Machine and Robot in Harmony

RPS: Quick run

Trio Motion Technology

Trio Robotics Series

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Trio Programming Guides are designed to aid learning of the TrioBASIC language through description and examples. Each one will cover a particular topic and discuss which commands and parameters in the TrioBASIC are required to complete the task.

A general understanding of TrioBASIC is required and it is recommended to attend an introduction to TrioBASIC training course. The programming guides are not a replacement for the TrioBASIC help files which can be found in *Motion* Perfect as well as the manual which cover each command and parameter in more detail and should be referenced when required.

Any examples given in the programming guide will work and have been tested on an isolated controller. If you choose to use these examples on a machine please take care that it will not cause damage or injury and that they are correctly included in the project changing parameters and values where required.

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SAFETY WARNING

During the installation or use of a control system, users of Trio products must ensure there is no possibility of injury to any person, or damage to machinery.

Control systems, especially during installation, can malfunction or behave unexpectedly.

Bearing this in mind, users must ensure that even in the event of a malfunction or unexpected behaviour the safety of an operator or programmer is never compromised.

This document uses the following icons for your reference:

Information that relates to safety issues and critical software information.

Information to highlight key features or methods.

Useful tips and techniques.

Example programs.

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1 Setting up 3D Visualisation

To visualise the robot, open the 3D Visualisation tool by clicking on this icon. The following window will open.

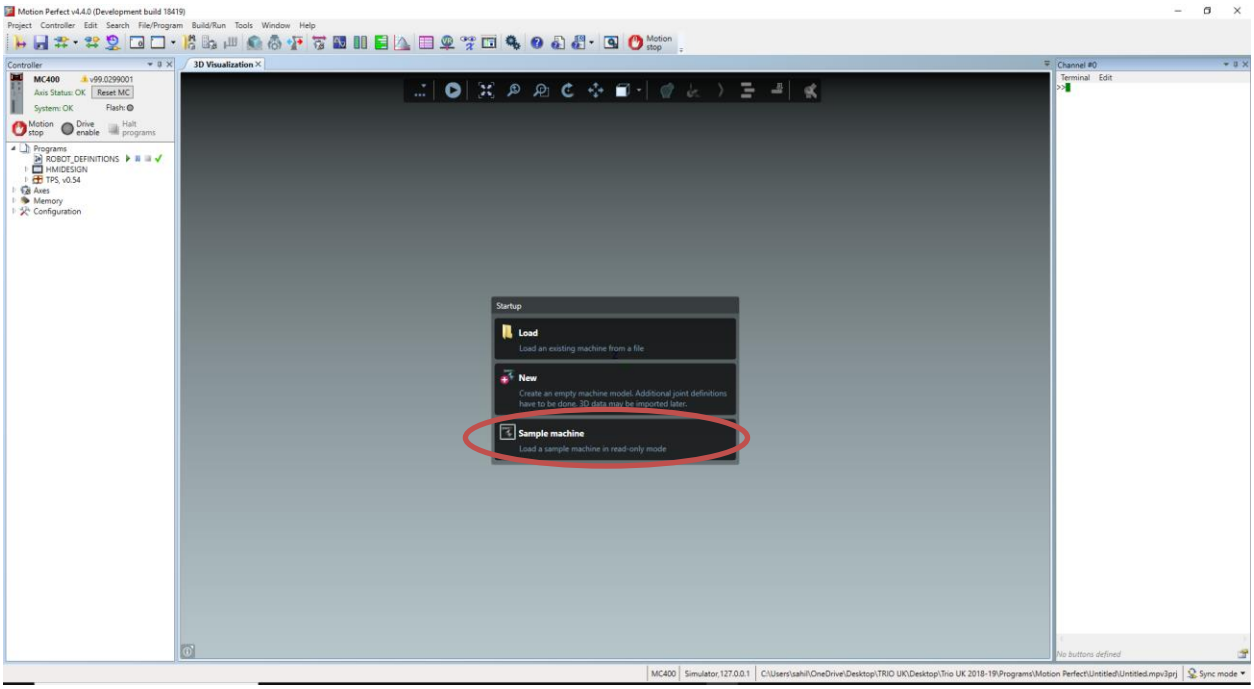


Figure 1. 3D Visualisation Tool

Click on '*Sample Machine*' and select a Robot. In this example a SCARA robot is selected.

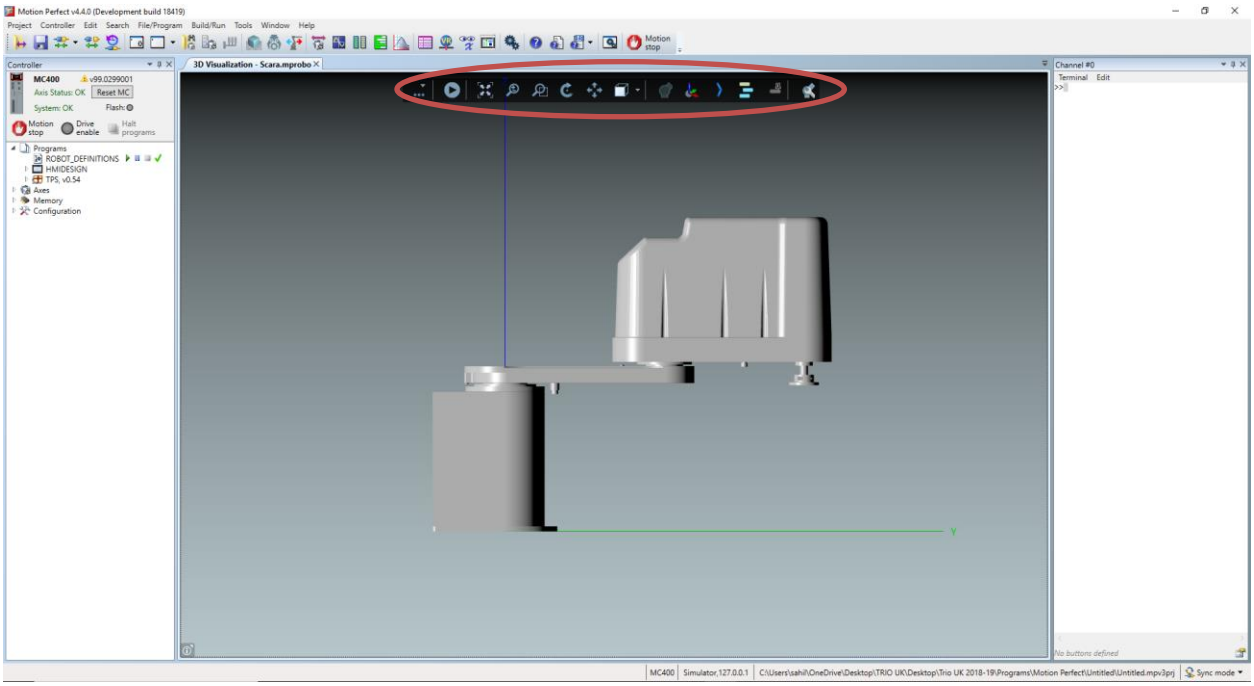


Figure 2. Setting up 3D tool

Click on the '*Display Joint Labels*' icon. Users can also click on the '*Align and Pin Labels*' button to align the labels. Users can also click on '*Display Joint Positions*' button to see where the joint is positioned. Users can also click on the '*X-Ray view*' button to see an X-Ray view of the model.

To navigate the 3D model using a mouse, a right click will pan the model, a left click will rotate the model and the scroll wheel will Zoom in/out the model.

Users can also click on the '*Display Joint Hierarchy*' button to see the joint hierarchy and the label assignment to joint.

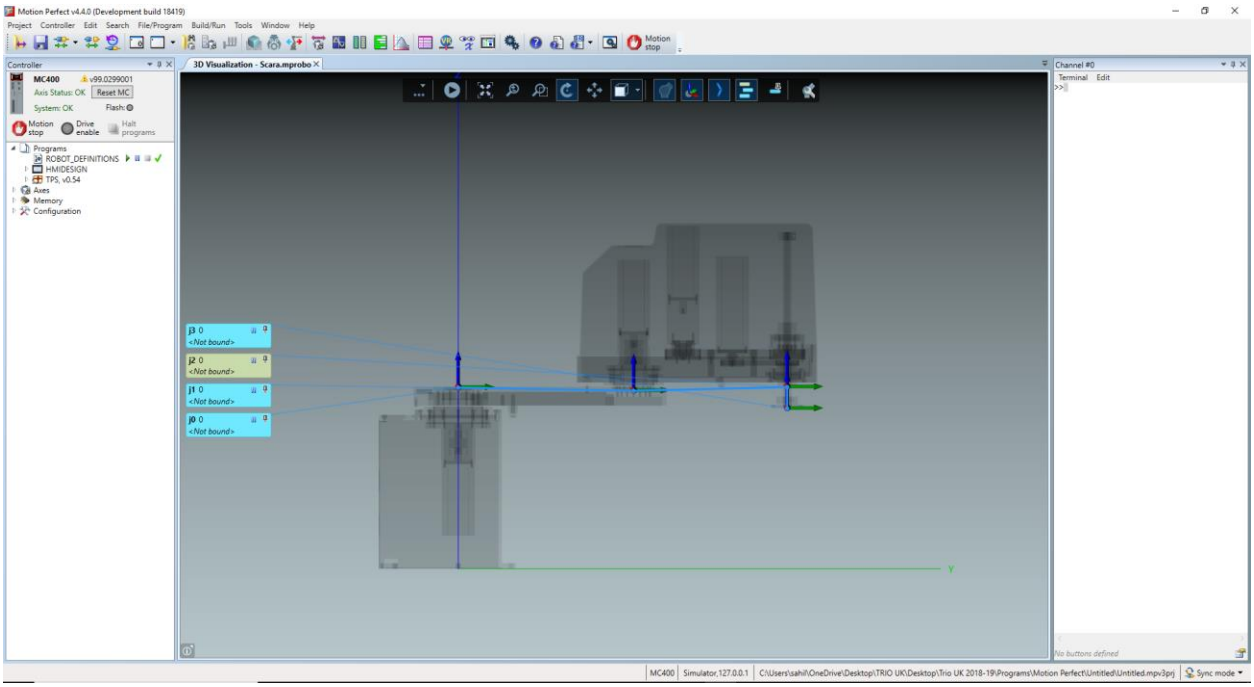


Figure 3. Setting up 3D tool

To assign joints to axes, click on the joint label '*<Not Bound>*' area. Select the axis that the joint.

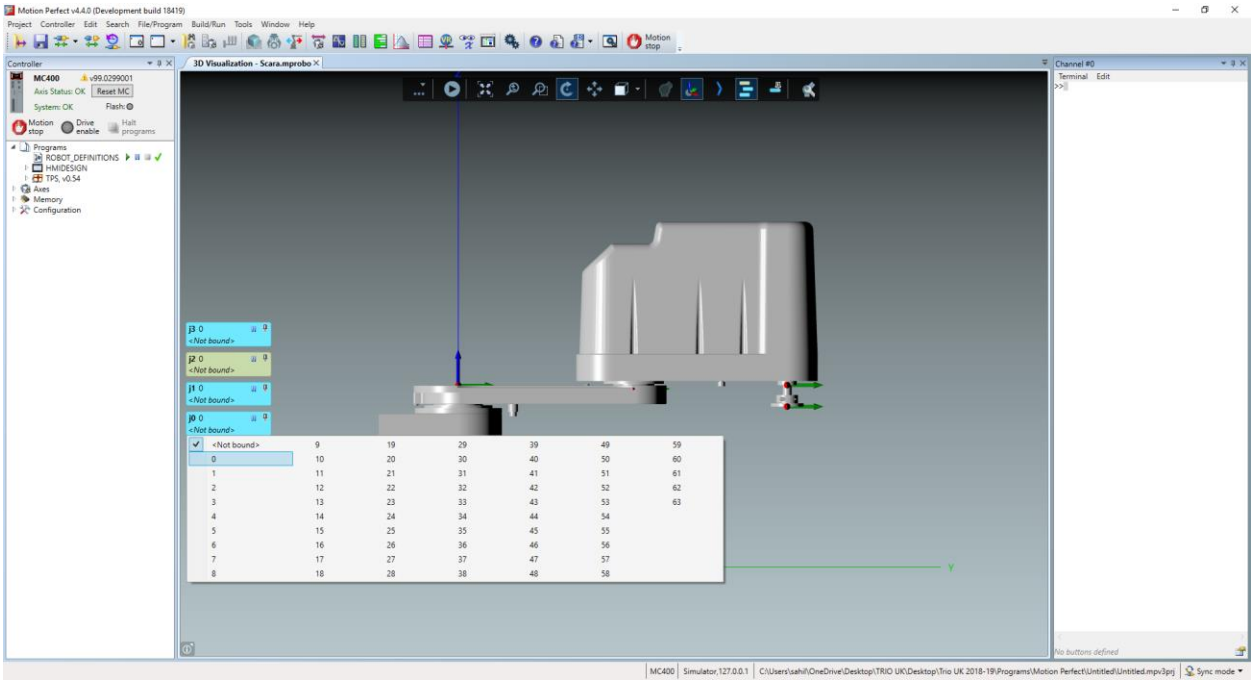


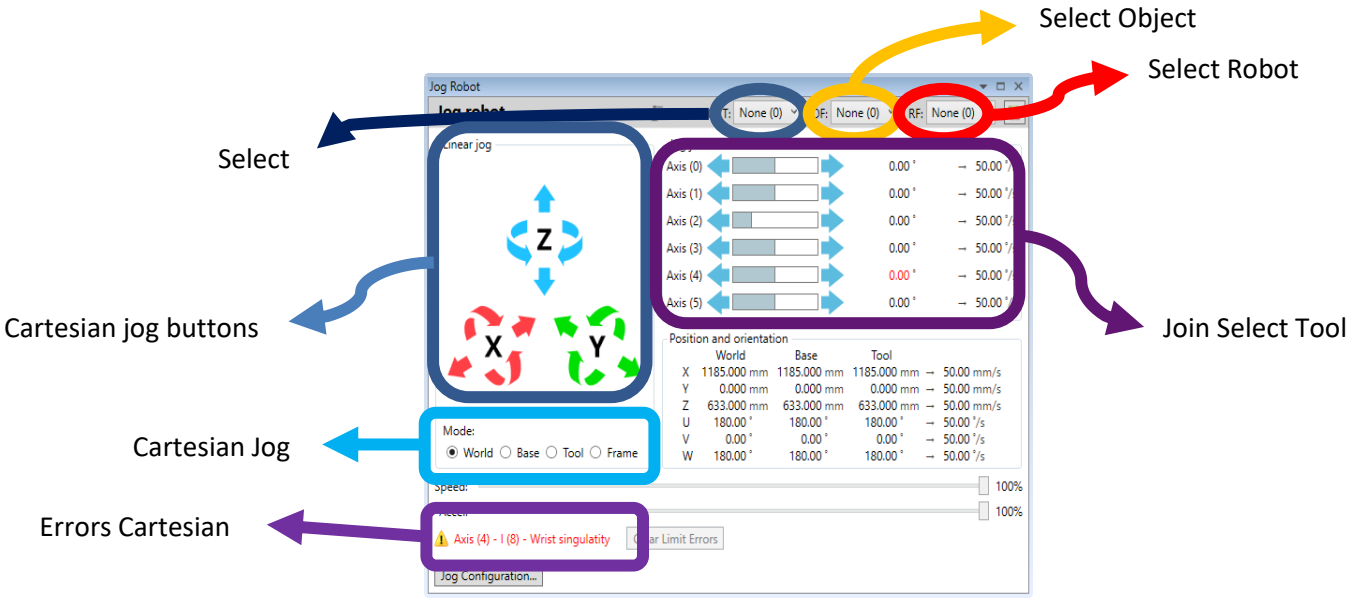
Figure 4. Assigning joints to axes

The 3D tool is now setup. Click on the '*Start Simulation*' button .

2 How jog a robot

The Jog Tool allows users to jog the robot in different modes, as well as select the different existing tools, object frames and robot frames.

To jog a robot, open the '*Jog Robot*' tool by clicking on icon.



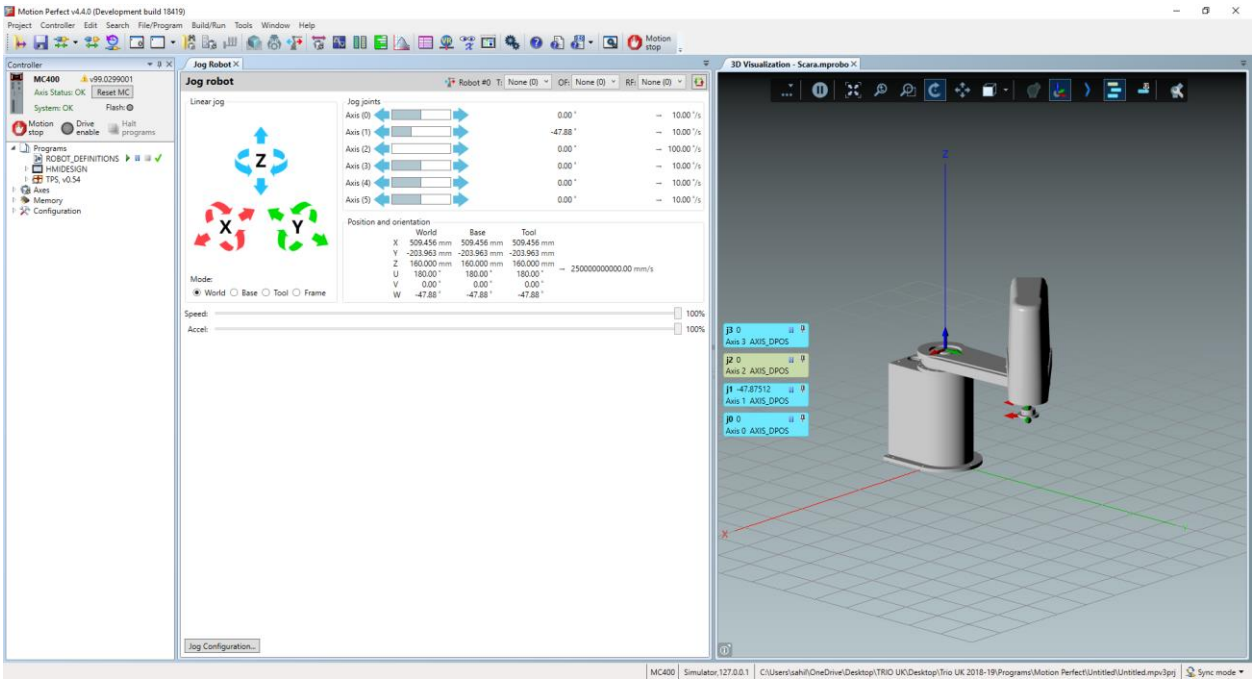


Figure 5. Opening jog tool

The robot can now be jogged in cartesian and joint modes.

3 How to write a program

3.1 Teaching Points using Motion Perfect

To teach points, object frames, Tool offset and more, open the '*Robot Tool*' buy clicking on this icon OR by clicking on Tools >> Robot Tool.

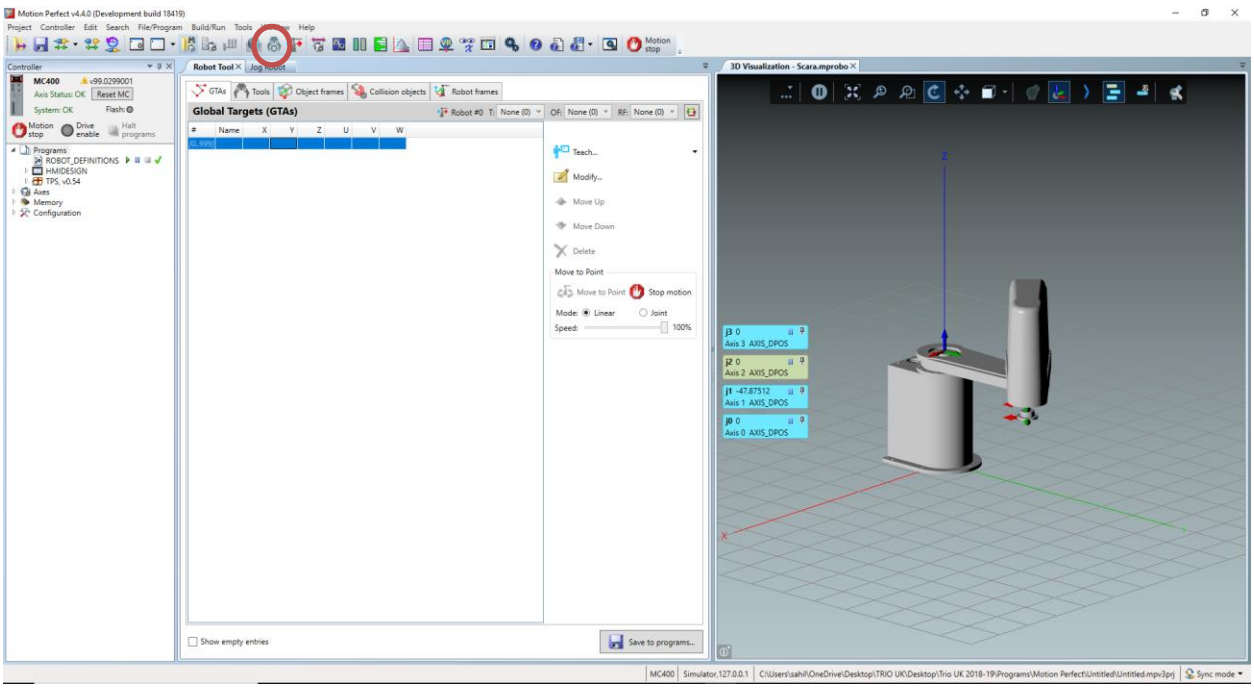


Figure 6. Opening Robot Tool

To teach a point, click on the highlighted 'Teach' button.

Jog the robot to the desired position and click on the '*Teach Point*' button.

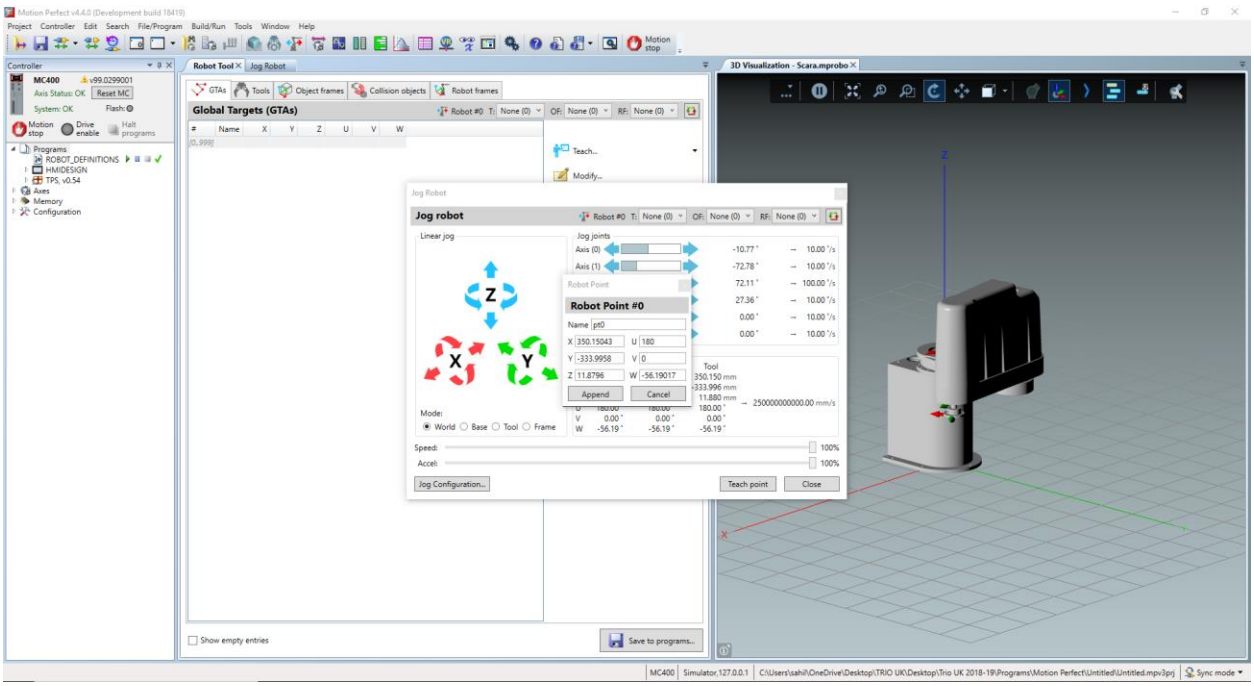


Figure 7. Teach points using Robot Tool

Click on '*Append*' to create a GTA (Global Target Array) to save the point.

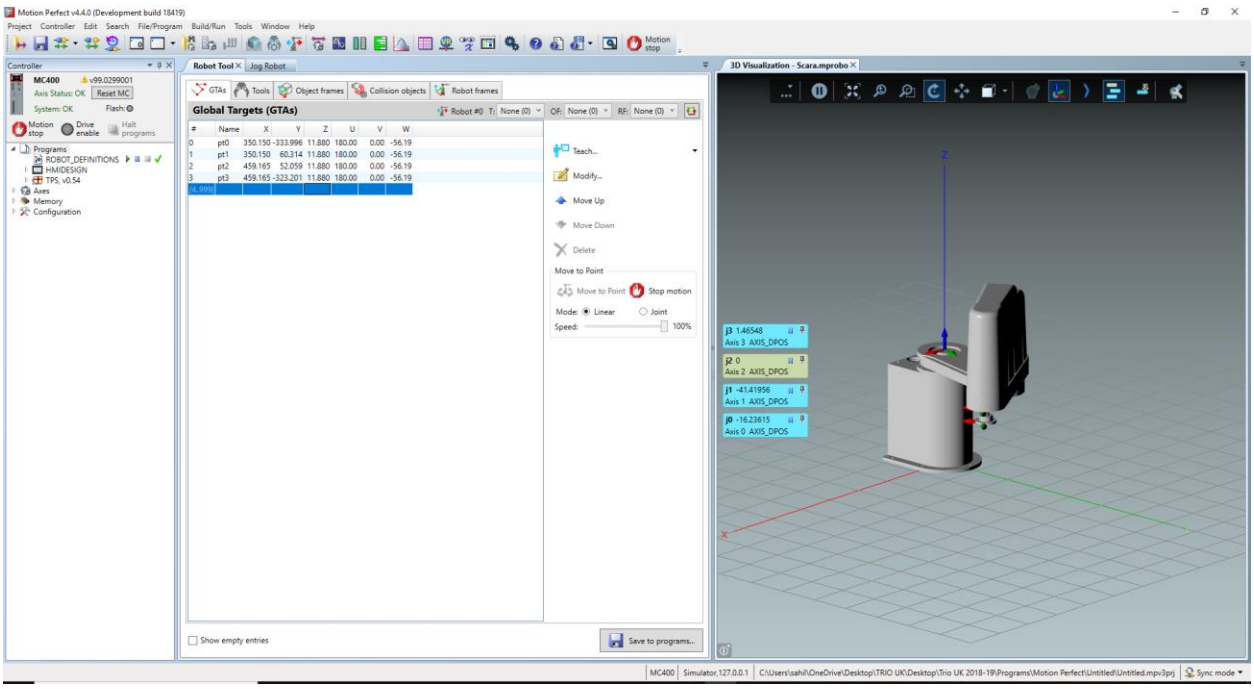


Figure 8. Teach points using Robot Tool

3.2 Writing a program using Motion Perfect

Create a new Robot/Robot Basic program by right clicking on '*Programs*' in the project tree.

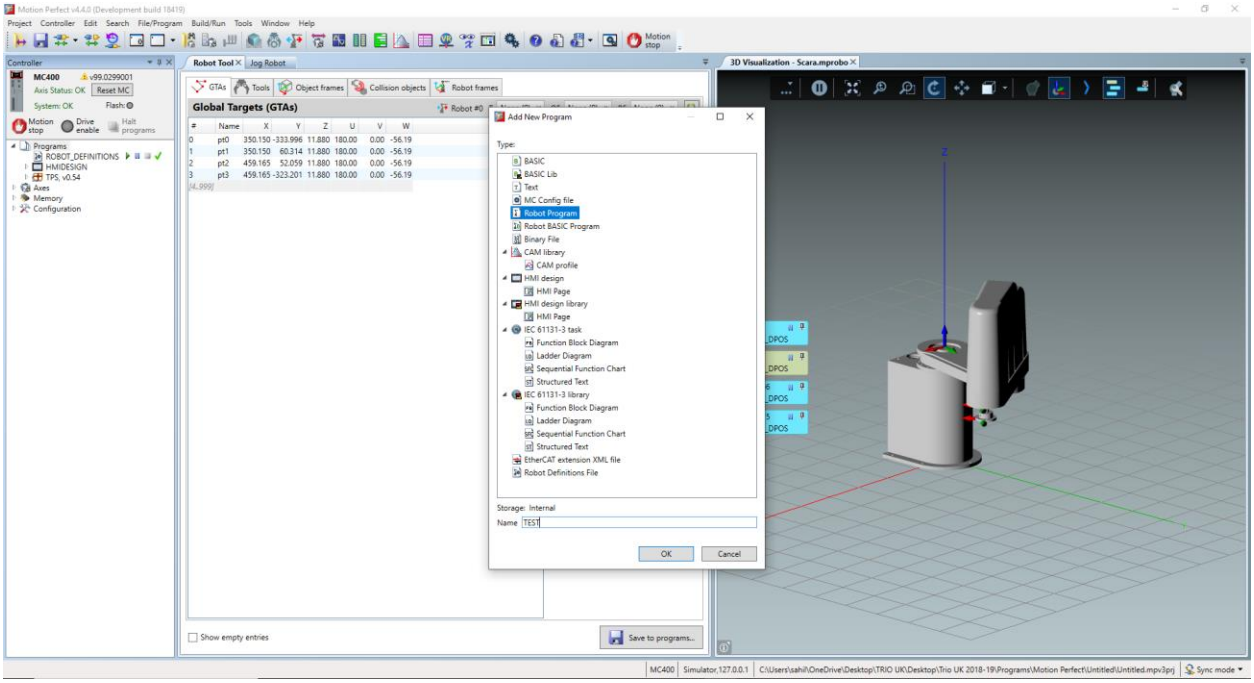


Figure 9. Create a new Robot Program

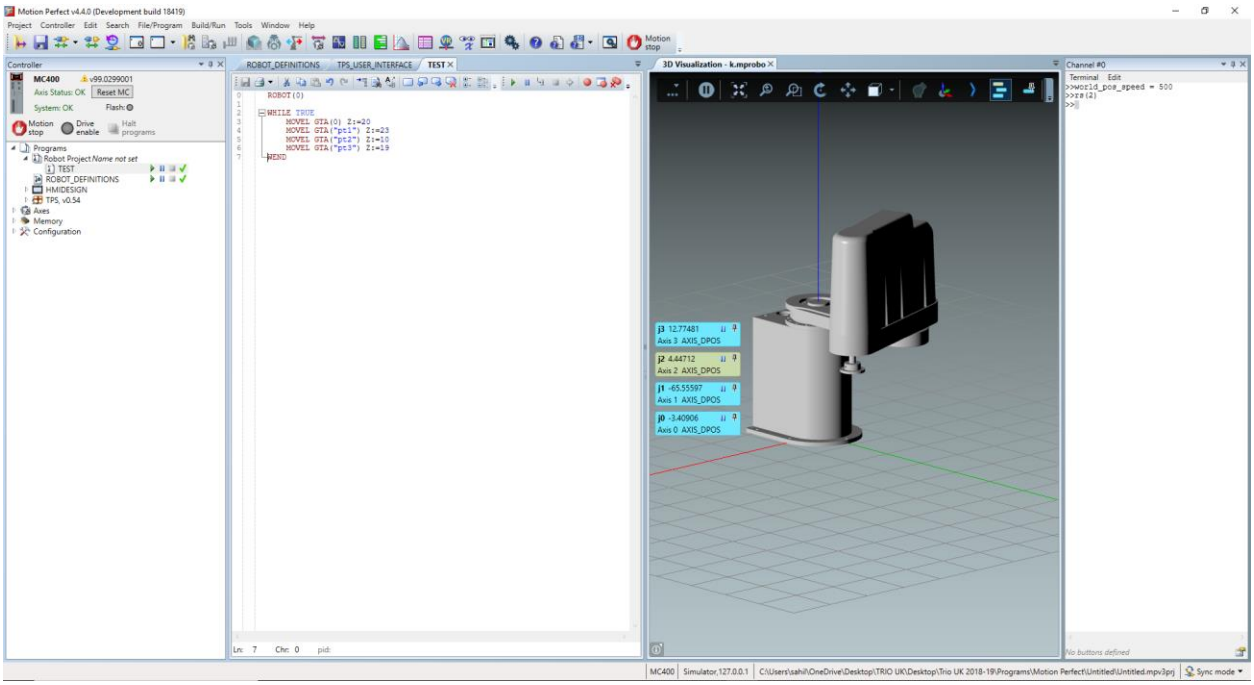


Figure 10. Writing a Robot Program

The example program is explained in Section 4.5.

3.3 Teaching Points using Teach Pendant

Teach Pendant contains a set of safety components by which the different modes and safety functions can be selected.

Please, refer to section 5 Safety components to know how to change system modes (manual, auto and disable modes), emergency stop and enable switch work before continue with this section.

Open the GTA page by clicking on the '*Menu*' button >> GTAs.

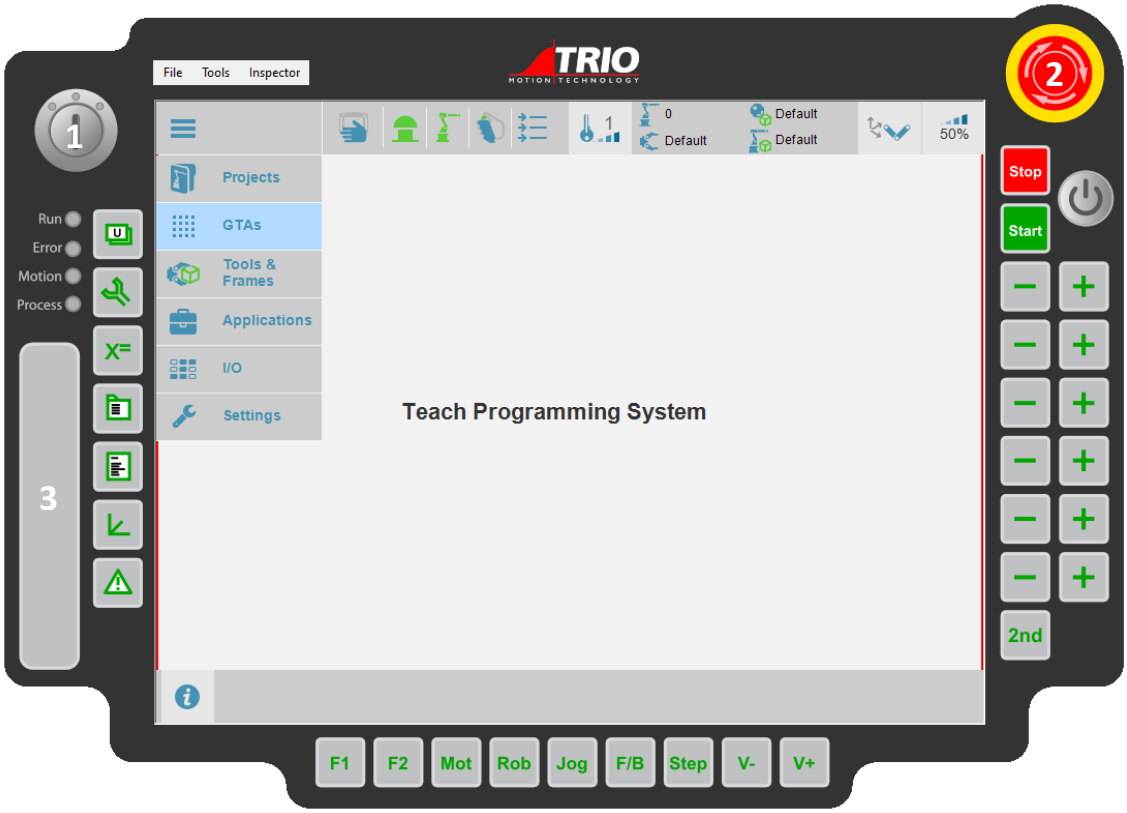


Figure 11. Opening GTAs page

Users can Teach a point by clicking on the Teach icon .

The robot has to be jogged to a desired position before Teach button is pressed.

To jog a robot from the teach pendant the follows requirements must be met:

1) The Pendant must be in Manual mode, .

2) Emergency Stop should be released (the input must be ON), .

3) Enable switch must be ON, .

Jogging is only permitted in Manual mode.

For a real Teach Pendant, the demand button must be held pressed.

Figure 12. GTAs Page

3.4 Creating a program using Teach Pendant

When working with Teach Pendant, it is necessary to pay attention to which connection mode with the controller is selected.

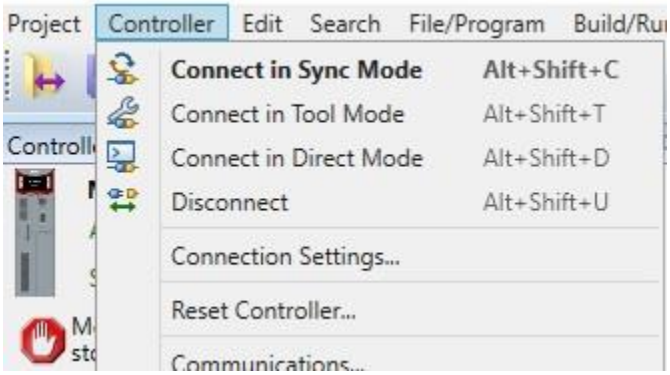


Figure 13. Connection modes

In order to access the project section of the Teach Pendant, Tool Mode or Direct Mode should be selected.

In case sync mode is selected, it is assumed that the user is going to draft the program from Motion Perfect. Hence, the project section in Teach Pendant is unavailable since that information is retrieved from Motion Perfect.

After the correct mode is specified, a New program from the project editor can be created by opening the Menu, click on Projects >> Editor.

Figure 14. Opening Project Editor

Click on the '*List programs*' icon and click on '*New*' to create a new program.

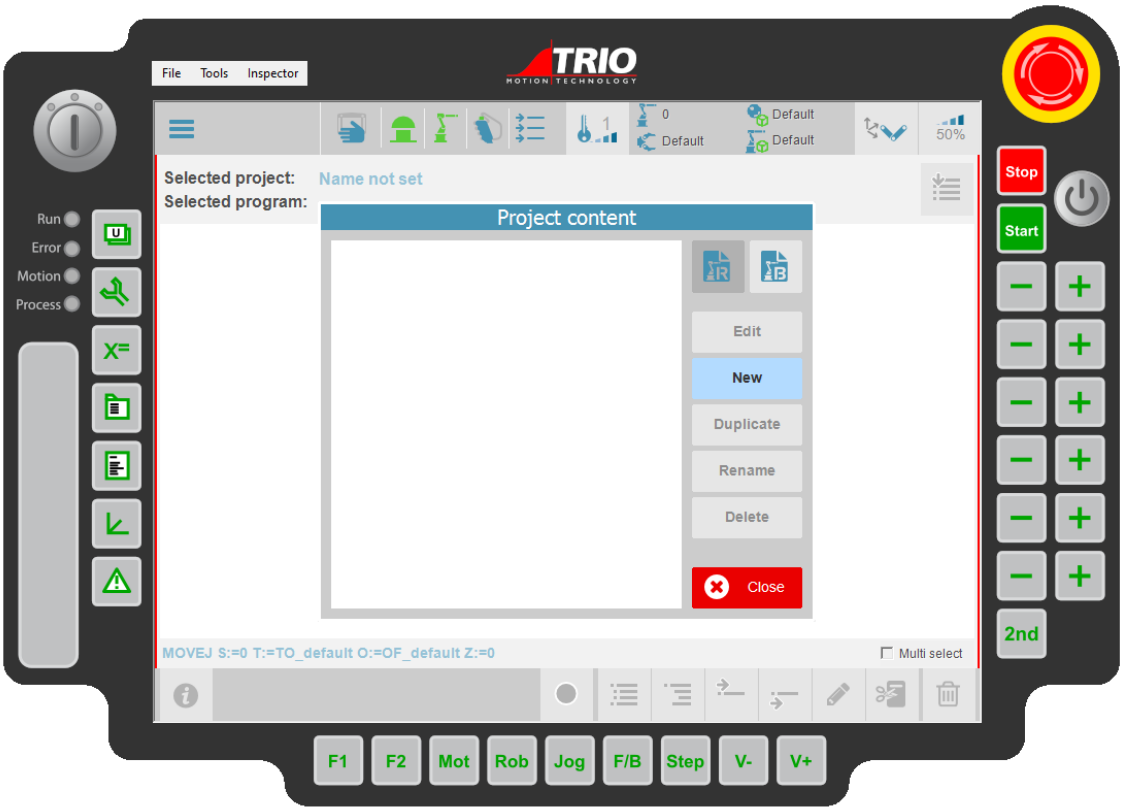


Figure 15. Creating a new program

Name the program and click on '*Apply*'. Once the program is created, users can add commands to the program now.

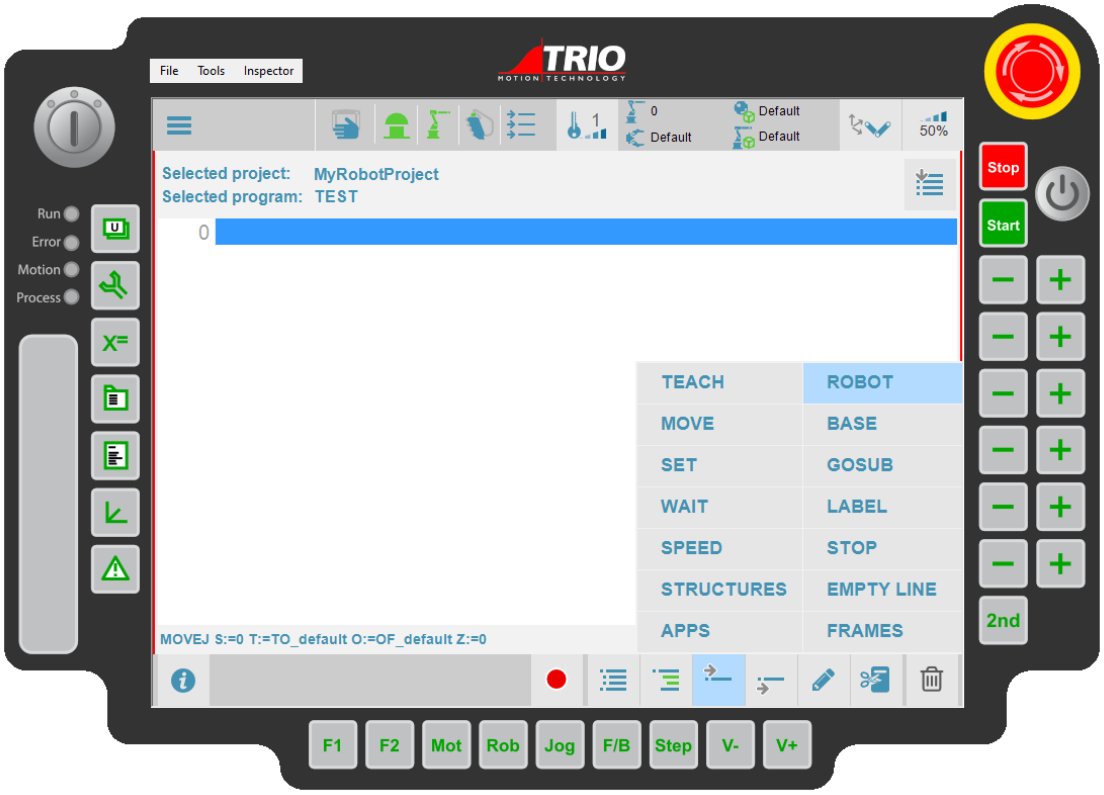


Figure 16. Adding commands to a program

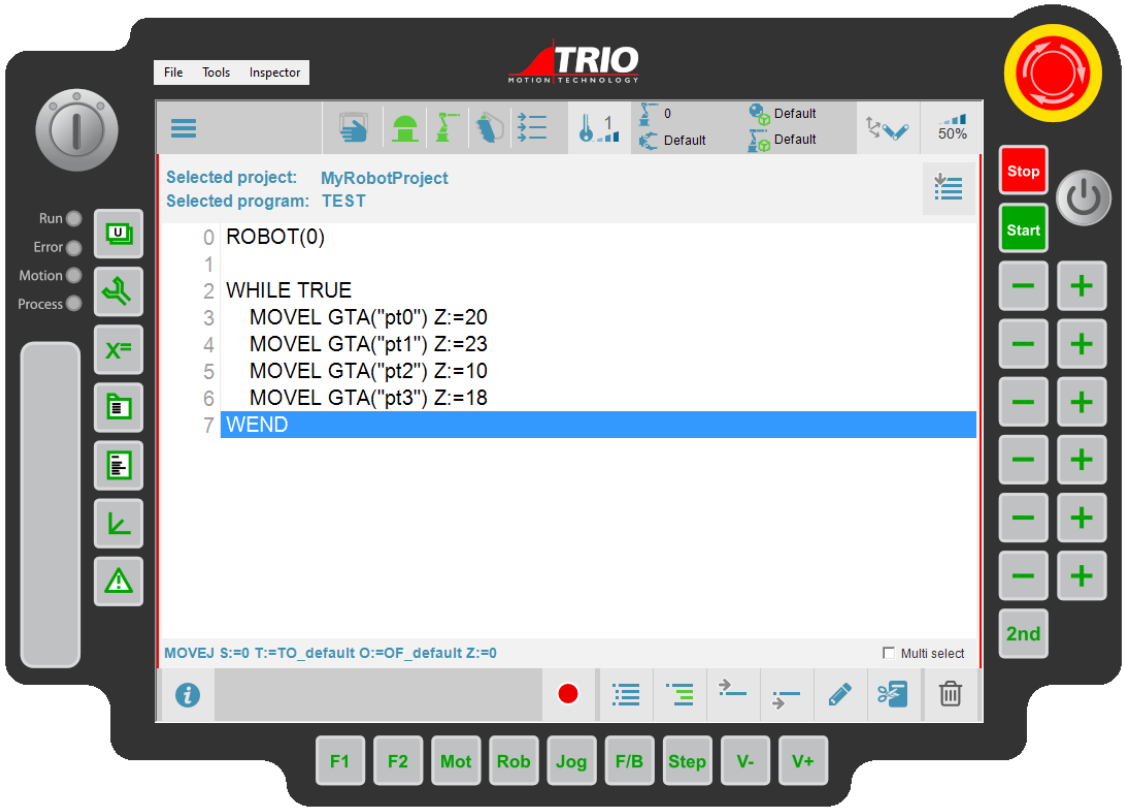


Figure 17. Program in Teach Pendant

3.5 Explantion of example program

The example program is as follows:

```
ROBOT(0)

WHILE TRUE
    MOVEL GTA(0) Z:=20
    MOVEL GTA("pt1") Z:=23
    MOVEL GTA("pt2") Z:=10
    MOVEL GTA("pt3") Z:=19
WEND
```

The first instruction ROBOT(0) selects Robot number 0 (This is the same a kinematic_group number).

The next instruction is a While loop which repeats forever.

The instruction MOVEL GTA(0) Z:=20 commands a linear move to GTA number 0 with the blend radius 20mm.

The instruction MOVEL GTA("pt1") Z:=23 commands a linear move to GTA with the name “pt1” with the blend radius of 23mm.

The different between the first and the second move is the GTA parameter. In the first move, an index is passed while the GTA name is passed in the second move. It is generally recommended to use GTA names as each name is unique and independent of GTA number.

4 Program state manipulation

4.1 Running from Teach Pendant

The program state can be changed by the start

and stop

keys.

Once a program is created, it could be started in different modes depending on how the start button is operated, the selected execution mode and the selected TPS mode.

TPS can be in Manual mode or Auto mode.

- If the system is in Manual mode then the demand switch has to be enabled, otherwise the system will prompt an error if intended to run a program.
- If the system is in Auto mode, MOT button

should be pressed to enable the system.

Once the system is enabled, a drive enable status icon will be depicted in green. Otherwise it will be red.

The following table describes the program execution behaviour:

TPS mode	Program execution behaviour
Manual	**Step mode**: program will step one line when the button is pressed and, if the instruction has not been completed, stopped when released. If the instruction has finished before release start button then the program will remain paused until stop button is pressed. **Continuous mode**: program will start running when the button pressed and hold, and will pause when released. The program will stop when stop button is pressed.
Auto	**Step mode**: program will step one line when start button is pressed, no matter when the button is released. **Continuous mode**: program will start running when start button pressed and it will stop when stop button is pressed.

To change the operation mode, step button

has to be pressed to toggle between step mode and continuous mode .

This section is only applicable to TPS. The program execution behaviour will be the same if it is performed through Motion Perfect and TPS package is installed in the system.

For a no TPS package system please, refer to the next setion.

4.2 Running from Motion Perfect

In the case of a system without Teach Pendant (no TPS package in the system), Motion Perfect program state buttons should be used to manipulate the program status.

Please, make sure TPS package is not in the system. If it is no TPS programs can be running and no TPS settings persist in the system making a fresh re-start of the controller.

5 Safety components

This section describes safety components and procedures to be used when the Teach Programming System is operated.

However, it does not cover how to design for safety nor how to install safety related equipment.

5.1.1 E-Stop

An emergency stop is a state that overrides any other robot control, disconnects drive power from the robot's motors, stops all moving parts and disconnects power from any potentially dangerous functions controlled by the robot system.

An emergency stop state means that all power is disconnected from the robot except for the manual brake release circuits.

The E-Stop button can be found in the upper right corner of both real and virtual teach pendant and it has the following outlook:

Figure 2-5: E-Stop real Teach Pendant

Figure 2-6: E-Stop virtual Teach Pendant

It must be performed a recovery procedure in order to return to normal operation.

The recovery procedure is triggered through the input "Error Reset".

5.1.2 Demand switch

Demand switch component is an enabling device, manually operated constant pressure three position push-button. The Teach Pendant is equipped with two demand switches, positioned at the left and right back side of the device, allowing for a left and right-handed operation.

The demand switch can be found at the back of the real Teach Pendant and at the front left side of the virtual one with the following outlook:

Figure 2-7: Demand switch real Teach Pendant

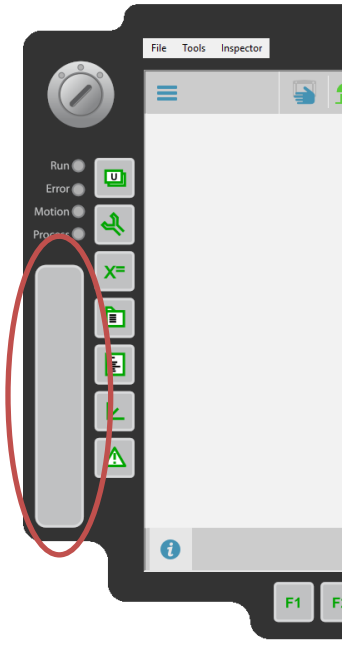


Figure 2-8: Demand switch virtual Teach Pendant

The demand switches can be in the following three positions:

Position	Function	Demand switch	Contacts
1	Home position	Is not pressed	Enabling output are open
2	Enabling	Is pressed	Enabling output are close
3	Panic	Is pressed strong	Enabling output are open

The Teach Pendant should be hold by the operator in a comfortable position, where demand switch can be pressed with one hand while programming or operating the keypad with the other hand.

A recommended way of holding it could be as the following picture:

Figure 2-9: Demand switch pressed

When demand switch is in enabling function, the system is in active status and the motors are powered, allowing for movement through different functions but not initiating them. In any other position, the motors will not be powered and the system will be safely stopped.

This component will enable the device only in manual mode. In auto mode Demand switch component is disabled and MOT button should be pressed to enable the system.

5.1.3 Key switch

There are three different modes where the system can be:

- **Manual**: to operate the system, demand switch must be enabled. The maximum speed will be set as WORLD_POS_REDUCED_SPEED and WORLD_ORI_REDUCED_SPEED, set by the system integrator.
- **Auto**: in this case demand switch will be disabled and MOT button

should be pressed to enable the system.
- **Disable**: Teach Pendant cannot be operated.

Three contacts key switch gives the possibility of changing between those three different modes secured with its physical key.

The Key switch can be found in the upper left corner of both real and virtual teach pendant and it has the following outlook:

Figure 2-10: Key switch real Teach Pendant

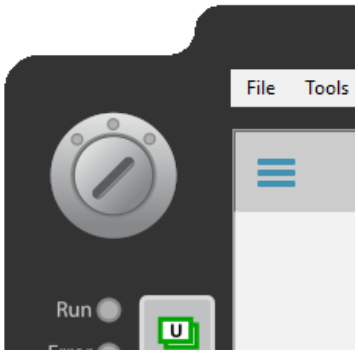


Figure 2-11: Key switch virtual Teach Pendant