Product description

Milan drive advanced

Servo motor with integral controls

GFC
AntriebsSysteme
GmbH

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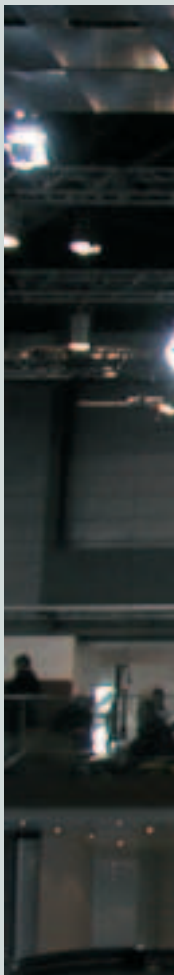

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The product features and technical data provided do not express or imply any warranty.

Applications

The Milan drive advanced can be used wherever high position accuracy with excellent dynamics is required. The nominal torque of the largest size is 4 Nm, the maximum output speed at size MDA 35.1 is 6,000 rpm.

The high enclosure protection IP 64, optionally IP 67, allows the use in extremely unfavourable ambient conditions.

The Milan drive advanced can be used e.g.

- in textile machinery
- in packaging machinery
- for pick and place
- in wood working machinery
- in medical technology
- in food processing machinery
- for servo cylinders
- in capping machinery
- in presses
- in printing machinery
- in safety technology
- for industrial robots
- in special mechanical engineering
- in materials handling technology
- for wine machinery
- in indexing tables

A particularly sophisticated task was the screen show which was staged during an exhibition presentation by VW at Geneva Motor Show. Four enormous flat screens were precisely positioned in accordance with a pre-defined choreography by Milan drives.

Milan drive advanced – Advantages

Advantages of integral controls

Milan drive advanced is one of those few servo drives equipped with all components required for operation in one housing. After having connected the power supply (230 V AC) and the data line, the device is immediately ready for operation – plug and play.

Advantages during design and development

- The high functionality and flexibility enables easy integration into the process
- Fixed quantifiable costs
- Easy integration into the fieldbus systems possible
- Internal supply of the electronics available
- Optimum adaptation of motor and electronics is ensured by the manufacturer
- Warranty for both motor and electronics

Advantages during installation

- Saving of time and material, as less components need to be installed
- Cooling measures within the control cabinet are not required as the power loss only occurs directly at the drive
- Motor and controls are optimally adapted to each other
- It is possible to directly connect and supply external sensors with the Milan drive advanced
- EMC guaranteed

Advantages during commissioning

- Ready-to-use drive with controls: connect, power on, ready-to-use
- Large variety of simple adaption possibilities to the process requirements
- Simple configuration via RS 232 interface using the Milan configuration software MDAwin
- Every Milan drive advanced is subject to comprehensive functional tests within the factory.

Advantages during operation

- Programming options allow adaptation to the process control system and, if necessary, to new operating conditions
- Excellent dynamics due to short scanning time
- High enclosure protection and high corrosion protection
- In case of a failure, the Milan drive advanced can be quickly and completely exchanged, thus reducing the downtime to a minimum
- Password functions protect from unauthorised access

Functions/equipment overview

● Standard ■ Option		Milan drive advanced	Description on page
Equipment	**3-phase AC synchronous servo motor**	●	11
	Special design versions	■	6
	Holding brake	■	9
	– Brake management	■	9
	Position indication system		11
	– Resolver	●	11
	– Multi-turn absolute encoder	■	11
	Servo amplifier	●	10
	Digital position and speed controller (current vector controller)	●	10, 14
	– 4 controller parameter records	●	14
	Power supply unit (voltage supply 230 V AC)	●	10
	Fieldbus interfaces e.g.		7
	– Profibus DP interface (Profidrive)	■	7
	– CANopen interface (DSP 402)	■	7
	4 freely programmable digital I/Os	●	8
	– Supply of sensors at digital inputs	●	8
	A bipolar analogue input (– 10 V to + 10 V)	●	8
	4 freely programmable digital outputs	●	8
	RS 232 programming interface	●	10
	Flange according to DIN 42948	●	11
	Motor shaft according to DIN 748	●	11
	– Parallel key groove	■	11
	Enclosure protection IP 64	●	18
	Enclosure protection IP 67	■	18
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Functions – Programming	**Programming/parameter setting**		12
	– via RS 232 interface	●	12
	– via Fieldbus interface	■	12
	– Programming/configuration software MDAwin	■	12
	– Program/configuration can be stored externally	●	12
	PLC functional blocks	■	13
	Reference positioning management	●	14
	Position control	●	14
	Manual operation (push-to-run driving data records)	●	14
	100 freely programmable driving data records	●	15
	– Single step mode	●	15
	– Cycles/branches	●	15
	– Acceleration/delay linear or $\sin^2$	●	15
	– Teach In	●	15
	Various control types		15
	– Output speed/speed	●	15
	– Contouring error	●	15
	– Torque/force	●	15
	– Position (absolute, relative or modulo)	●	15
	Technological functions e.g.		
	– Electronic gearing (synchronous operation)	■	16
	– Flying saw	■	16
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	– Temperature/Drive blocked	●	17
	– DC-link circuit	●	17
	– Event buffer	●	17
	– Operation hour counter	●	17
Acces-sories	**Electronic name plate**	●	17
	Ready-made cables	■	17
	Mounted gearing	■	17
	Operation box	■	17

Sizes/dimensions

Sizes

The Milan drive advanced is available in 3 standard sizes.

Other sizes on request.

The servo drives' outstanding feature is their compact design in all sizes.

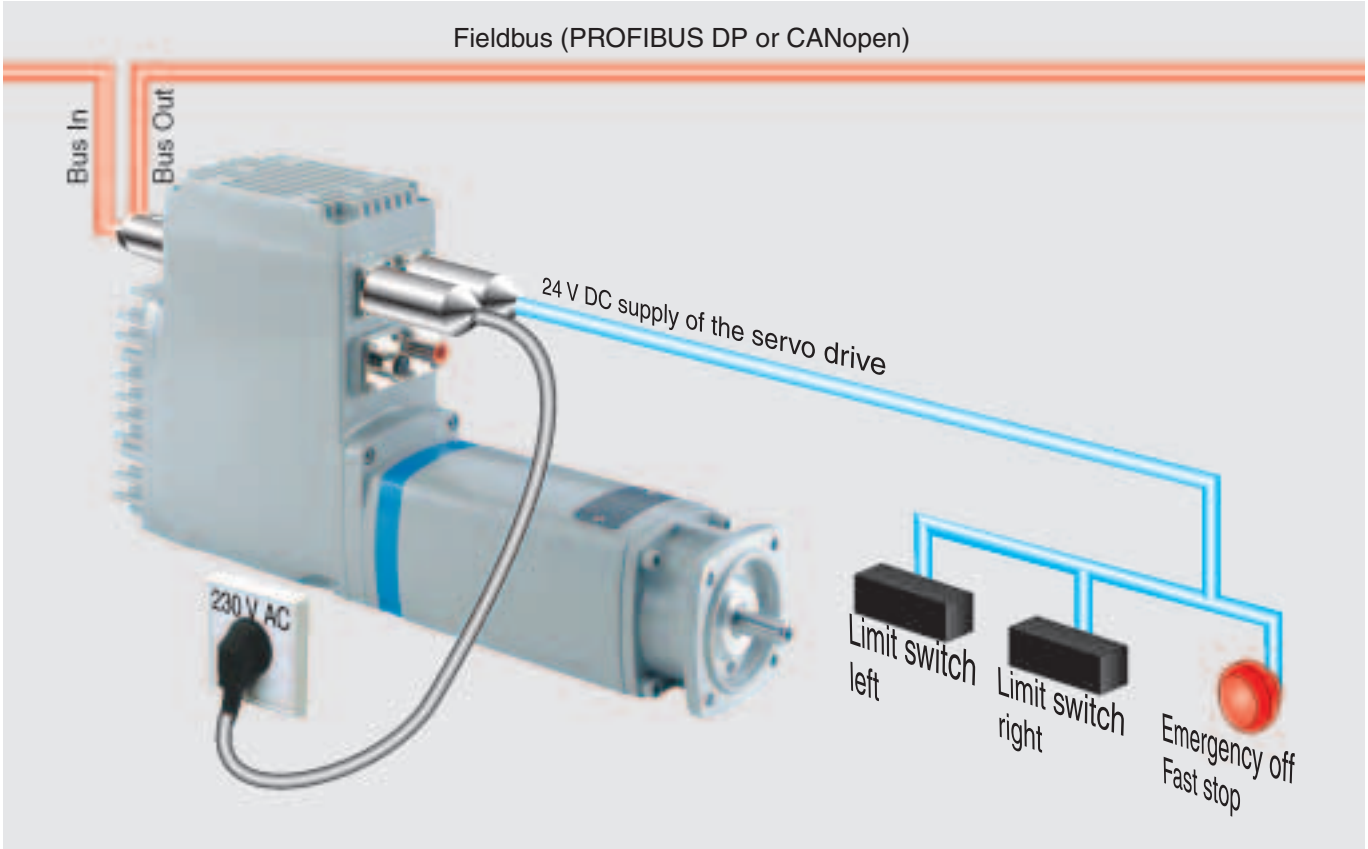
Type/size	MDA 35.1		MDA 56.1	MDA 63.1
Nominal torque for nominal speed [Nm]	0.7	1.5	2.5	4.0
Max. torque [Nm]	2.5	4.0	7.0	9.0
Nominal output speed [rpm]	6,000	3,000	3,000	3,000
Maximum output speed [rpm]	6,000	4,000	4,000	4,000
Nominal power for nominal output speed [kW]	0.47	0.47	0.78	1.26
Standard dimensions				
Max. length without/with holding brake [mm]	365.0/383.0		423.5/448.5	437.5/437.5
Height from axis centre [mm]	157.5		160.0	160.0
Width [mm]	75.0		90.0	110.0
Weight with/without holding brake [kg]	6.3/6.6		9.3/9.9	11.2/11.7
Dimensions special design version, bent (see below)				
Max. length without/with holding brake [mm]	229.0/247.0		245.0/270.0	257.0/257.0
Height from axis centre [mm]	242.5		285.0	285.0
Width [mm]	75.0		110.0	110.0
Weight with/without holding brake [kg]	6.6/6.9		10.2/10.7	12.0/12.5

Versions

If required due to the mounting conditions, Milan drive advanced is also available in a short bent version. In this version, the electronics and motor are mounted next to each other and not behind each other.

Equipment – Interfaces

Fieldbus interface (option) – PROFIBUS DP (Profidrive) or CANopen



The Milan drive advanced is available with a Profibus DP interface according to the Profidrive protocol tailor-made for variable-speed drives or with a CANopen interface according to DSP 4.02.

Further fieldbus interfaces are available on request.

For the Profibus DP interface, the transmission rate amounts to max. 12Mbit/s; for CANopen, the Milan drive advanced supports maximum 1 Mbit/s.

The Milan drive advanced is equipped with two separate M12 circular plugs for the galvanic separated fieldbus interfaces (Bus In and Bus Out).

A possible bus termination is made via an external termination resistor in M12 plug technology.

Equipment – Interfaces

Inputs and outputs, digital and analogue

The Milan drive advanced is equipped with inputs allowing to connect devices not compatible with fieldbus and outputs allowing the connection of e.g. indicators.

All inputs and outputs are freely programmable and can be assigned to individual driving data records.

Inputs/outputs	Description	Example assignment
4 freely programmable digital inputs	24 V DC galvanically isolated	■ Reference switch ■ Limit switch plus ■ Limit switch minus ■ Fast stop
1 analogue input	bipolar, – 10 V to + 10 V	■ Potentiometer for adjusting nominal output speed, or nominal torque or max. output speed or max. torque
4 freely programmable digital outputs	■ 1 relay output 30 V DC/1 A ■ 3 opto-isolators 30 V DC/10 mA	■ Setpoint reached ■ Driving data record is being executed ■ Failure signal ■ Holding brake

Holding brake (option)

If a holding brake is used, then the current position is reliably held. It prevents any change in position after the motor has been switched off, e.g. due to the effects of gravity or outside forces.

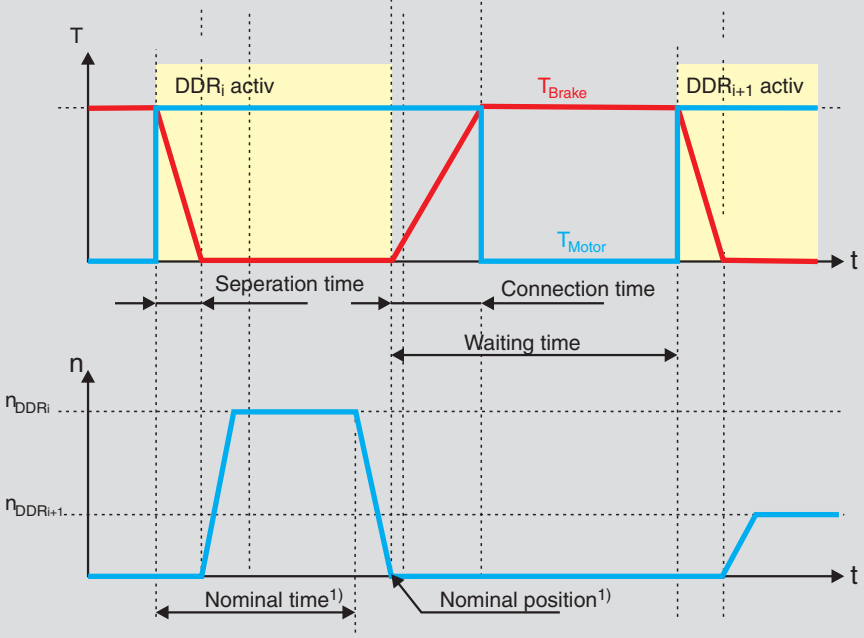
Static holding torques

■ MDA 35.1	2.0 Nm
■ MDA 56.1	4.5 Nm
■ MDA 63.1	9.0 Nm

Braking management

The brake is specifically integrated into the program procedures via the internal braking management (please refer to driving data record linking on page 15). The connection and separation times of the brake and possibly defined waiting and position control end times (refer to PID control, page 14) are automatically considered (refer to chart).

Example: Linking from DDR_i und DDR_{i+1} with waiting time and brake



DDR = Driving data record
T = Torque
n = Output speed
t = Time
1) Nominal time and nominal position depends on control type in DDR

As long as the brake is not completely closed or opened, the motor provides the holding torque. The waiting time can be set separately for each driving data record and describes the minimum waiting time until the next operation. During this waiting time, the separation and connection times of the brake are considered. If the sum of the separation and connection time exceeds the preset waiting time, the brake is not be applied.

Design principle

1 Electrical connection and inputs/outputs

The plug arrangement can be selected and varied as desired. It depends on the design requirements of the drive environment.

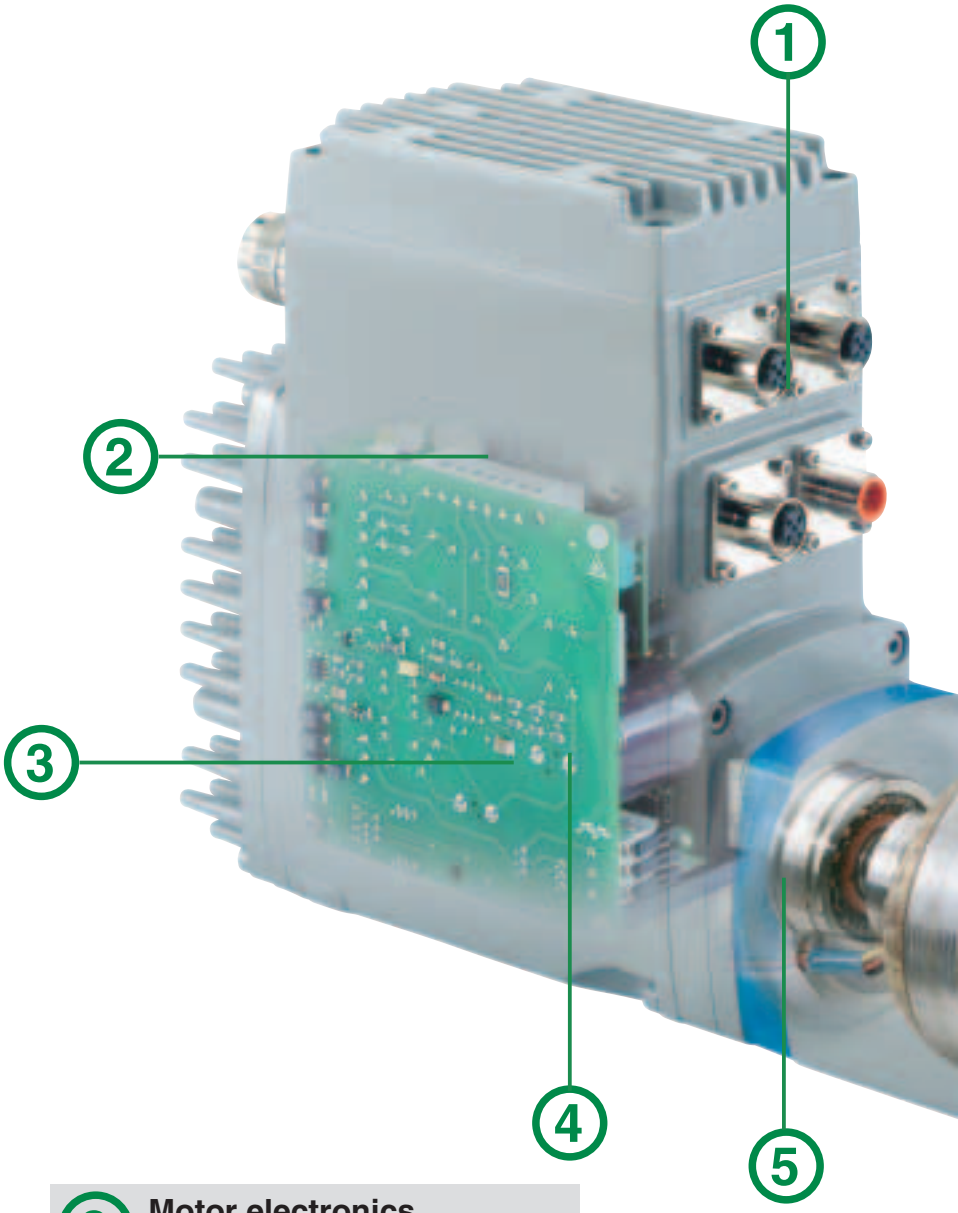
A possible plug arrangement could be as follows:

- Power supply (M23)
- Auxiliary voltage 24 V DC/brake (M12) for electronics
- RS 232 connection (M12)
- Fieldbus BUS IN (M12)
- Fieldbus BUS OUT (M12)
- Input connection (please refer to page 8) (4 digital inputs/ supply from the drive 24 V DC) (M12)
- Output connection (please refer to page 8) (4 digital outputs) (M12)

2 Fieldbus

A PROFIBUS DP or CANopen interface is installed within the drive using an additional plug-inmodule. Please refer to page 7 for the description of the fieldbus characteristics.

Further fieldbus interfaces on request.



3 Motor electronics

All control components, required for the operation of the motor, are integrated in the drive housing. This includes

- digital, sinus commutated servo amplifier, consisting of the components power supply unit (voltage supply 230 V AC), power end stage, positioning and sequence control, internal ballast resistance,
- digital current, position, and speed controller

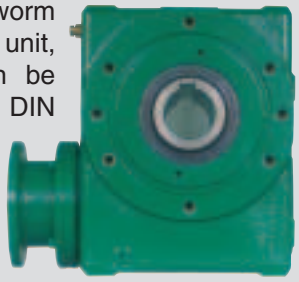
A heat insulation protects the electronics from any excessive motor temperatures.

7 Motor

The synchronous servo motor has a low rotor moment of inertia basis for the excellent motor dynamics. By using high quality materials a long lifetime is achieved. Therefore, no maintenance is required.

As an option, the motor is available with a holding brake.

6 Flange and connection shaft



A GFC helical worm gear or bevel gear unit, for example, can be mounted to the DIN standardised flange/shaft unit.

The Milan drive advanced is also implemented in combination with planetary gearings of most different manufacturers.

5 Position indication unit

With the maintenance-free resolver, the rotor position of the motor is registered allowing the speed and position to be derived. The resolution is 4096 increments per revolution, as a prerequisite for a high precision of positioning. As an alternative, the MDA can be equipped with a 12 bit multi-turn absolute encoder. Therefore, no reference traverse is required after switching on the actuator again.

4 Micro controller

Due to various programming options of the integral micro controller, the Milan drive advanced can quickly and easily be adapted to the specific application. Program procedures can be defined. The PLC controls are thus relieved and the data exchange is reduced. The Milan drive advanced thereby follows the clear trend towards decentralization of functions within the automation technology.

Programming – Parameter setting

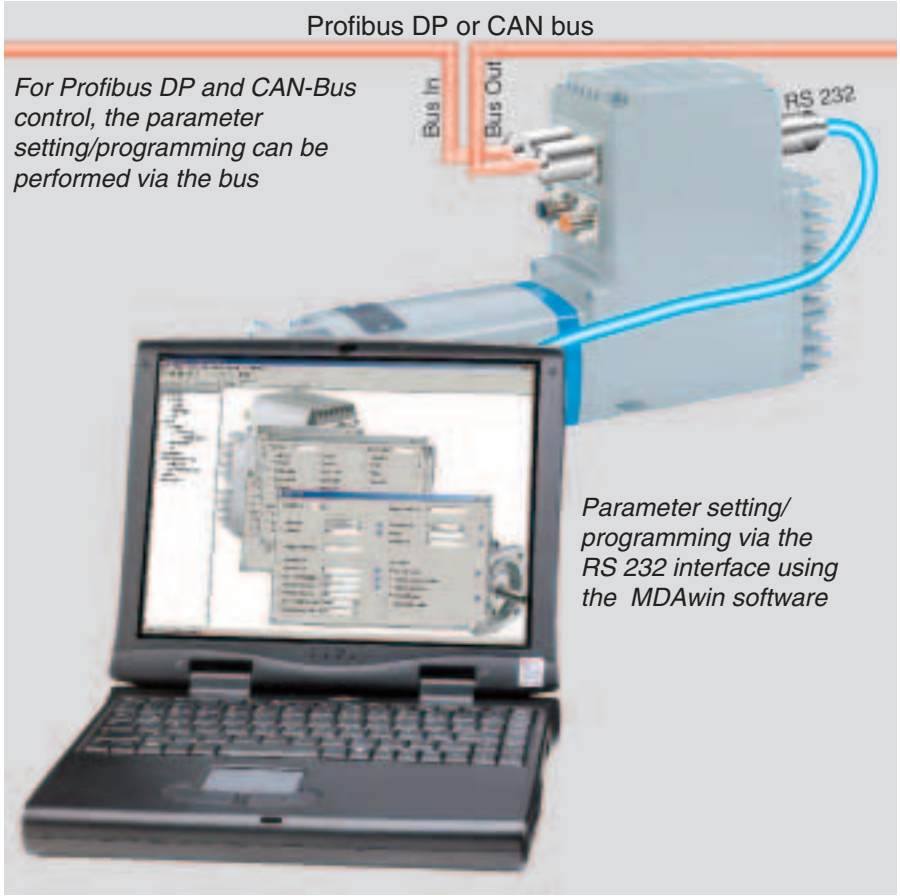
Programming – Parameter setting

The setting of the parameters or the programming of the driving data records are done with the aid of a computer or laptop which is connected to an RS 232 interface. The RS 232 interface is located on a separate plug, so that it remains accessible without having to separate the other connections.

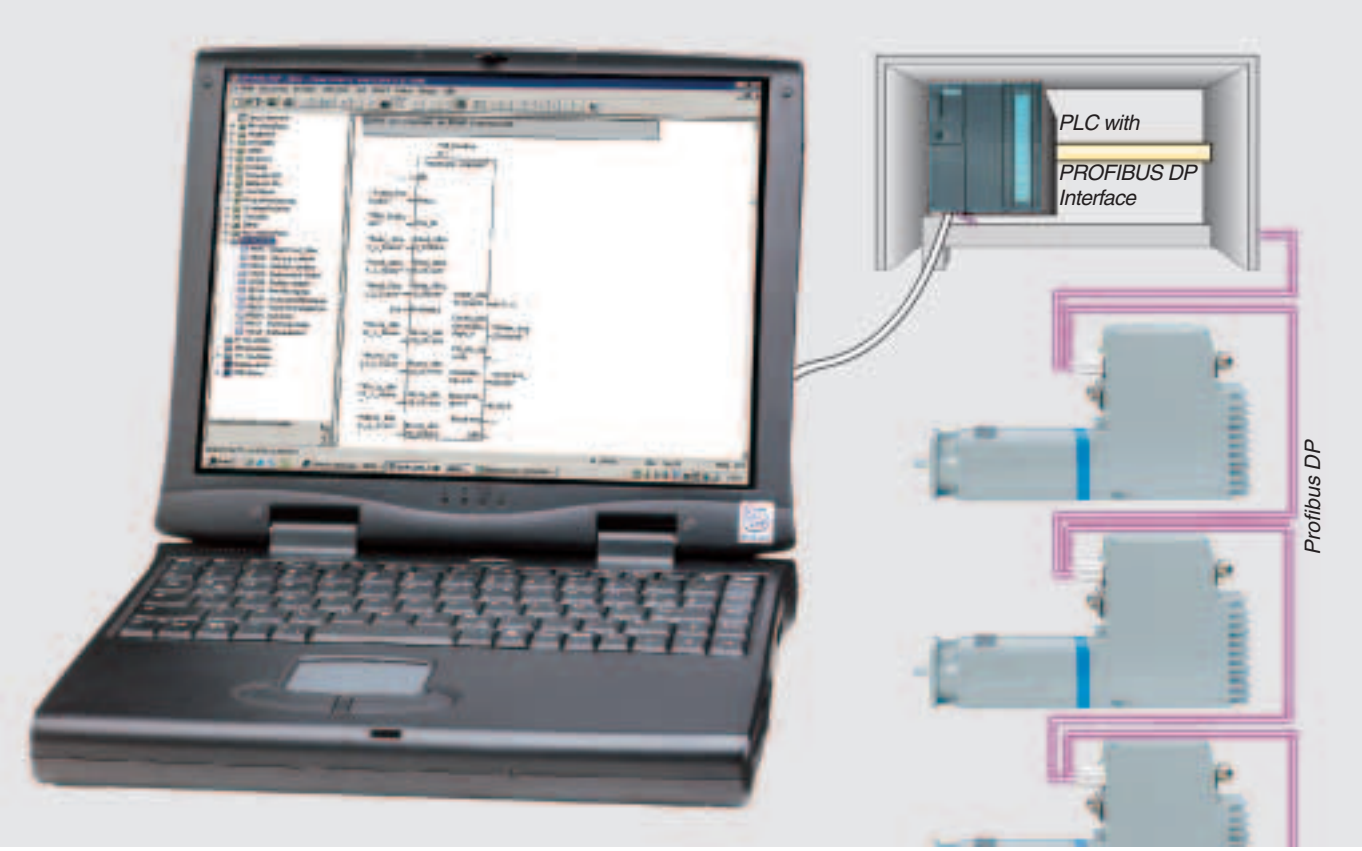
The PROFIBUS DP profile PROFIDRIVE and CANopen DSP 402 provide, in addition to the actual programming, the possibility to exchange the parameters. Parameter setting and programming can therefore be done via the overriding controls.

The MDAwin software is required for parameter setting via the RS 232 interface and can be supplied by GFC AntriebsSysteme GmbH. The Microsoft operating system Windows 2000/XP is required to run the software.

The program flow or the configuration of each Milan drive advanced can be stored on a data carrier, e.g. the hard drive of a laptop and can be modified offline. If a Milan drive advanced is replaced, the stored configuration can simply be loaded to the programming device and afterwards be transmitted to the replacement drive.



PLC functional blocks



Milan functional blocks can easily be integrated into the Step 7 user interface

Quick and easy commissioning of the Milan servo drives is possible due to a pool of Milan functional blocks[1)] on the basis of the Simatic Step 7 software in combination with Profibus DP. The PLC programmer does not have to deal with the detailed requirements of the PROFIBUS protocol (Profidrive) with regard to the control.

By combining the different functional blocks, almost any application can be implemented.

1) The programmer has to adapt the functional blocks to the given application.

Functions

System settings

By entering the reduction ratio of an interconnected gearing, the swivel movements and positions at the drive output are calculated for both rotary and linear axis.

The display units can be selected as follows:

- increments,
- revolutions/min.,
- μm, mm, cm…

Additional software limit switches can be defined via the system settings. The modulo function allows a precise positioning within one motor revolution C axis or stem orientation for machine tools).

Reference positioning management

An absolute drive position can be defined with the reference operation for the subsequent positioning tasks. End switches, reference switches, or end stops can be used as reference points. If an absolute encoder is available, the reference operation must only be performed at the time of commissioning.

The reference operation can be activated by:

- Connection of power supply (power up)
- First start
- Reference operation by external signal
- Manually via the MDAwin software

Reference operation speed/output speed and reference operation torque/rim pull can be pre-determined.

Position control

The positioning occurs internally via a position controller. The proportional amplification depends on the system to be controlled. There are four controller parameter records available, which can be independently set and assigned to individual driving data records.

The adjustable position control stop time indicates how long the drive can hold the required torque for modulating after the end of the program in order to prevent any change of the nominal position caused by external forces. The position control stop time can be adjusted between 0 and ∞.

Manual operation

The servo drive can be operated independent of the programmed “in manual operation ”movement profile using two independent push-to-run driving data records. The two push-to-run driving data records can be controlled directly via fieldbus.

Programmable driving data records

The Milan drive advanced allows free programming of 100 data records. The driving data records may be activated via Fieldbus.
The following settings are possible:

- Selection from various control types (see below)
- Output speed/speed
- Torque/force
- Acceleration
- Acceleration ramp linear or sine^2
- Delay
- Delay ramp linear or sine^2

Single step mode

The driving data records are individually activated by a start signal either via the bus, or the RS 232 interface, or a digital input.

Sequential control

Each driving data record can activate another data record, thus enabling the programming of closed loops. A waiting time can be defined between two driving data records.

Branches are possible via an external signal. As soon as this signal is received, the drive jumps to the programmed driving data record and performs the action defined there.

As a further possibility, the program sequence can be stopped after any driving data record and only be resumed by an external synchronisation signal.

Teach in

Teach in is the possibility to assign actual positions as nominal positions to certain driving data records. Externally determined sequence movements can therefore be displayed in the program flow.

Driving data record linking

The transitions between two driving data records can be programmed according to the specific application. The Milan drive advanced offers the following options:

- **Immediate switching**
  next driving data record is started without deceleration to 0 speed
- **Stop position**
  The actual position is maintained in position control during the indicated waiting time.
- **Waiting with brake**
  During the indicated waiting time, the actual position is maintained via the holding brake, in case the waiting time is superior to the separation time + connection time (implicates optional braking, please refer to page 9)
- **Waiting without current**
  During the waiting time, neither current nor torque is applied to the motor.

Control types

For each driving data record selection can be made among 6 control variations:

- **Output speed/speed**
  with this variable as primary feedback
- **Contouring error**
  is an output speed/speed control at which a programmable contouring error is controlled. Upon exceeding a contouring error window, the warning signal contouring error is generated.
- **Torque/force**
  with this variable as primary feedback
- **Absolute position**
  independent of the current position, the drive runs to the defined position
- Relative position
  from the current position, the drive runs to the next value indicated
- **Modulo position**
  With this control type, the drive can be positioned within one revolution. The position setpoint is reached via the shortest travel, i.e. the drive never performs more than half a rotation. Thereby the system influences e.g. due to the mounting of a gearbox must be observed.

Control types	possible applications
Output speed/speed/contouring error	Conveyor belts, centrifugal chambers, stems…
Torque/force	Capping machinery, presses, ...
Absolute/relative position	Textile, packaging, handling machines,...
Modulo position	C axis on working lathes, stem orientation, indexing tables,...

Customer-specific technological functions

Additional functions

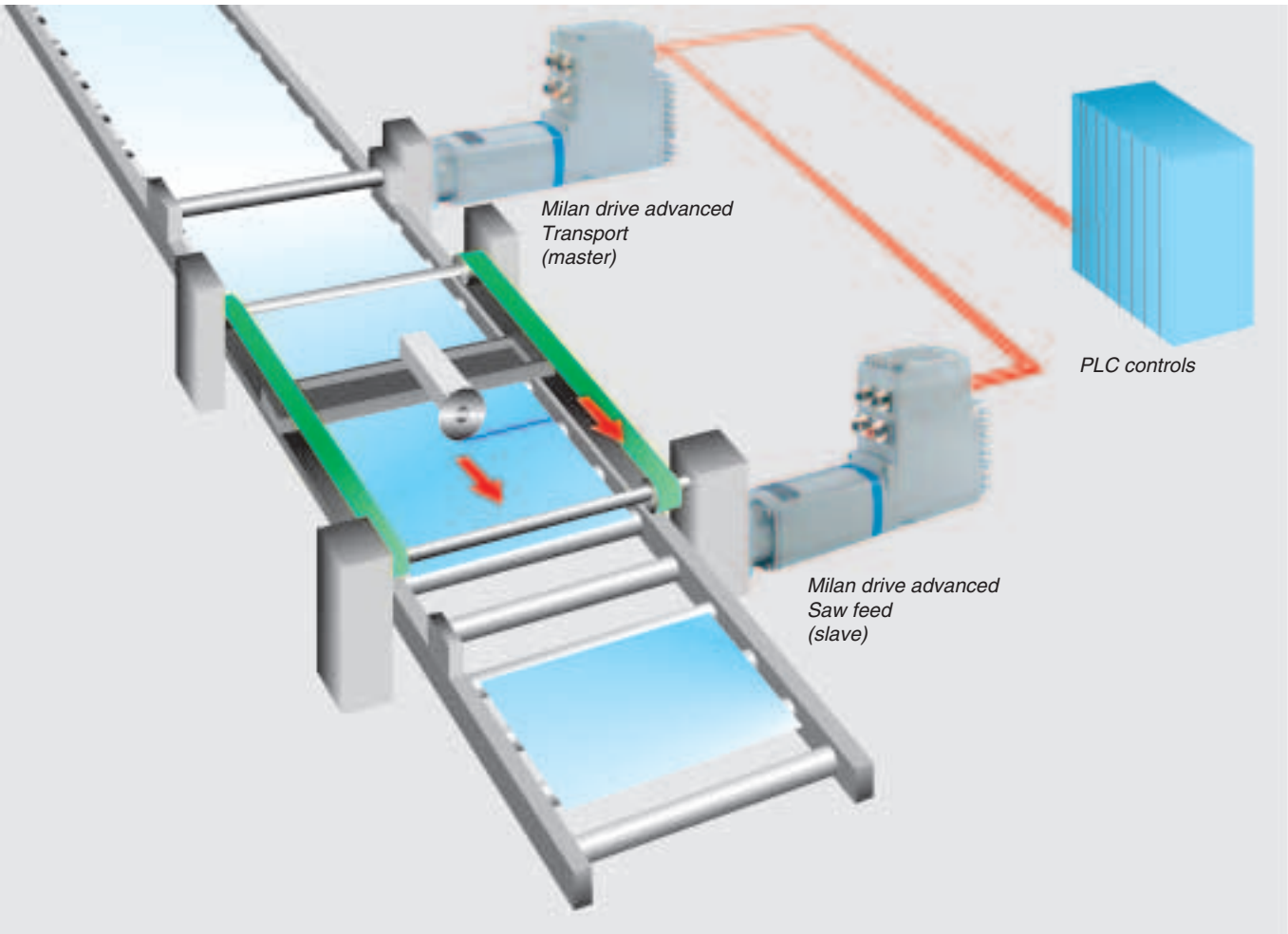
Upon request, further custom-designed functions can be implemented apart from those described e.g. flying referencing or an override functionality.

Electronic gearing (synchronous operation)

Many applications require a perfect synchronization of the output speeds of several servo drives. For such requirements the electronic gearing function is provided. One of several Milan drive advanced drives is declared the master. The slave drives are synchronized according to the master's output speed. This is possible for a reduction ratio of 1:1, i.e. synchronous operation, as well as for other transmission ratios.

Flying saw

In the field of printing, wood working, and plastics processing a flying saw is often used. It saws or cuts the material during transportation into single parts of certain lengths. This is where a straight cut of the required length depends on the synchronization of output speeds and the exact coordination of positioning processes of the various drives.



Flying saw

Signals/diagnosis/accessories

Monitoring

The Milan drive advanced is equipped with extensive monitoring functions and status signals. Basically, faults are distinguished by an immediate shut-down of the drive and by warnings, that merely generate a signal.

The warning is often considered as a preliminary stage of a fault.

The immediate shut-down in the event of a fault prevents the device or the plant from being damaged. The various diagnosis possibilities allow a swift location and elimination of the fault.

If the control is operated via Fieldbus, all faults and warning signals can be transmitted separately.

Warnings

Examples

- DC-link circuit lower than 220 V
- Brake voltage lower than 22 V or higher than 26 V
- Motor temperature higher than 130 °C
- Electronics temperature higher than 70 °C
- Contouring error
- Derating

Failure signals

- DC-link circuit lower than 180 V or higher than 400 V
- Brake voltage lower than 20 V or higher than 28 V
- Motor temperature higher than 140 °C
- Electronics temperature higher than 75 °C
- Fast stop command is available
- Drive blocked

Event buffer

The Milan Drive Advanced is equipped with an event buffer in which faults, warnings and other functional events, for example, are chronologically stored. The data is stored in a non-volatile memory.

Operation hour counter

The Milan drive advanced is equipped with an internal operation hour counter. The data is stored in a

Electronic name plate

A device identification code is stored in the non-volatile Milan drive advanced memory. At GFC AntriebsSysteme GmbH, all product relevant information is accessible under this code, eg. commision number, wiring diagram, firmware version, etc.

Additional customer-specific data can be entered in two designation fields.

Accessories

Ready-made cables

Power as well as signal cables can be supplied in various ready-made lengths. Detailed information can be found in the ‘Technical data sheet for cable sets Milan drive advanced´.

Mounted gearing

On request, the Milan drive advanced can also be supplied with mounted gearing. The gearing can either be obtained from GFC AntriebsSysteme GmbH or be made available by the customer. The gear transmission ratio is taken into consideration in the Milan drive advanced configuration menu.

Operation box

Interested users can temporarily obtain the Milan drive advanced, the operation box, ready-made cables and the MDAwin software for test purposes. Inputs and outputs can directly be operated at the operation box. Alternatively, external sensors such as end switches or reference switches can be directly connected at the operation box.

Documentation

The documentation consists of

- Operation instructions for the respective controls (PROFIBUS DP, CANopen)
- Technical data sheet and dimension sheet

and is as a standard available in German and English language. Other languages on request.

Service conditions/EU directives

Service conditions

Types of enclosure protection

- **IP 64**
  IP 64 means protection against ingress of dust and water
- **IP 67**
  IP 67 means protection against ingress of dust and immersion in water max. 1 m head of water for the duration of max. 30 minutes.

Corrosion protection

The housing of the Milan drive advanced is of a high quality corrosion-proof aluminium alloy. All other external parts such as screws/bolts and the motor shaft are of stainless steel.

The finish coating is grey. Other colours on request.

Ambient temperatures

– 10 °C to + 50 °C

Derating as from + 25 °C. Reduction of the nominal power by 2.5 % per Kelvin.

Explosion protection (option)

Milan drive advanced can be used in potentially explosive atmospheres after precisely checking the conditions. GFC confirms in a declaration of incorporation that the requirements of following ATEX product classification are fulfilled::
Group II,
Category 3,
Medium dust
(Zone 22)
Temperature class T4 (135 °C)

EU Directives

Machinery Directive

According to this directive, servo drives are not considered as complete machines. This means that a certificate of conformity cannot be issued, but GFC AntriebsSysteme GmbH confirms in a declaration of incorporation that during the design stage of the Milan drive advanced, the standards mentioned in the Machinery Directive were applied.

By mounting the servo drive to other components a ‘machine’ within the meaning of the Directive is created. Before commissioning, a Certificate of Conformity must be issued by the manufacturer of the machine.

Low Voltage and EMC Directive

The Milan drive advanced fulfils the requirements which were proven in extensive tests. Therefore, GFC AntriebsSysteme GmbH has issued a Declaration of Conformity according to these Directives.

CE Mark

Since the Milan drive advanced fulfils the requirements of the Low Voltage and EMC Directives, the drives are marked with the CE Mark in accordance with the directives.

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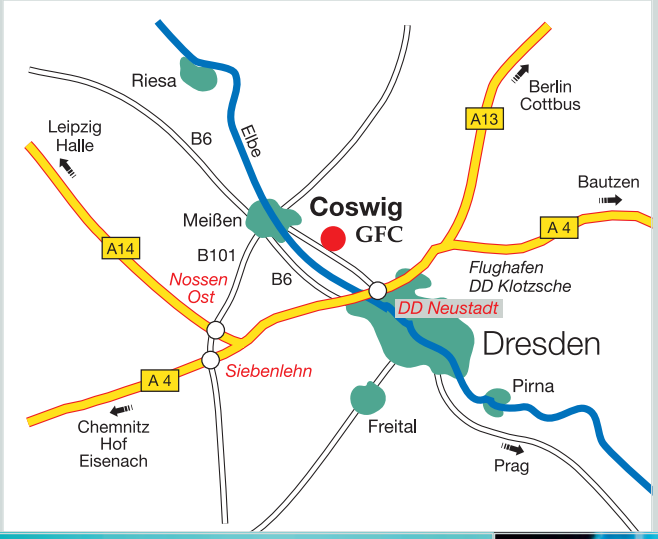

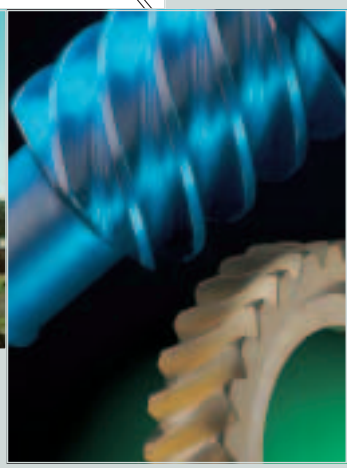

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