o	o	o	o
	Feeder indicators	o	o	o	o
	Conveyor Entrance/Exit covers	o	o	o	o
	Safety cover for feeder exchange	o	o	o	o
	Dummy Feeders	o	o	o	o
	Safety specifications according CE standards	o	o	o	o
	Spare parts kit + tools	o	o	o	o
	SMEMA kit	o	o	o	o
	Front and rear anti-static covers	o	o	o	o
	Signal tower + warning buzzer	o	o	o	o
Software	Windows XP Graphical User interface	o	o	o	o
	Multiple Accuracy Compensation System	o	o	o	o
	Fiducial Recovery function	o	o	o	o
	Bad Mark / Master Mark Sensing	o	o	o	o
	On-line teaching	o	o	o	o
	Alternative Feeder Function	o	o	o	o
	Automatic program change	o	o	o	o
	Variable XY axis speed per component	o	o	o	o
	On-line Help function	o	o	o	o
	Management Information System	o	o	o	o
	Template (pattern matching)	o	o	o	o
	Automatic rework cycle	o	o	o	o
	On-line data generator	o	o	o	o

Table 14

o = Standard
# = Optional
* = Special order
na = not available

Assembléon

Integrated electronics manufacturing solutions