General user manual for MPN equipment

MPN A/S

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Before use

Follow the instructions in this manual, and be sure to use only original parts in possible replacements. Contact your dealer/MPN A/S if you have any further questions.

Responsibility

The liable owner/user of the machine must select a person as responsible for the training of all personnel that deals with the MPN part of the plant. This manual must be read by all persons handling the machine.

The liable owner/user must ensure that the manual is updated accordingly in the case of changes to the machine.

This manual must be found in the nearby vicinity of the machine. If this is not possible, it must be clearly stated where the manual is kept.

Composition and function

Look at appendices for specific description of functionality and overview drawings of the machine/workcell.

The overview will point out location of emergency stop buttons and safety-zones.

Emergency Stop

The machine is fitted with emergency stop that will cut power for motors, 24V outputs and air for pnuematics when activated. The emergency circuit-breaker is also activated physically if a robot moves outside its normal workspace. Safety light curtains protects openings into safety-zones that are not already sealed off by a fence. *Emergency stop is only meant to be used in case of emergency. Hereby meaning a situation where there is a risk for injury to persons or damage to equipment. Under normal operating conditions the machine must first be stopped the usual way (the stop button on the touchscreen display) before going in to safety-zones and thereby activating the circuit-breaker.*

Light Tower

The light-tower uses its colours to indicate the state of the machine.

The signals must be interpreted like this:

Machine state:	*Green light:*	*Yellow light:*	*Red light:*	*Safe to enter safety-zone?:*
Emergency circuit breaker activated	off	off	on	Yes
The machine has just been powered on	off	on	off	Yes, but push emergency stop button first
Machine is in running state	on	off	off	NO
Machine is about to go to running state	blinks	on	off	NO
Machine is in paused state	blinks	blinks	off	Yes, but push emergency stop button first
Machine is in paused state with an error	off	blinks	off	Yes, but push emergency stop button first
Machine is on its way to paused state	blinks	on	off	NO

It's of great benefit, not least safety-wise, that the machine operator becomes highly familiar with these colour-codes.

Warnings

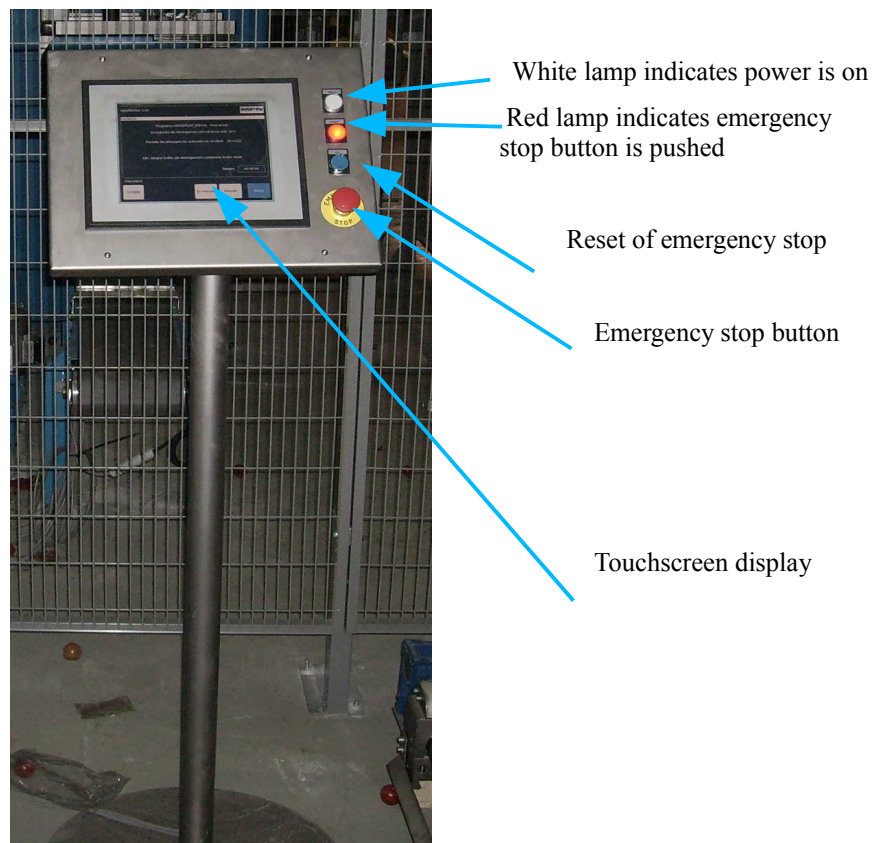**Direct specific prohibition when operating the machine:**

● It's strictly forbidden to reside inside a safety-zone when the machine is operating.

Elimination of risks:

● The machine safety-zone comes equipped with fence / safety light curtains. The machine must not be operated if these are dismounted or damaged.

● The emergency stop buttons must under no circumstances be blocked, so that the operator has no means of getting to them.

Operating the machine

The machine is operated by means of a touchscreen display located on an operating stand together with an emergency stop button and indicatorlights.


White lamp indicates power is on

Red lamp indicates emergency stop button is pushed

Reset of emergency stop

Emergency stop button

Touchscreen display

Electric cabinet with main power switch.

Start up

1. Make sure no persons or limbs are located in the safety zones. Ensure that products and pallets and so on are in a state where the machine can do a startup (see functional description in appendix).

2. Turn on the main power switch located on the eletric cabinet (all switches if there's more than one cabinet).

3. Wait for the panel pc (touchscreen display) to boot.

4. Make sure that the emergency stop button on the operating stand is pressed in and wait for this screen:
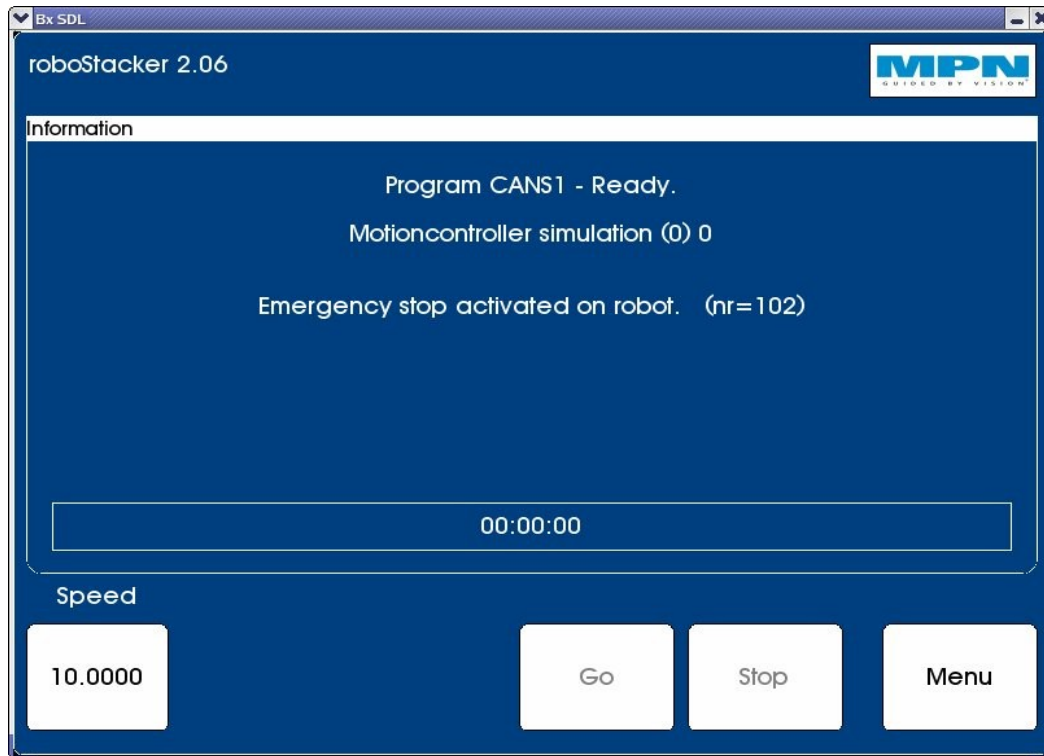
5. Release the emergency stop button and press the reset button to energize the machine.

⚠ If the main screen doesn't appear in reasonable time, or the main screen says that there has been a power failue, it is important that the dealer or MPN itself is contacted. In case the workcell contains a robot, it could have lost its calibration values and must therefore under no circumstances be started without the guidance of expert personnel.

Main Screen

The structure of the main screen usually looks like this:
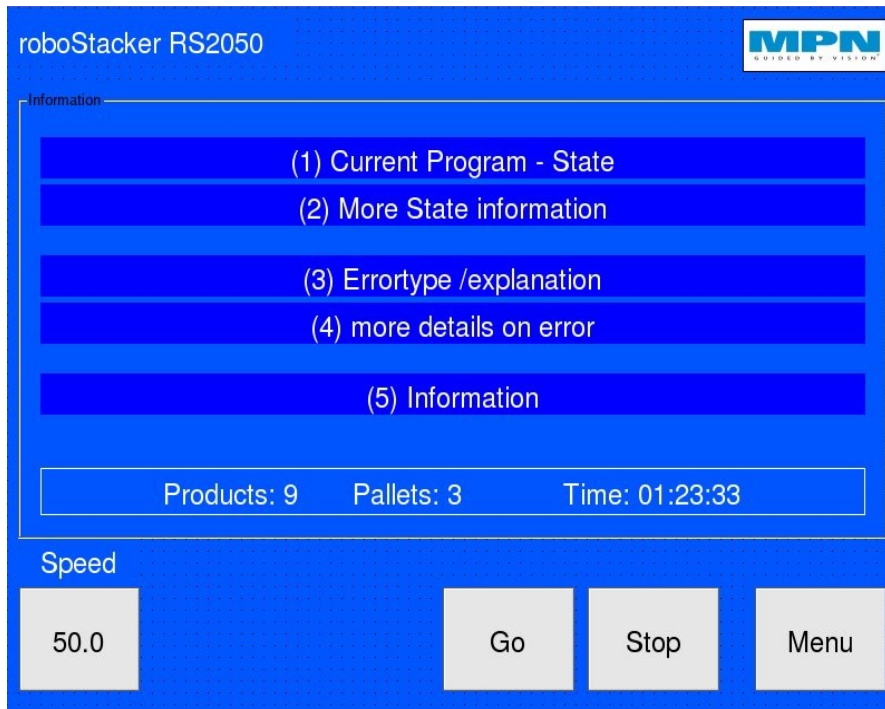
It consists of three or four buttons. There's a "Go"-button, a "Stop"-button, a "Menu"-button, and sometimes a "Speed"-Button.

The center of the screen gives information about:

1. What program is currently running, and present state of the machine.

2. More relevant state or statistics information.

3. Errortype and explanation. This field is empty if there is no error!

4. Details on error. This field is empty if there is no error!

5. Extra information on machine state. This field gives auxiliary information from various parts of the workcell.

6. The encased field at the bottom can show statistics. E.g. current runtime, pallets so far, and so on.

Start

To start production, press the "Go"-button. It can take take up to 10-20 seconds before all parts of the machine is running.

Tip: Look at the light tower to see if the machine is fully in running state.

Stop/Pause

To put the machine in paused press the "Stop"-button. It can take take up to 10-20 seconds before all parts of the machine is paused. Main screen says "paused" when all parts of the machine is stopped.

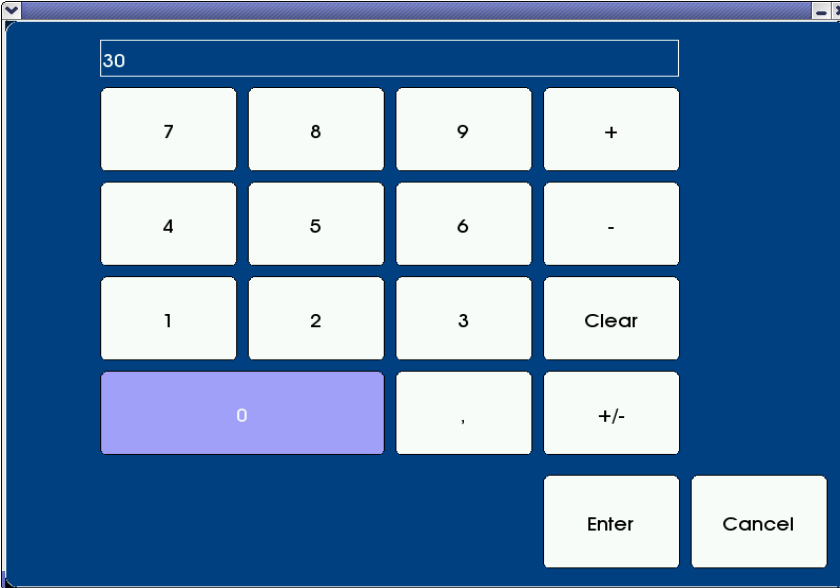Tip: You can also look at the light tower to see if the machine is paused.

Errors

When the machine detects an error, it will automatically go to paused-state, and display the errortype on screen. Most of the time the error-message wil even say what can be done to correct the error.

Speed change

A robots speed is represented as a number between 1 and 100. 100 corrosponds to the maximum allowable speed of the robot trajectories. If you set the speed to 50 the robot will take double the amount of time to complete a given trajectory.

Push the button "Speed" under the main screen. You'll now get the following screen:

Input the desired speed as a number between 1 and 100. Then press the "Enter"-button.

Press "Cancel" if you don't want to change the speed after all.

On some machines it is possible for the machine to autotune its speed to the workload. This option is enabled individually for each program.

Emergency stop

Once the machine has paused with an error, it might be necessary to enter the safety-zone to correct tilted products or the like. As a consequence the emergency stop is activated.

When possible errors has been corrected and all persons are on the right side of safety barriers again, release emergency stop and press reset. You can now start the machine again as described above.

The menu

The menu always contains the choices "Program" and "Login". Along with these the menu can display a number of other workcell-specific buttons. If there are any, they will be described in the functional description in the appendix.

The "Login"-button opens up for a whole array of advanced functions, that shouldn't be necessary under normal operating conditions.
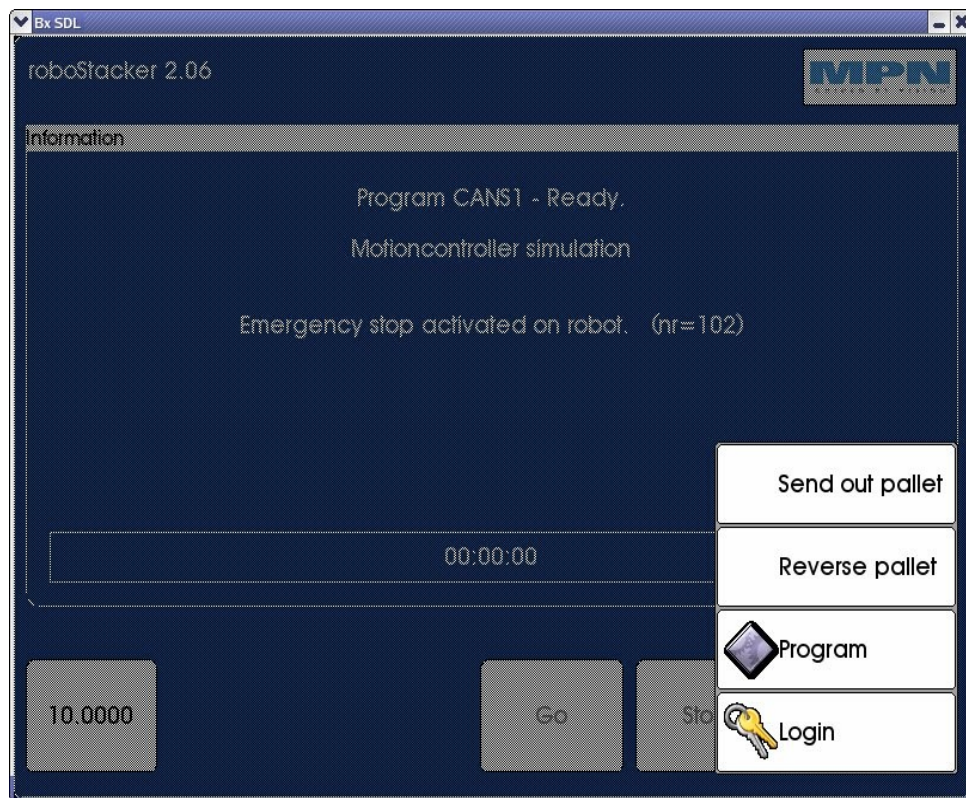
Program choice:

To choose a program, press the "menu"-button at the main screen, and then pick the "Program"-button. Then you'll see a list of programs. The description of programs are included in the appendix specific to your machine.
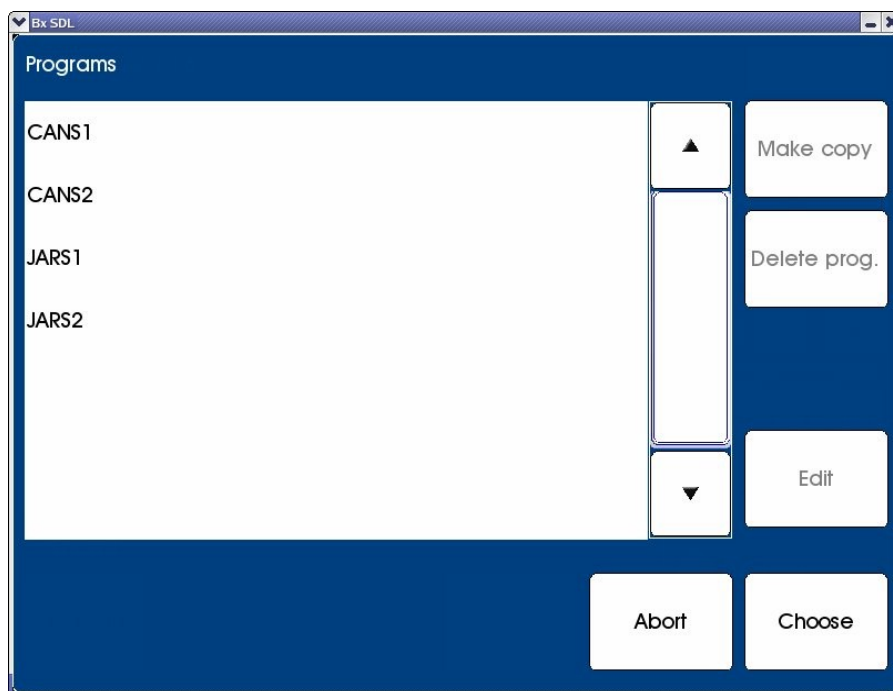
To make a program choice, pick the desired program from the list, and press "Choose".

When logged in at a higher accesslevel, it is also possible to make a new program as a copy from an existing program. You can also edit variables in existing programs.

Expert mode

⚠ Warning: Use of the following functions happens at your own risk. Erroneous operation can lead to damages to the machine. If in doubt, contact the supplier.

If you want to access more advanced function, you must fist login. Make sure the workcell is stopped/in pause. Now press the "Login"-button under the menu. You'll now get the following screen:

This is the username screen. Type the username here and press "Ok". In the next screen you have to input the correct password for the username:
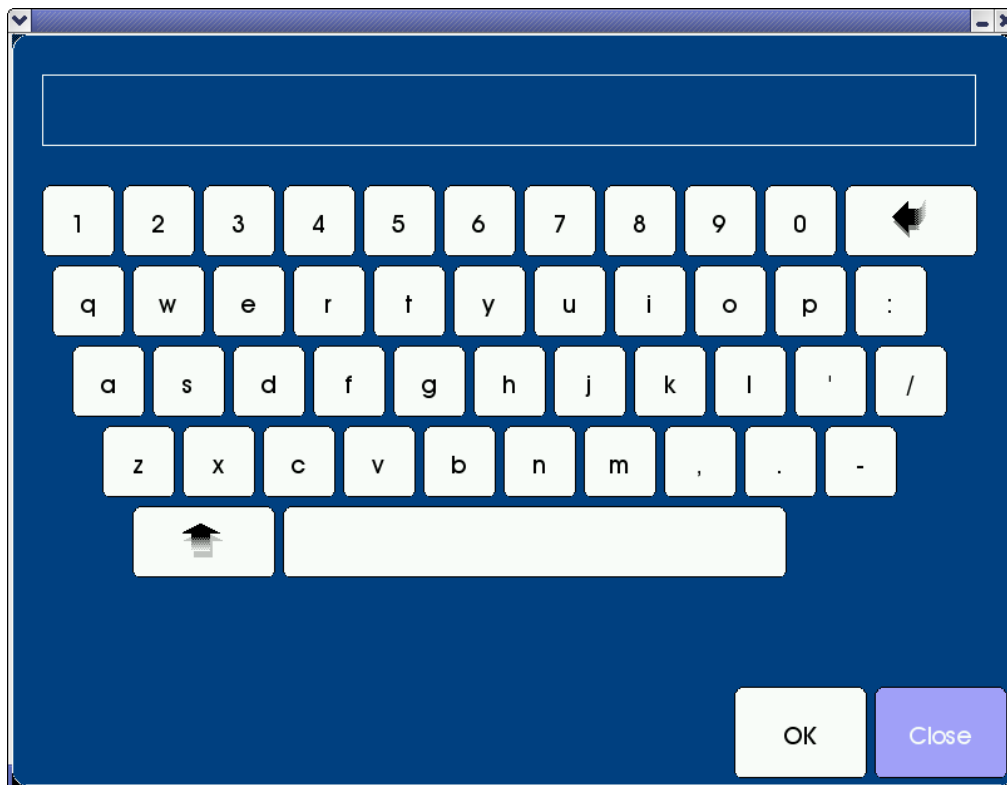
Once this is done correctly, you're logged in at a higher userlevel, and more advanced functions will be visible in the menu. It is possible to log in at different levels. The higher the level, the more function are at your service.

| *Level*	*Username*	*Password*	*Comment*
Operatorlevel	operator	operator	This is the default
Userlevel	user	useruser	
Servicelevel	service	service	Almost all functions are enabled here
Managerlevel	manager	manager	This is probably the highest level you'll ever need
Maxlevel	*****	*****	This is only for MPN experts

Jogging:

An important tool for the expertoperator is to be able to *jog* a robot. To jog is to guide the robots tool to a certain point in 3D space at low speed.

Choose "Tools"->"Jog   axis"->"Jog I.K." to get to the jogscreen.
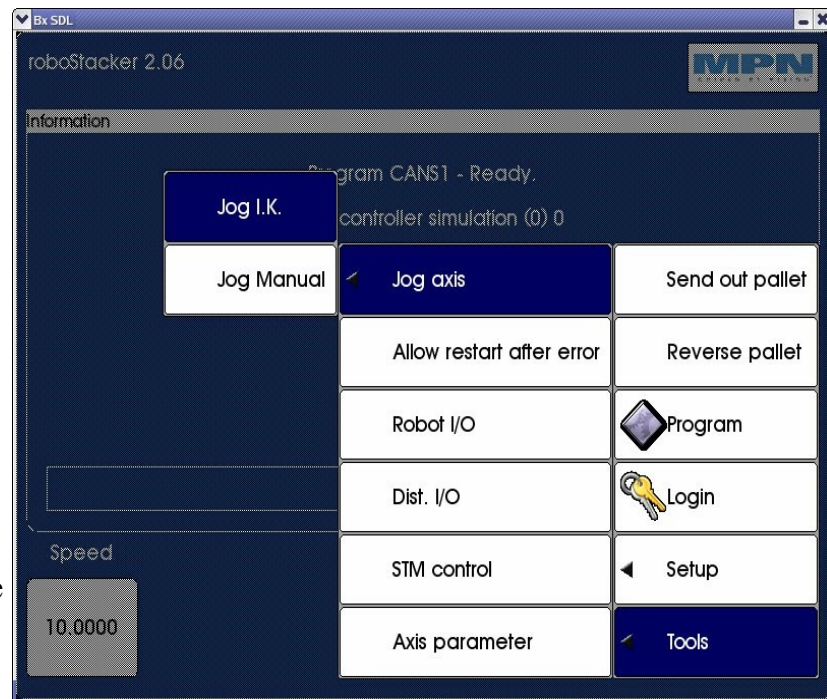
You can see the position of the robotarms tool (Tool Center Point, also TCP), in the X, Y and Z fields.

- X represents the distance from Gantry to TCP. The arm is streched farther out when X grows.

- Y represents the distance from the floor to TCP.

- Z represents the robots position along the gantry.
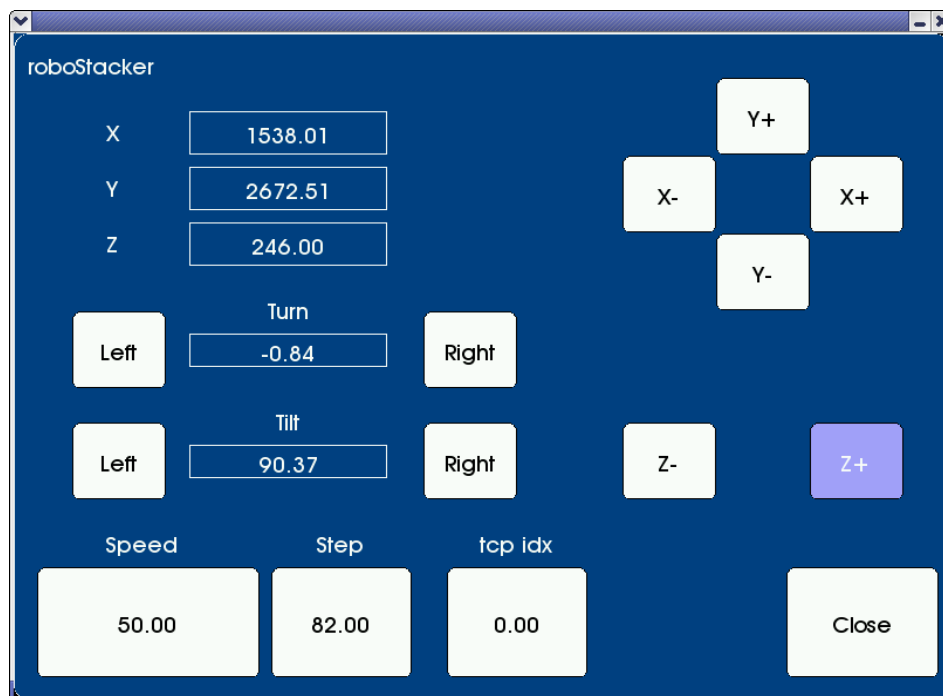
- The turn-field shows the rotation of the tool.

- The tilt-field represents the inclination of the tool. When the tool is level, tilt usually equals 90 degrees.

You can guide the tool to a certain position by using the "X-","X+","Y-",Y+","Z-" og "Z+" buttons. Every time you press one of these buttons the robot jogs "Step" mm in the buttons direction, with a speed of "Speed" mm/s. E.g. If you in the above screenshot pressed "Y+" once, the tool would move 82 mm upward, with a maximum speed of 50 mm per second.

Statemachines:

Control of a workcell is carried out by many small software agents called statemachines or STM for short.

A statemachine carries out small or large tasks, that often corrospond to some physical object. For instance a statemachine called "ConveyorOut" can handle a certain conveyor, including control of a motor and input from photocells and synchronisation to other parts of the system.

Choose "Menu" -> "Tools" -> "STM control" to get to the STM overview.
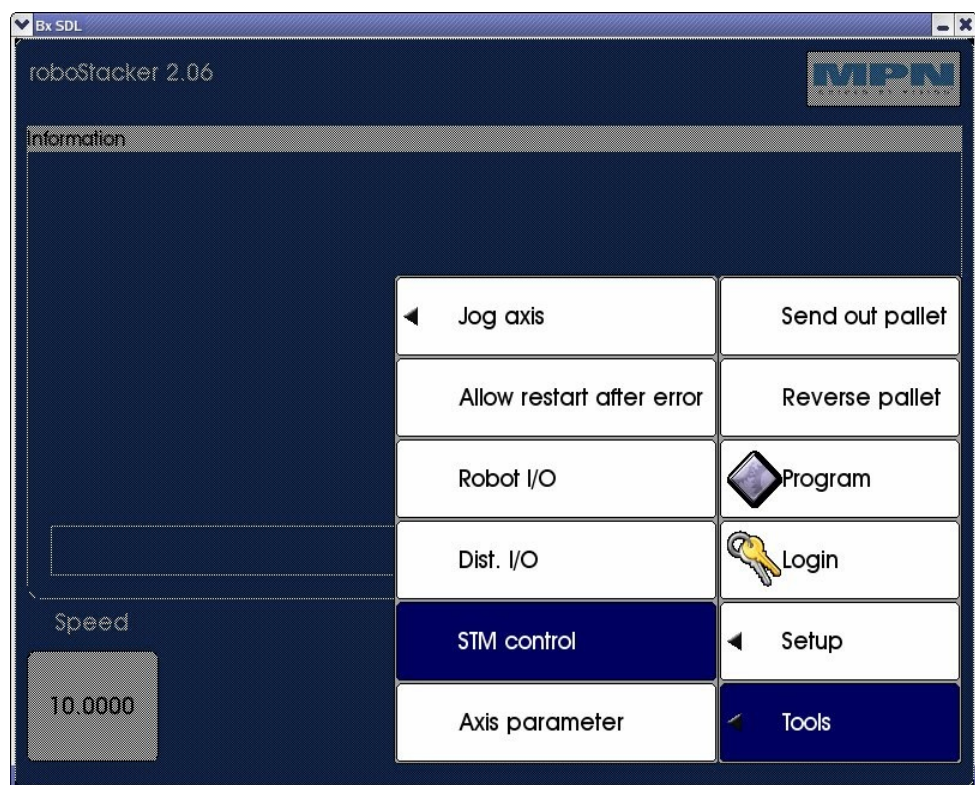
Here you'll see a list over all statemachine in the system and their current state:
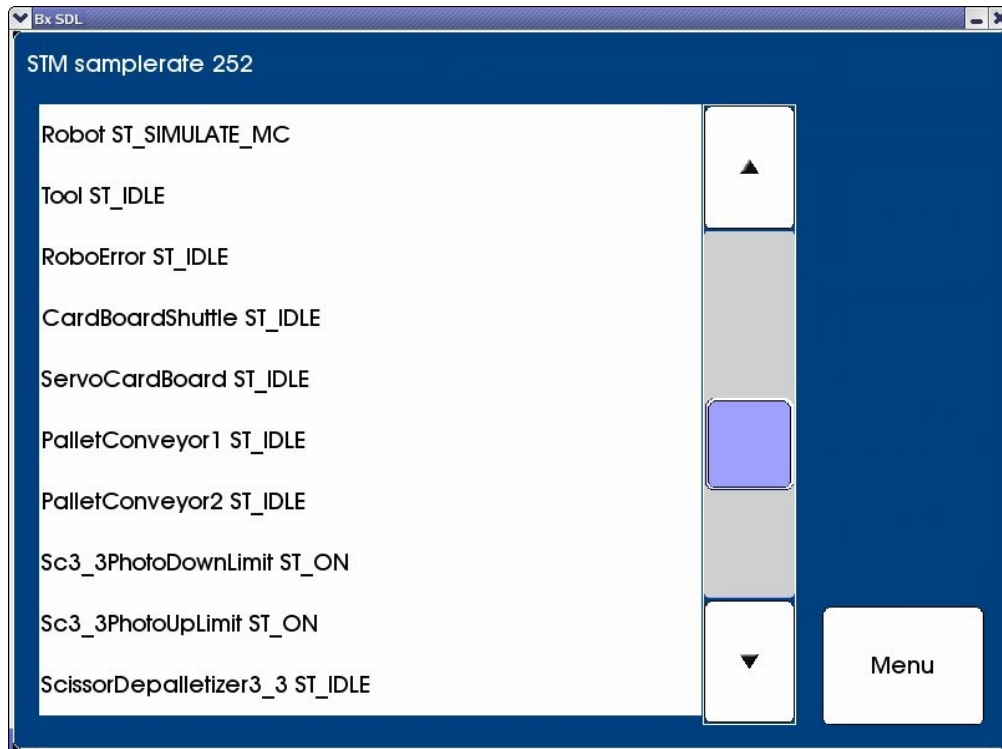
Pick a statemachine if you want to take a closer look at the details:
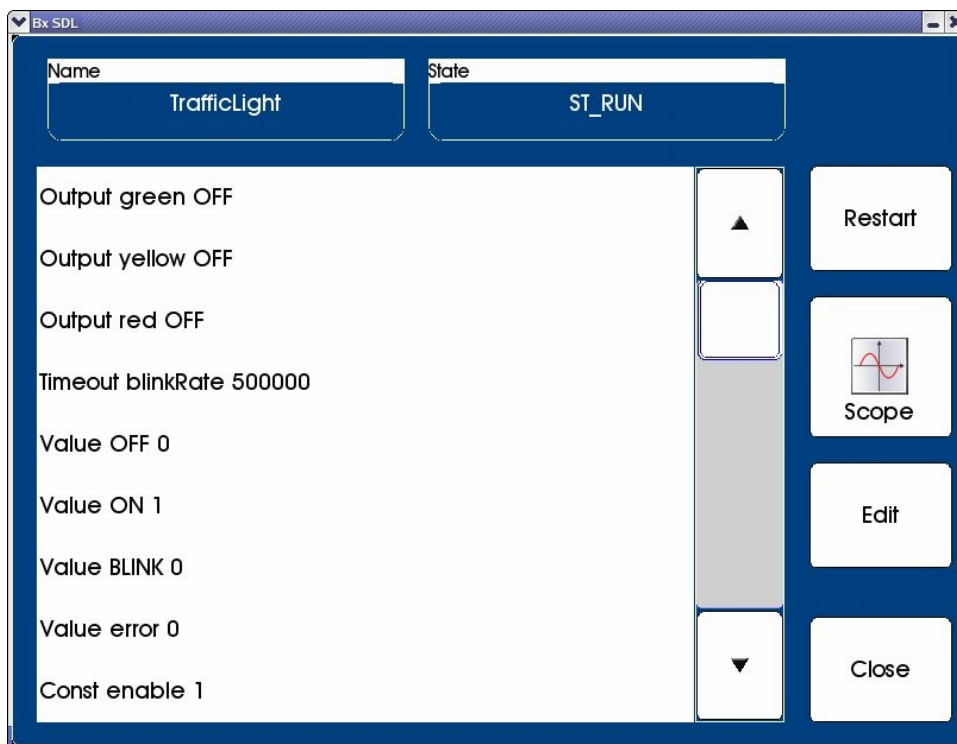
At this screen you can browse the values of inputs, outputs, timeout-values (in microseconds), constants and values. Beside that it's possible to edit Timeouts and Constants. The Scope-function lets you follow the progression of a signal in realtime.

Before editing anything in the statemachines, you should consult an MPN programmer, or really know what you are doing.

Language:

You can choose another user interface language than the default.
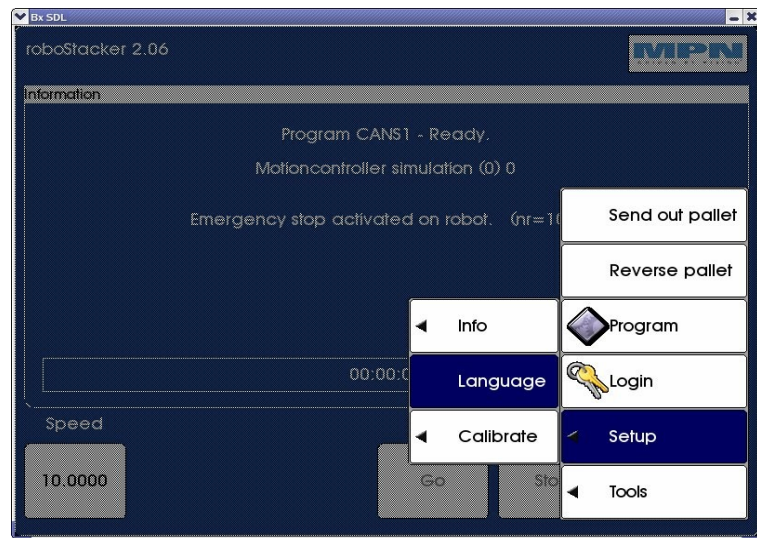
Choose "Menu" -> "Setup" ->
"Languagel" to get to the language
selection screen.

*For other expert functions, including
recalibration and autohoming: Contact
supplier.*

Error handling and troubleshooting

The machine will find and handle errors on it's own as far as possible. If an error occurs that
requires user intervention, the machine wil pause production an report the error on the touchscreeen
display. Generally you handle an error by rectifying the error described on screen, and then starting
the machine again.

Error: Follow Error on Axis x

This error should really be seen very rarely, as it only appears when the robot has collided with its
surroundings. In this situation it's important that the supplier is consulted before any further steps
are taken, because the mechanics or some sensors could have been damaged and be malfunctioning.
Some of the robots 5 axis' could even need a recalibration.

Error: Emergency stop actived while running

If the emergency stop was activated while the machine was running (which shouldn't be done in
normal operation!) the screen gives the following message: "Emergency pressed while running – the
workcell is STOPPED – Carry out a complete start procedure for the machine".

Your response: Turn of the machine at the main power switch. Wait a couple of seconds and turn it
on again. Do the startup procedure as described previously in this manual.

Other errors

If the machine behaves in another way than the expected and the plant can't autodetect the error and
go to paused-state, we are typically dealing with a mechanical type error or a sensor error. It could
be that products are piling up in one part of the system and doesn't get send along.

Examples of errors and solutions:

● Some product is stuck. Pull it free.

- Photocell is not detecting a product. Wipe clean, and if that doesn't help, maybe it needs readjusment, too align properly with reflector. Finally it could be damaged beyond repair. In that case replace it with a new one.

- A conveyor doesn't run when it looks like it is supposed too. This can be caused by either a damaged photocell, which would result in the statemachine not knowing that an object was ready to be conveyed, or it can be caused a tripped thermo relay.

Please check the electric cabinet for trips on the thermo relays. A thermo relay trips if a motor in the plant uses more current than expected. This is with all likelyhood caused by an extraordinary load being applied to the motor.

⚠️ Don't reset the thermo relay from the trip, before the cause of the trip has been investigated. The same rule applies to blown fuses. Contact the service provider in abnormal error situations, as they probably require guidance or interference from a technician.

Cleaning

It must be stressed that cleaning is necessary to avoid stops in production.

Therefore do in appropriate amount every day (before or after production):

1. **Remove tape, paper, cardboard, juice, dust and other remains from the workcell.**

2. **Wipe down photocells and reflectors regularly.**

NOTICE! machine must be shut off during cleaning.

Safety and health risks

It is prohibited youths under 18 years old to operate this machinery.

However youths under 18 years old, that is undergoing education of at least two years duration, can operate the machine according to Arbejdstilsynets departmental order no. 516 of 14/6 1996.

It's the customers responsibility, that changes or additions, electrically as well as mecanically, are documented technically and inserted as appendix to the declaration of conformity.

The signed declaration of conformity, must if necessary be updated.

It is prohibited to reside in dangerous area, hereby meaning inside safety barrier and safety light curtain, while the machine is in operation.

Maintenance

All maintenance and programming is done by the contractor. A service contract between customer and contractor can be made.

Connection and technical data

Following conditions must be provided by customer for the machine to function optimally.

Electrical supply (AC)   3x400V – 63 A

Air supply   min. 7 bar

Internet connection   preferably broadband

Software

The machine-control uses MPN's own-developed software.

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The computers operating sytem is GNU/Linux with matching GPL-software. Therefore you are, as a costumer, entitled to obtain the source code of the software that is licensed under GPL. If requested MPN A/S can provide the source code for the GPL'ed parts of the system. Look at http://www.gnu.org/copyleft/gpl.html for terms, conditions and rights that applies to the GPL licensed part of the software.

The source code for the GPL licensed part of the system can also be retrieved from the Internet:

Linux kernel 2.6.17:   http://www.kernel.org

glibc 2.3.5:   http://www.gnu.org/software/libc/libc.html

BusyBox 1.01:   http://www.busybox.net/

DropBear 0.46:   http://freshmeat.net/projects/dropbear/

SDL 1.2.9:   http://www.libsdl.org