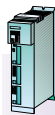


Compact and chassis units



Compact PLUS units

SIMOVERT MASTERDRIVES Motion Control

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Overview

The basic software for SIMOVERT MASTERDRIVES Motion Control converters and inverters contains many technology functions.

For more extensive applications, each SIMOVERT MASTERDRIVES Motion Control unit can be supplied with the technology software with functions that can be divided up into the following main categories:

- General technology functions (linear axis, rotary axis, roll feed)
- Positioning (point-to-point, automatic)
- Synchronous operation (angular synchronism, electronic gears, start/stop operation, print-mark synchronization, electronic cam).

The technology software is an option and can be ordered with the code F01. Even in a converter/inverter not supplied with this option, the technology software can be enabled later on by means of a PIN number (e.g. when units are replaced).

500-hour PIN

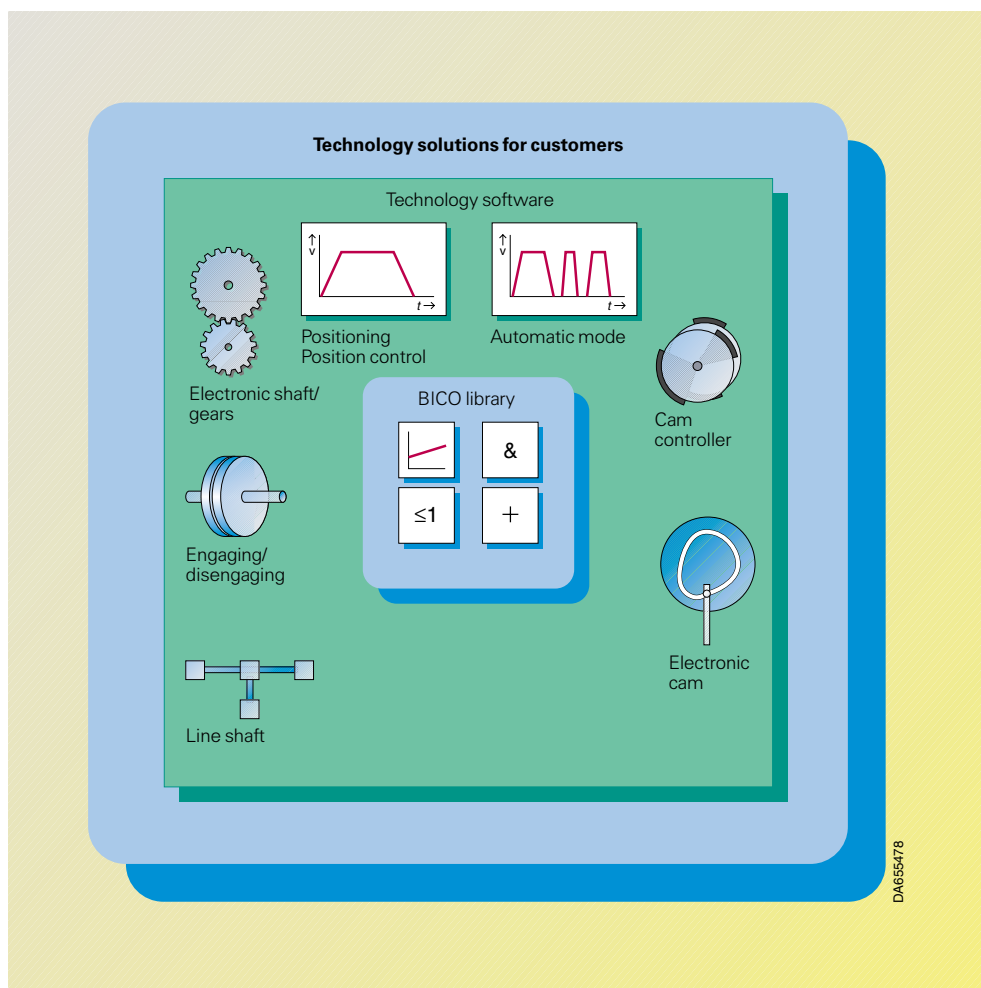
For testing and demonstration purposes or for using replacement units ordered without option F01, the technology software can be enabled free-of-charge for a one-off period of 500 hours with a special PIN number.

The 500-hour PIN is entered in parameter 2977:

U977.1 = 0727

U977.2 = 0101

When the PIN is enabled, this is indicated in parameter n 978 = 2.

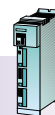


SIMOVERT MASTERDRIVES Motion Control

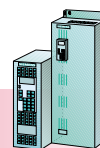
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Overview

Technology functions of SIMOVERT MASTERDRIVES Motion Control units

Number of axes

Any
axis-modular structure

Technology functions basic software

Simple and comfort ramp-function generator
PID controller
Brake control
Encoder evaluation for position detection
Position control with pre-control
Cam controller
Wobble generator
Motor potentiometer
Basic positioner
Logic and arithmetic functions
(AND, OR, NOR, +, -, x, /, comparator)
as free-function blocks which can be connected with
Drive ES or DriveMonitor via parameters.

Position cams, 2 x 2 cams, minimum reaction time 800 μ s

Functions technology software (option F01)

General functions

Linear axis
Rotary axis
Roll feed
Homing procedure
Homing on the fly

Positioning

Traversing range
Traversing speed
Acceleration/deceleration
Jerk limitation
Number of program blocks
Number of programs
Roll feed
Zero shift
Acceleration can be influenced by means of the G-function
Software limit switch
Actual-value evaluation factor
Tool corrections
Override for feeding and acceleration
Backlash compensation
Position-feedback setting/measuring on the fly
External start
External record change
External read-in enable
Switching functions (M functions)
Rotary axis
Teach-in
Simulation

+/- 1000 m (3281 ft)
0.01 mm/min up to 500 m/min
1.0 mm/s² to 99.999 mm/s²
1.0 mm/s³ to 99.999 mm/s³
50
20

Synchronous operation

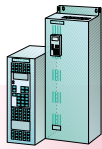
Master-setpoint sources:
– virtual
– actual-value based master axis
– setpoint driven master axis
Free allocation of master and slave axes
(cascading of the slave axes)
Electronic gears
– transmission ratio
Electronic cam
– number of tables
– number of interpolation points
– table change on the fly
Engaging/disengaging
Synchronization
– via fast input (print-mark synchronization)
– catch-up

Drive coupling via SIMOLINK or clock-synchronous PROFIBUS DP (CBP2)

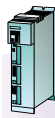
Via parameter connection

1 : 5 to 32 000 : 1, can be modified during operation

max. 8
max. 400



Compact and chassis units



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SIMOVERT MASTERDRIVES Motion Control

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Technology functions of the basic software

The functions described below are included in the basic software, as are the "free function blocks". Thus, they can always be implemented, irrespective of whether or not the converter was ordered with technology option F01.

Cam controller

A cam controller switches digital outputs on and off when pre-defined positions have been reached. This enables, external switching elements, such as pneumatic valves, to be operated at defined points during a movement (positioning cams).

The basic software for MASTERDRIVES Motion Control contains two cam controllers as free function blocks, each with two positioning cams that can be supplied by separate input signals, e.g. position setpoint slave and position setpoint master. There are therefore four cams with switch-on and switch-off positions which can be set independently of each other.

These cams an adjustable hysteresis for the switching point and a time resolution of at least 800 μ s. The outputs of the cam controllers are binectors which can be connected as required, e.g. to digital outputs of the MASTERDRIVES units for operating magnetic valves etc.

A speed-dependent compensation for switching time function and time cams are not provided. These functions, however, can often be implemented using the timers in the free function blocks.

If an extremely fast cam controller with switching-instant compensation and additional time cams are needed, an external hardware cam controller such as the SIMATIC S7 module FM352 ("FM Cams") or the T400 technology board should be used.

Brake control

The integrated brake control function prevents inconvenient waiting times when brakes are applied or released.

Hoisting gear can also be positioned quickly and reliably – with little effort in the external machine control unit and during start-up. Checkback contacts of the brake can be evaluated in the brake control function. Output signals of the brake control function are the binectors "Release brake" and "Close brake". Relays for operating the brake are not built into the MASTERDRIVES unit.

The following methods are available for brake operation:

- Use of a relay output on the EB1 expansion board
- Use of an external relay which is operated by a digital output of the MASTERDRIVES
- The relay (in compact and chassis units) for operating the main contactor can be used for operating the brake if there is no main contactor.

Releasing and closing the brake can be effected by means of external commands but, normally, the brake control function works fully automatically without any intervention by the external machine control unit.

Release brake

If the drive changes to the "On" state after power-on, the inverter enabling signal is given and the brake is released. After the set brake-release time and when the checkback signal "Brake released" is received, setpoint enabling takes place. An adjustable limit-value monitor can be used in special cases in order to make releasing of the brake dependent on a particular criterion.

Close brake

If the drive is shut down, i.e. if its speed has fallen below the set threshold and is switched off by means of OFF1 or OFF3, the brake

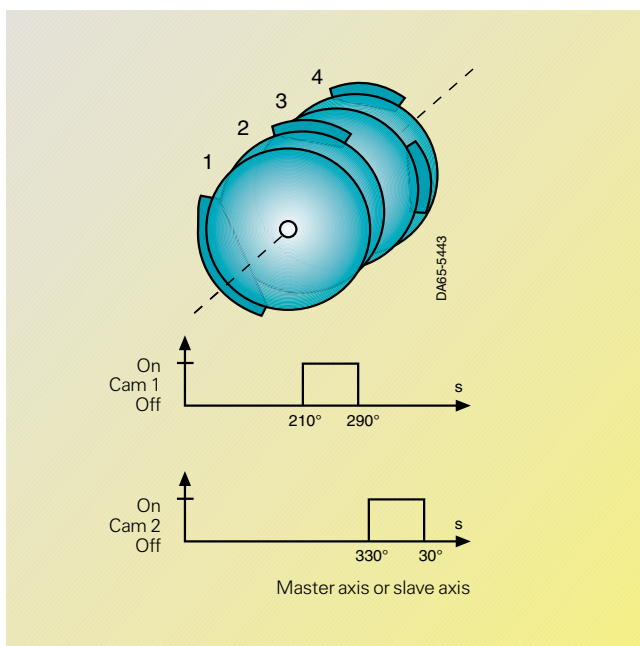
closes. The inverter enable signal is removed after the set brake-closing time has elapsed and the "Brake closed" signal has been sent (possibly by a checkback contact). OFF2 should not be used, if possible, because, an OFF2 command causes the pulses to be blocked immediately and the motor to be deenergized during the brake-closing time.

Basic positioner

The basic positioner is included in all MASTERDRIVES Motion Control units from firmware version 1.5 upwards as a "free function block". The basic positioner can be used to perform "simple positioning tasks" without activating the F01 technology option. The basic positioner performs the following functions:

- Absolute and relative positioning
- Linear and rotary axes
- With motor encoder or machine encoder
- Set up (position-controlled method using the speed setpoint)
- Referencing ("flying" and with homing procedure)
- Software limit switch (only in the case of linear axes)
- Play compensation
- Adoption of setpoints, continuous or edge-triggered
- Jerk-free changeover from set-up to positioning and vice versa, without standstill of the axis
- Setpoint changes for position, speed and acceleration during movement along the axis possible.

Standard applications are available, including parameterization and documentation. These can be obtained from your regional Siemens AG office and from the Applications Center for Production Machines.



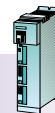
Cam controller for MASTERDRIVES Motion Control

SIMOVER MASTERDRIVES Motion Control

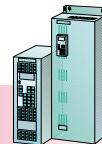
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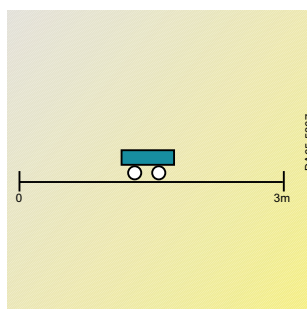


Technology software – General functions

The Motion Control technology software (F01) has the following general functions.

Linear axis

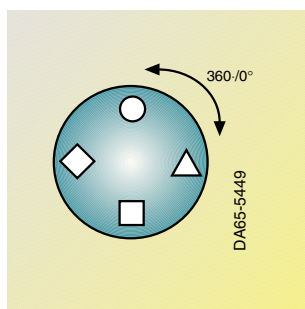
(with fixed stops and a max. traversing range of 1000 m (3281 ft) with a resolution of 1μ) software limit switches are evaluated. A traversing car is an example of a linear axis.



Linear axis

Rotary axis

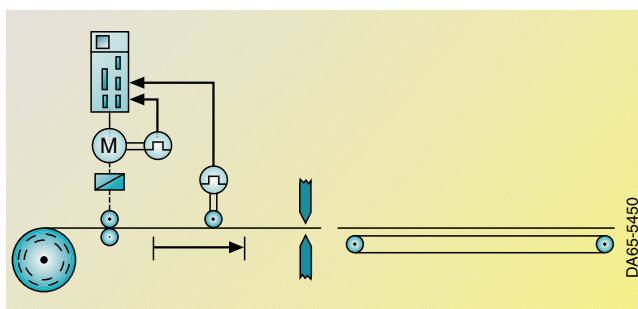
(permanently rotating, without fixed stops with definition of direction or direction "shortest distance"). A turntable is an example of a rotary axis.



Rotary axis

Roll feed

(permanently rotating rotary axis with "cut-to-length function") The illustration shows a roll feed used in a cutting machine.

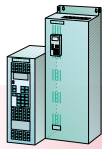


Roll feed

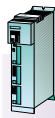
- Either the motor encoder (resolver, optical sin/cos incremental encoder, absolute-value encoder, incremental encoder) or an external machine encoder (e.g. incremental encoder or SSI absolute-value encoder) built on to the driven machine can act as a **position encoder**.

- The Motion Control software contains a sophisticated precontrol strategy. At any given moment, the position ramp-function generator appropriately controls the speed and accelerating torque by bypassing the position controller so that an optimum dynamic response is achieved and no significant following errors occur.

- Even if the high dynamic response is fully utilized, the mechanical components are subjected to very little stress. This is ensured by the position ramp-function generator with its flexibly adjustable jerk-limiter and accelerator.



Compact and chassis units



Compact PLUS units

SIMOVERT MASTERDRIVES Motion Control

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Technology software – Positioning

The MASTERDRIVES Motion Control unit has an easy-to-use integrated position control system with the following functions:

- **Setup:**
Position-controlled traversing of the axis in jog mode
- **Homing procedure:**
Variable function for establishing a relationship between an incremental measuring system and the mechanical equipment.
- **MDI:**
Point-to-point positioning (**Manual Data Input**)
 - Relative or absolute positioning (absolute or incremental dimension)
 - Stipulation of an MDI positioning record with position, speed and acceleration.

The MDI positioning record can be directly specified by the machine control unit, e.g. via PROFIBUS DP, or called using control commands from a table (stored in the MASTERDRIVES Motion Control unit) of 10 fixed position setpoints. Together with the MDI positioning record, the starting command can be transmitted in one and the same PROFIBUS DP telegram. This enables comfortable and time-saving operation of the positioning process even when using a small PLC.

- Changeover on the fly to another MDI record during travel is possible.
- Start command (a read-in enable in the case of roll feed) is possible via digital inputs of the MASTERDRIVES Motion Control or via the fieldbus.

- **Automatic function**
 - Execution of complete positioning programs in the automatic mode
 - Single-step mode possible
 - Creation of traversing programs using a powerful programming language in accordance with DIN 66 025 (industrial standard)
 - Input of traversing programs via SIMATIC S7-CPU or via the DriveMonitor service program with special editor
 - Up to 20 programs with a total of 50 records (traversing commands) can be programmed
 - Program-controlled output of switching functions (M functions)
 - Flying record change via digital input
 - Start and read-in enabling also possible via digital input
 - Zero shifting, tool correction and backlash compensation can be programmed
 - Acceleration can be influenced by means of the G-function
- Actual-value setting on the fly
- Starting command, record change and read-in enabling can be stipulated via fieldbus or digital inputs
- Teach-in: adoption of the current position in a traversing record is possible by means of set-up mode
- Speed override, acceleration override and time override
- Collision monitoring via external input
- Simulation mode for testing automation programs without motor, e.g. for recording the position-setpoint curve with simulation of the M-functions.
- **Roll feed:**
 - Automatic cut-to-length function for presses, stamping machines and cross-cutting machines in start/stop mode
 - Speed/acceleration profile of the traversing curve can be stipulated. In this way, optimum through-put times are achieved and material wear and slippage is avoided.

- Changeover between an external machine encoder and motor encoder is possible (at standstill)
- The number of loops (number of cutting processes) can be programmed.

Applications for the positioning function

Typical applications for the MASTERDRIVES Motion Control are positioning drives in the following areas:

- Wood-working machinery
- Roll feeders for presses
- Packaging machines
- Printing machines
- Drive tasks in the glass, tile and tire industries as well as in general machine building.

Operator control

DriveMonitor guides the user through operator screen forms where functions can be entered with a mouse click. Fig. 6/89 shows an example of a start-up screen form for axis configuration.

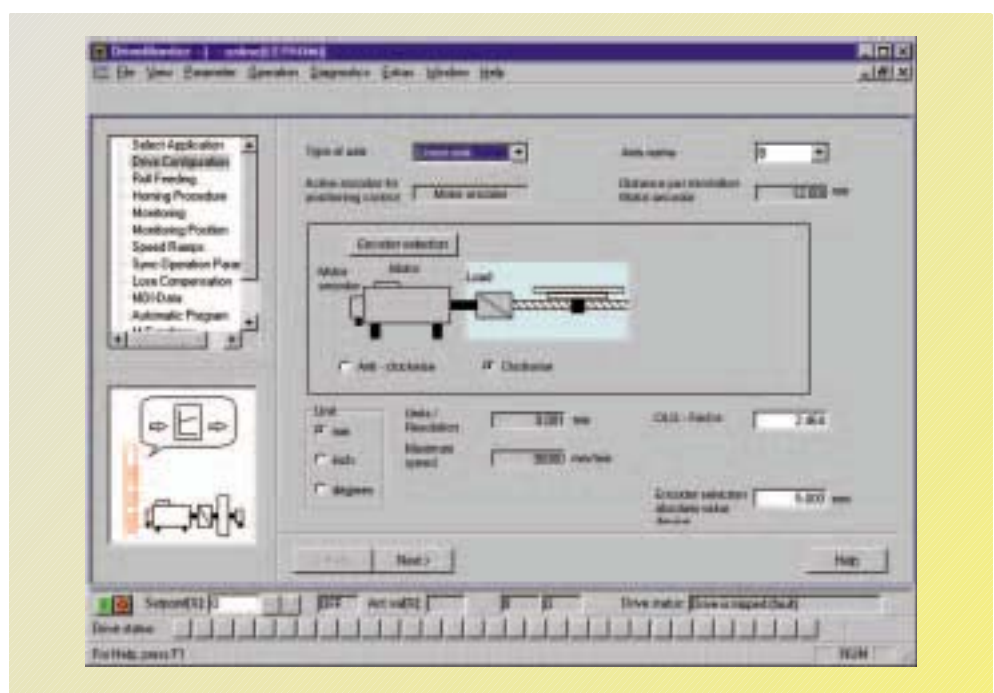


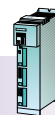
Fig. 6/89
Start-up screen form for axis configuration

SIMOVERT MASTERDRIVES Motion Control

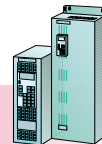
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Technology software – Positioning

Positioning in automatic mode

Fig. 6/90 shows a typical application for an automatic traversing program which is automatically executed by MASTERDRIVES Motion Control. A chipboard laminated on both sides is being drilled through. The traversing program goes through the following steps:

- **Travel A → B:**
The drill bit travels rapidly until it reaches the material and then begins to reduce the feeding speed. At point B precisely, the drill has reached the reduced feeding speed for drilling through the plastic coating.
- **Travel B → C:**
The coating is drilled through at reduced speed
- **Travel C → D:**
The chipboard itself is drilled through at normal feeding speed.
- **Travel D → E:**
The reduced feeding speed again applies for the lower coating.
- **Travel E → A:**
Drill returns at increased speed.

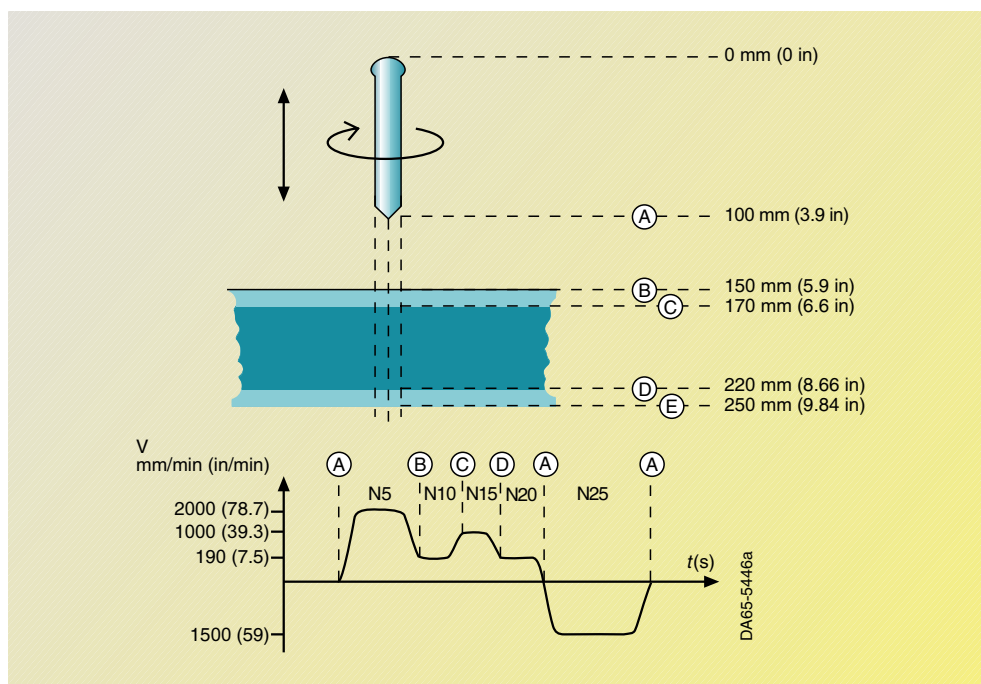
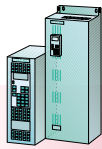


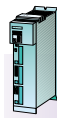
Fig. 6/90
Automatic drill function

The table shows the traversing program entered for this application in the MASTERDRIVES Motion Control (example).

NC program	
N5 X 150 F2000 G44 D1:	Record No. 5: travel to position 150 mm (5.9 in) at speed of 2000 mm/min (78.7 in/min), tool correction (G44) stored in D1 (100 mm (3.9 in))
N10 X 170 F190:	Record No. 10: Travel to position 170 mm (6.6 in) at speed of 190 mm/min (7.5 in/min)
N15 X 220 F1000:	Record No. 15: Travel to position 220 mm (8.66 in) at speed of 1000 mm/min (39.3 in/min)
N20 X 250 F190:	Record No. 20: Travel to position 250 mm (9.84 in) at speed of 190 mm/min (7.5 in/min)
N25 X 0 F1500 D0:	Record No. 25: Travel to standard position 0 and deselect tool correction (D0)



Compact and
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Technology software – Synchronous operation

General synchronous-operation functions

The following synchronous-operation functions are contained:

- **Electronic shaft** (exact synchronism of several axes with long-time stability)
- **Electronic gears** (with a transmission ratio that can be precisely tuned via numerator and denominator settings; the value range for numerators and denominators, respectively, is –32767 to +32767)
- **Transmission ratio can be changed even during operation.** If necessary, the stipulated transmission ratio can be adjusted using a free ramp-function generator in order to avoid sudden changes.
- **Electronic cam**
 - With up to 400 interpolation points. The 400 interpolation points can be divided into upto 8 tables. A table can be reloaded in the background and edited while the first table is running on-line. There is linear interpolation between the interpolation points.
 - The interpolation points do not have to be equidistant but can be set closer together in critical zones and farther apart from each other in linear areas.
 - Changing tables on the fly is possible during operation.
 - The table is scalable in both the X and Y directions and has integrated gears.
- The distance/angle set-point can be stipulated by a real “master axis” (internal or external) or by a “virtual master” created using the software.
- 2 digital inputs with interrupt capability for detecting synchronization signals, e.g. print marks.

SIMOLINK as the backbone of synchronous speed control

The drives participating in angular synchronism are linked via the serial setpoint link, SIMOLINK. SIMOLINK is a high-speed ring of fiber-optic cables that operates at 11 Mbd and is used to transmit the angle setpoints from drive to drive or from a control system to the drives. To transmit one hundred 32-bit values, for example, SIMOLINK takes only 630 μ s. Special SYNC telegrams are used to achieve exact, jitter-free transmission synchronization of the sampling times of up to 200 connected converters. This enables highly dynamic and precise synchronous operation of the drives. The master incremental encoder is normally not needed, as its function is performed by the software and transmitted via SIMOLINK (principle of the “virtual master axis”). Conventional operation with master incremental encoders is, of course, possible as well.

Thanks to SIMOLINK, the master-drive function can be assigned to any drive or even to a higher-level control system. This is especially necessary in the case of machines where drives are taken out of the combined drive system, e.g. in the case of shaftless printing machines.

The master-drive function can also be performed by a drive which is temporarily taken out of the combined drive system. SIMADYN D, SIMATIC M7 or SICOMP® SMP can act as the higher-level control system; SIMOLINK interfaces are also available for these systems.

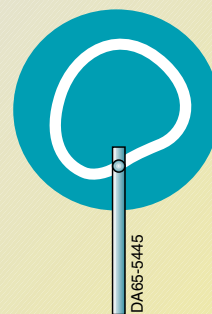
Electronic gears

Electronic gears can easily be used to substitute all kinds of variable gear-ratio gearboxes and shafts. The transmission ratio is precisely defined as the numerator and denominator of a fraction (16 bits each). Operation with encoders built onto Siemens motors, including absolute-value encoders (e.g. encoders with protocol according to SSI standard) and SIMOLINK.

Electronic cam for simulating mechanical contours

The electronic cam enables accurate relative movement between a master drive and a slave drive. It replaces mechanical eccentric cams, gear-change gearboxes or cranks as the following picture is intended to symbolize.

A maximum of 400 coordinate pairs of variables describe the relative movement by means of table interpolation. These 400 interpolation points can be divided up into upto 8 curves. x and y coordinates can be entered separately. The x values do not have to be equidistant, i.e. many points are placed at the tight sections of the curve and fewer in the straight sections. Linear interpolation takes place between the points. A very smooth torque curve can thus be achieved with relatively few points. These values, of course, can be parameterized via PROFIBUS DP. Therefore, where necessary, the cam may be changed within seconds (can be input by means of the DriveMonitor service program). A very high dynamic performance and a high degree of accuracy are achieved due to precontrol of the speed and torque.



Master	Slave
0°	20 mm (0.78 in)
5°	100 mm (3.9 in)
10°	300 mm (11.8 in)
.	.
.	.
360°	20 mm (0.78 in)

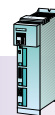
Electronic cam disc

SIMOVERT MASTERDRIVES Motion Control

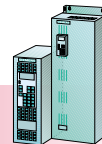
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Technology software – Synchronous operation

Start/stop function for product collation and product decollation

The start/stop function allows targeted shutdown and starting of the angular synchronism mode, including the cam function, at a precisely defined engaging position for one or several machine cycles. The ramp for the start/stop function can be stipulated as the distance. The engaging/disengaging action can also be started via a digital input.

The disengaging function is used, for example, for collating products if a product is missing in the continuous flow of goods.

The disengaging function stops the drive (slave drive) according to a corresponding request at a parking position and, after one or several machine cycles (product lengths), starts it again in angular synchronism with the master drive. The engaging function can be used for removing defective products. This function is similar to the disengaging function but, here, the drive starts for one or more machine cycles with angular synchronism, starting from a parking position relative to the master drive. After this, it again moves precisely to its parking position.

The start/stop function can also be used in combination with the gears and the cam.

Fig. 6/92 shows an example of using the start/stop function for ejecting defective products of a packing machine.

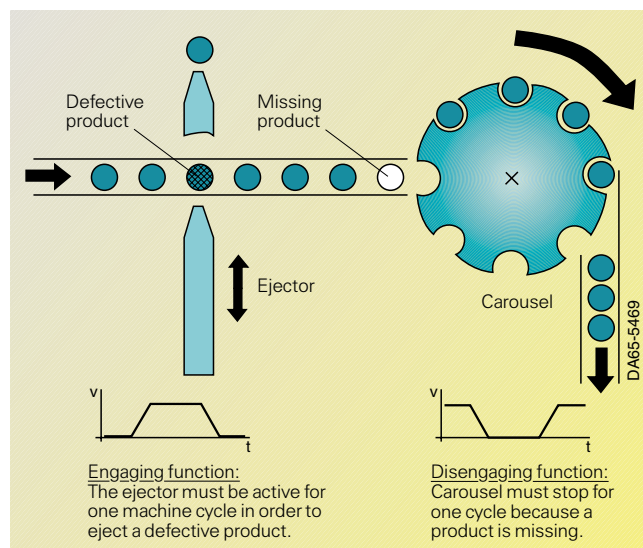


Fig. 6/92
Application example of the start/stop function for removing defective products in a packing machine

Print-mark control

The print-mark control system, in conjunction with suitable reading devices, is for matching the master drive to the slave drive. The synchronization signal is evaluated by a high-speed digital input with interrupt capability and a time resolution of a few μ s. The speed at which matching or the correction movement is carried out can be set.

An example of print-mark evaluation is a packing machine in which the continuous flow of goods must be packed in foil with the requirement that the printed image of the packing foil is always at the same position on the product. By detection of the print-mark on the foil, expansion (or shrinkage) of the foil – both of which always occur – can be detected and automatically compensated.

Drifting phenomena, which would be noticeable during operation without print-mark control, are thus reliably avoided.

Fig. 6/93 illustrates the method of functioning of print-mark synchronization.

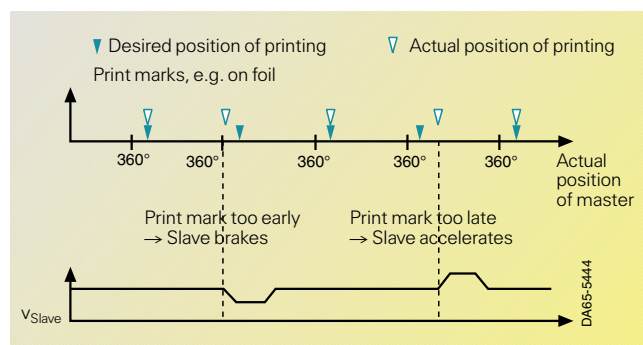


Fig. 6/93
Example of print-mark synchronization

Applications of the synchronous-operation function

With the angular synchronism control system, mechanical shafts, gears and cams can be replaced, e.g. in

- shaftless printing machines
- packing and filling machines
- looms and other textile machines
- gantry traversing units
- conveyor systems.