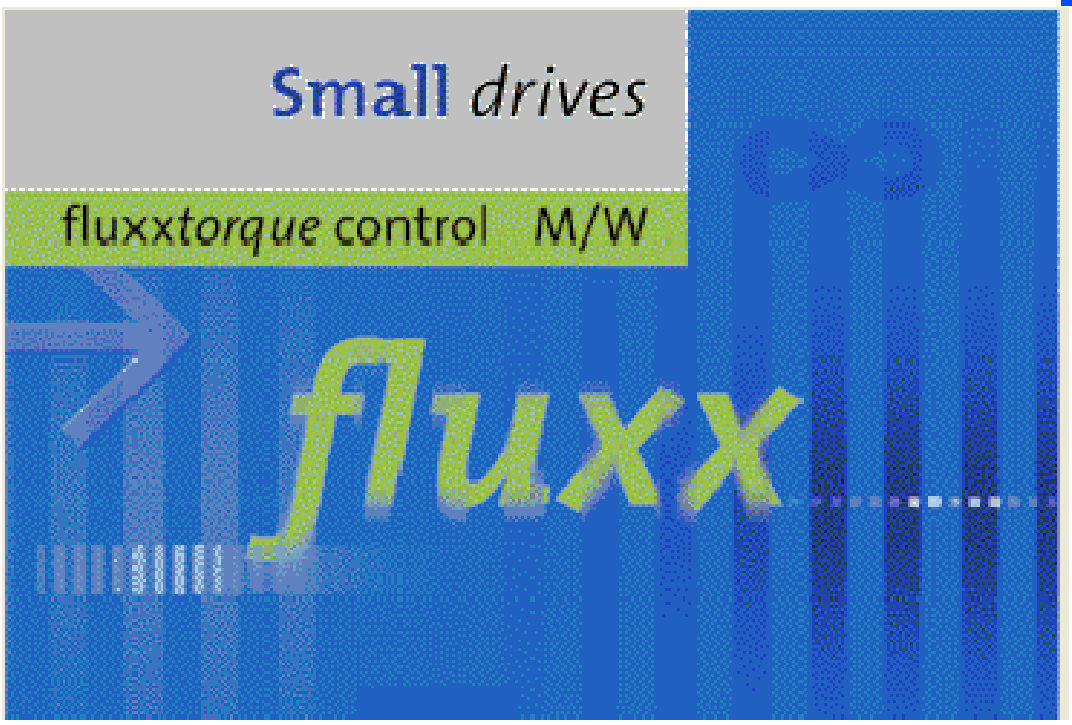
HB 13.0001-EN
13142788

L-force

Software manual

Servo Drives 930 *fluxxtorque*



Servo inverter

931M/W

Lenze

This Manual is valid for 931M/W servo inverters

- The 931 W inverter is used for separate mounting.
- The 931 M inverter is an integrated motor inverter. The motor, the electronics, the feedback, and possibly the brake is integrated into the system.

What is new, what has changed ?

Material No.	Version			Description
13142788	3.0	06/2006	TD31	First edition

Important note:
Software is provided to the user "as is". All risks regarding the quality of the software and any results obtained from its use remain with the user. The user should take appropriate security precautions against possible maloperation.
We do not accept any responsibility for direct or indirect damage caused, e.g. loss of profit, loss of orders or adverse commercial effects of any kind.
All trade names listed in this documentation are trademarks of their respective owners.

1 Preface and general information

With **"fluxx"**, Lenze offers a program for the comfortable commissioning, parameter setting and diagnostics of the Fluxxtorque 931 M and 931 W drive series.

The software described in this Manual is provided with the following functional range:

- Controlled commissioning via drive-specific dialogs for 931 M and W servo inverters.
- Parameter setting with a direct connection to the controller.
- Automatic drive identification for operation with a serial interface.
- Communication via RS232 serial interface.
- Simplified troubleshooting by diagnostics functions.
- Monitor window for representing all required drive parameters that are updated cyclically.
- PC parameter set storage in the PC for archiving or for service applications.
- Complete parameter set transfer between the PC and controller by using one command.
- Printout of the parameter settings for purposes of documentation.
- Saving/loading the drive configuration for an exchange between different computers.

Note!
The software also is available in English.

1.1 About this Manual

Target group

This Manual addresses to all persons who carry out dimensioning, commissioning and settings of servo inverters of the 931 series.

Together with the catalogue, it forms the basis for project planning for the mechanical engineer and system engineer.

Contents

The System Manual complements the Mounting Instructions included in the scope of supply:

- The features and functions are described in detail.
- It provides detailed information on possible applications.
- Parameter setting is clarified by means of examples.
- In case of doubt, the supplied Mounting Instructions are always valid.

Finding information

- Via the contents and the table of keywords, you'll quickly find the information regarding a specific problem.
- Descriptions and data with regard to further Lenze products can be gathered from the respective catalogues, Operating Instructions, and Manuals.
- You can request Lenze documentation from your responsible Lenze sales partner or download it as a PDF file from the Internet.

1.2 Terminology used

Term	In the following text used for
Controller	931M/W servo inverter
Drive	931M servo inverter or 931W servo inverter with connected motor

1.3 Legal regulations

Labelling	**Nameplate**	**CE identification**	**Manufacturer**
	Lenze drive controllers are definitely identified by the contents of the nameplate.	In compliance with the EC Low-Voltage Directive	Lenze GmbH & Co KG small drives Postfach 10 13 52 D-31763 Hameln
Application as directed	**931M/W servo inverters** ● must only be operated under the operating conditions prescribed in these instructions. ● are components – for the open and closed loop control of variable speed drives, – for installation in a machine, – for assembly with other components to form a machine. ● comply with the requirements of the Low-Voltage Directive. ● are not machines for the purpose of the Machinery Directive. ● are not to be used as domestic appliances, but only for industrial purposes. **Drive systems with 931M/W servo inverters** ● comply with the EMC Directive if they are installed according to the guidelines of CE-typical drive systems. ● can be used – for operation on public and non-public mains – for operation in industrial premises. ● The user is responsible for the compliance of his application with the EC directives. **Any other use shall be deemed as inappropriate!**		
Liability	● The information, data, and notes in these instructions met the state of the art at the time of printing. Claims on modifications referring to controllers which have already been supplied cannot be derived from the information, illustrations, and descriptions. ● The specifications, processes, and circuitry described in these Instructions are for guidance only and must be adapted to your own specific application. Lenze does not take responsibility for the suitability of the process and circuit proposals. ● Lenze does not accept any liability for damage and operating interference caused by: – disregarding of the Operating Instructions – unauthorised changes with regard to the drive controllers – operating errors – improper working on and with the drive controllers		
Warranty	● Terms of warranty: see Sales and Delivery Conditions of Lenze GmbH & Co KG small drives. ● Warranty claims must be made to Lenze immediately after detecting the deficiency or fault. ● The warranty is void in all cases where liability claims cannot be made.		
Disposal	**Material**	**Recycle**	**Dispose**
	Metal	●	-
	Plastic	●	-
	Assembled PCBs	-	●

1.4 Warranty terms

No changes except those described in the available Manual may be carried out on the device. Connect the inputs and outputs, as well as the interfaces only as described in the Manual. Send the device in original packaging only.

2 Safety instructions

2.1 Personnel responsible for safety

Operator

- An operator is any natural or legal person who uses the drive system or on behalf of whom the drive system is used.
- The operator or his safety officer must ensure
  - that all relevant regulations, instructions and legislation are observed.
  - that only qualified personnel work with and on the drive system.
  - that the personnel have the Operating Instructions available for all corresponding operations.
  - that non-qualified personnel are prohibited from working with and on the drive system.

Skilled personnel

Skilled personnel are persons who - because of their education, experience, instructions, and knowledge about corresponding standards and regulations, rules for the prevention of accidents, and operating conditions - are authorised by the person responsible for the safety of the plant to perform the required actions and who are able to recognise potential hazards.
(See IEC 364, definition of skilled personnel)

2.2 General safety and application notes for Lenze servo inverters

(According to: Low-Voltage Directive 73/23/EEC)

General

Lenze controllers (frequency inverters, servo inverters, DC controllers) and the accessory components can include live and rotating parts - depending on their type of protection - during operation. Surfaces can be hot.

Non-authorised removal of the required cover, inappropriate use, incorrect installation or operation, create the risk of severe injury to persons or damage to material assets.

More information can be obtained from the documentation.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110, and national regulations for the prevention of accidents must be observed).

According to this basic safety information, qualified, skilled personnel are persons who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications required for their occupation.

Application as directed

Drive controllers are components designed for installation into electrical systems or machines. They are not household appliances, but are only designed as components for industrial or professional purposes in terms of EN 61000-3-2.

When installing the controllers into machines, commissioning (i.e. starting operation asdirected) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 98/37/EC (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with the EMC Directive (89/336/EEC).

The technical data and information on connection conditions can be obtained from the nameplate and the documentation. They must be observed in any case.

Warning: The availability of controllers is restricted according to EN 61800-3. These products can cause radio interferences. In this case, special measures are required.

Transport, storage

Please observe the notes on transport, storage and appropriate handling.

Observe the climatic conditions in accordance with EN 50178.

Installation

The controllers must be installed and cooled according to the instructions given in the corresponding documentation.

Ensure proper handling and avoid mechanical stress. Do not bend any components and do not change any insulation distances during transport or handling. Do not touch any electroniccomponents and contacts.

Controllers contain electrostatically sensitive components, which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components, since this might endanger your health!

Electrical connection

When working on live controllers, the valid national regulations for the prevention of accidents (e. g. VBG 4) must be observed.

The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, PE connection). Additional information can be obtained from the documentation.

The documentation contains notes for the installation according to EMC (shielding, earthing and running of the cables). Also observe these notes with regard to CE-labelled drive controllers. The manufacturer of the system or machine is responsible for the compliance in accordance with the limit values required in connection with EMC legislation.

Operation

Where required, systems including controllers must be equipped with additional monitoring and protection devices according to the valid safety regulations (e.g. law on technical equipment, regulations for the prevention of accidents). The controller can be adapted to your application. Please observe the corresponding information given in the documentation.

After the drive controller has been disconnected from the voltage supply, all live components and power connections must not be touched immediately because capacitors can still be charged.

All protection covers and doors must be shut during operation.

Maintenance and service

The controllers do not require any maintenance if the prescribed conditions of operation are observed.

If the ambient air is polluted, the cooling surfaces of the controller may become dirty, or the air vents of the controller may be obstructed. Therefore, clean the cooling surfaces and air vents periodically under these operating conditions. Do not use sharp or pointed tools for this purpose!

Disposal

Recycle metal and plastic materials. Ensure professional disposal of assembled PCBs.

The product-specific safety and application notes given in these Operating Instructions must be observed!

2.3 General safety information

- ► These safety information are not claimed to be complete. In case of questions and problems, please contact your Lenze representative.
- ► At the time of delivery the communication interfaces meet the state of the art and ensure basically safe operation.
- ► The information given in these Operating Instructions refer to the specified hardware and software versions of the modules.

2.4 Residual hazards

Protection of persons

After power-off, the pins of the connection X2 (+320 V DC, 230 V AC L1, N or 0 V DC), UL, BR and GND still carry hazardous voltages for at least 3 minutes!

- ► Before working on the controller, check that no voltage is applied to the power terminals.
- ► Always protect the power terminals against contact.

The discharge current to ground (PE) is > 3.5 mA, in accordance with EN 50178

- ► If a fixed installation is required, just design the PE conductor with a cable cross-section of at least 1.5 mm^2, or design the PE conductor double.

Observe appropriately installed cables, correct bolted connections, and correct plug connections.

Due to the high currents in applications with extra-low voltages, current-carrying parts can be strongly heated.

Device protection

- ► Connect or disconnect all pluggable terminals in a deenergised state only!
- ► A cyclic connection and disconnection of the supply voltage can overload and destroy the input current limitation of the drive controller:
  - – When effecting a cyclic switching of the supply voltage over a longer period, the period between two switch-on processes at least has to be one minute!

Motor protection

Drive systems can reach dangerous overspeeds (e.g. setting of high field frequencies for motors and machines which are not qualified for this purpose):

- ► The controllers do not offer any protection against these operating conditions. Use additional components for this.

Protection of the machine/system

A missing or incorrect resolver adjustment can bring about undefined control states. The perfect operation is no longer guaranteed.

2.5 Definition of notes used

The following pictographs and signal words are used in this documentation to indicate dangers and important information:

Safety instructions

Structure of safety instructions:

Danger!

(characterises the type and severity of danger)

Note

(describes the danger and gives information about how to prevent dangerous situations)

Pictograph and signal word	Meaning
 **Danger!**	**Danger of personal injury through dangerous electrical voltage.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Danger!**	**Danger of personal injury through a general source of danger.** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Stop!**	**Danger of property damage.** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

Application notes

Pictograph and signal word	Meaning
 **Note!**	Important note to ensure troublefree operation
 **Tip!**	Useful tip for simple handling
	Reference to another documentation

3 Installation

3.1 System requirements

In order to be able to work with the ”fluxx” software, the following minimum requirements with regard to hardware and software have to be met:

- Microsoft Windows NT 4.0, 95/98, Windows 2000, Windows XP operating systems
- IBM-compatible PC (Pentium 90 processor or higher)
- 64 MB main memory (RAM) for Windows 9x/Me/NT, 128 MB for Windows XP/2000
- Free slots/interfaces according to the requirements of the fieldbus interface module to be used
- Hardware connection via RS232 connection (© GHB 931 M/W)

Tip!

It is recommended to use a mouse.

In order to be able to communicate online with the target system, you connect the target system to the PC via the respective interface/adaptor cable. Information regarding the connection can be gathered from the Operating Instructions of your servo inverter.

3.2 Installation of the software

The **”fluxx”** software does not have to be unpacked or installed. It can be copied on any accessible memory area on your PC and can be started by selecting the following symbol.

Lenze

fluxx.exe

4 User interface

4.1 Introduction

4.1.1 Program description

The ”fluxx” user software described in the following was developed for commissioning test and service applications.

For the commissioning of the servo inverter, this software enables a quick integration and adjustment to an existing system. By using the software, operating parameters, such as the performance parameters or communication settings can be quickly and easily adjusted to the application.

By means of test tools, which for example enable a recording of the most important state variables (speed, torque, ...) over a specific period, it is possible for the user to optimise the controller parameters and to analyse critical positions. In case of occurring errors, this software provides a deep insight into the ”condition” of the motor to the service technician, and therefore allows for quickly detecting and eliminating the cause of fault.

A plausibility check avoids the programming of steps that are technically not possible (e.g. set position beyond software limit switch range).

On a total of ten menu pages all accessible parameters can be set and altered depending on the depth of the access authorisation.

4.1.2 Menu pages

In case of the ”fluxx” software, operation is effected via menu pages where the functions of different groups of performance features are summarised. On the pages of the individual groups, for instance the access authorisation to the drive, the setting of the controller parameters, the functions of the interface modules can be set. The status of the drive and fieldbus communication is presented in a way that makes it possible to also use the software as a ”status display” of the drive.

The most important commands like ”Stop”, ”Start”, or ”Memory” are accessible via the upper menu bar.

4.1.3 Tab change

If you have carried out changes on a menu page and do not save them, when changing to another page a query (see diagram below) as to whether the changes are to be saved or discarded is effected. If they are saved, the changed parameters are stored in the EEPROM of the drive.

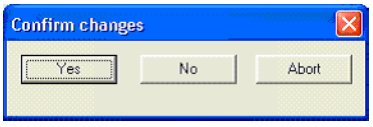
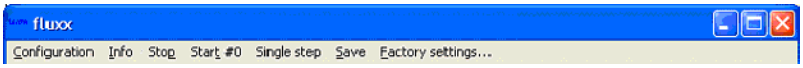


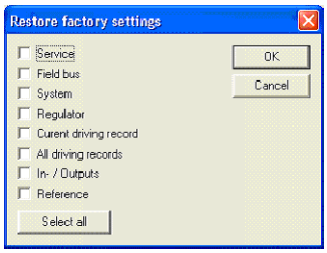
Fig. 1 Saving changes

4.1.4 Menu bar

fluxx menu bar



Menu bar	Description
Configuration	The set configuration of the drive unit can be loaded or saved on a hard disk, floppy disk, or on other storage devices connected to the PC, by means of the commands described in the following. ● **Load** – This command enables an upload of a drive configuration that is already stored. This configuration is only displayed and is not loaded in the drive if the user program is in offline mode (see ”Setup” menu). Otherwise, loading a drive configuration is only possible from level 3 (see access authorisation), as otherwise users with a lower access authorisation could ”overwrite” all motor settings. – If ”Load” is selected in the service level, the following warning appears: ”Service parameters are overwritten” Remedy: Switch-over to the operating mode ”Online level 4”. Continue loading? If the user continues loading in spite of this warning, all service parameters are overwritten, also those for the resolver. – In this case the drive might have to be dismounted and the resolver might have to be readjusted in the loadfree state, as the resolver adjustment has to be carried out individually for each motor and cannot be adopted even for a motor of the same type. If the resolver offset is set incorrectly, the motor cannot operate. ● **Save** – ”Save” stores the current settings under the destination and name that has already been defined. If they have not yet been defined, an automatic switch-over to ”Save as...” is effected, so that the user can specify the memory location and name. ● **Save as** – This command saves the drive configuration in accordance with the specification of the name and destination to be selected by the user. ● **Autosave** – This function is only provided in offline mode. If ”Autosave” is selected, all changes are accepted and saved in the RAM memory of the programming unit. However, this function does not replace the ”Save configuration” function.
Information	Under this menu item, the version of the operating software can be retrieved by selecting ”About”. In addition, the Lenze address is shown.
Stop	By activating this key, the travel program is stopped. If the stop key is activated 2 times, a quick stop with a maximum braking torque is effected. Afterwards the drive is switched to a deenergised state.
Start#x	By activating this key, the travel program is started with the travel data set that is currently selected in the ”Travel data sets” menu. Thereby, the number of the current travel data set is automatically placed behind the # symbol.
Single step	Via this switch, the single step mode can be switched on, off, or to the next step. According to whether the single step mode is activated or deactivated, a check mark appears on the submenu items ”On” or ”Off”. By selecting ”On” or ”Off”, the single step mode is switched on or off. If the single step mode is active, the subsequent travel data set which is defined in the ”Travel data sets” menu is either first started by means of a new starting command (single step~Next) in the user program, or via the motor input which is configured with ”Single step”.

Menu bar	Description
Save	If this function is selected, all changes that have been carried out on the current menu page are saved. This function is provided in the online status as well as in the offline status. If the function is carried out online, all changes are written into the read-only memory of the drive, so that they still remain stored in case of a mains failure. This function should not be mixed up with the function ”Save configuration”, which in contrast to ”Save” stores an image of the drive data in file format on a data medium of the PC.
Restoring the default setting 	• **Service** – Reset service data • **Fieldbus** – Reset fieldbus settings (CANopen or Profibus objects) • **System** – Reset system settings • **Controller** – Reset controller parameters • **Current travel data set** – Only reset current travel data set • **All travel data sets** – Reset all travel data sets • **intelliBox** – Reset inputs/outputs • **Reference** – Reset reference run

The selection has to be acknowledged afterwards.

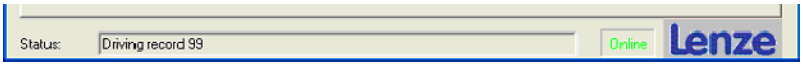
Stop!

If the setting of the ”Service” tab is reset, among other things the current factor and the resolver offset are overwritten.

In this case the drive might have to be dismounted and the resolver might have to be readjusted in the loadfree state, as the resolver adjustment has to be carried out individually for each motor and cannot be adopted even for a motor of the same type. If the resolver offset is set incorrectly, the motor cannot operate.

4.1.5 Status bar

Status bar



In the status bar, information such as page coordinations, date, time, and notes with regard to the selected command are displayed.

By means of a control display between the status display and the Lenze logo in the lower corner of the **”fluxx”** operating software, a quick, optical control of the communication status between the drive and fluxx can be effected. The display presents a text which in the case of an interface connection signalises

- ”online”: communication available (highlighted in green)
- ”offline”: communication not available (highlighted in red).

For different events, plain text messages for facilitating fault elimination are output in the status bar. In the case of an interruption of communication between the operating program and the drive, the message: ”No communication with drive possible !” is displayed in the dialog box.

In the case of maloperations or access conflicts, also plain text messages are shown in the status bar of the operating program:

Display	Error correction
Command in level 0 not permitted	Select higher online level
Command permitted from level 1 only	Select higher online level
Command permitted from level 2 only	Select higher online level
Command permitted from level 3 only	Select higher online level
Command permitted from level 4 only	Select higher online level
Travel data set number invalid	Select correct travel data set number
Password invalid	Check password
Only permitted if drive is in standstill	Brake drive to 0 rev/min
Only permitted if drive is deenergised	Switch motor to deenergised state
Fieldbus has parameter change rights	Reset parameter change rights of the bus system
Fieldbus has switching authority	Reset switching authority of the bus system
Parameter error	Check parameters set
Parameter setting program not compatible to the drive	Please refer to your sales partner
Not permitted for active travel command	Check drive status
Not permitted for active reference run	Check drive status. Wait for completion of reference run or cancel
Unknown command	Command unknown

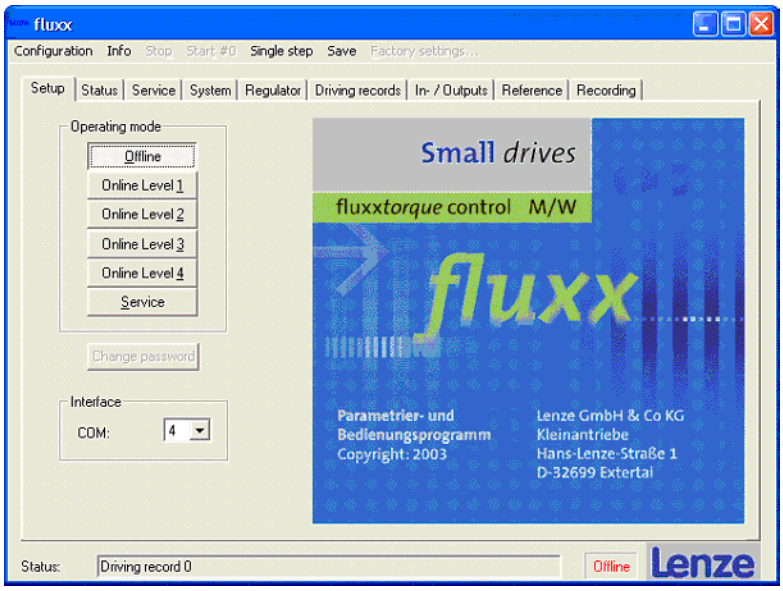
5 Software implementation and parameter setting

5.1 Setup menu

In this menu the access authorisations are defined, the operating level is specified, and the parameters of the RS232 interface are set.

Before the other menu pages can be used, communication with the drive first has to be established via this menu page. Via the operating level that is selected and permitted in this menu, the authorisation level or the access authorisations are automatically defined.

Setup



5.1.1 Operating modes

Offline

In this operating mode, the servo inverter is disconnected from the RS232 interface. A programming process may be effected in the offline status, though for transmission to the motor has to be saved on the PC by means of ”Save configuration” and be transferred to the inverter in online operation by means of the function ”Load configuration”.

Online level 1

The system is online from level 1. In this level, however, it can only be observed. This level serves to analyse the status of the drive system. If the inverter is controlled by means of a bus system (CAN, Profibus), important data can be observed.

Online level 2

Level 2 is protected by a password. In this level, programs saved within the electronics can be started and stopped. By default no password is stored for either level. By pressing the ”OK” button, you’ll reach level 2.

Note!

When using passwords, the user should regard that the servo inverter has to be sent to Lenze in case of a password loss, in order to deactivate the password protection.

Online level 3

The operating level 3 also is protected by a password. In this level, programs that are stored within the system can be started and stopped. In addition, travel data sets can be edited.

Online level 4

In level 4 all parameters of the servo inverter except for the functions in the ”Service” menu can be accessed. This operating mode also is protected by a password.

Service

The password-protected operating mode ”Service” solely serves to service purposes and therefore should not be used in normal operation. In this operating mode, the user can access all parameters of the 931M/W servo inverter, i. e. also the service parameters.

5.1.2 Changing the password

By means of this function, the password for the currently selected operating mode can be changed. Levels 2-4 and the operating mode ”Service” respectively are protected by different passwords. It is possible to switch over from one operating mode into a lower operating mode without entering the password. When entering into a higher operating mode, the password belonging to the selected operating mode is queried. On delivery of the inverter, no password is entered.

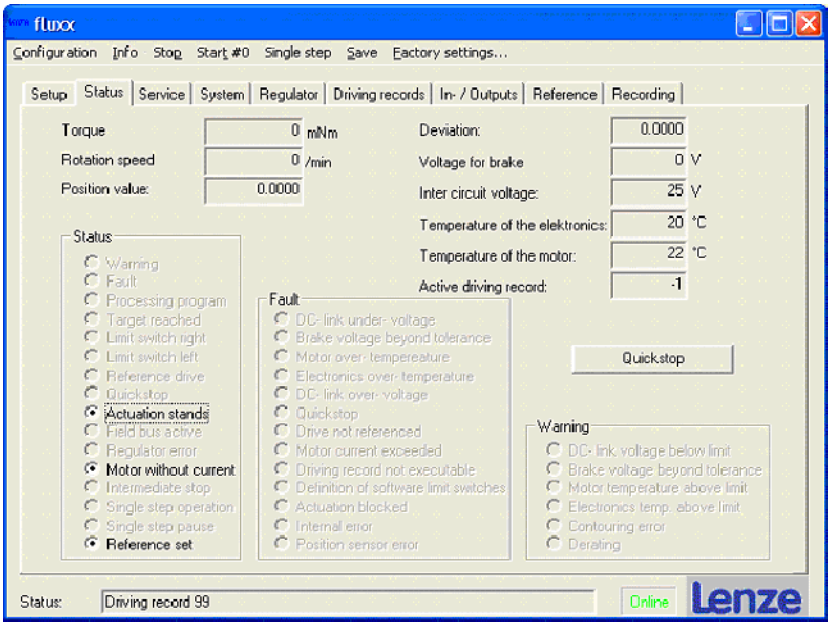
5.1.3 COM interface

Here the PC-COM interface the inverter is connected to is selected. The baud rate for data transmission is fixedly set to 38400 baud at the drive end.

5.2 Status menu

This menu page displays **warning signals** that do not result in a switch-off of the amplifier output stage, **fault messages** which cause a switch-off of the amplifier output stage, and **status messages** visualising the responses triggered by the warning signals and fault messages, as well as general operating states. In addition, the actual values including their units are displayed, reflecting the current physical and electrical operating states.

Status



Torque

In this field, the theoretically calculated output torque of a rotary axis, or the theoretically calculated output force of a linear axis is displayed. The value depends on the conversions and display units set in the ”System” menu. Furthermore there is a dependence with regard to the gearbox ratio. Thus, this value for instance becomes greater with an increasing reduction of the gearbox that is specified in the ”Service” menu. The efficiency and loss factors of the connected units (gearbox, linear axes, etc.) are not considered. The displayed value furthermore depends on the current factor that is set in the ”Service” menu.

Speed

Depending on the conversions and display units set in the ”System” menu, here the currently output velocity is displayed for a linear axis, and the currently output speed is displayed for a rotary axis. Thereby high gearbox ratios and gearbox reductions which have been defined in the ”Service” and ”System” menus, are integrated into the calculations.

Position value

Depending on the conversions and display units set in the ”System” menu and on the gearbox ratio set in the ”Service” menu, the current absolute position value is displayed here. The correctness of the value displayed here primarily depends on the reference run, as here a home mark is determined, to which all absolute position value are relating. The position encoder used in the motor technically speaking is not an absolute value encoder. As soon as the voltage is taken away from the motor electronics, and the axis is rotated in the deenergised state, the motor has to be referenced again, so that the position value is correct. In order to avoid a new reference run after the system has been switched off, e.g. by emergency stop, the current position value can be recorded further on by a 24 V emergency supply of the electronics.

System deviation

The difference between the setpoint and actual value is referred to as a system deviation. The amount of the system deviation furthermore depends on the conversions and display units set in the ”System” menu.

System deviation = setpoint - actual value

Eventually, the variable to be controlled is determined by the selected controller type of the current travel data set: velocity or speed, force or torque, and at last the position value.

Voltage for brake

If the motor is provided with a brake, and if this brake is connected to the electronics, this field indicates the voltage that is applied to the brake. For the open brake, a smoothed DC voltage of 24V ± 10% is required, which can also be provided by external operation, for instance via PLC. Be absolutely sure to note that this voltage is maintained during operation, as otherwise an unintentional closing of the brake may result in premature wear of the brake. For this purpose, a warning is output between 22 V and 26 V, in case of values below 20 V or above 28 V, the motor is switched off and a fault is indicated. If an error occurs, the brake can be separately disengaged via the supply, in order to enable a traversing of the axis in case of emergency stop activation (GHB 931M/W).

DC-bus voltage

The DC-bus voltage is displayed in volts and is the DC voltage required for the power section. If the DC-bus voltage is too low, the servo inverter outputs a warning or switches off the motor.

Device type	Voltage threshold	
	Warning signal (V)	Disconnection (V)
Mains voltage device 230 VAC/325 VDC	220	180
Low-voltage device 42 V	32	37
Low-voltage device 24 V	19	17

Equivalently to this, if the DC-bus voltage is exceeded, the motor at first is decelerated via loss resistance, and in case of further voltage rise it is switched off.

Device type	Voltage threshold	
	Brake resistor activation (V)	Disconnection (V)
Mains voltage device 230 VAC/325 VDC	370 - 380	400
Low-voltage device 42 V	-----	52
Low-voltage device 24 V	-----	36

Tab. 1 Voltage threshold: brake resistor

Electronics temperature

This field indicates the current electronics temperature. The limit value for the temperature of the electronics is 78°C. By means of a specific derating above 70°C, this limit is prevented from being exceeded. During the derating, the current and therefore the torque generated by the motor is linearly reduced from the output value to zero on the upper limit value. As this at any rate brings about a reduced output, the derating is displayed under a warning.

Motor temperature

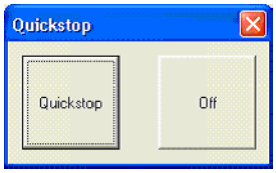
Another important value is the motor temperature that is displayed here, its limit value being 140°C. Here the motor power above 130°C is also linearly reduced by means of a derating , at which just like in case of the electronics temperature a warning is output. If the critical temperature limit of 140°C is reached in spite of the derating, the output stage is switched off, and a corresponding fault message is output.

Active travel data set

Here the currently edited travel data set is shown. The possible travel data set numbers in this connection can be 0 to 99. If currently no travel data set is being edited, the number ”-1” is displayed.

"Quick stop" field

Quick stop / Off



Via the "Quick stop" button, a menu field can be opened by means of which a quick stop or switch-off of the output stage (motor coasts) can be actuated, if required. This function is protected by a password query. After entering the correct password, the access authorisations of the operating program to the drive are increased to "Online level 4", and a possibly connected bus system is automatically restricted with regard to its access. This function provides a certain safety during a commissioning via bus systems. After entering the correct password, the following dialog box opens. By means of this dialog box, a quick stop or a normal stop (motor coasts) can be effected.

5.2.1 Status messages

Status messages are short information messages concerning the operating status of the drive. For this, the following possibilities are provided in the "Status" menu:

► Warning:

As soon as the drive is operated beyond the specified range, a warning signal appears. Warning signals do not yet result in a switch-off of the motor, but can notify potentially critical operating states.

Example: motor temperature > 130 °C.

► Fault:

If a fault occurs, the motor is automatically switched off.

Example: motor temperature > 140°C.

► Editing data set:

This status message occurs as soon as a travel data set is edited and still is in process at the time.

► Setpoint reached:

Here a message is effected as to whether the setpoint specified in the current travel data set has been reached by the actual value. The type of the setpoint depends on the controller type set in the "Travel data sets" menu, e.g. "Speed".

► Limit switch, right:

The right limit switch has been reached.

► Limit switch, left:

The left limit switch has been reached.

► Reference run:

At present, the motor is carrying out a reference run for the protective multiple earthing of the drive. This is absolutely required for determining the correct position value.

► Quick stop

An event (occurring error or by the digital input) can actuate a quick stop. In case of a quick stop, the motor decelerates to a speed of 0 U/rpm at maximum torque.

► Drive in standstill:

As soon as the drive is in standstill, i.e. speed=0, this status message occurs.

► Fieldbus active:

In this case, the status message is effected if the Profibus or CAN bus is activated, e.g. for communication of the motor as a DP slave with the Profibus master.

► System error:

A system error occurs as soon as the amount of the system deviation is greater than the value specified in the following error window of the ”Controller” menu. Additionally, the torque on the motor shaft has reached its maximum value.

► Motor deenergised:

”Motor deenergised” means that the output stage is switched off, i.e. a torque applied by the drive is no longer available on the motor shaft.

► Stopover:

A stopover is characterised by an interrupted travel data set. The command for a stopover is effected via the digital input (📖 48).

► Single step mode:

Here a status message occurs as soon as the motor is in single step mode. The single step mode can be activated by selecting ”Single step~On” in the upper menu bar of the user program.

► Single step pause:

The pause in single step mode is displayed, which eventually is effected automatically after completion of a travel data set in single step mode. The start of the next travel data set is either carried out by a new start command (Single step~Continue) in the user program, or via a digital input that is configured by ”Single step”.

► Reference set:

As soon as the reference is set, this status message occurs. This happens after a reference run has been successfully completed. The reference furthermore is set if no reference run has been set in the ”Reference” menu.

5.2.2 Fault messages

The menu item called ”Fault” in the ”Status” menu contains different fault messages, which in the following are explained in detail. If a fault occurs, the drive is automatically switched off, whereby the control electronics are further on supplied with voltage, i.e. only the output stage is disconnected.

► DC-bus voltage underrun

The DC-bus voltage that is responsible for supplying the power section has underrun the permissible limit value, so that the motor is not able to operate correctly anymore. The limit values are listed in the table: (📖 23)

► Brake voltage beyond the tolerance range

The voltage for the brake is beyond the set range that can be adjusted under the ”Service” tab (delivery condition 20...28 V).

► Motor temperature exceeded

In spite of the derating, i. e. linear deceleration of the motor power, the motor temperature has exceeded the critical value of 140°C.

► Electronics temperature exceeded

This fault message means that the temperature of the motor electronics has exceeded the maximum value of 78°C.

► DC-bus voltage exceeded

The DC-bus voltage has exceeded the critical value of the respective voltage variant (📖 23). A frequent cause for this is a deceleration process with a brake ramp that is too steep, so that the power recovery of the inverter results in an increase of the DC-bus voltage, which - in case of a power recovery that is too high - cannot be kept below the permissible limit values by the internal brake resistor (230 V AC device) or by the DC-supply device (24 V DC, 42 V DC, 320 V DC devices).

► Quick stop:

Due to an external event, a quick stop has been actuated. This is effected via the digital input of the inverter or via the ”Quick stop” operator panel. If a quick stop is carried out, the motor decelerates to 0 rpm at the maximum braking torque.

► Drive not referenced:

In this case, a fault has occurred during the reference run, or the reference run has not been carried out. Here in particular the parameter setting of the ”Reference” menu is to be examined. Often, however, other fault messages also indicate the cause of fault, e. g. by ”Drive blocks”.

► Motor exceeded:

This fault indicates that due to an overcurrent the output stage of the motor has been switched off. This can be caused by a short circuit or an overcurrent by disadvantageously set controller parameters.

► Travel data set not executable:

Here it is displayed that an error has occurred while carrying out the current travel data set. In case of the Profibus operation, this mostly occurs when a travel data set with the controller type ”Speed” in the operating mode ”Positioning” is started. If a travel data set is started from the user program, the motor is automatically switched to the correct operating mode without further measures by the user being required.

► Definition of software limit switch:

Due to incorrectly set system parameters, a fault message is output here. The fault occurs if during a reference run to a software limit switch the limit switch in question cannot be reached in a linear system due to incorrectly set system parameters. Thus, for ”Direction, positive/left” in the ”System” menu, the position value for the left software limit switch has to be higher than that for the right one, and vice versa.

► Drive inhibited:

The drive shaft either is mechanically blocked, for instance by a gearbox damage, or the torque set in the current travel data set is too low.

► Internal error:

This error message at present is not yet assigned.

► Position encoder:

For determining the actual position by means of the resolver, an error has occurred. The cause of fault can be due to an open circuit between the inverter and resolver or to a defective resolver.

5.2.3 Warning signals

The sector that is referred to as ”Warning”, in the ”Status” menu contains different warning signals, which are explained in the following.

► DC-bus voltage underrun

The DC-bus voltage has underrun the warning value. The limit values for the warning can be gathered from the ”Voltage threshold” table (📖 23).

► Brake voltage beyond the tolerance range

The voltage for the brake is beyond the warning range that is set (delivery condition 22...26 V).

► Motor temperature exceeded

The motor temperature has exceeded 130°C. A derating is initiated.

► Electronics temperature exceeded

This warning signal indicates that the temperature of the motor electronics has exceeded the value of 70°C and a derating is initiated.

► Following error

This warning signal indicates that the deviation between the current actual position value and position setpoint (the following error) is greater than the following error set.

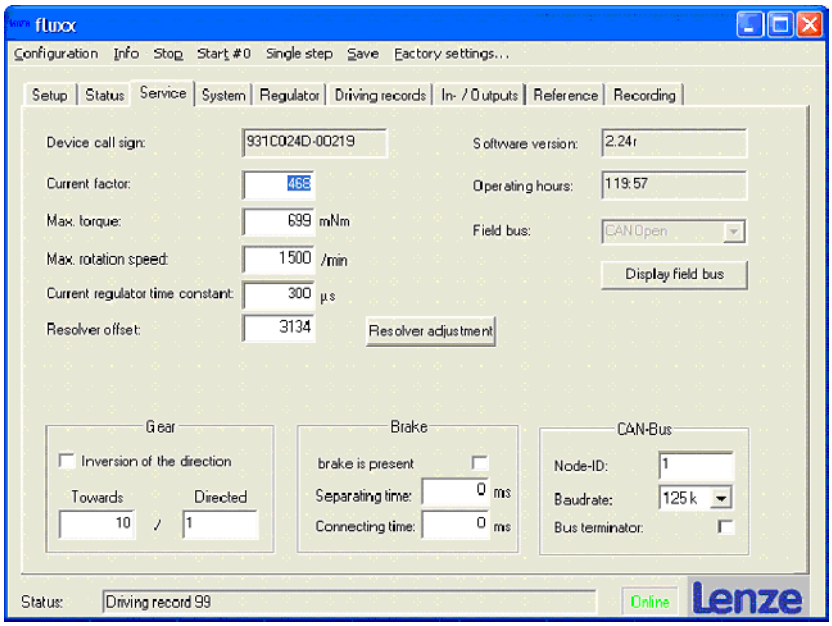
► Derating

Due to a too high temperature of the motor or the inverter, the output power of the inverter is reduced, in order to counteract further heating.

5.3 Service menu

The ”Service” menu page displays the electrical data of the servo inverter, the revision status of the operating system, as well as the operating hours. Furthermore, the limit values, gearbox ratios, the settings of the brake, and bus settings are defined.

Service



5.3.1 Device identification

This field indicates the identification or the serial number of the drive. The specification of the drive identification in particular is important for support requests.

Current factor

The current factor, which defines the ratio between the current and torque is a characteristic constant of the motor. The current factor is calculated from the rated data (rated torque and rated current of the motor and the rated current of the inverter attached) of the drive system. This data is preset to the correct value by the factory and therefore should not be altered:

$\text{Current factor} = \frac{M_{Nmotor}}{I_{Nmotor}} \times I_{Ninverter}$	M_N	Rated torque [mNm]
	I_N	Rated current [A]

Furthermore, the current factor has an impact on the maximum adjustable torque values in the ”Service”, ”Controller” and ”Travel data sets” menus. In this connection, the torque has to be entered in [mNm] and the current in [A]. The rated inverter currents can be gathered from the following table. The rated data of the motor can be gathered from the nameplate of the motor.

Inverter - supply voltage	Rated inverter current [A]
931M (24 V DC supply)	9
931M (42 V DC supply)	9
931M (230 V DC supply)	3
931M (320 V DC supply)	3

For the use of an SDS motor, the following current factors result:

Motor	SDS 035		SDS 047		SDS 056	SDS 063
Voltage	13V AC	25V AC	25V AC	210V AC	210V AC	210V AC
Current factor	426	880	1161	2182	2526	2575

Note!

For restoring the default setting, the current factor is overwritten. You can recalculate the value by using the above-mentioned formula or gather it from the above table.

Maximum motor torque

The maximum torque can be set. Due to the current limitation of the inverter, it can be maximally 150 % of the current factor.

Maximum motor speed

Corresponding to the maximum torque, also a speed limitation below the maximum speed can be effected. The maximum speed has to be selected between 0 and 6000 rpm. Due to the mechanical loads of the rotor resulting from the centrifugal forces, speeds above 6000 rpm are not permissible.

Resolver offset

By orientating the resolver, the angle which is stored as the offset angle of the motor-resolver combination in the axis controller can be calculated according to the number of motor and resolver pole pairs. The value that is determined is considered with regard to the rotary field generation and is device-defined. In case of operating errors or replacement of the electronics, it can also be re-entered manually. See also chapter ”Resolver adjustment”.

Resolver adjustment

By using this button, the resolver is adjusted, which is a calculation of the angle between the rotary field indicator and resolver indicator in increments and a software adjustment. In doing this, the motor axis is gradually moved for adjustment.

Note!

For adjusting the resolver, the motor has to be in a load-free state, which for a required resolver adjustment could possibly require a dismounting of the motor from an existing system.

As the resolver adjustment is already effected ex works, this button as far as possible should not be used. Particular care is to be taken when loading a configuration in the service mode - for this, see also the chapter ”Menu bar” (📖 16).

Current controller response time

The current controller response time describes the adjustable value of the phase shift between motor current and motor voltage. The current controller response time serves to compensate the phase shift of the current caused by the motor inductance. The following effects can be derived from the amount of the value that is set here:

0 µs	No effect
200 - 600 µs	The current is applied so that the phase shift caused by the inductance is compensated by the current controller response time selected. The current controller response time is to be determined in a speed-dependent and torque-dependent manner.
Value too high	In case of settings that are too high, the motor utilisation is degraded, which can be seen by a no-load current and rated current that that is too high.

As a standard value, a setting of 250 to 350 µs (basic setting: 350 µs) is recommended. Only for very high motor inductances, a higher setting of the current controller response time is reasonable.

5.3.2 Software version

Via this field, the firmware version of the motor can be viewed. This information, as well as the device identification, is also important for issues of support. Furthermore the firmware version determines the function. For the use on the Profibus-DP or CAN bus there are different firmware versions. In case of doubt, however, the Lenze support hotline should be notified.

5.3.3 Operating hours

Here the operating hours of the inverter that have already been achieved are entered in the format of hours: minutes.

5.3.4 Fieldbus

According to the purpose of the servo motor, the fieldbus in the operating mode ”Offline” can be selected in the service menu. If a drive is connected (operating mode ”Online” levels 1 - 4 or service), the fieldbus system of the drive is displayed. There are the following possibilities:

► **Without**

Only ”Offline” possible.

► **Profibus DP**

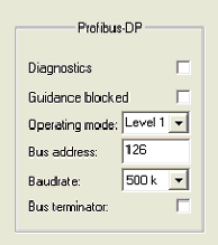
The servo motor is used as a DP slave, which is particularly reasonable for the integration into third-party systems, as here a reference to the widespread DP standard is effected.

► **CANOpen**

For operation on the CAN bus using the CAN-Open protocol (DS 301; DSP 402).

5.3.5 Profibus operation

The Profibus parameters can be specified in the ”Profibus DP” field down on the right in the ”Service” menu. In this case, the selection of the fieldbus, however, has to be set to ”Profibus DP”, as otherwise the following field is not displayed:



Diagnostics

Here the diagnostics function defined in the Profibus DP standard is activated.

Inhibiting control

”Inhibiting control” inhibits the control of the system of the Profibus DP relating to the starting or stopping of any travel programs or reference runs. Therefore, for instance, it is not possible for the DP master to start a motor in standstill anymore. Thus, this function is especially convenient for service applications.

Operating mode

The operating mode for the Profibus operation allows writing access to the Profibus DP for the respectively selectable parameters of the operating level that is set. Thereby, the levels 1, 3, 4 and ”Service” can be selected. Therefore, this selection should harmonise with the access depth in the Profibus system, in order to avoid access violations.

Bus address

A freely selectable slave address between 2 and 126 can be assigned to each device for operation on the Profibus. In doing this, it has to be observed that no address is assigned twice, as this would result in a bus error. Additionally, the bus address that has the highest priority for the master has to be considered and, where required, has to be altered.

Baud rate

By selecting the baud rate, the user defines the transmission rate of the Profibus DP interface. For this purpose, the following baud rates are provided:

9.6 k / 19.2 k / 93.75 k / 187.5k / 500 k / 1.5 M bauds

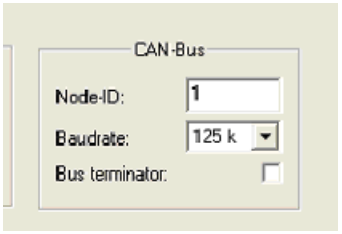
In particular with regard to higher baud rates, a clean bus termination should be observed, in order to avoid reflections and communication faults resulting therefrom.

Terminal (termination R)

In order to ensure a clean data transmission, at the beginning and end of a bus cable nodes have to be terminated by means of a resistor, so that no reflections or communication faults occur on the bus. When selecting this option, a relay in the drive of the terminating resistor is automatically connected. The status of the relay is maintained even after the supply voltage is switched off.

5.3.6 CAN bus operation

The CAN bus parameters can be specified in the ”CAN bus” field down on the right of the ”Service” menu. The selection of the fieldbus in this connection has to be set to ”CANOpen”, so that the CAN bus is activated and the respective bus parameters can be specified.



Node ID

The node ID defines the identity of the CAN nodes or the CAN bus address. The option ranges from 1 to 127.

Baud rate

In this place, the transmission speed of the CAN bus can be defined. Thereby the following baud rates can be set:

10k, 20k, 50k, 100k, 125k, 250k, 500k, 800k and 1000k bauds

Terminal (termination R)

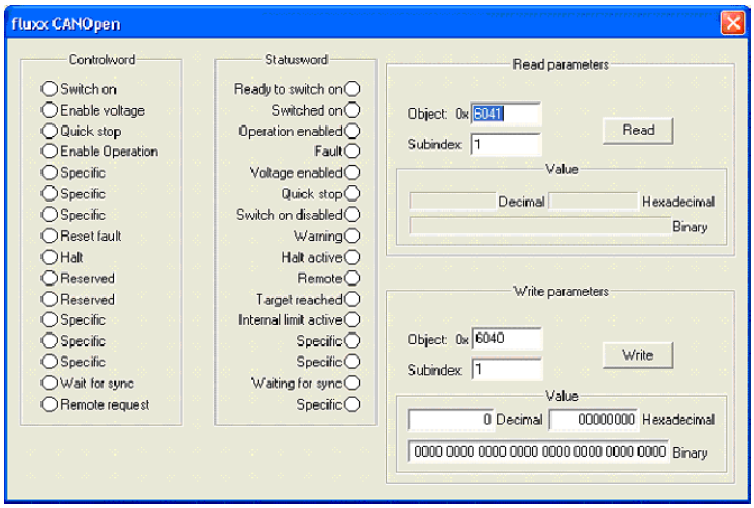
In order to guarantee a trouble-free data transmission, the nodes at the beginning and the end of a bus line have to be terminated by means of a resistor, so that no reflections or communication faults on the bus occur. If this option is selected, the terminating resistor is automatically connected via a relay in the drive.

5.3.7 Fieldbus displays

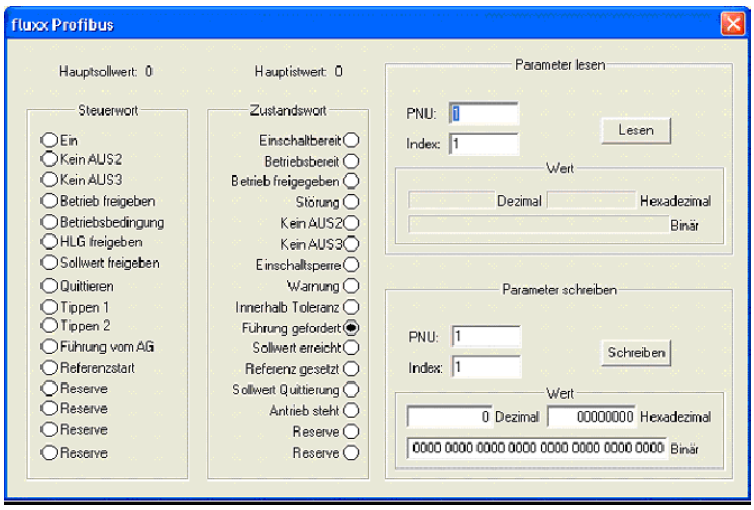
Via the ”Display fieldbus” field, an access to the communication objects of the current bus system of the drive can be established. After activation of the button, a dialog box will open, displaying the control word and the status word of the drive on the left side (see following illustrations). In the right part of the field there is an entry option for reading and writing communication objects. The two following diagrams show the dialog box of the CAN bus and that of the Profibus. In the operating mode ”Offline”, these fields cannot be displayed.

Further information, like for example an itemisation of the communication objects, can be gathered from the respective Communication Manuals.

fluxx CANOpen



fluxx Profibus



5.3.8 Gearbox

Direction reversal

By means of this item, a reversal of the direction of rotation caused by the gearbox can be compensated or considered. If a linear axis is used, the orientation of the limit switches does not change, the use of the ”Direction reversal” function may also depend on the mounting direction of the motor.

Input/output

The input/output ratio refers to the speed and identifies the ratio of the gearbox. If input < output, a high gear ratio is available, accordingly if input > output, this is referred to as a reduction.

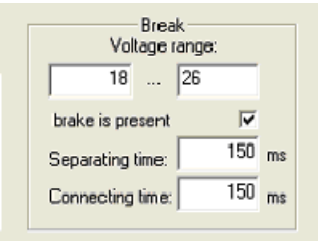
5.3.9 Brake

Selecting the brake

If a brake is available, the brake function can be controlled via the system electronics by confirming the parameter ”Available”. The actual operation of the brake then is defined in the ”Travel data sets” menu

Brake menu

3



Voltage range

In the fields under ”Voltage range”, on the left the minimum brake voltage, and on the right the maximum brake voltage can be entered. The minimum brake voltage can be set between 18 and 22 V, and the maximum brake voltage can be set between 26 and 32 V.

Disengagement time

The disengagement time is the time unit which is used for opening the brake. At the beginning of a travel data set, the motor and brake are immediately energised; the travel program, however, only starts after the disengagement time has elapsed. This is intended to prevent that the full motor torque unintentionally is positioned on the closed brake. A minimum disengagement time of 150 ms is recommended. This time is system-dependent.

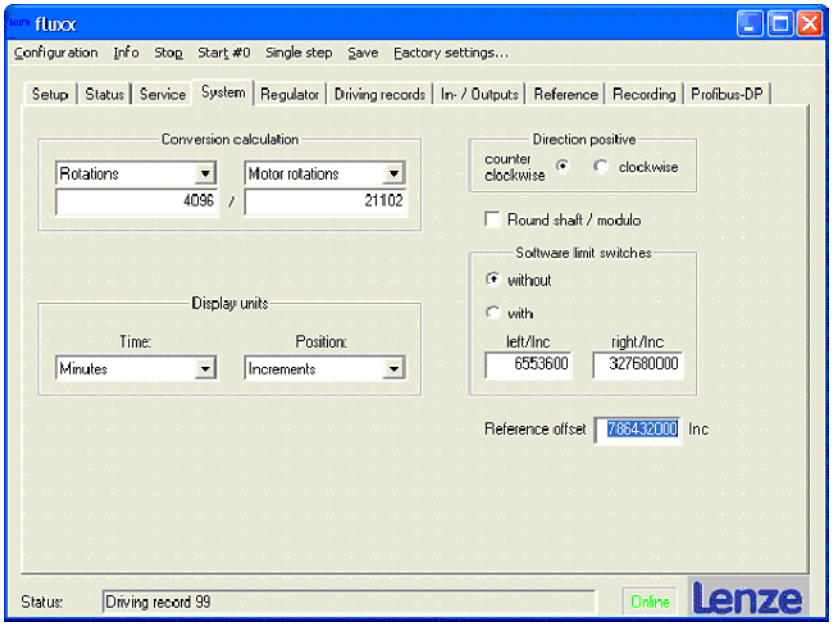
Engagement time

For closing (equivalent to the disengagement time for opening), the brake requires an application time. In the engagement time, the full holding torque is positioned on the drive, so that the position reached is also maintained during the closing process of the brake. A minimum engagement time of 150 ms is recommended. This time is system-dependent.

5.4 System menu

On this menu page, system units, such as conversion factors and display units, direction of rotation of the motor shaft with regard to the setpoint of the direction of rotation and to the limit switch are entered. Furthermore, the offset after the reference run and the type of evaluation of the motion, i. e. a linear axis or a rotary axis, can be specified on this menu page.

System



5.4.1 Conversion

Depending on whether a linear axis or a rotary axis is used, here the ratio of the primary motion (in motor revolutions, gearbox revolutions, or resolver increments) to the secondary motion on the rotary axis (in revolutions, on the linear axis in m, dm, cm, mm, mm) is specified. If the unit ”increments” is used, it has to be observed that 4096 increments correspond to one motor revolution or to 360°.

5.4.2 Display units

The unit for the time can be selected in minutes or seconds; the position can be specified in increments, revolutions, angular degree, angular minutes, angular seconds, or in m, dm, cm, mm, mm. All other parameters of the software are adapted to the units that are set.

5.4.3 Positive direction: right/left

In this function, apart from the orientation of the linear axis / rotary axis, also the position values for the limit switches are changed.

5.4.4 Modulo rotary axis

For rotary table applications, this field can be selected. After the selection has been effected, this operating mode is activated in the ”Travel data sets” menu and can be selected.

5.4.5 Software limit switch

Irrespective of the hardware limit switches, additional software limit switches can be defined, whereby according to the direction orientation of the linear or rotary axis reasonable values have to be defined for left/right (e.g. positive left direction meaning: position value for the left > position value for the right!). If the direction orientation is changed, also the values for the limit switches have to be altered, as otherwise faults can occur.

Example:

At the effort of trying to start a reference run in a linear system, the fault message ”System parameters” occurs immediately. Although ”Direction positive/left” has been set, the position value for the right software limit switch was set higher than that for the left one. Therefore, due to incorrectly set system parameters, it is not possible to approach the software limit switch correctly in the correct direction. For error correction, the position value for the left software limit switch has to be set higher than that for the right switch in the ”System” menu.

Note!

The software limit switches can only be used in the controller types ”absolute position” or ”relative position”.

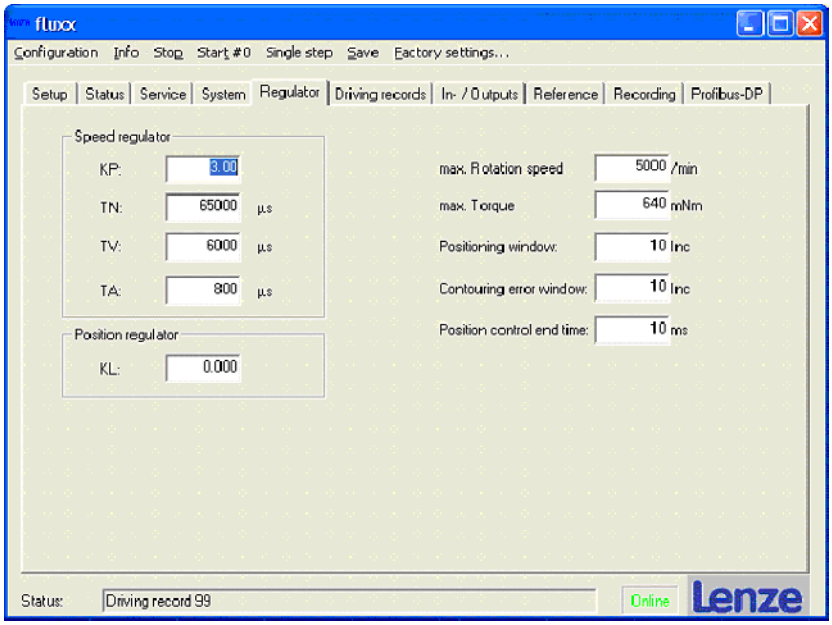
5.4.6 Offset reference

The ”Reference” offset effectuates a zero shift of the home position (standard value 0) by the position value entered here. A change of the reference offset only is accepted after a new reference run. Thereby, if required, the position of the software limit switches is to be checked again. The function of the home position in this connection remains unaffected by the reference offset.

5.5 Controller menu

This menu page specifies the control parameters of the speed controller, as well as limit values, for instance for positioning windows and following error windows.

Controller



The speed controller is designed as a PID controller. The D component of the speed controller in this connection has a special feature, as the controller only responses to setpoint changes. By this, an undesired gain of the measurement noise is prevented.

The position controller is realised as a pure proportional controller.

Note!

For the optimisation of the controller setting, the use of the oscilloscope is recommended.

5.5.1 Proportional gain

By means of the proportional gain of the PID controller, the damping behaviour of the speed controller can be influenced. The higher the P component is chosen, the quicker the controller responds to deviations between the speed setpoint and the actual speed value. By this, a low overshoot for speed variatons is effected.

If the P component is chosen too high, the drive responds very aggressively to setpoint changes. Furthermore, the measurement noise which is superimposed on the actual speed value is too strongly intensified, resulting in a continuously unsteady behaviour of the drive (”drive hums”). In this case, the gain is to be reduced.

The dimensioning has to be carried out depending on the entire mechanical drive train. Here, no general values can be specified. The value range of the P component is 0.01 to 100 and can be adjusted in steps of 0.01.

5.5.2 TN - integral-action time

The integral-action time defines the integral part of the PID speed controller. By means of this time constant, a degree for the dynamics of control processes is defined. The lower the time constant is selected, the quicker deviations between the speed setpoint and actual speed value can be compensated. In this regard, it is to be observed that due to the limitation of the actuating element - i. e. the maximum torque - the integral-action time cannot be selected in an optionally low manner, but is to be selected depending on the mass inertias to be accelerated and on the maximum torque. Integral-action times that are too low cause excessive dynamics and may result in an instable control system behaviour. Time constants that are too high cause changes to be compensated only after a longer time.

The integer value range for entering the integral-action time reaches from 2000 to 65535. Values are entered in µs. Reasonable values for the integral-action time considerably depend on the control process, in particular on the mass inertia to be accelerated and on the torque provided for this. A reasonable dimensioning of the integral-action time for many applications is between 4000 and 20000 µs.

5.5.3 TV - advance time

The differential component of the PID speed controller is set via the advance time. This component causes an additional drive torque to be applied in case of changes in the speed setpoint, in order to realise a quick adjustment of setpoint and actual value. The lower the time constant is selected, the higher is the additionally applied torque.

For the advance time, integer values from 0 to 30000 can be entered. The values are entered in µs.

5.5.4 TA - scanning time

The scanning time TA, which here is from 500 µ seconds to 5000 µ seconds, specifies the interval of the system scanning by the controller. If the scanning time is too low, the D component of the controller possibly is not active anymore.

In general, mechanical systems with a high mass inertia can rather be controlled using a higher scanning time. The reason for this is to be found in the fact that such systems only permit low dynamics, and that low scanning times therefore are not required.

5.5.5 KL position controller

The KL factor is the P component of the position controller. It can be set between 0.001 and 2. The proportional controller is superimposed on the speed controller.

The position controller is superimposed on the speed controller. For dimensioning purposes, for position control it is recommended to commission a speed-controlled system in the first place, and to optimise the speed controller. In order to achieve a good control mode, it is recommended not to select the dynamics of the speed controller too high. After the optimisation of the speed controller, the P component of the position controller can be optimised.

Generally, a P component of the position controller that is too low brings about longer settling times, whereas a component that is too high produces an uncontrolled system behaviour.

5.5.6 Max. speed/velocity

According to the setting of the conversion and display units in the ”System” menu, here the maximum speed or, with regard to the linear axis, the maximum velocity can be entered. The speed set here is the maximum limit for the control activity. If the value exceeds the value set in the ”Service” menu, the smaller speed limit value applies. The device-specific limit values here also have got to be observed.

5.5.7 Max. torque/force

The maximum value to be entered here, according to the entry, is effected in the ”System” menu as force or torque, the maximum value to be entered being the device-specific maximum torque. The actual maximum torque for the control activity results from the low limit value of the torque entered here and from the maximum torque that has been defined for the entire operation in the ”Service” menu.

5.5.8 Positioning window

If the controller type in the ”Travel data sets” menu is set to ”Relative position” or ”Absolute position”, the inverter tries to maintain the position specified in the respective travel data set with the precision defined herein. For the value ”0”, the maximum precision requirement results.

In the ”Status” menu, the message ”Setpoint reached” is shown as soon as the position in the specified position window is reached. As a maximum value, 30000 increments can be entered.

5.5.9 Following error window

In following error controlled systems, a higher-level following error controller is superimposed on the speed controller, by means of which the following errors that are caused by deviations between the actual speed value and the speed setpoint are compensated. A possible case of operation for this could for instance be a belt conveyor, on which several drives have to follow one setpoint in a synchronous manner without producing a deviation that is too high.

In the following error window, the maximum permissible deviation of the following error can be defined in increments. If this value is exceeded, the warning signal "Following error" is output (see "Status" tab). The entry "0" corresponds to the lowest following error, which, however, in practice due to the limited accuracy of measurement cannot be achieved. The maximum value is defined at 30000 increments.

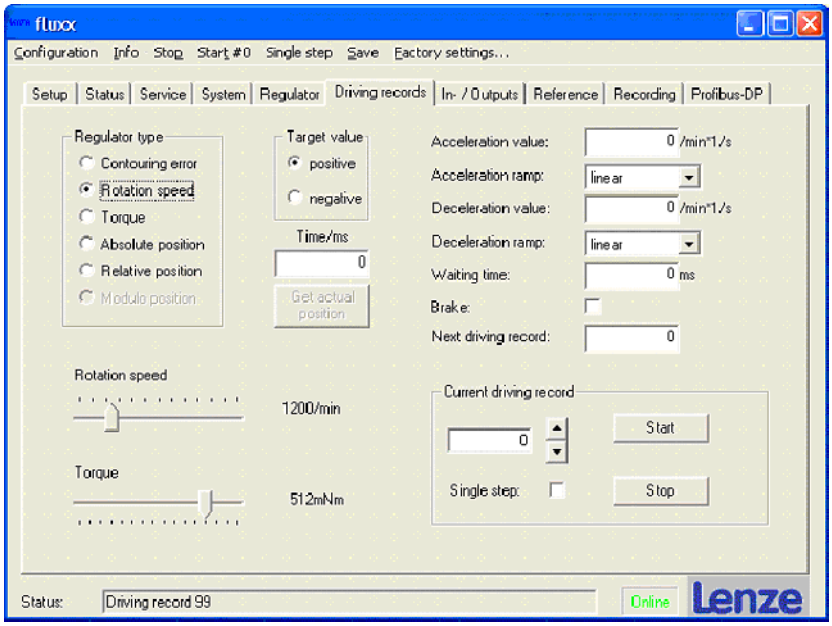
5.5.10 Position control end time

The position control end time specifies the time for which the controller remains active after completion of a travel data set. In this time, the maximum holding torque is placed on the motor shaft, serving to set and hold the exact set position. For entering the value "0", position control is effected for an infinitely long time.

5.6 Travel data sets menu

In the ”Travel data sets” menu, the functions of the individual steps are defined. An individual controller type (following error, speed, torque, or position control), individual ramps for acceleration and brakes, an individual speed and torque values, as well as the subsequent travel data set can be assigned to each travel data set.

Travel data sets



5.6.1 Controller type

Via the controller type, the basic mode of operation of the respective travel data set is defined, whereby in practice often a specific position or speed is set. In the following, the individual controller types are specified.

► Following error

In the case of the following error control, a following error controller is superimposed on the speed controller, setting the current following error which is calculated from the integral of the deviation between the speed setpoint and the actual speed value to 0. The following error control therefore is a specific form of the speed control.

► Speed

In the case of the ”Speed” controller type, a mere speed control with regard to the set speed setpoint is effected, whereby the following error in the case of speed deviations is not compensated.

► Torque

This controller type is a form of current control, where maximally the set torque can be released.

► Absolute position

This controller type produces the position setpoint set in relation to the reference point. The position setpoint can be entered on the right next to the field for the controller type, whereby the value always refers to the unit displayed above the checkbox for the position value. The sign of the position setpoint is defined by the selection ”Negative/positive direction”.

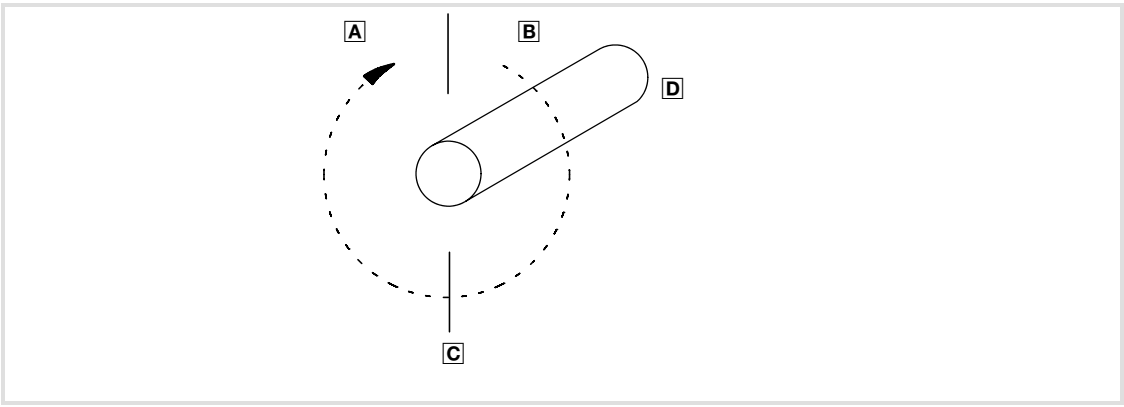
► Relative position

”Relative position” alters the position round the set position setpoint value relating to the absolute position value, which is valid at the start of the travel data set. In the case of ”Setpoint positive”, an addition to the current position setpoint is effected; in the case of ”Setpoint negative”, a subtraction is effected. The relative position setpoint can also be entered relating to the specified unit in the checkbox on the right next to the field for the controller type.

► Modulo position

The modulo positioning presents a specific positioning type for rotary table applications. This operating mode can only be selected if the option ”Rotary axis/modulo” has been selected on the ”System” tab. In this operating mode, a revolution of the rotary table is classified into a range of 2048 to -2048 increments. The gearbox factor (see ”Service” tab) or a conversion factor (see ”System” tab) is considered in this connection.

All target positions are apportioned to this classification. The drive follows the defined set position on the shortest path from the actual position to the set position. For instance, in the case of a setpoint selection of 4096 increments, the drive traverses to the position of 0 increments. As soon as the position control end time (see ”Controller” tab) has been reached, the drive is switched to a deenergised state. If an additional holding torque is to be applied after the target has been approached, the position control end time is to be adjusted accordingly, or a holding brake is to be provided.



A -2048 increments
B 2048 increments
C 0 increments
D Motor axis

5.6.2 Speed/velocity

By means of the slide for the speed/velocity, a continuously variable setting in the previously selected unit is effected. The display of the unit for the velocity thereby refers to the linear axis; the unit for the speed refers to the rotary axis. The value set here is valid for the currently set travel data set. It presents the max. permissible speed in a torque-controlled system or the speed setpoint in a speed-controlled system. In the case of a positioning, the profile velocity is defined.

The rough adjustment is carried out by moving the sliding switch using the mouse pointer. By means of the arrow keys on the PC keyboard, the value can be varied in smaller steps.

5.6.3 Torque/force

This is a continuously variable torque setting of a torque control (torque setpoint with regard to the selection of a limit of the maximum permissible torque) in the previously set unit. The display in the unit of a force is based on the linear axis, and in the unit of a torque is based on the rotary axis. The set value is valid for the currently set travel data set.

The rough adjustment is carried out by moving the sliding switch using the mouse pointer. By means of the arrow keys on the PC keyboard, a fine adjustment of the value can be effected.

5.6.4 Positive/negative setpoint

At this point, the orientation of the setpoint for the travel data set is defined, whereby the sign refers to the ”Positive direction” set in the ”System” menu. For instance, the direction of rotation of the motor drive shaft for ”Direction positive left” and ”Setpoint negative” without entering a change in direction for the gearbox is right.

5.6.5 Position - time

For the controller types ”Following error”, ”Speed” and ”Torque/force”, the possibility of setting the time and duration of the travel data set is provided, whereas for the controller types ”Absolute position” and ”Relative position”, one value for the position or for the position change is entered. The maximum value for the ”Absolute position” is 2^{31} increments. Like the other parameters, the unit of the entered value acts in accordance with the default setting; if the value ”0” is entered, no position change is effected in the case of a relative positioning, but observance of the other parameters, such as the position control end time and waiting time.

Note!

An entered time value of ”0” for the controller types ”Following error”, ”Speed” and ”Torque” causes the travel data set to be carried out for an optional duration until it is interrupted by a stop command, a fault, or by a disconnection from the supply.

► Accepting the actual position

By activating the ”Accept actual position” button, the current position value which is displayed in the status menu is entered in the position box and therefore is accepted as the absolute position value. This function correspondingly can only be activated for the controller type ”Absolute position”.

5.6.6 Acceleration value

An arbitrary acceleration value for starting a travel data set from a non-operative state or from a low speed up to a device-specific maximum limit of approx. 260000 rpm*1/s can be entered in this field. Particularly if low acceleration values are entered, the scanning time set in the ”Controller” menu has to be considered.

5.6.7 Acceleration ramp

The acceleration ramp describes the characteristics of the acceleration curve. The following acceleration ramps can be selected: linear or sine square. The advantage of the sine square curve is a soft start acceleration and therefore a reduction of the starting pressure.

5.6.8 Deceleration value

Here, in analogy to the ”Acceleration value” the deceleration value is set. The difference, however, is that in this case the entered value refers to the deceleration of the motor when the travel data set/travel program is stopped.

5.6.9 Deceleration ramp

For deceleration, the same ramp types as for the acceleration values can be configured: linear or sine square.

5.6.10 Waiting time

The waiting time describes the elapsing time between the end of the current travel data set and the defined following travel data set. During the transition, a speed of 0 rpm is maintained. Position control end time, engagement time and disengagement time are subordinated to the waiting time. During the waiting time is lapsing, the motor/controller can also be at zero current.

If the waiting time is set to 0 ms, a change from one travel data set to the next is effected. For a speed control, this for instance means that the drive during transition is not decelerated to a speed of 0 rpm, but that - in consideration of the acceleration ramps set - it directly switches over from one speed setpoint to the next speed setpoint.

5.6.11 Brake

If the servo inverter is equipped with a brake, it is only switched on after completing the travel data set if the ”Brake” parameter has been activated by means of the brake check box. The settings for the braking operation are carried out under the ”Service” menu item.

5.6.12 Next travel data set

In case of interlinking or loops of travel data sets, here for each travel data set correspondingly the next one is entered. It is possible to refer to the first travel data set again after a certain number of travel data sets has been carried out, as well as continuing with a specific travel data set. The travel data set ”0” exits the loop as a subsequent travel data set and stops the motor. This is a special feature of the travel data set 0, which has to be also observed in case of an interlinking.

5.6.13 Current travel data set

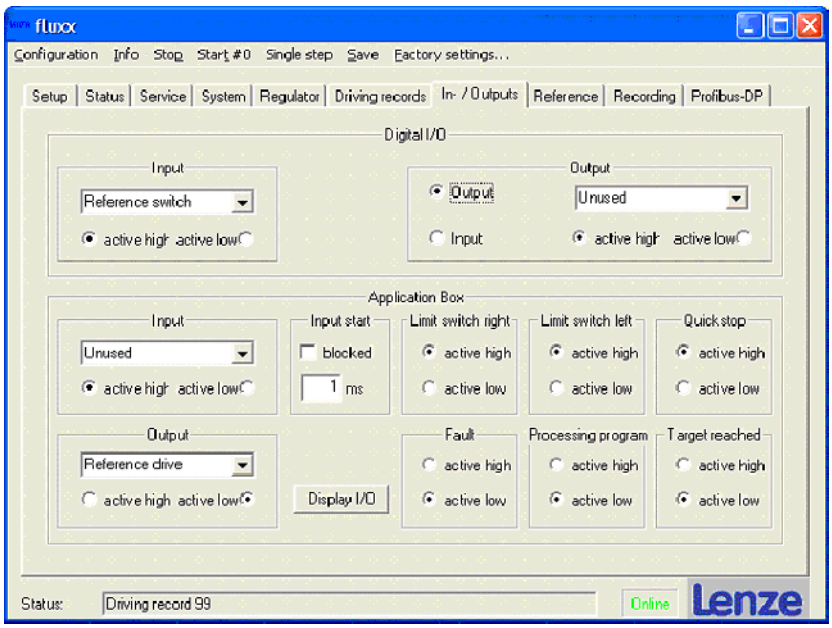
By means of this field, the user can select travel data sets between 0 and 99, start them by ”Start” and interrupt them by ”Stop”.

In the single step operation, which is activated by the single step check box, travel programs are gradually carried out from travel data set to travel data set, where each following travel data set is only started by reactivating the ”Start” key. The controller remains active between the travel data sets.

5.7 Inputs and outputs menu

The 930 fluxxtorque servo drive can either be procured as a drive with a digital input and output, respectively, or with a local CAN interface. Because of the local CAN interface, the use of function modules is possible. Currently, diverse function modules with different degrees of protection are provided, by means of which the evaluation of several inputs and outputs is possible. Further function modules - e.g. for evaluting analog signals or for effecting a master frequency coupling - are projected. More detailed information can be gathered from your Lenze sales department.

Inputs/outputs



In the ”Inputs/outputs” tab, both variants of the 930 fluxxtorque servo drive (with digital inputs/outputs or with a function module/application box) can be parameterised. In the following, the settings required for this are described.

5.7.1 Digital I/Os: digital input

The design with a digital input and output provides one input and one output, respectively, which can be freely assigned with regard to their functionality. The digital input as well as the digital output is configurable as ”Active high” or ”Active low”.

The individual functions of the digital input depend on the type of control (via Fluxx or via a bus system). The limited usability of the digital input for bus systems can be attributed to the nonconformity (DS402, Drivecom). For the input, the following selectable functions are provided:

Note!

For bus controlled systems it is recommended to set the function of the digital input and digital output via the according communication objects of the respectively used bus system (e.g. object 2006h for selecting the function of the digital input for CANopen systems).

If the setting of the functions of the digital IOs is effected via Fluxx, after allocating and saving the function for the digital input and output, the drive is to be switched to a deenergised state and to be reconnected afterwards. Only after the drive is restarted, the setting for the IOs for the bus system is accepted!

Function	Control via "Fluxx" or via digital IO	Control via CAN bus	Control via Profibus
Unused	No function	No function	No function
Reference (reference switch)	In case of the reference type "Reference switch", the digital input is evaluated as a reference switch. When a reference run is effected and the reference switch is reached, the home position is set in consideration of the settings carried out on the "Reference" tab.		
Output stage off	The output stage of the inverter is switched off if this input is activated while the electronics/control is supplied further on. If the motor is running at the time of activation, it will coast in an uncontrolled manner after the output stage has been switched off. There is no actively injected torque available on the motor shaft. After deactivation of the input, the drive can be restarted.	No function	No function
Quick stop	If the input is activated, the motor is braked to the speed 0 at the maximum permissible torque. Additionally, the mechanical holding brake engages if the input is activated. Afterwards, the output stage of the inverter is switched off, and the "Quick stop" fault is output. Then an actively applied toque is no longer available on the motor shaft. After the input has been deactivated, the drive can be restarted. For this purpose, an acknowledgement of the fault is required for an operation via bus systems.		
Goto 99	If the input is activated, the current travel data set is interrupted immediately, and the travel data set 99 is selected or started.		
Synchronisation	For synchronising several drive systems, the "Synchronisation" function can be used. The term "synchronisation" in this connection refers to the simultaneous start of several drive systems. For this purpose it is required to specify the number of the next travel data set with a negative sign in the field "Next travel data set". If, for instance, in case of a linkage between travel data sets, the travel data set number is entered in the field "Next travel data set" with a negative sign (e.g. -5 for the fifth travel data set), the subsequent travel data set is only started if the input is active.	No function	No function
Stopover	The current travel program is stopped if the input is active, and the drive is decelerated to the speed 0. The output stage remains active during the stopover. As soon as the input is deactivated, the program or the current travel data set is continued.	No function	No function
Single step mode	In case of a linkage of travel data sets, the subsequent travel data set only is started if the input is active.	No function	No function
Start/stop	If the input is active, the travel data set 0 is started. As long as the input is active, also defined subsequent travel data sets (see next travel data set on the "Travel data sets" tab) are carried out. If the input signal is inactive, the travel program is stopped. A reactivation starts the travel data set 0. The "Start/stop" function can only be used if the operating modes "Online level 1" or "Offline (Fluxx)" are set.	No function	No function

Function	Control via "Fluxx" or via digital IO	Control via CAN bus	Control via Profibus
Teach	By means of the "Teach" function, the current actual position of the drive can automatically be transmitted as a set position of the travel data set 0 under the following conditions: A The controller type of travel data set 0 is "Absolute position" B The output stage has to be switched off (motor at zero current) This function can only be used in the operating modes "Online level 1" or "Offline" of the Fluxx program.	No function	No function
Stopover at zero current	The current travel program is stopped if the input is active, and the drive is decelerated to the speed 0. Afterwards the output stage is switched off (motor at zero current). As soon as the input is deactivated, the output stage is activated, and the program or the current travel data set is continued.	No function	No function
Limit switch, left	In case of the reference type "Limit switch, left", the digital input is evaluated as a reference. When a reference run is effected and the limit switch is reached, the home position is set in consideration of the settings effected on the "Reference" tab. Furthermore, a quick stop is actuated if the limit switch is reached during normal operation.		
Limit switch, right	In case of the reference type "Limit switch, right", the digital input is evaluated as a reference. When a reference run is effected and the limit switch is reached, the home position is set in consideration of the settings effected on the "Reference" tab Furthermore, a quick stop is actuated if the limit switch is reached during normal operation.		

Tab. 2 Functions of the digital input

5.7.2 Digital I/Os: digital output

The digital output provided can be defined in a free manner with regard to its functions. The output is configurable as ”Active high” or ”Active low”, the function of the output not being dependent on the type of control (activation of the servo drive via bus, digital IOs, or the Fluxx program). For the output, the following selectable functions are provided:

Warning	If a warning occurs, the ouput becomes active. Warning signals do not yet result in a switch-off of the motor, but they can announce operating states which can become critical. *Example: motor temperature > 130°C*
Fault	If a fault occurs, the motor is switched off automatically, and in addition the output is set. *Example: motor temperature > 140°C*
Editing data set	The output is set as soon as a travel data set is edited, or if a travel data set currently is in process.
Setpoint reached	Here the output is activated from the time where the setpoint specified in the current travel data set has been reached. The type of the setpoint depends on the controller type set in the ”Travel data sets” menu, e.g. ”Speed”.
Reference run active	Here the output indicates that the motor currently is carrying out a reference run for protective multiple earthing of the drive.
Drive in standstill	As soon as the drive is in standstill, i. e. speed = 0 rpm, the output is activated.
Profibus active	In this case, the output activation is effected if the Profibus is activated, e.g. for communication of the motor as a DP slave with the Profibus master.
System error	A system error occurs as soon as the amount of the system deviation is greater than the value specified in the following error window of the ”Controller” menu.
Motor deenergised	”Motor deenergised” means that the output stage is disconnected, i. e. a torque no longer is available on the motor shaft.
Stopover	A stopover is characterised by an interrupted travel data set. The command for a stopover is effected via the digital input.
Single step mode	If this configuration is used, an active output signal occurs as soon as the drive is in single step mode. The single step mode can be activated by selecting ”Single step~On” in the upper menu bar of the user program. The second possibility to activate single step mode is to tick the ”Single step” check box in the ”Travel data sets” menu.
Single step pause	The pause in single step mode is displayed, which eventually is effected automatically after completion of a travel data set in single step mode. The start of the next travel data set is either carried out by a new start command (Single step~Continue) in the user program, or via a digital input that is configured by ”Single step”.
Reference set	As soon as the reference is set, the activation of the output signal is effected. This happens after a reference run has been successfully completed. The reference furthermore is set if no reference run has been set in the ”Reference” menu.

Tab. 3 Functions of the digital output

Stop!

The digital output can also be used as an input if a function module for inverters with an IO interface is used in addition. This, for instance, is reasonable for drive systems where 2 limit switches are to be evaluated. Without using a function module, only the use as an output is possible! The function module can be procured from Lenze under the designation 930FI020000 as part of the accessories.

For the use of this specific function module it is to be observed that the cycle time of the evaluation of the two digital inputs in comparison to the usual IO system is twice as long.

When using the 930FI020000 function module, the output can be used as a second input. This second input is configurable as ”Active high” or ”Active low”. With regard to the function, the same functions as to the first input can be allocated to the second input.

Stop!

An assignment of the same function to both inputs is to be avoided.

5.7.3 Application Box: digital inputs

Stop!

The application box, which can be purchased as part of the accessories from Lenze, can only be evaluated if the 931M/W inverter is equipped with a ”local CAN interface”.

For applications requiring a greater number of digital IOs or other functions (e.g. analog IOs or a master frequency coupling), the servo inverters with the local CAN interface offer the possibility of extending the functions via external function modules.

Currently 2 different designs of function modules or application boxes are available for evaluating a greater number of digital IOs. Further function modules - e.g. for evaluating analog signals or for a master frequency coupling - are under way. Further information on this can be received from your Lenze sales department.

The ”Fluxx” operating program is optimised for the evaluation of the existing function modules. These function modules are provided with a number of inputs and outputs featuring clearly predefined functions as well as a freely configurable input and output, respectively. All inputs and outputs can be configured as ”Active high” or ”Active low”. The function modules feature the following technical data:

	930FC140400	**930FC030200**
Type of protection	IP 20	IP54
Digital inputs	14	3
Digital outputs	4	2
Predefined functions of the inputs	• Start • Stop • Limit switch, left • Limit switch, right • Quick stop • 8 BCD-coded inputs for selecting the 100 travel data sets	• Limit switch, left • Limit switch, right
User-definable inputs:	1	1
Predefined functions of the outputs	• Fault • Edited data set • Target reached	• Fault
User-definable outputs	1	1

Tab. 4 Technical data of the function modules

The functions of the clearly predefined inputs depend on the type of control (bus system or IO). They are specified in the following table.

Predefined function	Control via ”Fluxx” or via digital IOs	Control via CAN bus	Control via Profibus
8 BCD-coded inputs (type 930MA140400 only)	The selection of the travel data set is effected via 8 inputs. For this purpose, the lower 4 inputs are used in a binary coded manner for the definition of the first decimal place (0...9), and the upper four inputs are used in a binary coded way for the second decimal place (0, 10, 20, ..., 90). The travel data set thus selected afterwards can be started by activating the ”Start” input.	No function	No function
Start	When the input is activated, the travel data set that is currently selected via the binary coded inputs of the application box (IP54 box: selected travel data set = 0) is started. After the start, also subsequent travel data sets (see next travel data set on the ”Travel data sets” tab) are effected. For starting a travel data set, the edge of the ”Start” input is evaluated. The ”Start” function can only be used if the operating modes ”Online level 1” or ”Offline (Fluxx)” are set.	No function	No function
Stop	In case of an active input signal, the travel program is stopped irrespectively of the status of the ”Start” input. After deactivation of the ”Stop” input, the selected travel program can be restarted by activating the ”Start” input. The ”Stop” function can only be used if the operating modes ”Online level 1” or ”Offline (Fluxx)” are set.	No function	No function
Limit switch, left	In case of the reference type ”Limit switch, left”, the digital input is evaluated as a reference. When a reference run is effected and the limit switch is reached, the home position is set in consideration of the settings carried out on the ”Reference” tab. Furthermore, a quick stop is actuated during operation if the limit switch is reached.		
Limit switch, right	In case of the reference type ”Limit switch, right”, the digital input is evaluated as a reference. When a reference run is effected and the limit switch is reached, the home position is set in consideration of the settings carried out on the ”Reference” tab. Furthermore, a quick stop is actuated during operation if the limit switch is reached.		
Quick stop	If the input is activated, the motor is braked to the speed 0 at maximum permissible torque. Additionally, the mechanical holding brake engages if the input is activated. Afterwards, the output stage of the inverter is switched off, and the ”Quick stop” fault is output. Then an actively applied torque no longer is available on the motor shaft. After deactivation of the input, the drive can be restarted. For this purpose, an acknowledgement of the fault is required for an operation via bus systems.		

Tab. 5 Functions of the predefined inputs of the function modules

The following functions can be assigned to the freely configurable digital input:

Function	Control via "Fluxx" or via digital IOs	Control via CAN bus	Control via Profibus
Unused	No function	No function	No function
Reference (reference switch)	In the case of the reference type "Edge" or "Reference switch", the digital input is evaluated as a reference switch. When a reference run is effected and the reference switch is reached, the home position is set in consideration of the settings carried out on the "Reference" tab.		
Output stage off	The output stage of the inverter is switched off if this input is activated, while the electronics/control is supplied further on. If the motor is running at the time of activation, it will coast in an uncontrolled manner after the output stage has been switched off. There is no actively injected torque available on the motor shaft. After deactivation of the input, the drive can be restarted.	No function	No function
Reference window	No function	No function	No function
Start reference run	The reference run which is specified in the "Reference" menu and which serves to the protective multiple earthing of the drive or to define all absolute position values is started when transition to the active status takes place, if the drive has not yet been referenced beforehand. A second referencing cannot be started via the input. For this purpose, the digital input is to be selected as "Reference start" in the "Reference" tab.	No function	No function
Goto 99	If the input is activated, the current travel data set is interrupted immediately, and the travel data set 99 is selected or started.		
Synchronisation	For synchronising several drive systems, the "Synchronisation" function can be used. The term "synchronisation" in this connection refers to the simultaneous start of several drive systems. For this purpose it is required to specify the number of the next travel data set with a negative sign in the field "Next travel data set". If, for instance, in the case of a linkage between travel data sets, the travel set data number is entered in the field "Next travel data set" with a negative sign (e.g. -5 for the fifth travel data set), the subsequent travel data set is only started if the input is active.	No function	No function
Stopover	The current travel program is stopped if the input is active, and the drive is decelerated to the speed 0. The output stage remains active during stopover. As soon as the input is deactivated, the program or the current travel data set is continued.	No function	No function
Single step mode	In the case of a linkage of travel data sets, the subsequent travel data set only is started if the input is active.	No function	No function
Teach	By means of the "Teach" function, the current actual position of the drive can automatically be transmitted as a set position of the travel data set 0 under the following conditions: A The controller type of travel data set 0 is "Absolute position" B The output stage has to be switched off (motor at zero current) This function can only be used in the operating modes "Online level 1" or "Offline" of the Fluxx program.	No function	No function
Stopover at zero current	The current travel program is stopped if the input is active, and the drive is decelerated to the speed 0. Afterwards the output stage is switched off (motor at zero current). As soon as the input is deactivated, the output stage is activated, and the program or the current travel data set is continued.	No function	No function

Tab. 6 Freely configurable input

5.7.4 Application box: digital outputs

The explanations concerning the functions of the clearly predefined outputs (fault, edited data set, objective achieved) can be gathered from the Tab. 4. In addition to the predefined outputs, a digital output can be freely configured. The possible functions can be gathered from the following table.

Warning	If a warning occurs, the ouput becomes active. Warning signals do not yet result in a switch-off of the motor, but they can announce operating states which can become critical. *Example: motor temperature > 130°C*
Fault	If a fault occurs, the motor is switched off automatically, and in addition the output is set. *Example: motor temperature > 140°C*
Editing data set	The output is set as soon as a travel data set is edited, or if a travel data set currently is in process.
Setpoint reached	Here the output is activated from the time where the setpoint specified in the current travel data set has been reached. The type of the setpoint depends on the controller type set in the ”Travel data sets” menu, e.g. ”Speed”.
Reference run active	Here the output indicates that the motor currently is carrying out a reference run for protective multiple earthing of the drive.
Drive in standstill	As soon as the drive is in standstill, i. e. speed = 0 rpm, the output is activated.
Profibus active	In this case, the output activation is effected if the Profibus is activated, e.g. for communication of the motor as a DP slave with the Profibus master.
System error	A system error occurs as soon as the amount of the system deviation is greater than the value specified in the following error window of the ”Controller” menu.
Motor deenergised	”Motor deenergised” means that the output stage is disconnected, i. e. a torque no longer is available on the motor shaft.
Single step mode	If this configuration is used, an active output signal occurs as soon as the drive is in single step mode. The single step mode can be activated by selecting ”Single step~On” in the upper menu bar of the user program. The second possibility to activate single step mode is to tick the ”Single step” check box in the ”Travel data sets” menu.
Single step pause	The pause in single step mode is displayed, which eventually is effected automatically after completion of a travel data set in single step mode. The start of the next travel data set is either carried out by a new start command (Single step~Continue) in the user program, or via a digital input that is configured by ”Single step”.
Reference set	As soon as the reference is set, the activation of the output signal is effected. This happens after a reference run has been successfully completed. The reference furthermore is set if no reference run has been set in the ”Reference” menu.

Tab. 7 Freely configurable output

5.7.5 Display of the digital IOs

For checking the digital input signals and output signals they can be visualised within a window. For this purpose, the ”Display I/O” button is to be activated. In the window, the high levels of the inputs and outputs are displayed by means of a filled out circle. In this connection, the display refers to drive systems with an IO or local CAN interface. The signals for devices with the function IO (a digital input and a digital output) are displayed in the upper part of the window. The current states of the inputs and outputs of the drives with a function module (local CAN drives) are displayed in the lower field.

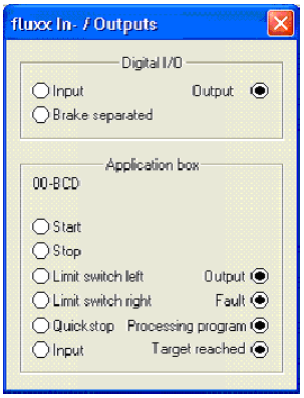
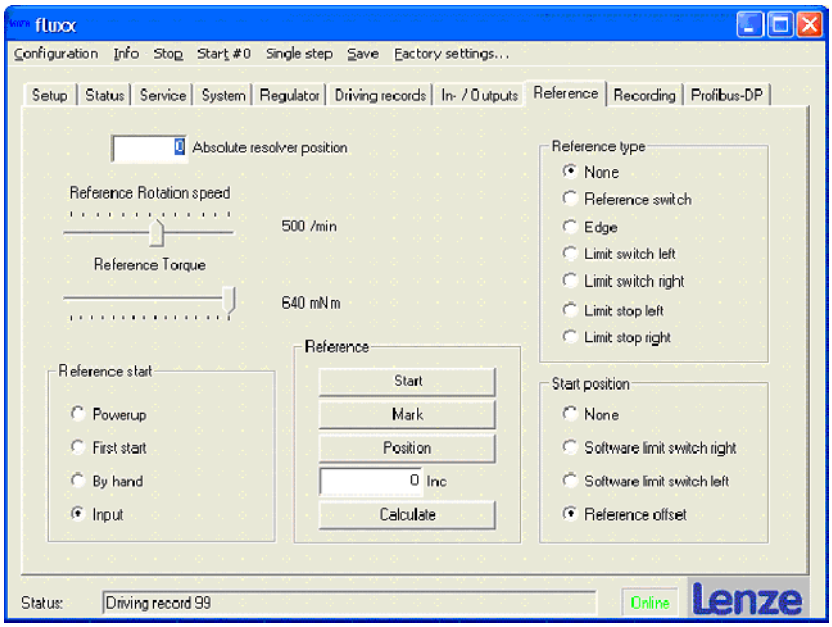


Fig. 2 Display of the digital inputs and outputs

5.8 Reference menu

On the ”Reference” menu page, the type of reference run, the travel profile (velocity and torque) and the starting time of the reference run can be defined. The different settings are described in the following.

Reference



5.8.1 Absolute resolver position

If a reference run is carried out on a limit switch, a reference switch, or an edge, referencing can be effected

- directly to the edge of the respective reference signal, or
- under evaluation of the zero pulse of the resolver

The definition of the exact home position is determined by the absolute resolver position. In this connection, the absolute resolver position can adopt the following values:

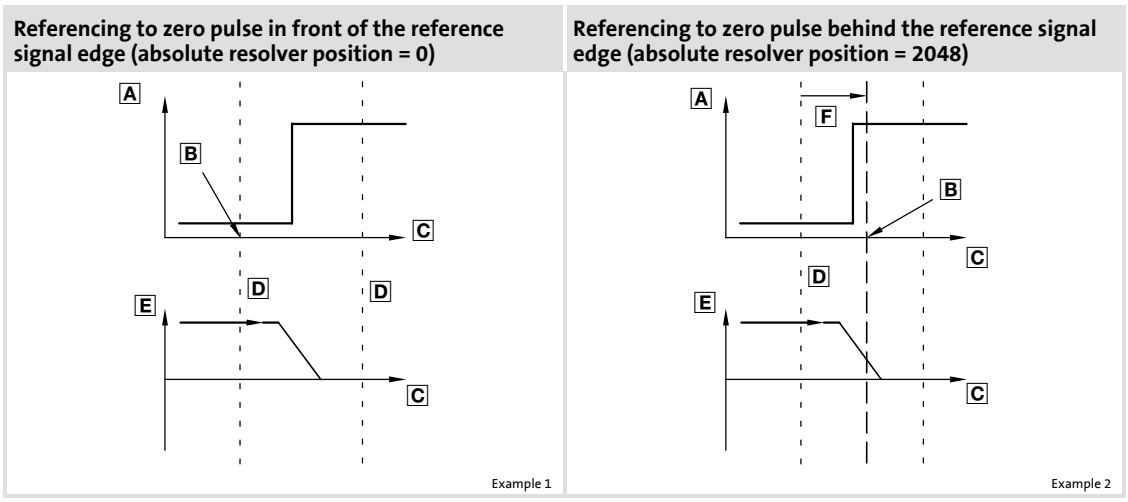
- ”-1”: Referencing is carried out directly to the edge of the reference signal selected.
- ”0-4095”: In addition to the reference signal, the zero pulse of the encoder system featuring the shortest distance to the edge of the reference signal is evaluated at the same time.

The integration of the zero pulse of the encoder system is recommended for applications where the reference signal due to variable ambient conditions (temperature, pressure, etc.) displays a certain leakage or a tolerance range. This expresses itself in the form of a range in which the reference signal - according to temperature and other ambient conditions - can temporarily be measured as a high as well as a low signal. In order to provide for a definite, repeatable home position, the zero pulse of the encoder system can be included.

For setting the absolute resolver position of 0 increments, referencing is carried out directly to the zero pulse which is nearest to the edge.

In case of a specification of 1 to 4095 increments, the zero pulse can be "shifted" in positive direction by the set number of increments, or it can be rotated within a motor revolution. Thus it is possible to optionally position the zero pulse within a motor revolution.

By the possibility of shifting the zero pulse - irrespective of the actual position of the real zero pulse - the reference signal can be placed behind as well as in front of an edge in any position. This is clarified by means of the following example.



A Reference signal level
B Home position
C Position
D Zero pulse
E $V_{reference}$
F Zero pulse adjustment

Fig. 3 Integrating the absolute resolver position into the referencing process

Both of the reference runs represented in the Fig. 3 are based on the same position of the zero pulse and the edge of the reference signal.

Example 1 the home position is to be placed in front of the rising edge of the reference signal. As the zero pulse is placed in front of the edge at minimum distance from the edge, an adjustment of the absolute resolver position is not required. The absolute resolver position is therefore selected at 0 increments.

Example 2 the home position is to be placed behind the rising edge. For this purpose, an "adjustment" of the zero pulse is required. The zero pulse (dotted line) is shifted by 2048 increments (half a revolution), so that the nearest zero pulse is placed behind the edge (dashed line). The target of a home position behind the rising edge therefore can be reached.

As the position of the zero pulse with regard to the edge is not known before a reference run, the following procedure is recommended:

1. Reference run with an absolute resolver position of 0.
2. Positioning of the rotor directly on the edge of the reference signal.
3. On the basis of the current actual position value, the distance between the zero pulse and the edge can be identified. Furthermore, from the sign of the actual position it can be identified whether referencing has been carried out to the zero pulse in front of or behind the edge of the reference signal.
4. Then the absolute resolver position can be adapted according to the above examples.

5.8.2 Speed or velocity reference

The selection of the speed/velocity reference is effected at the output end in the value and units defined by the conversions and display units. The direction and amount of the reference speed is adjustable depending on the process and influence the course of the referencing. More detailed information can be gathered from the individual descriptions of the reference type.

5.8.3 Torque/force reference

The selection of the torque/force reference is effected in the value and units defined by the conversions and display units. Limiting the reference torque is particularly required with regard to the reference type ”Limit stop, left/right”, in order to avoid damages on the mechanics or in the drive train. The value of the reference torque is to be selected depending on the respective process.

5.8.4 Start reference

The definition of when the reference run is to be carried out or started is effected under ”Reference start”. The following options can be selected.

Powerup	Immediately on connection of the supply voltage (without calling up a travel data set), a reference run in accordance with the programmed settings is automatically carried out.
First start	With regard to the first start of a travel data set, the reference run is carried out directly before the travel data set is effected. The reference run is carried out according to the programmed settings.
Manually	A reference run is carried out if the ”Start” key in the ”Reference” menu is pressed.
Input	The reference run is started by activating the digital input of a function module. For this, the ”Start reference” function has to be assigned to the freely configurable input. The reference run is effected in the programmed settings.

5.8.5 Reference type

None

In applications for which no referencing is required, the reference type ”None” is to be selected. This setting for example is reasonable for speed-controlled systems.

Note!

If no reference run is required for the process, the following setting is recommended:

- ► Absolute resolver position: -1
- ► Reference start: power up
- ► Reference type: none

Reference switch

Note!

When using reference and limit switches, the correct integration of the limit switches (see ”Inputs/outputs” tab) as well as the orientation of the right and left limit switch (ESL, ESR) is to be checked before carrying out the reference run. In principle, the following applies to a positive direction of movement (for this, see ”positive direction” setting in the ”System” tab):

”Positive direction” = right: The position value of the left limit switch has to be smaller than that of the right limit switch (ESL<ESR).

”Positive direction” = left: The position value of the right limit switch has to be smaller than that of the left limit switch (ESL>ESR)

The position of the reference switch has to be between the limit switches. In the case of a deviation, a fault with regard to the reference run or to operational performance can be assumed. By specifying the ”Positive direction” (”System” tab), the orientation of the coordinate system can be reversed.

A precondition for the evaluation of the limit switches and the reference switch is the use of a function module with an increased number of digital inputs.

For the reference type ”Reference switch”, referencing to a switch which has to be physically mounted between the two limit switches is carried out. The difference between a reference switch and an edge is explained in the following paragraph ”Edge”. Basically, a reference switch is a switch which - only in the geometrically limited active area of the switch - shows a change in the signal level. In front of and behind the reference switch the same signal level is to be found (see illustration 4).

In the following, for reasons of simplification, always a linear axis, and therefore a translatory motion is assumed. For evaluating the reference switch, the function of the digital input has to be set to ”Reference”. The actual reference run and the home position to be determined further on depend on the following settings:

- The sign of the *reference speed* specifies in which direction the reference switch is to be traversed when referencing is carried out.
- The *signal level* of the reference switch is defined via the setting ”Active low” or ”Active high” on the ”Inputs/outputs” tab.
- The setting of the *absolute resolver position* defines whether an evaluation of the zero pulse of the resolver is to be effected during referencing, or whether referencing is to be carried out directly to the edge (-1: no evaluation of the zero pulse of the resolver; 0...4095: evaluation of the zero pulse of the resolver).

- During the reference run, the limit switches can additionally be evaluated. This is recommended, as in many applications at the start of referencing it is not known in which direction the reference switch is positioned. For activating the evaluation of the limit switches, the ”Software limit switch” function on the ”System” tab has to be selected.
  - **With** *software limit switch*: limit switches are also evaluated
  - **Without** *software limit switch*: limit switches are not evaluated

If a limit switch is reached in the case of an active monitoring process of the limits switches during a reference run before the reference switch has been recognised, the reference speed is reversed, and the search for the reference switch is continued in the opposite direction.

If the software limit switches are used, the entered limit values (left / right) are irrelevant. Solely the numerical values have to plausible in themselves (e.g. left limit switch < right limit switch at positive clockwise direction of rotation).

If no limit switches are evaluated, the drive is traversed at the set reference speed if the drive is not positioned in the area of the reference switch (see Fig. 4 example 1 and example 2) at the start of the reference run. If the drive is positioned in the area of the reference switch, referencing at first is carried out at negatived reference speed until the area of the reference switch is left. Then the edge of the reference switch is traversed at the reference speed selected, and the home position is set.

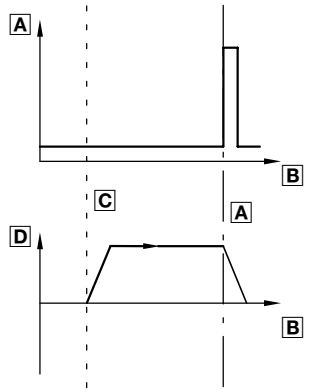
If the limit switches are evaluated, the reference run always is started at negatived reference speed. It is only reversed when a reference switch is left (see Fig. 4 example 4) or when a limit switch is reached (see Fig. 4 example 3). This procedure ensures that the drive is braked and has to be accelerated in the opposite direction only once during a reference run.

The reference run to a reference switch as well as the above settings is illustrated by means of examples. They are shown in the Fig. 4.

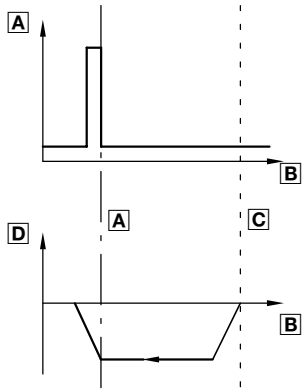
For **example 1**, a positively set reference speed is selected, and referencing is carried out to the edge to the high signal level. The limit switches at first are not evaluated. The drive - as it is not positioned in the area of the reference switch at the start - traverses at the set reference speed until the reference switch is recognised via the rising edge of the digital input. Here, the 0 position is set. Then the drive is stopped. **Example 2** shows a similar process at negative speed.

In **examples 3 and 4**, the limit switches are evaluated. In both cases, the drives are therefore started at the negatived reference speed. In **example 4**, the reference switch is recognised and traversed. After the reference switch has been traversed, the drive is stopped and afterwards accelerated to the defined reference speed. When the area of the reference switch is re-entered, the 0 position is set, and afterwards the drive is stopped. In the case of **example 3**, first the limit switch is reached. Here the drive reverses its direction of rotation and traverses at the defined reference speed until the rising edge of the reference switch is recognised.

Reference type "Reference switch", positive reference speed, "Reference" as "Active high", without evaluation of the limit switches

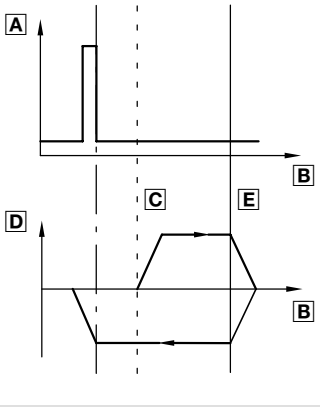


Reference type "Reference switch", negative reference speed, "Reference" as "Active high", without evaluation of the limit switches

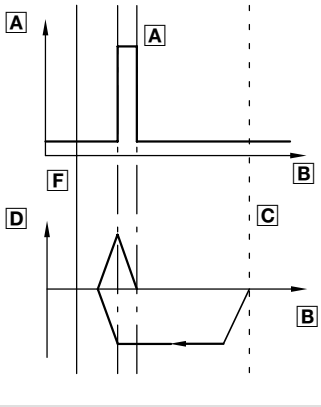


A Reference switch
B Position
C Starting point
D $V_{reference}$

Reference type "Reference switch", negative reference speed, "Reference" as "Active high", with evaluation of the limit switches



Reference type "Reference switch", positive reference speed, "Reference" as "Active high", with evaluation of the limit switches

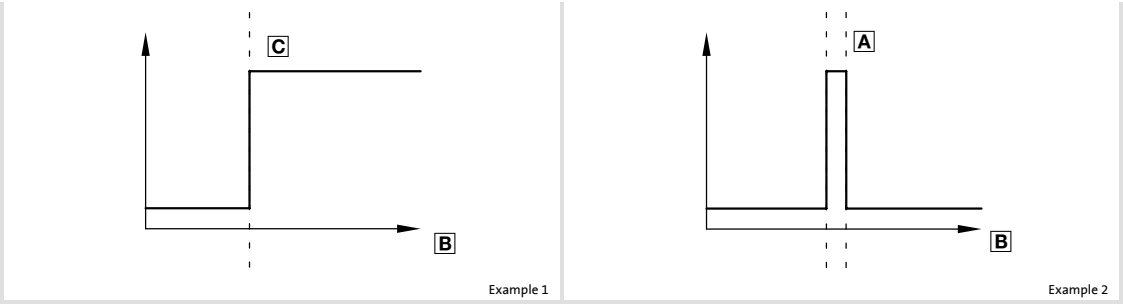


A Reference switch
B Position
C Starting point
D $V_{reference}$
E Limit switch, right
F Limit switch, left

Fig. 4 Examples for referencing to a reference switch

Edge

With this setting, the target of the reference run is an edge; an edge in this connection being a switch, the signal level of which only changes if the home position is reached. Compared to the reference switch, the signal level is not the same in front of and behind the edge. Thus, in front of the edge a low level may be available, whereas behind the edge a high level is available. The difference between an edge and a reference switch is exemplarily shown in the following illustration.



A Reference switch
B Position
C Edge

Fig. 5 Difference between an edge and a reference switch

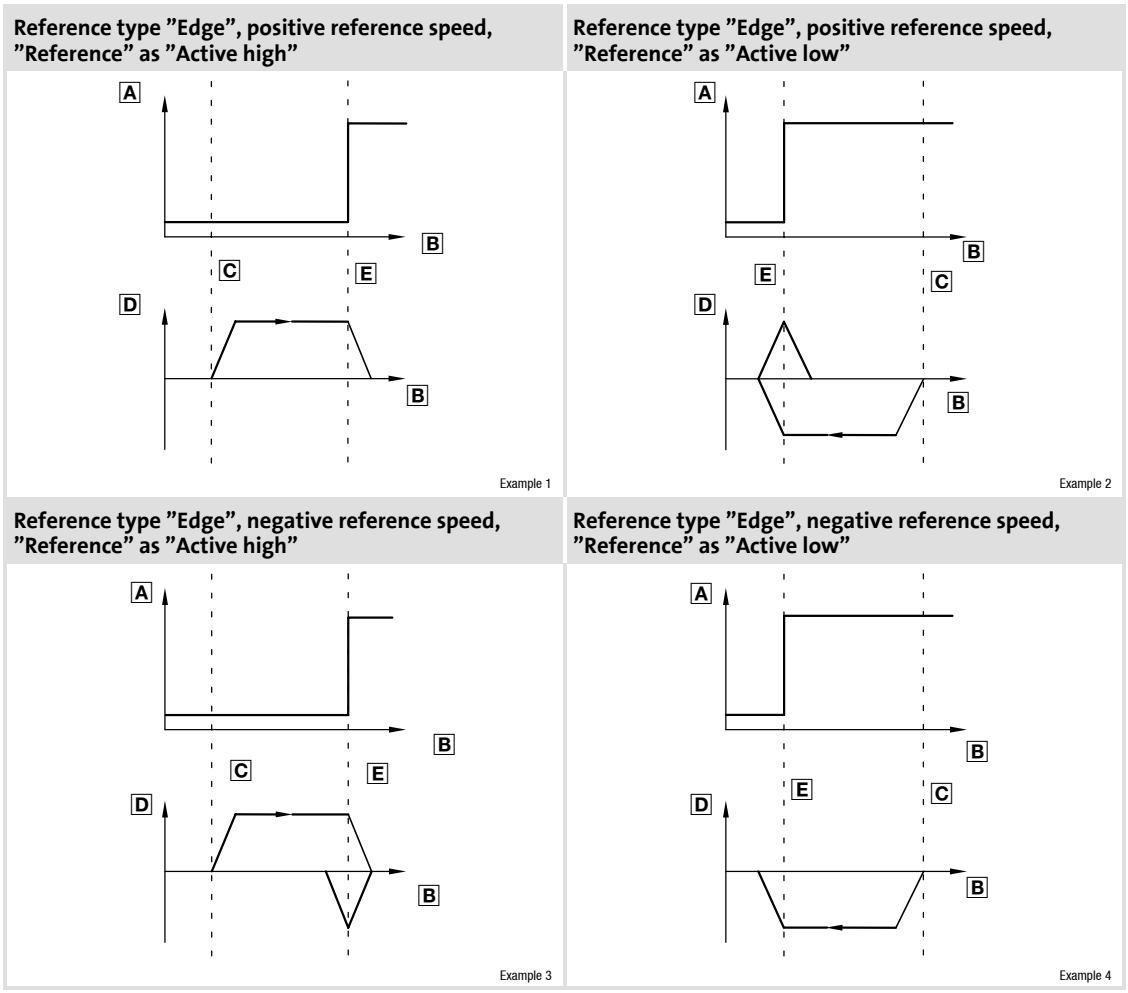
For evaluating the edge, the function of the digital input has to be set to ”Reference”. In this connection, the edge has to be placed between the limit switches of the system. The actual reference run and the home position to be determined further on depend on the following settings:

- The sign of the reference speed specifies in which direction the edge is to be traversed when referencing is carried out.
- The signal level of the edge is defined via the setting ”Active low” or ”Active high” on the ”Inputs/outputs” tab.
- The setting of the absolute resolver position defines whether an evaluation of the zero pulse of the resolver is to be effected during referencing, or whether referencing is to be carried out directly to the edge (-1: no evaluation of the zero pulse of the resolver; 0...4095: evaluation of the zero pulse of the resolver).
- Compared to the reference type ”Reference switch”, no evaluation of the limit switches can be effected during the reference run. If the limit switch towards which the drive moves is activated, a fault is caused.

Stop!

The positive edge of the ”Edge” signal - regarded from the low level of the signal - always is assumed in positive direction. In mechanical systems where the positive egde is to be found in the negative direction, an inversion of the direction is to be defined in the ”System” tab (positive direction ⇒ left).

The reference run to an edge as well as the above settings are clarified by examples.



A Edge signal level
B Position
C Starting point
D $V_{reference}$
E Edge

Fig. 6 Examples for referencing to an edge

In **example 1**, referencing is carried out at a positively set reference speed with the reference type "Edge" to a high level of the input. At starting time, the signal on the digital input "Reference" is low. The drive accelerates to the reference speed and traverses in positive direction at reference speed until the positive edge on the "Reference" input is reached. The 0 position is set here, and the drive is stopped.

The same preconditions apply to **example 2**. The level of the "Reference" input, though, at starting time represents the "High" status. The drive traverses at negative speed until the falling edge of the "Reference" signal is recognised. After the drive is stopped and accelerated again, it traverses over the edge at positive speed. The 0 position is set and the drive is stopped.

If a negative reference speed is set, and referencing is carried out to a high level of the ”Reference” input, the drive is traversed according to **example 3**. As the ”Reference” signal features a low level at starting time, the drive to begin with traverses in the positive direction until the rising edge is found. At this point the drive reverses its speed and traverses over the falling edge at negative speed.

In **example 4**, referencing to a falling edge is carried out at a negative referencing speed. The drive accelerates in negative direction and traverses at reference speed until the falling edge of the ”Edge” signal is identified.

Limit switch, right/left

Note!

When using limit switches, the correct integration of the limit switches (see ”Inputs/outputs” tab) as well as the orientation of the right and left limit switch (ESL, ESR) is to be checked before carrying out the reference run. In principle, the following applies to a positive direction of movement (for this, see ”Positive direction” setting in the ”System” tab):

”Positive direction” = right: The position value of the left limit switch has to be smaller than that of the right limit switch (ESL<ESR)

”Positive direction” = left: The position value of the right limit switch has to be smaller than that of the left limit switch (ESL>ESR)

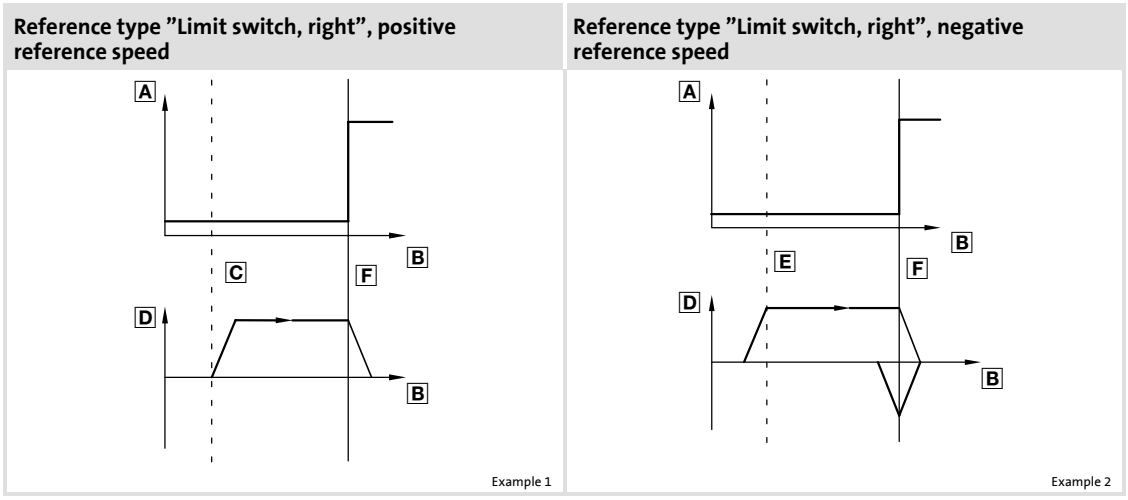
In case of a deviation, a fault with regard to the reference run or to the operational performance can be assumed. By using the specification of the ”Positive direction” (”System” tab), the orientation of the coordinate system can be reversed.

By using the correct setting of the ”Positive direction”, the sign of the reference velocity/speed is automatically defined (example: in case of a ”Positive direction = right”, the velocity of the reference run on the left limit switch in principal is negative, whereas the velocity on the right limit switch in principal is positive).

The amount of the reference velocity/speed is defined via the ”Speed reference” slide control. The sign of the setting of the ”Speed reference” slide control furthermore specifies in which way the limit switch is to be traversed. In general, the following applies to this:

- If the sign of the set ”Reference speed” corresponds to the speed required for the reference run (e.g. negative reference speed for a referencing to the left limit switch), the reference is set when the edge of the limit switch is reached, and the drive is stopped immediately.
- If, on the other hand, the reversed sign is set for the ”Reference speed” slide control (e.g. positive reference speed for a referencing to the left limit switch), the drive is stopped when the edge of the limit switch is reached and is accelerated to the amount of the reference velocity in the opposite direction. In this case the reference is set as soon the drive moves away again from the limits switch.

The different possibilities resulting therefrom are demonstrated by 2 examples, which can be gathered from the following illustration. The examples refer to a linear motion, defining the ”positive direction” on the right side. In both cases, referencing is carried out to the right limit switch (”Active high”).



A Limit switch signal level
B Position
C Starting point
D $V_{reference}$
E Edge
F Limit switch

Fig. 7 Reference run to a limit switch

Example 1: A positive reference speed is to be set. The drive is traversed until the edge of the limit switch is recognised. If the limit switch is entered, homing is carried out on this edge.

Example 2: A negative reference speed is to be set. In this case, the drive decelerates its speed to standstill when entering the limit switch and afterwards accelerates in the opposite direction. Homing is carried out on the falling edge of the limit switch, which sets itself when the limit switch is left.

End stop, left/right

Apart from referencing to a reference signal it is possible to select a mechanical limit stop as a home position. In this connection, a mechanical limit stop is recognised in an inverter-internal manner by means of the evaluation of the actual speed value and the reference torque. If, in spite of the available reference torque no change in position is effected for a period of 0.5 s (actual speed ~ 0), the mechanical limit stop is considered as recognised. The home position is set in this position.

The direction in which the mechanical limit stop is searched for is specified by the sign of the reference speed. In order to avoid damages on the mechanics or in the drive train, it is recommended for this reference run to select the reference torque below the rated torque of the drive.

If gearboxes are used and a greater output torque results from this, a reference run on an end stop has to be checked thoroughly. In the case of an incorrect dimensioning, the limit stops or the gearbox may suffer damage.

5.8.6 Starting position

The starting position is the position which is automatically assumed after the reference run has been effected before the travel program is started. If no starting position is specified, the drive remains in the position in which the reference run has ended until a travel data set is started.

The following options are provided:

- **None:**
  The drive stops near the home position after the reference run has been completed. The distance to the home position depends on the reference speed and the negative acceleration.
- **Software limit switch, left/right**
  The drive traverses to the position of the left or right software limit switch and remains in this position until a travel data set is started.
- **Resolver offset**
  The drive traverses to the position of the resolver offset. The resolver offset is set on the ”System” tab.

5.8.7 Reference

If a manual reference start is set, it can be actuated via the ”Start”, ”Mark”, or ”Position” keys. The individual functions are specified in the following.

Start

By means of the ”Start” key, the reference run is started according to the settings effected in the ”Reference” tab (reference type, reference speed,...).

Mark

The current actual position of the drive is accepted as zero position and therefore as home position. All further settings of the ”Reference” tab in this connection are ignored. After activating the ”Mark” key, the drive is considered as referenced.

Position

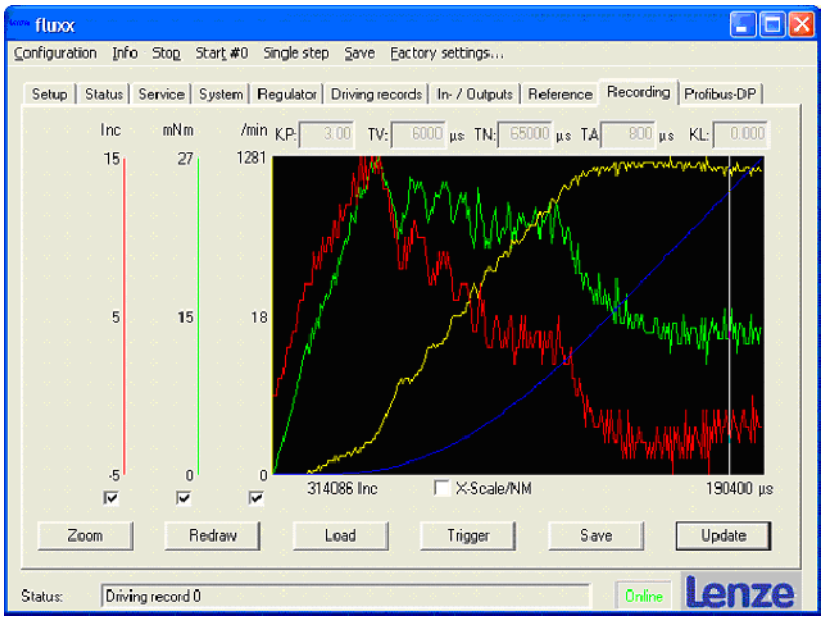
Below the ”Position” key, a position value in the default unit can be entered, which is directly accepted as zero position or as a current actual position when the ”Position” key is activated. After the ”Position” key has been activated, the drive is considered as referenced.

5.9 Recording menu

The ”Recording” menu page enables the graphical representation of the most important process data. This in particular is helpful for the optimisation of the controller parameters to the existing control process resulting from the application purpose of the motor. Furthermore, in practice a kind of ”monitoring” can be carried out in critical places of the travel program or the travel control. This is especially helpful and beneficial for commissioning an automation or control system.

As can be gathered from the following diagram, transient phenomenons can be noted:

Recording



The system deviation is recorded in red colour, the torque in green colour, the velocity in yellow colour, and the position in blue colour. The minimum values can be found on the lower end of the vertical scaling lines, the maximum values on the upper end. In the middle the current value is displayed, which is defined by the horizontal position of the mouse pointer. The position value is displayed below the recording window.

The check box below the vertical scaling lines serves to show or mask out the respective curves.

256 scans are always displayed, which are buffered in the motor before they reach visualisation via the interface. Due to the high data volume, buffering is required. The scanning time as well as the other characteristic parameters for the controller is shown automatically above the graph.

For operating the recording menu, the following buttons are used:

New design

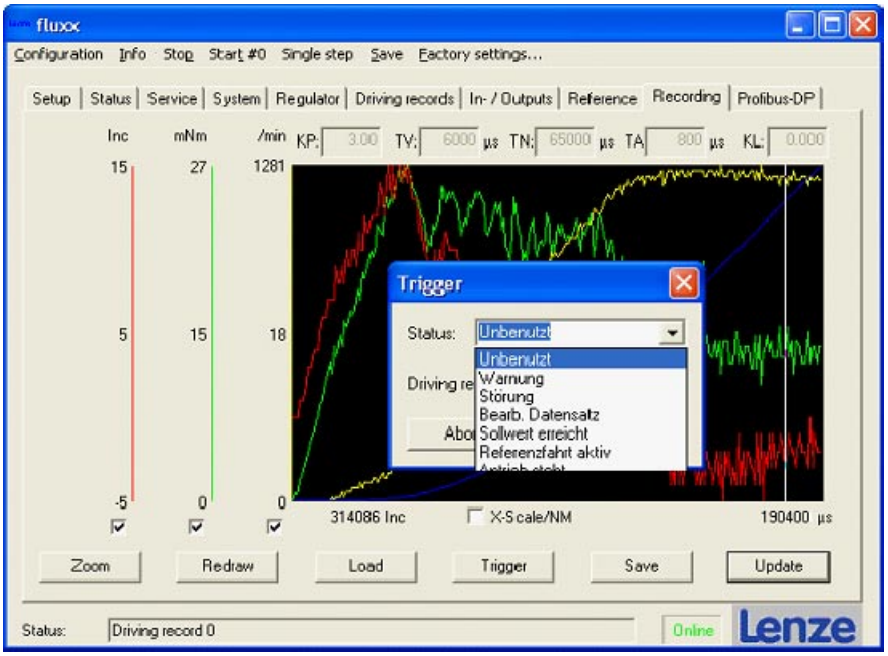
Recreation of the graphics.

Loading/saving

Loading or saving the recording by means of a data medium.

Triggering

This operational control defines the trigger point from which the recording is started. Apart from a defined travel data set, also an event may be triggered:



If a defined travel data set is to be triggered, the ”status” has to be selected as ”unused”. Otherwise, the selected event is triggered. The selected travel data set number then is only visible in a slightly shaded manner.

► Explanations of individual trigger conditions

Warning	If a warning signal occurs, a triggering process is effected, however, not yet resulting in a switch-off of the motor. *Example: motor temperature > 130°C*
Fault	If a fault message occurs, a triggering process is effected, resulting in the switch-off of the motor *Example: motor temperature > 140°C*
Editing data set	Recording is effected as soon as a travel data set is edited.
Setpoint reached	Here recording is effected from the time when the setpoint specified in the current travel data set has been reached. The type of setpoint depends on the controller type, e. g. ”Speed”.
Reference run active	Triggering the activation of the reference run.
Drive in standstill	As soon as the drive is in standstill, i.e. speed=0 rpm, triggering is effected.
Profibus active	In this case, recording is carried out if the Profibus is activated, e.g. for the communication start of the motor as a DP slave with the master.
System error	Triggering to system errors, i. e. the amount of the system deviation is greater than the value specified in the following error window of the ”Controller” menu. Additionally, the torque on the motor shaft has reached its maximum value.
Motor deenergised	The output stage is switched off, i. e. a torque is no longer available on the motor shaft.
Stopover	Triggering to a stopover which is characterised by an interrupted travel data set. The command for a stopover can be effected via the motor input (see ”Digital input/output” menu).
Single step mode	Here recording is effected if the motor is in single step mode. The single step mode can be activated by selecting ”Single step~On” in the upper menu bar of the user program.
Single step pause	The pause in single step mode is triggered, which eventually is effected automatically after completion of a travel data set in single step mode. The start of the next travel data set is either carried out by a new start command (Single step~Continue) in the service program, or via the motor input that is configured by ”Single step”.
Reference set	As soon as the reference is set, recording can be carried out. This happens after a reference run has been completed. The reference furthermore is set if no reference run has been set in the ”Reference” menu.

Reading

The data of the recording buffered in the inverter are transmitted to the PC via the serial interface. In order to accomplish this function, the trigger must have been activated beforehand, and then the corresponding trigger condition has to be met, e. g. the start of a specific travel data set.

6 Short setup

In the context of this paragraph, a short setup is described by means of an example. The main focus of this chapter in this connection is not the mechanical or electrical installation, but the software-controlled commissioning. For purposes of control, a speed control is parameterised. Only the steps that are obligatory, by means of which a drive is parameterised and commissioned, are described.

The electrical and mechanical installation of the fluxxtorque 931M and 931W drive series is to be carried out before the short setup. More detailed information can be gathered from the Operating Instructions.

Danger!

Observe the notes mentioned in the Operating Instructions. An incorrect installation may bring about damage to persons and to material assets.

6.1 Short setup of a speed control

Menu	Description
Setup → Operating mode: ”Service”	In the ”Setup” menu of the fluxx program, the operating mode ”Service” is to be selected for complete parameter setting. If a different operating mode is selected, due to the limited authorisations, not all of the parameters listed in the following can be changed.
↓	
Service * → Entry of the current factor → Entry of the max. motor torque → Entry of the max. motor speed → Brake available? → If required, implementation of a resolver adjustment	Afterwards, the most important parameters of the drive are to be defined in the ”Service” menu: ● Setting of the current factor (📖 30) ● Setting of the max. motor torque (📖 30) ● Setting of the max. motor speed (📖 30) ● If a brake is available, the respective option is to be selected by a check mark. Afterwards a resolver adjustment (adjusting resolver) can be effected in the load-free state. Optionally, also the gearbox ratio (if available) can be entered, or the fieldbus system can be parameterised. This, however, is not obligatory for a short setup.
↓	
Status ** → Check of the drive status → If required, elimination of faults	In the ”Status” menu it is to be checked whether faults are available. They for instance can be attributed to ● an exceeding or underrun of the permissible brake voltage **or** ● an exceeding or underrun of the permissible DC-bus voltage. Information on the elimination of faults can be gathered from the GHB 931M/W.
↓	
↓	

Menu	Description
Controller ** → Parameter setting of the speed controller (KP, TN, TV, TA, KL) → Entry of the max. torque → Entry of the max. speed	In the ”Controller” menu, the speed and position controller (📖 39) is to be parameterised (exception: torque control). Apart from the controller parameters KP (P component), TN (integral action component), TV (differential component) and TA (scanning time), the maximum torque and the maximum speed are to be defined in this application. If a following error or position control should be realised, the position control gain (KL), the following error window, or the positioning window are to be parameterised.
↓	
Travel data sets → Controller type: speed controller → Setpoint: positive → Setting of setpoint speed by means of slide control → Setting of torque by means of slide control → Setting of the acceleration and deceleration ramp	First the controller type (speed controller) is to be defined in the ”Travel data sets” menu. Afterwards the speed setpoint is to be set via the ”Speed” slide control, the max. torque of this travel data set via the ”Torque” slide control, and the sign of the setpoint is to be set via the selection ”Setpoint (positive/negative)”. For first commissioning it is advisable to select a small speed setpoint (e. g. 300 rpm) and for safety reasons to select a torque that is settled below the rated torque. Furthermore, the acceleration and deceleration ramps are to be defined. If this information has been given, all required parameters for initial commissioning are set.
↓	
Starting the drive → Press ”Start #0” in the menu bar	For starting the control, either press ”Start #0” in the menu bar, or activate the ”Start button” in the ”Travel data sets” menu. The drive is stopped again by pressing the ”Stop button”. Pressing the ”Stop button” twice results in an immediate standstill of the drive, disregarding the deceleration ramp.

* The settings on the ”Service” tab (current factor, max. motor torque, max. motor speed, brake available, as well as engagement and disengagement time) for 931M drives are already preset by the factory and do not need to be adjusted. These adjustments therefore are only required for 931W drives.

** The controller parameters KN, TN, TV, TA and TL are predefined by the factory so that for most applications a stable system behaviour can be achieved by these settings. For an operating test, they can generally be accepted without an adjustment.

7 Table of keywords

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