

# Safedoor

## User Manual

English (original)  
Version 1.0.0

Made **4**  
**CNC**



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# 1 Technical Sheet SD100

Safedoor is a unique automatic door system, especially designed for robotic tending of CNC machines. The Safedoor system is also an ideal solution for CNC tending without a robot, improving operator ergonomics.

The system contains actuator(s), and a controller which together enables safe, fast and reliable operation of a CNC machine door.

With adjustable travel speed and built-in force monitoring it is capable of safe operation alongside human operators.

## Features

- Easy installation, programming and risk assessment
- Optimized for integration with collaborative robots
- Fast and silent operation
- Automatic door size adjustment
- Force control optimized for safe and reliable operation
- Capable of handling both single and double door CNC machines
- Flexible mounting brackets for easy integration with different CNC machines

	Minimum	Typical	Maximum	Unit
Stroke	100	-	1000	mm
Installation length	1224.5		2224.5	mm
	48.2		87.5	inch
Adjustable Speed	280	500	500	mm/s
Open/close time @ 75 mm		3.1		s
Force @ 15 mm opening		108	150	N
Force @ 40 mm opening		124	150	N
Weight of a door		100	400	kg
		220	880	lb

## Specifications

IP rating, controller	IP66
IP rating, actuator	IP54
Digital interfaces	URCap (Polyscope $\geq$ 3.14 or 5.9) 24V galvanically isolated I/Os
Dimensions, controller	300 x 300 x 155 mm 11.8 x 11.8 x 6.1 inch
Dimensions, actuator	1224.5 x 284 x 130 mm 48.2 x 11.2 x 5.1 inch
Weight, controller	6.6 kg 14.5 lb
Weight, actuator	11.2 kg 24.7 lb

## Typical applications

- CNC machine tending by collaborative robots
- CNC machine tending by operators, improving ergonomics
- Automatic operation of CNC machines with one or two doors

## Operating Conditions

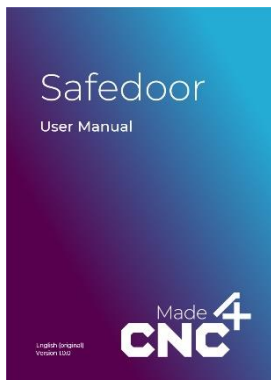
	Min.	Typical	Max.	Unit
Input voltage	90	230/110	260	VAC
Input voltage frequency	47	50/60	63	Hz
External fuse	6	-	16	A
Operating temperature, ambient	0	-	50	°C
	32	-	122	°F
Relative humidity (non-condensing)	10	-	95	%
Calculated MTBF (5 min cycle)	33,000			hours

## What is in the box?

The system is composed of two packages: one with the controller and another package per actuator. Depending on the type of CNC machine, you will need a controller package and either one or two actuator packages.

The controller package contains:

- Controller cabinet with:
  - Controller board
  - Power supply (110/220VAC to 24VDC)
  - 5m power cable (N+L+PE)
- Printed instruction manual
- USB stick, containing:
  - Digital instruction manual
  - URcap for Universal Robots PolyScope versions 3.14 / 5.9 and higher
- Operator panel with 5m cable



Each actuator package contains:

- Actuator, 1000mm, 300N, 500mm/s
- Low mounting bracket
- Tall mounting bracket
- Bag of mounting fasteners:
  - 2x M12x45 bolts
  - 2x M12 lock nuts
  - 4x M12 washers



Please check that all the parts are present and without defects before starting the installation.

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## 2 Quick guide



### DANGER

You must read, understand and follow all safety information in this manual, as well as the manuals for robot, CNC machine and all other associated machinery before initializing door motion. Failure to comply with safety information could result in severe injury or death.

### Actuator

1. Unpack the content of the box (See full list of supplied equipment on page 6)
2. Mount the tall bracket on the machine body.
3. Mount the low bracket on the door.
4. Make sure the two brackets are aligned and separated by at least 1210mm when the door is closed.
5. Mount the actuator between the brackets and secure it in place using the provided bolts, washers and lock nuts. Use the appropriate mounting holes in the tall bracket to ensure the actuator is leveled.
6. Tighten the bolts and ensure that the actuator is firmly seated in the brackets, unable to rotate axially in either end.
7. Route the actuator cable to the controller, through the cable gland and connect the motor cables to controller boards J4 / J5.
8. If installing two actuators, repeat the process for the second actuator on the second door.

See full description and other mounting options in the section *Mechanical integration* on page 12.



### INFO

The actuator must be able to fully reach the doors mechanical end stops in both directions. Therefore, the actuator cannot be fully retracted when the door is closed. The minimum spacing of 1210mm between the brackets must be respected.

### Controller

1. Mount the controller in a suitable location, typically close the CNCs control cabinet.
2. Connect the actuator cable to the controller PCB connector J4.
3. If installing two actuators, install the second actuators to J5.
4. Connect the CNC Not Active input from CNC Machine to the controller PCB connector J6.
5. If required, connect the operator open/close button panel to J8.
6. Connect the output signals in J3 to inputs on the robot.
7. Connect the input signals in J1 to outputs on the robot.

8. Connect "CNC Door Closed" to the CNC machines cycle start input.

For full list and description of inputs and outputs, see *IO functional description* page 20.

## Operator panel

1. Mount the operator panel on a flat surface where it is convenient for the operator to reach.
2. Route the cable from the panel to the controller cabinet.
3. Connect the button wires from the cable to J8 pins 1 and 2 on the Controller Board.
4. Connect power supply +24V to the cable and GND to J8 pin 3 (common).

See description in Button panel input group J8 on page 21.

## Configuration

1. Jog the connected doors to fully opened position using the Jog buttons on the Controller Board.
2. Press and hold "Config / Reset" on the Controller Board for 3 seconds to initiate the configuration cycle.
3. Observe the doors and ensure that both doors move all the way to the fully closed position.
4. Observe that the two green LEDs on the controller board light up, indicating that the configuration cycle was completed successfully.
5. Use the robot inputs (J1) or the button panel (J8) to open and close the door a few times, to allow the controller to adjust to the width of the door(s).

See full description in *Configuration* on page 23.



### INFO

The controller checks if the CNC is active before it attempts to open the doors. Ensure that the CNC Not Active signal is provided.

For more guides and instruction videos, visit [www.made4cnc.com](http://www.made4cnc.com)



# 3 Mechanical integration

It is important to plan the mounting process carefully before starting the work. This section guides you through the decisions in the process.

## Mounting configuration

To accommodate various CNC machine designs, the Safedoor actuator and accompanying brackets offer a variety of different mounting options.

The two mounting brackets share similar mounting hole patterns and can both be used to fixate either end of the actuator.

The low bracket is intended to be mounted on the highest of the two mounting points on the machine, and the tall bracket should be mounted on the lower mounting point. The tall bracket has multiple mounting positions for the actuator, allowing adjustment of the height to ensure the actuator is level with the door's direction of motion.

The end of the actuator with the motor-cabinet should always be mounted on the stationary side, i.e., on the CNC machine body. The rod end of the actuator should be mounted on the door of the CNC machine.

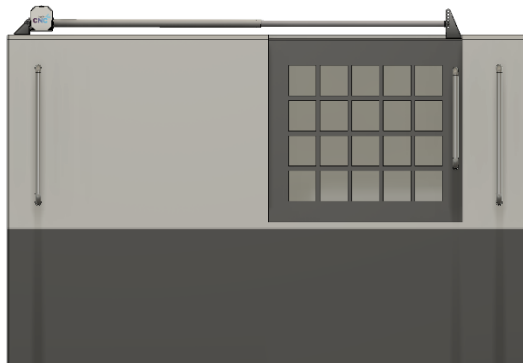
The actuator(s) can be mounted such that it is retracted when the door is closed and extended when the door is open – or extended when the door is closed and retracted when the door is open. Keep in mind that the wires in the motor connector J4 (J5 for secondary door) must be swapped when using the extended when closed option.



*Retracted when closed*

*Extended when closed*

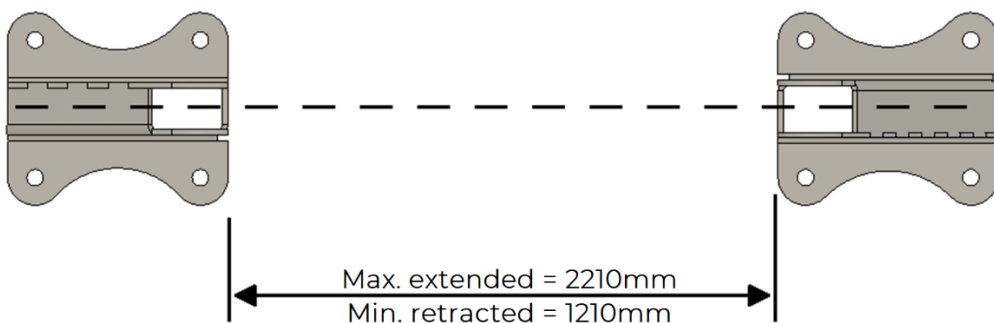
When the door is internal or the mounting point on the door, for other reasons, is lower than the body of the CNC machine, the tall bracket should be mounted on the door, to allow the actuator to remain parallel with the doors line of motion.



*Internal door mounting.*

## Mounting the brackets

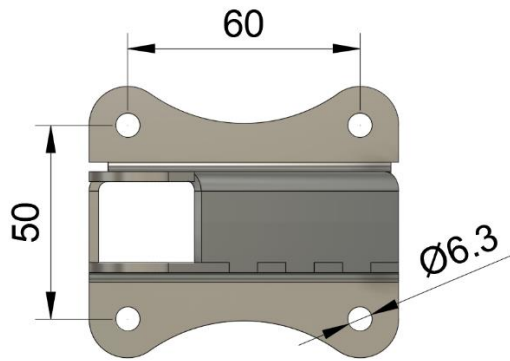
When determining the position of the mounting brackets, it is important to ensure that they are lined up correctly and that the distance between them is correct. When the two mounting brackets are closest together, there must be 1210mm between them to ensure proper operation of the actuator. The actuator will, when fully extended, push the brackets up to 2210mm apart.



*Maximum and minimum bracket distances over the travel length of the door.*

The movement of the door must be mechanically limited so that the maximum and minimum distances are observed. If the mechanical stops provided by the CNC machine is not able to provide such stops, additional stops must be installed.

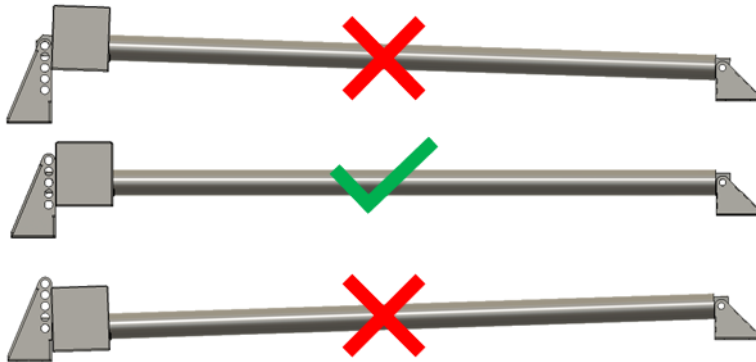
Once the positioning of the two mounting brackets have been determined, they can be mounted on the CNC machine body and door. The brackets should be mounted using the four mounting holes provided on each bracket.



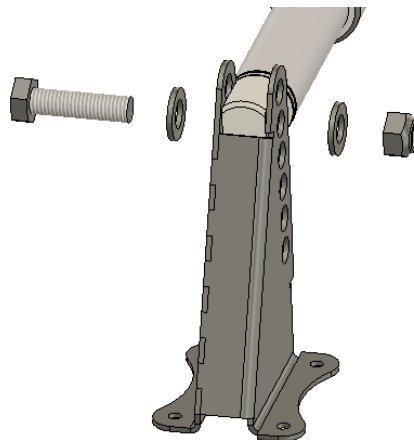
*Dimensions in mm.*

### **Mounting the actuator**

The tall mounting bracket is made with several sets of mounting holes to allow height adjustment during the installation. Use the correct set of holes to adjust the actuator to a horizontally aligned position.



Each end of the actuator should be bolted into the brackets using the provided M12x45 bolts, M12 washers and M12 safety nuts. See the figure below. The bolts must be tightened firmly, and the actuator should not be able to jiggle axially when correctly mounted.



Safedoor actuators must only be installed to work with axial pushing and pulling forces. Lateral and radial loading is not permitted.

The actuators must be mounted in the supplied mounting brackets using the supplied bolts, tensioned to the specified torque, to ensure that neither of the actuator's ends are able to rotate in the mounting bracket. The minimum distance between the mounting brackets must be respected, as the actuator cannot withstand retracting beyond this distance.



#### **DANGER**

Loose bolts can cause the actuator to fall from the CNC door. Always make sure that bolts are firmly tightened.

The actuator can come apart, fall and/or take damage if the driven beyond its specified length. Always ensure that the minimum and maximum distance between brackets is complied with.

Mechanical stops must be provided by the CNC machine or installed by separately the integrator, to ensure the minimum distance is kept. The Safedoor system uses the mechanical stops to automatically detect the width of the door and thereby scheduling proper acceleration and deceleration of the door prior to closure of the door. This ensures that the majority of the kinetic energy of the door is removed before the door closes, further reducing the severity of pinching and crushing hazards.

Do not connect the actuator's power cables before verifying that it is mechanically secured and unable to rotate axially in either of the attachment points.

## **Maintenance and repair**

All maintenance and repairs must be performed in compliance with this manual and latest service manual, which can be found on [www.made4cnc.com/support](http://www.made4cnc.com/support).

Repairs must be performed by authorized system integrations or made4CNC. Original spare parts must be used.

Actuators and controllers are marked with a product generation number. Only combine actuators and controllers with same generation number. Ask technical support for generation details.



### **WARNING**

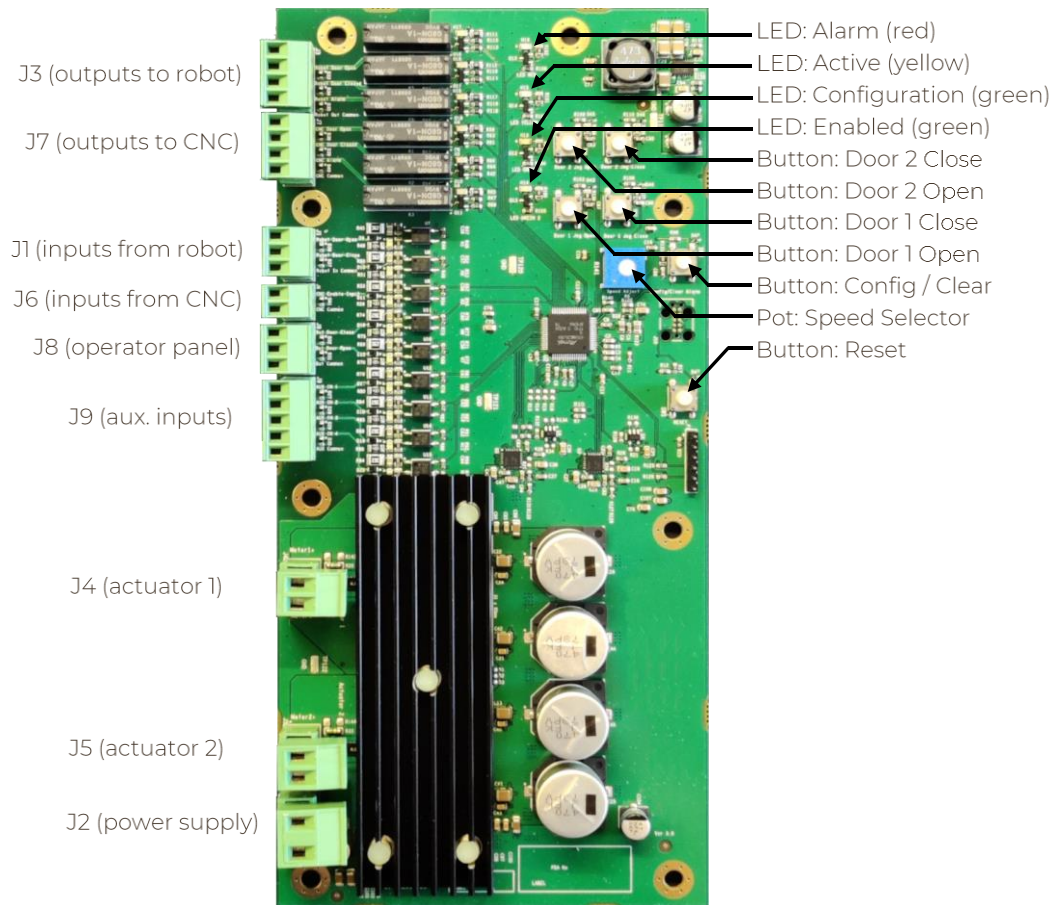
Combining actuators and controllers from different generations can change properties of the product significantly. Safety features might not be fully functional, which can result in injuries.

Use of non-original spare parts can change the safety features significantly. This can result in unacceptable impact forces and/or reduced product lifespan, which can result in injuries.





# 4 Electrical connections



## PCB controls

Name	Function
Button "Door 1 open"	Press and hold to open door 1.
Button "Door 1 close"	Press and hold to close door 1.
Button "Door 2 open"	Press and hold to open door 2.
Button "Door 2 close"	Press and hold to close door 2.
Button "Config / clear"	Press to clear alarms and to exit manual mode. Hold for 3 seconds to initiate configuration cycle.
Button "Reset"	Press to perform a hardware reset of the controller PCB.
Trim pot "Speed selector"	Determines the speed mode to be configured. See <i>Speed settings</i> on page 22.

## IO connections

Connection	Name	Signal type	Reference	Rating
J3 pin 1	Robot door opened	Digital output	J3 pin 4	24V <sub>dc</sub> / 1A <sub>dc</sub>
J3 pin 2	Robot door closed	Digital output	J3 pin 4	24V <sub>dc</sub> / 1A <sub>dc</sub>
J3 pin 3	Robot alarm	Digital output	J3 pin 4	24V <sub>dc</sub> / 1A <sub>dc</sub>
J3 pin 4	Robot 24V	Group common		
J7 pin 1	CNC door opened	Digital output	J7 pin 4	24V <sub>dc</sub> / 1A <sub>dc</sub>
J7 pin 2	CNC door closed	Digital output	J7 pin 4	24V <sub>dc</sub> / 1A <sub>dc</sub>
J7 pin 3	CNC alarm	Digital output	J7 pin 4	24V <sub>dc</sub> / 1A <sub>dc</sub>
J7 pin 4	CNC 24V	Group common		
J1 pin 1	Robot open door	Digital input	J1 pin 3	24V <sub>dc</sub>
J1 pin 2	Robot close door	Digital input	J1 pin 3	24V <sub>dc</sub>
J1 pin 3	Robot GND	Group common	J1 pin 3	
J6 pin 1	CNC Not Active	Digital input	J6 pin 2	24V <sub>dc</sub>
J6 pin 2	CNC GND	Group common		
J8 pin 1	Button door close	Digital input	J8 pin 3	24V <sub>dc</sub>
J8 pin 2	Button door open	Digital input	J8 pin 3	24V <sub>dc</sub>
J8 pin 3	GND	Group common		
J9 pin 1	Auxiliary input 1	Digital input	J9 pin 5	24V <sub>dc</sub>
J9 pin 2	Auxiliary input 2	Digital input	J9 pin 5	24V <sub>dc</sub>
J9 pin 3	Auxiliary input 3	Digital input	J9 pin 5	24V <sub>dc</sub>
J9 pin 4	Auxiliary input 4	Digital input	J9 pin 5	24V <sub>dc</sub>
J9 pin 5	GND	Group common		
J4 pin 1	Actuator 1 pos	24V power		24V <sub>dc</sub> / 12A <sub>dc</sub>
J4 pin 2	Actuator 1 neg	24V power		24V <sub>dc</sub> / 12A <sub>dc</sub>
J5 pin 1	Actuator 2 pos	24V power		24V <sub>dc</sub> / 12A <sub>dc</sub>
J5 pin 2	Actuator 2 neg	24V power		24V <sub>dc</sub> / 12A <sub>dc</sub>
J2 pin 1	24V supply	24V power		24V <sub>dc</sub> / 21A <sub>dc</sub>
J2 pin 2	GND	24V power		24V <sub>dc</sub> / 21A <sub>dc</sub>

Each connector group is galvanically isolated from the rest of the controller board and from each other and implemented in compliance with IEC-61131-2 Type 3.

All digital outputs are normally opened relays. When activated the output is electrically connected to the respective reference pin.

All digital inputs are optocoupled and activates when a voltage of 24V with respect to the group common ground is applied.

## IO functional description

### Robot output group J3

The connector group J3 is used to signal the state of the door to the robot. It should be powered by connecting the robot 24V power to J3 pin 4.

Pin	Description
Pin 1: Robot door opened	Relay contactor is closed when the door is fully opened. This signal can be used to signal the robot that it can enter the CNC machine.
Pin 2: Robot door closed	Relay contactor is closed when the door is fully closed.
Pin3: Robot alarm	Relay contactor is closed when the system is in an alarm state.
Pin4: Robot 24V	Common supply for the J3 group. Relays in this group close circuits to this pin when active.

### CNC output group J7

The connector group J7 is used to signal the state of the door to the CNC machine. It should be powered by connecting the CNC 24V power to J7 pin 4.

Pin	Description
Pin 1: CNC door opened	Relay contactor is closed when the door is fully opened.
Pin 2: CNC door closed	Relay contactor is closed when the door is fully closed. This signal can be used to indicate to the CNC machine that it can start a new machining cycle.
Pin 3: CNC alarm	Relay contactor is closed when the system is in an alarm state.
Pin 4: CNC 24V	Common supply for the J3 group. Relays in this group close circuits to this pin when active.

### Robot input group J1

The connector group J1 is used to signal the door to open and close from the robot. Signals should be 24V when activated and 0V when not activated, with reference to J1 pin 3.

Pin	Description
Pin 1: Robot open door	Request door open. Note that the CNC Not Active signal on J6 pin 1 must be high for door opening to be initiated.
Pin 2: Robot door closed	Request door close. This signal should be activated by the robot when it has completed its work in the CNC machine and has moved outside of the machine and clear of the door.
Pin 3: Robot 24V	Common GND for the J1 group. Signals in this group are activated when 24V with respect to this pin is presented on the inputs.

### CNC input group J6

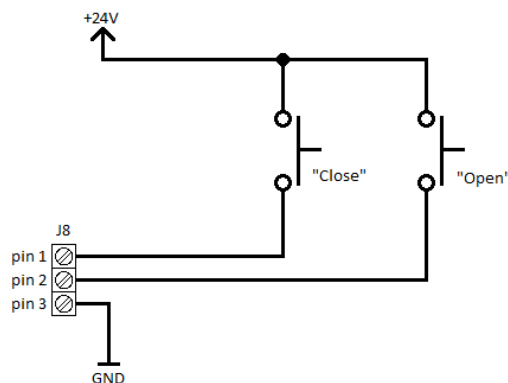
The connectors in group J6 is used to signal the door that it can safely open, as the CNC machine is not active and have unlocked the door.

Pin	Description
Pin 1: CNC Not Active	Should be activated by the CNC machine when the machining cycle has finished and any door locks have been unlocked. The door will not attempt to open the door if this signal is not set.
Pin 2: CNC GND	Common GND for the J6 group. Signals in this group are activated when 24V with respect to this pin is presented on the inputs.

### Button panel input group J8

The connectors in group J8 is used to connect an external button panel, allowing manual operation of the door.

Pin	Description
Pin 1: Button close door	Should be connected to the button for manually closing the door. When activated, the door will close.
Pin 2: Button open door	Should be connected to the button for manually opening the door. When activated, the door will open.
Pin 3: GND	Common GND for the J8 group. Signals in this group are activated when 24V with respect to this pin is presented on the inputs.



### Auxiliary input group J9

Signals in this group is not used and should be left unconnected.

### Actuator 1 connector J4

Connectors for powering the first door actuator. Note that the polarity should be inverted (i.e. the wires should be swapped), when the actuator is mounted in the extended when closed configuration.

### Actuator 2 connector J5

Connectors for powering the second door actuator. See description for *Actuator 1 group J4* above.

### Supply connector J2

Connector to power supply unit, providing power for the controller board and the attached actuators.






#### CAUTION

Pay attention to polarity when connecting signals and power to the controller board. Reversal of voltages may cause permanent damage to controller board, power-supply and any attached equipment.

## Speed settings

To allow the integrator to select the appropriate traversal speed for the installation, The Safedoor controller has three different speed settings. The speed is selected by turning the speed selector (see overview on page 18). The speed setting must be set prior to running a configuration cycle, as it is latched during the configuration. Changing the speed setting has no effect before a new configuration cycle is performed.

Setting	Description
	High speed: 500 mm/s The potentiometer is turned fully clockwise until meeting resistance.
	Medium speed: 390 mm/s The potentiometer is in center position, between the high- and low speed positions.
	Low speed: 280 mm/s The potentiometer is turned fully counterclockwise until meeting resistance.

See page 18 for selector placement.

## Manual operation (jogging)

During installation it can be beneficial to be able to drive the linear actuators manually. This can be done using the buttons on the controller PCB. When either of the buttons are pressed, the controller board enters Manual Operation Mode, and any action requested from the digital inputs are blocked until Manual Operation Mode is cancelled by pressing “Config / Reset”.

Button	Description
Door 1 Jog Open	Press and hold to slowly move door 1 in opening direction.
Door 1 Jog Close	Press and hold to slowly move door 1 in closing direction.
Door 2 Jog Open	Press and hold to slowly move door 2 in opening direction.
Door 2 Jog Close	Press and hold to slowly move door 2 in closing direction.

*See page 18 for button placements.*

Note that the “CNC Not Active” input must be set high to allow any motion.

## Configuration

A configuration cycle must be performed on each actuator after it has been installed. The cycle measures the width, resistance, weight and other parameters on each door and stores it internally on the controller board. This data is later used to ensure proper speed ramping as well as high force detection, once the system is in service.

To perform a configuration, follow these steps carefully:

6. Ensure that the CNC door can move freely
  - a. Linear rails must be clean, free from chips/dust/debris and well lubricated
7. Ensure that the actuator is mounted correctly on the CNC machine
  - a. The mounting brackets must be firmly mounted on the CNC machine
  - b. The actuator must be level with the machine and door
  - c. All bolts must be properly tensioned
  - d. All electrical connections must be firmly tightened
8. Ensure that the CNC machine is not operating, and that the “CNC Not Active” signal is provided and high
9. Ensure that power and PE is connected
  - a. AC power (110V or 220V) source must be connected to the power supply in the controller cabinet.
  - b. The power supply and the controller cabinet must be connected to PE (protective earth)

- c. 24V supply and GND cables must be mounted between the power supply and the controller board
10. Press and hold "Open door 1" to jog door 1 to the fully opened position.
  11. If a second door is installed, press and hold "Open door 2" to jog door 2 to the fully opened position.
  12. Press and hold "Config / Reset" for 3 seconds to initiate the configuration cycle.
    - a. Observe the doors and ensure that both doors move all the way to the fully closed position.
    - b. Observe that the two green LEDs on the controller board light up, indicating that the configuration cycle was completed successfully.
  13. Use the robot inputs (J1) or the button panel (J8) to open and close the door a few times, to allow the controller to adjust to the width of the door(s).



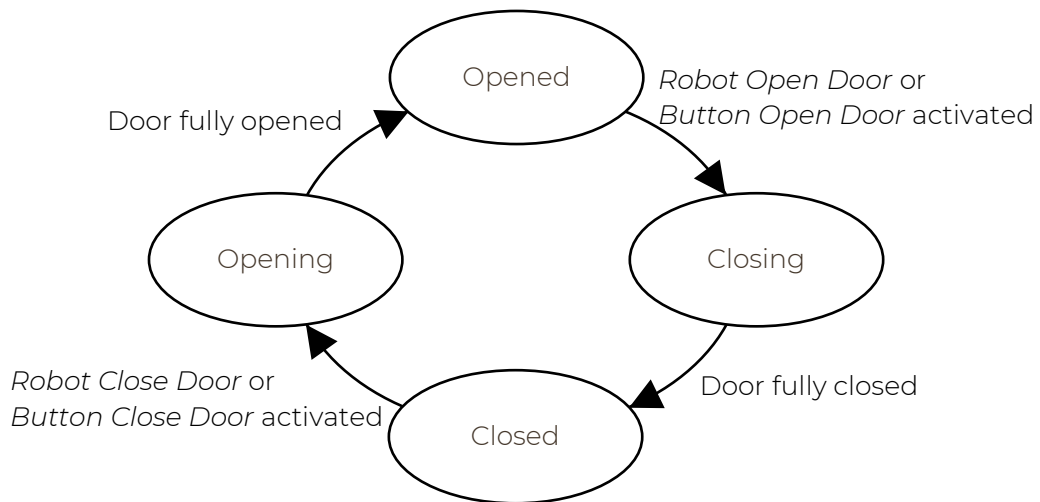


# 5 Software specification

## Operating states

The software on the Controller Board performs motion control and force monitoring of the actuators and communicate with the CNC machine, robot, operator panel and other equipment through digital inputs and outputs.

During normal operation, the Safedoor Controller has four operating states; Opening, Opened, Closing and Closed.



When the Controller is in *Opened* state the outputs *CNC Door Opened* and *Robot Door Opened* are activated. In this state the Controller waits for either *Robot Open Door* or *Button Open Door* to be set while *CNC Not Active* is also set. The Controller then clears the outputs and transitions to the *Closing* state,

When in *Closing* state, the door is accelerated to the configured maximum speed. The speed is maintained until the door approaches the fully closed position. Then it is slowed down and closed safely. Once the controller senses that the door is fully closed it transitions into *Closed* state and sets the outputs *CNC Door Closed* and *Robot Door Closed* active.

In the *Closed* state, the controller awaits *Robot Close Door* or *Button Close Door* to be set while *CNC Not Active* is also set. When these signals are provided, the Controller clears the *CNC Door Closed* and *Robot Door Closed* signals and transitions into *Opening* state.

When in *Opening* state, the door is accelerated to the configured maximum speed. The speed is maintained until the door approaches the fully opened position. Then it is slowed down and reaches the fully opened position safely. Once the controller senses that the door is fully opened it transitions into *Opened* state and sets the outputs *CNC Door Opened* and *Robot Door Opened*.

Note that the Controller will not respond to the inputs signals as described above if:

- 1) The controller is in Manual Mode after using the Jogging buttons. When done jogging, press Config / Reset to return to normal operation.
- 2) The controller is not configured or is currently running a configuration cycle. See *Configuration* on page 23.
- 3) An alarm has occurred. Once the cause of the alarm has been identified and rectified, the alarm can be cleared by pressing Config / Reset. See *Alarm LED (red)* on page 27.

## LEDs

The Controller Board has four LEDs, indicating the state of the Controller. Below is a description of each of the LED's; please refer to the Controller Board overview on page 18 for placement of the LEDs.

### Alarm LED (red)

The Alarm LED is off during normal operation. If a problem, which requires the operator's intervention, is detected the Controller switches to the *Alarm State* and the *Alarm LED* will flash one of the patterns below, to indicate the cause. The *Alarm* state is retained until the cause of the alarm is removed and the *Reset / Config* button is pressed.

Blink pattern	Cause	Description
Solid on	Manual mode	Either of the Jog buttons was pressed and the Controller Board is in Manual Mode.
Single flash	Temperature Alarm	The motor driver's temperature exceeded 60C. Make sure the rails are clean and the door can move without excessive resistance.
Two flashes	Motion Timeout	The door didn't finish a opening or closing motion within reasonable time. Check motor wire connections to ensure the actuator is properly connected.
Three flashes	Force Limit	The Controller Board registered a increased force during door motion. Check for chips and other blockages of the door. Ensure the linear rails are clean and well lubricated.
Four flashes	Motor driver malfunction	Various internal errors; drive voltage too high, tension too low, driver malfunction or overheating. Contact your supplier for more information.

### Active LED (yellow)

The Active LED is on when the system is currently opening or closing the door. The LED is also on if a configuration cycle is being performed or if the door is being jogged manually.

### **Configuration LED (green)**

The configuration LED is ON when the system has been properly configured. If not, it will flash to indicate that configuration is required before the system can be used.

### **Enable LED (green)**

The *Enable LED* is on, when the *CNC Not Active* input is on, and the system can move the door.

## **Interfacing with CNC machines**

When interfacing with the CNC machine, the system needs to be aware of the CNC's operating state, i.e. if the CNC is currently running a cycle and the doors need to remain closed, or if the cycle is completed and the door can be opened. This information should be given by setting the *CNC Not Active* signal high when the CNC is not operating, and the door can be opened. When the machine starts a cycle, it should clear this signal and remain cleared till the cycle is complete and the mechanical locks on the door have been unlocked.

The *CNC Door Opened* and *CNC Door Closed* signals can be used to signal the CNC to e.g. start a new cycle when the doors have been closed.

## **Interfacing with robots**

The robot interface, composed of J1 and J3, allows the robot to be determine of the current state of the CNC machine as well as initiating door motion. When the door opens, *Robot Door Opened* is set and the robot can start its part replacement cycle. When done, it can use the *Robot Close Door* signal the door to close. When the door is fully closed, the *CNC Door Closed* signal is set, which can be used to trigger Cycle Start on the CNC.

## URCap

The Safedoor URCap enables easy and reliable setup and operation, when using Safedoor in conjunction with a Universal Robots collaborative robot.

### Installation

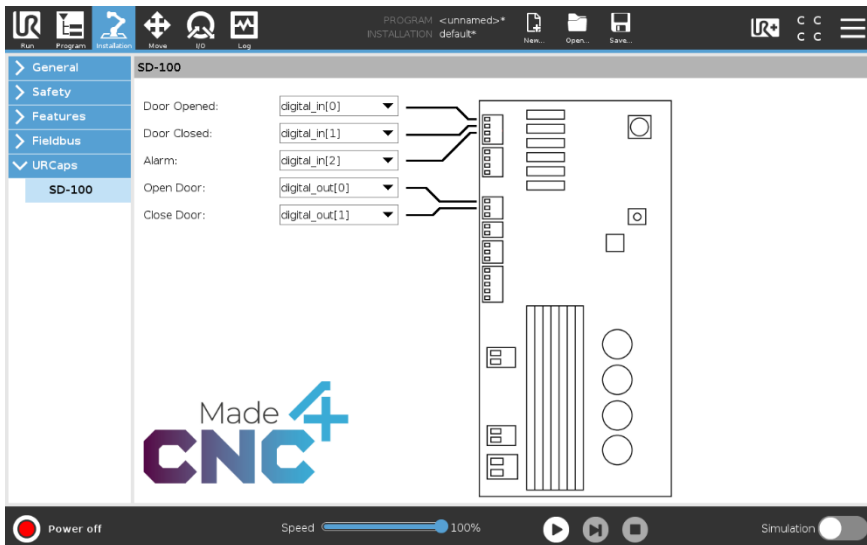
Install the URCap by inserting the provided USB stick into the USB port on the robot teach pendant. Follow these steps to install the URCap on the robot system:

1. Main menu → Setup Robot → URCaps
2. Press “+”
3. Select “USB” → “Safedoor.urcap”
4. Press “Open”
5. Press “Restart”

Polyscope will now restart and load the installed URCap.

### Installation screen

The installation screen contains settings related to the installation of the Safedoor system. It can be found by navigating to *Installation* → *URCaps* → *Safedoor*. Make sure all inputs and outputs are configured to represent the actual wiring.



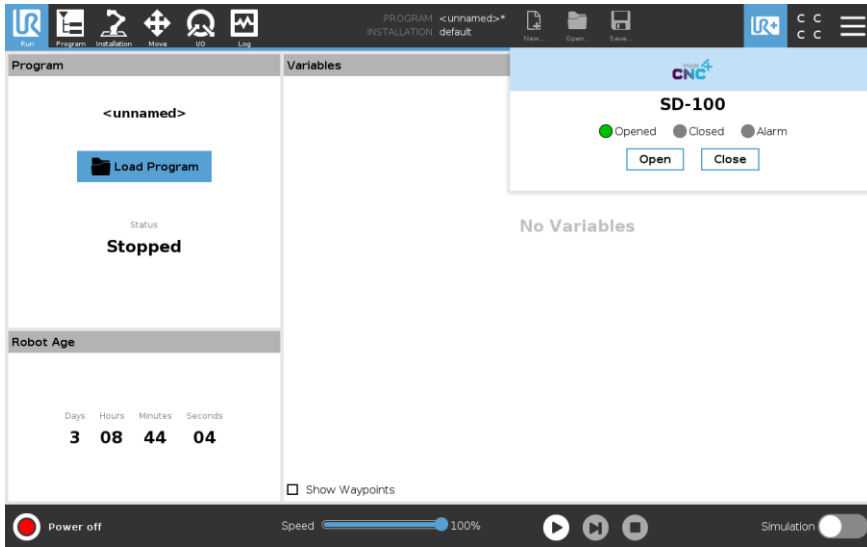
It is advised to verify the installation and settings, by using open- and close buttons on the toolbar (see *Toolbar* on page 30), before continuing. Verify that the indicators “Opened” and “Closed” light up when the door is in the respective positions.

The alarm signal can be tested by blocking the CNC door and attempting to close it, using the “Close” button. The Alarm signal must be cleared by pressing the “Config / Clear” on the controller board.

## Toolbar

The toolbar provides an overview of the door state as well as access to controls. The controls should not be used while running a program but can be useful while programming the robot.

The toolbar can be accessed by pressing the “UR+” logo in the top-right corner of the screen:



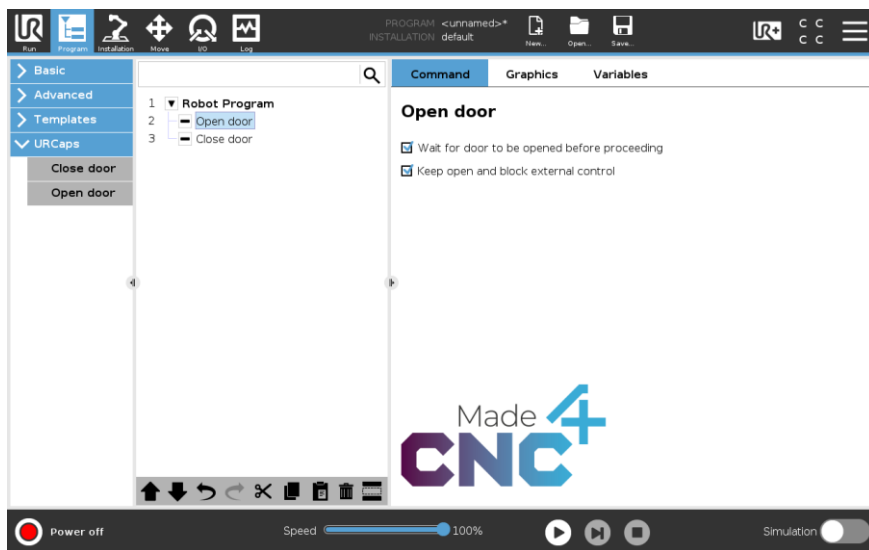
The toolbar is currently only available on Universal Robots eSeries robots.

## Open Door node

This program node can be inserted into the program tree, and it will request the door to open. Per default, this node will block until the door is opened and the robot can safely enter the CNC machine.

The “*Open Door*” program node can be inserted in the “*Program*” panel, at the currently selected location in the program tree, by clicking “*URCaps*” → “*Open Door*” in the structure panel.

The program node will clear the “*Close Door*” signal and set the “*Open Door*” signal. It will wait for the “*Door Closed*” signal to be cleared by the Controller Board, indicating that the signal to open the door was properly received and the motion initiated, before continuing to the next program node.



When the check box “*Wait for door to be opened before proceeding*” is checked, the program will not continue beyond this program node before the door is fully opened and the input signal set as “*Door Opened*” in the installation screen is high.

When the check box “*Keep open and block external control*” is checked the program will continuously set the “*Open Door*” signal high, preventing external overrides of this signal. Only subsequent “*Close Door*” program node will remove this blockage and allow the door to close.

## Close door node

This program node can be inserted into the program tree, and it will request the door to close.

The “Close Door” program node can be inserted in the “Program” panel, at the currently selected location in the program tree, by clicking “URCaps” → “Close Door” in the structure panel.

The program node will clear the “Open Door” signal and set the “Close Door” signal. It will wait for the “Door Open” signal to be cleared by the Controller Board, indicating that the signal to close the door was properly received and the motion initiated, before continuing to the next program node. The program node will also clear any external control blockage set by previous “Open Door” program nodes.



When the check box “Wait for door to be closed before proceeding” is checked the program will not continue beyond this program node before the door is fully closed and the Controller Board has set the “Door Closed” signal high.





# 6 Safety

## **System integrator responsibilities**

The system integrator is responsible for ensuring that the applicable safety laws and regulations in the country where the product is incorporated are followed and that all significant hazards in the complete automated system is eliminated. This includes, but is not limited to:

- Performing a risk assessment for the complete system, including CNC machine and/or robot
- Interfacing other machinery and additional safety devices, if defined according to the risk assessment
- Setting up the appropriate safety settings in the robot- and CNC software and other relevant safety controllers
- Ensuring that the user will not modify any safety measures
- Validating that the total system is working correctly and according to system requirements
- Writing instructions for use (To be read by daily operators etc.)
- Marking the installation with the relevant signs and contact information system integrator
- Collection all documentation in a technical file; including the risk assessment and this manual

## **Intended use**

The Safedoor system is intended to be installed on a CNC machine to automatically open and close one or two sliding doors of the CNC machine. The CNC machine must have mechanical stops at both ends of the door(s) linear travel and it must provide a safe locking mechanism, ensuring that the door cannot be opened while the CNC machine is operating.

The door can be opened to 1000mm and weight up to 400kg. Opening speed is maximum 500mm/s and will stop when meeting certain resistance. The Safedoor Actuators and Controller should only be used under conditions specified in the *Technical Sheet* on page 4.

The Safedoor Controller is installed with electrical 24V signals between controller and CNC machine and/or robot. The wiring must be carried out by qualified personnel, e.g. an electrician qualified to install wires in CNC machines and robots. When connecting to external machinery, such as CNC machines, robots and other industrial- and automation equipment, only signals intended for external communication. Note that some CNC machines have dedicated communication ports, specific digital I/Os, etc., designated for incorporation with an automated door function.

Any use of the Safedoor system deviating from the intended use is deemed to be impermissible misuse. This includes, but is not limited to:

- Use in potentially explosive atmospheres
- Use in non-industrial environments

- Use before conducting risk assessment
- Use where risk of clamping a human's head and/or neck is significant
- Use outside permissible operational conditions and specifications
- Use where the door(s) presents a cutting and/or impact risk
- Use where safety features of the CNC machine door(s) are bypassed or compromised
- Use as climbing or lifting aid
- Use where the actuator is constantly soaked in oil or other liquids

All operators must be trained in correct use of the equipment, including all relevant safety precautions.

## **Risk assessment**

The system integrator must perform a risk assessment on the complete CNC machine and/or robot application. The Safedoor Controller and Actuators is only components in an automation application and the safe use of the Safedoor system rely on the integrators ability to design a safe application.

The Safedoor system is designed with these risk reduction features:

- Three different speed settings, allowing the integrator to reduce the travel speed if required by the risk assessment. The lower travel speed, the lower impact from the inertia (weight) of the door.
- Force limiting, reducing pinch and crushing hazards
- Non-backdrivable gear, ensuring the door does not move unintended.

The safety of the overall automated system depends on the design and shape of individual CNC machine doors. The integrator of the Safedoor system must consider if the CNC machine doors are suitable for automatic operation, and if needed according to the integrators risk assessment edges of the door must be upgraded with soft padding or the edges must be smoothed to have suitable contact surfaces. All changes to the CNC machine itself must be done in according to guidelines and requirements for such CNC machine.

The weight (inertia) of the CNC door and thereby potential impact with such door must be considered in the risk assessment. Light doors with large and flat closing surfaces poses less risk than heavy doors with thin/smaller closing surfaces. The integrator must also consider how the Safedoor Actuator is mounted and ensure that the mounting itself do not create any additional risks, e.g. risk of clamping.

In applications where the Safedoor system is used together with a robot, the integrator must consider if a potential collision between the door(s) and robot can create any additional hazards and mitigate any risk from such hazards as required by the risk assessment.

It is the responsibility of the integrator to conduct a risk assessment of the final installation, including the Safedoor system, the CNC machine and any other

equipment used. All hazards as well as the severity of these must be identified and assessed before placing the installation into service.

Below is a list of the potential hazards that Made4CNC has identified as significant and that must be considered by the integrator:

- Collision between moving parts and human body parts (e.g. head and neck)
- Clamping between moving parts and robot or other equipment (e.g. head and neck)
- Consequences due to improper mounting and/or loosening of bolts/screws
- Consequences due to lack of maintenance
- Contact between door(s) and robotics equipment and/or workpiece

Maintenance and safety checks must be performed with appropriate and regular intervals, and at least once time per year. The integrator must define such appropriate intervals to the user and/or operator, e.g. in the information for use.

It is recommended that national standards and guidelines are observed in the design phase of the complete installation, and that the principles for risk assessment defined in ISO 12100 are followed.

In installations where a shared emergency stop functionality is wanted, so that the Safedoor Actuator is unable to move when robot and CNC machine is emergency stopped, it is recommended to cut power with a safety relay directly on the mains input power (230V/110V) for the controller box. It is recommended that the relay is a force guided type with a monitoring circuit and that principles of ISO 13849-1 are followed. If an emergency stop button is added solely for the Safedoor system it must also cut the mains input voltage (230V/110V), and it is recommended that it complies with ISO 13850.

It must be considered if a shared Lockout-Tagout function is required, where all mains power (230V/110V) to all parts of the installation can be disconnected at the same time (E.g the CNC machine, the robot and the Safedoor system all together). It is recommended to follow ISO 14118.

### **Exerted force**

The table below shows the typical actuator force at different levels of door openings. The data is based on tests carried out by third party test facility (Force Technology) and can be used as guidelines when performing risk assessment.

<b>Opening [mm]</b>	<b>Force [N]</b>
15	108
40	124
80	170
120	299
150	383

If it is found by risk assessment that the combination of physical properties of the CNC door and moving parts of Safedoor actuator and/or a robot results in risks that

cannot be sufficiently reduced with safety features provided by Safedoor System and/or the robot then additional risk reduction measures must be added. Such measures could include protective devices such as laser scanners or light curtains in combination with mechanical shielding.

## Environmental safety

The Safedoor system, including Actuators and Controllers, and any other Made4CNC product must be decommissioned and disposed in accordance with applicable national laws, regulations and standards.

The product is manufactured with restricted use of hazardous substances to protect environment and operators, as defined by the EU “RoHS” Directive 2001/65/EU. The restrictions include lead, cadmium, mercury, chromium VI, polybrominated biphenyls and polybrominated diphenyl ethers.

National requirements apply to importers according to EU “WEEE” Directive 2012/19/EU. Follow this link for more information.

<https://www.ewrn.org/national-registers/national-registers>



## General safety instructions

Generally, all laws, regulations and legislations of the country of installation and use must be complied with. Observe all guidelines in this manual and the warnings below:



### DANGER

All wiring and connections must be performed by personal qualified to work with mains voltage (230V/110V). Electrical shock can result in death.

Do not touch any electrical components inside the controller besides the dedicated buttons.

Do not take the internal power supply apart. It operates with internal voltages up to 500V, and voltage can be present for up to 24 hours after disconnection.

Do not use the product if any electrical or mechanical components are damaged or modified. Made4CNC disclaims any and all liability if the product is modified in any way. Made4CNC cannot be held responsible for any damages caused to the product or any other equipment due to programming errors or malfunction of the Safedoor product.

Do not modify any safety features of the CNC door(s). The CNC machine must be prevented from operating when the door is open. CNC machine operation with open door(s) can result in death or serious injury.

## 7 Warranties

### **Product warranty**

Without prejudice to any claims the customer (user) may have in relation to the dealer or retailer, the customer shall be granted a manufacturer's warranty under the conditions set out below:

In the case of new devices and their components exhibiting defects resulting from manufacturing and/or material faults within 12 months of entering into services (maximum 15 month after shipment), Made4CNC shall provide the necessary spare parts, while the customer shall provide the working hours to replace the spare parts, either replace the failed part with another part in similar state of wear and tear or repair said failed part.

This warranty shall be invalid if the defect is attributable to improper treatment and/or failure to comply with information contained in the user guides. This warranty shall not apply to or extend to service performed by an authorized dealer or the customer themselves (including installation, software downloads and configuration). Purchase documentation, together with the date of purchase, shall be required as evidence for invoking the warranty. Claims under this warranty must be submitted within one month of the defect becoming evident. Ownership of products, devices, components and spare parts replaced by and returned to Made4CNC shall vest in Made4CNC. Any other claims resulting out of or in connection with the product shall be excluded from this warranty. Nothing in this warranty shall attempt to limit or exclude a customer's statutory rights nor the manufacturer's liability for death or personal injury resulting from its negligence. Insofar as no warranty default exists, Made4CNC reserves the right to charge the customer for the replacement or repair. The above provision does not imply change in the burden of proof to the detriment of the customers. In case of a device exhibiting defects, Made4CNC shall not be liable for any incidental, special, indirect or consequential damages, including but not limited to, loss of profit, loss of use, loss of production or damages to other equipment.

### **Disclaimer**

Made4CNC continues to improve the reliability and performance of its products, and therefore reserve the right to upgrade the product without any prior notice. Made4CNC takes thorough care that the content of this manual is precise and correct but takes no responsibility of any erroneous or missing information.

# 8 Certifications

Declarations, certificates and standards are listed in this section.

## Applied standards

Standards used under the development of the product is listed in this section. EU Directive numbers noted in square brackets indicates that the standard is harmonized under that directive.

### ISO 12100:2010

#### EN ISO 12100:2010 (E) [2006/42/EC]

*Safety of machinery – General principles of design – Risk assessment and risk reduction*

The product is evaluated in accordance with the principles of these standards.

### IEC 60529:2013

#### EN 60529/A2:2013

*Degrees of protection provided by enclosures (IP Code)*

This standard defines enclosure ratings regarding protection against dust and water. The actuator and the controller are designed with an IP classification according to this standard. See stickers on the controller cabinet and actuator.

### IEC 61131-2:2017

#### EN 61131-2:2017 [Pending harmonization 2014/30/EU]

*Programmable controllers*

24 V I/O signals from/to the controller are designed for reliable communication with robots, CNC machines and PLCs conforming to this standard.

### ISO 13732-1:2007

#### EN ISO 13732-1:2008 [2006/42/EC]

Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces.

Part 1: Hot surfaces

The product is designed so that the surface temperature of the product is kept under the ergonomic limits defined by this standard.

### IEC 61000-6-2:2016

#### IEC 61000-6-4:2018

#### EN 61000-6-2:2019 [Pending harmonization 2014/30/EU]

#### EN 61000-6-4:2019 [Pending harmonization 2014/30/EU]

Electromagnetic compatibility (EMC)

Part 6-2: Generic standards – Immunity for industrial environments

Part 6-4: Generic standards – Emission standard for industrial environments

The product is evaluated according to the limits and principles in these standards.



IEC 60068-2-1:2007  
IEC 60068-2-2:2007  
IEC 60068-2-27:2008  
IEC 60068-2-64:2008  
EN 60068-2-1:2007  
EN 60068-2-2:2007  
EN 60068-2-27:2009  
EN 60068-2-64:2008

*Environmental testing*

*Part 2-1: Tests – Test A: Cold*

*Part 2-2: Tests – Test B: Dry heat*

*Part 2-27: Tests – Test Ea and guidance: Shock*

*Part 2-64: tests -Test Fh: Vibration broadband random and guidance*

The product is designed and prepared to pass tests defined in these standards.

**IEC 60664-1:2020**

**EN 60664-1:2020 [2014/35/EU]**

*Insulation coordination for equipment within low-voltage supply systems*

*Part 1: Principles, requirements and tests*

This standard is observed during development of the electrical circuits inside the product.

**ISO 10218-2:2011**

**EN ISO 10218-2:2011 [2006/42/EC]**

**ANSI/RIA R15.06**

**CAN/CSA-Z434-14**

*Robots and robotic devices – Safety requirements for industrial robots*

*Part 2: Robot systems and integration*

This standard is relevant for robotic applications and should be observed by integrators when integrating this product in conjunction with one or more robots. The product evaluated and prepared for integrations according to these standards.

**ISO/TS 15066:2016**

**RIA TR R15.606**

*Robots and robotic devices — Collaborative robots*

This technical specification is relevant for collaborative robot applications and should be observed by integrators when integrating this product in conjunction with one or more cobots. The product evaluated and prepared for integrations according to the normative requirements in this technical specification.

# CE/EU Declaration of incorporation (Original)

According to European Machinery Directive 2006/42/EC annex II 1.B.

The manufacturer:

Made4CNC ApS  
Helgavej 26  
DK-5230 Odense M  
DENMARK  
[www.made4cnc.com](http://www.made4cnc.com)

declares that the product:

Types:	SD000 to SD999 with controller
Model:	Safedoor
Generation:	1
Serial, controller:	SDC1-000000 to SDC1-999999
Serial, actuator:	SDA1-000000 to SDA1-999999

configured with one controller and one or two actuators is partly completed machinery according to 2006/42/EC and may not be put into service before the machinery in which it will be incorporated is declared in conformity with the provision of Directive 2006/42/EC and with the regulations transposing it into national law.

The product is prepared for compliance with essential requirements of Directive 2006/42/EC under correct incorporation conditions; follow instructions and guidance in this manual. Compliance with all essential requirements of Directive 2006/42/EC relies on a final risk assessment that also takes CNC machine, robot and other equipment into account.

Technical documentation is prepared according to Directive 2006/42/EC annex VII part B and is available in electronic form to national authorities upon legitimate request. Undersigned is based on the manufacturer's address and authorized to compile this documentation.

Additionally, the product declares in compliance with the following directives, according to which the product is CE marked:

- 2014/30/EU – Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU – Restriction of the use of hazardous substances (RoHS)

Relevant essential health and safety requirements of the following EU directives are also applied:

- 2014/35/EU – Low Voltage Directive (LVD)
- 2012/19/EU – Waste of Electrical and Electronic Equipment (WEEE)

A list of applied standards is provided in this manual.

Odense, May 12<sup>th</sup>, 2021

Corporate management



Peter Nadolny Madsen  
Chief Executive Officer



The Safedoor system is an innovative and safe solution to enable robotized tending of existing CNC machines.

The Actuator is specially designed for the purpose, allowing fast, continuous operation of CNC machine doors. The intelligent Controller monitors that all aspects of the doors motion is smooth and reliable.

The built-in safety features allow safe human / machine collaboration with out the need to safety fencing. This makes the Safedoor system ideal for collaborative robot applications.