

MCST3601 – Reference Search

Introduction

Because stepper motors are often used in positioning application, reference search is an essential feature offered by the MCST3601 controller for many users. The reference search function allows a full homing procedure to be automatically executed by the board on startup. When identified, the origin point can be used for absolute positioning and 3 axis coordinates management.

Reference search operating principle

Depending on the positioning system design, the origin identification can be performed through one or several electrical switches, light barriers or any detection method. The MCST3601 reference search feature is highly configurable and able to manage most of the existing detection technologies:

- Physically, voltages and I/O can be setup to allow pull-up/down implementation, ON/OFF states definitions, etc.
- Through software, which offers functions for most of the existing homing sequences (one switch, dual switches with origin on left side / right sides / middle, etc.), with speed / current setup and switch release parameters.

The homing parameters set by user are stored in the MCST3601 ROM. The right homing sequence is therefore automatically executed on each startup.

Reference search parametrization

1. Reference switches setup

Three reference and home switch inputs are available on the MCST3601 controller: REF_L / REF_R and HOME.

All three reference and home switch inputs offer the same input circuit with voltage resistor dividers, limiting diodes against over- and under-voltage and programmable 1k pull-ups to +5V. The programmable pull-ups can be switched on or off together for all three inputs.

The following diagram shows a simplified view of a reference switch input of the MCST3601 controller:

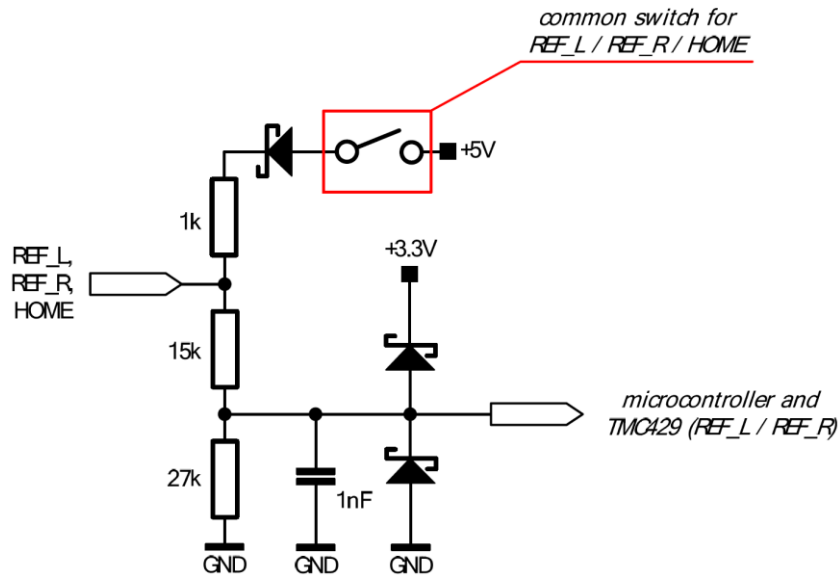


Figure 1: Reference switch input simplified diagram

According to the switches properties, the inputs can be setup with different pullup modes, or even ON/OFF states through dedicated functions.

REFERENCE SWITCH ENABLE

The reference switches can be enabled or disabled through dedicated commands. The latter can be either sent using Direct mode interface, or written in the processor code:

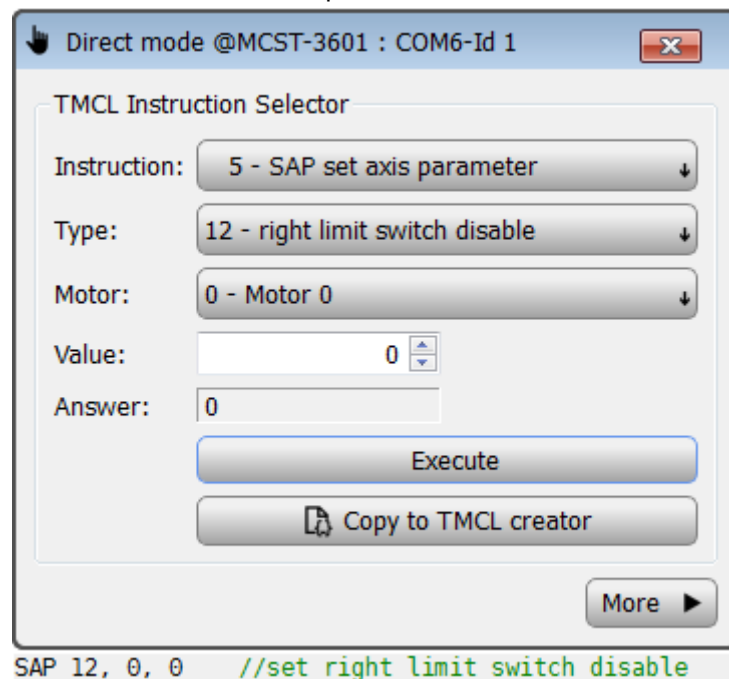


Figure 2: Reference switches disable command

To ensure that the limit switches are enabled, set the “disable” value to zero.

PULLUP MODE

If the used switch is connected to GND for any design reason, or has an open collector electronic, using the internal pullup could be necessary. To activate it, a dedicated command can be sent through Direct mode interface, or written in processor code:

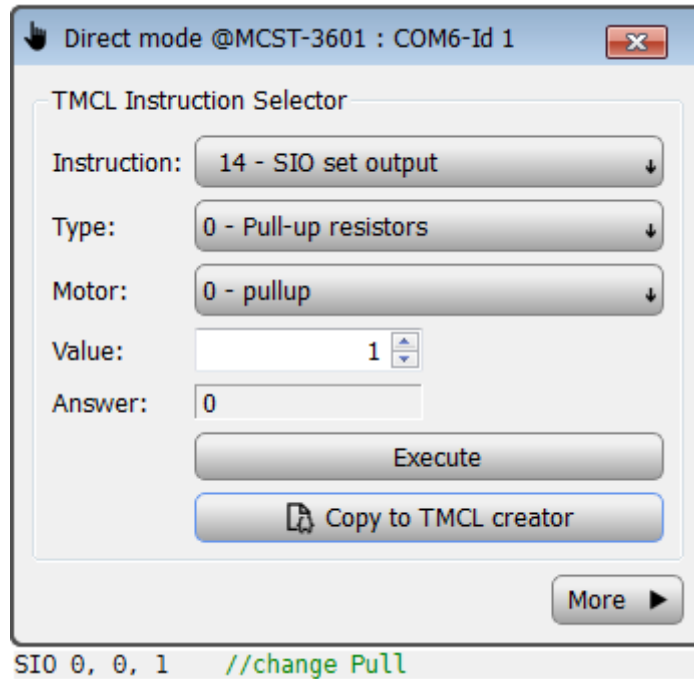


Figure 3: Pullup setup command

SWITCHES 5V SUPPLY ACTIVATION

The MCST3601 controller offers the possibility to share its 5V power supply voltage to the homing switches, through a dedicated output, called “+5V_SW”.

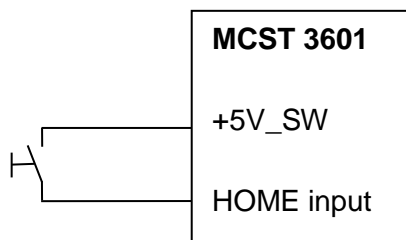


Figure 4: +5V Switch output

The user can control the switches activation through this dedicated 5V output, using an available command that can be sent through Direct mode interface, or written in processor code:

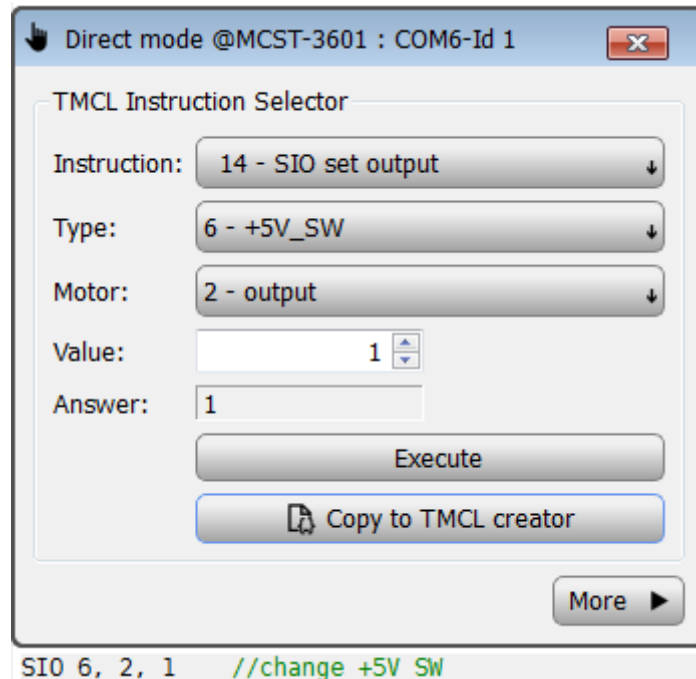


Figure 5: +5V switch output activation command

SWITCHES POLARITY

The limit switch polarity can be inverted by the user, depending on his need. Indeed, according to the electronic design, an ON state of the switch can correspond to either “0” or “1” electrical states. The user can invert the polarity using an available command that can be sent through Direct mode interface, or written in processor code:

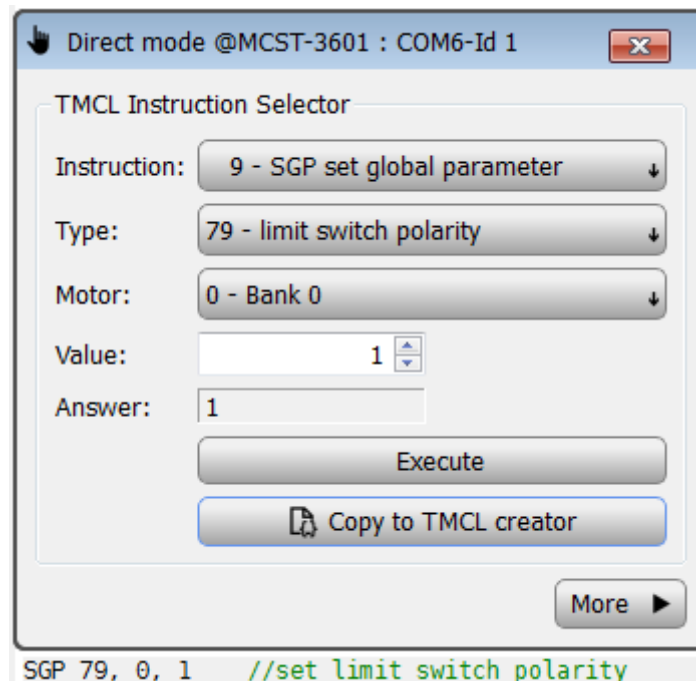


Figure 6: Limit switch polarity inversion command

HOME SWITCHES STATE CHECK

Before using the reference switches, some users may check if they are correctly setup, and if the related inputs react as expected. The I/O monitoring allows checking in real-time the I/O status. It is accessible by left clicking on the MCST-3601 ID number, highlighted in blue in the following screenshot:

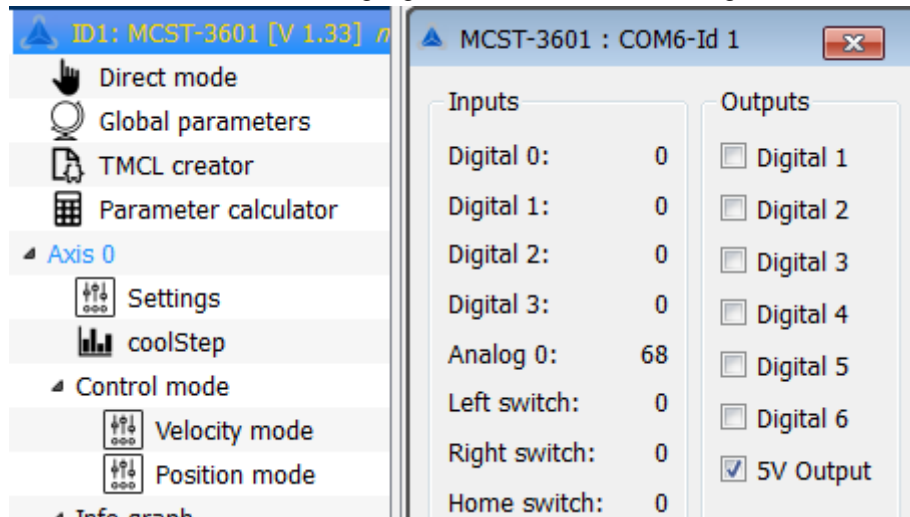


Figure 7: I/O monitoring interface

The 5V switches activation output state can also be monitored and manually activated/deactivated, using this interface, by simply clicking on it.

Using this monitoring feature, the user can manually activate the switches and check the state in the graphical user interface.

2. Homing parameters setup

After setting up the switches I/O, the reference search operation itself can be parametrized. Several parameters allow indeed defining how the homing is performed in terms of trajectory and speed.

REFERENCE SEARCH MODES

Depending on the number of switches that are used, how they react when they are reached, and where the origin has to be defined, several reference search modes are defined from the following parameters:

- Left only / right only / left and right switches search
- Searching sequence (left first / right first)
- Searching direction for each switch (from left / right)

Eight pre-defined different search sequences are stored in the MCST3601 controller, and can be defined by sending dedicated commands through Direct mode interface, or written in processor code:

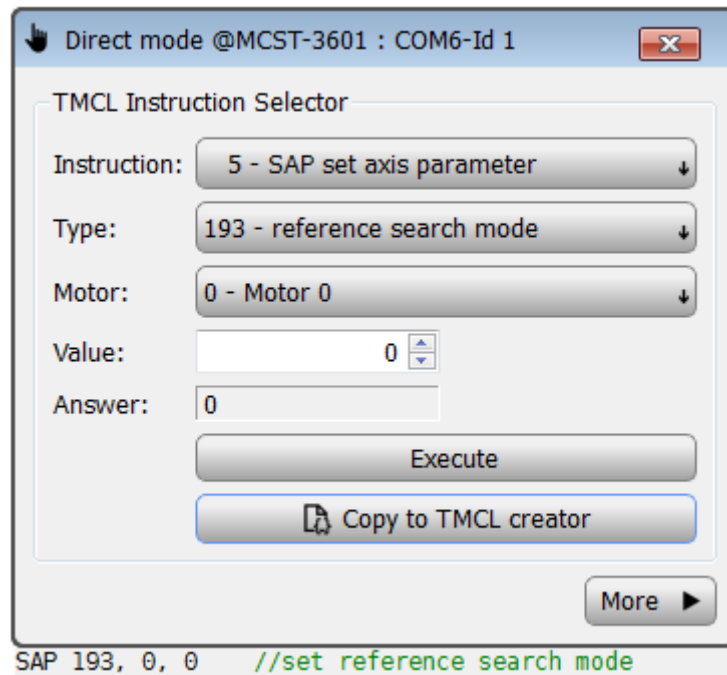


Figure 8: Reference search mode

The 8 available modes are fully described in the MCST3601 TMCL™ Firmware Manual. The following two examples show two available searching sequences:

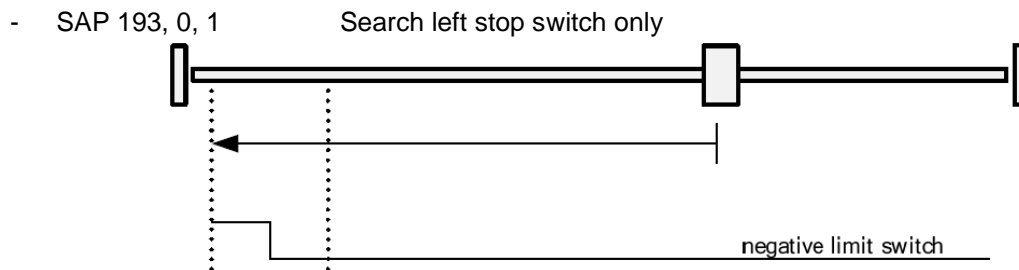


Figure 9: Reference search example: mode 1

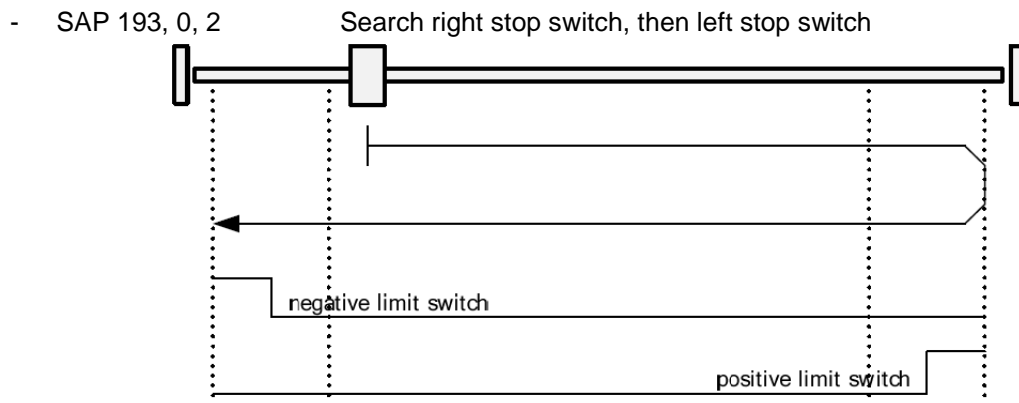


Figure 10: Reference search example: mode 2

REFERENCE SEARCH SPEED

The second parameter to be setup concerns the speed of the motor during reference search. Two values can actually be defined, one concerning the search speed before reaching the switch, and another concerning the speed of the motor during the release of the switch.

Separating both search and release values allows defining a rather high speed during the search process, and a low speed when releasing the switch, to allow a precise identification of the origin position.

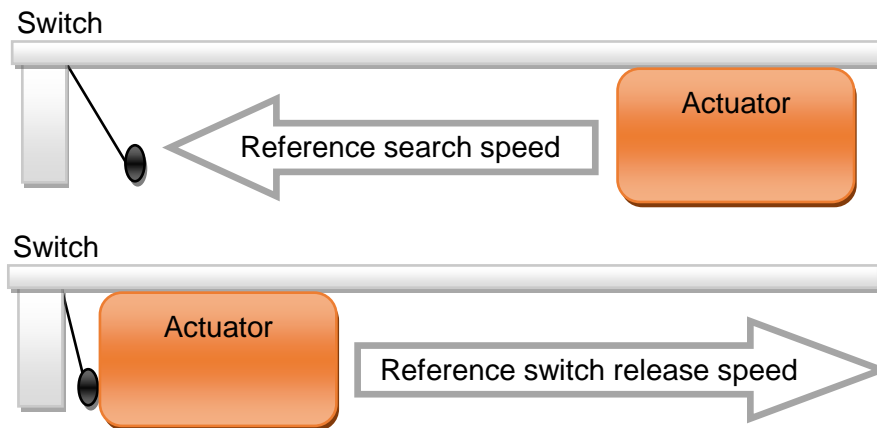


Figure 11: Reference search speed

Both speeds values can be defined by sending dedicated commands through Direct mode interface, or written in processor code:

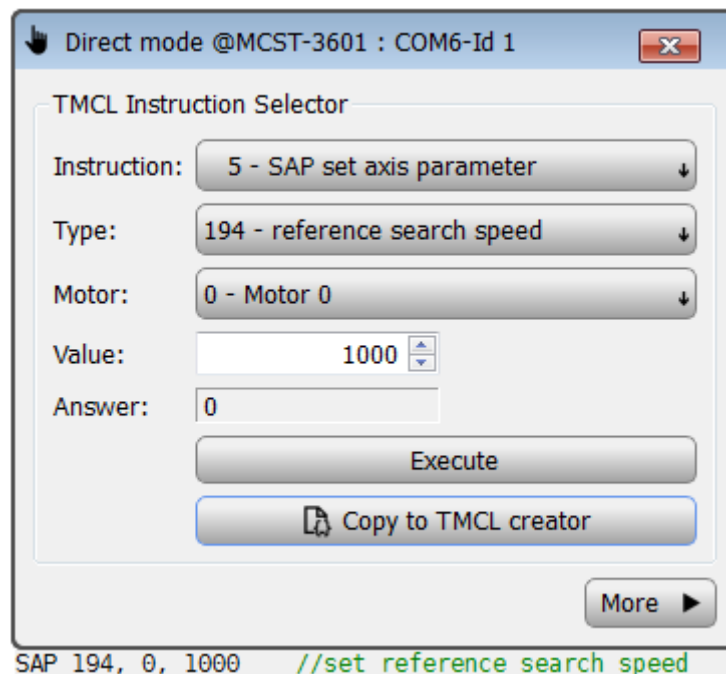


Figure 12: Reference search speed definition command

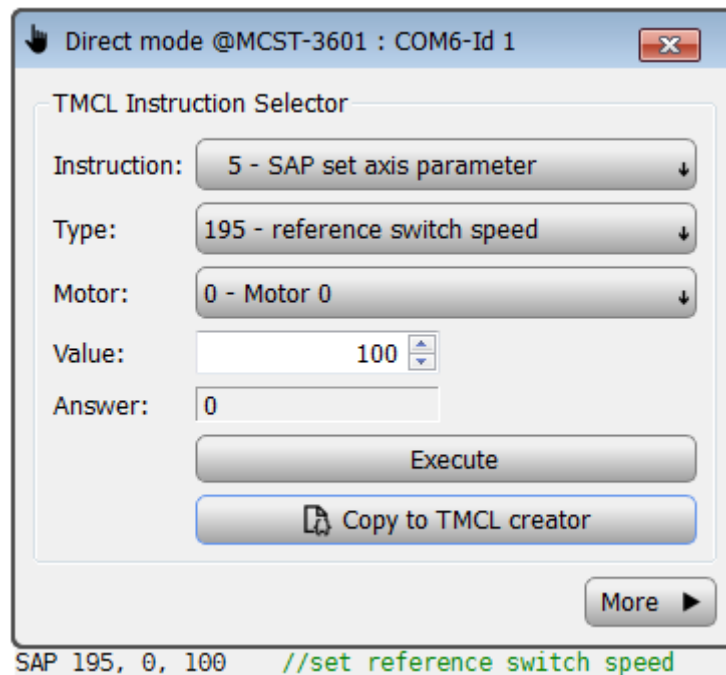


Figure 13: Reference switch release speed definition command

The switch release speed must be estimated considering the fact that the motor must be able to instantaneously stop when the switch state inversion is detected.

Reference search function usage

Once properly setup, the reference search operation can be easily started from a single command. Calling this function will allow, after the homing process execution, defining the complete mono/multi axes coordinates origin(s).

1. Reference search command

The reference search operation can be started by sending dedicated commands through Direct mode interface, or written in processor code:

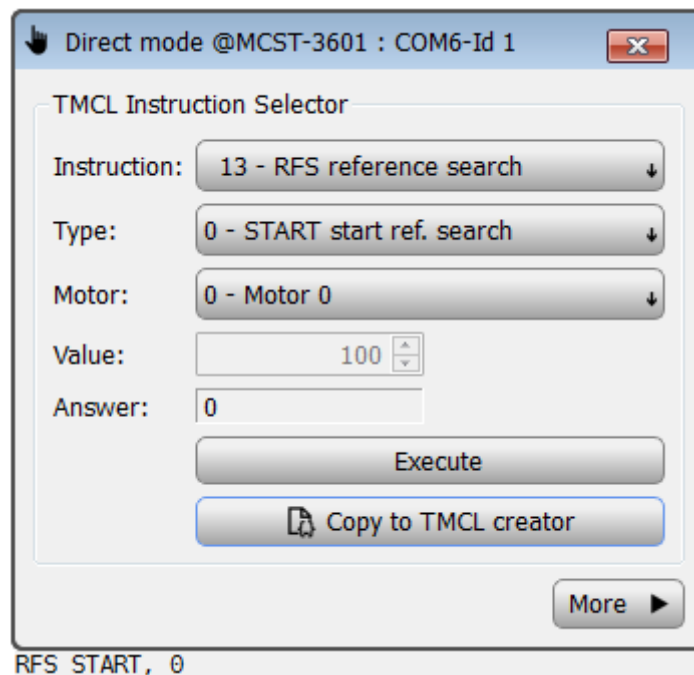


Figure 14: Reference search start command

When called, the RFS function starts the automatic reference search sequence. The latter will run until all the reference switches are reach. To allow managing any eventual failure during homing, a timeout process can also be implemented. The latter is fully described in the following point.

2. Timeout management

To avoid any blocking situation during the homing process, for example due to an unreachable switch, a timeout can be implemented in the embedded code. The timeout allows the automatic call of a defined routine if the homing operation is not finished after a certain time. The user can then define inside the routine how he wants the system to react (activation of an error flag, second try, etc.).

This feature is obviously useful inside a program code only, and cannot be used in direct mode. The code developer will have to activate the timeout after calling the reference search instruction, and define the sub-routine to be called in case of timeout reach.

The following code extract shows an example of a homing function, followed by a timeout activation sequence and sub-routine calling function in case of timeout:

```
RFS START, 0 // Start the homing
WAIT RFS, 0, 10000 // Implement the timeout (t=10000ms)
JC ETO, error_routine // Jump to "error_routine" if the timeout is reach
```

3. Absolute Axes coordinates management

When the reference search is done on each axis used in the application, a mono/multi-dimensional origin is identified, and the system ready to work with absolute coordinates. The absolute position can be used and managed through the axis parameter commands. To check that after homing, the absolute position of the concerned axis is rightly set to zero, the user can use the “get axis parameter” command with actual position parameter:

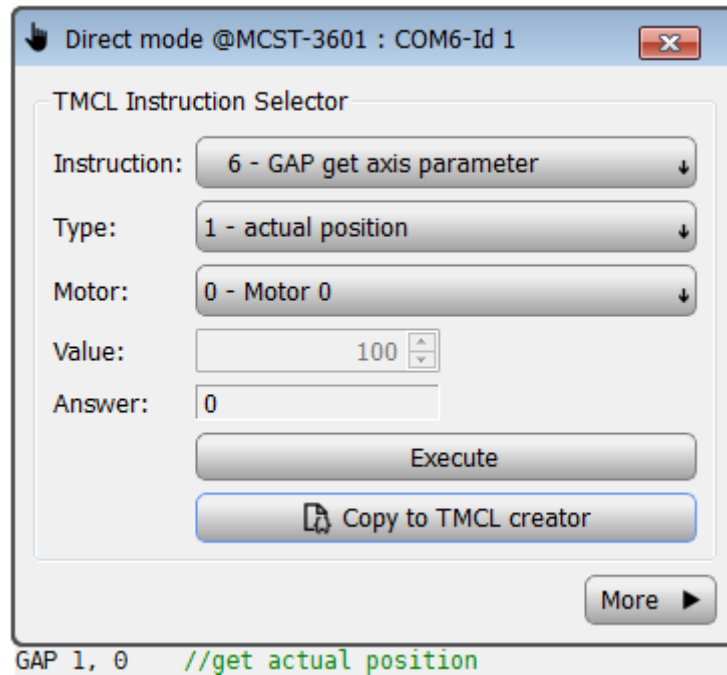


Figure 15: Get position command

The absolute positioning can be done through stored multi-dimensional coordinates. The MCST3601 controller offers a storage capability for 20 different 3D coordinates, which can be defined and used by the system. The program can manage movements to the different absolute coordinates stored in the memory.

The axes value (X, Y, Z) is defined by the motor number (0, 1, 2). For each coordinate, the position of all three motors is stored:

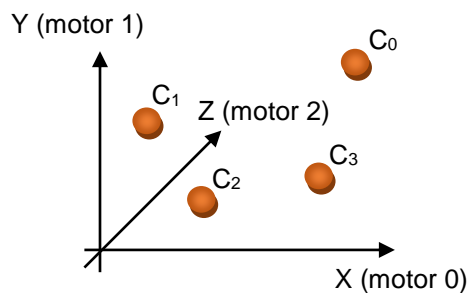


Figure 16: Coordinate system

A wide range of commands are available to control and use coordinate system, like the following two examples, describing respectively the “move to position” command, and the coordinate capture commands. Other functions are available. Refer to the MCST3601 TMCL™ Firmware Manual for more information.

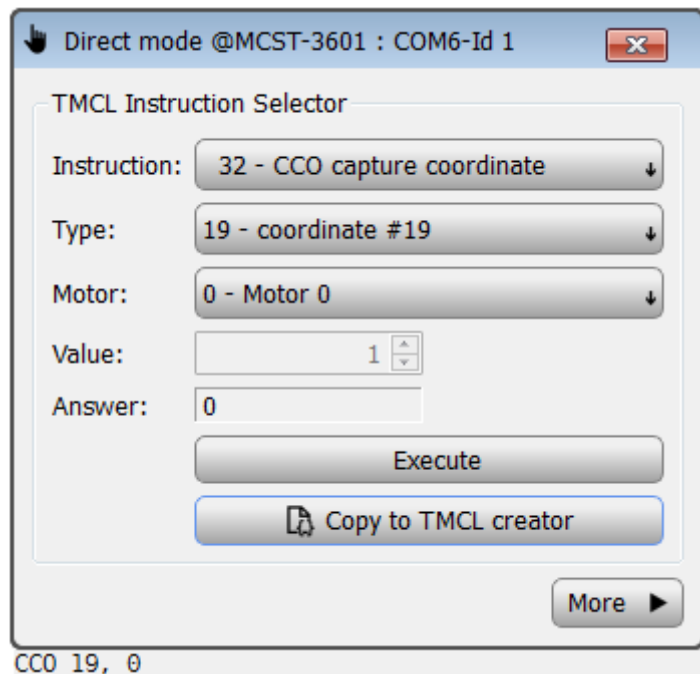
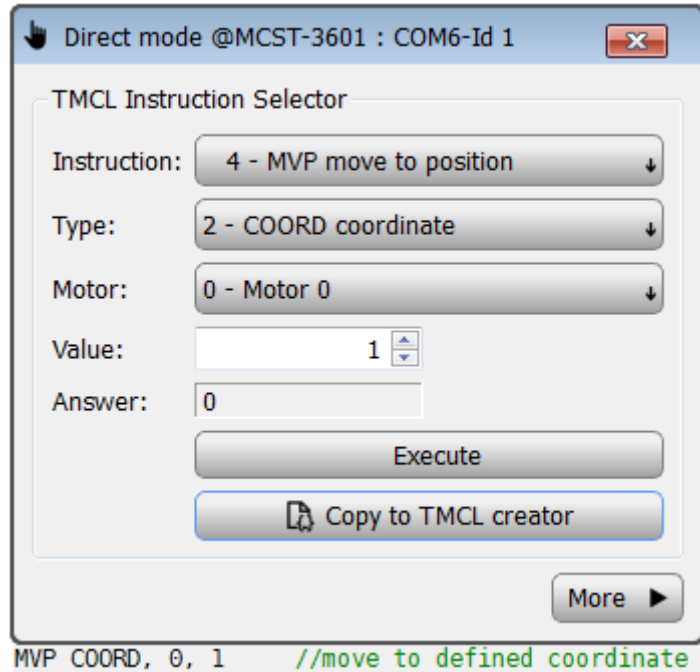


Figure 17: Coordinates management and usage commands examples

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