

Version : 20190913

## Specification GS336

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# ZEVA<sup>III</sup><sub>M+</sub>



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## 1 GENERAL INFORMATION

### 1.1 Area of application

The ZEVAm+ Selective Soldering System is an automatic machine, designed to solder printed circuit boards (PCB) with through-hole and/or SMD components.

The machine provides you a carefully controlled environment for high-quality soldering. PCB's are transported by a conveyor system over the fluxing station and preheat station. A special separate conveyor section holds the PCB above the moving SelectWave solderpot. The machine has many standard functions and has optional functions that can be added in a machine configuration. The ZEVAm+ is designed to meet the European CE directives.

### 1.2 Materials used

All customer-used chemicals must be compatible with the Vitronics Soltec used materials, such as: Fluorocarbon Elastomer, PVC (Polyvinyl chloride), PVDF (Polyvinylidene fluoride), PTFE, glass, steel, stainless steel and aluminum.

To avoid severe corrosion in the machine only the use of non-corrosive or so called "no-clean" fluxes is allowed. These are fluxes which need not to be removed from the PCB after soldering.

### 1.3 Product dimensions

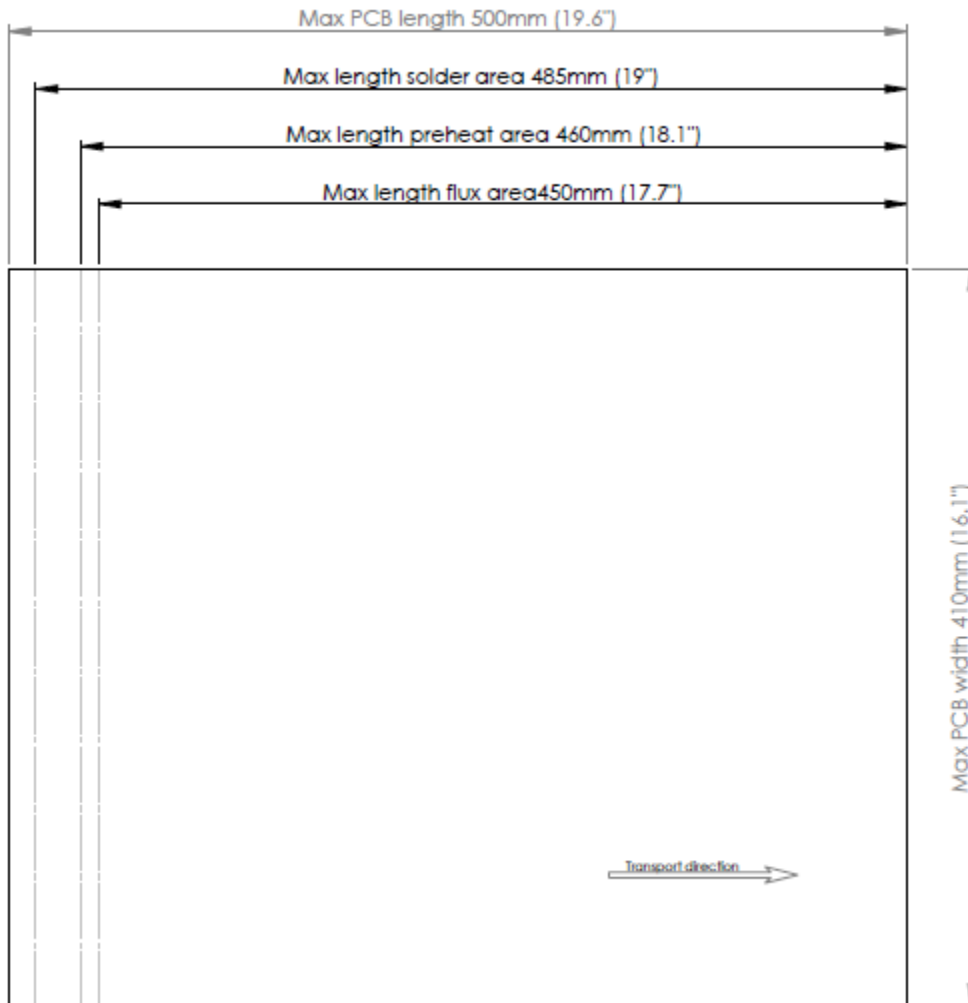
SPECIFICATION PCB AND PALLET	
Min - Max solderable PCB width	100 - 410 mm (3.94- 16.14 inch) <sup>(1)</sup>
Min - Max solderable PCB length	150 - 410mm (5.90-16.14 inch) <sup>(1)</sup>
Min - Max pallet width	100 - 410 mm (3.94-16.14 inch)
Min - Max pallet length	150 - 410 mm (5.90-16.14 inch)
Product thickness	0.8 – 3 mm (0.03-0.12 inch)
Product weight	Max 10 kg (22.05 lb.)
Component height top side	Max 120 mm (4.72 inch)
Component height bottom side	Max 25 mm (0.98 inch) Remark: height restriction around solder nozzle due to N2 cone about 10 mm.
PCB edge clearance	Min 3 mm (0.12 inch)
PCB flatness (% of PCB diagonal)	1 % with a maximum of 2 mm (0.08 inch)

<sup>1</sup> See paragraph 3.6

Remark: Solderarea on the conveyor side of the board is limited by the applied nozzle size/dimension.

### 1.3.1

**Increase maximum PCB length to 500mm (19.6") solder area 450mm (17.7")**



#### Limits:

- Second fluxer axis

Tilting angle must be reduced because of limitation is Z-height to max 8 dgr

For the preheater 2 lamps will be added perpendicular to the conveyor at the fluxer side.

Those lamps will be active at any width

## 2 MACHINE CONFIGURATION

A machine has different stations. In each station, a step of the soldering process is handled.

- ST1 Fluxer station
- ST2 Preheat station
- ST3 Solder station

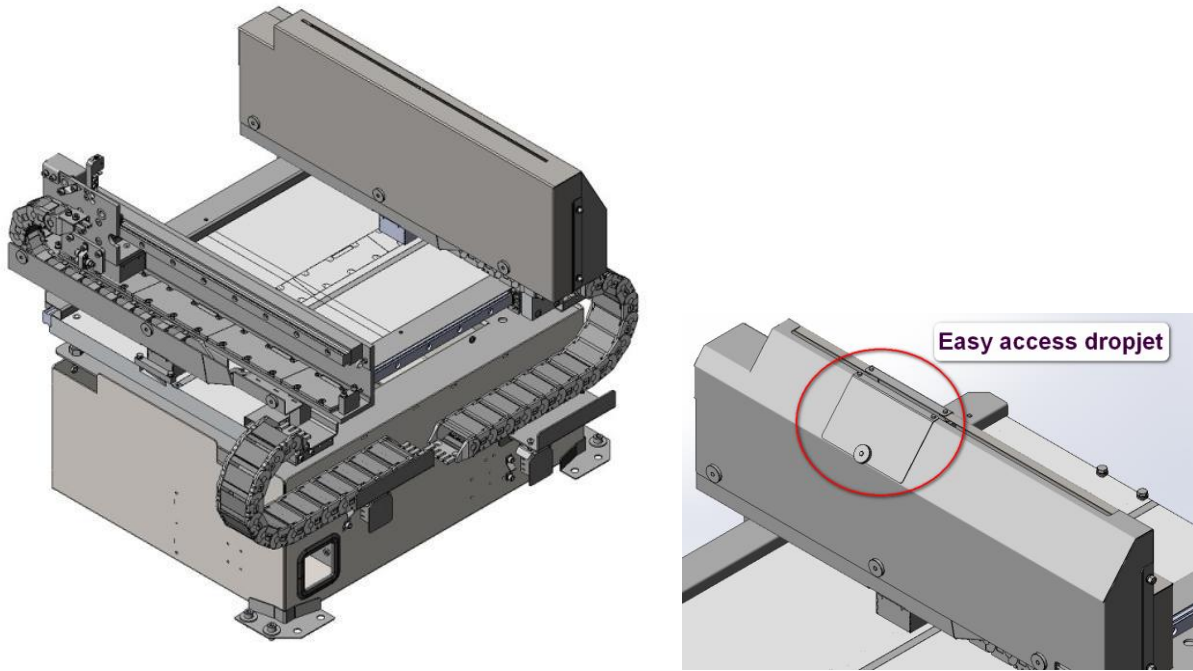
The following table shows the machine components on each station and the options that are available.

Station	1	2	3
MultiFlux single head 180 µm	Y	N	N
Second Y-axis (optional)	Y	N	N
Additional flux tank (optional)	Y	N	N
Flux flow guarding	Y	N	N
Preheater - quartz lamps bottomside	N	Y	N
Closed loop preheater management <sup>(2)</sup>	N	Y	Y
Preheater - quartz lamps topside	N	Y	Y
SelectWave	N	N	Y
SDC	N	N	Y
U rotation solderpot	N	N	Y
Disc conveyor	N	N	Y
Tilting	N	N	Y
Non-wettable nozzles	N	N	Y
Wettable nozzles	N	N	Y
Solderfeeder	N	N	Y
Process camera (for SelectWave)	N	N	Y

<sup>2</sup> Closed loop preheater management can only be installed in station 2 or 3.

## 3 STATIONS

### 3.1 Multi-fluxer – Station 1



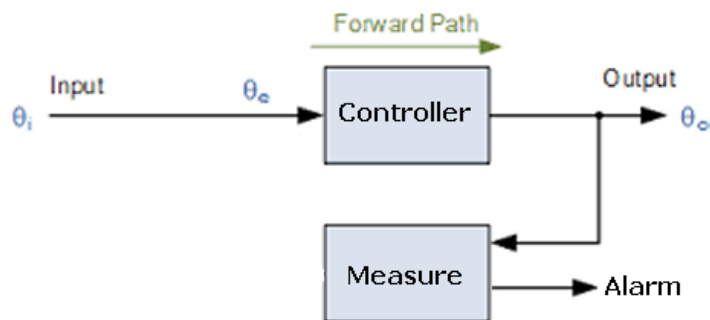
DESCRIPTION	
X fluxing range	410 mm (16.14 inch)
Y fluxing range	410 mm (16.14 inch)
X speed	1 m/s (3.28 ft/s)
X acceleration	2 m/sec <sup>2</sup> (6.56 ft./s <sup>2</sup> )
Y speed	1 m/s (3.28 ft/s)
Y acceleration	2 m/sec <sup>2</sup> (6.56 ft./s <sup>2</sup> )
Speed accuracy at drag speed	+/- 1 %
Position accuracy	+/- 0.1 mm (0.004 inch)
Position repeatability	+/- 0.1 mm (0.004 inch)
Dropjet nozzle	HF 180 μm
Second Y-axis	Optional
Second Y-axis distance to first Y axis	Min 90 mm (3.54 inch)
Pressure	0.2 - 0.7 bar (2.9 - 10.15 psi), factory default set on 0.3 bar (4.35 psi)
Pressure setting	Automatic
Pressure read out	On screen
Overpressure guarding with alarm	1.6 bar (23.21 psi)

Distance droplet to PCB	35 mm (1.38 inch)
Real time flux flow guarding with lower and upper limit (See GS348-A)	Optional
Capacity of flux container	1.6 liter (0.42 US gallon)
Additional flux tank (for replenishment during production)	Optional
Flux container level guarding	Selectable alarm level and fatal low level. Analog read out of level, load cell. Teachable alarm and low level.
Filter	30 micron

### 3.1.1 Flux flow guarding (Option)

The Flux Flow Guarding option is a measuring system to determine the reproducibility of the flux flow to the droplet head. The measuring system exists of a low volume mass flow meter, which is connected to the serial interface of the machine PC.

The flow measurement is done during the fluxer head movement and is totalized per PCB. When the fluxer has finished fluxing the PCB the totalized value is compared with a settable desired value within upper and lower boundary, an alarm is generated when the totalized value is outside the boundaries.



The bandwidth for alarm can be set in the software. If an alarm is raised, the machine will be blocked and the operator will be notified.

### 3.1.2 Flux flow control

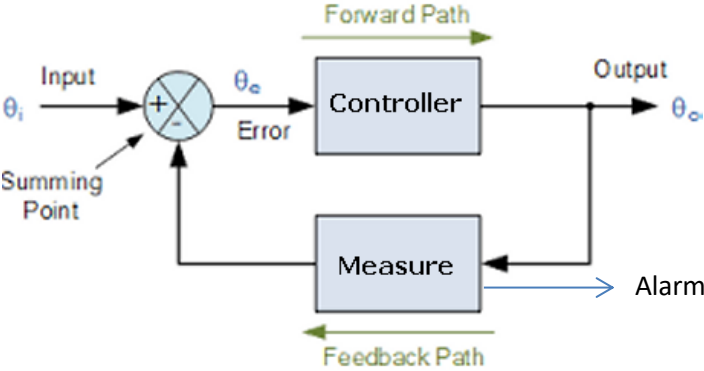
The same measurement can be used to control the flux amount applied. The measured flux amount now feeds back to the Summing Point that will correct the controller so the applied amount will meet the set-point again.

In case of Flux Flow Control, the measured value will be processed after the controller has finished fluxing. This implies that correction is not applied during fluxing (actual board), but will only be applied at the next board.

The control must be able to correct within a 10% bandwidth.

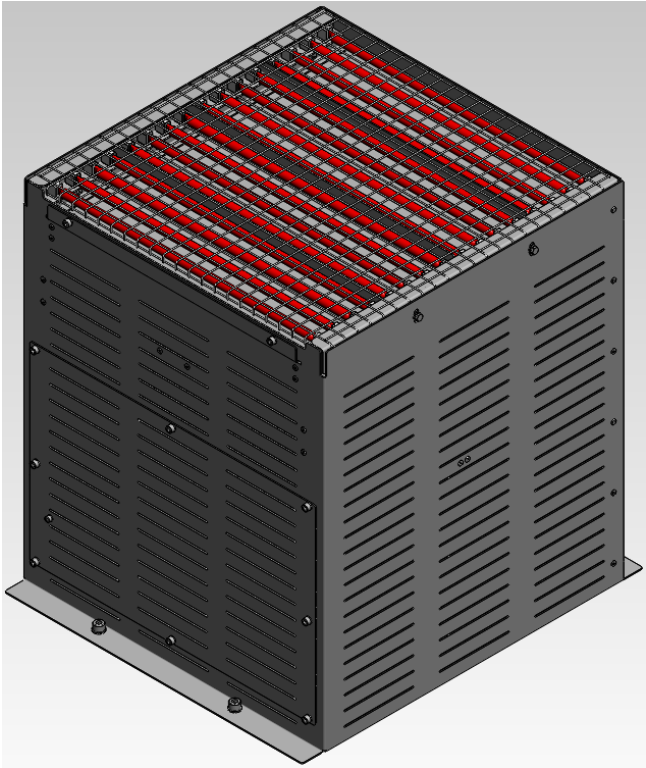
When the fluxer has finished fluxing the PCB the totalized value is compared with a settable desired value within upper and lower boundary, an alarm is generated when the totalized value is outside the boundaries.

The bandwidth for alarm can be set in the software. If an alarm is raised, the machine will be blocked and the operator will be notified.



Note: the correction will be applied to the open-time of the fluxer nozzle.

### 3.2 Quartz preheater – Station 2





DESCRIPTION	
Power / element	550 VA
Total elements	16
Width setting	Per 2 lamps
Total Power	8.8 kVA
Temperature control	On time and % output power
Control	Analog, no blinking
Overheat detection	None
Preheater temperature accuracy	+/- 15 °C @ >5 Sigma
Closed loop preheater management	Optional

### 3.2.1 Closed loop preheater management (Option)

The product on the quartz preheater station will be heated up to set value of desired temperature before the product is transferred to the solder station.

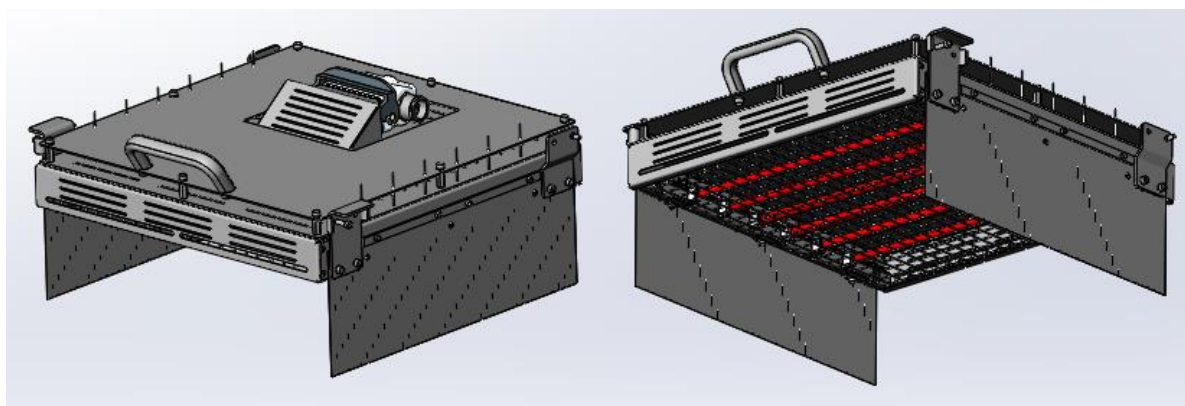
By automatically regulating the power of the lamps, the target reaches the desired final temperature by the end of the preheat cycle (linear temperature increase).

The option aims to ensure every product reaches the same required end temperature before being transferred to the solder station.

The advantages of this option are:

- Equal (linear) temperature profile
- No additional cycle time
- Improved Process Control

### 3.3 Topside preheating - Station 2 and 3 (Option)



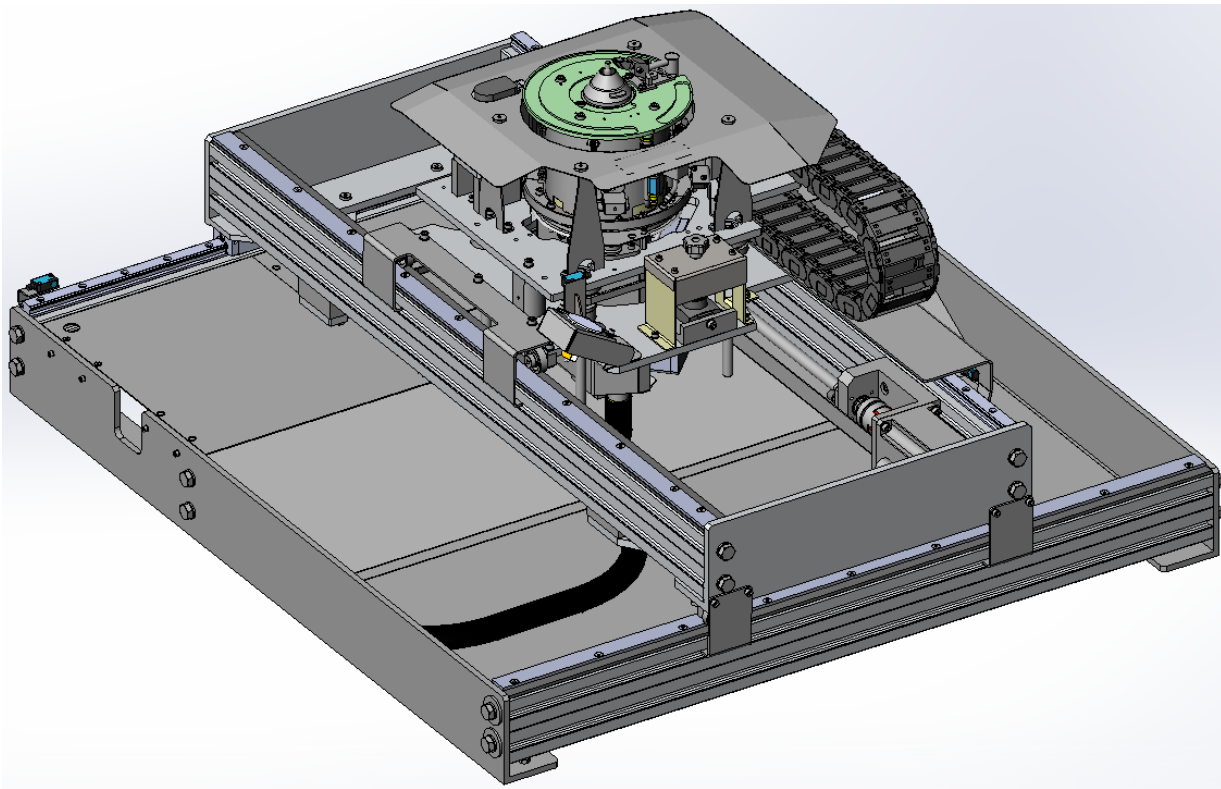
Topview

Bottomview

DESCRIPTION	
Power / element	550 VA
Total elements	8
Width setting	Per 2 lamps
Total Power	4.4 kVA
Temperature control	On time and % output power
Control	Analog, no blinking
Overheat detection	None
Preheater temperature accuracy	+/- 15 °C @ >5 Sigma
Closed loop preheater management (topside)	Optional

### 3.4 Robot - Station 3

The electromagnetic solderpot is mounted on a robot system which can move in X, Y and Z directions and the solderpot can turn in U-rotation (optional).

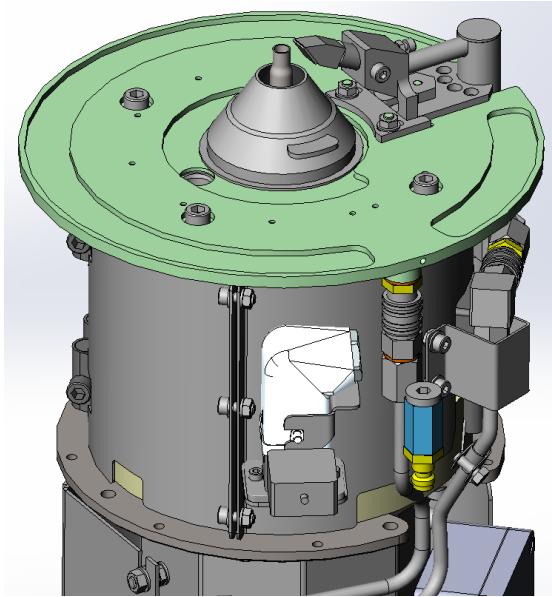


DESCRIPTION	
X-axis maximum speed	1 m/sec (3.28 ft/s)
X-axis maximum acceleration	1 m/sec <sup>2</sup> (3.28 ft/s <sup>2</sup> )
X stroke length	540 mm (21.26 inch)
X stroke drive	Closed loop servo control
Y-axis maximum speed	1 m/sec (3.28 ft/s)
Y-axis maximum acceleration	1 m/sec <sup>2</sup> (3.28 ft/s <sup>2</sup> )
Y stroke length	700 mm (27.56 inch)
Y stroke drive	Closed loop servo control
Z-axle maximum speed	50 mm/sec (0.16 ft/s)
Z-axle acceleration	Fixed
Z stroke length	120 mm (4.72 inch)
Z stroke drive	Stepper
Turn range (optional)	See paragraph 3.8
Turn maximum speed (optional)	10 °/sec
Turn acceleration (optional)	Fixed
Turn speed drive (optional)	Stepper
Speed accuracy at drag speed (optional)	+/- 1 %
Position accuracy	+/- 0.1 mm (0.004 inch)
Position repeatability	+/- 0.1 mm (0.004 inch)

## Items mounted on the robot

DESCRIPTION	
Selectwave	Standard
Teach camera	Standard
Process view camera	Optional
U-rotation	Optional
Fiducial correction bottom side PCB	Standard
Product Warpage Compensation	Optional

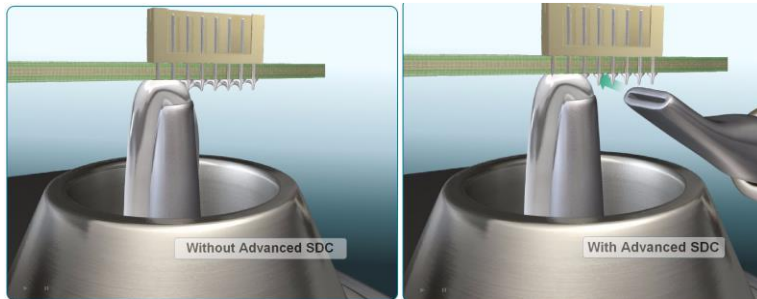
### 3.5 Selectwave - Station 3



DESCRIPTION	
Solderpot volume	1 - 8 KGS <sup>(3)</sup> (2.2 - 17.6 LBS)
Solder temperature	Max 330 °C (626°F)
Heating element power	1 kW
Heat up time to solder	Approximately 1.5 hours
Solderpump	Electromagnetic pump
Nitrogen	Standard
Nitrogen setting	Manual
Nitrogen consumption	17 l/min (0.636 ft <sup>3</sup> /min)
Wave height measurement	Standard with laser sensor
Wave height accuracy	+/- 0.2 mm
Over temperature guarding	Standard
Advanced SDC (Solder Drainage Conditioner)	Optional
Solder feeder	Optional
Process view camera	Optional
Product warpage compensation	To be released
Available wettable nozzle diameters	3, 4, 6 & 8 mm
Available non-wettable nozzle diameters	4, 6, 8, 10, 12 & 14 mm

<sup>3</sup> Solderpot must be filled with bars of 1 kg (max length = 110 mm) or smaller (eg pellet, solder wire or liquid solder).

### 3.5.1 Advanced Solder Drainer Conditioner (Option)



As the gas flow from the Advanced SDC nozzle hits the board, it heats the area where it is active and removes the bridge.

The gas flow setting is a parameter that could be used to optimize the Advanced SDC process. In general the gas flow should be set as low as possible to save energy and to avoid that solder will be blown out via-holes to the top side of the board.

Depending of the results, the process can be optimized by adjusting the gas flow temperature in combination with the nozzle width.

If the solder is cooling down too fast the Advanced SDC is unable to remove the solder bridges properly. For that reason it is beneficial to set the gas flow temperature higher than the ambient temperature. Preferably at least as high as the solderpot temperature.

Optimization of these settings can be found by reducing the gas flow as long as the solder bridges are still being removed. If at this setting not all solderbridges are removed, or if too much side effects are found, one should play with the gas flow and solder speed to optimize the debridging and/or to reduce the side effects.

In order to run the Advanced SDC successfully one has to investigate if the process can be setup within the window of the application.

The process window for the Advanced SDC application is:

- The boards must have plated through holes and lead pitches > 1.27 mm (0.05 inch).
- The solder speed must be in a range of 3 - 6 mm/sec (0.12 – 0.24 inch/sec).
- The gas flow range is ~0.5-10 l/min. (0.018 – 0.353 ft<sup>3</sup>/min)
- The gas flow in combination with the solder speed should be limited to a setting that no solder will be blown to the component side of the board.

DESCRIPTION	
Nitrogen gas flow range	0.5 – 10 l/min (0.018 – 0.353 ft <sup>3</sup> /min)
Nitrogen flow setting	Closed loop
Nitrogen flow accuracy	+/- 2 %
Nitrogen flow repeatability	+/- 5 %
Nitrogen setting	Parameter item, one setting per recipe
Nitrogen minimum temperature	250 °C (482°F)
Nitrogen maximum temperature	Depending on the selected flow
Temperature setting	% power

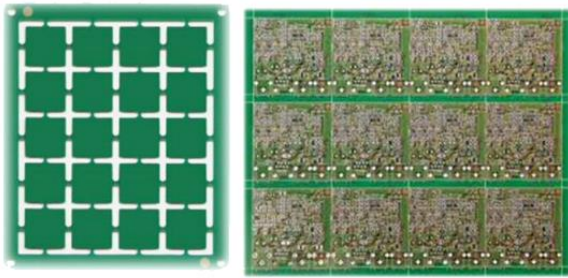
### 3.5.2 Product Warpage Compensation (Option)

Board warpage occurs for a number of reasons. Typical reason for board warpage is that the board cannot withstand the process temperatures, caused by unbalanced layers and/or misaligned fibers (thermodynamic stress).

Secondary may be the weight of components/heatsinks on the top surface causing warpage.

Third may be the conveyor not wide enough so the board gets warped due to the lack of room for X, Y expansion.

Note that multiple heat treatments in advance to selective soldering (Wave and/or Reflow) can be cause of permanent board warpage. For the selective soldering process this means that the board may enter the machine warped, and in addition get warped during the selective process.



Boards likely to warp.

#### Warpage Compensation by Z measurement

The Z position can change (up to 4mm) due to board warpage and is best compensated by Z position measurement and correction by SW.

#### Procedure

After the board has entered the solder station, the warpage of the board is measured by laser distance measurement device, which is attached to the solder robot, see fig. 9. Measurement is done in advance to soldering. The SW records the X, Y and the measured Z coordinates at certain points at the board.



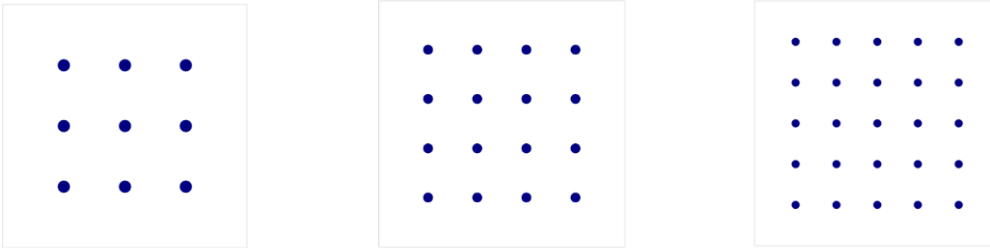
Laser distance measurement

#### Matrix

To get a good indication of the board warpage shape, a matrix of multiple measurement points is needed.

*Note*

If solder elements are clustered to a certain area of the board, then only one or two warpage elements near these solder elements will do. In this case there is no need to determine the complete warpage shape of the board.



Measurement matrix

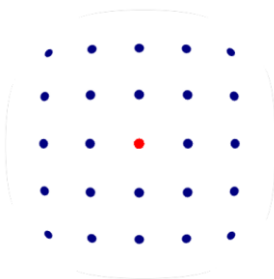
As shown in figure, a matrix of at least 9 points is needed to determine the warpage shape. The more points used in the matrix, the higher the accuracy of the warpage compensation will be.

Since the laser measurement device is mounted to the solder robot, warpage measurement will consume cycle time. This is a negative side effect.

**Reference shape**

To avoid loss of cycle time, we need the ability to make use of a reference shape. Starting point of this idea is that the same boards warp with the same shape, only the amplitude in which will differ. So if the warpage shape is for a certain board is known, only the amplitude needs to be determined per board.

In practice it means that the first board that enters the solder station for processing is used to create the warpage reference shape. The next [x] boards entering the solder station only need a one point Z measurement to determine the amplitude for the shape. This amplitude point can be extrapolated over this board by use of the reference shape.



Example:  
The reference warpage shape is determined by the blue dots in the reference shape measurement. The amplitude is determined by the red dot.

### Requirement

The position accuracy of the ZEVAm+ machine is specified at 0.1mm.

The specification for board bending is 1% of the board diameter with a maximum of 2mm.

Warpage compensation must bring this back to the robot positioning accuracy specification of **0.1mm**.

### Impact on cycle-time

This will mainly depend on the complexity of the Reference shape and also on the Reference interval. When only an Amplitude measurement is required, then approx. **3 sec** need to be added to the cycle-time.

### 3.5.3 Fiducial Correction

For selectwave soldering machines, PCB fiducials are used to eliminate PCB position faults introduced by machine's mechanical tolerances (PCB position tolerances) and PCBs (tolerances in break edges). A camera recognizes the fiducial at a certain PCB position and uses it as a reference to calibrate where the robot thinks it is on the PCB.

*Note:* For selectwave soldering, fiducial correction is only needed when a smaller nozzle size is used, <8mm. With a larger diameter nozzle, the possible position error is eliminated by the size of the nozzle diameter and solder wave.

### PCB position

In a mechanically perfect world the PCB would always position at the same spot, however, due to mechanical tolerances the PCB will position with a variable X, Y and U offset.

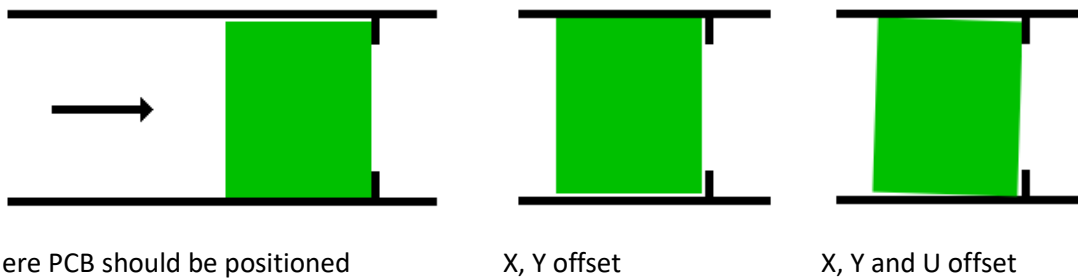


Figure 1a shows the conveyor transporting the PCB to the stoppers (Seen from above). Figures show some possible X, Y, U offsets that may be introduced due to mechanical tolerances.

### Requirement

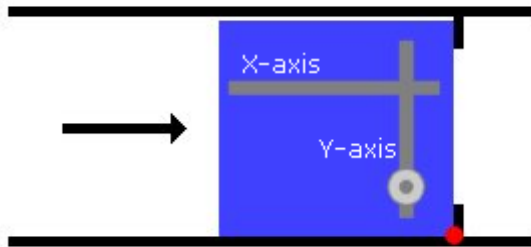
The position accuracy of the ZEVAm+ machine is specified at **0.1mm**. This means the robots is able to position within 0.1mm of the defined target.

### Procedure



Starting point of robot positioning is to determine where to expect the (0, 0) point of the PCB. This is defined in the Tooling Position. So, the Tooling Position is at the (0, 0) position of the PCB when the PCB is positioned into the fixed corner of the conveyor, see figure 2.

*Note:* For determining the Tooling Position, instead of a PCB, a more convenient Calibration Plate is used, simulating the PCB at soldering position.



With calibration plate in blue where the red dot is the (0, 0) X, Y position

*Note:* The red dot in figure 2 indicates the (0, 0) position of the PCB and also the tooling position of the selectwave nozzle or fluxer nozzle.

### Methods

Fiducial position(s) need to be determined for each project. The fiducials indicates where the system expects a certain position of the PCB to be. The position deviation between what is expected (reference) and what is measured (actual) determines the applied offset to the robot system.

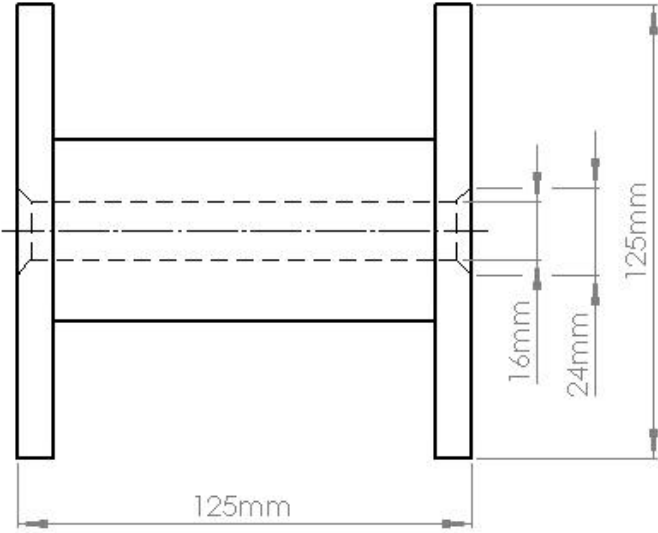
The ZEVA system offers implementation of one or two fiducial points. Applying *one* fiducial point allows correction in X and Y direction. Applying *two* fiducial points allows correction in X, Y and U direction.

### Impact on cycle-time

The chosen method depends on your application. Two fiducials will be more accurate, but also will consume more cycle-time. On average you need to add **4 sec** per fiducial position.

### 3.5.4 Solder feeder (Option)

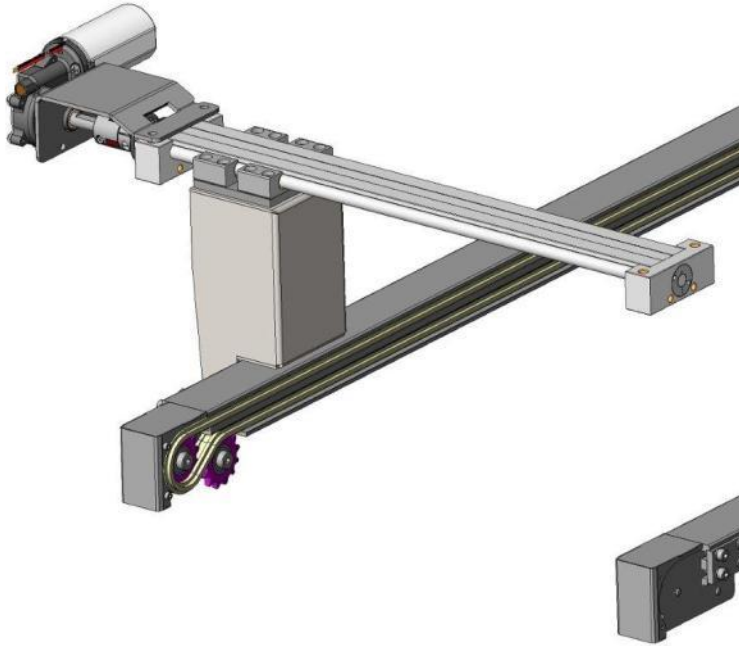
DESCRIPTION	
Dimensions solder reel	According DIN 36399
Diameter solder wire	3 - 4 mm, Optional 1.5 - 3 mm
Weight solder reel	Max 5 kg (11.02 LBS)
Solderfeed	Automatic or manual (pushbutton)
Solder feeder empty alarm	Standard
Advanced solder feeder	Standard



## 3.6 Conveyors

The system has 2 separate driven conveyors, one transports the board in the fluxer and preheating stations and the other one handles the product above the soldering station.

### 3.6.1 Conveyor at fluxer and preheating station

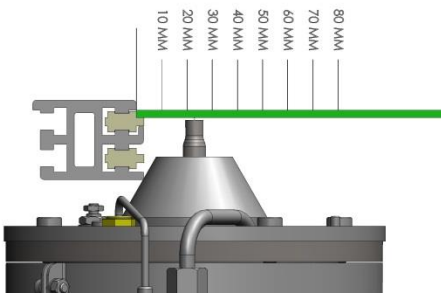
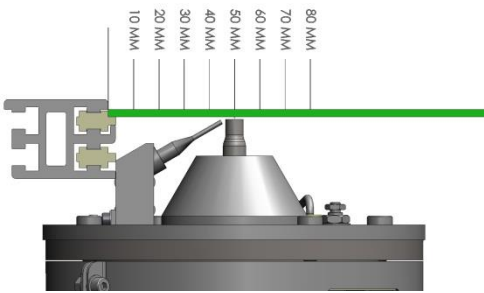
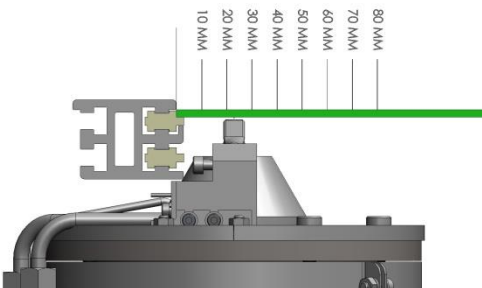
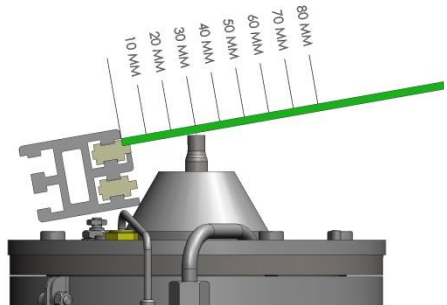


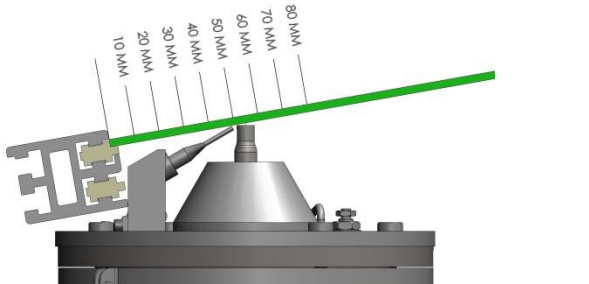
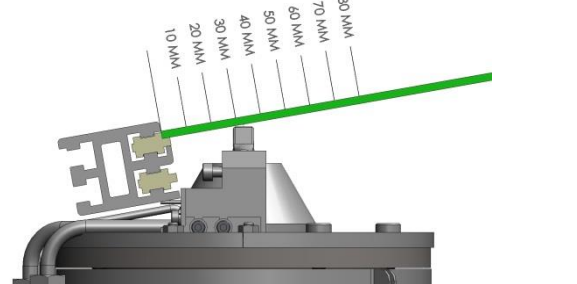
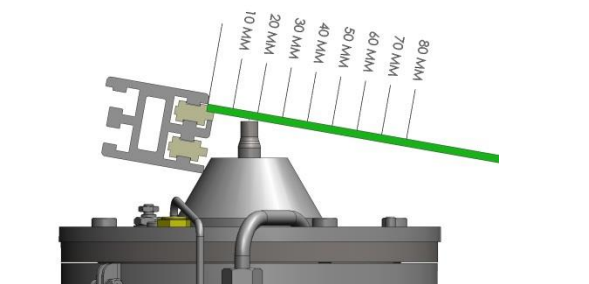
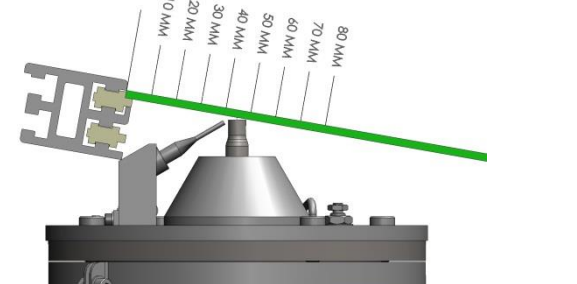
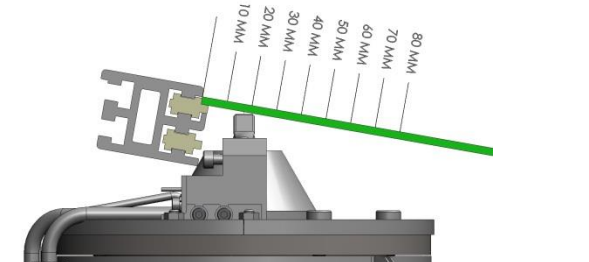
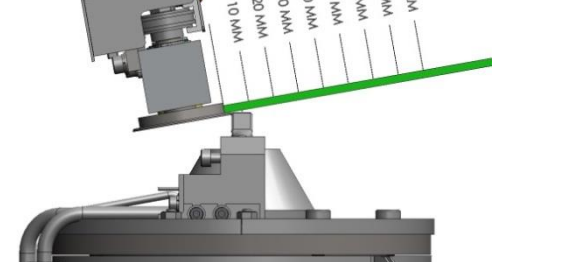
DESCRIPTION	
Conveyor height (bottom PCB level)	Adjustable from 940 to 965 mm (37 to 38 inch)
Conveyor speed	5 m/min (39.37 inch/min) at 50Hz
Chain	3 mm (0.12 inch) pin support
Roller chain	Not applicable
Automatic width adjustment	Standard
Width setting accuracy	+/- 0.1 mm (0.003 inch)

### 3.6.2 Pinchain conveyor above soldering station

DESCRIPTION	
Conveyor height (bottom PCB level)	Adjustable from 940 to 965 mm (37 to 38 inch)
Conveyor speed	5 m/min (39.37 inch/min) at 50Hz
Chain	3 mm (0.12 inch) pin support
Roller chain	Not available
Automatic width adjustment	Standard
Width setting accuracy	+/- 0.1 mm (0.003 inch)
Tilting angle	+/- 10° in X and Y direction (optional)

With the standard pinchain above the soldering station there are limitations for the soldering area. These limitations will depend on the soldering position, usage of Tilting and/or SDC. See below images for different situations. Some of these limitations, especially with SDC, can be avoided by changing the soldering orientation.

<p><b>Soldering horizontally:</b> From edge to soldering area = 25 mm (0.98 inch)</p> 	<p><b>Soldering horizontally with SDC:</b> From edge to soldering area = 50 mm (1.97 inch)</p> 
<p><b>Soldering horizontally with SDC 90 deg:</b> From edge to soldering area = 25 mm (0.98 inch)</p> 	<p><b>Soldering with Y+ tilting:</b> From edge to soldering area = 30 mm (1.18 inch)</p> 

<b>Soldering with Y+ tilting + SDC:</b> <b>From edge to soldering area = 55 mm (2.17 inch)</b>	<b>Soldering with Y+ tilting + SDC 90 deg:</b> <b>From edge to soldering area = 35 mm (1.38 inch)</b>
	
<b>Soldering with Y-tilting:</b> <b>From edge to soldering area = 20 mm (0.79 inch)</b>	<b>Soldering with Y-tilting + SDC:</b> <b>From edge to soldering area = 45 mm (1.77 inch)</b>
	
<b>Soldering with Y-tilting + SDC 90 deg:</b> <b>From edge to soldering area = 20 mm (0.79 inch)</b>	<b>Soldering with Disc conveyor:</b> <b>From edge to soldering area = 3 mm (0.12 inch)</b>
	

### 3.6.3 Disc Conveyor (Option)

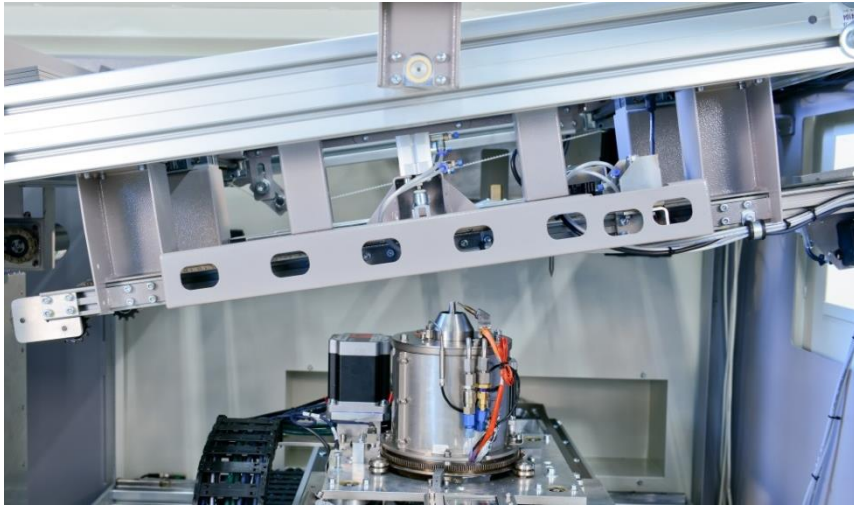
The pinchain in station 3 can be replaced by a disc conveyor. As the image in the table above shown, the disc conveyor will have practically no limitations with regards to the soldering area. With the disc conveyor the only limitation is the 3 mm free edge and the solder area on the conveyor side of the board is limited by the applied nozzle width.

### 3.6.4 Return Conveyor (Special)

Machine can be equipped with return conveyor to allow the pallet (if pallet used) to be return to infeed side through underneath machine frame. This option is available in special request. Please consult factory for details.

### 3.7 Tilting (Option)

Machine can be equipped with a Tilting option. This option will move the conveyor on station 3 during soldering under an angle of 10 degrees in X or Y direction. This angle can be programmed for every soldering point. Total there are 4 possibilities; X+, X-, Y+, Y- direction. Only one direction can be used for a soldering position. For example: X+ and Y- cannot be combined simultaneously.

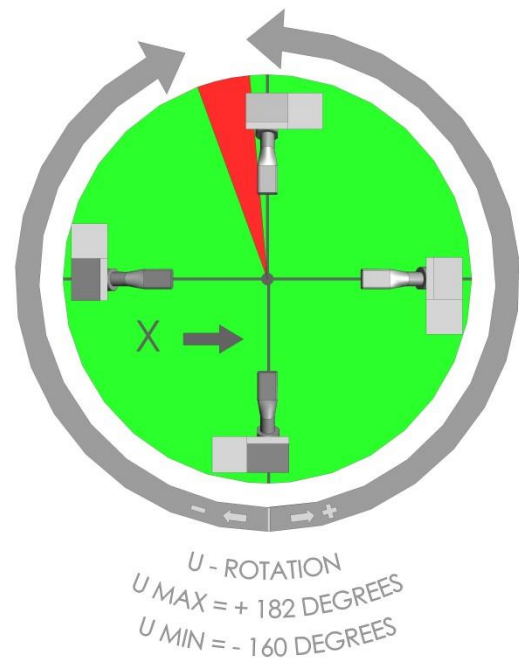


Example: station 3 in X+ tilting

### 3.8 U-rotation (Option)

When using non wettable nozzles and/or SDC option the Selectwave will most likely need to rotate. The complete solderpot will rotate. This rotation is limited because of the connected cables and hoses.

As the top view image on the right shows, the rotation is limited to U max = 182 degrees and U min = -160 degrees.



## 4 MACHINE REQUIREMENTS

### 4.1 Supplies

DESCRIPTION	
Power supply	400/415 V, 50/60 Hz, max 22 kVA.
Supply tolerance	+/- 10%
Power consumption	Depending on configuration
Customer main fuse	32 A
Power management	No
N2 pressure, all pneumatics are also N2 driven	6 bar (87.02 psi)
N2 low alarm	<=4,5 bar (65.27 psi)
N2 consumption	18 l/min (+10 l/min for SDC, optional) (0.99 ft <sup>3</sup> /min)
N2 and O2 separated (pneumatics on O2)	Optional
N2 purity	99.999%
Air pressure (optional)	6 bar (87.02 psi)
Air low alarm (optional)	<=4.5 bar (65.27 psi)

### 4.2 Power consumption

DESCRIPTION	AT SETPOINT
Basic power (controls, robot, PC, etc.)	0.6 kVA
Quartz preheater at stand by 10%, 8 lamps	0.5 kVA
Selectwave heating	0.5 kVA
Selectwave electromagnetic pump	0.4 kVA
Configuration with: - 1x Multifluxer - 1x IR heater - 1x Selectwave	2 kVA

### 4.3 Exhaust

DESCRIPTION	
Exhaust connection	1 connection mounted on top cover
Exhaust connection	Must be flexible for 1 meter.
Exhaust diameter connection	160 mm (6.23 inch)
Exhaust volume total	450 m <sup>3</sup> /h at 100 Pa (15,891 ft <sup>3</sup> /h)
Exhaust filter	No
Exhaust monitoring	Control input available to which the customer can connect an exhaust present signal.

## 5 GENERAL

### 5.1 Controls

DESCRIPTION	
Temperature guarding gantry	No
Machine air temperature guarding	No
General customer inputs/outputs	No
Working hours counter	To be released
SMEMA at infeed	Standard
Operating system	Based on Windows 8
Operator interface	Touch screen + keyboard
Off line teaching	Smart teach
Teach camera for easy data entry.	Standard
UL approved components used in control box	Optional
Management information system, storage of all parameters per soldered PCB (PCB triggered) in combination with Barcode Software Integration	Optional
Machine Capability Analysis Report (solder needs to be supplied by customer)	Optional

### 5.2 Operating conditions

DESCRIPTION	
Ambient temperature	18 to 40°C (64 to 104° F)
Relative humidity	30%-70%
Atmospheric pressure	950 mbar-1030 mbar (13.78 – 14.94 psi)
(Glass) Cover temperature	max 45°C (113°F)
(Inside) machine temperature	max 60°C (140°F)

### 5.3 Machine dimensions

DESCRIPTION	
Length	2370 mm (93.31 inch)
Width	1285 mm (50.59 inch)
Height (without light tower)	1220 mm (48.03 inch)
Max weight (incl solder)	900 kg (1984.16 lb)