

Amplifiersystem

**MGC*plus***

**Press-fit monitoring  
module ML85C**

B0541-5.3 en





---

# Contents

---

## A Introduction

- 1 **Safety instructions** ..... **A-3**
- 2 **Notes on the documentation** ..... **A-9**
- 3 **What does a press-fit monitoring module do?** ..... **A-11**

## B Connecting

- 1 **Inputs and outputs, remotes** ..... **B-3**
  - 1.1 Outputs and AP75 remotes ..... B-3
  - 1.2 AP75 connection board ..... B-4

## C Commissioning

- 1 **Instructions in brief** ..... **C-3**
- 2 **Basic set up of the amplifier** ..... **C-16**
  - 2.1 ML85C press-fit module ..... C-16
  - 2.2 Setting up the “force” and “displacement” measuring amplifiers ..... C-17
- 3 **Evaluation methods** ..... **C-18**
  - 3.1 Tolerance window procedure ..... C-19

<b>4</b>	<b>Setting up measurement parameters</b>	<b>C-20</b>
4.1	System of coordinates	C-20
4.1.1	Setting up the coordinate system	C-26
4.2	Alarm window	C-27
4.3	Range window	C-28
4.4	Thread-in window	C-29
4.5	Fitting window	C-32
4.6	End window and method	C-35
4.7	Transducer test	C-40
4.8	Data acquisition (CP42 only)	C-41
4.9	Printing the press-fit results	C-43
<b>5</b>	<b>PLC link</b>	<b>C-44</b>
5.1	Basic wiring	C-44
5.2	Expansion options for basic wiring	C-47
5.2.1	Online supervision of thread-in process	C-47
5.2.2	Transducer test	C-49
5.2.3	Autocalibration	C-51
5.2.4	Identification of wiring problems	C-53
5.2.5	Zero balance before the press-fit process	C-55
5.2.6	Trigger print task	C-57
5.2.7	Coding windows with errors	C-59
5.2.8	Selecting data sets	C-61
<b>6</b>	<b>Troubleshooting</b>	<b>C-63</b>

---

## D Measure

<b>1</b>	<b>LED display on front panel</b> .....	<b>D-3</b>
1.1	Amplifier plug-in units .....	D-3
1.2	Evaluation channel ML85C .....	D-4
<b>2</b>	<b>AB22A/AB32 in measuring mode</b> .....	<b>D-5</b>
<b>3</b>	<b>Display</b> .....	<b>D-6</b>
3.1	The first display .....	D-6
3.2	Display in measuring mode .....	D-7
3.3	Possible displays .....	D-9
3.3.1	Current values .....	D-9
3.3.2	I/O status .....	D-10
3.3.3	Diagnosis .....	D-11
3.3.4	Transducer test .....	D-12
3.3.5	Force-displacement diagram .....	D-13
3.3.6	Force-time diagram .....	D-15
3.3.7	Displacement-time diagram .....	D-16
<b>4</b>	<b>Statistics</b> .....	<b>D-17</b>
4.1	Statistics: Total .....	D-18
4.2	Statistics: windows .....	D-19
4.3	Statistics: end position .....	D-20
4.4	Calculation formulae .....	D-21

## E Menu structure

<b>1</b>	<b>Measuring mode</b> .....	<b>E-5</b>
<b>2</b>	<b>Setup mode</b> .....	<b>E-13</b>

## F Specifications

1.1	Amplifier modules ML85C .....	F-3
1.2	AP75 connection board .....	F-5

## G Keywords

## H Certificate of conformity

---

# A Introduction

---

ML85C



# 1 Safety instructions

---

Insert the mains plug only into a socket with a protection switch (Protection Class I).

Before you open the device, make sure it is switched off; remove the mains plug from the socket. Never pull the mains plug from the socket by the mains cable. Do not operate the device, if the mains cable is damaged.

If an amplifier module is to be removed, close off the plug-in unit with a blank plate.

The device complies with the safety requirements of DIN EN 61010-Part 1 (VDE 0411-Part 1); Protection Class I.

To ensure adequate immunity from interference, use only *Greenline* shielded ducting (see HBM offprint "*Greenline* shielding design, EMC-compliant measuring cable; G36.35.0)

The insulation resistance of the connecting cables ( $\leq 50$  V) must be a minimum of 350 V (AC).

Battery operation:

When connected to a 12 V battery, there is no potential separation.

To ensure adequate immunity from interference, use only *Greenline* shielded ducting (see HBM offprint "Greenline shielding design, EMC-compliant measuring cable; G36.35.0)

### **Use in accordance with the regulations**

The press-fit controller and its connected transducers are to be used exclusively for measurement tasks and directly related control tasks. Use for any additional purpose shall be deemed to be not in accordance with the regulations.

To ensure safety, only operate the device in accordance with the information given in the Operating Manual. It is also essential to comply with the legal and safety requirements for the application concerned during use. The same applies to the use of accessories.

### **General dangers of failing to follow the safety instructions**

The press-fit controller is a state-of-the-art device and is fail-safe. The device may give rise to residual dangers if it is inappropriately installed and operated by untrained personnel.

Any person instructed to carry out installation, commissioning, maintenance or repair of the device must have read and understood the Operating Manual and in particular the technical safety instructions.

---

### Conditions on site

Protect the desktop and plug-in devices from moisture or atmospheric influences such as rain, snow, etc.

Make sure that the ventilation slots on the side and the power pack ventilation slots on the back of the device are not covered up.

### Maintenance and cleaning

The press-fit controller is maintenance-free. Please note the following points when cleaning the housing:

Withdraw the mains plug from the socket before carrying out any cleaning.

Clean the housing with a soft, slightly damp (not wet!) cloth. **On no account** use solvents, since these may damage the labelling on the front panel.

When cleaning, ensure that no liquid gets into the device or connections.

### Residual dangers

The scope of supply and list of components provided with the press-fit controller only cover part of the scope of measurement technology. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of measurement technology in such a way as to minimize residual dangers. Existing regulations on the subject must be observed. Reference must be made to residual dangers connected with measurement technology.

Any risk of residual dangers when working with the press-fit controller is pointed out in this introduction by means of the following symbols:

Symbol:  **DANGER**

*Meaning:* **Maximum danger level**

Warns of a **decidedly** dangerous situation in which failure to comply with safety requirements **will** lead to death or serious physical injury.

Symbol:  **WARNING**

*Meaning:* **Possibly dangerous situation**

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **can** lead to death or serious physical injury.


Symbol:  **CAUTION**

*Meaning:* **Dangerous situation**

Warns of a possibly dangerous situation in which failure to comply with safety requirements **could** cause damage to property or lead to some form of physical injury.


---

Symbols indicating application notes and useful information:

Symbol: 

## **NOTE**

Means that important information about the product or its handling is being given.

Symbol: 

*Meaning:* CE mark

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC guidelines (see Declaration of conformity at the end of this Operating Manual).

**Working safely**

Error messages must only be acknowledged when the cause of the error has been removed and no further danger exists.

**Conversions and modifications**

The press-fit controller must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any damage resulting therefrom.

In particular, any repair or soldering work on motherboards is prohibited. When exchanging complete modules, use only original parts from HBM.

**Qualified personnel**

This instrument is only to be installed and used by qualified personnel strictly in accordance with the Specifications and with the safety rules and regulations which follow. It is also essential to observe the appropriate legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

Qualified personnel means persons entrusted with the installation, mounting, commissioning and operation of the product who possess the appropriate qualifications for their function.

Maintenance and repair work on an open device with the power on must only be carried out by trained personnel who are aware of the dangers involved.

---

## 2 Notes on the documentation

---

The full documentation for the press-fit controller consists of the following publications:

The ***Operating Manual***

explains how to operate the device manually and use it for taking measurements. If the system device is equipped with the CP22 or CP42 communications processor, there is also a CD-ROM containing the following documentation:

***Operation with computer or terminal,***

contains the commands for programming and measuring with a computer or terminal.

***MGCplus Assistant,***

documentation of the program for assigning parameters and controlling the *MGCplus* measuring amplifier system.

This manual holds all the information you need to operate the ML85C.

There are still more **guidelines** available:

- The *header* tells you which chapter or sub-section you are currently reading.

Example:

Connections → Mains connection . . . . . C-12

- The *page numbering* is combined with capital letters corresponding to the chapter headings.
- Page C-3 (*Control Elements*) explains about the display and the control keys.
- Chapter E (*Menu Structure*) gives you an overview of the selection window and the setup window.

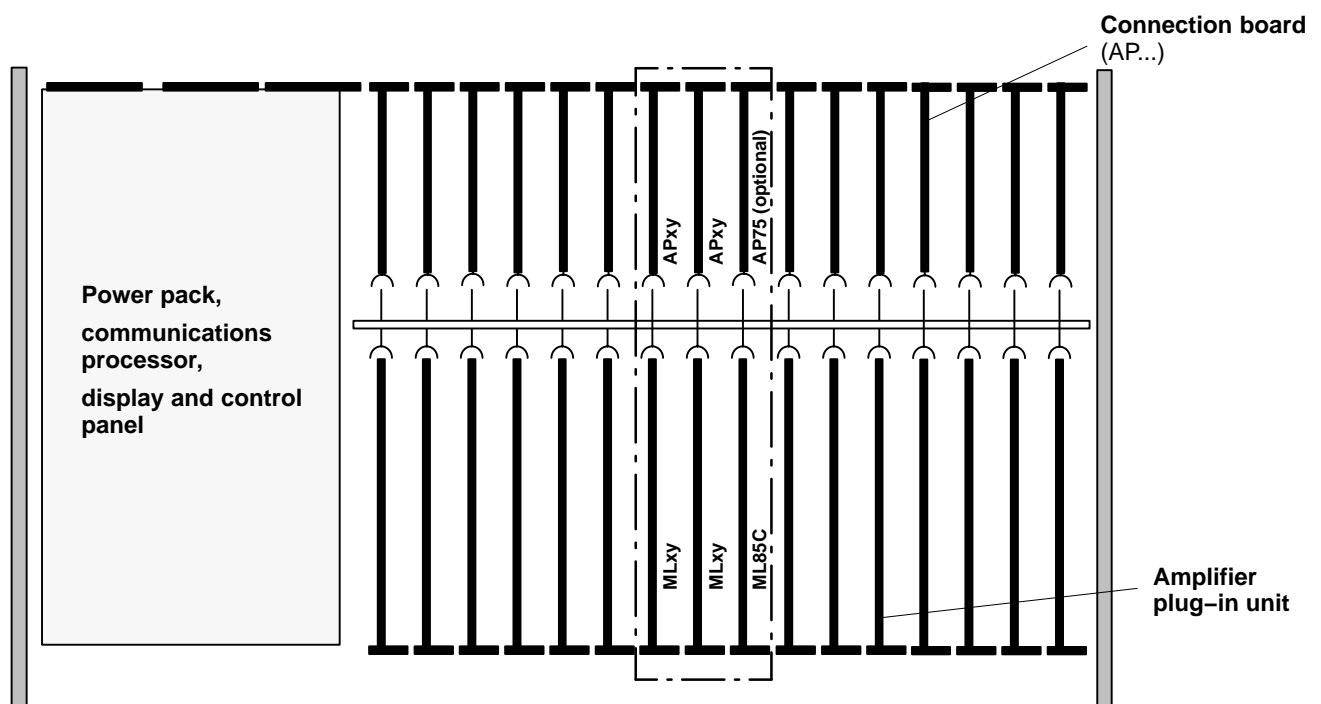


### 3 What does a press-fit monitoring module do?

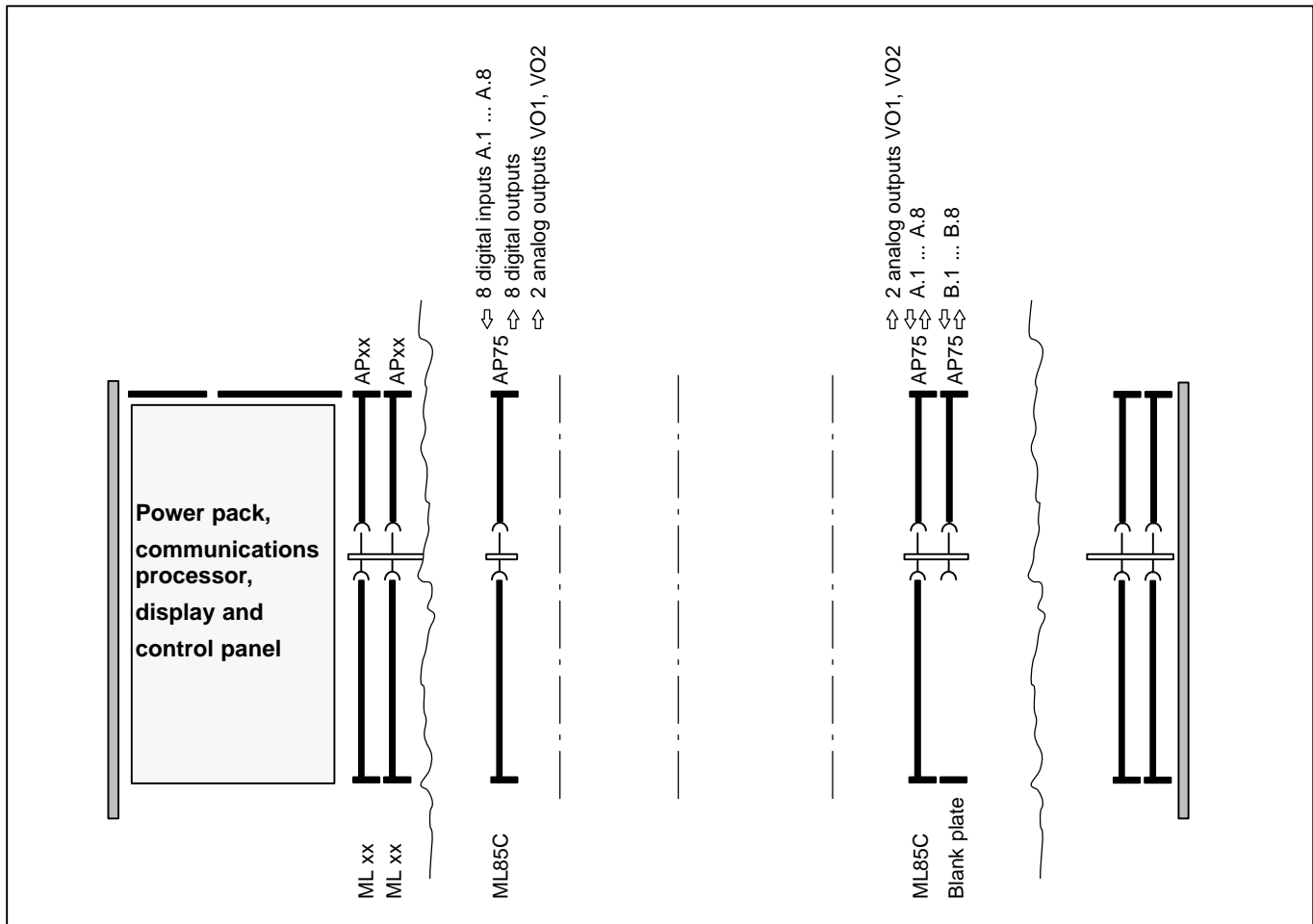
The ML85C press-fit monitoring module was specifically developed to monitor press-fit processes, with the aim being to safeguard quality even during the production process.

The module monitors two physical quantities (e.g. force and displacement) and their relation to one another. The two measured quantities can also be displayed as the functions of time (force-time or displacement-time diagram). The two physical quantities are measured by two single-channel amplifiers (ML01B, ML10B, ..., ML60B), inserted in two adjacent slots of the MGCplus housing. The press-fit monitoring module is installed directly to the right of these two measuring amplifiers.

The two measured quantities are evaluated in so-called "windows" (see also C-18). The size and position of the windows can be changed and the direction in which they operate can be defined.



**Fig.3.1:** ML85C press-fit monitoring module in the MGCplus housing (TG010B)



**Fig.3.2:** Use of one or two AP75 connection boards

If the AP75 connection board is located directly behind the ML85C module, the inputs and the outputs are identified in the set-up menus and in the display by **A**. If they are directly to the right, the numbers of the inputs and outputs are preceded by **B**.

ML85C

---

# B Connecting

---

ML85C

---

# 1 Inputs and outputs, remotes

---

## 1.1 Outputs and AP75 remotes

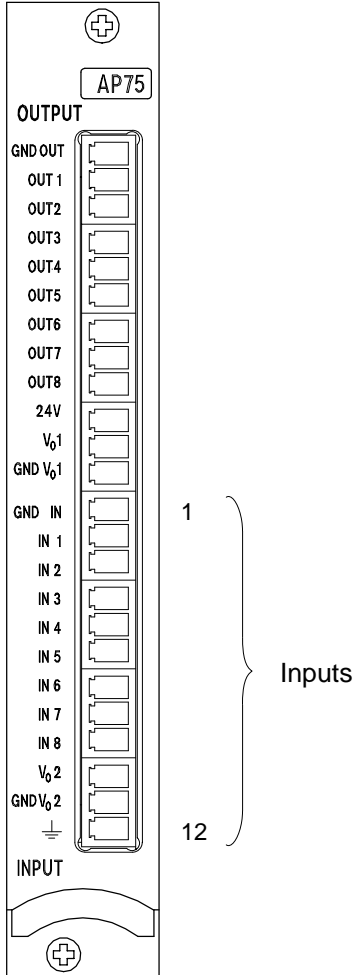
---

The AP75 connection board makes available control inputs and outputs, LIV outputs and a warning output with 24 V levels for direct connection to the I/Os of programmable controllers.

Control inputs and outputs are potential-separated by optical couplers. Digital inputs and outputs have separate grounding systems.

Digital outputs must be supplied by an external voltage source (24 V).



# 1.2 AP75 connection board



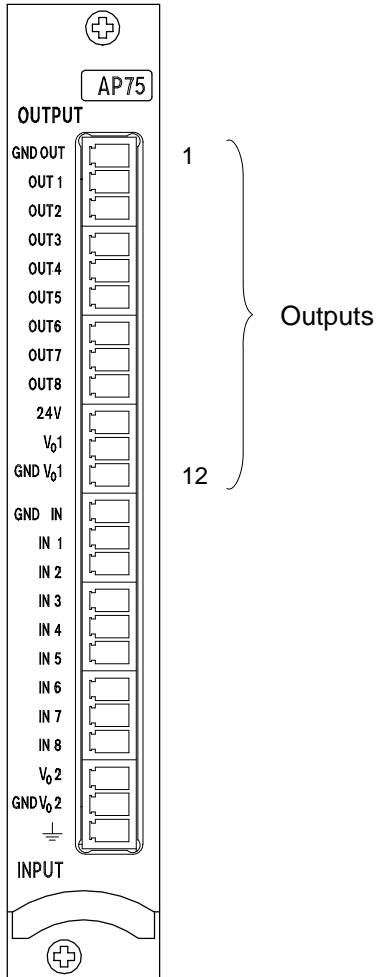
The AP75 connection board has eight digital inputs and eight digital outputs. The inputs and the outputs are individually electrically isolated and have separate grounding systems (GND OUT: ground for outputs; GND IN: ground for inputs). The outputs of the connection plate can be programmed with any function.

**Terminals marked  $V_{O1}$  and  $V_{O2}$  are not used in conjunction with the ML85C press-fit module!**

### Inputs

Terminal <sup>*)</sup>	Labeling	Function
GND IN	GND IN	Ground input
AP-A: IN 1	START	Measuring Start/Stop
AP-A: IN 2	P1	Switch data set ( $2^0$ )
AP-A: IN 3	P2	Switch data set ( $2^1$ )
AP-A: IN 4	P4	Switch data set ( $2^2$ )
AP-A: IN 5	PRINT	Trigger print task
AP-A: IN 6	CHECK	Activate transducer check
AP-A: IN 7	CLR	Clear statistics buffer
AP-A: IN 8	CAL	Trigger internal calibration
AP-B: IN 1	F-0	Set the force zero point
AP-B: IN 2	S-0	Set the displacement zero point
GND $V_{O2}$	GND $V_{O2}$	No function
		Housing ground

<sup>\*)</sup> **CAUTION:** The assignment depends on the mounting position A/B of the connection board. (see Fig.3.2)



**Outputs**

Terminal <sup>*)</sup>	Labeling	Function
GND OUT	GND OUT	Ground output
AP-A: OUT1	BUSY	BUSY
AP-A: OUT2	NOK	NOK message (summation message)
AP-A: OUT3	OK	OK message (summation message)
AP-A: OUT4	/ALARM	Alarm window for force or displacement overshoot or incorrect measured value (overload, calibration error, other error)
AP-A: OUT5	/WARN	Error message (Warning from amplifier channels), EEPROM checksum error
AP-A: OUT6	/THR	Force overshoot, thread-in window on-line
AP-A: OUT7	No1	In the event of a NOK message, the number of the defective window is specified in binary code by No1 ... No8. If a number of windows are affected, error number 15 is displayed.
AP-A: OUT8	No2	
AP-B: OUT1	No4	
AP-B: OUT2	No8	
V <sub>O1</sub>	V <sub>O1</sub>	No function
GNDV <sub>O1</sub>	GNDV <sub>O1</sub>	No function

<sup>\*)</sup> **CAUTION:** The assignment depends on the mounting position A/B of the connection board. (see Fig.3.2)

ML85C



---

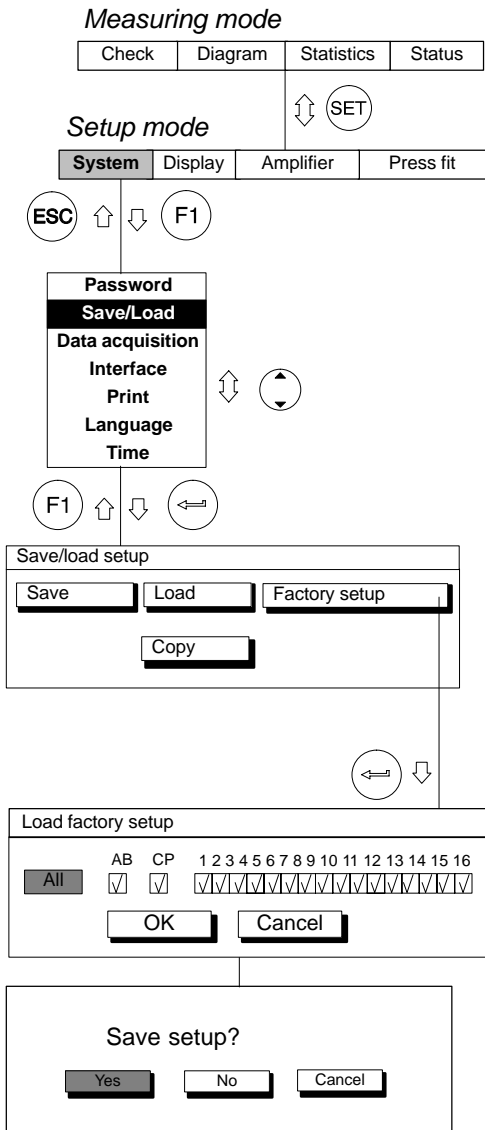
# C Commissioning

---

ML85C

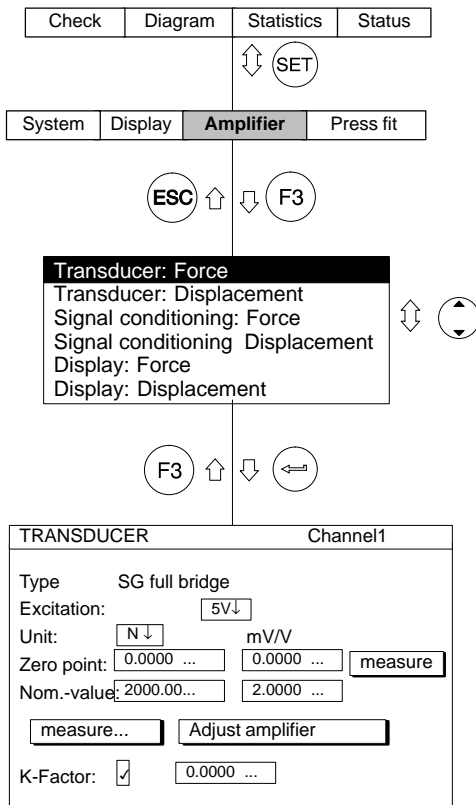
# 1 Instructions in brief

This section describes the major settings which will help the first-time user to start taking successful measurements quickly.



## 1. Call factory setup

- Using the channel selection keys, select the ML85C channel you want.
  - Use the shift key **SET** to return to setup mode.
  - Press **F1** (System)
  - Use to select "Save/Load" and confirm with .
- You are now in the "Save/Load Setup" setup menu.
- Use to select the "Factory Setup" button and confirm with .
  - Use to select the "All" button and confirm with (✓ will appear in all the activation fields).
  - Use to select the "OK" button and confirm with .
  - Press the shift key **SET** and confirm the security prompt with .



## 2. Setting up transducers

### Example:

(data from data sheet or from the identification plate of the transducer)

Force transducer: 2 mV/V  $\cong$  2 kN ( $\cong$  2000 N)

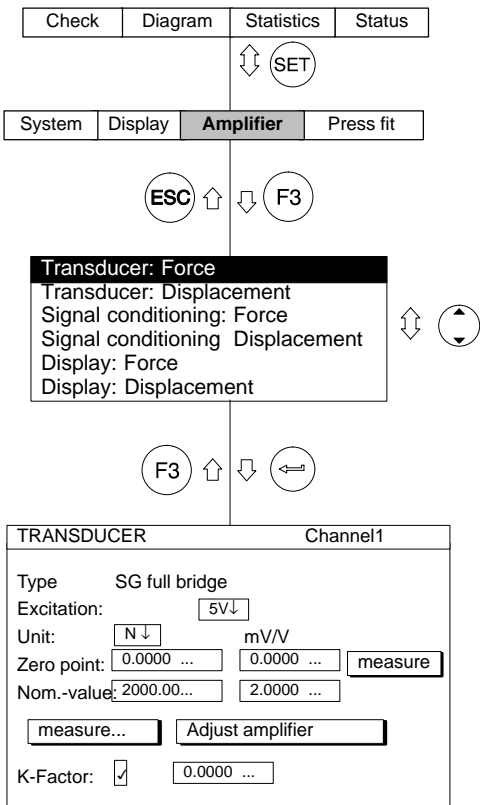
Transducer type: SG full bridge

Displacement transducer: 80 mV/V  $\cong$  50 mm

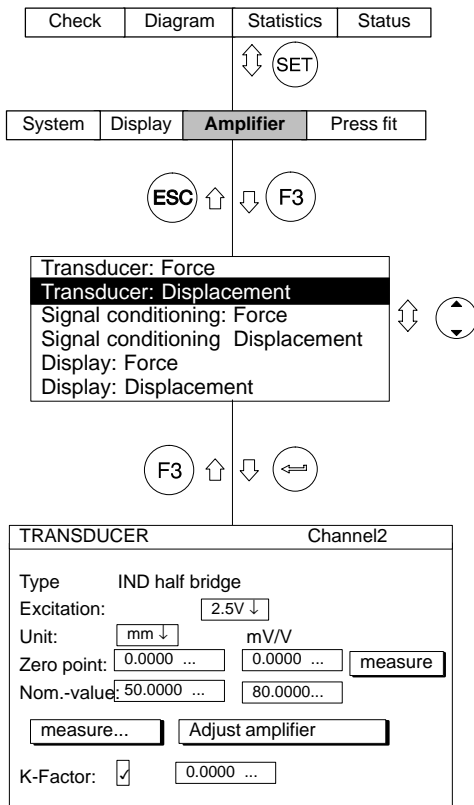
Transducer type: inductive half bridge

Setting up the force channel:

1. Unload the transducer.
2. Use the shift key (SET) to go to setup mode
3. Press (F3) (amplifier).
4. Use (down arrow) to select "Transducer: Force" and confirm with (right arrow).
5. Use (up/down arrow) to select "SG full bridge" and confirm with (right arrow).
6. Use (up/down arrow) to switch to the "Excitation" selection field, press (right arrow) and select 5 V.
7. Confirm this choice with (right arrow).
8. Use (up/down arrow) to switch to the "Unit" selection field and press (right arrow). Select unit "N" and confirm with (right arrow).

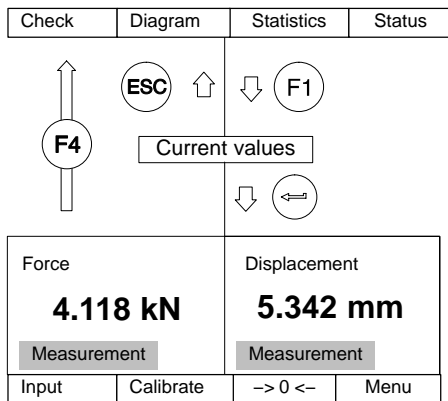


9. Use to switch to the "Zero point" edit field and in the **left-hand** edit field, enter the value "0". Confirm this choice with .
10. Use to select the **Measurement** button in the "Zero point" line and confirm with .
11. Use to select the input box in the "Nom.-value" line and confirm with .
12. Enter the value "2000" in the left-hand "Nom.-value" edit field.
13. In the right-hand "Nom.-value" edit field, enter the value "2" (below the unit mV/V).
14. Use to select **Adjust amplifier** and confirm with .



### Setting up the displacement channel:

1. Put the transducer to the zero position.
2. Press **(F3)** (amplifier).
3. Use **(↓)** to select "Transducer: Displacement" and confirm with **(←)**.
4. Use **(↕)** to select "IND half bridge" and confirm with **(←)**.
5. Use **(↕)** to switch to the "Excitation" selection field, press **(←)** and select 2.5V.
6. Confirm this choice with **(←)**.
7. Use **(↕)** to switch to the "Unit" selection field and press **(←)**. Select unit "mm" and confirm with **(←)**.
8. Use **(↕)** to switch to the "Zero point" edit field and in the **left-hand** edit field, enter the value "0". Confirm this choice with **(←)**.
9. Use **(↕)** to select the **Measurement** button in the "Zero point" line and confirm with **(←)**.
10. Use **(↕)** to select the input box in the "Nom.-value" line and confirm with **(←)**.
11. In the left-hand "Nom.-value" edit field, enter the value "50" (the nominal displacement of the transducer).
12. In the right-hand "Nom.-value" edit field, enter the value "80" (below the unit mV/V, the sensitivity of the transducer).
13. Use **(↕)** to select **Adjust amplifier** and confirm with **(←)**.



### 3. Checking transducer settings

1. Press **F1** (Service).
2. Use to select "Current values" and confirm with .
3. Load the transducer with a known force.
4. Simulate a known displacement.

Verify the measured values displayed against reference values. If there is significant deviation check the transducer settings, the installation and the wiring.

5. Exit from the menu using **F4** (Menu)

Check	Diagram	Statistics	Status								
↑↓ (SET)											
System	Display	Amplifier	Press fit								
(ESC) ↑ ↓ (F4)											
<table border="1"> <tr><td>Coordinates</td></tr> <tr><td><b>Range window</b></td></tr> <tr><td>Alarm window</td></tr> <tr><td>Thread-in window</td></tr> <tr><td>Fitting window</td></tr> <tr><td>End window + method</td></tr> <tr><td>Transducer test</td></tr> <tr><td>Version</td></tr> </table>				Coordinates	<b>Range window</b>	Alarm window	Thread-in window	Fitting window	End window + method	Transducer test	Version
Coordinates											
<b>Range window</b>											
Alarm window											
Thread-in window											
Fitting window											
End window + method											
Transducer test											
Version											
(F4) ↑ ↓ (←)											
Range window		Channel3									
F: min.	<input type="text" value="60..."/>	max.	<input type="text" value="1800..."/> N								
s: left	<input type="text" value="-25..."/>	right	<input type="text" value="25.00..."/> mm								
<input type="text" value="Data acquisition..."/>											
<input type="button" value="OK"/>		<input type="button" value="Cancel"/>									

#### 4. Setting up the range window

The range window defines the area in the force-displacement diagram within which the curve of the press-fit task will be contained.

1. Press (F1) (Service).
2. Use (↓) to select "Current values" and confirm with (←).
3. Read off displacement coordinates of the start and end position.
4. Press (F4) (Menu) to exit from the dialog.

Now call up the coordinates of the range window:

5. Press (SET).
6. Press (F4) (press fit).
7. Use (↓) to select "Range window" and confirm with (←).



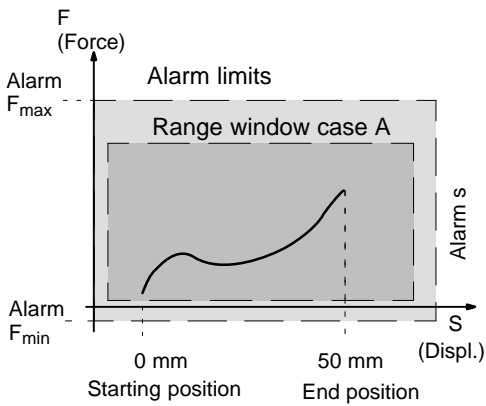
Continue with case A or case B depending on the start and end position:

Range window		Channel3	
F: min.	<input type="text" value="0.0..."/>	max.	<input type="text" value="2000..."/>
s: left	<input type="text" value="0.0..."/>	right	<input type="text" value="50.00..."/>
<input type="button" value="Data acquisition..."/>			
<input type="button" value="OK"/>		<input type="button" value="Cancel"/>	

**Case A: start position < end position**

The following criteria must be met

1. start position > range window coordinate s: left
2. end position > range window coordinate s: right
3.  $F_{min} < \text{expected force throughout the process} < F_{max}$



If one of the above criteria is not met, change the coordinates of the range window:

1. Use to select the corresponding editing field, press , , enter the new value and confirm with .
2. Use to select  and confirm with .
3. Press the shift key and confirm the security prompt with .

Continue with step 5 (First measurement curve, C-12).

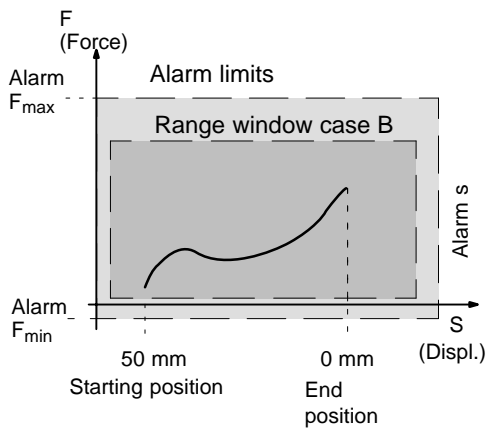
Range window		Channel3	
F: min.	<input type="text" value="0.0..."/>	max.	<input type="text" value="2000..."/> N
s: left	<input type="text" value="50.0..."/>	right	<input type="text" value="0.0..."/> mm
<input type="button" value="Data acquisition..."/>			
<input type="button" value="OK"/>		<input type="button" value="Cancel"/>	

### Case B: start position > end position

In this case the coordinates of the range window and the alarm limits need to be changed.

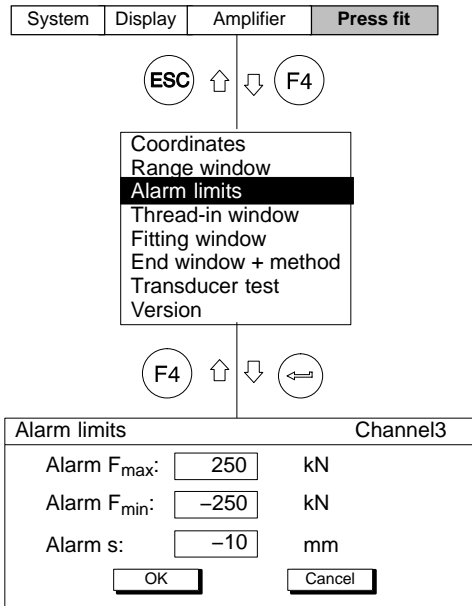
The coordinates of the range window **must** satisfy the following criteria:

1. start position < range window coordinate s: left
2. end position > range window coordinate s: right
3.  $F_{min} < \text{expected force throughout the process} < F_{max}$



If one of the above criteria is not met, change the coordinates of the range window:

1. Use  $\left(\begin{smallmatrix} \uparrow \\ \downarrow \\ \leftarrow \\ \rightarrow \end{smallmatrix}\right)$  to select the corresponding editing field, press  $\left(\leftarrow\right)$ ,  $\left(\text{CE}\right)$ , enter the new value and confirm with  $\left(\leftarrow\right)$ .
2. Use  $\left(\downarrow\right)$  to select  and confirm with  $\left(\leftarrow\right)$ .





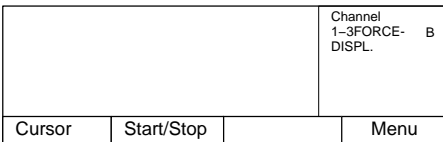
The displacement alarm limit must be less than or equal to the right-hand displacement coordinate of the range window (s right).

Change alarm limits:




1. Press **F4** (amplifier).
2. Use  $\downarrow$  to select "Alarm limits" and confirm with  $\leftarrow$ .
3. Use  $\downarrow$  to select the editing field "Alarm s", press  $\leftarrow$ , **CE**, enter the new value and confirm with  $\leftarrow$ .
4. Use  $\downarrow$  to select **OK** and confirm with  $\leftarrow$ .
5. Press the shift key **SET** and confirm the security prompt with  $\leftarrow$ .

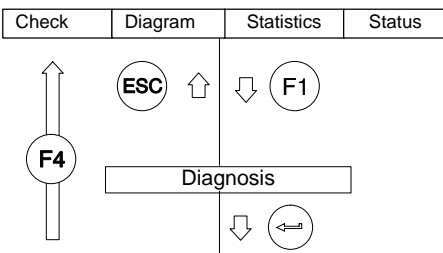
**5. Record first measurement curve of a press-fit process**

1. Press **F2** (Diagram).
2. Use  to select "Force - displ." and confirm with .
3. Start the measurement using **F2** (Start/Stop). Your press-fit task must take place within the next 10 seconds.
4. Press **F2** to end the measurement. The measurement curve should now appear in the display.





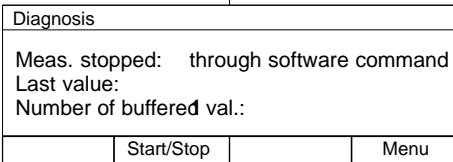
If no curve appears in the display this may be for the following reasons:

- The displacement direction is incorrect  repeat step 4.
- The max. measurement duration (factory setting 10 s) has been exceeded  change measurement duration (see page C-35).
- Change in force or displacement is too small in relation to the measuring range  change measuring range (see page C-28ff).

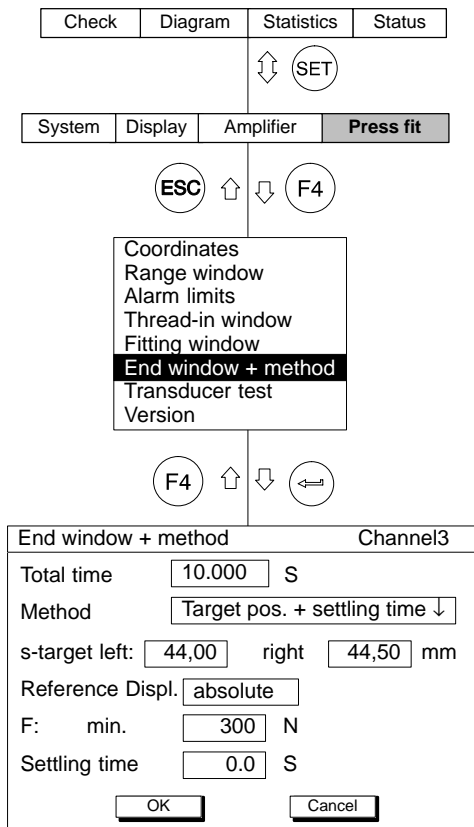


Further information on possible faults is available through the "Diagnosis" function:

1. Press **F4** (Menu) and then **F1** (Service).
2. Use  to select "Diagnosis" and confirm with .
3. Exit from the menu using **F4** (Menu)



Only go on to step 6 if a curve is displayed.



## 6. Analyze curve

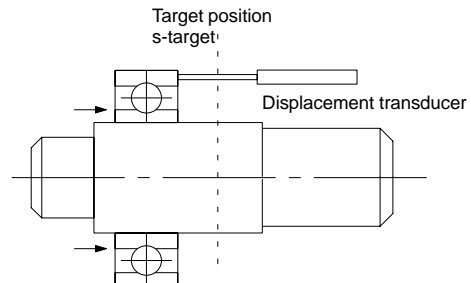
1. Press **F1** (Cursor)
2. Use the cursor keys **←** **→** to read the measured values.
3. Use **F2** and **F3** to enlarge the curve in the display.
4. Note important points (end position, end force, ...).

The further step are described only in principle, since they depend on the application.

## 7. Select evaluation method, define end window



4 methods are available for different applications for automatic recognition of the end of the press-fit task (see page C-35). Enter the method and end window coordinates.

**Example:** Press-fitting a bearing with displacement monitoring



## 8. Check method and window coordinates

After setting the end window and the method the measurement should be ended by the press-fit module automatically.



Start measurement recording as in step 5.. In measuring mode **F2** (Diagram) and use  to select "Force - displ.", then .

Use **F2** to start the measurement (the message "measure" will appear in the display), then start the press-fit task.

In a normal process the data acquisition of measured values will be ended automatically when the end criterion is met. The message "End" will appear in the display.

If this measurement did not go as expected:

you will find a description of the possible causes in the "Diagnosis" function:

1. Press **F4** (Menu) and then **F1** (Service).
2. Use  to select "Diagnosis" and confirm with .
3. Exit from the menu using **F4**.

## 9. Define fitting window, thread-in window

A curve analysis and the defaults from Design/Quality form the basis of the specification of the critical ranges in the curve. For the window settings see page C-29ff.

---

## 10. Setting up alarm limits

The alarm limits are designed to protect the transducer and the machine from overload. For setting the limits see page C-27ff.

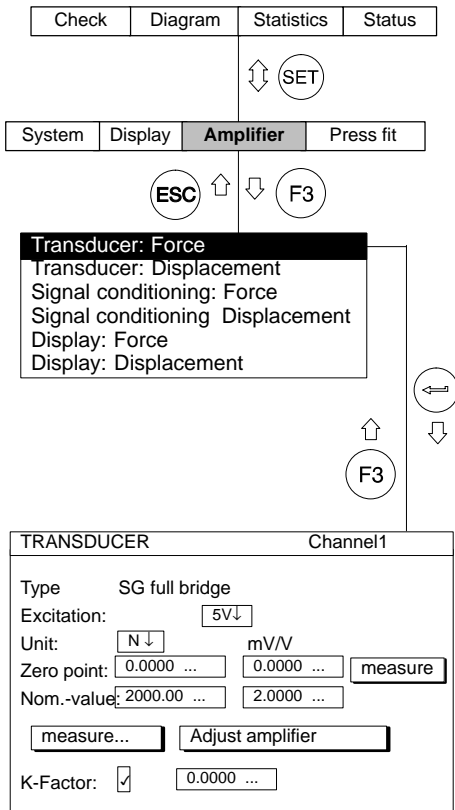
## 11. Connect PLC I/Os

For wiring diagrams see page C-44.

## 12. Test automatic mode

## 2 Basic set up of the amplifier

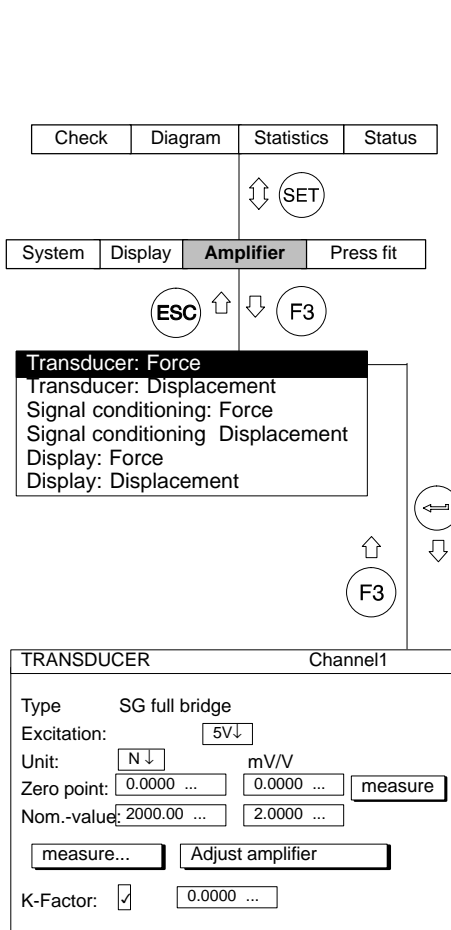
### 2.1 ML85C press-fit module



1. Use shift key (SET) to choose setup mode.
2. If necessary, set up the language preferred for the menus in the system settings.
3. Setting up the display (scope of display, step, decimal point)
4. After setting up the force channel and displacement channel, use shift key (SET) to return to measuring mode.
5. Use the shift key (SET) to switch to measuring mode and confirm the safeguard question with (←).



## 2.2 Setting up the “force” and “displacement” measuring amplifiers



- 1 Use shift key **SET** to choose setup mode.
- 2 After selecting “force transducer” or “displacement transducer”, the menus for both single-channel measuring amplifiers appear on the left of the press-fit monitoring module. Further details of the available setup options can be found in the Operating Manual “MGCplus with AB22A/AB32”. The same applies to the “Conditioning” menus.
- 3 After setting up the force channel and displacement channel, use shift key **SET** to return to measuring mode.

### 3 Evaluation methods

---

The two measured physical quantities are displayed in the x–y diagram. A check is made to establish whether the resultant curve lies within the square window specified by the user.

For example, the two measured physical quantities could be:

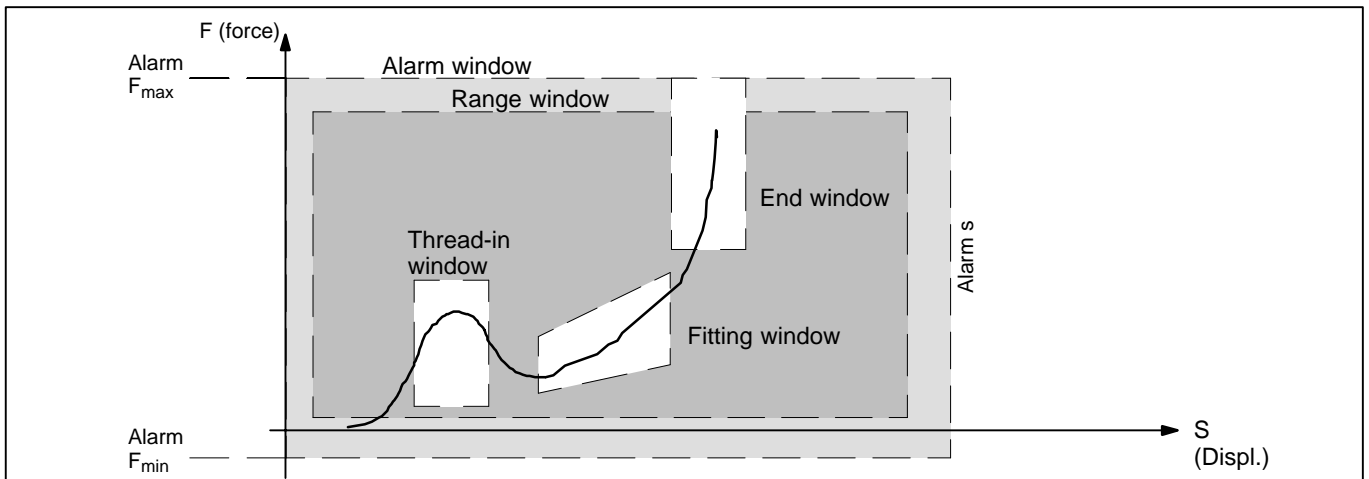
- force/displacement
- torque/angle of rotation
- force/angle of rotation

In most applications, the physical quantities of force/displacement are evaluated. The implementations below therefore relate to these two physical quantities, although this does not stop them being generally applicable.

## 3.1 Tolerance window procedure

First define a range (i.e. the "Window") in the x-y diagram within which, for example the force-displacement trend will be measured. You have the option to define up to 8 tolerance windows for force and displacement tolerance ranges. In particular these are:

- 1 Alarm limits Limits at which an alarm will be triggered. This window is used for the protection of the motor.
- 1 range window defines the overall range of the force-displacement diagram within which all other tolerance windows lie.
- 1 thread-in window for evaluating the alignment phase, which is when the insertion pieces are initially brought into contact and aligned.
- 1 ... 6 fitting windows for evaluating the press-fit process.
- 1 end window for evaluating the end phase of the press-fit process and terminating measurement.



**Fig. 3.1:** Force-displacement diagram; tolerance window

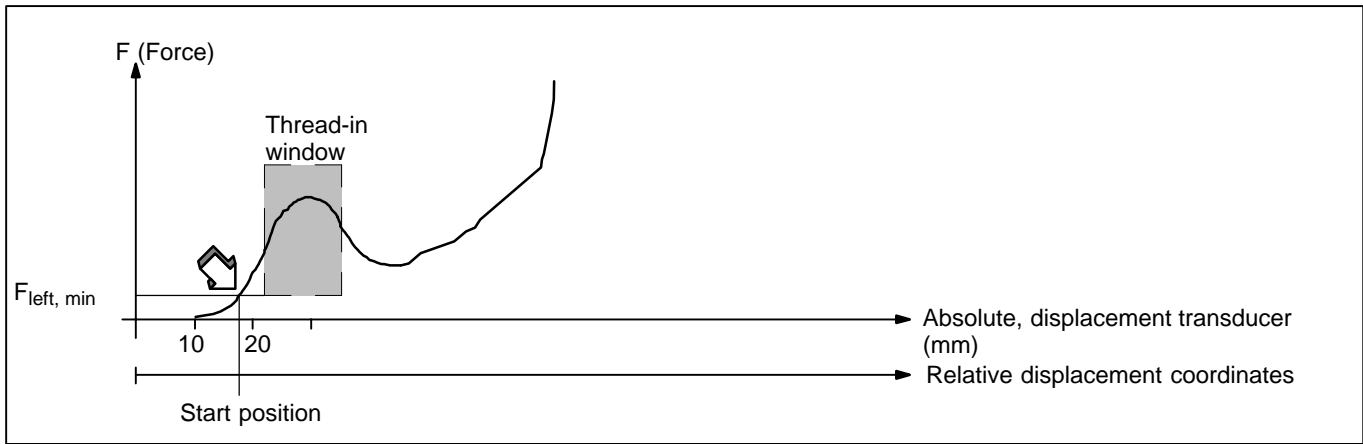
## 4 Setting up measurement parameters

### 4.1 System of coordinates

The displacement coordinates in the force-displacement diagram can be entered in absolute or relative terms. Relative displacement is specified in relation to either a start position (Fig. 4.1) or an end position (Fig. 4.3).

#### **Relative window, relative to start position**

The start position for the relative reference of the displacement coordinates is defined by undershooting the minimum force value for the thread-in window. The start position is located at the point where the minimum force value for the thread-in window is undershot (🏠).



**Fig. 4.1:** Specified displacement relative to start position

#### **Start position**

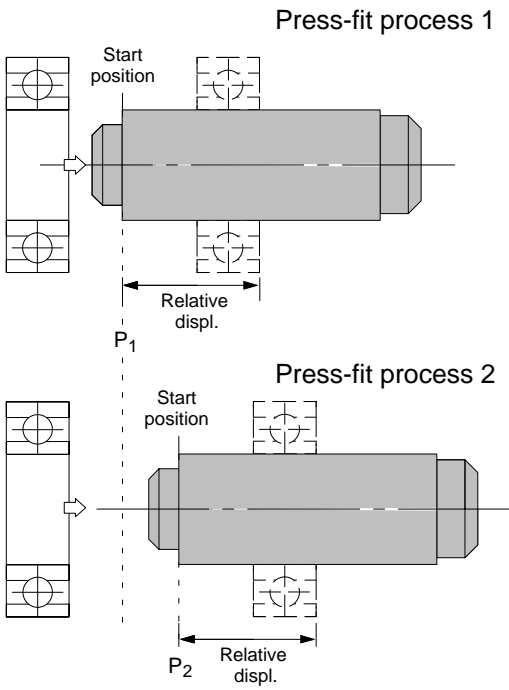
Reference point for the relative coordinate system

#### **Display of values in absolute terms**

Measured values are displayed in absolute terms (as defined by calibration of the displacement transducer).

#### **Display of values in relative terms**

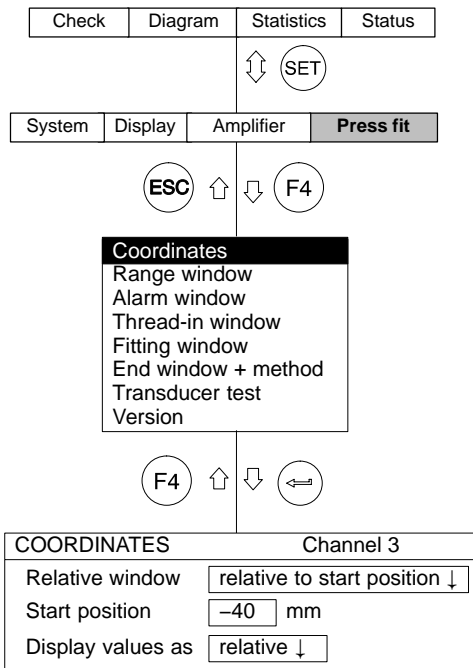
Measured values are displayed relative to the start position.



Press-fit process 1

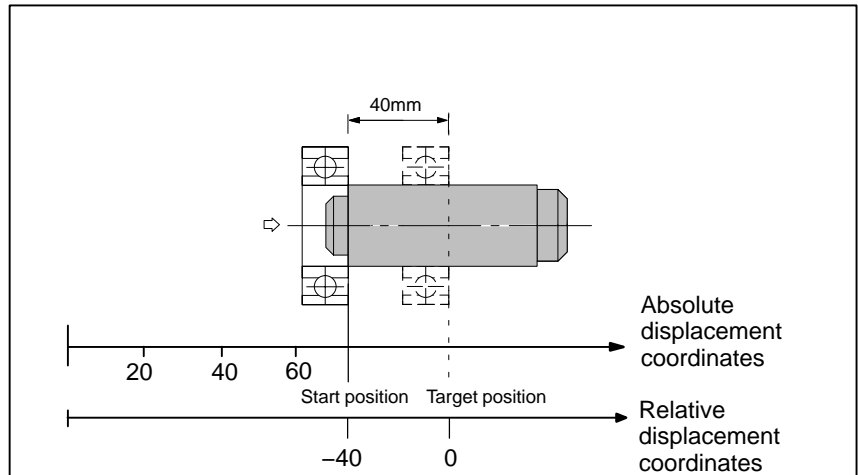
The relative system of coordinates is used when the absolute position of the insertion pieces (bearing/shaft) is not always consistent ( $P_1/P_2$ ). In the case of relative displacement coordinates, only the relative movement of the two insertion pieces from the start position is measured, making the process independent of their absolute position.

Press-fit process 2



**Example:**

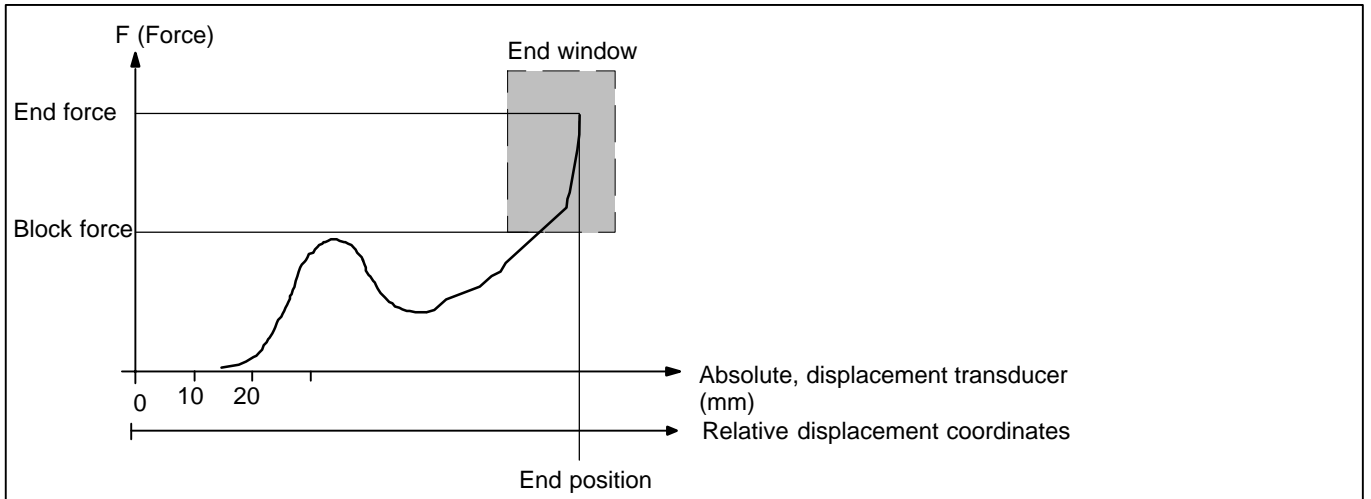
Press-fitting a bearing onto a shaft. The target position is reached at 40mm from the left-hand chamfer of the shaft. When the target position is reached, the display should show the value zero.



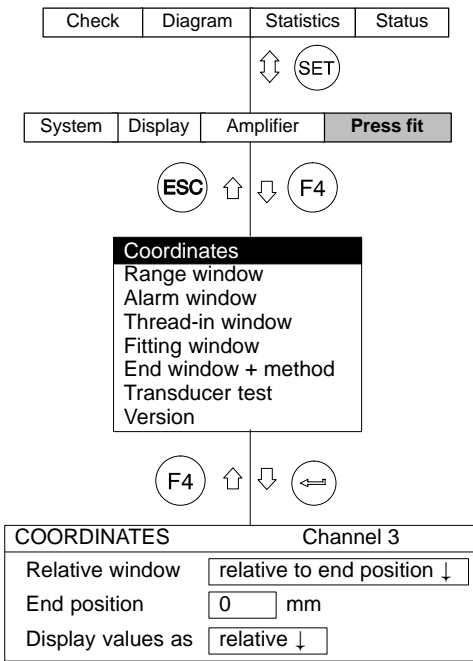
**Fig. 4.2:** Specified displacement relative to start position

**Relative window relative to end position**

The end position for the relative reference is defined by the last recorded displacement coordinates.

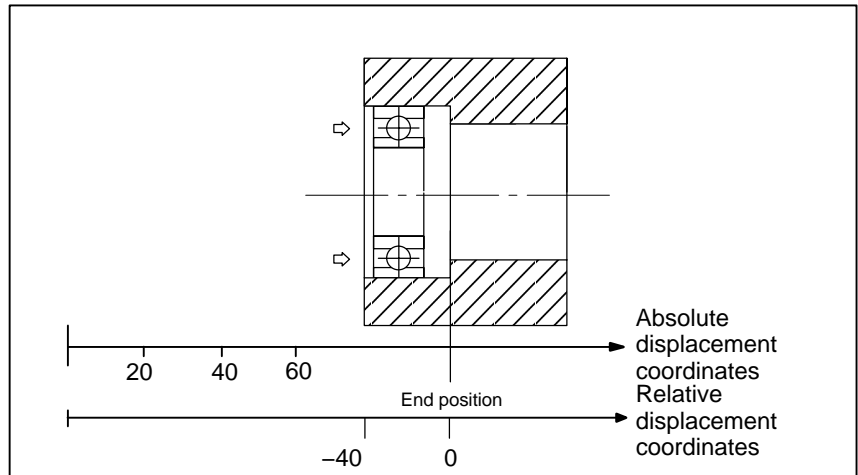


**Fig. 4.3:** Specified displacement relative to end position



**Example:**

Press-fitting a bearing into a hole. The end position is 40 mm from the left-hand edge of the hole. When the end position is reached, the display should show the value zero.

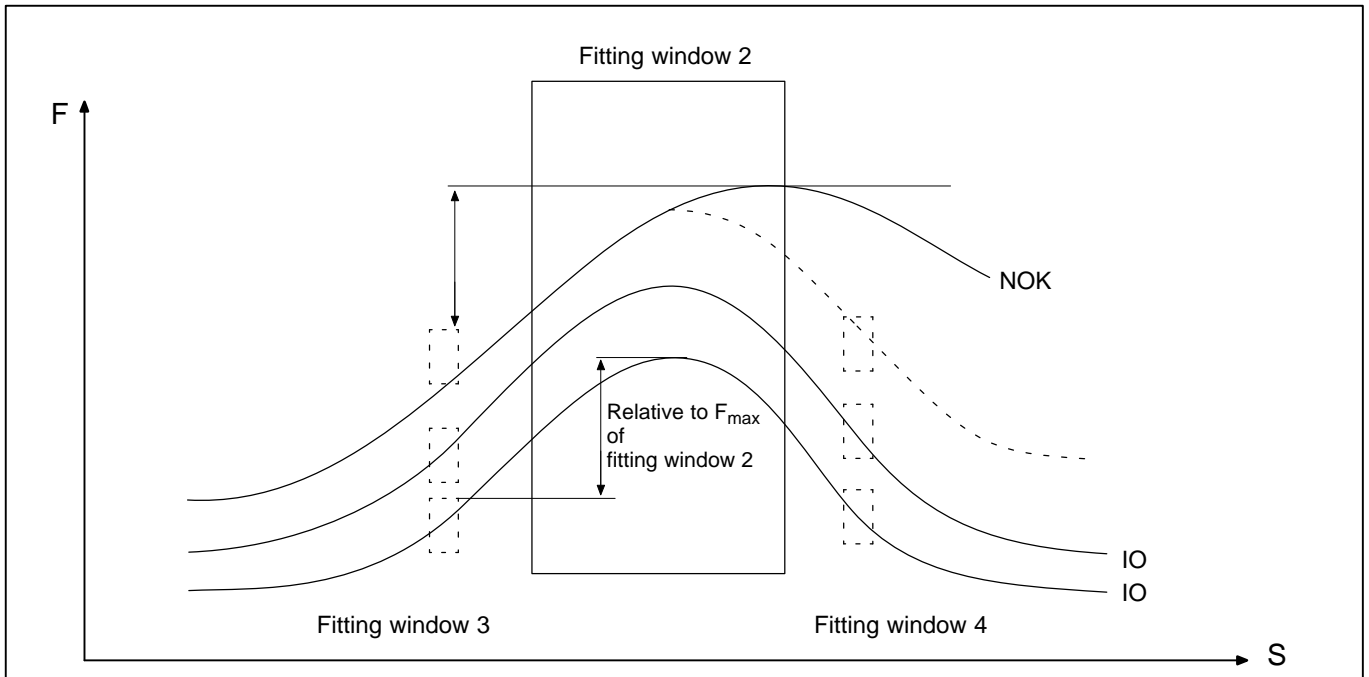


**Fig. 4.4:** Specified displacement relative to end position



### Evaluation of curves with force-relative windows

Example: locking lever for steering column adjustment



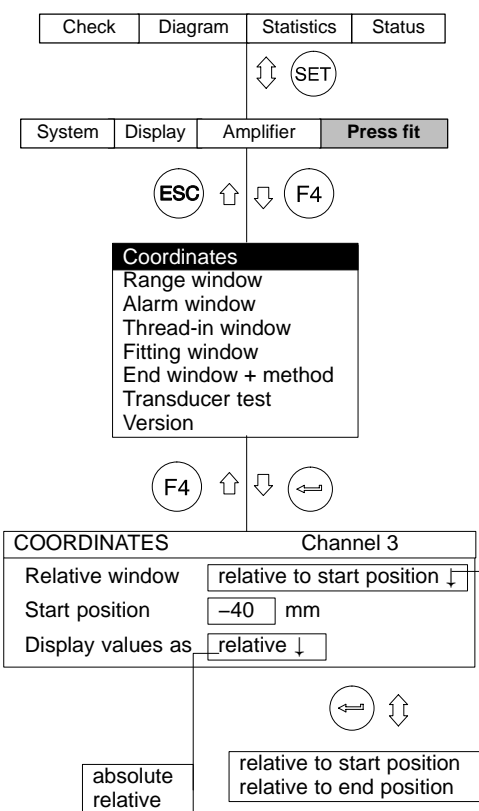
Fitting window 2 is defined absolutely.

Fitting window 3 is defined relative to  $F_{\max}$  or  $F_{\min}$  of fitting window 2

Fitting window 4 is defined relative to  $F_{\max}$  or  $F_{\min}$  of fitting window 2

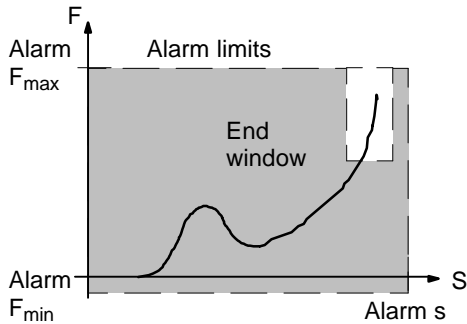
In such a "clamping process" it is important that the force increases evenly, reaches a maximum value (which is within a defined tolerance range) and then drops off again (engagement position). To evaluate this process, fitting windows 3 and 4 are defined relative to  $F_{\max}$  or  $F_{\min}$  of fitting window 2. The same curve shape is then always evaluated.

## 4.1.1 Setting up the coordinate system



1. Use the shift key **SET** to return to setup mode.
2. Press **F4**.
3. Use the cursor keys **↕** to select "Coordinates" from the pull-up menu and confirm with **←**.
4. Select the required settings from the selection fields and confirm each one with **←**.
5. Enter the required values in the "Start position" ("End position") edit field and confirm with **←**.
6. Use **F4** to return to the pull-up menu.
7. Use the shift key **SET** to switch to measuring mode.
8. Confirm the security prompt with **←**.

## 4.2 Alarm window

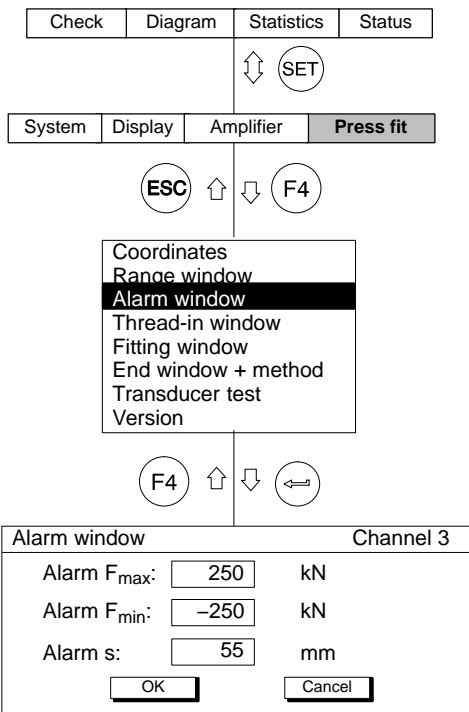


### Alarm window

The alarm window is monitored continuously and quite independently of the progress of any measurement run. If the set limit values ( $F_{max}$ ,  $F_{min}$ ,  $s_{right}$ ) are exceeded, this triggers a signal at the output from the AP75 connection board (/ALARM), and the current measurement run is interrupted (alarm triggered to protect the press-fit machine). The alarm output is reset by the next start (0→1).

The alarm limits define the furthest limits of the end window.

### Setting up alarm limits



### Setting up alarm limits

1. Use the shift key **SET** to return to setup mode.
2. Press **F4**.
3. Use the cursor keys  $\leftarrow \rightarrow$  to select "Alarm window" from the pull-up menu and confirm with  $\leftarrow$ .
4. Enter the required values in the edit fields and confirm with  $\leftarrow$ .
5. Use **OK** to return to the pull-up menu.
6. Use the shift key **SET** to switch to measuring mode.
7. Confirm the security prompt with  $\leftarrow$ .

# 4.3 Range window



Check	Diagram	Statistics	Status
↑↓ (SET)			
System	Display	Amplifier	Press fit
(ESC) ↑		↓ (F4)	
<div style="border: 1px solid black; padding: 2px;">                 Coordinates  <b>Range window</b>                  Alarm window                  Thread-in window                  Fitting window                  End window + method                  Transducer test                  Version             </div>			
(F4) ↑		↓ (←)	
Range window Channel 3 F: min. <input type="text" value="60..."/> max. <input type="text" value="300..."/> N s: left <input type="text" value="-25..."/> right <input type="text" value="50.00..."/> mm		Data acquisition... <input type="button" value="OK"/> <input type="button" value="Cancel"/>	
Data acquisition Channel 3 Store values at ΔF > <input type="text" value="0,9"/> % of the range window or Δs > <input type="text" value="0,5"/> % of the range window			
<input type="button" value="OK"/> <input type="button" value="Cancel"/>			

## Range window

Use the range window to define the range of the force-displacement diagram; the thread-in window and the fitting window must lie within this range. The range window is a rectangular window with 4 coordinates ( $F_{min}$ ,  $F_{max}$ ,  $S_{left}$ ,  $S_{right}$ ). These four coordinates define the scaling for the display.

## Data acquisition

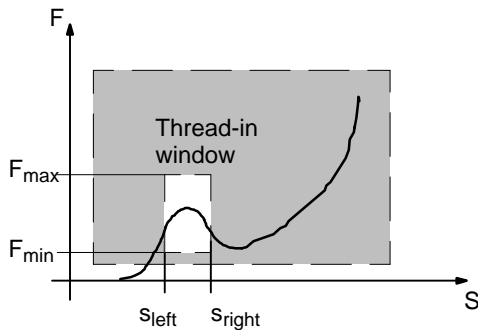
The ML85C can store up to 750 measured triple values (force, displacement, time). The measuring channels are scanned at 2400 Hz, but a new measurement point is only stored if the change in force or displacement exceeds a specified threshold value. This threshold value is specified as a % of the range window.

Enter the change (as a % of the range window) from which measurement values are to be stored. Since a rounding process is applied, the value displayed may vary by 0.1 % from the value entered.

## Setting up the range window

1. Use the shift key (SET) to return to setup mode.
2. Press (F4) .
3. Use the cursor keys (↕) to select "Range window" from the pull-up menu and confirm with (←) .
4. Enter the required values in the edit fields and confirm with (←) .
5. Use (OK) to return to the pull-up menu.
6. Use the shift key (SET) to switch to measuring mode.
7. Confirm the security prompt with (←) .

## 4.4 Thread-in window



### Thread-in window

Use the thread-in window to define the range of the force-displacement diagram which is intended to supervise the fitting process for the insertion pieces. The thread-in window is a rectangular window with 4 coordinates ( $F_{min}$ ,  $F_{max}$ ,  $S_{left}$ ,  $S_{right}$ ). These must always be entered as **absolute** coordinates.

The specified range of values is supervised online whilst measurement is in progress. Overshooting  $F_{max}$  in the range  $S_{left}$ ,  $S_{right}$  activates output THR (0 V) on the AP75 connection board in the course of the press-fit cycle.

You may switch the thread-in window on or off via Enable.

### Enable

"Yes" switches the thread-in window on, "No" switches it off.

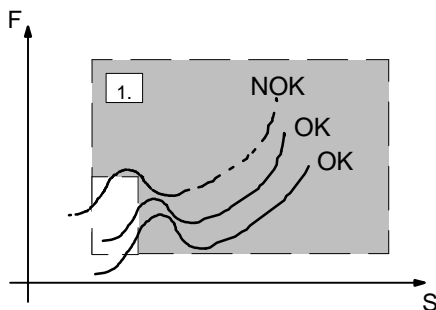
### Online evaluation

Displacement coordinates always refer to the absolute coordinate system, since this is the only system that can be evaluated online.

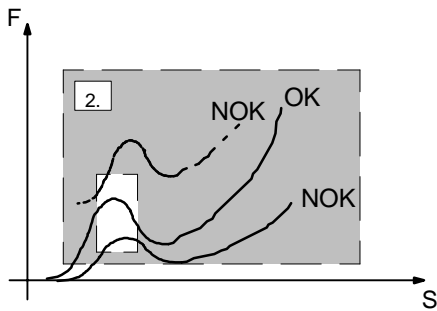
### Offline evaluation

In addition to online evaluation of the thread-in window, an offline evaluation is also carried out (when the press-fit task has ended). There are two possible situations giving rise to an OK:

1. Lower left-hand corner of range window and thread-in window coincide:

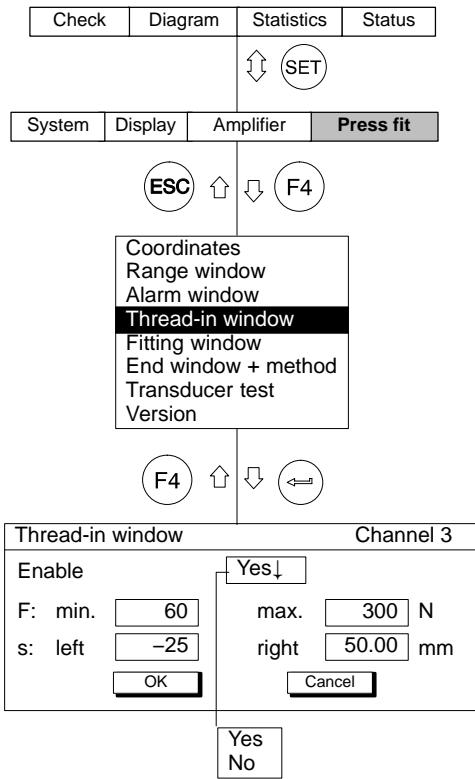


The window is evaluated as OK if the force trend does not touch or overshoot the upper border of the window. The force trend may enter from the left or from below, or start in the window itself.



2. Lower left-hand corner of range window and thread-in window do **not** coincide:

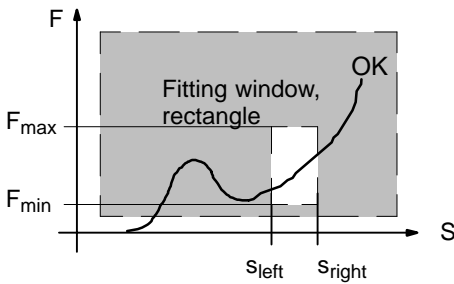
The window is pronounced OK if the characteristic curve enters the window from the left and exits the window from the right. Within the window, the trend line may not touch the upper or lower border.



### Setting up the thread-in window

1. Use the shift key **SET** to return to setup mode.
  2. Press **F4**.
  3. Use the cursor keys  $\left(\begin{smallmatrix} \uparrow \\ \downarrow \\ \leftarrow \\ \rightarrow \end{smallmatrix}\right)$  to select "Thread-in window" from the pull-up menu and confirm with  $\left(\leftarrow\right)$ .
  4. Enable/disable the thread-in window with the "Enable" selection field and confirm with  $\left(\leftarrow\right)$ .
  5. Enter the required values in the edit fields and confirm with  $\left(\leftarrow\right)$ .
- Note: The displacement coordinates are always absolute.
6. Use **F4** to return to the pull-up menu.
  7. Use the shift key **SET** to switch to measuring mode.
  8. Confirm the security prompt with  $\left(\leftarrow\right)$ .

# 4.5 Fitting window

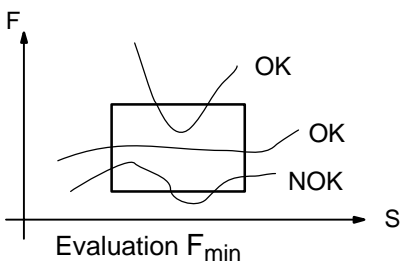


The fitting window supervises the actual press-fit task for insertion pieces. The specified range of values is evaluated after the press-fit task (offline).

### Fitting window

You may define a maximum of 6 fitting windows, and these may overlap. Fitting windows are numbered from 2 to 7 in the setup window.

### Curve evaluation



### Function

You can select the evaluation criteria of the fitting window or deactivate it.

#### disabled:

No supervision of the fitting window

#### Curve evaluation:

The curve must enter the fitting window at the side, must not go above  $F_{max}$  or below  $F_{min}$  and must leave the window at the side again.

#### Evaluation $F_{min}$ :

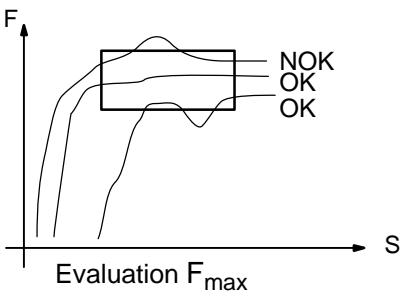
Only  $F_{min}$  is monitored.

#### Evaluation $F_{max}$ :

Only  $F_{max}$  is monitored.

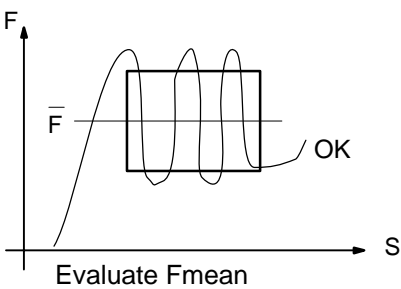
#### Evaluate $F_{mean}$ :

The force is averaged across the displacement of the window and evaluated (the mean value must lie within the window).



### Reference Displ.

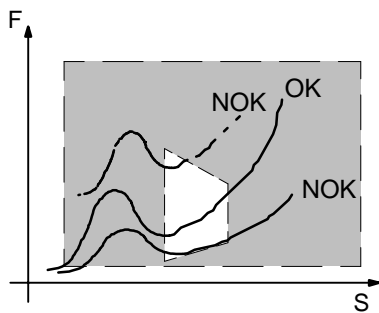
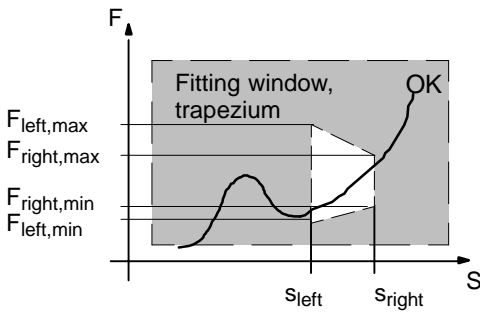
When the setting is "absolute", the reference is used as the zero point of the displacement transducer, and with a "relative" setting it becomes the start or end position of the relative coordinate system (see chapter 4.1).



### Reference Force

The "absolute" setting establishes the reference to the zero point of the force transducer, "relative to  $F_{min}/F_{max}$  window 2" to the maximum/minimum force of fitting window 2 (see Chapter 4.1).





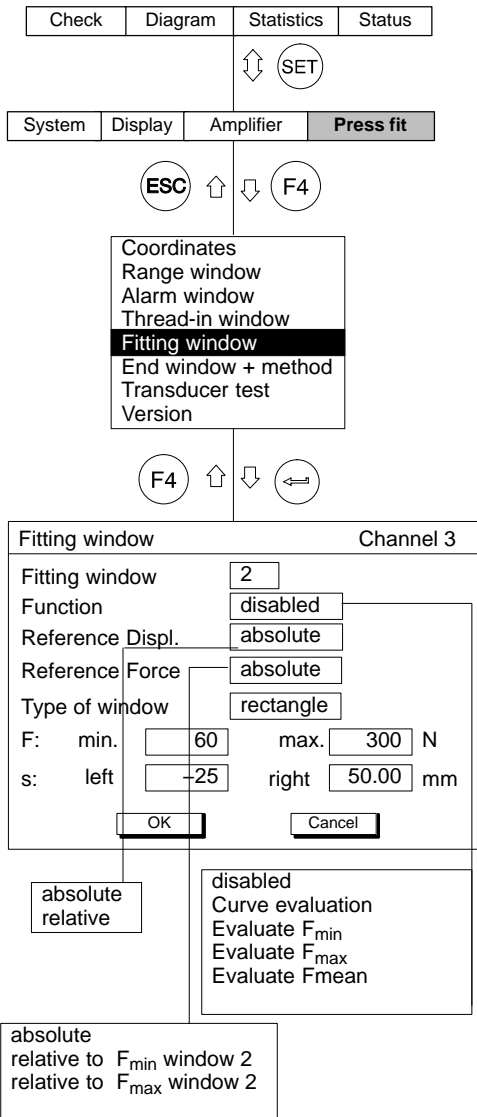
**Type of window**

Fitting windows can take the following forms:

1. Rectangular window with 4 coordinates ( $F_{min}$ ,  $F_{max}$ ,  $S_{left}$ ,  $S_{right}$ )
2. Trapezium window with 6 coordinates ( $F_{left,min}$ ;  $F_{left,max}$ ;  $F_{right,min}$ ;  $F_{right,max}$ ,  $S_{left}$ ,  $S_{right}$ ).

**Evaluation**

In the case of offline evaluation, windows are evaluated only if their function is enabled. The window is pronounced OK if the force trend enters the window from the left and exits the window from the right. Within the window, the trend line may not touch the upper or lower border.



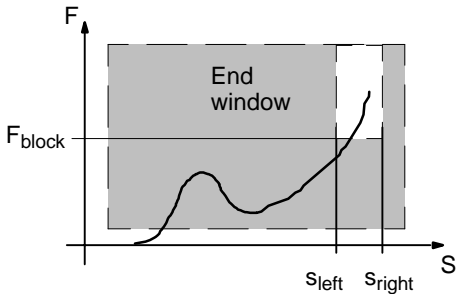
**Enable**

"Yes" switches the fitting window on, "No" switches it off.

**Setting up the fitting window**

1. Use the shift key (SET) to return to setup mode.
2. Press (F4).
3. Use the cursor keys (↕) to select "Fitting window" from the pull-up menu and confirm with (←).
4. Use the horizontal cursor keys (←) to select the number of the window you want to edit, or enter the number directly from the alphanumeric keypad.
5. Enable/disable the required fitting window with the "Function" selection field and confirm with (←).
6. Select your settings from the "Reference Displ.", "Reference Force" and "Type of window" selection fields and confirm each one with (←).
7. Enter the required force and displacement values in the edit fields.
8. Confirm your settings with (OK).
9. Use the shift key (SET) to switch to measuring mode.
10. Confirm the security prompt with (←).

# 4.6 End window and method



### End window

Use the end window to define the range for the F-s diagram in which you want the press-fit task to end. The end window is a rectangular window with 3 coordinates ( $F_{block}$ ,  $S_{left}$ ,  $S_{right}$ ).

**Important:** The end window must **not** intersect the thread-in window.

### Total time

The maximum length of time after which the measuring system will automatically stop measuring (BUSY → 0; NOK → 1).

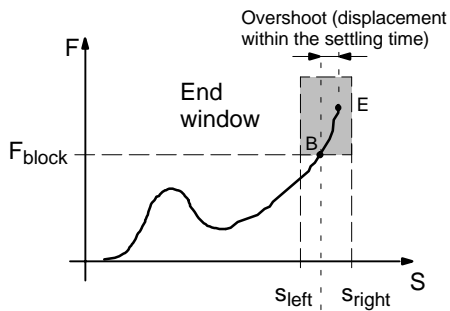
### Method

You may choose between four supervision methods:

1.  Block + settling time

When block force (B) is reached, measurement stops (settling time=0). If a settling time is defined, measurement continues for this time span.

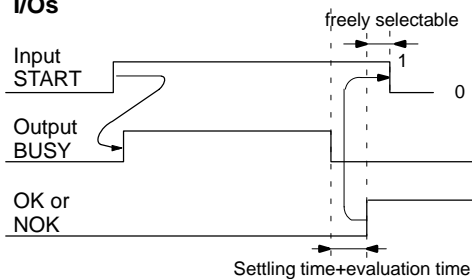
Method: Block + settling time



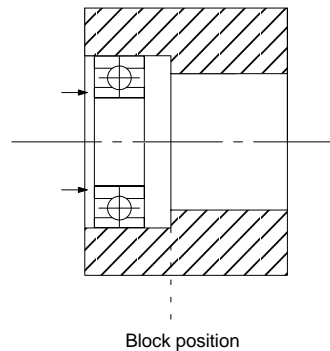
### Evaluation

The window is pronounced OK if the end position (E) lies within the end window. Evaluation ends when either of the OK/NOK outputs is set to 1.

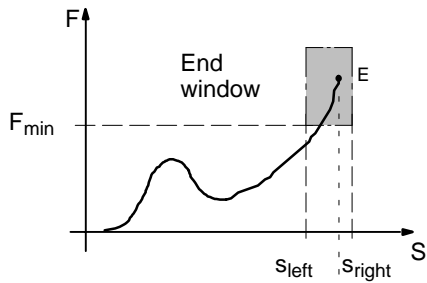
### I/Os



**Example:** Press fit a bearing at block position



Method: Standstill recognition

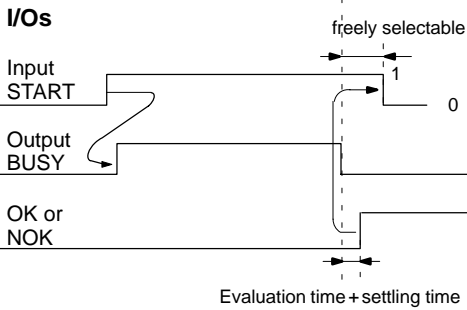


2. Standstill recognition

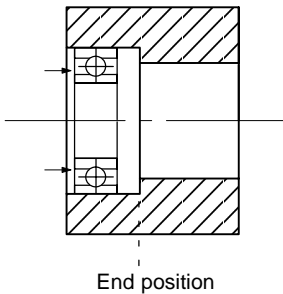
This method is used when it is necessary to ensure that the part which is to be press-fitted will remain under load in the end position for a certain length of time. Standstill is automatically indicated when no change of displacement is detected within the specified time.

**Evaluation**

The window is pronounced OK if the end position (E) lies within the end window.



**Example:** Bearing to be loaded with 3 kN for 5 seconds in the end position.



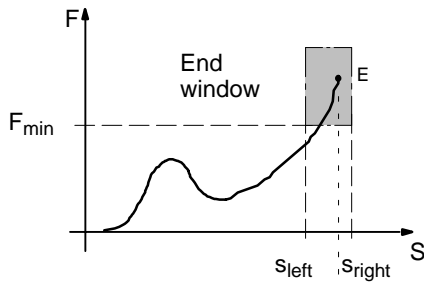
Method: External stop signal

3. External stop signal

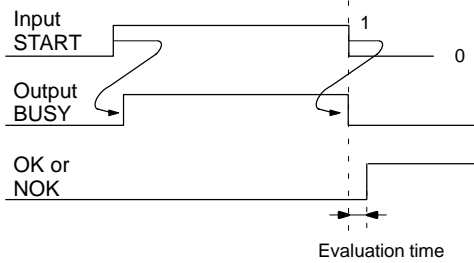
The end position is detected by an external signal generator (such as a proximity switch).

**Evaluation**

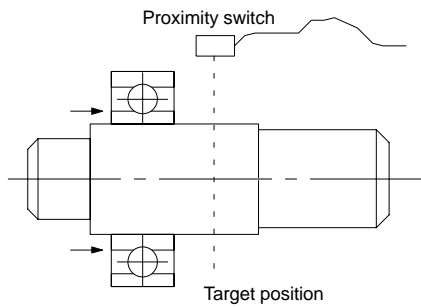
The window is pronounced OK if the end position (E) lies within the end window.



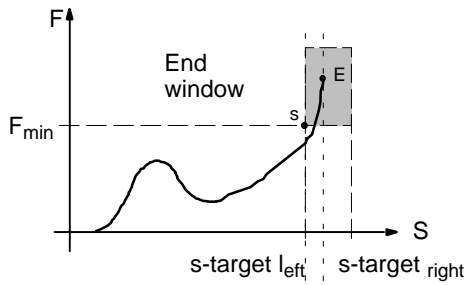
**I/Os**



**Example:** required position indicated by proximity switch.



Method: Target pos.+settling time



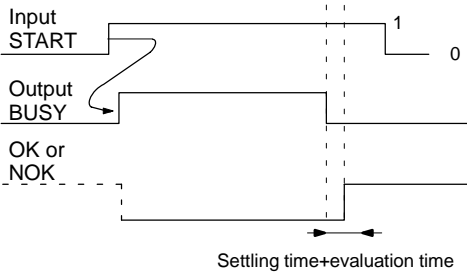
4. Target pos.+settling time

The end position is detected by the displacement channel.

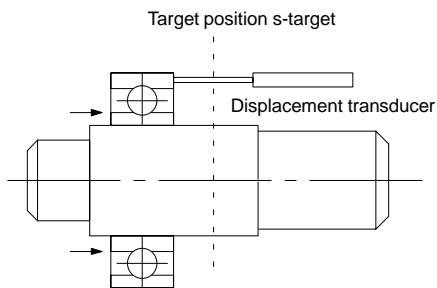
**Evaluation**

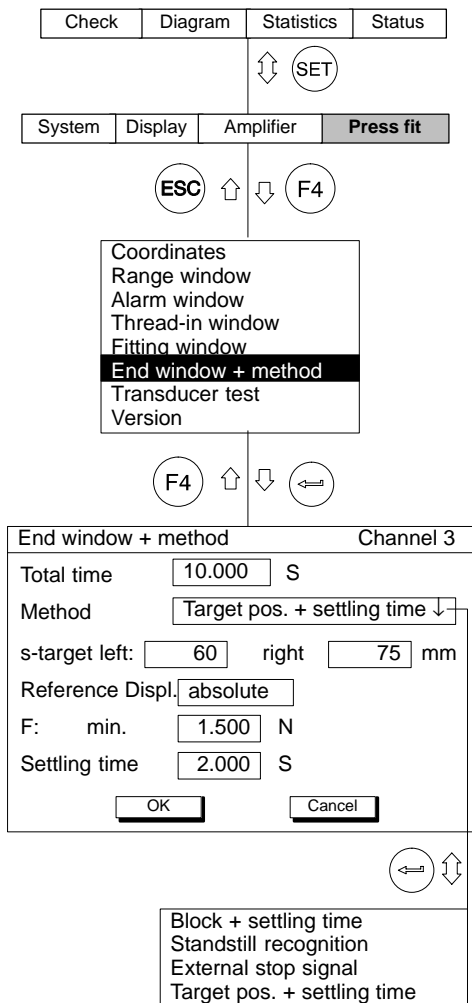
The window is pronounced OK if the characteristic curve ends within the window.

**I/Os**



**Example:** press-fitting a bearing with displacement monitoring

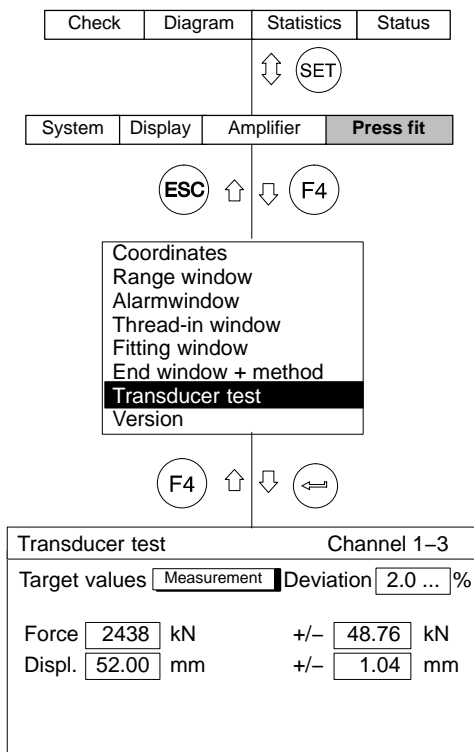




### Setting up end window and supervision method

1. Use the shift key **SET** to return to setup mode.
2. Press **F4**.
3. Use the cursor keys  $\left\langle \begin{smallmatrix} \uparrow \\ \downarrow \end{smallmatrix} \right\rangle$  to select "End window + method" from the pull-up menu and confirm with  $\left\langle \leftarrow \right\rangle$ .
4. Enter the required value in the "Total time" edit field and confirm with  $\left\langle \leftarrow \right\rangle$ .
5. Use the vertical cursor keys  $\left\langle \begin{smallmatrix} \uparrow \\ \downarrow \end{smallmatrix} \right\rangle$  to select the required supervision method from the "Method" selection field and confirm with  $\left\langle \leftarrow \right\rangle$ .
6. Enter the required force, displacement and time values in the edit fields and confirm each one with  $\left\langle \leftarrow \right\rangle$ .
7. Confirm your settings with **OK**.
8. Use the shift key **SET** to switch to measuring mode.
9. Confirm the security prompt with  $\left\langle \leftarrow \right\rangle$ .

## 4.7 Transducer test

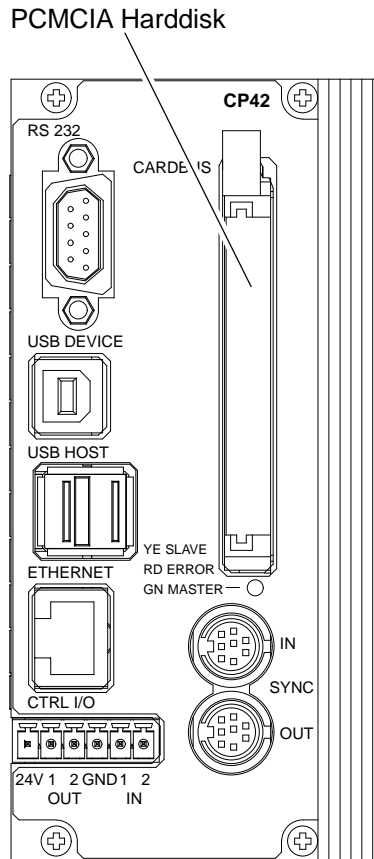


This function makes it possible to check preset values on displacement and force transducers (for example zero point). Enter the required values in the "Transducer test" setup window or measure them directly on the transducer. You may also specify a permitted deviation from the required value. The check is activated by remote control contact CHECK (see page C-49)

1. Use the shift key **SET** to return to setup mode.
2. Press **F4**.
3. Use the cursor keys  $\left(\begin{smallmatrix} \uparrow \\ \downarrow \\ \leftarrow \\ \rightarrow \end{smallmatrix}\right)$  to select "Transducer test" from the pull-up menu and confirm with  $\left(\leftarrow\right)$ .
4. Select the button **Measurement** and confirm with  $\left(\leftarrow\right)$  or enter the required values in the "Force" and "Displ." edit fields.
5. Use **F4** to return to the pull-up menu.
6. Use the shift key **SET** to switch to measuring mode.
7. Confirm the security prompt with  $\left(\leftarrow\right)$ .



## 4.8 Data acquisition (CP42 only)



With *MGCplus*, to record measurement series, you can configure and save up to 17 data acquisition programs (16 on the hard disk).

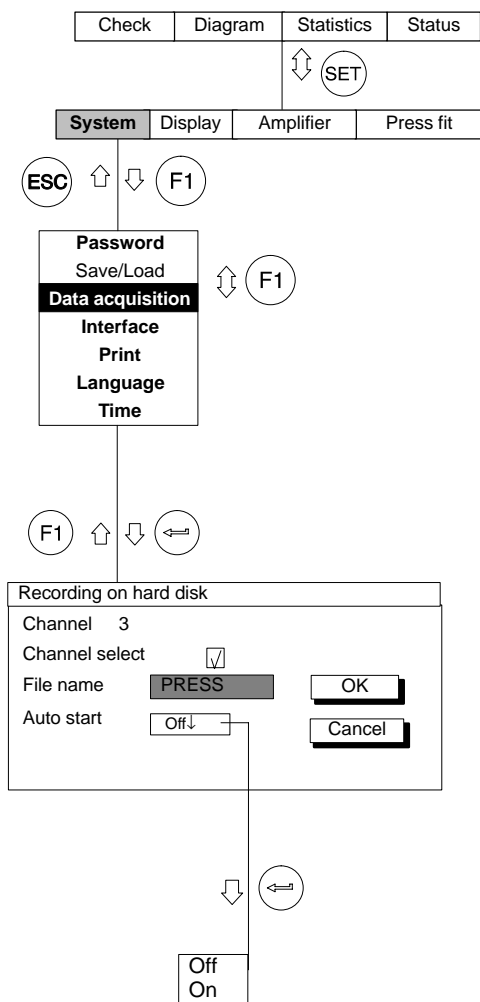
Saved data is stored in the RAM of communications processor CP42, or on its PC CARD (PCMCIA hard disk; optional).



### Caution

**Avoid electrostatic discharge! The PCMCIA hard disk might be damaged by static discharge. Touch a grounded object before installation or wear an approved grounding wristband.**

To set the measurement series parameters, use either display and control panel AB22A/AB32, or the PC software HBM *MGCplus* Assistant.



During a data acquisition you save the results of the press fit cycles – these are the extreme values of the thread-in, fitting and end windows. A binary file is created on the hard disk which you can convert to ASCII using the auxiliary program “Presconv.exe” found on the MGCplus system CD.

**Channel**

Display the channel numbers containing an ML85C evaluation unit.

**Channel select**

Select the channels for which data is to be recorded (  ).

**File name**

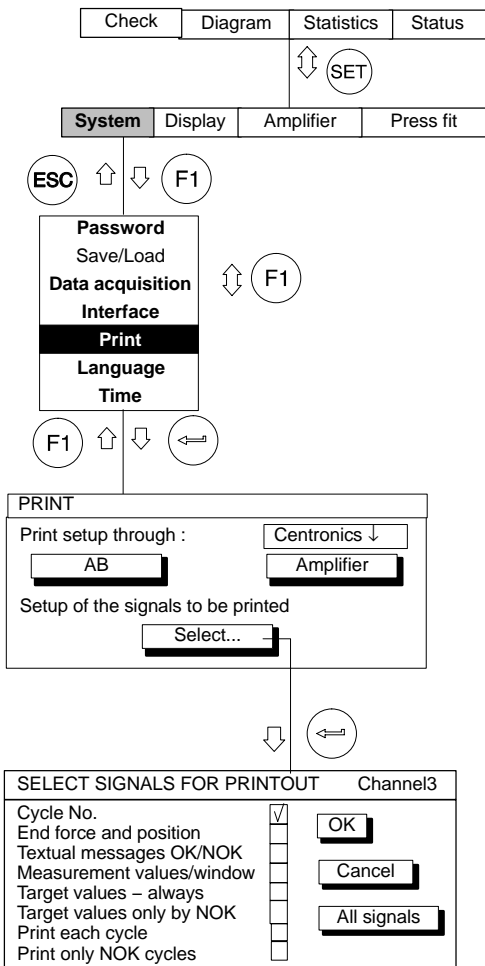
Enter the name of the data acquisition file here (maximum 8 characters; we recommend you use a max. of 5 characters, since in the event of the recording being interrupted the last three digits will be used as a counter).

**Auto start**

*On:* The results data is recorded automatically as soon as a measurement is started (function key **F2** in the factory settings or “Start” control input).

*Off:* The results data is not recorded until data acquisition is started manually (function key **F1**).

# 4.9 Printing the press-fit results



The "Print" function lets you print out the settings for the AB22A or for the selected amplifier plug-in unit together with the relevant data.

For printing the measurement data, you can specify the required signals under "Select"; the print task itself can be started by pressing a function key

1. Use the shift key **SET** to return to setup mode.
2. Press **F1**
3. Select "Print" from the pull-up menu and confirm with **↔**.

You are now in the "Print" setup menu.

4. Use **↕** to select the button you require and confirm with **↔**.

Another setup window then opens under "Select..."

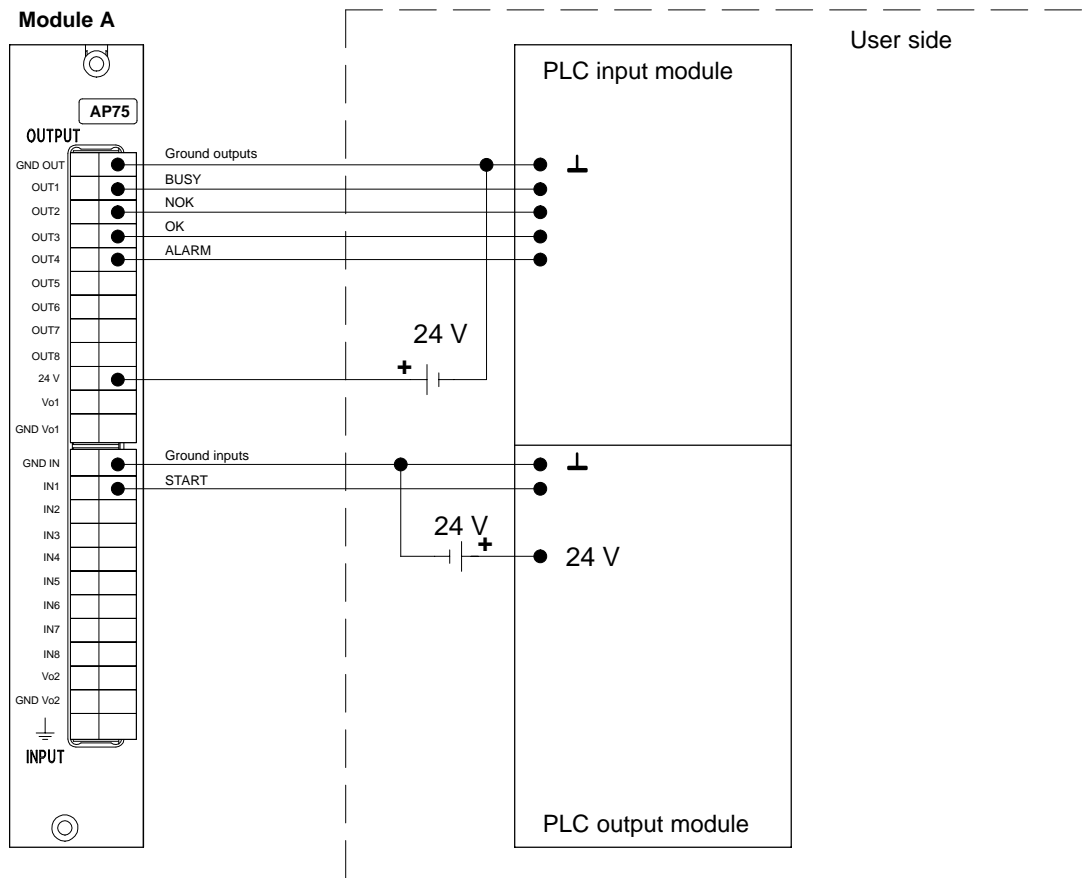
5. Use **↕** to select the check boxes for which you want to print the settings. Use **↔** to activate (✓ means "ON").
6. Use **↕** to select **OK** and confirm with **↔**.

# 5 PLC link

## 5.1 Basic wiring

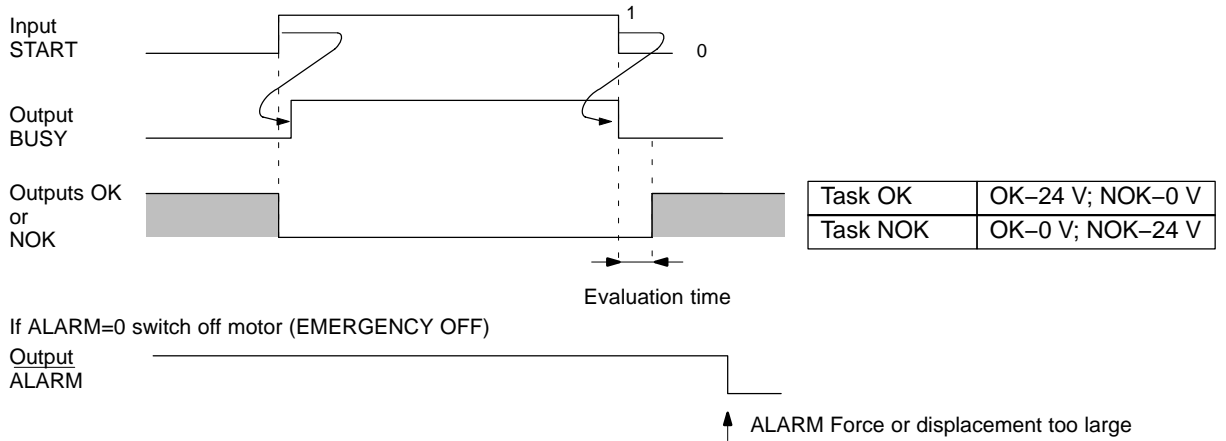
In order to integrate a programmable logic controller, basic wiring **must** be made up. Expansions are optional; you can also make up several at the same time.

The wiring options shown here relate to the pin assignment according to the factory settings of the ML85C.

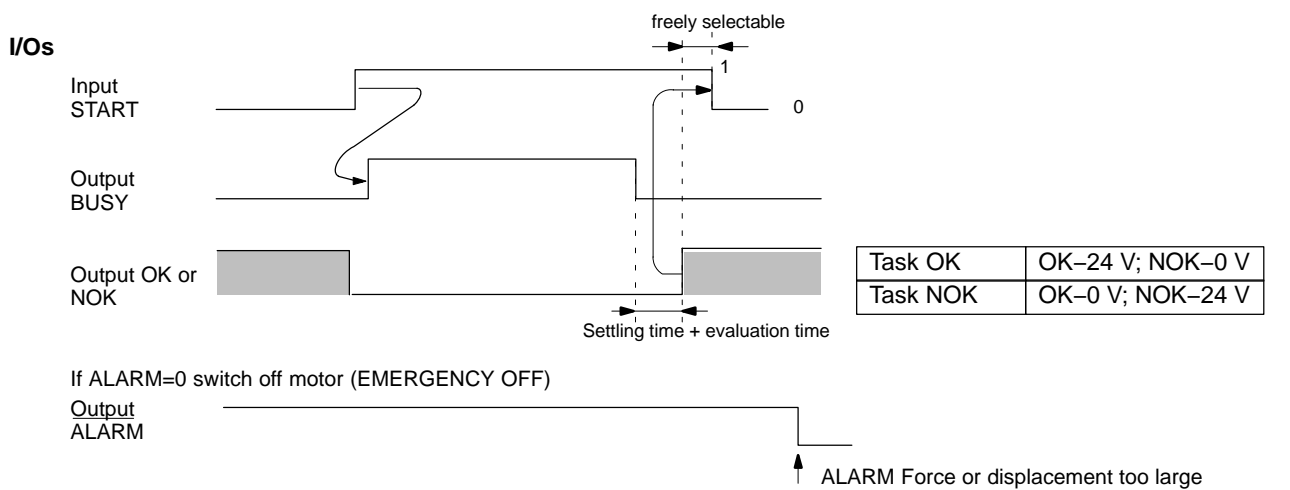


### 1) Time diagram for external stop signal

I/Os

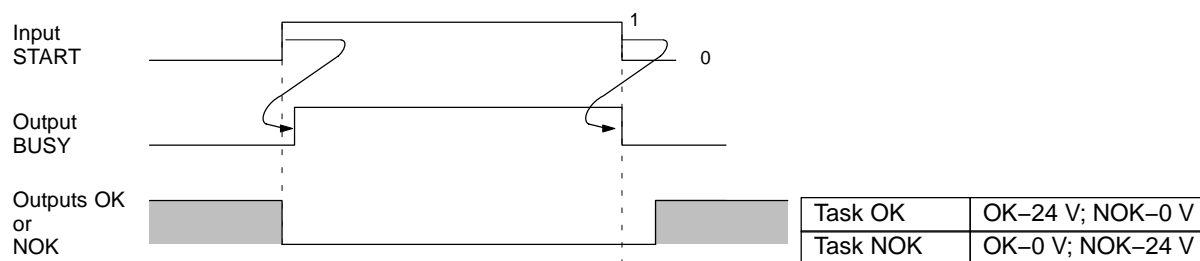


### 2) Time diagram for other methods



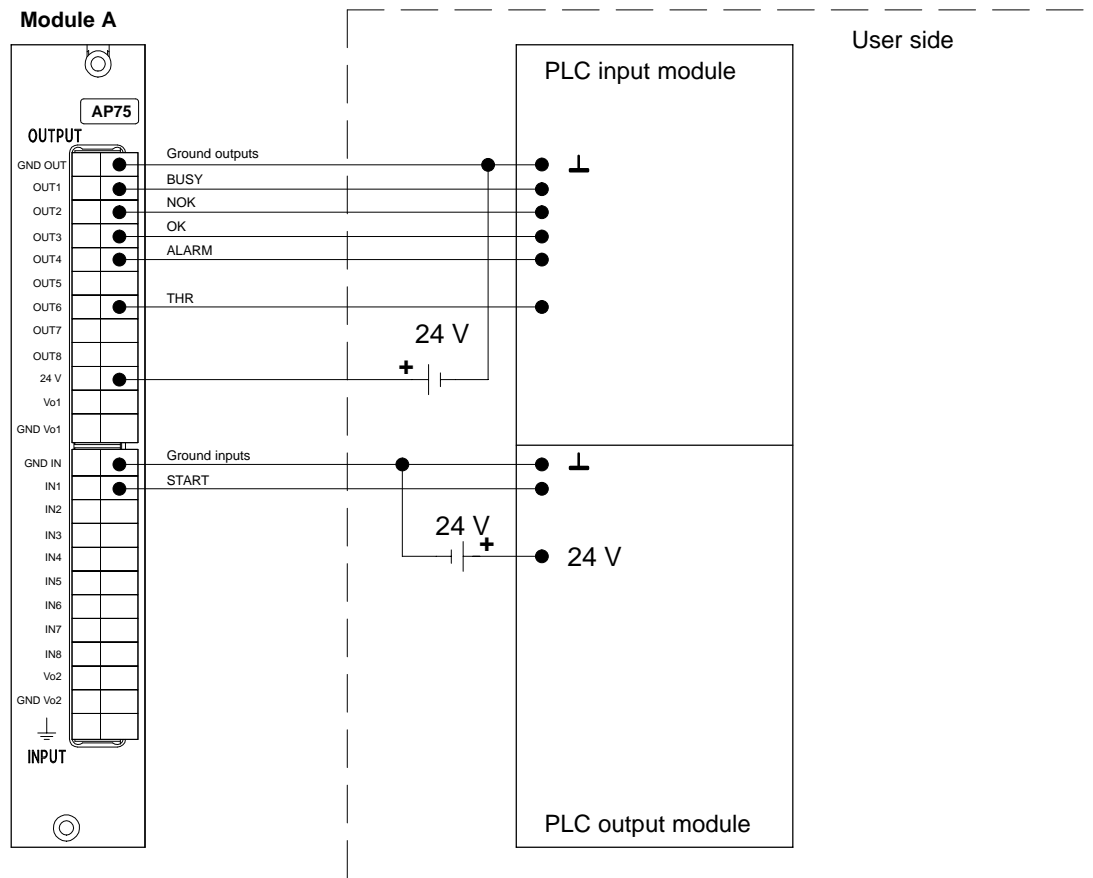
### 3) Interrupt by PLC

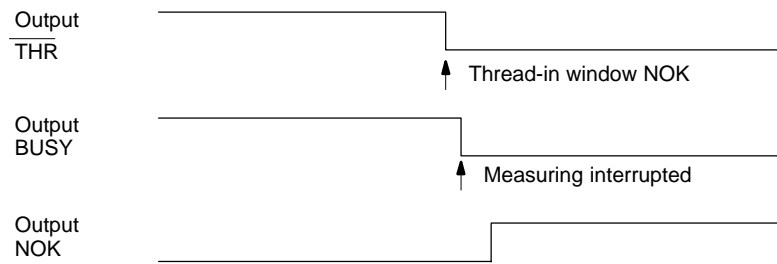
#### I/Os



## 5.2 Expansion options for basic wiring

### 5.2.1 Online supervision of thread-in process

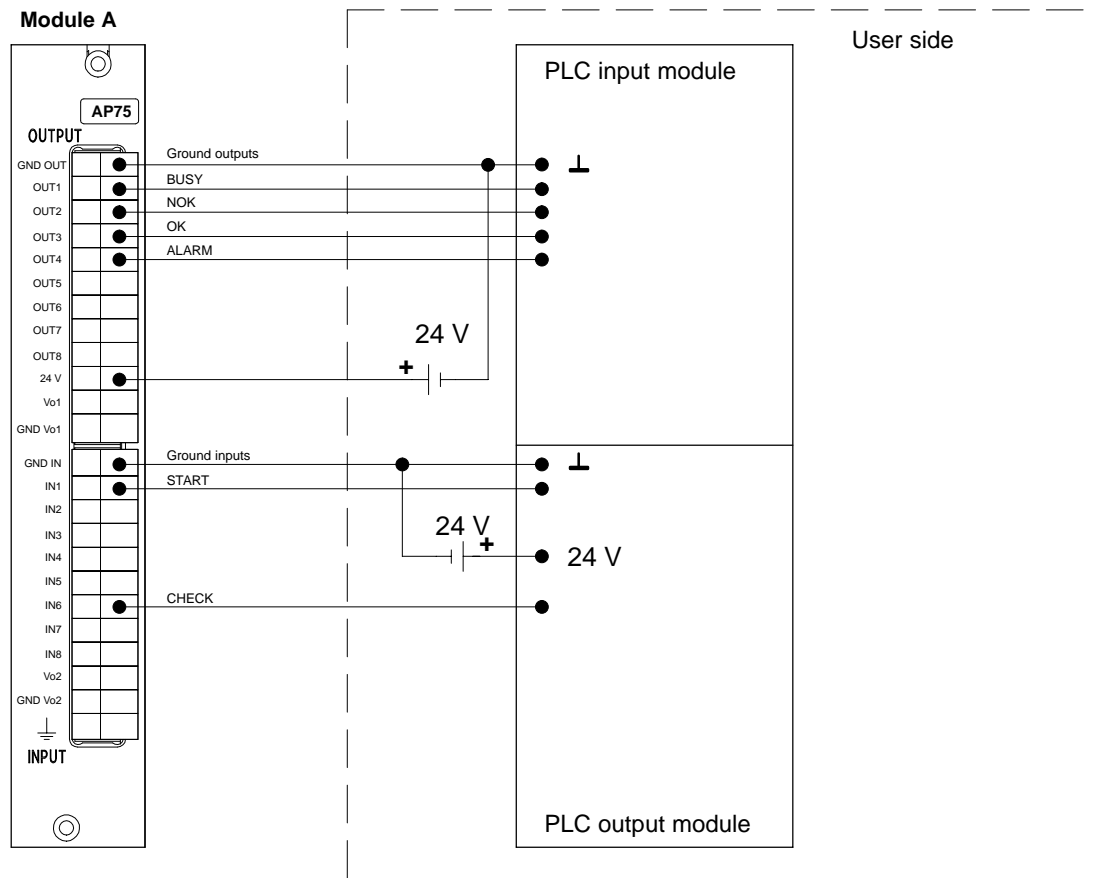


**Time diagram when thread-in process NOK****I/Os**

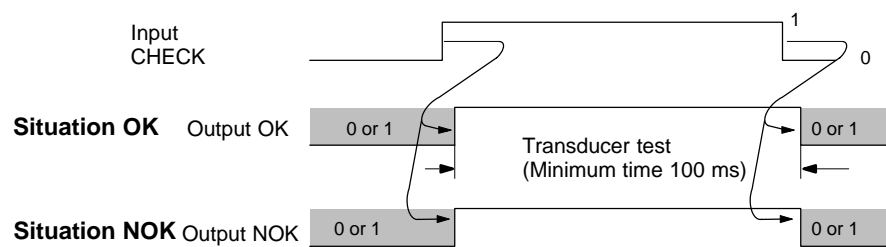


## 5.2.2 Transducer test

When the CHECK input is enabled, force and displacement signals are compared with the specified tolerance limits (see also page C-40).

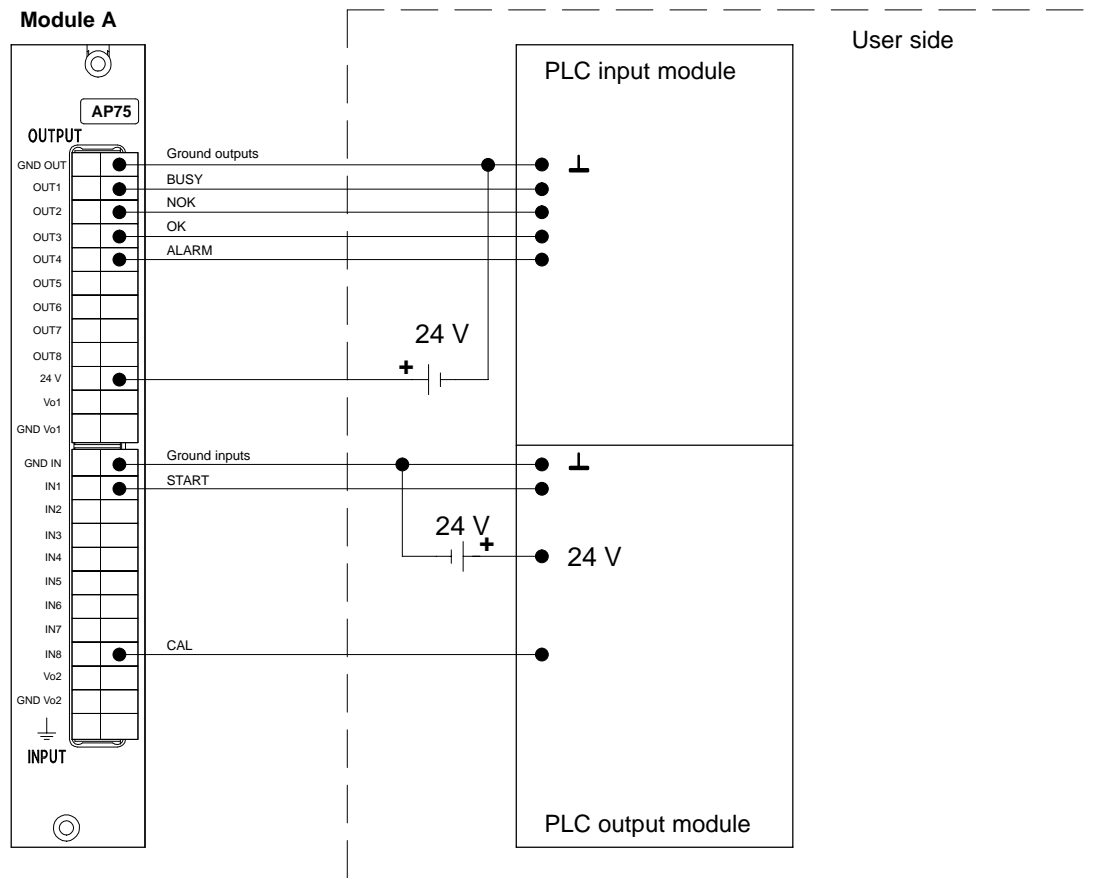


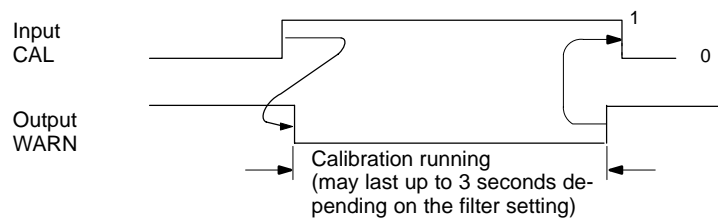
**Time diagram for transducer check**



## 5.2.3 Autocalibration

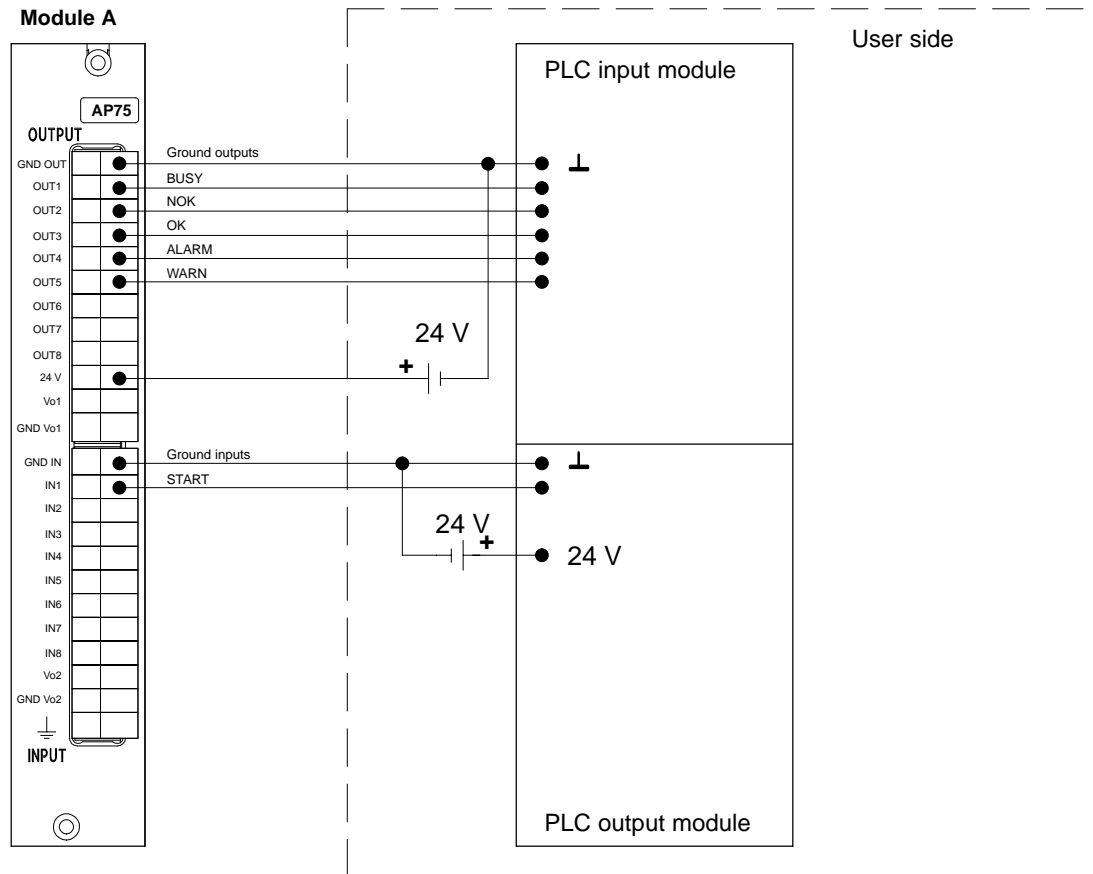
You can increase the precision of the measuring system by a factor of 5 or 10 by activating the internal calibration on the device every now and then.

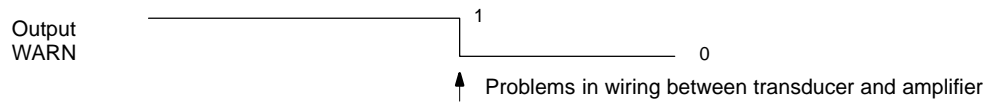


**Time diagram for calibration****I/Os**

## 5.2.4 Identification of wiring problems

In the output WARN indicates problems in the wiring between transducer and amplifier (a break in the cable or a defective transducer).

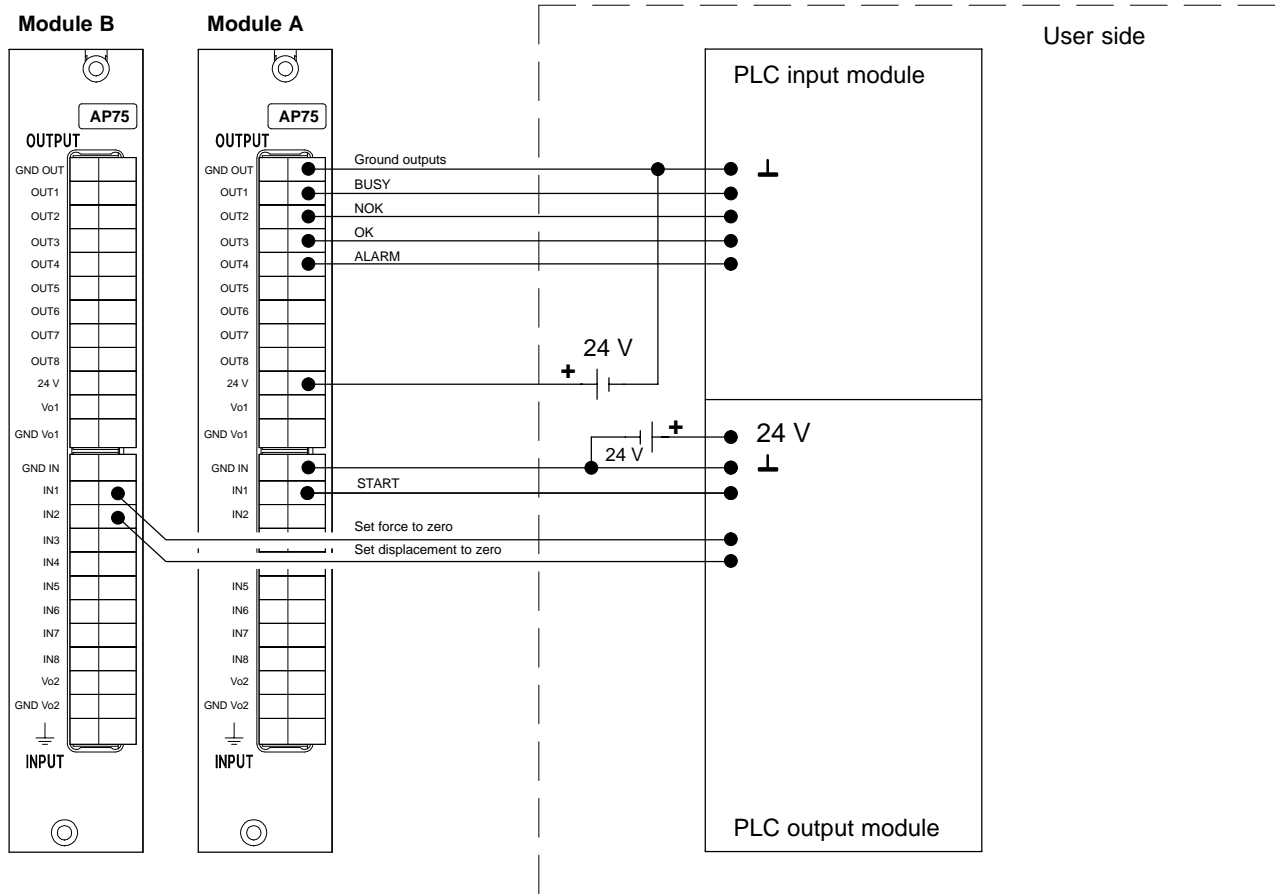


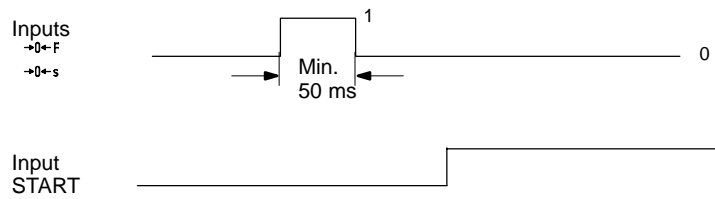
**Time diagram for error message**

Note: The output  $\overline{\text{WARN}}$  is similarly set to zero in the event of internal calibration (see also page C-51).

## 5.2.5 Zero balance before the press-fit process

For applications with greater zero point changes, we recommend running a zero balance before each press-fit process.



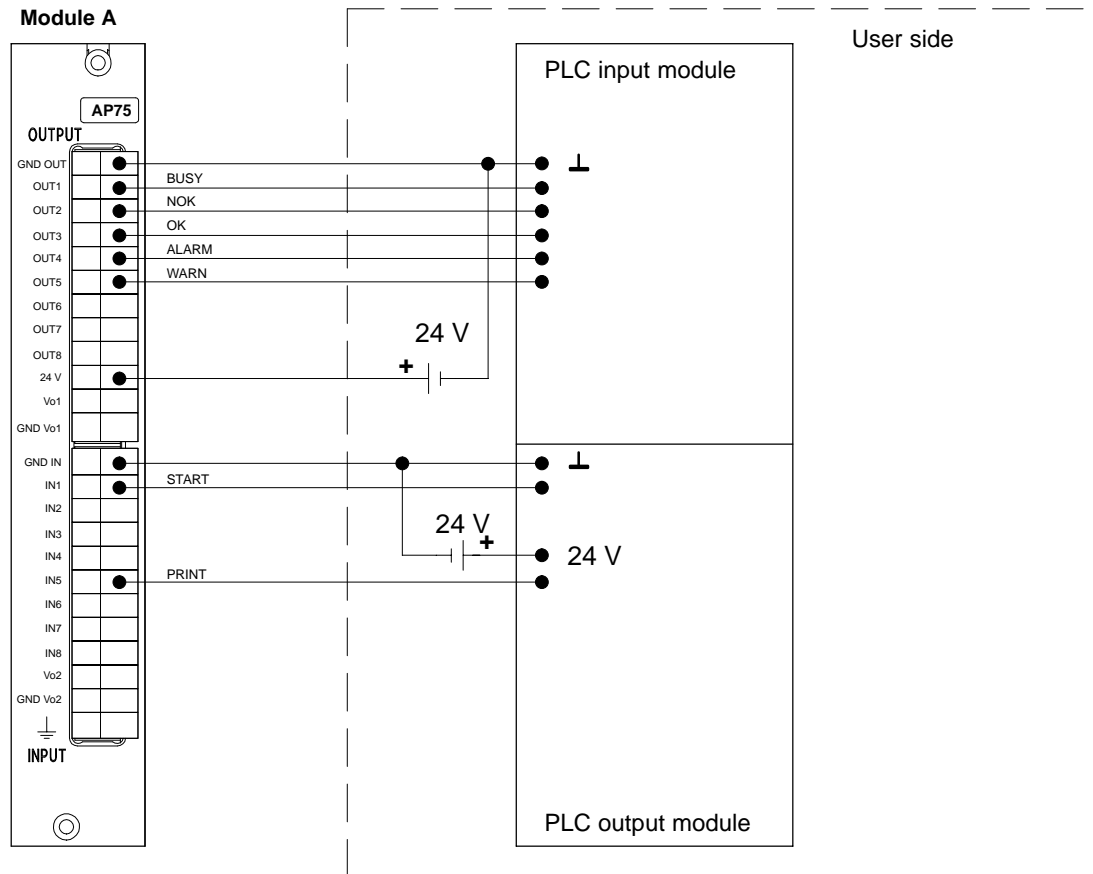
**Time diagram for zero balance**

If the zero balance time is a decisive factor, the AP13 can be used instead of the AP75 (zero balance time depending on amplifier module: about 250 ms with AP75; about 50 ms with AP13).

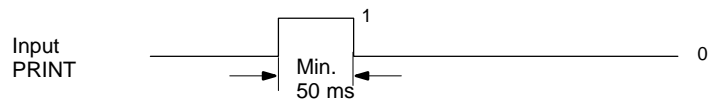


## 5.2.6 Trigger print task

The print task is triggered by a pulse.

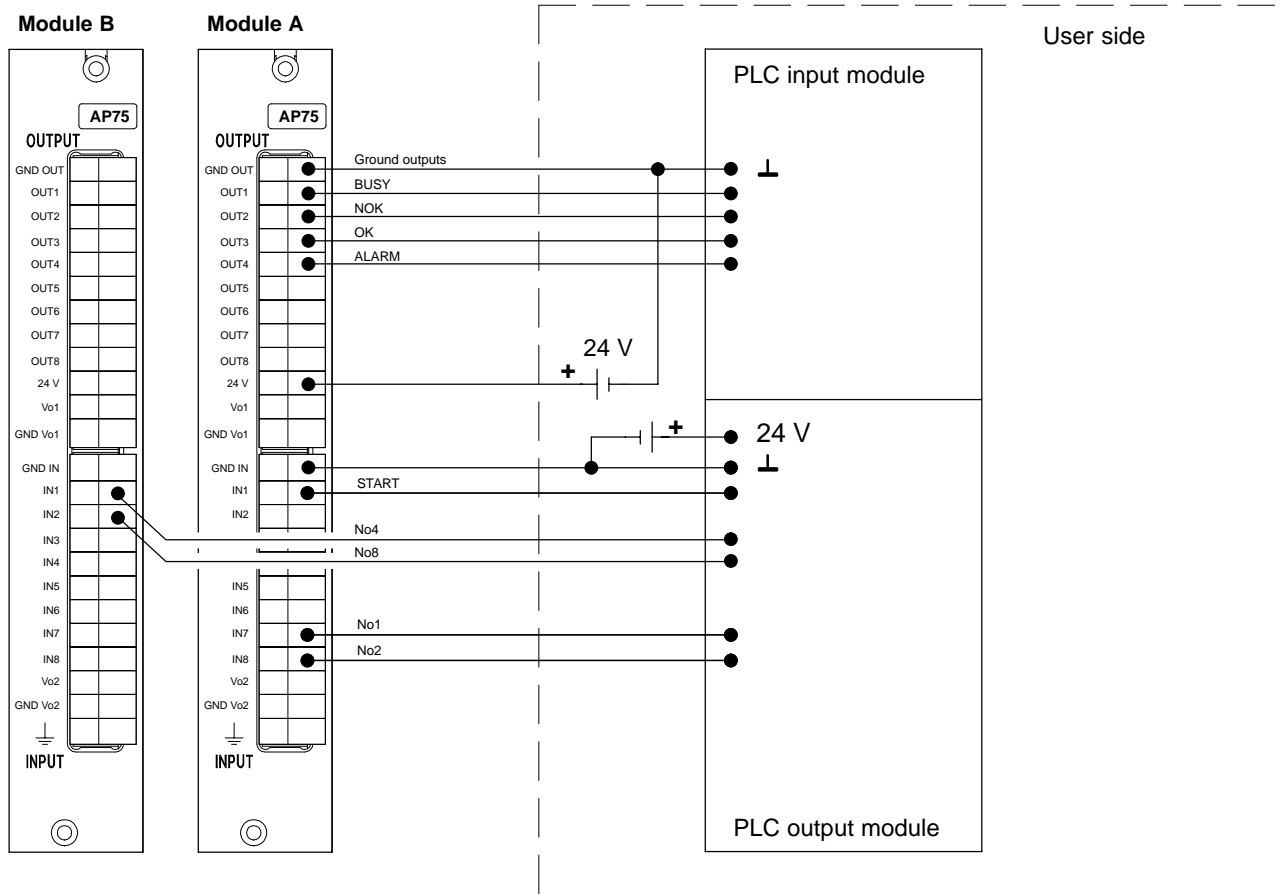


**Time diagram for print enabling**



## 5.2.7 Coding windows with errors

In the event of NOK tasks, outputs No.1 ... No.8 encode the number of the window that triggered the NOK evaluation.



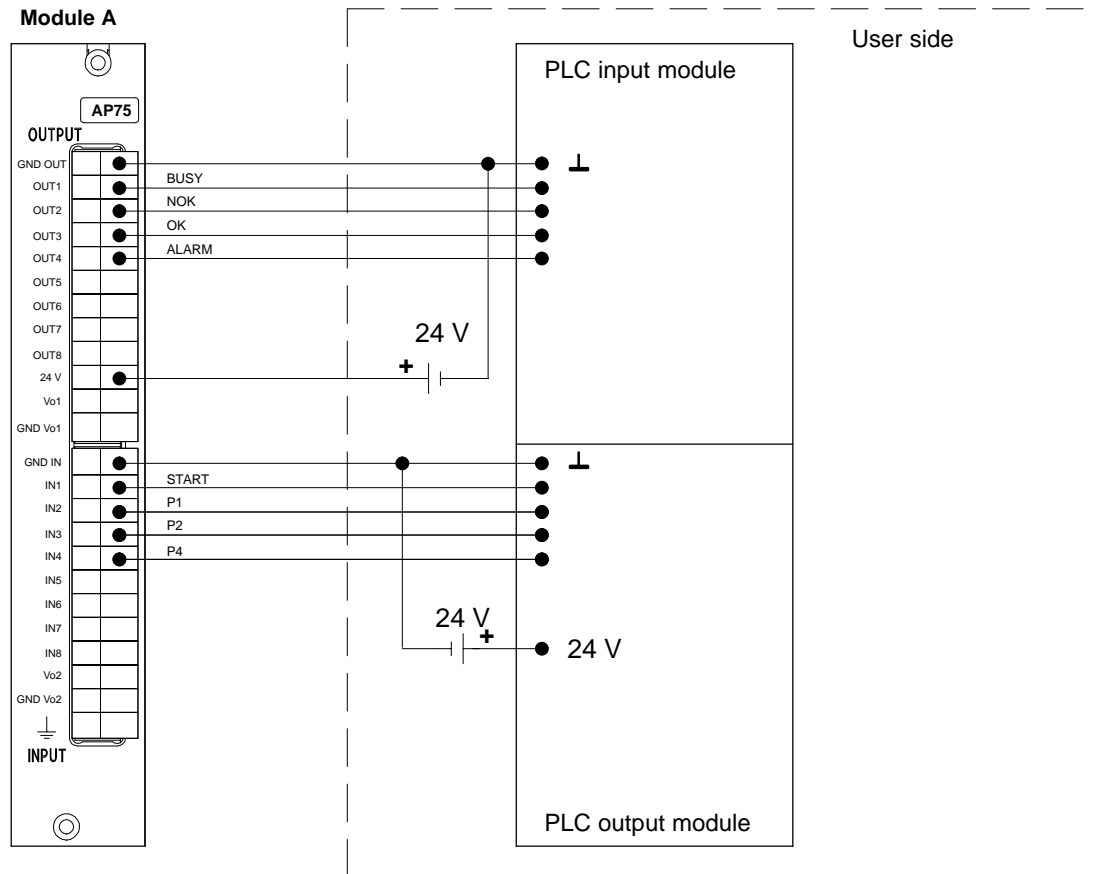
---

---

<b>No. 1</b>	<b>No. 2</b>	<b>No. 4</b>	<b>No. 8</b>	<b>Defective window</b>
0	0	0	0	All windows OK
1	0	0	0	Window 1 NOK (thread-in window)
0	1	0	0	Window 2 NOK (fitting window)
1	1	0	0	Window 3 NOK (fitting window)
0	0	1	0	Window 4 NOK (fitting window)
1	0	1	0	Window 5 NOK (fitting window)
0	1	1	0	Window 6 NOK (fitting window)
1	1	1	0	Window 7 NOK (fitting window)
0	0	0	1	Window 8 NOK (end window)
1	1	1	1	Several windows NOK

## 5.2.8 Selecting data sets

You may predefine up to 8 data sets; remote contacts P1, P2 and P4 select the active data set.



---

---

P1	P2	P4	Active data set
0	0	0	1
1	0	0	2
0	1	0	3
1	1	0	4
0	0	1	5
1	0	1	6
0	1	1	7
1	1	1	8

**Note:** Preferably use data sets 2 to 8, since in the case of data set 1 a break in the cable or an incorrect assignment will not be recognized. The data set can only be modified in status START=0 (input).

## 6 Troubleshooting

In the event of faults we recommend that you check the basic functions using the menu options Current values, I/O status and Diagnosis. These menu options may be found in the Service group (key F1 in measuring mode).

Current values

I/O status

Diagnosis

Force		Displ.		I/O status				Channel 1–3				Diagnosis					
<b>4.118 kN</b>		<b>5.342 mm</b>		START	1	CHECK	1	NF	0	BUSY	1	/THR	1	Meas. stopped: through software command Last measured value: Number of buffered val.: 1			
Measure		Measure		P1	0	CLEAR	1			NOK	0	NO1	0				
Input		Calibrate		P2	0	CAL	0			OK	1	NO2	0				
-> 0 <-		Menu		P4	0	F-0	1			/ALARM	1	NO4	0				
				PRINT	0	S-0	0			/WARN	1	NO8	0				
								Menu				Start/Stop		Menu			

The following table summarizes some potential faults and their possible causes:

Fault	Cause and remedy
Measuring is stopped immediately after START	Using F1(Service) > Diagnosis find cause of "Measuring end" Possible causes: Alarm limit passed: – check settings for alarm limits External stop signal – check PLC time response and START input at the connection board measured value buffer full – change resolution (see page C-28) – change filter frequency (see page E-17)

Fault	Cause and remedy
Lots of NOK messages	Call up F4 Status ◊ Total ↵ Analyze the cause of NOK messages. Check settings for the critical windows
Measuring is stopped too soon	Using F1(Service) > Diagnosis find cause of measurement ending Possible causes: Alarm limit passed – check settings for alarm limit External stop signal – check PLC time response and START input at the connection board Measured value buffer full – change resolution (see page C-28) – change filter frequency (see page E-17) Measurement duration exceeded – extend measurement duration (see page C-39)



D

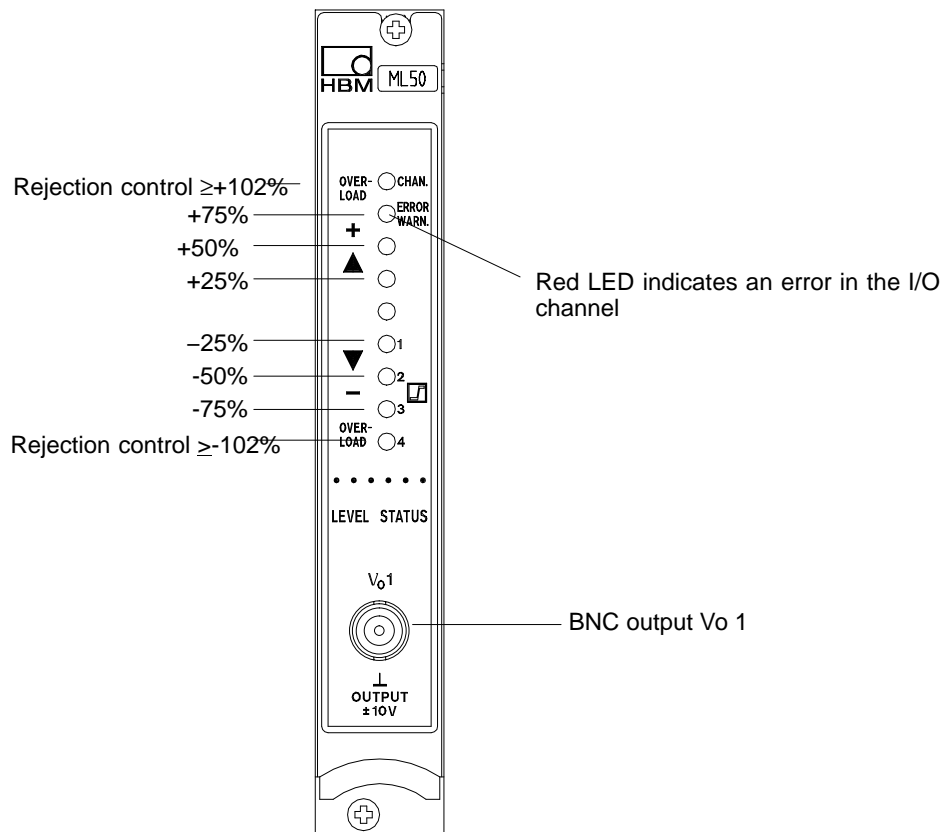
Measure

ML85C

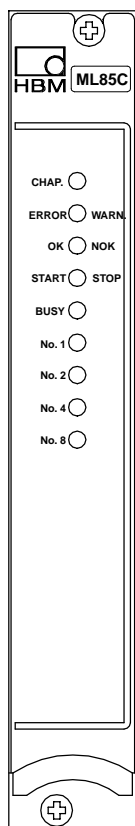
# 1 LED display on front panel

## 1.1 Amplifier plug-in units

The amplifier plug-in units operate independently, i.e. They have no effect on one another. For instance, if an amplifier fails, this has no effect on how the other Remaining amplifiers operate. Amplifiers are parameterized via the display and control panel. If you later plug an amplifier into a different slot (or device), its settings will all remain unchanged.



## 1.2 Evaluation channel ML85C

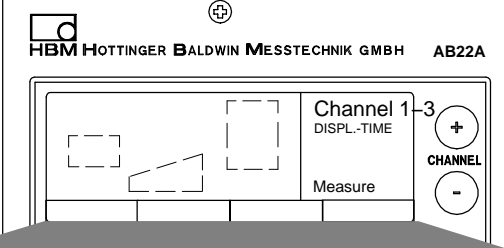


N o.	Color of LED	Label	Meaning
1	yellow	CHAP.	Select channel
2	red	ERROR	Error
3	red/yellow	OK, NOK	OK, Not OK
4	yellow	Start/Stop	Start/Stop signal
5	yellow	BUSY	Measuring running
6	red	No. 1	Fitting window error
7	red	No. 2	Fitting window error
8	red	No. 4	Fitting window error
9	red	No. 8	Alarm

## 2 AB22A/AB32 in measuring mode

The measuring functions of the press-fit monitoring module are collected in function-specific groups in the lower part of the display.

Display in measuring mode

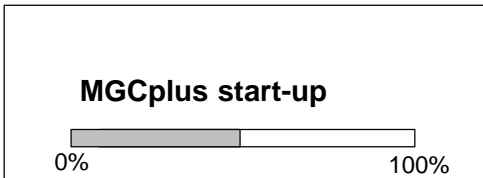


Check	Diagram	Statistics	Status
They monitor the current status of digital indicators, I/Os and transducer check.	They switch between the displays in the indicator:  Force - displ. Force - time Displ. - time	Statistical evaluation of the windows in histograms.	Contrasting the target and actual values of particular fitting windows.

Selection bar

## 3 Display

### 3.1 The first display



When the mains voltage is on, initialization of the AB22A/AB32 is indicated in the display by a horizontal progress bar.

After the opening display the force-displacement diagram is displayed as standard (factory setup). Pressing the shift key **SET** takes you to the setup mode, where you can configure the system, the display, the amplifiers and the press-fit parameters. We recommend that you set up the language first if you require a language other than German.

#### Symbol in the display (info box):



status indicator of data set memory

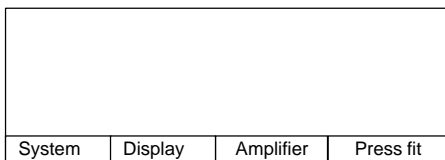
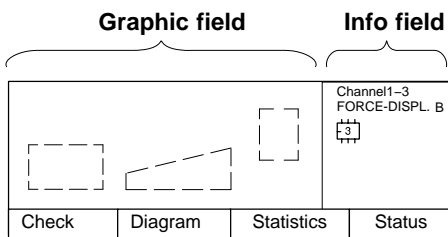
number 1 – 8    number of the current parameter set.

E                XM001 memory module

S                factory setup


X                user-defined setting; displayed when a data set has been modified.

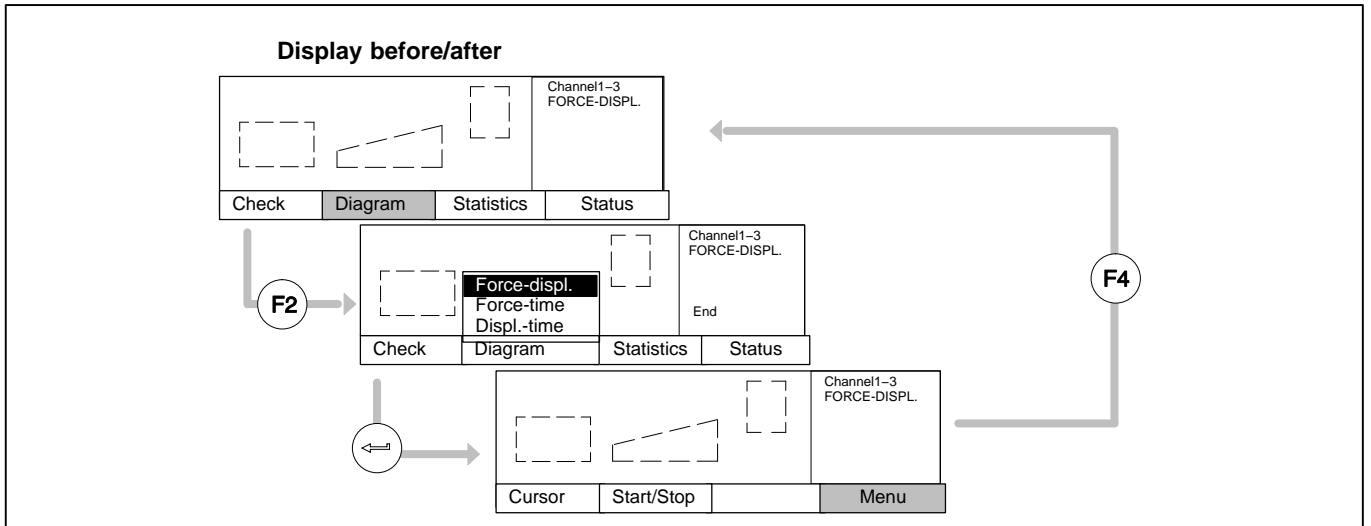
First display




For further information refer to pages D-13 to D-16.

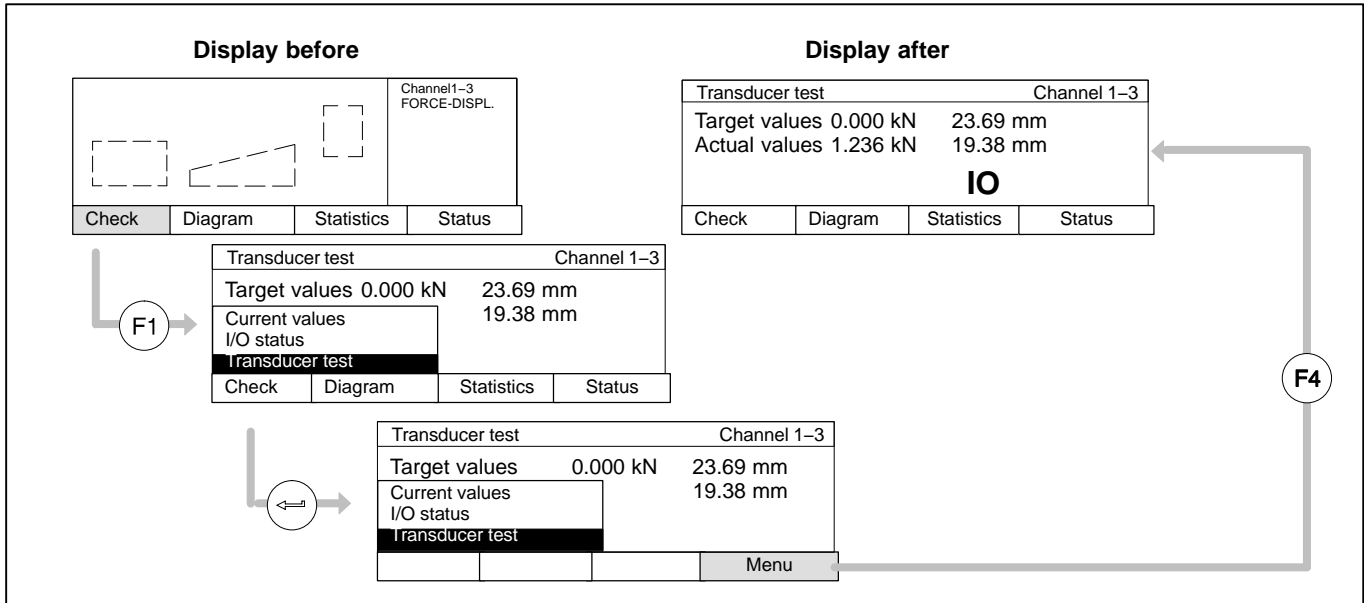
## 3.2 Display in measuring mode

The display during measuring mode depends on the function which has been selected (using the F-keys). Each time the device is switched off and on again, the force-displacement diagram is displayed as the standard factory setup. If you wish to activate the other functions, "Force-time and Displ.-time diagram", you are required to select them from the pull-up menu (F2) and confirm your choice with .



**Fig.3.1:** Measuring mode; display "Force-displ."

If you choose another function with the F-keys and then return to the menu with F4, the most recent display remains active until you choose another function and confirm with .



**Fig.3.2:** Measuring mode; changing the display



### 3.3 Possible displays

#### 3.3.1 Current values



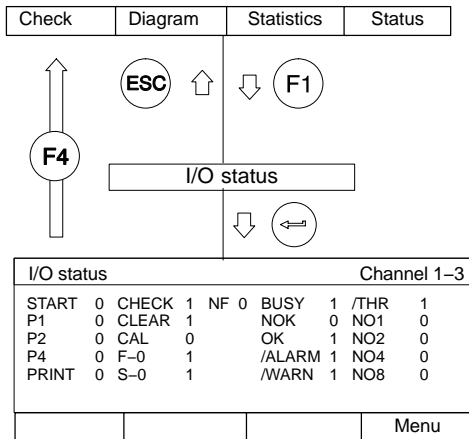
The display shows the current measured values. The left-hand display field shows the measured force values. The right-hand display field shows the measured displacement values. The header also gives the amplifier identification. The input connected is identified below the measured value indication. You can use function key **F1** to choose the inputs Measure, Zero and Calibrate for both I/O channels.

Use the **F2** key to trigger internal calibration.

Use the **F3** key to carry out a zero balance.

Use the **F4** key to return to the output menu.

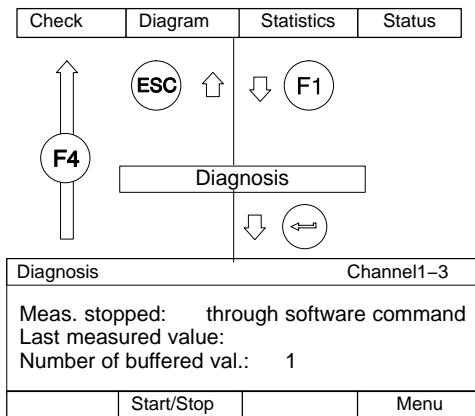
## 3.3.2 I/O status



Displays current I/O status (0=low; 1=high).

Abbreviation	Function
START	Start/stop measurement
P1	Switch data set ( $2^0$ )
P2	Switch data set ( $2^1$ )
P4	Switch data set ( $2^2$ )
PRINT	Trigger print task
CHECK	Transducer test
CLEAR	delete statistics buffer
CAL	Trigger internal calibration
F-0	Set force zero point
s-0	Set the displacement zero point
NF	reserve
BUSY	Status message
NOK	NOK message (summation message)
OK	OK message (summation message)
ALARM	Force or displacement overshoot, range window
WARN	error message
THR	Force overshoot, thread-in window
No. 1	In the event of a NOK message, the number of the defective window is specified in binary code. If all windows are affected, error number "0" is displayed.
No. 2	
No. 4	
No. 8	

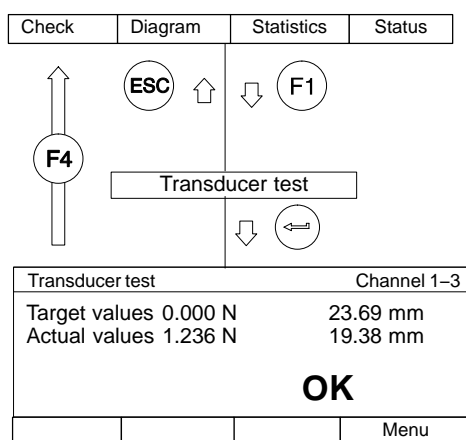
### 3.3.3 Diagnosis



You can use the “Diagnosis” function to establish why a measurement was ended and how many measured values were stored. The following processes end a measurement:

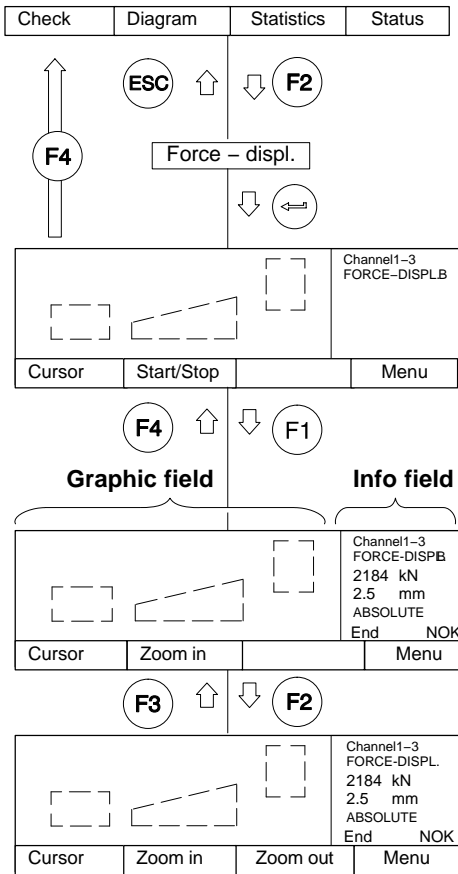
1. maximum measurement duration reached
2. settling time expired
3. by remote contact STOP (external stop signal)
4. by software command STOP (F-key or *MGCplus* Assistant)
5. standstill detected
6. measured value buffer full
7. force alarm exceeded (displays the last measured value)
8. displacement alarm exceeded (displays the last measured value)
9. s-right range window reached

## 3.3.4 Transducer test



You can use the "Transducer test" function to check the zero point setting (Displ. and Force). The result of the target/actual comparison is displayed as OK/NOK. Enter the permitted deviation in the "Transducer test" setup window, which you access via the "Press fit" pull-up menu (see page C-40).

### 3.3.5 Force-displacement diagram



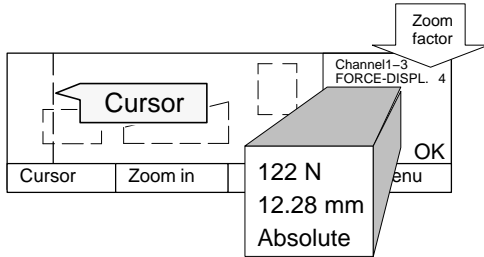
You can use the "Force vs. Displ." function to plot the force-displacement trend as a curve in the range window.

1. Press **F2**.
2. Select "Force – displ." from the pull-up menu and confirm with **↩**.
3. Press **F2** (Start/Stop) to begin measuring.


The display is divided into two areas. The force-displacement curve and the window are displayed in the graphic field. The info field contains the following:

- Channel numbers
- Diagram type and window type (A = alarm limits; B = range window)
- Coordinates (absolute/relative)
- Status (Measuring/End)
- Evaluation (OK/NOK)

The scaling of the display depends on the input values in the range window (see C-28).

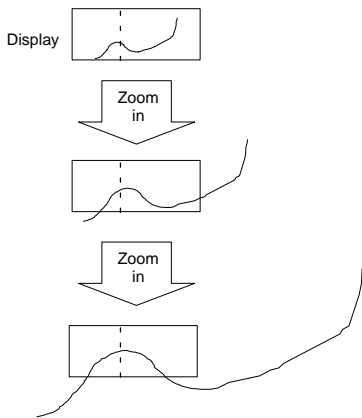


### Cursor

You may use function key **F1** to switch on a cursor in the display, and you can then use cursor keys  to move it up, down and from side to side. The cursor moves from value to value.

When the cursor is switched on, the info field also displays the following:

- Zoom factor (max. 32)
- Measured value Force (at cursor position)
- Measured value Displ. (at cursor position)
- Reference to Zero point (absolute/relative)



### Zoom in

Press function key **F2** to enlarge the display in the graphic field.

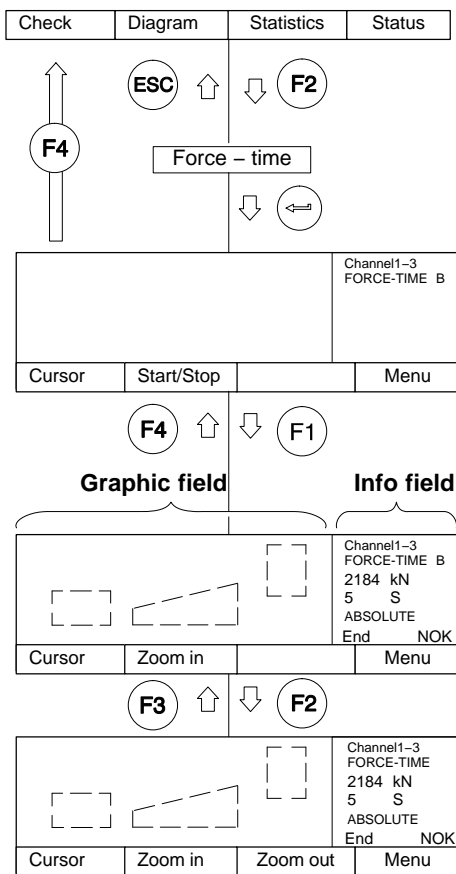
Enlargement takes place at the point where the cursor and the force-displacement curve intersect. The display is enlarged by a factor of 2 per keystroke.

### Zoom out

Press function key **F3** to reduce the display in the graphic field.

Reduction takes place at the point where the cursor and the force-displacement curve intersect. The display is reduced by a factor of 2 per keystroke (as far as the "alarm window" area).

### 3.3.6 Force-time diagram



7. Use to select "Save/Load" and confirm with .

You are now in the "Save/Load Setup" setup menu.

You can plot the force trend with the "Force-time diagram" function.

1. Press .
2. Select "Force – time" from the pull-up menu and confirm with .
3. Press (Start/Stop) to begin measuring.

The display is divided into two areas. The force-time diagram is displayed in the graphic field. The info field contains the following:

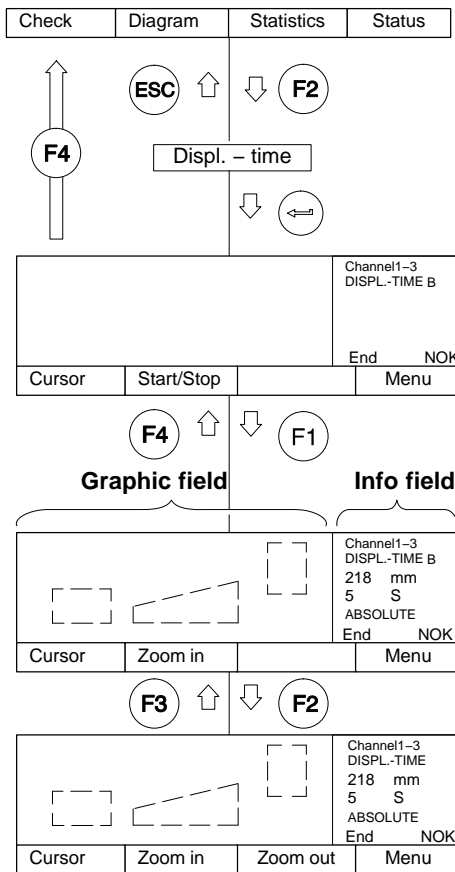
Channel numbers

Diagram type and window type (A = alarm limits; B = range window)

Status (Measuring/End)

Evaluation (OK/NOK)

## 3.3.7 Displacement-time diagram



Use the "Displ.-time Diagram" function to plot the displacement-time trend as a curve.

1. Press **F2**.
2. Select "Displ. - time" from the pull-up menu and confirm with **←**.
3. Press **F2** (Start/Stop) to begin measuring.

The display is divided into two areas. The displacement-time curve is displayed in the graphic field. The info field contains the following:

Channel numbers

Diagram type and window type (A = alarm limits; B = range window)

Status (Measuring/End)

Evaluation (OK/NOK)



---

## 4 Statistics

---

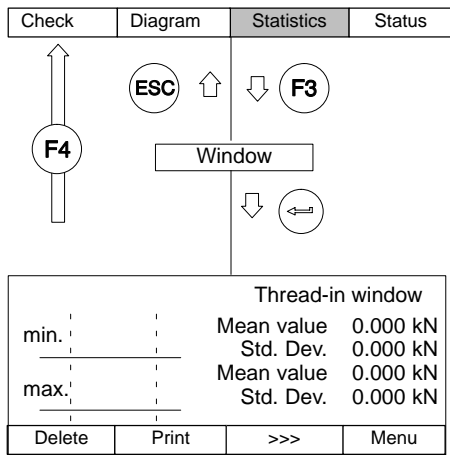
The Statistics function gives you the ability to assess the quality of your press-fit processes. It produces min/max force histograms for each window and continuously calculates the mean value and standard deviation. You can make statistical records for a maximum of 65000 press-fit processes. If the number of press-fit processes exceeds this value, the statistics buffer is cleared and re-initialized.

## 4.1 Statistics: Total

Check	Diagram	Statistics	Status
	ESC ↑	↓ F3	
F4 ↑	Total		
		↓ ←	
Statistics	Channel1-3		
Total number of cycles:	3		
OK cycles:	2		
NOK cycles:	1		
Check	Diagram	Statistics	Status

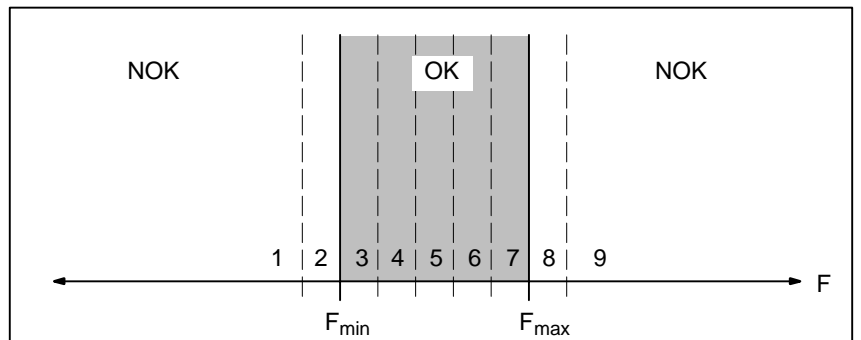
The function "Statistics: Total" displays the total number of press-fit processes together with the number of OK and NOK processes.

## 4.2 Statistics: windows



### Fitting window

The statistical data for a fitting window starts being acquired when the force trend for the press-fit process has at least one point within the specified displacement limits. Histograms are produced for force minima and maxima. Histograms are divided into nine force classes; five of these classes are within force limits, with a further two out-of-range classes on each side.

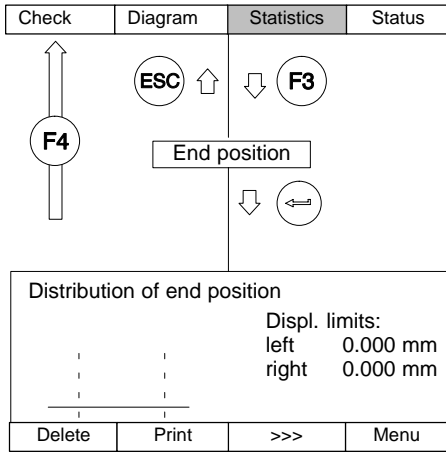


**Fig.4.1:** Class division: fitting window

Classes 2 to 8 are the same width, but 1 and 9 are unlimited. Mean value and standard deviation are continuously calculated for force min/max.

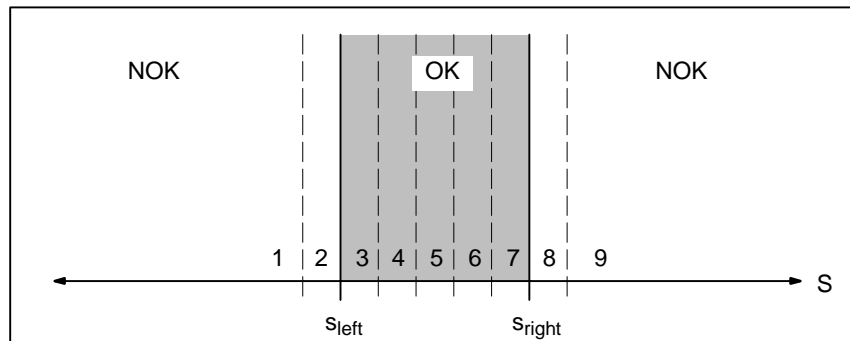
You can clear the statistics buffer with either function key F1 or a remote control contact (see page B-4).

# 4.3 Statistics: end position



## End position

A statistical record of the end window is made for each measurement. A histogram of the end position is produced. The histogram is divided into nine displacement classes; five of these classes are within displacement limits, with a further two out-of-range classes on each side.



**Fig.4.2:** Class division: end window

Classes 2 to 8 are the same width, but 1 and 9 are unlimited.

You can clear the statistics buffer with either function key F1 or a remote control contact (see page B-4).

## 4.4 Calculation formulae

### Class number

$$\text{Class number} = 2 + 5 \cdot \left( \frac{Y_{\text{extreme}} - Y_{\text{min}}}{Y_{\text{max}} - Y_{\text{min}}} \right)$$

$Y_{\text{extreme}}$  = extreme value (to be included in the histogram)

$Y_{\text{min}}$  = in range minimum

$Y_{\text{max}}$  = in range maximum

### Mean-value calculation

$$\text{Mean value} = \frac{1}{n} \cdot \sum x_i = \frac{1}{n} \cdot \text{sum of all measured values}$$

$n$  = number of press-fit processes

$X_i$  = individual measured value

### Standard deviation

$$\text{Standard deviation} = \sqrt{\frac{1}{n-1} \left[ \sum_{i=1}^n x_i^2 - \frac{1}{n} \left( \sum_{i=1}^n x_i \right)^2 \right]}$$

$n$  = number of press-fit processes

$X_i$  = individual measured value

ML85C

---

# E                    Menu structure

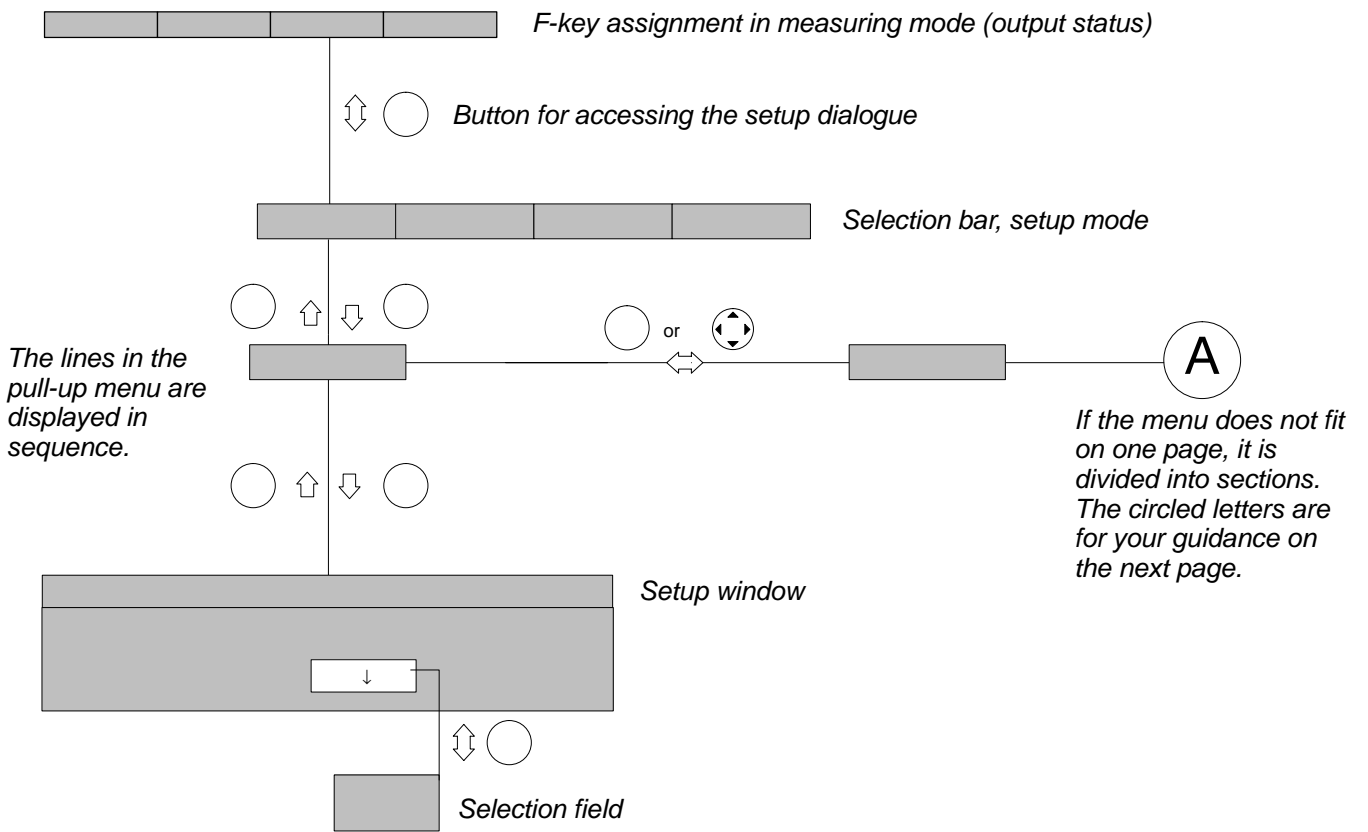
---

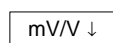
ML85C



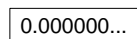
The menu structure that follows is intended to help you find the setup menus you are looking for more quickly. To begin with, the F-key assignment is displayed after you switch on the device and you are then informed of the sequence of keys you can use to call the various menus.

**Structural components**

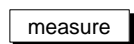


**Symbols**

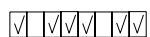
Selection field



Edit field



Button



Check boxes

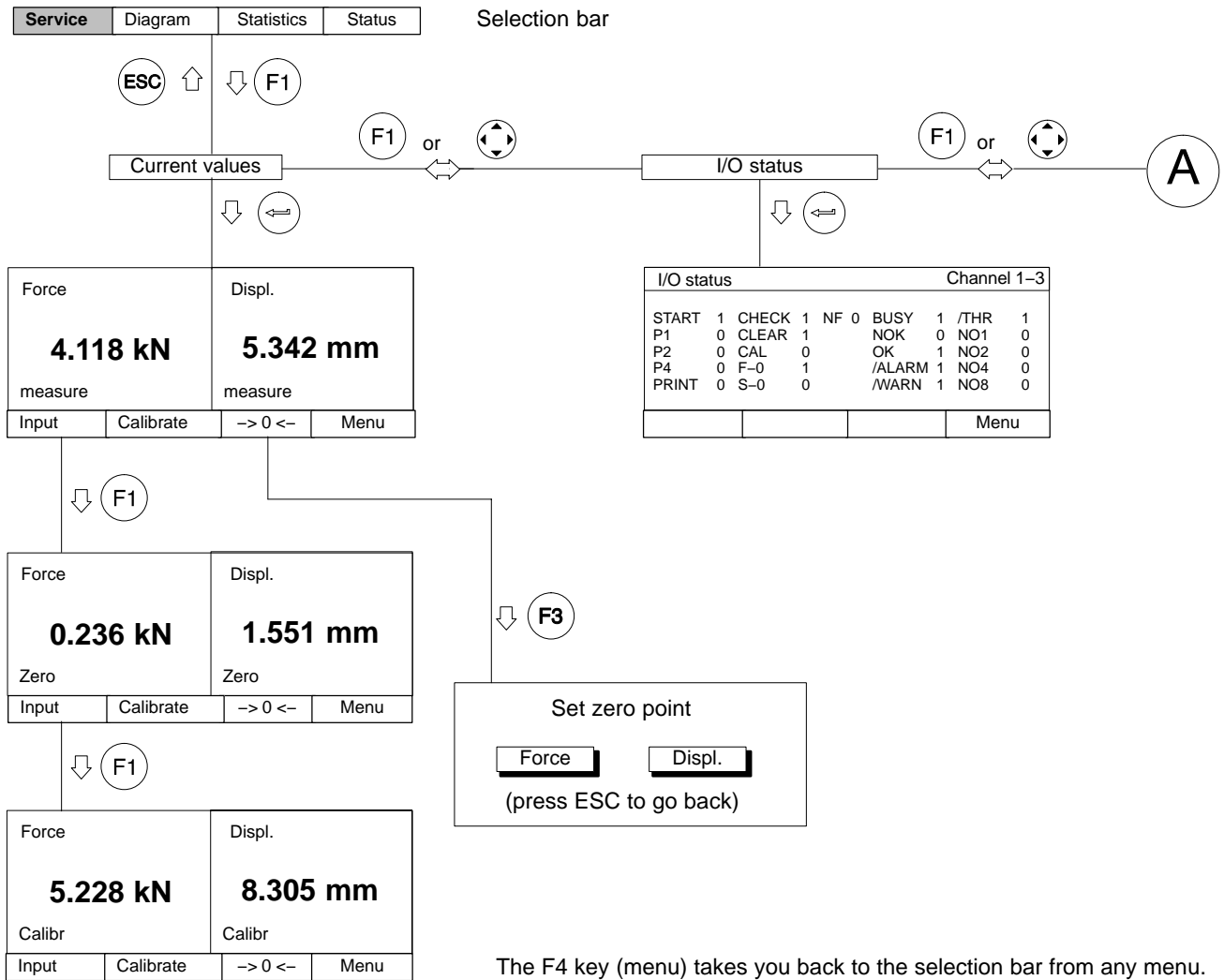


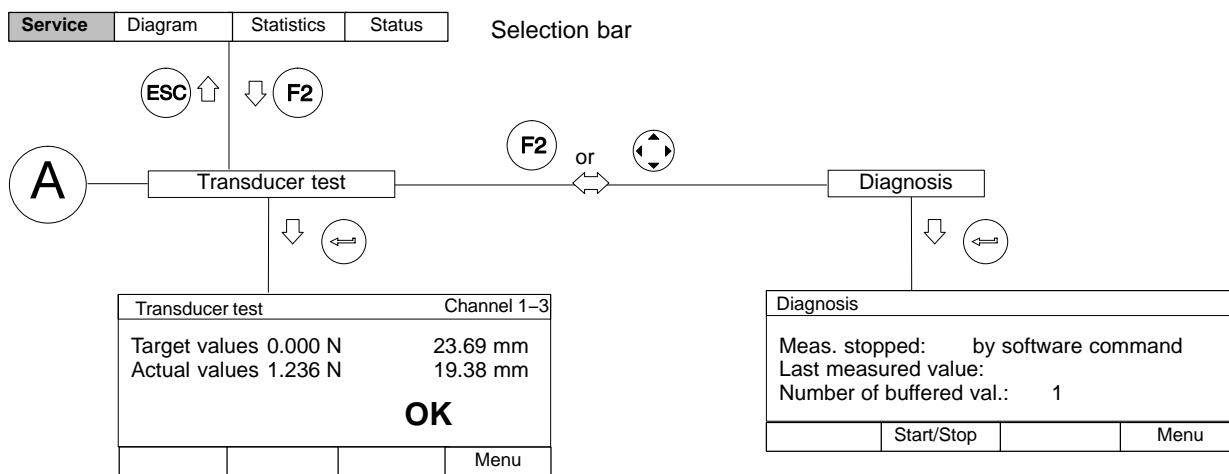
Cursor keys



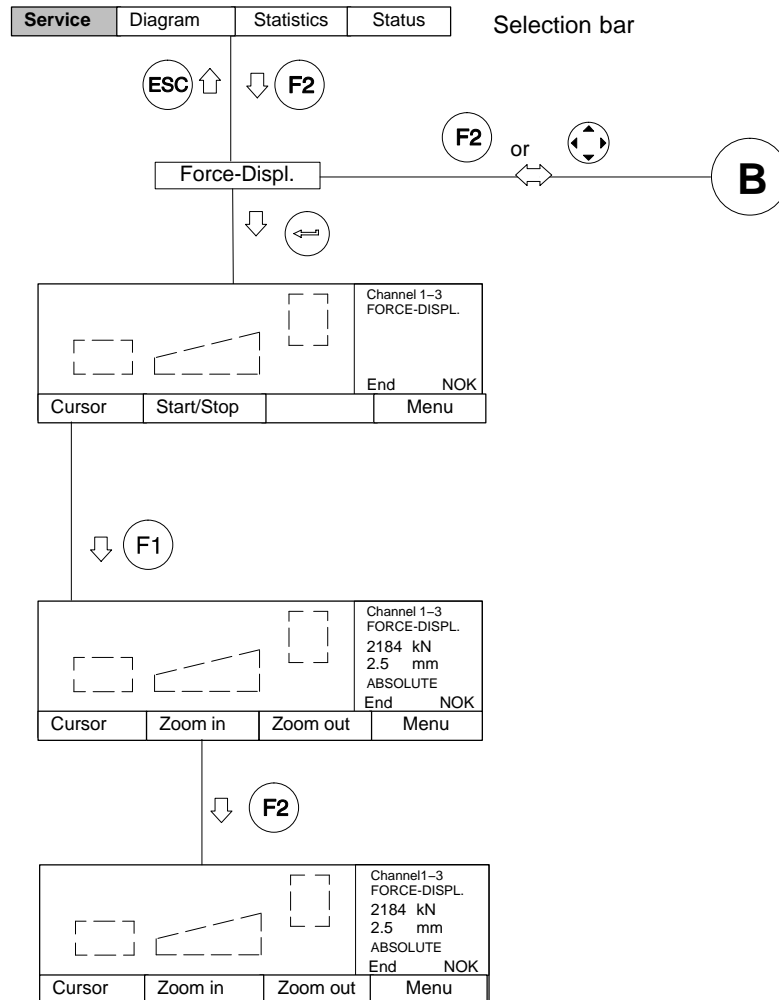
Arrows show the direction in which the keys work

# 1 Measuring mode

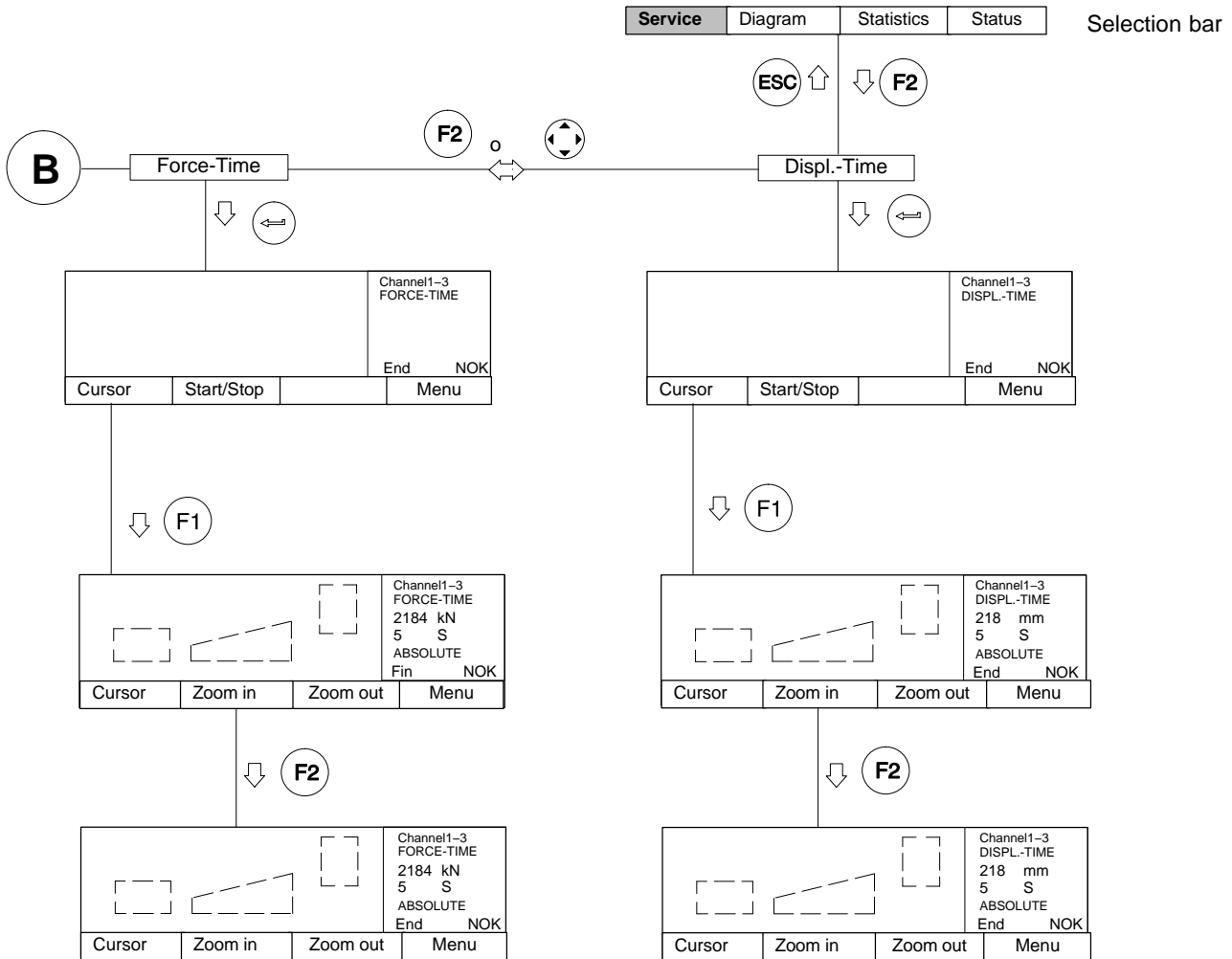




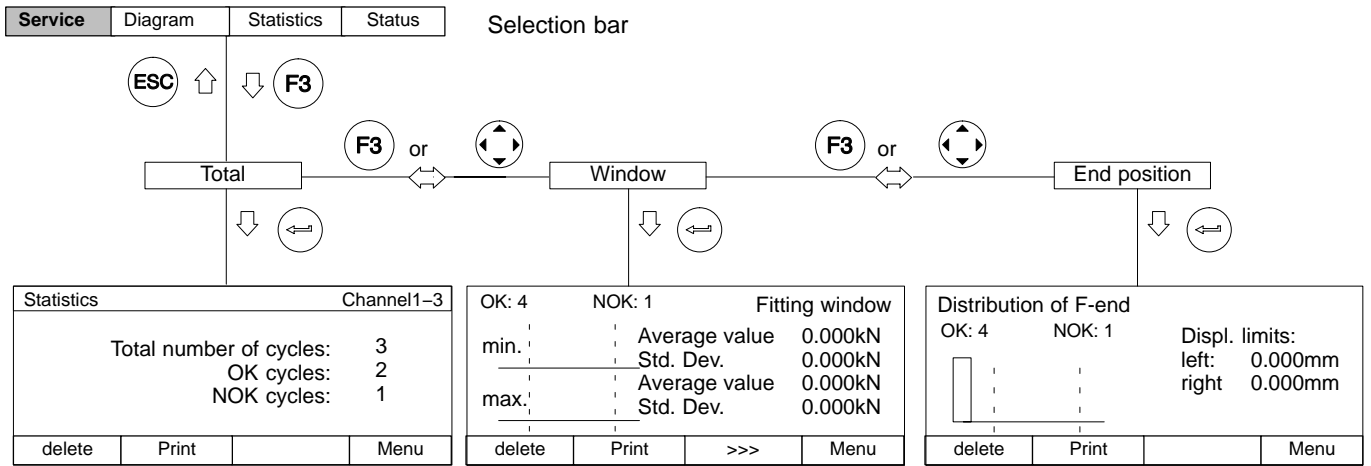
The F4 key (menu) takes you back to the selection bar from any menu.



The F4 key (menu) takes you back to the selection bar from any menu.



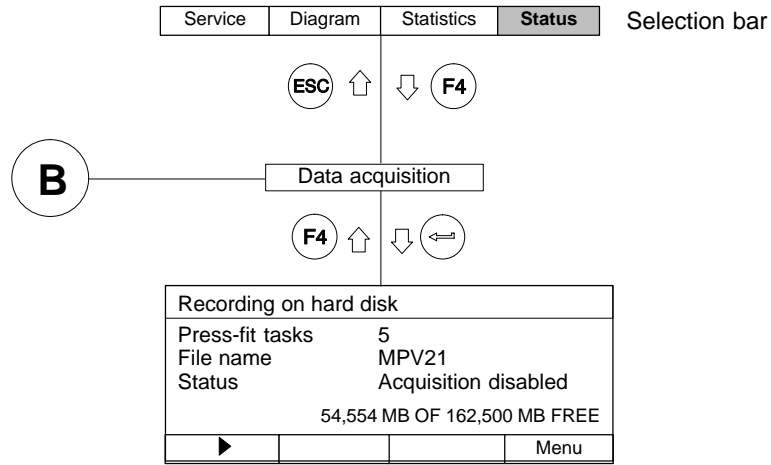
The F4 key (menu) takes you back to the selection bar from any menu.



The F4 key (menu) takes you back to the selection bar from any menu.



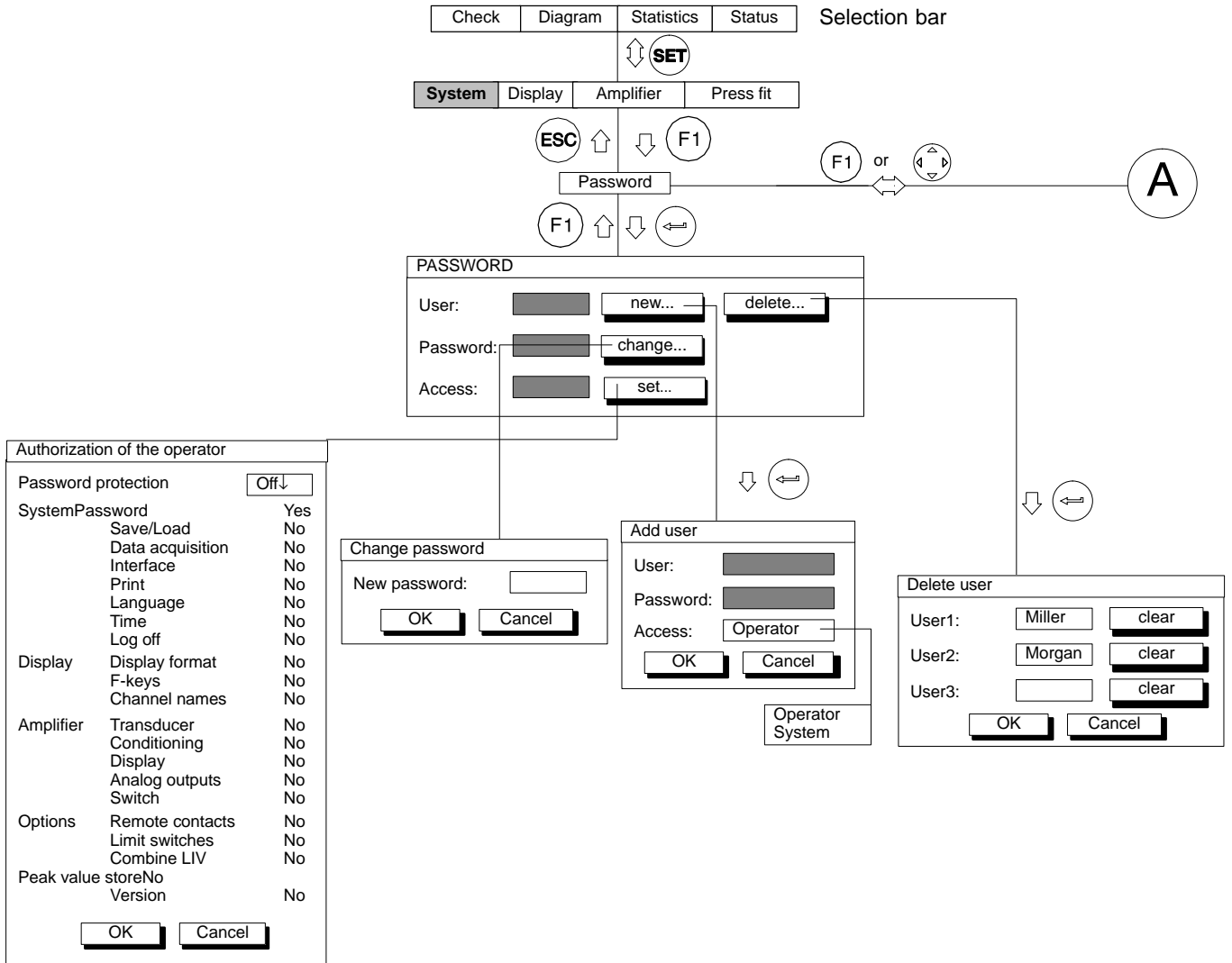


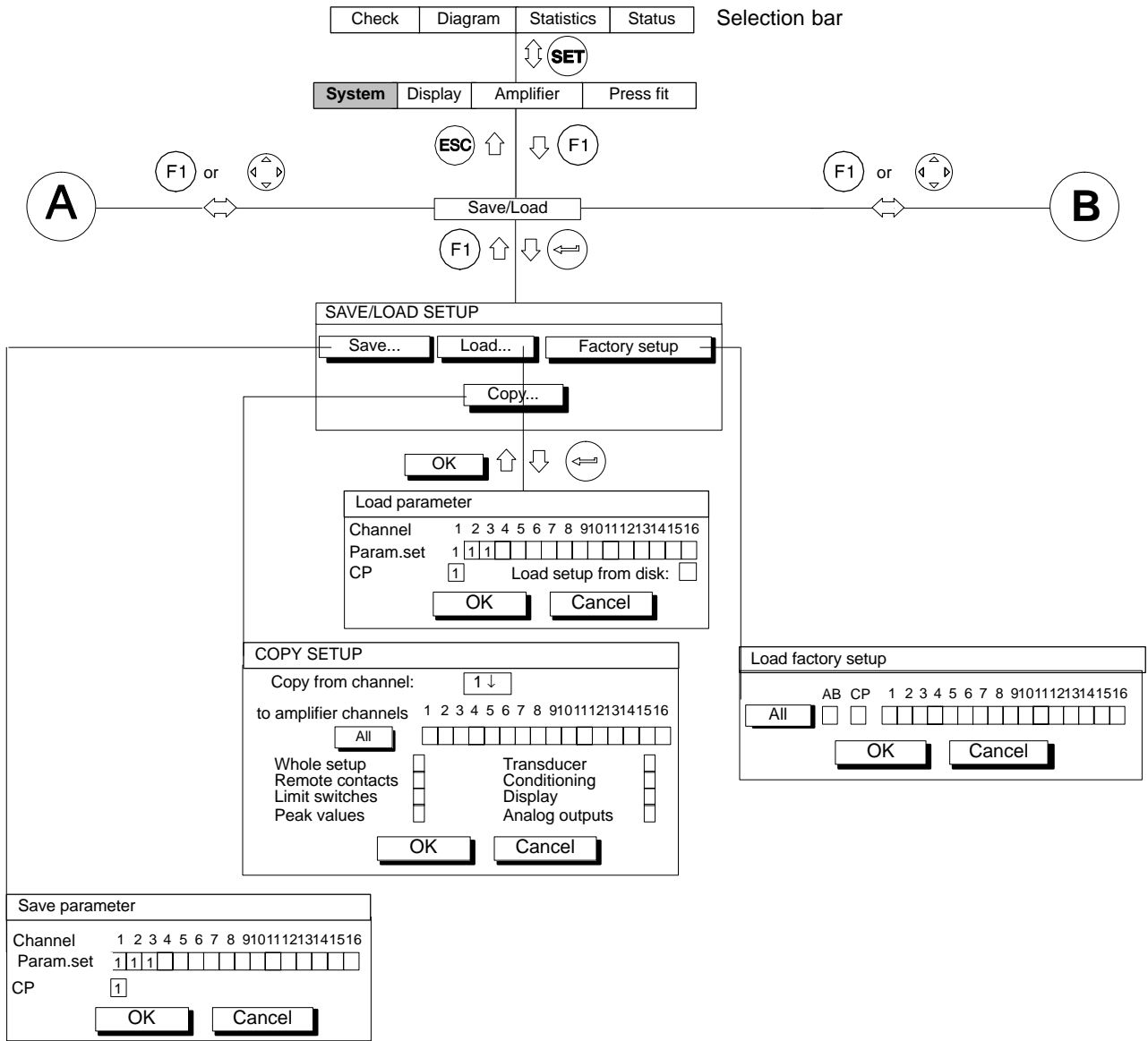


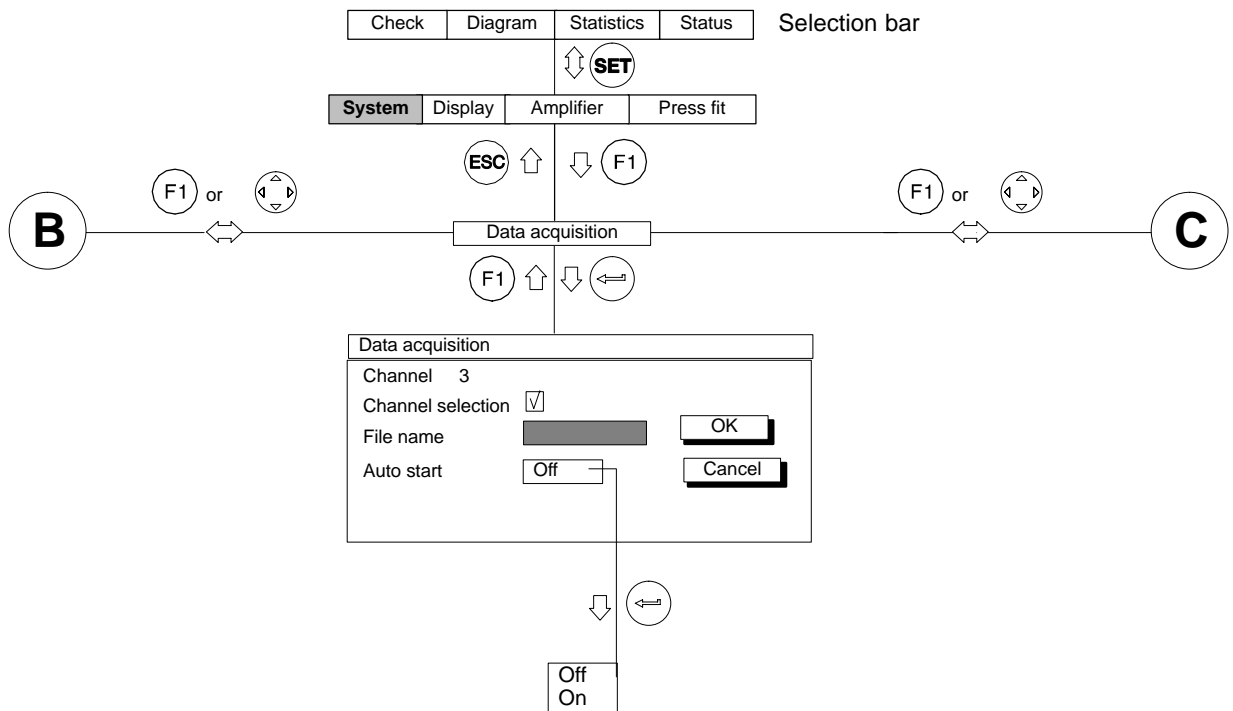
The F4 key (menu) takes you back to the selection bar from any menu.

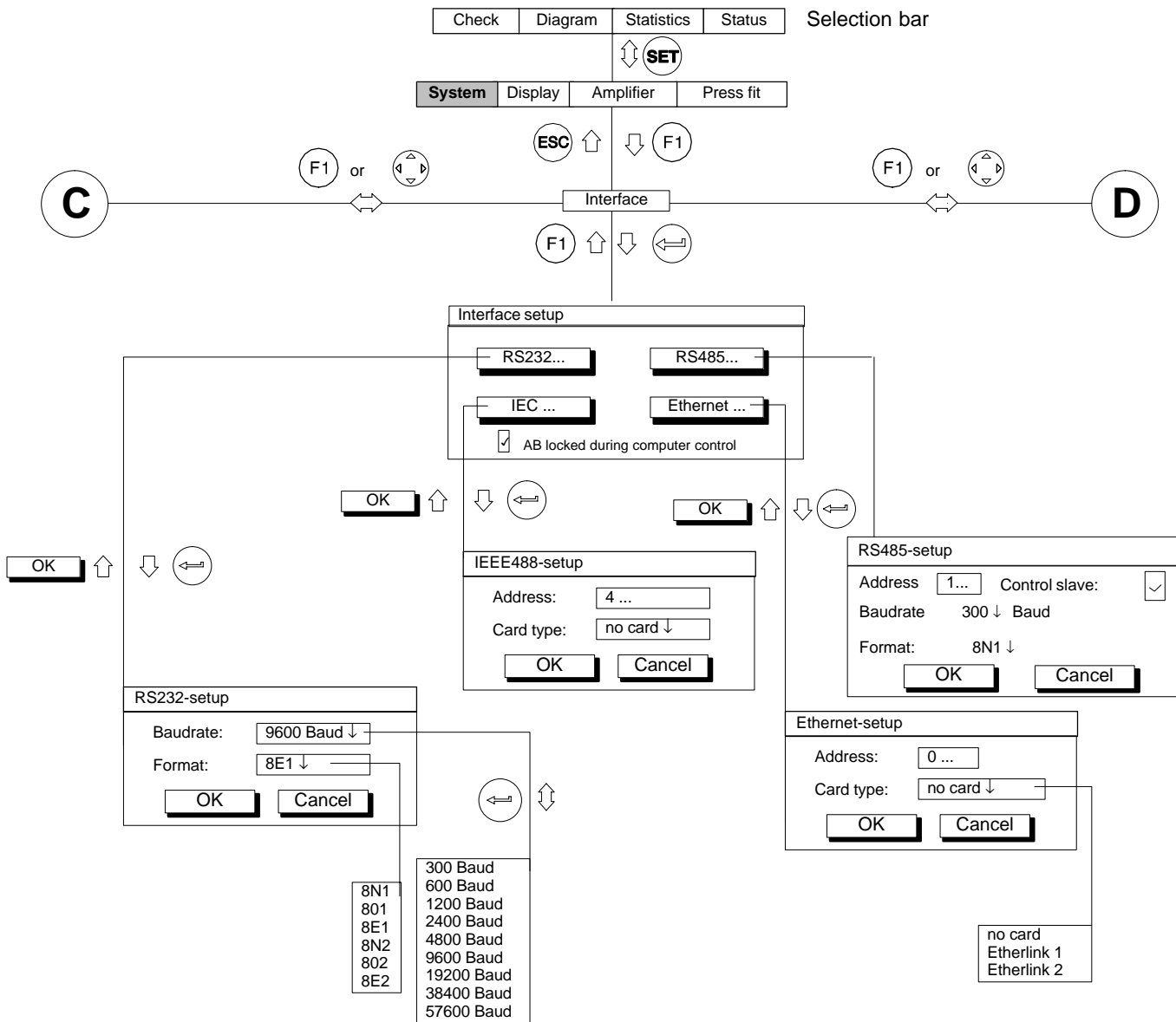
ML85C

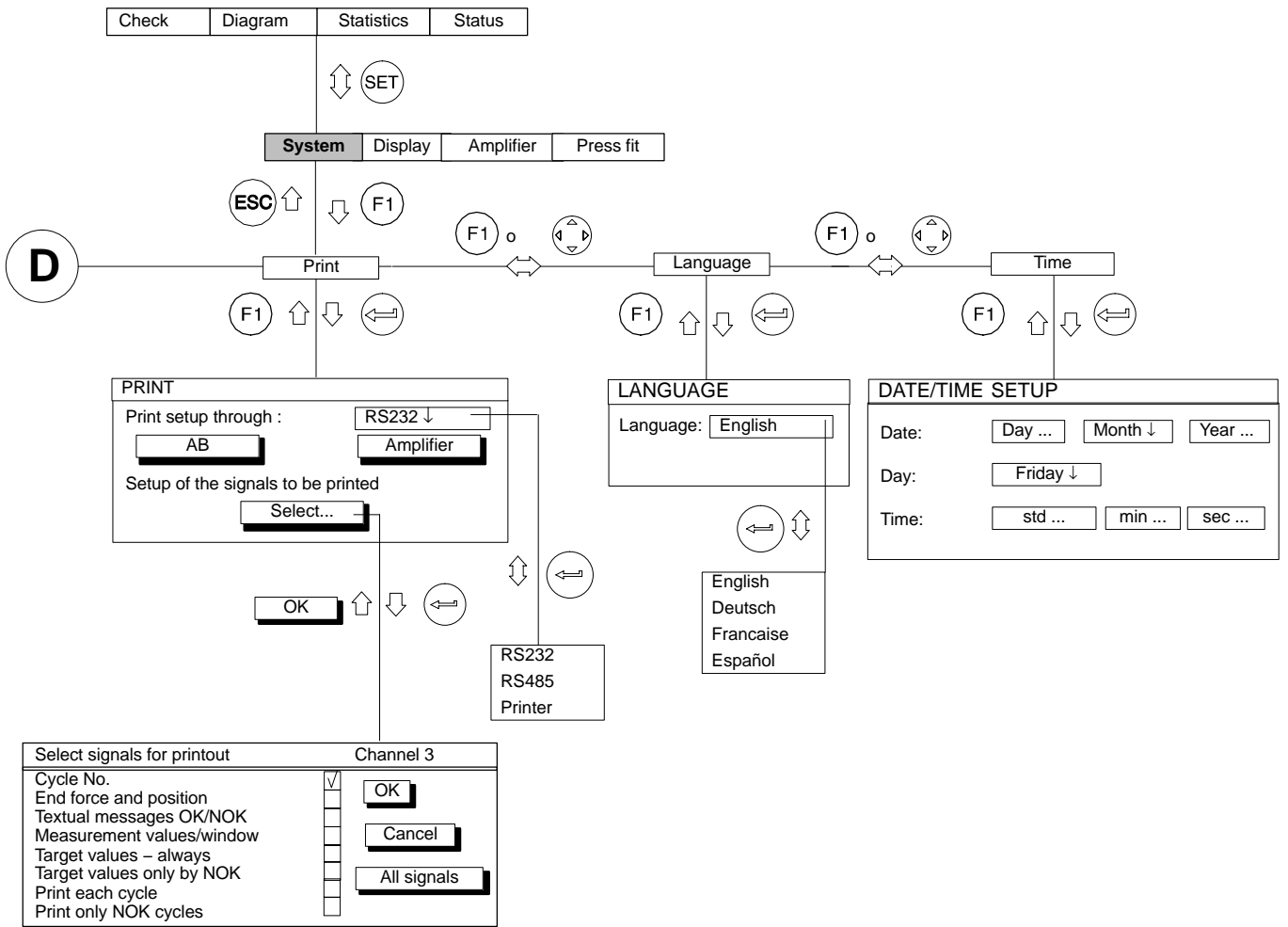
# 2 Setup mode

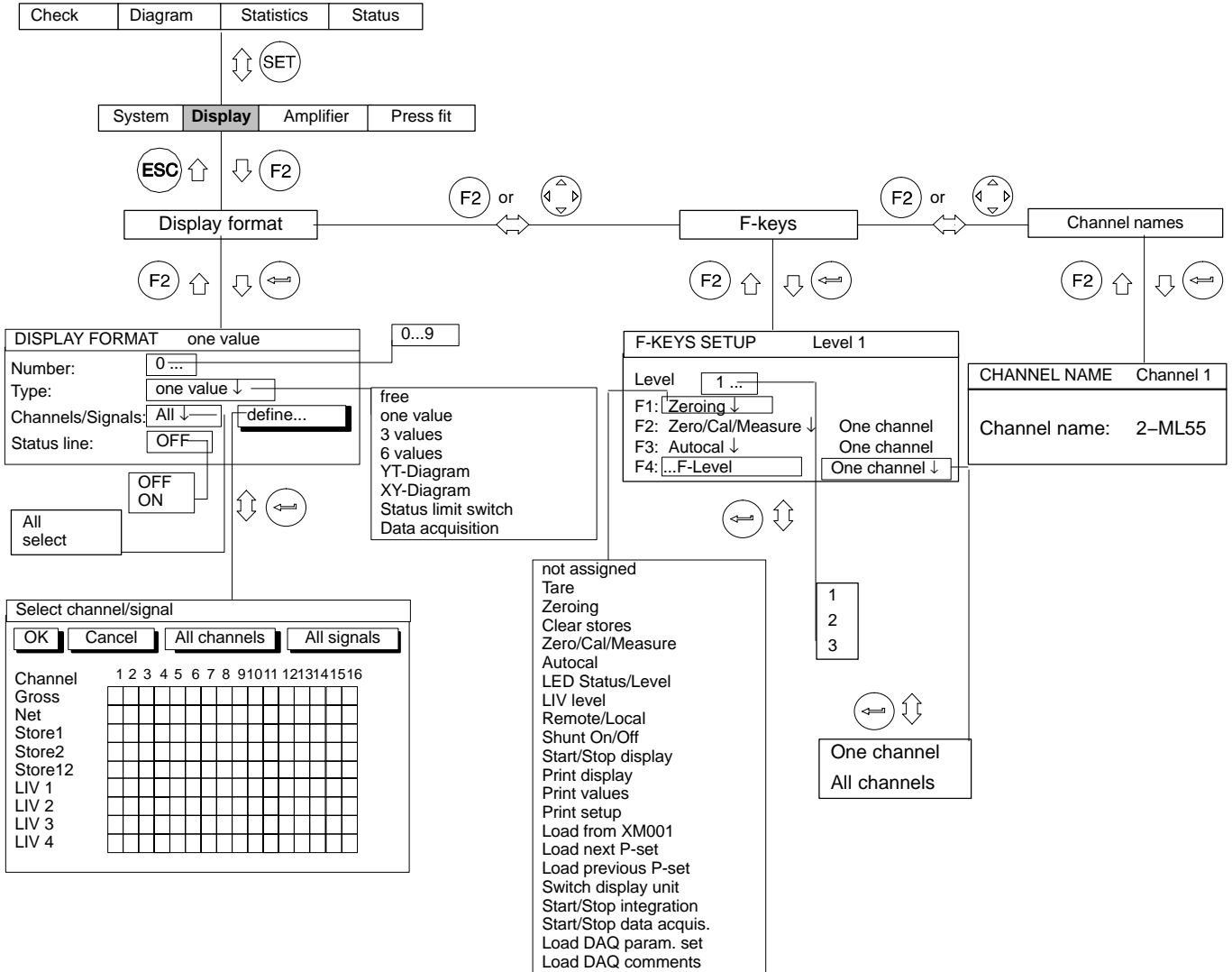




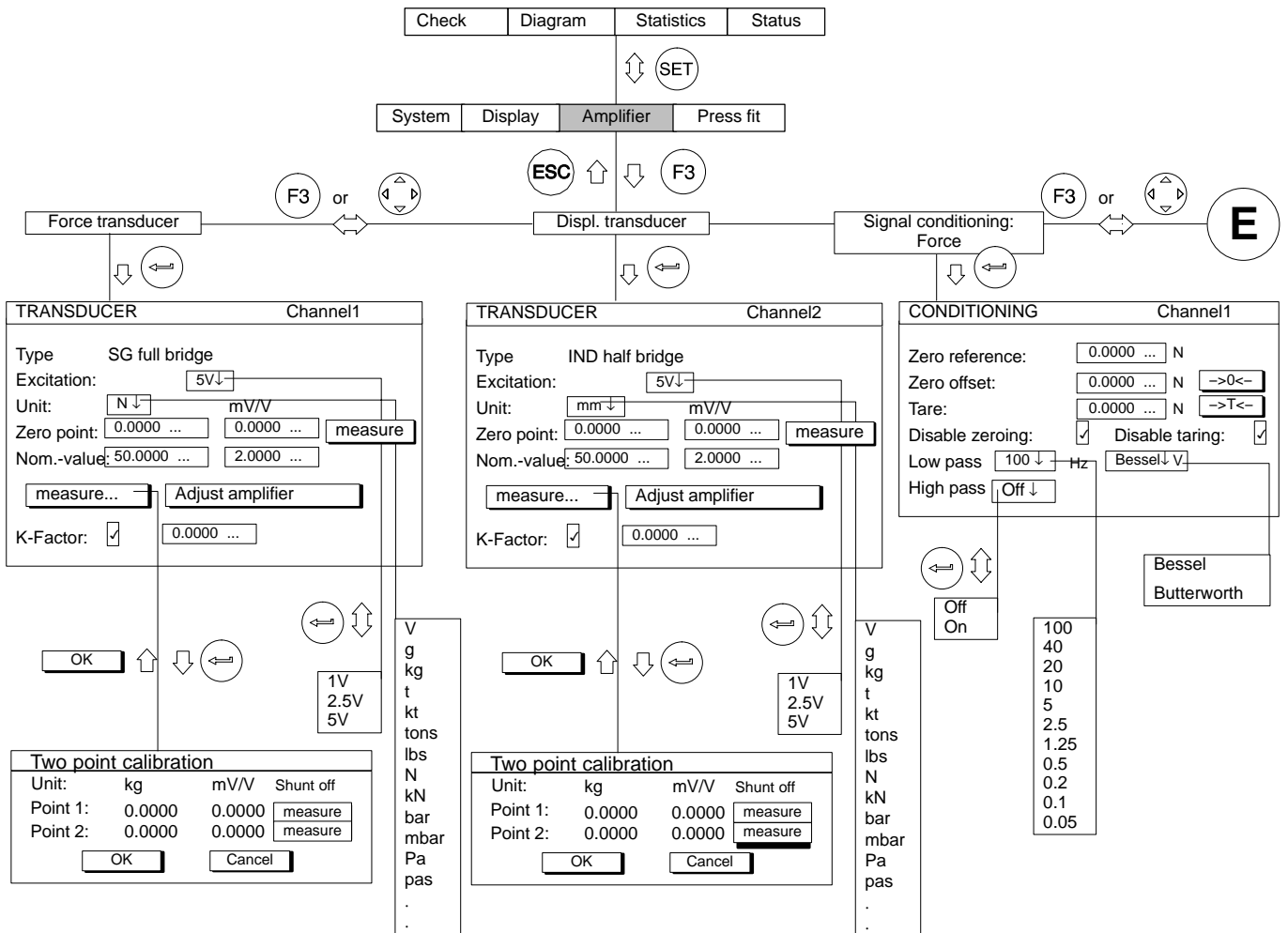


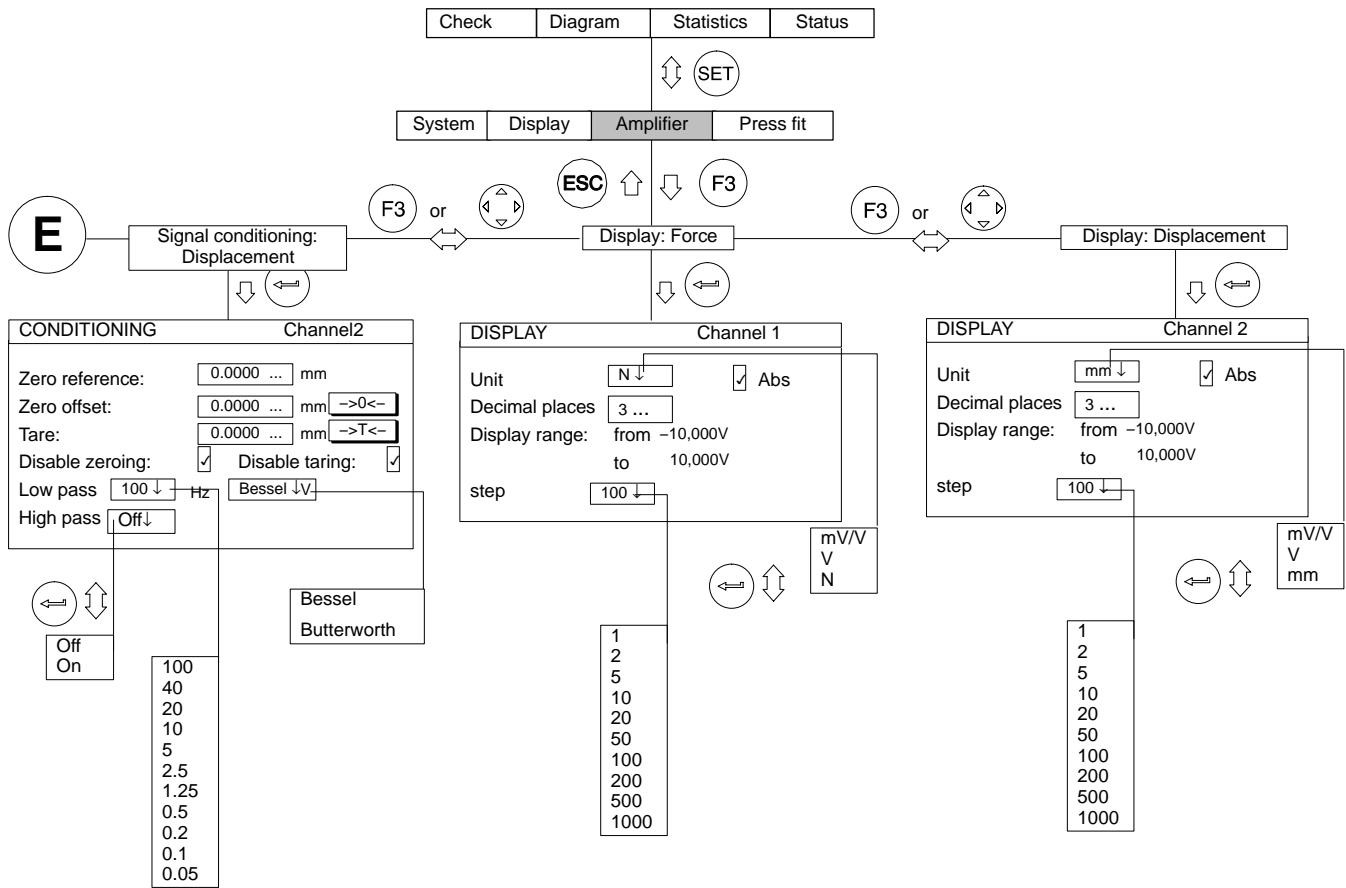


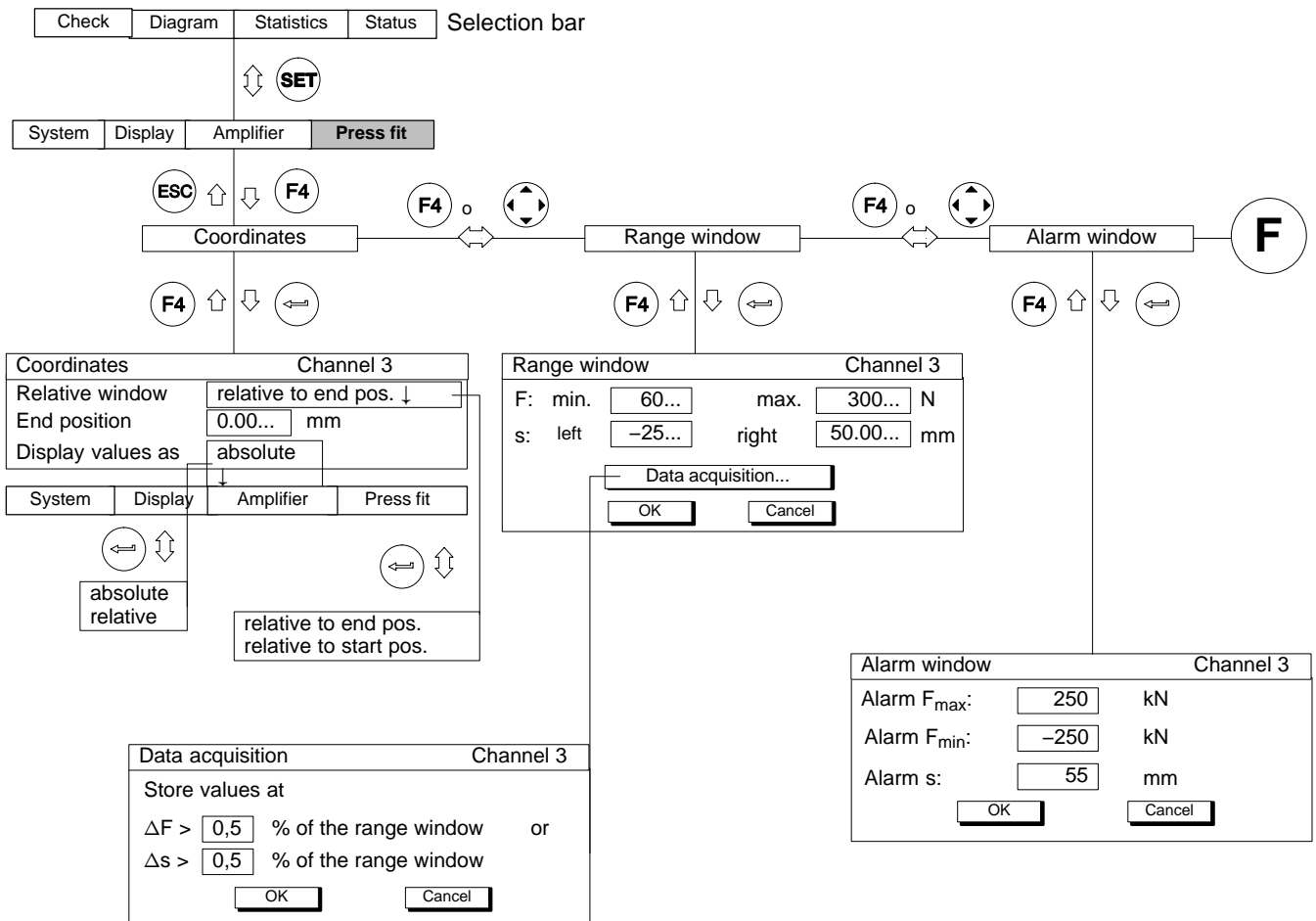


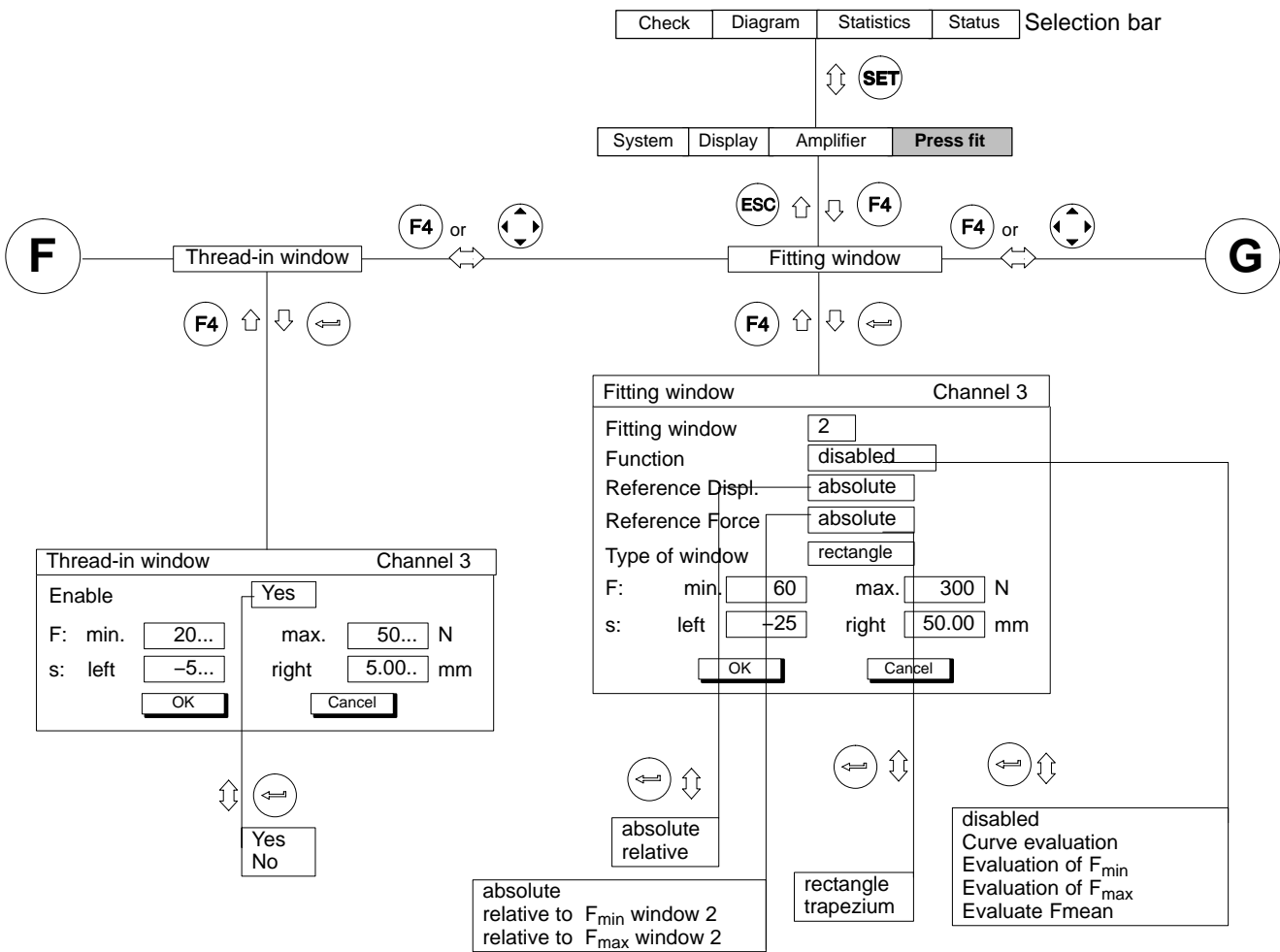


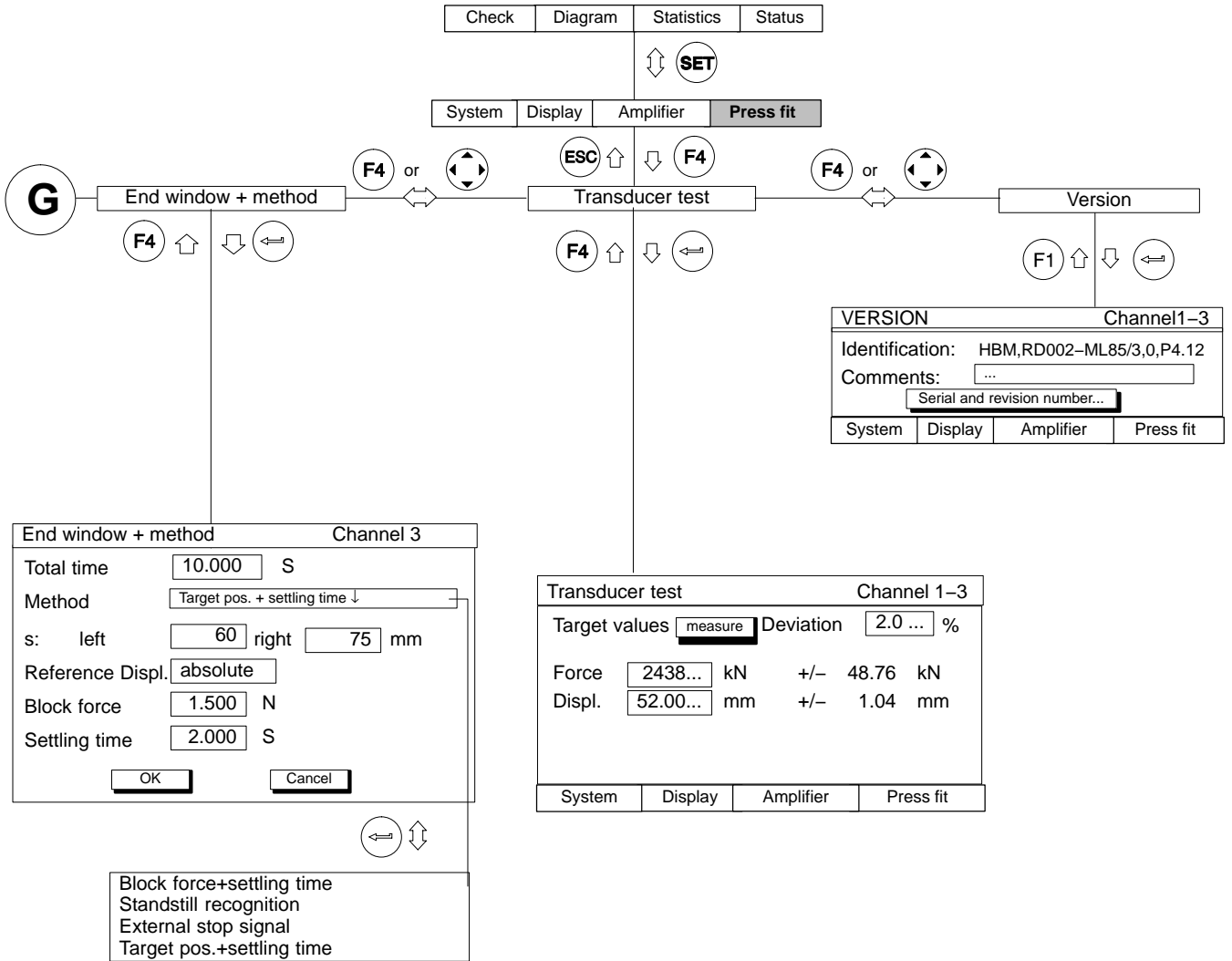












ML85C

---

# F Specifications

---

ML85C



## 1.1 Amplifier modules ML85C

<b>Max. number of force values</b>		750
<b>Max. number of displacement values</b>		750
<b>Max. measurement duration</b>	S	27
<b>Sampling rate</b>	Hz	2400
<b>Evaluation</b>		
<b>max. number of evaluation windows</b>		9
<b>Type of window</b>		trapezium or rectangle
<b>4 evaluation methods per window (from Version P4.00)</b>		Evaluation of the curve Evaluation of the minimum force in the window Evaluation of the maximum force in the window Evaluation of the mean force in the window
<b>Displacement coordinate systems in the display</b>		absolute/relative to start position/relative to end position
<b>Displacement coordinates fitting windows 2 – 7 (can be selected separately for each fitting window independent of the displacement coordinate system of the display)</b>		absolute/relative to start position/relative to end position
<b>Force coordinates fitting windows 3 – 7</b>		absolute/relative to $F_{\min}$ of fitting window 2/relative to $F_{\max}$ of fitting window 2
<b>force and displacement monitoring, alarm window</b>		online
<b>Thread-in window for force monitoring</b>		online
<b>Measurement methods</b>		1. Block + settling time / 2. Standstill recognition + settling time / 3. External stop signal / 4. Target pos. + settling time
<b>Number of independent data sets</b>		64
<b>Duration of offline evaluation, end window</b>	ms	1
<b>Duration of offline-evaluation rectangular window</b>	ms	1 + 5 $\mu$ s per measuring point
<b>Duration of offline-evaluation trapezium window</b>	ms	1 + 32 $\mu$ s per measuring point

Statistics		
Number of statistics buffers		64 (1 for each parameter set)
Maximum number of cycles		65000
Number of histogram classes for force maximum		9 per fitting window
Number of histogram classes for force minimum		9 per fitting window
Number of histogram classes for end position		9
Mean value calculation of $F_{\min}$ and $F_{\max}$ over all fitting cycles		separate for each fitting window
Calculation of standard deviation of $F_{\min}$ and $F_{\max}$ over all fitting cycles		separate for each fitting window
Nominal and operating conditions		
Nominal temperature range	°C [°F]	-20 ... +60 [-4 .. +140]
Operating temperature range	°C [°F]	-20 ... +60 [-4 ... +140]
Storage temperature range	°C [°F]	-25 ... +70 [-13 ... +158]
Operating voltages	V	+14.6 ... 17.0 (< 90 mA) -14.6 ... 17.0 (< 100 mA) -7 ... -9 (<10 mA)
Card format	mm	Europe 100 x 160
Width	mm	20.3 (4 divs.)
Connector		indirect DIN 41612

<sup>1)</sup> 0.05 at PWM

## 1.2 AP75 connection board

ML85C + connection board		AP75
<b>Digital inputs</b>		
Max. number of digital inputs		8 (16) <sup>1)</sup>
Input voltage range	V	0 ... 24
Electrical isolation	V	Typically 500
Low potential	V	< 5
High potential	V	> 10
Grounding systems		1, separated from the digital output
Control functions for groups of <i>MGCplus</i> channels		Autocalibration ON/OFF; Zeroing; Taring; Delete/retain peak value; Internal curve generator synchronization
<b>Digital outputs</b>		
Max. number of digital outputs		8 (16) <sup>1)</sup>
Output voltage range	V	0 ... 24
Output current	A	0,5
short-circuit current	A	1,5
Electrical isolation	V	Typically 500
Response time	ms	< 4
Grounding systems		1, separated from the digital inputs
Excitation	V	24 (external)
<b>Mechanical system</b>		
Nominal temperature range	°C [°F]	-20 ... +60 [-4 .. +140]
Operating temperature range	°C [°F]	-20 ... +60 [-4 ... +140]
Storage temperature range	°C [°F]	-25 ... +70 [-13 ... +158]
Operating voltages	V	+14.6 ... +17.0 (< 120 mA)/ -17.0 ... -14.6 (< 120 mA)/ -9.0 ... -7.0 (< 10 mA)
Card format	mm	Europa 160 x 100
Card format / width	mm	20.3 (4 divs.)
Connection technique		Pluggable screw terminals

<sup>1)</sup> When using 2 AP75 connection boards: 16 digital inputs and 16 digital outputs

ML85C

# G Keywords

---

## A

AB22/AB32, measuring mode, D-5  
alarm limits, C-19  
alarm window, C-27  
amplifier, set up, C-16

## B

block force, C-35  
button, E-4

## C

calibration, D-9  
check boxes, E-4  
connecting, B-1  
Connection boards, AP75, B-4  
cursor, D-14

## D

data acquisition, print, C-41  
Diagnosis, D-11  
diagram  
  displacement-time, D-16  
  force-displacement, D-13  
  force-time, D-15  
display, D-6  
  absolute, C-20–C-23

  current values, D-9  
  displacement-time diagram, D-16  
  display in measuring mode, D-7  
  first display, D-6  
  force-displacement diagram, D-13  
  force-time diagram, D-15  
  I/O status, D-10  
  relative, C-20–C-23  
  transducer check, D-12

## E

edit field, E-4  
end position, C-24  
end window, C-35  
  evaluation, C-35  
  method, C-35  
evaluation methods, C-18  
External stop signal, C-37

## F

fitting window, C-19 , C-32  
  setting up, C-34  
Front panels, LED display ML85B, D-4  
front panels, LED display, D-3  
  amplifier plug-in, D-3

## H

hard disk, installation, C-41  
histogram, D-17–D-21

**I**

I/O, status display, D-10  
inputs, B-4  
inputs and outputs, B-3

**M**

maintenance and cleaning, A-5  
measurement parameter, setting up, C-20–C-24  
Measuring amplifier, setup, force and displacement,  
C-17  
menu structure, E-1  
  measuring mode, E-5  
  setup mode, E-13  
ML85 press-fit module, C-16

**O**

outputs, B-5

**P**

Printing, C-43

**R**

range window, C-19 , C-28  
remotes, B-3  
  AP75 assignment, B-3

**S**

Safety instructions, A-3  
selection field, E-4  
setting up the coordinate system, C-26  
settling time, C-35  
specifications, F-1–F-7  
start position, C-20  
statistics, D-17  
  formulae, D-21  
  total, D-18  
  window  
    end position, D-20  
    fitting window, D-19  
System, printing, C-43  
system of coordinates, C-20

**T**

target pos.+settling time, C-38  
thread-in window, C-19 , C-29  
  setting up, C-31  
tolerance window procedure, C-19  
total time, C-35  
transducer check, C-40  
Troubleshooting, C-63

**W**

window  
  relative to end position, C-23  
  relative to start position, C-20

**Z**

zero balance, D-9  
zoom, D-14

ML85C



---

# H Certificate of conformity

---

ML85C



**HOTTINGER  
BALDWIN  
MESSTECHNIK**

**HOTTINGER BALDWIN MESSTECHNIK GMBH**  
Im Tiefen See 45 - D-64293 Darmstadt  
Tel. ++49/6151/803-0, Fax. ++49/6151/894896

**Konformitätserklärung**

**Declaration of Conformity**

**Déclaration de Conformité**

Document: 099/11.1997

Wir,

We,

Nous,

**Hottinger Baldwin Messtechnik GmbH, Darmstadt**

erklären in alleiniger Verantwortung, daß das Produkt

declare under our sole responsibility that the product

déclarons sous notre seule responsabilité que le produit

**Einpreßelektronik MGCpress (Komponenten siehe Rückseite)**

auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder normativen Dokument(en) übereinstimmt (siehe Seite 2) gemäß den Bestimmungen der Richtlinie(n)

to which this declaration relates is in conformity with the following standard(s) or other normative document(s) (see page 2) following the provisions of Directive(s)

auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou autre(s) document(s) normatif(s) (voir page 2) conformément aux dispositions de(s) Directive(s)

89/336/EWG - Richtlinie des Rates vom 3. Mai 1989 zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit, geändert durch 91/263/EWG, 92/31/EWG und 93/68/EWG

73/23/EWG - Richtlinie des Rates vom 19. Februar 1973 zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen, geändert durch 93/68/EWG

Erstmalige Anbringung der CE-Kennzeichnung: 1997

First attachment of the CE mark: 1997

Première application de la marque CE: 1997

Die Absicherung aller produkt-spezifischen Qualitätsmerkmale erfolgt auf Basis eines von der DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) seit 1986 zertifizierten Qualitätsmanagementsystems nach DIN ISO 9001 (Reg.Nr. DQS-10001). Die Überprüfung der sicherheits-relevanten Merkmale (Elektromagnetische Verträglichkeit, Sicherheit elektrischer Betriebsmittel) führt ein von der DATech erstmals 1991 akkreditiertes Prüflaboratorium (Reg.Nr. DAT-P-006 und DAT-P-012) unabhängig im Hause HBM durch.

All product-related features are secured by a quality system in accordance with DIN ISO 9001, certified by DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) since 1986 (Reg. No. DQS-10001). The safety-relevant features (electromagnetic compatibility, safety of electrical apparatus) are verified at HBM by an independent testing laboratory which has been accredited by DATech in 1991 for the first time (Reg. Nos. DAT-P-006 and DAT-P-012).

Chez HBM, la détermination de tous les critères de qualité relatifs à un produit spécifique est faite sur la base d'un protocole DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) certifiant, depuis 1986, notre système d'assurance qualité selon DIN ISO 9001 (Reg.Nr. DQS-10001). De même, tous les critères de protection électrique et de compatibilité électromagnétique sont certifiés par un laboratoire d'essais indépendant et accrédité depuis 1991 (Reg.Nr. DAT-P-006 et DAT-P-012).

Darmstadt, 28.11.1997

DW1061A1.03

Seite 2 zu	Page 2 of	Page 2 du
<b>Document: 099/11.1997</b>		
Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.	This declaration certifies conformity with the Directives listed above, but is no asseveration of characteristics. Safety directions of the delivered product documentation have to be followed.	Cette déclaration atteste la conformité avec les directives citées mais n'assure pas un certain caractère. S.v.p. observez les indications de sécurité de la documentation du produit ajoutée.
Folgende Normen werden zum Nachweis der Übereinstimmung mit den Vorschriften der Richtlinie(n) eingehalten:	The following standards are fulfilled as proof of conformity with the provisions of the Directive(s):	Pour la démonstration de la conformité aux disposition de(s) Directive(s) le produit satisfait les normes:
<b>EN 50082-2 : 1995</b>	<b>Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit;</b> Teil 2: Industriebereich; Deutsche Fassung	
<b>EN 55011 : 1991</b>	<b>Funk-Entstörung von Elektrischen Betriebsmitteln und Anlagen;</b> Grenzwerte und Meßverfahren für Funkstörungen von industriellen, wissenschaftlichen und medizinischen Hochfrequenzgeräten (ISM-Geräten) (CISPR 11 : 1990, modifiziert); Deutsche Fassung	
<b>... und:</b>		
<b>EN 55022 : 1994</b>	<b>Elektromagnetische Verträglichkeit von Einrichtungen der Informationsverarbeitungs- und Telekommunikationstechnik;</b> Grenzwerte und Meßverfahren für Funkstörungen von informationstechnischen Einrichtungen (IEC CISPR 22: 1993; Deutsche Fassung	
<b>EN 61010-1 : 1993</b>	<b>Sicherheitsbestimmungen für elektrische Meß-, Steuer-, Regel- und Laborgeräte;</b> Teil 1: Allgemeine Anforderungen (IEC 1010-1:1990 + A1:1992, modifiziert); Deutsche Fassung	
<b>Komponenten:</b> AB22Apress, ABX22Apress, BL12, ML85/1...3, AP85F, AP85S, AP85, CP12P		



Modifications reserved.  
All details describe our products in  
general form only. They are not to be understood as  
express warranty and do not constitute any liability  
whatsoever.

B0541-5.3 en

**Hottinger Baldwin Messtechnik GmbH**

Im Tiefen See 45, D-64293 Darmstadt, Germany  
Tel.: +49 6151 8030; Fax: +49 6151 803 9100  
E-mail: [support@hbm.com](mailto:support@hbm.com) [www.hbm.com](http://www.hbm.com)



measurement with confidence