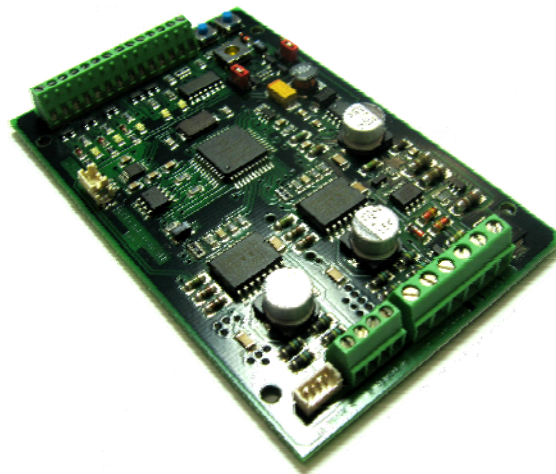


PRECISTEP

Programmable Stepping DRIVER Micro-Stepping DRIVER

USER MANUAL

AD PM 00
and
AD PM 00 Starter Kit



Release tracking

File	Description	Date
V4900UM051203	Initial preliminary release	05.12.2003
V4900UM301004	Addition of section 7 and 8	30.10.2004
V4900UM250907	Comment on Updated Motor database	25.09.2007
V4900UM080408	Change to PRECistep, pull-up introduction	08.04.2008
V4900UM160311	Update of complete user manual	16.03.2011
V4900UM300611	Correction of the MOTOR connection pins	30.06.2011

Product denomination key

Typical Product type **AD PM 00**

- AD** Driver product category
- P** Programmable driver
- M** Mode
- 00** Initial release of the driver

Support

You may inquire with your questions about the software or the driver by e-mail or directly with your sales office. It is in any case helpful to include the files you try to work with as well.

The e-mail contact address is:

info@precistep.com

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1. General Information

1.1 Product Description

The driver AD PM 00 is a programmable stepper motor driver which can be set-up for stand-alone operation using the *Kflash* programming software running under Windows™. Its functions include the set-up of individual motions and parameters which can be combined to an application. The power output stage and the associated drive modes are specifically designed for PRECIstep stepper motors. The AD PM 00 controls the motor that is used with the driver and can propose two control modes (current control or voltage control).

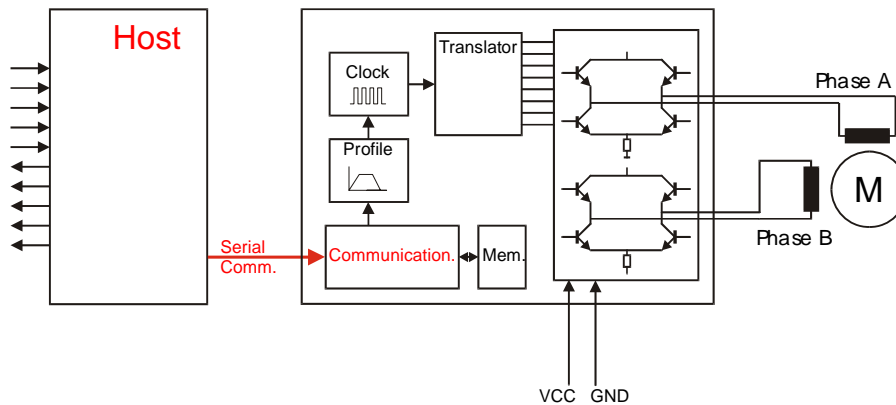
Main features

- Programmable with PC Software *Kflash*
- Firmware field-upgradeable
- RS-232 serial link
- Programmable inputs (Start/Stop, Sensor)
- Programmable outputs
- Full, half and micro-step operation
- Current control (0-800mA continuous)
- Voltage control (5.5-24VDC)
- Boost current set-up (110 to 200%)
- Standby current set-up (0-90%)
- One-phase ON, two-phase ON operation selection
- Automatic detection of motor
- Supply Voltage detection
- Motor error detection (NC, open lead)

Important note

**The motor database Motors.dat on the original installation folder is not updated.
To assist you with a complete database, please exchange it once the installations is finished with the Motors.dat provided on the CD.**

1.2 Block Diagram Description



1.3 Available Versions

The AD PM 00 is available in different versions.

- AD PM 00 Starter Kit**
 Standard stock item including:
 Driver board, RS232 connection cable, CD containing software and User Manual
- AD PM 00**
 Standard stock item, includes the driver board only.
 Board and on-board software identical to the Starter Kit.
- AD PM xx**
 Upon request, PRECIstep is able to provide software updates to suit specific functional needs, I/O or communication functions. This is optional and may be subject to NRE charges.

1.4 Technical Specifications (Hardware)



1.4.1 AD PM 00 Driver Board

			AD PM 00 used with <u>current</u> mode control	AD PM 00 used with <u>voltage</u> mode control
Power supply voltage	Min Max	V	5.5 28	5.5 24
Power supply current		mA	40	
Motor Output current	max.	mA	800 per phase	500 per phase Limited to 1.5 I _{nom}
Output current setting		mA	0-800 software setting (chopper)	none
Auxiliary on-board supply	Voltage Current	V mA	5 100	
Logic input level	low high	V	0 to 0.6 1.6 to 24	
Direction of rotation			cw/ccw	

Step mode			Full-step, 2ph-ON Full-step, 1ph-ON Half step Micro-steps 1/4, 1/8	Full-step, 2ph-ON Full-step, 1ph-ON Half-step
Step frequency	Min max.	step/s	0.0025 5000	
Temperature Range	Min max.	°C	-20 +70	
Dimensions		mm	94 x 60 x12	

1.4.2 RS232 connection cable (optional)

The connection cable is part of the Starter Kit only.

	PC-Side connector	Color	Hardware side
Connector type	D-Sub 9-pole female		Harwin M30-1100300 3-pole female
Image			
Ground	5	Yellow	3
RX	2	Brown	2
TX	3	Red	1

1.1.1. Communication

After setting-up and programming the electronics, the AD PM 00 can be operated without PC software. Then the driver can be controlled by either digital inputs or through the RS-232 serial link with the ASCII protocol. This protocol is supported by most operating systems. In the Windows HyperTerminal it is recommended to use the following parameters:

Parameter	Setting
Port	COM1, COM2,
Speed	9600
Data bits	8
Parity	none
Stop bits	1
Flow control	none
ASCII-Setup	activate: Send line ends... activate: Echo typed...

Addressing

With one serial communication chain, it is possible to control several drivers. They can be assigned with a "Node address" during the programming.

1.5 Suitable PRECstep motors

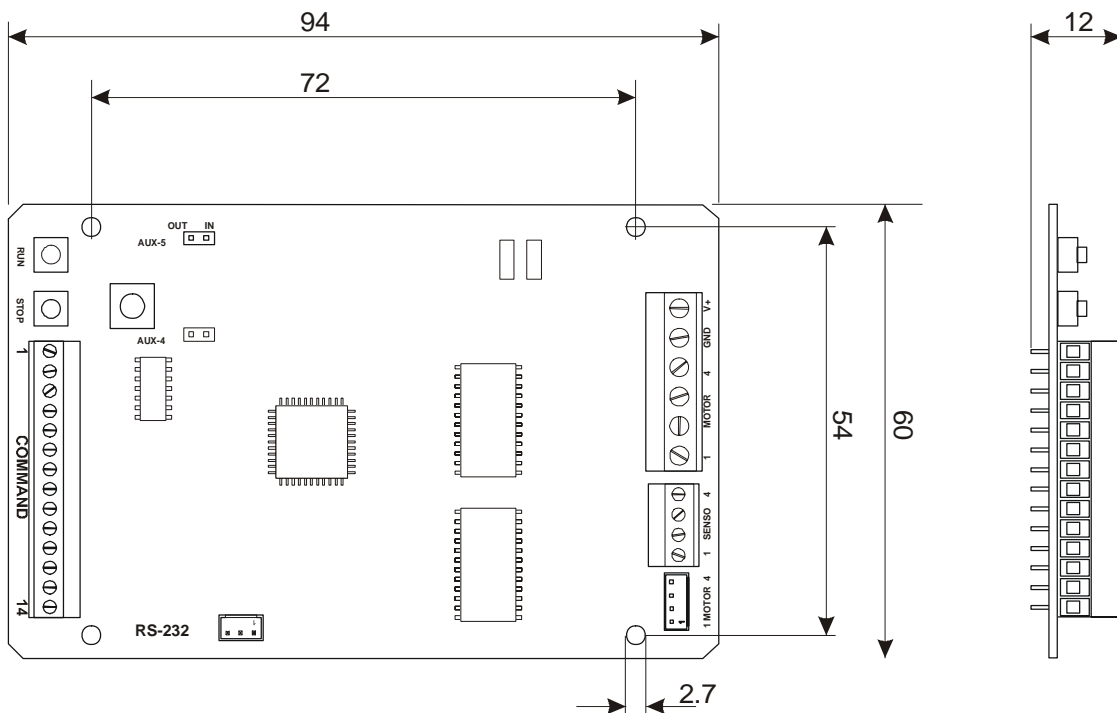
The driver of the series AD PM 00 is suitable for all PRECstep two phases stepper motors with voltage and current rated windings. With voltage rated windings all motors with a nominal voltage rating of over 5V, or in specific cases, motors with higher ratings driven at a lower voltage, can be driven. Do not forget that the minimal supply voltage of the board is 5.5V.

A specific version of the AD PM XX will become available for voltages lower than 5V.

Current rated windings are usually used with higher voltages, i.e. 12V or higher. In this case, please pay attention not to exceed the upper limit of 28V.

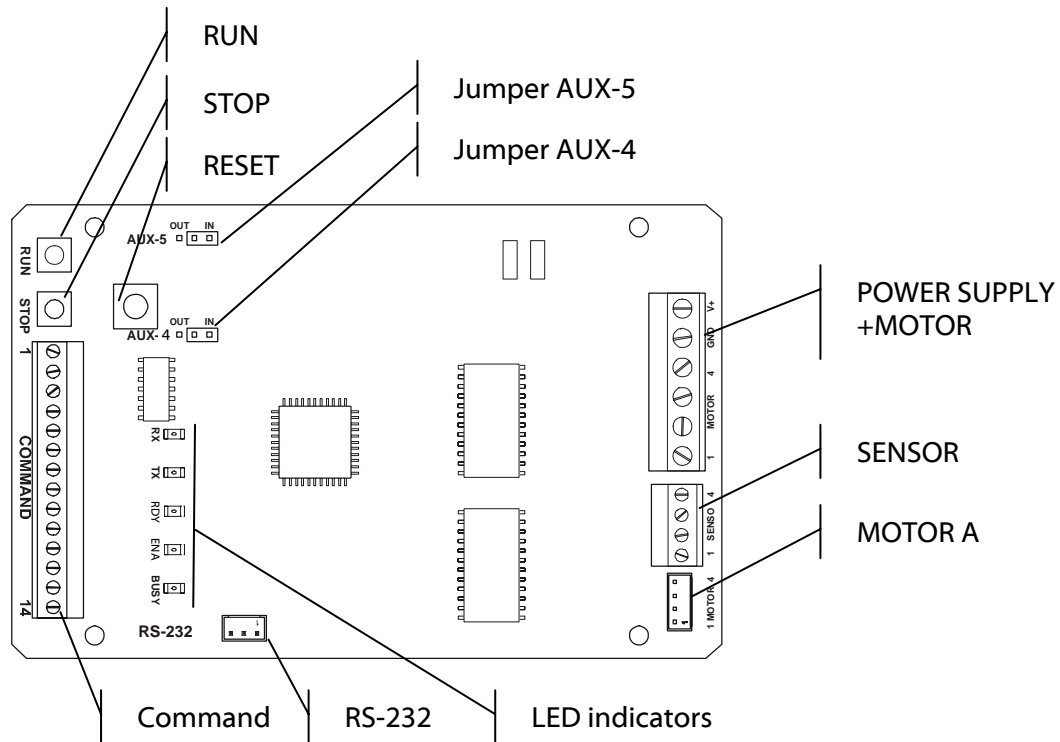
1.6 Dimensions and mounting

View on the board.



The design uses a single board that can be fixed with screws.

2. Set-up and installation of AD PM 00



2.1 Location of Components

- COMMAND, screw-type terminal, 14-positions
- RS-232, locking connector, Molex 3-pins miniature
- MOTOR A, locking connector, Molex 4-pins miniature
- POWER SUPPLY + MOTOR, screw type terminal, 6-positions
- SENSOR, screw-type terminal, 4-positions
- AUX-4, Jumper
- AUX-5, Jumper
- START, button
- STOP, button
- RESET, button
- Status LED indicators

For Pin-out and functional explanations, please see the respective section.

2.1.1 COMMAND Connector

#	I/O Type	Designation	Explanation
1	I	RUN	Starts motion, HCT compatible, HIGH=active
2	I	STOP	Stops Motion, HCT compatible, HIGH= active
3	I	AUX-1	Programmable Input
4	I	AUX-2	Programmable Input
5	I	AUX-3	Programmable Input
6	I or O	AUX-4	Programmable I/O
7	I or O	AUX-5	Programmable I/O
8	O	RX	RS-232 terminal
9	O	TX	RS-232 terminal
10	O	ERR-0	Must be green (see "Error message" section)
11	O	ERR-1	Must be off (see "Error message" section)
12	O	BUSY	Status output
13	O	GROUND	-
14	O	+ 5V	Max 100mA

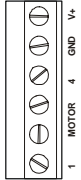
Functional description of the Inputs/Outputs on COMMAND connector:

- PIN1, START; identical function as Button START
It starts the loaded sequence by a command from the host or a hardware.
The start button on the board is deactivated
- PIN2 STOP; identical function as Button STOP
It stops the loaded sequence by a command from the host or a hardware
A started sequence or motion that does not include a wait for stop command will not read this input.
The stop button on the board is deactivated
- PIN3 AUX-1; Programmable Input, function set by software
PIN4 AUX-2; Programmable Input, function set by software
PIN5 AUX-3; Programmable Input, function set by software
- PIN 1-5 : inputs are HCT compatible (0...5V)
HIGH=active
- PIN6 AUX-4; Programmable I/O (pre-selection I or O by Jumper Aux-4)
function set by software
- PIN7 AUX-5; Programmable I/O (pre-selection I or O by Jumper Aux-5)
function set by software
- AUX4-5:
digital inputs: switched off/low: < 0.8V
switched on/high: 2.5 - 30V
digital outputs: Open Collector NPN, max. 30V, max. 50mA
- PIN8 RS-232 header pin, RX
not useable for programming the board, only for monitor function (outputs)
- PIN 9 RS-232 header pin, TX
not useable for programming the board, only for monitor function (outputs)
- PIN10 ERR0; indicates the status of the driver
0 in case of a fault (LED "RDY" is red), 1 after a successful start-up check after power-on (LED "RDY" is green)
- PIN11 ERR1, indicates that the driver has a fault
This imposes a hardware reset. LED "ENA" must be off to indicate a successful start-up.
In case of a detected fault it will indicate together with BUSY (PIN12) the kind of fault.
See Section "Serial instruction" and "Error messages" for more details
- PIN12 BUSY Output, indicates that the processor is executing a sequence. It is activated together with the LED "Busy".
In case of a detected fault it will indicate together with ERR1 (terminal 11) the kind of fault.
See Section "Serial instruction" and "Error messages" for more details

- PIN13 GND; Ground
- PIN 14 +5VDC; auxiliary supply output for sensor or other processors (maximum 100mA)

2.1.2 POWER SUPPLY + MOTOR Connector

6-position screw-type header for the connection of the power supply and the stepper motor.
The PIN-out is as follows:

	Pin #	Function	Motor PIN
	1	V+	-
	2	GND	-
	3	Phase A +	4
	4	Phase A -	3
	5	Phase B +	2
	6	Phase B -	1

The power supply must be between 5.5 and 28VDC in current mode and between 5.5 and 24VDC in voltage mode.

2.1.3 SENSOR Connector

Screw-type header for the connection of cable terminals.
The PIN-out is as follows:

Pin #	Contact description	Description
1	+5VDC	output
2	GROUND	output
3	AUX-2	
4	AUX-3	


Pins 3 + 4 are directly connected to AUX-2 and AUX-3 on the COMMAND connector . This allows to connect an incremental encoder on the same side with the motor leads and use the COMMAND connector for connection to the control side. The signal is not treated.

The driver can provide the step impulses on AUX-4 or AUX-5. This allows the controller host to compare step impulses and encoder impulses to detect step losses.

2.1.4 MOTOR Connector

Alternative connector, MOLEX locking type.

For hook-up information on the motors, please refer to the numbers on the motor PCB, the numbers of the connector pins and the numbers of the motor correspond to each other.

	Pin #	Motor Phase	Motor PIN
	1	Phase B -	4
	2	Phase B +	3
	3	Phase A -	2
	4	Phase A +	1

Connector Type: Molex 4 poles Nr 53047-0410

Mating Connector: Molex 4 poles Nr 51021-0400 with pins Molex 50058-8000

The cable is not supplied with the motor (where it is available as option), nor the AD PM 00 or the AD PM 00 Starter Kit. Please inquire with your point of sales to see our cable possibilities.

2.1.5 Jumper Aux 4

It configures manually the terminal AUX-4 of the command connector (PIN6) either as INPUT or as OUTPUT

Jumper AUX-4 IN position (right) = INPUT

Jumper AUX-4 OUT position (left) = OUTPUT

2.1.6 Jumper Aux 5

It configures manually the terminal AUX-5 of the command connector (PIN7) either as INPUT or as OUTPUT

Jumper AUX-5 IN position (right) = INPUT

Jumper AUX-5 OUT position (left) = OUTPUT

2.1.7 Button START and Button STOP

Their function is identical to the input terminals START (PIN1) and STOP (PIN2) of the COMMAND connector

2.1.8 RS-232 Header Connector

Duplicates the input RX and TX (PIN8 and PIN9 on the COMMAND connector) mainly for hook-up to a PC for set-up and initial programming

2.1.9 RESET Button

Hardware reset after an error. Reset is necessary because the processor is in a loop after the elimination of the error condition.

3. Programming the AD PM 00

During programming, only one driver can be connected to the PC.

3.1 Connection of the driver to the PC

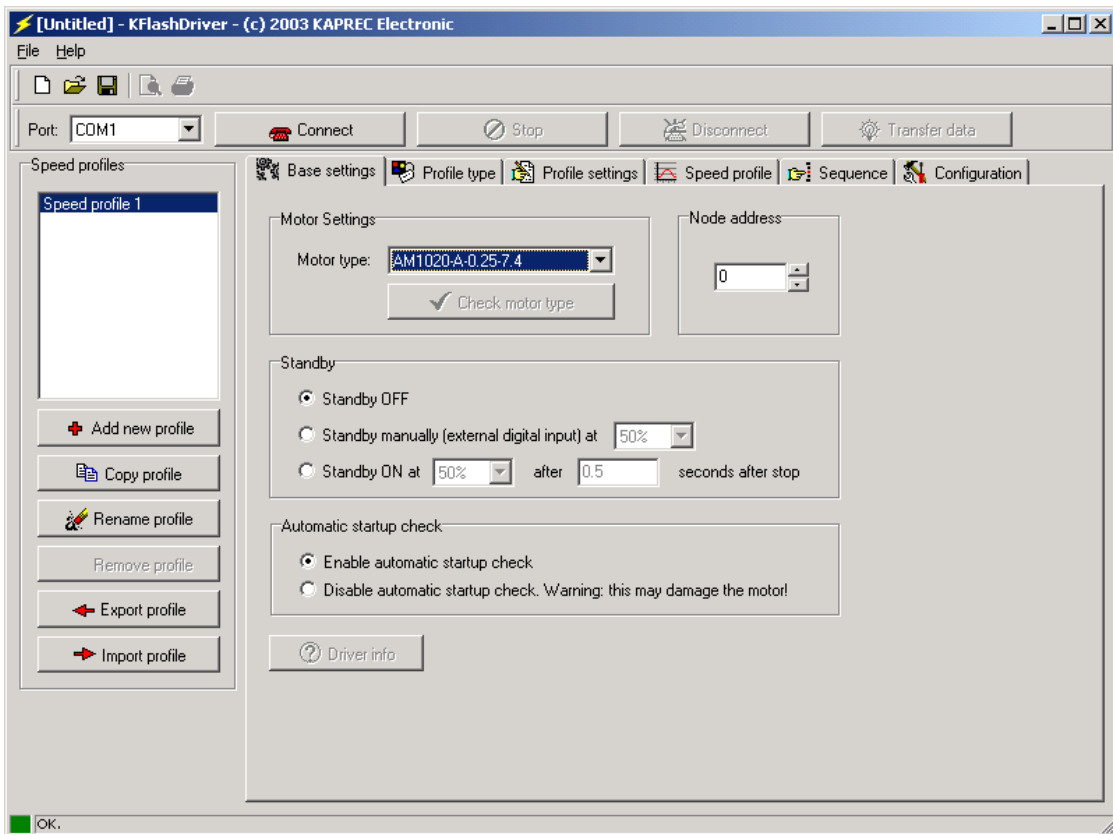
Please perform the following steps:

- Connect the motor with either using the MOTOR connector A or using a motor with Molex locking connector (if available - not supplied with motor or driver).
- Connect the RS-232 serial link of your PC by one of the following ways:
 - If available use the adapter cable of the AD PM 00 Starter Kit. Connect it to the locking connector RS-232.
 - If you have your own adaptor cable proceed as follows:
 - connect TX of your PC to the TX terminal of the Molex connector (see section 1.4.2)
 - connect RX of your PC to the terminal RX of the Molex connector (see section 1.4.2)Do not cross these lines, they are actually crossed in the hardware.
- Connect the Power supply using screw terminal. The voltage must be between 5.5 and 28VDC in current mode or 5.5 and 24VDC in voltage mode.
- Press RESET
It will reset the entire electronic and load the programmed motion sequence. RESET must also be pressed to reset drive after an Error.
- Now your driver can be programmed by using the *KflashDriver* software. See the next sections for more information.

3.2 PC-Program '*KFlashDriver*'

This software programs the AD PM 00 driver in a convenient and rapid way. It is possible to set-up the software on the PC off-line and later on connect the driver and transfer the developed and compiled software to its memory.

The driver enables the user to set-up and configure individual movements and to generate motion sequences which consist of a number of movements that are executed sequentially.



3.3 Programming Method

The Kflash Driver software opens with the screen above. It has three principal sections

- Connection with the AD PM 00 Board ("Base settings" tab)
- Speed profile definition ("Profile type", "Profile settings" and "Speed profile" tabs)
- Tabs for the configuration of the motion ("Sequence" and "configuration" tabs)

During the programming, the idea is to navigate in the menus from left to right until all the parameters are set.

3.3.1 Motion Configuration tabs

Tab	Entries
Base Settings	<ul style="list-style-type: none"> • Motor selection • Standby current settings • Automatic checking procedures • Node address (must be bigger than 0, ideally 1)
Profile Type	Select the type of profiles, see section 3.4.
Profile Setting	Set attributes of the selected profile: <ul style="list-style-type: none"> • Sense of rotation (CW/CCW) • One or two phase ON drive mode • Step resolution (full, half or micro step) • Current boost settings
Speed Profile	<ul style="list-style-type: none"> • Enter the motion parameters of the selected speed profile

	<ul style="list-style-type: none">• The number of parameters varies• On some speed profiles a check of the parameters helps to configure the motion
Sequence	Combines speed profiles and other functions to the sequence to execute in the application, including I/O and time functions.
Configuration	<ul style="list-style-type: none">• Configuration of the I/O• Compilation of the sequence (“Build data” button)

The logic behind this system is a step by step approach:

- Step 1 configure the base settings with the motor selection
- Step 2 Select a speed profile
- Step 3 Configure the motion attributes (CW/CCW, one or two phase ON, etc.)
- Step 4 Parameterize the selected speed profile
- Step 5 add other speed profiles if necessary
- Step 6 add time, I/O and start/stop functions
- Step 7 compose the sequence
- Step 8 configure the I/O
- Step 9 Compile the motion sequence by clicking on the “Build data” button

When changing a parameter in any of the tabs, only the highlighted profile in the “Speed Profile” listing is affected.

3.3.2 Transfer of data to the driver

To transfer the data on the driver, the following steps are necessary:

1. Select the serial port of the PC connected to the board and activate 'Connect'. The COM port number must be between 1 and 4.
2. Apply power to the board (if not done yet)
3. The connection is established and the “Disconnect” caption is activated in the program.
4. Create your motion sequence (if not done yet)
5. Click on the “Transfer data” button to load your sequence on the driver

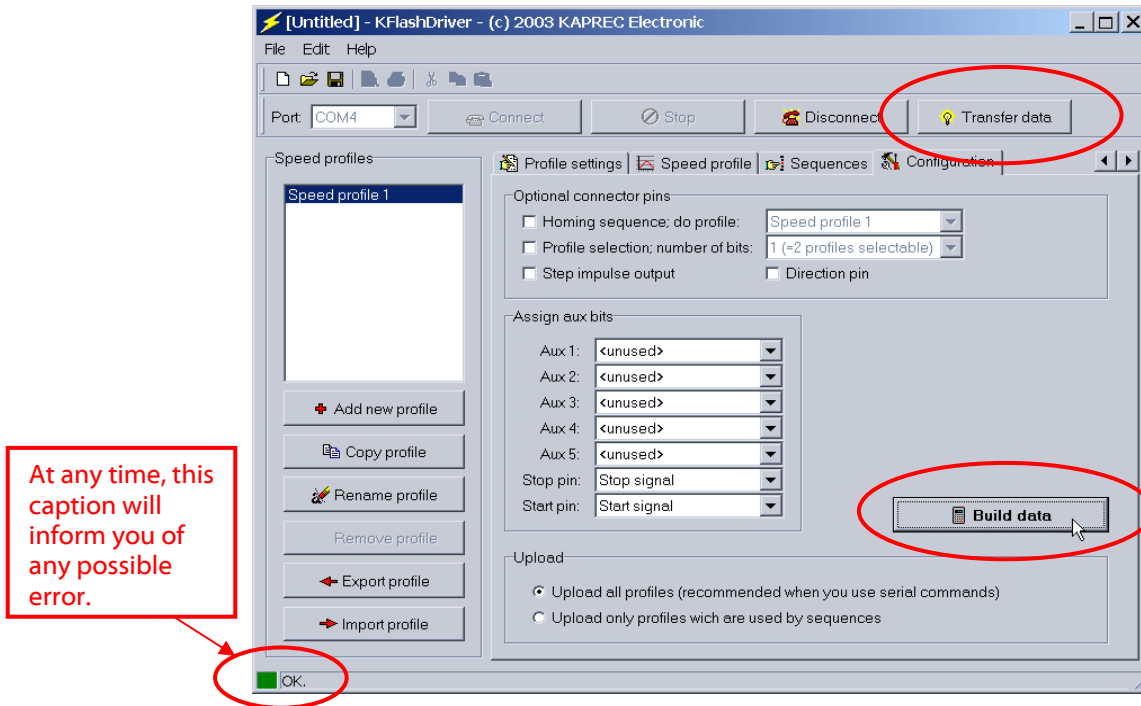
“Transfer data” is available when a connection is activated, a motor has been selected and when a sequence has been compiled with the “Build data” function

6. Click on the “Disconnect” button to end the transfer and use the driver

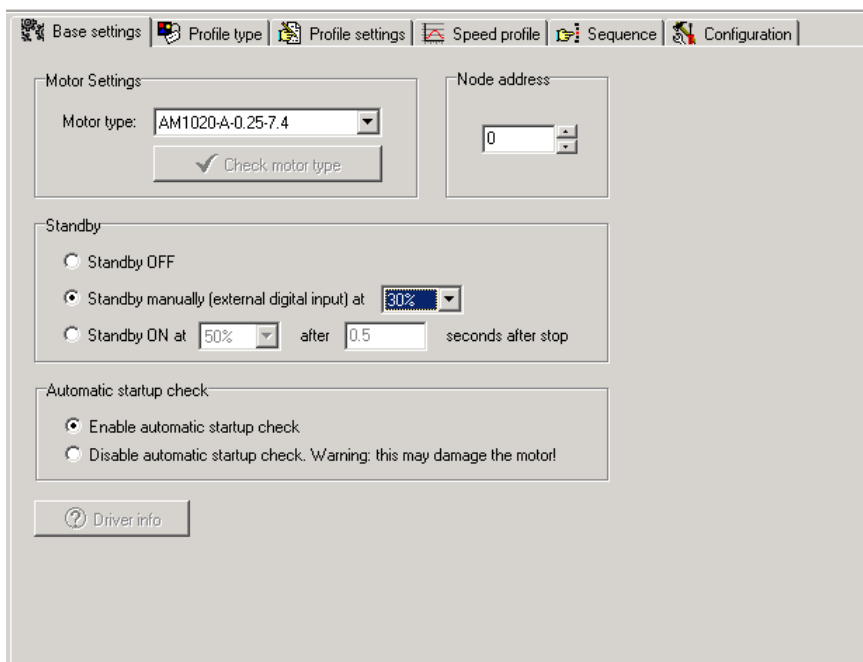


Notes

- In case of troubles, you may either power cycle the drive or press the 'RESET' button on the board. It is recommended to press the 'Connect' button in the program before powering the driver.
- No connection can be established when other than the 'Stop' input is activated.
- The sequence will be programmed and memorized on the driver as long as you do not overwrite it with a new one. Powering off or making a reset of the driver does not erase the sequence.



3.4 Base Settings Tab



The entries requested here are the following:

1. Motor selection from the list of motors provided (Motors.dat file)
2. **The node address of the driver (must be greater than 0, ideally 1)**
3. The current standby options
4. Automatic start-up check in order to protect the motor (it will check that power is suitable with the motor before actually energizing it)

By the selection of the motor, the motor current is automatically set to the catalogue level. For voltage control winding types, the maximum current allowed is $U/R \times 1.5$.

3.4.1 Motor selection

A list of all stepper motors proposed by PRECstep is available either in current or voltage mode. At this point, the user may also choose the operation mode (current or voltage) that he wants to use.

3.4.2 Motor checking functions

There are two kinds of tests: one is done manually and the other one is done automatically.

The manual test is accomplished by clicking on the "Check motor type" button and the automatic test is upon power-up and reset of the driver. The following operations are done for each test:

Manual test

- The supply voltage is compared with the nominal voltage of the selected motor. If this voltage is out of the requested range, the driver sets an error.
- The motor connection is checked first for short-circuit against Ground, thereafter the phase resistance is controlled. If there is any difference with the reference data, an error message is displayed on the PC screen (see 3.4.2) but no error is set.

Automatic test

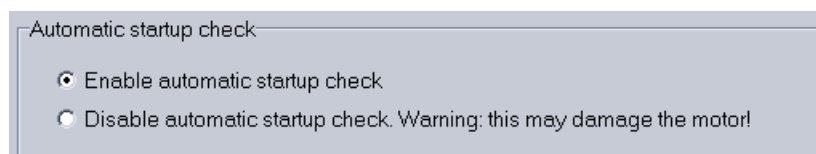
- The motor connection is checked first for short-circuit against Ground, thereafter the phase resistance is controlled. If there is any difference with the reference data, an error is set through the "ERR0" bit (Pin10 on COMMAND connector see 1.7.1).

None of these checks is realized during the operation (no continuous check up).

Limiting automatic test functions

The check functions may, for some motors where the resistance is very close to another or when the motor is hot, cause errors even though all operation parameters are correct

To avoid that the driver is becoming inoperable, the automatic motor checking functions can be restricted.



Notes

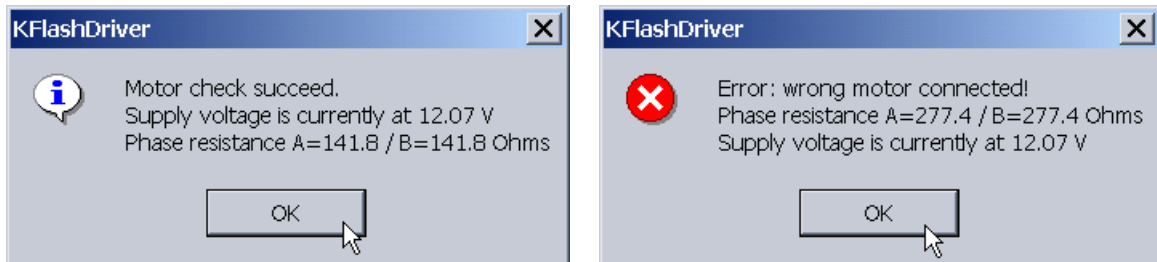
- Automatic test is limited to short-circuit checking.
- In case that the wrong motor is selected, this may cause damage to the driver because of over-current, especially with voltage mode windings.

3.4.3 Motor diagnosis (manual test)

The PC software can manually check the motor after the selection of the motor type.

After the successful connection of the driver via serial link the "Check motor type" button becomes active.

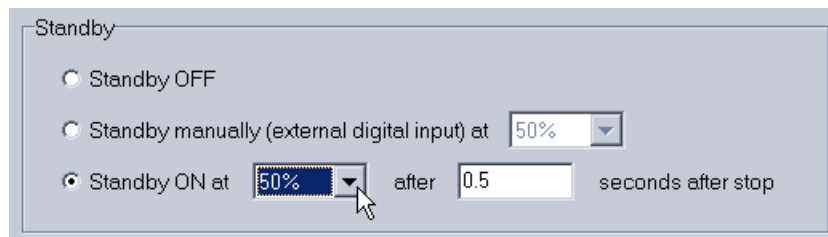
When clicking on this button, the test described in 3.4.1 is fulfilled and the result is displayed on the screen (no error is set). This allows checking whether the connected motor will operate properly after the programming of the driver and avoid any damage.



3.4.4 Standby

To avoid that the motor is heated unnecessarily during stand-still, the driver can reduce the current at the end of a movement.

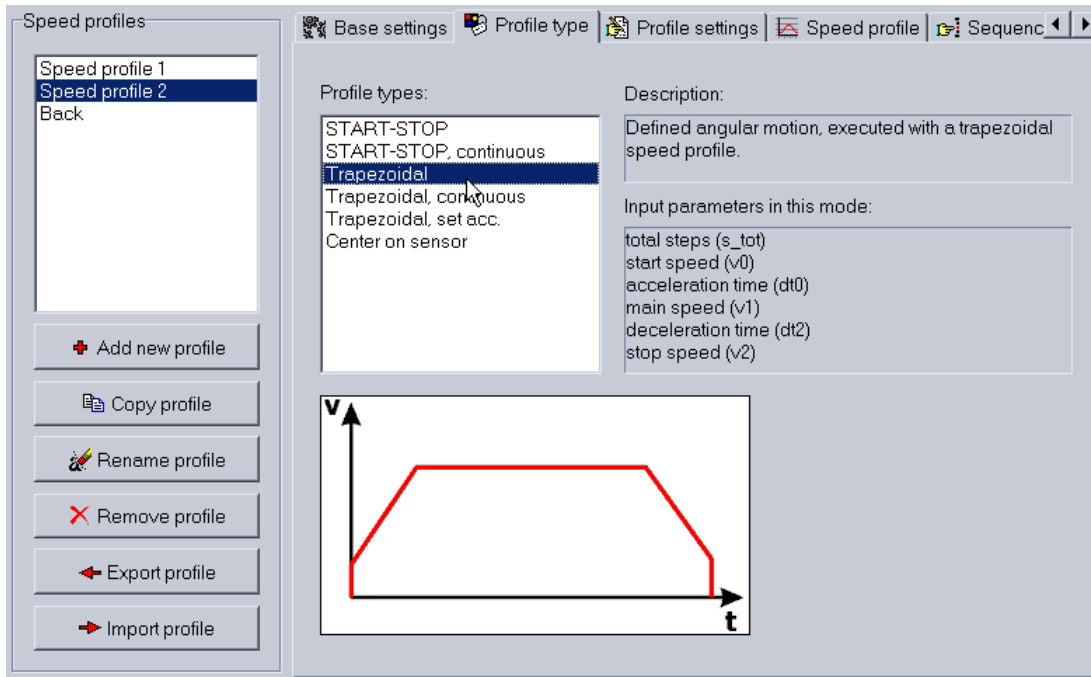
Two settings are possible: either the standby current is set after a delay, or it is manually activated upon a signal through an external input.



Note

If the standby option is not activated, the motor will be energized even when not in movement. This may heat or damage the motor, especially when powering with high current.

3.5 Profile type tab

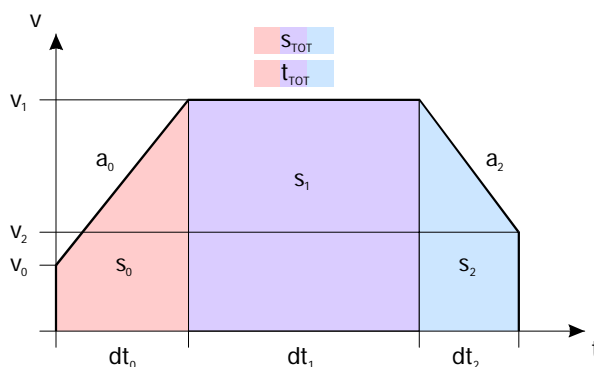


The AD PM 00 supports different types of motion profiles (see section 3.5.2) for the run of the PRECstep motors.

Each motion profile can be given a name which appears in the left window where all the movements that the user works on are displayed.

During the modification of a profile through the different tabs, only the profile which is highlighted in blue is going to be modified. This makes it possible to develop and test different motion profiles in parallel.

3.5.1 Profile parameter definitions



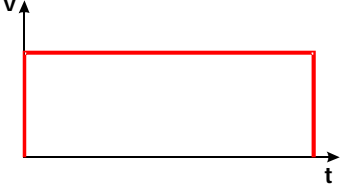
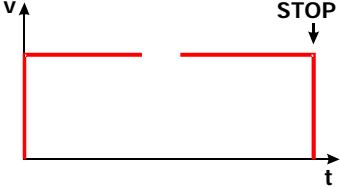
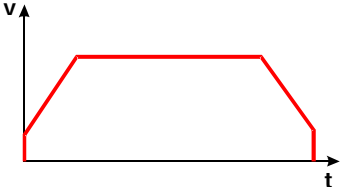
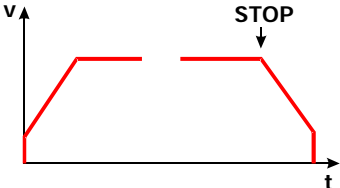
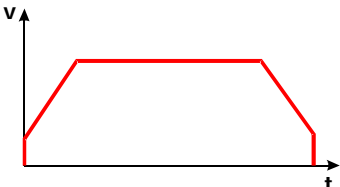
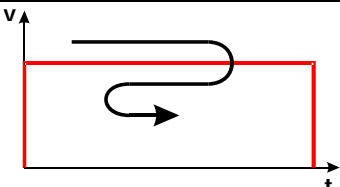
Designation	Unit	Description
s_{TOT}	steps	Total number of steps to move
t_{TOT}	s	Total time for the motion
v_0	steps/s	Start speed (speed of first step)
dt_0	s	Acceleration time
s_0	steps	Number of steps during acceleration
a_0	steps/s ²	Acceleration rate
s_1	steps	Number of steps at slew speed
dt_1	s	Time of run at slew speed
v_1	steps/s	Slew speed
s_2	steps	Number of steps during deceleration
a_2	steps/s ²	Acceleration rate
dt_2	s	Deceleration time
v_2	steps/s	Stop speed (speed of last step)

All parameters entered in the “Speed profile” tab have to be in FULL-STEPS!

Example: if the driver is set to half step and $s_{TOT}=20.5$ steps is entered, the motor will execute 20 full and one half step. Speed parameters are also entered in full-steps.
The advantage of this is that the execution of profiles is independent from the selected step mode.

3.5.2 Overview of profile types

The firmware of the AD PM 00 is set-up with the profiles described below.

Name Parameters required	Graphical representation	Comments
START-STOP Entry parameters: S_{TOT}, V_1		Motor reaches full speed during first step. Speed must not exceed pull-in frequency of the motor. A specific number of steps is executed.
START-STOP continuous Entry parameters: V_1		The motor reaches full speed within the first steps and continues to rotate at the speed until STOP is triggered.
Trapezoidal Entry parameters: $S_{TOT}, V_0, dt_0, V_1, dt_2, V_2$		Speed profile with accel/decel. ramps. A specific number of steps is executed. The start speed can be adapted.
Trapezoidal, continuous Entry parameters: $V_0, dt_0, V_1, dt_2, V_2$		Speed profile with accel/decel. ramps. The start speed can be adapted. The motor continues to rotate until STOP is triggered.
Trapezoidal, set acc. Entry parameters: $S_{TOT}, V_0, a_0, V_1, a_2, V_2$		Identical to Trapezoidal but requires acceleration rate.
Center on sensor Entry parameters: S_{TOT} , max. number of steps, V_1		Special profile for the use of a sensor. See section 3.5.3.

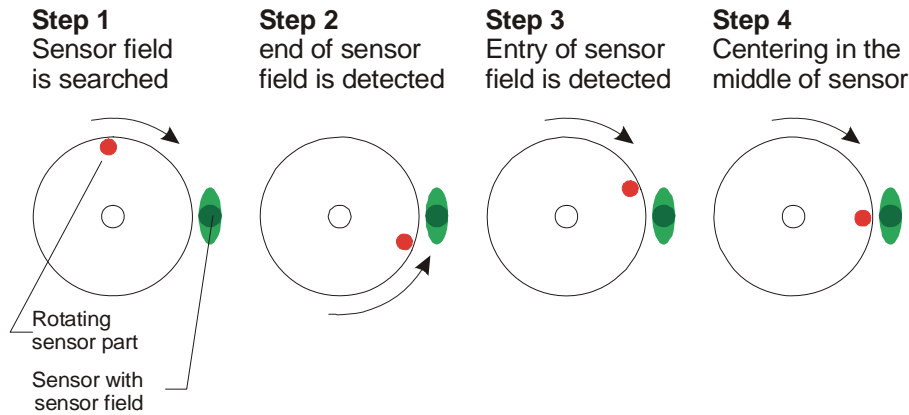
3.5.3 Center on sensor

This profile type represents a special position within the profiles and its use requires a full understanding of the function.

During the execution of a Center on sensor instruction in a sequence, the driver is detecting automatically both sides of a sensor field and will thereafter home itself in the middle between the detected range. This allows a

very precise homing.

A schematic description of the center on sensor process helps to understand:



The sensor must switch from digital HIGH to digital ZERO when it is activated.

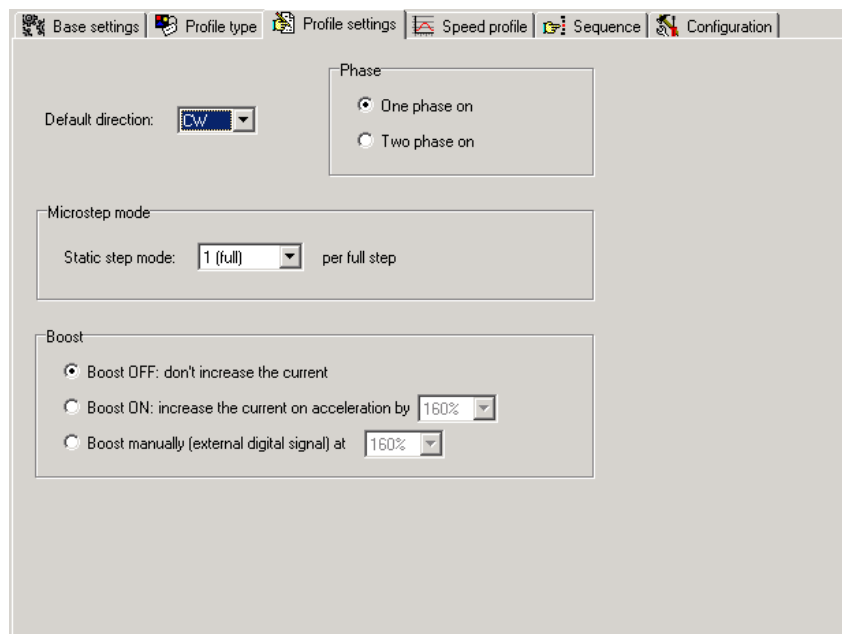
It is important to note that not all AUX inputs have the same electrical characteristics and it may be possible to connect therefore the sensor directly.

For instance, the sensor type can be a capacitive sensors or Hall switches.

The profile parameters have the following function:

- Sense of rotation** determines in which sense of rotation the sensor field is presumed to be and in which the motor rotates first.
- Total steps** requests the number of steps within which the detection of the sensor is expected. In case that the sensor is not activated within this number, an error is set on ERR1.
- Main speed** requests the speed at which the rotation of the motor should be during the homing routine. The speed should not be high because by increasing the speed the detection becomes less precise.

3.6 Profile settings tab



In the “Profile settings” tab it is possible to make different adjustments to the active profile. Active profile is the one selected in the field on the left of the *Kflash* Software window.
The possible adjustments include sense of rotation, step mode, current boost function, and operation mode described below.

- Sense of rotation** The default setting is CW (clockwise) but one can also choose CCW (counter clockwise).
- Phase** Defines the operation mode.
The driver is able to control the motor in one phase ON (only one winding is energized at any time) or two phase ON mode (both windings are energized at any time).
The setting has only an effect when full-step operation is selected.

The driver automatically adapts the current between one phase ON and two phase ON to provide the same torque in both conditions. This requires that the current in OPO is 1.4 times higher than in 2PO.
- Microstep Mode** Here the number of microsteps per full-step can be selected between half-step, 1/4 step and 1/8 step.
The higher the number of steps the less vibration and noise will be generated. It is recommended to use current drive mode type motors for micro-stepping.
- Boost** Used to increase the current for a short period. See next sub-section

Notes

- Switching the number of micro-steps during a sequence may cause step losses.
- When different step modes are used in a sequence and when the first profile stops on a half-step position, the driver will initially hold the position. When the next profile is started, which cannot start from this half position, the driver is doing step adjustment. To do so it will execute a step with a frequency of 100Hz into the set direction to the next full or partial step position from which the next profile can be executed. The partial steps or steps required to perform this correction are not counted.

Example.

A motor with 20steps/revolution (e.g. ADM1220S) executes in ¼ step mode 20.25 steps.

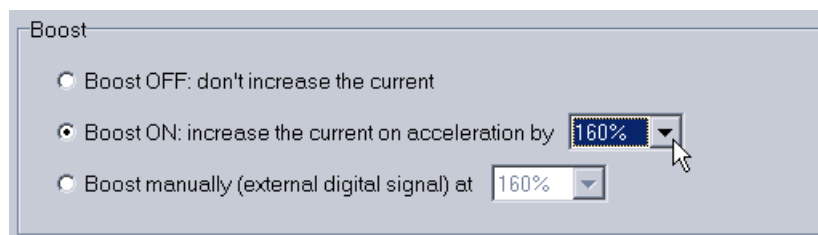
This means that it is turning 1 full revolution and adds a ¼ step and stops there.

The next profile requests to execute a full revolution in full-step mode (meaning a total motion of 19 steps).

The driver makes a correction by moving forward to fill to the 21st step. When the next profile requests the motor to move of 19 steps, two full revolutions have been made.

This is suitable for one phase ON operation.

3.6.1 Current boost operation



Motors with a current control winding

can be current boosted during the execution of a motion profile in different ways.

The nominal current of the selected motor/winding is automatically set by the driver.

- **Boost ON**
Starting from the nominal current level the current can be increased (during the acceleration phase only) by setting the percentage of nominal current.
Once the speed has been reached, the current is decreased to the nominal setting. At stand-still the boost function is not operational.

- **Boost Manually**

The function can be activated by an input at any time during the profile. At stand-still the boost function is not operational.

Motors with a voltage control winding

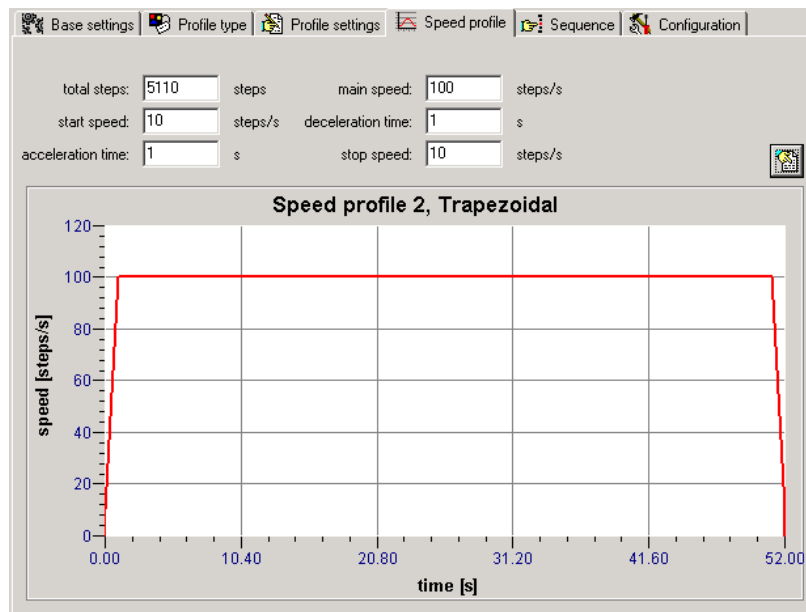
This feature is not possible for this motor type.

3.7 Speed profiles tab

In this tab the selected speed profile is configured.

The presented speed profile below is an example and the entry fields are different for each selection.

For each profile, the parameters mentioned and described in the table of section 3.5.2 (e.g. s_0 , v_0) will have to be defined in this tab.



3.7.1 Automatic checking of entries

The software is automatically checking after each entry whether the values entered can be executed by the driver. In case those entries are invalid, the entered parameters that must be changed to achieve a valid profile appear in RED.

By a click on the RED text, the entry field is automatically updated to offer a solution to the problem. It may however be necessary to change more than one parameter to reach a suitable solution.

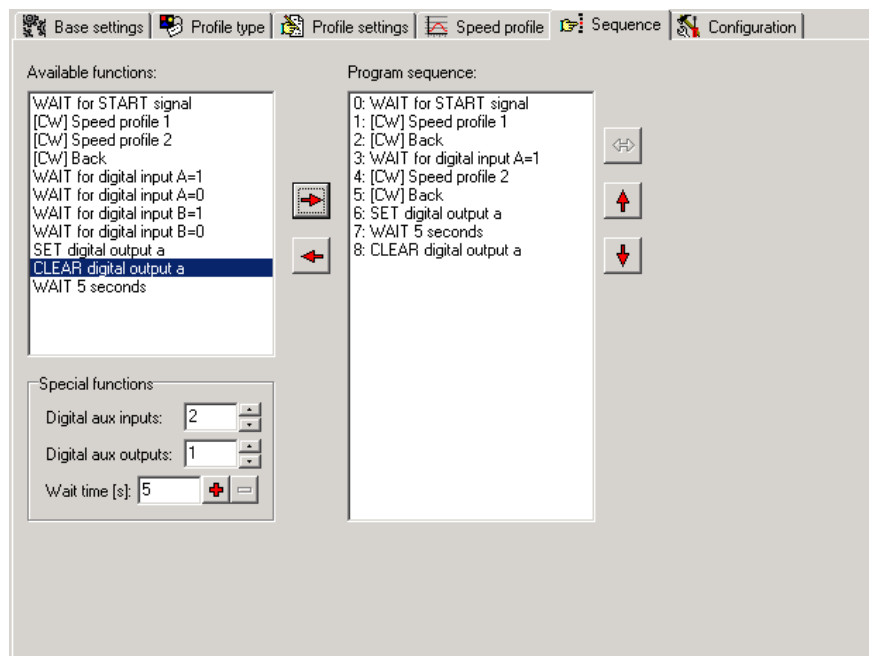
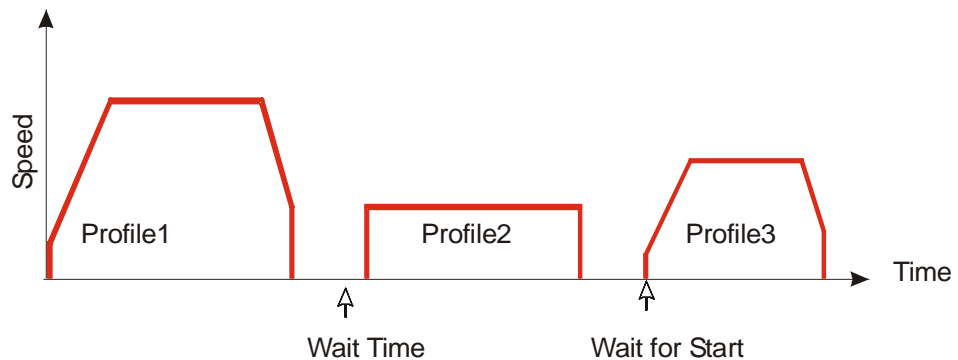
Such error may happen for the following reasons:

- Parameter out of possible range (example slew-speed >5000steps/s)
- The entered values determine a profile which is mathematically not possible. Example: the number of steps to execute with respect to the acceleration time and top speed is higher than the total number of steps entered in the first field



3.8 Sequence tab

In the sequence tab the configured movement profiles can be combined to a sequence.



After the definition of at least one motion profile a sequence can be generated.

All available profiles are shown in the left window and the sequence that is composed with it is displayed in the right window.

To compose the sequence it is only required to copy or remove the profile with the arrows shown between the two windows.

The sense of rotation can also be directly changed by selecting the speed profile in the right window and clicking on the horizontal double arrow.

3.8.1 Special functions

In addition to the motion profiles there are a number of instructions that can be accessed and configured when the "Sequence" tab is selected.

Digital inputs

Enables to execute a sequence or a motion only when a define input is activated.

In the field below it is possible to select the number of inputs which can be configured with the AUX ports in the "Configuration" tab.

START is a fix instruction that does not require input assignment.

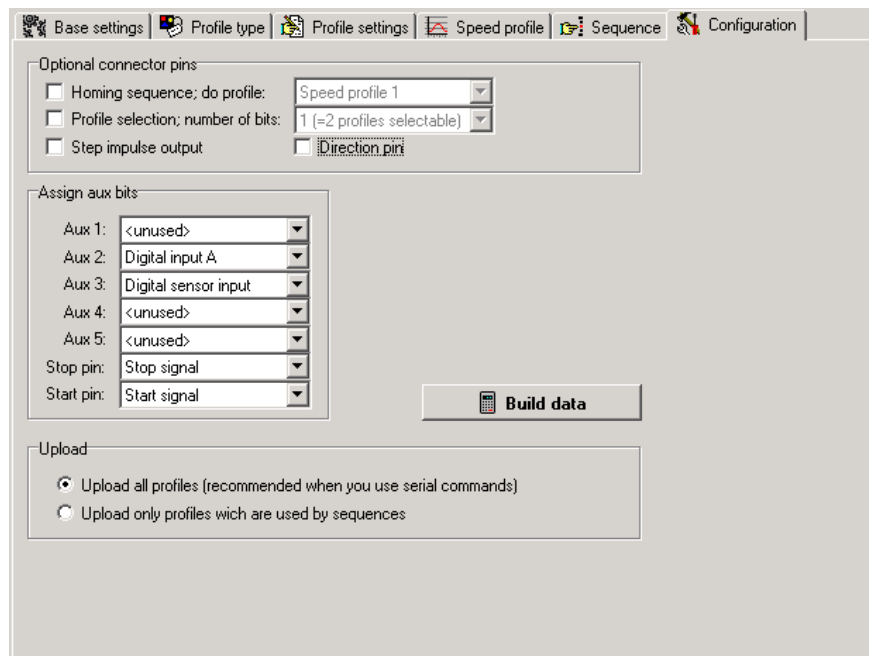
Each programmable input can be checked for either a 0 or a 1 (Low of High).

Time delay function This function enables to wait before executing the next motion. The time is entered in the field Wait time and it can be added or removed from the Available functions field using the + and - sign.
Time delay functions can be used at any time during the sequence.

Digital outputs It is possible to set digital outputs which the driver sets and resets during the execution of a sequence.
In the entry field in the "Sequence" tab it is possible to determine the number of outputs.
This way it is, for example, possible to indicate when a specific position has been reached.

3.9 Configuration tab

This is the last step to validate the sequence.



3.9.1 Homing

The AD PM 00 offers the possibility to home the motor output shaft to a specific position as zero reference.

- Upon activating the function in the "Configuration" tab, the speed profile which is used for the homing has to be selected. Any profile is suitable, including "Center on sensor"
- The execution of the Homing function is started with the external pin "start homing sequence" (see section 3.9.4)
- After the execution of the homing the driver continues to execute at beginning of the loaded sequence.

Note

Homing is a priority input.
In case that the pin is set at power-up, it will first execute this routine.

3.9.2 Profile and sense of rotation selection

Profiles can also be selected with external I/O.

This function is activated in the "Configuration" tab in the "profile selection" field and the profile number is selected.

The numbering depends on the position of the selected option in "Upload" (see section 3.9.7).

3.9.3 Step impulse output

The function can be activated for the case that the external controller requires to know the moment a step is triggered. The output is triggered for 10µs for each step.

Note

This is not providing feedback about the motor movement or position but information about the initiation of a step.

3.9.4 Assignments of I/O

At the moment a function requiring I/O is activated, it appears in the selection list of the AUX bits and can be assigned in the "Assign aux bits" field.

Note

Some I/O can only be used as inputs, some functions can therefore not be assigned to these AUX ports.

AUX 4 and AUX 5 have to be set manually as either Inputs or Outputs by moving the jumpers directly on the driver board, the function cannot be set by software.

The following functions require the use of I/O ports:

Function	Direction	Number of bit
All used I/O for the sequence	I/O	n
START, fixed port assignment	Input	1
STOP, fixed port assignment	Input	1
Center on sensor (digital sensor input)	Input	1
Start Homing Sequence	Input	1
External profile selection, max. 4 Bit = 16 Profiles	Input	1...4
Sense of rotation	Input	1
Step pulse output	Output	1
Standby activate	Input	1
Boost activate	Input	1

3.9.5 Sense of Rotation

The sense of rotation can be changed by the sense of rotation pin.

- 0=CW
- 1=CCW.

In case that the input is not used the sense of rotation programmed with the profile is used by the sequence.

Example:

- Select profile number 12 : Aux 4=1, Aux3=1, Aux 2=0, Aux 0=0 (12 = 1100 in binary)

- Set CCW (Direction Pin = Aux 5): Aux 5=1
- Set START-Bit (an impulse is sufficient): motor starts

3.9.6 Build Data

The “build data” function generates the data that can be transferred by the serial link to the driver. During the compiling operation the software is checking for compilation errors caused by missing assignments of aux pins. Any error will be indicated by an error message.

3.9.7 Upload

With the function “Upload” it is possible to differentiate whether the electronic is programmed with all available profiles or whether only those selected for the sequence. The numbering remains the same as with “Upload all”. The last option allows working and defining more profiles and to test them in a sequence before the final sequence is loaded.

However, the selection of the type of uploading influences the way the different profiles are numbered by the driver.

- Upload all
The numbering is based on the listing as the profiles appear in the left window of the “Sequence” tab.
- Upload only profiles used by sequences
The numbering is then based on the listing as it appears in the right window of the “Sequence” tab

4. Serial instructions

Some information to know about the use of serial communication:

- Each instruction is confirmed by a processor response (handshake)
In case that the driver does not respond to the transmission of an instruction an error is the most likely cause.
- During the execution of a motion profile, only the “Stop” command is accepted.
When a new instruction can be transmitted it is indicated by the BUSY output.
- A driver responds only after an instruction (strict Server/Client structure)
- Each instruction can be combined with the address of the driver which is sent before, example “5M”.
Each driver which receives an instruction is verifying whether the address header corresponds to its memorized address code and executes the instruction.
If the header gives a “0” as address, no driver will execute the instruction.
If the header gives a “99” as address, all driver will execute the instruction, example “99S” stops all drivers.

4.1 Instruction set

After each instruction follows a next line command (C-Syntax “\r\n”)

ASCII instruction	Description	Answer (with example)
99GNODEADR	Get node address. Requests the driver to provide the programmed node address. '99' indicates that the driver always responds	Address ex: 5
nGPCNT	Get profile count, requests the number of programmed profiles	Number ex: 20
nSPRFx	Set profile x, sets a profile x	Set profile x ex: 12

ASCII instruction	Description	Answer (with example)
nGPRF	Get current profile, requests the actual profile	Actual profile ex: 12
nSDIRx	Set direction of current profile (x=0: CW, 1: CCW), sets the sense of rotation of the actual profile	Set direction x ex: 1
nGDIR	Get direction of current profile, Requests the sense of rotation of the actual profile	Set direction CW=0, CCW=1
nM	Initiate motion (START)	OK=1 Error=0
nS	STOP motion. Stops the execution of the profile. It is the only instruction which is read during the execution of a profile	stopped while running = 1 already stopped/idle = 0
nGSTAT	Get status: 0=Error, 1=OK&enabled, 2=Busy, 3=disabled	status number 2
nGERR	Get error: 0=no err, 1=...	error number 5
nDI	Disable (set current to 0)	OK=1 (fails never)
nEN	Enable (set current to specified value in EEPROM)	OK=1 (fails never)
nRESET	Resets the driver	OK=1 (never fails)

Note

GSTAT, GERR, DI and EN are not supported for the moment.

5. Error messages

The presence of an error is indicated by the LEDs ENA, RDY and BUSY.
The ERR0 bit is cancelled when an error is present.

The reason for the error can be found by the error code indicated by these three LEDs:

LED RDY	LED ENA	LED BUSY	Error
ON	OFF	n/c	None
ON	ON		Sensor not found
OFF	ON	OFF	Supply voltage out of tolerance
OFF	ON	Slow blinking	No motor or phase interrupted
OFF	ON	Rapid blinking	Wrong motor type (not matching the selected type)
OFF	Rapid blinking	ON	Wrong motor or wrong serial resistance Attention: this may be caused by too high temperature
OFF	Slow blinking	OFF	Short-circuit to Ground, check cables

When an error is found, the software is operating in an indefinite cycle.
Once the error is no longer present, it is therefore necessary to press the RESET button, or the driver must be power-cycled.
The motor will be controlled only after the power-ON or after RESET.

After the successful start-up check, the driver sets again ERR0 and the operation can be restarted.

Center on Sensor has a special routine, when the sensor field is not found within the programmed number of steps, the execution of the profile is stopped and ERR1 is activated. The operation mode however is not stopped (the firmware is not in a continuous cycle, ERR0 remains active).

This allows checking whether the homing has been successfully executed. Note that the motion profiles can still be started even though no sensor was found.

6. Technical data

PROFILE		
Minimum Step frequency	0.0025	Hz
Maximal Step frequency	5000	Hz
Max. acceleration time	2	s
Minimal step frequency for an acceleration	5	Hz
Step resolution	full, half, 1/4, 1/8	
Minimal number of steps per profile	1	
Drive modes in full-step	one phase on two phase on	
Sense of rotation	CW, CCW	
Max. number of profiles	31 (16 controlled with AUX)	

SEQUENCES AND DIGITAL I/O		
Max. number of sequences	50	
Not programmable inputs	2	
Programmable I/O	5	
Max. number of inputs	5	
max. number of outputs	2	
Wait status for the inputs	high, low	
Max. waiting time	255	s
Resolution of the waiting time 1-25 s	0.1	s
Resolution of the waiting time 26...255 s	1	s

FUNCTIONS		
Time for activation of standby	0 to 25.5	s
Selectable range for standby current	0...90	%
Selectable range for boost current	110...200	%

ELECTRICAL AND OTHER DATA		
Operating voltage	5.5 ... 28 (24)	V DC
AUX1...3: digital inputs, type	HCT-compatible (0...5V)	
Digital inputs, active	HIGH-active	
AUX4+5: digital inputs, inactive/Low	< 0.8	V
AUX4+5: digital inputs, inactive/High	2.5 and 30	V
Digital outputs	Open Collector NPN	
Digital outputs, max voltage	30	V
Digital output, max. current	50	mA
Current consumption (no motor)	40	mA

ELECTRICAL AND OTHER DATA		
Max. phase current	800 (500)	mA
Temperature range	-20 ... 70	°C
Software operating system	Windows 95 to XP	
Communication Driver/PC	RS 232	

7. Failure Analysis

Problem	What to do
Motor does not move after programming a movement when pressing start	The start button on the driver board is handled like an external input. It must be programmed in the sequence to act on this button.

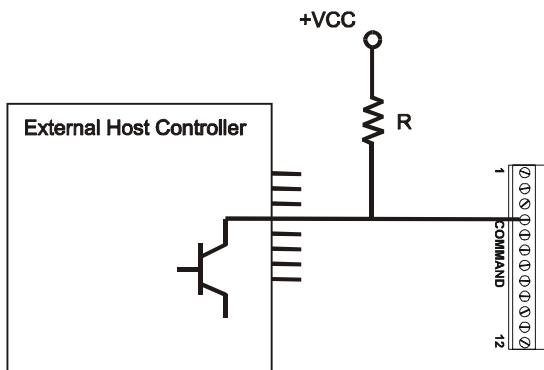
8. Special NOTES

8.1 Pull-up resistor

Pull-Up

The inputs of the drivers namely clock, direction, START/ STOP are open collector inputs.

Open Collector (or Open Drain) output is frequently offered by programmable logics because of their higher safety. They require an adaptation to the AD driver series with a PULL-UP resistor.



This configuration is necessary for the inputs/outputs 1-7 of all PREC1step drivers.

The value of resistor used to pull up an open-collector is not critical. Smaller values offer faster switching times at the price of higher current consumption.

Typical values range from a few thousand to a few hundred thousand Ohms.

Please note that the signal is inverted this way.