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Introduction Trinamic Motion Control Language (TMCL)**Date: Sep 10, 2003**

Overview

- 1) TMCL is a command language for the communication of embedded motion control systems with a host computer, normally a PC.
- 2) The TMCL commands can also be stored and executed in the flash memory of the TMC modules. Thus, TMCL is a programming language aswell.
- 3) The instruction set of TMCL is intended to be relatively small. Adding customer specific instructions is easily possible to meet the needs of complex or time critical tasks.

Required Hard- and Software

- 1) A TMC module: M-100, M-300, M-301, M-302, M-303 or M-310
- 2) A base board (except M-310): e.g. the Trinamic TMC-Evaluation Board or a Prototyping Board from Ingenieurbüro Stab.
- 3) Power supply, stepper motor and interface cable
- 4) software „TMCL IDE“: available free of charge e.g. on the Trinamic-website www.trinamic.com (see products/modules, select a module, item „download software“).

Set up the base board according to the manual and install the TMCL-IDE. This program is executable without installation, just run it in a arbitrary folder. See the “TMCL Reference” manual for details. This document is the most important for TMCL and it can also be downloaded from www.trinamic.com.

Starting the TMCL development environment (IDE)

After power-up, a slow flashing of a LED should show on the module. Start the TMCL-IDE and select the item „direct mode“ in the menu „TMCL“.

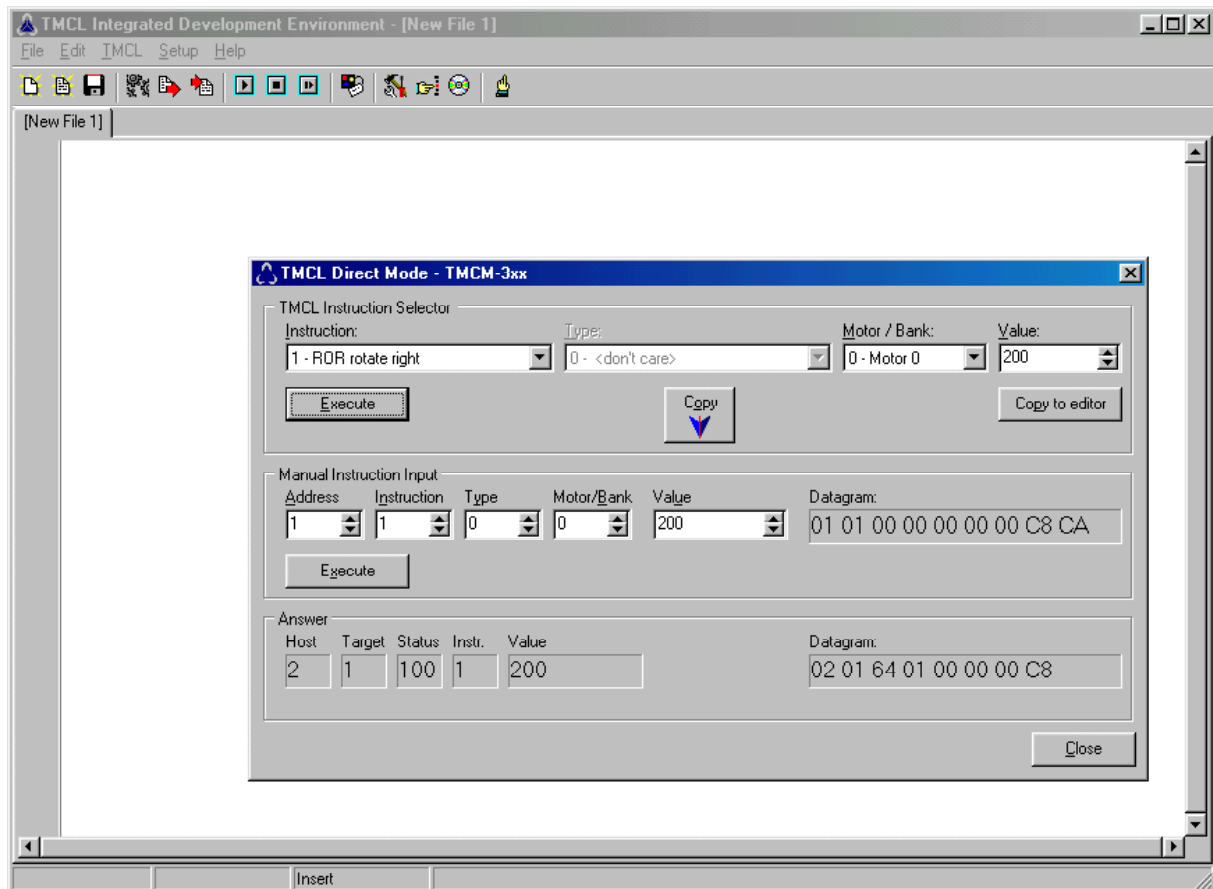


Figure 1: the „direct mode“ for testing of commands

Possible problem: if a pop-up window saying „The module type could not be detected“ appears, no connection to the module could have been established. Please check the number of the serial interface (e.g. COM1/COM2) and the type of cable (straight or crossed). Normally, (module with factory settings) all communications are correctly set: 8N1/9600, no parity, the most common format.

Testing basic commands and settings

Start off by testing the instruction „rotate right“: enter a value between 1 and 2047 in the „Value“ box. With the upper „Execute“ button the command gets sent directly.

The motor with the index 0 (the first one) should run slowly now.

With the „Copy“ button, the command to be sent is copied to the editing boxes in the middle of the panel. On the right hand side, the generated datagram is displayed in binary form. From there, it can be sent by the lower „Execute“ button.

In the lower margin of the Direct Mode panel the answer sent back from the module should be displayed. The format of the datagrams are explained in chapter 2 of the TMCL Reference Manual. A detailed description of all instructions can be found in chapter 3.

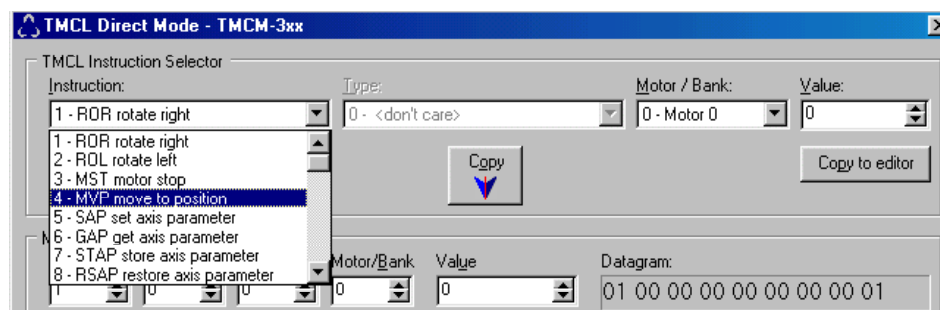


Figure 2: selecting instructions

Please try out more basic instructions for motor control:

Motor stop (MST) – stops the selected motor

Move to position (MVP) – moving to absolute or relative positions

All axis specific parameters can be set with “Set axis parameter (SAP)”, read back with “Get axis parameter (GAP)” and permanently stored with the “Store axis parameter (STAP)” instruction.

The most important settings are:

maximum current (no. 6) – the maximum motor current during motion (in mA, max. 1500)

standby current (no. 7) - the motor current 2s after the motor stopped (in mA, max. 1500)

maximum positioning speed (no. 4)

A short description of all axis parameters can be found in chapter 4 of the TMCL Reference.

Using reference/limit switches

Connecting switches is not obligatory, but the determination of the motor position after power-up is advisable in most cases (reference search). By default, the left limit switch is used for the reference point: this switch becomes active when the motor reaches the mechanical limit in negative direction (decrementing positioning values). So in this case, the reference switch and the left limit switch are identical. Other configurations are explained in chapter 6.1 of the TMCL reference.

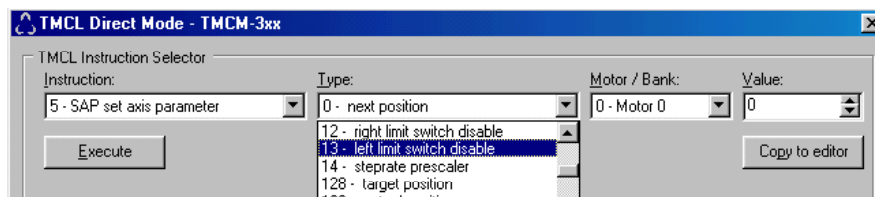


Figure 3: activating the reference switch

All limit switches must be set up as normally closed contacts to ground. Thus, in normal operation, a voltage of 0 is present at the input. The actual state of the switch can be checked with the "Get axis parameter (GAP)" instruction, type 9 (reference switch status).

All limit switches provide an automatic stop function: if active, the motor is stopped by hardware when the switch is hit, and motion is only possible in the opposite direction.

With no switch connected the appropriate input will show a high level (5V), which is identical to an active switch. Because of that, the automatic stop function is de-activated for all switches by default. Figure 3 shows how to activate the stop function by means of the axis parameter no.13.

All modules support a reference search function which is started by the instruction number 13 (RFS, reference search).

Writing a simple program

In „direct mode“ the instructions can not only be sent to the module but they also can be copied to the editor window:

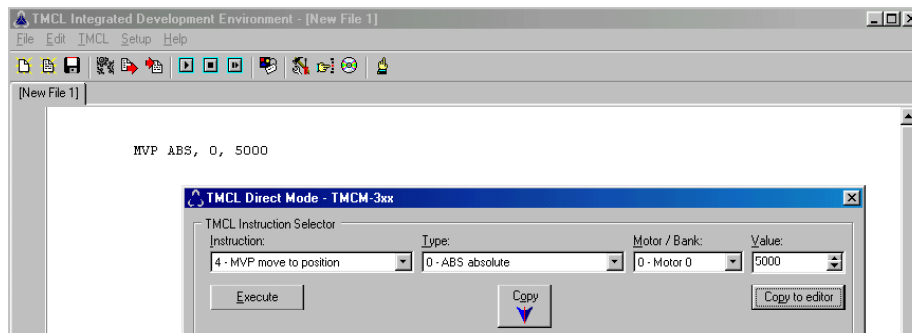


Figure 4: using the „copy to editor“ button for programming

example: automatic back and forth motion

We start off as shown in figure 4 with the instruction “Move to Position”, motor 0, 5000.

To halt the program until position 5000 is reached a WAIT instruction is used: instruction no. 27, type 1, motor 0 (Value: don't care). After that, the motor should go back – so we insert another MVP instruction this time with the target position 0 (Value). Again, a WAIT instruction follows. Finally, a jump back to the program start must be added, we select instruction no. 22 (Jump always). The jump position must be entered manually. The program should now like this:

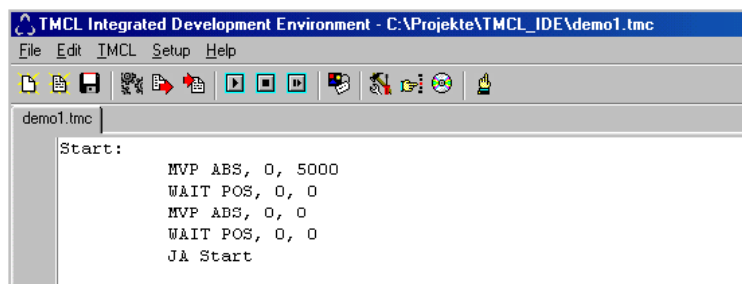


Figure 5: the complete example program

It is advisable to save the program using „File/save as“ before going on.

Downloading and execution of a TMCL program

First, the program text has to be transformed to the binary form („assembling“) which is done by the “TMCL/assemble” item or the button . The binary data can now be downloaded with the Download button  into the program memory of the module. Finally, „Run“  starts execution.

Motor 0 should now move back and forth continuously.

Changing parameters during program execution

Commands sent from the host computer can still be processed during run time. For example, we can change the motor speed with instruction no. 5 “Set axis parameter (SAP)” in direct mode:

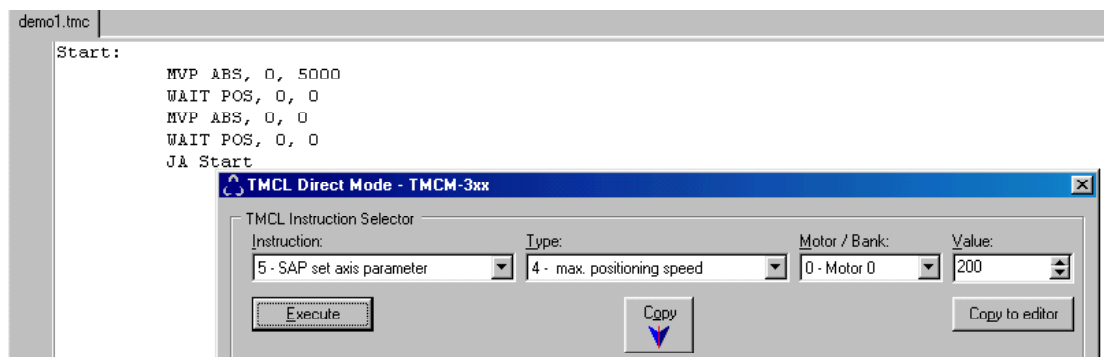


Figure 6: changing parameters during run time

Actual values can be read as well, e.g. the actual position with instruction no. 6 “Get axis Parameter”, type 1 (actual position).

The TMCL program can be started automatically after power-up:

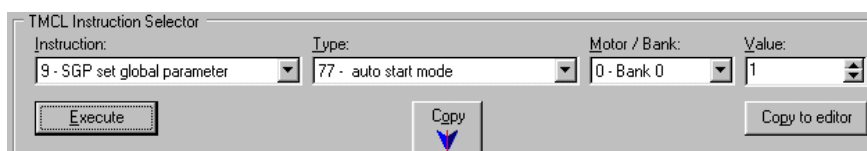


Figure 7: activating automatic start (Standalone Mode)