AMC20 / AMC21
AMC22
And
AMC20P / AMC21P
AMC22P

AC-Servo Motor Controller

User Manual

JVL Industri Elektronik A/S

Revised 07.03.2003

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Contents

1 Introduction

1.1 Features

Type Overview			
Type	**Power (Max)**	**Program Execution**	**JVL Bus Interface**
AMC20	**1kW**	**No**	**No**
AMC20P	**1kW**	**Yes**	**Yes**
AMC21	**2kW**	**No**	**No**
AMC21P	**2kW**	**Yes**	**Yes**
AMC22	**3kW**	**No**	**No**
AMC22P	**3kW**	**Yes**	**Yes**

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Types AMC20, AMC21 and AMC22 comprise a series of compact programmable AC servo motor controllers.

The Controllers are characterised by an ability for control via either the built-in RS232/RS485 interface or an analogue input (±10V).
In addition, the Controllers can be controlled as in a step motor system via pulse inputs.

The Controllers can be configured for absolute/-relative positioning via 6 digital inputs.
The Controllers accept a balanced or unbalanced signal from a standard 2-channel incremental encoder.

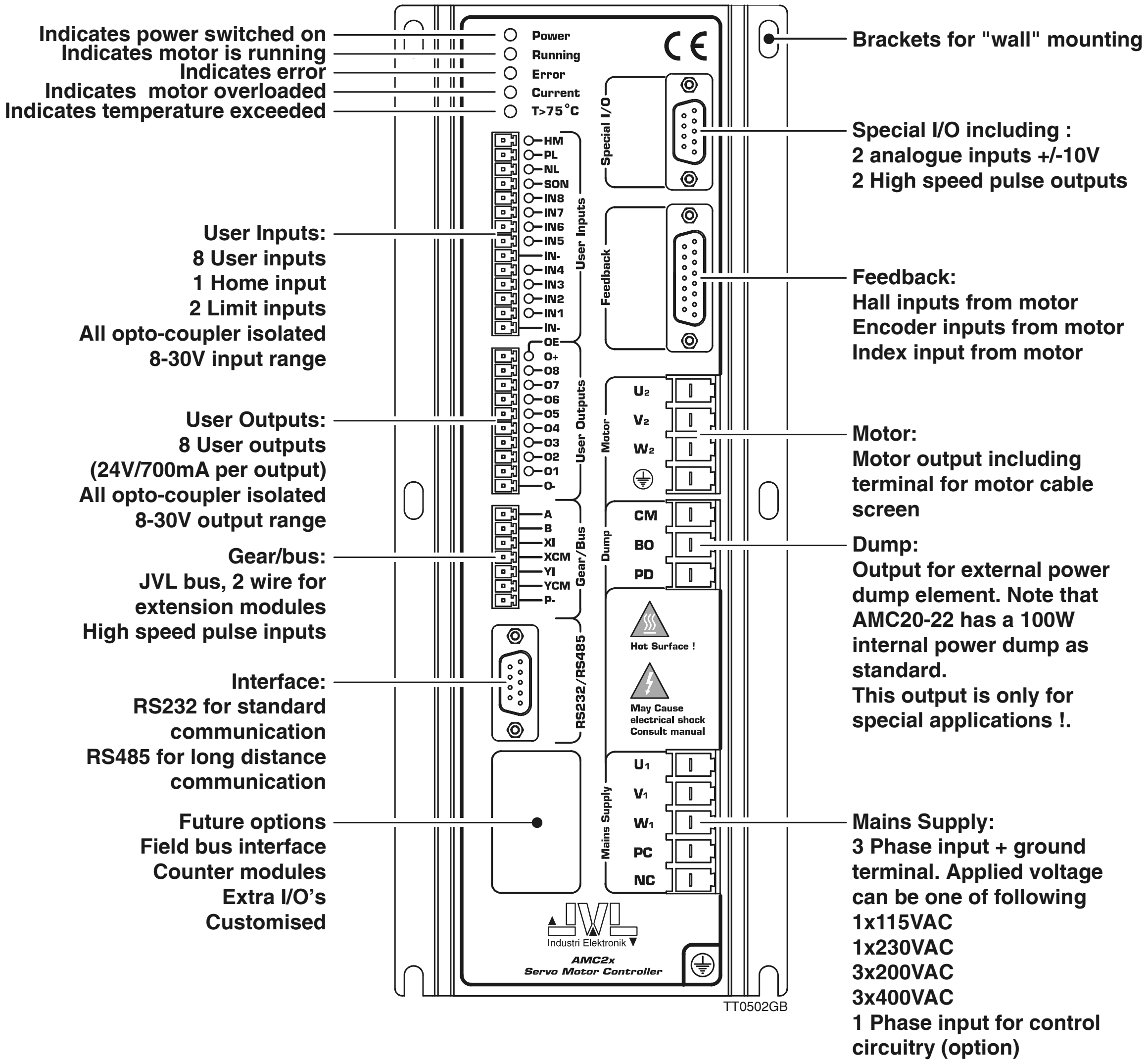
All user inputs and outputs are optically isolated and protected against voltage overloads.

The Controllers are equipped with 8 general-purpose outputs.
These can be configured, for example, to give a ready signal when the motor has reached its desired position, or an error signal if an obstruction occurs that prevents motor operation.
The Controllers can be wall mounted.

Main Features:

- Digital servo regulation (Z transformation)
- Extremely precise positioning
- Small physical dimensions
- AMC20 1kW, AMC21 2kW, AMC22 3kW
- Complete auto tuning of filter parameters
- Short-circuit and thermal-overload protection
- Absolute/Relative positioning
- EMC compliant construction - CE approved
- User interface based at Windows program
- Following input facilities:
  Analogue +/-10V
  Step-pulse and direction
  Pulse up - pulse down
  Incremental encoder
  Digital selection of position
  Program-controlled motion (AMC2xP)
- Graphic monitoring of velocity, torque, position, etc.
- End-of-travel limit inputs
- RS232/R485 Interface
- Set-up stored in FLASHPROM (no batteries)
- Can handle motors up to 3kW (10kW peak)
- Pre-programmed velocity profiles
- Programming via simple language
- Flexible, with more than 100 commands
- Any synchronous AC motor can be used
- Integrated mains supply filter

1.2 Controller Front Panel



1.2.1 Front Panel

The illustration above shows all the external connectors and LED indicators.
This illustration only serves as a general overview. For a specific description of each item, consult chapter 3 in this manual.

1.3 Overview of Operating Modes

1.3.1 Basic Modes of Controller Operation

The AMC series of Servo Controllers includes many individual features for use in a wide range of applications. The Controllers are operated in one of five basic modes of operation which are selected using the Mode command *MO*. The basic modes of operation are as follows:

1. Gear Mode

In Gear Mode, the Controller functions as in a step motor system. The motor will move one step each time a voltage pulse is applied to the Controller's pulse inputs. Velocity and acceleration/deceleration are determined by the externally applied pulse frequency. Configuration of these pulse inputs enables the following:

- Connection of an incremental encoder so that the motor operates at a selectable gearing ratio in relation to the encoder (electronic gearing).
- Connection of a step-pulse and direction signal to the 2 pulse inputs. This represents a typical step motor configuration.
- Connection of a pulse signal to one of the two pulse inputs. If the motor is required to move forward, pulses are applied to one input; if the motor is required to move in the opposite direction, pulses are applied to the other input.

2. Positioning Mode

In Positioning Mode, the Controller positions the motor via commands transmitted over the RS232 interface or RS485 interface.

This mode can be used primarily when the Controller is part of a system which is permanently connected to a PC via the RS232 interface. In addition, it is recommended that Positioning Mode is used during installation and commissioning of systems.

3. Register Mode

In this mode, the Controller's set of parameter registers (X0-X63) store the position and velocity values etc. required by the actual system. These registers can be addressed via the User Inputs and are activated by activating a start input. This mode of operation is especially powerful since the Controller itself takes care of the entire positioning sequence.

4. Velocity Mode

In this mode, the Controller controls the motor velocity via the analogue input.

This mode is typically used for simple applications or applications in which another device, such as a PC-card or PLC with controller modules, is used for overall control of velocity and position.

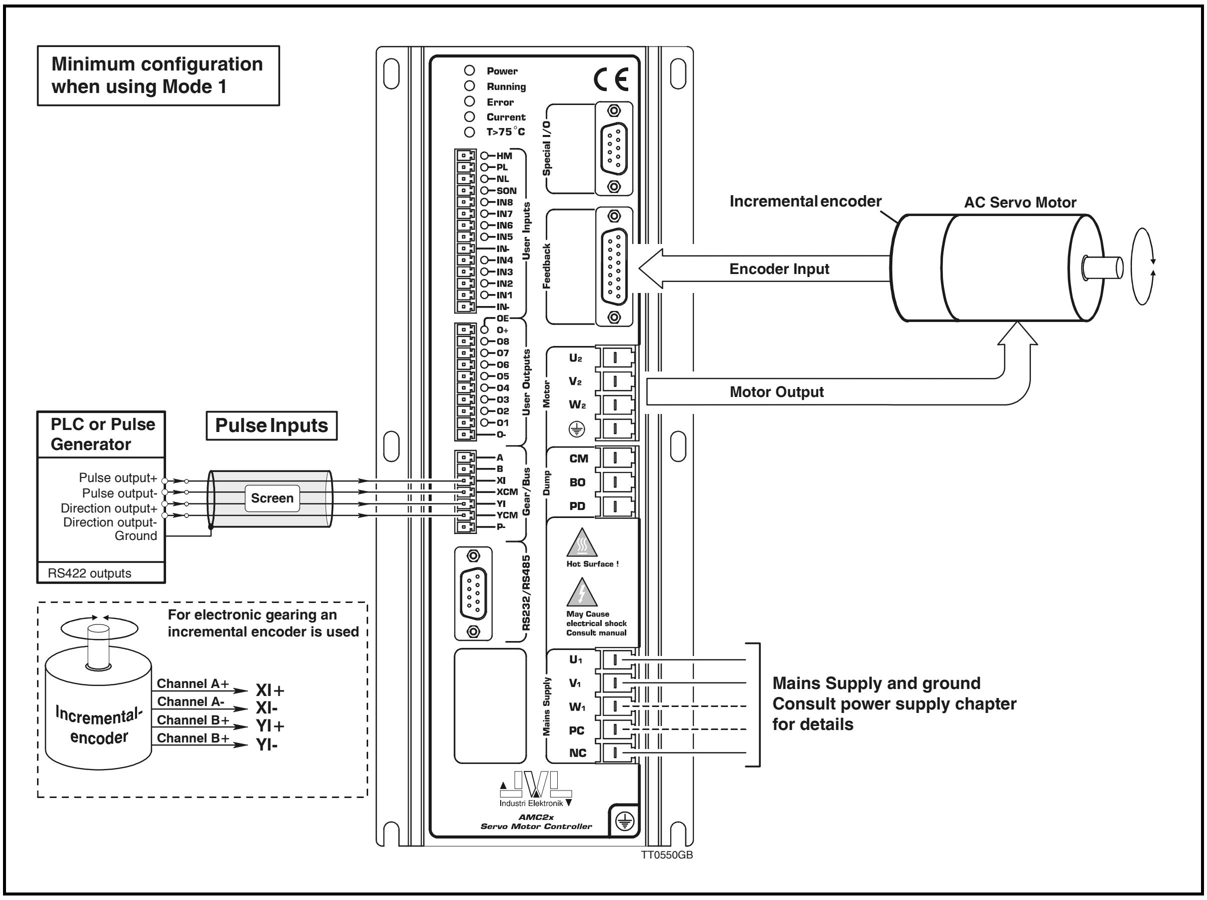
5. Torque Mode

In Torque Mode, the Controller controls the motor torque via the analogue input.

Typical applications for this mode include, for example, spooling or tensioning of foil, cable etc.

The individual modes of operation are illustrated further in the following pages. These pages provide a quick guide to setting up a functional system. For more detailed documentation of the modes of operation, the individual inputs and outputs and the Controller command set are described in *Hardware*, page 23 and *Software*, page 49.

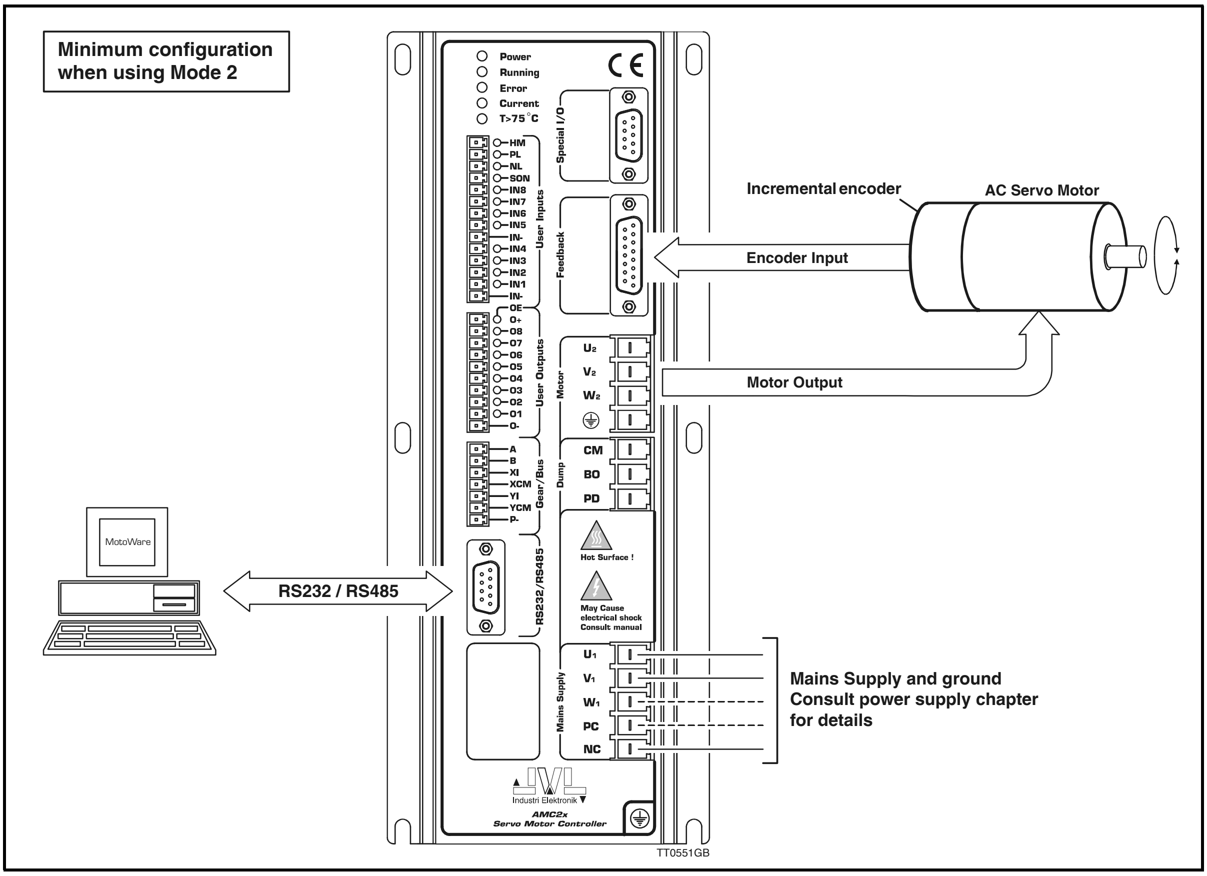
1.4 Getting Started — Gear Mode (Mode 1)



Follow the procedure below for operation of the Controller in Mode 1 (Gear Mode)

1. Connect the Controller as shown above. For further details, see: *Motor Connection*, page 27 / *Encoder Input*, page 29 / *Power Supply*, page 25 / *Pulse Inputs*, page 37.
2. Connect the PC via JVL's *MotoWare*, if necessary following the description of the RS232 interface in *RS232 Interface*, page 43.
3. Switch on the Controller, but ensure that all inputs are inactive. Only the *Power* LED and possibly *Out 1* may be active. If one or more of the red LEDs is active or blinks, the Controller is most likely set up for the wrong motor type. Follow the instructions in *General Aspects of Installation*, page 12
4. Send the command *?* (enter) to the Controller and wait until the Controller responds with a status overview.
   If the status overview is displayed, the RS232 interface and power supply are connected correctly.
5. Set the Controller to Gear Mode by sending the command *MO=1* (enter).
   The Controller should respond *Y*, indicating that Gear Mode (Mode 1) has been selected.
6. The Controller is now set to Gear Mode.

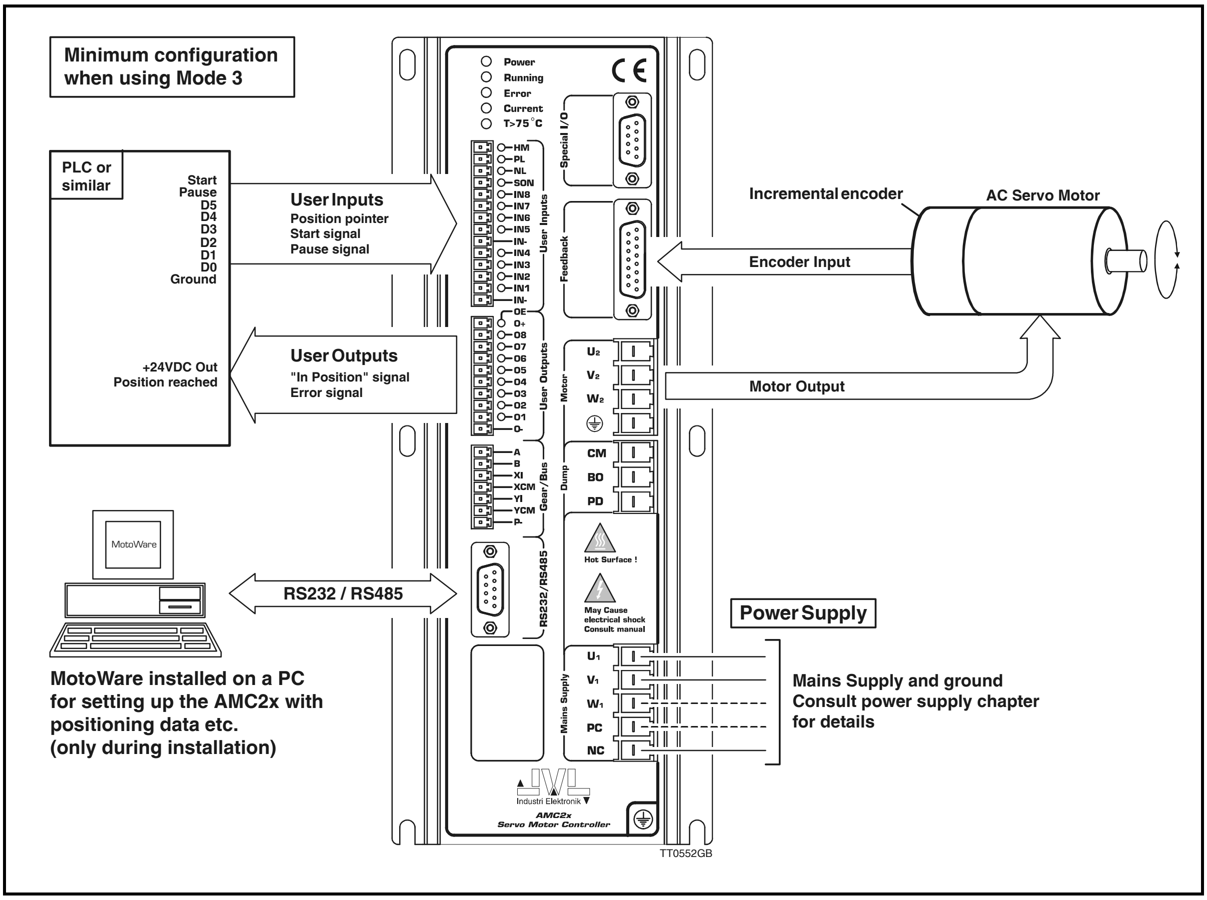
1.5 Getting Started — Positioning Mode (Mode 2)



Follow the procedure below for operation of the Controller in Mode 2 (Positioning Mode)

1. Connect the Controller as shown above. For further details, see: *Motor Connection*, page 27 / *Encoder Input*, page 29 / *Power Supply*, page 25.
2. Connect the PC via a terminal program (e.g. JVL's MotoWare or Windows *Terminal*), if necessary following the description of the RS232 interface in *RS232 Interface*, page 43.
3. Switch on the Controller, but ensure that all inputs are inactive. Only the *Power* LED and possibly *Out 1* may be active. If one or more of the red LEDs is active or blinks, the Controller is most likely set up for the wrong motor type. Follow the instructions in *General Aspects of Installation*, page 12
4. Send the command *?* (enter) to the Controller and wait until the Controller responds with a status overview.
   If the status overview is displayed, the RS232 interface and power supply are connected correctly.
5. Set the Controller to Positioning Mode by sending the command *MO=2* (enter).
   The Controller should respond Y, indicating that Positioning Mode has been selected.
6. The Controller is now set to Positioning Mode. As a test, the motor can be moved to absolute position 1000 by sending the command *SP=1000* (enter). The motor should move to the specified position. By sending the command *SP=-1000* (enter), the motor will move in the opposite direction to position -1000. If this does not occur, or if the motor runs for a very long time, it may be due to the fact that the position counter either was at position 1000, or that the previous position was far from 1000. See *Positioning Mode (MO=2)*, page 53 and *Command Description*, page 79 for details of other commands.

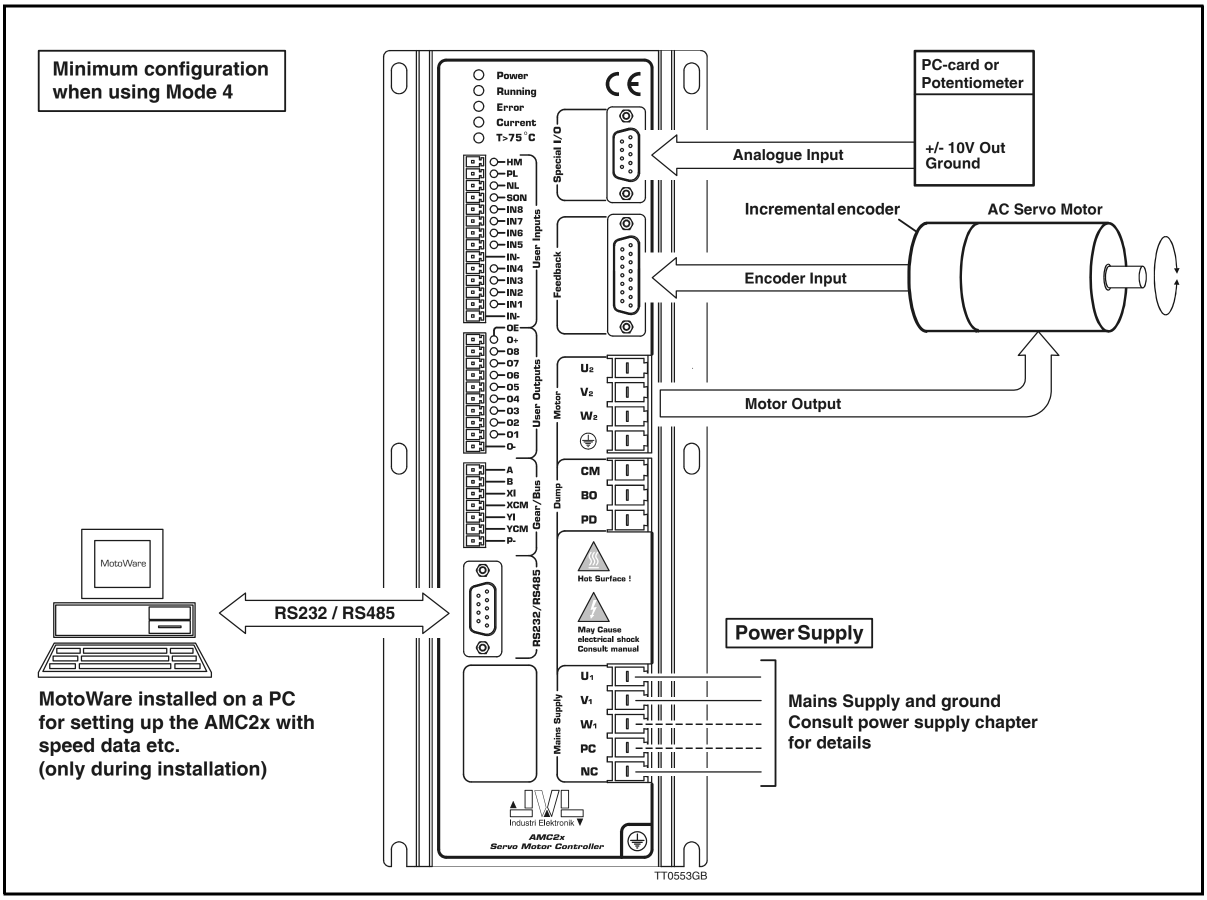
1.6 Getting Started — Register Mode (Mode 3)



Follow the procedure below for operation of the Controller in Mode 3 (Register Mode)

1. Connect the Controller as shown above. For further details, see: *Motor Connection*, page 27 / *User Inputs*, page 33 / *User Outputs*, page 36 / *Encoder Input*, page 29 / *Power Supply*, page 25.
2. Connect the PC via a terminal program (e.g. JVL's *MotoWare* or Windows *Terminal*), if necessary following the description of the RS232 interface in *RS232 Interface*, page 43.
3. Switch on the Controller, but ensure that all inputs are inactive. Only the *Power* LED and possibly *Out 1* may be active. If one or more of the red LEDs is active or blinks, the Controller is most likely set up for the wrong motor type. Follow the instructions in *General Aspects of Installation*, page 12
4. Send the command *?* (enter) to the Controller and wait until the Controller responds with a status overview.
   If the status overview is displayed, the RS232 interface and power supply are connected correctly.
5. Set the Controller to Register Mode by sending the command *MO=3* (enter).
   The Controller should respond *Y*, indicating that Register Mode has been selected.
6. The Controller is now set to Register Mode. As a test, connect a voltage to input 1 and 8 (start input).
   The motor should move to position 1000. This value is stored by default in register *XP1* on delivery.
   For further information on operation in Mode 3, see *Register Mode (MO=3)*, page 54

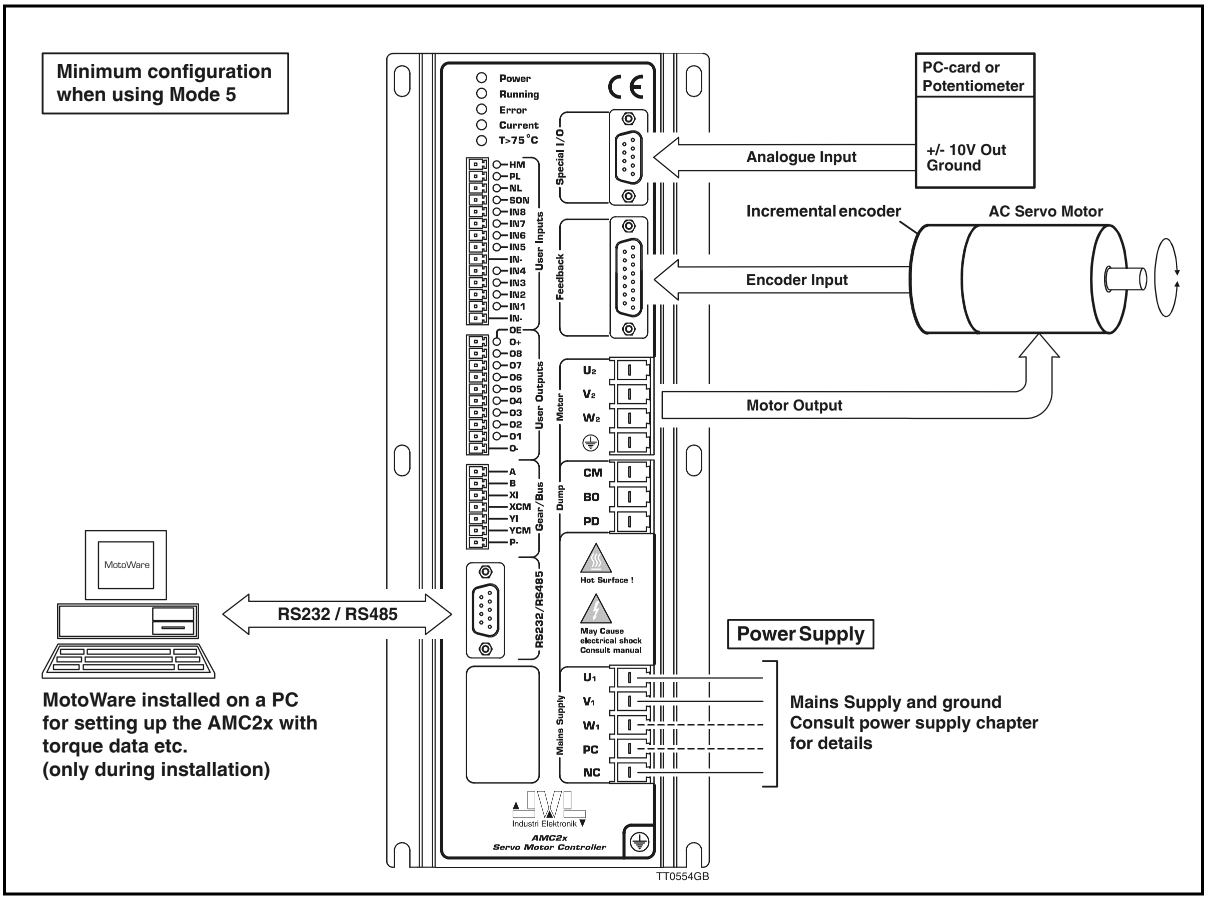
1.7 Getting Started — Velocity Mode (Mode 4)



Follow the procedure below for operation of the Controller in Mode 4 (Velocity Mode)

1. Connect the Controller as shown above. For further details, see: *Motor Connection*, page 27 / *Encoder Input*, page 29 / *Power Supply*, page 25 / *Analogue Inputs*, page 41.
2. Connect the PC via a terminal program (e.g. JVL's *MotoWare* or Windows *Terminal*), if necessary following the description of the RS232 interface in *RS232 Interface*, page 43.
3. Switch on the Controller, but ensure that the Analogue Input is 0 volt. Only the *Power* LED and possibly *Out 1* may be active. If one or more of the red LEDs is active or blinks, the Controller is most likely set up for the wrong motor type. Follow the instructions in *General Aspects of Installation*, page 12
4. Send the command *?* (enter) to the Controller and wait until the Controller responds with a status overview.
   If the status overview is displayed, the RS232 interface and power supply are connected correctly.
5. Set the Controller to Velocity Mode by sending the command *MO=4* (enter).
   The Controller should respond *Y*, indicating that Velocity Mode has been selected.
6. The Controller is now set to Velocity Mode. When the voltage applied to the analogue input is greater than 0V, the motor will move at a velocity which is proportional to the applied voltage. If the applied voltage is less than 0V (negative), the motor will move in the opposite direction.
   For further information, see *Velocity Mode (MO=4)*, page 59.

1.8 Getting Started — Torque Mode (Mode 5)



Follow the procedure below for operation of the Controller in Mode 5 (Torque Mode)

1. Connect the Controller as shown above. For further details, see also: *Motor Connection*, page 27 / *Power Supply*, page 25 / *Analogue Inputs*, page 41.
2. Connect the PC via a terminal program (e.g. JVL's *MotoWare* or Windows *Terminal*), if necessary following the description of the RS232 interface in *RS232 Interface*, page 43.
3. Switch on the Controller, but ensure that the Analogue Input is 0 volt. Only the *Power* LED and possibly *Out 1* may be active. If one or more of the red LEDs is active or blinks, the Controller is most likely set up for the wrong motor type. Follow the instructions in *General Aspects of Installation*, page 12
4. Send the command *?* (enter) to the Controller and wait until the Controller responds with a status overview.
   If the status overview is displayed, the RS232 interface and power supply are connected correctly.
5. Set the Controller to Torque Mode by sending the command *MO=5* (enter).
   The Controller should respond *Y,* indicating that Torque Mode has been selected.
6. The Controller is now set to Torque Mode. When the voltage applied to the Analogue Input is greater than 0V, the motor will produce a positive torque which is proportional to the applied voltage. When the input voltage is less than 0V (negative), the motor will produce a negative torque proportional to the applied voltage. If the motor is unloaded or the load torque is less than the adjusted torque, then the direction of motor movement will follow the sign at the analogue input.
   For further information, see *Torque Mode (MO=5)*, page 60.

2 Installation and Adjustment

2.1 General Aspects of Installation

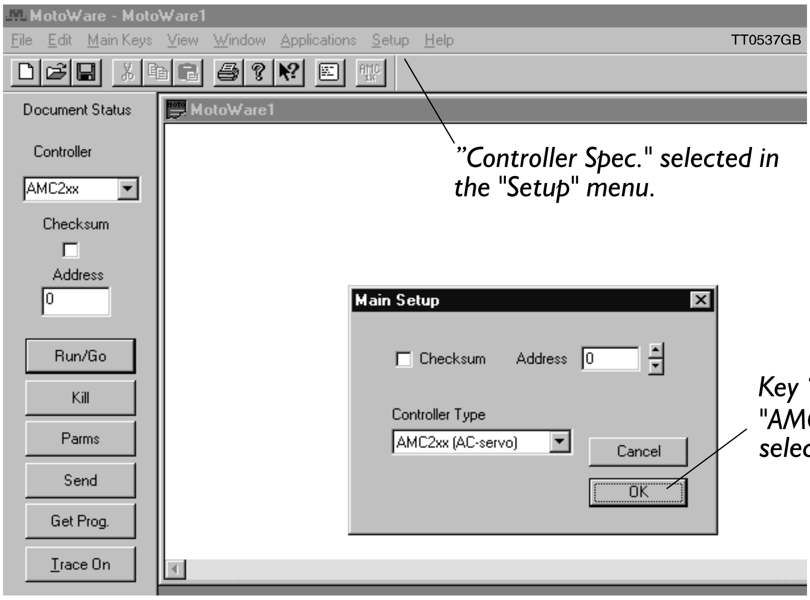
It is recommended that this section is read carefully in conjunction with the installation of the AC Servo Controller.
When the Controller has been installed, the following check-list should be followed:

1. Ensure that the selection of the Controller's basic mode of operation (1-5) is correct. If necessary, refer to *Overview of Operating Modes*, page 4, which explains the overall use of the various modes of operation.

2. Connect the motor, encoder, any hall-sensor, diverse end-of-travel inputs, inputs and outputs as required. Details of motor connection, inputs and inputs, powering, etc. are given in *Hardware*, page 23.
Note: For connection of motors and encoders, see the appendix *Examples of Motor Connection*, page 200, which gives specific connection diagrams for a number of AC servo motors. These sections also give the associated parameter values that the Controller should be set to for optimum motor operation.

3. Connect the power to the Controller. Most probably the default parameter settings will not correspond to the actual motor connected.
This will result in the Controller reporting an error and current to the motor will be disconnected.
If the actual motor used is one of the types named in the Appendix (*Examples of Motor Connection*, page 200) or included in *MotoWare*'s parameter list, these parameter values must be transferred to the Controller. See *Transfer of Parameters to the Controller*, page 13.
If the motor is recognised, the system should function optimally after transfer of the associated parameter set. Some fine adjustment may be carried out as described in this chapter. The basic installation of the Controller is now complete and the specific function of the Controller can now be set up and tested. See the description of Modes 1 to 5 in the Software section, pages 52 to 60, depending on the required mode of operation.
To optimise the complete system, follow the instructions given in *Adjustment of Servo Regulation*, page 18.
If the motor is **not** recognised, follow the instructions given in *Connection of an Unknown Motor Type*, page 190.

2.2 Transfer of Parameters to the Controller



Controller: AMC2xx

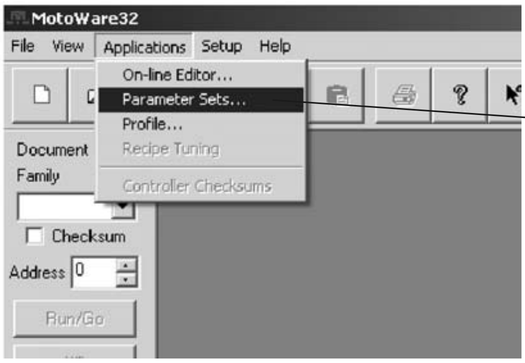
Address: 0

Main Setup: □ Checksum, Address 0, Controller Type AMC2xx (AC-servo)

"Controller Spec." selected in the "Setup" menu.

Key "OK" when "AMC2xx" is selected

For easy transfer of complete parameter sets to the Controller, JVL's PC-based programming tool *MotoWare* is recommended. The program is started and the RS232 cable connected to the Controller. Set *MotoWare* to work with the AC Servo Controller by selecting *AMC2xx (AC-Servo)* in the *Controller Spec.* window in the Setup menu. See illustration above. This adjusts *MotoWare* to work with the AMC20, 21 and 22, making available new windows that include, amongst others, a graphic display of motor operating conditions.
Key *OK* and the following screen is displayed.



Address: 0

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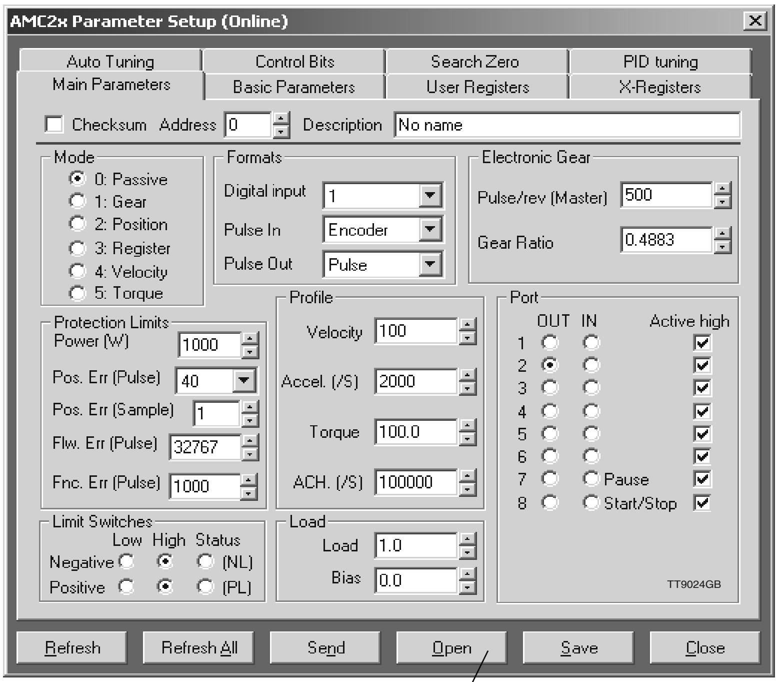
"Parameter sets" is selected in this menu

Select *Parameter Sets* in the *Applications* menu.
This gives access to the window containing all the basic parameters in the Controller.

2.2 Transfer of Parameters to the Controller



☐ Checksum Address 0 Description No name

Mode
● 0: Passive
○ 1: Gear
○ 2: Position
○ 3: Register
○ 4: Velocity
○ 5: Torque

Formats
Digital input 1
Pulse In Encoder
Pulse Out Pulse

Electronic Gear
Pulse/rev (Master) 500
Gear Ratio 0.4883

Protection Limits
Power (W) 1000
Pos. Err (Pulse) 40
Pos. Err (Sample) 1
Flw. Err (Pulse) 32767
Fnc. Err (Pulse) 1000

Profile
Velocity 100
Accel. (/S) 2000
Torque 100.0
ACH. (/S) 100000

Port

	OUT	IN		Active high
1	○	○		☑
2	●	○		☑
3	○	○		☑
4	○	○		☑
5	○	○		☑
6	○	○		☑
7	○	○	Pause	☑
8	○	○	Start/Stop	☑

Limit Switches

	Low	High	Status	
Negative	○	●	○	(NL)
Positive	○	●	○	(PL)

Load
Load 1.0
Bias 0.0

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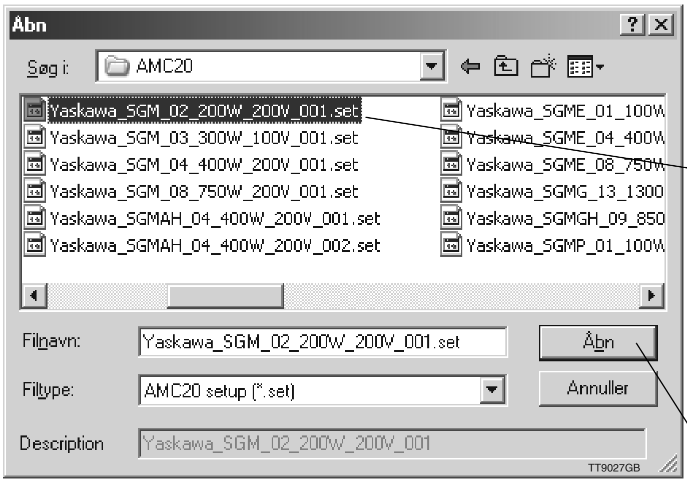
Select "Open" to obtain the motor list

To select a specific motor type, select *File*. The following window will appear.



Søg i: AMC20

Yaskawa_SGM_02_200W_200V_001.set
Yaskawa_SGM_03_300W_100V_001.set
Yaskawa_SGM_04_400W_200V_001.set
Yaskawa_SGM_08_750W_200V_001.set
Yaskawa_SGMAH_04_400W_200V_001.set
Yaskawa_SGMAH_04_400W_200V_002.set
Yaskawa_SGME_01_100W
Yaskawa_SGME_04_400W
Yaskawa_SGME_08_750W
Yaskawa_SGMG_13_1300
Yaskawa_SGMGH_09_850
Yaskawa_SGMP_01_100W

Filnavn: Yaskawa_SGM_02_200W_200V_001.set
Filtype: AMC20 setup (*.set)
Description Yaskawa_SGM_02_200W_200V_001

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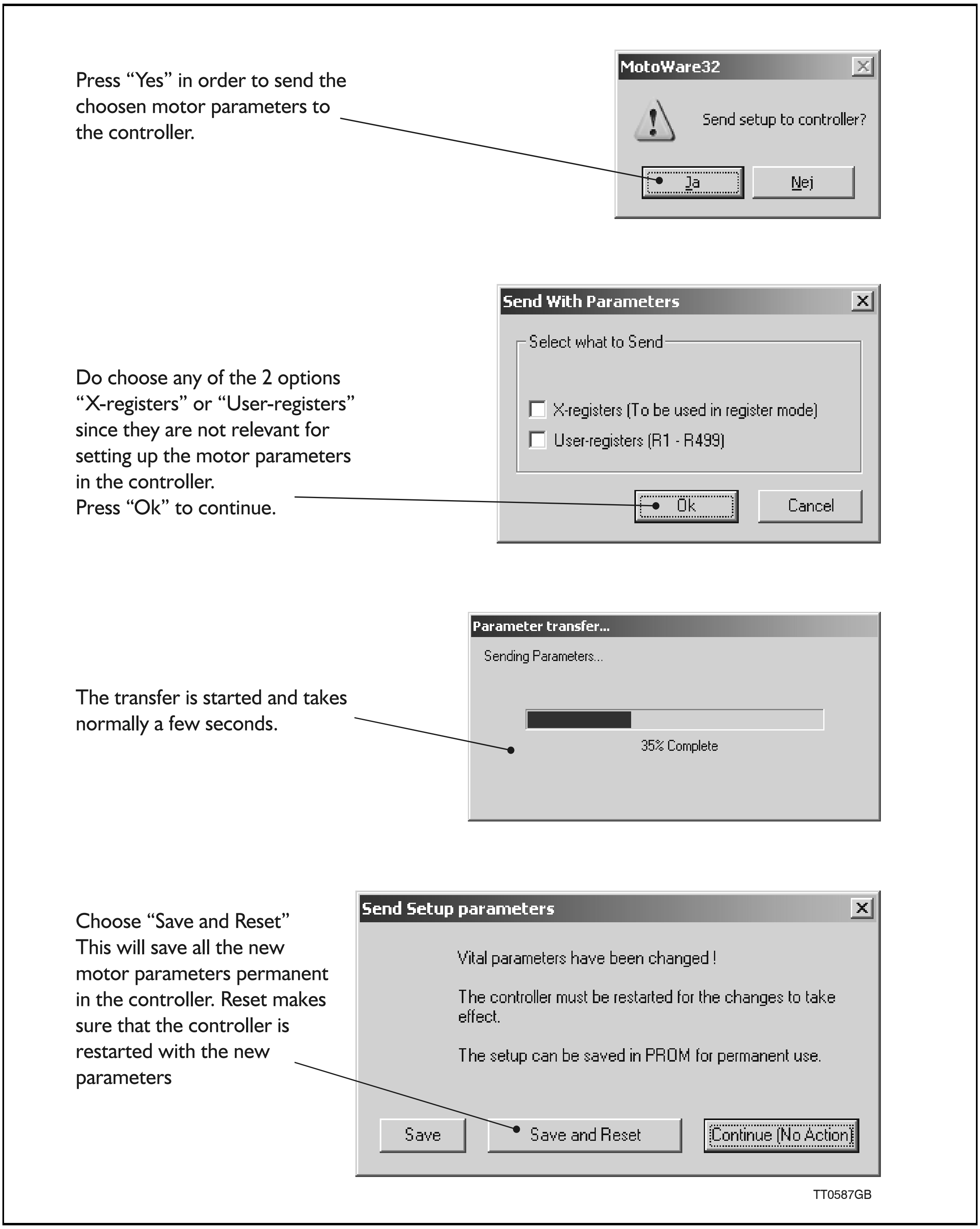
Select motor type

Select "Open" to obtain the motor parameters

Select the required motor type and select *Open* to view the parameters.

2.2 Transfer of Parameters to the Controller



Press “Yes” in order to send the choosen motor parameters to the controller.

MotoWare32

Send setup to controller?

Do choose any of the 2 options “X-registers” or “User-registers” since they are not relevant for setting up the motor parameters in the controller.
Press “Ok” to continue.

Send With Parameters

Select what to Send

□ X-registers (To be used in register mode)

□ User-registers (R1 - R499)

The transfer is started and takes normally a few seconds.

Parameter transfer...

Sending Parameters...

35% Complete

Choose “Save and Reset” This will save all the new motor parameters permanent in the controller. Reset makes sure that the controller is restarted with the new parameters

Send Setup parameters

Vital parameters have been changed !

The controller must be restarted for the changes to take effect.

The setup can be saved in PROM for permanent use.

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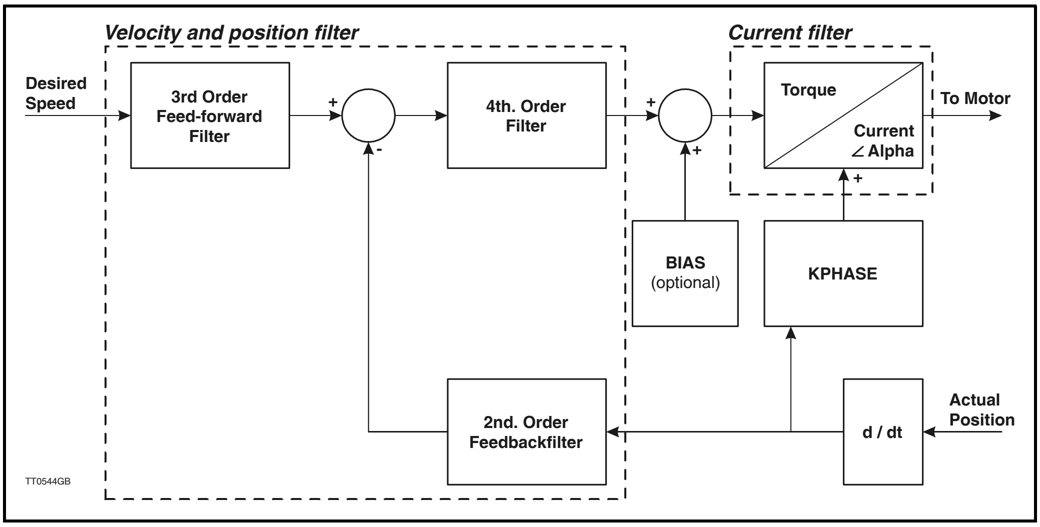
After going through the different dialog boxes above the controller will now be setup to control the actual motor chosen. The new parameters will now appear on the screen in the parameter window. The motor should be able to run now however the parameters probably needs to be optimised for the actual inertias etc.

2.3 Current filter optimizing

2.3.1 Optimizing the current filter (optional).

The files in the motor libary is ment to be a good choice for getting the motor fast up and running without playing around for hours to find the right motor setup.
The current filter optimize function must therefore be seen as an option.
Please be awear that the controller include two main filter blocks.

- **Velocity and position filter block**
  Controls the velocity, acceleration and position.
- **Current filter.**
  This filter is receiving the output from the velocity/position filter and convert the information to a specific motor current.



As it is seen, the result from the main filter (velocity and position) converted into a physical current in the current filter block. Therefore it is extremely important that the current filter is optimized as good as possible to obtain a perfect performance.
The filter is optimized by entering the following parameters in the parameter window.

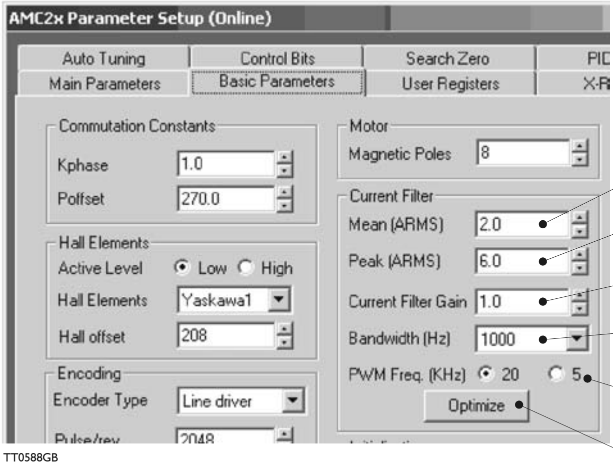
- **Mean (ARMS).**
  Make sure that the allowable average current for the actual motor is entered in this field.
- **Peak (ARMS).**
  Make sure that the allowable peak current for the actual motor is entered in this field. If the actual motor is specified for a higher peak current than the controller can handle the actual value must still be entered. Internally it will be limited to the value that the actual controller is capable of delievering but the value is also used internally to linearize the current at high values.
- **Current filter gain.**
  Leave this value to 1.0. If the motor is very small (<400W) it can sometimes be very unlinear when the peak current becomes close to the maximum. This will produce an audible high frequency which can be avoided by decreasing the current filter gain.
- **Bandwidth (Hz).**
  This value is important. 2 main aspects must be considered.
  If it is desired that the system must be quiet (no audible noise) a **low** value must be chosen.
  If it is desired that the system is very rapid and the motor needs to move at a high velocity with a good efficiency a **high** value must be chosen.
  See also Current Loop Bandwidth (MAXFREQ) page 129.

(continued next page)

2.3 Current filter optimizing

(continued from last page)

- **PWM Freq. (KHz)**
  Leave this value to 20 KHz. Only by using long motor cables or if the temperature of the controller starts to be critical it must be considered to chose 5 KHz.
  At 5 KHz the regulation is slower but the loses in the controller, the cable and in the motor is less. Normally it is not a problem to use 5KHz at motors with a rated power of 1kW and up since the internal timeconstant is anyway high.



Commutation Constants
Kphase 1.0
Polfset 270.0

Hall Elements
Active Level ● Low ○ High
Hall Elements Yaskawa1
Hall offset 208

Encoding
Encoder Type Line driver
Pulse/rev 2048

Motor
Magnetic Poles 8

Current Filter
Mean (ARMS) 2.0
Peak (ARMS) 6.0
Current Filter Gain 1.0
Bandwidth (Hz) 1000
PWM Freq. (KHz) ● 20 ○ 5

Enter the motors allowable average current in this field.

Enter the motors allowable peak current in this field.

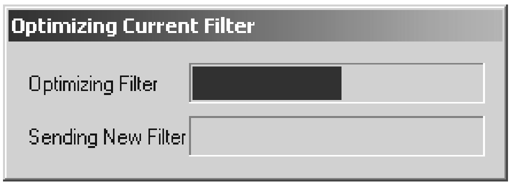
Leave this field at 1.0 (default).

Bandwidth for the current filter can be specified here. Normally 1000Hz will do.

The motor output carrier frequence is specified here (default = 20KHz).

Use "Optimize" after setting the parameters above to prober values.

When all the 5 parameters are setup start the optimize by selecting the "Optimize" button. In advance be sure that the controller is in passive mode (MO=0).
Now it will take a few seconds where the controller tests the actual motor connected to determine how the current filter must be calculated. Following progress bars will show.



Optimizing Current Filter

Optimizing Filter

Sending New Filter

When the progress bars dissapears the filter is optimized and ready to test.
Remember to save the result permanent in the controller by typing MS (memory save) in the online editor.

Please notice that if the basic motor setup is **NOT** done on basis of a motor parameter file from the motor libary it is important to tune the mainfilter (velocity/position filter). Follow the next couple of pages to do this.

2.4 Adjustment of Servo Regulation

2.4.1 Selection of Tuning Method

Before tuning is carried out, it should be noted that 2 different methods of tuning are available:

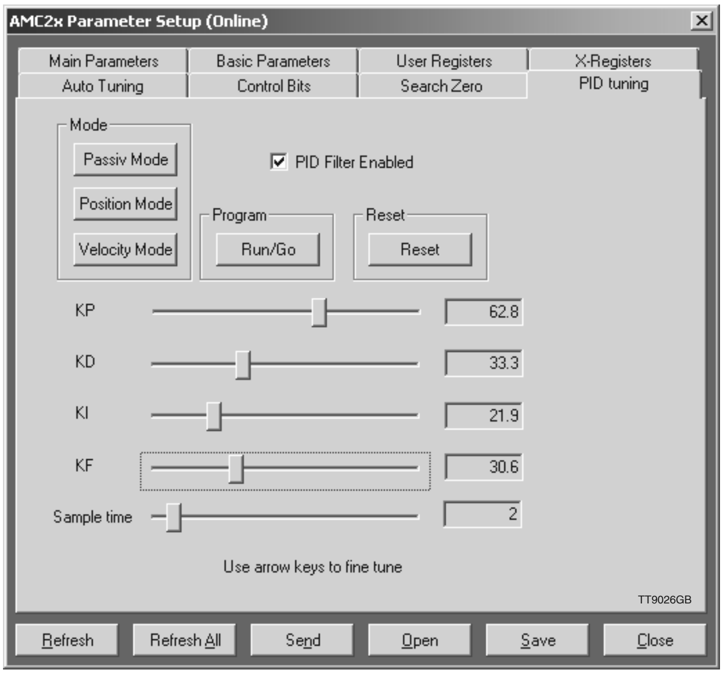
1. **Manual tuning using a PID filter**
   For simple and non-critical applications, the PID filter (1st. order filter) can be selected. The PID can only be manually adjusted. PID tuning involves 4 parameters: KP, KI, KD and KF (feed forward).
   Advantages:
   It is easy to obtain a stable system, also in cases where the transmission is elastic.
   Tuning can be done while the motor remains in a stationary position.
   Disadvantages:
   Dynamic performance is not as good as that obtained with auto-tuning.
   Coarse adjustment of the filter is done quickly, but it takes some time and know-how to optimise the filter for best performance.

2. **Auto-tuning using 2nd. to 6th. order filter.**
   Auto-tuning provides a method of tuning that is much better than manual tuning. This tuning involves a library of special "recipes" that are optimised for different applications and motor types.
   Advantages:
   It is easy to obtain an extremely good filter setting.
   Dynamic performance is optimal.
   The higher filter order makes it possible to avoid oscillations caused by non-linear mechanics.
   Very fast settling times can be obtained.
   Recipes can be made for OEM users who require specific system performance in an application.
   Disadvantages:
   The motor will move during the tuning sequence while the Controller determines the system performance.
   In case of extremely elastic or "sloppy" mechanics, it can be difficult to get a valid tuning result.

Choosing the right method of tuning:
Normally auto-tuning is recommended but in cases where the mechanics of a system are very elastic or the allowable positioning range of the motor is limited, manual PID tuning is recommended.

2.4.2 Manual tuning.

Use the window shown below. All relevant parameters are available via this window.



AMC2x Parameter Setup (Online)

Mode: Passiv Mode, Position Mode, Velocity Mode

☑ PID Filter Enabled

Program: Run/Go

Reset: Reset

KP 62.8

KD 33.3

KI 21.9

KF 30.6

Sample time 2

Use arrow keys to fine tune

Tuning sequence:

Make sure to activate the "PID Filter Enable" and chose "Position Mode" or "Velocity Mode" depending on the final application. "Position Mode" is used if the final mode is Gear Mode (MO=1), Position Mode (MO=2) or Register Mode (MO=3). Velocity Mode is chosen if the final mode is Velocity Mode (MO=4) or Torque Mode (MO=5).
Increase the KP factor very slowly until the motor starts to be noisy and unstable. At this point, decrease KP by 2-3 steps to make sure that the system remains stable.
Try to pull the motor/mechanics away from the stationary position. If the damping is not optimal, try to increase the KD factor until the damping improves. If the system starts to oscillate, decrease KD by 2-3 steps to make sure that the system remains stable.
KI can now be increased to ensure that a static positioning error will be minimized.

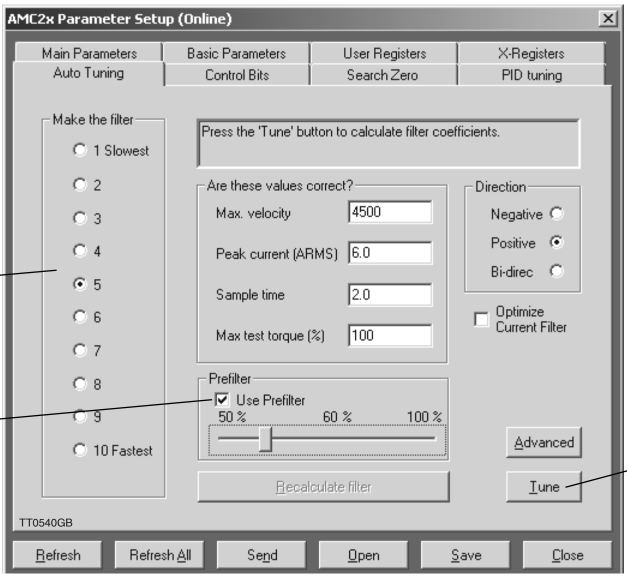
The feed forward factor KF can be used optionally. KF will make sure that the system has a fast response time when the speed reference goes up or down. KF is therefore important if the system must deliver a fast positioning cycle.

Errors during tuning:

If the tuning is interrupted by an error caused for example by heavy oscillations because of too high gain factors, it may be reset by the "Reset" botton.

2.4.3 Using Auto-tuning

The servo regulator in the Controller is a digital regulator based on a 7th. order filter, depending on the mode in which the Controller is operating. It is implemented using approximately 35 parameters, thus providing excellent regulation performance. The *MotoWare* software provides an aid by adjusting these parameters. Choose Filter Tuning in the parameter window.



AMC2x Parameter Setup (Online)

Press the 'Tune' button to calculate filter coefficients.

Make the filter: ○ 1 Slowest, ○ 2, ○ 3, ○ 4, ● 5, ○ 6, ○ 7, ○ 8, ○ 9, ○ 10 Fastest

Are these values correct?
- Max. velocity: 4500
- Peak current (ARMS): 6.0
- Sample time: 2.0
- Max test torque (%): 100

Direction: Negative ○, Positive ●, Bi-direc ○

□ Optimize Current Filter

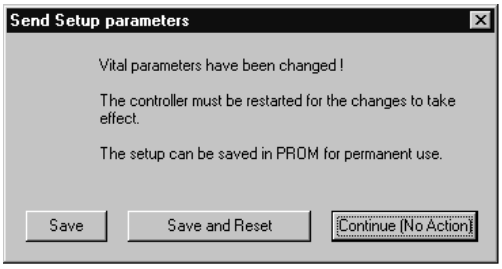
Prefilter: ☑ Use Prefilter (50 % – 60 % – 100 %)

Choose the filter response in 10 steps

The "Prefilter" is used if the positioning error must be low while the motor is running

Press "Tune" To start the filter adjustment

The following window will appear after tuning is completed. Before tuning please make sure that the parameters in the center "Max velocity" etc. is set to the right value since they are vital.



Send Setup parameters

Vital parameters have been changed !

The controller must be restarted for the changes to take effect.

The setup can be saved in PROM for permanent use.

Save: This will save the new filter parameters permanently.

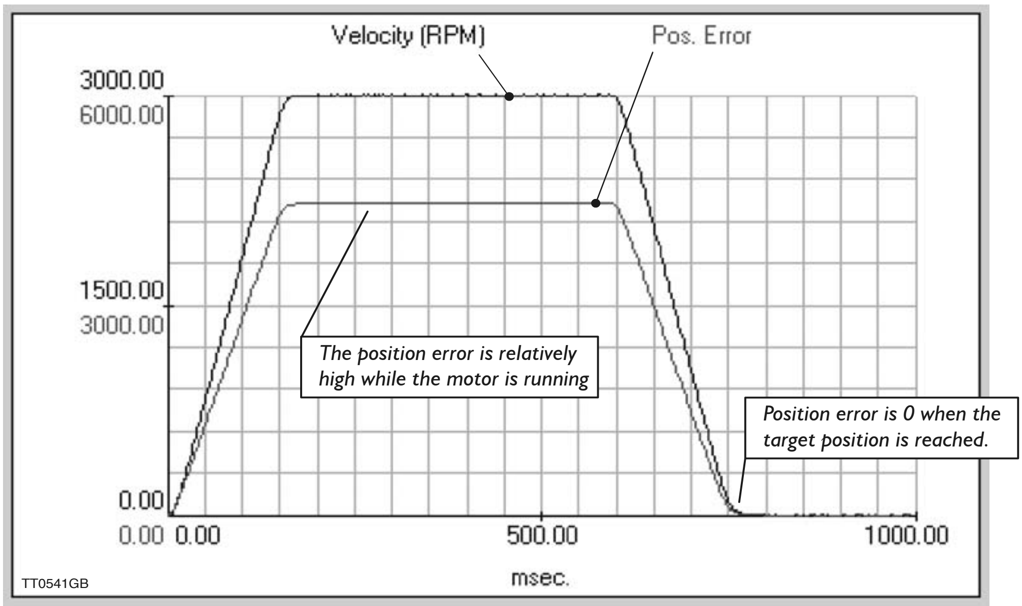
Save and Reset: This will save the new filter parameters permanently and perform a restart (reset) of the Controller.

Continue: This will not save the new filter parameters. The Controller will remain in the same mode as before the filter was tuned. The new filter parameters will be used but they will be lost if the power is switched off. The filter parameters can be saved subsequently by keying *MS* (enter) in the on-line editor.

2.4 Adjustment of Servo Regulation

The following curve shows a typical profile after tuning has been done **without** Prefilter.

Without "Prefilter"

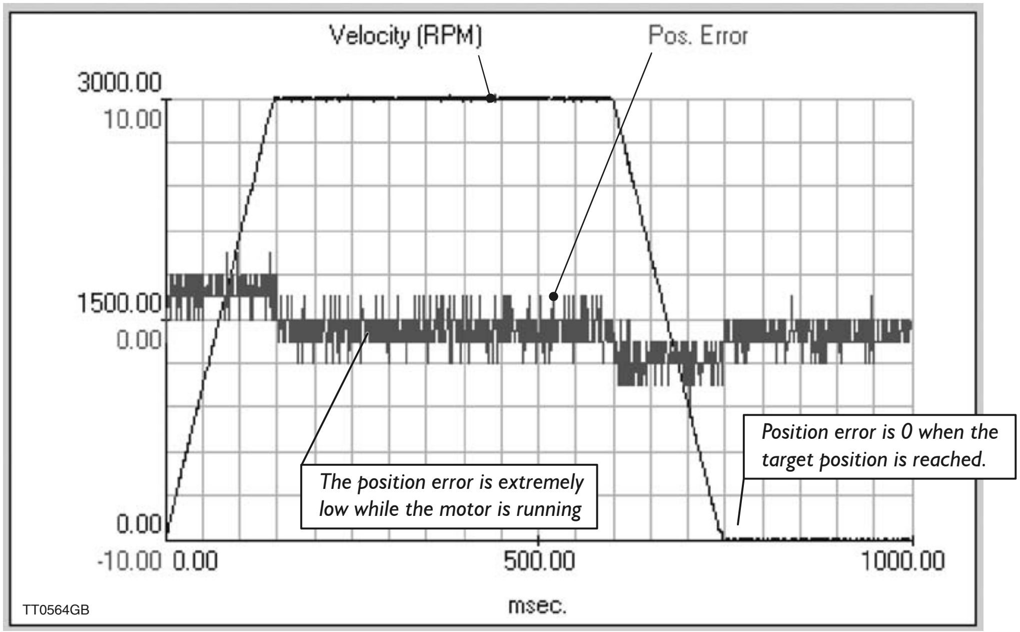


The position error is relatively high while the motor is running

Position error is 0 when the target position is reached.

By enabling the Prefilter (Prefilter set higher than 0%) the positioning error can be minimized to be close to zero.
The following curve shows a typical profile after tuning has been done **with** *Prefilter*.

With "Prefilter"



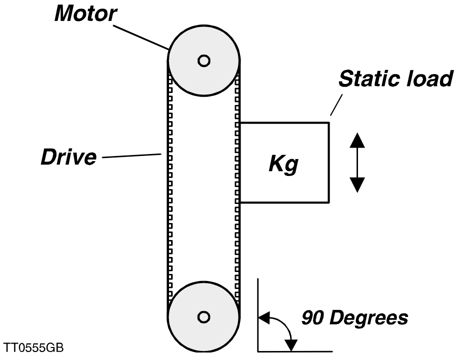
The position error is extremely low while the motor is running

Position error is 0 when the target position is reached.

The choice wheather to use Prefilter or not must depend on the audible noise desired, and the efficiency etc. In general using the prefilter will create a very "agressive" system which will reach very rapidly and hard against position errors.

2.5 Adjustment of BIAS

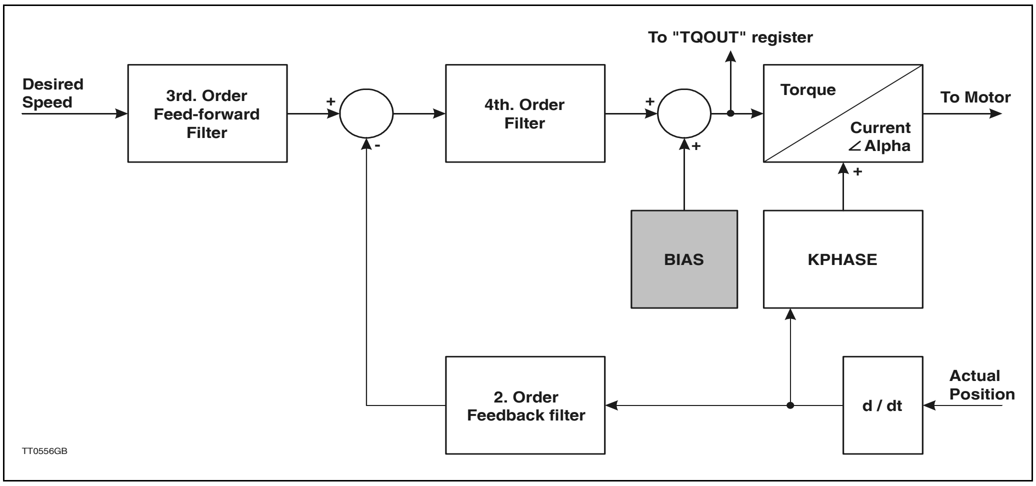
The Controller includes a parameter denoted BIAS. This parameter can be used in applications where the motor is subjected to a static load, e.g. a lifting mechanism.
The BIAS function enables a compensation to be made for the static load, regardless of whether the load is pushing or pulling on the motor. This BIAS adjustment is normally advantageous since the balance in the filter is uniform regardless of the direction of motor rotation and ultimately enables easier adjustment of the complete system and a faster response time.
Illustration of lifting mechanism:



Adjustment of the BIAS is made during system installation as follows:

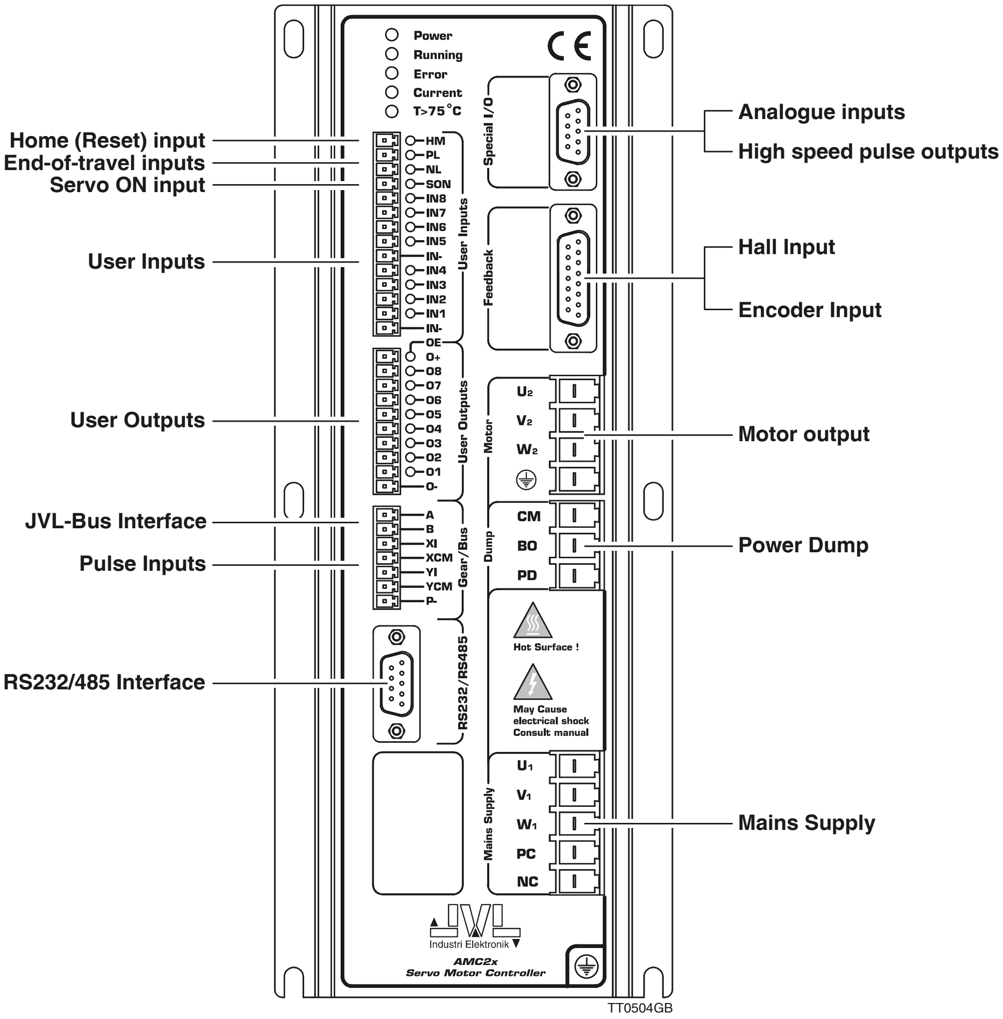
1. Ensure that motor installation (described elsewhere in this chapter) is done correctly and that the motor can operate normally. Open the *"On line editor"* in *MotoWare*.
2. Check that there is contact with the Controller by keying *? (enter)*.
3. Ensure that the motor is loaded with the required load for the system.
4. Set the Controller to Mode 2 by keying *MO=2 (enter)*.
5. Move to a position in the middle of the positioning range by keying *SP=n (enter)*. n specifies the desired position.
6. Read the internal filter torque value by keying *(enter). The controller will answer i.e. TQOUT=10.2*. Adjust the BIAS to this value by keying *BIAS=10.2 (enter)*. The system is now in equilibrium.
7. Finally, the *BIAS* value is stored in the Controller's non-volatile memory by sending the command *MS (enter)*. The filter constants may require re-adjustment after setting the *BIAS*. See *Adjustment of Servo Regulation*, page 18

The BIAS can also be adjusted using the main parameter window in *MotoWare*.



3 Hardware

3.1 Connections

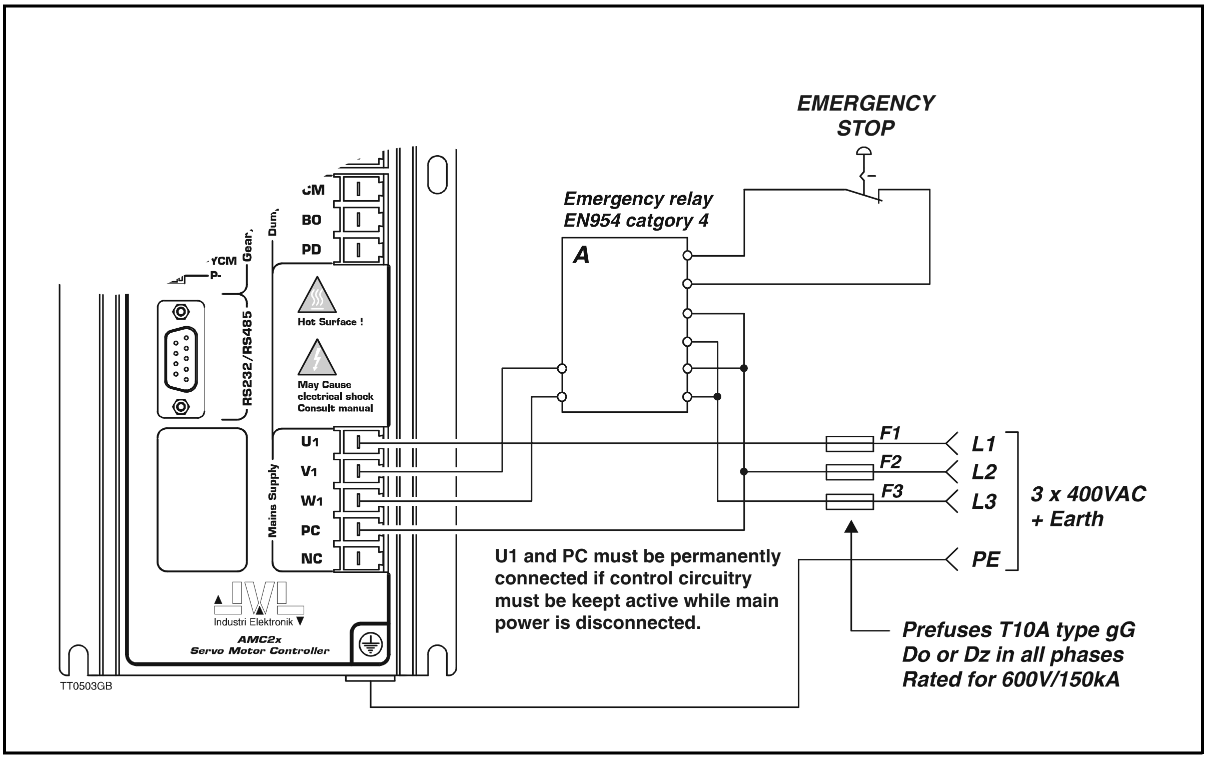


3.1.1 Connections

The illustration above shows the individual topics described in this Chapter. Each topic is described in the following sections:

Power Supply, page 25
Motor Connection, page 27
Encoder Input, page 29
Hall Input, page 31
Servo On Input (SON), page 32
User Inputs, page 33
End-of-travel Limit Inputs, page 34
Home (Reset) Input, page 35
User Outputs, page 36
Pulse Inputs, page 37
Pulse Outputs, page 40
Analogue Inputs, page 41
Power Dump Output, page 42
RS232 Interface, page 43
RS485 Interface, page 46
JVL-Bus Interface in the AMC2xP, page 47

3.2 Power Supply



3.2.1 General Aspects of Power Supply

Powering of the Controller is relatively simple. Types AMC20, AMC21 and AMC22 require a supply voltage in the range 200-250VAC single-phase or 100-400VAC three-phase.

3.2.2 3-Phase power supply of AMC20, AMC21 and AMC22

To ensure that powering of the Controller is as simple as possible, only a single supply voltage is connected. Internal supply circuitry ensures the correct supply voltages for the Driver, control circuits, etc.

For optimum driver performance, it is recommended that 1.5mm cable (minimum) is used to connect the power supply to the Controller. If the driver supply voltage falls below 80VAC, the internal reset circuitry will reset the driver. Provision should therefore be made to ensure that the supply voltage is always maintained at a minimum of 100VAC (3-phase) or 200VAC (single-phase), even in the event of a mains voltage drop.

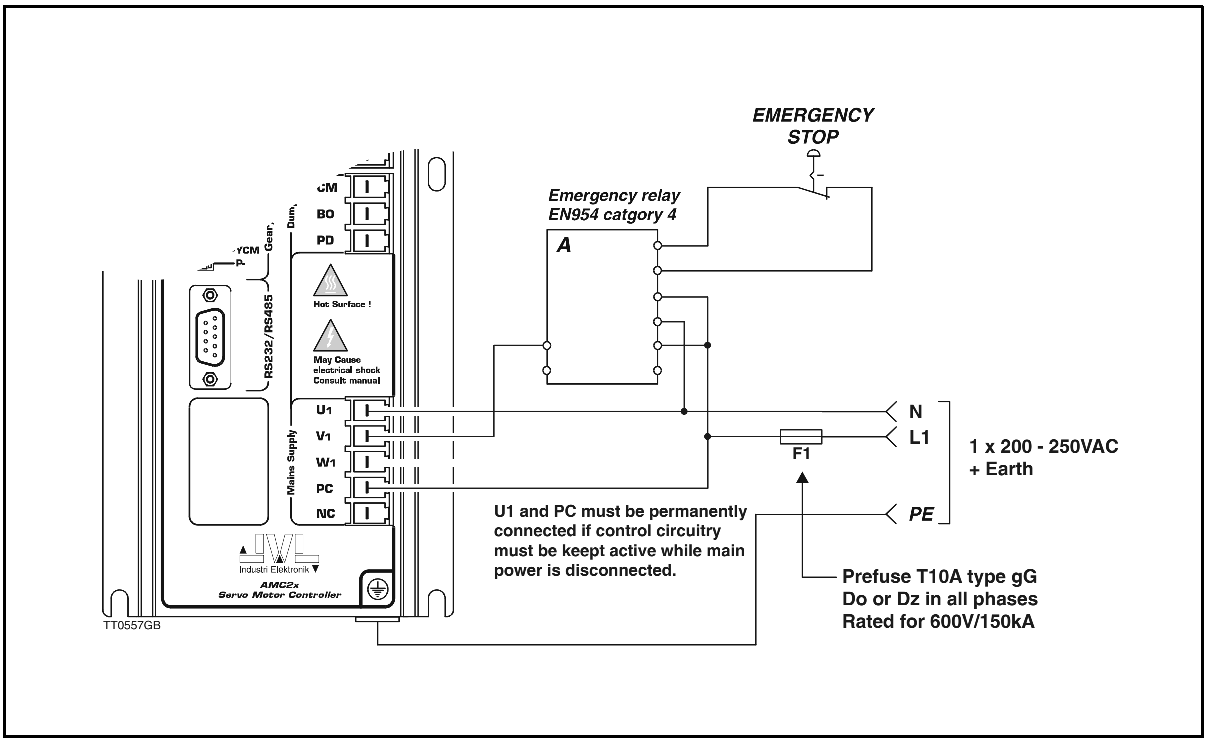
3.2.3 Earthing / Safety

To ensure proper earth connection, the earth terminal must always be connected before any other power source is connected to the Controller.

3.2.4 Power Supply Faults

The Controller is protected against undervoltage. If a voltage overload of the supply occurs, the error message E37 : Bus Voltage exceeds 800 V - Controller can be damaged ! page 170, will be given and the Controller will disable the motor driver circuitry. The motor will thus be without current.

Note that the Controller supply is only protected against voltage transients and not against a permanent overvoltage. The Controller can be damaged if the supply voltage is higher than 600VAC RMS between the supply terminals U1, V1, W1 and PC.



3.2.5 Single-phase Power Supply of AMC20 / AMC20P

A single-phase supply can be connected according to the above illustration.
It is only recommended that a single-phase supply is used if the power requirement is less than 800W. Power requirements greater than this require a 3-phase power supply.
AMC21 and AMC22 will therefore require a 3-phase power supply.

3.2.6 Earthing / Safety

To ensure proper earth connection, the earth terminal must always be connected before any other power source is connected to the Controller.

3.2.7 Power Supply Faults

The Controller is protected against undervoltage. If a voltage overload of the supply occurs, the error message "E37 : Bus Voltage exceeds 850 V" will be given and the Controller will disable the motor driver circuitry. The motor will thus be without current.
Note that the Controller supply is only protected against voltage transients and not against a permanent overvoltage. The Controller can be damaged if the supply voltage is higher than 600VAC RMS between the supply terminals U1, V1, W1 and PC.

3.3 Motor Connection

3.3.1 General Aspects of Motor Connection

The Controller is designed for use with common AC servo motors (brushless) with an incremental encoder. The Controller can supply high continuous and peak currents. These current values must be set using the software commands *CA* and *CP*.
The Controller Driver uses IGBT transistors, which give exceptionally good performance. The motor voltage is regulated at a frequency of 20kHz, which ensures that the motor does not produce any audible noise as a result of regulation.
The Driver's switching time is very short (<400nS), which can result in high-frequency noise components in the cables between the Driver and the motor.
In certain situations this can result in undesirable influences on other electronic equipment in close proximity to the servo motor system. To avoid this problem, the connection between the Controller and the motor should be made using screened cable, as shown in the illustrations on page 28. Furthermore, it is strongly recommended that screened cable is also used for the encoder cable to avoid any influence from the motor cable affecting the encoder signal.

3.3.2 Short-circuiting of the Motor Output

The Motor Output can withstand short-circuiting between the U2, V2, W2 terminals. In addition, all motor terminals can withstand short-circuiting to ground or to the positive supply.
If a short circuit occurs, the Controller will stop all activity and report an error condition by activating the red *Current* LED. In addition, the Controller's error register will be activated. See the ES and EST commands.

3.3.3 Allowable Motor Inductance

The Driver can drive motors that have an inductance per phase in the range 1 to 20 mH. Please note that the mains voltage also has an influence.
If a motor with a lower inductance is used, an inductance of 0.5-1mH must be connected in series with each motor lead. This inductance will function as an integrator and ensure that the Controller controls the current correctly.

3.3.4 Allowable cable length

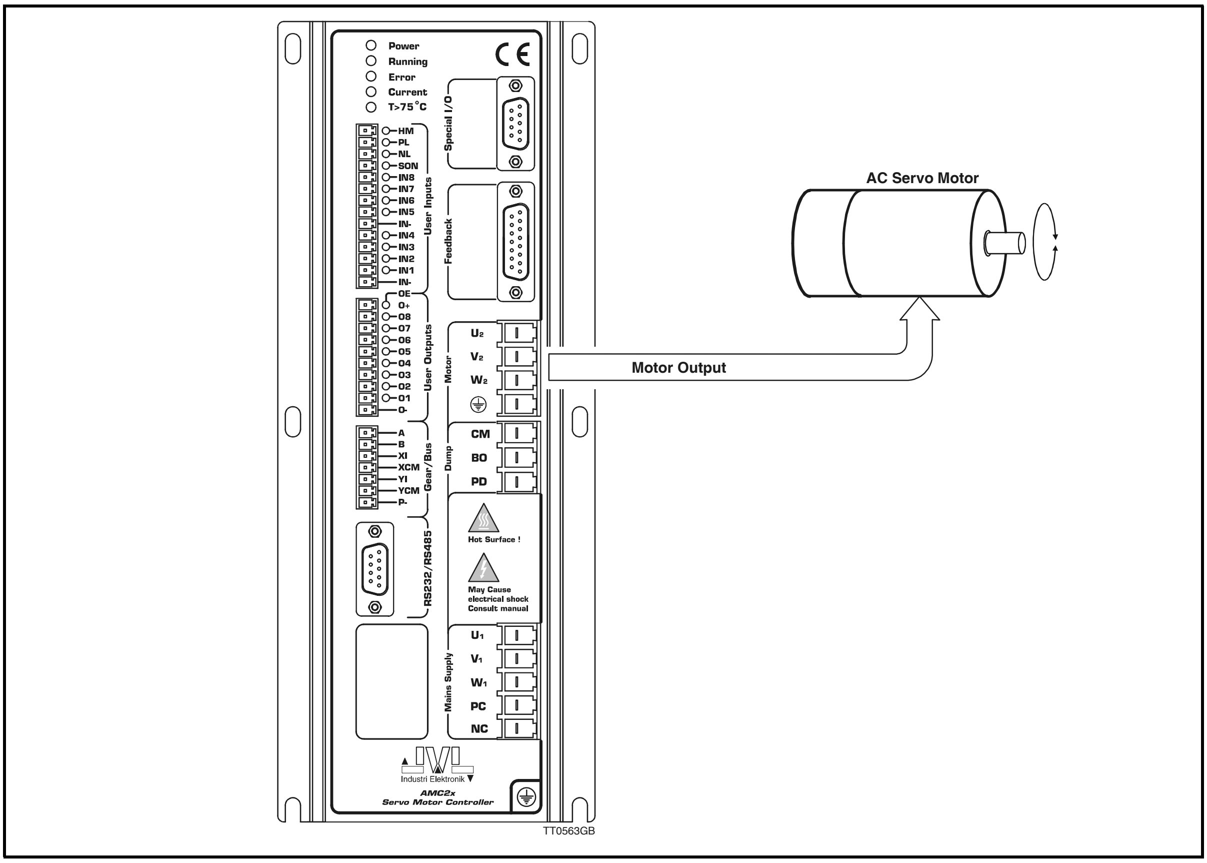
Since a typical motor cable have a capacitance of 0.22nF per meter the total cable length can not be infinitive since the switching losses in the cable as well as in the controller will be extreme.
As a general rule the following maximum lengths are recommended :

At 5kHz:
The capacitive load of the output of the controller may not exceed 12nF(18nF). This value is normally exceeded having more than 20m(30m) cable.

At 20kHz (default):
The capacitive load of the output of the controller may not exceed 3nF(4.5nF). This value includes the internal capacitance of the motor.
This value is normally exceeded having more than 5m(7.5m) cable.

The values in brackets () is valid if 230VAC is used as supply.

The controlbit CB2 determines the switching frequency. See also CB2 - Set low PWM output frequency page 92.
If a higher cable length is desired please insert a motor inductor between the controller and the cable.

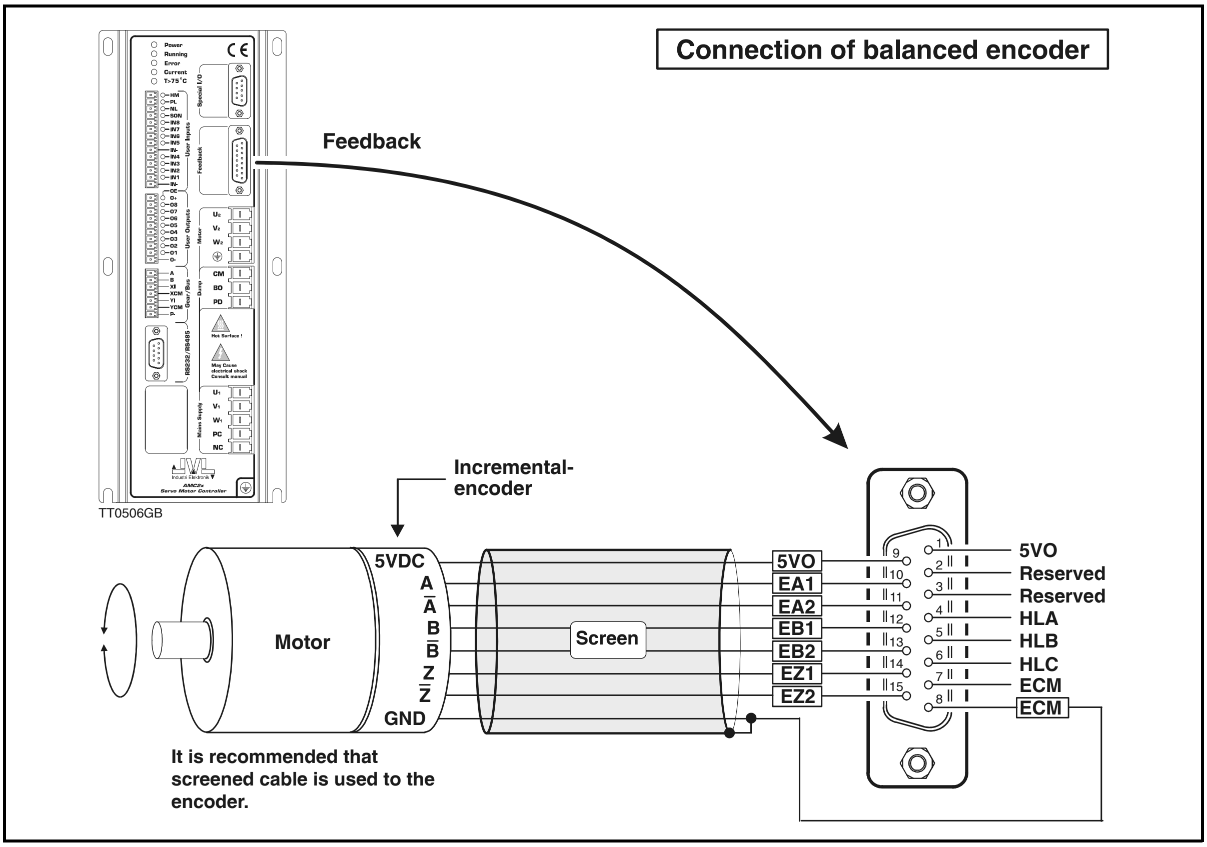


3.3.5 Connection of 3-phase Motor

To connect a 3-phase brushless motor to the Controller, terminals U2, V2 and W2 are used.
Screened cable must be used to connect the motor to the Controller.
The specific motor's average current and peak current must be set using the 2 Controller commands *CA* and *CP*. See *Setting the Motor Currents*, page 195.

See *Examples of Motor Connection*, page 200 for connection of various types of motor.

3.4 Encoder Input



3.4.1 General

For position and velocity feedback from the motor, an incremental encoder must be connected to the Controller at the connector marked *Feedback*.
It is recommended that an encoder with an index channel is used, i.e. that in addition to the A and B channels, the encoder has a third channel which produces 1 impulse for each motor revolution. This pulse is used to reset the Controller's commutation circuitry and ensures that compensation is made for a missing pulse on either the A or B channel. Without an index channel, over a long period of operation the Controller will produce an error due to incorrect commutation of the motor. Alternatively, system efficiency can be reduced.
The incremental encoder detects the motor's velocity and position. The encoder that is connected must be with RS422 output (balanced).
The Encoder Input can read an encoder signal up to 10MHz. The encoder signal voltage must be in the range 0 to 5V. If the encoder has an index channel (EZ), the index input must be activated by setting index=1. See also *Index Pulse On/Off (INDEX)*, page 122.
Note ! — The Cable between the encoder and the Controller must be screened and the screen must only be connected to the encoder ground terminal (ECM).
For details of general encoder set-up, see *Set-up of Encoder Resolution*, page 191.

3.4.2 Encoders with Balanced Output

To connect an encoder with a balanced output to the Controller, see the above illustration. Note that the use of an encoder with balanced outputs is recommended. It is recommended that 0.3mm^2 (minimum) screened cable is used. The encoder should under no circumstances share a cable with other signal cables as this can have serious and catastrophic effect on encoder signals. If the motor has a Hall element, these signals can be included in a common cable.

3.4.3 Special Encoders/Sensors

JVL currently plans to supply other adaptor modules for other types of encoder and sensor. Contact JVL Industri Elektronik for further details.

Today following adaptor modules exists:

- **Analogue feedback to encoder converter JVL type PA0094.**
  This module will convert an analogue voltage (or current) into an encoder signal which can be connected directly to the AMC2x controller. Contact your local JVL representive to get more information.

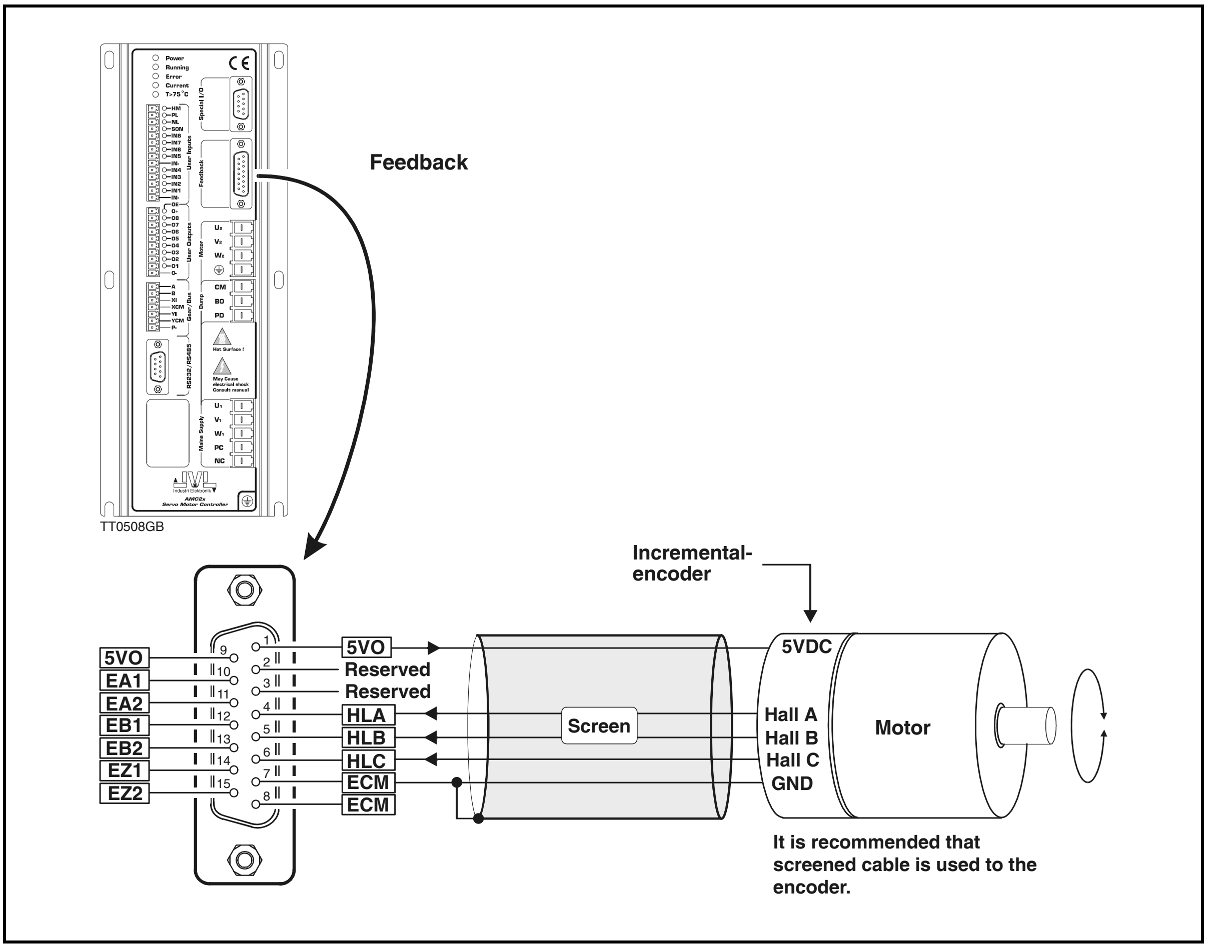
- **Resolver to Encoder converter JVL type PA0095.**
  This module will convert a resolver signal into an encoder signal which can be connected directly to the AMC2x controller. Contact your local JVL representive to get more information.

3.4.4 Encoders with serial data transmission.

The AMC2x also supports encoders with serial data communication in some extend. The two terminals at the "Feedback" connector is ment for this purpose.
The two terminals are Pin 2 (ED1 = Data+) and Pin 3 (ED2 = Data-). This serial channel is made as a RS485 bidirectional interface. The protocol today supports the Yaskawa SG-MAH, SGMPH, SGMPH and SGMSH. See also the *Encoder Type (ET)*, page 110 which shows how to setup the encoder input for different hardware formats/communication protocols.
For connecting Yaskawa motors see *Examples of Motor Connection*, page 200.

Please contact JVL if other motors from other manufactors need to be connected.

3.5 Hall Input

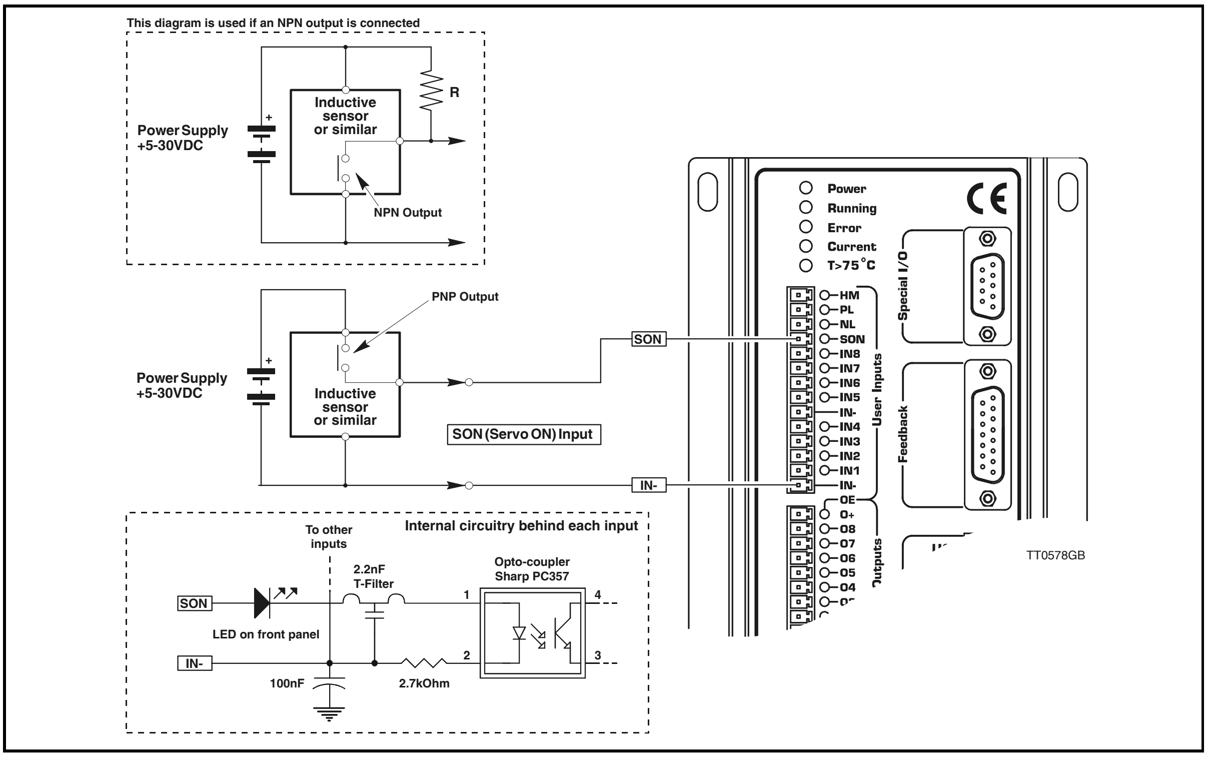


3.5.1 General

The Controller is equipped with 3 inputs for connection of a Hall sensor. This feature is only used if it is required that the motor does not move during start up of the Controller.

Almost all types of Hall sensor can be connected, providing they are equipped with one of the following types of output: NPN-, PNP-, or Push-Pull output.
The Hall sensor signals must be within the voltage range 0 to 5V.
Note ! — The cable between the Hall sensor and the Controller must always be screened cable and the screen must only be connected to the Controller's encoder/hall chassis terminal (*ECM*).
Some motor manufacturers, e.g. Yaskawa, use an integrated hall element where the output signals are encoded together with the incremental encoder signals. See *Examples of Motor Connection*, page 200
For further details, see *Setting the Hall Element*, page 196.

3.6 Servo On Input (SON)



3.6.1 General

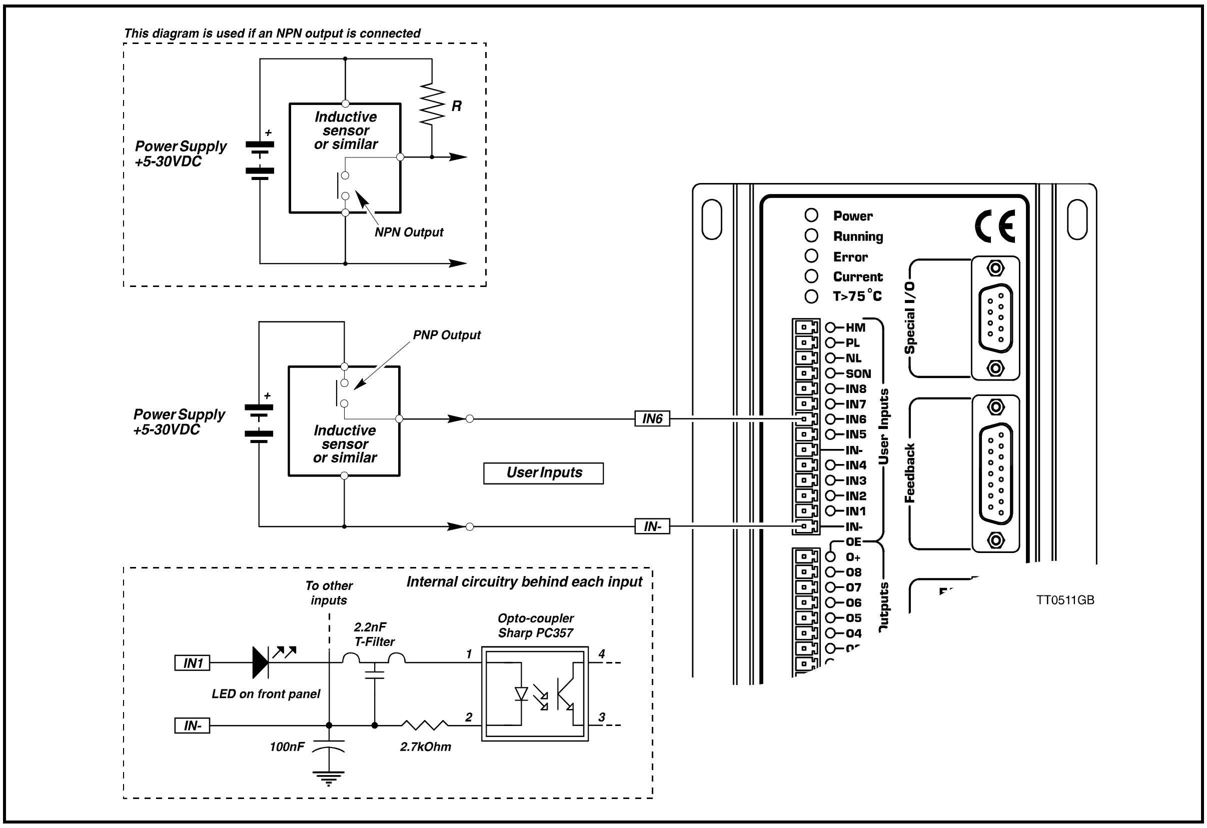
The SON (Servo ON Input) is used for protection and safety reasons.
The default settings in the Controller make it impossible for the motor to move unless an external voltage is applied to this input. During normal operation an external voltage must be applied to the SON Input; otherwise no current is supplied to the motor and the Controller will stay in Mode 0 (no operation).
The SON Input can however be disabled by setting the control bit CB9. See *CB9 - Ignore Servo On Signal*, page 94. Important ! : The SON Input is only intended as an extra safety function and a certified safety relay must still be inserted in the power supply as described in *3-Phase power supply of AMC20, AMC21 and AMC22*, page 25.
The Input is optically isolated from other Controller circuitry, with the exceptions of *IN1 - IN8*, *NL* and *PL* (End-of-travel Limit Inputs) and the *HM* (Home) Input. All these inputs have a common ground denoted *IN-*. The SON Input can operate with voltages in the range 5 to 30VDC. Note that the Input is designed to receive a signal from a PNP output since a positive current must be applied for the Input to be activated.
The SON input can also be used as a standard input like IN1, IN2 etc. i.e. in a program. To do this use the control bit CB9 to disable the input as a Servo ON input.
The SON input can also reset the controller if desired. See

3.6.2 Connection of NPN Output

To connect the Input to an NPN output, a Pull-Up resistor must be connected between the Input and the + supply. See above illustration. The size of the resistance depends on the supply voltage used. The following resistances are recommended:

Supply Voltage	Recommended Resistance
5-12VDC	1kOhm / 0.25W
12-18VDC	2.2kOhm / 0.25W
18-24VDC	3.3kOhm / 0.25W
24-30VDC	4.7kOhm / 0.25W

3.7 User Inputs



3.7.1 General

The Controller is equipped with a total of 8 digital inputs. Each input can be used for a variety of purposes depending on the basic mode of Controller operation selected. The Inputs are optically isolated from other Controller circuitry. All of the Inputs have a common ground terminal, denoted *IN-*. Note that this terminal is also used with the end-of-travel limit input and reset (Home) input. Each Input can operate with voltages in the range 5 to 30VDC. Note that the Inputs should normally be connected to a PNP output since a positive current must be applied for an input to be activated.

3.7.2 Connection of NPN Output

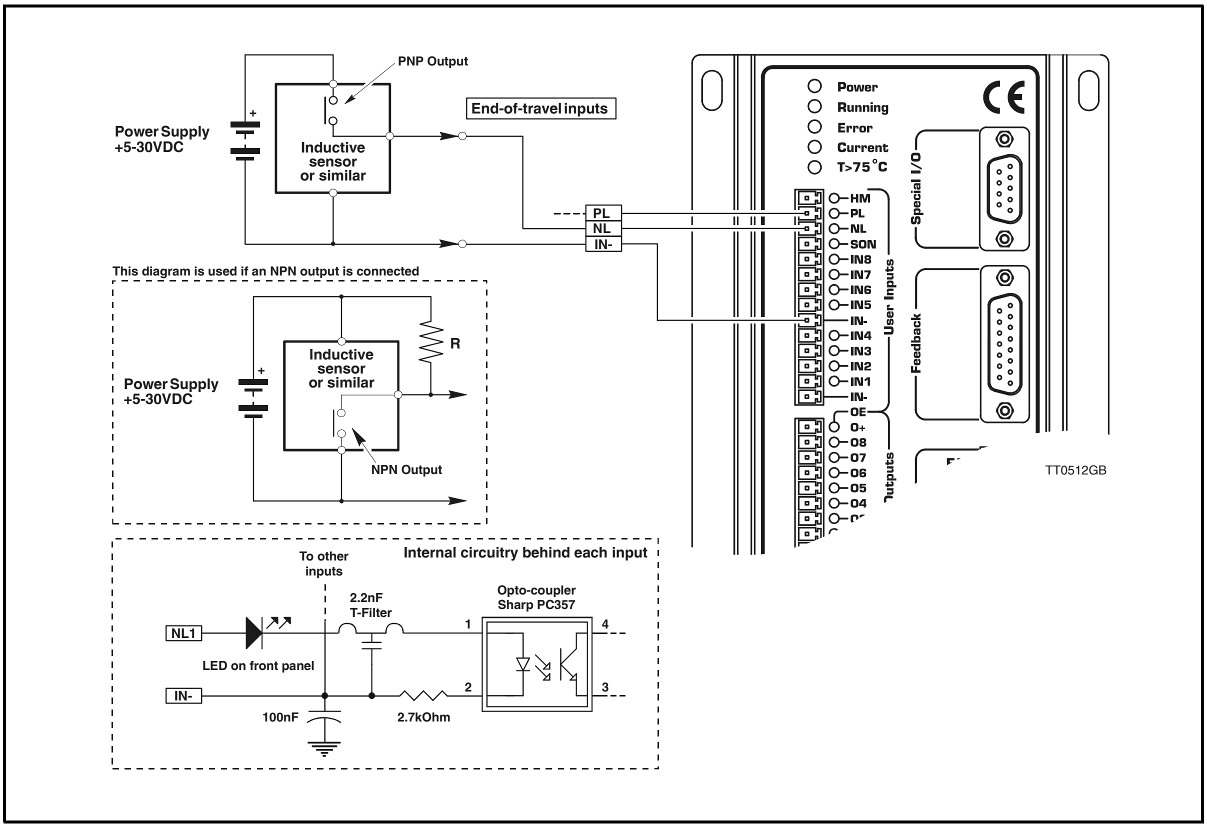
If an Input is connect to an NPN output, a Pull-Up resistor must be connected between the Input and the + supply. See above illustration. The value of the resistance used depends on the supply voltage. The following resistances are recommended:

Supply Voltage	Recommended Resistance
5-12VDC	1kOhm / 0.25W
12-18VDC	2.2kOhm / 0.25W
18-24VDC	3.3kOhm / 0.25W
24-30VDC	4.7kOhm / 0.25W

3.7.3 Indication of Input Status

To indicate the status of each Input, the Controller's front panel is equipped with LEDs. These LEDs are lit when the respective Input is activated. The brightness of the respective LED depends on the voltage applied.

3.8 End-of-travel Limit Inputs



3.8.1 General

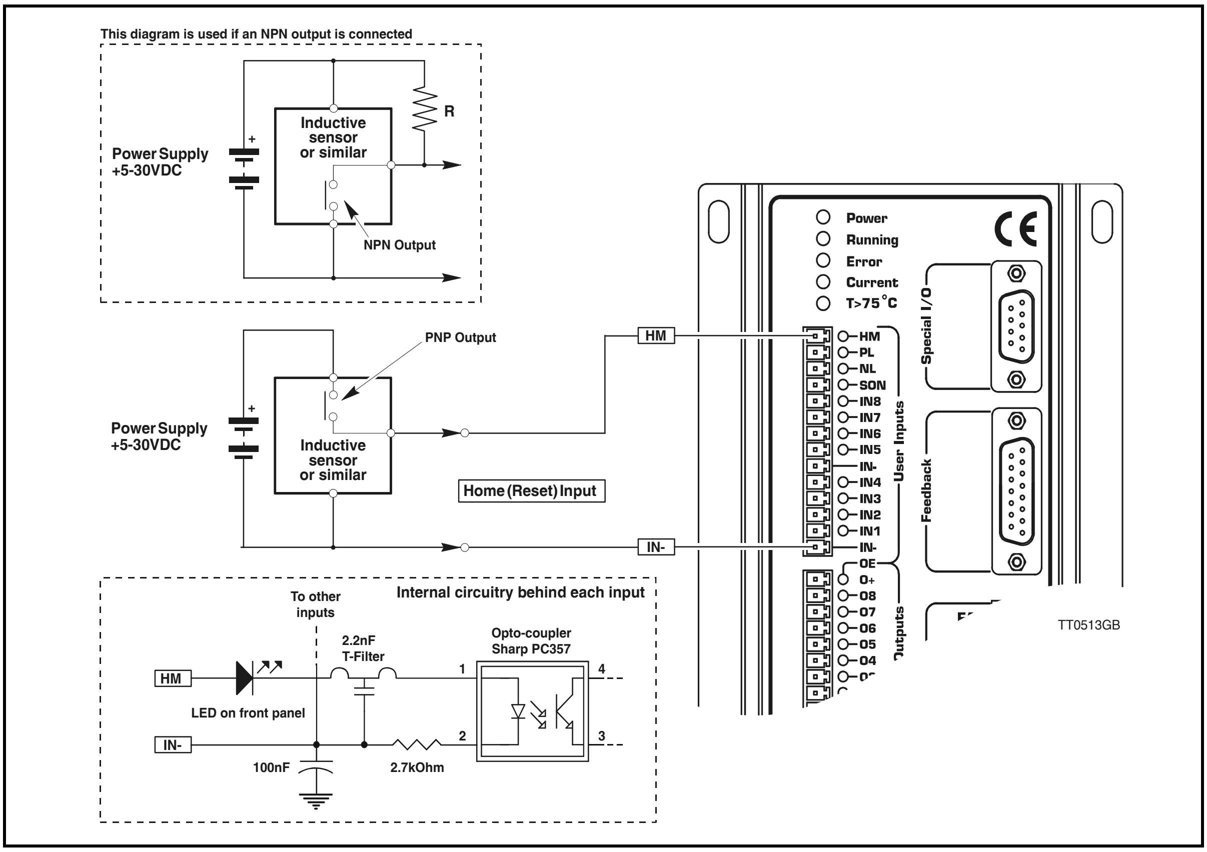
The Controller is equipped with end-of-travel limit inputs denoted *NL* (negative limit) and *PL* (positive limit). The Inputs are optically isolated from other Controller circuitry with the exceptions of *IN1 - IN8*, and *HM* (Home input). All of these inputs have a common ground denoted *IN-*. The End-of-travel Limit Inputs operate with voltages in the range 5 to 30VDC. Note that the Inputs must normally receive a signal from a PNP output since a positive current must be applied for the Inputs to be activated. Activation of the *PL* Input will halt motor operation if the motor is moving in a positive direction. The motor can however operate in a negative direction even if the *PL* Input is activated. Activation of the *NL* Input will halt motor operation if the motor is moving in a negative direction. The motor can however operate in a positive direction even if the *NL* Input is activated. The active level at the *NL* or *PL* inputs is determined by the *NLL* and *PLL* register. See *Negative Limit Input Level (NLL)*, page 133 or *Positive Limit Input Level (PLL)*, page 139. An error message will be set in the Controller's error register if either the *NL* or *PL* Inputs has been activated. See *Error Messages*, page 167

3.8.2 Connection of NPN Output

To connect an End-of-travel Input to an NPN output, a Pull-Up resistor must be connected between the Input and the + supply. See above illustration. The size of the resistance depends on the supply voltage used. The following resistances are recommended:

Supply Voltage	Recommended Resistance
5-12VDC	1kOhm / 0.25W
12-18VDC	2.2kOhm / 0.25W
18-24VDC	3.3kOhm / 0.25W
24-30VDC	4.7kOhm / 0.25W

3.9 Home (Reset) Input



3.9.1 General

The Reset Input *HM* (Home) is used during the zero-point seek function. A zero-point seek occurs after one of the following conditions:

1. The Controller receives the seek zero command SZ (reset). See *Search Zero Point (SZ)*, page 155.
2. The Controller is switched on (only if XR=1). See *Zero Point Search Function*, page 75
3. If the Controller is set to Mode 3 and register 0 is selected. See *Register Mode (MO=3)*, page 54

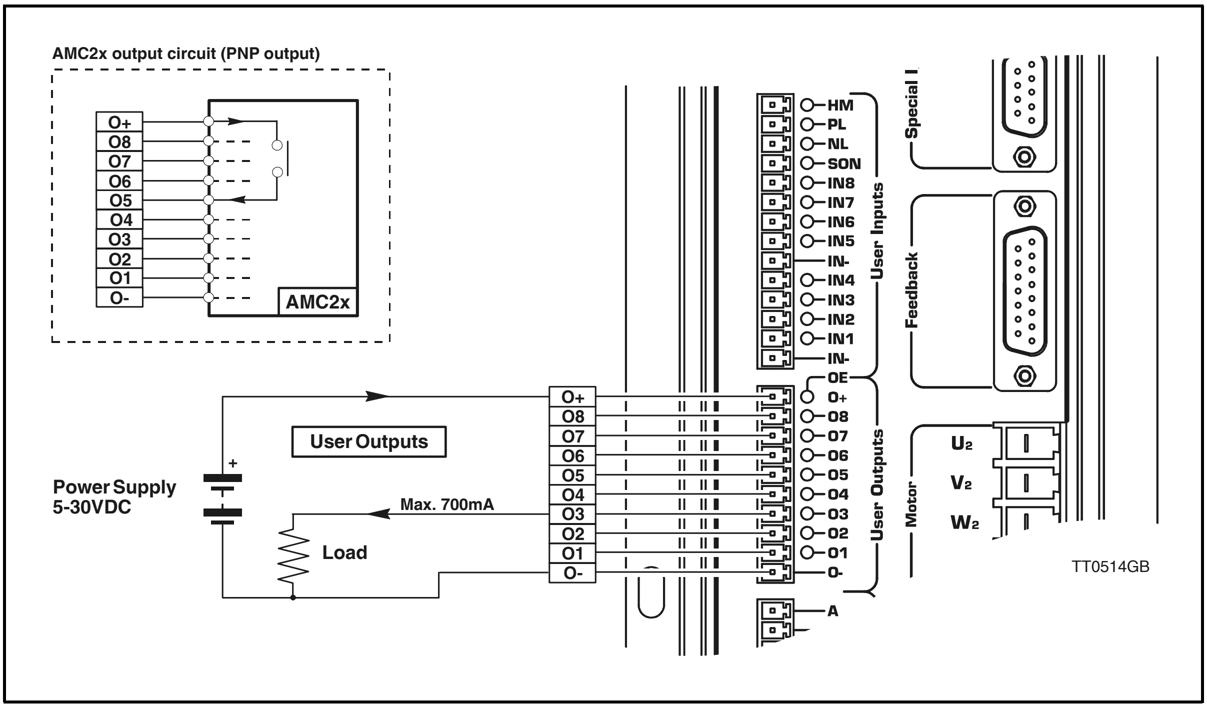
The Home Input is primarily used if the Controller is used for positioning purposes. The Input is optically isolated from other Controller circuitry, with the exceptions of *IN1 - IN8*, and *NL* and *PL* (End-of-travel Limit Inputs). All these inputs have a common ground denoted *IN-*. The Home Input can operate with voltages in the range 5 to 30VDC. Note that the Input is designed to receive a signal from a PNP output since a positive current must be applied for the Input to be activated.

3.9.2 Connection of NPN Output

To connect the Input to an NPN output, a Pull-Up resistor must be connected between the Input and the + supply. See above illustration. The size of the resistance depends on the supply voltage used. The following resistances are recommended:

Supply Voltage	Recommended Resistance
5-12VDC	1kOhm / 0.25W
12-18VDC	2.2kOhm / 0.25W
18-24VDC	3.3kOhm / 0.25W
24-30VDC	4.7kOhm / 0.25W

3.10 User Outputs



3.10.1 General

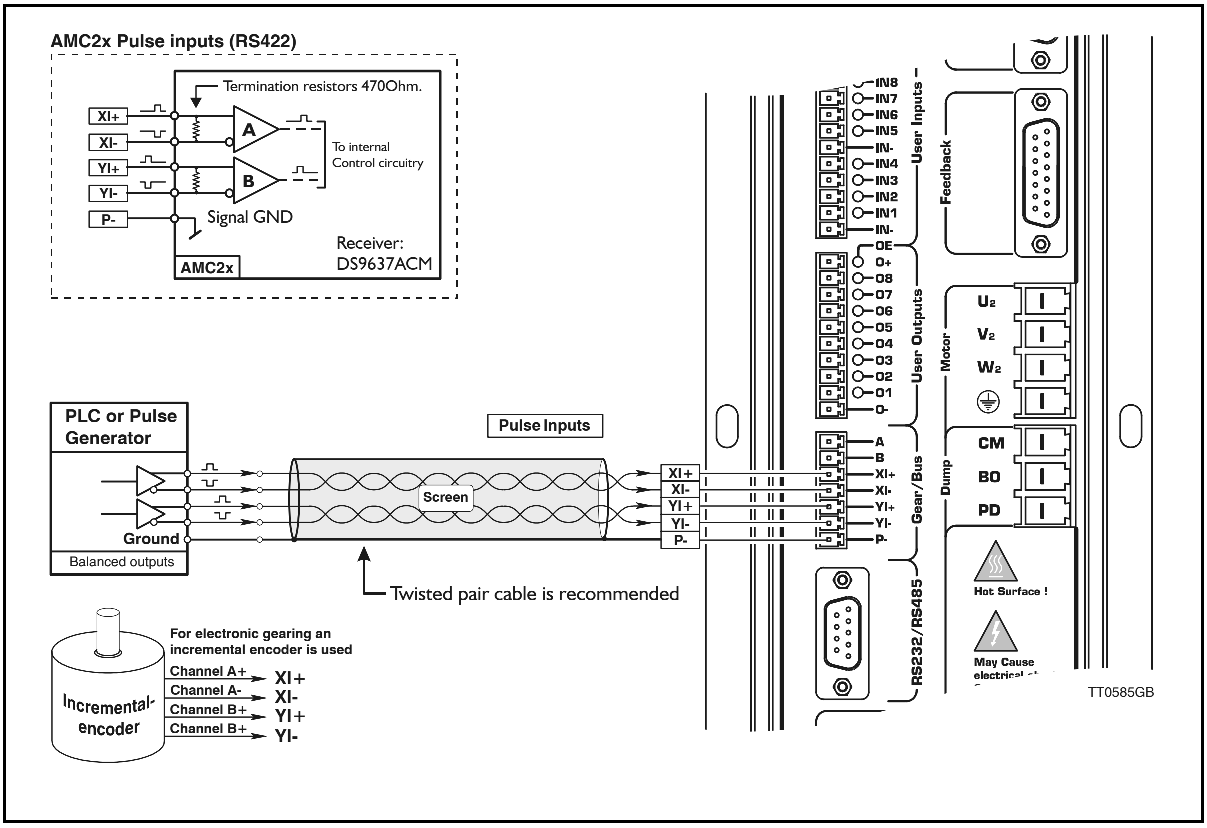
The Controller is equipped with a total of 8 digital outputs. Each output can be used for a variety of purposes depending on the Controller's basic mode of operation. The Outputs are optically isolated from other Controller circuitry. The output circuitry must be powered from an external power supply. This power supply is connected to the terminals O+ and O-. The output circuitry operates with voltages in the range 8-30VDC. Each output can supply a continuous current of 700mA. The Outputs are all source drivers (PNP), i.e. if a given Output is activated, contact is made between the +supply (O+) and the respective output terminal. See above illustration. To indicate the level of each output, the Controller front panel is equipped with LEDs, denoted O1, O2,..... O8. These LEDs are lit when the respective Output is activated.

Note ! Outputs 1 and 2 are reserved.
Output 1 is used in mode 2 and 3 as an "In position" indication. Output 1 is active when the motor is at its final position. If the motor is moving the output is passive. In mode 3 the function of output 1 can be changed, see *CB4 - Position Output (O1) Function*, page 92. Output 2 is a general error output (used in all modes). The output is normally active but if a fatal error has occurred, the output is set passive. See also *CB15 - Function of User Output 1 (O1)*, page 96. For information about the errors that cause the output to be activated, see *Read-out of Error Status (ES)*, page 106.

3.10.2 Overload of User Outputs

All of the Outputs are short-circuit protected, which means that the output is automatically disconnected in the event of a short circuit. The Output will first function normally again when the short-circuit has been removed. The *OE* LED on the Controller's front panel is lit when one or more of the Outputs are short-circuited. The LED also indicates if the output circuitry has overheated due to an overload. The error message *E46 : Overload on output ports* will appear in the error register.

3.11 Pulse Inputs



3.11.1 General

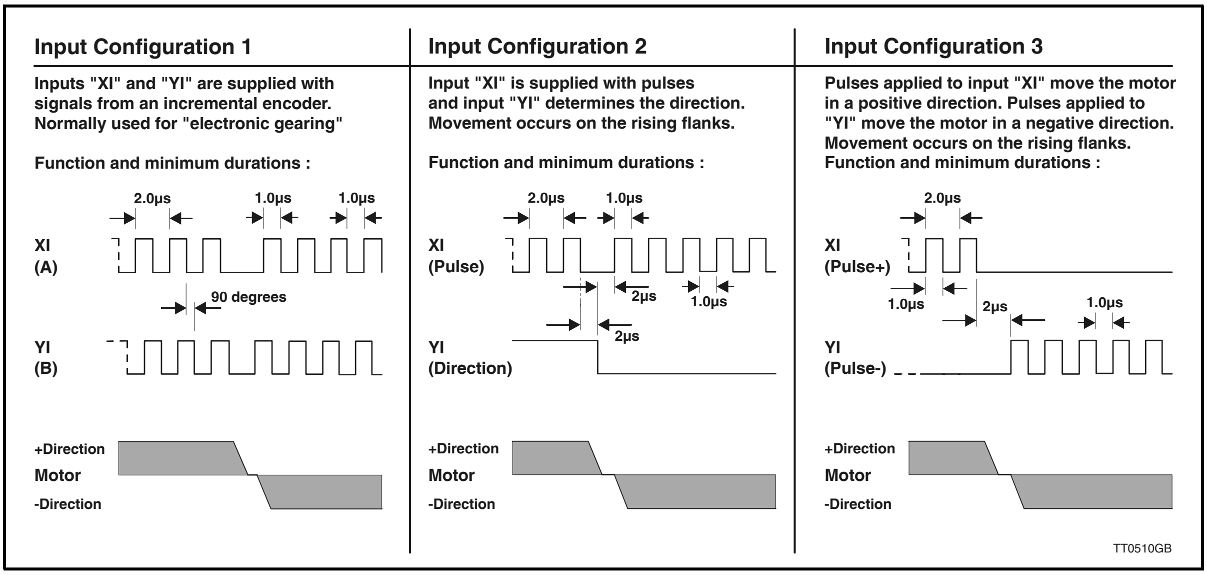
The Pulse Inputs are used in Mode 1.
Each time a voltage pulse is applied to the Inputs, the motor moves a specified distance.
3 different pulse formats can be chosen.
The ratio between input pulses and the movement distance is determined by the *GEAR* command and the encoder resolution.
Both Inputs are equipped with a built-in noise filter which cuts off all frequencies above 1MHz. The diagram on the following page illustrates minimum durations for the signals.

3.11.2 Input Voltage

As standard, the Inputs are designed according to the RS422 standard which means that the source must be a balanced output operating with a voltages of 5V.
Contact JVL if other signal formats must be used.

See also the description of Mode 1 *Getting Started — Gear Mode (Mode 1)*, page 5.

3.11 Pulse Inputs



Input Configuration 1

Inputs "XI" and "YI" are supplied with signals from an incremental encoder. Normally used for "electronic gearing"

Function and minimum durations :

Input Configuration 2

Input "XI" is supplied with pulses and input "YI" determines the direction. Movement occurs on the rising flanks.

Function and minimum durations :

Input Configuration 3

Pulses applied to input "XI" move the motor in a positive direction. Pulses applied to "YI" move the motor in a negative direction. Movement occurs on the rising flanks.

Function and minimum durations :

3.11.3 Pulse Input Format

The Pulse Inputs can be set to 3 different configurations. See above illustration. These configurations are selected using the *PIF* command. See *Pulse Input Format (PIF)*, page 138. The 3 configurations have the following function. For further details, see *Gear Mode (MO=1)*, page 52.

3.11.4 Input Format 1

This format is normally used if the Controller is used in a system as an electronic gear. An incremental encoder is connected to the input to read the motor movement. The *GEAR* command is set to select the required gear ratio and the *PIF* command is used to set Input Format 1 (*PIF=1*). The input circuitry will then decode the incoming pulses according to the above illustration. See also the *PRM* command.

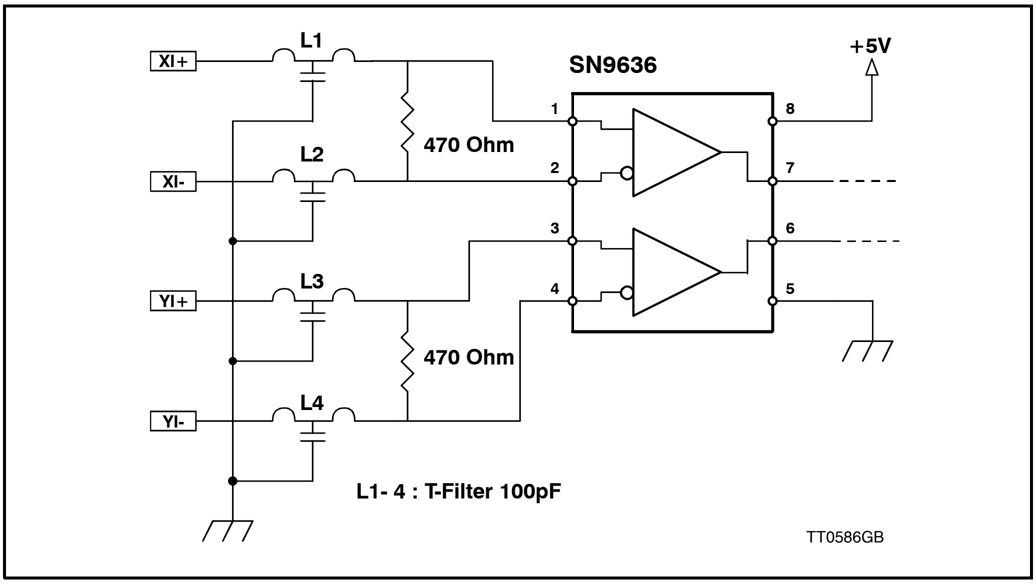
3.11.5 Input Format 2

This format is normally used if the system receives pulses from a PLC or PC controller module. The Controller functions as in a step motor system and the motor will move a specified amount each time a pulse is applied to the XI input. The voltage level at YI determines the direction of motor movement.

3.11.6 Input Format 3

This format corresponds to Format 2, but the direction of motor movement is determined by which input (XI or YI) pulses are applied to.

3.11 Pulse Inputs

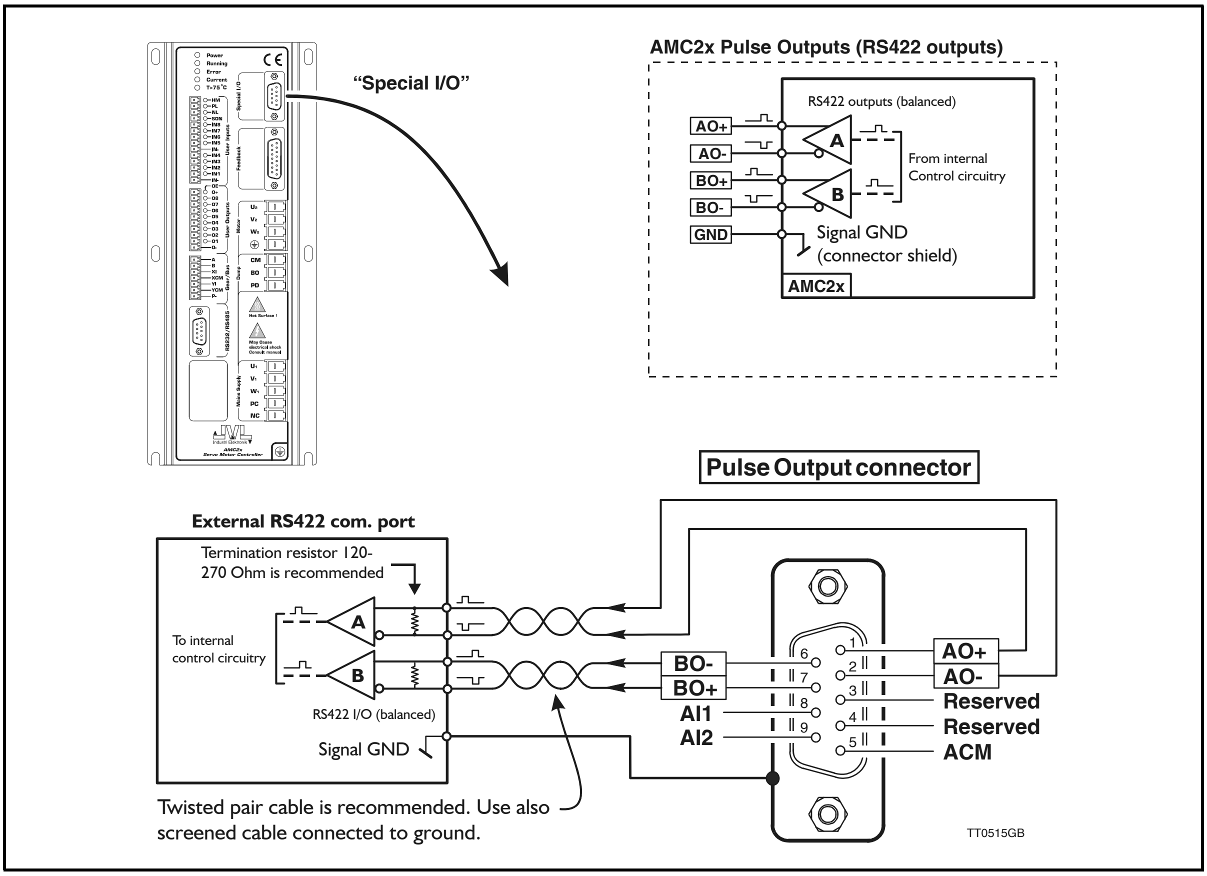


3.11.7 Pulse Inputs Hardware

The illustration above shows a detailed circuit diagram of the input circuitry of the pulse input terminals. This can often be helpful when auxiliary electronics must be connected. Please make sure that the inputs are not applied with more than 5V at any of the terminals compared to ground since this can damage the input circuitry.

Important: The input circuitry in controllers with serial numbers lower than 19500 is different. Please consult JVL for documentation.

3.12 Pulse Outputs



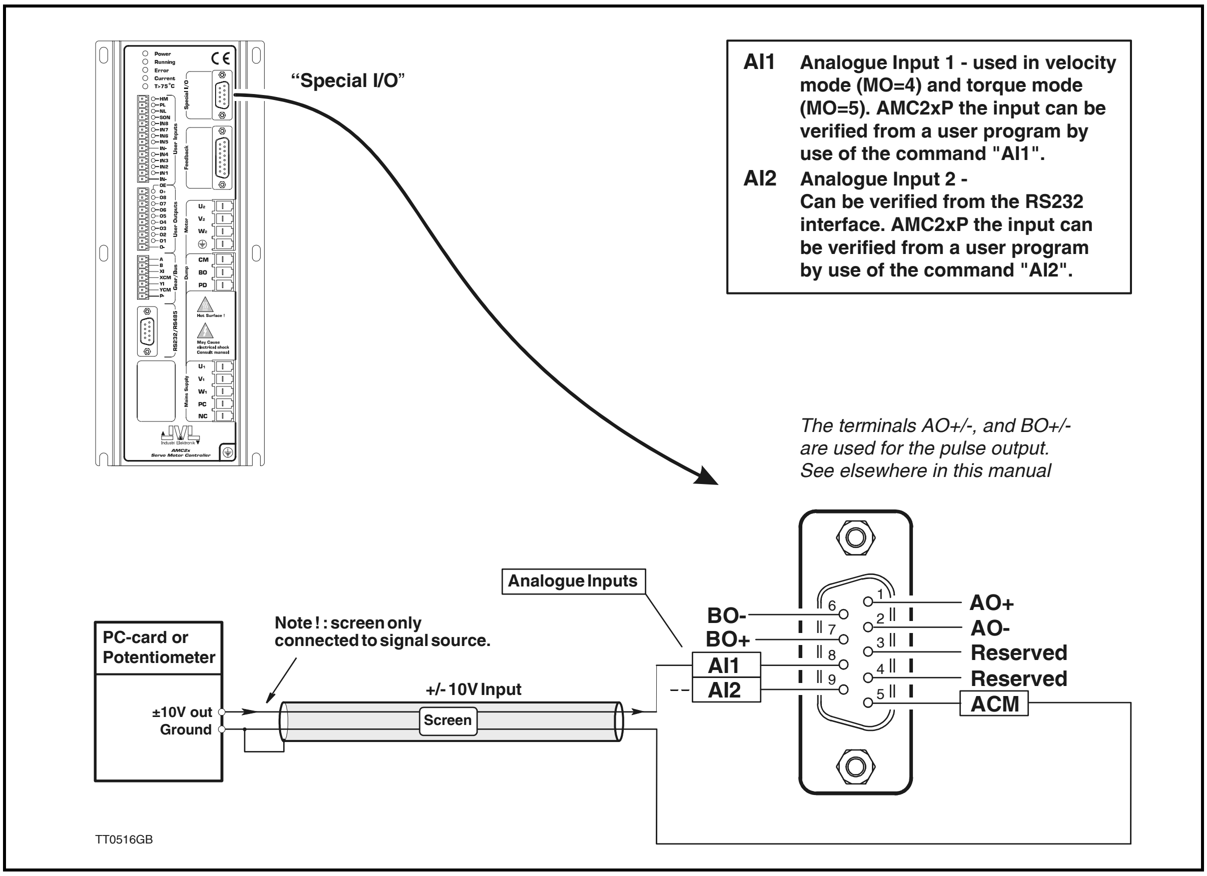
3.12.1 General

The 2 Pulse Outputs *AO* and *BO* produce 2 pulse signals which can be configured either to represent the motor encoder (*EA* and *EB*) or the signal connected to the pulse input (*XI* and *YI*). The Pulse Outputs are typically used in the following applications:

1. Master/slave system in which the master-controller's pulse outputs are connected to the slave controller's pulse inputs. The slave controller thus follows the master controller's movement.
2. PC-system. A Controller which is connected to a PC-card via the analogue input or the pulse input and exclusively functions as a velocity controller. The Pulse Output is connected to the PC-card and ensures that information on the current velocity and position is sent to the PC-card.

The Outputs are made as RS422 transmitters which means that they are balanced and withstand a certain common mode noise.
Each output can operate with frequencies up to 10MHz.
Note that Pulse Output configuration must be set using the *POF* command; see *Pulse Output Format (POF)*, page 140.

3.13 Analogue Inputs



AI1 **Analogue Input 1 - used in velocity mode (MO=4) and torque mode (MO=5). AMC2xP the input can be verified from a user program by use of the command "AI1".**

AI2 **Analogue Input 2 - Can be verified from the RS232 interface. AMC2xP the input can be verified from a user program by use of the command "AI2".**

The terminals AO+/-, and BO+/- are used for the pulse output. See elsewhere in this manual

3.13.1 General

The Analogue Inputs are used for example when the Controller is operated in Velocity Mode (Mode 4) or Torque Mode (Mode 5) or is under program control.

In these modes of operation, the motor is controlled to produce a velocity or torque determined by, and proportional to, the voltage applied to an Analogue Input.

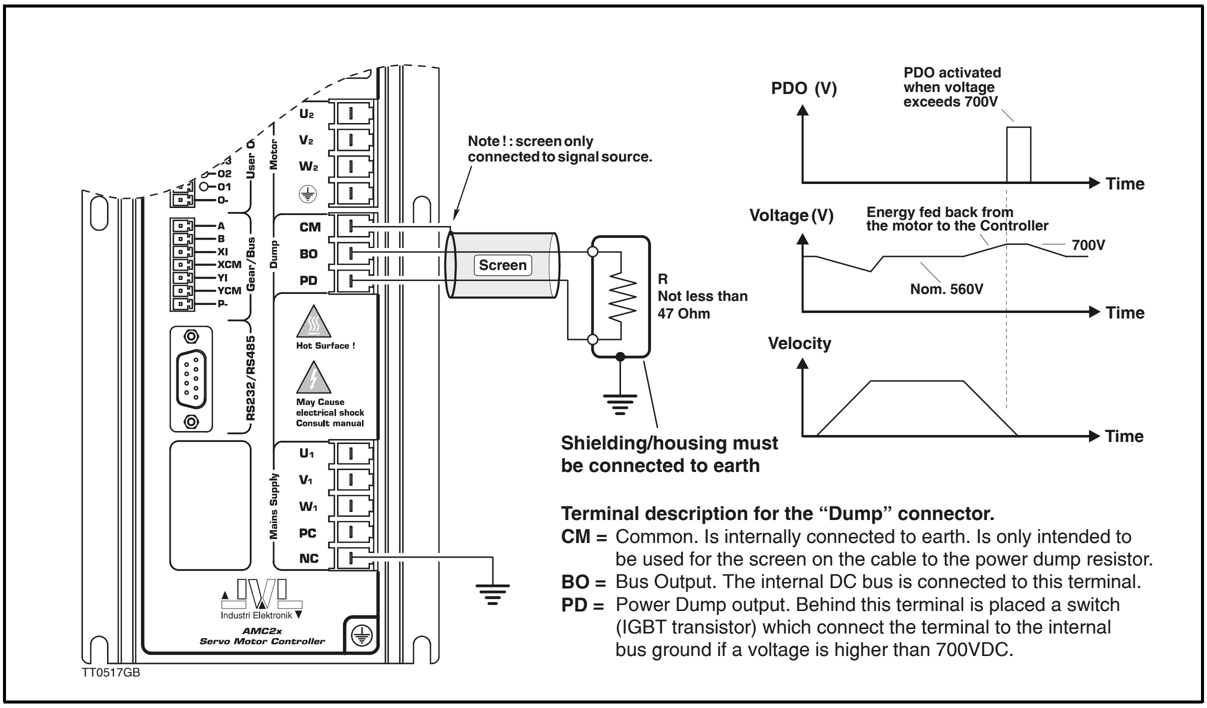
The Analogue Inputs accepts input voltages in the range -10V to +10V and are optically isolated from all other inputs and outputs, including supply terminals. Note however that the Inputs share a common internal supply with the RS232 interface and are therefore not galvanically isolated from the interface.

The Analogue Inputs are protected against voltage overload up to 100V peak and have a built-in filter which removes input signal noise.

Always use screened cable to connect the source used to control the Analogue Inputs since the motor, etc., can easily interfere with the analogue signal and cause instability.

The Controller is equipped with an analog-to-digital converter (ADC) which converts the measured analogue signal level. The ADC has a resolution of 12 bit, which gives a total operating range of 4096 steps in the range -10V to +10V.

3.14 Power Dump Output



U2
V2
W2
CM
BO
PD
U1
V1
W1
PC
NC
O3
O2
O1
O-
A
B
XI
XCM
YI
YCM
P-
User O
Motor
Gear/Bus
Dump
RS232/RS485
Mains Supply
Hot Surface !
May Cause electrical shock Consult manual
JVL Industri Elektronik
AMC2x Servo Motor Controller
Note ! : screen only connected to signal source.
Screen
R
Not less than 47 Ohm
Shielding/housing must be connected to earth
PDO (V)
PDO activated when voltage exceeds 700V
Time
Voltage (V)
Energy fed back from the motor to the Controller
700V
Nom. 560V
Time
Velocity
Time
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Terminal description for the "Dump" connector.

CM = Common. Is internally connected to earth. Is only intended to be used for the screen on the cable to the power dump resistor.

BO = Bus Output. The internal DC bus is connected to this terminal.

PD = Power Dump output. Behind this terminal is placed a switch (IGBT transistor) which connect the terminal to the internal bus ground if a voltage is higher than 700VDC.

3.14.1 General Aspects of the "Power Dump" Output

If the Controller is used in systems in which there are very large inertial loads (flywheels, etc.), a problem can arise during deceleration with energy being sent back from the motor to the Controller supply. This can result in increases in the supply voltage to a critically high level, above the Controller's maximum working range. The Controller has an internal power dump resistor that has been designed to take care of most applications. If the internal resistor is not sufficient however, the "Power Dump" Output (PD) can be used. This output can be used to sink the energy to an external shunt resistor and thus avoid that the Controller shuts down and reports an error. Note that reduction of the velocity VM, acceleration AC, or peak current CP can minimise the energy surge from the motor.

3.14.2 Detailed Description of "Power Dump"

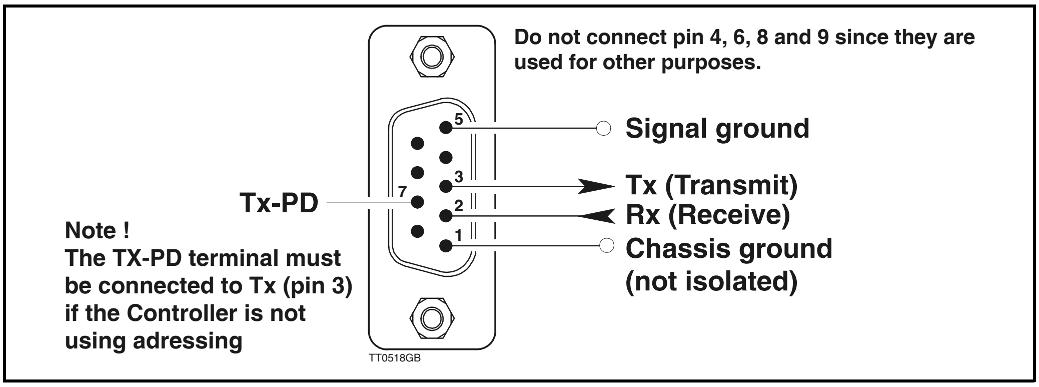
The value of the PDO shunt resistor will depend on many parameters, such as the max. rpm of the motor, the supply voltage, how rapidly the motor decelerates, etc. It is however recommended that the resistor has a minimum value of 47Ohm / 100W (not less). The rated power of the resistor can be greater or less depending on the actual load.

1. When the Controller registers that the supply voltage exceeds 700V, the PDO output is activated and the *Error* LED is lit. The Controller automatically transmits an warning message *W36 : Bus Voltage exceeds 700 V - Activating powerdump !*
2. If activation of the internal (and external) PD resistor does not stop the increase in supply voltage, the error message *E37 : Bus Voltage exceeds 800 V - Controller can be damaged !* is sent. This message indicates that the power dump circuitry has a problem handling the high amount of returned energy.
3. If activation of the PD output and thus the PD shunt resistor does not stop the increase in supply voltage, the following occurs: When the supply voltage exceeds 850V, the Controller shuts down completely and the motor is released to avoid damage to the internal circuitry. The Controller sends an error message *E38 : Bus Voltage exceeds 850 V*. The PD output is activated until the voltage falls below 700V, and the Controller remains in this error state until it receives the *RESET* command — see *Reset Controller (RESET)*, page 147.

3.15 RS232 Interface

3.15.1 Interface Connection

The Controller Interface uses the widespread RS232C standard, offering the advantage that all Personal Computers and standard terminals can be connected via the interface. The 3 interface signals Rx, Tx and ground are used. The interface cable length should not exceed 10 metres.



Do not connect pin 4, 6, 8 and 9 since they are used for other purposes.

Note !
The TX-PD terminal must be connected to Tx (pin 3) if the Controller is not using adressing

3.15.2 Communication Protocol

The Controller uses the following format: (1 startbit), 8 databit, Odd parity, 1 Stop bit Note that a startbit is always used in the RS232C/V24 protocol.

3.15.3 Communication Rate

The Controller operates at a fixed communication rate (Baud rate) of 9600 Baud. The Baud Rate must be set accordingly on the terminal or PC used to communicate with the Controller.

3.15.4 Command Syntax

Communication with the Controller must follow a specific command syntax:

[**Address**] **Command** [=**Argument**] [**; Command** [=**Argument**]] [**Checksum**] <**CR**>

Text in square brackets [] may be included or omitted depending on the set-up.

Address: This address must be used when more than one Controller is connected to the same interface. See also the ADDR command.

Command: The command itself.

Argument: The subsequent numeric argument for the command. An argument always begins with the equal-to sign "=". Certain commands do not use arguments. (e.g. commands that display set-ups).

; More than 1 command can be used in a single command line. A semi-colon ";" must be used to delimit multiple commands.

Checksum: In situations where long communication lines are used, a checksum can be used to ensure that the commands are received correctly. If an error occurs, the error message E9 is received and the command must be re-transmitted. See also the CHS command.

<CR>: ASCII value 13. This character terminates the command line.

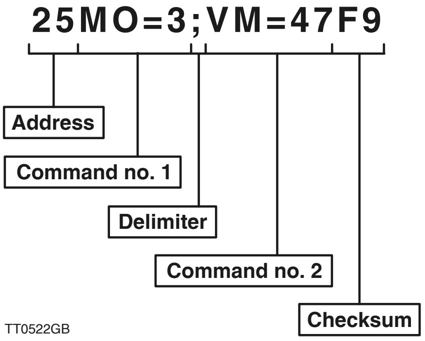
3.15.5 Synchronisation

During communication with the Controller, each command string must be terminated either by a <CR> (ASCII 13) or a semi-colon ";". This tells the Controller that the command string is complete and interpretation can begin. When a checksum is used, command interpretation will not begin until the entire command line has been received, i.e. is terminated by a <CR>. A maximum of 80 characters may be sent in a single command line.

If the Controller is set to use addressing (*ADDR>0*), the complete string shall be terminated by "; ;".

3.15.6 Checksum

In industrial applications, electrical noise from motors, etc., often occurs. This noise is quite arbitrary and random and cannot be eliminated 100% even by effective electrical filtering. To ensure correct transmission of Controller commands therefore, a checksum can be used. A typical command line may be as follows:



In this example, addressing is used (address 25). Two commands, delimited by a semi-colon ";", are transmitted followed by a checksum. The checksum consists of two characters. The checksum is a 'simple' checksum and is calculated in the following way: First the ASCII value of each of the characters in the command line is determined. These values are summed and the two least significant characters (the least significant byte) of the result's hexadecimal value are used.

The two least significant digits are converted to ASCII values and transmitted along with the command line. The actual calculation in this example is as follow:

50+53+77+79+61+51+59+86+77+61+52+55 = 761 (decimal) = 2F9 (hexadecimal)

The checksum is thus F9 which is sent as ASCII 70 (decimal) and 57 (decimal). The hex.characters a-f can also be sent as capitals, i.e. d can also be sent as ASCII 68 (decimal).

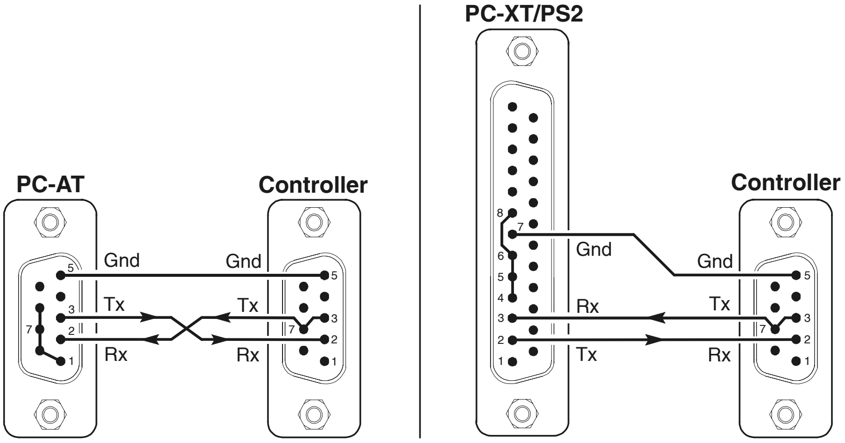
In the event that the command string is corrupted during transmission, the checksum will not correspond and the Controller will report an error message "E9", indicating that a checksum error has occurred. The command string must then be re-transmitted. The checksum function is activated using the CHS command.

The checksum feature must also be enabled in *MotoWare*. Use the Setup menu and choose *Controller spec*. Via this menu, *MotoWare* can be permanently setup for using checksum.

3.15 RS232 Interface

3.15.7 Connection to PC

For communication from a PC, the following connection diagrams can be used. These show the connections between the Controller and an IBM AT or IBM-XT/PS2:



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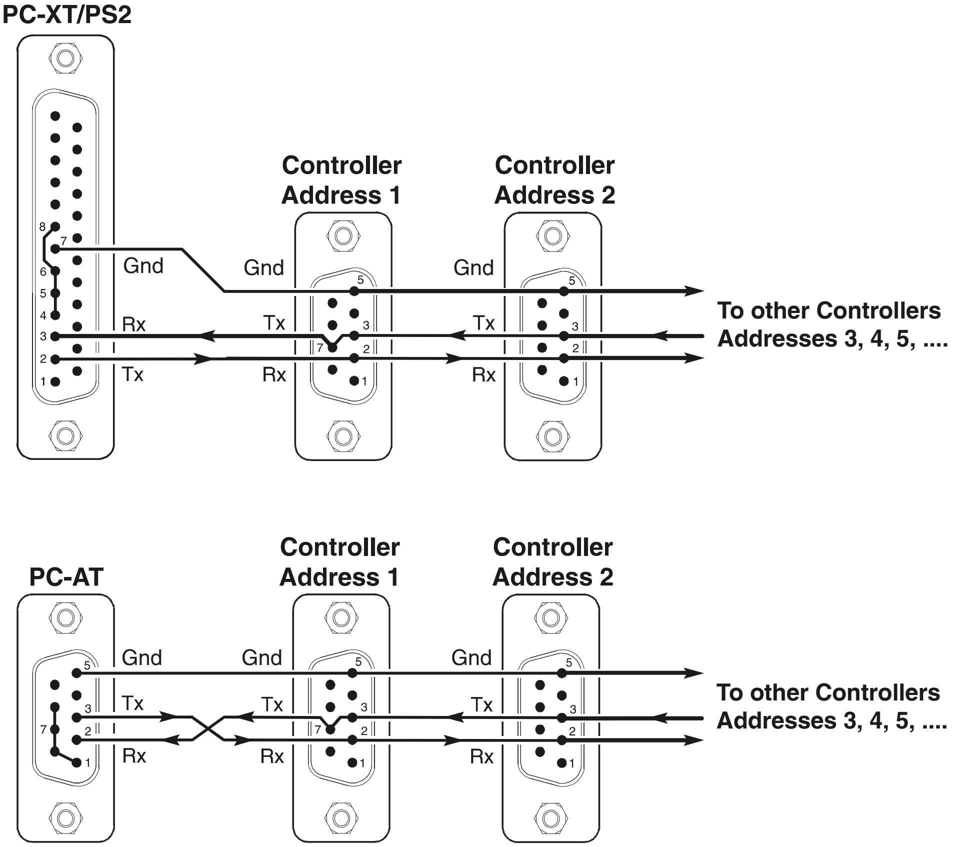
3.15.8 Connection of Several Controllers to a PC

For connection of more than 1 Controller to a PC (i.e. using addressing), the connection diagrams given below can be used. Note that Tx (pin 3) must be connected to TX-PD (pin 7) on one of the Controllers included in the system. The diagrams show the connections between Controllers and an IBM AT or IBM-XT/PS2:



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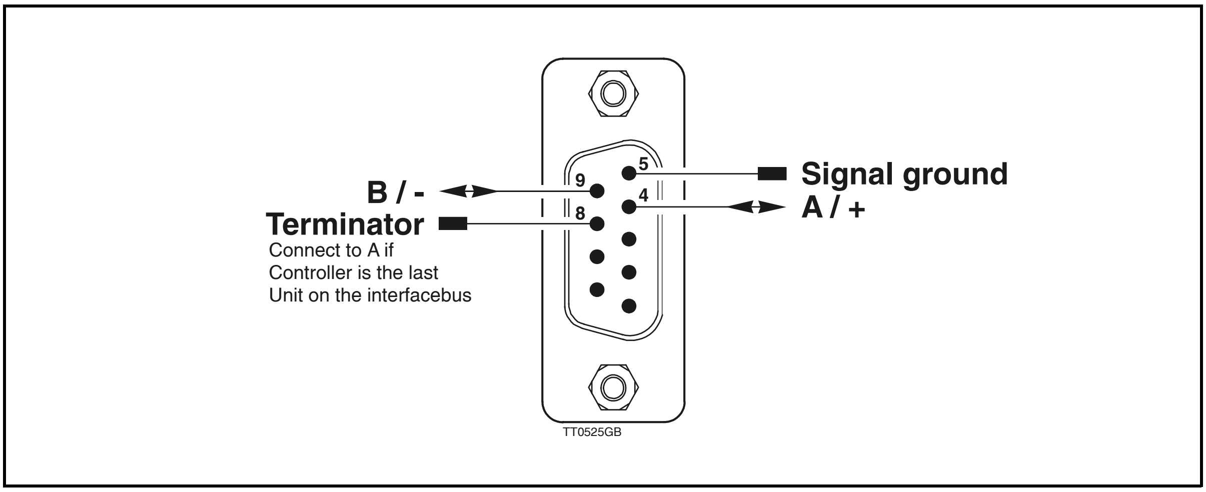
3.16 RS485 Interface

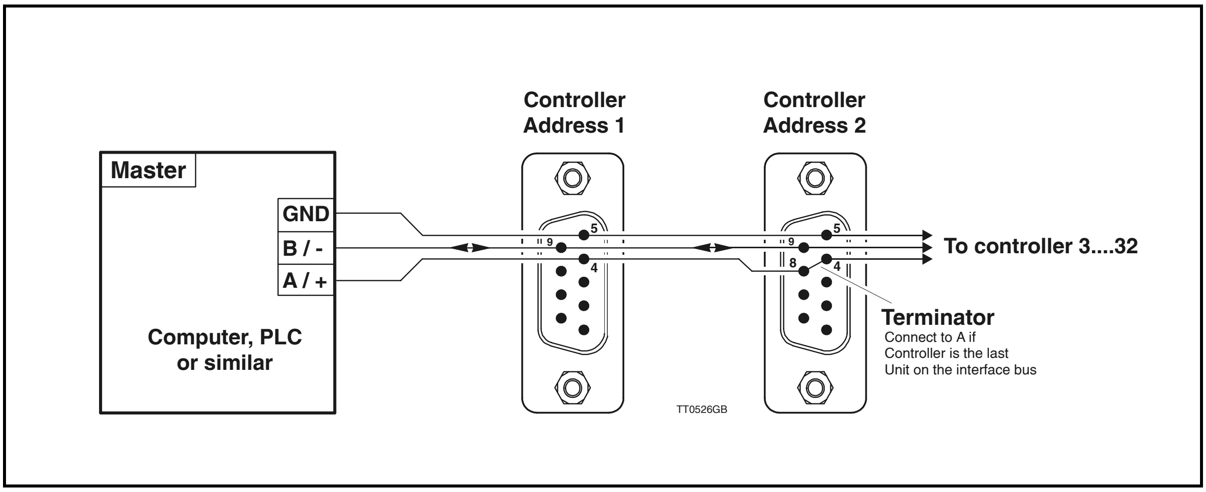
The Controller also includes an RS485 interface, in addition to the normal RS232 interface. The RS485 interface is intended for purposes where 1 to 32 controllers are connected on the same interface in a noisy environment.



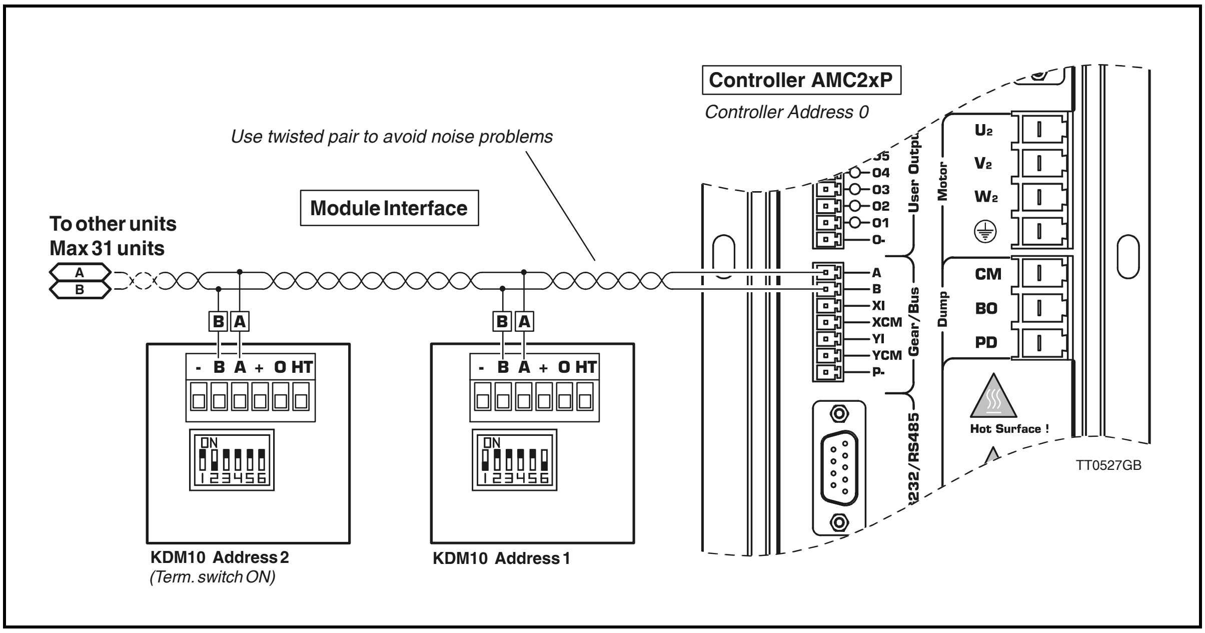
The communication protocol is exactly the same as that for RS232 communication. The only difference is the balanced signal lines, and the fact that all communication is half-duplex, which means that the Controller cannot send and receive at the same time, unlike RS232 communication.

The RS485 interface makes it possible for up to 32 units to be connected to the same interface bus. On the last Controller on the interface, the terminal marked Terminator (pin 8) must be shorted to the A terminal (pin 4).

The following illustration shows a typical system with 2 or more units connected to a computer or similar.



3.17 JVL-Bus Interface in the AMC2xP



3.17.1 JVL-Bus Interface

The Controller can be connected to different external modules such as a keyboard/display-module or input/output modules etc.
Connection to external modules is made via the Controller's serial JVL-Bus interface using the two terminals marked *A* and *B*. All external module functions are controlled via this interface. Up to 31 modules (and at least 1 motor controller) can be connected to the interface bus. The JVL-Bus interface offers several advantages in that the interface operates with a balanced output and has low impedance. In addition, the Controller's JVL-Bus interface is optically isolated from other Controller circuitry.
The JVL-Bus interface is protected against transients on the cable connecting the Controller to external modules. These factors enable communication at long distances despite the presence of electrical noise. It is recommended that twisted cable is used for connection between the Controller and other modules on the interface.
If the communication distance between 2 units in a system exceeds 25 metres, the DIP switch marked *TERM* must be set to the *ON* position on those units which are located more than 25 metres apart.
See the User Manual for the module in question for details of DIP switch settings.

3.17.2 Module Addresses

In communication systems where several modules are connected together, each unit must be assigned a unique address in the range 1 to 31. The above illustration shows how addresses in a typical system are set.
Note that care must be taken to ensure no two modules use the same address.
If the module addresses are not unique, the Controller will terminate program execution and an error message will occur. Note that the Controller's address is the same as that used for RS232 communication. See *Connection of Several Controllers to a PC*, page 45.
The address of each module should be set in accordance with the instructions given in the respective module's User Manual.

4 Software

4.1 Use of RS232 Commands

The AMC Controller can be controlled via its RS232 interface. Controller commands are sent as ASCII characters terminated by <CR> ASCII 13 (decimal) or ";". See also *RS232 Interface*, page 43.

Some of the Controller commands have associated command parameters, others do not. For those commands which use parameters, transmitting the command alone, without specifying the parameter, will provoke the Controller to respond with the command and the currently set value of the parameter. If no addressing is used, the Controller always responds when a command has been received. If the purpose of the command is to display a value or set-up, the required information will be sent as a reply, or a 'Y' will be transmitted to indicate that the command has been received. In the event that incorrect information has been sent to the Controller, for example a command that does not exist or a value that is out of range, the Controller will respond with an error message. Error messages consist of an 'E' followed by a number, followed by an explanatory text. See *Error Messages*, page 167.

Example:

Sent to Controller	`VM<CR>`
Received from Controller	`VM=500<CR>`
Sent to Controller	`VM=600<CR>`
Received from Controller	`Y<CR>`
Sent to Controller	`VM=-5<CR>`
Received from Controller	`E2: Out of range<CR>`

When addressing is used, the Controller will not acknowledge receipt of a command. Any errors in communication will be stored in the error status register 0. This register can be read using the command *EST0 (enter)* - see also *Error Status Text (EST)*, page 109

Commands may be sent as both upper-case and lower-case characters. With the exception of error messages, replies from the Controller are always upper-case.

The following sections described all of the RS232 commands. As mentioned above, all commands must be terminated by a carriage-return character <CR> or a semi-colon ";" before they will be interpreted by the Controller. These characters are not included in the description of the individual commands.

4.2 Operating Modes - General Description

The complete AMC2x series of Controllers offers 5 basic modes of operation. These 5 modes cover most typical applications. If a more complex solution is required, the AMC2xP models can be used. AMC2xP models offer the advantage of downloading a program in high-level language that describes a motion sequence together with I/O signals, etc.
If AMC2xP models are used, please note that switching between operating modes can be done under program control by using the *MO* command, but when shifting between 2 different modes there will be a short delay before the system stabilises. The delay time is in the range 1-5 mseconds.

4.3 Gear Mode (MO=1)

This mode is primarily intended for use as an electronic gear. The Pulse Input XI and YI are connected to an incremental encoder and the motor will then follow this encoder. The system can also be controlled as a step motor system via step-pulse and direction signals. The motor will move one step each time a voltage pulse is applied to the pulse input. This feature means that in many applications the Controller can replace a classic step motor system without encoder. The velocity and acceleration/deceleration are determined by the externally applied voltage pulses.
MO is set to 1 for operation of the AMC Controller in Gear Mode. See also *Getting Started — Gear Mode (Mode 1)*, page 5.

Example of the use of Gear Mode:
Adjust the servo loop (if necessary, see *Adjustment of Servo Regulation*, page 18) and any other parameters required.
Select Gear Mode, *MO=1*
Select the input format using the *PIF* command. See *Pulse Input Format (PIF)*, page 138

The motor can now be controlled via the Pulse Inputs XI and YI.

Commands of particular interest for operation in this mode are:
PIF, POF, ET, PR, PE, PRM, GEAR

4.4 Positioning Mode (MO=2)

In this mode of operation, the AMC Controller will position the motor via commands transmitted over the RS232 interface. Various operating parameters can be continuously adjusted via the interface while the motor is running. This mode is primarily used in systems in which the Controller is permanently connected to a PC via the RS232 interface. MO must be set to 2 for operation in this mode. See *Getting Started — Positioning Mode (Mode 2)*, page 6.

The position is specified in terms of pulses. Note that the Controller multiplies the number of encoder pulses by a factor of 4. If for example the encoder has a resolution of 500 pulses per revolution, the complete system will have a resolution of 2000 pulses per revolution. If an operation of 2000 pulses is specified, this means that the motor will rotate 1 revolution. The motor's instantaneous position can be read regardless of whether it is running or stationary. When a new position is set up, the motor moves to the new position using the pre-programmed velocity profile. See AC and VM.

Motor operation can use a programmed velocity profile by programming a maximum velocity and acceleration. In this mode, when the motor is operated to move to a new position, it will operate using the programmed velocity profile and the profile will always follow the acceleration/deceleration values. This means that the motor may not always attain maximum velocity if the distance is short. Motor status can be read us the RS command.

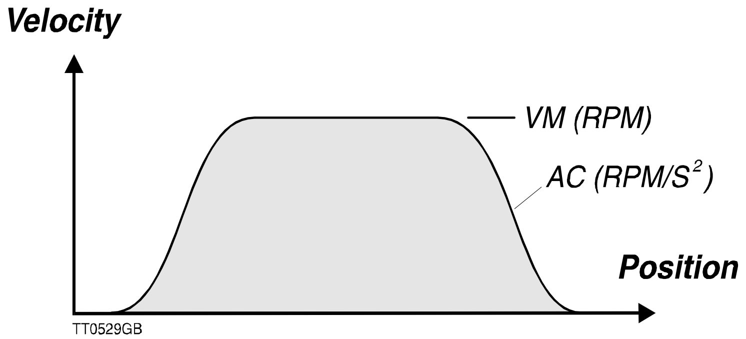
At any time the motor can be stopped using either the H or SH command.

Note: In order to achieve the correct velocity and acceleration, the number of encoder pulses per revolution must be set up using the PR command.

Example of the use of Positioning Mode:
Select Positioning Mode using MO=2
Set a maximum velocity using VM
Set an acceleration using AC
Adjust the servo loop. If necessary, see *Adjustment of Servo Regulation*, page 18

The motor can now be set to move to various positions using the SP or SR commands.

Commands of particular interest for operation in this mode are:
ET, PR, SP, SR, VM, AC, PE



4.5 Register Mode (MO=3)

4.5.1 General Description of Register Mode

The Controller can also be configured for absolute or relative positioning via 8 digital inputs. See also *Getting Started — Register Mode (Mode 3)*, page 7.
The Controller has 63 programmable parameter sets. Each parameter set can be used to store information about acceleration, position (relative or absolute) and velocity. Selection of a parameter set is made using inputs IN1-IN6. Input IN8 is a start/stop input. If IN8 is high, a parameter set is selected and the motor moves to a new position according to the selected velocity profile. If IN8 is set low before the desired position is reached, the motor will stop according to the pre-programmed deceleration (acceleration). When IN8 is again set high, the motor continues to the required position. When the required position is reached, O1 is set high to indicate that the motor has reached its destination. See also *Getting Started — Register Mode (Mode 3)*, page 7. Commands of particular interest for operation in this mode are: ET, PR, XR, XA, XP, XV, PE, PES.
Inputs IN1-IN6 select which parameter set is used for the actual motor operation.

Register set	Digital Inputs						Function			
	IN6	IN5	IN4	IN3	IN2	IN1	Acceleration	Velocity	Position	Relative
0 *	0	0	0	0	0	0	Zero search is started when this register is selected.			
1	0	0	0	0	0	1	XA1	XV1	XP1	XR1
2	0	0	0	0	1	0	XA2	XV2	XP2	XR2
3	0	0	0	0	1	1	XA3	XV3	XP3	XR3
4	0	0	0	1	0	0	XA4	XV4	XP4	XR4
5	0	0	0	1	0	1	XA5	XV5	XP5	XR5
6	0	0	0	1	1	0	XA6	XV6	XP6	XR6
7	0	0	0	1	1	1	XA7	XV7	XP7	XR7
8	0	0	1	0	0	0	XA8	XV8	XP8	XR8
9	0	0	1	0	0	1	XA9	XV9	XP9	XR9
10	0	0	1	0	1	0	XA10	XV10	XP10	XR10
11	0	0	1	0	1	1	XA11	XV11	XP11	XR11
12	0	0	1	1	0	0	XA12	XV12	XP12	XR12
13	0	0	1	1	0	1	XA13	XV13	XP13	XR13
14	0	0	1	1	1	0	XA14	XV14	XP14	XR14
15	0	0	1	1	1	1	XA15	XV15	XP15	XR15
16	0	1	0	ϕ	0	0	XA16	XV16	XP16	XR16
17	0	1	0	0	0	1	XA17	XV17	XP17	XR17
18	0	1	0	0	1	0	XA18	XV18	XP18	XR18
19	0	1	0	0	1	1	XA19	XV19	XP19	XR19
20	0	1	0	1	0	0	XA20	XV20	XP20	XR20
21	0	1	0	1	0	1	XA21	XV21	XP21	XR21
22	0	1	0	1	1	0	XA22	XV22	XP22	XR22
23	0	1	0	1	1	1	XA23	XV23	XP23	XR23
24	0	1	1	0	0	0	XA24	XV24	XP24	XR24
25	0	1	1	0	0	1	XA25	XV25	XP25	XR25
26	0	1	1	0	1	0	XA26	XV26	XP26	XR26
27	0	1	1	0	1	1	XA27	XV27	XP27	XR27
28	0	1	1	1	0	0	XA28	XV28	XP28	XR28
29	0	1	1	1	0	1	XA29	XV29	XP29	XR29

* Zero-point search function is started when X0 is selected. Zero search will occur according to the standard zero search parameters. See *Mechanical Reset*, page 75.

4.5 Register Mode (MO=3)

Register set	Digital Inputs						Function			
	IN6	IN5	IN4	IN3	IN2	IN1	Acceleration	Velocity	Position	Relative
30	0	1	1	1	1	0	XA30	XV30	XP30	XR30
31	0	1	1	1	1	1	XA31	XV31	XP31	XR31
32	1	0	0	0	0	0	XA32	XV32	XP32	XR32
33	1	0	0	0	0	1	XA33	XV33	XP33	XR33
34	1	0	0	0	1	0	XA34	XV34	XP34	XR34
35	1	0	0	0	1	1	XA35	XV35	XP35	XR35
36	1	0	0	1	0	0	XA36	XV36	XP36	XR36
37	1	0	0	1	0	1	XA37	XV37	XP37	XR37
38	1	0	0	1	1	0	XA38	XV38	XP38	XR38
39	1	0	0	1	1	1	XA39	XV39	XP39	XR39
40	1	0	1	0	0	0	XA40	XV40	XP40	XR40
41	1	0	1	0	0	1	XA41	XV41	XP41	XR41
42	1	0	1	0	1	0	XA42	XV42	XP42	XR42
43	1	0	1	0	1	1	XA43	XV43	XP43	XR43
44	1	0	1	1	0	0	XA44	XV44	XP44	XR44
45	1	0	1	1	0	1	XA45	XV45	XP45	XR45
46	1	0	1	1	1	0	XA46	XV46	XP46	XR46
47	1	0	1	1	1	1	XA47	XV47	XP47	XR47
48	1	1	0	0	0	0	XA48	XV48	XP48	XR48
49	1	1	0	0	0	1	XA49	XV49	XP49	XR49
50	1	1	0	0	1	0	XA50	XV50	XP50	XR50
51	1	1	0	0	1	1	XA51	XV51	XP51	XR51
52	1	1	0	1	0	0	XA52	XV52	XP52	XR52
53	1	1	0	1	0	1	XA53	XV53	XP53	XR53
54	1	1	0	1	1	0	XA54	XV54	XP54	XR54
55	1	1	0	1	1	1	XA55	XV55	XP55	XR55
56	1	1	1	0	0	0	XA56	XV56	XP56	XR56
57	1	1	1	0	0	1	XA57	XV57	XP57	XR57
58	1	1	1	0	1	0	XA58	XV58	XP58	XR58
59	1	1	1	0	1	1	XA59	XV59	XP59	XR59
60	1	1	1	1	0	0	XA60	XV60	XP60	XR60
61	1	1	1	1	0	1	XA61	XV61	XP61	XR61
62	1	1	1	1	1	0	XA62	XV62	XP62	XR62
63	1	1	1	1	1	1	XA63	XV63	XP63	XR63
	0 = Low (Inactive) **1 = High (Active)**									**0 = No** **1 = Yes**

4.5 Register Mode (MO=3)

Set-up of parameter set in *On line editor*.

Example 1:

Sent to Controller	`XV1=1000`	Set velocity in param. set 1 to 1000 RPM.
Received from Controller	`Y`	

Example 2:

Sent to Controller	`XV1`	Show speed in parameter set 1
Received from Controller	`XV1=1000`	

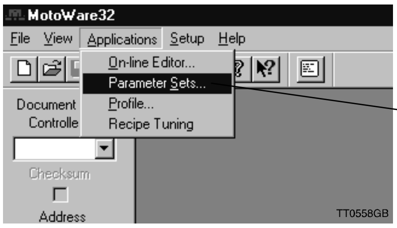
Example 3:

Sent to Controller	`XV`	Show all speed registers in parameter sets

Received from Controller	`XV1=10`
	`XV2=1000`
	`.............`
	`XV63=0`	

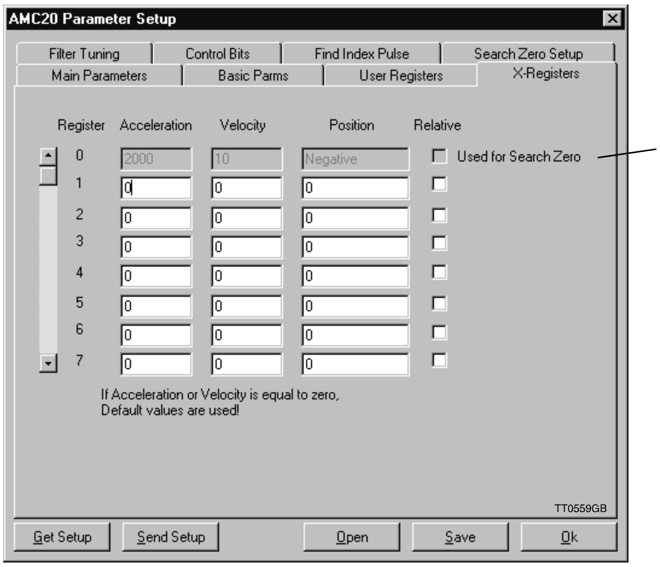
4.5.2 Setup of X Registers Using MotoWare

If MotoWare is used for installing and adjusting the X registers, this can be done by selecting the "Parameter Sets" menu.



Choose "Parameter Sets"

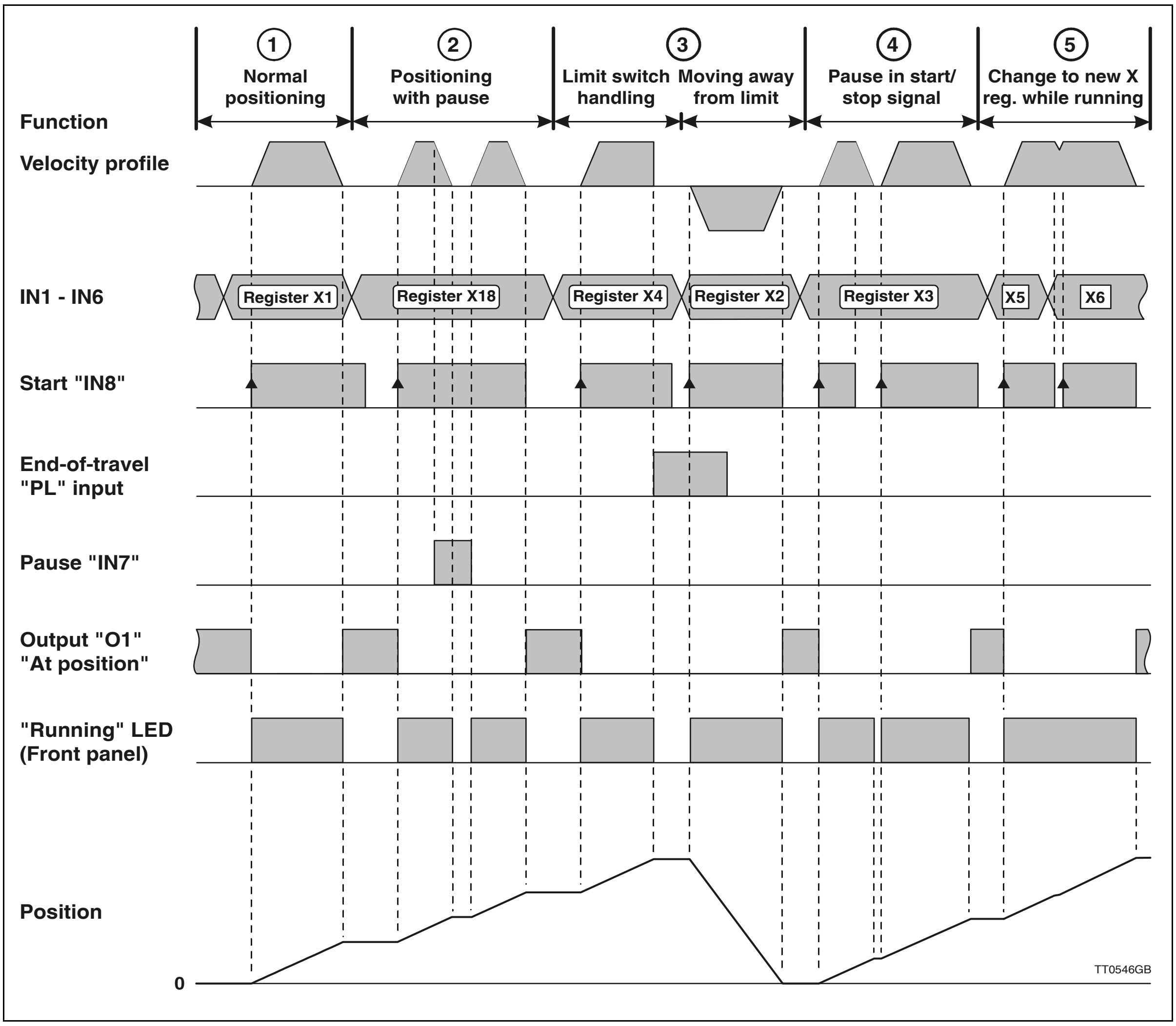
The "X-Registers" tab should then be selected to access the X-register window. This gives access to all of the X register settings. Note that it is not necessary to adjust the XV and XA registers since the default in the main parameter setup is used if a certain XV or XA register is set to 0.



Register	Acceleration	Velocity	Position	Relative
0	2000	10	Negative	□ Used for Search Zero
1	0	0	0	□
2	0	0	0	□
3	0	0	0	□
4	0	0	0	□
5	0	0	0	□
6	0	0	0	□
7	0	0	0	□

If Acceleration or Velocity is equal to zero,
Default values are used!

The parameters used for zero search are taken from the standard zero search registers ZA, ZV, ZD and ZR.



4.5.3 Register Mode Timing

The illustration above shows different situations when operating in Register Mode.

Situation 1 - Normal positioning.

Register 1 is chosen via inputs 1-6, and by activating the start input (IN8) the positioning is started and output 1 is cleared (set to 0V).

After the final position is reached, output 1 is activated and the positioning sequence is finished.

Situation 2 - Positioning with pause.

Same situation as situation 1 but before the final position is reached, the Pause input is activated and the motor decelerates to 0 RPM. The motor resumes operation after the Pause input is deactivated. The position output is activated when the final position is reached, as in situation 1.

Situation 3 - Limit switch handling / Moving away from limit switch

The positioning sequence is interrupted by the PL input (positive limit switch). The only solution to restart the motor is to move in a negative direction by selecting register set X2 (set up with a negative going position) whereby the limit switch is released. The position output (O1) stays passive until the final position defined by X2 is reached.

Situation 4 - Pause in start signal.

The positioning sequence is interrupted because the start input (IN8) is set to a passive state. The motor resumes operation after the start input is activated again. The position output (O1) stays passive until the final position defined by X3 is reached.

(Continued)

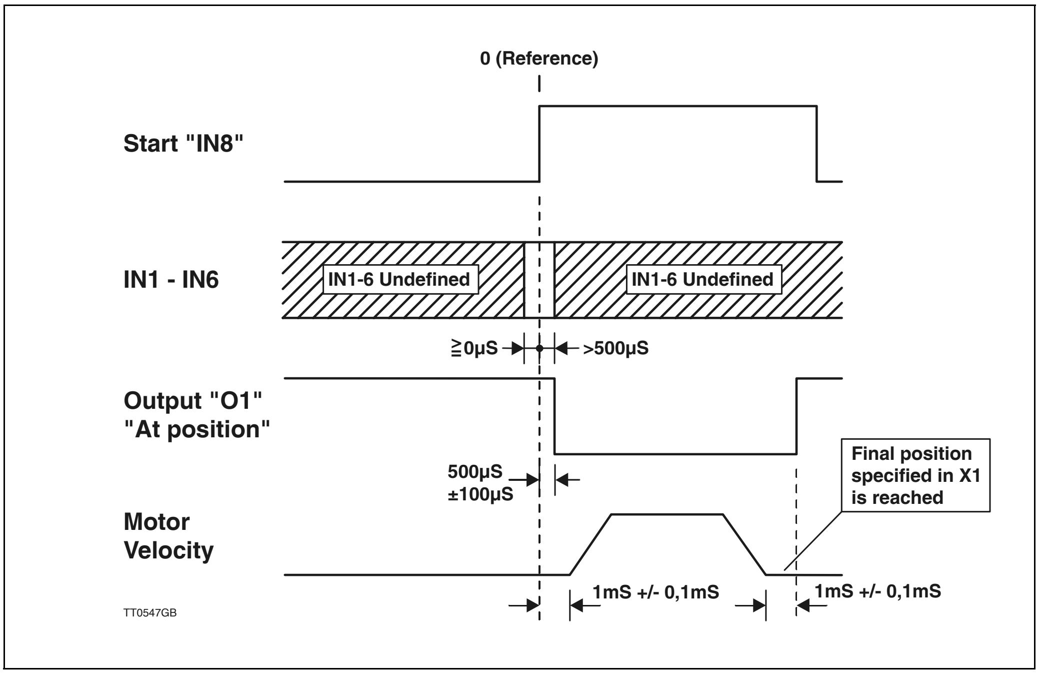
Situation 5 - Change to new X register while running.

The positioning sequence defined by the contents of X5 is started.
After a period, the X6 register is chosen (by changing inputs 1 to 6) and the start input is set to passive, causing the motor to start a deceleration.
The start input is activated again and the new register set is chosen. This will cause the motor to accelerate to nominal speed and the final position specified by X6 is reached. The position output which has been passive throughout the complete sequence is now activated.

Note that the LED on the front panel is lit when the motor is moving faster than >10 RPM regardless of the controller status.

4.5.4 Response Times

In many applications the timing can be important. The following timing scheme illustrates response times, i.e. from a start signal until the motor is running.



4.5.5 Using Mode 3 for Continuous Movement

Some applications may require that the motor is run in a certain direction at a certain speed. The DIF register can be used for this purpose. When DIF is set to 1 (default) the functionality of mode 3 is normal, as described elsewhere in this section. But if DIF is set to 2, all of the positions (XP registers) are ignored except for the sign in these registers. The XR registers are not used at all.

Example:
If XP1 is set to +1000, the motor will move in a positive direction when XP1 is selected and the start input is active. The velocity is defined by XV1 as normal.

Note that the zero search (register 0) is not affected by the DIF register setting. Register 0 can still be used to find the home/zero position.

4.6 Velocity Mode (MO=4)

Analogue control of the motor velocity can be achieved using the analogue input (AIN). The input voltage must be in the range -10V to +10V, with negative voltages producing motor movement in a negative direction and positive voltages producing movement in a positive direction. The VM command is used to specify the maximum velocity, i.e. the velocity at which the motor will rotate for maximum voltage applied to the analogue input.

The numeric value of the full-scale voltage does not have to be the same in both the positive and negative direction.
Use the AI1 command for adjustment of the Analogue Input 1.

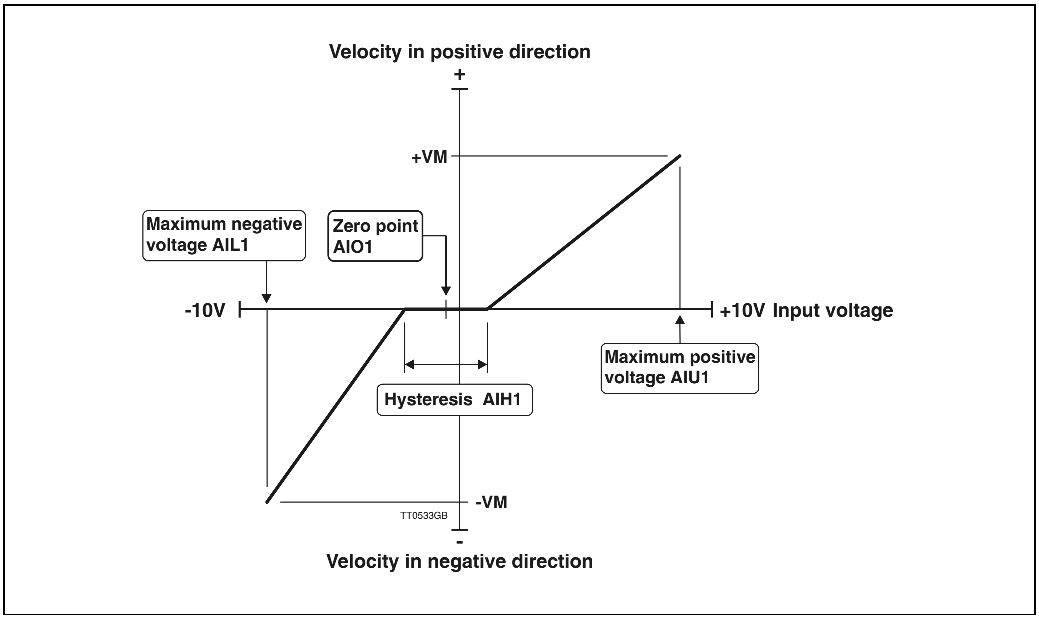
Once the servo loop has been adjusted, the Controller will ensure that the required velocity is maintained regardless of whether the motor is loaded or not. The load however must not be so great that the current limits are exceeded. If the rated current or peak current limits begins to regulate, motor operation will be very unsmooth and in extreme circumstances the motor will resonate.

If for example VM=500 RPM and the analogue input voltage is set to 5V, the motor will rotate at 250 RPM in a positive direction. See also *Getting Started — Velocity Mode (Mode 4)*, page 8.

Use of Velocity Mode:
Select Velocity Mode (MO=4)
Adjust the servo loop. If necessary see *Adjustment of Servo Regulation*, page 18
If necessary, adjust the analogue input. See *Adjustment of Analogue Input*, page 78
Set the maximum velocity using VM

The motor can now be controlled via the analogue input 1 (AIN1).

Commands of particular interest in this mode are:
ET, PR, VM, AIH1, AIL1, AIO1, AIU1


Velocity in positive direction
+
+VM
Maximum negative voltage AIL1
Zero point AIO1
-10V
+10V Input voltage
Maximum positive voltage AIU1
Hysteresis AIH1
-VM
TT0533GB
-
Velocity in negative direction

4.7 Torque Mode (MO=5)

The motor torque can be controlled by an analogue signal using the Analogue Input (AIN). The input voltage must be in the range -10V to +10V, with negative voltages producing a negative torque and positive voltages producing a positive torque. The value of the torque is specified in Amps. TQ is used to specify the maximum torque, i.e. the torque provided by the motor when a maximum input voltage is applied.

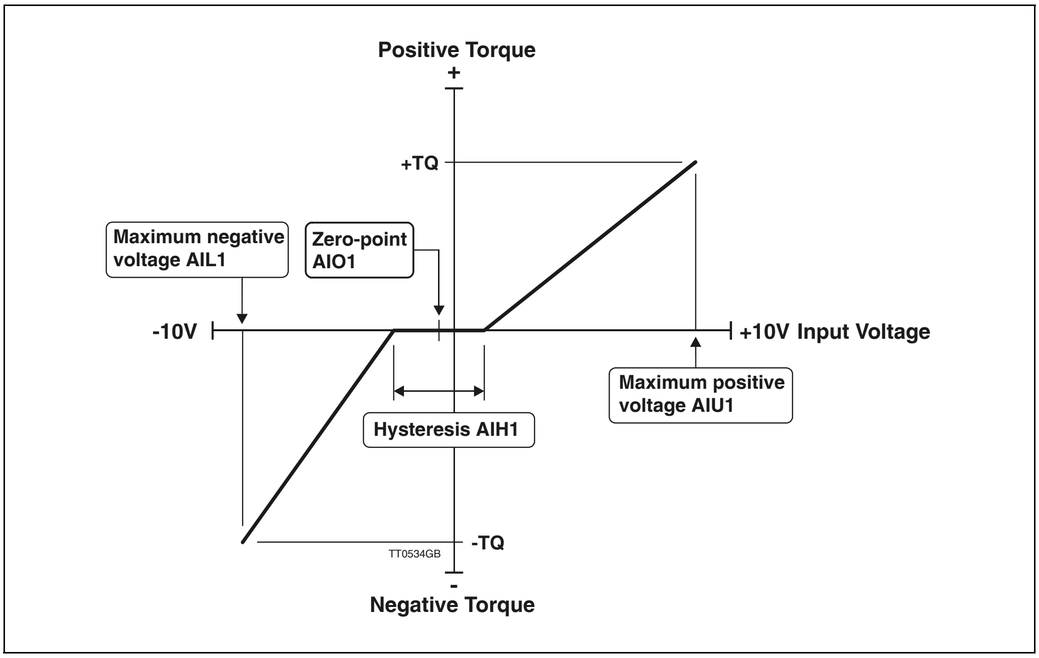
The numeric value of the full-scale voltage does not need to be the same in both the positive and negative directions. Use the AI1 commands to adjust the analogue input.

If for example TQ is set to 100% and the analogue input voltage is set to 5V, a torque corresponding to 50% will be produced. The torque range 0-100% refers to the maximum peak torque that the motor can produce by the actual CP (peak current) setting.

Use of Torque Mode:
Select Torque Mode (MO=5)
Adjust the servo loop. See *Adjustment of Servo Regulation*, page 18
If necessary, adjust the Analogue Input. See *Adjustment of Analogue Input*, page 78
Set any maximum velocity required using VM.
Set the maximum torque using the TQ command.

The motor can be controlled via the Analogue Input 1 (AI1). In this mode, VM is used to ensure that the motor does not exceed a velocity above which mechanical damage may occur or that the motor is overloaded. The velocity limit in this mode is a precautionary measure and not a precise control.

Commands of particular interest in this mode are:
TQ, VM, AIH1, AIL1, AIO1, AIU1



4.8 Program Execution in the AMC2xP

4.8.1 General Description

The AMC2x Servo Controller provides the additional feature that it can be programmed using a simple and flexible programming language which is built up around the interface command set. Thus all commands can be used for developing or executing programs. During program execution, all parameters in the Controller can be read or changed. All values that can be set and read using the same single command are called registers and can be used in arithmetic expressions.

Program execution is line based. A program can consist of up to 500 program lines, beginning with line number 0. A program line is executed every millisecond. The Controller can thus take care of all the functions required by an AC Servo Controller. For example, power consumption and average current are monitored and it is possible to communicate via the RS232 interface when a program is executed.

The programming language itself is very simple and resembles BASIC. The program is not compiled, but is interpreted during execution. This gives the advantage that in principle only a terminal program is required to program the Controller.

4.8.2 Use of Commands in a Program

The inclusion of a command, such as one of the "show value" commands, will result in the returned value being sent over the RS232 interface. For example, if the current acceleration is 100, the command *AC* alone will result in the following string on the interface: *AC=100*. The command *AC=200* however will change the acceleration to 200. When a command is included in an arithmetic expression, the value of the register is substituted into the expression. For example, the program line *VM=AC+100* will set the maximum velocity to the value of the acceleration plus 100. When register values are included in expressions in this way, no account is taken of the implied units (velocity and acceleration in this case). When, for example, velocity is changed using the *VM* command, the effect on motor operation occurs instantaneously. Changes in motor parameters must therefore be made with great care.

Examples of the use of commands in a program:

```
AC=330      // Set acceleration to 330 RPM/s
VM=500      // Set max. velocity to 500 RPM
SR=100000   // Advance the motor 100000 pulses
AP          // Show actual position via the RS232 interface
```

4.8.3 User Registers

All registers can be used for temporary storage of values. Since some registers have direct effect on motor movement, as mentioned above, the Controller is equipped with 500 user-definable registers denoted R0-R499. These can be used freely to store intermediate values. R0-R499 can be used and included in arithmetic expressions in the same way as any other parameter such as the motor parameters (VM, PR, CL, AC). The user registers can store values in the range -2.147.483.647 to +2.147.483.647 and can be saved in the Controller's non-volatile memory using the command *MS2*. When the contents of the user registers are saved in non-volatile memory, they must be recalled using the *MR1* command before they can be used.

Examples of the use of user registers:

```
R1=R2       // Set register 1 (R1) equal to register 2 (R2)
R1=-R1      // Negate the value of register 1
R1=-R2      // Negate the value of R2 and save the result in R1
R3=R1*-R2   // Negate R2, multiply by R1 and save result in R3
R1=KP*10    // Multiply KP by 10 and save the result in R1
```

4.8 Program Execution in the AMC2xP

The user registers can also be used for indirect addressing by using square brackets [and]. R[3] and R3 will give the same result. [and] give the possibility of using another register or an equation as the index for the register. The following gives examples of indirect addressing:

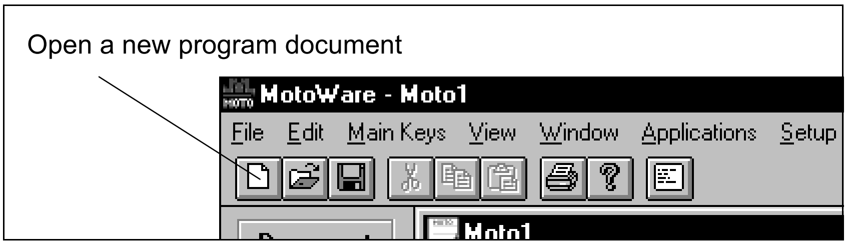
VM=R[R5]
CA=R[R5+1]

4.8.4 Programming the AMC2xP using MotoWare

Using *MotoWare,* programs can be easily developed and saved in the Controller.

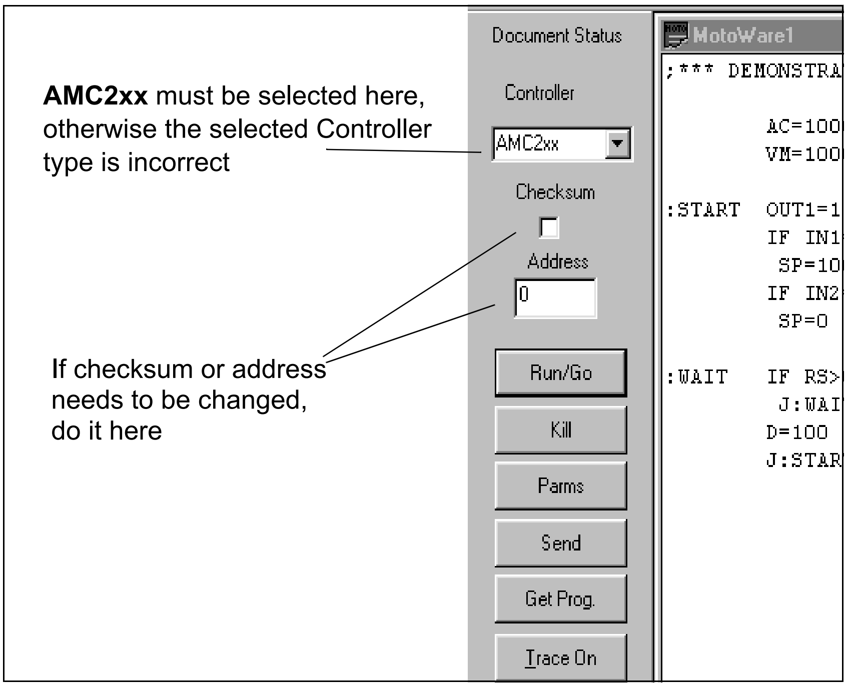
Proceed as follows to create a new program:

1) First, open a new program document: either by selecting FILE and then New... or by selecting the new document icon.



Open a new program document

2) Select the correct Controller type and, if required, whether addressing and checksum are to be used.



AMC2xx must be selected here, otherwise the selected Controller type is incorrect

If checksum or address needs to be changed, do it here

Document Status

Controller: AMC2xx

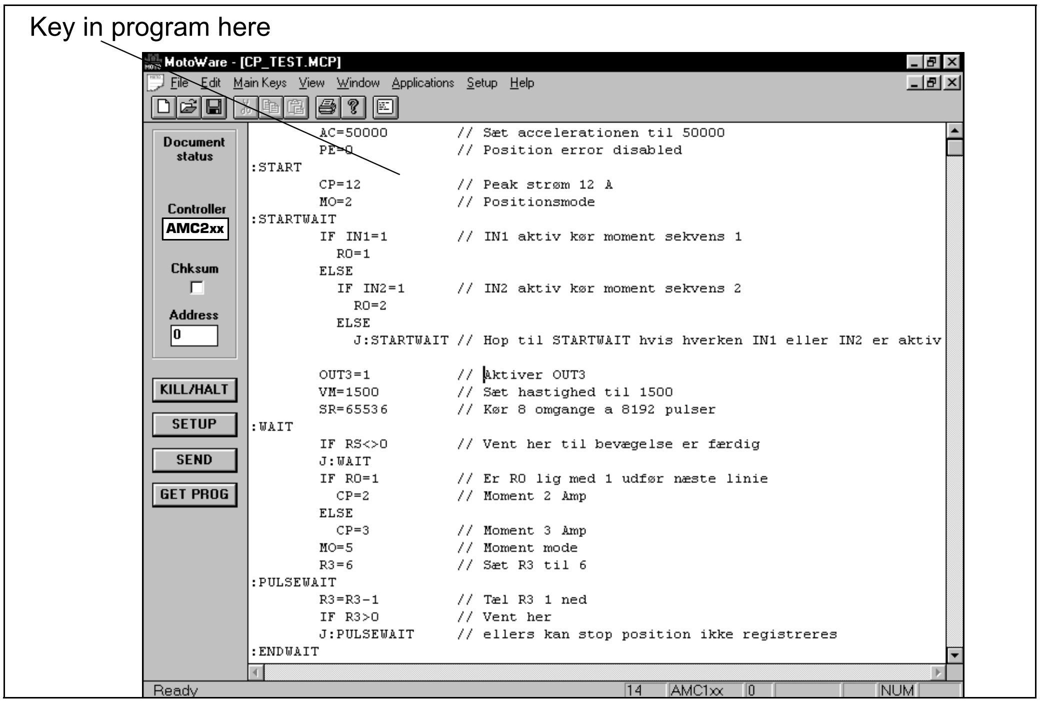
Checksum: □

Address: 0

```
;*** DEMONSTRA

        AC=100
        VM=100

:START  OUT1=1
        IF IN1
         SP=10
        IF IN2
         SP=0

:WAIT   IF RS>
         J:WAI
        D=100
        J:STAR
```

4.8 Program Execution in the AMC2xP

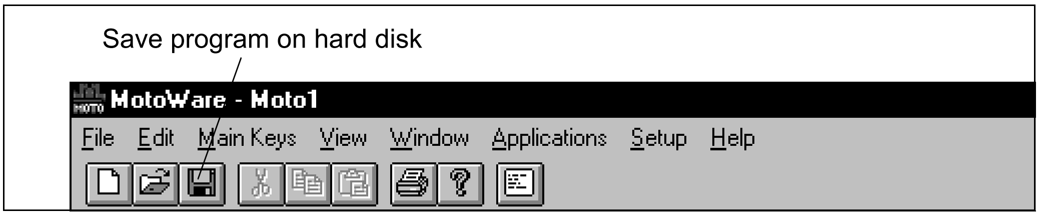
3) Key in the program in the program document editor window



Key in program here

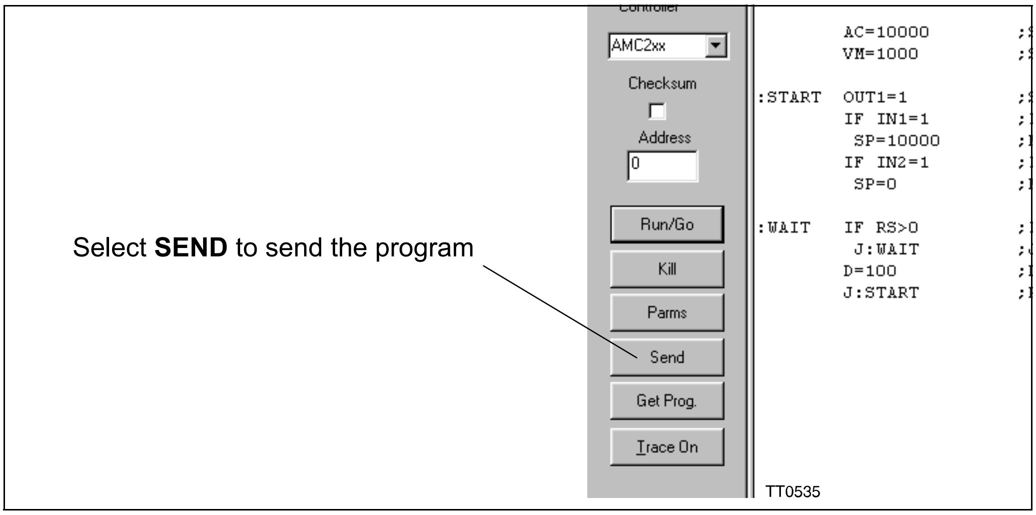
```
        AC=50000        // Sæt accelerationen til 50000
        PE=0            // Position error disabled
:START
        CP=12           // Peak strøm 12 A
        MO=2            // Positionsmode
:STARTWAIT
        IF IN1=1        // IN1 aktiv kør moment sekvens 1
          RO=1
        ELSE
          IF IN2=1      // IN2 aktiv kør moment sekvens 2
            RO=2
          ELSE
            J:STARTWAIT // Hop til STARTWAIT hvis hverken IN1 eller IN2 er aktiv

        OUT3=1          // Aktiver OUT3
        VM=1500         // Sæt hastighed til 1500
        SR=65536        // Kør 8 omgange a 8192 pulser
:WAIT
        IF RS<>0        // Vent her til bevægelse er færdig
        J:WAIT
        IF RO=1         // Er RO lig med 1 udfør næste linie
          CP=2          // Moment 2 Amp
        ELSE
          CP=3          // Moment 3 Amp
        MO=5            // Moment mode
        R3=6            // Sæt R3 til 6
:PULSEWAIT
        R3=R3-1         // Tæl R3 1 ned
        IF R3>0         // Vent her
        J:PULSEWAIT     // ellers kan stop position ikke registreres
:ENDWAIT
```

4) Once the program is complete, it can be saved to the hard disk.



Save program on hard disk

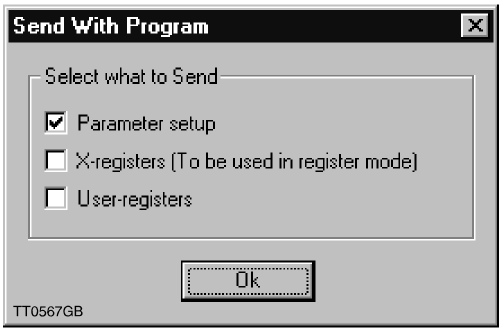
5) Once the program has been saved to hard disk, it must be sent to the Controller. Select **SEND**. If an error occurs, an error message will be displayed. See *Error Messages during Programming and Program Execution*, page 72.



Select **SEND** to send the program

```
          AC=10000          ;
          VM=1000           ;

:START    OUT1=1            ;
          IF IN1=1          ;
           SP=10000         ;
          IF IN2=1          ;
           SP=0             ;

:WAIT     IF RS>0           ;
           J:WAIT           ;
          D=100             ;
          J:START           ;
```

6) After SEND is selected the following dialogue box will appear.



Send With Program

Select what to Send

☑ Parameter setup

□ X-registers (To be used in register mode)

□ User-registers

This dialogue is used to decide which other parameters must be transferred together with the program (if any).

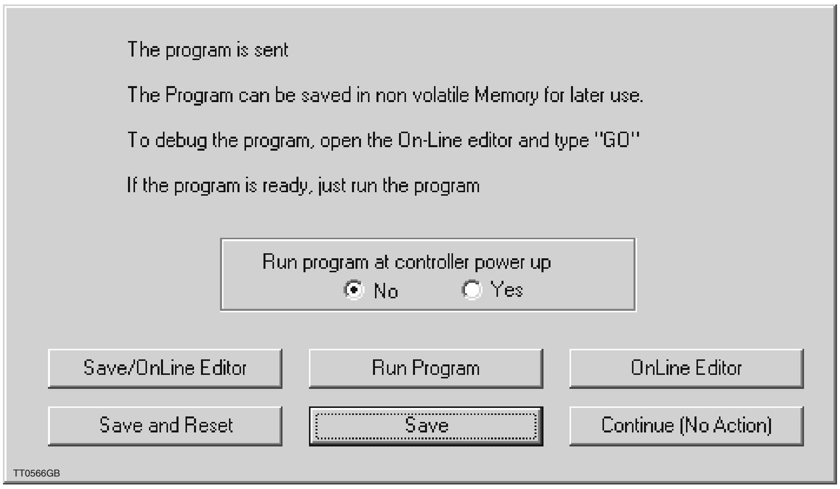
Parameter setup: This item covers all the standard parameters such as Velocity, Servo filter setup, and motor basic parameters. All parameters except X and R registers.

X-Registers : If X-Registers are selected, all the position and speed registers used in mode 3 are transferred together with the program.

User registers : If User registers are selected, all the user registers (R0-R499) are transferred together with the program.

Ok : Press Ok and the program will be transferred to the Controller including the selected register groups.

7) Once the program has been sent to the Controller, the dialogue box shown below is displayed. This provides several options. For example, you can choose to start the program automatically when the Controller is powered up. In this case *Yes* is selected followed by *Save*. The six command buttons have the following function:



The program is sent

The Program can be saved in non volatile Memory for later use.

To debug the program, open the On-Line editor and type "GO"

If the program is ready, just run the program

Run program at controller power up

● No ○ Yes

Save/Online Editor : Save the program in non-volatile memory and open the OnLine Editor. When this option is selected, the MS command is sent to the Controller. Then the OnLine Editor is started. The program can then be executed using the *GO* command. It is important to use the OnLine Editor during tests. In the event of program errors, the Controller sends error messages which are automatically displayed in the OnLine Editor.

Save and run Program : Save the program in non-volatile memory and start program execution. When this option is selected, the *MS* command is sent to the Controller, followed by the *GO* command. The program is saved and then executed.

Run Program : Start the program.When this option is selected, the *GO* command is sent to the Controller and program execution begins.

Save : Save the program in non-volatile memory.

OnLine Editor : Start the OnLine Editor directly. The OnLine Editor is opened and the program can be executed using the *GO* command. It is important to use the OnLine Editor during tests. In the event of program errors, the Controller sends error messages which are automatically displayed in the OnLine Editor.

Continue (No Action) : Close the dialogue box without any further action.

4.8.5 Program Size

The Controller is equipped with a program memory of 32kbyte. This memory will typically be able to contain a program of 1000-2000 program lines. Program capacity is however very dependent on which commands are used in a program. The "?" command in the online editor window can be used to display the actual program size in terms of % of total memory.
See *Show set-up (?)*, page 79.

4.8.6 Arithmetic expressions

All registers can be assigned a value by following the register name with an "equal to" sign "=", followed by an absolute value, a register name or an arithmetic expression. Absolute values, register values and the following four operators can be used in arithmetic expressions:

Arithmetic operators used in expressions:

+	**addition**
-	**subtraction**
*	**multiplication**
/	**division**

All calculations are performed either as 32-bit integers (-2.147.483.647 to +2.147.483.647) or as 32-bit decimal numbers ("floating- point") numbers. Integers are signed and have approximately 10 significant digits. The 32 bits for decimal numbers are used as follows: 1 bit sign, 8 bit exponent and 23 bit mantissa. Decimal numbers can thus be calculated with an accuracy of 23 bits, which gives approximately 7 significant digits. When calculations are made that involve large numbers, integers should be used. As a general rule, all expressions are calculated as integers. If a decimal number or register which is expressed as a decimal (e.g. CP) is included anywhere in an expression, the entire calculation is performed as a decimal. The number 3 will be treated in an expression as an integer, whereas 3.0 will result in the entire expression being calculated as a decimal. For integer calculations, any decimal remainder is discarded, also in intermediate calculations. Calculation does not automatically occur as a decimal number even if the register represented by the left-hand side of the expression is a decimal. Conversion of the result of the right-hand side of the equation occurs first when calculation is complete. Calculations that involve only integer values are performed much faster then decimal calculations. Therefore use decimal numbers only when necessary. The following examples illustrate calculations of expressions. The following register values are assumed: IN1= 1, R1=2, AC=500, CP=1.5 and VM=100

```
R4=3/2+3/2                            // R4 is assigned the value 2
R4=3.0/2+3/2                          // R4 is assigned the value 3
CP=7/3+3/2                            // CP is assigned the value 3.0
CP=7.0/3+3/2                          // CP is assigned the value 3.8
R4=AC/VM*CP                           // R4 is assigned the value 7
CP=AC/VM*CP                           // CP is assigned the value 7.5
R4=IN1*35+CP*AC                       // R4 is assigned the value 785
R4=IN1*35+(R1-AC)*2--2*(7+3*(VM-50))  // R4 is assigned the value -647
```

4.8.7 Operator Precedence and Order of Evaluation

The following table gives the rules of operator precedence and order of evaluation for operators that can be used in arithmetic and/or logical expressions. Operators on the same line of the table have the same rank, i.e. multiplication * and division / are ranked equally and an expression is evaluated from left to right. For example, 2*35/3 results in a value of 23, and 35/3*2 gives a value of 22 (note integer arithmetic is used here). The table is listed in order of precedence. Thus * and / have a higher rank than addition + and subtraction -. This means that multiplication and division are calculated first. For example, 35+3*2 gives the result 41. Parentheses "( )" can be used to change the order of evaluation of arithmetic operators. For example, the expression (35+3)*2 results in a value of 76.

4.8 Program Execution in the AMC2xP

Operator precedence, from higest to lowest

Operator	Evaluation direction	Type
NOT - ~ SIN COS TAN	Right against left	Unary
* / MOD	Left against right	Binary
+ -	Left against right	Binary
SHL SHR	Left against right	Binary
< <= > >=	Left against right	Binary
= <>	Left against right	Binary
&	Left against right	Binary
^	Left against right	Binary
|	Left against right	Binary
AND	Left against right	Binary
OR	Left against right	Binary
=	Right against left	Assignment

Operator descriptions.

Operator	Datatype(s) in	Datatype(s) out	Description
NOT	Bool	Bool	Logical negation
-	Int, Float	Int, Float	Arithmetical negation
~	Int	Int	Binary negation
SIN	Float	Float	Sine function input in radians
COS	Float	Float	Cosine function input in radians
TAN	Float	Float	Tang. function input in radians
*	Int, Float	Int, Float	Arithmetic multiplication
/	Int, Float	Int, Float	Arithmetic division
MOD	Int	Int	Full number division spare
+	Int, Float	Int, Float	Arithmetic addition
-	Int, Float	Int, Float	Arithmetic subtraction
SHL	Int	Int	Binary shift to left
SHR	Int	Int	Binary shift to right
>	Int, Float	Bool	Greater than
<	Int, Float	Bool	Less than
>=	Int, Float	Bool	Greater than or equal
<=	Int, Float	Bool	Less than or equal
=	Int, Float	Bool	Equal
<>	Int, Float	Bool	Not equal
&	Int	Int	Binary AND
^	Int	Int	Binary XOR
|	Int	Int	Binary OR
AND	Bool	Bool	Logical AND
OR	Bool	Bool	Logical OR
= (assignment)	Bool, Int, Float	Bool, Int, Float	Variable assignement

Data types.

Type	Description	Priority
Bool	Can be true (1) or false (0)	1
Int	32 Bit Integer with sign	2
Float	32 Bit floating point with sign	3

4.8 Program Execution in the AMC2xP

The datatype is automatically converted into the type which the operator can use. If a floating point value is converted to an integer the nearest value is chosen.
If the operator is working with to different data types the data type with the lowest priority is converted into the same type as the data type with the highest priority.
Example:
A floating point value is added to an integer therefore the integer is before the addition converted into a floating point value.

Logical equations:
Logical equations are used to evaluate whether one of more conditions are fulfilled in connection with IF statements. Formally the syntax is as follows:

Logical equation::= *logical expression* { **OR** *logical expression* }
logical expression::= *logical factor* { **AND** *logical factor* }
logical *factor*::= *value* rel_op *value*(where rel_op is <, >, =, <=, >= or <>).
value::= *register* or *arithmetic expression*

Logical equations may use ordinary arithmetic expressions, registers, relational operators (<, >, =, <=, >= or <>) and logical operators (AND and OR). The order of evaluation for OR and AND cannot be changed using parentheses "( )". A logical expression must be specified before and after an AND or an OR operator. A logical expression must contain a relational operator. Thus it is not sufficient to specify an expression such as *AC OR VM* but an expression such as *AC>0 OR VM>0* is legal. As many relational and logical operators as required may be used providing the formal requirements are met. A logical equation may also include arithmetic expressions in which the result is compared to value, register or another arithmetic expression. The following illustrates examples of logical equations:

Equations :	Comments:
IN1=1 OR IN2=1 OR IN3=1 AND IN4=1	Is true if IN1 or IN2 is 1 or IN3 and IN4 is 1.
AC>8*(4-3) AND IN1=IN2*IN3*IN4	Is true if the acceleration is greater than 8 and when IN1 is 1 at the same time as IN2, IN3 and IN4 are 1 or IN1=0 and only one of IN2, IN3 or IN4 is 0.
AC<>VM*IN1	Is always true when the acceleration is greater than zero and different from the velocity.
The following are illegal:	
(AC>45 OR VM<67) AND AC<>VM	Parentheses cannot be used to change the order of evaluation of OR and AND the right bracket is expected after 45.
IN1 OR IN2	Relational operator missing.

Examples:

R1= 3.5 + 5 * 7 => R1=39

First of all 5*7 will be calculated since * (multiply) has the higest precedence. The result of this calculation will be an integer (Int).
Now the floating point value 3.5 + the integer 35 is processed. In the first place the value 35 will be converted to a floating point value and afterwards the addition will be done. The result will be the floating point value 38.5.
Since R0 is an integer the value will be converted into an integer (39) which is transfered to the register R1.

R1 = 7*3*3.5 => R1=74

First of all 7*3 will be calculated since * (multiply) is evaluated from left against right. The result of this is the integer 21. Secondly 21*3.5 is calculated but in the first place 21 is converted into a floating point value. The result is 73.5 which is converted to an integer and transfered to the register R1.

R1 = 47/2/2.0 => R1=12

First of all 47/2 will be calculated as a integer division since a division is evaluated from left to right. The result is 23. Secondly 23/2.0 is calculated. This is done by converting 23 to a floating point value. The result is presented as a floating point value of 11.5 which is converted to the integer value 12. In the end the result 12 is transfered to R1.

R1 = NOT 12 + 7 => R1=7

First of all NOT 12 is processed since NOT has the highest precedence.
Since NOT only can function at a "Bool" type, the state of 12 will be converted to such one. The result of this is 1 (true). The NOT operator will secondly do a negation of this value with the result 0 (false). In the end the (Bool)0 is added to the integer 7. The (Bool)0 will at the first place be converted to an integer and thereafter added to 7. The result will therefore be 7.

4.8.8 IF Statement

Logical expressions can be evaluated using an IF statement. Together with ELSE, the IF statement can be used to express "decisions" within the programming sequence. Formally the syntax for the IF statement is as follows:

```
IF expression
   action1
ELSE
   action2
```

in which the ELSE clause is optional. The conditional test is performed by evaluating *expression*. If it is true, *action1* is carried out. If *expression* is false, and if an ELSE clause is included, then *action2* is carried out. The IF statement is line based: *action1* must be specified on the lines following the IF statement, and if an ELSE clause is used, ELSE and *action2* must be specified on the following lines. *action1* can include several command lines terminated by ELSE or ENDIF. If action2 consist of several lines the sequence must be terminated by ENDIF, otherwise the IF ELSE statement will only include first line and the following lines will always be executed. Because of the above, the following program segment will not work:

```
IF IN1=1          // NB this program segment will not work
IF IN2=1
AC
ELSE
VM
```

If IN1 is 1, the program segment will work since the following line IF IN=2 will be evaluated. If however IN1 is 0, the line IF IN2=1 will be skipped and the AC command executed. The next line begins an ELSE clause. Lines following an ELSE are only executed if a preceding IF statement has been evaluated false, which is not the case in this example.

A solution to the above could be:

```
         IF IN1=0       // Execute next line if IN1 is 0
            J:NN        // Jump to label NN
         IF IN2=1       // Execute next line if IN2 is 1
            AC          // Show acceleration on RS232 interface
         ELSE           // Execute next line if IN2 is 0
            VM          // Show velocity on RS232 interface
:NN
```

Or the solution could also be:

```
IF IN1=1/
BEGIN
IF IN2=1
AC
ELSE
VM
END
```

4.8 Program Execution in the AMC2xP

The following general construct:

```
IF expression
action
ELSE
BEGIN
IF expression
action
ELSE
BEGIN
IF expression
action
ELSE
action
END
END
```

occurs so often, that a brief explanation is given here. This sequence of IF statements is the most general way of making conditional tests between many possible cases. The expressions are evaluated in sequence and if one of the expressions is true, the action associated with that expression is performed and the entire chain terminated. As always, the code for each action is a program line specifying a command.

The final ELSE clause takes care of the situation when none of the previous conditions have been met. If no action is required in this case, the final ELSE clause:

```
ELSE
action
```

can be omitted. To illustrate a conditional test involving 3 branches, the following examples shows how a program segment can be used to wait for input from IN1 or IN2. When IN1 is active (1), the acceleration is set to 500 and the program continues. If IN1 is inactive (0) and IN2 is active (1), the acceleration is set to 900 and the program continues.

```
:START
        IF IN1=1    // If IN1 is active, set AC=500
        AC=500
        ELSE
        BEGIN
        IF IN2=1    // If IN2 is active, set AC=900
        AC=900
        ELSE
        J:START     // Jump to START if neither IN1 nor IN2 is active
        END
```

Note: if more IF ELSE statements are used in connection, you must use BEGIN and END tags. ('{' and '}' can be used instead of BEGIN and END)

4.8.9 Error Messages during Programming and Program Execution

Three types of error message can occur during programming and program execution: grammatical errors, syntactic errors, and errors during execution (runtime errors). A check for grammatical errors is carried out immediately during transfer of a program to the Controller. A check is made to ensure that the individual commands and operators exist, that absolute values are not too large, etc. A check is also made to ensure that commands are used in the correct context. For example, the following program line:

```
AC=H
```

will result in the error message: *Error: This command must not be included in an equation*. The H command is not of the register type. When a program is transferred via the *MotoWare* program editor and an error occurs, transfer is interrupted and the line containing the error is highlighted.

When a program is interpreted during execution, any syntax errors are found while the program is in use. During testing therefore, it is important to use *MotoWare* with the On-Line editor window open. During execution, the Controller will automatically transmit any error messages. The following is an example:

```
VM=500
AC=VM=CP    // This line has incorrect syntax.
IF VM>600
VM=900
```

The above program segment will result in the error message: *Error in line: 1 Des.: Syntax* indicating a syntax error in line number 1.

```
VM=500
R4=14
AC=VM
IF (VM>600 OR AC<>800// Right (closing bracket) missing after 600
```

The above program segment will result in the error message: *Error in line: 3 Des.: Right parenthesis expected,* indicating that a closing bracket is missing in line 3. (Remember that line numbering begins with line 0). If syntax errors occur, program execution is stopped.

The third type of error is those that occur during normal operation of a program that otherwise functions. These are not program errors as such but errors for example in the use of registers. Assigning a value which is too great or too small to a register during on-line control will normally result in the error message: *E2: Out of range*. During program execution however, this type of error will not generate error messages on the RS232 interface. Instead, information about previous errors is stored in a register which can be read using the ES command. These types of error can thus be handled during program execution and therefore do not require the program to be stopped. The following example illustrates how such errors can be avoided:

```
R1=ES0            // Clear any error messages
AC=100000         // Set acceleration to 100000
IF ES0>0          // If error, ES0 is greater than 0
AC=50000          // Set acceleration to 50000
```

resulting in the acceleration being set to 50000

4.8.10 Jumping to Program Lines and the Use of Labels

The Jump command *J* provides a facility for program control by jumping to a specified program line number. The Jump command can only be understood correctly by the Controller when it is used together with an absolute value, for example *J50* (jump to line number 50). Using absolute line number values can give problems when programs are modified. When *MotoWare* is used however, labels can be used. *MotoWare* interprets and translates the individual labels and sends the correct command to the Controller. Label names may in principle consist of all displayable characters, but it is recommended that only numerals and the letters (a-z) are used since problems may occur if programs are moved between computers with different set-ups. Labels are case sensitive.

The following program segment:

```
:START  IF IN1=1            // If IN1 is equal to 1, next line is executed
        J:OK                // Jump to label OK
        ELSE                // If IN1 is 0, execute line after ELSE
        J:ERROR             // Jump to label ERROR
:OK     OUT5=1              // Set OUT5
        J:START             // Jump to label START. Begin again
:ERROR  OUT5=0              // Clear OUT5
        J:START             // Jump to label START. Begin again
```

is translated to:

```
        IF IN1=1
        J4
        ELSE
        J6
        OUT5=1
        J0
        OUT5=0
        J0
```

4.8.11 Call of Sub-routine

If the same sequence of commands is used often, it is a good idea to create a sub-routine. A sub-routine is started with a label and terminated by the RET command. A sub-routine is called by the JS (Jump Subroutine) command. When the JS command is executed, program execution continues from the line number specified by the command in the form of a number or a label. When the RET (Return) command is encountered in the sub-routine, the program returns to the main program at the line immediately after the JS command and continues from there. The following gives an example of the use of a sub-routine:

```
       R5=500
       R6=1000
       R1=5
       JS:TEST// set acceleration to 500
       R1=6
       JS:TEST// set acceleration to 1000
       J:END

:TEST  AC=R[R1]
       RET
:END   ....
```

4.8.12 Pause in Program Execution (Delay)

The D command pauses program execution. The break in msec. is defined by specifying D=pause or D(pause). While a program line is executed every 2 msec., the delay specified will be in even multiples of msec. For example, D=13 will make a break for 14 msec.

```
R1=20   // Set R1 to 20
D=R1    // Wait for 20 msec.
```

4.9 Mechanical Reset

4.9.1 Zero Point Search Function

The motor can be brought to a known mechanical reference position, i.e. reset, using the zero-point search function. This is achieved using a sensor connected to the HM (Home) Input (default). The motor index signal can also be used. The parameter set *ZA, ZV, ZD, ZR* and *ZM* determine how the zero-point search is carried out. The parameter *HML* determines the Home Input's active level. These parameters have the following functions:

Parameter	Function	
ZA	Specifies acceleration/deceleration during zero-point search. The specified value is expressed in RPM/Second. If ZA is set to 0, the Controller will use the AC parameter during zero-point search.	
ZD	ZD=-1 results in zero-point search in a negative direction. (default).	ZD=1 results in zero-point search in a positive direction.
ZV	Specifies the nominal velocity during zero-point search. If ZV is set to 0, the Controller will use the standard velocity VM parameter during zero-point search.	
ZR	ZR=0 Specifies that the Controller does not perform a zero-point search when powered up.	ZR0=1 Specifies that the Controller automatically performs a zero-point search when powered up.
HML	HML=0 HM input active low.	HML=1 HM input active high.
ZM	ZM = 0 (default) HM input is used for sensor. After a home seek is started, the motor will move until the HM input is activated.	ZM = 1 HM is disabled. The index (EZ input) is used as for home sensing. After a home seek is started, the motor will move until the index signal changes.

4.9.2 Start a Zero-search

A zero-point search will be carried out after one of the following conditions is met:

1. After start-up (power up) or after the Controller has received the *RESET* command. This only occurs if *ZR=1* (see above table).
2. If the Controller receives the search zero command *SZ*.
3. If the Controller is set to Mode 3 (Register Mode) and register 0 is selected.

During zero-search, the RS register will have the value 6.

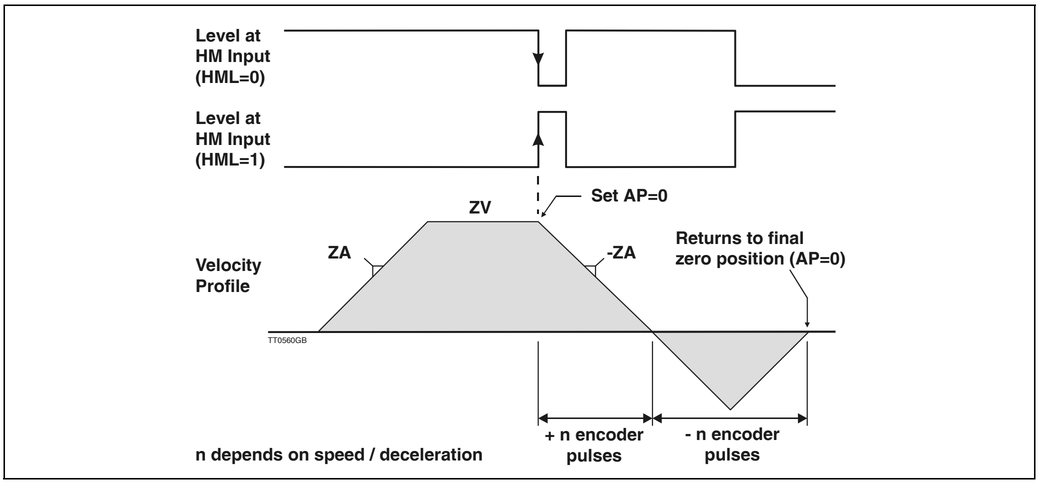
4.9.3 Zero-search Interruption

A zero search can be stopped or paused in following ways:

1. A Halt command (H) will stop the zero search immediately. The RS register will be 7 as usual when using halt. The actual position counter will have been updated during the zero-search and the contents will therefore be intact.
   The zero search can be restarted by using the commands mentioned above under "Start a Zero-search".
2. A Soft halt command (SH) will stop the zero search according to the acceleration/deceleration specified in the ZA register. The behaviour of the AP and RS register etc. will be the same as that using halt.
3. Changing to mode 0 (passive mode). This situation can happen after many situations such as when using the SON input or if a fatal error has occurred.
   The motor will be de-energised and the RS register will be set to 4.
   If the mode is changed back to an active mode (1-5) the RS register will be set to 0 and the zero-search is not continued.

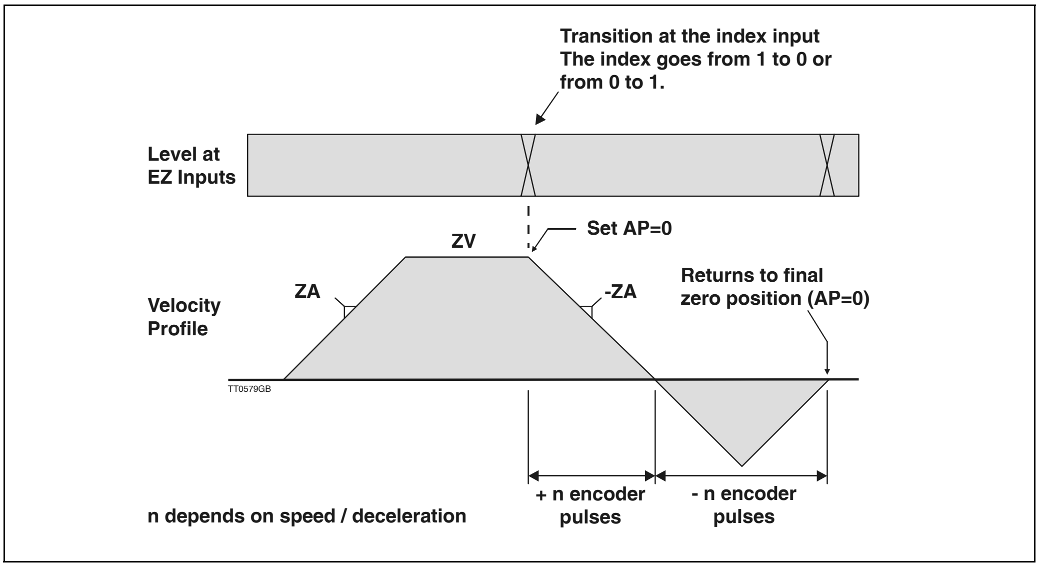
4.9.4 Zero-Search Sequence using the HM Input (ZM=0)

When the zero-point search function is activated, the motor moves in the specified direction and at the specified velocity until the *HM* Input becomes active. The motor then decelerates and stops, after which it moves in the opposite direction to the position where *HM* was activated. The result of the sequence is that the motor is positioned precisely at the zero-point contact. The zero-point is thus located and the motor's position *AP* (Actual Position) is set to 0.


Level at HM Input (HML=0)
Level at HM Input (HML=1)
Set AP=0
ZV
ZA
-ZA
Returns to final zero position (AP=0)
Velocity Profile
TT0560GB
+ n encoder pulses
- n encoder pulses
n depends on speed / deceleration

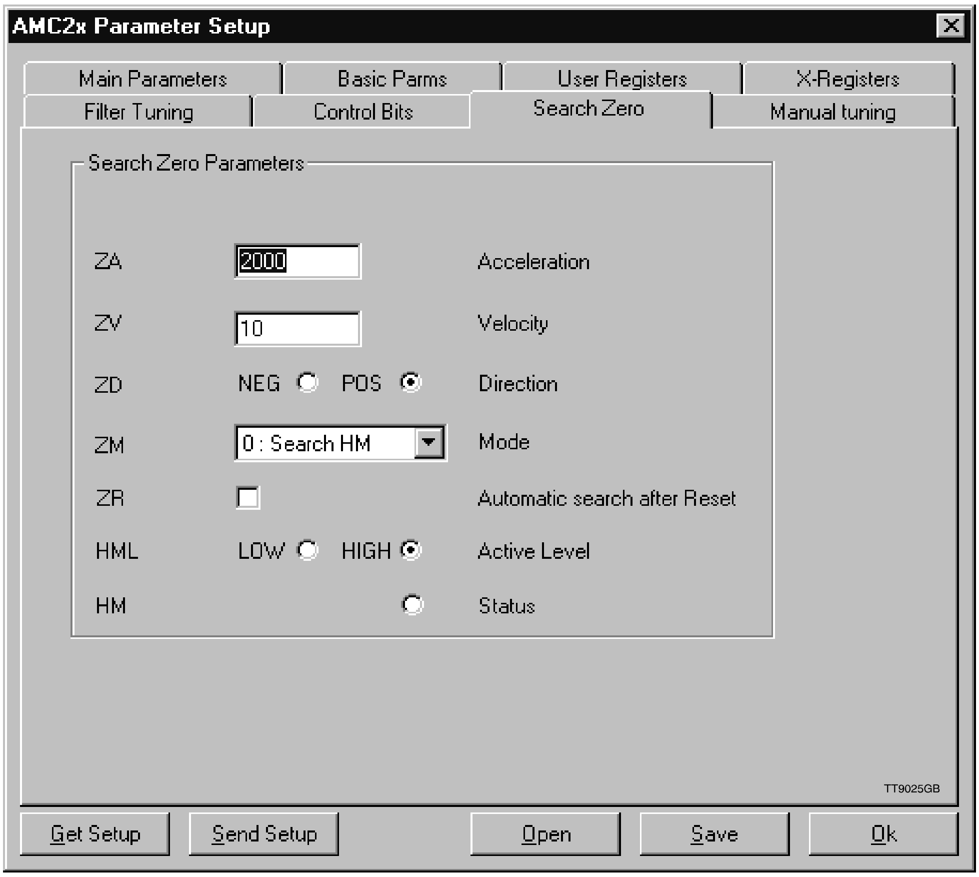
4.9.5 Zero-search Sequence using the Index Input (ZM=1)

When the zero search format (ZM) is set to 1, the Controller will use the index inputs EZ1 and EZ2 from the encoder mounted at the motor - see also *Encoder Input*, page 29. When the zero-point search function is activated, the motor moves in the specified direction and at the specified velocity until a transition occurs at the index input. The motor then decelerates and stops, after which it moves in the opposite direction to the position where *the index* was registered. The result of the sequence is that the motor is positioned precisely at the index position. The zero-point is thus located and the motor's position *AP* (Actual Position) is set to 0.


Transition at the index input
The index goes from 1 to 0 or from 0 to 1.
Level at EZ Inputs
Set AP=0
ZV
ZA
-ZA
Returns to final zero position (AP=0)
Velocity Profile
TT0579GB
+ n encoder pulses
- n encoder pulses
n depends on speed / deceleration

4.9.6 Using MotoWare to Set Up Zero Search.

The easiest way to access all the parameters used for zero search is to use the MotoWare parameter setup.



Search Zero Parameters

ZA 2000 Acceleration

ZV 10 Velocity

ZD NEG ○ POS ● Direction

ZM 0 : Search HM Mode

ZR □ Automatic search after Reset

HML LOW ○ HIGH ● Active Level

HM ○ Status

ZA The acceleration used for zero search.

ZV The velocity used for zero search.

ZD The direction used for zero search when it is started.

ZM Zero search mode. See the other pages in this section, which explains in detail how the different zero search modes are carried out.

ZR If the zero search must be started automatically after power up, this checkbox must be selected.

HML The active level for the actual sensor used for zero sensing. For some modes (i.e. mode 1 - using index) this field can be by-passed since the value is not used.

HM Show the actual level at the HM input. Actual level means that high (a dot in the field) is when the input is applied a voltage corresponding to logic 1. See also *Technical Data*, page 182.

After adjusting the necessary parameters, they can be sent by pressing the *Send Setup* button. Remember that all the other parameters also will be sent.

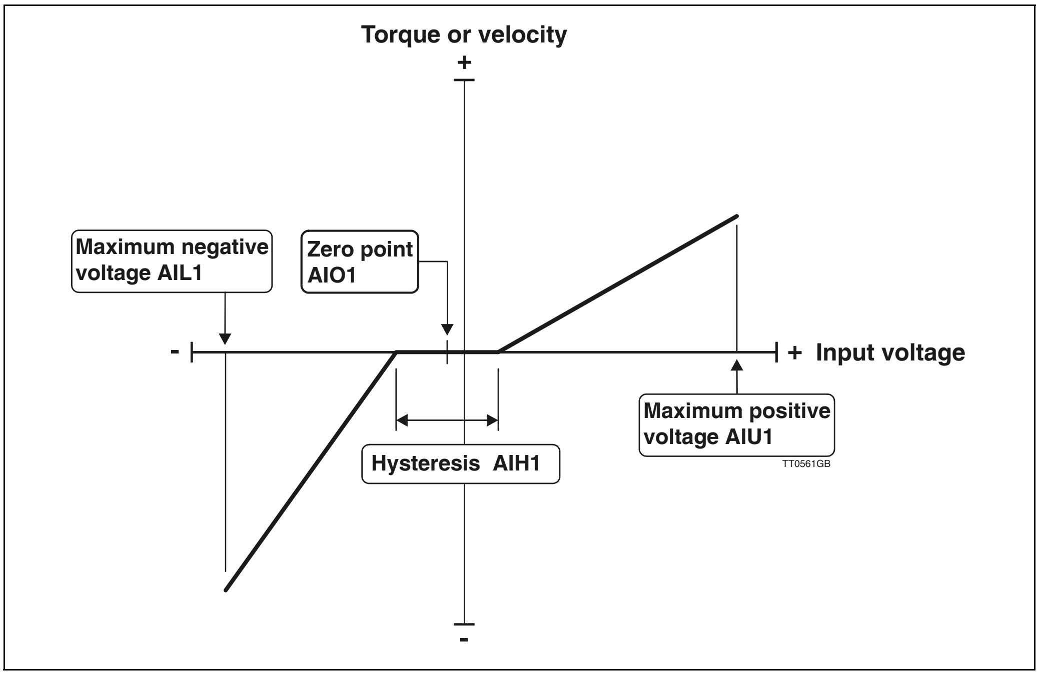
4.10 Adjustment of Analogue Input

The analogue input is adjusted by default for ±10.00V and 0.00V as zero point. The hysteresis is default adjusted to ±25mV. If this setting is to be changed, the following procedure must be followed.
The motor can be controlled directly using an analogue signal applied to the Controller's Analogue Input. Voltages applied to the Analogue Input must be in the range ±10 V. The Analogue Input is used in Velocity Mode (MO=4) and in Torque Mode (MO=5). See *Analogue Inputs*, page 41 for further information about the Analogue Input.

Before the Analogue Input is used, it must be adjusted for the actual application. This adjustment is necessary because the signal source supplying the control signal to the Controller may have an offset error or may only be able to supply for example ±9.5V or less.

1. Select Velocity Mode (MO=4) or Torque Mode (MO=5).
2. Ensure that the motor can run without damaging anything.
3. Adjust the zero point by setting the input to 0V, and send the command AIO1.
4. Set the input voltage to the maximum negative value (max. -10V) and send the command AIL1.
5. Set the input voltage to the maximum positive value (max. +10V) and send the command AIU1.
6. Set a hysteresis value using AIH1. AIH1 is set in steps of 4.88 mV. The hysteresis is the range (+/-) around the 0V point in which the motor must not move.
7. Reset the input voltage (apply 0V).

The motor can now be controlled within the limits set by AIL1 and AIU1, with a range around the zero point given by AIO1 and AIH1 in which the motor remains stationary. The motor is controlled linearly in the range from the maximum negative voltage to the hysteresis value below the zero point, and in the range from the zero point plus the hysteresis level to the maximum positive voltage. Note that if the zero-point is not 0V, and the negative voltage is not numerically equal to the positive voltage, the control profile will be asymmetric.



4.11 Command Description

4.11.1 Show set-up (?)

Command ?

Modes 1, 2, 3, 4, 5

Description The most important details of status and set-up can be displayed using this single command.

Usage **?** Display values.

Example Sent to Controller `?`
Received from Controller (type no. and values are examples):

```
AMC20P,VE=2.45 /MCV=4.5 /PCV=1.5 Jan 15 2001:ADDR=0
Max. Velocity (RPM):       VM=100
Acceleration (RPM/S):      AC=6000
Average current (AMP):     CA=3.00
Peak current (AMP):        CP=10.00
Temperature:               TP1=28, TP2=32
Torque:                    100.0%
Pulses/Revolution:         PR=8192
Mode:                      MO=2
Motor status:              Running
Zero Search:               Inactive
Program Mode:              Standby
Program memory:            1% Used
Encoder Type:              ET=1
Input (IN8-IN1):           IN=00000000
Input PL,NL,HM:            0,0,0
Output (O8-O1):            OUT=00000000
Actual Position (PULSES): AP=-1272
Analogue inputs: (V)       AI1=-1, AI2=0
```

4.11.2 Controller Type (!)

Command !

Modes 1, 2, 3, 4, 5

Description This command (an exclamation mark) can be used to obtain information about the Controller type and its address. The Controller will reply to this command regardless of whether addressing or checksum is used. Thus there must only be 1 Controller connected to the interface if this command is used without an address. The command can be used alone, i.e. *!* or together with an address.

Usage **!** Show Controller type and address.

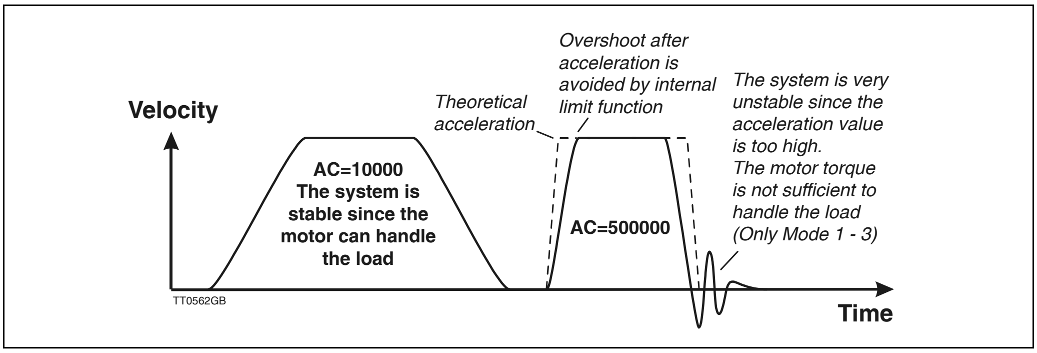
Example Sent to Controller `!`
Received from Controller`AMC20:ADDR=24`

Note that the above is only an example. The address (24 in the above example) will also depend on the actual address of the Controller in question.

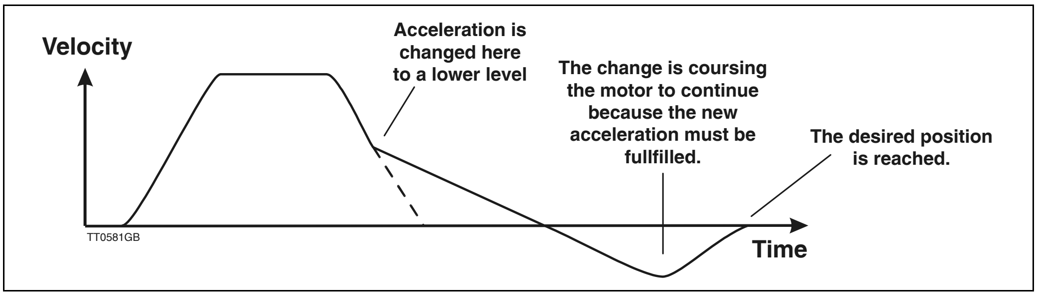
4.11.3 Acceleration (AC)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AC	Acceleration	# 100	# 1000000	2000	0.5	x	+	+	+	+	+	+	RPM/s
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command is used to specify the acceleration/deceleration profile. Note that the AC parameter has effect in all modes.
In general the acceleration must be set to a proper value that ensures the motor is powerful enough to start and stop the load inertia. The left-hand illustration below shows a situation where the acceleration is set to a proper value (AC=10000), thus giving a smooth velocity profile with no overshoots or oscillations. The right-hand illustration shows an example where the acceleration is set to an extreme value (AC=500000), causing the system to oscillate.



Important ! : It is possible to change the acceleration during a motion sequence - but if this is done in mode 1, 2 or 3 (position related modes), a side effect of the change can be that a certain position overshoot occurs.
The side effect only takes place if the AC change is done during deceleration.
The side effect may arise because the acceleration has higher priority than the positioning which often can be an advantage since the mechanics are not overloaded by rapid speed changes.



Example1			
	Sent to Controller	`AC=1000`	Set the acceleration to 1000 RPM/sec.
	Received from Controller	`Y`	The controller has received the AC command and AC is now updated with the value 1000 RPM/sec.
	Sent to Controller	`AC`	Ask the controller to read back the actual acceleration.
	Received from Controller	`AC=1000`	This value indicates that the acceleration is set at 1000 RPM/sec.

4.11.4 Deceleration under a Halt Condition (ACH)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ACH	Deceleration after Halt	# 100	# 1000000	100000	0.5	x	+	+	+	+	+	+	RPM/s
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description

This command is used to specify the deceleration profile to be used when a halt condition has occurred. A halt condition could be one of following.
- Limit switches activated (NL or PL)
- The Halt (H) command is executed.

Normally a Halt condition requires a fast response since the motor movement could cause damage if it doesn't stop quickly enough. However too rapid a deceleration could cause damage to the transmission (drive-belt, gears etc.) between the motor and load if the system has high inertia. Se also *Smooth Halt of Motor (SH)*, page 150.

Example1

Sent to Controller	`ACH=100000`	Set the acceleration to 100000 RPM/sec.
Received from Controller	`Y`	The controller has received the AC command and AC is now updated with the value 100000 RPM/sec.
Sent to Controller	`ACH`	Ask the controller to read back the actual acceleration.
Received from Controller	`ACH=100000`	This value indicates that the acceleration is set at 100000 RPM/sec.

4.11.5 Address (ADDR)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ADDR	Address	0	255	0	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The Controller can be configured to react to all communication via the interface bus (Point to Point communication). In this case, the Controller address must be set to 0. When the address is set to 0, the address must not be transmitted together with any command during communication with the Controller. It is also possible to connect several Controllers to the same interface bus. In this case each Controller must be assigned its own unique address in the range 1-255. The number of Controllers that can be simultaneously controlled is however dependent on the system hardware. Note: If the address of a Controller has been forgotten, the ! (exclamation mark) command can be used.

Usage **ADDR**=x Set address to x.
ADDR Show address.

Example1

Sent to Controller	`ADDR`	Ask the controller to read back the actual address.
Received from Controller	`ADDR=0`	This value indicates that the controller is setup for address 0 (no address).

Example2 If the controller is setup with an address higher than 0 it will not respond since a reply is only made if an address number equal to the actual controller address is added before the ADDR command.

Sent to Controller	`5ADDR`	Ask the controller to read back the actual address.
Received from Controller	`ADDR=5`	This value indicates that the controller is setup for address 5. In case only the ADDR command was send and not 5ADDR the controller would not have answered the request.

Example3 If the address is unknown use the ! command.

Sent to Controller	`!`
Received from Controller	`AMC20:ADDR=24`

See also *Controller Type (!)*, page 79.

4.11.6 Read Analogue Input (AI1 / AI2)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AI1 / 2	Show analogue input value	-2048	2047	(0)	0.5	+	+	+	+	+	+	+	ADC steps
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command is used to read the Controller’s analogue inputs directly. The returned value is given in analog to digital converter steps. The A/D converter resolution is 12 bit which gives a complete number of 4096 steps in the range -10V to +10V.

Usage **AI1** Read analogue input 1 in ADC steps.
AI2 Read analogue input 2 in ADC steps.

Example

Sent to Controller	`AI1`	Ask the controller to read back the A/D value
Received from Controller	`AI1=2047`	This value indicates that the analogue input is applied with +10.00 Volt.

4.11.7 Analogue Input — Hysteresis (AIH1 / AIH2)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AIH1 / 2	Hysteresis for analogue input	0	200	10 (50mV)	0.5	+				+	+	+	ADC steps (1step=5mV)
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The AIH1 command is used to define a range around the zero point of the analogue input voltage in which the motor must not move. The hysteresis range is symmetrical around the zero point (twice the value specified). The AIH1 value is specified in terms of a number of AD-converter steps. The ADC has an operating range of 4096 steps (12 bit), i.e. with an adjustment of -10V to +10V at the input, a resolution of approximately 5 mV per step is obtained. See *Adjustment of Analogue Input*, page 78 for further information about the use of this command.

Usage **AIH1** = x Where x specifies the hysteresis value

AIH1 Show current hysteresis value and current values of the three calibration commands (AIL1, AIO1 and AIU1).

Example

Sent to Controller	`AIH1`	Ask the controller to read back the hysteresis for analogue input 1
Received from Controller	`AIH1=10`	This value indicates that the hysteresis for analogue input 1 is adjusted at ±10 ADC steps (±50mV).

4.11.8 Analogue Input — Maximum Negative (-10V) Value (AIL1 / AIL2)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AIL1 / 2	Negative voltage for analogue input	-10V	Zero-point	-	0.5	+				+	+	+	ADC steps
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Calibrate full-scale — set negative voltage (max. -10V) at one of the analogue inputs and send the AIL1 or AIL2 command. The Controller will then calibrate the analogue input's negative value. The negative input voltage must not be greater than the zero-point voltage. See *Adjustment of Analogue Input*, page 78 for further information about the use of this command.

Usage **AIL1** Maximum negative voltage at analogue input 1 (AI1) is calibrated
AIL2 Maximum negative voltage at analogue input 2 (AI2) is calibrated.

Example Sent to Controller `AIL1` Calibrate the negative full-scale for analogue input 1.
Received from Controller `Y` The calibration is done.

4.11.9 Analogue Input — Zero-point Voltage (AIO1 / AIO2)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AIO1 / 2	Zero-point for analogue input	-10V	+10V	0	0.5	+				+	+	+	ADC steps
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description These commands are used to calibrate the analogue input's zero-point voltage. To calibrate the Controller, the zero-point voltage should be applied to one of the analogue inputs (AI1 or AI2) and the command sent to the Controller. The Controller will then reset the input. In the majority of cases, the zero-point voltage will be 0 Volt, but this is not a requirement however. The zero-point voltage must lie within the range from the maximum negative voltage to the maximum positive voltage. See *Adjustment of Analogue Input*, page 78 for further information about the use of this command.

Usage **AIO1** Zero-point voltage at input 1 is calibrated.
AIO2 Zero-point voltage at input 2 is calibrated.

Example Sent to Controller `AIO1` Calibrate the zero-point voltage for analogue input 1.
Received from Controller `Y` The calibration is done.

4.11.10 Analogue Input — Maximum Positive (+10V) Value (AIU1 / AIU2)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AIU1 / 2	Positive voltage for analogue input	Zero-point	+10V	+10V	0.5	+				+	+	+	ADC steps
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Calibrate full-scale — set positive voltage (max. +10V) at one of the analogue inputs and send the AIU1 or AIU2 command. The Controller will then calibrate the analogue input's positive voltage. The positive voltage must not be less than the zero-point voltage. See *Adjustment of Analogue Input*, page 78 for further information about the use of this command.

Usage **AIU1** Maximum positive voltage at input 1 is calibrated
AIU2 Maximum positive voltage at input 2 is calibrated

Example

Sent to Controller	`AIU1`	Calibrate the maximum voltage for analogue input 1.
Received from Controller	`Y`	The calibration is done.

4.11.11 Logical AND operator (AND) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AND	Logical AND operator	-	-	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The Logical AND operator is used in IF statements when two or more conditional statements must be fulfilled simultaneously. The AND operator can only be used in IF statements.

Usage IF *expression* AND *expression*

Example IF AC>34 AND IN1=1

See also *Logical equations:*, page 68.

4.11.12 Activate Flag in External Module (AO) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AO	Activate flag in external module	Address 0 Flag 0	Address 31 Flag 65535	-	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The Activate command is used to activate a flag in an external module whose address is specified by "a".
The Flag number is specified by "o". For example, the flag may refer to an output on a IOM11 module. When the flag is activated, an output will be activated. A flag in a different module may refer to a completely different function. For example if flag 3 in a KDM10 module is activated, the cursor on the module's LCD display will blink. Flags with the same number in different modules can have different functions.
See the instruction manual for the individual module for a description of the function of the module's flags.

Format: AO{1<=a<=31}.{1<=o<=255}

Example 1: A Keyboard-Display Module has address 4. The module display is to be erased so that new text can be displayed. The following command will erase the display and position the cursor at the top left-hand corner of the display.

```
AO4.1   // Erase LCD display
```

Example 2: An IOM11 module and the Controller are connected together in a system. The IOM11 module address is 10. Output 4 is to be activated. The following command is used:

```
AO10.4
```

4.11.13 Actual Position (AP)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
AP	Motor's Actual Position	-2147483648	+2147483647	-	0.5	+	+	+	+	+	+	+	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The motor position can be read at any given time. The position is given in terms of encoder pulses relative to the zero point. The motor's position can also be "reset" by specifying an argument to the AP command.
It is recommended that the position is only changed when the motor is stationary.

Example

Sent to Controller	`AP=1234`	Set the actual position counter equal 1234.
Received from Controller	`Y`	The controller has received the AP command and AP is now updated with the value 1234.
Sent to Controller	`AP`	Verify the actual position.
Received from Controller	`AP=1234`	The actual position is 1234.

4.11.14 Actual Position of the Master Axis (APM)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
APM	Actual Position of master axis	-2147483648	+2147483647	-	0.5	+	+						Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The position for the master axis can be read at any given time.
The position is given in terms of encoder pulses. The position can also be "reset" by specifying an argument to the APM command such as APM=0 or APM=1234.
The APM counter is controlled by the X1 and Y1 pulse inputs - see also *Pulse Inputs*, page 37.

Note that the APM register will not be updated when the controller is set in mode 2, 3, 4, or 5.

Example

Sent to Controller	`APM=50`	Set the APM counter equal 50.
Received from Controller	`Y`	The controller has received the APM command and APM is now updated with the value 50.
Sent to Controller	`APM`	Verify the APM counter.
Received from Controller	`APM=50`	The APM counter is 50.

4.11.15 Baud Rate and Serial Protocol (BAUD)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
BAUD	Baud rate for RS232/RS485	1	8	6	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Use the BAUD command to change the protocol used for serial communication. Note that the BAUD register cannot be saved permanently. Therefore the Controller will always start-up with BAUD=6. This is a safety precaution to avoid that the Controller is set to a communication format which is not supported by the host.

Baud rate and serial protocol settings				
	Baud rate	Databits	Parity	Stopbit
BAUD=1	No effect	No effect	No effect	No effect
BAUD=2	9600	7	Odd Parity	1
BAUD=3	19200	7	Odd Parity	1
BAUD=4	38400	7	Odd Parity	1
BAUD=5	No effect	No effect	No effect	No effect
BAUD=6 (default)	9600	8	No Parity	1
BAUD=7	19200	8	No Parity	1
BAUD=8	38400	8	No Parity	1

Example

Sent to Controller	`BAUD=7`	Set the baud rate to 19200 with 8 databits.
Received from Controller	`Y`	The Controller has received the BAUD command and the baud rate is set to the new value. Note that the Y character is transmitted with the old setting. The new setting will take effect next time communication takes place.
Sent to Controller	`BAUD`	Verify the BAUD register.
Received from Controller	`BAUD=7`	The baud rate is set to 19200 with 8 databits.

4.11.16 Start Program Block (BEGIN) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
BEGIN	Begin program block	-	-	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description BEGIN is used in IF statements when several command lines must be grouped in a block. BEGIN can be used in IF statements only.
For a more detailed description see *IF Statement*, page 70.

Usage

```
IF AC>500
BEGIN
    AC=500
    VM=1000
END
```

4.11.17 Bias after Servo Filter (BIAS)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
BIAS	Bias after filter	-100	+100	0	0.5	x	+	+	+	+	+	+	%
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The BIAS command can be used in applications in which the motor is subjected to a persistent load, such as in a lifting mechanism.
The BIAS command enables the static load to be balanced regardless of whether the load pushes or pulls on the motor. This counter balancing is usually advantageous since the load on the servo filters is uniform regardless of whether the motor will move in one direction or the other, and ultimately use of the BIAS function gives an easier adjustment of the complete system and thus a faster response time.
See *Adjustment of BIAS*, page 22 for a complete adjustment description.

Usage

BIAS=xx	Set BIAS to xx.
BIAS	Show current BIAS setting.

Examples

Sent to Controller	`BIAS=8.3`	Set bias after the filter to 8.3% of full torque.
Received from Controller	`Y`	The controller has accepted the command - bias is now changed.

Sent to Controller	`BIAS`	Show the actual bias setting.
Received from Controller	`BIAS=8.3`	The actual bias is set at 8.3%.

4.11.18 Average (Rated) Current (CA)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CA	The maximum allowable average RMS current per motor phase	0.1	5 (AMC20) 10 (AMC21) 15 (AMC22)	1	0.5	x	o	o	o	o	o	o	ARMS/Ph.
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description

To protect the motor from overload and to ensure that its operational lifetime is not reduced, a maximum rated current value can be set. The system will automatically shut down and report an error message *E35 : Average Current limit exceeded*, if the specified average current is exceeded. The average current can be specified to 2 decimal places. See also the CP command for limiting the motor's peak current.
The CA value is specified as the maximum allowable RMS current per motor phase. Please note that some motor manufacturers specify this value using other terms such as the maximum motor current, which means the total current flowing into the motor. This value will be higher by a factor of the square root of 3 (1.732).
See also *Current Level in % (CL)*, page 99 or *Peak Current (CP)*, page 101.
The actual motor phase current can be measured with the command : *Motor Current (CU)*, page 102

Usage

CA=xx.xx	Set average current value in Amp.
CA	Show actual setting of max. average current.

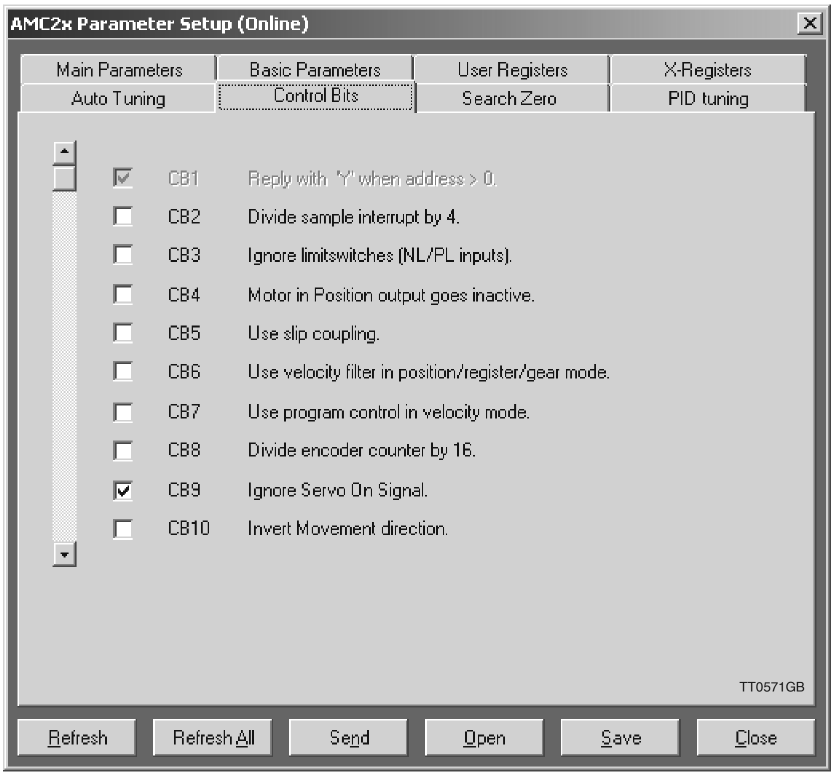
Examples

Sent to Controller	`CA=4.15`	Set the allowable average motor current to 4.15A.
Received from Controller	`Y`	The controller has accepted the command.
Sent to Controller	`CA`	Show current average current limit.
Received from Controller	`CA=4.15`	The max allowable average motor current is set to 4.15A.

See also *Setting the Motor Currents*, page 195.

4.11.19 Control Bits in General (CB)

In addition to the user registers (R registers), the Controller contains a number of control bits. These bits control some basic parameters/functions in the Controller. Mostly these parameters or functions are special compared to the standard functions described in this chapter.
For example, a bit can control whether a certain input should be activated at logic 1 or logic 0. Some of the bits can only be read. These bits show the status of different conditions during program execution — for example, in which direction the motor is moving or whether errors have been signalled in the error registers.
The following Control bits are available.



☑ CB1 Reply with "Y" when address > 0.
□ CB2 Divide sample interrupt by 4.
□ CB3 Ignore limitswitches (NL/PL inputs).
□ CB4 Motor in Position output goes inactive.
□ CB5 Use slip coupling.
□ CB6 Use velocity filter in position/register/gear mode.
□ CB7 Use program control in velocity mode.
□ CB8 Divide encoder counter by 16.
☑ CB9 Ignore Servo On Signal.
□ CB10 Invert Movement direction.

The control bit can be accessed by entering the Control Bit page under parameter settings.
Descriptions of the individual bits are given in the following sections.

4.11.20 CB1 - RS232/RS485 Answer if ADDR > 0

If the Controller is set up with an address higher than 0 (0 = point-to-point), it will not respond with any answer if a command is received. Only requests that require read-back of a certain register, e.g. actual position (AP), are answered. This default setting optimises the speed of communication.
The CB1 flag can be used to define if any received message must be answered.
The CB1 flag can be set in the following states.

CB1=0 If the address is set > 0 no reply is returned. Only register read-backs.
CB1=1 If the address is set > 0 any request will be answered (Default).

4.11.21 CB2 - Set low PWM output frequency

To minimise heat disippation from the drive the PWM frequency used in the IGBT output stage can be decreased from 20kHz (default) to 5kHz.
Normally a decrease of the sample rate in the current loop will reduce the audible noise significantly. However the dynamic performance will also be reduced.
Using a PWM frequency at 5kHz will normally not influence the dynamic perfomance at motors above 1-1.5kW since the timeconstant is typically also higher at motors in this power range.
CB2=0 PWM frequency = 20kHz (default AMC20 and AMC21).
CB2=1 PWM frequency = 5kHz (default AMC22).

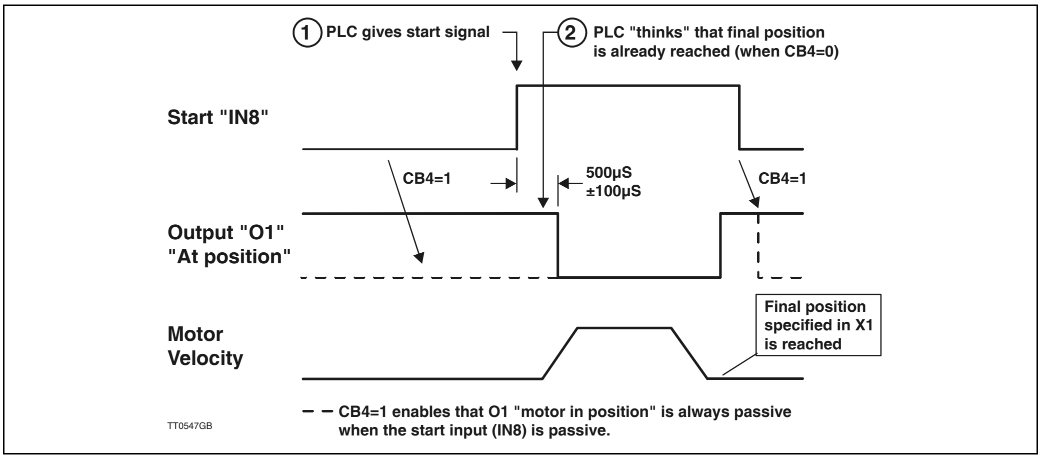
Important: Remember to retune the current filter after changing the CB2. See also , page 157.

4.11.22 CB3 - Enable / Disable Limit Switches

If the limit inputs NL and PL are used for other purposes, the limit function can be disabled. Disabling means that the inputs will still be usable but they will not interrupt the motor operation or cause any error/warning messages. The inputs NL and PL can always be used in a program or can be verified by the RS232/RS485 interface. The commands NL and PL can be used to verify the level at the inputs.
CB3=0Limit switches enabled (default)
CB3=1Limit switches disabled

4.11.23 CB4 - Position Output (O1) Function

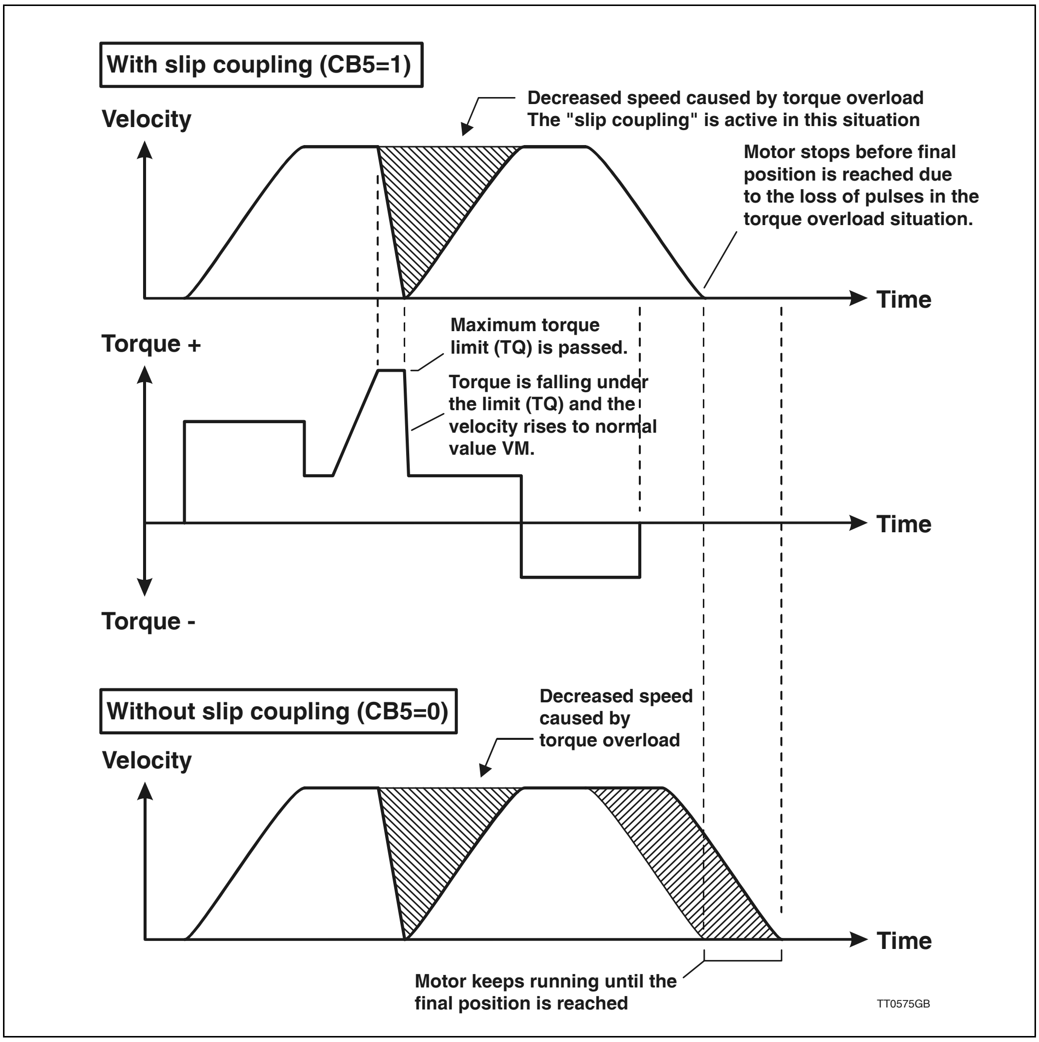
CB4 is only used in mode 3 (register mode). Output 1 (motor in position) is normally fed back to the source that generates the position signals. The source could for example be a PLC. In some applications timing problems can occur between the start input (IN8) and motor in position output (O1). This problem is caused by the delay that appears when the start input is activated until the motor in position output following is passive.
If the external source, e.g. a PLC, sends the start signal and with a very small time margin (< 1 msec.) is looking at the "In position output", the output is still active. After 1 msec. the AMC2x will set the output passive since the motor is now moving but has not reached the final position. The problem is illustrated in the following timing diagram.


1 PLC gives start signal
2 PLC "thinks" that final position is already reached (when CB4=0)
Start "IN8"
CB4=1
500µS ±100µS
CB4=1
Output "O1" "At position"
Motor Velocity
Final position specified in X1 is reached
– – CB4=1 enables that O1 "motor in position" is always passive when the start input (IN8) is passive.
TT0547GB

CB4=0 Output 1 is not influenced when IN8 goes passive (default).
CB4=1 Output 1 goes passive when IN8 goes passive.

4.11.24 CB5 - Slip Coupling On/Off

The slip coupling has the same function as a mechanical slip coupling. If the motor is running in mode 1, 2 or 3 and the load gets higher than the maximum allowable torque (TQ), the speed will decrease. In this situation the motor is not able to follow the specified speed and thereby reach the final position in the correct time. Whether the slip coupling is used or not, this situation will occur if the torque is higher than TQ.
If the slip coupling is not enabled (CB5=0), the final position will still be reached but of course after some additional time.
If the slip coupling is enabled (CB5=1), the distance that is lost during the torque overload is subtracted from the total distance and the final position is therefore not reached. The illustration below shows the situation.


With slip coupling (CB5=1)
Velocity
Decreased speed caused by torque overload
The "slip coupling" is active in this situation
Motor stops before final position is reached due to the loss of pulses in the torque overload situation.
Time
Torque +
Maximum torque limit (TQ) is passed.
Torque is falling under the limit (TQ) and the velocity rises to normal value VM.
Time
Torque -
Without slip coupling (CB5=0)
Decreased speed caused by torque overload
Velocity
Time
Motor keeps running until the final position is reached
TT0575GB

CB5=0	Slip coupling disabled (default).
CB5=1	Slip coupling enabled.

4.11.25 CB6 - Filter Selection

Use velocity filter in position/register/gear mode (modes involving absolute positioning). If the mechanical system is elastic, and the position tolerance is low, the velocity filter can be used to ensure a more stable system.

CB6=0	Use position filter (default)
CB6=1	Use velocity filter

Please note that the positioning precision is not as good when the velocity filter is used. It is therefore recommended that the following registers are adjusted to a higher value than by using the position filter :

FE	Following Error - see *Following Error (FEM)*, page 111.
PE	Maximum Pulse Error - see *Maximum Pulse Error (PE)*, page 136.
PES	Pulse Error Samples - see *Pulse Error Samples (PES)*, page 137.

4.11.26 CB7 - Mode 4 Source Selection

Use program control in velocity mode (MO=4)
Instead of controlling the velocity via the analogue input, AI1, it is possible to control the velocity via VM commands via the controller status window in MotoWare, or via VM commands in a MotoWare program.

CB7=0	Use AI1 (default)
CB7=1	Use program control

4.11.27 CB8 - Divide Encoder Input by 16

When this control bit is set, the encoder input will be divided by 16.
This feature is seldom used but if the Controller is used together with an encoder with a very high resolution, it can be necessary because the encoder input only allows encoder resolutions up to 65535 pulses per electrical cycle.
If CB8 is set (CB8=1), the PR value must also be divided by 16. See also *Encoder Pulses (PR)*, page 142.

Example:
An encoder rated at 20000 pulses per revolution is used, mounted at a 2-pole motor. 20000 pulses per revolution is internally converted to 80000 pulses per revolution since all the transitions in the encoder signals are used. A value of 80000 pulses per revolution is too high (maximum is 65535) and therefore CB8 must be set. The PR register must also be corrected to 1250 (20000/16) instead of 20000.
Remember to make a new tuning of the servo filter.

CB8=0	Passive (default).
CB8=1	Divide encoder input by 16.

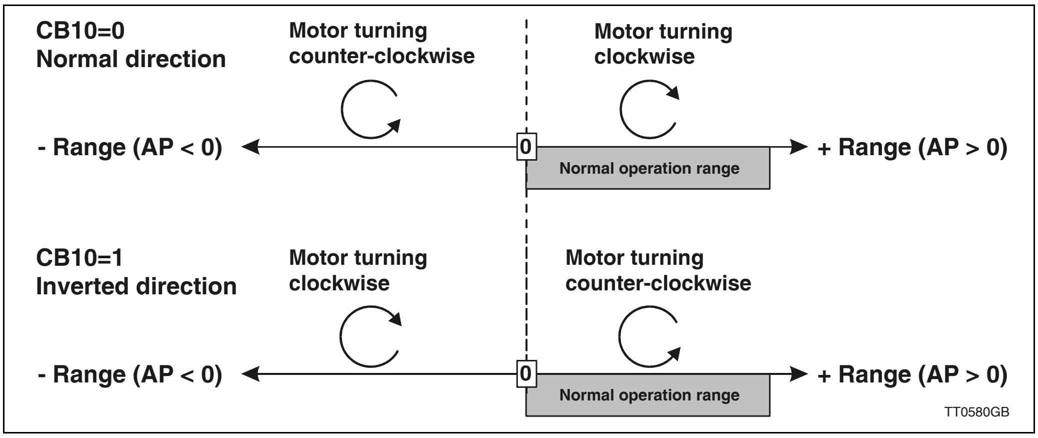
4.11.28 CB9 - Ignore Servo On Signal

The Controller input SON can normally be used for safety. The motor will stay currentless until this input is supplied with an external voltage. CB9 is made to bypass this feature.
If CB9 is set to 1, the SON input will be passive (not used) and the motor output will stay fully operational regardless the voltage at the SON input. See also *Servo On Input (SON)*, page 32.

CB9=0	SON input enabled (default).
CB9=1	SON input disabled.

4.11.29 CB10 - Invert Movement Direction

The definition of positive and negative directions can be changed by the flag CB10.
In some applications the zero-point is placed in the positive direction which can be a disadvantage since all movements then must be done in negative direction.



CB10=0 Do not invert direction (default).
CB10=1 Invert direction.

4.11.30 CB11 - Invert encoder signal.

If it is desired to reset the controller by a hardware signal from outside, this can be done by using the SON input. By enabling this feature the controller will be reset every time the SON input changes state from passive to active (0 to1).

CB11=0 Do not reset when SON changes state (default).
CB11=1 Reset when SON goe

4.11.31 CB12 - Invert Hall signal.

If it is desired to reset the controller by a hardware signal from outside, this can be done by using the SON input. By enabling this feature the controller will be reset every time the SON input changes state from passive to active (0 to1).

CB12=0 Do not reset when SON changes state (default).
CB12=1 Reset when SON goe

4.11.32 CB13 - Reset servo when SON goes high again.

If it is desired to reset the controller by a hardware signal from outside, this can be done by using the SON input. By enabling this feature the controller will be reset every time the SON input changes state from passive to active (0 to1).

CB13=0 Do not reset when SON changes state (default).
CB13=1 Reset when SON goes from passiv to active (0 to 1).

4.11.33 CB14 - Enable PID Filter

The Controller normally uses a very advanced filter that can be adjusted up to 6 orders. This "standard" filter however involves up to 35 filter constants which are impossible to adjust manually since the behaviour of each filter constant is extremely complex. Only the auto-tuning facility in MotoWare can be used to adjust this filter.
As an alternative, a traditional PID filter is available. The PID filter can be adjusted manually and is intended to be used in applications where the auto tuning is not possible. See also *Adjustment of Servo Regulation*, page 18 where a complete description of the filter adjustment is given.

CB14=0	PID filter disabled (default).
CB14=1	PID filter enabled.

4.11.34 CB15 - Function of User Output 1 (O1)

The user output 1 is set up by default to show when the motor is in position (CB15=1 or CB15=2). This function is only used in mode 2 and 3.
Alternatively, the output can be configured to work as a general output with the same function as outputs 2 to 8 (O2-O8), which means that O1 can be controlled through commands send via the RS232 interface or OUT commands implemented in a program (only AMC2xP).
In this case the output 1 will not be influenced when the motor is in position or not.

CB15=0	Output 1 can be used for general purposes.
CB15=1	Output 1 is used as "in position output". Active high. - Default.
CB15=2	Output 1 is used as "in position output". Active low.

4.11.35 CB16 - Function of User Output 2 (O2)

By default, the user output 2 is set up to show when the Controller is in fully operational and no fatal errors have occurred (CB16=1 or CB16=2).
Alternatively, the output can be configured to work as a general output with the same function as outputs 1 and 3 to 8 (O1, O3-O8), which means that O2 can be controlled through commands send via the RS232 interface or OUT commands implemented in a program (only AMC2xP). In this case the output 2 will not be influenced when the Controller is in a passive state or if a fatal error occurs.

CB16=0	Output 2 can be used for general purpose.
CB16=1	Output 2 is used as "Controller OK Output". Active high. - Default.
CB16=2	Output 2 is used as "Controller OK Output". Active low.

4.11.36 CB17 - Function of User Output 3 (O3)

By default, the user output 3 is set up to work as a general output with the same function as outputs 1, 2 and 4 to 8 (O1, O2, O4-O8), which means that O3 can be controlled through commands send via the RS232 interface or OUT commands implemented in a program (only AMC2xP). In this case, output 3 will not be influenced by any other activity in the Controller.
Output 3 can however be set up to control a brake at the motor by setting CB17=1 or 2. The output will then be active during normal operation, which means that the brake will be released. If any error occurs or if mode 0 (passive mode) is selected, the output is set passive whereby the brake keeps the motor in a stationary position.

CB17=0	Output 3 can be used for general purpose - Default.
CB17=1	Output 3 is used as "Brake Output". Active high.
CB17=2	Output 3 is used as "Brake Output". Active low.

4.11.37 CB18 - Enable extended gear mode

This bit enables extended gear mode. By extended gear mode means that every pulse received at the pulse inputs is "remembered" also in situations where the maximum motor torque is reached which means that the motor has difficulties by moving in the same speed as the pulses are specifying.

CB18=0 Extended gear mode disabled
CB18=1 Extended gear mode enabled (default)

4.11.38 CB19 - Enable passive halt mode.

Sometimes it can be desired that the running status register RS is not going to 0 if a Halt or Soft Halt command is executed. By setting CB19 to 1 the RS register will go to 7 instead of 0 if a Halt or Soft Halt command is executed. See also *Report Motor Status (RS)*, page 147.

CB19=0 Disable passive halt mode. RS will be set to 0 if a Halt or Soft halt command is executed. (default).
CB19=1 Enable passive halt mode. RS will be set to 7 if a Halt or Softhalt command is executed.

4.11.39 CB20 - Enable direct torque mode.

In torque mode the response can be optimized by CB20. By enabling direct torque mode the bandwidth is increased significantly but the limits made by AC (the acceleration parameter) and VM (the topspeed parameter) is completely ignored.

CB20=0 Disable direct torque mode (default).
CB20=1 Enable direct torque mode.

4.11.40 CB21 - Use balanced analogue inputs.

-

CB21=0 Disable (default).
CB20=1 Enable.

4.11.41 CB22 - Enable pulse torque mode.

-

CB22=0 Disable (default).
CB22=1 Enable.

4.11.42 CB23 - Invert pulse input direction.

-

CB23=0 Disable (default).
CB23=1 Enable.

4.11.43 CFE Current Following Error in Pulses

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CFE	Show current following error	0	32767	-	0.5	o	o	o	o	o	o	o	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description CFE can be verified to see the static position error in the system.
CFE must be seen in combination with FEM which sets the maximum allowable number of pulses in CFE. If this limit is passed, the error message *E102 : Encoder error or position error limit exceeded* will be given.

Usage **CFE** Show the actual following error in pulses.

Example Send the command `CFE(enter)` In the MotoWare online editor .
Following is received `CFE=15` Which means that the actual static position error is 15 pulses.

4.11.44 CFNE Current Following Error Nominal in Pulses

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CFNE	Show current following error nom.	0	32767	-	0.5	o	o	o	o	o	o	o	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description CFNE can be verified to see the static position error in the system.
CFNE must be seen in combination with FNEM which sets the maximum allowable number of pulses in CFNE. If this limit is passed, the error message *E102 : Encoder error or position error limit exceeded* will be given.

Usage **CFNE** Show the actual following error in pulses.

Example Send the command `CFNE(enter)` In the MotoWare online editor .
Following is received `CFNE=15` Which means that the actual static position error is 15 pulses.

4.11.45 Interface Checksum (CHS)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CHS	Use Checksum	0=no	1=yes	0	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

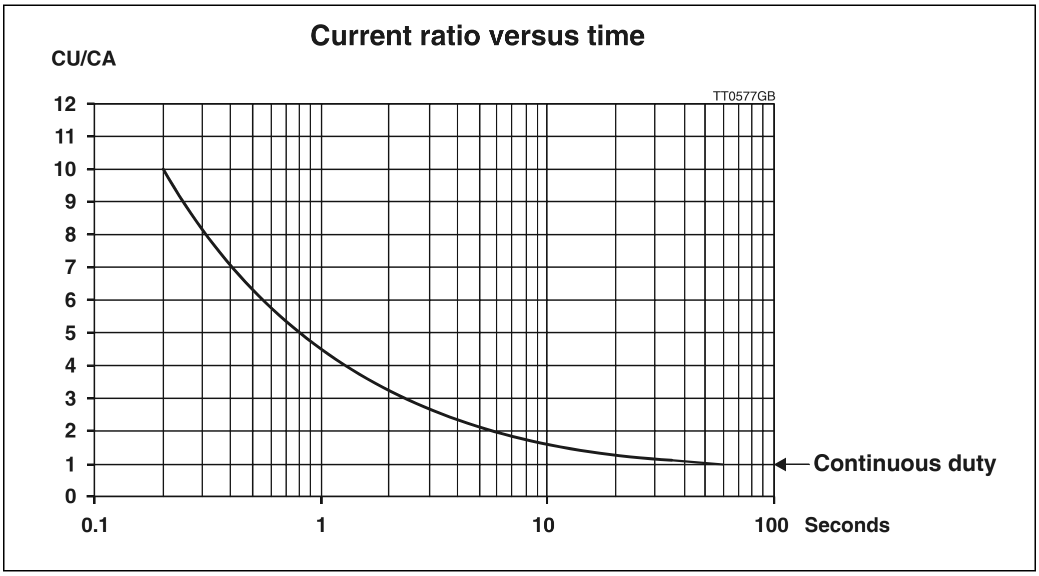
Description As described in *Checksum*, page 44 a checksum can be used for communication via the interface.

Usage **CHS**=x 0=do not use checksum, 1=use checksum.
CHS Show checksum status.

4.11.46 Current Level in % (CL)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CL	Show motor current (%) re CA	0	100	-	0.5	+	+	+	+	+	+	+	%
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The CL command can be used to monitor the average motor load. If the CL command is sent to the Controller, the Controller will respond to display the actual average motor current, expressed as a percentage of the motor's maximum allowable average current specified using the CA command. If CL exceeds 99.9%, the Controller is set in Mode 0 and the motor is set currentless. In addition, the error message E23 Average current limit exceeded is sent by the serial interface and stored in the error register.
Note that CL is based on a "integrating algorithm" and the value is averaged over a long period. This enables the short-term current to be much higher than the value specified by CA. Use CP to specify the absolute maximum current.
This curve below shows the relationship between current and time.



Usage **CL** Show percentage load on motor.

See also *Setting the Motor Currents*, page 195

4.11.47 Clear Flag in External Module (CO) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CO	Clear flag in external module	Address 0 Flag 0	Address 31 Flag 65535	-	0.5	+	+	+	+	+	+	+	

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description: The Clear command is used to clear a flag in an external module. The number of flags which that can be cleared in different external modules varies, but each module has at least 1 flag. For the KDM10 module (Keyboard-Display Module) for example, the Clear command can be used to clear the LCD display; in the IOM11 module (I/O module) the Clear command can be used to deactivate one of the Module's outputs, etc.

Format: CO {1<=a<=31}.{1<=o<=255}

Example 1: The Controller and a KDM10 module are connected in a system via the JVL Bus interface. The address of the Controller is 1 and the KDM10 module address is 3. The Cursor on the KDM10's LCD display is to be switched off. If the cursor is active while text is being printed using the PRINT command, the display may flicker. This is avoided by switching off the cursor as follows:

```
CO3.3    // Deactivate cursor
```

Example 2: The Controller and an IOM11 module are connected in a system via the JVL Bus interface. The IOM11 module's address is 5. The IOM11's output 7 is to be de-activated. The command is as follows:

```
CO5.7    // Deactivate output 7 on IOM11 module with address 5.
```

4.11.48 Peak Current (CP)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CP	The maximum allowable instantaneous RMS current per motor phase.	0	9.55 (AMC20) 15.92 (AMC21) 22.28 (AMC22)	2	0.5	x	o	o	o	o	o	o	ARMS/Ph.

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description

To protect the motor from overload and to ensure its operational lifetime is not reduced, a maximum peak current value can be specified. The system can withstand currents for short periods that are higher than the maximum allowable rated current (CA command), but the motor can be protected from high current peaks. The CP command is used to set the maximum allowable peak current to the motor. Typically CP is set to a value 3 times greater than the maximum allowable average current (CA). The specified current is valid for a single motor phase. See also *Setting the Motor Currents*, page 195.
The CP value is specified as the maximum allowable instantaneous RMS current per motor phase. Please note that some motor manufacturers specify this value using other terms such as the maximum motor current, which usually means the total current flowing into the motor. This value will be higher by a factor of the square root of 3 (1.732). See also *Average (Rated) Current (CA)*, page 90 or *Current Level in % (CL)*, page 99.
The actual motor phase current can be measured using the command : *Motor Current (CU)*, page 102

Examples

Sent to Controller	`CP=8.1`	Set the allowable instantaneous RMS motor current to 8.1A.
Received from Controller	`Y`	The controller has accepted the command.
Sent to Controller	`CP`	Show the instantaneous RMS current limit.
Received from Controller	`CP=8.1`	The max allowable instantaneous RMS motor current is set to 8.1A.

See also *Setting the Motor Currents*, page 195 for a complete guide to setup the motor currents.

4.11.49 Current Power Level (CPL)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CPL	Show current power level	0	200	-	0.5	o	o	o	o	o	o	o	%

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description

The actual total power consumption of the Controller can be read using this command. The power consumption is integrated over 12 seconds and expressed in % of the maximum allowable power consumption, PM. See *Power Management (PM)*, page 140.
If *CPL* reaches 100 %, the Controller is set in mode 0 and the error message *E34 : Power consumption too high* is transmitted.

Examples

Sent to Controller	`CPL`	Show the actual power consumption in % with reference to the PM register.
Received from Controller	`CPL=8%`	The actual power consumption is currently 8% of the value specified in the PM register.

4.11.50 Motor Current (CU)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CU	Show motor current	0	AMC20: 10 AMC21: 16 AMC22: 23	-	0.5	o	o	o	o	o	o	o	ARMS/Ph.
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The motor current can be read using this command.
The current shown is the actual current flowing through the motor.
The returned value is given in ARMS per motor phase. Note that the same current definition is used for the CA and CP (allowable average and peak current) registers.

Usage **CU** Show motor current consumption in ARMS per phase.

Example Send the command `CU(enter)` In the MotoWare online editor .
Following is received `CU=4.35` Which means that the motor phase current is now 4.35 A RMS.

4.11.51 Bus Current (CUB)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CUB	Show DC-bus current	-10.00	+10.00	(0)	0.5	o	o	o	o	o	o	o	Amp/RMS
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The actual DC-bus current can be measured using this command. The bus current is the current flowing from the main supply to the output driver in the AMC2x.
The current shown represents the actual current measured. The bus voltage can also be monitored by using the VOL command. See Bus Voltage (VOL) page 160.

Usage **CUB** Show the actual bus current in Amps.

Example Send the command `CUB(enter)` In the MotoWare online editor .
Following is received `CUB=1.57` Which means that the actual bus current is now 1.57 A RMS.

4.11.52 Current Velocity (CV)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
CV	Show Current Velocity	0	-	-	0.5	o	o	o	o	o	o	o	RPM
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The motor velocity can be read at any time using this command.

Usage **CV** Show current velocity in RPM.

Example Send the command `CV(enter)`
Following is received `CV=1000` Which means that the actual speed is now 1000 RPM

4.11.53 Delay (D)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
D	Delay in program	1	2147483647	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The D command pauses program execution. The delay can be specified in 1 msec. steps.

Usage D(20) // Wait for 20 msec.
D=20 // Wait for 20 msec.

4.11.54 Digital Input Format (DIF)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
DIF	Digital input format	1 (position)	2 (Velocity)	1	0.5	x	x	x	+	x	x	x	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description In some applications a requirement may be to run the motor in a certain direction at a certain speed. For this purpose the DIF register can be used. When DIF is set to 1 (default), the functionality of mode 3 is normal. But if DIF is set to 2, all the positions (XP registers) are ignored except the sign in these registers. The XR registers are not used at all.

Example:
If XP1 is set to +1000, the motor will move in a positive direction when XP1 is selected and the start input is active. The velocity is defined by XV1 as normal.
The motor will run as long as IN8 is active.

Note that the X0 registers are not affected by the DIF register setting. These registers can still be used to find the home/zero position (IN1-6 = 0 together with a start signal at IN8).

Positive direction is chosen when the actual XP register is set to 0 or a value higher than 0. Negative is when the actual XP register is set lower than 0 - only negative values.

Usage **DIF=x** Set Digital Input Format to x.
DIF Show current DIF setting.

See also *Using Mode 3 for Continuous Movement*, page 58

4.11.55 ELSE - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ELSE	ELSE statement	-	-	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The ELSE statement is used in conjunction with the IF statement. The program line following **ELSE** will be executed if the IF statement is false.

Usage

```
IF condition
    expression
ELSE
    expression
```

Example

```
IF AC>(8+7)*2
    AC=100
ELSE
    AC=VM+98
```

4.11.56 End Program Block (END) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
END	End program block	-	-	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description END is used in IF statements when several command lines must be grouped in a block. END can be used in IF statements only. See IF Statement page 70.

Usage

```
IF AC>500
BEGIN
    AC=500
    VM=1000
END
```

4.11.57 Terminate Program Block (ENDIF) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
END	End program block	-	-	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description ENDIF is used in IF statements when several command lines must be grouped in a block. ENDIF can be used in IF statements only. See IF Statement page 70.

Usage

```
IF AC>500
    AC=500
    VM=1000
ELSE
    AC=600
    VM=900
ENDIF
```

4.11.58 Execute Program Flag (EP) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
EP	Execute Program flag	0=no	1=yes	0	0.5	x	x	x	x	x	x	x	(power-up)
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Selection 0 = Do not start program when the Controller is switched on
1 = Start program when the Controller is switched on.

Description A user program which is stored in the Controller memory can be automatically loaded and executed at power up. If EP is set to 1, the program is retrieved from non-volatile memory at power up, loaded and executed. If EP is set to 0, the Controller starts up normally without executing a user program (the MR1 and GO commands can then be used to start a program). The EP command can only be used with the AMC2xP Controller.

Usage **EP**=x Set Execute Program flag.
EP Show current set-up.

4.11.59 Read-out of Error Status (ES)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ES	Error status	0	3	-	0.5	o	o	o	o	o	o	o	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description During operation of a system, various error conditions can arise. Some errors can be attributed to communication and set-up (error status register 0) and others attributed to hardware and motor control errors. The error status can be read using the ES (Error Status) command. The command invokes the Controller to transmit a number in either binary format, which means a series of zeroes (0) and ones (1), or as a decimal number. A quick overview of error messages is thus obtained which can also be interpreted by other software programs. Using the command EST, an overview of text responses is obtained. See also *Error Status Text (EST)*, page 109. There are three error status registers.

ES0	Communications errors
ES1	Motor overload errors
ES2	Internal errors
ES3	Motion Errors

Register 0 provides information about RS232/RS485 communication and set-up errors. This register accumulates and stores all errors that have occurred since the register was last read. When the register is read, the information is automatically erased.

Error status register 0 (ES0) - These errors are related to communication		
Bit no.	**E/W no.**	**Explanation**
0	W0	No errors
1	E1	Error
2	E2	Out of range
3	E3	Number of parameters is wrong
4	E4	Instruction does not exist
5	E5	It is not an instruction
6	E6	Parameter error or out of range
7	E7	Register number error or out of range
8	E8	Data cannot be stored in FLASHPROM
9	E9	Checksum error
10	W10	Parameter will be rounded
11	E11	No Program available
12	E12	Zero Search Function Active
13	E13	Command not valid in this mode
14	E14	Not allowed due to previous fatal error
15	E15	Error Initializing motor
16-30	E16-30	Reserved for future use
31	E32	Check other Status Registers

Register 1 provides information about Controller and motor errors. Some error conditions may be temporary, for example the maximum peak current may have been exceeded for a short duration and the corresponding bit set in the status register. The error indication is cleared after reading the error status. For critical (vital) errors, motor operation is interrupted and the error information remains in the register, and O2 is set high (=1). The user must then either switch the system off and on again to reset the error status, or use the RESET command.

Error status register 1 (ES1) - These errors are related to motor control circuitry					
Bit no.	**Error status cleared by reading**	**O2 set high**	**Error send at RS232**	**System must be reset**	**Error no. + Explanation**
0	No	Yes	Yes	Yes	E33: Current Overload - Motor short-circuited
1	No	Yes	No	Yes	E34 : Power consumption too high
2	No	Yes	Yes	Yes	E35 : Average Current limit exceeded
3	Yes	No	Yes	No	W36 : Bus Voltage exceeds 700 V - Activating powerdump !
4	Yes	No	Yes	No	E37 : Bus Voltage exceeds 800 V - Controller can be damaged !
5	No	Yes	Yes	Yes	E38 : Bus Voltage exceeds 850 V
6	No	Yes	Yes	Yes	E39 : The motor is not mounted correctly
7	No	Yes	Yes	Yes	E40 : The motor is not connected
8	Yes	No	Yes	No	E41 : HALL element is not connected properly
9	Yes	No	Yes	No	W42 : Temperature exceeded 75□C.
10	No	Yes	Yes	Yes	E43 : Temperature exceeded 85□C
11	No	Yes	Yes	Yes	E44 : Bus current exceeds plus 10A
12	No	Yes	Yes	Yes	E45 : Bus current exceeds minus 10A
13	Yes	No	Yes	No	E46 : Overload on output ports
14	Yes	Yes	Yes	No	E47: Bus voltage too low
15-30	-	-	-	-	Check the encoder cable and make sure that the right encoder type is chosen. See also Encoder Type (ET), page 110.
31	No	No	-	No	E32: Check Other Status Register

Error status register 2 (ES2) - These errors are related to internal faults					
Bit no.	**Error status cleared by reading**	**O2 set high**	**Error send at RS232**	**System must be reset**	**Error no. + Explanation**
0	No	Yes	No	Yes	E65 : Motor controller Communication error
1	Yes	Yes	Yes	Yes	E66 : Power processor Timeout
2	No	Yes	Yes	Yes	E67 : Unknown error from Power processor
3	No	Yes	Yes	Yes	E68 : Average current cannot be measured correctly
4	No	No	Yes	No	E69 : FLASHPROM Checksum error
5	Yes	No		No	E70: RS232/RS485 Output buffer error
6	Yes	No		No	E71 : RS232/RS485 Input buffer error
7	Yes	No	Yes	No	E72 : DSP Busy timeout
8	Yes	No	Yes	No	E73 : DSP Busy executing answer timeout
9-30	-	-		-	E74 - 94: Reserved for future use
31	No	No		No	E32: Check Other Status Register

Error status register 3 (ES3) - These errors are related to motion errors					
Bit no.	**Error status cleared by reading**	**O2 set high**	**Error send at RS232**	**System must be reset**	**Error no. + Explanation**
0	No	No	No	No	E97 : Negative Limit Switch active
1	No	No	No	No	E98 : Positive Limit Switch active
2	Yes	No	No	No	E99 : Negative Limit Switch has been active
3	Yes	No	No	No	E100 : Positive Limit Switch has been active
4	Yes	No	No	No	E101 : Position counter overflow
5	No	Yes	Yes	Yes	E102 : Encoder error or position error limit exceeded
6	No	Yes	Yes	No	E103 : Servo On Signal is not active
7	No	Yes	Yes	Yes	E104 : Encoder power supply error, possibly short-circuited.
8	No	Yes	Yes	No	*E105: Filter velocity error overflow*
9-30	-	-	-	-	E106 - E126 : Reserved for future use
31	No	No		No	E32: Check Other Status Register

Usage

ES0# Show the error status register 0 in binary format.
ES0 Show the error status register 0 in decimal format.

Example

Sent to Controller `ES3#`
Received from Controller `ES3=#00000000000000000000000000010000`

This indicates that the position counter is in overflow.
Note: bit 0 is the rightmost bit. The total length of the string is 32 bits.

The same in decimal :

Sent to Controller `ES3`
Received from Controller `ES3=16`

This indicates that the position counter is in overflow.
Note: bit 0 is the rightmost bit. The total length of the string is 32 bits.

4.11.60 Error Status Text (EST)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
EST	Error status in text	0	3	-	0.5	o	o	o	o	o	o	o	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The EST command has exactly the same function as the ES command described above, with the exception that the error status is reported as plain text. The EST command produces an English list of the error status. If there are no errors, the error response is *E0: No errors*. A list of the error messages is given in *Error Messages*, page 167.

Usage

EST Read complete list of errors from all error registers

EST0 Read out error status register 0 as text.

EST1 Read out error status register 1 as text.

EST2 Read out error status register 2 as text.

EST3 Read out error status register 3 as text.

4.11.61 Encoder Type (ET)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ET	Encoder type (PNP, NPN, Linedr.)	0	2	2	0.5	x	o	o	o	o	o	o	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Selection 0=PNP / 1=NPN / 2=LINE DRIVER

Description To achieve correct positioning and precise velocity and acceleration, it is important that the encoder set-up is correct. The encoder may be either a PNP, NPN or a line driver type.
This gives the possibility for using a balanced or an unbalanced signal from a standard 2-channel incremental encoder. For details of encoder connection, see *Set-up of Encoder Resolution*, page 191. The ET command is used to specify the type of encoder connected to the Controller. If an encoder with a balanced output is used, the setting ET must be set to 2 (ET=2) If however an unbalanced encoder with NPN outputs is used, ET must be set to 1 (ET=1). If an unbalanced encoder with PNP outputs is used, ET must be set to 0 (ET=0).

Usage **ET**=x Set encoder type.

ET Show encoder type setting.

4.11.62 Leave Programming Mode (EXIT) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
EXIT	Exit programming mode	-	-	-	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description When a new program is to be input to the Controller, the sequence is started using the PROGRAM command. Once programming is complete, the EXIT command is used to leave programming mode. The program is then ready for execution (GO). Remember to store the program in the Controller's permanent memory using the MS1 command.

Usage **EXIT** Leave Programming mode.

4.11.63 Following Error (FEM)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
FEM	Following error maximum	0 (disabled)	32767 #	32767 #	0.5	x	+	+	+	+	+	+	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description As a safety limit, a maximum allowable pulse error can be specified. If the error between the desired position and the actual position is too large, the encoder may be at fault or the motor is blocked. If the pulse error exceeds the specified limit, the motor is stopped and made currentless. The FEM command can be used in Gear Mode (MO=1), Positioning Mode (MO=2) and Register Mode (MO=3). The *Running*, *Error*, *Current*, and *T>80°C* LEDs on the front panel flash simultaneously if the maximum pulse error is exceeded.
If FEM is set to 0, the limit function is disabled which means that the Controller will allow an infinitely high error level without stopping motor operation and reporting an error

Examples

Sent to Controller	`FEM=10000`	Set maximum following error to 10000 encoder counts.
Received from Controller	`Y`	The controller has accepted the command, the maximum following error is now changed.
Sent to Controller	`FEM`	Show the maximum following error setting.
Received from Controller	`FEM=10000`	The actual maximum following error limit is set at 10000 encoder counts.

4.11.64 Nominal Following Error Maximum (FNEM)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
FNEM	Nominal following error maximum	0 (disabled)	32767 #	100 #	0.5	+	+	x	x			x	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This safety limit is almost equivalent to the FEM parameter except that FNEM only has an effect during a movement sequence.
FNEM will typical protect the system in case of an encoder, index or hall errors.
If the difference between the internal profile generator and the actual move becomes higher than the value specified in FNEM, the power at the motor will be disconnected and the error message *E102 : Encoder error or position error limit exceeded* will be given. The FNEM command can be used in Gear Mode (MO=1), Positioning Mode (MO=2) and Register Mode (MO=3). The *Running*, *Error*, *Current*, and *T>80°C* LEDs on the front panel flash simultaneously if the maximum pulse error is exceeded. If FNEM is set to 0, the limit function is disabled which means that the Controller will allow an infinitely high error level without stopping motor operation and reporting an error. To protect the system in mode 4 and 5 use the FEM command - see *Following Error (FEM)*, page 111.

Examples

Sent to Controller	`FEM=10000`	Set maximum following error to 10000 encoder counts.
Received from Controller	`Y`	The controller has accepted the command, the maximum following error is now changed.
Sent to Controller	`FEM`	Show the maximum following error setting.
Received from Controller	`FEM=10000`	The actual maximum following error limit is set at 10000 encoder counts.

4.11.65 Gearing (GEAR)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
GEAR	Gearing between master and slave	0.001 #	32766.999 #	1.000	0.5	x	+						
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command is used to specify the ratio between the number of pulses at the pulse input and the number of pulses at the motor's encoder. The GEAR command can only be used in Mode 1 and is intended for use when the Controller is used for so-called electronic gearing. The gear factor can only be specified as a positive value.
See also *Encoder Pulses for Master (PRM)*, page 145 or *Gear Mode (MO=1)*, page 52.
Important : Since the gear ratio is internally converted into a 8 bit scalar, the difference between the master encoder and the motor can be some pulses after a certain distance. This difference however means no loss of position since the start position will still be the same.

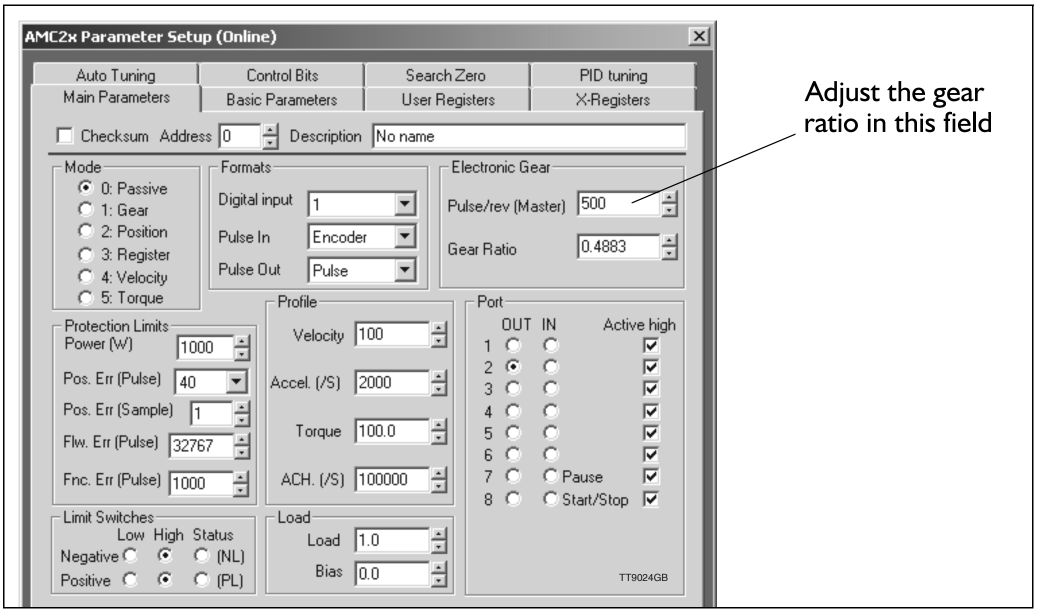
Example The actual GEAR setting must be verified.

Sent to Controller	`GEAR`	
Received from Controller	`GEAR=1.000`	Which means that the actual gear ratio between the master encoder connected at X1 and Y1 and the motor is 1:1.

The actual GEAR setting must be changed to 1.2 which means that the motor must move factor 1.200 with reference to the master encoder.

Sent to Controller	`GEAR=1.2`
Received from Controller	`Y`

The gear factor can also be set in MotoWare using the parameter window.



AMC2x Parameter Setup (Online)

Checksum ☐ Address 0 Description No name

Mode: ● 0: Passive ○ 1: Gear ○ 2: Position ○ 3: Register ○ 4: Velocity ○ 5: Torque

Formats: Digital input 1; Pulse In Encoder; Pulse Out Pulse

Electronic Gear: Pulse/rev (Master) 500; Gear Ratio 0.4883

Protection Limits: Power (W) 1000; Pos. Err (Pulse) 40; Pos. Err (Sample) 1; Flw. Err (Pulse) 32767; Fnc. Err (Pulse) 1000

Profile: Velocity 100; Accel. (/S) 2000; Torque 100.0; ACH. (/S) 100000

Load: Load 1.0; Bias 0.0

Limit Switches (Low / High / Status): Negative ○ ● ○ (NL); Positive ○ ● ○ (PL)

Port (OUT / IN / Active high):
1 ○ ○ ☑
2 ● ○ ☑
3 ○ ○ ☑
4 ○ ○ ☑
5 ○ ○ ☑
6 ○ ○ ☑
7 ○ ○ Pause ☑
8 ○ ○ Start/Stop ☑

Adjust the gear ratio in this field

4.11.66 Execute Program (GO) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
GO	Execute program	-	-	-	0.5	+	+	+	+	+	+		
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command is used to start execution of the program in the program memory.

Usage **GO**Execute Program.

4.11.67 Halt of Motor (H)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
H	Halt motor and program	-	-	-	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Modes 1 - 5 (for AMC2xP the program will also be stopped)

Description This command is used to stop the motor instantaneously, regardless of velocity, deceleration etc. For the AMC2xP this command will also stop execution of the Controller program.
The stop is done with the deceleration specified in ACH register - for further details see *Deceleration under a Halt Condition (ACH)*, page 81. Note that the deceleration is nearly instantaneous since the ACH default is 100000 RPM/second.

When a Halt has been executed, it can be released again by using the Unhalt command (UH) - for further details see *Unhalt (UH)*, page 158.

The halt and unhalt commands can be used in all modes. In mode 2 a positioning command i.e. SR or SP will automatically release the halt state.

Usage **H** Halt motor.

Example

Sent to Controller	`H`	Halt the motor.
Received from Controller	`Y`	The controller has accepted the command.

4.11.68 Hall-element Type (HALL)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
HALL	Motor initialisation, hall-based *	0	3	2 (Yask.)	0.5	x	o	o	o	o	o	o	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The Controller can be initialised either with or without the use of Hall elements in the motor. Normally the Hall element is not necessary if the motor may be allowed to move during start-up. In this case the HALL command is used to set the Hall register to 0. If however it is required that the motor remains completely stationary during start-up, a Hall element in the motor must be used and the HALL command is used to set the Hall type.

The Hall element is used during start-up to tell the Controller the position of the motor so that the commutation circuitry can lock the applied magnetic field at the motor's actual position without the motor moving. The information from the motor's incremental encoder cannot be used for this purpose since it only detects a relative move not an absolute position. The Hall element is only used during start-up.

The following Hall types can be selected:

HALL register:	Function	Index source
HALL = 0	Start-up without HALL	Index is generated from the Hall signals
HALL = 1	Normal HALL format - The signals applied to the primary Hall inputs HLA, HLB and HLC are used.	Index is generated from the encoder EZ input.
HALL = 2	Yaskawa HALL encoding type 1. Use only encoder inputs EA and EB incl. the Index channel EZ. Motor series SGM, SGMP, SGME, SGMG, SGMS is supported by this Hall setting.	The Index is generated via the internal Hall signals which are generated from the 3 encoder signals.
HALL = 3	Yaskawa HALL encoding type 2. Uses only encoder inputs incl. the Index channel EZ.	The index is generated directly from the 3 encoder inputs.

By "Index source" means which source that is used to produce the internal index pulse for aligning the motor commutation during normal/continous operation. See also *Setting the Index Input*, page 193.

Note that Yaskawa motors have their HALL signals encoded together with the encoder signals, including the index signal. This minimises the number of cables between the motor and the Controller. See also *Hall Input*, page 31

Usage **HALL**=x Set HALL type.

HALL Show current setting of HALL type.

4.11.69 Command Overview (HELP)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
HELP	Show commands	-	-	-	0.5	o	o	o	o	o	o	o	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The HELP command is used to display an alphabetical list of the commands that can be used with the Controller.

Example

```
Sent to Controller        HELP
Received from Controller  Following Instructions can be used
                          AC    ADDR  AP    CHS   CL    .....
                          .....
```

4.11.70 HALL Level Type (HL)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
HL	Hall element type *	0=PNP	1=NPN	0 (PNP)	0.5	x	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description To achieve correct decoding of the HALL element in the motor (if the Hall element is used), it is vital that the HALL set-up is correct. HALL elements may either be PNP types or NPN types. In addition, both a balanced or unbalanced signal from the HALL element can be accepted. For details of HALL element connection, see *Hall Input*, page 31.

If a HALL element with a balanced output is used, the setting of the HL value can be omitted. If however an unbalanced NPN Hall element is used, HL must be set to 1 (HL=1). If an unbalanced PNP Hall element is used, HL must be set to 0 (HL=0).
If a Yaskawa motor is used, the setting of the HL parameter is unimportant since the HALL signal is encoded with the encoder signal itself and the HALL-Input is therefore not used.

Usage **HL**=x Set HALL type.

HL Show current setting of HALL type.

4.11.71 Home Signal Status (HM)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
HM	Show Home input status	0=low	1=high	(0)	0.5	o	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Show the actual level of the zero-point contact, high (1) or low (0). Note that the HM command does not show whether the contact is active or not, but whether the input is high (1) or low (0). The definition high means that a voltage is applied to the HM input. The HM command is not influenced by the HML setting. See *Home Signal Level (HML)*, page 116.
The HM input is basically intended to be used together with the zero search function but the HM command can also verify the HM input in general.

For a hardware description of the HM input see *Home (Reset) Input*, page 35.
For a complete description of the zero search function and related commands see *Mechanical Reset*, page 75.

Usage **HM** Show current level at the HM input.

Examples
Sent to Controller `HM` Show the actual level at the HM input.
Received from Controller `HM=1` The actual level at the HM input is 1 which means that a voltage is applied to the input.

4.11.72 Home Signal Level (HML)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
HML	Level for zero-point contact	0	1	1	0.5	x	x	+	+	x	x	x	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The zero-point contact is connected to the HM input. The contact can be active high (1), if a *normally open* sensor is used, or low (0), if a *normally closed* sensor is used.
Note that a resistor must be connected between HM and a voltage source if an NPN sensor is used. For a complete description of the zero search function and related commands see *Mechanical Reset*, page 75.

Usage
HML=x Set the active level for zero-point contact, 0 = low, 1 = high.
HML Show current level.

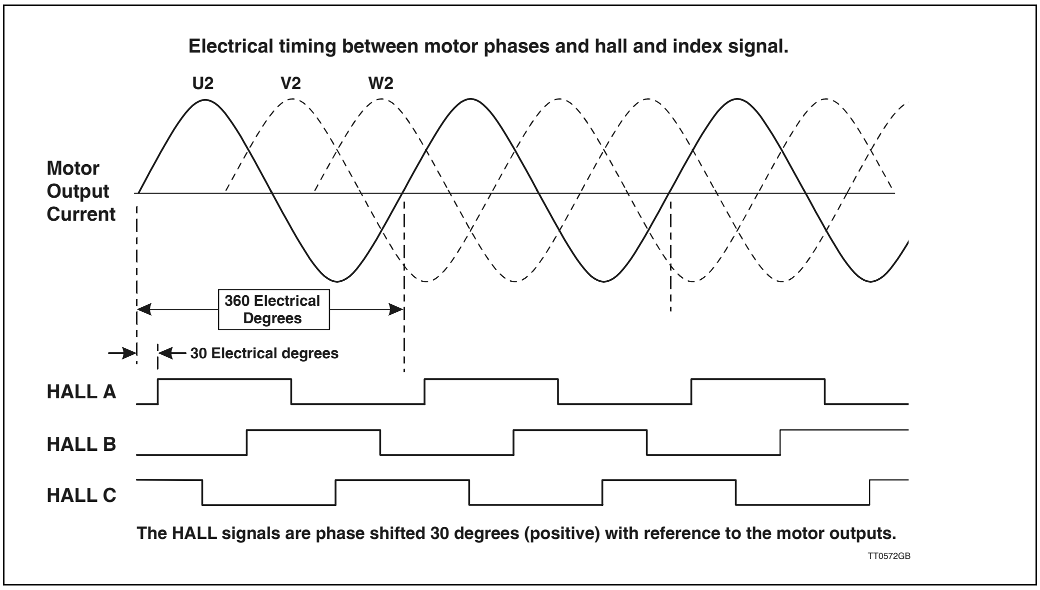
Examples
Sent to Controller `HML=1` Set home signal level 1 - normally open sensor.
Received from Controller `Y` The controller has accepted the command.

Sent to Controller `HML` Show current home signal level.
Received from Controller `HML=1` The current home signal level is 1.

4.11.73 Hall Offset (HOFFSET)

Com- mand	Description	Limits Min.	 Max.	Default	Exec. Time (msec)	Mode 0	 1	 2	 3	 4	 5	 P	Unit
HOFFSET	Set HALL offset angle *	0	360	0	0.5	x	o	o	o	o	o	o	Elec.deg.
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description To achieve correct decoding of the HALL elements in the motor (if the Hall element is used), it is vital that the HALL signals are aligned in comparison with the motor phases. The Hall signals give the advantage that the motor stays in a stationary position after power-up.
If the Hall signals are not used, the only alternative is fixed field initialization which will make the motor move a certain distance during initialization. See also *Initialisation Type (INITTYPE)*, page 122. If possible, Hall initialization is always recommended.
The HOFFSET register is used to specify how many electrical degrees the Hall signals must be phase-shifted with reference to the motor phases.
See illustration below.


Electrical timing between motor phases and hall and index signal.
U2
V2
W2
Motor Output Current
360 Electrical Degrees
30 Electrical degrees
HALL A
HALL B
HALL C
The HALL signals are phase shifted 30 degrees (positive) with reference to the motor outputs.
TT0572GB

In the illustration above the phase shift is 30 degrees which means that the HOFFSET register must be set to 30.0.
Note that HOFFSET only can be set to an unsigned value.

Usage **HOFFSET**=x Set HALL offset.

HOFFSET Show current setting of HALL offset.

4.11.74 IF statement (IF) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
IF	IF statement	-	-	-	0.5							+	-

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description

Program execution can be controlled using conditional statements. If the condition specified by the IF statement is true (not 0), the next line in the program is executed. If the statement is false (=0), the next program line is skipped and program execution continues. The ELSE statement can also be used in conjunction with the IF statement. All registers and commands that return a value can be used in IF statements.

The following operators can be used in the statement:

Operator	Description
<	Less than
>	Greater than
=	Equal to
<=	Less than or equal to
>=	Greater than or equal to
<>	not equal to
AND	Logical AND operator
OR	Logical OR operator

Usage

IF statement { **OR** statement }
statement::= expression { **AND** expression }
expression::=value rel_op value (where rel_op is <, >, =, <=, >= or <>)
value::= register or equation

Examples

IF AC>56 **AND** IN1=1
AC=789

IF IN1=1

IF IN2=1 **OR** IN3=0 **AND** IN4=1 **OR** IN5=1

IF IN5=IN6

IF AC>6+VM-IN1+3*9 **OR** IN7=1

4.11.75 Verify Flag in External Module - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
IF (ext)	IF statement (External module)	-	-	-	0.5							+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Execute next line if flag in external module (connected to the Bus) is equal to the specified logic level. The function can be used to verify a flag or a certain input. If the specified condition is true, the next line in the program is executed.
This function can be useful to control the program flow in the AMC2xP, since the only alternative function is the INPUT command *Read Data from External Module (INPUT) - Only AMC2xP*, page 124. This command however reads a complete register in the external module and not a single input or flag. The INPUT command therefore requires a following mask routine to extract a specific input or flag.

Usage IF I[a].[f]=[l]

Command Format :

a Specifies the address of the external module from which input is required. The address parameter must be specified as a value between 0 and 31. The JVL Bus interface enables up to 32 modules to be connected to the interface. The address of each module must be set via DIP switches on the individual module. Consult the user manual for the actual module.

f Specifies the flag or input in the external module from which input is to be read. f must be specified in the range 0-255. Consult the user manual for the actual module to see which flags or inputs are available.

Examples An IOM11 Input/output module is used. The Module address is 2. Input 5 has to be read and tested to determine if the value is logic 1 (input is activated). If this is the case, the module Counter is read and the program continues. In the instruction manual for the IOM11 module, the Counter register is specified as register 2 and the register for all 16 inputs is 3.

```
:START  IF I2.5=1       ; VERIFY FLAG 5 IN MODULE 2 (ADDRESS 2)
                        ; IF FLAG IS EQUAL 1 (LOGIC 1), MOVE
                        ; MOTOR TO POSITION 5000. OTHRWISE
                        ; BYPASS NEXT LINE (SP=5000).
        SP=5000         ; MOVE MOTOR TO POSITION 5000
        OUT1=4          ; ACTIVATE OUTPUT 4
```

4.11.76 Read Status of Inputs (IN1 - IN8)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
IN	Read input port status	0	255	-	0.5	o	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The Controller has 8 inputs. The status of these inputs can be read using the IN command.
The Inputs have certain pre-defined functions depending on the Controller's mode of operation. Inputs can be read individually using the INx command, where x specifies the input to be read. All inputs can be read simultaneously using the IN command.

Input	Function	
	Register Mode (MO=3)	All other Modes
IN1	D0 (Least significant bit)	General input
IN2	D1	General input
IN3	D2	General input
IN4	D3	General input
IN5	D4	General input
IN6	D5 (Most significant bit)	General input
IN7	Pause input	General input
IN8	Start / stop input	General Input

Usage

IN	Read inputs.
INx	Read input x

Example

Sent to Controller	`IN4`
Received from Controller	`IN4=0`
Sent to Controller	`IN`
Received from Controller	`IN=00010100` Note that IN8 is the leftmost digit (MSB)

4.11.77 Input Active Level (INAL)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
INAL	Input active level	0	255 Decimal 11111111 Binary	255	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Range 0 - 255(decimal) or 00000000 - 11111111 (binary)
Default 11111111 (all inputs are active high)

Description The active level of the digital inputs can be independently programmed to be active high (1) or active low (0). Active high (1) means that the input is activated when a positive voltage is applied at the input with reference to the input common terminal *IN-*. Active low (0) means that the actual input terminal is left open (no voltage applied) with reference to the terminal *IN-*.

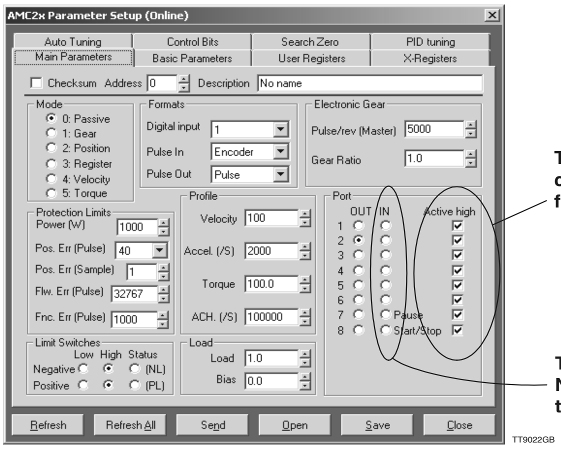
Example All inputs must be active high therefore INAL=11111111 is set.
All inputs must be active low therefore INAL=00000000 is set.

Input active level (INAL) - Continued

Example 2:
Input 8 is required to be active low, therefore INAL=01111111 is set.

Usage **INAL**Read active level for all inputs
INAL=abcdefghSet active level for all inputs (a is IN8, abc.. can be either 0 or 1)
INALxRead active level for input x
INALx=nSet active level to n for input x

INAL can also be set from MotoWare using the parameter window.



□ Checksum Address 0 Description No name

Mode
● 0: Passive
○ 1: Gear
○ 2: Position
○ 3: Register
○ 4: Velocity
○ 5: Torque

Formats
Digital input 1
Pulse In Encoder
Pulse Out Pulse

Electronic Gear
Pulse/rev (Master) 5000
Gear Ratio 1.0

Protection Limits
Power (W) 1000
Pos. Err (Pulse) 40
Pos. Err (Sample) 1
Flw. Err (Pulse) 32767
Fnc. Err (Pulse) 1000

Profile
Velocity 100
Accel. (/S) 2000
Torque 100.0
ACH. (/S) 100000

Port	OUT	IN		Active high
1	○	○		☑
2	●	○		☑
3	○	○		☑
4	○	○		☑
5	○	○		☑
6	○	○		☑
7	○	○	Pause	☑
8	○	○	Start/Stop	☑

Limit Switches

	Low	High	Status
Negative	○	●	○ (NL)
Positive	○	●	○ (PL)

Load
Load 1.0
Bias 0.0

The active level for each input can be easily setup in these fields.

The actual input levels can be monitored here. Note that the levels shown are shown after the active level compensation (INAL).

4.11.78 Index Pulse On/Off (INDEX)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
INDEX	Index from encoder ON/OFF	0 (OFF)	1 (ON)	1	0.5	x	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description If an encoder with index channel is used, the Controller's Index Input must be set active. Otherwise it is recommended that the index input is set inactive to avoid spurious electrical noise interfering with Controller operation. Please note that index must be set before initialization of the motor, i.e. before power up of the Controller or execution of a reset command.

Usage **INDEX** Read actual index input setup
INDEX=n Setup index input to be active or passive

Example INDEX=1 Activate index input.

4.11.79 Initialisation Type (INITTYPE)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
INITTYPE	Initialisation type (Hall etc.)	0	2	2	0.5	x	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The INITTYPE register defines what kind of motor initialisation the Controller must use after power up. The motor initialisation is the sequence that locks the electrical angle to the mechanical angle. 3 different initialisation formats are available:

0 Fixed field initialisation
This format is only recommended for motors without hall feedback.
The initialisation is done by applying a fixed current to the motor. This current forces the motor to move into a predictable position. When the motor is stable, the commutation position is set to zero and the current is removed. The motor commutation is now initialised.Note that the motor will move a certain distance when this type of initialisation is used. Use type 2 (Hall) if it is important that the motor remains stationary.

1 Reserved for future use

2 Use Hall element for initialisation.
This initialisation type will make sure that the motor remains stationary under initialisation. This initialisation requires a motor with integral hall sensors. The hall signals can be different formats and can be connected to either the normal hall inputs or integrated in the encoder signals. The hall register specifies this - see *Hall-element Type (HALL)*, page 114.

Continues next page.

Initialisation type (INITTYPE) - Continued

Usage	**INITTYPE**	Read actual inittype setup.
	INITTYPE=n	Set inittype to "n" type.
Example	INITTYPE=2	Set initialisation type to Hall element - Use Hall element to initialise after powering up the system.

4.11.80 Read Data from External Module (INPUT) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
INPUT	Read data from external module	-	-	-	0.5	o	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The INPUT command is used to read-in data from external modules connected to the JVL Bus interface. It can be used to read-in data from modules such a Keyboard, Display, thumbwheel, BCD data from PLC equipment, printer, extra inputs, digital-to-analogue modules, etc. All of the above-mentioned external modules are intelligent and will therefore contain registers whose contents can be read into the Controller's registers using the INPUT command. The size and number of registers in external modules may vary, but each module has at least 1 register.

Usage INPUTx.y

Command Format :

x Specifies the address of the external module from which input is required. The address parameter must be specified as a value between 0 and 31. The JVL Bus interface enables up to 32 modules to be connected to the interface. The address of each module must be set via DIP switches on the individual module.

y Specifies the register in the external module from which input is to be read. n2 must be specified in the range 0-255.

Examples An IOM11 Input/output module is used. The Module address is 5. All 16 inputs are to be read and tested to determine if the value is 255. If this is the case, the module Counter is read and the program continues. In the user manual for the IOM11 module, the Counter register is specified as register 2 and the register for all 16 inputs is 3.

```
:READINP      R10=INPUT5.2   ; READ ALL 16 INPUTS AND TRANSFER
                             ; CONTENTS TO R10
              IF R10=255     ; IF INPUTS NOT EQUAL TO 255 READ AGAIN
              J:READ_COUNT
              J:READINP      ; ELSE READ COUNTER VALUE AND CONTINUE
                             ; PROGRAM
:READ_COUNT   R30=INPUT5.3   ; READ COUNTER AND TRANSFER TO R30
```

4.11.81 Jump Statement (J) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
J	Jump statement	0	500	-	0.5							+	Line
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Jump statement. The Jump statement causes an unconditional jump to a specified program line. Program execution continues from there.

Usage **Jx** Where x is a line number.

Examples J50 Jump to line 50
J:LABEL1 Jump to :LABEL1. Can be used while programming via MotoWare.

4.11.82 Jump to Sub-routine (JS) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
JS	Jump Sub-routine	0	500	-	0.5							+	Line
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Jump Sub-routine statement. The Jump statement causes an unconditional jump to a subroutine at the specified program line. Program execution continues from there. When the RET (Return) command is encountered the program returns to the main program at the line immediately after the JS command and continues from there. You can make up to 16 nested sub-routine calls.

Usage **JSx** Where x is a line number.

Examples JS50 Jump to line 50
JS:LABEL1 Jump to :LABEL1. Can be used while programming via MotoWare.

4.11.83 Velocity-dependent Commutation Offset (KPHASE)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
KPHASE	Velocity-dep. commutation offset	0	100	1.0	0.5	x	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

The KPHASE parameter is decisive for how far commutation of the motor is offset from the motor's actual position. KPHASE is velocity dependent, which means that it has increasing significance as motor velocity increases. The KPHASE parameter is automatically calculated when the current filter is tuned. This means that KPHASE is set at a relative zero-point of 1.0. Additional adjustment must be done with reference to this value.
It is of vital importance to system performance that this parameter is adjusted correctly since poor adjustment will result in the motor not providing optimum torque at high velocities.
In the worst case, the motor will not be able to run at full velocity and the system will produce an error when the positioning error exceeds the limit specified by the FEM or FNEM register — see *Following Error (FEM)*, page 111 and *Nominal Following Error Maximum (FNEM)*, page 111.
Also too high a current consumption can be a problem if KPHASE is not adjusted correctly.
See also *Setting KPHASE*, page 198.

Usage

KPHASE =x	Set KHASE to value x.
KPHASE	Show current KPHASE set-up value.

Examples

Sent to Controller	`KPHASE=1.3`	Set KPHASE to 1.3 (30% higher than default).
Received from Controller	`Y`	The controller has accepted the command and the KPHASE is changed.
Sent to Controller	`KPHASE`	Show KPHASE value.
Received from Controller	`KPHASE=1.3`	The current KPHASE value is 1.3

4.11.84 Show Line Number (LINE) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
LINE	Show program line number	0	500	-	0.5	o	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The LINE command returns the line number of the last command executed, whether the program is running or not.

Usage **LINE** Show line number

4.11.85 List Program (LIST) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
LIST	Show user program (upload to PC)	-	-	-	0.5	o	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description List the user program in RAM memory. Note that jump labels from original program code created in MotoWare are converted into absolute line numbers. Additionally, comments, etc. are not retrieved since they are only kept together with the original program.

Usage **LIST** List the program.

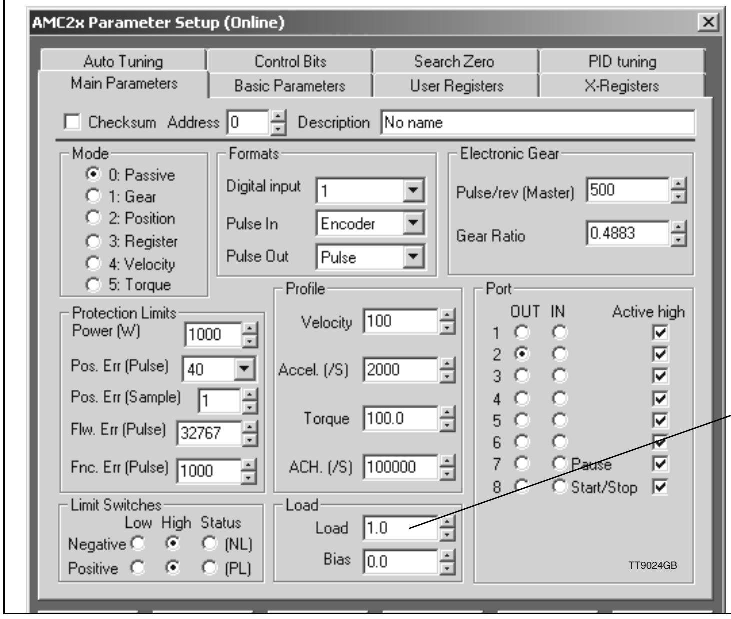
4.11.86 Load Inertia Register (LOAD)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
LOAD	Load Inertia Register	0.50	10.00	1.00	0.5	+	+	+	+	+	+	+	%
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This register compensates the filter in applications where a higher load inertia has been added the motor after the tuning is done.

Usage **LOAD** = x Set load register to factor x
LOAD Show actual load register setting.

Example The tuning is done at a motor with 1kg/m² but no load. Afterwards a load inertia is added with the same inertia as the motor (1kg/m²). The load register must therefore be set to 2. The following must be done to achieve this.
Sent to Controller `LOAD=2.0`
Received from Controller `Y`
The parameter window in MotoWare can also be used to set the load factor.



☐ Checksum Address 0 Description No name

Mode: ● 0: Passive ○ 1: Gear ○ 2: Position ○ 3: Register ○ 4: Velocity ○ 5: Torque

Formats: Digital input 1; Pulse In Encoder; Pulse Out Pulse

Electronic Gear: Pulse/rev (Master) 500; Gear Ratio 0.4883

Protection Limits: Power (W) 1000; Pos. Err (Pulse) 40; Pos. Err (Sample) 1; Flw. Err (Pulse) 32767; Fnc. Err (Pulse) 1000

Profile: Velocity 100; Accel. (/S) 2000; Torque 100.0; ACH. (/S) 100000

Port:

	OUT	IN		Active high
1	○	○		☑
2	●	○		☑
3	○	○		☑
4	○	○		☑
5	○	○		☑
6	○	○		☑
7	○	○	Pause	☑
8	○	○	Start/Stop	☑

Limit Switches:

	Low	High	Status
Negative	○	●	○ (NL)
Positive	○	●	○ (PL)

Load: Load 1.0; Bias 0.0

Adjust the load factor here

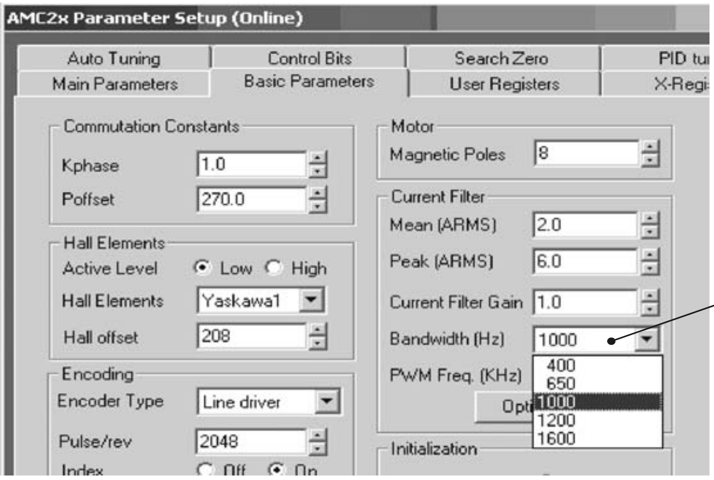
4.11 Command Description

4.11.87 Current Loop Bandwidth (MAXFREQ)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
MAXFREQ	Current Loop bandwidth	0	2	2 (1000 Hz)	0.5	x	o	o	o	o	o	o	-

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description The motor current is updated with a fixed frequency of 5kHz or 20kHz which is considered a quite high frequency. This high update frequency offers extremely good dynamic regulation performance.
For some motor types with low time constants, it can cause some audible noise. For this situation, the *MAXFREQ* register can be used.
By decreasing the maximum bandwidth to 400 or 650 Hz in the current filter, the noise can be decreased significantly. The disadvantage is that the dynamic performance is also decreased but not proportionally since the filter algorithm is optimised in a way to ensure that the response within 3- 5 samples is the same as >=1000 Hz bandwidth.
Please note that the filter must be re-optimized if the MAXFREQ register has been changed. The bandwidth can also be changed in MotoWare by entering the *Basic Parameters* window under the *Parameter Setup* window.



Commutation Constants
Kphase 1.0
Poffset 270.0

Hall Elements
Active Level ● Low ○ High
Hall Elements Yaskawa1
Hall offset 208

Encoding
Encoder Type Line driver
Pulse/rev 2048
Index ○ Off ● On

Motor
Magnetic Poles 8

Current Filter
Mean (ARMS) 2.0
Peak (ARMS) 6.0
Current Filter Gain 1.0
Bandwidth (Hz) 1000
400
650
1000
1200
1600
PWM Freq. (KHz)

Initialization

The bandwidth can be changed here. Remember to use the "Optimize" function afterwards in order to recalculate the current filter.

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Please notice that when changing control bit 2 (CB2) the bandwith is also changed. CB2 is controlling the PWM frequency at the motor output. The table below show the influence at the bandwiths by changing MAXFREQ and CB2.
See also *CB2 - Set low PWM output frequency*, page 92

MAXFREQ setup	Bandwith when 20KHz (CB2=0)	Bandwith when 5KHz (CB2=1)
0	400 Hz	100 Hz
1	650 Hz	163 Hz
2	1000 Hz	250 Hz
3	1200 Hz	300 Hz
4	1600 Hz	400 Hz

See also *Setting the Motor Currents*, page 195 for the complete current setting procedure.

4.11.88 Mode Selection (MO)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
MO	0=Passive 1=Gear, 2=Position, 3=Register, 4=Velocity, 5=Torque	0	5	0	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Control of the motor can be made in one of six basic modes of Controller operation, as given in the table below. The MO command is used to select the Controller mode of operation. A sixth mode (mode 0) can be used to power down the motor output and make the mode currentless. The complete control circuitry including in- and outputs will still be active after the mode is set to 0.

Usage **MO** = x

Mode no.	Mode
0	Passive (passive output)
1	Gear
2	Positioning
3	Register
4	Velocity
5	Torque

MO Show current mode of operation.

4.11.89 Recall Set-up (MR)

Com- mand	Description	Limits Min.	 Max.	Default	Exec. Time (msec)	Mode 0	 1	 2	 3	 4	 5	 P	Unit
MR	Recall data from FLASHPROM	0	2	-	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Controller set-up data can be permanently stored in non-volatile FLASHPROM memory, i.e. without the need for current to retain the data. The Memory Recall command MR is used to recall data from the FLASHPROM memory and set-up the Controller and system using these values.

Usage **MR** Restore all.
For AMC20-22 this command will restore set-up data.
For AMC20P-AMC22P this command will restore set-up data, program and user registers.

MR0 Restore controller set-up (including X registers for use in Mode 3)

MR1 Restore program - only AMC2xP.

MR2 Restore user registers - only AMC2xP.

4.11.90 Save Set-up (MS)

Com- mand	Description	Limits Min.	 Max.	Default	Exec. Time (msec)	Mode 0	 1	 2	 3	 4	 5	 P	Unit
MS	Save set-up in FLASHPROM	0	2	-	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The Controller set-up data can be permanently stored in non-volatile FLASHPROM memory, i.e. without the need for current to retain the data. The Memory Save (MS) command is used to store the Controller set-up in permanent memory.

MS0, MS1 and MS2 can be used with a AMC2xP only.

Usage **MS** Save all. For AMC20, AMC21 and AMC22 this command will save set-up data. For AMC20P, AMC21P and AMC22P this command will save set-up data, program and user registers.

MS0 Save set-up including X registers for use in mode 3.

MS1 Save program - only AMC2xP.

MS2 Save user registers - only AMC2xP.

4.11.91 Motor test (MTEST)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
MTEST	Finds the motor parameters	-	-	-	3-10 sec.	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The MTEST command is used to verify the actual motor connected to the Controller. The command is only used to monitor the parameters of the actual motor versus the actual setup in the controller. The command do not change any parameters. If certain parameters are not equal (set to the correct value) the change must be done manually in the online editor or in the parameter window.

When the MTEST command is executed it will apply a fixed current equal to the the CA (average current) setting and move the field for approximately 2 motor revolutions or until it meets the index pulse from the encoder. During this sequence all the feedback signals are observed and it is afterward analysed how many pulses the encoder have produced in one revolution, where the indexpulse was detected etc.

A "trap" could be if one of the 4 parameters CP, CA, PR og POL is not set to a prober value before the test since those 4 parameters could make a big influence on the test result. Also make sure that the motor can move freely within any mechanical collisions. An optimal situation is if the motor is not fitted to any mechanical load.

Usage **MTEST** Motor test. The test will be started.

Example It is desired to test if the actual motor connected to the controller matches the setup of the controller. Therefore the MTEST command is sent in the "online editor".

```
Sent to Controller          MTEST
Received from Controller    Motor Data: CP=8.0, CA=4.0, PR=2048, POL=8
                            Parameter:  Setup  Actual
                            -------------------------
                            PR           2048    2046
                            POFFSET     270.0   269.3
                            HOFFSET     208.0   209.4
                            CB11            1       1
                            CB12            1       0
                            INDEX           1       1
```

This test shows that all the parameters are set correct except for the CB12 bit (Direction of the Hall sensors). It is acceptable that the PR, POFFSET, HOFFSET shows a small tolerance. In general the tolerance must not exceed +/-3%. If the tolerance is higher it must be corrected.

To correct the CB12 bit sent following string

```
Sent to Controller          CB12=0
Received from Controller    Y
```

Now all parameters is set correct. Try the MTEST command once more to make sure and finish by sending the MS command in order to save the setup permanent in the controller. See also the chapter *Connection of an Unknown Motor Type*, page 190.

4.11.92 Negative Limit signal status (NL)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
NL	Negative Limit input status	0=low	1=high	-	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description
Shows the actual level of the NL (negative limit input), high (1) or low (0). Note that the NL command does not show whether the connected contact is active or not, but whether the input is high (1) or low (0). The definition high means that a voltage is applied to the NL input. The NL command is not influenced by the NLL setting. See *Negative Limit Input Level (NLL)*, page 133.
The NL input is basically intended to be used for the negative limit switch, but the NL command can also verify the NL input in general.

For a hardware description of the NL input see *End-of-travel Limit Inputs*, page 34.

Usage
NL Show current level at the NL input.

Examples

Sent to Controller	`NL`	Show the actual level at the NL input.
Received from Controller	`NL=1`	The actual level at the NL input is 1 which means that a voltage is applied to the input.

4.11.93 Negative Limit Input Level (NLL)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
NLL	Negative Limit input active Level	0=low	1=high	1	0.5	x	x	+	+	x	x	x	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description
The PL and NL Inputs function as end-of-travel limits. If the motor is moving in a negative direction and NL is activated, the motor is stopped instantaneously. The PL Input is the positive end-of-travel input. The two limit switches can be independently programmed to be active high (1=Normally open sensor) or active low (0=Normally closed sensor). The NLL command is used to set this active level for the NL input (positive limit switch). For connection of the end-of-travel inputs, see *End-of-travel Limit Inputs*, page 34.

Usage
NLL=x Set the active level for the negative limit switch sensor connected to the NL input, 0 = low(normally closed), 1 = high(normally open).
NLL Show current active level for the NL input.

Examples

Sent to Controller	`NLL=1`	Set NL active level to 1 - normally open sensor.
Received from Controller	`Y`	The controller has accepted the command.
Sent to Controller	`NLL`	Show current NL active level.
Received from Controller	`NLL=1`	The current NL active level is 1.

4.11.94 Logical OR Operator (OR) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
OR	Logical OR operator	-	-	-	0.5							+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Logical OR operator. OR can only be used in conditional IF statements and is used when only one of the conditional expressions is required to be fulfilled.

Usage **IF** *expression* **OR** *expression*

Example **IF** VM<>500 **OR** AC=750

4.11.95 Read/Set Status of Outputs (O1 - O8)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
OUT	Show/set levels at User Outputs	0	255	0	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The 8 user outputs can be set or read by this command. The status of these outputs can be read or set using the OUT command. The OUT command is expressed in decimal values. If the output level must be defined in binary, a # character is added after the command - see following examples. Note that the 8 LEDs *O1 - O8* at the Controller front panel always show the actual levels at the respective outputs.
Outputs 1 and 2 are by default dedicated for use as "In position" and "Controller OK" outputs. The functionality of these outputs can however be redefined - see :
CB4 - Position Output (O1) Function, page 92.
CB15 - Function of User Output 1 (O1), page 96.
CB16 - Function of User Output 2 (O2), page 96
CB17 - Function of User Output 3 (O3), page 96

Bit no.	Output	Function
0	O1	Default used as "In position output". Default levels : 1 = In position (only used in mode 2 and 3). CB4 and CB15 control the function of this output. Output 1 can also be used as a general output.
1	O2	Default used as "Controller OK". Default levels : 0 = Fatal error(s), 1 = Controller OK. CB16 controls the function of this output. Output 2 can also be used as a general output.
2	O3	Output 3. Can be used via the OUT command. Output 3 can also be used to control a brake - see CB17 description.
3	O4	Output 4. Can be used via the OUT command
4	O5	Output 5. Can be used via the OUT command
5	O6	Output 6. Can be used via the OUT command
6	O7	Output 7. Can be used via the OUT command
7	O8	Output 8. Can be used via the OUT command

Continued on following page.

Usage	**OUT**	Read status of outputs
	OUT n	Read status of output n (n=1 to 8)
	OUT n=x	Set output n to x (0 or 1)
	OUT# =xxxxxxxx	Set all outputs to x, where x is 0 or 1.
	OUT = x	Set all 8 outputs to decimal value x (x= 0-255)

Examples	Sent to Controller	*OUT*	Read outputs as a decimal value.
	Received from Controller	*OUT=0*	Which means that all outputs (O1-O8) are passive (logic 0).
	Sent to Controller	*OUT3=1*	Set O3 to 1
	Received from Controller	*Y*	
	Sent to Indexer	*Out#=1010*	Sets outputs to 00001010
	Received from Indexer	*Y*	All digits to the left of MSB will be set to 0
	Sent to Indexer	*OUT#*	Read outputs
	Received from Indexer	*OUT#=00001010*	Note *O1* is the rightmost digit (LSB)
	Sent to Indexer	*OUT=255*	Sets all outputs to 1
	Received from Indexer	*Y*	

4.11.96 Toggle a Single Output

In some applications it can be necessary to toggle a single output. Toggling means that a specific output is changed from active to passive or visa versa. Use OUTx=1-OUTx.

Example	Sent to Controller	*OUT5=1-OUT5*	Toggle output 5.
	Received from Controller	*Y*	Which means that the output is now toggled. If the output was active before the command was executed, it will now be passive and visa versa.

4.11.97 Maximum Pulse Error (PE)

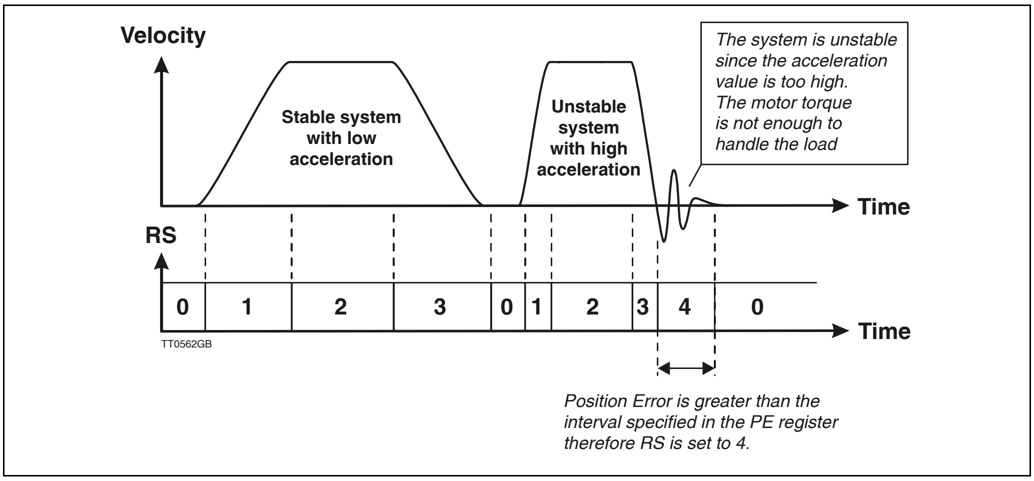
Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PE	Maximum Pulse Error	0	15	7	0.5	x	+	+	+				(pulses)

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description

To determine when the motor is in position, the RS register is normally used - see *Report Motor Status (RS)*, page 147. The state of RS is partly controlled by PE since PE specifies the interval in which the final position of the motor is accepted. RS is set according to the following conditions :

RS=0 Motor in position. The position is within the number of pulses specified by PE.
RS=1 Motor is accelerating.
RS=2 Motor is running at constant speed.
RS=3 Motor is decelerating.
RS=4 Motor in position but the position is outside the tolerance specified by PE.


Velocity
Stable system with low acceleration
Unstable system with high acceleration
The system is unstable since the acceleration value is too high. The motor torque is not enough to handle the load
Time
RS
0
1
2
3
0
1
2
3
4
0
Time
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Position Error is greater than the interval specified in the PE register therefore RS is set to 4.

As shown, RS will change depending on the actual motor status. PE only has effect when the motor theoretically is stopped at the final position. If the interval specified by PE is fulfilled, RS is 0. If not RS is set to 4.
The table below shows the conversion between PE values and the actual number of pulses.

PE Value	Pulses	PE Value	Pulses
0	2	8	60
1	3	9	90
2	5	10	135
3	8	11	202
4	12	12	303
5	18	13	454
6	27	14	682
7 (default)	40	15	1024

The *Running* LED also depends on the RS register, which means that the *Running* LED is only lit when RS is equal 0 (position within PE). Note that PES (Position Error Samples) also determines the state of RS.

Usage

PE = x Set pulse error
PE Show current Pulse Error limit

4.11.98 Pulse Error Samples (PES)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PES	Enc. pulse error sample number	0	15	1	0.5	x	+	+	+				(samples)
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description PES specifies the number of samples required to verify the interval specified by PE before RS is set to 0.

Example1 PES is set to 10 and PE is set to 7 (40 pulses).
The motor is running until it stops.
The RS register is now set to 0 after the position error has been within +/-40 encoder pulses for 10 samples. 1 sample is by default 1 msecond, but if the *STIME* (sample time) register has been changed, this value may differ.

Example2

Example2	Sent to Controller	`PES=10`	Set PES register value to 10 (10 samples).
	Received from Controller	`Y`	The controller has accepted the command.
	Sent to Controller	`PES`	Show current PES value.
	Received from Controller	`PES=10`	The current PES value is 10.

4.11.99 Pulse Input Format (PIF)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PIF	Pulse Input Format	1	8	1	0.5	+	+	x	x	x	x	x	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The PIF register determines how the incoming pulse signal at the Pulse Input (XI and YI) is decoded.
The PIF register is only relevant when the Controller is set to Mode 1 — Gear Mode.
The following Pulse Input Formats can be selected:

Set-up	Function	Typical Application
PIF = 0	Reserved for future use. Cannot be selected	
PIF = 1	Incremental encoder format The bandwidth at the signal input is 2 MHz (see PIF=5) The input can be connected to a standard incremental encoder with 2 channels which are shifted 90 degrees in phase.	Electronic gear
PIF = 2	Pulse and direction format The bandwidth at the signal input is 2 MHz (see PIF=6) A pulse signal is connected to XI to control the motor's position and velocity. A direction signal is connect to YI to determine the direction of motor operation.	Simulation of step-motor system. Control from PLC controller module
PIF = 3	Pulse / Pulse format The bandwidth at the signal input is 2 MHz (see PIF=7) A pulse signal is connected to XI to control the motor's position and velocity in the positive direction of operation. If the motor is required to operate in a negative direction, the pulse signal is connected to YI.	Simulation of step-motor system. Control from PLC controller module
PIF = 4	Reserved for future use. Cannot be selected	
PIF = 5	Incremental encoder format Same as PIF = 1, with a 200 kHz filter at the signal input. The input can be connected to a standard incremental encoder with 2 channels which are shifted 90 degrees in phase.	Electronic gear
PIF = 6	Pulse and direction format Same as PIF = 2, with a 200 kHz filter at the signal input. A pulse signal is connected to XI to control the motor's position and velocity. A direction signal is connect to YI to determine the direction of motor operation.	Simulation of step-motor system. Control from PLC controller module
PIF = 7	Pulse / Pulse format Same as PIF = 3, with a 200 kHz filter at the signal input. A pulse signal is connected to XI to control the motor's position and velocity in the positive direction of operation. If the motor is required to operate in a negative direction, the pulse signal is connected to YI.	Simulation of step-motor system. Control from PLC controller module

See also *Pulse Inputs*, page 37

Usage **PIF** = x Set Pulse Input Format = x

PIF Show current Pulse Input Format.

4.11.100 Positive Limit Signal Status (PL)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PL	Positive Limit input status	0=low	1=high	-	0.5	o	o	o	o	o	o	o	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Shows the actual level of the PL (positive limit input), high (1) or low (0). Note that the PL command does not show whether the connected contact is active or not, but whether the input is high (1) or low (0). The definition high means that a voltage is applied to the PL input. The PL command is not influenced by the PLL setting. See *Positive Limit Input Level (PLL)*, page 139.
The PL input is basically intended to be used for the positive limit switch, but the PL command can also verify the PL input in general.

For a hardware description of the PL input see *End-of-travel Limit Inputs*, page 34.

Usage **PL** Show current level at the PL input.

Examples

Sent to Controller	`PL`	Show the actual level at the PL input.
Received from Controller	`PL=1`	The actual level at the PL input is 1 which means that a voltage is applied to the input.

4.11.101 Positive Limit Input Level (PLL)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PLL	Positive Limit input active Level	0=low	1=high	1	0.5	x	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The PL and NL Inputs function as end-of-travel limits. If the motor is moving in a negative direction and NL is activated, the motor is stopped instantaneously. The PL Input is the positive end-of-travel input. The two limit switches can be independently programmed to be active high (1=Normally open sensor) or active low (0=Normally closed sensor). The PLL command is used to set this active level for the PL input (positive limit switch). For connection of the end-of-travel inputs, see *End-of-travel Limit Inputs*, page 34.

Usage **PLL**=x Set the active level for the positive limit switch sensor connected to the PL input, 0 = low(normally closed), 1 = high(normally open).
PLL Show current active level for the PL input.

Examples

Sent to Controller	`PLL=1`	Set PL active level to 1 - normally open sensor.
Received from Controller	`Y`	The Controller has accepted the command.
Sent to Controller	`PLL`	Show current PL active level.
Received from Controller	`PLL=1`	The current PL active level is 1.

4.11.102 Power Management (PM)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PM	Power management	10	(3000)	1, 2, 3k	0.5	x	+	+	+	+	+	+	Watt
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command specifies the maximum allowable power consumption. If the power consumption exceeds the value specified by PM, the Controller enters mode 0 (standby) and error register 1 will contain the message "*E22 : Power consumption too high*". The *Reset* command must then be used to initiate the Controller.

Note that the power consumption is integrated over 12 seconds. This makes it possible to increase power consumption to 200-300% or more within this period, which is useful during acceleration. Power consumption is measured additively, i.e. reverse power feeds from the motor during deceleration will be subtracted from the measured value.

The actual power consumption can be shown at any time using the CPL command. See *Current Power Level (CPL)*, page 101

Usage **PM** = 750 Set maximum power consumption to 750 watts.
PM Show actual level of the PM register.

4.11.103 Pulse Output Format (POF)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
POF	Pulse Output Format	0	2	1	0.5	x	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The POF register determines which signal is output at the pulse outputs (*AO* and *BO*). The following two formats can be selected:

Set-up	Function	Typical Application
POF = 0	Pulse outputs AO and BO are passive (no signal)	Test.
POF = 1	Pulse Input (XI and YI) signals are output at AO and BO respectively.	Monitoring.
POF = 2	Motor's encoder. Channels A and B of the motor's encoder are output in undecoded form at AO and BO.	To overall PC or PLC controller module

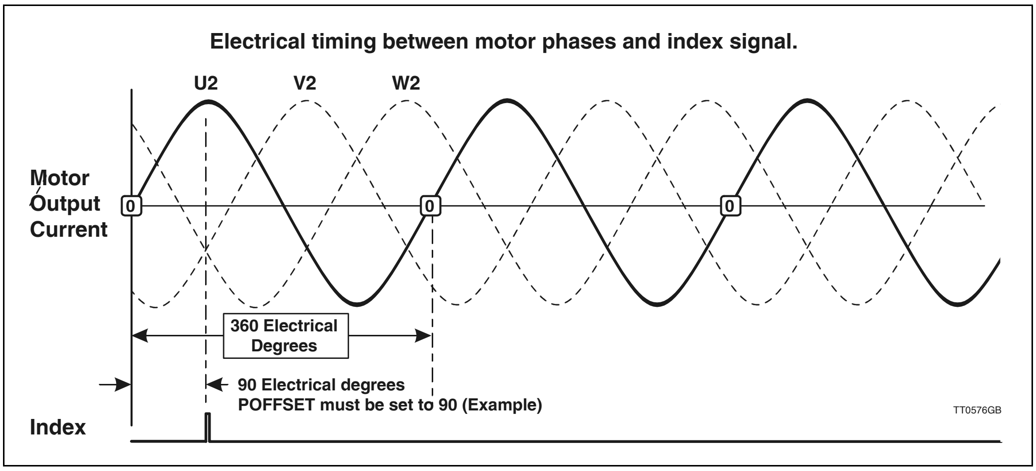
See also *Pulse Outputs*, page 40

Usage **POF** = x Set Pulse Output Format = x
POF Show current Pulse Output Format.

4.11.104 Phase Offset Angle (POFFSET)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
POFFSET	Phase offset	0	360	0	0.5	x	+	+	+	+	+	+	Elect. deg.
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The POFFSET command sets the phase offset angle between the index signal and the motor outputs used to maintain proper motor commutation.
The value specified is electrical degrees, and represents the offset from the index mark to the motor phase U passing through 0 from a negative value. This parameter can be changed on the fly if desired.
The illustration below shows the timing between the motor outputs and the index signal.


Electrical timing between motor phases and index signal.
U2
V2
W2
Motor Output Current
0
0
0
360 Electrical Degrees
90 Electrical degrees
POFFSET must be set to 90 (Example)
TT0576GB
Index

Usage **POFFSET** = x Set the phase offset angle.

POFFSET Show phase offset angle setting.

4.11.105 Number of Motor Poles (POL)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
POL	Number of motor poles	2	100	8	0.5	x	o	o	o	o	o	o	Poles
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description In order for the motor to be commutated correctly, it is vital that the POL register is set-up for the precise number of motor poles. A typical step motor with 200 steps per revolution has 100 poles (50 pole sets) and a typical AC servo motor has 2 or 4 poles.
If this parameter is set up incorrectly, the Controller will produce an error. Note however that the encoder resolution PR can also have the same effect.

Usage **POL** = x Set the number of motor poles.

POL Show current POL setting.

4.11.106 Encoder Pulses (PR)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PR	Pulses per revolution	100	50000	8192	0.5	x	+	+	+	+	+	+	Pulses

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description To achieve correct velocity and commutation of the motor, the number of encoder lines per revolution must be programmed. The value specified here must be the resolution specified for the encoder.
Note that the Controller internally multiplies this resolution by a factor of 4, so that for example an encoder/motor with a resolution of 500 lines per revolution effectively has a resolution of 2000 pulses per revolution. If the motor is to rotate 1 revolution, the positioning command must be based on the effective resolution of 2000 pulses.
PR cannot be set to a value lower than the number of motor poles times 128. If *PR* is set lower, the Controller responds with an error message: *E2: Out of range*

Usage

PR = x	Set encoder pulses per revolution.
PR	Show encoder pulses per revolution.

Example

Sent to Controller	`PR`	Show the actual PR setting.
Received from Controller	`PR=500`	The actual number of encoder lines per revolution is set to 500, which means that the total counts per revolution is 2000.

4.11.107 Print to External Module (PRINT) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PRINT	Print to external module	Address: 0 Register: 0 Value: 0	Address: 31 Register: 65535 Value: 65535 - or text	-	0.5	+	+	+	+	+	+	+	

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description The Print command is used to print out the contents of registers to external modules. At present, print-out to 4 external modules is possible: to a PC via the RS232 interface and to DIS10, KDM10 and IOM11 Modules via the JVL Bus interface.

Usage PRINTn1.n2.n3

n1 Specifies the address of the module to be printed to (1-31). Address 255 is reserved for a PC.
n2 Specifies the register or cursor position to be printed to in the external module.
n3 Specifies the register, numeric value or text string in the Controller to be printed. When n3 is a string, then the string contains two types of objects: ordinary characters, which are simply copied to the display, and conversion specifications, each of which causes conversion and printing of the next successive argument to PRINT. Each conversion specification is introduced by the character % and ended by a conversion character. If a decimal number is included in the successive argument, then the argument must be surrounded by parentheses. E.g. (CA*1.5).
The conversion characters and their meanings are:
% To print a single '%' include two '%' in the string like "%%"
c The argument is taken to be a single character
i The argument is taken to be a 16-bit integer in the range (-32768 to 32767)
l The argument is taken to be a 32-bit integer (-2.147.483.647 to +2.147.483.647)
f The argument is taken to be a 32-bit decimal number ("floating- point") number with one decimal.
.nf The argument is taken to be a 32-bit decimal number ("floating- point") number with n numbers of decimals. n must be in the range 0 to 4.

Example 1:

```
PRINT1.0.R23
```

Prints the contents of register R23 to the module whose interface address is 1. Since transmission via the JVL Bus interface is balanced, it is possible to locate external modules up to 500 metres from the Controller.

Example 2:

```
PRINT255.0."TEST"
```

Prints the text "TEST" to a PC via the RS232 interface. Address 255 is reserved as the address for PCs. Note that the Print command can be used to print out register contents at run-time. It is especially well-suited for debugging a program. If JVL's *MotoWare* program is used, once the Controller program has been transferred, the online feature can be used to display when a Print command is executed at run-time.

Print to External Module (PRINT) Cont. - Only AMC2xP

Example 3:

```
PRINT3.41."Key in Value: "
```

When a Keyboard-Display Module KDM10 is incorporated in a system, it is often desirable to display information to the user. The above example illustrates how text can be written to the module's LCD display. In the example, the address of the module is 3. The second parameter value is cursor position 41, which is the first character on line 2 of the display.

Example 4:

```
R1=5555         // ASSIGN A VALUE OF 5555 TO REGISTER R1
R30=333         // ASSIGN A VALUE OF 333 TO REGISTER R30
PRINT5.41.R1    // PRINT THE CONTENTS OF REGISTER R1 TO CURSOR
                // POSITION 41 OF A KDM10 MODULE WITH ADDRESS 5
PRINT2.0.R30    // PRINT THE CONTENTS OF REGISTER R30 TO THE
                // DISPLAY
                // OF A DIS10 MODULE WITH ADDRESS 2
```

When external modules DIS10 or KDM10 are used in a system, it is often necessary to print out the contents of register on the displays of the modules. As illustrated in the above example, this is best accomplished using the PRINT command to print the contents of a register either to a cursor position or directly to the LED display of the DIS10 module.

Example 5:

```
PRINT3.41."ACT. POSITION:%l".AP

                 // PRINT THE STRING ACT.POSITION AND THE VALUE OF
                 // ACTUAL POSITION REGISTER TO CURSOR POSITION
                 // OF A KDM10 MODULE WITH ADDRESS 3.

PRINT3.1."IN:%i%i%i%i%i%i%i%i".IN8.IN7.IN6.IN5.IN4.IN3.IN2.IN1

                 // PRINT INPUTS 8-1 (IN8-IN1)
```

The above example illustrates how a text string including conversion specifications can be written to the module's LCD display.

Example 6:

```
PRINT3.41."CP=%.1f".(CP*1.5)
```

The above example illustrates how a decimal value can be included in a text string.

4.11.108 Encoder Pulses for Master (PRM)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PRM	Encoder pulses per rev., master	50	20000	500	0.5		x						Pulses per rev.
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description If the Controller is used in Mode 1 (electronic gear) the PRM register is used to define the resolution of the master encoder connected to the pulse input (XI and YI).
As with the case of the PR command, the value specified here is the number of pulses (the resolution) of the encoder.
Note that the Controller internally multiplies this resolution by a factor of 4.
The Controller uses the PRM register to calculate the correct gear ratio between the incoming pulses at X1 and Y1 and the movement the motor is required to make.
Note that PRM is not only significant when an encoder is connected to the pulse input but also is significant if a pulse and direction signal are connected to the pulse input (format 2/ *PIF=2*) or a pulse and pulse signal (format 3 / *PIF=3*)

Usage **PRM** = x Set pulses per revolution on master encoder

PRM Show encoder pulses per revolution on master encoder

4.11.109 Start Programming Mode (PROGRAM) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
PRO-GRAM	Enter programming mode	-	-	-	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command sets the AMC2xP Controller in programming mode. Subsequent commands, statements etc. (with a few exceptions) will then be included in the user program. The EXIT or GO commands will end the programming sequence.

Usage **PROGRAM** Set the Controller in programming mode.

4.11.110 User Registers (R) - Only AMC2xP

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
R	User registers	0	499	0 (content)	0.5	x	x	x	x	x	x	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description

The Controller includes 500 user registers which can be used freely in a program. The registers can be assigned a value, be included in equations, etc. The registers can contain values in the range -2147483648 - +2147483648.

Usage

Rx=v	Set register x the value of v
Rx	Show the value of register x

Examples

R1=100+R1-2*(AC-34)+R99

R67	Show the value of register 67 on the RS232

IF R45>666 OR R1=99
R2=AC

4.11 Command Description

4.11.111 Reset Controller (RESET)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
RESET	Reset Controller	-	-	-	2000	o	o	o	o	o	o		-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description If a system overload occurs, for example if the supply voltage is too high (see the ES command), the system must be reset before motor control is possible again. The Reset command has the same effect as turning the Controller off and then on again. The Controller's set-up values can be stored (using the MS command) before the Reset command is used.
Warning ! - When using the Reset command, always maintain a minimum delay of 1 second before sending additional commands.

Usage **RESET** Reset Controller.

4.11.112 Terminate Sub-routine (RET) - Only AMC2xP

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
RET	Return from sub-routine	-	-	-	0.5							+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description RET (Return) is used to terminate a sub-routine. See Call of Sub-routine page 73.

Usage **RET**Return to main program.

4.11.113 Report Motor Status (RS)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
RS	Running status. Actual motor status	0	7	0	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description During operation, the system can report information about the status of the motor (stationary, running, etc.) using the RS command.
RS is also influenced by PE and PES see *Maximum Pulse Error (PE)*, page 136 or *Pulse Error Samples (PES)*, page 137 although this is only when using mode 2 or mode 3.

Usage **RS** Motor Status: RS=0 Stationary
RS=1 Accelerating
RS=2 Max velocity
RS=3 Decelerating
RS=4 Position theoretically reached but not within the range specified in the PE and PES registers. Wait until motor is settled.
RS=5 Fatal error has occurred.
RS=6 Zero Search in progress.
RS=7 System is halted. This state occurs if the Controller has received an H or SH command or if one of the limit inputs (NL, PL) is activated. In register mode (MO=3) an activation of the pause input (IN7) or a deactivation of the start input during a move will also cause RS=7.

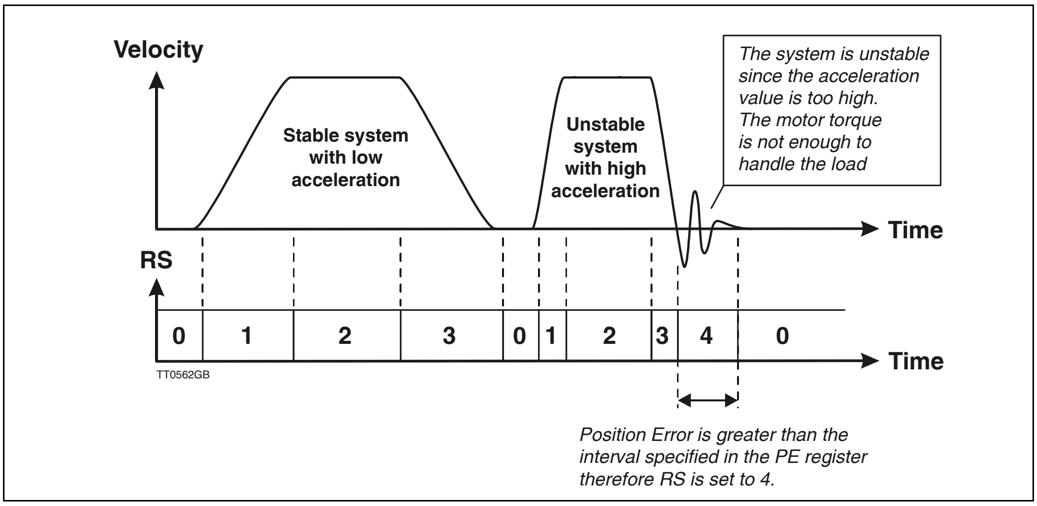
The different status values in the RS register are not used for all modes. The table below shows the relation between function mode and the RS status.

RS status	Description	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5
RS=0	Motor stationary	-	+	+	-	-
RS=1	Motor accelerating	+	+	+	+	+
RS=2	Motor max. speed	+	+	+	+	+
RS=3	Motor decelerating	+	+	+	+	+
RS=4	Not settled in position	-	+	+	-	-
RS=5	Fatal error	+	+	+	+	+
RS=6	Zero Search in progress	-	+	+	-	-
RS=7	System is halted (CB19=1)	+	+	+	+	+

+ Means that actual RS status is supported

- Means that the actual RS status is not supported and will never be shown in the actual function mode.

Example :
When using mode 2 or mode 3, a typical positioning sequence appears as below.


Velocity
Stable system with low acceleration
Unstable system with high acceleration
Time
RS
0
1
2
3
0
1
2
3
4
0
Time
TT0562GB

The system is unstable since the acceleration value is too high. The motor torque is not enough to handle the load

Position Error is greater than the interval specified in the PE register therefore RS is set to 4.

The illustration above shows the connection between the actual motor movement and the value in the RS register. Note that RS will not be set to 0 (position reached) unless the criteria in the PE and PES registers are fulfilled.

See also *CB19 - Enable passive halt mode.*, page 97.

4.11.114 Report Motor/Program Status in text (RST)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
RST	Report status in text	-	-	Empty	0.5	+	+	+	+	+	+	+	
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description During operation, the system can report information about the status of the motor (stationary, running, etc.) using the RST command. For the AMC2xP Controller this command will report program status also.
Compared to the RS command, RST returns a complete status in plain text. This can typically be done from the on-line editor in MotoWare.

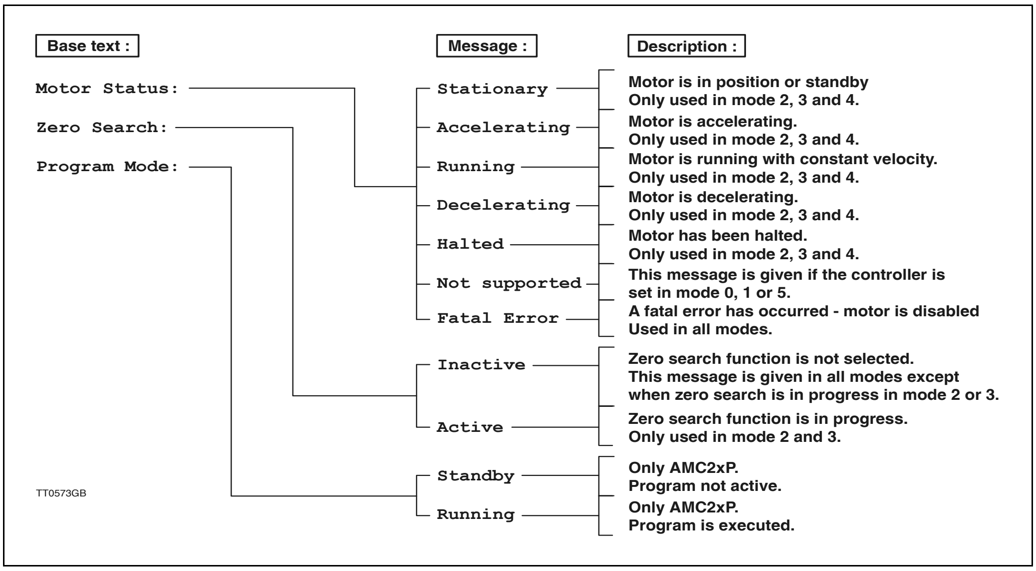
Usage **RST** will return following (example)

```
Motor Status:   Standby
Zero Search:    Inactive
```

When using the AMC2xP, the reply includes also program status (example).

```
Motor Status:   Standby
Zero Search:    Inactive
Program Mode:   Active
```

The following scheme shows the different messages that are returned, depending on the actual Controller and motor status.



Motor is in position or standby
Only used in mode 2, 3 and 4.
Motor is accelerating.
Only used in mode 2, 3 and 4.
Motor is running with constant velocity.
Only used in mode 2, 3 and 4.
Motor is decelerating.
Only used in mode 2, 3 and 4.
Motor has been halted.
Only used in mode 2, 3 and 4.
This message is given if the controller is set in mode 0, 1 or 5.
A fatal error has occurred - motor is disabled
Used in all modes.
Zero search function is not selected.
This message is given in all modes except when zero search is in progress in mode 2 or 3.
Zero search function is in progress.
Only used in mode 2 and 3.
Only AMC2xP.
Program not active.
Only AMC2xP.
Program is executed.

4.11.115 System Default (SD)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SD	Default set-up	-	-	-	0.5	x	o	o	o	o	o		
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The SD command is used to recall the Controller's factory default set-up. Note however that after recalling the factory default set-up, the Controller will almost certainly report an error since the motor parameters (*POL, PN, HALL*, etc.) most likely will not correspond to the actual motor used. The values originally keyed-in can be recalled using the *MR* (Memory Recall) command, providing these were stored in the Controller memory.

The factory defaults are listed in the individual command descriptions and in the *Alphabetical Overview of Commands*, page 176.

Usage **SD** Recall factory default set-up

Example

Sent to Controller	`SD`	Set all the registers in the Controller to default.
Received from Controller	`Y`	The Controller has accepted the command and has set all the registers to default values - Use MS to save the default setting permanently.

4.11.116 Smooth Halt of Motor (SH)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SH	Smooth Halt of motor	-	-	-	0.5		o	o	o	o	o		
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Has effect.													

Description This command is used to perform a controlled halt of the system. The motor is stopped in accordance with the pre-programmed deceleration/acceleration parameter AC.
See also *Acceleration (AC)*, page 80.
Please note that after using the SH command, the running status register RS will be set to 7 (RS=7). To release this state, use the UH command (Unhalt), see also *Unhalt (UH)*, page 158.
AMC2xP types : Using the SH command will not stop program execution.

Usage **SH** Smooth halt of motor.

Example

Sent to Controller	`SH`	Make an immediate soft halt.
Received from Controller	`Y`	The Controller has accepted the command and is about to carry out deceleration according to the AC parameter.

4.11.117 Servo ON Input Status (SON)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SON	SON - Servo ON input status	0=low	1=high	-	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description Shows the actual level of the Servo ON input, high (1) or low (0). Note that the SON command does not show whether the Servo ON function is active or not, but whether the input is high (1) or low (0). The definition high means that a voltage is applied to the SON input.The Servo ON input is basically intended to be used for energizing the motor for safety reasons, but the SON command can also verify the Servo ON input in general.

For a hardware description of the Servo ON input see *Servo On Input (SON)*, page 32.

Usage **SON** Show current level at the SON input.

Examples

Sent to Controller	`SON`	Show the actual level at the Servo ON input.
Received from Controller	`SON=1`	The actual level at the Servo ON input is 1 which means that a voltage is applied to the input.

4.11.118 Set New Position (SP)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SP	Set new absolute position	- 2147483647	2147483648	0	0.5			+				+	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description In Positioning Mode (MO=2) and Register Mode (MO=3), the motor can be set to move to a new position specified in terms of pulses. Note that the number of pulses refers to the number of encoder pulses times 4. For example, an encoder/motor with 500 pulses per revolution effectively has a resolution of 2000 pulses per revolution. If the motor is to rotate 1 revolution, the *SP* command is based on a value of 2000 pulses.

Example

Sent to Controller	`SP=-1000`	Move to absolute position -1000
Received from Controller	`Y`	

4.11.119 Relative Positioning (SR)

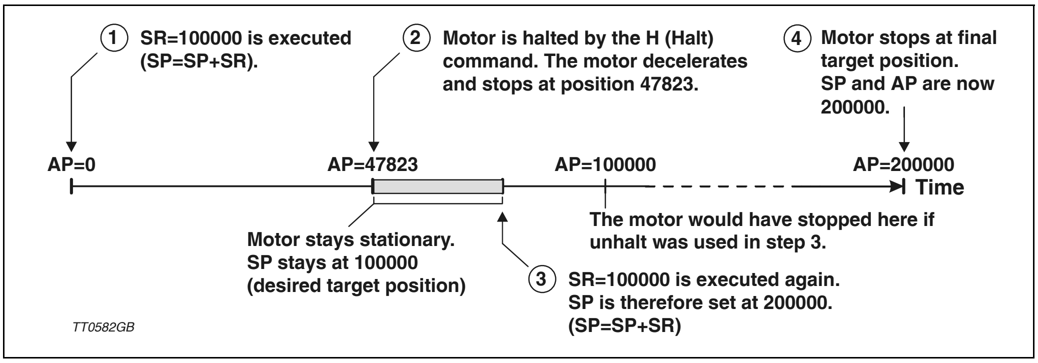
Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SP	Set new relative position	- 2147483647	2147483648	0	0.5		+	+				+	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description In Positioning Mode (MO=2) and Register Mode (MO=3) the motor can be set to move a specified number of pulses in a positive or negative direction. The SR command can also be used in Gear Mode (MO=1). In this situation the motor will move the extra length specified by SR in parallel with the normal gear operation. The velocity and acceleration is still followed also in this situation.
For movement in a negative direction, the parameter value is specified with a minus sign. Note that the number of pulses refers to the number of encoder pulses times 4.
For example, an encoder/motor with 500 pulses per revolution effectively has a resolution of 2000 pulses per revolution. If the motor is to rotate 1 revolution, the *SR* command is based on a value of 2000 pulses. Note that SR is done with reference to SP which is the theoretical position. See also *Relative Positioning with Reference to AP (SRA)*, page 153

Example

Sent to Controller	`SR=5000`	Move 5000 pulses in positive direction
Received from Controller	`Y`	

If a halt command is used or a limit switch is activated during the relative positioning sequence, the final position (SP) will still be the calculated value specified by SP=SP+SR. The UH (unhalt) command can be used to release the halt state. In this case, the SP target position calculated when the SR command was issued will be used. See illustration.


1 SR=100000 is executed (SP=SP+SR).
2 Motor is halted by the H (Halt) command. The motor decelerates and stops at position 47823.
4 Motor stops at final target position. SP and AP are now 200000.
AP=0
AP=47823
AP=100000
AP=200000
Time
Motor stays stationary. SP stays at 100000 (desired target position)
The motor would have stopped here if unhalt was used in step 3.
3 SR=100000 is executed again. SP is therefore set at 200000. (SP=SP+SR)
TT0582GB

4.11.120 Relative Positioning (SR+ or SR-)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SR+/-	Continuous move positive or negative	-	-	-	0.5			+				+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

In mode 2, the motor can be set to move continuously in a specified direction. The SR command is followed by a + or - parameter which specifies the direction of movement. To stop the motor once the *SR* command has been issued, a *SH* (Smooth Stop) or *H* (Halt) command must be used.

Example			
	Sent to Controller	`SR+`	Move in positive direction
	Received from Controller	`Y`	Which means that the command is accepted and will be executed.

4.11.121 Relative Positioning with Reference to AP (SRA)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SRA	Relative move with AP as ref.	- 2147483647	2147483648	0	0.5			+				+	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

The SRA command has the same function as the SR command but the motor movement is done with reference to the motor's actual position (AP) before execution of the command. In contrast, the SR command performs the move with reference to the theoretical position (SP).
In Positioning Mode (MO=2), the motor can be set to move a specified number of pulses in a positive or negative direction. For movement in a negative direction, the parameter value is specified with a minus sign.
Note that the number of pulses refers to the number of encoder pulses times 4.
For example, an encoder/motor with 500 pulses per revolution effectively has a resolution of 2000 pulses per revolution. If the motor is to rotate 1 revolution, the *SR* command is based on a value of 2000 pulses.

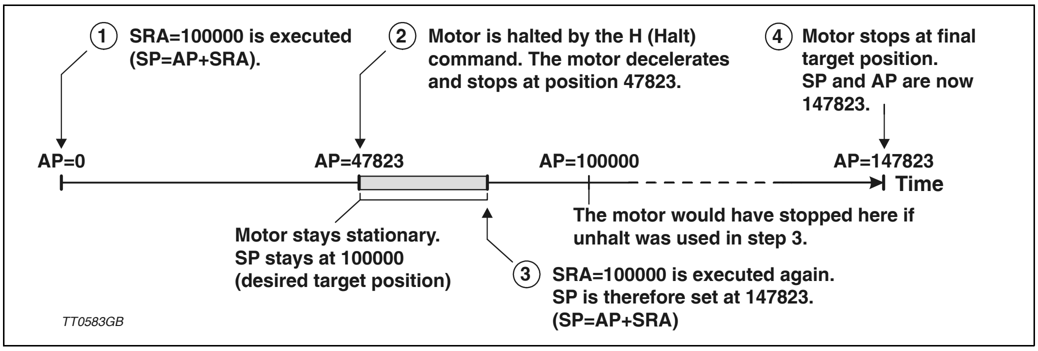
Example The actual position counter AP is 1000.

Sent to Controller	`SRA=100`	Move 100 pulses in positive direction
Received from Controller	`Y`	Which means that the command is accepted and will be executed.

After the SRA=100 command is sent and the motor has moved, the actual position will be 1100.
See also *Relative Positioning (SR)*, page 152.

Example

If a halt command is used or a limit switch is activated during the relative positioning sequence, the final position (SP) will still be the calculated value specified by SP=AP+SRA. The UH (unhalt) command can be used to release the halt state. In this case, the SP target position calculated when the SRA command was issued will be used. See illustration.


1 SRA=100000 is executed (SP=AP+SRA).
2 Motor is halted by the H (Halt) command. The motor decelerates and stops at position 47823.
4 Motor stops at final target position. SP and AP are now 147823.
AP=0
AP=47823
AP=100000
AP=147823
Time
The motor would have stopped here if unhalt was used in step 3.
Motor stays stationary. SP stays at 100000 (desired target position)
3 SRA=100000 is executed again. SP is therefore set at 147823. (SP=AP+SRA)
TT0583GB

See also the commands:
Halt of Motor (H), page 113.
Smooth Halt of Motor (SH), page 150.
Unhalt (UH), page 158

4.11.122 Sample Time (STIME)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
STIME	Show/set update time pos./velocity loop	0.2	30.0	1	0.5	x	o	o	o	o	o	o	mSec.
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The sample time for the outer servo filter can be adjusted using this command.
The outer servo filter covers the position loop and the speed loop. The current loop filter that controls the current to the motor cannot be adjusted and is fixed to 50 µS (20kHz).
The resolution for the sample rate is 0.05 msecond.
If high inertias are applied to the motor, the sample rate must be increased.
A more detailed description is given in *Adjustment of Servo Regulation*, page 18

Usage **STIME** = x Set servo filter sample time.
STIME Show servo filter sample time.

Example

Sent to Controller	`STIME=5.0`	Set sample time to 5.0 msecond (200Hz).
Received from Controller	`Y`	The Controller has accepted the command - sample time is now changed.

Sent to Controller	`STIME`	Show the actual sample time setting.
Received from Controller	`STIME=5.0`	The actual sample time is set at 5.0 second.

4.11.123 Search Zero Point (SZ)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
SZ	Search zero-point	-	-	-	0.5			+				+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command is used to reset the motor position to a known zero point.
See also *Home (Reset) Input*, page 35 or *Mechanical Reset*, page 75

Usage **SZ** Begin zero point search.

Example

Sent to Controller	`SZ`	Begin zero search.
Received from Controller	`Y`	The Controller has accepted the command.

4.11.124 Show Temperature (TPx)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
TP1	Report temperature in driver stage	0	100	-	0.5	+	+	+	+	+	+	+	’C
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The TP1 and TP2 commands can be used to monitor the actual temperature in the Controller.
TP1 shows the temperature in the power section (normally the highest temperature).
The TP1 sensor is also used for the temperature (thermal overload) protection.
TP2 shows the temperature in the processor section.

Usage **TP1** Shows the temperature in degrees Celsius.

4.11.125 Maximum Torque (TQ)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
TQ	Set maximum allowable torque	0	100	100	0.5	x	+	+	+	+	+	+	%
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description This command is used to specify the maximum torque at the motor output shaft.

Usage TQ=xxx Set maximum torque.
TQ Show actual TQ setting.

4.11.126 Actual Torque (TQOUT)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
TQOUT	Show Actual torque level	0	300	-	0.5	x	+	+	+	+	+	+	%
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The TQOUT command is used to check the actual torque. 100% means peak torque, which is the absolute maximum torque the motor can produce with the setup value in the peak current register CP - see *Peak Current (CP)*, page 101.
The torque register TQOUT can be used to verify the actual torque produced from the motor see also *Maximum Torque (TQ)*, page 156.

Usage **TQOUT** Show the actual torque in %.

Example1

Sent to the Controller	`TQOUT`	Show the actual motor torque.
Received from Controller	`TQOUT=17`	The actual motor torque level is returned, which is 17% of full scale.

Example2 The maximum torque TQ is set at 50% which means that full-scale is only 50% of the maximum that the motor can really produce. During the following operation, the actual torque is verified:

Sent to the Controller	`TQOUT`	Show the actual motor torque.
Received from Controller	`TQOUT=50`	The actual motor torque level is returned, which is 100% of full scale.

4.11.127 Unhalt (UH)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
UH	Unhalt - release halt state	-	-	-	0.5	x	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The UH command resets a halt state. It is intended to be used after a Halt command. If the motor is running and a Halt (H) command is sent to the Controller, the motor will be stopped but will still be energized.
The UH command will, in this situation, release the halt state and allow the motor to continue.
The Halt and Unhalt commands can be used in all modes. In mode 2, the positioning commands SR, SRA, SR+/-, SP, and SZ (zero-search) will automatically release the halt state before any movement is made.
In mode 3, a start signal at IN8 will also automatically release the halt state.
For all other modes the halt can only be released by the UH command.
See also *Halt of Motor (H)*, page 113.

Usage UH Release the halt state (if any).

Example Sent to Controller `UH` Release the halt state.
Received from Controller `Y` The Controller has accepted the command.

4.11.128 Firmware Version (VE)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
VE	Show firmware version and date	-	-	-	0.5	+	+	+	+	+	+	+	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The VE command provides information about the Controller firmware and hardware version and date.

Usage **VE** Show version and date of all internal firmware and hardware.

Example Sent to Controller `VE` Show the actual firmware version
Received from Controller

```
VE=3.06/MCV=6.4/PCV=1.6/HV=1.51/JBV=1.5
Mar 06 2003
```

VE=3.06	The main processor firmware version
MCV=6.4	The motor processor (DSP) firmware version.
PCV=1.6	The power processor firmware version
HV=1.51	The processorboard hardware version
JBV=1.5	The JVL bus controller firmware version

MAR 06 2003 is the release date for the main software.

Please notice that the main processor + motor processor firmware can be updated by using a special firmware updating program. Please contact JVL in this matter.

4.11.129 Maximum Velocity (VM)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
VM	Set Maximum velocity	0	32767	100	0.5	x	+	+	+	+	+	+	RPM
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The VM command is used to set the maximum/nominal velocity.

In gear mode (MO=1), VM is used to limit the maximum speed. I.e. if the external master encoder causes the motor to have a rotation speed higher than VM, then the motor velocity is limited to VM.

In Positioning Mode (MO=2), VM is used to set the velocity to which the motor will accelerate and maintain until it is decelerated.

In Register Mode (MO=3), VM is used if a given XV register is set to 0.

In Velocity Mode (MO=4), VM sets the limit for the velocity corresponding to maximum input at the analog input. If for example VM is set to 1000 and the analogue input is adjusted to an input voltage in the range -10V to +10V, the motor will rotate at 500 RPM in a negative direction for an applied voltage of -5V.

In Torque Mode (MO=5), VM is used to set a limit for the motor. Regulation of the velocity in this mode is not precise and is used only as an additional precautionary measure.

The maximum VM is given by the formula :

MaxVM = (2^15-1) / (STIME*VFACTOR*PRP*2133.3*10^-9)

Where PRP = pulses per electrical period - PRP = PR*8/POL

Note that the Controller will give the error message E2: Out of range if the value is set too high. VM will then be set to the nearest possible value that matches the original value.

Usage **VM** = x Set maximum velocity in RPM.
VM Show current max. velocity

Example Sent to Controller `VM=1000` Set maximum velocity to 1000 RPM.
Received from Controller `Y` The Controller has accepted the command.

4.11.130 Bus Voltage (VOL)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
VOL	Show supply voltage	100	1000	Sup. dep.	0.5	+	+	+	+	+	+	+	Volt DC

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description The VOL command is used to check the internal DC bus voltage in the Controller. Note that 3 different warning/error messages are given if the bus voltage exceeds 700VDC. Normally the bus voltage is not higher than 570VDC.
The following messages will be given if the voltage exceeds 700VDC.
W36 : Bus Voltage exceeds 700 V - Activating powerdump !.
E37 : Bus Voltage exceeds 800 V - Controller can be damaged !.
E38 : Bus Voltage exceeds 850 V.

Usage **VOL** Show voltage in DC Volts

4.11.131 Wait for condition (WAIT) - Only AMC2xP

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
WAIT	Wait for condition	-	-	-	0.5							+	-

x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.

Description Using this command is it possible to wait at a specific program line until a condition is fulfilled. It is possible to use all user registers, predefined registers and control bits.
The WAIT command functions in the way that the condition is checked first time and thereafter the program line is executed again and again until the condition is fulfilled. 0.5ms may therefore elapse before the next line is executed.

Usage **WAIT** "*condition*"

Example It is intended to make a program with following behavoure. The program execution must be halted until input 1 is activated. Then the motor must run 100000 pulses with the velocity of 1000 RPM. When the position has passed the first 8000 pulses, the motor should accelerate up to 2000 RPM. After the motor has reached the final position (100000), it must return to zero position.

```
          VM=1000        ; Set velocity equal 1000 RPM
          AP=0           ; Zero the actual position counter
:START    WAIT IN1=1     ; Wait until input 1 is activated
          SP=100000      ; Run motor to position 100000
          WAIT AP>=8000  ; Wait here until position 8000 is
                         ; passed - then change velocity to
                         ; 2000 RPM
          VM=2000        ; Accelerate to velocity 2000 RPM
          WAIT RS=0      ; Wait here until motor is stopped
          SP=0           ; Return motor to zero position.
          WAIT RS=0      ; Wait here until motor is stopped
          J:START        ; Jump to label START
```

4.11.132 Show all Parameter Set Values (X)

Com- mand	Description	Limits Min.	 Max.	Default	Exec. Time (msec)	Mode 0	 1	 2	 3	 4	 5	 P	Unit
X	Show parameter sets	none or 0	63	-	0.5	x	x	x	+	x	x	x	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The X command can be used to obtain a quick overview of all the values in the 64 parameter sets.

Usage **X** Show all parameter sets
The Controller responds as follows:

```
X1:  A=0,   V=0,   P=100, R=0
X2:  A=0,   V=0,   P=20,  R=1
......
......
X63: A=0,   V=0,   P=0,   R=0
```

Note that these values are default values and can vary if the set-up has changed.

4.11.133 Acceleration in Parameter Sets (XA)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
XA	Acceleration in parameter sets	100	1000000 #	2000	0.5	x	x	x	+	x	x	x	RPM/s
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description A required acceleration can be set for each parameter set. If the acceleration is set to 0, the acceleration will not be changed by selecting the parameter set in question, i.e. the previous acceleration value will be used.

Usage **XAn**=x Set acceleration in parameter set n to x RPM/Second.

XAn Show acceleration in parameter set n

XA Show all acceleration values

4.11.134 Position in Parameter Sets (XP)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
XP	Position in parameter sets	- 2147483647	2147483648	0	0.5	x	x	x	+	x	x	x	Pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description A required position can be set for each parameter set. If the position is set to null, no change in position will occur but the acceleration and velocity will be changed.

Usage **XPn**=x Set Position parameter to x pulses for parameter set n

XPn Show position

XP Show position values for all parameter sets.

4.11.135 Relative Positioning in Parameter Sets (XR)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
XR	Relative positioning	0=no	1=yes	0	0.5	x	x	x	+	x	x	x	pulses
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The relative positioning parameter set (XR) contains information about whether the required position is relative or absolute.

Usage **XRn** = x x specifies whether the position is absolute (0) or relative (1)

XRn Show relative positioning set-up in parameter set n

XR Show all relative positioning values

4.11.136 Velocity in Parameter Sets (XV)

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
XV	Velocity in parameter sets	1	10000 #	0	0.5	x	x	x	+	x	x	x	RPM
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description A required velocity can be set for each parameter set. If the velocity is set to null, the velocity will not be changed when the parameter set is selected, i.e. the previous velocity setting will be re-used.

Usage **XVn** = x Set maximum velocity in parameter set n to x RPM.
XVn Show velocity value in parameter set n
XV Show all velocity values for all parameter sets.

4.11.137 Zero Search Acceleration (ZA)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ZA	Zero search Acceleration	100	1000000 #	0	0.5	x	x	+	+	x	x	x	RPM/s
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The zero search acceleration is defined by the ZA register. ZA is used during zero search in any situation where the motor changes speed.
See also *Mechanical Reset*, page 75 for a detailed description of the complete zero search function including related parameters.

Usage

ZA=n	Set zero search acceleration n RPM/second.
ZA	Show actual zero search acceleration.

Examples

Sent to Controller	`ZA=1000`	Set zero search acceleration to 1000 RPM/second.
Received from Controller	`Y`	The Controller has accepted the command.
Sent to Controller	`ZA`	Show current zero search acceleration.
Received from Controller	`ZA=1000`	The current zero search acceleration is 1000 RPM/second.

4.11.138 Zero Search Direction (ZD)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ZD	Zero search Direction	-1 (negative)	1 (positive)	-1	0.5	x	x	+	+	x	x	x	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The zero search direction is defined by the ZD register. The zero search direction is negative if ZD is set to -1. The direction is positive if ZD is set to 1.
See also *Mechanical Reset*, page 75 for a detailed description of the complete zero search function including related parameters.

Usage

ZD=n	Set zero search direction to direction n.
ZD	Show actual zero search direction.

Examples

Sent to Controller	`ZD=-1`	Set zero search direction to negative.
Received from Controller	`Y`	The Controller has accepted the command.
Sent to Controller	`ZD`	Show current zero search direction.
Received from Controller	`ZD=-1`	The current zero search direction is negative.

4.11.139 Zero Search Mode (ZM)

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ZM	Zero search mode	0	1	0	0.5	x	x	+	+	x	x	x	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The zero search can be executed in different modes.
Short mode description :
ZM = 0 Default. Zero searching is in progress until the HM (Home) input is activated.
ZM = 1 Zero searching is in progress until the motor index signal is level shifted.

Please refer to *Mechanical Reset*, page 75 for details of the zero search modes. Related commands are also described in this chapter.

Usage
ZM = n Set zero search mode to n
ZM Show current zero search mode.

Examples

Sent to Controller	`ZM=0`	Set zero search function to mode 0 (Search HM).
Received from Controller	`Y`	The Controller has accepted the command.
Sent to Controller	`ZM`	Show current zero search mode.
Received from Controller	`ZM=0`	The current zero search mode is 0.

4.11.140 Zero Search After Reset (ZR)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ZR	Zero search after Reset	0	1	0	0.5	x	x	+	+	x	x	x	-
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Selection 0=No automatic zero search after reset.
1=Automatic zero search after reset.

Description *ZR* determines whether a zero-point search should be carried out when the Controller is turned on or has received a *RESET* command.
For a complete description of the zero search function and related commands, see *Mechanical Reset*, page 75.

Usage	**ZR** = n	Enable or disable the automatic zero search.
	ZR	Show the actual setting of ZR.

Example	Sent to Controller	`ZR=1`	Enable automatic zero search after reset or power up.
	Received from Controller	`Y`	The Controller has accepted the command.
	Sent to Controller	`ZR`	Show current state of ZR.
	Received from Controller	`ZR=1`	The automatic zero search is enabled.

4.11.141 Zero Search Velocity (ZV)

Com-mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit
		Min.	Max.			0	1	2	3	4	5	P	
ZV	Zero search Velocity	1	10000 #	10	0.5	x	x	+	+	x	x	x	RPM
x = Can be set/verified but no effect / + = Has effect, can be set/verified / o = Can be verified but not changed, has effect.													

Description The velocity for Zero search can be set using the ZV register. If the ZV velocity is set to null, the general velocity register VM will be used.

Usage	**ZV** = n	Set zero search velocity to n RPM.
	ZV	Show actual zero search velocity.

Example	Sent to Controller	`ZV=50`	Set zero search velocity to 50 RPM.
	Received from Controller	`Y`	The Controller has accepted the command.
	Sent to Controller	`ZV`	Show current zero search velocity.
	Received from Controller	`ZV=50`	The zero search velocity is 50 RPM.

4.12 Error Messages

When an error occurs in communication with the Controller or when an internal error occurs, the Controller transmits an error message. The error message consists of an 'E', followed by an error number, followed by a colon ':', followed by a descriptive English text. The following illustrates an example of an error message:

Example: `E2: Out of range`

The error messages can be read by typing "EST (enter)" in the on-line editor in MotoWare. When a old message is read once, it will be deleted from the error register and not shown again.

4.12.1 Description of Error Messages

E0: No errors

No errors have occurred since the last request.

E1: Error

The command string cannot be understood.
Example:
    asdfælkj (enter)
    Results in error E1.
Correction:
    Carefully check the command sent to Controller and compare with the description of the command given in this manual.

E2: Out of range

The parameter value specified with the command is out of the allowable range.
Example:
    CP=100
    The above command attempts to set the peak current to 100 Amps, which is outside the allowable range. The Controller therefore reports an E2 error.
Correction:
    Specify a parameter value within the allowable range for the actual command.

E3: Number of parameters is wrong

The number of parameters specified with the command is incorrect.
Example:
    VM100 or *ES0=9*
    Both of the above command examples will produce an E3 error.
Correction:
    The VM command has only 1 register associated with it and can therefore only be called by specifying VM. Correction : send the command VM=100.
    The ESO command is only used to show information and therefore specifying a parameter has no meaning.

E4: Instruction does not exist

The command does not exist.
Example:
    ABCDEF
Correction:
    Use a valid Controller command. See the description of the command for details of the required command syntax.

4.12 Error Messages

E5: It is not an instruction

The Controller has not received a proper command.

Example:

4R

If the Controller is not using addressing, this example will result in error E5.

Correction:

Use a proper command.

E6: Parameter error or out of range

There is an error in the specified parameter or the parameter value is out of the allowable range.

Example:

SP=111111111111 or *VM=8G7*

Correction:

The Controller cannot handle values as great as *111111111111* in the first example.
Use a value within the allowable range.
In the second example: parameter values must not contain alphabetic characters.

E7: Register number error or out of range

Error in register number.

Example:

XP7777 or *XP4F*

Correction:

In the first example: use a register number in the allowable range.
In the second example: register number must not contain alphabetic characters.

E8: Data can not be stored in FLASHPROM

The set-up cannot be stored in the FLASHPROM. A hardware error has occurred that prevents the CPU from communicating with FLASHPROM.

Correction:

Try to restart the Controller by shutting off the power.
Try to set Controller to default by typing SD followed by MS. Restart Controller.

E9: Checksum error

The Controller's (receiver's) calculated checksum is not the same as the transmitted checksum.

Example:

255KP=25F3

Correction:

Send the command as 255KP=25DB.

W10: Parameter will be rounded

The Controller has received a parameter value which must be an integer.

Example:

VM=1000.8

Correction:

Send the command specifying an integer value VM=1000 or VM=1001.

Example:

The calculation *R1=5 / 2* will cause the W10 warning to appear since R1 will be rounded to 2.

4.12 Error Messages

E11: No Program available

There is no program in the program (RAM) memory.

Example:

After executing a GO command, the E11: No Program available will appear if there is no program in the program memory.

Correction:

Use MR to retrieve the program from FLASHPROM or enter a new program.

E12: Zero Search Function Active

The zero search function is already active. The motor is moving while the Controller is waiting for a signal at the HM input or other signal (depending on ZM - zero search mode register)

Example:

An SZ command (start zero search) is sent but the zero search is already in progress.

Correction:

Avoid starting a zero search when a zero search is already in progress.

E13: Command not valid in this mode

The Controller is setup in a mode (Mode register) where the use of the chosen command or register is not possible.

Example:

The SP command (set position) is used in mode 5 (torque mode). This is not possible because mode 5 is only intended for torque control and not position control.

Correction:

Set the Controller in position mode (MO=2) and send the SP command.

E14: Not allowed due to previous fatal error

The Controller is in a fatal error state, which typically means that the motor is not able to make any movements. This state is typically provoked by too high an average current or a following error, but other circumstances can also be the reason. Verify the other messages in the error register to determine the exact cause of the fatal error state.

Example:

The average current during normal operation has been too high and the Controller is set in mode 0. If a positioning command is used, such as SP=xxx, the Controller will return the E14: Not allowed due to previous fatal error.

Correction:

Only a RESET or power down of the Controller will cancel the fatal error and thereby allow the actual command to be executed.

E15: Error initialising motor

The Controller has tried to initialise the motor but for some reason this was not possible. The problem can be one of following.

1. The INITTYPE is set to 0 (fixed field initialisation) but during initialization the motor was unstable. The commutation angle could not be found.
2. The INITTYPE is set to 1 (mixed field initialisation). This is a future option not supported. The initialization is therefore cancelled.
3. The INITTYPE is set to 2 (hall initialisation) but the HALL register is not adjusted for the right Hall sensor.

Correction:

Check the motor and feedback (encoder/hall) connections and consult the *Initialisation Type (INITTYPE)*, page 122 or *Hall-element Type (HALL)*, page 114 to ensure the correct setting.

E32: Check Other Status Register

An error has been detected in one of the other status registers. Read register ES0, ES1, ES2 or ES3. This error message can appear while reading one of these registers.

E33: Current Overload - Motor short-circuited

The Controller has been overloaded/short-circuited.

Correction:

Use another motor or insert an inductance of approximately 1mH in series with the motor leads. The inductances must be placed in the FA, FB, FC leads.

This error can also appear if the current loop has been faultily tuned. Try a new auto-tuning. Remember to tune using a realistic mains voltage.

E34 : Power consumption too high

The Controller/motor has been drawing too much power from the supply.

This limit is set by the PM command.

Correction:

Decrease the motor speed / load or increase the value of the PM register.

See also *Power Management (PM)*, page 140

E35 : Average Current limit exceeded

The maximum allowable average current has been exceeded.

Example:

The velocity or load is very high or the CA (average current) register is not set correct for the actual motor.

Correction:

Reduce velocity or load until the error disappears. Check that CA is set correctly.

W36 : Bus Voltage exceeds 700 V - Activating powerdump !

The power Bus voltage has exceeded 700V. This is only a warning. Under normal operation this can happen if the motor decelerates with a high inertia causing a lot of energy to flow back from the motor to the Controller and thereby increasing the bus voltage.

Example:

The power supply voltage is too high or the motor has been decelerated quickly with a high inertial load.

Correction:

If the supply voltage is too high, it should be reduced.

During deceleration the motor can send current back to the Controller, causing the bus voltage to increase. The deceleration (AC) can be reduced until the error disappears. If required, a “Power Dump” shunt resistor should be inserted as described in *Power Dump Output*, page 42. If deceleration must be rapid, this warning is ok.

E37 : Bus Voltage exceeds 800 V - Controller can be damaged !

The power Bus voltage has exceeded 800V. This is an error that indicates that the power dump circuitry is not able to consume the extra amount of energy that flows back from the motor to the Controller, thereby increasing the bus voltage. This energy is typically caused by high inertial load on the motor which makes the internal supply increase if the deceleration of the motor is rapid. This error is number 2 of 3. See also *W36 : Bus Voltage exceeds 700 V - Activating powerdump !* or *E38 : Bus Voltage exceeds 850 V.* Note that if the voltage reaches 850V, the Controller will shut down the driver circuit and therefore make the motor currentless.

Correction:

Decrease the deceleration (AC) until the error disappears. If required, a “Power Dump” shunt resistor should be inserted as described in *Power Dump Output*, page 42.

E38 : Bus Voltage exceeds 850 V

The Bus voltage has exceeded 850V.

Important ! : This error message can be fatal since too high a voltage can damage the power circuitry inside the Controller.

Example:

The power supply voltage is too high or the motor is being decelerated too quickly.

Correction:

If the power supply voltage is too high, it must be reduced.

During deceleration the motor can send current back to the Controller, causing an increase in the bus voltage. The deceleration (AC) must be reduced until the error disappears. The problem can also be alleviated by using a “Power Dump” shunt resistor. See *Power Dump Output*, page 42.

E39 : The motor is not mounted correctly

The motor is not connected correctly.

Example:

The motor is moving in the wrong direction.

Correction:

Read the section dealing with motor connections see *Motor Connection*, page 27.

E40 : The motor is not connected

The motor is not connected.

Example:

The motor does not move.

Correction:

Check the motor connections.

E41 : HALL element is not connected properly

The Hall element’s signals are not connected or are faulty.

Correction:

Check the Hall element connections and check that the Hall register and HL are adjusted correctly. If operation without the use of a Hall element is required, the Hall register is set to 0 (normal). See *Hall-element Type (HALL)*, page 114

W42 : Temperature exceeded 75°C.

This is only a warning. The temperature inside the Controller has exceeded 75°C. The Controller will continue to function normally, but if the temperature exceeds 85°C, the Controller’s thermal overload protection will prevent damage by setting the power section to standby, which means that the motor will be current less. The *T>75°C* LED on the front of the Controller will be lit.

Correction:

- Reduce the ambient temperature or reduce load at the motor.
- Consider to decrease the PWM frequency to 5KHz - see *CB2 - Set low PWM output frequency*, page 92.
- If the *W36 : Bus Voltage exceeds 700 V - Activating powerdump !* is often shown it indicates that the internal power dump resistor is often used. Consider to mount an external power dump in order to decrease the internal heat in the controller.

E43 : Temperature exceeded 85°C

The temperature inside the Controller has exceeded 85°C. The Controller will prevent internal damage by setting the power section to standby, which means that the motor will be current less.

Correction:

- Reduce the ambient temperature or reduce load at the motor.
- Consider to decrease the PWM frequency to 5KHz - see *CB2 - Set low PWM output frequency*, page 92.
- If the *W36 : Bus Voltage exceeds 700 V - Activating powerdump !* is often shown it indicates that the internal power dump resistor is often used. Consider to mount an external power dump in order to decrease the internal heat in the controller.

E44 : Bus current exceeds plus 10A

The current at the internal DC bus has exceed +10A RMS which means that the energy flowing is too high. This can be caused by too high an inertial load on the motor or too high deceleration.

Correction:

The deceleration (AC) can be reduced until the error disappears.
The load inertia at the motor must be decreased.

E45 : Bus current exceeds minus 10A

The current at the internal DC bus has exceed -10A RMS which means that the energy flowing is too high. This can be caused by too high an inertial on the motor or too high acceleration.

Correction:

The acceleration (AC) can be reduced until the error disappears.
The load inertia at the motor must be decreased.

E46 : Overload on output ports

The user outputs (O1-O8) have been overloaded. The overload can be caused by an overload on one or more of the outputs. An overload occurs if an output is short circuited or too high a current is drawn (>700mA).

Correction:

Check that no short-circuit exists between an output and ground (O-).
Check that the current at each of the 8 outputs (O1-O8) does not exceed 700mA at any time, also during an activation if the load is capacitive.

E47: Bus voltage too low

The voltage at the internal DC-bus is too low.

This may be caused by too low a voltage at the supply terminals U1, V1, or W1, or if the Controller is supplied by a single-phase supply, the total power consumption of the motor is so high that the internal DC-voltage sometimes drops below 100VDC.

Correction:

- Check that the mains supply fulfils the voltage requirements listed in *Technical Data*, page 182.
- If only a single-phase supply is used as the mains supply, consider using a 3-phase supply. However, ensure that the actual motor is rated for the higher voltage which will be present when using 3 supply phases instead of a single phase.
- See: *Power Supply*, page 25 for details.

E48: Error initializing motor

The controller have not been able to determine the position of the motor (rotor) after power up or an initialization. A typical error source is the Hall signals. If an invalid code on this signals appears the E48 message will be shown.
The error message only appears when an active mode is selected (Mode 1 to 5).
Correction:

Check the Hall/Encoder cables or verify that the Hall setup is done correct. See also *Setting the Hall Element*, page 196

E49: Serial Encoder failed

This message only apears if a serial encoder is used. The message indicates that the serial communication with the encoder could not be established.
Correction:

Check the encoder cable and make sure that the right encoder type is chosen. See also *Encoder Type (ET)*, page 110.

E50: Currentfilter overflow

The current filter has not been able to control the motor current within the range that that the controller can handle. The maximum peak current has been exceeded.
Correction:

Lower the acceleration or deceleration.
Try to reoptimize the current filter with a higher bandwidth. See also *Current filter optimizing*, page 16

E51 - 63: Reserved for future use

E65 : Motor controller Communication error

Internal error. The main processor is not able to communicate with the motor processor (DSP) that takes care of the motor and servo filter.
Correction:

Turn off power immediately and consult JVL.

E66 : Power processor Timeout

Internal error. The main processor is not able to communicate with the power processor that takes care of the driver section including power supply.
Correction:

Turn off power immediately and consult JVL.

E67 : Unknown error from Power processor

Internal error. The main processor is not able to communicate with the power processor that takes care of the driver section including power supply.
Correction:

Turn off power immediately and consult JVL.

E68 : Average current cannot be measured correctly

The average current value in the motor phases cannot be measured correctly.
Correction:

Turn the Controller off and then on again. If the error condition persists, a hardware error has occurred.
It is important to note that the motor must not be moving when the Controller is switched on.

E69 : FLASHPROM Checksum error

The checksum of the main memory (FLASHPROM) is faulty. Some of the memory addresses may be faulty and it is not recommended to use the Controller in normal operation mode.

Correction:

Turn the Controller off and then on again. If the error condition persists, a hardware error has occurred. Consult JVL.

E70: RS232/RS485 Output buffer error

The output buffer for the serial interface is out of synchronisation.

Correction:

Consult JVL.

E71 : RS232/RS485 Input buffer error

The input buffer for the serial interface is out of synchronisation.

Correction:

Reduce speed / amount of incoming data. Please respect the software handshake protocol. After sending an instruction to the Controller, a *Y* must be returned before sending additional data.

E72 : DSP Busy timeout

Internal error. The main processor is not able to communicate properly with the motor processor (DSP) that takes care of the motor and servo filter.

Correction:

Turn off power immediately and consult JVL.

E73 : DSP Busy executing answer timeout

Internal error. The main processor is not able to communicate with the motor processor (DSP) that takes care of the motor and servo filter.

Correction:

Turn off power immediately and consult JVL.

E74 - 94: Reserved for future use

E97 : Negative Limit Switch active

The negative end-of-travel limit (NL input) is active. Motor movement in the negative direction is stopped. Only positive movement is now possible.

E98 : Positive Limit Switch active

The positive end-of-travel limit (PL input) is active. Motor movement in the positive direction is stopped. Only negative movement is now possible.

E99 : Negative Limit Switch has been active

The negative end-of-travel limit (NL input) has been active but is released again.

E100 : Positive Limit Switch has been active

The positive end-of-travel limit (PL input) has been active but is released again.

4.12 Error Messages

E101 : Position counter overflow

The position counter has exceeded its maximum range from -1073741824 to +1073741823.

Correction:

Avoid repeated use of the *SR* command or perform frequent system resets. Possibly use *SP* (absolute positioning instead of *SR*)

E102 : Encoder error or position error limit exceeded

The encoder is not connected or the motor is jammed.

Example:

The motor is blocked by a brake when the Controller is switched on. The encoder can therefore not be checked. The encoder may also be connected incorrectly or not connected at all.

Correction:

Ensure that the motor is free to move when the Controller is switched on. Also check the encoder connections. Note that this is irrelevant if using Hall sensor.

E103 : Servo On Signal is not active

All motor operations are cancelled since the SON input is not active. The SON input is a protective input to which a voltage must be applied under normal operation.

Correction:

Connect a voltage at the SON input.

Alternative CB9 can be set to 1. This will disable the SON input. See also *CB9 - Ignore Servo On Signal*, page 94

E104 : Encoder power supply error, possibly short-circuited.

The 5VO supply output for the encoder is normally guaranteed to be in the range 4.8V to 5.2V.

This error message is given if this voltage is outside this range.

Correction:

Please make sure that the 5VO output is not overloaded. Make sure that the current is less than 200mA.

Check that the encoder is not damaged.

E105: Filter velocity error overflow

The acceleration and velocity in combination with motor and inertia are set too high. A sudden mechanical collision can also cause this error since the deceleration is done in an uncontrolled manner.

Correction:

- Decrease the acceleration.
- Make a new tuning of the prefilter, adjusted to a lower level.

E106 - E126 : Reserved for future use

4.13 Alphabetical Overview of Commands

4.13.1 Explanation of Command Overview Table

Default value from factory
or after using the SD
(set default) command

For further details consult
this page

Command name

The value is defined by this unit

Min./max limits
for the command
value

Short function
description

Typical execution time
for the actual command

Com- mand	Description	Limits Min.	 Max.	Default	Exec. Time (msec)	Mode 0	 1	 2	 3	 4	 5	 P	Unit	Page
!	Show Controller type and address	-	-	-	0.5	+	+	+	+	+	+	+	-	79
?	Show set-up	-	-	-	0.5	+	+	+	+	+	+	+	-	79
AC	Acceleration	# 100	# 1000000	2000	0.5	x	+	+	+	+	+	+	RPM/s	80

Marker explanation :

x : The command or register can be set and verified but has no effect in the actual mode.

o : The command or register can be verified and has an effect in the actual mode but no changes can be made. This marker is mostly used together with the Basic Motor registers.

+ : The command or register can be set and verified. There will be

P=Program - only valid for extenc
ed Controller types AMC2xP.

4.13 Alphabetical Overview of Commands

Command	Description	Limits		Default	Exec. Time (msec)	Mode							Unit	Page
		Min.	Max.			0	1	2	3	4	5	P		
!	Show Controller type and address	-	-	-	0.5	+	+	+	+	+	+	+	-	79
?	Show set-up	-	-	-	0.5	+	+	+	+	+	+	+	-	79
AC	Acceleration	# 100	# 1000000	2000	0.5	x	+	+	+	+	+	+	RPM/s	80
ACH	Deceleration after Halt	# 100	# 1000000	100000	0.5	x	+	+	+	+	+	+	RPM/s	81
ADDR	Address	0	255	0	0.5	+	+	+	+	+	+	+		82
AI1 / 2	Show analogue input value	-2048	2047	(0)	0.5	+	+	+	+	+	+	+	ADC steps	83
AIH1 / 2	Hysteresis for analogue input	0	200	100	0.5	+				+	+	+	ADC steps	83
AIL1 / 2	Negative voltage for analogue input	-10V	Zero-point	-	0.5	+				+	+	+	ADC steps	84
AIO1 / 2	Zero-point for analogue input	-10V	+10V		0.5	+				+	+	+	ADC steps	84
AIU1 / 2	Positive voltage for analogue input	Zero-point	+10V		0.5	+				+	+	+	ADC steps	85
AND	Logical AND operator				0.5							+		86
AO	Activate flag in external module	-	-		0.5	+	+	+	+	+	+	+		86
AP	Motor’s Actual Position	-2147483648	+2147483647		0.5	+	+	+	+	+	+	+	Pulses	87
APM	Actual Position of master axis	-2147483648	+2147483647		0.5	+	+							87
BAUD	Baud rate for RS232/RS485	1	8	6	0.5	+	+	+	+	+	+	+	-	88
BEGIN	Begin program block				0.5							+		88
BIAS	Bias after filter	-100	+100	0	0.5	x	+	+	+	+	+	+	%	89
CA	Motor’s allowable average current	0.1	5 /10 / 15	1	0.5	x	o	o	o	o	o	o	Amp/RMS	90
CB1-18	Control bits	0	(2)	-	0.5	x	o	o	o	o	o	o	-	91
CFE	Show current following error	0	32767		0.5	o	o	o	o	o	o	o	Pulses	98
CFNE	Show current following error nom.	0	32767		0.5	o	o	o	o	o	o	o	Pulses	98
CHS	Use Checksum	0=no	1=yes	0	0.5	+	+	+	+	+	+	+		99
CL	Show motor current (%) re CA	0	100		0.5	+	+	+	+	+	+	+	%	99
CO	Clear flag in external module	-	-		0.5	+	+	+	+	+	+	+		100
CP	Set motor’s max. peak current	0	9.55 / 15.92 / 22.28	2	0.5	x	o	o	o	o	o	o	Amp/RMS	101
CPL	Show current power level	0	200	-	0.5	o	o	o	o	o	o	o	%	101
CU	Show motor current				0.5	o	o	o	o	o	o	o	Amp	102
CUB	Show DC-bus current	-10.00	+10.00	(0)	0.5	o	o	o	o	o	o	o	Amp/RMS	102
CV	Show Current Velocity				0.5	o	o	o	o	o	o	o	RPM	102
D	Delay in program	1	2147483647		0.5							+		103
DIF	Digital input format	1 (position)	2 (Velocity)	1	0.5	x	x	x	+	x	x	x		103
ELSE	ELSE statement				0.5							+		104
END	End program block				0.5							+		105
ENDIF	Terminate program block				0.5							+		105
EP	Execute Program flag	0=no	1=yes	0	0.5	x	x	x	x	x	x	x	(power-up)	105
ES	Error status	0	3		0.5	o	o	o	o	o	o	o		106
EST	Error status in text	0	3		0.5	o	o	o	o	o	o	o		109
ET	Encoder type (PNP, NPN, Linedr.)	0	2	2	0.5	x	o	o	o	o	o	o		110
EXIT	Exit programming mode				0.5	+	+	+	+	+	+	+		110
FEM	Following error maximum	0 (disabled)	32767 #	32767 #	0.5	x	+	+	+	+	+	+	Pulses	111

Continued on following page

Notes :
# : Depending on the VFACTOR and PR register setting - Consult the detailed command description.

4.13 Alphabetical Overview of Commands

Com- mand	Description	Limits		Default	Exec. Time (msec)	Mode							Unit	Page
		Min.	Max.			0	1	2	3	4	5	P		
FNEM	Nominal Following error maximum	0 (disabled)	32767 #	100 #	0.5	x	+	+	+			+	Pulses	111
GEAR	Gearing between master and slave	0.001 #	100 #	1.000	0.5	x	+							112
GO	Execute program				0.5	+	+	+	+	+	+			113
H	Halt motor and program				0.5	+	+	+	+	+	+	+		113
HALL	Motor initialisation, hall-based *	0	3	2 (Yask.)	0.5	x	o	o	o	o	o	o		114
HELP	Show commands	-	-	-	0.5	o	o	o	o	o	o	o		114
HM	Show Home input status	0=low	1=high	(0)	0.5	o	o	o	o	o	o	o	-	116
HML	Level for zero-point contact	0	1	1	0.5	x	x	+	+	x	x	x	-	116
HOFFSET	Set HALL offset angle *	0	360	0	0.5	x	o	o	o	o	o	o	Elec.deg.	117
HL	Hall element type *	0=PNP	1=NPN	0 (PNP)	0.5	x	o	o	o	o	o	o	-	115
IF	IF statement	-	-	-	0.5							+	-	118
IF (ext)	IF statement (External module)	-	-	-	0.5							+	-	119
IN	Read input port status	0	255		0.5	o	o	o	o	o	o	o	-	120
INAL	Input active level	0	255	255	0.5	+	+	+	+	+	+	+	-	120
INDEX	Index from encoder ON/OFF	0 (OFF)	1 (ON)	1	0.5	x	o	o	o	o	o	o	-	122
INITTYPE	Initialisation type (Hall etc.)	0	2	2	0.5	x	o	o	o	o	o	o	-	122
INPUT	Read data from external module	-	-		0.5	o	o	o	o	o	o	o	-	124
J	Jump statement	0	500		0.5							+	Line	125
JS	Jump Sub-routine	0	500		0.5							+	Line	125
KPHASE	Velocity-dep. commutation offset	0	100	1.0	0.5	x	+	+	+	+	+	+	-	126
LINE	Show program line number	0	500		0.5	o	o	o	o	o	o	o	-	127
LIST	Show user program (upload to PC)				0.5	o	o	o	o	o	o	o	-	128
LOAD	Inertia adjustment	1.0	10.0	1	0.5	x	+	+	+	+	+	+	-	128
MAXFREQ	Current Loop bandwidth	0	2	2 (400 Hz)	0.5	x	o	o	o	o	o	o	-	129
MO	0=Passive 1=Gear, 2=Position, 3=Register, 4=Velocity, 5=Torque	0	5	0	0.5	+	+	+	+	+	+	+	-	130
MR	Recall data from FLASHPROM	0	2		0.5	+	+	+	+	+	+	+	-	131
MS	Save set-up in FLASHPROM	0	2		0.5	+	+	+	+	+	+	+	-	131
NL	Negative Limit input status	0=low	1=high	-	0.5	+	+	+	+	+	+	+	-	133
NLL	Negative Limit input active Level	0=low	1=high	1	0.5	x	x	+	+	x	x	x	-	133
OR	Logical OR operator				0.5							+	-	134
OUT	Show/set levels at User Outputs	0	255	0	0.5	+	+	+	+	+	+	+	-	134
PE	Maximum Pulse Error	0	15	7	0.5	x	+	+	+				(pulses)	136
PES	Enc. pulse error sample number	0	15	1	0.5	x	+	+	+				(samples)	137
PIF	Pulse Input Format	1	8	1	0.5	+	+	x	x	x	x	x		138
PL	Positive Limit input status	0=low	1=high	-	0.5	o	o	o	o	o	o	o	-	139
PLL	Positive Limit input active Level	0=low	1=high	1	0.5	x	+	+	+	+	+	+	-	139
PM	Power management	10	(3000)	1, 2, 3k	0.5	x	+	+	+	+	+	+	Watt	140
POF	Pulse Output Format	0	2	1	0.5	x	+	+	+	+	+	+		140
POFFSET	Phase offset	0	360	0	0.5	x	+	+	+	+	+	+	Elect. deg.	141

Continued on following page

Notes :

* : Changing this register will first have effect when mode 0 has been selected.

# : Depending on the VFACTOR and PR register setting - Consult the detailed command description.

4.13 Alphabetical Overview of Commands

Com- mand	Description	Limits		Default	Exec. Time msec	Mode							Unit	Page
		Min.	Max.			0	1	2	3	4	5	P		
POL	Number of motor poles	2	100	8	0.5	x	o	o	o	o	o	o	Poles	141
PR	Encoder pulses per revolution	50	65000	8192	0.5	x	o	o	o	o	o	o	Pulses per rev.	142
PRINT	Print to external module	-	-		0.5	+	+	+	+	+	+	+		143
PRM	Encoder pulses per rev., master	50	20000	500	0.5		x						Pulses per rev.	145
PROGRAM	Enter programming mode	-	-	-	0.5	+	+	+	+	+	+	+	-	145
R	User registers	0	499	0 (content)	0.5	x	x	x	x	x	x	+		146
RESET	Reset Controller	-	-	-	2000	o	o	o	o	o	o		-	147
RET	Return from sub-routine			-	0.5							+		147
RS	Running status. Actual motor status	0	7	0	0.5	+	+	+	+	+	+	+		147
RST	Report status in text			Empty	0.5	+	+	+	+	+	+	+		149
SD	Default set-up			-	0.5	x	o	o	o	o	o			150
SH	Smooth Halt of motor			-	0.5		o	o	o	o	o			150
SON	SON - Servo ON input status	0=low	1=high	-	0.5	+	+	+	+	+	+	+	-	151
SP	Set new position	- 2147483647	2147483648	0	0.5			+				+	Pulses	151
SR	Set relative position	- 2147483647	2147483648	0	0.5			+				+	Pulses	152
SRA	Set relative position. Ref to act. pos.	- 2147483647	2147483648	0	0.5			+				+	Pulses	153
SR+/-	Continuous move positive or negative	-	-	-	0.5			+				+	-	153
STIME	Show/set update time pos./vel. loop	0.2	10.0	1	0.5	x	o	o	o	o	o	o	mSec.	155
SZ	Search zero-point	-	-	-	0.5			+				+	-	155
TP1	Report temperature in driver stage	0	100	-	0.5	+	+	+	+	+	+	+	'C	156
TP2	Report temperature in processor	0	100	-	0.5	+	+	+	+	+	+	+	'C	156
TQ	Set maximum allowable torque	0	100	100	0.5	x	+	+	+	+	+	+	%	156
TQOUT	Show Actual torque level	0	300	-	0.5	x	+	+	+	+	+	+	%	157
UH	Unhalt - release halt state	-	-	-	0.5	x	+	+	+	+	+	+	-	158
VFACTOR	Velocity filter scale factor	-	-	256	0.5	x	o	o	o	o	o	o	-	
VE	Show firmware version and date			-	0.5	+	+	+	+	+	+	+	-	158
VM	Set Maximum velocity	0	32767	100	0.5	x	+	+	+	+	+	+	RPM	158
VOL	Show supply voltage	100	1000	Sup. dep.	0.5	+	+	+	+	+	+	+	Volt	160
WAIT	Wait for a condition	-	-	-	0.5							+	-	160
X	Show parameter sets	none or 0	63		0.5	x	x	x	+	x	x	x	-	161
XA	Acceleration in parameter sets	100	1000000 #	2000	0.5	x	x	x	+	x	x	x	RPM/s	162
XP	Position in parameter sets	- 2147483647	2147483648	0	0.5	x	x	x	+	x	x	x	Pulses	162
XR	Relative positioning	0=no	1=yes	0	0.5	x	x	x	+	x	x	x	pulses	163
XV	Velocity in parameter sets	1	10000 #	0	0.5	x	x	x	+	x	x	x	RPM	163
ZA	Zero search Acceleration	100	1000000 #	0	0.5	x	x	+	+	x	x	x	RPM/s	164
ZD	Zero search Direction	-1	1	-1	0.5	x	x	+	+	x	x	x	-	164
ZM	Zero search mode	0	1	0	0.5	x	x	+	+	x	x	x	-	165
ZR	Zero search after Reset	0	1	0	0.5	x	x	+	+	x	x	x	-	166
ZV	Zero search Velocity	1	10000 #	10	0.5	x	x	+	+	x	x	x	RPM	166

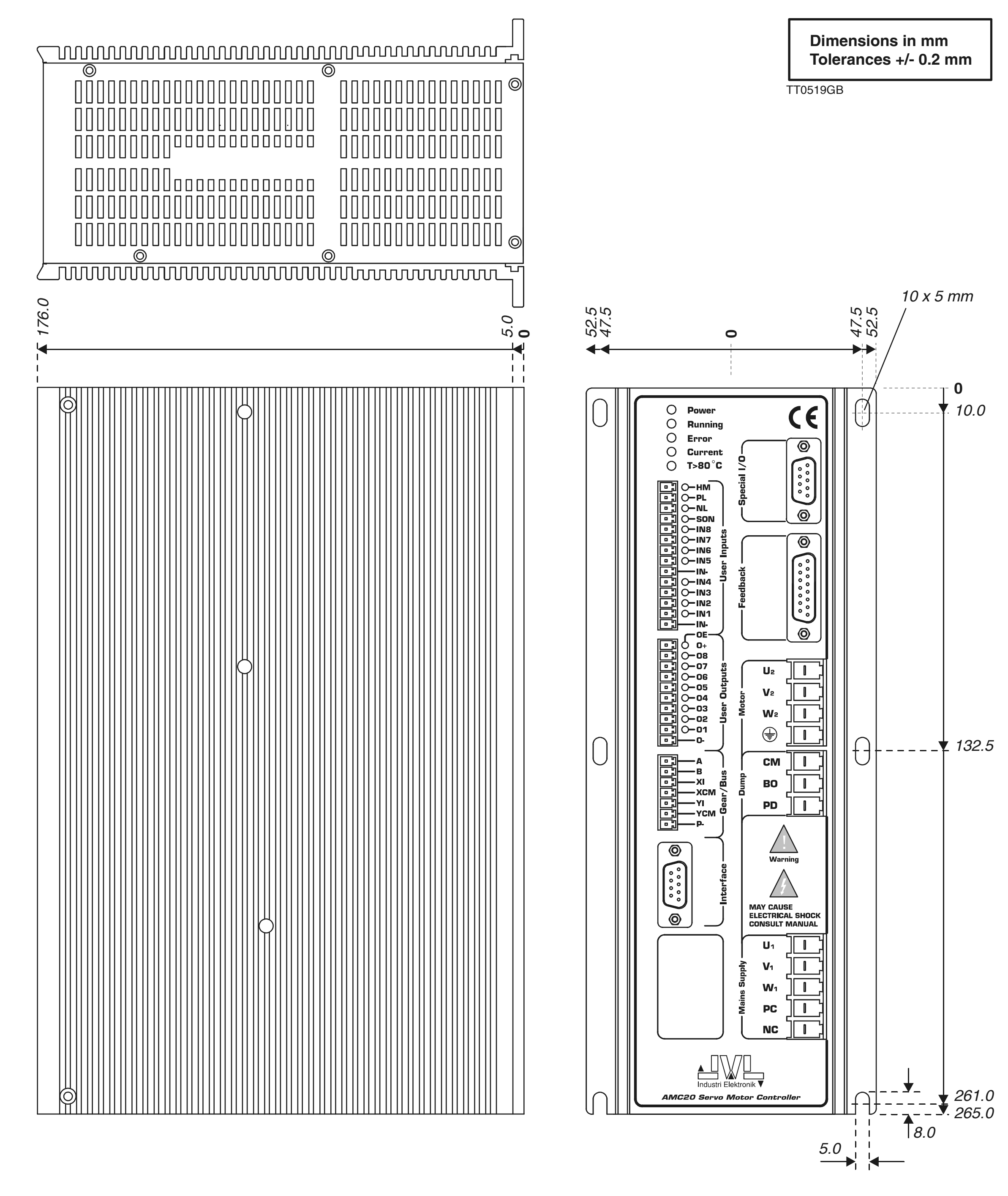
Notes :
# : Depending on the VFACTOR and PR register setting. Consult the detailed command description.

5 Appendix

5.1 Technical Data

Description	Min.	Typical	Max.	Units
Supply U1, V1, W1				
Supply Voltage (AMC20) single phase	175		450	V AC
Supply Voltage (AMC20, 21, 22) three phase	100		450	V AC
Supply frequency	50		60	Hz
Power Consumption (unloaded)		12		W
Motor Output U2, V2, W2				
Output Voltage (dependent on supply)	0		600	V RMS
Continuous Motor Current (AMC20, AMC20P)	0		5	A RMS
Continuous Motor Current (AMC21, AMC21P)	0		10	A RMS
Continuous Motor Current (AMC22, AMC22P)	0		15	A RMS
Instantaneous Max. Current (AMC20, AMC20P)	0		9.55	A RMS
Instantaneous Max. Current (AMC21, AMC21P)	0		15.92	A RMS
Instantaneous Max. Current (AMC22, AMC22P)	0		22.28	A RMS
PWM Frequency (depends on the CB2 control bit).		19.531 or 4.883		kHz
Encoder/Hall-Input (Feedback connector)				
Supply to encoder (pin 1 + 9) "5VO"	4.8		5.2	V DC
Allowable load on encoder supply (pin 1 + 9) "5VO"			200	mA
Encoder Frequency (50% duty-cycle)	0		1	MHz
Pulse Inputs (Gear/Bus connector)				
Allowable Input Frequency (50% duty-cycle)			500	kHz
Positive pulse width	1.0			µs
Negative pulse width	1.0			µs
Logic “0”			1.8	V DC
Logic “1”	3.8			V DC
User Inputs IN1-IN8, PL, NL, HM "User Inputs" con.				
Input Impedance	3.2		3.6	kOhm
Logic "0"	-1		2.5	V DC
Logic "1"	4.5		30	V DC
Logic "0"	-		1.0	mA DC
Logic "1"	2.0		-	mA DC
User Outputs O1 - O8 "User Outputs" connector				
Supply Voltage	8		28	V DC
Load Current per Output			700	mA DC
Analogue Input "Special connector"				
Input Voltage (nominal) "AI1" or "AI2"	-10.0		10.0	V DC
Input Impedance		20		kOhm
Power Dump Output - "Dump connector"				
Voltage	0		850	V DC
Shunt Resistor	220			Ohm
Diverse:				
Operating Temperature Range	0		45	°C
Weight (AMC20 and AMC20P)		4100		grams
Weight (AMC21 and AMC21P)		4200		grams
Weight (AMC22 and AMC22P)		4200		grams

( ) = Values valid for AMC2x



Dimensions in mm
Tolerances +/- 0.2 mm

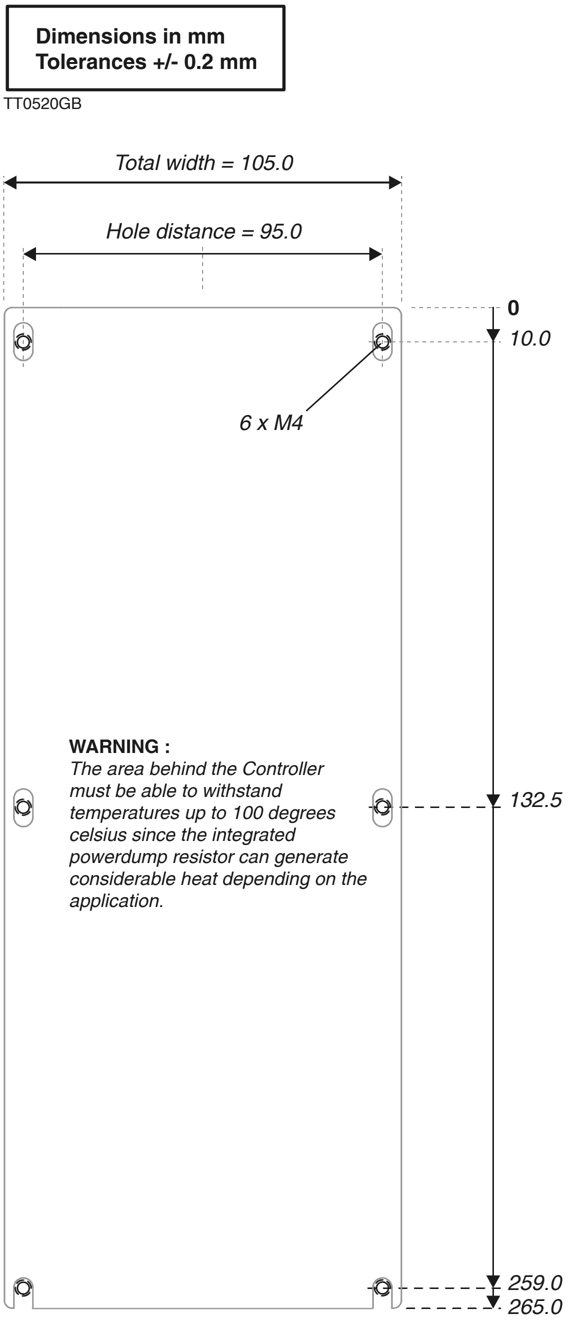
TT0519GB

5.2.1 Physical Dimensions of AMC2x and AMC2xP

The illustration above shows the mechanical dimensions of the AMC2x / AMC2xP. Consult *Controller Mounting (Drill drawing)*, page 184 for mounting details.

5.2 Physical Dimensions

5.2.2 Controller Mounting (Drill drawing)



WARNING :
The area behind the Controller must be able to withstand temperatures up to 100 degrees celsius since the integrated powerdump resistor can generate considerable heat depending on the application.

5.3 Power Dissipation

5.3.1 Power Dissipation.

The controller is optimized for lowest possible losses since losses means heat dissipation. The total power disipation can be calculated after following formular

Total power dissipation = 40 + (Motor Power * 0.1)

The formular covers worst case which is mains supply 3 x 400 VAC.
If only 1 x 230 VAC single phase supply is used the dissipation is much lower.

Example :

In an application the total output power to the motor is 3 kW.
This surcomstance result in following power dissipation :

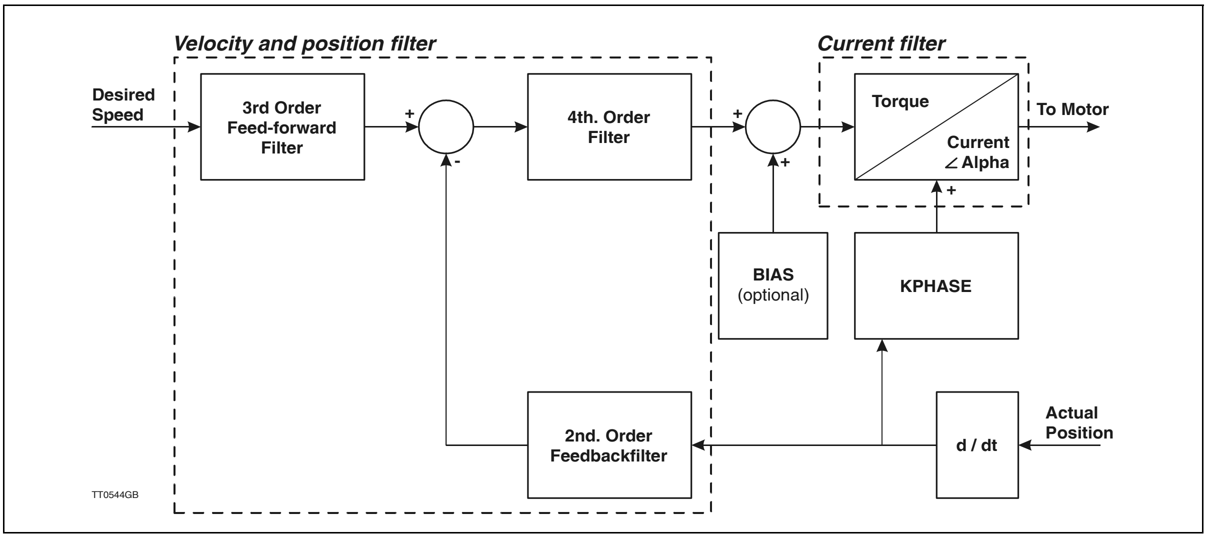
40 + (3000 * 0.1) = 340W

This amount of power (340W) will be dissipated as heat inside the controller.
The surounding cabinet must therefore be able to absorb some of this heat.

Please make sure that an area is keept free in each end of the controller to asure that a free air circulation is possible.

5.4 Servo Loop

The Controller uses a servo loop based on Z transformations, as illustrated in the figure below.



5.4.1 Servo Loop

The servo loop can be adjusted using the Controller's auto-tuning facility.
Additionally the BIAS parameter can be optimised if the system is loaded with a constant force in one direction. The BIAS can establish equilibrium in such a manner that the basic filters can be concentrated on regulating the motor force under dynamic conditions. See also *Adjustment of BIAS*, page 22

The KPHASE parameter must be adjusted to optimise the commutating angle at high speeds. If the motor library is used for set up, the KPHASE parameter is already optimised for the chosen motor. Se also *Setting KPHASE*, page 198

5.5 Error Indication

In addition to their normal function, the Controller LEDs are also used to indicate vital error conditions. The following describes the normal functions of the LEDs and then their additional functions. See also *Error Status Text (EST)*, page 109, concerning Controller error messages.

5.5.1 Error LED

The *Error* LED is lit when a fatal error occurs. A fatal error is an error which prevents motor operation, e.g. a fault in an encoder cable, the motor is jammed, a temperature overload, short-circuiting of the motor output, voltage overload, average current exceeded.

5.5.2 Current LED

The Current LED is lit if the specified average (rated) current (CA) is exceeded for any length of time.
The *Error* LED is also lit.
The Current LED is also lit if an overload occurs. The system must be reset after an overload. See *Reset Controller (RESET)*, page 147.

5.5.3 T>75°C LED

The *T>75°C* LED is lit when the Controller's internal temperature exceeds 75°C. The Controller must be reset.

5.5.4 Out Error LED

The *Out Error* LED is lit when an error occurs at one of the eight Outputs O1-O8.

5.5.5 Four LEDs Blinking in Sequence

If the four LEDs *Running*, *Error*, *Current* and *T>75°C* blink in sequence, it is an indication of a PROM error. When the Controller is switched on, the checksum in the Controller's program memory (PROM) is verified. If the pre-programmed checksum does not match the calculated checksum, the Controller will not operate the motor.
The PROM may be defective. Try resetting the Controller.

5.5.6 Four LEDs Blinking Simultaneously

If the four LEDs *Running, Error, Current* and *T>75°C* blink simultaneously, a motor error or encoder error has occurred. When the Controller is switched on, a check is carried out to ensure that the motor and encoder are connected correctly. The PWM signal to the motor is gradually increased until movement is registered or the PWM signals reach 50%.

In this way the Controller can check whether:

1. The motor is correctly connected, i.e. moves in the right direction.
2. The motor is blocked, i.e. draws a lot of current without the motor moving.
3. The encoder is connected incorrectly.

Check that the motor or encoder is connected correctly. Use the *EST* command (*Error Status Text (EST)*, page 109) for further information from the Controller.

5.6 Typical Errors

During installation and use of the Controller, various errors may occur. Information about many of these can be obtained from the Controller itself using the *EST* command (see *Error Status Text (EST)*, page 109). Some error conditions are similar to other errors. The following describes some of the most common errors and possible solutions.

5.6.1 Motion Errors :

The motor runs ok but at higher speeds the error message "average current exceeded" appears.

The error could be

1. The current filter is not tuned properly. Please re-tune the current filter using the TUNE1 command. See also *Setting the Motor Currents*, page 195
2. The KPHASE register is not set properly. Please let the motor run at a speed as high as possible without causing this error. Try then to adjust the KPHASE value until the CL (melt integral) is settling at a minimum. Try now at full speed.

5.6.2 Temperature

The temperature is very high at the surface of controller or a temperature warning is often displayed in MotoWare.

The error could be

1. The ambient temperature is too high. Make sure that the ambient temperatures specified in *Technical Data*, page 182 is not exceeded.
2. The cable length or the cable capacitance is too high.
   Decrease the PWM frequency at the motor output by using the CB2 parameter. See also *CB2 - Set low PWM output frequency*, page 92.
3. The airflow through the cooling channel in the controller is too bad due to narrow mounting. Mount an extra fan in the housing around the controller or improve the air ciculation by mounting the controller with a better distance to the surounding housing.

Incorrect Velocity
It is important that the servo constants are adjusted correctly. The system cannot maintain the correct velocity if the servo loop is not adjusted.

Incorrect Velocity even though the servo constants have been adjusted
It is important that the specification of the encoder resolution (pulses/revolution) is set correctly. Use the PR command; see *Encoder Pulses (PR)*, page 142.

The motor does not move to the correct position by selecting XP0
XP0 is used for the zero-point search function and has therefore a different function than the other position registers.

The motor and encoder are connected correctly but still report an error
Check that the encoder type is set correctly using the *ET* command (page 110).

The motor does not supply the correct torque
It is important that the servo constants are adjusted. The system cannot produce the correct torque if the servo loop is not adjusted.

5.6 Typical Errors

Four LEDs blink simultaneously
A problem has occurred with either the encoder or the motor. The encoder has fallen off or the motor is jammed. In cases where the encoder and motor appear to be connected correctly, check the maximum allowable pulse error using the *PE* command (*Maximum Pulse Error (PE)*, page 136). Check also the encoder type using the *ET* command; see *Encoder Type (ET)*, page 110.

5.7 Connection of an Unknown Motor Type

This section should be followed if the Controller is to be adjusted for an unknown motor type which is not included in the MotoWare parameter list.
Proceed as follows:

1. Find the following data for the actual motor and adjust the Controller accordingly:

— Number of motor poles: parameter *POL*. See *Setting the Number of Motor Poles*, page 194.
— Number of encoder pulses per revolution and encoder type: parameters *PR, ET*, and *INDEX.* See *Set-up of Encoder Resolution*, page 191.
— Motor currents. The values of the motor's allowable average current/peak current: parameters *CA* and *CP.* See *Setting the Motor Currents*, page 195

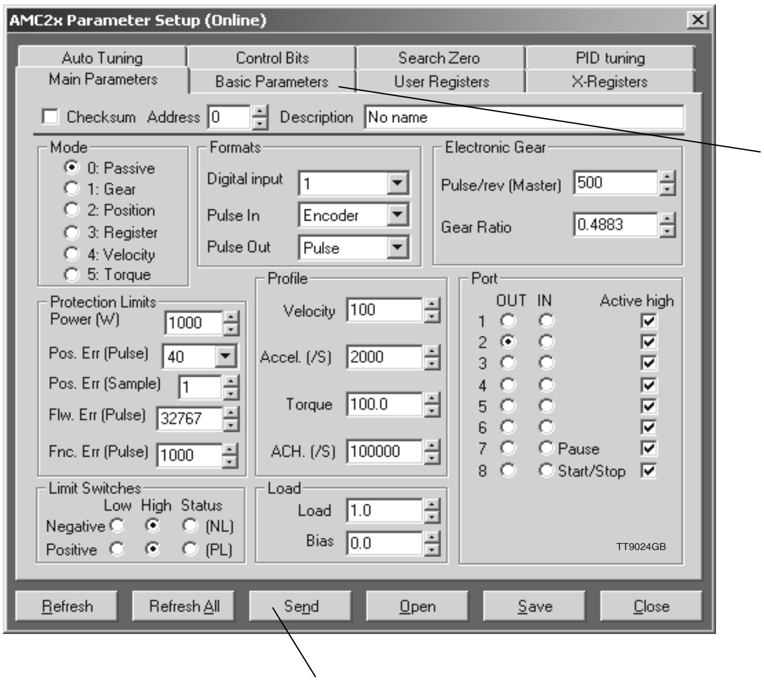
It is recommended that the Controller is adjusted without using Hall elements, even if the motor is equipped with Hall elements. These should first be connected and used after the basic adjustment.
If the motor does not have Hall elements, follow the instructions in *Start-up of Motor without Hall Element*, page 199.
If the motor has Hall elements, these may be used. See *Setting the Hall Element*, page 196.

2. Adjust the other critical parameters for the actual type of motor, including:
— Current filter. See *Current filter optimizing*, page 16
— Servo filter parameters. See *Adjustment of Servo Regulation*, page 18.
— Velocity dependent commutation offset: parameter KPHASE. See *Setting KPHASE*, page 198.

A usefull command for determine the motor parameters is the *Motor test (MTEST)*, page 132.

For set up of other Controller functions, see *Software*, page 49

5.7 Connection of an Unknown Motor Type



☐ Checksum Address 0 Description No name

Mode
● 0: Passive
○ 1: Gear
○ 2: Position
○ 3: Register
○ 4: Velocity
○ 5: Torque

Formats
Digital input 1
Pulse In Encoder
Pulse Out Pulse

Electronic Gear
Pulse/rev (Master) 500
Gear Ratio 0.4883

Protection Limits
Power (W) 1000
Pos. Err (Pulse) 40
Pos. Err (Sample) 1
Flw. Err (Pulse) 32767
Fnc. Err (Pulse) 1000

Profile
Velocity 100
Accel. (/S) 2000
Torque 100.0
ACH. (/S) 100000

Port

	OUT	IN		Active high
1	○	○		☑
2	●	○		☑
3	○	○		☑
4	○	○		☑
5	○	○		☑
6	○	○		☑
7	○	○	Pause	☑
8	○	○	Start/Stop	☑

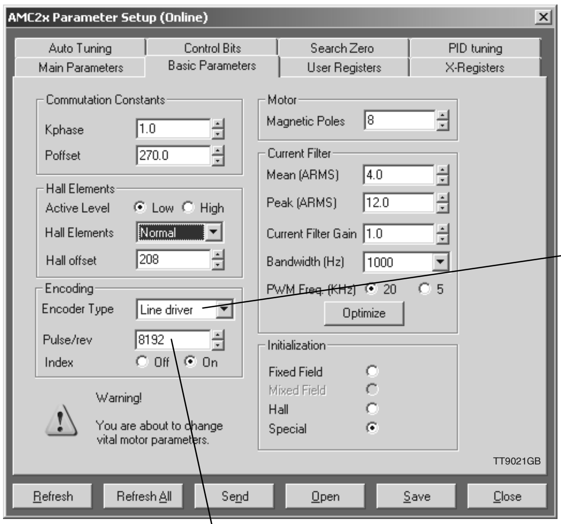
Limit Switches

	Low	High	Status
Negative	○	●	○ (NL)
Positive	○	●	○ (PL)

Load
Load 1.0
Bias 0.0

Select Basics here on index input. ①

④ Send set-up to the Controller



Commutation Constants
Kphase 1.0
Poffset 270.0

Hall Elements
Active Level ● Low ○ High
Hall Elements Normal
Hall offset 208

Encoding
Encoder Type Line driver
Pulse/rev 8192
Index ○ Off ● On

Warning!
You are about to change vital motor parameters.

Motor
Magnetic Poles 8

Current Filter
Mean (ARMS) 4.0
Peak (ARMS) 12.0
Current Filter Gain 1.0
Bandwidth (Hz) 1000
PWM Freq. (KHz) ● 20 ○ 5

Initialization
Fixed Field ○
Mixed Field ○
Hall ○
Special ●

Encoder type set here ③

② Encoder resolution set here

5.7.1 Set-up of Encoder Resolution

To achieve correct velocity and commutation of the motor, the number of encoder pulses per revolution (the encoder resolution) must be programmed. Here the resolution specified for the encoder must be used. Note that the Controller internally multiplies this resolution by a factor of 4 so that an encoder with a resolution of e.g. 500 pulses per revolution in effect has a resolution of 2000 pulses per revolution. If the motor is to rotate 1 revolution, the positioning command must be based on the resolution of 2000 pulses. The encoder resolution cannot be set to a value less than the number of motor poles multiplied by 128. If the encoder resolution is set to a lower value, the Controller will respond with an error message: *E2 Out of range*.

The encoder resolution must be set to a value in the range 256 to 20000 pulses per revolution.
Set the encoder resolution in the *Pulse/rev (S)* field and send the information by pressing *Send*. If required, store the value in the Controller's non-volatile memory by pressing *FLASHPROM*.

If the encoder resolution is set via the on-line editor, the *PR* command is used.

Example:

`PR=2048(enter)`	Sets the encoder resolution to 2048 pulses per revolution.
`PR(enter)`	Displays the current encoder resolution set-up.

To store the value in the Controller's permanent memory, key *MS (enter)*.

5.7.2 Setting the Encoder Type

The encoder used with the AMC Controller can be of either a PNP or NPN type. In addition, the Controller accepts both a balanced and unbalanced signal from a standard 2-channel incremental encoder. For connection of the encoder, see *Encoder Input*, page 29.
The *Encoder Type* field determines which type of encoder is connected to the Controller.
If an encoder with a balanced output is used, this setting can be omitted.
If however an unbalanced NPN type encoder is used, the field must be set to *NPN*. If the encoder is a PNP type, the field is set to *PNP*.
Send the information to the Controller by pressing *Send*. If required, save the setting in the Controller's non-volatile memory by pressing *FLASHPROM*.

If the encoder type is set via the on-line editor, the *ET* command is used.

Example:

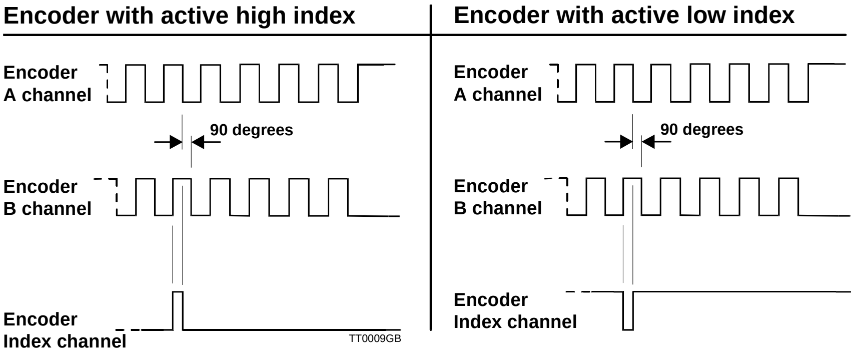
`ET=0(enter)`	Set encoder type to PNP.
`ET=1(enter)`	Set encoder type to NPN.
`ET(enter)`	Display current setting for encoder type

To store the setting in the Controller's permanent memory, key *MS (enter)*.

5.7.3 Setting the Index Input

It is recommended that an encoder with an index channel is used. If an encoder with index channel is used, the Controller’s Index Input (EZ1 and EZ2) must be enabled by Setting the INDEX paramter to 1 (INDEX=1).
The index inputs will only read a transistion at the input therefore the polarity of the index pulse is irrelevant.

Illustration of active levels:

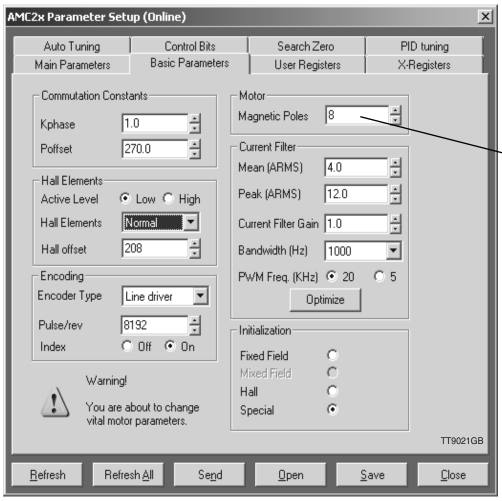


If the index input is enabled via the on-line editor, the *INDEX* command can be used.

Example:

`INDEX=1(enter)`	Enable the index input.
`INDEX(enter)`	Display current index input status (enabled or disabled).

5.7 Connection of an Unknown Motor Type



AMC2x Parameter Setup (Online)

Commutation Constants
Kphase: 1.0
Poffset: 270.0

Hall Elements
Active Level: ● Low ○ High
Hall Elements: Normal
Hall offset: 208

Encoding
Encoder Type: Line driver
Pulse/rev: 8192
Index: ○ Off ● On

Warning!
You are about to change vital motor parameters.

Motor
Magnetic Poles: 8

Current Filter
Mean (ARMS): 4.0
Peak (ARMS): 12.0
Current Filter Gain: 1.0
Bandwidth (Hz): 1000
PWM Freq. (KHz): ● 20 ○ 5

Initialization
Fixed Field ○
Mixed Field ○
Hall ○
Special ●

Number of poles set here.

5.7.4 Setting the Number of Motor Poles

The motor's number of poles must be specified for the Controller to function correctly. If the number of poles is specified incorrectly, the Controller will produce an error after start-up or during the first motor operation, and report the error message *E102 : Encoder error or position error limit exceeded*, page 175. Depending on the actual motor position etc. other messages can also be reported.
The number of poles can be specified in the range 2-100. The majority of 3-phase servo motors have 2, 4, 6 or 8 poles.

The number of motor poles is most easily set using the parameter window.
Key in the number of poles in the *Magnetic poles* field and send the information to the Controller by pressing *SEND*.
If required, save the setting in the Controller's non-volatile memory by pressing *SAVE in the send dialog window*.

To set the number of poles via the on-line editor, the *POL* command is used.

Example:

`POL=8 (enter)`	Set the number of poles to 8 (4 sets).
`POL (enter)`	Display the current number of poles setting.

To save the setting in the Controller's permanent memory, key *MS (enter)*.

5.7.5 Setting the Motor Currents

A brushless AC servo motor has 2 current limits which must not be exceeded in order to avoid overheating the motor or reducing its operational lifetime. These current limits are the maximum allowable average current and the maximum allowable peak current and are specified in the following manner - Use the online editor in the MotoWare program from JVL.

Step 1 - Average Current (CA)
Consult the data sheet for the actual motor in question to determine the max. allowable average current. This value may be specified as "Continuous Current", "Rated Current", or "Nominal Current".
The average current is set using the Controller command *CA* in the on-line editor.
Example:
To set the average current value to 1.4 Amp., key *CA=1.4* (enter).
The Controller will then under no circumstances allow the motor to draw a continuous current greater than 1.4 Amp for a long duration.
Note that the average current can be adjusted with a resolution of 100mA.

Step 2 - Adjustment of Peak Current (CP)
Consult the data sheet for the actual motor in question to determine the specified allowable peak current. This value may be specified as "Peak Current", "Instantaneous max. Current", or "Stall Current". Most motor types can withstand a peak current that is 3-4 greater than the average current value.
The peak current is set using the Controller command *CP*.
Example:
To set the peak current to 4.0 Amp., key *CP=4.0* (enter).
The Controller will then under no circumstances allow the motor to draw a peak current greater than 4.0 Amp.
Note that the peak current can be adjusted with a resolution of 100mA.

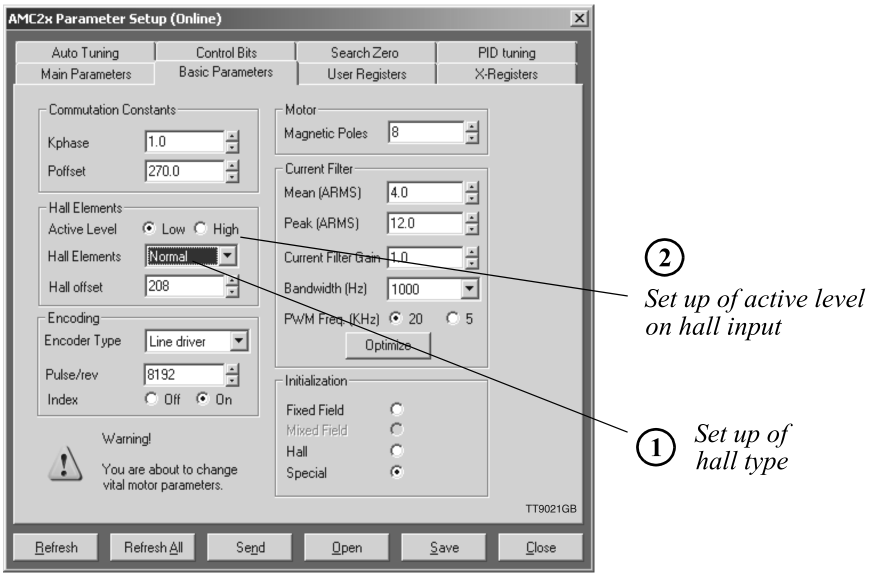
Step 3 - Current filter tuning (TUNE1)
Enter the command TUNE1 in the on-line editor. The tuning can be done even if the motor is blocked.
After 4-5 seconds the current loop is tuned and a Y is returned from the controller
Save all the settings permanent in the controller by typing MS in the on-line editor.
The complete current loop is now adjusted for the actual motor.

Important !:
Note that the tuning must be done once more if the CP parameter has been changed.
The tuning must also be repeated if the parameters MAXFREQ or CB2 has been changed.

If the motor sounds noisy it is propably caused by the high bandwith and PWM frequency in the current loop. If the noise is inconvenient the parameter MAXFREQ can be decreased.

See also the command descriptions :
- *Average (Rated) Current (CA)*, page 90
- *CB2 - Set low PWM output frequency*, page 92
- *Peak Current (CP)*, page 101
- *Current Loop Bandwidth (MAXFREQ)*, page 129
- , page 157

5.7 Connection of an Unknown Motor Type



Commutation Constants
Kphase 1.0
Poffset 270.0

Hall Elements
Active Level ● Low ○ High
Hall Elements Normal
Hall offset 208

Encoding
Encoder Type Line driver
Pulse/rev 8192
Index ○ Off ● On

Warning!
You are about to change vital motor parameters.

Motor
Magnetic Poles 8

Current Filter
Mean (ARMS) 4.0
Peak (ARMS) 12.0
Current Filter Gain 1.0
Bandwidth (Hz) 1000
PWM Freq (KHz) ● 20 ○ 5

Initialization
Fixed Field ○
Mixed Field ○
Hall ○
Special ●

2 *Set up of active level on hall input*

1 *Set up of hall type*

5.7.6 Setting the Hall Element

The Controller can be initialised with or without Hall elements in the motor. Normally the Hall element is not used if the motor may be allowed to move during start-up. In this case the Hall register is set to 0. If however the motor is required to remain completely stationary during start-up, the motor's Hall element must be used and the Hall register is set to 1, 2 or 3.

The Hall element is used during start-up to tell the Controller the motor position so that the commutation circuitry can lock the applied magnetic field to the motor's actual position without the motor moving. The information obtained from the motor's incremental encoder cannot be used to determine this position. The Hall element is only used during start-up.

The following Hall types can be selected.

HALL register	MotoWare field	Function
HALL = 0	Off	Start-up without HALL
HALL = 1	Normal	Normal HALL - use HLA, HLB and HLC inputs
HALL = 2	Yaskawa 1	Yaskawa HALL encoding type 1. Use only encoder inputs incl. Index channel.
HALL = 3	Yaskawa 2	Yaskawa HALL encoding type 2. Use only encoder inputs incl. Index channel.

Note that Yaskawa motors have their HALL signals encoded together with the encoder signals including index-signal. This minimises the number of cables between the motor and the Controller. See also *Examples of Motor Connection*, page 200

Set the Hall type in the *Hall elements* field and send the information to the Controller by pressing *Send*. If required, save the setting in the Controller's non-volatile memory by pressing *FLASHPROM*.

To set the Hall type via the on-line editor, the *HALL* command is used.

Example:

`HALL=1 (enter)`	Set Hall type to normal hall sensor.
`HALL   (enter)`	Display current setting for Hall type.

To save the setting in the Controller's permanent memory, key *MS (enter)*.

5.7.7 Adjustment of Hall Type

In order to achieve correct decoding of the motor Hall element (if this is used), it is vital that the Hall set-up is correct. Hall elements can either be PNP or NPN types. In addition, both a balanced and unbalanced signal can be accepted from the Hall element. For connection of the Hall element, see *Hall Input*, page 31.
If a Hall element with a balanced output is used, the setting of the hall type can be omitted. If however an unbalanced NPN or PNP Hall element is used, the setting must be made in the parameter window's *Hall* field.
For an NPN type Hall element, the field is set to *High*. For a PNP type Hall element, the field is set to *Low*.
If a Yaskawa motor is used, the setting of the Hall type is unnecessary since the Hall signal is encoded with the encoder signal and the Hall input is therefore not used.

Send the information to the Controller by pressing *Send*. If required, save the setting in the Controller's non-volatile memory by pressing *FLASHPROM*.

To set the Hall type via the on-line editor, the *HL* command is used.

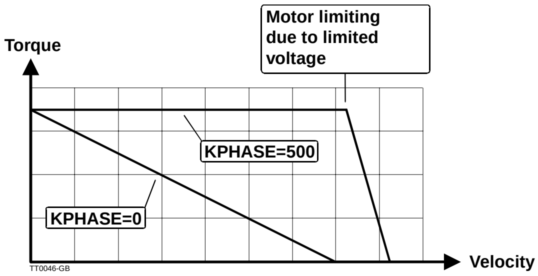
Example:

`HL=0 (enter)`	Set Hall type to PNP.
`HL=1 (enter)`	Set Hall type to NPN.
`HL (enter)`	Display the current setting for Hall type.

To store the setting in the Controller's permanent memory, key *MS (enter)*.

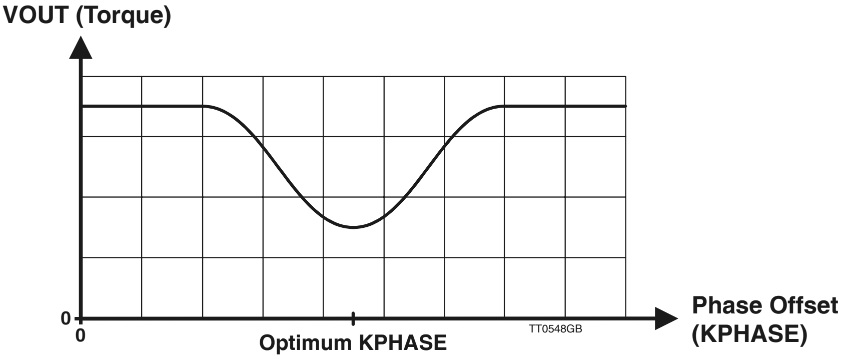
5.7.8 Setting KPHASE

The Controller includes a parameter denoted KPHASE. This determines how far the commutation of the motor is offset in relation to the motor's actual position. KPHASE is velocity dependent, i.e. it becomes more significant the faster the motor is running.
It is of vital importance for system performance that KPHASE is adjusted correctly. Incorrect adjustment will result in the motor not being able to supply sufficient torque at high velocities. In the worst case, the motor will not run at full speed and the system will produce an error when the positioning error becomes too great. See illustration below.

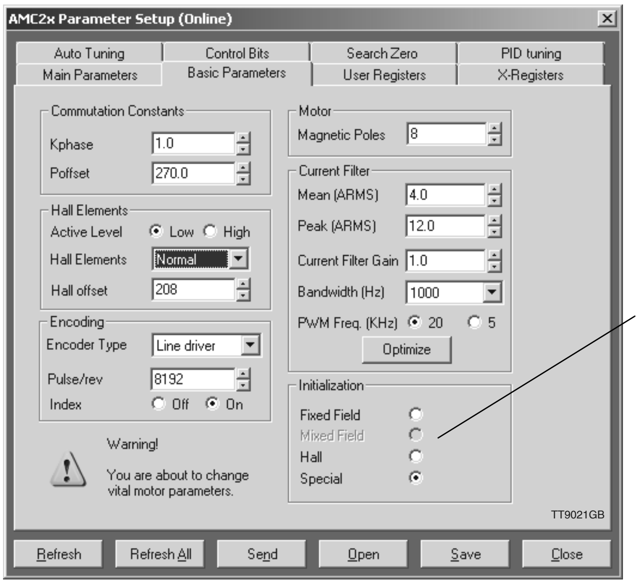


Adjustment of KPHASE is made during system installation as follows:.

1. Start MotoWare and the Controller. Open the "*On line editor"*.
2. Check that there is contact with the Controller by keying *? (enter)*.
3. Ensure that the motor can run at an arbitrary speed and distance without any mechanism connected being damaged.
4. Set the Controller to Mode 2 by keying *MO=2 (enter)*.
5. Set the max. velocity (-20%) on the Controller so that it corresponds to that specified by the motor manufacturer for the maximum velocity with load, typically 3000 RPM. This is done by keying *VM=2400 (enter)*. This value is found by subtracting 20% from the nominal speed.
   Also, set KPHASE to a value of 100 by keying *KPHASE=100 (enter)*
6. Allow the motor to run for a good distance by keying *SP=5555555*.
7. The motor should now run. If the Controller produces an error after only running a short time, KPHASE is set incorrectly or the supply voltage to the system is not set to the same value as the motor's nominal voltage. If necessary, repeat from step 5 and specify a lower velocity or use a higher supply voltage that corresponds to the motor's nominal voltage.
8. When the motor is running at the desired velocity, *KPHASE* can then be adjusted as follows. Check the internal torque reference *TQOUT* by sending the command *TQOUT (enter)*. The Controller will respond with the message, for example, *TQOUT=200*, indicating that the actual torque is 200 units. Adjust *KPHASE* up or down until the value for *TQOUT* is close to zero (+/-50).
9. Finally, save the determined value of *KPHASE* in the Controller's non-volatile memory by sending the command *MS (enter)*.



5.7 Connection of an Unknown Motor Type



Commutation Constants
Kphase 1.0
Poffset 270.0

Hall Elements
Active Level ● Low ○ High
Hall Elements Normal
Hall offset 208

Encoding
Encoder Type Line driver
Pulse/rev 8192
Index ○ Off ● On

Warning!
You are about to change vital motor parameters.

Motor
Magnetic Poles 8

Current Filter
Mean (ARMS) 4.0
Peak (ARMS) 12.0
Current Filter Gain 1.0
Bandwidth (Hz) 1000
PWM Freq. (KHz) ● 20 ○ 5
Optimize

Initialization
Fixed Field ○
Mixed Field ○
Hall ○
Special ●

TT9021GB

1

Set up of initialisation type
- Set to "Fixed Field" - no hall.

5.7.9 Start-up of Motor without Hall Element

The Controller can be initialised with or without the use of a Hall element in the motor. Hall sensors in the motor offer the advantage that the motor stays in a stationary position after turning on the power. For operation without the use of a Hall element, the alternative method is to apply a fixed current and thus produce a fixed magnetic field in the motor. This fixed field will make the motor move to a known position where the Controller commutation firmware will be set to a zero value.
This is absolutely necessary in a servo system since the magnetic field is controlled in a closed loop. Proceed as follows:

1. The Controller's Hall input must be disabled and fixed field initialisation must be selected. Set *Initialisation* to *Fixed Field*, or send the command *Initialisation=0* in the "On-line" editor.
2. After start-up, the motor will be supplied with the current specified in the peak current register *CP*.
3. The current will be applied until the motor is stabilised.
4. After this duration, which is typically set to 10-1000 ms, the motor is moved to a position of equilibrium in the generated magnetic field and the Controller locks its commutation circuitry to the actual motor position.
   Initialisation is then complete and the Controller is operational.

Set the parameters mentioned above and send the set-up to the Controller by pressing *Send*. To save the settings in the Controller's non-volatile memory, type *MS* in the "online editor window.

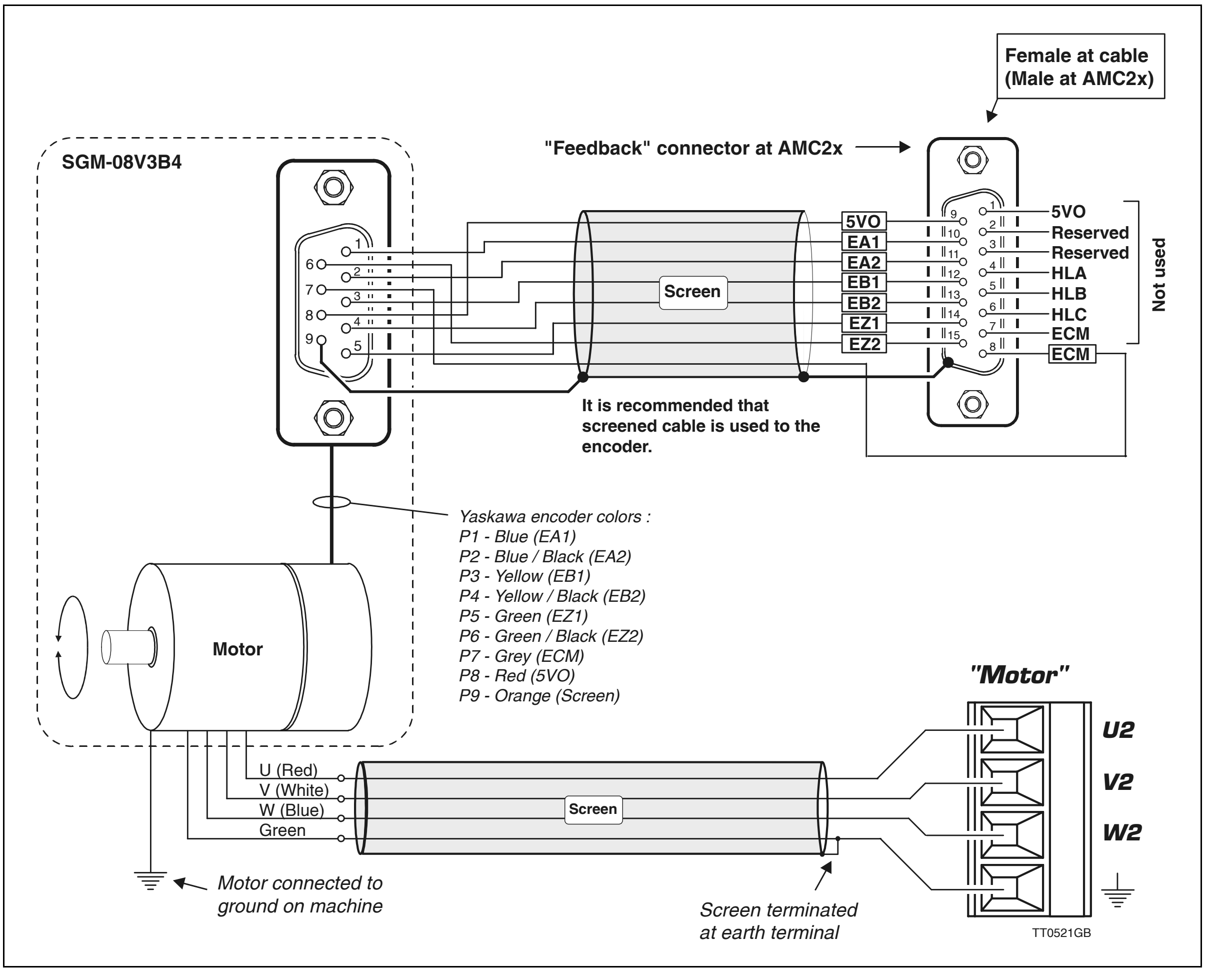
If the motor is required to remain completely stationary during start-up, the motor's Hall element must be used and the Hall register is set to 1, 2 or 3. See *Setting the Hall Element*, page 196

5.8 Examples of Motor Connection

This section illustrates examples of motor connection for 3 phase motors, including the settings for vital Controller parameters. For details of general set-up and fine tuning, see *General Aspects of Installation*, page 12.

5.8.1 Yaskawa series SGM, SGME, and SGMP

If set-up is performed with the MotoWare parameter set-up, select the correct motor in the motor library. Follow this setup by running an auto-tuning to optimise the filter parameters. See also *General Aspects of Installation*, page 12.

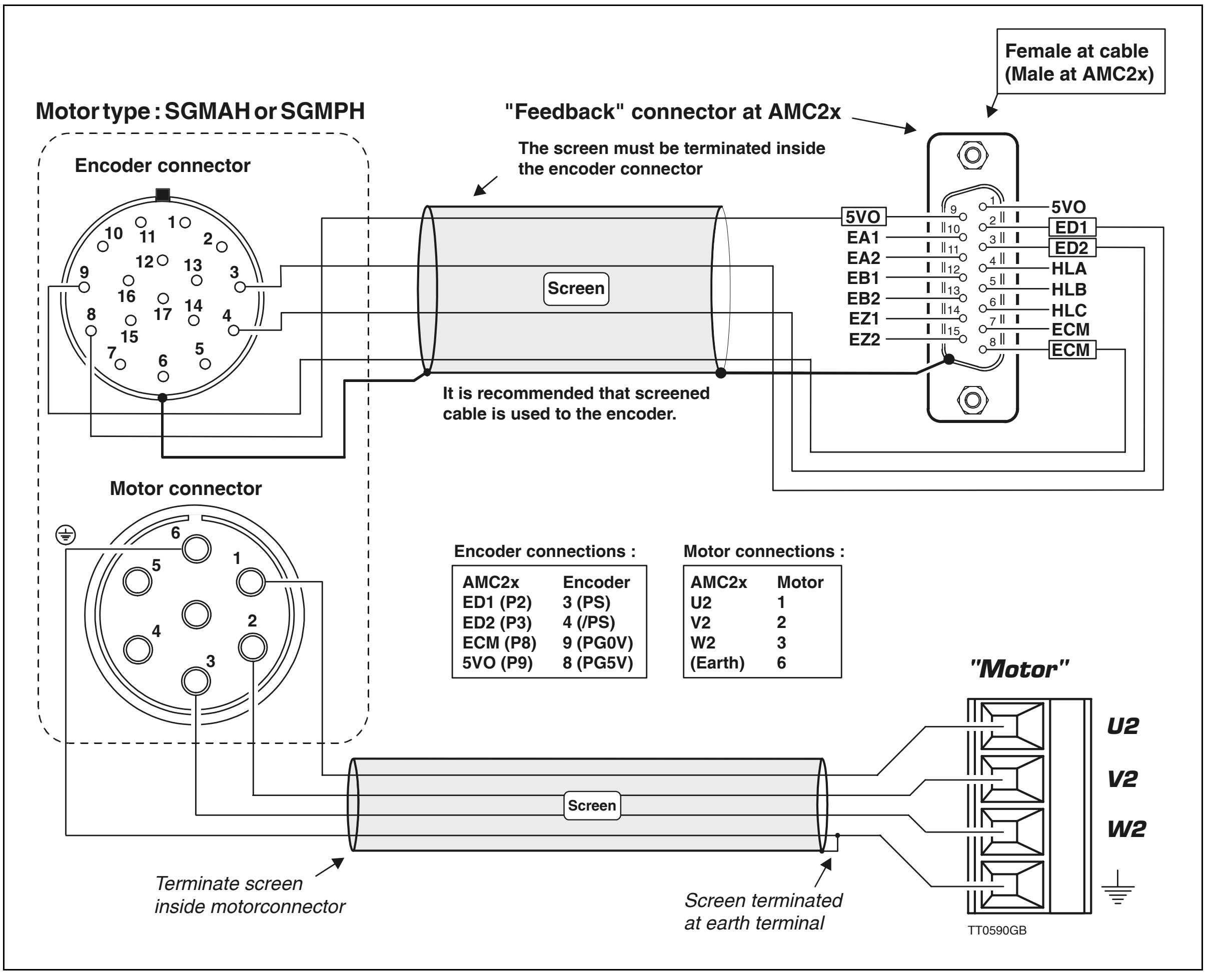


See also *Accessories*, page 207 for a list of standard cables.

5.8 Examples of Motor Connection

5.8.2 Yaskawa series SGMAH, SGMPH.

If set-up is performed with the MotoWare parameter set-up, select the correct motor in the motor library. Follow this setup by running an auto-tuning to optimise the filter parameters. See also *General Aspects of Installation*, page 12.



The screen must be terminated inside the encoder connector

It is recommended that screened cable is used to the encoder.

Terminate screen inside motorconnector

Screen terminated at earth terminal

Encoder connections :

AMC2x	Encoder
ED1 (P2)	3 (PS)
ED2 (P3)	4 (/PS)
ECM (P8)	9 (PG0V)
5VO (P9)	8 (PG5V)

Motor connections :

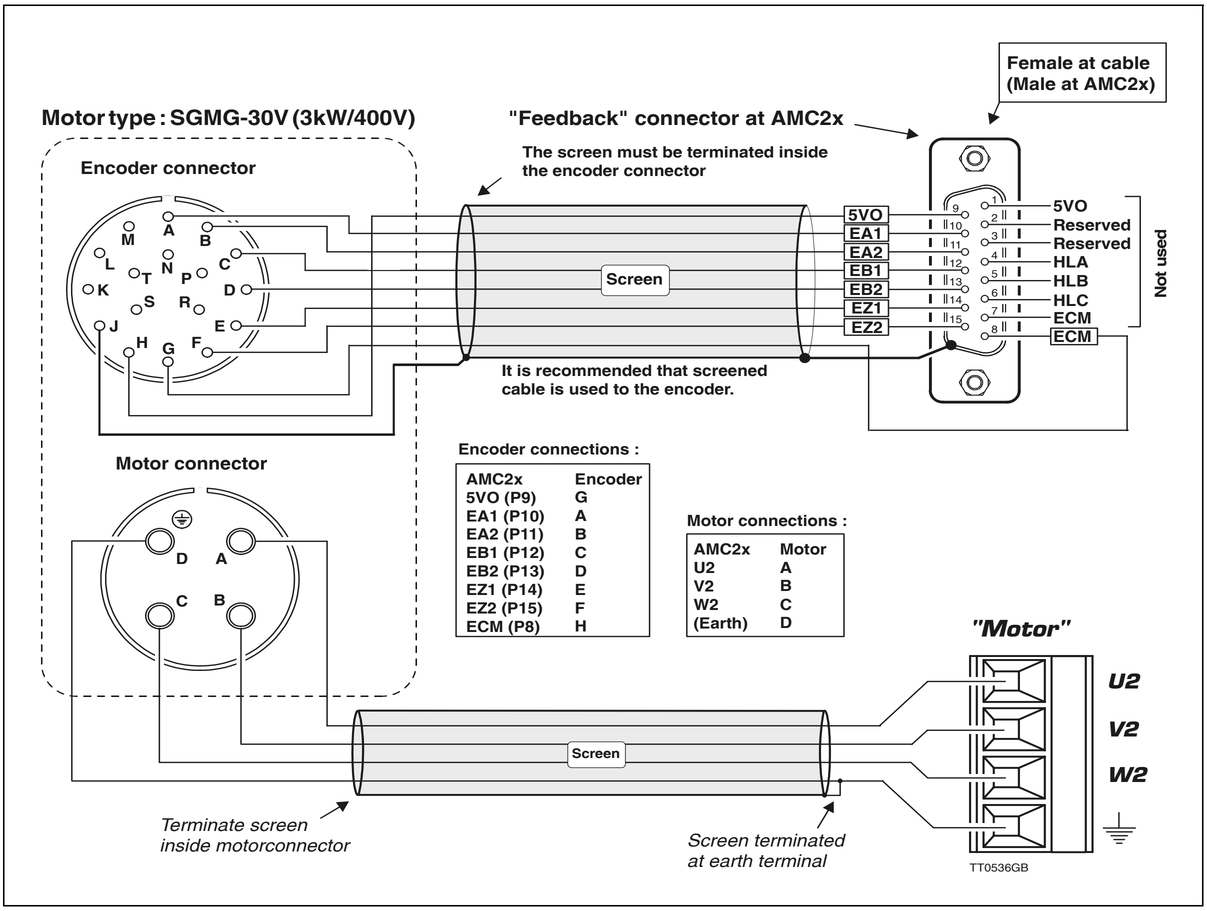
AMC2x	Motor
U2	1
V2	2
W2	3
(Earth)	6

See also *Accessories*, page 207 for a list of standard cables.

5.8 Examples of Motor Connection

5.8.3 Yaskawa SGMG, SGMS series

If set-up is performed with the MotoWare parameter set-up, select the correct motor in the motor library. Follow this setup by running an auto-tuning to optimise the filter parameters. See also *General Aspects of Installation*, page 12.


Female at cable
(Male at AMC2x)
Motor type : SGMG-30V (3kW/400V)
"Feedback" connector at AMC2x
Encoder connector
The screen must be terminated inside the encoder connector
M
A
B
L
C
T
N
P
K
D
S
R
J
E
H
G
F
Screen
5VO
EA1
EA2
EB1
EB2
EZ1
EZ2
9
10
11
12
13
14
15
1
2
3
4
5
6
7
8
5VO
Reserved
Reserved
HLA
HLB
HLC
ECM
ECM
Not used
It is recommended that screened cable is used to the encoder.
Motor connector
D
A
C
B
Screen
"Motor"
U2
V2
W2
Terminate screen inside motorconnector
Screen terminated at earth terminal
TT0536GB

Encoder connections :

AMC2x	Encoder
5VO (P9)	G
EA1 (P10)	A
EA2 (P11)	B
EB1 (P12)	C
EB2 (P13)	D
EZ1 (P14)	E
EZ2 (P15)	F
ECM (P8)	H

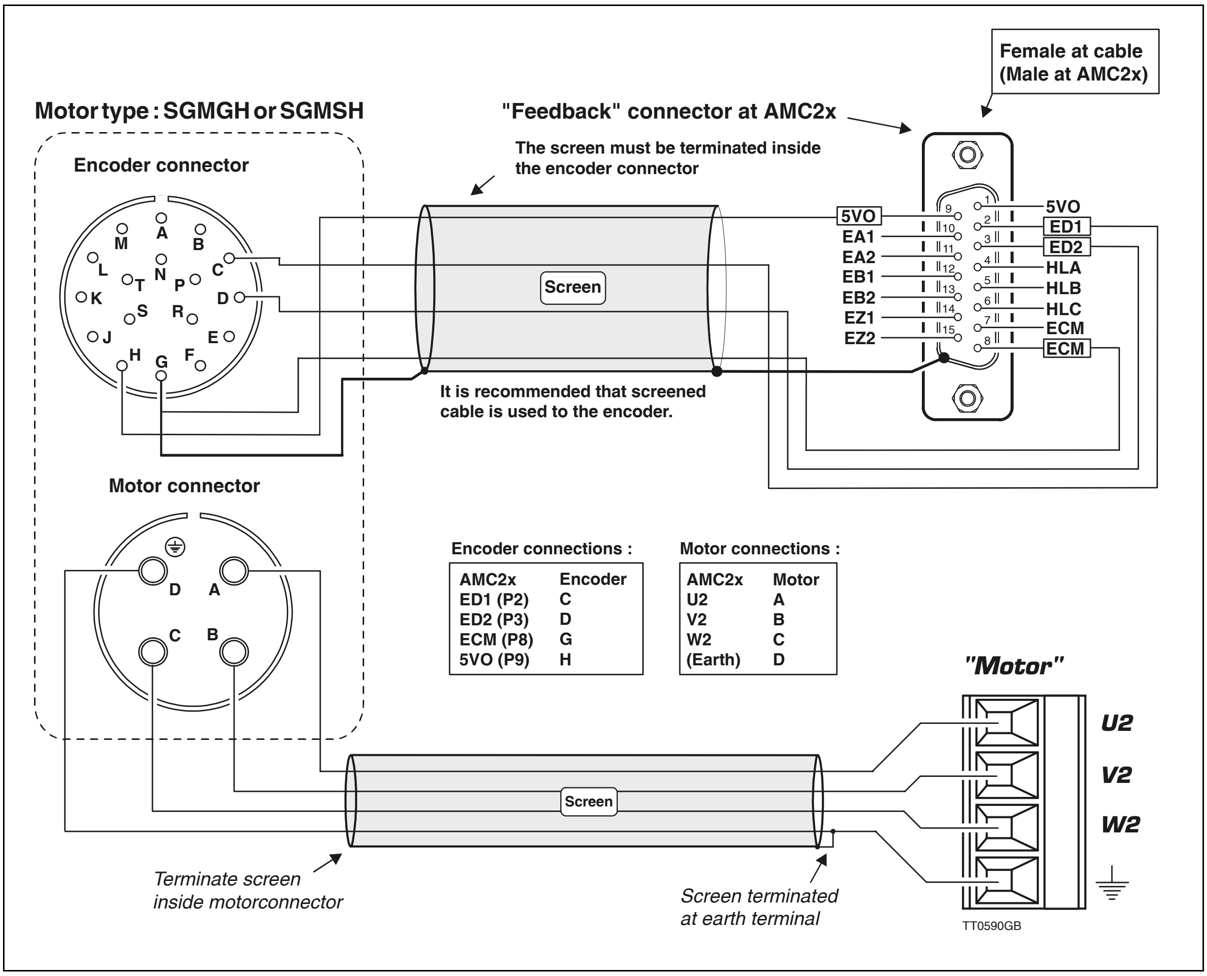
Motor connections :

AMC2x	Motor
U2	A
V2	B
W2	C
(Earth)	D

See also *Accessories*, page 207 for a list of standard cables.

5.8.4 Yaskawa SGMGH, SGMSH series

If set-up is performed with the MotoWare parameter set-up, select the correct motor in the motor library. Follow this setup by running an auto-tuning to optimise the filter parameters. See also *General Aspects of Installation*, page 12.


Female at cable
(Male at AMC2x)
Motor type : SGMGH or SGMSH
"Feedback" connector at AMC2x
Encoder connector
The screen must be terminated inside the encoder connector
M
A
B
L
T
N
P
C
K
S
R
D
J
E
H
G
F
Screen
5VO
EA1
EA2
EB1
EB2
EZ1
EZ2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
5VO
ED1
ED2
HLA
HLB
HLC
ECM
ECM
It is recommended that screened cable is used to the encoder.
Motor connector
D
A
C
B
"Motor"
U2
V2
W2
Screen
Terminate screen inside motorconnector
Screen terminated at earth terminal
TT0590GB

Encoder connections :

AMC2x	Encoder
ED1 (P2)	C
ED2 (P3)	D
ECM (P8)	G
5VO (P9)	H

Motor connections :

AMC2x	Motor
U2	A
V2	B
W2	C
(Earth)	D

5.8 Examples of Motor Connection

5.8.5 Linear Drives - Size 2504 with Hall

If set-up is performed with the MotoWare parameter set-up, select the correct motor in the motor library. Follow this setup by running an auto-tuning to optimise the filter parameters. See also *General Aspects of Installation*, page 12.

Motor connections.

Motor	AMC2x motor connector.
Red	U2
Yellow	V2
Blue	W2
Green	Earth

Hall connections.

Hall	AMC2x feedback connector (SUBD15 pole)
H0+ (Yellow)	Pin 4
H1+ (Violet)	Pin 5
H2+ (Blue)	Pin 6
0V (Green)	Pin 7
+V (Red)	Pin 1
Black	Unused
White	Unused
Grey	Unused
Brown	Unused
Pink	Unused
Shield	Case.

Encoder (Renishaw 9pole)	AMC2x feedback connector (SUBD15 pole)
A+ (Pin 2)	Pin 10
A- (Pin 6)	Pin 11
B+ (Pin 4)	Pin 12
B- (Pin 8)	Pin 13
Z+ (Pin 3)	Pin 14
Z- (Pin 7)	Pin 15
5V (Pin 5)	Pin 9
0V (Pin 1)	Pin 8
Inner shield (Pin 9)	Pin 8
Outer shield	Case

5.9 Using Linear Motors

5.9.1 Conversion Formulae

Please note that all the speed related registers in AMC2x are specified with reference to a rotating motor.
Example:
VM (nominal speed) is expressed in RPM (revolutions per minute).

When using the Controller to drive a linear motor, all of the speed related registers must be converted.
The following formulae give the conversion between RPM and m/s or vice versa.

Parameters involved:

POLEPITCH The pole pitch in m
Example : A certain motor has 50mm between the poles which means that an electrical cycle is 50mm long.

ENCRES The encoder resolution in m. If the encoder has a resolution of 1micron, ENCRES is set to 0.000001. Note that most of the linear encoders are defined in terms of total resolution (total transitions at the A and B channels). In contrast rotary encoders are always defined as the number of pulses which is 4 times lower than the number of transitions.

POL Physical register in the AMC2x.
The selected number of poles, according to the POL register. Always use POL=2.

VM Physical register in the AMC2x.
The selected top speed in RPM.

AC Physical register in the AMC2x.
The selected acceleration in RPM/s.

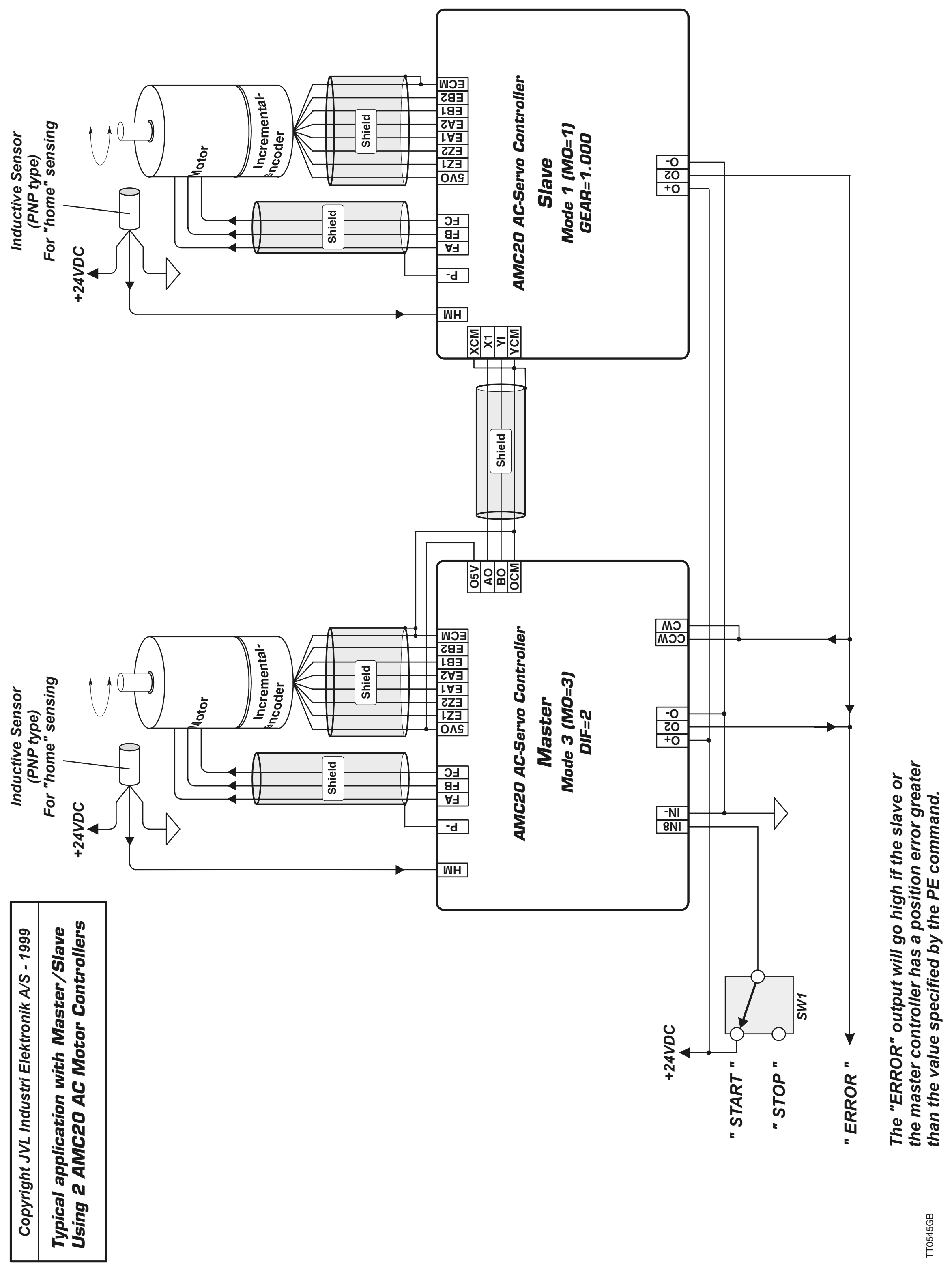
Speed related parameters can be converted using the following formulae:

$$\text{Velocity} = \frac{\text{VM} \cdot \text{PR} \cdot \text{ENCRES}}{15} \qquad \text{VM} = \frac{\text{Velocity} \cdot 15}{\text{PR} \cdot \text{ENCRES}}$$

$$\text{Acceleration} = \frac{\text{AC} \cdot \text{PR} \cdot \text{ENCRES}}{15} \qquad \text{AC} = \frac{\text{Acceleration} \cdot 15}{\text{PR} \cdot \text{ENCRES}}$$

VM : The speed in RPM
AC : The acceleration in RPM/s
Velocity: The speed in m/s
Acceleration: The acceleration in m/s^2

5.10 Typical Applications



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Typical application with Master/Slave Using 2 AMC20 AC Motor Controllers

The "ERROR" output will go high if the slave or the master controller has a position error greater than the value specified by the PE command.

5.11 Accessories

JVL supplies the following accessories for use with the Controller.

5.11.1 Software

JVL's unique MotoWare software can be used for set up and installation of the Controller. MotoWare also includes a motor library and program editor for making advanced motion-control programs which can be downloaded to the AMC2xP Controllers.

5.11.2 Cables

The following cables are available for programming interface, motor etc.

Motor cables (only motor)			
Type (order no.)	**Motor manufacturer**	**Motor type**	**Power Range**
WM19xx	Yaskawa	SGM(E) / SGMP	SGM(E) : 0-750W SGMP : 0-1500W
WM20xx	Drive Systems	BLS70	750W
WM21xx	Yaskawa	SGMG/SGMS	SGMG : 0.5 - 0.9 - 1.3 kW SGMS : 1.0 - 1.5 kW
WM22xx	Yaskawa	SGMG/SGMS	SGMG : 2 - 3 kW SGMS : 3 kW
WM23xx	Yaskawa	SGMG/SGMS	SGMG : 4.4 - 5.5 - 7.5 kW SGMS : 4.0 - 5.0 kW

All motor cables can be delivered in any length. Specify the WM number and 2 digits depending on the motor type. The last 2 digits specify the required length in metres.
Example : WM1905 specifies a cable for a Yaskawa SGM/SGMP motor and a required length of 5 metres.

Encoder cables			
Type (order no.)	**Motor manufacturer**	**Motor type**	
WE14xx	Yaskawa	SGM(E) / SGMP	
WE15xx	Drive Systems	BLS70	
WE16xx	Yaskawa	SGMG/SGMS	

All encoder cables can be delivered in any length. Specify the WE number and 2 digits depending on the motor type. The last 2 digits specify the required length in metres.
Example : WE1403 specifies a cable for a Yaskawa SGM/SGMP motor and a required length of 3 metres.

Programming cables between PC and AMC2x Controller			
Type (order no.)	**Length**	**PC connector**	
RS232-9-1	3m	9 Pole SUB-D	

6 Index