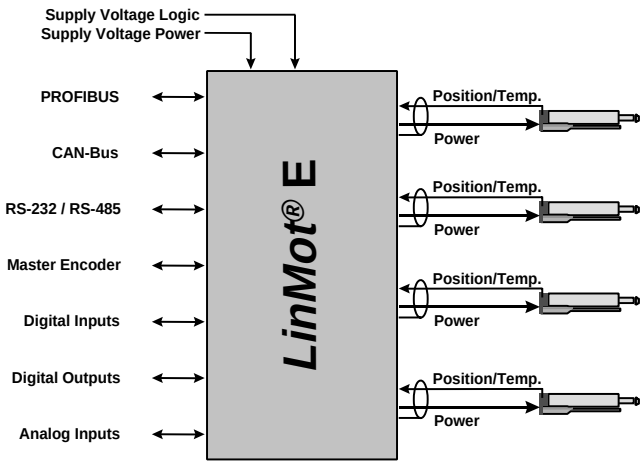
Servo Controller *LinMot*® E

LinMot® E

LinMot® comprises various families of servo-drives that are primarily designed for linear motion. For their actuation, highly integrated *LinMot*®-E servo controllers are available. *LinMot*®-E servo controllers include a power section for driving the motors as well as a control section with an integrated position controller. This allows the direct setting of positional set-points or the calling up of stored motion profiles from an overlaid control system by means of simple analog or digital signals. Connection to the overlaid control system can also be made via a serial port or a field bus. The control section looks after all control and monitoring actions necessary for controlling the drives.

LinMot®-E is a family of modular servo controllers that are derived from each other. The user can chose between units in various performance classes for up to four different, independently controllable motors. Linear motors from various LinMot families can be connected to the same controller as well as standard two-phase stepping motors and solenoids.



System representation of a Servo Controller with four linear motors

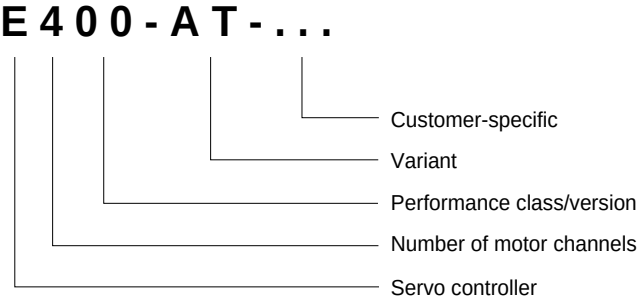
LinMot® servo controllers are normally used as drive controllers. Using signals from an overlaid control system, the motors are driven to the positions required. This action can be combined with the use of integrated motion profile curve functions. This allows jumps in set points to be carried out in a non-jerky and gentle manner. Customised functions, complete sequential control or PLC functions can be integrated into the servo controller using application software.

The configuration of the *LinMot*®-E servo controller is done on a menu basis using the windows-based *LinMot*® Talk PC-software. *LinMot*® Talk also assists the user when commissioning the drives: On-line measurements of motor data and movements made by the controller can be shown in graphical form and stored on a PC.

Construction forms and designation scheme

LinMot®-E servo-controllers are available in two performance classes: Series 100 and Series 1000 for the control of one, two or four motors. Units of a particular performance class with different control interfaces have the same outside dimensions, but differ in respect to hardware and software.

The key to the designation scheme is illustrated by the following example for the *LinMot*®-E 400AT servo controller:



Types of motor which can be connected

The *LinMot*®-E servo controller's hardware allows any type of single or two-phase motors (*LinMot*® linear motors, stepping motors, solenoids etc.) to be connected. Each motor channel consists of the four connections for the two motor phases, two inputs for the collection of positional data and one input for the monitoring of motor temperature. The motor cable between the servo controller and Series P01 linear motors can be extended using *LinMot*® motor cable up to 50m in length.

Mixed system configuration comprising LinMot® P02-23x80 and P01-23x160 linear motors, LinMot®-E 400 servo controller along with a stepping motor and a solenoid.

Position control and motion profiles

The servo controllers include a complete digital position-control system. This means there are no drift or offset problems, such as those encountered with analogue controllers. Further, it is possible to define motion profiles and thus follow adapted motion profiles.
Trajectory control is particularly of great importance in connection with the highly dynamic *LinMot*® P linear motors.

Modes of operation

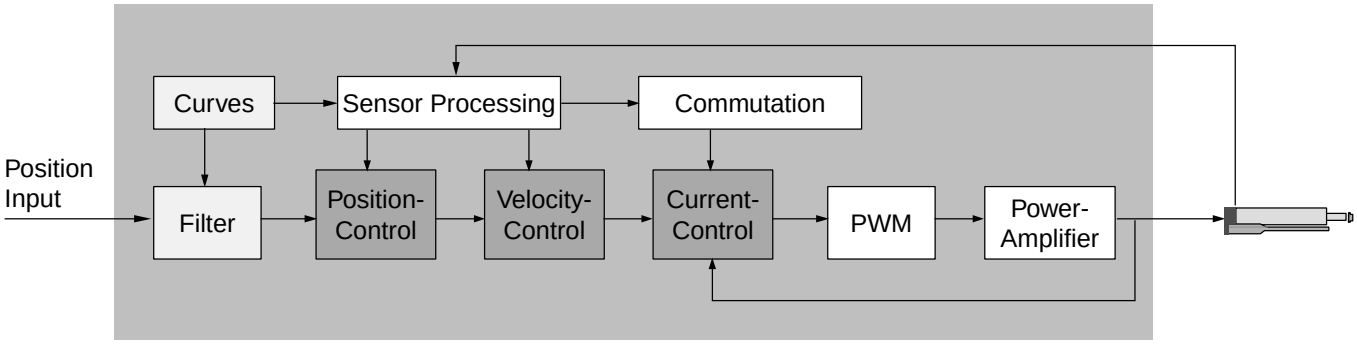
Depending on the type of *LinMot*®-E servo controller, various different modes of operation are available. The modes of operation define the control interface, the method for defining set points and how error reports are handled by the overlaid control system.

±10V Servo Interface
The new VF series Servo Amplifier provides standard interfacing to an external position controller or multi axes motion controller. A ±10V analog signal from the overlaid position control loop controls force or velocity of the linear motor. Position feedback from the linear motor's internal position sensor can be accessed by means of incremental position signal outputs. These signals allow to close the position loop externally without any external position sensors.
In the force mode the VF Servo Amplifier works like a torque-mode Amplifier for rotary motors. The analog command signal is converted into a output current for the linear motor. This current will generate a force in the Linear Motor that is proportional to the input voltage. In the velocity mode the analog input voltage is corresponding to the velocity of the slider. In both operation modes, the position loop must be closed by an external motion controller.

Analogue positional set-point
For the analogue setting of positional set-points, the supervesory controller passes down the set-point directly as an analogue signal. In the servo controller, the working range is defined by allocating positions to the maximum and minimum input voltage. By inputting the appropriate voltage, any position in the working range can be reached.

Two-point operation
In two-point operation, two end positions can be reached by using a digital input signal. The two end positions are configured in the servo controller and can be chosen at will. This mode of operation allows pneumatic cylinders to be directly replaced: instead of the valves, the servo controller is controlled by digital control signals.

Running motion profiles (up to two)
In this mode, two freely defined motion profiles per drive can be called up. The profiles, which are stored in the drive electronics, are run on the rising and falling transitions of the digital input signals.



Simplified block diagram of the digital motor position control

Running motion profiles (up to sixty-four)
This mode allows up to 64 various motion profiles to be defined per drive. The profiles, which are stored in the drive electronics are started by addressing them via the digital input signals.

Programmed sequences
Complex motion sequences are laid down on a step-for step basis in a table. The instructions stored in the drive electronics are worked through one by one via digital input signals or are directly addressed individually.

Teach-in
When configuring the servo controller, the positions targeted are laid down in a table. In the teach-in mode, the slider of the linear motor is brought by hand into the position required and the current position stored in the table. The positions stored in the drive electronics are called up via the digital input signals.

Step, Direction
In the stepping motor mode, one linear motor per controller can be positioned using two digital signals from the overlaid controller. The first signal defines that a step should be carried out and the second defines the direction of motion. Step values can be configured to the values required.

RS 232 serial operation
The overlaid controller can communicate with the servo controller via an RS 232 interface. Using an ASCII protocol, setpoint positions can be directly defined or motion profiles that are stored in the servo controller can be run. The serial interface makes it possible to call up current values such as the actual position or the motor current of the linear motor. A detailed description of the ASCII protocol and the commands available can be found in the annexe.

RS 485 serial operation
Via an RS485 interface, up to 24 linear motors can be controlled from the overlaid system. Using the ASCII protocol the same functions ca be activated as with the RS 232 interface. A detailed description of the ASCII protocol and the commands available can be found in the annexe.

Field buses Profibus / DeviceNet
Using a field bus interface, up to 125 servo controllers can be integrated into a single bus system. The field bus standards for Profibus DP or DeviceNet allows the direct definition of positional set-points, as well as the running of motion profiles stored in the servo controller. The connection via field buses makes it possible to call up current values such as the actual position or the motor current of the linear motor. The standard field bus interfaces guarantees trouble-free commissioning and reliable operation with control systems from different suppliers.

CAN bus
The CAN field bus allows the operation of up to 32 servo controllers in a field bus system. As no standardised protocol for all control systems is available, protocols are integrated on a customer-specific basis. Basically, all the standard functions can be implemented as is possible with the with the ASCII command described in the annexe.

Synchronisation with main shaft / Encoder follower
When mechanical cams are to be replaced or in applications where the linear motor is to perform motions synchronised to a main shaft or to a master drive, the Master Encoder Interface is necessary. The Master Encoder Interface allows the synchronous running of motion profiles that are stored in the servo controller. The overlaid control system only has to indicate which profile is to be implemented.

Synchronisation / PROFIBUS DP
The synchronisation with a main shaft or to a machine drive is possible using the PROFIBUS DP interface. The synchronisation signals are provided over the Master Encoder Interface and the required motion profile is selected via the PROFIBUS DP interface.

Overview *LinMot*® Servo Controllers

Servo Controller		-AT	-MT	-DP	-DN	-VF	-ME
Analog position mode		x	x		x		
Two point operation		x	x	x	x		
Running motion profiles (max 2)		x	x	x	x		
Running motion profiles (max 64)			x	x	x		
Step, Direction			x		x		x
Serial Interface RS232	57.6kBaud	x	x				
Serial Interface RS485	57.6kBaud	x	x				
Profibus DP	12MBaud			x			x
DeviceNet	500kBaud				x		x
SERVOnet	500kBaud				x		
CAN Bus	500kBaud		x				
Synchronisation to main shaft			x	x	x		x
Analog servo interface -10....+10V for velocity						x	
Analog servo interface -10....+10V for force						x	
Customer specific implementations			x	x	x	x	x

* For STEP/DIR or main shaft synchronisation, Master Encoder Module ME01 will be required.

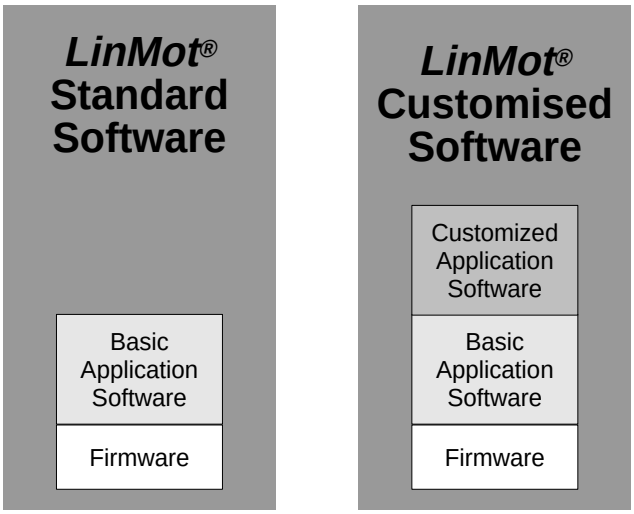
Alarms and error messages

For each of the motors connected, *LinMot*®-E servo controllers are equipped with independently configurable masks for fault signalling and warning messages. Apart from the usual error messages, warnings can be issued. These make it possible for early action to be taken if particular operational parameters are exceeded or for the overlaid control system to run the machine down in a controlled manner. In order to ensure fast and secure fault identification and correction, operational and fault states are indicated in a coded form by LEDs on the front side of the controllers.

Firmware

As with the *LinMot*® series of hardware products, the software is also modular and allows the simple integration of customer-specific extensions (applications).

The following illustrations show graphically how the software is constructed. The so-called "Firmware" forms the base layer, which controls internal, hardware-close functions.



The "basic application software" placed above the firmware provides the user with all functions in connection with the control of motor position. Customer-specific application programmes can be integrated as the third level in the software structure (see chapter on "application software" in the annexe).

Power supplies

All servo controllers are provided with separate power supplies for the logic and power sections. This allows the power section to be cut off if an emergency situation arises at machine level whilst keeping the supply for the logic functions active. In this way, no current data is lost and communication with the up-line control system is still possible even in emergency stop situations.

Power consumption of the power section depends directly on the number of motors connected and their loading. Assuming that all motors do not have to deliver peak power at the same time, the power supply can be dimensioned significantly smaller than if the peak power requirements of all connected motors were added together.

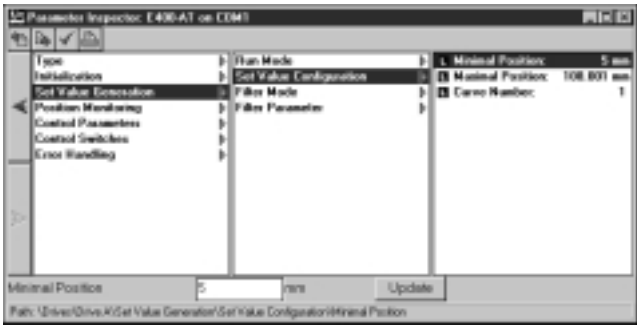
For the supply of voltage to the servo controllers, only approved, DC isolated power supplies may be used.

LinMot® Talk Configuration Software

The *LinMot*® Talk configuration software is an MS-Windows-based interface, which supports the user when configuring and commissioning the *LinMot*®-E servo controllers. The software exhibits a powerful modular graphical interface, which covers all tasks encountered when using of *LinMot*®-E servo controllers. During its development, great value was laid on a high level of usability. A short description of the five main modules follows.

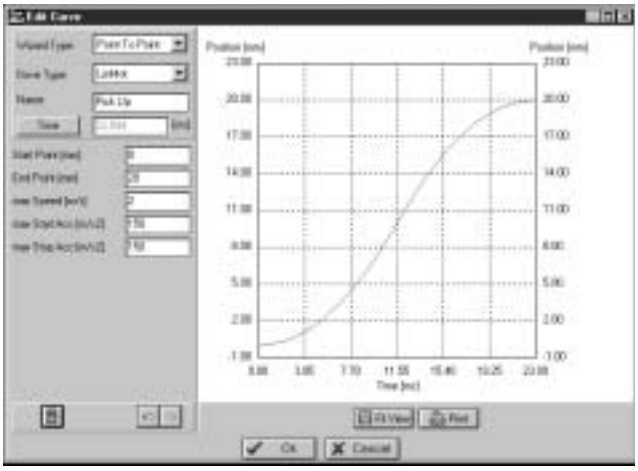
PARAMETER INSPECTOR

Using the parameter inspector, the *LinMot*®-E servo controller's parameters can be adjusted in a simple and easy way. Whole sets of parameters can be loaded, stored and printed. The user is provided with several possibilities for making settings. These apply to initialisation, operating modes, error management, warning messages and control parameters. The parameters are set using the parameter inspector. All settings made may be stored at will and transferred to other controllers.



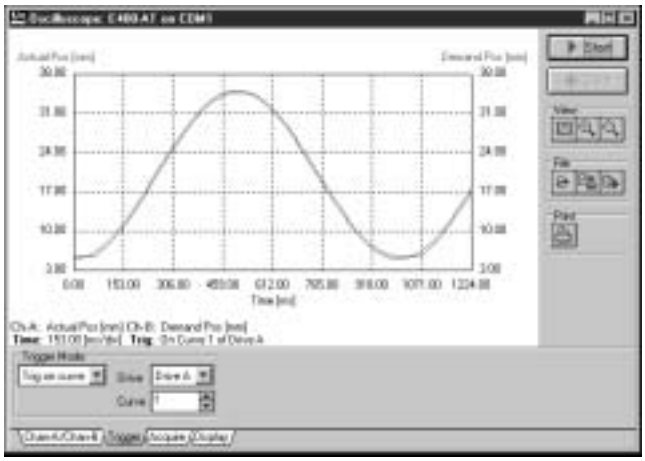
CURVE EDITOR

The "curve editor" can be used to generate and manage the set-point curves required for *LinMot*®-E controllers. Existing curves can be loaded, stored edited, hung together and printed. This allows the required motion profiles to be generated. Also, using MS Excel, existing motion profiles can be imported or complex motions generated which are put together as one likes. These are loaded in the servo controller by the "curve inspector" in a simple manner.



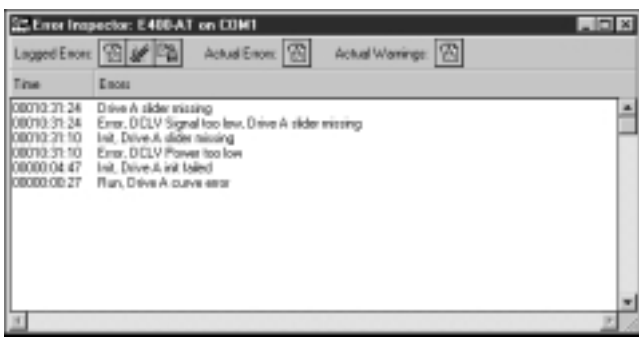
OSCILLOSCOPE

The oscilloscope" assists the user when commissioning a *LinMot*® system. Internal variables like set-points and actual positions are registered in real time and displayed on the screen and can subsequently be printed out. The data captured can be stored in CSV-format for further processing in MS Excel or for use in documentation.



ERROR INSPECTOR

Using the "error inspector", the user can display stored error messages and all current faults and warnings from the *LinMot*® servo controller. The last 10 error messages and the reading of the hours of operation counter are stored in the servo controller's memory.
Further, the status of all inputs and outputs can be read using the "error inspector". This allows the signals to and from the overlaid controller to be looked at in a fast and uncomplicated way.



Force Velocity Servo Amplifier

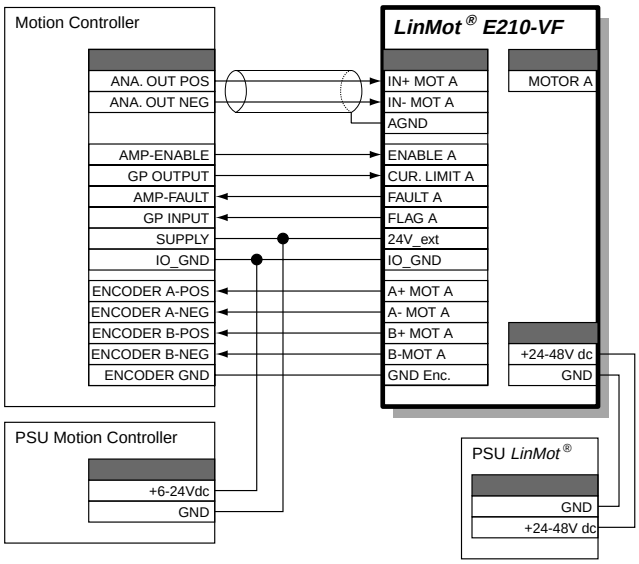
The E210-VF and the more powerful E2010-VF two channel servo amplifiers will allow *LinMot*® P linear motors to be integrated in standard motion controller systems with analog velocity or force (torque) output. For position feedback no additional sensor is required.

SYSTEM DESCRIPTION

The *LinMot*® servo amplifiers E210-VF and E2010-VF accept as command signals between -10V and +10V. These signals command either the force or the velocity of a connected LinMot. The current position of the motor is available as incremental position signal (A/B).

The amplifier supports two completely independent axis. Each axis has its own control and status signals.

The servo amplifiers can be easily configured with the Windows based *LinMot*® Commander over the serial interface.



OPERATING MODES

Force - Mode

The amplifier works in the foce-mode like a torque-mode amplifier for rotary motors. The analog command signal is converted to the current the amplifier is outputting into the connected motor. The current is directly linked to the produced force over the motor constant c_f found in the motor datasheets.
There is no velocity-loop in the amplifier. The velocity-loop must be closed by the motion controller.

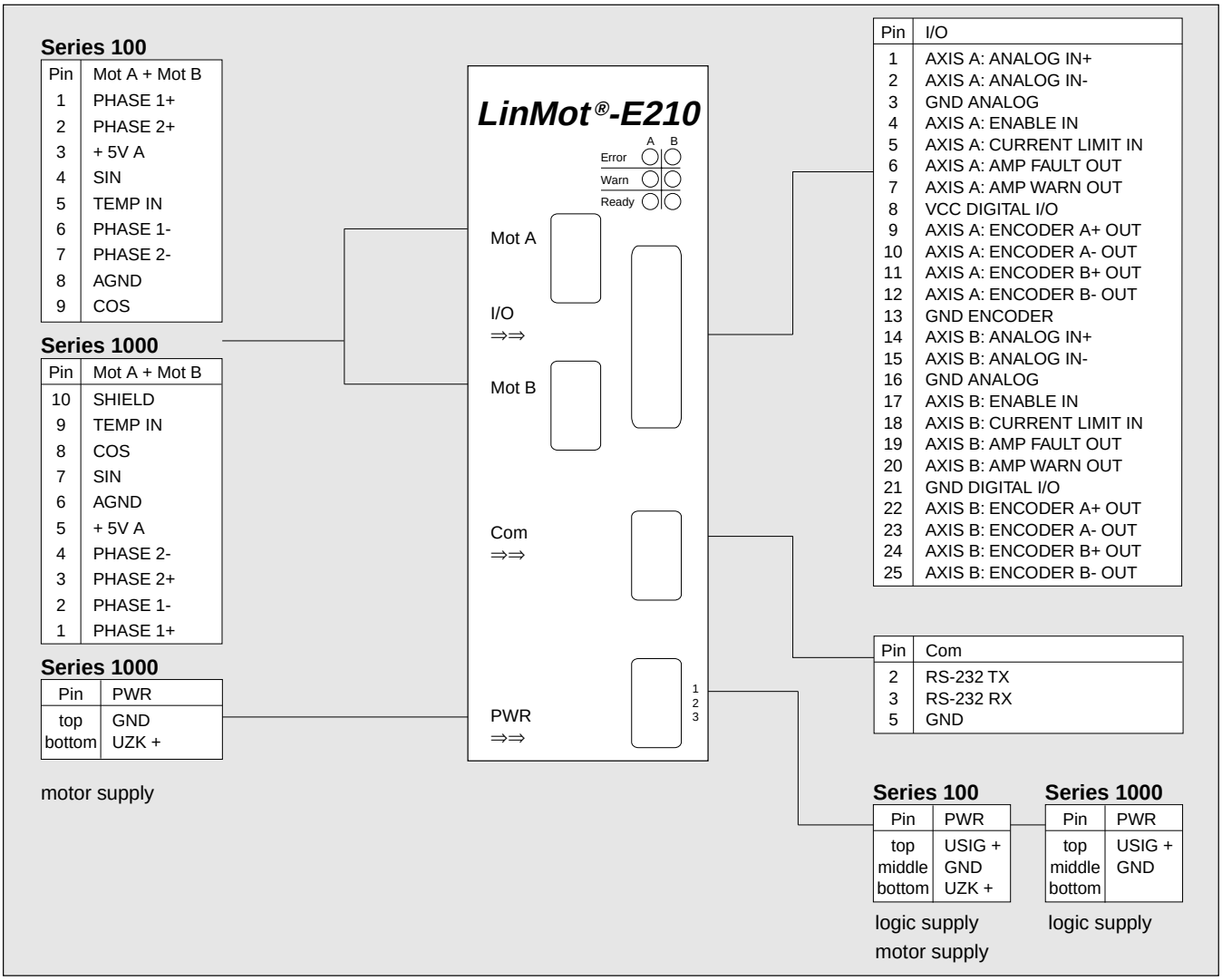
Velocity - Mode

The analog command signal is converted to a velocity the connected linear motor moves with. The velocity loop is closed inside the amplifier by a PI structured controller.

Current Limit Adjustments

The *LinMot*® E2x10-VF Servo Controller features an additional current limit control by a digital input.
Motion can be executed with full dynamic at maximum current. If the work peace has to be handled gently, the maximum current (and force) of the motor can be reduced to a save level.

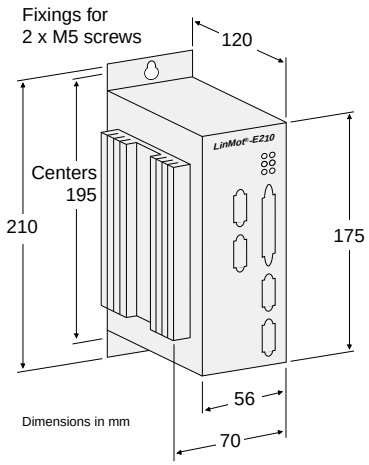
TERMINALS



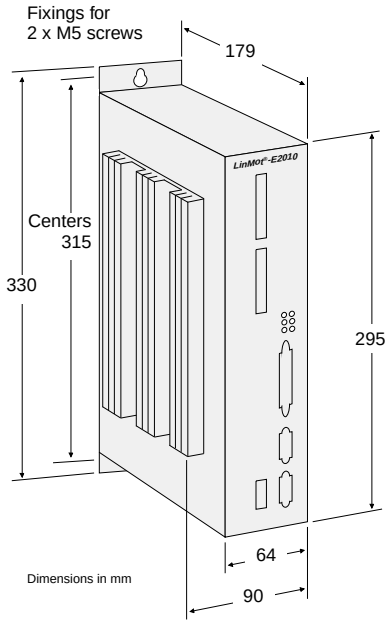
Signal	Description	Electrical Specification	
ANALOG IN +/-	Analog command input	not referenced to analog GND	(-10V ... +10V)
GND ANALOG	Analog GND / Shield	do not be connected with Controller	
ENABLE IN	Amplifier enable / disable	galvanic isolated input	(max. 24V / 20mA)
GP IN	General Purpose Input	galvanic isolated input	(max. 24V / 20mA)
FAULT OUT	Amplifier fault output	isolated high side switch output	(max. 24V / 250mA)
WARNING OUT	Warning output	isolated high side switch output	(max. 24V / 250mA)
VCC DIGITAL I/O	I/O Supply	supply for digital outputs	(6..24V DC / <1A)
GND DIGITAL I/O	I/O GND	return for output supply and inputs	
ENCODER A +/-	Quadrature position outputs A track	differential output (RS422)	(5V)
ENCODER B +/-	Quadrature position outputs B track	differential output (RS422)	(5V)
GND ENCODER	Encoder ground	ground input for position signals	
RS-232 RX/TX	RS232 Receive/Transmit	Serial connection to PC	

LinMot® Servo Amplifier					
		E110-VF	***E210-VF***	***E1010-VF***	***E2010-VF***
Number of motor Channels		1	2	1	2
Max. current output per phase	A	3		6	
Logic supply	V_{DC}	24..48		24..48	
Power consumption logic	W	5		10	
Motor supply	V_{DC}	24..48		48..72	
Digital Inputs		2 per Axis		2 per Axis	
Analog Inputs		1 per Axis (-10V..+10V, 12Bit)		1 per Axis (-10V..+10V, 12Bit)	
Encoder Outputs		A+,A-,B+,B- (RS422) per Axis		A+,A-,B+,B- (RS422) per Axis	
Encoder Resolution		1,2,5,10µm		1,2,5,10µm	
Digital Outputs		2 per Axis		2 per Axis	
RS232-Interface		1		1	
Width	mm (in)	70 (2.8)		90 (3.5)	
Height	mm (in)	210 (8.3)		330 (13)	
Height (without fixings)	mm (in)	175 (6.9)		295 (11.6)	
Depth	mm (in)	120 (4.7)		179 (7)	
Weight	kg (lb)	1.1 (2.4)	1.2 (2.7)	2.5 (5.5)	2.6 (5.7)
Case	IP	40		40	
Storage temperature	°C (°F)	-25..70 (-13..158)		-25..70 (-13..158)	
Operating temperature	°C (°F)	0..50 (32..122)		0..50 (32..122)	
Max. case temperature	°C (°F)	65 (149)		65 (149)	

E110-VF / E210-VF



E1010-VF / E2010-VF



Ordering Information

Servo Amplifier	Description	Art.-No.
E110-VF	Velocity Force Controller 1 axis (48V/3A)	0150-1651
E210-VF	Velocity Force Controller 2 axes (48V/3A)	0150-1652
E1010-VF	Velocity Force Controller 1 axis (72V/6A)	0150-1655
E2010-VF	Velocity Force Controller 2 axes (72V/6A)	0150-1656

Specification of products are subject to change without notification

Analog Trigger Servo Controller

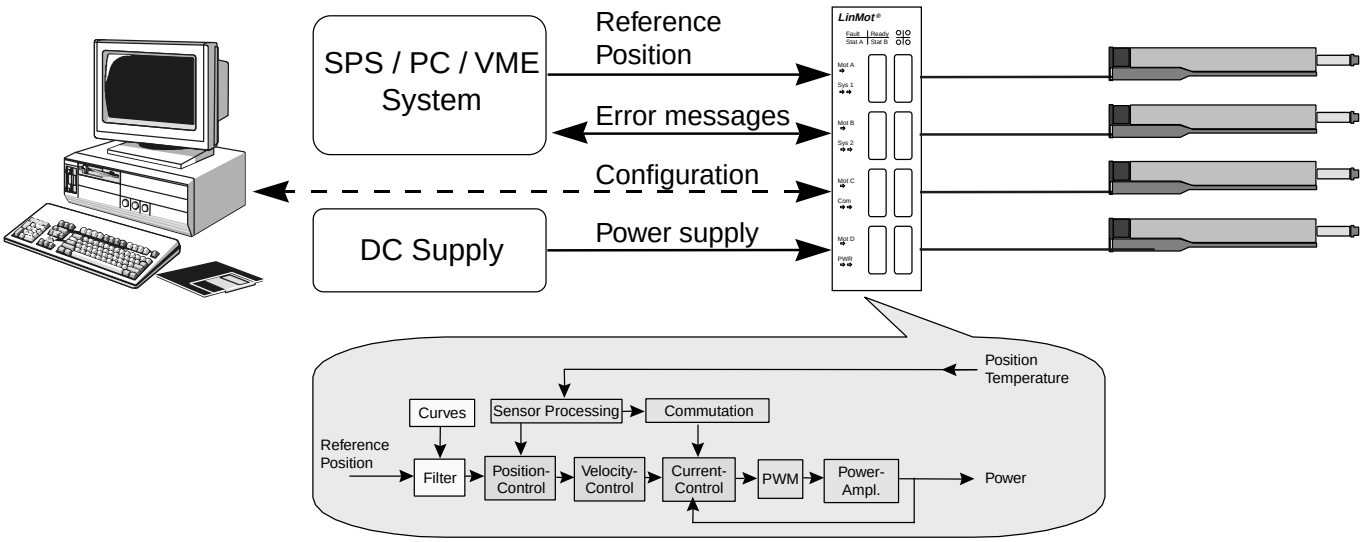
The Series E100-AT servo controllers and the more powerful Series E1000-AT offer, together with the *LinMot*® P family, ready-to-use positioning systems for one, two or four linear motors.

SYSTEM DESCRIPTION

The required value for the position is supplied directly by an overlaid controller (PLC, industrial PC, VME system) via analogue position signals or a serial interface. Motion profiles stored in the AT servo controllers can be run by simple digital triggering signals.

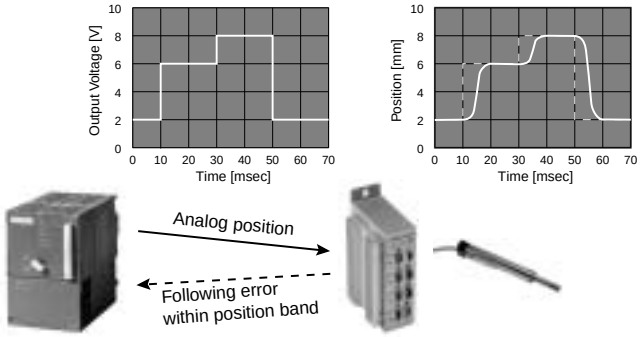
The servo controllers are configured using *LinMot*®Talk configuration software under MS Windows. Adjustments and settings made during commissioning can be stored on a PC and transferred to other servo controllers as necessary. For the configuration work, the servo controller is connected to the PC via an RS232 interface.

As an enhancement to the system, stepping motors and inductive loads such as solenoids or pneumatic valves can be controlled instead of linear motors. This feature allows, amongst other things, the synchronisation of linear motion with the control of gripping devices, solenoids etc.



Operating modes

Analogue position

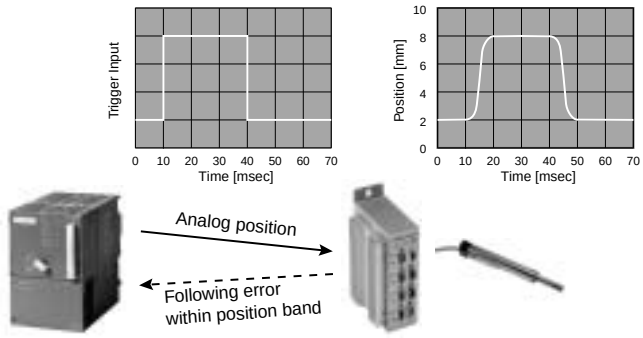


The required position is given via a voltage signal on the analogue input of the servo controller. The user can define the positional range represented by the voltage range at the analogue input.

In order to limit the enormous dynamics of the linear motors when jumps in set point values occur, maximum speed and acceleration can be defined independently for each linear motor.

The resolution of the analogue input is 10 bits.

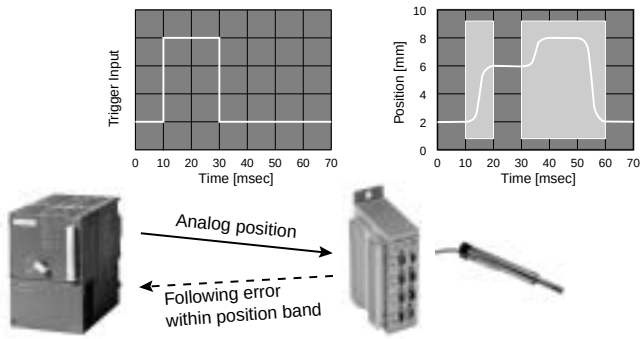
Two-point trig



If only two end positions have to be reached (e.g. replacement for a pneumatic cylinder), control is carried out in "two-point trig" mode. On the basis of a digital control signal, the two positions stored in the servo controller are executed.
The dynamics of the motor can be limited by defining maximum speed and acceleration.

End positions can be defined during operation via the RS 232 or RS485 interface and triggered by a digital signal.

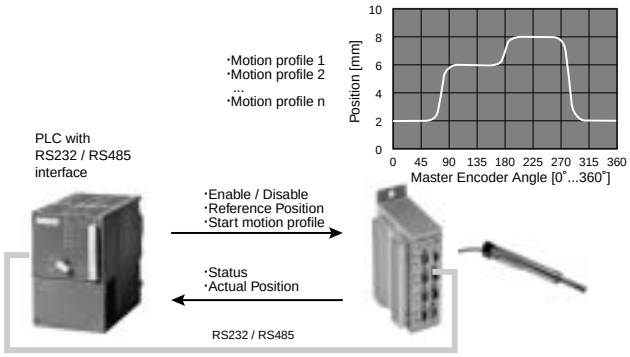
Trig curve / Continuous curve



In the servo controller, two freely chosen motion profiles can be stored per motor which are run on the rising and falling transitions of the digital input signal. An unrestricted number of profiles can be stored with up to 4,000 curve points. A linear interpolation is performed between the individual curve points. Profiles can be selected via the RS232 or RS485 interfaces and started via digital input signals.

In the continuous curve mode, the linear motor travels continuously along the stored curve.

Serial position



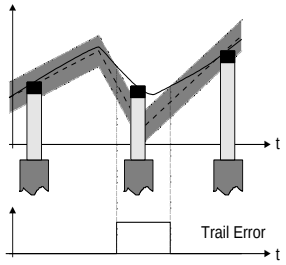
Up to six servo controllers can be controlled from overlaid controller via the serial interface (RS232, RS485). Required positions can be directly defined using the ASCII protocol or motion profiles stored in the servo controller run. The serial interface also provides possibilities to read out current values such as current position or motor current (force) of the linear drives.

A detailed description of the ASCII protocol and a list of commands can be found in the annexe.

Set-point filter

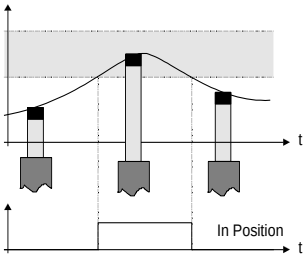
Using the built-in set-point filter, both the dynamics and the speed of the drives can be adjusted to the individual applications. The set-point filter allows a maximum allowable speed and a maximum allowable acceleration to be defined for each drive. Every movement made by the drive (e.g. set-point jump, freeze etc.) is carried out taking these limits into consideration. The dynamics of the profiles stored in the servo controller is not influenced by the filter settings.

POSITION MONITORING



Following Error

The difference between required position and actual position may not exceed tolerance values set by the user. If the difference (following error) is too large, a warning is issued via a digital output or the motors are stopped. Following errors occur when set-point curves are too fast, when moving (too) large masses or when sliders are jammed etc.

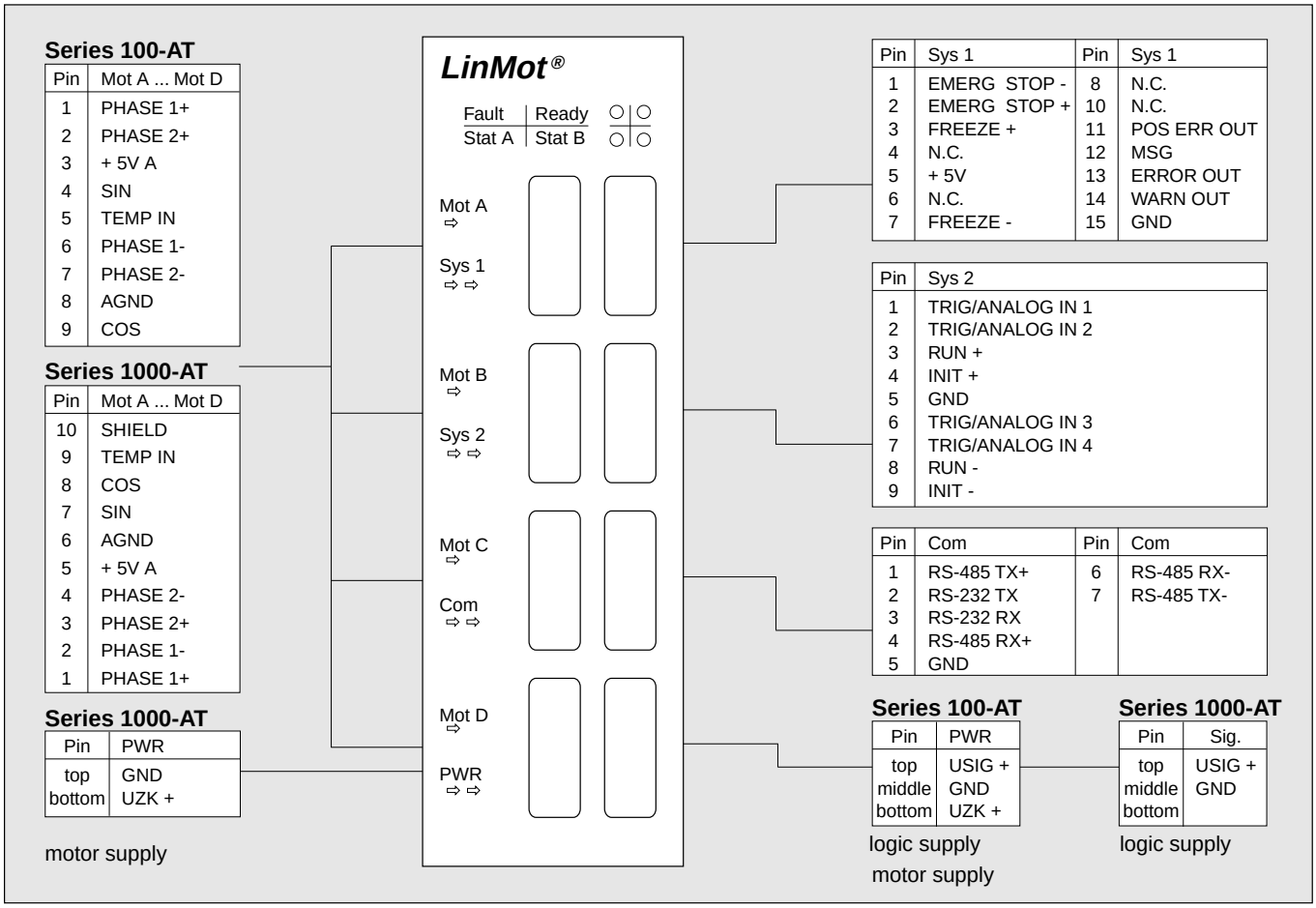


Band monitoring

For each motor there exists a freely definable position band. Should a slider be positioned outside this band, this is signalled via a digital output. This monitoring can be used in situations when a slider is in an area where other parts of the machine are in motion for a period of time and the overlaid controller should be informed when the slider is outside the danger area.

SPECIAL FUNCTIONS

Emergency stop	A SW "emergency stop" mode for the motors can be activated via a digital input. For each linear motor, it can be defined in the case of an emergency stop if the slider should stay where it is, travel to a particular position or if the motor is to be switched off.
Freeze	If this input is activated, all motors connected stop at their current position until the input is reset.
Error handling	To a great extent, the user himself can define under which conditions warning and error messages are issued.
Overheating	Both the electronics unit and the linear motors connected to it are protected from overheating by integrated temperature sensors.
Power supply	All servo controllers are provided with separate power inputs for the power and the logic sections. If the motors have to be switched off (e.g. emergency stop), it is sufficient to disrupt only the power supply to the power section, so that homing is not necessary on restart.
Master / Booster	In order to increase force, up to four linear motors can be driven in parallel in master / booster mode (see annexe).



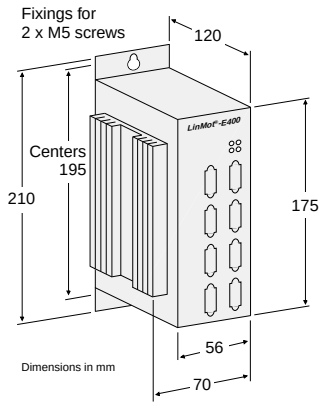
Signal	Description	Electrical specification	
INIT +/-	Motor initialization input	Isolated input	(max. 24 V / 20 mA) *
RUN +/-	Motor start input	Isolated input	(max. 24 V / 20 mA) *
EMERGENCY STOP +/-	Emergency stop input	Isolated input	(max. 24 V / 20 mA) *
FREEZE +/-	Freeze position input	Isolated input	(max. 24 V / 20 mA) *
TRIG/ANALOG IN 1/2/3/4	Analog position set value or digital trigger inputs	Analog position input Digital trigger inputs	(0…10 V / 100 kΩ) * (max. 24 V)
WARNING OUT	Warning output	Open collector output	(max. 24 V / 50 mA)
ERROR OUT	Error output	Open collector output	(max. 24 V / 50 mA)
Pos ERROR OUT	Position error output	Open collector output	(max. 24 V / 50 mA)
MSG OUT	Message output	Open collector output	(max. 24 V / 50 mA)
+5V	5V output	Logic supply output	(max. 50 mA)
RS-232 TX/RX	RS232 Transmit / Receive	Serial connection to the PC	
USIG+	Supply (logic)	Supply input logic	(24-48 VDC)
GND	Ground	Ground input for logic and input drives	
UZK+	Supply (power)	Supply series 100 Supply series 1000	(24-48 VDC) (48-72 VDC)

* Low: < 1.6V, High: > 4.0V

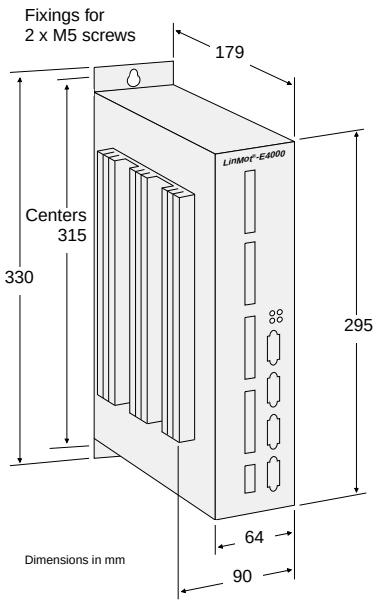
Analog-Trigger Servo Controller							
		E100-AT	***E200-AT***	***E400-AT***	***E1000-AT***	***E2000-AT***	***E4000-AT***
Number of motor channels		1	2	4	1	2	4
Max. Output current per phase	A	3			6		
Logic supply	V_{DC}	24-48			24-48		
Power consumption logic	W	5			10		
Power supply	V_{DC}	24-48			48-72		
Digital inputs		4			4		
Analog inputs*		4 (0...10V, 10 Bit)			4 (0...10V, 10 Bit)		
Trigger inputs*		4			4		
Digital outputs		4			4		
RS-232 interface		1			1		
RS-485 interface		1			1		
Width	mm (in)	70 (2.8)			90 (3.5)		
Height	mm (in)	210 (8.3)			330 (13)		
Height (without fixings)	mm (in)	175 (6.9)			295 (11.6)		
Depth	mm (in)	120 (4.7)			179 (7)		
Weight	kg (lb)	1.1 (2.4)	1.2 (2.7)	1.3 (2.9)	2.5 (5.5)	2.6 (5.7)	2.7 (5.9)
Case	IP	40			40		
Storage temperature	°C	-25...70			-25...70		
Operating temperature	°C	0...50			0...50		
Max. case temperature	°C	65			65		

* optional

E100-AT / E200-AT / E400-AT



E1000-AT / E2000-AT / E4000-AT



Ordering Information

Servo Controller	Description	Art. No.
E100-AT	Analog Trigger Servo Controller for 1 actuator (48V / 3A)	0150-1601
E200-AT	Analog Trigger Servo Controller for 2 actuator (48V / 3A)	0150-1602
E400-AT	Analog Trigger Servo Controller for 4 actuator (48V / 3A)	0150-1604
E1000-AT	Analog Trigger Servo Controller for 1 actuator (72V / 6A)	0150-1605
E2000-AT	Analog Trigger Servo Controller for 2 actuator (72V / 6A)	0150-1606
E4000-AT	Analog Trigger Servo Controller for 4 actuator (72V / 6A)	0150-1608

Specification of products are subject to change without notification

Multi Trigger Servo Controller

The Series E100-MT servo controllers and the more powerful Series E1000-MT offer, together with the *LinMot*® linear motor family, ready-to-use positioning systems for one, two or four linear axes. The multi trigger (MT) functionality allows the programming of complex motion sequences directly in the servo controller. In this way, the MT servo controller can be directly co-ordinated from the overlaid controller without having to employ additional axis and position controllers, even for complex motion sequences.

The multi trigger function is an extension to the analogue trigger functions. In the multi trigger servo controllers, the full range of analogue trigger functions remains available. This data sheet covers only the multi trigger functions. For a description of the analogue trigger functions, please refer to the appropriate data sheet.

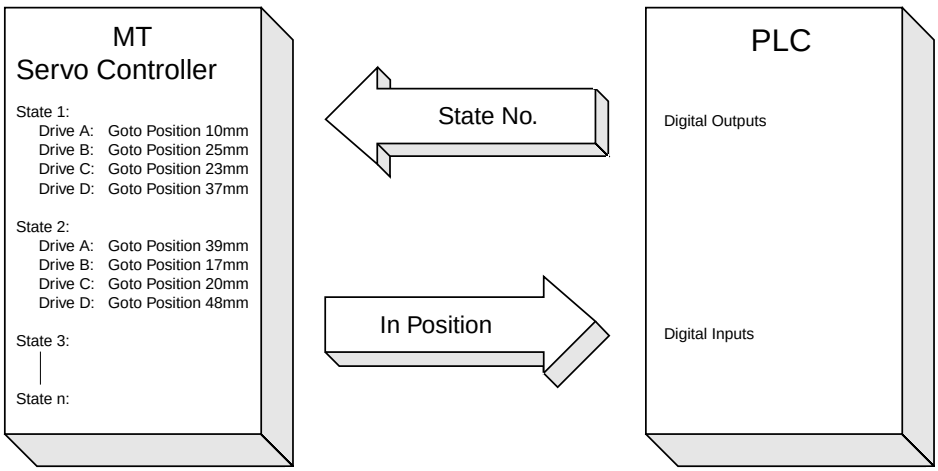
SYSTEM DESCRIPTION

The Series E100-MT and E1000-MT series servo controllers allow the direct programming of complex motion sequences with up to 64 commands per axis. The servo controllers are commanded via digital signals from the overlaid controller.

Commands for each axis are stored in a state table in the servo controller. The individual states in the table are controlled using addressing via digital signals by the overlaid controller. As soon as the overlaid controller calls up a state, the axis-movements or the command defined for that state are carried out.

The IN POSITION signal indicates to the overlaid controller that all commands have been carried out and the target positions have been reached.

If an axis is not to perform any motion, the appropriate axis' entry in the state table is set to a NO OPERATION command.



THE STATE TABLE

Up to 64 states can be defined in the state table. In each of the states, the motions or commands to be performed by the motor concerned are defined. The following commands are available:

No operation
The actor carries out no motion or completes a motion already started. Used for servo controllers for several axes when, in a particular state, an actor should not carry out any motion or should complete a motion already started.

Abs. position
The actor is positioned at the required absolute position (relative to zero-position) while taking adjustable maximum speed and acceleration into consideration. As soon as the actor reaches the final position, the IN POSITION output becomes active.

Abs. current
This command is used to define phase current output when driving inductive loads.

Rel. position
The actor is driven a required distance (relative to current position) while taking adjustable maximum speed and acceleration into consideration. As soon as the actor reaches the new position, the IN POSITION output becomes active.

Rel. current
This command is only available when driving inductive loads and is used to change the value of the phase current in the actor's output.

Curve
A stored motion profile, which is stored in the drive electronics, is run . As soon as the actor reaches the last set-point in the curve, the IN POSITION output becomes active.

Move home position
Curves and absolute positions are always referred to the reference position established during initialisation. With the move home position command, the reference position (zero-point) of the appropriate drive is shifted by the required amount. This command may only be carried out when all actors are motionless and none of the motors is in the FREEZE state.

Redefine position
With this command, the current position is redefined. This command may only be carried out when motor has reached its required position is not in the FREEZE state.

Stop
The current motion is aborted and the actor is brought to a stop while taking adjustable maximum deceleration into consideration. As soon as the actor has stopped, the IN POSITION output becomes active.

Freeze / Unfreeze
On the FREEZE command, the current motion is interrupted and the actor is brought to a stop while taking the maximum deceleration defined for the current motion into consideration. In contrast to the STOP command, the IN POSITION output is not activated for the FREEZE command. Using the UNFREEZE command, the interrupted motion can be finished. As soon as the motion is completed, the IN POSITION output becomes active.

Set current
This command redefines the actor's maximum current and thereby its force. Only positive values may be set.

Set cur. Offset
This command defines the current offset. The current offset is used to compensate a static force (compensation of load mass in vertical applications).

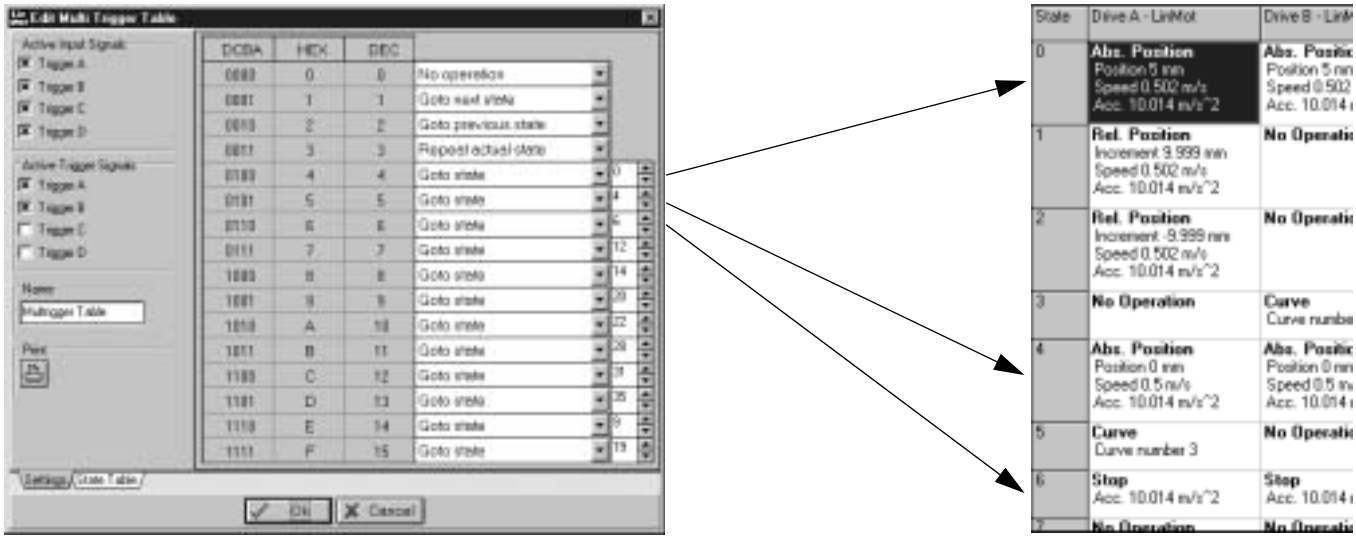
Set FF
This command sets the feed forward parameter. It is used to optimally adjust the position controller when considerable load mass changes occur.

Set PID
This command sets the position controller's PID parameters. It is used to optimally adjust the position controller during operation and when considerable load mass changes occur.

Set CP
This command sets the parameters for the scaling of motion profiles. It allows the adjustment of speed, amplitude and offset for the motion profiles during operation.

CONTROLLING THE INDIVIDUAL STATES

Individual states are set by the overlaid control system (e.g. PLC) via four digital signals (TRIG IN 1 - 4). Each of the 16 possible configurations of the input signals is assigned to a command. These commands allow particular states to be directly addressed, the following state to be called, the previous state to be called or the same state to be carried out again.



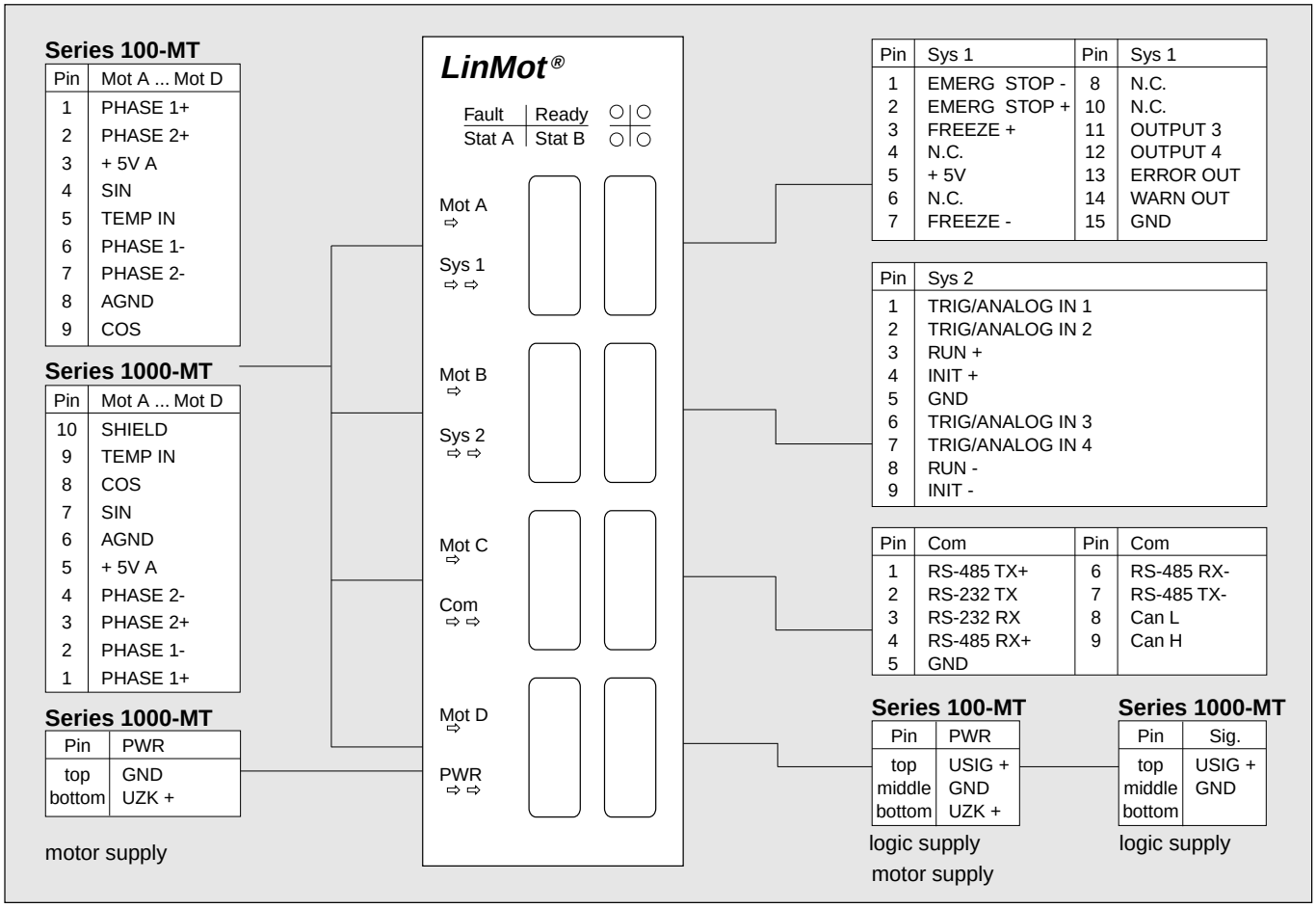
EXAMPLE

In the example shown in the table below, it can be seen how the overlaid controller can call the states required using the four digital input signals TRIG IN-1 - 4. A new command will only be carried out when the changed combination of the input signals has been constantly available for a fixed period of time (jitter-filter). The table shows the motion of drive A in the illustration above.

Input signals	Command	Actual state number	Motion of motor A
0100	Goto state 0	0	Move to absolute position +5mm • max. speed 0.5m/s • max. acceleration 10m/s²
0001	Goto next state	1	Move to absolute position +10mm • max. speed 0.5m/s • max. acceleration 10m/s²
0000	No operation	1	-
0001	Goto next state	2	Move to absolute position -10mm • max. speed 0.5m/s • max. acceleration 10m/s²
0000	No operation	2	-
0011	Repeat actual state	2	Move to absolute position -10mm • max. speed 0.5m/s • max. acceleration 10m/s²
0000	No operation	2	-
0001	Goto next state	3	Slider stays in present position or completes the state motion.
0000	No operation	3	-
0110	Goto state 6	6	Slider is stopped with 10m/s² of acceleration
…	…	…	…

Output signals

The overlaid controller is informed when the motors have reached their target positions via digital output signals. The two digital outputs (OUTPUT 3 and OUTPUT 4) can be configured so that they can be activated when any one, two or four motors reach their target position (IN POSITION).



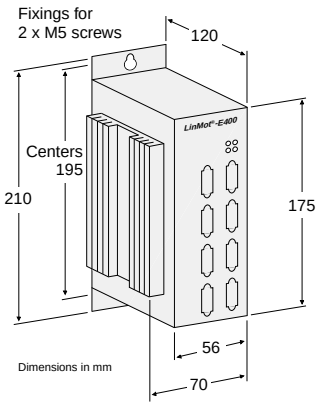
Signal	Description	Electrical specification	
INIT +/-	Motor initialization input	Isolated input	(max. 24 V / 20 mA) *
RUN +/-	Motor start input	Isolated input	(max. 24 V / 20 mA) *
EMERGENCY STOP +/-	Emergency stop input	Isolated input	(max. 24 V / 20 mA) *
FREEZE +/-	Freeze position input	Isolated input	(max. 24 V / 20 mA) *
TRIG IN 1/2/3/4	Analog position set value or digital trigger inputs	Analog position input Digital trigger inputs	(max. 24 V) (0…10 V / 100 kΩ) *
WARNING OUT	Warning output	Open collector output	(max. 24 V / 50 mA)
ERROR OUT	Error output	Open collector output	(max. 24 V / 50 mA)
OUTPUT 3	End position reached outputs	Open collector output	(max. 24 V / 50 mA)
OUTPUT 4	End position reached outputs	Open collector output	(max. 24 V / 50 mA)
+5V	5V output	Logic supply output	(max. 50 mA)
RS-232 TX/RX	RS232 Transmit / Receive	Serial connection to the PC	
USIG+	Supply (logic)	Supply input	(24-48 VDC)
GND	Ground	Ground input for logic and input drives	
UZK+	Supply (drives)	Supply input	(24-48 VDC) (48-72 VDC)

* Low: < 1.6V, High: > 4.0V

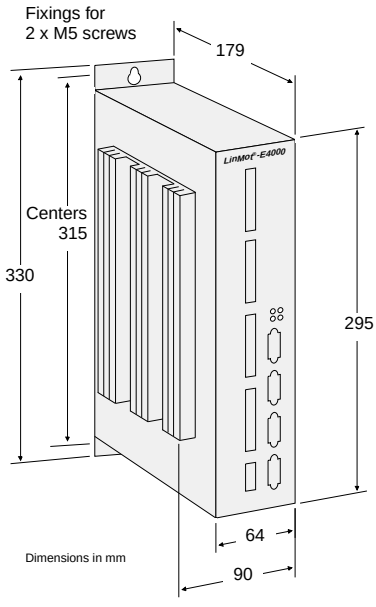
Multi-Trigger Servo Controller							
		E100-MT	***E200-MT***	***E400-MT***	***E1000-MT***	***E2000-MT***	***E4000-MT***
Number of motor channels		1	2	4	1	2	4
Max. Output current per phase	A	3			6		
Logic supply	V_{DC}	24-48			24-48		
Power consumption logic	W	5			10		
Power supply	V_{DC}	24-48			48-72		
Digital inputs		4			4		
Analog inputs*		4 (0...10V, 10 Bit)			4 (0...10V, 10 Bit)		
Trigger inputs*		4			4		
Digital outputs		4			4		
RS-232 interface		1			1		
CAN-Bus / RS-485 interface		1			1		
Width	mm (in)	70 (2.8)			90 (3.5)		
Height	mm (in)	210 (8.3)			330 (13)		
Height (without fixings)	mm (in)	175 (6.9)			295 (11.6)		
Depth	mm (in)	120 (4.7)			179 (7)		
Weight	kg (lb)	1.1 (2.4)	1.2 (2.7)	1.3 (2.9)	2.5 (5.5)	2.6 (5.7)	2.7 (5.9)
Case	IP	40			40		
Storage temperature	°C	-25...70			-25...70		
Operating temperature	°C	0...50			0...50		
Max. case temperature	°C	65			65		

* optional

E100-MT / E200-MT / E400-MT



E1000-MT / E2000-MT / E4000-MT



Ordering Information

Servo Controller	Description	Art. No.
E100-MT	Multi Trigger Servo Controller for 1 actuator (48V / 3A)	0150-1611
E200-MT	Multi Trigger Servo Controller for 2 actuator (48V / 3A)	0150-1612
E400-MT	Multi Trigger Servo Controller for 4 actuator (48V / 3A)	0150-1614
E1000-MT	Multi Trigger Servo Controller for 1 actuator (72V / 6A)	0150-1615
E2000-MT	Multi Trigger Servo Controller for 2 actuator (72V / 6A)	0150-1616
E4000-MT	Multi Trigger Servo Controller for 4 actuator (72V / 6A)	0150-1618

Specification of products are subject to change without notification

PROFIBUS-DP Servo Controller

The Series E130-DP and E1030-DP servo controllers are characterised by their integrated PROFIBUS-DP interface. This standardised interface allows an exceptionally fast and simple connection to controllers at a higher hierarchical level.

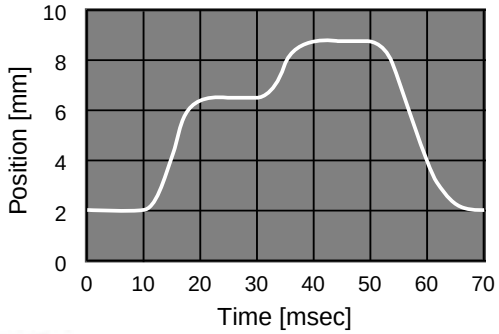
As a result of the cyclical definition of set-point positions and other process data, this servo controller is the ideal solution for applications where movements and sequences often change.

PROFI PROCESS FIELD BUS BUS

SYSTEM DESCRIPTION

PROFIBUS-DP offers the user a standardised field bus interface for the fast transfer of data between servo controller and overlaid controller. The maximum Baud rate of 12 MBit/s guarantees fast system reaction times even if there are many stations on the bus.

The user can freely adapt the type and volume of data to be transmitted per motor according to his requirements.



PROFIBUS-DP INTERFACE

The PROFIBUS-DP interface supports all Baud rates between 9.6 kBit/s up to 12MBit/s. The connection is via a 9-pin female DSUB connector and conforms to the PROFIBUS standard (use of standardised connectors). A power supply for an external bus termination is supplied. A positive direction-control signal is available for the control of repeaters and fibre-optic connections. All signals on the PROFIBUS connector are DC isolated.

The PROFIBUS-DP address is set using two hex code switches (ID1 and ID2). All addresses allowed by the norm are supported (0 -125).

The lowest bus cycle time reached is 100us.

The maximum amount of data transferred in cyclical data transfer mode is 64 Byte per cycle. The structure and amount of the cyclic data can be determined during the planning of the installation using any individual data modules up to a total data volume of 64 bytes, whereby the data for individual motors can differ.

For the open project planning as defined by the PROFIBUS-DP standard, a device master file is supplied.

The total amount of data is variable (only the configured data is exchanged).

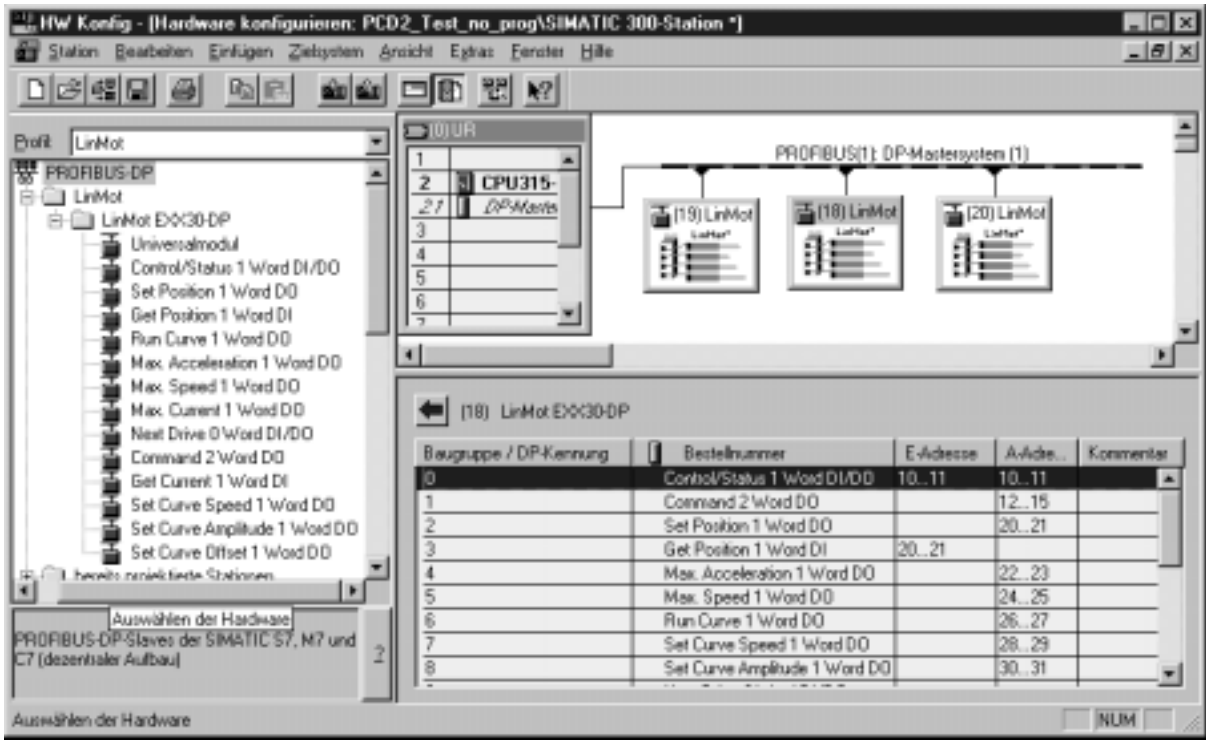
PROFIBUS device diagnosis is supported (configurable) and contains the following information:

- Faults and warnings (separated for system and motors A-D)
- Plain text messages on diagnosis information are supplied by the GSD file.

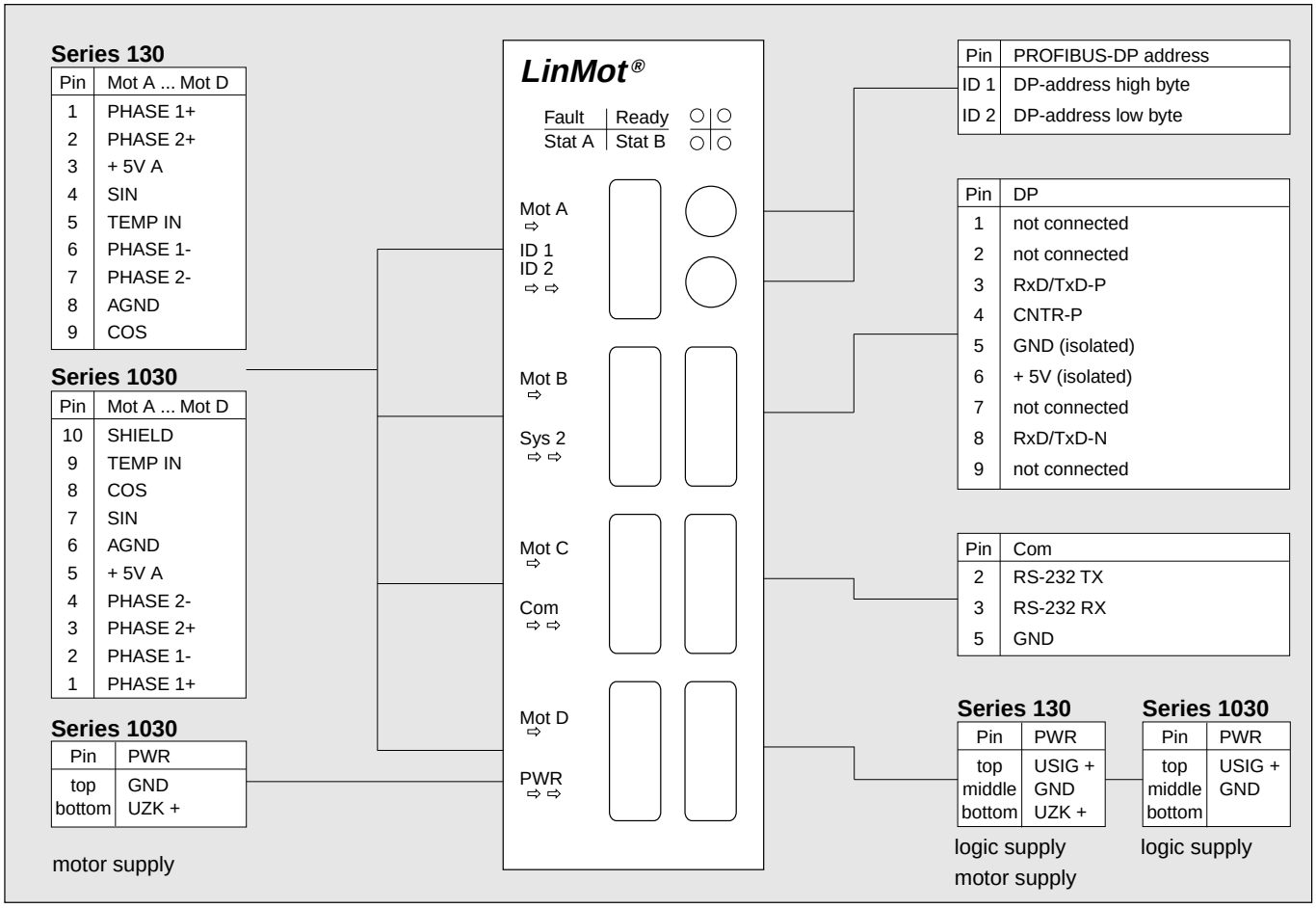
Further information on PROFIBUS is available under the following URL: http://www.profibus.com

PROJECT PLANNING

The PLC configuration tools allow simple graphical bus programming using the GSD file provided. The illustration below shows the Siemens (S7) PC user interface for the graphical programming of the PROFIBUS. In the example shown, three *LinMot*® servo controllers are connected via PROFIBUS to the overlaid controller. The data modules necessary for the control of the linear motors are inserted on the left-hand side of the table.



(Screenshot: STEP7 of Siemens)

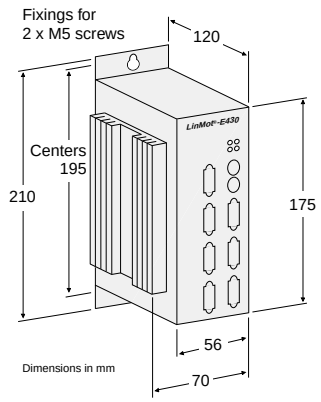


Commands

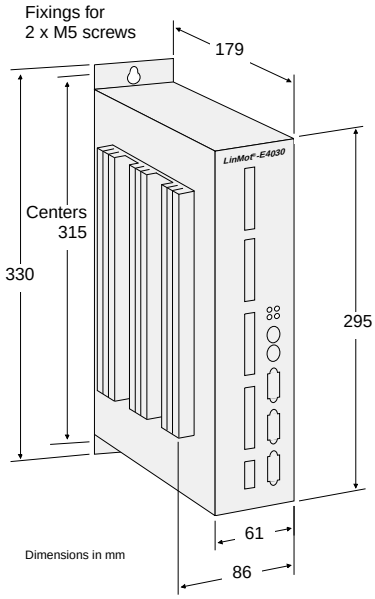
Data module	Description
Command	Enables the configuration of the position contoller for the linear motors as well as shifting to the zero-position.
Control	The states of the servo controller (INIT, RUN, FREEZE, STOP) are requested by the next higher control system over the control data module.
Status	The status module returns the actuator state flags from the servo controlle (ERROR, WARNING, INIT DONE) as well as from the motors (IN POSITION; CURVE DONE).
Get Position	Reads the current position of the motor
Get Current	Reads the actual current
Max. Acceleration	Sets the maximal acceleration
Max. Current	Sets the maximal current/force
Max. Speed	Sets the maximal speed
Next Drive	Tags a new motor
Run Curve	Starts a stored motion profile
Set Position	Sets the wanted position of the motor
Set Curve Speed	Sets the speed
Set Curve Amplitude	Sets the curve amplitude
Set Curve Offset	Sets the curve position offset

PROFIBUS-DP Servo Controller							
		E130-DP	***E230-DP***	***E430-DP***	***E1030-DP***	***E2030-DP***	***E4030-DP***
Number of motor channels		1	2	4	1	2	4
Max. output current per phase	A	3			6		
Logic supply	V_{DC}	24-48			24-48		
Power consumption logic	W	5			10		
Power supply	V_{DC}	24-48			48-72		
PROFIBUS-DP interface		up to 12 MBit/s			up to 12 MBit/s		
PROFIBUS-DP adress		set by switch			set by switch		
RS-232 / CAN-Bus Schnittstelle		1			1		
Width	mm (in)	70 (2.8)			90 (3.5)		
Height	mm (in)	210 (8.3)			330 (13)		
Height (without fixings)	mm (in)	175 (6.9)			295 (11.6)		
Depth	mm (in)	120 (4.7)			179 (7)		
Weight	kg (lb)	1.1 (2.4)	1.2 (2.7)	1.3 (2.9)	2.5 (5.5)	2.6 (5.7)	2.7 (5.9)
Case	IP	40			40		
Storage temperature	°C	-25...70			-25...70		
Operating temperature	°C	0...50			0...50		
Max. case temperature	°C	65			65		

E130-DP / E230-DP / E430-DP



E1030-DP / E2030-DP / E4030-DP



Ordering Information

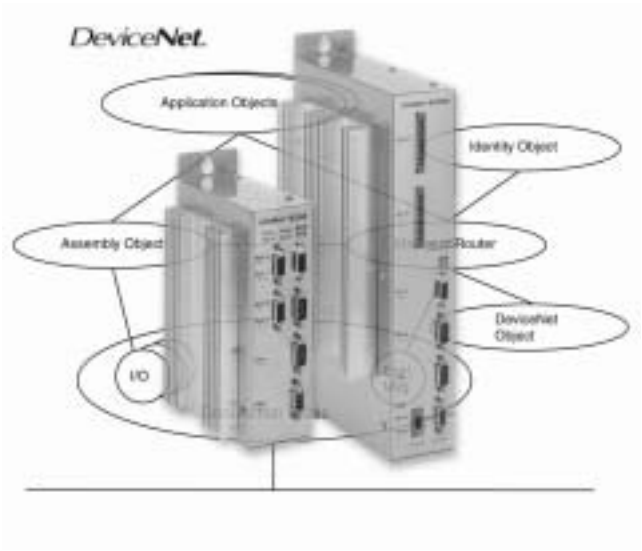
Servo Controller	Description	Art. No.
E130-DP	PROFIBUS-DP Servo Controller for 1 actuator (48V / 3A)	0150-1621
E230-DP	PROFIBUS-DP Servo Controller for 2 actuators (48V / 3A)	0150-1622
E430-DP	PROFIBUS-DP Servo Controller for 4 actuators (48V / 3A)	0150-1624
E1030-DP	PROFIBUS-DP Servo Controller for 1 actuator (72V / 6A)	0150-1625
E2030-DP	PROFIBUS-DP Servo Controller for 2 actuators (72V / 6A)	0150-1626
E4030-DP	PROFIBUS-DP Servo Controller for 4 actuators (72V / 6A)	0150-1628

Specification of products are subject to change without notification

DeviceNet Servo Controller

The Series E100-DN and the more powerful Series E1000-DN servo controllers are characterised by ther integrated DeviceNet Field Bus interface. With this standardised bus interface a fast and simple integration into hierarchical higher controllers is supprted.

With the DeviceNet Field bus interface also complex application can be resolved in a easy way.



SYSTEM DESCRIPTION

DeviceNet is an open field bus standard based on the CAN bus. Within DeviceNet different communication channels are supported. Through the DeviceNet connection the *LinMot*® servo controller can be controlled and monitored.

The basic operation modes and functions of the *LinMot*® DeviceNet servo controllers -DN are identical with the *LinMot*® AT servo controller.

Additional to the -AT functionality, the DeviceNet servo controllers offers extended field bus possibilities:
- Direct position control
- Monitoring of internal Parameters
- Runtime read/write access to all life Parameters
- Runtime configuration
- Diagnostic

The configuration of the servo controller will be done with the delivered *LinMot*® Talk Software.

Supported Connections

Explicit Messaging
The Explicit Message connection is used to setup the DeviceNet IO-connections. The *LinMot*® DeviceNet servo controller offers one Explicit Message Connection for one Master.

If two Masters want to use this connection on the same time, the second Master has to wait until the first Master releases this connection.

Polled IO Connections
The polled IO connection is used to exchange data between a master and a slave. The master starts the data exchange with a Poll Command Message that is responded by the slave with the Poll Response Message.

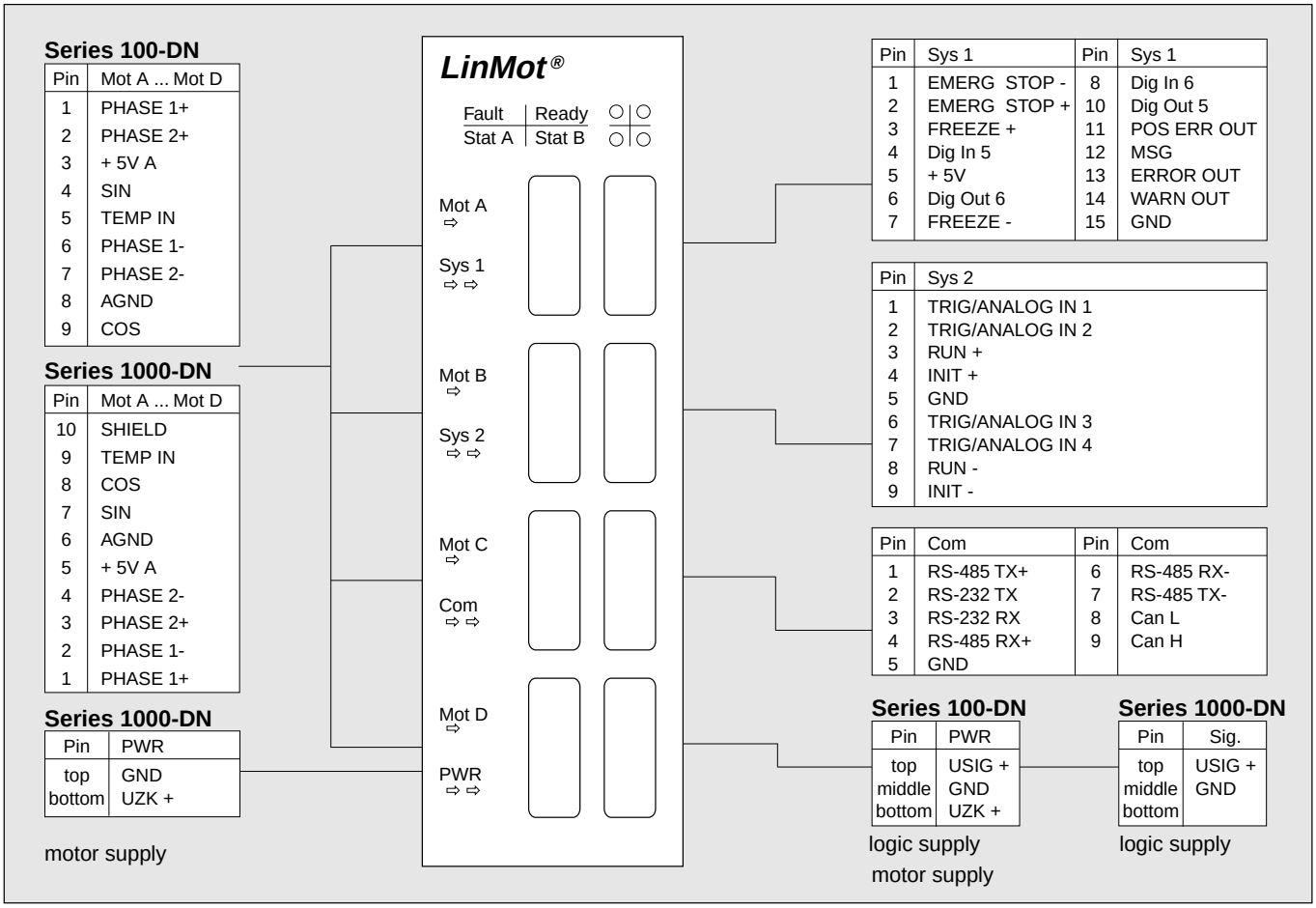
Tough the master uses the same identification for the polled and CoS/Cyclic IO connections only one could be active at time, so if both (Polled and CoS/Cyclic) IO connections are selected the master transmits its data over the polled IO connection.

Change of State IO connection
The Change of State IO connection is used to exchange data between a master and its slave. Data are transmitted if in the master/slave the state has changed. The receiver of the data may acknowledge the reception. In addition the data are transmitted after a specified heartbeat time.

To avoid bus overload an inhibit time can be configured. The inhibit time has to be waited before new data is transmitted even if the state has changed.

Cyclic IO connection
Instead of the Change of State IO connection a cyclic IO connection could be configured.

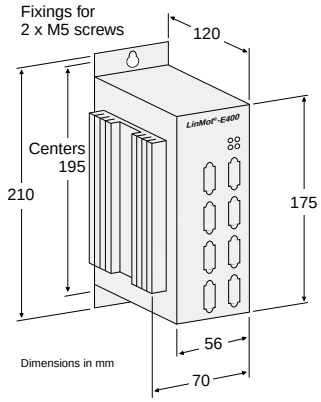
Data are transmitted strictly cyclic. The receiver of the data may acknowledge the reception.



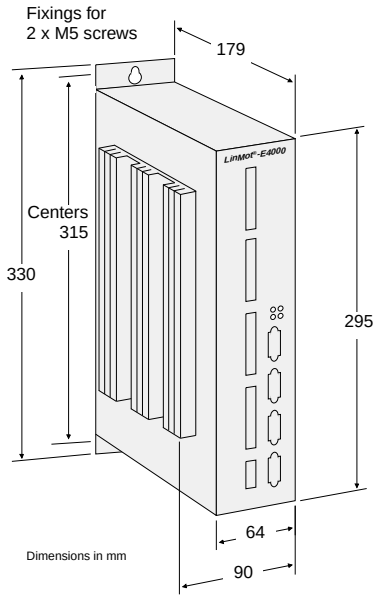
Signal	Description	Electrical specification	
INIT +/-	Motor initialization input	Isolated input	(max. 24 V / 20 mA) *
RUN +/-	Motor start input	Isolated input	(max. 24 V / 20 mA) *
EMERGENCY STOP +/-	Emergency stop input	Isolated input	(max. 24 V / 20 mA) *
FREEZE +/-	Freeze position input	Isolated input	(max. 24 V / 20 mA) *
TRIG/ANALOG IN 1/2/3/4	Analog position set value or digital trigger inputs	Analog position input Digital trigger inputs	(0…10 V / 100 kΩ) * (max. 24 V)
DIG IN 5/6	digital (trigger) inputs	Digital (trigger) inputs	(max. 24 V/ 100kΩ)
WARNING OUT	Warning output	Open collector output	(max. 24 V / 50 mA)
ERROR OUT	Error output	Open collector output	(max. 24 V / 50 mA)
Pos ERROR OUT	Position error output	Open collector output	(max. 24 V / 50 mA)
MSG OUT	Message output	Open collector output	(max. 24 V / 50 mA)
DIG OUT 5	digital output	Open collector output	(max. 24 V / 50 mA)
DIG OUT 6	digital output	Open collector output	(max. 24 V / 100 mA)
+5V	5V output	Logic supply output	(max. 50 mA)
RS-232 TX/RX	RS232 Transmit / Receive	Serial connection to the PC	
RS-485 TX+-/RX+-	RS485 Transmit / Receive	Serial bus connection to higher level controller (PLC/PC)	
CAN +-	CAN +-	Serial bus connection to higher level controller (PLC/PC)	
USIG+	Supply (logic)	Supply input logic	(24-48 VDC)
GND	Ground	Ground input for logic and input drives	
UZK+	Supply (power)	Supply series 100 Supply series 1000	(24-48 VDC) (48-72 VDC)

* Low: < 1.6V, High: > 4.0V

E100-DN / E200-DN / E400-DN



E1000-DN / E2000-DN / E4000-DN



Ordering Information

Servo Controller	Description	Art. No.
E100-DN	DeviceNet Servo Controller for 1 actuator (48V / 3A)	0150-1641
E200-DN	DeviceNet Servo Controller for 2 actuators (48V / 3A)	0150-1642
E400-DN	DeviceNet Servo Controller for 4 actuators (48V / 3A)	0150-1644
E1000-DN	DeviceNet Servo Controller for 1 actuator (72V / 6A)	0150-1645
E2000-DN	DeviceNet Servo Controller for 2 actuators (72V / 6A)	0150-1646
E4000-DN	DeviceNet Servo Controller for 4 actuators (72V / 6A)	0150-1648

Specification of products are subject to change without notification